



Board of Building Standards

EDUCATION COMMITTEE MEETING AGENDA

DATE: JUNE 22, 2023
TIME: 10:00 AM
LOCATION: BBS LIBRARY, 6606 TUSSING ROAD, REYNOLDSBURG, OHIO 43068
[Click here to join the meeting](#)

Call to Order

Consent Agenda

Course Applications

[ER-1](#) Photovoltaic Systems: NEC Requirements and Industry Standards (Ohio Certificate Renewal)
All certifications (4 hours)
Staff Notes: Received after ESIAC submission: recommend approval.
ESIAC Recommendations:
Committee Recommendation:

[ER-2](#) Standby Generators: NEC Requirements and Generator Installation Methods (Ohio Certificate Renewal)
All certifications (4 hours)
Staff Notes: Received after ESIAC submission: recommend approval.
ESIAC Recommendation:
Committee Recommendation:

[ER-3](#) The New ACI Code 440.11 on GFRP Reinforced Concrete (American Concrete Institute)
All certifications (1 hour)
Staff Notes: Administratively approved based on AIA approval (see slides, p. 2). Submitted for ratification.
Committee Recommendation:

[ER-4](#) Residential Building Inspector (2021 IRC) (West Coast)
Residential certifications (11 hours)
Staff Notes: Not yet code in Ohio, but likely to be in the next Code update. Recommend approval.
Committee Recommendation:

[ER-5](#) Residential Building Inspector (2021 IRC) (in Spanish) (West Coast)
Residential certifications (11 hours)
Staff Notes: Not yet code in Ohio, but likely to be in the next Code update. Recommend approval.
Committee Recommendation:

- [ER-6](#) Residential Electrical Inspector (2021 IRC) (West Coast)
Residential certifications (16.5 hours)
Staff Notes: Received after ESIAC submission. Recommendation to be added in update agenda Wednesday.
ESIAC Recommendation:
Committee Recommendation:
- [ER-7](#) Residential Mechanical Inspector (2021 IRC) (West Coast)
Residential certifications (11 hours)
Staff Notes: Not yet code in Ohio, but likely to be in the next Code update. Recommend approval.
Committee Recommendation:
- [ER-8](#) Residential Plans Examiner (2021 IRC) (West Coast)
Residential certifications (16 hours)
Staff Notes: Not yet code in Ohio, but likely to be in the next Code update. Recommend approval.
Committee Recommendation:
- [ER-9](#) Residential Plumbing Inspector (2021 IRC) (West Coast)
Residential certifications (7.5 hours)
Staff Notes: Recommendation to be included in Wednesday update agenda.
Committee Recommendation:

Old Business

New Business

Adjourn

**EDUCATION COMMITTEE MEETING
CONSENT AGENDA**

Course Applications

- [EC-1](#) 2021 IBC Update (West Coast)
All certifications (5 hours)

- [EC-2](#) Commercial Building Inspector and Plans Examiner (2021 IBC) (West Coast Code
Consultants)
All certifications (19.5 hours)

- [EC-3](#) Commercial Mechanical Inspector and Plans Examiner (2021 IMC)
All certifications (13 hours)

- [EC-4](#) Commercial Plumbing Inspector and Plans Examiner (2021 IPC) (West Coast Code
Consultants)
All certifications (11 hours)

File Attachments for Item:

ER-1 Photovoltaic Systems: NEC Requirements and Industry Standards (Ohio Certificate Renewal)

All certifications (4 hours)

Staff Notes: Received after ESIAC submission: recommend approval.

ESIAC Recommendations:

Committee Recommendation:

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *

Harold Plant

Organization

Ohio Certificate Renewal

Email *

mayda@ohiocertificate.com

Phone Number *

(614) 451-9003

Address *

P.O. Box 211102

City *

Columbus

State *

Ohio

Zip Code *

43221

Website

ohiocertificate.com

Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e.

BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

Photovoltaic Systems – NEC Requirements and Industry Standard

Course instructor

J.D. White

Course description

Learners will gain an understanding of PV basics and electrical series and parallel circuits, with regard to volts and amperages. The course will cover fundamentals of solar power, PV components and wiring requirements & calculations and system sizing considerations & Evaluations.

Instructional hours per session

4

Number of Sessions

1

Course Date

2023-06-23

Course Location

online, on-demand and in-per

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction
- Plumbing Instruction

Conference Course

Conference Name

Conference location

Course to be offered online?

- Yes
- No

On Demand

Webinar

Course Website

OhioCertificate.com

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):

login, audio/visual confirmation, or quiz

Course applicable for the following certifications *

- Residential Certifications Only
- Administrative Course, All Certifications
- Commercial and Residential Certifications

Application materials included *

- Course Outline or Course Learning Objectives
- Presentation Materials/Slides (not required for roundtable courses)
- Assessment Materials (for online courses)
- Presenter Bio
- Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
PV-4hr-BBS-2023-06-7.pdf	6.31 MB

Applicant Full Name *

Harold L. Plant

Date of Submission

06/09/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



Application for Continuing Education Course Approval

Provider Information:

Name: Harold L. Plant
Organization: Ohio Certificate Renewal
Address: P.O. Box 211102, Columbus, Ohio 43221
E-mail: mayda@ohiocertificate.com and Hal@ohiocertificate.com Telephone: 614-451-9003
Website: ohiocertificate.com
Conference Sponsor (if applicable) _____ Conference Email: _____

Check here if Course Renewal: _____ Prior course number _____ (i.e. BBS2018-429)
*Renewals will only be granted for identical content and certifications, within the current code cycle.
Attach a copy of prior course approval letter for confirmation. No further information is required.*

New Course Information:

Course title: Photovoltaic Systems – NEC Requirements and Industry Standards
Course instructor: J.D. White
Course description: Learners will gain an understanding of PV Basics and Electrical Series and Parallel Circuits, with regard to Volts and Amperages. The course will cover Fundamentals of Solar Power. Participants will learn about the PV components and Wiring Requirements & Calculations and System Sizing Considerations & Evaluations.
Instructional hours per session: 4 Number of Sessions: _____
Course Date(s) and Location: 06/23/2023 online and in-person TBD

Special Content:

Code Administration: _____ Conference Course: _____
Existing Buildings: _____ Conference Name: _____
Electrical Instruction: _____ Conference location: _____
Plumbing Instruction: _____

Course to be offered online? **On Demand** **Webinar**

Course Website: ohiocertificate.com
Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):
login and/or audio/visual confirmation, quizzes

Course applicable for the following certifications

Residential Certifications Only: _____ Commercial Certifications: _____
Administrative Course, All Certifications: _____

Application materials included:

- Course Outline or Course Learning Objectives
- Presentation Materials/Slides (not required for roundtable courses)
- Assessment Materials (for online courses)
- Presenter Bio

Please submit application and materials in .pdf format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov

Ohio Certificate Renewal

(614) 451-9003

OhioCertificate.com

P.O. Box 211102 Columbus, Ohio 43221-1102



Photovoltaic Systems – NEC Requirements and Industry Standards

Outline:

- PV Basics
- Electrical Series and Parallel Circuits, with regard to Volts and Amperages
- Fundamentals of Solar Power
- Photovoltaic Modules
- Batteries for Storage of Power & Reserve
- Charge Controllers
- Converters and Inverters – Sizing to Match
- PV System Wiring Requirements & Calculations
- PV System Sizing Considerations & Evaluations

Objectives:

- Understanding of the photovoltaic market
- List advantages and disadvantages of photovoltaic systems
- Understanding of the different types of photovoltaic systems
- Understanding of the basic components that make up a photovoltaic system
- Basic electrical theory
- The relationship between electrical theory and PV system installation
- Series, parallel, and combination arrangements of PV modules and batteries in a PV system installation
- Appreciation of Solar radiation, solar irradiance, and solar irradiation
- Learning effects of Magnetic declination, solar azimuth, and the solar window
- Learning how electricity is produced by a photovoltaic cell
- Gain knowledge of a PV module and its construction
- The differences among single crystalline, multi-crystalline, and thin-film types of silicon PV modules
- Identify different storage battery types used in a PV system
- Understanding of how a typical PV system battery works
- Understanding of charge controller operating principles
- Identify different types of charge controllers

Ohio Certificate Renewal

(614) 451-9003

P.O. Box 211102 Columbus, Ohio 43221-1102 OhioCertificate.com

- Understanding of inverter operating principles
- Identify different types of inverters and their features
- Identify several PV system terms and definitions used in *Article 690* of the *NEC*
- Understanding of the general wiring rules in *Article 690* that apply to a PV system
- Understanding of the *NEC* requirements for circuit wiring in a PV system
- Understanding of the *NEC* requirements for disconnecting means in a PV system
- Demonstrate an understanding of the *NEC* requirements for different wiring methods used in PV systems

PV Questions

Select which is an advantage of photovoltaic systems

- Expensive
- Reliable (checked)
- Solar radiation amounts vary across the country
- Energy storage solutions

Which is NOT a type of photovoltaic systems?

- Day-use only
- Direct current system with batteries
- Hydrostatic system (checked)
- Direct current system powering an AC load
- Hybrid system
- Stand-alone system
- Grid-tie system

Check which are basic components that make up a photovoltaic system

- Module (checked)
- Charge Controller (checked)
- Battery (checked)
- Router
- Inverter (checked)
- None of the Above

Check which is NOT a type of charge controller.

- SHUNT-TYPE
- SERIES TYPE
- PULSE-WIDTH MODULATION
- MAXIMUM POWER POINT TRACKING (MPPT)
- DIVERSION-TYPE
- DISTRIBUTOR (checked)

The NEC requirements for disconnecting means in a PV system include which of the following?

- Manually operated circuit breaker or switch
- Must be accessible
- Stainless material
- No exposure or live parts
- Indicate open or closed position
- Rated for the voltage and available current
- All the Above (checked)

JD White

6048 Astor Avenue
Columbus, OH 43232

614-546-7884
jd.white2000@gmail.com

Objective:

To provide timely and informative teaching relative to Electrical Theory, Electrical Practices, and NEC Updates. All teaching is primarily geared for licensed contractors, architects, engineers, electrical inspectors, and electrician apprentices. Electrical Design and Drafting of small to moderate sized projects, using AutoCAD.

Work and Teaching

Experience:

06/2007 - Present
Columbus State Community College
Title: Skilled Trades Apprenticeship Supervisor
Supervisor: Doug House, 614-287-2576

01/2006 – Present
Voltaire Electric Company, Inc. – Columbus, OH
Electrical System Design and Drafting
Title: Consultant 614-546-7884

06/2007 - Present
Columbus State Community College
Title: Adjunct Faculty Teaching:
Electrical Courses, National Electric Code, Employability,
Construction Overview, Construction Estimating,
Manual Drafting, and AutoCAD
Supervisor: Doug House, 614-287-2576

09/1999 – Present
Electrician Apprenticeship Instructor
Title: Year 1 – Year 4 Lead Instructor
OCILB Instructor, as needed
IEC Central Ohio 614-473-1050

10/2001 – Present
OCILB Instructor, 1-2 seminars per year
Ohio Contractor Training 614-203-1531

12/2008 – Present
OCILB Instructor, 4 seminars per year
Rebecca Warren Training 614-402-6551

JD White

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11/2017 – Present
OCILB Instructor, 2-6 seminars per year
HalfMoon Education Services 715-835-5900

10/2005 - 08/2006
MG Abbott Electric Company – Columbus, OH
Title: Commercial Electrician, Estimator, and ITS Coordinator
Supervisor: Joe Abbott-President, 614-837-3614

07/1995 - 08/2005
Just Dandy Electric Systems, Inc. – Columbus, OH
Title: Owner, Electrician, Estimator, Project Designer...

08/1989 - 07/1995
Safeway Electric Company, Inc. – Columbus, OH
Title: Commercial Electrician, Commercial Division Manager
Supervisor: Andy Untch, 614-443-7672

10/1987 - 08/1989
Mansfield Wesleyan Church – Mansfield, OH
Title: Senior Pastor
Supervisor: Rev. Clyde Hanks-District Supervisor

09/1982 - 07/1987
Delphos Wesleyan Church – Delphos, OH
Title: Senior Pastor
Supervisor: Walter Jefferies-District Supervisor

07/1976 - 09/1982
MG Abbott Electric Company – Columbus, OH
Title: Electrician, Field Supervisor
Supervisor: Gene Abbott-Owner

07/1972 - 06/1974
US Navy – Quonset Point-RI
Title: ADJ (Aviation Machinist Mate Jet)
Supervisor: Various

JD White

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Licensure:

Electrical
11/1990
Cities of: Columbus, Elyria, Springfield, Youngstown, Toledo,
Dayton, and others
07/1992

Electrical State of Ohio
02/1996
State of Ohio #EL 14058

Fire Alarm Installer
02/2003
State of Ohio #54.25.3708

Education:

06/2005 – 05/2015
Columbus State Community College – Columbus, OH
ATS Electrical System Architecture Designer

09/1982 - 05/1987
Indiana Wesleyan University – Marion, IN
Christian Ministries & Biblical Literature

06/1981 - 05/1982
Columbus Technical Institute – Columbus, OH
General Education Studies

06/1973
GED Central High School, Columbus, OH

07/1972 - 08/1973
Naval Aviation Technical Training Center
Aviation A School Jet Engines – Memphis, TN
Naval Aviation Technical Training Center
Aviation B School Helicopters – Quonset Pt, RI
Rating: Aviation Machinist Mate Jet

References:

Joe Abbott - Previous Employer: 614-837-3614
Barb Tipton – Present Employer: 614-473-1050
Dr. Andy Rezin – Previous Supervisor: 614-551-8378
Doug House – Present Supervisor: 614-287-2576
Other References Available Upon Request

Sample Ad:

EL-ESI Electrical Code **Friday, June 23, 2023**

Instructor: J.D. White



7:30 AM - 3:45 PM (EST)

Morning Session: 7:30 AM to 11:20 AM Eastern Time.

Afternoon Session: 12 PM noon to 3:45 PM Eastern Time.

This course consists of two 4-hour sessions. Attend both for a full 8 hours.

Approved Code class for OCILB, ICC and Ohio BBS.

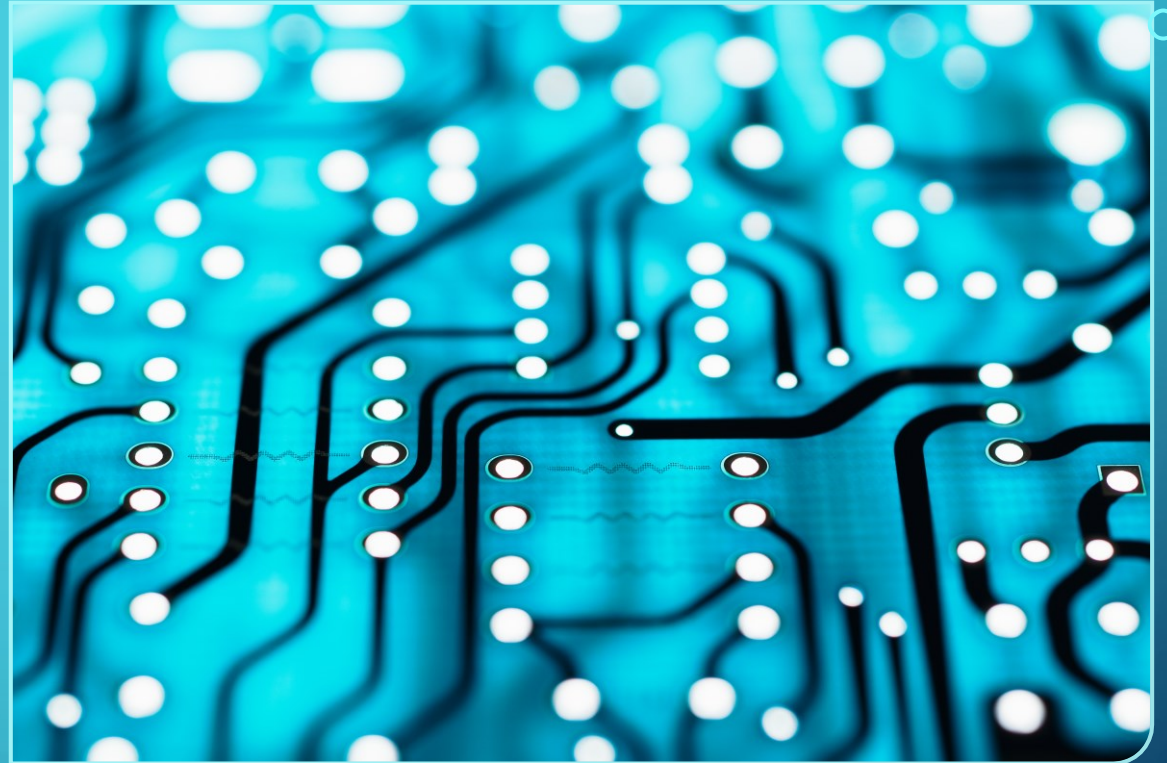
This webinar will satisfy OCILB requirements for EL ESI PL HY HV RE

[View Details and Register](#)

Registration Closes the day before at 8 pm.

Just want to do a half day?

Choose a **4-hour webinar** with option to attend in the morning or afternoon



PHOTOVOLTAIC SYSTEMS

NEC AND INDUSTRY STANDARDS

INTRODUCTION TO SOLAR PHOTOVOLTAIC SYSTEMS

- Made up of components that convert solar energy to electrical energy
- Solar cell
 - Basic PV system component
 - Generates electricity when exposed to sunlight

PV SYSTEM ADVANTAGES

- Advantages
 - Reliable
 - Durable
 - Low maintenance costs
 - No fuel costs
 - Modularity
 - Allow for energy independence

PV SYSTEM DISADVANTAGES

- Disadvantages
 - Expensive
 - Solar radiation amounts vary across the country
 - Energy storage solutions
 - Education



PHOTOVOLTAIC SYSTEM COMPONENTS

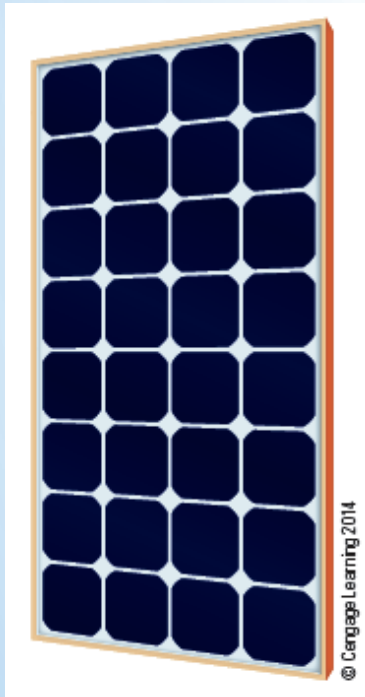


Figure 1-2: A PV module. Modules are often referred to as panels.

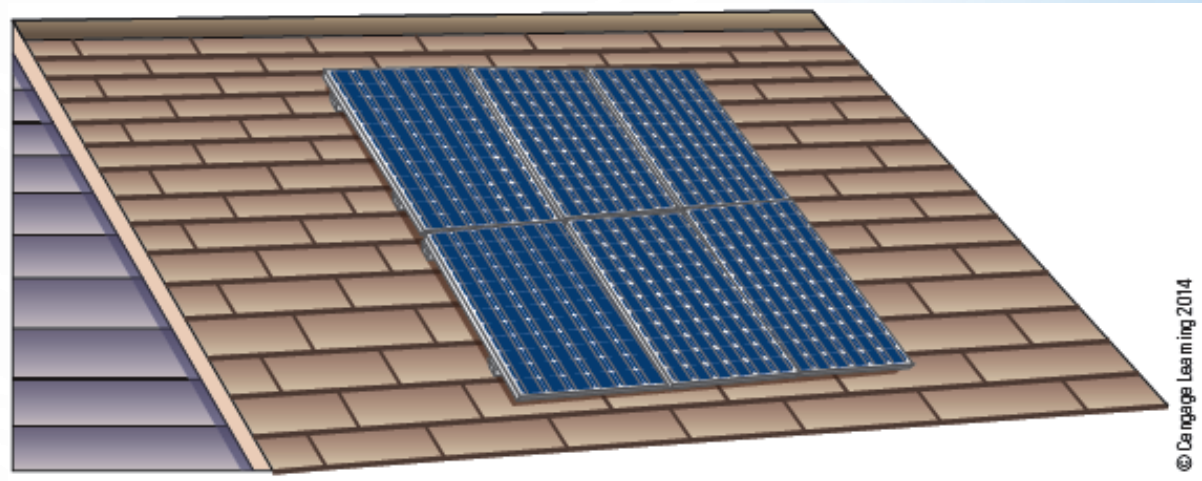


Figure 1-3: Modules are wired together to form a PV array.

TYPES OF PHOTOVOLTAIC SYSTEMS

- Day-use only
 - Simplest and least expensive
- Direct current system with batteries
 - Loads can be powered day and night
- Direct current system powering an AC load
 - Must use an inverter

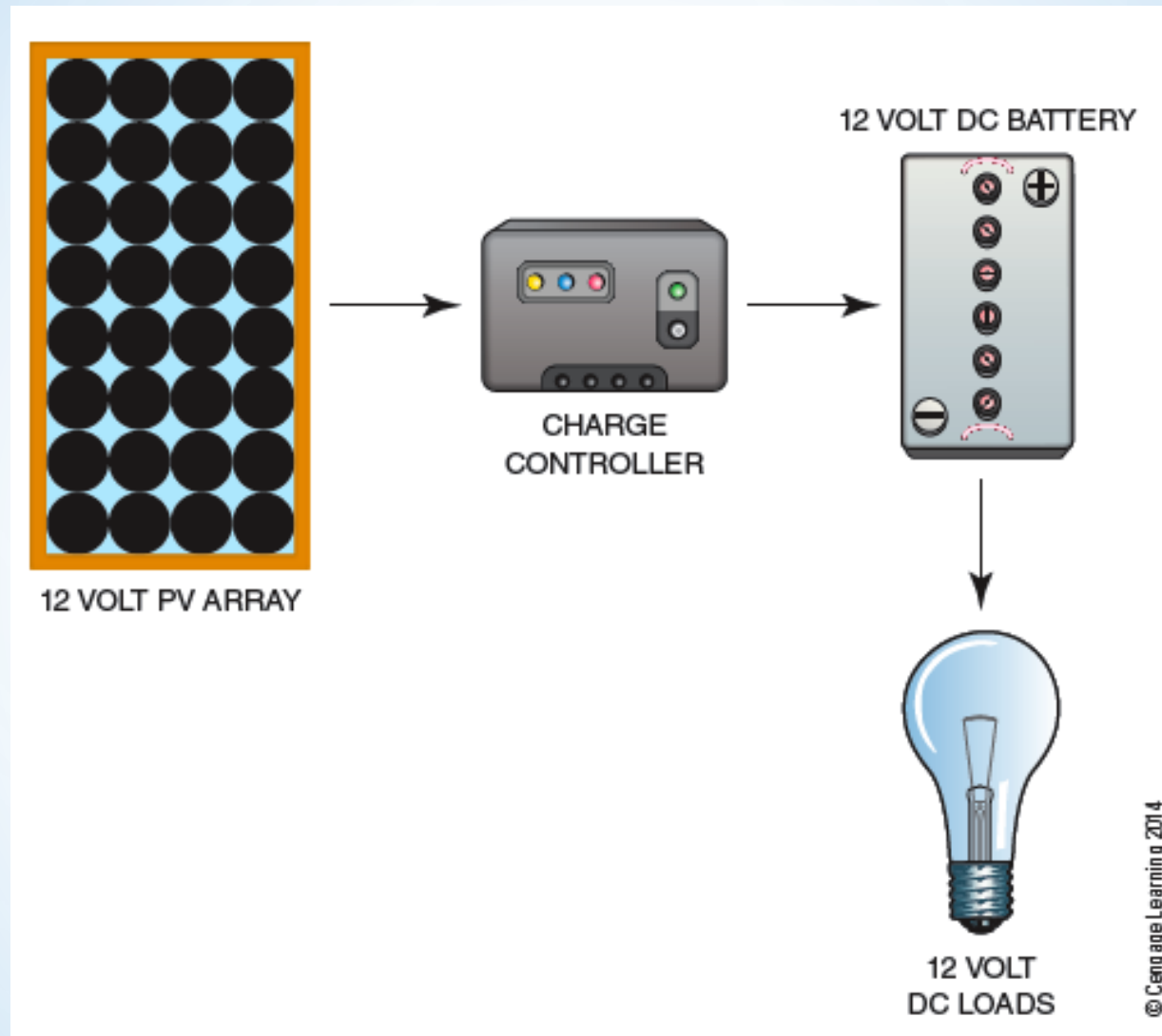


Figure 1-8: A direct current system with storage batteries is a PV system where loads can be powered day or night.

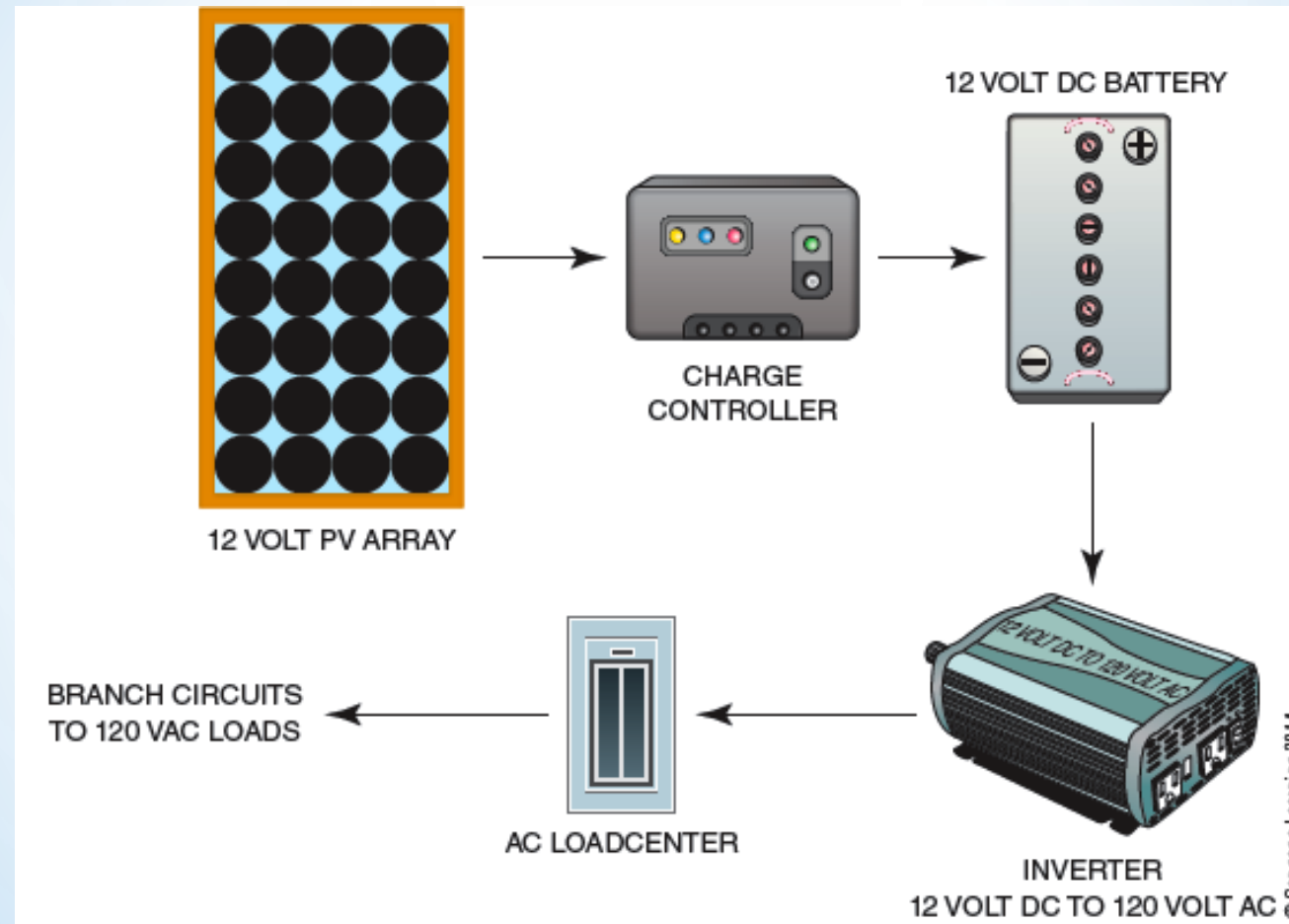


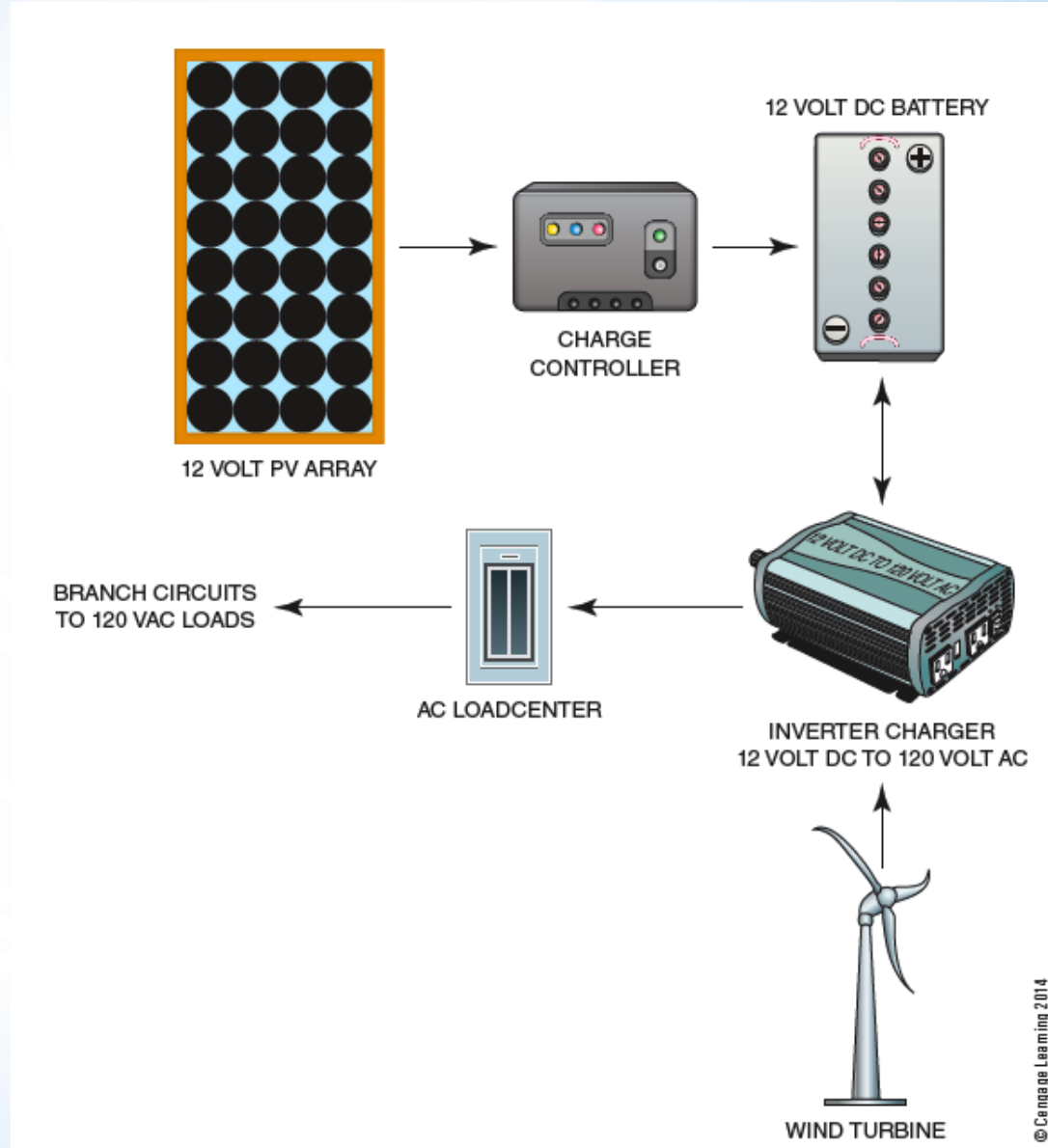
Figure 1-9: A direct current system powering an alternating-current load is a PV system that must use an inverter to convert the DC electricity to AC electricity.

TYPES OF PHOTOVOLTAIC SYSTEMS (CONT'D.)

- Hybrid system
 - Incorporates a gas or diesel generator
- Stand-alone systems
 - No connection to the local utility grid system
- Grid-tie systems
 - Connected to the utility grid system



Figure 1-11: A hybrid system uses another energy source like a small wind turbine to supplement a PV system.



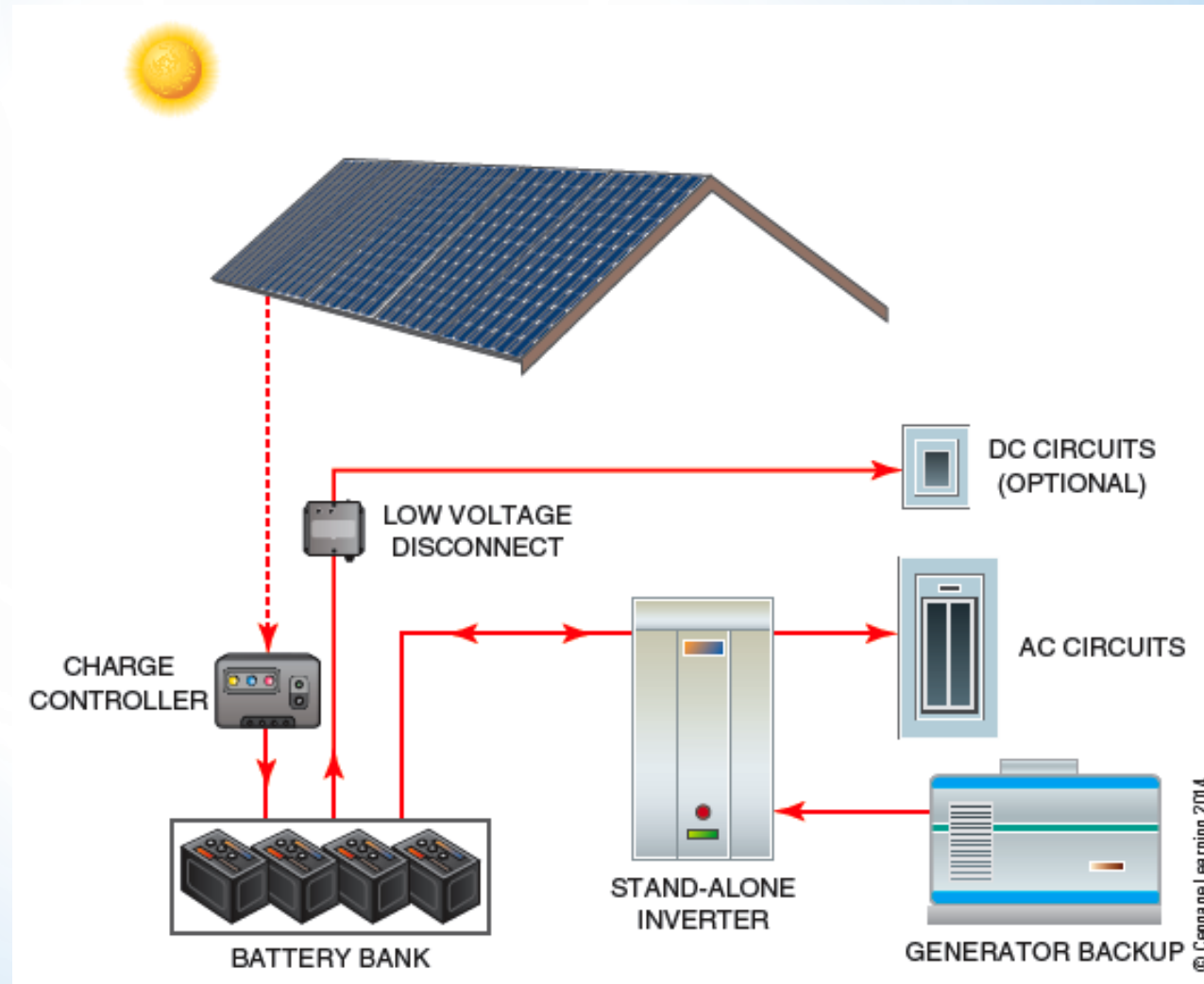


Figure 1-12: A typical stand-alone PV system.

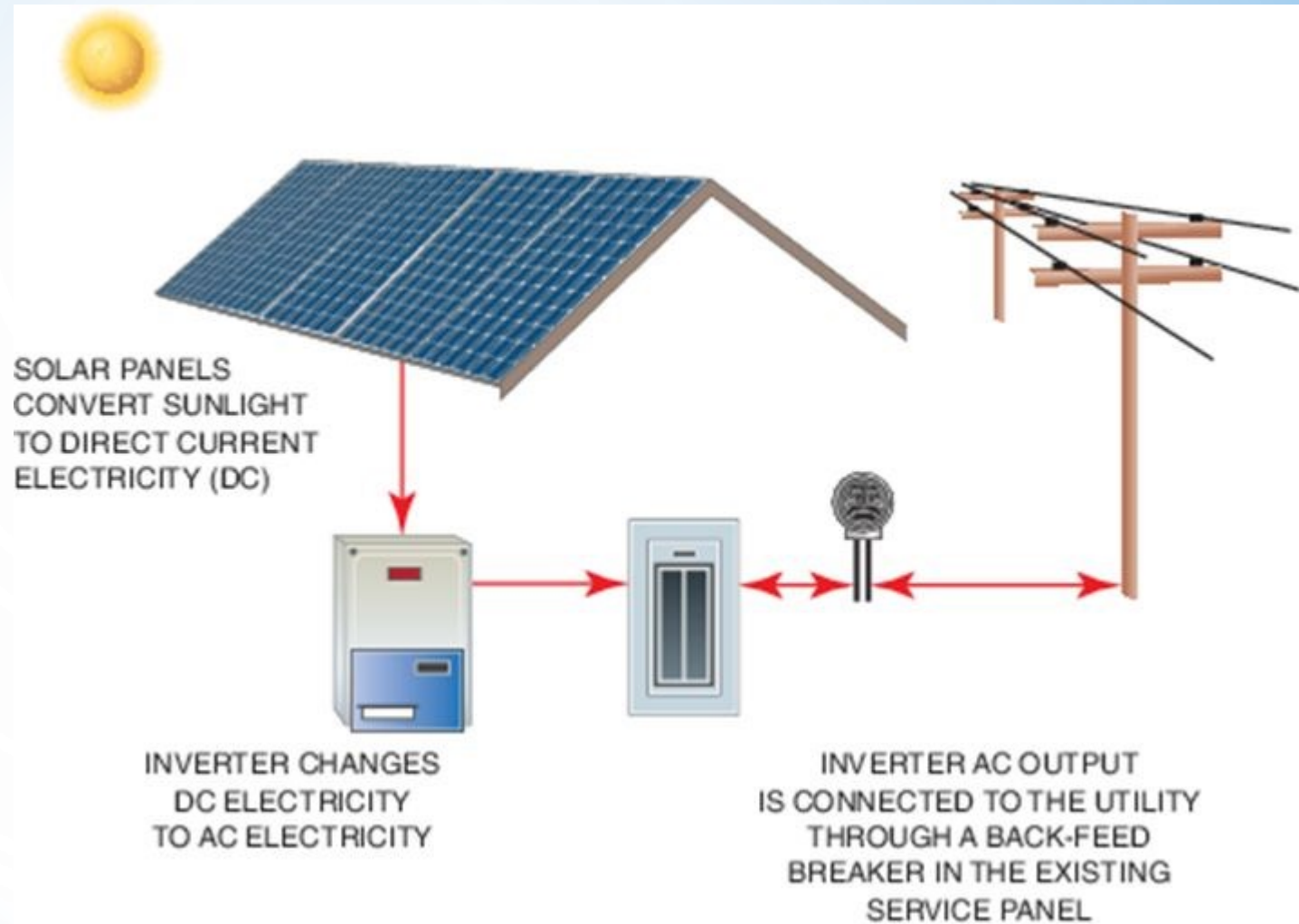
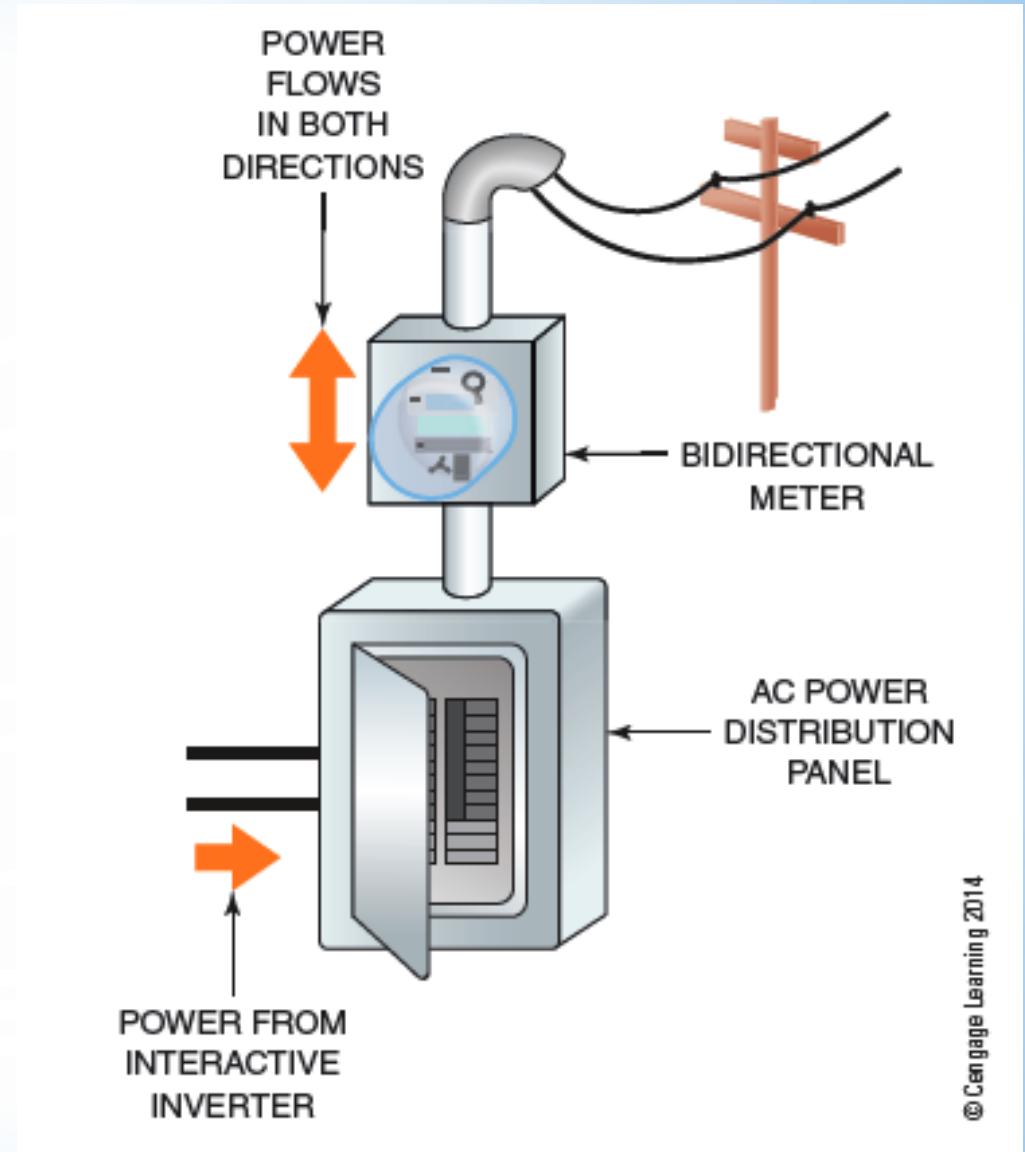


Figure 1-13: A typical interactive (grid-tied) PV system.

PHOTOVOLTAIC GRID-TIE SYSTEMS AND NET METERING

- Net meter
 - Moves forward when electricity flows from utility to building
 - Moves backward when excess electricity flows from building to utility grid

Figure 1-14: In a net-metering system, the net meter moves forward when electricity is flowing from the utility into the house, and the meter moves backward when excess solar energy flows back to the utility grid. At the end of the month, the customer is billed for the amount of electricity consumed less the amount of electricity produced.



UNDERSTANDING PHOTOVOLTAIC SYSTEM ELECTRICITY BASICS

- PV systems can be wired three ways:
 - Series
 - Parallel
 - Series-parallel
- To get desired system voltage and current

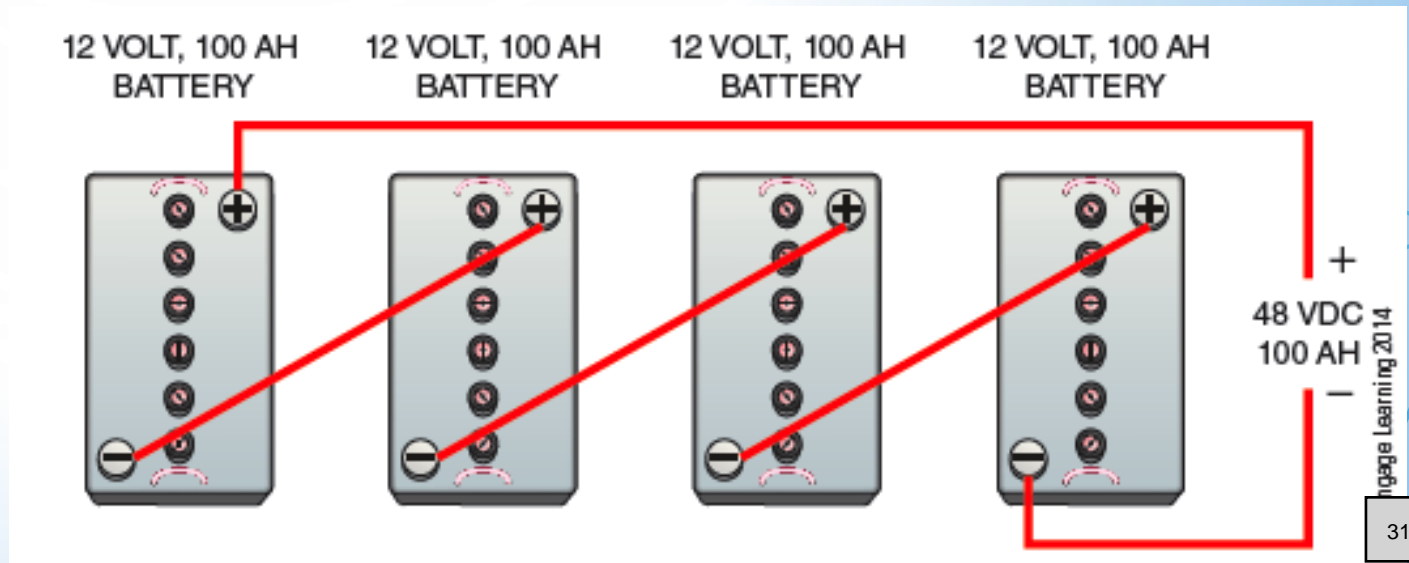
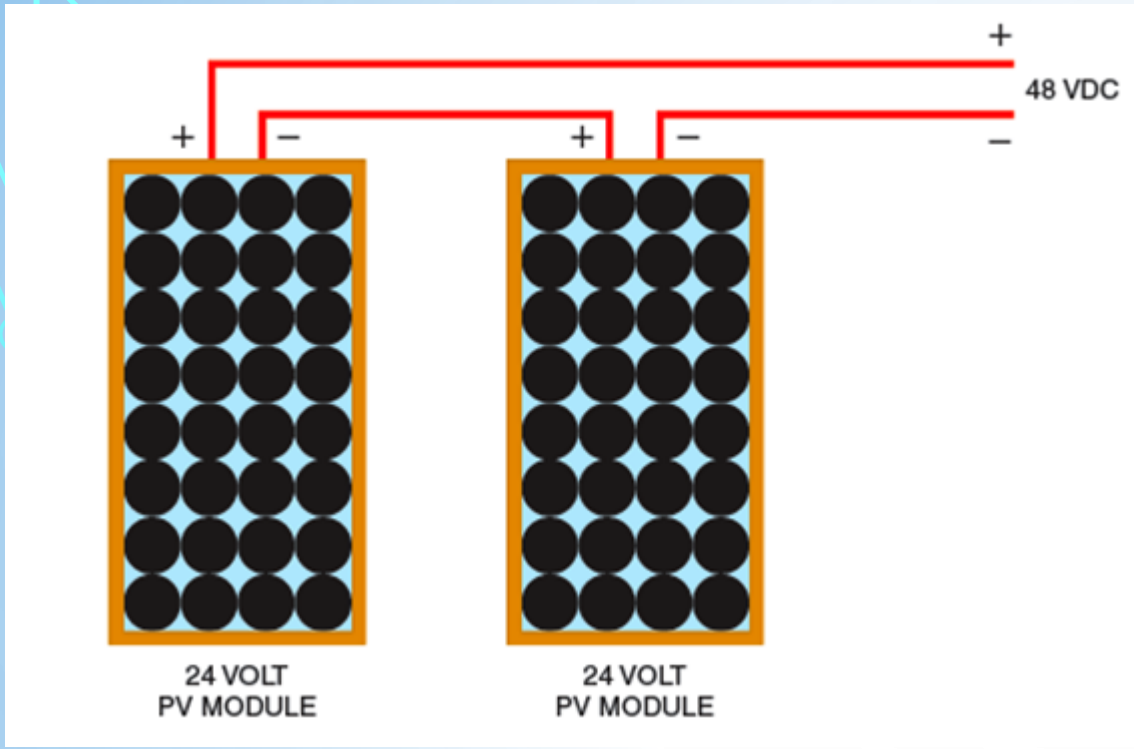


Figure 3-3: PV modules and batteries in a series configuration.

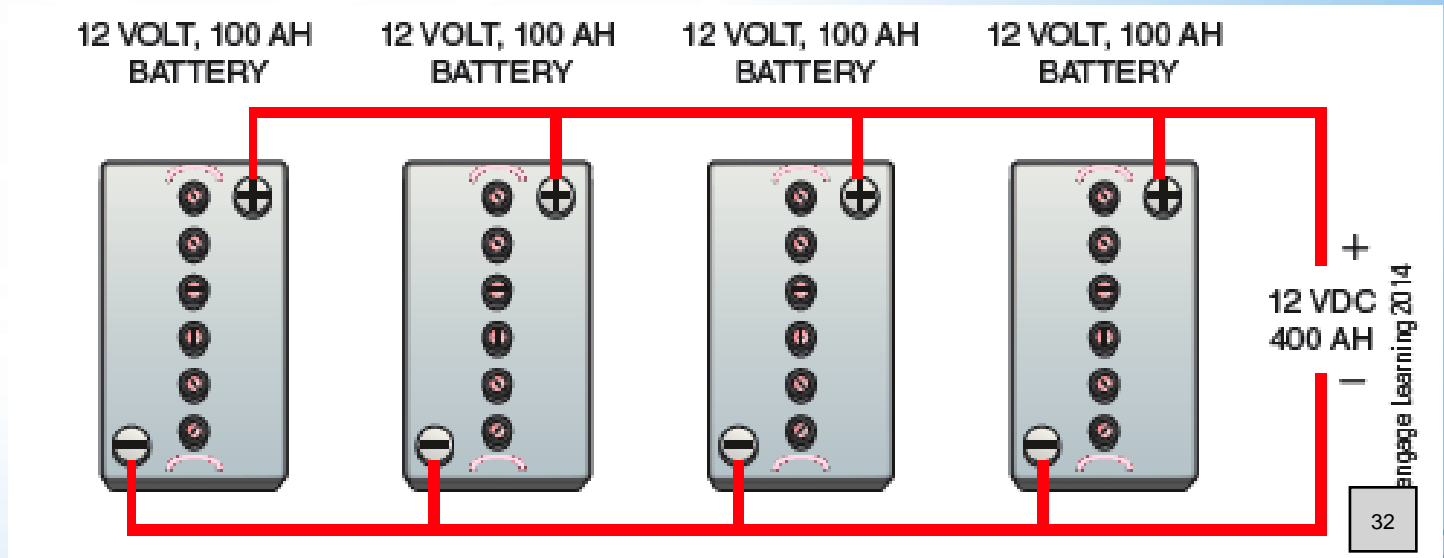
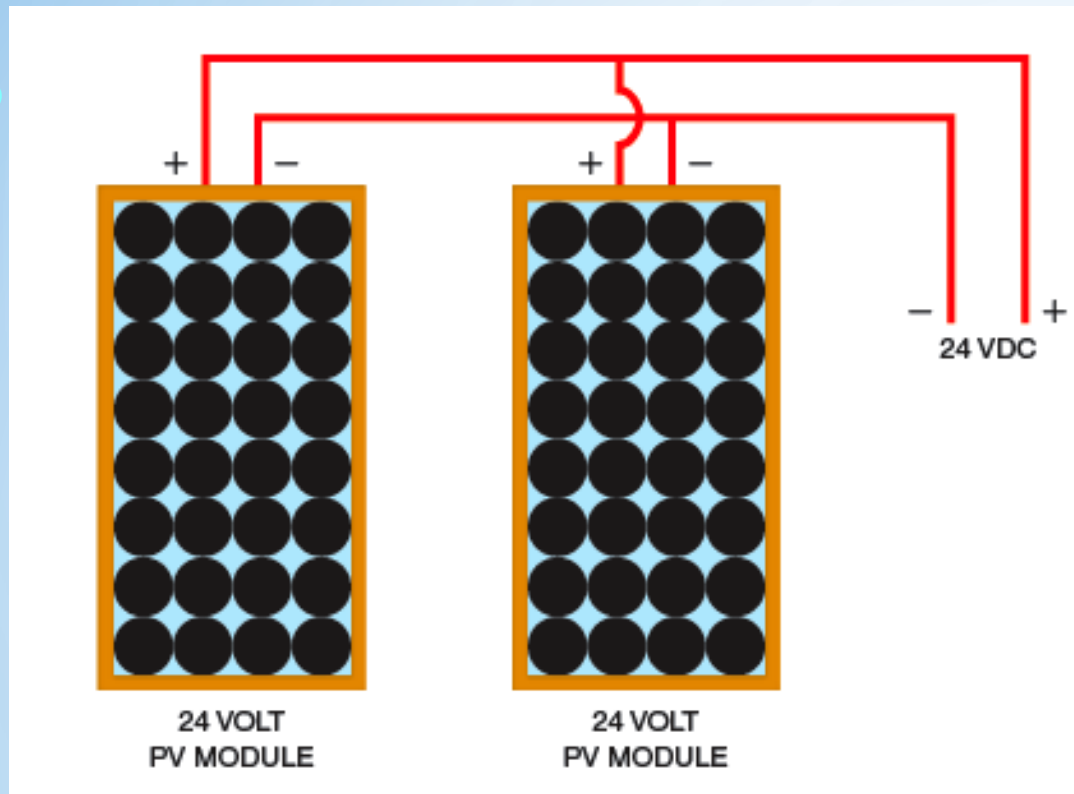
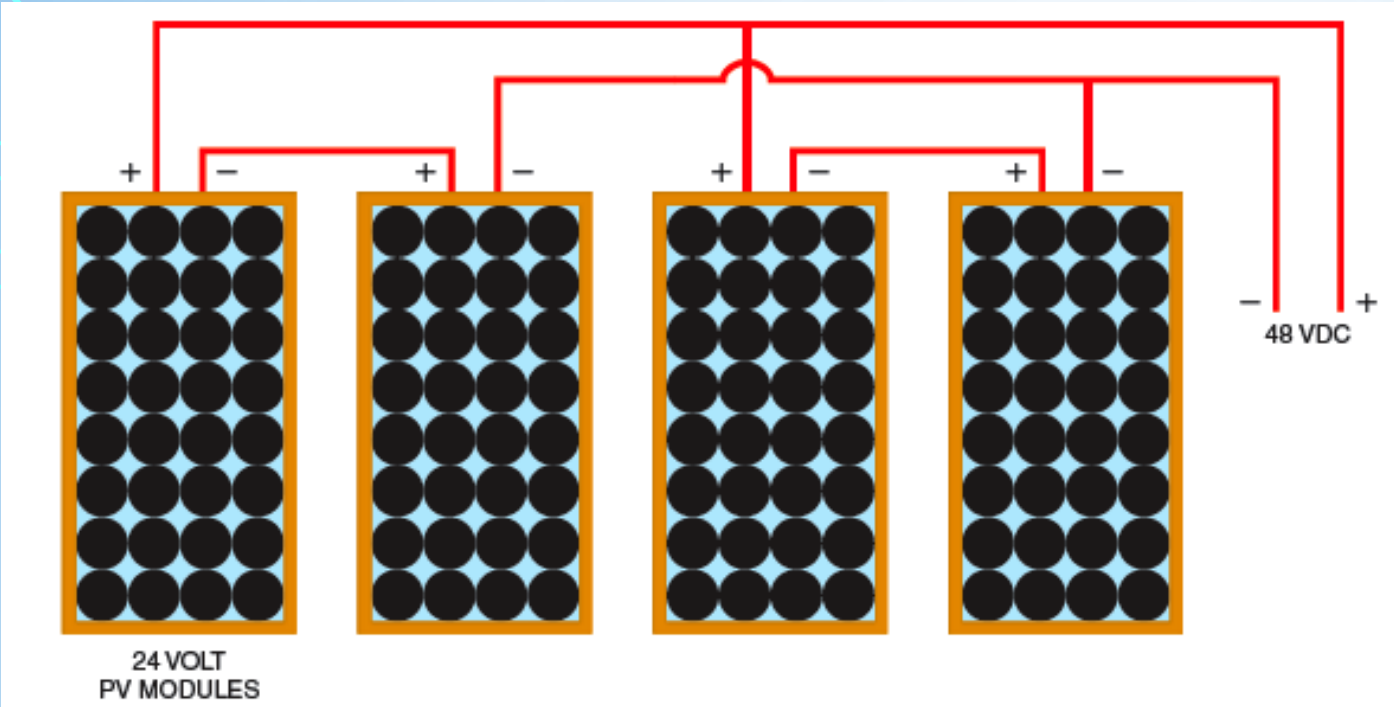


Figure 3-4: PV modules and batteries in a parallel configuration.



12 VOLT, 100 AH BATTERIES

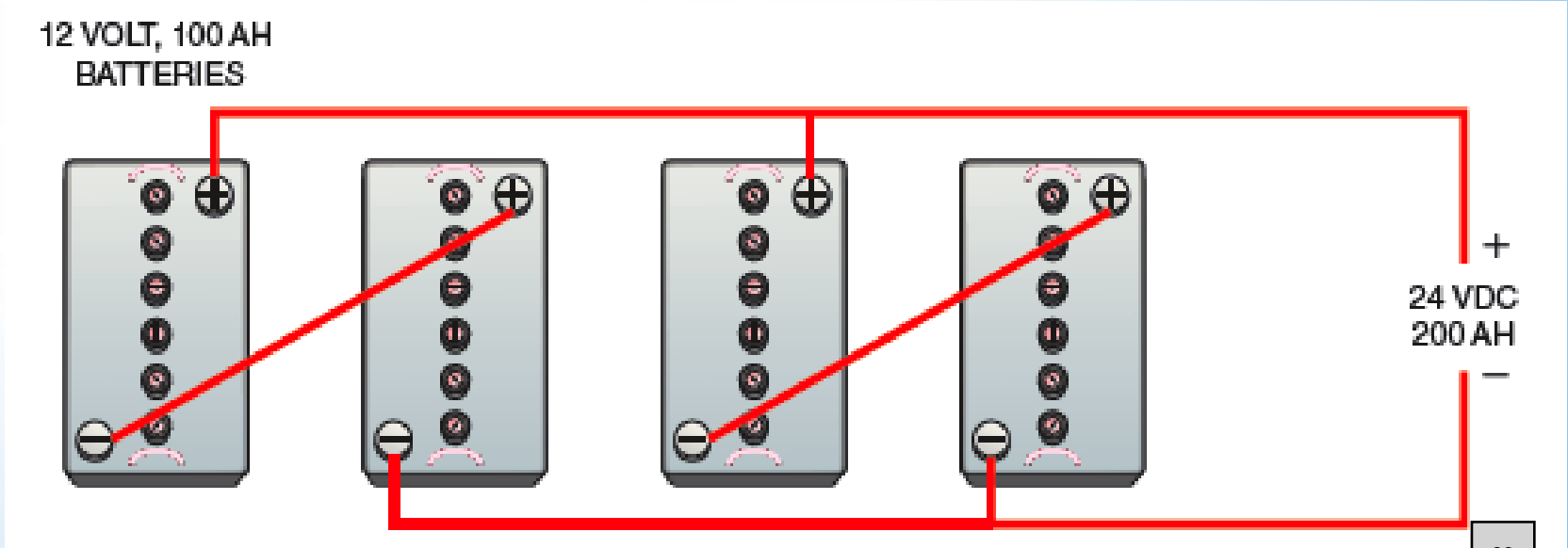


Figure 3-5: PV modules and batteries in a series-parallel configuration.

TEST AND MEASUREMENT INSTRUMENTS USED IN PV SYSTEM INSTALLATION

- Digital Multi Meters Give precise Values
 - Wiggies Only Indicate approximate values of voltage for either DC or AC systems
- Ammeters
 - Measure amount of current flowing in a circuit
 - Used to locate overloads and open circuits

SOLAR ENERGY BASICS

- Solar radiation – energy coming from the sun in the form of waves and small particles
- Solar noon – time of day when the sun is at it's highest point in the sky
- Solar constant – energy of 1000 W/m^2 at the equator at sea level at solar noon

- Solar irradiance – measure of solar power striking a specific location
- Solar irradiation – total amount of solar energy accumulated on an area over a period of time
- Insolation – another term for solar irradiation

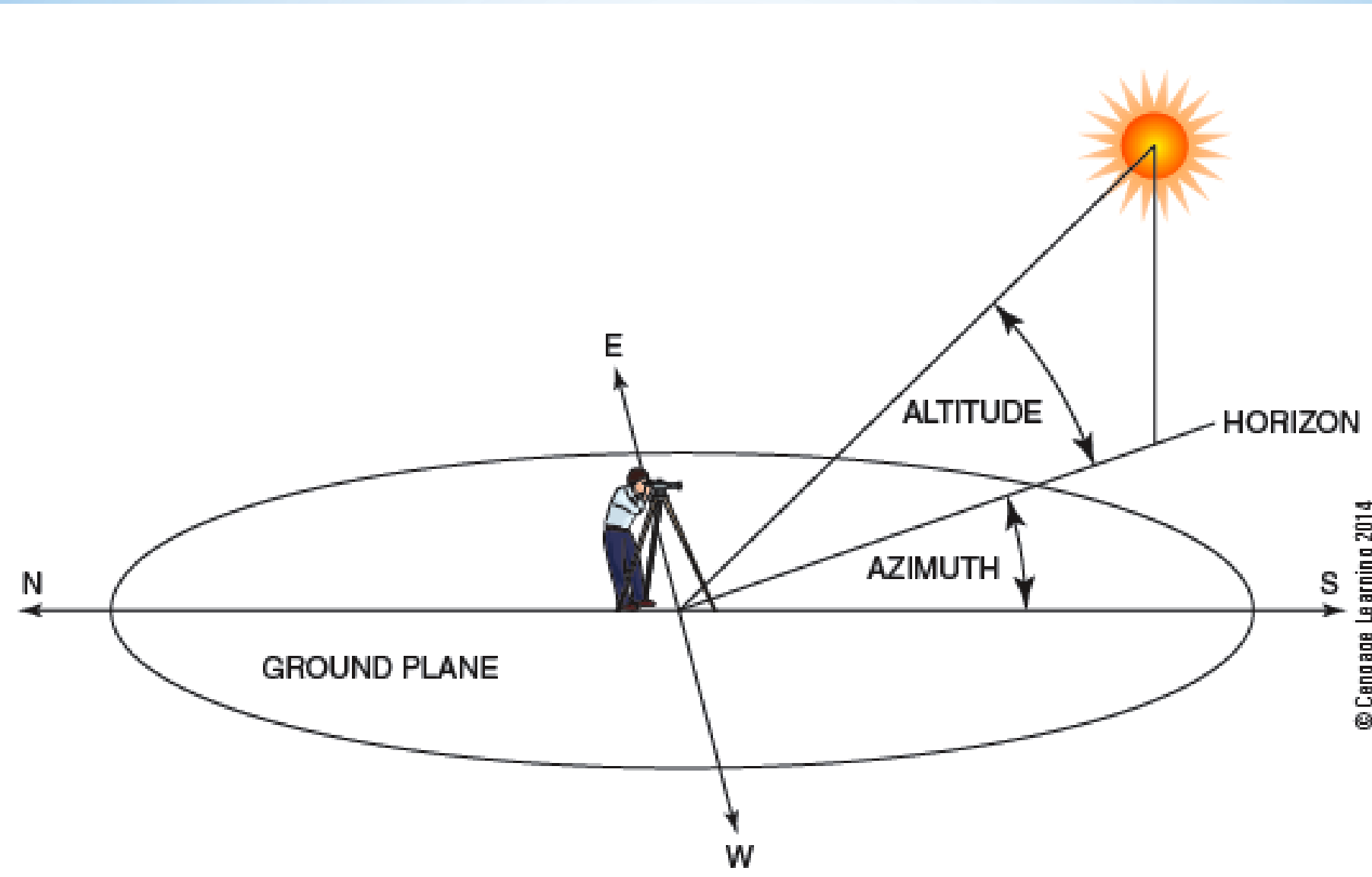


Figure 4-4: The sun's height above the horizon is called altitude. The sun's apparent location in the sky east or west of true south is called azimuth.

- Solar window

- The area in the sky that is between the sun path of the winter solstice (December 21) and the sun path for the summer solstice (June 21) for the hours of 9:00 am to 3 pm
- Highest average insolation on a PV module
 - Tilt equal to latitude



SOLAR INSOLATION DATA

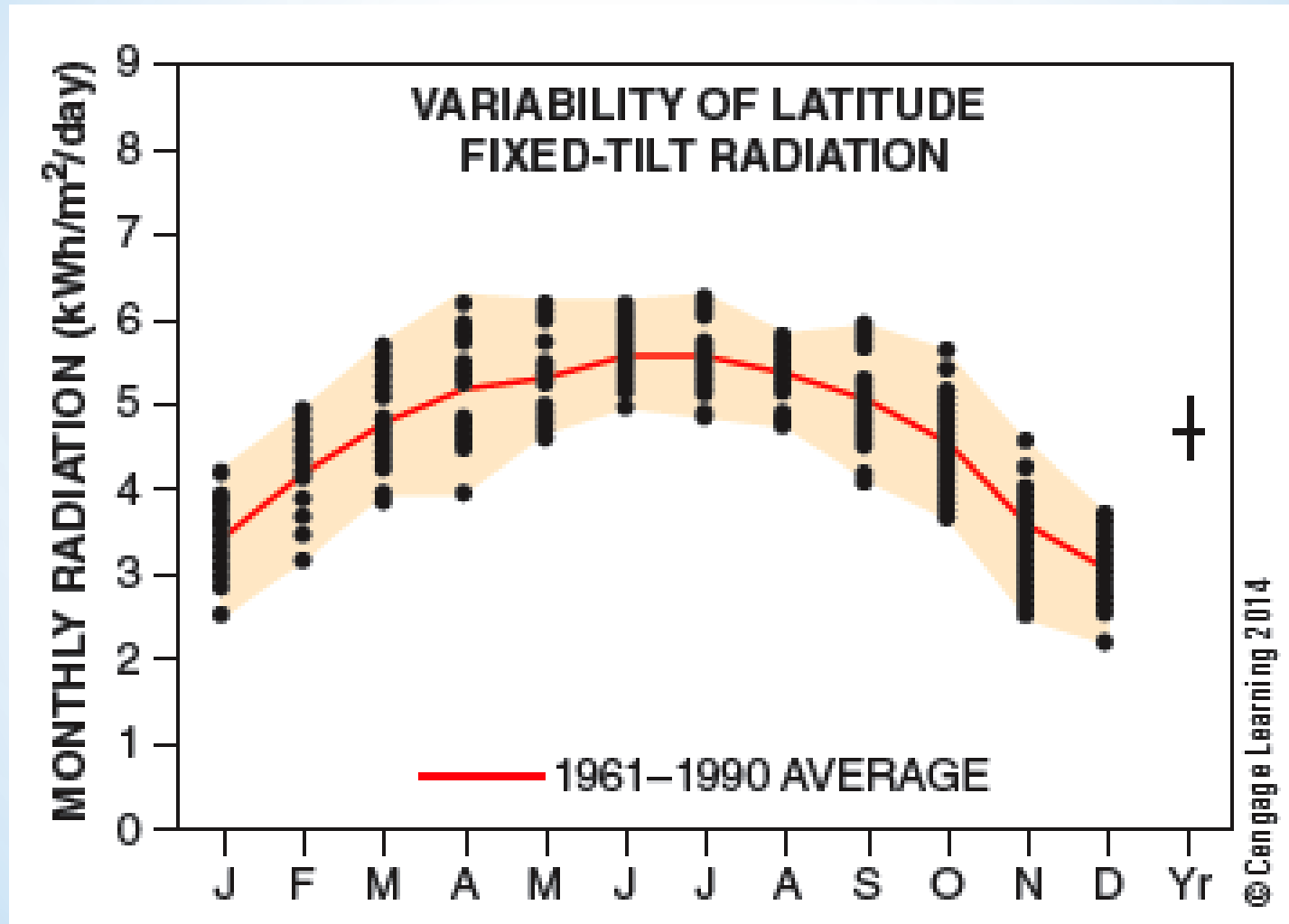


Figure 4-6: An example of the solar radiation data available from the National Renewable Energy Lab (NREL). This information applies to Baltimore, Maryland.

ARRAY PERFORMANCE

- Solar radiation data used to size and estimate PV array performance
- Can be calculated manually or with a computer program

SITE EVALUATION

- Site visit equipment includes
 - Digital camera
 - Notebooks
 - Calculator
 - Compass
 - Level
 - Other Misc. Electrical Tools

EVALUATING THE SITE FOR SHADING

- Shading greatly affects array performance
- Sun path charts
 - Altitude angle
 - Transit
 - Protractor

SUN PATH CHART FOR 40° NORTH LATITUDE

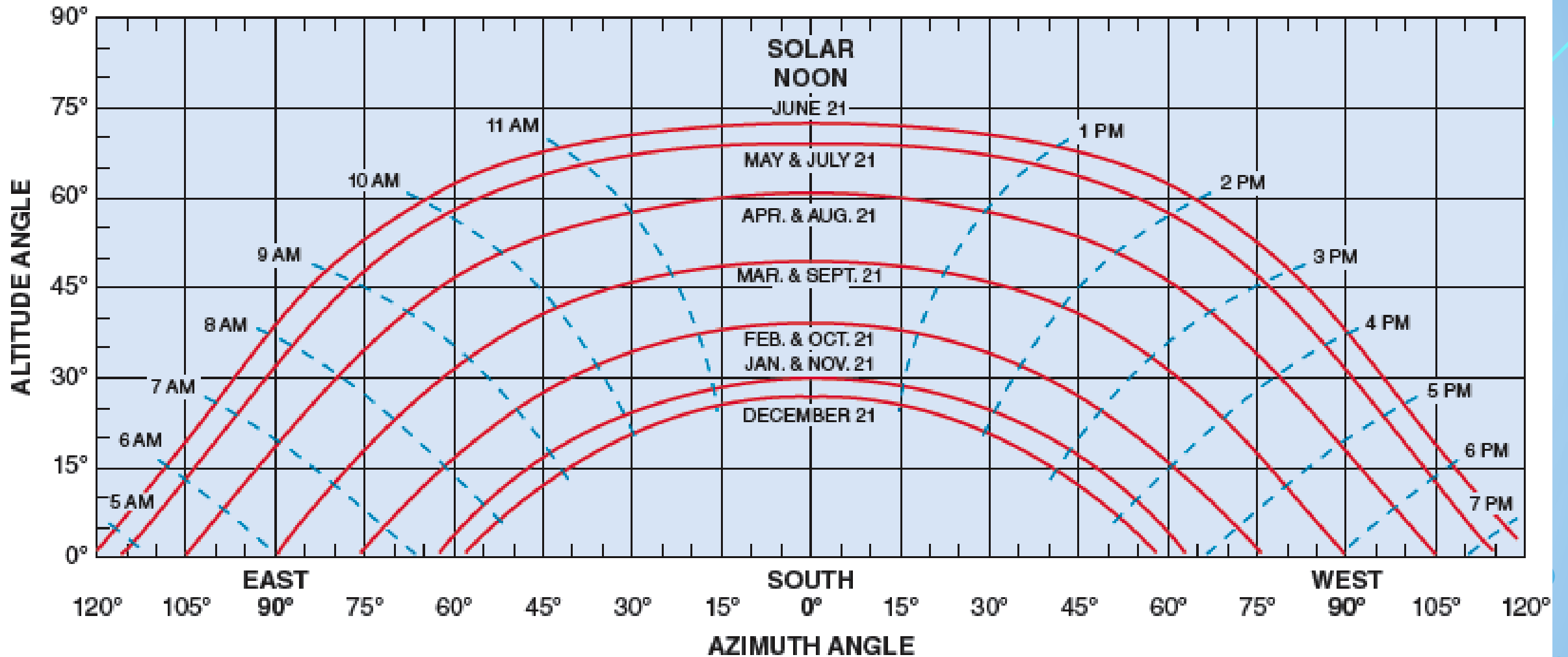


Figure 4-13: Sun path charts show the path of the sun at different dates and times for a specific location.

SUN PATH CHART FOR 40° NORTH LATITUDE

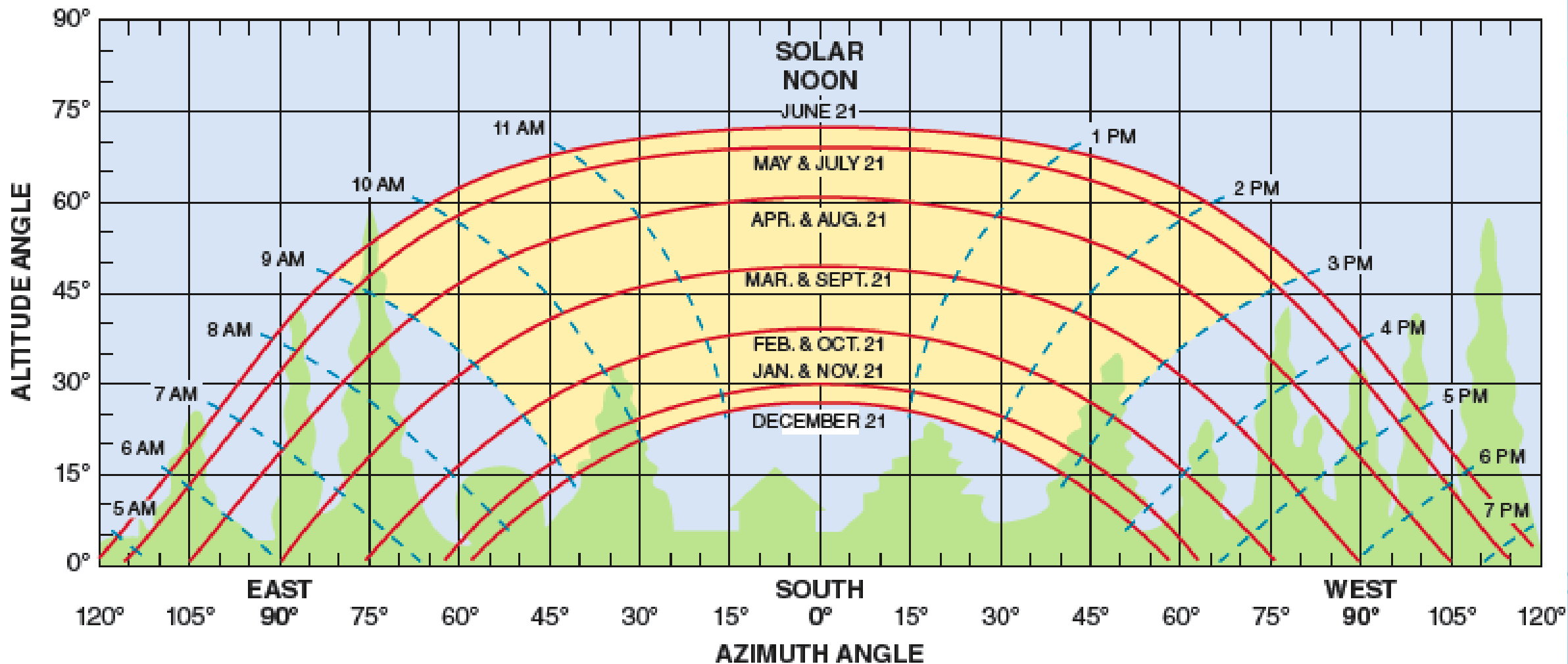


Figure 4-16: An example of a sun path chart for 40° north latitude. This chart shows that three trees will cause minor shading in the 9 am to 3 pm solar window at certain times of the year.



Ohio Certificate Renewal
"Since 1994"

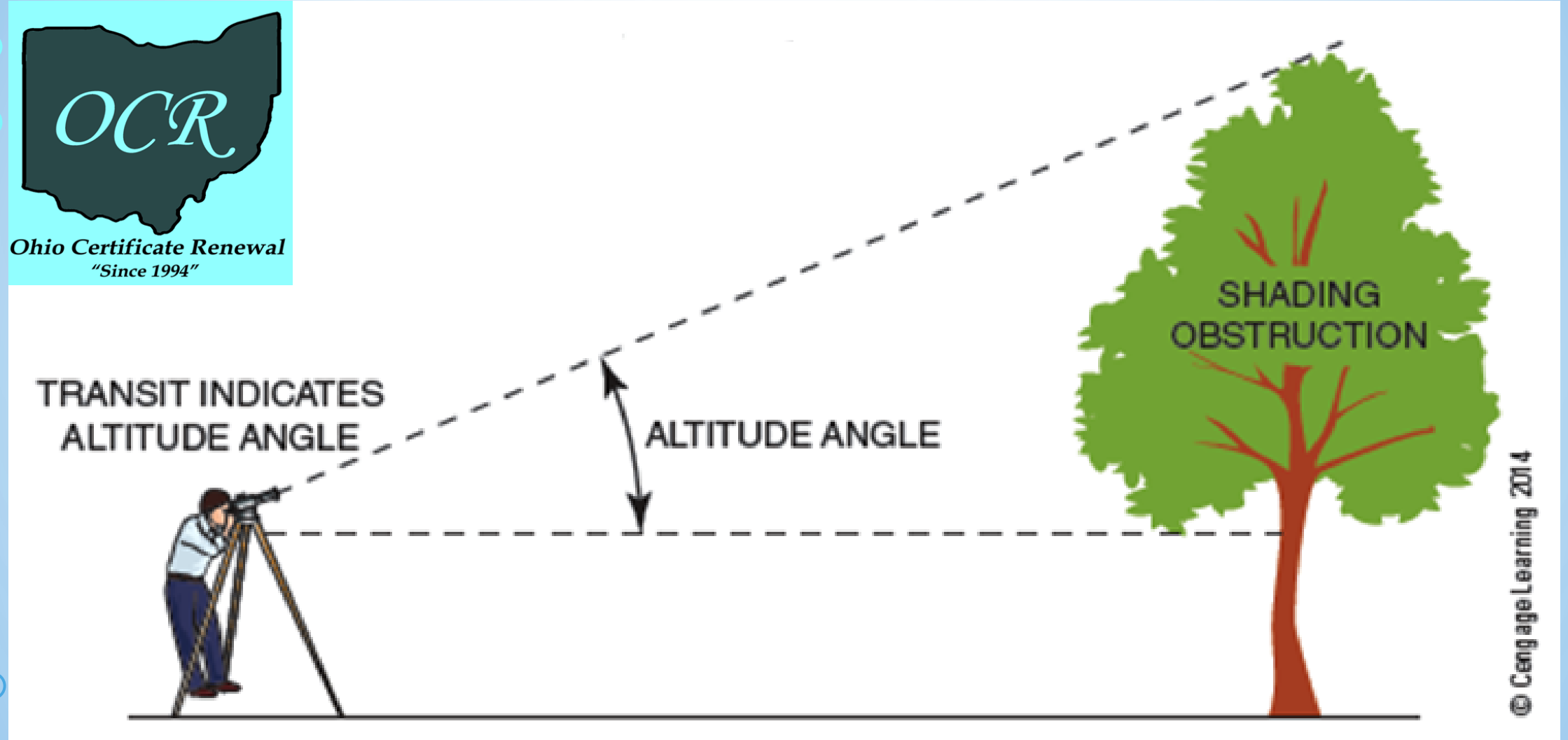
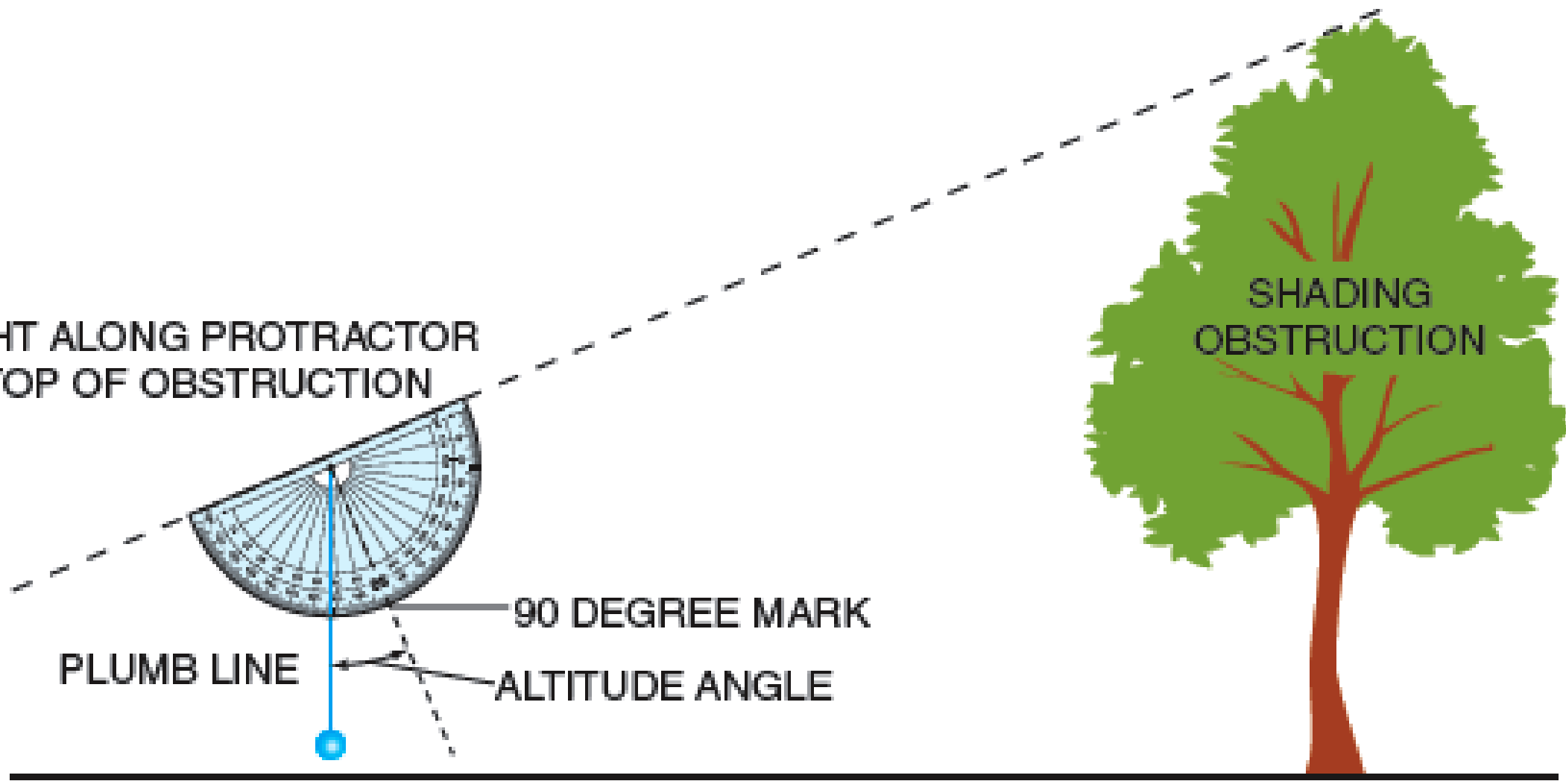


Figure 4-14: A transit being used to determine the altitude angle of a possible shading obstruction.

SIGHT ALONG PROTRACTOR
TO TOP OF OBSTRUCTION



© Cengage Learning 2014

Figure 4-15: A protractor can also be used to determine the altitude angle of a possible shading obstruction.

PROFILE ANGLE CALCULATION

- Profile angle equation

$$d = h \times \cos \theta / \tan \psi$$

- d = minimum distance between rows
- h = height of row
- θ = solar azimuth angle
- ψ = solar altitude angle

SOLAR SITE SELECTOR DEVICES

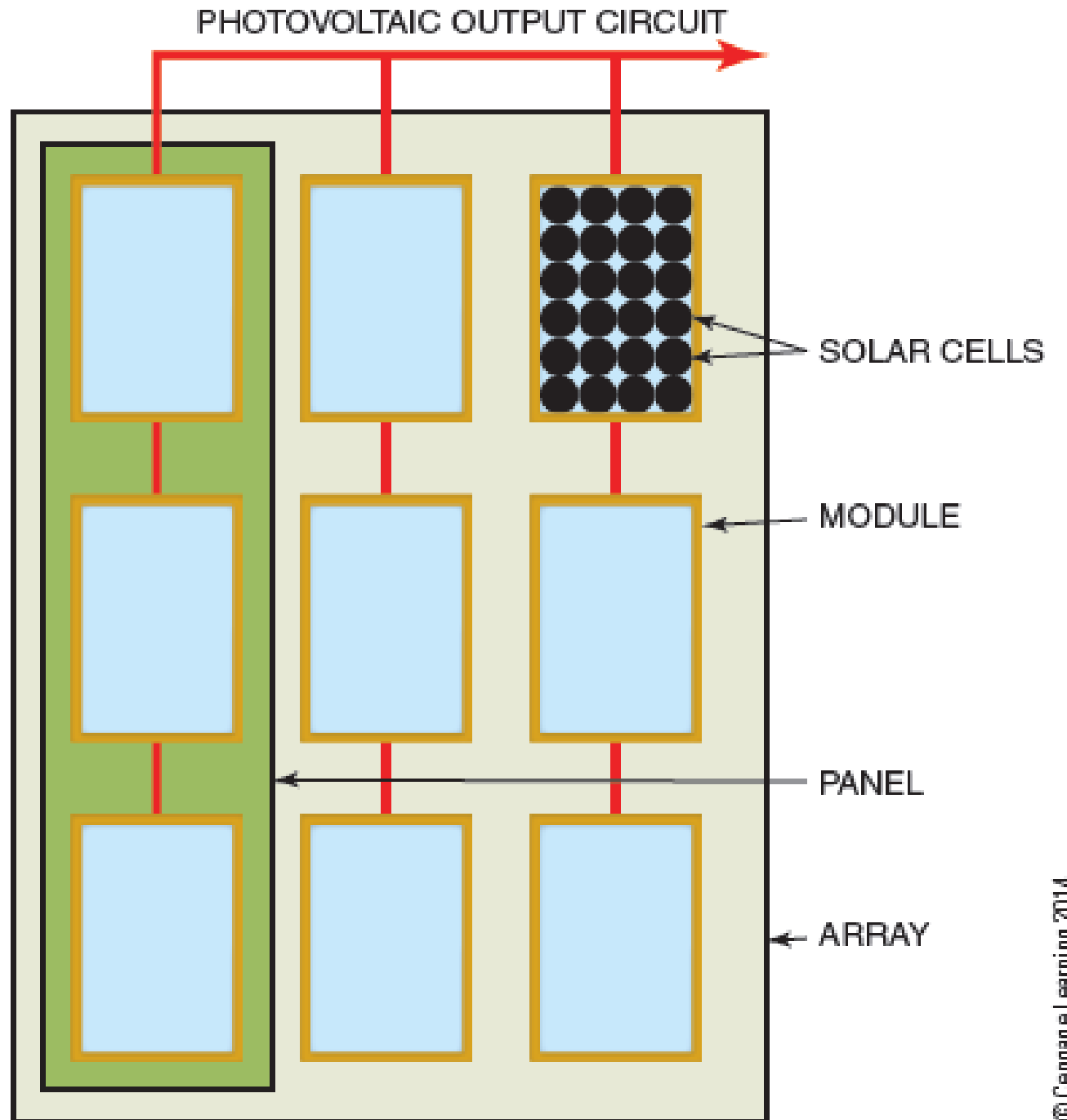
- Common available devices with sun charts built in
 - Solar Pathfinder™
 - Solometric SunEye™

PV MODULES

- Cell – primary component of PV system
- Modules – assemblies of cells
 - Superstrate – glass used to support cells and also as a “window” for light to pass through
 - Substrate – material that completes encapsulation of cells
- Array – modules wired together

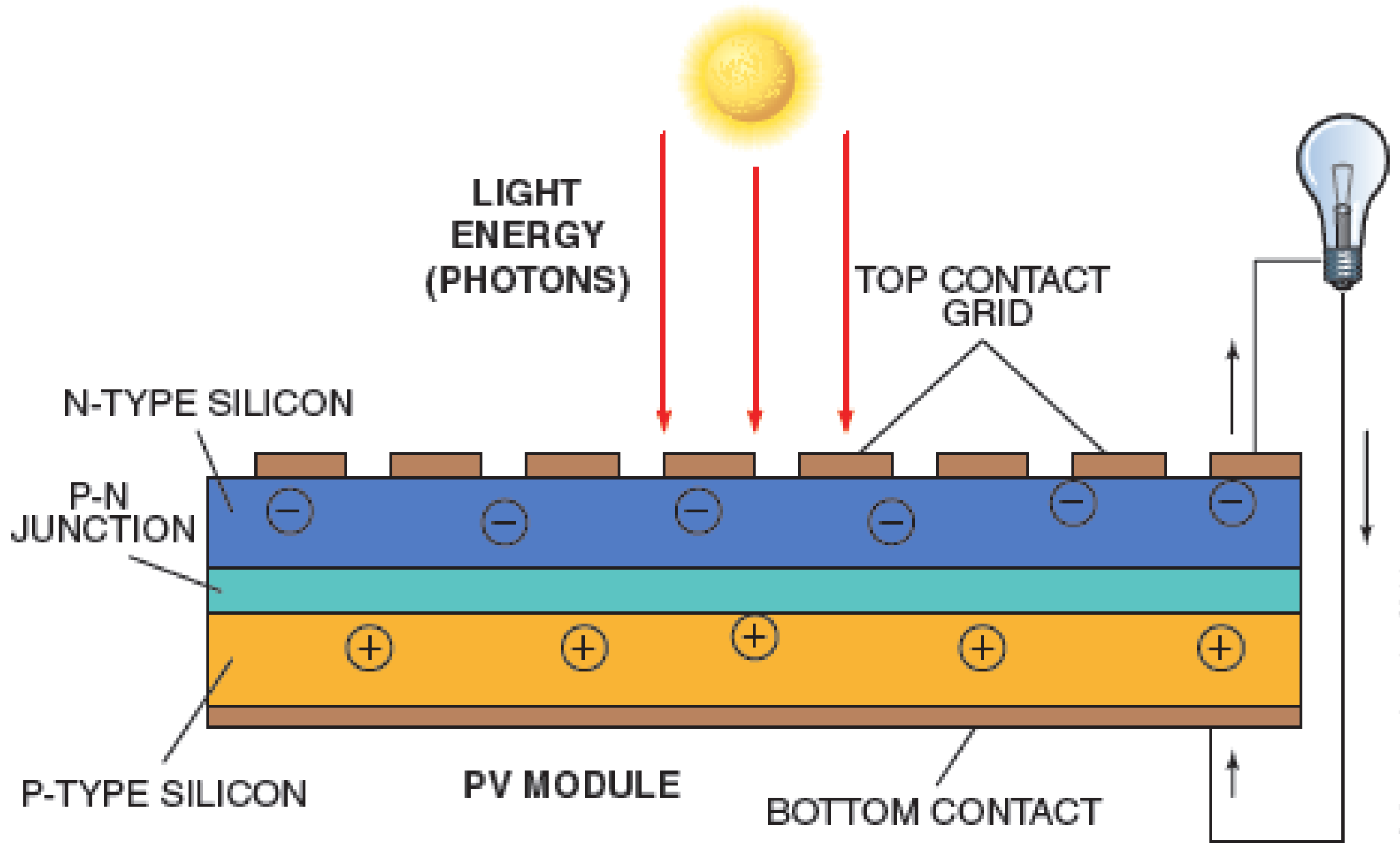


Figure 5-4: A comparison of solar cell, module, panel, and array.



THE PHOTOVOLTAIC EFFECT

- Voltage production in a PV cell
- Semiconductor – material that can be an insulator or conductor depending on temperature
- Silicon – major material for solar cells
 - A semiconductor, Doping changes properties (Conductance)
- Single-crystalline silicon
 - Grown as a single crystal
- Multicrystalline silicon
 - Cast into an ingot of multiple crystals



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Figure 5-5: An illustration of the photovoltaic effect.

- Ribbon silicon
 - Drawn out and allowed to cool and solidify as a continuous multicrystalline strip
- Amorphous silicon
 - Deposited as a thin film
- Copper indium gallium selenium (CIGS)
- Cadmium telluride (CdTe)
- Gallium arsenide (GaAs)
- Photochemical cell

PV MODULE PERFORMANCE CHARACTERISTICS

- I-V curve
 - Representation of all voltage and current values for a specific module
 - V_{oc} – open circuit voltage
 - Maximum voltage available when no current is being drawn
 - I_{sc} – short circuit current
 - Maximum current output with no resistance

- MPP – maximum power point
 - Maximum output of the PV module
 - Maximum voltage x maximum current
- Solar cells work most efficiently at the MPP
 - Electrical load or battery bank will determine actual operating point



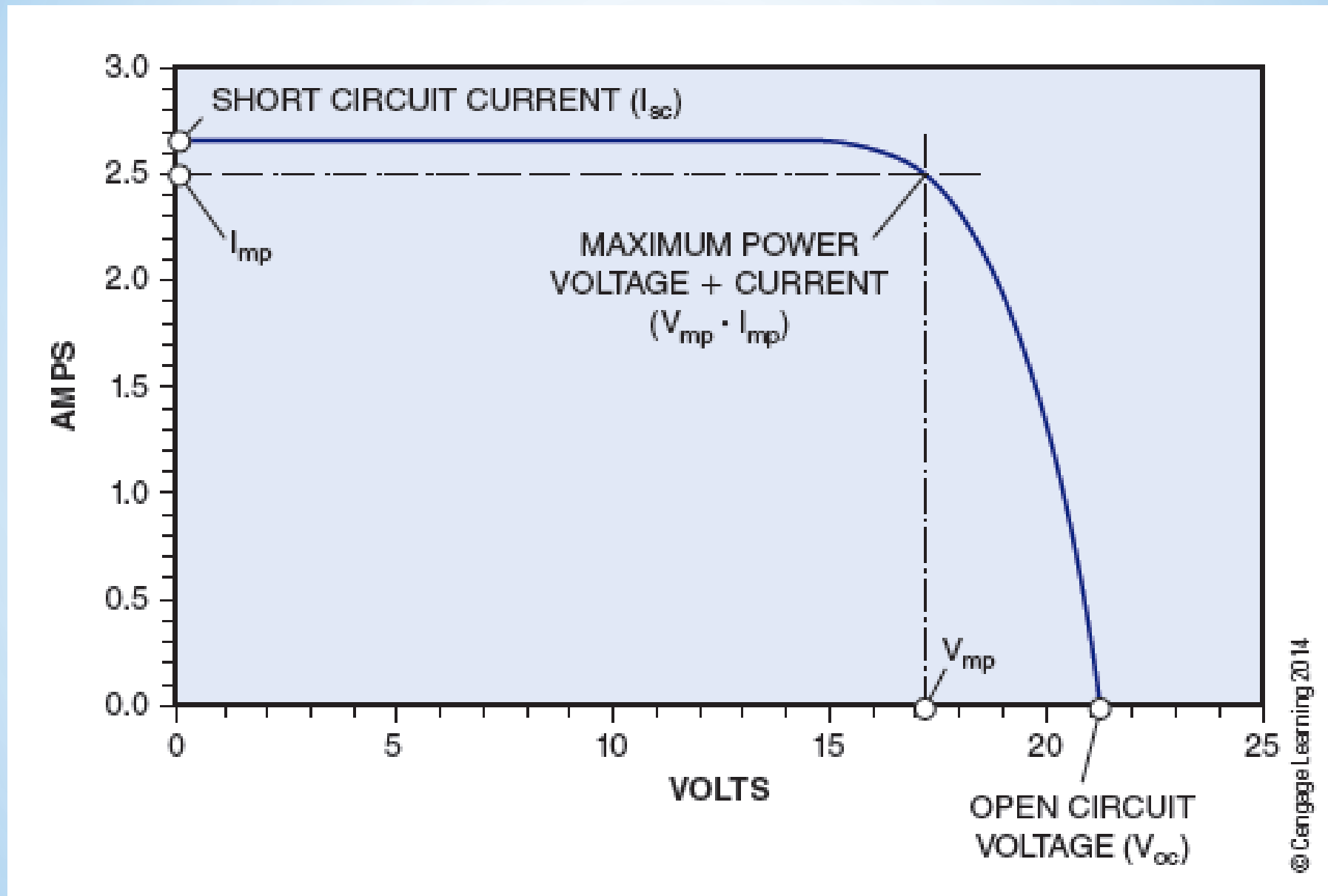
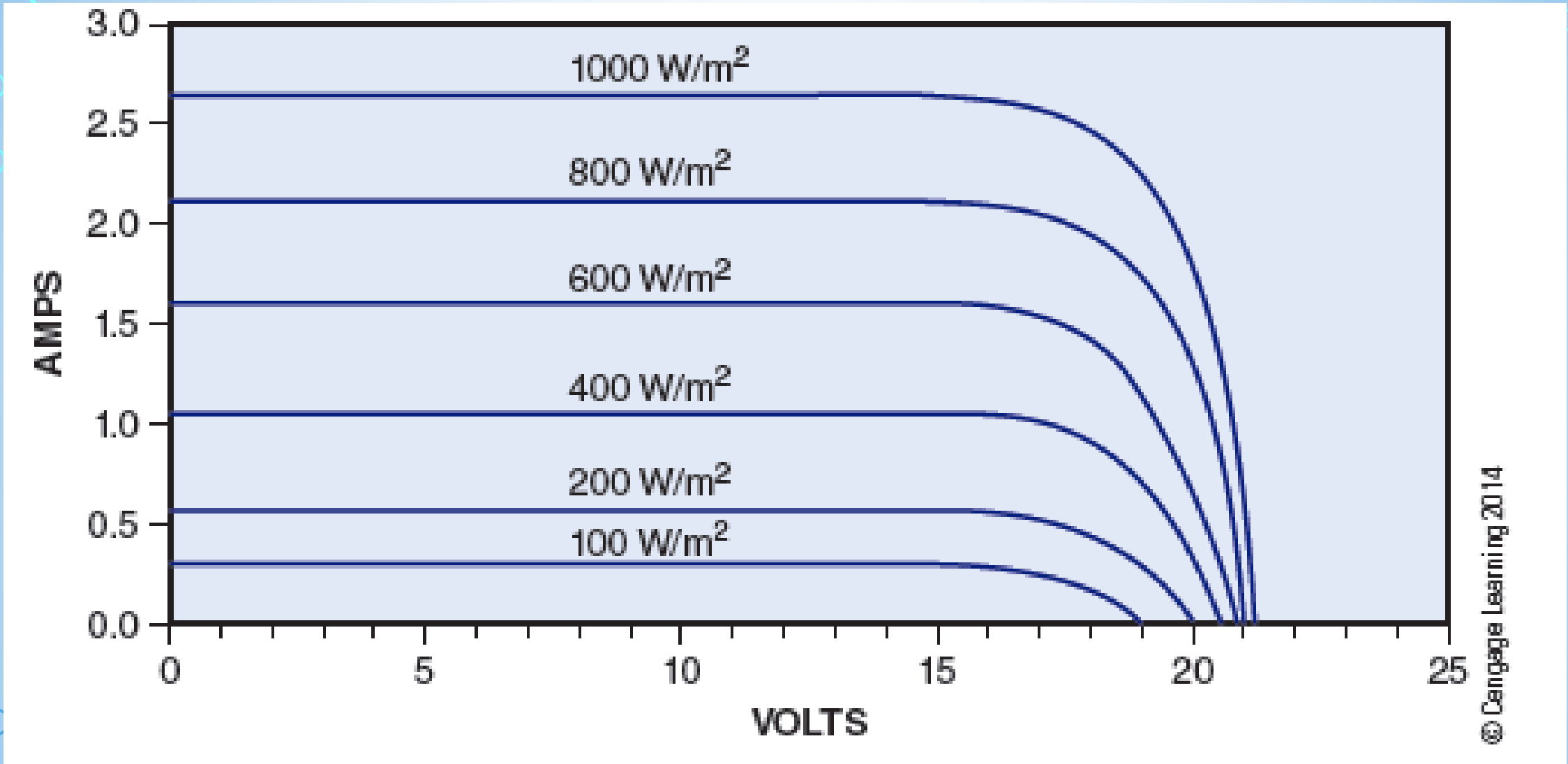
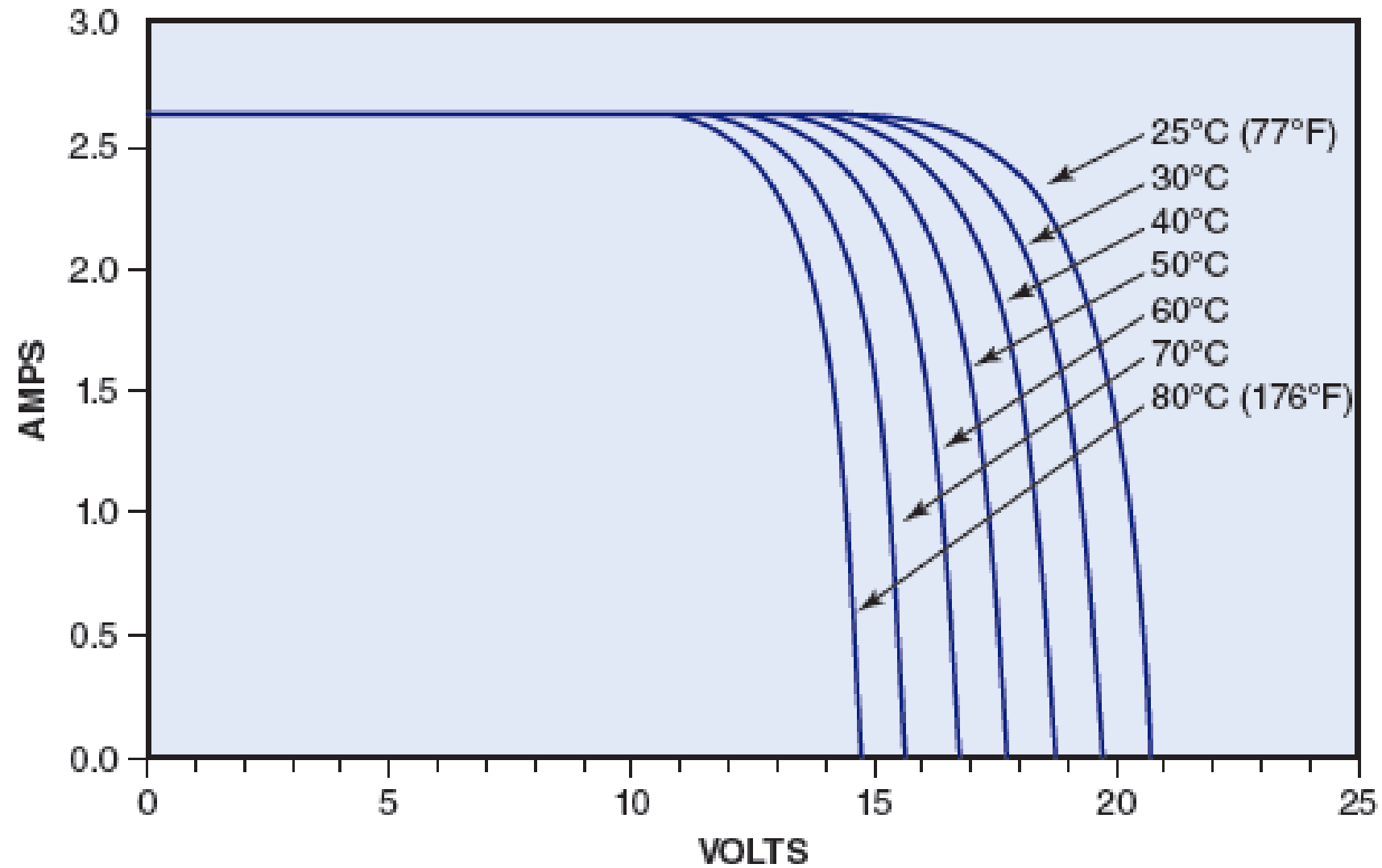


Figure 5-9: An I-V curve for a common PV module size.



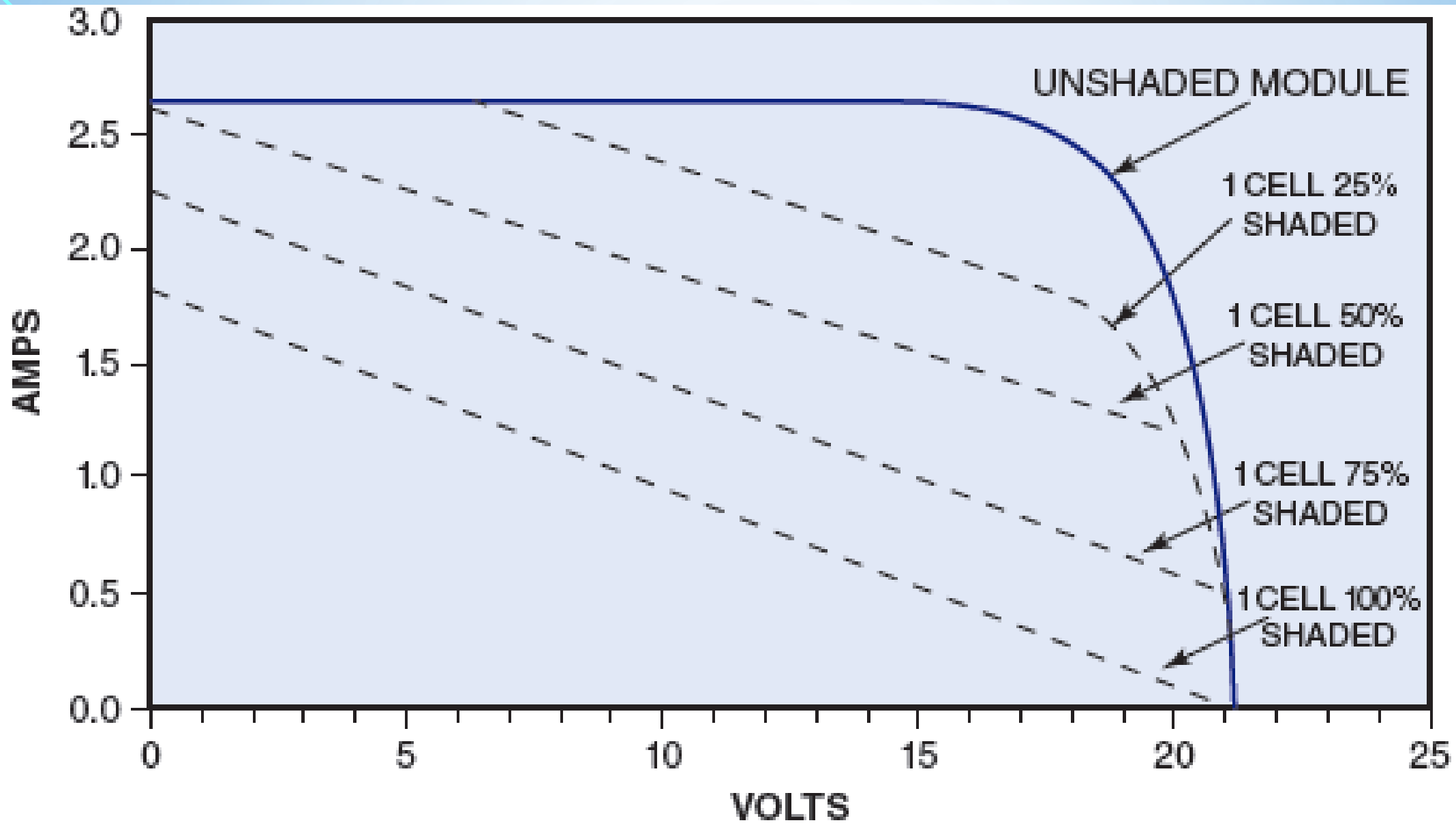
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Figure 5-12: The current output of this 12V DC nominal module decreases as the available solar irradiance decreases. Voltage changes very little.



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Figure 5-13: The voltage of this 12V DC nominal module decreases as the cell temperature rises. The current output changes very little.

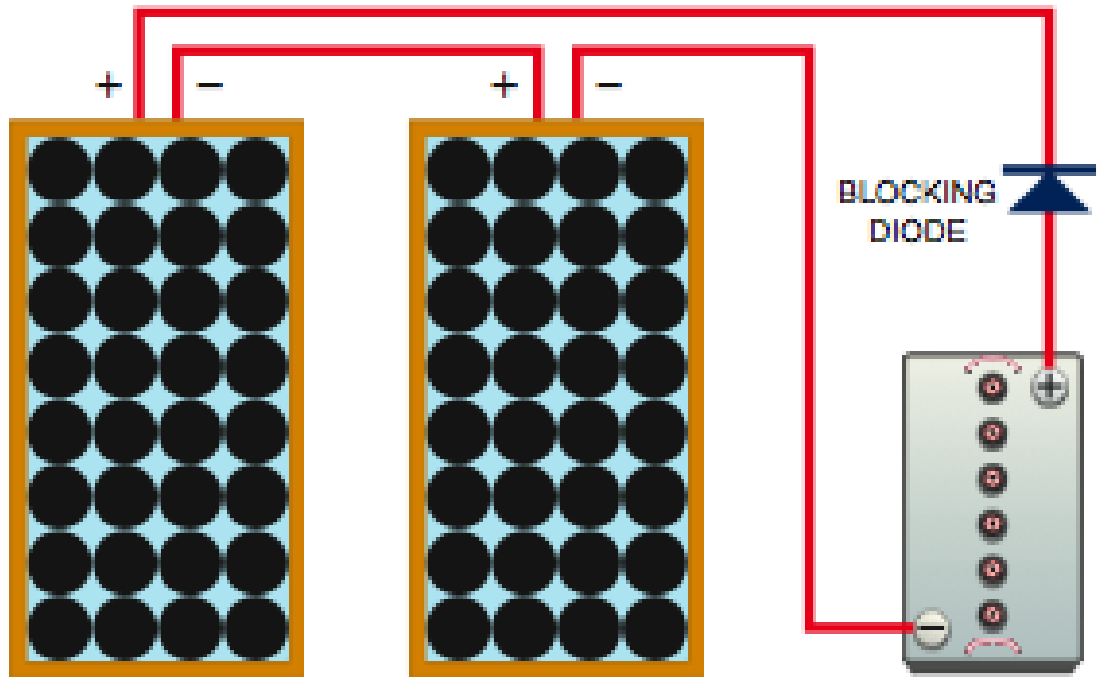


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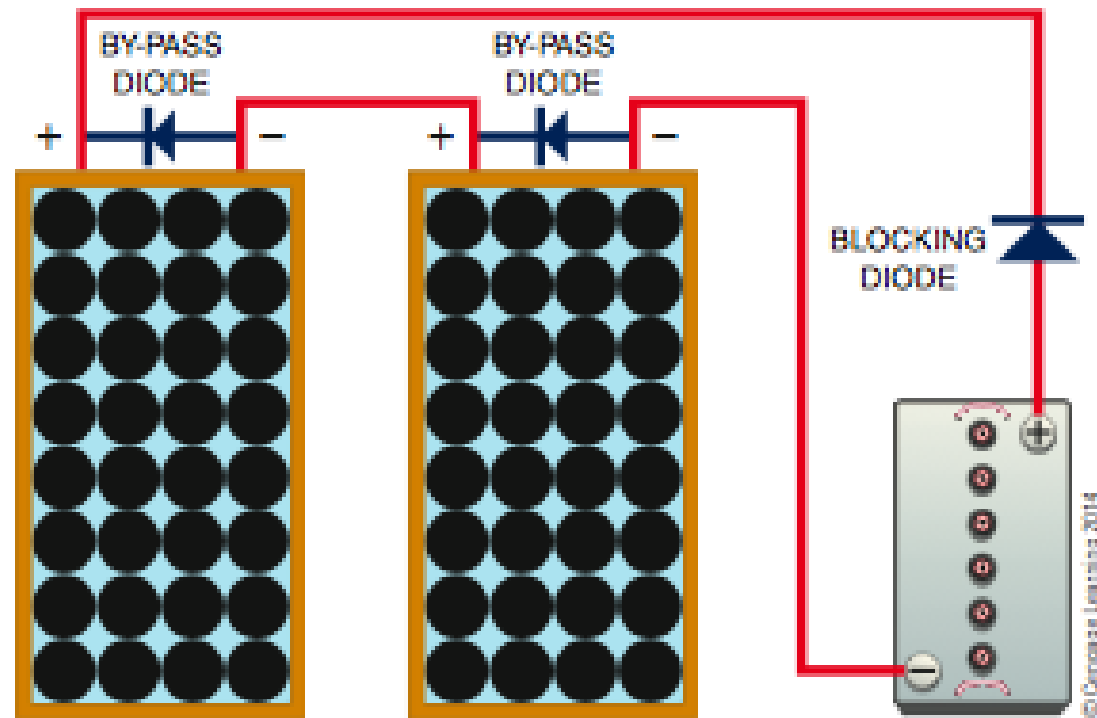
Figure 5-15: The effect of shading on a common 12-volt PV module.

PV MODULES AND DIODES

- Diode – semiconductor device
 - Allows current to pass through only in one direction
- Blocking diodes
 - Placed in the positive line between modules and battery bank
 - Prevent battery current from reversing
- Bypass diodes
 - Wired in parallel with a module
 - Divert current around the module if too much shading



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Figure 5-17: Blocking diodes are placed in the positive line between modules and the battery bank (if used) to prevent current from reversing its flow from the battery bank to the array at night or during cloudy weather.

Figure 5-18: Bypass diodes are wired in parallel with a module to divert current around the module in the event of too much shading.

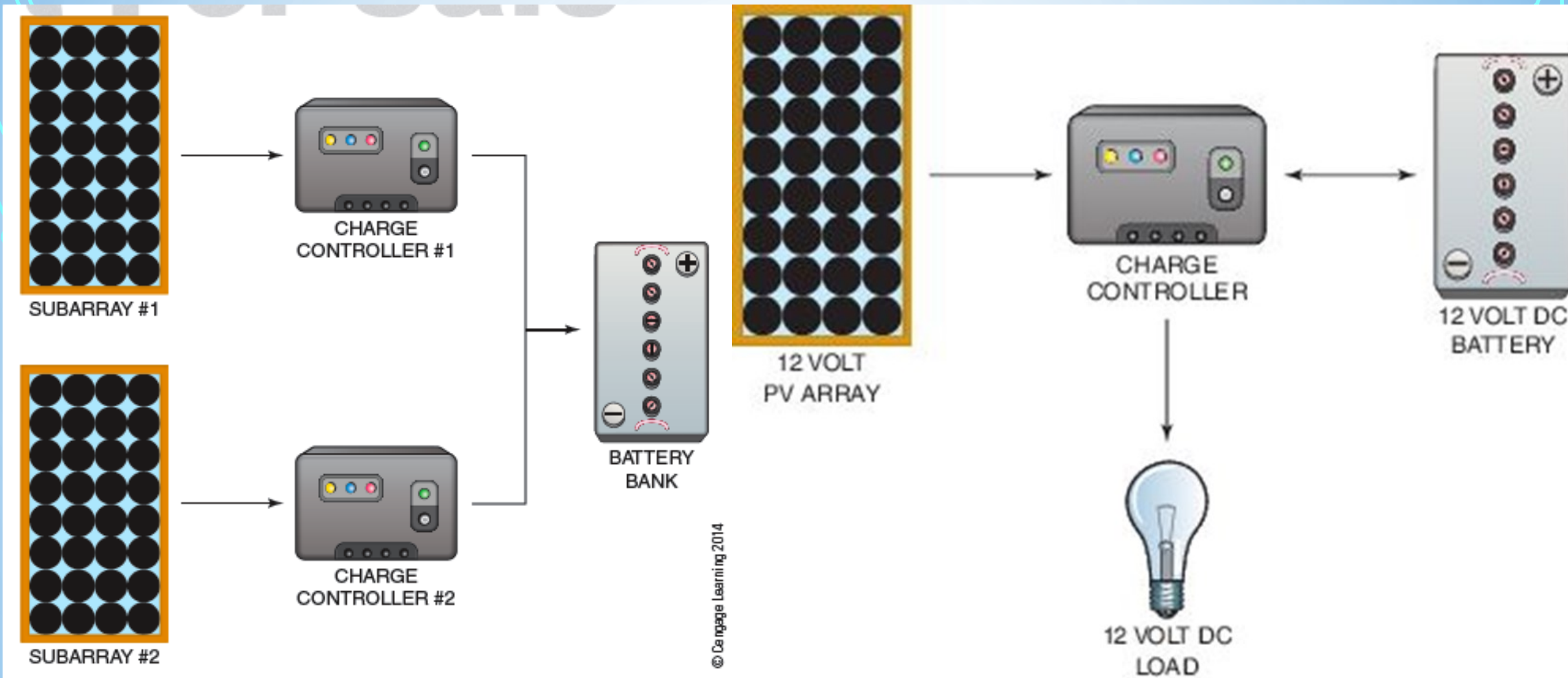
PV MODULE RATINGS

- Manufacturer determined
 - Standard performance ratings
 - PVUSA test conditions
 - Standard operating conditions
 - Nominal operating conditions
 - Clearly labeled on each module
 - Polarity of connections
 - Maximum fuse or circuit breaker rating
 - V_{oc} , V_{pmax} , I_{pmax} , I_{sc} , P_{max}



CHARGE CONTROLLERS

- Charge controller in a PV system
 - Primary function
 - Prevent batteries from being overcharged
 - Prevent batteries from being over discharged
 - Come in sizes rated from a few to 80 amps



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Figure 7-3: Some larger PV systems may require multiple charge controllers. In this illustration, each charge controller is connected to a different subarray. All of the charge controllers are connected to the same battery bank.

Figure 7-2: A simple PV system with storage batteries. The charge controller controls electricity flow among the PV array, battery bank, and electrical load.

SHUNT-TYPE CHARGE CONTROLLERS

- Designed for small PV systems
- Prevent overcharge by shunting, or bypassing, batteries when they are fully charged
- Suffer from heat buildup

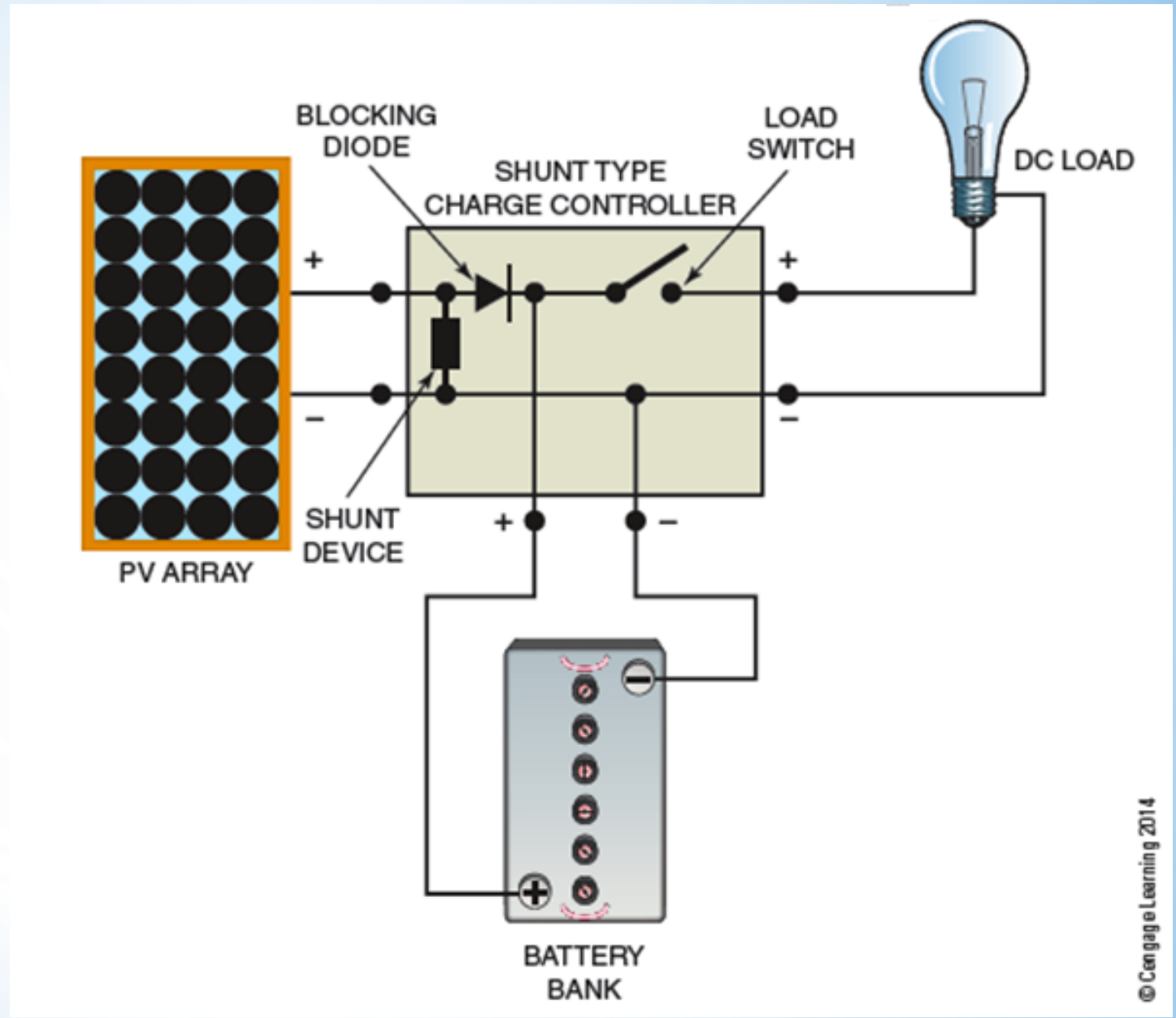


Figure 7-6: A shunt-type charge controller regulates battery charging by short-circuiting the PV system array.

SERIES TYPE CHARGE CONTROLLERS

- Prevents overcharging by switching the current path from the PV array off
 - When battery voltage reaches the Charge Termination Set Point (CTSP)
 - Automatically allows recharging when battery voltage reaches the Charge Resumption Set Point (CRSP)

PULSE-WIDTH MODULATION (PWM)-TYPE CHARGE CONTROLLER

- Circuitry allows simulation of variable charging current
 - Charges battery by rapidly switching full charging current ON and OFF
 - Works well with sealed batteries
 - Has a limited number of PV array module configurations and voltages

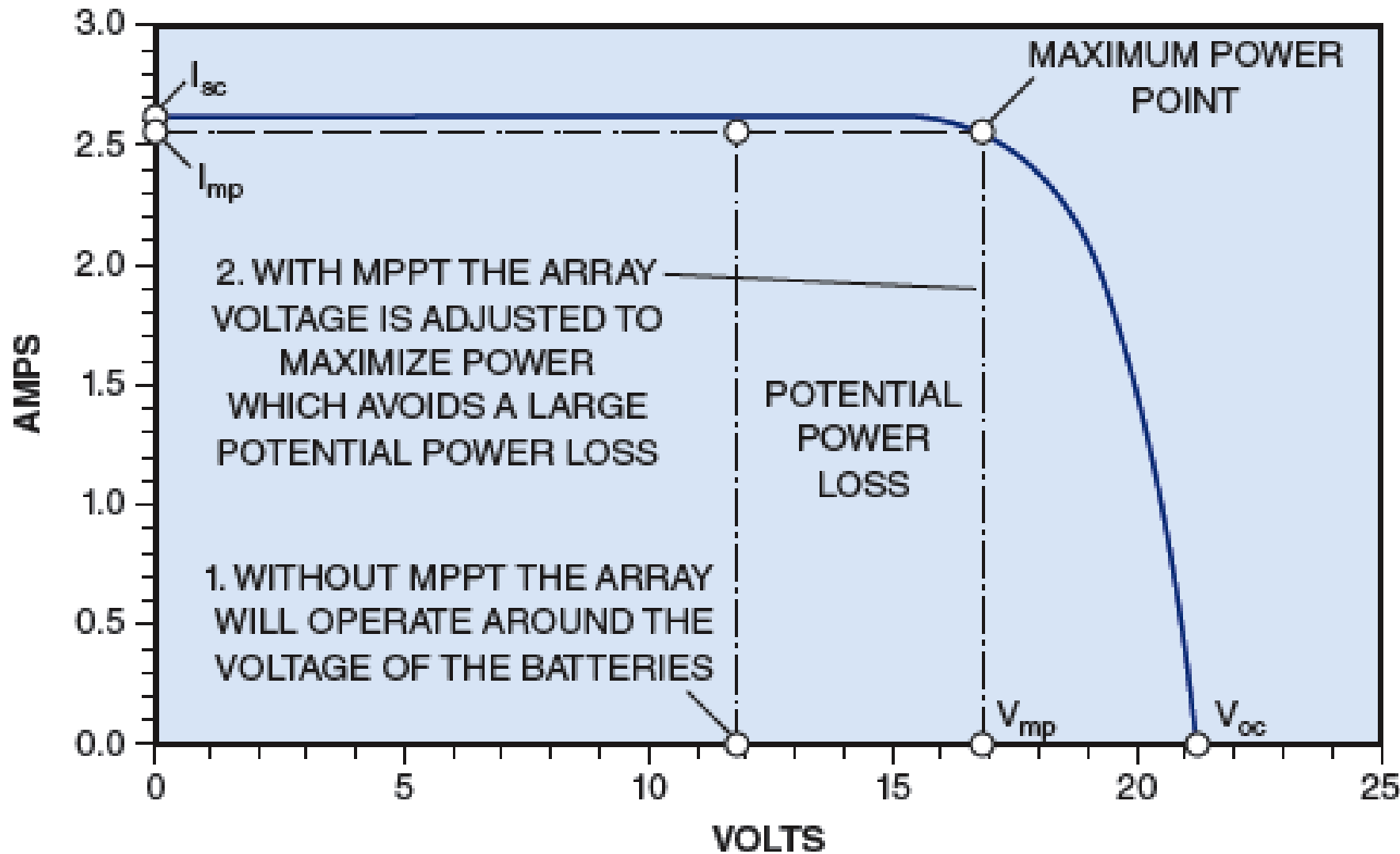
DIVERSION-TYPE CHARGE CONTROLLER

- Diverts excess charging current to some type of electrical load
- Automatically establish different charging currents based on a battery's state of charge
- Produces heat

MAXIMUM POWER POINT TRACKING (MPPT) CHARGE CONTROLLERS

- Most common type installed with PV systems
 - Microprocessor controlled
 - MPPT optimizes battery performance
 - Average energy gain is 10% or more





I-V CURVE FOR A 12 VOLT NOMINAL MODULE

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Figure 7-9: Maximum power point tracking (MPPT) optimizes the battery performance of a PV system. The average energy gain of a PV system when using MPPT is 10% or more.

CHARGE CONTROLLER FEATURES

- Overcharge protection
 - Considered the most important feature
 - Lead-acid and NiCad batteries can experience thermal failure when overcharged
- Over-discharge protection

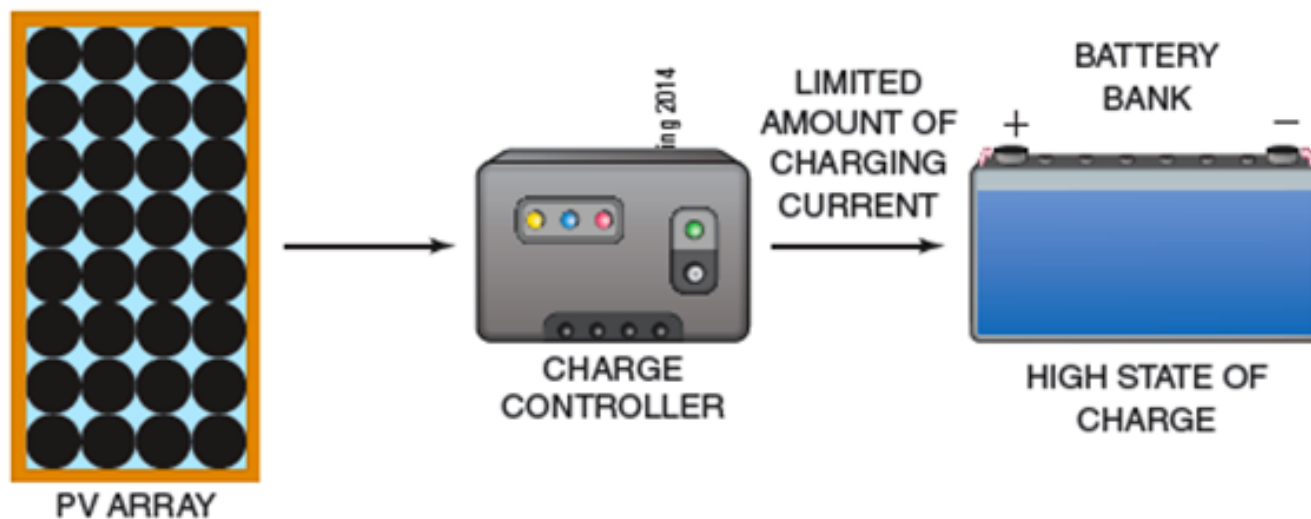
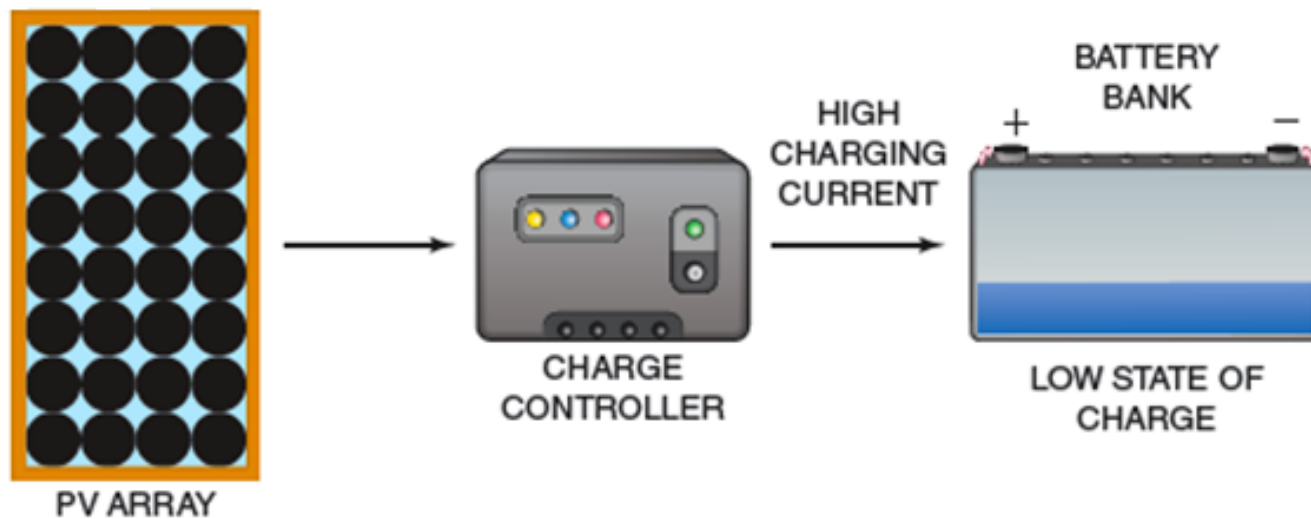


Figure 7-11: Overcharge protection is considered to be the most important feature that a charge controller must have. Batteries are protected when a charge controller terminates or limits the amount of charging current.

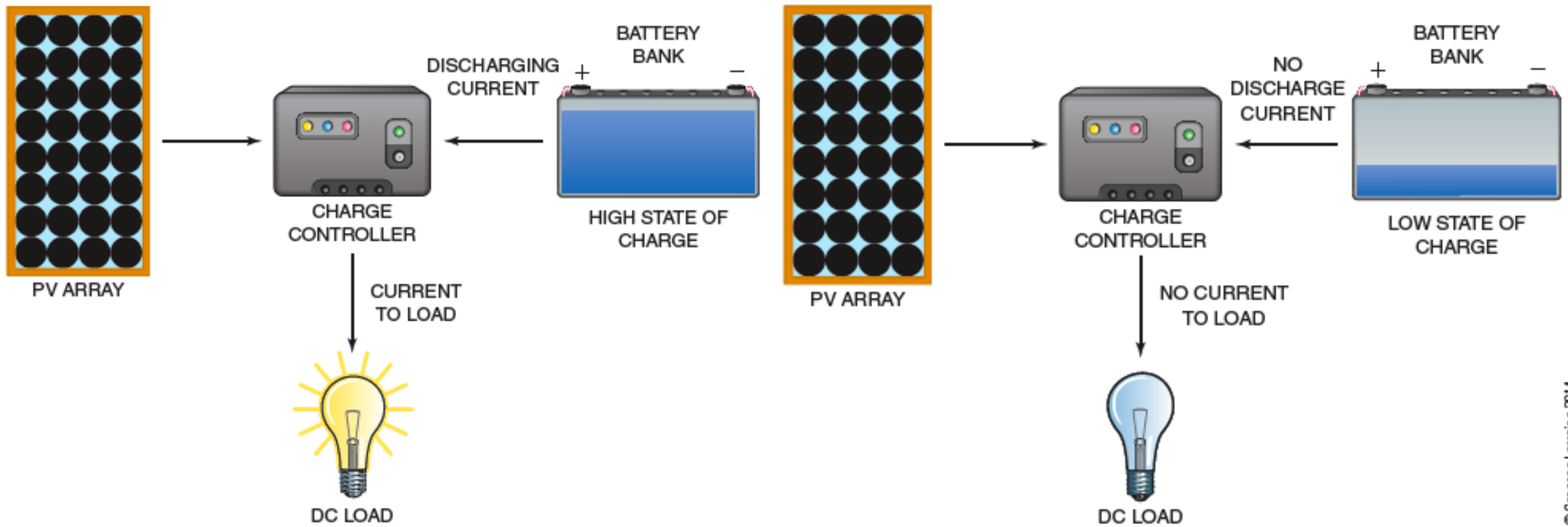


Figure 7-12: Over-discharge protection is also an important feature for a charge controller to have. Batteries are protected from over-discharge when a charge controller disconnects loads when the battery voltage reaches a predetermined set point.

INVERTERS

- Primary purpose of an inverter is to change the DC produced by the array to AC
- PV systems typically have an inverter
 - Electrical loads in buildings operate on AC

INVERTER CATEGORIES

- **Grid-tie inverter**
 - Designed to be connected to the utility grid
 - Reacts to the incoming DC voltage from the PV array
- **Stand-alone inverter**
 - Connected to the batteries in a stand-alone PV system
 - Converts battery DC power to AC
 - Performance affected by AC loads in the building
- **Bimodal inverter**

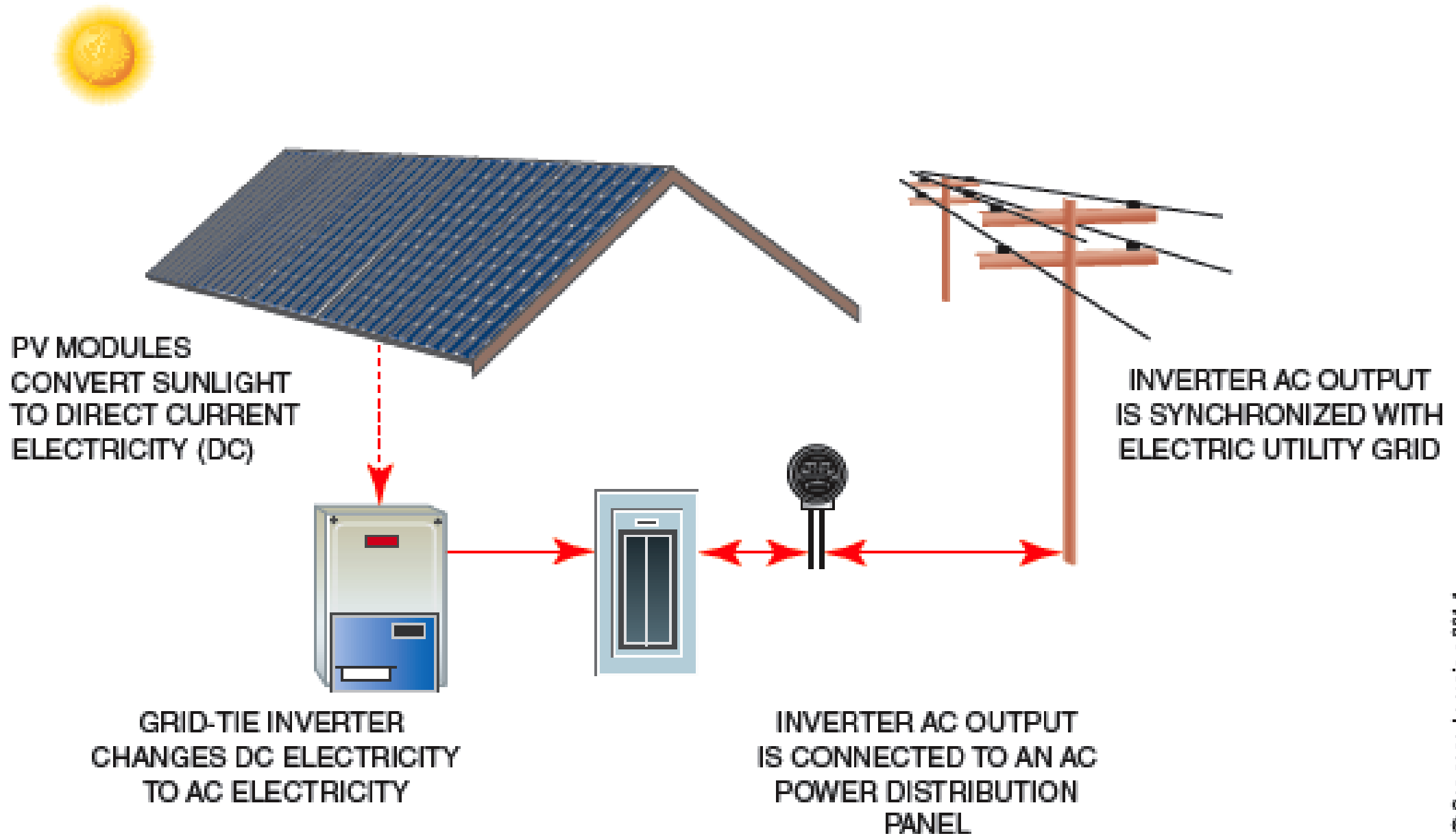


Figure 8-3: A grid-tie inverter is connected to the electric utility grid in an interactive PV system.

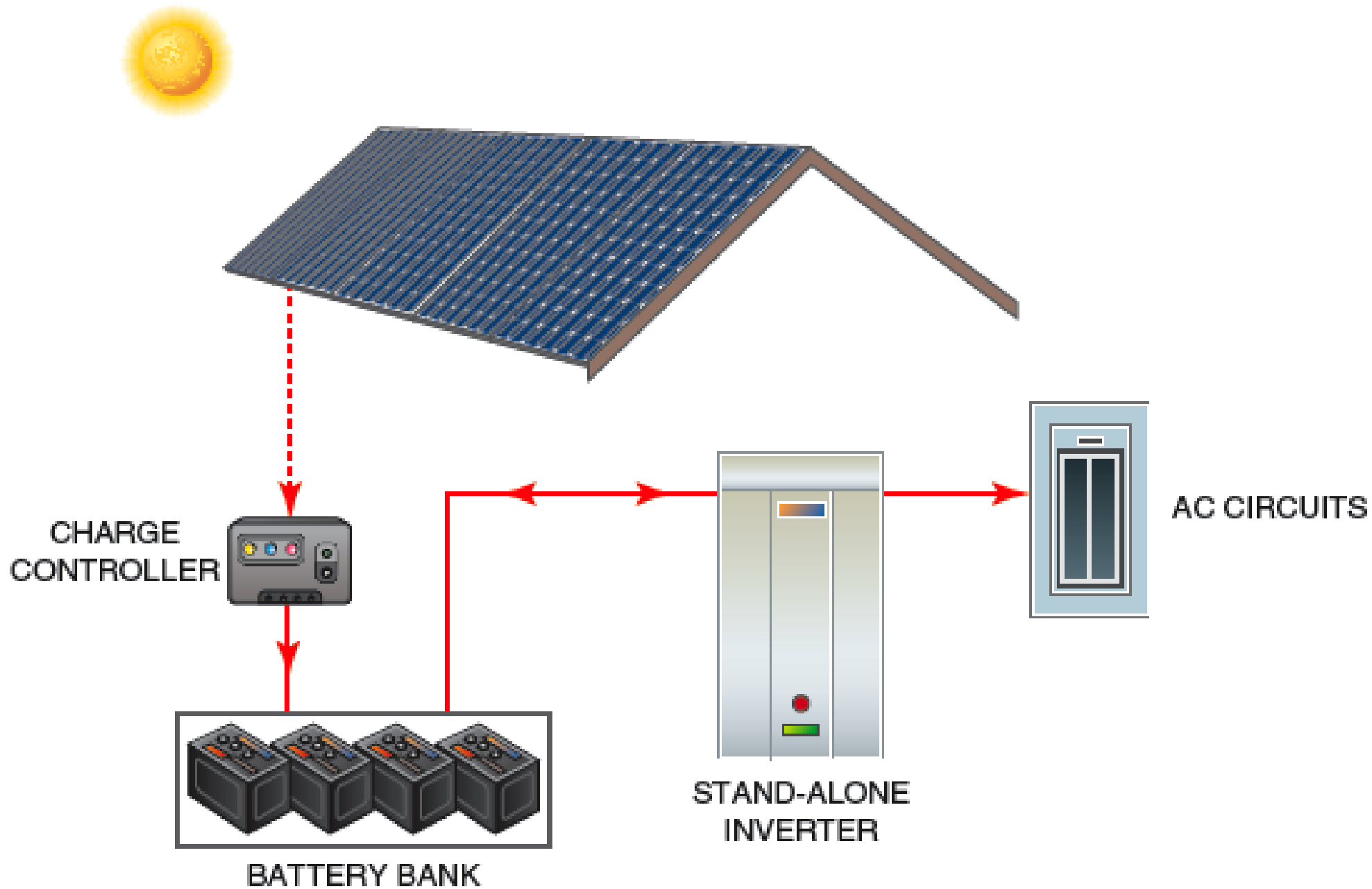
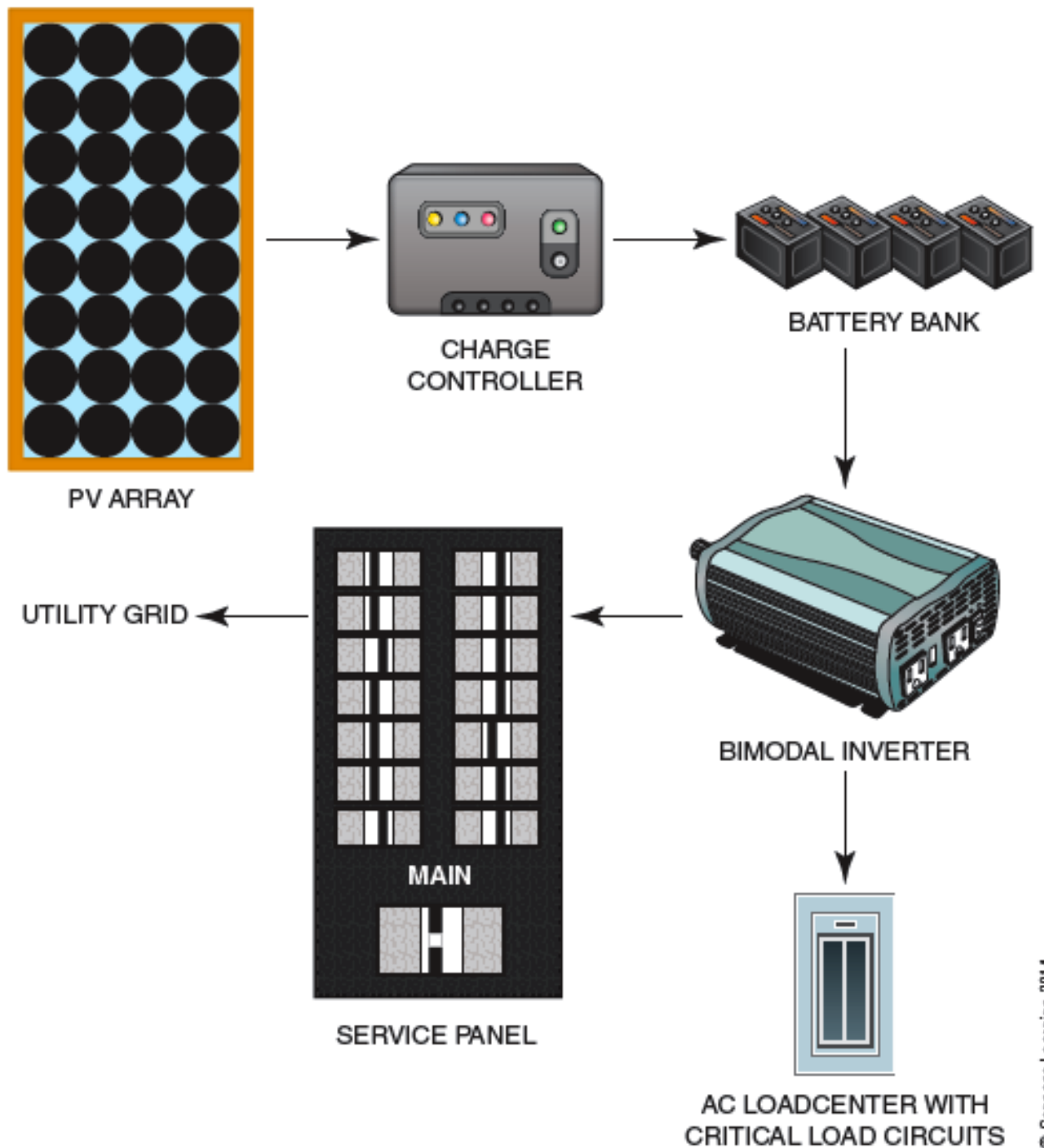


Figure 8-4: A stand-alone inverter is connected to the batteries in a stand-alone PV system.



Figure 8-5: A bimodal inverter can work as either a grid-tie or stand-alone inverter.



INVERTER WAVEFORMS

- Square wave inverter
 - Suitable for small resistive heating loads, small appliances, incandescent lighting
- Modified square wave inverter
 - Wide variety of loads
 - Some loads may pick up inverter noise
- True sine wave inverter
 - Suitable for sensitive electronic equipment
 - Output with very little distortion

POWER CONDITIONING UNITS

- Equipment that can perform electrical power processing and control functions
 - Rectifying AC to DC
 - Transforming AC voltage up or down
 - Converting DC to DC voltages
 - Maximum power point tracking

COMMON INVERTER FEATURES AND SPECIFICATIONS

- Inverter efficiency
 - Up to 95%
- Frequency regulation
 - 60 Hz output frequency
- Harmonic distortion

COMMON INVERTER FEATURES AND SPECIFICATIONS

- Power factor correction
 - Output power factor between 95% leading and 95% lagging
- Size and weight
- Remote control and data management
- Series and parallel inverter connections

GRID-TIE INVERTER SPECIFICATIONS

- Must meet IEEE Standard 1547
- Must meet FCC Part 15
- Must meet safety requirements of UL 1741
- Power rating
- Input voltage
- Output voltage
- Current ratings

STAND-ALONE INVERTER FEATURES AND SPECIFICATIONS

- High surge capacity
- Sealed or vented closures
- Battery charging capability
- AC power output rating
- DC input voltage
- Output voltage
- Surge capacity
- Waveform type



BIMODAL INVERTER FEATURES AND SPECIFICATIONS

- Battery charging capability
- Automatic warning or shutoff
- High surge capacity for motor loads
- Generator auto start and stop
- Power conditioning unit
- Sealed or vented closures

BIMODAL INVERTER FEATURES AND SPECIFICATIONS

- Specifying a bimodal inverter
 - AC output wattage
 - DC input voltage from batteries
 - AC output voltage
 - AC output frequency
 - Surge capacity

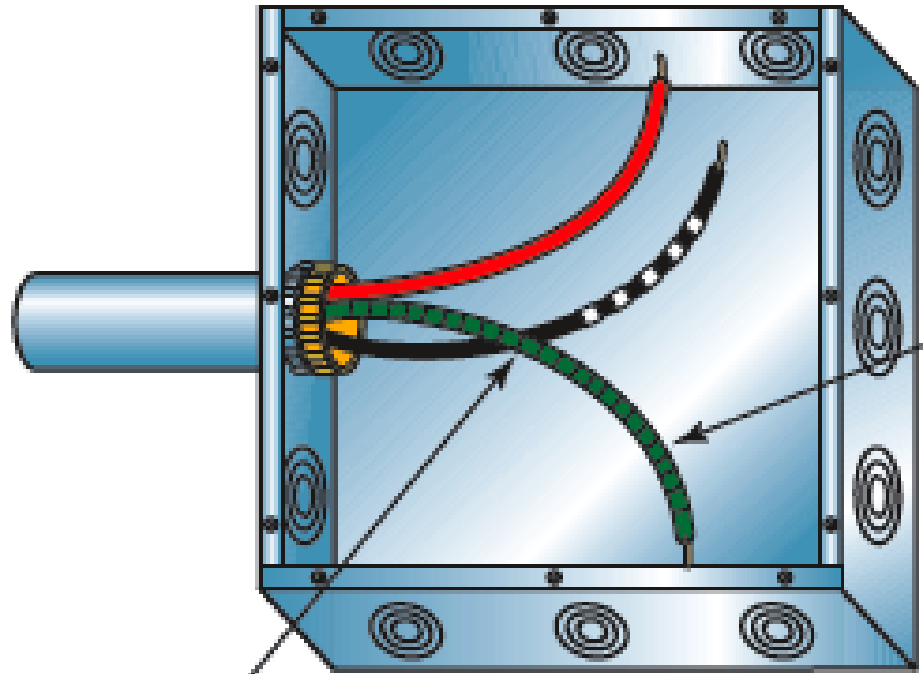
PV SYSTEMS AND THE NEC

- Copper wire recommended
 - Aluminum wire may be used where allowed
- Solid or stranded wire
- Insulation must be suitable for location
 - Dry, damp, or wet

COLOR CODING OF WIRES			
ALTERNATING CURRENT (AC) WIRING		DIRECT CURRENT (DC) WIRING	
APPLICATION	COLOR	APPLICATION	COLOR
UNGROUND CONDUCTOR	ANY COLOR OTHER THAN WHITE, GRAY, OR GREEN	UNGROUND CONDUCTOR (TYPICALLY THE POSITIVE CONDUCTOR)	ANY COLOR OTHER THAN WHITE, GRAY, OR GREEN (RED IS OFTEN USED)
GROUND CONDUCTOR	WHITE OR GRAY	GROUND CONDUCTOR (TYPICALLY THE NEGATIVE CONDUCTOR)	WHITE OR GRAY
EQUIPMENT GROUNDING CONDUCTOR	GREEN OR BARE	EQUIPMENT GROUNDING CONDUCTOR	GREEN OR BARE

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Figure 9-4: Typical conductor color coding for PV system wiring.



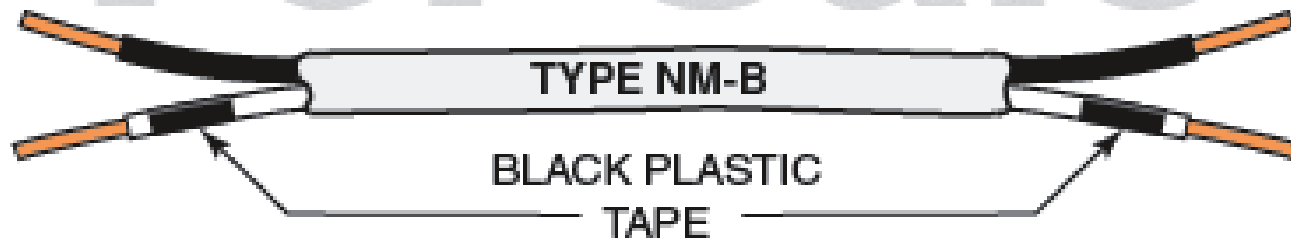
EQUIPMENT
GROUNDING
CONDUCTORS
ARE USUALLY
IDENTIFIED
WITH GREEN
TAPE.

4 AWG OR LARGER
CONDUCTORS

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Figure 9-5: Installers most often use white tape that completely encircles the conductor to identify a grounded conductor that is 4 AWG or larger.

Figure 9-6: Installers most often use green tape that completely encircles the conductor to identify an equipment grounding conductor that is 4 AWG or larger.



BLACK PLASTIC
TAPE

WHITE WIRE REIDENTIFIED AS A "HOT" CONDUCTOR

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Figure 9-7: A white- or gray-colored conductor in a cable assembly is typically reidentified as an ungrounded conductor with black electrical tape.

PV SYSTEM WIRING METHODS

- Cable types
 - Type NM cable
 - Type UF cable
 - Type AC cable
 - Type MC cable
 - Type USE cable



SIZING CONDUCTORS IN A PV SYSTEM

- Two criteria:
 - Ampacity
 - Voltage drop
- Ambient temperature correction
 - Ampacity must be derated for temperatures above 86o
- Rooftop installation derating
 - More than three current-carrying conductors
 - Termination temperatures

ARTICLE 690 CONDUCTOR SIZING

- PV output circuit sizing
 - Multiply sum of short circuit currents of the parallel connected modules by 125%
- Battery circuit sizing
 - Wire from batteries same size as PV output circuit conductors, whichever is larger

STAND-ALONE PV SYSTEM

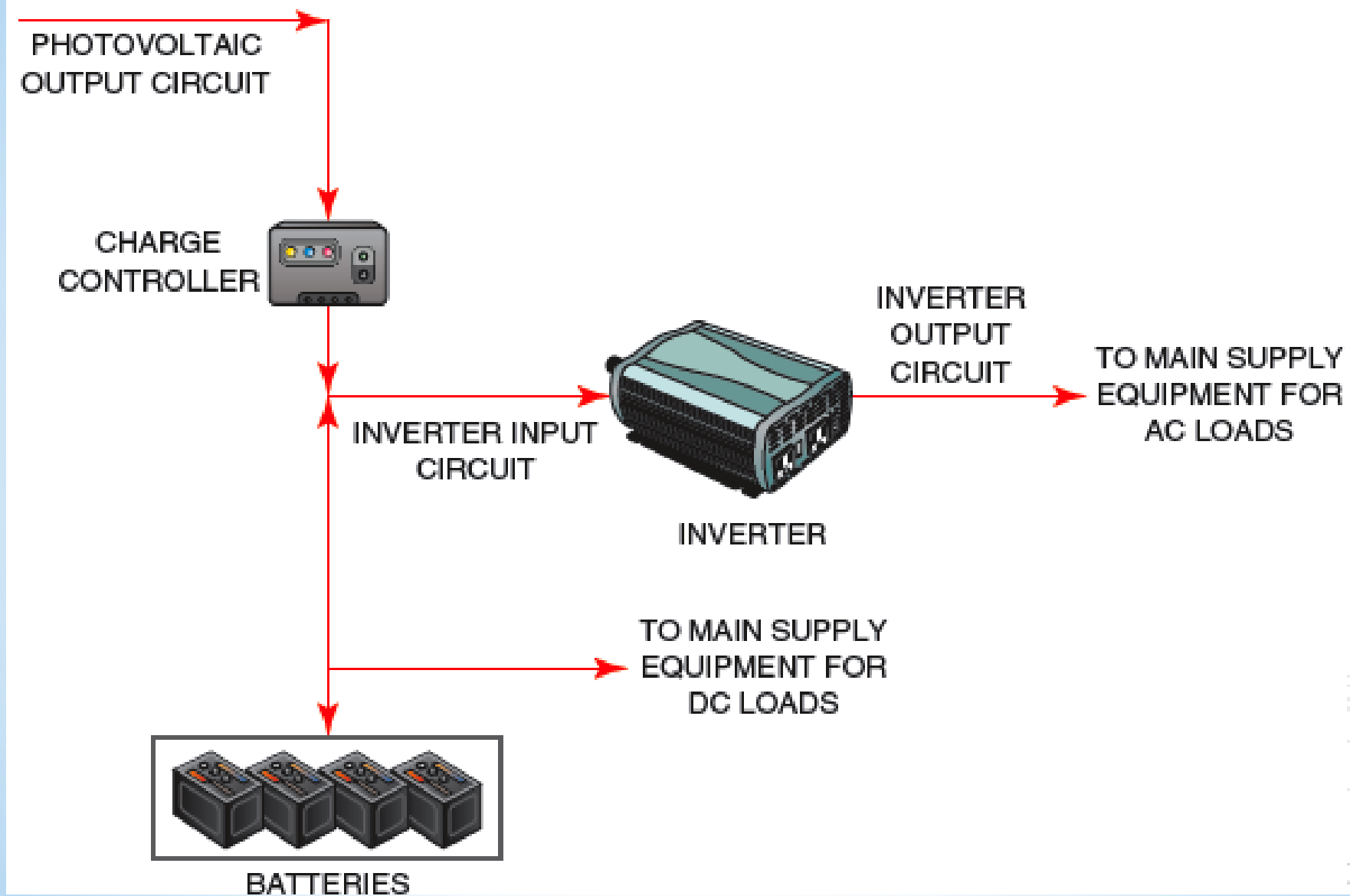


Figure 9-27: This illustration shows where the various PV circuit types are located in a typical stand-alone system.

INTERACTIVE (GRID-TIE) PV SYSTEM

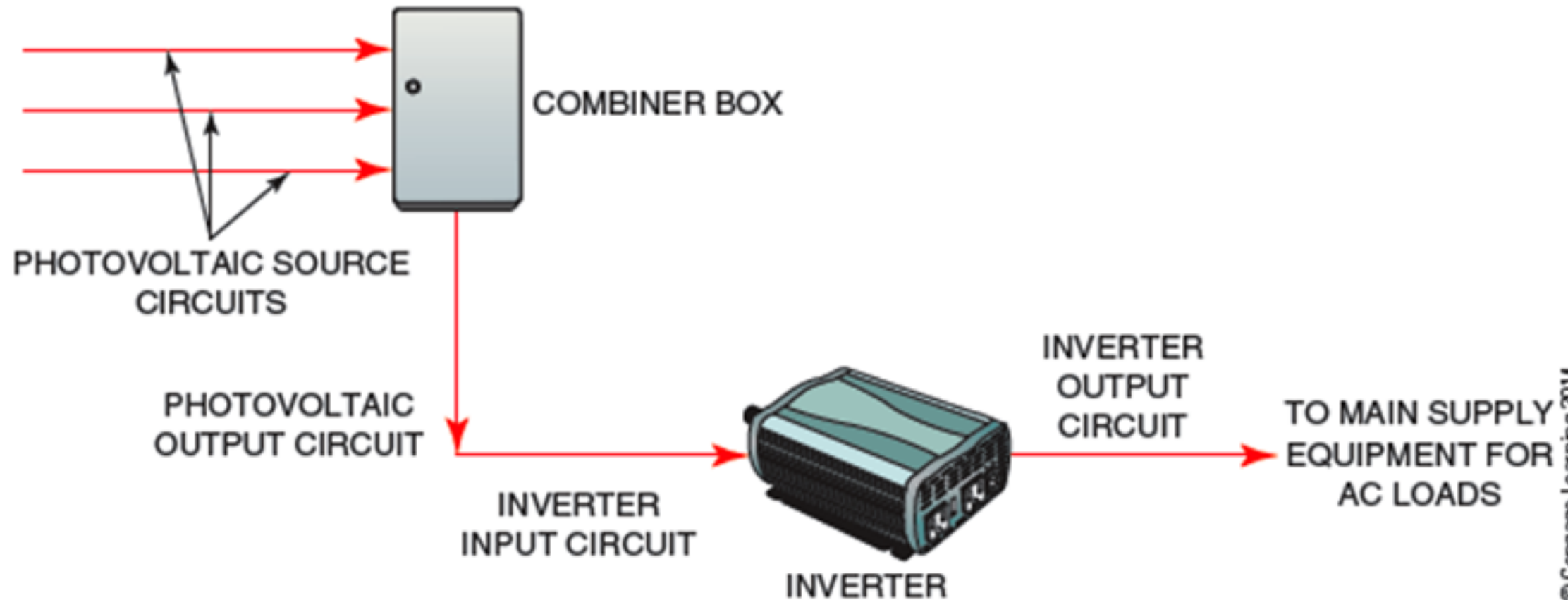


Figure 9-28: This illustration shows where the various PV circuit types are located in a typical utility interactive (grid-tie) system.

MORE ARTICLE 690 CONDUCTOR SIZING ITEMS

- Inverter output circuit sizing for grid-tie systems
- Inverter input circuit sizing for stand-alone systems

OVERCURRENT PROTECTION

- Overcurrent protection placement
 - Combiner box
- Overcurrent protection sizing
 - Less than or equal to the ampacity of the wire



PV SYSTEM DISCONNECTING MEANS

- Manually operated circuit breaker or switch
 - Must be accessible
 - No exposure or live parts
 - Indicate open or closed position
 - Rated for the voltage and available current

GROUNDING IN A PV SYSTEM

- System grounding
- Equipment grounding
- Reasons for grounding:
 - Limiting voltages due to surges
 - Stabilizing voltages and providing common ground
 - Providing low resistance current path



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Figure 9-50: The grounding point on a PV module must be identified by the manufacturer.

GROUND-FAULT PROTECTION

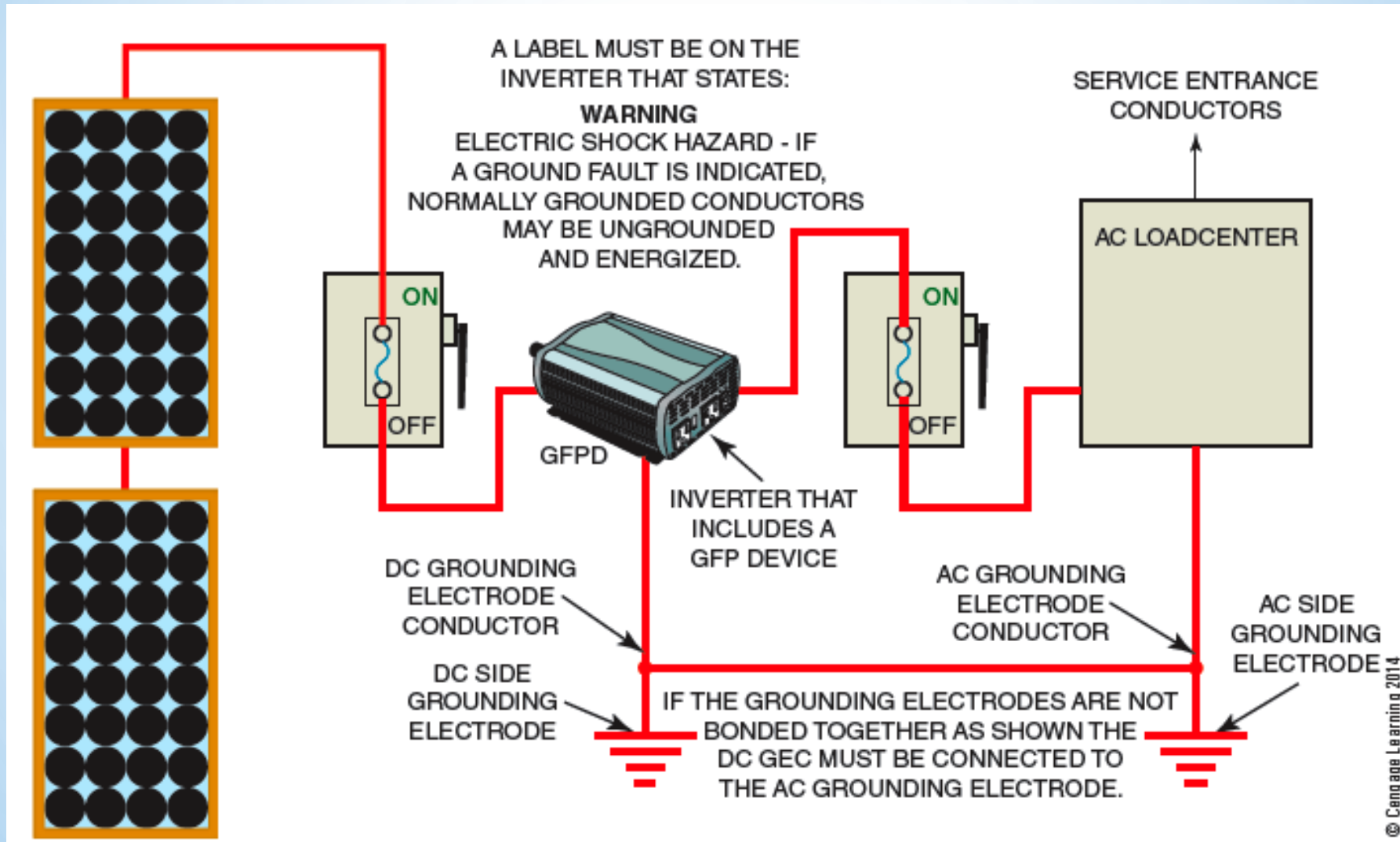


Figure 9-61: GFP devices are usually installed inside the grid-tied inverter or in the DC power center in a stand-alone PV system.

PV SYSTEM MARKING REQUIREMENTS

- Rated maximum power point current
- Rated maximum power point voltage
- Maximum system voltage
- Short circuit current
- Maximum rated output of charge controller

KEY CONSIDERATIONS TO SIZING A PV SYSTEM

- Determining the electrical load
- Work backwards to the PV array
- Properly site the PV system
- Design wiring to minimize voltage drop

SIZING A STAND-ALONE PV SYSTEM

- **Determining the electrical load**
 - Must be able to supply total building load
 - Load shifting
 - Phantom load
 - Surge load
- Use a load analysis worksheets to play system
- **Determining the size of the battery bank**
 - Use the battery bank sizing worksheet (Figure 10-3)
 - Example: see (Figure 10-4)

STAND-ALONE PV SYSTEM LOAD ANALYSIS WORKSHEET

Month: December

Load Description	Qty	X	Load Voltage (volts)	X	Load Current (amps)	=	DC Load Power (watts)	Or	AC Load Power (watts)	X	Daily Duty Cycle (hrs/day)	X	Weekly Duty Cycle (days/week)	÷7 Days	=	Watt-Hours DC	Watt-Hours AC		
Refrigerator / Freezer	1	X	120	X	4.16	=		Or	500	X	8	X	7	÷7	=		4000		
Microwave Oven	1	X	120	X	10.83	=		Or	1300	X	0.33	X	7	÷7	=		429		
Dishwasher	1	X	120	X	10.83	=		Or	1300	X	0.67	X	7	÷7	=		871		
Toaster	1	X	120	X	9.58	=		Or	1150	X	0.067	X	5	÷7	=		58		
Coffee Maker	1	X	120	X	12.5	=		Or	1500	X	1	X	7	÷7	=		1500		
Clothes Washer	1	X	120	X	4.16	=		Or	500	X	1	X	7	÷7	=		500		
Water Pump	1	X	120	X	6.67	=		Or	800	X	0.33	X	7	÷7	=		264		
46" LED TV	1	X	120	X	1.78	=		Or	213	X	3	X	7	÷7	=		639		
DVD Player	1	X	120	X	0.42	=		Or	50	X	3	X	2	÷7	=		43		
Satellite Receiver	1	X	120	X	0.25	=		Or	30	X	3	X	7	÷7	=		90		
Computer	1	X	120	X	1	=		Or	120	X	2	X	7	÷7	=		240		
Monitor	1	X	120	X	1.25	=		Or	150	X	2	X	7	÷7	=		300		
Printer	1	X	120	X	0.5	=		Or	60	X	0.083	X	7	÷7	=		5		
Dryer Motor	1	X	120	X	2.92	=		Or	350	X	1	X	7	÷7	=		350		
Blower Motor	1	X	120	X	5.42	=		Or	650	X	2	X	7	÷7	=		1300		
Receptacle Loads	1	X	120	X	2.5	=		Or	300	X	1	X	7	÷7	=		300		
CFLs	4	X	120	X	0.25	=		Or	120	X	5	X	7	÷7	=		600		
DC Total Connected Watts							=		DC Average Daily Load in Watt-Hours							=			
AC Total Connected Watts									=	9093	AC Average Daily Load in Watt-Hours						=		11,489

System Location: Portland, Maine Insolation: Tilt -15° 2.6 Latitude 3.0 Tilt +15° 3.2

AC Average Daily Load in Watt-Hours	÷	0.90 (Inverter Efficiency)	=	DC Average Daily Load in Watt-Hours	÷	Insolation	=	Design Month Ratio
11,489	÷	0.90	=	12,766	÷	3.0	=	4255

FIGURE 10-2

The completed load analysis worksheet for the stand-alone PV system example.

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STAND-ALONE PV SYSTEM BATTERY BANK SIZING WORKSHEET*

1	AC Average Daily Load (watt-hrs/day) ÷ Inverter Efficiency (0.90) [†]	+	DC Average Daily Load (watt-hrs/day)	+	DC System Voltage	=	Average Amp-Hours/Day		
	11,489 ÷ 0.90 = 12,766	+	NA	+	48	=	266		
2	Average Amp-Hours/Day	×	Days of Autonomy	÷	Battery Discharge Limit	÷	Battery Amp-Hour Capacity	=	Batteries in Parallel
	266	×	3	÷	0.50	÷	200	=	8
3	DC System Voltage	÷	Nominal Battery Voltage	=	Batteries in Series	×	Batteries in Parallel	=	Total Number of Batteries in Bank
	48	÷	12	=	4	×	8	=	32
Battery Make: ACME Battery Company									
Battery Model: PV200									
Nominal Battery Voltage: 12 volts									
Battery Rated Amp-Hour Capacity: 200 AH									
Battery Type: VRLA									
Battery Bank Description: Eight strings of batteries in parallel with each other; all strings have four batteries in series with each other.									

*Use this worksheet to size the battery bank used in a stand-alone PV system.

†The inverter manufacturer's efficiency rating is usually higher than 90%. However, the 90% efficiency rating is used in this worksheet as a more conservative number and takes into account constantly changing AC load conditions. It is okay to use the manufacturer's peak efficiency rating, but it is recommended that you use 90%.

FIGURE 10-4

The completed battery bank sizing worksheet for the stand-alone PV system example.

- Determining the size of the PV array

- Use the worksheet (Figure 10-6)

- Example:

STAND-ALONE PV SYSTEM STANDARD ARRAY SIZING WORKSHEET*											
1	Average Amp-Hours/Day			÷	Battery Charging Efficiency (0.85) [†]		÷	Design Month Sun Hours per Day (Insolation)		=	Array Maximum Power Amps
	266			÷	0.85		÷	3.0		=	104
2	Array Maximum Power Amps			÷	Maximum Power Amps per Module (Imp)		=	Number of Modules in Parallel			
	104			÷	8.0		=	13			
3	DC System Voltage	÷	Nominal Module Voltage	=	Number of Modules in Series		×	Number of Modules in Parallel		=	Total Number of Modules in Array
	48	÷	24	=	2		×	13		=	26
Building Location: Portland, Maine											
Design Month: December						Sun Hours per Day (Insolation): 3.0					
Module Make: SCHOTT Solar											
Module Model: Perform Poly 240											
Module Specifications:											
STC Wattage Rating = <u>240 W</u> ; Nominal Module Voltage = <u>24 V</u>											
Open-Circuit Voltage (Voc) = <u>37.3 V</u> ; Maximum Power Voltage (Vmp) = <u>30.4 V</u>											
Short Circuit Current (Isc) = <u>8.52 A</u> ; Maximum Power Current (Imp) = <u>8.0 A</u>											
Array Rated Power: 26 modules × 240 watts each = 6240 watts, or 6.24 kW											
Array Description: The array will consist of 26 modules. The modules are configured with 13 strings of two series-connected modules. All of the 13 strings are in parallel with each other.											

*Use this worksheet when the array voltage and the battery bank voltage are the same. This allows the use of a standard charge controller.
[†]The average amp-hours per day must be adjusted because of the inefficiency of charging the batteries. To make things less complicated, the inefficiency value is estimated to be 85% and is the number used unless you are able to use the manufacturer's battery specifications to get a different value.

FIGURE 10-7

- Determining the size and type of charge controller
 - Use the standard charge controller worksheet (Figure 10-9)
 - Example:

STAND-ALONE PV SYSTEM STANDARD CHARGE CONTROLLER SIZING WORKSHEET*							
1	PV Module Short Circuit Current (Isc)	×	Number of Modules in Parallel	×	1.25	=	Array Short Circuit Amps (Isc)
	6.28	×	10	×	1.25	=	78.5
2	DC Total Connected Watts	÷	DC System Voltage			=	Maximum DC Load Amps
	1200	÷	24			=	50
Charge Controller Make: ACME Solar							
Charge Controller Model: CC-80							
Charge Controller Array Amp Rating: 80 A							
Charge Controller DC Load Amp Rating: 50 A							
Charge Controller Specifications: Low-Voltage Disconnect (LVD), Low-Voltage Warning Beeper, Automatic Equalization							

*Use this worksheet when the PV array voltage is the same as the battery bank voltage and a standard charge controller is used.

SIZING A STAND-ALONE PV SYSTEM

- When a MPPT charge controller is used, the input volts and amps will not be the same as the output volts and amps
 - Use the MPPT charge controller worksheet (Figure 10-10)
 - Example:



**STAND-ALONE PV SYSTEM
ARRAY AND MPPT AND/OR STEP-DOWN CHARGE CONTROLLER
SIZING WORKSHEET***

1	AC Average Daily Load (watt-hrs/day)	÷	Inverter Efficiency (0.90) ¹	+	DC Average Daily Load (watt-hrs/day)	=	Total Daily Load (watt-hrs/day)				
	11,489	÷	0.90	+	0	=	12,766				
2	Total Daily Load (watt-hrs/day)	÷	Sun Hours per Day (Insolation)	÷	Battery Charging Efficiency (0.85) ²	÷	Array Temperature Losses (0.88) ³	÷	System Losses (0.85) ⁴	=	Array Watts
	12,766	÷	3.0	÷	0.85	÷	0.88	÷	0.85	=	6693
3	Array Watts	÷	Module STC Wattage Rating	=	Initial Number of Modules Needed in the Array ⁵	=	Final Number of Modules Needed in the Array ⁵				
	6693	÷	240	=	28	=	28				
4	Array Nominal Voltage	÷	Nominal Module Voltage	=	Number of Modules in Series ⁵						
	48	÷	24	=	2						
5	Final Number of Modules Needed in the Array	×	Module STC Wattage Rating	=	Maximum Wattage the Charge Controller Must Handle						
	28	×	240	=	6720						
6	Maximum Wattage the Charge Controller Must Handle	÷	MPPT and/or Step-Down Charge Controller Wattage Rating at Nominal Battery Voltage	=	Number of MPPT and/or Step-Down Charge Controllers Needed						
	6720	÷	4000	=	2						
7	PV Module Open-Circuit Voltage (Voc)	×	Number of Modules in Series	×	Table 690.7 Correction Factor	=	Array Maximum Voltage ⁶				
	37.3	×	2	×	1.21	=	90.3				
Sun Hours per Day (Insolation): 3.0											
Module Make: SCHOTT Solar				Module Model: Perform Poly 240							
Module Specifications:											
STC Wattage Rating = <u>240 W</u> ; Nominal Module Voltage = <u>24 V</u>											
Open-Circuit Voltage (Voc) = <u>37.3 V</u> ; Maximum Power Voltage (Vmp) = <u>30.4 V</u>											
Short Circuit Current (Isc) = <u>8.52 A</u> ; Maximum Power Current (Imp) = <u>8.0 A</u>											
Array Rated Power: 6693 W, or 6.69 kW		Array Nominal Voltage: 48 VDC		Battery Bank Nominal Voltage: 48 VDC							
MPPT and/or Step-Down Charge Controller Make: Solar Tech											
MPPT and/or Step-Down Charge Controller Model: XW-SCC80											
MPPT and/or Step-Down Charge Controller Wattage Rating at Nominal Battery Voltage: 4000 W											
MPPT and/or Step-Down Charge Controller Array Open-Circuit Voltage Rating: 150 VDC											
Charge Controller Specifications: Automatic Equalization, Temperature Compensation, Voltage Step-Down Capability											

*Use this worksheet for a stand-alone PV system that is using an MPPT and/or a step-down charge controller.

¹The inverter manufacturer's efficiency rating is usually higher than 90%. However, the 90% efficiency rating is used in this worksheet as a more conservative number and takes into account constantly changing AC load conditions. It is okay to use the manufacturer's peak efficiency rating, but it is recommended that you use 90%.

²The total daily load must be adjusted because of the inefficiency of charging the batteries. To make things less complicated, the inefficiency value is estimated to be 85% and is the number used unless you are able to use the manufacturer's battery specifications to get a different value.

³The total daily load must be adjusted because of the array temperature losses. STC ratings where cell temperature is based on 25°C are not realistic because of the hot temperatures that are generated when the modules are located out in the sun's rays. A derate value of 0.88 is used in this worksheet to reflect temperature losses based on an assumed average ambient temperature of 68°F (20°C).

⁴There are many other system losses to account for, such as soiling (dirty modules), shading, age of the modules, and wiring losses. Again, to make things less complicated, the system losses are reflected using an estimated derating factor of 85%.

⁵The number of modules in series must divide evenly into the number of modules needed in the array so that the configuration is compatible with the array nominal voltage. If it does not, round up the total number of modules needed until the number of modules in series divides evenly into the total number of modules needed in the array. The adjusted number is the final number of modules needed in the array.

⁶The array maximum voltage must be checked to make sure it doesn't exceed the maximum Voc rating of the charge controller when temperatures at the stand-alone PV system's location may be quite low. Use the historic lowest temperature for the location of the PV system, and then use the corresponding correction factor from Table 690.7 in the *National Electrical Code*[®] (NEC[®]).

FIGURE 10-13

The completed MPPT and/or step-down charge controller sizing worksheet for the stand-alone PV system example. (This figure begins on the preceding page.)

SIZING A STAND-ALONE PV SYSTEM

- Determining the size and type of inverter
 - Matching system requirements to an inverter's specifications rather than performing a calculation
 - Use the worksheet (Figure 10-14) Example:

STAND-ALONE PV SYSTEM INVERTER SIZING WORKSHEET*				
1	Battery Bank DC Voltage	48 VDC	Required Inverter DC Input Voltage	48 VDC
2	AC Load Voltage ¹	120 VAC	Required Inverter AC Output Voltage	120 VAC
3	AC Load Frequency and Waveform	60 Hz, true sine wave	Required Inverter AC Load Frequency and Waveform	60 Hz, true sine wave
4	Total Connected AC Load in Watts ²	9093 W	Chosen Inverter Output Size in Watts ³	6000 W
5	Total Connected AC Load in Watts	+	Chosen Inverter Wattage Rating	= Number of Inverters Needed ⁴
	9093	+	6000	= 2
6	Total Connected AC Load in Watts	×	2.5 =	Surge Capacity Needed ⁵
	9093	×	2.5 =	22,733 W
7	Surge Capacity Needed	+	Chosen Inverter Surge Capacity	= Number of Inverters Needed ⁶
	22,733 W	+	12,000 W	= 2
Inverter Make: Solar Tech		Inverter Model: XW6000		
Inverter Efficiency: 95%				
Inverter AC Output Wattage Rating: 6000 W				
Inverter DC Input Voltage from Battery Bank: 44–64 VDC range				

Inverter AC Output Voltage: 120 VAC
Inverter Output Voltage Frequency: 60 Hz
Inverter Rated Surge Wattage: 12,000 watts (10 seconds)
Inverter Waveform Type: True sine wave
Other Inverter Features: UL1741 Can be used as a grid-tie inverter Can be interconnected with up to three other XW6000 inverters

*Use this worksheet to size the inverter used in a stand-alone PV system.

¹The AC load voltage could be 120 VAC, 240 VAC, or 120/240 VAC, or a combination of these voltages. The inverter you choose must be able to supply the correct load voltage. It may be necessary to install two 120-volt inverters to get the 240 volts needed by some loads. Always check with the inverter manufacturer about whether the inverters can be interconnected.

²The total connected AC load in watts is found in the load analysis worksheet.

³If the chosen inverter output wattage size is less than the total connected AC load, proceed to section 5. If the chosen inverter output size is equal to or greater than the total connected AC load, proceed to section 6. Note: Oversizing the inverter allows for future system expansion but may result in a lower system efficiency and will increase the initial cost of the stand-alone PV system.

⁴Make sure to verify that the inverter make and model you have chosen can be interconnected with other inverters. Not all inverters have this capability.

⁵The surge capacity needed is found either by doing an in-depth analysis of the actual surge amounts for all AC loads that will be used at the same time or by using the rule of thumb of multiplying the AC load watts by 2.5 to get the estimated surge watts needed. It is recommended that you multiply the AC load by 2.5 to get the surge capacity needed.

⁶The number of inverters needed in section 5 should match the number of inverters needed in section 7. If the number of inverters needed based on their surge capacity in section 7 is higher than the number of inverters needed based on their wattage ratings in section 5, you must increase the total number of inverters needed until their overall surge capacity meets the system's surge capacity requirement.

FIGURE 10-15

The completed inverter sizing worksheet for the stand-alone PV system example.

- Multiple worksheets depending on the wire placement:
 - PV source and PV output circuit (Figure 10-16)
 - Battery bank or charge controller to inverter (Figure 10-17)

**STAND-ALONE PV SYSTEM
WIRE SIZING WORKSHEET
PV SOURCE CIRCUIT AND PV OUTPUT CIRCUIT***

1	PV Module Isc	×	Number of Array Modules in Parallel			=	Total Circuit Isc Amps	
		×				=		
2	Total Circuit Isc Amps	×	1.25 ¹	×	1.25 ²	=	Wire Sizing Amps #1 ³	
		×		×		=		
3	Wire Type (Cu or Al)	Wire Insulation Type ⁴	Lowest Termination Temperature ⁵	Ambient Temperature Correction Factor ⁶	Ambient Temperature Adjustment for Conduit on Rooftops ⁷	More Than Three Current-Carrying Conductors Adjustment Factor ⁸		
4	Total Circuit Isc Amps	×	1.25 ¹	÷	Final Ambient Temperature Correction Factor ⁹	÷	More Than Three Current-Carrying Conductors Adjustment Factor	= Wire Sizing Amps #2 ¹⁰
		×		÷		÷		=
5	Choose the Larger of Wire Sizing Amps #1 or Wire Sizing Amps #2 ¹¹		=	Wire Size from Table 310.15(B)(16) or Table 310.15(B)(17) ¹²		Use this wire size if it is the same size or larger than the wire size calculated based on voltage drop in section 7.		
			=					
6	Circuit Voltage	Total Circuit Isc Amps ¹³		One-Way Distance (ft)	Voltage Drop (%) ¹⁴			
					2%			
7	Voltage Drop Wire Size ¹⁵ : $cm = \frac{K \times I \times L \times 2}{VD}$		=	Use this wire size if it is larger than the NEC ^c calculated wire size in section 5.				

**STAND-ALONE PV SYSTEM
WIRE SIZING WORKSHEET
BATTERY BANK TO THE INVERTER
OR
CHARGE CONTROLLER TO THE INVERTER***

1	Inverter Wattage Rating	÷	Inverter Efficiency ¹ × Inverter Lowest Operating Voltage ²			=	Maximum Inverter Input Amps	
		÷				=		
2	Maximum Inverter Input Amps		×	1.25 ³	=	Inverter Input Circuit Wire Sizing Amps #1		
			×		=			
3	Wire Type (Cu or Al)	Wire Insulation Type ¹	Lowest Termination Temperature ⁵	Ambient Temperature Correction Factor ⁶	Ambient Temperature Adjustment for Conduit on Rooftops ⁷	More Than Three Current-Carrying Conductors Adjustment Factor ⁸		
4	Maximum Inverter Input Amps	÷	Final Ambient Temperature Correction Factor ⁹		÷	More Than Three Current-Carrying Conductors Adjustment Factor	=	Inverter Input Circuit Wire Sizing Amps #2
		÷			÷		=	
5	Choose the Larger of Wire Sizing Amps #1 or Wire Sizing Amps #2 ¹⁰		=	Wire Size from Table 310.15(B)(16) or Table 310.15(B)(17) ¹¹		Use this wire size if it is the same size or larger than the wire size calculated based on voltage drop in section 7.		
			=					
6	Circuit Voltage	Maximum Inverter Input Amps ¹²		One-Way Distance (ft)	Voltage Drop (%) ¹³			
					2%			
7	Voltage Drop Wire Size ¹⁴ : $cm = \frac{K \times I \times L \times 2}{VD}$		=	Use this wire size if it is larger than the NEC ^c calculated wire size in section 5.				

- Battery bank or charge controller to DC load center (Figure 10-18)
- Inverter to AC load center (Figure 10-19)

STAND-ALONE PV SYSTEM WIRE SIZING WORKSHEET BATTERY BANK TO THE DC LOADCENTER OR CHARGE CONTROLLER TO DC LOADCENTER*											
1	DC Load Wattage	÷	DC System Voltage	=	DC Total Amps	×	1.25 ¹	=	Circuit Wire Sizing Amps		
		÷		=		×		=			
2	Wire Type (Cu or Al)		Wire Insulation Type ²		Lowest Termination Temperature ³		Ambient Temperature Correction Factor ⁴		Ambient Temperature Adjustment for Conduit on Rooftops ⁵		More Than Three Current-Carrying Conductors Adjustment Factor ⁶
3	Circuit Wire Sizing Amps	+	Final Ambient Temperature Correction Factor ⁷	+	More Than Three Current-Carrying Conductors Adjustment Factor	=	NEC ⁸ Wire Size Calculation Amps				
4	NEC ⁸ Wire Size Calculation Amps	-	Wire Size from Table 310.15(B)(16) or Table 310.15(B)(17) ⁸	Use this wire size if it is the same size or larger than the wire size calculated based on voltage drop in section 6.							
5	Circuit Voltage		DC Total Amps ⁹		One-Way Distance (ft)		Voltage Drop (%) ¹⁰		2%		
6	Voltage Drop Wire Size ¹¹ : $cm = \frac{K \times I \times L \times 2}{VD}$	-	Use this wire size if it is larger than the NEC ⁸ calculated wire size in section 4.								

STAND-ALONE PV SYSTEM WIRE SIZING WORKSHEET INVERTER TO THE AC LOADCENTER*											
1	Inverter Wattage Rating	÷	Inverter Output Circuit Voltage Rating	=	Inverter Continuous Output Circuit Current ¹						
2	Inverter Continuous Output Circuit Current	×	1.25 ²	=	Inverter Output Circuit Wire Sizing Amps #1						
3	Wire Type (Cu or Al)		Wire Insulation Type ³		Lowest Termination Temperature ⁴		Ambient Temperature Correction Factor ⁵		Ambient Temperature Adjustment for Conduit on Rooftops ⁶		More Than Three Current-Carrying Conductors Adjustment Factor ⁷
4	Inverter Continuous Output Circuit Current	+	Final Ambient Temperature Correction Factor ⁸	+	More Than Three Current-Carrying Conductors Adjustment Factor	=	Inverter Output Circuit Wire Sizing Amps #2				
5	Choose the Larger of Wire Sizing Amps #1 or Wire Sizing Amps #2 ⁹	=	Wire Size from Table 310.15(B)(16) or Table 310.15(B)(17) ¹⁰	Use this wire size if it is the same size or larger than the wire size calculated based on voltage drop in section 7.							
6	Circuit Voltage		Inverter Continuous Output Circuit Current ¹¹		One-Way Distance (ft)		Voltage Drop (%) ¹²		2%		
7	Voltage Drop Wire Size ¹³ : $cm = \frac{K \times I \times L \times 2}{VD}$	=	Use this wire size if it is larger than the NEC ⁸ calculated wire size in section 5.								

SIZING A GRID-TIE PV SYSTEM

- Simpler than sizing a stand-alone PV system
- Determining the electrical load supplied by the grid-tie PV system
 - Annual electric energy usage can be found on a building's electric utility bill, or the building owner can contact the local electric utility



- Load analysis is done when the building is new
- Use load analysis worksheet (Figure 10-24)
- Example:

GRID-TIE PV SYSTEM ELECTRICAL LOAD SIZING WORKSHEET*					
1	Annual Electrical Energy Usage Amount (kWh) ¹	÷	365 Days	=	Average Daily Load (kWh/day)
	8760	÷	365	=	24
2	Average Daily Load (kWh/day)	×	% Power from Grid-Tie PV System ²	=	PV System (kWh/day)
	24	×	0.50	=	12

* Use this worksheet to determine the number of kilowatt-hours per day that the grid-tie PV system needs to supply when the system is being installed in an existing building.

¹ This value is found in an existing building's electric utility bill or the building owner can contact the local electric utility. If the building is new and there is no prior electrical usage data you need to estimate the building's electrical usage using the grid-tie PV system load analysis worksheet.

² The desired percentage of the average daily kWh load that the grid-tie PV system produces is determined after consultation with the building owner.

FIGURE 10-26

The completed electrical load sizing worksheet for the grid-tie PV system example.

- Determining the size of the array
- Determining the size and type of inverter
- Determining the wire size from the array to the inverter
- Determining the wire size from the inverter to the AC loadcenter



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File Attachments for Item:

ER-2 Standby Generators: NEC Requirements and Generator Installation Methods (Ohio Certificate Renewal)

All certifications (4 hours)

Staff Notes: Received after ESIAC submission: recommend approval.

ESIAC Recommendation:

Committee Recommendation:

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

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Harold Plant

Organization

Ohio Certificate Renewal

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State *

Ohio

Zip Code *

43221

Website

ohiocertificate.com

Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e.

BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

Standby Generators – NEC Requirements and Generator Installati

Course instructor

J.D. White

Course description

Learners will gain an understanding of the generator market, advantages and disadvantages of Whole House verse Partial systems, different types of generator systems and essential components. Learners will gain an understanding of the NEC requirements for circuit wiring in a PV system, disconnecting means and differing wiring methods. Learners will gain competency in load calculations.

Instructional hours per session

4

Number of Sessions

1

Course Date

2023-06-23

Course Location

online, on-demand and in-per

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction
- Plumbing Instruction

Conference Course

Conference Name

Conference location

Course to be offered online?

- Yes
- No

On Demand

Webinar

Course Website

OhioCertificate.com

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):

login, audio-visual or quiz

Course applicable for the following certifications *

- Residential Certifications Only
- Administrative Course, All Certifications
- Commercial and Residential Certifications

Application materials included *

- Course Outline or Course Learning Objectives
- Presentation Materials/Slides (not required for roundtable courses)
- Assessment Materials (for online courses)
- Presenter Bio
- Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
Generators-4hr-BBS-2023-06-8.pdf	3.53 MB

Applicant Full Name *

Harold L. Plant

Date of Submission

06/09/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



Application for Continuing Education Course Approval

Provider Information:

Name: Harold L. Plant
Organization: Ohio Certificate Renewal
Address: P.O. Box 211102, Columbus, Ohio 43221
E-mail: mayda@ohiocertificate.com and Hal@ohiocertificate.com Telephone: 614-451-9003
Website: ohiocertificate.com
Conference Sponsor (if applicable) _____ Conference Email: _____

Check here if Course Renewal: _____ Prior course number _____ (i.e. BBS2018-429)
*Renewals will only be granted for identical content and certifications, within the current code cycle.
Attach a copy of prior course approval letter for confirmation. No further information is required.*

New Course Information:

Course title: Standby Generators – NEC Requirements and Generator Installation Methods
Course instructor: J.D. White
Course description: Learners will gain an understanding of the generator market, advantages and disadvantages of Whole House verse Partial systems, different types of generator systems and essential components.
Learners will gain an understanding of the NEC requirements for circuit wiring in a PV system, disconnecting means and differing wiring methods. Learners will gain competency in load calculations.
Instructional hours per session: 4 Number of Sessions: _____
Course Date(s) and Location: 06/23/2023 online and in-person TBD

Special Content:

Code Administration: _____ Conference Course: _____
Existing Buildings: _____ Conference Name: _____
Electrical Instruction: _____ Conference location: _____
Plumbing Instruction: _____

Course to be offered online? **On Demand** **Webinar**

Course Website: ohiocertificate.com
Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):
login and/or audio/visual confirmation, quizzes

Course applicable for the following certifications

Residential Certifications Only: _____ Commercial Certifications: _____
Administrative Course, All Certifications: _____

Application materials included:

- Course Outline or Course Learning Objectives
- Presentation Materials/Slides (not required for roundtable courses)
- Assessment Materials (for online courses)
- Presenter Bio

Please submit application and materials in .pdf format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov

Ohio Certificate Renewal

(614) 451-9003

OhioCertificate.com

P.O. Box 211102 Columbus, Ohio 43221-1102



Standby Generators – NEC Requirements and Generator Installation Methods

Outline:

- Generator Basics
- Emergency Systems
- Legally Required Standby Systems
- Optional Standby Systems
- Optional Standby Systems Portable
- NEC Overview regarding basic structure
- Principle NEC Articles regarding Optional Standby
 - Article 220, Branch, Feeders, and Service Calculations
 - Article 250, Grounding
 - Article 445, Generators
 - Article 702, Optional Standby Systems
- Transfer equipment
 - Standard Models
 - Load Center Models
 - Service Entrance Models
 - Load Control Modules
- Default Rules all types of Generator
- Specific Rules
- Separately Derived vs Non-Derived Setup Grounding and Bonding

Objectives:

- Understanding of the generator market
- List advantages and disadvantages of Whole House verse Partial systems
- Understanding of the 4 basic different types of generator systems
- Understanding of the essential components which comprise a complete generator system
- Understanding of the *NEC* requirements for circuit wiring in a PV system
- Understanding of the *NEC* requirements for disconnecting means in a PV system
- Demonstrate an understanding of the *NEC* requirements for different wiring methods used in different generator systems
- Learning Competency of Load Calculations
- Differentiation of Separately Derived systems
- Calculations needed for when to use Load Modules for smaller Generator Sets
- Understanding Standard and Optional Load Calculations

Generators Quiz Questions:

As per NEC 702.2 Definition optional stand-by systems operation may be:

- manual
- automatic
- either (checked)
- none of the above

Fill in the blank.

As per NEC 702.5 A transfer switch is _____ for all fixed/permanently installed optional standby systems.

- required (checked)
- not required
- optional
- none of the above

A generator will be a separately derived system if it has _____

- no direct connection to other system conductors. (checked)
- at least two ground rods

A neutral-to-case connection must _____ on the load side of the service disconnecting means.

- not be made (checked)
- always be made

JD White

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Objective:

To provide timely and informative teaching relative to Electrical Theory, Electrical Practices, and NEC Updates. All teaching is primarily geared for licensed contractors, architects, engineers, electrical inspectors, and electrician apprentices. Electrical Design and Drafting of small to moderate sized projects, using AutoCAD.

Work and Teaching

Experience:

06/2007 - Present
Columbus State Community College
Title: Skilled Trades Apprenticeship Supervisor
Supervisor: Doug House, 614-287-2576

01/2006 – Present
Voltaire Electric Company, Inc. – Columbus, OH
Electrical System Design and Drafting
Title: Consultant 614-546-7884

06/2007 - Present
Columbus State Community College
Title: Adjunct Faculty Teaching:
Electrical Courses, National Electric Code, Employability,
Construction Overview, Construction Estimating,
Manual Drafting, and AutoCAD
Supervisor: Doug House, 614-287-2576

09/1999 – Present
Electrician Apprenticeship Instructor
Title: Year 1 – Year 4 Lead Instructor
OCILB Instructor, as needed
IEC Central Ohio 614-473-1050

10/2001 – Present
OCILB Instructor, 1-2 seminars per year
Ohio Contractor Training 614-203-1531

12/2008 – Present
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10/2005 - 08/2006
MG Abbott Electric Company – Columbus, OH
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Supervisor: Joe Abbott-President, 614-837-3614

07/1995 - 08/2005
Just Dandy Electric Systems, Inc. – Columbus, OH
Title: Owner, Electrician, Estimator, Project Designer...

08/1989 - 07/1995
Safeway Electric Company, Inc. – Columbus, OH
Title: Commercial Electrician, Commercial Division Manager
Supervisor: Andy Untch, 614-443-7672

10/1987 - 08/1989
Mansfield Wesleyan Church – Mansfield, OH
Title: Senior Pastor
Supervisor: Rev. Clyde Hanks-District Supervisor

09/1982 - 07/1987
Delphos Wesleyan Church – Delphos, OH
Title: Senior Pastor
Supervisor: Walter Jefferies-District Supervisor

07/1976 - 09/1982
MG Abbott Electric Company – Columbus, OH
Title: Electrician, Field Supervisor
Supervisor: Gene Abbott-Owner

07/1972 - 06/1974
US Navy – Quonset Point-RI
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Supervisor: Various

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Licensure:

Electrical
11/1990
Cities of: Columbus, Elyria, Springfield, Youngstown, Toledo,
Dayton, and others
07/1992

Electrical State of Ohio
02/1996
State of Ohio #EL 14058

Fire Alarm Installer
02/2003
State of Ohio #54.25.3708

Education:

06/2005 – 05/2015
Columbus State Community College – Columbus, OH
ATS Electrical System Architecture Designer

09/1982 - 05/1987
Indiana Wesleyan University – Marion, IN
Christian Ministries & Biblical Literature

06/1981 - 05/1982
Columbus Technical Institute – Columbus, OH
General Education Studies

06/1973
GED Central High School, Columbus, OH

07/1972 - 08/1973
Naval Aviation Technical Training Center
Aviation A School Jet Engines – Memphis, TN
Naval Aviation Technical Training Center
Aviation B School Helicopters – Quonset Pt, RI
Rating: Aviation Machinist Mate Jet

References:

Joe Abbott - Previous Employer: 614-837-3614
Barb Tipton – Present Employer: 614-473-1050
Dr. Andy Rezin – Previous Supervisor: 614-551-8378
Doug House – Present Supervisor: 614-287-2576
Other References Available Upon Request

Sample Ad:

EL-ESI Electrical Code **Friday, June 23, 2023**

Instructor: J.D. White



7:30 AM - 3:45 PM (EST)

Morning Session: 7:30 AM to 11:20 AM Eastern Time.

Afternoon Session: 12 PM noon to 3:45 PM Eastern Time.

This course consists of two 4-hour sessions. Attend both for a full 8 hours.

Approved Code class for OCILB, ICC and Ohio BBS.

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- ▶ Four Classifications of Generator Installations
 - ▶ Emergency Systems
 - ▶ Legally Required Standby Systems
 - ▶ Optional Standby Systems Installed
– Today's Focus
 - ▶ Optional Standby Systems Portable

NEC & GENERATOR OVERVIEW

Emergency Systems NEC 700

Definition – Article 700 applies to the installation, operation and maintenance of “emergency systems” consisting of circuits and equipment intended to supply, distribute, and control electricity for illumination or power, or both, to required facilities when the normal electrical supply or system is interrupted.

- Essential for safety to human life.
- Emergency systems are those systems legally required and classed as emergency by municipal, state, federal or other codes or by a governmental agency having jurisdiction.
- When normal power is lost, emergency systems shall be able to supply standby power within 10 seconds or less.
- NEC 700.10 B – wiring from an emergency source to emergency loads shall be kept entirely independent of all other loads.

Legally Required Systems NEC 701

“Legally required standby systems are intended to automatically supply power to selected loads (**other than those classed as emergency systems**) in the event of failure of the normal source.”

- Typically supply loads, such as heating and refrigeration systems, communications systems, ventilation and smoke removal systems and industrial process, that, **when stopped could create hazards or hamper rescue or fire-fighting operations.**
- When normal power is lost these systems shall be able to supply standby power within **60 seconds or less**
- Requirement determined by NFPA-101, NFPA-110 and NFPA -99

Emergency & Legally Required Systems

International Building Code (IBC) Chapter 27, Electrical

- List when Emergency and Legally required standby systems are required.
- All other systems are Optional Standby.
- These are Not Emergency or Legally Required Systems
 - Most power outages are an inconvenience but not an emergency
 - Do not refer to Optional Standby Systems as Emergency Power...

NEC Overview

- Chapters 1-4 are General Requirements and apply to all applications
 - Default Rules – Broad Application Guidelines
- Chapters 5-7 can supplement or modify requirements of chapters 1-4
 - Specific Rules - Narrow Application Guidelines
- Chapter 8 is not subject to chapters 1-7 unless specifically referenced
- Chapter 9 are Tables and are referenced by all chapters
- Annexes are informational only and not directly enforceable
- Ohio has elected January 1, 2015 as NEC 2014 Implementation

Optional Standby Systems NEC 702

Principle Code Articles for Optional Standby Systems:

- Article 220, Branch-Circuit, Feeders, and Service Calculations
- Article 250, Grounding
- Article 445, Generators – Default rules for any type of Generator
- Article 702, Optional Standby Systems



Optional Standby Systems NEC 702

NEC 702.2 Definition

- Optional standby systems are intended to supply power to public or private facilities or property where life safety does not depend on the performance of the system.
- Optional standby systems typically provide electrical power for processes that, when stopped could cause discomfort, economic loss, serious interruption of the process, or damage to the product or process.
- Operation may be either manual or automatic
- They may power: Total Loads, Partial Loads, or only a few Selected Loads.

Optional Standby Systems NEC 702

NEC 702.4 Capacity and rating

- **Optional standby systems must have adequate capacity to carry safely all loads that are expected to operate simultaneously.**
- The user of the optional standby system may select the loads connected to the system.

Note – NEC 2011 Handbook

- The standby source must have the capacity to supply all the loads connected to it, unless an **automatic load management system** is used to ensure that the transfer load does not overload the source.
 - **This requirement applies only to systems where the switching between power sources occurs automatically.**

Optional Standby Systems NEC 702

NEC 702.4 Capacity and rating cont.

- (B) The calculations of load on the standby source shall be made in accordance with Article 220 or by another approved method.
- 702.4
 - (2) Automatic Transfer Equipment
 - (a) *Full load. The standby source shall be capable of supplying the full load that is transferred by the automatic transfer equipment.*
 - (b) *Load Management. Where a system is employed that will automatically manage the connected load, the standby source shall have a capacity sufficient to supply maximum load that will be connected by the load management system.*

Optional Standby Systems NEC 702

NEC 702.5 Transfer Equipment

- A transfer switch is required for all fixed/permanently installed optional standby systems.
- Equipment shall be suitable for intended use.



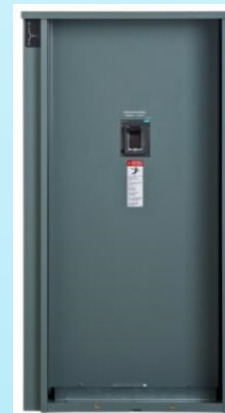
Standard Model



Load Center Model



Service Entrance Models

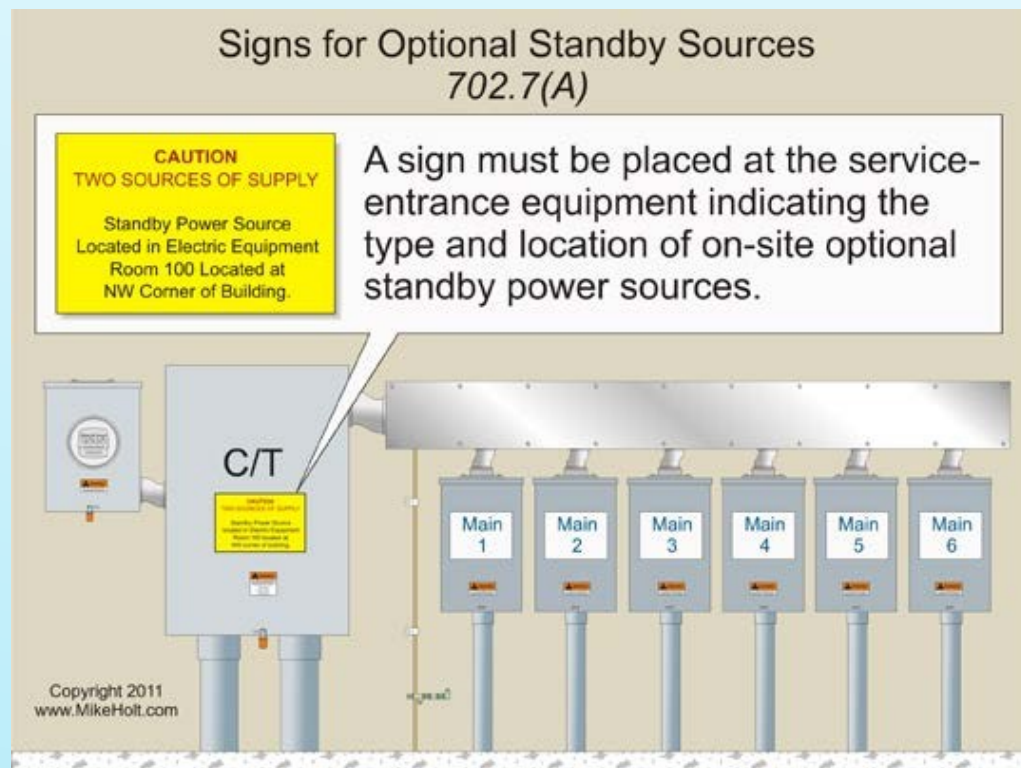


Load Control Module

Optional Standby Systems NEC 702

NEC 702.7 Signs

- A sign that indicates the type and location of the on-site optional standby power must be placed at the service-entrance equipment.
- Exit and Emergency Lighting units do not require these signs. Typically, they have self-contained batteries.



Optional Standby Systems NEC 702

NEC 702.10 Wiring

- Optional standby systems wiring may occupy the same raceways, cables, boxes, and cabinets with other general wiring.

Optional Standby Systems NEC 702

NEC 702.12 Outdoor generator sets

- If a generator is located out-doors and equipped with a readily accessible disconnecting means located within sight of the building, an additional disconnect means is not required on or at the building/structure.



Outdoor Generator Sets - Generator Disconnect 702.12

Generator Feeder Disconnect
Not Required on Building

Outdoor Generator
Disconnect

Maximum
50 ft

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A disconnect isn't required on or at the building or structure if the generator disconnect is readily accessible and within sight of the building.

Optional Standby Systems - Portables NEC 702

- A portable generator used for temporary power, like those used on construction sites, does **NOT** fall within the scope of Article 702 unless the generator is connected to the premises wiring.

NEC 702.1 Portable

- Connection may be automatic or manual.
- Allowed to be manual if a condition of maintenance and supervision is present to ensure only qualified persons provide service.
- Equipment must have lockouts to ensure utility service is not back fed.



Optional Standby Power *Section 702.1*

Optional
Standby Power

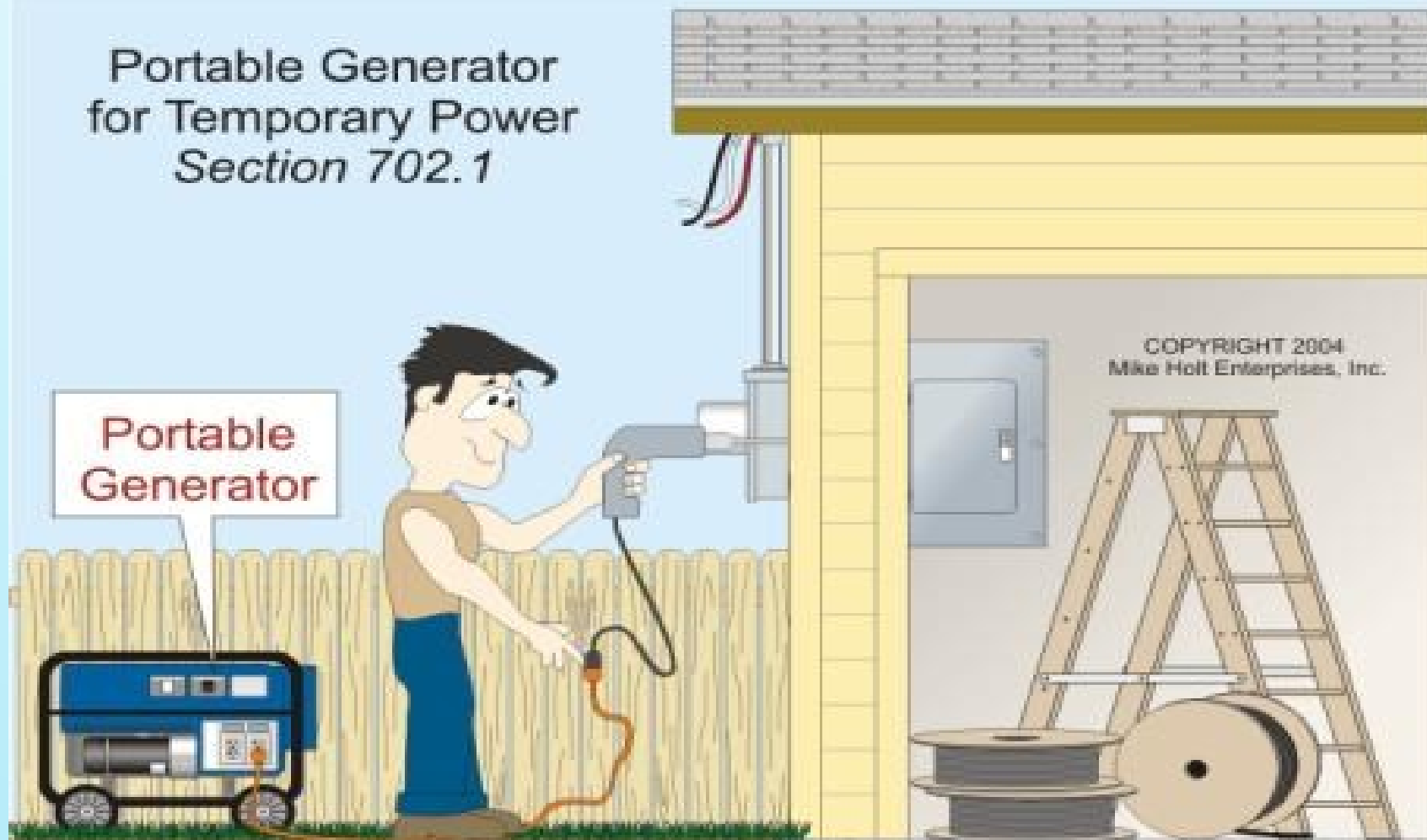


Manual or automatic
transfer switch [702.6]

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Article 702 applies to both fixed and portable alternate power supplies commonly used for telecommunication facilities, wastewater pump stations, homes, and offices.

Portable Generator for Temporary Power *Section 702.1*



Portable generators for temporary power are not covered by Article 702 if not connected to the premises wiring.

NEC 445 GENERATORS

Scope – Contains the installation and other requirements for generators.

- Locations
- Markings
- Overcurrent Protection
- Ampacity of Conductors
- Disconnecting Means
- Supplying Multiple Loads

NEC 445 DEFAULT RULES FOR ALL GENERATORS

NEC 445.10 Location

- Generators shall be of type suitable for the locations in which they are install.
- Generators shall satisfy NEC 430.14
 - Generators shall be located such that:
 - Adequate Ventilation
 - Readily Accessible for Maintenance, Lubrication, and Replacement of parts
- NEC 110.3(B) According to Listing and Labeling
 - If this conflicts with NEC, go by whichever is more stringent, & consult with AHJ first.

NEC 445 Default Rules for All Generators

NEC 445.11 Marking

- Generators must be provided with a nameplate indicating,
 - Manufacturer's name
 - Rated frequency
 - Power factor
 - Number of phases
 - Rating in kilowatts (kW) or kilovolt amperes (kVA)
 - Volts
 - Amperes corresponding to the rating
 - RPM
 - Insulation class
 - Rated ambient temperature or rated temperature rise
 - Time rating



NEC 445 Default Rules for All Generators

445.11 Marking NEC Additional Nameplate Information

- If the stationary and portable is above 15 kW
 - Whether or not generator neutral is bonded to the generator frame. Additional markings if modified in the field.



NEC 445 Default Rules for All Generators

NEC 445.12 Overcurrent Protection

- (A) Constant voltage generators shall protect from overload by
 - Inherent design
 - Circuit breakers
 - Fuses
 - Protective relays
 - Other identified means suitable for the conditions used



NEC 445 Default Rules for All Generators

Overcurrent

- Definition:
 - Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit or ground fault.
- Number One Cause of Electrical Fires, Improper Overcurrent Protection
- Number Two is loose Connections Creating Arching Faults

NEC 445 Default Rules for All Generators

NEC 240.21 Overcurrent Protection, Location in Circuit

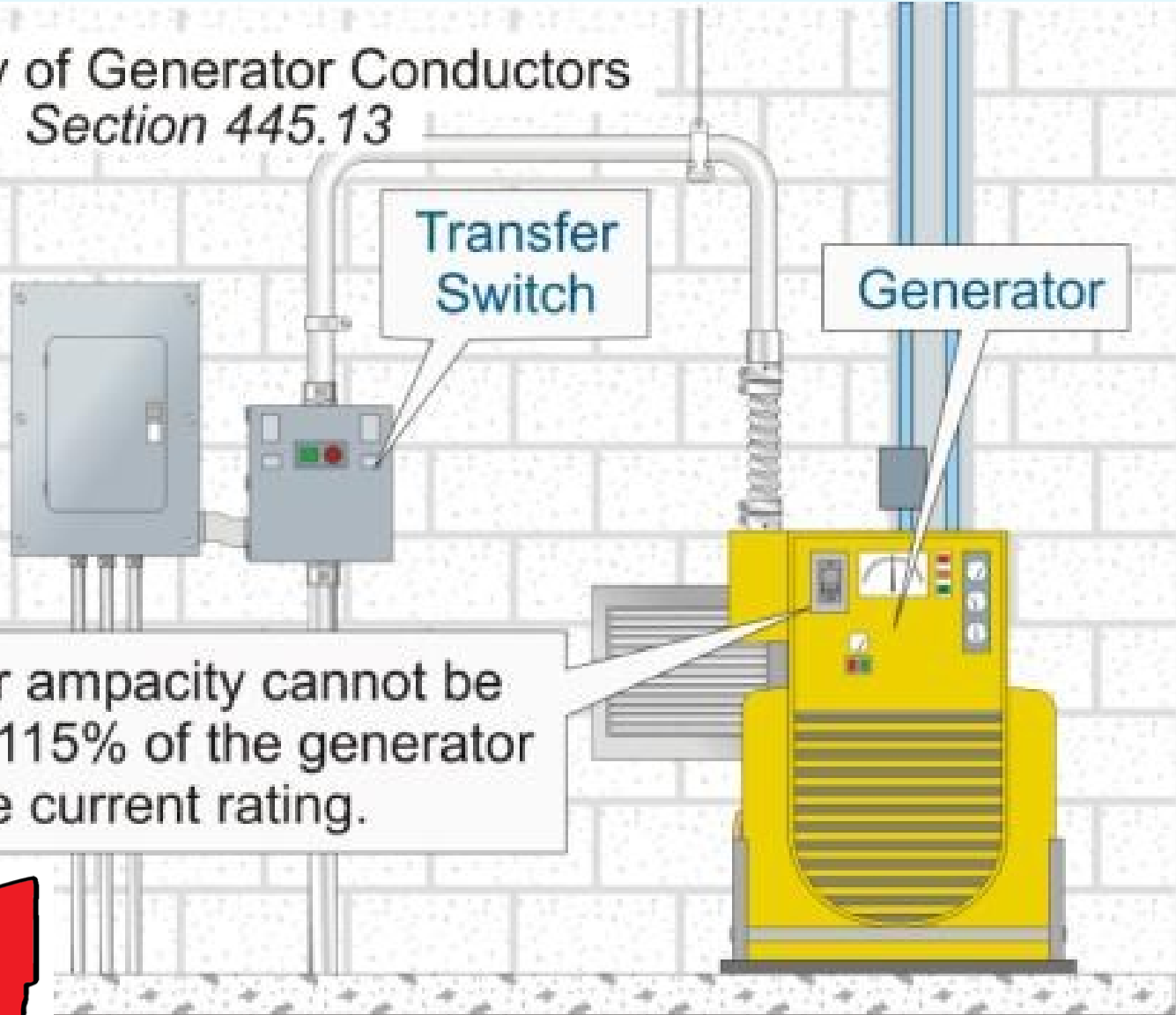
240.21 (G) Conductors from Generator Terminals.

- Conductors from generator terminals that meet the size requirement in 445.13 shall be permitted to be protected against overload protective device(s) required by 445.12

NEC 445.13 Ampacity of conductors

- Shall be sized 115% of the nameplate current rating to the first distribution device(s)

Ampacity of Generator Conductors Section 445.13



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NEC 445 Default Rules for All Generators

NEC 445.16 Bushings

- It is very common for conductors to connect to an enclosure in a wiring terminal box which is within an outer enclosure. Be sure to install a bushing such as a chase nipple with a bushing on it.
- The same is true for control wires as well as the feeders.



NEC 445 Default Rules for All Generators

NEC 445.18 Disconnecting means required for generators

- Generators shall be equipped with disconnect(s), lockable in the open position to disconnect entirely the generator and all protective devices and control apparatus
- Exceptions:
 - If the driving means can be readily shut down and,
 - If the generator is not arranged to operate in parallel with another generator or other source of power.



Because you can make it work.....



Doesn't not make it right...



About that Accessible thing...

Grounding and Bonding of Generators

NEC 100 – Definitions

Equipment Grounding Conductor: The conductive path(s) that provides a ground-fault current path and connects normally non-current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both.



Grounding and Bonding of Generators

NEC 100 – Definitions

Grounding Electrode. A conducting object through which a direct connection to earth is established.

Grounding Electrode Conductor. A conductor used to connect the system grounded conductor or the equipment to a grounding electrode or to a point on the grounding electrode system.

Grounding and Bonding of Generators

NEC 100 – Definitions

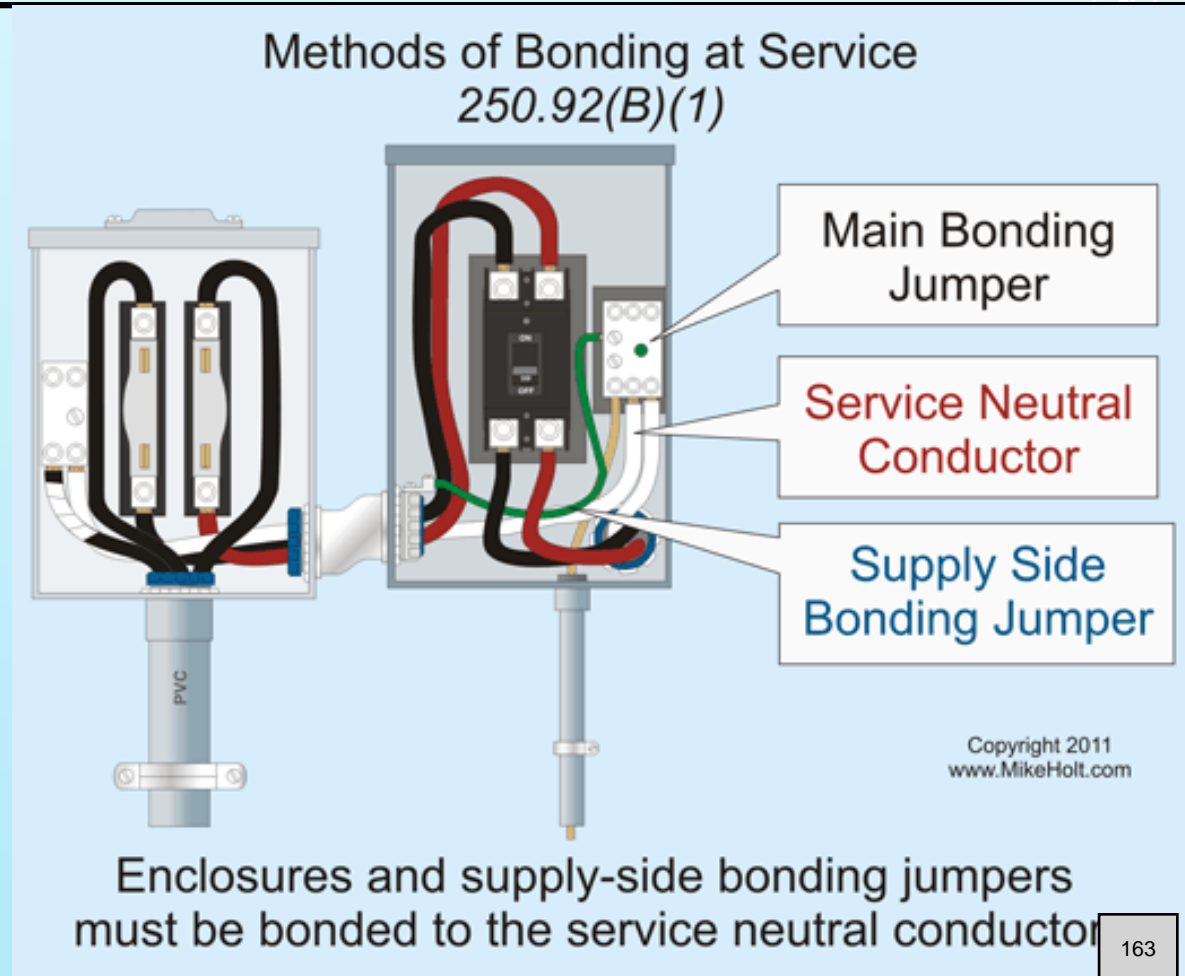
Neutral Conductor: The conductor connected to the neutral point of a system that is intended to carry current under normal conditions.

Neutral Point: The common point on a wye-connection in a polyphase system or midpoint on a single-phase, 3-wire system, or midpoint of a single-phase portion of a 3-phase delta system, or a midpoint of a 3-wire, direct-current system.

Grounding and Bonding of Generators

Main Bonding Jumper:

This ensures a fault path from phase conductors who might fault to the enclosures or raceways to the grounded conductor.



Grounding and Bonding of Generators

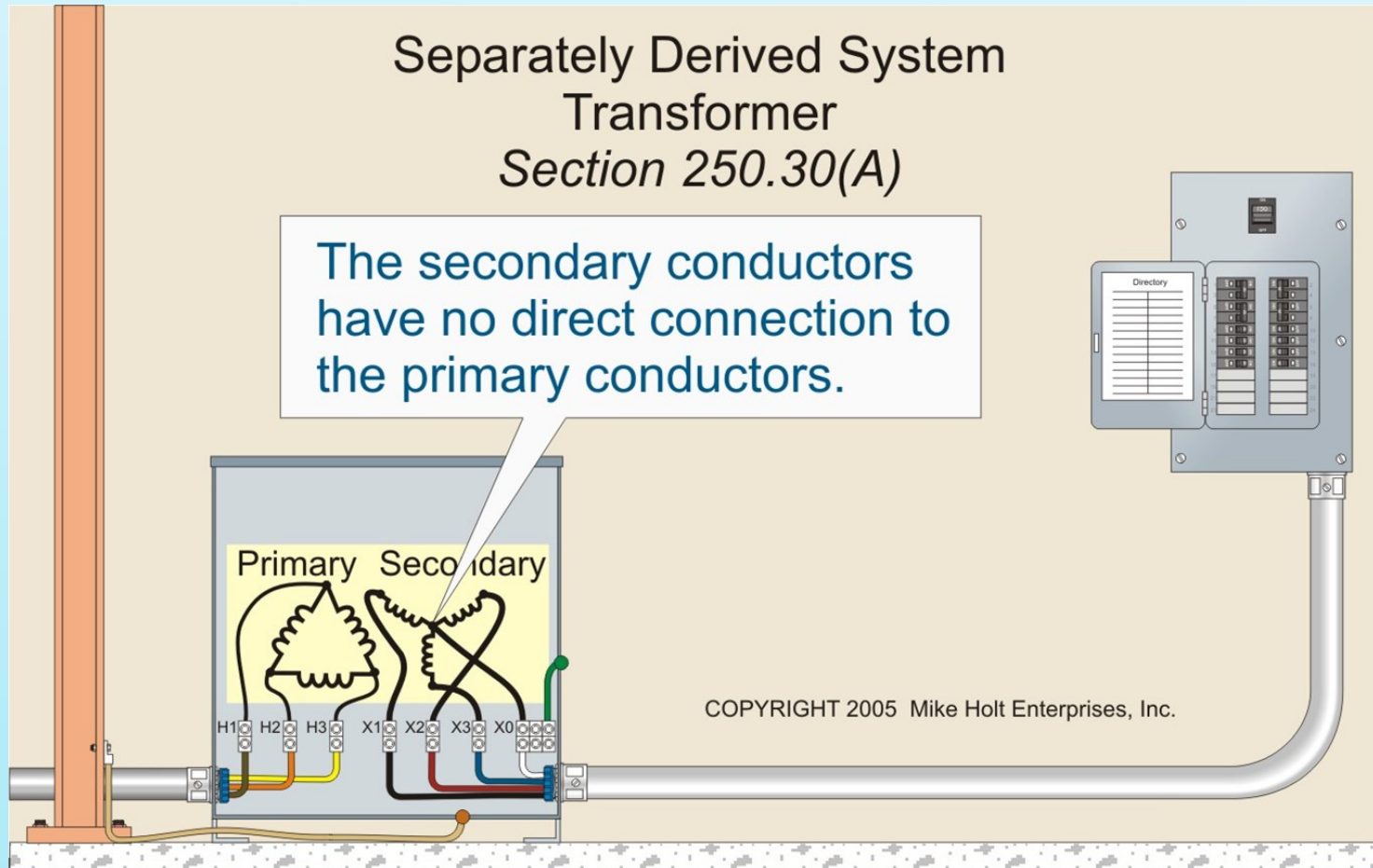
NEC 100 – Definitions

Separately Derived System. An electrical source, other than a service, having no direct connection(s) to circuit conductors of any other electrical source other than those established by grounding and bonding connections.

Grounding and Bonding of Generators

Separately Derived System Transformer *Section 250.30(A)*

The secondary conductors have no direct connection to the primary conductors.

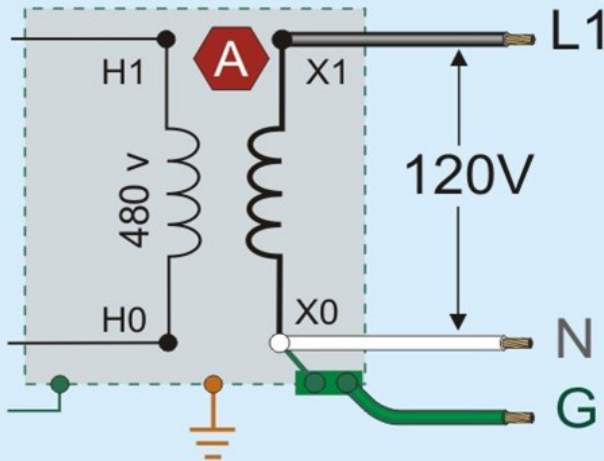


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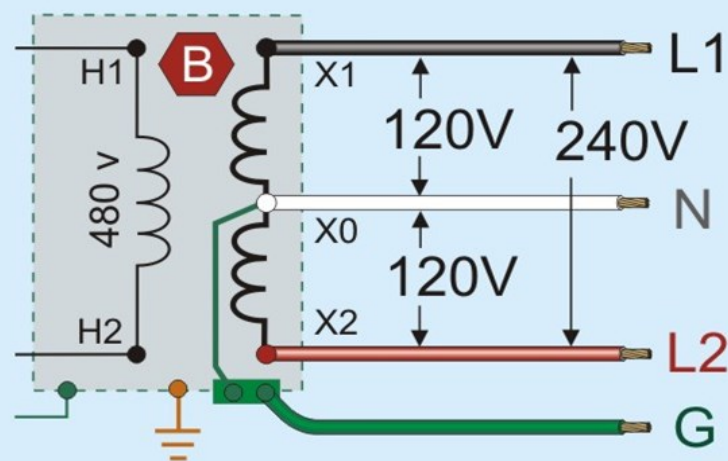
Systems Required to be Grounded (Bonded)

Sections 250.20(B) and 250.26

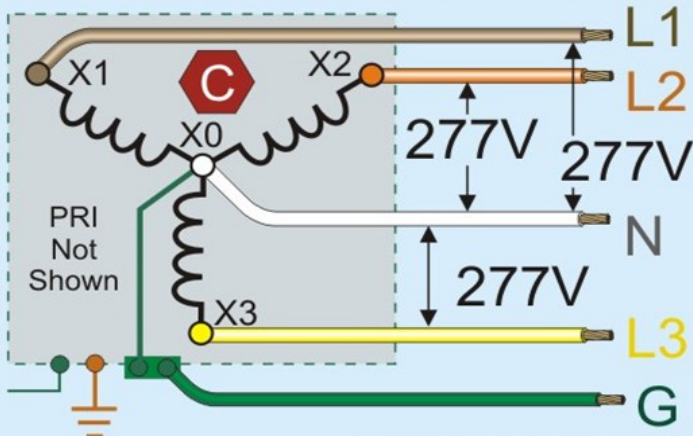
1-Phase, 2-Wire
Ground Any Conductor



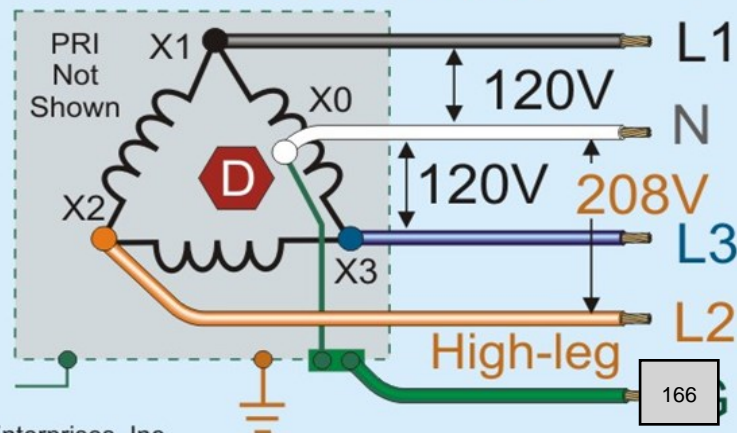
1-Phase, 3-Wire
Ground Neutral Conductor



Wye 3-Phase, 4-Wire
Ground Common Conductor



Delta 3-Phase, 4-Wire
Ground Midpoint of One Phase

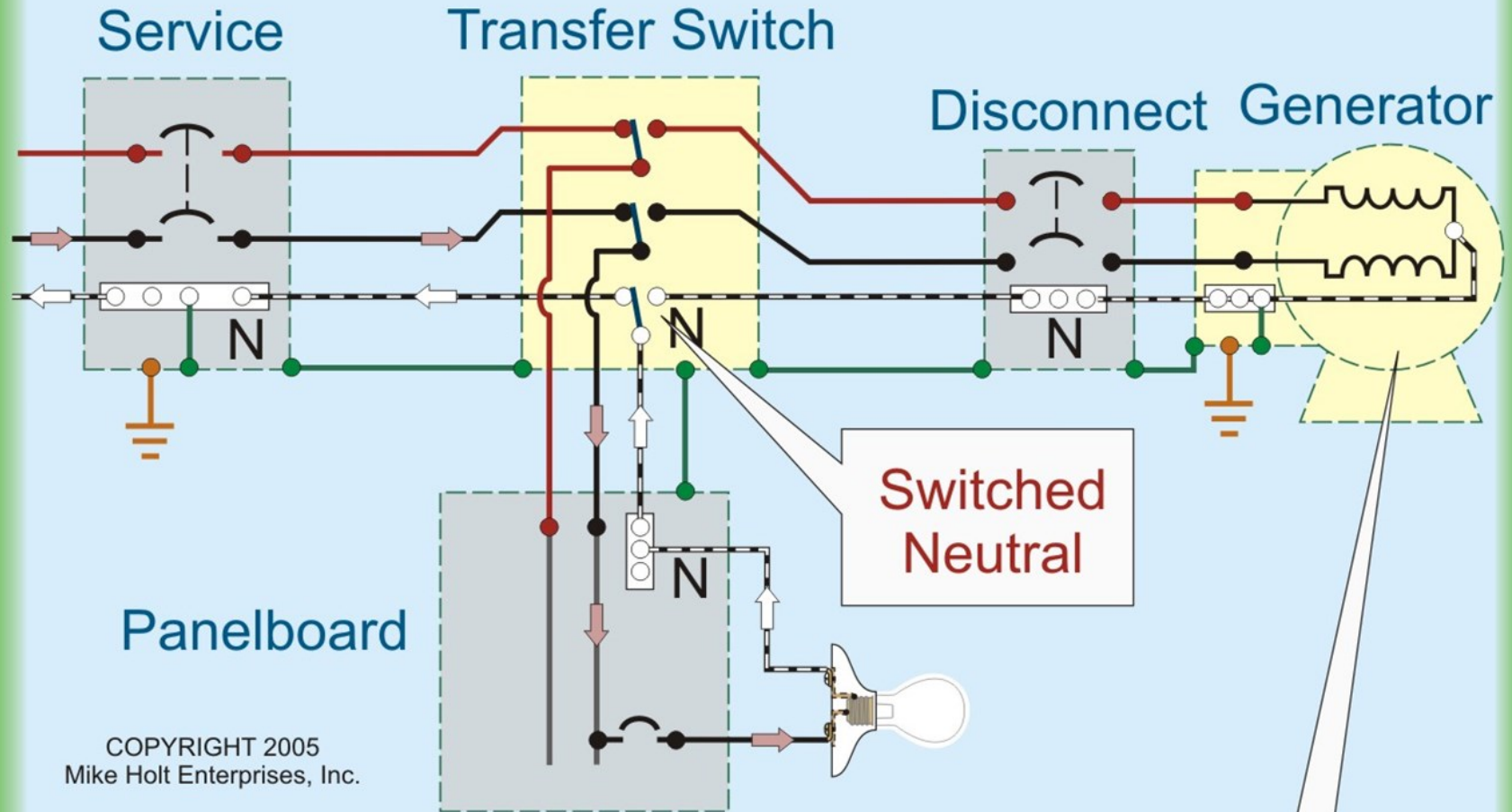


All Are Separately Derived Systems



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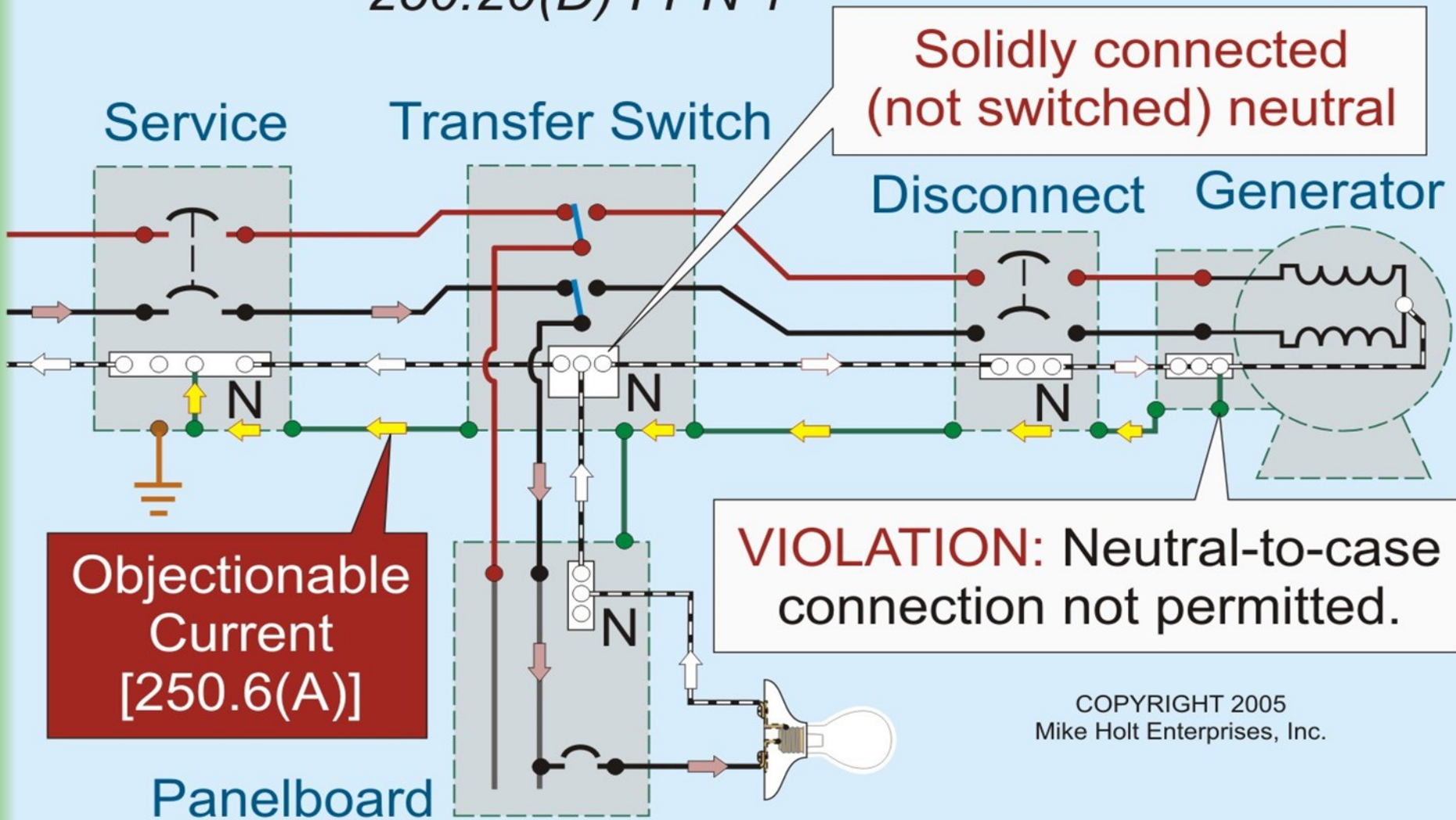
Separately Derived System Generator *Article 100 Definition*



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A generator will be a separately derived system if it has no direct connection to other system conductors.

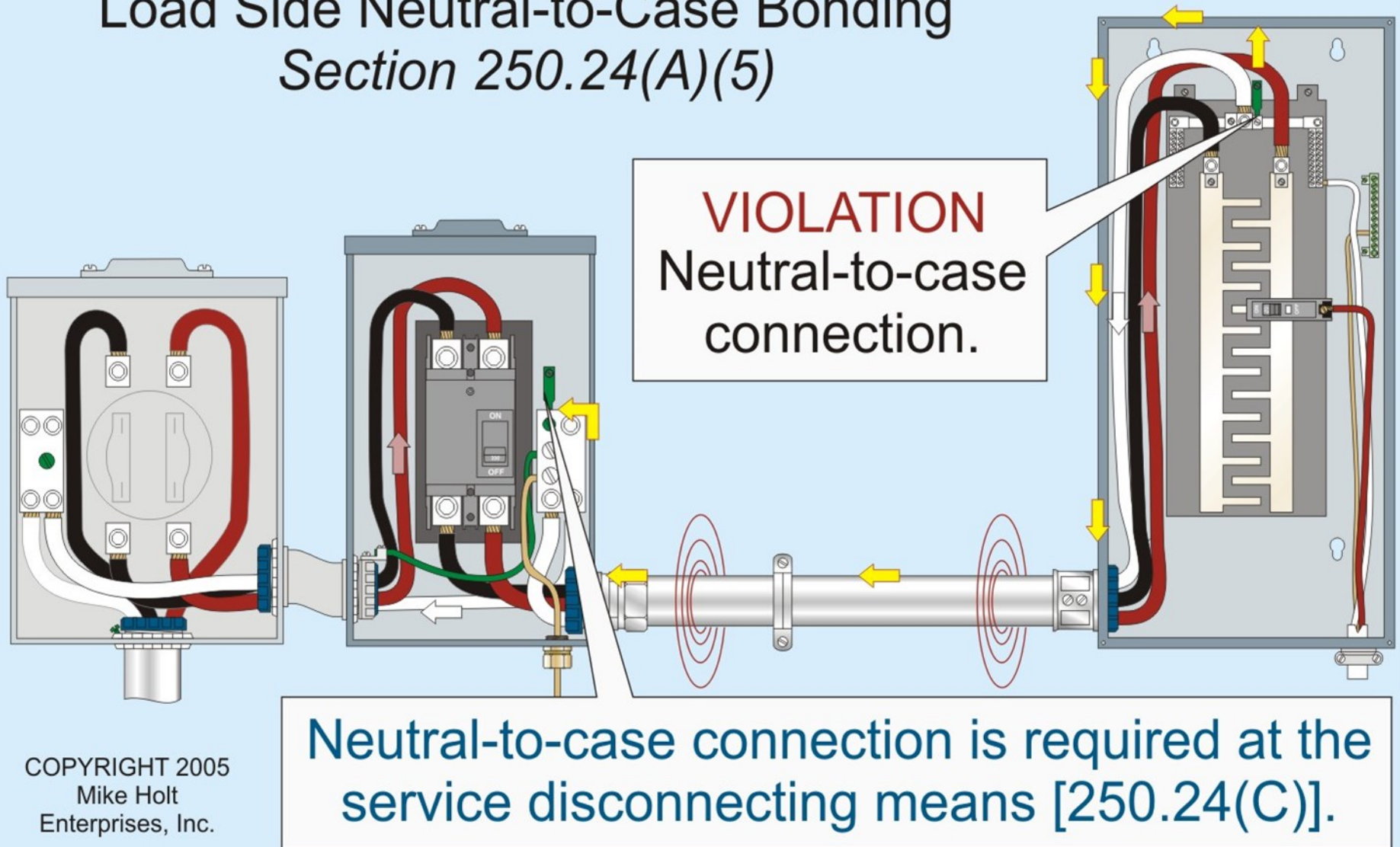
Generator - Not Separately Derived System 250.20(D) FPN 1



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A generator is not a separately derived system if the grounded conductor is not opened by the transfer switch

Load Side Neutral-to-Case Bonding *Section 250.24(A)(5)*

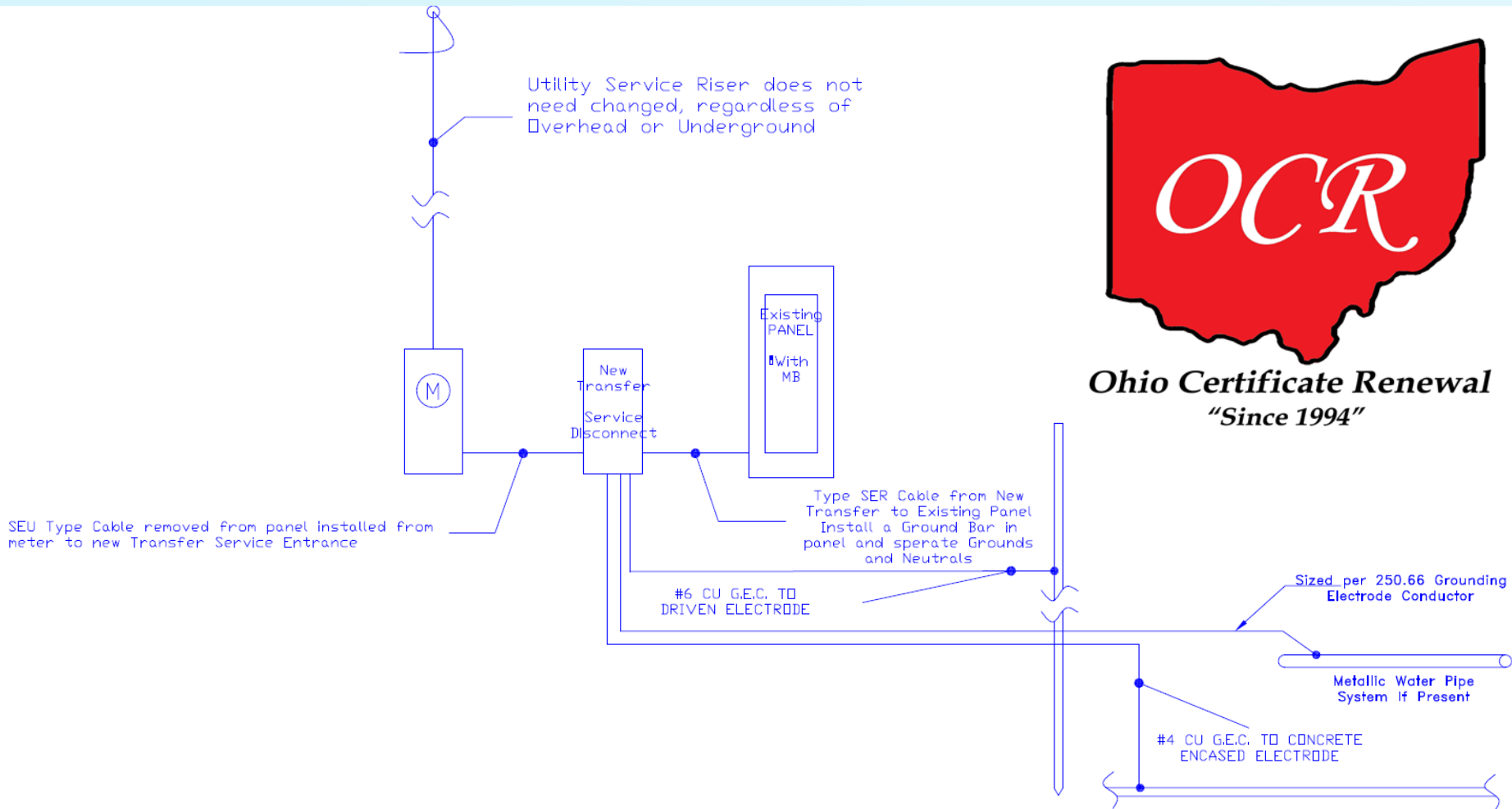


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A neutral-to-case connection must not be made on the load side of the service disconnecting means.

TRANSFER SWITCH TYPES

Service Disconnect Transfer Switch



Service Entrance Type Transfer Switch

- Existing Service, with a new Service Entrance Transfer Switch:
- The new Transfer installs between the meter and existing panel
- SEU from meter to panel goes into new Transfer
- SER will be installed between the new Transfer and existing panel
- The Main Breaker in the Existing panel will no longer be the Service Disconnect, it will now be a Principle or Main Breaker.
- All Earth and Electrode Bonding will be in the new Transfer.

Service Entrance Type Transfer Switch

- The Main Breaker will be the new Service Disconnect.
- All Grounds and Neutrals in existing panel will need installed on separate terminations, Neutrals on the neutral bar, with the Bond screw/strap removed
- All Grounds will be moved to a new ground bar.
- If you have three wire feeding a Range or Dryer, this will need up graded to a Four Wire method. There is not a legal method for leaving it/reconnecting.

Service Entrance Type Transfer Switch W/ Load Center

- Existing Service, with a new Service Entrance Transfer Switch:
- The new Transfer installs between the meter and existing panel
- SEU from meter to panel goes into new Transfer Panel
- The Main Breaker will be the Service Disconnect.
- All Earth and Electrode Bonding will be in this SE Transfer Load Center.



Service Entrance Type Transfer Switch W/ Load Center

- All Grounds and Neutrals in this panel can be together or separate, Neutrals on the neutral bar, with the Bond screw/strap Installed.
- All Grounds can be on Neutral bar and or a ground bar.
- If you have three wire feeding a Range or Dryer, this will not have to be upgraded to a Four Wire method.

Standard Model Type Transfer Switch

- Typically, this is done when a new sub-panel is going to be installed and feed via this Standard Model Transfer Switch.
- SER will be installed between Existing Panel - New Transfer – To new Sub-Panel
- A Two Pole breaker will be installed in the existing panel to power the utility power to this new sub-panel via transfer switch.
- The Service Disconnect will not be changed, all grounds and Neutrals in existing panel remain as installed.
- The grounds and neutrals in the SER will be connected to different terminals in both the transfer switch and the new sub-panel.
- Power Shed is possible with this method as well as the Service Entrance Unit.
- If you have three wire feeding a Range or Dryer, this will need up graded to a Four Wire method, if relocated from existing service to new sub-panel.

Load Center Model Type Transfer Switch

- Typically, this is done to save installing a new sub-panel.
- SER will be installed between Existing Panel - New Load Center Type Transfer Switch.
- A Two Pole breaker will be installed in the existing panel to power the utility power to this new Load Center switch.
- The Service Disconnect will not be changed, all grounds and Neutrals in existing panel remain as installed. A bond will not be installed in this panel

Load Center Model Type Transfer Switch

- The grounds and neutrals in the SER will be connected to different terminals in the new Load Center.
- Power Shed is Not possible with this method.
- If you have three wire feeding a Range or Dryer, this will need up graded to a Four Wire method, if relocated from existing service to new sub-panel.



QUESTIONS?





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THANK
YOU!

File Attachments for Item:

ER-3 The New ACI Code 440.11 on GFRP Reinforced Concrete (American Concrete Institute)

All certifications (1 hour)

Staff Notes: Administratively approved based on AIA approval (see slides, p. 2). Submitted for ratification.

Committee Recommendation:

Presentation: The New ACI CODE 440.11 on GFRP Reinforced Concrete: Implementation for Building Code Officials

Coarse Description: This presentation provides an overview of the new ACI CODE 440.11-22: Building Code Requirements for Structural Concrete Reinforced with Glass Fiber-Reinforced Polymer (GFRP) Bars. ACI 440.11 was developed by an ANSI-approved consensus process and addresses structural systems, members, and connections, including cast-in-place, precast, non-prestressed, and composite construction. The Code provides minimum requirements for the materials, design, and detailing of structural concrete buildings and, where applicable, nonbuilding structures reinforced with GFRP bars that conform to the requirements of ASTM D7957-22. The presentation will cover basic design requirements as well as requirements for construction documentation, field testing and inspections related to structures utilizing GFRP bars. Case studies of current projects and applicable uses will be provided.

This presentation has been approved for continuing education by ICC and AIA.

Learning Objectives:

- 1) Identify the basic material performance properties of GFRP reinforcing bars; how they compare to traditional steel reinforcement and where they would be used.
- 2) Explain where the new ACI Code for GFRP applies.
- 3) Interpret the Code requirements as it relates to GFRP bars.
- 4) Understand basic mechanics of GFRP reinforced concrete.

Speaker Bio(s):

Will Gold, PE – Mr. Gold joined ACI in July of 2022 as a staff engineer. Prior to joining ACI he was with Master Builders Solutions for over 25-years. He brings a depth of experience in the use of fiber-reinforced polymer (FRP) composite materials to reinforce concrete and masonry structures for both new construction and repair. Will has been an ACI member for many years and is a Fellow of the institute. He is past Chair of ACI Committee 440, Fiber-Reinforced Polymer Reinforcement and currently serves as the Secretary of ACI Committee 440S, FRP Repair and Rehabilitation of Concrete Code, which is focused on developing the code language for the design of FRP strengthening systems. He has a bachelor's degree in architectural engineering from the University of Kansas and completed master's degree work in Structural Engineering at the Pennsylvania State University. He is a registered Professional Engineer in the State of Ohio.

Jay Pease, PE - Jay Pease, PE, is the FRP Applications Engineer for Owens Corning Infrastructure Solutions. Additionally, he is active within numerous ACI committees including 440 – Fiber Reinforced Polymer Reinforcement, 332 – Residential Concrete Work, and 322 – Concrete Pool and Watershape Code. Jay is a licensed civil-structural engineer in the state of Ohio residing in Summit County. Prior to joining Owens Corning, he spent 6 years as structural design engineer in Northeast Ohio.

The New ACI CODE 440.11-22
on GFRP Reinforced Concrete:
Implementation for Building Code Officials

The New ACI CODE 440.11-22 on GFRP Reinforced Concrete: Implementation for Building Code Officials

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*The online course based on this webinar is registered with **AIA/CES** for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. **The American Institute of Architects has approved this course for 6.0 AIA/CES HSW Learning Unit.***



*The American Institute of Architects has approved this session for **6.0 AIA/CES HSW Learning Units**. ACI is an AIA/CES registered provider.*



*The International Code Council has approved this session for **0.6CEU**.*



Learning Objectives

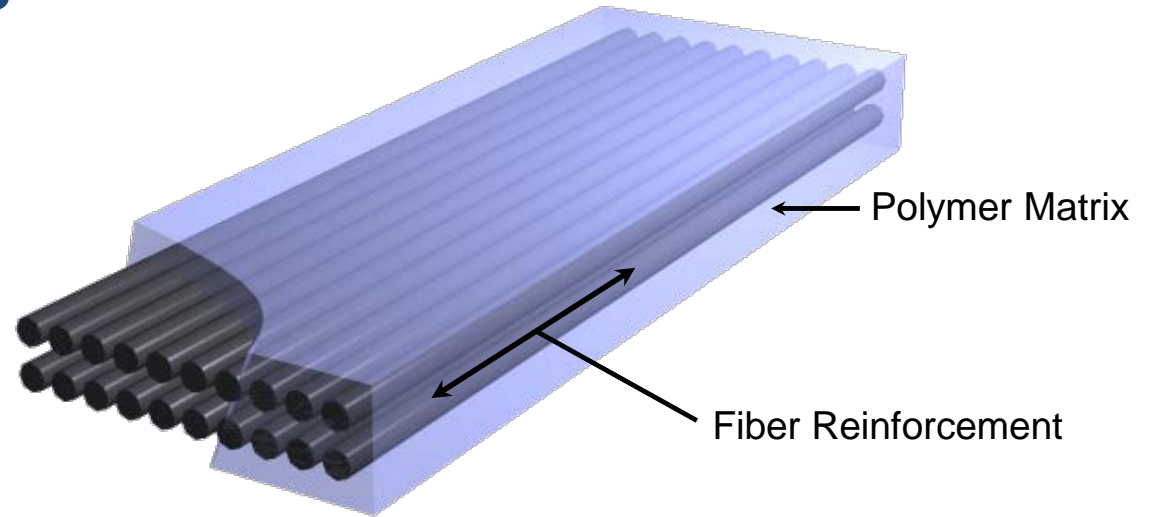
- Identify the basic material performance properties of GFRP reinforcing bars; how they compare to traditional steel reinforcement; and where they would be used.
- Explain where the new ACI code for GFRP reinforced concrete applies; what the limitations are for using this code; and how it relates to other codes and standards from ACI, ASTM, and ICC.
- Interpret the code requirements as it relates to the installation of GFRP bars; inspection requirements; and other general considerations for their field application.
- Understand the basic mechanics of GFRP reinforced concrete; how it compares to steel reinforced concrete; and the associated code requirements.



FRP Materials

Fiber Reinforced Polymers

- High strength continuous fibers
- Encapsulated in a polymer matrix
- Commonly used in aerospace, automotive, and sporting goods applications

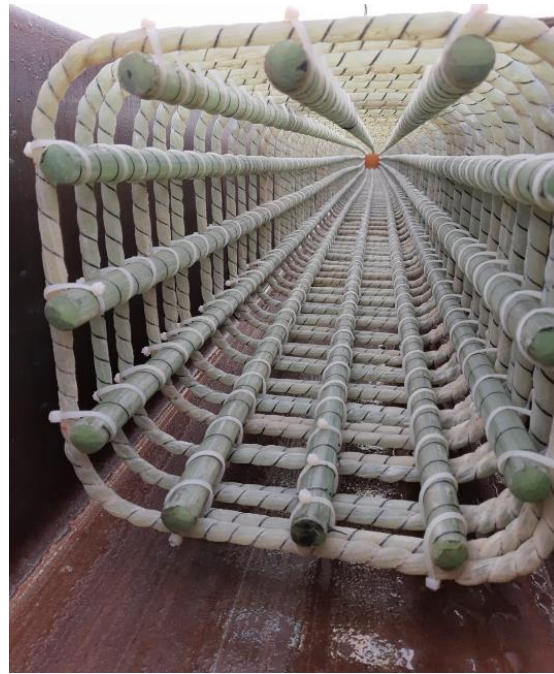




FRP Materials

GFRP Reinforcing Bars

Glass Fiber Reinforced Polymer (GFRP) bars, alternative reinforcement for concrete





FRP Materials

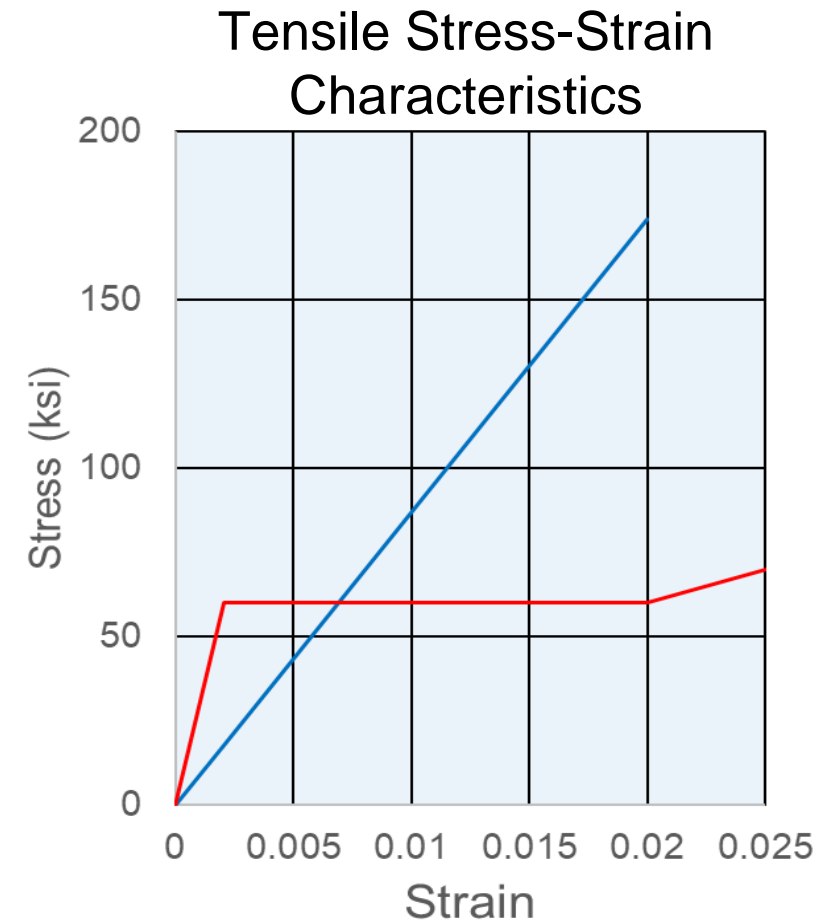
GFRP Reinforcement Properties

- High longitudinal strength to weight ratio
- Non-corrosive
- Electro-magnetic neutrality
- High fatigue endurance
- Low thermal and electrical conductivity
- Lightweight
- Easily cut onsite
- No yielding before failure
- Low transverse strength
- Relatively low modulus
- Susceptible to fire and smoke production
- High coefficient of thermal expansion perpendicular to fibers
- Cannot be field bent

FRP Materials

Mechanical Behavior

- Higher tensile strength, but less stiff than steel
 - Provides less confinement to concrete and RC members have more deflection than steel-RC
- Anisotropic behavior
 - High strength in the fiber direction
 - Low shear strength and dowel action (resin dominated)
- Elastic up to failure - no ductility
 - No plastic hinges formed in RC members





FRP Materials

Tensile Stress-Strain Characteristics

Tensile Properties

	Yield Stress (ksi)	Tensile Strength (ksi)	Elastic Modulus (x 10 ³ ksi)	Yield Strain (%)
Steel	40 to 75	70 to 100	29	0.14 to 0.25
GFRP	N/A	77 to 175	6.5 to 8.7	N/A

FRP Materials

Density and CTE

Density (lb/ft³)

Concrete (normal weight)	135 to 160
Steel	493
GFRP	150

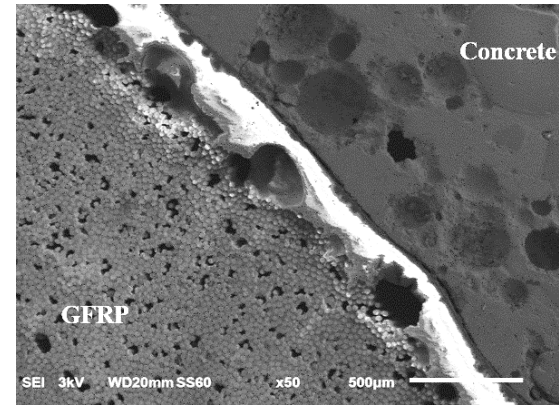
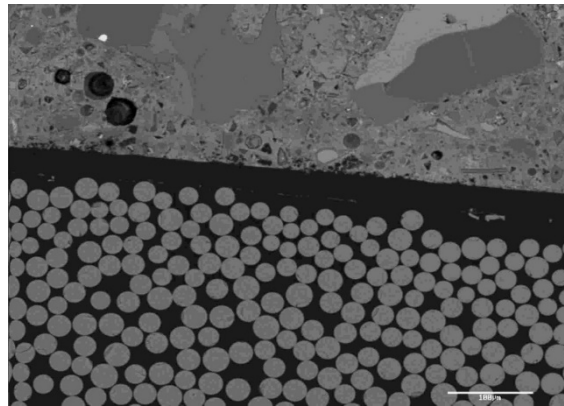
Coefficient of Thermal Expansion (10⁻⁶/°F)

	Longitudinal Direction	Transverse Direction
Concrete	4 to 6	4 to 6
Steel	6.5	6.5
GFRP	3.5 to 5.6	12

FRP Materials

Durability

- FRP bars will not corrode, but glass fibers have potential for degradation under high pH
 - 2% reduction in tensile strength seen after 17 years of in-field service
 - High pH testing now required by ASTM D7957



Source: Long-term Durability of GFRP Reinforcement in Concrete: A Case Study after 15 Years of Service - O. Gooranorimi, E. Dauer, J. Myers, A. Nanni



FRP Materials

Other Mechanical Properties

- Strength of FRP at bends
 - FRP bars can be fabricated with bends, however the tensile strength at bends is reduced by about 40%
- Compressive behavior of FRP bars
 - Reduced strength and stiffness as compared to tensile properties
- Shear behavior of FRP bars
 - Unidirectional FRP materials have a lower interlaminar shear modulus and shear strength as compared to steel
- Behavior under sustained and cyclic loading
 - FRP bars can undergo creep-rupture under sustained loading and fatigue rupture under cyclic loading

Applications

Concrete Exposed to Deicing Chemicals

- Bridge decks
- Approach slabs
- Barrier walls
- Railroad crossings
- Salt storage facilities
- Parking Garages
- Walkways



Applications

Concrete Exposed to Marine Chlorides



- Balconies in Coastal Locations
- Seawalls
- Piers, Wharfs, Docks
- Bridges over Coastal Locations
- Seawater Spillways

Applications

Electromagnetic Transparency

- MRI rooms in hospitals
- Airport radio & compass calibration pads
- Electrical high voltage transformer vaults
- Concrete near high voltage cables and substations
- Cable Duct Banks
- Toll Road Inductance Loops



Applications

Low Thermal Conductivity



- Thermal Breaks in Insulated Panels
- Reinforcement for ICF Walls

Applications

Consumable Reinforcement

- Soft-eyes (tunneling)
- Slab penetrations



Applications

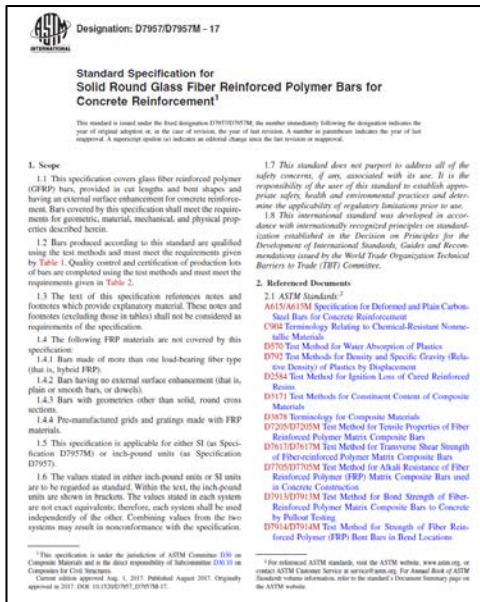
Ease of Handling



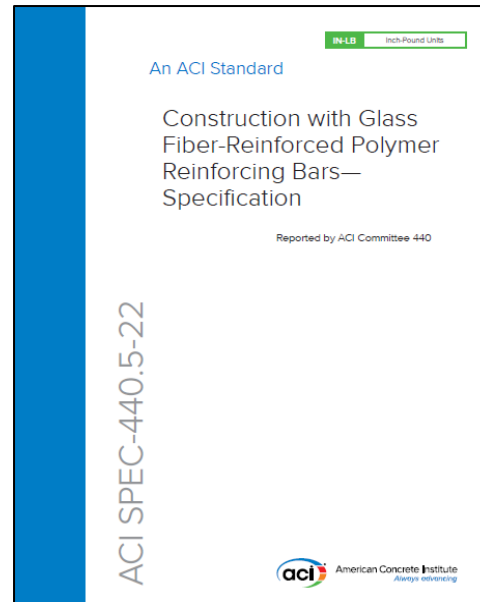
- Flatwork
- Residential Basement Walls and Foundations
- Areas that are difficult to access

Standards and Guides

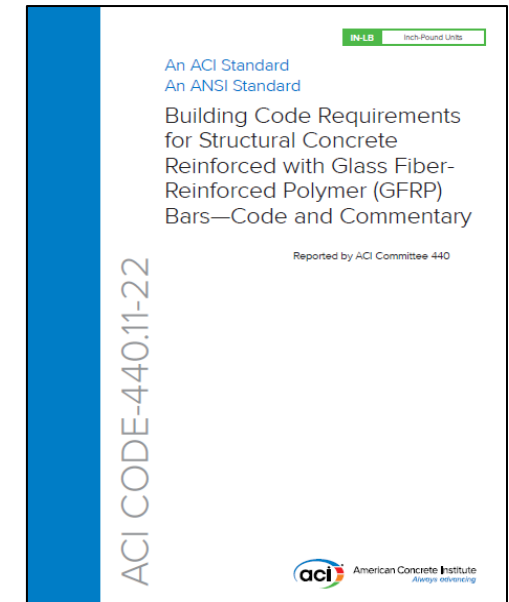
The Three Legs of the Stool



ASTM D7957
Material Spec



ACI SPEC 440.5
Construction Spec




ACI CODE 440.11
Design Code

Standards and Guides Material Specification

ASTM D7957 – Standard Specification for Solid Round GFRP Bars for Concrete Reinforcement

- Glass fiber, vinyl ester resin bars only
- Manufactured by pultrusion
- Specified material properties
- Specified bond properties
- Specified durability properties

 Designation: D7957/D7957M - 17

Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement¹

This standard is issued under the fixed designation D7957/D7957M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers glass fiber reinforced polymer (GFRP) bars, provided in cut lengths and bent shapes and having an external surface enhancement for concrete reinforcement. Bars covered by this specification shall meet the requirements for geometric, material, mechanical, and physical properties described herein.

1.2 Bars produced according to this standard are qualified using the test methods and must meet the requirements given by Table 1. Quality control and certification of production lots of bars are completed using the test methods and must meet the requirements given in Table 2.

1.3 The text of this specification references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables) shall not be considered as requirements of the specification.

1.4 The following FRP materials are not covered by this specification:

1.4.1 Bars made of more than one load-bearing fiber type (that is, hybrid FRP).

1.4.2 Bars having no external surface enhancement (that is, plain or smooth bars, or dowels).

1.4.3 Bars with geometries other than solid, round cross sections.

1.4.4 Pre-manufactured grids and gratings made with FRP materials.

1.5 This specification is applicable for either SI (as Specification D7957M) or inch-pound units (as Specification D7957).

1.6 The values stated in either inch-pound units or SI units are to be regarded as standard. Within the text, the inch-pound units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.7 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health and environmental practices and determine the applicability of regulatory limitations prior to use.

1.8 This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 *ASTM Standards*:²

A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

C904 Terminology Relating to Chemical-Resistant Nonmetallic Materials

D570 Test Method for Water Absorption of Plastics

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D2584 Test Method for Ignition Loss of Cured Reinforced Resins

D3171 Test Methods for Constituent Content of Composite Materials

D3878 Terminology for Composite Materials

D7205/D7205M Test Method for Tensile Properties of Fiber Reinforced Polymer Matrix Composite Bars

D7617/D7617M Test Method for Transverse Shear Strength of Fiber-reinforced Polymer Matrix Composite Bars

D7705/D7705M Test Method for Alkali Resistance of Fiber Reinforced Polymer (FRP) Matrix Composite Bars used in Concrete Construction

D7913/D7913M Test Method for Bond Strength of Fiber-Reinforced Polymer Matrix Composite Bars to Concrete by Pullout Testing

D7914/D7914M Test Method for Strength of Fiber Reinforced Polymer (FRP) Bent Bars in Bend Locations

¹ This specification is under the jurisdiction of ASTM Committee D30 on Composite Materials and is the direct responsibility of Subcommittee D30.10 on Composites for Civil Structures.
Current edition approved Aug. 1, 2017. Published August 2017. Originally approved in 2007. DOI: 10.1520/D7957_D7957M-17.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

ASTM D7957

Material Requirements



TABLE 1 Property Limits and Test Methods for Qualification^A

Property	Limit	Test Method
Mean Glass Transition Temperature	Midpoint temperature ≥ 100 °C [212 °F]	ASTM E1356
Mean Degree of Cure	≥ 95 %	ASTM E2160
Mean Measured Cross-Sectional Area	Table 3	ASTM D7205/D7205M, subsection 11.2.5.1
Guaranteed ^B Ultimate Tensile Force	Table 3	ASTM D7205/D7205M
Mean Tensile Modulus of Elasticity	$\geq 44,800$ MPa [6 500 000 psi]	ASTM D7205/D7205M
Mean Ultimate Tensile Strain	≥ 1.1 %	ASTM D7205/D7205M
Guaranteed ^B Transverse Shear Strength	≥ 131 MPa [19 000 psi]	ASTM D7617/D7617M
Guaranteed ^B Bond Strength	≥ 7.6 MPa [1100 psi]	ASTM D7913/D7913M
Mean Moisture Absorption to Saturation	≤ 1.0 % to saturation at 50 °C [122 °F]	ASTM D570, subsection 7.4
Mean Alkaline Resistance	≥ 80 % of initial mean ultimate tensile force following 90 days at 60 °C [140 °F]	ASTM D7705/D7705M, Procedure A
Guaranteed ^B Ultimate Tensile Force of Bent Portion of Bar	≥ 60 % of the values in Table 3	ASTM D7914/D7914M

^AFor the determination of the mean and guaranteed properties, at least 24 samples shall be obtained in groups of eight or more from three or more different production lots. The mean and guaranteed properties shall satisfy the limits.

^BGuaranteed property is defined in 3.2.4.

ASTM D7957 Test Methods



ASTM D7205
Tensile
Properties

$E_f > 6,500$ ksi



ASTM D7913
Bond Strength
to Concrete

$> 1,100$ psi



ASTM D7617
Transverse
Shear Strength

> 19 ksi



ASTM D7914
Strength of Bars
at Bends

$> 60\%$ Straight Portion

ASTM D7957 Test Methods



ASTM D7705
Resistance to
Alkalinity

Maintain 80% of
initial mean
tensile force
after 90-days at
140°F



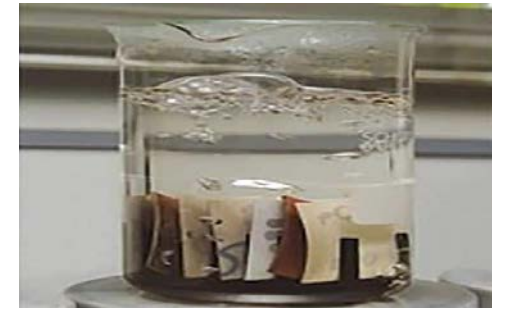
ASTM E2160
Enthalpy of
Polymerization

> 95%



ASTM E1356
Glass Transition
Temperature

> 212°F



ASTM D570
Water
Absorption

< 1% at 122°F

ASTM D7957

Guaranteed Tensile Properties

ASTM D7957 requires properties obtained from the bar manufacturer be based on ASTM D7205 and ASTM D7914 tests

- Straight bar guaranteed tensile strength, f_{fu}^*

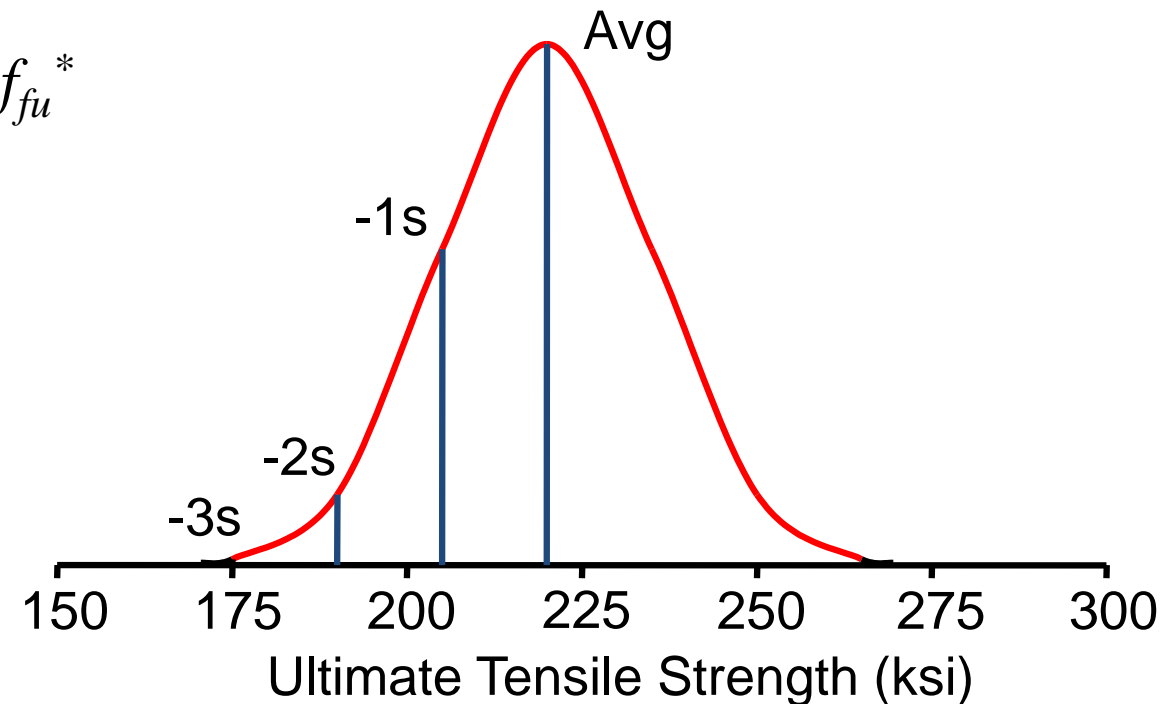
$$f_{fu}^* = f_{fu,ave} - 3\sigma$$

- Mean tensile modulus, E_f

$$E_f = E_{f,ave}$$

- Guaranteed tensile strength at bend, f_{fb}^*

$$f_{fb}^* = f_{fb,ave} - 3\sigma$$



ASTM D7957 GFRP Bar Types

Bars compliant with ASTM D7957 are solid, round GFRP bars. But may “look” different.

- Different Colors
- Different Surface Treatments
 - (A & F) Sand coated + helical wrap
 - (B) Helically wrapped
 - (C) Ribbed
 - (D) Sand coated
 - (E) Helically grooved



ASTM D7957

Bar Sizes

- Standard Bar Sizes are the Same as Steel Bars (No. 2 thru No. 10)
- Bar Areas are the Same as Steel Bars
- But...strength varies by bar size
 - No. 2 is 125-ksi minimum
 - No. 10 is 77-ksi minimum

ASTM D7957 Bar Strength

- Strength is specified in terms of minimum tensile force

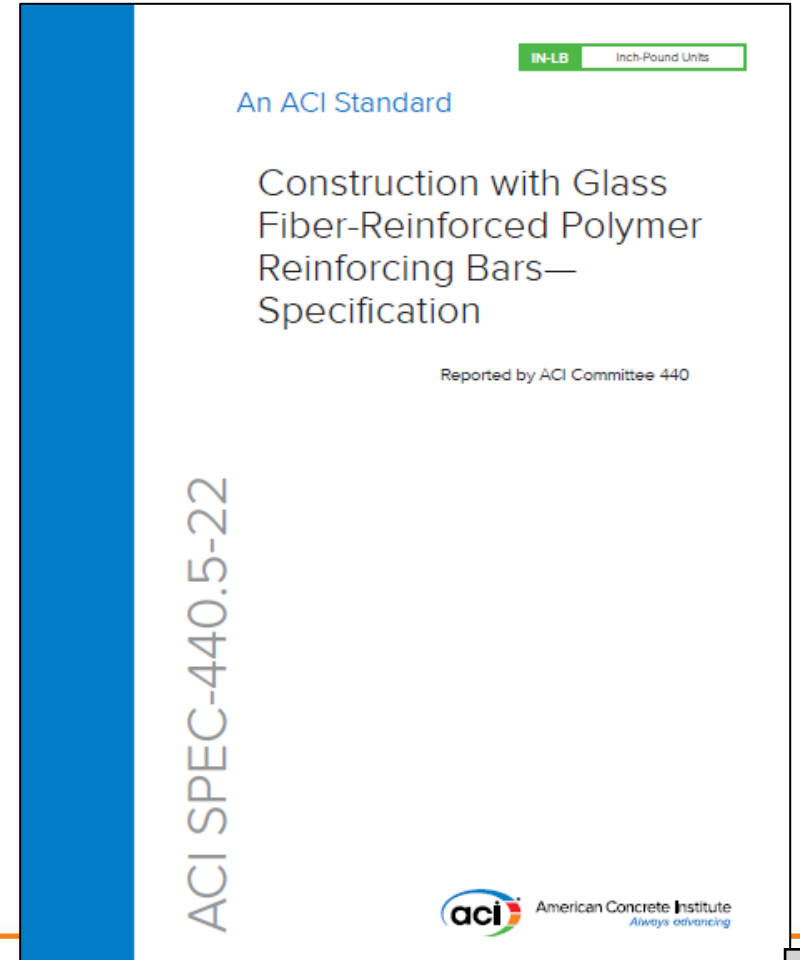
TABLE 3 Geometric and Mechanical Property Requirements

Bar Designation No.	Nominal Dimensions		Measured Cross-Sectional Area Limits mm ² [in. ²]		Minimum Guaranteed Ultimate Tensile Force kN [kip]
	Diameter mm [in.]	Cross-Sectional Area mm ² [in. ²]	Minimum	Maximum	
M6 [2]	6.3 [0.250]	32 [0.049]	30 [0.046]	55 [0.085]	27 [6.1]
M10 [3]	9.5 [0.375]	71 [0.11]	67 [0.104]	104 [0.161]	59 [13.2]
M13 [4]	12.7 [0.500]	129 [0.20]	119 [0.185]	169 [0.263]	96 [21.6]
M16 [5]	15.9 [0.625]	199 [0.31]	186 [0.288]	251 [0.388]	130 [29.1]
M19 [6]	19.1 [0.750]	284 [0.44]	268 [0.415]	347 [0.539]	182 [40.9]
M22 [7]	22.2 [0.875]	387 [0.60]	365 [0.565]	460 [0.713]	241 [54.1]
M25 [8]	25.4 [1.000]	510 [0.79]	476 [0.738]	589 [0.913]	297 [66.8]
M29 [9]	28.7 [1.128]	645 [1.00]	603 [0.934]	733 [1.137]	365 [82.0]
M32 [10]	32.3 [1.270]	819 [1.27]	744 [1.154]	894 [1.385]	437 [98.2]

Standards and Guides Construction Specification

ACI SPEC 440.5-22 Construction with Glass Fiber-Reinforced Polymer Reinforcing Bars

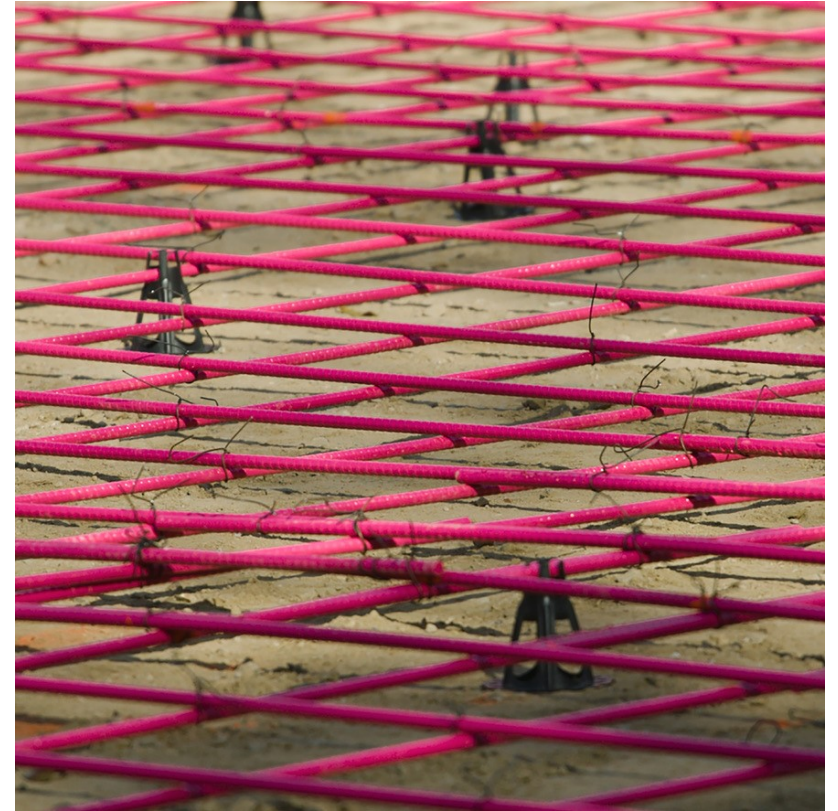
- Like ACI 301 Section 3, but covers GFRP bars



ACI SPEC 440.5

Submittals

- GFRP Bar Manufacturer's certified test reports in conformance with ASTM D7957
- Placement drawings showing size, spacing, splice locations and lengths, bends
- Description of supports and ties to be used



ACI SPEC 440.5

Storage and Handling



- Store off the ground
- Protect from dirt, oils, and other contaminants
- Direct sunlight will eventually start to affect the resin
 - Cover if being exposed over 4 months
- Prevent exposure to temperatures exceeding 120°F

ACI SPEC 440.5

Storage and Handling



- GFRP bars are less than 1/3 the weight of steel bars
 - A 30-ft long, #5 GFRP bar weighs 9-lbs. A 30-ft long, #5 steel bar weighs 30-lbs.
- Lift bars up to 40-ft long with 2 pick points (3 pick points for bars over 40-ft long)
- Avoid dragging, dropping, or excessive bending

ACI SPEC 440.5

Damaged Bars



- If bars are damaged, ACI 440.5 allows them to be used if the damage is less than 2% of the surface area of the length of bar and that the depth of the damage is less than around 1/32 in.
- Bars with damage beyond these limits should not be used.
- Alternatively, splices of new bars over damaged sections can be done. Splices need to be appropriately designed and detailed per ACI 440.11 requirements.

ACI SPEC 440.5

Cutting

- Bars can be easily cut using rotary saws with a silica carbide blade, reciprocating saws with a fine-tooth blade (suitable for cutting metal) or manually using a hack saw
- Do not cut by shearing action (bolt cutters)
- Do not cut with torches
- Do not cut by bending



ACI SPEC 440.5

Ties

- Can be tied using traditional methods
- If corrosion resistance or non-metallic properties are critical, use:
 - Nylon Zip Ties (can be used with cable tie guns)
 - Double Loop PVC-coated, Galvanized, or Stainless-Steel Wire Ties (for use with automatic wire twisters)
 - PVC-coated, Galvanized, or Stainless-Steel Tie Wire
 - Plastic bar clips



ACI SPEC 440.5

Bar Supports

- Chairs are required to maintain bar position
 - Plastic chairs or concrete dobies should be used in non-metallic applications
- Chairs should be spaced tighter than equivalent steel bar supports (2/3 spacing)
- Weights may be needed to prevent bars from floating in fresh concrete



ACI SPEC 440.5

Cover Requirements

- Cover requirements are not substantially different than steel reinforcement

Table 3.2.3.1—Concrete cover requirements for GFRP reinforcement

Concrete exposure	Member	Reinforcement	Specified cover, in.
Cast against and permanently in contact with ground	All	All	3
Exposed to weather	All	No. 6 through No. 10 bars	2
		No. 5 bar and smaller	1-1/2
Not exposed to weather or cast against the ground	Slabs, joists, and walls	All	3/4
	Beams, columns, pedestals, and tension ties	All	1-1/2

ACI SPEC 440.5

Bends



- **Bars cannot be field bent**
- All bends, hooks, and transitions are fabricated by the bar manufacturer
- Bend diameters are larger than steel hooks, minimums in ASTM D7957

TABLE 4 Minimum Inside Bend Diameter of Bent Bars^A

Bar Designation, mm [U.S. Standard]	Minimum Bend Diameter mm [in.]
M6 [2]	38 [1.50]
M10 [3]	58 [2.25]
M13 [4]	76 [3.00]
M16 [5]	96 [3.75]
M19 [6]	114 [4.50]
M22 [7]	134 [5.25]
M25 [8]	152 [6.00]

ACI SPEC 440.5

Bends

Table 25.3.1—Standard hook geometry for development of GFRP bars in tension

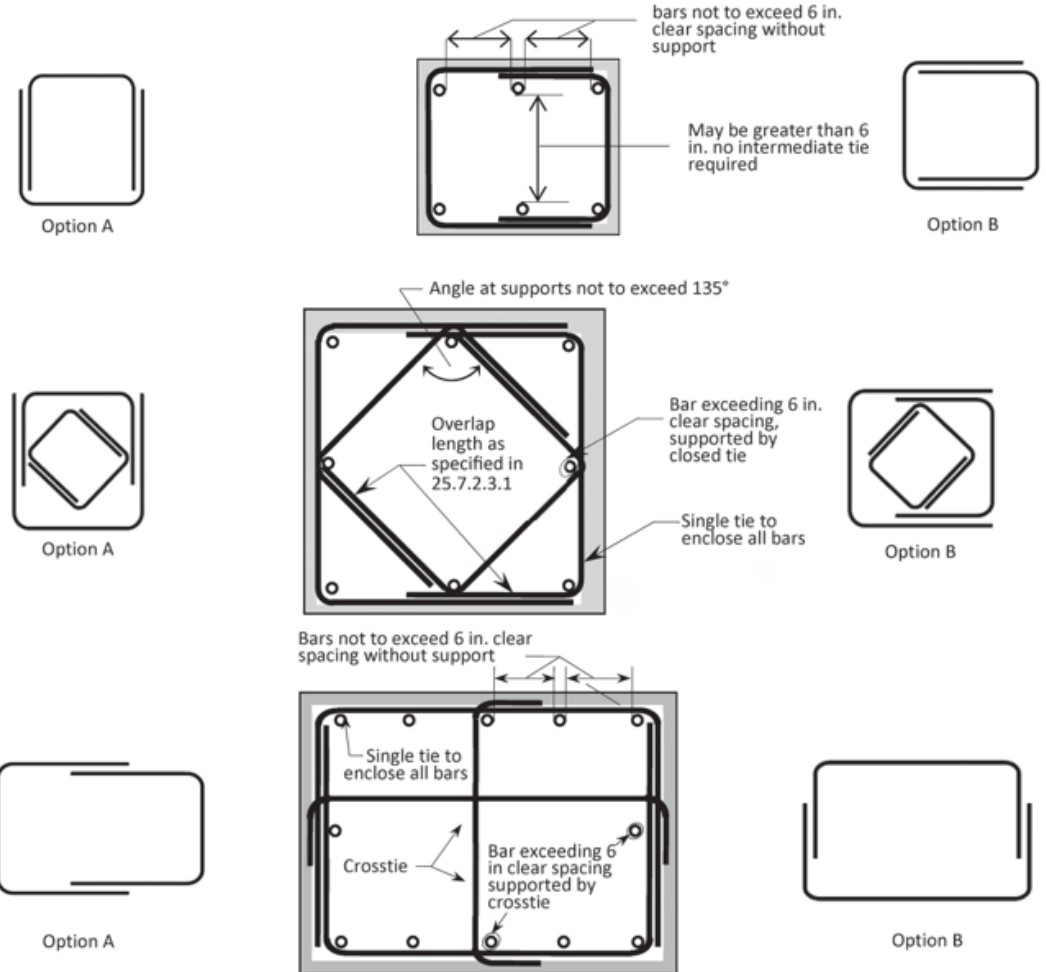
Type of standard hook	GFRP bar size	Minimum inside bend diameter, in.	Straight extension* l_{ext} , in.	Type of standard hook
90-degree hook	No. 2 through No. 8	Refer to ASTM D7957	$12d_b$	

*A standard hook for bars in tension includes the inside bend diameter specified by ASTM D7957 and straight extension length defined in Table 25.3.1. It shall be permitted to use a longer straight extension at the end of a hook. A longer extension shall not be considered to increase the anchorage capacity of the hook.

ACI SPEC 440.5

Bends

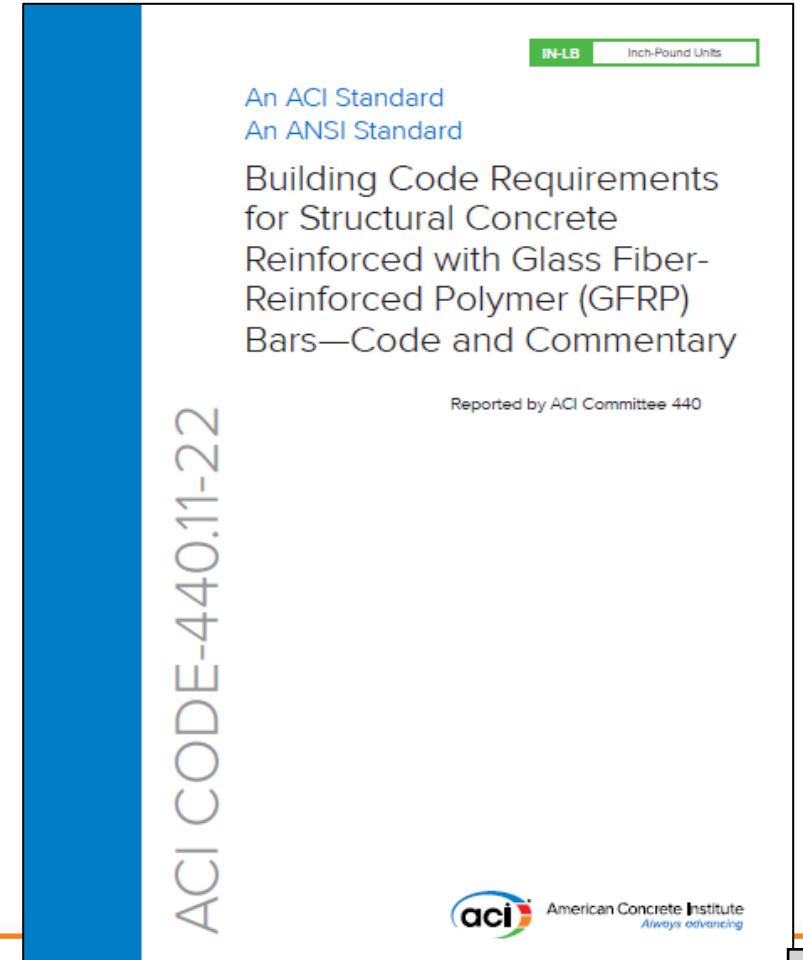
- 135° bends are not common
- Typically overlapping “C” or “U” shaped stirrups/ties are used to create closed loops
- This does vary by bar manufacturer; some offer wider varieties than others



Standards and Guides Code Requirements

The new **ACI CODE 440.11-22** Building Code Requirements for Structural Concrete Reinforced with Glass Fiber-Reinforced Polymer (GFRP) Bars

- Dependent on ACI 318-19
 - Same layout and chapters as 318-19
 - Consistent numbering with 318-19 where possible



The New **ACI CODE 440.11-22** Scope

The code covers:

- Beams
- One-way and two-way slabs
- Columns
- Walls
- Foundations
- Joints/Connections between members
- Strength evaluation of existing structures

The New ACI CODE 440.11-22

Scope

Excluded Chapters either marked

- “NOT ADDRESSED”
 - Not included in this version, but expected to be included in future versions
 - Chapter 12 – Diaphragms (likely next edition)
 - Chapter 17 – Anchoring to Concrete
 - Chapter 18 – Earthquake-Resistant Structures
 - Chapter 23 – Strut-and-Tie Models
- Or “NOT APPLICABLE”
 - Chapter 14 – Plain Concrete

The New **ACI CODE 440.11-22** Scope

Code also does not currently cover

- Lightweight concrete
- Prestressed concrete
- Deep beams
- Shotcrete
- SDC D-F totally excluded
- SDC B-C if part of the lateral load resisting system



The New ACI CODE 440.11-22 Format

Clauses that are identical to ACI 318-19 are marked with a “=” before the start of the clause

=9.2.1.1 Design properties for concrete shall be selected to be in accordance with **Chapter 19**.

The New ACI CODE 440.11-22 Format

- Some chapters and sections marked “Not Applicable”
 - Not included and not deemed applicable to GFRP reinforced concrete

**CHAPTER 14—PLAIN CONCRETE—NOT
APPLICABLE**

Covered by 318

*20.5.2 Nonprestressed coated reinforcement—Not
applicable*

The New ACI CODE 440.11-22 Format

- Some numbered sections marked “out of scope”
 - Not included in this version, but likely to be added in the future

7.7.4 Flexural reinforcement in prestressed slabs—Out of scope

- Some numbered sections marked “intentionally left blank”
 - Numbered section left as a placeholder to keep numbering consistent with 318-19

1.4.4 Intentionally left blank.

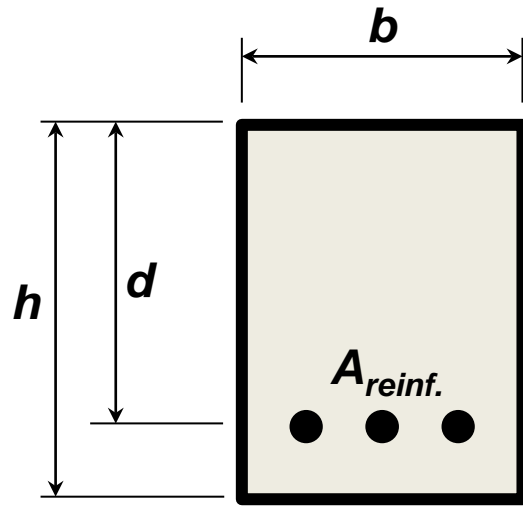
The New ACI CODE 440.11-22

Major Differences in Design

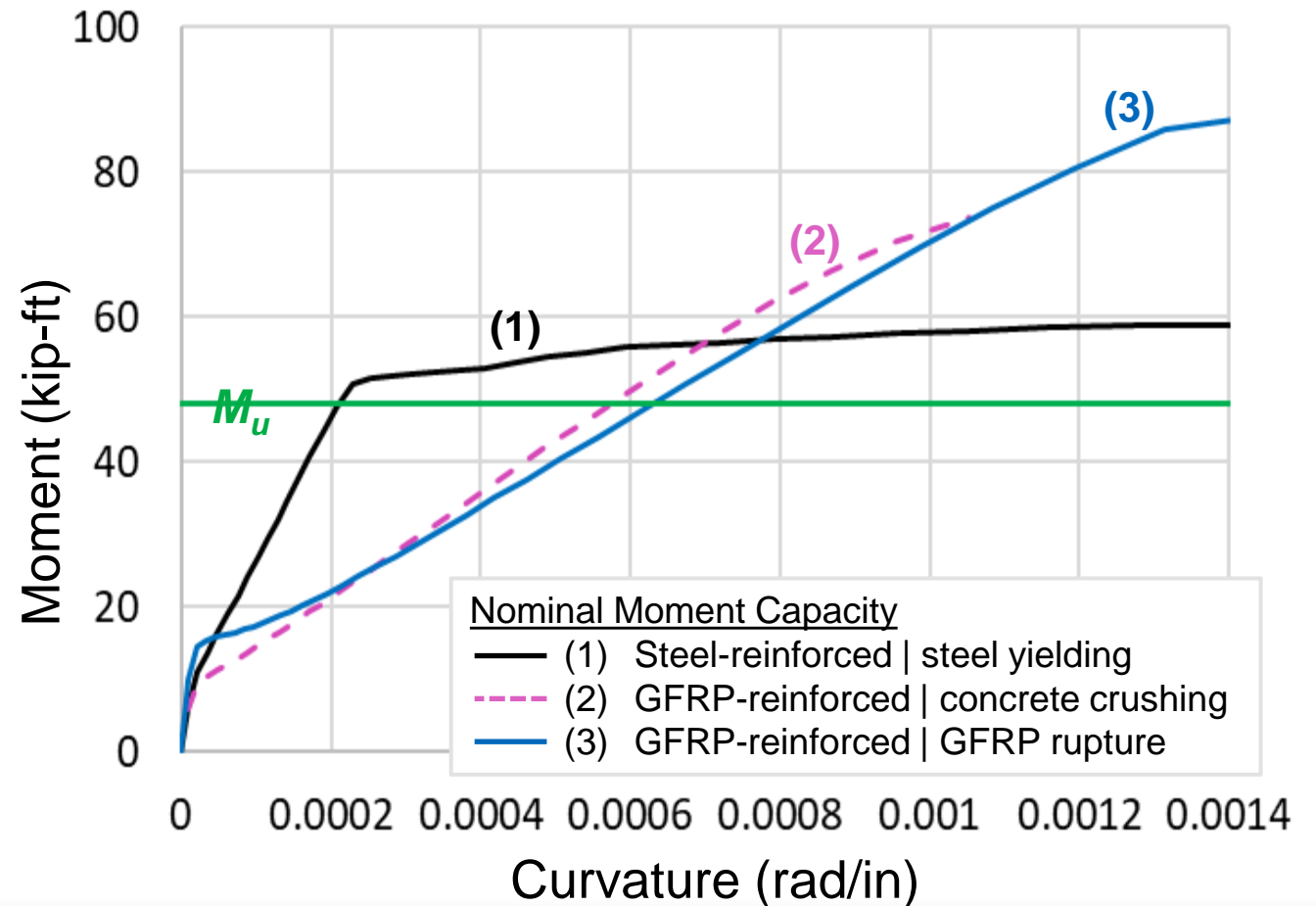
- Serviceability considerations often control design
 - Cracking – Excessive crack width is undesirable for aesthetic and other reasons that can damage or deteriorate the structural concrete
 - Deflection – Deflections should be within acceptable limits imposed by the use of the structure
- Substitution of GFRP for steel on an equal area basis → larger deflections and wider crack widths
 - Not the philosophy of the code

The New ACI CODE 440.11-22

Major Differences in Design

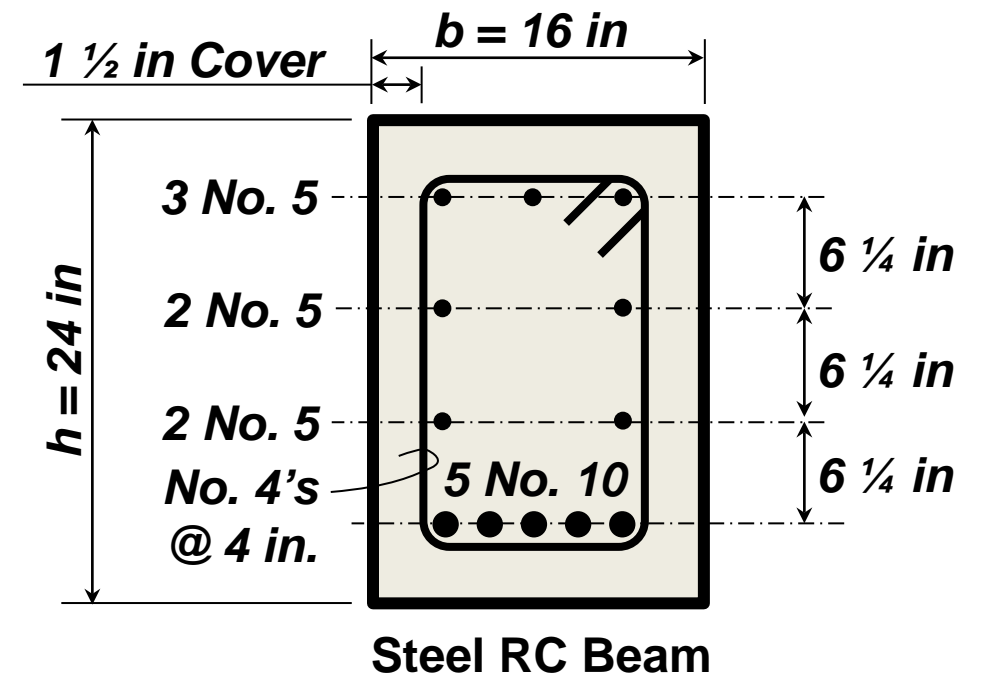
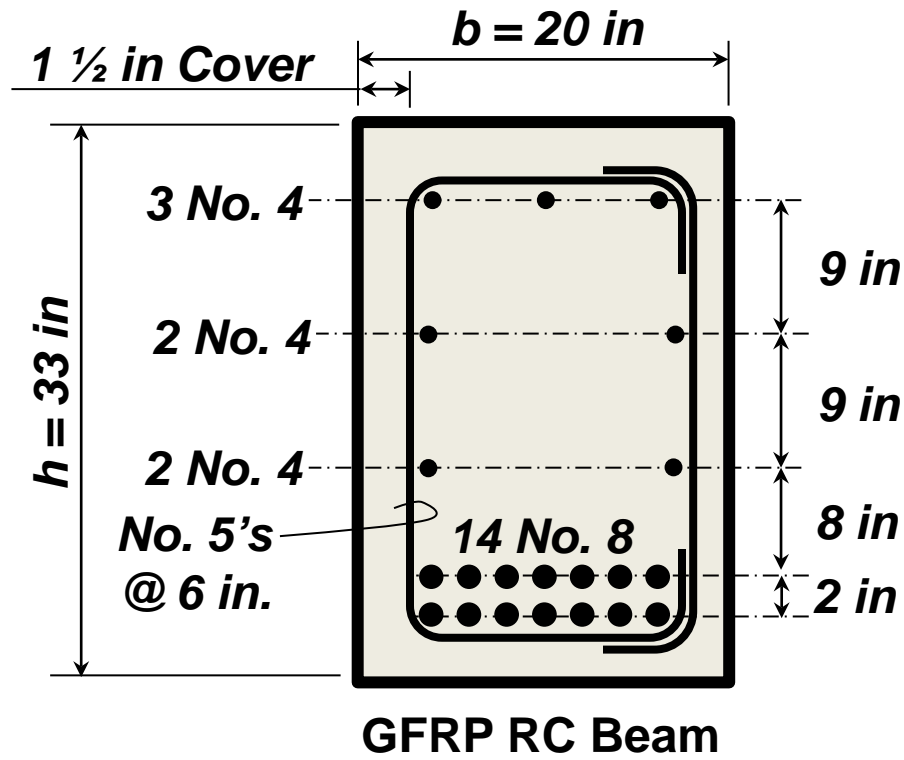


	b (in)	h (in)	d (in)	$A_{reinf.}$ (in ²)
(1)	8	15	12.5	0.93
(2)	8	15	12.5	0.93
(3)	12	16	13.5	0.62



The New ACI CODE 440.11-22

Major Differences in Design

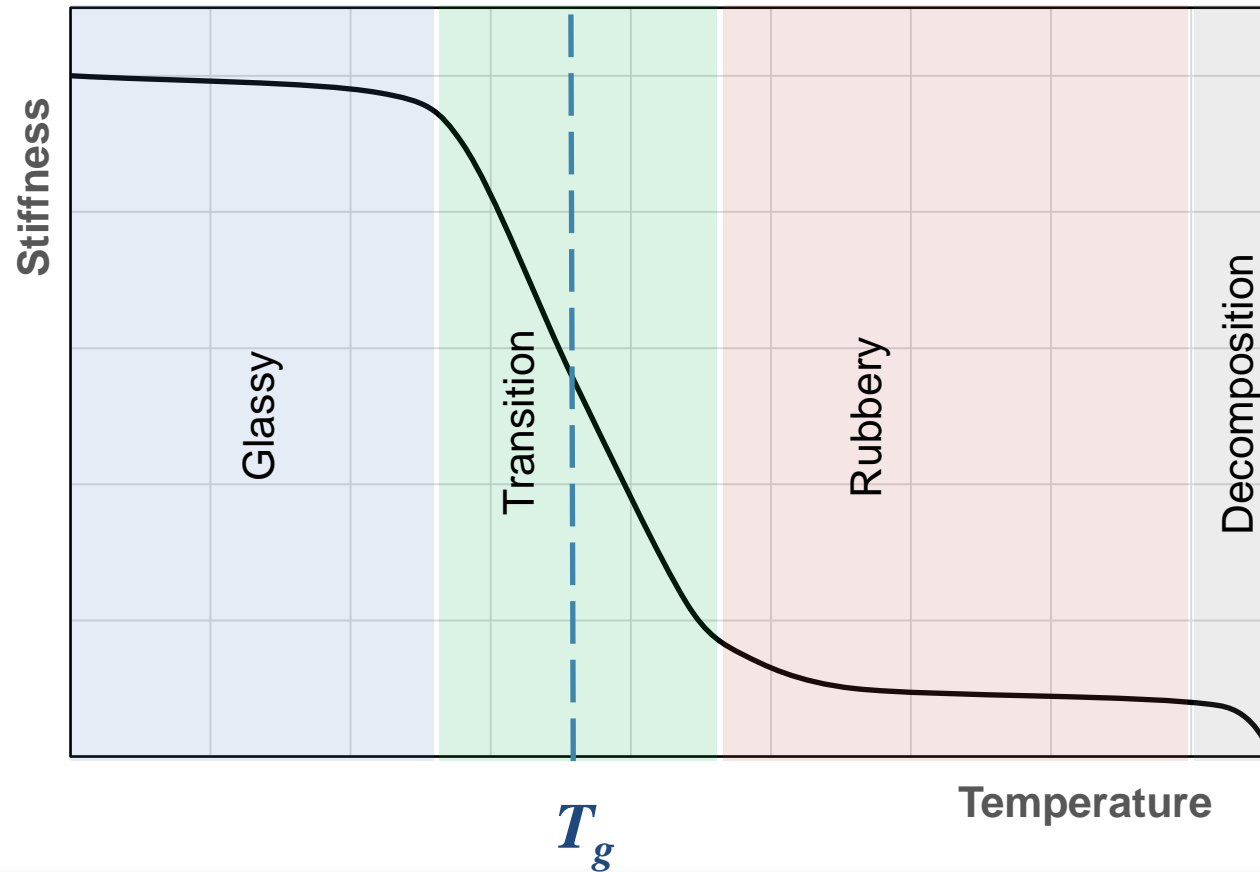


The New ACI CODE 440.11-22

Major Differences in Design

- Design is typically driven by bar stiffness / elastic modulus
 - ASTM D7957 specifies a minimum modulus of 6,500-ksi (does not vary with bar size)
 - Manufactures often exceed this value substantially (8,700-ksi is not uncommon)
 - ACI 440.11 allows ASTM D7957 minimums or manufacturer specific values to be used
 - Thus, the size and spacing of bars may be different for different manufacturers' bars
 - Submittals are critical!

The New ACI CODE 440.11-22 Elevated Temperatures 4.11.3



The New ACI CODE 440.11-22

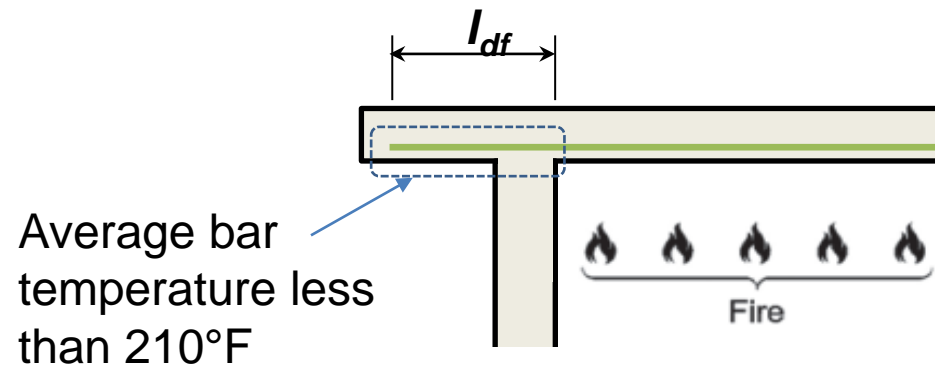
Fire Resistance 4.11.1

- Fire Resistance
 - Structural concrete reinforced with GFRP bars shall not be permitted where fire-resistance ratings are required except where the fire resistance has been shown to be adequate by calculations or tests and approved by the building official.

The New ACI CODE 440.11-22

Fire Resistance R4.11.1

- Commentary to Code on Fire Resistance
 - Fire endurance relies on maintaining bond between the GFRP bars and concrete
 - Specific detailing in the way of “cool anchorage” is needed to reasonably achieve fire ratings
 - Service level stress in the bars should be limited to $0.30f_{fu}$



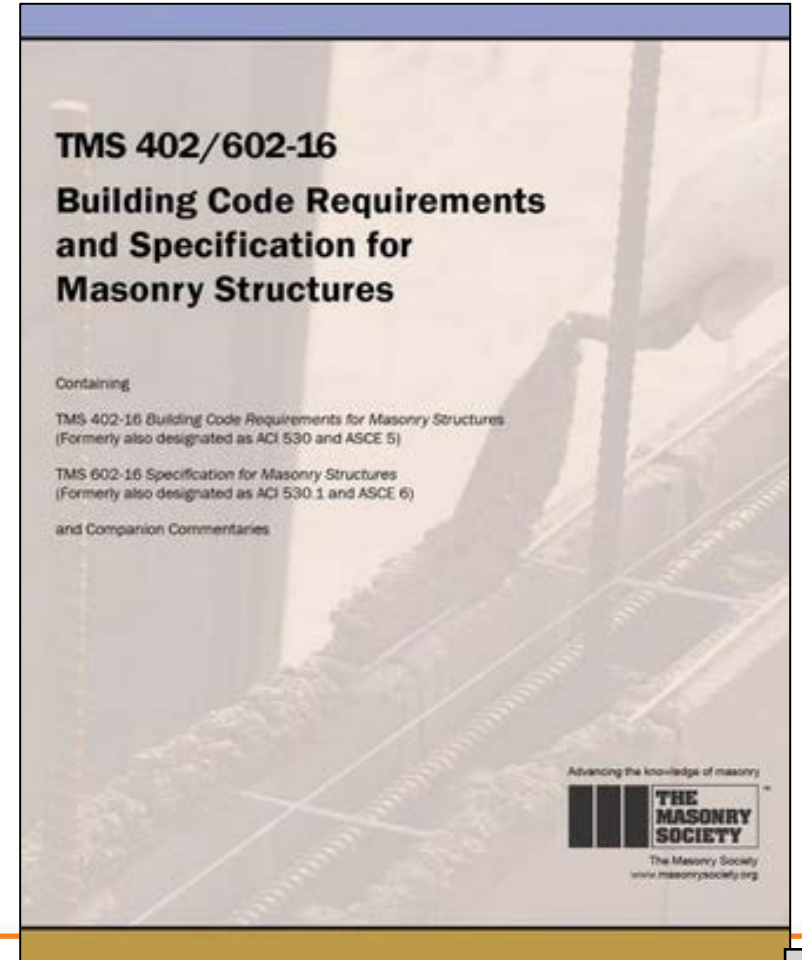
l_{df} is the bond development length corresponding to 1.3 times the maximum bar stress due to full service loads (1.0D + 1.0L)

Standards and Guides

Other Codes

TMS 402 Building Code Requirements for Masonry Structures

- Appendix D on masonry reinforced with GFRP bars

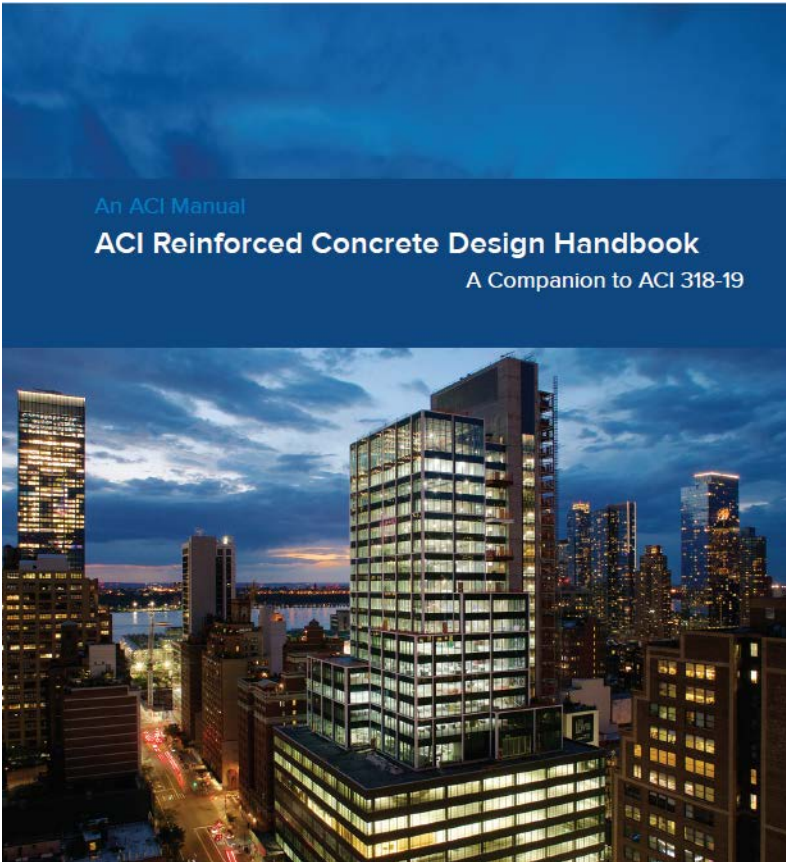


Wrap Up

Upcoming

- Next version of the CODE
 - Expanded Fire Resistance Requirements
 - Validation of commentary approach through ASTM E119 testing
 - Consideration of other elements (columns and walls)
 - Guide for Fire Resistance of GFRP-Reinforced Concrete Structures
 - Diaphragm Chapter
 - Calibration of Shear Friction Models

Wrap Up Upcoming



- Design Handbook to Accompany 440.11
 - T Beam examples
 - Shear and Torsion examples
 - Two-way slab example
 - Column examples
 - Wall example
 - Foundation and retaining wall examples
- Handbook on Pre-Engineered Structures
 - Practical construction aspects
 - Prescriptive tables for foundation walls and slabs-on-ground

**The New ACI CODE 440.11-22
on GFRP Reinforced Concrete:
Implementation for Building Code Officials**

Thank You for Attending!

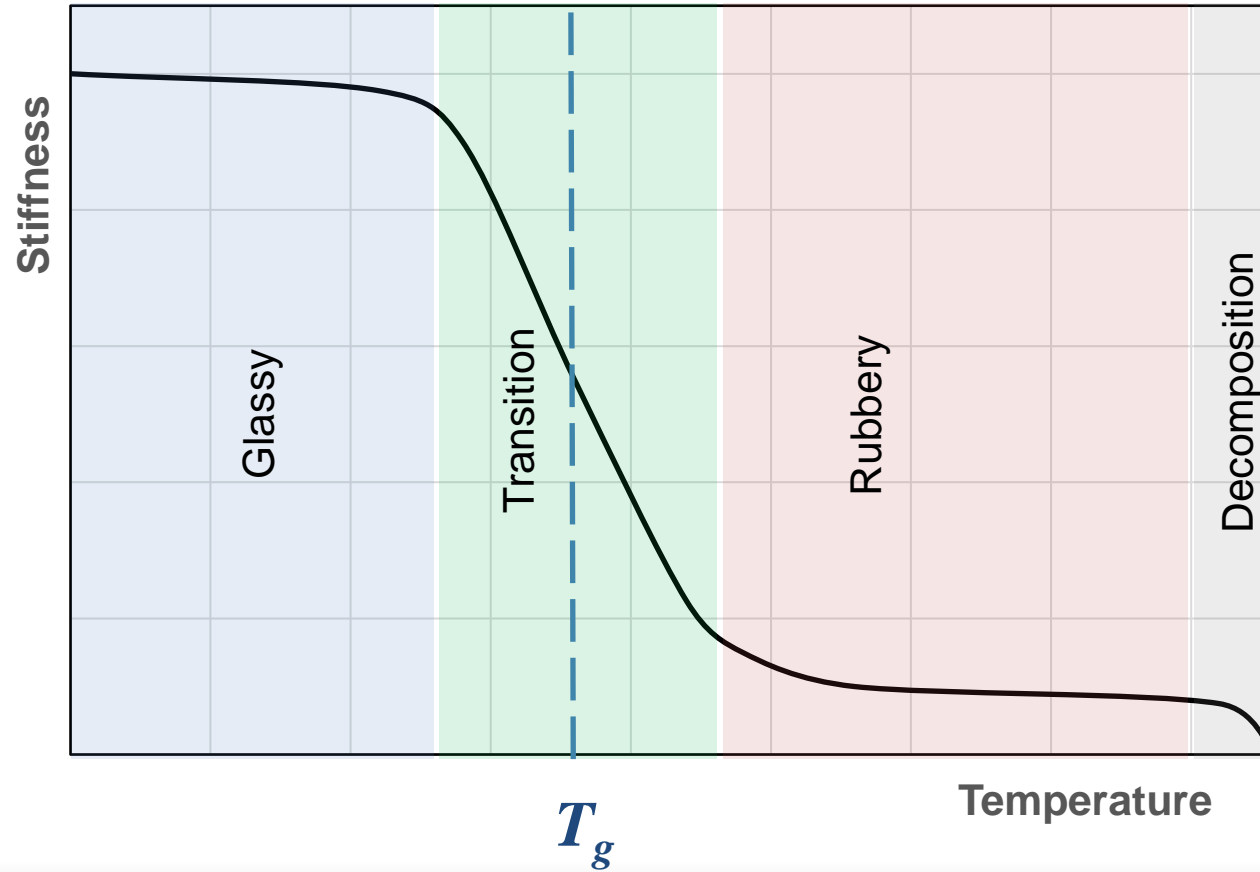
Final Questions?

The New ACI CODE 440.11-22
on GFRP Reinforced Concrete:
Implementation for Building Code Officials

APPENDIX

FRP Materials

Glass Transition Temperature



The New ACI CODE 440.11-22

Elevated Temperatures 4.11.3

- Service Temperature Limitations
 - GFRP bars shall not be used in environments with a service temperature higher than 27°F below the glass transition temperature.

$$T_g - 27^\circ\text{F}$$

- Many commercially available GFRP bars have a glass transition temperature of around 250°F. ASTM D 7957 requires a minimum glass transition temperature of 212°F.

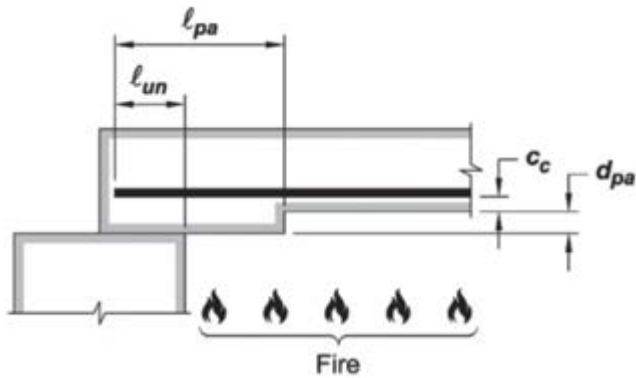
185°F

Maximum service temperature based on
ASTM D 7957 minimum T_g

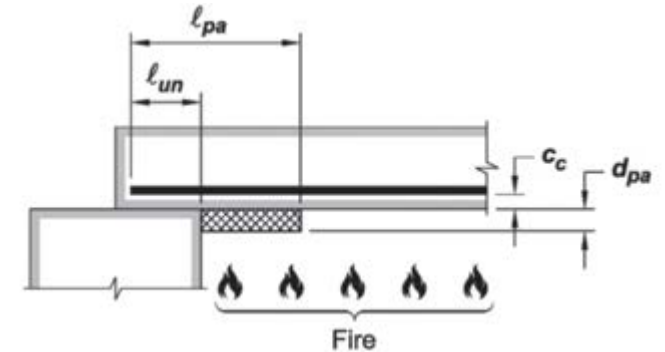
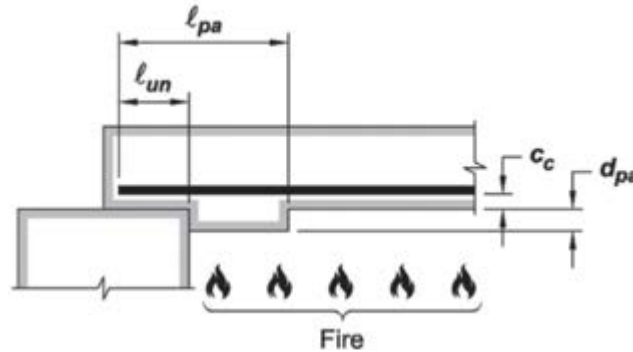
The New ACI CODE 440.11-22

Fire Resistance R4.11.1

- Commentary to Code on Fire Resistance
 - Various potential fire proofing options



Increase concrete cover by using a haunch or drop panel at the anchorage location



Insulate anchorage

The New ACI CODE 440.11-22

Fire Resistance R4.11.1

- Commentary to Code on Fire Resistance
 - Insulation should be at least 2 in. thick and the insulation material should be tested for application on concrete in accordance with ASTM E119 to verify that the insulated concrete surface temperature does not exceed 300°F for the duration of the required fire-resistance rating

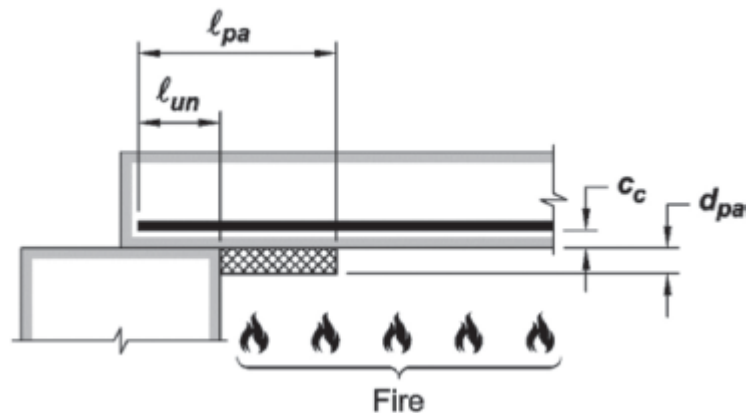


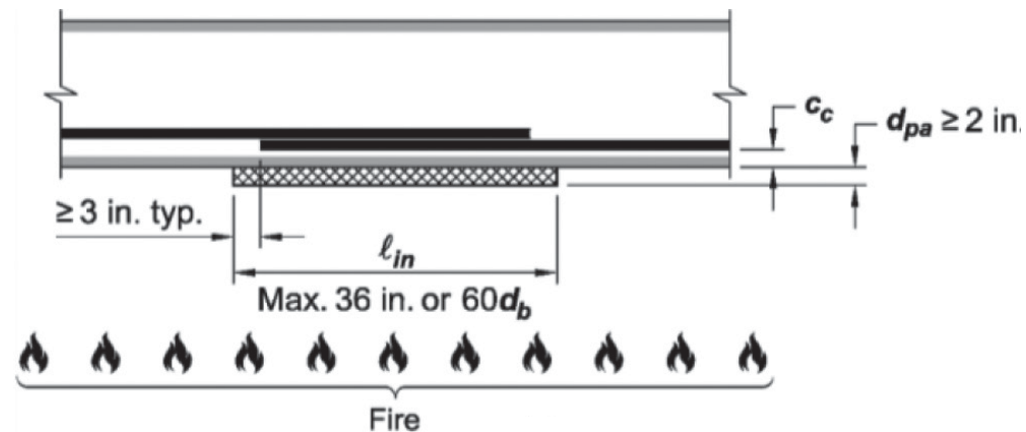
Table R4.11.1—Haunch, drop panel, or insulation for protection of GFRP reinforcement near supports

l_{un} , in.	l_{pa} , in.	d_{pa} , in.
4	Max(22 or $30d_b$)	2
6	Max(20 or $28d_b$)	2
8	Max(16 or $25d_b$)	2
10	Max(14 or $22d_b$)	2
Max(12 or $20d_b$)	—	—

*For 2-hour fire exposer. Assumes clear cover ≥ 1.5 in., $f'_c \geq 4000$ psi, and maximum bar stress due to $1.0D + 1.0L < 35$ ksi.

The New ACI CODE 440.11-22 Fire Resistance R4.11.1

- Commentary to Code on Fire Resistance
 - Splices need protection too!



**APPLICATION FOR CONTINUING EDUCATION APPROVAL
COURSE CONDITIONS AND GUIDELINES**

The Ohio Board of Building Standards is committed to the ongoing education and professional development of board-certified personnel through the delivery of high-quality, accurate and engaging professional continuing education content. To this end, the Board reviews and approves Continuing Education Courses for building department personnel.

Board approval is granted for course instruction on current codes and standards, including the OBC, OMC, OPC, and RCO, and any other content areas directly related to the responsibilities of the certification for which credit is being requested.

Promotion: Any person or organization promoting an approved course is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, categories for which the BBS has approved the class, and fees in promotion materials and advertising. **The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising.** Advertising may not falsely state BBS approval before approval is granted. Course providers may state that BBS approval is pending.

Application Submission: All Applications and associated materials shall be submitted by email in .pdf format. Instructions for completing the application are attached.

Certificate of Completion: Course providers shall provide participants a certificate of completion containing the following information:

- Name of participant
- Title of approved courses
- BBS approval #
- BBS approved certifications
- Date of the continuing education program
- Number of approved credit hours awarded, and
- Signature of authorized sponsor or instructor.

Any person or organization administering an approved course shall return a completed BBS Course Attendance form by email.

Participants: Participants must attend the complete course as presented by the instructor to receive credit hours approved by the Board. The organization or instructor of online courses shall plan and execute methods to verify the individual's attendance and completion of the course. No partial credit will be given to any participant who failed to complete the entire course as approved.

Board approval: All courses are approved for the calendar year in which application is made. Courses may be renewed so long as the referenced code is in effect, and the CEUs, certification and content remain unchanged. When the referenced code is updated, courses must be updated, and new approvals obtained.

Facility/training area: BBS Course may be delivered in person or online, or both, at the sponsor's option. Course facilities shall include the following:

In Person Classes:

- Sufficient seating capacity
- ADA accessible facilities
- Appropriate Audio/Visual devices for delivery
- Writing surfaces for participants

Online Classes:

- Web-accessible
- ADA accessible delivery
- Tech support available
- Live and recorded courses permitted

In-person facilities shall comfortably and safely seat at least the number of attendees present in the room and shall be climate controlled, non-smoking, and sound controlled so that outside noise will not interfere with the training.



Application for Continuing Education Course Approval

Provider Information:

Name: Kerry Sutton, PE LEED AP
Organization: American Concrete Institute
Address: 38800 Country Club Drive, Farmington Hills, MI 48331
E-mail: Kerry.Sutton@concrete.org Telephone: 734-673-2195
Website: https://www.concrete.org/
Conference Sponsor (if applicable) _____ Conference Email: _____

Check here if Course Renewal: _____ Prior course number _____ (i.e. BBS2018-429)
*Renewals will only be granted for identical content and certifications, within the current code cycle.
Attach a copy of prior course approval letter for confirmation. No further information is required.*

New Course Information:

Course title: The New ACI Code 440.11 on GFRP Reinforced Concrete: Implementation for Building Code Officials
Course instructor: Will Gold, PE and Jay Pease, PE
Course description: This presentation provides an overview of the new ACI Code 440.11-22 Building Code Requirements for Structure Concrete Reinforced with Glass Fiber Reinforced Polymer (GFRP) Bars. The Code provides minimum requirements for the materials, design, and detailing of structural concrete buildings and, where applicable non building structures reinforced with GFRP bars that conform to the requirements of ASTM D7957-22. The presentation will cover basic design requirements for construction documentation, field testing and inspection related to structures utilizing GFRP bars. Case studies will be provided.
Instructional hours per session: 1 hr Number of Sessions: TBD
Course Date(s) and Location: TBD

Special Content:

Code Administration: Conference Course: _____
Existing Buildings: Conference Name: _____
Electrical Instruction: Conference location: _____
Plumbing Instruction:

Course to be offered online? On Demand Webinar

Course Website: _____

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation): _____

Course applicable for the following certifications

Residential Certifications Only: Commercial Certifications:
Administrative Course, All Certifications:

Application materials included:

- Course Outline or Course Learning Objectives
- Presentation Materials/Slides (not required for roundtable courses)
- Assessment Materials (for online courses)
- Presenter Bio

Please submit application and materials in .pdf format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least on commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review. Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content. Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.

Course applicable for the following certifications

This section represents a major change from previous BBS course approval forms.

1. If the course is only for residential certifications, check 'Residential Certifications Only'. The course, if approved, will be approved for all residential certifications.
2. If the course is appropriate for any commercial certifications, check Commercial Certifications. The course, if approved, will be approved for all commercial certification **AND** all residential certifications.
3. If the course is intended to meet required instruction in Code Administration (Chapter 1) or Existing Buildings (commercial or residential) check 'Administrative Course, All Certifications'.

Application Materials Included

This is a checklist for the course submitter's use, to be sure all materials necessary for review are included with the application. All materials should be submitted in .pdf format, along with the application, via email to Michael.Lane@com.ohio.gov or BBS@com.ohio.gov

File Attachments for Item:

ER-4 Residential Building Inspector (2021 IRC) (West Coast)

Residential certifications (11 hours)

Staff Notes: Not yet code in Ohio, but likely to be in the next Code update. Recommend approval.

Committee Recommendation:

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *

Brittany Allen

Organization

West Coast Code Consultant

Email *

brittanya@wc-3.com

Phone Number *

(385) 237-3722

Address *

9131 S Monroe St Unit A

City *

Sandy

State *

Utah

Zip Code *

84070

Website

https://www.pathlms.com/w

Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e.

BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

2021 Residential Building Inspector

Course instructor

George Williams and Chris Kimball

Course description

Course Description: This 8-module course, followed by a two-hour practice examination, is based on Chapters 1 through 10 of the 2021 International Residential Code (IRC). It teaches the practical application of the IRC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 33 to 61 min. in length.

Course Objectives: This course is designed to prepare you for the International Code Council's (ICC) Residential Building Inspector exam (B1), utilizing the 2021 IRC. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Instructional hours per session

11

Number of Sessions

Course Date

Course Location

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction
- Plumbing Instruction

Conference Course

Conference Name

Conference location

On Demand

Webinar

Course to be offered online?

Yes

No

Course Website

<https://www.pathlms.com/wc3-academy/courses/47>

Detail online course participation confirmation method (i.e. test, quizzes, participant activity confirmation):

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. You can progress through this course at your own pace; however, you only have access for 120 days.

Course applicable for the following certifications *

Residential Certifications Only

Administrative Course, All Certifications

Commercial and Residential Certifications

Application materials included *

Course Outline or Course Learning Objectives

Presentation Materials/Slides (not required for roundtable courses)

Assessment Materials (for online courses)

Presenter Bio

Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
2021 Residential Building Submittal Documents.pdf	12.81 MB

Applicant Full Name *

Brittany Allen

Date of Submission

06/06/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



2021 Residential Building Inspector

Course Outline

Cost: \$207, allowing for 120 days of access.

Course Description: This **8-module course**, followed by a two-hour practice examination, is based on Chapters 1 through 10 of the *2021 International Residential Code (IRC)*. It teaches the practical application of the IRC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 33 to 61 min. in length.

Course Objectives: This course is designed to prepare you for the *International Code Council's (ICC)* Residential Building Inspector exam (B1), utilizing the *2021 IRC*. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Texts and Readings: The *2021 International Residential* is the textbook for this course. It is highly recommended that you purchase a paper-back copy of these codes, which are available online at www.iccsafe.org. A physical copy can be utilized during the actual exams, which are open book, and serves as a valuable reference for in the field inspections.

Course Outline of Topics:

Module:	Topics:	Readings:	Quiz:	Duration:
1	Scope & Administration	IRC Chapter 1	Y	43 min.
2	Building Planning Part I	IRC Chapter 3	Y	34 min.
3	Building Planning Part II	IRC Chapter 3	Y	49 min.
4	Building Planning Part III	IRC Chapter 3	Y	33 min.
5	Building Planning Part IV & Foundations	IRC Chapters 3 & 4	Y	48 min.
6	Foundations & Floors/Decks	IRC Chapters 4 & 5	Y	61 min.
7	Wall Construction & Coverings	IRC Chapter 6 & 7	Y	41 min.
8	Roof/Ceiling Construction; Roof Assemblies; Chimneys & Fireplaces	IRC Chapters 8, 9 & 10	Y	39 min.
	8 Quizzes 104 Questions, 2 min. each	2021 IRC		208 min.
	Practice Exam	2021 IRC		120 min.
	Total Course Hours			11 hours

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this



2021 Residential Building Inspector

course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. Marking, tabbing, and highlighting in the code book is highly recommended. We have laid out a plan and method to help you learn the material, but it's up to you to put in the work necessary for you to master the material. You can progress through this course at your own pace; however, you only have access for 120 days.

Continuing Education Credits: Completion of this course results in **1.10 CEUs** (11 hours) being provided by ICC, as West Coast Code Consultants is a Preferred Provider.

Instructor:



George Williams, MCP, CBO is the Director of WC3 Academy, but primarily identifies as a commercial plans examiner and building inspector. He has been a building inspector since 2005, has a masters degree in construction management, and has been ICC Master Code Professional since 2009. George has been instrumental in the start-up of multiple building departments including the adoption of codes, implementation of permit processes, development of policies and procedures, as well as the hiring and training of staff.



Chris Kimball, PE, SE, CBO is one of WC3's Vice Presidents. He is a licensed structural engineer, ICC Master Code Professional, Certified Building Official, fire code official, combination plans examiner, and combination building inspector. He has performed plan reviews for thousands of projects throughout the western states. In addition, Chris has provided numerous training classes to help design professionals, building officials, and contractors alike to understand the requirements of the adopted building codes. Chris regularly teaches for ICC and has been involved in assisting ICC with various publications.



2021 Residential Building Inspector

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1

2021 Exam Breakdowns

Residential Building Inspector Exam (BI)	
Code Administration	4%
Building Planning/Site Plan	8%
Footings & Foundations	16%
Floor Construction	14%
Wall Construction & Coverings	27%
Roof/Ceiling Construction	14%
Public Safety & Special Construction	17%

Two hour exam with 60 questions.
Approximately 2 minutes per question.

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2

Module I

IRC Chapter I: Scope and Administration

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3

3

IRC Chapter I

4% Scope & Administration

INTERNATIONAL RESIDENTIAL CODE®
For One- and Two-Family Dwellings

2021

International Code Council 2021 IRC ©




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4

4

LEARNING OBJECTIVES




1. Understand what type of structures can be built under the International Residential Code.
2. Understanding what type of work does not require a building permit.
3. Become familiar with residential building code administration.
4. Know where to find defined terms.

5

Preparation

- Focus on the building chapters but be prepared for questions from other chapters.
- Personal study: **2-hrs.** for every **1-hr.** of class time
- Highlight important sections
- Write key numbers in large print
- Tab your book




6

Examples

501.4 Intake opening location. Air intake openings shall comply with all of the following:

1. Intake openings shall be located not less than 10 feet (3048 mm) from lot lines or buildings on the same lot.
2. Mechanical and gravity ~~vents~~ **air** intake openings shall be located not less than 10 feet (3048 mm) horizontally from any hazardous or noxious combustion source, such as vents, streets, alleys, parking lots and loading docks, except as specified in Item 3 or Section 501.3.1. Outdoor air **intake** openings shall be permitted to be located less than 10 feet (3048 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such location. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.
3. Intake openings shall be located not less than 3 feet (914 mm) below contaminat sources where such sources are located within 10 feet (3048 mm) of the opening.




10

7

Key Items

- Marginal Markings
 - Solid vertical lines- New or modified
 - [➡] Entire section, paragraph, exception is deleted
 - [*] indicates text/table has been relocated elsewhere
 - [**] indicates text/table has been relocated there
- Italicized Terms (Definitions)

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Should be tabbed, highlighted and marked.

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Should be tabbed, highlighted and marked.

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To attic	R807	AIR LEAKAGE	N1102.4, N1103.3.5, N1103.3.6
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To plumbing fixtures	P2705	ALTERATIONS	
To whirlpool pumps	P2705.1	Defined	N1101.6
ACCESS HATCHES	N1102.6.4	Requirements	N1111
ACCESSIBILITY	R302		E3501

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Concepts

What items are covered in the IRC?

- Building Planning
- Structural integrity, life safety, fire safety, and livability for dwelling units
- Townhouses
- Live/work units
- Dwelling Unit Fire Sprinkler Systems
- Means of Egress
- Energy Efficiency
- Structural Design
- Mechanical
- Plumbing
- Electrical

11



Scoping

- Prescriptive method
 - i.e., "Cookbook"
- Limited to 1 & 2 Family Dwellings and Townhouses
- Several limitations, especially in high-seismic or high-wind regions

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Parts of the IRC

- 1) Part I – Administrative
- 2) Part II – Definitions
- 3) Part III – Building Planning & Construction
- 4) Part IV – Energy Conservation
- 5) Part V – Mechanical
- 6) Part VI – Fuel Gas
- 7) Part VII – Plumbing
- 8) Part VIII – Electrical
- 9) Part IX – Referenced Standards



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13



Part I

Scope & Administration


14

14



Scope

IRC R101.2

- “Applies to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, removal and demolition of...”
 - Single-Family Dwellings
 - Two-Family Dwellings
 - Townhouses
 - Accessory Structures



Limited to 3-stories above grade.

15



15

Scope

IRC R101.2

- Exceptions for sprinkled buildings*
 - Live/work units in townhomes (Per IBC 508.5)
 - Owner-occupied lodging (≤ 5 guestrooms)
 - Care facility (≤ 5 receiving custodial care within a dwelling unit)
 - Care facility (≤ 5 receiving medical care within a dwelling unit)
 - Care facility (≤ 5 guests within an SFD)

**Can be built using the prescriptive IRC requirements as opposed to the IBC*



16

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Additions, Alterations or Repairs

IRC R102.7.1

- The code references the International Existing Building Code (IEBC) only when alterations are part of a change to a use or occupancy outside the scope of the IRC.
- "Where the alteration causes the use or occupancy to be changed to one not within the scope of this code, the provisions of the International Existing Building Code shall apply."

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References

IRC R102.4

Shall be considered part of this code





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Appendices

IRC R102.5

- "...shall not apply unless specifically referenced in the adopted ordinance."
- Appendix AA – Appendix AW
- + Resource A

APPENDIX AA SIZING AND CAPACITIES OF GAS PIPING..... AA-1	
Section	
AA101 General Piping Considerations.....	AA-1
AA102 Description of Tables.....	AA-1
AA103 Use of Capacity Tables.....	AA-4
AA104 Use of Sizing Equations.....	AA-6
AA105 Pipe and Tube Diameters.....	AA-7
AA106 Examples of Piping System Design and Sizing.....	AA-7

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Existing

IRC R102.7.1

Additions, alterations, or repairs...shall not cause an existing structure to become unsafe or adversely affect the performance of the building.

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Duties & Powers

IRC R104

Can interpret the code but must restrict all decisions to the *intent* and purpose of code and *may not waive* any code requirements.

City of (Jurisdiction)
Department of Building Safety

Name of individual Photo

Job function

The individual identified on the badge is a duly authorized employee of (the Jurisdiction) and is a designated representative of the Department of Building Safety.

Valid through _____ Date Building Official _____

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Records

IRC R104.7

- Applications
- Permits issued
- Certificates issued
- Fees collected
- Inspection reports
- Notices & orders

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How long should these records be retained?

22

Alternatives

IRC R104.11

- “...not specifically prescribed by this code”
 - Materials
 - Design
 - Methods of Construction
 - Equipment

By the code

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Not by the code

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Alternatives

IRC R104.11




- “...the Building Official shall have the authority to require tests as evidence of compliance...”
- “Tests shall be performed by an approved agency.”

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Work Exempt from Permit

IRC R105.2

- 1-story detached accessory structures ≤ 200ft²
 - Storage sheds, playhouses & similar uses
- Fences ≤ 7-feet high
- Retaining walls ≤ 4-feet
 - From bottom of footing to top of wall
 - Unless supporting a surcharge
- Water tanks ≤ 5,000 gallons
 - Must be supported on grade, and...
The ratio of height to diameter must be ≤ 2:1




25

25

Work Exempt from Permit

IRC R105.2

- Sidewalks & driveways
- Painting, papering, tiling, carpeting, cabinets, counter tops and similar finish work.
- Prefabricated swimming pools ≤ 24" deep
- Swings & other playground equipment
- Window awnings w/ projections ≤ 54"
- Decks ≤ 200ft², ≤ 30" from grade, detached from dwelling, does not serve "required" exit door
- Miscellaneous Electrical, Gas, Mechanical items




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Exemptions

IRC R105.2

All work should still be performed in accordance with the code and any other laws and ordinances of the jurisdiction.




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Emergency


IRC R105.2.1

"Where equipment replacement or repairs must be performed in an emergency situation, the permit application shall be submitted within the **next working business day** to the B.O."

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Time Limitations

Permit Application (R105.3.2)

- 180 days after date of filing
- Unless application has been pursued in "good faith"
- B.O. can grant one or more extensions of 180 days

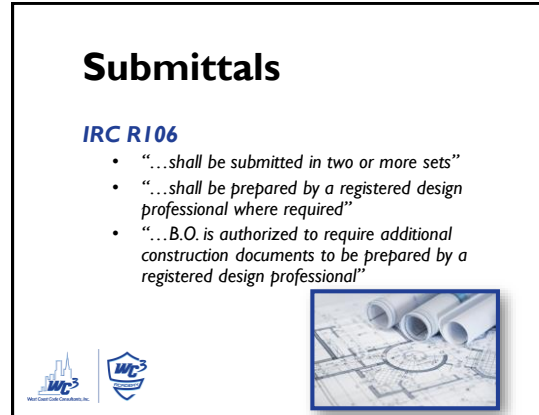
Building Permit (R105.5)

- Work must commence within 180 days of issuance
- Suspended or abandoned for a period of 180 days
- B.O. can grant one or more extensions of 180 days



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Submittals

IRC R106

- "...shall be submitted in two or more sets"
- "...shall be prepared by a registered design professional where required"
- "...B.O. is authorized to require additional construction documents to be prepared by a registered design professional"



30

30

Submittals


IRC R106

- "...shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code"
- Manufacturer's installation instructions
- Flood hazard information
- Site plan "...showing the size and location of new construction and existing structures on the site and distances from the lot lines."

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Temporary

IRC R107

- **Temporary Structures & Uses**
 - "...shall not be permitted for more than 180 days."
 - B.O. is authorized to grant extensions.

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Fees

IRC R108

- Work Commencing Prior to Permit
 - "...shall be subject to a fee established by the applicable governing authority... in addition to the required permit fees."




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Inspections



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IRC R109

- Most critical activity in code enforcement!
- Foundation
- Plumbing, mechanical, gas & electrical systems
- Floodplain
- Frame & masonry
- Fire-resistance-rated
- Others as required by B.O.
- Final



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Certificate of Occupancy (C.O.)

IRC R110

"No building or structure shall be used or occupied... until the B.O. has issued a certificate of occupancy."



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35

C.O.

IRC R110

- "...shall contain the following:"
 - Building permit number
 - Address of structure
 - Name & address of owner
 - Description of area for which it is issued
 - Statement that it has been inspected per the code.
 - Name of B.O.
 - Code edition
 - Automatic sprinkler system?
 - Any special stipulations





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36

C.O.

IRC R110
"Issuance of a certificate of occupancy shall not be construed as an approval of a violation..."






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Service Utilities

IRC R111
"...shall not make connections from a utility...to any building or system...for which a permit is required, until approved by the building official."



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Appeals

IRC R112



- The purpose of the Board of Appeals is to hear and decide appeals of orders, decisions or determinations made by the B.O.
- B.O. is ex-officio member but has no vote.
- The board has no authority to waive requirements of the code.
- Shall consist of members who are qualified by experience and training in matters pertaining to building construction but are not employees of the jurisdiction.

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Violations

IRC R113
"Unlawful to erect, construct, alter, extend, repair, move, remove, demolish or occupy any building, structure or equipment regulated by this code...in violation of any of the provisions..."





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Stop Work

IRC R114

- The building official is authorized to issue a stop work order when work being performed is:
 - Contrary to the code
 - Dangerous
 - Unsafe



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41



END OF MODULE I





42

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Module 2

**IRC Chapter 3:
Building Planning Part I**




1



IRC Chapter 3



8% Building Planning



2

LEARNING OBJECTIVES

1. Gain an understanding of seismic design considerations.
2. Know the different types of loads and how they affect a building.
3. Become familiar with wind exposure classifications.
4. Recognize irregularities in buildings.

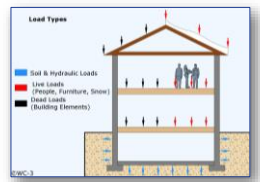





3

Gravity Load Path

What loads need to be considered?

- Dead loads
- Live loads
- Snow loads
- Soil loads
- Hydrostatic loads
- Rain loads
- Flood loads

4

Gravity Load Path

1. Concentrated Loads
2. Uniform Loads

Load Terminology

Concentrated Loads

Uniform Loads

©WC-3

5

Gravity Load Path

Gravity load paths are pretty easy to follow.

- What are some common problems?

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6

Lateral Load Path

Not as easily understood

- What loads need to be considered?
 - Wind
 - Seismic

7

Lateral Load Path

Wind:

- Wind acts against the sides of a building like the sail on a boat
- Most forces are transferred up into the roof/floor, while the rest into the foundation.

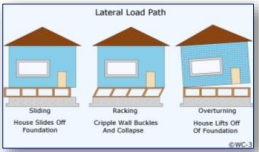
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8

Lateral Load Path

Seismic:

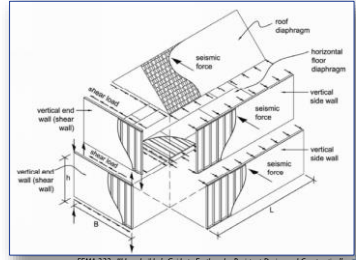
- Ground shaking causes the structure's mass to be accelerated back and forth.
- Forces are developed where the structures mass is the largest.



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Lateral Load Path

Lateral-Resisting-Elements:



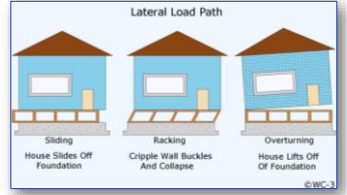
FEMA 232: "Homebuilder's Guide to Earthquake Resistant Design and Construction"



10

Lateral Load Path

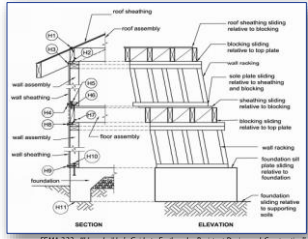
Foundations must resist sliding and overturning.



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Lateral Load Path

Sliding Load Path



FEMA 232: "Homebuilder's Guide to Earthquake Resistant Design and Construction"



12

Lateral Load Path

Overturning Load Path

FEMA 232: Homebuilder's Guide to Earthquake Resistant Design and Construction

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Lateral Load Path

How important are the connections?

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Lateral Load Path

- The building must be designed to withstand lateral forces in each direction.
- What controls in one direction may not control in the other.

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Application

IRC R301.1

- Buildings and structures shall be constructed to safely support:
 - All loads
 - Dead loads
 - Live loads
 - Roof loads
 - Flood loads
 - Snow loads
 - Wind loads
 - Seismic loads

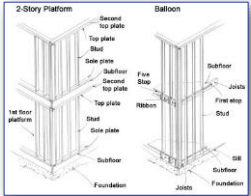
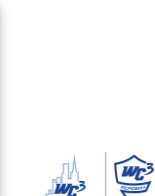
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Framing

IRC R301.1.2

IRC provisions "...are based on platform and balloon-frame construction"







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Engineering

IRC R301.1.3

"Where a building of otherwise conventional construction contains structural elements exceeding the limits of Section R301 or this Code, these elements shall be designed in accordance with accepted engineering practice"



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Intermodal Shipping Containers

R301.1.4

Intermodal shipping containers that are repurposed for use as buildings or structures, shall be designed in accordance with the structural provisions in Section 3115 of the International Building Code.








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IRC Table R301.2(1)

Table IRC R301.2(1)

"Additional criteria shall be established by the local jurisdiction and set forth in Table R301.2(1)"

Minimum Wind Speed	Special Inspection	Special Inspections	CLIMATIC AND GEOTECHNICAL DESIGN CRITERIA				FLOOD RESISTANCE	AIR PURIFICATION	MECHANICAL
			SEISMIC DESIGN CATEGORY	SEISMIC DESIGN CATEGORY	SEISMIC DESIGN CATEGORY	SEISMIC DESIGN CATEGORY			
15	None	None	None	None	None	None	None	None	None
20	None	None	None	None	None	None	None	None	None
25	None	None	None	None	None	None	None	None	None
30	None	None	None	None	None	None	None	None	None
35	None	None	None	None	None	None	None	None	None
40	None	None	None	None	None	None	None	None	None
45	None	None	None	None	None	None	None	None	None
50	None	None	None	None	None	None	None	None	None
55	None	None	None	None	None	None	None	None	None
60	None	None	None	None	None	None	None	None	None
65	None	None	None	None	None	None	None	None	None
70	None	None	None	None	None	None	None	None	None
75	None	None	None	None	None	None	None	None	None
80	None	None	None	None	None	None	None	None	None
85	None	None	None	None	None	None	None	None	None
90	None	None	None	None	None	None	None	None	None
95	None	None	None	None	None	None	None	None	None
100	None	None	None	None	None	None	None	None	None






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Wind

IRC R301.2.1.1

IRC does not apply to the design of building where the ultimate design wind speed is greater than or equal to 140 mph in a special wind region.

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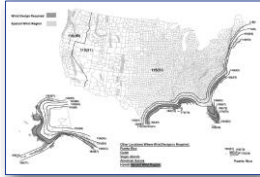

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Wind Exposure

IRC R301.2.1.4

If someone were to call and ask, what wind exposure would you specify for your jurisdiction?

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Wind Exposure

IRC R301.2.1.4

- **Exposure A:** Large city centers with 50% of buildings ≥ 70-feet
- **Exposure B:** Urban & suburban areas with closely spaced obstructions having the size of single-family dwellings

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Wind Exposure

IRC R301.2.1.4

- **Exposure C:** Open terrain with scattered obstructions typically < 30-feet in height.
- **Exposure D:** Flat, unobstructed areas exposed to wind flowing over open water for a distance of at least 1 mile.

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Wind Design Components

IRC R301.2.1

Wall & roof coverings, exterior windows, skylights, garage doors, exterior doors...

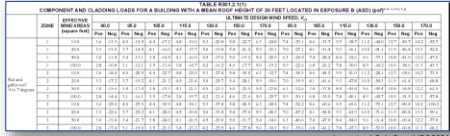
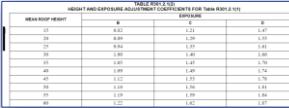


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Wind Design Components

Table R301.2.1(1):

Table R301.2.1(2):



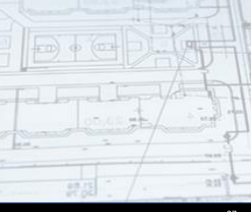


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Seismic Design

IRC R301.2.2

- Two methods of determining S.D.C.
 - Figure R301.2(2) & Table R301.2.2.1.1, or
 - IBC Methodology


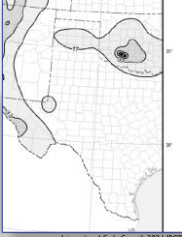


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Seismic Design

IRC R301.2.2

- New Seismic Maps - R301.2.2.1.1
- Verify the site-specific ground motions...
 - <https://seismicmaps.org/>

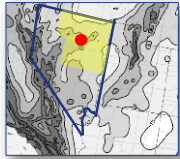





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Seismic Design

IRC Figure R301.2.2.1.1(5):



CALCULATED S_{ap}	SEISMIC DESIGN CATEGORY
$S_{ap} \leq 0.17g$	A
$0.17g < S_{ap} \leq 0.33g$	B
$0.33g < S_{ap} \leq 0.50g$	C
$0.50g < S_{ap} \leq 0.67g$	D ₁
$0.67g < S_{ap} \leq 0.83g$	D ₂
$0.83g < S_{ap} \leq 1.17g$	D ₃
$1.17g < S_{ap}$	E




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Site Class

IRC R301.2.2.1

- The IRC assumes Site Class 'D'
 - Based upon upper 100-feet
 - Site Class A: Hard rock
 - Site Class B: Rock
 - Site Class C: Very dense soil and soft rock
 - Site Class D: Stiff soil
 - Site Class E: Soft clay soil
 - Site Class F: Soils requiring site response analysis



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Seismic Design

IRC R301.2.2.2

- Weights of Materials:
 - Roofs ≤ 15 psf
 - Floors ≤ 10 psf
 - Exterior Walls ≤ 15 psf
 - Interior Walls ≤ 10 psf






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Seismic Design

IRC R301.2.2.3

- Stone & Masonry Veneer:
 - "...shall comply with the requirements of Sections R702.1 and R703."
 - R703.7.2: Weight of veneer ≤ 40 psf if SDC 'D'

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IRC Chapter 3
Irregular Buildings (R301.2.2.6)

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Irregular Buildings

IRC R301.2.2.6

Out-of-plane offsets

Regular Shape
Not Exceeding (40D) Joint doubled at ends of braced wall panel
D= Joint Depth
Continuous thru joint
Joint less than 2x10 or more than 18" O.C.
Shear wall or braced wall panel

Irregular Shape
Exceeding (40D) Joint Depth
D= Joint Depth
No Continuous thru joint
Joint less than 2x10 or more than 18" O.C.
Joints not doubled at ends of braced wall panel
Shear wall or braced wall panel

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Irregularities

IRC R301.2.2.6

Item #4: Diaphragm openings exceeding either 12-feet or 50% of the least floor/roof dimension.

Regular Shape
Floor Plan
Less Than Or Equal To (X/2) Or 12"
Opening In Floor Or Roof (X)

Irregular Shape
Floor Plan
More Than (X/2) Or 12"
Opening In Floor Or Roof (X)

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Irregularities

IRC R301.2.2.6

- Item #5: Floor levels with vertical offsets
 - Exceptions:
 - Framing must be supported directly by continuous foundations at the perimeter.
 - Floor framing must be lapped or tied together as required by R502.6.1. (i.e., 3" lap and (3)10d face nails, or equivalent)

Regular Shape Floor Level Vertical Offset
No Vertical Offset
Floor Framing Lapped or Tied Together Per IRC R502.6.1

Irregular Shape Floor Level Vertical Offset
Vertical Offset And Floor Framing Lapped or Tied Together Per IRC R502.6.1

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Irregularities

IRC R301.2.2.6
Item #6: Braced wall lines that do not occur in two perpendicular directions

Braced Wall Lines Plan View

Regular Shape	Irregular Shape
Braced Wall Lines Are Perpendicular	Braced Wall Lines Are Not Perpendicular
90 Degree	75 Degree

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Snow Load

IRC R301.2.3
 Buildings in areas having ground snow loads > 70 psf shall be engineered.

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Floodplain

IRC R301.2.4

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Floodplain

IRC R301.2.4

- “...constructed in whole or in part in flood hazard areas shall be designed per R322”
 - If located in multiple flood hazard areas use most restrictive
 - If located in identified floodway, design per ASCE 24.

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Live Loads

IRC R301.5

USE	UNIFORM LOAD (psf)	CONCENTRATED LOAD (lb)
Uninhabitable attics without storage ^a	10	—
Uninhabitable attics with limited storage ^a	20	—
Habitable attics and attics served with fixed stairs	30	—
Balconies (terraces) and decks	40	—
Fire escapes	40	—
Garage	—	200 ^b
Guard in fill components ^c	—	50 ^c
Handrail ^d	200 ^d	—
Passenger vehicle garage ^e	50 ^e	2,000 ^e
Areas other than sleeping areas	40	—
Sleeping areas	30	—
Stairs	40 ^f	300 ^f

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Deflection

Per IRC Table R301.7:
For cantilever members, L shall be taken as twice the length of the cantilever.

STRUCTURAL MEMBER	ALLOWABLE DEFLECTION
Rafters having slopes greater than 3:12 with finished ceiling not attached to rafters	L/180
Interior walls and partitions	H/180
Floors	L/360
Ceilings with brittle finishes (including plaster and stucco)	L/360
Ceilings with flexible finishes (including gypsum board)	L/240
All other structural members	L/240
Exterior walls—wind loads ^b with plaster or stucco finish	H/360
Exterior walls—wind loads ^b with other brittle finishes	H/240
Exterior walls—wind loads ^b with flexible finishes	H/120 ^c
Limits supporting masonry veneer walls ^d	L/600

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END OF MODULE 2



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MODULE 3

**IRC Chapter 3:
Building Planning Part 2**




1



IRC Chapter 3



8% Building Planning (continued)



2

LEARNING OBJECTIVES

1. Become familiar with the concepts of fire- resistant construction.
2. Understand the difference between townhouses and two-family dwellings.
3. Gain knowledge related to penetrations, and the difference between fireblocking and draftstopping.
4. Know the importance of air intake and exhaust.



3

FRC

IRC R302

- Fire-Resistant Construction:
 - IRC Table R302.1(1)

FIREHOLD WALL ELEMENT	TABLE R302.1(1) EX-TERIOR WALLS	
	MINIMUM FIRE RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated 1 hour—meets or exceeds with ASTM E119, U.S. 263 or Section 703.3 of the International Building Code with response time both values.	0 feet
	Not fire-resistance rated 0 hours	0 feet
Partitions	Fire-resistance rated 1 hour on the substrate, or heavy timber, or fire-retardant-treated wood**	0 feet
	Not fire-resistance rated 0 hours	0 feet
Openings in walls	20% maximum of wall area Unrated	0 feet
	Unrated	0 feet
Penetrations	Comply with Section R302.4	0 feet
	None required	0 feet

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FRC

IRC R302

- If equipped throughout with an automatic sprinkler system...
 - IRC Table R302.1(2)

EXTERIOR WALL ELEMENT	FIRE RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—rated in accordance with ASTM E119, UL 207 or Section 703.2.2 of the International Building Code with exposure from the outside
	Not fire-resistance rated	0 feet
Projections	Fire-resistance rated	1 hour on the outside, or heavy timber, or fire-retardant-treated wood ³⁹
	Not fire-resistance rated	0 hours
Openings in walls	Not allowed	3 feet
	Allowed	NA
Penetrations	All	2 feet
	Comply with Section R302.4	0 feet



FRC

IRC R302

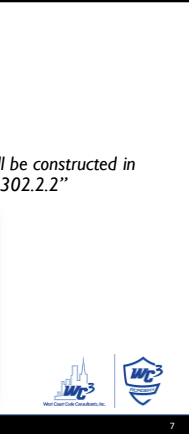
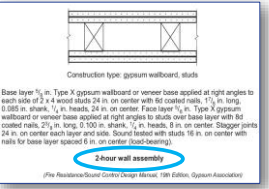
- Exceptions to Tables R302.1...
 - Wall, projections, openings or penetrations perpendicular to the property line in question.
 - Walls of dwelling units and accessory structures on same lot.
 - Detached sheds, playhouses or similar structures exempted from a building permit. (Projections shall not extend over the lot line!)
 - Detached garages located within 2-feet of lot line may have roof projections of up to 4-inches.
 - Foundation vents are permitted.



Townhouses

IRC R302.2

“Walls separating townhouse units shall be constructed in accordance with Section R302.2.1 or R302.2.2”



Townhouses

IRC R302.2.2

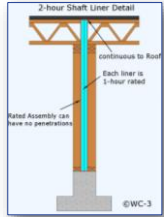



- Common walls separating townhouse units shall be given a fire-resistance rating per Section R302.2 Items 1 or 2.
 1. Fire Sprinkler system provided per P2904 – Common wall shall be rated a minimum of 1-hour.
 2. Fire Sprinkler system not provided. Common wall shall be rated not less than 2-hours.



Townhouses

IRC R302.2

- Townhouses sharing a common wall cannot be constructed with “plumbing or mechanical equipment, ducts or vents in the cavity”
 - The wall shall be rated for fire exposure from both sides.
 - Shall be tight against exterior walls
 - Shall be tight against the underside of the roof
- Penetrations of outlets shall comply with R302.4




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Townhouses

IRC R302.2.3

“...The fire-resistance-rated wall or assembly shall be continuous from the foundation to the underside of the roof sheathing, deck or slab”.



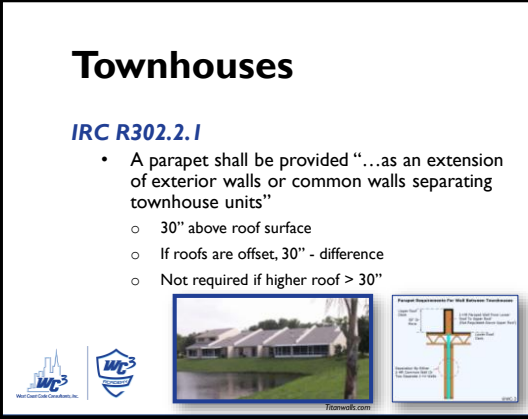


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Townhouses

IRC R302.2.1

- A parapet shall be provided “...as an extension of exterior walls or common walls separating townhouse units”
 - 30" above roof surface
 - If roofs are offset, 30" - difference
 - Not required if higher roof > 30"


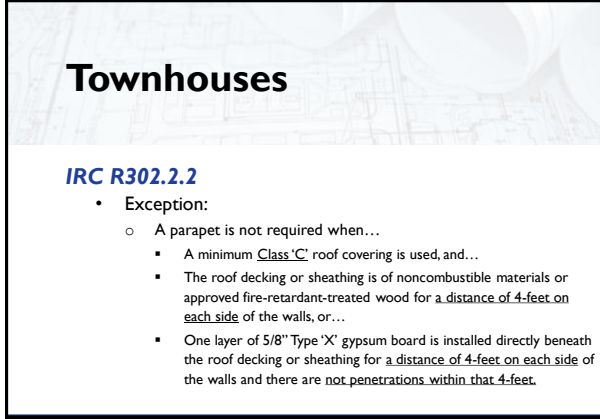


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Townhouses

IRC R302.2.2

- Exception:
 - A parapet is not required when...
 - A minimum Class 'C' roof covering is used, and...
 - The roof decking or sheathing is of noncombustible materials or approved fire-retardant-treated wood for a distance of 4-feet on each side of the walls, or...
 - One layer of 5/8" Type 'X' gypsum board is installed directly beneath the roof decking or sheathing for a distance of 4-feet on each side of the walls and there are not penetrations within that 4-feet.

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Two-Family Dwelling Separation

IRC R302.3

- "Dwelling units in two-family dwellings shall be separated a **1-hour fire-resistance rating**..."
- *"Such separation shall be provided regardless of whether a lot line exists between the two dwelling units or not."*

Fire doesn't know or care if there is a property line or not!



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Two-Family Dwellings

IRC R302.3

- Exceptions:
 - 1/2-hour if fully-sprinklered
 - Not required to extend through attic if...
 - Ceiling is protected by 5/8" Type 'X' and...
 - An attic draft stop is provided to create spaces ≤ 1,000ft²

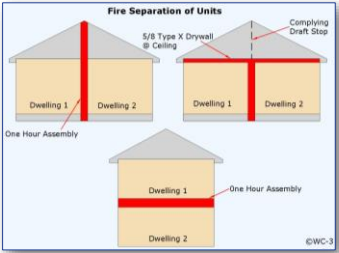
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Two-Family Dwellings

IRC R302.3

Fire Separation of Units



©WC-3





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Penetrations

IRC R302.4.1

- Through Penetrations
 - Fire-rated assembly: Installed as tested in the approved assembly.
 - Firestop system: Approved firestop system having appropriate F-rating




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Penetrations

IRC R302.4.1

- Exceptions:
 - Steel, ferrous or copper pipes, tubes or conduits...
 - Typical: Annular space shall be filled with material that prevents the passage of flame and hot gases
 - Concrete/Masonry: Annular space shall be filled with concrete, grout or mortar

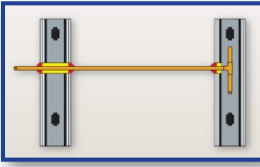


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Penetrations

IRC R302.4.2

- Membrane Penetrations
 - Same requirements as "Through Penetrations"
 - Recessed fixtures shall be installed so as not to reduce the fire-resistance-rating


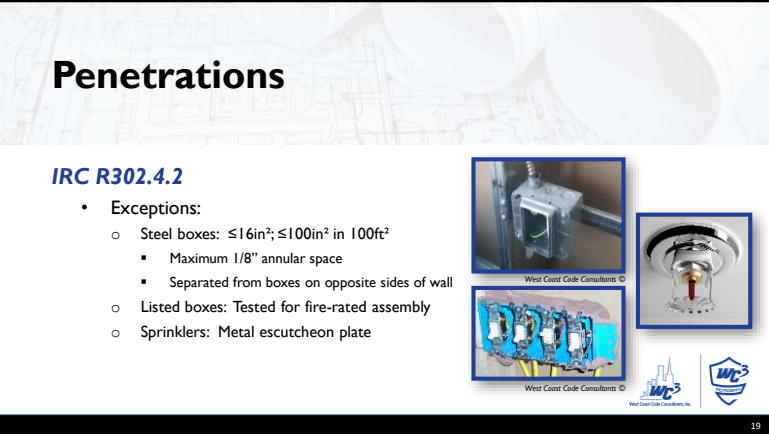

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Penetrations

IRC R302.4.2

- Exceptions:
 - Steel boxes: $\leq 16in^2$; $\leq 100in^2$ in 100ft²
 - Maximum 1/8" annular space
 - Separated from boxes on opposite sides of wall
 - Listed boxes: Tested for fire-rated assembly
 - Sprinklers: Metal escutcheon plate

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Dwelling-Garage Opening Protection

IRC R302.5.1:

1. Solid wood | 3/8" +
2. Solid or honeycomb-core steel | 3/8" +
3. 20 min. fire-rated door
 - Doors shall be self-latching and equipped with a self-closing or an automatic-closing device.





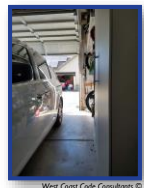
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Garage Openings

IRC R302.5.1

- Opening Protection:
 - Not permitted from the garage into a sleeping room.



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Garage Openings

IRC R302.5.2

- Duct Penetration:
 - No. 26 gage ducts
 - No openings into the garage
- Other Penetrations:
 - Annular space shall be filled with approved material



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Garage Separation

TABLE R302.6 DWELLING-GARAGE SEPARATION	
SEPARATION	MATERIAL
From the residence and attic	Not less than 1/2-inch gypsum board or equivalent applied to the garage side.
From habitable rooms above the garage	Not less than 1/2-inch Type X gypsum board or equivalent.
From the supporting floor-ceiling assemblies used for separation required by the code.	Not less than 1/2-inch gypsum board or equivalent.
Overhang located less than 3 feet from a dwelling unit on the same lot	Not less than 1/2-inch gypsum board or equivalent applied to the exterior side of exterior walls that are within this zone.

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IRC R302.6

- 1/2 inch drywall between garage walls and living space
- 5/8 inch drywall between garage ceilings and living space



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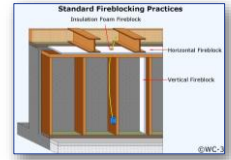
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Fireblocking

IRC R302.11

Locations:

- Concealed spaces in walls
 - Vertically at the ceiling and floor levels
 - Horizontally ≤ 10-feet



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Fireblocking

IRC R302.11

Locations:

- Interconnections of vertical & horizontal concealed spaces “...such as occur at soffits, drop ceilings and cove ceilings”

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Fireblocking

IRC R302.11

- Locations:
 - Top & bottom of stair stringers
 - Note: Enclosed spaces under stairs- Only required to comply with R302.7

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Fireblocking

IRC R302.11

- Locations
 - Openings around vents, pipes, ducts, cables and wires at the ceiling and floor level.
 - Approved material to resist the free passage of flame and products of combustion

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Fireblocking

IRC R302.11

- Locations:
 - All spaces between chimneys and floors/ceilings shall be fireblocked with non-combustible material

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Fireblocking

IRC R302.11

- Locations:
 - Cornices of two-family dwellings at the line of dwelling unit separation



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Fireblocking

IRC R302.11

- "...shall be provided to cut off all concealed draft openings (both vertical and horizontal)"
- Materials:
 - 2" nominal lumber
 - Two layers of 1" lumber
 - Two layers of 23/32" wood structural panels
 - Two layers of 3/4" particle board
 - 1/2" gypsum board
 - 1/4" cement-based millboard
 - Batts or blankets of mineral wool or glass fiber
 - Cellulose insulation



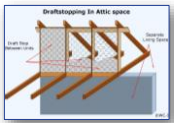

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Draftstopping

IRC R302.12

- "...shall be installed so that the area of the concealed space does not exceed 1,000ft²"
- Installed parallel to floor framing members
- Materials:
 - 1/2" gypsum board
 - 3/8" wood structural panel

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Fire Protection of Floors

IRC R302.13

- Requires protection of floor framing members above crawl spaces containing:
 - fuel-fired appliances or
 - electric-powered appliances







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Fire Protection

IRC R302.13
 The underside of all floors shall be protected by 1/2" gypsum wallboard or 5/8" structural sheathing

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Fire Protection

IRC R302.13

- Exceptions:
 - Floors over sprinklered space
 - Floors over crawl spaces not used for storage or fuel-fired or electric-powered appliances
 - Areas ≤ 80ft² which are fireblocked
 - Dimension or structural composite lumber having nominal dimensions of 2"x10" or greater

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Habitable Space

IRC R202

- A space within a building used for living, sleeping, eating or cooking
 - Bathrooms, closets, halls, storage and similar areas are not considered habitable spaces





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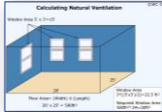


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Habitable Rooms

IRC R303.1

- Lighting:
 - Aggregate glazing area ≥ 8% of floor area
- Ventilation:
 - Openings such as windows, doors, louvers...
 - Readily accessed & controlled by occupants
 - Openable area to outdoors ≥ 4% of floor area



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Habitable Rooms

IRC R303.1

- Exceptions:
 - Openings need not be openable when not required for emergency escape and a whole-house mechanical ventilation system is provided (per M1507)
 - 8% glazing not required when artificial light is provided producing an average illumination of 6 footcandles throughout the room at a height of 30"
 - Sunrooms or patio covers can be used for natural ventilation as long as 40% of exterior walls are open, or they are enclosed with insect screening

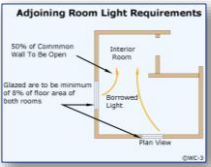


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Adjoining Rooms

IRC R303.2

- 50% of common wall is open
- Provides opening of not less than 1/10 floor area of interior room and not less than 25ft²



38

38

Air Intake/Exhaust

IRC R303.5

- Intake Openings:
 - ≥ 10-feet from "...any hazardous or noxious contaminants, such as vents, chimneys, plumbing vents, streets, alleys, parking lots, and loading docks"
 - If located within 10-feet, the intake opening shall be a minimum of 3-feet below the contaminant source
 - Exhaust from toilet rooms, bathrooms and kitchens shall not be considered hazardous or noxious
- Exhaust Openings:
 - Exhaust air shall not be directed onto walkways

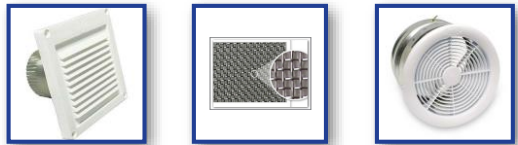


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Air Intake/Exhaust

IRC R303.6

- Outside Opening Protection:
 - Shall be protected with corrosion-resistant screens, louvers or grilles having a minimum opening size of 1/4-inch and maximum opening of 1/2-inch

40

40



41




MODULE 4

**IRC Chapter 3:
Building Planning Part 3**



1



IRC Chapter 3



8% Building Planning (continued)



2

LEARNING OBJECTIVES

1. Understand when stairway illumination is required.
2. Become familiar with minimum room sizes and ceiling height.
3. Be able to identify hazardous locations requiring safety glazing.
4. Know when emergency escape and rescue openings are required, and how they must be configured.

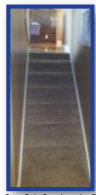





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Illumination

IRC R303.7 - R303.8

- Interior Stairways:
 - Light source in immediate vicinity of each landing and treads.
 - Shall illuminate treads and landings at ≥ 1 foot-candle. (Or 1 Lumen per Square Foot)
- Exterior Stairways:
 - Light source in immediate vicinity of top landing.
 - Basement stairways shall provide light source in immediate vicinity of bottom landing.

4

Illumination

IRC R303.7

- Light Activation:
 - A lighting outlet shall be provided at each floor level where the stairway has six or more risers

5

Required Heat

IRC R303.10

- Winter Design Temperature < 60-Deg F:
 - Shall be provided with heating facilities capable of maintaining 68-Deg. F at a point 3' above the floor, and 2' from exterior walls
 - Portable space heater shall not be used to achieve compliance

6

Room Areas

IRC R304

- Minimum Areas:
 - Habitable rooms shall be ≥ 70ft²
- Minimum Dimensions:
 - Habitable Rooms ≥ 7-feet in any horizontal dimension
 - Exception: Kitchens
- Ceiling Height:
 - Sloped Ceilings >5ft
 - Furred Ceilings >7ft

7

Ceiling Height

IRC R305




- “Habitable space, hallways, bathrooms, toilet rooms and portions of basements containing these spaces shall have a ceiling height of not less than 7-feet”
- Exceptions:
 - Sloped ceilings → 50% at least 7'-0", but no portion less than 5'-0" shall be considered
 - Bathrooms and showers ≥ 6'-8"
 - Uninhabitable basements ≥ 6'-4"

8

Ceiling Height

IRC R305.1.1

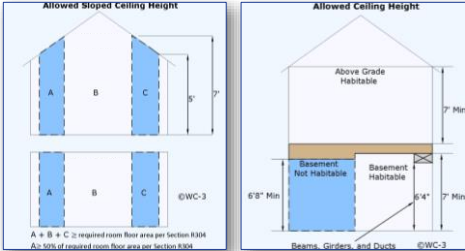


- Minimum height
 - In all habitable spaces, the minimum ceiling height is reduced to 78 inches under beams spaced at least 36 inches apart.

9

9

Ceiling Height

10

10

Sanitation

IRC R306

- Toilet Facilities:
 - Each dwelling shall have a toilet, sink, and a bathtub or shower.
- Kitchen:
 - Each dwelling shall have a kitchen with a sink.
- Sewage Disposal & Water Supply:
 - All plumbing fixtures shall be connected to a sanitary sewer and shall be connected to an approved water supply.



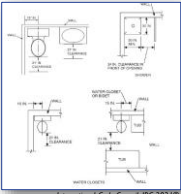



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Bath Spaces

IRC R307

- Bathtub & Shower Spaces:
 - Nonabsorbent surface ≥ 6-feet above floor

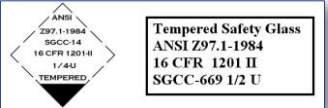
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Glazing

IRC R308.1

- Identification
 - "...each pane of glazing installed in hazardous locations... shall be provided with a manufacturer's designation... which is visible in the final installation".



Tempered Safety Glass
ANSI Z97.1-1984
SGCC-14
16 CFR 1201 II
1/2 U
TEMPERED







13

Glazing

IRC R308.1

- Identification of multiple assemblies.
- At least one pane of multiple assemblies having individual panes \leq 1ft² shall be labeled.

14

Impact Loads


IRC R308.3

Individual glazed areas shall pass the test requirements of CPSC 16 CFR or ANSI Z97.1

TABLE R308.3.1(1) MINIMUM CATEGORY CLASSIFICATION OF GLAZING USING CPSC 16 CFR 1201						
EXPOSED SURFACE AREA OF ONE SIDE OF ONE LITE	GLAZING IN STORES OR COMBINATION DOORS (Category Class)	GLAZING IN DOORS (Category Class)	GLAZED PANELS REGULATED BY SECTION R308.4.1 (Category Class)	GLAZED PANELS REGULATED BY SECTION R308.4.2 (Category Class)	GLAZING IN DOORS AND ENCLOSURES AND GLASS DOORS PATIO TYPE (Category Class)	SLIDING GLASS DOORS (Category Class)
9 square feet or less	I	I	NR	I	II	II
More than 9 square feet	II	II	II	II	II	II

TABLE R308.3.1(2) MINIMUM CATEGORY CLASSIFICATION OF GLAZING USING ANSI Z97.1			
EXPOSED SURFACE AREA OF ONE SIDE OF ONE LITE	GLAZED PANELS REGULATED BY SECTION R308.4.1 (Category Class)	GLAZED PANELS REGULATED BY SECTION R308.4.2 (Category Class)	DOORS AND ENCLOSURES REGULATED BY SECTION R308.4.3 (Category Class)
9 square feet or less	No requirement	A	A
More than 9 square feet	A	A	A

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Safety Glazing

IRC R308.4.1 to R308.4.7

- Exceptions:
 - Glazing in walls on latch side & perpendicular to door
 - Intermediate wall between glazing and door
 - Door is to a closet having a depth of \leq 3ft
 - Adjacent to fixed panel of patio doors
 - Decorative glazing

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Glazing and Wet Surfaces

IRC R308.4.1

- All glazing in swinging, sliding and bi-fold doors
- Exceptions:
 - Openings for which 3-inch sphere cannot pass
 - Decorative glazing






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Safety Glazing

IRC R308.4.2

- Glazing adjacent to doors:
 - Safety glazing is required if...
 - Glazing is within the 24 inches of either side of the door in the plane of the door in a closed position.
 - On a wall less than 180 degrees from the plane of the door and within 24 inches of the hinge side.





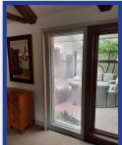


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Safety Glazing

IRC R308.4.3

- Individual panes meeting all the following...
 - Exposed area $\geq 9 \text{ ft}^2$
 - Bottom edge is < 18 -inches above floor
 - Top edge is > 36 -inches above floor
 - Walking surface within 36-inches

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19

Safety Glazing

IRC 308.4.4.1

- Structural Glass Baluster Panels:
 - Attached top rail or handrail is required
 - The top rail must be supported by ≥ 3 baluster panels
 - Not required for glazing of ≥ 2 plies of laminated glass.









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Safety Glazing

Glazing in guards or rails regardless of area.

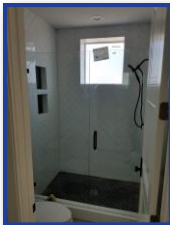
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Safety Glazing

IRC R308.4.5
“Glazing in walls adjacent to hot tubs, spas, whirlpools, saunas, steam rooms, bathtubs, showers and indoor or outdoor swimming pools where the bottom edge < 60-inches vertically above any standing surface.”

Exception: Glazing that is > 60” from the water’s edge of a bathtub, hot tub, spa, whirlpool or pools.



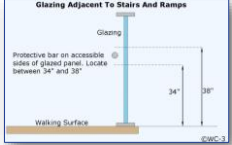
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Safety Glazing

IRC R308.4.6

- Glazing adjacent to stairs and ramps
- Bottom edge is < 36-inches from walking surfaces of stairways, landings and ramps
- Exceptions:
 - Rail provided between 34”-38” above walking surface
 - Glazing is ≥ 36” horizontally from walking surface




23



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Safety Glazing

IRC R308.4.7

- Glazing adjacent to stairway bottom landing if...
 - Bottom edge of glazing is < 36-inches above landing
 - Glazing is within 60-inches of bottom tread



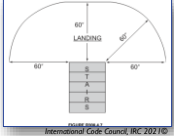
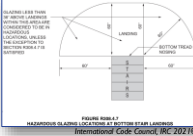
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Safety Glazing

IRC R308.4.7

- Adjacent to bottom of stair landing:
 - "The safety glazing at the bottom of stairs is only required within 60 inches in a 180-degree plane from the bottom tread."

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Skylights

IRC R308.6

- Skylights & Sloped Glazing:
 - Glazing shall be installed in accordance with this section.
- Materials:
 - Laminated glass 1/8" FT2 or less and not more than 12 FT above walking surface
 - Fully tempered
 - Heat-strengthened
 - Wired glass
 - Approved rigid plastics






26



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Skylights

IRC R308.6.8

- Skylight Curbs:
 - Required when roof < 3:12
 - Shall extend ≥ 4" above the plane of the roof



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Carports

IRC R309

- "...shall be open on at least 2 sides."
- If 3 closed sides are present it is considered a garage.
- Approved noncombustible floor.




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Emergency Escape Openings

IRC R310.1

- “Basements, habitable attics and every sleeping room shall have at least one operable emergency escape”
- Required in each sleeping room of basements
- Shall open directly into public way or yard.
- Exception 1:
 - Basements $\leq 200\text{ft}^2$ and housing mechanical equipment



29

29

Emergency Escape Openings

IRC R310.1

- Exception 2: An emergency escape and rescue opening is not required for every sleeping room in a basement if:
 - Home has fire sprinklers and,
 - Two means of egress from basement, or
 - One means of egress and one emergency escape and rescue.




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Minimum Dimensions

Requirements:

- Bottom of opening $\leq 44"$
- Min. clear opening area of 5.7ft^2
 - At grade 5.0ft²
- Min. clear opening height of $24"$
- Min. clear opening width of $20"$
- Shall be the result of normal operation





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Window Wells

IRC R310.2.3

- Min. horizontal area of 9ft^2
- Min. horizontal projection width of $36"$
- Ladder required if $> 44"$ deep
 - Rungs: Min. width = $12"$; Min. spacing = $18"$
 - Shall project at least $3"$ from wall


32



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Area Wells

IRC R310.4.3

- Drainage
 - Proper drainage system complying with R405.1.
 - In summary, if soils are well draining, a drainage system is not necessary.





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Window Wells

IRC R310.4.4.4

- Bars, Grilles, Covers & Screens
 - Shall provide min. net clear opening size
 - Releasable without use of key, tool, special knowledge or force


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Dwelling Additions

IRC R310.6

- “Where dwelling additions contain sleeping rooms, emergency escape openings shall be provided for every new sleeping room.”
- Each new basement must be provided with emergency escape openings.
- Exceptions:
 - Not required in basements with a sleeping room with an emergency escape opening
 - Not required in new basements that can access the existing opening in an existing basement






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35

END OF MODULE 4




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MODULE 5

*IRC Chapters 3 & 4:
Building Planning Part IV & Foundations*





1



IRC Chapter 3

8% Building Planning (continued)







2

1

2

LEARNING OBJECTIVES

1. Understand the minimum requirements associated with residential egress doors.
2. Become familiar with minimum and maximum dimension related to stairways, ramps, handrails, and guards.
3. Know the minimum life safety requirements for residential dwellings.
4. Become familiar with prescriptive requirements related to foundations and building placement.

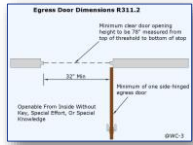



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Egress Door

IRC R311.2

- At least **one** egress door shall be provided.
- Requirements:
 - Shall be **hinged**
 - Min. clear width of 32"
 - Min. clear height of 78"
 - Readily openable from inside w/out key or special knowledge.


4

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Exterior Door

IRC R311.3

- All exterior doors shall have a landing or floor on each side.
- Landing Requirements:
 - Min. width of 36" in direction of travel
 - Maximum 2% slope in any direction



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5

Exterior Door

IRC R311.3

- Required Egress Doors
 - Landing or finished floors shall not be > 1.5" lower than top of threshold.
 - Exceptions:
 - May be ≤ 7.75" if the door DOES NOT swing over the landing.



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6


Exterior Door

IRC R311.3

- Other Exterior Doors
 - Landing or finished floors shall not be > 7.75" lower than top of threshold
 - Exceptions:
 - A landing is not required on exterior side when...
 - two or fewer risers are provided and
 - the door DOES NOT swing over the stairway.



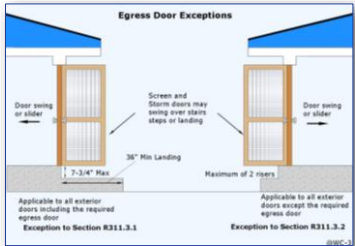
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Exterior Door

IRC R311.3



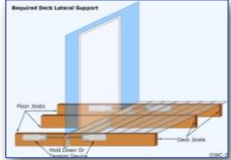

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8

Construction

IRC R311.5
 “Exterior landings, decks, balconies, stairs and similar facilities shall be positively anchored to the primary structure to resist both **vertical** and **lateral** forces.”

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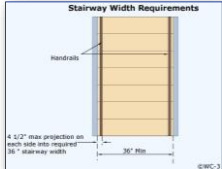



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Stairways

IRC R311.7.1

- Width:
 - Min. 36” in clear width
 - Handrails shall not project > 4.5”
- Vertical Rise:
 - 12-feet maximum between floors or landings
- Headroom:
 - Minimum 6’-8”





10


Stairways

IRC R311.7

- **Added exceptions:** stairways are **not required** to comply with these sections when they:
 - Are not within or attached to a building/porch/deck
 - Lead to non-habitable attics
 - Lead to a crawl space



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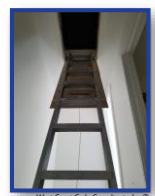


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Stairways (cont.)

IRC R311.7.3

- Vertical Rise
 - A flight of stairs shall not have a vertical rise larger than 12 feet 7 inches (151) inches between floor levels or landings.
 - 4 inches were added to accommodate 10’ ceilings and 24” deep floor trusses.



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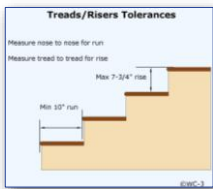




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Treads/Risers

IRC R311.7.5

- Risers:
 - ≤ 7.75"
 - Max. 3/8" difference
 - Open risers- 4" diameter sphere
- Treads:
 - ≥ 10"
 - Max. 3/8" difference







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Stairway Landing

IRC R311.7.7

- Landings must have maximum 2% slope
- Exception: "Where the surface of a landing is required elsewhere in the code to drain surface water, the walking surface of the landing shall be sloped not steeper than 1 unit vertical in 20 units horizontal (5-percent slope) in the direction of travel."

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Handrails

- Required on at least one side if ≥ 4 risers
- Height:
 - Min. = 34"
 - Max. = 38"
- Projection:
 - Not more than 4.5"








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Handrails

IRC R311.7.8

- Clearance:
 - Min. = 1.5" from wall
- Continuity:
 - Full length of flight
 - Top riser to bottom riser
 - Return to wall/post

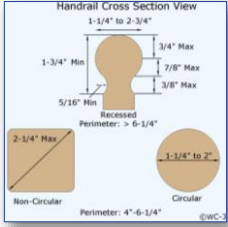



16

Grip Size

IRC R311.7.8.5

- Type I Grip:
 - Circular section between 1.25"-2" in diameter, or...
 - Perimeter between 4"-6.25" & 2.25" max. dimension
- Type II Grip:
 - Perimeter > 6.25"
 - Grasable finger recess area on both sides




The diagram shows a handrail cross-section with a finger recess. For a non-circular grip, the width is 1-1/4" to 2-3/4", the depth is 3/4" max, and the recessed perimeter is 4"-6-1/4". For a circular grip, the diameter is 1-1/4" to 2".

17

Alternating Tread

IRC R311.7.11

- Alternating Tread Device
 - Shall not be used as means of egress
 - Allowed as means of egress for lofts, mezzanines, etc. ≤ 200 ft²
 - 20" min. clear width
 - Treads
 - 5" – 8 1/2" Depth
 - 7" Width
 - 9 1/2" Rise
 - 50-to-70-degree slope
 - Handrails
 - Both sides
 - 30" – 34" high




18

Ships Ladders

IRC R311.7.12

- Shall not be used as means of egress
 - Allowed as means of egress for lofts, mezzanines, etc. ≤ 200 ft²
- 20" min. clear width
- Treads
 - 5" – 8 1/2" Depth
 - 9 1/2" Rise
- Handrails
 - Both sides
 - 30" – 34" high

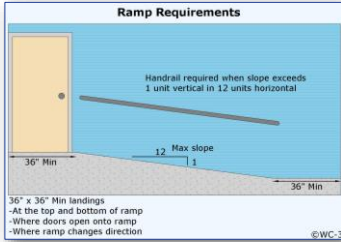


19

Ramps

IRC R311.8

Ramp Requirements




The diagram shows a ramp with a maximum slope of 12 units vertical to 1 unit horizontal. It requires a 36-inch minimum clear width on both sides and a 36-inch by 36-inch minimum landing at the top and bottom. Handrails are required when the slope exceeds 1 unit vertical in 12 units horizontal.

20

Ramps

IRC R311.8

- Exception: ramps are not required to comply with these sections when they:
 - Are not within a building or serving a building/porch/deck






21

Guards

IRC R312.1.1

- At open-sided walking surfaces $\geq 30''$ from grade (within 36" horizontally)
- "...insect screening shall not be considered a guard"






22

Guards

IRC R312.1

- Requirements:
 - Height: $\geq 36''$ (34" at stairs)
 - Opening Limitations: $\leq 4''$ diameter
 - Triangular Openings at Risers: $\leq 6''$ diameter






23

Windowsill

IRC R312.2.1

- If operable windows are located $> 72''$ from grade...
 - Lowest part of clear opening less than 24" from finished floor, or...
 - Cannot allow passage of 4" diameter sphere or
 - Window opening control device (ASTM F2090)






24

Emergency Escape and Rescue

IRC R312.2.2

Window opening control devices once released can not reduce the required net clear opening of the escape window/opening.



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Sprinklers

IRC R313

- Townhouses and One- and Two-Family per **P2904** or NFPA 13D
- Not required for additions or alterations to existing buildings without sprinklers


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Smoke Alarms

IRC R314.3

- Smoke alarms shall be installed in...
 - Each sleeping room
 - Outside each separate sleeping area
 - Each additional story of the dwelling





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Smoke Alarms

IRC R314.3

- Smoke alarms shall be installed...
 - Not within 3 feet – doors to bathrooms with tub and/or shower
 - Rooms open to hallways serving bedrooms with ceiling height $\geq 24''$ higher than the hallway





28

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Near Cooking Appliances

IRC R314.3.1

- Ionization: not < 20 feet from permanent cooking appliance
- Ionization w/silencing: not < 10 feet from permanent cooking appliance
- Photoelectric: not < 6 feet from permanent cooking appliance
- Listed and marked "helps reduce cooking nuisance alarms" shall not be installed < 6 feet horizontally from permanent cooking appliance

29

Interconnection

IRC R314.4

- More than one alarm: All devices shall be interconnected
- Primary Power: Building wiring
- Secondary Power: Battery

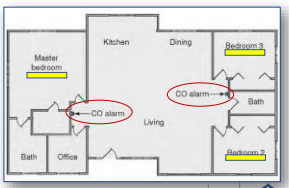




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CO Alarms

IRC R315

- Required when:
 - Dwelling contains a fuel-fired appliance **OR**
 - Has an attached garage (door between)
- Locations:
 - Outside each separate sleeping area in the vicinity of the bedrooms.
 - Within bedrooms containing fuel burning appliances.






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CO Alarms

IRC R315.2.2

- Alterations, repairs and additions
 - Where work requiring a permit occurs, individual dwelling units shall be equipped with carbon monoxide alarms.
 - Locate as per new construction
 - Exceptions
 - Exterior surfaces: roofing, windows, doors, decks, etc.
 - Plumbing installation/alterations/repairs, i.e., water heaters.
 - Mechanical installation/alterations/repairs, i.e., furnaces.

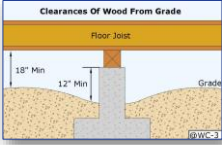





32

Wood Protection

IRC R317

- Naturally durable or preservative treated if:
 - Joists < 18" or girders < 12" to exposed ground
 - Wood on concrete or masonry w/in 8" of ground
 - Siding or sheathing < 6" from ground



33

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Protection of wood against decay

IRC R317.1

- Location required
 - Protection from decay is required in the following locations:
 - Wood joists closer than 18 inches to ground or wood columns closer than 8 inches
 - Portions of wood structural members exposed to the weather
 - Woods columns in contact with basement floor slabs

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Wood Protection

IRC R317

Supporting moisture permeable floors or roofs exposed to weather.





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Address

IRC R319

Numbers shall be min. 4" high with min. stroke width of 1/2"








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Accessibility

IRC R320

- Shall comply with IBC Chapter 11 if ≥ 4 units
 - **Note: IBC Exempts** multilevel dwelling units without elevators (townhomes that are more than one story are exempt).




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Flood-Resistant

IRC R322

- Structural systems designed to prevent flotation, collapse, or lateral movement
- Design flood elevation used to define flood hazard areas
- Protection of MEP, water supply, and sanitary sewer
- Foundation design and construction
- Underground tanks to be anchored



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Habitable Attics

IRC R326

- Considered a story above grade plane.
- Exceptions: (must meet all 4)
 - Not greater than 1/3rd area of story below
 - If fire sprinkled- Not greater than one half area of story below
 - Enclosed by roof assembly
 - Floor does not extend beyond exterior walls
 - If above a 3rd story- Entire building fire-sprinkled

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Swimming Pools, Etc.

IRC R327

The design and construction of pools and spas shall comply with the International Swimming Pool and Spa Code.





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IRC
INTERNATIONAL RESIDENTIAL CODE®
For One- and Two-Family Dwellings

2021

IRC Chapter 4

16% Foundations

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41

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Drainage

IRC R401.3

- Graded away from foundation
- Min. 6 inches in first 10 feet

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Soil Tests

IRC R401.4

- Required if expansive, compressible, shifting, or other questionable soils are present.
- Otherwise, the load-bearing values of Table R401.4.1 shall be assumed.

CLASS OF MATERIAL	LOAD-BEARING CAPACITY (pounds per square foot)
Crystalline bedrock	12,000
Sedimentary and igneous rock	6,000
Hard gravel and/or gravel (GSP and GSP)	3,000
Hard, clay, sandy, silty sand, clay gravel and clayey gravel (GSP, SP, ML, SC, GM and GC)	2,000
Clay, sandy, clay, silty clay, silty clay silt and sandy silty clay	1,500*
CL, ML, MH and CH	

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Materials

IRC R402


- Concrete:
 - Minimum strength specified in Table R402.2
 - "Moderate" to "severe" weathering requires air entrainment of 5-7%

TYPE OR LOCATION OF CONCRETE CONSTRUCTION	MINIMUM SPECIFIED COMPRESSIVE STRENGTH (f' _c) Weathering Potential	
	Nonaggregates 1 inch to 3 inches	3 inches
Basement walls, foundations and other concrete not exposed to the weather	2,500	2,500
Basement walls and exterior walls on grade, except garage floor slabs	2,500	2,500*
Basement walls, foundations, walls, exterior walls and other vertical concrete work exposed to the weather	2,500	3,000*
Floors, except slabs and tops exposed to the weather in single floor slabs	2,500	3,000**†

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Minimum Size


IRC R403.1.1

- Min. Width and Thickness:
- Per Tables R403.1(1) through R403.1(3)
- Projections (T): 2" min. and $P \leq T$

TABLE R403.1.1 MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS FOR SDC D0, D1 AND D2	TABLE R403.1.1.1 FOOTINGS FOR SDC D0, D1 AND D2		TABLE R403.1.1.2 FOOTINGS FOR SDC D0, D1 AND D2		TABLE R403.1.1.3 FOOTINGS FOR SDC D0, D1 AND D2	
	W	T	W	T	W	T
2" depth for base	1. 4" x 4" x 12"	4"	1. 4" x 4" x 12"	4"	1. 4" x 4" x 12"	4"
	2. 4" x 4" x 12"	4"	2. 4" x 4" x 12"	4"	2. 4" x 4" x 12"	4"
	3. 4" x 4" x 12"	4"	3. 4" x 4" x 12"	4"	3. 4" x 4" x 12"	4"
	4. 4" x 4" x 12"	4"	4. 4" x 4" x 12"	4"	4. 4" x 4" x 12"	4"
4" depth for base	1. 4" x 4" x 12"	4"	1. 4" x 4" x 12"	4"	1. 4" x 4" x 12"	4"
	2. 4" x 4" x 12"	4"	2. 4" x 4" x 12"	4"	2. 4" x 4" x 12"	4"
	3. 4" x 4" x 12"	4"	3. 4" x 4" x 12"	4"	3. 4" x 4" x 12"	4"
	4. 4" x 4" x 12"	4"	4. 4" x 4" x 12"	4"	4. 4" x 4" x 12"	4"
6" depth for base	1. 4" x 4" x 12"	4"	1. 4" x 4" x 12"	4"	1. 4" x 4" x 12"	4"
	2. 4" x 4" x 12"	4"	2. 4" x 4" x 12"	4"	2. 4" x 4" x 12"	4"
	3. 4" x 4" x 12"	4"	3. 4" x 4" x 12"	4"	3. 4" x 4" x 12"	4"
	4. 4" x 4" x 12"	4"	4. 4" x 4" x 12"	4"	4. 4" x 4" x 12"	4"




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Minimum Size

R403.1.3 states:

Concrete footings located in SDC D0, D1 and D2, shall have minimum reinforcement per this section and Figure 403.1.3

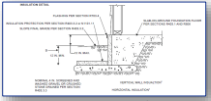



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Depth

IRC R403.1.4

- Exterior Footings ≥ 12 inches
- Frost Protection:
 - Extend below frost line
 - Frost-protected (R403.3 or ASCE 32)
 - Erected on solid rock
 - Not bear on frozen soil

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Depth

IRC R403.1.4

- Exceptions:
 - Accessory structures $\leq 600\text{ft}^2$ and $\leq 10\text{-feet eave height}$ (wood or steel framed)
 - Accessory structures $\leq 400\text{ft}^2$ and $\leq 10\text{-feet eave height}$ (other, block, etc.)
 - Freestanding Decks (See R507.3)





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Slope

IRC R403.1.5

- Top Surface:
 - Shall be level
- Bottom Surface:
 - Slope \leq 1:10 (10% slope), otherwise...
 - Footings shall be stepped



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Anchorage

IRC R403.1.6

- Anchor Bolts:
 - Minimum 1/2" diameter
 - Minimum 7" embedment
- Placement:
 - Max. spacing = 6-feet
 - Two bolts per plate
 - \leq 12" from end of plate
 - \geq 7db from end of plate



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Slopes

IRC R403.1.7

- Footings on Slopes
 - Ascending Slopes (R403.1.7.1)
 - Descending Slopes (R403.1.7.2)
 - Alternate setbacks & clearances allowed by the Building Official (R403.1.7.4)



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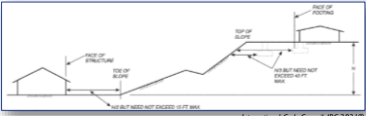
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Slopes

IRC R403.1.7

- Footings on Slopes (cont.)
 - IRC Figure R403.1.7.1
 - Descending: H/3, but not greater than 40-feet
 - Ascending: H/2, but not greater than 15-feet



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Elevation

IRC R403.1.7.3
 Top of exterior foundation shall extend above the elevation of the street gutter by a minimum of 12" plus 2 percent.


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END OF MODULE 5


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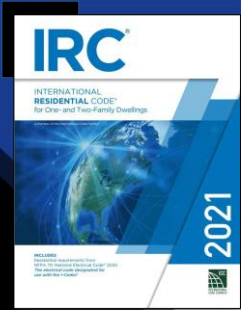


MODULE 6

*IRC Chapters 4 & 5:
Foundations and Floors/Decks*




1



IRC Chapter 4



16% Foundations (cont.)



2

LEARNING OBJECTIVES

1. Understand the basics of foundation and retaining wall design.
2. Become familiar with foundation drainage and waterproofing requirements.
3. Know where to locate, and how to use joist and girder span charts.






3

Foundations

IRC R401 - General

- Chapter focuses on concrete foundations with provisions for both concrete and CMU foundation walls.
- Wood foundations can be used but must comply with AWC PWF.
 - Cannot be > 2 stories
 - Engineering required in SDC D₀, D₁, or D₂






4

Foundations

IRC R401.3 – Surface Drainage

- Lots shall be graded to drain surface water away from foundation walls.
- **6-inches within first 10-feet**
- Diverted to storm sewer or other approved point of collection that does not create a hazard.
- Exceptions:
 - Drains or swales
 - Impervious surfaces shall slope \geq 2% away



5

Foundations

IRC R401.4 – Soil Tests

- Expansive, compressible, shifting, or questionable soils → soils investigation

CLASS OF MATERIAL	LOAD-BEARING PRESSURE (pounds per square foot)
Crystalline bedrock	12,000
Sedimentary and foliated rock	4,000
Sandy gravel and/or gravel (GW and GP)	3,000
Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000
Clay, sandy, silty clay, clayey silt, silt and sandy silt/clay (CL, ML, MH and CH)	1,500 [†]



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Foundations

IRC R402 – Materials

- Wood – special treatment and fasteners
- Concrete → IRC Table R402.2
- Precast concrete → 5,000psi
- Masonry → 1,500psi

TYPE OR LOCATION OF CONCRETE CONSTRUCTION	MINIMUM SPECIFIED COMPRESSIVE STRENGTH ^a (f _c)		
	Weathering Potential ^b		
	Negligible	Moderate	Severe
Basement walls, foundations and other concrete not exposed to the weather	2,500	2,500	2,500 ^c
Basement slabs and interior slabs on grade, except garage floor slabs	2,500	2,500	2,500 ^c
Basement walls, foundation walls, exterior walls and other vertical concrete work exposed to the weather	2,500	3,000 ^c	3,000 ^c
Porches, carport slabs and steps exposed to the weather, and garage floor slabs	2,500	3,000 ^{c,f-1}	3,500 ^{c,f-1}

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Foundations

IRC R403 – Footings

- Minimum size – per **Tables***, but...
 - Width = 12-inches min.
 - Thickness = 6-inches min.
 - Depth = 12-inches min. (Frost!)
- Frost protection:
 - Extend to below frost depth
 - Frost protected (IRC R403.3 or ASCE 32)
 - Erected on Rock

Exceptions:

1. Free-standing accessory structures of light-frame construction with eaves \leq 10-feet → **600 ft²**
2. Free-standing accessory structures of other than light-frame construction with eaves \leq 10-feet → **400 ft²**





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Foundations

IRC R403 – Footings

- Reinforcement Cover:
 - Cast against earth = 3-inches
 - Cast against forms:
 - 1.5-inches (≤ #5 bars)
 - 2-inches (> #5 bars)
- Slope:
 - Top shall be level
 - Bottom ≤ 1V:10H (10% slope)

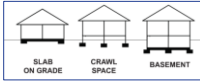



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Foundations

IRC Tables R403.1(1), (2), and (3)

- Prescribe minimum width and depth of footings based upon...
 - Roof Live Load (20psf) or Ground Snow Load (up to 70psf)
 - # of stories (1 to 3 + basement)
 - Soil load-bearing value → IRC Table R401.4.1 or soils report
 - Table R4013.1(1) → Light-frame construction
 - Table R4013.1(2) → Light-frame construction with masonry veneer or plaster
 - Table R4013.1(3) → Concrete or masonry construction

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Foundations

Assume 2-story with crawl space, light-frame with siding, 50psf ground snow, and 1,500psf allowable soil bearing pressure.

Minimum 17-inch wide by 6-inch thick footing is required.

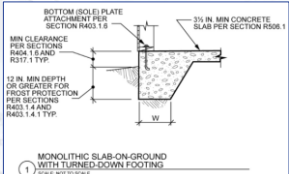
GROUND SNOW LOAD OR ROOF LIVE LOAD	STORY AND TYPE OF STRUCTURE WITH LIGHT FRAME	LOAD-BEARING VALUE OF SOIL (psf)					
		1,500	2,000	2,500	3,000	3,500	4,000
50 psf	1 story—slab-on-grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	18 × 6	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	15 × 6	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	17 × 6	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—plus basement	21 × 7	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—slab-on-grade	18 × 6	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—with crawl space	20 × 6	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—plus basement	24 × 8	18 × 6	14 × 6	12 × 6	12 × 6	12 × 6

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Foundations

IRC R403.1.6 – Foundation Anchorage

- Plate shall be protected against decay
- Min. 1/2-inch diameter anchors bolts
- Shall extend 7-inches min. into concrete
- Located within middle third of sill plate
- 2 min. per plate
- Within 12-inches of ends
- Not closer than 7d_b of ends
- Maximum spacing of 6-feet o.c.



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Foundations

IRC R404.1 – Foundation Walls

- Table R404.1.2(1) provides horizontal reinforcement requirements
- Multiple tables are provided for vertical reinforcement of concrete & masonry foundations

TABLE R404.1.2(1) MINIMUM HORIZONTAL REINFORCEMENT FOR CONCRETE BASEMENT WALLS**	
MAXIMUM UNSUPPORTED WALL HEIGHT (ft)	LOCATION OF HORIZONTAL REINFORCEMENT
≤ 8	One No. 4 bar within 12 inches of the top of the wall story and one No. 4 bar near mid-height of the wall story.
> 8	One No. 4 bar within 12 inches of the top of the wall story and one No. 4 bar near third points in the wall story.

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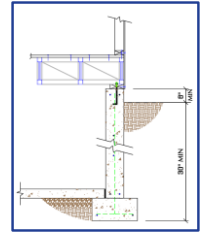


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Foundations

IRC R404.1.1

- Design required if...
 - Subject to hydrostatic pressure*
 - Support > 48" of unbalanced backfill and permanent lateral support is not provided at the top or bottom



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Foundations

IRC R404.1.4.2

- SDC D₀, D₁ and D₂: Limited to
 - Wall heights ≤ **8-feet**
 - Unbalanced backfill ≤ **4-feet**
 - Thickness of **7.5" min.**
 - 6" allowed if wall height is ≤ 4'-6"
 - If not, vertical steel per Tables R404.1.2 (2-9)



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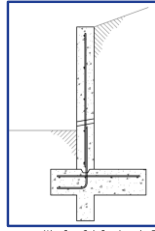


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Retaining Walls

IRC R404.4

- Design required if...
 - Retain > 4-feet of soil and not laterally supported top & bottom, or...
 - Retain > 24-inches of soil and resist lateral loads in addition to soil
- Design must provide a factor of safety of 1.5 against sliding and overturning.



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Drainage

IRC R405 – Foundation Drainage

- Foundation drains are required around all concrete or masonry foundations that retain earth and enclose habitable or usable spaces.
- Exception:
 - Not required when foundation is installed on well-drained ground or sand-gravel mixture

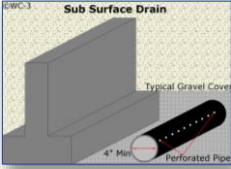

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Drainage

IRC R405.1 - Requirements

- Shall discharge by gravity or mechanical means
- Gravel or crushed stone drain
- Extends ≥ 1-foot beyond outside edge of footing
- Extends ≥ 6-inches above top of footing
- Covered in filter material



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Damproofing

IRC R406.1

- Foundation walls that retain soil and interior spaces shall be damproofed.
- From finished grade to the top of footing.
- Masonry walls shall have 3/8-inch cement parging applied prior to damproofing.
- Damproofing materials shall be the same as those required for **waterproofing***.


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Waterproofing


IRC R406.2

- Foundations shall be water-proofed, if...
 - High water table, or...
 - Severe soil-water conditions

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Waterproofing


IRC R406.2

- Two-ply hot-mopped felts
- 55 lb. roll roofing
- 40 mil polymer-modified asphalt
- 60 mil flexible polymer cement
- 1/8th inch cement-based, fiber reinforced, waterproof coating
- 60 mil solvent-free liquid-applied synthetic rubber



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Columns

IRC R407

- Wood protection
 - Protected against decay (R317)
- Steel column protection
 - All surfaces shall have rust-inhibitive paint
- Structural requirements:
 - Wood ≥ 4"x4" nominal
 - Steel ≥ 3" diameter Schedule 40





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Under-Floor Space

IRC R408

- Ventilation
 - Min. net area ≥ 1ft² for each 150ft²
 - Covered by Class I vapor retarder → 1,500ft²
 - One opening w/in 3-feet of each building corner
 - Not required when Class I vapor retarder is used
 - Openings covered w/least dimension ≥ 1/4"
- Access
 - 18"x24" through the floor
 - 16"x24" through the perimeter wall

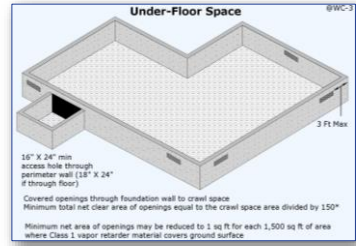



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Under-Floor Space


IRC R408



16" X 24" min access hole through perimeter wall (18" X 24" if through floor)

Covered openings through foundation wall to crawl space
Minimum total net clear area of openings equal to the crawl space area divided by 150*

Minimum net area of openings may be reduced to 1 sq ft for each 1,500 sq ft of area where Class I vapor retarder material covers ground surface



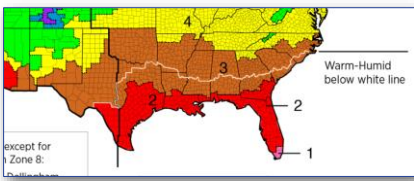
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Under-Floor Vapor Retarder

IRC R408.8

- Climate Zones 1A, 2A, and 3A below the warm-humid line
 - Class I or II vapor retarder on the exposed face of air permeable insulation installed between the floor joists and exposed to the grade



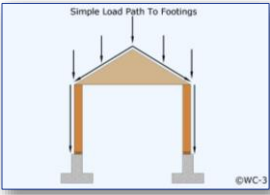
IRC Chapter 5

14% Floor Construction

Gravity Load Path

IRC R501.2

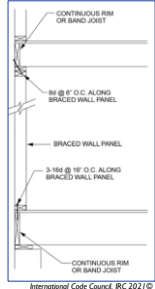
“Floor construction shall be capable of accommodating all loads... and transmitting the resulting loads to the supporting structural elements.”



Lateral Load Path

IRC R502.2.1

“A load path for lateral forces shall be provided between floor framing and braced wall panels located above or below a floor”



Joist Spans

TABLE R502.3.1(2)
FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES & Residential living areas (Live load = 40 psf, U.S. 2001)
DESIGN LOAD = 5 psf

JOIST SPACING (inches)	SPECIES AND GRADE	Maximum floor joist spans					
		2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 12
		(ft-in)	(ft-in)	(ft-in)	(ft-in)	(ft-in)	(ft-in)
	Douglas fir-larch	SS 11-4	15-0	19-1	23-3	11-4	15-0
	Douglas fir-larch	#1 10-11	14-5	18-5	22-0	10-11	14-2
	Douglas fir-larch	#2 10-0	14-2	18-0	21-11	10-0	13-6
	Douglas fir-larch	#3 8-11	11-3	15-0	18-0	8-1	10-3
	Hem-fir	SS 10-0	14-2	18-0	21-11	10-0	14-2
	Hem-fir	#1 10-0	13-10	17-8	21-0	10-0	13-10
	Hem-fir	#2 10-0	13-2	16-10	20-4	10-0	13-2
	Hem-fir	#3 8-8	11-0	13-5	15-7	7-11	10-0
	Southern pine	SS 11-2	14-4	18-0	22-10	11-2	14-8
	Southern pine	#1 10-0	13-2	18-0	21-11	10-0	14-11
	Southern pine	#2 10-0	13-0	16-2	19-4	9-10	12-0
	Southern pine	#3 9-2	10-3	12-6	14-0	5-5	9-5
	Spruce-pine-fir	SS 10-0	13-10	17-8	21-0	10-0	13-10
	Spruce-pine-fir	#1 10-3	13-5	17-3	20-7	10-3	13-3
	Spruce-pine-fir	#2 10-0	13-0	17-3	20-7	10-0	13-0
	Spruce-pine-fir	#3 8-8	11-0	13-5	15-7	7-11	10-0


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Cantilever Joist Spans

IRC R502.3.3(1)

- Shall not exceed depth of floor joist, unless...
- Supports light-frame bearing wall and a roof only → per IRC Table R502.3.3(1)



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TABLE R502.3.3(1)
CANTILEVER SPANS FOR FLOOR JOISTS SUPPORTING LIGHT-FRAME EXTERIOR BEARING WALL AND ROOF ONLY^{1, 2, 3, 4, 5, 6}
(Floor live load ≤ 40 psf, roof live load ≤ 20 psf)
MAXIMUM CANTILEVER SPAN (uplift force at base span support in lb/ft)⁷

MEMBER & SPACING	Ground Snow Load					
	5 psf		10 psf		15 psf	
	Roof	Roof	Roof	Roof	Roof	Roof
2 x 8 @ 12"	34 ft	15'	34 ft	15'	34 ft	15'
	(177)	(227)	(209)	---	---	---
2 x 10 @ 10"	20'	21'	20'	18'	---	---
	(228)	(207)	(364)	(271)	(354)	---
2 x 10 @ 12"	16'	20'	16'	22'	16'	20'
	(166)	(219)	(270)	(193)	(243)	(224)

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Joist Spans

IRC R502.3(2) – Cantilevers at Exterior Balconies

TABLE R502.3.3(2)
CANTILEVER SPANS FOR FLOOR JOISTS SUPPORTING EXTERIOR BALCONY^{1, 2, 3, 4}

MEMBER SIZE	SPACING	MAXIMUM CANTILEVER SPAN (uplift force at base span support in lb/ft) ⁵	
		Ground Snow Load	
		5 psf	10 psf
2 x 8	12"	42" (130)	30" (116)
2 x 8	16"	36" (111)	34" (117)
2 x 10	12"	61" (184)	57" (189)
2 x 10	16"	53" (160)	49" (208)
2 x 10	24"	43" (212)	40" (241)
2 x 12	16"	72" (228)	67" (260)
2 x 12	24"	58" (279)	54" (319)

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Girder & Header Spans

IRC R502.5 → IRC Tables R602.7(1), (2) & (3)

TABLE R602.7(1)
GIRDER SPANS AND HEADER SPANS FOR EXTERIOR BEARING WALLS
(Maximum spans for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir and required number of jack studs)

GIRDER AND HEADER SUPPORTS	RISER	Building width (feet)											
		10				12				14			
		Roof	Roof	Roof	Roof	Roof	Roof	Roof	Roof	Roof	Roof	Roof	Roof
Roof and ceiling	12	13	13	13	13	13	13	13	13	13	13	13	13
	14	14	14	14	14	14	14	14	14	14	14	14	14
Roof and ceiling	16	16	16	16	16	16	16	16	16	16	16	16	16
	18	18	18	18	18	18	18	18	18	18	18	18	18
Roof and ceiling	20	20	20	20	20	20	20	20	20	20	20	20	20
	22	22	22	22	22	22	22	22	22	22	22	22	22
Roof and ceiling	24	24	24	24	24	24	24	24	24	24	24	24	24
	26	26	26	26	26	26	26	26	26	26	26	26	26
Roof and ceiling	28	28	28	28	28	28	28	28	28	28	28	28	28
	30	30	30	30	30	30	30	30	30	30	30	30	30
Roof and ceiling	32	32	32	32	32	32	32	32	32	32	32	32	32
	34	34	34	34	34	34	34	34	34	34	34	34	34
Roof and ceiling	36	36	36	36	36	36	36	36	36	36	36	36	36
	38	38	38	38	38	38	38	38	38	38	38	38	38
Roof and ceiling	40	40	40	40	40	40	40	40	40	40	40	40	40
	42	42	42	42	42	42	42	42	42	42	42	42	42

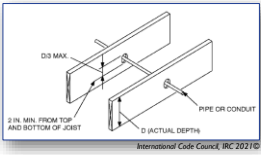
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Notching

IRC R502.8

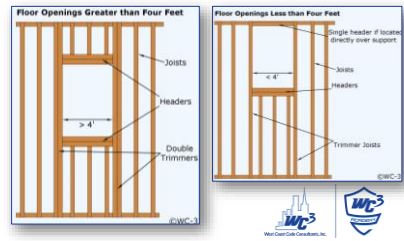
- Diameter of holes bored or cut into joists and beams shall...
 - Not exceed 1/3 of member depth
 - Not be closer than 2" from bottom of member or any other hole or notch



Openings

IRC R502.10

- ≤ 4-foot Opening:
 - Single header joist
 - Single trimmer joist if header is w/in 3-feet of bearing
- > 4-foot Opening:
 - Double header joist
 - Double trimmer joists



Floor Sheathing

TABLE R503.1
MINIMUM THICKNESS OF LUMBER FLOOR SHEATHING

JOIST OR BEAM SPACING (inches)	MINIMUM NET THICKNESS	
	Perpendicular to joist	Diagonal to joist
24	1 1/8"	3/4"
16	5/8"	5/8"
48"	1 1/2" T & G	N/A
54"		
60"		

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Sheathing

TABLE R503.2.1(1)
ALLOWABLE SPANS AND LOADS FOR WOOD STRUCTURAL PANELS FOR ROOF AND SUBFLOOR SHEATHING AND COMBINATION SUBFLOOR OVERLAYMENT**

SPAN RATING	MINIMUM NOMINAL PANEL THICKNESS (inches)	ALLOWABLE LIVE LOAD (psf)		MAXIMUM SPAN (inches)		LOAD (pounds per square foot at maximum span)		MAXIMUM SPAN (inches)
		SPAN @ 16' o.c.	SPAN @ 24' o.c.	With edge support	Without edge support	Total load	Live load	
Sheathing								
16-0	1/2	30	—	16	16	40	30	0
20-0	3/4	50	—	20	20	40	30	0
24-0	1	100	30	24	20*	40	30	0
24-16	1 1/8	100	40	24	24	50	40	16
32-16	3/2	180	70	32	28	40	30	16*
40-20	3/2	305	130	40	32	40	30	20*
48-24	3/2	—	175	48	36	45	35	24
60-32	1	—	305	60	48	45	35	32
Underlayment								
O-C (single, single floor)								
Roof								
16 o.c.	3/8	100	40	24	24	50	40	16*
20 o.c.	3/8	150	60	32	32	40	30	20**
24 o.c.	3/8	240	100	48	36	35	25	24
32 o.c.	1/2	—	155	48	40	50	40	32
48 o.c.	1 1/2	—	290	60	48	50	40	48

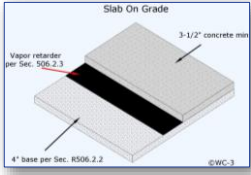
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Slab-on-Grade

IRC R506.2.3

- Vapor Retarder
 - 6-mil polyethylene
 - Joints lapped **6-inches**
 - **Exception:** Garages, accessory structures, flatwork and where approved by B.O.



Slab On Grade
3-1/2" concrete min
Vapor retarder per Sec. 506.2.3
4" base per Sec. R506.2.2



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Exterior Decks

IRC R507 – Breakdown of Requirements

- Materials*
- Footings*
- Posts*
- Beams & Joists*
- Vertical & Lateral Supports*
- Exterior Guards*
- **Huge change → now includes 50, 60, and 70psf ground snow loads in tables!**




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Exterior Decks

IRC R507.2 – Materials

- Naturally-durable or preservative-treated lumber unless water-impermeable membrane.
- Composite materials → ASTM D7032
- Fasteners → IRC R317.3 or IRC Table R507.2.3
- Flashing → Corrosion-resistant ≥ 0.019-inches thick or approved nonmetallic material
- Alternate materials can be allowed.



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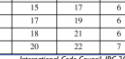
Exterior Decks

IRC R507.3 – Footings

- Minimum size per IRC Table R507.3.1
- Depth ≥ 12-inches below grade min. (**Frost!**)

LIVE OR GROUND SNOW LOAD ⁴ (psf)	TRIBUTARY AREA (ft ²)	1,500 ¹		2,000 ²		≥ 3,000 ³	
		Side of a square footing (inches)	Thickness (inches)	Side of a square footing (inches)	Thickness (inches)	Side of a square footing (inches)	Thickness (inches)
40	5	7	6	7	6	7	6
	20	10	6	9	6	7	6
	40	14	6	12	6	10	6
	60	17	6	15	6	12	6
	80	20	7	17	6	14	6
	100	22	8	19	6	15	6
	120	24	9	21	7	17	6
	140	26	10	22	8	18	6
	160	28	11	24	9	20	7

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Exterior Decks



IRC R507.4 – Deck Posts

- Single-level decks → IRC Table R507.4

		TABLE R507.4 DECK POST HEIGHT																			
		"REGULAR" AREA (FT ²) ¹					"IRREGULAR" AREA (FT ²) ²														
LOADS (psf) ³	POST SPECIES ⁴	POST SIZE		MAXIMUM DECK POST HEIGHT ⁵ (feet-inches)																	
		50	40	60	80	100	120	140	160	180	200	220	240								
@ 1 live load	Southern pine	4 × 4	14-0	13-2	13-6	9-5	8-1	7-5	6-0	5-2											
		4 × 6	14-0	14-0	14-0	13-11	12-0	10-8	9-4	8-10	6-2										
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas fir ⁶ Hemlock ⁶ Spruce-pine-fir ⁶	4 × 4	14-0	13-4	13-10	9-3	8-0	7-0	5-0	5-2	5-3										
		4 × 6	14-0	14-0	13-10	11-10	10-8	9-5	8-7	7-10											
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood ⁶ Western cedar ⁶ Pine-spruce ⁶ Red pine ⁶	4 × 4	14-0	13-2	13-3	8-1	5-8	NP	NP	NP	NP										
		4 × 6	14-0	14-0	13-6	11-4	8-0	8-4	6-8	6-7											
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0

2021 IRC Table R507.4 ©









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Exterior Decks

IRC R507.5 – Deck Beams

- Deck beams per IRC Tables R507.5(1) through (4)
 - R507.5(1) → 40psf live load
 - R507.5(2) → 50psf ground snow load
 - R507.5(3) → 60psf ground snow load
 - R507.5(4) → 70psf ground snow load




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
Exterior Decks

IRC R507.5 – Deck Beams

		TABLE R507.5(1) MAXIMUM DECK BEAM SPAN—40 PSF LIVE LOAD ¹														
		EFFECTIVE DECK JOIST SPAN LENGTH ² (feet)														
BEAM SPECIES ³	BEAM SIZE ⁴	6		8		10		12		14		16		18		
		MAXIMUM DECK BEAM SPAN LENGTH (feet-inches) ^{5,6}														
Southern pine	1-2 × 6	4-7	4-0	3-7	3-3	3-0	2-10	2-8								
	1-2 × 8	5-11	5-1	4-7	4-2	3-10	3-7	3-5								
	1-2 × 10	7-0	6-0	5-5	4-11	4-7	4-3	4-0								
	1-2 × 12	8-3	7-1	6-4	5-10	5-5	5-0	4-9								
	2-2 × 6	6-11	5-11	5-4	4-10	4-6	4-3	4-0								
	2-2 × 8	8-9	7-7	6-9	6-2	5-9	5-4	5-0								
	2-2 × 10	10-4	9-0	8-0	7-4	6-9	6-4	6-0								
	2-2 × 12	12-2	10-7	9-5	8-7	8-0	7-5	7-0								
	3-2 × 6	8-6	7-5	6-8	6-1	5-8	5-3	4-11								
	3-2 × 8	10-11	9-6	8-6	7-9	7-2	6-8	6-4								
	3-2 × 10	13-0	11-2	10-0	9-2	8-6	7-11	7-6								
	3-2 × 12	15-3	13-3	11-10	10-9	10-0	9-4	8-10								

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Exterior Decks

IRC R507.6 – Deck Joists

- Joists farming into the sides of a beam or ledger shall be supported by joist hanger
- Joists bearing on top of beam or ledger shall be attached by mechanical connector
- Joist ends & bearing locations shall be provided with lateral resistance → blocking to ≥ 60% of joist depth
- Max. spans per IRC Table R507.6

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Exterior Decks

**TABLE R507.6
MAXIMUM DECK JOIST SPANS**

LOAD* (psf)	JOIST SPECIES ²	JOIST SIZE	ALLOWABLE JOIST SPAN ^{1,2} (feet-inches)				MAXIMUM CANTILEVER ^{1,2} (feet-inches)										
			Joist spacing (inches)				Joist back span ³ (feet)										
			12	16	24		4	6	8	10	12	14	16	18			
40 live load	Southern pine	2 x 6	9-11	9-0	7-7	1-0	1-6	1-5	NP	NP	NP	NP	NP	NP	NP	NP	NP
		2 x 8	13-1	11-10	9-8	1-0	1-6	2-0	2-6	2-3	NP	NP	NP	NP	NP	NP	NP
		2 x 10	16-2	14-0	11-5	1-0	1-6	2-0	2-6	3-0	3-4	3-4	NP	NP	NP	NP	NP
		2 x 12	18-0	16-6	13-6	1-0	1-6	2-0	2-6	3-0	3-6	4-0	4-1	NP	NP	NP	NP
	Douglas fir-larch ⁴ Hem-fir ⁴ Spruce-pine-fir ⁴	2 x 6	9-6	8-4	6-10	1-0	1-6	1-4	NP	NP	NP	NP	NP	NP	NP	NP	NP
		2 x 8	12-6	11-1	9-1	1-0	1-6	2-0	2-3	2-0	NP	NP	NP	NP	NP	NP	NP
		2 x 10	15-8	13-7	11-1	1-0	1-6	2-0	2-6	3-0	3-3	NP	NP	NP	NP	NP	NP
		2 x 12	18-0	15-9	12-10	1-0	1-6	2-0	2-6	3-0	3-6	3-11	3-11	NP	NP	NP	NP
	Redwood ⁴ Western cedars ⁴ Ponderosa pine ⁴ Red pine ⁴	2 x 6	8-10	8-0	6-10	1-0	1-4	1-1	NP	NP	NP	NP	NP	NP	NP	NP	NP
		2 x 8	11-8	10-7	8-8	1-0	1-6	2-0	1-11	NP	NP	NP	NP	NP	NP	NP	NP
		2 x 10	14-11	13-0	10-7	1-0	1-6	2-0	2-6	3-0	2-9	NP	NP	NP	NP	NP	NP
		2 x 12	17-5	15-1	12-4	1-0	1-6	2-0	2-6	3-0	3-6	3-8	NP	NP	NP	NP	NP

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Exterior Decks

IRC R507.8 – Vertical & Lateral Support

- Vertical → Ledger attachment
- Lateral → Hold-downs

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Exterior Decks

R507.9.1 – Vertical Connection Attachment

**FIGURE R507.9.1(3)1
PLACEMENT OF LAG SCREWS AND BOLTS IN LEDGERS**

LOAD* (psf)	JOIST SPAN ¹ (feet)	ON-CENTER SPACING OF FASTENERS ² (inches)		
		1/2-inch diameter lag screw with 1/2-inch maximum sheathing ³	3/4-inch diameter bolt with 1/2-inch maximum sheathing ³	1/2-inch diameter bolt with 1-inch maximum sheathing ³
40 live load	6	30	36	36
	8	23	36	36
	10	18	34	29
	12	15	29	24
	14	13	24	21
	16	11	21	18
	18	10	19	16

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Exterior Decks

IRC R507.9.2 – Lateral Connection

- Two Options:
 - (2) 1500# hold-down devices, or...
 - (4) 750# hold-down devices

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Exterior Decks

IRC R507.10 – Exterior Guards

- Guard loads must be transferred directly to deck joists
- Where guards are connected to interior side of joists → connect to adjacent joists to prevent rotation
- Where guards are mounted on top of the decking – framing and blocking required for load transfer
- 4"x4" wood posts cannot be notched at connections



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END OF MODULE 6



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MODULE 7



27% 2021 IRC Chapters 6 & 7:
Wall Construction & Wall Coverings



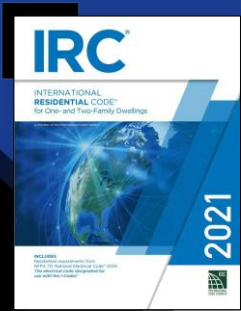
1

LEARNING OBJECTIVES

1. Become familiar with basic wall construction requirements, specific to fasteners, stud sizes, headers and plates.
2. Understand the how to properly evaluate prescriptive wall bracing.
3. Know the proper use and application of various wall coverings, including gypsum, plaster and weather barriers.





2



IRC Chapter 6

Wall Construction





3

Wall Construction

IRC R602.1 – Wall Framing Materials

- **Sawn Lumber:** Grade mark (DOC PS 20)
 - Studs shall be #3 or stud grade lumber
- **Glulam:** ANSI A190.1, ANSI 117, ASTM D3737
- **Log Members:** ICC 400
- **Structural Composite Lumber:** ANSI/APA PRG 320
- **CLT:** ANSI/APA PRG 320
- **Eng. Rim Board:** ANSI/APA PRR 410 or ASTM D7672
- **Wood Structural Panels:** DOC PS1, DOC PS2
- **Structural Insulated Panels:** ANSI/APA PRS 610.1

4

Connections

IRC R602.3 – Design & Construction

- Components of exterior walls shall be fastened per IRC Tables R602.3(1) through R602.3(4)
- Remember the gravity and lateral load paths!

ITEM	DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER**	SPACING AND LOCATION
1	Blocking between ceiling joists, rafters or trusses to top plate or other framing below	4-8d box (2") x 0.113", or 3-8d common (2") x 0.131", or 3-16d box (3") x 0.128", or 3-3" x 0.131" nails	Toe nail
	Blocking between rafters or truss not at the wall top plates, to rafter or truss	3-8d common (2") x 0.131", or 3-16d common (3") x 0.162", or 3-3" x 0.131" nails	Each end toe nail
	Flat blocking to truss and web filler	16d common (3") x 0.162", or 3" x 0.131" nails	End nail
2	Ceiling joists to top plate	4-8d box (2") x 0.113", or 3-8d common (2") x 0.131", or 3-16d box (3") x 0.128", or 3-3" x 0.131" nails	6" o.c. face nail
			Per joist, toe nail

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Connections

Footnotes: (Make Sure to Read)

For SE: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s, 1 ksi = 6.895 MPa.

- Nails are smooth-shank, box or deformed shanks except where otherwise stated. Nails used for framing and sheathing connections are carbon steel and shall have minimum average tensile strength or ultimate stress: 90 ksi for shank diameter of 0.192 inch (200 common nail), 90 ksi for shank diameter larger than 0.142 inch but not larger than 0.177 inch, and 100 ksi for shank diameters of 0.142 inch or less. Connections using nails and staples of other materials, such as stainless steel, shall be designed by accepted engineering practice or approved under Section R104.11.
- RSRS-01 is a Roof Sheathing Ring Shank nail meeting the specifications in ASTM F1667.
- Nails shall be spaced at not more than 6 inches on center at all supports where spans are 48 inches or greater.
- Four-foot by 8-foot or 4-foot by 9-foot panels shall be applied vertically.
- Spacing of fasteners not included in this table shall be based on Table R602.3(2).
- For wood structural panel roof sheathing attached to gable end roof framing and to intermediate supports within 48 inches of roof edges and ridges, nails shall be spaced at 4 inches on center where the ultimate design wind speed is greater than 130 mph in Exposure B or greater than 110 mph in Exposure C. Gypsum sheathing shall conform to ASTM C1396 and shall be installed in accordance with ASTM C1280 or GA 253. Fiberglass sheathing shall conform to ASTM C208.
- Spacing of fasteners on floor sheathing panel edges applies to panel edges supported by framing members and required blocking and at floor perimeter only. Spacing of fasteners on roof sheathing panel edges applies to panel edges supported by framing members and required blocking. Blocking of roof or floor sheathing panel edges perpendicular to the framing members need not be provided except as required by other provisions of this code. Floor perimeter shall be supported by framing members or solid blocking.
- Where a rafter is fastened to an adjacent parallel ceiling joist in accordance with this schedule, provide two toe nails on one side of the rafter and toe nails from the ceiling joist to top plate in accordance with this schedule. The toe nail on the opposite side of the rafter shall not be required.

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Wood Stud Walls

IRC R602.3.1 – Stud Size, Height & Spacing

- Per IRC Tables R602.3(5) or (6)

STUD SIZE (inches)	Laterally unsupported stud height* (feet)	BEARING WALLS			NONBEARING WALLS	
		Maximum spacing where supporting a roof-ceiling assembly or a habitable attic assembly, only (inches)	Maximum spacing where supporting one floor, plus a roof-ceiling assembly or a habitable attic assembly (inches)	Maximum spacing where supporting two floors, plus a roof-ceiling assembly or a habitable attic assembly (inches)	Maximum spacing where supporting one floor height* (inches)	Maximum spacing (inches)
2 x 3 ¹	---	---	---	---	10	16
2 x 4	10	24 ¹	16 ¹	---	24	14, 24
3 x 4	10	24	24	---	24	14, 24
2 x 5	10	24	24	---	24	16, 24
2 x 6	10	24	24	16	24	20, 24

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Wood Stud Walls

STUD HEIGHT	SUPPORTING	STUD SPACING ^a	ULTIMATE DESIGN WIND SPEED				
			115 mph ^b				
			130 mph ^b	140 mph ^b			
11 ft	Roof only	12 in	2 x 4	2 x 4	2 x 4	2 x 4	2 x 4
		16 in	2 x 4	2 x 4	2 x 4	2 x 6	2 x 4
		24 in	2 x 6	2 x 6	2 x 6	2 x 6	2 x 6
	Roof and one floor	12 in	2 x 4	2 x 6	2 x 4	2 x 6	2 x 6
		16 in	2 x 6	2 x 6	2 x 6	2 x 6	2 x 6
		24 in	2 x 6	2 x 6	2 x 6	2 x 6	2 x 6
12 ft	Roof only	12 in	2 x 4	2 x 4	2 x 4	2 x 4	2 x 4
		16 in	2 x 4	2 x 6	2 x 6	2 x 6	2 x 6
		24 in	2 x 6	2 x 6	2 x 6	2 x 6	2 x 6
	Roof and one floor	12 in	2 x 4	2 x 6	2 x 6	2 x 6	2 x 6
		16 in	2 x 6	2 x 6	2 x 6	2 x 6	2 x 6
		24 in	2 x 6	2 x 6	2 x 6	2 x 6	2 x 6

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Wood Stud Walls

IRC R602.3.2 – Top Plate

- Walls shall be capped with double top plate
- 2" nominal plates
- Must overlap at corners and intersections
- Offset end joints 24"

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Drilling & Notching

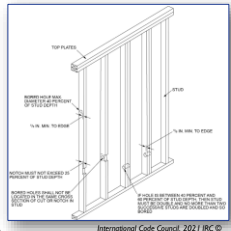

IRC R602.6

Notches:

- Exterior ≤ 25% width
- Bearing ≤ 25% width
- Partition ≤ 40% width

Drilling:

- Edge ≥ 5/8"
- Ø ≤ 40% width (single)
- Ø ≤ 60% width (double)

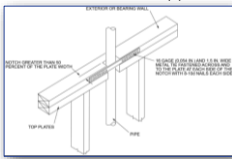




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Top Plate Notching

IRC R602.6.1

- If > 50% of top plate width is notched or drilled...
- Provide a 1.5" wide x 16ga. galvanized metal tie
- Fasten to either side w/ (8) 10d nails

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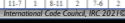
Headers

IRC Tables R602.7(1), (2) & (3)

**TABLE R602.7(1)
ORDER SPANS* AND HEADER SPANS* FOR EXTERIOR BEARING WALLS
(Maximum spans for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir, and required number of jack studs)**

GROUND SNOW LOAD (psf)

GIRDERS AND HEADERS SUPPORTING	SIZE	Building width (feet)																	
		10				12				15									
		12	24	36	48	12	24	36	48	12	24	36							
Roof and ceiling Roof and ceiling	12x4	4-0	1	3-11	2	5-7	2	5-5	1	2-8	2	5-3	2	3-0	2	2-4	2	2-0	2
	12x6	3-3	2	3-11	2	3-3	2	4-4	2	3-4	2	2-10	2	3-10	2	3-6	2	2-6	3
	12x10	6-0	2	4-8	2	3-11	2	2-5	2	4-0	2	2-4	3	4-7	2	3-6	3	3-0	3
	12x12	8-1	2	5-0	2	4-0	3	4-1	2	4-8	2	3-11	3	5-0	2	4-2	3	3-6	3
	22x4	4-0	1	3-1	1	2-7	1	3-5	1	2-7	1	3-0	1	2-4	1	2-0	1	2-0	1
	22x6	6-0	1	4-7	1	3-10	1	3-11	1	3-11	1	3-3	2	4-6	1	3-6	2	2-11	2
	22x8	8-0	1	5-0	1	4-10	2	4-0	1	5-0	2	4-2	2	5-0	1	4-0	2	3-9	2
	22x10	9-0	1	6-10	2	5-9	2	7-8	2	5-11	2	4-11	2	6-9	2	5-3	2	4-5	2
	22x12	10-7	2	8-1	2	6-10	2	9-0	2	6-11	2	5-10	2	8-0	2	6-2	2	5-2	3
	32x4	4-0	1	3-0	1	2-3	1	2-3	1	2-3	1	2-3	1	2-3	1	2-3	1	2-3	1
	32x6	6-0	1	4-0	1	3-0	1	3-0	1	3-0	1	3-0	1	3-0	1	3-0	1	3-0	1
	32x8	8-0	1	5-0	1	4-0	1	4-0	1	4-0	1	4-0	1	4-0	1	4-0	1	4-0	1
32x10	10-0	1	6-0	1	5-0	1	5-0	1	5-0	1	5-0	1	5-0	1	5-0	1	5-0	1	
32x12	12-0	1	7-0	1	6-0	1	6-0	1	6-0	1	6-0	1	6-0	1	6-0	1	6-0	1	
42x4	4-0	1	3-0	1	2-0	1	2-0	1	2-0	1	2-0	1	2-0	1	2-0	1	2-0	1	
42x6	6-0	1	4-0	1	3-0	1	3-0	1	3-0	1	3-0	1	3-0	1	3-0	1	3-0	1	
42x8	8-0	1	5-0	1	4-0	1	4-0	1	4-0	1	4-0	1	4-0	1	4-0	1	4-0	1	
42x10	10-0	1	6-0	1	5-0	1	5-0	1	5-0	1	5-0	1	5-0	1	5-0	1	5-0	1	
42x12	12-0	1	7-0	1	6-0	1	6-0	1	6-0	1	6-0	1	6-0	1	6-0	1	6-0	1	

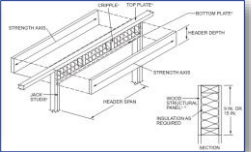


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Box Headers

IRC Table R602.7.3

SIZE	TABLE R602.7.3 GIRDER AND HEADER SPANS ¹ FOR OPEN PORCHES (Maximum span for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir) ²							
	SUPPORTING ROOF				SUPPORTING FLOOR			
	Ground Snow Load (psf)							
	30				70			
	8		14		8		14	
	Depth of Porch ³ (ft/ft)							
2-2 x 6	7-0	7-8	6-2	4-8	5-4	4-0	6-4	4-0
2-2 x 8	10-1	7-7	8-3	6-2	7-1	5-4	8-5	6-4
2-2 x 10	12-4	9-4	10-1	7-7	8-0	6-7	10-4	7-9
2-2 x 12	14-4	10-10	11-8	8-10	10-1	7-8	11-11	9-0



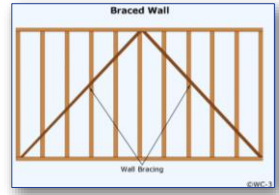
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Wall Bracing

IRC R602.10

- Key Terminology:
 - Wall Bracing
 - Braced Wall Line (BWL)
 - Braced Wall Panel (BWP)
 - Length
 - Spacing



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B. Wall Bracing

Braced Wall Panels (R602.10.4):

- Intermittent Bracing (12 methods)
- Continuous Sheathing (4 methods)




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METHOD/MATERIAL	MINIMUM THICKNESS	CONNECTION/DETAIL	
		FRAME	SPACING
LB Lath & plaster	1/4" x wood or approved metal strip at 45° to 90° angles for maximum 16" stud spacing	Wood stud and top and bottom plates	Wood stud and top and bottom plates
BWP Diagonal wood bracing	1/2" x 1" nominal for maximum 16" stud spacing	2x4@2' spacing or 2x6@1.5' spacing	Per stud
WSP Wood structural panel (See Section B603)	3/4"	Staggered sheathing per Table B603.3.1 or B603.3.2	4" edges 12" field
CS-WSP Wood structural panel (See Section B603)	3/4"	See Section B603.3.2	4" at panel edges 12" at intermediate supports 4" at board wall panel end panel
SB Shear blocking	1/2" x 1/2" x 4" max. maximum 16" stud spacing	1/2" x 1/2" x 4" max. 16" stud spacing	7" edges 47" field
CB Cypress board	1/2"	See Section B603.3.2	7" edges 47" field
PS Particulate sheathing (See Section B603)	1/2" or 1/4" for maximum 16" stud spacing	See Section B603.3.2	7" edges 47" field
PCP Particulate cement plaster	See Section B603.3.2 for maximum 16" stud spacing	1/2" x 1/2" x 4" max. 16" stud spacing	7" edges 47" field
BPS Block/brick masonry	1/2" for maximum 16" stud spacing	1/2" x 1/2" x 4" max. 16" stud spacing	4" edges 47" field
ABW Aluminum braced wall	1/2"	See Section B603.3.1	See Section B603.3.1

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Wall Bracing

IRC R602.10.1 – Braced Wall Lines

- Length = "The length of a (BWL) shall be the distance between its ends. The end of a (BWL) shall be the intersection with a perpendicular (BWL), an angled (BWL), or an exterior wall..."

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Wall Bracing

IRC R602.10.1 – Braced Wall Lines

- Spacing → IRC Table R602.10.1.3

APPLICATION	CONDITION	BUILDING TYPE	BRACED WALL LINE SPACING CRITERIA		
			Maximum Spacing	Exception to Maximum Spacing	
Wind bracing	Ultimate design wind speed < 140 mph	Detached, townhouse	60 feet	None	
		SDC A – C	Detached	Use wind bracing	
		SDC A – B	Townhouse	Use wind bracing	
Seismic bracing	SDC C	Townhouse	35 feet	Up to 50 feet when length of required bracing per Table R602.10.3(3) is adjusted in accordance with Table R602.10.3(4).	
			Up to 35 feet to allow for a single room not to exceed 900 square feet. Spacing of all other braced wall lines shall not exceed 25 feet.		
		SDC D, D, D, D	Detached, townhouses, one- and two-story only	25 feet	Up to 35 feet when length of required bracing per Table R602.10.3(3) is adjusted in accordance with Table R602.10.3(4).
		SDC D, D, D, D	Detached, townhouse	25 feet	Up to 35 feet when length of required bracing per Table R602.10.3(3) is adjusted in accordance with Table R602.10.3(4).

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Wall Bracing

IRC R602.10.1 – Braced Wall Lines

- Location of BWP along BWL
 - No more than 2/3 of BWP length can be located along one side of BWL
 - BWP can be offset 4-feet to either side of BWL

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Wall Bracing

IRC R602.10.1 – Braced Wall Lines

- Angled Walls:
 - Maximum diagonal length of 8-feet
 - If > 8-feet, shall be considered a separate BWL

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Wall Bracing

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Wall Bracing

IRC R602.10.2 – Braced Wall Panels

- Shall be...
 - Full-height sections
 - No vertical/horizontal offsets
 - Placed along BWL
- Location:
 - w/in 10-feet from each end
 - Spacing ≤ 20-feet edge-to-edge
 - BWL ≤ 16-feet → 2 BWP of any length or one 4-foot BWP
 - BWL > 16-feet → 2 BWP

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Wall Bracing

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Wall Bracing

SDC D₀, D₁, D₂:

- SDC D₀, D₁, D₂ → at each end, or...
 - 2-foot panel on each side
 - 1,800# holdown
- Floors or roofs not laterally supported by braced walls: **6 feet max.**

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Wall Bracing

Required Length of Bracing (R602.10.3):

- Min. Length of BWPs on **each** BWL

Mixing (R602.10.4.1):

- From story to story → **Any method**
- From BWL to BWL → **Intermittent only**
- **Not** allowed **within a BWL** (SDC 'D₀' or above)

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Wall Bracing

Wind Only – Tables R602.10.3(1) & (2)

- SDC A and B – All structures
- SDC C – Detached structures

Wind & Seismic – Tables R602.10.3(1) – (4)

- SDC C – Townhouses
- SDC D – All structures




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Wall Bracing

8 Steps to Verifying Bracing:

1. What bracing method is being used?
2. Braced length requirement – Wind
3. Apply wind adjustment factors.
4. Braced length requirement – Seismic
5. Apply seismic adjustment factors.
6. What braced wall length controls?
7. BWL locations & spacing
8. BWP minimum widths, locations & spacing

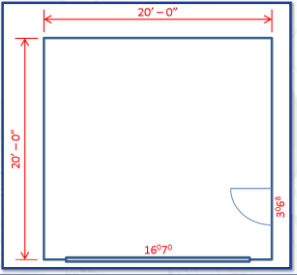
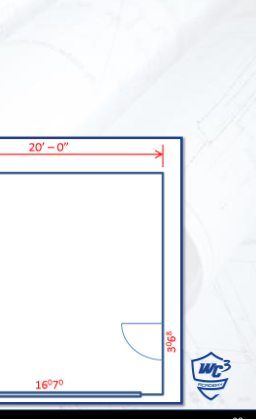

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Example – Detached Garage

Given:

- 20'x20' footprint
- 8' wall height
- 4:12 roof pitch
- Mfr. Trusses
- WSP
- Wind: 115mph, Exposure 'B'
- SDC 'D2'

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IRC Chapter 7
Wall Coverings

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Wall Coverings

IRC R702 – Interior Coverings

- Interior Plaster (R702.2)
- Gypsum (R702.3)*
- Ceramic Tile (R702.4)
- Other Finishes (R702.5)
- Wood Shake/Shingles (R702.6)
- Vapor Retarders (R702.7)*

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Gypsum Application

IRC R702.3.5

- Edges shall occur over framing members, except those that are perpendicular to framing
- Shall not be installed where it is directly exposed to weather or to water
- Fastening per **IRC Table R702.3.5***
- Type W or S screws → shall penetrate wood $\geq 5/8"$

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Gypsum Application

TABLE R702.3.5 MINIMUM THICKNESS AND APPLICATION OF GYPSUM BOARD AND GYPSUM PANEL PRODUCTS

THICKNESS OF GYPSUM BOARD OR GYPSUM PANEL PRODUCTS (INCHES)	APPLICATION	DIRECTION OF GYPSUM BOARD OR GYPSUM PANEL PRODUCTS TO FRAMING	MAXIMUM SPACING OF FASTENERS (INCHES)	SIZE OF NAILS FOR APPLICATION TO WOOD FRAMING*	
				Nails†	Screws†
Application without adhesive					
1/2	Ceiling‡	Perpendicular	16	7	12
	Wall	Either direction	16	8	16
5/8	Ceiling‡	Perpendicular	18	7	12
	Wall	Either direction	24	8	12
1	Ceiling‡	Perpendicular	16	7	12
	Wall	Either direction	16	8	16
5/8	Ceiling‡	Perpendicular	24	7	12
	Wall	Either direction	24	8	12
1	Type X or garage ceiling beneath habitable rooms	Perpendicular	24	6	6
	Wall	Either direction	16	8	16

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Gypsum Application

IRC R702.3.7 – Water-Resistant

- If used as base or backer for ceramic tile or other nonabsorbent finish...
- ASTM C1178, C1278 or C1396
- Shall not be installed over Class I or II vapor retarder in shower or tub compartment
- Cut or exposed edges shall be sealed per Mfr




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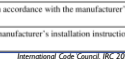
Vapor Retarders

R702.7:

- Classified per IRC Table R702.7(1)
- Required on the interior side of frame walls per IBC Table R702.7(2)
- Exceptions:
 - Basement walls or below-grade portions of walls
 - Climate Zones 1, 2 & 3

TABLE R702.7(1) VAPOR RETARDER MATERIALS AND CLASSES	
ACCEPTABLE MATERIALS	
I	Sheet polyethylene, nonperforated aluminum foil or other approved materials with a perm rating less than or equal to 0.1.
II	Kraft-faced fiberglass bats, vapor retarder paint or other approved materials applied in accordance with the manufacturer's installation instructions for a perm rating greater than 0.1 and less than or equal to 1.0.
III	Latex paint, enamel paint or other approved materials applied in accordance with the manufacturer's installation instructions for a perm rating greater than 1.0 and less than or equal to 10.0.

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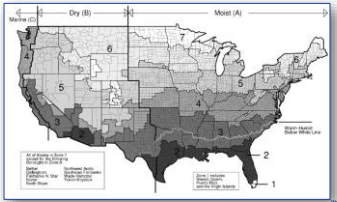



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Vapor Retarders

CLIMATE ZONE	TABLE R702.7(2) VAPOR RETARDER OPTIONS		
	CLASS I*	CLASS II*	CLASS III
1, 2	Not Permitted	Not Permitted	Permitted
3, 4 (except Marine 4)	Not Permitted	Permitted†	Permitted
Marine 4, 5, 6, 7, 8	Permitted†	Permitted†	See Table R702.7(3)



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Vapor Retarders

CLIMATE ZONE	TABLE R702.7(3) CLASS III VAPOR RETARDERS PERMITTED FOR**	
	VENTILATED	NON-VENTILATED
Marine 4	Vented cladding over wood structural panels.	
	Vented cladding over fiberboard.	
	Vented cladding over gypsum.	
5	Continuous insulation with R-value ≥ 2.5 over 2 x 4 wall.	
	Continuous insulation with R-value ≥ 2.75 over 2 x 6 wall.	
	Vented cladding over wood structural panels.	
6	Vented cladding over fiberboard.	
	Vented cladding over gypsum.	
	Continuous insulation with R-value ≥ 3 over 2 x 4 wall.	
7	Continuous insulation with R-value ≥ 11.25 over 2 x 4 wall.	
	Continuous insulation with R-value ≥ 10 over 2 x 6 wall.	
	Continuous insulation with R-value ≥ 13 over 2 x 4 wall.	
8	Continuous insulation with R-value ≥ 12.5 over 2 x 4 wall.	
	Continuous insulation with R-value ≥ 20 over 2 x 6 wall.	

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Wall Coverings

IRC R703 – Exterior Covering

- **General (R703.1)***
- **WRB (R702.2)***
- **Cladding Thickness (R703.3)***
- **Flashing (R703.4)***
- Wood Siding (R703.5)
- Wood Shakes/Shingles (R703.6)
- **Exterior Plaster (R703.7)***
- Attached Masonry Veneer (R703.8)

- EIFS (R703.9)
- Fiber Cement Siding (R703.10)
- Vinyl Siding (R703.11)
- Adhered Masonry Veneer (R703.12)
- Insulated Vinyl Siding (R703.13)
- Polypropylene Siding (R703.14)
- Cladding Over Foam (R703.15-17)






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Wall Coverings

IRC R703.1 – General

- **Water Resistance:** Constructed to prevent the accumulation of water within the wall assembly by...
 - Providing water-resistive barrier (WRB) behind exterior cladding, and...
 - Providing a means of draining to the exterior
- Coverings and backing materials must be capable of withstanding wind loads per IRC Tables R301.2.1(1) and (2).




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WRB

IRC R703.2 Water-resistive barrier

- Not fewer than one layer of WRB applied to exterior studs or sheathing (with flashing)
- **WRB Materials:**
 - No. 15 felt complying with ASTM D226, Type I
 - ASTM E2556, Type I or II
 - ASTM E331 in accordance with Section R703.1.1
 - Other approved materials
- **No. 15 asphalt felt and water-resistive barriers complying with ASTM E2556:**
 - Applied horizontally with upper layer lapped over lower layer not less than 2 inches
 - Lapped not less than 6 inches where joints occur



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Cladding Thickness

SIDING MATERIAL	MINIMUM THICKNESS (inches)	JOINT TREATMENT	TYPE OF SUPPORTS FOR THE SIDING MATERIAL AND FASTENERS					
			Wood or metal structural panel sheathing into stud	Fiberboard sheathing into stud	Opposite sheathing into stud	From joists, sheathing into stud	Direct to studs	Number or spacing of fasteners
Anchored veneer: brick, concrete, masonry or stone (see Section R703.8)	2	Section R703.8	Section R703.8					
Adhered veneer: concrete, stone or masonry (see Section R703.12)	—	Section R703.12	Section R703.12					
Fiber cement siding (see Section R703.10.1)	7/8	Section R703.10.1	Ad common (2" x 0.113")	Ad common (2" x 0.113")	Ad common (2" x 0.113")	Ad common (2" x 0.113")	Ad common (1 1/2" x 0.099")	6" panel edges 12" inter. sp.
Lap siding (see Section R703.10.2)	7/8	Section R703.10.2	Ad common (2" x 0.113")	Ad common (2" x 0.113")	Ad common (2" x 0.113")	Ad common (2" x 0.113")	Ad common (2" x 0.113")	Note f
Hardboard panel siding (see Section R703.5)	7/8	—	0.120" nail (chank) with 0.225" head	0.120" nail (chank) with 0.225" head	0.120" nail (chank) with 0.225" head	0.120" nail (chank) with 0.225" head	0.120" nail (chank) with 0.225" head	6" panel edges 12" inter. sp.
Hardboard lap siding (see Section R703.5)	7/8	Note e	0.090" nail (chank) with 0.240" head	0.090" nail (chank) with 0.240" head	0.090" nail (chank) with 0.240" head	0.090" nail (chank) with 0.240" head	0.090" nail (chank) with 0.240" head	Stems or nails spacing 2 per 12" heading

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Flashing

IRC R703.4 – Flashing:

- Shall consist of corrosion-resistant flashing, or...
- Self-adhered membrane per AAMA 711, or...
- Fluid-applied membranes per AAMA 714.
- Shall prevent water entry into wall cavity.



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Flashing

IRC R703.4 – Flashing:

- Locations:
 - Exterior window and door openings.
 - At the intersection of chimneys or other masonry construction with frame or stucco walls.
 - Under and at the ends of masonry, wood or metal copings and sills.
 - Continuously above all projecting wood trim.
 - Where exterior porches, decks or stairs attach.
 - At wall and roof intersections.
 - At built-in gutters.



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Exterior Plaster

IRC R703.7

- Installation per ASTM C 926 and ASTM C1063
 - Lath:
 - Lath & attachments shall be corrosion-resistant
 - Attach lath at 6" o.c.
 - Plaster:
 - At least 3 coats over metal or wire lath
 - At least 2 coats over masonry or concrete
 - Other:
 - At least 2 layers of Grade D paper
 - Weep screeds at or below foundation line (2"-4" above grade)

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END OF MODULE 7



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MODULE 8




*IRC Chapters 8, 9 & 10:
Roof/Ceiling Construction; Roof
Assemblies; Chimneys &
Fireplaces*



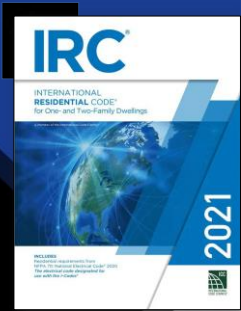

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LEARNING OBJECTIVES

1. Understand the requirements of roof-ceiling construction.
2. Become familiar with the requirements for roof assemblies.
3. Know how to use joist and rafter span charts.







2



IRC Chapter 8

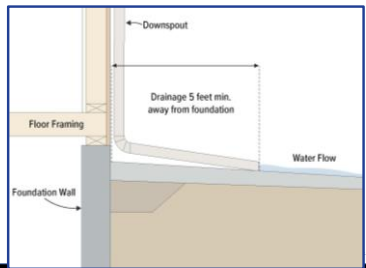

14% Roof/Ceiling Construction

3

Roof Drainage

IRC R801.3





4

Sawn Lumber

IRC R802.1.1

- Sawn lumber shall be identified by a grade make of an accredited agency
- Design values must be certified by a body complying with **DOC PS 20**




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Fire-Retardant

IRC R802.1.5

- Fire-retardant-treated wood (FRTW) shall have a listed frame spread index of **25 or less**
- Panels shall be labeled
- Strength adjustments shall be made



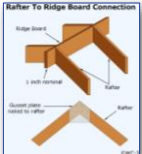



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Framing Details

IRC R802.3

- “Rafters shall be framed to a ridge board or to each other with a gusset plate as a tie”
- If roof pitch < 3:12, a ridge beam (R802.4.4)

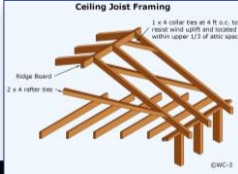

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Framing Details

IRC R802.3

- Ceiling joists or rafter ties shall be connected to rafters (otherwise an engineered ridge beam)
- Collar ties or ridge straps shall be connected in the upper third of the attic space

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Rafter Spans

Example #1: 2x6 Hem-Fir #3 @ 24" o.c.

TABLE R802.4.1(1) - continued
RAFTER SPANS FOR COMMON LUMBER SPECIES (Ground snow load = 20 psf, ceiling not attached to rafters, L/Δ ≤ 180)

RAFTER SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 psf						DEAD LOAD = 20 psf					
		2 x 4		2 x 6		2 x 8		2 x 4		2 x 6		2 x 8	
		(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)
24	Douglas fir-larch	S5	9-1	14-8	18-10	23-9	None D	9-1	13-3	18-10	20-7	23-10	
	Douglas fir-larch	#1	8-7	12-6	15-10	18-5	22-8	7-5	10-10	13-9	16-9	19-6	
	Douglas fir-larch	#2	8-2	11-11	15-1	18-5	21-4	7-0	10-4	13-0	15-11	18-6	
	Douglas fir-larch	#3	6-2	9-1	11-6	14-1	16-3	5-4	7-10	10-0	12-2	14-1	
	Hem-fir	S5	8-7	13-6	17-10	22-9	None D	8-7	12-10	16-3	19-10	23-0	
	Hem-fir	#1	8-8	12-8	15-8	18-2	22-2	7-4	10-9	13-7	16-7	19-3	
	Hem-fir	#2	7-11	11-7	14-8	17-10	20-9	6-10	10-0	12-8	15-6	17-11	
	Hem-fir	#3	6-1	8-11	11-3	13-8	15-11	5-3	7-8	9-9	11-10	13-9	
	Southern pine	S5	8-11	14-7	18-6	23-8	None D	8-11	13-10	17-6	20-10	24-8	
	Southern pine	#1	8-7	12-9	16-2	18-11	22-6	7-5	11-1	14-0	16-5	19-0	
	Southern pine	#2	7-4	11-0	13-11	16-6	19-6	6-4	9-6	12-1	14-4	16-10	
	Southern pine	#3	5-8	8-4	10-6	12-9	15-1	4-11	7-3	9-1	11-0	13-1	
Spruce-pine-fir	S5	8-5	13-1	17-5	21-8	25-2	8-4	12-2	15-4	18-9	21-9		
Spruce-pine-fir	#1	8-0	11-9	14-10	18-2	21-0	6-11	10-2	12-10	15-8	18-3		
Spruce-pine-fir	#2	8-0	11-9	14-10	18-2	21-0	6-11	10-2	12-10	15-8	18-3		
Spruce-pine-fir	#3	6-1	8-10	11-3	13-8	15-11	5-3	7-8	9-9	11-10	13-9		



Rafter Spans

Example #2: 2x6 Hem-Fir #3 @ 24" o.c.

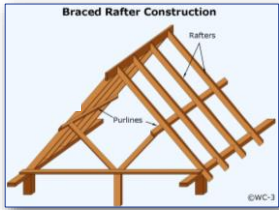
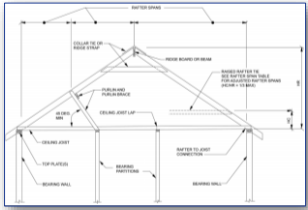
TABLE R802.4.1(1) - continued
RAFTER SPANS FOR COMMON LUMBER SPECIES (Ground snow load = 50 psf, ceiling not attached to rafters, L/Δ ≤ 180)

RAFTER SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 psf						DEAD LOAD = 20 psf					
		2 x 4		2 x 6		2 x 8		2 x 4		2 x 6		2 x 8	
		(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)
24	Douglas fir-larch	S5	6-8	10-5	13-2	16-1	18-9	6-7	9-4	12-7	14-11	17-3	
	Douglas fir-larch	#1	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1	
	Douglas fir-larch	#2	5-6	8-1	10-3	12-6	14-6	5-1	7-6	9-5	11-7	13-5	
	Douglas fir-larch	#3	4-3	6-2	7-10	9-6	11-1	3-11	5-8	7-3	8-10	10-3	
	Hem-fir	S5	6-4	9-11	12-9	15-7	18-0	6-4	9-4	11-9	14-5	16-8	
	Hem-fir	#1	5-9	8-5	10-8	13-0	15-1	5-4	7-9	9-10	12-0	13-11	
	Hem-fir	#2	5-4	7-10	9-11	12-1	14-1	4-11	7-3	9-2	11-3	13-0	
	Hem-fir	#3	4-1	6-9	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0	
	Southern pine	S5	6-7	10-4	13-8	16-4	19-3	6-7	10-0	12-8	15-2	17-10	
	Southern pine	#1	5-10	8-8	11-0	12-10	15-3	5-5	8-0	10-2	11-11	14-1	
	Southern pine	#2	5-0	7-5	9-5	11-3	13-2	4-7	6-11	8-9	10-5	12-3	
	Southern pine	#3	3-10	5-8	7-1	8-8	10-3	3-8	5-3	6-7	8-0	9-6	
Spruce-pine-fir	S5	6-2	9-6	12-0	14-8	17-1	6-0	9-10	11-2	13-7	15-9		
Spruce-pine-fir	#1	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2		
Spruce-pine-fir	#2	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2		
Spruce-pine-fir	#3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0		



Purlins

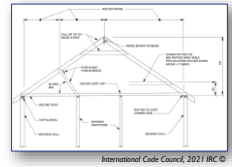
IRC R802.5.1: Purlins may be used to reduce rafter spans.



Collar Ties

IRC R802.4.6


- Not less than 1" x 4"
- Space at not less than 4'-0" o.c.
- Can be replaced by ridge straps
 - o 1.25" x 20 gage
 - o Nailed to the top edge with 3 or more 10d common



Ceiling Joists

CEILING JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 2 psf				
		WITHOUT CEILING JOIST SPANS				
		2 x 4	2 x 6	2 x 8	2 x 10	
12	Douglas fir-larch	SS	15-2	20-8	Note a	Note a
	Douglas fir-larch	R1	12-8	19-11	Note a	Note a
	Douglas fir-larch	R2	12-5	19-6	25-8	Note a
	Douglas fir-larch	R3	11-1	16-3	20-7	25-2
	Hem-fir	SS	12-5	19-6	25-8	Note a
	Hem-fir	R1	12-7	19-1	25-2	Note a
	Hem-fir	R2	11-7	18-2	24-0	Note a
	Hem-fir	R3	10-10	15-10	20-1	24-6
	Southern pine	SS	12-11	20-3	Note a	Note a
	Southern pine	R1	12-5	19-6	25-8	Note a
	Southern pine	R2	11-10	18-8	24-7	Note a
	Southern pine	R3	10-1	14-11	19-9	22-9
Spruce-pine-fir	SS	12-2	19-1	25-2	Note a	
Spruce-pine-fir	R1	11-10	18-8	24-7	Note a	
Spruce-pine-fir	R2	11-10	18-8	24-7	Note a	
Spruce-pine-fir	R3	10-10	15-10	20-1	24-6	

2x6 Southern Pine #1 @ 12"o.c.; no ceiling; uninhabitable without storage (Table R301.5)



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Joist and Rafters

IRC R802.5.2

- Fastened to top plate per **Table R602.3(1)**
- Ends shall be lapped not less than 3"
- Rafter ties shall not be less than 2"x4" installed @ 24-inches o.c.
- Blocking not less than utility grade lumber

Blocking between ceiling joists, rafters or trusses to top plate or other framing below

4-8d box (2 1/2" x 0.113"); or
3-8d common (2 1/2" x 0.131"); or
3-10d box (3" x 0.128"); or
3-3" x 0.131" nails


Toe nail

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Heel Connection

IRC R802.5.2

RAFTER SLOPE	RAFTER SPACING (inches)	GROUND SNOW LOAD (psf)											
		20						10					
		12	24	36	10	24	36	12	24	36	12	24	36
3:12	12	3	5	8	3	6	9	5	9	13	6	12	17
	16	4	7	10	4	8	12	6	12	17	8	15	21
	19-2	4	8	12	5	10	14	7	14	21	9	18	27
	24	5	10	15	6	12	18	9	17	26	12	23	34
4:12	12	3	4	6	3	5	7	4	7	10	5	9	13
	16	3	5	8	3	6	9	5	9	13	6	12	17
	19-2	3	6	9	4	7	11	6	11	16	7	14	21
	24	4	8	11	5	9	13	7	13	19	9	17	26
5:12	12	3	3	5	3	4	6	3	6	8	4	7	11
	16	3	4	6	3	5	7	4	7	11	5	9	14
	19-2	3	5	7	3	6	9	5	9	13	6	11	17
	24	3	6	9	4	7	11	6	11	16	7	14	21



Rafter To Joist Heel Connection
Simpson H2.5 or approved equal at each rafter.
Nails @ each ceiling joist to rafter connection table R802.5.1



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Bearing

IRC R802.6:

- Ends of each rafter or ceiling joist shall have:
 - 1.5" bearing – wood or metal
 - 3" of bearing – concrete or masonry

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Notching

IRC R802.7

- Cutting, drilling, notching per R502.8.1, except:
 - Cantilevered rafters
 - Tapered ceiling joists

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Trusses

IRC R802.10 – Wood Trusses

- Drawings shall be provided to B.O. and approved prior to installation.
- Drawings shall be provided with shipment of trusses.
- Truss drawings shall include...
 - Slope/depth, span and spacing
 - Location of all joints
 - Required bearing widths
 - Design loads
 - Adjustment factors (i.e. CD)
 - Reactions
 - Connector type
 - Lumber size, specifies and grade
 - Calculated deflections
 - Maximum axial forces
 - Required permanent truss bracing

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Uplift

IRC R802.11.1

If forces ≤ 200 pounds, per fastener schedule

RAFTER OR TRUSS SPACING (inches)	RAFTER OR TRUSS SPACING (inches)	TABLE R802.11.1 RAFTER OR TRUSS UPLIFT CONNECTION FORCES FROM WIND (AS SET) (POUNDS PER CONNECTION) EXPOSURE B											
		Ultimate Design Wind Speed V_w , mph				100				140			
		10	15	20	30	10	15	20	30	10	15	20	30
12" o.c.	12	48	43	39	33	70	64	59	50	122	113	104	88
	18	59	52	46	38	80	73	67	56	142	131	120	101
	24	71	62	55	45	88	80	73	61	157	145	133	111
	30	79	69	61	50	93	84	77	64	165	152	140	116
	36	86	75	66	54	97	88	80	67	170	156	143	119
	42	92	80	70	57	100	91	83	69	174	160	147	122
	48	97	85	74	60	103	94	86	71	177	163	150	124
	54	101	89	77	62	105	96	88	73	180	165	152	126
	60	105	92	80	64	107	98	90	75	182	167	154	127
	66	108	95	83	66	109	100	92	77	184	169	156	128
	72	111	97	85	67	110	101	93	78	185	170	157	129
	78	114	100	87	69	111	102	94	79	186	171	158	130
18" o.c.	12	64	57	51	42	93	84	77	64	142	131	120	101
	18	77	68	61	50	100	91	83	69	157	145	133	111
	24	88	77	69	56	105	96	88	73	165	152	140	116
	30	96	84	75	60	108	99	91	76	170	156	143	119
	36	102	89	80	63	110	101	93	78	174	160	147	122
	42	107	93	84	65	112	103	95	80	177	163	150	124
	48	111	96	87	67	114	105	97	81	179	165	152	126
	54	114	99	89	68	115	106	98	82	180	167	154	127
	60	117	101	91	70	116	107	99	83	181	168	155	128
	66	119	103	93	71	117	108	100	84	182	169	156	129
	72	121	105	95	72	118	109	101	85	183	170	157	130
	78	123	106	96	73	119	110	102	86	184	171	158	131

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Roof Sheathing

IRC Table R803.1:

- Lumber used as roof sheathing shall conform to Table R803.1.
- SDC D₂ → Spaced lumber sheathing is not allowed

TABLE R803.1 MINIMUM THICKNESS OF LUMBER ROOF SHEATHING	
RAFTER OR BEAM SPACING (inches)	MINIMUM NET THICKNESS (inches)
24	1/8
48"	1 1/2 T & G
60"	
72"	




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Roof Ventilation

IRC R806

- Cross ventilation is required for separate enclosed attic space
- Vent Area $\geq 1/150$ of vented space, or...
- $\geq 1/300$ if vapor retarder is installed on warm side of ceiling in Climate Zones 6, 7 and 8
- AND 40-50% is in upper portion of roof


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Attic Access

IRC R807

- Required for areas $> 30ft^2$ and height of 30"
- Opening Requirements:
 - Located in hallway or readily accessible location
 - 22"x30" & shall allow removal of largest appliance
 - Min. of 30" unobstructed headroom

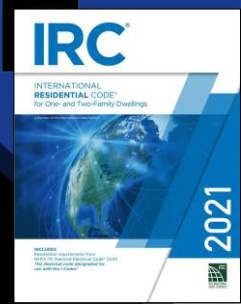


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IRC Chapter 9

Roof Assemblies

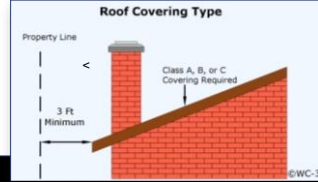


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Roof Covering

IRC R902.1

- Class A, B or C roofing is required in areas designated by law or when the edge of the roof is **< 3-feet** from a lot line.
- Listed per ASTM E108 or UL 790

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Flashing

IRC R903.2

- Installed in a manner that prevents moisture from entering the wall and roof
- Required at wall and roof intersections, wherever there is a change in roof slope or direction, and around openings.
- Crickets or saddles → on ridge side of penetration more than **30-inches** in width



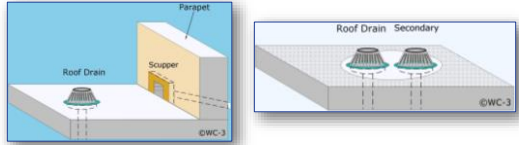
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Drainage

IRC R903.4

- Unless sloped to drain over roof edges...
 - Drains at low point of roof
 - Secondary drains shall be 2" above
 - Scuppers **3 times the size** shall be 2" above



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Roof Coverings

IRC R905 – Requirements for Roof Coverings

- **Underlayment***
- **Asphalt shingles***
- Clay & concrete tile
- Metal roof shingles
- Mineral-surfaced roll roofing
- Slate shingles
- Wood shingles
- Wood shakes
- Built-up roofs
- Metal roof panels
- Modified bitumen roofing
- Thermoset single-ply roofing
- Thermoplastic single-ply roofing
- Sprayed polyurethane foam roofing
- Liquid-applied roofing
- Photovoltaic shingles
- Building-integrated PV roof panels



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Underlayment

IRC R905.1.1:

- Shall comply with ASTM D226, D1970, D4869 & D6757
- Classification → IRC Table 905.1.1(1)
- Applied → IRC Table 905.1.1(2)
- Attached → IRC Table 905.1.1(3)

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TABLE R905.1.1(1) UNDERLAYMENT TYPES			
ROOF COVERING	SECTION	AREAS WHERE WIND DESIGN IS NOT REQUIRED OR IN ACCORDANCE WITH FIGURE R901.2.1.1	AREAS WHERE WIND DESIGN IS REQUIRED OR IN ACCORDANCE WITH FIGURE R901.2.1.1
Asphalt shingles	R905.2	ASTM D226 Type I or II	ASTM D226 Type II
		ASTM D4869 Type I, II, III or IV	ASTM D4869 Type III or Type IV
		ASTM D6757	
Clay and concrete tile	R905.3	ASTM D226 Type II	ASTM D226 Type II
		ASTM D6308 Type I	
Metal roof shingles	R905.4	ASTM D226 Type II	ASTM D226 Type II
		ASTM D4869 Type I, II, III or IV	ASTM D4869 Type III or Type IV
Mineral-surfaced roll roofing	R905.5	ASTM D226 Type I or II	ASTM D226 Type II
		ASTM D4869 Type I, II, III or IV	ASTM D4869 Type III or Type IV
Slate and slate-type shingles	R905.6	ASTM D226 Type I	ASTM D226 Type II
		ASTM D4869 Type I, II, III or IV	ASTM D4869 Type III or Type IV
Wood shingles	R905.7	ASTM D226 Type I or II	ASTM D226 Type II
		ASTM D4869 Type I, II, III or IV	ASTM D4869 Type III or Type IV
Wood shakes	R905.8	ASTM D226 Type I or II	ASTM D226 Type II
		ASTM D4869 Type I, II, III or IV	ASTM D4869 Type III or Type IV

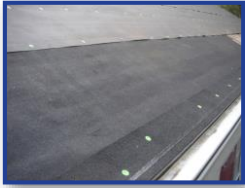
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Underlayment

IRC R905.1.2 – Ice Barriers

- Required in areas where there has been a history of ice forming along eaves
- Consists of...
 - ≥ 2 layers of underlayment cemented together, or...
 - A self-adhering polymer-modified bitumen sheet
- Extend from lowest edges of all roof surfaces to a point 24-inches inside the exterior wall line



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Asphalt Shingles

IRC R905.2

- Asphalt Shingles:
 - Roof slopes \geq 2:12
 - Double underlayment is required if $<$ 4:12
 - 12ga fasteners which **penetrate \geq 3/4"** into sheathing



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Asphalt Shingles

IRC R905.2

- Requirements for...
 - Materials
 - Fasteners
 - Attachment
 - Flashing
 - Requires a drip edge at eaves and rake:
 - 2" overlap, segment-to-segment
 - Extend 1/4" below sheathing
 - Extend 2" onto roof deck
 - Fastened at 12" o.c.



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Reroofing

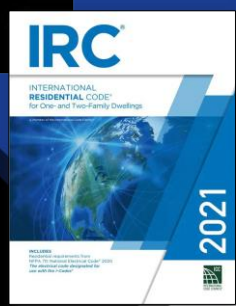
IRC R908:

- Roof Replacement:
 - Removal of existing layers of roof coverings down to the roof deck
- Roof Recover:
 - Additional layer of roofing over an existing roofing material
 - Limited to a single existing layer

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IRC Chapter 10

2% Chimneys & Fireplaces


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Chimney and Fireplace Clearances

Clearances from Combustible Materials:

- Fireplaces shall have a clearance from combustible materials **2-inches** from the front and sides and **4-inches** from the back (*R1001.11*)
- Chimneys shall have a minimum clearance of **2-inches** to combustibles. When located outside the exterior walls, the minimum airspace shall be **1-inch** (*R1003.18*)




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Fireplace Dimensions

IRC R1001.6 - Firebox Dimensions:

- Firebox → 20-inch depth, minimum
- The throat of the firebox shall be 8-inches minimum above the fireplace opening with an opening not less than 4-inches deep.
- Cross sectional area of the passageway above the firebox shall not be less than the cross-sectional area of the flue.




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Hearth Dimensions


Hearth and Hearth Extensions:

- Shall be constructed of non-combustible materials, no combustible materials shall be allowed on the underside of the hearth and hearth extensions.
- Thickness → **4-inches** minimum (*R1001.9.1*)
- Hearth Extension Thickness → **2-inches** minimum
- Hearth Extensions, minimum dimensions:
 - < 6 ft² → 16-inches in front and 8-inches on each side
 - > 6 ft² → 20-inches in front and 12-inches on each side



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Masonry Heaters


IRC R1002:

- Design standards:
 - Shall comply with ASTM E1602 *or* UL 1482 or CEN 15250:R1002.2.
- Floor:
 - Shall be **4-inches** minimum in thickness and be of noncombustible materials (R1002.3)
- Clearances:
 - Combustible materials shall not be within **36-inches** of the outside surface of a masonry heater



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Masonry Chimney


Footings & Foundations:

- Shall consist of concrete or masonry \geq 12-inches thick, and...
- Extend \geq 6-inches beyond foundation or support wall on all sides
- Placed 12-inches below grade or to frost depth, where applicable.



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Masonry Chimney


Seismic Requirements:

- Vertical reinforcing:
 - 40" wide \rightarrow (4) #4
 - > 40" wide \rightarrow two additional for each additional 40"
- Horizontal reinforcing: #2 ties at 18-inches o.c.
- Anchorage:
 - (2) 3/16" x 1" straps embedded 12-inches into chimney
 - Hooked around outer bars
 - Fastened to not less than (4) floor joists



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Masonry Chimney

Chimney Construction Above the Roof:

- IRC R1003.9: Chimneys shall...
 - Extend **2-feet** higher than any portion of the building within **10-feet**, but...
 - Be a minimum of **3-feet** above the highest point of the roof when the chimney passes through the roof.
- Crickets shall be provided where the dimension parallel to the ridgeline is > 30-inches.



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Factory-Built Chimneys

IRC R1005:

- *Decorative shroud*: Shall not be installed at the termination of the chimney, unless listed and labeled to do so.
- Where offsets are part of the design of the chimney no part of the design shall be at an angle more than **30-degrees**.
- Factory built fireplaces when passing through insulated material → an insulation shield shall be used.
 - When in an attic the shield shall terminate \geq 2-inches above the insulation



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Exterior Air Supply

IRC R1006:

- Exterior air intake shall not be located in...
 - Garage, or...
 - Basement
- Clearance:
 - Unlisted combustion air ducts within 5-feet of the duct outlet shall have a minimum **1-inch** clearance to combustible materials.
- Outlet:
 - Located on back, side, or outside of the firebox at a level of the hearth and not greater than **24-inches** from the firebox opening.



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END OF MODULE 8

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Module 1 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A two-family dwelling that is four stories in height shall fall under the provisions of which code?	IRC R101.2	IRC R101	2	International Residential Code	International Building Code		
Which of the following is exempt from a permit?	IRC R105.2 Electrical 3	IRC R105	3	retaining wall 5 feet in height	new deck 250 sf in area	replacing branch circuit overcurrent devices	a new water heater
Any _____ to existing structures are not permitted to cause the existing structure to be come unsafe.	IRC R102.7.1	IRC R102	4	repairs	additions	alterations	all of the above
The duties and powers of the building official include all of the following, except:	IRC R104.1	IRC R104	2	interpret the code	waive the code	enforce provisions of the code	adopt policies and procedures
For what period of time should records be retained?	IRC R104.7	IRC R104	1	the period required for the retention of public records	180 days	90 days	60 days
What is the permitted size of a 1-story detached accessory structure to be installed without a building permit?	IRC R105.2 Building 1	IRC R105	3	180 ft ²	250 ft ²	200 ft ²	150 ft ²
A prefabricated swimming pool ≤ 28" deep is exempt from a building permit	IRC R105.2 Building 7	IRC R105	2	TRUE	FALSE		
Where equipment replacement or repairs must be performed in an emergency situation, the permit application shall be submitted _____ to the B.O.	IRC R105.2.1	IRC R105	4	as soon as possible	the following day	within 48 hours	within the next business day
Work must commence on a building permit within ____ days of issuance.	IRC R105.3.2	IRC R105	3	60	120	180	90
A certificate of occupancy shall include all of the following information, except:	IRC R110.3	IRC R110	1	Issuance date	Address of the structure	Name of the owner	Name of the code official

Module 2 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the ultimate design wind speed for Utah?	IRC Figure R301.2(2)	IRC R301	1	105 mph	120 mph	125 mph	150 mph
Is a roof with a height of 47 feet permitted to use No. 8 wood screws with a wind speed of 175mph.	IRC R301.2.1.2 Exception	IRC R301	2	True	False		
Open terrain with scattered obstructions, including surface undulations or other irregularities that are generally less than 30 feet in height shall be classified as _____.	IRC R301.2.1.4 Item 2	IRC R301	3	Exposure A	Exposure B	Exposure C	Exposure D
Wind is the only load that needs to be considered when determining a lateral load path.	IRC R301	IRC R301	2	True	False		
A building is required to be engineered when it contains structural elements that exceed the limits of the IRC.	IRC R301.1.3	IRC R301	1	True	False		
Urban areas and wooded areas shall be classified as _____.	IRC R301.2.1.4 Item 1	IRC R301	2	Exposure A	Exposure B	Exposure C	Exposure D
What is the seismic design category for central New York?	IRC Figure R301.2(2)	IRC R301	1	A	B	C	D
What is the minimum uniformly distributed live load (uniform load) for fire escapes?	IRC Table R301.7	IRC R301	4	50	25	30	40
Stiff soil is classified as Site Class _____.	IRC R301.2.2.1	IRC R301	3	B	A	D	E
If a floodplain is located in an identified floodway, the design shall be done per ASCE _____.	IRC R301.2.4	IRC R301	4	10	52	28	24

Module 3 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the minimum fire separation distance for an exterior wall?	IRC Table R302.1(1)	IRC R302	2	5 feet	0 feet	2 feet	10 feet
For outside opening protection air intake/exhaust, openings shall be protected with corrosion-resistant screens, louvers or grilles having a minimum opening size of _____.	IRC R303.6	IRC R303	1	1/4 inch	1/2 inch	3/4 inch	1 inch
A common wall separating a townhouse with an NFPA-13R sprinkler system shall have a minimum rating of _____.	IRC 302.2.2 item 1	IRC 302	1	1 hour	1.5 hours	2 hours	3 hours
A parapet shall be provided for all of the following conditions except:	IRC 302.2.4 Item 2 exception	IRC 302	3	Class A	Class B	Class C roof covering	
A _____ inches thick door shall be provided between private garages and sleeping rooms.	IRC 302.5.1	IRC 302	4	1 3/8 inch	1 1/2 inch	1 5/8 inch	Not permitted
Where heat-producing devices are listed for lesser clearances, combustible insulation complying with the listing requirements shall be separated by _____.	IRC R302.14	IRC 302	1	whatever conditions are stipulated in the listing	3 inches	2 inches	1 inch
When the permitted roof eave projection is 4 inches maxes for a detached garages accessory to a dwelling unit, how close is the building permitted to be to the lot line?	IRC Table R302.1(1)	IRC R302	2	1 foot	2 feet	3 feet	4 feet
Habitable rooms shall have a minimum openable area to the outdoors of _____ of the floor area being ventilated.	IRC R303.1	IRC 303	1	4%	6%	8%	10%
Under which condition is mechanical ventilation required for a dwelling unit?	IRC R303.4	IRC 303	3	20 air changes per hour	10 air changes per hour	5 air changes per hour	
What is the minimum aggregate glazing for lighting in a habitable room?	IRC R303.1	IRC 303	4	2%	6%	4%	8%

Module 4 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the minimum required clearance to be provided in front of the shower compartment?	IRC Figure R307.1	IRC R307	1	24 inches	21 inches	18 inches	15 inches
The nonabsorbent finish provided for a shower shall be a minimum of _____ above the floor.	IRC R307.2	IRC R307	4	3 feet	4 feet	5 feet	6 feet
How many lighting outlets are required on a stairway of 5 risers?	IRC R303.7	IRC R303	2	2 outlets	1 outlet	not required	determined by the B.O.
What is the minimum floor area required for a kitchen?	IRC R304.1	IRC 304	1	70 SF	80 SF	90 SF	100 SF
What is the minimum ceiling height required for a laundry room?	IRC R305.1	IRC R305	3	7'-6"	7"	6'-8"	6"
All dwelling units are required to be provided with a water closet, lavatory, and shower.	IRC R306.1	IRC R306	1	True	False		
What is the minimum category classification of glazing for glazing in sliding glass patio doors, where the exposed area of one side is 8 square feet?	IRC Table R308.3.1(1)	IRC R308	2	Class I	Class II	Class III	Class IV
Glazing and fixed and operable panels of _____ shall be considered a hazardous location.	IRC R308.4.1	IRC R308	4	bifold doors	sliding doors	swinging doors	all of the above
Carports shall be provided with openings on not less than _____.	IRC R309.2	IRC R309	2	one side	two sides	three sides	four sides
What is the minimum clearance required between a bathtub and the water closet?	IRC Figure 307.1	IRC R307	2	12 inches	15 inches	18 inches	21 inches
What is the minimum required thickness for a piece of wired louvered glass that is 36 inches in length?	IRC R308.2	IRC R308	2	4/8 inch	3/16 inch	3/8 inch	5/8 inch

Module 5 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the minimum clear width that shall be provided for the egress door?	IRC R311.2	IRC R311	2	24 inches	32 inches	36 inches	40 inches
What is the minimum required width of hallways provided in dwelling units?	IRC R311.6	IRC R311	1	3 feet	4 feet	5 feet	6 feet
Which of the following locations is required to be provided with protection from decay?	IRC R317.1	IRC R317	4	wood framing members on concrete less than 8 inches from the ground	wood sheathing with a clearance of 6 inches from the ground	wood furring attached directly to the exterior masonry walls	all of the above
What is the minimum thickness required of concrete to be provided to foam plastics to eliminate a thermal barrier?	IRC R316.5.1	IRC R316	4	2 inches	1 3/8 inches	1 1/2 inches	1 inch
What is the minimum clear height required for egress doors?	IRC R311.2	IRC R311	2	72 inches	78 inches	84 inches	96 inches
A photoelectric smoke alarm has been installed in a house. What is the maximum horizontal distance from a cooking appliance it can be when installed?	IRC R314.3.1	IRC R314	1	6 feet	5 feet	4 feet	3 feet
Which of the following conditions triggers the requirements for carbon monoxide alarms to be installed in a dwelling unit?	IRC R315.2.1	IRC R315	4	A- an attached garage with openings that communicate with the dwelling unit	B- fuel-burning appliance(s) in the dwelling unit	neither A or B	either A or B
The minimum stroke width for address characters shall be _____.	IRC R319.1	IRC R319	3	1 inch	0.75 inches	0.5 inches	0.25 inches
When is a structure required to comply with the IBC for accessibility?	IRC R320.1	IRC R320	1	4 or more dwelling units or sleeping units in a single structure	all townhouses	3 condo units	a duplex
All of the following except _____ is required for a quality mark on pressure-preservative lumber:	IRC R317.2.1	IRC R317	3	type of preservative	standard to which it was treated	the maximum preservative retention	the end use for which the product was treated
What is the maximum vertical rise permitted between floor levels within a single-family dwelling?	IRC R311.7.3	IRC R311	3	196 inches	147 inches	151 inches	132 inches
What is the minimum required height to be provided for a guardrail provided for a balcony?	IRC R312.1.2	IRC R312	1	36 inches	24 inches	21 inches	18 inches
Solar panels located on a roof with a slope of 2:12 shall be located in a manner than provides two 3-foot-wide access paths.	IRC R324.6	IRC R324	2	True	False		
What is the minimum clear height below a mezzanine floor?	IRC R325.2	IRC R325	2	6'-8"	7'	7'-6"	8'
The surface burning characteristics of foam plastic that is 4 inches thick or less shall have a flame spread index of _____ and a smoke-developed index of not more than _____.	IRC R316.3	IRC R316	3	25, 450	50, 450	75, 450	100, 450

Module 6 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the load-bearing pressure of sedimentary rock?	IRC Table R401.4.1	IRC R401	3	12,000 psf	8,000 psf	4,000 psf	3,000 psf
The minimum compressive strength required for precast concrete is _____ for a minimum of _____.	IRC R402.3.1	IRC R402	3	2,000 psi, 30 days	3,500 psi, 15 days	5,000 psi, 28 days	8,000 psi, 28 days
The top surface of footings shall be level.	IRC R403.1.5	IRC R403	1	True	False		
A single story plus basement dwelling of light-frame construction must have a footing of _____ where the load bearing value of the soil is 3500 psi and a snow load of 20 psf.	IRC Table R403.1(1)	IRC R403	4	15x9	14x8	13x7	12x6
The foundations for single-story light-framed buildings under _____ square feet are not required to extend to frost depth.	IRC R403.1.4.1, Exception #1	IRC R403	2	400	600	900	1000
Joints for the moisture barrier provided for exterior foundation walls prior to backfilling shall be _____ minimum.	IRC R406.3.2	IRC R406	3	2 inches	4 inches	6 inches	8 inches
A vapor retarder with joists lapped not less than _____ shall be placed between the slab and the subgrade.	IRC R506.2.3	IRC R506	3	2 inches	4 inches	6 inches	8 inches
Crush stone footings are permitted in all of the following seismic design categories except?	IRC R403.4.1	IRC R403	4	Category A	Category B	Category C	Category D
A 6-foot-high plain masonry foundation wall subjected to 4 feet of unbalanced backfill of soil class is GC, must have a wall thickness of _____ nominal.	IRC Table R404.1.1(1)	IRC R404	2	6 inches	8 inches	10 inches	12 inches
What is the maximum span of Douglas-fir-larch #1 2x6 floor joist spaced at 19.2 inches on center, when the dead load is 20 in a living room?	IRC Table R502.3.1(2)	IRC R502	4	11 feet	10 feet 5 inches	9 feet 9 inches	8 feet 10 inches
The end of each girder shall have not less than _____ of bearing on wood.	IRC R502.6	IRC R502	1	1 1/2 inches	2 inches	2 1/2 inches	3 inches
What is the minimum thickness of lumber floor sheathing, where the floor joists are spaced 24 inches and installed diagonal to the joist?	IRC Table R503.1	IRC R503	2	11/16 inch	3/4 inch	5/8 inch	3/8 inch
Subflooring is permitted to be omitted where joist spacing does not exceed _____.	IRC R503.1.1	IRC R503	3	10 inches	12 inches	16 inches	18 inches
If four hold-down tension devices are used on a deck, they shall have an allowable tension capacity of not less than _____ pounds.	IRC R507.9.2	IRC R507	1	750	800	950	1000
Deck boards, stair treads, guards, and handrails that have wood shall be _____.	IRC R507.2.2.3	IRC R507	2	decay resilient	decay resistant	termite resilient	termite resistant

Module 7 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A _____ vapor retarder shall be used in Climate Zone Marine 4 on cladding for fiberboard.	IRC Tables R702.7(1-3)	IRC R702	1	Class III	Class II	Class I	
Asphalt felt used as a water barrier applied horizontally shall be lapped not less than _____ over the lower layer.	IRC R703.2	IRC R703	2	1 inch	2 inches	3 inches	4 inches
Interior nonbearing wall shall be permitted to be constructed with _____ inch by _____ inch studs.	IRC R602.5	IRC R602	4	2x10	2x8	2x5	2x3
The maximum nominal thickness of masonry veneer on wood framing in seismic category C shall be _____.	IRC Table R703.8(1)	IRC R703	3	3 inches	4 inches	5 inches	6 inches
Where the backing of masonry walls are bonded with adjustable wall ties, a wall tie shall be provided for each _____ of wall area.	IRC R606.13.2.2	IRC R606	3	4.67 square feet	3.57 square feet	2.67 square feet	1.98 square feet
Where 3/8 gypsum board is used as an interior ceiling covering and installed perpendicular to the framing member at 16 inches on center, the maximum spacing of screws shall be _____.	IRC Table R702.3.5	IRC R702	3	8 inches	10 inches	12 inches	16 inches
What is the minimum solid wall length the walls supporting the second story and a roof of light-framed construction in Seismic Category C?	IRC Table R606.12.2.1	IRC R606	3	35	30	25	20
What is the minimum plaster thickness for wire lath based gypsum plaster masonry?	IRC Table R702.1(1)	IRC R702	2	3/4 inch	5/8 inch	1/2 inch	7/8 inch
Each coat of cement plaster shall be kept in moist conditions for a minimum of _____ before the application of the next coat.	IRC R702.2.2.1	IRC R702	2	12 hours	24 hours	36 hours	48 hours
A stud in a bearing partition is permitted to be notched to a depth not exceeding _____ percent of its width.	IRC R602.6 Item 1	IRC R602	1	25	30	35	40
A wood stud double top plate shall be not less than _____ in nominal thickness.	IRC R602.3.2	IRC R602	3	1 inch	1 1/2 inches	2 inches	2 1/2 inches
Type S and Type W screws are approved to attached gypsum board and gypsum panels to wood framing.	IRC R702.3.5.1	IRC R702	1	TRUE	FALSE		
The maximum center to center stud spacing when supporting a roof is _____ where the stud size is 3x4.	IRC Table R602.3(5)	IRC R602	3	16 inches	20 inches	24 inches	36 inches
Townhomes in Seismic Design Category C <u>do not</u> need to use the seismic tables for determining the braced wall length along each braced wall line, and can simply refer to the wind tables.	IRC Table R602.10.3(3)	IRC Table R602.10.3(3)	2	TRUE	FALSE		
The maximum spacing of braced wall lines in Seismic Design Category B is _____.	IRC Table R602.10.1.3	IRC Table R602.10.1.3	4	25 feet	35 feet	20 feet	60 feet
Mullions shall be capable of resisting a load _____ the design pressure loads applied by the window assembly.	IRC R609.8.3	IRC R609	4	5 times	3 times	2.5 times	1.5 times

Module 8 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the minimum flame spread index for fire-retardant-treated wood used in roof framing?	IRC R802.1.5	IRC R802	1	25	50	75	100
A Class A, B, or C roof shall be installed where the edge of a roof is less than _____ from the lot line.	IRC R902.1	IRC R902	2	4 feet	3 feet	2 feet	1 foot
When a chimney penetration is _____ wide, a cricket shall be installed on the ridge side.	IRC R903.2.2	IRC R903	2	24 inches	30 inches	36 inches	48 inches
A hearth extension shall be not less than _____ inches in front of and not less than _____ inches beyond each side of the fireplace.	IRC R1001.10	IRC R1001	3	8, 16	16, 16	16, 8	8, 8
A minimum of _____ - 16d common nails shall be used at the heel connection of a rafter and ceiling joist when the rafter has a slope of 4:12, spacing of 24-inches on-center, the roof span is 24-feet, and the ground snow load is 30psf.	IRC Table R802.5.2(1)	IRC R802	3	7	8	9	13
Where Douglas fir-larch #3 ceiling joists create an uninhabitable attic without storage and are spaced at 12 inches on center, what is the maximum allowable span when 2x6 members are used?	IRC Table R802.4.1(1)	IRC R802	1	16 feet, 3 inches	11 feet, 1 inch	20 feet, 7 inches	15 feet, 10 inches
For stick-framed roofs, a ridge beam is required in lieu of a ridge board when the slope of the roof is less than _____.	IRC R802.3	IRC R802	3	1:12	2:12	3:12	4:12
Metal roof shingles may be installed on roof slopes that are _____ or greater.	IRC R905.4.2	IRC R905	1	3:12	2:12	1:12	1/2:12
The minimum number of fasteners per slate for slate shingles shall be _____.	IRC R905.6.5	IRC R905	3	4	3	2	1
What is the maximum roof rafter span for a 2x8's spaced at 19.2 inches on-center and consisting of Hem-fir #2 when a ceiling is attached and the roof live load equals 20 psf. (Assume a dead load of 10 psf.)	IRC Table R804.3.2.1(1)	IRC R804	2	12'-4"	13'-3"	16'-10"	16'-3"
An eave can overhang a maximum of _____.	IRC R804.3.2.1.1	IRC R804	4	12 inches	18 inches	20 inches	24 inches
What is the minimum thickness required for roof sheathing that is on a rafter spaced at 24 inches?	IRC Table R803.1	IRC R803	2	3/8 inch	5/8 inch	1 inch	1 1/2 inch
For stick-framed roofs, collar ties are to be placed within the upper third of the attic space at a maximum spacing of 2-feet on-center.	IRC R802.4.6	IRC R802	2	TRUE	FALSE		
What is the minimum clearance to combustibles for an unlisted combustion air duct supplying outside air to a factory-built fireplace?	IRC R1006.3	IRC R1006	1	1 inch	2 inches	3 inches	5 inches
Rafters and ceiling joists shall bear a minimum of _____ on concrete or masonry walls.	IRC R802.6	IRC R802	4	1 inch	1.5 inches	2 inches	3 inches
Which of the following Climate Zones is not required to install a vapor retarder on the warm-in-winter side of the ceiling?	IRC R806.2	IRC R806	1	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
The minimum dimensions for attic access openings shall be _____ inches by _____ inches.	IRC R807.1	IRC R807	4	30 by 20	22 by 24	30 by 30	22 by 30

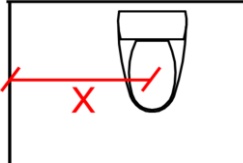
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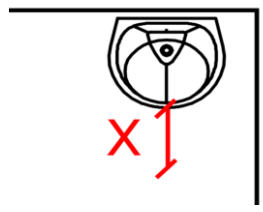
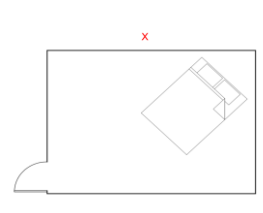
Question Text	Description	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A two-story slab on grade house of grouted masonry wall construction shall have a footing of _____ where the load bearing value of the soil is 3,000 psf and the snow load is 30 psf.		IRC Table R403.1(1)	IRC R403	1	12"x6"	15"x6"	17"x6"	24"x6"
What is the maximum roof rafter span of a member designation of 800S162-43, where the ground snow load is 20 psf and the rafter spacing is 24 inches O.K.?		IRC Table R804.3.2.1(1)	IRC R804	3	19' 9"	17' 0"	16' 1"	13' 7"
Attic ventilation openings shall have a maximum dimension of _____.		IRC R806.1	IRC R806	2	1/2 inch	1/4 inch	1/8 inch	1/16 inch
In Climate Zone 7, the net free ventilated area of a roof shall be _____ of the vented space where a vapor retarder has be installed.		IRC R806.2 Exception	IRC R806	4	1/150	1/200	1/250	1/300
What is the minimum clearance required between a bathtub and the front of a water closet?		IRC Figure 307.1	IRC R307	4	12 inches	15 inches	18 inches	21 inches
A 9-foot-high plain masonry foundation wall subjected to 7 feet of unbalanced backfill of soil class is GW, must have a wall thickness of _____ nominal.		IRC Table R404.1.1(1)	IRC R404	3	6 inches	8 inches	10 inches	12 inches
What is the maximum span of 7/16-inch OSB roof sheathing without edge support and having a span rating of 24/0?		IRC Table R503.2.1.1(1)	IRC R503	2	16-inches	20-inches	24-inches	32-inches
What is the minimum depth below grade for exterior footings not considering frost?		IRC R403.1.4	IRC R403	3	6-inches	9-inches	12-inches	18-inches
What is the minimum category classification of glazing for glazing in sliding glass patio doors, where the exposed area of one side is 8 square feet?		IRC Table R308.3.1(1)	IRC R308	2	Class I	Class II	Class III	Class IV
Glazing shall be considered hazardous if located in all but which of the following fixed and operable panel door types.		IRC R308.4.1	IRC R308	4	bifold doors	sliding doors	swinging doors	overhead doors
Carpports shall be open on not less than _____.		IRC R309.2	IRC R309	2	one side	two sides	three sides	four sides
Which of the following is exempt from a permit?		IRC R105.2 Electrical 3	IRC R105	3	5 foot high retaining wall	250 square foot deck	replacing branch circuit overcurrent devices	a new water heater
Which of the following must be provided to eliminate ventilation openings in an under-floor space?		IRC R408.3	IRC 408	1	a continuous Class I vapor retarder	mechanical exhaust ventilation	conditioned air supply	a dehumidification system
Window wells with a vertical depth greater than _____ shall be provided with a permanently affixed ladder.		IRC R310.4.2	IRC R310	4	36 inches	40 inches	42 inches	44 inches
What is the minimum clear width that shall be provided for the required egress door.		IRC R311.2	IRC R311	2	24 inches	32 inches	36 inches	40 inches
When is a structure required to comply with the IBC for accessibility?		IRC R320.1	IRC R320	1	an apartment complex with 10 units	townhouses	3 condo units	a duplex

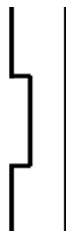
A _____ thick door shall be provided between private garages and sleeping rooms.	IRC 302.5.1	IRC 302	4	1 3/8 inch	1 1/2 inch	1 5/8 inch	Not permitted
Combustible insulation shall be separated from recessed cans by a minimum of _____ when not otherwise provided with a listing.	IRC R302.14	IRC 302	2	6 inches	3 inches	2 inches	1 inch
A 9-foot-high, flat concrete foundation wall of 10-inch nominal thickness subjected to 5 feet of unbalanced backfill of soil class SP, must have a minimum vertical reinforcement of _____ at _____ on center.	IRC Table R404.1.2(4)	IRC R404	4	No. 6 at 28 inches	No. 6 at 35 inches	No. 6 at 59 inches	not required
A crushed stone foundation drain shall extend not less than _____ beyond the outside edge of the footing and _____ above the top of the footing.	IRC R405.1	IRC R405	1	12 inches, 6 inches	6 inches, 6 inches	18 inches, 12 inches	12 inches, 18 inches
What is the load-bearing pressure of sandy gravel?	IRC Table R401.4.1	IRC R401	4	1,000 psf	1,500 psf	2,000 psf	3,000 psf
The exterior of a residential building must slope a minimum of _____ within the first 10 feet from the building foundation?	IRC R401.3	IRC R401	1	6 inches	8 inches	10 inches	12 inches
What is the maximum allowable live load of wood structural panels used for subfloor sheathing is _____ when wood structural panels have a span rating of 24/16, a thickness of 7/16 and a span of 16 inches O.K.?	IRC Table R503.2.1.1(1)	IRC R503	1	100	70	50	40
For a detached garage (accessory to a dwelling unit) located within 2 feet of the lot line, how much roof eave projection is permitted?	IRC R302 Exception 4	IRC R302	2	1 foot	4 inches	6 inches	Not Permitted
What is the minimum amount of aggregate glazing required in habitable rooms?	IRC R303.1	IRC 303	1	8%	10%	12%	14%
A 9-foot-high, flat concrete foundation wall of 10-inch nominal thickness subjected to 5 feet of unbalanced backfill of soil class SP, must have a minimum vertical reinforcement of _____ on center.	IRC Table R404.1.2(4)	IRC R404	4	No. 6 at 28 inches	No. 6 at 35 inches	No. 6 at 59 inches	Not required.
Which of the following documents is the building department required to retain in the official records for durations consistent with the retention of public records laws?	IRC R104.7	IRC R104	1	permit applications	meeting minutes	inspection requests	fee schedules
What is the minimum thickness of lumber floor sheathing, where the floor joists are spaced 16 inches and installed perpendicular to the joist?	IRC Table R503.1	IRC R503	2	3/8 inch	5/8 inch	3/4 inch	11/16 inch
A two-family dwelling that is four stories in height shall fall under the provisions of which code?	IRC R101.2	IRC R101	2	International Residential Code	International Building Code		

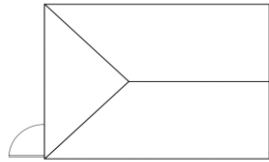
The maximum center to center stud spacing when supporting one floor and a roof is _____ where the stud size is 2x6.	IRC Table R602.3(5)	IRC R602	1	24 inches	20 inches	16 inches	14 inches
What is the maximum span of 2x10 floor joists of spruce-pine-fir #1, when the dead load is 10 psf in a living area?	IRC Table R502.3.1(1)	IRC R502	3	12 feet 9 inches	15 feet 8 inches	17 feet 3 inches	16 feet 7 inches
Masonry walls shall have not less than _____ Portland cement parging applied to the exterior wall.	IRC R406.1	IRC R406	3	1/4 inch	1/2 inch	3/8 inch	5/8 inch
Wood columns shall be a minimum of _____ inches x _____ inches nominal.	IRC R407.3	IRC R407	1	4,4	4,6	6,6	8,8
What is the minimum ceiling height required for a laundry room?	IRC R305.1	IRC R305	3	7'-6"	7'-0"	6'-8"	6'-0"
All dwelling units are required to be provided with a water closet, lavatory, and shower.	IRC R306.1	IRC R306	1	True	False		
All of the following are types of structural composite lumber except _____.	(Definition of Structural Composite Lumber and Definition of Engineered Wood Rim Board)	IRC R202	2	oriented strand lumber	parallel veneer lumber	engineered wood rim board	laminated strand lumber
For an exterior bearing wall, what is the maximum span for a double 2x10 header supporting a roof, ceiling and two clear-span floors? (Assume 30 psf Ground Snow Load and a 24-foot building width.)	IRC R602.7(1)	IRC R602.7	3	4' 9"	4' 1"	3' 10"	2' 7"
What is the ultimate design wind speed for Michigan?	IRC Figure 301.2(2)	IRC 301	1	115 mph	120 mph	125 mph	150 mph
For a building with a roof with a height of 47 feet where the wind speed is 175 mph, No. 8 wood screws are permitted to fasten wood structural panels.	IRC R301.2.1.2 Exception	IRC 301	2	True	False		
Cold-formed steel walls shall be limited to sites where the ultimate wind speed is less than _____ miles per hour.	IRC R603.1.1	IRC R603	2	115	140	143	159
when braced walls are not in one plane vertically. In which seismic design category can the home be built per the IRC without requiring _____	IRC R301.2.2.6	IRC R301	4	C	D ₁	D ₂	D ₃
_____ inches of concrete cover is required for steel reinforcement when cast against the earth.	IRC R403.1.3.5.3	IRC R403	4	1.5	2	2.5	3
A photoelectric smoke alarm has been installed in a house. What is the maximum horizontal distance from a permanently installed cooking appliance?	IRC R314.3.1	IRC R314	1	6 feet	5 feet	4 feet	3 feet

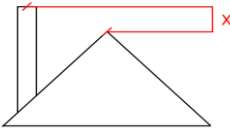
What is the minimum solid wall length for an exterior wall of a Two-story Townhouse located in Seismic Design Category D1?	IRC Table R606.12.2.1	IRC R606	4	NP	35	30	25
In seismic design category D1, exterior masonry veneers with an installation weight of 45 pounds per square foot shall be permitted to be supported on wood construction.	IRC R703.8.2	IRC R703	2	True	False		
Any _____ to existing structures are not permitted to cause the existing structure to become unsafe.	IRC R102.7.1	IRC R102	4	repairs	additions	alterations	all of the above
The minimum curing period for a three-coat cement plaster system shall be _____ hours.	IRC R702.2.2.2	IRC R702	1	48	36	24	12
When 5/8 gypsum board is used as an interior ceiling covering and installed perpendicular to framing members spaced at 24 inches on center, the maximum spacing of nails shall be _____.	IRC Table R702.3.5	IRC R702	2	6 inches	7 inches	8 inches	12 inches
Which of the following materials is not acceptable for use as fireblocking in combustible construction?	IRC R302.11	IRC R302	3	two thicknesses of 1 inch nominal lumber with broken laps	½ inch gypsum board	1/8 inch cement based millboard	unfaced fiberglass batts not less than 16 inch vertically
Discharge drainage from roofs shall terminate not less than _____ feet from foundation walls.	IRC R801.3	IRC R801	2	6	5	4	3
Metal roof shingles shall only be installed on roof slopes that are _____ or greater.	IRC R905.4.2	IRC R905	1	3:12	2:12	1:12	1/2:12
Wood shingles shall be attached to the roof with _____ fasteners per shingle.	IRC R905.7.5	IRC R905	2	1	2	3	4
What is the offset permitted for wood framed rafters connecting to ridge boards?	IRC R802.4.2	IRC R802	3	2 1/2 inches	2 inches	1 1/2 inches	1 inch
Collar ties in ceiling joist shall be a minimum of _____.	IRC R802.4.6	IRC R802	3	2"x4"	1"x2"	1"x4"	1"x3"
What is the minimum clearance to combustibles for an unlisted combustion air duct serving a factory-built fireplace that is located within 5 feet of the duct outlet?	IRC R1006.3	IRC R1006	1	1 inch	2 inches	3 inches	5 inches
A maximum of _____ inches shall be provided from the firebox opening for the exterior air outlet provided for a firebox chamber.	IRC R1006.5	IRC R1006	3	12 inches	18 inches	24 inches	30 inches
Which of the following materials is acceptable for use as draft stopping in a combustible single-family home without other approval?	IRC R302.12.1	IRC R302.12	2	3/8" gypsum board	3/8" wood structural panel	26 ga. Sheet steel	2" mineral wool batts
Floor joists exceeding _____ by _____ inches shall be supported laterally by solid blocking.	IRC R502.7.1	IRC R502	4	2, 6	2, 8	2, 10	2, 12
Fire separation distances are measured from the building face to all but which one of the following?	IRC 202 (Definition Fire)	IRC Chapter 2	2	the closest interior lot line	the top-back of curb	an imaginary line between two buildings on the lot	the centerline of a street

The provisions of this code shall apply to the construction of detached one-and two family dwellings for all of the following except which?	IRC R301.2	IRC R301	4	1 story	2 stories	3 stories	4 stories	
Where conflicts between provisions of this code and referenced codes and standards the provisions of _____ shall apply.	IRC R102.4.1	IRC R102	3	referenced codes and standards	stricter requirements	this code	building official's interpretation	
Which of the following is not exempt from a permit?	IRC R105.2 Item 9	IRC R105	1	window awnings that project 60 inches from the exterior wall of the building	a fence that is 6 feet 10 inches in height	a deck that is 150 square feet in area and is 12 inches from the ground not attached to the house	a slide that is 10 feet in height in a seismic category zone	
What is to be included in a certificate of occupancy?	IRC R110.3 Item 8	IRC R110	4	the name of the builder	the next code edition from what the code was reviewed under	the name and address of the designer of the approved plans	where an automatic sprinkler system is provided	
Where the building official find any work regulated by this code being performed in a manner contrary to the provisions of this code or in a dangerous or _____ manner, the building official is authorized to issue a stop work order.	IRC R114.1	IRC R114	3	harmful	safe	unsafe	different	
An extension or increase in floor area, number of stories, or height of a story or height of a building or structure.	IRC 202	IRC 202	1	Addition	Area Increase	Alteration	Remodel	
The total area of all buildings or structures on any lot or parcel of ground projected on a horizontal plane, excluding permitted projections as allowed by this code.	IRC 202	IRC 202	4	Habitable space	Roof area	Building area	Occupied space	
Water free from impurities present in amounts sufficient to cause disease or harmful physiological effects and conforming in bacteriological and chemical qualities to the requirements of the public health authority having jurisdiction.	IRC 202	IRC 202	2	Clear water	Potable water	Nonportable water	Tap water	
A general term for walls that are designed and constructed to resist racking from seismic and wind by use of masonry, concrete, cold-form steel or wood framing in accordance with chapter 6 of this code and the associated limitations in section R301.2 of this code.	IRC 202	IRC 202	3	Wall framing	Exterior wall	Shear Wall	Wall assembly	
What is the minimum dimension for X (this being from the wall to the centerline of the toilet)?		IRC Figure R307.1	IRC R307	1	15 inches	16 inches	18 inches	24 inches

What is the minimum clear floor space in front of the sink?		IRC Figure R307.1	IRC R307	3	15 inches	18 inches	21 inches	24 inches
If the length of "X" is 10 feet, what would be the minimum dimension that "Y" is permissible to be?		IRC R304.2	IRC R304	2	6 feet	7 feet	8 feet	10 feet
Which of the following is not permissible to be used as fire blocking?		IRC R302.11.1	IRC R302	4	Two-inch nominal lumber	One-half gypsum board	23/32 wood structural panels	One-eight inch cement-based millboard
Glazing where the bottom exposed edge of the glazing is less than _____ above the plan of the plan of the adjacent walking surface of the stairways shall be considered to be a hazardous location (exceptions ignored).		IRC R308.4.6	IRC R308	3	18 inches	24 inches	36 inches	48 inches
Smoke alarms shall be installed in all except the following locations:		IRC R314.3	IRC R314	3	In each sleeping room	Outside each separate sleeping area in the immediate vicinity of the bedrooms	On each story excluding basements and habitable attics and including crawl spaces and uninhabitable attics	Not less than 3 feet horizontally from the door or opening of a bathroom that contains a bathtub.
What is the minimum specified compressive strength of concrete for a basement slab?		IRC Table R402.2	IRC R402	3	1,500	2,000	2,500	3,000
What is the minimum width and thickness for concrete footings with cast-in-place concrete or partially grouted masonry wall construction with a ground snow load of 30 psf for 2 stories with a basement with a load-bearing value of soil of 2,500 psf?		IRC Table R403.1(3)	IRC R403	4	12" x 12"	15" x 12"	15" x 4"	15" x 6"
What is the minimal thickness of a plain masonry foundation wall with an unbalanced backfill of 4.5 feet an a maximum unsupported wall height of 6 feet for soil class SC?		IRC Table R404.1.1(1)	IRC R404	2	6 inches	8 inches	10 inches	12 inches
In areas where the water table are known to exist exterior foundation walls that retain earth and enclose interior spaces and floors below grade shall be waterproofed from the fished grade to the height of the top of the footing or _____ below the top of the basement floor.		IRC R406.2	IRC R406	2	4 inches	6 inches	8 inches	12 inches

The top surface of the footings shall be level. The bottom surface of footings shall not have a slope exceeding 1 unit vertical in _____ units horizontal.		IRC R403.1.5	IRC R403	3	20	12	10	8
What is the maximum floor joist span for Hem-fir #1 for residential sleeping areas with a live load of 30 psf and a dead load of 20 psf using 2x8 lumber spaced 16 inches on center.		IRC Table R502.3.1(1)	IRC R502	4	18-0	16-1	13-5	13-4
The ends of each joist shall not less than _____ inches of bearing on wood or metal.		IRC R502.6	IRC R502	1	1 1/2	2	2.5	3
What is the minimum thickness of floor sheathing where the joists are spaced 24 inches on center running diagonal to the joists?		IRC Table R503.1	IRC R503	2	11/16 inches	5/8 inches	3/4 inches	1 1/2 T&G
Slab on ground concrete floor shall be a minimum _____ inches thick.		IRC R506.1	IRC R506	3	2	2 1/2	3 1/2	4
Deck footings shall be placed not less than _____ inches below the undisturbed ground surface.		IRC R507.3.2	IRC R507	2	16	12	8	6
A 2x6 bearing wall has been notched. Please indicate the maximum depth the bearing wall is permitted to be notched.		IRC R602.6	IRC R602	1	1.375 inches	2 inches	2.25 inches	2.375 inches
A stud in an exterior wall or bearing partition shall no be cut or notched to a depth exceeding _____ percent of its depth. Studs in nonbearing partitions shall not be notched to a depth exceeding _____ percent of its depth of a single stud depth.		IRC R602.6	IRC R602	1	25, 40	40, 25	25, 25	40, 40
What is the minimum rebar size and spacing for a waffle grid above grade wall for an 8 inch thick wall 9 feet high with a wind speed of 130 miles per hour in an exposure category B?		IRC Table R608.6(2)	IRC R608	2	5 at 47	4 at 48	5 at 35	6 at 46
Where cripple walls exceed 4 feet in height, such walls shall be framed of studs having the size required for _____.		IRC R602.9	IRC R602	4	a basement	an attic	an additional top plate	an additional story
Which one of the fasteners is not listed to be used as a continuous header to stud?		IRC Table R602.3(1)	IRC R602	4	5-8d box	4-8d common	4-10d box	4 staples, 1" crown 16 g
What is the minimum thickness for a masonry bearing wall more than one story in height?		IRC R606.4.1	IRC R606	2	6 inches	8 inches	C.10 inches	12 inches
Horizontal aluminum siding is allowed to be applied directly to studs without insulation.		IRC Table R703.3(1)	IRC R703	1	Incorrect, this cannot be applied directly to the studs.	once 3 coats of paint has been applied	if siding nails sized 1 1/2 x 0.120" is used	if siding nails 2" x 0.120" is used

Where provided, furring shall consist of wood furring strips not less than _____.		IRC R703.7.1.1	IRC R703	2	1" x 1"	1" x 2"	2" x 2"	2" x 4"
How soon can the second coat of a two-coat cement plaster be applied after the first coat?		IRC R703.7.5	IRC R703	4	48 hours	3 days	5 days	one week
The lintels shall have a length of bearing not less than _____ inches.		IRC R703.8.3	IRC R703	3	2	3	4	6
What is the minimum thickness of polypropylene siding shall be installed over and attached to wood structural panel sheathing?		IRC R703.14.1.1	IRC R703	3	3/16 inches	2/3 inches	7/16 inches	5/8 inches
What is the rafter span for a Southern pine#1 spaced 19.2 inches on center with a ground snow load of 30 psf and a dead load of 10 psf ceiling attached to rafters using lumber sized 2x10?		IRC Table R802.4.1(4)	IRC R802	1	17-7	15-4	15-1	20-2
What is the allowable 2x6 ceiling joist span for Southern Pine #2 spaced at 24-inches o.c.? Assume uninhabitable attic with limited storage.		IRC Table R802.5.1(2)	IRC R802	2	6' - 7"	9' - 10"	11' - 0"	11' - 5"
Purlins shall be continuous and shall be supported by _____ braces installation to bearing wall at a slope of not less than _____ degrees from the horizontal.		IRC R802.4.5	IRC R802	4	1x2, 20	2x2, 90	1x2, 45	2x4, 45
The ends of each rafter or ceiling joist shall have not less than _____ inches when bearing on masonry or concrete.		IRC R802.6	IRC R802	3	1.5	2	3	4
A roof area is 1,000 square feet. What is the minimum net free ventilating area (exception ignored)?		IRC R806.2	IRC R806	1	6-2/3 sq ft	7-5/8 sq ft	5-3/2 sq ft	4-4/7 sq ft
Underlayment for asphalt shingles shall comply with which ASTM requirement?		IRC R905.1.1	IRC R905	4	ASTM D226	ASTM D1970	ASTM 4869	All of the above
Ice barriers shall be required in areas _____.		IRC R905.1.2	IRC R905	1	where there has been a history of ice forming along the eaves	for all roofs with shingles	in areas with an annual snowfall of 6 inches or more per year	when the average temperature of the year is below 40 degrees
A roof recover shall not be permitted where the existing roof has _____ or more applications of any type of roof covering.		IRC R908.3.1.1	IRC R908	4	roof recover is not permitted	only patch replacement is permitted	one	two
Metal roof shingle shall not be installed on roof slopes below _____ units vertical in 12 units horizontal.		IRC R905.4.2	IRC R905	4	8	6	4	3
Thermoplastic single-ply membrane roofs shall have a design slope of not less than _____ unit vertical in 12 units horizontal.		IRC R905.13.1	IRC R905	3	1/8	3/8	1/4	1/2

The minimum bearing length of a lintel on both ends of the fireplace opening shall be ____ inches.		IRC R1001.7	IRC R1001	3	2	3	4	6
The minimum thickness of fireplace hearth shall be ____ inches.		IRC R1001.9.1	IRC R1001	2	2	4	6	8
Footings for masonry chimneys shall be constructed of concrete or solid masonry not less than ____ inches thick and shall extend not less than ____ inches beyond the face of the foundation or support wall on all sides.		IRC R1003.2	IRC R1003	1	12, 6	6, 12	6, 8	8, 8
What is the minimum height (X) the chimney must extend beyond the highest point of the roof assuming that the portion is within 10 feet?		IRC R1003.9	IRC R1003	3	4 feet	3 feet	2 feet	1 foot
The exterior air outlet shall be located in the back or side of firebox chamber or shall be located outside of the firebox at the level of the hearth and not greater than ____ inches from the firebox opening.		IRC R1006.5	IRC R1006	3	12	18	24	36



EDUCATION

**MASTER OF SCIENCE
CONSTRUCTION MANAGEMENT**
Brigham Young University, 2015

**BACHELOR OF SCIENCE
CONSTRUCTION MANAGEMENT**
Weber State University, 2008

LICENSES | CERTIFICATIONS

LICENSES

Combination Inspector
Utah 6048299-5601

ICC CERTIFICATIONS

Master Code Professional
Certified Building Official
Commercial Combination Inspector
Residential Combination Inspector
Building Plans Examiner
Plumbing Code Official
Plumbing Plans Examiner
Mechanical Code Official
Mechanical Plans Examiner
Commercial Energy Inspector
Commercial Energy Plans Examiner
Residential Energy Inspector/Plans
Examiner
Accessibility Inspector/Plans
Examiner
Housing Code Official
Property Maintenance & Housing
Inspector

And several more...

AFFILIATIONS

Beehive Chapter of ICC
Vice President & Member

IAEI Utah Chapter
Member

AWARDS

Utah Chapter ICC
2016 Chapter Service Award
Eagle Scout - 1998

George Williams

MCP, CBO

SENIOR PLAN REVIEW EXAMINER

Mr. Williams has worked on a contract basis for numerous jurisdictions in California, Nevada, Washington, Utah, Wyoming and North Dakota throughout his 13-year career in the industry. From 2009 through mid-2014 he acted as the contract building official for City of Holladay as well as the resort town of Alta, both in Utah. He was also responsible for start-up of two county building departments in North Dakota, including the adopting of codes, implementation of permitting processes, and the development of policies and procedures in a part of the country where no previous form of building or construction regulatory processes existed. In addition to substantial municipal work, Mr. Williams has acted and continues to act as Lead Inspector for a number of multi-million-dollar projects for Utah's Division of Facilities and Construction Management (DFCM). Mr. Williams has numerous ICC certifications and received his ICC Master Code Professional certification in 2009. Currently he performs complex commercial plan reviews for clients in California, Nevada, Wyoming and Utah, as well as commercial inspections.

EXPERIENCE

SENIOR INSPECTOR / PLAN REVIEWER

West Coast Code Consultants, Inc. / 2014 – Present

Provides plan reviews and inspections services for a variety of commercial projects. Specializes in several code disciplines including, building, mechanical, plumbing, electrical, accessibility, energy and green codes. Familiar with both the International and Uniform codes, as plan review and inspection work encompassing numerous municipalities in multiple states. Regularly responsible for overseeing code compliance and inspection of large-scale state-owned buildings; including oversight of special inspection firms.

BUILDING OFFICIAL / INSPECTOR

Forsgren Associates / 2005 – 2014

Developed, maintained, administered, organized and oversaw building departments for various municipalities. Responsible for all aspects of building department administration, including creating policies and procedures, commercial and residential plan reviews, calculating permit fees, meeting with architects and engineers, performing field inspections, reviewing special inspection reports, interpreting codes and local ordinances, data and document management, and many other diverse tasks. Responsible for managing 2-4 field inspectors on a daily basis. Clients included numerous municipalities in multiple states, school districts, architects, law firms, and private entities.

PUBLICATIONS

Graduate Thesis: (2015) *Assessing the Repercussions of a Mass Departure of Building Inspectors from the Code Professional Industry.* Brigham Young University, Provo, Utah.

Article: (2015) *Construction Challenges Associated with the Sudden Population Growth in the Willison Basin Oil Boom,* presented at ASC Annual International Conference, College Station, TX: Associated Schools of Construction.

Article: (2019) *Understanding the Impacts of the Aging Population of Code Professionals in Utah,* presented at ASC Annual International Conference, Denver, CO: Associated Schools of Construction.



Chris Kimball

PE, SE, MCP, CBO

VICE PRESIDENT / PROJECT MANAGER

EDUCATION

**MASTER OF ENGINEERING
STRUCTURAL EMPHASIS**
Utah State University, 2001

**BACHELOR OF SCIENCE
CIVIL ENGINEERING**
Utah State University, 2000

LICENSES | CERTIFICATIONS

LICENSES

Professional Engineer

Washington 53117

California C 67857

Nevada 019503

Arizona 48503

Structural Engineer

Utah 4775874-2203

CERTIFICATES

ICC Certified:

Master Code Professional

Certified Building Official

Certified Fire Code Official

Combination Plans Examiner

4-Way Commercial Inspector

Residential Plans Examiner

Residential Energy

4-Way Residential Inspector

Accessibility Plans Examiner/Insp.

Fire Plans Examiner

Fire Inspector I & II

AFFILIATIONS

SEAU

Past President

Beehive Chapter of ICC

Past President

Utah Chapter of ICC

Member

Bonneville Chapter of ICC

Member

AWARDS

SEAU

2014 Engineer of the Year

ICC Utah Chapter

Industry Award for Excellence 2010

Mr. Kimball is a licensed engineer and an ICC Master Code Professional. He is also certified by ICC as a building official, fire code official, combination plans examiner, combination building inspector, fire plans examiner/inspector, and as an accessibility plans examiner/inspector. He received his Master's degree with an emphasis in structural engineering and currently serves as the Vice President of West Coast Code Consultants, Inc. He has performed plan reviews for thousands of projects throughout the Western United States and is an ICC approved instructor. Mr. Kimball has provided code training classes to building official, design professional and contractor organizations all over the United States.

EXPERIENCE

VICE PRESIDENT

West Coast Code Consultants, Inc. / 2009 – Present

Oversee the plan review and building inspection services provided by numerous WC3 offices. This includes the management of administrative, plan review, and inspection staff. Accountable for the complete plan review of projects which are seeking a building permit to ensure that designs are safe and in compliance with the adopted building codes. Responsible for providing technical training classes to clients, building officials, design professionals, contractors, and owners.

PRESIDENT / OWNER

Kimball Engineering / 2005 – 2009

Provided structural and complete plan review services to local jurisdictions throughout Utah, Arizona, Nevada, and Wyoming. Often provided training with regards to the structural building code requirements for both new and existing buildings to building official, design professional, and contractor organizations.

STRUCTURAL PLANS EXAMINER

Salt Lake City Corporation / 2005 - 2007

Performed structural review of plans, specifications, calculations, and engineering reports to ensure compliance with the adopted building codes. Met with clients, design professionals, contractors, and owners to discuss projects during the design-development stage and throughout the construction process. Provided training classes to design professionals to help them understand the structural requirements of the code. Provided engineering design and consulting services for city-owned projects.

CIVIL ENGINEER

U.S. Bureau of Reclamation / 2003 – 2005

Responsible for the structural design of a wide variety of projects including the retrofit of power plants, design of new buildings, and repairs to concrete and earthen dams. Prepared construction documents, including drawings and detailed project specifications for solicited work. Reviewed designs performed by the Technical Services Center, Area offices, and private consultants. Participated in several value engineering studies.

CIVIL ENGINEER

C.A. Dept. of Water Resources / 2002 – 2003

Provided preliminary designs for the repair of levees and other flood mitigation measures. Reviewed proposals and work performed by consultants. Developed required hydrology for modeling purposes. Reviewed hydraulic modeling efforts. Involved in writing/reviewing a joint EIR/EIS. Prepared construction cost estimates.

File Attachments for Item:

ER-5 Residential Building Inspector (2021 IRC) (in Spanish) (West Coast)

Residential certifications (11 hours)

Staff Notes: Not yet code in Ohio, but likely to be in the next Code update. Recommend approval.

Committee Recommendation:

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *

Brittany Allen

Organization

West Coast Code Consultant

Email *

brittanya@wc-3.com

Phone Number *

(385) 237-3722

Address *

9131 S Monroe St Unit A

City *

Sandy

State *

Utah

Zip Code *

84070

Website

https://www.pathlms.com/w

Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e.

BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

2021 Residential Building Inspector (Spanish)

Course instructor

Gregg Kniff

Course description

Descripción del curso: Este curso de 9 módulos, seguido de un examen práctico de dos horas, se basa en los Capítulos 1 a 10 del Código Internacional Residencial (IRC) de 2021. Enseña la aplicación práctica del IRC. Cada módulo consta de una presentación de video integrada, que incluye diapositivas de presentación, explicaciones, ejemplos y cuestionarios de revisión. Los módulos están diseñados para ser de 30 a 60 minutos en longitud.

Objetivos del curso: Este curso está diseñado para prepararlo para el examen de Inspector de Edificios Residenciales (B1) del International Code Council (ICC), utilizando el IRC 2021. Este curso también sirve como revisión para aquellos que ya están familiarizados con el IRC y puede servir como un curso de actualización para aquellos que no están familiarizados con la edición 2021 del código.

This 9-module course, followed by a two-hour practice examination, is based on Chapters 1 through 10 of the 2021 International Residential Code (IRC). It teaches the practical application of the IRC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 30 to 60 min. in length.

Course Objectives: This course is designed to prepare you for the International Code Council's (ICC) Residential Building Inspector exam (B1), utilizing the 2021 IRC. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Instructional hours per session

11

Number of Sessions

Course Date

Course Location

367

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction
- Plumbing Instruction

Conference Course

Conference Name

Conference location

Course to be offered online?

 On Demand Webinar

Course Website

 Yes No

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):

Pruebas y Exámenes: A cada módulo asociado con este curso le seguirá una prueba de evaluación de duración variable. Se requiere un puntaje de aprobación del 75% para avanzar al siguiente módulo. Al final del curso hay un examen práctico cronometrado. El examen es similar en longitud, contenido y duración a los exámenes reales del ICC, con 60 preguntas seleccionadas al azar de un grupo de más de 100 preguntas en total. Se requiere un puntaje de aprobación del 75% para obtener un certificado de finalización de WC3 para este curso. Los temas del examen y las pruebas pueden o no haber sido cubiertos en los módulos de video. Puede ser necesaria una lectura completa del código para poder progresar en este curso.

Expectativa de los participantes: Este curso requiere que vea cada video de capacitación, y que completa cada prueba y el examen. Se espera que lea partes del código aplicable y se familiarice con su diseño y organización. Recomendamos 2 horas de estudio personal por cada módulo. Puede avanzar en este curso a su propio ritmo; sin embargo, solo tiene acceso durante 120 días.

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. You can progress through this course at your own pace; however, you only have access for 120 days.

Course applicable for the following certifications *

- Residential Certifications Only
- Administrative Course, All Certifications
- Commercial and Residential Certifications

Application materials included *

- Course Outline or Course Learning Objectives
- Presentation Materials/Slides (not required for roundtable courses)
- Assessment Materials (for online courses)
- Presenter Bio
- Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
2021 Residential Building Spanish Submittal Documents.pdf	13.41 MB

Applicant Full Name *

Date of Submission

368

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



2021 Residential Building Inspector (Spanish)

Esquema del curso

Costo: \$207, permitiendo 120 días de acceso.

Descripción del curso: Este curso de 9 módulos, seguido de un examen práctico de dos horas, se basa en los Capítulos 1 a 10 del *Código Internacional Residencial (IRC)* de 2021. Enseña la aplicación práctica del IRC. Cada módulo consta de una presentación de video integrada, que incluye diapositivas de presentación, explicaciones, ejemplos y cuestionarios de revisión. Los módulos están diseñados para ser de 30 a 60 minutos en longitud.

Objetivos del curso: Este curso está diseñado para prepararlo para el examen de Inspector de Edificios Residenciales (B1) del *International Code Council (ICC)*, utilizando el *IRC 2021*. Este curso también sirve como revisión para aquellos que ya están familiarizados con el IRC y puede servir como un curso de actualización para aquellos que no están familiarizados con la edición 2021 del código.

Textos y Lecturas: El *Código Internacional Residencial* de 2021 es el libro de texto de este curso. Se recomienda enfáticamente que compre una copia impresa de estos códigos, que están disponibles en línea en www.iccsafe.org. Se puede utilizar una copia física durante los exámenes reales, que son de libro abierto, y sirve como una referencia valiosa para las inspecciones de campo.

Esquema del curso por temas:

Módulo:	Tema:	Referencia:	Prueba:	Duración:
1	Alcance y Administración	IRC Capítulo 1	Sí	54 min.
2	Estudio personal y Definiciones	IRC Capítulo 2	Sí	30 min.
3	Planificación de Edificaciones Parte I	IRC Capítulo 3	Sí	31 min.
4	Planificación de Edificaciones Parte II	IRC Capítulo 3	Sí	35 min.
5	Planificación de Edificaciones Parte III	IRC Capítulo 3	Sí	28 min.
6	Planificación de Edificaciones Parte IV & Fundaciones	IRC Capítulos 3-4	Sí	47 min.
7	Fundaciones & Pisos	IRC Capítulos 4-5	Sí	42 min.
8	Construcción y Revestimientos de muros	IRC Capítulos 6-7	Sí	30 min.
9	Construcción de techo-cielorraso y Sistemas de techado	IRC Capítulos 8-10	Sí	27 min.
	9 Pruebas 112 Preguntas, 2 min. cada una	2021 IRC		224 min.
	Examen Práctico	2021 IRC		120 min.
	Horas totales del curso			11 horas

Pruebas y Exámenes: A cada módulo asociado con este curso le seguirá una prueba de evaluación de duración variable. Se requiere un puntaje de aprobación del 75% para avanzar al siguiente módulo. Al final del curso hay un examen práctico cronometrado. El examen es similar en longitud, contenido y duración a los exámenes reales del ICC, con 60 preguntas seleccionadas al azar de un grupo de más de 100 preguntas en total. Se requiere un puntaje de aprobación del 75% para obtener un certificado de



2021 Residential Building Inspector (Spanish)

finalización de WC3 para este curso. Los temas del examen y las pruebas pueden o no haber sido cubiertos en los módulos de video. Puede ser necesaria una lectura completa del código para poder progresar en este curso.

Expectativa de los participantes: Este curso requiere que vea cada video de capacitación, y que completa cada prueba y el examen. Se espera que lea partes del código aplicable y se familiarice con su diseño y organización. Recomendamos 2 horas de estudio personal por cada módulo. Se recomienda marcar, tabular y resaltar en el libro de códigos. Hemos establecido un plan y un método para ayudarlo a aprender el material, pero depende de usted hacer el trabajo necesario para dominar el material. Puede avanzar en este curso a su propio ritmo; sin embargo, solo tiene acceso durante 120 días.

Créditos de educación continua (CEU): La finalización de este curso da como resultado **1.1 CEU** (11 horas) proporcionados por ICC, ya que West Coast Code Consultants es un proveedor preferido.

Instructor:



Gregg Kniff es una persona organizada y autodisciplinada que disfruta trabajar junto a otros profesionales, donde juntos pueden ayudarse mutuamente a esforzarse por desarrollar mejor sus habilidades. Gregg ha demostrado ser un examinador de planos diligente para West Coast Code Consultants, Inc., reuniendo información clave para proporcionar revisiones detalladas y comentarios para clientes jurisdiccionales. A lo largo de su carrera profesional, ha ocupado diversos cargos construyendo relaciones y trabajando de forma colaborativa en diversos entornos. El Sr. Kniff habla inglés y español con fluidez; tiene conocimientos y habilidades relacionados con una variedad de programas de software tecnológicos; y sobresale en influenciar a otros y convertirse en su defensor.



2021 Inspector de Edificaciones Residenciales






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Exámenes 2021

Examen de Inspector Residencial (BI)

Administración	4%
Planificación y Construcción de Edificaciones	8%
Zapatas y Fundaciones	16%
Construcción de Pisos	14%
Construcción y Revestimiento de Muros	27%
Construcción de Techo-Cielorraso	14%
Construcción Especial y Seguridad Pública	17%

Examen de 2 horas con 60 preguntas
Aproximadamente 2 minutos por pregunta


2

Módulo I

IRC Capítulo I: Alcance y Administración






3



IRC Capítulo I

4% Alcance y Administración

4

Objetivos del Aprendizaje

1. Comprender cuáles tipos de estructuras se pueden construir utilizando el Código Internacional Residencial (IRC)
2. Entender qué tipo de trabajo no requiere permiso de construcción
3. Familiarizarte con la administración de códigos residenciales
4. Saber orientarte de los términos definidos



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Preparación

- Enfócate en los capítulos de construcción pero a la vez esté preparado para preguntas de otros capítulos
- Estudio personal: **2 horas** de estudio por cada **(1) hora** de clases
- Resalta o subraya las secciones importantes
- Escribe los números clave en letra grande (en los márgenes)



Utiliza pestañas permanentes para marcar tu libro

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Ejémplos

501.4 Intake opening location. Air intake openings shall comply with all of the following:

1. Intake openings shall be located not less than 10 feet (3048 mm) from lot lines or buildings on the same lot.
2. Mechanical and gravity outdoor air intake openings shall be located not less than 10 feet (3048 mm) horizontally from any hazardous or noxious combustion source, such as vents, streets, alleys, parking lots and loading docks, except as specified in Item 3 or Section 501.3.1. Outdoor air intake openings shall be permitted to be located less than 10 feet (3048 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such location. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.
3. Intake openings shall be located not less than 3 feet (914 mm) below contaminant sources where such sources are located within 10 feet (3048 mm) of the opening.

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Puntos Clave

- Marcas en el Margen
 - Líneas verticales continuas – Cambios técnicos o algo nuevo añadido
 - [➡] Sección completa, párrafo o excepción borrado
 - [*] indica texto/tabla que se ha reubicado
 - [**] indica texto/tabla que se ha reubicado ahí
 - Términos en Cursivas (definiciones)



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Tabla de Contenidos

Se debe colocar una pestaña, ser resaltada y marcada

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Conceptos

¿Cuáles conceptos se aplican al IRC?

- Planificación y construcción de edificaciones
- Resistencia estructural, salud, seguridad pública, seguridad de incendios, protección de la vida, etc.
- Casas contiguas (townhouses)
- Viviendas
- Sistemas residenciales de rociadores contra incendios
- Medios de salida
- Conservación de la energía
- Diseño estructural
- Mecánica
- Plomería
- Eléctrica

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Alcance

- Método recetario
 - ej., “Recetario de cocina”
- Limitado a las viviendas de 1 o 2 familias y casas contiguas
- Varias limitaciones, especialmente en regiones sísmicas altas o vientosas

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Secciones del IRC

- 1) **Parte I – Administrativa**
- 2) **Part II – Definiciones**
- 3) **Part III – Planificación y Construcción de Edificaciones**
- 4) Part IV – Conservación de Energía
- 5) Part V – Mecánica
- 6) Part VI – Gas Combustible
- 7) Part VII – Instalaciones Hidráulicas y Sanitarias (Plomería)
- 8) Part VIII – Eléctrica
- 9) **Part IX – Normas Citadas**






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Parte I

Administrativa (Alcance y Administración)


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Alcance

IRC R101.2

- “se deben aplicar a la construcción, modificación, traslado, aplicación, reemplazo, reparación, equipo, uso y destino, ubicación, eliminación y demolición de...”
 - Viviendas separadas de una familia
 - Viviendas de dos familias
 - Casas contiguas
 - Estructuras accesorias



Limitadas a 3 pisos de altura por encima del plano de nivel de terreno

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Alcance

IRC R101.2

- Excepciones a edificios con un sistema residencial de rociadores contra incendios*
 - Unidades de vivienda/trabajo ubicadas en casas contiguas (Por IBC 508.5)
 - Casas de alojamiento donde habita el dueño (≤ 5 cuartos de huéspedes)
 - Instalaciones de cuidado (≤ 5 personas que reciben cuidado supervisado dentro de una vivienda)
 - Instalaciones de cuidado (≤ 5 personas que reciben cuidado médico dentro de una vivienda)
 - Instalaciones de cuidado (≤ 5 personas que reciben cuidado dentro de una vivienda unifamiliar)

**Se puede construir utilizando los requisitos del IRC en vez del IBC*

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Ampliaciones, Modificaciones o Reparaciones

IRC R102.7.1

- Los códigos hacen referencia al International Existing Building Code (IEBC) solamente cuando las modificaciones son parte de un cambio de uso u ocupación fuera del alcance del IRC
- “Cuando la alteración provoque el cambio del uso u ocupación a uno que no esté dentro del alcance de este código, se aplicarán las disposiciones del Código Internacional de Edificación Existente (IEBC)”




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Normas citadas

IRC R102.4

Deben ser considerados como parte de los requisitos de este código




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Apendices

IRC R102.5

- “...no deben aplicarse a menos que estén citadas específicamente en la ordenanza de adopción.”
- Apéndice AA – Apéndice AW
- + Recurso A

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Existente

IRC R102.7.1

Las ampliaciones, modificaciones, reparaciones o reubicaciones no deben provocar que una estructura existente se vuelva insegura o afecte adversamente el rendimiento de la edificación





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Responsabilidades y facultades

IRC R104

El funcionario de la edificación debe tener la autoridad para interpretar este código...deben estar de acuerdo con **la intención** y propósito de este código...dichas políticas y procedimientos no deben tener el efecto de **anular** los requisitos.




City of (Jurisdiction)
Department of Building Safety

Name of individual _____ Photo _____

Job Location _____

The individual identified on the badge is a duly authorized employee of the jurisdiction and is a designated representative of the Department of Building Safety.

Valid Through _____ Date _____ Building Official _____



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Registros

IRC R104.7

- Se debe guardar:
 - Solicitudes recibidas
 - Permisos emitidos
 - Certificados emitidos
 - Cuotas recolectadas
 - Reportes de inspecciones
 - Notificaciones y órdenes



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¿Por cuánto tiempo se debe guardar estos documentos?



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Alternativas

IRC R104.11

- “...no menos del equivalente al prescrito de este código”
 - Materiales
 - Diseño
 - Métodos de construcción
 - Equipo

Cumple con el código



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No cumple



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Alternativas

IRC R104.11

- “...el funcionario de la edificación debe tener autoridad para solicitar ensayos como evidencia de conformidad...”
- “Los ensayos deben ser realizados por agencias **aprobadas.**”




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Trabajos extentos de permiso

IRC R105.2

- Estructuras accesorias de un piso ≤ 200 pies²
 - Depósitos de almacenamiento, lugares de juego & usos similares
- Cercas ≤ 7 pies de altura
- Muros de contención ≤ 4 pies
 - Desde la base de la fundación a la parte superior del muro
 - A menos que soporten una sobrecarga
- Tanques de agua $\leq 5,000$ galones
 - Apoyados directamente sobre el nivel del terreno
 - La relación de altura con respecto al diámetro $\leq 2:1$




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Trabajos extentos de permiso

IRC R105.2

- Aceras y caminos de acceso
- Pintura, empapelado, azulejado, alfombrado, gabinetes, mostradores y trabajos de acabados similares
- Piscinas prefabricadas $\leq 24"$ profundidad
- Columpios y otros equipos de patio de recreo
- Todos de ventanas soportados por un muro exterior que se proyectan $\leq 54"$
- Cubiertas ≤ 200 pies², $\leq 30"$ nivel de terreno, no fijadas a una vivienda y no sirvan a la puerta de salida exterior
- Trabajos misceláneos de mecánica, eléctrica y gas


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Excepciones

IRC R105.2

“Las excepciones de requisitos de permisos de este código no deben ser consideradas como una concesión de autorización a ningún trabajo que se realice de alguna manera que viole las disposiciones de este código o cualquier otra ley u ordenanza”








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Reparaciones de emergencia

IRC R105.2.1

“Cuando se deban realizar reparaciones y reemplazos de equipos en una situación de emergencia, la solicitud del permiso debe ser presentada al funcionario de la edificación dentro del siguiente día hábil.”

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Límites de tiempo

IRC R105.3.2 – Solicitud para un permiso

- 180 días después de la fecha de archivado
- A menos que dicha solicitud haya sido seguida de "buena fe"
- El funcionario de la edificación está autorizado a otorgar una o más extensiones de tiempo de 90 días cada una


IRC R105.5 – Caducidad del permiso

- Trabajo se debe comenzar dentro de 180 días
- Se considera "suspendido o inválido" si el trabajo no comienza dentro de 180 días
- El funcionario de la edificación está autorizado a otorgar una o más extensiones de 180 días cada una



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Presentación de documentos


IRC R106

- "...debe ser presentada en dos o más juegos"
- "...deben ser preparados por un profesional registrado de diseño..."
- "...el funcionario de la edificación está autorizado a requerir documentos de construcción adicionales preparados por un profesional registrado de diseño"

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Presentación de documentos

IRC R106

- "Los documentos de construcción deben ser lo suficientemente claros para indicar la ubicación, naturaleza y extensión del trabajo propuesto y mostrar en detalle que se cumplen las disposiciones de este código..."
- Instrucciones de instalación del fabricante
- Información para la construcción en áreas de peligro de inundación
- Plano del sitio "...que muestre a escala el tamaño y la ubicación de la nueva construcción y las estructuras existentes en el sitio, distancias a las líneas del lote."



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Estructuras temporales

IRC R107

- **Estructuras** y usos temporales
 - "...no deben extenderse por más de 180 días."
 - El funcionario de la edificación está autorizado a otorgar extensiones




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Tarifas

IRC R108.6

- Trabajos que comienzan antes de la emisión del permiso
 - "...debe estar sujeta a una tarifa establecida por el funcionario de la edificación además de las tarifas requeridas por permisos."






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Inspecciones

IRC R109

- ¡La parte mas crucial de los códigos!
- Fundación
- Sistemas hidráulicos y sanitarios, mecánicos, de gas y eléctricos
- Áreas de inundación
- Mampostería y estructura
- Construcción clasificada como resistente al fuego
- Otras requeridas por el funcionario de la edificación
- Final

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Certificado de destino (C.O.)

IRC R110

"Ninguna edificación o estructura debe ser utilizada u ocupada... hasta que el funcionario de la edificación haya emitido un certificado de destino..."






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Certificado de destino

IRC R110

- "...que incluya lo siguiente:"
 - El número del permiso de edificación
 - La dirección de la estructura
 - El nombre y la dirección del propietario o agente autorizado
 - Una descripción de la parte de la estructura para la cual se emite el certificado
 - Una declaración indicando que la parte descrita de la estructura ha sido inspeccionada para cumplir con los requisitos de este código
 - El nombre del funcionario de la edificación
 - La edición del código baja el cual fue emitido el permiso
 - ¿Hay sistema de rociadores automáticos?
 - Cualquier estipulación y condición especial

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Certificado de destino

IRC R110

“La emisión de un certificado de destino no debe ser interpretada como la aprobación de un incumplimiento...”



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Servicios Públicos

IRC R111

“Ninguna persona debe hacer conexions... a ninguna edificación o sistema... para lo que se requiere un permiso, hasta que sea aprobado por el funcionario de la edificación.”



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Apelaciones

IRC R112

- El propósito de la junta de apelaciones es conocer y decidir sobre apelaciones de órdenes, decisiones o determinaciones hechas por el funcionario de la edificación
- El funcionario de la edificación debe ser miembro de oficio de dicha junta pero **no debe tener voto** en ningún asunto presentado a la junta
- La junta **no debe tener autoridad para exonerar** el cumplimiento de los requisitos de este código
- Debe estar integrada por miembros calificados por su experiencia y capacitación para decidir sobre asuntos pertinentes a la construcción de edificaciones y que **no sean empeados de la jurisdicción**



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Violaciones

IRC R113

“Debe ser ilegal para cualquier persona, empresa, o corporación edifique, construya, codifique, amplie, repare, traslade, retire, demuela u ocupe cualquier edificación, estructura o equipo regulado por este código...en violación a cualquiera de las disposiciones...”



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Orden de suspension del trabajo

IRC R114

- El funcionario de la edificación está autorizado a ejecutar un orden de suspension de cualquier trabajo cuando se esté haciendo:
 - Contrario a este código
 - Peligroso
 - Inseguro



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FIN DEL MÓDULO I

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1



2

Objetivos del Aprendizaje


1. Comprender cuáles definiciones del IRC son las más relevantes para ser inspector residencial
2. Entender las diferencias en el lenguaje utilizado para los libros ICC y el lenguaje cotidiano
3. Saber orientarte en el IRC, tanto en inglés como español



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Puntos de considerar




1. Actualmente el ICC está en proceso de traducción para el IRC en español para 2021. Las tablas y referencias en este curso son de la versión inglés de 2021
2. Se modifican las referencias de ciclo a ciclo cada 3 años, pero el contenido en sí es básicamente igual de 2018 a 2021
3. El lenguaje que se emplea en los libros ICC puede parecer diferente al lenguaje cotidiano



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Puntos de considerar

- 3. El ICC ofrece los libros tanto en inglés como en español. Sin embargo, desafortunadamente el examen solamente se ofrece en inglés
- 4. Se recomienda usar un ejemplar físico del libro durante el examen
- 5. Debes traer contigo las versiones de inglés y español para poder encontrar fácilmente las respuestas

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IRC Capítulo 2

Definiciones relevantes








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Definiciones

IRC Capítulo 2

- Las definiciones que vas a querer saber antes, durante y después del examen se encuentran en el capítulo 2 del IRC
- Aquí incluiremos varias definiciones relevantes al examen de inspector, pero por el largo del capítulo no se incluirán todas
- Recordatorio – por cada hora de enseñanza se recomienda 2 horas de estudio personal

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Definiciones

1. **Estructura accesoria** (Accessory Structure)
2. **Modificación** (Alteration)
3. **Líneas de muros arriostrados** (Braced wall line BWL)
4. **Panel de muros arriostrados** (Braced wall panels BWP)

[R] ESTRUCTURA ACCESORIA (ACCESSORY STRUCTURE). Una estructura que es accesoria y fortuita a la de la(s) vivienda(s) y que está ubicada en el mismo lote.
[R] MODIFICACIÓN (ALTERATION). Cualquier construcción, reforzamiento o renovación a una estructura existente que no sea reparación o ampliación y que requiera un permiso. También, cualquier cambio al sistema eléctrico, de instalaciones de gas, mecánico o hidrosanitario en una edificación que involucre una extensión, ampliación o cambio a la disposición, tipo o propósito de la instalación original que requiera un permiso. Para la definición aplicable en el Capítulo 11, vea Sección N1101.6.
[R] LINEA DE MUROS ARRIOSTRADOS (BRACED WALL LINE). Una línea recta a través de la planta de la edificación que representa la ubicación de la resistencia lateral provista por el arriostramiento de muros.
[R] PANEL DE MUROS ARRIOSTRADOS (BRACED WALL PANEL). Una sección de muro de altura completa construida para resistir cargas de corte en su plano a través de la interacción de los miembros de entramado, el material de entablado y los anclajes. La longitud del panel cumple con los requisitos correspondientes a su método particular de arriostramiento, y contribuye a la cantidad total requerida de arriostramiento a lo largo de su línea de muros arriostrados de acuerdo con la Sección R602.10.1.

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Definiciones

- 5. **Edificación (Building)**
- 6. **Funcionario de la edificación (Building Official)**
- 7. **Alarma de monóxido de carbono (Carbon Monoxide Alarm)**
- 8. **Detector de monóxido de carbono (Carbon Monoxide Detector)**

[RB] EDIFICACIÓN (BUILDING). Cualquier vivienda para una o dos familias o porción de ello, incluyendo casas contiguas, que es usada o diseñada o proyectada para ser usada para la habitación humana, para vivir, dormir, cocinar alimentos o comer, o cualquier combinación de eso, y debe incluir las estructuras adicionales a eso o cualquier estructura accesoria. Para la definición aplicable en el Capítulo 11, vea Sección N1101.6.

[RB] FUNCIONARIO DE LA EDIFICACIÓN (BUILDING OFFICIAL). El funcionario u otra autoridad designada a cargo de la administración y vigilancia del cumplimiento de este código, o su representante debidamente autorizado. Para la definición aplicable en el Capítulo 11, vea Sección N1101.6.

[RB] ALARMA DE MONÓXIDO DE CARBONO (CARBON MONOXIDE ALARM). Una alarma de estación simple o múltiple destinada a detectar gas de monóxido de carbono y alertar a los ocupantes mediante una señal audible distinta. Contiene un sensor, componentes de control y un dispositivo de notificación de alarma en una sola unidad.

[RB] DETECTOR DE MONÓXIDO DE CARBONO (CARBON MONOXIDE DETECTOR). Un dispositivo con un sensor integral para detectar gas de monóxido de carbono y transmitir una señal de alarma a una unidad de control de alarma conectada.

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Definiciones

- 9. **Espacio angosto (Crawl space)**
- 10. **Cargas muertas (Dead loads)**
- 11. **Vivienda (Dwelling)**
- 12. **Unidad de vivienda Dwelling unit)**

[RB] ESPACIO ANGOSTO (CRAWL SPACE). Un espacio debajo del piso que no es un sótano.

[RB] CARGAS MUERTAS (DEAD LOADS). El peso de todos los materiales de construcción incorporados en la edificación, incluyendo pero no limitándose a muros, pisos, techos, cielorrasos, escaleras, tabiques empotrados, terminaciones, revestimiento, y otros artículos arquitectónicos y estructurales incorporados en forma similar y el equipo de servicio fijo.

[RB] VIVIENDA (DWELLING). Cualquier edificación que contiene una o dos unidades de viviendas usadas, proyectadas, o diseñadas para ser construidas, usadas, alquiladas, arrendadas, rentadas o contratadas para ser ocupadas, o que están ocupadas con el propósito de habitarlas.

[RB] UNIDAD DE VIVIENDA (DWELLING UNIT). Una sola unidad que provee instalaciones completas e independientes de vivienda para una o más personas, incluyendo las disposiciones permanentes para vivir, dormir, comer, cocinar e higiene. Para la definición aplicable en el Capítulo 11, vea Sección N1101.6.

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Definiciones

- 13. **Cubierta de muros exteriores (Exterior wall covering)**
- 14. **Distancia de separación al fuego (Fire separation distance)**
- 15. **Bloqueo antifuego (Fireblocking)**
- 16. **Índice de propagación de llama (Flame Spread Index)**

[RB] CUBIERTA DE MUROS EXTERIORES (EXTERIOR WALL COVERING). Un material o conjunto de materiales aplicados en el lado exterior de muros exteriores con el propósito de proveer una barrera resistente a la intemperie, aislamiento o con fines estéticos, incluyendo, entre otros, chapas, revestimiento, aislamiento exterior y sistemas de acabado, terminados arquitectónicos y adornos como cornisas, plafones y fascias.

[RB] DISTANCIA DE SEPARACIÓN AL FUEGO (FIRE SEPARATION DISTANCE). La distancia medida desde la fachada de la edificación hasta uno de los siguientes:

1. La línea interior de lote más cercana; o
2. La línea central de la calle, callejón o vía pública; o
3. A una línea imaginaria entre dos edificaciones en el lote.

La distancia se debe medir en ángulo recto desde la cara del muro.

[RB] BLOQUEO ANTIFUEGO (FIREBLOCKING). Materiales para edificación o materiales aprobados para su uso como bloqueo antifuego, instalados para resistir el libre pasaje de llama hacia otras áreas de la edificación a través de espacios ocultos.

[RB] ÍNDICE DE PROPAGACIÓN DE LLAMA (FLAME SPREAD INDEX). Una medida de comparación, expresada como un número adimensional, derivada de mediciones visuales de la propagación de la llama contra el tiempo para un material ensayado de acuerdo con ASTM E84 o UL 723.

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Definiciones

- 17. **Área vidriada (Glazing area)**
- 18. **Plano de nivel de terreno (Grade plane)**
- 19. **Gypsum board (Tablero de yeso)**

[RB] ÁREA VIDRIADA (GLAZING AREA). El área de la superficie interior de todo el ventanaje de vidrio, incluyendo el área de hoja, borde u otros elementos estructurales, que encierran un espacio acondicionado. Incluye el área de ventanaje de vidrio en muros que limitan sótanos acondicionados.

[RB] PLANO DE NIVEL DE TERRENO (GRADE PLANE). Un plano de referencia que representa el promedio del nivel terminado del terreno adyacente a la edificación en todos los muros exteriores. Donde el nivel terminado del terreno se inclina hacia fuera desde los muros exteriores, el plano de referencia debe establecerse por los puntos más bajos dentro del área entre la edificación y la línea del lote o, donde la línea del lote está a más de 6 pies (1829 mm) de la edificación entre la estructura y un punto a 6 pies (1829 mm) de la edificación.

[RB] TABLERO DE YESO (GYPSUM BOARD). El nombre genérico de una familia de productos laminados que consiste en un núcleo no combustible principalmente de yeso con revestimiento de papel. Paneles de yeso, revestimiento de yeso, base de yeso para inyección de yeso enchapado, tableros de sofo exterior de yeso, tableros de yeso predecorado y paneles de respaldo de yeso resistentes al agua que cumplen con las normas enumeradas en la Sección R702.3 y la Parte IX de este código son tipos de paneles de yeso.

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Definiciones

- 20. Unidad de mampostería (Masonry unit)**
- 21. Contrahuella (Riser)**
- 22. Sistema de techado (Roof Assembly)**
- 23. Categoría de diseño sísmico (Seismic Design Category)**

[RB] UNIDAD DE MAMPOSTERÍA (MASONRY UNIT). Ladrillo, teja, piedra, bloque de vidrio o bloque de concreto que cumpla los requisitos especificados en la Sección 2103 del Código Internacional de la Edificación (IBC).

[RB] CONTRAHUELLA (ESCALERA) (RISER (STAIR)). El componente vertical de un escalón o escalera.

[RB] SISTEMA DE TECHADO (ROOF ASSEMBLY). Un sistema diseñado para proporcionar protección ambiental y resistencia a las cargas de diseño. El sistema consiste en un revestimiento de techo y una cubierta de techo o un solo componente que sirve como revestimiento y cubierta de techo. Un sistema de techado incluye la cubierta de techo, capa base y revestimiento de techo, y también puede incluir una barrera térmica, una barrera ignífuga, aislamiento, o un retardador de vapor. Para la definición aplicable en el Capítulo 11, vea Sección N1101.6.

[RB] CATEGORÍA DE DISEÑO SÍSMICO (SDC) [(SEISMIC DESIGN CATEGORY (SDC)). Una clasificación asignada a una estructura en base a su categoría de destino y la severidad del movimiento del terreno correspondiente al terremoto de diseño en el sitio.



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Definiciones


- 24. Claraboyas y vidriado en pendiente (Skylights & Sloped glazing)**
- 25. Espacio habitable (Habitable space)**
- 26. Casas contiguas (Townhouses)**
- 27. Muro de contención (Retaining wall)**

[RB] CLARABOYAS Y VIDRIADO EN PENDIENTE (SKYLIGHTS AND SLOPED GLAZING). Vidrio u otro material vidriado transparente o traslucido instalado a una pendiente de no más de 15 grados (0.26 rad) o más desde la vertical. Las claraboyas unitarias, dispositivos tubulares de luz diurna y materiales de vidriado en solárium, terrazas acristaladas, techos y muros inclinados están incluidos en esta definición. Para la definición aplicable en el Capítulo 11, vea Sección N1101.6.

[RB] ESPACIO HABITABLE (HABITABLE SPACE). Un espacio en una edificación para vivir, dormir, comer o cocinar. Los baños, servicios, armarios, vestíbulos, bodegas o espacios de uso general y áreas similares no son considerados espacios habitables.

[RB] CASAS CONTIGUAS (TOWNHOUSE). Una unidad de vivienda para una familia construida en un grupo de tres unidades vinculadas o más en las cuales cada unidad se extiende desde la fundación hasta el techo y con un patio o camino público sobre al menos dos lados.

[RB] CONTENCION, MURO DE (WALL, RETAINING). Un muro que no está soportado lateralmente en su extremo superior, que resiste empuje lateral de suelo y otras cargas impuestas.



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FIN DEL MÓDULO 2



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Módulo 3

IRC Capítulo 3: Planificación de edificaciones Parte I




1

1



IRC Capítulo 3

8% Planificación de edificaciones





2

2

Objetivos del Aprendizaje

1. Adquirir conocimiento sobre las categorías de diseño sísmico
2. Entender los diferentes tipos de cargas y como afectan a las estructuras
3. Familiarizarte con los criterios de diseño del viento
4. Reconocer irregularidades en las edificaciones

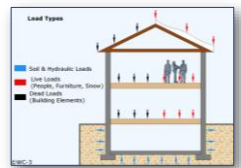

3

3

Trayectoria de carga por gravedad

¿Cuáles cargas se deben considerar?

- Cargas muertas
- Cargas vivas
- Cargas de nieve
- Cargas de tierra
- Cargas hidroestáticas
- Cargas de lluvia
- Cargas de inundación



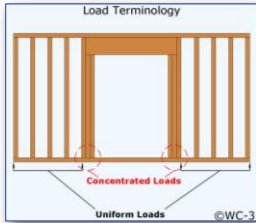


4


4

Trayectoria de carga por gravedad

1. Cargas concentradas
2. Cargas uniformes



©WC-3



5

Trayectoria de carga por gravedad

La trayectoria de carga por gravedad es relativamente fácil de seguir

- ¿Cuáles son algunos problemas comunes?



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6

Cargas laterales

No tan fáciles de entender

- ¿Cuáles cargas se deben considerar?
 - Viento
 - Sísmicas





7


Cargas laterales

Viento:

- El viento actúa contra los lados de un edificio como la vela de un barco
- La mayoría de las fuerzas se transfieren hacia arriba al techo/piso, mientras que el resto se transfiere a la fundación



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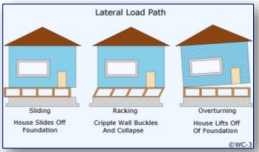


8

Cargas laterales

Sismicas:

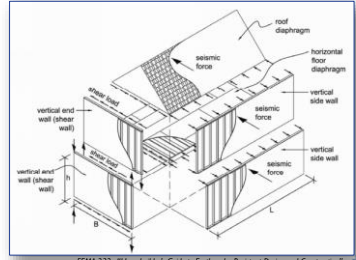
- El movimiento de la tierra hace que la masa de la estructura se acelere de un lado a otro
- Las fuerzas se desarrollan donde la masa de las estructuras es mayor



9

Cargas laterales

Elementos resistentes a las cargas laterales:



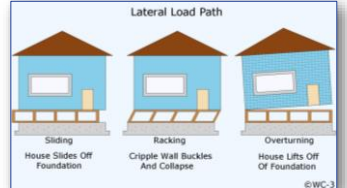
FEMA 232: "Homebuilder's Guide to Earthquake Resistant Design and Construction"



10

Cargas laterales

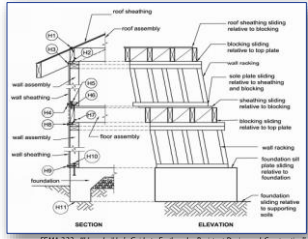
Las fundaciones deben resistir el deslizamiento y el vuelco



11

Cargas laterales

Cargas de deslizamiento



FEMA 232: "Homebuilder's Guide to Earthquake Resistant Design and Construction"



12

Cargas laterales

Cargas de vuelco

FEMA 212: Homebuilder's Guide to Earthquake Resistant Design and Construction

13

Cargas laterales

¿Cuán importante son las conexiones?

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Cargas laterales

- El edificio debe estar diseñado para soportar fuerzas laterales en cada dirección
- Lo que controla en una dirección quizás no controle en la otra

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Aplicación

IRC R301.1

- Las edificaciones y estructuras, y todas sus partes, deben ser construidas para soportar de manera segura:
 - Todas las cargas
 - Cargas muertas
 - Cargas vivas
 - Cargas de techo
 - Cargas de inundación
 - Cargas de viento
 - Cargas sísmicas

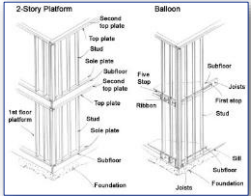
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Sistemas constructivos

IRC R301.1.2

Los requisitos "...se basan en la construcción en plataforma y tipo balloon para edificaciones de entramado liviano."









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Diseño de ingeniería

IRC R301.1.3

"Cuando una edificación construida de manera diferente a la convencional contenga elementos estructurales que excedan los límites de la Sección R301 o de otra manera, no conforme a este código, dichos elementos deben ser diseñados de acuerdo con las prácticas aceptadas de la ingeniería"



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Contenedores de transporte intermodal

R301.1.4

Los contenedores de transporte intermodal que se reutilizan para su uso como edificios o estructuras deben diseñarse de acuerdo con las disposiciones estructurales de la Sección 3115 del IBC








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IRC Tabla R301.2(I)

Tabla IRC R301.2(I)

"Los criterios adicionales deben ser establecidos por la jurisdicción local y exponerse en la Tabla R301.2(1)"

Climate Zone	Special Inspection	Special Inspections	Special Inspections	CLIMATIC AND GEOTECHNICAL DESIGN CRITERIA				FLOOD RESISTANCE	WIND RESISTANCE
				SEISMIC DESIGN CATEGORY	SEISMIC DESIGN CATEGORY	SEISMIC DESIGN CATEGORY	SEISMIC DESIGN CATEGORY		
1	None	None	None	None	None	None	None	None	None
2	None	None	None	None	None	None	None	None	None
3	None	None	None	None	None	None	None	None	None
4	None	None	None	None	None	None	None	None	None
5	None	None	None	None	None	None	None	None	None
6	None	None	None	None	None	None	None	None	None
7	None	None	None	None	None	None	None	None	None
8	None	None	None	None	None	None	None	None	None
9	None	None	None	None	None	None	None	None	None
10	None	None	None	None	None	None	None	None	None
11	None	None	None	None	None	None	None	None	None
12	None	None	None	None	None	None	None	None	None
13	None	None	None	None	None	None	None	None	None
14	None	None	None	None	None	None	None	None	None
15	None	None	None	None	None	None	None	None	None
16	None	None	None	None	None	None	None	None	None
17	None	None	None	None	None	None	None	None	None
18	None	None	None	None	None	None	None	None	None
19	None	None	None	None	None	None	None	None	None
20	None	None	None	None	None	None	None	None	None




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Viento

IRC R301.2.1.1

El IRC no se aplica al diseño de edificios donde la velocidad máxima del viento de diseño ≥ 140 mph en una región de viento especial








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Categoría de exposición

IRC R301.2.1.4

Si alguien te llamara y preguntara, ¿qué exposición al viento especificarías para tu jurisdicción?

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Categoría de exposición

IRC R301.2.1.4

- Exposición A: Grandes centros de ciudad con 50% de edificios ≥ 70 pies
- Exposición B: Áreas urbanas y suburbanas con numerosas obstrucciones estrechamente espaciadas que tengan el tamaño de viviendas unifamiliares o más grandes






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Categoría de exposición

IRC R301.2.1.4

- Exposición C: Terreno abierto con obstrucciones esparcidas que generalmente tienen alturas < 30 pies
- Exposición D: Llano, áreas sin obstrucciones expuestas a vientos fluyendo sobre áreas abiertas de agua para una distancia de por lo menos 5,000 pies.






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Crterios de diseo de viento

IRC R301.2.1

Recubrimientos de muro, recubrimientos de techo, ventanas exteriores, claraboyas, puertas de garajes y puertas exteriores



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Crterios de diseo de viento

Tabla R301.2.1(1):

ZONE	TABLE R301.2.1(1) COMPONENT AND CLADDING LOADS FOR A BUILDING WITH A MEAN ROOF HEIGHT OF 30 FEET, LOCATED IN EXPOSURE B (AS2) (IMP) (S) (S) (S) (S) (S) (S) (S) (S) (S) (S)											
	WIND DIRECTION			WIND DIRECTION			WIND DIRECTION			WIND DIRECTION		
Pressure (psf)	W	SW	SE	W	SW	SE	W	SW	SE	W	SW	SE
Roof	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Wall	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Floor	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Tabla R301.2.1(2):

MEAN ROOF HEIGHT	EXPOSURE	
	A	B
0-15	0.18	0.15
15-30	0.16	0.14
30-45	0.14	0.13
45-60	0.13	0.12
60-75	0.12	0.11
75-90	0.11	0.10
90-105	0.10	0.09
105-120	0.09	0.08
120-135	0.08	0.07
135-150	0.07	0.06
150-165	0.06	0.05
165-180	0.05	0.04
180-200	0.04	0.03

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Diseo ssmico

IRC R301.2.2

- Dos mtodos para determinar las disposiciones ssmicas
 - 1) Figura R301.2(2) y Tabla R301.2.2.1.1, o
 - 2) Metodologa IBC

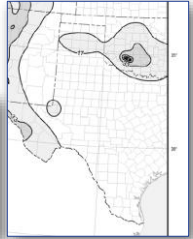


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Diseo ssmico

IRC R301.2.2

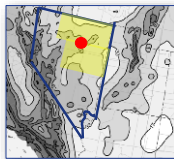
- Nuevos mapas ssmicas - R301.2.2.1.1
- Verifica los movimientos del suelo especificos del sitio...
 - o <https://seismicmaps.org/>





International Code Council, 2021/IRC

Diseño sísmico

IRC Figura R301.2.2.1.1(5):



CALCULATED S_{ap}	SEISMIC DESIGN CATEGORY
$S_{ap} \leq 0.17g$	A
$0.17g < S_{ap} \leq 0.33g$	B
$0.33g < S_{ap} \leq 0.50g$	C
$0.50g < S_{ap} \leq 0.67g$	D_1
$0.67g < S_{ap} \leq 0.83g$	D_2
$0.83g < S_{ap} \leq 1.17g$	D_3
$1.17g < S_{ap}$	E



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Sitios de clases

IRC R301.2.2.1

- El IRC asume la categoría de sitio "D"
 - Basado en los 100 pies superiores
 - Sitio de clase A: Roca dura
 - Sitio de clase B: Roca
 - Sitio de clase C: Tierra muy densa y roca suave
 - Sitio de clase D: Tierra dura
 - Sitio de clase E: Tierra arcillosa suave
 - Sitio de clase F: Tierra que requiere análisis de respuesta del sitio


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Diseño sísmico

IRC R301.2.2.2

- Pesos de los materiales
 - Techos \leq 15 libras por pie cuadrado
 - Pisos \leq 10 libras por pie cuadrado
 - Muros exteriores \leq 15 libras por pie cuadrado
 - Muros interiores \leq 10 libras por pie cuadrado



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Diseño sísmico

IRC R301.2.2.3

- Revestimiento de piedra y mampostería
 - "...debe cumplir con los requisitos de las Secciones R702.1 y R703."
 - R703.7.2: Peso de mampostería \leq 40 libras por pie cuadrado si esta en diseño sísmico Categoría D






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2021

IRC Capítulo 3
Edificaciones irregulares

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Edificaciones Irregulares

IRC R301.2.2.6

Out-of-plane offsets

Regular Shape
Not Exceeding (40")
Joint doubled at ends of braced wall panel
D= Joint Depth
≥ 2" or Larger joint at 36" O.C. minimum
Shear wall or braced wall panel

Irregular Shape
Exceeding (40")
D= Joint Depth
No Continuous rim joint
Joint less than 2x12 or more than 36" O.C.
Joints not doubled at ends of braced wall panel

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Irregularidades

IRC R301.2.2.6

Ítem #4: Las condiciones cuando una abertura en un piso o techo excede el menor de 12 pies o 50% de la menor dimension del piso o techo

Regular Shape
Floor Plan
Less Than Or Equal To (X/2) Or 12'

Irregular Shape
Floor Plan
More Than (X/2) Or 12'

35

Irregularidades

IRC R301.2.2.6

- **Ítem #5:** Desplazamiento a nivel del piso
 - Excepciones:
 - Las estructuras apoyadas directamente por fundaciones continuas en el perímetro
 - Que los pisos estén verticalmente desplazados cuando el entramado de piso está soplado o amarrado, como se requiere en la seccion R502.6.1

Regular Shape Floor Level Vertical Offset
No Vertical Offset
Floor Framing Supported On Wall As Required Per IRC R502.6.1

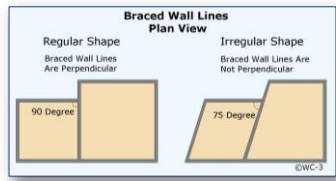
Irregular Shape Floor Level Vertical Offset
Vertical Offset And Floor Framing Not Supported Or Tied Together Per IRC R502.6.1

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Irregularidades

IRC R301.2.2.6

Ítem #6: Cuando los muros de corte y muros arriostrados perpendiculares no se presentan en dos direcciones perpendiculares



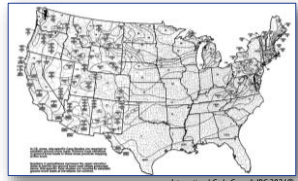
37

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Cargas de nieve

IRC R301.2.3

Edificaciones que se encuentran en regiones con cargas de nieve en el terreno > 70 libras por pie² se deben diseñar de acuerdo con las prácticas aceptadas de la ingeniería



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Construcción en áreas de inundación

IRC R301.2.4



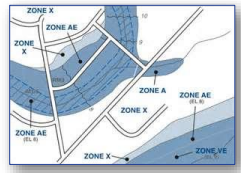
39

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Construcción en áreas de inundación

IRC R301.2.4

- “...construidas completamente o en parte en áreas con peligro de inundación según la Sección R322”
 - Si se encuentra en múltiples áreas de riesgo de inundación, se usa la más restringida
 - Si está ubicado en un cauce de inundación identificado, se diseña según ASCE 24.



40


40

Cargas vivas

IRC R301.5

USE	UNIFORM LOAD (psf)	CONCENTRATED LOAD (lb)
Uninhabitable attics without storage ¹	10	---
Uninhabitable attics with limited storage ²	20	---
Habitable attics and attics served with fixed stairs	30	---
Balconies (terraces) and decks ³	40	---
Fire escapes	40	---
Corridors	---	200 ⁴
Guard in fill components ⁵	---	50 ⁶
Handrails ⁷	200 ⁸	---
Passages vehicle garages ⁹	50 ¹⁰	2,000 ¹¹
Areas other than sleeping areas	40	---
Sleeping areas	30	---
Stairs	40 ¹²	300 ¹³

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Deflexión

IRC Tabla R301.7:
Para los miembros en voladizo, L se debe tomar como dos veces la longitud del voladizo

MIEMBRO ESTRUCTURAL ¹	DEFLEXIÓN ADMISIBLE
Columnas que soporten paredes ligeras o 3/4 con columnas ancladas en cimientos o columnas	L/100
Columnas y balcones interiores	4H/100
Paredes	L/250
Deflexiones con acabado de pisos (incluye moqueta y vinilo)	L/360
Columnas con terminación flexible (incluye maderas de piso)	L/240
Todos los demás miembros estructurales	L/240
Miembros adosados - cargas de viento ² con acabado de moqueta o vinilo	4H/100
Miembros adosados - cargas de viento ² con otros acabados de pisos	4H/120
Miembros adosados - cargas de viento ² con terminación flexible	4H/150
Columnas que soporten paredes de acabados de mampostería ³	L/100

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FIN DEL MÓDULO 3



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MÓDULO 4

IRC Capítulo 3: Planificación de Edificaciones Parte 2



1



IRC Capítulo 3



8% Planificación de Edificaciones (cont.)



2

Objetivos del Aprendizaje

1. Familiarizarte con los conceptos de construcción resistente a incendios
2. Entender la diferencia entre casas contiguas y viviendas de dos familias
3. Ganar conocimiento relacionado a penetraciones y la diferencia entre bloqueo antifuego y cierres de tiro
4. Conocer la importancia de las aberturas de toma y extracción


3

Construcción resistente al fuego

IRC R302

- Construcción resistente al fuego
 - IRC Tabla R302.1(I)

ELEMENTO DE MURO EXTERIOR		TABLA R302.1(I) MURDES EXTERIORES	CLASIFICACIÓN MÍNIMA DE RESISTENCIA AL FUEGO	DISTANCIA MÍNIMA DE SEPARACIÓN AL FUEGO
Muros	Clasificados resistentes al fuego	1. Para un propósito de acuerdo con ASTM E119, UL 207 o un método TBC 1 con Código Internacional de la Edificación (IRC) con requisitos desde arriba.	0 horas	0 pies
	Sin clasificación de resistencia al fuego		0 horas	≥ 6 pies
Particiones	No permitidas	*Para edificios de una familia, o edificios con solo 1 miembro grupal**	0 horas	0 pies
	Clasificados resistentes al fuego		0 horas	≥ 2 pies
Aberturas en muros	Sin clasificación de resistencia al fuego	Cualquier tipo de aberturas	0 horas	≥ 2 pies a 10 pies
	No permitidas		0 horas	≥ 5 pies
Particiones en áticos	Resistentes	Cualquier tipo de aberturas	0 horas	0 pies
	No resistentes		0 horas	0 pies
Particiones en sótanos	Resistentes	Cualquier tipo de aberturas	0 horas	0 pies
	No resistentes		0 horas	0 pies



4


Construcción resistente al fuego

IRC R302

- Si está equipada con un sistema de rociadores automáticos...
 - IRC Tabla R302.1(2)

TABLA R302.1(2) MUROS EXTERIORES—VIVIENDAS CON ROCIADORES ANTIFUEGO		
ELEMENTO DE MURO EXTERIOR	CLASIFICACIÓN MÍNIMA DE RESISTENCIA AL FUEGO	DISTANCIA MÍNIMA DE SEPARACIÓN AL FUEGO
Muros	1 hora equipada de acuerdo con ASTM E119, UL 263 o la Sección 703.3 del Código Internacional de la Edificación (IEC) con exposición desde el exterior	3 pies
Proyecciones	1 hora	3 pies
Aberturas en muros	1 hora	3 pies
Penetraciones	1 hora	3 pies

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Construcción resistente al fuego

IRC R302

- Excepciones a la Tabla R302.1(1)
 - Los muros, proyecciones, aberturas o penetraciones perpendiculares a la línea utilizada para terminar la distancia de separación al fuego
 - Muros de unidades de vivienda individuales y sus estructuras accesorias ubicados en el mismo lote
 - Cobertizos para herramientas y almacenamiento separados, casas de muñecas y estructuras similares extentas de permisos. (Las proyecciones no deben extenderse sobre la línea de lote).
 - Garajes separados accesorios a una vivienda ubicada dentro de los 2 pies de una línea de lote pueden tener proyecciones que no excedan 4 pulgadas
 - Se permiten los respiraderos de fundación

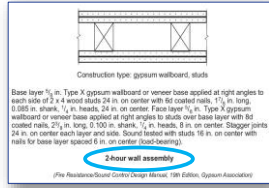


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Casas contiguas

IRC R302.2

“Los muros que separan las unidades de casas contiguas deben construirse de acuerdo con la Sección R302.2.1 o R302.2.2”




Construction type: gypsum wallboard, studs

Base layer 1/2 in. Type X gypsum wallboard or veneer base applied at right angles to each side of 2 x 4 wood studs 24 in. on center with 160 coated nails, 1 1/2 in. long, 0.085 in. shank, 1/4 in. heads, 24 in. on center. Face layer 1/2 in. Type X gypsum wallboard or veneer base applied at right angles to studs over base layer with 160 coated nails, 2 1/2 in. long, 0.100 in. shank, 1/4 in. heads, 8 in. on center. Stagger joints 24 in. on center each layer and side. Sound tested with studs 16 in. on center with walls for base layer spaced 8 in. on center (staggering).

2-hour wall assembly

(From Residential-Sound Control Design Manual, 1991 Edition, Gypsum Association)




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Casas contiguas

IRC R302.2.2

- Los muros comunes que separan casas contiguas deben asignar una clasificación de resistencia al fuego de acuerdo con los Items 1 o 2 de la Sección R302.2
 - Un sistema de rociadores contra incendios provisto de acuerdo con la Sección P2904 – el muro común debe tener una clasificación de mínimo **1 hora de resistencia al fuego**
 - Cuando un sistema de rociadores contra incendios **no esté provisto** de acuerdo con la Sección P2904 – el muro común debe tener una clasificación de mínimo **2 horas de resistencia al fuego**



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Casas contiguas

IRC R302.2

- El muro común compartido por dos casas contiguas no se debe construir con "instalaciones hidráulicas y sanitarias o equipo mecánico, conductos o respiraderos en la cavidad del muro común"
 - El muro debe estar clasificado para exposición al fuego en ambas caras.
 - Debe estar ajustado contra muros exteriores y la cara inferior del entablado del techo
- "Las penetraciones de la membrana de los muros comunes para cajas de tomas de corriente deben estar de acuerdo con la Sección R302.4"





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Continuidad de las casas contiguas

IRC R302.2.3

"...El muro o sistema clasificado resistente al fuego que separa casas contiguas debe ser continuo desde la fundación hasta la cara inferior del entablado de techo, de la cubierta o de la losa".


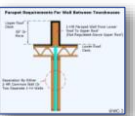
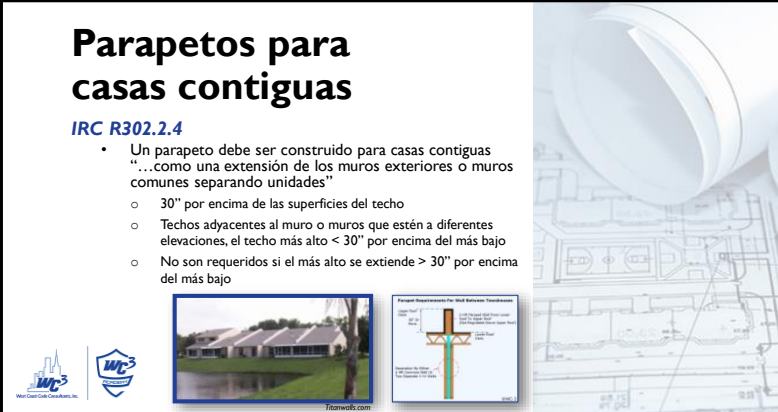




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Parapetos para casas contiguas

IRC R302.2.4

- Un parapeto debe ser construido para casas contiguas "...como una extensión de los muros exteriores o muros comunes separando unidades"
 - 30" por encima de las superficies del techo
 - Techos adyacentes al muro o muros que estén a diferentes elevaciones, el techo más alto < 30" por encima del más bajo
 - No son requeridos si el más alto se extiende > 30" por encima del más bajo


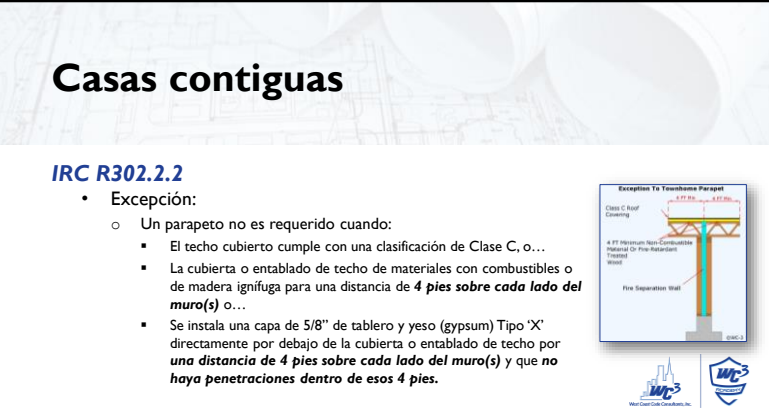






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Casas contiguas

IRC R302.2.2

- Excepción:
 - Un parapeto no es requerido cuando:
 - El techo cubierto cumple con una clasificación de Clase C, o...
 - La cubierta o entablado de techo de materiales con combustibles o de madera ignífuga para una distancia de **4 pies sobre cada lado del muro(s)** o...
 - Se instala una capa de 5/8" de tablero y yeso (gypsum) Tipo 'X' directamente por debajo de la cubierta o entablado de techo por **una distancia de 4 pies sobre cada lado del muro(s)** y que **no haya penetraciones dentro de esos 4 pies.**

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Viviendas de dos familias

IRC R302.3

- "Las unidades de vivienda en viviendas de dos familias deben estar separadas...una **1 hora de clasificación de resistencia al fuego...**"
- "Dicha separación se proporcionará independientemente de si existe o no una línea de lote entre las dos unidades de vivienda."



¡Al fuego no sabe ni le importa si hay una línea de propiedad o no!

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Viviendas de dos familias

IRC R302.3

- Excepciones
 - ½ hora de protección si la edificación esté equipado con un sistema de rociadores automáticos
 - No necesitan extenderse a través del ático si...
 - El cielorraso esté protegido por tablero de yeso (gypsum) Tipo X de no menos de 5/8" y...
 - Se proporcione un cierre de tiro del ático para crear espacios ≤ 1000 pies cuadrados

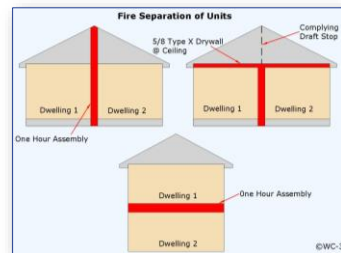


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Viviendas de dos familias

IRC R302.3



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Penetraciones completas

IRC R302.4.1

- Penetraciones completas
 - Sistema clasificado resistente al fuego: Las penetraciones deben ser instaladas como sea ensayado en el sistema aprobado
 - Sistema cortafuego de la penetración: Sistema contrafuego aprobado que tiene una clasificación F



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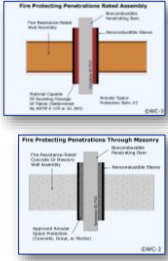

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Penetraciones

IRC R302.4.1

- Excepciones:
 - Para las tuberías, tubos o conductos de acero, ferrosos o de cobre...
 - Típico: El material usado para rellenar el espacio anular debe evitar el pasaje de llama y gases calientes
 - Concreto/Mampostería: El espacio anular se debe rellenar con concreto, lechada o mortero

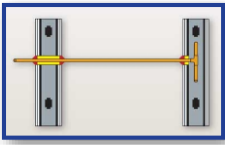

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Penetraciones

IRC R302.4.2

- Penetraciones de membrana
 - Mismos requisitos que las "penetraciones completas"
 - Los artefactos en nicho deben ser instalados de modo que la clasificación de resistencia al fuego requerida no sea reducida

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Penetraciones

IRC R302.4.2

- Excepciones:
 - Cajas eléctricas de acero: ≤ 16 pulgadas²; ≤ 100 pulgadas² en 100 pies²
 - Máximo de 1/8" de espacio anular
 - Cajas deben estar separadas de lados opuestos del muro no menos de 24" de distancia
 - Cajas listadas: Ensayadas para uso en sistemas clasificados resistentes al fuego
 - Rociadores: Placa protectora metálica





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Protección en abertura de vivienda-garaje

IRC R302.5.1:

- Puertas macizas de madera (1 3/8") +
- Puertas macizas de acero o con núcleo en panel (1 3/8") +
- Puertas con clasificación al fuego de 20 minutos
 - Equipado con un dispositivo de cierre automático



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Protección en abertura de vivienda-garaje

IRC R302.5.1

- Protección de la abertura:
 - No se permite la abertura directa desde un garaje privado hacia un cuarto utilizado para dormir

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Protección en abertura de vivienda-garaje

IRC R302.5.2

- Penetración de conductos:
 - Ductos construidos de lámina de acero con calibre mínimo No. 26
 - Ninguna abertura hacia el garaje
- Otras penetraciones:
 - Espacio anular debe ser relleno con material aprobado







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Separación contra incendio vivienda-garaje

SEPARACIÓN	MATERIAL
Desde la residencia y áticos	No menos que 1/2 pulgada de tablero de yeso o equivalente ubicado al lado del garaje
Desde todos los cuartos habitables por encima del garaje	No menos que 1/2 pulgada de tablero de yeso Tipo X o equivalente
Espacios que requieren sistemas de protección: utilizados para la separación requerida por esta Sección	No menos que 1/2 pulgada de tablero de yeso o equivalente
Garajes ubicados a menos de 3 pies desde una unidad de vivienda en el mismo lote	No menos que 1/2 pulgada de tablero de yeso o equivalente aplicado al lado interior de muros exteriores que están dentro de una zona

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IRC R302.6

- 1/2" de tablero de yeso (gypsum) desde el **garaje a los cuartos habitables**
- 5/8" de gypsum desde los cuartos habitables **por encima del garaje**







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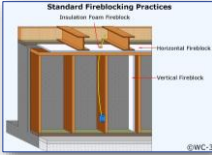

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Bloqueo antifuego

IRC R302.11

Ubicaciones:

- Espacios ocultos de muros
 - Verticalmente en los niveles de cielorraso y piso
 - Horizontalmente ≤ 10-pies

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Bloqueado antifuego

IRC R302.11

Ubicaciones:

- En todas las interconexiones entre espacios ocultos verticales y horizontales "...como ocurre en soffits, cielorrasos suspendidos y cielorrasos en caveto."







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Bloqueado antifuego

IRC R302.11

- Ubicaciones:
 - "Los espacios ocultos entre largueros de escaleras en el extremo superior e inferior del recorrido"
 - Nota: "Los espacios cerrados bajo escaleras deben cumplir con la Sección R302.7"







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Bloqueado antifuego

IRC R302.11

- Ubicaciones:
 - Aberturas alrededor de respiraderos, tuberías, conductos, cables y alambres al nivel de cielorraso y de piso
 - Material aprobado para resistir el libre pasaje de la llama y los productos de combustión




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Bloqueado antifuego

IRC R302.11

- Ubicaciones:
 - Todos los espacios entre las chimeneas y pisos/cielorrasos deben ser bloqueados con materiales no combustibles de acuerdo con la Sección R1003.19






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Bloqueado antifuego

IRC R302.11

- Ubicaciones:
 - Cornisas de una vivienda de dos familias en la línea de separación de la unidad de vivienda




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Materiales del bloqueo antifuego

IRC R302.11.1

- “...se debe proveer bloqueo antifuego para cortar todas las aberturas de tiro ocultas verticales y horizontales y para formar una barrera efectiva al fuego entre pisos...”
- Materiales:
 - 2" madera elaborada
 - Dos espesores de 1" nominal de madera elaborada
 - Dos espesores de paneles estructurales de madera de 23/32"
 - Dos espesores de madera aglomerada de 3/4"
 - 1/2" tablero de yeso (gypsum)
 - 1/4" cartón con base cementada
 - Lámina o manta de lana mineral o fibra de vidrio
 - Aislamiento (insulación) de celosa

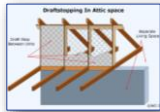
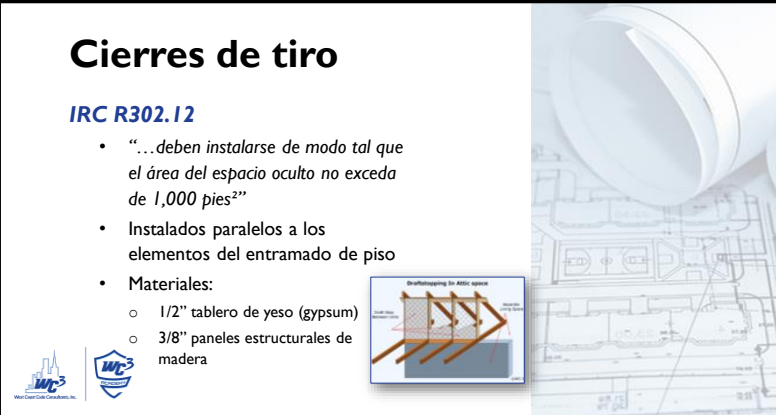
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Cierres de tiro

IRC R302.12

- “...deben instalarse de modo tal que el área del espacio oculto no exceda de 1,000 pies²”
- Instalados paralelos a los elementos del entramado de piso
- Materiales:
 - 1/2" tablero de yeso (gypsum)
 - 3/8" paneles estructurales de madera

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Protección contra incendios de pisos

IRC R302.13

- Requiere protección de los miembros de los sistemas de piso por encima de los espacios de arrastre que contienen:
 - Aparatos de calefacción alimentados por combustible o
 - Aparatos eléctricos

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Protección contra incendios

IRC R302.13

La parte inferior del miembro del entramado del piso debe estar provisto de una membrana de cartón de yeso (gypsum) de 1/2" o membrana de panel estructural de madera de 5/8"



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Protección contra incendios

IRC R302.13

- Excepciones:
 - Ensamblados de piso ubicados directamente sobre un espacio protegido por un sistema de rociadores automáticos
 - Los sistemas de piso ubicados directamente sobre un espacio de arrastre no destinados al almacenamiento o para la instalación de aparatos de calefacción alimentados por combustible o eléctricos
 - Áreas ≤ 80 pies² de las cuáles son protegidas contra incendios
 - Madera elaborada de dimension o madera elaborada compuesta estructural igual o mayor que 2"x10" de dimension nominal



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Espacio Habitable

IRC R202

- Un espacio en una edificación para **vivir, dormir, comer o cocinar**
 - Los baños, servicios, armarios, vestíbulos, bodegas o espacios de uso general y áreas similares **no son considerados espacios habitables**



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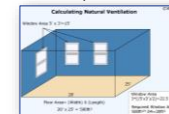
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Cuartos habitables


IRC R303.1

- Iluminación:
 - Las áreas vidriadas agregadas $\geq 8\%$ del área del piso
- Ventilación:
 - Aberturas como ventanas, claraboyas, puertas o celosías...
 - Acceso directo o fácilmente controlables por los ocupantes de la edificación
 - El área de abrir para el exterior $\geq 4\%$ del área del piso



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Cuartos habitables


IRC R303.1

- Excepciones:
 - Las áreas vidriadas no necesitan abrirse donde la abertura no es requerida por la Sección R310 y un sistema de ventilación mecánico para toda la vivienda es instalado (Sección M1507)
 - 8% de área vidriada no requerida cuando se provee una luz artificial capaz de producir una iluminación promedio de 6 pie bujías sobre el área del cuarto a una altura de 30"
 - El uso de jardines de invierno y cubiertas de patio (R202) debe estar permitidas para ventilación natural si más de 40% de los muros exteriores de la terraza acristalada están abiertos o son encerrados solo por pantallas para insectos



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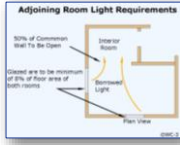

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Cuartos contiguos


IRC R303.2

- 50% del muro común está abierto
- Abertura sin obstrucciones que proporcione no menor de 10% del área del piso del cuarto interior y no menor que 25 pies cuadrados

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Aberturas de toma

IRC R303.5

- Aberturas de toma:
 - ≥ 10 pies de "...cualquier contaminante peligroso o nocivo, tales como respiraderos, chimeneas, respiraderos sanitarios, calles, callejones, estacionamientos y andenes de carga"
 - Si está ubicada a menos de 10 pies, la abertura de toma debe estar a 3 pies de distancia o más por debajo de la fuente de contaminantes
 - La extracción de unidades de vivienda, escusados, baños y cocinas no debe ser considerada como peligrosa o nociva
- Aberturas de extracción:
 - El aire de extracción no debe ser dirigido hacia los caminos



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Aberturas de toma

IRC R303.6

- Protección de las aberturas al exterior
 - Deben ser protegidas con pantallas, celosías o rejillas resistentes a la corrosión teniendo un tamaño de abertura de 1/4" y un máximo de 1/2"




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MÓDULO 5

IRC Capítulo 3: Planificación de Edificaciones Parte 3



1



IRC Capítulo 3



Planificación de Edificaciones (cont.)



2

Objetivos del Aprendizaje

1. Comprender cuando se requiere la iluminación en las escaleras
2. Familiarizarte con las dimensiones mínimas de los cuartos y altura del cielorraso
3. Poder identificar las ubicaciones peligrosas que requieren áreas vidriadas agregadas
4. Saber cuando las salidas de emergencia y aberturas de rescate son requeridas y como se deben configurar







3

Iluminación

IRC R303.7 - R303.8

- Escalera interior:
 - Las escaleras interiores deben ser provistas con una fuente de iluminación artificial para iluminar los descansos y huellas
 - Capaces de iluminar las huellas y descansos a niveles ≥ 1 pie bujía. (o 1 Lumen por cada pie cuadrado)
- Escalera exterior:
 - Provistas con una fuente de iluminación artificial localizada en el aterrizaje superior de la escalera
 - Las escaleras hacia el sótano desde el nivel del terreno exterior deben ser provistas con una fuente de iluminación artificial localizada en el aterrizaje superior de la escalera

4

Iluminación

IRC R303.7

- Fuente de iluminación
 - Debe haber un interruptor de muro en cada nivel del piso para controlar la fuente de iluminación donde la escalera tiene **6 o más escalones** verticales





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Calefacción requerida

IRC R303.10

- Temperatura de diseño invernal < 60°F:
 - Debe ser provista con las instalaciones de calefacción capaces de mantener una temperatura del cuarto de no menos de 68°F en un punto a 3' sobre el piso y a 2' de los muros exteriores
 - La instalación de uno o más calefactores de espacio portátiles no deben utilizarse para el cumplimiento con esta sección





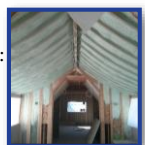


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Áreas mínimas de cuartos

IRC R304

- Área mínima:
 - Cuartos habitables ≥ 70 pies²
- Dimensiones mínimas:
 - Cuartos habitables ≥ 7 pies en cualquier dirección horizontal
 - Excepción: Cocinas
- Altura sobre el área del cuarto:
 - Cielorraso inclinado > 5 pies
 - Cielorraso enrasado > 7 pies

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Altura del cielorraso

IRC R305

- “El espacio habitable, pasillos y partes de sótanos que contienen esos espacios deben tener una altura de cielorraso **no menor que 7 pies**”
- Excepciones:
 - Cielorraso inclinado \rightarrow 50% del área no menos de 7'-0", pero ninguna porción menos que 5'-0" se puede incluir
 - Baños y duchas $\geq 6'-8"$
 - Sótanos no habitables con vigas o conductos $\geq 6'-4"$





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Altura del cielorraso

IRC R305.1.1

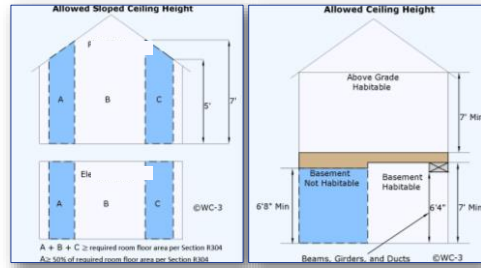
- **Altura mínima**
 - En todos los espacios habitables, la altura mínima del cielorraso se reduce a 78" (6' 6") debajo de las vigas con una separación de al menos 36"






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Altura del cielorrasos





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Higiene

IRC R306

- **Artefactos sanitarios:**
 - Cada unidad de vivienda debe estar provista con un inodoro, un lavabo (lavamanos), y una bañera o ducha
- **Cocina:**
 - Cada unidad de vivienda debe estar provista de un área de cocina que sea provista de un fregadero
- **Eliminación de residuos y suministro de agua**
 - Los artefactos sanitarios deben ser conectados a una cloaca sanitaria o a un sistema de eliminación de residuos cloacales privado aprobado



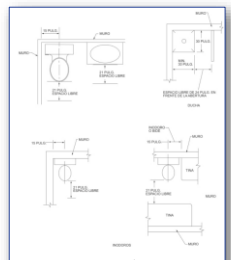
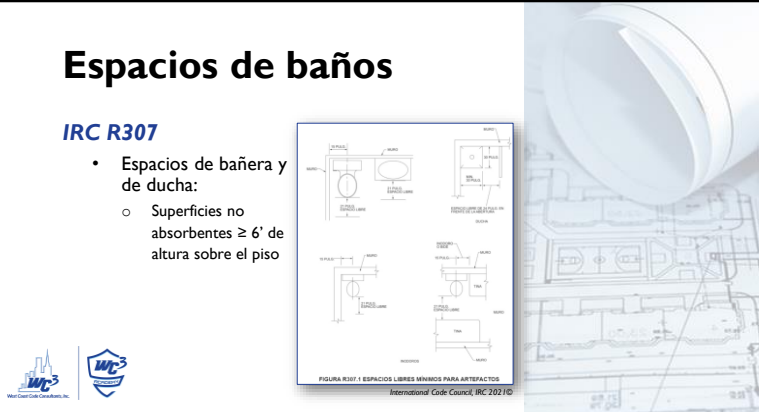


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Espacios de baños

IRC R307

- **Espacios de bañera y de ducha:**
 - Superficies no absorbentes $\geq 6'$ de altura sobre el piso

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Vidriado

IRC R308.1

- Designación del fabricante
 - “...cada hoja de vidrio instalada en localizaciones peligrosas...debe ser provista con una designación del fabricante especificando quién aplicó la designación, el tipo de vidrio y la norma de vidrioado de seguridad con la que cumple, y que es visible en la instalación final.”






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Vidriado

IRC R308.1

- Identificación de sistemas múltiples
- Al menos una hoja de vidrio del sistema múltiple con hojas de vidrio individuales ≤ 1 pie² debe ser sellada

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Cargas de impacto humanas

IRC R308.3

Las hojas de vidrio deben ser selladas “CPSC 16 CFR 1201” o “ANSI Z97.1” según sea apropiado

TABLA R308.3 (1) CATEGORÍA MÍNIMA DE CLASIFICACIÓN DE LOS VIDRIADOS USANDO CPSC 16 CFR 1201						
ÁREA SUPERFICIAL EXPUESTA EN LA CARA DE UNA LAMINA	VIDRIADOS EN PUERTAS DE CERRAMIENTOS O COMBINADOS (Clase de Categoría)	VIDRIADO EN PUERTAS (Clase de Categoría)	PANELES VIDRIADOS REGULADOS POR LA SECCIÓN R308.4.3 (Clase de Categoría)	PANELES VIDRIADOS REGULADOS POR LA SECCIÓN R308.4.2 (Clase de Categoría)	VIDRIADOS EN PUERTAS Y CERRAMIENTOS REGULADOS POR LA SECCIÓN R308.4.1 (Clase de Categoría)	PUERTAS CERRAMIENTOS DE VIDRIO TIPO PATIO (Clase de Categoría)
0 pies cuadrados o menos	0	0	0	0	0	0
Más de 0 pies cuadrados	0	0	0	0	0	0

TABLA R308.3 (2) CATEGORÍA MÍNIMA DE CLASIFICACIÓN DE LOS VIDRIADOS USANDO ANSI Z97.1			
ÁREA DE SUPERFICIE EXPUESTA EN UNA CARA DE UNA LAMINA	PANELES VIDRIADOS REGULADOS POR LA SECCIÓN R308.4.3 (Clase de Categoría)	PANELES VIDRIADOS REGULADOS POR LA SECCIÓN R308.4.2 (Clase de Categoría)	PUERTAS Y CERRAMIENTOS REGULADOS POR LA SECCIÓN R308.4.1 (Clase de Categoría)
0 pies cuadrados o menos	0	0	0
Más de 0 pies cuadrados	0	0	0


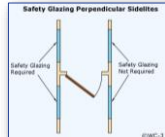



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Vidriado

IRC R308.4.1 al R308.4.7

- Excepciones:
 - Vidriado en el muro del lado de la bisagra y perpendicular a la puerta
 - Cuando hay un muro intermedio entre la puerta y el vidrioado
 - Cuando el acceso a través de la puerta sea a un armario o área de almacenamiento ≤ 3 pies de profundidad
 - Vidriado que sea adyacente al panel fijo de puertas de patio
 - Vidriado decorativo








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Vidriado y superficies mojadas

IRC R308.4.5

- Vidriado en todas las puertas giratorias, deslizantes y plegables
- Excepciones:
 - Aberturas vidriadas de un tamaño de abertura tal que una esfera de 3" de diámetro no puede pasar
 - Vidriado decorativo




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Vidriado

IRC R308.4.2

- Vidriado adyacente para puertas
 - Es requerido si...
 - El vidriado está dentro de 24" a cada lado de la puerta en el plano de la puerta en una posición cerrada
 - Está en un muro a menos de 180" del plano de la puerta en posición cerrada y dentro de 24" del lado de la bisagra de un apertura giratoria




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Vidriado en ventanas

IRC R308.4.3

- Vidriado en un panel individual fijo que...
 - Área expuesta ≥ 9 pies²
 - Borde inferior < 18" por encima del piso
 - Borde superior > 36" por encima del piso
 - Una superficie de circulación dentro de 36"

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Vidriado

IRC 308.4.4.1

- Paneles estructurales de vidrio de balaustrada
 - Debe instalarse con una barra superior o pasamanos adjunto
 - La barra superior debe soportar ≥ 3 paneles de vidrio balaustrados
 - No requerido cuando los paneles de vidrio de balaustrada son de vidrio laminado con 2 o más capas de vidrio del mismo espesor





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Vidriado

Vidriado en barandas y barras sin importar el área





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Vidriado

IRC R308.4.5

“Vidriado en muros, cerramientos o cercas que contienen o dan a tinas calientes, spas, tinas de remolinos, saunas, cuartos de vapor, bañeras y duchas donde el borde expuesto inferior del vidrio está ≥ 60 ” verticalmente por encima de cualquier superficie para pararse



Excepción: Vidriado que está > 60 ” desde el borde del agua de una bañera, jacuzzi, spa, hidromasaje o piscinas.



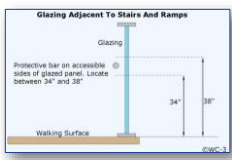

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Vidriado

IRC R308.4.6

- Vidriado adyacente de trayectos de escalera
- El borde expuesto superior < 36 ” de trayectos de escalera, descansos entre tramos y rampas
- Excepciones:
 - Una barra horizontal instalada de 34 ”- 38 ” por encima del plano de la superficie de circulación
 - Vidriado de ≥ 36 ” horizontalmente de la superficie de circulación



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Vidriado

IRC R308.4.7

- Vidriado adyacente de los descansos en el extremo inferior de la escalera si...
 - El extremo inferior < 36 ” sobre el descanso
 - Dentro de un arco horizontal de 60 ”

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Vidriado

IRC R308.4.7

- Adyacente de los descansos en el extremo inferior del trayecto de la escalera:
 - "El vidriado en la parte inferior de las escaleras solo se requiere dentro de las 60 pulgadas en un plano de 180 grados desde la huella inferior".

Figure R308.4.7 International Code Council, IRC 2021 ©

International Code Council, IRC 2021 ©

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Claraboyas

IRC R308.6

- Las claraboyas y los vidrios en pendiente:
 - Instalados de acuerdo con esta sección
- Materiales:
 - Vidrio laminado de 16 pies² o menos y no más de 12 pies² sobre superficie de circulación
 - Vidrio totalmente templado
 - Vidrio termorrigidado
 - Vidrio armado
 - Plásticos rígidos aprobados

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Claraboyas

IRC R308.6.8

- Bordillos para claraboyas:
 - Requerido cuando el techo mide < 3:12 unidades verticales por horizontales
 - Debe extender por lo menos ≥ 4" por encima del plano del techo

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Garajes y cocheras abiertas

IRC R309



- "...deben estar abiertos en por lo menos 2 lados"
- Si están cerrados por mas de 2 lados, se deben considerar un garaje
- El área de piso usada debe estar en declive para facilitar el movimiento de líquidos al desagüe

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Aberturas para escapes de emergencia

IRC R310.1

- “Los sótanos, áticos habitables y cada dormitorio debe tener al menos una abertura para escape de emergencia y rescate operable”
- Requerido en cada dormitorio del sótano habitable
- Deben abrirse directamente hacia un camino público
- Excepción 1:
 - Sótanos ≤ 200 pies² que alberguen equipo mecánico



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Aberturas para escapes de emergencia

IRC R310.1

- Excepción 2: No se requiere una abertura para escape de emergencia en cada dormitorio habitable del sótano si:
 - La vivienda está equipada con un sistema de rociadores automáticos y,
 - Dos medios de salida del sótano, o
 - Un medio de salida del sótano y una abertura para escapes de emergencia y rescate



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Área mínima de abertura

Requisitos:

- Parte inferior de la abertura ≤ 44 "
- Abertura libre neta mínima de 5.7 pies²
 - De grado - 5.0 pies²
- Altura libre neta mínima de 24"
- Ancho libre neto mínimo de 20"
- Debe ser el resultado de **operación normal**


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Patio inglés

IRC R310.4

- Área horizontal mínima de 9 pies²
- Proyección horizontal mínima de 36"
- Escalera de mano requerida si mide > 44 " de profundidad vertical
 - Peldaños: Ancha min. = 12"; Separación min. = 18"
 - Proyección mínima de 3"





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Patio inglés

IRC R310.4.3

- Drenaje
 - Drenaje adecuado mediante la conexión al sistema de drenaje de Fundación de edificaciones requerido por la Sección R405.1.
 - No se requiere un sistema de drenaje si la fundación esté en suelos bien drenados



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Patio inglés

IRC R310.4.4.4

- Barras, parrillas, tapas y pantallas
 - Debe contar con el tamaño mínimo de la abertura libre neta según las secciones R310.2.1 al R310.2.3
 - “Se debe poder desenganchar o remover desde el interior sin el uso de una llave, herramienta, conocimiento especial o fuerza mayor requerida para el funcionamiento normal...”




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Ampliaciones de vivienda

IRC R310.6

- “Cuando las ampliaciones de vivienda contengan dormitorios, se debe proveer un escape de emergencia y rescate en cada nuevo dormitorio.”
- Se debe proveer una abertura para escape de emergencia y rescate en cada sótano nuevo
- Excepciones:
 - No requerido para sótanos que contengan un dormitorio con una abertura para escape de emergencia y rescate
 - No requerido para sótanos nuevos donde haya una abertura para escape de emergencia y rescate en un sótano existente



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FIN DEL MÓDULO 5

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MÓDULO 6

IRC Capítulos 3 & 4:
Planificación de Edificaciones Parte IV & Fundaciones



1



IRC Capítulo 3



8% Planificación de Edificaciones (cont.)



2

Objetivos de Aprendizaje

1. Entender los requisitos mínimos relacionados con las puertas de salida
2. Familiarizarte con las dimensiones mínimas y máximas relacionadas a las escaleras, rampas, barandas y pasamanos
3. Conocer los requisitos mínimos de seguridad para las viviendas residenciales
4. Familiarizarte con los requisitos prescritos relacionados con las fundaciones y ubicación de la edificación

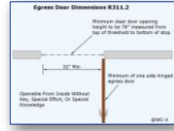





3

Puerta de salida

IRC R311.2

- Se provee al menos **una puerta de salida** para cada unidad de vivienda
- Requisitos:
 - Debe llevar bisagra
 - Ancho libre mínimo de **32"**
 - Altura libre mínima de **78"**
 - Deben abrirse fácilmente desde el interior sin el uso de una llave o esfuerzo o conocimiento especial






4


Puertas de salida

IRC R311.3

- “Debe haber un descanso o piso en cada lado de una puerta exterior.”
- Requisitos del descanso:
 - Ancho mínimo de **36"** en dirección del recorrido
 - Pendiente máxima de **2%** en cualquier dirección



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Puertas de salida

IRC R311.3

- Puertas de salida requeridas
 - Descansos o pisos terminados no deben ser $> 1.5"$ más bajo que la parte superior del umbral
 - Excepciones:
 - Puede ser $\leq 7.75"$ siempre que la puerta NO GIRE sobre el descanso o piso



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Puertas de salida

IRC R311.3

- Otras puertas exteriores
 - El descanso o piso del lado exterior no debe ser $> 7.75"$ por debajo del borde superior del umbral
 - Excepciones:
 - Un descanso no es requerido del lado exterior cuando...
 - Solo haya dos alzadas en un trayecto de escalera y
 - La puerta NO GIRE sobre el trayecto de escalera



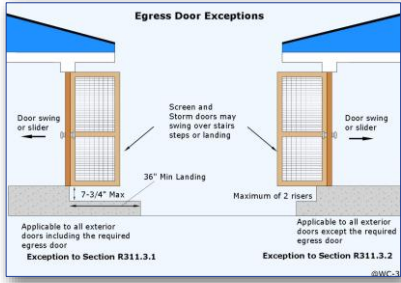
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Puerta de salida

IRC R311.3



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Construcción

IRC R311.5

“Los descansos, cubiertas, balcones, escaleras e instalaciones similares exteriores deben ser positivamente anclado a la estructura principal para resistir tanto las fuerzas verticales como laterales...”




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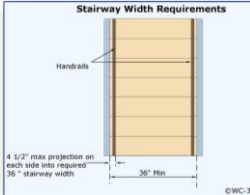


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Trayectos de escaleras


IRC R311.7.1

- Ancho:
 - Ancho mínimo de un vestíbulo **36”**
 - Los pasamanos no deben proyectar **> 4.5”**
- Subida vertical:
 - **Máximo de 12’** (151”) entre los niveles del piso o los descansos
- Altura libre:
 - Mínimo de 6’-8”



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Trayectos de escaleras

IRC R311.7

- **Excepciones:** Las escaleras no son requeridas a cumplir con estas secciones si...
 - No están dentro o adjuntos a un edificio/porche/terracea
 - Llevan a áticos no habitables
 - Llevan a un espacio de rastreo



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Escaleras (cont.)


IRC R311.7.3

- Subida vertical
 - “Un tramo de escaleras no debe tener una subida vertical mayor a 12’7” (151”) entre los niveles del piso o los descansos.”
 - En este ciclo de los códigos, se agregaron 4 pulgadas para acomodar techos de 10’ y entramados de piso de 24” de profundidad



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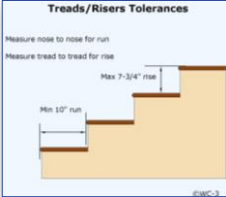



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Contrahuellas y huellas

IRC R311.7.5

- Contrahuellas:
 - Altura $\leq 7.75"$
 - Máx. $3/8"$ de diferencia entre cada escalón
 - Escalones abiertos que no permitan esfera $4"$
- Huellas:
 - $\geq 10"$ profundidad
 - Máx. $3/8"$ de diferencia entre escalones






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Superficie de circulación de trayectos de escalera

IRC R311.7.7

- La superficie de circulación y descanso debe estar en una pendiente $\leq 2\%$
- Excepción:** "Cuando la superficie de un descanso se requiera en otra parte del código para drenar el agua superficial, la superficie para caminar del descanso deberá tener una pendiente no mayor de 1 unidad vertical en 20 unidades horizontales (**pendiente del 5%**) en la dirección de desplazamiento".

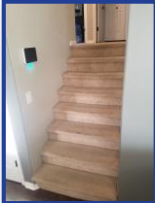




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Pasamanos

IRC R311.7.8

- Requerido al menos un lado si hay ≥ 4 contrahuellas (escalones)
- Altura:
 - Min. = $34"$
 - Máx. = $38"$
- Proyección:
 - Máximo de $4.5"$ desde la pared

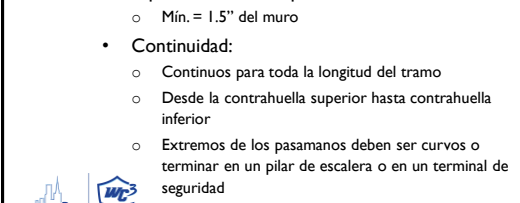




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Pasamanos

IRC R311.7.8

- Espacio libre de los pasamanos:
 - Min. = $1.5"$ del muro
- Continuidad:
 - Continuos para toda la longitud del tramo
 - Desde la contrahuella superior hasta contrahuella inferior
 - Extremos de los pasamanos deben ser curvos o terminar en un pilar de escalera o en un terminal de seguridad

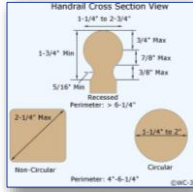



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Medida del agarre

IRC R311.7.8.5

- 1er Tipo de agarre:
 - Sección transversal circular de 1.25" a 2" de diámetro o...
 - Perímetro de 4" a 6.25" y 2.25" dimensión máxima
- 2do Tipo de agarre:
 - Perímetro mayor > 6.25"
 - Área de manilla que se puede agarrar en ambos lados del perfil



The diagram shows two types of handrail cross-sections. The first is a circular profile with a diameter between 1.25" and 2". The second is a non-circular profile with a perimeter greater than 6.25". Dimensions for the circular profile include a maximum width of 3.14" and a maximum height of 3/8". Dimensions for the non-circular profile include a maximum width of 2.14" and a maximum height of 3/8".

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Dispositivo de huella alterna

IRC R311.7.11

- Dispositivo de huella alterna
 - No deben usarse como medio de salida
 - Pueden usarse como medio de salida para entretechos, entrepisos, etc. ≤ 200 pies²
 - Mínimo de 20" ancho libre
 - Huellas
 - 5" – 8 1/2" profundidad
 - 7" ancho
 - 9 1/2" alto
 - Ángulo de ascenso de entre 50 a 70°
 - Pasamanos
 - Ambos lados
 - 30" – 34" de altura




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Escaleras de mano para barcos

IRC R311.7.12

- No deben usarse como medio de salida
 - Pueden usarse como medio de salida para entretechos, entrepisos, etc. ≤ 200 pies²
- 20" mín. de ancho libre
- Huellas
 - 5" – 8 1/2" de profundidad
 - 9 1/2" de altura
- Pasamanos
 - Ambos lados
 - 30" – 34" de altura

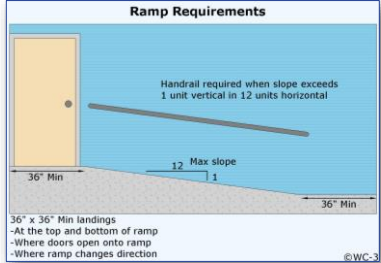


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Rampas

IRC R311.8

Ramp Requirements



The diagram shows a ramp with a maximum slope of 12 units vertical in 1 unit horizontal. It includes 36" x 36" minimum landings at the top and bottom of the ramp, and where the ramp changes direction. A handrail is required when the slope exceeds 1 unit vertical in 12 units horizontal.

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Rampas

IRC R311.8

- Excepción: Las rampas no se requieren cuando:
 - No están dentro de un edificio ni sirviendo a un edificio/porche/terracea






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Barandas

IRC R312.1.1

- Las barandas en los lados abiertos de las escaleras deben tener una altura $\geq 30''$ del grado (dentro de 36'' horizontalmente)
- “...maya para insectos no se debe considerar una baranda”



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Barandas

IRC R312.1

- Requisitos:
 - Altura: $\geq 36''$ (34'' en el trayecto de la escalera)
 - Límites de aberturas: \leq esfera de 4'' de diámetro
 - Aberturas triangulares en el lado abierto: \leq esfera de 6'' de diámetro



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Ventanas de soporte

IRC R312.2.1

- Donde el soporte de una abertura de ventana está ubicada sobre el piso terminado $> 72''$ y...
 - La parte inferior está ubicada a menos de 24'' y...
 - No permiten que pase una esfera de 4'' de diámetro y...
 - Dispositivo de prevención de caídas de ventanas según (ASTM F2090)

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Dispositivos de control de apertura de ventanas

IRC R312.2.2

"El dispositivo de control de apertura de la ventana, después de la operación para liberar el dispositivo de control que permite que la ventana se abra por completo, no debe reducirse al área de apertura neta libre de la unidad a menos del área requerida por la Sección 310.2.1."



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Rociadores automáticos

IRC R313

- Casas contiguas y viviendas de una y dos familias de acuerdo con la **P2904** o **NFPA 13D**
- No requeridos para ampliaciones o modificaciones a los edificios existentes que no tengan rociadores automáticos



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Alarmas de humo

IRC R314.3

- Alarmas de humo deben instalarse en...
 - Cada cuarto de dormir
 - Fuera de cada área de dormir independiente de la cercanía inmediata de los dormitorios
 - Cada piso adicional a la vivienda



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Alarmas de humo

IRC R314.3

- Las alarmas de humo deben instalarse...
 - No menos de 3 pies horizontalmente desde la puerta o la abertura de un baño que contenga bañera o ducha
 - Habitaciones abiertas a pasillos que dan servicio a habitaciones con altura de $\geq 24'$ más alta que el pasillo



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Instalación cerca de artefactos de cocina

IRC R314.3.1

- **Ionización:** No deben instalarse a menos de 20 pies de un artefacto de cocina instalado permanentemente
- **Ionización con interruptor silenciador de alarma:** No deben instalarse a menos de 10 pies de un artefacto de cocina instalado permanentemente
- **Fotoeléctrica:** No deben instalarse a menos de 6 pies de un artefacto de cocina instalado permanentemente
- Listado y marcado como "ayuda a reducir las alarmas molestas de la cocina" no debe instalarse a menos de 6 pies horizontalmente del artefacto de cocina permanente







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Interconexión

IRC R314.4

- **Más de una alarma:** Todos los dispositivos deben estar interconectados de tal manera que la activación de una alarma active todas las alarmas
- **Fuente de energía principal:** El cableado de la edificación
- **Fuente de energía secundaria:** Batería

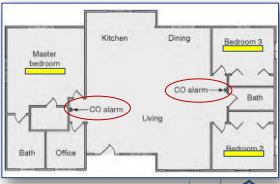

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Alarmas de monóxido de carbono

IRC R315

- Requeridas cuando:
 - La unidad de vivienda contiene un artefacto de combustible quemado o...
 - Tiene un garaje adjunto con una abertura que se comunica con la unidad de vivienda
- Ubicaciones:
 - Fuera de cada área de dormir separada en las inmediaciones de las habitaciones
 - Dentro de una habitación que contenga un artefacto de combustión



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Alarmas de monóxido de carbono

IRC R315.2.2

- Modificaciones, reparaciones y ampliaciones
 - "Cuando ocurran modificaciones, reparaciones o ampliaciones que requieran un permiso, la unidad de vivienda individual debe estar equipada con alarmas de monóxido de carbono"
 - Ubica según la construcción nueva
 - Excepciones
 - Superficies exteriores: reemplazo de techos o revestimientos, ventanas, puertas, etc.
 - Instalación, modificación o reparaciones de sistemas sanitarios o mecánicos

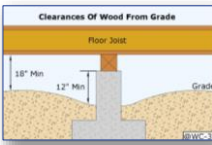

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Protección de la madera

IRC R317

- Madera naturalmente durable o tratada preservativamente:
 - Viguetas < 18" o vigas maestras < 12" al suelo expuesto
 - Los miembros estructurales de madera que descansan sobre muros exteriores de fundación de concreto o mampostería a menos de 8" del suelo expuesto
 - La madera de revestimientos, entablados y estructura de muros en el exterior de una edificación que tengan un espacio < 6" del terreno



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Protección de la madera

IRC R317.1

- Ubicación requerida
 - Protección contra la descomposición se requiere en las siguientes ubicaciones:
 - Vigas de madera más cerca que 18" del suelo expuesto u 8" de columnas de madera
 - Porciones de los miembros estructurales de madera que estén expuestas a la intemperie
 - Columnas de madera que estén en contacto con el suelo del sótano

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Protección de la madera

IRC R317

Soporte de pisos permeables a la humedad o techos expuestos a la intemperie





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Direcciones

IRC R319

Los números de las direcciones deben medir un mínimo 4" de altura con un ancho de trazo de 1/2"





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Accesibilidad

IRC R320

- Deben aplicar las prescripciones del Capítulo 11 de IBC cuando hay ≥ 4 unidades
 - **Nota: IBC exige las unidades de vivienda de varios niveles sin ascensores (las casas contiguas de más de un piso están exentas)**



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Construcción resistente a inundaciones

IRC R322

- Sistemas estructurales para resistir la flotación, colapso o movimiento lateral permanente
- La elevación de la inundación de diseño debe ser usada para definir las áreas propensas a inundación
- Protección de los sistemas mecánicos, sanitarios y eléctricos
- Diseño y construcción de la fundación
- Los tanques subterráneos deben anclarse



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Áticos habitables

IRC R325

- Se considera un piso superior al piso de cuarto
- Excepciones: **(deben cumplir con los 4)**
 - No mayor a un tercio del área del piso de cuarto
 - Si equipado con sistema de rociadores automáticos – no mayor de la mitad del área del piso de cuarto
 - El área total del piso del espacio está completamente encerrado
 - El piso no se extiende más allá de las paredes exteriores
 - Si está encima de un 3^{er} piso – la edificación completa debe estar equipada con rociadores automáticos



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Piscinas, spas y jacuzzis

IRC R327

El diseño y construcción de piscinas y spas debe cumplir con el Código Internacional de Piscinas y Spa (ISPSC)



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IRC Capítulo 4

16% Fundaciones



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Desagüe

IRC R401.3

- Nivelados para evacuar el agua superficial hacia afuera de los muros de la fundación
- Min. 6" dentro de los primeros 10'

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Ensayos de suelo

IRC R401.4

- Requerido si los suelos son expansivos, compresibles, deslizables u otras características cuestionables
- En lugar de una evaluación geotécnica complete, deben asumirse los valores de carga de la Tabla R401.4.1

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Tabla R401.4.1

TABLA R401.4.1 VALORES DE CAPACIDAD DE CARGA PRESUNTOS PARA MATERIALES DE FUNDACIÓN ^a	
CLASE DE MATERIAL	CAPACIDAD DE CARGA (libras por pie cuadrado)
Lecho de roca cristalina	12,000
Roca sedimentaria y foliada	4,000
Grava arenosa y/o grava (GW y GP)	3,000
Arena, arena limosa, arena arcillosa, grava limosa y grava arcillosa (SW, SP, SM, SC, GM y GC)	2,000
Arcilla, arenosa, arcilla limosa, limo arcilloso, limo y limo arenoso (CL, ML, MH y CH)	1,500 ^b

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Materiales

IRC R402

- Concreto:
 - Compresión mínima de acuerdo con la Tabla R402.2
 - La intemperie "moderada" a "severa" requiere el aire incorporado de 5 a 7%




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Tabla R402.2

TABLA R402.2 RESISTENCIA MÍNIMA ESPECIFICADA A LA COMPRESIÓN DEL CONCRETO

TIPO O UBICACIÓN DE LA CONSTRUCCIÓN DE CONCRETO	RESISTENCIA MÍNIMA ESPECIFICADA A LA COMPRESIÓN ^a (f' _c)		
	Potencial de Intemperización ^b		
	Insignificante	Moderado	Severo
Muros del sótano, fundaciones y otro concreto no expuesto a la intemperie	2,500	2,500	2,500 ^c
Losas de sótano y losas interiores sobre el terreno, excepto las losas de piso de garaje	2,500	2,500	2,500 ^c
Muros de sótano, muros de la fundación, muros exteriores y otros trabajos de concreto vertical expuesto a la intemperie	2,500	3,000 ^d	3,000 ^d
Terrazas cubiertas, losas de cochera abierta y escalones expuestos a la intemperie, y losas de piso de garaje	2,500	3,000 ^d + 1	3,500 ^d + 1

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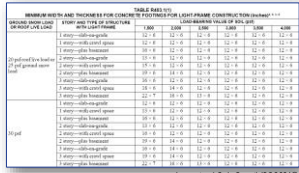

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Medidas mínimas de zapatas

IRC R403.1.1

- Ancho (W) y espesor (T) mínimos
- De acuerdo con las Tablas R403.1(1) hasta la R403.1(3)
- Proyecciones (T): 2" min. and W ≤ T

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Tamaño mínimo

R403.1.3 dice:

Las zapatas de concreto ubicadas en las Categorías de Diseño Sísmico D0, D1, y D2, como se establece en la Tabla R301.2(1), deben tener resfuerzo mínimo de acuerdo con esta Sección y la Figura R403.1.3



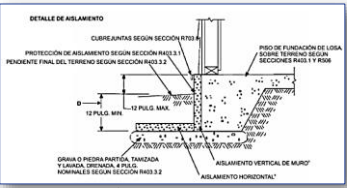

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Profundidad mínima

IRC R403.1.4

- Zapatas exteriores ≥ 12 pulgadas
- Protección contra el congelamiento:
 - Extendidos por debajo de la línea de congelamiento
 - Construidos de acuerdo con la Sección (R403.3 or ASCE 32)
 - Construidos sobre roca sólida
 - No deben estar apoyadas sobre suelo congelado



International Code Council, IRC 2021 (©) Figura R403.3(1)



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Profundidad mínima

IRC R403.1.4

- Excepciones:
 - Estructuras accesorias ≤ 600 pies² y ≤ 10 pies de la altura de alero (entramado liviano)
 - Estructuras accesorias ≤ 400 pies² y ≤ 10- pies de la altura de alero (no entramado liviano)
 - Cubiertas no soportadas por una vivienda (R507.3)



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Pendiente

IRC R403.1.5

- Superficie superior
 - Deber estar nivelada
- Superficie del fondo
 - Pendiente ≤ 1:10 (10%), si no...
 - Zapatas deben estar escalonadas



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Anclaje de fundación

IRC R403.1.6

- Pernos de anclaje:
 - Diámetro mínimo de 1/2"
 - No deben extenderse más que 7"
- Ubicados:
 - Separación máxima = 6 pies
 - 2 pernos por sección de placa
 - ≤ 12" desde el extremo de cada placa
 - ≥ 7db (diámetros del perno) del extremo de cada placa



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Pendientes

IRC R403.1.7

- Zapatas sobre o adyacentes a pendientes
 - Pendientes ascendentes (R403.1.7.1)
 - Pendientes descendentes (R403.1.7.2)
 - Otros retiros y espacios libres permitidos por el funcionario de las edificaciones (R403.1.7.4)

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Pendientes

IRC R403.1.7

- Zapatas en las pendientes (cont.)
 - IRC Figura R403.1.7.1
 - Descendente: H/3, pero no más que 40 pies
 - Ascendente: H/2, pero no más que 15 pies



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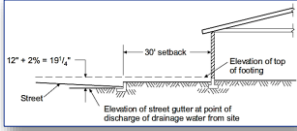
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Elevación

IRC R403.1.7.3

La parte superior de cualquier fundación exterior debe extenderse no menos de 12 pulgadas más un 2% por encima de la elevación del punto de descarga de la cuneta de la calle o por encima de la boca de un dispositivo de desagüe aprobado



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FIN DEL MÓDULO 6

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MÓDULO 7

*IRC Capítulos 4 & 5:
Fundaciones y Pisos*




1



IRC Capítulo 4



16% Fundaciones (cont.)



2

Objetivos del Aprendizaje

- Entender los principios básicos de las fundaciones y el diseño de los muros de contención
- Familiarizarte con los conceptos del drenaje de fundaciones y los requisitos de la impermeabilización
- Saber encontrar y utilizar las tablas del entramado y entablado de pisos de madera


3

Fundaciones

IRC R404.1

- Tabla R404.1.2(1) provee los requisitos de refuerzos horizontales
- Se proveen muchas tablas para los requisitos de refuerzos verticales para las fundaciones de concreto

TABLA R404.1.2(1) REFUERZO HORIZONTAL MÍNIMO PARA MUROS DE SÓTANO DE CONCRETO ^{a, b}	
ALTURA MÁXIMA NO APOYADA DEL MURO DEL SÓTANO (pies)	UBICACIÓN DEL REFUERZO HORIZONTAL
≤ 8	Una barra No. 4 dentro de las 12 pulgadas del extremo superior de piso del muro y una barra No. 4 cerca de la altura media de piso del muro.
> 8	Una barra No. 4 dentro de las 12 pulgadas del extremo superior de piso del muro y una barra No. 4 cerca de los tercios en el piso del muro.



4

Fundaciones

IRC R404.1.1

- Se requiere diseño si...
 - Los muros están sujetos a presión hidrostática de aguas freáticas
 - Los muros que soportan > 48" de relleno no balanceado que no tiene el apoyo lateral permanente superior en la base





5


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Fundaciones

IRC R404.1.4.2

- SDC (Categorías de Diseño Sísmico) D0, D1 y D2: Limitadas a
 - Altura de muro ≤ 8 pies
 - Altura del relleno no balanceado ≤ 4 pies
 - Espesor nominal mínimo de 7.5"
 - Se permite 6" si la altura del muro es $\leq 4'-6"$
 - Si no, acero vertical de acuerdo con las Tablas R404.1.2(2-9)








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Muros de contención

IRC R404.4

- Diseñados de acuerdo con la práctica aceptada de la ingeniería para un factor de seguridad de 1.5 contra el desplazamiento lateral y el vuelco si:
 - No son lateralmente soportados en su parte superior; y...
 - Retienen > 24" de relleno no balanceado

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Drenaje de fundaciones

IRC R405.1

- Se requieren drenajes alrededor de toda fundación de concreto/mampostería que retienen suelo y encierran espacios habitables o utilizables localizados debajo del nivel de terreno
- Excepción:
 - No requerido cuando la fundación se instala en suelos de fácil drenaje o tierras de mezcla de arena-grava





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Drenaje

IRC R405.1

- Requisitos para los drenajes de fundación:
 - Debe descargar por gravedad o medios mecánicos
 - Drenaje de grava o de piedra partida
 - Extiende $\geq 1'$ más allá del borde externo de la zapata
 - Extiende $\geq 6''$ por encima de la parte superior de la zapata
 - Cubierto con un material de membrana de filtro aprobado



Sub Surface Drain
Typical Gravel Cover
4" Min. Perforated Pipe



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Impermeabilización

IRC R406

- Las fundaciones deben ser protegidas contra la humedad si:
 - El nivel freático es alto
 - Hay condiciones severas de humedad del suelo




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Impermeabilización

IRC R406.2

- Dos hojas de fieltro aplicado en caliente
- Techado prearmado de 55 libras
- 40 milipulgadas de asfalto polímero modificado
- 60 milipulgadas de cemento polímero flexible
- 1/8vo de pulgada de recubrimiento impermeable a base de cemento, reforzado con fibra
- 60 milipulgadas de goma sintética aplicada en líquido libre de solvente




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Columnas

IRC R407

- Protección para columnas de madera
 - Protegida contra la descomposición (R317)
- Protección de columnas de acero
 - Todas las superficies deben recibir una cubierta de pintura inhibidora de óxido
- Requisitos estructurales:
 - Para columnas de madera $\geq 4'' \times 4''$ tamaño nominal
 - Acero $\geq 3''$ diámetro de tubo Cédula 40





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Espacio bajo piso

IRC R408

- Ventilación
 - Área neta mínima ≥ 1 pie² por cada 150 pies²
 - Cubierto por el material retardador de vapor Clase I \rightarrow 1,500 pies²
 - Una abertura dentro de 3 pies de cada esquina de la edificación
 - Las aberturas deben cubrirse un mínimo de $\geq 1/4$ "
- Acceso
 - 18"x24" debajo del piso
 - 16"x24" a través de un muro perimetral



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Retardador de vapor

IRC R408.8

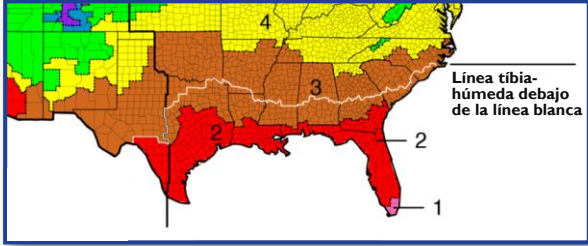
- Zonas climáticas 1A, 2A, y 3A debajo de la línea tibia-húmeda-
 - Se debe proporcionar un retardador de vapor continuo Clase I o II en la cara expuesta del aislamiento (insulación) permeable al aire instalado entre las vigas del piso y expuesto al grado.
 - El retardador de vapor deberá tener una permeabilidad máxima al vapor de agua de I
 - Excepción: No se requiere en espacios subterráneos sin ventilación


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Retardador de vapor



Linea tibia-húmeda debajo de la línea blanca

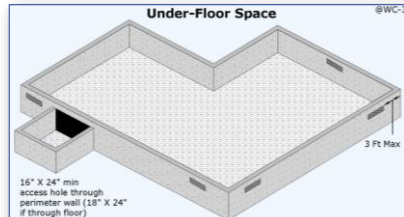


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Espacio subterráneo

IRC R408




Under-Floor Space @WC-3

16" X 24" min access hole through perimeter wall (18" X 24" if through floor)

Covered openings through foundation wall to crawl space
Minimum total net clear area of openings equal to the crawl space area divided by 150"

Minimum net area of openings may be reduced to 1 sq ft for each 1,500 sq ft of area where Class 1 vapor retarder material covers ground surface.



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IRC Capítulo 5

14% Pisos

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Estuctura en líneas de muros arriostrados

IRC R502.2.1

“Se debe proveer un camino de carga para fuerzas laterales entre la estructura de piso y los paneles de muros arriostrados ubicados sobre o debajo de un piso”

Simple Load Path To Footings

©WC-3

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Luces de viguetas

TABLE R502.3.1(2)
FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES (Residential living areas. Live load = 40 psf L/A = 360")

JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 psf						DEAD LOAD = 20 psf					
		2 x 8		2 x 10		2 x 12		2 x 8		2 x 10		2 x 12	
		(ft-in)	(ft-in)	(ft-in)	(ft-in)	(ft-in)	(ft-in)	(ft-in)	(ft-in)	(ft-in)	(ft-in)	(ft-in)	(ft-in)
12	Douglas fir-larch SS	11-4	15-0	19-1	23-3	11-4	15-0	19-1	23-3				
	Douglas fir-larch #1	10-11	14-5	18-5	22-0	10-11	14-2	17-4	20-1				
	Douglas fir-larch #2	10-9	14-2	18-0	20-11	10-8	13-6	16-5	19-1				
	Douglas fir-larch #3	8-11	11-3	13-9	16-0	8-1	10-3	12-7	14-7				
	Hem-fir SS	10-9	14-2	18-0	21-11	10-9	14-2	18-0	21-11				
	Hem-fir #1	10-6	13-10	17-8	21-6	10-6	13-10	17-1	19-10				
	Hem-fir #2	10-0	13-2	16-10	20-4	10-0	13-1	16-0	18-6				
	Hem-fir #3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3				
	Southern pine SS	11-2	14-8	18-9	22-10	11-2	14-8	18-9	22-10				
	Southern pine #1	10-9	14-2	18-0	21-11	10-9	14-2	16-11	20-1				
	Southern pine #2	10-3	13-6	16-2	19-1	9-10	12-6	14-9	17-5				
	Southern pine #3	8-2	10-3	12-6	14-9	7-5	9-5	11-5	13-6				
Spruce-pine-fir SS	10-6	13-10	17-8	21-6	10-6	13-10	17-8	21-6					
Spruce-pine-fir #1	10-3	13-6	17-3	20-7	10-3	13-3	16-3	18-10					
Spruce-pine-fir #2	10-3	13-6	17-3	20-7	10-3	13-3	16-3	18-10					
Spruce-pine-fir #3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3					

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Voladizo para viguetas de piso

IRC R502.3.3(1)

TABLE R502.3.3(1)
LUCES EN VOLADIZO PARA VIGUETAS DE PISO SOPORTANDO SOLO MURO DE CARGA EXTERIOR Y TECHO DE ENTRAMADO LIVIANO^{a, b, c, e, f} (Carga viva de piso ≤ 40 psf. Carga viva de techo ≤ 20 psf)

ELEMENTO Y SEPARACIÓN	LUZ MÁXIMA EN VOLADIZO (Fuerza de levantamiento en el apoyo interior en lbs/ft) ^g															
	Carga de Nieve del Terreno															
	< 20 psf				30 psf				50 psf				70 psf			
	Ancho de techo			Ancho de techo			Ancho de techo			Ancho de techo			Ancho de techo			
	24 pies	32 pies	40 pies	24 pies	32 pies	40 pies	24 pies	32 pies	40 pies	24 pies	32 pies	40 pies	24 pies	32 pies	40 pies	
2 x 8 @ 12"	20' (177)	15' (227)	—	18' (209)	—	—	—	—	—	—	—	—	—	—	—	
2 x 10 @ 16"	20' (228)	21' (297)	15' (264)	18' (254)	—	—	20' (375)	—	—	—	—	—	—	—	—	
2 x 10 @ 12"	30' (196)	30' (276)	20' (238)	24' (198)	22' (263)	18' (234)	20' (277)	—	—	19' (266)	—	—	—	—	—	
2 x 12 @ 16"	—	32' (287)	20' (256)	30' (253)	20' (345)	21' (420)	30' (387)	20' (484)	—	—	23' (471)	—	—	—	—	
2 x 12 @ 12"	—	42' (299)	31' (263)	—	37' (253)	27' (271)	30' (271)	27' (258)	17' (447)	31' (348)	19' (462)	—	—	—	—	
2 x 12 @ 8"	—	48' (136)	45' (166)	—	48' (154)	38' (206)	—	47' (233)	38' (236)	38' (236)	35' (236)	18' (378)	—	—	—	

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Viguetas de piso que soportan balcón exterior

Tabla R502.3(2)

DIMENSION DEL ELEMENTO	ESPACIADO	LUZ MÁXIMA EN VOLADIZO (fuerza de levantamiento en el apoyo anterior en lbs.) ^{a, b, c, d}		
		Carga de Nieve sobre el Terreno		
		50 psf	60 psf	70 psf
2 x 8	12"	42" (109)	30" (76)	34" (86)
2 x 8	16"	30" (76)	34" (77)	29" (74)
2 x 10	12"	61" (154)	57" (144)	49" (124)
2 x 10	16"	53" (136)	49" (124)	42" (107)
2 x 10	24"	43" (109)	40" (101)	34" (86)
2 x 12	16"	72" (183)	67" (170)	57" (144)
2 x 12	24"	58" (147)	54" (137)	47" (119)


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Juntas bajo tabiques portantes

IRC R502.4

- Las viguetas debajo de tabiques portantes paralelos deben ser de tamaño adecuado para soportar la carga
- Las viguetas dobles pueden estar separadas y deben ser macizas en toda su profundidad y reforzadas con madera no menos de **2" en espesor nominal** no espaciado más de **4' de centro en centro**



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Luces de vigas

IRC R502.5 & 602.7

VIGAS PRINCIPALES Y CABEZALES QUE SOPORTAN	TABLADO	CARGA DE NIEVE EN TERRENO (psf)															
		Ancho de la abstracción ⁽¹⁾ (pies)															
		30			60			90			120						
		12	24	36	12	24	36	12	24	36	12	24	36				
Techo y cielorraso cabezal	12'-0"	4-8	1	3-1	2	2-7	2	3-5	1	2-6	2	2-3	2	2-4	2	2-0	2
	12'-6"	5-1	2	3-5	2	3-4	2	4-4	2	3-4	2	2-10	2	3-0	2	2-8	2
	12'-10"	5-6	2	4-4	2	3-11	2	5-2	2	4-0	2	3-4	2	3-7	2	3-0	2
	12'-12"	5-7	2	5-5	2	4-7	2	5-1	2	4-6	2	3-11	2	3-5	2	3-2	2
	22'-4"	6-0	1	3-1	1	2-7	1	3-0	1	2-7	1	2-2	1	2-8	1	2-4	1
	22'-8"	6-6	1	4-7	1	3-10	1	3-11	1	3-3	2	3-6	1	3-4	2	2-11	2
	22'-10"	7-1	1	5-0	1	4-10	2	4-9	2	4-2	2	3-9	1	4-5	2	3-9	2
	22'-12"	8-0	1	5-10	2	5-8	2	5-11	2	4-11	2	4-8	2	4-5	2	4-4	2
	22'-12"	10-7	2	6-1	2	6-10	2	6-8	2	6-11	2	5-10	2	5-9	2	5-2	2
	32'-0"	9-5	1	7-3	1	6-7	1	6-7	1	6-3	2	7-2	1	5-8	2	4-8	2
32'-10"	10-2	1	8-7	1	7-5	2	8-7	1	7-4	2	6-8	1	6-7	2	5-4	2	
32'-12"	10-2	1	10-1	2	8-6	2	10-3	2	7-4	2	10-0	2	7-9	2	6-8	2	
42'-0"	10-11	1	8-4	1	7-0	1	8-4	1	7-2	1	8-0	1	6-4	1	5-4	2	
42'-10"	10-11	1	9-11	1	8-4	1	10-1	1	8-0	1	7-2	1	6-10	1	5-7	2	
42'-12"	10-1	1	11-5	1	9-10	2	10-5	2	8-5	2	8-0	1	5-10	2	5-0	2	

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Luces de vigas

IRC R502.5 & 602.7

VIGAS PRINCIPALES Y CABEZALES PARA MUROS PORTANTES EXTERIORES	TABLADO	CARGA DE NIEVE EN TERRENO (psf)															
		Ancho de la abstracción ⁽¹⁾ (pies)															
		30			60			90			120						
		12	24	36	12	24	36	12	24	36	12	24	36				
Techo, cielorraso y un piso de apoyo central	12'-0"	4-8	1	3-1	2	2-7	2	3-5	1	2-6	2	2-3	2	2-4	2	2-0	2
	12'-6"	5-1	2	3-5	2	3-4	2	4-4	2	3-4	2	2-10	2	3-0	2	2-8	2
	12'-10"	5-6	2	4-4	2	3-11	2	5-2	2	4-0	2	3-4	2	3-7	2	3-0	2
	12'-12"	5-7	2	5-5	2	4-7	2	5-1	2	4-6	2	3-11	2	3-5	2	3-2	2
	22'-4"	6-0	1	3-1	1	2-7	1	3-0	1	2-7	1	2-2	1	2-8	1	2-4	1
	22'-8"	6-6	1	4-7	1	3-10	1	3-11	1	3-3	2	3-6	1	3-4	2	2-11	2
	22'-10"	7-1	1	5-0	1	4-10	2	4-9	2	4-2	2	3-9	1	4-5	2	3-9	2
	22'-12"	8-0	1	5-10	2	5-8	2	5-11	2	4-11	2	4-8	2	4-5	2	4-4	2
	22'-12"	10-7	2	6-1	2	6-10	2	6-8	2	6-11	2	5-10	2	5-9	2	5-2	2
	32'-0"	9-5	1	7-3	1	6-7	1	6-7	1	6-3	2	7-2	1	5-8	2	4-8	2
32'-10"	10-2	1	8-7	1	7-5	2	8-7	1	7-4	2	6-8	1	6-7	2	5-4	2	
32'-12"	10-2	1	10-1	2	8-6	2	10-3	2	7-4	2	10-0	2	7-9	2	6-8	2	
42'-0"	10-11	1	8-4	1	7-0	1	8-4	1	7-2	1	8-0	1	6-4	1	5-4	2	
42'-10"	10-11	1	9-11	1	8-4	1	10-1	1	8-0	1	7-2	1	6-10	1	5-7	2	
42'-12"	10-1	1	11-5	1	9-10	2	10-5	2	8-5	2	8-0	1	5-10	2	5-0	2	

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Entalladuras

IRC R502.8.1

- El diámetro de las perforaciones taladradas o cortadas en los elementos...
 - No deben exceder un 1/3 de la profundidad del elemento
 - Los agujeros **no deben estar más cerca de 2"** de la cara superior o inferior del elemento, o de cualquier otro agujero localizado en el elemento

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Entramado de aberturas

IRC R502.10

- Aberturas ≤ 4 pies:
 - Vigueta cabezal de un solo elemento
 - Una sola vigueta brochal para soportar una sola vigueta cabezal que se ubica dentro de los 3 pies de apoyo de la vigueta que soporta el cabecero
- Aberturas > 4 pies:
 - Viguetas cabezales duplicadas
 - Viguetas brochales duplicadas
 - Colgadores aprobados

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Entablado de madera

Table IRC R503.1

TABLA R503.1 ESPEORES MINIMOS DE ENTABLADOS DE PISO DE MADERA

SEPARACIÓN DE VIGAS O VIGUETAS (pulgadas)	ESPESOR NETO MÍNIMO	
	Perpendicular a vigueta	Diagonal a vigueta
24	1 1/16"	3/4"
16	5/8"	5/8"
48 ^a	1 1/2" T & G	N/A
54 ^b		
60 ^c		

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Entarimado primario

IRC R503.2.2

TABLA R503.2.1 (1) LUCES Y CARGAS ADMISIBLES PARA PANELES ESTRUCTURALES DE MADERA PARATECHOS Y ENTARIMADO PRIMARIO Y ENTARIMADO DE BASE COMBINADO^{a, b, c}

CLASIFICACION LUZ	MÍNIMO ESPESOR NOMINAL DE PANEL (pulgadas)	CARGA VIVA ADMISIBLE (psf) ^d		LUZ MÁXIMA (pulgadas)		CARGA MUERTA PER PIE CUADRADO, en lb (kg) MÍNIMA		LUZ MÁXIMA (pulgadas)
		LUZ @ 16" a.l.	LUZ @ 24" a.l.	Con apoyo de bodega ^e	Sin apoyo de bodega	Carga total	Carga viva	
	Entablado ^a							Entablado primario ^b
1000	3/4"	80	—	16	16	40	30	0
2000	3/4"	80	—	20	20	40	30	0
2400	1 1/8"	100	—	24	20 ^f	40	30	0
2800	1 1/8"	100	40	24	24	40	30	16
3200	1 1/8"	100	70	32	28	40	30	16 ^g
4000	1 3/8"	100	100	40	32	40	30	20 ^h
4800	1 3/8"	—	100	48	36	40	30	24
5600	1 3/8"	—	100	60	40	40	30	32
	Base plus, entablado C-C, plus o menos							Entablado de base combinado ^c
1000	3/4"	100	40	24	24	30	40	16 ⁱ
2000	3/4"	100	80	32	32	40	30	20 ^j
2400	1 1/8"	100	100	40	36	35	25	24
2800	1 1/8"	—	100	48	40	30	40	30
3200	1 1/8"	—	100	60	42	30	40	36

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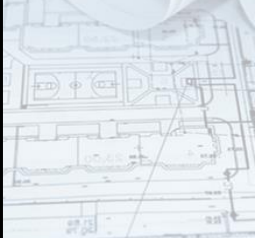

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Losa-en-grado

IRC R506.2.3

- Retardador de vapor
 - 6 milipulgadas polietileno
 - Juntas empalmadas 6-pulgadas
 - Excepción:** Garajes, estructuras accesorias, trabajos planos y donde este aprobado por el funcionario de la edificación



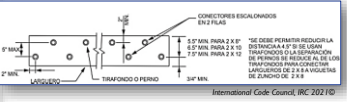

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Cubiertas exteriores

IRC R507.9.1 Conexión verticales:

LOAD (lbs)	DECK LEDGER CONNECTION TO BARGE JOIST		
	JOIST SPAC (ins)	6x6-CENTERS JOISTS OF 14-TIMBER ¹ (inches)	1/2-inch diameter bolt with 1/2-inch diameter steeling ²
10 live load	6	30	36
	8	23	36
	10	18	36
	12	15	29
	14	13	24
15 ground snow load	6	29	36
	8	22	36
	10	17	36
	12	14	27
	14	12	23

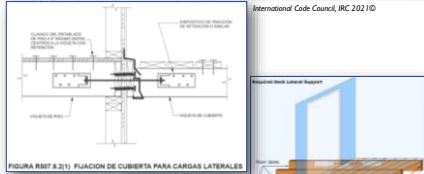
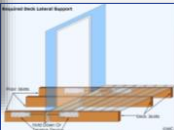


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Cubiertas exteriores

IRC R507.9.2

- Conexión de carga lateral:
 - Mínimo de (2) dispositivos con capacidad de diseño por tensiones no menos de 1500 libras cada uno
 - (4) dispositivos de tensión de 750 libras cada uno

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Cubiertas exteriores

IRC R507.7 – Cubiertas

- Permite el uso de "otros sistemas aprobados de entablado y sujetadores" según los requisitos del fabricante.

IRC R507.9.1.2 – Detalles de viga de zuncho

- Debe apoyarse completamente en la estructura primaria.

IRC R507.9.1.4- Detalles de largueros alternativos

- Permite configuraciones alternativas de entramado que soportan un larguero construido






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Zapatas

IRC R507.3

- Excepciones:
 - Las cubiertas sin adosar que consisten de juntas apoyadas directamente en el nivel de terreno sobre toda su longitud
 - No se requieren zapatas para cubiertas sin adosar que cumplen con todos los siguientes criterios:
 - 2.1. Las viguetas se apoyan directamente sobre bloques de pilares de hormigón prefabricado a nivel sin el apoyo de vigas o postes,
 - 2.2. El área de la cubierta no excede los 200 pies cuadrados
 - 2.3. La superficie para caminar no está a más de 20 pulgadas por encima del nivel del suelo en ningún punto dentro de las 36 pulgadas medidas horizontalmente desde el borde



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Postes de cubierta

IRC Tabla R507.4

- Altura de los postes
 - Cargas añadidas de 50, 60 y 70 libras por pie cuadrado
 - Tengan en cuenta las áreas tributarias (más postes = más altos)

LOADS (psf)	POST SPECIES	TYPICAL AREA (sq ft)						
		50	60	70	80	90	100	
40 (see foot)	Softwood pine	4'-4"	15.0	15.0	15.0	15.0	15.0	15.0
		4'-8"	18.0	18.0	18.0	18.0	18.0	18.0
		4'-12"	21.0	21.0	21.0	21.0	21.0	21.0
		5'-0"	24.0	24.0	24.0	24.0	24.0	24.0
		5'-4"	27.0	27.0	27.0	27.0	27.0	27.0
		5'-8"	30.0	30.0	30.0	30.0	30.0	30.0
40 (see foot)	Douglas fir* Spruce* Western pine**	4'-4"	14.0	14.0	14.0	14.0	14.0	14.0
		4'-8"	17.0	17.0	17.0	17.0	17.0	17.0
		4'-12"	20.0	20.0	20.0	20.0	20.0	20.0
		5'-0"	23.0	23.0	23.0	23.0	23.0	23.0
		5'-4"	26.0	26.0	26.0	26.0	26.0	26.0
		5'-8"	29.0	29.0	29.0	29.0	29.0	29.0
40 (see foot)	Redwood** Pine/Spruce** Oak**	4'-4"	14.0	14.0	14.0	14.0	14.0	14.0
		4'-8"	17.0	17.0	17.0	17.0	17.0	17.0
		4'-12"	20.0	20.0	20.0	20.0	20.0	20.0
		5'-0"	23.0	23.0	23.0	23.0	23.0	23.0
		5'-4"	26.0	26.0	26.0	26.0	26.0	26.0
		5'-8"	29.0	29.0	29.0	29.0	29.0	29.0


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Vigas de cubierta

IRC Tabla R507.5

- Luces de juntas de cubierta se abarca en varias tablas
 - R507.5 (1) Luz máxima de juntas de cubierta—40 PSF carga viva
 - R507.5 (2) Luz máxima de juntas de cubierta—50 PSF carga de nieve del suelo
 - R507.5 (3) Luz máxima de juntas de cubierta—60 PSF carga de nieve del suelo
 - R507.5 (4) Luz máxima de juntas de cubierta—70 PSF carga de nieve del suelo
 - R507.5 (5) Factores de luz de viguetas para calcular la luz efectiva de las viguetas de la plataforma [para usar con la Nota j en las Tablas 507.5 (1), 507.5 (2), 507.5 (3) y 507.5 (4)]
 - Las nuevas tablas representan un voladizo de 1/4 en todos los casos, hasta que se corrija mediante el uso de la Tabla R507.5(5)



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Vigas de cubierta

IRC R507.5

BEAM SPECIES ²	BEAM SIZE ³	EFFECTIVE DECK JOIST SPAN LENGTH ⁴ (ft) (mm)				
		6	8	10	14	18
Softwood pine	1-2 x 6	4-7	4-0	3-7	3-3	3-0
	1-2 x 8	5-11	5-1	4-7	4-2	3-10
	1-2 x 10	5-0	4-0	3-5	4-11	4-7
	1-2 x 12	6-3	5-1	4-4	5-10	5-5
	2-2 x 6	6-11	5-11	5-4	4-10	4-0
	2-2 x 8	8-0	7-5	6-0	6-2	5-0
	2-2 x 10	10-4	9-0	8-0	7-4	6-0
	2-2 x 12	12-2	10-7	9-5	8-7	8-0
	3-2 x 6	8-0	7-5	6-0	6-1	5-0
	3-2 x 8	10-11	9-0	8-0	7-0	6-4
	3-2 x 10	13-0	11-2	10-0	9-2	8-4
	3-2 x 12	15-3	13-0	11-10	10-0	9-4

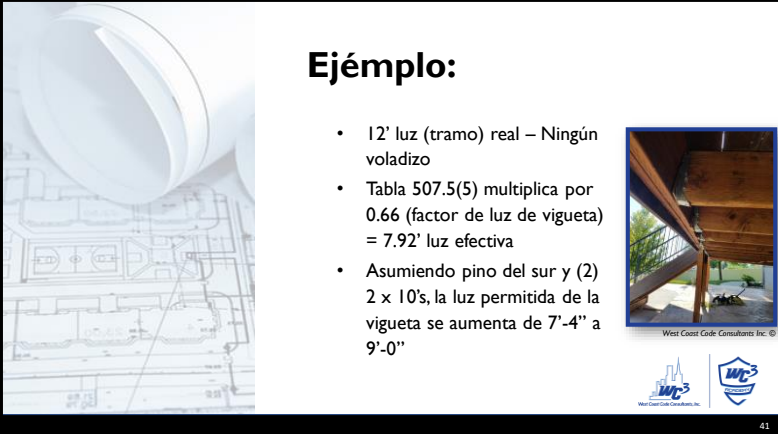
CSF	JOIST SPAN FACTOR
0 (see example)	0.80
1/2 (210.87)	0.72
1 (310.10)	0.80
1.8 (1125)	0.84
1.8 (1187)	0.90
1.4 (1240)	1.00

1. Minimum factor not included.
 2. Deck joist span as shown in Figure R507.5.
 3. For calculations of effective deck joist span, the actual joist span length shall be multiplied by the joist span factor as indicated in Table R507.5(5).
 4. For calculations of effective deck joist span, the actual joist span length shall be multiplied by the joist span factor as indicated in Table R507.5(5).
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Ejemplo:

- 12' luz (tramo) real – Ningún voladizo
- Tabla 507.5(5) multiplica por 0.66 (factor de luz de viga) = 7.92' luz efectiva
- Asumiendo pino del sur y (2) 2 x 10's, la luz permitida de la viga se aumenta de 7'-4" a 9'-0"



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Viguetas de cubierta

IRC R507.6

LOAD ¹ (psf)	JOIST SPECIES ²	JOIST SIZE	ALLOWABLE JOIST SPAN ¹ (feet-inches)								MAXIMUM CANTILEVER ¹ (feet-inches)							
			JOIST SPACING (inches)				JOIST BACK SPAN ³ (feet)				JOIST SPACING (inches)				JOIST BACK SPAN ³ (feet)			
			12	16	24	4	8	8	10	12	14	16	18	18	24	30	36	48
40 live load	Southern pine	2 x 6	9-11	9-0	7-7	1-0	1-4	1-5	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
		2 x 8	13-1	11-10	9-8	1-0	1-6	2-0	2-6	2-3	NP	NP	NP	NP	NP	NP	NP	NP
		2 x 10	16-2	14-0	11-5	1-0	1-6	2-0	2-6	3-0	3-4	3-4	NP	NP	NP	NP	NP	NP
	Douglas fir-larch ⁴	2 x 12	18-0	16-8	13-6	1-0	1-6	2-0	2-6	3-0	3-6	4-0	4-1	NP	NP	NP	NP	NP
		2 x 6	9-6	8-4	6-10	1-0	1-4	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
		2 x 8	12-6	11-1	9-1	1-0	1-6	2-0	2-4	2-0	NP	NP	NP	NP	NP	NP	NP	NP
	Hem-fir ⁴	2 x 10	15-8	13-7	11-1	1-0	1-6	2-0	2-6	3-0	3-3	NP	NP	NP	NP	NP	NP	NP
		2 x 12	18-0	15-0	12-10	1-0	1-6	2-0	2-6	3-0	3-6	3-11	3-11	NP	NP	NP	NP	NP
		2 x 6	8-10	8-0	6-10	1-0	1-4	1-1	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
	Western cedar ⁴	2 x 8	11-8	10-7	8-8	1-0	1-6	2-0	1-11	NP	NP	NP	NP	NP	NP	NP	NP	NP
		2 x 10	14-11	13-0	10-7	1-0	1-6	2-0	2-6	3-0	2-0	NP	NP	NP	NP	NP	NP	NP
		2 x 12	17-5	15-1	12-4	1-0	1-6	2-0	2-6	3-0	3-6	3-8	NP	NP	NP	NP	NP	NP
Red pine ⁴	2 x 10	14-11	13-0	10-7	1-0	1-6	2-0	2-6	3-0	2-0	NP	NP	NP	NP	NP	NP	NP	
	2 x 12	17-5	15-1	12-4	1-0	1-6	2-0	2-6	3-0	3-6	3-8	NP	NP	NP	NP	NP	NP	

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Cubiertas

IRC Tabla R507.7 Máxima separación de viguetas para cubierta

- Tabla actualizada para 2021

DECKING MATERIAL TYPE AND NOMINAL SIZE	TABLE R507.7 MAXIMUM JOIST SPACING FOR WOOD DECKING			
	DECKING PERPENDICULAR TO JOIST		DECKING DIAGONAL TO JOIST ¹	
	Single span ²	Multiple span ²	Single span ²	Multiple span ²
1 1/2-inch-thick wood ³	12	16	8	12
2-inch-thick wood	24	24	18	24

La tabla considera un tramo simple (en 2 vigas) frente a varios tramos (en 3 o más vigas).


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Barandas exteriores

IRC R507.10

- **R507.10.1:** Las cargas de barandas deben transferirse a través de la estructura de la cubierta a las vigas de la cubierta
- **R507.10.1.1:** Cuando las barandas estén conectadas al lado interior de las vigas, conéctalas a las vigas adyacentes para evitar la rotación
- **R507.10.1.2:** Donde se montan barandas en la parte superior de la cubierta: se requiere marco y bloqueo para la transferencia de carga
- **R507.10.2:** Los postes de madera de 4"x4" no pueden ser entallados en las conexiones



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MÓDULO 8

27% IRC Capítulos 6 & 7:
Construcción y Revestimiento de Muros



1



IRC Capítulo 6



Construcción de muros



2

Objetivos del Aprendizaje

1. Familiarizarte con los requisitos básicos de construcción de muros, específicos para sujetadores, tamaños de vigas, cabeceras y placas
2. Comprender cómo evaluar adecuadamente el arriostamiento prescriptivo de muros
3. Conocer el uso y la aplicación adecuados de varios revestimientos de muros, incluyendo el tablero de yeso (gypsum), revoque de yeso y barreras contra la intemperie

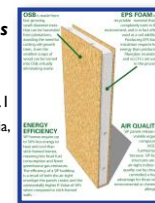




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Paneles estructurales aislados

IRC R602.1.11

- **Paneles estructurales aislados**
 - (Nuevo) producto de madera
 - Fabricados e identificados de acuerdo con ANSI/APA PRS 610.1
 - Debido al estándar de referencia, se eliminó parte del lenguaje





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Altura del muro

IRC R602.3.1

- **Dimensión, altura y espaciamiento de los montantes**
 - Excepción 3 agregada:
 - Montantes portantes exteriores
 - ≤ 20 libras por pie² (psf) carga viva del techo
 - ≤ 30 libras por pie² (psf) carga de nieve en terreno
 - Exposición 'B'
 - Montantes y peletas de madera clasificada #2
 - Máximo de 12' de altura

10 pies		Rango de viento					
		10-15 mph	16-20 mph	21-25 mph	26-30 mph	31-35 mph	36-40 mph
Solo Tech	10-15 mph	2.0	2.0	2.0	2.0	2.0	2.0
	16-20 mph	2.0	2.0	2.0	2.0	2.0	2.0
Solo y 1/4 Pie	10-15 mph	2.0	2.0	2.0	2.0	2.0	2.0
	16-20 mph	2.0	2.0	2.0	2.0	2.0	2.0

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Anclajes

Tabla R602.3(1)

Determina cuáles anclajes son apropiados para usar al unir miembros estructurales

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Anclajes

IRC R602.3

TABLA R602.3(1) ESQUEMA DE ANCLAJES (CONTINUACIÓN)

ITEM	DESCRIPCIÓN DE ELEMENTOS DE LA ESPECIFICACIÓN	NÚMERO Y TIPO DE ANCLAJE ^{1,2}	ESPECIFICACIÓN Y UBICACIÓN
1.	Taladro entre viguetas de celosía o celosía a traviesa superior	4-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102)	Cilindro cilíndrico
2.	Viguetas de celosía a traviesa superior	4-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102)	Por viguetas cilíndricas
3.	Viguetas de celosía en la tapa o celosía paralela, incluyendo celosía de madera laminada (ver Nota R602.3.2), Nota R602.3.2, Nota R602.3.2	4-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 4-2" x 102 pines	Cilindro de hierro
4.	Apoyos en un lado, cilindra cilíndrica o 1/2" x 102" cilindro cilíndrico en celosía	2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102)	Cilindro de hierro en cada lado
5.	Cilindro cilíndrico en la tapa	2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102)	2 cilindros cilíndricos en cada lado y 1 cilindro cilíndrico en el lado opuesto de cada lado y 1 cilindro
6.	Cilindro cilíndrico en la tapa	4-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102)	Cilindro cilíndrico
7.	Cilindro cilíndrico en la tapa	2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102) o 2-60 pines (2" x 8-102)	Cilindro cilíndrico

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Anclajes

Asegúrate de leer las notas de pie

Para 9/16: 1 pulgada = 25.4 mm, 1 pie = 304.8 mm, 1 mil por hora = 0.447 m/s, 1 kg = 0.002 58 lb

- Los clavos son comunes, para madera o con fuste deformado a menos que se especifique de otro modo. Los clavos usados para conexiones de entramado y entablados deben tener el límite de fluencia promedio como se indica: 80 ksi para el diámetro de fuste de 5/16 pulgada (208 clavos cilíndricos), 90 ksi para diámetros de fuste mayores a 0.142 pulgada pero no mayores que 0.177 pulgada, y 100 ksi para diámetros de fuste de 0.142 pulgada o menos.
- Las grampas son de alambre calibre #1 y tienen un mínimo de 7/16 pulgada en el ancho del diámetro de la corona.
- Los clavos deben estar espaciados a no más de 6 pulgadas entre centros en todos los soportes en donde las luces sean de 48 pulgadas o más.
- Los paneles de cuatro pies por 8 pies o 4 pies por 8 pies deben estar espaciados verticalmente.
- El espaciamiento de los anclajes no incluidos en esta tabla se debe basar en la Tabla R602.3(2).
- Para el entablado de techo de panel estructural de madera fuste al extremo del entramado de techo a diez aguas y a los apoyos intermedios dentro de 48 pulgadas de los bordes del techo y coronas, los clavos deben estar espaciados a 6 pulgadas entre centros donde la velocidad final del viento de diseño sea menor de 130 mph y debe ser espaciado a 6 pulgadas entre centros donde la velocidad final del viento de diseño sea 130 mph o más pero menor que 140 mph.
- El entablado de yeso debe cumplir con ASTM C1106 y debe ser instalado de acuerdo con (A.25). El entablado de telero de fibra debe cumplir con ASTM C208.
- El espaciamiento de los anclajes en los bordes de los paneles de entablado se aplica solamente a los bordes del panel apoyado por elementos de entramado y a las trabas requeridas y a todos los perfiles de pino. El espaciamiento de los anclajes en los bordes de los paneles de entablado de techo de pino perpendicularmente a los elementos de entramado excepto cuando sea requerido por otras disposiciones de este código. El perfiles de pino debe ser apoyados por elementos de entramado y trabas necesarias.
- Donde un cable está sujeto a una vigueta de celosía paralela adyacente de acuerdo con este esquema, provisto de dos clavos cilíndricos en un lado del cable y un clavo cilíndrico desde la vigueta de celosía a la otra sujeta de acuerdo con este esquema. No se debe requerir el clavo cilíndrico en el lado opuesto del cable.

1. R602.3(1) es un clavo R602.3(1) (de Fuste Abulido de Entablado de fuste) que cumple con las especificaciones en ASTM F1887



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Dimensión, altura y espaciamiento de los montantes

IRC R602.3.1

- Excepciones:
 - Usos generales (16" de centro a centro y ≤ 8 pies si son muros portantes) o > 10 pies para muros interiores no portantes
 - Cargas de nieve son < 25 libras por pulgada² y el diseño de viento si menos de 130 mph
 - 2x6 permitido hasta los 18' de largo a 16" de centro a centro y 20' de largo a 12" de centro a centro

9

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Travesaño superior

IRC R602.3.2

- Los muros de madera con montantes deben encabersarse con un travesaño superior doble
- Placas de 2"
- Debe instalarse para proporcionar un traslape en las esquinas e intersecciones con los tabiques portantes
- "Las juntas encoladas por testa en los travesaños superiores deben estar desplazadas al menos 24"





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Perforación y entalladura de montantes

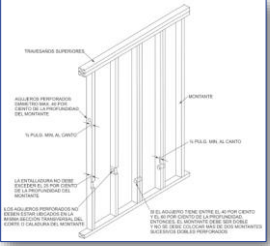

IRC R602.6

Entalladura:

- Exterior ≤ 25% de ancho
- Portantes ≤ 25% de ancho
- No portantes ≤ 40% de ancho

Perforación:

- Borde ≥ 5/8"
- Ø ≤ 40% de ancho (singular)
- Ø ≤ 60% de ancho (duplicado)

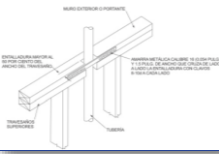

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Perforación y entalladura de montantes

IRC R602.6.1

- Si > 50% del ancho del travesaño superior tiene perforación o entalladura...
 - Se debe instalar una amarra de metal galvanizado de ≥ 0.054" de espesor y 1.5" de ancho sobre la abertura
 - Se amarra con no menos de 8 clavos tipo 10d a cada lado de la placa

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Cabezales

Tablas R602.7(1), R602.7(2), y R602.7(3)

Tabla R602.7(1)
LUCES DE VIGAS PRINCIPALES Y LUCES DE CABEZALES PARA MUROS PORTANTES DE TORNOS (Luzes de vigas para Abeto-Hem Douglas, Abeto-Hem, Pino Sur y Pino Pino-Abeto), Muros de Madera Sólida y Muros de Madera

TAMANO	CARGA DE NEVE EN TERRENO (kN/m²)															
	10				15				20				30			
	10	15	20	30	10	15	20	30	10	15	20	30	10	15	20	30
2x4	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2x6	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2x8	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2x10	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2x12	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1

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Cabezales

IRC R602.7

- Las tablas se combinaron en el Capítulo 6
- Cabezales singulares y duplicados
- Nueva tabla de cabezales para porches abiertos
- Cabezales en cajón
- Pino Sur #2 agregado (Tabla 602.7(3))

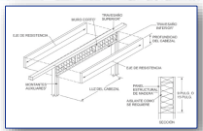


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Cabezales en cajón para tableros estructurales de madera

IRC R602.7.3



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TAMANO	RECIO DE SOPORTE							
	CARGA DE NEVE EN TERRENO (kN/m²)				CARGA DE VIENTO EN TERRENO (kN/m²)			
	10				15			
2x4	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2x6	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2x8	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2x10	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2x12	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1

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Arriostramiento de muro

IRC R602.10

- Terminología:
 - Arriostramiento de muro
 - Líneas de muro arriostrado (BWL)
 - Paneles de muro arriostrado (BWP)
 - Longitud
 - Espaciamiento





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Desplazamientos en la línea de muros arriostrados

IRC R602.10.1.2

“Los muros exteriores paralelos a una línea de muros arriostrados deben estar desplazados no más de 4 pies desde la ubicación designada de la línea de muros arriostrados como se muestra en la Figura R602.10.1.1. Los muros interiores usados como arriostramiento deben estar desplazados no más de 4 pies desde una línea de muros arriostrados a través del interior de la edificación como se muestra en la Figura R602.10.1.1.”

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Requisitos de arriostramiento

- **IRC Tabla R602.10.3(1)** Requisitos de arriostramiento basados en la velocidad del viento
 - Requisitos agregados para velocidades de viento de 95 mph
- **IRC R602.10.2.3(3)** Requisitos de arriostramiento basados en la categoría del diseño sísmico
 - Notas de pie y títulos revisados para mayor claridad
- **IRC R602.10.2.3(4)** Factores de ajuste sísmico a la longitud requerida del arriostramiento de muro
 - Límites aclarados del uso de revestimiento de ladrillo
 - Se agregó la nota a pie g que requiere arriostramiento adicional para SDC D0, D1 y D2.




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Requisitos de arriostramiento

IRC Tabla R602.10.5

Longitud mínima de paneles de muro arriostrado

METHO (See Table R602.10.6)	Panel member lengths					
	8 feet	8 feet	10 feet	11 feet	12 feet	12 feet
PFH	Supporting one story and roof	16	16	16	None e	None e
	Supporting one story and roof	24	24	24	None e	None e
PFH		24	27	30	None d	None d
		16	18	20	None e	None e
CS-PP	SDC A, B and C	16	18	20	None e	None e
	SDC D, E, and F	16	18	20	None e	None e

For 10' - 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s.

SP: See Footnotes.

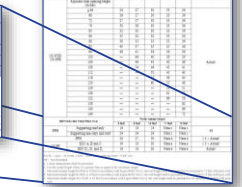

A. Lateral displacement shall be prevented.

B. The full actual length is given; thus no need to specify the minimum length.

C. Minimum member length for PFH is 10 feet in accordance with Figure R602.10.6.2, but wall length shall be permitted to be increased to 12 feet with proper bracing.

D. Minimum member length for PFH is 10 feet in accordance with Figure R602.10.6.2, but wall length shall be permitted to be increased to 12 feet with proper bracing.

E. Minimum member length for CS-PP is 10 feet in accordance with Figure R602.10.6.4, but wall length shall be permitted to be increased to 12 feet with proper bracing.






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Revestimiento de piedra y mampostería

IRC R602.10.6.5

- Arriostramiento de muros para viviendas con piedras o mampostería en la categoría de diseño sísmico D0, D1 y D2
 - Las residencias en categorías de diseño sísmico se diseñarán de acuerdo con la práctica de ingeniería aceptada
 - Se agregó la sección R602.10.6.5.1 Revestimiento solo en el primer piso
 - Se agregó la sección R602.10.6.5.2 Revestimiento que excede la altura del primer piso
 - Sección agregada y excepciones R602.10.6.5.3 Revestimiento limitado que excede la altura del primer piso
 - Sección revisada R602.10.6.5.4 Longitud del arriostramiento

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Arriostramiento de muro

IRC R602.10

- Métodos de arriostramiento:
 - Arriostramiento Intermitente (12 métodos)
 - Arriostramiento Continuo (4 métodos)








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Arriostramiento de muro

Intermittent Bracing (Table R602.10.4)

TABLA R602.10.4 MÉTODOS DE ARRIOSTRAMIENTO





MÉTODOS, MATERIAL	ESPESOR MÍNIMO	FIGURA	CRITERIOS DE CONEXIÓN*	
			Anclajes	Espaciamiento
LSB Light-Steel Bracing (Arriostramiento entubado)	Máximo de 1" x 4" o placas metálicas equivalentes a según de 40" hasta 60" para un espaciamiento máximo de montantes de 16"		Madera 2x6 (clave común a 3" @ 12" 1/2 según IRC 602.10.4) Placa metálica según el fabricante	Madera por montante y travieso cuando se pueda utilizar Metal según el fabricante
DMB Diagonal wood bracing (Tablero de madera diagonal)	1/2" nominal para espaciamiento regular de montantes de 24"		2x6 (2" 1/2 según IRC 602.10.4) Clave 2" x 1/2" según parámetros	Por montante
WSP Wood structural panel (Panel estructural de madera) (Vea Sección R602)	3/4"		Enclavado exterior según la Tabla R602.3(1)	8" bordes 12" pulg. Vértice por anclaje
WSP Wood structural panel with steel or masonry embed (Panel estructural de madera con embebido de acero o mampostería) (Vea Sección R602.10.4.5)	3/4"		Clavado exterior según la Tabla R602.3(1) o R602.3(2)	Vértice por anclaje 8" en los bordes de panel 12" en los bordes interiores y en los bordes exteriores del panel de muros arriostrados

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Arriostramiento de muro

Intermittent Bracing (Table R602.10.4):

Métodos de Arriostramiento Continuo	CS-WSP Continuously attached wood structural panel (Embebido continuo de panel estructural de madera)	3/4"		Embebido exterior según la Tabla R602.3(1)	8" bordes 12" pulg.
	CS-SP Continuously attached wood structural panel adjacent to garage opening (Embebido continuo de panel estructural de madera adyacente a aberturas de garaje)	3/4"		Vea Método CS-WSP	Vea Método CS-WSP
	CS-SP Continuously attached panel frame (Embebido continuo del marco del panel)	3/4"		Vea Sección R602.10.4.4	Vea Sección R602.10.4.4
	CS-SFP Continuously attached structural floorboard (Embebido continuo de tablero de fibra estructural)	1/2" a 3/4" para espaciamientos máximos de montantes de 16"		Clave de hecho galvanizada 1 1/2" x 3/8" o 1 1/2" x 1/2" de espesor de embebido 1/2" según IRC 602.10.4.5	8" bordes 6" pulg.

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Arriostramiento de muro

IRC R602.10.4.1

- Combinación de métodos
 - De piso a piso (cualquier método)
 - Desde la línea de muros arriostrados hasta la línea de muros arriostrados dentro de un piso (solo intermitente)
 - Varía dependiendo de la categoría de diseño sísmico

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Arriostramiento de muro

IRC R602.10

Cada línea de muro arriostrado (BWL) debe ser revisado para viento y sísmico




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Arriostramiento de muro

IRC R602.10

- Longitud de la línea de muro arriostrado (BWL) (R602.10.1.1) = la distancia entre sus extremos
 - "El extremo de una línea de muros arriostrados debe ser la intersección con una línea de muros arriostrados perpendicular, una línea de muros arriostrados en ángulo...o un muro exterior."
- Espaciamiento (R602.10.1.3):
 - Viendo (100 - 140mph) ≤ 60 pies
 - Categoría de diseño sísmico A - C → usa arriostramiento de viento
 - SDC D ≤ 25 pies



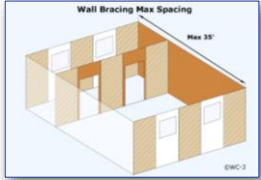

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Arriostramiento de muro

IRC R602.10

- Excepción:
 - El espacio se puede aumentar a 35 pies para acomodar una habitación individual que no exceda los 900 pies cuadrados

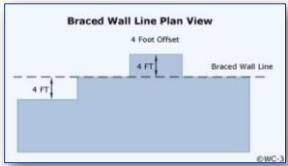

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Arriostramiento de muro

IRC R602.10

- Desplazamientos en la línea del muro arriostrado (R602.10.1.2.):
 - Hasta 4 pies de desplazamiento de cualquier lado

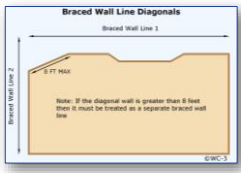
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Arriostamiento de muro

IRC R602.10.1.4

- Muros en ángulo
 - Longitud máxima diagonal de 8 pies
 - Si mide > 8 pies, se debe considerar que es una línea de muros arriostrosados separada



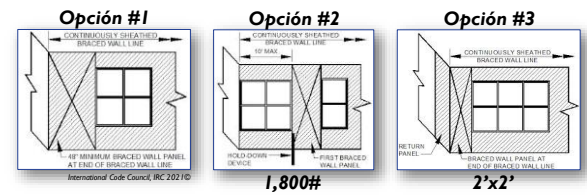
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Arriostamiento de muro

R602.10.2.2 - Ubicaciones de paneles de muros arriostrosados

Requerido desde cada extremo de la línea de muros arriostrosados

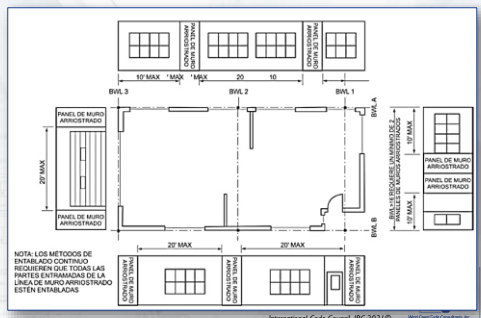


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Arriostamiento de muro

IRC R602.10.2.2

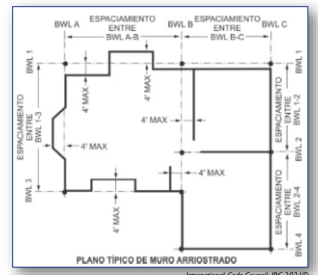


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Arriostamiento de muro

IRC R602.10.1.1



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IRC Capítulo 7

Revestimiento de muros

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Aplicación de gypsum

IRC R702.3.5

- Deben aplicarse en ángulos rectos o paralelos a los miembros del entramado
- No se deben instalar tableros de yeso interiores donde quedan expuestos directamente al clima o al agua
- **Deben penetrar la madera no menos de 5/8"**

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Aplicación de gypsum

Tabla IRC R702.3.5

TABLA R702.3.5 ESPESOR MÍNIMO Y APLICACIÓN DE TABLERO DE YESO Y PRODUCTOS DE PANELES DE YESO

ESPEJOR DEL TABLERO DE YESO O PRODUCTOS DE PANELES DE YESO (pulgadas e. l.)	APLICACIÓN	ORIENTACIÓN DEL TABLERO DE YESO O PRODUCTOS DE PANELES DE YESO AL ENTRAMADO	ESPESOR MÍNIMO DE LOS MIEMBROS DE ENTRAMADO (pulgadas e. l.)		ESPESOR MÍNIMO DE ANCLAJES (pulgadas e. l.)		TAMBIÉN DE LOS CLAVOS PARA APLICACIÓN SOBRE ENTAMADO DE MADERA*
			Clase**	Tamaño*	Clase**	Tamaño*	
1/2	Cielos*	Perpendicular	16	7	12	Cables 1/8" longitud 1" x, cables 3/16" diámetro 0 000", 1" x, anclaje compuesto, clavos de entornillo 0 000", longitud 1 1/2", cables 1/2"	
		En cualquier dirección	16	8	16		
	Muro	Perpendicular	16	7	12		
		En cualquier dirección	24	7	12		
	Cielos**	Perpendicular	24	8	12		
		En cualquier dirección	24	8	12		
5/8	Cielos*	Perpendicular	16	8	16		
		En cualquier dirección	24	7	12		
	Muro	Perpendicular	16	7	12		
		En cualquier dirección	24	7	12		
	Cielos**	Perpendicular	24	7	12		
		En cualquier dirección	24	7	12		
1	Tipo I en edificios de parve tablo de cuatro muros**	Perpendicular	24	8	8	Cables resistentes de la longitud 1 1/2" e equivalente para tornillos de muro en muro. Los tornillos deben cumplir con la Sección R702.3.5.1	
		En cualquier dirección	24	8	12		
	Muro	Perpendicular	24	8	12		
		En cualquier dirección	16	8	16		
	Cielos**	Perpendicular	24	7	12		
		En cualquier dirección	24	7	12		

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Retardadores de vapor

IRC R702.7

“Se requieren retardadores de vapor de Clase I o II en el lado interior de los muros de armazón en las zonas climáticas 5, 6, 7, 8 y marina 4”

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Retardadores de vapor

IRC R702.7 Retardadores de vapor

- Cuando se requiera un retardador de vapor, se debe proporcionar en las paredes laterales interiores y de la clase correcta según la zona climática.
- Excepción 3 revisada:
 - "Construcción donde la humedad o su congelación no dañarán los materiales."
- Excepción 4 agregada:
 - "Un retardador de vapor no será requerido en las zonas climáticas 1, 2 y 3"

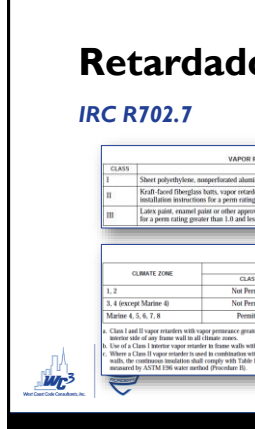
IRC Tablas R702.7 (1-4)

- Todas agregadas o reorganizadas



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Retardadores de vapor

IRC R702.7

CLASS	ACCEPTABLE MATERIALS
I	Sheet polyethylene, unperforated aluminum foil or other approved materials with a perm rating less than or equal to 0.1.
II	Kraft-faced fiberglass bats, vapor retarder paint or other approved materials applied in accordance with the manufacturer's installation instructions for a perm rating greater than 0.1 and less than or equal to 1.0.
III	Low perm, mineral paint or other approved materials applied in accordance with the manufacturer's installation instructions for a perm rating greater than 1.0 and less than or equal to 10.0.


CLIMATE ZONE	VAPOR RETARDER CLASS		
	CLASS I ^a	CLASS II ^b	CLASS III ^c
1, 2	Not Permitted	Not Permitted	Permitted
3, 4 (except Marine 0)	Not Permitted	Permitted	Permitted
Marine 4, 5, 6, 7, 8	Permitted ^d	Permitted	See Table R702.7(3)

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Barrera resistente al agua


IRC R703.2 Barrera resistente al agua

- Se requiere no menos de una capa aplicada en las paredes exteriores (con tapajuntas)
- Los materiales de barrera deberán cumplir con uno de los siguientes:
 - Feltro n.º 15 que cumple con la norma ASTM D226, Tipo I
 - ASTM E2556, Tipo I o II
 - ASTM E331 de acuerdo con la Sección R703.1.1
 - Otros materiales aprobados instalados de acuerdo con las instrucciones de instalación del fabricante.
- Feltro asfáltico n.º 15 y barreras resistentes al agua que cumplen con la norma ASTM E2556:
- Aplicado horizontalmente con la capa superior superpuesta sobre la capa inferior no menos de 2 pulgadas
- Superpuesto no menos de 6 pulgadas donde se producen juntas



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Barrera resistente al agua

(Cont.)
IRC R703.7.3.1 Climas secas

- Se requiere uno de los siguientes en climas secos:
 - Dos capas (o equivalente/más grande) de papel grado D de 10 minutos instaladas de forma independiente con tapajuntas entre capas
 - Una capa (o equivalente/más grande) de papel Grado D de 60 minutos separada del estuco por una capa que no absorbe agua (similar) a un revestimiento aislante de espuma plástica

IRC R703.7.3.2 Climas húmedas o marinas

- Se requiere uno de los siguientes en climas húmedos (además de R703.7.3.1.):
 - Un espacio o material de drenaje no menos de 3/16" aplicado al lado exterior de la barrera resistente al agua
 - Eficiencia de drenaje no inferior al 90%




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Barrera resistente al agua

IRC R703.2

“Se debe aplicar una capa de fieltro asfáltico No. 15, libre de huecos y roturas, cumpliendo con ASTM D226 Tipo I... sobre los montantes o el establero de los muros exteriores.”



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Revoque

IRC R703.7

- Instalación de acuerdo con ASTM C 926 y ASTM C1063
 - Listón:
 - Los listones y los accesorios deben ser resistentes a la corrosión.
 - Fije el listón a 6" o.c.
 - Yeso:
 - Al menos 3 capas sobre malla metálica o de alambre
 - Al menos 2 capas sobre mampostería u hormigón
 - Otro:
 - Al menos 2 capas de papel grado D
 - Soleras de drenaje en o por debajo de la línea de cimentación (2"-4" por encima del nivel)

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Anclaje de mampostería

IRC Tabla R703.8.4(1)

- Requisitos del anclaje y espacio de aire
 - Se permite un espacio de aire detrás de la mampostería para acomodar el aislamiento continuo

REQUIREMENT	MINIMUM R/F	PROVIDED BY FASTENER	ANCHORAGE
Wood stud backing with staggered stud rafter	2:1 (1/2" gap) (0.029 in.) ¹ to 1/4" wide	6d common nail (2") or 8d (3")	Minimum 1 in. between stud and rafter
Wood stud backing with staggered stud rafter	W/ 2" (1/2" gap) staggered stud rafter	6d common nail (2") or 8d (3")	Minimum 1/2" in. between backing and rafter
Wood stud backing with staggered stud rafter	W/ 2" (1/2" gap) staggered stud rafter	6d common nail (2") or 8d (3")	Minimum 1/2" in. between backing and rafter
Continuous stud backing with staggered stud rafter	W/ 2" (1/2" gap) staggered stud rafter	6d common nail (2") or 8d (3")	Minimum 1/2" in. between backing and rafter
Continuous stud backing with staggered stud rafter	W/ 2" (1/2" gap) staggered stud rafter	6d common nail (2") or 8d (3")	Minimum 1/2" in. between backing and rafter

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FIN DEL MÓDULO 8



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MÓDULO 9

IRC Capítulos 8 & 9:
Construcción de techo-cielorraso y sistemas de techado

1

1

Objetivos del Aprendizaje

1. Entender los requisitos de construcción techo-cielorraso
2. Familiarizarte con los requisitos de los sistemas de techado
3. Saber cómo se utilizan las tablas de tramos de viguetas y vigas

2

2



IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings

2021

IRC Capítulo 8

14% Construcción techo-cielorraso

3

3

Madera de construcción aserrada

IRC R802.1.1

- Debe estar identificada por una marca de grado de una agencia clasificadora de madera de construcción
- Diseño debe ser certificado y aprobado por un organismo de acreditación que cumpla con **DOC PS 20**



4

4

Madera ignífuga

IRC R802.1.5

- La madera ignífuga (FRTW) debe tener un índice listado de propagación de llamada de **25 o menos** y no presente evidencia de combustión progresiva significativa por un periodo adicional de **20 minutos**
- Los paneles deben ser marcados de identificación
- Se deben hacer ajustes de resistencia

5

Detalles de estructura

IRC R802.4.2

- “Los cabios deben estar entramados no más de 1.5” de desplazamiento entre cada uno a una tabla de cumbrera o directamente opuestos uno del otro con una amarra de collar...”
- “Si el grado de inclinación < 3:12, los miembros estructurales que soportan los cabios, tales como las sumbreras, limas hoya y limas testa, deben diseñarse como vigas y la carga debe proveerse para los cabios...”





6

Correas

IRC R802.4.5

“Se permite la instalación de correas a fin de reducir la luz de cabios...”







7

Detalles de estructura

IRC R802.4.6

- Las vigas del ciellorraso o los lazos de las vigas deben conectarse a las vigas (o una viga de cumbrera diseñada)
- “Donde las amarras de collar de usen para conectar cabios opuestos, deben estar ubicadas en el **1/3 superior del espacio** del ático y fijadas de acuerdo con la Tabla R602.3(1)”

8

Luces de cabios

TABLE R802.4.1(1)—continued
RAFTER SPANS FOR COMMON LUMBER SPECIES (Roof live load = 20 psf, ceiling not attached to rafters, L/D = 180)

RAFTER SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 psf										
		2 x 4				2 x 6						
		(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)	(feet-inches)			
24	Douglas fir-larch	SS	9-1	14-8	18-10	22-9	Note b	9-1	13-9	18-10	20-7	25-10
	Douglas fir-larch	#1	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
	Douglas fir-larch	#2	8-2	11-11	15-1	18-5	21-4	7-0	10-4	13-0	15-11	18-6
	Douglas fir-larch	#3	6-2	9-1	11-6	14-1	16-3	5-4	7-10	10-0	12-2	14-1
	Hem-fir	SS	8-7	13-6	17-10	22-9	Note b	8-7	12-10	16-3	19-10	23-0
	Hem-fir	#1	8-5	12-4	15-8	19-2	22-2	7-4	10-9	13-7	16-7	19-3
	Hem-fir	#2	7-11	11-7	14-8	17-10	20-9	6-10	10-0	12-8	15-6	17-11
	Hem-fir	#3	6-1	10-0	11-3	13-8	15-11	5-3	7-8	9-9	11-10	13-9
	Southern pine	SS	8-11	14-1	18-6	23-8	Note b	8-11	13-10	17-6	20-10	23-8
	Southern pine	#1	8-7	12-9	16-2	18-11	22-6	7-5	11-1	14-0	16-5	19-6
	Southern pine	#2	7-4	11-0	13-11	16-6	19-6	6-4	9-6	12-1	14-4	16-10
	Southern pine	#3	5-8	8-4	10-6	12-9	15-1	4-11	7-3	9-1	11-0	13-1
	Spruce-pine-fir	SS	8-5	13-3	17-5	21-8	25-2	8-4	12-2	15-4	18-9	21-9
	Spruce-pine-fir	#1	8-0	11-9	14-10	18-2	21-0	6-11	10-2	12-10	15-8	18-3
	Spruce-pine-fir	#2	8-0	11-9	14-10	18-2	21-0	6-11	10-2	12-10	15-8	18-3
	Spruce-pine-fir	#3	6-1	8-10	11-3	13-8	15-11	5-3	7-8	9-9	11-10	13-9

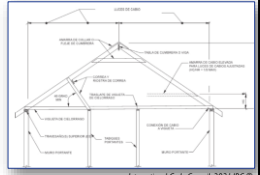


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Amarras de collar

IRC R802.4.6

- No menos de 1" x 4" nominales
- Espaciadas no más de 4' entre centros
- Pueden ser reemplazadas con los flejes de cumbreras
 - 1.25" x 20 calibre
 - Clavado al borde superior con 3 o más clavos comunes 10d



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Luces de cabios

TABLE R802.5.1(1)
CEILING JOIST SPANS FOR COMMON LUMBER SPECIES (Uninhabitable attics without storage, live load = 10 psf, L/D = 240)

CEILING JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 8 psf				
		2 x 4		2 x 6		
		(feet-inches)	(feet-inches)	(feet-inches)		
12	Douglas fir-larch	SS	13-2	20-8	Note a	Note a
	Douglas fir-larch	#1	12-8	19-11	Note a	Note a
	Douglas fir-larch	#2	12-5	19-6	25-8	Note a
	Douglas fir-larch	#3	11-1	16-3	20-7	25-2
	Hem-fir	SS	12-5	19-6	25-8	Note a
	Hem-fir	#1	12-2	19-1	25-2	Note a
	Hem-fir	#2	11-7	18-2	24-0	Note a
	Hem-fir	#3	10-10	15-10	20-1	24-6
	Southern pine	SS	12-11	20-3	Note a	Note a
	Southern pine	#1	12-5	19-6	25-8	Note a
	Southern pine	#2	11-10	18-8	24-7	Note a
	Southern pine	#3	10-1	14-11	18-9	22-9
	Spruce-pine-fir	SS	12-2	19-1	25-2	Note a
	Spruce-pine-fir	#1	11-10	18-8	24-7	Note a
	Spruce-pine-fir	#2	11-10	18-8	24-7	Note a
	Spruce-pine-fir	#3	10-10	15-10	20-1	24-6



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Viguetas de cielorraso y conexiones de cabios

IRC R802.5.2

- Conectados a los cabios en la placa superior según la Tabla R802.3(1)
- Extremos de las viguetas de cielorraso se deben traslapar a un mínimo de 3"
- Las amarras de cabios de madera deben ser de no menos de 2"x4"
- Las trabas deben tener grado de utilidad de madera de construcción




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Estructura de techo de madera

IRC Tabla R802.5.2(1)

- **Conexiones de juntas de talón de cabio y vigueta de cielorraso**
 - Revisado para incluir tramos de techo de 24 y 36 pies y espacio entre vigas de 19.2"



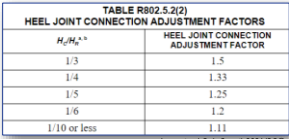
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Estructura de techo de madera

IRC Table R802.5.2(2)

- **Factores de ajuste de la conexión del talón**
 - Nueva tabla que detalla los requisitos para las conexiones según la altura de la cumbreira del techo y la altura de las vigas del techo




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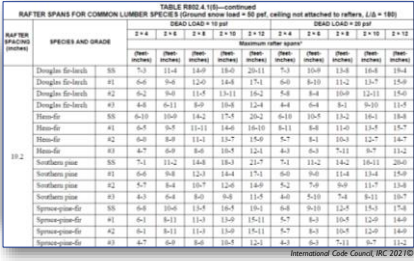
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Vigas

IRC R802.5



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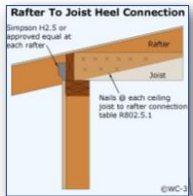


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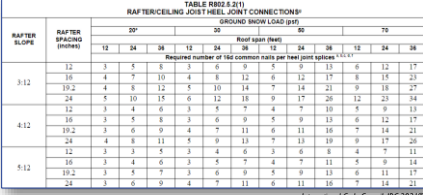
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Conexión de talón

IRC R802.5.2



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Apoyo

IRC R802.6:

- Los extremos de cada cabio o vigueta de cielorraso deben contar con:
 - 1.5" de apoyo – madera o metal
 - 3" de apoyo – concreto o mampostería

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Cortes, perforaciones y entalladuras

IRC R802.7

- Cortes, perforaciones y entalladuras según el R502.8.1, excepto:
 - Vigas de voladizo
 - Viguetas de cielorraso de corte ahusado











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Reticulados de madera

IRC R802.10

- Diseño → ANSI/TPI I
- Planos de diseño de reticulado:
 - Pendiente o profundidad, luz y espaciamiento
 - Anchos de apoyo requeridos
 - Cargas de diseño aplicables
 - Ajustes
 - Fuerza de reacción
 - Tamaño de la madera, especie y grado para cada elemento
- Arriostamiento → BCSI



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Resistencia al levantamiento

IRC R802.11.1

Si son fuerzas ≤ 200 libras, según la tabla






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Entablado de madera de construcción

Table R803.1:

- “Las luces (tramos) admisibles para madera de construcción que se utilice para entablado de techo deben ser conformes con la Tabla R803.1.”
- No está permitido entablado de madera de construcción espaciado en Categoría de Diseño D2

ESPACIAMIENTO DE CABIO O VIGA (pulgadas)	ESPEOR NETO MÍNIMO (pulgadas)
24	$\frac{3}{4}$
48	
96	1 1/2 T & G
72	

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Entramado de techo de acero

IRC R804.2:

- 24” máximo - medido horizontalmente

IRC R804.3.2.3:

- “Los cabios de techo no deben empalmarse.”

IRC R804.3.3:

- “Las alas y rebordes...no deben ser cortados ni entallados.”

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Límites de Aplicabilidad

IRC R804.3.2.1.1 (también R802.10.2.1)

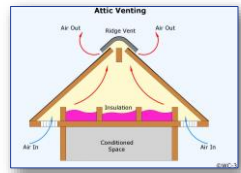
- Límites de aplicabilidad:
 - 60 pies o menos – longitud perpendicular
 - 40 pies o menos – ancho paralelo
 - 3 pisos por encima del plano de nivel del terreno
 - Pendientes de techo no menores de 3:12 a 12:12 máximo

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Ventilación de techo

IRC R806

- La ventilación cruzada es requerida para los espacios de áticos cerrados separados
- Área de Vent. $\geq 1/150$ del espacio ventilado, o
- $\geq 1/300$ si un retardador de vapor está instalado en el lado cálido en invierno del cielorraso en las zonas climáticas 6, 7, y 8
- $\leq 40-50\%$ está ubicado en la parte superior del ático o cabio



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Acceso a ático

IRC R807

- Requerido para áreas > 30 pies² y con altura de 30"
- Requisitos de la abertura:
 - "...debe ubicarse en un vestíbulo o en otra ubicación de acceso rápido."
 - 22"x30" & debe permitir el acceso para remover cualquier equipo mecánico del ático
 - Mín. de 30" de altura sin obstrucciones en el espacio del ático



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IRC Capítulo 9

Sistemas de techado

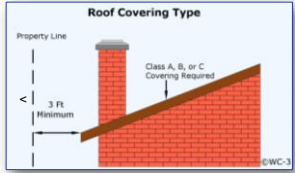
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Materiales de revestimiento de techados

IRC R902.1

"Los techados de Clase A, B o C, deben instalarse en jurisdicciones designadas por ley como requieren su uso o cuando el borde del techo esté menos de 3' desde una línea de propiedad."



Roof Covering Type

Property Line

< 3 Ft. Minimum

Class A, B, or C Covering Required

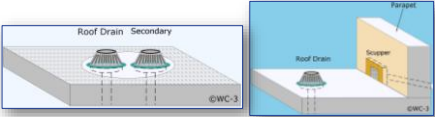
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Desagüe

IRC R903.4

- "A menos que los techos tengan una pendiente adecuada que permita desagüe sobre sus bordes..."
 - Se deben instalar al punto bajo del techo
 - Desagüe secundario del mismo tamaño instalado 2" por encima del primario
 - Embornales de desborde que sean 3x más grandes que los desagües del techo, con abertura mínima de 4" y 2" por encima del punto inferior del techo servido



Roof Drain Secondary

Roof Drain

Overflow

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Tejas de asfalto

IRC R905.2

- Tejas de asfalto:
 - Pendientes $\geq 2:12$
 - Se requiere la aplicación de capa base doble si $< 4:12$
 - Anclajes con calibre 12 que **penetran $\geq 3/4$ "** dentro del entarimado de tejado



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Tejas de asfalto

IRC R905.2.7

- Barrera contra hielo:
 - Requerido en áreas donde hay un historial de formación de hielo a lo largo de los aleros
 - Se extenderá desde el borde más bajo hasta un punto de al menos **24"** dentro del muro exterior



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Cubrejuntas

IRC R905.2.8

- Requerido en aleros y cenefa:
 - Superposición de 2", segmento a segmento
 - Extendido $1/4$ " por debajo del revestimiento
 - Extendido 2" sobre la cubierta del techo
 - Sujetado a 12" al centro.
 - Instalado -
 - Sobre contrapiso - Aleros
 - Debajo del contrapiso - Rastrillo



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Techado

R905.3 - Tejas cerámicas y de concreto


- Pendientes $\geq 2.5:12$
- Anclajes de calibre 11 que penetran $\geq 3/4$ " o a través del espesor de la cubierta

R905.7 & 905.8 - Tejas o ripias de madera

- Pendientes $\geq 3:12$
- Anclajes que penetran $\geq 1/2$ " el espesor de la cubierta



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Tejas de metal resistentes al viento

IRC R905.4.4.1

- Las tejas de metal para techos aplicadas a una plataforma sólida o muy ajustada deben probarse según:
 - ASTM D3161, FM 4474, UL 580, o UL 1897

TABLE R905.4.4.1 CLASSIFICATION OF STEEP SLOPE METAL ROOF SHINGLES TESTED IN ACCORDANCE WITH ASTM D3161		
MAXIMUM UL TRAYED DESIGN WIND SPEED: <i>V_{up}</i> FROM FIGURE R901.2(2) (mph)	MAXIMUM TRAYED DESIGN WIND SPEED: <i>V_{up}</i> FROM TABLE R901.2.1.3 (mph)	SHINGLE CLASSIFICATION
110	85	A, D or F
116	90	A, D or F
129	100	A, D or F
142	110	F
155	120	F
168	130	F
181	140	F
194	150	F

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Tejas fotovoltaicas

IRC R905.16:

- “La instalación de tejas fotovoltaicas debe cumplir con la Sección 324 y NFPA 70 (NEC)”
- Deben ser usadas solo en pendientes de techo 2:12 o mayores
- Las tejas fotovoltaicas deben estar listadas y selladas de acuerdo con **UL 7103**

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Retejado

IRC R908

- Reemplazo del techo:
 - “El reemplazo del techo debe incluir la remoción de capas existentes de revestimientos por debajo de la cubierta del techo”
- Retejado:
 - Capa adicional de techado sobre un material de techado existente
 - Limitado a una sola capa existente

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FIN DEL MÓDULO 9

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Module 1 Quiz Questions

Question	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
¿Una vivienda para dos familias de cuatro pisos de altura estará sujeta a las disposiciones de qué código?	IRC R101.2	IRC R101	2	Código Internacional Residencial (IRC)	Código Internacional de Edificaciones (IBC)		
¿Cuál de los siguientes está exento de un permiso?	IRC R105.2 Electricidad 3	IRC R105	3	muro de contención de 5 pies de altura	nueva cubierta de 250 pies cuadrados en el área	reemplazo de dispositivos de sobrecorriente de circuito derivado	un nuevo calentador de agua
No se permite que _____ a las estructuras existentes provoque que la estructura existente se vuelva insegura.	IRC R102.7.1	IRC R102	4	reparaciones	ampliaciones	modificaciones	todas las anteriores
Los deberes y poderes del funcionario de la edificación incluyen todo lo siguiente, excepto:	IRC R104.1	IRC R104	2	interpretar el código	anular los requisitos del código	hacer cumplir todas las disposiciones del código	adoptar políticas y procedimientos
¿Por cuánto tiempo se deben guardar los registros?	IRC R104.7	IRC R104	1	el periodo requerido para conservación de registros públicos	180 días	90 días	60 días
¿Cuál es el tamaño permitido de una estructura accesoria separada de 1 piso que se permite instalar sin un permiso de construcción?	IRC R105.2 Edificación 1	IRC R105	3	180 pies ²	250 pies ²	200 pies ²	150 pies ²
Una piscina prefabricada de ≤ 28" de profundidad está exenta de un permiso de construcción	IRC R105.2 Edificación 7	IRC R105	2	CIERTO	FALSO		
Cuando se deba realizar el reemplazo o las reparaciones del equipo en una situación de emergencia, la solicitud de permiso deberá presentarse _____ al funcionario de las edificaciones.	IRC R105.2.1	IRC R105	4	tan pronto que sea posible	el siguiente día	dentro de 48 horas	dentro del siguiente día hábil
La obra debe comenzar con un permiso de construcción dentro de los _____ días de su emisión.	IRC R105.3.2	IRC R105	3	60	120	180	90
Un certificado de ocupación deberá incluir toda la siguiente información, excepto:	IRC R110.3	IRC R110	1	La fecha de emisión	La dirección de la estructura	El nombre del propietario	El nombre del funcionario de la edificación

Module 2 Quiz Questions

Question	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
¿Cada cuántos años se hace una revisión del libro IRC?	IRC Prefacio Desarrollo	IRC Prefacio	2	Cada 4 años	Cada 3 años	Cuando sea necesario	Anualmente
Una sección de muro de altura completa construida para resistir cargas de corte en su plano a través de su interacción de los miembros del entramado se conoce como:	IRC Capítulo 2	IRC Capítulo 2	2	Línea de muro arriostrado (BWL)	Panel de muro arriostrado (BWP)	mampostería	línea recta
El término en inglés "Building Official" se traduce como:	IRC Capítulo 2	IRC Capítulo 2	3	oficial de casas	oficial de edificios	funcionario de la edificación	oficial de la jurisdicción
¿Cuál es la función de una alarma de monóxido de carbono?	IRC Capítulo 2	IRC Capítulo 2	1	detectar gas de monóxido de carbono y alertar a los ocupantes mediante una señal audible	detectar el gas de monóxido de carbono y avisar a las autoridades	señalizar a los ocupantes con ruido y luces	indicar que debe ser dióxido de carbono y no monóxido
¿Cuál es la diferencia entre un espacio angosto y un sótano?	IRC Capítulo 2	IRC Capítulo 2	4	Un espacio angosto solamente es el único sitio donde se permite la instalación de equipos mecánicos	Un espacio angosto y un sótano coexisten en las edificaciones	Ninguna, son iguales	Un espacio angosto no tiene altura suficiente para caminar y vivir
Una unidad de vivienda para una familia construida en un grupo de ___ unidades vinculadas o más se define como casa contigua.	IRC Capítulo 2	IRC Capítulo 2	2	2	3	4	5
¿Cuál material es el más común para el revestimiento de los muros interiores de una vivienda?	IRC Capítulo 2	IRC Capítulo 2	3	mampostería	paneles de madera	tablero de yeso	planchas de acero
La medida vertical de cada escalón en un tramo de una escalera se conoce como:	IRC Capítulo 2	IRC Capítulo 2	1	contrahuella	paso	elemento	escalera

Module 3 Quiz Questions

Question	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
¿Cuál es la velocidad máxima del viento de diseño para Utah?	IRC Figura R301.2(2)	IRC R301	1	105 mph	120 mph	125 mph	150 mph
Se permite que un techo con una altura de 47 pies use tornillos para madera No. 8 con una velocidad del viento de 175 mph.	IRC R301.2.1.2 Excepción	IRC R301	2	CIERTO	FALSO		
El terreno abierto con obstrucciones dispersas, incluidas las ondulaciones de la superficie u otras irregularidades que generalmente tienen menos de 30 pies de altura se clasificarán como _____.	IRC R301.2.1.4 Ítem 2	IRC R301	3	Exposición A	Exposición B	Exposición C	Exposición D
El viento es la única carga que debe tenerse en cuenta al determinar una trayectoria de carga lateral.	IRC R301	IRC R301	2	CIERTO	FALSO		
Se requiere que un edificio sea diseñado por un ingeniero cuando contiene elementos estructurales que exceden los límites del IRC.	IRC R301.1.3	IRC R301	1	CIERTO	FALSO		
Las áreas urbanas y las áreas arboladas se clasificarán como _____.	IRC R301.2.1.4 Ítem 1	IRC R301	2	Exposición A	Exposición B	Exposición C	Exposición D
¿Cuál es la categoría de diseño sísmico para el centro de Nueva York?	IRC Figura R301.2(2)	IRC R301	1	A	B	C	D
¿Cuál es la carga viva mínima uniformemente distribuida (carga uniforme) para las fugas de incendios?	IRC Tabla R301.7	IRC R301	4	50	25	30	40
El suelo rígido se clasifica como clase de sitio _____.	IRC R301.2.2.1	IRC R301	3	B	A	D	E
Si una llanura aluvial está ubicada en un cauce de inundación identificado, el diseño se debe realizar según ASCE _____.	IRC R301.2.4	IRC R301	4	10	52	28	24

Module 4 Quiz Questions

Question	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
¿Cuál es la distancia mínima de separación del fuego para un muro exterior?	IRC Tabla R302.1(1)	IRC R302	2	5 pies	0 pies	2 pies	10 pies
Para la entrada/salida de aire de protección de aberturas exteriores, las aberturas deben estar protegidas con pantallas, persianas o rejillas resistentes a la corrosión que tengan un tamaño de abertura mínimo de ____.	IRC R303.6	IRC R303	1	1/4 de pulgada	1/2 pulgada	3/4 de pulgada	1 pulgada
Una muro común que separe una casa contigua con un sistema de rociadores NFPA-13R debe tener una clasificación mínima de ____.	IRC 302.2.2 Ítem 1	IRC 302	1	1 hora	1.5 horas	2 horas	3 horas
Se proporcionará un parapeto para todas las siguientes condiciones, excepto:	IRC 302.2.4 Ítem 2 excepción	IRC 302	3	Clase A	Clase B	Revestimiento de techo Clase C	
Se instalará una puerta de _____ pulgadas de espesor entre los garajes privados y los dormitorios.	IRC 302.5.1	IRC 302	4	1 pulgada y 3/8	1 pulgada y media	1 pulgada y 5/8	No permitido
Cuando los dispositivos que producen calor estén listados para espacios libres menores, el aislamiento combustible que cumpla con los requisitos de listado debe estar separado por _____.	IRC R302.14	IRC 302	1	cualesquiera que sean las condiciones estipuladas en el listado	3 pulgadas	2 pulgadas	1 pulgada
Cuando la proyección permitida del alero del techo es de 4 pulgadas como máximo para un accesorio de garaje separado de una unidad de vivienda, ¿qué tan cerca se permite que esté el edificio del límite del lote?	IRC Tabla R302.1(1)	IRC R302	2	1 pie	2 pies	3 pies	4 pies
Los cuartos habitables deberán tener un área mínima que se pueda abrir al exterior de _____ del área del piso que se está ventilando.	IRC R303.1	IRC 303	1	4%	6%	8%	10%
¿Bajo qué condición se requiere ventilación mecánica para una unidad de vivienda?	IRC R303.4	IRC 303	3	20 cambios de aire por hora	10 cambios de aire por hora	5 cambios de aire por hora	
¿Cuál es el vidriado agregado mínimo para la iluminación en un cuarto habitable?	IRC R303.1	IRC 303	4	2%	6%	4%	8%

Module 5 Quiz Questions

Question	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
¿Cuál es el espacio libre mínimo requerido que se debe proporcionar frente al compartimiento de la ducha?	IRC Figura R307.1	IRC R307	1	24 pulgadas	21 pulgadas	18 pulgadas	15 pulgadas
El acabado no absorbente provisto para una ducha debe estar a un mínimo de _____ por encima del piso.	IRC R307.2	IRC R307	4	3 pies	4 pies	5 pies	6 pies
¿Cuántos interruptores se requieren en una escalera de 5 contrahuellas?	IRC R303.7	IRC R303	2	2 interruptores	1 interruptor	no requeridos	determinado por el funcionario de la edificación
¿Cuál es el area mínima necesaria para una cocina?	IRC R304.1	IRC 304	1	70 pies ²	80 pies ²	90 pies ²	100 pies ²
¿Cuál es la altura mínima del techo requerida para una lavandería?	IRC R305.1	IRC R305	3	7'-6"	7"	6'-8"	6"
Se requiere que todas las unidades de vivienda estén provistas de un inodoro, lavabo y bañera/ducha.	IRC R306.1	IRC R306	1	CIERTO	FALSO		
¿Cuál es la clasificación de categoría mínima de vidriado para vidriado en puertas corredizas de vidrio para patio, donde el área expuesta de un lado es de 8 pies cuadrados?	IRC Tabla R308.3.1(1)	IRC R308	2	Clase I	Clase II	Clase III	Clase IV
El vidriado y los paneles fijos y operables de _____ se considerarán un lugar peligroso.	IRC R308.4.1	IRC R308	4	puertas plegables	puertas deslizantes	puertas giratorias	todas las anteriores
Las cocheras abiertas deben estar provistas de aberturas en no menos de _____.	IRC R309.2	IRC R309	2	un lado	dos lados	tres lados	cuatro lados
¿Cuál es el espacio libre mínimo requerido entre una bañera y el inodoro?	IRC Figura 307.1	IRC R307	2	12 pulgadas	15 pulgadas	18 pulgadas	21 inches
¿Cuál es el grosor mínimo requerido para una pieza de vidrio con persianas de 36 pulgadas de largo?	IRC R308.2	IRC R308	2	4/8 de pulgada	3/16 de pulgada	3/8 de pulgada	5/8 de pulgada

Module 6 Quiz Questions

Question	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
¿Cuál es el ancho libre mínimo que se debe proporcionar para una puerta de salida?	IRC R311.2	IRC R311	2	24 pulgadas	32 pulgadas	36 pulgadas	40 pulgadas
¿Cuál es el ancho mínimo requerido de los pasillos provistos en las unidades de vivienda?	IRC R311.6	IRC R311	1	3 pies	4 pies	5 pies	6 pies
¿Cuál de las siguientes ubicaciones debe contar con protección contra la descomposición?	IRC R317.1	IRC R317	4	elementos de estructura de madera sobre concreto a menos de 8 pulgadas del suelo	revestimiento de madera con un espacio libre de 6 pulgadas desde el suelo	listón de madera adherido directamente a los muros exteriores de mampostería	todas las anteriores
¿Cuál es el espesor mínimo requerido de concreto que se debe proporcionar a las espumas plásticas para eliminar una barrera térmica?	IRC R316.5.1	IRC R316	4	2 pulgadas	1 pulgada y 3/4	1 pulgada y media	1 pulgada
¿Cuál es la altura libre mínima requerida para las puertas de salida?	IRC R311.2	IRC R311	2	72 pulgadas	78 pulgadas	84 pulgadas	96 pulgadas
Se ha instalado una alarma de humo fotoeléctrica en una casa. ¿Cuál es la distancia horizontal máxima desde un aparato de cocina que puede estar cuando está instalado?	IRC R314.3.1	IRC R314	1	6 pies	5 pies	4 pies	3 pies
¿Cuál de las siguientes condiciones activa los requisitos para instalar alarmas de monóxido de carbono en una unidad de vivienda?	IRC R315.2.1	IRC R315	4	A- un garaje adjunto con aberturas que se comunican con la unidad de vivienda	B- aparato(s) que quema(n) combustible(s) en la unidad de vivienda	ni A ni B	A o B
El ancho de trazo mínimo para los caracteres de dirección será _____.	IRC R319.1	IRC R319	3	1 pulgada	0.75 pulgadas	0.5 pulgadas	0.25 pulgadas
¿Cuándo se requiere que una estructura cumpla con el IBC para la accesibilidad?	IRC R320.1	IRC R320	1	4 o más unidades de vivienda o unidades para dormir en una sola estructura	todas las casas contiguas	3 unidades de condominio	vivienda de dos familias (dúplex)
Se requiere todo lo siguiente, excepto _____, para una marca de calidad en la madera contra la descomposición:	IRC R317.2.1	IRC R317	3	el tipo de conservantes	el estándar con el cuál fue tratado	la máxima retención de conservantes	el uso final para el que se trató el producto
¿Cuál es la subida vertical máxima permitida entre los niveles de piso dentro de una vivienda unifamiliar?	IRC R311.7.3	IRC R311	3	196 pulgadas	147 pulgadas	151 pulgadas	132 pulgadas
¿Cuál es la altura mínima requerida para proporcionar una baranda para un balcón?	IRC R312.1.2	IRC R312	1	36 pulgadas	24 pulgadas	21 pulgadas	18 pulgadas
Los paneles solares ubicados en un techo con una pendiente de 2:12 se ubicarán de manera que proporcionen dos vías de acceso de 3 pies de ancho.	IRC R324.6	IRC R324	2	CIERTO	FALSO		
¿Cuál es la altura libre mínima debajo de un entrepiso?	IRC R325.2	IRC R325	2	6'-8"	7'	7'-6"	8'
Las características de combustión de la superficie de la espuma plástica de 4 pulgadas de espesor o menos deben tener un índice de propagación de llama de _____ y un índice de desarrollo de humo de no más de _____.	IRC R316.3	IRC R316	3	25, 450	50, 450	75, 450	100, 450

Module 7 Quiz Questions

Question	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
¿Cuál es la presión de carga de la roca sedimentaria?	IRC Tabla R401.4.1	IRC R401	3	12,000 libras por pie cuadrado	8,000 libras por pie cuadrado	4,000 libras por pie cuadrado	3,000 libras por pie cuadrado
La resistencia a la compresión mínima requerida para el concreto prefabricado es _____ para un mínimo de _____.	IRC R402.3.1	IRC R402	3	2,000 libras por pie cuadrado, 30 días	3,500 libras por pie cuadrado, 15 días	5,000 libras por pie cuadrado, 28 días	8,000 libras por pie cuadrado, 28 días
La superficie superior de las zapatas debe estar nivelada.	IRC R403.1.5	IRC R403	1	CIERTO	FALSO		
tener una base de _____ donde el valor de carga del suelo es de 3500 libras por pie cuadrado y una carga de nieve de 20 libras por pie cuadrado	IRC Tabla R403.1(1)	IRC R403	4	15x9	14x8	13x7	12x6
El Grupo de Suelos _____ incluye suelos descritos como "arcillas limosas", tienen una Clasificación Unificada de Suelos de OL.	IRC Tabla R405.1	IRC R405	4	I	II	III	IV
Las juntas para la barrera contra la humedad provista para los muros exteriores de las fundaciones antes del relleno deberán ser _____ como mínimo.	IRC R406.3.2	IRC R406	3	2 pulgadas	4 pulgadas	6 pulgadas	8 pulgadas
Se colocará un retardador de vapor con viguetas traslapadas no menos de _____ entre la losa y la subrasante	IRC R506.2.3	IRC R506	3	2 pulgadas	4 pulgadas	6 pulgadas	8 pulgadas
Las zapatas de piedra partida están permitidas en todas las siguientes categorías de diseño sísmico, excepto:	IRC R403.4.1	IRC R403	4	Categoría A	Categoría B	Categoría C	Categoría D
Un muro de fundación de mampostería simple de 6 pies de altura sujeto a 4 pies de relleno no balanceado de clase de suelo GC, debe tener un espesor nominal mínimo de _____.	IRC Tabla R404.1.1(1)	IRC R404	2	6 pulgadas	8 pulgadas	10 pulgadas	12 pulgadas
¿Cuál es la luz máxima de la vigueta de piso de 2x6 de abeto Douglas #1 espaciada a 19.2 pulgadas entre centros, cuando la carga muerta es de 20 en una sala de estar?	IRC Tabla R502.3.1(2)	IRC R502	4	11 pies	10 pies 5 pulgadas	9 pies 9 pulgadas	8 pies 10 pulgadas
El extremo de cada viga deberá tener no menos de _____ de apoyo sobre la madera.	IRC R502.6	IRC R502	1	1 pulgada y media	2 pulgadas	2 pulgadas y media	3 pulgadas
¿Cuál es el grosor mínimo del revestimiento del piso de madera, donde las vigas del piso están espaciadas 24 pulgadas e instaladas en diagonal a la viga?	IRC Tabla R503.1	IRC R503	2	11/16 de pulgada	3/4 de pulgada	5/8 de pulgada	3/8 de pulgada
Se permite omitir el entarimado primario cuando la separación entre las viguetas no exceda _____.	IRC R503.1.1	IRC R503	3	10 pulgadas	12 pulgadas	16 pulgadas	18 pulgadas
Los dispositivos de tracción de retención instalados en una cubierta deberán tener un diseño de tensión admisible de no menos de _____ libras.	IRC R507.9.2	IRC R507	1	750	800	950	1000
Los tableros de cubierta compuestos de plástico, las huellas de escalera, barandas y pasamanos que contengan madera serán _____.	IRC R507.2.2.3	IRC R507	2	resilientes a la descomposición	resistentes a la descomposición	resilientes a las termitas	resistentes a las termitas

Module 8 Quiz Questions

Question	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Se debe usar un retardador de vapor _____ en la Zona climática Marina 4 en el revestimiento de tableros de fibra.	IRC Tablas R702.7(1-3)	IRC R702	1	Clase III	Clase II	Clase I	
Asphalt felt used as a water barrier applied horizontally shall be lapped not less than _____ over the lower layer.	IRC R703.2	IRC R703	2	1 pulgada	2 pulgadas	3 pulgadas	4 pulgadas
Se permitirá que el muro interior no portante se construya con montantes de _____ pulgadas por _____ pulgadas.	IRC R602.5	IRC R602	4	2x10	2x8	2x5	2x3
El espesor nominal máximo del revestimiento de mampostería sobre estructura de madera en la categoría sísmica C debe ser _____.	IRC Tabla R703.8(1)	IRC R703	3	3 pulgadas	4 pulgadas	5 pulgadas	6 pulgadas
Cuando el tabique visto y el de respaldo de mampostería esté unido con amarres de muros ajustables, se debe proporcionar un amarre de muro para cada _____ del área del muro.	IRC R606.13.2.2	IRC R606	3	4.67 pies ²	3.57 pies ²	2.67 pies ²	1.98 pies ²
Cuando se utilice un panel de yeso de 3/8 como revestimiento de cielo raso interior y se instale perpendicularmente al miembro estructural a 16 pulgadas entre centros, el espacio máximo entre tornillos deberá ser _____.	IRC Tabla R702.3.5	IRC R702	3	8 pulgadas	10 pulgadas	12 pulgadas	16 pulgadas
¿Cuál es la longitud mínima sólida de los muros que soportan el segundo piso y un techo de construcción de estructura liviana en la categoría sísmica C?	IRC Tabla R606.12.2.1	IRC R606	3	35	30	25	20
¿Cuál es el espesor mínimo del revoque para mampostería de yeso a base de malla de alambre?	IRC Tabla R702.1(1)	IRC R702	2	3/4 de pulgada	5/8 de pulgada	1/2 pulgada	7/8 de pulgada
Cada capa de yeso de cemento se mantendrá en condiciones húmedas durante un mínimo de _____ antes de la aplicación de la siguiente capa.	IRC R702.2.2.1	IRC R702	2	12 horas	24 horas	36 horas	48 horas
Se permite entallar un montante en una partición de apoyo a una profundidad que no exceda el _____ % de su ancho.	IRC R602.6 Item 1	IRC R602	1	25	30	35	40
Una placa superior doble con postes de madera no debe tener menos de _____ de espesor nominal.	IRC R602.3.2	IRC R602	3	1 pulgada	1 pulgada y media	2 pulgadas	2 pulgadas y media
Los tornillos tipo S y tipo W están aprobados para fijar tablas de yeso y paneles de yeso a estructuras de madera.	IRC R702.3.5.1	IRC R702	1	CIERTO	FALSO		
El espacio máximo entre los montantes de centro a centro cuando se sostiene un techo es _____ donde el tamaño de los montantes es 3x4.	IRC Tabla R602.3(5)	IRC R602	3	16 pulgadas	20 pulgadas	24 pulgadas	36 pulgadas
La altura sin apoyo de los pilares de mampostería no debe exceder _____ su dimensión mínima.	IRC R606.7	IRC R606	2	5 veces	10 veces	15 veces	20 veces
Cuando se exceda _____, se desechará el mortero no utilizado.	IRC R607.8	IRC R607	1	1 hora y media	1 hora y media	2 horas	2 horas y media
Los parteluces deberán ser capaces de resistir una carga _____ las cargas de presión de diseño aplicadas por el conjunto de la ventana.	IRC R609.8.3	IRC R609	4	5 veces	3 veces	2.5 veces	1.5 veces

Module 9 Quiz Questions

Question	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
¿Cuál es el índice mínimo de propagación de la llama para la madera tratada con retardador de fuego utilizada en la estructura del techo?	IRC R802.1.5	IRC R802	1	25	50	75	100
Se instalará un techo Clase B donde el borde de un techo esté a menos de _____ del límite del lote.	IRC R902.1	IRC R902	2	4 pies	3 pies	2 pies	1 pie
Cuando la penetración de una chimenea tiene _____ de ancho, se debe instalar un caballete plano sobre el lado de la cumbrera.	IRC R903.2.2	IRC R903	2	24 pulgadas	30 pulgadas	36 pulgadas	48 pulgadas
La extensión de la chimenea no debe ser menos de _____ pulgadas hacia el frente ni menos de _____ pulgadas más allá de cada lado de la chimenea.	IRC R1001.10	IRC R1001	2	8, 16	16, 8	16, 16	8, 8
El piso del fogón de un calefactor de mampostería debe tener al menos _____ de espesor.	IRC R1002.3	IRC R1002	2	2 pulgadas	4 pulgadas	6 pulgadas	8 pulgadas
Donde las viguetas de cielo raso Douglas fir-larch #3 crean un ático inhabitable sin almacenamiento y están espaciadas a 12 pulgadas entre centros, ¿cuál es la distancia máxima permitida cuando se usan miembros de 2x6?	IRC Tabla R802.4.1(1)	IRC R802	1	16 pies, 3 pulgadas	11 pies, 1 pulgada	20 pies, 7 pulgadas	15 pies, 10 pulgadas
La luz máxima de un entramado en techo de acero conformado en frío no debe ser mayor que _____.	IRC R804.1.1	IRC R804	2	20 pies	40 pies	60 pies	80 pies
Las tejas de techo de metal deben instalarse en pendientes de techo que sean _____ o más.	IRC R905.4.2	IRC R905	1	3:12	2:12	1:12	1/2:12
El número mínimo de sujetadores por teja para tejas de pizarra será _____.	IRC R905.6.5	IRC R905	3	4	3	2	1
¿Cuál es la luz máxima de las vigas del techo de una designación de miembro de 350S162-68, donde la carga de nieve en el suelo es de 30 libras por pie cuadrado y el espacio entre vigas es de 16 pulgadas de centro a centro?	IRC Tabla R804.3.2.1(1)	IRC R804	2	12'-10"	14'-8"	9'-11"	10'-9"
Un cabio de techo puede sobresalir un máximo de _____.	IRC R804.3.2.1.1	IRC R804	4	12 pulgadas	18 pulgadas	20 pulgadas	24 pulgadas
¿Cuál es el espesor mínimo requerido para el revestimiento del techo que está en una viga con una separación de 24 pulgadas?	IRC Tabla R803.1	IRC R803	2	3/8 de pulgada	5/8 de pulgada	1 pulgada	1 pulgada y media
¿Cuál es el espesor mínimo requerido para el revestimiento del techo que está en una viga espaciada a 60 pulgadas?	IRC Tabla R803.1	IRC R803	1	1 pulgada y media	3/4 de pulgada	1/2 pulgada	5/8 de pulgada
¿Cuál es la distancia mínima para un conducto de aire de combustión no listado a combustibles dentro de los 5 pies de la salida del conducto?	IRC R1006.3	IRC R1006	1	1 pulgada	2 pulgadas	3 pulgadas	5 pulgadas
Se proporcionará un máximo de _____ desde la abertura de la cámara del fogón para la salida de aire exterior provista para una cámara de fogón.	IRC R1006.5	IRC R1006	3	12 pulgadas	18 pulgadas	24 pulgadas	30 pulgadas

Module 9 Quiz Questions

¿Cuál de las siguientes zonas climáticas no se requiere para instalar un retardador de vapor en el lado cálido del techo en invierno?	IRC R806.2	IRC R806	1	Zona Climática 5	Zona Climática 6	Zona Climática 7	Zona Climática 8
Las dimensiones mínimas para las aberturas de acceso al ático serán de _____ pulgadas por _____ pulgadas.	IRC R807.1	IRC R807	4	30 x 20	22 x 24	30 x 30	22 x 30

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Question	Description	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Una losa de dos pisos en una casa de nivelación de una construcción de muro de mampostería con lechada debe tener una base de _____ donde el valor de carga del suelo es de 3,000 psi y la carga de nieve es de 30 psf.		IRC Tabla R403.1(1)	IRC R403	1	12x6	15x6	17x6	24x6
¿Cuál es la extensión máxima de las vigas del techo de una designación de miembro de 800S162-43, donde la carga de nieve sobre el terreno es de 20 libras por pie cuadrado y el espacio entre vigas es de 24 pulgadas de centro a centro?		IRC Tabla R804.3.2.1(1)	IRC R804	3	19' 9"	17' 0"	16' 1"	13' 7"
Las aberturas de ventilación del ático deberán tener una dimensión máxima de _____ pulgadas.		IRC R806.1	IRC R806	2	1/2 pulgada	1/4 de pulgada	1/8 de pulgada	1/16 de pulgada
En la Zona climática 7, el área ventilada libre neta de un techo debe ser _____ del espacio ventilado donde se ha instalado un retardador de vapor.		IRC R806.2 Excepción	IRC R806	4	1/150	1/200	1/250	1/300
¿Cuál es el espacio libre mínimo requerido entre una bañera y el frente de un inodoro?		IRC Figura 307.1	IRC R307	4	12 pulgadas	15 pulgadas	18 pulgadas	21 pulgadas
Un muro de fundación de mampostería simple de 9 pies de altura sujeta a 7 pies de relleno desequilibrado de clase de suelo GW, debe tener un espesor nominal de pared de _____.		IRC Tabla R404.1.1(1)	IRC R404	3	6 pulgadas	8 pulgadas	10 pulgadas	12 pulgadas
Cuando se utilice madera contrachapada lijada del grupo de especies 4 como contrapiso combinado, el grosor mínimo requerido de la madera contrachapada donde las vigas están espaciadas a 20 pulgadas de centro a centro es _____.		IRC Tabla R503.2.1.1(2)	IRC R503	2	1 pulgada	7/8 pulgada	3/4 pulgada	5/8 pulgada
Los pisos de sótano de madera están limitados a aplicaciones en las que la profundidad diferencial del relleno en las paredes exteriores opuestas de los cimientos es de _____ pies o menos.		IRC R504.1.1	IRC R504	1	2	2 1/2	3	3 1/2
¿Cuál es la clasificación de categoría mínima de vidriado para vidriado en puertas deslizantes de vidrio para patio, donde el área expuesta de un lado es de 8 pies cuadrados?		IRC Tabla R308.3.1(1)	IRC R308	2	Clase I	Clase II	Clase III	Clase IV
El vidriado se considerará peligroso si se encuentra en todos menos en cuáles de los siguientes tipos de puertas de paneles fijos y operables.		IRC R308.4.1	IRC R308	4	Puertas plegables	Puertas deslizantes	Puertas abatibles (tradicionales)	Puertas basculantes
Los estacionamientos techados deberán estar abiertos en no menos de _____ lados.		IRC R309.2	IRC R309	2	Un lado	Dos lados	Tres lados	Cuatro lados
¿Cuál de los siguientes está exento de un permiso?		IRC R105.2 Eléctrica 3	IRC R105	3	muro de contención de 5 pies de altura	nueva cubierta de 250 pies cuadrados en el área	reemplazo de dispositivos de sobrecorriente de circuito derivado	un nuevo calentador de agua

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¿Cuál de los siguientes es un requisito necesario para eliminar las aberturas de ventilación en un espacio debajo del piso?	IRC R408.3	IRC R408	1	Un retardador de vapor continuo Clase I	Salida mecánica que proporciona 0.5 pies cúbicos por minuto por cada 50 pies cuadrados de área debajo del piso	Suministro de aire acondicionado equivalente a 1 pie cúbico por minuto por cada 50 pies cuadrados de área bajo el piso	Dos aberturas en el piso de al menos 0,85 pies cuadrados al espacio acondicionado arriba
Los patios ingleses con una profundidad vertical superior a _____ pulgadas deben estar provistos de una escalera fijada de forma permanente.	IRC R310.4.2	IRC R310	4	36	40	42	44
¿Cuál es el ancho libre mínimo que se debe proporcionar para la puerta de salida requerida?	IRC R311.2	IRC R311	2	24 pulgadas	32 pulgadas	36 pulgadas	40 pulgadas
¿Cuándo se requiere que una estructura cumpla con el IBC para la accesibilidad?	IRC R320.1	IRC R320	1	Complejo de apartamentos con 10 unidades	Casas contiguas	3 unidades de condominio	Dúplex (viviendas de dos familias)
Se instalará una puerta de _____ pulgadas de espesor entre los garajes privados y las habitaciones.	IRC 302.5.1	IRC 302	4	1 3/8	1 1/2	1 5/8	No permitido
El aislamiento (insulación) combustible debe estar separado de las latas empotradas por un mínimo de _____ pulgadas cuando no se proporcione una certificación.	IRC R302.14	IRC 302	2	6	3	2	1
Un muro de cimentación de concreto plano de 9 pies de alto y 10 pulgadas de espesor nominal sujeto a 5 pies de relleno desequilibrado de clase de suelo SP, debe tener un refuerzo vertical mínimo de _____ a _____ en el centro.	IRC Tabla R404.1.2(4)	IRC R404	4	No. 6, 28 pulgadas	No. 6, 35 pulgadas	No. 6, 59 pulgadas	No requeridos
Un drenaje de fundación de piedra triturada debe extenderse no menos de _____ más allá del borde exterior de la base y _____ por encima de la parte superior de la base.	IRC R405.1	IRC R405	1	12 pulgadas, 6 pulgadas	6 pulgadas, 6 pulgadas	18 pulgadas, 12 pulgadas	12 pulgadas, 18 pulgadas
¿Cuál es la presión de carga de la grava arenosa?	IRC Tabla R401.4.1	IRC R401	4	12,000 libras por pie ²	8,000 libras por pie ²	4,000 libras por pie ²	3,000 libras por pie ²
El exterior de un edificio residencial debe tener una pendiente mínima de _____ pulgadas dentro de los primeros 10 pies desde la fundación del edificio.	IRC R401.3	IRC R401	1	6	8	10	12
¿Cuál es la carga viva máxima permitida de los paneles estructurales de madera utilizados para el revestimiento del subsuelo es _____ cuando los paneles estructurales de madera tienen una clasificación de luz de 24/16, un espesor de 7/16 y una luz de 16 pulgadas de centro a centro?	IRC Tabla R503.2.1.1(1)	IRC R503	1	100	70	50	40
Para un accesorio de garaje independiente para una unidad de vivienda ubicada dentro de los 2 pies de la línea del lote, ¿cuánta proyección del alero del techo se permite?	IRC R302 Excepción 4	IRC R302	2	1 pie	4 pulgadas	6 pulgadas	No permitido
¿Cuál es la cantidad mínima de vidriado agregado requerida en las habitaciones habitables?	IRC R303.1	IRC 303	1	8%	10%	12%	14%
¿Cuál de los siguientes documentos en el departamento de construcción es requerido retener en los registros oficiales, por períodos consistentes con las leyes de retención de registros públicos?	IRC R104.7	IRC R405	1	Solicitudes de permisos	Tiempo de reuniones	Resultados de inspecciones	Informes del clima

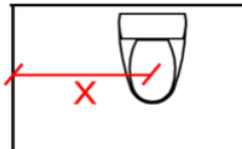
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¿Cuál es el grosor mínimo del revestimiento del piso de madera, donde las vigas del piso están espaciadas 16 pulgadas y se instalan perpendiculares a la viga?	IRC Tabla R503.1	IRC R503	2	3/8 pulgada	5/8 pulgada	3/4 pulgada	11/16 pulgada
¿Una vivienda para dos familias de cuatro pisos de altura estará sujeta a las disposiciones de qué código?	IRC R101.2	IRC R101	2	Código Internacional Residencial	Código Internacional de Edificaciones		
El espacio máximo entre los montantes de centro a centro cuando se soporta un piso y un techo es _____ donde el tamaño de los montantes es 2x6.	IRC Tabla R602.3(5)	IRC R602	1	24 pulgadas	20 pulgadas	16 pulgadas	14 pulgadas
¿Cuál es la luz máxima de la vigueta de piso de Pícea-Pino-Abeto #1 2x10, cuando la carga muerta es 10 y carga muerta es 40 en una sala de estar?	IRC Tabla R502.3.1(2)	IRC R502	3	12 pies 9 pulgadas	15 pies 8 pulgadas	17 pies 3 pulgadas	16 pies 7 pulgadas
Las paredes de mampostería deben tener no menos de _____ pulgadas de cemento portland aplicado a la pared exterior.	IRC R406.1	IRC R406	3	1/4 pulgada	1/2 pulgada	3/8 pulgada	5/8 pulgada
Las columnas de madera deben tener un mínimo de _____ pulgadas x _____ pulgadas nominales.	IRC R407.3	IRC R407	1	4x4	4x6	6x6	8x8
¿Cuál es la altura mínima del techo requerida para un cuarto lavandería?	IRC R305.1	IRC R305	3	7'-6"	7'-0"	6'-8"	6'-0"
Se requiere que todas las unidades de vivienda tengan un inodoro, lavamanos y ducha.	IRC R306.1	IRC R306	1	Cierto	Falso		
La madera compuesta estructural consiste de todo lo siguiente, excepto:	IRC R202	IRC R202	2	Madera de virutas orientadas	Madera de virutas paralelas	Tablero de madera de borde prefabricado	Madera de virutas laminada
Para un muro de carga exterior, ¿cuál es la luz máxima para un cabezal doble de 2x10 que soporta un techo, cielo raso y dos pisos libres? (Suponga una carga de nieve sobre el suelo de 30 psf y un ancho de construcción de 28 pies)	IRC R602.7(1)	IRC R602.7	4	5' 9"	5' 1"	4' 9"	4' 1"
¿Cuál es la velocidad máxima del viento de diseño para Michigan?	IRC Figura 301.2(2)	IRC 301	1	115 mph	120 mph	125 mph	150 mph
¿Se permite que un techo con una altura de 47 pies use tornillos para madera No. 8 con una velocidad del viento de 175 mph?	IRC R301.2.1.2 Excepción	IRC 301	2	Sí	No		
Los muros de acero conformado en frío se limitarán a sitios donde la velocidad máxima del viento sea inferior a _____ millas por hora.	IRC R603.1.1	IRC R603	2	115 mph	140 mph	143 mph	159 mph
Una casa residencial se considera irregular debido a que los muros arriostrados están en planos desplazados. ¿En qué categoría de diseño sísmico se puede construir la vivienda sin necesidad de ingeniería estructural adicional?	IRC R301.2.2.6	IRC R301	4	D1	C	D2	A
El espesor especificado de las unidades de vidrio delgado no debe ser inferior a _____ pulgadas cuando se considera una unidad sólida.	IRC R607.3.2	IRC R607	2	2 pulgadas y media	3 pulgadas	3 pulgadas y 1/8	3 pulgadas y 1/4
Se ha instalado una alarma de humo fotoeléctrica en una casa. ¿Cuál es la distancia horizontal máxima desde un aparato de cocina instalado permanentemente?	IRC R314.3.1	IRC R314	1	6 pies	5 pies	4 pies	3 pies

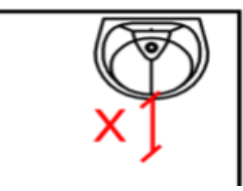
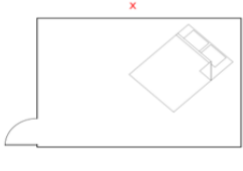
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¿Cuál es la longitud mínima de pared sólida para una pared exterior de una casa contigua de dos pisos en la categoría sísmica D1?	IRC Tabla R606.12.2.1	IRC R606	4	NP	35	30	25
En la categoría de diseño sísmico D1, se permitirá que los revestimientos exteriores de mampostería con un peso de instalación de 45 libras por pie cuadrado se apoyen en construcciones de madera.	IRC R703.8.2	IRC R703	2	Cierto	Falso		
No se permite que cualquier _____ a las estructuras existentes provoque que la estructura existente se vuelva insegura.	IRC R102.7.1	IRC R102	4	Reparaciones	Ampliaciones	Alteraciones	Todas las anteriores
El período mínimo de curado para un sistema de yeso de cemento de tres capas será de _____ horas.	IRC R702.2.2.2	IRC R702	1	48 horas	36 horas	24 horas	12 horas
Cuando se utilice un panel de yeso (gypsum) de 5/8 como revestimiento de cielo raso interior y se instale perpendicularmente a los miembros de la estructura con una separación de 24 pulgadas entre centros, la separación máxima de los clavos deberá ser _____.	IRC Tabla R702.3.5	IRC R702	2	6 pulgadas	7 pulgadas	8 pulgadas	12 pulgadas
¿Cuál de los siguientes materiales no es aceptable para usar como bloqueo antifuego en construcciones combustibles?	IRC R302.11	IRC R302	3	Dos espesores de madera nominal de 1" con traslapes rotos	Tablero de yeso de 1/2"	Cartón a base de cemento de 1/8"	Bloques de fibra de vidrio sin revestimiento de no menos de 16" verticalmente
El drenaje de descarga de los techos debe terminar a no menos de _____ pies de las paredes de las fundaciones.	IRC R801.3	IRC R801	2	6 pies	5 pies	4 pies	3 pies
Las tejas de techo de metal solo se deben instalar en pendientes de techo que sean _____ o más.	IRC R905.4.2	IRC R905	1	3:12	2:12	1:12	1/2:12
El número mínimo de sujetadores por teja para tejas de pizarra será _____.	IRC R905.7.5	IRC R905	3	4	3	2	1
¿Cuál es el desplazamiento permitido para vigas con estructura de madera que se conectan a tablas de cumbrera?	IRC R802.4.2	IRC R802	3	2 1/2 pulgadas	2 pulgadas	1 1/2 pulgadas	1 pulgadas
Las amarras de collar en la viga del techo deben tener un mínimo de _____.	IRC R802.4.6	IRC R802	3	2"x4"	1"x2"	1"x4"	1"x3"
¿Cuál es la distancia mínima para un conducto de aire de combustión no listado a combustibles dentro de los 5 pies de la salida del conducto?	IRC R1006.3	IRC R1006	1	1 pulgada	2 pulgadas	3 pulgadas	5 pulgadas
Se debe proporcionar un máximo de _____ pulgadas desde la abertura de la cámara de combustión para la salida de aire exterior provista para una cámara de combustión.	IRC R1006.5	IRC R1006	3	12	18	24	30
¿Cuál de los siguientes materiales es aceptable para su uso como cierres de tiro en una vivienda unifamiliar combustible sin otra aprobación?	IRC R302.12.1	IRC R302.12	2	Tablero de yeso de 3/8"	Paneles estructurales de madera de 3/8"	Calibre 26 chapa de acero	Bloques de lana mineral de 2"
Las viguetas de piso que excedan ____ por ____ pulgadas deben estar soportadas lateralmente por bloques sólidos.	IRC R502.7.1	IRC R502	4	2x6	2x8	2x10	2x12
Las distancias de separación de incendios se miden desde el frente del edificio hasta todos menos cuál de los siguientes?	IRC Capítulo 2	IRC Capítulo 2	2	La línea de lote interior más cercana	La parte superior trasera de la cera	Una línea imaginaria entre dos edificios en el lote	La línea central de una calle


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Las disposiciones de este código se aplicarán a la construcción de viviendas de una y dos familias separadas para todo lo siguiente, excepto ¿cuál?		IRC R301.2	IRC R301	4	1 piso	2 pisos	3 pisos	4 pisos
Cuando existan conflictos entre las disposiciones de este código y los códigos y normas a los que se hace referencia, se aplicarán las disposiciones de _____.		IRC R102.4.1	IRC R102	3	normas citadas	los requisitos más estrictos	este código	interpretación del funcionario de las edificaciones
¿Cuál de los siguientes no está exento de un permiso?		IRC R105.2 Ítem 9	IRC R105	1	toldos de ventana que sobresalen 60 pulgadas de la pared exterior del edificio	una cerca de 6 pies y 10 pulgadas de altura	una cubierta que tiene un área de 150 pies cuadrados y está a 12 pulgadas del suelo que no está fijada a una vivienda	un tobogán de 10 pies de altura en una zona de categoría sísmica
¿Qué se debe incluir en un certificado de ocupación?		IRC R110.3 Ítem 8	IRC R110	4	el nombre del constructor	la próxima edición del código a partir de la cual se revisó el código	el nombre del diseñador de la vivienda	cuando un sistema de rociadores automáticos esté provisto
Cuando el funcionario de la edificación encuentre que algún trabajo regulado por este código se realiza de manera contraria a las disposiciones de este código o de manera peligrosa o _____, está autorizado a emitir una orden de suspensión de trabajo.		IRC R114.1	IRC R114	3	dañina	segura	insegura	diferente
Una extensión o aumento del área cubierta, número de pisos o altura de una edificación o estructura.		IRC 202	IRC 202	1	ampliación	aumento del área	modificación	remodelo
El área total de todas las edificaciones o estructuras en cualquier porción o lote de terreno proyectada en un plano horizontal, excluyendo las proyecciones permitidas previstas por este código.		IRC 202	IRC 202	4	espacio habitable	área del techo	area de la edificación	espacio ocupado
Agua libre de la presencia de impurezas en cantidades suficientes para causar enfermedades o efectos fisiológicos dañinos que satisface en calidad bacteriológica y química los requisitos de la autoridad de salud pública competente.		IRC 202	IRC 202	2	agua clara	agua potable	agua no potable	agua del grifo
Un término general para muros que se diseñan y construyen para resistir deformaciones laterales sísmicas y eólicas usando mampostería, concreto, entramados de acero conformado en frío o de madera.		IRC 202	IRC 202	3	encuadre del muro	muro exterior	muro de corte	construcción del muro
¿Cuál es la dimensión mínima para X (desde el muro hasta la línea central del inodoro)?		IRC Figura R307.1	IRC R307	1	15 pulgadas	16 pulgadas	18 pulgadas	24 pulgadas

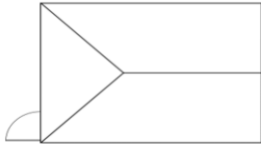
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<p>¿Cuál es el espacio libre mínimo en el piso frente al lavamanos?</p>		<p>IRC Figura R307.1</p>	<p>IRC R307</p>	<p>3</p>	<p>15 pulgadas</p>	<p>18 pulgadas</p>	<p>21 pulgadas</p>	<p>24 pulgadas</p>
<p>Si la longitud de "X" es de 10 pies, ¿cuál sería la dimensión mínima que se permite que tenga "Y"?</p>		<p>IRC R304.2</p>	<p>IRC R304</p>	<p>2</p>	<p>6 pies</p>	<p>7 pies</p>	<p>8 pies</p>	<p>10 pies</p>
<p>¿Cuál de los siguientes no está permitido para ser utilizado como bloqueo contra incendios?</p>		<p>IRC R302.11.1</p>	<p>IRC R302</p>	<p>4</p>	<p>madera elaborada de dos pulgadas</p>	<p>tablero de yeso de 1/2"</p>	<p>un espesor de 23/32-pulgada de panelestructurales de madera</p>	<p>cartón de 1/8 de pulgada con base cementada</p>
<p>El vidrioado donde el borde inferior expuesto del vidrioado está a menos de _____ por encima del plano del plano de la superficie para caminar adyacente de las escaleras se considerará un lugar peligroso (se ignoran las excepciones).</p>		<p>IRC R308.4.6</p>	<p>IRC R308</p>	<p>3</p>	<p>18 pulgadas</p>	<p>24 pulgadas</p>	<p>36 pulgadas</p>	<p>48 pulgadas</p>
<p>Se instalarán detectores de humo en todos los lugares, excepto:</p>		<p>IRC R314.3</p>	<p>IRC R314</p>	<p>3</p>	<p>En cada cuarto para dormir</p>	<p>Fuera de cada área de dormir independiente en la cercanía inmediata de los dormitorios</p>	<p>En cada piso, excluyendo sótanos y áticos habitables e incluyendo espacios angostos y áticos inhabitables</p>	<p>No menos de 3 pies horizontalmente desde la puerta o la abertura de un baño que contenga una bañera o ducha</p>
<p>¿Cuál es la resistencia a la compresión mínima especificada del concreto para una losa de sótano?</p>		<p>IRC Tabla R402.2</p>	<p>IRC R402</p>	<p>3</p>	<p>1,500</p>	<p>2,000</p>	<p>2,500</p>	<p>3,000</p>
<p>¿Cuál es el ancho y el espesor mínimos para fundaciones de concreto con concreto vaciado en el lugar o construcción de muros de mampostería parcialmente lechada con una carga de nieve en el suelo de 30 psf para 2 pisos con un sótano con un valor de carga del suelo de 2,500 libras por pie²?</p>		<p>IRC Tabla R403.1(3)</p>	<p>IRC R403</p>	<p>4</p>	<p>12" x 12"</p>	<p>15" x 12"</p>	<p>15" x 4"</p>	<p>15" x 6"</p>
<p>¿Cuál es el espesor mínimo de un muro de fundación de mampostería simple con un relleno no balanceado de 4.5 pies y una altura máxima de muro sin soporte de 6 pies para la clase de suelo SC?</p>		<p>IRC Tabla R404.1.1(1)</p>	<p>IRC R404</p>	<p>2</p>	<p>6 pulgadas</p>	<p>8 pulgadas</p>	<p>10 pulgadas</p>	<p>12 pulgadas</p>
<p>En las áreas donde se sabe que existe un nivel freático, los muros exteriores de las fundaciones que retienen tierra y encierran los espacios interiores y los pisos por debajo del nivel del suelo deben impermeabilizarse desde el nivel del suelo hasta la altura de la parte superior de la zapata o _____ por debajo de la parte superior del piso del sótano.</p>		<p>IRC R406.2</p>	<p>IRC R406</p>	<p>2</p>	<p>4 pulgadas</p>	<p>6 pulgadas</p>	<p>8 pulgadas</p>	<p>12 pulgadas</p>

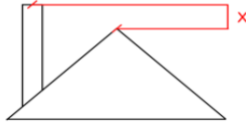
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La superficie superior de las zapatas debe estar nivelada. La superficie inferior de las zapatas no debe tener una pendiente que exceda 1 unidad vertical en ____ unidades horizontales.		IRC R403.1.5	IRC R403	3	20	12	10	8
¿Cuál es la luz máxima de las vigas del piso para Hem-fir #1 para dormitorios residenciales con una carga viva de 30 libras por pie cuadrado y una carga muerta de 20 libras por pie cuadrado usando madera de 2x8 con una separación de 16 pulgadas entre centros?		IRC Tabla R502.3.1(1)	IRC R502	4	18-0	16-1	13-5	13-4
Los extremos de cada vigueta no deben soportar menos de ____ pulgadas sobre madera o metal.		IRC R502.6	IRC R502	1	1 1/2	2	2.5	3
¿Cuál es el grosor mínimo del revestimiento del piso donde las viguetas están espaciadas 24 pulgadas en el centro en diagonal a las viguetas?		IRC Tabla R503.1	IRC R503	2	11/16 de pulgada	5/8 de pulgada	3/4 de pulgada	1 pulgada y 1/2
La losa sobre el suelo de concreto debe tener un espesor mínimo de ____ pulgadas.		IRC R506.1	IRC R506	3	2	2 1/2	3 1/2	4
Las zapatas de la cubierta se colocarán a no menos de ____ pulgadas por debajo de la superficie del suelo intacta.		IRC R507.3.2	IRC R507	2	16	12	8	6
Se ha hecho una entalladura en un muro de carga de 2x6. Indique la profundidad máxima que se permite entallar en el muro de carga.		IRC R602.6	IRC R602	1	1.375 pulgadas	2 pulgadas	2.25 pulgadas	2.375 pulgadas
Un montante en una muro exterior o tabique de soporte no debe cortarse ni entallarse a una profundidad que exceda el ____ % de su profundidad. Los montantes de las particiones no portantes no deben tener muescas a una profundidad que exceda el ____ % de la profundidad de un solo montante.		IRC R602.6	IRC R602	1	25, 40	40, 25	25, 25	40, 40
¿Cuál es el tamaño y el espacio mínimos de las barras de refuerzo para una rejilla reticular sobre un muro de grado para un muro de 8 pulgadas de espesor y 9 pies de alto con una velocidad del viento de 130 millas por hora en una categoría de exposición B?		IRC Tabla R608.6(2)	IRC R608	2	barra 5 a las 47 pulgadas	barra 4 a las 48 pulgadas	barra 5 a las 35 pulgadas	barra 6 a las 46 pulgadas
Cuando los muros cortos excedan los 4 pies de altura, dichos muros deberán estar enmarcados con montantes que tengan el tamaño requerido para _____.		IRC R602.9	IRC R602	4	un sótano	un ático	una placa superior adicional	un piso adicional

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¿Cuál de los sujetadores no está en la lista para usarse como un cabezal continuo para montar?		IRC Tabla R602.3(1)	IRC R602	4	5-8d de caja	4-8d común	4-10d de caja	4 grapas, 1" corona 16 g
¿Cuál es el espesor mínimo para un muro de carga de mampostería de más de un piso de altura?		IRC R606.4.1	IRC R606	2	6 pulgadas	8 pulgadas	10 pulgadas	12 pulgadas
Se permite que el revestimiento de aluminio horizontal se aplique directamente a los montantes sin aislamiento.		IRC Tabla R703.3(1)	IRC R703	1	Incorrecto, esto no se puede aplicar directamente a los montantes.	cuando 3 manos de pintura se han aplicado	si se usan clavos para revestimiento de tamaño 1 1/2 x 0.120"	si se usan clavos para revestimiento de 2" x 0.120"
Cuando se proporcione, el enrasado consistirá en listones de enrasado de madera no menos de _____.		IRC R703.7.1.1	IRC R703	2	1" x 1"	1" x 2"	2" x 2"	2" x 4"
¿Qué tan pronto se puede aplicar la segunda capa de un revoque de cemento de dos capas después de la primera capa?		IRC R703.7.5	IRC R703	4	48 horas	3 días	5 días	1 semana
Los dinteles deberán tener una longitud de carga no menor de _____ pulgadas.		IRC R703.8.3	IRC R703	3	2	3	4	6
¿Cuál es el grosor mínimo del revestimiento de polipropileno que se debe instalar y unir al revestimiento del panel estructural de madera?		IRC R703.14.1.1	IRC R703	3	3/16 de pulgada	2/3 de pulgada	7/16 de pulgada	5/8 de pulgada
¿Cuál es la luz de la viga para un pino del sur n.º 1 con una separación de 19.2 pulgadas entre centros con una carga de nieve en el suelo de 30 libras por pie cuadrado y una carga muerta de 10 libras por pie cuadrado en el cielorraso unido a las vigas usando madera de tamaño 2x10?		IRC Tabla R802.4.1(4)	IRC R802	1	17-7	15-4	15-1	20-2
¿Cuál es la luz permitida entre las vigas del cielorraso de 2x6 para el pino del sur n.º 2 con un espacio de 24 pulgadas al centro? Suponga un ático inhabitable con almacenamiento limitado.		IRC Tabla R802.5.1(2)	IRC R802	2	6' - 7"	9' - 10"	11' - 0"	11' - 5"
Las correas deben ser continuas y deben estar sostenidas por riostradas _____ instaladas en el muro de carga con una pendiente de no menos de _____ grados desde la horizontal.		IRC R802.4.5	IRC R802	4	1x2, 20	2x2, 90	1x2, 45	2x4, 45
Los extremos de cada viga o vigueta del techo no deben tener menos de _____ pulgadas cuando se apoyen sobre mampostería o concreto.		IRC R802.6	IRC R802	3	1.5	2	3	4
Un área de techo es de 1,000 pies cuadrados. ¿Cuál es el área de ventilación libre neta mínimo? (se ignora la excepción)		IRC R806.2	IRC R806	1	6-2/3 pies cuadrados	7-5/8 pies cuadrados	5-3/2 pies cuadrados	4-4/7 pies cuadrados
¿Con qué requisito de ASTM debe cumplir el contrapiso para tejas de asfalto?		IRC R905.1.1	IRC R905	4	ASTM D226	ASTM D1970	ASTM 4869	Todas las anteriores

2021 Residential Building Inspector Spanish Practice Exam Questions

Se requerirán barreras de hielo en las áreas _____.		IRC R905.1.2	IRC R905	1	donde ha habido una historia de formación de hielo a lo largo de los aleros	para todos los techos con tejas	en áreas con nevadas anuales de 6 pulgadas o más por año	cuando la temperatura media del año es inferior a 40 grados
No se permitirá el recubrimiento de un techo cuando el techo existente tenga _____ o más aplicaciones de cualquier tipo de cubierta de techo.		IRC R908.3.1.1	IRC R908	4	recubrimiento de techo no está permitido	solo se permite el reemplazo por parches	una	dos
Las tejas de techo metalicas no se deben instalar en pendientes de techo por debajo de _____ unidades verticales en 12 unidades horizontales.		IRC R905.4.2	IRC R905	4	8	6	4	3
Los techos de membrana termoplástica de una sola capa deben tener una pendiente de diseño de no menos de _____ unidades verticales en 12 unidades horizontales.		IRC R905.13.1	IRC R905	3	8	6	2	4
La empotramiento mínimo de soporte de un dintel en cada lado de la abertura de la chimenea debe ser de _____ pulgadas.		IRC R1001.7	IRC R1001	3	2	3	4	6
El espesor mínimo del hogar de la chimenea será de _____ pulgadas.		IRC R1001.9.1	IRC R1001	2	2	4	6	8
Las zapatas para chimeneas de mampostería deben construirse de concreto o mampostería sólida de no menos de _____ pulgadas de espesor y deben extenderse no menos de _____ pulgadas más allá del frente del muro de fundación o de apoyo en todos los lados.		IRC R1003.2	IRC R1003	1	12, 6	6, 12	6, 8	8, 8
¿Cuál es la altura mínima (X) que la chimenea debe extenderse más allá del punto más alto del techo, suponiendo que la porción está dentro de los 10 pies?		IRC R1003.9	IRC R1003	3	4 pies	3 pies	2 pies	1 pie
La salida de aire exterior debe estar ubicada en la parte posterior o lateral de la cámara de combustión o debe ubicarse fuera de la cámara de combustión al nivel del hogar y no más de _____ pulgadas de la abertura de la cámara de combustión.		IRC R1006.5	IRC R1006	3	12	18	24	36



EDUCATION

BACHELOR OF ARTS GRAPHIC DESIGN

University of Panama, 2019

LICENSES | CERTIFICATIONS

CERTIFICATES

ICC Certified (10098557):

Permit Technician

Residential Building Inspector

WC³ Academy:

Residential Mechanical Inspector

Solar PV Inspector

Gregg Kniff

RESIDENTIAL PLANS EXAMINER

Mr. Kniff is an organized and self-disciplined individual that enjoys working alongside other professionals, where together they can help one another strive to better develop skills. Gregg has proven himself to be a diligent plans examiner for West Coast Code Consultants, Inc., gathering key information to provide detailed reviews and feedback for jurisdictional clients. Throughout his professional career, he has held many positions building relationships and working collaboratively in diverse environments. Mr. Kniff is fluent in English and Spanish; has knowledge and skill involving a variety of technological software programs; and excels at influencing others and becoming their advocate.

EXPERIENCE

RESIDENTIAL PLANS EXAMINER

West Coast Code Consultants, Inc. / 2022 – Present

Provides complete building plan reviews for multiple residential projects associated with a variety of WC³ client jurisdictions. Ensures that all plans and construction documents comply with all applicable codes and standards as adopted by the local jurisdiction and state of Utah. Safeguards that all life safety elements in the project comply with the code.

PERMIT TECHNICIAN / BUILDING INSPECTOR

Interwest / 2021 - 2022

Responsible for issuing building permits for various cities and jurisdictions, which included: building, mechanical, electrical, plumbing, and other permits. Gregg also inspected said residential solar PV systems, HVAC, water heaters, roofs and more, for proper installation and compliance with current CBC, CRC, and IBC codes.

ENGLISH / GRAPHIC DESIGN / DRAFTING TEACHER

Thomas Jefferson School / 2015 - 2021

Mr. Kniff taught high school level students from 7th to 12th grade English skills to help develop advanced writing skills, detailed investigation, hard work, communication skills in a second language, and high-level vocabulary for conversational and professional situations. Previously, he taught Graphic Design and Drafting, focused primarily on design elements in the Adobe Creative Suite programs. Students gained enthusiastic interest towards potential career opportunities in Architecture, Engineering, Graphic Design, and others.

SALES ASSOCIATE

The Home Depot / 2014 - 2014

Worked to create a clean, organized, and well-maintained sales environment for the customers and fellow employees by continually restocking shelves and assisting everyone's inquires, in the English or Spanish languages.

SALES ASSOCIATE

Staples / 2014 - 2014

Gregg strived to learn the layout and organization of the store to assist the customers easily and efficiently with their specific needs; accompanying them to the various locations in the store to find their products. He learned people skills, customer service, organizational skills, among many other necessary attributes for everyday life.

File Attachments for Item:

ER-6 Residential Electrical Inspector (2021 IRC) (West Coast)

Residential certifications (16.5 hours)

Staff Notes: Received after ESIAC submission. Recommendation to be added in update agenda Wednesday.

ESIAC Recommendation:

Committee Recommendation:

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *

Brittany Allen

Organization

West Coast Code Consultant

Email *

brittanya@wc-3.com

Phone Number *

(385) 237-3722

Address *

9131 S Monroe St Unit A

City *

Sandy

State *

Utah

Zip Code *

84070

Website

https://www.pathlms.com/w

Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e.

BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

2021 Residential Electrical Inspector

Course instructor

Doug Smith and David Leckie

Course description

Course Description: This 12-module course, followed by a two-hour practice examination, is based on Chapters 34 through 43 of the 2021 International Residential Code (IRC), It teaches the practical application of those chapters of the IRC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be approximately 30 to 90 minutes in length.

Course Objectives: This course is designed to prepare you for the International Code Council's (ICC) Residential Electrical Inspector exam (E1), utilizing the 2021 IRC. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Instructional hours per session

16.5

Number of Sessions

Course Date

Course Location

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction
- Plumbing Instruction

Conference Course

Conference Name

Conference location

On Demand

Webinar

Course to be offered online?

Yes

No

Course Website

<https://www.pathlms.com/wc3-academy/courses/52>

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):

Quizzes and Exams: Each topic covered in this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC³ for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. You can progress through this course at your own pace; however, you only have access for 120 days.

Course applicable for the following certifications *

Residential Certifications Only

Administrative Course, All Certifications

Commercial and Residential Certifications

Application materials included *

Course Outline or Course Learning Objectives

Presentation Materials/Slides (not required for roundtable courses)

Assessment Materials (for online courses)

Presenter Bio

Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
2021 Residential Electrical Submittal Documents.pdf	18.43 MB

Applicant Full Name *

Brittany Allen

Date of Submission

06/06/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



2021 Residential Electrical Inspector

Course Outline

Cost: \$207, allowing for 120 days of access.

Course Description: This **12-module course**, followed by a two-hour practice examination, is based on Chapters 34 through 43 of the *2021 International Residential Code (IRC)*. It teaches the practical application of those chapters of the IRC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be approximately 30 to 90 minutes in length.

Course Objectives: This course is designed to prepare you for the *International Code Council's (ICC)* Residential Electrical Inspector exam (E1), utilizing the *2021 IRC*. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Texts and Readings: The *2021 International Residential Code* is the textbook for this course. An optional secondary reference for this exam is the *2020 National Electrical Code*. It is highly recommended that you purchase a paper-back copy of these codes, which are available online at www.iccsafe.org. A physical copy can be utilized during the actual exams, which are open book, and serves as a valuable reference for field inspections.

Course Outline of Topics:

Module:	Topics:	Readings:	Quiz:	Duration:
1	General Requirements	Chapter 34	Y	90 min.
2	Electrical Definitions	Chapter 35	Y	49 min.
3	Services Part I	Chapter 36 E3601-E3606	N	61 min.
4	Services Part II	Chapter 36 E3607-E3611	Y	66 min.
5	Branch Circuits and Feeders Part I	Chapter 37 E3701-E3704	N	42 min.
6	Branch Circuits and Feeders Part II	Chapter 37 E3705-E3706	Y	59 min.
7	Wiring Methods	Chapter 38	Y	29 min.
8	Power and Lighting Distribution Part I	Chapter 39 E3901-E3902	N	43 min.
9	Power and Lighting Distribution Part II	Chapter 39 E3902-E3905	N	82 min.
10	Power and Lighting Distribution Part III	Chapter 39 E3906-E3909	Y	79 min.
11	Devices and Luminaires	Chapter 40	Y	34 min.
12	Appliances, Pools and Class 2 Circuits	Chapter 41, 42 & 43	Y	68 min.
	8 Quizzes			
	90 Questions, 2 min. each	2021 IRC		180 min.
	Practice Exam	2021 IRC		120 min.
	Total Course Hours			16.5 hours



2021 Residential Electrical Inspector

Quizzes and Exams: Each topic covered in this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC³ for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. Marking, tabbing, and highlighting in the code book is highly recommended. We have laid out a plan and method to help you learn the material, but it's up to you to put in the work necessary for you to master the material. You can progress through this course at your own pace; however, you only have access for 120 days.

Continuing Education Credits: Completion of this course results in **1.65 CEUs** (16.5 hours) being provided by ICC, as West Coast Code Consultants is a Preferred Provider.

Instructor:




Doug Smith, MCP, CBO currently serves as Energy Division Lead for West Coast Code Consultants (WC³) and has been an inspector/plan reviewer for over 15 years. He has obtained 19 ICC certifications, including Master Code Professional and Certified Building Official. Mr. Smith has performed well over 10,000 plan reviews for renewable energy projects, including solar PV and energy storage systems. Mr. Smith currently serves as a Standards Technical Panel (STP) Member for the following UL Standards: UL 9540 (Energy Storage Systems and Equip.), UL 9540A (Test Method for Evaluating Thermal Runaway...in Battery Energy Storage Systems), UL 1741 (Inverters, Converters, Controllers...), and UL 1703/61730 (PV Modules/Panels). Mr. Smith was also recently appointed by IAEI to be on Code Making Panel #10 for the National Electrical Code (NEC). He is considered an expert regarding energy storage and solar PV systems and has taught many courses on the subjects.



David Leckie serves WC³, and our jurisdictional clients offering solar services, as a plans examiner and inspector. With years of experience managing a team of technicians for residential solar installations, David is extremely knowledgeable in solar photovoltaic (PV) technologies and associated battery energy storage systems. He holds multiple International Code Council (ICC) certifications as an Electrical Inspector and Electrical Plans Examiner, and is licensed by the State of Utah as a Limited Building Inspector. His background and training in various manufacturers' battery installation procedures serve him well when combined with his knowledge of the applicable code.





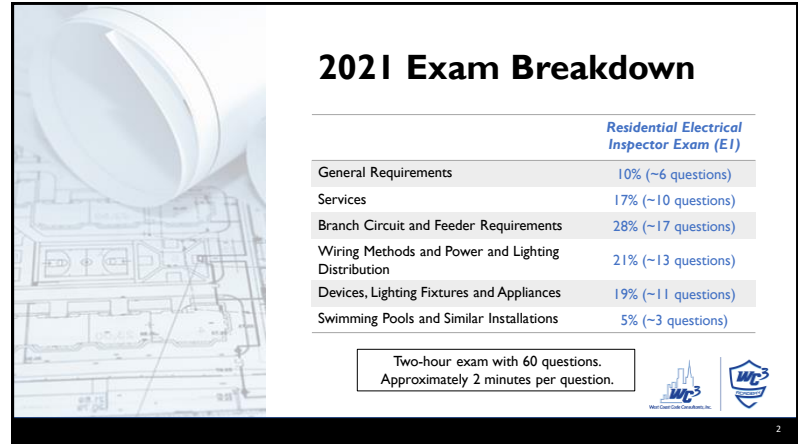
2021 Residential Electrical Inspector

Doug Smith, MCP, CBO
Dave Leckie, Inspector



1


1



2021 Exam Breakdown

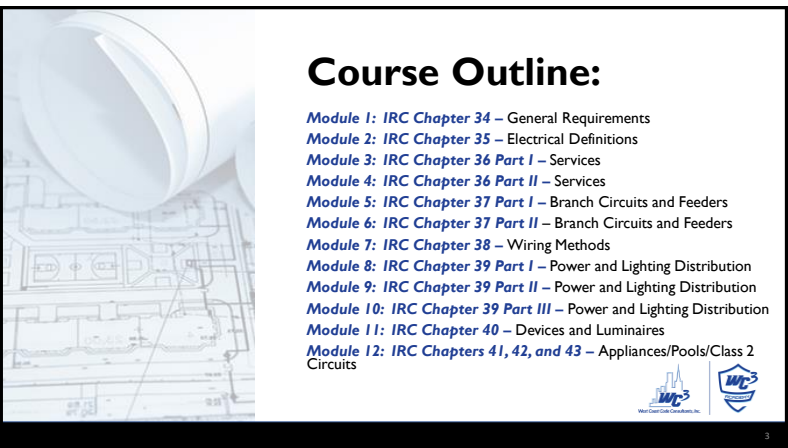
	Residential Electrical Inspector Exam (EI)
General Requirements	10% (~6 questions)
Services	17% (~10 questions)
Branch Circuit and Feeder Requirements	28% (~17 questions)
Wiring Methods and Power and Lighting Distribution	21% (~13 questions)
Devices, Lighting Fixtures and Appliances	19% (~11 questions)
Swimming Pools and Similar Installations	5% (~3 questions)

Two-hour exam with 60 questions.
Approximately 2 minutes per question.




2

2



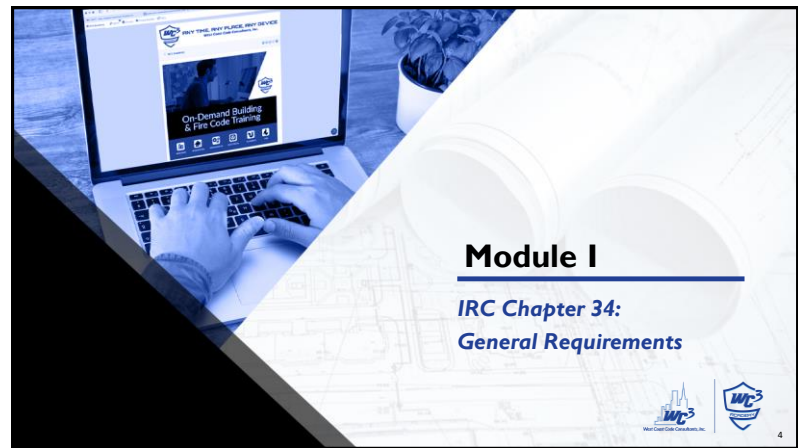
Course Outline:

- Module 1: IRC Chapter 34 – General Requirements
- Module 2: IRC Chapter 35 – Electrical Definitions
- Module 3: IRC Chapter 36 Part I – Services
- Module 4: IRC Chapter 36 Part II – Services
- Module 5: IRC Chapter 37 Part I – Branch Circuits and Feeders
- Module 6: IRC Chapter 37 Part II – Branch Circuits and Feeders
- Module 7: IRC Chapter 38 – Wiring Methods
- Module 8: IRC Chapter 39 Part I – Power and Lighting Distribution
- Module 9: IRC Chapter 39 Part II – Power and Lighting Distribution
- Module 10: IRC Chapter 39 Part III – Power and Lighting Distribution
- Module 11: IRC Chapter 40 – Devices and Luminaires
- Module 12: IRC Chapters 41, 42, and 43 – Appliances/ Pools/ Class 2 Circuits




3

3



Module I

IRC Chapter 34: General Requirements





4


4

Learning Objectives

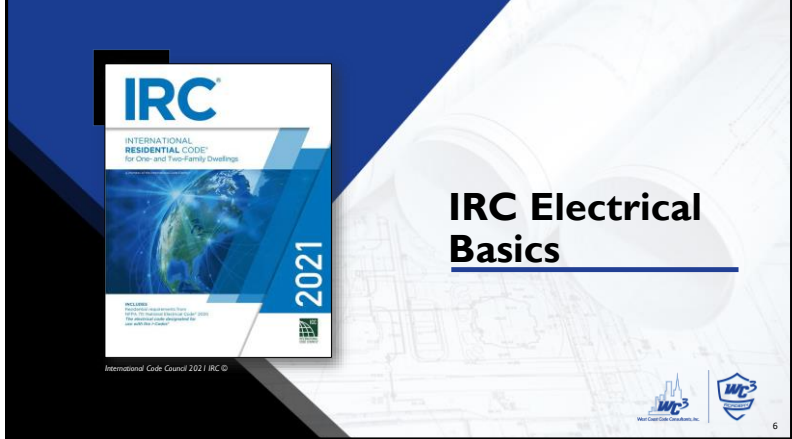

1. Basic circuit concepts
2. Volts, amps, watts, and Ohms
3. General equipment requirements
4. General wiring requirements

5





IRC Electrical Basics

6

Basic Electrical Terms & Definitions

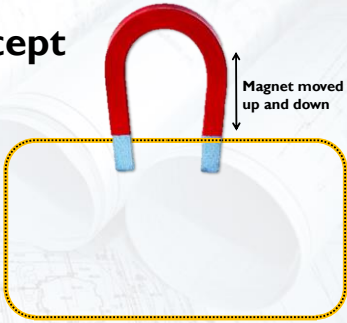
- **Volt (Voltage)** - Unit of electrical pressure
- **Ampere (Current)** - Intensity of current
- **Ohms (Resistance)** - Opposition of flow
- **Watts or VA (Power)** - Electrical energy

7

Simple Circuit Concept

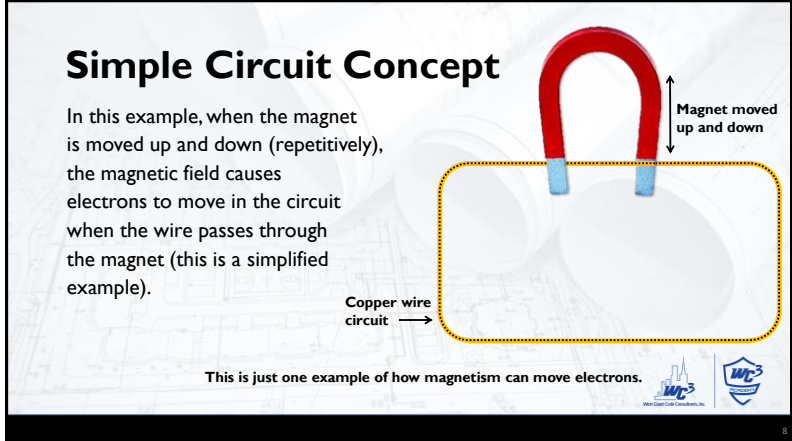

In this example, when the magnet is moved up and down (repetitively), the magnetic field causes electrons to move in the circuit when the wire passes through the magnet (this is a simplified example).



Copper wire circuit →

Magnet moved up and down

This is just one example of how magnetism can move electrons.

8

Circuit Concept Continued...

The magnetic force on the utility side of the transformer causes electrons to move (hence, current flows) when a circuit is completed on the house side of the transformer. Such as turning on a light (as shown in this example).

Home's Service Panel

(Utility side) Utility Transformer

(Meter base)

(100A main service breaker)

(15A branch circuit breaker)

Light switch turned on

Neutral wire (Branch Circuit)

Home's Service Wires

(Neutral's bus bar)

(Grounding electrode wire not shown)

(Equipment grounding wires not shown)

———— = "Hot" wire (ungrounded conductor)

----- = Neutral wire (grounded conductor)

In this example, when the light switch is turned on (and assuming the 100A and 15A breakers are also on) then current flows from the transformer to the light (via the "hot" or ungrounded wiring) and then back to the transformer (via the neutral wiring). Hence the circuit is completed.

9

Watt's Wheel

$P = \text{power (watts)}$

$V = \text{voltage}$

$I = \text{current (amps)}$

$R = \text{resistance (Ohms)}$

Volts × Amps = Watts

Watts ÷ Volts = Amps

When any two of the above noted items are known (such as watts, volts, current, or resistance) then a third item can always be found using the "Watt's Wheel."

10

Calculations (simplified)

To find the amps on this circuit, divide the wattage by the voltage:
 $60 \text{ watts} \div 120 \text{ volts} = .5 \text{ amp}$.

To find the resistance (Ohms) of the light bulb, divide the volts by the amps:
 $120 \text{ volts} \div .5 \text{ amps} = 240 \text{ Ohms}$

Amperage can also be figured by dividing the voltage by the resistance (Ohms) of a circuit: $120 \text{ volts} \div 240 \text{ Ohms} = .5 \text{ amps}$

120 Volt Power Source

The source voltage and also the resistance of a circuit determine how much current (amps) will be on a circuit.

60 watt, 120 volt Light bulb

(The above noted calculations and statements have been simplified and do not take into consideration any other forms of resistance (impedance) in the circuit.)

11

IRC Chapter 34

General Requirements

International Code Council 2021 IRC ©

12

Chapter 34 – General Requirements

Chapters 34 through 43 in the 2021 International Residential Code® (IRC) are produced and copyrighted by the National Fire Protection Association (NFPA) and is based on the 2020 National Electrical Code® (NEC®) (NFPA 70-2014), copyright 2019 National Fire Protection Association, all rights reserved.

If you can't find something you're looking for in the electrical portion of the IRC, don't forget to always check Chapter 34!



13

13

Scope

IRC E3401.2

- Electrical systems, equipment or components not specifically covered in these Chapters (34 - 43) shall comply with the applicable provisions of the NFPA 70 (*National Electrical Code*).
- Services within the scope of the IRC code are limited to 120/240V, 0 to 400A, single phase systems.

Requirements for a solar photovoltaic (PV) system are a good example of when the IRC will no longer govern, however the requirements for such system will be found in the NEC.



14

14

Purpose of the Code

- Primary purpose is electrical safety.
- The purpose is described in NEC text as the "practical safeguarding of persons and property from the hazards arising from the use of electricity."
- Electrical installations installed in compliance with Code rules minimize the hazards and reduce the risk of fires.



15

15

Drilling and Notching

IRC E3402.1

- Drilling and Notching are not covered in the electrical portion because it is deferred to other parts of the code that have already addressed it:
 - IRC R502.8 (Floors)
 - IRC R602.6 (Walls)
 - IRC R802.7 (Ceilings/roof rafters)

*Mark the above noted references in the electrical section for quicker reference.



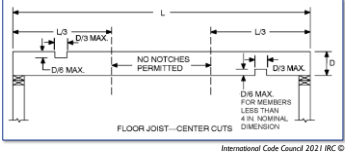
16

16

Notching

IRC R502.8

- Notches in joists and beams shall...
 - Not exceed 1/6 of member depth
 - Not be longer than 1/3 member depth
 - Not be located in middle 1/3 of span

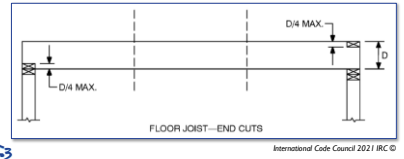


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Notching

IRC R502.8

Notches at the ends of the member shall not exceed 1/4 of the member depth.

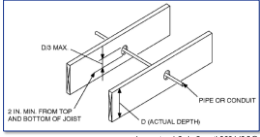


International Code Council 2021 IRC ©

Notching

IRC R502.8

- Diameter of holes bored or cut into joists and beams shall...
 - Not exceed 1/3 of member depth
 - Not be closer than 2" from bottom of member or any other hole or notch



International Code Council 2021 IRC ©

Notching

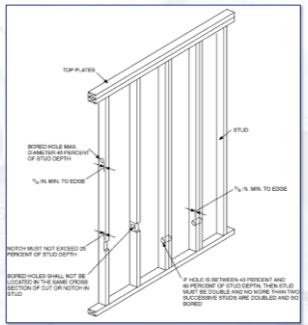
IRC R602.6

Notches:

- Exterior ≤ 25% width
- Bearing ≤ 25% width
- Partition ≤ 40% width

Drilling:

- Edge ≥ 5/8"
- Ø ≤ 40% width (single)
- Ø ≤ 60% width (double)



International Code Council 2021 IRC ©



Notching

IRC R602.6.1

- If > 50% of top plate width is notched or drilled...
 - Provide a 1.5" wide x 16ga. galvanized metal tie
 - Fasten to either side w/ (8) 10d nails

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21

Fire Blocking

IRC R3402.2

All penetrations through firewalls, fireblocking, and draft stopping must be protected with approved materials for firestopping. [NEC 300.21]

22

Listed or Labeled Equipment

IRC E3403.3

- Many Code rules specifically require listed equipment.
- Listed equipment is tested and certified by a third party, independent and qualified testing organization.
- Internal parts of listed equipment need not be inspected except to detect alterations or damage.

Note: see the definitions of "listed" and "labeled" in IRC Chapter 35 for more information.

23

Installation and Use

- Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling [NEC 110.3(B) or IRC E3403.3].
- Instructions sometimes accompany the product.
- Instructions may also be found on the product.
- Instructions also included in the UL information online directories.

24

Listing and Labelling

Equipment or materials that have a label, symbol, or mark of a qualified electrical testing lab.

Label

Listed

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25

Voltage Rating of Equipment

IRC E3404.1

The voltage rating of equipment cannot be less than the nominal voltage of the circuit the equipment is connected to. [NEC 110.4]

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 Series / Serie : 002
 Box Cat. No. :
 Caja Nº de cat. : HOMB612L100RB
 Mains 100A Max. / Línea Principal de 100A como Máximo
 See Main or Service Disconnect ratings
 120 / 240 Vac
 Suitable for use with 75°C copper or aluminum main conductors.
 See branch breakers for branch ratings.

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Interrupting Rating

IRC E3404.2

- Equipment intended to “interrupt” current at fault levels must be rated a minimum of 10,000 amperes.
- Equipment intended to interrupt current other than fault levels must be rated not less than the current it must interrupt. [NEC 110.9]

Interrupting rating refers to the maximum amp rating in which a fuse, breaker, or enclosure will not explode while “tripping” when there is an electrical fault in the electrical system.

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Interrupting Rating

TYPE HOM
10 kA
UL LISTED
C.B.
ISSUE NO. AB-4867
HACR TYPE TIPO CARR

INTERRUPTING RATING
10 000 A

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Enclosure Types

IRC E3404.4

- Outdoor enclosures are also suitable for use indoors if they meet the environmental conditions present. [NEC 110.28]
- Type 1 - Indoor Use
 - Type 1 enclosure may be marked "Indoor Use Only"
- Type 3R - Outdoor use, undamaged by the formation of ice on the enclosure.
 - Type 3R enclosure may be marked "Rainproof"

Catalog No. / No. **D222**
 Series / Série: F01 Am
 Frequency / Frecuencia
 Type 3R Enclosure /
 Gabinete Tipo 3R
 Rainproof / A Prueba de
 Single Throw Fusible
 with Solid Neutral /
 Fusible de un polo
 con Neutro sólido

(See also Table 3404.4, including table notes)





29

Unused Openings to be Closed

IRC E3404.6



- Unused openings, other than those intended for the operation of equipment, those intended for mounting purposes, or those permitted as part of the design for listed equipment, shall be effectively closed. [NEC 110.12(A)]
- Components used to provide this protection must be equivalent to the wall of the equipment.

30

Unused Openings to be Closed

IRC E3404.6





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Damage or Contamination

IRC E3404.7

Internal parts must be protected from damage and contamination of foreign materials like paint, cleaners, and corrosion. [NEC 110.12(B)]



32



Mounting of Equipment


IRC E3404.8

- Proper installation and support of electrical equipment is essential for safe electrical installations. [NEC 110.13(A)]
- Equipment is required to be secured on the surface where it is installed.
- Wooden plugs are not acceptable as anchors.



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Protection of Energized Parts

IRC E3404.9

Any energized parts operating at 50 volts or more must be provided with approved enclosures to guard them from accidental contact. [NEC 110.27(A)]




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Protection from Physical Damage

IRC E3404.10

Where electrical equipment is subject to damage, enclosures or guards are required to be installed and be of enough strength to prevent damage to the equipment. [NEC 110.27(B)]



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Field-applied hazard markings

IRC E3404.12

- Where caution, warning, or danger signs or labels are required by the NEC, the labels shall meet the following requirements [NEC 110.21(B)]:
 - The marking shall adequately warn of the hazard using effective words and/or colors and/or symbols.
 - The label shall be permanently affixed to the equipment or wiring method and shall NOT be hand written (unless the information is subject to change).
 - The label must be of sufficient durability to withstand the environment it's installed.



My electrician won't boss that this warning label up after the code inspector said his warning labels were not in-line with the code.
Instagram.com/obasthnick



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Identification of Disconnects

IRC E3404.13

Unless the purpose of the disconnect is obvious, each disconnect must be legibly marked to indicate its purpose. [NEC 110.22(A)]

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Working Space About Electrical Equipment

IRC E3405.1 & E3405.2

- Ample working space is required in the vicinity of service equipment so any repairs, operation, or servicing of equipment can be performed safely. [NEC 110.26(A)]
- Minimum 30 inches wide in front or the width of the equipment whichever is greater and 36 inches deep extending from the panel forward.
- Minimum headroom required – 6½ ft.
 - *Exception: In existing dwelling units, service equipment or panelboards not exceeding 200 amperes are permitted in spaces where the headroom is less than 2.0 m (6½ ft).*
- Doors to swing a minimum of 90° angle.

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[Clear] Working Space About Electrical Equipment

IRC E3405

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Limited Access (to equipment)

IRC E3405.2 [See also 110.26(A)(4) in NEC]

- Whenever equipment is required (based on installation instructions or by function) to be located in a space with limited access, and such equipment is likely to be energized while being examined or serviced, the following applies:
 - When above a lay-in ceiling, an access of 22"×22" is required
 - When in a crawl space, an access of 22"×30" is required
 - The width of the working space must not be less than the width of the equipment or 30", whichever is greater
 - The enclosure door must be able to open at 90 degrees
 - The clear space in front of the equipment must be as per NEC Table 110.26(A)(1) of NFPA 70 (NEC), however a horizontal ceiling structural member or the access panel is permitted in such clear space.

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110.26(A)(4) Limited Access (continued)




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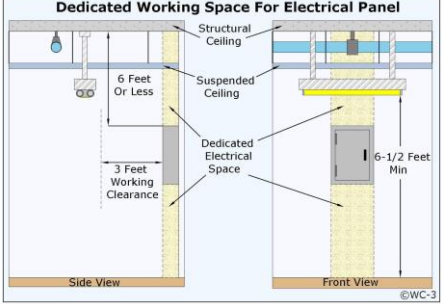

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Dedicated Panelboard Space

IRC E3405.3

The space equal to the width and depth of the panelboard from the floor to 6 feet above the panelboard, or the structural ceiling, whichever is lower, must be dedicated for the installation of the electrical system. [NEC 110.26(E)(1)]

Note: see similar requirements for panelboards located outdoors (IRC E3405.4)



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Locations of Equipment and Working Spaces

IRC E3405.5

- Working spaces of equipment cannot be designated for storage.
- Panelboards and overcurrent protection devices (OCPD) are not allowed in clothes closets, bathrooms, or over the steps of a stairway. [NEC 110.26(B) and 240.24(D) through (F)]



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Illumination of Workspace

IRC E3405.7

- Illumination shall be provided for all working spaces about service equipment and panelboards installed indoors. [NEC 110.26(D)]
- Additional lighting outlets not required where the workspace is illuminated by an adjacent light source.
- Illumination source cannot be controlled by an automatic means only (such as a motion sensor).

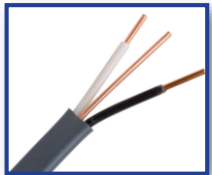





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Conductor Material

IRC E3406.2
 Unless other types of conductors are specified, Chapters 34 through 43 apply to copper conductors. [NEC 110.5]]







45

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Min. Size Conductors

IRC E3406.3
 Minimum size conductors (wires) for feeders and branch circuits must be at least #14 AWG (American Wire Gauge) if copper, or at least #12 AWG if aluminum. [NEC 310.3(A)]


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Conductor Insulation Designation

IRC E3406.5
H = 75°C, 15°C Temperature rise over 60°C
HH = 90°C, 30°C Temperature rise over 60°C
N = Outer nylon jacket or equivalent coating
R = Rubber Insulation
T = Thermoplastic insulation
U = Underground use
W = Moisture resistant
X = Cross-linked synthetic polymer insulation
 [NEC 310.10(B)&(C) and 310.4]

(It's a good idea to write these designations in your IRC.)




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Conductors in Parallel

IRC E3406.6
 Conductors (wires) that are connected in parallel must be the same material, same size, same length, and terminated in the same manner, and cannot be smaller than 1/0 AWG in size. [NEC 310.10(G)]



Example of service conductors (wires) in parallel.




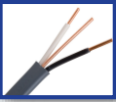
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Conductors for the Same Circuit

IRC E3406.7

All conductors for a circuit are required to be contained within the same raceway (such as conduit), cable or cord. This includes, where used, the grounded (neutral) conductor and all equipment grounding conductors and bonding conductors. [NEC 310.3(B)]

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Conductor Material

IRC E3406.8

Wire connectors or the unit containers are marked with the type of conductor material(s) as follows [NEC 110.14]:

Marking:	For Use With:
AL	Aluminum Only
CC	Copper-Clad Aluminum Only
AL-CU or CU-AL	Copper, Aluminum or Copper-Clad Aluminum
CC-CU or CU-CC	Copper or Copper-Clad Aluminum
CU, CU-CU	Copper Only or equivalent wording

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Conductor Terminals

IRC E3406.10

- Connection of conductors to terminal parts shall ensure a thoroughly good connection without damaging the conductors. [NEC 110.14(A)]
- Connections shall be made by means of pressure connectors (including set-screw type), solder lugs, or splices to be flexible leads.
- Connection by means of wire binding screws or studs and nuts having upturned lugs, or equivalent shall be permitted for 10 AWG or smaller conductors.
- Terminals for more than one conductor and terminals used to connect aluminum shall be so identified.

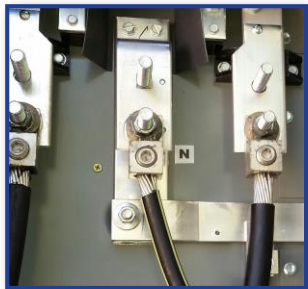
For fine-stranded cables, see E3406.9

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Conductor Terminals Continued...



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Tightening Torque for Wire Connectors

IRC E3406.12

- Tighten connections in compliance with manufacturer's markings [NEC 110.3(B) or IRC E3403.3].
- Comply with equipment listing and any instructions as required.
- Do not over- or under-tighten connections.
- Comply with applicable connection rules of NEC Section 110.14 or IRC E3406.







53

Splices

IRC E3406.11

- Splices must be connected with devices listed for the purpose. [NEC 110.14(B)]
- Wire connectors or splicing devices that are to be direct buried must be listed for such use.



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Continuity of Conductors (wires)

IRC E3406.11.1

Conductors (wires) installed in raceways (conduit) must be continuous between outlets, boxes, and devices and cannot be spliced within the raceway (such as conduit) unless it is a surface-mounted raceway that has a removable cover and is designed for such a splice. [NEC 300.13(A)]






55

Device Connections

IRC E3406.11.2

- The continuity of the grounded (neutral) conductor in a multiwire branch circuit cannot be dependent on connections to devices. [NEC 300.13(B)]
- The continuity of the equipment grounding conductor in any circuit cannot be dependent on a devices connections.

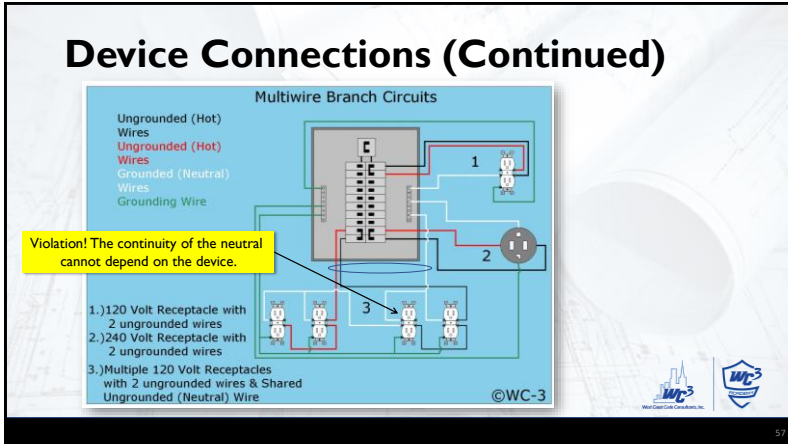



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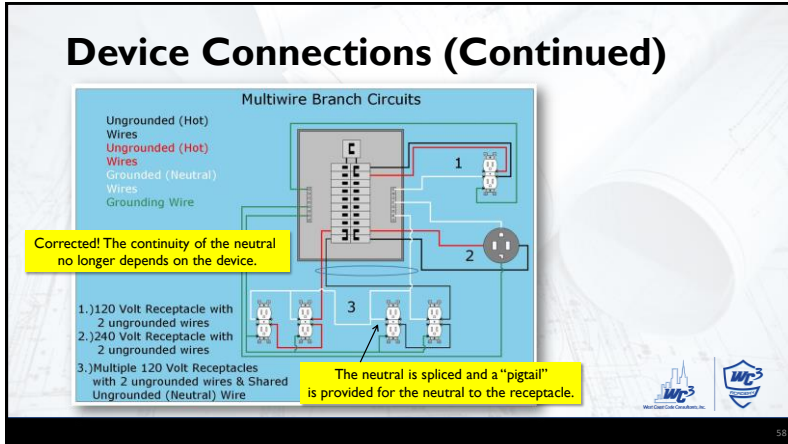
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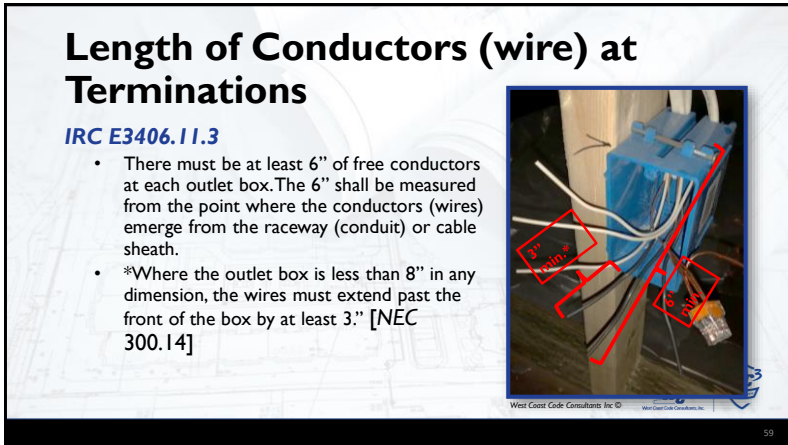
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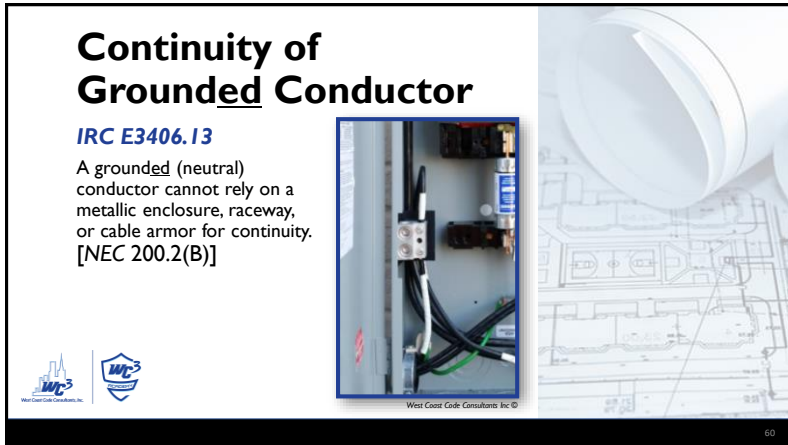
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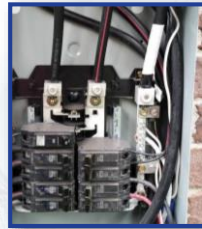


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Color Markings for Grounded Conductor

IRC E3407.1

- Insulated grounded (neutral) conductor 6 AWG or smaller required to be identified by a continuous white or continuous gray outer finish or by three continuous white stripes on other than green insulation along its entire length.
- Insulated grounded (neutral) conductors 4 AWG or larger shall be identified either by a continuous white or continuous gray finish or by three continuous white stripes on other than green insulation or at the time of installation by a distinctive white marking at its termination.
- This marking shall encircle the conductor or insulation. [NEC 200.6(A) and (B)]



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Identification of Equipment Grounding Conductors

IRC E3407.2

- Identification of equipment grounding conductors (EGC) must be by continuous green color, or green with one or more yellow stripes.
- EGCs can also be bare, covered, or insulated.
- An insulated or covered EGC larger than 4 AWG shall be permitted, at the time of installation, to be permanently identified as an EGC at each end and at every point where the conductor is accessible.
- Identification shall encircle the conductor. [NEC 250.119]



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Identification of Ungrounded (“hot”) Conductors

IRC E3407.3

- Ungrounded conductors must have insulation that is a color other than white, gray, or green. [NEC 310.6(C)]
 - Exception: A conductor that is part of a cable assembly (Romex® wire is an example of a cable assembly) and has a white or gray finish shall be permitted to be used as an ungrounded (hot) conductor as long as the insulation is re-identified at all terminations and where the wire is visible and accessible.



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END OF MODULE I



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Module 2
IRC Chapter 35: Definitions

1

1

Learning Objective

1. Gain a basic knowledge concerning important IRC electrical definitions.

2

2

IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings
2021

IRC Chapter 34
General Requirements

3

3

Chapter 35: Definitions

- **Accessible [2018 IRC]:** (for equipment) "Admitting close approach; not guarded by locked doors, elevation or other effective means."
- **Accessible [2021 IRC]:** (for equipment) "Capable of being reached for operation, renewal and inspection."
- **Accessible:** (for wiring) "Capable of being removed or exposed without damaging the building structure or finish, or not permanently closed in by the structure or finish of the building."

4

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Chapter 35: Definitions

- **Accessible, Readily:** “Capable of being reached quickly for operation, renewal or inspections, without requiring those to whom ready access is requisite to take actions such as to use tools, other than keys, to climb over or remove obstacles or to resort to portable ladders, etc.”



5

Chapter 35: Definitions

- **Ampacity:** “The maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.”



6

Chapter 35: Definitions

- **Approved:** “Acceptable to the authority having jurisdiction.”
- **Authority Having Jurisdiction (AHJ):** “The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.” (NEC Article 100)



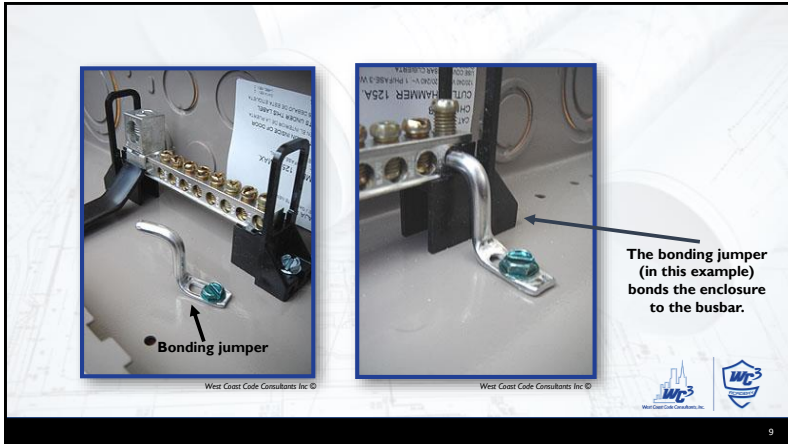
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Chapter 35: Definitions

- **Bonded:** “Connected to establish electrical continuity and conductivity”
- **Bonding Conductor or Jumper:** “A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected”



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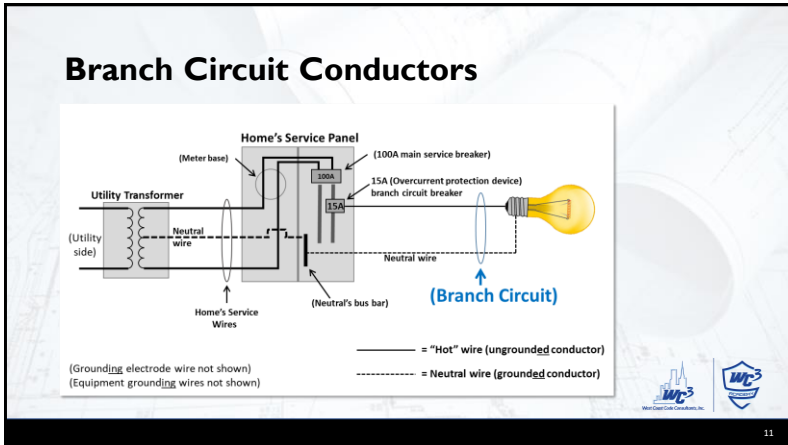


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Chapter 35: Definitions

- Branch Circuit:** "The circuit conductors between the final overcurrent device (such as a breaker) protecting the circuit and the outlets"

10



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Chapter 35: Definitions

- Branch Circuit, Appliance:** "A branch circuit that supplies energy to one or more outlets to which appliances are to be connected, and that has no permanently connected luminaires that are not a part of an appliance."
- Branch Circuit, General Purpose:** "A branch circuit that supplies two or more receptacle outlets or outlets for lighting and appliances."
- Branch Circuit, Individual:** "A branch circuit that supplies only one utilization equipment!"

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Chapter 35: Definitions

- Multiwire Branch Circuit:** "A branch circuit consisting of two or more ungrounded conductors having a voltage difference between them, and a grounded (neutral) conductor having equal voltage difference between it and each ungrounded conductor of the circuit, and that is connected to the neutral or grounded conductor of the system."

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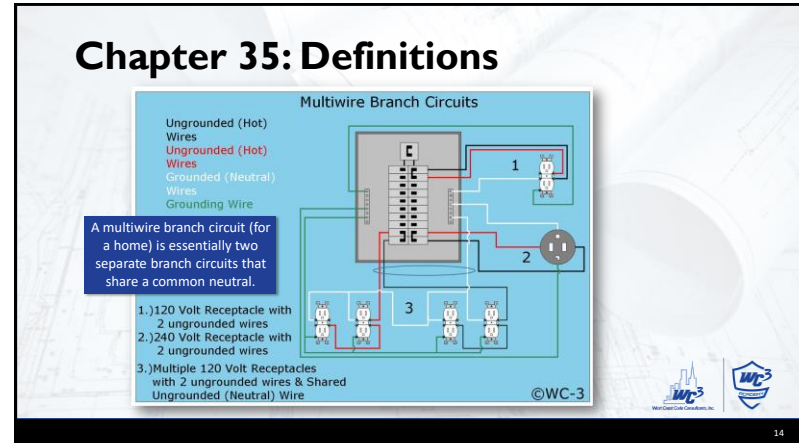
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Chapter 35: Definitions

Multiwire Branch Circuits


- Ungrounded (Hot) Wires
- Ungrounded (Hot) Wires
- Grounded (Neutral) Wires
- Grounding Wire

A multiwire branch circuit (for a home) is essentially two separate branch circuits that share a common neutral.



- 1.) 120 Volt Receptacle with 2 ungrounded wires
- 2.) 240 Volt Receptacle with 2 ungrounded wires
- 3.) Multiple 120 Volt Receptacles with 2 ungrounded wires & Shared Ungrounded (Neutral) Wire

©WC-3





14

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Chapter 35: Definitions

- Conductor - Bare:** "A conductor having no covering or electrical insulation whatsoever."
- Conductor - Covered:** "A conductor encased within material of composition or thickness that is not recognized by this code as electrical insulation."
- Conductor - Insulated:** "A conductor encased within material of composition and thickness that is recognized by this code as electrical insulation."






15

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Chapter 35: Definitions

- Continuous Load:** "A load where the maximum current is expected to continue for 3 hours or more" (continuously running for 3 or more hours).
- Device:** "A unit of an electrical system that carries or controls electric energy as its principal function."
- Disconnecting Means (disconnect):** "A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply."

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Chapter 35: Definitions

Devices and Disconnect

Some may be classified as devices and disconnects (such as a breaker)

devices

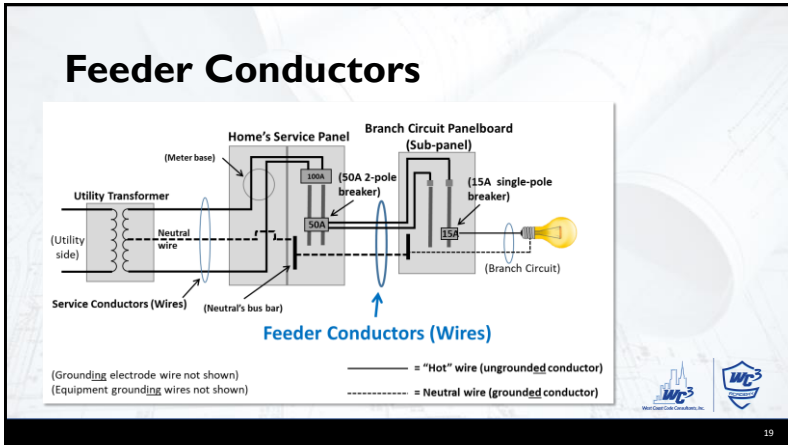
disconnect

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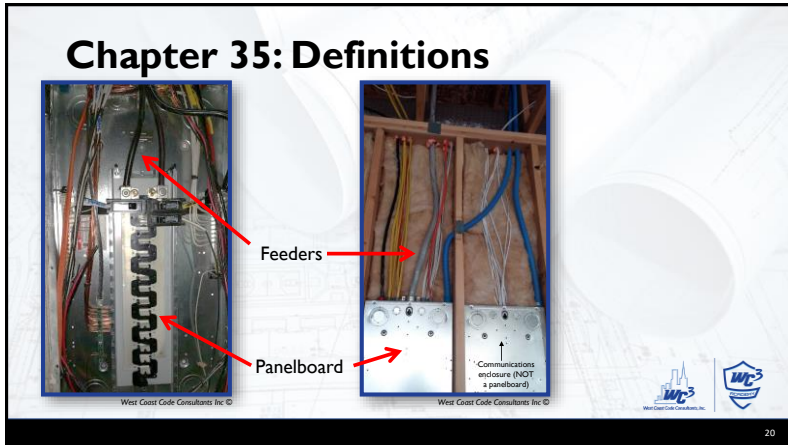
Chapter 35: Definitions

- **Feeder:** "All circuit conductors between the service equipment... and the final branch-circuit overcurrent device" (feeder wires are essentially the wiring between overcurrent devices – Feeder wires are NOT branch circuit wiring).

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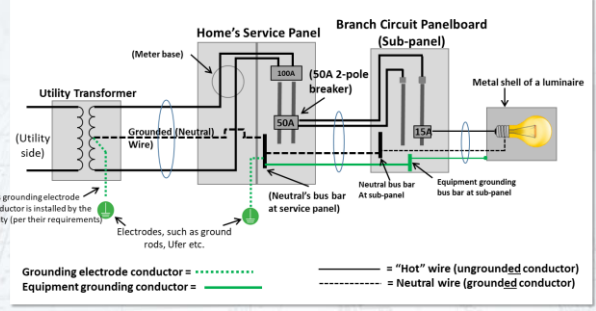
Chapter 35: Definitions

- **Ground:** "The earth."
- **Grounded Conductor:** "A system or circuit conductor that is intentionally grounded" (this conductor is commonly called the neutral wire)
- **Equipment Grounding Conductor (EGC):** "A conductive path(s) that is part of an effective ground-fault current path and connects normally non-current-carrying metal parts of equipment together and, to the system grounded conductor, the grounding electrode conductor, or both"
- **Grounding Electrode Conductor (GEC):** "A conductor used to connect the system grounded conductor or the equipment to a grounding electrode or to a point on the grounding electrode system"




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Grounded, and Grounding Conductors




Grounding electrode conductor =
 Equipment grounding conductor = ——— (green)
 "Hot" wire (ungrounded conductor) = ———
 Neutral wire (grounded conductor) = - - - - -



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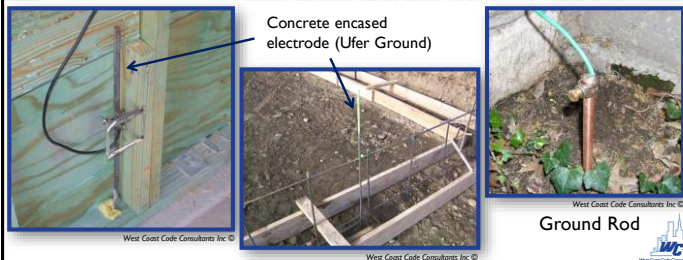
Chapter 35: Definitions

- **Grounding Electrode:** "A conducting object through which a direct connection to earth is established"
- **Examples include:** Ground rods, metal water pipe, concrete encased rebar in footings and foundations (Ufer ground), ground rings etc...




23

Chapter 35: Definitions



Concrete encased electrode (Ufer Ground)
 Ground Rod
 Ufer Ground





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Chapter 35: Definitions

- Effective Ground-Fault Current Path:** "An intentionally constructed, low-impedance electrically conductive path designed and intended to carry current under ground-fault conditions from the point of a ground fault on a wiring system to the electrical supply source and that facilitates the operation of the overcurrent protective device or ground-fault detectors."

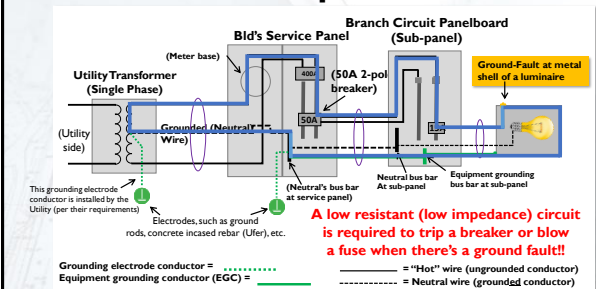
The earth is NOT considered an effective ground fault pathway!

25


25

Electrical Continuity of Metal Parts to the EGC is VERY Important!!



A low resistant (low impedance) circuit is required to trip a breaker or blow a fuse when there's a ground fault!!

The earth is NOT considered an effective ground fault pathway!





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Definitions

In Sight From (Within Sight From, Within Sight): Where [the] Code specifies that one piece of equipment shall be "in sight from," "within sight from," "within sight of," or similarly stated from/of another piece of equipment, the specified equipment is to be visible and more than 50 ft distant from the other.






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Chapter 35: Definitions

- Labeled:** "Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner."



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Chapter 35: Definitions

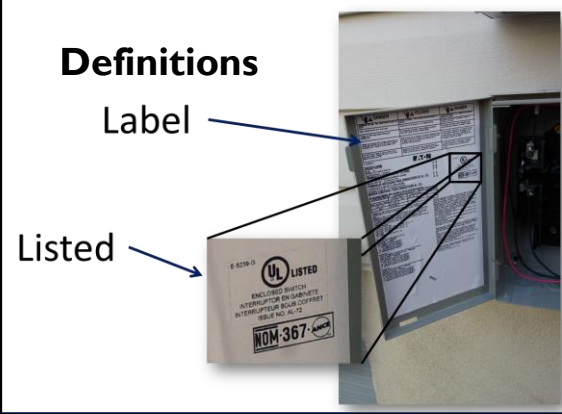
- Listed:** "Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or services meets identified standards or has been tested and found suitable for a specified purpose."

29



29

Definitions




Label

Listed

30



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Chapter 35: Definitions

- Identified (as applied to equipment):** "Recognizable as suitable for the specific purpose, function, use, environment, application, etc., where described in a particular Code requirement."

Informational Note: Some examples of ways to determine suitability of equipment for a specific purpose, environment, or application include investigations by a qualified testing laboratory (listing and labeling), an inspection agency, or other organizations concerned with product evaluation.







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Chapter 35: Definitions

- Outlet:** "A point on the wiring system at which current is taken to supply utilization equipment."
 - A receptacle, light outlet, smoke detector etc, are all considered an "outlet."
- Lighting Outlet:** "An outlet intended for the direct connection of a lampholder or a luminaire."

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Chapter 35: Definitions

- **Luminaire:** "A complete lighting unit consisting of a light source such as a lamp or lamps, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light."
- A lampholder itself is not a luminaire.

Lampholder →



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Luminaires



34

34

Chapter 35: Definitions

- **Location, Damp:** "Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture."
- Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns and some cold-storage warehouses.



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Chapter 35: Definitions

- **Location, Dry:** "A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction."
- **Location, Wet:** "Installations under ground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather."



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Damp or Wet Locations?

Many inspectors agree that lighting and receptacles mounted directly under a roof or overhang are mounted in a damp location. However, this is subject to interpretation.

But what about receptacles and lights mounted on an exterior wall? Inspectors will need to determine if they feel it's in a wet location (subject to saturation with water).

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Chapter 35: Definitions

- Overcurrent:** "Any current in excess of the rated current of equipment or the ampacity of a conductor. Such current might result from overload, short circuit, or ground fault."
- Overload:** "Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload."

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Chapter 35: Definitions

- Panelboard:** "A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front."
- Cabinet:** "An enclosure that is designed for either surface or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung."

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Cabinet

Panelboard (the connections, busbars, and breakers – also is often called the "guts" of the panel)

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Chapter 35: Definitions

- **Raceway:** "An enclosed channel expressly for holding wires, cables, or busbars, with additional functions as permitted in the code.
- Examples of raceways include: Rigid metal conduit (RMC), rigid non-metallic conduit (RNC), intermediate metal conduit (IMC), liquidtight flexible conduit, flexible metal tubing, flexible metal conduit, electrical metallic tubing (EMT), underfloor raceways, cellular concrete floor raceways, wireways, and busways.

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- Liquidtight flexible conduit
- Rigid non-metallic conduit
- Rigid metal conduit
- Wireway





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Chapter 35: Definitions

- **Receptacle:** "A contact device installed at the outlet for the connection of an attachment plug, or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device. A single receptacle is a single contact device with no other contact device on the same yoke or strap. A multiple receptacle is two or more contact devices on the same yoke or strap."

Receptacles

Note: A "receptacle outlet" is an outlet with one or more receptacles installed.





43

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Chapter 35: Definitions

- **Service:** "The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served."
- **Service Equipment:** "The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the serving utility and intended to constitute the main control and disconnect of the serving utility."
- **Service Cable:** "Service conductors made up in the form of a cable." (example: multiple wires made up together with an overall outer sheath)
- **Service Conductors:** "The conductors from the service point to the service disconnecting means." (see also the definition of "service point")


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Chapter 35: Definitions

- **Service Conductors, Overhead:** “The overhead conductors between the service point and the first point of connection to the service-entrance conductors at the building or other structure.”
- **Service Conductors, Underground:** “The underground conductors between the service point and the first point of connection to the service-entrance conductors in a terminal box, meter, or other enclosure, inside or outside the building wall.”
 - **Informational Note:** Where there is no terminal box, meter, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building




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Chapter 35: Definitions

- **Service Lateral:** “The underground conductors between the utility electric supply system and the service point.”
- **Service Point:** “The point of connection between the facilities of the serving utility and the premises wiring.”
 - **Informational Note:** The service point can be described as the point of demarcation between where the serving utility ends and the premises wiring begins. The serving utility generally specifies the location of the service point based on the conditions of service




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Chapter 35: Definitions

- **Service Drop:** “The overhead conductors between the serving utility and the service point.”
- **Service-Entrance Conductors, Overhead System:** “The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop or overhead service conductors.”




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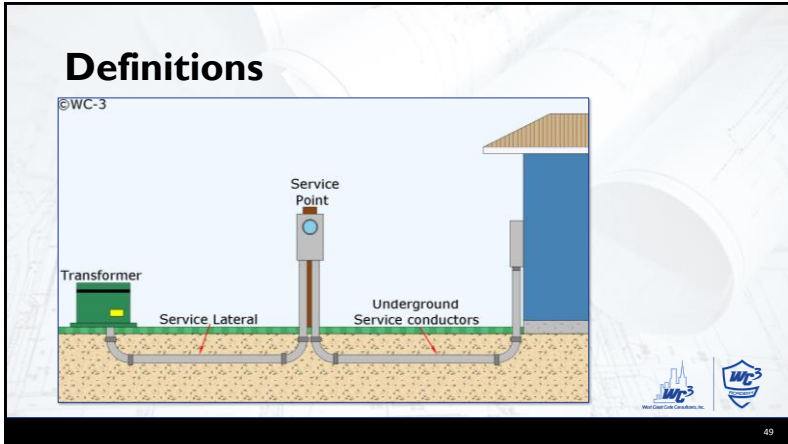
Chapter 35: Definitions

- **Service-Entrance Conductors, Underground System:** “The service conductors between the terminals of the service equipment and the point of connection to the service lateral or underground service conductors.”
 - **NEC Informational Note:** Where service equipment is located outside the building walls, there may be no service-entrance conductors or they may be entirely outside the building.

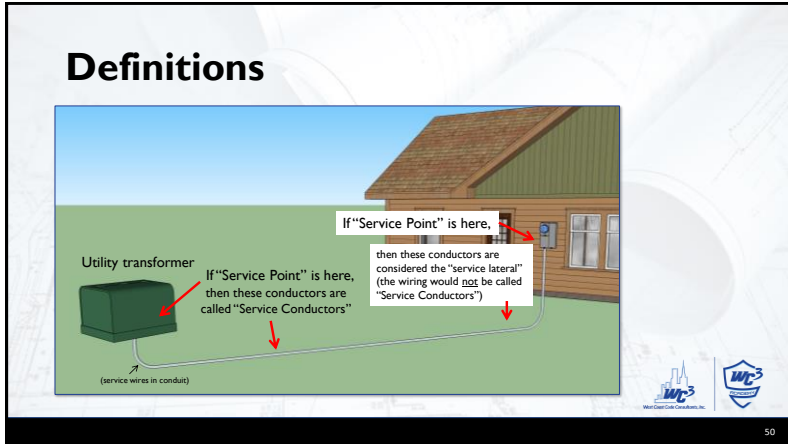


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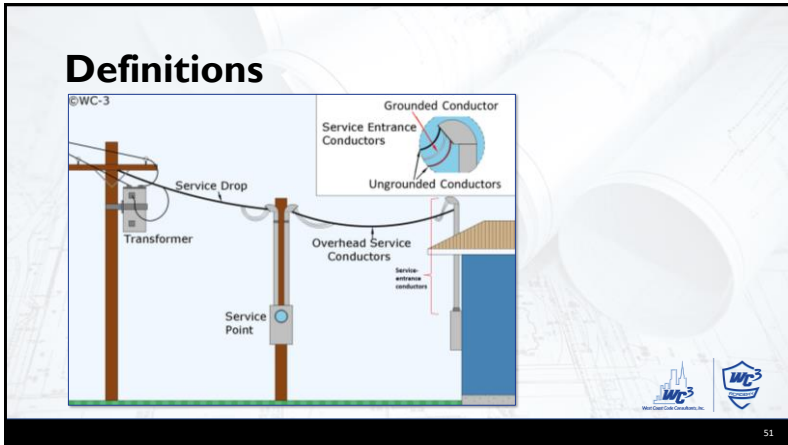
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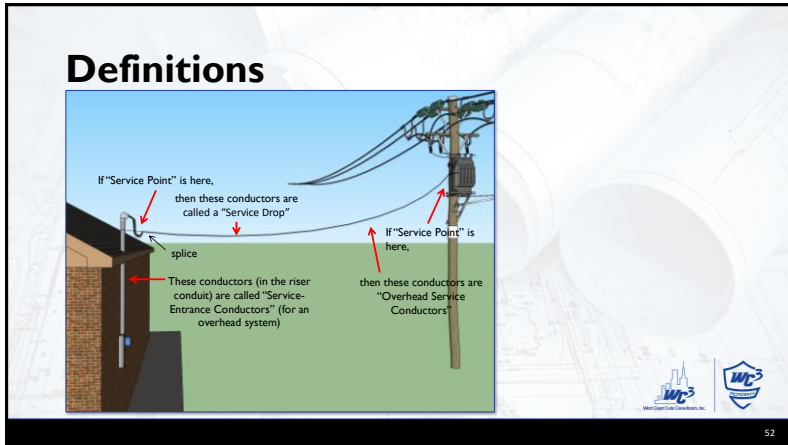
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Chapter 35: Definitions

- **Voltage (of a Circuit):** "The greatest root-mean-square (rms) (effective) difference of potential between any two conductors of the circuit concerned."
- **Voltage, Nominal:** "A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment."
- **Voltage To Ground:** "For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded. For ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit."



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Module 3
IRC Chapter 36: Part I

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1

Learning Objectives

1. Services and service disconnects
2. Basics of load calculations
3. Size of service conductors and main feeder wires
4. Size of grounded (neutral) conductors and grounding electrode conductors

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IRC Chapter 36
Services – Part I

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3

General Requirements for Service

IRC E3601.2

A building or other structure is generally required to be served by only one service [NEC 230.2].

Main Service Entry

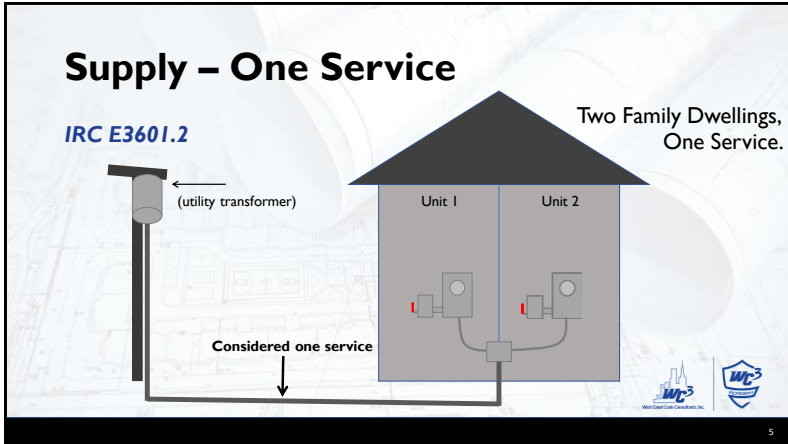
Apartment meter

Apartment meter

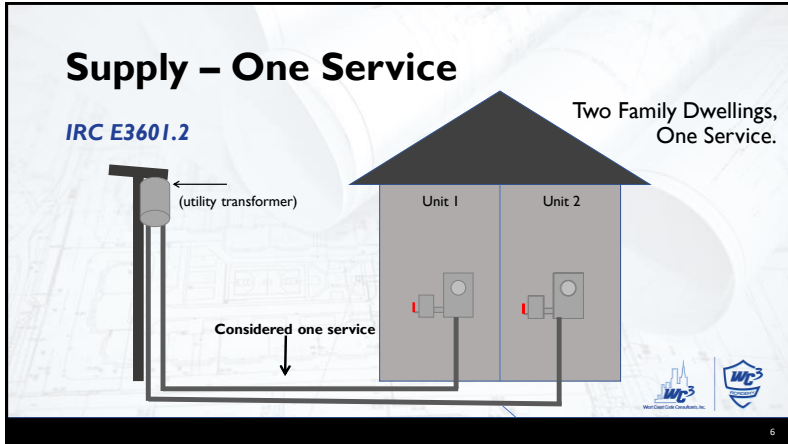
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The above shown equipment is considered as a single service.

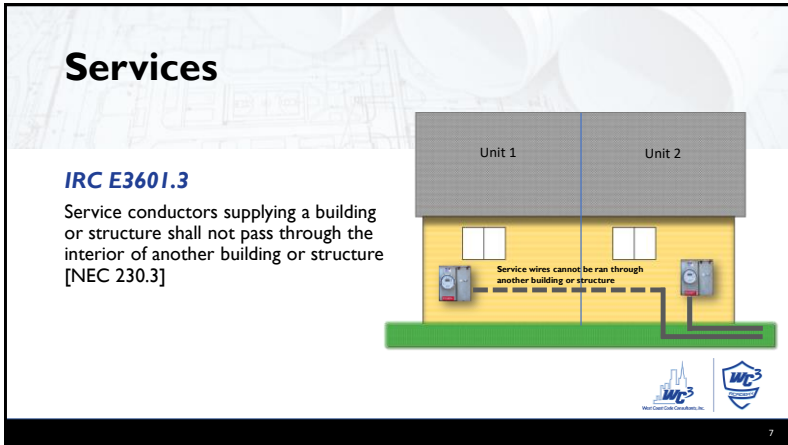
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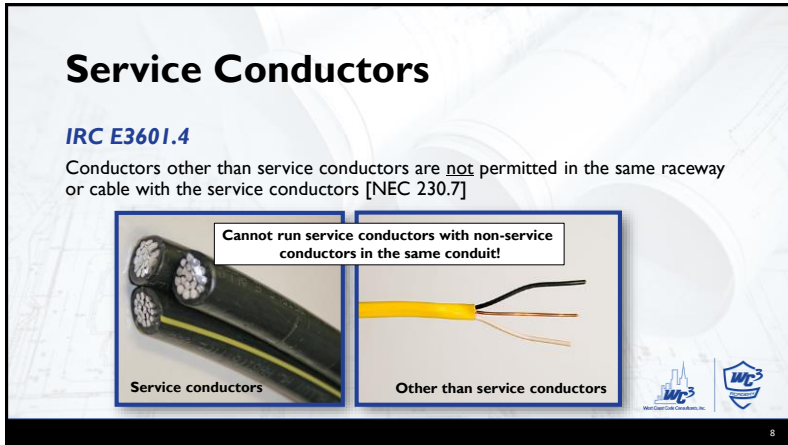
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Service Disconnect Required


IRC E3601.6

- Disconnect(s) must be required to disconnect a building from the service. [NEC 230.70]
- The service disconnect(s) must be labeled as such (E3601.6.1).
- The service disconnect(s) must be located at a readily accessible location on the outside of the building or nearest point of entrance of the service conductors into a building (E3601.6.2).
- Service disconnects cannot be located in bathrooms (E3601.6.2)
- Each occupant must have access to their dwellings disconnect (E3601.6.2).


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Service Disconnect



Service disconnect(s) required

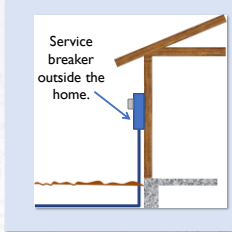
Service disconnects must be labeled



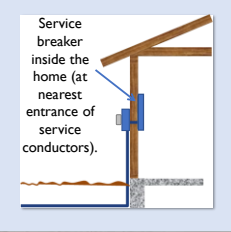
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Service Disconnect

IRC E3601.6.2




Service breaker outside the home.



Service breaker inside the home (at nearest entrance of service conductors).

Service disconnect(s) must be readily accessible and can be located outside of the home or inside at nearest point of entry into the house.



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Service Disconnect

IRC E3601.6.2



Service disconnects cannot be located in a bathroom.



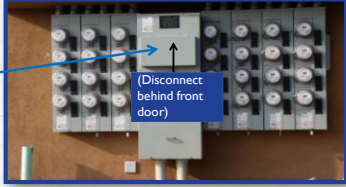
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Maximum Number of Disconnects

IRC E3601.7

There shall not be more than 6 service disconnects per service to a building.

This service is equipped with a (one) single main disconnect to shut down the whole building.

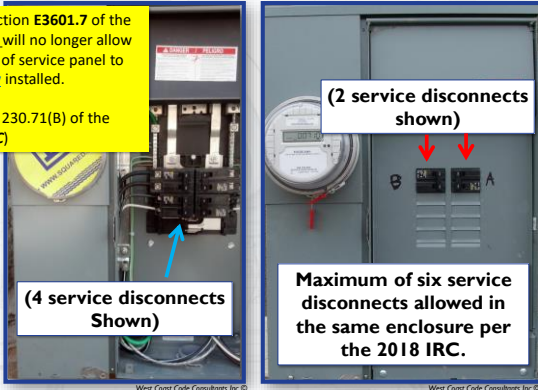


Note: the above shown service is not for a building that falls under the IRC. Such photo is only provided to explain the concept of service disconnects.

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Note: Section E3601.7 of the 2021 IRC will no longer allow this type of service panel to be newly installed. (see also 230.71(B) of the 2020 NEC)

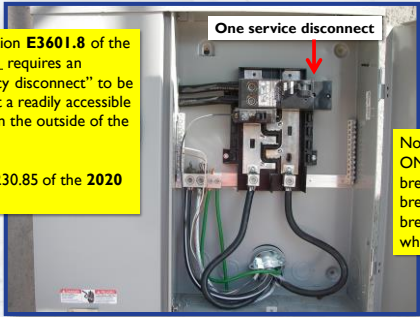


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Service Disconnect Continued...

Note: Section E3601.8 of the 2021 IRC requires an "emergency disconnect" to be installed at a readily accessible location on the outside of the dwelling. (see also 230.85 of the 2020 NEC)



Note: for this particular service panel, the ONLY service breaker is the 150A breaker. All others are not service breakers. In other words, the 150A breaker will shut off the whole house when tripped.

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Minimum Size of Service-Entrance Conductors

IRC E3602

- The service conductors (wires) must have an ampacity not less than the load served. [NEC 230.42(B)]
- The service wires must have a minimum ampacity of 100 amperes for one-family dwellings.
- Must have a minimum ampacity of 60 amps for all other services (other than dwellings). [NEC 230.79]

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Minimum Service Load Calculations

IRC Table E3602.2

- General lighting load of 3 VA per square foot.
- Load of 1500 VA (watts) for each of the 20A small-appliance branch circuits required (minimum of 2).
- Load of 1500 VA (watts) for each laundry circuit.
- Application of demand factors permitted.
- Other loads - ampere rating of appliance or load served.
- Motor loads.
- Air-conditioning or refrigeration equipment.

Note: IRC Table E3602.2 also applies to feeder wires that serve 100% of the home's loads.



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Calculation Requirements

IRC Table E3602.2

**TABLE E3602.2
MINIMUM SERVICE LOAD CALCULATION**

LOADS AND PROCEDURE

3 volt-amperes per square foot of floor area for general lighting and general use receptacle outlets.

Plus

1,500 volt-amperes multiplied by total number of 20-ampere-rated small appliance and laundry circuits.

Plus

The nameplate volt-ampere rating of all fastened-in-place, permanently connected or dedicated circuit-applied appliances such as ranges, ovens, cooking units, clothes dryers not connected to the laundry branch circuit and water heaters.

Apply the following demand factors to the above subtotal:

The minimum subtotal for the loads above shall be 100 percent of the first 10,000 volt-amperes of the sum of the above loads plus 40 percent of any portion of the sum that is in excess of 10,000 volt-amperes.

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Plus the largest of the following:

One hundred percent of the nameplate ratings of the air-conditioning and cooling equipment.

One hundred percent of the nameplate ratings of the heat pump, where a heat pump is used without any supplemental electric heating.

One hundred percent of the nameplate rating of the electric thermal storage and other heating systems where the annual load is expected to be continuous at the full nameplate value. Systems qualifying under this selection shall not be figured under any other category in this table.

One hundred percent of nameplate rating of the heat pump compressor and sixty-five percent of the supplemental electric heating load for central electric space-heating systems. If the heat pump compressor is prevented from operating at the same time as the supplementary heat, the compressor load does not need to be added to the supplementary heat load for the total central electric space-heating load.


Sixty-five percent of nameplate rating of electric space-heating units if less than four separately controlled units.

Forty percent of nameplate ratings of electric space-heating units of four or more separately controlled units.

The minimum total load in amperes shall be the volt-ampere sum calculated above divided by 240 volts.

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Minimum service load calculation for dwellings




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Residential Load Calc. Example

Example residential load calc simplified:

3 VA × (1200 Square ft of home)	= 3,600 VA
1500 VA × 20A sm appl branch circuits (2 min)	= 3,000 VA
1500 VA x each laundry circuit (1 min)	= 1,500 VA
Fastened in place/permanent/dedicated circuits: Dryer- 5500 VA, Range- 6000 VA, dishwasher- 1200 VA, microwave- 1800VA	= 14,500 VA
total	22,600 VA
22,600 VA ← 10,000 VA = 12,600 VA	
12,600 VA × .40 = 5,040 VA + 10,000 VA	= 15,040 VA
Then add in air conditioner (or a larger heating load)	= 9,000 VA
Final Total	24,040 VA
24,040 VA ÷ 240V = 100.16A required service	




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Residential Load Calc. Example

Optional Method Load Calculation for One-Family Dwellings

1 General lighting and receptacle loads, 3 VA per sq ft of floor area (1200 sq ft) = 3600	2 Small-appliance branch circuits, 1500 VA each (2 min) = 3000	3 Laundry branch circuits, 1500 VA each (1 min) = 1500	4 Fastened-in-place/permanent/dedicated circuits: Dryer 5500, Range 6000, Dishwasher 1200, Microwave 1800 = 14500	5 Demand factor applied to sum of 1-4: 100% of 22600 = 22600 40% of 12600 = 5040 Total = 27640	6 Heating or air conditioning loads, 9000	7 Nameplate ratings of other loads: Range 6000, Dishwasher 1200, Microwave 1800 = 9000	8 Demand factor applied to sum of 5-7: 100% of 27640 = 27640 65% of 9000 = 5850 Total = 33490
---	--	--	--	---	---	---	--

Final Volt-ampere Demand Load	33490	÷	240	=	139.5	Minimum Size Conductor	2/0 copper
Divide the total volt-amperes by the voltage.						Minimum Size Neutral Conductor	1/2 copper
Divide the total volt-amperes by the voltage.						Minimum Size Grounding Conductor	4 copper



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Voltage Rating

IRC E3602.4
Electrical systems for dwellings must be single phase, 120/240 volt, and 3 wire with a grounded neutral. [NEC 220.82(A)]

Single phase system:

Utility Transformer (Utility side) - Grounded Neutral Wire - Meter base - Home's Service Panel - Branch Circuit Panelboard (Sub-panel) - Light fixture

Service conductors

Grounding electrode conductor = - - - - -
Equipment grounding conductor = - - - - -

--- = "Hot" wire (ungrounded conductor)
- - - - - = Neutral wire (grounded conductor)

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Ampacity of Service Conductors

IRC E3603.1

- For services rated 100A through 400A that supply the entire load associated with a one-family dwelling, the service conductors must have an ampacity of not less than **83%** of the rating of the service [overcurrent protection device(s)]. (E3603.1.1 and NEC 310.12 of the 2020 NEC)
- This same rule also applies to feeder wires that supply the entire loads of the home. (E3603.1.2)

Note per 2021 IRC: If no adjustment or correction factors are required, then okay to use Table E3603.1.1.

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Table E3603.1.1

- This table was removed in the 2015 and 2018 IRC. But it has been put back in the 2021 IRC.
- But the silly thing was that the exact same size of wires (conductors) could have still been calculated in conjunction with the 83% allowance of E3603.1.1 and ampacity Table E3705.1.

SERVICE OR FEEDER RATING (amperes)	CONDUCTOR (AWG or kcmil)	
	Copper	Aluminum or Copper-clad Aluminum
100	4	2
110	3	1
125	2	1/0
150	1	2/0
175	1/0	3/0
200	2/0	4/0
225	3/0	250
250	4/0	300
300	250	350
350	350	500
400	400	600

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Example of sizing service wires (conductors) per the 83% calculation of E3603.1.1

Service conductors supplying the entire loads for a dwelling must have an ampacity not less than 83% of the service rating.


A 100A service × .83 = 83A. #4 AWG copper has an ampacity of 85A and can be used since it has an ampacity more than 83A.

CONDUCTOR SIZE	CONDUCTOR TEMPERATURE RATING						CONDUCTOR SIZE
	60°C		75°C		90°C		
	Types TW, UF	Types RHW-2, THHN, THWN, THWN-2, XHHW USE, XHHW-2, USE-2	Types TW, UF	Types RHW-2, THHN, THWN, THWN-2, XHHW USE, XHHW-2, USE-2	Types TW, UF	Types RHW-2, THHN, THWN, THWN-2, XHHW USE, XHHW-2, USE-2	
14"	15	20	25	30	15	20	25
12"	20	25	30	35	20	25	30
10"	30	35	40	45	30	35	40
8"	40	50	55	60	40	45	50
6"	55	65	75	80	50	55	60
4"	70	85	95	100	65	75	80
3"	90	100	115	125	85	95	100
2"	110	125	140	150	100	110	120
1"	135	150	170	180	120	135	150
3/0	165	180	200	225	150	175	200
2/0	195	210	230	260	180	205	230
1/0	230	250	280	320	220	250	280
3/4"	270	290	330	370	260	290	330
1/2"	310	330	370	420	300	330	370
3/8"	350	370	420	470	340	370	420
1/4"	400	420	470	530	390	420	470

For SI, °C = [(°F) - 32]/1.8.
a. See Table B3705.3.3 for conductor overcurrent protection limitations.
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Minimum Size of the Grounded (neutral) Service Conductor


IRC E3603.1.4 & NEC 310.12

- The service grounded (neutral) wire must be rated for the maximum unbalance of the home's load.
- The service neutral also cannot be smaller than the minimum size of the grounding electrode conductor (per Table E3603.4).



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Grounding Electrode Conductor

IRC E3603.4 and Table E3603.4

TABLE E3603.4 GROUNDING ELECTRODE CONDUCTOR SIZE ^{A, B, C, D, E, F}			
SIZE OF LARGEST UNGROUNDED SERVICE-ENTRANCE CONDUCTOR OR EQUIVALENT AREA FOR PARALLEL CONDUCTORS (AWG/kcmil)		SIZE OF GROUNDING ELECTRODE CONDUCTOR (AWG/kcmil)	
Copper	Aluminum or copper-clad aluminum	Copper	Aluminum or copper-clad aluminum
2 or smaller	1/0 or smaller	8	6
1 or 1/0	2/0 or 3/0	6	4
2/0 or 3/0	4/0 or 250	4	2
Over 3/0 through 350	Over 250 through 500	2	1/0
Over 350 through 600	Over 500 through 900	1/0	3/0

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Don't Forget Footnotes!!

IRC Table E3603.4

For Grounding electrode conductors (GEC):

- Where installed in a ferrous metal conduit (conduit made with iron) the GEC must be electrically bonded to each end of the metal conduit. [see NEC 250.64(E)]
- #8 AWG GEC must be protected in conduit. [NEC 250.64(B)]
- #6 AWG GEC can closely follow the structures surface for protection and must be properly supported.
- Sole connections to ground rods the GEC need not be larger than #6 AWG copper [NEC 250.66(A)]
- Sole connections to concrete encased electrodes (Ufer grounds) the GEC need not be larger than #4 AWG Copper [NEC 250.66(B)].




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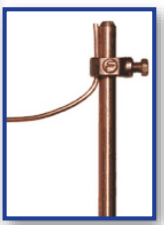

Footnotes Continued...

IRC Table E3603.4

(Sole connections to ground rods need not exceed #6 AWG copper)



(Sole connections to Ufer ground need not exceed #4 AWG copper)

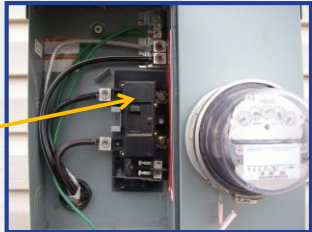
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Overload Protection

IRC E3603.3

Service-entrance ungrounded (“hot”) conductors must have overload protection rated not more than allowed per IRC E3603.1. [NEC 230.90]



Grounded (neutral) wires cannot be connected to a breaker or disconnect unless the breaker or disconnect simultaneously disconnects all the ungrounded (hot) and grounded (neutral) conductors (per IRC E3603.3.2).

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Overhead Service Clearances

IRC E3604.1

Service wires must be at least 3' from: sides of doors, porches, decks, stairs, ladders, balconies, fire escapes, and from sides and bottom of operable windows.

[see also NEC 230.9(A)]

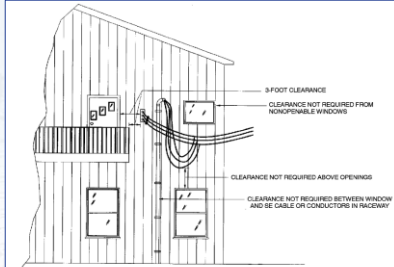


FIGURE E3604.1
CLEARANCES FROM BUILDING OPENINGS
International Code Council, 2021 IRC ©

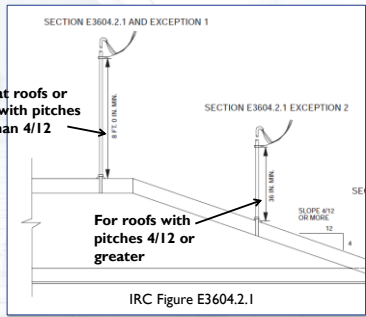
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Vertical Clearances Above Roofs

IRC E3604.2

For flat roofs or roofs with pitches less than 4/12

For roofs with pitches 4/12 or greater



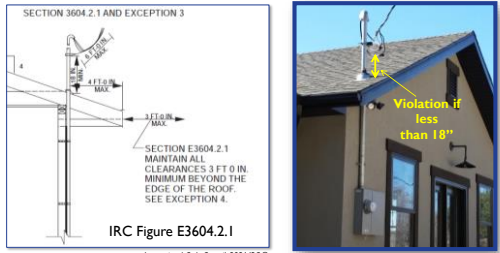
IRC Figure E3604.2.1
International Code Council, 2021 IRC ©

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Vertical Clearances Above Roofs Continued...

SECTION 3604.2.1 AND EXCEPTION 3

MAINTAIN ALL CLEARANCES 3 FT 0 IN. MINIMUM BEYOND THE EDGE OF THE ROOF. SEE EXCEPTION 4.



IRC Figure E3604.2.1
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Vertical Clearance From Grade

IRC E3604.2.2

[see also NEC 230.24(B)]

- 10' min. (over sidewalks or areas accessed by pedestrians)
- 12' min. (over residential property and driveways)
- 18' min. (over public streets, alleys, or parking areas or streets subject to truck traffic)

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Service Masts as Supports

IRC E3604.5

The service mast must be strong enough to handle the weight of the service conductors or braces/guy wires must be used to secure the mast. [NEC 230.28(A)]

Violations!

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Service-Entrance Conductors Insulation

IRC E3605.1

Service-entrance conductors must be insulated. [NEC 230.41]

- Exception 1 – A copper grounded (neutral) conductor is not required to be insulated if:
 - The service-entrance conductors are installed in a raceway (conduit) or is part of a cable assembly,
 - If directly buried in soil "suitable" for such,
 - Or is part of a listed cable assembly that is listed for direct burial without regard to soil conditions.
- Exception 2 – Aluminum or copper-clad aluminum grounded conductor is not required to be insulated where identified for direct burial or for utilization in underground raceways (conduit).

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Service-Entrance Conductors Insulation Continued...

Bare grounded service conductor

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Spliced Service Conductors

IRC E3605.3

Service-entrance conductors are permitted to be spliced within enclosures or can be direct buried if listed splice kits are used. The splice must still be performed as required by code. [NEC 230.33 and 230.46]

This is an example ONLY. Always verify if equipment is listed and identified for the splicing of service conductors and for direct burial use!



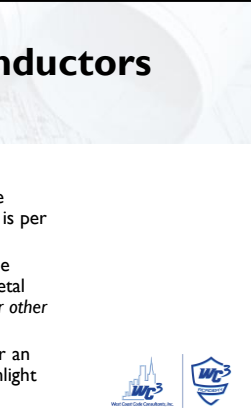

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Protection of Service Conductors

IRC E3605.4 – E3605.6

- Underground service-entrance conductors must be protected per Chapter 38 (see Table E3803.1). This is per E3605.4 (and NEC 230.32).
- Above ground service-entrance conductors must be protected with rigid metal conduit, intermediate metal conduit, electrical metal tubing, schedule 80 PVC, or other approved means (E3605.5 and NEC 230.50(B)(1)).
- Service conductors exposed to sunlight (such as for an overhead system) must be listed and marked as sunlight resistant (E3605.6 and NEC 310.10(D)).

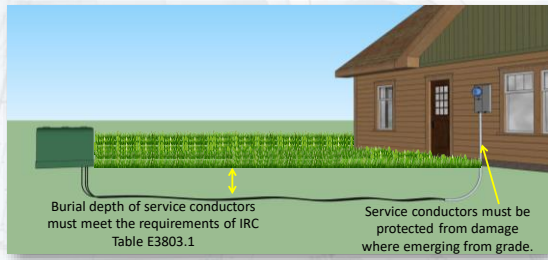


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Protection of Service Conductors (continued...)

IRC E3605.4 – E3605.6



Burial depth of service conductors must meet the requirements of IRC Table E3803.1

Service conductors must be protected from damage where emerging from grade.



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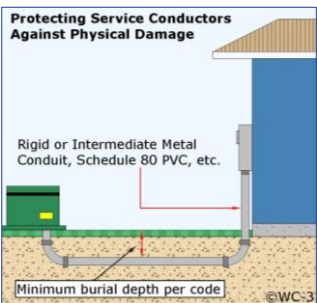

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Protection of Service Conductors

Protecting Service Conductors Against Physical Damage

Rigid or Intermediate Metal Conduit, Schedule 80 PVC, etc.

Minimum burial depth per code


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Overhead Service-Entrance Conductors

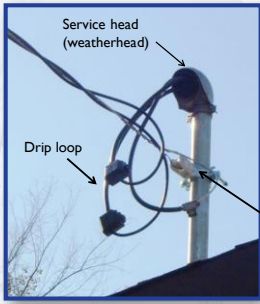


IRC E3605.9 and NEC 250.54

- Overhead service conduits must have a service head (weatherhead) or gooseneck for the entrance of the wires into the conduit (E3605.9.1 and E3605.9.2).
- The service head must be located above the point of support for the wires (E3605.9.3).
- Each wire must have its own bushed opening at the service head (weatherhead), per E3605.9.4.
- Drip loops must be formed to prevent water from entering the weatherhead (E3605.9.5 and E3605.9.6).



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Overhead Services Continued...

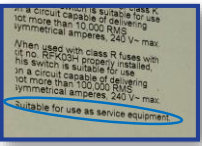






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Service Equipment Marking

IRC E3606.4

- Service equipment must be marked as suitable for use as service equipment. [NEC 230.66]
- An individual meter socket is not considered as service equipment.

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“Suitable ONLY for use as service equipment”

Equipment marked “suitable only for use as service equipment” cannot be used for anything other than service equipment.






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Surge Protection

New for 2021 IRC

IRC E3606.5

- All services for one-and-two family dwellings are required to be provided with a surge protective device (SPD). [NEC 230.67]
- The SPD is required to be part of the service equipment or located adjacent to it.
 - The SPD is not required as part of the service equipment if each "next-level" downstream distribution equipment is provided with an SPD.
- The SPD is required to be Type 1 or 2.
- The SPD(s) is/are required for a new service.



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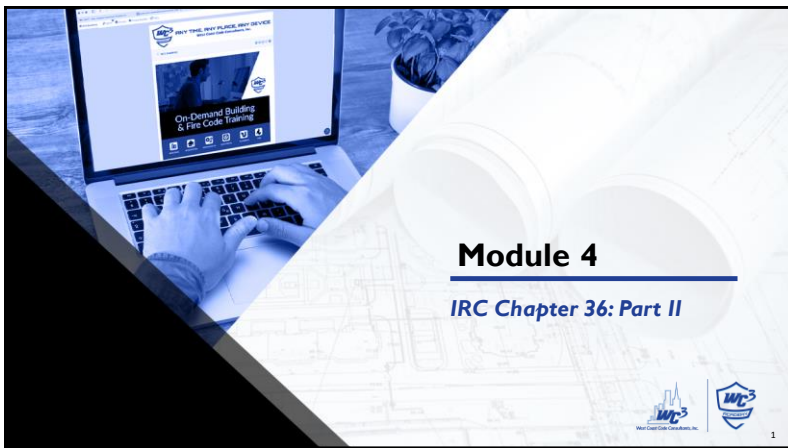


END OF MODULE 3



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Module 4
IRC Chapter 36: Part II

1

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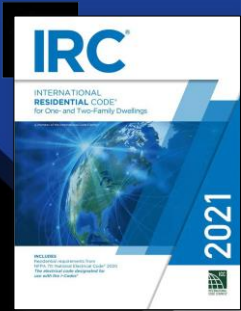
Learning Objectives

1. Basics of system grounding
2. Types of grounding electrodes
3. Requirements for grounding electrode systems



2

2



IRC Chapter 36
Services – Part II


3

3

System Grounding

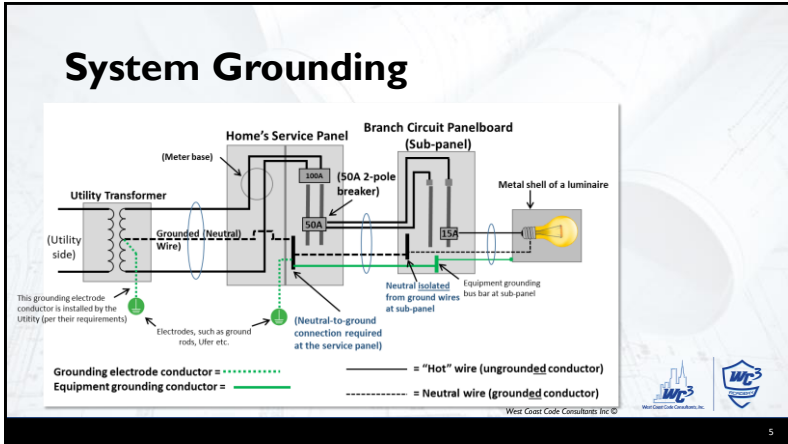
IRC E3607 – NEC 250.20(B) & 250.24

- The premise wiring system must be grounded using a grounding electrode conductor (GEC) that connects to the grounding electrode system (E3607.1).
- The grounding electrode conductor must be connected to the system grounded (neutral) conductor at the service equipment (E3607.2).
- The grounding connection to the grounded (neutral) conductor cannot be made anywhere other than at the service equipment (cannot be made anywhere on the "load side of the service disconnect"). (E3607.2)

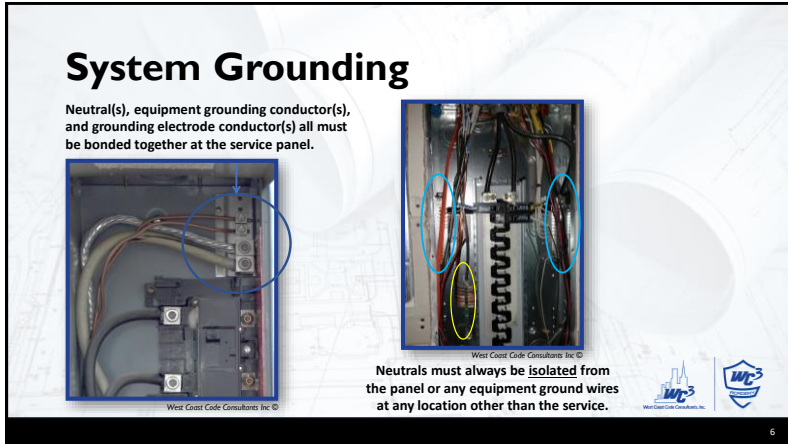


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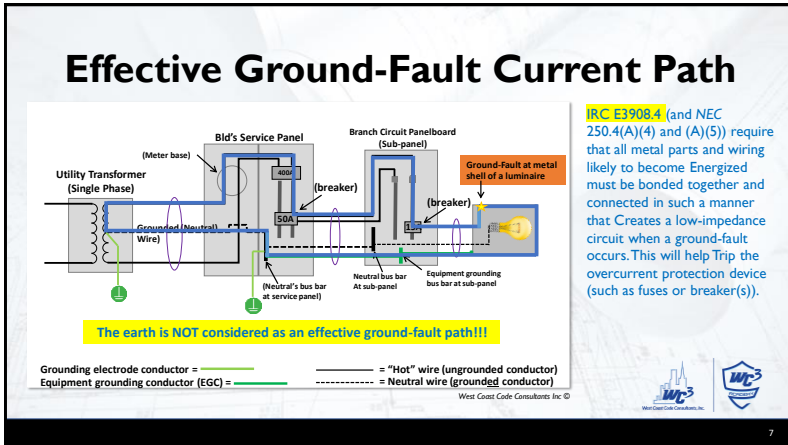
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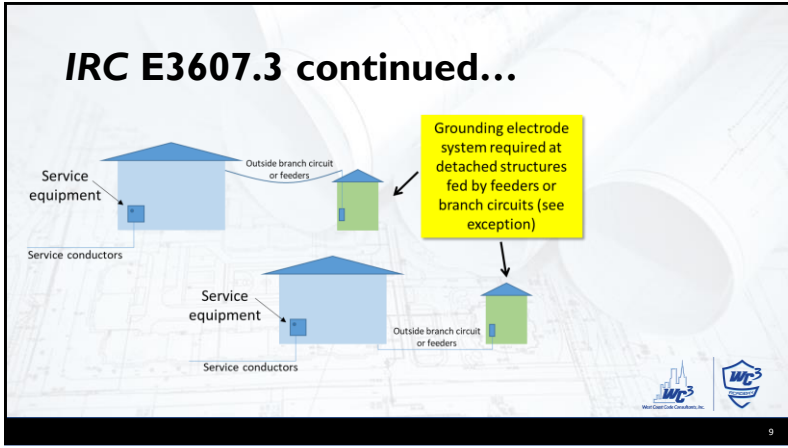
[Detached] Structures Supplied by Feeder or Branch Circuits

IRC E3607.3

- Other structures (such as detached structures) fed by feeder or branch circuits must have a grounding electrode system installed (a grounding electrode conductor that connects to an electrode, such as ground rods, concrete encased electrode (Ufer) etc...)
- [NEC 250.32(A)]**
 - Exception:** Detached structures that are fed by a single branch circuit do not have to have a grounding electrode system (a multiwire branch circuit is also considered as a single branch circuit for the purpose of this requirement).

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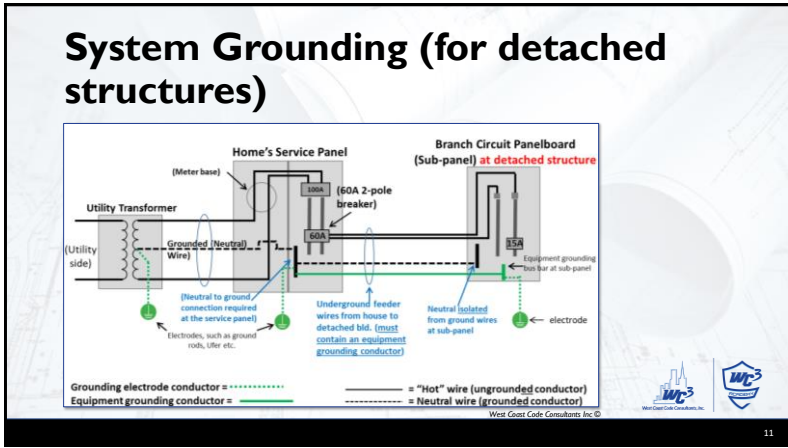
9

[Detached] Structures Continued...

IRC E3607.3

- The grounding electrode conductor must be connected to the equipment grounding conductors at the detached structure's main disconnect(s) enclosure (E3607.3 and E3607.4).
- There must be an equipment grounding conductor installed with the feeder or branch circuits feeding the structure (E3607.3.1).

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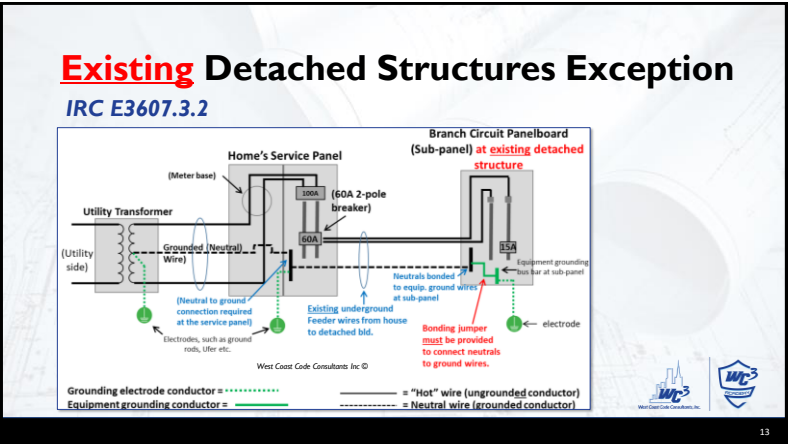
11

Existing Detached Structures Exception

IRC E3607.3.2

- For **existing** detached structures that have an **existing** electrical supply to a building (installed per code at the time of construction) may not be required to have an equipment grounding conductor be run with the feeder or branch wires to the structure. [NEC 250.32(B)(1) exception]
- To meet this allowance, there cannot be any metallic pathways (such as metal water pipes, phone lines, etc.) between the home and the detached structure.
- The grounded (neutral) conductor **must** be bonded to the equipment grounding conductors at the detached structure's disconnect enclosure.

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Electrode System

IRC E3608.1

- All electrodes present at each building or structure served, must be bonded together to form the grounding electrode system. [NEC 250.50]
 - Exception: Existing homes or buildings do not need to have their concrete encased steel (Ufer) be connected to the electrode system.
- If no electrode exists at each building served with power, then one or more electrodes must be installed.

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Examples of electrodes:

Any electrodes present at a building must be bonded together to form the grounding electrode system (IRC E3608.1).

Labels for the images: Metal water pipe, Ground rod, Concrete encased electrode (often called "Ufer" ground).

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Grounding Electrodes

IRC E3608.1 & NEC 250.52

The following are considered grounding electrodes:

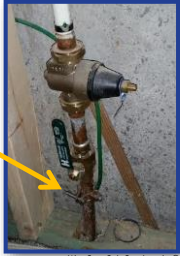

- Metal water pipe that is in contact with the earth for 10 feet or more,
- Concrete encased electrodes (Ufer),
- Ground rings,
- Ground rods or pipes,
- Plate electrodes,
- Or any other electrodes listed for such use.

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Metal Underground Water Pipe

IRC E3608.1.1

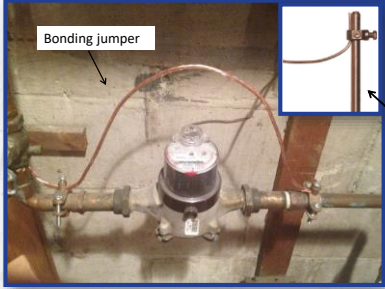
- Metal water pipe that is in direct contact with the earth for 10' or more is to be used for an electrode.
- The grounding electrode conductor must connect to the water pipe within 5' of the pipe entering the ground.
- Metal water pipes further than 5' from the entrance of the water pipes into the home cannot be used to bond other electrodes to the water pipe (E3608.1.1.1 and NEC 250.68(C)(1))


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Metal Water Pipe Electrodes Continued...



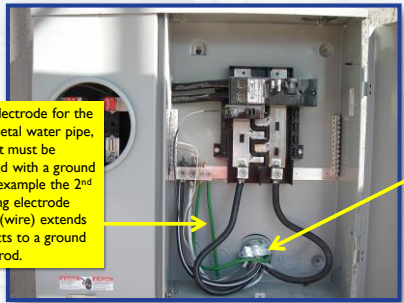
- Continuity of the bonding path cannot rely on water meters, filtering devices or similar equipment.
- If only a metal water pipe electrode is present on site, then it must be supplemented by a ground rod (installed per E3608.1.4 and NEC 250.53(D)).



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Metal Water Pipe Electrodes Continued...



If the only electrode for the home is a metal water pipe, then it must be supplemented with a ground rod. In this example the 2nd grounding electrode conductor (wire) extends and connects to a ground rod.

Grounding electrode conductor (wire) that enters the home and connects to the interior metal water pipe (within 5' of the metal pipe emerging from the earth).



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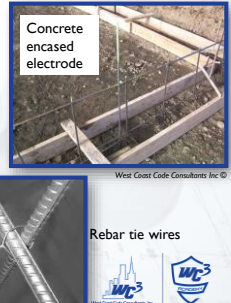

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Concrete Encased Electrode (Ufer)

IRC E3608.1.2

- Must consist of at least 20 feet of rebar in footing or foundation. [NEC 250.52(A)(3)]
- Rebar can be tied together with regular tie wires to achieve the 20' length.
- Instead of using the rebar, 20' of #4 bare copper wire can be used within the footing or foundation. [NEC 250.66(B)]
- The rebar or #4 copper wire must be encased by no less than 2" of concrete.

Note: Rebar cannot be used for interconnecting electrodes together, per 2021 IRC E3608.2.

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Ground Ring Electrode

IRC E3608.1.3

- A ground ring is to be #2 AWG bare copper wire that encircles the home or structure. [NEC 250.52(A)(4)]
- The wire must be a minimum of 20' long. [NEC 250.53(F)]
- The wire must be installed at least 30" deep.

Note: ground rings are rarely used for a residential home.



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Ground Rod and Pipe Electrodes

IRC E3608.1.4

- Rod or pipe electrodes must be at least 8' long and be one of the following:
 - Pipe or conduit electrodes cannot be smaller than 3/4" and where of iron or steel, must have a corrosion resistant coating.
 - Rod electrodes of stainless steel and copper, or zinc coated steel must be at least 5/8".
 - Other listed ground rods permitted. (listed 1/2" copper coated ground rods are commonly used for residential homes when a ground rod is needed) [NEC 250.52(A)(5)]



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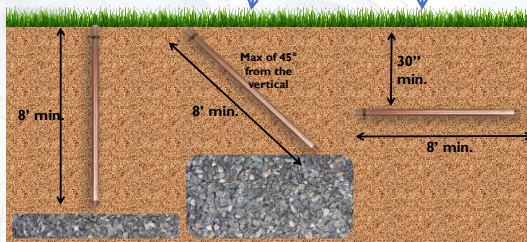
22

Rod and Pipe Electrodes Installation

Must first attempt to drive the ground rod straight down.

If bedrock is encountered, then the ground rod can be driven on a 45° angle or can be buried horizontally if at least 30" deep.

IRC E3608.1.4.1



23

23

Supplemental Electrode

IRC E3608.4

- If a home or structure has only a single ground rod, pipe or plate electrode, there must be a supplemental electrode installed. [NEC 250.53(A)(2) and (A)(3)]
- Electrodes must be at least 6' apart.
- A supplemental electrode (as noted above) is not required if it can be shown that the installed electrode has a resistance of 25 Ohms or less to the earth.



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Spacing of Rod, Pipes, and Plate Electrodes

IRC E3608.3

Minimum of 6' apart

25

Prohibited Electrodes

IRC E3608.5 & E3608.6

- Aluminum electrodes are not allowed.
- Metal underground gas pipe also cannot be used as an electrode.
- Pool, spa, and hot tub metal structures or reinforcing steel cannot be used as a grounding electrode for a building. [NEC 250.52(B)]

26

Bonding (General)

IRC E3609.1

Bonding is required where necessary to ensure electrical continuity and must have the capacity to safely conduct any fault current likely to be imposed. [NEC 250.90]

Example of a bonding jumper connected to a metal box. The bonding jumper must be connected to the circuit equipment grounding conductor.

27

Bonding For Other Systems

IRC E3609.3

- An intersystem bonding termination must be provided for the bonding of other systems such as phone lines, satellite systems, cable tv etc...[NEC 250.94]
- The intersystem bonding termination must be accessible.
- Must have provisions for the connection of at least three bonding wires.
- It must be connected to the service enclosure or the home's grounding electrode conductor with no smaller than #6 AWG copper wire.

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Intersystem Bonding Terminal

Device must have not less than 3 terminations available.

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Intersystem Bonding Terminal Violation (example)

Must connect the intersystem bonding terminal to the service enclosure with a minimum of #6 AWG copper wire (cannot use self-tapping screws to accomplish this)

Self-taping sheet metal screws are not okay for proper bonding to service equipment.

30

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Intersystem Bonding

Intersystem Bonding Terminal Grounding busbar in the service panel.

To Grounding Electrode

6 AWG MIN
10 AWG MIN
8 AWG MIN

Phone
Cable

Grounding Electrode

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Bonding at Service

IRC E3609.2 & E3609.4

- All normally non-current carrying metal parts of conduits, enclosure etc... must be bonded together at the service. [NEC 250.92(A)]
- The bonding of parts cannot rely on normal conduit locknuts or bushings.
- Bonding is also required around impaired connections such as reducing washers, or at oversized concentric or eccentric knockouts.

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32

Bonding at Service

Fittings with Concentric Knockouts

Knockout Grounding Wedge Bonding Bushing

Grounding (bonding) Conductor

4 bolt threaded conduit hubs need not have additional bonding (E3609.4.2).

Metal conduit must be provided with a **supply-side bonding Jumper** (or a listed conduit bonding fitting that makes such jumper unnecessary).

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Sizing Service-Side and Main Bonding Jumpers

IRC E3609.5

Service-side and main bonding jumpers must be sized based on Table E3603.4 (same size as what is shown in the table for grounding electrode conductors).

SIZE OF LARGEST EINGROUNDED SERVICE-ENTRANCE CONDUCTOR OR EQUIVALENT AREA FOR PARALLEL CONDUCTORS (AWG/kcmil)		SIZE OF GROUNDING ELECTRODE CONDUCTOR (AWG/kcmil)	
Copper	Aluminum or copper-clad aluminum	Copper	Aluminum or copper-clad aluminum
2 or smaller	1/0 or smaller	8	6
1 or 1/0	2/0 or 3/0	6	4
2/0 or 3/0	4/0 or 250	4	2
Over 3/0 through 350	Over 250 through 500	2	1/0
Over 350 through 600	Over 500 through 900	1/0	3/0

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Bonding of Other Metal Piping

IRC E3609.7

Metal piping systems that are capable of becoming energized must be bonded to one of the following: The service enclosure, the grounded (neutral) conductor at the service, the grounding electrode conductor (where it is of sufficient size), or to one of the grounding electrodes used. [NEC 250.104(B)]

There have been a variety of different interpretations concerning this requirement. Many inspectors feel that when a system (such as metal water piping or metal gas piping) is capable of being energized, the electrical equipment that could energize such piping is *already* bonded to the piping via the equipment grounding conductor provided for the electrical equipment. Hence, some inspectors/Building Officials feel there is no need to require an additional bonding wire to bond the metal piping back to the service panelboard.

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35

Electrical equipment that's capable of energizing metal piping?

Electric water heater

Electric power to a gas furnace

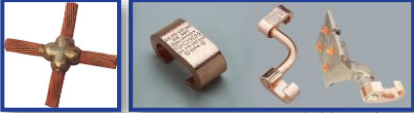
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Grounding Electrode Conductors (GECs)


IRC E3610

- A grounding electrode conductor (GEC) must be in one continuous length (E3610.1 and NEC 250.64(C)).
- If a GEC is spliced, it must be done with an irreversible compression-type connector or be exothermically welded (E3610.1 and NEC 250.64(C)(1)).



Exothermic Welding
Amiablempex.com

Burdy Compression Connectors





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GECs Continued...

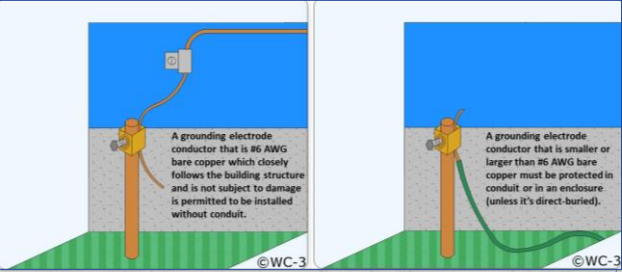
- GEC(s) larger than #6 AWG must be protected in conduit where exposed to damage (E3610.2 and NEC 250.64(B)).
- A GEC that is #6 AWG that is free from physical damage is allowed to closely follow the surface of building where it is securely fastened thereto (E3610.2).
- GEC(s) smaller than #6 AWG must be protected in conduit (E3610.2).
- GEC's do not have to meet the burial requirements of IRC E3803.

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GECs Continued...



A grounding electrode conductor that is #6 AWG bare copper which closely follows the building structure and is not subject to damage is permitted to be installed without conduit.

A grounding electrode conductor that is smaller or larger than #6 AWG bare copper must be protected in conduit or in an enclosure (unless it's direct-buried).

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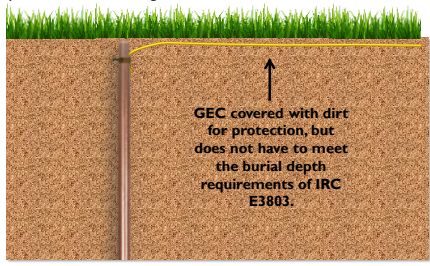


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GECs Continued...

Per IRC E3610.2 (NEC 250.64(B)(4)), GEC's do not have to meet the burial requirements of IRC E3803, however the wire still must be protected from damage.



GEC covered with dirt for protection, but does not have to meet the burial depth requirements of IRC E3803.




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GECs Continued...

- Bare aluminum or copper-clad aluminum GECs cannot be used where in direct contact with masonry or the earth.
- Bare aluminum or copper-clad aluminum GECs cannot be installed within 18" of the earth. [NEC 250.64(A)]



Violations – Can't have more than one wire under the lug and can't use aluminum GECs.





41



41

GECs Continued...

Any GECs installed in ferrous metal (contains iron) enclosures or conduit must be made electrically continuous by bonding each end of the metal enclosure and/or conduit(s) to the GEC wire. [NEC 250.64(E)]



Examples of bond bushings that can be used at each end of a ferrous metal conduit for bonding a GEC to the ends of the conduit.



42

42

Connections to Grounding Electrodes

IRC E3611.1

- Connections to electrodes are to be made by one of the following [NEC 250.70]:
 - Exothermic welding
 - Listed lugs,
 - Listed pressure connectors,
 - Listed clamps or by other listed means.
 - Solder shall not be used,
 - If for direct burial must be listed for such,
 - Must be listed for the number of conductors attached to the connector,
 - Must be accessible (if not direct buried or in concrete), E3611.2.






43

43

Connections to Electrodes Continued...

- The connection must ensure a permanent and effective grounding path [NEC 250.68(B)].
- Bonding must be provided around any insulated joints or around any equipment that is likely to be disconnected for repairs or replacement (for metal water piping), E3611.3.
- For metal water piping electrodes, the GEC connection to the water pipe must be within 5' of where the metal piping emerges from the ground (E3611.4).
- All clamps and fittings must be protected from damage or be listed for such situations.
- Any non-conductive coatings must be removed to ensure good electrical continuity. [IRC E3611.7 and NEC 250.12]

44

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Module 5
IRC Chapter 37: Part I

1

1

Learning Objectives

1. General branch circuit requirements
2. Ratings of circuits
3. Basic feeder load calculations

2

2

IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings
2021

IRC Chapter 37
Branch Circuit and Feeder Requirements – Part I

3

3


General Branch Circuit and Feeder Requirements

IRC E3701

- Chapter 37 applies to all branch circuits and feeder conductors.
- Any feeder conductors that service 100% of the home's loads must be sized per Chapter 36 (E3701.1). [NEC 310.12(B)]

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Ampacity of Branch-Circuit and Feeder Conductors

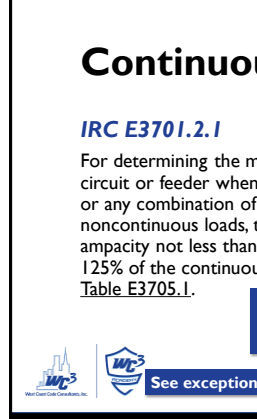
IRC E3701.2

- Branch-circuits and feeder wires must be sized per the load they serve (E3701.2).
- Conductors serving continuous loads (loads expected to run for longer than 3 hours) must have an ampacity of at least 125% of the load(s), E3701.2.



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Continuous Loads

IRC E3701.2.1

For determining the minimum required size branch circuit or feeder when dealing with continuous loads or any combination of continuous and noncontinuous loads, the conductors must have an ampacity not less than the noncontinuous load plus 125% of the continuous load in accordance with Table E3705.1.

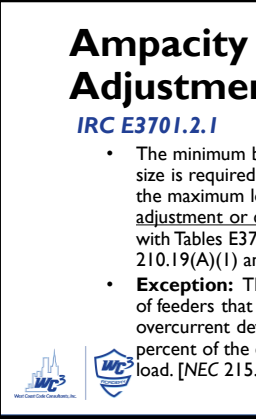
100% noncontinuous loads
+
125% continuous loads

See exception on next slide for neutral conductors



6


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Ampacity Adjustment/Correction

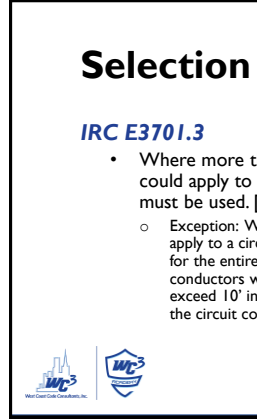
IRC E3701.2.1

- The minimum branch-circuit or feeder conductor size is required to have an ampacity not less than the maximum load to be served after any adjustment or correction factors in accordance with Tables E3705.1, E3705.2 and E3705.3. [NEC 210.19(A)(1) and 215.2(A)(1)]
- Exception:** The grounded (neutral) conductors of feeders that are not connected to an overcurrent device are allowed to be sized at 100 percent of the continuous and noncontinuous load. [NEC 215.1(A)(1) Exception 3].



7


7



Selection of Ampacity

IRC E3701.3

- Where more than one calculated ampacity could apply to a circuit, the lowest value must be used. [NEC 310.14(A)(2)]
 - Exception: Where two different ampacities could apply to a circuit, the higher value may be used for the entire circuit as long as the section of conductors with the lower ampacity does not exceed 10' in length or 10% of the total length of the circuit conductors, whichever is less.



8

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Selection of Ampacity (Example)

Total length of circuit in this example is 50 feet from the panelboard to the air conditioner.

In this example, the wiring would not have to be derated even though passing through the hot attic.

9

Multi-Wire Branch Circuits

IRC E3701.5

- All wires for a multi-wire branch circuit must originate from the same panelboard.
- Each multi-wire branch circuit must be provided with disconnecting means that simultaneously disconnect both ungrounded (hot) conductors (E3701.5.1 and NEC 210.4(B)).
- Multi-wire branch circuit conductors must be grouped together with cable ties or similar means in at least one location in the panelboard in which they originate (E3701.5.2).

10

Multiwire branch circuit handle ties

If two single pole breakers are used for a multiwire branch circuit, they must have a listed handle tie.

Example of a breaker handle tie

Not a listed handle tie

11

Multi-Wire Branch Circuits

Multiwire Branch Circuits

Ungrounded (Hot) Wires
Ungrounded (Hot) Wires
Grounded (Neutral) Wires
Grounding Wire

- 1.) 120 Volt Receptacle with 2 ungrounded wires
- 2.) 240 Volt Receptacle with 2 ungrounded wires
- 3.) Multiple 120 Volt Receptacles with 2 ungrounded wires & Shared Ungrounded (Neutral) Wire

Connection between outlet screws removed.

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Branch Circuit Ratings

IRC E3702

- The voltage of branch circuits that serve luminaires or receptacles for cord-and-plug connected loads up to 1,400 VA (watts) or less than ¼ horsepower, is limited to only 120 volts (E3702.1).
- Voltages of branch circuits that serve cord-and-plug connected or permanently connected equipment at or over 1,440 or ¼ horsepower can be either 120 or 240 volt circuits (**luminaires not noted**), E3702.1. [NEC 210.6(A) through (C)]
- Other than individual branch circuits shall have a rating of 15, 20, 30, 40, or 50 amps (E3702.2 and NEC 210.18).
- The rating of the overcurrent protection device (the breaker or fuses) will determine the rating of the circuit conductors (E3702.2).



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15 and 20 Amp Branch Circuits

IRC E3702.3 and NEC 210.23 [(A)(1) & (2)]

- Allowed to serve lighting, utilization equipment, or a combination of both.
- The rating of any one cord-and-plug equipment **NOT** fastened in place cannot exceed 80% of the rating of the branch circuit.
 - Example: 100% of a 20A (120volt) branch circuit is $20A \times 120V = 2,400$ watts. 80% of 2,400 watts is **1,920 watts allowed**.
- The total rating of any equipment fastened in place (other than lights) cannot exceed 50% of the rating of the branch circuit.
 - Example: 50% of 2,400 watts is **1,200 watts allowed on a 20A circuit**.



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Branch Circuit Ratings Continued...

- General purpose branch circuits serving multiple outlets consisting of lighting or receptacles must have a rating not to exceed 20 amps (E3702.5 and NEC 210.23(A) through (C)).
- Branch circuit conductors serving a single motor must be sized at least 125% of the motor's full load current (amp) rating (E3702.6 and NEC 430.22(A)). (amp rating shown on motor's nameplate)



15

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Branch Circuit Ratings Continued...

The rating of branch circuits serving fixed in place motor appliance(s) with a motor having more than 1/8 horsepower, and also serving other loads, must be based on 125% of the largest motor load and the sum of all other loads. (E3702.7 and NEC 220.18(A))

Example: If we have two motors on the same circuit and one motor's amp rating is 9A and the other is 4A, then the required ampacity of the branch circuit conductors must be at least $15.25A$ ($9A \times 1.25 = 11.25A + 4A = 15.25A$)



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Branch Circuit Load For Cooking Appliances

IRC E3702.9

- It is allowed to use IRC Table E3704.2(2) to calculate the minimum required branch circuit rating.
- Ranges with a rating of 8,750 VA (8.75 kVA) or more must be supplied with a branch circuit having a rating of at least 40 amps (E3702.9.1 and NEC 210.19(A)(3)).

NUMBER OF APPLIANCES	MAXIMUM DEMAND**		DEMAND FACTORS (percent)**	
	Column A maximum 12 kVA rating	Column B less than 27 kVA rating	Column B 27 to 36 kVA rating	Column C 37 to 48 kVA rating
1	8 kVA	80		
2	11 kVA	75		65

a. Column A shall be used in all cases except as provided for in Footnote d.
b. For ranges all having the same rating and individually rated more than 12 kVA but not more than 27 kVA, the maximum demand in Column A shall be increased 5 percent for each additional kVA of rating or range fraction thereof by which the rating of individual ranges exceeds 12 kVA.
c. For ranges of unequal ratings and individually rated more than 8.75 kVA, but none exceeding 27 kVA, an average value of rating shall be computed by adding together the ratings of all ranges to obtain the total connected load being 12 kVA for any ranges rated less than 12 kVA and dividing by the total number of ranges, and then the maximum demand in Column A shall be increased 5 percent for each kVA or range fraction thereof by which this average value exceeds 12 kVA.
d. Over 12 kVA through 8.75 kVA. As an alternative to the method provided in Column A, the nameplate ratings of all ranges rated more than 1.75 kVA but not more than 8.75 kVA shall be added and the sum shall be multiplied by the demand factor specified in Column B or C for the given number of appliances.

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Branch Circuit Load For Cooking Appliances

IRC E3702.9

Examples:

- (1) 12kVA range can use a demand of 8 kVA
- (2) 12kVA ranges can use a demand of 11 kVA
- (2) 7 kVA ranges = 14kVA x .65 (note d) = 9.1 kVA demand
- (1) 14kVA range (see note b), 2kVA over 12kVA, so column a demand factor of 8kVA must be increased by 10%, which is demand of 8.8 kVA
- (2) 14kVA ranges (see note b), they are 2kVA over 12kVA, so again apply 10% increase. so column a demand factor of 11kVA must be increased by 10%, which is a demand of 12.1 kVA


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Branch Circuits for Heating Loads

IRC E3702.10

- Electric water heaters having a capacity of 120 gallons or less, or space heating appliances must be considered as continuous loads (they are expected to run for 3 or more hours) – conductors and breaker or fuses must be rated for 125% of the calculated load. [NEC 422.13]
- Ratings of circuits serving multiple outlets for fixed electric space heating must be rated 15, 20, 25, or 30 amps (30A max). [NEC 424.3(A)&(B)]




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Branch Circuits for Air-Conditioning and Heat Pumps

IRC E3702.11

Branch circuits must be rated not less than what is marked on air conditioning or a heat pump equipment label. [NEC 440.4(B) and 440.35]



Minimum ampacity of circuit wires

Maximum Breaker rating

Air conditioner label

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Air Conditioner Circuit Ampacity:

Disconnecting means shall be located within sight of AC and be readily accessible

AC Condenser

Check label on air conditioner for wire ampacity and max circuit breaker rating.

©WC-3

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Electric Vehicle Branch Circuit

IRC E3702.13

When an outlet is installed for an electric vehicle, such outlet must be on a dedicated branch circuit and such circuit shall serve no other outlets, and they are considered as continuous loads. [NEC 625.40 and 625.42]

Electric vehicle charger

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Branch Circuit Summary

IRC Table E3702.14

- For circuits with multiple outlets or receptacles, Table E3702.14 gives a summary of requirements. [NEC 210.24 and 210.25]
- Branch circuits for a dwelling cannot serve any loads not associated with the dwelling such as public or common areas.

	CIRCUIT RATING		
	15 amp	20 amp	30 amp
Conductors:			
Minimum size (AWG) circuit conductors	14	12	10
Maximum overcurrent-protection device rating:			
Ampere rating	15	20	30
Outlet devices:			
Lampholders permitted	Any type	Any type	NA
Receptacle rating (amperes)	15 maximum	15 or 20	30
Maximum load (amperes)	15	20	30

^a These pages are for copper conductors.
^b NA = Not Allowed.

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Required Branch Circuits for Heating

IRC E3703.1

- Central heating equipment (other than fixed electric space heating) must be provided with an individual branch circuit (dedicated circuit).
- However, air conditioning and auxiliary equipment directly associated with the central heating equipment are allowed to be on the same circuit as the heating equipment. [NEC 422.12 and exceptions 1 and 2]
 - Examples: pumps, motorized valves, humidifiers, electric air cleaners etc...

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Branch Circuits for Heating Continued...

Single branch circuit supplying furnace

Furnace disconnect switch

Furnace auxiliary equipment (pump) okay to be on the same circuit

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Kitchen and Dining Circuits

IRC E3703.2

- There must be a minimum of two 20A branch circuits to serve the kitchen counter space receptacles. [NEC 210.11(C)(1)]
- These required branch circuits are *permitted* to also serve other receptacles in the kitchen, pantry, breakfast, and dining area, including the fridge. (see IRC E3901.3).
- Exception added for 2021 IRC: "Additional receptacle outlets for specific appliances shall be permitted to be supplied from an individual branch circuit rated 15 amperes or greater." [NEC 210.52(B)(1) Exception 2]

Receptacles serving kitchen countertops

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Laundry Circuit

IRC E3703.3

- Receptacles in each laundry area must be served with at least one 20A branch circuit. [NEC 210.11(C)(2)]
- The required 20A circuit must only supply the receptacles in the laundry area and serve no other outlets.

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Bathroom Branch Circuit

IRC E3703.4

- There must be a minimum of one 20A branch circuit that supplies bathroom receptacle(s). [NEC 210.11(C)(3)]
- The branch circuit is not allowed to serve anything else other than the bathroom receptacle(s).
 - Exception: If a single bathroom is on a dedicated 20A branch circuit, then the circuit is allowed to serve other outlets in the bathroom, such as the fan and lights.
- A receptacle is required within 3' of the edge of a bathroom sink, per IRC E3901.6.

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Bathroom Branch Circuit

20A branch circuit

To other bathroom receptacles permitted

To other bathroom receptacles permitted

The light(s) and fan cannot be on the same circuit as the receptacle(s) unless the single bathroom is on a dedicated 20A circuit not sharing with any other room.

Lighting circuit

Light

Fan

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Load Proportioning

IRC E3703.7

Loads should be evenly proportioned among multioutlet branch circuits within a panelboard (wherever possible). [NEC 210.11(B)]

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Feeder Conductor Size and Load Calculation

IRC E3704.1

For sizing feeders that do serve 100% of the home's loads use IRC Table E3602.2 (same load calc. table used for service conductors that serve 100% of the home's loads).

Feeders

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Feeder Load Calculation

IRC E3704.2

Use IRC Table E3704.2(1) for sizing feeders that do **NOT** serve 100% of the home's loads.

TABLE E3704.2(1) FEEDER LOAD CALCULATION	
LOAD CALCULATION PROCEDURE	APPLIED DEMAND FACTOR
Lighting and receptacles: A unit load of not less than 1 VA per square foot of total floor area shall constitute the lighting and 130-volt, 15- and 20-ampere general-use receptacle load. 1,500 VA shall be added for each 20-ampere branch circuit serving receptacles in the kitchen, dining room, pantry, breakfast area and laundry area.	100 percent of first 3,000 VA or less and 33 percent of that in excess of 3,000 VA.
Plus	
Appliances and motors: The nameplate rating load of all fastened-in-place appliances (i.e., hot-water or gas water heaters, water heaters, electric clothes dryers, other than dryers, ranges, air-conditioning and space-heating equipment).	100 percent of load for three or less appliances, 75 percent of load for four or more appliances.
Plus	
Fixed motors: Full-load current of motors plus 25 percent of the full-load current of the largest motor.	
Plus	
Electric clothes dryer: The dryer load shall be 5,000 VA for each dryer circuit or the nameplate rating load of each dryer, whichever is greater.	
Plus	
Cooking appliances: The nameplate rating of ranges, wall-mounted ovens, counter-mounted cooking units and other cooking appliances rated in excess of 1.75 kVA shall be summed.	Demand factors shall be as allowed by Table E3704.3(2).
Plus the largest of either the heating or cooling load	
Largest of the following two selections:	
1. 100 percent of the nameplate rating(s) of the air conditioning and cooling, including heat pump compressors.	
2. 100 percent of the rated electric space heating.	
For 10: 1 square foot = 0.0929 m ² .	

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Feeder Load Calculation

Owner: _____ Location: _____

Total Floor Area of Dwelling (NEC 220.12) **1200** SQ. FT.

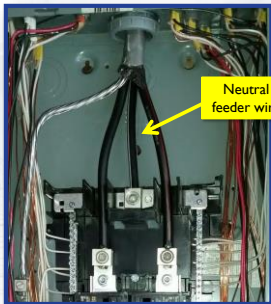
Factor	Quantity	Volt Amperes (VA)
General Lighting		
1. General Lighting (SQ. FT. X 3 VA/SQ. FT. (Table 220.12))	1200 x 3	3600
2. Small Appliance Circuits (1500 VA per circuit) (NEC 220.52(A) (Info. 2))		3000
3. Laundry Circuit (1500 VA per circuit) (NEC 220.52(B))		1500
4. Total General Lighting Load (Add lines 1, 2 & 3)		8100
5. First 3000 VA @ 100%		3000
6. Total General Lighting Load = 3000 + _____ @ 50%	5100	1785
7. Net General Lighting Load (Per NEC 220.12) (Add lines 5 & 6)		4785
Appliances (fastened in place, non dryers, No ranges or AC units)		
	Quantity	Volt Amperes (VA)
Dishwasher		1200
Garbage Disposal		750
Microwave		1500
	Total	3750
8. 3 or less Appliances, Total Appliance VA.		3750
4 or more Appliances, 75% Total Appliance VA (NEC 220.53)		
Other Loads (other than motors)		
	Nonappliance Rating (VA)	Adjusted Rating (VA)
9. Clothes Dryer (5000 VA min)		5000
10. Cooking Range		6000
11. Air Conditioner (or a larger heating load)		6500
12.		
13.		
14. 25% of largest motor (NEC 430.24) (such as for the disposal motor, for example)		187.5
Total Volt-Amperes (VA) (Add lines 7, 8 & 9 thru 14) =		26,222.5 VA
Total Volt-Amperes / 240-volts = Amperes		109.2 A
Conductor Size (Indicate Copper or Aluminum)		

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Sizing the Neutral Feeder Wire

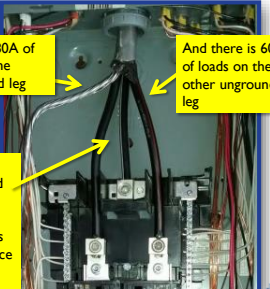
IRC E3704.3 and NEC 220.61(A) and (B)

- A neutral feeder wire must be sized base on the following:
 - Sized based on the maximum unbalanced load,
 - Or be sized no less than 70% of the calculated load on the ungrounded conductors (when the home includes electric ranges, wall ovens, counter ovens, and electric dryers).



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Example of "unbalanced load"



If there is 80A of loads on one ungrounded leg →

And there is 60A of loads on the other ungrounded leg ←


Then the neutral feeder wire would see 20A (which is the difference between the amps on each leg – hence the "unbalanced load.")

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Lighting and General Use Load

IRC E3704.4

- When figuring the general use and lighting load for the feeder calculation (per Table E3704.2(1)), 3 VA (watts) is figured for each square foot of the home. [NEC 220.11 & 220.14(j)]
- The floor area of the home shall be figured by taking the outside dimensions of the home.
- Open porches, garages, or unused or unfinished spaces that are not adaptable for future use, are not figured into the 3 VA per square foot requirement.



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Module 6
IRC Chapter 37: Part II

1

1

Learning Objectives

1. Determine ampacity of conductors
2. Know how to de-rate conductor ampacity
3. Understand overcurrent protection requirements

2

2

IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings
2021

IRC Chapter 37
Branch Circuit and Feeder Requirements – Part II

3

3

General - Ampacity for Conductors

Ampacity of conductors must be based per IRC Table 3705.1 and per Sections E3705.2 and E3705.3. [NEC 310.14(A)]

4

4

Conductor Sizing and Overcurrent Protection

IRC E3705

Note: the actual Table E3705.1 in the 2021 IRC is the same but extends to 900 kcmil wire.
See also NEC Table 310.16

E3705.1: Ampacities for conductors must be determined per Table E3705.1 and sections E3705.2 and E3705.3.

CONDUCTOR SIZE	CONDUCTOR TEMPERATURE RATING						CONDUCTOR SIZE
	60°C		75°C		90°C		
	Types THW, UF	Types RHW, THHW, THW, THHN, USE, XHHW	Types RHW-2, THHW, THW, THHN, XHHW-2, USE-2	Types THW, UF	Types RHW, THHW, THW, THHN, USE, XHHW	Types RHW-2, THHW, THW, THHN, XHHW-2, USE-2	
	Copper			Aluminum or copper-clad aluminum			
14	15	20	25	—	—	—	12
12	20	25	30	15	20	25	No 14 AWG
10	30	35	40	25	30	35	Aluminum
8	40	50	55	35	40	45	8
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	115	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	145	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	185	230	260	150	180	205	4/0

For SI: °C = (°F) - 32 / 1.8
a. See Table E3705.3 for conductor overcurrent protection limitations.
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Ambient (surrounding environment) Temperature Adjustment

IRC E3705.2 and NEC 310.15(B)(1)

If a wire is installed in an environment where the ambient temperature is more than 86°F (30°C) then the allowable ampacity specified at Table E3705.1 must be multiplied by the appropriate factor shown at Table E3705.2.

Ambient Temperature (°C)	Temperature Rating of Conductor			Ambient Temperature (°F)
	60°C	75°C	90°C	
10 or less	1.29	1.20	1.15	50 or less
11-15	1.23	1.15	1.12	51-59
16-20	1.15	1.11	1.08	60-68
21-25	1.08	1.05	1.04	69-77
26-30	1.00	1.00	1.00	78-86
31-35	0.91	0.88	0.86	87-95
36-40	0.82	0.80	0.81	96-104
41-45	0.71	0.70	0.67	105-113
46-50	0.58	0.57	0.52	114-122
51-55	0.41	0.67	0.50	123-131
56-60	—	0.58	0.54	132-140
61-65	—	0.47	0.65	141-149
66-70	—	0.37	0.58	150-158
71-75	—	—	0.50	159-167
76-80	—	—	0.41	168-176
81-85	—	—	0.29	177-185

For SI: °C = (°F) - 32 / 1.8
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Example highlights only actual temp and wire type may vary

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Ambient Temperature Ampacity Adjustment

Example:
If we have 1/0 aluminum feeder wires (and are rated for 75°C) installed in an attic which we know can reach temperatures of up to 108°F in the summer:

- Wire ampacity using 75°C column of Table E3705.1 = **120 amps.**
- 120A × .82 (from the 75°C column of Table E3705.2) = **98.4 amps** allowed for that conductor. (see the exception to this found at E3701.3 which is discussed in the beginning of the Module for Chapter 37, Part I).

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Conductor Proximity Adjustment Factors

IRC E3705.3

Where more than 3 current-carrying conductors are installed in the same conduit or where bundled together for longer than 24," the wire ampacity must be multiplied by the appropriate factor shown at Table E3705.3 (this is in addition to ambient temp correction requirements of E3705.2). [NEC 310.15(C)(1)]

See also exceptions to E3705.3

NUMBER OF CURRENT-CARRYING CONDUCTORS IN CABLE OR RACEWAY	PERCENT OF VALUES IN TABLE E3705.1
4-6	80
7-9	70
10-20	50
21-30	45
31-40	40
41 and above	35

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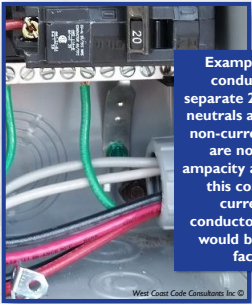
8

Current-Carrying Conductors?

- All ungrounded (“hot”) conductors are considered as current-carrying.
- Neutrals that carry the full amount of current (amps) as an ungrounded conductor (such as on a 120V circuit) are considered as current-carrying.
- Neutrals that only carry the unbalance current (such as for 240V circuits or some multi-wire branch circuits) are NOT considered as current-carrying.
- Equipment grounding conductors are also NOT considered as current-carrying.

Example: Shown are conductors for two separate 240V circuits. The neutrals are considered as non-current-carrying and are not counted for ampacity adjustment. Thus this conduit has four current-carrying conductors and ampacity would be adjusted by a factor of .80.

For the above information see NEC 310.15(E)





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Equipment Temperature Rating Limitations

IRC E3705.4

- The temperature rating (ie. 60°C, 75°C, or 90°C) used to select the ampacity of a wire must be based on the lowest temperature rating of any wire, termination (lugs, connectors etc), and devices.
- Often called the “weakest-link” rule for determining ampacity of conductors.





10

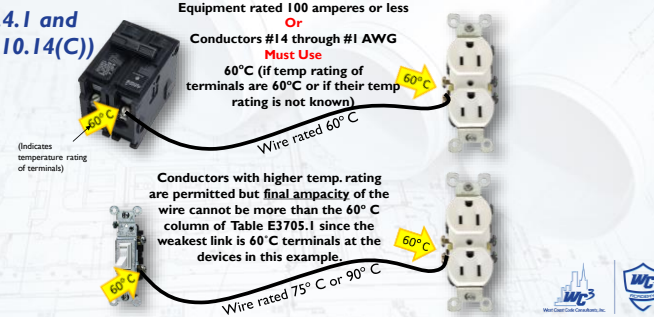
Conductors and Terminations 100 Amperes or Less - 60°C

E3705.4.1 and NEC 110.14(C)

Equipment rated 100 amperes or less

Conductors #14 through #1 AWG **Must Use** 60°C (if temp rating of terminals are 60°C or if their temp rating is not known)

Conductors with higher temp. rating are permitted but final ampacity of the wire cannot be more than the 60°C column of Table E3705.1 since the weakest link is 60°C terminals at the devices in this example.



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E3705.4.1 Continued...

CONDUCTOR SIZE AWG kcmil	TABLE E3705.1 ALLOWABLE AMPACITIES						CONDUCTOR SIZE AWG kcmil
	CONDUCTOR TEMPERATURE RATING						
	60°C	75°C	90°C	60°C	75°C	90°C	
Types RHW-2, THHN, THW, THHW, USE, XHHW	Types RHW-2, THHN, THW, THHW, USE, XHHW	Types RHW-2, THHN, THW, THHW, THHW-2, XHHW, XHHW-2, USE-2	Types RHW-2, THHN, THW, THHW, THHW-2, XHHW, XHHW-2, USE-2	Types RHW, THHN, THW, THHW, USE, XHHW	Types RHW-2, THHN, THW, THHW, THHW-2, XHHW, XHHW-2, USE-2		
Copper							
14"	15	20	25	—	—	—	—
12"	20	25	30	15	20	25	12"
10"	30	35	40	25	30	35	10"
8	40	50	55	35	40	45	8
Aluminum or copper-clad aluminum							
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	115	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	145	85	100	115	1
Aluminum							
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0

For 50°C = (119), 32(1) & a. See Table E3705.5.3 for conductor overcurrent protection limitations.

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Example: If we have #4 AWG copper wire which is rated for 75°C but we either don't know what the terminals are rated or the terminals are only rated for 60°C, then the final ampacity of the wire cannot exceed the ampacity shown in the 60°C column of Table E3705.1.

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Conductors and Terminations 100 Amps or More

IRC E3705.4.2 and NEC 110.14(C)(1)

If the conductors (wires), all terminations, and all devices are all rated for 75°C (and ampacity adjustment is not needed for conduit fill or ambient temp. correction) then it's okay to use the 75°C column of Table E3705.1 for the ampacity of the conductors, AND the conductors are NOT sizes #14 AWG cu, #12 AWG cu, #10 AWG cu, and #8 AWG al (see Table E3705.5.3).

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Conductors and Terminations continued...

IRC E3705.4.2

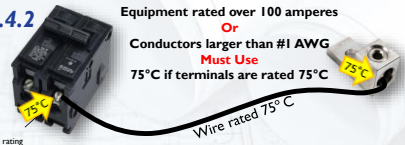
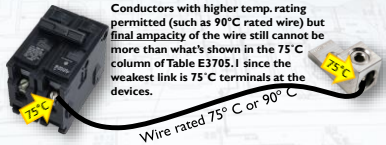

Equipment rated over 100 amperes
Or
Conductors larger than #1 AWG
Must Use
75°C if terminals are rated 75°C

Wire rated 75°C

(Indicates temperature rating of terminals)

Conductors with higher temp. rating permitted (such as 90°C rated wire) but final ampacity of the wire still cannot be more than what's shown in the 75°C column of Table E3705.1 since the weakest link is 75°C terminals at the devices.

Wire rated 75°C or 90°C







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Examples of ampacity of conductors

Scenario 1:

There's six #4 AWG copper THWN-2 (90°C rated) current-carrying conductors in the same conduit and ratings of all terminals that the wires connect to are not known.

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Examples of ampacity of conductors (continued for Scenario 1)


NUMBER OF CURRENT-CARRYING CONDUCTORS IN CABLE OR RACEWAY	PERCENT OF VALUES IN TABLE E3705.1
4-6	80
7-9	70
10-30	50
21-30	45
31-40	40
41 and above	35

CONDUCTOR SIZE	CONDUCTOR TEMPERATURE RATING			
	60°C	75°C	90°C	95°C
AWG	Types THHN, THWN, USE, XHHW	Types THHN, THWN, USE, XHHW	Types THHN-2, THWN-2, XHHW-2, USE-2	Types THHN-2, THWN-2, XHHW-2, USE-2
	Copper			
14"	15	20	25	—
12"	20	25	30	15
10"	30	35	40	25
8	40	50	55	35
6	55	65	75	40
4	70	85	100	55
3	85	100	115	65
2	95	115	130	75
1	110	130	145	85
1/0	125	150	170	100
2/0	145	175	195	115
3/0	165	200	225	130
4/0	195	230	—	—

95A x .80 = ~~76A~~

Final conductor ampacity cannot be more than the 60°C column since we don't know what the ratings of the terminals are (see E3705.4.1)

Since the wires are 90°C rated, we can use this ampacity to start our deration of the wire





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Examples of ampacity of conductors

Scenario 2:

- There's nine 1/0 copper THWN-2 (90°C rated) current-carrying conductors in the same conduit and ratings of all terminals that the wires connect to are not known.
- Also, the conduit will be installed in a portion of the building known to be at a constant temperature of 110°F.

See next two slides for calculations to find the conductors adjusted ampacity.

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Examples of ampacity of conductors (continued for scenario 2)

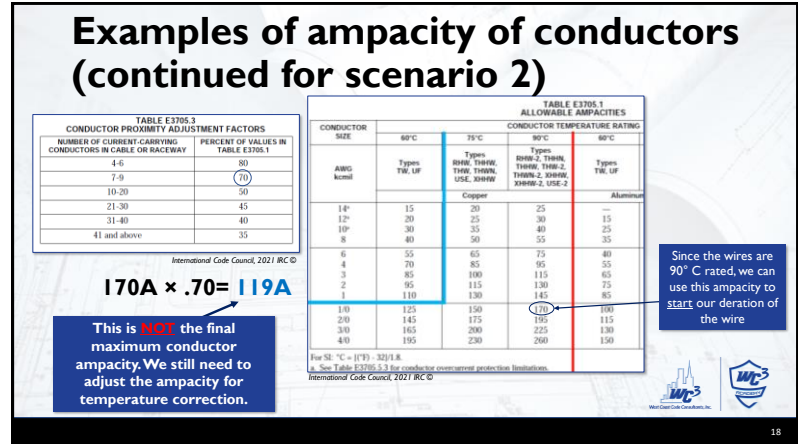

NUMBER OF CURRENT-CARRYING CONDUCTORS IN CABLE OR RACEWAY	PERCENT OF VALUES IN TABLE E3705.1
4-6	80
7-9	70
10-20	50
21-30	45
31-40	40
41 and above	35

CONDUCTOR SIZE	CONDUCTOR TEMPERATURE RATING			
	90°C		75°C	
	Types THW, UF	Types RHW, THHW, THW, THWN, USE, XHHW	Types RHW, THHW, THW, THWN, THWN-2, XHHW, XHHW-2, USE-2	Types THW, UF
14	15	20	25	—
12	20	25	30	15
10	30	35	40	25
8	40	50	55	35
6	55	65	75	40
4	70	85	95	55
3	85	100	115	65
2	95	115	130	75
1	110	130	145	85
1/0	125	150	170	100
2/0	145	175	195	115
3/0	165	200	225	130
4/0	195	230	260	150

$170A \times .70 = 119A$

This is NOT the final maximum conductor ampacity. We still need to adjust the ampacity for temperature correction.

Since the wires are 90°C rated, we can use this ampacity to start our deration of the wire.

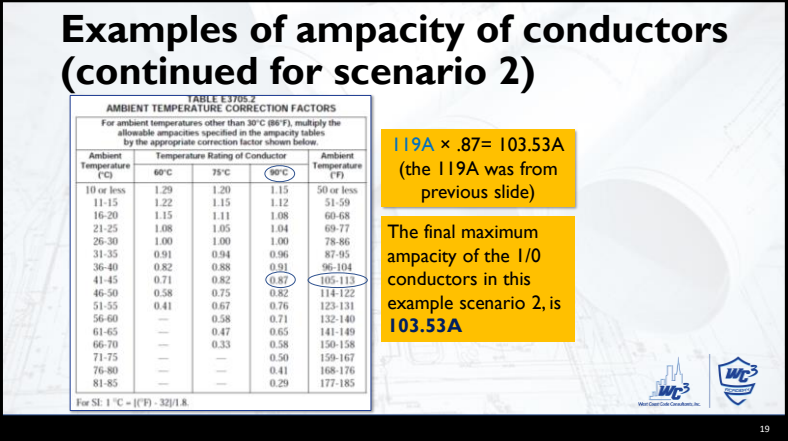

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Examples of ampacity of conductors (continued for scenario 2)

Ambient Temperature (°C)	Temperature Rating of Conductor			Ambient Temperature (°F)
	60°C	75°C	90°C	
10 or less	1.29	1.20	1.15	50 or less
11-15	1.22	1.15	1.12	51-59
16-20	1.15	1.11	1.08	60-68
21-25	1.08	1.05	1.04	69-77
26-30	1.00	1.00	1.00	78-86
31-35	0.91	0.94	0.96	87-95
36-40	0.82	0.88	0.91	96-104
41-45	0.71	0.82	0.87	105-113
46-50	0.58	0.75	0.82	114-122
51-55	0.41	0.67	0.76	123-131
56-60	—	0.58	0.71	132-140
61-65	—	0.47	0.65	141-149
66-70	—	0.33	0.58	150-158
71-75	—	—	0.50	159-167
76-80	—	—	0.41	168-176
81-85	—	—	0.29	177-185

$119A \times .87 = 103.53A$
(the 119A was from previous slide)

The final maximum ampacity of the 1/0 conductors in this example scenario 2, is **103.53A**


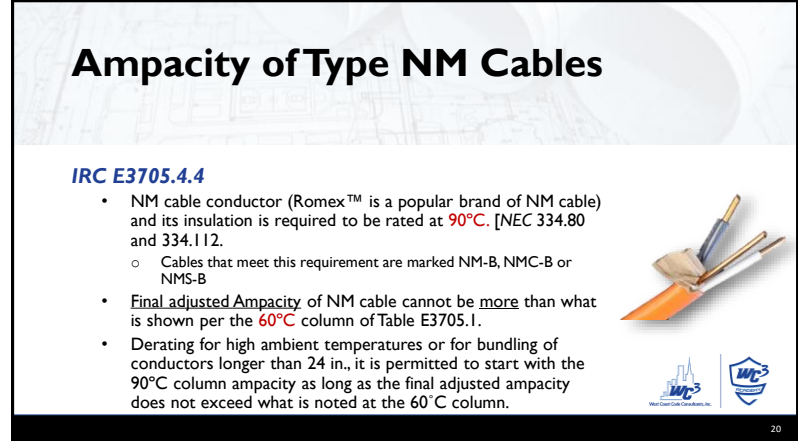




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Ampacity of Type NM Cables

IRC E3705.4.4

- NM cable conductor (Romex™ is a popular brand of NM cable) and its insulation is required to be rated at 90°C. [NEC 334.80 and 334.112.
 - Cables that meet this requirement are marked NM-B, NMC-B or NMS-B
- Final adjusted Ampacity of NM cable cannot be more than what is shown per the 60°C column of Table E3705.1.
- Derating for high ambient temperatures or for bundling of conductors longer than 24 in., it is permitted to start with the 90°C column ampacity as long as the final adjusted ampacity does not exceed what is noted at the 60°C column.

20

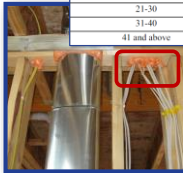
NM Cable Continued...

Example when using NM cable:

CONDUCTOR SIZE	CONDUCTOR TEMPERATURE RATING														
	60°C			75°C			90°C			60°C			90°C		
	Types THW, UF		Types RHW-2, THHN, THW, THWN, USE, XHHW	Types RHW-2, THHN, THW, THWN, USE, XHHW		Types THW, UF	Types RHW-2, THHN, THW, THWN, USE, XHHW		Types THW, UF	Types RHW-2, THHN, THW, THWN, USE, XHHW		Types THW, UF			
	Copper						Aluminum or copper-clad aluminum								
14"	15	20	25	—	—	—	—	—	—	—	—	—	12"		
12"	20	25	30	15	20	25	15	20	25	15	20	25	10"		
10"	30	35	40	25	30	35	25	30	35	25	30	35	8"		
8"	40	50	55	35	40	45	35	40	45	35	40	45	6"		
6"	55	65	75	40	50	55	40	50	55	40	50	55	4"		
4"	70	85	95	55	65	75	55	65	75	55	65	75	3"		
3"	95	100	115	—	—	—	—	—	—	—	—	—	2"		
2"	95	115	130	—	—	—	—	—	—	—	—	—	1"		
1"	110	130	145	—	—	—	—	—	—	—	—	—	1/0		
1/0	125	150	170	150	180	205	150	180	205	150	180	205	4/0		

It is ok to start with the ampacity noted in the 90°C column when beginning ampacity derations (for NM Cable).

If after all derations are complete then the final ampacity of the NM cable still cannot be more than what is shown for that size wire in the 60°C column.



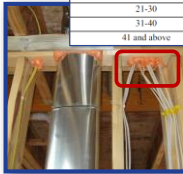
21

Ampacity of Type NM Cables

IRC E3705.4.4

When there are more than two NM cables (that have two or more current-carrying conductors) are installed with thermal insulation around them without maintaining spacing between cables, the allowable ampacity of each conductor must be adjusted in accordance with Table E3705.3. [NEC 334.80]

NUMBER OF CURRENT-CARRYING CONDUCTORS IN CABLE OR RACEWAY	PERCENT OF VALUES IN TABLE E3705.1
4-6	80
7-9	70
10-20	50
21-30	45
31-40	40
41 and above	35




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Examples of ampacity of conductors

Scenario 3:

- There's four 2-wire #12 AWG copper NM cable bundled together with foam insulation around them. Note: 2-wire NM cable each has an ungrounded (hot) wire, neutral wire, and equipment grounding conductor wire.

See next slide for calculations to find the NM cable conductors adjusted ampacity.



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Examples of ampacity of conductors (continued for scenario 3)

NUMBER OF CURRENT-CARRYING CONDUCTORS IN CABLE OR RACEWAY	PERCENT OF VALUES IN TABLE E3705.1
4-6	80
7-9	70
10-20	50
21-30	45
31-40	40
41 and above	35


$30A \times .70 = 21A$

For NM cable, our final ampacity cannot be more than what is shown in the 60°C column, so the final ampacity is 20A for each of the NM cables.

CONDUCTOR SIZE	CONDUCTOR TEMPERATURE RATING														
	60°C			75°C			90°C			60°C			90°C		
	Types THW, UF		Types RHW-2, THHN, THW, THWN, USE, XHHW	Types RHW-2, THHN, THW, THWN, USE, XHHW		Types THW, UF	Types RHW-2, THHN, THW, THWN, USE, XHHW		Types THW, UF	Types RHW-2, THHN, THW, THWN, USE, XHHW		Types THW, UF			
	Copper						Aluminum								
14"	15	20	25	—	—	—	—	—	—	—	—	—	12"		
12"	20	25	30	15	20	25	15	20	25	15	20	25	10"		
10"	30	35	40	25	30	35	25	30	35	25	30	35	8"		
8"	40	50	55	35	40	45	35	40	45	35	40	45	6"		
6"	55	65	75	40	50	55	40	50	55	40	50	55	4"		
4"	70	85	95	55	65	75	55	65	75	55	65	75	3"		
3"	95	100	115	—	—	—	—	—	—	—	—	—	2"		
2"	95	115	130	—	—	—	—	—	—	—	—	—	1"		
1"	110	130	145	—	—	—	—	—	—	—	—	—	1/0		
1/0	125	150	170	150	180	205	150	180	205	150	180	205	4/0		

Since NM cable is 90°C rated, we can use this ampacity to start our deration of the wire


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Overcurrent Protection (Breakers or Fuses)

IRC E3705.5

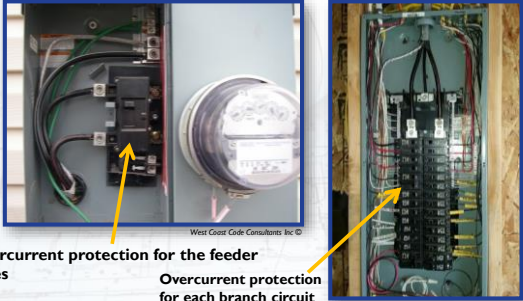
- Must protect conductors against overcurrent in accordance with their ampacities as specified in Table E3705.1 (and after any ampacity derations or adjustments).
- Generally, the overcurrent protection is typically required to be located at the point where the conductor receives its supply.



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25

Overcurrent Protection Required!




Overcurrent protection for the feeder wires

Overcurrent protection for each branch circuit



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Next Size Up Breaker or Fuses


IRC E3705.5.2 and NEC 240.4(B)

- The next size up rating of fuses or breaker(s) rated more than the ampacity of a wire may be used to protect the wire(s) as long as the following is met:
 - The conductors being protected are not part of a branch circuit supplying more than one receptacle for cord-and-plug loads.
 - The ampacity of the wires (after any ampacity derations) are between the standard rating of fuses or breakers.
 - The next size up breaker does not exceed 400A.



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27




Examples of ampacity of conductors

Scenario 4:

- There's four ungrounded (hot) and four neutral wires in the same conduit and each circuit serves multiple receptacles.
- The wires are #12 AWG copper **THHW** (75°C or 90°C rated) and ratings of all terminals that the wires connect to are NOT known.
- Location of the wiring is inside the home.

See next slide for calculations to find the conductors final adjusted ampacity.



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Examples of ampacity of conductors (continued for scenario 4)

NUMBER OF CURRENT-CARRYING CONDUCTORS IN CABLE OR RACEWAY	PERCENT OF VALUES IN TABLE E3705.1
4-6	80
7-9	70
10-20	50
21-30	45
31-40	40
41 and above	35

CONDUCTOR SIZE AWG/kcmil	CONDUCTOR TEMPERATURE RATING					
	60°C		75°C		90°C	
	Types THW, UF	Types RHW, THHW, THWN, THHN, USE, XHHW	Types RHW-2, THHN, THWN, THWN-2, XHHW, XHHW-2, USE-2	Types THW, UF	Types RHW, THHW, THWN, THHN, USE, XHHW	Types THW, UF
14	15	20	25	—	—	—
12	20	27	30	15	15	15
10	30	37	40	25	25	25
8	40	50	55	35	35	35
6	55	65	75	40	40	40
4	70	85	95	55	55	55
3	85	100	115	65	65	65
2	95	115	130	75	75	75
1	110	130	145	85	85	85
1/0	125	150	170	100	100	100
2/0	145	175	195	115	115	115
3/0	165	200	225	130	130	130
4/0	195	230	260	150	150	150

25A × .70 = 17.5A

The final adjusted ampacity is NOT more than the 60°C column ampacity, so 17.5A can be used, but since multiple receptacles are fed by the circuits, we cannot use the next size up breaker (20A), we need to use 15A breakers.

Since the wires could be 75°C or 90°C rated (for THHW), we should use the 75°C column for the ampacity to start our deration of the wire

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Standard Fuse or Breaker Ratings

IRC E3705.6

- See Table E3705.6 for list of standard ratings of fuse or breakers [NEC 240.6(A)]:
 - 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250, 300, 350, and 400.

If the ampacity of conductors falls between breaker (or fuse) ratings, then it's okay to use the next size up breaker to protect such conductors as long as the circuit does not supply more than one receptacle for cord-and-plug equipment and the breaker or fuses are not rated more than 400A.



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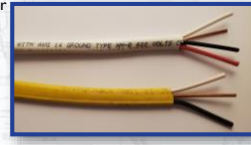
Overcurrent-Protection Rating for Small Conductors

IRC E3705.5.3

- The rating of overcurrent protection for small conductors must not exceed that shown at Table E3705.5.3. [NEC 240.4(D)]
 - However, air conditioning and heat pump conductors are permitted to be protected as per E3702.11. (E3705.5.4)

COPPER		ALUMINUM OR COPPER-CLAD ALUMINUM	
Size (AWG)	Maximum overcurrent-protection-device rating ^a (amps)	Size (AWG)	Maximum overcurrent-protection-device rating ^a (amps)
14	15	12	15
12	20	10	25
10	30	8	30

^a The maximum overcurrent-protection-device rating shall not exceed the conductor allowable ampacity determined by the application of the correction and adjustment factors in accordance with Sections E3705.2 and E3705.3.



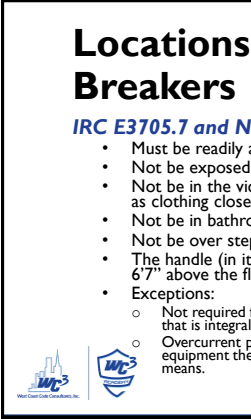
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Locations of Fuses or Breakers

IRC E3705.7 and NEC 240.24

- Must be readily accessible (see Chapter 35 definition).
- Not be exposed to physical damage.
- Not be in the vicinity of easily ignitable material (such as clothing closets).
- Not be in bathrooms.
- Not be over steps of a stairway.
- The handle (in its highest position) cannot be over 6'7" above the floor or platform.
- Exceptions:
 - Not required for supplemental overcurrent protection that is integral to the equipment.
 - Overcurrent protection devices installed next to the equipment they supply can be accessible by portable means.



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Height of breaker example (of what not to do)

Highest point of the handle of breakers or fused disconnects cannot be more than 6'7" above the floor or working platform.

Violation: the rock is not a level 30" wide and 36" deep platform.

Over 6'7" from ground level to the breaker

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Ready Access and Enclosures

IRC E3705.8 & E3705.9

- Each occupant is required to be able to have ready access to all overcurrent protection devices protecting the conductors supplying that occupancy.
- All overcurrent protection devices (fuses or breakers) must be enclosed in cabinets, cutout boxes or be part of equipment assemblies.

Cabinet → Cutout box →

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Panelboards

IRC E3706

- All panelboards must have a rating not less the required service or feeder ampacity (E3706.1 and NEC 408.30).
- All circuits must be legibly identified as to their specific purpose or use (must clearly specify the rooms and circuits they serve). E3706.2 and NEC 408.4(A)

Each breaker must be clearly labeled.

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Grounded (Neutral) Conductor Terminations

IRC E3706.4 and NEC 408.41

Each grounded (neutral) conductor in a panelboard must terminate to its own terminal.

Only one neutral wire per terminal (per lug)

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Backfed Breakers

IRC E3706.5 and NEC 408.36

Plug-in type breakers that are backfed must be secured in place by an additional fastener that requires other than a pull to release the breaker.

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END OF MODULE 6

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Module 7
IRC Chapter 38

1

1

Learning Objectives

1. Types of wiring methods
2. Installation and protection of wiring

2

2

IRC
INTERNATIONAL RESIDENTIAL CODE®
For One- and Two-Family Dwellings

2021

IRC Chapter 38
Wiring Methods

3

3

Allowable Wiring Methods


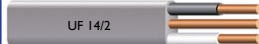
IRC E3801.2



TABLE E3801.2 ALLOWABLE WIRING METHODS	
ALLOWABLE WIRING METHOD	DESIGNATED ABBREVIATION
Armored cable	AC
Electrical metallic tubing	EMT
Electrical nonmetallic tubing	ENT
Flexible metal conduit	FMC
Intermediate metal conduit	IMC
Liquidtight flexible conduit	LFC
Metal-clad cable	MC
Nonmetallic sheathed cable	NM
Rigid metallic conduit	RMC
Rigid polyvinyl chloride conduit (Type PVC)	RNC
Reinforced thermosetting resin conduit (Type RTRC)	RTRC
Service entrance cable	SE
Surface raceways	SR
Underground feeder cable	UF
Underground service cable	USE

4

4

Wiring Methods Continued...



 <p>12/2 type NM</p>	 <p>UF 14/2</p>
NM Nonmetallic-Sheathed Cable	UF Underground Feeder Cable






5

Wiring Methods Continued...



SE Cable (Service Entrance Cable)



 <p>4-wire cable assembly</p>	
--	---

6

Wiring Methods Continued...




 <p>Armored (AC) Cable</p>
 <p>Metal Clad (MC) Cable</p>

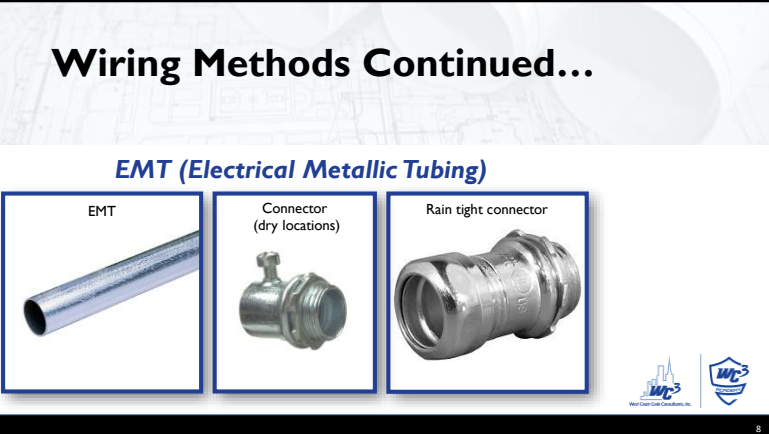




7

Wiring Methods Continued...

EMT (Electrical Metallic Tubing)


 <p>EMT</p>	 <p>Connector (dry locations)</p>	 <p>Rain tight connector</p>
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8


Wiring Methods Continued...



Rigid Metal Conduit (RMC)



Rigid Metal Conduit

RMC Connector



9

Wiring Methods Continued...

Flexible Metal Conduit


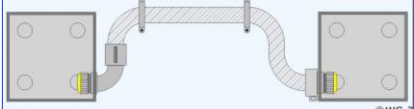
Not permitted in wet Locations


Listed connectors only

Maximum 360 degree bends between pull points conduit bodies and boxes

Secure every 4-1/2 Feet

Check listings for grounding applications



10

Wiring Methods Continued...

LFNC- Liquid tight Flexible Nonmetallic Conduit











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Wiring Methods Continued...

Schedule 80 PVC Conduit






12

Wiring Methods Continued...

Electrical Nonmetallic Tubing


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Circuit Conductors

IRC E3801.3

All conductors of the same circuit (including any equipment grounding or bonding conductors, and neutral conductors) must be contained in the same conduit, trench, cable assembly, or cord. [NEC 300.3(B)]



Violation!! Equipment grounding conductor is not in the same conduit as the circuit wires it serves.

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Application of Wiring Methods

IRC E3801.4

Wiring methods noted in Table E3801.2 must follow the requirements of Table E3801.4.

ALLOWABLE APPLICATIONS (specification allowed where marked with an "A")	TABLE E3801.4 (Chapter 3 and 300.2) ALLOWABLE APPLICATIONS FOR WIRING METHOD ¹											
	AC	EMT	ENT	FMC	IRC RMC	LFC ²	MC	NM	SR	SE	UP	USE
Services	—	A	A ³	A	A	A	A	—	—	A	—	A
Feeders	A	A	A	A	A	A	A	—	—	A ³	A	A ⁴
Branch circuits	A	A	A	A	A	A	A	A	A	A ⁴	A	—
Inside a building	A	A	A	A	A	A	A	A	A	A	A	—
Wet locations exposed to sunlight	—	A	A ³	—	A	A	—	—	—	A	A ⁴	A ⁴
Damp locations	—	A	A	A ³	A	A	A	—	—	A	A	A
Embedded in nonmetallic concrete in dry location	—	A	A	—	A	A ⁵	—	—	—	—	—	—
In nonmetallic concrete in contact with grade	—	A ⁶	A	—	A ⁶	A ⁶	—	—	—	—	—	—
Embedded in plaster and exposed to dampness	A	A	A	A	A	A	A	—	—	A	A	—
Embedded in masonry	—	A	A	—	A ⁶	A ⁶	—	—	—	—	—	—
In masonry walls and cells exposed to dampness or below grade line	—	A ⁶	A ⁶	A ⁶	A ⁶	A ⁶	—	—	—	A	A	—
Embedded in masonry walls	A	—	A	—	A	A	—	—	—	A	A	—
In masonry walls and cells not exposed to dampness	A	A	A	A	A	A	A	—	—	A	A	—
Rain exposed	A	A	A	A	A	A	A	A	A	A	A	—
Rain exposed and subject to physical damage	—	—	—	—	A ⁷	—	—	—	—	—	—	—
For direct burial	—	A ⁸	—	—	A ⁸	—	—	—	—	—	—	A

Footnote 1: 1. 1/2 inch - 2 1/2 inch size.
2. Liquidtight flexible nonmetallic conduit without integral reinforcement within the conduit wall shall not exceed 6 feet in length.
3. Type IEM cable shall not be used inside buildings.
4. The grounded conductor shall be insulated.
5. Conductors shall be type approved for wet locations and the installation shall prevent water from entering other raceways.
6. Shall be listed as "Sunlight Resistant."
7. Metal raceways shall be protected from corrosion and approved for the application. Aluminum RMC requires approved supplementary corrosion protection.
8. RMC shall be Schedule 80. RTRC shall be RTRC-XW.
9. Shall be listed as "Sunlight Resistant" where exposed to the direct rays of the sun.
10. Conduit shall not exceed 6 feet in length.
11. Liquidtight flexible nonmetallic conduit is permitted to be encased in concrete where listed for direct burial and only straight connectors listed for use with LFC are used.
12. In wet locations under any of the following conditions:
1. The metallic covering is impervious to moisture.
2. A lead sheath or moisture-impervious jacket is provided under the metal covering.
3. The insulated conductors under the metallic covering are listed for use in wet locations and a corrosion-resistant jacket is provided over the metallic sheath.

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ALLOWABLE APPLICATIONS (specification allowed where marked with an "A")	TABLE E3801.4 (Chapter 3 and 300.2) ALLOWABLE APPLICATIONS FOR WIRING METHOD ¹											
	AC	EMT	ENT	FMC	IRC RMC	LFC ²	MC	NM	SR	SE	UP	USE
Services	—	A	A ³	A	A	A	A	—	—	A	—	A
Feeders	A	A	A	A	A	A	A	—	—	A ³	A	A ⁴
Branch circuits	A	A	A	A	A	A	A	A	A	A ⁴	A	—
Inside a building	A	A	A	A	A	A	A	A	A	A	A	—
Wet locations exposed to sunlight	—	A	A ³	—	A	A	—	—	—	A	A ⁴	A ⁴
Damp locations	—	A	A	A ³	A	A	A	—	—	A	A	A
Embedded in nonmetallic concrete in dry location	—	A	A	—	A	A ⁵	—	—	—	—	—	—
In nonmetallic concrete in contact with grade	—	A ⁶	A	—	A ⁶	A ⁶	—	—	—	—	—	—
Embedded in plaster not exposed to dampness	A	A	A	A	A	A	A	—	—	A	A	—
Embedded in masonry	—	A	A	—	A ⁶	A ⁶	—	—	—	—	—	—
In masonry walls and cells exposed to dampness or below grade line	—	A ⁶	A ⁶	A ⁶	A ⁶	A ⁶	—	—	—	A	A	—
Embedded in masonry walls	A	—	A	—	A	A	—	—	—	A	A	—
In masonry walls and cells not exposed to dampness	A	A	A	A	A	A	A	—	—	A	A	—
Rain exposed	A	A	A	A	A	A	A	A	A	A	A	—
Rain exposed and subject to physical damage	—	—	—	—	A ⁷	—	—	—	—	—	—	—
For direct burial	—	A ⁸	—	—	A ⁸	—	—	—	—	—	—	A

Footnote 1: 1. 1/2 inch - 2 1/2 inch size.
2. Liquidtight flexible nonmetallic conduit without integral reinforcement within the conduit wall shall not exceed 6 feet in length.
3. Type IEM cable shall not be used inside buildings.
4. The grounded conductor shall be insulated.
5. Conductors shall be type approved for wet locations and the installation shall prevent water from entering other raceways.
6. Shall be listed as "Sunlight Resistant."
7. Metal raceways shall be protected from corrosion and approved for the application. Aluminum RMC requires approved supplementary corrosion protection.
8. RMC shall be Schedule 80. RTRC shall be RTRC-XW.
9. Shall be listed as "Sunlight Resistant" where exposed to the direct rays of the sun.
10. Conduit shall not exceed 6 feet in length.
11. Liquidtight flexible nonmetallic conduit is permitted to be encased in concrete where listed for direct burial and only straight connectors listed for use with LFC are used.
12. In wet locations under any of the following conditions:
1. The metallic covering is impervious to moisture.
2. A lead sheath or moisture-impervious jacket is provided under the metal covering.
3. The insulated conductors under the metallic covering are listed for use in wet locations and a corrosion-resistant jacket is provided over the metallic sheath.

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Installation and Supports

IRC E3802.1

Wiring methods must be installed and supported per the requirements of Table E3802.1.

Don't forget the footnotes!

(Requirement applicable only to wiring methods marked "A")	AC MC	EFT MC MC	EMT	FMC LFC	NM UP	RMC RTRC	SE	SM ¹	USE
Where run parallel with the framing member or furring strip, the wiring shall be not less than 1/4 inch from the edge of a furring strip or a framing member such as a joist, rafter or stud or shall be physically protected.	A	—	A	A	A	—	A	—	—
Bored holes in framing members for wiring shall be located not less than 1/4 inches from the edge of the framing member or shall be protected with a minimum 0.0625-inch steel plate or sleeve, a listed steel plate or other physical protection.	A ²	—	A ²	A ²	A ²	—	A ²	—	—
Where installed in grooves, to be covered by wallboard, siding, paneling, carpeting, or similar finish, wiring methods shall be protected by 0.0625-inch-thick steel plate, sleeve, or equivalent, a listed steel plate or by not less than 1/4-inch free space for the full length of the groove in which the cable or raceway is installed.	A	—	A	A	A	—	A	A	A
Securely fastened bushings or grommets shall be provided to protect wiring run through openings in metal framing members.	—	—	A ³	—	A ³	—	A ³	—	—
The maximum number of 90-degree bends shall not exceed four between junction boxes.	—	—	A	A	A	—	A	—	—
Bushings shall be provided where entering a box, fitting or enclosure unless the box or fitting is designed to afford equivalent protection.	A	A	A	A	A	—	A	—	A
Ends of raceways shall be stanced to remove rough edges.	—	—	A	A	—	—	A	—	—
Maximum allowable on center support spacing for the wiring method in feet.	12 ^a	10	3 ^b	4.5 ^b	4.5 ^b	3 ^b	2.5 ^b	—	2.5
Maximum support distance in inches from box or other termination.	12 ^a	36	36	12 ^a	12 ^a	36	12	—	—

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.0175 rad.
 a. Installed in accordance with listing requirements.
 b. Supports not required in accessible ceiling spaces between light fixtures where lengths do not exceed 6 feet.
 c. Six feet for MC cable.
 d. Five feet for trade sizes 1/4 through 2 inches, 6 feet for trade sizes 2 1/2 through 3, 7 feet for trade sizes 3 1/2 through 5 inches, 8 feet for trade size 6 inches.
 e. Two and one-half feet where used for service or outdoor feeder and 4.5 feet where used for branch circuit or indoor feeder.
 f. Twenty-four inches for Type MC cable and 36 inches for interlocking Type MC cable where flexibility is necessary.
 g. Where flexibility after installation is necessary, lengths of flexible metal conduit and liquidtight flexible metal conduit measured from the last point where the raceway is securely fastened shall not exceed: 36 inches for trade sizes 1/2 through 1 1/4, 48 inches for trade sizes 1 1/2 through 2, and 5 feet for trade sizes 2 1/2 and larger.
 h. Within 8 inches of boxes without cable clamps.
 i. Flat cables shall not be stapled on edge.
 j. Bushings and grommets shall remain in place and shall be listed for the purpose of cable protection.
 k. See Sections R502.8 and R802.7 for additional limitations on the location of bored holes in horizontal framing members.

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(Requirement applicable only to wiring methods marked "A")	AC MC	EFT MC MC	EMT	FMC LFC	NM UP	RMC RTRC	SE	SM ¹	USE
Where run parallel with the framing member or furring strip, the wiring shall be not less than 1/4 inches from the edge of a furring strip or a framing member such as a joist, rafter or stud or shall be physically protected.	A	—	A	A	A	—	A	—	—
Bored holes in framing members for wiring shall be located not less than 1/4 inches from the edge of the framing member or shall be protected with a minimum 0.0625-inch steel plate or sleeve, a listed steel plate or other physical protection.	A ²	—	A ²	A ²	A ²	—	A ²	—	—
Where installed in grooves, to be covered by wallboard, siding, paneling, carpeting, or similar finish, wiring methods shall be protected by 0.0625-inch-thick steel plate, sleeve, or equivalent, a listed steel plate or by not less than 1/4-inch free space for the full length of the groove in which the cable or raceway is installed.	A	—	A	A	A	—	A	A	A
Securely fastened bushings or grommets shall be provided to protect wiring run through openings in metal framing members.	—	—	A ³	—	A ³	—	A ³	—	—
The maximum number of 90-degree bends shall not exceed four between junction boxes.	—	—	A	A	A	—	A	—	—
Bushings shall be provided where entering a box, fitting or enclosure unless the box or fitting is designed to afford equivalent protection.	A	A	A	A	A	—	A	—	A
Ends of raceways shall be stanced to remove rough edges.	—	—	A	A	—	—	A	—	—

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.0175 rad.
 a. Installed in accordance with listing requirements.
 b. Supports not required in accessible ceiling spaces between light fixtures where lengths do not exceed 6 feet.
 c. Six feet for MC cable.
 d. Five feet for trade sizes 1/4 through 2 inches, 6 feet for trade sizes 2 1/2 through 3, 7 feet for trade sizes 3 1/2 through 5 inches, 8 feet for trade size 6 inches.
 e. Two and one-half feet where used for service or outdoor feeder and 4.5 feet where used for branch circuit or indoor feeder.
 f. Twenty-four inches for Type MC cable and 36 inches for interlocking Type MC cable where flexibility is necessary.
 g. Where flexibility after installation is necessary, lengths of flexible metal conduit and liquidtight flexible metal conduit measured from the last point where the raceway is securely fastened shall not exceed: 36 inches for trade sizes 1/2 through 1 1/4, 48 inches for trade sizes 1 1/2 through 2, and 5 feet for trade sizes 2 1/2 and larger.
 h. Within 8 inches of boxes without cable clamps.
 i. Flat cables shall not be stapled on edge.
 j. Bushings and grommets shall remain in place and shall be listed for the purpose of cable protection.
 k. See Sections R502.8 and R802.7 for additional limitations on the location of bored holes in horizontal framing members.

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Cables in Accessible Attics

IRC E3802.2.1

When permanent stairs or a permanent ladder are provided for attic access, all wiring in the attic which is lower than 7' above the attic floor must be protected with guard strips, be in conduit, or be installed within the framing of the wall. [NEC 334.23 and 320.23(A)]



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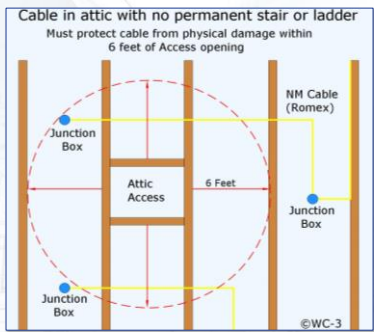



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Cables in Accessible Attics

IRC E3802.2.1 cont.

Cable in attic with no permanent stair or ladder
Must protect cable from physical damage within 6 feet of Access opening



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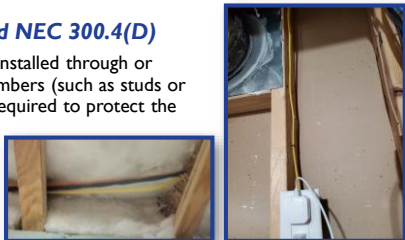




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Cables through or next to framing members

IRC E3802.2.2 and NEC 300.4(D)

Whenever cables are installed through or parallel to framing members (such as studs or joist), guards are not required to protect the wiring.



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Exposed Cable

IRC E3802.3

- In exposed work, other than that noted in section E3802.2 (accessible attics) and section E3802.4 (unfinished basements or crawlspaces), cables must meet the following:
 - Cables must closely follow the surface of the building finish or running boards.
 - Where subject to damage must be protected in RMC, IMC, EMT, Sch. 80 PVC, or other approved means.
 - Where passing through a floor, the cable must be protected in one of the conduits as noted above, and the conduit must extend at least 6" above the floor.
 - Must be listed as sunlight resistant where exposed to sunlight.

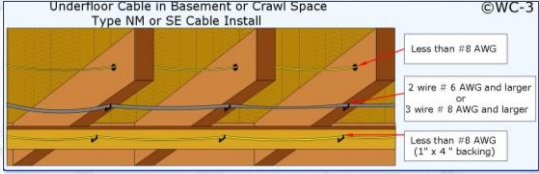
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Unfinished Basements and Crawl Spaces

IRC E3802.4

NM or SE cables attached to the bottom of floor joists must be at least 2 wire #6 AWG or larger, or 3 wire #8 AWG or larger. Cables with wires smaller than this must be installed on a continuous backing strip or be installed through bored holes in the joist. [NEC 334.15(C)]



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Unfinished Basements and Crawl Spaces Cont.

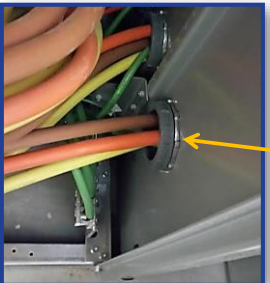
- NM or SE cable installed on the wall of an unfinished basement must be installed in listed conduit or tubing or must meet the requirements of Table E3802.1.
- Conduit must have insulating bushings where cables enter (to protect the cable from abrasion).
- The sheath of the NM or SE cable must extend into the outlet or device box at least 1/4".
- The cable must be secured within 12" of entering the conduit.


24

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Example of conduit insulating bushing



Conduit insulation bushings protect the wires from rubbing on the edge of the conduit.



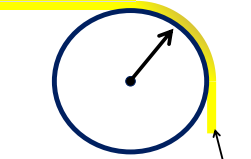
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Bends

IRC E3802.5

- Bends for conduit must be such that the conduit is not damaged and also its internal diameter is not reduced.
- Bends for NM and SE cable must have a radius of the curve not less than 5 times the diameter of the cable.



If the NM cable is 1/2" wide, the minimum radius of the bend must not be less than 2.5" (5 x .5" = 2.5")





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Bends Continued...

- Conduit bends should be made only using tools designed for such.
- The conduit cannot be damaged, and the bend cannot reduce the internal diameter of the conduit.


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Securing cables


IRC E3802.6

Cables are required to be supported/secured using staples, listed cable ties (listed for the supporting of wiring), straps, or hangers that are designed and installed to not damage the cable. [NEC 300.9]



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Is this a violation?



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Raceways (Conduit) in Wet Locations

IRC E3802.8 and E3803.10

- When conduit is installed in wet locations, the interior of the conduit is also considered a wet location. [NEC 300.9]
- Any insulated cables or conductors within the conduit must be rated for wet locations. [NEC 300.5(B)]



Example of wet-rated wire insulation



Minimum Cover Requirements

IRC E3803.1

Direct buried cables or conduit must meet the requirements of Table E3803.1 (see also NEC Table 300.5).

TABLE E3803.1
MINIMUM COVER REQUIREMENTS, BURIAL IN INCHES^{a, b, c, d, e}

LOCATION OF BURIAL METHOD OR CONDUIT	TYPE OF WIRING METHOD OR CONDUIT				
	1 Direct-buried cables or conductors	2 Rigid metal conduit or intermediate metal conduit	3 Rigid nonmetallic conduit for direct burial without concrete encasement or other approved raceway	4 Flexible nonmetallic conduit used for wet or dry locations and protection of raceway entrances of all antennas	5 Conduits for control of irrigation and landscape lighting buried in areas that do not contain any other raceway cable or raceway
All locations not specified below	24	6	18	12	6
In trench below 2-inch-thick concrete or equivalent	18	6	12	6	6
Under a building (In raceway only or Type MC identified for direct burial)	0	0	0	(In raceway only or Type MC identified for direct burial)	(In raceway only or Type MC identified for direct burial)
Under minimum of 4-inch-thick concrete exterior slab with no vehicular traffic and the slab extending not less than 6 inches beyond the underground raceway	18	4	4	6 (Direct burial) 6 (In raceway)	6 (Direct burial) 6 (In raceway)
Under streets, highways, roads, alleys, driveways and parking lots	24	24	24	24	24
Clear and free family driveway, parking areas, and yards only for dwelling-related purposes	18	18	18	12	18
In wall rack where covered by minimum of 2 inches concrete extending down to rack	2 (In raceway only)	2	2	2 (In raceway only)	2 (In raceway only)

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Minimum cover requirements cont.



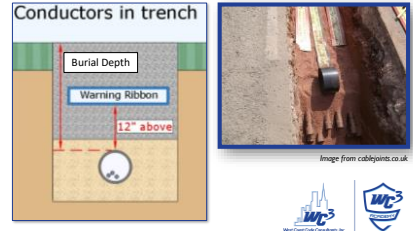
For residential circuits operating at 120V or less connecting to a 20A (or less) breaker (or fuses) and are protected by GFCI, then the burial depth of the wiring can be 12".


120V yard light

Warning Ribbon

IRC E3803.2



Underground service conductors that are not encased in concrete and that are buried 18" or more below grade shall have their location identified by a warning ribbon that is placed in the trench at least 12" above the underground installation. [NEC 300.5(D)(3)]






Underground Installation Requirements Cont.

- Direct buried conductors emerging from grade must be protected in conduit beginning at the required depth noted at Table E3803.1 and extending to at least 8' above grade (E3803.3 and NEC 300.5(D)(1) through (D)(3)).
- The depth of the conduit does not have to be deeper than 18."

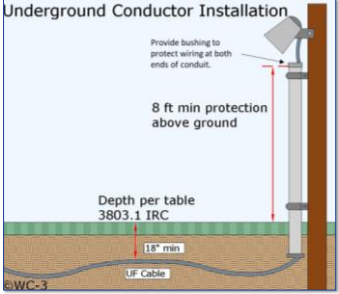
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Direct-Buried Cable Emerging From Grade

Underground Conductor Installation



Provide bushing to protect wiring at both ends of conduit.



8 ft min protection above ground

Depth per table 3803.1 IRC

18" min

UF Cable

E.WC-3






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Underground Installation Requirements Cont.

- Backfill containing large rocks, large or sharp material, or corrosive material must not be used in backfilling an excavation where it could damage the wiring or conduit (E3803.5 and NEC 300.5(F)).
- Conduits (including spare or unused conduits) must be sealed at either or both ends where water can enter (E3803.6).



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Ground Movement

IRC E3803.9

Where soil settlement or frost damage could occur, the conduit or conductors must be arranged so as to be protected from such damage (E3803.9 and NEC 300.5(j)).




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Ground Movement

IRC E3803.9

Service conduit riser secured to house (or must provide an approved expansion joint for the conduit)




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Conductors Under a Building

IRC E3803.11

- Any underground cable installed under a building must be in a raceway (conduit).
- Exception, MC cable that meets all of the following requirements:
 - The MC cable is listed for direct burial.
 - The metal covering is impervious to moisture.
 - There is a moisture impervious jacket under the metal covering.
 - The conductors within the MC cable have insulation that is listed for use in wet locations.
 - There is a corrosion-resistant jacket covering the metal sheath.

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END OF MODULE 7




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Module 8
IRC Chapter 39, Part I

1

Learning Objectives

1. Required locations of receptacles
2. Ground fault circuit interrupter (GFCI) requirements

2

IRC Chapter 39
Power and Lighting Distribution – Part I

3

General Receptacle Requirements

IRC E3901.1

- Receptacles must be provided per sections E3901.2 through E3901.11.
- The receptacles are to be served by either 15 or 20 amp circuits.
- The following receptacles do not count towards those required by sections E3901.2 – E3901.11:
 - Part of a luminaire or appliance.
 - Located within cabinets or cupboards.
 - Controlled by a wall switch.
 - Is located more than 5.5 feet above the floor.

4

General Receptacle Requirements Cont.

Receptacles located over 5'6" above the floor do not count.

Receptacles that are part of luminaires or appliances do not count.

5

General Purpose Receptacles

IRC E3901.2

- There must be general receptacles provided per E3901.2.1 through E3901.2.3 in the following rooms:
 - Kitchen, family room, dining room, living room, parlor, library, den, sunroom, bedroom, recreation room, or similar areas.

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Dwelling Unit Receptacle Outlets

IRC E3901.2

- Spacing rules call for installation of receptacle outlets so that no point along the floor line in any wall space is more than 6 ft measured horizontally from an outlet in that space (E3901.2.1)
- Includes (2 ft or wider) wall space and wall space occupied by fixed panels in exterior or interior walls (E3901.2.2).
- Fixed room dividers are included in the 1.8 m (6 ft) measurement (E3901.2.2).

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Dwelling Unit Receptacle Outlets

IRC E3901.2

Wall Receptacle Spacing

Wall receptacles serve spaces for 6 feet on each side of receptacle

12 ft. max

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Dwelling Unit Receptacle Outlets

IRC E3901.2 & E3901.3

Receptacle Spacing Requirements

Indicates 6 ft max distance served by receptacle

Floor receptacle requirements per E3701.2.3

Receptacle required if wall space is wider than 2 ft

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Dwelling Unit Receptacle Outlets Cont.



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Small Appliance Receptacles

IRC E3901.3

- At least two 20-ampere small appliance branch circuits are required to serve the countertop surfaces in the kitchen.
- Either or both of these two small appliance branch circuits can also supply other receptacle outlets in the same room or adjacent permitted areas such as a dining room or pantry (or similar areas).
- The branch circuits are also permitted to serve the fridge.
- No small appliance branch circuit can serve more than one kitchen (E3901.3.2).


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Other Outlets Prohibited

IRC E3901.3.1

- The required two or more 20 amp circuits that serve the kitchen, and dining room (or similar areas) wall and floor receptacles, must not serve any other outlets.
- Exceptions:
 - A receptacle installed for a clock.
 - Receptacles for supplemental equipment that are part of gas-fired ranges, ovens, or cooktops



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Kitchen Countertop Receptacles

IRC E3901.4

- Receptacle outlets shall be installed so that no point along the counter wall line is more than **24 in.** measured horizontally from a receptacle outlet in that space.
 - Exception: Receptacles are not required behind ranges, cooktops, or sinks as shown in figure E3901.4.1.
 - A receptacle outlet must be installed at each wall countertop space that is **12 in.** or wide.
 - Countertop spaces separated by rangetops, refrigerators, or sinks shall be considered as separate countertop spaces (E3901.4.4).
- Each 12 inches of a multioutlet assembly (having 2 or more receptacles) can count as a receptacle outlet.

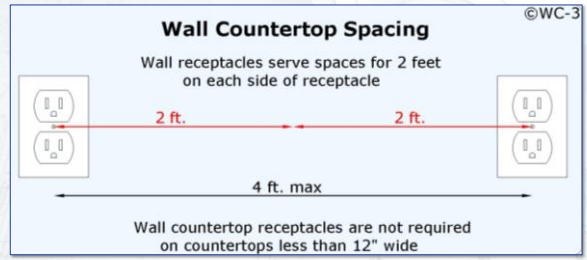


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Dwelling Unit Receptacle Outlets

IRC E3901.4.1



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Dwelling Unit Receptacle Outlets Continued..

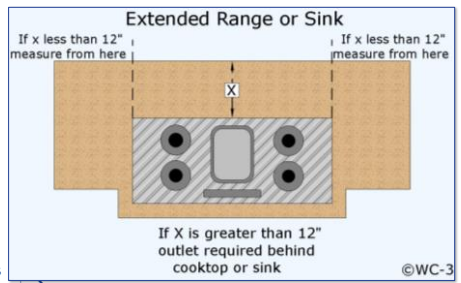
IRC E3901.4.1



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Range, Cooktop, Or Sinks



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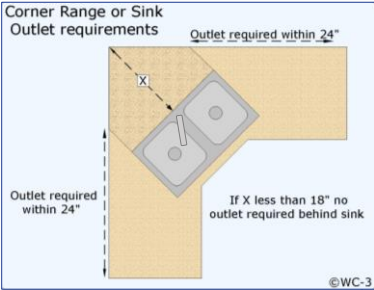
16

Range, Cooktop, Or Sinks




Range, Cooktop, Or Sinks

Corner Range or Sink
Outlet requirements



Outlet required within 24"

If X less than 18" no outlet required behind sink

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Island and Peninsular Countertop Receptacles


New for 2021 IRC

IRC E3901.4.2

- At least one receptacle outlet is required for the first **9 square feet** of countertop space at an **island**. A receptacle outlet is also required for each additional **18 square feet** (or fraction of) of island counter space.
- At least one receptacle shall be installed at each island or **peninsular countertop** space with a long dimension of **24 in.** or greater and a short dimension of **12 in.** or greater.
 - A peninsular countertop is measured from the connecting edge (of the base counter tops).



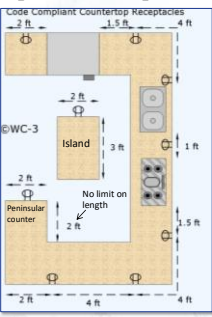
Kitchen Island


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Kitchen Countertop Receptacles

- In this example (to the left), the kitchen island is only **6 square feet** and would only require a single receptacle outlet.
- But if the island was **20 square feet**, for example, then at least two receptacle outlets would be required for the island.
- If the island was **28 square feet**, for example, then at least three receptacle outlets would be required.




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Receptacle Location

IRC E3901.4.3

- Receptacles serving a countertop space must be located per one of the following:
 - Not more than 20 inches above the countertop.
 - Listed receptacle assemblies installed at the countertop or work surface.
 - Or not be more than 12 inches below the countertop with not more than 6" of countertop overhanging the receptacle.



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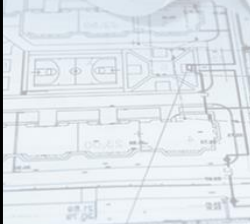
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Receptacle Location cont.

IRC E3901.4.3

- Receptacles cannot be mounted in the face up position (this is no longer clear in the 2021 IRC, but it is implied since listed receptacles are required at the countertop, when used).
- Receptacle outlet assemblies listed for the application shall be permitted to be installed in countertops.

Examples of surface-mounted receptacles






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Receptacle Location continued...

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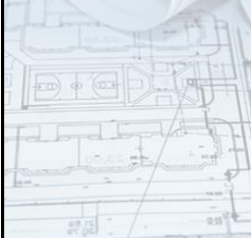
20" max

Receptacles cannot be over 20" above the countertop



12" max


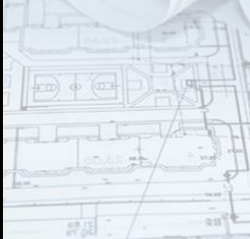

Receptacles at islands (with no vertical wall space) must be mounted no more than 12" down from the top of the counter and there cannot be over a 6" overhang (IRC E3901.4.3 item 3).

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Vertical wall space provided at countertop?


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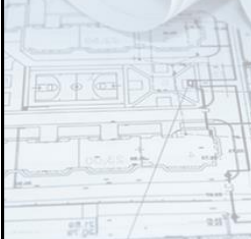
Appliance Receptacles

IRC E3901.5

Receptacles installed for specific appliances, such as the laundry equipment, must be located within 6' of the intended location of the appliance.



(See also E3901.8 for receptacle required for laundry equipment)

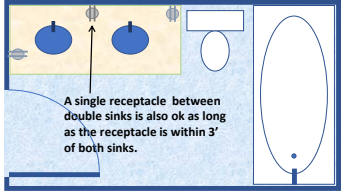
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Bathroom Receptacle(s)

IRC E3901.6

- There must be a receptacle within 3' of the edge of each sink.
- The required outlet is also permitted to be mounted no more than 12" below the countertop on the front or side of the cabinet. [NEC 210.52(D)]



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Bathroom Receptacle (continued)




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Outdoor Receptacles

IRC E3901.7

- There must be a receptacle located on the front and back of the house and be accessible from grade.
- There must be a receptacle within the perimeter of each balcony, deck, or porch that are accessible from the inside of the house. [NEC 210.52(E)]
- Such receptacles as noted above must not be mounted over 6'6" above grade level or above the floor surface.




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Basements, Garages, and Accessory Bldgs.

IRC E3901.9 and NEC 210.52(G)(I) – (III)

- At least one receptacle must be provided in each portion of an unfinished basement and in each attached garage.
- At least one receptacle (in addition to any provided for specific equipment) must be provided in each detached garage or accessory structure that is supplied with power.



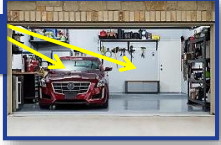



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Basements, Garages, & Accessory Bldgs. (Cont.)

- Branch circuits that supply receptacles in the garage shall not supply any other receptacles outside of the garage.
- There must also be provided at least one receptacle for each vehicle space in a garage (including detached garages provided with power).



This two car garage would require two receptacles and such cannot be more than 5.5' above floor level.



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Hallways

IRC E3901.10
Hallways 10' or longer require at least one receptacle. [NEC 210.52(H)]




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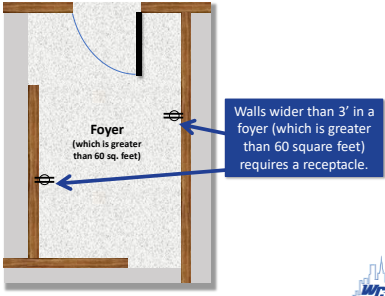



Foyers

IRC E3901.11
Foyers that are not also part of a hallway and that have an area that is greater than 60 sq. ft. must have a receptacle at each wall space that is 3' or longer and that is unbroken by doors or floor-to-ceiling windows. [NEC 210.52(l)]


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Foyers continued...

32

Foyers?




33

33

HVAC Outlet

IRC E3901.12



- There must be a [convenience] receptacle that is located on the same level as and within 25' of HVAC equipment (for servicing the equipment). [NEC 210.63]
 - Exception: A receptacle is not required for the servicing of an evaporative cooler (swamp cooler).



Convenience receptacle


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The convenience receptacle must be within 25' of the HVAC equipment and not be supplied on the load side of the equipment's disconnect.

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GFCI and AFCI Protection

IRC E3902

How GFCIs Work

GFCIs sense an imbalance in current (between the ungrounded ("hot") conductor and the neutral) and will trip when there's an imbalance of 6 milliamps or more (remember, there's 1,000 mA in one amp). This helps prevent electric shock.



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GFCI Protection Location

IRC E3902.15

- All GFCIs must be located in a readily accessible location.
- "When determining distance from receptacles, the distance shall be measured as the shortest path the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, or fixed barrier, or the shortest path without passing through a window." [NEC 210.8(A)]

Note: E3902.14 of the 2018 IRC does not count a cord passing through a "doorway."



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Required GFCI Protection for circuits (125 volts, 250V receptacles were added to the 2021 IRC)

- Bathrooms (E3902.1)
- Garages and Accessory Buildings (E3902.2)
- Outdoors (E3902.3)
 - Exception: Inaccessible receptacles for snow melting equip. (see E4101.7)
- Crawl Spaces that are below grade level (E3902.4)
- Unfinished** Basements (E3902.5)
 - Exception: Receptacles for permanently installed fire or burglar alarms.
- Kitchen countertop spaces (E3902.6)
- Sinks [Within 6' of Laundry, Utility, Wet Bar, etc. sinks] (E3902.7)
- Bathub or shower stalls (E3902.8)
- Laundry areas** (E3902.9)
- Indoor damp or wet locations** (E3902.10)
- Kitchen dishwasher** (E3902.11)
- Boathouses (E3902.12)
- Boat Hoists (E3902.13)
- Electrically Heated Floors – in bathrooms, kitchens, & spa/hot tub areas (E3902.14)
- Swimming Pools and Similar Installations – Chapter 42

To clarify, the GFCI requirements apply per the sections noted to the left, for any receptacle that has a voltage to ground of 150V or less, which was added to the 2021 IRC.

New for 2021 IRC

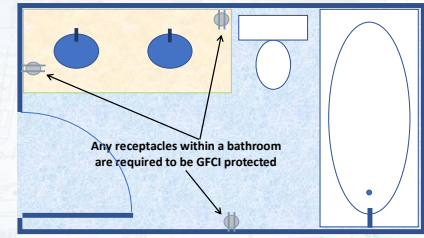



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GFCIs for Bathrooms

IRC E3902.1

All 125-250 volt, single-phase receptacles installed in bathrooms shall have ground-fault circuit-interrupter protection.





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GFCIs for Garages

IRC E3902.2

All 125-250 volt, single-phase receptacles installed in garages and grade-level portions of unfinished accessory buildings used for storage or work areas shall have ground-fault circuit-interrupter protection.

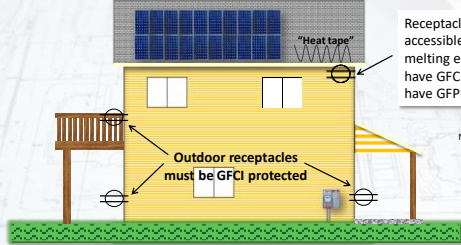
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GFCIs for Outdoor Receptacles


IRC E3902.3

All 125-250 volt, single-phase receptacles installed outdoors shall have ground-fault circuit-interrupter protection.

Receptacles that are NOT readily accessible and are dedicated for snow-melting equipment are not required to have GFCI protection, BUT MUST still have GFPE protection (see E4101.7).



Note: GFCIs have a trip sensitivity of about 6mA whereas a GFPE has a sensitivity of around 30mA.




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GFCIs for Crawl Spaces

IRC E3902.4

All 125-250 volt, single-phase receptacles installed in a crawl space (which is below grade) shall have ground-fault circuit-interrupter protection.



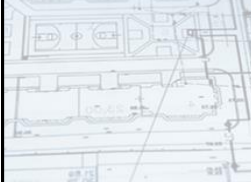
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GFCIs for Unfinished Basements

IRC E3902.5

- All 125-250 volt, single-phase receptacles installed in a unfinished basement shall have ground-fault circuit-interrupter protection.
 - Exception: Receptacles only supplying a permanently installed fire or burglar alarm do not require GFCI protection.



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GFCIs for Kitchen Receptacles

IRC E3902.6

All 125-250 volt, single-phase receptacles which serve kitchen countertop surfaces shall have ground-fault circuit-interrupter protection.



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GFCIs for Receptacles Near Sinks

IRC E3902.7

All 125-250 volt, single-phase receptacles installed within 6' of any sink shall have ground-fault circuit-interrupter protection. This is measured along a cord extending from the receptacle to the edge of the sink.



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GFCIs for Receptacles Near Bathtubs or Showers

IRC E3902.8

All 125-250 volt, single-phase receptacles installed within 6' of a tub or shower stall shall have ground-fault circuit-interrupter protection.

Any receptacles within 6' of a bathtub or shower stall are required to be GFCI protected

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GFCIs for Laundry Areas

IRC E3902.9

All 125-250 volt, single-phase receptacles installed in a laundry room shall have ground-fault circuit-interrupter protection.

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GFCIs for Indoor Damp or Wet Locations

IRC E3902.10

All 125-250 volt, single-phase receptacles installed in an indoor damp or wet location shall have ground-fault circuit-interrupter protection.

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GFCI Protection for Dishwashers


IRC E3902.11

The circuit supplying a dishwasher (in a dwelling) must be protected by a ground-fault circuit-interrupter.

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GFCIs for Boathouse Receptacles

IRC E3902.12

All 125-250 volt, single-phase receptacles installed in a boathouse shall have ground-fault circuit-interrupter protection.



In addition, any 240V or less outlets that serve boat hoists must have ground-fault circuit interrupter protection for personnel (E3902.13).

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GFCI Protection for Electrically Heated Floors

IRC E3902.14


GFCI protection must be provided for electrically heated floors in bathrooms, kitchens, and around hydromassage bathtub, spa, and hot tub locations.





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Locations of GFCIs



IRC E3902.14

Ground-fault circuit interrupters must be installed in readily accessible locations. (see Chapter 35 for the definition of "accessible, readily")



Apparently, one of the main reasons this item was added to the code is because manufacturers of GFCIs typically require GFCIs to be tested monthly. Having the GFCI test button be readily accessible makes testing the receptacles possible.

Everyone tests their GFCIs, right?! 😊

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END OF MODULE 8




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Module 9
IRC Chapter 39, Part II

1

1

Learning Objectives

1. Arc-fault circuit interrupters (AFCIs)
2. Lighting outlets
3. Mechanical and electrical continuity of metal parts
4. Box fill calculations

2

2

IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings
2021

IRC Chapter 39
Power and Lighting Distribution – Part II

3

3


Arc-Fault Circuit-Interrupters (AFCI)

IRC E3902.16

Arc-fault circuit interrupters (AFCIs) are required to be readily accessible (E3902.16 and NEC 210.12)

4



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Arc-Fault Circuit-Interrupters

IRC E3902.16

- AFCI is a device intended to provide protection from the effects of arcing type faults (which could cause a fire).
- An AFCI device recognizes the characteristics that are unique to arcing.



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Arc-Fault Circuit-Interrupters

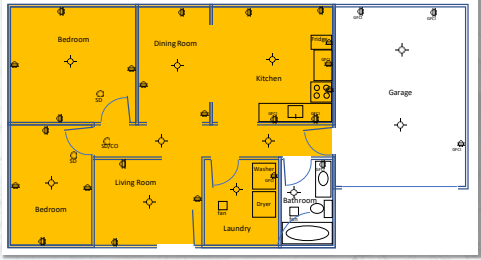
IRC E3902.17

- Required for all 125-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets installed in dwelling unit in the following locations:
 - Family rooms, kitchens, dining rooms, laundry rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, and similar rooms or areas.
- In general, AFCIs must be the combination type (see also items 1 through 6, per E3902.17, for alternate designs).






6

AFCIs – Where Required



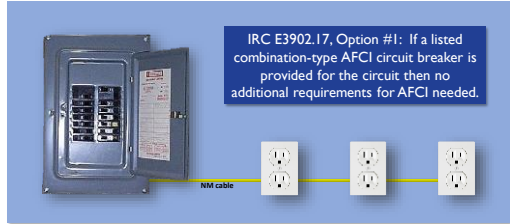
All 125V, 15 and 20A circuits, installed within the shown areas highlighted in orange must have AFCI protection. This includes (but not limited to) circuits for receptacles, lights, fridge, laundry equipment, and even smoke detectors.



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Methods of providing AFCI protection

Option #1



IRC E3902.17, Option #1: If a listed combination-type AFCI circuit breaker is provided for the circuit then no additional requirements for AFCI needed.

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Methods of providing AFCI protection

Option #2

IRC E3902.17, Option #2: If a listed branch/feeder-type AFCI circuit breaker is provided for the circuit then the first outlet must be a listed AFCI receptacle.

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Methods of providing AFCI protection

Option #3

IRC E3902.17, Option #3: A listed "supplemental arc protection" circuit breaker can be installed for the circuit if used in combination with a listed AFCI receptacle located at the first outlet of the circuit. (items 3.1 through 3.3 must also be met)

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Methods of providing AFCI protection

Option #4

IRC E3902.17, Option #4: A listed circuit breaker can be installed for the circuit if a listed AFCI receptacle is located at the first outlet of the circuit and the breaker and the AFCI receptacle together are listed and identified as meeting the requirements of a "system combination-type AFCI." (items 4.1 through 4.4 must also be met)

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Methods of providing AFCI protection

Option #5

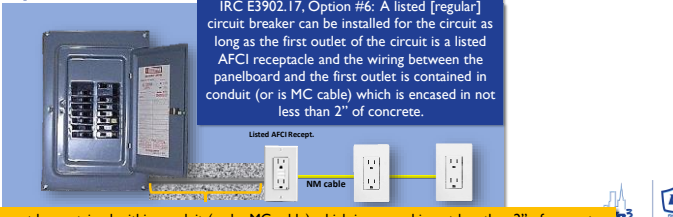
IRC E3902.17, Option #5: A listed [regular] circuit breaker can be installed for the circuit as long as the first outlet of the circuit is a listed AFCI receptacle and the wiring between the panelboard and the first outlet is contained in metal raceways or be AC or MC cables.

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Methods of providing AFCI protection

Option #6

IRC E3902.17, Option #6: A listed [regular] circuit breaker can be installed for the circuit as long as the first outlet of the circuit is a listed AFCI receptacle and the wiring between the panelboard and the first outlet is contained in conduit (or is MC cable) which is encased in not less than 2" of concrete.



Wiring must be contained within conduit (or be MC cable) which is encased in not less than 2" of concrete.


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AFCI – Exception

IRC E3902.16

Exception: AFCI protection is not required for an individual branch circuit which supplies only a fire alarm system and where the branch circuit wiring is contained within metal outlet and junction boxes and within metal raceways, metal gutter, steel-sheathed armored cable Type AC or Type MC (which must meet the requirements of Section E3908.8).




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AFCI For Branch Circuit Extensions

IRC E3902.18

- If a branch circuit in one of the locations noted at E3902.17 is altered or extended, then **one** of the following is required:
 - There must be a listed combination-type AFCI located at the origin of the branch circuit (the breaker).
 - A listed AFCI type receptacle is to be located at the first receptacle of the existing branch circuit.
 - Exception: AFCI protection is not required where an extension of existing conductors is not more than 6' and **does not** include any additional outlets or devices (other than splicing devices). The measurement does not include the wiring inside of the box or enclosure.



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Lighting Outlets

IRC E3903

- Must have at least one wall switch (or wall-mounted control device) that controls lighting in every habitable room and every bathroom and kitchen.
 - Exception 1: In **other than** kitchens and bathrooms a receptacle that is controlled by a wall switch is allowed (it's assumed that a cord connected lamp could be used for the room's lighting).
 - Exception 2: Lights can be controlled by an occupancy sensor as long as the sensor is equipped with a manual override that allows it to also act as a wall switch.

The required wall switch or control device must be located near an entrance to the room (new for 2021 IRC).



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Lighting Outlets Continued

IRC E3903.2

The required wall switch or control device must be located near an entrance to the room (new for 2021 IRC).

In other than kitchens and bathrooms, it's permissible to have switch controlled receptacles for the lighting outlet (but don't forget that general purpose receptacles are still required per E3901.2).

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Lighting At Additional Locations

IRC E3903.3

- At least one wall switch (control device) for lighting must be installed for hallways, stairs, attached garages, and detached garages (that have power provided).
- Must have a wall-switch (control device) to control lights located on the exterior of each outside door that provides access to grade level (this includes man doors at detached garages that have power provided to the garage).
 - Exception: Lights at hallways, stairs, and outside doors are permitted to have remote, central, or automatic controls.

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Lighting Continued...

Stairs that have 6 or more risers must have a wall switch at the top and bottom of the flight of stairs.

- Exception:** Lights at hallways, stairs, and outside doors are permitted to have remote, central, or automatic controls.

Switches would be required at top and bottom of each set of stairs if the landing had a door leading to another room.

For this photo, there only needs to be a switch at the very bottom and very top of the stairs (no switches required at the landing).

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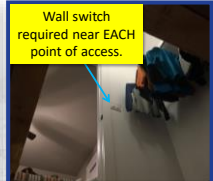
Lighting at Storage and Equipment Spaces

IRC E3903.4

- Lighting is required in attics, under-floor spaces, utility rooms, and basements when the area is to be used for storage or if there is equipment that may require servicing.
- The light must be located in the area of the equipment.
- The light(s) must be controlled by a switch (control device) located near the access to that space.
- There must be a light switch (control device) **at each access** to the attic, underfloor space, utility room, or basement (added for the 2021 IRC).

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Lighting at Storage and Equipment Spaces (Continued...)

Wall switch required near EACH point of access.

Attics, under-floor spaces, utility rooms, and basements which are used for storage or contain equipment (that could require servicing) must be provided with lighting and there must be lighting near the equipment.

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Electrical Continuity of Conduits and Enclosures

IRC E3904.1

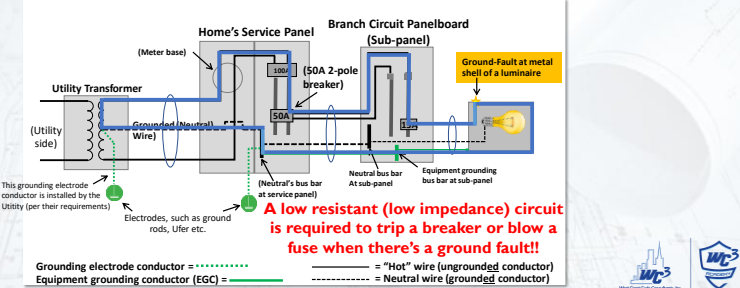
- All metal raceways (conduit), cable armor, and metal enclosures must be mechanically connected together for effective electrical continuity.
- Conduits and cables must be mechanically secured to boxes, fittings, cabinets, etc.
 - Exception: Short sections of conduit used only for support or protection of damage. [NEC 300.10 exception 1]



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Electrical Continuity of Metal Parts To The EGC Is VERY Important!!



A low resistant (low impedance) circuit is required to trip a breaker or blow a fuse when there's a ground fault!!

Grounding electrode conductor =
 Equipment grounding conductor (EGC) =
 = "Hot" wire (ungrounded conductor)
 = Neutral wire (grounded conductor)

This grounding electrode conductor is installed by the Utility (per their requirements)

Electrodes, such as ground rods, Ufer etc.

(Utility side)

(Meter base)

Home's Service Panel

Branch Circuit Panelboard (Sub-panel)

(SOA 2-pole breaker)

Ground-Fault at metal shell of a luminaire

(Neutral's bus bar at service panel)

Neutral bus bar At sub-panel

Equipment grounding bus bar at sub-panel

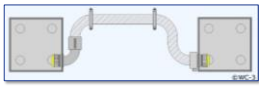
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Mechanical Continuity

IRC E3904.2 & E3904.5

- All metal or non-metallic raceways (conduit) and any cable sheaths must be continuous between cabinets, boxes, fittings, etc.
- All raceways must be completely installed between outlets, junction, or splicing points before installing the wires in the raceway (E3904.5).
- Exception: Short sections of conduit used only for support or protection of damage.

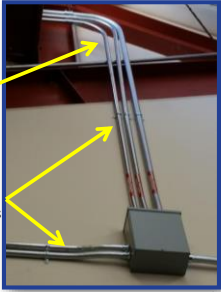


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Mechanical Continuity (Continued...)

All conduit must be continuous between outlets or pull boxes/conduit bodies. (unless short sections of conduit are only used for protecting cables)



Conduit is required to be secured within 3' of boxes and other terminations. Proper connection to the box is also required.




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Securing and Supporting

IRC E3904.3

- All raceways, cables, boxes, cabinets and fittings must all be securely fastened in place.
- Cable wiring methods are not allowed to support other cables, raceways, or other nonelectrical equipment (E3904.3.1).




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Raceways Used As Supports

IRC E3904.4

- Raceways are allowed to be used as a support for other cables, conduits, and non-electrical equipment **ONLY** if any of the following is met:
 - Where the raceway is designed and identified for such use.
 - Where the conduit has power supply wiring in it and the conduit is supporting class 2 circuit conductors that serve the same equipment as the wiring in the conduit.
 - Where the conduit is used to support boxes or conduit bodies per sections E3906.8.4 and E3906.8.5.

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Minimum Size of Raceways

- E3904.6 refers to Tables E3904.6(1) through E3904.6(10) which provides general information on the allowed number and size of conductors (wires) permitted in raceways (conduit).
- Controlling the number of wires in a conduit limits the buildup of heat from current-carrying conductors and minimizes damage to the conductors.
- Table E3907.8 provides maximum percentages for conduit fill:

IRC Table E3907.8 and NEC Chapter 9 Percentage of Fill for Raceways			
Number of Conductors	1	2	Over 2
All Conductor Types	53%	31%	40%

Note: one of the reasons "over two" wires allows for more conduit fill is because testing has shown that only pulling two wires in a conduit will "jam up" more often than when pulling more than two wires in a conduit.

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Conduit and Tubing Fill [see also Annex C.1 in the NEC]

IRC Tables E3904.6(1) – E3904.6(10)

TABLE E3904.6(1) MAXIMUM NUMBER OF CONDUCTORS IN ELECTRICAL METALLIC TUBING (EMT)*								
TYPE LETTERS	CONDUCTOR SIZE AWG/kcmil	TRADE SIZES (inches)						
		1/8	1/4	1/2	3/4	1	1 1/4	2
THHN, THWN, THWN-2	14	12	22	35	61	84	138	
	12	9	16	26	45	61	101	
	10	5	10	16	28	38	63	
	8	3	6	9	16	22	36	
	6	2	4	7	12	16	26	
	4	1	2	4	7	10	16	
	3	1	1	3	6	8	13	
	2	1	1	3	5	7	11	
	1	1	1	1	4	5	8	
	1/0	1	1	1	3	4	7	
	2/0	0	1	1	2	3	6	
	3/0	0	1	1	1	3	5	
4/0	0	1	1	1	2	4		


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Air Handling Stud and Joist Cavities (Plenums)

IRC E3904.7

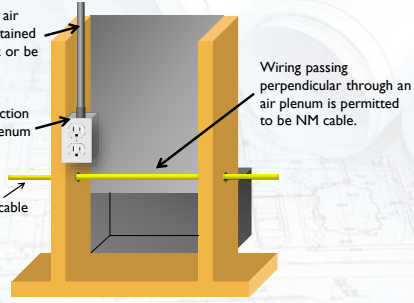
- Nonmetallic sheathed wiring methods in the joist or stud plenums in dwelling units is permitted **ONLY** where wiring passes through **perpendicular** to the long dimension of such spaces.
- If the wiring cannot be installed perpendicular to the long dimension of the plenum, then metallic wiring methods such as electrical metallic tubing, flexible metallic tubing, intermediate or rigid metal conduit would typically be required.



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Wiring Within an Air Plenum

IRC E3904.7 & NEC 300.22(C) exception




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Boxes or Conduit Bodies Required


IRC E3905.1

- A box or conduit body shall be installed at each wire splice point, outlet, switch point, junction point, and pull point (unless otherwise permitted per E3905.1.1 through E3905.1.6).
- E3905.1.1 through E3905.1.6 (when boxes and conduit bodies are not required):
 - o Integral junction box, compartment, or enclosure that is part of listed equipment.
 - o Where the conduit is only being used to protect the wiring or used for supports.
 - o A fitting identified for the use is permitted in lieu of a conduit body or box as long as it remains accessible and does not have any spliced wires within it.
 - o Buried cables that have been spliced using approved splicing methods.
 - o When using a luminaire that is listed to be used as a raceway.




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Light Fixture



This particular light fixture is required to be mounted to an electrical box (the wiring is not enclosed).

Example of an electrical box for a light fixture.





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Metal Boxes

IRC E3905.2

All metal boxes must be grounded (must be connected to the equipment grounding conductor). [NEC 314.4]

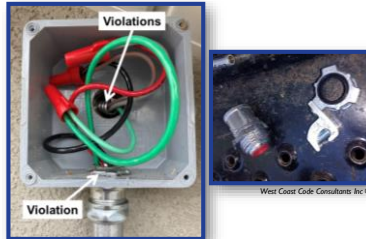




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Nonmetallic Boxes

IRC E3905.3


- Only nonmetallic sheathed cables, flexible cords, and nonmetallic conduit are allowed to be used with nonmetallic boxes.
- Exceptions:
 - Where internal bonding means are provided between all entries, then metal conduit or metal-armored cable (MC or AC cable) is permitted.
 - Where provisions for attaching an equipment grounding jumper to the conduit and such connection is within the box.


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Example

Bonding metal conduit to an equipment grounding conductor



Bushing with a lug for bonding metal conduit to equipment grounding conductor.





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Securing to Boxes


IRC E3905.3.1

- All wiring methods must be secured to electrical boxes.
- Exception:
 - When NM cable is used with boxes not larger than 2-1/4" by 4" that are mounted in walls or ceilings, and the cable is fastened within 8" of the box.
- The cable sheath is always required to extend into the box at least 1/4".
- Nonmetallic boxes must be suitable for the lowest temperature rating of the wires entering the box (E3905.3.2).



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Securing NM Cable



Must secure NM cable within 8" of the box when the wiring is not attached directly to the Box (and box is not larger than 2 1/4" by 4"). [E3905.3.1 exception]


Outer sheath of the NM cable must extend into the box at least 1/4" (E3905.3.1).



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Securing NM cable to boxes larger than 2 1/4" by 4" (Cont.)

The NM cable is required to be secured directly to the box, and the cable must be secured within 12" of the box. (note: MC cable must also always be secured within 12" of a box)



(This box has listed pressure devices that hold the wire to the box)






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Minimum Depth of Boxes

IRC E3905.4

- Outlet boxes that do not contain devices or utilization equipment must have an internal depth of not less than 1/2 inch (E3905.4.1 and NEC 314.24(A)).
- Boxes that enclose devices or equipment must be deep enough to accommodate the device and still leave enough room for the wires behind the device (E3905.4.2).
- Boxes that enclose large equipment (projects more than 1 7/8 in. into the box) are required to have a depth not less than depth of equipment plus 1/4 inch.
- Other boxes enclosing devices or utilization equipment must be sized based on the supply conductors to the devices or utilization equipment (see next slide).

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Depth of Boxes With Wires and Equipment

Provisions of E3905.4.2, items 1-5:

Note: Internal depth of boxes includes any installed extension boxes, plaster rings or raised covers that provide more depth in the box (E3905.4.2).

The exception to the requirements E3905.4.2 is utilization equipment that is listed to be installed within specific boxes, are permitted.

Size of wires or equipment at boxes:	Minimum required depth of the box that contains a device or equipment:
Boxes with devices that projects more than 1 7/8" into the box	Not less than the depth of the device or equipment plus 1/4".
Conductors larger than 4 AWG	Boxes must be designed and identified for the use. Otherwise, the box must be larger than 100 cubic inches and spacing at terminals of device must meet E3907.9.
Conductors of sizes 8, 6, or 4 AWG	An internal depth of not less than 2 1/16"
Conductors 12 or 10 AWG	Depth not less than 1 3/16" unless the device extends into the box more than 1" then the required depth is to be the depth of the device plus 1/4".
Conductors 14AWG or smaller	An internal depth of not less than 15/16"

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TABLE E3907.9.1(1) [Table 312.6(B)]
MINIMUM WIRE-BENDING SPACE AT TERMINALS (see Note 1)

WIRE SIZE (AWG or kcmil)	Compact stranded AA-8000 aluminum alloy conductors (see Note 3)	WIRES PER TERMINAL			
		One (see Note 2)		Two	
		inches	mm	inches	mm
14-10	12-8	Not specified	Not specified	—	—
8	6	1 1/2	38.1	—	—
6	4	2	50.8	—	—
4	2	3	76.2	—	—
3	1	3	76.2	—	—
2	1/0	3 1/2	88.9	—	—
1	2/0	4 1/2	114	—	—
1/0	3/0	5 1/2	140	5 1/2	140
2/0	4/0	6	152	6	152
3/0	250	6 1/2	165	6 1/2	165
4/0	300	7	178	7 1/2	190
250	350	8 1/2	216	8 1/2	229
300	400	10	254	10	254
350	500	12	305	12	305
400	600	13	330	13	330
500	700-750	14	356	14	356
600	800-900	15	—	—	—
700	1,000	16	—	—	—

Notes:
 1. Bending space at terminals shall be measured in a straight line from the end of the leg or wire connector in a direction perpendicular to the enclosure wall.
 2. For removable and lay-in wire terminals intended for only one wire, bending space shall be permitted to be reduced by the following number of inches (millimeters):
 a. 1/8 inch (12.7 mm)
 b. 1 inch (25.4 mm)
 c. 1 1/2 inches (38.1 mm)
 d. 2 inches (50.8 mm)
 e. 3 inches (76.2 mm)
 3. This column shall be permitted to determine the required wire-bending space for compact stranded aluminum conductors in sizes up to 1,000 kcmil and manufactured using AA-8000 series electrical grade aluminum alloy conductor material.

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Boxes for Luminaires

IRC E3905.6.1


Boxes used for the support of luminaires must be designed for such use.

If a box is wall-mounted (vertical surface) and is rated for luminaires weighing other than 50 lbs, must have the weight rating marked on the inside of the box

- Exception: Wall-mounted luminaires weighing not more than 6 lbs as long as the luminaire is secured to the box with at least 2 No. 6 or larger screws.



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Boxes for Luminaires Continued...

IRC E3905.6.2

- Ceiling-mounted boxes used for luminaires must be capable of supporting a luminaire up to 50 lbs.
- Any ceiling-mounted luminaires that weigh over 50 lbs must be supported independent of the box or the box must be designed for such and must have the weight rating noted inside of the box.





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Floor Boxes

IRC E3905.7

Floor boxes must be designed for such use and listed for the application. [NEC 314.27(B)]

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Boxes for Ceiling Fans


IRC E3905.8

Boxes used for the sole support of ceiling fans must be marked as suitable for such use and cannot support fans weighing over 70 lbs.

Boxes supporting fans weighing over 35 lbs must be marked with the rated weight on the inside of the box.



Since the max weight is not noted in this box then it must be assumed it cannot hold more than 35lbs.




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Accessibility of Conduit Bodies, J-boxes, Pull Boxes, and Outlet Boxes

IRC E3905.10 & NEC 314.29(A)&(B)

Any conduit bodies, junction boxes, pull boxes, and outlet boxes must be installed so the wiring therein can be rendered accessible without removing any part of the building construction or excavating sidewalks, paving, or earth. (see exception)



Violation! Building construction cannot cover up an electrical box.





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Boxes in Damp or Wet Locations

IRC E3905.11

- When a box or conduit bodies and fittings are in a damp or wet location, they need to be installed in such a way or be equipped to prevent moisture from entering or accumulating within the box/body.
- When the box or conduit body and fittings are in a wet location, they must be listed for such use.
- Where drainage openings are installed (or drilled) in the field, they must not be smaller than 1/8" or larger than 1/4" openings (or be per manufacturer's instructions).



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Box Fill

IRC E3905.12

- Total volume (space) of a box determines the number and size of conductors and wiring devices permitted to be contained within the box.
- The volume of a box is the total volume in cubic inches of the assembled sections (including extensions, etc.).
- All boxes (enclosures) must be large enough to provide sufficient free space for all enclosed conductors to prevent overcrowding and possible physical damage.




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Box Fill Continued...

IRC E3905.12

- IRC Table E3905.12.1 provides box dimension and trade size in inches for standard metal boxes.
- Any metal box 100 cubic inches or less, and all nonmetallic boxes, must have their cubic inch capacity durably and legibly marked by the manufacturer inside the box (E3905.12.1.2).



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Volume of Unmarked Metal Boxes

IRC Table E3905.12.1

BOX DIMENSIONS (inches trade size and type)	MAXIMUM CAPACITY (cubic inches)	MAXIMUM NUMBER OF CONDUCTORS*							
		18 Avg	16 Avg	14 Avg	12 Avg	10 Avg	8 Avg	6 Avg	
4 x 1 1/2 round or octagonal	12.5	8	7	6	5	5	4	2	
4 x 1 1/2 round or octagonal	15.5	10	8	7	6	6	5	3	
4 x 2 1/4 round or octagonal	21.5	14	12	10	9	8	7	4	
4 x 1 1/2 square	18.0	12	10	9	8	7	6	3	
4 x 1 1/4 square	21.0	14	12	10	9	8	7	4	
4 x 2 1/4 square	30.3	20	17	15	13	12	10	6	
4 1/16 x 1 1/2 square	25.5	17	14	12	11	10	8	5	
4 1/16 x 1 1/2 square	29.5	19	16	14	13	11	9	5	
4 1/16 x 2 1/4 square	42.0	28	24	21	18	16	14	8	
3 x 2 x 1 1/2 device	7.5	5	4	3	3	3	2	1	
3 x 2 x 2 device	10.0	6	5	5	4	4	3	2	
3 x 2 x 2 1/2 device	10.5	7	6	5	4	4	3	2	
3 x 2 x 2 1/2 device	12.5	8	7	6	5	5	4	2	
3 x 2 x 2 1/2 device	14.0	9	8	7	6	5	4	2	
3 x 2 x 3 1/2 device	18.0	12	10	9	8	7	6	3	
4 x 2 1/4 x 1 1/2 device	10.3	6	5	5	4	4	3	2	
4 x 2 1/4 x 1 1/2 device	13.0	8	7	6	5	5	4	2	
4 x 2 1/4 x 2 1/2 device	14.5	9	8	7	6	5	4	2	
3 1/2 x 2 x 2 1/2 masonry box/gang	14.0	9	8	7	6	5	4	2	
3 1/2 x 2 x 2 1/2 masonry box/gang	21.0	14	12	10	9	8	7	4	

51

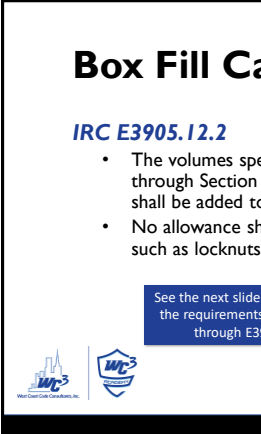


51

Box Fill Calculations

IRC E3905.12.2

- The volumes specified in Sections E3905.12.2.1 through Section E3905.12.2.5, where applicable, shall be added together.
- No allowance shall be required for small fittings such as locknuts and bushings.

See the next slide for a summary of the requirements of E3905.12.2.1 through E3905.12.2.5.

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Box Fill Calculations

IRC E3905.12.2.1 – E3905.12.2.5

Conductor, Device or Type of Fitting	Conductor Volume Allowance
Each conductor originating outside and terminating inside the box	1
Each conductor passing through the box unbroken	1
Looped or coiled conductor longer than 300 mm (12 in.)	2
Conductors that do not leave box (such as a jumper wires)	0
Max. of (4) fixture wires smaller than 14 AWG plus EGC (domed luminaire canopy)	0
Cable clamps (all combined clamps, not individual) (LB)	1
Support fittings (luminaire stud or hickey)(per fitting) (LB)	1
Device or equipment (receptacle, switch, etc.)(per yoke) (LC)	2
Large device wider than 50 mm (2 in.) with double mounting yokes (LC)	4
Equipment grounding conductors (up to 4 wires) (excluding isolated EGC) (LB)	1
Additional equipment grounding conductors for isolated EGC (LS)	1

LB = Largest conductor in box
 LC = Largest conductor connected to device
 LS = Largest conductor of additional set
 *No allowance is required for small fittings like locknuts and bushings

53

Required Space Per Wire/Device

IRC Table E3905.12.2.1

TABLE E3905.12.2.1 VOLUME ALLOWANCE REQUIRED PER CONDUCTOR	
SIZE OF CONDUCTOR	FREE SPACE WITHIN BOX FOR EACH CONDUCTOR (cubic inches)
18 AWG	1.50
16 AWG	1.75
14 AWG	2.00
12 AWG	2.25
10 AWG	2.50
8 AWG	3.00
6 AWG	5.00

54

By taking the volume noted in the box and dividing such volume by the free space required per conductor (shown at IRC Table 3905.12.2.1 – see previous slide), it will tell us how many conductors/devices are allowed.

For example: $22.5 \text{ in}^3 \div 2$ (for #14 AWG wire) = maximum of 11. Notice that this electrical box has already noted the maximum allowed wire/device fill for #14, #12, and #10 AWG wire.

55

Total calculated wire fill for this example = 9

Our box (as shown on the previous slide) allows up to (11) #14 AWG for wire fill.

OK!

#14 AWG wires


Up to 4 ground wires = 1 (each additional ground wire = .25 of a wire for fill calcs, new per 2021 IRC)



56

Exception

IRC E3905.12.2.1 Exception

Up to four fixture wires which are smaller than #14 AWG are permitted to be omitted from a box fill calculation where such fixture wires are part of a domed fixture or similar canopy.



57

Splices, Taps, or Devices in Conduit Bodies

IRC E3905.12.3.1

Conduit bodies cannot contain any wire splices or devices unless the volume (cubic inches) is clearly marked by the manufacturer, and all requirements for wire fill (Section E3905.12) are met.






58



END OF MODULE 9




59



Module 10

IRC Chapter 39, Part III







1

1

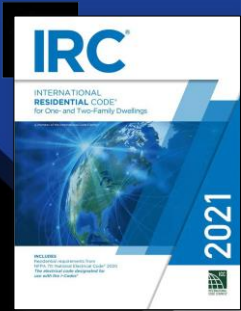
Learning Objectives

1. Electrical box and conduit mounting/connections
2. Requirements for grounding and bonding
3. General rules for flexible cords



2

2



IRC Chapter 39

Power and Lighting Distribution – Part III

3




3

Insulated Fittings

IRC E3906.1

- All conductors entering boxes, conduit bodies, or fittings must be protected from abrasion.
- Where conduit with #4 AWG or larger conductors enters a box or cabinet, there must be an insulating bushing on the end of the conduit to protect the wires from abrasion, unless the wires are secured in place with clamps or fittings designed to protect the wires.
- Threaded hubs, bosses, or fittings that have a smooth rounded edges are not required to have the insulated bushing.


Insulating bushings cannot be the only means of attaching a conduit to a box or cabinet.

4

4

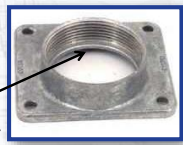
Insulated Fittings



Conduit bushings are not allowed to connect conduit to a box (for example, must have a locknut to secure the conduit to the box and then add the bushing).

Conduit bushings required for wires #4 AWG and larger.

Conduit hubs or bosses that have a smooth rounded edge do not require a conduit bushing.





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5

Unused openings

IRC E3906.4 & NEC 110.12(A)

- Unused openings are required to be closed to afford protection equivalent to the wall of the enclosure or equipment.
- Openings for mounting purposes, operation of listed equipment, or those per the design of listed equipment, do not have to comply with this requirement.


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6

Boxes Mounted In Walls or Ceilings

IRC E3906.5

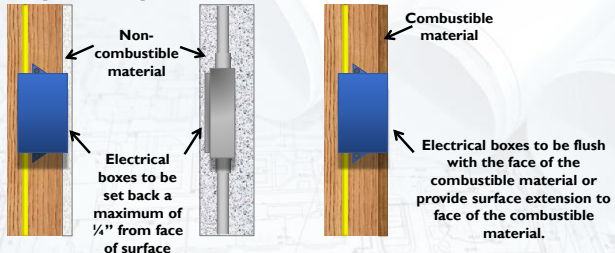
- Boxes mounted in walls or ceilings of non-combustible material (such as concrete, tile, etc.) must be set back from the surface of the wall or ceiling no more than 1/4".
- Boxes mounted in combustible construction must be flush with the surface of the wall or ceiling.
- Extension boxes, plaster rings, or listed extenders are allowed to be installed to meet the above noted requirements.



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Boxes Mounted In Walls or Ceilings (cont.)



Non-combustible material

Electrical boxes to be set back a maximum of 1/4" from face of surface


Combustible material

Electrical boxes to be flush with the face of the combustible material or provide surface extension to face of the combustible material.

Extension boxes, plaster rings, or listed extenders are allowed to be installed to meet the above noted requirements.

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8



Boxes in Noncombustible Surfaces

IRC E3906.6


- Openings in noncombustible surfaces that are for electrical boxes with flush-type covers or faceplates, must be as such that there is not more than an 1/8" gap around the edge of the box.
- Openings in *combustible surfaces* is not noted in the code, which could be interpreted that gaps are NOT allowed at all around an electrical box.



9

9


Recess and Gap Requirements Around Boxes (Cont.)



Cannot be more than 1/8" gap around box in noncombustible surfaces. Code doesn't specify required gaps when the box is in combustible surfaces (E3906.6).


Boxes cannot be set back more than 1/4" in non-combustible surfaces, or must be flush with combustible surfaces (E3906.5).

Multiple violations shown in the above photo!



10


10



Supports of Boxes and Enclosures

IRC E3906.8

All boxes and enclosures must be secured to a building or surface that provides a strong and stable support and the structure must be made of material that is durable and able to withstand the environment it is located in.





11

11

Boxes Without Devices Supported by Conduit

IRC E3906.8.4

- A box that does not exceed 100 cubic inches and does not contain a device or luminaire is permitted to be supported by two or more threaded conduits that enter the box.
- The conduit must be RMC or IMC (threaded conduit).
- The conduit must be secured within 3' of the box or secured within 18" of the box when both conduits connect to the box on the same side.

12

12

Boxes With Devices or Luminaire Supported by Conduit

IRC E3906.8.5

- A box not exceeding 100 cubic inches that does contain a device or luminaire is permitted to be supported by two or more threaded conduits that enter the box.
- The conduit must be secured within 18" of the box regardless of what side of the box they connect to.
- See exceptions for the support of a light weighing not over 20lbs and supported with a single RMC or IMC conduit, and for conduit bodies.



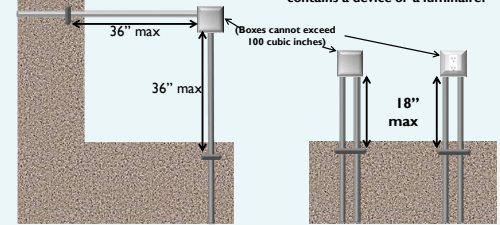
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13

Conduit Supporting Boxes

Conduit must be secured within 36" of box that does not contain a device (when conduit connects to the box on two separate sides).

Conduit must be secured within 18" of any box when both conduits connect to the box on the same side of the box or when the box also contains a device or a luminaire.



All conduit must be threaded connections to the box (RMC or IMC only).



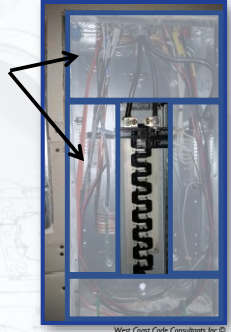
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14

Wire Fill in Cabinets and Panelboards

IRC E3907.1

- Total area of wires (conductors) cannot exceed **40%** of any cross section area of wiring space.
- Total area of all wires, splices, and taps cannot exceed **75%** of any cross section area of wiring space.
- A warning label is required to identify the disconnecting means for any feed-through wiring. This is new for the 2021 IRC.



15

15

Power Monitoring/Energy Management Equipment

IRC E3907.1.2

- When power monitoring/energy management equipment is installed in the wiring space of enclosures for switches or breakers, all of the following must be met:
 - The equipment must be listed as a field installable accessory in such enclosures.
 - Area of conductors/splices/taps not to exceed 75% (per E3907.1).
 - Conductors be Class 1 circuits, or if smaller than 18 AWG (but not smaller than 22 AWG) wire must comply with E3907.1.2 (3.2). This is new for the 2021 IRC.



16

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Cabinets in Damp and Wet Locations

IRC E3907.2

- Must be designed to prevent moisture or water from entering or accumulating within the cabinet or cutout box.
- Enclosures installed in wet locations shall be weatherproof.



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Damp and Wet Locations (continued)


Enclosures shall be mounted so there is at least 1/4 inch airspace between the enclosure and the wall or surface.

- Exception: Nonmetallic enclosures mounted on concrete, masonry, tile or similar surfaces do not have to have the 1/4" airspace.

Some cabinets have flared mounting holes to provide the needed 1/4" gap between the enclosure and the wall or surface.



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Damp and Wet Locations (continued)

IRC 3907.2 cont.

For enclosures in wet locations, raceways or cables entering above uninsulated live parts must have fittings listed for wet locations.



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Grounding of Metal Enclosures

IRC E3908.1

- All metal enclosures for electrical wiring, devices, and equipment must be connected to the equipment grounding conductor.
 - Exception 1: Short sections of conduit used only for protection of wiring.
 - Exception 2: A metal elbow installed underground a minimum of 18" deep or 2" of concrete covering the elbow.



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Effective Ground-Fault Current Pathway

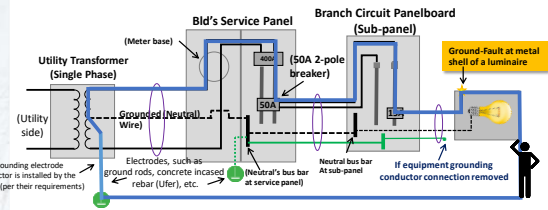
IRC E3908.4 & E3908.5

- All electrical equipment and wiring and other electrically conductive parts that may become energized must be installed in a manner that creates a low-impedance (low resistance) circuit that will facilitate the operation of a fuse or breaker.
- Such circuit must be capable of safely carrying the maximum ground-fault current likely to be imposed.
- The earth shall NOT be considered as an effective ground-fault current pathway!!**



21


Electrical Continuity of Metal Parts To The EGC Is VERY Important!!



A circuit completed through the earth is considered to be a high resistant circuit and will likely not allow enough current (amps) to flow to trip a breaker!!

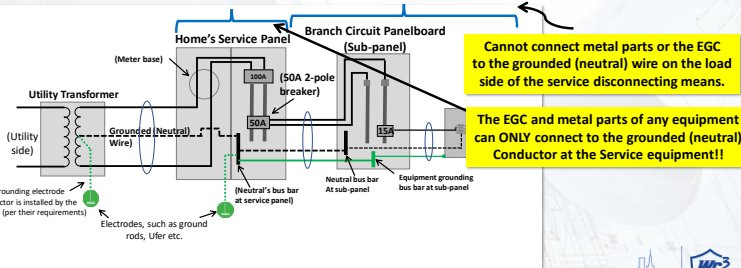
Grounding electrode conductor =
 Equipment grounding conductor (EGC) = ———— = "Hot" wire (ungrounded conductor)
 = Neutral wire (grounded conductor)

The earth is NOT considered an effective ground fault pathway!



22


Grounded (Neutral) Conductor Connections



Cannot connect metal parts or the EGC to the grounded (neutral) wire on the load side of the service disconnecting means.

The EGC and metal parts of any equipment can ONLY connect to the grounded (neutral) Conductor at the Service equipment!!

Grounding electrode conductor =
 Equipment grounding conductor (EGC) = ———— = "Hot" wire (ungrounded conductor)
 = Neutral wire (grounded conductor)




23

Types of Equipment Grounding Conductors

IRC E3908.9

- The equipment grounding conductor that is ran with the circuit conductors or is enclosing the circuit conductors must be one or more of the following:
 - A copper, aluminum, or copper-clad conductor. This conductor can be solid or stranded, insulated or bare, and can be a wire or busbar.
 - Rigid metal conduit (RMC)
 - Intermediate metal conduit (IMC)
 - Electrical metal tubing (EMT)
 - Armor type AC cable (per E3908.4)
 - MC (metal-clad) cable that has an equipment ground or is listed with a sheath that can be used as an equipment ground.
 - Other electrically continuous metal raceways or auxiliary gutters.
 - Surface metal raceways listed for grounding.



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Types of Equipment Grounding Conductors (cont.)

IRC, IMC, and EMT can count as an equipment grounding conductor as long as they have proper fittings and are properly connected to enclosures.

EMT and PVC conduit must have an equipment grounding conductor (wire) provided.

25

25

Types of Equipment Grounding Conductors (cont.)

MC cable has a wire type insulated equipment grounding conductor provided.

MC cable's sheath is permitted to be considered as an equipment grounding conductor IE listed for such. One example of this is listed hospital grade MC cable.

Non-metallic sheathed cable must contain an equipment grounding wire.

Electrically continuous gutters (or metal wireways) are also permitted to be considered as equipment grounding conductors.

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Flexible Metal Conduit Used as an EGC

IRC E3908.9.1

- If equipment does not require movement after installation, then flexible metal conduit may be used as an equipment grounding conductor (EGC) as long as all of the following is met:
 - The conduit is terminated with listed fittings.
 - The circuit conductors within the conduit are protected with no larger than 20A breaker(s) or fuse(s).
 - The total length of the conduit cannot exceed 6' in length.
- If equipment requires movement after installation, then there must be a wire type EGC installed in the conduit.

Flexible metal conduit

27

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Liquid-Tight Flex Metal Conduit Used as an EGC

IRC E3908.9.2

- If equipment does not require movement after installation, liquid-tight flexible metal conduit may be used as an EGC as long as all of the following is met:
 - The conduit connects to listed fittings.
 - For 3/8" and 1/2" conduit, the circuit conductors in the conduit must be protected by fuse(s) or breaker(s) rated no larger than 20A.
 - For 3/4" through 1 1/4" conduit, the circuit conductors in the conduit must be protected by fuse(s) or breaker(s) rated no more than 60A and there cannot be any 3/8" or 1/2" flexible metal conduit in the ground fault current path.
 - The total length of the conduit cannot exceed 6' in length.

Liquid-tight flexible metal conduit


28

28

Equipment Grounding Conductor Size

IRC E3908.13

- EGCs must be sized per Table E3908.13 (NEC Table 250.122) based on the rating of the fuse or breaker protecting the circuit conductors that the EGC is installed with.
- However, the EGC does not have to be larger than the ungrounded circuit conductors they are installed with.
- Other types of EGCs, such as metal conduit, AC cable, or listed MC cable can be used for the EGC as long as they meet the requirements of E3908.4 (see also E3908.9).
- Where circuit conductors are increased in size, the EGC must also be proportionately increased in size.



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EGC Sizing

IRC Table E3908.13

Note: if a breaker or fuse rating for a circuit is between the above noted ratings, then use the next higher rating shown. For example: if the circuit is protected by a 40A breaker we would base the size of the EGC per 60A shown in the table.

RATING OR SETTING OF AUTOMATIC OVERCURRENT DEVICE IN CIRCUIT AHEAD OF EQUIPMENT, CONDUIT, ETC., NOT EXCEEDING THE FOLLOWING RATINGS (amperes)	MINIMUM SIZE	
	Copper wire No. (AWG)	Aluminum or copper-clad aluminum wire No. (AWG)
15	14	12
20	12	10
60	10	8
100	8	6
200	6	4
300	4	2
400	3	1

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A Single EGC For Multiple Circuits

IRC E3908.13.1

- When a single equipment grounding conductor (EGC) is installed in a conduit that contains multiple circuits, then the EGC must be sized based on the largest breaker or fuse rating protecting any of the circuits.

For example:
If we have 3 different circuits in the same conduit and we only want to pull one EGC, and if the breakers are sized per the following: Circuit 1 – 20A breaker, Circuit 2 – 30A breaker, and Circuit 3 is protected by a 40A breaker.

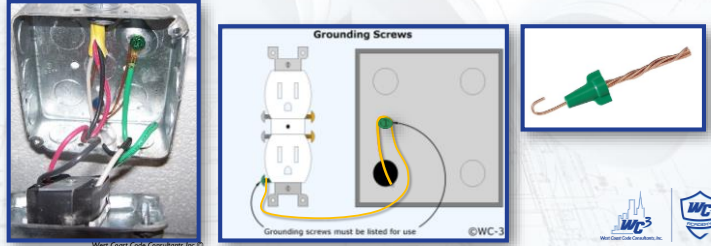
We size the EGC (per Table E3908.13) based on the largest rated breaker, which is 40A. Per Table E3908.13, our EGC must be at least #10 copper, or #8 aluminum. (NOTE: Since 40A is not shown at Table E3908.13, we must use the next rating shown, which is 60A)




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Grounding of Boxes and Receptacles

IRC E3908.14 & E3908.15



Grounding screws must be listed for use ©WC-3





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Grounding Conductors at Boxes

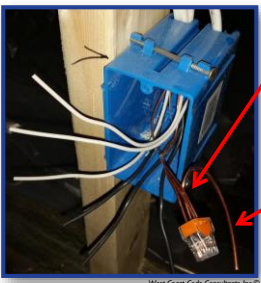
IRC E3908.14

- Where circuit conductors are spliced within a box or terminated on equipment within or supported by a box, any equipment grounding conductors associated with the circuit conductors shall be connected [together] within the box or [be connected] to the box with devices suitable for the use.
- The arrangement of grounding connections shall be such that the disconnection or removal of a receptacle, luminaire or other device fed from the box will not interfere with or interrupt the grounding continuity.


33

Grounding Conductors at Boxes (continued)



All equipment grounding conductors (EGCs) must be connected together in the electrical box. If the box was metal it also would need to be connected to the EGCs (see also E3908.15).

Bonding jumper provided to connect the EGCs to the grounding connection at the receptacle (or other device).



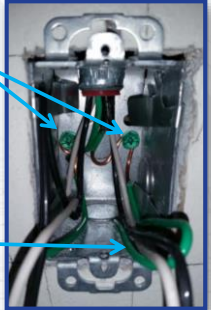

34

Grounding Conductors at Boxes (cont.)

In this example the metal box is bonded to the EGC's and the EGCs are bonded together because of the metal box.

Screws for connection must be machine threaded. **Cannot use sheet metal screws, drywall screws, grabber screws, etc.**

The extra length of EGC can then be used to connect to the receptacle or device.

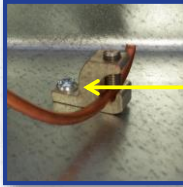
35

Nonconductive Coatings (Clean Surfaces)


IRC E3908.18

- Nonconductive coatings such as paint, lacquer, etc. must be removed from threads and other contact surfaces in order to ensure electrical continuity.
- Equipment is also permitted with fittings which are designed so removal of nonconductive coatings is not necessary.

In this example the ground lug is mounted on bare metal. However, if the lug was mounted on or in a painted enclosure (and the lug was not provided for the enclosure at the factory) the paint would need to be removed so the lug directly contacts the enclosure metal.



Screw must also be machine threaded. Can't use grabber screws, sheetrock screws, sheet metal screws, etc.



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Factory-punched hole for connections.

Ground lug with paint scraped off in enclosure.

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Bonding Other Enclosures

IRC E3908.19

Metal raceways, conduits, metal cable sheath etc. must be effectively bonded to the equipment grounding conductor or a metal enclosure that is effectively bonded to the equipment grounding conductor, and any paint or nonconductive coatings must be removed for the connection (or use devices that do not require the removal of the coatings).

Locknuts with teeth to dig into any paint or coatings.

Bond bushing for bonding metal conduit to the EGC.

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Flexible Cords

IRC E3909

- Appliances that use flexible cords for their connection to the power supply must be listed for flexible cord use.
- Flexible cords cannot be installed as a fixed wiring method of the home or structure.
- Flexible cords cannot be installed through or be concealed behind any walls, floors, ceilings, or suspended ceilings.

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Flexible Cords (cont.)

Appliances not designed for flexible cord connection must be hard wired as required per the manufacturer.

Violation! Can't use a flexible cord to supply furnace.




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40


40

Improper Use Of Flexible Cords

Violation! Cannot use flexible cords for permanent wiring! Also, flexible cords must be energized from a receptacle outlet (see E3909.4).

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Flexible Cords (cont.)

Sink disposals are one example of equipment which is supposed to be cord-and-plug connected.



Faucet.com



42


Maximum Amps For Flexible Cords

IRC Table E3909.2

- The maximum ampere load (as note in Table E3909.2) must not exceed what is allowed for flexible cords, unless the cord is designed and listed for use with a specific appliance.
- Flexible cords must be continuous without splices or taps.
- Flexible cords must have attachment plugs and connect only to receptacles (also, no hard-wiring allowed).

CORD SIZE (AWG)	TABLE E3909.2 MAXIMUM AMPERE LOAD FOR FLEXIBLE CORDS	
	CORD TYPES S, SE, SEQ, S1, S1E, S1EO, S1JO, S1JT, S1JO, S1JTO, SO, SOD, SRD, SRDE, SRDT, ST, STD, SV, SVO, SVOD, SVFO, SVFTGO	
	Maximum ampere load	
	Three current-carrying conductors	Two current-carrying conductors
18	7	10
16	10	13
14	15	18
12	20	25

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END OF MODULE 10



44

Module II
IRC Chapter 40

1

Learning Objectives

1. Requirements for switches
2. Requirements for receptacles
3. Allowable locations for lighting outlets

2

IRC Chapter 40
Devices and Luminaires

3


Rating of Snap Switches

IRC E4001.1

- General use snap switches shall be used within their rating and can control only the following:
 - Resistive and inductive loads not exceeding the amp rating of the switch at the supplied voltage.
 - Tungsten-filament lamp loads not exceeding the amp rating of the switch at 120 volts.
 - Motor loads not exceeding 80% of the amp rating of the switch at its rated voltage.
 - Electric discharge lamps that do not have loads exceeding the amp and voltage rating of the switch.
 - "Electronic ballasts, self-ballasted lamps, compact fluorescent lamps, and LED lamp loads with their associated drivers, not exceeding 20 amperes and not exceeding the ampere rating of the switch at the voltage applied." [NEC 404.14(A)]

Example of a snap switch


4



Switches Connected to Aluminum Wiring


IRC E4001.2

- Snap switched rated 20 amps or less that are connected to aluminum wiring must be marked as CO/ALR.
- This requirement also applies to receptacles (see E4002.3). [NEC 404.14(C)]



5


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Indicating of Switches


IRC E4001.3

- General-use switches, motor-circuit switches, and circuit breakers must clearly indicate when they are in the open (off) position or closed (on) position.
- Where single-throw switches or breakers are operated vertically, then the up position of the handle must be the ON (closed) position.




Example of a "throw switch"

Height of handle (in highest position) cannot be more than 67" above floor level, unless the switch is adjacent to a motor or appliance it supplies. (E4001.6)



6


6



Grounded Conductors

IRC E4001.8 & E4001.9

- Switches or circuit breakers cannot disconnect a grounded (neutral) conductor, except where the switch or circuit breaker simultaneously disconnects all conductors of the circuit (E4001.8).
- Three and four-way switches must be wired so switching only occurs in the ungrounded (Hot) conductor (E4001.9).
 - Exception: Switch loops do not require a neutral conductor.

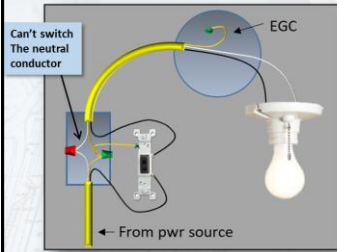


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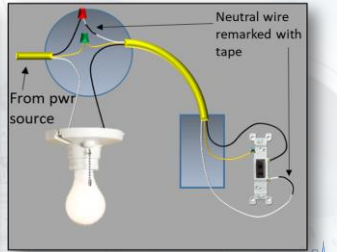
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Grounded conductors at switches (cont.)

Typical switch wiring example:



Switch-loop example:





8

8

Snap Switch Faceplates

IRC E4001.11

- Faceplates provided for snap switches must be installed so as to completely cover the opening and, where the switch is flush mounted, sit against the finished surface.
- Metal faceplates must also be bonded to a metal enclosure that's connected to an EGC, or bonded to a device that's connected to an EGC, per the requirements of E4001.11.1.



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Violation! Foil tape does not count as a faceplate!



9

9

Dimmer Switches

IRC E4001.12

- Dimmer switches can only control fixed in place lighting.
- Dimmer switches can only control other loads as long as it is designed and listed for such use.



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Snap Switches for Cord-and-plug Connected Loads

IRC E4001.14

“Where snap switches are used to control cord-and-plug-connected equipment on a general-purpose branch circuit, each snap switch controlling receptacle outlets or cord connectors that are supplied by permanently connected cord pendants shall be rated at not less than the rating of the maximum permitted ampere rating or setting of the overcurrent device protecting the receptacles or cord connectors, as provided in Sections E4002.1.1 and E4002.1.2.”



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Switches For Lighting Loads

IRC E4001.15

- There must be a grounded (neutral) conductor brought with the circuit conductors to each switch location for switches serving lighting loads in bathrooms, hallways, stairways, and habitable rooms or occupiable spaces.
 - See next slide for seven examples of when a neutral does not need to be brought to a switch.



Some switching devices require a neutral conductor for proper operation.



12

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When a neutral does not need to be installed to a switch:

- Where conductors enter the box enclosing the switch through a raceway, provided that the raceway is large enough for all contained conductors, including a grounded conductor.
- Where the box enclosing the switch is accessible for the installation of an additional or replacement cable without removing finish materials.
- Where snap switches with integral enclosures comply with E3905.1.3.
- Where lighting in the area is controlled by automatic means.
- Where the switch controls a receptacle load.
- Where replacing existing switches and the grounded (neutral) conductor cannot be extended to the switch location without removing finished materials.



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Receptacle Ratings

IRC E4002.1.1 & E4002.1.2

- A single receptacle installed on a dedicated branch circuit must have a rating not less than the rating of the circuit (in other words, if it's on a dedicated 20A circuit, it must be rated for 20A).
- Two or more receptacles on a single branch circuit must have a rating in accordance with Table E4002.1.2.

CIRCUIT RATING (amperes)	RECEPTACLE RATING (amperes)
15	15
20	15 or 20
30	30
40	40 or 50
50	50

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Receptacles In Damp/Wet Locations

IRC E4002.8 – E4002.10

- 15A and 20A receptacles on 125V or 250V circuits in **damp locations** can have covers that are weatherproof when the plug is not inserted (often called “flip covers”).
- Any receptacles on 125V or 250V circuits in **wet locations** must be weatherproof whether or not the plug is inserted (hence, “bubble covers” required), and must be listed as “extra-duty.”
 - Exception: The above noted requirement does not apply in wet location that is subject to routine high-pressure spray washing.
- E4002.10 allows receptacles that are rated other than 15A or 20A, can be weatherproof only when the plug is not connected when the equipment intended to be connected to the receptacle requires there be someone at the outlets location while the equipment is in use.
- All receptacles located in wet or damp locations must be listed as “weather resistant.”



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Receptacles In Damp/Wet Locations

IRC E4002.8 – E4002.10



Required for wet locations
(see 2nd half of E4002.10
for exception)



All receptacles installed
outside must be marked
“weather resistant” (E4002.8)



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Bathtub and Shower Spaces

IRC E4002.11

Receptacles are not permitted to be located within or directly over a tub or shower stall.

This is a 2018 IRC requirement (see next slide for 2021 IRC requirements)



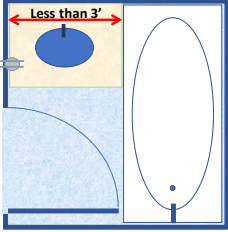


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Bathtub and Shower Space

IRC E4002.11

- Per E4002.11 of the 2021 IRC, there cannot be any receptacles located within 3 feet horizontally, and 8 feet vertically, to a shower threshold or tub rim.
- Exception:** When the bathroom is smaller than the above noted dimensions, the receptacle can be installed on the opposite wall from the tub or shower.

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Exposed Terminals

IRC E4002.13

All receptacles must be enclosed so that live wiring terminals are not exposed to contact.

Extremely dangerous violation!!! Receptacles must be in enclosed boxes!



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Tamper-Resistant Receptacles

IRC E4002.14


- All 15A and 20A 125-250V non-locking type receptacles installed inside or outside of the home must be the tamper resistant type (Section E3901.1 through E3901.11 specify required receptacle outlets).
- Exceptions:
 - Receptacles mounted more than 5.5 feet above the floor or grade level.
 - The receptacles are part of a luminaire or appliance.
 - Receptacles installed behind large appliances that are not easily moved.


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Tamper-Resistant Receptacles (Exceptions)



Receptacles that are part of a luminaire or appliance are not required to be tamper resistant.



Receptacles that are mounted over 5'6" above the floor or are located behind large appliances that are not easily moved, are not required to be tamper resistant.



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Recessed Incandescent Luminaires

IRC E4003.5

- Recessed incandescent luminaires must have thermal protection and be listed as such.
- Exceptions:
 - Thermal protection is not required for recessed lights that are installed in concrete and are listed for such installations.
 - Thermal protection is not required in recessed luminaires that have an equivalent design, construction and thermal performance characteristics as thermally protected luminaires.
- All luminaires must be installed so that combustible material will not be subject to temperatures over 194 F (E4003.2).

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Bathtub and Shower Areas

IRC E4003.11

- There cannot be any cord-connected luminaires, suspended luminaires, track lighting, pendants, or paddle fans in the zone located 8 feet above the rim of the tub (or shower threshold) and extending out 3 feet from the edge of the tub or shower.
- Permitted lights located directly over the tub or shower and less than 8' above the tub rim or shower threshold must be listed for damp locations, or listed for wet locations when subject to shower spray.

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Wet or Damp Locations

IRC E4003.9

- Luminaires installed in wet locations are required to be marked "suitable for wet locations."
- Any luminaires in damp locations must be marked either "suitable for wet locations" or "suitable for damp locations."

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Bathtub and Shower Areas

IRC E4003.11

©WC-3

Lights 8' or less directly above tub or shower threshold must be damp or wet rated

No pendants, track lights, or paddle fans in shaded zone

Receptacle within 3' of sink edge or on vanity within 12' of countertop

8 Ft

3 Ft

WC3

25

25

Luminaires In Clothing Closets

IRC E4003.12

- Only surface-mounted or recessed luminaires are allowed in a clothing closet (and can only be incandescent, fluorescent, or LED luminaires).
- There cannot be any exposed or partially exposed light bulbs for incandescent or LED light fixtures.
- Surface-mounted incandescent or LED luminaires cannot be installed closer than 12" to storage space (see explanation of storage space at beginning of E4003.12).
- Surface-mounted fluorescent fixtures must be installed at least 6" away from storage areas.
- Recessed incandescent, LED, or fluorescent light fixtures must be installed at least 6" away from the storage area.
- The above noted clearances are **not required** for surface-mounted fluorescent or LED fixtures where they are identified to be located in the storage areas of a clothing closet.

WC3

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Luminaires Not Permitted in Closets

IRC E4003.12

Pendant lights not allowed in clothing closets.

Surface-mounted or recessed incandescent or LED light fixtures with unenclosed light bulbs are not allowed in clothing closets.

Note: When can lights (with exposed bulbs) are installed in a clothing closet, sometimes an inspector will allow shower trim covers to be added to the lights so the bulbs are no longer exposed. Other types of covers or luminaires may also work as well (subject to AHJ approval).

WC3

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Lighting In Clothing Closets

Closest Light Clearances

©WC-3

Surface ceiling mount

Recessed light

Wall mount ok above closet door

6"

12"

12"

24"

72"

Shaded areas indicate storage area. Measurements indicate light clearances.

Storage area above the shelf is the shelf width or 12", whichever is greater

WC3

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Lights In Clothing Closets (cont.)

Minimum of 12" for surface-mounted incandescent fixtures. Minimum of 6" for recessed incandescent fixtures, or 6" for surface-mounted fluorescent fixtures.

Vertical line from edge of shelf to ceiling.

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Polarization Of Luminaires

IRC E4003.13.1

- Luminaires must be wired so the screw-shell that holds the light bulb is connected to the grounded conductor (neutral).
- Note: code refers to a bulb as a "lamp."

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Supports of Luminaires at Lampholders

IRC E4004.4

A luminaire that weighs more than 6 lbs or has a dimension that exceeds 16 inches, cannot be supported by the screw shell of a lampholder.

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Recessed Luminaire Clearance

IRC E4004.8

- Any recessed luminaires that are listed and identified as Type IC are allowed to be in contact with combustible material.
- Luminaires **not** IC rated must have all parts (except for supports) to be kept at least 1/2" from combustibles or 3" from thermal insulation (see also E4004.9).

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Track Lighting

IRC E4005

- The track lighting must be rated per the connected load (must be rated for the combined loads of each light), E4005.3.
- Track lighting is not allowed in the following locations:
 - Where subject to physical damage.
 - In wet or damp locations.
 - Where subject to corrosive vapors.
 - In storage battery rooms.
 - In hazardous locations.
 - Where concealed.
 - Where extending through walls or partitions.
 - Where less than 5' above the floor, unless the track lighting is protected, or unless the track operates at 30 volts or less.
 - Above shower or tub areas in accordance with E4003.1.1.



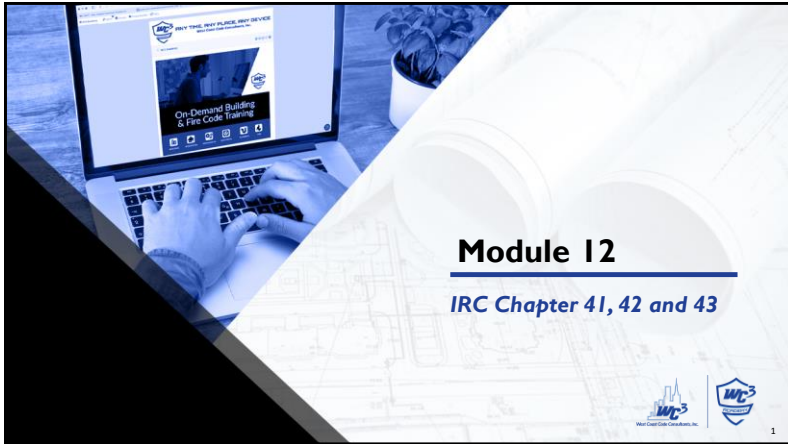
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END OF MODULE II

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Module 12
IRC Chapter 41, 42 and 43

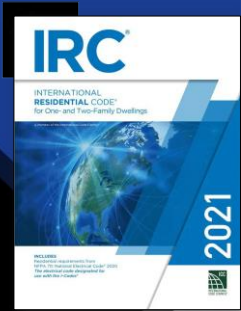
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Learning Objectives



1. Flexible cord requirements
2. Appliance disconnects
3. General swimming pool and spa/hot tub requirements
4. Hydro massage bathtub requirements
5. Basics of low voltage wiring

2



IRC Chapter 41
Appliance Installation








3

Flexible Cords

IRC E4101.3

- Appliances and equipment must be installed per the manufacturer's installation instructions (E4101.2).
- Receptacles for cord-and-plug-connected equipment must be accessible and be located to avoid any damage to the cord (and example of this could be over a stove or cooktop).

4


Flexible Cords

IRC E4101.3 cont.

- An individual branch circuit must serve a cord-and-plug range hood.
- A receptacle for a dishwasher (if cord-and-plug connected) must be located in the cabinet space next to the dishwasher.
- Cords for specific appliances must have minimum and maximum lengths as per Table E4101.3 (see also E3909).

APPLIANCE	MINIMUM CORD LENGTH (inches)	MAXIMUM CORD LENGTH (inches)
Kitchen waste disposal	18	36
Built-in dishwasher	36	48
Trash compactor	36	48
Range hoods	18	36

It's a good idea to cross reference E4101.3 with E3909 since they both deal with flexible cords.




5

Overcurrent Protection for Appliances

IRC E4101.4.1

- The rating of the fuse(s) or breaker serving a single non-motor-operated appliance must not exceed what is marked on the appliance.
- Where the overcurrent protection rating is not marked on the appliance and the appliance is rated over 13.3 amps, then the rating of the fuse(s) or breaker cannot exceed 150% of the rated current (amps) of the appliance.
- Where 150% of the current rating of the appliance does not correspond to a standard fuse or breaker size, then the next size up can be used.

Example: if we had an appliance rated at 15A, then the rating of the breaker for such appliance cannot exceed 25A. This is figured by taking the appliance rating of 15A and multiplying it by 150% which is 22.5A. Since 22.5A is not a standard breaker rating, it is acceptable to use a 25A breaker.





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Overcurrent Protection

IRC E4101.4.1 cont.

Where the overcurrent protection rating is not marked on appliances rated 13.3 amps or less, the fuse(s) or breaker cannot exceed 20 amps.





7

Disconnecting Means

IRC E4101.5

- Every appliance must be provided with a means to disconnect all ungrounded (hot) supply conductors.
- Switches or circuit breakers used for a disconnecting means must be the indicating type (shows when it is on or off).
- See Table E4101.5 for disconnect requirements for appliances.




8


Disconnecting Means

IRC Table E4101.5

In general, typically cord-and-plugs can count as a disconnect for an appliance as long as the appliance is listed to be cord-and-plug-connected and all requirements for flexible cords are met.



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Disconnecting Means

IRC Table E4101.5 cont.

- The disconnect for permanently connected appliances, rated not over 300VA (watts) or 1/8 horsepower, can be the circuit breaker or switch which is located within sight of the appliance, or located remote from the appliance if the breaker or switch is capable of being locked in the open (off) position.
- The disconnect for permanently connected appliances rated over 300VA can be the circuit breaker or switch which is located within sight of the appliance, or located remote from the appliance if the breaker or switch is capable of being locked in the open (off) position.
- See also Table 4101.5 for motors rated more than 1/8 horsepower, heating equipment, air conditioning units, and appliances with unit switches.



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Lockable Disconnects

IRC E4101.8

- Whenever a disconnecting means is required to be lockable, it must be capable to be locked in the open (off) position. The provisions for locking the disconnect must remain in place with or without the lock installed.
 - Exception: The locking provisions of a cord-and-plug connection is not required to remain in place when the lock is not installed.



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Snow-Melt Equipment Protection

IRC E4101.7

- Receptacles located in the eaves of roofs that are not readily accessible and that supply snow-melt and deicing equipment are not required to be GFCI protected.
- However, such receptacles are still required to have ground fault protection of equipment protection (GFPE).

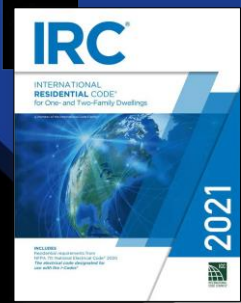


Example of a ground-fault protection of equipment breaker (GFPE). Note: A GFCI breaker typically has a fault-tripping sensitivity of about 6 mA, but a GFPE breaker typically has a sensitivity of about 30 mA.



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IRC Chapter 42

Swimming Pools

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Definitions

- **(new for 2021 IRC) Corrosive Environment.** Areas where pool sanitation chemicals are stored, handled, or dispensed, and confined areas under decks adjacent to such areas, as well as areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations.
- **Dry-Niche Luminaire.** A luminaire intended for installation in the floor or wall of a pool or spa in a niche that is sealed against the entry of water.
- **Wet-Niche Luminaire.** A luminaire intended for installation in a forming shell mounted in a pool structure where the luminaire will be completely surrounded by water.
- **No-Niche Luminaire.** A luminaire intended for installation above or below the water without a niche.





Image from inyopools.com

The luminaire is installed in what's called a "forming shell"

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Definitions

Permanently installed swimming, wading, immersion and therapeutic pools: "Those that are constructed in the ground or partially in the ground, and all others capable of holding water with a depth greater than 42 inches, and all pools installed inside of a building, regardless of water depth, whether or not served by electrical circuits of any nature."




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Definitions

STORABLE SWIMMING, WADING OR IMMERSION POOLS; OR STORABLE/PORTABLE SPAS AND HOT TUBS. Swimming, wading, or immersion pools that are intended to be stored when not in use, that are constructed on or above the ground and that are capable of holding water with a maximum depth of 42 inches (1067 mm), or a pool, spa, or hot tub that is constructed on or above the ground with nonmetallic, molded polymeric walls or inflatable fabric walls regardless of dimension.



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Allowable Wiring Methods In Corrosive Environments

IRC Table E4202.1

WIRING LOCATION OR PURPOSE (Application allowed where marked with an "A")	PERMITTED WIRING METHODS IN CORROSIVE ENVIRONMENTS				FLEXIBLE CONDUIT
	WPC ^a	LFMC ^b	LFMC ^c	WPC ^d	
Panelboards that supply pool equipment: from service equipment to panelboard	A	—	A	—	—
Wet niche and wet niche luminaires: from branch circuit OCPD to disk or junction box	A	—	A	—	—
Wet niche and wet niche luminaires: from disk or junction box to forming shell	A	—	A	—	A ^e
Dry niche: from branch circuit OCPD to luminaires	A	—	A	—	—
Pool-associated equipment: from branch circuit OCPD to motor ^f	A	A ^g	A	A	A ^h
Pool-associated equipment: from branch circuit OCPD to luminaire	A	A	A	A	A ⁱ
Packaged or self-contained outdoor spa and hot tubs with underwater luminaire: from branch circuit OCPD to spa or hot tub	A	A	A	A	A ^j
Packaged or self-contained outdoor spa and hot tubs without underwater luminaire: from branch circuit OCPD to spa or hot tub	A	A	A	A	A ^k
Indoor spa and hot tubs, and other pool, spa or hot tub associated equipment: from branch circuit OCPD to equipment	A	A	A	A	A ^l
Connection to pool lighting, transformers or power supplies	A	A	A	A	—

For ID: 1 For = R44 runs.
 a. For all wiring methods, see Section E4201 for equipment grounding conductor requirements.
 b. See Section E4202.2 for use of metal conduits in corrosive environments.
 c. Limited to those necessary to replace flexible connections or adjacent to a pool motor.
 d. Flexible conduit shall be installed in accordance with Section E4202.5.
 e. Nonmetallic conduit shall be rigid polyvinyl chloride (Type PVC) or reinforced thermoplastic resin conduit (Type RTRC).
 f. Underwater conductors shall not be permitted in the pool area where subject to corrosion.
 g. Where installed in direct contact with or in enclosures, Type MC cables shall be listed and identified for the location.
 h. See Section E4202.3 for listed, dry-rated outdoor pool power outlets.
 i. Limited to use in individual lengths not to exceed that. The total length of all individual runs of LFMC shall not exceed 10 feet.
 j. Metal conduit shall be constructed of brass or other approved corrosion-resistant metal.
 k. Metal conduit shall be constructed of brass or other approved corrosion-resistant metal.

Added in the 2018 IRC

Don't forget footnotes!

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Receptacle Outlets

IRC E4203.1.1 & E4203.1.2

- Receptacles cannot be located closer than 6' to the edge of the pool or any spa/hot tub.
- The 6' measurement is the shortest path a cord would follow from the receptacle to the edge of the pool without piercing a floor, wall, ceiling, doorway with hinged or sliding door, window opening, or another effective permanent barrier. (E4203.1)

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Receptacle Outlets Continued

IRC E4203.1.1 & E4203.1.2 (cont.)

- There must be at least one 15A or 20A (125 volt) receptacle located within 20' (but not closer than 6') of waters edge of the pool or any outdoor hot tub. This receptacle cannot be located over 6'6" above the ground or floor level (E4203.1.2).
- All receptacles within 20' of the pool must be GFCI protected (E4203.1.4).

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GFCI Protection

IRC E4203.1.4

All pool pump motors rated 60A or less on circuits operating at 150 volts to ground (or less) must be Class A GFCI protected, regardless of whether the connection to the motor is by cord-and-plug or is hardwired (E4203.1.4).

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Receptacle Outlets Continued

IRC E4203.1.4

- For **indoor locations**, receptacles must not be located closer than 6' to the edge of the spa or hot tub.
- For indoor locations, there must be a GFCI protected receptacle between 6' and 10' of the edge of the **spa or hot tub** (E4203.1.4 and E4203.1.5).
- Any receptacles rated 30A or less and within 10' of a spa or hot tub, must be GFCI protected (E4203.1.6).
- At least one receptacle is required in the pool equipment room and all receptacles in such room must be GFCI protected. (new for 2021 IRC, E4203.1.7)



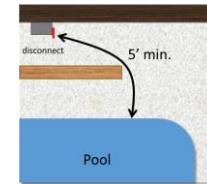
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Switching Devices

IRC E4203.2

- Switches shall not be located closer than 5' horizontally to the edge of the pool or spa/hot tub.
- Switches can be located closer to the edge of the pool or spa as long as there is a permanent barrier between the pool or spa and the switch, OR the switch is listed to be closer than 5 feet to the pool.



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Disconnecting Means

IRC E4203.3

- All pool equipment (except lighting) must have disconnecting means located within in sight of the equipment and be readily accessible.
- Such disconnecting means cannot be located closer than 5' to the edge of the pool or spa (unless separated by a permanent barrier).



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Luminaires And Ceiling Fans Outdoors

IRC E4203.4.1

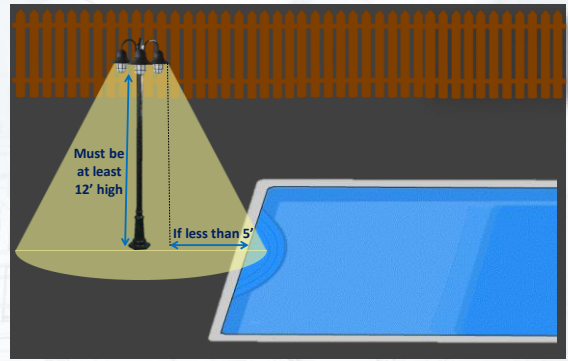
Any lights or ceiling-suspended paddle fans outdoors cannot be installed within 5 feet horizontally, or 12 feet vertically over a pool or spa/hot tub.



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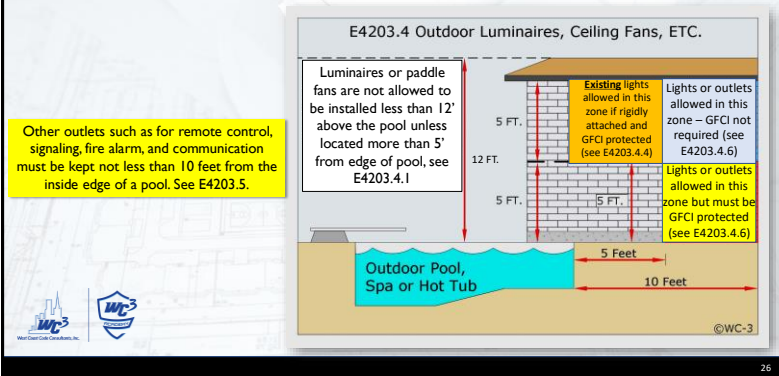
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Outdoor lighting (or paddle fans) near pools



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Outdoor lighting (or paddle fans) near pools (cont.)



26

Luminaires And Ceiling Fans Indoors

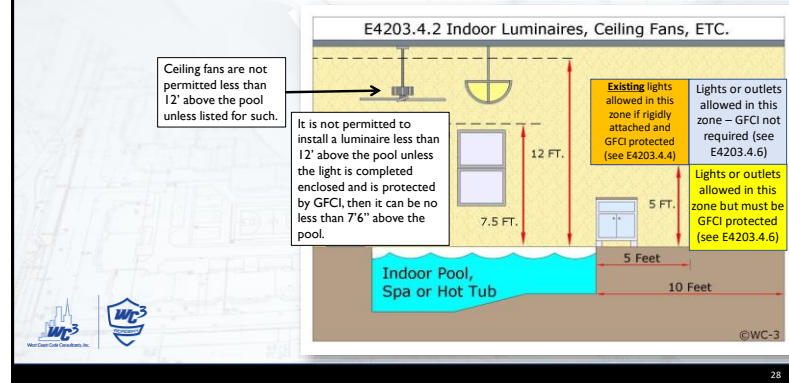
IRC E4203.4.2 & E4203.4.5

- Non-GFCI protected lights or paddle fans must be installed the same as required for outdoor locations (see E4203.4.1).
- lights are allowed to be installed less than 12' where they are installed at least 7'6" or more above maximum pool or spa water level and they are GFCI protected.
- To meet the above noted allowance, the lights must be the totally enclosed type.



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Indoor Pool, Luminaires, Ceiling Fans, etc.



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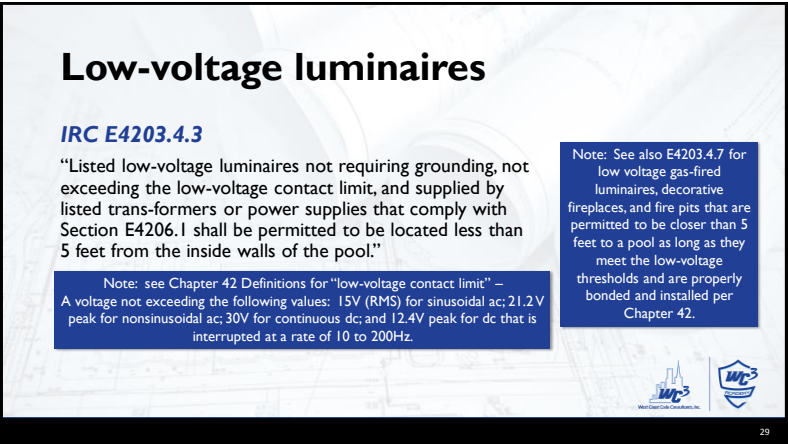
Low-voltage luminaires



IRC E4203.4.3

“Listed low-voltage luminaires not requiring grounding, not exceeding the low-voltage contact limit, and supplied by listed transformers or power supplies that comply with Section E4206.1 shall be permitted to be located less than 5 feet from the inside walls of the pool.”

Note: see Chapter 42 Definitions for “low-voltage contact limit” – A voltage not exceeding the following values: 15V (RMS) for sinusoidal ac; 21.2 V peak for nonsinusoidal ac; 30V for continuous dc; and 12.4V peak for dc that is interrupted at a rate of 10 to 200Hz.

Note: See also E4203.4.7 for low voltage gas-fired luminaires, decorative fireplaces, and fire pits that are permitted to be closer than 5 feet to a pool as long as they meet the low-voltage thresholds and are properly bonded and installed per Chapter 42.





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Overhead Conductor Clearances

IRC E4203.7

	INSULATED SUPPLY OR SERVICE DROP CABLES, 0-750 VOLTS TO GROUND, SUPPORTED ON AND CABLED TOGETHER WITH AN EFFECTIVELY GROUNDING BARE MESSANGER OR EFFECTIVELY GROUNDING NEUTRAL CONDUCTOR (feet)	ALL OTHER SUPPLY OR SERVICE DROP CONDUCTORS (feet)	
		Voltage to ground	
		0 to 15 kV	Greater than 15 to 90 kV
A. Clearance in any direction to the water level, edge of water surface, base of diving platform, or permanently anchored raft	22.5	25	27
B. Clearance in any direction to the diving platform	14.5	17	18

For SI: 1 foot = 304.8 mm.

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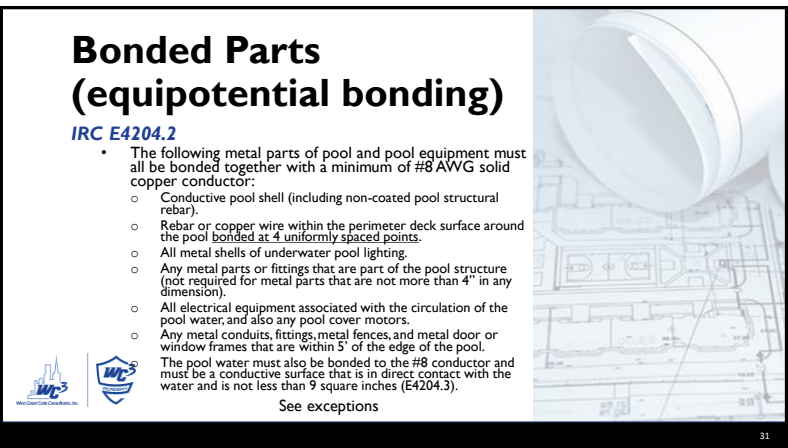
Bonded Parts (equipotential bonding)



IRC E4204.2

- The following metal parts of pool and pool equipment must all be bonded together with a minimum of #8 AWG solid copper conductor:
 - Conductive pool shell (including non-coated pool structural rebar).
 - Rebar or copper wire within the perimeter deck surface around the pool bonded at 4 uniformly spaced points.
 - All metal shells of underwater pool lighting.
 - Any metal parts or fittings that are part of the pool structure (not required for metal parts that are not more than 4" in any dimension).
 - All electrical equipment associated with the circulation of the pool water, and also any pool cover motors.
 - Any metal conduits, fittings, metal fences, and metal door or window frames that are within 5' of the edge of the pool.

The pool water must also be bonded to the #8 conductor and must be a conductive surface that is in direct contact with the water and is not less than 9 square inches (E4204.3).

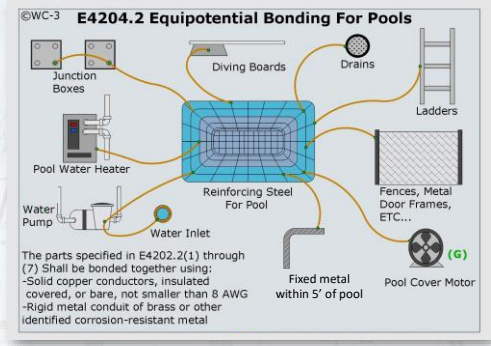
See exceptions



31



Equipotential Bonding (continued)



The parts specified in E4202.2(1) through (7) Shall be bonded together using:


- Solid copper conductors, insulated covered, or bare, not smaller than 8 AWG
- Rigid metal conduit of brass or other identified corrosion-resistant metal

All metal parts specified in E4204.2 must be bonded together using a solid bare #8 AWG copper wire or by using rigid metal conduit of brass or other identified corrosion resistant material.

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Equipotential Bonding (continued)



Pool rebar, metal shells, metal light fixtures, metal parts within 5' of the pool, pool circulation system, and the pool water itself must all be bonded together using a #8 AWG bare copper conductor.

Lugs must be listed for direct burial and must be installed per the manufacturer's requirements.

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Bonding of Parts



Perimeter surface to be bonded at 4 locations (evenly spaced) with a #8 AWG bare copper conductor.

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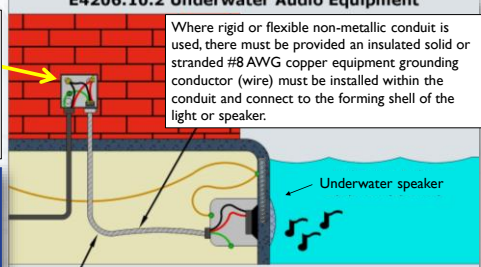
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Wiring for a forming shell:

E4206.10.2 Underwater Audio Equipment

Junction boxes for wiring to forming shells must be listed as a swimming pool junction box, must be mounted at least 4" about ground level or 8" above max water level (whichever is greater, and cannot be located any closer than 4' to water's edge of pool (see E4206.9).

Where rigid or flexible non-metallic conduit is used, there must be provided an insulated solid or stranded #8 AWG copper equipment grounding conductor (wire) must be installed within the conduit and connect to the forming shell of the light or speaker.



Underwater speaker

It's permitted to use RMC of brass or other identified corrosion-resistant metal, PVC, rigid thermosetting resin conduit, or liquid-tight flexible metal conduit (LFNC-B) to extend from the forming shell to a listed or suitable junction box (see E4206.9).

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Hydromassage Bathtubs

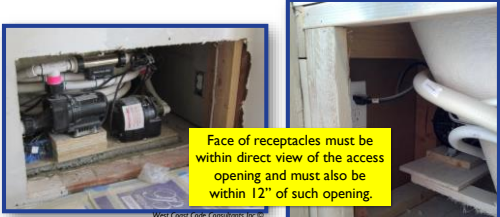
IRC E4209.1

- All hydromassage bathtubs must be protected by a ground fault circuit interrupter (GFCI).
- The GFCI protection device is required to be readily accessible (can't be hidden under the tub).
- The receptacle under the tub must be within 12" of the access opening and the face of the outlet must be visible from the access opening (E4209.3).

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Hydromassage Bathtubs (continued)



Face of receptacles must be within direct view of the access opening and must also be within 12" of such opening.

Receptacles for hydromassage bathtubs must be protected by an upstream GFCI device. This is required since a GFCI receptacle cannot be located under the tub (GFCIs must be readily accessible).


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Hydromassage Bathtubs - Bonding

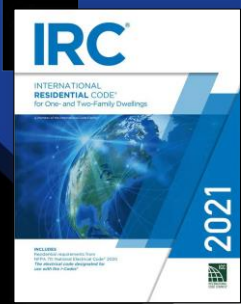
IRC E4209.5

- The following are required to be bonded together with a bare or insulated #8 AWG copper wire:
 - Metal fittings in contact with the circulating water.
 - Metal parts associated with the tub water circulating system.
 - Metal sheathed cables, metal raceways, and metal piping within 5 feet of the tub and not separated by a barrier.
 - Exposed metal surfaces within 5 feet of the tub and not separated by a barrier.
 - Noncurrent-carrying metal parts of electrical devices and controls not associated with the tub and are located within 5 feet of the tub.
 - The above noted bonding requirements are not required for short sections of metal piping under the tub (and remainder of the home has plastic water pipes), and metal parts not likely to become energized such as drain fittings, towel bars, mirror frames, and similar.
 - The above noted bonding requirement is also not required for motors with cords having double insulation protection.



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IRC Chapter 43

Class 2 Remote Control, Signaling and Power-Limited Circuits

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Class 2 circuits

E4302.1 – A class 2 circuit is where the source is one of the following:


- A listed Class 2 transformer.
- A listed Class 2 power supply.
- Other listed equipment marked to identify the Class 2 power source.
- Listed audio/video information technology (computer equipment) limited power circuits.
- A battery source or battery source system that is listed and identified as Class 2.

See Section E4303 for allowable wiring methods.

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Class 2 circuits (cont.)


IRC E4303.2.1 –

Class 2 cables in ducts, air plenums, or spaces for environmental air, must be Type CL2P cables listed as suitable for use and listed as having adequate fire-resistant and low smoke-producing characteristics.

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Class 2 circuits (cont.)


IRC E4304.1 –

- Class 2 circuits must not be placed in the same cable, compartment, enclosure, outlet box, device box, raceway, or similar fitting with conductors of lighting, power, Class 1 circuits, or nonpower-limited fire alarm circuits.
 - See exceptions, such as separation with a barrier, or when connecting the Class 2 wiring with other conductors to the same device.

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Class 2 circuits (cont.)


IRC E4304.2 –

- Class 2 circuits must be separated by at least 2" from conductors of lighting, power, Class 1 circuits, or nonpower-limited fire alarm circuits.
 - See exceptions for wiring in raceways or metal sheathed cable, or UF cable.

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Class 2 circuits (cont.)

IRC E4304.5 –

- Class 2 cables must be properly secured/supported with fittings designed to not damage the cable.
- The cables must also be protected in accordance with Table E3802.1 regarding cables run parallel to framing members and furring strips.

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Chapter 34 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Work space in front of an electrical panel board shall be minimum of _____ in width, but no less than the width of the panel board.	IRC E3405.2	IRC E3405	1	30-inches	36-inches	42-inches	48-inches
Where electrical conductors are to be spliced, terminated or connected to fixtures or devices, a minimum length of _____ of free conductor shall be provided at each outlet, junction or switch point.	IRC E3406.11.3	IRC E3406	2	4-inches	6-inches	8-inches	12-inches
Energized parts operating at a minimum of _____ shall be guarded against accidental contact by people through the use of approved enclosure.	IRC E3404.9	IRC E3404	1	50 volts	60 volts	90 volts	110 volts
The dedicated space above an indoor electrical panelboard shall be a minimum of _____ high or to the structural ceiling, whichever is lower.	IRC E3405.3	IRC E3405	3	4-feet	5-feet	6-feet	6.5-feet
An electrical panelboard requiring access while energized shall be provided with a minimum of _____ in depth of clear space in front of the panelboard measured in the direction of access.	IRC E3405.2	IRC E3405	2	30-inches	36-inches	42-inches	48-inches
Which of the following methods is not permitted for identifying equipment grounding conductors?	IRC E3407.2	IRC E3407	1	Continuous white color	Continuous green color	Bare	Continuous green color with one or more yellow stripes
Electrical services within the scope of the IRC shall be limited to _____ - volt, 0- to _____ - ampere, single-phase systems.	IRC E3401.2	IRC E3401	2	120/240 & 300	120/240 & 400	240 & 500	120 & 500
Equipment identified only for indoor use, such as "dry location," "indoor use only" "damp locations" or enclosure Type 1, 2, 5, 12, 12K and 13, and not identified for outdoor use shall be...	IRC E3404.5	IRC E3404	3	not permitted to be unidentified	protected against frost	protected against damage from the weather during construction	protected by harsh weather conditions
Plugs driven into plaster, masonry, concrete, or similar materials used for mounting electrical equipment shall not be made of what material?	IRC E3404.8	IRC E3404	4	PVC	metal	plastic	wood
Which of the following colors are an example of what is allowed for identification of ungrounded conductors:	IRC E3407.3	IRC E3407	1	red	gray	white	green

Chapter 35 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A continuous load is a load that is expected to continue for ____ hours or more?	IRC Chapter 35 definition	Chapter 35	3	0.5	2	3	4
A location protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture is considered a ____ location?	IRC Chapter 35 definition	Chapter 35	4	Dry	Wet	Moist	Damp
A system or circuit conductor that is intentionally grounded is considered a _____ conductor?	IRC Chapter 35 definition	Chapter 35	2	Grounding	Grounded	Ungrounded	Bonding
Which of the following is not considered as a raceway?	IRC Chapter 35 definition	Chapter 35	2	Electric Metallic Tubing	Cavity of a wall	Rigid Metallic Conduit	Wireway
The point of connection between the serving utility and the premise wiring system is called the _____?	IRC Chapter 35 definition	Chapter 35	4	Service lateral	Service conductors	Service drop	Service point
An overload, short circuit, or ground fault is considered to be _____?	IRC Chapter 35 definition	Chapter 35	1	Overcurrent	Fault	Overload	All of the above
What does the term "accessible" mean in regards to electrical equipment?	IRC Chapter 35 definition	Chapter 35	2	Having an ADA accessible ramp near equipment	Capable of being reached for operation, renewal and inspection	Able to access without professional assistance	A licensed electrician is the only person able to access the equipment
The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s) is known as:	IRC Chapter 35 definition	Chapter 35	3	Bonding wire	Arc-fault circuit	Branch circuit	Conductor
What does it mean for the equipment to be "grounded"?	IRC Chapter 35 definition	Chapter 35	1	Connected to ground or to a conductive body that extends the ground connection	Located close to the ground/earth	Installed used a grounding wire	Equipment is located underneath the ground for enhanced protection
A point on the wiring system at which current is taken to supply utilization equipment is known as:	IRC Chapter 35 definition	Chapter 35	4	Service conductor	Service cable	Receptacle	Outlet

Chapter 36 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A metal underground water pipe used as part of the grounding electrode system shall be in direct contact with the earth for a minimum of _____.	IRC E3608.1.1	IRC E3608	2	5 feet	10 feet	15 feet	20 feet
What is the minimum permitted size of a grounded service conductor when the ungrounded service conductors are 2/0 aluminum?	IRC E3603.1.4 and Table E3603.4	IRC E3603	2	No. 6 aluminum	No. 6 copper	No. 2/0 aluminum	No. 1 copper
Overhead service conductors shall have a minimum clearance of _____ over residential property and driveways.	IRC E3604.2.2, Item 2	IRC E3604	3	8 feet	10 feet	12 feet	15 feet
Where used outside, an aluminum or copper-clad aluminum grounding electrode conductor shall be installed a minimum of _____ from the earth.	IRC E3610.2	IRC E3610	3	6 inches	12 inches	18 inches	30 inches
As a general rule, for roofs having a slope of less than 4 inches in 12 inches of slope, overhead service conductors shall have a vertical clearance of not less than _____ feet above the roof surface.	IRC E3604.2.1	IRC E3604	1	8	10	12	15
When using PVC conduit to protect above-ground service-entrance cables that are subject to physical damage, the PVC conduit shall be schedule _____ PVC conduit.	IRC E3605.5	IRC E3605	4	75	40	60	80
Interior metal water piping located more than _____ feet from the point of entrance into the building shall not be used as a conductor to interconnect electrodes of the grounding electrode system.	IRC E3608.1.1.1	IRC E3608	2	8	5	10	12
Electrodes of the rod and pipe variety shall not be less than _____ in length.	IRC E3608.1.4	IRC E3608	1	8 feet	10 feet	12 feet	20 feet
Bonding shall be provided where necessary to ensure electrical _____ and the capacity to conduct safely any fault current likely to be imposed.	IRC E3609.1	IRC E3609	1	continuity	assurance	bonding	clearance
Where not buried or encased in concrete, all mechanical elements used to terminate a grounding electrode conductor or bonding jumper to the grounding electrodes shall be _____.	IRC E3611.2	IRC E3611	3	grounded	available	accessible	bonded

Chapter 37 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
The total rating(s) of all cord-and-plug equipment not fastened in place are not allowed to exceed _____ of the rating of a 15 or 20A branch circuit?	IRC E3702.3	IRC E3702	4	20%	60%	50%	80%
When a branch circuit serves multiple loads or outlets and includes lighting, such circuit is to have a maximum rating of _____ amps?	IRC E3702.3 & E3702.5	IRC E3702	2	30	20	15	25
The total rating(s) of all cord-and-plug equipment fastened in place are not allowed to exceed _____ of the rating of a 15 or 20A branch circuit where lighting units, cord-and-plug connected equipment, or both, are also supplied?	IRC E3702.3	IRC E3702	3	20%	60%	50%	80%
Branch circuits supplying a single motor must be sized not less than _____ of the motor's full-load current?	IRC E3702.6	IRC E3702	3	100%	80%	125%	115%
If a conduit has 8 current-carrying conductors, what factor must be used to derate the allowable ampacity of the wires?	IRC Table E3705.3	IRC E3705	3	0.50	0.60	0.70	0.80
.#10 AWG THHW copper wire has a maximum ampacity of _____ amps if all terminals and devices the wire connects to are rated 75°C?	IRC Table E3705.1 But don't forget that the maximum breaker (or fuses) rating for #10 AWG copper wire is only 30A, as required per Table E3705.5.3!	IRC E3705	2	40	35	30	25
What is the maximum ampacity of #6 THWN copper wire if ratings of wire terminals cannot be verified?	IRC Table E3705.1 & E3705.4.1	IRC E3705	1	55A	65A	75A	60A
.#2 AWG THWN-2 aluminum wire has a maximum ampacity of _____ amps if all terminals and devices the wire connects to are rated 75°C?	IRC Table E3705.1 & E3705.4.4	IRC E3705	1	90	100	75	95
What is the maximum ampacity of #4 Type NM copper cable if ratings of all wire terminals are 75°C?	IRC Table E3705.1 & E3705.4.4	IRC E3705	4	95A	85A	75A	70A
What is the maximum ampacity of #4 THHW copper wire if all terminals are known to be rated 75°C?	IRC Table E3705.1 & E3705.4.1	IRC E3705	2	95A	85A	75A	70A
How many grounded conductors are allowed per terminal at a panelboard?	IRC E3706.4	IRC E3706	3	3	No more than 2	Only 1	What's a grounded conductor?
What is the maximum ampacity of #3 THWN-2 copper wires that are installed in an environment having a temperature of 105°F (hint: terminals not noted)?	IRC Table E3705.1, Table E3705.2, & E3705.4.1	IRC E3705	4	100.05A	115A	100A	85A
What is the maximum ampacity of #6 THWN-2 copper wires that are installed in a conduit located in an environment having a temperature of 114°F and there's 8 current-carrying wires within the conduit, and all wire terminals are rated for 75°C?	IRC Table E3705.2, Table E3705.3, & E3705.4.1	IRC E3705	3	48.6A	75A	43A	65A
What is the maximum overcurrent protection device ampacity rating for #12 AWG copper wire?	IRC Table E3705.5.3	IRC E3705	2	15A	20A	25A	30A

Chapter 38 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Cables ran across the top of floor joist in an attic that is served by a permanent ladder is required to have the cables protected within ____ of the attic access?	IRC E3802.2.1	IRC E3802	4	6-feet	12-feet	Protection is not required	Anywhere in the accessible portion of the attic
Which of the following wiring methods is not permitted to be used for a service?	IRC Table E3801.4	IRC E3801	4	MC Cable	EMT Conduit	IMC Conduit	AC Cable
What is the maximum distance from an electrical box that a NM cable is required to be secured when the cable terminates in the box and the box does not have cable clamps?	IRC Table E3802.1 Footnote "h"	IRC E3802	3	6-inches	12-inches	8-inches	Not required to be secured
What is the maximum distance from an electrical box that a NM cable is required to be secured when the cable terminates in the box and the box does have cable clamps?	IRC Table E3802.1	IRC E3802	2	6-inches	12-inches	8-inches	Not required to be secured
Intermediate Metal Conduit (IMC) that is in a trench and the conduit is covered with at least 2" of concrete must be a minimum of ____ inches deep?	IRC Table E3803.1	IRC E3803	4	24	18	12	6
Nonmetallic conduit buried under a one-and-two family dwelling driveway must be buried at least ____ inches deep?	IRC Table E3803.1	IRC E3803	3	2	12	18	24
Insulated cables and conductors used where exposed to direct sun rays shall be listed or listed and marked, as being _____ .	IRC E3802.3.3	IRC E3802	1	Sunlight resistant	Heat resistant	Heat proof	Melt resistant
Where raceways are installed in wet locations above grade, the interior of said raceways shall be considered to be a _____ location.	IRC E3802.8	IRC E3802	2	damp	wet	humid	hazardous
Underground service conductors not encased in concrete and that are buried 18 inches or more below grade shall have their location identified by a(n) _____ .	IRC E3803.2	IRC E3803	3	yellow marker	orange indicator	warning ribbon	hazard flag
Direct buried cables and conductors which emerge from the ground shall be protected by raceways or enclosures extending from the minimum cover distance below grade...to a point at least ____ above finished grade.	IRC E3803.3	IRC E3803	1	8 feet	6 feet	10 feet	4 feet

Chapter 39 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Required grade level receptacles cannot be installed more than ____ above grade level?	IRC E3901.7	IRC E3901	4	6-feet	8-feet	5.5-feet	6.5-feet
A wall switched receptacle is allowed for lighting in any living area in a home except a bathroom and a _____?	IRC E3903.2, Exception 1	IRC E3903	2	Laundry room	Kitchen	Attic	Dining room
In order to be counted as a required wall receptacle in a living space, the receptacle cannot be mounted more than ____ above the floor?	IRC E3901.1, Item 4	IRC E3901	1	5-feet 6-inches	6-feet	8-feet	6.5-feet
Receptacles are required to be ground-fault circuit interrupter (GFCI) protected in all of the following areas except?	IRC E3902 does not specify that receptacles in attics must have GFCI protection.	IRC E3902	1	Attic	Kitchen counter space	Bathroom	Crawl space that is at grade level
Arc-fault circuit interrupter (AFCI) protection is required in all of the following areas except?	IRC E3902.17	IRC E3902	3	Bedroom	Sunroom	Bathroom	Hallway
What size copper equipment grounding conductor is required when installed with circuit conductors that are protected by a 70A breaker?	IRC Table E3908.13 (since 70A lands between ratings in the table, need to use next size up over 70A, which is 100A at the table)	IRC E3908	3	#14	#12	#8	#10
If the total required conductors for box fill is (12) #12 AWG conductors, what is the minimum required volume of the box?	IRC Table E3905.12.2.1	IRC E3905	4	24 cubic inches	25 cubic inches	21 cubic inches	27 cubic inches
The outer sheath of nonmetallic sheathed cable (NM cable) must extend into a box at least ____ of an inch?	IRC E3905.3.1	IRC E3905	2	1/2-inch	1/4-inch	3/8-inch	3/4-inch
There cannot be more than ____ #10 THHN conductors in a 1" electrical nonmetallic tubing (ENT)?	IRC Table E3904.6(2)	IRC E3904	1	15	16	8	26
If an electrical box is not specifically designed to support a luminaire, what is the maximum weight of a luminaire that can connect to the box if the light is mounted on the ceiling?	IRC E3905.6.2	IRC E3905	4	6 lbs.	50 lbs.	35 lbs.	Not allowed
If an electrical box is not specifically rated to support a luminaire, what is the maximum weight of the luminaire that can connect to the box if the light is wall mounted?	IRC E3905.6.1, Exception	IRC E3905	1	6 lbs.	50 lbs.	35 lbs.	Not allowed

Chapter 40 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A single receptacle installed on an individual branch circuit that protected by a 20A breaker must be rated at least ____?	IRC E4002.1.1	IRC E4002	3	15A	15A or 20A	20A	30A
When more than one receptacle is installed on a branch circuit that is protected by a 20A breaker, then the minimum required rating of the receptacle is ____?	IRC Table E4002.1.2 - 15 or 20A is acceptable, but the question asks for the "minimum" rating, which is 15A	IRC E4002	1	15A	15A or 20A	20A	30A
A receptacle is not required to be the tamper-resistant type when a receptacle installation meets all of the following except for?	IRC E4002.14	IRC E4002	3	Where mounted more than 5.5 above the floor level in a living area.	Where the receptacle is part of a luminaire.	Where installed at a kitchen countertop space.	Where the receptacle is serving and is behind large equipment that is difficult to move.
A receptacle installed directly over a shower or tub space must _____?	IRC E4002.11	IRC E4002	2	Have GFCI protection.	Be mounted 8' or more above the tub rim or shower threshold.	Not allowed to be mounted over the tub or shower space.	Have a weather proof cover.
Where a clothing closet has a shelf that is 18" wide and is mounted on the back wall of the closet, how far away must a recessed incandescent light fixture be located from the back wall of the closet?	IRC E4003.12, Item 3	IRC E4003	4	6-inches	12-inches	18-inches	24-inches
For a non-IC rated can light, insulation must be kept at least ____ inches away from the can light wiring compartment?	IRC E4004.9	IRC E4004	4	2-inches	1-inches	6-inches	3-inches
Track lighting is allowed to be installed in all of the following locations except?	IRC E4005.4, Item #2	IRC E4005	1	At an outside carport.	In a bathroom where mounted more than 8' above the tub rim.	At an unfinished basement.	In a kitchen.
A snap switch rated 20A amperes or less which have aluminum conductors connecting to it must be marked as ____?	IRC E4001.2	IRC E4001	3	CU/AL	C/A	CO/ALR	Cop/Alum
Switches and circuit breakers used as switches shall be installed so that the center of the grip of the operating handle of the switch or circuit breaker, when in the highest position, will not be more than ____ feet ____ inches above the floor or working platform.	IRC E4001.6	IRC E4001	2	6, 8	6, 7	4, 6	4, 8
Recessed incandescent luminaires shall have _____ protection.	IRC E4003.5	IRC E4003	1	thermal	heat	ambient	frost

Module Chapters 41-43 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the maximum overcurrent protection device rating for a circuit that supplies a single non-motor appliance rated 15 amps and the maximum overcurrent protection is not marked on the appliance?	IRC E4101.4.1 (150% × 15A= 22.5A, and next size up breaker is 25A)	IRC E4101	1	25A	15A	20A	30A
The disconnect for an air-conditioning condensing unit must be located where?	IRC Table E4101.5	IRC E4101	3	At the breaker panel if the breaker is lockable.	A snap switch located inside of the home.	A disconnect located within sight of the unit.	A disconnect located out of sight of the unit as long as it is lockable.
Which of the following is not allowed for a disconnect serving a permanently connected appliance rated more than 300 volts?	IRC Table E4101.5	IRC E4101	3	A breaker located within sight of the appliance.	A switch located next to the appliance.	A non-lockable switch not located within sight of the appliance.	A breaker that is lockable in the off position.
The minimum length of flexible cord for a trash compactor is ___ feet?	IRC Table E4101.3	IRC E4101	1	3	4	1.5	2
Which of the following type of conduit/raceway is not permitted for underground wiring installed within 5 feet of a pool?	IRC E4203.8	IRC E4203	2	Rigid Metal Conduit	Electrical Non-Metallic Tubing	Polyvinyl Chloride (PVC)	Intermediate Metal Conduit
In order to be considered as a storable swimming pool, the maximum water depth cannot exceed ___ inches deep and be constructed above ground?	IRC Chapter 42 Definition - Storable Swimming Pool	IRC Chapter 42	4	18-inches	36-inches	24-inches	42-inches
Which of the following wiring methods is not allowed for wiring originating at the branch circuit OCPD and extending to a junction box, for a wet niche luminaire?	IRC Table E4202.1	IRC E4202	4	ENT	LFNMC	RMC	LFMC
A light switch cannot be located closer than ___ feet to the edge of a pool?	IRC E4203.2	IRC E4203	4	6-feet	10-feet	20-feet	5-feet
At least one 15 or 20A receptacle must be located within ___ feet of the pool for servicing the pool area?	IRC E4203.1.3	IRC E4203	1	20-feet	10-feet	6-feet	5-feet
What is the minimum required overhead clearance for 120V lighting installed directly above a pool?	IRC Table 4203.7	IRC E4203	2	22.5 feet	25 feet	27 feet	No clearance required if the lighting is GFCI protected.
All receptacles located within ___ feet of a hydromassage bathtub must be GFCI protected?	IRC E4209.2	IRC E4209	3	20-feet	10-feet	6-feet	5-feet
The receptacle located under a hydromassage tub must be located within ___ inches of the access opening?	IRC E4209.4	IRC E4209	2	6-inches	12-inches	18-inches	24-inches
Unless listed for such interconnection, a Class 2 power source shall not have its output connections paralleled or otherwise interconnected with...	IRC E4302.2	IRC E4302	1	another Class 2 power source	Class 2 transformer	Class 3 power source	Class 3 Plenum Cable
Which rating shall not be marked on Class 2 cables?	IRC E4303.2.5	IRC E4303	4	energy ratings	wattage ratings	amperage ratings	voltage ratings
Cables and conductors installed exposed on the surface of ceilings and sidewalls shall be supported by the building structure by any of the following methods except:	IRC E4304.5	IRC E4304	3	straps	staples	a fitting that could damage the cable	cable ties

2021 Residential Electrical Inspector Practice Exam Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the maximum overcurrent protection device rating for a circuit that supplies a single non-motor appliance rated 15 amps and the maximum overcurrent protection is not marked on the appliance?	IRC E4101.4.1 (150% × 15A= 22.5A, and next size up breaker is 25A)	IRC E4101	3	15A	20A	25A	30A
The disconnect for an air-conditioning condensing unit must be located where?	IRC Table E4101.5	IRC E4101	3	At the breaker panel if the breaker is lockable.	A snap switch located inside of the home.	A disconnect located within sight of the unit.	A disconnect located out of sight of the unit as long as it is lockable.
A single receptacle installed on an individual branch circuit that protected by a 20A breaker must be rated at least ____?	IRC E4002.1.1	IRC E4002	3	15A	15A or 20A	20A	30A
When more than one receptacle is installed on a branch circuit that is protected by a 20A breaker, then the minimum required rating of the receptacle is ____?	IRC Table E4002.1.2 - 15 or 20A is acceptable, but the question asks for the "minimum" rating, which is 15A	IRC E4002	1	15A	15A or 20A	20A	30A
The total rating(s) of all cord-and-plug equipment not fastened in place are not allowed to exceed _____ of the rating of a 15 or 20A branch circuit?	IRC E3702.3	IRC E3702	4	20%	60%	50%	80%
When a branch circuit serves multiple loads or outlets and includes lighting, such circuit is to have a maximum rating of ____ amps?	IRC E3702.3 & E3702.5	IRC E3702	3	30	25	20	15
What is the maximum ampacity of #6 THWN-2 copper wires that are installed in a conduit located in an environment having a temperature of 114°F and there's 8 current-carrying wires within the conduit, and all wire terminals are rated for 75°C?	IRC Table E3705.2, Table E3705.3, & E3705.4.1	IRC E3705	3	48.6A	75A	43A	65A
Required grade level receptacles cannot be installed more than ____ above grade level?	IRC E3901.7	IRC E3901	4	6-feet	8-feet	5.5-feet	6.5-feet
A wall switched receptacle is allowed for lighting in any living area in a home except a bathroom and a _____?	IRC E3903.2, Exception 1	IRC E3903	2	Laundry room	Kitchen	Attic	Dining room
How many grounded conductors are allowed per terminal at a panelboard?	IRC E3706.4	IRC E3706	3	3	No more than 2	Only 1	What's a grounded conductor?
What is the maximum ampacity of #3 THWN-2 copper wires that are installed in an environment having a temperature of 105°F (hint: terminals not noted)?	IRC Table E3705.1, Table E3705.2, & E3705.4.1	IRC E3705	4	100.05A	115A	100A	85A
A metal underground water pipe used as part of the grounding electrode system shall be in direct contact with the earth for a minimum of _____.	IRC E3608.1.1	IRC E3608	2	5-feet	10-feet	15-feet	20-feet
What is the minimum permitted size of a grounded service conductor when the ungrounded service conductors are 2/0 aluminum?	IRC E3603.1.4 and Table E3603.4	IRC E3603	3	No. 6 aluminum	No. 1 copper	No. 6 copper	No. 2/0 aluminum
Cables ran across the top of floor joist in an attic that is served by a permanent ladder is required to have the cables protected within ____ of the attic access?	IRC E3802.2.1	IRC E3802	4	6-feet	12-feet	Protection is not required	Anywhere in the accessible portion of the attic
Which of the following wiring methods is not permitted to be used for a service?	IRC Table E3801.4	IRC E3801	4	MC Cable	EMT Conduit	IMC Conduit	AC Cable
A light switch cannot be located closer than ____ feet to the edge of a pool?	IRC E4203.2	IRC E4203	4	6-feet	10-feet	20-feet	5-feet

2021 Residential Electrical Inspector Practice Exam Questions

At least one 15 or 20A receptacle must be located within ___ feet of the pool for servicing the pool area?	IRC E4203.1.2	IRC E4203	1	20-feet	10-feet	6-feet	5-feet
What is the maximum distance from an electrical box that a NM cable is required to be secured when the cable terminates in the box and the box does not have cable clamps?	IRC Table E3802.1 Footnote "h"	IRC E3802	3	6-inches	12-inches	8-inches	Not required to be secured
What is the maximum distance from an electrical box that a NM cable is required to be secured when the cable terminates in the box and the box does have cable clamps?	IRC Table E3802.1	IRC E3802	2	6-inches	12-inches	8-inches	Not required to be secured
The total rating(s) of all cord-and-plug equipment fastened in place are not allowed to exceed _____ of the rating of a 15 or 20A branch circuit where lighting units, cord-and-plug connected equipment, or both, are also supplied?	IRC E3702.3	IRC E3702	3	20%	60%	50%	80%
Branch circuits supplying a single motor must be sized not less than ____ of the motor's full-load current?	IRC E3702.6	IRC E3702	3	100%	80%	125%	115%
In order to be counted as a required wall receptacle in a living space, the receptacle cannot be mounted more than ____ above the floor?	IRC E3901.1, Item 4	IRC E3901	1	5-feet 6-inches	6-feet	8-feet	6.5-feet
If an electrical box is not specifically designed to support a luminaire, what is the maximum weight of a luminaire that can connect to the box if the light is mounted on the ceiling?	IRC E3905.6.2	IRC E3905	4	25 lbs.	35 lbs.	50 lbs.	Not allowed
If an electrical box is not specifically rated to support a luminaire, what is the maximum weight of the luminaire that can connect to the box if the light is wall mounted?	IRC E3905.6.1, Exception	IRC E3905	1	6 lbs.	50 lbs.	35 lbs.	Not allowed
A non-metallic conduit listed for direct burial installed within 5' of the edge of the pool, with no concrete slab above it, must be buried how many inches deep?	IRC Table 4203.7	IRC E4203	2	6-inches	18-inches	24-inches	12-inches
All receptacles located within ___ feet of a hydromassage bathtub must be GFCI protected?	IRC E4209.2	IRC E4209	3	20-feet	10-feet	6-feet	5-feet
The receptacle located under a hydromassage tub must be located within ___ inches of the access opening?	IRC Table E4209.3	IRC E4209	2	6-inches	12-inches	18-inches	24-inches
Overhead service conductors shall have a minimum clearance of _____ over residential property and driveways.	IRC E3604.2.2, Item 2	IRC E3604	3	8-feet	10-feet	12-feet	15-feet
Where used outside, an aluminum or copper-clad aluminum grounding electrode conductor shall be installed a minimum of _____ from the earth.	IRC E3610.2	IRC E3610	3	6-inches	12-inches	18-inches	30-inches
A continuous load is a load that is expected to continue for ____ hours or more?	IRC E3501	IRC Chapter 35	3	0.5	2	3	4
A location protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture is considered a ____ location?	IRC E3501	IRC Chapter 35	4	Dry	Wet	Moist	Damp
Intermediate Metal Conduit (IMC) that is in a trench and the conduit is covered with at least 2" of concrete must be a minimum of ___ inches deep?	IRC Table E3803.1	IRC E3803	1	6	12	18	24
Nonmetallic conduit buried under a one-and-two family dwelling driveway must be buried at least ___ inches deep?	IRC Table E3803.1	IRC E3803	3	2	12	18	24
If a conduit has 8 current-carrying conductors, what factor must be used to derate the allowable ampacity of the wires?	IRC Table E3705.3	IRC E3705	3	0.50	0.60	0.70	0.80

2021 Residential Electrical Inspector Practice Exam Questions

#10 AWG THHW copper wire has a maximum ampacity of ____ amps if all terminals and devices the wire connects to are rated 75°C?	IRC E3705.1 - But don't forget that the maximum breaker (or fuses) rating for #10 AWG copper wire is only 30A, as required per Table E3705.5.3!	IRC E3705	2	40	35	30	25
Track lighting is allowed to be installed in all of the following locations except?	IRC E4005.4, Item #2	IRC E4005	1	At an outside carport.	In a bathroom where mounted more than 8' above the tub rim.	At an unfinished basement.	In a kitchen.
A snap switch rated 20A amperes or less which have aluminum conductors connecting to it must be marked as ____?	IRC E4001.2	IRC E4001	3	CU/AL	C/A	CO/ALR	Cop/Alum
A system or circuit conductor that is intentionally grounded is considered a _____ conductor?	IRC E3501	IRC Chapter 35	2	Grounding	Grounded	Ungrounded	Bonding
Which of the following is not considered as a raceway?	IRC E3501	IRC Chapter 35	2	Electric Metallic Tubing	Cavity of a wall	Rigid Metallic Conduit	Wireway
Receptacles are required to be ground-fault circuit interrupter (GFCI) protected in all of the following areas except?	IRC E3902 does not specify that receptacles in attics must have GFCI protection.	IRC E3902	1	Attic	Kitchen counter space	Bathroom	Crawl space that is at grade level
Arc-fault circuit interrupter (AFCI) protection is required in all of the following areas except?	IRC E3902.17	IRC E3902	1	Bathroom	Sunroom	Bedroom	Hallway
What is the maximum ampacity of #6 THWN copper wire if ratings of wire terminals cannot be verified?	IRC Table E3705.1 & E3705.4.1	IRC E3705	1	55A	65A	75A	60A
#2 AWG THWN-2 aluminum wire has a maximum ampacity of ____ amps if all terminals and devices the wire connects to are rated 75°C?	IRC Table E3705.1 & E3705.4.4	IRC E3705	1	90	100	75	95
In order to be considered as a storable swimming pool, the maximum water depth cannot exceed ____ inches deep and be constructed above ground?	IRC E4201.2 Definition of Storable Swimming Pool	IRC Chapter 42	4	18-inches	36-inches	24-inches	42-inches
Which of the following wiring methods is not allowed for wiring originating at the branch circuit OCPD and extending to a junction box, for a wet niche luminaire?	IRC Table E4202.1	IRC E4202	4	ENT	LFNMC	RMC	LFMC
The point of connection between the serving utility and the premise wiring system is called the _____?	IRC E3501	IRC Chapter 35	4	Service lateral	Service conductors	Service drop	Service point
An overload, short circuit, or ground fault is considered to be _____?	IRC E3501	IRC Chapter 35	1	Overcurrent	Fault	Overload	All of the above
.The outer sheath of nonmetallic sheathed cable (NM cable) must extend into a box at least ____ of an inch?	IRC E3905.3.1	IRC E3905	2	1/2-inch	1/4-inch	3/8-inch	3/4-inch
There cannot be more than ____ #10 THHN conductors in a 1" electrical nonmetallic tubing (ENT)?	IRC Table E3904.6(2)	IRC E3904	1	15	16	8	26
Work space in front of an electrical panel board shall be minimum of _____ in width, but no less than the width of the panel board.	IRC E3405.2	IRC E3405	1	30-inches	36-inches	42-inches	48-inches
Where electrical conductors are to be spliced, terminated or connected to fixtures or devices, a minimum length of ____ of free conductor shall be provided at each outlet, junction or switch point.	IRC E3406.11.3	IRC E3406	2	4-inches	6-inches	8-inches	12-inches

2021 Residential Electrical Inspector Practice Exam Questions

A receptacle is not required to be the tamper-resistant type when a receptacle installation meets all of the following except for?	IRC E4002.14	IRC E4002	3	Where mounted more than 5.5 above the floor level in a living area.	Where the receptacle is part of a luminaire.	Where installed at a kitchen countertop space.	Where the receptacle is serving and is behind large equipment that is difficult to move.
A receptacle installed directly over a shower or tub space must _____ ?	IRC E4002.11	IRC E4002	2	Have GFCI protection.	Be mounted 8' or more above the tub rim or shower threshold.	Not allowed to be mounted over the tub or shower space.	Have a weather proof cover.
Energized parts operating at a minimum of _____ shall be guarded against accidental contact by people through the use of approved enclosure.	IRC E3404.9	IRC E3404	1	50 volts	60 volts	90 volts	110 volts
The dedicated space above an indoor electrical panelboard shall be a minimum of _____ high or to the structural ceiling, whichever is lower.	IRC E3405.3	IRC E3405	3	4-feet	5-feet	6-feet	6.5-feet
Where a clothing closet has a shelf that is 18" wide and is mounted on the back wall of the closet, how far away must a recessed incandescent light fixture be located from the back wall of the closet?	IRC E4003.12, Item 3	IRC E4003	4	6-inches	12-inches	18-inches	24-inches
For a non-IC rated can light, insulation must be kept at least ___ inches away from the can light wiring compartment?	IRC E4004.9	IRC E4004	4	2-inches	1-inches	6-inches	3-inches
An electrical panel board requiring access while energized shall be provided with a minimum of _____ in depth measured in the direction of access.	IRC E3405.2	IRC E3405	2	30-inches	36-inches	42-inches	48-inches
Which of the following methods is not permitted for identifying equipment grounding conductors?	IRC E3407.2	IRC E3407	4	Bare	Continuous green color	Continuous green color with one or more yellow stripes	Continuous white color
What is the maximum ampacity of #4 Type NM copper cable if ratings of all wire terminals are 75°C?	IRC Table E3705.1 & E3705.4.4	IRC E3705	4	95A	85A	75A	70A
What is the maximum ampacity of #4 THHW copper wire if all terminals are known to be rated 75°C?	IRC Table E3705.1 & E3705.4.1	IRC E3705	2	95A	85A	75A	70A
What size a copper equipment grounding conductor that is installed with circuit conductors that are protected by a 70A breaker?	IRC Table E3908.13 (since 70A lands between ratings in the table, need to use next size up over 70A, which is 100A at the table)	IRC E3908	3	#14	#12	#8	#10
If the total required conductors for box fill is (12) #12 AWG conductors, what is the minimum required volume of the box?	IRC Table E3905.12.2.1	IRC E3905	4	24 cubic inches	25 cubic inches	21 cubic inches	27 cubic inches
What is the maximum ampacity of #6 THWN copper wire if ratings of wire terminals cannot be verified?	IRC Table E3705.1 & E3705.4.1	IRC E3705	1	55A	65A	75A	60A
The minimum length of flexible cord for a trash compactor is ___ feet?	IRC Table E4101.3	IRC E4101	1	3	4	1.5	2
Unless serving the pool, underground wiring must be kept at least ___ feet away from the inside walls of the pool?	IRC E4203.8	IRC E4203	2	6-feet	5-feet	10-feet	20-feet
Plugs driven into plaster, masonry, concrete, or similar materials used for mounting electrical equipment shall not be made of what material?	IRC E3404.8	IRC E3404	4	PVC	metal	plastic	wood
Ungrounded conductors shall not be insulated with a continuous _____ color.	IRC E3407.3	IRC E3407	3	red	blue	white	yellow
What does the term "accessible" mean in regards to electrical equipment?	IRC E3501	IRC Chapter 35	2	Having an ADA accessible ramp near equipment	Capable of being reached for operation, renewal and inspection	Able to access without professional assistance	A licensed electrician is the only person able to access the equipment
The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s) is known as:	IRC E3501	IRC Chapter 35	3	Bonding wire	Arc-fault circuit	Branch circuit	Conductor

2021 Residential Electrical Inspector Practice Exam Questions

What does it mean for the equipment to be "grounded"?	IRC E3501	IRC Chapter 35	1	Connected to ground or to a conductive body that extends the ground connection	Located close to the ground/earth	Installed used a grounding wire	Equipment is located underneath the ground for enhanced protection
A point on the wiring system at which current is taken to supply utilization equipment is known as:	IRC E3501	IRC Chapter 35	4	Service conductor	Service cable	Receptacle	Outlet
Electrodes of the rod and pipe variety shall not be less than _____ in length.	IRC E3608.1.4	IRC E3608	1	8 feet	10 feet	12 feet	20 feet
Bonding shall be provided where necessary to ensure electrical _____ and the capacity to conduct safely any fault current likely to be imposed.	IRC E3609.1	IRC E3609	4	clearance	assurance	bonding	continuity
Where not buried or encased in concrete, all mechanical elements used to terminate a grounding electrode conductor or bonding jumper to the grounding electrodes shall be _____.	IRC E3611.2	IRC E3611	2	grounded	accessible	available	bonded
Insulated cables and conductors used where exposed to direct sun rays shall be listed or listed and marked, as being _____.	IRC E3802.3.3	IRC E3802	1	Sunlight resistant	Heat resistant	Heat proof	Melt resistant
Where raceways are installed in wet locations above grade, the interior of said raceways shall be considered to be a _____ location.	IRC E3802.8	IRC E3802	2	damp	wet	humid	hazardous
Underground service conductors not encased in concrete and that are buried 18 inches or more below grade shall have their location identified by a(n) _____.	IRC E3803.2	IRC E3803	3	yellow marker	orange indicator	warning ribbon	hazard flag
Direct buried cables and conductors which emerge from the ground shall be protected by raceways or enclosures extending from the minimum cover distance below grade...to a point at least _____ above finished grade.	IRC E3803.3	IRC E3803	1	8 feet	6 feet	10 feet	4 feet
Switches and circuit breakers used as switches shall be installed so that the center of the grip of the operating handle of the switch or circuit breaker, when in the highest position, will not be more than _____ feet _____ inches above the floor or working platform.	IRC E4001.6	IRC E4001	3	4, 6	4, 8	6, 7	6, 8
Recessed incandescent luminaires shall have _____ protection.	IRC E4003.5	IRC E4003	1	thermal	heat	ambient	frost
Unless listed for such interconnection, a Class 2 power source shall not have its output connections paralleled or otherwise interconnected with...	IRC E4302.2	IRC E4302	1	another Class 2 power source	Class 2 transformer	Class 3 power source	Class 3 Plenum Cable
Which rating shall not be marked on cables?	IRC E4303.2.5	IRC E4303	4	energy ratings	wattage ratings	amperage ratings	voltage ratings
Cables and conductors installed exposed on the surface of ceilings and sidewalls shall be supported by the building structure by any of the following methods except:	IRC E4304.5	IRC E4304	4	straps	staples	cable ties	a fitting that could damage the cable
Which of the following is not a listed enclosure type in the IRC?	IRC E3404.4	IRC E3404	4	panelboards	meter sockets	transfer switches	vinyl stakes
Wooden plugs driven into masonry, concrete, plaster, or similar materials may be used.	IRC E3404.8	IRC E3404	2	TRUE	FALSE		

2021 Residential Electrical Inspector Practice Exam Questions

Artificial illumination shall not be controlled by automatic means only.	IRC E3405.7	IRC E3405	1	TRUE	FALSE		
Grounded and grounding are synonymous terms in electrical application.	IRC E3501	IRC Chapter 35	2	TRUE	FALSE		
A lamp-holder is considered to be a luminaire.	IRC E3501	IRC Chapter 35	2	TRUE	FALSE		
Where exposed to the weather, raceways enclosing service-entrance conductors shall be listed or approved for use in wet locations and arranged to drain.	IRC E3605.8	IRC E3605	1	TRUE	FALSE		
Central heating equipment other than fixed electric space heating shall be supplied by a(n):	IRC E3703.1	IRC E3703	3	workable space	conductor	individual branch circuit	overbranch circuit
A unit load of not less than _____ shall constitute the minimum lighting and general use receptacle load for each square foot of floor area.	IRC E3704.4	IRC E3704	1	3 volt-amperes	4 volt-amperes	5 volt-amperes	6 volt-amperes
Where raceways contain 4 AWG or larger insulated circuit conductors and these conductors enter a cabinet, box enclosure, or raceway, the conductors shall be protected in accordance with any of the following, EXCEPT:	IRC E3906.1.1	IRC E3906	4	Threaded hubs or bosses in a cabinet, box, enclosure, or raceway providing a smoothly rounded or flared entry for conductors	An identified fitting providing a smoothly rounded insulating surface	A listed metal fitting that has smoothly rounded edges	A container using R-8 insulation around the surface of the raceway
Noncombustible surfaces that are broken or incomplete shall be repaired so that there will not be gaps or open spaces greater than _____ at the edge of the cabinet or cutout box employing a flush-type cover.	IRC E3907.4	IRC E3907	2	1/4 inch	1/8 inch	1/2 inch	3/8 inch
Lighting track shall not be installed all of the following locations, EXCEPT:	IRC E4005.4	IRC E4005	1	protected areas from physical damage	Wet or damp locations	concealed	Where subject to corrosive vapors
Each appliance shall be provided with a means to disconnect all ungrounded supply conductors.	IRC E4101.5	IRC E4101	1	TRUE	FALSE		
For swimming pools, outdoor spas and hot tubs, receptacles that provide power for water-pump motors or other loads directly related to the circulation and sanitation system shall be located at least _____ away.	IRC E4203.1.1	IRC E4203	3	4 feet	8 feet	6 feet	10 feet
Receptacles rated ___ volts and ___ amperes or less and located within ___ feet of the inside walls of a spa or hot tub installed indoors shall be ground-fault circuit interrupters.	IRC E4203.1.6	IRC E4203	2	125, 20, 8	125, 30, 10	125, 30, 8	225, 20, 10
What material shall be used to bond parts together for a proper equipotential bond in a swimming pool?	IRC E4204.2	IRC E4204	4	12 AWG	10 AWG	6 AWG	8 AWG
What is a "UFER" ground?	IRC E3501	IRC Chapter 35	2	8 ft ground rod	Concrete encased grounding electrode	Underground Flexible Electrode Rod	Any ground rod used to ground the electrical equipment



STANDARDS

Doug currently serves as an STP Member for the following solar-related UL Standards: UL 1703, UL 1741, UL 2703, UL 6703, and UL 9540.

LICENSES | CERTIFICATIONS

LICENSES

Building Inspector
Utah 5863079-5601

CERTIFICATES

Certified Master Code Professional
Certified Building Official
Comb. Commercial Plans Examiner
Combination Commercial Building Inspector
Residential Plans Examiner
Combination Residential Building Inspector
Accessibility Inspector/Plans Examiner
Fire Plans Examiner
Fire Inspector I & II
Com. Energy Plans Examiner

AFFILIATIONS

Utah Chapter of IAEE
Past President and current Board Member

Utah Chapter of ICC
Past Region Coordinator

Bonneville Chapter of ICC
Secretary and a Past President

AWARDS

ICC Certified Master Code Professional

Al Brown Award for Outstanding Building Inspector (Bonn. Chapter ICC)

Tri-County Region Coordinator-Outstanding Service Award (Utah Chapter ICC)

Doug Smith MCP, CBO

SENIOR PLAN REVIEW EXAMINER

Mr. Smith has been an inspector for over 13 years and has been in the construction industry for over 19 years. He began his career as a Building Inspector in 2005. During his career he has obtained 19 ICC certifications, including Certified Building Official and Master Code Professional. As for his understanding of the building codes, you could say he is "well rounded," but particularly he specializes in electrical code requirements and is especially knowledgeable on the topic of solar photovoltaics. Doug has taught many electrical and solar photovoltaic classes over the years for various organizations throughout the Western United States. With WC3 he primarily does electrical and solar PV plan reviews, however he's able to do many other types of reviews. As far as solar reviews are concerned, last year alone he performed over 2,000 reviews for many jurisdictions in Utah, Nevada and California. The largest solar PV system plan review that he's performed was a 240 mega-watt California Energy Solar PV project which included over a million solar arrays.

EXPERIENCE

SENIOR INSPECTOR / PLANS EXAMINER

West Coast Code Consultants, Inc. / 2013 – Present

Provides building, electrical, and fire plan review as well as inspections of local commercial, residential, and photovoltaic projects. Provides training for jurisdictions on electrical inspections.

BUILDING INSPECTOR

Kaysville City / 2005 – 2013

Performed inspections for local commercial and residential projects. Worked with contractors and homeowners to obtain building permits and provide counter work.

FRAMER

Michael K. Wright Construction / 1998 - 2005

Worked as part of a crew to framer residential and commercial projects.



EDUCATION

ASSOCIATES HISTORY EMPHASIS

Utah Valley State College, 2005

**SOLAR ENERGY
INTERNATIONAL TRAINING**
Advanced PV System Design and the
NEC (Grid-Direct), 2019

LICENSES | CERTIFICATIONS

LICENSES

Limited Building Inspector
Utah: 12220334-5602

CERTIFICATES

OSHA 10-hour Safety
Certification

ICC Certified (9954943):

Residential Electrical Inspector
Commercial Electrical Inspector
Electrical Inspector
Electrical Plans Examiner

Other Certifications:

Sonnen Battery Installer, 2017
LG Chem Battery Installer, 2017
Enphase Battery Installer, 2020
NABCEP Installer – Test Pending

OTHER

Forklift Operator Training and
Experience Fluent in Portuguese and
basic Spanish

David Leckie

PLANS EXAMINER / INSPECTOR

Mr. Leckie serves WC³, and our jurisdictional clients offering solar services, as a plans examiner and inspector. With years of experience managing a team of technicians for residential solar installations, David is extremely knowledgeable in solar photovoltaic (PV) technologies and associated battery energy storage systems. He holds multiple International Code Council (ICC) certifications as an Electrical Inspector and Electrical Plans Examiner, and is licensed by the State of Utah as a Limited Building Inspector. His background and training in various manufacturers' battery installation procedures serve him well when combined with his knowledge of the applicable code. Mr. Leckie displays extreme professionalism with all levels of clients and coworkers, and works aggressively to successfully complete all projects on time and within budget.

EXPERIENCE

PLANS EXAMINER / INSPECTOR

West Coast Code Consultants, Inc. / 2020 – Present

Performs solar plan review and inspection services for solar system installations to ensure compliance with installation instructions, building/electrical/mechanical/plumbing codes and standards, and industry best practices. Demonstrates a strong knowledge of Photovoltaic (PV) technologies and installation practices, as well as the application of corresponding building, electrical and fire codes.

DIRECTOR OF OPERATIONS

New Star Solar – Lindon, UT / 2016 - 2020

Oversaw residential solar sales in the states of UT, CO, TX, NC and SC. Managed a team of Solar Technicians and facilitated inventory proposals, site surveys, designs, plan reviews, installations, quality reviews, audits, and coordination of AHJ for final inspections. Performed quality inspections of all projects by internal installation teams and subcontractors. Trained staff in installation procedures including electrical wiring. Produced documentation for contractors, electricians, engineers, and project designers with project expectations and requirements. Developed continuing education programs for staff and managed safety programs.

MAINTENANCE DIRECTOR / ASSISTANT ADMINISTRATOR

Osmand Senior Living - Lindon, UT / 2015 – 2016

Oversaw the setup, launch, and operations of a new 64 bed assisted living facility. Performed facility maintenance and managed all aspects of building operations. Installed building low voltage electrical systems - phones, internet, TV, and cameras systems. Established procedures and record keeping processes for state compliance.

REGIONAL INSTALLATION MANAGER

Newstar Communications - American Fork, UT / 2011 – 2015

As a DirecTV and Dish Network Install Subcontractor, coordinated work and managed 50+ installation technicians, including performance management, recruiting, and training. Installed over 35,000 new accounts in 2014 with an inventory loss below 0.5%. Coordinated install schedules with sales teams and performed quality audits on installed systems. Oversaw the installation department for the second largest DirecTV door to door sales company. Handled escalated customer complaints, install issues, and damage claims.

INSTALLATION MANAGER

InstallPro (HaloPrime) - Orem UT / 2005 – 2011

Managed the largest office of a Dish Network installer subcontractor for Central Utah and South West Wyoming. Coordinated schedules and availability with Dish Network for hiring and training of new installers, inspections audits, damage claims, and escalated issues. Managed inventory ordering, aging, and consignment.

File Attachments for Item:

ER-7 Residential Mechanical Inspector (2021 IRC) (West Coast)

Residential certifications (11 hours)

Staff Notes: Not yet code in Ohio, but likely to be in the next Code update. Recommend approval.

Committee Recommendation:

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *

Brittany Allen

Organization

West Coast Code Consultant

Email *

brittanya@wc-3.com

Phone Number *

(385) 237-3722

Address *

9131 S Monroe St Unit A

City *

Sandy

State *

UT

Zip Code *

84070

Website

https://www.pathlms.com/w

Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e.

BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

2021 Residential Mechanical Inspector

Course instructor

George Williams

Course description

Course Description: This 9-module course, followed by a two-hour practice examination, is based on Chapters 12 through 24 of the 2021 International Residential Code (IRC). It teaches the practical application of the IRC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 15 to 50 minutes in length.

Course Objectives: This course is designed to prepare you for the International Code Council's (ICC) Residential Mechanical Inspector exam (M1), utilizing the 2021 IRC. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Instructional hours per session

Number of Sessions

Course Date

Course Location

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction
- Plumbing Instruction

Conference Course

Conference Name

Conference location

On Demand

Webinar

Course to be offered online?

Yes

No

Course Website

<https://www.pathlms.com/wc3-academy/courses/47>

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. You can progress through this course at your own pace; however, you only have access for 120 days.

Course applicable for the following certifications *

Residential Certifications Only

Administrative Course, All Certifications

Commercial and Residential Certifications

Application materials included *

Course Outline or Course Learning Objectives

Presentation Materials/Slides (not required for roundtable courses)

Assessment Materials (for online courses)

Presenter Bio

Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
2021 Residential Mechanical Submittal Documents.pdf	11.51 MB

Applicant Full Name *

Brittany Allen

Date of Submission

06/06/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



2021 Residential Mechanical Inspector

Course Outline

Cost: \$207, allowing for 120 days of access.

Course Description: This **9-module course**, followed by a two-hour practice examination, is based on Chapters 12 through 24 of the *2021 International Residential Code (IRC)*. It teaches the practical application of the IRC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 15 to 50 minutes in length.

Course Objectives: This course is designed to prepare you for the *International Code Council's (ICC)* Residential Mechanical Inspector exam (M1), utilizing the *2021 IRC*. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Texts and Readings: The *2021 International Residential Code* is the textbooks for this course. It is highly recommended that you purchase a paper-back copy of these codes, which are available online at www.iccsafe.org. A physical copy can be utilized during the actual exams, which are open book, and serves as a valuable reference for in the field inspections.

Course Outline of Topics:

Module:	Topics:	Readings:	Quiz:	Duration:
1	Exam Breakdown & Key Definitions	IRC Chapter 2	Y	29 min.
2	Administration, General Requirements & Heating/Cooling Appliances	IRC Chapters 12-14	Y	21 min.
3	Exhaust, Ducts, Combustion Air, Chimneys/Vents & Special Equipment	IRC Chapters 15-19	Y	27 min.
4	Boilers, Water Heaters, Hydronic Piping, Special Piping/Storage Tanks & Solar Systems	IRC Chapters 20-23	Y	14 min.
5	Fuel Gas Part 1 - General Requirements, Combustion Air & Gas Pipe Sizing	IRC Chapter 24	Y	50 min.
6	Fuel Gas Part 2 - Fuel Gas Piping & Vents	IRC Chapter 24	Y	32 min.
7	Fuel Gas Part 3 - Appliance Venting	IRC Chapter 24	Y	34 min.
8	Supplemental Module – Combustion Air			20 min.
9	Supplemental Module – Gas Line Sizing			38 min.
	7 Quizzes			
	65 Questions, 2 min. each	2021 IRC		130 min.
	Practice Exam (60 Questions)	2021 IRC		120 min.
	Total Course Hours			8.5 hours



2021 Residential Mechanical Inspector

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. Marking, tabbing, and highlighting in the code book is highly recommended. We have laid out a plan and method to help you learn the material, but it's up to you to put in the work necessary for you to master the material. You can progress through this course at your own pace; however, you only have access for 120 days.

Continuing Education Credits: Completion of this course results in **0.85 CEU's** (8.5 hours) being provided by ICC, as West Coast Code Consultants is a Preferred Provider.

Instructor:

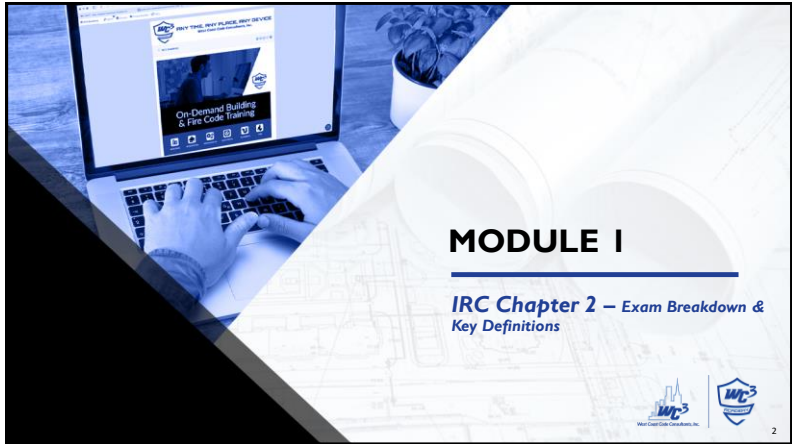


George Williams, MCP, CBO is the Director of WC3 Academy, but primarily identifies as a commercial plans examiner and building inspector. He has been a building inspector since 2005, has a master's degree in construction management, and has been ICC Master Code Professional since 2009. George has been instrumental in the start-up of multiple building departments including the adoption of codes, implementation of permit processes, development of policies and procedures, as well as the hiring and training of staff.

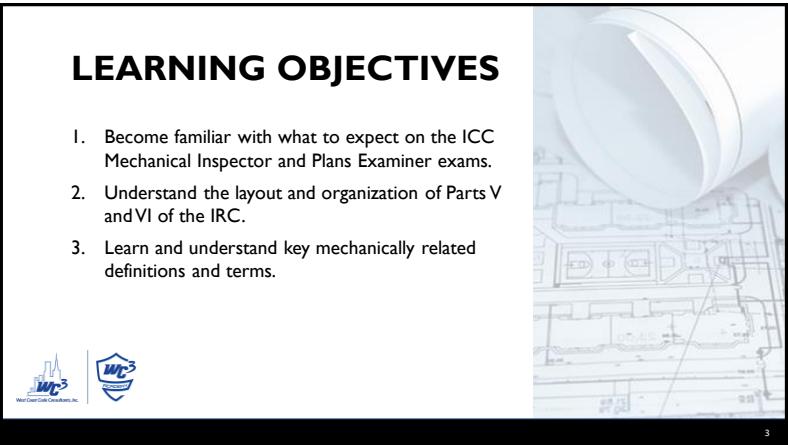




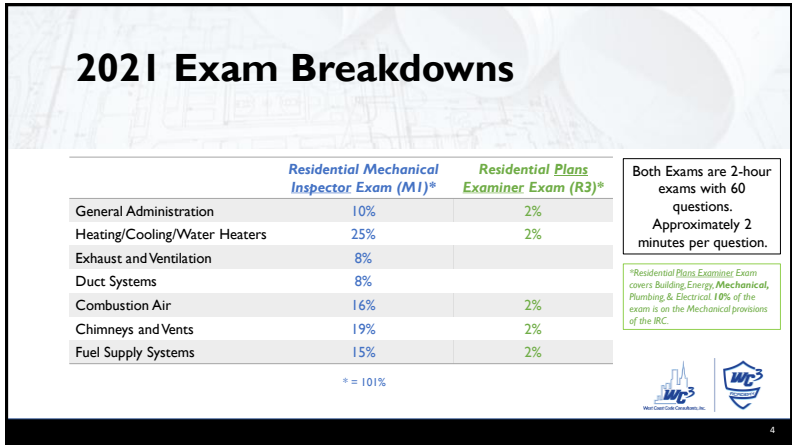
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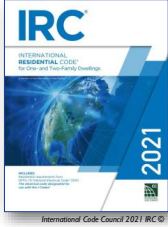


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4

2021 Exam References




- 2021 International Residential Code.
 - Primarily the Parts V and VI – Mechanical and Fuel Gas Chapters 12 - 24
 - Be familiar with Chapter 24 Fuel Gas
 - Chapter 2 - Definitions
 - Questions may come out of other chapters of the book (Chapters 1 & 11).

5

Preparation

- Focus on the mechanical chapters but be prepared for questions from other chapters.
- Personal study: **2-hrs.** for every **1-hr.** of class time
- Highlight important sections
- Write key numbers in large print
- Tab your book








6

Examples

501.4 Intake opening location. Air intake openings shall comply with all of the following:




1. Intake openings shall be located not less than 10 feet (3048 mm) from lot lines or buildings on the same lot.
2. Mechanical and gravity ~~vent~~ **10** intake openings shall be located not less than 10 feet (3048 mm) horizontally from any hazardous or noxious combustion source, such as vents, streets, alleys, parking lots and loading docks, except as specified in Item 3 or Section 501.3.1. Outdoor air ~~intake~~ **10** openings shall be permitted to be located less than 10 feet (3048 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such location. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.
3. Intake openings shall be located not less than 3 feet (914 mm) below contaminant sources where such sources are located within 10 feet (3048 mm) of the opening.

7

Key Items

- Marginal Markings
 - Solid vertical lines- New or modified
 - [→] Entire section, paragraph, exception is deleted
 - [*] indicates text/table has been relocated elsewhere
 - [**] indicates text/table has been relocated there
- Italicized Terms (Definitions)

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Should be tabbed, highlighted and marked.

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Should be tabbed, highlighted and marked.

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To plumbing fixtures P2705	AMPACITY E3501
To whirlpool pumps P2720.1	
ACCESS HATCHES N1102.2.4	
ACCESSIBILITY R320	

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10

Part V- 12 Chapters (48 pgs.)

12. Mechanical Administration	- 1 page
13. General Mechanical System Req.	- 6 pages
14. Heating and Cooling Equipment	- 5 pages
15. Exhaust Systems	- 4 pages
16. Duct Systems	- 4 pages
17. Combustion Air	- 1 page
18. Chimneys and Vents	- 4 pages
19. Special Appliances, Eq. and Systems	- 1 page
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Part VI- 1 Chapter (80 pgs.)

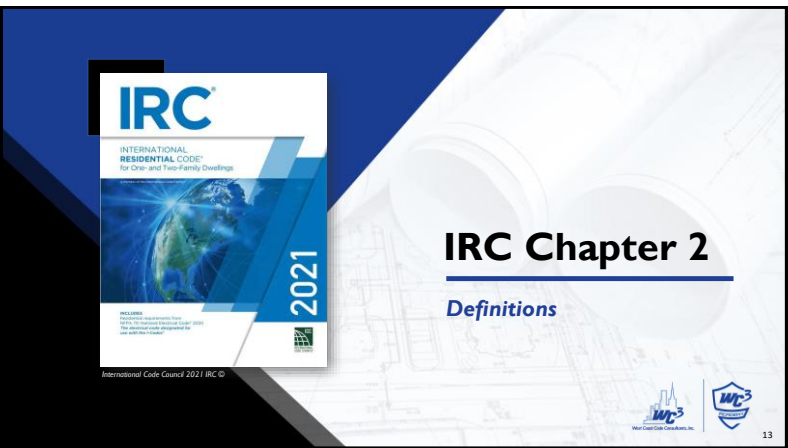
24. Fuel Gas

VI Facility Services, www.dnbhbook.com

(C2404.1 (301.1) Scope. This section shall govern the approval and installation of all equipment and appliances that comprise parts of the installations regulated by this code in accordance with Section C2401)

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13

Basic Mechanical Terms & Definitions

Air-Conditioning System →

Appliance →

[MP] AIR-CONDITIONING SYSTEM. A system that consists of heat exchangers, blowers, filters, supply, exhaust and return-air systems, and shall include any apparatus installed in connection therewith.

[MP] APPLIANCE. A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements.

14

Basic Mechanical Terms & Definitions

Balanced Ventilation →

Boiler →

BTU/H →

Carbon Monoxide Alarm vs. Carbon Monoxide Detector →

[MP] BALANCED VENTILATION. Any combination of concurrently operating mechanical exhaust and mechanical supply whereby the total mechanical exhaust airflow rate is within 10 percent of the total mechanical supply airflow rate.

[MP] BOILER. A self-contained appliance from which hot water is circulated for heating purposes and then returned to the boiler, and that operates at water pressures not exceeding 160 pounds per square inch gage (psig) (1102 kPa gage) and at water temperatures not exceeding 250 F (121 C).

[MP] BTU/H. The *listed* maximum capacity of an appliance, absorption unit or burner expressed in British thermal units input per hour.

[RB] CARBON MONOXIDE ALARM. A single- or multiple-station alarm intended to detect carbon monoxide gas and alert occupants by a distinct audible signal. It incorporates a sensor, control components and an alarm notification appliance in a single unit.

[RB] CARBON MONOXIDE DETECTOR. A device with an integral sensor to detect carbon monoxide gas and transmit an alarm signal to a connected alarm control unit.

15

Basic Mechanical Terms & Definitions

Chimney →

Combustible Material →

Non-combustible Material →

Combustion Air →

Condensate →

[MP] CHIMNEY. A primary vertical structure containing one or more flues, for the purpose of carrying gaseous products of combustion and air from a fuel-burning appliance to the outside atmosphere.

[RB] COMBUSTIBLE MATERIAL. Any material not defined as noncombustible.

[RB] NONCOMBUSTIBLE MATERIAL. A material that passes ASTM E136.

[MP] COMBUSTION AIR. The air provided to fuel-burning equipment including air for fuel combustion, draft hood dilution and ventilation of the equipment enclosure.

[MP] CONDENSATE. The liquid that separates from a gas due to a reduction in temperature; for example, water that condenses from flue gases and water that condenses from air circulating through the cooling coil in air conditioning equipment.

16

Basic Mechanical Terms & Definitions

Conditioned Air →



Volume Damper →

Direct Vent Appliance →

[RB] CONDITIONED AIR. Air treated to control its temperature, relative humidity or quality.

[MP] DAMPER, VOLUME. A device that will restrict, retard or direct the flow of air in any duct, or the products of combustion of heat-producing equipment, vent connector, vent or chimney.

[MP] DIRECT-VENT APPLIANCE. A fuel-burning appliance with a sealed combustion system that draws all air for combustion from the outside atmosphere and discharges all flue gases to the outside atmosphere.

17

17

Basic Mechanical Terms & Definitions

Draft →

Induced Draft →

Natural Draft →



Draft Hood →

[MP] DRAFT. The pressure difference existing between the appliance or any component part and the atmosphere, that causes a continuous flow of air and products of combustion through the gas passages of the appliance to the atmosphere.

Induced draft. The pressure difference created by the action of a fan, blower or ejector, that is located between the appliance and the chimney or vent termination.

Natural draft. The pressure difference created by a vent or chimney because of its height, and the temperature difference between the flue gases and the atmosphere.

[MP] DRAFT HOOD. A device built into an appliance, or a part of the vent connector from an appliance, that is designed to provide for the ready escape of the flue gases from the appliance in the event of no draft, backdraft or stoppage beyond the draft hood; prevent a backdraft from entering the appliance; and neutralize the effect of stack action of the chimney or gas vent on the operation of the appliance.

18

18

Basic Mechanical Terms & Definitions



Duct System →

Factory-Built Chimney →

[MP] DUCT SYSTEM. A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

For the definition applicable in Chapter 11, see Section N1101.6.

[MP] FACTORY-BUILT CHIMNEY. A listed and labeled chimney composed of factory-made components assembled in the field in accordance with the manufacturer's instructions and the conditions of the listing.

19

19

Basic Mechanical Terms & Definitions

Appliance Flue →



Flue Collar →

Flue Gases →

[MP] FLUE, APPLIANCE. The passages within an appliance through which combustion products pass from the combustion chamber to the flue collar.

[MP] FLUE COLLAR. The portion of a fuel-burning appliance designed for the attachment of a draft hood, vent connector or venting system.

[MP] FLUE GASES. Products of combustion plus excess air in appliance flues or heat exchangers.

20

20


Basic Mechanical Terms & Definitions

Furnace →

Hazardous Location →

[MP] FURNACE. A vented heating *appliance* designed or arranged to discharge heated air into a *conditioned space* or through a duct or ducts.

[MP] HAZARDOUS LOCATION. Any location considered to be a fire hazard for flammable vapors, dust, combustible fibers or other highly combustible substances.



21

Basic Mechanical Terms & Definitions

Local Exhaust →


Mechanical System →

Natural Draft →

[MP] LOCAL EXHAUST. An exhaust system that uses one or more fans to exhaust air from a specific room or rooms within a dwelling.

[MP] MECHANICAL SYSTEM. A system specifically addressed and regulated in this code and composed of components, devices, *appliances* and *equipment*.

[MP] NATURAL DRAFT SYSTEM. A venting system designed to remove flue or vent gases under nonpositive static vent pressure entirely by natural draft.



22

Basic Mechanical Terms & Definitions

Plenum →

Refrigerant →

Return Air →


Supply Air →

[MP] PLENUM. A chamber that forms part of an air-circulation system other than the *occupied space* being conditioned.

[MP] REFRIGERANT. A substance used to produce refrigeration by its expansion or evaporation.

[MP] RETURN AIR. Air removed from an *approved conditioned space* or location and recirculated or exhausted.

[MP] SUPPLY AIR. Air delivered to a *conditioned space* through ducts or plenums from the heat exchanger of a heating, cooling or ventilating system.



23


Basic Mechanical Terms & Definitions

Vent →

Vent Gases →

[MP] VENT. A passageway for conveying flue gases from fuel-fired *appliances*, or their vent connectors, to the outside atmosphere.

[MP] VENT GASES. Products of combustion from fuel-burning *appliances*, plus excess air and dilution air, in the venting system above the draft hood or draft regulator.



24



25

MODULE 2

IRC Chapters 12-14 – Mechanical Administration, General System Requirements, Heating & Cooling Equipment & Appliances

1

1

LEARNING OBJECTIVES

1. Become familiar with the requirements applicable to existing mechanical systems.
2. Understand general mechanical requirements applicable to a majority of mechanical equipment installations.
3. Learn specific code requirements applicable to the installation of HVAC systems.

2

2

IRC Chapter 12

Mechanical Administration

3

3

Layout and Scope


IRC M1201.1:

Part V- Chapters 12 through 23
Part VI- Chapter 24

M1201.1 Scope. The provisions of Chapters 12 through 24 shall regulate the design, installation, maintenance, alteration and inspection of mechanical systems that are permanently installed and used to control environmental conditions within buildings. These chapters shall also regulate those mechanical systems, system components, equipment and appliances specifically addressed in this code.

4


4





Existing Systems

IRC MI202.1:
 Additions, alternations, renovations, repairs:

- Shall not cause existing to become:
 - Unsafe
 - Hazardous
 - Overloaded



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5



Existing Systems


IRC MI202.1:
 Minor changes

- Meet the provisions for new construction
- Unless done in same manor as existing
 - Not hazardous
 - Approved








6



Existing Installations

IRC MI202.2:

- Except as otherwise provided, shall not require
 - Removal, alteration, abandonment
 - Prevent continued use or maintenance
- If lawfully in existence at time of adoption of this code








7

Maintenance

IRC MI202.3:
 Mechanical systems shall be maintained

- All parts in proper condition
- Maintained in compliance with the code under which installed
- Owner or designated agent is responsible
- Building Official has authority to have re-inspected

8



IRC Chapter 13

General Mechanical System Requirements

International Code Council 2021 | IRC ©

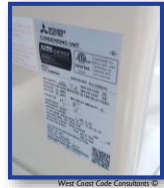

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9

Labeling

IRC M1303.1:
Factory-Applied Nameplates:

- Manufacturer's name/trademark
- Model Number
- Serial Number
- Seal or Mark of Testing Agency
- (5) Additional Requirements- Specific Appliances

10

10

Work Space


IRC M1305.1:
Furnaces & Air Handlers:

Appliance Access

- Level space 30" x 30" in front of control side

Appliances in compartments, alcoves, basements and similar spaces:

- Opening or passages way 24" min. width
- Large enough to remove largest appliance



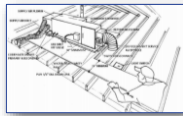
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11

Attic Installations

IRC M1305.1.2:

- 30" x 20" access that allows removal of largest equipment
- Solid flooring 24" wide x 20' in length
 - 6' clearance allows for 50' length
- Level service space 30" x 30"
 - Unless serviceable from access point




12

12


Under Floor

IRC M1305.1.3:

- Access to allow removal of largest equipment (22"x30")
- Passageway 22" x 30", limited to 20' in length
 - 6" clearance allows for 50' length
- Level service space 30" x 30"
 - Unless serviceable from access point



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13

Clearances from Combustibles

IRC M1306:

- Installed (M1306.1)
 - Per Appliance Label
 - Per Manufacturer's Installation Instructions
- Reductions (M1306.2)
 - M1306.2.1- Listed Protective Assembly- **UL 1618**
 - M1306.2.2- Reduction Table- M1306.2

14

13



14

Table M1306.2

TABLE M1306.2 REDUCTION OF CLEARANCES WITH SPECIFIED FORMS OF PROTECTION

WHERE THE REQUIRED CLEARANCE WITHOUT PROTECTION FROM APPLIANCE, VENT CONNECTOR, OR SINGLE WALL METAL PIPE IS:

TYPE OF PROTECTION APPLIED TO AND COVERING ALL SURFACES OF CONTACT OF THE APPLIANCE, VENT PIPE, OR SINGLE WALL METAL PIPE WITH THE CLEARANCE WITH THE PROTECTION (See Figure M1306.2 for details)	Allowable clearances with specified protection (inches)					
	36 inches or more	18 inches	12 inches	6 inches	3 inches	0 inches
1" - each-thick masonry wall without vented airspace	—	24	—	12	—	6
— each-thick masonry wall with vented airspace	24	18	12	9	6	4
— each-thick masonry wall with vented airspace and a minimum thickness of 0.0276-inch (No. 24 gage) steel sheet metal with a minimum thickness of 0.0276-inch (No. 24 gage) steel sheet metal with a vented airspace	18	12	9	6	4	3
1" - each-thick masonry wall with vented airspace	—	12	—	6	—	6
— each-thick masonry wall with vented airspace and a minimum thickness of 0.0276-inch (No. 24 gage) steel sheet metal with a vented airspace	18	12	9	6	4	3
— each-thick masonry wall with vented airspace and a minimum thickness of 0.0276-inch (No. 24 gage) steel sheet metal with a vented airspace	18	12	9	6	4	3
— each-thick masonry wall with vented airspace and a minimum thickness of 0.0276-inch (No. 24 gage) steel sheet metal with a vented airspace	18	12	9	6	4	3

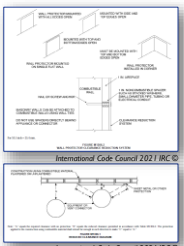
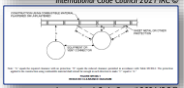

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15

Reductions


IRC M1306.2:

- Labeled Assemblies:
 - Clearance shall be based on approved reduction clearance protection per listing and labeled (UL 1618)
- Reduction Table
 - Manufacturer's instructions
 - Table M1306.2 and the requirements of Items 1 – 4

16


16



Appliance Installation

IRC M1307.1

- Shall conform to the conditions of their *listing* and *label* and the manufacturer's instructions
- The manufacturer's operating and installation instructions shall remain attached to the appliance






17

Anchorage

IRC M1307.2:

Seismic Design Categories D0, D1, D2 and Townhouses (C)

- Upper and lower 1/3rd
- 4" above controls
- According to manufacturer's recommendations

18

Notching



IRC M1308.1:

Wood members


- Drilling and Notching
 - R502.8 – Floors
 - R602.6 – Walls
 - 25% Bearing
 - 40% Non-Bearing
 - R802.7 – Roof
- Less than 1 1/2" clearance requires shield plates

Note:

- Not required for galvanized and cast iron






19



IRC Chapter 14

Heating & Cooling Equipment and Appliances





20



Sizing of Equipment

IRC MI401.3:
Heating and Cooling Equipment

- Sized- ACCA Manual S based on loads per ACCA Manual J
- Other *approved* sizing or load calculation methods
- Exceptions:
 - Multi-stage or Variable Refrigerant Flow (and within range)
 - Equipment cannot satisfy both required heating and cooling (next large standard size)



ACCA Manual S ©




21

21

Floor Furnaces

IRC MI408.3:

- Registers > 6" from walls and inside corners
- Registers > 12" from doors in any position
- Register > 5' below combustible material
- Shall not project into occupied under-floor area


22

22



Wall Furnaces

IRC MI409:

- Shall not circulate air from bathrooms
- Located > 12" from door in any position
- No ductwork attached to furnace
- Manual shut off valve installed ahead of controls



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23

23

Condensate Disposal

IRC MI411.3:
Shall be conveyed from the drain pan outlet to an approved place of disposal

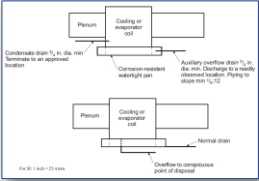




Fig. 61-1.6-1-12.4-10



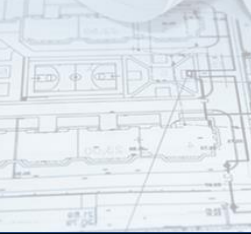
24

24

Drain Pan

IRC M1411.3.1:

- Depth $\geq 1.5"$
- 3" larger than equipment
 - Materials
 - Cast Iron
 - Galvanized Steel
 - Copper
 - Polybutylene
 - Polyethylene
 - ABS
 - CPVC or PVC



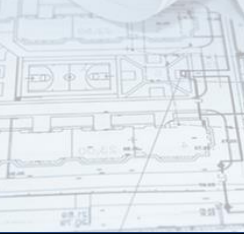
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Locking Port Caps

IRC M1411.9:

- Refrigerant circuit access ports located outdoors
- Must have locking tamper-resistant caps **OR**
- Secured to prevent unauthorized access

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Stoves

IRC M1414:

Fireplace stoves shall be listed, labelled, installed per the listing.

- Tested per UL 737
- Hearth Extension installed as listed
 - Readily distinguishable

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END OF MODULE 2




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MODULE 3

IRC Chapters 15-19

Exhaust Systems, Duct Systems, Combustion Air, Chimneys/Vents, and Special Appliances, Equipment and Systems








1

1


LEARNING OBJECTIVES

1. Understand exhaust requirements for common residential mechanical equipment.
2. Become familiar with acceptable methods & materials suitable for mechanical ductwork.
3. Differentiate between combustion air requirements for solid fuel burning appliances vs. fuel-gas appliances.
4. Know how to properly vent fuel burning appliances.

2

2



IRC Chapter 15

Exhaust Systems




3

3

Outdoor Discharge

IRC M1501.1:

Air removed by a mechanical exhaust system shall be discharged to the **outdoors**.






4


4



Dryer Exhaust



IRC M1502:

- Independent of other systems
- Terminations shall be per MFR instructions
- If not provided...
 - ≥ **3-feet** from openings into buildings & soffits
- Backdraft damper required
- Screens not permitted
- 4" diameter




5

Duct Length



IRC M1502.4.6.1:
Max. of **35-feet** from connection to outlet

TABLE M1502.4.6.1 DRYER EXHAUST DUCT FITTING EQUIVALENT LENGTH	
DRYER EXHAUST DUCT FITTING TYPE	EQUIVALENT LENGTH
4-inch radius smooth 45-degree elbow	2 feet 0 inches
4-inch radius smooth 90-degree elbow	5 feet
6-inch radius smooth 45-degree elbow	1 foot
6-inch radius smooth 90-degree elbow	1 foot 9 inches
8-inch radius smooth 45-degree elbow	1 foot
8-inch radius smooth 90-degree elbow	1 foot 7 inches
10-inch radius smooth 45-degree elbow	9 inches
10-inch radius smooth 90-degree elbow	1 foot 6 inches

FIG. 10. 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.0175 rad.



Dryer Duct Permitted Length
Development length = length of duct + bend equivalent
Note: length limited to 35 feet
Max. clear = 3 feet
7 x 4.5 = 31.5 ft







6

Range Hoods

IRC M1503.1:

- Shall discharge to outdoors
- Duct shall have a smooth interior surface (No Flex)
 - Air tight, and equipped with backdraft damper
- May not terminate in an attic or crawl space









7

Exhaust Openings

IRC M1504.3:

- Terminate > 3' from openings and property lines
- Terminate > 10' from air intakes < 3' above

8

Exhaust Duct Length

IRC M1504.2:

- General exhaust duct length per Table M1504.2
- Lengths not always limited (see exception)

DUCT TYPE	FLEX DUCT										SMOOTH-WALL DUCT									
	50	60	70	80	90	100	110	120	130	140	50	60	70	80	90	100	110	120	130	140
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	NL	81	42	16	2	X	X	X	NL	152	94	51	28	4	X	X	X	X	X	
6	NL	NL	150	141	132	123	114	105	NL	NL	100	100	100	100	100	100	100	100	100	
7	NL	NL	NL	NL	104	78	49	19	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	
8 and above	NL	NL	NL	NL	NL	100	111	69	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	

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Whole-house Ventilation

IRC M1505.4.3:

The whole-house mechanical ventilation system shall be designed per Table M1505.4.3(1) or as per Equation 15-1

DWELLING UNIT FLOOR AREA (Square Feet)	NUMBER OF BEDROOMS				
	0-1	2-3	4-5	6-7	> 7
< 1,500	30	45	60	75	90
1,501-3,000	45	60	75	90	105
3,001-4,500	60	75	90	105	120
4,501-6,000	75	90	105	120	135
6,001-7,500	90	105	120	135	150
> 7,500	105	120	135	150	165

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Ventilation rate in cubic feet per minute = (0.01 × total square foot area of house) ÷ (7.5 × (number of bedrooms + 1)) (Equation 15.1)

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Kitchen/Bath

IRC M1505.4.4:

Shall have capacity as noted in Table M1505.4.4

AREA TO BE EXHAUSTED	EXHAUST RATES
Kitchens	100 cfm intermittent or 25 cfm continuous
Bathrooms-Toilet Rooms	Mechanical exhaust capacity of 50 cfm intermittent or 20 cfm continuous

For SI: 1 cubic foot per minute = 0.0004719 m³/s, 1 inch water column = 0.2488 kPa.

a. The listed exhaust rate for bathrooms-toilet rooms shall equal or exceed the exhaust rate at a minimum static pressure of 0.25 inch water column in accordance with Section M1505.3.

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IRC Chapter 16

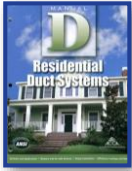


Duct Systems

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Duct Sizing

IRC M1601.1:
Duct systems shall be sized per ACCA Manual D, the appliance manufacturer's installation instructions, or other approved methods




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Duct Systems

IRC M1601.1.1:

- Maximum temperature of 250°F
- Factory made shall be listed and labeled per UL 181
- Fibrous ducts shall conform to SMACNA or NAIMA Standards
- Minimum thickness of metal ducts shall be per Table 1601.1.1
- Gypsum can be used, if the air temperature <125°F
- Maximum flame spread index of 200

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Table M1601.1.1

**TABLE M1601.1.1
DUCT CONSTRUCTION MINIMUM SHEET METAL THICKNESS FOR SINGLE DWELLING UNITS***

ROUND DUCT DIAMETER (inches)	STATIC PRESSURE			
	1/2-inch water gauge Thickness (inches)		1-inch water gauge Thickness (inches)	
	Galvanized	Aluminum	Galvanized	Aluminum
<12	0.015	0.018	0.013	0.018
12 to 14	0.013	0.018	0.016	0.023
15 to 17	0.016	0.023	0.019	0.027
18	0.016	0.023	0.024	0.034
19 to 20	0.019	0.027	0.024	0.034

RECTANGULAR DUCT DIMENSION (inches)	STATIC PRESSURE			
	1/2-inch water gauge Thickness (inches)		1-inch water gauge Thickness (inches)	
	Galvanized	Aluminum	Galvanized	Aluminum
≤ 8	0.015	0.018	0.013	0.018
9 to 10	0.015	0.018	0.016	0.023
11 to 12	0.016	0.023	0.019	0.027
13 to 16	0.019	0.027	0.019	0.027
17 to 18	0.019	0.027	0.024	0.034
19 to 20	0.024	0.034	0.024	0.034

* For 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 inch ducts. 1/2 inch water gauge = 1.0 Pa.
* Ductwork that exceeds 20 inches by diameter or exceeds a pressure of 1 inch water gauge shall be constructed in accordance with SMACNA, RTAC Duct Construction Standards—Metal and Flexible.
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Stud Cavity Limitations

IRC M1601.1 (7):

- Not allowed for supply air
- Can't be in a fire rated wall
- Limited to air from one floor level
- Must be fireblocked
- Can't be in an exterior wall
- Must be sealed




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Underground Duct Systems

IRC M1601.1.2:

- Materials
 - Concrete
 - Clay
 - Metal
 - Plastic
- Temperature < 150°F
- Corrosion Resistant or encased in 2" of concrete
- Slope to an accessible point for drainage

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Duct Installation



IRC M1601.4.1:



Joints:

- Joints, longitudinal and transverse seams, and connections shall be securely fastened & sealed
- UL 181A- (P-tape, M-mastic, H-heat)

Supports:

- Based upon the materials, and shall be provided based on the approved standard SMACNA







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Duct Insulation

IRC M1601.3:

- Covering and Linings- ASTM E84 or UL 723
- Not flame or glow when tested ASTM C411
- Labeled at 36" o.c.
 - Manufacturer
 - R-value
 - Flame Spread
 - Smoke-Developed



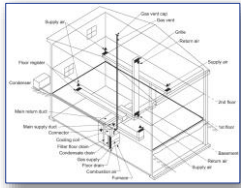





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Outdoor Air

IRC M1602:

Outdoor intake opening locations are per Section R303.5.1 (10 ft.)








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Return Air

IRC M1602.2:
 Openings for heating, ventilation, and air condition shall comply with **ALL** the provisions of M1602.2.

1. Located **10 ft** from a combustion chamber/draft hood of other appliances in same room/space.
2. Return air taken shall not be greater than the supply air.
3. Sized per Manual D, appliance manufacturer or registered design professional.


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Return Air

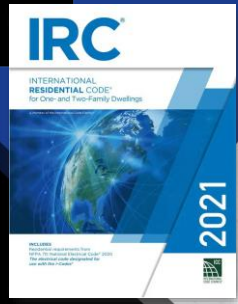
IRC M1602.2:

4. Not taken from closet, bathroom, toilet room, kitchen, garage, mechanical room, boiler room, furnace room or unconditioned attic.
(Exception: Kitchen ok if >10' from cooking appliances)
5. Not from indoor swimming pool areas. (unless dehumidified)
6. Not by direct connection to return side, if sourced from unconditioned crawl.
7. Must be from the same dwelling unit.



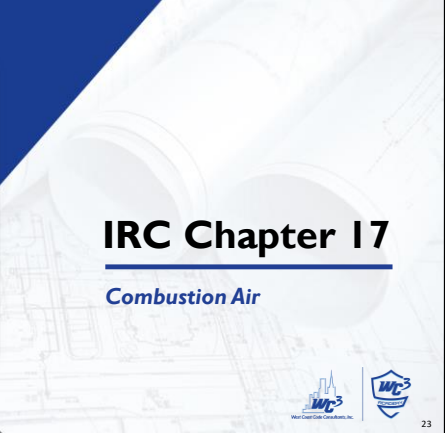


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IRC Chapter 17

Combustion Air



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Combustion Air


IRC M1701:

- Solid-fuel-burning appliances- Per manufacturer's installation instructions
- Oil-fired appliances - **NFPA 31**
- Does not apply to
 - Fireplaces
 - Fireplace stoves
 - Direct vent appliances
- At or above floor elevation- in flood hazard areas

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Combustion Air


IRC M1701:
For LP-Gas or Natural Gas appliances: Combustion Air in accordance with IRC Chapter 24

Part VI—Fuel Gas

**CHAPTER 24
FUEL GAS**

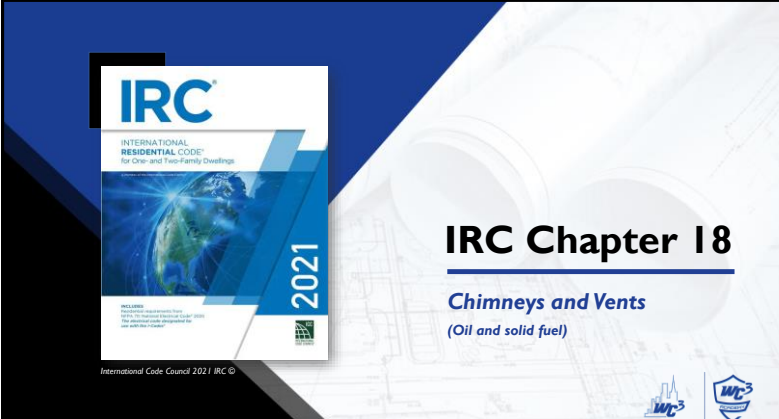
The text of this chapter is extracted from the 2021 edition of the International Fuel Gas Code and has been modified where necessary to conform to the scope of application of the International Residential Code for One- and Two-Family Dwellings. The section numbers appearing in parentheses after each section number are the section numbers of the corresponding text in the International Fuel Gas Code.


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IRC Chapter 18

Chimneys and Vents

(Oil and solid fuel)





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Venting

IRC M1801.1:
Fuel burning appliances shall be vented to outdoors

- Per manufacturer listing
- Gas fired appliances per Chapter 24

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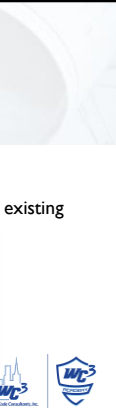
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Existing Chimneys & Vents

IRC M1801.3:
Where an appliance is permanently disconnected or when connected to an existing chimney or vent:

- Needs to be resized
- Flue passageways cleaned and free of obstructions
- Cleanout in masonry chimneys per R1003.17
- Clearance to combustibles per manufacturer listing
 - Masonry chimneys with a lining system are exempt (Tested and Listed per UL 1777)

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Fireblocking

IRC M1801.9:
Locations & Materials as per R602.8

Concealed Spaces

- Vertically at ceilings and floors
- Horizontally at intervals < 10'
- Connections between concealed vertical and horizontal spaces
- Concealed spaces between stair stringers




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Fireblocking

IRC M1801.9:
Locations (R302.11)

- Openings around vents, pipes, ducts, cables and wires
- Chimneys and fireplaces

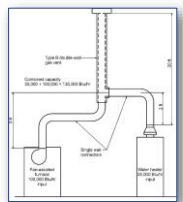


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Venting

IRC M1801.11:
Multiple appliances connected to a common venting system

- Located on the same floor
- Inlets must be offset
- Natural draft not connected to a positive pressure mechanical draft system




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Venting

IRC M1801.12:
Multiple solid fuel prohibited

- Shall not connect to a chimney passageway venting another appliance


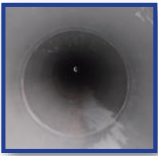





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Obstructions

IRC M1802.3:
Oil-fired appliances shall be equipped with a device that will stop burner operation if venting system is obstructed.



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Vents

IRC M1804.2:

- Vents passing through a roof shall extend through flashing as per manufactures installation
- Vents for natural draft appliances shall terminate > 5' above the highest connected appliance outlet
- Gas vents serving wall furnaces shall terminate > 12' above the bottom of the furnace



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Connectors

IRC M1803.3.1:

- Slope not less than 1/2" per Foot
- Shall not pass through a floor or ceiling (exceptions)






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Vent Terminations

IRC M1804.2.2:
Decorative shrouds can only be installed if listed and labeled for use with the specific venting system

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Mechanical Draft Systems


IRC MI804.2.6:
Comply with UL 378

1. Terminate > 3' above a forced air inlet within 10 feet
2. Terminate not less than 4' below, 4' horizontally from, or 1' above any door, window or gravity air inlet




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Mechanical Draft Systems


IRC MI804.2.6: (Cont.)

3. Not closer than 3' from an interior corner.
4. At least 12" above finished ground.
5. Not above or within 3' of an oil tank or gas meter.
6. 10 feet from property lines. (power exhausters)
7. Directed away from the building.



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Masonry Chimneys

IRC MI805.2

- Connector shall enter 6" min. above the bottom
- Cleanout required
- Flush with inner liner
- Cemented into masonry

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IRC Chapter 19

Special Appliances, Equipment and Systems





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Ranges

IRC M1901.1:

- Shall have a vertical clearance above the cooktop of **30"**
- Cooking appliances Listed and labeled for household use
- Electric- UL 858 or UL 1026
- Solid-Fuel-Fired- UL 737
- Microwaves- UL 923

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Sauna Heaters

IRC M1902:

- Protected from accidental contact
- Comply with **UL 875**
- Thermostat shall limit room temperature to 194°F

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END OF MODULE 3

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MODULE 4

IRC Chapters 20-23

Boilers, Water Heaters, Hydronic Piping, Special Piping/Storage Systems and Solar Energy Systems

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LEARNING OBJECTIVES

1. Become familiar with proper installation and utilization of hot water heaters, boilers and distribution piping.
2. Understand the key considerations associated with hydronic piping systems.
3. Be able to identify proper installation of fuel oil tanks and associated piping.
4. Become competent at evaluating code compliance associated with solar hot water systems.

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IRC

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For One- and Two-Family Dwellings

2021

IRC Chapter 20

Boilers and Water Heaters

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Boilers

IRC M2001.1.1:

Standards

- Provide listing for electric and solid-fuel-fired boilers
- Gas-fired boilers shall conform to Chapter 24

IRC M2001.3:

Boilers to have shutoff valve in the supply and return piping





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Operations

IRC M2002:

- Safety controls
 - Hot water boiler gauges
 - Pressure
 - Temperature
 - Read the normal range
- Steam boiler gauges
 - Water-gauge glass
 - Show mid point
- Pressure
 - Normal range
- Pressure-relief valve
 - Minimum rated capacities
 - Set at maximum rating
 - Discharge 18" above floor
- Boiler low-water cutoff
 - Steam and hot water

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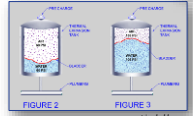


Expansion Tanks

IRC M2003:

- Boilers shall be provided with expansion tanks
 - Securely fastened to the structure or boiler
 - Supported to carry twice the weight of the tank filled with water
- Non-pressurized
 - Supported to carry twice the weight of the tank filled with water
- Minimum capacity per Table M2003.2

(No issues with over-sizing)

SYSTEM VOLUME (GALLONS)	PRESSURIZED EXPANSION TANK	NON-PRESSURIZED TANK
10	1.0	1.3
20	1.5	2.0
30	2.1	4.3
40	2.8	6.6
50	4.0	7.5
60	5.0	9.0
70	6.0	10.0
80	6.5	12.0
90	7.5	13.0
100	8.0	15.0





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Hydronic Heating

IRC M2004:

Water heater used for both potable water and space heating

- Installation per M2005, Chapter 24 (G2408.2), Chapter 28, and per manufacturer's instructions

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Water Heaters

IRC M2005:

- Water heaters installed in attics per M1305.1.3
- Gas fired as per Chapter 24
 - Fuel-fired water heaters shall not be installed in room used for storage
 - Not be installed in a bedroom or bathroom unless combustion air is not taken from living space
 - Access through attic or closet located in a bedroom or bathroom is ok






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Pool Heaters

IRC M2006:

- Installed per manufacturer's instructions (Oil-fired UL 726, Electric UL 1261)
- Clearances shall not interfere with combustion air, draft hood, flue relief, or accessibility
- Provide temperature relief valves
- Provide bypass valve between inlet and outlet piping if not provided



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2021
INCLUDES:
International Residential Code
ICC 605.4 International Mechanical Code
ICC 605.4.1 International Mechanical Code Supplement
ICC 605.4.2 International Mechanical Code Supplement
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IRC Chapter 21
Hydronic Piping

Hydronic Piping Materials

IRC M2101:

Piping shall conform to Table M2101.1

MATERIALS	APPLICABLE CODES	REMARKS	NOTES
Asbestos-free fibrous-reinforced plastic (FRP) pipe	ASTM D2838, ASTM F2949, ASTM F2969	Asbestos content limits	---
Chemical pipe made of advanced H-PPVC pipe and tubing	ASTM D2658	Substituted solvent system, ultraviolet rays and chemical solvents	---
Copper and copper alloy pipe	ASTM B88, ASTM B41, ASTM B882	Brass, stainless steel and mechanical fittings (threaded, welded and flanged)	---
Copper and copper alloy tubing (Types K, L or M)	ASTM B152, ASTM B75, ASTM B76, ASTM B77, ASTM B78, ASTM B79, ASTM B80	Brass, stainless steel, galvanized and flared mechanical fittings	Flare prohibited in systems that are brazed
Cross-linked polyethylene (PEX) pipe	ASTM F2950, ASTM F2951	Other PEX fittings	Install in accordance with manufacturer's instructions
Cross-linked polyethylene (PEX) pipe and tubing	ASTM F2950, ASTM F2951	Mechanical components	Install in accordance with manufacturer's instructions
PEX fittings	ASTM F2950, ASTM F2951, ASTM F2952, ASTM F2953, ASTM F2954, ASTM F2955, ASTM F2956, ASTM F2957, ASTM F2958, ASTM F2959, ASTM F2960, ASTM F2961, ASTM F2962, ASTM F2963, ASTM F2964, ASTM F2965, ASTM F2966, ASTM F2967, ASTM F2968, ASTM F2969, ASTM F2970, ASTM F2971, ASTM F2972, ASTM F2973, ASTM F2974, ASTM F2975, ASTM F2976, ASTM F2977, ASTM F2978, ASTM F2979, ASTM F2980, ASTM F2981, ASTM F2982, ASTM F2983, ASTM F2984, ASTM F2985, ASTM F2986, ASTM F2987, ASTM F2988, ASTM F2989, ASTM F2990, ASTM F2991, ASTM F2992, ASTM F2993, ASTM F2994, ASTM F2995, ASTM F2996, ASTM F2997, ASTM F2998, ASTM F2999, ASTM F3000	Copper component fittings and expansion fittings	Install in accordance with manufacturer's instructions

1. Use only:
1. Extra grade.
2. Extruded or solid center.
3. Copper with 100% copper.
4. Low temperature (LPT) applications with temperature rating and wall thickness per Table 601.4.

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Hydronic Piping

IRC M2101:

- Hydronic piping systems shall be installed to permit draining of the system (M2101.2)
- The potable water system shall be protected from backflow (M2101.3)


IRC M2101.10:

- Piping shall be tested at 1.5 x working pressure (100 psi min.)
 - o Test duration 15 min. but not more than 20 min.



Hanger Spacing

IRC M2101.9:
Piping shall be supported at intervals per Table M2101.9



PIPE MATERIAL	MINIMUM HANGER SPACING (feet)	MAXIMUM HANGER SPACING (feet)
ASB	4	10'
CPVC 1/2 inch pipe or tubing	3	7'
CPVC 3/4 inch	4	10'
Copper or copper alloy pipe	12	18'
Copper or copper alloy tubing	6	12'
PE pipe or tubing	2.67	4
PE pipe or tubing	2.67	4
PE-RT 1/2 inch	2.67	10'
PE-RT 3/4 inch	4	10'
PEX tubing 1/2 inch	2.67	4
PEX tubing 3/4 inch	4	10'
PP - 1/2 inch pipe or tubing	2.67	4
PP - 3/4 inch	4	10'
PVC	4	10'
Steel pipe	12	15'
Steel tubing	6	10'



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Floor Heating

IRC M2103.1:
Materials

- Steel pipe
- Copper Tubing
- PEX
- CPVC
- Polypropylene (with a rating of not less than 80 psi at 180°F)

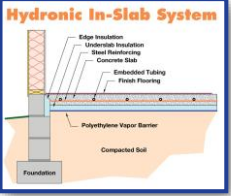
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Required Testing

IRC M2103.4:
Embedded piping

- Hydrostatic pressure = 100 PSI for 30 minutes
- All joints visually inspected



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Ground-Source Heat-Pump

IRC M2105.20:

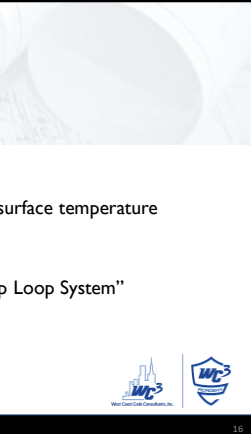
- A 1" min. clearance required- piping having an exterior surface temperature exceeding 250-Deg. F

IRC M2105.25:

- Labels where enters building "Ground-Source Heat-Pump Loop System"
 - Indicate chemical names and concentrations


IRC M2105.28:

- Tested at 100 PSI for 15 min
- Flow or pressure drop within 10% of calculated design



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IRC Chapter 22
Special Piping and Storage Systems



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Fuel Oil Tanks

IRC M2201.2:

- Above-ground fuel-oil tanks
- Maximum **660 gallons**
 - > 5' from property line
- Tanks within buildings
 - Able to be installed/removed as a whole
 - Larger than 10 gal > 5' from any flame source



18

Under Ground Tanks

IRC M2201.3:

- 1' earth coverage
- 1' separation from property line

Oil piping steel, copper, or steel tubing (M2202.1)






19

Supply Piping

IRC M2203.2:

- Supply piping must be **3/8" diameter** or larger of steel/copper piping/tubing
- Fill opening (M2203.3)
 - 2' or more away from any building opening at same or lower level

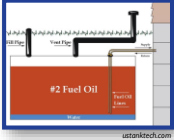




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Vent Piping

IRC M2203.4:

- Min. 1-1/4" pipe draining toward tank with no dips or sags
- Must terminate not less than 2' from any building opening
- Located to avoid being blocked by snow and ice


21

21

Pumps and Valves

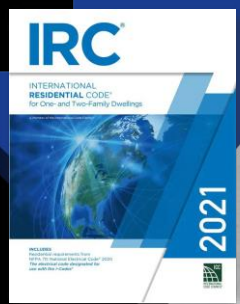
IRC M2204:

- Positive Displacement Type- UL 343
- Shutoff Valve- Between tank and burner
- Pressure at inlet to appliance 3 PSI or less



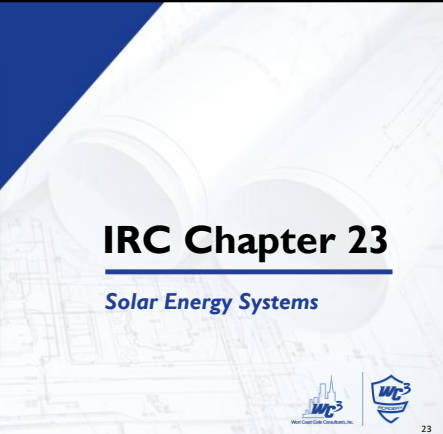
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IRC Chapter 23

Solar Energy Systems



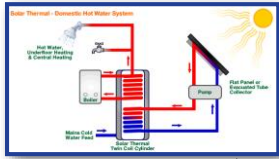

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Thermal Solar Energy Systems

IRC M2301.1:

Provides for the design, construction, installation, alteration and repair of equipment using thermal solar energy to provide space heating, cooling, hot water heating, or swimming pool heating

24

24

Access

IRC M2301.2.1:
 Access must be provided to all solar energy collectors, controls, dampers, fans, blowers, and pumps for inspection, maintenance, repair or replacement



Solar thermal collectors







25

25

Max Temperature Limiting

IRC M2301.2.12:
 Thermal solar systems shall be equipped with means to limit the maximum temperature of the system fluid entering or exchanging heat with any pressurized vessel inside of a dwelling to **180°F (82°C)**.




26

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Collector Labeling

IRC M2301.3.1:
 Must contain:

- Manufacture's name
- Model number
- Serial number
- Collector weight
- Collector maximum temperatures and pressures
- Type of heat transfer liquids compatible with the collector

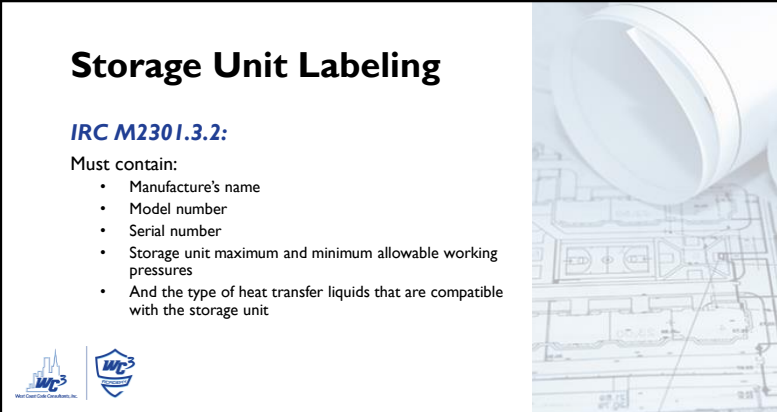

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Storage Unit Labeling

IRC M2301.3.2:
 Must contain:

- Manufacture's name
- Model number
- Serial number
- Storage unit maximum and minimum allowable working pressures
- And the type of heat transfer liquids that are compatible with the storage unit

28

28



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MODULE 5

*IRC Chapter 24 Part I:
Fuel Gas*

1

1

LEARNING OBJECTIVES

1. Understand terminology common to fuel gas systems and components.
2. Know where fuel gas appliances can and cannot be located.
3. Be able to calculate combustion air using each one of the (3) allowable methods.
4. Understand how to properly size gas lines based on pipe length and gas demand.

2

2

IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings

2021

IRC Chapter 24

Fuel Gas - Part I

3

3


Scope

IRC G2401.1:
Text has been extracted from the 2021 IFGC and modified where necessary

IFGC
INTERNATIONAL FUEL GAS CODE
2021

4


4




Scoping

IRC G2401.1:


- Fuel gas piping systems, appliances, venting, and combustion air
- Piping Systems limited to point of delivery to the outlet of the appliance shutoff valves
- If not specifically covered- refer to the IFGC



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5




Definitions

Chapter 24- Separate Definitions Section


- Definitions specific to fuel gas burning systems
- **7 additional pages of definitions**
- **Review!**

C2402.3 (01.3) Terms defined in other codes. Where terms are not defined in this code and are defined in the International Building Code, International Fire Code, International Mechanical Code, International Fuel Gas Code or International Plumbing Code, such terms shall have meanings ascribed to them as in those codes.

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6



Definitions

IRC G2403:

- BTU- British Thermal Unit
- Burner
- Combustion air
- Connector – appliance (fuel)
- Connector – chimney or vent

BTU. Abbreviation for British thermal unit, which is the quantity of heat required to raise the temperature of 1 pound (454 g) of water 1°F (0.56°C) (1 *Btu* = 1055 J).


BURNER. A device for the final conveyance of the gas, or a mixture of gas and air, to the combustion zone.

COMBUSTION AIR. Air necessary for complete combustion of a fuel, including theoretical air and excess air.

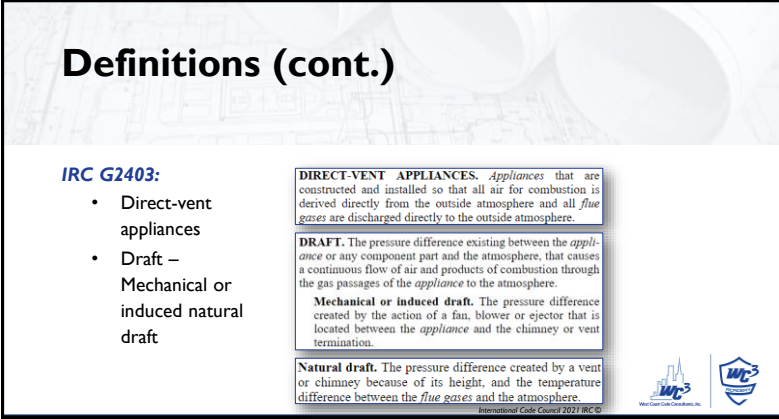
CONNECTOR, APPLIANCE (Fuel). Rigid metallic pipe and fittings, semirigid metallic tubing and fittings or a listed and labeled device that connects an appliance to the gas piping system.

CONNECTOR, CHIMNEY OR VENT. The pipe that connects an appliance to a chimney or vent.

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7



Definitions (cont.)

IRC G2403:

- Direct-vent appliances
- Draft – Mechanical or induced natural draft


DIRECT-VENT APPLIANCES. Appliances that are constructed and installed so that all air for combustion is derived directly from the outside atmosphere and all *flue gases* are discharged directly to the outside atmosphere.

DRAFT. The pressure difference existing between the *appliance* or any component part and the atmosphere, that causes a continuous flow of air and products of combustion through the gas passages of the *appliance* to the atmosphere.

Mechanical or induced draft. The pressure difference created by the action of a fan, blower or ejector that is located between the *appliance* and the chimney or vent termination.

Natural draft. The pressure difference created by a vent or chimney because of its height, and the temperature difference between the *flue gases* and the atmosphere.

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8

Definitions (cont.)

IRC G2403:

- Draft hood
- Fuel gas
- Regulator pressure vent

DRAFT HOOD. A nonadjustable device built into an appliance, or made as part of the vent connector from an appliance, that is designed to: provide for ready escape of the flue gases from the appliance in the event of no draft, backdraft, or stoppage beyond the draft hood; prevent a backdraft from entering the appliance; and neutralize the effect of stack action of the chimney or gas vent upon operation of the appliance.

FUEL GAS. A natural gas, manufactured gas, liquefied petroleum gas or mixtures of these gases.

REGULATOR. A device for controlling and maintaining a uniform gas supply pressure, either pounds-to-inches water column (MP regulator) or inches-to-inches water column (appliance regulator).

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General Requirements

IRC G2404:

- Equipment and Appliances
 - Listed and Labeled
 - Defective material must be repaired or replaced
 - Appliances in flood hazard areas to be above flood elevation
 - Designed to resist earthquake
 - Supports designed to resist seismic loads
 - Protection against entry of rodents



Structural Safety

IRC G2405:

- Building is not be weakened by installation or repair of gas piping
- Truss member not to be modified without written approval
- Engineered wood products not to be modified unless by manufactures recommendations



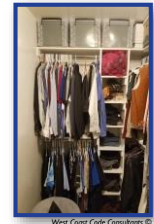
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Appliance Location

IRC G2406:

- Not located in rooms
 - Sleeping
 - Bath
 - Toilet
 - Storage closets
 - Spaces that only open into such rooms
 - (Exceptions 1-5)
 - Outdoor application as per listings



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Dedicated Enclosure

IRC G2406 Ex. 5
 "... provided with a solid, weather-stripped door...and equipped with an approved self-closing device."

Solid



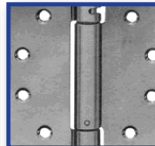
www.windowcenter.co.uk

Weather-stripped



www.familyhandyman.com

Self-closing



www.hardwaresource.com

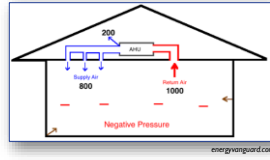




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Makeup Air

IRC G2407.4:
 Where exhaust fans, clothes dryers and kitchen ventilation interfere with the operation of appliances, makeup air shall be provided.


14

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Combustion Air

2021 IRC G2407



15

15

Combustion Air



IRC G2407:

- Category I appliances:
 - G2407.5 (Indoor)
 - G2407.6 through G2407.9 (Outdoor)

Category I. An appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

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- Direct Vent & Others:
 - Exception: Type I clothes dryers per G2439.5

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Combustion, Ventilation, Dilution Air

IRC G2407.2:

- Located not to interfere with proper circulation

IRC G2407.4:

- Make up air required where exhaust fans, clothes dryers, kitchen ventilation interfere

17

17

Indoor Air

IRC 2407.5.1:

- Required 50 cubic feet per 1,000 btu/h

IRC G2407.5.3.1:

- Combining spaces (same level):
 - Each opening shall have a min. free area of 1 in² per 1,000 Btu/h, but ≥ 100in²
 - Openings within 12" of the ceiling and floor
 - Minimum dimensions 3" or greater

18

18

Indoor Air

IRC G2407.5.3.2:

- Combining spaces (different levels):
 - Each opening shall have a min. free area of 2 in² per 1,000 Btu/h

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Outdoor Air

IRC G2407.6.1:

- Two-permanent-openings:
 - Each opening within 12" of ceiling and floor
 - 1 in² per 4,000 Btu/h directly to exterior
 - 1 in² per 2,000 Btu/h through ducts
 - Openings 3" minimum

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Outdoor Air

IRC G2407.6.2:


- One-permanent-opening
 - Within 12" of ceiling
 - Clearance 1" sides, 6" front
 - 1 in² per 3,000 Btu/h
- Openings 3" minimum

IRC G2407.7:

- Allows for a combination of indoor and outdoor air openings



CHIMNEY OR GAS VENT
OPENING
ALTERNATE OPENING LOCATION
FIGURE G2407.6.2 (ONE OR TWO) SINGLE COMBUSTION AIR OPENING, ALL AIR FROM OUTDOORS (see Section G2407.6.2)
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Example Problem #1

Determine the required indoor combustion air volume for (2) 200K btu water heaters.

Step 1: Calculate total btu's:
200,000 btus x 2 = 400,000 btu's

Step 2: Calculate the needed combustion air volume:
50 cubic feet per 1,000 btu's (IRC G2407.5.1)
400,000/1,000 = 400
400 x 50 = 20,000 cubic feet required



22

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Example Problem #2

Determine the necessary size ducts required to supply combustion air for a 20,000 btu appliance, using the two-opening method, assuming horizontal ducts.

Step 1: Calculate required square inches of openings
1 square inch/2,000 btu's (IRC G2407.6.1)
20,000/2,000 = 10 square inches per opening.

Step 2: Calculate required size of ducts
Square Duct: L X W IRC G2407.6— 3" minimum dim.
Multiple options: 3" x 4" minimum
Round Duct: $\pi \times R^2$ R = Radius $\pi = 3.14$
4" duct = 12.57 square inches

Duct Size	Area
3	7.07
4	12.57
5	19.63
6	28.27
8	50.27
10	78.54
12	113.1




23

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Installation

IRC M2408:

- Ignition source (M2408.2)
 - 18" above floor in:
 - Hazardous locations, garages, fuel dispensing areas, parking garages
 - Rooms not part of living space and that communicate with garage
 - Exception: Flammable vapor ignition resistant
 - Residential garages (M2408.2.1)
 - Separate room (no door) with combustion air from outside



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24

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Installation of Equipment

IRC G2408.3:



- Private garages- 6' above floor

IRC G2408.4:

- Clearance from grade
 - Concrete slab 3" above grade
 - Suspended 6" min. above grade

IRC G2408.5:

- Clearance to combustibles as per manufacturer

25


Clearance Reduction

IRC G2409:

- Clearance to combustibles Similar to (M1306.2)
- Reductions as per Table G2409.2

TYPE OF PROTECTION APPLIED TO AND COVERING ALL SURFACES OF COMBUSTIBLE MATERIALS WITH THE CLEARANCE SPECIFIED AS THE REQUIRED CLEARANCE WITH NO PROTECTION (See Figure G2409.2.1, G2409.2.2, and G2409.2.3)	INDICATE THE REQUIRED CLEARANCE WITH NO PROTECTION FROM APPLIANCE, VENT CONNECTOR, OR SINGLE-WALL METAL PIPE IS (inches)									
	24"		12"		6"		6"		3"	
	Above Col. 1	Size per Col. 2	Above Col. 1	Size per Col. 2	Above Col. 1	Size per Col. 2	Above Col. 1	Size per Col. 2	Above Col. 1	Size per Col. 2
1. 3"-thick brick masonry wall without vented airspace	—	24	—	12	—	6	—	6	—	3
2. 1"-thick insulation based on or 1-inch glass fiber or mineral wool batts	24	18	12	9	6	6	6	5	4	3
3. 0.124-inch (nominal 24 gauge) sheet metal over 1-inch glass fiber or mineral wool batts installed with wire on one face with vented airspace	18	12	9	6	6	4	4	3	3	3

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Electrical

IRC G2410:

- Gas piping shall not be used as a **grounding electrode**

IRC G2411:

- Shall be bonded to an effective ground-fault current path (considered bonded where connected to the appliance)
- G2411.1.1.2: CSST Shall be bonded to an effective ground-fault current with not smaller than #6 AWG- Must be less than 75' in length







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General Requirements

IRC G2412:

- Existing piping to be checked when additional appliances added
- Pipe Identification:
 - Yellow label "gas" in Black letters spaced at 5 feet maximum
- Two or more meters on same property can't be interconnected on the outlet side
- Meters must be permanently identified

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Maximum Gas Demand

IRC G2412:

- If a home is at sea-level, to find CFH, simply divide the BTUs by 1,000
 - Example: A furnace with an input of 100,000 BTUs will have a calculated CFH of 100 (at sea level)
- Higher elevations reduce the BTUs per CFH (Cubic Feet per Hour)
- Total connected hourly load- Assume all appliances are to be operated at full capacity at the same time



Gas Pipe Sizing

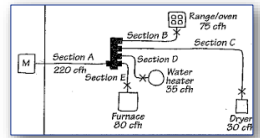
2021 IRC G2413

30

Gas Pipe Sizing

IRC G2413.1:

*“The volumetric flow rate of gas to be provided shall be the **sum** of the maximum input of the appliances served.”*



80 + 35 + 75 + 30 = 220 CFH



Sizing Tables & Equations



IRC G2413.4:

- Gas piping systems must be sized per one of the following methods:
 - G2413.4.1 – Longest length method
 - G2413.4.2 – Branch length method
 - G2413.4.2 – Hybrid pressure



Precautions

- No danger in oversizing the line size, but there is danger supplying too much pressure
- Under sizing gas lines results in reduced equipment life, increased condensation, delayed ignition and reduced performance. (Minimal Safety Risk)

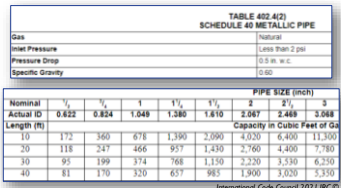



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General Rules:


1 P.S.I. = 16 oz.

- Pressure Drop:**
 - 4 oz. System- Use 0.5 in. w.c.
 - 2 lb. System- Use 1 in. w.c.
- Specific Gravity:**
 - Natural Gas- 0.6
 - Propane- 1.5
- Inlet Pressure:**
 - Residential- 4 oz.
 - Commercial- 2 P.S.I.



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Make sure you're in the right table and verify values!



34

Longest Length Method

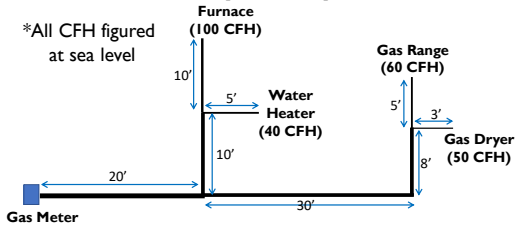
IRC G2413.4.1:
Take the length from the appliance to the gas meter for the appliance that is furthest away from the gas meter and use that same length for sizing each section of pipe.

35

Longest Length Method (cont.)



*All CFH figured at sea level



Gas Meter 20' 30' 3' 8' 5' 5' 10' 5' 10'

Furnace (100 CFH) Water Heater (40 CFH) Gas Dryer (50 CFH)

Appliance furthest away from meter = 63'
We only use 63' for sizing every section of pipe based on the amount of CFH the section of pipe serves.

36

Longest Length Method (cont.)

Less than 2 psi table for schedule 40 metallic pipe (use for 4 oz systems):

TABLE G2413.4(1) (402.4(2))
SCHEDULE 40 METALLIC PIPE

Gas Natural
Inlet Pressure Less than 2 psi
Pressure Drop 0.5 in. w.c.
Specific Gravity 0.60

Nominal Length (ft)	PIPE SIZE (inches)													
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026	6.047	6.065	7.981	10.020	11.958
Capacity in Cubic Feet of Gas per Hour	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100	41,800	67,600	139,000	252,000	399,000
10	118	247	466	957	1,430	2,760	4,400	7,780	15,900	28,700	46,500	95,500	173,000	275,000
20	95	199	374	768	1,150	2,220	3,530	6,250	12,700	23,000	37,300	76,700	139,000	220,000
30	81	170	320	657	985	1,900	3,020	5,350	10,900	19,700	31,900	65,600	119,000	189,000
40	72	151	284	583	873	1,680	2,680	4,740	9,660	17,500	28,300	58,200	106,000	167,000
50	65	137	247	528	791	1,520	2,430	4,290	8,760	15,800	25,600	52,700	95,700	152,000
60	60	126	237	486	728	1,400	2,230	3,950	8,050	14,600	23,600	48,500	88,100	139,000
70														

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Branch Length Method

IRC G2413.4.2:

- Sections of pipe serving multiple appliances shall be sized based on the longest length of pipe from the meter to the most remote appliance that the pipe serves
- Individual branches must be sized based on the total distance from the appliance to the meter measured along the pipe

38

Branch Length Method (cont.)

*All CFH figured at sea level.

Each branch section is to be individually sized based on the length of pipe from each appliance to the gas meter.

For sizing this section, take the length of the furthest away appliance from the meter (from the range to the meter).

This section to be sized based on the distance from the furnace to the meter.

These 2 sections of pipe are to be sized based on the distance from the gas range to the meter.

39

Branch Length Method (cont.)

Less than 2 psi table for schedule 40 metallic pipe (use for 4 oz systems):

TABLE G2413.4(1) (402.4(2))
SCHEDULE 40 METALLIC PIPE

Gas Natural
Inlet Pressure Less than 2 psi
Pressure Drop 0.5 in. w.c.
Specific Gravity 0.60

Nominal Length (ft)	PIPE SIZE (inches)													
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026	6.047	6.065	7.981	10.020	11.958
Capacity in Cubic Feet of Gas per Hour	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100	41,800	67,600	139,000	252,000	399,000
10	118	247	466	957	1,430	2,760	4,400	7,780	15,900	28,700	46,500	95,500	173,000	275,000
20	95	199	374	768	1,150	2,220	3,530	6,250	12,700	23,000	37,300	76,700	139,000	220,000
30	81	170	320	657	985	1,900	3,020	5,350	10,900	19,700	31,900	65,600	119,000	189,000
40	72	151	284	583	873	1,680	2,680	4,740	9,660	17,500	28,300	58,200	106,000	167,000
50	65	137	247	528	791	1,520	2,430	4,290	8,760	15,800	25,600	52,700	95,700	152,000
60	60	126	237	486	728	1,400	2,230	3,950	8,050	14,600	23,600	48,500	88,100	139,000
70														

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Gas Hybrid Systems

IRC G2413.4.3:

- The higher pressure section of pipe must be sized based on the total CFH it serves and also by using the length of pipe from the gas regulator to the gas meter
- The piping after the gas regulator must be sized using the branch length method (based on distances from the appliances to the gas regulator, not to the gas meter)

Diagram labels: Gas Meter, Gas regulator (to reduce gas pressure to 4 oz.), Furnace (100 CFH), Water Heater (40 CFH), Gas Range (60 CFH), Gas Dryer (50 CFH). Distances: 20' from meter to regulator, 10' from regulator to furnace, 5' from regulator to water heater, 5' from regulator to gas range, 3' from regulator to gas dryer.

Legend:
 Length of run: A = 100 ft, B = 10 ft, C = 15 ft, D = 20 ft
 Symbols: [Symbol] = 100 CFH, [Symbol] = 40 CFH, [Symbol] = 60 CFH, [Symbol] = 50 CFH
 [Symbol] = Gas meter, [Symbol] = Gas regulator, [Symbol] = Gas range, [Symbol] = Gas dryer, [Symbol] = Furnace, [Symbol] = Water heater

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Hybrid Systems (cont.)

***All CFH figured at sea level.**

Gas regulator (to reduce gas pressure to 4 oz.)

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Hybrid System Continued...

2 psi table for schedule 40 metallic pipe:

TABLE G2413.4(2) [402.4(5)]
 SCHEDULE 40 METALLIC PIPE

Nominal	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Cubic Feet of Gas per Hour								
10	1,510	3,040	5,560	11,400	17,100	32,900	52,500	92,800	189,000
20	1,070	2,150	3,930	8,070	12,100	23,300	37,100	65,600	134,000
30	869	1,760	3,210	6,590	9,880	19,000	30,300	53,600	109,000
40	753	1,520	2,780	5,710	8,550	16,500	26,300	46,400	94,700
50	673	1,360	2,490	5,110	7,650	14,700	23,500	41,500	84,700
60	615	1,240	2,270	4,660	6,980	13,500	21,400	37,900	77,300
70	569	1,150	2,100	4,320	6,470	12,500	19,900	35,100	71,600
80	532	1,080	1,970	4,040	6,050	11,700	18,600	32,800	67,000

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Maximum Pressure

IRC G2413.6:

- Maximum pressure inside a building **5 lbs.**, except when:
 - Piping is welded,
 - Piping is in a ventilated chase or
 - Piping is for temporary construction

DANGER
HIGH PRESSURE

44



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MODULE 6

IRC Chapter 24: Part 2
Fuel Gas Piping & Appliance Venting

1

1

LEARNING OBJECTIVES

1. Understand what materials are permitted to be used in fuel gas systems.
2. Become familiar with code considerations associated with the installation of gas lines.
3. Understand inspection and testing requirements necessary for gas piping systems.
4. Know how to properly vent gas fired appliances.

2

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IRC Chapter 24

Fuel Gas - Part 2

3

3

Pipe Materials

IRC G2414.2:

- Used materials must be clean of foreign material and ascertained to be adequate

IRC G2414.3:

- Other Materials:
 - Tested for safety and suitability
 - Recommended for the service intended by the manufacturer
 - Approved by the Building Official




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Pipe Materials- Metallic

IRC G2414.3:

- Cast Iron pipe **SHALL NOT** be used
- Steel & Wrought Iron **SHALL** be at least standard weight "Schedule 40"



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Pipe Materials - Metallic Tubing

IRC G2414.4:

- Seamless copper
 - Type K or L ASTM B 88 or ASTM B 280
 - Copper or brass not used -
 - Gas contains average > 0.3 grains of hydrogen sulfide per 100 standard cubic feet of gas
 - Aluminum alloy Steel tubing
 - As per ASTM A-254
 - CSST as per ANSI LC 1/CSA 6.26




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Pipe Material- Plastics

IRC G2414.5:

- Plastic Pipe, Tubing & Fittings
 - Polyethylene as per 2008 - ASTM D 2513, Shall be marked "Gas" & "ASTM D 2513"
 - Other than Polyethylene as per 2008 - ASTM D 2513, Shall be marked "Gas" & "ASTM D 2513"

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Anodeless Risers

IRC G2414.5.1:

- Used by gas utilities to connect services lines to gas meter sets
- Do not require cathodic protection
- Shall be leak tested by the manufacturer
- Service head adapters per Category I of **ASTM D2513**


IRC G2414.5.2:

- LP-gas systems per **NFPA 58**


8

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CSST

IRC G2415.2
 Installed in accordance with the terms of approval, conditions of listing, manufacturer's instructions and the code.



Corrugated Stainless Steel Tubing



9




Installation

IRC G2415.3:

- Prohibited Locations:
 - Shall not be installed in or through ducted supply, return or exhaust, a clothes chute, chimney or gas vent, dumbwaiter or elevator shaft





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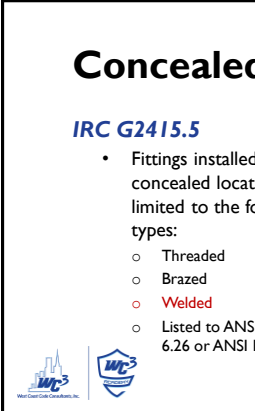


Piping in Solid Partitions & Walls

IRC G2415.4
"Concealed piping shall not be located in solid partitions and solid walls, unless installed in a chase or casing."



11



Concealed Joints

IRC G2415.5

- Fittings installed in concealed locations shall be limited to the following types:
 - Threaded
 - Brazed
 - **Welded**
 - Listed to ANSI LC-1/CSA 6.26 or ANSI LC-4







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Underground Penetrations

IRC G2415.6

- Gas piping shall not penetrate building foundation walls at any point below grade
- Annular space between the pipe and the wall shall be sealed




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Shield Plates

IRC G2415.7.1 – G2415.7.3

- Piping through holes or notches in framing members **< 1 1/2 inches** from the face of the member shall be protected by shield plates
- Plates shall cover the width of the pipe and the framing member and extend not less than **4 inches** to each side of the member
- Must be 16 gage

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Isolation & Protection

IRC G2415.10

- Metallic piping and tubing conveying LP-gas from a storage container shall be dielectrically isolated between above ground and underground portions.

IRC G2415.11

- U.G. steel pipe or tubing- must be protected
 - Galvanizing is **NOT** adequate
 - Corrosion-resistant material
 - Factory-applied coatings
 - Cathodic protection system

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Minimum Burial Depth

IRC G2415.12

- "Underground piping systems shall be installed a minimum depth of **12 inches** below grade, except as provided for in Section G2415.12.1."

IRC G2415.12.1

- Individual lines for lights, grills, etc. can be **8 inches** below grade.

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Bends

IRC G2416.2- Metallic Pipe

- Metallic pipe bends shall only be made with bending tools.
- Pipe shall not be bent through an arc of more than 90 degrees.
- Inside radius limited to 6x the outside pipe diameter



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Bends

IRC G2416.3- Plastic Pipe

- Plastic pipe bends shall not damage the internal diameter of the pipe.
- Radius of inner curve shall be not less than 25 times the inside diameter of the pipe.
- Special bending tools required when indicated by the manufacturer.



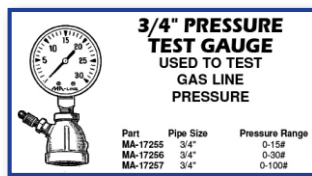
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Inspections and Testing

IRC G2417.1

Prior to acceptance and initial operation, pipe shall be visually inspected and pressure tested.



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Tracer Wire

IRC G2415.17.3

- A yellow insulated copper tracer wire shall be installed adjacent to underground nonmetallic piping
- Shall not be less than **18 AWG** and the insulation type shall be suitable for direct burial





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Test Pressure Measurement

IRC G2417.4
 Test pressure shall be measured with a pressure-measuring device with a range not greater than **fives times** the test pressure.

Example: 5 P.S.I. Test = 25 P.S.I. Maximum Gauge



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Pressure

IRC G2417.4.1
 “The test pressure to be used shall be not less than **1 ½ times** the proposed maximum working pressure, but **not less than 3 psig**”

Example: 2 lb. System = 3 P.S.I. Test

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Discharge of Purged Gases

IRC G2417.7.1.3

- The open end shall discharge directly to an outdoor location

Req. #2

- Point of discharge shall be located **>10 feet** from sources of ignition, **>10 feet** from building openings and not less than **25 feet** from mechanical air intakes

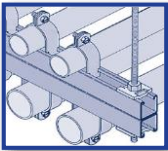

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Supports

IRC G2418

- Piping shall be supported per Table G2424.1
- Designed to prevent undue strains
- Conform to MSS SP-58

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Drips and Sloped Pipes

IRC G2419:

- Slopes $\geq .25''$ in 15'
- Drips- Wet gas exists
- Location needs to be readily accessible
 - Cleaning or emptying
 - Not subject to freezing



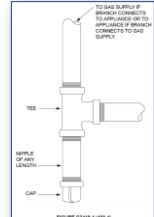
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Sediment Trap

IRC G2419.4

Where not incorporated as part of the appliance, a sediment trap shall be installed downstream of the appliance shutoff valve, as close to the inlet of the appliance as practical.



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Shutoff Valve

IRC G2420:

- Meter Valve
 - Located on the supply side
- Outside of each building
- Ahead of each MP Regulator



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Shutoff Valves

IRC G2420.5.1

"Shall be located in the same room as the appliance... shall be within 6 feet of the appliance, and shall be installed upstream of the union, connector or quick disconnect device it serves."



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Flow Controls

IRC G2421:

- Pressure Regulators (G2421.1)
 - At appliance designed at lower pressure
 - Access required
 - Protected from damage
- MP Regulators
 - Approved & suitable for inlet and outlet pressure
 - Maintain outlet pressure at lockup
 - Adequate capacity
 - Access required






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MP Regulators

IRC G2421.2:

- Tee fitting, one opening capped or plugged shall be installed:
 - Between Regulator and (upstream) shutoff valve
 - Allow connection of measuring device & serve as a sediment trap
 - Within 10 pipe diameters downstream

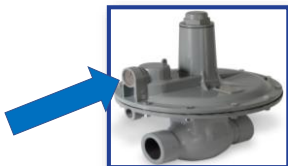

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Venting of Regulators

IRC G2421.3

“Pressure regulators that require a vent shall be vented directly to the outdoors. The vent shall be designed to prevent the entry of insects, water and foreign objects.”



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Appliance Connections

IRC G2422:

- Appliance Connectors
 - Listed and Labeled quick-disconnect
 - Protected from damage (G2422.1.1)
 - Maximum length 6' (G2422.1.2)
 - Rigid metal pipe may be longer than 6', if sized as gas pipe
 - Minimum size (G2422.1.3)
 - Sized for total demand of appliance

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Connecting Appliances

IRC G2422.1

- Appliances shall be connected to the piping system by one of the following:
 - Rigid metal pipe
 - CSST
 - Semi-rigid metallic tubing- 6 foot max.
 - Other listed connectors

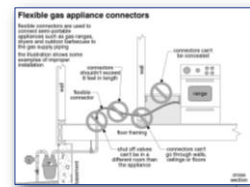


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Prohibited Locations

IRC G2422.1.2.3:

- SHALL not be concealed or extended through:
 - Walls
 - Floors
 - Partitions
 - Ceilings
 - Appliance housings



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Supports

IRC G2424.1:

Supports per Table G2424.1

TABLE G2424.1 (415.1) SUPPORT OF PIPING			
STEEL PIPE, NOMINAL SIZE OF PIPE (inches)	SPACING OF SUPPORTS (feet)	NOMINAL SIZE OF TUBING SMOOTH-WALL (inch O.D.)	SPACING OF SUPPORTS (feet)
1/2	6	1/2	4
3/4 or 1	8	3/4 or 1	6
1 1/2 or larger (horizontal)	10	1 or 1 (horizontal)	8
1 1/2 or larger (vertical)	Every floor level	1 or larger (vertical)	Every floor level

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Vents

2021 IRC G2426 – G2429


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Types of Vents

- **Special Gas Vent-** A vent listed and labeled for use with listed Cat. II, III and IV gas appliances
- **Type B-** A vent listed and labeled for use only with gas-fired appliances
- **Type L-** A vent listed and labeled for use with oil-burning appliances or gas-fired appliances
- **Pellet Vent-** A vent listed and labeled for use with pellet-fuel-burning appliances.




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Masonry Chimneys

IRC G2425.3
Masonry chimneys shall be constructed in accordance with G2427.5 and Ch. 10




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Abandoned Inlet Openings

IRC 2425.5
Abandoned inlet openings shall be closed by an approved method.






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Unvented Appliances

IRC G2425.8:

- “The following appliances shall not be required to be vented.”
 - Ranges
 - Hot plates and laundry stoves
 - Type I clothes dryers (residential)
 - Refrigerators
 - Listed room heaters

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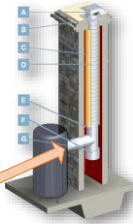
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Chimney Entrance

IRC G2425.9:

“Connectors shall connect to a chimney flue at a point not less than **12 inches** above the lowest portion of the interior of the chimney flue.”

12" min.



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Existing Chimneys and Vents

IRC G2425.15

- When connecting to an existing chimney or vent the new installation shall comply with 2425.15.1 through 2425.15.4.
 - 2425.15.1- The chimney or vent shall be resized as necessary
 - 2425.15.2- Passageway free from obstructions and deposits
 - 2425.15.3- A cleanout must be provided
 - 2425.15.4- Clearances from combustibles must be verified



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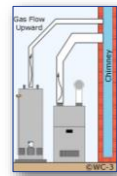
Vents & Connectors

IRC G2426.1:

- Labeled and listed
- Type B & BW – UL 441
- Type L – UL 641
- Category II & III – UL 1738
- Category IV - Plastic as per manufacturer

IRC G2426.2:

- Used to connect to vertical chimney or vent
- Size, material, construction, install per G2427.4



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Insulation Shield

IRC G2426.4

“Where vents pass through insulated assemblies, an **insulation shield** constructed of not less than No. 26 gage sheet metal shall be installed to provide clearance between the vent and the insulation material.”




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Door Swing

IRC G2426.7.1

*“Appliance and equipment vent terminals shall be located such that doors cannot swing within **12 inches** horizontally of the vent terminals. **Door-stops or closures shall not be installed to obtain this clearance.**”*



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END OF MODULE 6



46

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MODULE 7

IRC Chapter 24: Part 3
Fuel Gas Piping & Appliance Venting

1

LEARNING OBJECTIVES

1. Understand the (4) types of vented appliances and what makes them different.
2. Know how gas vents must be terminated.
3. Become familiar with the proper installation of appliance vent connectors.
4. Understand how to read basic vent tables.

2

IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings
2021

IRC Chapter 24
Venting of Appliances

3

Vented Appliance Categories


Category 1 • Flue negative pressure • Flue gas is over 140°F	Vent Pipe Above 140°	Category 3 • Flue positive pressure • Flue gas over 140°F • Sealed combustion
Vent Pipe Negative ←		→ Vent Pipe Positive
Category 2 • Flue negative pressure • Flue gas is under 140°F • Some condensing of flue gases	Vent Pipe Below 140°	Category 4 • Flue positive pressure • Flue gas under 140°F • Condensing of flue gas • Sealed combustion

• Traditional flue/chimney, natural draft (B-vent)
 • No or very little equipment in this category, no longer manufactured
 • 80% direct side-wall vented (Stainless Steel)
 • "90%-plus" or "condensing" units (Plastic)

4

Table G2427.4

TABLE G2427.4 (503.4) TYPE OF VENTING SYSTEM TO BE USED	
APPLIANCES	TYPE OF VENTING SYSTEM
Listed Category I appliances	Type B gas vent (Section G2427.6)
Listed appliances equipped with draft hood	Chimney (Section G2427.5)
Appliances listed for use with Type B gas vent	Single-wall metal pipe (Section G2427.7)
	Listed chimney lining system for gas venting (Section G2427.5.2)
	Special gas vent listed for these appliances (Section G2427.4.2)
Listed vented wall furnaces	Type B-W gas vent (Sections G2427.6, G2436)
Category II, Category III and Category IV appliances	As specified or furnished by manufacturers of listed appliances (Sections G2427.4.1, G2427.4.2)
Unlisted appliances	Chimney (Section G2427.5)
Decorative appliances in vented fireplaces	Chimney
Direct-vent appliances	See Section G2427.2.1
Appliances with integral vent	See Section G2427.2.2





5

Masonry Chimneys

IRC G2427.5.2

- Shall be built and installed in accordance with **NFPA 211** and shall be lined with:
 - Approved clay flue lining
 - A listed chimney lining system
 - Other approved material
- Must resist corrosion, erosion, softening or cracking from vent gases at temperatures up to **1,800°F**

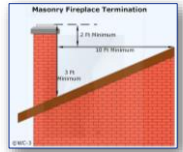




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Chimney Termination

IRC G2427.5.3

“Chimneys for residential-type or low-heat appliances shall extend not less than 3 feet above the highest point where they pass through a roof of a building and not less than 2 feet higher than any portion of a building within a horizontal distance of 10 feet.”





7

Size of Chimneys


IRC G2427.5.4:

- Appliances with draft hoods, Category I Appliance & others using Type B vents
 - Per Section G2428
 - One appliance:** Not less than the area of the flue color or draft hood outlet
 - Two or more appliances: The largest draft hood + **50%** of the smallest but not **> 7x** the smallest
 - Approved engineering methods





8

Area Calculations

Area = πr^2 or 

$\pi = 3.14$

Example:
 4" Diameter Flue Collar = $\pi(3.14) \times r(2) \times r(2) = 12.56$ si
 10" Diameter Flue = $\pi(3.14) \times r(5) \times r(5) = 78.5$ si
 12.56 x 7 = 87.92 – 10" chimney is ok







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Space Surrounding Lining

IRC G2427.5.9:

- Not to be used to vent another appliance
- Insertion of another liner or vent OK if approved by manufacturer
- Not to be used to supply combustions air






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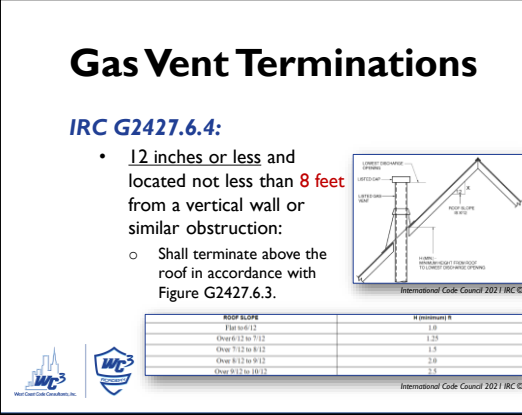

Gas Vent Terminations

IRC G2427.6.4:

- 12 inches or less and located not less than 8 feet from a vertical wall or similar obstruction:
 - Shall terminate above the roof in accordance with Figure G2427.6.3.



ROOF SLOPE	Minimum H
Flat to 1:12	1.8
Over 1:12 to 3:12	1.25
Over 3:12 to 9:12	1.5
Over 9:12 to 15:12	2.0
Over 15:12 to 18:12	3.5






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Gas Vent Terminations

IRC G2427.6.4:

- Over 12 inches or are located less than 8 feet from a vertical wall or similar obstruction:
 - Shall terminate not less than 2 feet above the highest point where they pass through the roof and not less than 2 feet above any portion of a building within 10 feet.

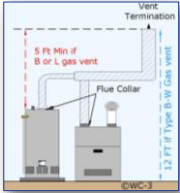




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Minimum Height

IRC G2427.6.5

- A Type B or L gas vent shall terminate not less than **5 feet** above the highest connected appliance draft hood or flue collar
- A Type B-W gas vent shall terminate not less than **12 feet** above the bottom of the wall furnace

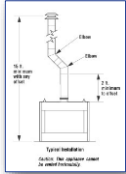




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Offsets

IRC G2427.6.9.2:

- Type B & L vents
 - Extend in a generally vertical direction (>45 degrees)
 - 45° offsets OK
 - Not more than one 60° offset OK
 - Total horizontal + connector length, not greater than **75%** of the vertical height


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Fastener Penetrations

IRC G2427.6.12:

Not to penetrate inner lining double wall except at:

1. Draft-hood
2. Flue collar
3. Single wall to double wall





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Cold Climates

IRC G2427.7.2

“Uninsulated single-wall metal pipe shall not be used outdoors for venting appliances in regions where the 99-percent winter design temperature is below 32°F.”

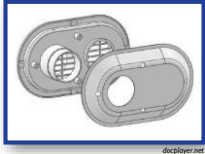





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Venting Terminations

IRC G2427.8

- Min. **3 feet** above forced-air inlets within **10 feet**.
- Mechanical Draft- **4 feet** below, **4 feet** horizontal, **1 foot** above doors, windows, gravity inlets.




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Venting Terminations

IRC G2427.8

- Direct Vent:
 - 10,000 btu/h or less: **6"** from air openings
 - >10,000 – 50,000 btu/h: **9"** from air openings
 - >50,000 btu/h: **12"** from air openings



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Venting Terminations

IRC G2427.8

- Through-the-wall vents for Cat. II & IV appliances:
 - Shall not be above walkways. (condensation)
- Cat. IV appliances wall terminations:
 - **10 feet** horizontally, **2 feet** above, **25 feet** below operable openings in adjacent buildings.

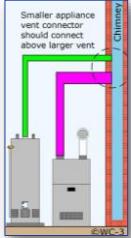
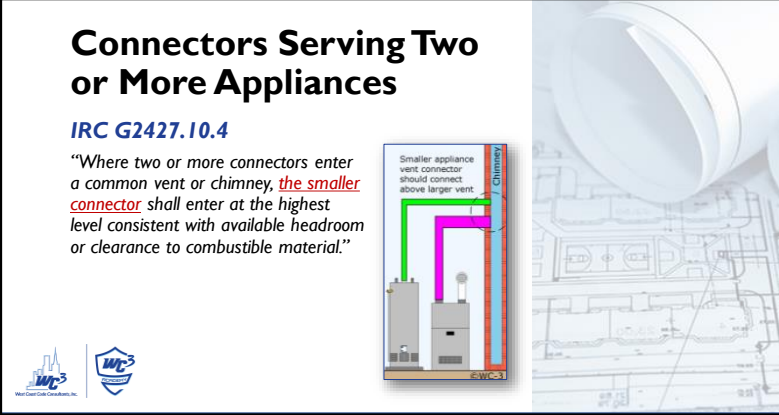

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Connectors Serving Two or More Appliances

IRC G2427.10.4

“Where two or more connectors enter a common vent or chimney, the smaller connector shall enter at the highest level consistent with available headroom or clearance to combustible material.”

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Connector Clearances

Table G2427.10.5:

TABLE G2427.10.5 (503, 10.5)
CLEARANCES FOR CONNECTORS*

APPLIANCE	MINIMUM DISTANCE FROM COMBUSTIBLE MATERIAL			
	Listed Type B gas vent material	Listed Type L vent material	Single-wall metal pipe	Factory-built chimneys sections
Listed appliances with draft hoods and appliances listed for use with Type B gas vents	As listed	As listed	6 inches	As listed
Residential boilers and furnaces with listed gas conversion burner and with draft hood	6 inches	6 inches	9 inches	As listed
Residential appliances listed for use with Type L vents	Not permitted	As listed	9 inches	As listed
Listed gas-fired isolates	Not permitted	As listed	As listed	As listed
Unlisted residential appliances with draft hood	Not permitted	6 inches	9 inches	As listed
Residential and low-heat appliances other than above	Not permitted	9 inches	18 inches	As listed
Medium-heat appliances	Not permitted	Not permitted	36 inches	As listed

For SI, 1 inch = 25.4 mm.
* These clearances shall apply unless the manufacturer's installation instructions for a listed appliance or connector specify different clearances, in which case the listed clearances shall apply.



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Vent Connectors

IRC G2427.10.7

Shall be installed without dips or sags and shall slope upward toward the vent or chimney not less than 1/4 inch per foot.

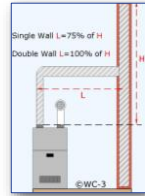


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Horizontal Lengths

IRC G2427.10.8

- Single-wall connector shall be **75 percent** of the height of the chimney or vent except for engineered systems.
- Type B double-wall connector shall be **100 percent** of the height of the chimney or vent except for engineered systems.



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Inspection Access

IRC G2427.10.11

"The entire length of a vent connector shall be provided with ready access for inspection, cleaning and replacement."






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Wall Penetrations

IRC G2427.16

Where vents, including direct-vent appliances, penetrate outside walls the annular spaces shall be permanently sealed using approved materials to prevent entry of combustion products.



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Connector Length

IRC G2428.3.2

- Vent connector shall be routed utilizing the shortest possible route
- Except as provided in Section G2428.3.3, the maximum horizontal vent connector shall be 1 1/2 feet for each inch of connector diameter as per Table G2428.3.2

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Connector Length

Table G2428.3.2

TABLE G2428.3.2 (504.3.2) MAXIMUM VENT CONNECTOR LENGTH	
CONNECTOR DIAMETER (inches)	CONNECTOR MAXIMUM HORIZONTAL LENGTH (feet)
3	4 1/2
4	6
5	7 1/2
6	9
7	10 1/2
8	12
9	13 1/2

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

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Cat. I Venting Systems

IRC G2428.2:

- Single Appliance Vent Tables
 - Tables G2428.2(1) & G2428.2(2)

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Venting Tables

		TABLE G2428.2(1) (504.2)(1) TYPE B DOUBLE-WALL GAS VENT																				
		Number of Appliances / Single Appliance Type / Category I Appliance Vent Connection / Connected directly to vent																				
HEIGHT (ft)	LATERAL (ft)	VENT DIAMETER (D)—inches																				
		3			4			5			6											
		APPLIANCE INPUT RATING IN THOUSANDS OF BTUH																				
		FAN	NAT	FAN	NAT	FAN	NAT	FAN	NAT	FAN	NAT	FAN	NAT									
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max									
0	0	78	86	0	152	96	0	251	141	0	375	205	0	524	285	0	698	370	0	897	470	
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	323	217	53	421	288	63	543	370
	4	21	49	34	30	94	64	39	155	103	50	237	155	66	316	211	79	419	279	93	534	362
6	0	23	46	32	34	91	61	47	149	100	59	223	149	76	218	205	93	413	273	110	520	354
	2	12	44	29	26	84	54	41	138	93	48	218	143	64	309	207	77	406	270	91	517	350
	4	20	43	28	25	82	52	39	136	91	46	216	141	62	307	205	75	404	268	89	515	348
8	0	84	50	0	165	94	0	276	155	0	415	235	0	583	320	0	780	415	0	1,006	537	
	2	12	27	40	16	109	75	25	178	120	28	263	180	42	365	247	50	483	322	60	619	413
	4	23	53	38	32	103	71	42	171	115	53	255	173	70	356	237	83	473	313	99	607	407
8	35	49	35	33	108	86	51	164	109	64	247	165	84	347	237	99	463	303	117	594	390	

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Vent Offsets

IRC G2428.2.3:

- Single-appliance venting configurations with lateral lengths include (2) 90-degree elbows
- Each elbow 45° and smaller- Reduce by 5%
- Each elbow >45° reduce by 10%

30

Minimum Sizes

IRC G2428.2.2:

Where the determined size is smaller than the draft hood outlet or collar it can be used if all of the following are met:

- Total vent height is at least 10'
- Vents 12" or smaller not reduced more than 1 table size
- Vent >12" not reduced more than 2 table sizes
- Max. capacity for fan assisted is reduced 10%
- Draft hood outlet > 4"

(Do not connect a 3" vent to a 4" collar)

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Cat. I Venting Systems


IRC G2428.2.4:

- Zero Lateral: Straight vertical attached to top of draft hood or collar

IRC G2428.2.5:

- High Altitude Installations
 - Sea level ratings used for maximum
 - Actual inputs used for minimum



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Multiple Input Ratings

IRC G2428.2.6:

- Minimum vent capacity (Fan Min) must be **less than** the lowest rated input rating
- Maximum capacity (Fan Max / Nat Max) must be **greater than** the highest rating



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Vent Area & Diameter

IRC G2428.2.8:

- Vertical vent > the connector; vertical vent used for **minimum capacity**
- Connector size** used for the maximum capacity
- Flow area of the vertical pipe not to exceed **7x** the flow rate of the appliance


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Connectors


IRC G2428.2.10:

- Corrugated vent connectors shall not be smaller than the categorized vent dia., draft hood or collar



IRC G2428.2.11:

- Connector size shall not be increased more than **two sizes**



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Cat. I Venting Systems

IRC G2428.2.14:



- Table Interpolation permitted for calculating capacities for vent dimensions **between** table entries

IRC G2428.2.15:

- Extrapolation **beyond** the tables is **prohibited**

IRC G2428.2.16:

- Engineering calculation allowed for vent heights **less than 6'** and greater than the tables

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Cat. I Venting Systems

TABLE G2402.1(1) (04/1/17)
TYPE B DOUBLE-WALL GAS VENT

Number of Appliances (Single)
Appliance Type (Category I)
Appliance Vent Connection (Connected directly to vent)

HEIGHT (ft) (m)	LATERAL (ft) (m)	VENT DIAMETER (in) - inches																				
		APPLIANCE INPUT RATINGS IN THOUSANDS OF BTUH																				
		3		4		5		6		8		10										
FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT								
Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max							
0	0	75	460	0	1523	865	0	2511	1410	0	3758	2085	0	5224	2935	0	6688	3763	0	8917	4763	
		13	51	36	18	97	47	21	137	805	32	232	127	44	221	217	53	425	281	63	543	270
		21	49	34	30	94	44	38	193	805	50	227	133	66	316	211	79	419	276	93	536	262
		25	46	12	36	91	45	47	169	800	59	223	146	70	303	205	88	413	275	120	536	254
8	0	84	50	0	165	94	0	276	155	0	411	235	0	583	326	0	760	413	0	1006	537	
		12	37	40	18	100	71	23	178	120	28	263	180	42	367	247	50	483	322	60	619	418
		18	51	38	32	105	73	42	212	115	51	256	175	70	286	237	61	475	313	69	607	400
		28	49	15	39	98	46	51	184	109	64	247	167	34	347	227	99	463	303	117	596	398
10	0	88	53	0	179	100	0	293	166	0	447	251	0	631	345	0	847	450	0	1096	585	
		12	41	42	17	118	81	23	184	129	26	289	195	40	402	273	48	533	353	57	684	457
		18	57	40	32	113	71	41	187	114	52	286	188	48	362	263	81	522	346	90	671	446
		30	50	31	30	41	104	70	53	176	114	67	267	176	88	376	254	104	564	358	121	651

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Cat. I Venting Systems

TABLE G2402.2(1) (04/1/17)
TYPE B DOUBLE-WALL GAS VENT

Number of Appliances (Single)
Appliance Type (Category I)
Appliance Vent Connection (Single wall metal connector)

HEIGHT (ft) (m)	LATERAL (ft) (m)	VENT DIAMETER (in) - inches																				
		APPLIANCE INPUT RATINGS IN THOUSANDS OF BTUH																				
		3		4		5		6		8		10		12								
FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT								
Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max							
0	0	75	460	0	1523	865	0	2511	1410	0	3758	2085	0	5224	2935	0	6688	3763	0	8917	4763	
		13	51	36	18	97	47	21	137	805	32	232	127	44	221	217	53	425	281	63	543	270
		21	49	34	30	94	44	38	193	805	50	227	133	66	316	211	79	419	276	93	536	262
		25	46	12	36	91	45	47	169	800	59	223	146	70	303	205	88	413	275	120	536	254
8	0	84	50	0	165	94	0	276	155	0	411	235	0	583	326	0	760	413	0	1006	537	
		12	37	40	18	100	71	23	178	120	28	263	180	42	367	247	50	483	322	60	619	418
		18	51	38	32	105	73	42	212	115	51	256	175	70	286	237	61	475	313	69	607	400
		28	49	15	39	98	46	51	184	109	64	247	167	34	347	227	99	463	303	117	596	398
10	0	88	53	0	179	100	0	293	166	0	447	251	0	631	345	0	847	450	0	1096	585	
		12	41	42	17	118	81	23	184	129	26	289	195	40	402	273	48	533	353	57	684	457
		18	57	40	32	113	71	41	187	114	52	286	188	48	362	263	81	522	346	90	671	446
		30	50	31	30	41	104	70	53	176	114	67	267	176	88	376	254	104	564	358	121	651

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Factory-Built Chimneys

IRC G2430.1:

- For appliances having a flue gas temperature of **1,000 deg. F** or less
- Listed per UL 103



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Specific Appliances

- **G2432**- Decorative Appliances in Fireplaces
- **G2434**- Vented Gas Fireplaces
- **G2437**- Floor Furnaces
- **G2438**- GAS Clothes Dryers
 - o Listed per ANSI Z21.5.1/CSA 7.1
- **G2439**- GAS Clothes Dryer Exhaust
 - o Similar to M1512



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Specific Appliances

- **G2440-** Sauna Heaters
- **G2441-** Pool and Spa Heaters
- **G2442-** Forced-Air Warm-Air Furnaces
 - Prohibited Sources of OA or Return Air (**See all 7**)
 - Within 10' of an appliance vent outlet or plumbing vent
 - Less than 10' above a driveway or street
 - Very small rooms
 - Closets, bathrooms, toilet rooms, kitchen, garage, others
 - Direct connection- return air to crawl space





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Specific Appliances

- **G2444-** Unit Heaters
 - Clearances to combustibles
 - 18" sides
 - 12" bottom
 - 6" top (see exceptions)
- **G2445-** Unvented Room Heaters
- **G2446-** Vented Room Heaters
- **G2447-** Cooking Appliances



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Specific Appliances

- **G2448-** Water Heaters
 - When utilized for both space-heating and potable water, must be listed and labeled for such application
- **G2449-** Air-Conditioning Appliance (Gas-fired)
- **G2450-** Illuminating Appliances (Lamps)
 - Posts > 3': 2.5" diameter post 0.064 in
or 1" diameter Sch. 40
 - Posts 3' and less: ¾" diameter Sch. 40

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Specific Appliances

- **G2451-** Infrared Radiant heaters
- **G2452-** Boilers
- **G2453-** Outdoor Decorative Appliances



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2021 IRC Supplement A

Combustion Air Sample Questions

1

LEARNING OBJECTIVES

1. Practice multiple sizing examples to better understand methods of obtaining combustion air.
2. Understand how to use the equations in the IRC to accurately calculate combustion air volume, and opening sizes.
3. Work through the math step-by-step to ensure arrival at the correct answer.

2

Combustion Air

IRC M1701:

- Solid-fuel-burning appliances- Per manufacturer's installation instructions
- Oil-fired appliances- **NFPA 31**
- Does not apply to
 - Fireplaces
 - Fireplace stoves
 - Direct vent appliances
- At or above flood elevation- in flood hazard areas

3

Combustion Air

IRC M1701:

For LP-Gas or Natural Gas appliances: Combustion Air in accordance with **IRC Chapter 24!**


Part VI—Fuel Gas

**CHAPTER 24
FUEL GAS**

The text of this chapter is extracted from the 2021 edition of the International Fuel Gas Code and has been modified where necessary to conform to the scope of application of the International Residential Code for One- and Two-Family Dwellings. The section numbers appearing in parentheses after each section number are the section numbers of the corresponding text in the International Fuel Gas Code.

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Combustion, Ventilation, Dilution Air

IRC G2407:
 Category I appliances:


- G2407.5 (Indoor)
- G2407.6 through G2407.9 (Outdoor)

Category I. An appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.


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Direct Vent & Others:

- Per Manufacturer
- Exception: Type I clothes dryers per G2439.5 (not required)



5





Combustion, Ventilation, Dilution Air

IRC G2407.2:

- Located not to interfere with proper circulation

IRC G2407.4:

- Make up air required where exhaust fans, clothes dryers, kitchen ventilation interfere with combustion air

6

Indoor Air

IRC 2407.5.1:

- Required 50 cubic feet per 1,000 btu/h

IRC G2407.5.3.1:

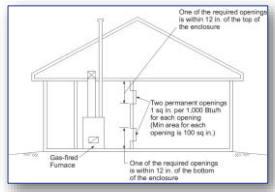

Combining spaces (same level):

- Each opening shall have a min. free area of 1 in² per 1,000 Btu/h, but ≥ 100 in²
 - Openings within 12" of the ceiling and floor
 - Minimum dimensions 3" or greater

IRC G2407.5.3.2:

Combining spaces (different levels):

- Each opening shall have a min. free area of 2 in² per 1,000 Btu/h





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Indoor Combustion Air Caution:

Please be aware that the 50 cubic feet option is only available if the known natural air infiltration rate is 0.40 ACH or higher. Almost everything built new in the past 30 years has a natural infiltration rate of 0.35 ACH or LOWER.

What was one a "rule of thumb" for sizing indoor combustion air has become somewhat outdated. Modern construction is too tight to utilize this method with confidence.



8

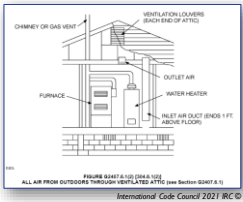

Outdoor Air

IRC G2407.6.1:

Two-permanent-openings:

- Each opening within **12"** of ceiling and floor
 - 1 in² per **4,000 Btu/h** directly to exterior
 - 1 in² per **2,000 Btu/h** through ducts

Openings 3" minimum

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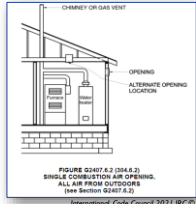

Outdoor Air

IRC G2407.6.2:

- One-permanent-opening
 - Within 12" of ceiling
 - Clearance 1" sides, 6" front
 - 1 in² per **3,000 Btu/h**
- Openings 3" minimum

IRC G2407.7:

- Allows for a combination of indoor and outdoor air openings


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Example Problem #1

Determine the required indoor combustion air volume for (2) 199K btu water heaters.

Step 1: Calculate total btu's:
 $2 \times 199,000 = 398,000 \text{ btu's}$

Step 2: Calculate the needed combustion air:
 50 cubic feet per 1,000 btu's (IRC G2407.5.1)
 $398,000 / 1,000 = 398$
 $398 \times 50 = 19,900 \text{ cubic feet}$




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Example Problem #2

Determine the required room size necessary for (3) 90K btu water heaters, assuming 9' ceilings.

Step 1: Calculate total btu's:
 $3 \times 90,000 = 270,000 \text{ btu's}$

Step 2: Calculate the needed combustion air:
 50 cubic feet per 1,000 btu's (IRC G2407.5.1)
 $270,000 / 1,000 = 270$
 $270 \times 50 = 13,500 \text{ cubic feet}$





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Example Problem #2

Step 3: Calculate required room size
 13,500 cubic feet / 9-foot ceilings = 1,500 SF

Multiple Choice Options:

- A. 1,000 SF
- B. 1,200 SF
- C. 1,500 SF
- D. 2,000 SF

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Example Problem #3

Determine the necessary size ductwork required to supply outdoor combustion air to a 40,000 btu appliance, using the two-opening method, assuming horizontal ducts.

Step 1: Calculate required square inches of openings
 1 square inch/2,000 btu's (IRC G2407.6.1)
 $40,000/2,000 = 20$ square inches per opening.

Step 2: Calculate required size of each duct
 Square Duct: L X W IRC G2407.6 – 3" minimum dim.
 Multiple options: 3" x 7" minimum = 21 si
 Round Duct: $\pi \times R^2$ R = Radius $\pi = 3.14$
 6" duct = 28.27 si = square inches

Duct Size	Area
3	7.07
4	12.57
5	19.63
6	28.27
8	50.27
10	78.54
12	113.1

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Example Problem #4

Determine the necessary size ductwork required to supply outdoor combustion air for an 40,000 btu appliance, using the one permanent opening method.

Step 1: Calculate required square inches of openings
 1 square inch/3,000 btu's (IRC G2407.6.2)
 $40,000/3,000 = 13.33$ square inches

Step 2: Calculate required size of ducts
 Square Duct: L X W IRC G2407.6 – 3" minimum dim.
 Multiple options: 3" x 4" minimum = 12 si
 Round Duct: $\pi \times R^2$ R = Radius $\pi = 3.14$
 5" duct = 19.63 si

Duct Size	Area
3	7.07
4	12.57
5	19.63
6	28.27
8	50.27
10	78.54
12	113.1

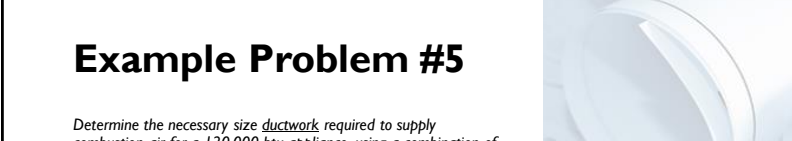

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Example Problem #5

Determine the necessary size ductwork required to supply combustion air for a 120,000 btu appliance, using a combination of indoor and outdoor combustion air. Assume the indoor space is a room with 150 square feet of floor are and an 8' ceiling.

Step 1: Calculate the volume of the indoor space
 150 square feet x 8' ceiling = 1,200 cubic feet

Step 2: Calculate the needed combustion air volume:
 50 cubic feet per 1,000 btu's (IRC G2407.5.1)
 $120,000/1,000 = 120$
 $120 \times 50 = 6,000$ cubic feet

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Example Problem #5

Step 3: Determine the ratio of available vs. required volume
 $1,200 / 6,000 = 0.20$

Step 4: Determine the outdoor size reduction factor
 $1 - 0.20 = 0.80$

Step 5: Calculate required size of outdoor air using the one or two-permanent openings method. (assume one-permanent opening per G2407.6.2)

Step 5a: Calculate required square inches of openings
 $1 \text{ square inch} / 3,000 \text{ btu's (IRC G2407.6.2)}$
 $120,000 / 3,000 = 40 \text{ square inches.}$

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Example Problem #5

Step 5b: Reduce by the reduction factor (Step 4)
 $40 \text{ si required} \times 0.80 = 32 \text{ si}$

Step 6: Calculate required size of ducts
 Square Duct: $L \times W$ IRC G2407.6 - 3" minimum dim.

Multiple options: 6" x 6" minimum = 36 si
 Round Duct: $\pi \times R^2$ $R = \text{Radius}$ $\pi = 3.14$
 8" duct = 50.27 si si = square inches

Duct Size	Area
3	7.07
4	12.57
5	19.63
6	28.27
8	50.27
10	78.54
12	113.1

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END





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**2021 IRC
Supplement B**



**Gas Line Sizing Sample
Questions**



1

LEARNING OBJECTIVES

1. Practice multiple sizing examples to better understand gas pipe sizing.
2. Understand how to use the tables in the IRC to accurately answer gas line sizing questions.
3. Work through the equations step-by-step to ensure arrival at the correct answer.

2


Three Sizing Options

IRC 2413.3:

1. **Table in the IRC**
2. **Manufacturer's Tables**
3. **Approved Engineering Methods**

G2413.3 (402.3) Sizing. Gas piping shall be sized in accordance with one of the following:

1. Pipe sizing tables or sizing equations in accordance with Section G2413.4 or G2413.5, as applicable.
2. The sizing tables included in a *listed piping* system's manufacturer's installation instructions.
3. *Approved engineering methods.*



3

Three Sizing Methods


IRC 2413.4:

G2413.4 (402.4) Sizing tables and equations. This section applies to piping materials other than noncorrugated stainless steel tubing. Where Tables G2413.4(1) through G2413.4(2) are used to size piping or tubing, the pipe length shall be determined in accordance with Section G2413.3.1, G2413.4.2 or G2413.4.3.

Key Factors:

1. **Length of Pipe**
2. **Pressure of System**
3. **Btu's Served (Loads)**

1. **Longest Length G2413.4.1**
2. **Branch Length G2413.4.2**
3. **Hybrid Pressure G2413.4.3**



4

IRC
Gas Line Sizing – Question #1

5

Question #1: 4 oz. Meter ★

Size the blue sections of steel natural gas pipe using the longest length method. Assume 0.5 in. w.c. pressure drop.

6

Longest Length Method

IRC 2413.4.1: (Also see IFGC 402.4.1)

G2413.4.1 (402.4.1) Longest length method. The pipe size of each section of gas piping shall be determined using the longest length of piping from the point of delivery to the most remote outlet and the load of the section.

7

General Rules:

TABLE G2413.4(1) (402.4(2)) SCHEDULE 40 METALLIC PIPE

Gas (Natural)	
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60

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Nominal Length (ft)	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.822	0.924	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Capacity in Cubic Feet of Gas per Hour									
10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
20	118	247	466	957	1,430	2,760	4,400	7,780	15,900
30	95	199	374	768	1,150	2,230	3,530	6,250	12,700
40	81	170	320	657	985	1,900	3,020	5,350	10,900
50	72	151	284	583	873	1,680	2,680	4,740	9,660

International Code Council 2021 IRC, Table G2413.4(1)(a)

Pressure Drop:

- 4 oz. System- Use 0.3 in. w.c.
- 2 lb. System- Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

Step I: Find the Right Table

*1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.*

Make sure you're in the right table and verify values!

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Question #1:

First Section:
 Longest Length = 45' (10+15+15+5)
 Total btu's = 230,000 btu (120k + 40k + 70k) 230,000/1,000 = 230 CFH

Nominal	PIPE SIZE (inches)						
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.688
Length (ft)	10	172	360	678	1,390	2,090	4,020
	20	118	247	466	957	1,430	2,760
	30	95	199	374	768	1,150	2,220
	40	81	170	320	657	985	1,900
	50	72	151	284	583	873	1,680

International Code Council 2021 IRC Table G2413.4(1)D

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

9

Impact of Gas Content

Check with gas utility- btu's per CFH vary from location to location and are affected by altitude

Depending upon the utility provider:
 1 CFH = +/- 1,000 btu's
 or
 1 CFH = 800 - 1,000 btu's

STANDARD DERATION FACTORS				
Code	Deration Factor (Altitude %)	Deration %	Specific Gravity	BTU Calc. FT
Each field (cont.)	78	88	0.90	210
Chickville	78	88	0.90	210
Elmore	78	88	0.90	210
Fairburn	78	88	0.90	210
Fairview	78	88	0.90	210
Forsyth	78	88	0.90	210
Franklin	78	88	0.90	210
Greene	78	88	0.90	210
Hamilton	78	88	0.90	210
Highland	78	88	0.90	210
Lawson	78	88	0.90	210

10

Question #1:

Next Section:
 Longest Length = 45' (Doesn't change)
 Total btu's = 110,000 btu (40k + 70k) 110,000/1,000 = 110 CFH

Nominal	PIPE SIZE (inches)						
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.688
Length (ft)	10	172	360	678	1,390	2,090	4,020
	20	118	247	466	957	1,430	2,760
	30	95	199	374	768	1,150	2,220
	40	81	170	320	657	985	1,900
	50	72	151	284	583	873	1,680

International Code Council 2021 IRC Table G2413.4(1)D

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

11

Question #1:

Final Section:
 Longest Length = 45' (Doesn't change)
 Total btu's = 70,000 (70k) 70,000/1,000 = 70 CFH

Nominal	PIPE SIZE (inches)						
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.688
Length (ft)	10	172	360	678	1,390	2,090	4,020
	20	118	247	466	957	1,430	2,760
	30	95	199	374	768	1,150	2,220
	40	81	170	320	657	985	1,900
	50	72	151	284	583	873	1,680

International Code Council 2021 IRC Table G2413.4(1)D

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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Question #1:

Branch Lines:
Longest Length = 45'
Total btu's = 120,000 btu (120k) $120,000/1,000 = 120$ CFH

Nominal	PIPE SIZE (inches)									
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.549	3.068	4.026	5.048
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
	20	118	247	466	857	1,430	2,760	4,400	7,780	15,000
	30	95	199	374	708	1,150	2,220	3,530	6,250	12,700
	40	81	170	320	657	985	1,900	3,020	5,350	10,900
	50	72	151	284	583	873	1,680	2,680	4,740	9,660

International Code Council 2021 IRC, Table G2413.4(1)D

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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Question #1:

Branch Lines:
Longest Length = 45'
Total btu's = 40,000 btu (40k) $40,000/1,000 = 40$ CFH

Nominal	PIPE SIZE (inches)									
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.549	3.068	4.026	5.048
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
	20	118	247	466	857	1,430	2,760	4,400	7,780	15,000
	30	95	199	374	708	1,150	2,220	3,530	6,250	12,700
	40	81	170	320	657	985	1,900	3,020	5,350	10,900
	50	72	151	284	583	873	1,680	2,680	4,740	9,660

International Code Council 2021 IRC, Table G2413.4(1)D

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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IRC
 INTERNATIONAL RESIDENTIAL CODE®
 for One- and Two-Family Dwellings

2021

IRC
 Gas Line Sizing – Question #2

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Question #2:

2 lb. Meter ★

Size the blue sections of steel natural gas pipe using the longest length method. Assume 1.0 in. w.c. pressure drop.

Note: Standard natural gas appliances are designed for 4 oz. pressures. This system would require a regulator at each appliance.

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General Rules:

TABLE G2413.4(2) (402.415) SCHEDULE 40 METALLIC PIPE

Gas: Natural
Inlet Pressure: 2.0 psi
Pressure Drop: 1.0 psi
Specific Gravity: 0.60

Pressure Drop:

- 1 lb. System - Use 0.3 in. w.c.
- 2 lb. System - Use 1 in. w.c.

Specific Gravity:

- Natural Gas- **0.6**
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. 4 oz. (typ.) **2 lb.** available
- Commercial- **2 lb.** (typ.) 5 lb. available

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Nominal Actual ID	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Length (ft)	0.822	0.824	1.049	1.380	1.610
	Capacity in Cubic Feet of C				
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050

International Code Council 2021 IRC, Table G2413.4(2)D

Make sure you're in the right table and verify values!

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Question #2:

First Section:
Longest Length = 80' (20 + 25 + 25 + 10)
Total btu's = 210,000 (75k + 35k + 100k) 210,000/1,000 = 210 CFH

CFH = +/- 1,000 BTU
*real world application- adjust per local conditions

* Gas utility companies may require 3/4" minimum lines to support the gas meter. Check local requirements

18

Question #2:

Next Section:
Longest Length = 80' (Doesn't change)
Total btu's = 135,000 (35k + 100k) 135,000/1,000 = 135 CFH

CFH = +/- 1,000 BTU
*real world application- adjust per local conditions

19

Question #2:

Final Section:
Longest Length = 80' (Doesn't change)
Total btu's = 100,000 (100k) 100,000/1,000 = 100 CFH

CFH = +/- 1,000 BTU
*real world application- adjust per local conditions

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IRC
Gas Line Sizing – Question #3

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Question #3:
Size the blue sections of steel propane gas pipe using the longest length method. Assume 0.5 in. w.c. pressure drop.

Propane

22

General Rules:

Gas: Undiluted Propane

- Inlet Pressure 11.0 in. w.c.
- Pressure Drop 0.5 in. w.c.
- Specific Gravity 1.50

Nominal Length (ft)	PIPE SIZE (inches)					
	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067
Capacity in Thousands of Btu per Hour	10	291	608	1,150	2,350	3,520
	20	200	418	787	1,620	2,420
						4,660

Pressure Drop: See table- 0.5 in. w.c.

Specific Gravity: Natural Gas- 0.6
 Propane- 1.5

Inlet Pressure: From storage tank- likely 10.5 in W.C.
 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

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Question #3:

Nominal Length (ft)	PIPE SIZE (inches)					
	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067
Capacity in Thousands of Btu per Hour	10	291	608	1,150	2,350	3,520
	20	200	418	787	1,620	2,420
						4,660

First Section:
Longest Length = 20' (3+3+5+1+5+3)
Total btu's = (50,000 + 65,000 + 120,000 + 100,000 + 80,000) = 415,000 btu's
(Divide by 1,000 = 415 kbtu/h)

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Question #3:

Second Section:
 Longest Length = 20' (Doesn't change)
 Total btu's = 365,000 (Divide by 1,000 = 365)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 1/2	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	290	418	787	1,620	2,420	4,660

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Question #3:

Third Section:
 Longest Length = 20' (Doesn't change)
 Total btu's = 300,000 (Divide by 1,000 = 300)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 1/2	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	290	418	787	1,620	2,420	4,660

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Question #3:

Fourth Section:
 Longest Length = 20' (Doesn't change)
 Total btu's = 180,000 (Divide by 1,000 = 180)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 1/2	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	290	418	787	1,620	2,420	4,660

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Question #3:

Final Section:
 Longest Length = 20' (Doesn't change)
 Total btu's = 80,000 (Divide by 1,000 = 80)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 1/2	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	290	418	787	1,620	2,420	4,660

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IRC
Gas Line Sizing – Question #4

29

Branch Length ★

Question #4:
Size all pipe sections of natural gas pipe using the branch length method. Assume 0.5 in. w.c. pressure drop.

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Branch Length Method

IRC G2413.4.2: (Also see IFGC 402.4.2)

G2413.4.2 (402.4.2) Branch length method. Pipe shall be sized as follows:

- Pipe size of **each section** of the longest pipe run from the **point of delivery** to the most remote **outlet** shall be determined using the longest run of piping and the load of the section.
- The pipe size of each section of branch piping not previously sized shall be determined using the length of piping from the **point of delivery** to the most remote **outlet** in each branch and the load of the section.

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General Rules:

TABLE G2413.4(1) [402.4(2)] SCHEDULE 40 METALLIC PIPE

Gas (Natural)

- Inlet Pressure: Less than 2 psi
- Pressure Drop: 0.5 in. w.c.
- Specific Gravity: 0.50

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Nominal Length (ft)	PIPE SIZE (inches)			
	2 1/2"	3"	4"	6"
10	172	360	678	1,390
20	118	247	466	957
30	95	199	374	768
40	81	170	320	657
50	72	151	284	583

International Code Council 2021 IRC, Table G2413.4(1)D

Pressure Drop:

- 4 oz. System- Use 0.5 in. w.c.
- 2 lb. System- Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

Step I: Find the Right Table

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

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Question #4:

Branch #3:
Branch Length (Section 1) = 45' (10+15+15+5)
Total Branch btu's = 230,000 btu (120k + 40k + 70k) 230,000/1,000 = 230 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,990	3,020	5,350
	50	72	151	284	583	873	1,800	2,800	4,760

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Question #4:

Branch #3:
Branch Length (Section 2) = 45'
Total Branch btu's = 110,000 btu (40k + 70k) 110,000/1,000 = 110 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,990	3,020	5,350
	50	72	151	284	583	873	1,800	2,800	4,760

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Question #4:

Branch #3:
Branch Length (Section 3) = 45'
Total Branch btu's = 70,000 btu (70k) 70,000/1,000 = 70 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,990	3,020	5,350
	50	72	151	284	583	873	1,800	2,800	4,760

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Question #4:

Branch #2:
Branch Length = 28' (10 + 15 + 3)
Total Branch btu's = 40,000 btu (40k) 40,000/1,000 = 40 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,990	3,020	5,350
	50	72	151	284	583	873	1,800	2,800	4,760

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Question #4:

Branch #1:
Branch Length = 15' (10 + 5)
Total btu's = 120,000 (120k) $120,000/1,000 = 120$ CFH

Nominal Length (ft)	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.622	0.824	1.049	1.310	1.615	2.067	2.469	3.068	4.026
Capacity in Cubic Feet of Gas per Hour	172	360	678	1,390	2,090	4,020	6,400	11,200	23,100
30	95	189	374	768	1,150	2,220	3,530	6,250	12,700
40	81	170	320	657	985	1,980	3,020	5,350	10,900
50	72	151	284	583	873	1,680	2,680	4,760	9,660

International Code Council 2021 IRC, Table G2413.4(1)D

CFH = +/- 1,000 BTU
 Largest branch requirement governs

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Compare:

LONGEST LENGTH

BRANCH LENGTH

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IRC
 Gas Line Sizing – Question #5

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Question #5:

Hybrid Pressure ★

Size the blue sections of natural gas pipe using the hybrid method. Assume Sch. 40 steel from the meter to the regulator, and CSST after the regulator.

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Hybrid Pressure Method

IRC 2413.4.3: (Also see 402.4.3)

G2413.4.3 (402.4.3) Hybrid pressure. The pipe size for each section of higher pressure gas piping shall be determined using the longest length of piping from the point of delivery to the most remote line pressure regulator. The pipe size from the line pressure regulator to each outlet shall be determined using the length of piping from the regulator to the most remote outlet served by the regulator.

PRESSURE CONVERSION CHART		
1/4 PSI =	7" w.c. =	4 oz.
1/2 PSI =	14" w.c. =	8 oz.
1 PSI =	28" w.c. =	16 oz.
2 PSI =	56" w.c. =	32 oz.

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General Rules:

Gas: Natural

TABLE G2413.4(2) (402.4(5)) SCHEDULE 40 METALLIC PIPE

- Inlet Pressure: 2.0 psi
- Pressure Drop: 1.0 psi
- Specific Gravity: 0.80

Nominal Length (ft)	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050
90	502	1,010	1,850	3,810	5,700

Capacity in Cubic Feet of Gas

Pressure Drop:

- 1 lb. System - Use 0.3 in. w.c.
- 2 lb. System - Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

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Question #5:

First Section:

Longest Length to Regulator = 11' (3+3+5) i.e. Length 1

Longest Length from Regulator = 14' (5+1+5+3) i.e. Length 2

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Question #5:

First Section:

Longest Length = 11' (Length 1)

Total btu's = 4,350 cfh (1,200 + 750 + 800 + 600 + 1,000)

Nominal Length (ft)	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050
90	502	1,010	1,850	3,810	5,700

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Question #5:

Next Section:
Longest Length = 11' (Length 1 - again)
Total btu's = 3,150 cfh (750 + 600 + 800 + 1000)

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.822	0.824	1.049	1.310	1.610
Length (ft)	10	1.510	3.040	5.560	11.000
Capacity in Cubic Feet of Gas	20	1,070	2,150	3,150	4,600
30	300	3,500	4,500	6,500	9,000
40	755	1,250	2,760	5,710	8,550
50	215	1,260	2,490	5,110	7,650
60	615	1,260	2,370	4,660	6,960
70	569	1,150	2,100	4,320	6,470
80	532	1,060	1,970	4,040	6,050

International Code Council 2021 IRC, Table G2413.4(2) ©

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Question #5:

End Section:
Longest Length = 11' (Length 1 - again)
Total btu's = 2,400 cfh (600 + 800 + 1000)

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.822	0.824	1.049	1.310	1.610
Length (ft)	10	1.510	3.040	5.560	11.000
Capacity in Cubic Feet of Gas	20	1,070	2,150	3,150	4,600
30	300	3,500	4,500	6,500	9,000
40	755	1,250	2,760	5,710	8,550
50	215	1,260	2,490	5,110	7,650
60	615	1,260	2,370	4,660	6,960
70	569	1,150	2,100	4,320	6,470
80	532	1,060	1,970	4,040	6,050

International Code Council 2021 IRC, Table G2413.4(2) ©

Note: The 750 cfh and 1,200 cfh appliance would require individual regulators to drop pressure to appliances.

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Question #5:

1st Section:
Longest Length = 14' (Length 2 - CSST)
Total btu's = 2,400 cfh (600 + 800 + 1000)

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.822	0.824	1.049	1.310	1.610
Length (ft)	10	1.510	3.040	5.560	11.000
Capacity in Cubic Feet of Gas	20	1,070	2,150	3,150	4,600
30	300	3,500	4,500	6,500	9,000
40	755	1,250	2,760	5,710	8,550
50	215	1,260	2,490	5,110	7,650
60	615	1,260	2,370	4,660	6,960
70	569	1,150	2,100	4,320	6,470
80	532	1,060	1,970	4,040	6,050

International Code Council 2021 IRC, Table G2413.4(2) ©

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Pressure Regulators:

Check with Manufacturer Regarding:

- Outlet Pressure (0.5 psi is common)
- Pressure Drop (+/- 0.5 in w.c. common)*

*Use the 3.0 in. w.c. table

Model Number	Pipe Size	Outlet Pressure Inlet Point	Operating Inlet Pressure		
			1/2 gal (0.8 MPa)	1 gal (1.2 MPa)	1.5 gal (1.8 MPa)
125-10-17	1/2" x 1/2"	10" w.c.	125 (1.5)	125 (1.5)	125 (1.5)
		10" w.c.	100 (1.2)	125 (1.5)	125 (1.5)

7" w.c. = 0.25 psi

Model Number	Pipe Size	Pressure Drop	
		77 w.c. (1.7 MPa)	3/4 gal (1.8 MPa)
125-10-17	1/2" x 1/2"	100 (1.2)	100 (1.2)

Adjustable to +/- 0.5 psi

Conversions:
 In w.c. divided by 27.708 = psi
 Psi x 27.708 = in. w.c.

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Manufacturer's Table:

Table 7-5 Table 7-5 Table 7-5 Table 7-5	Table 7-5 Table 7-5 Table 7-5 Table 7-5										
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	4 1/2"
15	378	438	498	558	618	678	738	798	858	918	978
18	450	525	600	675	750	825	900	975	1050	1125	1200
21	525	607	690	772	855	937	1020	1102	1185	1267	1350
24	600	693	786	879	972	1065	1158	1251	1344	1437	1530
27	675	780	885	990	1095	1200	1305	1410	1515	1620	1725
30	750	862	974	1086	1198	1310	1422	1534	1646	1758	1870
33	825	943	1062	1181	1300	1419	1538	1657	1776	1895	2014
36	900	1023	1146	1269	1392	1515	1638	1761	1884	2007	2130
39	975	1103	1230	1357	1484	1611	1738	1865	1992	2119	2246
42	1050	1185	1320	1455	1590	1725	1860	1995	2130	2265	2400
45	1125	1267	1410	1552	1694	1836	1978	2120	2262	2404	2546
48	1200	1350	1500	1650	1800	1950	2100	2250	2400	2550	2700

Pipe Material

- CSST (Corrugated Stainless-Steel Tubing) - GasTite

Pressure Drop:

- Regulator Manufacturer- Use 3.0 in. w.c.

Specific Gravity:

- Natural Gas- 0.6

Inlet Pressure:

- 0.5 PSI- Given in Example

Pressure Conversion Chart

1/4 PSI = 7" w.c. = 4 oz.
 1/2 PSI = 14" w.c. = 8 oz.
 1 PSI = 28" w.c. = 16 oz.
 2 PSI = 56" w.c. = 32 oz.

Make sure you're in the right table and verify values!

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Question #5:

1st Section:

Longest Length = 14' (Length 2)

Total btu's = 2,400 cfh (600 + 800 + 1000)

Table 7-5 Table 7-5 Table 7-5 Table 7-5	Table 7-5 Table 7-5 Table 7-5 Table 7-5										
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	4 1/2"
15	378	438	498	558	618	678	738	798	858	918	978
18	450	525	600	675	750	825	900	975	1050	1125	1200
21	525	607	690	772	855	937	1020	1102	1185	1267	1350
24	600	693	786	879	972	1065	1158	1251	1344	1437	1530
27	675	780	885	990	1095	1200	1305	1410	1515	1620	1725
30	750	862	974	1086	1198	1310	1422	1534	1646	1758	1870
33	825	943	1062	1181	1300	1419	1538	1657	1776	1895	2014
36	900	1023	1146	1269	1392	1515	1638	1761	1884	2007	2130
39	975	1103	1230	1357	1484	1611	1738	1865	1992	2119	2246
42	1050	1185	1320	1455	1590	1725	1860	1995	2130	2265	2400
45	1125	1267	1410	1552	1694	1836	1978	2120	2262	2404	2546
48	1200	1350	1500	1650	1800	1950	2100	2250	2400	2550	2700

EHD = Equivalent Hydraulic Diameter

Check with manufacturer- as nominal pipe sizes and EHD may vary slightly

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Question #5:

Next Section:

Longest Length = 14' (Length 2)

Total btu's = 1,800 cfh

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Question #5:

End Section:

Longest Length = 14' (Length 2)

Total btu's = 1,000 cfh

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Materials not Covered:

- **PE Pipe (Polyethylene Plastic)**
 - Similar process, use Tables G2413.4(7), (8), (20)
- **PE Tubing (Polyethylene Plastic)**
 - Similar process, use Tables G24013.4(21)
- **Semirigid Copper Tubing**
 - Similar process, use Tables G2413.4(3), (4), (13-15)



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**END**

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Module 1 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A fuel-burning appliance with a sealed combustion system that draws all air for combustion from the outside atmosphere and discharges all flue gases to the outside atmosphere is a _____.	IRC 202	IRC 202	3	sealed appliance	vented appliance	direct-vent appliance	combustion appliance
Match the term with the correct definition.	IRC 202	IRC 202		Return Air Air removed from an approved conditioned space or location and recirculated or exhausted.	Supply Air Air delivered to a conditioned space through ducts or plenums from the heat exchanger of a heating, cooling or ventilating system.	Combustion Air The air provided to fuel-burning equipment including air for fuel combustion, draft hood dilution and ventilation of the equipment enclosure.	Conditioned Air Air treated to control its temperature, relative humidity or quality.
A device with an integral sensor to detect carbon monoxide gas and transmit an alarm signal to a connected alarm control unit is a _____.	IRC 202	IRC 202	2	carbon monoxide alarm	carbon monoxide detector		
The passages within an appliance through which combustion products pass from the combustion chamber to the flue collar are _____.	IRC 202	IRC 202	1	appliance flues	combustion passages	combustion flues	flue collars
_____ is the pressure difference existing between the appliance or any component part and the atmosphere, that causes a continuous flow of air and products of combustion through the gas passages of the appliance to the atmosphere.	IRC 202	IRC 202	3	Natural draft	Induced draft	Draft	

Module 2 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A duct heater shall have a minimum of _____ from a heat pump or air conditioner, unless listed and labeled otherwise.	IRC M1407.3	IRC M1407	4	18 inches	24 inches	36 inches	48 inches
What is the permitted maximum length of the passage leading to appliances located in an attic?	IRC M1305.1.2	IRC M1305	3	10 feet	15 feet	20 feet	25 feet
All of the following materials are permitted to be used for condensate piping except?	IRC M1411.3.2	IRC M1411	1	aluminum tubing	copper tubing	ABS	galvanized steel
A water heater being installed within a house located in seismic design category D2, shall have straps located a minimum of _____ above the controls.	IRC M1307.2 Item 1	IRC M1307	4	10 inches	8 inches	6 inches	4 inches
Fittings and piping used for refrigerant vapor lines shall be insulated with a minimum of _____ insulation.	IRC M1411.6	IRC M1411	4	R-6	R-5	R-4	R-3
Which of the following is not required on a label provided for absorption units?	IRC M1303.1 Item 2	IRC M1303	1	weight of unit	type of fuel	required clearances	type of refrigerant
The concrete pad for a ground supported appliance shall extend a minimum of _____ above the adjoining ground.	IRC M1305.1.3.1	IRC M1305	2	2 inches	3 inches	4 inches	5 inches
What is the minimum access opening size that shall be provided to a vented floor furnace?	IRC M1408.4	IRC M1408	4	30 inches by 30 inches	22 inches by 30 inches	20 inches by 30 inches	18 inches by 24 inches
Alterations to a mechanical system shall conform to the requirements for a new mechanical system and require the existing mechanical system to comply with all of the requirements of the code.	IRC M1202.1	IRC Chapter 12	2	TRUE	FALSE		
Heating and cooling equipment and appliances shall be sized in accordance with _____ based on building loads calculated in accordance with _____.	IRC M1401.3	IRC M1401	3	Manual J, Manual D	Manual J, Manual S	Manual S, Manual J	Manual S, Manual D

Module 3 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the maximum amount of exhaust air that is permitted for a kitchen hood before outside air is required?	IRC M1503.6	IRC M1503	2	450 cfm	400 cfm	350 cfm	300 cfm
A vent provided for a natural draft appliance shall be located at what minimum distance above the highest connected appliance before it is permitted to be terminated?	IRC M1804.2.3	IRC M1804	2	4 feet	5 feet	6 feet	7 feet
A sauna heater shall be limited to what maximum room temperature?	IRC M1902.4	IRC M1902	3	180°F	186°F	194°F	198°F
The minimum vertical distance a hood is permitted to be located above the cooking surface is _____.	IRC M1901.1	IRC M1901	4	36 inches	34 inches	32 inches	30 inches
A vibration isolator spaced between mechanical equipment and metal duct systems shall be a maximum of _____.	IRC M1601.2	IRC M1601	2	12 inches	10 inches	8 inches	6 inches
Labeling provided on flexible ducts and the insulation shall be printed at intervals not to exceed _____ maximum. This information includes: Manufacturer's name, R-values, installed thickness, and smoke-developed index.	IRC M1601.3 Item 4	IRC M1601	3	48 inches	42 inches	36 inches	30 inches
What is the minimum termination height of a Type L Vent above the highest point of the roof penetration?	IRC M1804.2.4	IRC M1804	2	1 foot	2 feet	3 feet	4 feet
When gypsum board is used in the construction of a return air plenum, the maximum air temperature shall not exceed _____ and the exposed surfaces shall not be subject to condensation.	IRC M1601.1.1 Item 5	IRC M1601	4	210°F	180°F	150°F	125°F
Gaseous hydrogen systems covered by the IRC shall be installed in accordance with all of the following codes except the _____.	IRC M1904.1	IRC M1904	2	International Building Code	International Mechanical Code	International Fire Code	International Fuel Gas Code
Power exhauster termination locations shall be a minimum of _____ from lot lines and adjacent buildings.	IRC M1804.2.6 Item 6	IRC M1804	3	20 feet	15 feet	10 feet	5 feet

Module 4 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the maximum hanger space for horizontal 1" PEX tubing used for hydronic heating?	IRC Table M2101.9	IRC M2101	1	2.67 feet	3 feet	4 feet	10 feet
What is the minimum size a pressurized diaphragm type expansion tank that should be used for a 90-gallon forced hot-water system?	IRC Table M2003.2	IRC M2003	3	6.0 gallons	6.5 gallons	7.5 gallons	9.0 gallons
A single low-pressure steam boiler shall have shutoff valves in what location?	IRC M2001.3 Exception	IRC M2001	4	In the supply piping	In the return piping	In the supply & return piping	shutoff valves are not required
The fluid heated by a pressurized solar system heat exchanger inside the dwelling shall be limited to a maximum temperature of _____.	IRC M2301.2.12	IRC M2301	2	170°F	180°F	190°F	200°F
All of the following details must be noted on the label for a pressurized thermal storage unit except for:	IRC M2301.3.2	IRC M2301	4	serial number	model number	manufacturer's address	maximum allowable operating speed
What is the maximum vertical spacing of 1-1/4" copper tubing for hydronic piping?	IRC Table M2101.9	IRC M2101	4	7 feet	8 feet	9 feet	10 feet
A fuel oil fill pipe is permitted to terminate from any building opening at a minimum of _____ when it is at the same or a lower level.	IRC M2203.3	IRC M2203	1	2 feet	3 feet	4 feet	5 feet
Hydronic heating systems piping embedded in concrete shall have a minimum rating of _____.	IRC M2103.1	IRC M2103	2	80 psi at 160°F	80 psi at 180°F	120 psi at 200°F	140 psi at 220°F
What is the minimum size a nonpressurized type expansion tank that should be used for a forced hot-water system with a volume of 40 gallons?	IRC Table M2003.2	IRC M2003	1	6.0 gallons	5.0 gallons	4.0 gallons	3.0 gallons
An above ground fuel oil tank can be located _____ minimum from the property line.	IRC M2201.2.2	IRC M2201	4	20 feet	15 feet	10 feet	5 feet

Module 5 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A steam heating boiler has a maximum operating pressure of _____.	IRC G2403	IRC 2403	3	10 psig	12 psig	15 psig	18 psig
What is the minimum mounting height for an appliance installed in a private garage?	IRC G2408.3	IRC G2408	1	6 feet	7 feet	8 feet	9 feet
Which of the following standards is used for the installation of liquefied petroleum gas?	IRC G2412.2	IRC G2412	3	NFPA 85	NFPA 82	NFPA 58	NFPA 51
A CSST piping system is being installed in a home. This system has been bonded to the electrical service grounding electrode system, what is the minimum size bonding jumper wire to be used?	IRC G2411.2.2	IRC G2411	4	9 AWG	8 AWG	7 AWG	6 AWG
Ventilation, dilution, and combustion air accessed from combined spaces indoors on the same story shall have an area of 1 square inch per _____.	IRC G2407.5.3.1	IRC G2407	1	1,000 Btu/h	2,000 Btu/h	3,000 Btu/h	4,000 Btu/h
Gas piping systems shall have a maximum design pressure of _____ used inside a building.	IRC G2413.7	IRC G2413	2	4 psi	5 psi	6 psi	7 psi
Outdoor combustion air openings shall have a minimum dimension of _____.	IRC G2407.6	IRC G2407	3	1"	2"	3"	4"
Which of the following is the standard method used for calculating the minimum required amount of combustion air?	IRC G2407.5.1	IRC G2407	3	70 cubic feet per 1,000 Btu/h	60 cubic feet per 1,000 Btu/h	50 cubic feet per 1,000 Btu/h	40 cubic feet per 1,000 Btu/h
Pipe size of each section of the longest pipe run from the _____ to the _____ outlet shall be determined using the longest run of piping and the load of the section.	IRC G2413.4.2 Item 1	IRC G2413	2	meter, furthest	point of delivery, most remote	point of delivery, closest	furthest branch, most remote
A fuel gas furnace installed in a garage shall be elevated a minimum of _____ above the floor.	IRC G2408.2	IRC G2408	3	12 inches	15 inches	18 inches	24 inches

Module 6 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Gas piping has been installed in an area prone to condensation. What is the minimum slope that must be provided?	IRC G2419.1	IRC G2419	3	1/2" in 15 feet	3/8" in 15 feet	1/4" in 15 feet	1/8" in 15 feet
An outdoor individual appliance has a gas line installed. What is the minimum burial depth of the gas line?	IRC G2415.12.1	IRC G2415	4	5 inches	6 inches	7 inches	8 inches
Connectors shall connect to a chimney flue at a point not less than _____ above the lowest portion of the interior of the chimney flue.	IRC G2425.9	IRC G2425	1	1 foot	2 feet	3 feet	4 feet
What is the maximum distance between pipe supports for a 1 inch black steel gas pipe?	IRC Table G2424.1	IRC G2424	3	4 feet	6 feet	8 feet	10 feet
The maximum length of a flexible gas connector for a furnace shall be _____.	IRC G2422.1.2.1	IRC G2422	1	6 feet	5 feet	4 feet	3 feet
A gas shutoff valve shall be installed a maximum of _____ from the appliance it serves.	IRC G2420.5.1	IRC G2420	2	7 feet	6 feet	5 feet	4 feet
Which of the following is not permitted to be used for conduit to encase an underground gas line that runs under a building?	IRC G2415.14	IRC G2415	3	steel pipe	plastic pipe	copper pipe	wrought iron pipe
The minimum melting point of materials used for brazing joints for gas lines shall be _____.	IRC G2414.9.1	IRC G2414	3	800°F	900°F	1,000°F	1,100°F
A union shall be installed within _____ of either side of the MP regulator where connected to rigid piping.	IRC G2421.2 Item 7	IRC G2421	2	6 inches	12 inches	18 inches	24 inches
Appliance and equipment vent terminals shall be located such that doors cannot swing within _____ horizontally of the vent terminals.	IRC G2426.7.1	IRC G2426	4	3 inches	6 inches	9 inches	12 inches

Module 7 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Each 90° elbow decreases the vent capacity by how much?	IRC G2428.2.3	IRC G2428	3	0%	5%	10%	15%
What is the maximum length of a 4" diameter vent connector?	IRC Table 2428.3.2	IRC G2428	1	6 feet	7.5 feet	9 feet	10.5 feet
A listed chimney lining has been provided for a masonry chimney, what is the maximum temperature that it must be able to withstand without cracking?	IRC G2427.5.2	IRC G2427	2	2,000°F	1,800°F	1,600°F	1,400°F
What minimum thickness shall be provided for an 8" galvanized steel chimney connector for a low-heat appliance?	IRC Table G2427.10.2.4	IRC G2427	4	0.064"	0.034"	0.028"	0.023"
What is the maximum length of a 8" diameter vent connector?	IRC Table 2428.3.2	IRC G2428	3	9 feet	10.5 feet	12 feet	13.5 feet
Mechanical draft systems shall be listed in accordance with _____ and shall be installed in accordance with the _____ for both the appliance and the mechanical draft system.	IRC G2427.3.3 Item 1	IRC G2427	3	UL 376, manufacturer's instructions	UL 376, listing	UL 378, manufacturer's instructions	UL 378, listing
The minimum ventilation opening dimensions shall be _____ for the top of a sauna room door.	IRC G2440.7	IRC G2440	2	3"x8"	4"x8"	5"x8"	6"x8"
Which of the following vent types is listed for use with a wall furnace?	IRC Table G2427.4	IRC G2427	1	Type B-W gas vent	Type B vent	Type L vent	special gas vent
A vent connector shall have a minimum slope of _____ per foot.	IRC G2427.10.8	IRC G2427	2	1/8"	1/4"	3/8"	1/2"
For sizing a gas vent connected to two appliances with draft hoods, the effective area of the vent shall be not less than the area of the larger draft hood outlet plus _____ of the area of the smaller draft hood outlet, nor greater than _____ times the smaller draft hood outlet area.	IRC G2427.6.9.1 Item 3	IRC G2427	3	25%, two	30%, three	50%, seven	60%, four

2021 Residential Mechanical Inspector Practice Exam Questions

Question Text	Description	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A duct heater shall have a minimum of _____ from a heat pump or air conditioner, unless listed and labeled otherwise.		IRC M1407.3	IRC M1407	4	18 inches	24 inches	36 inches	48 inches
A fuel oil fill pipe is permitted to terminate from any building opening at a minimum of _____ when it is at the same or a lower level.		IRC M2203.3	IRC M2203	1	2 feet	3 feet	4 feet	5 feet
Ventilation, dilution, and combustion air accessed from combined spaces indoors on the same story shall have an area of 1 square inch per _____.		IRC G2407.5.3.1	IRC G2406	1	1,000 BTU/h	2,000 BTU/h	3,000 BTU/h	4,000 BTU/h
The maximum amount of exhaust air in CFM permitted for a kitchen hood before outside air is required?		IRC M1503.6	IRC M1503	2	450 cfm	400 cfm	350 cfm	300 cfm
What is the minimum access opening size that shall be provided to a vented floor furnace?		IRC M1408.4	IRC M1408	2	30-inches by 30-inches	22-inches by 30 inches	20-inches by 30 inches	18-inches by 24-inches
What is the maximum length of a 4" diameter vent connector?		IRC Table 2428.3.2	IRC G2428	1	6 feet	7.5 feet	9 feet	10.5 feet
What is the maximum vertical spacing of 1-1/4" copper tubing for hydronic piping?		IRC Table M2101.9	IRC M2101	4	7 feet	8 feet	9 feet	10 feet
Which of the following is not permitted to be used for conduit to encase an underground gas line that runs under a building?		IRC G2415.14	IRC G2415	3	Wrought iron pipe	Plastic pipe	Copper pipe	Steel pipe
Gas piping systems shall have a maximum design pressure of _____ used inside a building.		IRC G2413.7	IRC G2413	2	4 psi	5 psi	6 psi	7 psi
What is the permitted maximum length of the passage leading to appliances located in an attic?		IRC M1305.1.3	IRC M1305	3	10 feet	15 feet	20 feet	25 feet
The maximum length of a flexible gas connector for a furnace shall be _____ feet.		IRC G2422.1.2.1	IRC G2422	1	6 feet	5 feet	4 feet	3 feet
Hydronic heating systems piping embedded in concrete shall have a minimum ratings of _____.		IRC M2103.1	IRC M2103	2	80psi at 160°F	80psi at 180°F	120psi at 200°F	140psi at 220°F
A listed chimney lining has been provided for a masonry chimney, what is the maximum temperature that it must be able to withstand without cracking?		IRC G2427.5.2	IRC G2427	2	2,000°F	1,800°F	1,600°F	1,400°F

2021 Residential Mechanical Inspector Practice Exam Questions

A vent provided for a natural draft appliance shall be located at what minimum distance above the highest connected appliance before it is permitted to be terminated?	IRC M1804.2.3	IRC M1804	2	4 feet	5 feet	6 feet	7 feet
Outdoor combustion air intakes shall have a minimum opening size of _____.	IRC G2407.6	IRC G2407	2	1/8 inch	1/4 inch	3/8 inch	1/2 inch
A Sauna Heater shall be limited to a maximum room temperature of what?	IRC M1902.4	IRC M1902	3	180°F	186°F	194°F	198°F
What minimum thickness shall be provided for an 8" galvanized steel chimney connector for a low-heat appliance?	IRC Table G2427.10.2.4	IRC G2427	4	0.064"	0.034"	0.028"	0.023"
A gas shutoff valve can installed a maximum of _____ from the appliance it serves.	IRC G2420.5.1	IRC G2420	2	7 feet	6 feet	5 feet	4 feet
All of the following materials are permitted to be used for condensate piping except?	IRC M1411.3.2	IRC M1411	1	Aluminum Tubing	Copper Tubing	ABS	Cast Iron
What is the maximum length of a 8" diameter vent connector?	IRC Table G2428.3.2	IRC G2428	3	9 feet	10.5 feet	12 feet	13.5 feet
The minimum vertical distance a hood can be located above the cooking surface shall be _____.	IRC M1901.1	IRC M1901	4	36 inches	34 inches	32 inches	30 inches
The minimum ventilation opening dimensions shall be _____ for the top of a sauna room door.	IRC G2440.7	IRC G2440	2	3"x8"	4"x8"	5"x8"	6"x8"
What is the minimum size a nonpressurized type expansion tank that should be used for a forced hot-water system with a volume of 40 gallons?	IRC Table M2003.2	IRC M2003	1	6.0 gallons	5.0 gallons	4.0 gallons	3.0 gallons
What is the maximum distance between pipe supports for a 1 inch black steel gas pipe?	IRC Table G2424.1	IRC G2424	3	4 feet	6 feet	8 feet	10 feet
Which of the following vent types is listed for use with a wall furnace?	IRC Table G2427.4	IRC G2427	1	Type BW vent	Type B vent	Type L vent	Special gas vent
A water heater being installed within a house located in seismic design category D2, shall have straps located a minimum of _____ above the controls.	IRC M1307.2 Item 1	IRC M1307	4	10 inches	8 inches	6 inches	4 inches
An above ground fuel oil tank can be located _____ minimum from the property line.	IRC M2201.2.2	IRC M2201	4	20 feet	15 feet	10 feet	5 feet
A vibration isolator spaced between mechanical equipment and metal duct systems shall be a maximum of _____.	IRC M1601.2	IRC M1601	2	12 inches	10 inches	8 inches	6 inches
A single low-pressure steam boiler shall have shutoff valves in what location?	IRC M2001.3 Exception	IRC M2001	4	On the inlet	On the outlet	On the inlet and outlet	No valves required.

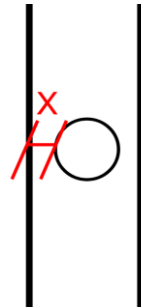
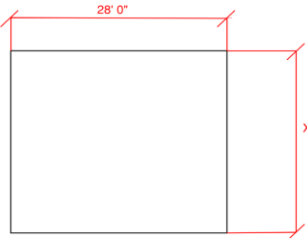
2021 Residential Mechanical Inspector Practice Exam Questions

Fittings and piping used for refrigerant vapor lines shall insulated piping with a minimum R value of _____.		IRC M1411.6	IRC M1411	4	R-6	R-5	R-4	R-3
An outdoor individual appliance has a gas line installed. What is the minimum burial depth of the gas line?		IRC G2415.12	IRC G2415	4	5 inches	6 inches	7 inches	8 inches
Which of the following is the standard method used for calculating the minimum required amount of combustion air?		IRC G2407.5.1	IRC G2407	3	70 cubic feet per 1,000 BTU/h	60 cubic feet per 1,000 BTU/h	50 cubic feet per 1,000 BTU/h	40 cubic feet per 1,000 BTU/h
A ground supported appliance shall have a pad of concrete a minimum of _____.		IRC M1305.1.3.1	IRC M1305	2	2 inches	3 inches	4 inches	5 inches
What amount is the capacity reduced by each elbow when 90° elbows are installed?		IRC G2428.2.3	IRC G2428	3	0%	5%	10%	15%
Labeling provided on flexible ducts and the insulation shall be printed at intervals printed not to exceed _____ maximum. This information includes: Manufacturer's name, R-values, installed thickness, and smoke-developed index.		IRC M1601.3.4	IRC M1601	3	48 inches	42 inches	36 inches	30 inches
The minimum melting point of materials used for brazing joints for gas lines shall be _____.		G2414.9.2	IRC G2414	3	800°F	900°F	1,000°F	1,100°F
A vent connector shall have a minimum slope of _____ in 15 feet.		IRC G2419.1	IRC G2419	2	1/8"	1/4"	3/8"	1/2"
Which of the following is not required on a label provided for absorption units?		IRC M1303.1 Item 2	IRC M1303	1	Weight of unit	Type of fuel	Required clearances	Type of refrigerant.
The fluid heated by a pressurized solar system heat exchanger shall be limited to a maximum temperature of _____ located on a dwelling unit.		IRC M2301.2.12	IRC M2301	2	170°F	180°F	190°F	200°F
Gas piping has been installed in an area prone to condensation. What is the minimum slope that must be provided?		IRC G2419.1	G2419	3	1/2" in 15 feet	3/8" in 15 feet	1/4" in 15 feet	1/8" in 15 feet
What is the termination height of the Type L Vent above the highest point of the roof penetration at minimum?		IRC M1804.2.4	IRC M1804	2	1 foot	2 feet	3 feet	4 feet

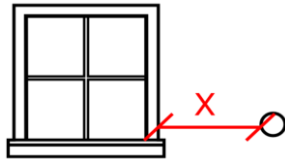
2021 Residential Mechanical Inspector Practice Exam Questions

All of the following details must be noted on the label for a pressurized thermal storage unit except for which:	IRC M2301.3.2	IRC M2301	3	Serial number	Model number	Pipe connections	Type of heat transfer fluids
When gypsum board is used in the construction of a return air plenum, the maximum air temperature permitted is _____ and the exposed surfaces are not subject to condensation	IRC M1601.1.1 Item 5	IRC M1601	4	210°F	180°F	150°F	125°F
A CSST piping system is being installed in a home. This system has been bonded to the electrical service grounding electrode system, what is the minimum size bonding jumper wire to be used?	IRC G2411.2.2	IRC G2411	4	9 AWG	8 AWG	7 AWG	6 AWG
Power exhauster termination locations shall be a minimum of _____ from lot lines and adjacent buildings.	IRC M1804.2.6 Item 6	IRC M1804	3	20 feet	15 feet	10 feet	5 feet
Which of the following standards is used for the installation of liquefied petroleum gas?	IRC G2412.2	IRC G2412	3	NFPA 85	NFPA 82	NFPA 58	NFPA 51
What is the minimum mounting height for an appliance installed in a private garage above the floor?	IRC G2408.3	IRC G2408	1	6 feet	7 feet	8 feet	9 feet
What is the maximum hanger space for horizontal PEX tubing ≤ 1" used for hydronic heating?	IRC Table M2101.9	IRC M2101	1	2.6 feet	3 feet	4 feet	5 feet
A steam heating boiler has a maximum operating pressure of _____.	IRC G2403	IRC 2403	3	10 psig	12 psig	15 psig	18 psig
What is the minimum size a pressurized diaphragm type expansion tank that should be used for a 90-gallon forced hot-water system?	IRC Table M2003.2	IRC M2003	3	6.0 gallons	6.5 gallons	7.5 gallons	9.0 gallons
All of the following code standards cover the installation of gaseous hydrogen systems except:	IRC M1904.1	IRC M1904	2	International Building Code	International Mechanical Code	International Fire Code	International Fuel Gas Code
The provisions of chapters 12 through 24 shall regulate all the following except for:	IRC M1202.1	IRC M1202	2	Installation	Daily Use	Maintenance	Design
Minor additions, alterations, or repairs to existing mechanical systems shall meet the provisions for new construction, unless such work is done in the same manner and arrangement as was the existing system, is not _____, and is approved.	IRC M1202.1	IRC M1202	1	hazardous	secure	protected	installed by owner

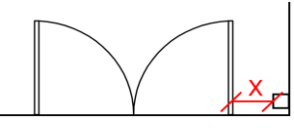
2021 Residential Mechanical Inspector Practice Exam Questions

Except as otherwise provided for in this code, a provision in this code shall not require the _____, alteration, or abandonment, nor prevent the continued use and maintenance of an existing mechanical system lawfully in existence at the time of the adoption of this code.		IRC M1202.2	IRC M1202	4	replacement	substitution	renewal	removal
The owner or the _____ shall be responsible for maintenance of the mechanical system.		IRC M1202.3	IRC M1202	3	contractor	permit holder	owner's designated agent	designer
Devices or safeguards that are required by this code shall be _____ in compliance with the code edition under which such safeguards were installed.		IRC M1202.3	IRC M1202	2	removed	maintained	supplied	secured
Under floor spaces containing appliances shall be provided with an unobstructed passageway large enough to remove the largest appliance, but not less than _____ inches high, _____ wide.		IRC M1305.1.3	IRC M1305	3	36, 24	20, 18	30, 22	30, 30
What is the minimum distance "X" can be for a shield plate not to be required?		IRC M1308.2.1	IRC M1308	3	1 inch	1 1/4 inches	1 1/2 inches	1 5/8 inches
An indoor location intended for hydrogen generating or refueling is being used inside a home. One dimension of the room is 28 feet in length. What is the maximum the other dimension "X" can be?		IRC M1307.4.1	IRC M1307	2	29 feet	30 feet	31 feet	32 feet
A furnace is located within a garage, what is the minimum height from the ignition source above the floor?		IRC M1307.3	IRC M1307	2	16 inches	18 inches	24 inches	30 inches
Gypsum board shall be able to be used as a support base under an appliance when which condition applies?		IRC M1307.7	IRC M1307	1	Gypsum board shall not be used as a support base under an appliance.	Gypsum board that is a minimum of 5/8 inches in thickness.	Gypsum board that is within a garage.	Gypsum board that has a minimum of two coats of latex paint.

2021 Residential Mechanical Inspector Practice Exam Questions

Heating and cooling equipment and appliances shall be sized in accordance with _____ or other approved methodologies based on building load calculated in accordance with _____ or other approved heating and cooling calculation methodologies.		IRC M1401.3	IRC M1401	2	ACCA Manual D, ACCA Manual F	ACCA Manual S, ACCA Manual J	ACCA Manual J, ACCA Manual S	ACCA Manual A, ACCA Manual E
Electric baseboard heaters shall comply with UL _____.		IRC M1405.1	IRC M1405	4	1492	1812	1776	1042
Duct heaters located within ___ feet of a heat pump or air conditioner shall be listed and labeled for such installations.		IRC M1407.3	IRC M1407	1	4	6	8	10
A floor access for a floor furnace equipped with a trap door shall not be less than ___ inches by ___ inches.		IRC M1408.4	IRC M1408	4	24, 32	18, 48	18, 24	22, 30
Room heaters shall be installed on noncombustible floors or approved assemblies constructed of noncombustible materials that extend not less than ___ inches beyond the appliance on all sides.		IRC M1410.2	IRC M1410	3	12	16	18	24
What is the minimum distance an exhaust duct can be from a window?		IRC M1502.3	IRC M1502	2	No opening is permitted on the same side of the house with a window.	3 feet	4 feet	5 feet
A domestic booster fan shall _____ be installed in dryer exhaust systems.		IRC M1502.4.5	IRC M1502	1	not	always	integrally	readily
Ducts serving domestic cooking exhaust equipment shall be of all the following except:		IRC M1503.4	IRC M1503	2	galvanized steel	anodized bismuth	stainless steel	copper
A kitchen shall have a continuous exhaust rated of ___ cfm.		IRC Table M1505.4.4	IRC Table M1505	3	15	20	25	30
Exhaust air from bathrooms and toilet rooms shall not be recirculated within a residence or circulated to another dwelling unit and shall be exhausted directly to the _____.		IRC M1505.2	IRC M1505	4	floor	attic	crawl space	outdoors
Access to an under-floor plenum shall be provided through an opening in the flow with a minimum dimensions of ___ inches by ___ inches.		IRC M1601.5.4	IRC M1601	3	16, 20	18, 22	18, 24	20, 24
Vibration isolators installed between mechanical equipment and metal ducts shall be fabricated from approved materials and shall not exceed ___ inches in length.		IRC M1601.2	IRC M1601	2	6	10	14	18

2021 Residential Mechanical Inspector Practice Exam Questions

Ducts shall be installed with not less than ____ inches separation from earth except where they meet the requirements of section M1601.1.2.		IRC M1601.4.8	IRC M1601	1	4	6	8	10
The furnace shall be equipped with an automatic control that will start the air-circulating fan when the air in the furnace bonnet reaches a temperature not higher than ____ degrees Fahrenheit.		IRC M1601.5.5	IRC M1601	4	120	125	130	150
The under-floor space, including the sidewall insulation, shall be formed by materials having flame spread index values not greater than 200 when tested in accordance with ASTM ____ or UL ____.		IRC M1601.5.2	IRC M1601	1	E84, 723	E52, 450	E32, 560	E17, 990
Oil-fired appliances shall be provided with combustion air in accordance with NFPA ____.		IRC M1701.1	IRC M1701	4	70	13	13R	31
The horizontal run of an uninsulated connector to a natural draft chimney shall not exceed ____ percent of the height of the vertical portion of the chimney above the connect.		IRC M1803.3.2	IRC M1803	3	25	50	75	100
Appliances and equipment vent terminals shall be located such that doors cannot swing within ____ inches horizontal of the terminals. Door stops or closers shall not be installed to obtain this clearance.		IRC M1804.4	IRC M1804	2	6	12	18	24
Where the thermostat is not an integral part of the heater for a sauna, the heat-sensing element shall be located within ____ inches of the ceiling.		IRC M1902.4	IRC M1902	3	3	4	6	10
Discharge from a pressure relief valve for a boiler shall be piped to drains by gravity to within ____ 18 inches of the floor or to an open receptor.		IRC M2002.4	IRC M2002	2	12	18	24	30
Convectors shall be supported _____ of the hydronic piping.		IRC M2102.1	IRC M2102	1	independently	conjointly	mutually	collectively
For an underground oil tank the clearance from the tank to the nearest wall of a basement shall be not less than ____.		IRC M2201.3	IRC M2201	1	1 foot	2 feet	3 feet	5 feet

2021 Residential Mechanical Inspector Practice Exam Questions

For solar thermal energy systems shall be equipped with a means to limit the maximum water temperature of the system fluid entering or exchanging heat with any pressurized vessel inside the dwelling to _____ degrees Fahrenheit.		IRC M2301.2.1.2	IRC M2301	4	120	140	150	180
A house is equipped with a gas range of 45,000 btus, a fireplace of 35,000, a furnace of 150,000 btus, and a water heater of 50,000 btus. What is the size opening required for combustion air when communicating with different stories?		IRC G2407.5.3.2	IRC G2407	2	280 square inches	140 square inches	93 square inches	50 square inches
A house is equipped with a gas range of 55,000 btus, a furnace of 120,000 btus, and a water heater of 45,000 btus. What is the opening sizes for two permanent openings venting to the outdoors?		IRC G2407.6.1	IRC G2407	1	2 openings at 55 square inches each	2 openings at 50 square inches each	2 openings at 65 square inches each	2 openings at 70 square inches each
A house is equipped with a gas range 75,000 btus, a furnace of 135,000 btus, and a water heater of 40,000 btus. What is the opening size for one permanent opening to the outdoors?		IRC G2407.6.2	IRC G2407	3	75 square inches	80.25 square inches	83.33 square inches	85.33 square inches
A house is equipped with a water heater of 160,000 btus and a water heater of 20,000 btus. What is the combustion air rate when there is a mechanical air supply to the outdoors?		IRC G2407.9	IRC G2407	4	420 cubic feet per minute	560 cubic feet per minute	590 cubic feet per minute	630 cubic feet per minute
What is the minimum size of the blue line of the 15-foot section using the longest length method with undiluted propane with a pressure drop of 1.0 psi, specific gravity of 1.50, and inlet pressure of 10.0 psi using schedule 40 metallic pipe?		IRC Table G2413.4(9)	IRC Table G2413	1	1/2 inch diameter	3/4 inch diameter	1 inch diameter	1 1/4 inch diameter
What is the minimum size of the blue line 28-foot section using the longest length method for schedule 40 metallic pipe for natural gas, with an inlet pressure of 2.0 psi, pressure drop of 1.0 psi, and specific gravity of 0.60?		IRC Table G2413.4(2)	IRC Table G2413	1	1/2 inch diameter	3/4 inch diameter	1 inch diameter	1 1/4 inch diameter

2021 Residential Mechanical Inspector Practice Exam Questions

<p>What is the minimum size of the blue line 28-foot using the longest length method for CSST for natural gas, inlet pressure less than 2 psi, a pressure drop of 0.5 in water column, and a specific gravity of 0.60?</p>		<p>IRC Table G2413.4(5)</p>	<p>IRC Table G2413</p>	<p>2</p>	<p>60 EHD</p>	<p>46 EHD</p>	<p>37 EHD</p>	<p>25 EHD</p>
<p>What is the size of the pipe in blue with schedule 40 metal pipe for natural gas with an inlet pressure of less than 2.0 psi, a pressure drop of 0.5 in w.c., and specific gravity 0.60?</p>		<p>IRC Table G2413.4(1)</p>	<p>IRC Table G2413</p>	<p>1</p>	<p>1 inch in diameter</p>	<p>3/4 inches in diameter</p>	<p>1/2 inches in diameter</p>	<p>1/4 inches in diameter</p>
<p>What is the minimum size of a tracer wire?</p>		<p>IRC G2415.17.3</p>	<p>IRC G2415</p>	<p>2</p>	<p>24 AWG</p>	<p>18 AWG</p>	<p>16 AWG</p>	<p>8 AWG</p>
<p>Which of the following is not permitted as a test medium?</p>		<p>IRC 2417.2</p>	<p>IRC 2417</p>	<p>2</p>	<p>Carbon Dioxide</p>	<p>Oxygen</p>	<p>Inert gas</p>	<p>Nitrogen</p>
<p>What is the space of piping support for steel pipe size 1 inch in diameter?</p>		<p>IRC Table G2424.1</p>	<p>IRC Table G2424</p>	<p>2</p>	<p>6 feet</p>	<p>8 feet</p>	<p>10 feet</p>	<p>every floor level</p>



George Williams

MCP, CBO

SENIOR PLAN REVIEW EXAMINER

EDUCATION

**MASTER OF SCIENCE
CONSTRUCTION MANAGEMENT**
Brigham Young University, 2015

**BACHELOR OF SCIENCE
CONSTRUCTION MANAGEMENT**
Weber State University, 2008

LICENSES | CERTIFICATIONS

LICENSES

Combination Inspector
Utah 6048299-5601

ICC CERTIFICATIONS

Master Code Professional
Certified Building Official
Commercial Combination Inspector
Residential Combination Inspector
Building Plans Examiner
Plumbing Code Official
Plumbing Plans Examiner
Mechanical Code Official
Mechanical Plans Examiner
Commercial Energy Inspector
Commercial Energy Plans Examiner
Residential Energy Inspector/Plans
Examiner
Accessibility Inspector/Plans
Examiner
Housing Code Official
Property Maintenance & Housing
Inspector

And several more...

AFFILIATIONS

Beehive Chapter of ICC
Vice President & Member

IAEI Utah Chapter
Member

AWARDS

Utah Chapter ICC
2016 Chapter Service Award
Eagle Scout - 1998

Mr. Williams has worked on a contract basis for numerous jurisdictions in California, Nevada, Washington, Utah, Wyoming and North Dakota throughout his 13-year career in the industry. From 2009 through mid-2014 he acted as the contract building official for City of Holladay as well as the resort town of Alta, both in Utah. He was also responsible for start-up of two county building departments in North Dakota, including the adopting of codes, implementation of permitting processes, and the development of policies and procedures in a part of the country where no previous form of building or construction regulatory processes existed. In addition to substantial municipal work, Mr. Williams has acted and continues to act as Lead Inspector for a number of multi-million-dollar projects for Utah's Division of Facilities and Construction Management (DFCM). Mr. Williams has numerous ICC certifications and received his ICC Master Code Professional certification in 2009. Currently he performs complex commercial plan reviews for clients in California, Nevada, Wyoming and Utah, as well as commercial inspections.

EXPERIENCE

SENIOR INSPECTOR / PLAN REVIEWER

West Coast Code Consultants, Inc. / 2014 – Present

Provides plan reviews and inspections services for a variety of commercial projects. Specializes in several code disciplines including, building, mechanical, plumbing, electrical, accessibility, energy and green codes. Familiar with both the International and Uniform codes, as plan review and inspection work encompassing numerous municipalities in multiple states. Regularly responsible for overseeing code compliance and inspection of large-scale state-owned buildings; including oversight of special inspection firms.

BUILDING OFFICIAL / INSPECTOR

Forsgren Associates / 2005 – 2014

Developed, maintained, administered, organized and oversaw building departments for various municipalities. Responsible for all aspects of building department administration, including creating policies and procedures, commercial and residential plan reviews, calculating permit fees, meeting with architects and engineers, performing field inspections, reviewing special inspection reports, interpreting codes and local ordinances, data and document management, and many other diverse tasks. Responsible for managing 2-4 field inspectors on a daily basis. Clients included numerous municipalities in multiple states, school districts, architects, law firms, and private entities.

PUBLICATIONS

Graduate Thesis: (2015) *Assessing the Repercussions of a Mass Departure of Building Inspectors from the Code Professional Industry.* Brigham Young University, Provo, Utah.

Article: (2015) *Construction Challenges Associated with the Sudden Population Growth in the Willison Basin Oil Boom,* presented at ASC Annual International Conference, College Station, TX: Associated Schools of Construction.

Article: (2019) *Understanding the Impacts of the Aging Population of Code Professionals in Utah,* presented at ASC Annual International Conference, Denver, CO: Associated Schools of Construction.

File Attachments for Item:

ER-8 Residential Plans Examiner (2021 IRC) (West Coast)

Residential certifications (16 hours)

Staff Notes: Not yet code in Ohio, but likely to be in the next Code update. Recommend approval.

Committee Recommendation:

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *

Brittany Allen

Organization

West Coast Code Consultant

Email *

brittanya@wc-3.com

Phone Number *

(385) 237-3722

Address *

9131 S Monroe St Unit A

City *

Sandy

State *

Utah

Zip Code *

84070

Website

https://www.pathlms.com/w

Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e.

BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

Residential Plans Examiner

Course instructor

George Williams and Chris Kimball

Course description

Course Description: This 15-module course, followed by a two-hour practice examination, is based on the 2021 International Residential Code (IRC). It teaches you how to apply the IRC during the plan review process. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 15 to 60 minutes in length.

Course Objectives: This course is designed to assist you in learning the residential plan review process, key code sections relevant to many residential plan reviews, and help you prepare for the International Code Council's (ICC) Residential Plans Examiner exam (R3), utilizing the 2021 IRC. Similar to the ICC exam, this course focuses more heavily on the building portions (Chapters 1-10) of the code and provides only a quick overview of the Energy, Mechanical, Plumbing, and Electrical provisions. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Instructional hours per session

16

Number of Sessions

Course Date

Course Location

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction

Conference Course

Conference Name

Conference location

762

Plumbing Instruction

Course to be offered online?

On Demand

Webinar

Course Website

Yes

No

<https://www.pathlms.com/wc3-academy/courses/53>

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. Due to the randomization, practice exams may contain questions weighted heavier toward a specific topic. Please consult the ICC Exam Catalog Outline for a breakdown of exam topics and anticipated percentages of questions related to each area of the code. A passing score of 75% on the timed practice exam is required in order to obtain a certificate of completion from WC³ for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. You can progress through this course at your own pace; however, you only have access for 120 days.

Course applicable for the following certifications *

Residential Certifications Only

Administrative Course, All Certifications

Commercial and Residential Certifications

Application materials included *

Course Outline or Course Learning Objectives

Presentation Materials/Slides (not required for roundtable courses)

Assessment Materials (for online courses)

Presenter Bio

Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
Residential Plans Examiner Submittal Documents.pdf	21.90 MB

Applicant Full Name *

Brittany Allen

Date of Submission

06/06/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



Residential Plans Examiner

Course Outline

Cost: \$247, allowing for 120 days of access.

Course Description: This **15-module course**, followed by a **two-hour practice examination**, is based on the *2021 International Residential Code (IRC)*. It teaches you how to apply the IRC during the plan review process. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 15 to 60 minutes in length.

Course Objectives: This course is designed to assist you in learning the residential plan review process, key code sections relevant to many residential plan reviews, and help you prepare for the *International Code Council's (ICC) Residential Plans Examiner exam (R3)*, utilizing the *2021 IRC*. Similar to the ICC exam, this course focuses more heavily on the building portions (Chapters 1-10) of the code and provides only a quick overview of the Energy, Mechanical, Plumbing, and Electrical provisions. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Texts and Readings: The *2021 International Residential* is the textbook for this course. It is highly recommended that you purchase a paper-back copy of this code, which is available online at www.iccsafe.org. A physical copy can be utilized during the actual exams, which are open book, and serves as a valuable reference for in-field inspections and plan reviews.

Course Outline of Topics:

Module:	Topics:	Readings:	Quiz:	Duration:
1	Residential Plan Review Basics		N	59 min.
2	How to Read Plans		N	13 min.
3	Administration	IRC Chapter 1	Y	18 min.
4	Structural Load Paths & Design Criteria	IRC Section R301	Y	41 min
5	Building Planning Part I	IRC Chapter 3	Y	48 min.
6	Building Planning Part II	IRC Chapter 3	Y	55 min.
7	Building Planning Part III	IRC Chapter 3	Y	36 min.
8	Foundations	IRC Chapter 4	Y	18 min.
9	Floors & Decks	IRC Chapter 5	Y	20 min
10	Wall Construction Part I	IRC Chapter 6	Y	35 min
11	Wall Construction Part II	IRC Chapter 6	Y	30 min
12	Wall Coverings, Roof/Ceiling Construction; Roof Assemblies; Chimneys & Fireplaces	IRC Chapters 7-10	Y	34 min.
13	Energy	IRC Chapter 11	Y	33 min.
14	Mechanical & Plumbing Requirements	IRC Chapters 13-33	Y	44 min.
15	Electrical Requirements	IRC Chapters 34-43	Y	15 min.
	13 Quizzes 172 Questions, 2 min. each	2021 IRC		344 min.
	Practice Exam	2021 IRC		120 min.
	Total Course Hours			16 hours

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of



Residential Plans Examiner

the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. Due to the randomization, practice exams may contain questions weighted heavier toward a specific topic. Please consult the [ICC Exam Catalog Outline](#) for a breakdown of exam topics and anticipated percentages of questions related to each area of the code. A passing score of 75% on the timed practice exam is required in order to obtain a certificate of completion from WC³ for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. Marking, tabbing, and highlighting in the code book is highly recommended. We have laid out a plan and method to help you learn the material, but it's up to you to put in the work necessary for you to master the material. You can progress through this course at your own pace; however, you only have access for 120 days.

Exam Preparation: This course and the ICC Residential Plans Examiner (R3) exam cover a wide variety of topics. To adequately prepare for the ICC exam, please consult the [ICC Exam Catalog Outline](#) for a breakdown of exam topics and anticipated percentages of questions related to each area of the code. Approximately 35% of the ICC exam questions will be on energy (5%), mechanical (10%), plumbing (10%), and electrical (10%) IRC code requirements. For those interested in more in-depth coverage of the mechanical, plumbing, and/or electrical provisions of the IRC, consider purchasing the WC³ Academy [Residential Mechanical Inspector](#), [Residential Plumbing Inspector](#) and/or [Residential Electrical Inspector](#) courses. For those that would prefer to simply test their familiarity with the other sections of the code, you can purchase a WC³ Academy [practice exam](#) for residential mechanical, plumbing or electrical codes.

Continuing Education Credits: Completion of this course results in **1.6 CEUs** (16 hours) being provided by ICC, as West Coast Code Consultants is a Preferred Provider.

Instructors:



George Williams, MCP, CBO is the Director of WC³ Academy, but primarily identifies as a commercial plans examiner, code instructor and building inspector. He has been a code professional since 2005, has a master's degree in construction management, and has been ICC Master Code Professional since 2009. George has been instrumental in the start-up of multiple building departments including the adoption of codes, implementation of permit processes, development of policies and procedures, as well as the hiring and training of staff.



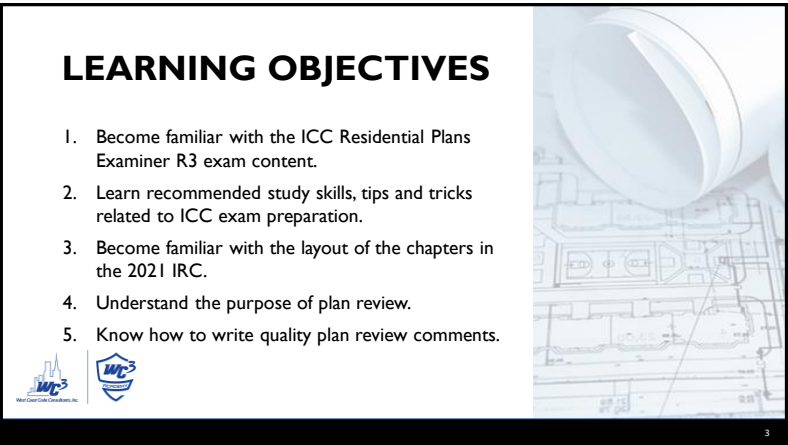
Chris Kimball, PE, SE, CBO is one of WC³'s Vice Presidents. He is a licensed structural engineer, ICC Master Code Professional, Certified Building Official, fire code official, combination plans examiner, and combination building inspector. He has performed plan reviews for thousands of projects throughout the western states. In addition, Chris has provided numerous training classes to help design professionals, building officials, and contractors alike to understand the requirements of the adopted building codes. Chris regularly teaches for ICC and has been involved in assisting ICC with various publications.



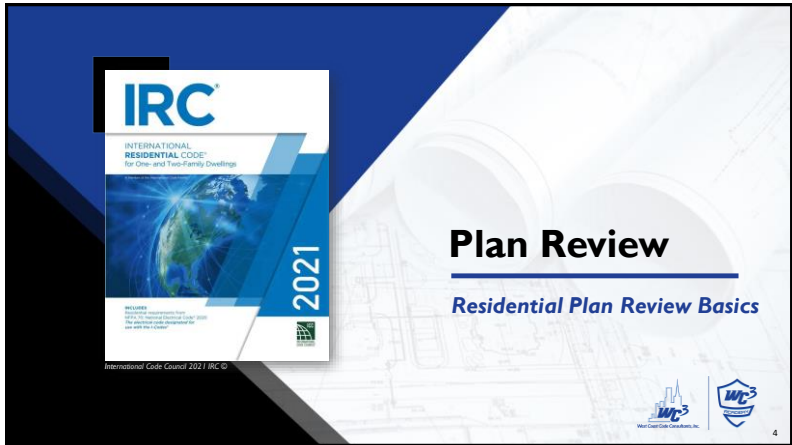
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Exam Breakdown – R3

General Administration	5%
Site Plan	10%
Architectural & Life Safety	25%
Structural	25%
Energy Efficiency	5%
Mechanical	10%
Plumbing	10%
Electrical	10%

For a more detailed breakdown of the test visit:
<https://www.iccsafe.org/certification-exam-catalog/>




5




Preparation

- What to study?
 - Review the ICC website for topics covered and reference materials
- Plan on personal study of at least 2-hours for every 1-hour of course time
- **Highlight** important sections or values so that your eyes are quickly drawn to them
- Tab your book so you can quickly find frequently referenced sections





6



Register for The Exam

- Computer-Based Testing (CBT)
 - PRONTO (Online Proctored Testing)

<https://shop.iccsafe.org/residential-plans-examiner.html>

7




IRC Organization




Residential Plan Review Basics



8

Key Items

- Marginal Markings
 - Solid vertical lines- New or modified
 - [➡] Entire section, paragraph, exception is deleted
 - [*] indicates text/table has been relocated elsewhere
 - [**] indicates text/table has been relocated there
- Italicized Terms (Definitions)




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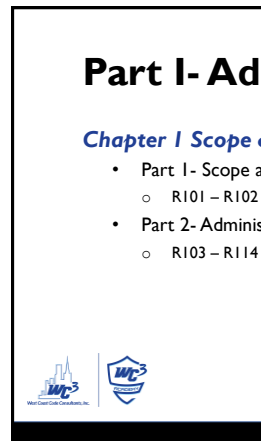






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Part I- Administrative

Chapter 1 Scope & Administration

- Part 1- Scope and Application
 - R101 – R102
- Part 2- Administration and Enforcement
 - R103 – R114








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Part II- Definitions

Chapter 2 Definitions

- R201 – R202

13

Part III- Building Planning & Construction

Chapter 3 Building Planning

- R301 – R327

Chapter 4 Foundations




- R401 – R408

Chapter 5 Floors

- R501 – R507

Chapter 6 Wall Construction

- R601 – R610

14

Part III- Building Planning & Construction

Chapter 7 Wall Covering

- R701 – R703

Chapter 8 Roof-Ceiling Construction




- R801 – R807

Chapter 9 Roof Assemblies

- R901 – R908

Chapter 10 Chimneys and Fireplaces

- R1001 – R1006








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Part IV- Energy Conservation

Chapter 11- Energy Efficiency

- N1101 – N1111

16



Part V- Mechanical

Chapter 12 Mechanical Administration

- M1201 – M1202

Chapter 13 General Mechanical Systems

- M1301 – M3108



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Part VI- Fuel Gas

Chapter 24 Fuel Gas

- G2401 – G2453

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Part VII- Plumbing

Chapter 25 Plumbing Administration

- P2501 – P2503

Chapter 26 General Plumbing Requirements



- P2601 – P2609

Chapter 27 Plumbing Fixtures

- P2701 – P2725

Chapter 28 Water Heaters

- P2801 – P2804

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Part VII- Plumbing (cont.)

Chapter 29 Water Supply and Distribution

- P2901 – P2913

Chapter 30 Sanitary Drainage

- P3001 – P3011

Chapter 31 Vents



- P3101 – P3114

Chapter 32 Traps

- P3201

Chapter 33 Storm Drainage

- P3301 – P3303

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Part VIII- Electrical

Chapter 34 General Requirements

- E3401 – E3407

Chapter 35 Electrical Definitions




- E3501

Chapter 36 Services

- E3601 – E3611

Chapter 37 Branch Circuit and Feeder Requirements

- E3701 – E3706

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Part VIII- Electrical (cont.)

Chapter 38 Wiring Methods

- E3801 – E3803

Chapter 39 Power and Lighting Distribution




- E3901 – 3909

Chapter 40 Devices and Luminaires

- E4001 – E4005

Chapter 41 Appliance Installation

- E4101

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Part VIII- Electrical (cont.)

Chapter 42 Swimming Pools

- E4201 – E4209

Chapter 43 Class 2 Remote-Control, Signaling and Power-Limited Circuits

- E4301 – E4304

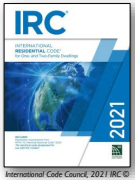







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Applicable Code

This course is focused on plan review based on the IRC

- Once you know the code, know how to use it
- Uses in plan review







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Course Format

Course Modules

<ol style="list-style-type: none"> 1. Introduction 2. How to Read Plans 3. Chapter 1-Administration 4. Loads and Design Criteria 5. Chapter 3- Building Planning: Part 1 6. Chapter 3- Building Planning: Part 2 7. Chapter 3- Building Planning: Part 3 8. Chapter 4- Foundations 9. Chapter 5- Floors and Decks 	<ol style="list-style-type: none"> 10. Chapter 6-Wall Construction: Part 1 11. Chapter 6-Wall Construction: Part 2 12. Chapters 7, 8, 9 & 10- Structural Provisions 13. Chapter 11- Energy 14. Mechanical & Plumbing Requirements 15. Electrical Requirements
--	---



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What is the purpose of the IRC?

R101.3 Purpose. The purpose of this code is to establish minimum requirements to provide a reasonable level of safety, health and general welfare through affordability, structural strength, means of egress, stability, sanitation, light and ventilation, energy conservation and safety to life and property from fire and other hazards and to provide a reasonable level of safety to fire fighters and emergency responders during emergency operations.

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- Our job is to enforce a “reasonable level of safety, health and general welfare...”
- There will always be “what-ifs”



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Who can do what?


- The Building Official delegates “powers” or authority

R103.3 Deputies. In accordance with the prescribed procedures of this jurisdiction and with the concurrence of the appointing authority, the building official shall have the authority to appoint a deputy building official, the related technical officers, inspectors, plan examiners and other employees. Such employees shall have powers as delegated by the building official.

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- Effective use of the IRC requires delegation or authority

R104.1 General. The building official is hereby authorized and directed to enforce the provisions of this code. The building official shall have the authority to render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be in compliance with the intent and purpose of this code. Such policies and procedures shall not have the effect of waiving requirements specifically provided for in this code.

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Plan Review Basics

- Is there a way to perform **smarter** residential plan reviews?
- Can we develop a method that saves us time, as well as the applicant?
- What really matters?
- Why have we been doing it this way for so long?



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Goals of the Course:

- Increase** the Quality of Plan Reviews.
- Decrease** the Time Spent on Plan Reviews (turn plans around faster).

- Can these two things coexist?
- How do we define a quality plan review?
 - "A review that leads to clean inspections, low-cost corrections and a code compliant home"



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Are Plan Reviews Required?

R104.2 Applications and permits. The building official shall receive applications, **prepare construction documents** and issue permits for the erection and alteration of buildings and structures, inspect the premises for which such permits have been issued and enforce compliance with the provisions of this code.

R106.1 Submittal documents. Submittal documents consisting of construction documents, and other data shall be submitted in two or more sets, or in a digital format where allowed by the building official, with each application for a permit. The construction documents shall be prepared by a registered design professional where required by the statute of the jurisdiction in which the project is to be constructed. Where special conditions exist, the building official is authorized to require additional construction documents to be prepared by a registered design professional.

Exception: The building official is authorized to **waive the submission of construction documents** and other data not required to be prepared by a registered design professional if it is found that the nature of the work applied for is such that reviewing of construction documents is **not necessary to obtain compliance with this code.**

- Shall = Must
- The "Review" can conclude that the "nature of the work...is such that reviewing...is not necessary to obtain compliance with this code."




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What Makes Acceptable Plans?

- We're evaluating what will be built (proposed work), not necessarily the plans themselves
- Reasonable" and "as soon as practicable" are unfortunately not determined by the Building Dept.
- Sufficient Clarity- IS NOT a reproduction of the IRC on the plans!

R105.3.1 Action on application. The building official shall examine or cause to be examined applications for permits and amendments thereto within a reasonable time after filing. If the application or the construction documents do not conform to the requirements of pertinent laws, the building official shall reject such application in writing stating the reasons therefor. If the building official is satisfied that the proposed work conforms to the requirements of this code and laws and ordinances applicable thereto, the building official shall issue a permit therefor as soon as practicable.


R106.1.1 Information on construction documents. Construction documents shall be drawn upon suitable material. Electronic media documents are permitted to be submitted where approved by the building official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations, as determined by the building official.



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Plan Review Considerations

- Does your plan review ignore the experience level of your inspector(s)?
 - Know your inspectors, involve them!
- Do your plan review comments add value to the project? If so, how?
- Does the cost (time is money) of adjusting the plans exceed the cost of making the correction in the field if missed?
- Don't make inspection-based comments, in the plan review!
- Are you enforcing this in the field? If not, you might be wasting your time
 - More comments **does not** = higher quality





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Contractor Expectations/Considerations

- What are contractors consistently missing?
 - Ask the inspectors!
- What's new in the code that contractors aren't used to?
- Is the permit for an owner-builder, production builder, or small-time builder?
 - Adjust accordingly!
- Will the plans really make a difference for a particular issue or item?
 - Obscure notes in random places help no one.

The plans aren't our backstop- **The Code Is!**



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Issued with Corrections

- As a building department, you have authority to issue a permit with conditions
- An "Issued with Corrections" list can be included as part of the approved plans, and would be legally binding
- Stamp the list, staple to the plans, or merge electronically. Clarify that it must be on-site at the time of inspections

Issued with Corrections

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What if we Miss Something?



- "Reviewed For Code Compliance" certifies that the plans were reviewed **not** that they are in complete compliance with the IRC
- Our authority to enforce the code is **never** weakened due to plan review approval
- Pick up the "crumbs" in the field, the code allows us to do that

R105.6 Suspension or revocation. The building official is authorized to suspend or revoke a permit issued under the provisions of this code whenever the permit is issued in error or on the basis of incorrect, inaccurate or incomplete information, or in violation of any ordinance or regulation or any of the provisions of this code.

R106.3.1 Approval of construction documents. Where the building official issues a permit, the construction documents shall be approved in writing or by a stamp that states "REVIEWED FOR CODE COMPLIANCE." One set of construction documents so reviewed shall be retained by the building official. The other set shall be returned to the applicant, shall be kept at the site of work and shall be open to inspection by the building official or a duly authorized representative.

R113.1 Unlawful acts. It shall be unlawful for any person, firm or corporation to erect, construct, alter, extend, repair, move, remove, demolish or occupy any building, structure or equipment regulated by this code, or cause same to be done, in conflict with or in violation of any of the provisions of this code.

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Building Department Communication

- Plans examiners and inspectors must communicate regularly.
- The same plan review comment on 100 plans, may easily be eliminated with one staff meeting.
- You have to establish as a department what is important, you can't be divided.


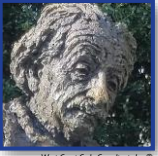



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Pet Peeves

- Just because something happened once in 1997, doesn't mean every permit applicant should pay for it for the next 30 years!
- The plans are a guide, not literal representation of the home


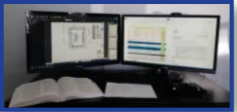



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Practical Tips for Plan Review

- Allocate sufficient time, in blocks not small chunks.
 - One 5-hour block of time is **not** equal to five 1-hour blocks of time.
- Ensure adequate space (paper based).
- Ensure proper equipment (electronic).

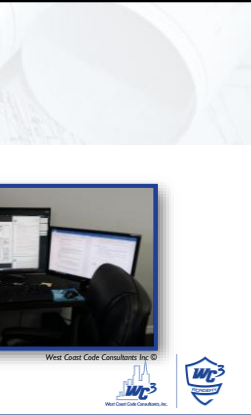
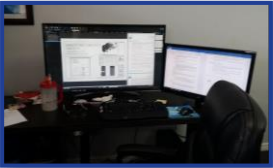
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Plan Review Equipment

- Large Monitors- Bigger is Better
- Multiple Monitors- At least two
- Electronic Codes are Helpful
- PDF Viewer- **Bluebeam** is Best
- Quality Chair
- Standing or Sitting- Healthier

We perform better when we feel good!






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Electronic Plan Reviews

- Blockbuster vs. Netflix- Who's still in business?
- Electronic plans, electronic correction letters
 - Never type a comment twice- Get organized!
 - Never hand-write comments- They can't be used again.
- Be professional, raise the profile of our industry.

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A Good Plan Review Comment:

Key Elements:



- Number your comments
- Reference a plan sheet
- Include a code reference
- Write clearly, use spell check, be specific
- Provide direction

It may take more time initially but remember you're only typing it once!

1. Sheet E1: IRC R302.13 requires a 3" gap to be placed between canned lighting or ceiling fan motors to any combustible insulation. Please indicate how this is being addressed for the main floor ceiling framing. Provide a note or detail on the plans.

The code requires a 3" gap at can lights. **Bad**

Good!

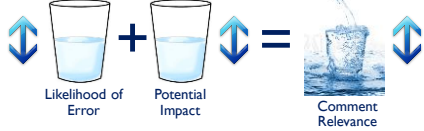


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Comment Relevance:

After you complete a review, read through the comments. Evaluate likelihood of error & potential impact. If those two elements combined are high, keep the comment, if not- consider removing the comment.

Likelihood of Error + Potential Impact = Comment Relevance

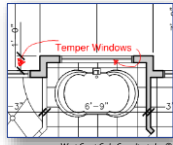
It takes a fair amount of both, or a whole lot of one or the other to make a comment relevant.


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Redlines Can Save Time

- You can redline on electronic plans
- It does save time
- Be careful, you're not the designer
- Stick to notes
- Inform the applicant
- Protect the documents



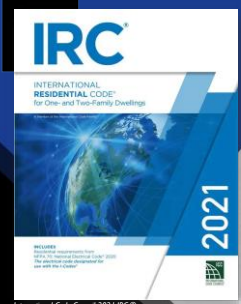
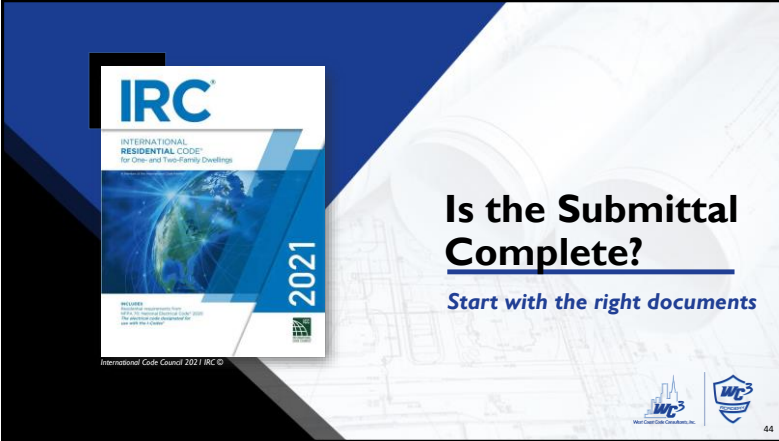

Temper Windows



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Is the Submittal Complete?

Start with the right documents

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Minimum Submittal Requirements

- Get a quality submittal before you start the plan review!
- Stop wasting time with "Please provide..." comments.

NEW RESIDENTIAL PERMIT PLAN SUBMITTAL CHECKLIST

Project Name: _____ Contact Name: _____
 Building Address: _____ Contact Phone: _____

1. TWO SETS (MINIMUM 36" X 24" - ALL PAGES MUST BE THE SAME SIZE) signed and dated with Architect or Engineer not paper.
2. CONSTRUCTION DOCUMENTS, ONE (1) SET HARD COPIES
3. A DISK WITH THE PDF COPY OF BOTH PLANS AND CONSTRUCTION DOCUMENTS
4. "DESIGN BUILT" IN LIEU OF PROPER PLANS IS NOT ACCEPTABLE
5. FIRE SPRINKLER AND ALARMS CAN BE DEFERRED SUBMITTAL

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Minimum Submittal Requirements

BUILDING PERMIT FORMS:


- _____ BUILDING APPLICATION FORM
- _____ RES CHECK (Residential energy analysis report), provided by your Architect or Engineer
- _____ GEO TECH REPORT (Soils Analysis) provided by your Architect or Engineer

PLAN SUBMITTALS

Two full sets of building plans (minimum size: 36 x 24)

Engineering is required unless home is of conventional light-frame construction (plans must be stamped, signed, and dated by an engineer licensed by the State of Utah)

- _____ Site Plan, including all property lines and set-back distances & Landscaping Plan
- _____ Landscaping plan
- _____ Elevations
- _____ Footing / foundation / basement plans
- _____ Floor plans, identify rooms, doors, windows, appliances
- _____ Wall cross sections
- _____ Separation wall details with U.L. numbers (if applicable)
- _____ Floor Framing Design / Layout
- _____ Roof Framing Design / Layout
- _____ Beam and header schedules
- _____ Stairways, landings, handrail, guard details and specifications
- _____ Plumbing information:




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Minimum Submittal Requirements

- _____ Water service size
- _____ Size, type, and location of water heater
- _____ Gas piping plan with hoods, lengths, sizes, material and pressure.
- _____ Piping methods and sizing for water heater and laundry pans, if applicable
- _____ Location of backwater valve if there are fixtures lower than the next upstream manhole cover
- _____ Locations of all basement fixture rough-ins
- _____ Electrical information:
 - _____ Service size and location
 - _____ Breaker panel location
 - _____ Locations of outlets, switches, fans, smoke alarms, CO detectors, etc.
 - _____ GFCI and AFCI protected outlets identified
- _____ Mechanical information:
 - _____ HVAC equipment sizes and locations
 - _____ Combustion air sources, locations, and sizes
 - _____ Vents sized to meet GAMA tables
- _____ Best Management Practices (required by EPA) Contact Ed Ralston, Public Works Inspector at 801-412-3219 for required documentation.

My signature below indicates that I have carefully reviewed the permit application and plans and verify that all of the items above have been included. I have checked each item and have assured the submittals are complete. I realize that incomplete submittals will substantially delay the plan review and permit issuing processes.



Applicant's Signature: _____ Date: _____
 Print Name: _____




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Submittal Requirements

- Get the Right Information Upfront
- Make Available to Contractors
 - Website
 - Handout
- Have Permit Tech check for complete submittal prior to accepting
 - Electronic system may do this automatically

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Checklists

Is it okay to use checklists?

RESIDENTIAL PLAN REVIEW CHECKLIST

Submittals List _____
 Building Address _____
 Applicant Name: _____
 Phone #: _____ Email: _____

GENERAL

1. Check Provide a square footage summary for each of the following: main level, upper level, finished basement, finished basement, garage, deck, covered porch, and accessory buildings. WC3 Section 1001.4



2. Check Note all subdivision requirements, easements, and/or restrictions. 1001.4

FOUNDATIONS

1. Check Footing details (exterior and exterior) shall be located on the foundation sheet or the detail sheet and shall be cross-referenced to the foundation plan. Specify depth and size of all footings and pads. Show all reinforcing steel (vertical and horizontal). WC3 Section 1001.4

2. Check Foundation plates and walls shall be tied to the foundation with minimum 1/2" rebar at 18" max. on this and embedded a minimum 7 diameters into foundation. Anchor bolts must be placed in the middle one third of the plate. WC3 Section 1001.4

3. Check All plate (exterior and exterior, load bearing and non load bearing) shall be pressure treated or of naturally durable timber. All wood columns shall be pressure treated unless supported on a 1" pedestal. WC3 Section 1001.4

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Checklists

- Outlines serve as a guide and are better than a checklist
- Page by Page method works, but is inefficient
- The key is to develop a method and stick to it

Code Outline Checklist

I. Chapter 1 - Scope

A. Use Plan (1001.2.1)

B. Egress Plan (1001.2.2)

C. Substantial Submittal (101.14.1)

D. Code Analysis (Ch. 1, 5, 6, 10)

E. Outgoing documents (101.1)

F. Calculations, loadings, reports, etc. (1001.4)

II. Chapter 2 - Use Groups

A. Verify Use Group

B. Small Assembly Areas (1001.2)

C. Mechanical materials in factories or Storage (Table 1001.2.1, 1001.2.2)

III. Chapter 3 - Special Uses

A. Use of any of these sections apply:

1. Access and egress by architect

2. If Access is defined check all items for compliance

IV. Chapter 4 - Accessible height and area

A. Access (1001.2)

B. Seating and area analysis (1001)

V. Emergency Escape and rescue (1001)

A. Stairs (1006)

B. Clear Trailing (1006.1)

C. Ladders (1006.1.1)

D. Clear Trailing (1006.1.2)

E. Clear Trailing (1006.1.3)

F. Clear Trailing (1006.1.4)

G. Clear Trailing (1006.1.5)

H. Clear Trailing (1006.1.6)

I. Clear Trailing (1006.1.7)

J. Clear Trailing (1006.1.8)

K. Clear Trailing (1006.1.9)

L. Clear Trailing (1006.1.10)

M. Clear Trailing (1006.1.11)

N. Clear Trailing (1006.1.12)

O. Clear Trailing (1006.1.13)

P. Clear Trailing (1006.1.14)

VI. Chapter 5 - Accessibility

A. Use Accessibility

B. Loading Docks (1006.7)

C. Site Requirements (1006)

D. Accessible Route (1006)

E. Access

F. Assembly Seating (1006.1)

G. Seating (1006.1.1)

H. Seating (1006.1.2)

I. Seating (1006.1.3)

J. Seating (1006.1.4)

K. Seating (1006.1.5)

L. Seating (1006.1.6)

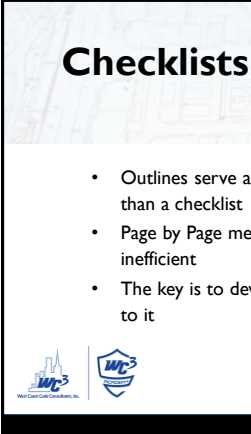

M. Seating (1006.1.7)

N. Seating (1006.1.8)

O. Seating (1006.1.9)

P. Seating (1006.1.10)

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Organization of Comment Letter

- Reference the applicant and permit number
- Include received date, and date of comments
- Follow a logical order- Based on sheet numbers
- Provide contact information of the reviewer

APR 11 2023

WC3 Permit #: 277-014-01
 Submittal Number: 1001.4

City of Seattle
 400 5th Ave
 Seattle, WA 98101
 Phone: (206) 320-1313

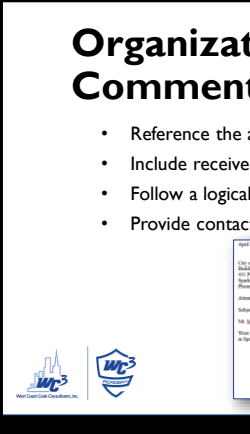

Attention: Mark Skidmore, Chief Planning Officer
 Subject: Gateway/Chadlow - Five Barons Condominiums (2018-01)

Mr. Skidmore

West Coast Code Consultants has completed the review of the proposed Gateway Condominium project located at 400 5th Ave. The review was based on the following:

1. Architectural drawings by Pacific West Design-Build Services, LLC, dated and signed by Donald Greenfield, Licensed Architect, on 04/08/2023.
2. Civil drawings by Wood Rodgers, Inc. dated and signed by Dale L. Parker, Professional Engineer.
3. Structural drawings and calculations by WCC.
4. Mechanical and plumbing drawings by Alexander Schmitt & Associates, dated and signed by Alexander S. Schmitt, Professional Engineer.
5. Electrical drawings by WCC/Mark Skidmore, Inc.
6. Construction management report (CMR) by Wood Rodgers, Inc.

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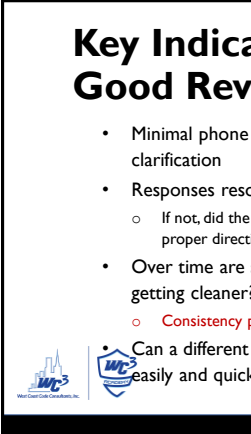




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Key Indicators of a Good Review

- Minimal phone calls and emails asking for clarification
- Responses resolve the original comments
 - If not, did the original comment make sense and give proper direction?
- Over time are submittals from regular applicants getting cleaner?
 - Consistency pays off!
- Can a different reviewer perform the re-check easily and quickly?

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Tools for Improvement

- Find a mentor, within your jurisdiction or elsewhere (ICC Chapter, etc.).
- Job shadow other plan reviewers from time to time.
 - Winter is great for this.
- Self evaluations, or formal evaluations.
- Be a resource in your community.
 - Teaching the designers is the best way to stay sharp.
- Don't Plateau- Most reviewers only get "good enough."
- A rotation between inspector & plans examiner is best.



*(5 years of experiences is better than
1 year of experience 5 times)*

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MODULE 2

How to Read Plans

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1

LEARNING OBJECTIVES

1. Understand the different types of plan sheets common to residential construction.
2. Become familiar with how residential plans are laid out.
3. Gain a basic understanding of how to read residential plans.

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2

IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings

2021

Plan Review

How to Read Plans – Basic Skills

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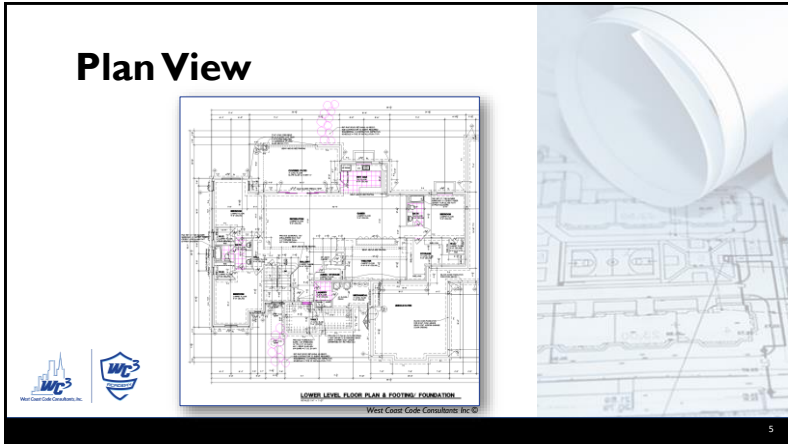
How to Read Plans

Basic Skills

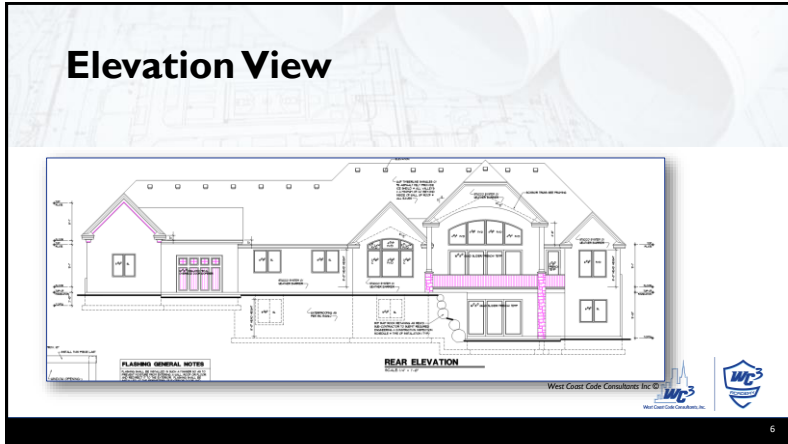
- Plan View- View from above w/ x-ray vision
- Elevation- Side view from the ground
- Section- Cut through the building
- Detail- Specific assembly instructions, with notes
- Symbols- Shapes and line combinations with meaning
- General Notes- Where most information is hidden
- Typical Layout- Expected order of plan sheets
- Calculations- The math and science behind the pretty pictures

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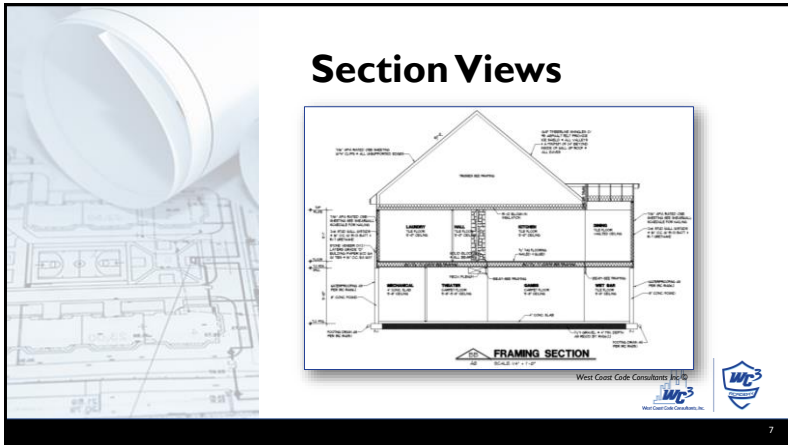
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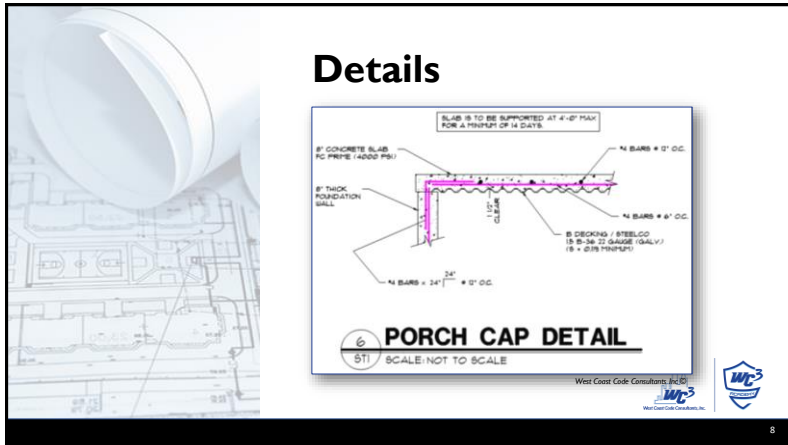
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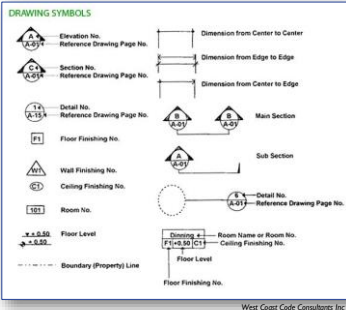


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Common Symbols



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General Notes

FRAMING GENERAL NOTES 2015 I.R.C.

- ALL BEARING MEMBERS (JOISTS AND BEAMS) SHALL BE 16-18 IN. (1200 PER 16) OR BETTER. ALL BEARING COLUMNS SHALL BE 16-18 IN. (1200 PER 16) OR BETTER. ALL BEARING STUDS & TRIMMERS SHALL BE 16-18 IN. (1200 PER 16) OR BETTER. FOR TRIMMERS ALLOWED 182 STD. HEIGHT SCHEDULE GALVAPLATED TRIMMER MEMBERS SHALL HAVE A MINIMUM ALLOWABLE BENDING STRESS OF 2400 psi (24 IN. LATHING) WHERE OTHERS SHALL HAVE A MINIMUM ALLOWABLE BENDING STRESS OF 2000 psi.
- PROVIDE SOLID BLOCKING AT LEAST 1/2 IN. THICK AND FULL DEPTH OF JOIST # ENDS AND AT EACH SUPPORT OF JOIST. PROVIDE SOLID BLOCKING & BEARING BRICK OF TRIMMERS.
- LATHING BUILT-UP BEAMS OF 2X TRIMMERS SHALL BE SPICED TOGETHER WITH NOT LESS THAN (2) NAILS BE SPICED AT TOP AND BOTTOM. BEAMS & TRIMMERS SHALL NOT EXCEED MAXIMUM SPAN RATING. ROOF BEAMS SHALL BE 1X4 SPICED WITH A SPAN RATING OF 24 IN. ROOF BEAMS SHALL BE FASTENED TO TRIMMERS WITH #10 @ 4 IN. BOUNDARY AND BEAMS 1/4 IN. @ 4 IN. @ 4 IN.
- ALL STRUCTURAL BEARING SHALL BE SPICED AND SHALL NOT EXCEED MAXIMUM SPAN RATING. ROOF BEAMS SHALL BE 1X4 SPICED WITH A SPAN RATING OF 24 IN. ROOF BEAMS SHALL BE FASTENED TO TRIMMERS WITH #10 @ 4 IN. BOUNDARY AND BEAMS 1/4 IN. @ 4 IN. @ 4 IN.
- TRIMMERS TO BE DESIGNED & ENGINEERED BY MANUFACTURER AND GUARANTEED TO WITHSTAND LOADS AS SHOWN IN DESIGN DATA SHEET. TRIMMER MANUFACTURER TO DESIGN TRIMMERS FOR ALL APPLICABLE BUCKLING CONDITIONS PER I.R.C.
- PROVIDE FINE BLOCKING IN JOIST BAY SPACES GREATER THAN 4 FT.
- PROVIDE BRIMMERS AT JOISTS & EACH TRIMMER ON BEARING ENDS OF ALL TRIMMERS & RUMMERS.
- PROVIDE JOIST HANGERS UNDER BEAM OR AS NEARLY APPLICABLE.
- PROVIDE TRIMMERS UNDER BEARING ENDS OF JOIST TRIMMERS & BEAMS EQUIVALENT TO THE WIDTH OF THE TRIMMER SUPPORTED OR AS SPECIFIED ON FRAMING PLANS.
- PROVIDE GABLE END TRIMMERS AS REQUIRED.
- ALL NONBEARING INTERIOR PARTITION # 2" @ 16".
- TRIMMERS TO RESIST ALL FLOOR OVERLAYS PLAY SHEET & CEILING HANGERS AS PER PLAN.
- ALL WOOD BEAMS AND HEADERS SHALL BEAR ON TRIMMERS OF (1) TRIMMER STUD AT EACH END UNLESS SHOWN OTHERWISE.
- PROVIDE SOLID BLOCKING IN FLOORS TO TRANSFER COLUMN POINT LOADS THROUGH FLOOR (1/4" x 1/4" x 1/4" AND 1/4" x 1/4" x 1/4" OF EACH FLOOR 1/2" @ 16").
- NOT TYPE OR OTHER OTHER UNCALLED ITEMS THAT PROSE HEAVY LOADS ON STRUCTURAL MEMBERS WILL REQUIRE ADDITIONAL ENGINEERING & NOT SHOWN ON ORIGINAL PLANS USED FOR DESIGN. STRUCTURAL MEMBERS MAY NEED TO BE INCREASED FOR THE ADDITIONAL IMPOSED LOADS.

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Typical Layout

- Cover Sheet
- General Notes Site Plan
- Basement Plan/Footing and Foundation Plan
- Main Floor Plan/Shear Wall Plan
- Upper Floor Plan/Shear Wall Plan
- Roof Plan
- Elevations
- Sections
- Details
- Structural Framing
 - joists/beams/posts
- MEP Plans



11

Calculations

Steel Beam

DESCRIPTION Beam at front wall above door (WF)

Vertical Reactions	Support 1	Support 2
Load Combination		
+D+0.750L+0.750E+0.450W+H	7.860	7.860
+D+0.750L+0.750E+0.450W+H	18.314	18.314
+D+0.750L+0.750E+0.450W+H	18.314	18.314
+D+0.750L+0.750E+0.450W+H	18.314	18.314
+D+0.750L+0.750E+0.450W+H	18.314	18.314
+D+0.750L+0.750E+0.450W+H	3.155	3.155
+D+0.750L+0.750E+0.450W+H	3.155	3.155
+D+0.750L+0.750E+0.450W+H	3.155	3.155
+D+0.750L+0.750E+0.450W+H	3.155	3.155
D Only	9.258	9.258
L Only	1.464	1.464
L Only	1.740	1.740
S Only	18.669	18.669
H Only		

Steel Section Properties : W12x35

Depth	12.900 in	1 xx	8	285.00 in ⁴
Web Thickness	0.300 in	5 xx		45.60 in ³
Flange Width	6.500 in	6 xx		5.500 in
Flange Thickness	0.520 in	2x		51.000 in ³
Area	10.300 in ²	1yy		24.500 in ⁴
Weight	35.000 lbf	1yy		7.470 in ³
Kagness	0.820 in	R yy		1.540 in
kt	0.750 in	2y		11.500 in ³
Rt	1.790 in			
Vcg	6.250 in			

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MODULE 3

**2021 IRC - Chapter 1
Administration**

1

LEARNING OBJECTIVES

1. Understand when the IRC can and cannot be used.
2. Learn the administrative duties and powers of a building official.
3. Become familiar with work exempt from permitting requirements.
4. Gain an understanding of code required inspections.

2

Plan Review

Part 1 - Administration

3

Scope

IRC R101.2

- “Applies to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, removal, and demolition of...”

4

References

IRC R102.4
References shall be considered part of this code.

Logos for various professional organizations: AD (Architectural Drafting), AWP (Architectural Woodwork Institute), ASME (American Society of Mechanical Engineers), ASABE (American Society of Agricultural and Biological Engineers), APA (The Engineered Wood Association), SI (International Standards Institute), AFSP (The Association of Pool & Spa Professionals), ASCE (American Society of Civil Engineers), and others.

5

Appendices

IRC R102.5

- "...shall not apply unless specifically referenced in the adopted ordinance"
- IRC- Appendices AA-AX
 - 24 total appendices
- **Know before you go!**

6

Additions & Alterations

IRC R102.7.1
"...shall not cause an existing structure to become unsafe or adversely affect the performance of the building"

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7

Duties & Powers

IRC R104
Can interpret the code but must restrict all decisions to the intent and purpose of code, and **may not waive** any code requirements.

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8

Alternatives

IRC R104.11

- “not intended to prevent...not specifically prescribed by this code”
 - Materials
 - Design
 - Methods of Construction
 - Equipment






9

Alternatives

IRC R104.11

- The B.O. shall have the authority to require tests as evidence of compliance
 - Shall be performed by an approved agency
 - Who are you “approving”?







10

Exemptions

IRC R105.2

- One-story detached 200 ft² or less
 - Retaining walls less than 4 feet high*
 - Decks less than 200 ft² and less than 30” above grade, and not attached, and not the exit
 - Minor repairs
 - Low-voltage wiring
 - Portable appliances








11

Exemptions

IRC R105.2

All work should still be performed in accordance with the code and any other laws and ordinances of the jurisdiction.






12

Construction Documents

IRC R106

- Submitted in two or more sets (or electronically)
- Prepared by a registered design professional where required
- The Building Official is authorized to require additional construction documents to be prepared by a registered design professional
- Sufficient clarity to indicate the location, nature and extent of the work proposed
- Show in detail that it will conform to the provisions of this code
- Manufacturer's installation instructions
- Flood hazard information
- Site plan- showing the size and location of new construction and existing structures on the site and distances from the lot lines



13

Approval

IRC R106.3.1

Shall be approved in writing or by a stamp that states:
"REVIEWED FOR CODE COMPLIANCE"





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Required Inspections

IRC R109.1

- Foundation Inspection
- Rough Plumbing, Mechanical, Gas and Electrical Inspection
- Floodplain Inspection
- Framing and Masonry
- Fire-Resistance-Rated Construction
- Final Inspection



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END OF MODULE 3



16

MODULE 4

2021 IRC – Structural Load Paths & Design Criteria

1

1

LEARNING OBJECTIVES

1. Understand how to evaluate design criteria for structural design.
2. Learn general concepts related to load paths, and how to recognize them.
3. Become familiar with wind loads and how to determine exposure categories.
4. Understand seismic loading and design categories.
5. Recognize when design elements are beyond the prescriptive limitations of the code.

2

2

Plan Review

Design Criteria, Loads and Load Paths, Seismic Hazards

3

3

Design Criteria

Critical Element

DESIGN CRITERIA	
A. GRAVITY DEAD LOADING; REFER TO FRAMING PLANS	
1. TYPICAL ROOF	35 PSF
C. GRAVITY LIVE LOADING; REFER TO FRAMING PLANS	
1. MAX ROOF SNOW	122 PSF (WARM)
D. SEISMIC FORCES	
1. SEISMIC DESIGN CATEGORY	D
2. SOIL CLASS	D - DEFAULT
3. S ₁	0.016
4. S ₂	0.341
5. S _{0.5}	0.813
6. S _{0.1}	0.412
7. BASE SHEAR	V = 0.250 W
E. WIND FORCES	
1. VELOCITY	115 MPH 3 SECOND GUST
2. EXPOSURE	C
F. FOUNDATION	
1. SOIL BEARING PRESSURE: 1500 PER SOILS REPORT. CODE MIN. USED FOR DESIGN.	



4

4

Design Criteria

IRC R301.1

- "...shall be constructed to safely support all loads... as prescribed by this code."
- "The construction... shall result in a system that provides a **complete load path**."

5




Load Paths

Newton's 3rd Law:

- "To every action there is an equal and opposite reaction."

Load Path:

- How the loads are transferred from the point of origin to where they are resisted.

6

Load Paths

What causes vertical loads?

- Gravity

What causes lateral loads?

- Wind
- Seismic

What resists these loads?

- Ground











7

Parts of Structure


- Beams, columns, headers
- Diaphragms, shear walls, collectors
- Footings, foundations, soil
- Connections, connections, connections


8

Not Part of Structure

- Interior partitions
- Drywall and other finishes
- Roofing, insulation, MEP



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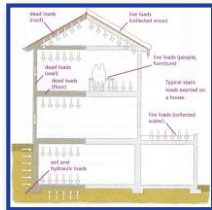




9

Gravity Load Path

What loads need to be considered?

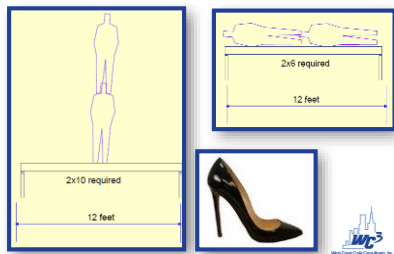

- Dead loads
- Live loads
- Snow loads
- Soil loads
- Hydrostatic loads
- Rain loads
- Flood loads

10

Gravity Load Path


Concentrated vs. Uniform Loads

11

Gravity Load Path

- The load path is pretty easy to follow.
- What are some common problems?








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Lateral Load Path

- Not as easily understood
- What loads need to be considered?
 - Wind
 - Seismic

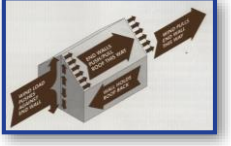


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13

Lateral Load Path

Wind:

- Wind acts against the sides of a building like the sail on a boat.
- Most forces are transferred up into the roof/floor while the rest into the foundation.




14

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Lateral Load Path

Seismic:

- Ground shaking causes the structure's mass to be accelerated back and forth.
- Forces are developed where the structures mass is the largest.

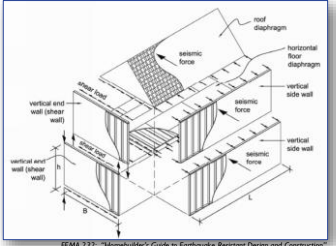




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Lateral Load Path

Lateral-Resisting-Elements:



FEMA 222 - "Homebuilder's Guide to Earthquake Resistant Design and Construction"

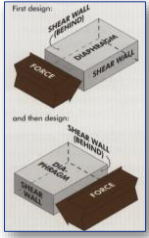



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Lateral Load Path

- The building must be designed to withstand lateral forces in each direction.
- What controls in one direction may not control in the other.



First design: SHEAR WALL RESISTANCE, SHEAR WALL, FORCE

wind floor design: SHEAR WALL RESISTANCE, SHEAR WALL, FORCE







25

25

Lateral Load Path

- Special attention should be paid to structural irregularities.
- The ideal structure would have no irregularities.










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Wind Loads

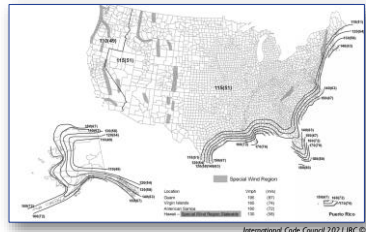
Wind Loading:
Must be designed in accordance with the WFCM, ICC-600, AISI S230, ASCE-7, or the IBC.



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Wind Speeds



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Exposure

IRC R301.2.1.4

If someone were to call and ask, what wind exposure would you specify for your jurisdiction?



Paramount Pictures / 1980 Airplane™




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Exposure

IRC R301.2.1.4

- **Exposure A:** Reserved.
- **Exposure B:** Urban & suburban areas with closely spaced obstructions having the size of **single-family dwellings**.




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Exposure

IRC R301.2.1.4

- **Exposure C:** Open terrain with scattered obstructions typically **< 30-feet** in height
- **Exposure D:** Flat, unobstructed areas exposed to wind flowing over open water, mud flats, salt flats, etc. for a distance of at least **5000 feet**.

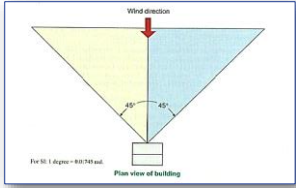
31

31



Exposure

Section 26.7.2 of ASCE 7-16

“A ground surface roughness within each 45° sector shall be determined upwind of the site... for the purpose of assigning an exposure...”



Plan view of building




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Exposure

IRC R301.2.1.4

What "Wind Exposure" should be used in the design of the lot shown below?

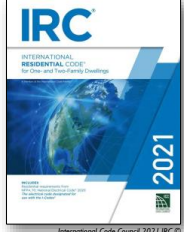


33

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Seismic Hazard

Methods of determining S.D.C.

- Figure R301.2(2)
- Table R301.2.2.1.1, or...
- IBC Methodology

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Seismic Hazard

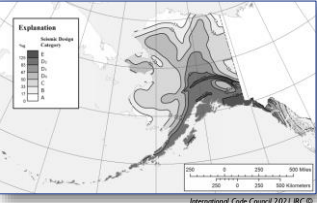



TABLE R301.2.2.1.1	
SEISMIC DESIGN CATEGORY DETERMINATION	
CALCULATED S_{ds}	SEISMIC DESIGN CATEGORY
$S_{ds} < 0.1g$	A
$0.17g < S_{ds} < 0.33g$	B
$0.33g < S_{ds} < 0.50g$	C
$0.50g < S_{ds} < 0.67g$	D _s
$0.67g < S_{ds} < 0.83g$	D _s
$0.83g < S_{ds} < 1.25g$	D _s
$1.25g < S_{ds}$	E



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Seismic Hazard

The IRC assumes Site Class 'D'

Based upon upper 100-feet

- Site Class A: Hard rock
- Site Class B: Rock
- Site Class C: Very dense soil and soft rock
- Site Class D: Stiff soil
- Site Class E: Soft clay soil
- Site Class F: Soils requiring site response analysis

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Seismic

IRC R301.2.2

- The IBC is more specific...
 - First we need to verify the project coordinates...

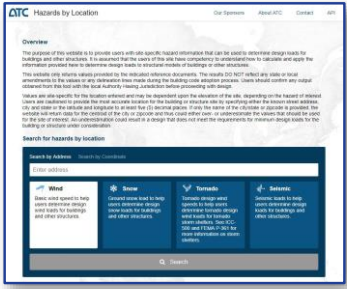
Needed Information
 Elevation = 4548'
 Lat = 40.233923°
 Long = -111.662703°

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Seismic

<https://hazards.atcouncil.org/>




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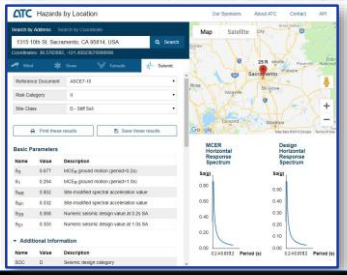
Wind

<https://hazards.atcouncil.org/>




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Seismic




SEISMIC DESIGN CATEGORY BASED ON 5% Damped RESPONSE ACCELERATION

VALUE OF R_n	W	A	B	C	D
$R_n = 0.5$	A	A	A	A	A
$0.5 < R_n \leq 1.0$	B	B	C	C	C
$1.0 < R_n \leq 1.5$	C	C	D	D	D
$R_n > 1.5$	D	D	D	D	D

SEISMIC DESIGN CATEGORY BASED ON 10% Damped RESPONSE ACCELERATION

VALUE OF R_n	W	A	B	C	D
$R_n = 0.5$	A	A	A	A	A
$0.5 < R_n \leq 1.0$	B	B	C	C	C
$1.0 < R_n \leq 1.5$	C	C	D	D	D
$R_n > 1.5$	D	D	D	D	D

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Conventional Limits

Some Conventional Construction Limitations:

- Floodplain Construction (R301.2.4)
- Weight limitations for concrete, masonry, and metal stud
- Irregular Buildings (R301.2.2.2.5)
- Story Height (R301.3): 11'-7" – light-framed
- In SDC 'D₀' or greater...
 - ≤ 3 stories
 - ≤ 2 stories if Structurally Insulated Panels (SIP)
 - Anchored masonry veneer (R702.1 and R703)
 - Masonry chimneys (Chapter 10)

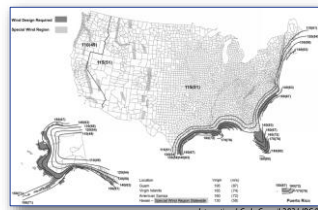


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Conventional Limits

IRC R301.2.1.1

- **Wind Limitations**
 - Figure R301.2(5)B → > 140mph




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Wind

IRC R301.2.1

IRC does not apply to hurricane-prone regions or areas with a basic wind speed ≥ 140mph





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Conventional Limits

IRC R301.2.2

- **Seismic Provisions**
 - Applies to Seismic Design Categories D0, D1, & D2.
 - Also applies to townhomes in SDC 'C'.
 - SDC 'E' shall comply with the IBC.

44

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Irregular

IRC R301.2.2.2.5

Item #3: End of braced wall segment occurring more than 1-foot over an opening below.

REGULAR SHAPE

ENTIRE LENGTH OF BRACED WALL PANEL DOES NOT OCCUR OVER OPENING

INDICATES BRACED WALL PANEL

HEADER REQUIRED: PER SECTION 6.1. THE PANEL EXTENDS MORE THAN 1'-0" OVER OPENING

ELEVATION VIEW (FIGURE 3.1)

IRREGULAR SHAPE

ENTIRE LENGTH OF BRACED WALL PANEL OCCURS OVER OPENING

INDICATES BRACED WALL PANEL

NO HEADER PER SECTION 6.1 AND PANEL EXTENDS MORE THAN 1'-0" OVER OPENING

ELEVATION VIEW (FIGURE 3.2)

49

Irregular

IRC R301.2.2.2.5

Item #4: Diaphragm openings exceeding either 12-foot or 50% of the least floor/roof dimension.

REGULAR SHAPE

LESS THAN OR EQUAL TO (X) OR 12'-0"

OPENING IN FLOOR OR ROOF

PLAN VIEW (FIGURE 4.1)

IRREGULAR SHAPE

MORE THAN (X) OR 12'-0"

OPENING IN FLOOR OR ROOF

PLAN VIEW (FIGURE 4.2)

50

Irregular

IRC R301.2.2.2.5

- Item #5: Floor levels with vertical offsets.
 - Exceptions:
 - Framing must be supported directly by continuous foundations at the perimeter.
 - Floor framing must be lapped or tied together as required by R502.6.1. (i.e. 3" lap and (3)10d face nails, or equivalent)

REGULAR SHAPE

REGULAR SHAPE

REGULAR SHAPE

REGULAR SHAPE

REGULAR SHAPE

IRREGULAR SHAPE

IRREGULAR SHAPE

IRREGULAR SHAPE

IRREGULAR SHAPE

IRREGULAR SHAPE

51

Irregular

IRC R301.2.2.2.5

Item #6: Braced wall lines that do not occur in two perpendicular directions.

REGULAR SHAPE

BRACED WALL LINES ARE PERPENDICULAR

90°

PLAN VIEW (FIGURE 6.1)

IRREGULAR SHAPE

BRACED WALL LINES ARE NOT PERPENDICULAR

70°

PLAN VIEW (FIGURE 6.2)

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Irregular

IRC R301.2.2.2.5
Item #7: Above grade masonry or concrete

REGULAR SHAPE

FIREPLACE OR CHIMNEY PERMITTED PER IRC

ALL WOOD WALL FRAMING

PLAN VIEW (FIGURE 3.2)



IRREGULAR SHAPE

MASONRY OR CONCRETE

WOOD WALL FRAMING

MASONRY OR CONCRETE

PLAN VIEW (FIGURE 3.3)






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Irregular

IRC R301.2.2.2.5
Item #8: Hillside – **New to 2021 IRC**

- ☐ All the following must apply...
 - Grade > 1V:5H, and...
 - Tallest cripple wall > 7-feet, and...
 - Of the total plan area below the lowest framed floor, whether open or enclosed, less than 50 percent is living space having interior wall finishes conforming to Section R702.

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Conventional Limits

IRC R301.2.3

- **Snow Loads**
 - Ground Snow Load (P_g) ≤ 70 psf
 - <https://hazards.atcouncil.org/>

ATC Hazards by Location

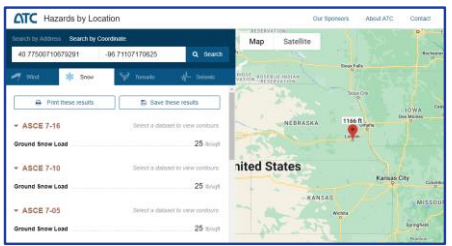

40.77600710070294 -98.71027178625

Ground Snow Load 25 lb/ft²

ASCE 7-16 Ground Snow Load 25 lb/ft²

ASCE 7-10 Ground Snow Load 25 lb/ft²

ASCE 7-05 Ground Snow Load 25 lb/ft²






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Story Height

IRC R301.3

- **Limitations for Conventional Const.**
 - Wood wall framing: 11'-7"
 - Cold formed steel: 11'-7"
 - Stud height < 10'-0"
 - Masonry Walls: 13'-7"
 - 12'-0" Bearing wall height
 - + 8'-0" for gable end walls
 - Insulated concrete forms: 11'-7" (10'-0" Walls)
 - Structural Insulated Panel (SIP) Wall: 11'-7"
 - Wall height 10'-0"

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Conventional Limits

IRC R301.5
Live Loads

TABLE R301.5 MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS (in pounds per square foot)		
USE	UNIFORM LOAD (psf)	CONCENTRATED LOAD (plf)
Uninhabitable areas without storage ^a	10	---
Uninhabitable areas with limited storage ^a	20	---
Habitable areas and areas served with food trays	30	---
Balconies (exclusive of decks) ^b	40	---
Fire escapes	40	---
Garage	---	2000 ^c
Garage in E1 component ^d	---	500 ^c
Roofs ^e	200P	---
Passenger vehicle garage ^f	50P	2,000P
Areas other than sleeping areas	40	---
Sleeping areas	30	---
Stairs	40P	100P

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Conventional Limits

IRC R301.1.3

- **Engineered Design**
 - *“When a building of otherwise conventional construction contains structural elements exceeding the limits of... (the IRC), these elements shall be designed in accordance with accepted engineering practice.”*

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END OF MODULE

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MODULE 5




2021 IRC – Chapter 3
Building Planning I




1

LEARNING OBJECTIVES

1. Understand places within an IRC building where fire-resistant construction is required.
2. Learn the differences between townhouses and two-family dwellings.
3. Become familiar with fire-blocking and draftstopping and where they are required by the code.







2



Plan Review

Fire Resistant Construction







3

Fire-Resistant Construction

IRC R302
IRC Table R302.1(1)

EXTERIOR WALL ELEMENT	TABLE R302.1(1) EXTERIOR WALLS	
	FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour - tested in accordance with ASTM E119, UL 263 or Section 703.3 of the International Building Code with exposure from both sides.
	Not fire-resistance rated	0 hours
Projections	Not allowed	N/A
	Fire-resistance rated	1 hour on the underside, or heavy timber, or fire-retardant-treated wood ⁹
	Not fire-resistance rated	0 hours
Openings in walls	Not allowed	N/A
	25% maximum of wall area	0 hours
	Unlimited	0 hours
Penetration	All	Comply with Section R302.4
		None required

4

Fire-Resistant Construction

IRC R302

- If equipped throughout with an automatic sprinkler system...
 - IRC Table R302.1 (2)

TABLE R302.1 (2) EXTERIOR WALLS - DWELLING UNITS WITH FIRE SPRINKLERS			
EXTERIOR WALL CATEGORY	MINIMUM FIRE RESISTANCE RATING	MINIMUM FIRE RESISTANCE RATING	MINIMUM FIRE RESISTANCE RATING
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E119, E152, or Section 703.2 of the International Building Code with exposure from the outside	0 feet
	Not fire-resistance rated	None	3 feet
Projections	Fire-resistance rated	N/A	< 2 feet
	Not fire-resistance rated	N/A	0 feet
Openings in walls	Fire-resistance rated	1 hour on the outside, or heavy timber, or fire-resistance-rated steel ^a	2 feet ^b
	Not fire-resistance rated	0 hours	0 feet
Penetrations	Fire-resistance rated	1 hour	< 3 feet
	Not fire-resistance rated	0 hours	< 3 feet
Penetrations	Fire-resistance rated	1 hour	< 3 feet
	Not fire-resistance rated	0 hours	< 3 feet

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Distance to Property Lines

6

Definitions

Chapter 2

- BUILDING**- Any one- or two-family dwelling or townhouse, or portion thereof, used or intended to be used for human habitation, for living, sleeping, cooking or eating purposes, or any combination thereof, or any accessory structure. For the definition applicable in Chapter II, see Section N1101.6.
- TOWNHOUSE**- A building that contains three or more attached townhouse units.
- TOWNHOUSE UNIT**- A single-family dwelling unit in a townhouse that extends from foundation to roof and that has a yard or public way on not less than two sides.

7

Fire-Resistant Construction

Exceptions to Tables R302.1...

- Wall, projections, openings or penetrations **perpendicular** to the property line in question
- Walls of dwelling units and accessory structures **on same lot**
- Detached sheds, playhouses or similar structures **exempted from a building permit**. (Projections shall not extend over the lot line!)
- Detached garages located within 2-feet of lot line may have roof projections of up to **4-inches**
- Foundation vents **are** permitted

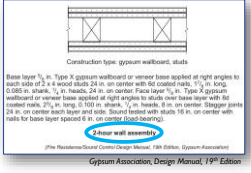
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Townhomes

IRC R302.2

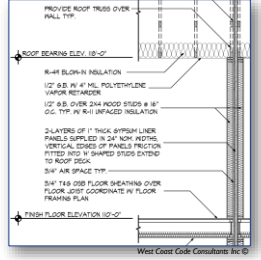
Common walls shall be...

- Sprinkled: 1-hour
- Non-sprinkled: 2-hour



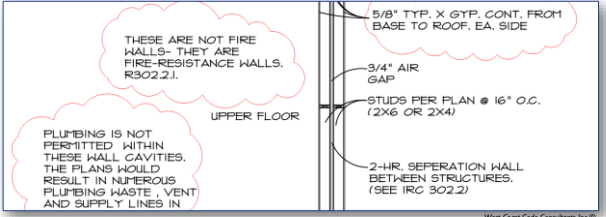
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Townhomes – Shaft Wall Separation



10

Townhomes – Framed Wall Separation



11

Townhomes

IRC R302.2

- Shall be constructed without plumbing or mechanical equipment, ducts or vents in the cavity (Electrical is OK)
- The wall shall be rated for fire exposure from both sides
- Penetrations of outlets shall comply with R302.4
- "...shall be continuous from the foundation to the underside of the roof sheathing, deck or slab"



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Townhomes

IRC R302.2

A parapet shall be provided "...as an extension of exterior walls or common walls"

- 30" above roof surface
- If roofs are offset, 30" (-) difference
- None if higher roof is >30"

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Townhomes

IRC R302.2

Exception: A parapet is not required when...

- A minimum Class 'C' roof covering is used, **and...**
- The roof decking or sheathing is of noncombustible materials or approved **fire-retardant-treated wood** for a distance of **4-feet** on each side of the walls, **or...**
- One layer of 5/8" Type 'X' gypsum board installed directly beneath the roof decking for a distance of **4-feet** on each side of the walls with no penetrations within that **4-feet**.

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Non-Parapet Example (most common)

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Two-Family Dwellings

IRC R302.3

"... shall be separated by wall and/or floor assemblies having not less than 1-hour fire-resistance-rating"

Exceptions:

- 1/2-hour if fully equipped automatic sprinkler system
- Not required to extend through attic if...
 - Ceiling is protected by 5/8" Type 'X' **and...**
 - An attic draft stop is provided to create spaces ≤ 1,000ft²



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Two-Family Dwellings Fire Separation

IRC R302.3 Two-family dwellings


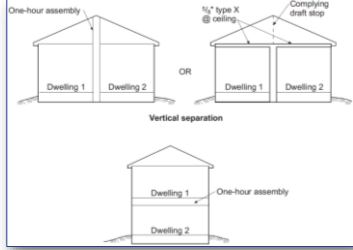
"Dwelling units in two-family dwellings shall be separated from each other by wall and floor assemblies having not less than a 1-hour fire-resistance rating where tested in accordance with ASTM E 119, UL 263 or Section 703.3 703.2.2 of the International Building Code. Such separation shall be provided regardless of whether a lot line exists between the two dwelling units or not."


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Two-Family Dwellings

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Penetrations

IRC R302.4.1

- Fire-rated assembly: Installed as tested in the approved assembly
- Fire stop system: Approved fire stop system having appropriate F-rating



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Penetrations


IRC R302.4

Exceptions:

- Steel, ferrous or copper pipes, tubes or conduits...
 - Typical: Annular space shall be filled with material that prevents the passage of flame and hot gases.
 - Concrete/Masonry: Annular space shall be filled with concrete, grout or mortar.



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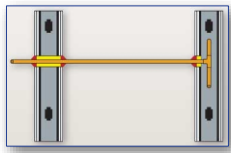


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Penetrations

IRC R302.4.2

- Same requirements as "Through Penetrations"
- Recessed fixtures shall be installed to not reduce the fire-resistance-rating





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Penetrations

Exceptions:

- Steel boxes: $\leq 16 \text{ in}^2$; $\leq 100 \text{ in}^2$ in 100 ft^2
 - Maximum $1/8''$ annular space
 - Separated from boxes on opposite sides of wall
- Listed boxes: Tested for fire-rated assembly
- Sprinklers: Metal escutcheon plate


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Garage Openings

IRC R302.5

- Solid wood doors $\geq 1\text{-}3/8$ inch **or 20-minute door**
- Doors shall be self-latching and equipped with a self-closing or an automatic-closing device.
- Not permitted from the garage into a sleeping room (Plan Review)


23

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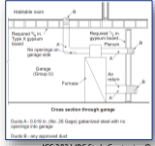


Garage Openings

Duct Penetration:

- No. 26 gage ducts
- No openings into the garage

Other Penetrations:

- Annular space shall be filled with approved material

24

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Separation

TABLE R502 DWELLING-GARAGE SEPARATION		MATERIAL	
From the residence and attic:	Not less than 1/2-inch gypsum board or equivalent applied to the garage side.	1 1/2" Type X gypsum board or equivalent	
From habitable rooms above the garage:	Not less than 1/2-inch Type X gypsum board or equivalent.	1 1/2" Type X gypsum board or equivalent	
Fireplaces supporting floor/ceiling assemblies used for separation required by this section:	Not less than 1/2-inch gypsum board or equivalent.	1 1/2" Type X gypsum board or equivalent	
Garages located less than 3 feet from a dwelling unit on the same lot:	Not less than 1/2-inch gypsum board or equivalent applied to the garage side of exterior walls, but not within this area.	1 1/2" Type X gypsum board or equivalent	

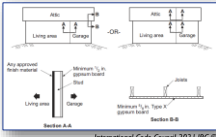



TABLE R503 MINIMUM THICKNESS AND APPLICATION OF GYPSUM BOARD AND GYPSUM PANEL PRODUCTS				
Ceiling	Either direction	18	7	12
	Perpendicular	3/4	7	12
Type X or at garage ceiling (except habitable attic areas)	Perpendicular	24	6	6
	Either direction	24	9	12
Wall	Either direction	24	9	12
	Either direction	18	8	18

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Fireblocking

- "...shall be provided to cut off all concealed draft openings (both vertical and horizontal)."
- Materials:
 - 2" nominal lumber
 - Two layers of 1" lumber
 - Two layers of 23/32" wood structural panels
 - Two layers of 3/4" particle board
 - 1/2" gypsum board
 - 1/4" cement-based millboard
 - Batts or blankets of mineral wool or glass fiber
 - Cellulose insulation (tested to ASTM E 119 for this)

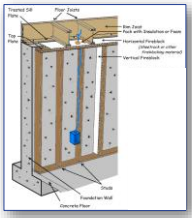


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Fireblocking

Locations:

- Concealed spaces in walls
 - Vertically at the ceiling and floor levels
 - Horizontally ≤ 10-feet


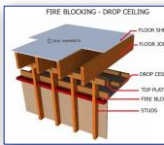



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Fireblocking

Locations:

Interconnections of vertical & horizontal concealed spaces "...such as occur at soffits, drop ceilings and cove ceilings."

28

Fireblocking

Locations:
Top & bottom of stair stringers & enclosed space under stairs.

Stairs in Line with Stairs Run
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Fireblocking

Locations:

- Openings around vents, pipes, ducts, cables and wires at the ceiling and floor level
 - Approved material to resist the free passage of flame and products of combustion

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Fireblocking

Locations:
All spaces between chimneys and floors/ceilings shall be fireblocked with non-combustible material

FIRE BLOCKING - CHIMNEY
FIRE BLOCKING - CHIMNEY
FIRE BLOCKING - CHIMNEY

31

Draftstopping

IRC R302.12

- "...shall be installed so that the area of the concealed space does not exceed 1,000ft²."
- Installed parallel to floor framing members
- Materials:
 - 1/2" gypsum board
 - 3/8" wood structural panel

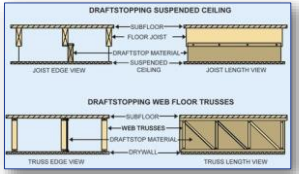
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Draftstopping

Locations:

- Ceiling is suspended under the floor framing
- Floor framing is constructed of open-web or perforated members

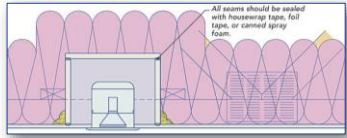


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Luminaires

IRC R302.14

- Combustible insulation separated by $\geq 3''$ from recessed luminaires
- Unless listed for lesser clearances



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END OF MODULE 5



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MODULE 6

2021 IRC – Chapter 3
Building Planning II

1

1

LEARNING OBJECTIVES

1. Learn how to recognize what is considered habitable space
2. Know the code requirements applicable to all habitable spaces
3. Understand when and where safety glazing is required
4. Become familiar with the emergency egress provisions of the code

2

2

Plan Review

Habitable Spaces, Light & Ventilation, Safety Glazing and Egress

3

3

Definition

IRC R202 – Habitable Space

- Space used for **living, sleeping, eating** or **cooking**
- What is not considered “Habitable space”?



4

4

Habitable Rooms

IRC R303.1

- Lighting:
 - Aggregate glazing area $\geq 8\%$ of floor area
- Ventilation:
 - Openings such as windows, doors, louvers...
 - Readily accessed & controlled by occupants
 - Openable area to outdoors $\geq 4\%$ of floor area

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Habitable Rooms



IRC R303.1

- Exceptions:
 - Openings need not be openable when not required for emergency escape and a whole-house mechanical ventilation system is provided

[M]P1 WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM. An exhaust system, supply system, or combination thereof that is designed to mechanically exchange indoor air for outdoor air where operating continuously or through a programmed intermittent schedule to satisfy the whole-house ventilation rate.

For the definition applicable in Chapter 11, see Section N1101.6.

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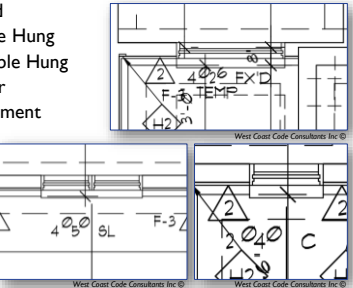




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Windows (Plan View)

- Fixed
- Single Hung
- Double Hung
- Slider
- Casement



7

7

Windows (Elevations)

- Fixed
- Single Hung
- Double Hung
- Slider
- Casement

WINDOW SCHEDULE					
WINDOW NO.	WINDOW TYPE	MANUFACTURER NUMBER	WINDOW SIZE (W x H)	COMMENTS	
W1	SLIDER	BL	3'0\"	BL	
W2	SLIDER	BL	3'0\"	BL	
W3	SLIDER	BL	3'0\"	BL	
W4	SLIDER	BL	3'0\"	BL	

8

8

Whole-House Ventilation

Types of whole-house mechanical ventilation

There are three types of whole-house mechanical ventilation systems: exhaust-only, supply-only, and balanced. Each system can a combination of fans, ducting, dampers, and controls:

Figure 1. Exhaust-only vents to depressure the building.

Exhaust-only: A fan connects an efficient bath fan exhausted indoor air. Outdoor makeup air is drawn into the house through leaks in the building enclosure.

Figure 2. Supply-only vents to pressurize the building.

Supply-only: A fan draws outdoor air into the house indoor air escapes through the building enclosure and exhaust the fresh. Supply only duct for a mechanical system, or more commonly a central fan-energy star (CES) system. Whole CES system outdoor air is drawn to the return registers of an HVAC air handler that draws in and distributes the outdoor air.

Figure 3. Balanced limits pressure imbalance.

Balanced: A combination of exhaust and supply networks provides approximately equal outdoor exhaust and outdoor supply air forcing an exhaust fan combined with a supply fan or passive heat recovery. Balanced systems include a heat recovery ventilator (HRV) or an energy-recovery ventilator (ERV).

9

Habitable Rooms

Exceptions:

8% glazing not required when artificial light is provided producing an average illumination of 6 footcandles throughout the room at a height of 30"

10

Intake/Exhaust

IRC R303.5

Intake Openings:

- ≥ 10 -feet from "...any hazardous or noxious contaminants, such as vents, chimneys, plumbing vents, streets, alleys, parking lots, and loading docks"
- If located within 10-feet, the intake opening shall be a minimum of **3-feet below** the contaminant source
- Exhaust from toilet rooms, bathrooms and kitchens shall not be considered hazardous or noxious

Exhaust Openings:

- Exhaust air **shall not be** directed onto walkways

11

Intake/Exhaust

For 30' x 40' x 10' min.

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Illumination

IRC R303.7 – Interior Stairways

- Switch at each floor level if ≥ 6 risers
- Treads and landings at ≥ 1 foot-candle

IRC R303.8 – Exterior Stairways

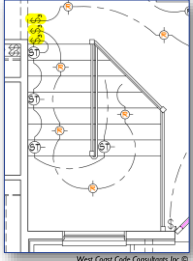

- Light source near top landing
- Basement stairways shall have light source near bottom landing

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Illumination

14

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Room Areas

IRC R304.1 – Minimum Areas

- Habitable rooms $\geq 70\text{ft}^2$

IRC R304.2 – Minimum Dimensions

- Habitable rooms $\geq 7\text{-feet}$ in any horizontal dimension
- Exception: Kitchens




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Ceiling Height

IRC R305

- Habitable space, hallways and portions of basements $\rightarrow \geq 7$ feet
- Bathrooms and laundry rooms $\rightarrow \geq 6\text{'-}8\text{'}$
- Portions of basements w/out habitable space $\rightarrow \geq 6\text{'-}8\text{'}$

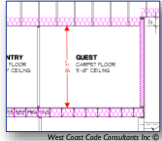


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Ceiling Height

IRC R305

- Where to find?
 - Check building sections or wall sections
 - You may have to measure this yourself
- Areas of Concern:
 - Basements, attics, and remodels




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Sanitation

IRC R306

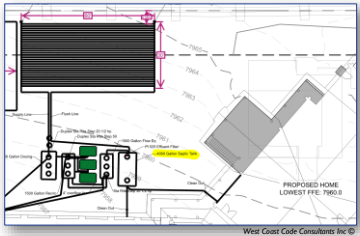


- Toilet Facilities:
 - Each dwelling → toilet, sink, and bathtub or shower
- Kitchen:
 - Each dwelling → kitchen with a sink
- Sewage Disposal & Water Supply:
 - All plumbing fixtures shall be connected to a sanitary sewer and to an approved water supply

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Septic Systems

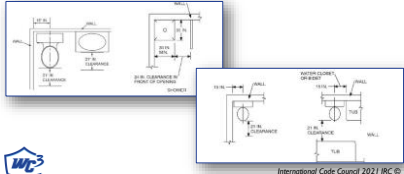


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Bath Spaces

IRC R307

- Bathtub & Shower Spaces:
 - Nonabsorbent surface ≥ 6-feet above floor

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Fixture Clearances

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Glazing

IRC R308.1

“...each pane of glazing installed in hazardous locations... shall be provided with a manufacturer’s designation... which is visible in the final installation.”

ANSI
Z97.1-1984
SGCC-14
16 CFR 1201.10
1/4U
TEMPERED

Tempered Safety Glass
ANSI Z97.1-1984
16 CFR 1201.10
SGCC-669 1/2 U

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Glazing

IRC R308.1.1

At least one pane of multiple assemblies having individual panes $\leq 1ft^2$ shall be labeled.

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Safety Glazing

IRC R308.4.1

- Indoors:
 - All glazing in swinging, sliding and bifold doors
 - **Exceptions:**
 - Openings for which **3-inch sphere** cannot pass
 - Decorative glazing

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Safety Glazing

IRC R308.4.2

Adjacent to Doors:

- Bottom edge is $\leq 60''$ above floor, and...
- Panes in the plane of door and w/in $24''$, or...
- Panes on wall perpendicular to door that are w/in $24''$ and on the hinge side

25

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Safety Glazing

IRC R308.4.2

- Exceptions
 - Decorative glazing
 - Intermediate wall between glazing and door
 - Door is to a closet having a depth ≤ 3 feet
 - Adjacent to fixed panel of patio doors

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Safety Glazing

IRC R308.4.3

- Windows meeting all the following...
 - Exposed area $\geq 9 \text{ ft}^2$
 - Bottom edge is $< 18\text{-inches}$ above floor
 - Top edge is $> 36\text{-inches}$ above floor
 - **Walking surface** within 36-inches

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Safety Glazing

IRC R308.4.4 – Guards and Railings

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Safety Glazing

IRC R308.4.5

- Wet Surfaces:
 - Glazing in walls, enclosures or fences, containing or adjacent to: hot tubs, spas, whirlpools, saunas, steam rooms, bathtubs, showers, swimming pools < **60-inches**
- Exceptions
 - Glazing that is > 60" from the water's edge of...





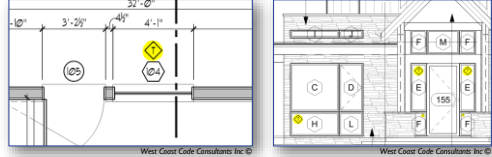
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Safety Glazing


IRC R308.4.5

Where do we find the information?



Plan View Elevations

Also, Window Schedule*



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Safety Glazing

IRC R308.4.6

Adjacent to Stairs & Ramps:

- Bottom edge is < **36-inches** from walking surfaces of stairways, landings and ramps
- Exceptions:
 - Glazing is ≥ 36" horizontally from walking surface
 - Rail provided between 34"-38" above walking surface





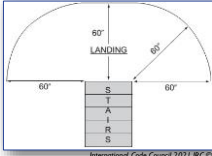


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Safety Glazing

IRC R308.4.7

- Adjacent to Bottom Stair Landing:
 - Bottom edge is < **36"** above landing, and...
 - w/in **60" horizontal arc**

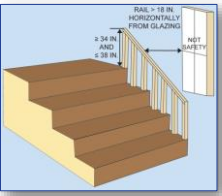

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Safety Glazing

IRC R308.4.7

- Exceptions:
 - Protected by a guard and > 18" from guard

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Skylights

IRC R308.6

- Required when roof < 3:12
- Shall extend ≥ 4" above the plane of the roof









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Carports

IRC R309

- "...shall be open on at least 2 sides."
- Approved noncombustible floor


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Emergency Egress

IRC R310.1

- Basements, habitable attics (*bonus rooms*), sleeping rooms
- Shall opening directly into public way or yard
- **Exception:**
 - Storm shelters ≤ 200 ft²
 - Basements ≤ 200 ft² and housing only mechanical equip.





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Emergency Egress

IRC R310.2

- Openings:
 - Min. clear opening area of **5.7ft² (Exc. 5.0ft²)**
 - Min. clear opening height of **24"**
 - Min. clear opening width of **20"**
 - Opening height **≤ 44"**

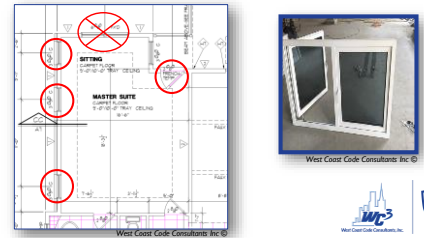

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Emergency Egress

IRC R310.2

Which openings comply?

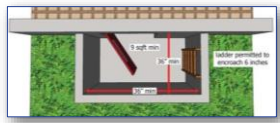

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Emergency Egress

IRC R310.2

- Window Wells:
 - Min. horizontal area of **9ft²**
 - Min. horizontal projection width of **36"**
 - Ladder required if **> 44" deep**
 - Rungs: Min. width = 12"; Min. spacing = 18"
 - Shall project at least 3" from wall



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Emergency Egress

IRC R310.2

- Window Wells (cont.):
 - Shall be designed to drain to foundation drainage system required by R405.1
 - Drainage system not required when well drained soil exists



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Emergency Egress

IRC R310.2

- Window Wells (cont.):
 - Emergency escape windows are allowed under decks and porches provided that:
 - Window meets opening requirements
 - Provides a path $\geq 36"$ in height to yard

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Emergency Egress

IRC R310.2

- Emergency Escape & Rescue Doors:
 - Side-hinged or slider
 - Below-grade doors require a bulkhead enclosure
 - Drainage similar to window well




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Emergency Egress

IRC R310.4 – Area Wells

- Bars, Grilles, Covers & Screens:
 - Shall provide min. net clear opening size
 - Releasable without use of key, tool, special knowledge or force





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END OF MODULE 6



44

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MODULE 7



2021 IRC – Chapter 3
Building Planning III



1

LEARNING OBJECTIVES

1. Become familiar with the requirements for a primary egress door
2. Know and understand the requirements associated with stairs, landings, guardrails and handrails
3. Learn code requirements associated with fire and smoke protection and detection

2



Plan Review

Doors & Landings, Stairs & Guards, Sprinklers & Alarms

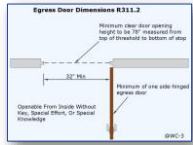




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Egress Door

IRC R311.2

- At least **one** egress door shall be provided.
- Requirements:
 - Shall be **hinged**
 - Min. clear width of 32"
 - Min. clear height of 78"
 - Readily openable from inside w/out key or special knowledge.








4

Exterior Door

IRC R311.3

- All exterior doors shall have a landing or floor on each side
- Landing Requirements:
 - Min. width of **36"** in direction of travel
 - Exterior landings may have a **2% slope**




5

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Exterior Door

IRC R311.3.1

- Required Egress Doors
 - Landing or finished floors shall not be **> 1.5"** lower than top of threshold
- Exceptions:
 - May be **≤ 7.75"** if door swing is not over landing

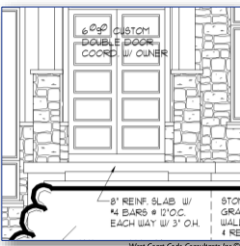
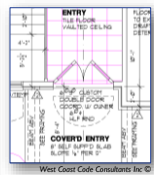






6

6

Exterior Door

How to check?

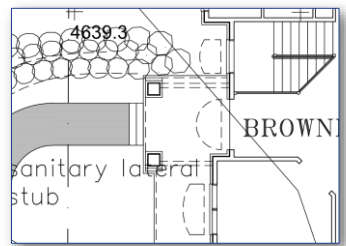







7

7

Exterior Door

Site Plan

8

8

Exterior Door

IRC R311.3.2

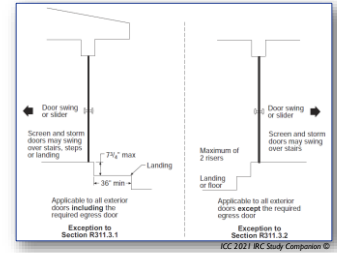
- Other Exterior Doors
 - Landing or finished floors shall not be > 7.75" lower than top of threshold
- Exceptions:
 - A landing is not required on exterior side when...
 - 2 or fewer risers are provided
 - The door does not swing over the stairway



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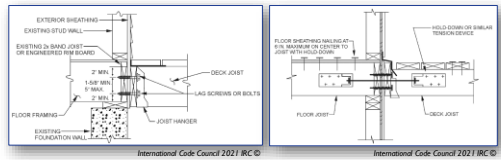
Exterior Door



Construction

IRC R311.5.1

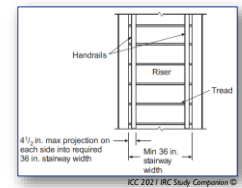
“Exterior landings, decks, balconies, stairs and similar facilities shall be positively anchored to the primary structure to resist both **vertical** and **lateral** forces”



Stairways

IRC R311.7

- **Width:**
 - Min. 36" in clear width
 - Handrails shall not project > 4.5"
- **Vertical Rise:**
 - 12' 7" max. between floors or landings
- **Headroom:**
 - Min. 6'-8"

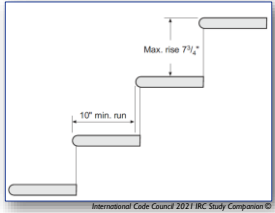


ICC 2021 IRC Study Companion ©

Treads/Risers

IRC R311.7.5

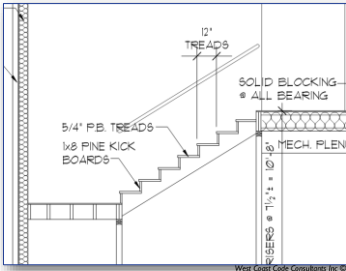
- **Risers:**
 - $\leq 7.75"$
 - Max. 3/8" difference
 - 4" diameter sphere
- **Treads:**
 - $\geq 10"$
 - Max. 3/8" difference



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Treads/Risers



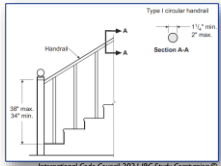
Wear Coast Code Consultants Inc ©

14

Handrails

IRC R311.7.8

- Required on at least one side if ≥ 4 risers
- Height:
 - Min. = **34"**
 - Max. = **38"**
- Continuity:
 - Full length of flight
 - 1.5" between wall




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15

Stair Landing

IRC R311.7.6

- Landings:
 - Required at top & bottom of each stairway
 - Shall be as long as width of flight served (**36" min.**)
- Exception: Not required at an interior flight of stairs if door does not swing over the stairs





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16

Ramps

IRC R311.8

- Slope:
 - Maximum slope of **1:8**, or...
 - Those that serve egress door to have max. **1:12**
 - 1:12 = 1" rise for every 12" in run (length)
- Landings: Required at top, bottom & change of direction
- Handrails: Required on one side

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Guards

IRC R312.1

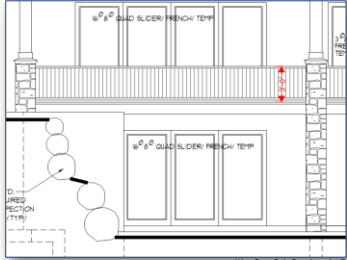

- At open-sided walking surfaces $\geq 30"$ from grade
- "...insect screening shall not be considered a guard"






18

Guards

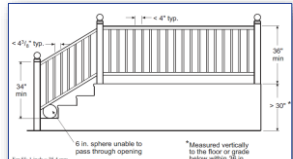



19


Guards

IRC R312.1

- Requirements:
 - Height: $\geq 36"$
 - Opening Limitations: $\leq 4"$ diameter sphere



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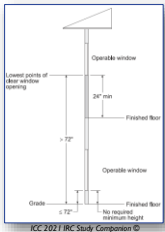


20


Window Sill

IRC R312.2

- If operable windows are located > 72" from grade...
 - Lowest part of clear opening < 24" from finished floor, **or...**
 - Cannot allow passage of 4" diameter sphere



The diagram shows a cross-section of a window. The lowest part of the clear opening is 24 inches above the finished floor. The window is set in a frame with a finished box. The distance from the bottom of the window frame to the finished floor is labeled as > 72 inches. A note indicates 'No required minimum height' for the window frame itself. The diagram is labeled 'ICC 2021 IRC Study Companion ©'.






21

21

Sprinklers

IRC R313.1

- Townhouses per P2904
- One- and Two-Family per **P2904 or NFPA 13D**
- Not required for additions or alterations to existing

22

22

Smoke Alarms

IRC R314

- **Shall be installed in...**
 - Each sleeping room
 - Outside each separate sleeping area
 - Each additional story of the dwelling
 - Not w/in 3 feet of door to a **bathroom** that contains a bathtub or shower
- **Shall not be installed...**
 - Ionization- w/in 20 feet from cooking appliance
 - Ionization- w/ alarm silencing switch < 10 feet from cooking appliance
 - Photoelectric w/in 6 feet from cooking appliance



The floor plan shows a house with a living area, kitchen, and bedrooms. Yellow dots indicate required smoke alarm locations: one in each bedroom, one in the living area, and one outside the sleeping area. A note indicates that alarms should not be installed within 3 feet of a bathroom door.





23

23

Smoke Alarms

IRC R314 (cont.)

- **Ionization smoke alarms** may detect flaming fires sooner as these fires generally release millions of smaller and less visible charged ("ionized") fire particles. These particles interfere with the electrical current that flows through the detection chamber which then triggers the alarm to sound
- **Photoelectric smoke alarms** may detect smoldering fires sooner as these fires generally produce larger, more visible fire particles. These particles interfere with and reflect the alarm's light beam, which then triggers the alarm to sound

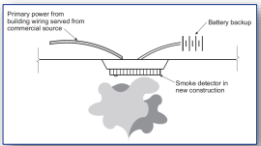
24

24

Smoke Alarms

IRC R314 (cont.)




- If > 1 alarm, all devices shall be **interconnected** so that one alarm activates all alarms
- Primary Power: Building wiring
- Secondary Power: Battery



Primary power from building wiring served from commercial source

Battery backup

Smoke detector in new construction

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Smoke Alarms

IRC R314

- **Combination alarms** can be used in lieu of smoke alarms
- **Fire alarm systems** may be used in lieu of smoke alarms









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CO Alarms

IRC R315

- Required if...
 - Dwelling unit contains a **fuel-fired appliance**, or...
 - The dwelling unit has an **attached garage**, or...
 - Additions, alterations or new bedrooms in **existing dwellings**

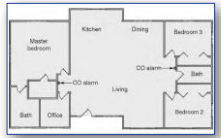



27

27

CO Alarms

IRC R315

- Carbon monoxide alarms shall be installed...
 - Outside each separate sleeping area in the vicinity of the bedrooms
 - Within a bedroom if the room contains a fuel-burning appliance

28

28

Wood Protection

IRC R317

- Naturally durable or preservative treated if...
 - Joists < 18" or girders < 12" of ground
 - Wood on concrete or masonry w/in 8" of ground
 - Siding or sheathing < 6" from ground
 - Sills or sleepers on concrete

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Wood Protection

IRC R317

- Continued...
 - Supporting moisture permeable floors or roofs exposed to weather
 - Furring attached to below-grade concrete or masonry walls unless a vapor retarder is installed

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30

Wood Protection

IRC R317 (cont.)

- Wood Columns: Shall be treated unless...
 - Deck posts, basements or posts exposed to weather and >1" above concrete floor or >6" from earth
 - Crawl space and >8" from exposed earth
- Fasteners (R317.3):
 - Zinc-coated
 - Stainless steel
 - Silicone bronze
 - Copper

31

31

Address

IRC R319

- Must be visible from the street
- Numbers shall be min. 4" high with min. stroke width of 1/2"




32

32

Accessibility

IRC R320

- Shall comply with IBC Chapter 11 if ≥ 4 units
 - **Note: IBC Exempts** multilevel dwelling units without elevators (townhomes that are more than one story are exempt).



33

33

Habitable Attics

IRC R326

- Considered a story above grade plane.
- Exceptions: (must meet all 4)
 - Not greater than 1/3rd area of story below
 - If fire sprinkled- Not greater than one half area of story below
 - Enclosed by roof assembly
 - Floor does not extend beyond exterior walls
 - If above a 3rd story- Entire building fire-sprinkled

34

34



END OF MODULE 7



35

35

MODULE 8

**2021 IRC - Chapter 4
Foundations**

1

1

LEARNING OBJECTIVES

1. Become familiar with the correct placement of footings and backfill.
2. Learn anchoring requirements for wood framed buildings to concrete foundation walls.
3. Understand the code provisions governing water and moisture protection of foundations.
4. Know code compliant methods of ventilating crawl spaces.

2

2

Chapter 4

Foundations

3

3

Drainage

IRC R401.3

- Graded away from foundation
- 6 inches in first 10 feet

4

4

Depth

IRC R403.1.4

- Exterior Footings ≥ 12 inches
- Frost Protection:
 - Extend below frost line
 - Frost-protected (R403.3 of ASCE 32)
 - Erected on solid rock

5

5

Depth

IRC R403.1.4 (cont.)

- **Exceptions:**
 - Accessory structures $\leq 600ft^2$ and ≤ 10 -feet to eave (wood)
 - Accessory structures $\leq 400ft^2$ and ≤ 10 -feet to eave (other)
 - Freestanding Decks

6

6

Slope

IRC R403.1.5

- Top Surface:
 - Shall be level
- Bottom Surface:
 - Slope $\leq 1:10$ (10% slope), otherwise...
 - Footings shall be stepped

7

7

Anchorage

IRC R403.1.6

- Anchor Bolts:
 - 1/2" diameter
 - 7" embedment
- Placement:
 - Max. spacing = 6-feet
 - Two bolts per plate
 - ≤ 12 " from end of plate
 - $\geq 7bd$ from end of plate
 - **Middle third of plate**

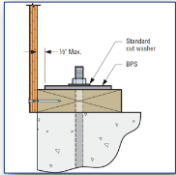

8

8

Anchorage

IRC R403.1.6.1

- SDC D₀, D₁ and D₂:
 - 3"x3"x0.229" plate washers are required
 - Max. spacing = 4-feet if two-stories or more
 - Special cripple wall provisions (R602.11.2)

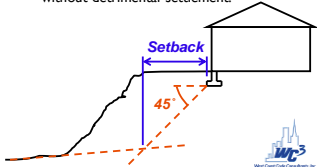




9

Slopes

IRC R403.1.7

- Footings on Slopes (cont.):
 - Descending Slopes (R403.1.7.2)
 - Setback = "...set back from the slope surface sufficient to provide vertical and lateral support for the footing without detrimental settlement."





10


Slopes

IRC R403.1.7

Footings on Slopes (cont.):



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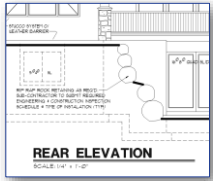


11


Retaining Walls

IRC R404.4

- Design required if...
 - > 48" of unbalanced backfill
 - > 24" and not laterally supported at top
- Design must include...
 - Safety factor of 1.5 against sliding and overturning
 - Excessive foundation pressure
 - Water uplift



REAR ELEVATION
SCALE: 1/4" = 1'-0"
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12

Drainage

IRC R405.1

- Foundation drains are **required** around all concrete or masonry foundations that retain earth and enclose habitable or usable spaces
- Exception:
 - Not required when foundation is installed on well-drained ground or sand-gravel mixture

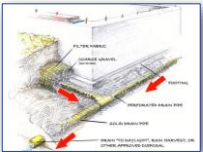
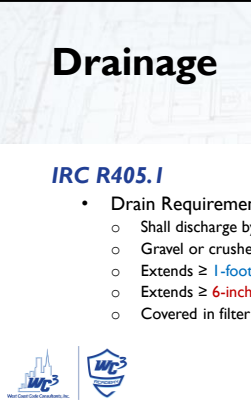

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13

Drainage

IRC R405.1

- Drain Requirements:
 - Shall discharge by gravity or mechanical means
 - Gravel or crushed stone drain
 - Extends \geq 1-foot beyond outside edge of footing
 - Extends \geq 6-inches above top of footing
 - Covered in filter material







14

Dampproofing

IRC R406.1

- Foundations shall be dampproofed unless they are required to be waterproofed
- This shall consist of...
 - Bituminous coating
 - 3 pounds/ft of acrylic modified cement
 - 1/8" surface-bonding cement
 - Any waterproofing material
 - Other approved methods

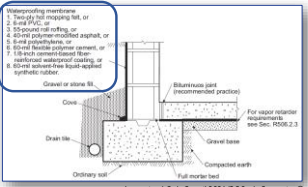





15

Waterproofing

IRC R406

- Foundations shall be water-proofed, if...
 - High water table
 - Severe soil-water conditions






16


Columns

IRC R407

- Wood Protection
 - Protected against decay (R317)
- Steel Column Protection
 - All surfaces shall have rust-inhibitive paint
- Structural Requirements:
 - Wood $\geq 4" \times 4"$ nominal
 - Steel $\geq 3"$ diameter Schedule 40



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17

Under-Floor

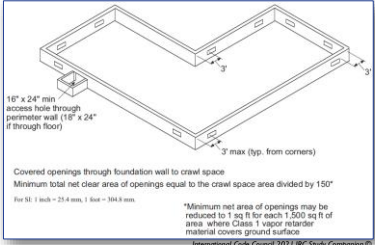
IRC R408

- Ventilation
 - Min. net area $\geq 1ft^2$ for each $150ft^2$
 - Covered by Class I vapor retarder $\rightarrow 1,500ft^2$
 - One opening w/in 3-feet of each building corner
 - Openings covered w/ least dimension $\geq 1/4"$
- Access
 - $18" \times 24"$ through the floor
 - $16" \times 24"$ through the perimeter wall

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Under-Floor



16" x 24" min access hole through perimeter wall (18" x 24" if through floor)


3" max (typ. from corners)

Covered openings through foundation wall to crawl space
Minimum total net clear area of openings equal to the crawl space area divided by 150"

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm

*Minimum net area of openings may be reduced to 1 sq ft for each 1,500 sq ft of area where Class I vapor retarder material covers ground surface

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Unvented Crawl Spaces

IRC R408.3

- Exposed earth covered with Class I vapor retarder **and one** of the following:
 - Mechanical ventilation and crawl space walls insulated
 - Conditioned air supply and crawl space walls insulated
 - Dehumidification per manufacturer's specs

20



21

MODULE 9

2021 IRC – Chapter 5
Floors and Decks

1

LEARNING OBJECTIVES

1. Become familiar with joist spans and general principles of floor framing.
2. Learn where to find information related to deck framing and anchorage.

2

Chapter 5

Floors

3

Load Path

IRC R502.2.1

“A load path for lateral forces shall be provided between floor framing and braced wall panels located above or below a floor...”

4

Joist Spans

IRC R502.3

TABLE R502.3.1(1) - continued
FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES (Maximum live load, see Item 4 of 40 pgs. L14 & 206)
DEAD LOAD = 10 psf

JOIST SPECIES (GRADE)	2 x 4				2 x 6				2 x 8			
	SP1	SP2	SP3	SP4	SP1	SP2	SP3	SP4	SP1	SP2	SP3	SP4
Douglas fir-larch 5S	18.3	14.1	18.0	21.10	18.3	14.1	18.0	21.4	18.3	14.1	18.0	21.4
Douglas fir-larch 5L	18.4	13.7	18.0	19.6	9.8	12.4	13.0	17.0	18.4	13.7	18.0	19.6
Douglas fir-larch 6C	19.1	13.0	15.11	18.4	9.3	11.4	14.3	16.8	19.1	13.0	15.11	18.4
Douglas fir-larch 8D	7.10	8.60	12.2	14.1	7.0	8.11	10.11	12.7	7.10	8.60	12.2	14.1
Hem-fir 5S	18.1	13.4	17.0	20.8	10.1	13.4	17.0	20.7	18.1	13.4	17.0	20.7
Hem-fir 5L	18.10	13.6	16.7	19.3	9.7	12.2	14.10	17.2	18.10	13.6	16.7	19.3
Hem-fir 6C	8.5	12.5	15.6	17.1	8.11	11.4	13.10	16.1	8.5	12.5	15.6	17.1
Hem-fir 8D	7.0	8.0	11.00	12.9	6.00	8.0	10.7	12.6	7.0	8.0	11.00	12.9
Southern pine 5S	18.6	13.10	17.8	21.4	10.6	13.10	17.8	21.8	18.6	13.10	17.8	21.8
Southern pine 5L	18.1	13.4	16.5	19.6	9.11	12.7	14.8	17.0	18.1	13.4	16.5	19.6
Southern pine 6C	9.4	12.1	14.4	16.10	8.6	10.10	12.10	15.1	9.4	12.1	14.4	16.10
Southern pine 8D	7.3	9.1	11.0	13.1	6.3	8.2	9.10	11.8	7.3	9.1	11.0	13.1
Spruce-pine-fir 5S	8.00	11.0	16.7	20.2	8.00	11.0	16.7	19.6	8.00	11.0	16.7	19.6
Spruce-pine-fir 5L	8.4	12.0	15.8	18.3	9.1	11.6	14.1	16.3	8.4	12.0	15.8	18.3
Spruce-pine-fir 6C	8.7	9.8	12.9	15.8	10.3	11.6	14.1	16.3	8.7	9.8	12.9	15.8
Spruce-pine-fir 8D	7.4	8.9	11.00	13.9	6.0	8.0	10.7	12.6	7.4	8.9	11.00	13.9

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Joist Spans

IRC R502.3

TABLE R502.3.1(2) - continued
FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES (Maximum live load, see Item 4 of 40 pgs. L14 & 206)
DEAD LOAD = 10 psf

JOIST SPECIES (GRADE)	2 x 4				2 x 6				2 x 8			
	SP1	SP2	SP3	SP4	SP1	SP2	SP3	SP4	SP1	SP2	SP3	SP4
Douglas fir-larch 5S	9.3	12.10	16.4	19.10	9.8	12.10	16.4	19.6	9.3	12.10	16.4	19.6
Douglas fir-larch 5L	9.4	12.4	15.0	17.3	9.10	11.3	13.4	15.11	9.4	12.4	15.0	17.3
Douglas fir-larch 6C	9.2	11.4	14.3	16.6	8.5	10.8	13.0	15.1	9.2	11.4	14.3	16.6
Douglas fir-larch 8D	7.0	8.11	10.11	12.7	6.5	8.2	9.11	11.8	7.0	8.11	10.11	12.7
Hem-fir 5S	8.2	12.1	15.5	18.0	9.2	12.1	15.5	18.0	8.2	12.1	15.5	18.0
Hem-fir 5L	9.0	11.10	14.10	17.2	8.9	11.1	13.6	15.8	9.0	11.10	14.10	17.2
Hem-fir 6C	8.7	11.3	13.10	16.1	8.2	10.4	12.8	14.8	8.7	11.3	13.10	16.1
Hem-fir 8D	6.00	8.0	10.7	12.6	6.0	7.11	9.8	11.3	6.00	8.0	10.7	12.6
Southern pine 5S	9.6	12.7	16.0	19.6	9.4	12.7	16.0	19.6	9.6	12.7	16.0	19.6
Southern pine 5L	8.2	12.1	14.8	17.5	9.0	11.5	13.5	15.11	8.2	12.1	14.8	17.5
Southern pine 6C	8.6	10.10	12.10	15.1	7.9	9.10	11.8	13.9	8.6	10.10	12.10	15.1
Southern pine 8D	6.5	8.2	9.10	11.8	5.11	7.5	9.0	10.8	6.5	8.2	9.10	11.8
Spruce-pine-fir 5S	8.0	11.00	15.1	18.4	9.0	11.00	15.1	17.0	8.0	11.00	15.1	17.0
Spruce-pine-fir 5L	8.9	11.6	14.1	16.3	8.3	10.6	12.10	14.10	8.9	11.6	14.1	16.3
Spruce-pine-fir 6C	8.0	11.6	14.1	16.3	8.3	10.6	12.10	14.10	8.0	11.6	14.1	16.3
Spruce-pine-fir 8D	6.00	8.0	10.7	12.6	6.0	7.11	9.8	11.3	6.00	8.0	10.7	12.6

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Joist Spans

IRC R502.3

TABLE R502.3.1(3)
CANTILEVER SPANS FOR FLOOR JOISTS SUPPORTING L50# FRAMES EXTERIOR BEARING WALL AND ROOF ONLY (L14 & 206)
Floor live load = 40 psf, roof live load = 20 psf
MAXIMUM CANTILEVER SPAN length at backspan support in ft"

MEMBER & SPACING	Ground Borne Load											
	0 psf				30 psf				70 psf			
	24 R	30 R	40 R	24 R	30 R	40 R	24 R	30 R	40 R	24 R	30 R	40 R
2 x 8 @ 12"	20"	15"	18"	—	—	—	—	—	—	—	—	—
2 x 10 @ 16"	29"	21"	16"	26"	18"	—	20"	—	—	—	—	—
2 x 10 @ 12"	36"	26"	20"	34"	22"	16"	30"	—	19"	—	—	—
2 x 12 @ 16"	—	32"	18"	38"	29"	21"	36"	—	21"	—	—	—
2 x 12 @ 12"	—	42"	31"	—	37"	27"	36"	—	17"	31"	19"	—
2 x 12 @ 8"	—	48"	45"	—	48"	38"	—	40"	26"	36"	20"	18"

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Joist Spans

IRC R502.3

TABLE R502.3.1(4)
CANTILEVER SPANS FOR FLOOR JOISTS SUPPORTING EXTERIOR BALCONY (L14 & 206)
MAXIMUM CANTILEVER SPAN length at backspan support in ft"

MEMBER SIZE	SPACING	Ground Borne Load		
		0 psf	70 psf	70 psf
		42" (139)	39" (156)	34" (105)
2 x 8	12"	36" (151)	34" (171)	29" (180)
2 x 10	12"	61" (164)	57" (139)	49" (201)
2 x 10	16"	53" (180)	49" (208)	42" (220)
2 x 10	24"	43" (212)	40" (241)	34" (255)
2 x 12	16"	72" (228)	67" (260)	57" (268)
2 x 12	24"	58" (279)	54" (319)	47" (330)

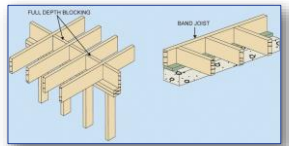

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8

Restraint

IRC R502.7

- Full-depth blocking shall be provided...
 - At the ends of joists
 - At intermediate supports (SDC D0, D1 and D2 only)
 - At 8-feet on center (> 2"x12" dimension lumber)

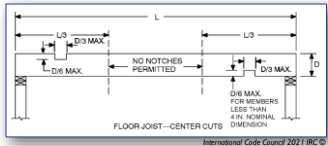




9

Notching

IRC R502.8

- Notches in joists and beams shall...
 - Not exceed 1/6 of member depth
 - Not be longer than 1/3 member depth
 - Not be located in middle 1/3 of span

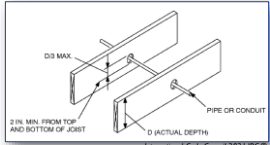




10

Notching

IRC R502.8

- Diameter of holes bored or cut into joists and beams shall...
 - Not exceed 1/3 of member depth
 - Not be closer than 2" from bottom of member or any other hole or notch

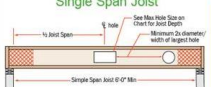

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Boise Cascade Joist Hole Chart

Large Rectangular Holes in BCI® Joists

Hole size table based on maximum uniform load of 40 psf live load and 10 psf dead load, at maximum spacing of 24" on-center.

Joist Depth	Maximum Hole Size	
	Single Span	Multiple Span
9 1/2"	6" x 14"	6" x 12"
11 1/4"	7" x 15" 8" x 15"	6" x 12"
14"	8" x 16" 10" x 15"	6" x 15"
16"	8" x 18" 10" x 18"	10" x 14"





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Openings

IRC R502.10

- **≤ 4-foot Opening:**
 - Single header joist
 - Single trimmer joist if header is w/in 3-feet of bearing
- **> 4-foot Opening:**
 - Double header joist
 - Double trimmer joists
 - Approved hangers



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Trusses

IRC R502.11

- Truss Design Drawings per R502.11.4
- Shall be braced to prevent rotation (BCSI)
- Shall not be altered
- Draftstopping required per R302.12
- Fireblocking required per R302.11



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Truss Bracing

Shown on individual truss drawings

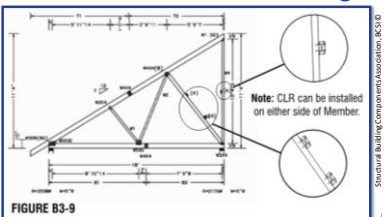



FIGURE B3-9

Note: CLR can be installed on either side of Member.

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Truss Bracing

2021 IBC clarifies what is required:

- Member restraint (PITMR) in "green"
- Diagonal bracing (PITMDB) at each PITMR in "red"

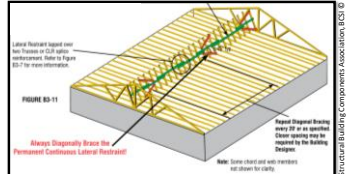



FIGURE B3-11

Always Diagonally Brace the Permanent Continuous Lateral Restraint

Note: Some chord and web members may require bracing.

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Sheathing

IRC R503.2.2

SPAN WIDTH (feet)	MINIMUM PANEL THICKNESS (inches)	ALLOWABLE LIVE LOAD (psf)		MAXIMUM SPAN (feet)		LOADS (pounds per square foot at maximum span)		MAXIMUM SPAN (feet)
		SPAN @ 16" o.c.	SPAN @ 24" o.c.	With edge support	Without edge support	Total load	Live load	
Sheathing								
12-00	5/8	—	—	18	18	40	30	8
12-00	3/4	—	—	20	20	40	30	8
24-0	3/4	100	30	24	24	40	30	8
24-0	1/2	100	40	24	24	50	40	10
12-00	3/4	100	70	32	24	40	30	10*
12-00	1/2	200	80	—	32	40	30	20*
48-24	3/4	—	170	48	36	45	35	24
48-24	1/2	—	300	60	48	45	35	32
Underlayment, G.C. sheathing, single floor								
12-00	3/8	100	40	24	24	40	30	10*
24-0	3/8	150	40	32	32	40	30	20*
24-0	1/2	240	100	48	36	50	25	24
12-00	3/8	—	180	48	48	70	40	32
12-00	1/2	—	200	60	48	70	40	40

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Slab-on-Grade

IRC R506

- Vapor Retarder (R506.2.3)
 - 10-mil polyethylene (ASTM E1745 Class A)
 - Joints lapped 6-inches
 - Exception: Garages, accessory structures, flatwork and where approved by B.O.

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Decks

IRC R507

- Lateral Connection:
 - A minimum of two 1500# hold-down tension devices shall be provided at the deck
 - w/in 24" of each end of deck

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Decks

IRC R507

- Lateral Connection:
 - A minimum of four 750# hold-down tension devices shall be provided at the deck

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Decks


IRC R507

- Decking:
 - Shall be attached to each supporting member with not less than (2) 8d threaded nails or wood screws
 - Maximum joists spacing per table....

DECKING MATERIAL TYPE AND NOMINAL SIZE	DECKING PERPENDICULAR TO JOIST*		DECKING DIAGONAL TO JOIST†	
	Single span	Multiple span	Single span	Multiple span
1" each-thick wood	12	16	8	12
2" each-thick wood	24	24	18	24

FIG. R507.1 Deck = 24 mm, 2 (max) = 104.8 mm, 2 (max) = 101.747 mm.
 * Maximum angle of 45 degrees from perpendicular for wood deck boards.
 † Other connections are provided by an accredited fastening or fastener agency also allowed.
 ‡ Half-thick wood deck boards supported by two joists shall be considered single span and have no span joist shall be considered multiple spans.

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Decks

Joists

BEAM SPECIES	BEAM SIZE	EFFECTIVE DECK JOIST SPAN LENGTH (ft) (max)				
		4	6	8	10	12
Southern pine	1-2-4	4.7	6.0	7.3	8.6	10.0
	1-2-6	5.1	6.4	7.7	9.0	10.3
	1-2-8	5.5	6.8	8.1	9.4	10.7
	1-2-10	6.0	7.3	8.6	9.9	11.2
	1-2-12	6.5	7.8	9.1	10.4	11.7
	2-2-4	6.1	7.4	8.7	10.0	11.3
	2-2-6	6.6	7.9	9.2	10.5	11.8
	2-2-8	7.1	8.4	9.7	11.0	12.3
	2-2-10	7.6	8.9	10.2	11.5	12.8
	2-2-12	8.1	9.4	10.7	12.0	13.3
Douglas fir-larch Hem-fir	1-2-4	4.7	6.0	7.3	8.6	10.0
	1-2-6	5.1	6.4	7.7	9.0	10.3
	1-2-8	5.5	6.8	8.1	9.4	10.7
	1-2-10	6.0	7.3	8.6	9.9	11.2
	1-2-12	6.5	7.8	9.1	10.4	11.7
	2-2-4	6.1	7.4	8.7	10.0	11.3
	2-2-6	6.6	7.9	9.2	10.5	11.8
	2-2-8	7.1	8.4	9.7	11.0	12.3
	2-2-10	7.6	8.9	10.2	11.5	12.8
	2-2-12	8.1	9.4	10.7	12.0	13.3

(1) Deck = 24 mm, 2 (max) = 104.8 mm, 2 (max) = 101.747 mm.
 (2) Maximum angle of 45 degrees from perpendicular for wood deck boards.
 (3) Other connections are provided by an accredited fastening or fastener agency also allowed.
 (4) Half-thick wood deck boards supported by two joists shall be considered single span and have no span joist shall be considered multiple spans.

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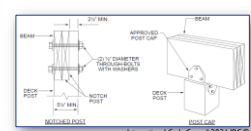
Decks (R507)

Beams


BEAM SPECIES	BEAM SIZE	EFFECTIVE DECK JOIST SPAN LENGTH (ft) (max)				
		4	6	8	10	12
Southern pine	1-2-4	4.7	6.0	7.3	8.6	10.0
	1-2-6	5.1	6.4	7.7	9.0	10.3
	1-2-8	5.5	6.8	8.1	9.4	10.7
	1-2-10	6.0	7.3	8.6	9.9	11.2
	1-2-12	6.5	7.8	9.1	10.4	11.7
	2-2-4	6.1	7.4	8.7	10.0	11.3
	2-2-6	6.6	7.9	9.2	10.5	11.8
	2-2-8	7.1	8.4	9.7	11.0	12.3
	2-2-10	7.6	8.9	10.2	11.5	12.8
	2-2-12	8.1	9.4	10.7	12.0	13.3

Posts

LOADS (psf)	POST SIZE	MINIMUM AREA (ft²)				
		16	20	24	30	36
Southern pine	4" x 4"	14.0	17.5	21.0	24.5	28.0
	6" x 6"	14.0	17.5	21.0	24.5	28.0
	8" x 8"	14.0	17.5	21.0	24.5	28.0
	10" x 10"	14.0	17.5	21.0	24.5	28.0
	12" x 12"	14.0	17.5	21.0	24.5	28.0
Douglas fir-larch Hem-fir	4" x 4"	14.0	17.5	21.0	24.5	28.0
	6" x 6"	14.0	17.5	21.0	24.5	28.0
	8" x 8"	14.0	17.5	21.0	24.5	28.0
	10" x 10"	14.0	17.5	21.0	24.5	28.0
	12" x 12"	14.0	17.5	21.0	24.5	28.0



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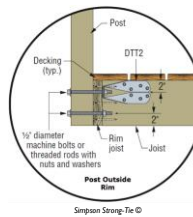


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Decks

IRC R507.10 – Guards – New to 2021 IRC


- Supported by side of **deck framing** → connected to adjacent joists to prevent rotation



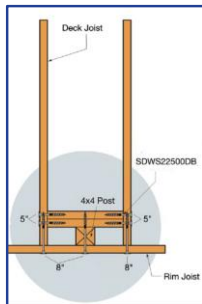
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Decks



Supported on top of deck → shall be connected to the **deck framing or blocking** to transfer loads to adjacent joists



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END OF MODULE 9



26

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MODULE 10

2021 IRC – Chapter 6
Wall Construction- Part I

1

1

LEARNING OBJECTIVES

1. Know how to navigate header tables and requirements.
2. Understand difference between intermittent and continuous wall bracing.
3. Know how to confirm that required wall bracing has been provided.

2

2

Chapter 6

Wall Construction

3

3

Top Plate

IRC R602.3.2

- Studs shall be capped with a double top plate
- 2” nominal plates
- Must overlap at corners and intersections
- Offset end joints 24”

4

4

Headers

IRC R602.7
Supports

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9

Wall Bracing

IRC R602.10

- **Terminology:**
 - Wall Bracing
 - Braced Wall Line
 - Braced Wall Panel
 - Length
 - Spacing

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Wall Bracing

Braced Wall Line (IRC R202):

- “A straight line through the building plan that represents the location of the lateral resistance provided by the wall bracing.”

BWL shown on plans! (IRC R602.10.1):

- “The braced wall lines shall be designated as straight lines in the building plan placed in accordance with this section.”

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Wall Bracing

BWL Length (IRC R602.10.1.1):

- Equals the distance between its ends
- “The end of a BWL shall be the intersection with a perpendicular BWL, an angled BWL... or an exterior wall.”

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Wall Bracing

BWL Locations & Permitted Offsets:

- BWL can be offset up to **4-feet** on either side
- $\leq 2/3$ of BWL length can be placed to either side **(New to 2021 IRC)**

TYPICAL BRACED WALL PLAN

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Wall Bracing

BWL Spacing (IRC R602.10.1.3):

- BWL Spacing:

>25 feet and \leq 30 feet:	1.2
>30 feet and \leq 35 feet:	1.4

TABLE R602.10.1.3 BRACED WALL LINE SPACING					
APPLICATION	CONDITION	BUILDING TYPE	BRACED WALL LINE SPACING CRITERIA		
			Maximum Spacing	Exception to Maximum Spacing	
Wind bracing	Ultimate design wind speed $<$ 140 mph	Detached, townhouse	60 feet	None	
		SDC A - C	Detached	Use wind bracing	
		SDC A - B	Townhouse	Use wind bracing	
Seismic bracing	SDC C	Townhouse	35 feet	Up to 50 feet when length of required bracing per Table R602.10.3(3) is adjusted in accordance with Table R602.10.3(4).	
		SDC D _s , D _i , D _o	Detached, townhouses, one- and two-story only	25 feet	Up to 35 feet to allow for a single room not to exceed 900 square feet. Spacing of all other braced wall lines shall not exceed 25 feet.
		SDC D _s , D _i , D _o	Detached, townhouse	25 feet	Up to 35 feet when length of required bracing per Table R602.10.3(3) is adjusted in accordance with Table R602.10.3(4).

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Wall Bracing

Angled Walls (IRC R602.10.1.4):

- Maximum diagonal length of 8-feet
- If $>$ 8-feet, shall be considered separate BWL

NOTE: IF THE DIAGONAL WALL IS GREATER THAN EIGHT FEET LONG, IT MUST BE TREATED AS A SEPARATE BRACED WALL LINE.

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Wall Bracing

Braced Wall Panel (IRC R202):

- "A full-height section of wall constructed to resist in-plane shear loads through interaction of framing members, sheathing material and anchors. The panel's length meets the requirements of its particular bracing method and contributes toward the total amount of bracing required along its braced wall line in accordance with Section R602.10.1."

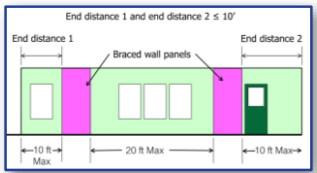
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Wall Bracing

Braced Wall Panels (R602.10.2):

- Shall be...
 - Full-height sections
 - No vertical/horizontal offsets
 - Placed along BWL
- Location:
 - Spacing \leq 20-feet
 - w/in 10-feet from each end

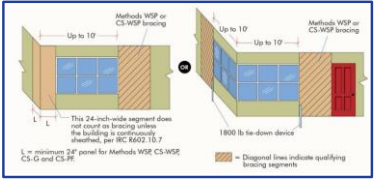


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Wall Bracing

Braced Wall Panels (R602.10.2):

- SDC D₀, D₁, & D₂ → 10-feet from end
 - 2-foot panel on each side
 - 1,800# holdown



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Wall Bracing

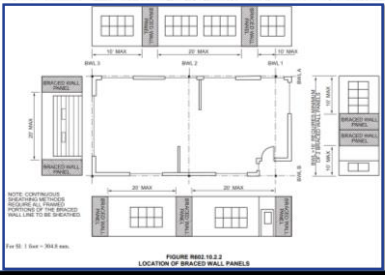
BWP – Min. Number (R602.10.2.3):

- BWL \leq 16-feet → 2 BWP of any length or one 4-foot BWP
- BWL > 16-feet → 2 BWP
- Floors or roofs not laterally supported by braced walls: **6 feet max.**



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Wall Bracing



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Wall Bracing

IRC R602.10

- Bracing Methods:
 - Intermittent Bracing (12 methods)
 - Continuous Sheathing (4 methods)




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Wall Bracing

Intermittent Bracing (Table R602.10.4):

TABLE R602.10.4 BRACING METHODS					
METHODS, MATERIAL	MINIMUM THICKNESS	FIGURE	CONNECTION CRITERIA*		
			Fasteners	Spacing	
LJB Let-in-bracing	1 x 4 wood or approved metal straps at 45° to 60° angles for maximum 16" stud spacing		Wood: 2-8d common nails or 3-8d (2 1/2" long x 0.113" dia.) nails	Wood: per stud and top and bottom plates	
			Metal strap: per manufacturer	Metal: per manufacturer	
DWB Diagonal wood boards	1/2" (1" nominal) for maximum 24" stud spacing		2-8d (2 1/2" long x 0.113" dia.) nails or 2 - 1 1/2" long staples	Per stud	
WSP Wood structural panel (See Section R604)	1/2"		Exterior sheathing per Table R602.3(3)		6" edges 12" field
WSP Wood structural panel (See Section R602.10.6.5)	1/2"		Interior sheathing per Table R602.3(1) or R602.3(2)		Varies by fastener
BV-WSP Wood structural panels with stone or masonry veneer (See Section R602.10.6.5)	3/8"	See Figure R602.10.6.5	8d common (2 1/2" x 0.131) nails		4" at panel edges 12" at intermediate supports 4" at braced wall panel end posts

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Wall Bracing

Continuous Bracing (Table R602.10.4):

Continuous Sheathing Methods	METHODS, MATERIAL	MINIMUM THICKNESS	FIGURE	CONNECTION CRITERIA*	
				Fasteners	Spacing
Continuous Sheathing Methods	CS-WSP Continuously sheathed wood structural panel	1/2"		Exterior sheathing per Table R602.3(3)	6" edges 12" field
	CS-G*	3/8"		Interior sheathing per Table R602.3(1) or R602.3(2)	Varies by fastener
	CS-G**	3/8"		See Method CS-WSP	See Method CS-WSP
	CS-PF Continuously sheathed partial frame	1/16"		See Section R602.10.6.4	See Section R602.10.6.4
CS-SFB* Continuously sheathed structural fiberboard	1/2" or 3/16" for maximum 16" stud spacing	1 1/2" long x 0.12" dia. (for 1/2" thick sheathing) 1 1/8" long x 0.12" dia. (for 3/16" thick sheathing) galvanized roofing nails		3" edges 6" field	

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Wall Bracing

Mixing (R602.10.4.1):

- From story to story → **Any method**
- From BWL to BWL → **Intermittent only**
- Not allowed **within a BWL** (SDC 'D₀' or above)



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Wall Bracing

Braced Wall Panels (R602.10.5):

- Minimum Length:

METHOD (See Table R602.10.4)	MINIMUM LENGTH* (Inches)					CONTRIBUTING LENGTH (Inches)
	Wall Height					
	8 feet	9 feet	10 feet	11 feet	12 feet	
DWB, WSP, SFB, FIBS, PCP, HPS, BV-WSP	48	48	48	53	58	Actual ^a
GB	48	48	48	53	58	Double solid = Actual Single solid = 0.5 × Actual
LIB	55	62	69	NP	NP	Actual ^a
ABW	SDC A, B and C, ultimate design wind speed < 140 mph	28	32	34	38	42
	SDC D _s , D _e and D _o , ultimate design wind speed < 140 mph	32	32	34	NP	NP

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Wall Bracing

	Adjacent clear opening height (inches)						
	≤ 64	24	27	30	33	36	
CS-WSP, CS-SFB	68	26	27	30	33	36	Actual ^a
	72	27	27	30	33	36	
	76	30	29	30	33	36	
	80	32	30	30	33	36	
	84	35	32	32	33	36	
	88	38	35	33	33	36	
	92	43	37	35	35	36	
	96	48	41	38	36	36	
	100	—	44	40	38	38	
	104	—	49	43	40	39	
	108	—	54	46	43	41	
	112	—	—	50	45	43	
	116	—	—	55	48	45	
	120	—	—	60	52	48	
	124	—	—	—	56	51	
	128	—	—	—	61	54	
	132	—	—	—	66	58	
	136	—	—	—	—	62	
140	—	—	—	—	66		
144	—	—	—	—	72		

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Wall Bracing

Braced Wall Panels (R602.10.5):

METHOD	Supporting roof only	MINIMUM LENGTH* (Inches)					CONTRIBUTING LENGTH (Inches)
		8 feet	9 feet	10 feet	11 feet	12 feet	
PFH	Supporting one story and roof	24	24	24	Note c	Note c	48
	PFG	24	27	30	Note d	Note d	1.5 × Actual ^a
CS-PF	SDC A, B and C	16	18	20	Note e	Note e	1.5 × Actual ^a
	SDC D _s , D _e and D _o	16	18	20	Note e	Note e	Actual ^a

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Wall Bracing

Required Length of Bracing (R602.10.3):


- Min. Length of BWP on **each** BWL

Only Table R602.10.3(1) Wind

- SDC A and B – All structures
- SDC C – Detached structures (acc. or 1 family)
- Modified by Table R602.10.3(2)

Both Table R602.10.3(1) and R602.10.3(3) Wind & Seismic

- SDC C – Townhouses
- SDC D – All structures
- Modified by Table R602.10.3(2) and R602.10.3(4)



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Wind (SDC A, B, or C)

TABLE RB03.10.1(1) BRACING REQUIREMENTS BASED ON WIND SPEED

EXPOSURE CATEGORY B
 30-FOOT MEAN ROOF HEIGHT
 40-FOOT WALL HEIGHT
 3-BRACED WALL LINES

MINIMUM TOTAL LENGTH (FEET) OF BRACED WALL PANELS REQUIRED ALONG EACH BRACED WALL LINE

Ultimate Design Wind Speed (mph)	Story Location	Braced Wall Length (feet)	Methods (WSP, WSP, SFB, PCT, PCT, APPL. BY WSP, SFB, PCT, PCT, CS, SFB)				Methods (CS, WSP, CS, CS, CS, SFB)
			Method 1B ¹	Method 1B	Method 2B ²	Method 2B	
30	2.5	2.5	2.5	2.5	2.5	1.0	
30	4.5	4.5	2.5	2.5	2.5	1.0	
30	6.5	6.5	4.0	3.5	3.5	1.0	
40	6.5	6.5	5.0	4.0	4.0	1.0	
50	10.5	10.5	6.0	5.0	5.0	1.0	
60	12.5	12.5	7.0	6.0	6.0	1.0	
70	7.0	7.0	5.0	4.5	4.5	1.0	
80	6.5	6.5	5.0	4.5	4.5	1.0	
90	12.5	12.5	7.0	6.0	6.0	1.0	
100	16.0	16.0	9.5	8.0	8.0	1.0	
110	20.0	20.0	11.5	10.0	10.0	1.0	
120	21.5	21.5	11.5	11.5	11.5	1.0	
10	NP	7.0	4.0	3.5	3.5	1.0	
20	NP	11.0	7.5	6.5	6.5	1.0	
30	NP	16.5	10.5	9.0	9.0	1.0	
40	NP	24.0	13.5	11.5	11.5	1.0	
50	NP	28.5	17.0	14.5	14.5	1.0	
60	NP	34.0	20.0	17.0	17.0	1.0	

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Wind Adjustment

TABLE RB03.10.2(1) WIND ADJUSTMENT FACTORS TO THE REQUIRED LENGTH OF WALL BRACING

ITEM NUMBER	ADJUSTMENT BASED ON	STORY/SUPPORTING	CONDITION	ADJUSTMENT FACTOR (From Table RB03.10.1(1) Min. Length)	APPLICABLE METHODS	
1	Exposure category ¹	Roof only	One-story structure	B	1.30	All methods
			C	1.20		
			D	1.20		
			Two-story structure	B	1.30	
			C	1.20		
			D	1.20		
2	Roof cantilever height	Roof + 1 floor	0-5 feet	0.70	All methods	
			5-10 feet	0.80		
			10-15 feet	0.90		
			15-20 feet	1.00		
			20-25 feet	1.10		
			25-30 feet	1.20		
3	Roof + 2 floors	Roof only	0-5 feet	0.70	All methods	
			5-10 feet	0.80		
			10-15 feet	0.90		
			15-20 feet	1.00		
			20-25 feet	1.10		
			25-30 feet	1.20		

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Wind Adjustment

TABLE RB03.10.2(2) WIND ADJUSTMENT FACTORS TO THE REQUIRED LENGTH OF WALL BRACING

ITEM NUMBER	ADJUSTMENT BASED ON	STORY/SUPPORTING	CONDITION	ADJUSTMENT FACTOR ¹ (From Min. Length from Table RB03.10.1(1) Required)	APPLICABLE METHODS
3	Story height (Section R301.3)	Any story	0 feet	0.95	DRB, WSP, SFB, PCT, PCT, WSP
			0-6 feet	1.00	
			6-11 feet	1.05	
			11-15 feet	1.10	
4	Number of braced wall lines per plane (diagonal) ²	Any story	3	1.30	DRB, WSP, SFB, PCT, PCT, WSP, CS, G, CS, SFB
			4	1.40	
			≥ 5	1.40	
5	Additional WSP-proved hold-down device	Top story only	Fastened to the end studs of each braced wall panel and to the foundation or framing below	0.80	DRB, WSP, SFB, PCT, PCT, WSP
			Fastened from inside face of braced wall panels	1.40	
6	Section gypsum board finish (or equivalent)	Any story	Checked from inside face of braced wall panels	1.40	DRB, WSP, SFB, PCT, PCT, WSP, CS, G, CS, SFB
			4 inches or greater edges including top and bottom plates, and all horizontal joints finished	0.7	
7	Cypress board finishing	Any story	Any story	0.7	DRB
8	Horizontal bracing	Any story	Method 2B or 2B	1.0	WSP, CS, SFB

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SDC 'D' (Townhouse C)

TABLE RB03.10.3(1) BRACING REQUIREMENTS BASED ON SEISMIC DESIGN CATEGORY

SOIL CLASS OF WEAK MEDIUM TO FIRM
 30-FOOT MEAN ROOF HEIGHT
 40-FOOT WALL HEIGHT
 3-BRACED WALL LINE SPACING: 30 FEET

MINIMUM TOTAL LENGTH (FEET) OF BRACED WALL PANELS REQUIRED ALONG EACH BRACED WALL LINE

Seismic Design Category	Story Location	Braced Wall Line Length (feet)	Methods (WSP, WSP, SFB, PCT, PCT, APPL. BY WSP, SFB, PCT, PCT, CS, SFB)				Methods (CS, WSP, CS, CS, CS, SFB)
			Method 1B ¹	Method 1B	Method 2B ²	Method 2B	
C (Townhouse only)	Roof only	10	2.5	2.5	2.5	1.0	1.4
		20	5.0	5.0	5.0	1.0	1.4
		30	7.5	7.5	7.5	1.0	1.4
		40	10.0	10.0	10.0	1.0	1.4
		50	12.5	12.5	12.5	1.0	1.4
		60	15.0	15.0	15.0	1.0	1.4
	Roof + 1 floor	10	NP	4.5	4.5	3.0	1.6
		20	NP	9.0	9.0	6.0	1.6
		30	NP	13.5	13.5	9.0	1.7
		40	NP	18.0	18.0	12.0	1.8
		50	NP	22.5	22.5	15.0	1.8
		60	NP	27.0	27.0	18.0	1.9
Roof + 2 floors	10	NP	6.0	6.0	4.5	1.8	
	20	NP	12.0	12.0	9.0	1.9	
	30	NP	18.0	18.0	13.5	1.9	
	40	NP	24.0	24.0	18.0	1.9	
	50	NP	30.0	30.0	22.5	1.9	
	60	NP	36.0	36.0	27.0	1.9	

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SDC 'D' (Townhouse C)

What if BWL > 50-feet?

Seismic Design Category ^a	Story Location	Braced Wall Line Length (feet)	MINIMUM TOTAL LENGTH (FEET) OF BRACED WALL PANELS REQUIRED ALONG EACH BRACED WALL LINE ^b			
			Method C/F	Method CS	Method PFG/CS-SFB ^c	Method BV-WSP ^d
D _s	Top	20	NP	8.0	8.0	4.3
		30	NP	12.0	12.0	6.0
		40	NP	16.0	16.0	8.5
	Other	20	NP	20.0	20.0	10.0
		30	NP	27.5	27.5	14.0
		40	NP	35.0	35.0	18.5
D _m	Top	20	NP	15.0	15.0	6.4
		30	NP	22.5	22.5	11.0
		40	NP	30.0	30.0	15.7
	Other	20	NP	37.5	37.5	21.4
		30	NP	NP	NP	NP
		40	NP	NP	NP	NP

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Footnotes

- NP = Not Permitted.
- a. Linear interpolation shall be permitted.
- b. Wall bracing lengths are based on a soil site class "D." Interpolation of bracing length between the S_{ps} values associated with the seismic design categories shall be permitted when a site-specific S_{ps} value is determined in accordance with Section 1613.2 of the *International Building Code*.
- c. Where the braced wall line length is greater than 50 feet, braced wall lines shall be permitted to be divided into shorter segments having lengths of 50 feet or less, and the amount of bracing within each segment shall be in accordance with this table.
- d. Method L/B shall have gypsum board fastened to not less than one side with nails or screws in accordance with Table R602.3(1) for exterior sheathing or Table R702.3.5 for interior gypsum board. Spacing of fasteners at panel edges shall not exceed 8 inches.
- e. Methods PFG and CS-SFB do not apply in Seismic Design Categories D_s, D_m, and D_o.
- f. Where more than one bracing method is used, mixing methods shall be in accordance with Section R602.10.4.1.

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Seismic Adjustments

ITEM NUMBER	ADJUSTMENT BASED ON	STORY	CONDITION	ADJUSTMENT FACTOR ^a (Multiply length from Table R602.10.3(3) by this factor)	APPLICABLE METHODS
1	Story height (Section 301.3)	Any story	≤ 10 feet	1.0	All methods
			> 10 feet and ≤ 12 feet	1.2	
2	Braced wall line spacing, townhouses in SDC C	Any story	≤ 35 feet	1.0	
			> 35 feet and ≤ 50 feet	1.43	
3	Braced wall line spacing, in SDC D _s , D _m , D _o	Any story	> 25 feet and ≤ 30 feet	1.2	
			> 30 feet and ≤ 35 feet	1.4	
4	Wall dead load	Any story	> 8 psf and < 15 psf	1.0	
			< 8 psf	0.85	
5	Roof/ceiling dead load for wall supporting	1-, 2- or 3-story building	≤ 15 psf	1.0	
		2- or 3-story building	> 15 psf and ≤ 25 psf	1.1	
		1-story building or top story	> 15 psf and ≤ 25 psf	1.2	

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Seismic Adjustments

ITEM NUMBER	ADJUSTMENT BASED ON	STORY	CONDITION	ADJUSTMENT FACTOR ^a (Multiply length from Table R602.10.3(3) by this factor)	APPLICABLE METHODS
6	Walls with stone or masonry veneer, townhouses in SDC C ^b	Any story	≤ 10 feet	1.0	All methods
			> 10 feet and ≤ 12 feet	1.2	
			> 12 feet	1.5	
7	Walls with stone or masonry veneer, detached one- and two-family dwellings in SDC D _s , D _m	Any story	See Table R602.10.6.5	1.5	BV-WSP

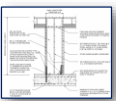
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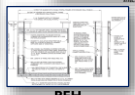
Wall Bracing

IRC R602.10.6.1

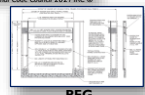
- Construction Methods**
 - Requirements for most methods can easily be determined from Table R602.10.4. Some methods are more detailed and are specifically highlighted in the code with construction details.



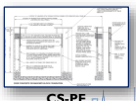
ABW





PFH



PFG



CS-PF

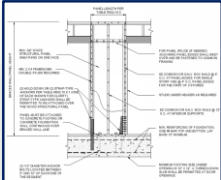
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Wall Bracing

IRC R602.10.6.1

- Alternate Braced Wall Panels**
 - Must follow hold down requirements of Table 602.10.6.1

SEISMIC DESIGN CATEGORY AND WIND SPEED	SUPPORTING STORY	HOLD-DOWN FORCE (pounds)			
		Height of Braced Wall Panel			
		8 feet	10 feet	12 feet	14 feet
SDC A, B, and C Ultimate design wind speed < 140 mph	One story	1,000	1,000	1,000	2,000
	First of two stories	3,000	3,000	3,000	3,000
SDC D, Ds, and Ds Ultimate design wind speed < 140 mph	One story	1,800	1,800	1,800	NP
	First of two stories	1,800	3,000	3,000	NP

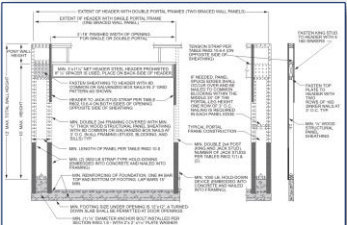







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Wall Bracing

IRC R602.10.6.2 Portal Frame with Hold-downs

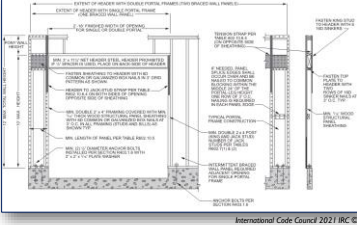







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Wall Bracing

IRC R602.10.6.2 Portal Frame at Garage



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Wall Bracing

IRC R602.10.2

- Continuous Sheathing**
 - Continues sheathing methods require structural panel sheathing on all surfaces of on side of the braced wall including above and below openings and gable ends
 - Bracing wall length is based on clear opening height adjacent to the braced wall unit.

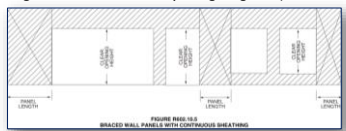




FIGURE R602.10.2
BRACED WALL PANELS WITH CONTINUOUS SHEATHING
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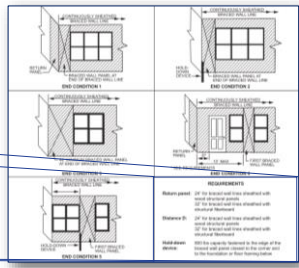



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Wall Bracing

IRC 602.10.7

- End of Braced Wall Lines With Continuous Sheathing:**
 - Continuous sheathing must follow one of these conditions for the end of the brace wall, which is dependent on three factors





REQUIREMENTS

Return panel: 24" for braced wall braced sheathed with wood structural panels
32" for braced wall braced sheathed with structural sheathing

Distance D: 24" for braced wall braced sheathed with wood structural panels
32" for braced wall braced sheathed with structural sheathing

Hold-down device: R500 tie capacity fastened to the edge of the braced wall panel closest to the corner joint to the foundation or floor framing below.

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Wall Bracing

IRC 602.10.6

- Continuous Sheathing Methods**
 - Continues sheathing methods require structural panel sheathing on all surfaces of on side of the braced wall including above and below openings and gable ends

Method	Panel Size	Minimum Sheathing per Table R602.10.6	Notes
CS-WSP Continuously sheathed wood structural panel	1/2"	See Method CS-WSP	4" edges 12" field
CS-SP Continuously sheathed wood structural panel adjacent to gable end	1/2"	See Method CS-WSP	Notes by Section
CS-SP Continuously sheathed wood structural panel gable end	1/2"	See Section R602.10.6.4	See Section R602.10.6.4
CS-WSP Continuously sheathed structural sheathing	1/2" or 5/8" (for exterior) 3/4" (for interior)	1" long x 0.17" dia. (for 1/2" thick sheathing) 1" long x 0.17" dia. (for 3/4" thick sheathing) gable end	3" edges 6" field


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Wall Bracing

IRC Table 602.10.4- Method CS-WSP





Method	Panel Size	Minimum Sheathing per Table R602.10.6	Notes
CS-WSP Continuously sheathed wood structural panel	1/2"	See Table R602.10.6	4" edges 12" field
Interior sheathing per Table R602.10.6			Notes by Section

REQUIREMENTS FOR WOOD STRUCTURAL PANEL WALL SHEATHING USED TO RESIST WIND PRESSURES^{1,2,3}

MINIMUM PANEL SIZE	MINIMUM WOOD STRUCTURAL PANEL SPAN RATIO	MINIMUM PANEL THICKNESS (inches)	MAXIMUM WALL STUD SPACING (inches)	PANEL NAIL SPACING (inches)		ULTIMATE DESIGN WIND SPEED ^{1,2,3} (mph)		
				Edges (min 6 in.)	Field	W	C	D
4d Common 2.0" x 0.113"	1.5	24.0	16	6	12	140	115	110
4d Common 2.2" x 0.131"	1.75	24.16	16	6	12	170	140	135
			24	6	12	160	115	110

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Wall Bracing

IRC Table 602.10.4- Method CS-SFB

CS-SFB	Continuously sheathed structural fiberboard	1/2" or 7/8" for maximum 16" stud spacing		1 1/2" long x 0.13" dia. (for 1/2" thick sheathing) 1 1/2" long x 0.12" dia. (for 7/8" thick sheathing) galvanized roofing nails	3" edges 6" field
--------	---	---	--	--	-------------------

High-Density Fiberboard Panel for Added Structural Strength

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Wall Bracing

IRC Table 602.10.4- Method CS-G

CS-G	Continuously sheathed wood structural panel adjacent to garage openings	1/2"		See Method CS-WSP	See Method CS-WSP
------	---	------	--	-------------------	-------------------

F. Applies to panels used in garage door opening where supporting gable end wall or roof load only. Shall only be used on one wall of the garage. In Seismic Design Categories D, D_s and D_m, roof covering dead load shall not exceed 3 psf.
G. Garage openings adjacent to a Method CS-G panel shall be provided with a header in accordance with Table R602.7.11. A full-height clear opening shall not be provided adjacent to a Method CS-G panel.

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Wall Bracing

IRC Table 602.10.4- Method CS-PF

CS-PF	Continuously sheathed panel bracing	1/2"		See Section R602.10.6.4	See Section R602.10.6.4
-------	-------------------------------------	------	--	-------------------------	-------------------------

OVER RAISED WOOD FLOOR - FRAMING ANCHOR OPTION

OVER RAISED CONCRETE OR MASONRY BLOCK FOUNDATION

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END OF MODULE 10

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MODULE 11



2021 IRC – Chapter 6
Wall Construction- Part 2



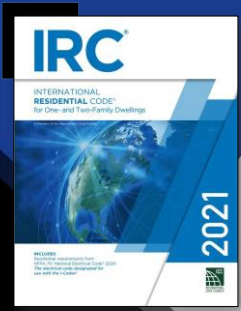

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LEARNING OBJECTIVES

1. Discuss limitations of simplified wall bracing.
2. Perform several examples of calculating required IRC wall bracing.
3. Discuss load path and detailing requirements for braced walls.






2



Chapter 6

Wall Bracing







3

Simplified Wall Bracing

IRC R602.12

- Can be done in lieu of requirements in 602.10
- Entire building must be braced according to this section

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Simplified Wall Bracing

R602.12: Must Meet ALL Requirements:

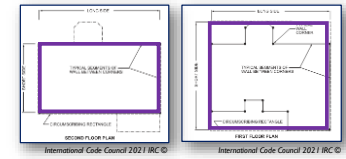
- ≤ 3 stories above basement
- ≤ 24" Floor cantilever
- ≤ 10-foot Wall height
- ≤ 15 ft Eave to Ridge
- ½ interior gyp on ext. walls
- <130 mph, Exp. B or C
- SDC A-C (SFD)
- SDC A-B (Townhouse)
- No cripple walls in 3 story



Simplified Wall Bracing

IRC R602.12.1

- **Circumscribed Rectangle**
 - ✓ Rectangle must include all offsets and projections like sunrooms.
 - ✓ Rectangle can exclude open structures like carports and decks.
 - ✓ Rectangle can't have any length of one side greater than 60 feet.
 - ✓ Ratio from the long side to the short side cannot be greater than 3:1.



Simplified Wall Bracing

IRC R602.12.2

- **Sheathing Materials**
 - Exterior walls must be sheathed with one of the following.
 - Wood Structural Panel at least 3/8"
 - Structural Fiber Board at least 1/2"



Different material types cannot be mixed.



Simplified Wall Bracing

IRC R602.12.3 – Bracing Unit



Where all ext. is sheathed according to 602.12.2, including between bracing units, bracing panel must be 3 feet.



Where all ext. is sheathed according to 602.12.2, except between bracing units, brace unit must be 4 feet.



Simplified Wall Bracing

IRC R602.12.4
Number of Bracing Units

Seismic Design Category	Seismic Risk Category	10' or less		10' to 20'		20' to 30'		30' to 40'		40' to 50'		50' to 60'		60' to 70'		70' to 80'		80' to 90'		90' to 100'		
		W	E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	
A	I	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	II	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	III	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	IV	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B	I	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B	II	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B	III	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B	IV	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C	I	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C	II	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C	III	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C	IV	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	I	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	II	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	III	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	IV	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Each side of the rectangle should have a certain number of braced walls based on Table R602.12.4

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Simplified Wall Bracing

IRC R602.12.5

- Distribution of Bracing Units**
 - ✓ Bracing unit cannot start more than 12 feet from the wall corner
 - ✓ The distance between two braced units can't be more than 20 feet
 - ✓ Any wall segment > 8 feet must have at least 1 braced unit

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Wall Bracing

IRC R602.10

- 8 Steps to Verifying Bracing**
 - 1) What bracing method is being used?
 - 2) Braced length requirement – Wind
 - 3) Apply wind adjustment factors.
 - 4) Braced length requirement – Seismic
 - 5) Apply seismic adjustment factors.
 - 6) What braced wall length controls? (W or E)
 - 7) BWL locations & spacing?
 - 8) BWP locations & spacing?

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Detached Garage

Given:

- 20'x20' footprint
- 8' wall height
- 4:12 roof pitch
- Mfr. Trusses
- WSP
- Wind: 95mph, Exp. 'B'
- SDC 'D₁'

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Detached Garage

Step 1: What bracing method is being used?

TABLE R602.10.4 BRACING METHODS

METHODS, MATERIAL	MINIMUM THICKNESS	FIGURE	CONNECTION CRITERIA*	
			Fasteners	Spacing
LIB Let-in-bracing	1 x 4 wood or approved metal straps at 45° to 60° angles for maximum 16" stud spacing		Wood: 2-8d common nails or 3-8d (2 1/2" long x 0.113" dia.) nails	Wood: per stud and top and bottom plates
			Metal strap: per manufacturer	Metal: per manufacturer
DWB Diagonal wood boards	3/4" (1" nominal) for maximum 24" stud spacing		2-8d (2 1/2" long x 0.113" dia.) nails or 2 - 1 1/2" long staples	Per stud
WSP Wood structural panel (See Section R604)	3/8"		Exterior sheathing per Table R602.3(3) Interior sheathing per Table R602.3(1) or R602.3(2)	6" edges 12" field Varies by fastener

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Detached Garage

Step 2: Braced length – Wind

TABLE R602.10.3(1) BRACING REQUIREMENTS BASED ON WIND SPEED

* EXPOSURE CATEGORY B
 + 20-FOOT MEAN ROOF HEIGHT
 + 10-FOOT WALL HEIGHT
 + 2 BRACED WALL LINES

Ultimate Design Wind Speed (mph)	Story Location	Braced Wall Line Spacing* (feet)	Method LIB†	Method GB	MINIMUM TOTAL LENGTH (FEET) OF BRACED WALL PANELS REQUIRED ALONG EACH BRACED WALL LINE*	
					Methods DWB, WSP, SFB, PBS, PCP, HPS, BV-WSP, ABW, PFL, PFG, CS-SFB	Methods CS-WSP, CS-G, CS-PF
< 95 mph		10	2.5	2.5	1.5	1.5
		20	4.5	4.5	2.5	2.5
		30	6.5	6.5	4.0	3.5
		40	8.5	8.5	5.0	4.0
		50	10.5	10.5	6.0	5.0
		60	12.5	12.5	7.0	6.0

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Detached Garage

Step 3: Apply Wind Adjustment Factors

TABLE R602.10.3(2) WIND ADJUSTMENT FACTORS TO THE REQUIRED LENGTH OF WALL BRACING

ITEM NUMBER	ADJUSTMENT BASED ON	STORY/SUPPORTING	CONDITION	ADJUSTMENT FACTOR* (multiply length from Table R602.10.3(1) by this factor)	APPLICABLE METHODS
1	Exposure category	One-story structure	B	1.00	All methods
			C	1.20	
			D	1.50	
			B	1.00	
			C	1.30	
			D	1.60	
2	Roof eave-to-ridge height	Roof only	≤ 5 feet	0.70	
			10 feet	1.00	
			15 feet	1.30	
			20 feet	1.60	
			Roof + 1 floor	≤ 5 feet	0.85
				10 feet	1.00
15 feet	1.15				
20 feet	1.30				

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Detached Garage

Step 3: Apply Wind Adjustment Factors (cont.)

TABLE R602.10.3(2) WIND ADJUSTMENT FACTORS TO THE REQUIRED LENGTH OF WALL BRACING

ITEM NUMBER	ADJUSTMENT BASED ON	STORY/SUPPORTING	CONDITION	ADJUSTMENT FACTOR* (multiply length from Table R602.10.3(1) by this factor)	APPLICABLE METHODS
3	Story height (Section R501.3)	Any story	8 feet	0.90	All methods
			9 feet	0.95	
			10 feet	1.00	
			11 feet	1.05	
			12 feet	1.10	
4	Number of braced wall lines (per plan direction)	Any story	3	1.00	
			4	1.45	
			5	1.30	
			≥ 5	1.60	
6	Interior gypsum board finish (or equivalent)	Any story	Omitted from inside face of braced wall panels	1.40	DWB, WSP, SFB, PBS, PCP, HPS, CS-WSP, CS-G, CS-SFB

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Detached Garage

Step 3: Apply Wind Adjustment Factors (cont.)

- Adjusted Braced Wall Length for Wind:

Exp. B

Wall Height

No Gypsum Board


Eave-to-Ridge Height

Lines

How many BWP per BWL are required?

What is the minimum width of the BWPs?

$$LW = 2.5 * 1.0 * 0.7 * 0.9 * 1.0 * 1.4 = 2.2' / BWL$$





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Detached Garage

Step 4: Braced length requirement - Seismic

TABLE R602.10.3(3)—continued
BRACING REQUIREMENTS BASED ON SEISMIC DESIGN CATEGORY

Seismic Design Category ^a	Story Location	Braced Wall Line Length (feet) ^b	MINIMUM TOTAL LENGTH (FEET) OF BRACED WALL PANELS REQUIRED ALONG EACH BRACED WALL LINE ^c				
			Method LIB ^d	Method GB	Methods DWB, SFB, PBS, PCP, HPS, CS-SFB ^e	Methods WSP, ABW, PFH and PFG ^f	Methods CS-WSP, CS-G, CS-PF
D ₁		10	NP	3.0	3.0	2.0	1.7
		20	NP	6.0	6.0	4.0	3.4
		30	NP	9.0	9.0	6.0	5.1
		40	NP	12.0	12.0	8.0	6.8
		50	NP	15.0	15.0	10.0	8.5




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Step 5: Apply Seismic Adjustment Factors

TABLE R602.10.3(4)
SEISMIC ADJUSTMENT FACTORS TO THE REQUIRED LENGTH OF WALL BRACING




ITEM NUMBER	ADJUSTMENT BASED ON	STORY ^a	CONDITION	ADJUSTMENT FACTOR ^b (Multiply length from Table R602.10.3(3) by this factor)	APPLICABLE METHODS
1	Story height (Section 301.3)	Any story	≤ 10 feet	1.0	All methods
			> 10 feet and ≤ 12 feet	1.2	
2	Braced wall spacing, townhouses in SDC C ^c	Any story	≤ 35 feet	1.0	
			> 25 feet and ≤ 50 feet	1.43	
3	Braced wall line spacing, in SDC D ₁ , D ₂ , D ₃	Any story	> 25 feet and ≤ 30 feet	1.2	
			> 30 feet and ≤ 35 feet	1.4	
4	Wall dead load	Any story	> 8 psf and < 15 psf	1.0	All methods
			< 8 psf	0.85	
5	Roof/ceiling dead load for wall supporting	1-, 2- or 3-story building	≤ 15 psf	1.0	
		2- or 3-story building	> 15 psf and ≤ 25 psf	1.1	All methods
		1-story building or top story	> 15 psf and ≤ 25 psf	1.2	




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Detached Garage

Step 5: Apply Seismic Adjustment Factors (cont.)

6	Walls with stone or masonry veneer, townhouses in SDC C ^a		1.0	All methods
			1.5	
			1.5	



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Step 5: Apply Seismic Adjustment Factors (cont.)

7	Walls with stone or masonry veneer, detached one- and two-family dwellings in SDC D _s - D ₂	Any story	See Section R602.10.6.5.4	1.0	BV-WSP
8	Walls with stone or masonry veneer, detached one- and two-family dwellings in SDC D _s - D ₂	First and second story of two-story dwelling	Limited brick veneer on second story. See Section R602.10.6.5.3.	1.2	WSP, CS-WSP
9	Interior gypsum board finish (or equivalent)	Any story	Omitted from inside face of braced wall panels	1.5	DWB, WSP, SFB, PBS, PCF, HPS, CS-WSP, CS-G, CS-SFB
10	Horizontal blocking	Any story	Horizontal blocking omitted	2.0	WSP, PBS, CS-WSP

Treatment Code: 2021-100

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Detached Garage

Step 5: Apply Seismic Adjustment Factors (cont.)

- Adjusted Braced Wall Length for Seismic:

Story Height

Wall DL

Veneer

Blocking

BWL Spacing

Roof DL

Interior Gypsum

How many BWP per BWL are required?

What is the minimum width of the BWPs?

- $LS = 4.0 * 1.0 * 1.0 * 1.0 * 1.0 * 1.0 * 1.5 * 1.0 = 6.0' / BWL$

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Detached Garage

Step 6: What Bracing Length Controls?

- Wind: Adjusted Length = 4.9' / BWL
- Seismic: Adjusted Length = 6.0' / BWL
- 6.0' / BWL
- While that is the calculated braced wall length, it does not control!**

How many BWP per BWL are required?

What is the minimum width of the BWPs?

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Detached Garage

The last two steps (#7 & #8) are to verify the locations of the braced walls and their spacing.

details

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Detached Garage

Step 7:
BWL Locations & Spacing

Step 8:
BWP Locations & Spacing

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Detached Garage

Portal Frame with Hold-downs (PFH)

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Simpson Calculator

The Kimball Shed

- Simpson's "Wall-Bracing Length Calculator"

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WALL-BRACING Length Calculator

Project Information

Year: 2018 IRC

Project Name: Kimball Shed

Project Address: 123 Green

Project City, State: East Lake City, Utah

Project Zip Code: 84101

Project User Director: Front to Back

Ultimate Design Category: II

Ultimate Design Wind Speed: 115 mph

Wind Exposure Category: B

Roofs or Vapors/Venue Exceeding in Story Height: No

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WALL-BRACING Length Calculator

Front To Back Walls Description

Number of Front To Back Braced Wall Lines: 2

The Braced Wall Line Spacing @ between Wall Line A-1 and Wall Line B-1: 12'-0"

Braced Wall Line A-1: 1st of 3 story

Braced Wall Line B-1: 1st of 3 story

Braced Wall Line A-1 Height: 8'-0"

Braced Wall Line B-1 Height: 8'-0"

Wind Dead Load: 1.5 psf

Wind Ceiling Dead Load: 1.5 psf

Braced Wall Line Length: 12'-0"

Wall Height: 8'-0"

Bracing Method: WSP

Support Wall Board on Inside: No

Wall Construction Type: N/A

Inverted Joints Braced: Yes

Recessed Device Used: No

Buttons: BACK, CALCULATE

Simpson Strong Tie™

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RESULTS

Tabulated Wind Bracing Amount	2.3 N	2.3 N
Exposure Height Factor	1	1
Eave-to-Ridge Height Factor	0.7	0.7
Wind Wall Height Factor	0.9	0.9
Number of Brac. Factor	1	1
Hullbus Factor	1	1
Blocked Joint Factor	1	1
Openum on Inade Factor	1.4	1.4
Wind CB Construction Factor	1	1
Required Wind Bracing Amount	2.03 N	2.03 N

Tabulated Seismic Bracing Amount	0 N	0 N
Seismic Wall Height Factor	1	1
SMW Spacing Factor	1	1
Blocked Joint Factor	1	1
Openum on Inade Factor	1.5	1.5
Seismic CB Construction Factor	1	1
Wind Dead Load Factor	0.85	0.85
Floor Dead Load Factor	1	1
Versec Factor	1	1
Required Seismic Bracing Amount	3.83 N	3.83 N

REQUIREMENTS

Length of Wall Bracing Required	3.83 N	3.83 N
---------------------------------	--------	--------

Simpson Strong Tie™

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Simpson Calculator

Steps 7 & 8:

12'-0"

8'-0"

4'-0"

12'-0"

8'-0"

4'-0"

5'6"

2'6"

2020

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APA Calculator

- APA's calculator → great for designer's www.apawood.org/calculator

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Lateral Loads

- In dealing with wind & seismic we need to ensure there is a complete lateral load path.
- **Connections, connections, connections**

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Load Path

IRC R602.10.8

- **Braced Wall Connections**
 - Framing perpendicular to BWL

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Load Path



Braced Wall Connections (cont.)
Framing parallel to BWL

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Load Path

Braced Wall Connections (cont.)

- Sole plate anchorage:
 - 1/2" Ø anchor bolts having 7" minimum embedment
 - Two minimum per plate
 - Place within 12" of end but not closer than 7db
 - 3"x3"x0.229" plate washers at braced wall lines
- Top plate splice → (8) 16d common nails on each side

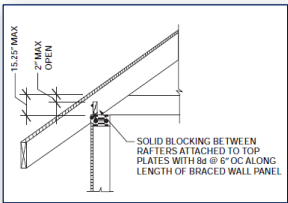

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Load Path

Braced Wall Connections (cont.)

- Eave Blocking:
 - Where $d \leq 15-1/4"$

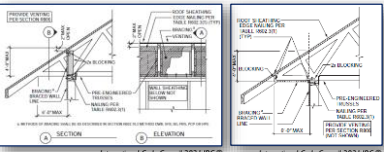

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Load Path

Braced Wall Connections (cont.)

- Where $d > 15-1/4"$
- 4 methods: Figures below, full-depth blocking or accepted engineering practice

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D. Load Path

Fastening - Table R602.3(1):

- #1: Blocking to top plate, toenail (3-10d)
- #6: Rafter or roof truss to plate, toenail (3-16d)
- #8: Built-up studs, face nail (10d @ 16" o.c.)
- #9: Wall corners, face nail (16d @ 12" o.c.)

ITEM	DESCRIPTION OF BUILDING ELEMENTS	FASTENING REQUIREMENTS	
		NUMBER AND TYPE OF FASTENERS ^{1,2}	SPACING AND LOCATION
Roof			
1	Blocking between ceiling joists, rafters or trusses to top plate or other blocking below	4-6d toenails ³ @ 12" o.c.	End nail
		3-8d toenails ³ @ 12" o.c. or 3-2" @ 16" o.c.	End nail
		2-8d toenails ³ @ 12" o.c. or 2-2" @ 16" o.c.	End nail
2	Blocking between ceiling or truss end at the wall top plates, or ceiling or truss	2-8d toenails ³ @ 12" o.c. or 2-2" @ 16" o.c.	End nail
		2-8d toenails ³ @ 12" o.c. or 2-2" @ 16" o.c.	End nail
		2-8d toenails ³ @ 12" o.c. or 2-2" @ 16" o.c.	End nail
3	Eave blocking to truss and web Siller	4-6d toenails ³ @ 12" o.c.	6" max. face nail
		3-8d toenails ³ @ 12" o.c. or 3-2" @ 16" o.c.	6" max. face nail
		2-8d toenails ³ @ 12" o.c. or 2-2" @ 16" o.c.	6" max. face nail
4	Chilling joists to top plates	4-6d toenails ³ @ 12" o.c.	Per joint, face nail
		3-8d toenails ³ @ 12" o.c. or 3-2" @ 16" o.c.	Per joint, face nail
		2-8d toenails ³ @ 12" o.c. or 2-2" @ 16" o.c.	Per joint, face nail



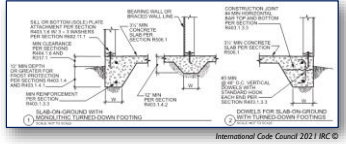
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Load Path

Footings/Foundation:

- Monolithic Footings (R403.1.3.3)
- 600ft² max. & 10-foot max. eave height (R403.1.4.1)



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The image shows a laptop displaying a website for 'On-Demand Building & Fire Code Training'. The website features a person's photo and the text 'ANY TIME. ANY PLACE. ANY DEVICE'. Below the laptop, the text 'END OF MODULE I I' is displayed in a large, bold font. The background also includes architectural blueprints and a white pipe.



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MODULE 12

2021 IRC - Chapters 7-10

1

1

LEARNING OBJECTIVES

1. Understand provisions related to wall coverings.
2. Become familiar with evaluating rafter and ceiling joist spans.
3. Learn the code requirements for different types of common roofing materials.
4. Discover requirements specific to masonry fireplace construction.

2

2

Chapter 7

Wall Covering

3

3

Water-Resistive

IRC R703.2

“One layer of No. 15 asphalt felt, free from holes and breaks, complying with ASTM D 226 Type I... shall be applied over studs or sheathing of all exterior walls.”

4



4

Exterior Plaster

IRC R703.7

Installation per ASTM C 926 and ASTM C1063

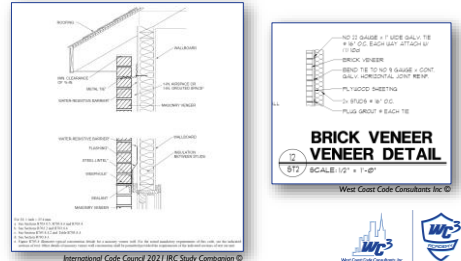

- Lath:
 - Lath & attachments shall be corrosion-resistant
 - Attach lath at 6"o.c.
- Plaster:
 - At least 3 coats over metal or wire lath
 - At least 2 coats over masonry or concrete
- Other:
 - At least 2 layers of Grade D paper
 - Weep screeds at or below foundation line
 - (2"-4" above grade)

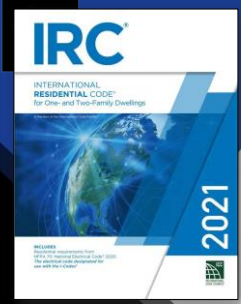
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Masonry Veneer

IRC R703.8





6



Chapter 8

Roof-Ceiling Construction



7

Fire-Retardant

IRC R802.1.5

- Fire-retardant-treated wood (FRTW) shall have a listed frame spread index of **25 or less**
- Panels shall be labeled
- Strength adjustments shall be made (Plan Review)

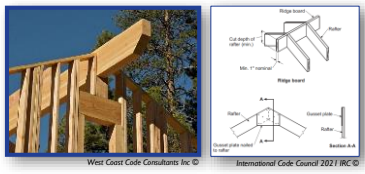



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Framing Details

IRC R802.3

- "Rafters shall be framed... to a ridge board or to each other with a gusset plate as a tie."
- If roof pitch < 3:12, a ridge beam is needed

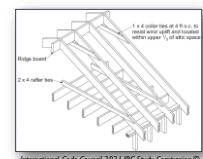


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Framing Details

IRC R802.3

- Ceiling joists or rafter ties shall be connected to rafters (otherwise an engineered ridge beam)
- Collar ties or ridge straps shall be connected in the upper third of the attic space



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Rafters

IRC R802.4

TABLE R802.4(1)
RAFTER SPANS FOR COMMON LUMBER SPECIES (Roof live load = 20 psf, ceiling not attached to rafters, L₁₀ & 100)

RAFTER SPECIES (Species)	SLOPE OF RAFTER										
	2:4				3:12						
	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12			
Douglas fir-larch	16	11.6	14.0	23.0	None b	None b	11.6	14.0	23.0	None b	None b
	18	13.1	15.4	25.5	None b	None b	13.1	15.4	25.5	None b	None b
Douglas fir-larch	18	18.0	19.0	21.4	26.4	None b	18.0	19.0	21.4	26.4	None b
	20	20.0	21.0	23.4	28.4	None b	20.0	21.0	23.4	28.4	None b
Hem-fir	16	11.6	14.0	23.0	None b	None b	11.6	14.0	23.0	None b	None b
	18	13.1	15.4	25.5	None b	None b	13.1	15.4	25.5	None b	None b
Hem-fir	18	18.0	19.0	21.4	26.4	None b	18.0	19.0	21.4	26.4	None b
	20	20.0	21.0	23.4	28.4	None b	20.0	21.0	23.4	28.4	None b
Hem-fir	16	11.6	14.0	23.0	None b	None b	11.6	14.0	23.0	None b	None b
	18	13.1	15.4	25.5	None b	None b	13.1	15.4	25.5	None b	None b
Hem-fir	18	18.0	19.0	21.4	26.4	None b	18.0	19.0	21.4	26.4	None b
	20	20.0	21.0	23.4	28.4	None b	20.0	21.0	23.4	28.4	None b
Southern pine	16	11.6	14.0	23.0	None b	None b	11.6	14.0	23.0	None b	None b
	18	13.1	15.4	25.5	None b	None b	13.1	15.4	25.5	None b	None b
Southern pine	18	18.0	19.0	21.4	26.4	None b	18.0	19.0	21.4	26.4	None b
	20	20.0	21.0	23.4	28.4	None b	20.0	21.0	23.4	28.4	None b
Spruce-pine-fir	16	11.6	14.0	23.0	None b	None b	11.6	14.0	23.0	None b	None b
	18	13.1	15.4	25.5	None b	None b	13.1	15.4	25.5	None b	None b
Spruce-pine-fir	18	18.0	19.0	21.4	26.4	None b	18.0	19.0	21.4	26.4	None b
	20	20.0	21.0	23.4	28.4	None b	20.0	21.0	23.4	28.4	None b
Spruce-pine-fir	16	11.6	14.0	23.0	None b	None b	11.6	14.0	23.0	None b	None b
	18	13.1	15.4	25.5	None b	None b	13.1	15.4	25.5	None b	None b
Spruce-pine-fir	18	18.0	19.0	21.4	26.4	None b	18.0	19.0	21.4	26.4	None b
	20	20.0	21.0	23.4	28.4	None b	20.0	21.0	23.4	28.4	None b

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Ceiling Joists

IRC R802.5

TABLE R802.5(1)
CEILING JOIST SPANS FOR COMMON LUMBER SPECIES (Ceiling joist attached to rafters without live load = 10 psf, L₁₀ & 100)

CEILING JOIST SPECIES (Species)	SLOPE OF RAFTER										
	2:4				3:12						
	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12			
Douglas fir-larch	16	11.6	14.0	23.0	None a	None a	11.6	14.0	23.0	None a	None a
	18	13.1	15.4	25.5	None a	None a	13.1	15.4	25.5	None a	None a
Douglas fir-larch	18	18.0	19.0	21.4	26.4	None a	18.0	19.0	21.4	26.4	None a
	20	20.0	21.0	23.4	28.4	None a	20.0	21.0	23.4	28.4	None a
Hem-fir	16	11.6	14.0	23.0	None a	None a	11.6	14.0	23.0	None a	None a
	18	13.1	15.4	25.5	None a	None a	13.1	15.4	25.5	None a	None a
Hem-fir	18	18.0	19.0	21.4	26.4	None a	18.0	19.0	21.4	26.4	None a
	20	20.0	21.0	23.4	28.4	None a	20.0	21.0	23.4	28.4	None a
Hem-fir	16	11.6	14.0	23.0	None a	None a	11.6	14.0	23.0	None a	None a
	18	13.1	15.4	25.5	None a	None a	13.1	15.4	25.5	None a	None a
Hem-fir	18	18.0	19.0	21.4	26.4	None a	18.0	19.0	21.4	26.4	None a
	20	20.0	21.0	23.4	28.4	None a	20.0	21.0	23.4	28.4	None a
Southern pine	16	11.6	14.0	23.0	None a	None a	11.6	14.0	23.0	None a	None a
	18	13.1	15.4	25.5	None a	None a	13.1	15.4	25.5	None a	None a
Southern pine	18	18.0	19.0	21.4	26.4	None a	18.0	19.0	21.4	26.4	None a
	20	20.0	21.0	23.4	28.4	None a	20.0	21.0	23.4	28.4	None a
Spruce-pine-fir	16	11.6	14.0	23.0	None a	None a	11.6	14.0	23.0	None a	None a
	18	13.1	15.4	25.5	None a	None a	13.1	15.4	25.5	None a	None a
Spruce-pine-fir	18	18.0	19.0	21.4	26.4	None a	18.0	19.0	21.4	26.4	None a
	20	20.0	21.0	23.4	28.4	None a	20.0	21.0	23.4	28.4	None a
Spruce-pine-fir	16	11.6	14.0	23.0	None a	None a	11.6	14.0	23.0	None a	None a
	18	13.1	15.4	25.5	None a	None a	13.1	15.4	25.5	None a	None a
Spruce-pine-fir	18	18.0	19.0	21.4	26.4	None a	18.0	19.0	21.4	26.4	None a
	20	20.0	21.0	23.4	28.4	None a	20.0	21.0	23.4	28.4	None a

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Heel Joint Connection

IRC R802.5.2

TABLE R802.5.2(1)
RAFTER/CEILING JOIST HEEL JOINT CONNECTIONS*

RAFTER SLOPE	RAFTER SPACING (INCHES)	GROUND SNOW LOAD (PSF)												
		20				30				50				
		12	24	36	48	12	24	36	48	12	24	36	48	
Required number of 1x6 common nails per heel joint splice **1217														
3:12	12	3	5	8	9	6	9	6	13	0	12	17		
	18	4	7	10	4	8	12	6	12	17	9	15	23	
	24	5	10	15	6	10	14	7	14	21	9	18	27	
4:12	12	3	4	6	3	5	7	4	7	10	5	9	13	
	18	3	5	8	3	6	9	5	9	13	6	12	17	
	24	4	6	9	4	7	11	6	11	16	7	14	21	
5:12	12	3	3	5	3	4	6	3	6	8	4	7	11	
	18	3	4	6	3	5	7	4	7	11	5	9	14	
	24	3	5	7	4	6	9	5	9	13	6	11	17	

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Notching

IRC R802.7

- Cutting, notching or drilling per R502.8.1, except:
 - Cantilevered rafters
 - Tapered ceiling joists

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Ventilation

IRC R806

- Cross ventilation is required for separate enclosed attic space
- Vent Area $\geq 1/150$ of vented space
 - $\geq 1/300$ if vapor retarder is installed on warm side of ceiling in Climate Zones 6, 7 and 8

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Unvented attics and rafters

IRC R806.5

- Must comply with one of the options listed
- R806.5 #5.1.1 – **Air-impermeable** insulation directly below the sheathing.

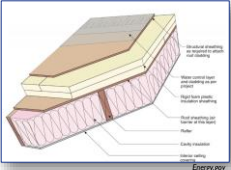

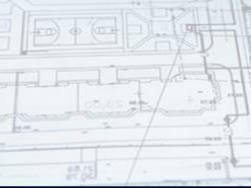
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16

Unvented attics and rafters

IRC R806.5

- R806.5 #5.1.2 – **Air-permeable** insulation directly below the sheathing **and** rigid board or sheet insulation directly above the sheathing.

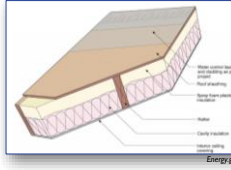

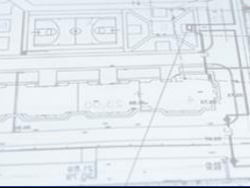
Energy.gov

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Unvented attics and rafters

IRC R806.5

- R806.5 #5.1.3 – **Air-impermeable** insulation directly below the sheathing and **air-permeable** insulation directly below the air-impermeable insulation.

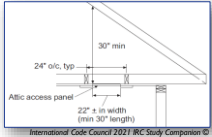


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Attic Access

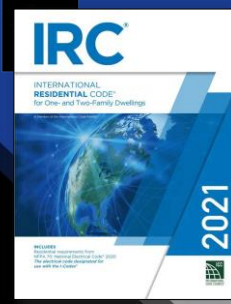
IRC R807

- Required for areas **> 30ft²** and height of **30"**
- Opening Requirements:
 - Located in hallway or readily accessible location
 - 22"x30"** & shall allow removal of largest appliance
 - Min. of 30" unobstructed headroom

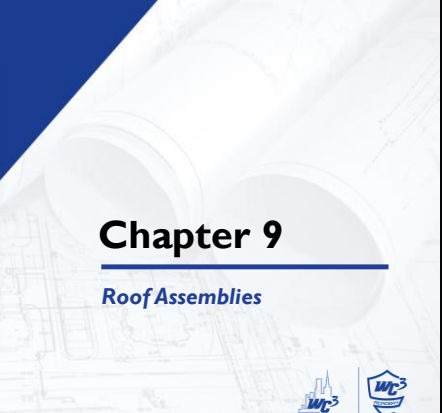
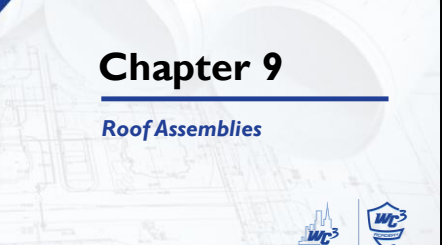
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Chapter 9

Roof Assemblies

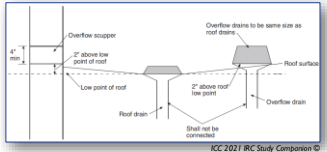
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Drainage

IRC R903.4

- Unless sloped to drain over roof edges...
 - Drains at low point of roof
 - Secondary drains shall be 2" above
 - Scuppers 3 times the size shall be 2" above

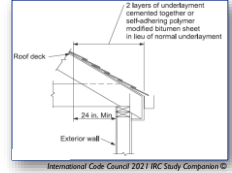


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Underlayment

IRC R905.1

- Ice Barrier:
 - Required where history of ice forming along eaves
 - Shall extend from lowest edge to a point at least 24" inside the exterior wall

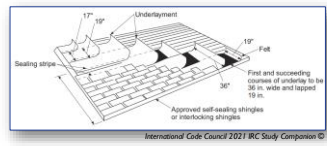


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Asphalt

IRC R905.2

- Asphalt Shingles:
 - Roof slopes \geq 2:12
 - Double underlayment is required if $<$ 4:12
 - 12ga fasteners which penetrate \geq 3/4" into sheathing

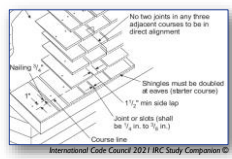


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Roofing

IRC R905

- Clay & Concrete Tile (R905.3):
 - Roof slopes \geq 2.5:12
 - 11ga fasteners shall penetrate \geq 3/4" or through sheathing
- Wood Shingles or Shakes (R905.7 & R905.8):
 - Roof slopes \geq 3:12
 - Fasteners shall penetrate \geq 1/2" into sheathing



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IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings
2021

Chapter 10
Chimneys and Fireplaces

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25

Support

IRC R1001.2

- Footings shall be $\geq 12''$ thick
- Shall extend $\geq 6''$ beyond face of fireplace
- Shall extend below frost depth

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Hearth

IRC R1001.9

- Concrete or masonry
- Min. Hearth thickness of 4"
- Min. Extension thickness of 2"

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Seismic

IRC R1003.4

- Anchorage
 - At each floor, ceiling or roof line > 6-feet above grade
 - Two 3/16"x1" straps embedded 12" into chimney and hooked around outer bars
 - Straps shall be fastened to a minimum of four floor joists with two 1/2" bolts

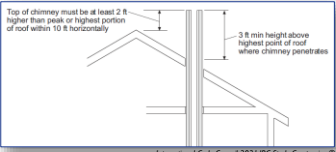
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Termination

IRC R1003.9

- Shall extend \geq 2-feet above any portion of a building within 10-feet, but...
- Shall not be $<$ 3-feet above the highest point where it passes through the roof



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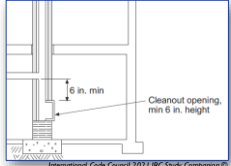
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Cleanouts

IRC R1003.17

Cleanouts shall be provided within 6" of the base of each flue.



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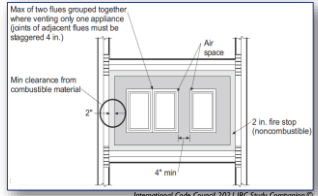
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Clearances

IRC R1003.18

- Min. air space from combustibles of 2"
 - 1" allowed if constructed entirely on the exterior



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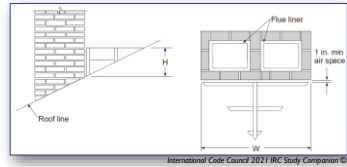
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Cricket

IRC R1003.20


- Required when...
 - Dimension parallel to ridgeline $>$ 30" and it does not intersect the ridgeline
 - Intersection shall be flashed and counter-flashed



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Exterior Air

IRC R1006.1

- Intake:
 - Shall not be located within the garage or basement
 - Must be located at an elevation < than the firebox
 - Corrosion-resistant screen of $\frac{1}{4}$ " mesh
- Clearance:
 - Unlisted combustion air ducts shall have a clearance of ≥ 1 " to combustibles for all parts of the duct within 5-feet of outlet



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END OF MODULE 12




34

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MODULE 13




2021 IRC – Chapter 11
Energy

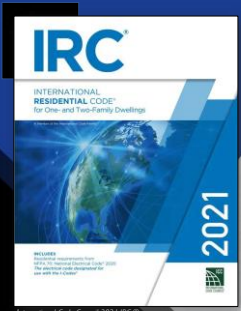
1

LEARNING OBJECTIVES

1. Recognize the method of demonstrating energy compliance for residential buildings.
2. Become familiar with prescriptive code requirements associated with building envelopes, mechanical equipment compliance and electrical lighting requirements.
3. Understand the other non-prescriptive methods of achieving energy code compliance.







2



Chapter 11

Energy Efficiency








3

Scope

IRC N1101.1

- Energy efficiency requirements for one- and two-family dwellings & townhomes
- Parallels the residential provisions of the 2021 IECC



4

Prescriptive Compliance

IRC N1101-N1104

- Just follow the recipe!
- N1102- Building Thermal Envelope
- N1103- Systems
- N1104- Electrical Power & Lighting
- Must install one of the additional energy efficiency options listed in N1108.2.

Prescriptive

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Thermal Envelope

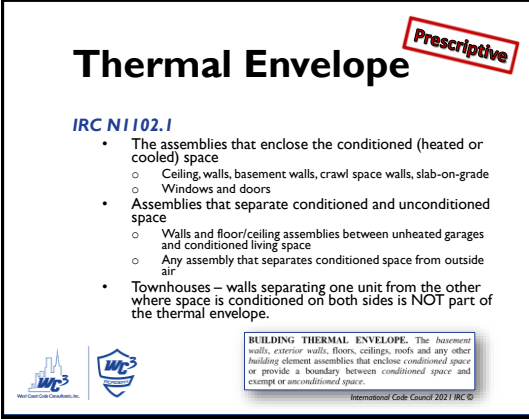

IRC N1102.1

- The assemblies that enclose the conditioned (heated or cooled) space
 - Ceiling, walls, basement walls, crawl space walls, slab-on-grade
 - Windows and doors
- Assemblies that separate conditioned and unconditioned space
 - Walls and floor/ceiling assemblies between unheated garages and conditioned living space
 - Any assembly that separates conditioned space from outside air
- Townhouses – walls separating one unit from the other where space is conditioned on both sides is NOT part of the thermal envelope.

Prescriptive

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floors, ceilings, roofs and any other building element assemblies that enclose conditioned space or provide a boundary between conditioned space and unconditioned space.

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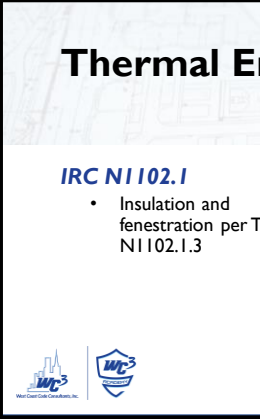

Thermal Envelope

IRC N1102.1

- Insulation and fenestration per Table N1102.1.3

Prescriptive

CLIMATE ZONE	FENESTRATION U-FACTOR	FENESTRATION SHADING COEFFICIENT	GLAZING FENESTRATION ENERGY	CEILING ASSEMBLY	FLOOR/SLAB ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY	WALL ASSEMBLY
1	NR	0.75	0.25	30	13 or 12	10	13	13	0	0	0	0	0	0	0	0	0	0
2	NR	0.75	0.25	30	13 or 12	10	13	13	0	0	0	0	0	0	0	0	0	0
3	0.30	0.55	0.25	40	13 or 12	10	13	13	19	19	19	19	19	19	19	19	19	19
4 or 5 or 6 or 7	0.30	0.55	0.40	60	13 or 12	10	13	13	19	19	19	19	19	19	19	19	19	19
8 and 9	0.30	0.55	0.60	60	13 or 12	10	13	13	19	19	19	19	19	19	19	19	19	19
10	0.30	0.55	NR	60	13 or 12	10	13	13	19	19	19	19	19	19	19	19	19	19
11 and 12	0.30	0.55	NR	60	13 or 12	10	13	13	19	19	19	19	19	19	19	19	19	19

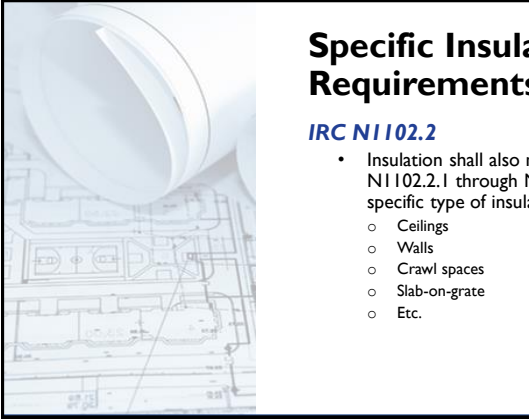

11

Specific Insulation Requirements

IRC N1102.2

- Insulation shall also meet requirements of N1102.2.1 through N1102.2.12 for the specific type of insulation
 - Ceilings
 - Walls
 - Crawl spaces
 - Slab-on-grade
 - Etc.

Prescriptive

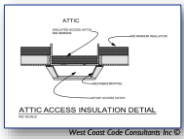
12

Attic Hatches & Doors


Prescriptive

NI 102.2.4

- Access hatches that separate conditioned and unconditioned space (attics, crawlspaces) shall be insulated.
- Access hatches shall be weatherstripped



ATTIC ACCESS INSULATION DETAIL
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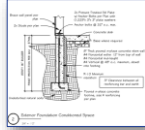
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Slab-on-grade floors


Prescriptive

NI 102.2.9

- Slab insulation shall be provided for all slabs with a floor surface less than 12" below grade (for heated spaces)
 - Slab-on-grade construction
 - Walk-out-basements
 - Heated garages
- Insulation shall extend downward from the top of the slab on the inside or outside of the foundation wall.



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Air Leakage


Prescriptive

NI 102.4

- Thermal envelope shall be constructed to limit air leakage
- Air leakage testing per NI 102.4.1.2 (Blower Door Test)

Component	TABLE 102.4.1.2 (1) AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION	TABLE 102.4.1.2 (2) AIR BARRIER INSTALLATION
Ceiling/ceiling-roofline	A membrane or barrier shall be installed in the building envelope. Beads or joints in the air barrier shall be sealed.	As possible, insulation shall be used as a sealing agent.
Columns	The air barrier or air leakage-resisting or sealing shall be aligned with the columns and any gaps in the air barrier shall be sealed. Access openings, drop-downs and knee walls shall have an air barrier and air space shall be sealed.	The insulation in any dropped ceiling shall be aligned with the air barrier.
Walls	The joints of the insulation and air barrier shall be sealed. The joints of the top plate and the top of insulation shall be sealed. Knee walls shall be sealed.	On masonry walls, concrete and masonry of frame walls shall be mechanically fastened using the specific details shown in Figure 102.4.1.2.1.2.1. The concrete or masonry shall be sealed with a 2-ply seal. The concrete or masonry shall be sealed with a 2-ply seal. The concrete or masonry shall be sealed with a 2-ply seal.

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Systems

Prescriptive

NI 103

- Duct Insulation (NI 103.3.1)
 - Supply and return ducts outside conditioned space shall be insulated
- Duct Testing (NI 103.3.5)
 - Ducts shall be pressure tested to determine air leakage
- Mechanical Ventilation (NI 103.6)
 - Buildings shall be provided with mechanical ventilation
 - Outdoor air intakes and exhausts shall be provided with automatic or gravity dampers




16

Equipment Sizing

NI 103.7 Prescriptive

- Manual J – how much heating and cooling is needed?
- Manual S – is the equipment properly sized based for the home?
- Heating and cooling equipment shall be sized in accordance with Manual S based on building loads calculated in accordance with Manual J.
 - Does not have to be Manual J and Manual S – equivalent documentation is okay!
- Information on Manual J & S should be consistent with information provided on the energy compliance documents and the plans.




17

Electrical Power & Lighting Systems

NI 104 Prescriptive

- All permanent lighting shall be high-efficacy
 - Except kitchens
- Interior lighting requires dimmer or occupant sensor
 - Exceptions: bathrooms, hallways, exterior lighting, security lighting
- Total exterior lighting exceeding 30 watts:
 - Shall be controlled by a manual controls that permit automatic shut-off
 - Shall automatically shut off during sufficient daylight
 - Controls that override automatic shut-offs are not allowed unless the override automatically discontinues within 24 hours.




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Total UA Alternative

NI 102.1.5

- REScheck or other approved program
- Trade-off method
 - More efficient assemblies make up for less efficient assemblies
- U-factor of the thermal envelope as a whole, better than equal to the U-factor of the thermal envelope as a whole using the prescriptive table = PASS




19

Total UA Alternative

NI 102.1.5

- Must comply with SHGC of Table NI 102.1.2
- Must comply with maximum fenestration per NI 102.5
- **ONLY** replaces requirements of Table NI 102.1.3
- **ALL OTHER Prescriptive Option requirements (NI 101 through NI 104) are still required**
- Must install one of the additional energy efficiency options listed in NI 108.2





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Total Building Performance

NI 105

- Sections listed in Table NI 105.2 still required
- Thermal envelope must meet or exceed requirements of 2009 IECC Table R402.1.1 or R402.1.3
- Annual energy cost is less than or equal to the annual energy cost of the standard reference design
 - Must install one of the additional energy efficiency options listed in NI 108.2 WITHOUT including it in the proposed design **OR**
 - Proposed design must have an annual energy cost less than or equal to 95% of the annual energy cost of the standard reference design



21

21

Energy Rating Index (ERI)

NI 106

- Sections listed in Table NI 106.2 still required
- Third Party HERS rater uses modeling to generate an ERI or HERS score, equal to or lower than the required score for the applicable Climate Zone found in Table NI 106.5
 - Per NI 101.13.5, the ERI value shall be at least 5% less than the Energy Rating Index target specified



22

22

Tropical Climate Region

NI 107

- Alternative for homes in the tropical region at elevations less than 2,400 feet
- No more than 1/2 of occupied space is air conditioned
- Occupied space is not heated
- Operable fenestration 14% or greater
- Bedroom doors capable of being secured in open position
- See NI 107.2 for more

23

23

Additional Efficiency Package Options

NI 108

- Enhanced envelope performance
- More efficient HVAC equipment performance
- Reduced energy use in service water-heating
- More efficient duct thermal distribution system
- Improved air sealing and efficient ventilation system




24

24



25

MODULE 14

IRC – Mechanical & Plumbing Requirements

1

LEARNING OBJECTIVES

1. Learn code requirements associated with the installation of mechanical equipment
2. Become familiar with mechanical exhaust system requirements
3. Understand fuel gas piping calculations and system requirements
4. Discover plumbing requirements related to the installation of plumbing piping and appliances

2

Part V- Mechanical

Chapter 12- Mechanical Administration

Chapter 13- General Mechanical System Requirements

Chapter 14- Heating and cooling Equipment and Appliances

Chapter 15- Exhaust Systems

Chapter 16- Duct Systems

Chapter 17- Combustion Air

3

Part V- Mechanical

Chapter 18- Chimneys and Vents

Chapter 19- Special Appliances, Equipments and Systems

Chapter 20- Boilers and Water Heaters

Chapter 21- Hydronic Piping

Chapter 22- Special Piping and Storage Systems

Chapter 23- Solar Thermal Energy Systems

4

IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings
2021

Chapter 13
General Mechanical System Requirements

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5

Work Space

IRC M1305.1.1

- Door and access passageway 24" minimum width
 - Wide enough to allow removal
 - Level service space of 30"x30"

6

Attics

IRC M1305.1.1

125 VAC convenience receptacle
Light fixture
Furnace
Equipment disconnect switch
Light switch near access opening
Min 24 in. wide doorway
Access opening min 20 in. by 30 in.
Passageway to be min 22 in. by 30 in. (Large enough to allow removal of largest piece of equipment)

7

Under Floor

IRC M1305.1.1

Switch for light
Light and outlet
Supports
Gas vent
12 in. min side and rear clearance
6 in. min clearance to excavated ground
30 in. min clearance on control side of furnace
Waterproof concrete or masonry walls extending 4 in. above adjoining grade when excavation exceeds 12 in.
Passageway large enough to remove furnace
12 in.

8

Installation

IRC MI307

- Install appliances per manufacturer's instructions and per listing
- **Anchorage:** SDC D₀, D₁ & D₂

9

9

Chapter 14

Heating and Cooling Equipment and Appliances

10

10

Sizing

IRC MI401.3

- Equipment shall be sized per ACCA Manual S
- Building loads calculated per ACCA Manual J

11

11

Sizing

Manual J – Heating & Cooling Load Calculations

Job: 3087 Blue Sage Trail Lot 35 Painted Sky Promontory, Park City, UT 84098
Date: Feb 19, 2019

Design information		Infiltration		
	Mag	Og		
Outside db (°F)	0	91	Method	Simplified
Inside db (°F)	70	75	Construction quality	Semi-tight
Design Td (°F)	70	18	Fireplaces	0
Daily range	-	14		
Inside humidity (%)	30	50		
Moisture @ Reverse (gr/lb)	33	57		

12

12


Sizing

Manual S – Equipment Sizing based on load calculations

Cooling Equipment	
Equipment type:	Split AC
Manufacturer:	Lemco
Model:	XIC20-080-230A™-C03-4RC-EL266LH900V90C*+DR
Actual surface:	1200 sqm
Design capacity:	48000 Btu/h 100% of load
Latent capacity:	8500 Btu/h 18% of load
Total capacity:	57000 Btu/h 118% of load

Heating Equipment	
Equipment type:	Gas furnace
Manufacturer:	Lemco
Model:	EL266LH900V90C*
Actual surface:	1500 sqm
Output capacity:	85000 Btu/h 175% of load

Temp. rise: 50 °F

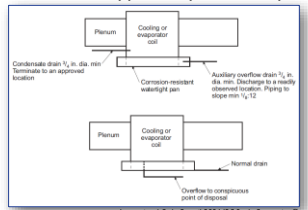



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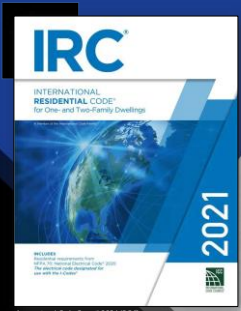
Condensate

IRC M1411.3

Condensate shall be conveyed from the drain pan outlet to an approved place of disposal.





14



Chapters 15-19

Exhaust Systems

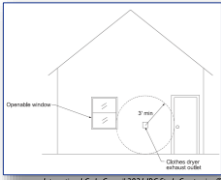



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Exhaust

IRC M1502.3

- Terminations shall be per MFR instructions
- If not provided...
 - ≥ 3-feet from openings into buildings

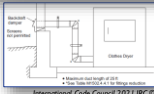

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Duct Length

IRC M1502.4.6

- Max. of **35-feet** from connection to outlet
 - Must be reduced per Table M1502.4.6.1

DRYER EXHAUST DUCT FITTING TYPE	EQUIVALENT LENGTH
1/2-inch radius smooth 45-degree elbow	2 feet 6 inches
1/2-inch radius smooth 90-degree elbow	5 feet
1/2-inch radius smooth 45-degree elbow	1 Elbow
1/2-inch radius smooth 90-degree elbow	2 feet 9 inches
1/2-inch radius smooth 45-degree elbow	1 Elbow
1/2-inch radius smooth 90-degree elbow	2 feet 7 inches
1/2-inch radius smooth 45-degree elbow	1 Elbow
1/2-inch radius smooth 90-degree elbow	2 feet 6 inches






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Range Hoods

IRC M1503.1

- Shall discharge to outdoors
- Duct shall have a smooth interior surface, be air tight, and be equipped with a backdraft damper
- May not terminate in an attic or crawl space

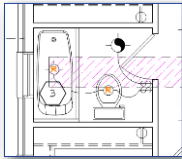

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Kitchen/Bath

IRC M1505.4.4

Shall have the capacity to exhaust the minimum air flow rate noted in Table M1505.4.4.

AREA TO BE EXHAUSTED	EXHAUST RATES
Kitchens	100 cfm intermittent or 25 cfm continuous
Bathrooms-Toilet Rooms	Mechanical exhaust capacity of 50 cfm intermittent or 20 cfm continuous






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Installation

IRC M1601.4

- Joints:**
 - All joints, longitudinal and transverse seams, and connections shall be securely fastened & sealed
- Supports:**
 - Per manufacturer's instructions or per SMACNA

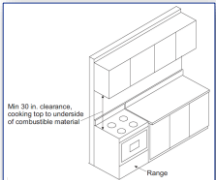
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Ranges

IRC M1901.1

Shall have a vertical clearance above the cooktop of 30".

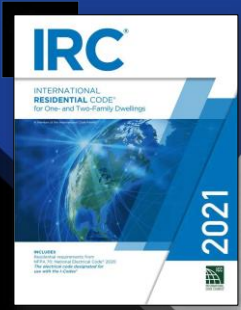


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Chapter 24

Fuel Gas

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22

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Scope

IRC G2401.1

Text has been extracted from the 2021 IFGC and modified where necessary.



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How to Check Gas Line Schematics

A Gas Line Supplemental Module is included at the end of this course that includes more detailed examples.



24

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Appliances

IRC G2406

- Fuel-fired appliances shall not be located in...
 - Sleeping rooms
 - Bathrooms
 - Toilet rooms
 - Storage closets
 - Surgical rooms
- Shall not be placed in operation until after...
 - Piping system has been checked for leakage
 - Piping system has been purged
 - Connections have been checked for leakage

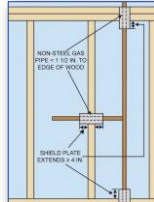


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Piping Installation

IRC G2415

- **Prohibited Locations:**
 - Shall not be installed in or through ducted supply, return or exhaust, a clothes chute, chimney or gas vent, dumbwaiter or elevator shaft
- **Protection:**
 - Shield plates if w/in 1.5" from nearest edge of wood

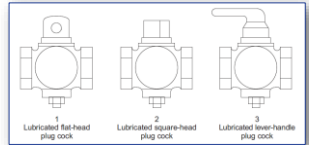
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Shutoff Valve

IRC G2420

- Each system shall have a shutoff valve
 - Prohibited in concealed locations & furnace plenums
 - Sufficient access shall be provided

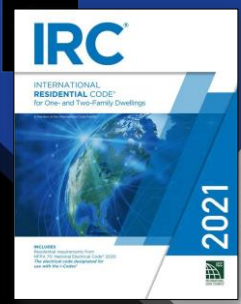


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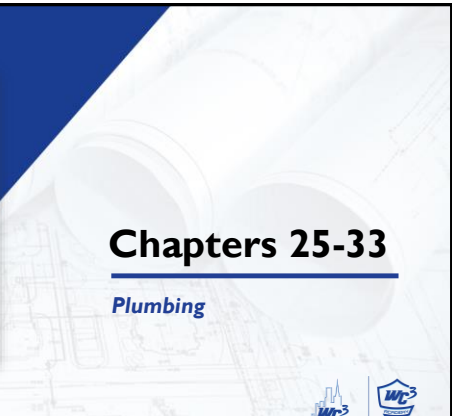

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Chapters 25-33

Plumbing






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Part VII- Plumbing

- Chapter 25- Plumbing Administration**
- Chapter 26- General Plumbing Requirements**
- Chapter 27- Plumbing Fixtures**
- Chapter 28- Water Heaters**
- Chapter 29- Water Supply and Distribution**






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Part VII- Plumbing

- Chapter 30- Sanitary Drainage**
- Chapter 31- Vents**
- Chapter 32- Traps**
- Chapter 33- Storm Drainage**



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Tests

IRC P2503

- DWV:
 - Water Test: 10-feet of head for 15 minutes
 - Air test: 5psi for 15 minutes
 - Not allowed for plastic piping
- Water-Supply:
 - Water Test: System working pressure for 15 minutes
 - Air test: 50psi for 15 minutes
 - Not allowed for plastic piping
- Shower Liner: 2" depth for 15 minutes
- Backflow Prevention: Determine if operable

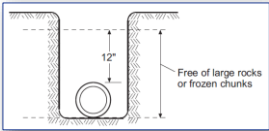
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Freezing

IRC P2603.5

- If winter design temperature $\leq 32^{\circ}\text{F}$...
 - Water, soil or waste pipes shall not be installed outside of building, in exterior walls, in attics or crawl spaces, or other areas subject to freezing
 - Pipe shall be installed $\geq 12"$ deep and not less than 6" below frost line



Free of large rocks or frozen chunks



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Piping Support

IRC P2605.1

PIPE OR TUBING	MINIMUM HORIZONTAL SPACING (in.)	MINIMUM VERTICAL SPACING (in.)
ASB pipe	10	12
Aluminum tubing	10	12
Copper pipe	10	12
Copper or copper alloy pipe	12	18
Copper or copper alloy tubing (1" under or diameter not smaller)	12	18
Copper or copper alloy tubing (1 1/2" under or diameter not larger)	10	12
Cross-linked polyethylene (PEX) pipe, 1 inch and smaller	2, 4(1/2) (under)	10
Cross-linked polyethylene (PEX) pipe, 1 1/2 inch and larger	4	10
Cross-linked polyethylene (PEX) pipe, 2 inch and larger	2, 4(1/2) (under)	10
CPVC pipe or tubing (1" under or diameter not smaller)	4	10
CPVC pipe or tubing (1 1/2" under or diameter not larger)	4	10
Lead pipe	4	4
PE pipe or tubing	2, 4(1/2) (under)	4
Polyethylene of raised temperature (PE-RT) pipe, 1 inch and smaller	2, 4(1/2) (under)	10
Polyethylene of raised temperature (PE-RT) pipe, 1 1/2 inch and larger	2, 4(1/2) (under)	10
Polyethylene of raised temperature (PE-RT) pipe, 2 inch and larger	2, 4(1/2) (under)	10
Polypropylene (PP) pipe or tubing (1 inch and smaller)	2, 4(1/2) (under)	10
Polypropylene (PP) pipe or tubing (1 1/2 inch and larger)	4	10
PVC pipe	4	10
Reinforced drainage systems	10	10
Steel pipe	10	12



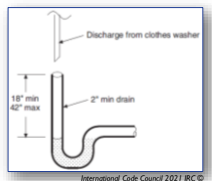

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Standpipes

IRC P2706.1.2

- Shall extend $\geq 18"$, but $\leq 42"$ above the trap
 - $\geq 12"$ in its smallest space (P2704.1)

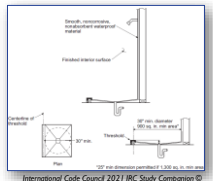

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Showers

IRC P2708.1

- $\geq 900 \text{ in}^2$ of interior area
- $\geq 30"$ in minimum dimension
- $\geq 70"$ height at shower drain

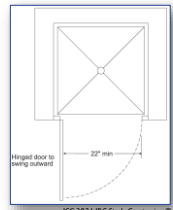

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Showers

IRC P2708.1.1

The shower compartment access/egress shall have a clear width of $\geq 22"$

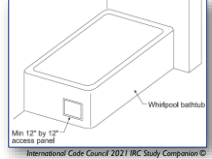
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Whirlpools

IRC P2720.1

- Access to pump shall comply with MFR.
- If not specified...
 - 12"x12"
 - 18"x18" if pumps are located more than 2-feet from access opening



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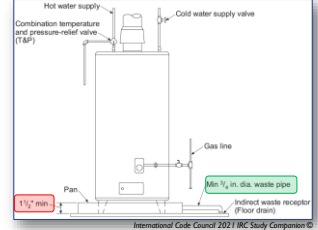
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Required Pan

IRC P2801.6

24ga. Galvanized steel pan, plastic or other



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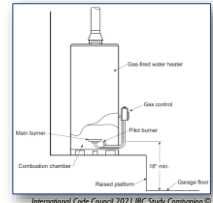
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Garage

IRC P2801.7

Water heaters having an ignition source shall be elevated such that the ignition source is 18" above the garage floor.



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Restraint

IRC P2801.8

- SDC D₀, D₁ and D₂
- Anchored/Strapped:
 - Upper 1/3
 - Lower 1/3



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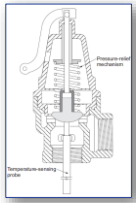

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Relief Valves

IRC P2804

- Appliances used for heating and storing water shall be protected by...
 - Separate pressure-relief and temperature-relief valves, **or...**
 - A combination pressure- and temperature-relief valve


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Relief Valves

IRC P2804

- Relief valves should be set ≥ 25 psi above the system pressure but not > 150 psi
 - Setting shall not exceed tank's rating
- Temperature valves shall be set to monitor water within upper 6" of tank
 - It shall be set to open at $\leq 210^{\circ}\text{F}$
- Valves shall discharge into a full-size drain that extends from the valve to an indirect waste



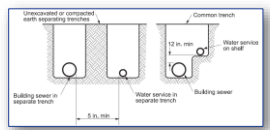


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Water Service

IRC P2906.4

- Permitted to be located within same trench as building sewer provided...
 - The sewer pipe is listed for below ground use, **or...**
 - It is separated from water pipe by ≥ 5 -feet, **or...**
 - The water pipe is placed on a ledge 12" above the sewer line

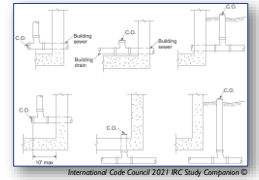


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Cleanouts

IRC P3005.2

- Installed not more than **100-feet** apart
- At each change in direction $> 45^{\circ}$
 - Only one cleanout required per **40-feet**

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Extension

IRC P3103.1

- Open vent pipes that extend through a roof shall extend $\geq 6''$ above the roof or $\geq 6''$ above the anticipated snow accumulation
- If outside design temperature is $\leq 0^{\circ}\text{F}$, the vent extension shall be $\geq 3''$ in diameter

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Trap Distance

IRC P3105

TABLE P3105.1 MAXIMUM DISTANCE OF FIXTURE TRAP FROM POINT			
FIXTURE CATEGORY	DIAMETER	MINIMUM	MAXIMUM
1	1 1/2"	4'	8'
	2"	4'	10'
2	1 1/2"	4'	10'
	2"	4'	12'

Separate points A and B by a min of 2 pipe diameters
Crown vent limitations

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Trap Seal

IRC P3201.2

Shall have a liquid seal of $\geq 2''$ but $\leq 4''$

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of Fixtures per Trap

IRC P3201.6

- Each fixture shall be separately trapped
- Vertical distance from fixture to trap $\leq 24''$
- Horizontal distance from fixture to trap $\leq 30''$

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Trap Size

IRC P3201.7

TABLE P3201.7 SIZE OF TRAP FOR PLUMBING FIXTURES	
PLUMBING FIXTURE	TRAP SIZE (Minimum Inches)
Bedbath (with or without shower head and/or bathtub attachment)	1½
Bidet	1½
Charger/washer/rinse tray	2
Dishwasher (on separate taps)	1½
Floor drain	2
Kitchen sink (one or two traps, with or without dishwasher and food waste disposer)	1½
Lavatory tub (one or more compartments)	1½
Lavatory	1½
Shower (based on the total flow rate through showerheads and body sprays) Flow rate: 5.7 gpm and less	1½
Shower (based on the total flow rate through showerheads and body sprays) Flow rate: More than 5.7 gpm up to 12.3 gpm	2
Shower (based on the total flow rate through showerheads and body sprays) Flow rate: More than 12.3 gpm up to 20.6 gpm	3
Shower (based on the total flow rate through showerheads and body sprays) Flow rate: More than 20.6 gpm up to 31.9 gpm	4

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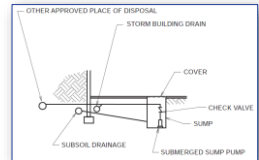


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Sump Pits

IRC P3303.1.2

- Pit Requirements:
 - Accessible
 - ≥ 18" in diameter
 - ≥ 24" deep



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END OF MODULE 14





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MODULE 15



IRC – Electrical Requirements

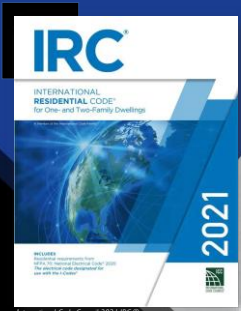
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LEARNING OBJECTIVES

1. Understand considerations related to proper placement of electrical panels and required clearances.
2. Become familiar with required electrical receptical locations, spacing and types.
3. Understand considerations related to proper placement and protection of electrical services.






2



Chapters 34-43



Electrical Requirements

3

Part VIII- Electrical

- Chapter 34- General Requirements*
- Chapter 35- Electrical Definitions*
- Chapter 36- Services*
- Chapter 37- Branch Circuits and Feeder Requirements*
- Chapter 38- Wiring Methods*

4

Part VIII- Electrical

- Chapter 39- Power and Lighting Distribution
- Chapter 40- Devices and Luminaires
- Chapter 41- Appliance Installation
- Chapter 42- Swimming Pools
- Chapter 43- Class 2 Remote-Control, Signaling and Power-Limited Circuits

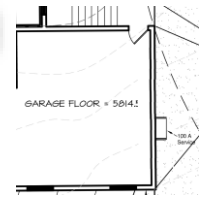


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Protection of Services

E3404.10

E3404.10 Prevent physical damage. In locations where electrical equipment is likely to be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent such damage. [110.27(B)]



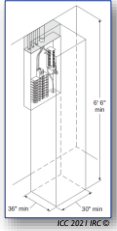
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Clearances

IRC E3405.2

- The dimension of the working space in front of the panel board shall be...
 - ≥ 36" in depth, and...
 - ≥ 30" in width, but...
 - Not < width of equipment



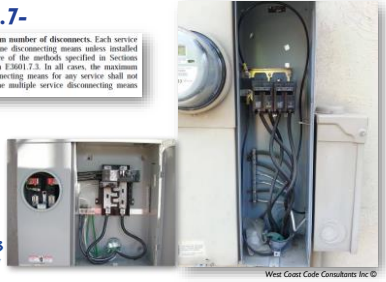
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Single Disconnect

E3601.7-

E3601.7 Maximum number of disconnects. Each service shall have only one disconnecting means unless installed using one or more of the methods specified in Sections E3601.7.1 through E3601.7.3. In all cases, the maximum number of disconnecting means for any service shall not exceed six and the multiple service disconnecting means shall be enclosed.




8

8

Minimum Size of Service-Entrance Conductors

IRC E3602

- The service wires must have a minimum ampacity of 100 amperes for one-family dwellings.
- Must have a minimum ampacity of 60 amps for all other services (other than dwellings). [NEC 230.79]

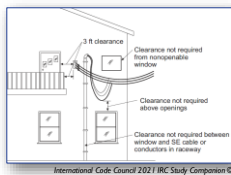



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Clearance

IRC E3604.1

Open conductors and cables shall have a clearance of ≥ 3 -feet from the sides of doors, porches, decks, stairs, ladders, fire escapes, balconies and operable windows






10

Grounding

IRC E3608.1

- Methods...
 - Metal underground water pipe
 - Concrete-encased electrode (i.e. UFER)
 - Ground rings
 - Rod and pipe electrodes
 - Plate electrodes
 - Other electrodes


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Summary

IRC E3702.14

Requirements for two or more outlets or receptacles (other than kitchen, dining, laundry & bathroom)...

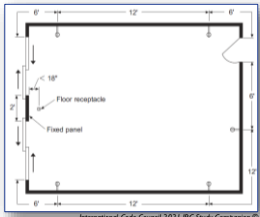


	CIRCUIT RATING		
	15 amp	20 amp	30 amp
Conductors:			
Minimum size (AWG) - circuit conductors	14	12	10
Maximum overcurrent- protection device rating - Ampere rating	15	20	30
Outlet devices:			
Lampholders permitted	Any type	Any type	NA
Receptacle rating (amperes)	15 maximum	15 or 20	30
Maximum load (amperes)	15	20	30




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Receptacles

IRC E3901.2
Spacing: Any point along a wall is w/in 6-feet

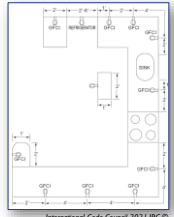


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Countertops

IRC E3901.4

- Countertops $\geq 12"$ or wider, **24"** at any point
- Islands: **One (1)** required

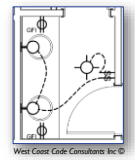

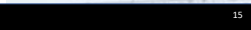
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Required Receptacles

IRC E3901

- Bathrooms – within 36" of each lavatory
- Front and back of each dwelling
- Each balcony, deck and/or porch
- Within 6 feet of appliances
- Laundry areas
- Each unfinished portion of a basement


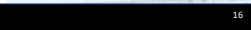
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Required Receptacles

IRC E3901 cont.

- Each vehicle bay of attached garages
- Each vehicle bay of detached garages that are provided with power
- Accessory buildings provided with power
- Hallways
- Foyers
- Within 25 feet of HVAC and refrigeration equipment (indoor, outdoor, and rooftop)


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GFCI

IRC E3902

- All 125-volt through 250-volt, single-phase, 15- and 20-ampere receptacles installed in...
 - Bathrooms
 - Garages
 - Accessory buildings
 - Outdoors
 - Crawl spaces
 - Basements
 - finished and unfinished
 - Kitchens
 - Within 6-feet of sinks, showers, and bathtubs
 - Laundry areas
 - Dishwashers
 - Indoor damp and wet locations





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Arc-Fault

IRC E3902.16

- All 125-volt, single-phase, 15- and 20-ampere receptacles installed in...
 - kitchens
 - family rooms
 - dining rooms
 - living rooms
 - parlors
 - libraries
 - dens
 - bedrooms
 - sun-rooms
 - recreation rooms
 - closets
 - hallways
 - laundry areas
 - similar rooms
 - etc.


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Boxes

IRC E3905

- Outlet boxes used as the sole support for ceiling fans shall...
 - Be labeled as such, and...
 - Shall not support fans > 70 pounds



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END OF MODULE 15



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2021 IRC Supplement A

Combustion Air Sample Questions

1

LEARNING OBJECTIVES

1. Practice multiple sizing examples to better understand methods of obtaining combustion air.
2. Understand how to use the equations in the IRC to accurately calculate combustion air volume, and opening sizes.
3. Work through the math step-by-step to ensure arrival at the correct answer.

2

Combustion Air

IRC M1701:

- Solid-fuel-burning appliances- Per manufacturer's installation instructions
- Oil-fired appliances- **NFPA 31**
- Does not apply to
 - Fireplaces
 - Fireplace stoves
 - Direct vent appliances
- At or above flood elevation- in flood hazard areas

3

Combustion Air

IRC M1701:

For LP-Gas or Natural Gas appliances: Combustion Air in accordance with **IRC Chapter 24!**


Part VI—Fuel Gas

**CHAPTER 24
FUEL GAS**

The text of this chapter is extracted from the 2021 edition of the International Fuel Gas Code and has been modified where necessary to conform to the scope of application of the International Residential Code for One- and Two-Family Dwellings. The section numbers appearing in parentheses after each section number are the section numbers of the corresponding text in the International Fuel Gas Code.

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Combustion, Ventilation, Dilution Air

IRC G2407:
 Category I appliances:


- G2407.5 (Indoor)
- G2407.6 through G2407.9 (Outdoor)

Category I. An appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.


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Direct Vent & Others:

- Per Manufacturer
- Exception: Type I clothes dryers per G2439.5 (not required)



5




Combustion, Ventilation, Dilution Air

IRC G2407.2:


- Located not to interfere with proper circulation

IRC G2407.4:

- Make up air required where exhaust fans, clothes dryers, kitchen ventilation interfere with combustion air



(replace Peluse.com)



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Indoor Air

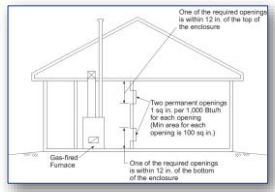
IRC 2407.5.1:

- Required 50 cubic feet per 1,000 btu/h

IRC G2407.5.3.1:

Combining spaces (same level):


- Each opening shall have a min. free area of 1 in² per 1,000 Btu/h, but ≥ 100 in²
 - Openings within 12" of the ceiling and floor
 - Minimum dimensions 3" or greater



IRC G2407.5.3.2:

Combining spaces (different levels):

- Each opening shall have a min. free area of 2 in² per 1,000 Btu/h




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Indoor Combustion Air Caution:

Please be aware that the 50 cubic feet option is only available if the known natural air infiltration rate is 0.40 ACH or higher. Almost everything built new in the past 30 years has a natural infiltration rate of 0.35 ACH or LOWER.

What was one a "rule of thumb" for sizing indoor combustion air has become somewhat outdated. Modern construction is too tight to utilize this method with confidence.



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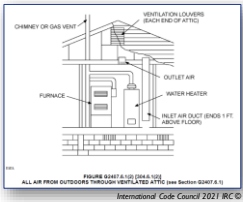

Outdoor Air

IRC G2407.6.1:

Two-permanent-openings:

- Each opening within **12"** of ceiling and floor
 - 1 in² per **4,000 Btu/h** directly to exterior
 - 1 in² per **2,000 Btu/h** through ducts

Openings 3" minimum

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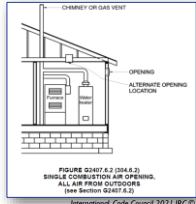

Outdoor Air

IRC G2407.6.2:

- One-permanent-opening
 - Within 12" of ceiling
 - Clearance 1" sides, 6" front
 - 1 in² per **3,000 Btu/h**
- Openings 3" minimum

IRC G2407.7:

- Allows for a combination of indoor and outdoor air openings

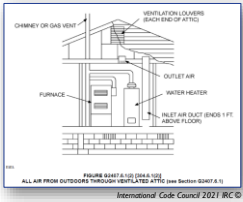

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Example Problem #1

Determine the required indoor combustion air volume for (2) 199K btu water heaters.

Step 1: Calculate total btu's:
 $2 \times 199,000 = 398,000 \text{ btu's}$

Step 2: Calculate the needed combustion air:
 50 cubic feet per 1,000 btu's (IRC G2407.5.1)
 $398,000 / 1,000 = 398$
 $398 \times 50 = 19,900 \text{ cubic feet}$

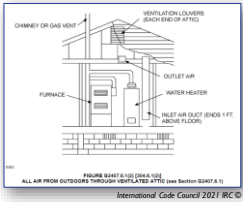

11

Example Problem #2

Determine the required room size necessary for (3) 90K btu water heaters, assuming 9' ceilings.

Step 1: Calculate total btu's:
 $3 \times 90,000 = 270,000 \text{ btu's}$

Step 2: Calculate the needed combustion air:
 50 cubic feet per 1,000 btu's (IRC G2407.5.1)
 $270,000 / 1,000 = 270$
 $270 \times 50 = 13,500 \text{ cubic feet}$



12

Example Problem #2

Step 3: Calculate required room size
 13,500 cubic feet / 9-foot ceilings = 1,500 SF

Multiple Choice Options:

- A. 1,000 SF
- B. 1,200 SF
- C. 1,500 SF
- D. 2,000 SF

13

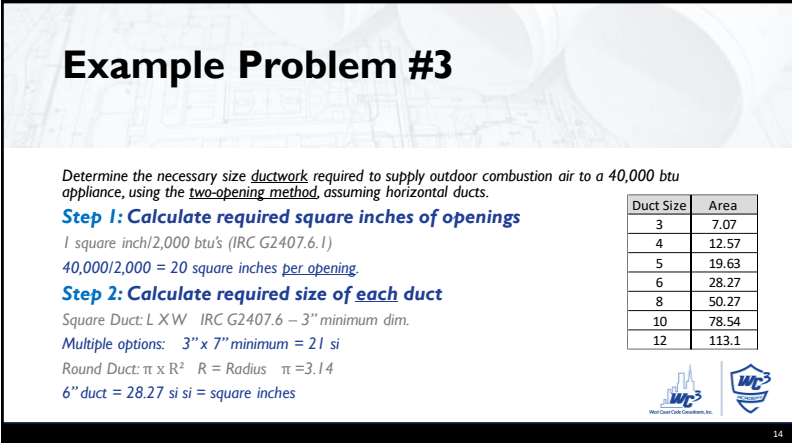

Example Problem #3

Determine the necessary size ductwork required to supply outdoor combustion air to a 40,000 btu appliance, using the two-opening method, assuming horizontal ducts.

Step 1: Calculate required square inches of openings
 1 square inch/2,000 btu's (IRC G2407.6.1)
 $40,000/2,000 = 20$ square inches per opening.

Step 2: Calculate required size of each duct
 Square Duct: L X W IRC G2407.6 – 3" minimum dim.
 Multiple options: 3" x 7" minimum = 21 si
 Round Duct: $\pi \times R^2$ R = Radius $\pi = 3.14$
 6" duct = 28.27 si = square inches

Duct Size	Area
3	7.07
4	12.57
5	19.63
6	28.27
8	50.27
10	78.54
12	113.1

14

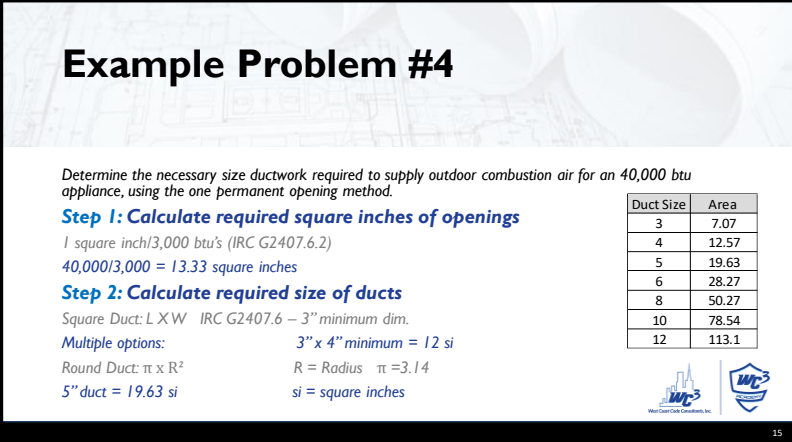

Example Problem #4

Determine the necessary size ductwork required to supply outdoor combustion air for an 40,000 btu appliance, using the one permanent opening method.

Step 1: Calculate required square inches of openings
 1 square inch/3,000 btu's (IRC G2407.6.2)
 $40,000/3,000 = 13.33$ square inches

Step 2: Calculate required size of ducts
 Square Duct: L X W IRC G2407.6 – 3" minimum dim.
 Multiple options: 3" x 4" minimum = 12 si
 Round Duct: $\pi \times R^2$ R = Radius $\pi = 3.14$
 5" duct = 19.63 si

Duct Size	Area
3	7.07
4	12.57
5	19.63
6	28.27
8	50.27
10	78.54
12	113.1

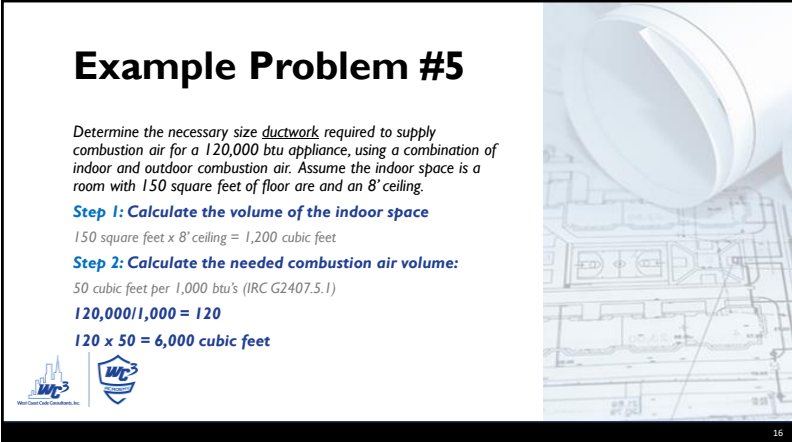

15

Example Problem #5

Determine the necessary size ductwork required to supply combustion air for a 120,000 btu appliance, using a combination of indoor and outdoor combustion air. Assume the indoor space is a room with 150 square feet of floor are and an 8' ceiling.

Step 1: Calculate the volume of the indoor space
 150 square feet x 8' ceiling = 1,200 cubic feet

Step 2: Calculate the needed combustion air volume:
 50 cubic feet per 1,000 btu's (IRC G2407.5.1)
 $120,000/1,000 = 120$
 $120 \times 50 = 6,000$ cubic feet

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Example Problem #5

Step 3: Determine the ratio of available vs. required volume
 $1,200 / 6,000 = 0.20$

Step 4: Determine the outdoor size reduction factor
 $1 - 0.20 = 0.80$

Step 5: Calculate required size of outdoor air using the one or two-permanent openings method. (assume one-permanent opening per G2407.6.2)

Step 5a: Calculate required square inches of openings
 $1 \text{ square inch} / 3,000 \text{ btu's (IRC G2407.6.2)}$
 $120,000 / 3,000 = 40 \text{ square inches.}$

17

17




Example Problem #5

Step 5b: Reduce by the reduction factor (Step 4)
 $40 \text{ si required} \times 0.80 = 32 \text{ si}$

Step 6: Calculate required size of ducts
 Square Duct: $L \times W$ IRC G2407.6 – 3" minimum dim.

Multiple options: 6" x 6" minimum = 36 si
 Round Duct: $\pi \times R^2$ $R = \text{Radius}$ $\pi = 3.14$
 8" duct = 50.27 si si = square inches

Duct Size	Area
3	7.07
4	12.57
5	19.63
6	28.27
8	50.27
10	78.54
12	113.1

18

18



END




19

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**2021 IRC
Supplement B**

*Gas Line Sizing Sample
Questions*

1

LEARNING OBJECTIVES

1. Practice multiple sizing examples to better understand gas pipe sizing.
2. Understand how to use the tables in the IRC to accurately answer gas line sizing questions.
3. Work through the equations step-by-step to ensure arrival at the correct answer.

2

Three Sizing Options

IRC 2413.3:

1. **Table in the IRC**
2. **Manufacturer's Tables**
3. **Approved Engineering Methods**

G2413.3 (402.3) Sizing. *Gas piping* shall be sized in accordance with one of the following:

1. *Pipe* sizing tables or sizing equations in accordance with Section G2413.4 or G2413.5, as applicable.
2. The sizing tables included in a *listed piping* system's manufacturer's installation instructions.
3. *Approved engineering methods*.

3

Three Sizing Methods

IRC 2413.4:

G2413.4 (402.4) Sizing tables and equations. This section applies to piping materials other than noncorrugated stainless steel tubing. Where Tables G2413.4(1) through G2413.4(2) are used to size *piping or tubing*, the *pipe* length shall be determined in accordance with Section **G2413.3.1, G2413.4.2 or G2413.4.3.**

Key Factors:

1. **Length of Pipe**
2. **Pressure of System**
3. **Btu's Served (Loads)**

1. **Longest Length G2413.4.1**
2. **Branch Length G2413.4.2**
3. **Hybrid Pressure G2413.4.3**

4

IRC
Gas Line Sizing – Question #1

International Code Council 2021 IFGC ©

5

Question #1: 4 oz. Meter ★

Size the blue sections of steel natural gas pipe using the longest length method. Assume 0.5 in. w.c. pressure drop.

International Code Council 2021 IRC ©

6

Longest Length Method

IRC 2413.4.1: (Also see IFGC 402.4.1)

G2413.4.1 (402.4.1) Longest length method. The pipe size of each section of gas piping shall be determined using the longest length of piping from the point of delivery to the most remote outlet and the load of the section.

International Code Council 2021 IRC ©

7

General Rules:

TABLE G2413.4(1) (402.4(2)) SCHEDULE 40 METALLIC PIPE		Gas (Natural)
Inlet Pressure		Less than 2 psi
Pressure Drop		0.5 in. w.c.
Specific Gravity		0.60

International Code Council 2021 IRC ©

Nominal Length (ft)	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.822	0.924	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Capacity in Cubic Feet of Gas per Hour									
10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
20	118	247	466	957	1,430	2,760	4,400	7,780	15,900
30	95	199	374	768	1,150	2,220	3,530	6,250	12,700
40	81	170	320	657	985	1,900	3,020	5,350	10,900
50	72	151	284	583	873	1,680	2,680	4,740	9,660

International Code Council 2021 IRC, Table G2413.4(1)(a)

Step I: Find the Right Table

Pressure Drop:

- 4 oz. System- Use 0.3 in. w.c.
- 2 lb. System- Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

I P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

International Code Council 2021 IRC ©

8

Question #1:

First Section:
Longest Length = 45' (10+15+15+5)
Total btu's = 230,000 btu (120k + 40k + 70k) $230,000/1,000 = 230$ CFH

Nominal	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.669	3.368	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,900	3,020	5,350
	50	72	151	284	583	873	1,680	2,680	4,740

International Code Council 2021 IRC, Table G2413.4(1)(D)

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

9

Impact of Gas Content

Check with gas utility- btu's per CFH vary from location to location and are affected by altitude

Depending upon the utility provider:
 1 CFH = +/- 1,000 btu's
 or
 1 CFH = 800 - 1,000 btu's

Country	STANDARD DERATION FACTORS			
	Density Factor (Relative to Air)	Thermal Conductivity	Specific Gravity	BTU/cubic ft
Eachfield (cont)				
Cookville	76	88	0.90	710
Elmore	76	89	0.90	710
Fairburn	76	89	0.90	710
Fairview	76	89	0.90	710
Fayetteville	76	89	0.90	710
Fountain Creek	76	89	0.90	710
Greenville	76	89	0.90	710
Greenville	80	90	0.90	800

10

Question #1:

Next Section:
Longest Length = 45' (Doesn't change)
Total btu's = 110,000 btu (40k + 70k) $110,000/1,000 = 110$ CFH

Nominal	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.669	3.368	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,900	3,020	5,350
	50	72	151	284	583	873	1,680	2,680	4,740

International Code Council 2021 IRC, Table G2413.4(1)(D)

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

11

Question #1:

Final Section:
Longest Length = 45' (Doesn't change)
Total btu's = 70,000 (70k) $70,000/1,000 = 70$ CFH

Nominal	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.669	3.368	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,900	3,020	5,350
	50	72	151	284	583	873	1,680	2,680	4,740

International Code Council 2021 IRC, Table G2413.4(1)(D)

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

12

Question #1:

Branch Lines:
Longest Length = 45'
Total btu's = 120,000 btu (120k) $120,000/1,000 = 120$ CFH

Nominal	PIPE SIZE (inches)									
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.549	3.068	4.026	5.047
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
Capacity	20	118	247	466	857	1,430	2,760	4,400	7,780	15,000
	30	95	199	374	708	1,150	2,220	3,530	6,250	12,760
	40	81	170	320	657	985	1,900	3,020	5,350	10,900
	50	72	151	284	583	873	1,680	2,680	4,740	9,660

International Code Council 2021 IRC Table G2413.4(1)D

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

13

Question #1:

Branch Lines:
Longest Length = 45'
Total btu's = 40,000 btu (40k) $40,000/1,000 = 40$ CFH

Nominal	PIPE SIZE (inches)									
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.549	3.068	4.026	5.047
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
Capacity	20	118	247	466	857	1,430	2,760	4,400	7,780	15,000
	30	95	199	374	708	1,150	2,220	3,530	6,250	12,760
	40	81	170	320	657	985	1,900	3,020	5,350	10,900
	50	72	151	284	583	873	1,680	2,680	4,740	9,660

International Code Council 2021 IRC Table G2413.4(1)D

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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IRC
 INTERNATIONAL RESIDENTIAL CODE®
 for One- and Two-Family Dwellings

2021

IRC
 Gas Line Sizing – Question #2

International Code Council 2021 IRC ©

15

Question #2:

2 lb. Meter ★

Size the blue sections of steel natural gas pipe using the longest length method. Assume 1.0 in. w.c. pressure drop.

Note: Standard natural gas appliances are designed for 4 oz. pressures. This system would require a regulator at each appliance.

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General Rules:

Gas: Natural

TABLE G2413.4(2) (402,415) SCHEDULE 40 METALLIC PIPE

Inlet Pressure: 2.0 psi

Pressure Drop: 1.0 psi

Specific Gravity: 0.60

Nominal Length (ft)	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.622	0.824	1.049	1.315	1.610
Capacity in Cubic Feet of Gas					
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050

International Code Council 2021 IRC, Table G2413.4(2)D

Pressure Drop:

- 1 lb. System - Use 0.3 in. w.c.
- 2 lb. System - Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

17

Question #2:

First Section:
Longest Length = 80' (20 + 25 + 25 + 10)
Total btu's = 210,000 (75k + 35k + 100k) 210,000/1,000 = 210 CFH

CFH = +/- 1,000 BTU

*real world application- adjust per local conditions

* Gas utility companies may require 3/4" minimum lines to support the gas meter. Check local requirements

18

Question #2:

Next Section:
Longest Length = 80' (Doesn't change)
Total btu's = 135,000 (35k + 100k) 135,000/1,000 = 135 CFH

CFH = +/- 1,000 BTU

*real world application- adjust per local conditions

19

Question #2:

Final Section:
Longest Length = 80' (Doesn't change)
Total btu's = 100,000 (100k) 100,000/1,000 = 100 CFH

CFH = +/- 1,000 BTU

*real world application- adjust per local conditions

20

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for One- and Two-Family Dwellings

2021

IRC
Gas Line Sizing – Question #3

International Code Council 2021 IRC ©

21

Question #3:

Size the blue sections of steel propane gas pipe using the longest length method. Assume 0.5 in. w.c. pressure drop.

Propane ★

West Coast Code Consultants, Inc. ©

22

22

General Rules:

Gas: Undiluted Propane

- Inlet Pressure 11.0 in. w.c.
- Pressure Drop 0.5 in. w.c.
- Specific Gravity 1.50

International Code Council 2021 IRC ©

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
Nominal Length (ft)	PIPE SIZE (inches)					
	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067
Capacity in Thousands of Btu per Hour	10	291	608	1,150	2,350	3,520
	20	200	418	787	1,620	2,420
						4,660

International Code Council 2021 IRC, Table G2413.4(12) ©

Pressure Drop:
See table- 0.5 in. w.c.

Specific Gravity:
Natural Gas- 0.6
Propane- 1.5

Inlet Pressure:
From storage tank- likely 10.5 in W.C.
1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

23

23

Question #3:

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
Nominal Length (ft)	PIPE SIZE (inches)					
	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067
Capacity in Thousands of Btu per Hour	10	291	608	1,150	2,350	3,520
	20	200	418	787	1,620	2,420
						4,660

International Code Council 2021 IRC, Table G2413.4(12) ©

First Section:
Longest Length = 20' (3+3+5+1+5+3)
Total btu's = (50,000 + 65,000 + 120,000 + 100,000 + 80,000) = 415,000 btu's
(Divide by 1,000 = 415 kbtu/h)

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24

Question #3:

Second Section:
 Longest Length = 20' (Doesn't change)
 Total btu's = 365,000 (Divide by 1,000 = 365)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 3/4	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	590	1,216	2,300	4,700	7,040	13,580

International Code Council 2021 IRC, Table G2413.4(1)(2) D

25

Question #3:

Third Section:
 Longest Length = 20' (Doesn't change)
 Total btu's = 300,000 (Divide by 1,000 = 300)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 3/4	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	590	1,216	2,300	4,700	7,040	13,580

International Code Council 2021 IRC, Table G2413.4(1)(2) D

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Question #3:

Fourth Section:
 Longest Length = 20' (Doesn't change)
 Total btu's = 180,000 (Divide by 1,000 = 180)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 3/4	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	590	1,216	2,300	4,700	7,040	13,580

International Code Council 2021 IRC, Table G2413.4(1)(2) D

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Question #3:

Final Section:
 Longest Length = 20' (Doesn't change)
 Total btu's = 80,000 (Divide by 1,000 = 80)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 3/4	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	590	1,216	2,300	4,700	7,040	13,580

International Code Council 2021 IRC, Table G2413.4(1)(2) D

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IRC
Gas Line Sizing – Question #4

29

Branch Length ★

Question #4:
Size all pipe sections of natural gas pipe using the branch length method. Assume 0.5 in. w.c. pressure drop.

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Branch Length Method

IRC G2413.4.2: (Also see IFGC 402.4.2)

G2413.4.2 (402.4.2) Branch length method. Pipe shall be sized as follows:

1. Pipe size of **each section** of the longest pipe run from the **point of delivery** to the most remote **outlet** shall be determined using the longest run of piping and the load of the section.
2. The pipe size of each section of branch piping not previously sized shall be determined using the length of piping from the **point of delivery** to the most remote **outlet** in each branch and the load of the section.

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General Rules:

TABLE G2413.4(1) [402.4(2)] SCHEDULE 40 METALLIC PIPE

Gas (Natural)
 Inlet Pressure: Less than 2 psi
 Pressure Drop: 0.5 in. w.c.
 Specific Gravity: 0.60

International Code Council 2021 IRC ©

Nominal Length (ft)	PIPE SIZE (inches)			
	2 1/2	3	4	6
Actual ID	0.622	0.824	1.049	1.310
Capacity in Cubic Feet of Gas per Hour	2,090	4,020	6,400	11,900
10	172	360	678	1,300
20	118	247	466	957
30	95	199	374	768
40	81	170	320	657
50	72	151	284	583

International Code Council 2021 IRC, Table G2413.4(1)D

Pressure Drop:
 4 oz. System- Use 0.5 in. w.c.
 2 lb. System- Use 1 in. w.c.

Specific Gravity:
 Natural Gas- 0.6
 Propane- 1.5

Inlet Pressure:
 Residential- 4 oz. (typ.) 2 lb. available
 Commercial- 2 lb. (typ.) 5 lb. available

Step I: Find the Right Table
 1 P.S.I. = 16 oz. or 28 in. w.c.
 4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

32

Question #4:

Branch #3:
Branch Length (Section 1) = 45' (10+15+15+5)
Total Branch btu's = 230,000 btu (120k + 40k + 70k) 230,000/1,000 = 230 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal Length (ft)	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Capacity in Cubic Feet of Gas per Hour	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,900	3,020	5,350
	50	72	151	284	583	873	1,680	2,880	4,760

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Question #4:

Branch #3:
Branch Length (Section 2) = 45'
Total Branch btu's = 110,000 btu (40k + 70k) 110,000/1,000 = 110 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal Length (ft)	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Capacity in Cubic Feet of Gas per Hour	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,900	3,020	5,350
	50	72	151	284	583	873	1,680	2,880	4,760

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Question #4:

Branch #3:
Branch Length (Section 3) = 45'
Total Branch btu's = 70,000 btu (70k) 70,000/1,000 = 70 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal Length (ft)	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Capacity in Cubic Feet of Gas per Hour	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,900	3,020	5,350
	50	72	151	284	583	873	1,680	2,880	4,760

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Question #4:

Branch #2:
Branch Length = 28' (10 + 15 + 3)
Total Branch btu's = 40,000 btu (40k) 40,000/1,000 = 40 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal Length (ft)	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Capacity in Cubic Feet of Gas per Hour	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,900	3,020	5,350
	50	72	151	284	583	873	1,680	2,880	4,760

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Question #4:

Branch #1:
Branch Length = 15' (10 + 5)
Total btu's = 120,000 (120k) $120,000/1,000 = 120$ CFH

Nominal Length (ft)	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.622	0.824	1.049	1.380	1.615	2.067	2.469	3.068	4.026
Capacity in Cubic Feet of Gas per Hour	172	360	678	1,390	2,090	4,020	6,400	11,200	23,100
30	95	189	374	768	1,150	2,220	3,530	6,250	12,700
40	81	170	320	657	985	1,900	3,020	5,350	10,900
50	72	151	284	583	873	1,680	2,680	4,760	9,660

International Code Council 2021 IRC, Table G2413.4(1)D

CFH = +/- 1,000 BTU
 Largest branch requirement governs

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Compare:

LONGEST LENGTH

BRANCH LENGTH

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IRC
 INTERNATIONAL RESIDENTIAL CODE®
 for One- and Two-Family Dwellings

2021

IRC
 Gas Line Sizing – Question #5

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Question #5:

Hybrid Pressure ★

Size the blue sections of natural gas pipe using the hybrid method. Assume Sch. 40 steel from the meter to the regulator, and CSST after the regulator.

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Hybrid Pressure Method

IRC 2413.4.3: (Also see 402.4.3)

G2413.4.3 (402.4.3) Hybrid pressure. The pipe size for each section of higher pressure gas piping shall be determined using the longest length of piping from the point of delivery to the most remote line pressure regulator. The pipe size from the line pressure regulator to each outlet shall be determined using the length of piping from the regulator to the most remote outlet served by the regulator.

PRESSURE CONVERSION CHART		
1/4 PSI =	7" w.c. =	4 oz.
1/2 PSI =	14" w.c. =	8 oz.
1 PSI =	28" w.c. =	16 oz.
2 PSI =	56" w.c. =	32 oz.

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General Rules:

TABLE G2413.4(2) (402.4(5)) SCHEDULE 40 METALLIC PIPE

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.622	0.824	1.049	1.380	1.610
Length (ft)	Capacity in Cubic Feet of Gas				
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050
90	502	1,010	1,850	3,810	5,700

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Pressure Drop:

- 1 lb. System - Use 0.3 in. w.c.
- 2 lb. System - Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

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Question #5:

First Section:
Longest Length to Regulator = 11' (3+3+5) i.e. Length 1
Longest Length from Regulator = 14' (5+1+5+3) i.e. Length 2

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Question #5:

First Section:
Longest Length = 11' (Length 1)
Total btu's = 4,350 cfh (1,200 + 750 + 800 + 600 + 1,000)

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.622	0.824	1.049	1.380	1.610
Length (ft)	Capacity in Cubic Feet of Gas				
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050
90	502	1,010	1,850	3,810	5,700

International Code Council 2021 IRC, Table G2413.4(2) ©

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Question #5:

Next Section:
Longest Length = 11' (Length 1 - again)
Total btu's = 3,150 cfh (750 + 600 + 800 + 1000)

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.822	0.824	1.049	1.310	1.610
Length (ft)	10	1510	3040	5560	11000
Capacity in Cubic Feet of Gas	20	1,070	2,150	3,930	8,070
10	300	300	1,760	3,110	4,300
40	755	1,250	2,740	5,110	8,550
50	875	1,340	2,490	5,110	7,650
60	915	1,340	2,370	4,660	6,960
70	949	1,150	2,100	4,320	6,470
80	932	1,080	1,970	4,040	6,050

International Code Council 2021 IRC, Table G2413.4(2) ©

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Question #5:

End Section:
Longest Length = 11' (Length 1 - again)
Total btu's = 2,400 cfh (600 + 800 + 1000)

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.822	0.824	1.049	1.310	1.610
Length (ft)	10	1510	3040	5560	11000
Capacity in Cubic Feet of Gas	20	1,070	2,150	3,930	8,070
10	300	300	1,760	3,110	4,300
40	755	1,250	2,740	5,110	8,550
50	875	1,340	2,490	5,110	7,650
60	915	1,340	2,370	4,660	6,960
70	949	1,150	2,100	4,320	6,470
80	932	1,080	1,970	4,040	6,050

International Code Council 2021 IRC, Table G2413.4(2) ©

Note: The 750 cfh and 1,200 cfh appliance would require individual regulators to drop pressure to appliances.

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Question #5:

1st Section:
Longest Length = 14' (Length 2 - CSST)
Total btu's = 2,400 cfh (600 + 800 + 1000)

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.822	0.824	1.049	1.310	1.610
Length (ft)	10	1510	3040	5560	11000
Capacity in Cubic Feet of Gas	20	1,070	2,150	3,930	8,070
10	300	300	1,760	3,110	4,300
40	755	1,250	2,740	5,110	8,550
50	875	1,340	2,490	5,110	7,650
60	915	1,340	2,370	4,660	6,960
70	949	1,150	2,100	4,320	6,470
80	932	1,080	1,970	4,040	6,050

International Code Council 2021 IRC, Table G2413.4(2) ©

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Pressure Regulators:

Check with Manufacturer Regarding:

- Outlet Pressure (0.5 psi is common)
- Pressure Drop (+/- 0.5 in w.c. common)*

*Use the 3.0 in. w.c. table

Model Number	Pipe Size	Outlet Pressure Inlet Point	Operating Inlet Pressure		
			1/2 gal (0.8 MPa)	1 gal (1.2 MPa)	1 gal (1.5 MPa)
125-147	1/2" x 1/2"	10" w.c.	125 (1.5)	125 (1.5)	125 (1.5)
		10" w.c.	100 (1.2)	125 (1.5)	125 (1.5)

7" w.c. = 0.25 psi

Model Number	Pipe Size	Pressure Drop	
		7" w.c. (1.7 MPa)	3/4 gal (1.2 MPa)
125-147	1/2" x 1/2"	100 (1.2)	100 (1.2)

Adjustable to +/- 0.5 psi

Conversions:
 In w.c. divided by 27.708 = psi
 Psi x 27.708 = in. w.c.

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Manufacturer's Table:

Pipe Material

- CSST (Corrugated Stainless-Steel Tubing) - GasTite

Pressure Drop:

- Regulator Manufacturer- Use 3.0 in. w.c.

Specific Gravity:

- Natural Gas- 0.6

Inlet Pressure:

- 0.5 PSI- Given in Example

Pressure Conversion Chart

1/4 PSI	=	7" w.c.	=	4 oz.
1/2 PSI	=	14" w.c.	=	8 oz.
1 PSI	=	28" w.c.	=	16 oz.
2 PSI	=	56" w.c.	=	32 oz.

Make sure you're in the right table and verify values!

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Question #5:

1st Section:
Longest Length = 14' (Length 2)
Total btu's = 2,400 cfh (600 + 800 + 1000)

EHD = Equivalent Hydraulic Diameter

Check with manufacturer- as nominal pipe sizes and EHD may vary slightly

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Question #5:

Next Section:
Longest Length = 14' (Length 2)
Total btu's = 1,800 cfh

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Question #5:

End Section:
Longest Length = 14' (Length 2)
Total btu's = 1,000 cfh

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Materials not Covered:

- **PE Pipe (Polyethylene Plastic)**
 - Similar process, use Tables G2413.4(7), (8), (20)
- **PE Tubing (Polyethylene Plastic)**
 - Similar process, use Tables G24013.4(21)
- **Semirigid Copper Tubing**
 - Similar process, use Tables G2413.4(3), (4), (13-15)



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Module 3 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A two-family dwelling that is four stories in height shall fall under the provisions of which code?	IRC R101.2	IRC R101	2	International Residential Code	International Building Code		
Which of the following is exempt from a permit?	IRC R105.2 Electrical 3	IRC R105	3	retaining wall 5 feet in height	new deck 250 sf in area	replacing branch circuit overcurrent devices	a new water heater
Any _____ to existing structures are not permitted to cause the existing structure to be come unsafe.	IRC R102.7.1	IRC R102	4	repairs	additions	alterations	all of the above
The duties and powers of the building official include all of the following, except:	IRC R104.1	IRC R104	2	interpret the code	waive the code	enforce provisions of the code	adopt policies and procedures
For what period of time should records be retained?	IRC R104.7	IRC R104	1	the period required for the retention of public records	180 days	90 days	60 days
What is the permitted size of a 1-story detached accessory structure to be installed without a building permit?	IRC R105.2 Building 1	IRC R105	3	180 ft ²	250 ft ²	200 ft ²	150 ft ²
A prefabricated swimming pool ≤ 28" deep is exempt from a building permit	IRC R105.2 Building 7	IRC R105	2	TRUE	FALSE		
Where equipment replacement or repairs must be performed in an emergency situation, the permit application shall be submitted _____ to the B.O.	IRC R105.2.1	IRC R105	4	as soon as possible	the following day	within 48 hours	within the next business day
Work must commence on a building permit within ____ days of issuance.	IRC R105.3.2	IRC R105	3	60	120	180	90
A certificate of occupancy shall include all of the following information, except:	IRC R110.3	IRC R110	1	Issuance date	Address of the structure	Name of the owner	Name of the code official

Module 4 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the ultimate design wind speed for Utah?	IRC Figure R301.2(2)	IRC R301	1	105 mph	120 mph	125 mph	150 mph
Is a roof with a height of 47 feet permitted to use No. 8 wood screws with a wind speed of 175mph.	IRC R301.2.1.2 Exception	IRC R301	2	True	False		
Open terrain with scattered obstructions, including surface undulations or other irregularities that are generally less than 30 feet in height shall be classified as _____.	IRC R301.2.1.4 Item 2	IRC R301	3	Exposure A	Exposure B	Exposure C	Exposure D
Wind is the only load that needs to be considered when determining a lateral load path.	IRC R301	IRC R301	2	True	False		
A building is required to be engineered when it contains structural elements that exceed the limits of the IRC.	IRC R301.1.3	IRC R301	1	True	False		
Urban areas and wooded areas shall be classified as _____.	IRC R301.2.1.4 Item 1	IRC R301	2	Exposure A	Exposure B	Exposure C	Exposure D
What is the seismic design category for central New York?	IRC Figure R301.2(2)	IRC R301	1	A	B	C	D
What is the minimum uniformly distributed live load (uniform load) for fire escapes?	IRC Table R301.7	IRC R301	4	50	25	30	40
Stiff soil is classified as Site Class _____.	IRC R301.2.2.1	IRC R301	3	B	A	D	E
If a floodplain is located in an identified floodway, the design shall be done per ASCE _____.	IRC R301.2.4	IRC R301	4	10	52	28	24

Module 5 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the minimum fire separation distance for an exterior wall?	IRC Table R302.1(1)	IRC R302	2	5 feet	0 feet	2 feet	10 feet
For outside opening protection air intake/exhaust, openings shall be protected with corrosion-resistant screens, louvers or grilles having a minimum opening size of ____.	IRC R303.6	IRC R303	1	1/4 inch	1/2 inch	3/4 inch	1 inch
A common wall separating a townhouse with an NFPA-13R sprinkler system shall have a minimum rating of ____.	IRC 302.2.2 item 1	IRC 302	1	1 hour	1.5 hours	2 hours	3 hours
A parapet shall be provided for all of the following conditions except:	IRC 302.2.4 Item 2 exception	IRC 302	3	Class A	Class B	Class C roof covering	
A _____ inches thick door shall be provided between private garages and sleeping rooms.	IRC 302.5.1	IRC 302	4	1 3/8 inch	1 1/2 inch	1 5/8 inch	Not permitted
Where heat-producing devices are listed for lesser clearances, combustible insulation complying with the listing requirements shall be separated by _____.	IRC R302.14	IRC 302	1	whatever conditions are stipulated in the listing	3 inches	2 inches	1 inch
When the permitted roof eave projection is 4 inches maxes for a detached garages accessory to a dwelling unit, how close is the building permitted to be to the lot line?	IRC Table R302.1(1)	IRC R302	2	1 foot	2 feet	3 feet	4 feet
Habitable rooms shall have a minimum openable area to the outdoors of _____ of the floor area being ventilated.	IRC R303.1	IRC 303	1	40%	60%	80%	100%
Under which condition is mechanical ventilation required for a dwelling unit?	IRC R303.4	IRC 303	3	20 air changes per hour	10 air changes per hour	5 air changes per hour	
What is the minimum aggregate glazing for lighting in a habitable room?	IRC R303.1	IRC 303	4	2%	6%	4%	8%

Module 6 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the minimum required clearance to be provided in front of the shower compartment?	IRC Figure R307.1	IRC R307	1	24 inches	21 inches	18 inches	15 inches
The nonabsorbent finish provided for a shower shall be a minimum of _____ above the floor.	IRC R307.2	IRC R307	4	3 feet	4 feet	5 feet	6 feet
How many lighting outlets are required on a stairway of 5 risers?	IRC R303.7	IRC R303	2	2 outlets	1 outlet	not required	determined by the B.O.
What is the minimum floor area required for a kitchen?	IRC R304.1	IRC 304	1	70 SF	80 SF	90 SF	100 SF
What is the minimum ceiling height required for a laundry room?	IRC R305.1	IRC R305	3	7'-6"	7"	6'-8"	6"
All dwelling units are required to be provided with a water closet, lavatory, and shower.	IRC R306.1	IRC R306	1	True	False		
What is the minimum category classification of glazing for glazing in sliding glass patio doors, where the exposed area of one side is 8 square feet?	IRC Table R308.3.1(1)	IRC R308	2	Class I	Class II	Class III	Class IV
Glazing and fixed and operable panels of _____ shall be considered a hazardous location.	IRC R308.4.1	IRC R308	4	bifold doors	sliding doors	swinging doors	all of the above
Carports shall be provided with openings on not less than _____.	IRC R309.2	IRC R309	2	one side	two sides	three sides	four sides
What is the minimum clearance required between a bathtub and the water closet?	IRC Figure 307.1	IRC R307	2	12 inches	15 inches	18 inches	21 inches

Module 7 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the minimum required thickness for a piece of wired louvered glass that is 36 inches in length?	IRC R308.2	IRC R308	2	4/8 inch	3/16 inch	3/8 inch	5/8 inch
What is the minimum clear width that shall be provided for the egress door?	IRC R311.2	IRC R311	2	24 inches	32 inches	36 inches	40 inches
What is the minimum required width of hallways provided in dwelling units?	IRC R311.6	IRC R311	1	3 feet	4 feet	5 feet	6 feet
Which of the following locations is required to be provided with protection from decay?	IRC R317.1	IRC R317	4	wood framing members on concrete less than 8 inches from the ground	wood sheathing with a clearance of 6 inches from the ground	wood furring attached directly to the exterior masonry walls	all of the above
What is the minimum thickness required of concrete to be provided to foam plastics to eliminate a thermal barrier?	IRC R316.5.1	IRC R316	4	2 inches	1 3/8 inches	1 1/2 inches	1 inch
What is the minimum clear height required for egress doors?	IRC R311.2	IRC R311	2	72 inches	78 inches	84 inches	96 inches
A photoelectric smoke alarm has been installed in a house. What is the maximum horizontal distance from a cooking appliance it can be when installed?	IRC R314.3.1	IRC R314	1	6 feet	5 feet	4 feet	3 feet
Which of the following conditions triggers the requirements for carbon monoxide alarms to be installed in a dwelling unit?	IRC R315.2.1	IRC R315	4	A- an attached garage with openings that communicate with the dwelling unit	B- fuel-burning appliance(s) in the dwelling unit	neither A or B	either A or B
The minimum stroke width for address characters shall be _____.	IRC R319.1	IRC R319	3	1 inch	0.75 inches	0.5 inches	0.25 inches
When is a structure required to comply with the IBC for accessibility?	IRC R320.1	IRC R320	1	4 or more dwelling units or sleeping units in a single structure	all townhouses	3 condo units	a duplex
All of the following except _____ is required for a quality mark on pressure-preservative lumber:	IRC R317.2.1	IRC R317	3	type of preservative	standard to which it was treated	the maximum preservative retention	the end use for which the product was treated
What is the maximum vertical rise permitted between floor levels within a single-family dwelling?	IRC R311.7.3	IRC R311	3	196 inches	147 inches	151 inches	132 inches
What is the minimum required height to be provided for a guardrail provided for a balcony?	IRC R312.1.2	IRC R312	1	36 inches	24 inches	21 inches	18 inches
Solar panels located on a roof with a slope of 2:12 shall be located in a manner than provides two 3-foot-wide access paths.	IRC R324.6	IRC R324	2	True	False		
What is the minimum clear height below a mezzanine floor?	IRC R325.2	IRC R325	2	6'-8"	7'	7'-6"	8'
The surface burning characteristics of foam plastic that is 4 inches thick or less shall have a flame spread index of _____ and a smoke-developed index of not more than _____.	IRC R316.3	IRC R316	3	25, 450	50, 450	75, 450	100, 450

Module 8 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the load-bearing pressure of sedimentary rock?	IRC Table R401.4.1	IRC R401	3	12,000 psf	8,000 psf	4,000 psf	3,000 psf
The minimum compressive strength required for precast concrete is _____ for a minimum of _____.	IRC R402.3.1	IRC R402	3	2,000 psi, 30 days	3,500 psi, 15 days	5,000 psi, 28 days	8,000 psi, 28 days
The top surface of footings shall be level.	IRC R403.1.5	IRC R403	1	True	False		
A single story plus basement dwelling of light-frame construction must have a footing of _____ where the load bearing value of the soil is 3500 psi and a snow load of 20 psf.	IRC Table R403.1(1)	IRC R403	4	15x9	14x8	13x7	12x6
The foundations for single-story light-framed buildings under _____ square feet are not required to extend to frost depth.	IRC R403.1.4.1, Exception #1	IRC R403	2	400	600	900	1000
Joints for the moisture barrier provided for exterior foundation walls prior to backfilling shall be _____ minimum.	IRC R406.3.2	IRC R406	3	2 inches	4 inches	6 inches	8 inches
A vapor retarder with joists lapped not less than _____ shall be placed between the slab and the subgrade.	IRC R506.2.3	IRC R506	3	2 inches	4 inches	6 inches	8 inches
Crush stone footings are permitted in all of the following seismic design categories except?	IRC R403.4.1	IRC R403	4	Category A	Category B	Category C	Category D
A 6-foot-high plain masonry foundation wall subjected to 4 feet of unbalanced backfill of soil class is GC, must have a wall thickness of _____ nominal.	IRC Table R404.1.1(1)	IRC R404	2	6 inches	8 inches	10 inches	12 inches
Masonry piers which are hollow shall have a minimum nominal thickness of _____ inches.	IRC R404.1.9	IRC R404	1	8	6	4	10
Wood sill plates shall be anchored to the foundation with minimum _____ inch diameter anchor bolts that are spaced not more than _____ feet on center.	IRC R403.1.6	IRC R403	3	1/2, 8	1/4, 6	1/2, 6	5/8, 8
Exterior footings shall be placed not less than _____ inches below the undisturbed ground surface.	IRC R403.1.4	IRC R403	4	6	8	10	12

Module 9 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the maximum span of Douglas-fir-larch #1 2x6 floor joist spaced at 19.2 inches on center, when the dead load is 20 in a living room?	IRC Table R502.3.1(2)	IRC R502	4	11 feet	10 feet 5 inches	9 feet 9 inches	8 feet 10 inches
The end of each girder shall have not less than _____ of bearing on wood.	IRC R502.6	IRC R502	1	1 1/2 inches	2 inches	2 1/2 inches	3 inches
What is the minimum thickness of lumber floor sheathing, where the floor joists are spaced 24 inches and installed diagonal to the joist?	IRC Table R503.1	IRC R503	2	11/16 inch	3/4 inch	5/8 inch	3/8 inch
Subflooring is permitted to be omitted where joist spacing does not exceed _____.	IRC R503.1.1	IRC R503	3	10 inches	12 inches	16 inches	18 inches
If four hold-down tension devices are used on a deck, they shall have an allowable tension capacity of not less than _____ pounds.	IRC R507.9.2	IRC R507	1	750	800	950	1000
Deck boards, stair treads, guards, and handrails that have wood shall be _____.	IRC R507.2.2.3	IRC R507	2	decay resilient	decay resistant	termite resilient	termite resistant
Notches made in solid lumber joists, rafters and beams shall not exceed _____ of the depth of the member, not longer than _____ of the depth of the member and not be located in the middle _____ of the span.	IRC R502.8.1	IRC R502	4	1/4, 1/2, 1/3	1/4, 1/3, 1/3	1/8, 1/4, 1/4	1/6, 1/3, 1/3
The side of tension of solid lumber joist members _____ inches or greater in nominal thickness shall not be notched, unless done at the ends of the members.	IRC R502.8.1	IRC R502	3	6	3	4	2
The header joist shall be a single member the same size as the floor joist where the span does not exceed _____ feet.	IRC R502.10	IRC R502	1	4	6	8	10
Lips and flanges of load-bearing cold-formed steel floor framing members shall not be _____ or cut for any reason.	IRC R505.3.5	IRC R505	2	altered	notched	spliced	changed
Slab-on-grade floors constructed of concrete shall be a minimum _____ inches thick.	IRC R506.1	IRC R506	3	4 1/2	4	3 1/2	3

Module 10 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Interior nonbearing wall shall be permitted to be constructed with ____ inch by ____ inch studs.	IRC R602.5	IRC R602	4	2x10	2x8	2x5	2x3
Where the backing of masonry walls are bonded with adjustable wall ties, a wall tie shall be provided for each ____ of wall area.	IRC R606.13.2.2	IRC R606	3	4.67 square feet	3.57 square feet	2.67 square feet	1.98 square feet
What is the minimum solid wall length the walls supporting the second story and a roof of light-framed construction in Seismic Category C?	IRC Table R606.12.2.1	IRC R606	3	35	30	25	20
A stud in a bearing partition is permitted to be notched to a depth not exceeding ____ percent of its width.	IRC R602.6 Item 1	IRC R602	1	25	30	35	40
A wood stud double top plate shall be not less than ____ in nominal thickness.	IRC R602.3.2	IRC R602	3	1 inch	1 1/2 inches	2 inches	2 1/2 inches
The maximum center to center stud spacing when supporting a roof is ____ where the stud size is 3x4.	IRC Table R602.3(5)	IRC R602	3	16 inches	20 inches	24 inches	36 inches
Townhomes in Seismic Design Category C <u>do not</u> need to use the seismic tables for determining the braced wall length along each braced wall line, and can simply refer to the wind tables.	IRC Table R602.10.3(3)	IRC Table R602.10.3(3)	2	TRUE	FALSE		
The maximum spacing of braced wall lines in Seismic Design Category B is ____.	IRC Table R602.10.1.3	IRC Table R602.10.1.3	4	25 feet	35 feet	20 feet	60 feet
Mullions shall be capable of resisting a load ____ the design pressure loads applied by the window assembly.	IRC R609.8.3	IRC R609	4	5 times	3 times	2.5 times	1.5 times
Steel studs and other structural members are not permitted to be ____ without an approved design.	IRC R603.3.5	IRC R603	1	spliced	cut	notched	bored
What is the minimum thickness of masonry bearing walls more than one story high?	IRC R606.4.1	IRC R606	3	10 inches	6 inches	8 inches	12 inches
What percentage of a single stud in a non-bearing wall is permitted to be notched?	IRC R606.4.2	IRC R607	2	25%	40%	33%	50%

Module 11 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
In cold-form steel framing, cripple, jack, and king studs shall be the same thickness and dimension as the adjacent _____ studs.	IRC R603.7	IRC R603	2	foundation	wall	partition	bearing
Continuously sheathed and intermittent braced wall panels shall be constructed in accordance with this section. Mixing bracing methods shall be _____.	IRC R602.10.4.1	IRC R602	1	permitted	prohibited	considered by the building official	done with approval by the AHJ
What must the ultimate design wind speed be in order to use the simplified wall bracing methods for the structure being built?	IRC R602.12	IRC R602	4	≤ 110 mph	≤ 120 mph	≤ 140 mph	≤ 130 mph
End joints in top plates shall be offset not less than _____ inches for wood stud walls that are capped with a double top plate that provides overlapping at corners and intersections with bearing partitions.	IRC R602.3.2	IRC R602	4	8	12	18	24
What is the minimum thickness of solid masonry walls for one-story dwellings and garages which are not greater than 9 feet in height?	IRC R606.4.1	IRC R606	3	4 inches	8 inches	6 inches	12 inches
What type of pipes are not permitted for the pumping of grout?	IRC R606.3.5.1	IRC R606	2	steel	aluminum	cast iron	PVC
Where rafters, joists, or trusses are spaced greater than 16 inches on center and the bearing studs below are spaced 24 inches on center, such members shall bear within _____ inches of the studs beneath.	IRC R602.3.3	IRC R602	1	5	6	8	4
What percentage of a stud depth in an exterior wall or bearing partition is permitted to be cut or notched?	IRC R602.6	IRC R602	1	25%	40%	33%	not permitted
What is the minimum number of braced wall panels required for braced wall lines greater than 16 feet?	IRC R602.10.2.3	IRC R602	4	three	five	four	two
How offset (in feet) shall exterior wood frame walls parallel to braced wall lines be from the designated braced wall line location?	IRC 602.10.1.2	IRC R602	3	6 feet	5 feet	4 feet	3 feet

Module 12 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A _____ vapor retarder shall be used in Climate Zone Marine 4 on cladding for fiberboard.	IRC Tables R702.7(1-3)	IRC R702	1	Class III	Class II	Class I	
Asphalt felt used as a water barrier applied horizontally shall be lapped not less than _____ over the lower layer.	IRC R703.2	IRC R703	2	1 inch	2 inches	3 inches	4 inches
The maximum nominal thickness of masonry veneer on wood framing in seismic category C shall be _____.	IRC Table R703.8(1)	IRC R703	3	3 inches	4 inches	5 inches	6 inches
Where 3/8 gypsum board is used as an interior ceiling covering and installed perpendicular to the framing member at 16 inches on center, the maximum spacing of screws shall be _____.	IRC Table R702.3.5	IRC R702	3	8 inches	10 inches	12 inches	16 inches
What is the minimum plaster thickness for wire lath based gypsum plaster masonry?	IRC Table R702.1(1)	IRC R702	2	3/4 inch	5/8 inch	1/2 inch	7/8 inch
Each coat of cement plaster shall be kept in moist conditions for a minimum of _____ before the application of the next coat.	IRC R702.2.2.1	IRC R702	2	12 hours	24 hours	36 hours	48 hours
Type S and Type W screws are approved to attached gypsum board and gypsum panels to wood framing.	IRC R702.3.5.1	IRC R702	1	TRUE	FALSE		
What is the minimum flame spread index for fire-retardant-treated wood used in roof framing?	IRC R802.1.5	IRC R802	1	25	50	75	100
A minimum of _____ - 16d common nails shall be used at the heel connection of a rafter and ceiling joist when the rafter has a slope of 4:12, spacing of 24-inches on-center, the roof span is 24-feet, and the ground snow load is 30psf.	IRC Table R802.5.2(1)	IRC R802	3	7	8	9	13
Where Douglas fir-larch #3 ceiling joists create an uninhabitable attic without storage and are spaced at 12 inches on center, what is the maximum allowable span when 2x6 members are used?	IRC Table R802.4.1(1)	IRC R802	1	16 feet, 3 inches	11 feet, 1 inch	20 feet, 7 inches	15 feet, 10 inches
For stick-framed roofs, a ridge beam is required in lieu of a ridge board when the slope of the roof is less than _____.	IRC R802.3	IRC R802	3	1:12	2:12	3:12	4:12
What is the maximum roof rafter span for a 2x8's spaced at 19.2 inches on-center and consisting of Hem-fir #2 when a ceiling is attached and the roof live load equals 20 psf. (Assume a dead load of 10 psf.)	IRC Table R804.3.2.1(1)	IRC R804	2	12'-4"	13'-3"	16'-10"	16'-3"
An eave can overhang a maximum of _____.	IRC R804.3.2.1.1	IRC R804	4	12 inches	18 inches	20 inches	24 inches
What is the minimum thickness required for roof sheathing that is on a rafter spaced at 24 inches?	IRC Table R803.1	IRC R803	2	3/8 inch	5/8 inch	1 inch	1 1/2 inch
For stick-framed roofs, collar ties are to be placed within the upper third of the attic space at a maximum spacing of 2-feet on-center.	IRC R802.4.6	IRC R802	2	TRUE	FALSE		
Rafters and ceiling joists shall bear a minimum of _____ on concrete or masonry walls.	IRC R802.6	IRC R802	4	1 inch	1.5 inches	2 inches	3 inches
Which of the following Climate Zones is not required to install a vapor retarder on the warm-in-winter side of the ceiling?	IRC R806.2	IRC R806	1	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8

Module 12 Quiz Questions

The minimum dimensions for attic access openings shall be _____ inches by _____ inches.	IRC R807.1	IRC R807	4	30 by 20	22 by 24	30 by 30	22 by 30
A Class A, B, or C roof shall be installed where the edge of a roof is less than _____ from the lot line.	IRC R902.1	IRC R902	2	4 feet	3 feet	2 feet	1 foot
When a chimney penetration is _____ wide, a cricket shall be installed on the ridge side.	IRC R903.2.2	IRC R903	2	24 inches	30 inches	36 inches	48 inches
Metal roof shingles may be installed on roof slopes that are _____ or greater.	IRC R905.4.2	IRC R905	1	3:12	2:12	1:12	1/2:12
The minimum number of fasteners per slate for slate shingles shall be _____.	IRC R905.6.5	IRC R905	3	4	3	2	1
What is the minimum clearance to combustibles for an unlisted combustion air duct supplying outside air to a factory-built fireplace?	IRC R1006.3	IRC R1006	1	1 inch	2 inches	3 inches	5 inches
A hearth extension shall be not less than _____ inches in front of and not less than _____ inches beyond each side of the fireplace.	IRC R1001.10	IRC R1001	3	8, 16	16, 16	16, 8	8, 8

Module 13 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What shall be completed and located in an approved location that lists the predominant R-values of the insulation installed in the ceiling/roof walls, walls, foundation and ducts outside conditioned spaces, and U-factors for fenestration?	IRC N1101.14	IRC N1101	2	An approved building permit	A permanent certificate	Authorization from AHJ	REScheck
Attic and crawl space access doors from the conditioned space to unconditioned spaces shall be _____ and _____.	IRC N1102.2.4	IRC N1102	3	protected, conditioned	accessible, illuminated	weather stripped, insulated	clean, free of obstructions
Slab-on-grade floors shall be insulated when the floor surface is less than _____.	IRC N1102.2.10	IRC N1102	1	12 inches	10 inches	8 inches	6 inches
No less than what percentage of the lamps permanently installed in lighting fixtures shall be high efficacy lamps?	IRC N1104.1	IRC N1104	2	60%	75%	80%	100%
The air barrier for the building envelope shall be verified using what type of test?	IRC N1102.4.1.1	IRC N1102	2	peppermint oil test	blower door test	water pressure test	insulation test
In what Climate Zone is Lubbock, Texas located?	IRC Table N1101.7	IRC N1101	4	3A	2B	2A	3B
What is the insulation minimum R-Value for basement walls in Climate Zone 3?	IRC Table N1102.1.3	IRC N1102	3	19ci or 4	10ci or 13	5ci or 13	15ci or 19
Windows, skylights and sliding glass doors shall have an air filtration rate of not greater than _____ cfm per square foot and _____ cfm for swinging doors.	IRC N1102.4.3	IRC N1102	1	0.3, 0.5	0.5, 0.5	1, 0.75	0.6, 0.8
Supply and return ducts located outside conditioned space shall be insulated to an R-value of not less than _____ for ducts 3 inches in diameter.	IRC N1103.3.1	IRC N1103	2	R-6	R-8	R-15	R-10
In what Climate Zone is San Diego, California located?	IRC Table N1101.7	IRC N1101	3	5B	4A	3B	4B
What is the maximum assembly U-Factor for a ceiling located in Climate Zone 2?	IRC Table R1102.1.2	IRC N1102	4	0.35	0.049	0.55	0.026

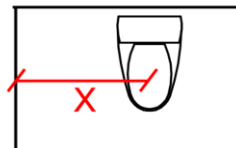
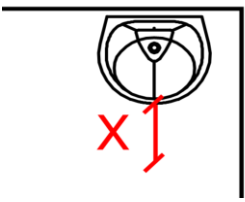
Module 14 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A water heater being installed within a house located in seismic design category D2, shall have straps located a minimum of _____ above the controls.	IRC M1307.2 Item 1	IRC M1307	4	10 inches	8 inches	6 inches	4 inches
An above ground fuel oil tank can be located _____ minimum from the property line.	IRC M2201.2.2	IRC M2201	4	20 feet	15 feet	10 feet	5 feet
A vibration isolator spaced between mechanical equipment and metal duct systems shall be a maximum of _____.	IRC M1601.2	IRC M1601	2	12 inches	10 inches	8 inches	6 inches
A single low-pressure steam boiler shall have shutoff valves in what location?	IRC M2001.3 Exception	IRC M2001	4	On the inlet	On the outlet	On the inlet and outlet	No valves required.
Fittings and piping used for refrigerant vapor lines shall insulated piping with a minimum R value of _____.	IRC M1411.6	IRC M1411	4	R-6	R-5	R-4	R-3
An outdoor individual appliance has a gas line installed. What is the minimum burial depth of the gas line?	IRC G2415.12	IRC G2415	4	5 inches	6 inches	7 inches	8 inches
Which of the following is the standard method used for calculating the minimum required amount of combustion air?	IRC G2407.5.1	IRC G2407	3	70 cubic feet per 1,000 BTU/h	60 cubic feet per 1,000 BTU/h	50 cubic feet per 1,000 BTU/h	40 cubic feet per 1,000 BTU/h
A ground supported appliance shall have a pad of concrete a minimum of _____.	IRC M1305.1.3.1	IRC M1305	2	2 inches	3 inches	4 inches	5 inches
What amount is the capacity reduced by each elbow when 90° elbows are installed?	IRC G2428.2.3	IRC G2428	3	0%	5%	10%	15%
Labeling provided on flexible ducts and the insulation shall be printed at intervals printed not to exceed _____ maximum. This information includes: Manufacturer's name, R-values, installed thickness, and smoke-developed index.	IRC M1601.3.4	IRC M1601	3	48 inches	42 inches	36 inches	30 inches
What is the hot water-supply fixture-unit value for a laundry standpipe and tub?	IRC Table P2903.6	IRC P2903	2	1.9 w.s.f.u.	1.8 w.s.f.u.	1.4 w.s.f.u.	1.0 w.s.f.u.
Water service pipe shall be installed not less than _____ deep and not less than _____ below the frost line.	IRC P2603.5	IRC P2603	3	6 inches, 18 inches	18 inches, 12 inches	12 inches, 6 inches	6 inches, 12 inches
The maximum vertical hanger spacing for a 1 1/2 inch cast iron pipe is:	IRC P2605.1	IRC P2605	2	20 feet	15 feet	10 feet	5 feet
What is the maximum working pressure required for water service piping?	IRC P2906.4.1	IRC P2906	4	130 psi	140 psi	150 psi	160 psi
What is the drainage fixture unit value for a full bath group with greater than 1.6 gpm per flush?	IRC Table P3004.1	IRC P3004	4	3	4	5	6
The ignition source of a water heater located in a garage shall be not less than _____ above the garage floor.	IRC P2801.7	IRC P2801	3	36 inches	24 inches	18 inches	12 inches
What is the maximum flow rate for a shower head?	IRC Table 2903.2	IRC P2903	1	2.5 gpm	2.2 gpm	1.6 gpm	0.8 gpm
GIVEN: (1) 1.8 gpf full bath groups, (2) 1.8 gpf half bath groups, (2) kitchen groups, (2) laundry groups, and (2) bar sinks. What is the total drainage fixture unit value for this home?	IRC Table P3004.1	IRC P3004	2	21	28	37	46
What is the minimum weight of sheet lead liners?	IRC P2709.3.1	IRC P2709	1	4 lbs. per sq foot	5 lbs. per sq foot	8 lbs. per sq foot	12 lbs. per sq foot
Factory-built chimneys for fuel gas appliances having a temperature not greater than _____ °F shall be listed and labeled in accordance with _____.	IRC P2430.1	IRC P2430	3	1000, UL 102	1200, UL 102	1000, UL 103	1200, UL 103

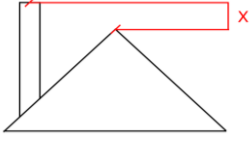
Module 15 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Which of the following is not a listed enclosure type in the IRC?	IRC E3404.4	IRC E3404	4	panelboards	meter sockets	transfer switches	vinyl stakes
Wooden plugs driven into masonry, concrete, plaster, or similar materials may be used.	IRC E3404.8	IRC E3404	2	TRUE	FALSE		
Artificial illumination shall not be controlled by automatic means only.	IRC E3405.7	IRC E3405	1	TRUE	FALSE		
What is the maximum ampacity of #6 THWN copper wire if ratings of wire terminals cannot be verified?	IRC Table E3705.1 & E3705.4.1	IRC E3705	1	55A	65A	75A	60A
The minimum length of flexible cord for a trash compactor is ___ feet?	IRC Table E4101.3	IRC E4101	1	3	4	1.5	2
Unless serving the pool, underground wiring must be kept at least ___ feet away from the inside walls of the pool?	IRC E4203.8	IRC E4203	2	6-feet	5-feet	10-feet	20-feet
Central heating equipment other than fixed electric space heating shall be supplied by a(n):	IRC E3703.1	IRC E3703	3	workable space	conductor	individual branch circuit	overbranch circuit
A unit load of not less than _____ shall constitute the minimum lighting and general use receptacle load for each square foot of floor area.	IRC E3704.4	IRC E3704	1	3 volt-amperes	4 volt-amperes	5 volt-amperes	6 volt-amperes
Where raceways contain 4 AWG or larger insulated circuit conductors and these conductors enter a cabinet, box enclosure, or raceway, the conductors shall be protected in accordance with any of the following, EXCEPT:	IRC E3906.1.1	IRC E3906	4	Threaded hubs or bosses in a cabinet, box, enclosure, or raceway providing a smoothly rounded or flared entry for conductors	An identified fitting providing a smoothly rounded insulating surface	A listed metal fitting that has smoothly rounded edges	A container using R-8 insulation around the surface of the raceway
Noncombustible surfaces that are broken or incomplete shall be repaired so that there will not be gaps or open spaces greater than _____ at the edge of the cabinet or cutout box employing a flush-type cover.	IRC E3907.4	IRC E3907	2	1/4 inch	1/8 inch	1/2 inch	3/8 inch
Lighting track shall not be installed all of the following locations, EXCEPT:	IRC E4005.4	IRC E4005	1	protected areas from physical damage	Wet or damp locations	concealed	Where subject to corrosive vapors
Each appliance shall be provided with a means to disconnect all ungrounded supply conductors.	IRC E4101.5	IRC E4101	1	TRUE	FALSE		
For swimming pools, outdoor spas and hot tubs, receptacles that provide power for water-pump motors or other loads directly related to the circulation and sanitation system shall be located at least _____ away.	IRC E4203.1.1	IRC E4203	3	4 feet	8 feet	6 feet	10 feet
Receptacles rated ___ volts and ___ amperes or less and located within ___ feet of the inside walls of a spa or hot tub installed indoors shall be ground-fault circuit interrupters.	IRC E4203.1.6	IRC E4203	2	125, 20, 8	125, 30, 10	125, 30, 8	225, 20, 10
What material shall be used to bond parts together for a proper equipotential bond in a swimming pool?	IRC E4204.2	IRC E4204	4	12 AWG	10 AWG	6 AWG	8 AWG
What is a "UFER" ground?	IRC Chapter 35 definition	IRC Chapter 35	2	8 ft ground rod	Concrete encased grounding electrode	Underground Flexible Electrode Rod	Any ground rod used to ground the electrical equipment

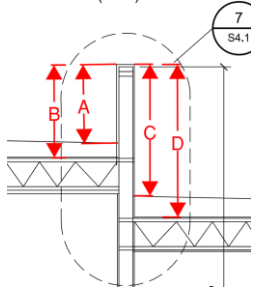
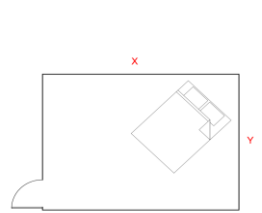
Residential Plans Examiner Practice Exam

Question Text	Description	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
An extension or increase in floor area, number of stories, or height of a story or height of a building or structure.		IRC R202	IRC Chapter 2	1	Addition	Area Increase	Alteration	Remodel
The total area of all buildings or structures on any lot or parcel of ground projected on a horizontal plane, excluding permitted projections as allowed by this code.		IRC R202	IRC Chapter 2	4	habitable space	roof area	building area	occupied space
Water free from impurities present in amounts sufficient to cause disease or harmful physiological effects and conforming in bacteriological and chemical qualities to the requirements of the public health authority having jurisdiction.		IRC R202	IRC Chapter 2	2	clear water	potable water	nonpotable water	tap water
Fire separation distances are measured from the building face to all but which one of the following?		IRC R202 (Definition Fire Separation Distance)	IRC Chapter 2	2	the closest interior lot line	the top-back of curb	an imaginary line between two buildings on the lot	the centerline of a street
What is the minimum clearance required between a bathtub and the front of a water closet?		IRC Figure 307.1	IRC R307	4	12 inches	15 inches	18 inches	21 inches
What is the minimum dimension for X (this being from the wall to the centerline of the toilet)?		IRC Figure R307.1	IRC R307	1	15 inches	16 inches	18 inches	24 inches
What is the minimum clear floor space in front of the sink?		IRC Figure R307.1	IRC R307	3	15 inches	18 inches	21 inches	24 inches
The minimum bearing length of a lintel on both ends of the fireplace opening shall be ___ inches.		IRC R1001.7	IRC R1001	3	2	3	4	6
The minimum thickness of fireplace hearth shall be ___ inches.		IRC R1001.9.1	IRC R1001	2	2	4	6	8
Footings for masonry chimneys shall be constructed of concrete or solid masonry not less than ___ inches thick and shall extend not less than ___ inches beyond the face of the foundation or support wall on all sides.		IRC R1003.2	IRC R1003	1	12, 6	6, 12	6, 8	8, 8

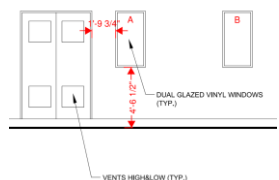
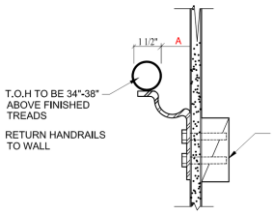
Residential Plans Examiner Practice Exam

What is the minimum height (X) the chimney must extend beyond the highest point of the roof assuming that the portion is within 10 feet?		IRC R1003.9	IRC R1003	3	4 feet	3 feet	2 feet	1 foot
What is the minimum clearance to combustibles for an unlisted combustion air duct serving a factory-built fireplace that is located within 5 feet of the duct outlet?		IRC R1006.3	IRC R1006	1	1 inch	2 inches	3 inches	5 inches
A maximum of _____ inches shall be provided from the firebox opening for the exterior air outlet provided for a firebox chamber.		IRC R1006.5	IRC R1006	3	12 inches	18 inches	24 inches	30 inches
The exterior air outlet shall be located in the back or side of firebox chamber or shall be located outside of the firebox at the level of the hearth and not greater than _____ inches from the firebox opening.		IRC R1006.5	IRC R1006	3	12	18	24	36
A two-family dwelling that is four stories in height shall fall under the provisions of which code?		IRC R101.2	IRC R101	2	International Residential Code	International Building Code		
Where conflicts between provisions of this code and referenced codes and standards the provisions of _____ shall apply.		IRC R102.4.1	IRC R102	3	referenced codes and standards	stricter requirements	this code	building official's interpretation
Any _____ to existing structures are not permitted to cause the existing structure to become unsafe.		IRC R102.7.1	IRC R102	4	repairs	additions	alterations	all of the above
Which of the following documents is the building department required to retain in the official records for durations consistent with the retention of public records laws?		IRC R104.7	IRC R104	1	permit applications	meeting minutes	inspection requests	fee schedules
Which of the following is exempt from a permit?		IRC R105.2 Electrical 3	IRC R105	3	5 foot high retaining wall	250 square foot deck	replacing branch circuit overcurrent devices	a new water heater
Which of the following is not exempt from a permit?		IRC R105.2 Item 9	IRC R105	1	window awnings that project 60 inches from the exterior wall of the building	a fence that is 6 feet 10 inches in height	a deck that is 150 square feet in area and is 12 inches from the ground not attached to the house	a slide that is 10 feet in height in a seismic category zone
What is to be included in a certificate of occupancy?		IRC R110.3 Item 8	IRC R110	4	the name of the builder	the next code edition from what the code was reviewed under	the name and address of the designer of the approved plans	where an automatic sprinkler system is provided
Where the building official find any work regulated by this code being performed in a manner contrary to the provisions of this code or in a dangerous or _____ manner, the building official is authorized to issue a stop work order.		IRC R114.1	IRC R114	3	harmful	safe	unsafe	different

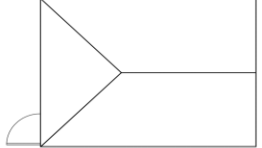
Residential Plans Examiner Practice Exam

The provisions of this code shall apply to the construction of detached one-and two family dwellings for all of the following except which?		IRC R101.2	IRC R101	4	1 story	2 stories	3 stories	4 stories
For a detached garage (accessory to a dwelling unit) located within 2 feet of the lot line, how much roof eave projection is permitted?		IRC R302 Exception 4	IRC R302	2	1 foot	4 inches	6 inches	Not Permitted
Which of the following materials is not acceptable for use as fireblocking in combustible construction?		IRC R302.11	IRC R302	3	two thicknesses of 1 inch nominal lumber with broken laps	½ inch gypsum board	1/8 inch cement based millboard	unfaced fiberglass batts not less than 16 inch vertically
Which of the following is not permissible to be used as fire blocking?		IRC R302.11.1	IRC R302	4	Two-inch nominal lumber	One-half gypsum board	23/32 wood structural panels	One-eight inch cement-based millboard
Which of the following materials is acceptable for use as draft stopping in a combustible single-family home without other approval?		IRC R302.12.1	IRC R302.12	2	3/8" gypsum board	3/8" wood structural panel	26 ga. Sheet steel	2" mineral wool batts
Combustible insulation shall be separated from recessed cans by a minimum of _____ when not otherwise provided with a listing.		IRC R302.14	IRC 302	2	6 inches	3 inches	2 inches	1 inch
Assuming the wall shown is separating two townhouse units. Which of the following measurements governs compliance with parapet wall minimum heights?		IRC R302.2.4 Item #2	IRC R302	3	Measurement A	Measurement B	Measurement C	Measurement D
A _____ thick door shall be provided between private garages and sleeping rooms.		IRC R302.5.1	IRC 302	4	1 3/8 inch	1 1/2 inch	1 5/8 inch	Not permitted
What is the minimum amount of aggregate glazing required in habitable rooms?		IRC R303.1	IRC 303	1	8%	10%	12%	14%
If the length of "X" is 10 feet, what would be the minimum dimension that "Y" is permissible to be?		IRC R304.2	IRC R304	2	6 feet	7 feet	8 feet	10 feet
What is the minimum ceiling height required for a laundry room?		IRC R305.1	IRC R305	3	7'-6"	7'-0"	6'-8"	6'-0"
All dwelling units are required to be provided with a water closet, lavatory, and shower.		IRC R306.1	IRC R306	1	True	False		

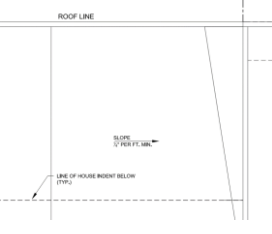
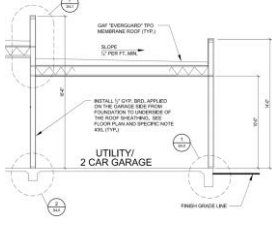
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Glazing shall be considered hazardous if located in all but which of the following fixed and operable panel door types.		IRC R308.4.1	IRC R308	4	bifold doors	sliding doors	swinging doors	overhead doors
Glazing where the bottom exposed edge of the glazing is less than _____ above the plan of the plan of the adjacent walking surface of the stairways shall be considered to be a hazardous location (exceptions ignored).		IRC R308.4.6	IRC R308	3	18 inches	24 inches	36 inches	48 inches
Windows A and B are both located within 60 inches horizontally of a bathtub. Identify which windows are required to have safety glazing.		IRC R308.5.6	IRC R308	4	Window A only	Window B only	Neither A nor B	Both A and B
Carpports shall be open on not less than _____.		IRC R309.2	IRC R309	2	one side	two sides	three sides	four sides
Window wells with a vertical depth greater than _____ shall be provided with a permanently affixed ladder.		IRC R310.4.2	IRC R310	4	36 inches	40 inches	42 inches	44 inches
What is the minimum clear width that shall be provided for the required egress door.		IRC R311.2	IRC R311	2	24 inches	32 inches	36 inches	40 inches
What is the minimum allowed measurement for dimension A shown in the graphic?		IRC R311.7.8.3	IRC R311	4	No minimum	1 inch	1/2 inch	1 1/2 inches
Smoke alarms shall be installed in the following locations except:		IRC R314.3	IRC R314	3	In each sleeping room.	Outside each separate sleeping area in the immediate vicinity of the bedrooms.	On each story excluding basements and habitable attics and including crawl spaces and uninhabitable attics.	Not less than 3 feet horizontally from the door or opening of a bathroom that contains a bathtub.
A photoelectric smoke alarm has been installed in a house. What is the maximum horizontal distance from a permanently installed cooking appliance?		IRC R314.3.1	IRC R314	1	6 feet	5 feet	4 feet	3 feet
When is a structure required to comply with the IBC for accessibility?		IRC R320.1	IRC R320	1	an apartment complex with 10 units	townhouses	3 condo units	a duplex
The exterior of a residential building must slope a minimum of _____ within the first 10 feet from the building foundation?		IRC R401.3	IRC R401	1	6 inches	8 inches	10 inches	12 inches

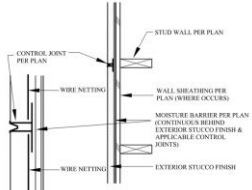
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The minimum curing period for a three-coat cement plaster system shall be ____ hours.		IRC R702.2.2.2	IRC R702	1	48	36	24	12
What is the minimum thickness of polypropylene siding shall be installed over and attached to wood structural panel sheathing?		IRC R703.14.1.1	IRC R703	3	3/16 inches	2/3 inches	7/16 inches	5/8 inches
Where provided, furring shall consist of wood furring strips not less than _____.		IRC R703.7.1.1	IRC R703	2	1" x 1"	1" x 2"	2" x 2"	2" x 4"
How soon can the second coat of a two-coat cement plaster be applied after the first coat?		IRC R703.7.5	IRC R703	4	48 hours	3 days	5 days	one week
In seismic design category D1, exterior masonry veneers with an installation weight of 45 pounds per square foot shall be permitted to be supported on wood construction.		IRC R703.8.2	IRC R703	2	True	False		
The lintels shall have a length of bearing not less than ____ inches.		IRC R703.8.3	IRC R703	3	2	3	4	6
Discharge drainage from roofs shall terminate not less than _____ feet from foundation walls.		IRC R801.3	IRC R801	2	6	5	4	3
What is the offset permitted for wood framed rafters connecting to ridge boards?		IRC R802.4.2	IRC R802	3	2 1/2 inches	2 inches	1 1/2 inches	1 inch
Purlins shall be continuous and shall be supported by _____ braces installation to bearing wall at a slope of not less than ____ degrees from the horizontal.		IRC R802.4.5	IRC R802	4	1x2, 20	2x2, 90	1x2, 45	2x4, 45
Collar ties in ceiling joist shall be a minimum of _____.		IRC R802.4.6	IRC R802	3	2"x4"	1"x2"	1"x4"	1"x3"
The ends of each rafter or ceiling joist shall have not less than _____ inches when bearing on masonry or concrete.		IRC R802.6	IRC R802	3	1.5	2	3	4
Attic ventilation openings shall have a maximum dimension of _____.		IRC R806.1	IRC R806	2	1/2 inch	1/4 inch	1/8 inch	1/16 inch
A roof area is 1,000 square feet. What is the minimum net free ventilating area (exception ignored)?		IRC R806.2	IRC R806	1	6-2/3 sq ft	7-5/8 sq ft	5-3/2 sq ft	4-4/7 sq ft
In Climate Zone 7, the net free ventilated area of a roof shall be ____ of the vented space where a vapor retarder has been installed.		IRC R806.2 Exception	IRC R806	4	1/150	1/200	1/250	1/300

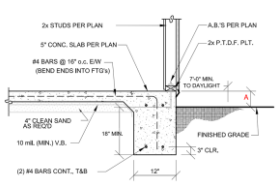
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Underlayment for asphalt shingles shall comply with which ASTM requirement?		IRC R905.1.1	IRC R905	4	ASTM D226	ASTM D1970	ASTM 4869	All of the above
Ice barriers shall be required in areas _____.		IRC R905.1.2	IRC R905	1	where there has been a history of ice forming along the eaves	for all roofs with shingles	in areas with an annual snowfall of 6 inches or more per year	when the average temperature of the year is below 40 degrees
Thermoplastic single-ply membrane roofs shall have a design slope of not less than ____ unit vertical in 12 units horizontal.		IRC R905.13.1	IRC R905	3	1/8	3/8	1/4	1/2
Metal roof shingles shall only be installed on roof slopes that are _____ or greater.		IRC R905.4.2	IRC R905	1	3:12	2:12	1:12	1/2:12
Metal roof shingle shall not be installed on roof slopes below ____ units vertical in 12 units horizontal.		IRC R905.4.2	IRC R905	4	8	6	4	3
Wood shingles shall be attached to the roof with _____ fasteners per shingle.		IRC R905.7.5	IRC R905	2	1	2	3	4
Assuming a roof has the slope shown in the graphic, which of the following roofing materials is permitted?		IRC R905.9.1	IRC R905	4	asphalt shingles	metal roof shingles	mineral-surfaced roll roofing	built-up roofs
A roof recover shall not be permitted where the existing roof has _____ or more applications of any type of roof covering.		IRC R908.3.1.1	IRC R908	4	roof recover is not permitted	only patch replacement is permitted	one	two
What material is not permissible to be installed on the underside of the roof/ceiling joists shown in the graphic below?		IRC Table R302.6	IRC R302	1	5/8" OSB	5/8" Gypsum board	1/2" Gypsum board	(2) layers of 1/2" Gypsum board
What is the minimum category classification of glazing for glazing in sliding glass patio doors, where the exposed area of one side is 8 square feet?		IRC Table R308.3.1(1)	IRC R308	2	Class I	Class II	Class III	Class IV


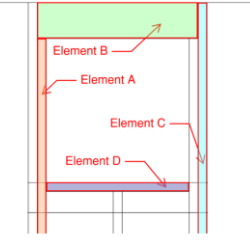
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<p>What is the minimum required thickness of exterior cement plaster (stucco) allowed in the wall assembly shown?</p>		<p>IRC Table R702.1(1)</p>	<p>IRC R702</p>	<p>4</p>	<p>1 inch</p>	<p>1/2 inch</p>	<p>3/4 inch</p>	<p>7/8 inch</p>
<p>Where 5/8 gypsum board is used as an interior ceiling covering and installed perpendicular to framing members spaced at 24 inches on center, the maximum spacing of nails shall be _____.</p>		<p>IRC Table R702.3.5</p>	<p>IRC R702</p>	<p>2</p>	<p>6 inches</p>	<p>7 inches</p>	<p>8 inches</p>	<p>12 inches</p>
<p>Horizontal aluminum siding is allowed to be applied directly to studs without insulation.</p>		<p>IRC Table R703.3(1)</p>	<p>IRC R703</p>	<p>1</p>	<p>Incorrect, this cannot be applied directly to the studs.</p>	<p>once 3 coats of paint has been applied</p>	<p>if siding nails sized 1 1/2 x 0.120" is used</p>	<p>if siding nails 2" x 0.120" is used</p>
<p>What is the rafter span for a Southern pine#1 spaced 19.2 inches on center with a ground snow load of 30 psf and a dead load of 10 psf ceiling attached to rafters using lumber sized 2x10?</p>		<p>IRC Table R802.4.1(4)</p>	<p>IRC R802</p>	<p>1</p>	<p>17-7</p>	<p>15-4</p>	<p>15-1</p>	<p>20-2</p>
<p>What is the allowable 2x6 ceiling joist span for Southern Pine #2 spaced at 24-inches o.c.? Assume uninhabitable attic with limited storage.</p>		<p>IRC Table R802.5.1(2)</p>	<p>IRC R802</p>	<p>2</p>	<p>6' - 7"</p>	<p>9' - 10"</p>	<p>11' - 0"</p>	<p>11' - 5"</p>
<p>What is the maximum roof rafter span of a member designation of 800S162-43, where the ground snow load is 20 psf and the rafter spacing is 24 inches O.K.?</p>		<p>IRC Table R804.3.2.1(1)</p>	<p>IRC R804</p>	<p>3</p>	<p>19' 9"</p>	<p>17' 0"</p>	<p>16' 1"</p>	<p>13' 7"</p>
<p>A general term for walls that are designed and constructed to resist racking from seismic and wind by use of masonry, concrete, cold-form steel or wood framing in accordance with chapter 6 of this code and the associated limitations in section R301.2 of this code.</p>		<p>IRC R202</p>	<p>IRC Chapter 2</p>	<p>3</p>	<p>Wall framing</p>	<p>Exterior wall</p>	<p>Shear Wall</p>	<p>Wall assembly</p>
<p>What is the ultimate design wind speed for Michigan?</p>		<p>IRC Figure 301.2(2)</p>	<p>IRC 301</p>	<p>1</p>	<p>115 mph</p>	<p>120 mph</p>	<p>125 mph</p>	<p>150 mph</p>
<p>All of the following are types of structural composite lumber except _____.</p>		<p>IRC R202 (Definition of Structural Composite Lumber and Definition of Engineered Wood Rim Board)</p>	<p>IRC Chapter 2</p>	<p>2</p>	<p>oriented strand lumber</p>	<p>parallel veneer lumber</p>	<p>engineered wood rim board</p>	<p>laminated strand lumber</p>

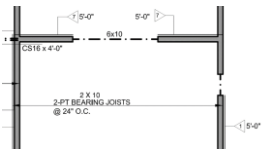
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For a building with a roof with a height of 47 feet where the wind speed is 175 mph, No. 8 wood screws are permitted to fasten wood structural panels.		IRC R301.2.1.2 Exception	IRC 301	2	True	False		
A residential home is considered to be irregular when braced walls are not in one plane vertically. In which seismic design category can the home be built per the IRC without requiring engineering?		IRC R301.2.2.6	IRC R301	4	C	D ₁	D ₂	D ₃
_____ inches of concrete cover is required for steel reinforcement when cast against the earth.		IRC R403.1.3.5.3	IRC R403	4	1.5	2	2.5	3
What is the minimum depth below grade for exterior footings not considering frost?		IRC R403.1.4	IRC R403	3	6-inches	9-inches	12-inches	18-inches
The top surface of the footings shall be level. The bottom surface of footings shall not have a slope exceeding 1 unit vertical in _____ units horizontal.		IRC R403.1.5	IRC R403	3	20	12	10	8
What is the minimum required height above finished grade for dimension A shown in the graphic below?		IRC R404.1.6	IRC R404	3	4 inches	5 inches	6 inches	8 inches
A crushed stone foundation drain shall extend not less than _____ beyond the outside edge of the footing and _____ above the top of the footing.		IRC R405.1	IRC R405	1	12 inches, 6 inches	6 inches, 6 inches	18 inches, 12 inches	12 inches, 18 inches
Masonry walls shall have not less than _____ Portland cement parging applied to the exterior wall.		IRC R406.1	IRC R406	3	1/4 inch	1/2 inch	3/8 inch	5/8 inch
In areas where the water table are known to exist exterior foundation walls that retain earth and enclose interior spaces and floors below grade shall be waterproofed from the finished grade to the height of the top of the footing or _____ below the top of the basement floor.		IRC R406.2	IRC R406	2	4 inches	6 inches	8 inches	12 inches
Wood columns shall be a minimum of _____ inches x _____ inches nominal.		IRC R407.3	IRC R407	1	4,4	4,6	6,6	8,8
Which of the following must be provided to eliminate ventilation openings in an under-floor space?		IRC R408.3	IRC 408	1	a continuous Class I vapor retarder	mechanical exhaust ventilation	conditioned air supply	a dehumidification system
The ends of each joist shall not less than _____ inches of bearing on wood or metal.		IRC R502.6	IRC R502	1	1 1/2	2	2.5	3

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Floor joists exceeding ___ by _____ inches shall be supported laterally by solid blocking.		IRC R502.7.1	IRC R502	4	2, 6	2, 8	2, 10	2, 12
Slab on ground concrete floor shall be a minimum _____ inches thick.		IRC R506.1	IRC R506	3	2	2 1/2	3 1/2	4
Deck footings shall be placed not less than _____ inches below the undisturbed ground surface.		IRC R507.3.2	IRC R507	2	16	12	8	6
A 2x6 bearing wall has been notched. Please indicate the maximum depth the bearing wall is permitted to be notched.		IRC R602.6	IRC R602	1	1.375 inches	2 inches	2.25 inches	2.375 inches
A stud in an exterior wall or bearing partition shall no be cut or notched to a depth exceeding _____ percent of its depth. Studs in nonbearing partitions shall not be notched to a depth exceeding _____ percent of its depth of a single stud depth.		IRC R602.6	IRC R602	1	25, 40	40, 25	25, 25	40, 40
For an exterior bearing wall, what is the maximum span for a double 2x10 header supporting a roof, ceiling and two clear-span floors? (Assume 30 psf Ground Snow Load and a 24-foot building width.)		IRC R602.7(1)	IRC R602.7	3	4' 9"	4' 1"	3' 10"	2' 7"
Where cripple walls exceed 4 feet in height, such walls shall be framed of studs having the size required for _____.		IRC R602.9	IRC R602	4	a basement	an attic	an additional top plate	an additional story
Cold-formed steel walls shall be limited to sites where the ultimate wind speed is less than _____ miles per hour.		IRC R603.1.1	IRC R603	2	115	140	143	159
Which element in the diagram represents a king stud?		IRC R603.7	IRC R603	3	Element A	Element B	Element C	Element D
What is the minimum thickness for a masonry bearing wall more than one story in height?		IRC R606.4.1	IRC R606	2	6 inches	8 inches	10 inches	12 inches

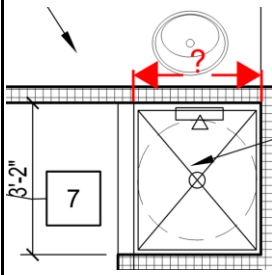
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What is the load-bearing pressure of sandy gravel?	IRC Table R401.4.1	IRC R401	4	1,000 psf	1,500 psf	2,000 psf	3,000 psf
What is the minimum specified compressive strength of concrete for a basement slab?	IRC Table R402.2	IRC R402	3	1,500	2,000	2,500	3,000
A two-story slab on grade house of grouted masonry wall construction shall have a footing of _____ where the load bearing value of the soil is 3,000 psf and the snow load is 30 psf.	IRC Table R403.1(1)	IRC R403	1	12"x6"	15"x6"	17"x6"	24"x6"
What is the minimum width and thickness for concrete footings with cast-in-place concrete or partially grouted masonry wall construction with a ground snow load of 30 psf for 2 stories with a basement with a load-bearing value of soil of 2,500 psf?	IRC Table R403.1(3)	IRC R403	4	12" x 12"	15" x 12"	15" x 4"	15" x 6"
What is the minimal thickness of a plain masonry foundation wall with an unbalanced backfill of 4.5 feet an a maximum unsupported wall height of 6 feet for soil class SC?	IRC Table R404.1.1(1)	IRC R404	2	6 inches	8 inches	10 inches	12 inches
A 9-foot-high plain masonry foundation wall subjected to 7 feet of unbalanced backfill of soil class is GW, must have a wall thickness of _____ nominal.	IRC Table R404.1.1(1)	IRC R404	3	6 inches	8 inches	10 inches	12 inches
A 9-foot-high, flat concrete foundation wall of 10-inch nominal thickness subjected to 5 feet of unbalanced backfill of soil class SP, must have a minimum vertical reinforcement of _____ at _____ on center.	IRC Table R404.1.2(4)	IRC R404	4	No. 6 at 28 inches	No. 6 at 35 inches	No. 6 at 59 inches	not required
A 9-foot-high, flat concrete foundation wall of 10-inch nominal thickness subjected to 5 feet of unbalanced backfill of soil class SP, must have a minimum vertical reinforcement of _____ on center.	IRC Table R404.1.2(4)	IRC R404	4	No. 6 at 28 inches	No. 6 at 35 inches	No. 6 at 59 inches	not required
	IRC Table R502.3.1(1)	IRC R502	2	16'-2"	14'-3"	13'-3"	12'-0"
What is the maximum span of 2x10 floor joists of spruce-pine-fir #1, when the dead load is 10 psf in a living area?	IRC Table R502.3.1(1)	IRC R502	3	12 feet 9 inches	15 feet 8 inches	17 feet 3 inches	16 feet 7 inches

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What is the maximum floor joist span for Hem-fir #1 for residential sleeping areas with a live load of 30 psf and a dead load of 20 psf using 2x8 lumber spaced 16 inches on center.	IRC Table R502.3.1(1)	IRC R502	4	18-0	16-1	13-5	13-4
What is the minimum thickness of lumber floor sheathing, where the floor joists are spaced 16 inches and installed perpendicular to the joist?	IRC Table R503.1	IRC R503	2	3/8 inch	5/8 inch	3/4 inch	11/16 inch
What is the minimum thickness of floor sheathing where the joists are spaced 24 inches on center running diagonal to the joists?	IRC Table R503.1	IRC R503	2	11/16 inches	5/8 inches	3/4 inches	1 1/2 T&G
What is the maximum span of 7/16-inch OSB roof sheathing without edge support and having a span rating of 24/0?	IRC Table R503.2.1.1(1)	IRC R503	2	16-inches	20-inches	24-inches	32-inches
What is the maximum allowable live load of wood structural panels used for subfloor sheathing is _____ when wood structural panels have a span rating of 24/16, a thickness of 7/16 and a span of 16 inches O.K.?	IRC Table R503.2.1.1(1)	IRC R503	1	100	70	50	40
Which one of the fasteners is not listed to be used as a continuous header to stud?	IRC Table R602.3(1)	IRC R602	4	5-8d box	4-8d common	4-10d box	4 staples, 1" crown 16 g
The maximum center to center stud spacing when supporting one floor and a roof is _____ where the stud size is 2x6.	IRC Table R602.3(5)	IRC R602	1	24 inches	20 inches	16 inches	14 inches
What is the minimum solid wall length for an exterior wall of a Two-story Townhouse located in Seismic Design Category D1?	IRC Table R606.12.2.1	IRC R606	4	NP	35	30	25
What is the minimum rebar size and spacing for a waffle grid above grade wall for an 8 inch thick wall 9 feet high with a wind speed of 130 miles per hour in an exposure category B?	IRC Table R608.6(2)	IRC R608	2	5 at 47	4 at 48	5 at 35	6 at 46
Slab-on-grade floors shall be insulated when the floor surface is less than _____.	IRC N1102.2.10	IRC N1102	1	12 inches	10 inches	8 inches	6 inches
The air barrier for the building envelope shall be verified using what type of test?	IRC N1102.4.1.1	IRC N1102	2	peppermint oil test	blower door test	water pressure test	insulation test
Windows, skylights and sliding glass doors shall have an air filtration rate of not greater than _____ cfm per square foot and _____ cfm for swinging doors.	IRC N1102.4.3	IRC N1102	1	0.3, 0.5	0.5, 0.5	1, 0.75	0.6, 0.8
Supply and return ducts located outside conditioned space shall be insulated to an R-value of not less than _____ for ducts 3 inches in diameter.	IRC N1103.3.1	IRC N1103	2	R-6	R-8	R-15	R-10
Which of the following is not specified an allowable energy code compliance option?	IRC N1101.13	IRC N1101	3	Energy Rating Index	Prescriptive Compliance	Thermal Envelope Tradeoff	Total Building Performance

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Residential buildings demonstrating energy code compliance using the Total Building Performance option must also install at least one additional efficiency package.		IRC N1101.13.5 #2	IRC N1101	2	True	False		
Batt insulation provided between wall studs placed 24 inches on center is a type of _____.		IRC N1101.6	IRC Chapter 11	2	air barrier	cavity insulation	continuous insulation	thermal envelope
Which is not specified as an additional efficiency package option?		IRC N1108.2	IRC N1108	4	Locating all ducts and air handlers within conditioned space.	A 95% AFUE gas furnace and 16 SEER air conditioner.	Enhanced envelope performance.	A 0.82 EF electric water heater.
All of the following is required for the exterior walls of a new addition except:		IRC N1110.3.1 Exception	IRC N1110	3	The walls shall be constructed to limit air leakage.	The walls shall be provided with a vapor retarder on the interior side.	The walls shall be tested for air leakage.	The walls shall be insulated in accordance with the requirements for the applicable climate zone.
Provided the length of the shower is 38", what is the minimum width required to result in a code compliant shower compartment?		IRC R307.1 and P2708.1	IRC R307 and P2708	3	24 inches	25 inches	30 inches	34 inches



George Williams

MCP, CBO

SENIOR PLAN REVIEW EXAMINER

EDUCATION

**MASTER OF SCIENCE
CONSTRUCTION MANAGEMENT**
Brigham Young University, 2015

**BACHELOR OF SCIENCE
CONSTRUCTION MANAGEMENT**
Weber State University, 2008

LICENSES | CERTIFICATIONS

LICENSES

Combination Inspector
Utah 6048299-5601

ICC CERTIFICATIONS

Master Code Professional
Certified Building Official
Commercial Combination Inspector
Residential Combination Inspector
Building Plans Examiner
Plumbing Code Official
Plumbing Plans Examiner
Mechanical Code Official
Mechanical Plans Examiner
Commercial Energy Inspector
Commercial Energy Plans Examiner
Residential Energy Inspector/Plans
Examiner
Accessibility Inspector/Plans
Examiner
Housing Code Official
Property Maintenance & Housing
Inspector

And several more...

AFFILIATIONS

Beehive Chapter of ICC
Vice President & Member

IAEI Utah Chapter
Member

AWARDS

Utah Chapter ICC
2016 Chapter Service Award
Eagle Scout - 1998

Mr. Williams has worked on a contract basis for numerous jurisdictions in California, Nevada, Washington, Utah, Wyoming and North Dakota throughout his 13-year career in the industry. From 2009 through mid-2014 he acted as the contract building official for City of Holladay as well as the resort town of Alta, both in Utah. He was also responsible for start-up of two county building departments in North Dakota, including the adopting of codes, implementation of permitting processes, and the development of policies and procedures in a part of the country where no previous form of building or construction regulatory processes existed. In addition to substantial municipal work, Mr. Williams has acted and continues to act as Lead Inspector for a number of multi-million-dollar projects for Utah's Division of Facilities and Construction Management (DFCM). Mr. Williams has numerous ICC certifications and received his ICC Master Code Professional certification in 2009. Currently he performs complex commercial plan reviews for clients in California, Nevada, Wyoming and Utah, as well as commercial inspections.

EXPERIENCE

SENIOR INSPECTOR / PLAN REVIEWER

West Coast Code Consultants, Inc. / 2014 – Present

Provides plan reviews and inspections services for a variety of commercial projects. Specializes in several code disciplines including, building, mechanical, plumbing, electrical, accessibility, energy and green codes. Familiar with both the International and Uniform codes, as plan review and inspection work encompassing numerous municipalities in multiple states. Regularly responsible for overseeing code compliance and inspection of large-scale state-owned buildings; including oversight of special inspection firms.

BUILDING OFFICIAL / INSPECTOR

Forsgren Associates / 2005 – 2014

Developed, maintained, administered, organized and oversaw building departments for various municipalities. Responsible for all aspects of building department administration, including creating policies and procedures, commercial and residential plan reviews, calculating permit fees, meeting with architects and engineers, performing field inspections, reviewing special inspection reports, interpreting codes and local ordinances, data and document management, and many other diverse tasks. Responsible for managing 2-4 field inspectors on a daily basis. Clients included numerous municipalities in multiple states, school districts, architects, law firms, and private entities.

PUBLICATIONS

Graduate Thesis: (2015) *Assessing the Repercussions of a Mass Departure of Building Inspectors from the Code Professional Industry.* Brigham Young University, Provo, Utah.

Article: (2015) *Construction Challenges Associated with the Sudden Population Growth in the Willison Basin Oil Boom,* presented at ASC Annual International Conference, College Station, TX: Associated Schools of Construction.

Article: (2019) *Understanding the Impacts of the Aging Population of Code Professionals in Utah,* presented at ASC Annual International Conference, Denver, CO: Associated Schools of Construction.



Chris Kimball

PE, SE, MCP, CBO

VICE PRESIDENT / PROJECT MANAGER

EDUCATION

**MASTER OF ENGINEERING
STRUCTURAL EMPHASIS**
Utah State University, 2001

**BACHELOR OF SCIENCE
CIVIL ENGINEERING**
Utah State University, 2000

LICENSES | CERTIFICATIONS

LICENSES

Professional Engineer

Washington 53117
California C 67857
Nevada 019503
Arizona 48503

Structural Engineer

Utah 4775874-2203

CERTIFICATES

ICC Certified:

Master Code Professional
Certified Building Official
Certified Fire Code Official
Combination Plans Examiner
4-Way Commercial Inspector
Residential Plans Examiner
Residential Energy
4-Way Residential Inspector
Accessibility Plans Examiner/Insp.
Fire Plans Examiner
Fire Inspector I & II

AFFILIATIONS

SEAU

Past President

Beehive Chapter of ICC

Past President

Utah Chapter of ICC

Member

Bonneville Chapter of ICC

Member

AWARDS

SEAU

2014 Engineer of the Year

ICC Utah Chapter

Industry Award for Excellence 2010

Mr. Kimball is a licensed engineer and an ICC Master Code Professional. He is also certified by ICC as a building official, fire code official, combination plans examiner, combination building inspector, fire plans examiner/inspector, and as an accessibility plans examiner/inspector. He received his Master's degree with an emphasis in structural engineering and currently serves as the Vice President of West Coast Code Consultants, Inc. He has performed plan reviews for thousands of projects throughout the Western United States and is an ICC approved instructor. Mr. Kimball has provided code training classes to building official, design professional and contractor organizations all over the United States.

EXPERIENCE

VICE PRESIDENT

West Coast Code Consultants, Inc. / 2009 – Present

Oversee the plan review and building inspection services provided by numerous WC3 offices. This includes the management of administrative, plan review, and inspection staff. Accountable for the complete plan review of projects which are seeking a building permit to ensure that designs are safe and in compliance with the adopted building codes. Responsible for providing technical training classes to clients, building officials, design professionals, contractors, and owners.

PRESIDENT / OWNER

Kimball Engineering / 2005 – 2009

Provided structural and complete plan review services to local jurisdictions throughout Utah, Arizona, Nevada, and Wyoming. Often provided training with regards to the structural building code requirements for both new and existing buildings to building official, design professional, and contractor organizations.

STRUCTURAL PLANS EXAMINER

Salt Lake City Corporation / 2005 - 2007

Performed structural review of plans, specifications, calculations, and engineering reports to ensure compliance with the adopted building codes. Met with clients, design professionals, contractors, and owners to discuss projects during the design-development stage and throughout the construction process. Provided training classes to design professionals to help them understand the structural requirements of the code. Provided engineering design and consulting services for city-owned projects.

CIVIL ENGINEER

U.S. Bureau of Reclamation / 2003 – 2005

Responsible for the structural design of a wide variety of projects including the retrofit of power plants, design of new buildings, and repairs to concrete and earthen dams. Prepared construction documents, including drawings and detailed project specifications for solicited work. Reviewed designs performed by the Technical Services Center, Area offices, and private consultants. Participated in several value engineering studies.

CIVIL ENGINEER

C.A. Dept. of Water Resources / 2002 – 2003

Provided preliminary designs for the repair of levees and other flood mitigation measures. Reviewed proposals and work performed by consultants. Developed required hydrology for modeling purposes. Reviewed hydraulic modeling efforts. Involved in writing/reviewing a joint EIR/EIS. Prepared construction cost estimates.

File Attachments for Item:

ER-9 Residential Plumbing Inspector (2021 IRC) (West Coast)

Residential certifications (7.5 hours)

Staff Notes: Recommendation to be included in Wednesday update agenda.

Committee Recommendation:

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *

Brittany Allen

Organization

West Coast Code Consultant

Email *

brittanya@wc-3.com

Phone Number *

(385) 237-3722

Address *

9131 S Monroe St Unit A

City *

Sandy

State *

Utah

Zip Code *

84070

Website

https://www.pathlms.com/w

Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e.

BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

2021 Residential Plumbing Inspector

Course instructor

George Williams

Course description

Course Description: This 7-module course, followed by a two-hour practice examination, is based on Chapters 25 through 33 of the 2021 International Residential Code (IRC). It teaches the practical application of the IRC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 20 to 55 minutes in length.

Course Objectives: This course is designed to prepare you for the International Code Council's (ICC) Residential Plumbing Inspector exam (P1), utilizing the 2021 IRC. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Instructional hours per session

7.5

Number of Sessions

Course Date

Course Location

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction
- Plumbing Instruction

Conference Course

Conference Name

Conference location

On Demand

Webinar

Course to be offered online?

Yes

No

Course Website

<https://www.pathlms.com/wc3-academy/courses/47>

Detail online course participation confirmation method (i.e. test, quizzes, participant activity confirmation):

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. You can progress through this course at your own pace; however, you only have access for 120 days.

Course applicable for the following certifications *

Residential Certifications Only

Administrative Course, All Certifications

Commercial and Residential Certifications

Application materials included *

Course Outline or Course Learning Objectives

Presentation Materials/Slides (not required for roundtable courses)

Assessment Materials (for online courses)

Presenter Bio

Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
2021 Residential Plumbing Submittal Documents.pdf	8.31 MB

Applicant Full Name *

Brittany Allen

Date of Submission

06/06/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



2021 Residential Plumbing Inspector

Course Outline

Cost: \$207, allowing 120 days of access.

Course Description: This **7-module course**, followed by a two-hour practice examination, is based on Chapters 25 through 33 of the *2021 International Residential Code (IRC)*. It teaches the practical application of the IRC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 20 to 55 minutes in length.

Course Objectives: This course is designed to prepare you for the *International Code Council's (ICC)* Residential Plumbing Inspector exam (P1), utilizing the *2021 IRC*. This course also serves as a review for those already familiar with the IRC and may serve as an update course for those unfamiliar with the 2021 edition of the code.

Texts and Readings: The *2021 International Residential Code* is the textbook for this course. It is highly recommended that you purchase a paper-back copy of these codes, which are available online at www.iccsafe.org. A physical copy can be utilized during the actual exams, which are open book, and serves as a valuable reference for in the field inspections.

Course Outline of Topics:

Module:	Topics:	Readings:	Quiz:	Duration:
1	Introduction & Definitions	IRC Chapter 2	Y	53 min.
2	Plumbing Administration & General Plumbing	IRC Chapters 25-28	Y	39 min.
3	Water Supply & Distribution	IRC Chapter 29	Y	30 min.
4	Sanitary Drainage	IRC Chapter 30	Y	25 min.
5	Vents, Traps, & Storm Drainage	IRC Chapters 31-33	Y	26 min.
6	Supplemental Module – Combustion Air			20 min.
7	Supplemental Module – Gas Line Sizing			38 min.
	5 Quizzes 48 Questions, 2 min. each	2021 IRC		96 min.
	Practice Exam (60 questions)	2021 IRC		120 min
	Total Course Hours			7.5 hours

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.



2021 Residential Plumbing Inspector

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. Marking, tabbing, and highlighting in the code book is highly recommended. We have laid out a plan and method to help you learn the material, but it's up to you to put in the work necessary for you to master the material. You can progress through this course at your own pace; however, you only have access for 120 days.

Continuing Education Credits: Completion of this course results in **0.75 CEU's** (7.5 hours) being provided by ICC, as West Coast Code Consultants is a Preferred Provider.

Instructor:



George Williams, MCP, CBO is the Director of WC3 Academy, but primarily identifies as a commercial plans examiner and building inspector. He has been a building inspector since 2005, has a master's degree in construction management, and has been ICC Master Code Professional since 2009. George has been instrumental in the start-up of multiple building departments including the adoption of codes, implementation of permit processes, development of policies and procedures, as well as the hiring and training of staff.

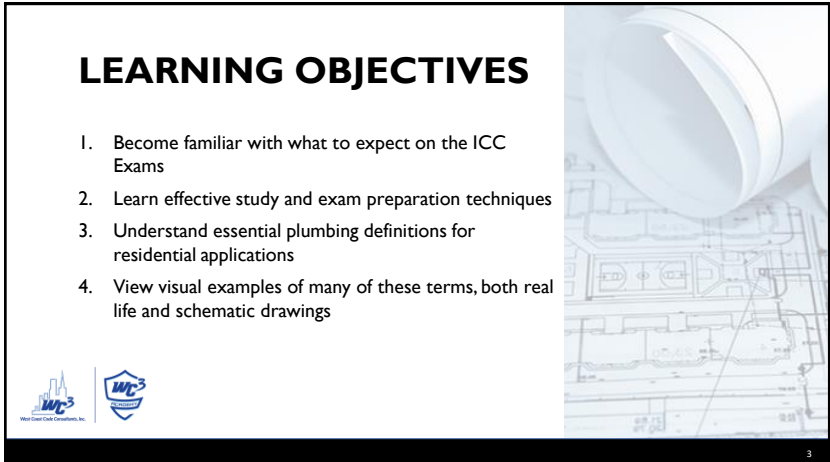




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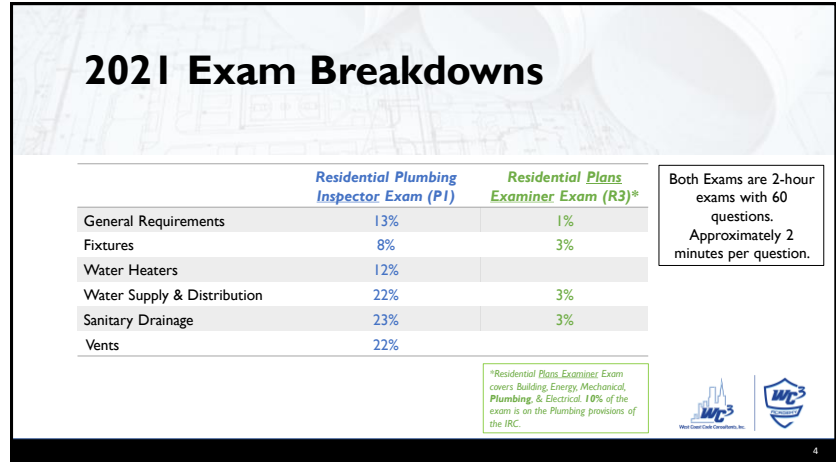
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3

LEARNING OBJECTIVES

- 1. Become familiar with what to expect on the ICC Exams
- 2. Learn effective study and exam preparation techniques
- 3. Understand essential plumbing definitions for residential applications
- 4. View visual examples of many of these terms, both real life and schematic drawings



4

2021 Exam Breakdowns

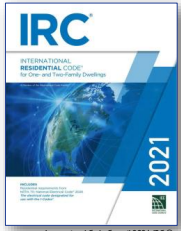
	Residential Plumbing Inspector Exam (P1)	Residential Plans Examiner Exam (R3)*
General Requirements	13%	1%
Fixtures	8%	3%
Water Heaters	12%	
Water Supply & Distribution	22%	3%
Sanitary Drainage	23%	3%
Vents	22%	



Both Exams are 2-hour exams with 60 questions. Approximately 2 minutes per question.

*Residential Plans Examiner Exam covers Building, Energy, Mechanical, Plumbing, & Electrical. 10% of the exam is on the Plumbing provisions of the IRC.

2021 Exam References

- 2021 International Residential Code.
 - Primarily the Part VII – Plumbing, Chapters 25-33
 - Be familiar with Chapter 24 Fuel Gas
 - Chapter 2 - Definitions
 - Questions may come out of other chapters of the book (Chapter 3).









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Preparation


- Focus on the plumbing chapters but be prepared for questions from other chapters.
- Personal study: **2-hrs.** for every **1-hr.** of class time
- Highlight important sections
- Write key numbers in large print
- Tab your book



6



Examples



601.4 Intake opening location. Air intake openings shall comply with all of the following:

1. Intake openings shall be located not less than 10 feet (3048 mm) from lot lines or buildings on the same lot.
2. Mechanical and gravity ~~air~~ **air** intake openings shall be located not less than **10 feet** (3048 mm) horizontally from any hazardous ~~or~~ **or** business, commercial, or residential source, such as vents, stoves, alleys, parking lots and loading docks, except as specified in Item 3 or Section 501.3.1. Outdoor air intake openings shall be permitted to be located less than **10 feet** (3048 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such location. When openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.
3. Intake openings shall be located not less than 3 feet (914 mm) below contaminant sources where such sources are located within **10 feet** (3048 mm) of the opening.


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Key Items

- Marginal Markings
 - Solid vertical lines- New or modified
 - [➡] Entire section, paragraph, exception is deleted
 - [*] indicates text/table has been relocated elsewhere
 - [**] indicates text/table has been relocated there
- Italicized Terms (Definitions)



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Should be tabbed, highlighted and marked.

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Should be tabbed, highlighted and marked.

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A	AIR CONDITIONERS
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ACCESS (TO)	Room air conditioners
AIR INFILTRATION	Requirements
AIR LEAKAGE	Of floor joists
ALLOWABLE SPANS	Of headers
ALTERATIONS	Of rafters and ceiling joists
AMPACT	Defined

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- ## Chapters
1. Scope and Administration
 2. Definitions
 3. Building Planning
 24. Fuel Gas
 25. Plumbing Administration
 26. General Plumbing Requirements
 27. Plumbing Fixtures
 28. Water Heaters
 29. Water Supply and Distribution
 30. Sanitary Drainage
 31. Vents
 32. Traps
 33. Storm Drainage
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-

11

IRC Chapter 2

Definitions & Plumbing Basics

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12

Basic Plumbing Terms & Definitions

Air Admittance Valve - A one-way valve designed to allow air into the plumbing drainage system where a negative pressure develops in the piping. This device shall close by gravity and seal the terminal under conditions of zero differential pressure (no flow conditions) and under positive internal pressure.

Air Break - When a drain discharges indirectly into another fixture, receptacle, or interceptor below flood level rim and above trap seal.

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Basic Plumbing Terms & Definitions

Air Gap (Drainage) - Unobstructed vertical distance through the free atmosphere between the outlet of the waste pipe and the flood level rim of the receptacle it's discharging into.

Air Gap (Distribution) - Unobstructed vertical distance through the free atmosphere between lowest opening of water supply pipe to a tank, fixture, or other device and the flood level rim of the receptacle.

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Basic Plumbing Terms & Definitions

Backflow (Water Distribution) - The flow of water or other liquids into the potable water-supply piping from any sources other than its intended source..

Backflow Preventer (Reduced-pressure-zone type) - A backflow-prevention device consisting of two independently acting check valves, internally force loaded to a normally closed position and separated by an intermediate chamber (or zone) in which there is an automatic relief means of venting to atmosphere internally loaded to a normally open position between two tightly closing shutoff valves and with means for testing for tightness of the checks and opening of relief means.

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Basic Plumbing Terms & Definitions

Backpressure - Pressure created by any means in the water distribution system, which by being in excess of the pressure in the water supply mains causes a potential backflow condition.

Branch Vent - Vent connecting one or more individual vents with a vent stack or stack vent.

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Basic Plumbing Terms & Definitions (Cont.)

Cleanout - Access opening in the drainage system utilized for the removal of obstructions.



Common Vent - Vent connecting at the junction of two fixture drains or to a fixture branch and serving as a vent for both fixtures.

Crown Vent - A vent within two pipe diameters from the trap weir (this vent is prohibited)

Drainage Fixture Unit (DFU) - A measure of the probable discharge into the drainage system by various types of plumbing fixtures.

DWV - Abbreviated term for drain, waste and vent piping as used in common plumbing practice.

Flood Level Rim - The edge of the receptacle from which water overflows.

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Basic Plumbing Terms & Definitions (Cont.)

Flow Pressure - The static pressure reading in the water-supply pipe near the faucet or water outlet while the faucet or water outlet is open and flowing at capacity.

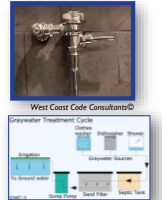

Fixture Group, Main - The main water-distribution pipe (or secondary branch) serving a plumbing fixture grouping such as a bath, kitchen or laundry area to which two or more individual fixture branch pipes are connected.

Flushometer Valve - A flushometer valve is a device that discharges a predetermined quantity of water to fixtures for flushing purposes and is actuated by direct water pressure.

Full Way Valve - A valve that in the fully open position has an opening cross-sectional area that is not less than 85 percent of the cross-sectional area of the connecting pipe.

Graywater - Waste discharged from lavatories, bathtubs, showers, clothes washer, and laundry trays.

Hot Water - Water at a temperature greater than 120°F (49°C).

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Basic Plumbing Terms & Definitions (Cont.)

Indirect Waste Pipe - A waste pipe that discharges into the drainage system through an air gap into a trap, fixture or receptor.



Individual Vent - Pipe installed to vent a fixture trap and that connects with the vent system above the fixture served or terminates in the open air.

Main - The principal pipe artery to which branches are connected.

Manifold Water Distribution Systems - A fabricated piping arrangement in which a large supply main is fitted with multiple branches in close proximity in which water is distributed separately to fixtures from each branch.

Nonpotable Water - Water not safe for drinking, personal, or culinary utilization.

Plumbing Fixture - A receptacle or device that is connected to a water supply system or discharges to a drainage system or both. Such receptacles or devices require a supply of water; or discharge liquid waste or liquid borne solid waste; or require a supply of water and discharge waste to a drainage system.

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Basic Plumbing Terms & Definitions (Cont.)

Potable Water - Water free from impurities present in amounts sufficient to cause disease or harmful physiological effects.



Pressure Relief Valve - A pressure-actuated valve held closed by a spring or other means and designed to automatically relieve pressure at the pressure at which it is set to a drainage system.

Quick-Closing Valve - A valve or faucet that closes automatically where released manually or controlled by mechanical means for fast-action closing.

Receptor - A fixture or device that receives the discharge from indirect waste pipes.

Reclaimed Water - Nonpotable water that has been derived from the treatment of wastewater by a facility or system licensed or permitted to produce water meeting the jurisdiction's water requirements for its intended uses.

Relief Vent - A vent whose primary function is to provide circulation of air between drainage and vent systems.

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Basic Plumbing Terms & Definitions (Cont.)



Rim – An unobstructed open edge of a fixture.

Sanitary Sewer - A sewer that carries sewage and excludes storm, surface and groundwater.

Septic Tank - A watertight receptor that receives the discharge of a building sanitary drainage system and is constructed so as to separate solids from the liquid, digest organic matter through a period of detention, and allow the liquids to discharge into the soil outside of the tank through a system of open joint or perforated piping or a seepage pit.

Slope – The fall (pitch) of a line of pipe in reference to a horizontal plane. Slope is expressed as the fall in units vertical per units horizontal for a length of pipe.

Stack – A General term for any vertical line of soil, waste, vent, or inside conductor piping that extends through not fewer than one story with or without offsets.

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Basic Plumbing Terms & Definitions (Cont.)



Stack Vent – The extensions of a soil or waste stack above the highest horizontal drain connected to the stack.

Sump Pump – An automatic water pump powered by an electric motor for the removal of drainage, except raw sewage, from a sump, pit, or low point.

Sweep - A drainage fitting designed to provide a change in direction of a drainpipe of less than the angle specified by the amount necessary to establish the desired slope of the line. Sweeps provide a longer turning radius than bends and a less turbulent flow pattern (see "Bend" and "Elbow").

Temperature-Relief Valve - A temperature-actuated valve designed to discharge automatically at the temperature at which it is set.

Trap – A fitting or device that provides a liquid seal to prevent the emission of sewer gases without materially affecting the flow of sewage or wastewater through the trap.

22

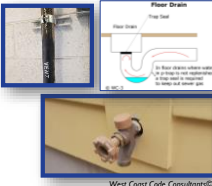

Basic Plumbing Terms & Definitions (Cont.)

Trap Seal - The trap seal is the maximum vertical depth of liquid that a trap will retain, measured between the crown weir and the top of the dip of the trap.

Vacuum Breaker - A device that prevents back-siphonage of water by admitting atmospheric pressure through ports to the discharge side of the device.

Vent Stack - A vertical vent pipe installed to provide circulation of air to and from the drainage system and that extends through one or more stories.

Vent System - Piping installed to equalize pneumatic pressure in a drainage system to prevent trap seal loss or blowback due to siphonage or back pressure.



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Basic Plumbing Terms & Definitions (Cont.)

Waste Receptor – A floor sink, standpipe, hub drain, or floor drain that receives the discharge of one or more indirect waste pipes.

Water Supply Fixture Unit (w.s.f.u.) – A measure of the probable hydraulic demand on the water supply by various types of plumbing fixtures used to size water-piping systems. The water-supply fixture-unit value for a particular fixture depends on its volume rate of supply, on the time duration of a single supply operation and on the average time between successive operations.

Wet Vent - A vent that receives the discharge of wastes from other fixtures.

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MODULE 2

*IRC Chapters 25-28:
Plumbing Administration,
General Plumbing, etc.*




1



IRC Chapter 25




Plumbing Administration



2

Existing Systems

IRC P2502:
Existing sewers and drains connected to new systems must be inspected to internally examine slope, quality and obstructions.








3

Additions

IRC P2502.2:

- Additions, alteration or repairs must comply
 - Existing plumbing systems do not need to meet the requirements of code
 - Additions shall not cause an existing system to become unsafe, unsanitary or overloaded

4



Minor Plumbing Work

IRC P2502.2:
 Minor additions, alteration or repairs to existing systems are permitted, provided they are not hazardous and are approved.



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Inspections

IRC P2503:

- Inspection required on new plumbing and parts of existing systems affected by new work prior to concealment.
 - Test equipment, materials etc. shall be provided by the permit holder.








6

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Building Sewer Testing

IRC P2503.4:

- Inspection required on new plumbing and parts of existing system affected by new work.
 - 10-foot of head for minimum of 15 minutes
 - 5 psi air pressure for 15 minutes

7

7

Drain, Waste & Vent Testing

IRC P2503.5:

- Must be tested with water, air (non-plastic) or vacuum.
 - Water test: 10-foot of head for minimum of 15 minutes
 - Air test: 5 psi air pressure for 15 minutes
 - Vacuum test: -5 psi for 15 minutes








8

8

Testing P-traps and Connections

IRC P2503:

- Finished plumbing
 - Water tightness: each fixture shall be filled and then drained
 - Gas tightness: smoke test for 15 minutes at 1-inch water column or 2 ounces of peppermint

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Testing Water-Supply

IRC P2503.7:

- Water pressure equal to working pressure of system **OR**
- Air pressure equal to 50 psi (non-plastic only*)
- 15 min. test duration

Exception: PEX piping authorized by manufacturer










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Shower Pan

IRC P2503.6:
Water test- 2" depth at threshold, 15 min. duration





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Test Gauges

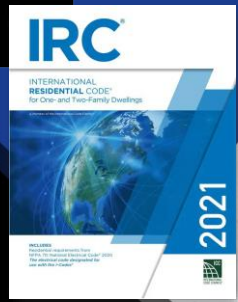
IRC P2503.9:

- Test 10 psi or less: **0.10 psi** increments
- Test >10 psi - 100 psi: **1 psi** increments
- Tests >100 psi: **2 psi** increments

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IRC Chapter 26

13% General Plumbing Requirements
1%

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Water Supply

IRC 2602.1:

- Water supply must connect to public water supply where available
- Where not available, individual water supply required
- Individual water supply subject to state and local laws, or **NGWA-01** if no laws exist

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Sanitary Drainage

IRC 2602.1:

- Sanitary drainage must connect to public sewer where available
- Where not available, private sewage disposal system required
- Private sewage subject to state and local laws, or **IPSDC** if no laws exist

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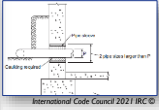
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Structural Protection

IRC 2603:

- Drilling and notching per Sections R502.8, R602.6, R802.7, and R802.7.1.
- Holes or notches < 1-1/4" from stud face require 16 gage plate which extends 2 inches
- Pipes through foundation walls provided with sleeve and sealant (P2606)
- Protected from freezing in attics and exterior

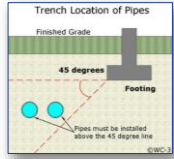
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Trenching

IRC P2604:

- Backfill shall be free from discarded construction material
- Trenching shall not extend below the 45-degree bearing plane



Pipe Support

IRC Table P2605.1:

- Prevent sagging
- Expansion and contraction

PIPE MATERIAL	MAXIMUM HORIZONTAL SPACING, feet	MAXIMUM VERTICAL SPACING, feet
ABS pipe	4	10
Cast-iron pipe	12	15
Cast-iron pipe	8	15
Copper or copper alloy pipe	12	15
Copper or copper alloy tubing (1/2 inches in diameter and smaller)	6	15
Copper or copper alloy tubing (1/2 inches in diameter and larger)	8	15
Cross-linked polyethylene (PEX) pipe, 1/2 inch and smaller	2.0 (1.2 inches)	10
Cross-linked polyethylene (PEX) pipe, 1/2 inch and larger	4	10
Encased or protected polyethylene (PEX) pipe, 1/2 inch and larger	2.0 (1.2 inches)	10
CPVC pipe or tubing (1/2 inch in diameter and smaller)	8	10
CPVC pipe or tubing (1/2 inch in diameter and larger)	4	10
Lead pipe	4	10
PE pipe or tubing	2.0 (1.2 inches)	10
Polybutylene of rated temperature (PB-1) pipe, 1/2 inch and smaller	2.0 (1.2 inches)	10
Polybutylene of rated temperature (PB-1) pipe, 1/2 inch and larger	4	10
Polysulfone (PSF) pipe or tubing (1/2 inch and smaller)	2.0 (1.2 inches)	10
Polysulfone (PSF) pipe or tubing (1/2 inch and larger)	4	10
PVC pipe	4	10
Unvented water storage systems	12	15
Steel pipe	12	15

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Considerations

- **IRC P2606:**
 - Sealing of penetrations in envelope
- **IRC P2607:**
 - Waterproofing of penetrations in walls and roofs
- **IRC P2608:**
 - Workmanship
- **IRC P2609:**
 - Identification of materials
 - Installed per accepted standards



IRC Chapter 27

8% Plumbing Fixtures
3%






Fixtures & Tail Pieces

IRC P2703:

- Approved strainers required for all fixtures except water closets.

IRC P2703:

- Tail pieces 1.5" – sinks, dishwashers, laundry tubs, bathtubs and similar
- Tail pieces 1.25" – bidets, lavatories and similar




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Access

IRC P2704:

- Access to connections
 - Slip connection to have access panel of 12" in its smallest dimension
 - Made of approved elastomeric sealing gasket




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Installation

IRC P2705:

- Floor mounted fixtures must be secured to floor with corrosion-resistant hardware
- Wall-hung shall be rigidly supported
- Contact areas shall be watertight
- Fixtures shall be usable


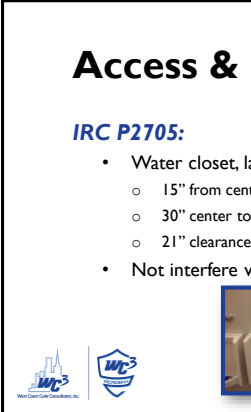
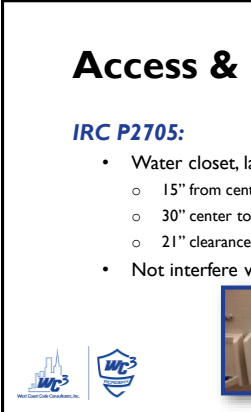
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Access & Installation

IRC P2705:

- Water closet, lavatory or bidet:
 - 15" from center line to side wall or vanity
 - 30" center to center
 - 21" clearance in front
- Not interfere with doors/windows

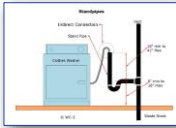


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Waste Receptors

IRC P2706:

- Hub drains that receive only clear-water waste and standpipes: no strainer
- Removable strainer or basket to cover waste outlet or receptors
- Not installed in plenums, attics, crawl spaces
- Standpipe shall extend 18" - 42"








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Directional Fittings

IRC P2707:

- Required at fixture tail pieces receiving discharge from:
 - Food-waste disposer
 - Dishwashers

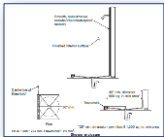






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Showers

IRC P2708:

- Minimum 900 square inches
- Minimum dimension of 30 inches independent of fixtures or grab bars for a height of 70 inches
- Exceptions-
 - Fold-down seats permitted (900 sq in when seat is folded up)
 - If < 25" in minimum dimension- Area must be 1,300 square inches+

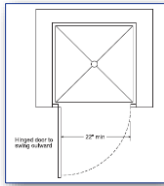






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Showers

IRC P2708:

- Opening
 - 22-inch minimum opening
- Drain
 - 1.5" minimum
- Control Valves
 - Limit water temp to 120°F

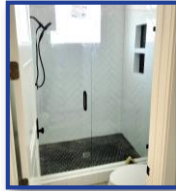




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Shower Receptors

IRC 2709

- Curbs 2" min. and 9" max.
- Floor slope 1/4" per foot min. 1/2" per foot max.
- Lining required: PVC, CPE, Hot-mopping, Lead, Copper, Etc.



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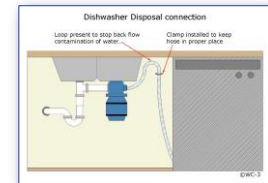
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Waste Connections

IRC P2711 – 2719:

- Sinks
 - Provide 1-1/2 inch waste outlet
- Food Waste Grinder
 - Connected to drain 1-1/2 inch in diameter
- Dishwashing Machines
 - Sink and dishwasher on single 1-1/2 inch discharge
 - Connect washer drainpipe to underside of counter



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Bathtub Overflow

IRC 2713.1

- Overflows are **not required**
- Where installed must be 1.5" diameter



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Whirlpool Baths

IRC P2720:

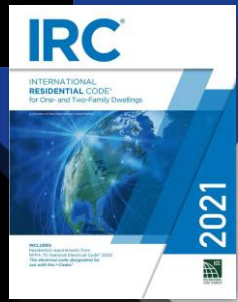
- Access to Pump
 - 12 inch x 12 inch access door where ≤ 2 feet from pump
 - 18 inch x 18 inch access door where ≥ 2 feet from pump



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IRC Chapter 28

12% Water Heaters

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Required Hot Water

IRC P2801.1:
Hot water shall be supplied to plumbing fixtures and plumbing appliances intended for bathing, washing, and culinary purposes




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Installation Location

IRC 2801.4:

- In accordance with M1305
 - Accessible for inspections, service, repair, and replacement
 - Flat working space **30 in. X 30 in.**
 - All other requirements of M1305 apply

Appliance

30" 30"

*Note that other installation and location requirements are covered in Mechanical Chapters 20-24

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Required Pans

IRC P2801.6:

- Required where leakage could cause damage
- Made of galvanized steel, plastic, or approved material
- Pan Size and Drain
 - 1½ inch deep
 - Drain must be ¾ inch dia.
- Drain Termination
 - Over a suitable location
 - Termination to the exterior must be > 6 inch but < 24 inch above ground level



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Installation in Garages

IRC P2801.7:

- Elevated **18 inches** above floor if it has an ignition source

Exception: Does not need to be elevated if listed as Flammable Vapor Ignition-Resistant

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Seismic Bracing

IRC P2801.8:

- Anchored in Seismic Design Category D0, D1, and D2 & Category C for townhomes
 - Upper 1/3rd and lower 1/3rd
 - Must resist horizontal pressure equal to **1/3rd of weight**

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Solar Water Heating Systems

IRC P2802:

- Water provided from a Solar Thermal System shall have a Thermostatic mixing valve (**ASSE 1070**)
- Solar Thermal Systems shall comply with Section P2803.2






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Water Heaters Used for Space Heating

IRC P2803:

- Temperature Controls
 - When a space heating system requires water temperatures higher than **140°F** a master thermostatic mixing valve shall be installed to temper water temperature below **140°F** for domestic use




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Relief Valves

IRC P2804:

- Any appliance made to heat or store hot water must be protected by:
 - A separate pressure-relief valve and temperature-relief valve, **OR**
 - A combination pressure and temperature-relief valve

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Settings

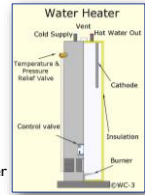

IRC 2804.3:

- Pressure-Relief Valve
 - Set to open at **25 psi** or greater, but not over **150 psi**
 - Shall not exceed the tank's working pressure

IRC P2804.4:

- Temperature-Relief Valve
 - Sensing element must monitor water within the top **6 inches**
 - Valve shall open at a temperature not greater than **210°F**

(opening temperature should be compatible with temperature conditions of appliance)




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42

Discharge Pipe

IRC P2804.6.1:

- Not directly connected to drainage system
- Single relief device
- Not cause personal injury or structural damage
- Not be trapped
- Flow by gravity
- May not have valves or tee fittings

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END OF MODULE 2



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MODULE 3

*IRC Chapter 29:
Water Supply and Distribution*

1

1

LEARNING OBJECTIVES

1. Understand code requirements related to water supply piping.
2. Become familiar with methods of protecting potable water.
3. Learn basic requirements for the installation of fire sprinkler systems.

2

2

IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings

2021

IRC Chapter 29

22% Water Supply and Distribution

3%

3

3

Chapter 29 Overview

- Protecting Potable Water
 - Air gaps, Backflows, and Connections
- Water Supply System
 - Flow Rates, Pressures, and Valves
- Fire Sprinkling System
 - Location/Installation, Pressure Loss, and Allowable Length Tables

4

4

Required Potable Water

IRC P2901:

- Plumbing fixtures and appliances shall be supplied with potable water
- If non-potable water is used, must be labeled with tags, colors, signage, etc.
- If colors are used for non-potable water- **purple**





FIGURE P2901.3.1
PHOTOGRAPH—DO NOT DRINK
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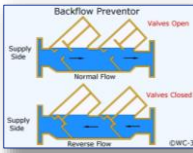

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Backflow Prevention

IRC P2902.3:

- Potable water systems must be protected by backflow prevention methods:
 - Air Gaps (P2902.3.1)
 - Atmo.Type Vacuum Breaker (P2902.3.2)
 - Intermediate Atmospheric Vent (P2902.3.3)
 - Pressure Vacuum Breaker (P2902.3.4)
 - Reduce Pressure Principle (P2902.3.5)
 - Double Check-Valve (P2902.3.6)

6

6

Air Gaps

IRC P2902.3.1:

- Air gaps are measured vertically from bottom of water outlet to the top of flood rim
- Minimum air gap - twice the diameter of outlet opening but
- Not less than Table 2902.3.1

FITTURE	MINIMUM AIR GAP	
	Away from a wall device	Close to a wall device
Effective openings greater than 1 inch	Two times the diameter of the effective opening	Three times the diameter of the effective opening
Lavatories and other fixtures with effective opening not greater than 1/2 inch in diameter	1	1.5
Over-the-sink bath fixtures and other fixtures with effective openings not greater than 1 inch in diameter	2	3
Sinks, laundry trays, greenhouse bath fixtures and other fixtures with effective openings not greater than 3/4 inch in diameter	1.5	2.5

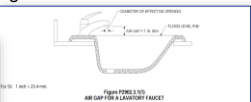



FIGURE P2902.3.1
AIR GAP FOR A LAVATORY FACET
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Application for Backflow Preventers

IRC Table P2902.3:

What type of backflow preventer is required - 2902.4 thru 2902.5.

8

8

Protection of Connections

IRC P2902.5:

- Boilers
- Heat Exchangers
- Lawn Irrigation Systems
- Automatic Fire Sprinklers
- Solar Thermal Systems



Locations

IRC P2902.6:

- Access required per manufacturer's instructions
- Not located in areas subject to freezing (unless removable or protected)
- Relief port shall discharge to an approved indirect waste or outdoors



Supply Capacity

IRC Table P2903.1:

Required water supply under peak demand

TABLE P2903.1 REQUIRED CAPACITY AT POINT OF OUTLET DISCHARGE FIXTURE SUPPLY OUTLET SERVING		
FIXTURE	FLOW RATE (GPM)	FLOW (GALLONS PER MINUTE)
Ballcock, indirect pressure, thermostatic or combination ballcock/thermostatic mixing valve	4	20
Fixture, thermostatic mixing valve	2	10
Disinfectant	2.5	8
Laundry tray	4	8
Laundry	8.8	9
Shower, indirect pressure, thermostatic or combination ballcock/thermostatic mixing valve	2.9	20
Sink, hot water	5	8
Toilet	1.75	8
Water closet, flushometer tank	1.8	10
Water closet, tank, close coupled	3	20
Water closet, tank, one piece	6	20

Note 1. 1 gallon per minute = 0.803 L/min, 1 gallon per minute = 3.785 L/min.
 a. When the shower mixing valve manufacturer indicates a lower flow rating for the mixing valve, the lower value shall be applied.

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Maximum Flow Rates

IRC P2903.2:

TABLE P2903.2 MAXIMUM FLOW RATES AND CONSUMPTION FOR PLUMBING FIXTURES AND FIXTURE FITTINGS ^a	
PLUMBING FIXTURE OR FIXTURE FITTING	MAXIMUM FLOW RATE OR QUANTITY
Lavatory faucet	2.2 gpm at 60 psi
Shower head ^b	2.5 gpm at 80 psi
Sink faucet	2.2 gpm at 60 psi
Water closet	1.6 gallons per flushing cycle

For 50: 1 gallon per minute = 3.785 L/min, 1 pound per square inch = 6.895 kPa.
 a. A hand-held shower spray shall be considered for a shower head.
 b. Consumption tolerances shall be determined from referenced standards.

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Supply Pressure

Step 1: Add w.s.f.u's-

- One (1) full-bath: 3.6
- One (1) half-bath: 2.6
- One (1) kitchen + dishwasher: 2.5
- One (1) clothes washer: 1.4
- Total of 10.1 w.s.f.u's

TYPE OF FIXTURES OR GROUP OF FIXTURES	WATER SUPPLY SYSTEM UNIT VALUE (W.S.U.)	WATER SUPPLY SYSTEM UNIT VALUE (W.S.U.)	WATER SUPPLY SYSTEM UNIT VALUE (W.S.U.)
Full-bath (with/without mechanical shower head)	3.6	3.6	3.6
Half-bath	2.6	2.6	2.6
Toilet	1.0	1.0	1.0
Washbasin	1.0	1.0	1.0
Kitchen sink	1.0	1.0	1.0
Dishwasher	1.5	1.5	1.5
Laundry tub	1.4	1.4	1.4
Shower stall	1.0	1.0	1.0
Shower stall (with/without shower head)	1.0	1.0	1.0
Shower stall (with/without shower head and bench seat)	1.0	1.0	1.0
Shower stall (with/without shower head and bench seat) (with/without bidet)	1.0	1.0	1.0
Shower stall (with/without shower head and bench seat) (with/without bidet) (with/without bidet)	1.0	1.0	1.0
Shower stall (with/without shower head and bench seat) (with/without bidet) (with/without bidet) (with/without bidet)	1.0	1.0	1.0
Shower stall (with/without shower head and bench seat) (with/without bidet) (with/without bidet) (with/without bidet) (with/without bidet)	1.0	1.0	1.0
Shower stall (with/without shower head and bench seat) (with/without bidet) (with/without bidet) (with/without bidet) (with/without bidet) (with/without bidet)	1.0	1.0	1.0

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Supply Pressure

Step 2: Convert to GPM

- 10.1 w.s.f.u's (round up)= 11
- Left column = Flush Tanks
- Demand = 15.4 GPM

Level	Water supply fixture units	Gallons per minute	Level	Water supply fixture units	Gallons per minute
1	1.0	2.0	11	11.0	22.0
2	2.0	4.0	12	12.0	24.0
3	3.0	6.0	13	13.0	26.0
4	4.0	8.0	14	14.0	28.0
5	5.0	10.0	15	15.0	30.0
6	6.0	12.0	16	16.0	32.0
7	7.0	14.0	17	17.0	34.0
8	8.0	16.0	18	18.0	36.0
9	9.0	18.0	19	19.0	38.0
10	10.0	20.0	20	20.0	40.0
11	11.0	22.0	21	21.0	42.0
12	12.0	24.0	22	22.0	44.0
13	13.0	26.0	23	23.0	46.0
14	14.0	28.0	24	24.0	48.0
15	15.0	30.0	25	25.0	50.0
16	16.0	32.0	26	26.0	52.0
17	17.0	34.0	27	27.0	54.0
18	18.0	36.0	28	28.0	56.0
19	19.0	38.0	29	29.0	58.0
20	20.0	40.0	30	30.0	60.0
21	21.0	42.0	31	31.0	62.0
22	22.0	44.0	32	32.0	64.0
23	23.0	46.0	33	33.0	66.0
24	24.0	48.0	34	34.0	68.0
25	25.0	50.0	35	35.0	70.0
26	26.0	52.0	36	36.0	72.0
27	27.0	54.0	37	37.0	74.0
28	28.0	56.0	38	38.0	76.0
29	29.0	58.0	39	39.0	78.0
30	30.0	60.0	40	40.0	80.0
31	31.0	62.0	41	41.0	82.0
32	32.0	64.0	42	42.0	84.0
33	33.0	66.0	43	43.0	86.0
34	34.0	68.0	44	44.0	88.0
35	35.0	70.0	45	45.0	90.0
36	36.0	72.0	46	46.0	92.0
37	37.0	74.0	47	47.0	94.0
38	38.0	76.0	48	48.0	96.0
39	39.0	78.0	49	49.0	98.0
40	40.0	80.0	50	50.0	100.0

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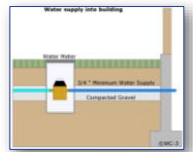
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Sizing Mains


IRC P2903.7:

- Water service pipe ¾ inches minimum
- Sizing method can be determined/approved by code official
- Any method must consider water demand, friction losses, and pipe lengths

*Prescriptive method is found in Appendix P



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Manifolds


IRC P2903.8.1:

Manifolds should be sized using Table 2903.8.1 based on gpm for all outlets


PLASTIC		METALLIC	
Nominal Size ID (inches)	Maximum gpm	Nominal Size ID (inches)	Maximum gpm
¾	17	¾	11
1	29	1	20
1½	46	1½	31
2	66	2	44

Note: See Table P2903.6(1) for w.s.f.u and Table 2903.6(1) for gallon-per-minute (gpm) flow rates.

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Minimum Manifold

IRC 2903.8.2:

- When the following conditions exist
- Developed length is 60 feet or less
- Pressure at the meter is 40 psi or more
- Individual distribution lines shall be not less than **3/8 inches**

Developed length- The length of a pipeline measured along the center line of the pipe and fittings.





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21

Fixture Valves

IRC P2903.9.3

- Shutoff Valves Required:
 - Each plumbing appliance
 - Each plumbing fixture
 - (Except bathtubs and showers)
- Valves for drinking water must be **NSF 61** compliant

22





22

Hose Bibs

IRC P2903.10

- Must be "frost proof" type
- Equipped with an accessible stop-and-waste-type drain valve.

Exception: Where stem extends into building to a heated or semi conditioned space.

23

23

Fire Sprinkler Systems

IRC P2904:


- Section 2904 does not specify what buildings are required to be sprinklered, it only regulates systems being installed
- Section **R313** requires **all** townhomes and one/two family dwellings to have an automatic fire sprinkler system






24

24



Required Sprinkler Locations


IRC 2904.1.1:

- Everywhere in a dwelling unit except...
 - Attics, crawlspaces, unoccupied concealed spaces without fuel-burning appliances.
 - Cloths closets, linen closets, and pantries less than **24 sq. ft** with the smallest dimension 3 feet or less and lined with gypsum board
 - Bathrooms **55 sq. ft** or less
 - Garages, carport, unheated entry with outside entrance



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Temperature Ratings

IRC P2904.2.1:

- Sprinklers should have a temperature rating range of **135°F to 225°F**
 - This means they are activated after reaching these temperatures.
- Intermediate temperature sprinklers should be installed in areas of abnormal heat like above a fireplace or under a skylight, attics, concealed spaces under a room
 - Intermediate temperature sprinklers have a temperature range of **175°F to 225°F**




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Freeze Protection

IRC P2904.2.3:

- Sprinkler piping shall be protected from freezing:
 - Dry-pipe systems
 - Dry-sidewall or dry-pendent (wet pipe in nonfreezing areas, dry pipe in freezing areas)



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Coverage

IRC P2904.2.4:

- Single sprinkler coverage not to exceed **400 sq. ft.**
- Based on the listing and manufacturer's instructions
- Not blocked by obstructions (unless other coverage provided)



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Locations for Intermediate Temperature

IRC Table P2904.2.2:

HEAT SOURCE	RANGE OF DISTANCE FROM HEAT SOURCE WITHIN WHICH INTERMEDIATE TEMPERATURE SPRINKLERS ARE REQUIRED ^a (feet/inches)
Fireplace, side of open or recessed fireplace	12 to 36
Fireplace, front of recessed fireplace	36 to 60
Cool and wood burning stove	12 to 42
Kitchen range top	0 to 30
Oven	0 to 30
Vent connector or chimney connector	0 to 30
Boiling fluid, not enclosed	0 to 30
Hot water pipes, not insulated	0 to 12
Side of ceiling or wall steam air register	12 to 36
Front of wall-mounted steam air register	18 to 36
Water heater, furnace or boiler	3 to 6
Luminaires up to 200 watts	3 to 6
Luminaires 200 watts up to 400 watts	0 to 12

^a Sprinklers shall not be located at distances less than the minimum table distance unless the sprinkler listing allows a lesser distance.
^b Distance shall be measured in a straight line from the nearest edge of the heat source to the nearest edge of the sprinkler.
^c Intermediate temperature sprinklers shall be installed in accordance with the manufacturer's instructions.

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Modifications, Support & Materials

IRC P2904.2.6:

- Painting, Caulking or Modifying prohibited

IRC P2904.3:

- Support in accordance with cold water distribution piping
- CPVC, PEX and PE-RT must be listed for use in a residential fire sprinkler system
- Non-metallic pipe/tubing must be protected from the living space by 3/8" gyp. or 1/2" plywood



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Shutoff Valves

IRC P2904.3.2

- Main water- Permitted
- Master control locked open- Permitted
- Other valve isolating one or more sprinklers- Prohibited

IRC P2904.3.3

- Piping shall not serve more than one dwelling



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Required Capacity

IRC P2904.5.2:

- Seven minutes for dwelling units one story AND less than 2,000 sq. ft.
- Ten minutes for dwelling units with two or more stories OR 2,000 sq. ft. or greater



Top story 600 sqft

Does this house require a seven minute or ten-minute capacity?

Main story 1100 sqft

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Prescriptive Pipe Sizing

- The equation is simply taking the pressure available (Psup) minus the losses from the Tables P2904.6.2(1) through P2904.6.2(9)
- See 5 Steps
- Other Option- Hydraulic Calculations per NFPA 13D

$P_1 - P_{29} = P_{20} - P_{21} - P_{22} - P_{23} - P_{24}$ (Equation 29.1)

where:

- P_1 = Pressure used in applying Tables P2904.6.2(1) through P2904.6.2(9).
- P_{20} = Pressure available from the water supply source.
- P_{21} = Pressure loss in the water service pipe. [Table P2904.6.2(1)]
- P_{22} = Pressure loss in the water meter. [Table P2904.6.2(2)]
- P_{23} = Pressure loss from devices other than the water meter.
- P_{24} = Pressure loss associated with changes in elevation. [Table P2904.6.2(3)]
- P_{25} = Maximum pressure required by a fixture.

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Pipe length

Use **Tables P2904.6.2(4) thru P2904.6.2(9)** to determine the maximum allowable length of pipe.



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Instructions and Signs

IRC P2904.7

- Owners must be provided
- Sign Required

P2904.7 Instructions and signs. An owner's manual for the fire sprinkler system shall be provided to the owner. A sign or valve tag shall be installed at the main shutoff valve to the water distribution system stating, "Warning: the water system for this home supplies fire sprinklers that require certain flows and pressures to fight a fire. Devices that restrict the flow or decrease the pressure or automatically shut off the water to the fire sprinkler system, such as water softeners, filtration systems and automatic shutoff valves, shall not be added to this system without a review of the fire sprinkler system by a fire protection specialist. Do not remove this sign."

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Required Inspections

IRC P2904.8.1

- Preconcealment Inspection
- (8) Items to verify

IRC P2904.8.2

- Heads not painted or damaged
- Pumps start automatically
- PRV's, filters, softeners not added
- Signage and owner's manual






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Hot Water Supply

IRC P2905.3

- The length of hot water piping serving fixtures is limited to **100 feet**
- Measured to recirculation loop if present




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Materials, Joints, and Connections

IRC P2906.2:

- Lead content in pipe and fittings used in pipes and fittings used in the water supply system shall be not greater than 8 percent
- Lead content of drinking water shall not have an average lead content of more than 0.25 percent.








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Saddle Tap Fittings

IRC P2906.6.1 – Saddle Tap Fittings
No longer allowed on water distribution system.



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Non-potable Water Systems


IRC P2910.2.1 Residual Disinfectants:

- Where chlorine is used for disinfection, the non-potable water shall contain not more than 4ppm of chloramines or free chlorine.
- Where ozone is used for disinfection, the non-potable water shall not contain gas bubbles having elevated levels of ozone at the point of use.

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Non-potable Water Systems (Cont.)


IRC P2910.3 Signage Required:

Non-potable water outlets shall be identified at the point of use for each outlet that reads, "Non-potable water is utilized for [application name]. Caution: Non-potable water. Do not drink."

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Nonpotable Water Reuse System

IRC P2911:

- Types of non-potable reuse systems
 - Water used for flushing toilets and urinals
 - Water used for subsurface landscape irrigation





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Nonpotable Water Reuse System (Cont.)

IRC P2911:

- Materials, testing, and inspections are all the same as sewer DWV system
- Gray water must be filtered and disinfected before it goes to fixtures
- Collection tank must be vented
- Nonpotable water collected containing untreated gray water shall be retained for not more than 24 hours




43

43

Non-potable Rainwater Systems

IRC P2912

- Collection shall only be from impervious roof surfaces
 - Vehicular parking and walkway surfaces shall be prohibited except for landscape irrigation.
- Downspouts shall be equipped with a means to prevent contamination such as leaves, sticks, and pine needles.

44

44

Reclaimed Water Systems

IRC P2913.2 Regulation:

Where reclaimed water is greater than 80 psi static pressure a pressure-reducing valve shall be installed to reduce the pressure in the system piping to 80 psi or less.



45

45

A blue-tinted image showing a person's hands typing on a laptop. The laptop screen displays a website for 'On-Demand Building & Fire Code Training'. The background features a large, semi-transparent image of a white PVC pipe and a technical plumbing diagram. The text 'END OF MODULE 3' is prominently displayed in the center-right of the image.

END OF MODULE 3



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MODULE 4

*IRC Chapter 30:
Sanitary Drainage*

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1

LEARNING OBJECTIVES

1. Become familiar with piping and materials
2. Gain a better understanding of the following items:
 - A. Drainage fixture units
 - B. Drainage pipe sizing
 - C. Sump pumps
 - D. Gray water systems

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2

IRC
INTERNATIONAL RESIDENTIAL CODE
For One- and Two-Family Dwellings

2021

IRC Chapter 30

23% Sanitary Drainage
3%

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3

Materials

IRC P3002:

- Drain, Waste, and Vent (DWV) should be constructed of approved material from the following tables
 - Table P3002.1(1) **Above Ground Pipe**
 - Table P3002.1(2) **Underground Pipe**
- Wrought-Iron and Galvanized Steel cannot be used underground, must be maintained a minimum of 6 inches above ground

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Drainage Pipe

IRC P3002.3.1:

- Smooth interior waterway
- Same diameter (no reduction)
- No ledges, smooth connections (Nothing that can restrict flow)

2% Min. Slope

5

Joints and Connections

IRC P3003.1 & 2

- Shall be gas and watertight
- Shall not be drilled, tapped, burned, or welded
- Running threads and band joints are not allowed

(Threads shall be tapered P3003.1.1)

Tapered Thread

Parallel Thread

Band joint

Running thread

RUNNING THREADS NOT ALLOWED TO FACILITATE INSTALLATION OR COUPLING

6

Types of Pipe Joints and Connections

IRC P3003.3 – P3003.14:

- Cast Iron
- ABS Plastic
- PVC Plastic
- Steel
- Copper
- Brass
- Lead
- Polyolefin Plastic
- Vitrified Clay
- Concrete Joints

7

Drainage Fixture Units

IRC P3004:

- DWV load is measured in Drainage Fixture Units (d.f.u) as per Table P3004.1
- Notice that DFU's are not exactly correlated with the increase of fixtures because of the probability of simultaneous use

8

Changes in Direction

IRC Table P3005.1:

TYPE OF FITTING PATTERN	FITTINGS FOR CHANGE IN DIRECTION		
	Horizontal to vertical ^a	Vertical to horizontal	Horizontal to horizontal
Slackend bend	X	X	X
English bend	X	X	X
Sixth bend	X	X	X
Quarter bend	X	X ^b	X ^c
Short sweep	X	X ^b	X ^c
Long sweep	X	X	X
Sanitary tee	X ^d	---	---
Wye	X	X	X
Combination wye and eighth bend	X	X	X

For 1/2, 3/4 and 1 inch = 25.4 mm.
 a. The fittings shall only be permitted for a 2-inch or smaller fixture drain.
 b. Three inches and larger.
 c. For a transition to multiple connection fittings, see Section P3005.1.1.

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9

Changes in Direction

IRC P3005.1:
Use appropriate sanitary tee, wyes, sweeps, and bends.

SANITARY TEE

CAST-IRON HUBLESS COMBINATION WYE AND 1/8 BEND

COPPER DWV LONG TURN TEE-WYE

LONG SWEEP 1/8 BEND WITH LOW HEEL INLET

1/8 BEND 45°

CAST-IRON HUBLESS SWEEP

ABS AND PVC COMBINATION WYE AND 1/8 BEND SINGLE AND DOUBLE

LONG SWEEP 1/8 BEND ABS + PVC

10

Examples of Pipe Bends

1/16 Bend Pipe
22.5 degree

1/8 Bend Pipe
45 degree

1/6 Bend Pipe
60 degree

1/4 Bend Pipe
90 degree

Short Sweep
90 degree

Long Sweep
90 degree

11

Fitting Restrictions

IRC P3005.1.6:
Drainage piping shall not be reduced in size in the direction of flow. A 4x3 WC connection is not considered a reduction.

IRC P3005.2.2:
Low-Heel inlets are not to be used for wet venting

Low-Heel Inlet

High-Heel Inlet

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Cleanouts

IRC P3005.2:

- Not more than 100ft apart (8-inch or smaller)
- Underground cleanouts shall extend vertically to above grade
- At each fitting with more than 45 degrees of change in direction
- Cleanout must be accessible
 - 18-inches for \leq 6-inch piping
 - 36-inches for 8-inch and larger piping

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Required Cleanouts

IRC P3005.2:

- Base of stacks
- Allow cleaning in the direction of flow
- Shall be the same size as the pipes they serve up to 4 inches

14

Cleanout Equivalent

IRC P3005.2.10.1:
A fixture trap or a fixture with an integral trap, removable without altering the concealed piping, shall be acceptable as a cleanout equivalent.

15

Drainage Slope

IRC P3005.3:

For pipes 2 1/2 inches or less... **2% Slope**

For pipes 3 inches or larger... **1% Slope**

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Drain Pipe Sizing

IRC P3005.4:

- Step 1- Draw layout showing fixtures
- Step 2- Assign DFU's to fixtures and/or groups
- Step 3- Start with most remote and add DFU's
- Step 4- Use Table P3005.4.1 to size branches and stacks according to DFU's
- Step 5- Use Table P3005.4.2 to size building drain and building sewer using slope and DFU's

DIAMETER OF PIPE (INCH)	SLOPE PER FOOT		
	1/8" inch	1/4" inch	1/2" inch
1 1/2"	12	None a	None a
2"	21	21	21
2 1/2"	24	31	31
3"	36	42	50
4"	180	216	250

NOMINAL PIPE SIZE (INCHES)	ANY HORIZONTAL FIXTURE BRANCH	ANY ONE VERTICAL STACK OR DRINK
1 1/2"	3	4
2"	6	10
2 1/2"	12	20
3"	30	48
4"	140	240

For 3/4, 1 inch = 25.4 mm, 1 foot = 304.8 mm.
a. 1 1/2-inch pipe size limited to a building drain serving not more than two water closets, or not more than one water closet if serving a permitted discharge fixture or garbage grinder discharge.
No water closets.

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*note- footnote "b" determines that any line with a toilet needs to be 3 inches or greater

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Definitions

- **Building Drain**-The lowest pipe that collects the discharge from all the other drainage piping inside the house and extends 30-inches past the exterior wall
- **Building Sewer**- That part of the drainage that connects to the building drain and conveys discharge to the public sewer

Example

18

Vertical offset

IRC P3006.1:

- Vertical drains with not more than 45-degree change in direction are sized as a vertical
- Vertical drains with more than 45-degree change should be sized as follows-
 - The portion above the offset: Regular stack according to dfu's
 - The offset: Building drain per Table 3005.4.2
 - Below the offset: Sized per larger of offset or total dfu's

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Sumps and Ejectors

IRC P3007:

Sumps shall be used when the building cannot gravity flow to the public sewer



(A check valve and a full open valve shall be placed on the discharge line between the pump and gravity drainage system)

20

Sump Design

IRC P3007.3:

- Sump pit
 - Be at least **18-inches** in diameter and **24-inches** deep
 - Made of tile, concrete, steel, plastic, or approved materials
 - Covered with gas-tight lid
- Discharge pipe and fittings
 - Made of approved materials
 - Be made for maximum operating pressure
- Effluent Level
 - Should be maintained to prevent levels from getting within **2 inches** of the inlet opening

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Sump Capacity (P3007.6)

IRC P3007.6:

- Sumps that discharge waste from water closets must be able to handle solids with a **2-inch sphere**
- All other sumps must be able to handle solids with a **1-inch sphere**
- Minimum capacity is derived from Table 3007.6

DIAMETER OF THE DISCHARGE PIPE (inches)	CAPACITY OF PUMP OR EJECTOR (gpm)
2	21
2½	30
3	46

For SI: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/min.
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Backwater Valves

IRC P3008.1:

Backwater valves shall be installed where the flood level rims of plumbing fixtures are below the elevation of the manhole cover of the next upstream manhole in the public sewer, and a backwater valve is installed in the building drain or horizontal branch serving such fixtures

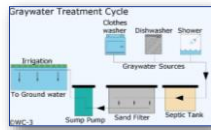





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Gray Water Recycling

IRC P3009:

- Gray water does not need to be disinfected or colored
- Water collection needs to be estimated by assumed number of occupants
- Percolation test need to be performed in the absorption area to test permeability of soil
- System location is limited by Table 3009.9.
- Loads come from Table 3009.10.1 based of percolation rate




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Replacement of Underground Plumbing

IRC P3010:

- Pre-installation (P3010.3) shall be inspected. This video shall include notations of positions of cleanouts and depth of connections to existing piping.
- Post-installation (P3010.7) shall be reviewed and approved by the building official prior to pressure testing the replacement system.

Where cleanouts have not been installed by code, cleanout fittings shall be installed where required (P3010.6).




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Relining of Underground Plumbing

- Prior to issuing a permit of relining, the building official shall review and evaluate the video of pre-installed piping and quality of piping (P3011.3).
- Where the preinstallation video reveals that piping systems are not installed correctly, or defects exist, relining shall not be permitted (P3011.5).

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END OF MODULE 4




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MODULE 5

*IRC Chapters 31-33:
Vents, Traps and Storm Drainage*







1

1


LEARNING OBJECTIVES

1. Learn about venting requirements
2. Gain a better understanding of common vents
3. Become familiar with wet vents
4. Understanding different the kinds of traps



2

2



IRC Chapter 31

22% Vents





3

3

Vents

IRC P3101:

- Vents are required for all traps and trapped fixtures
- Cold climates must protect against frost
- Vents in flood areas must be protected from flooding

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Vent Stacks

IRC P3102:

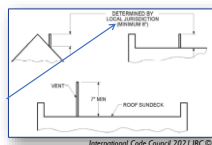
- Every building drain shall have at least **one vent** to the outdoors
 - Vertical vent must be attached to the building drain or attached to a connector
 - Vertical drain must be a dry vent
 - Must be sized per P3113.1



Vent Terminals

IRC P3103:

- Roof Extensions- At least **6 inches** above the roof line or snow accumulation, **7 feet** at roof patios, sundecks, etc.
- Wall Extensions- Vents shall terminate at least **10 feet** from lot line and **10 feet** above any grade within **10 feet**



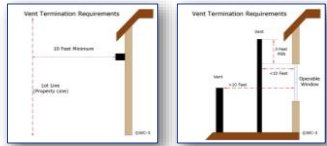
Jurisdictions to determine snow depths



Clearances From Openings

IRC P3103:

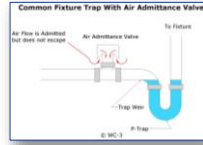
- At least **4 feet** below any opening or **3 feet** above any opening, **10 feet** horizontally from any opening
- Can't terminate under vented soffit



Vent Stacks

IRC P3102:

- All individual branches should have an open-air vent
- Exception- Air admittance valves (Studor ® vent) may be used*
- Vents must be sloped so that moisture runs back to drainage system
- Vent ends and connections must rise at least **6 inches** above the flood level of the highest trap



Fixture Vents

IRC P3105:

- The distance from trap to vent is limited in Table P3105.1
- The total fall of pipe drain cannot exceed 1 pipe diameter
- Vent opening must be 2 pipe diameters from trap weir

SIZE OF TRAP (inches)	SLOPE (inch per foot)	DISTANCE FROM TRAP (feet)
1 1/4	1/4	8
1 1/2	1/4	6
2	1/4	8
3	1/4	12
4	1/4	16

For 1/4 inch = 25.4 mm, 1 foot = 304.8 mm, 1 inch per foot = 83.33 mm/m.

(The purpose is to make sure there is air along the top of the entire trap arm so that a siphon isn't created in the trap)

9

Individual vs. Common Vents

IRC P3106:

- It's best to vent every trap/trapped fixture with its own individual vertical vent
- This isn't always practical so common vents can be used for multiple fixtures

10

Common Vent

IRC P3107:

- A common vent may be used for two traps/trapped fixtures on the same story
- Connection at the same level-
 - Vent connections must be at the connection point of the two fixture drains or down stream from that point

11

Common Vent

IRC P3107.3:

- Connection at different levels-
 - Vertical drain shall be considered the drain for lower fixture but the vent connecting the upper fixture and lower must meet the DFU's in Table 3107.3
 - Toilets cannot be the upper fixture
 - Don't be confused by the language of "same or different levels", they are not referring to different stories
 - Common vented fixture must be on the same story.** It is referring to fixtures that connect to the drain at a different elevations but on the same story



PIPE SIZE (INCHES)	MAXIMUM DISCHARGE FROM UPPER FIXTURE DRAIN (L.F.U.)
1 1/2	4
2	6
2 1/2 to 3	8

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Wet Venting Basics

IRC P3108:

- Wet vent: a horizontal drain that is over sized to allow the flow of air over drainage that is discharging
- Wet venting is only allowed in bathroom groups- **Up to two** bathroom groups may be wet vented together
- A dry vent must be connected to the wet vent to allow air

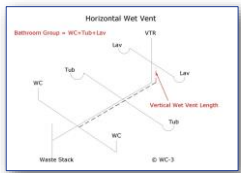




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Vertical Wet Venting

IRC P3108:

- Vertical wet venting is permitted with the following conditions-
 - Fixtures being vented must be on the same story
 - All water closet drains must drain at the same elevation
 - All fixtures must connect independently to the vertical wet vent

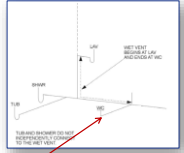



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Horizontal Wet Venting

IRC P3108.2.1:

- Fixtures must independently connect to the wet drain
- One fixture is allowed to connect upstream of the dry vent
- Configuration in Example is not allowed because the shower and the tub are not independently connected to the wet drain



**If tub were connected here, it would be allowed*



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Wet Venting Sizing

IRC P3108.3:


- The wet vent shall be sized according to Table 3108.3
- The dry vent serving the wet vent is to be sized based on the largest portion of the wet vent

WET VENT PIPE SIZE (inches)	FIXTURE UNIT LOAD (F.U.)
1 1/2	1
2	4
2 1/2	6
3	12
4	32

Note that the values in this table are the exact same as those in the common vent chart, because a common vent is essentially a vertical wet vent



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Waste Stack Vent

IRC P3109:

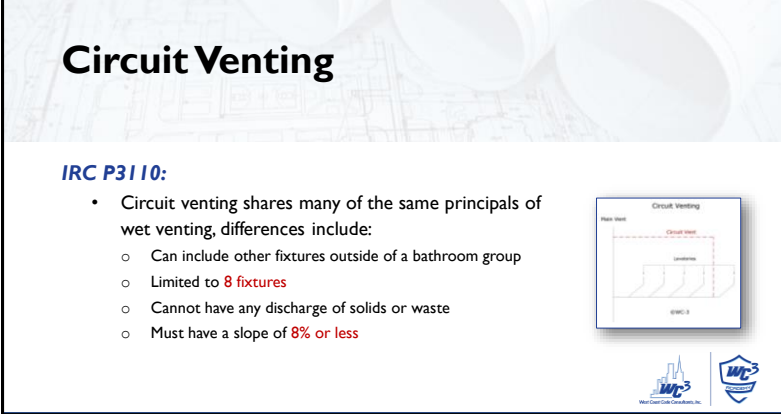
- Waste stacks are vertical stacks that do not allow the connection of toilets
- Waste Stacks may serve fixtures on different stories
- Waste Stacks may not be horizontal
- Offsets are permitted but not between the lowest fixture drain and the highest fixture drain
- Every fixture drain shall connect to the stack independently.

"Waste" is defined as: "Liquid borne waste that is free of fecal matter"



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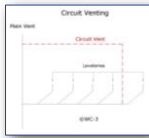

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Circuit Venting


IRC P3110:

- Circuit venting shares many of the same principals of wet venting, differences include:
 - Can include other fixtures outside of a bathroom group
 - Limited to **8 fixtures**
 - Cannot have any discharge of solids or waste
 - Must have a slope of **8% or less**

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Combination Waste and Vent


IRC P3111:

- Waste and vent combination systems are only to serve floor drains, sinks, and lavatories
- Shall not have a slope greater than **4%**
- Sized according to Table 3111.3

TABLE P3111.3 SIZE OF COMBINATION WASTE AND VENT PIPE		
DIAMETER PIPE (inches)	MAXIMUM NUMBER OF FIXTURE UNITS (FUU)	
	Connecting to a horizontal branch or stack	Connecting to a building drain or building subdrain
2	3	4
2½	6	26
3	12	31
4	20	50

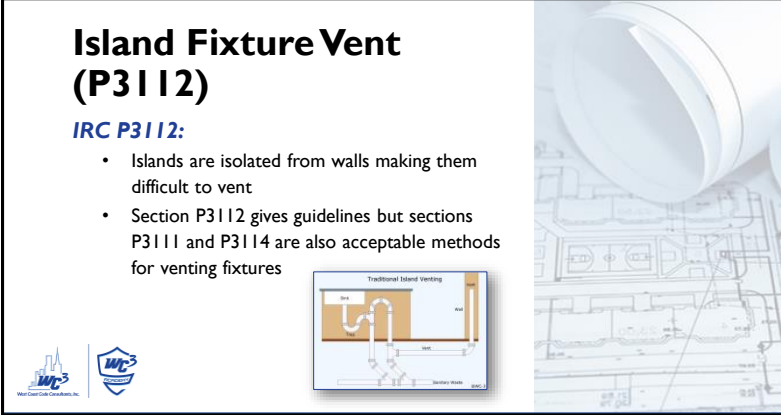
For SI: 1 inch = 25.4 mm.

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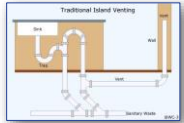

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Island Fixture Vent (P3112)

IRC P3112:

- Islands are isolated from walls making them difficult to vent
- Section P3112 gives guidelines but sections P3111 and P3114 are also acceptable methods for venting fixtures

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Island Fixture Vent

IRC P3112:

- Only permitted for sinks and lavatories
- Vent must rise above the drainage outlet of the fixture

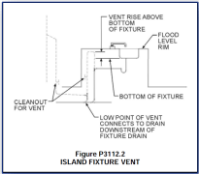




Figure P3112.2
ISLAND FIXTURE VENT
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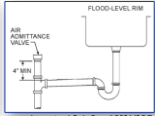

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Air Admittance Valve

IRC P3114:

- Shall be at least **4 inches** above the fixture drain
- Stack type shall be **6 inches** above the flood level rim of the highest fixture
- Must be accessible
- Must be in ventilated area that allows air flow

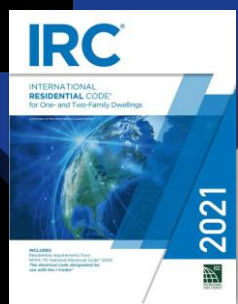



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22

22



IRC Chapter 32

Traps



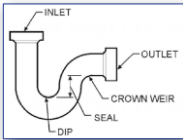

23

23

Traps

IRC P3201:

- Each fixture must have its own trap (Exceptions)
- Vertical distance from the fixture outlet to the trap weir can't exceed **24-inches**
- Horizontal distance cannot exceed **30-inches**
- Liquid trap seal must be 2 - 4 inches



24

24

Traps (Continued)

IRC P3201.5: Prohibited Traps

- Bell Traps
- "S" Traps
- Drum Traps
- Trap Designs with Moving Parts
- Separate fixture traps with interior partitions (except lavatory traps made of plastic, stainless steel, or other corrosion-resistant materials)

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Trap Sizing

IRC P3201:
Traps shall be sized to allow rapid draining but not less than Table 3201.7


PLUMBING FEATURE	TRAP SIZE (MINIMUM INCHES)
Drainfall outlet or minimal shower head outlet (shallow attachments)	1 1/2
Wash	1 1/2
2-Wheel washer standpipes	2
Disinfecter (no separate trap)	1 1/2
Floor drain	2
Shower with one or two traps, with or without disinfecter and garbage grinder	1 1/2
Lavatory tub (one or more compartments)	1 1/2
Lavatory	1 1/2

Shower (based on the total flow rate through showerheads and bodysprays)
Flow rate:
0-7 gpm and less: 1 1/2"
More than 7 gpm up to 12.1 gpm: 2"
More than 12.1 gpm up to 24.2 gpm: 3"
More than 24.2 gpm up to 35.6 gpm: 4"

Water closet:
16-18 inch - 2 1/2 inch
18-30 inch - 3 inch
Consult manufacturer for trap dimension of specific models.





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IRC Chapter 33

Storm Drainage




27

Subsoil Drains

IRC P3302:

- Subsoil drains shall be open-jointed, horizontally split, or perforated pipe.
- Pipes shall not be less than 4 inches in diameter.
- Drains shall discharge into a trapped area drain, sum, dry well, or approved location above ground.



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2021 IRC Supplement A

Combustion Air Sample Questions

1

LEARNING OBJECTIVES

1. Practice multiple sizing examples to better understand methods of obtaining combustion air.
2. Understand how to use the equations in the IRC to accurately calculate combustion air volume, and opening sizes.
3. Work through the math step-by-step to ensure arrival at the correct answer.

2

Combustion Air

IRC M1701:

- Solid-fuel-burning appliances- Per manufacturer's installation instructions
- Oil-fired appliances- **NFPA 31**
- Does not apply to
 - Fireplaces
 - Fireplace stoves
 - Direct vent appliances
- At or above flood elevation- in flood hazard areas

3

Combustion Air

IRC M1701:

For LP-Gas or Natural Gas appliances: Combustion Air in accordance with **IRC Chapter 24!**


Part VI—Fuel Gas

**CHAPTER 24
FUEL GAS**

The text of this chapter is extracted from the 2021 edition of the International Fuel Gas Code and has been modified where necessary to conform to the scope of application of the International Residential Code for One- and Two-Family Dwellings. The section numbers appearing in parentheses after each section number are the section numbers of the corresponding text in the International Fuel Gas Code.

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Combustion, Ventilation, Dilution Air

IRC G2407:
 Category I appliances:


- G2407.5 (Indoor)
- G2407.6 through G2407.9 (Outdoor)

Category I. An appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.


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Direct Vent & Others:

- Per Manufacturer
- Exception: Type I clothes dryers per G2439.5 (not required)



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Combustion, Ventilation, Dilution Air

IRC G2407.2:

- Located not to interfere with proper circulation

IRC G2407.4:

- Make up air required where exhaust fans, clothes dryers, kitchen ventilation interfere with combustion air

6

Indoor Air

IRC 2407.5.1:

- Required 50 cubic feet per 1,000 btu/h

IRC G2407.5.3.1:

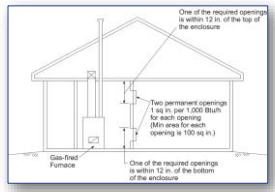

Combining spaces (same level):

- Each opening shall have a min. free area of 1 in² per 1,000 Btu/h, but ≥ 100 in²
 - Openings within 12" of the ceiling and floor
 - Minimum dimensions 3" or greater

IRC G2407.5.3.2:

Combining spaces (different levels):

- Each opening shall have a min. free area of 2 in² per 1,000 Btu/h





7

Indoor Combustion Air Caution:

Please be aware that the 50 cubic feet option is only available if the known natural air infiltration rate is 0.40 ACH or higher. Almost everything built new in the past 30 years has a natural infiltration rate of 0.35 ACH or LOWER.

What was one a "rule of thumb" for sizing indoor combustion air has become somewhat outdated. Modern construction is too tight to utilize this method with confidence.



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Outdoor Air

IRC G2407.6.1:

Two permanent-openings:

- Each opening within **12"** of ceiling and floor
 - 1 in² per **4,000 Btu/h** directly to exterior
 - 1 in² per **2,000 Btu/h** through ducts

Openings 3" minimum

FIGURE G2407.6.1 (2018 I.C.)
ALL AIR FROM OUTDOORS THROUGH VENTILATED AT THE (see Section G2407.6.1)
International Code Council 2021 IRC ©

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Outdoor Air

IRC G2407.6.2:

- One permanent-opening
 - Within 12" of ceiling
 - Clearance 1" sides, 6" front
 - 1 in² per **3,000 Btu/h**
- Openings 3" minimum

IRC G2407.7:

- Allows for a combination of indoor and outdoor air openings

FIGURE G2407.6.2 (2018 I.C.)
SINGLE COMBUSTION AIR OPENING,
ALL AIR FROM OUTDOORS
(see Section G2407.6.2)
International Code Council 2021 IRC ©

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Example Problem #1

Determine the required indoor combustion air volume for (2) 199K btu water heaters.

Step 1: Calculate total btu's:
 $2 \times 199,000 = 398,000 \text{ btu's}$

Step 2: Calculate the needed combustion air:
 50 cubic feet per 1,000 btu's (IRC G2407.5.1)
 $398,000 / 1,000 = 398$
 $398 \times 50 = 19,900 \text{ cubic feet}$

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Example Problem #2

Determine the required room size necessary for (3) 90K btu water heaters, assuming 9' ceilings.

Step 1: Calculate total btu's:
 $3 \times 90,000 = 270,000 \text{ btu's}$

Step 2: Calculate the needed combustion air:
 50 cubic feet per 1,000 btu's (IRC G2407.5.1)
 $270,000 / 1,000 = 270$
 $270 \times 50 = 13,500 \text{ cubic feet}$



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Example Problem #2

Step 3: Calculate required room size
 13,500 cubic feet / 9-foot ceilings = 1,500 SF

Multiple Choice Options:

- A. 1,000 SF
- B. 1,200 SF
- C. 1,500 SF ←
- D. 2,000 SF

13



Example Problem #3

Determine the necessary size ductwork required to supply outdoor combustion air to a 40,000 btu appliance, using the two-opening method, assuming horizontal ducts.

Step 1: Calculate required square inches of openings
 1 square inch/2,000 btu's (IRC G2407.6.1)
 $40,000/2,000 = 20$ square inches per opening.

Step 2: Calculate required size of each duct
 Square Duct: L X W IRC G2407.6 – 3" minimum dim.
 Multiple options: 3" x 7" minimum = 21 si
 Round Duct: $\pi \times R^2$ R = Radius $\pi = 3.14$
 6" duct = 28.27 si = square inches

Duct Size	Area
3	7.07
4	12.57
5	19.63
6	28.27
8	50.27
10	78.54
12	113.1

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Example Problem #4

Determine the necessary size ductwork required to supply outdoor combustion air for an 40,000 btu appliance, using the one permanent opening method.

Step 1: Calculate required square inches of openings
 1 square inch/3,000 btu's (IRC G2407.6.2)
 $40,000/3,000 = 13.33$ square inches

Step 2: Calculate required size of ducts
 Square Duct: L X W IRC G2407.6 – 3" minimum dim.
 Multiple options: 3" x 4" minimum = 12 si
 Round Duct: $\pi \times R^2$ R = Radius $\pi = 3.14$
 5" duct = 19.63 si

Duct Size	Area
3	7.07
4	12.57
5	19.63
6	28.27
8	50.27
10	78.54
12	113.1



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Example Problem #5

Determine the necessary size ductwork required to supply combustion air for a 120,000 btu appliance, using a combination of indoor and outdoor combustion air. Assume the indoor space is a room with 150 square feet of floor are and an 8' ceiling.

Step 1: Calculate the volume of the indoor space
 150 square feet x 8' ceiling = 1,200 cubic feet

Step 2: Calculate the needed combustion air volume:
 50 cubic feet per 1,000 btu's (IRC G2407.5.1)
 $120,000/1,000 = 120$
 $120 \times 50 = 6,000$ cubic feet

16




Example Problem #5

Step 3: Determine the ratio of available vs. required volume
 $1,200 / 6,000 = 0.20$

Step 4: Determine the outdoor size reduction factor
 $1 - 0.20 = 0.80$

Step 5: Calculate required size of outdoor air using the one or two-permanent openings method. (assume one-permanent opening per G2407.6.2)

Step 5a: Calculate required square inches of openings
 $1 \text{ square inch} / 3,000 \text{ btu's (IRC G2407.6.2)}$
 $120,000 / 3,000 = 40 \text{ square inches.}$

17

17




Example Problem #5

Step 5b: Reduce by the reduction factor (Step 4)
 $40 \text{ si required} \times 0.80 = 32 \text{ si}$

Step 6: Calculate required size of ducts
 Square Duct: $L \times W$ IRC G2407.6 - 3" minimum dim.

Multiple options: 6" x 6" minimum = 36 si
 Round Duct: $\pi \times R^2$ $R = \text{Radius}$ $\pi = 3.14$
 8" duct = 50.27 si si = square inches

Duct Size	Area
3	7.07
4	12.57
5	19.63
6	28.27
8	50.27
10	78.54
12	113.1

18

18



END




19

19

**2021 IRC
Supplement B**

*Gas Line Sizing Sample
Questions*

1

LEARNING OBJECTIVES

1. Practice multiple sizing examples to better understand gas pipe sizing.
2. Understand how to use the tables in the IRC to accurately answer gas line sizing questions.
3. Work through the equations step-by-step to ensure arrival at the correct answer.

2

Three Sizing Options

IRC 2413.3:

1. **Table in the IRC**
2. **Manufacturer's Tables**
3. **Approved Engineering Methods**

G2413.3 (402.3) Sizing. Gas piping shall be sized in accordance with one of the following:

1. Pipe sizing tables or sizing equations in accordance with Section G2413.4 or G2413.5, as applicable.
2. The sizing tables included in a *listed piping* system's manufacturer's installation instructions.
3. *Approved engineering methods.*

3

Three Sizing Methods

IRC 2413.4:

G2413.4 (402.4) Sizing tables and equations. This section applies to piping materials other than noncorrugated stainless steel tubing. Where Tables G2413.4(1) through G2413.4(2) are used to size piping or tubing, the pipe length shall be determined in accordance with Section G2413.3.1, G2413.4.2 or G2413.4.3.

Key Factors:

1. **Length of Pipe**
2. **Pressure of System**
3. **Btu's Served (Loads)**

1. **Longest Length G2413.4.1**
2. **Branch Length G2413.4.2**
3. **Hybrid Pressure G2413.4.3**

4

IRC
Gas Line Sizing – Question #1

5

Question #1: 4 oz. Meter ★

Size the blue sections of steel natural gas pipe using the longest length method. Assume 0.5 in. w.c. pressure drop.

6

Longest Length Method

IRC 2413.4.1: (Also see IFGC 402.4.1)

G2413.4.1 (402.4.1) Longest length method. The pipe size of each section of gas piping shall be determined using the longest length of piping from the point of delivery to the most remote outlet and the load of the section.

7

General Rules:

TABLE G2413.4(1) (402.4(2)) SCHEDULE 40 METALLIC PIPE	Gas (Natural)
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60

International Code Council 2021 IRC ©

Nominal Length (ft)	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.822	0.924	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Capacity in Cubic Feet of Gas per Hour									
10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
20	118	247	466	957	1,430	2,760	4,400	7,780	15,900
30	95	199	374	768	1,150	2,230	3,530	6,250	12,700
40	81	170	320	657	985	1,900	3,020	5,350	10,900
50	72	151	284	583	873	1,680	2,680	4,740	9,660

International Code Council 2021 IRC, Table G2413.4(1)(a)

Pressure Drop:

- 4 oz. System- Use 0.3 in. w.c.
- 2 lb. System- Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

Step I: Find the Right Table

*1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.*

Make sure you're in the right table and verify values!

8

Question #1:

First Section:
Longest Length = 45' (10+15+15+5)
Total btu's = 230,000 btu (120k + 40k + 70k) $230,000/1,000 = 230$ CFH

Nominal	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.468	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,900	3,020	5,350
	50	72	151	284	583	873	1,680	2,680	4,740

Capacity in Cubic Feet of Gas per Hour

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

9

Impact of Gas Content

Check with gas utility- btu's per CFH vary from location to location and are affected by altitude

Depending upon the utility provider:
 1 CFH = +/- 1,000 btu's
 or
 1 CFH = 800 - 1,000 btu's

Code	Deration Factor (Altitude %)	Deration %	Specific Gravity	BTU Calc. FT
Eachfield (cont)				
Cookeville	76	88	0.960	813
Elizabet	76	89	0.956	813
Fairburn	76	89	0.955	811
Fayette	76	89	0.960	812
Fayetteville	80	89	0.960	814
Franklin	76	89	0.956	813
Franklin Greenh	76	89	0.956	813
Greeneville	80	90	0.960	814
Greeneville	80	90	0.960	814

10

Question #1:

Next Section:
Longest Length = 45' (Doesn't change)
Total btu's = 110,000 btu (40k + 70k) $110,000/1,000 = 110$ CFH

Nominal	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.468	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,900	3,020	5,350
	50	72	151	284	583	873	1,680	2,680	4,740

Capacity in Cubic Feet of Gas per Hour

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

11

Question #1:

Final Section:
Longest Length = 45' (Doesn't change)
Total btu's = 70,000 (70k) $70,000/1,000 = 70$ CFH

Nominal	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.468	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,900	3,020	5,350
	50	72	151	284	583	873	1,680	2,680	4,740

Capacity in Cubic Feet of Gas per Hour

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

12

Question #1:

Branch Lines:
Longest Length = 45'
Total btu's = 120,000 btu (120k) $120,000/1,000 = 120$ CFH

Nominal	PIPE SIZE (inches)									
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.549	3.068	4.026	5.047
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
Capacity	20	118	247	466	857	1,430	2,760	4,400	7,780	15,000
	30	95	199	374	708	1,150	2,220	3,530	6,250	12,760
	40	81	170	320	657	985	1,900	3,020	5,350	10,900
	50	72	151	284	583	873	1,680	2,680	4,740	9,660

International Code Council 2021 IRC Table G2413.4(1)D

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

13

Question #1:

Branch Lines:
Longest Length = 45'
Total btu's = 40,000 btu (40k) $40,000/1,000 = 40$ CFH

Nominal	PIPE SIZE (inches)									
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.549	3.068	4.026	5.047
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
Capacity	20	118	247	466	857	1,430	2,760	4,400	7,780	15,000
	30	95	199	374	708	1,150	2,220	3,530	6,250	12,760
	40	81	170	320	657	985	1,900	3,020	5,350	10,900
	50	72	151	284	583	873	1,680	2,680	4,740	9,660

International Code Council 2021 IRC Table G2413.4(1)D

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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Gas Line Sizing – Question #2

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Question #2:

★ 2 lb. Meter

Size the blue sections of steel natural gas pipe using the longest length method. Assume 1.0 in. w.c. pressure drop.

Note: Standard natural gas appliances are designed for 4 oz. pressures. This system would require a regulator at each appliance.

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General Rules:

Gas: Natural

TABLE G2413.4(2) (402.415) SCHEDULE 40 METALLIC PIPE

- Inlet Pressure: 2.0 psi
- Pressure Drop: 1.0 psi
- Specific Gravity: 0.60

International Code Council 2021 IRC

Nominal Actual ID	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Length (ft)	0.822	0.824	1.049	1.380	1.610
	Capacity in Cubic Feet of C				
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050

International Code Council 2021 IRC, Table G2413.4(2)D

Pressure Drop:

- 1 lb. System - Use 0.3 in. w.c.
- 2 lb. System - Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

17

Question #2:

First Section:

Longest Length = 80' (20 + 25 + 25 + 10)

Total btu's = 210,000 (75k + 35k + 100k) 210,000/1,000 = 210 CFH

CFH = +/- 1,000 BTU

*real world application- adjust per local conditions

* Gas utility companies may require 3/4" minimum lines to support the gas meter. Check local requirements

Nominal Actual ID	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Length (ft)	0.822	0.824	1.049	1.380	1.610
	Capacity in Cubic Feet of C				
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050

International Code Council 2021 IRC, Table 2413.4(2) D

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Question #2:

Next Section:

Longest Length = 80' (Doesn't change)

Total btu's = 135,000 (35k + 100k) 135,000/1,000 = 135 CFH

CFH = +/- 1,000 BTU

*real world application- adjust per local conditions

Nominal Actual ID	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Length (ft)	0.822	0.824	1.049	1.380	1.610
	Capacity in Cubic Feet of C				
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050

International Code Council 2021 IRC, Table 2413.4(2) D

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Question #2:

Final Section:

Longest Length = 80' (Doesn't change)

Total btu's = 100,000 (100k) 100,000/1,000 = 100 CFH

CFH = +/- 1,000 BTU

*real world application- adjust per local conditions

Nominal Actual ID	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Length (ft)	0.822	0.824	1.049	1.380	1.610
	Capacity in Cubic Feet of C				
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050

International Code Council 2021 IRC, Table 2413.4(2) D

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IRC
Gas Line Sizing – Question #3

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Question #3:

Size the blue sections of steel propane gas pipe using the longest length method. Assume 0.5 in. w.c. pressure drop.

Propane ★

West Coast Code Consultants, Inc. ©

22

General Rules:

Gas: Undiluted Propane

- Inlet Pressure 11.0 in. w.c.
- Pressure Drop 0.5 in. w.c.
- Specific Gravity 1.50

International Code Council 2021 IRC ©

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
Nominal Length (ft)	PIPE SIZE (inches)					
	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067
Capacity in Thousands of Btu per Hour	10	291	608	1,150	2,350	3,520
	20	200	418	787	1,620	2,420
						4,660

International Code Council 2021 IRC, Table G2413.4(12) ©

Pressure Drop:
See table- 0.5 in. w.c.

Specific Gravity:
Natural Gas- 0.6
Propane- 1.5

Inlet Pressure:
From storage tank- likely 10.5 in W.C.
1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

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Question #3:

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
Nominal Length (ft)	PIPE SIZE (inches)					
	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067
Capacity in Thousands of Btu per Hour	10	291	608	1,150	2,350	3,520
	20	200	418	787	1,620	2,420
						4,660

International Code Council 2021 IRC, Table G2413.4(12) ©

First Section:
Longest Length = 20' (3+3+5+1+5+3)
Total btu's = (50,000 + 65,000 + 120,000 + 100,000 + 80,000) = 415,000 btu's
(Divide by 1,000 = 415 kbtu/h)

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Question #3:

Second Section:
Longest Length = 20' (Doesn't change)
Total btu's = 365,000 (Divide by 1,000 = 365)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 1/2	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	580	1,216	2,300	4,700	7,040	13,580

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Question #3:

Third Section:
Longest Length = 20' (Doesn't change)
Total btu's = 300,000 (Divide by 1,000 = 300)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 1/2	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	580	1,216	2,300	4,700	7,040	13,580

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Question #3:

Fourth Section:
Longest Length = 20' (Doesn't change)
Total btu's = 180,000 (Divide by 1,000 = 180)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 1/2	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	580	1,216	2,300	4,700	7,040	13,580

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Question #3:

Final Section:
Longest Length = 20' (Doesn't change)
Total btu's = 80,000 (Divide by 1,000 = 80)

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (low pressure)						
PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/2	1 1/2	2
Actual ID	0.822	0.924	1.048	1.315	1.610	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	608	1,150	2,350	3,520	6,790
20	580	1,216	2,300	4,700	7,040	13,580

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IRC
Gas Line Sizing – Question #4

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Branch Length

Question #4:
Size all pipe sections of natural gas pipe using the branch length method. Assume 0.5 in. w.c. pressure drop.

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Branch Length Method

IRC G2413.4.2: (Also see IFGC 402.4.2)

G2413.4.2 (402.4.2) Branch length method. Pipe shall be sized as follows:

1. Pipe size of **each section** of the longest pipe run from the **point of delivery** to the most remote **outlet** shall be determined using the longest run of piping and the load of the section.
2. The pipe size of each section of branch piping not previously sized shall be determined using the length of piping from the **point of delivery** to the most remote **outlet** in each branch and the load of the section.

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General Rules:

TABLE G2413.4(1) [402.4(2)] SCHEDULE 40 METALLIC PIPE

Gas (Natural)

- Inlet Pressure: Less than 2 psi
- Pressure Drop: 0.5 in. w.c.
- Specific Gravity: 0.60

International Code Council 2021 IRC ©

Nominal Length (ft)	PIPE SIZE (inches)			
	2 1/2	3	4	6
10	172	360	678	1,390
20	118	247	466	957
30	95	199	374	768
40	81	170	320	657
50	72	151	284	583

International Code Council 2021 IRC, Table G2413.4(1)D

Pressure Drop:

- 4 oz. System- Use 0.5 in. w.c.
- 2 lb. System- Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

Step I: Find the Right Table

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

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Question #4:

Branch #3:
Branch Length (Section 1) = 45' (10+15+15+5)
Total Branch btu's = 230,000 btu (120k + 40k + 70k) 230,000/1,000 = 230 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,990	3,020	5,350
	50	72	151	284	583	873	1,690	2,860	4,760

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Question #4:

Branch #3:
Branch Length (Section 2) = 45'
Total Branch btu's = 110,000 btu (40k + 70k) 110,000/1,000 = 110 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,990	3,020	5,350
	50	72	151	284	583	873	1,690	2,860	4,760

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Question #4:

Branch #3:
Branch Length (Section 3) = 45'
Total Branch btu's = 70,000 btu (70k) 70,000/1,000 = 70 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,990	3,020	5,350
	50	72	151	284	583	873	1,690	2,860	4,760

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Question #4:

Branch #2:
Branch Length = 28' (10 + 15 + 3)
Total Branch btu's = 40,000 btu (40k) 40,000/1,000 = 40 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

PIPE SIZE (inches)									
Nominal	1/2	3/4	1	1 1/2	2	2 1/2	3	4	
Actual ID	0.622	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	172	360	678	1,390	2,090	4,020	6,650	11,300
	20	118	247	466	957	1,430	2,760	4,400	7,780
	30	95	199	374	768	1,150	2,220	3,530	6,250
	40	81	170	320	657	985	1,990	3,020	5,350
	50	72	151	284	583	873	1,690	2,860	4,760

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Question #4:

Branch #1:
Branch Length = 15' (10 + 5)
Total btu's = 120,000 (120k) $120,000/1,000 = 120$ CFH

Nominal Length (ft)	PIPE SIZE (inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.622	0.824	1.049	1.380	1.615	2.067	2.469	3.068	4.026
Capacity in Cubic Feet of Gas per Hour	172	360	678	1,390	2,090	4,020	6,400	11,200	23,100
30	95	199	374	768	1,150	2,220	3,530	6,250	12,700
40	81	170	320	657	985	1,980	3,020	5,350	10,900
50	72	151	284	583	873	1,680	2,680	4,760	9,660

International Code Council 2021 IRC, Table G2413.4(1)D

CFH = +/- 1,000 BTU
 Largest branch requirement governs

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Compare:

LONGEST LENGTH

BRANCH LENGTH

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2021

IRC
 Gas Line Sizing – Question #5

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Question #5:

Hybrid Pressure ★

Size the blue sections of natural gas pipe using the hybrid method. Assume Sch. 40 steel from the meter to the regulator, and CSST after the regulator.

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Hybrid Pressure Method

IRC 2413.4.3: (Also see 402.4.3)

G2413.4.3 (402.4.3) Hybrid pressure. The pipe size for each section of higher pressure gas piping shall be determined using the longest length of piping from the point of delivery to the most remote line pressure regulator. The pipe size from the line pressure regulator to each outlet shall be determined using the length of piping from the regulator to the most remote outlet served by the regulator.

PRESSURE CONVERSION CHART

1/4 PSI = 7" w.c. = 4 oz.

1/2 PSI = 14" w.c. = 8 oz.

1 PSI = 28" w.c. = 16 oz.

2 PSI = 56" w.c. = 32 oz.

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General Rules:

Gas (Natural)

Inlet Pressure 2.0 psi

Pressure Drop 1.0 psi

Specific Gravity 0.80

International Code Council 2021 IRC ©

Nominal Length (ft)	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
10	1,510	3,040	5,560	11,400	17,100
20	1,070	2,150	3,930	8,070	12,100
30	869	1,760	3,210	6,590	9,880
40	753	1,520	2,780	5,710	8,550
50	673	1,360	2,490	5,110	7,650
60	615	1,240	2,270	4,660	6,980
70	569	1,150	2,100	4,320	6,470
80	532	1,080	1,970	4,040	6,050
90	502	1,010	1,850	3,810	5,700

International Code Council 2021 IRC, Table G2413.4(2) ©

Pressure Drop:

- 1 lb. System - Use 0.3 in. w.c.
- 2 lb. System - Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

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Question #5:

First Section:

Longest Length to Regulator = 11' (3+3+5) i.e. Length 1

Longest Length from Regulator = 14' (5+1+5+3) i.e. Length 2

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Question #5:

First Section:

Longest Length = 11' (Length 1)

Total btu's = 4,350 cfh (1,200 + 750 + 800 + 600 + 1,000)

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Question #5:

Next Section:
Longest Length = 11' (Length 1 - again)
Total btu's = 3,150 cfh (750 + 600 + 800 + 1000)

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.822	0.824	1.049	1.310	1.610
Length (ft)	10	1.510	3.040	5.560	11.000
Capacity in Cubic Feet at 0.5 in. w.c.	20	1,070	2,150	3,150	4,600
40	369	736	1,094	1,580	2,280
60	553	1,104	1,656	2,416	3,420
80	715	1,428	2,142	3,213	4,599
100	865	1,730	2,595	3,893	5,580
120	1,005	2,010	3,015	4,373	6,330
140	1,135	2,270	3,405	4,860	6,960
160	1,255	2,510	3,765	5,355	7,620

International Code Council 2021 IRC, Table G2413.4(2) ©

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Question #5:

End Section:
Longest Length = 11' (Length 1 - again)
Total btu's = 2,400 cfh (600 + 800 + 1000)

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.822	0.824	1.049	1.310	1.610
Length (ft)	10	1.510	3.040	5.560	11.000
Capacity in Cubic Feet at 0.5 in. w.c.	20	1,070	2,150	3,150	4,600
40	369	736	1,094	1,580	2,280
60	553	1,104	1,656	2,416	3,420
80	715	1,428	2,142	3,213	4,599
100	865	1,730	2,595	3,893	5,580
120	1,005	2,010	3,015	4,373	6,330
140	1,135	2,270	3,405	4,860	6,960
160	1,255	2,510	3,765	5,355	7,620

International Code Council 2021 IRC, Table G2413.4(2) ©

Note: The 750 cfh and 1,200 cfh appliance would require individual regulators to drop pressure to appliances.

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Question #5:

1st Section:
Longest Length = 14' (Length 2 - CSST)
Total btu's = 2,400 cfh (600 + 800 + 1000)

Nominal	PIPE SIZE (inches)				
	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.822	0.824	1.049	1.310	1.610
Length (ft)	10	1.510	3.040	5.560	11.000
Capacity in Cubic Feet at 0.5 in. w.c.	20	1,070	2,150	3,150	4,600
40	369	736	1,094	1,580	2,280
60	553	1,104	1,656	2,416	3,420
80	715	1,428	2,142	3,213	4,599
100	865	1,730	2,595	3,893	5,580
120	1,005	2,010	3,015	4,373	6,330
140	1,135	2,270	3,405	4,860	6,960
160	1,255	2,510	3,765	5,355	7,620

International Code Council 2021 IRC, Table G2413.4(2) ©

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Pressure Regulators:

Check with Manufacturer Regarding:

- **Outlet Pressure (0.5 psi is common)**
- **Pressure Drop (+/- 0.5 in w.c. common)***

*Use the 3.0 in. w.c. table

Model Number	Pipe Size	Outlet Pressure Inlet Pressure	Operating Inlet Pressure		
			1/2 gal (0.8 MPa)	1 gal (1.2 MPa)	1.5 gal (1.8 MPa)
125-10-1	1/2" x 1/2"	10" w.c.	125 (1.5)	125 (1.5)	125 (1.5)
		10" w.c.	100 (1.2)	125 (1.5)	125 (1.5)

7" w.c. = 0.25 psi

Model Number	Pipe Size	Pressure Drop	
		7" w.c. (1.7 MPa)	3/4 gal (1.8 MPa)
125-10-1	1/2" x 1/2"	0.5 (0.2)	0.5 (0.2)

Adjustable to +/- 0.5 psi

Conversions:
In w.c. divided by 27.708 = psi
Psi x 27.708 = in. w.c.

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Manufacturer's Table:

Table 7-5
Maximum Capacity of Gasco®/HaskShield® Flexible Gas Piping in Table 7-5 with a Gas Pressure of 0.5 psi and a Pressure Drop Line Regulator Under 0.5 w.c. (Based on a 0.02 specific gravity)

Table 7-5	Table Length (ft)									
	10	15	20	25	30	35	40	50	60	75
1 1/2" Dia.	13	18	23	28	33	38	43	48	53	58
1 3/4" Dia.	18	23	28	33	38	43	48	53	58	63
2" Dia.	23	28	33	38	43	48	53	58	63	68
2 1/2" Dia.	28	33	38	43	48	53	58	63	68	73
3" Dia.	33	38	43	48	53	58	63	68	73	78
3 1/2" Dia.	38	43	48	53	58	63	68	73	78	83
4" Dia.	43	48	53	58	63	68	73	78	83	88
4 1/2" Dia.	48	53	58	63	68	73	78	83	88	93
5" Dia.	53	58	63	68	73	78	83	88	93	98
5 1/2" Dia.	58	63	68	73	78	83	88	93	98	103
6" Dia.	63	68	73	78	83	88	93	98	103	108
6 1/2" Dia.	68	73	78	83	88	93	98	103	108	113
7" Dia.	73	78	83	88	93	98	103	108	113	118
7 1/2" Dia.	78	83	88	93	98	103	108	113	118	123
8" Dia.	83	88	93	98	103	108	113	118	123	128
8 1/2" Dia.	88	93	98	103	108	113	118	123	128	133
9" Dia.	93	98	103	108	113	118	123	128	133	138
9 1/2" Dia.	98	103	108	113	118	123	128	133	138	143
10" Dia.	103	108	113	118	123	128	133	138	143	148

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Pipe Material

- CSST (Corrugated Stainless-Steel Tubing) - GasTite

Pressure Drop:

- Regulator Manufacturer- Use 3.0 in. w.c.

Specific Gravity:

- Natural Gas- 0.6

Inlet Pressure:

- 0.5 PSI- Given in Example

Make sure you're in the right table and verify values!

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Question #5:

1st Section:
Longest Length = 14' (Length 2)
Total btu's = 2,400 cfh (600 + 800 + 1000)

Table 7-5
Maximum Capacity of Gasco®/HaskShield® Flexible Gas Piping in Table 7-5 with a Gas Pressure of 0.5 psi and a Pressure Drop Line Regulator Under 0.5 w.c. (Based on a 0.02 specific gravity)

Table 7-5	Table Length (ft)									
	10	15	20	25	30	35	40	50	60	75
1 1/2" Dia.	13	18	23	28	33	38	43	48	53	58
1 3/4" Dia.	18	23	28	33	38	43	48	53	58	63
2" Dia.	23	28	33	38	43	48	53	58	63	68
2 1/2" Dia.	28	33	38	43	48	53	58	63	68	73
3" Dia.	33	38	43	48	53	58	63	68	73	78
3 1/2" Dia.	38	43	48	53	58	63	68	73	78	83
4" Dia.	43	48	53	58	63	68	73	78	83	88
4 1/2" Dia.	48	53	58	63	68	73	78	83	88	93
5" Dia.	53	58	63	68	73	78	83	88	93	98
5 1/2" Dia.	58	63	68	73	78	83	88	93	98	103
6" Dia.	63	68	73	78	83	88	93	98	103	108
6 1/2" Dia.	68	73	78	83	88	93	98	103	108	113
7" Dia.	73	78	83	88	93	98	103	108	113	118
7 1/2" Dia.	78	83	88	93	98	103	108	113	118	123
8" Dia.	83	88	93	98	103	108	113	118	123	128
8 1/2" Dia.	88	93	98	103	108	113	118	123	128	133
9" Dia.	93	98	103	108	113	118	123	128	133	138
9 1/2" Dia.	98	103	108	113	118	123	128	133	138	143
10" Dia.	103	108	113	118	123	128	133	138	143	148

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EHD = Equivalent Hydraulic Diameter

Check with manufacturer- as nominal pipe sizes and EHD may vary slightly

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Question #5:

Next Section:
Longest Length = 14' (Length 2)
Total btu's = 1,800 cfh

Table 7-5
Maximum Capacity of Gasco®/HaskShield® Flexible Gas Piping in Table 7-5 with a Gas Pressure of 0.5 psi and a Pressure Drop Line Regulator Under 0.5 w.c. (Based on a 0.02 specific gravity)

Table 7-5	Table Length (ft)									
	10	15	20	25	30	35	40	50	60	75
1 1/2" Dia.	13	18	23	28	33	38	43	48	53	58
1 3/4" Dia.	18	23	28	33	38	43	48	53	58	63
2" Dia.	23	28	33	38	43	48	53	58	63	68
2 1/2" Dia.	28	33	38	43	48	53	58	63	68	73
3" Dia.	33	38	43	48	53	58	63	68	73	78
3 1/2" Dia.	38	43	48	53	58	63	68	73	78	83
4" Dia.	43	48	53	58	63	68	73	78	83	88
4 1/2" Dia.	48	53	58	63	68	73	78	83	88	93
5" Dia.	53	58	63	68	73	78	83	88	93	98
5 1/2" Dia.	58	63	68	73	78	83	88	93	98	103
6" Dia.	63	68	73	78	83	88	93	98	103	108
6 1/2" Dia.	68	73	78	83	88	93	98	103	108	113
7" Dia.	73	78	83	88	93	98	103	108	113	118
7 1/2" Dia.	78	83	88	93	98	103	108	113	118	123
8" Dia.	83	88	93	98	103	108	113	118	123	128
8 1/2" Dia.	88	93	98	103	108	113	118	123	128	133
9" Dia.	93	98	103	108	113	118	123	128	133	138
9 1/2" Dia.	98	103	108	113	118	123	128	133	138	143
10" Dia.	103	108	113	118	123	128	133	138	143	148

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Question #5:

End Section:
Longest Length = 14' (Length 2)
Total btu's = 1,000 cfh

Table 7-5
Maximum Capacity of Gasco®/HaskShield® Flexible Gas Piping in Table 7-5 with a Gas Pressure of 0.5 psi and a Pressure Drop Line Regulator Under 0.5 w.c. (Based on a 0.02 specific gravity)

Table 7-5	Table Length (ft)									
	10	15	20	25	30	35	40	50	60	75
1 1/2" Dia.	13	18	23	28	33	38	43	48	53	58
1 3/4" Dia.	18	23	28	33	38	43	48	53	58	63
2" Dia.	23	28	33	38	43	48	53	58	63	68
2 1/2" Dia.	28	33	38	43	48	53	58	63	68	73
3" Dia.	33	38	43	48	53	58	63	68	73	78
3 1/2" Dia.	38	43	48	53	58	63	68	73	78	83
4" Dia.	43	48	53	58	63	68	73	78	83	88
4 1/2" Dia.	48	53	58	63	68	73	78	83	88	93
5" Dia.	53	58	63	68	73	78	83	88	93	98
5 1/2" Dia.	58	63	68	73	78	83	88	93	98	103
6" Dia.	63	68	73	78	83	88	93	98	103	108
6 1/2" Dia.	68	73	78	83	88	93	98	103	108	113
7" Dia.	73	78	83	88	93	98	103	108	113	118
7 1/2" Dia.	78	83	88	93	98	103	108	113	118	123
8" Dia.	83	88	93	98	103	108	113	118	123	128
8 1/2" Dia.	88	93	98	103	108	113	118	123	128	133
9" Dia.	93	98	103	108	113	118	123	128	133	138
9 1/2" Dia.	98	103	108	113	118	123	128	133	138	143
10" Dia.	103	108	113	118	123	128	133	138	143	148

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Materials not Covered:

- **PE Pipe (Polyethylene Plastic)**
 - Similar process, use Tables G2413.4(7), (8), (20)
- **PE Tubing (Polyethylene Plastic)**
 - Similar process, use Tables G24013.4(21)
- **Semirigid Copper Tubing**
 - Similar process, use Tables G2413.4(3), (4), (13-15)



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Module 1 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Sweeps provide a _____ turning radius than bends.	IRC 202	IRC 202	3	shorter	smaller	longer	larger
Match the term to the correct definition.	IRC 202	IRC 202		Vent Stack A vertical vent pipe installed to provide circulation of air to and from the drainage system and that extends through one or more stories.	Vent System . Piping installed to equalize pneumatic pressure in a drainage system to prevent trap seal loss or blowback due to siphonage or back pressure.	Wet Vent A vent that receives the discharge of wastes from other fixtures.	Individual Vent A pipe installed to vent a single fixture drain that connects with the vent system above or terminates independently outside the building.
140°F water is considered _____.	IRC 202	IRC 202	2	scalding	hot water	excessively hot	
A _____ is a single pipe venting two trap arms within the same branch interval, either back-to-back or one above the other.	IRC 202	IRC 202	4	branch vent	individual vent	dual vent	common vent
Cleanouts are used in drainage systems for the removal of _____.	IRC 202	IRC 202	1	obstructions	waste	debris	water

Module 2 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
How often is a double check detector assembly required to be tested?	IRC P2503.8.2	IRC P2503	1	Annually	Semiannually	Every 3 years	Every 5 years
A water heater used for space heating shall have a maximum temperature not greater than _____ for domestic uses.	IRC P2803.2	IRC P2803	4	110°F	120°F	130°F	140°F
What is the minimum size of a shower compartment?	IRC P2708.1	IRC P2708	1	900 sq inches	1,024 sq inches	1,156 sq inches	1,200 sq inches
What is the maximum hanger spacing, for a 1-inch copper alloy tube water line horizontally?	IRC Table P2605.1	IRC P2605	2	7 feet	6 feet	5 feet	4 feet
A water heater drain pan shall have a minimum drain pipe of what size?	IRC P2801.6.1	IRC P2801	2	.50"	.75"	1.0"	1.25"
How many times larger than the pipe should the sleeve be when passing through a foundation wall?	IRC P2603.4	IRC P2603	2	1 pipe size	2 pipe sizes	3 pipe sizes	4 pipe sizes
What is the minimum depth for water service piping to be protected from freezing?	IRC P2603.5	IRC P2603	3	6 inches deep, 18 inches below frost line	18 inches deep, 12 inches below frost line	12 inches deep, 6 inches below frost line	6 inches deep, 12 inches below frost line
The ignition source of a water heater located in a garage shall be not less than _____ above the garage floor.	IRC P2801.7	IRC P2801	3	36 inches	24 inches	18 inches	12 inches
What is the minimum weight of sheet lead liners?	IRC P2709.3.1	IRC P2709	1	4 lbs per sq foot	5 lbs per sq foot	8 lbs per sq foot	12 lbs per sq foot
The maximum vertical hanger spacing for a 1 1/2 inch cast iron pipe is:	IRC Table P2605.1	IRC P2605	2	20 feet	15 feet	10 feet	5 feet
The minimum clearance required in front of a lavatory to any wall or door shall be:	IRC P2705.1(5)	IRC P2705	3	27 inches	25 inches	21 inches	15 inches
What is the minimum amount of time required to perform a smoke test on a plumbing system to check for gas tightness?	IRC P2503.5.2(2.1)	IRC P2503	3	30 minutes	25 minutes	15 minutes	10 minutes

Module 3 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A critical level fill valve shall be not less than _____ above the flood level rim.	IRC P2902.4.1	IRC P2902	3	1/4 inch	1/2 inch	1 inch	2 inches
For outlets with an effective opening greater than 1 inch, the minimum air gap away from a wall shall be _____.	IRC Table P2902.3.1	IRC P2902	1	2 times the diameter of the effective opening	2 inches	3 times the diameter of the effective opening	3 inches
If the developed length of pipe is 60 feet and the pressure is 40 psi then the distribution line shall be not less than _____ in diameter.	IRC P2903.8.2	IRC P2903	1	3/8 inch	1/2 inch	5/8 inch	1 inch
What is the water service pressure loss for a 18 gpm pipe that comes from a 1-inch 25 foot pipe for a sprinkler system?	IRC Table P2904.6.2(1)	IRC P2904	3	22.9 psi	13.2 psi	6.7 psi	11.4 psi
What is the maximum working pressure required for water service piping?	IRC P2906.4	IRC P2906	4	130 psi	140 psi	150 psi	160 psi
What is the maximum flow rate for a shower head?	IRC Table 2903.2	IRC P2903	4	2.5 gpm at 60 psi	2.2 gpm at 60 psi	1.6 gpm at 80 psi	2.5 gpm at 80 psi
What is the hot water-supply fixture-unit value for a laundry standpipe and tub?	IRC Table P2903.6	IRC P2903	2	1.9 w.s.f.u.	1.8 w.s.f.u.	1.4 w.s.f.u.	1.0 w.s.f.u.
What is the maximum coverage area for a single sprinkler?	IRC P2904.2.4.1	IRC P2904	3	200 sq ft	350 sq ft	400 sq ft	600 sq ft
A 4 inch diameter pipe shall have identification provided for a length of _____ for the background and _____ for the letter sizes.	IRC Table P2901.2.2.2	IRC P2901	4	12 inches, 0.75 inches	8 inches, 0.5 inches	2.5 inches, 2.5 inches	12 inches, 1.25 inches
Which of the following fixtures can have a supply with a flow rate of 6 gpm at the point of outlet discharge?	IRC Table P2903.1	IRC P2903	2	Bathtub	Water closet	Shower	Sink

Module 4 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
GIVEN: (3) 1.6 gpf full bath groups, (4) 1.6 gpf half bath groups, (2) bidets 1 1/4" traps, (2) kitchen groups, (2) laundry groups, and (4) bar sinks. What is the total drainage fixture unit value for this home?	IRC Table P3004.1	IRC P3004	1	47	51	58	63
GIVEN: (3) 1.6 gpf full bath groups, (4) 1.6 gpf half bath groups, (2) bidets 1 1/4" traps, (2) kitchen groups, (2) laundry groups, and (4) bar sinks. What is the building drain size required for this home, if it is sloped at 1/4" per foot?	IRC Table P3005.4.2	IRC P3005	4	2"	2 1/2"	3"	4"
What is the maximum permitted slope per 100 feet of distribution piping?	IRC P3009.11	IRC P3009	3	2 inches	3 inches	4 inches	5 inches
What is the minimum size required for a below grade drainage pipe?	IRC P3005.4.1	IRC P3005	3	1/2"	1"	1 1/2"	2"
Under what conditions is it permitted to have a back-to-back water closet connection with a double sanitary tee?	IRC P3005.1.1 Exception	IRC P3005	2	Where the horizontal developed length between the outlet of the water closet and the connection to the double sanitary tee is 18 inches or less.	Where the horizontal developed length between the outlet of the water closet and the connection to the double sanitary tee is 18 inches or greater.	It is always permitted.	It is never permitted.
What is the drainage fixture unit value for a full bath group with greater than 1.6 gpm per flush?	IRC Table P3004.1	IRC P3004	4	3	4	5	6
GIVEN: (1) 1.8 gpf full bath groups, (2) 1.8 gpf half bath groups, (2) kitchen groups, (2) laundry groups, and (2) bar sinks. What is the total drainage fixture unit value for this home?	IRC Table 3004.1	IRC P3004	2	21	28	37	46
GIVEN: (1) 1.8 gpf full bath groups, (2) 1.8 gpf half bath groups, (2) kitchen groups, (2) laundry groups, and (2) bar sinks. What is the building drain size required for this home, if it is sloped at 1/2" per foot?	IRC Table 3005.4.2 footnote b	IRC P3005 (check footnotes)	1	3"	2 1/2"	2"	1 1/2"
What are the minimum dimensions for a sump?	IRC P3007.3.2	IRC P3007	3	18" deep and 24" in diameter	18" wide and 24" deep	18" in diameter and 24" deep	18" deep and 24" in wide
DWV systems located in places subjected to freezing temperatures shall be protected from freezing by _____.	IRC P3001.2	IRC P3001	4	A) providing insulation	B) providing heat	C) A and B	D) either A or B

Module 5 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the maximum drainage fixture unit load for a 3" wet vent?	IRC Table P3108.3	IRC P3108	2	6 d.f.u.	12 d.f.u.	32 d.f.u.	4 d.f.u.
What is the maximum slope permitted for a combination vent and waste pipe?	IRC P3111.2.1	IRC P3111	2	2:12 (16%)	1/2:12 (4%)	1:12 (8.3%)	1/4:12 (2%)
What is the minimum height above the flood level rim of a fixture before it can turn vertically?	IRC P3104.4	IRC P3104	4	9 inches	8 inches	7 inches	6 inches
What is the minimum size of a trap provided for a bidet?	IRC Table 3201.7	IRC P3201	3	2"	1.5"	1.25"	1"
What is the minimum distance that a vent terminating through a wall shall be above the highest grade within 10 feet of the termination point?	IRC P3103.1.4	IRC P3103	2	8 feet	10 feet	12 feet	15 feet
Subsoil drains shall not be less than _____ in diameter.	IRC P3302.1	IRC P3302	3	2 inches	3 inches	4 inches	5 inches
Which of the following vent type is not permitted to terminate with an air admittance valve?	IRC P3114.3	IRC P3114	3	stack vents	circuit vents	dual vents	individual vents
Which of the following traps is permitted to be used by code?	IRC P3201.5	IRC P3201	3	Bell trap	Drum trap	P-trap	S-trap
What is the maximum vertical distance a trap can be located from the centerline of a fixture outlet of the trap inlet?	IRC P3201.6	IRC P3201	4	48"	36"	30"	24"
When a horizontal vent pipe forms a branch, the vent shall be not less than ____ inches above the floor level rim of the highest fixture.	IRC P3104.5	IRC P3104	3	10 inches	7 inches	6 inches	5 inches
What is the maximum total discharge for the stack for a 3" waste stack vent?	IRC Table P3109.4	IRC P3109	2	No limit	24	8	4

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Question Text	Description	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
How often is a double check detector assembly required to be tested?		IRC P2503.8.2	IRC P2503	1	Annually	Semiannually	Every 3 years	Every 5 years
GIVEN: (3) 1.6 gpf full bath groups, (4) 1.6 gpf half bath groups, (2) bidets 1 1/4" traps, (2) kitchen groups, (2) laundry groups, and (4) bar sinks. What is the total drainage fixture unit value for this home?		IRC Table P3004.1	IRC P3004	1	47	51	58	63
What is the water service pressure loss for a 18 gpm pipe that comes from a 3/4-inch 25 foot pipe for a sprinkler system?		IRC Table P2904.6.2(1)	IRC Table 2904	2	27.8 psi	22.9 psi	26.3 psi	10.7 psi
What is the minimum height above the flood level rim of a fixture before it can turn vertically?		IRC P3104.4	IRC P3104	4	9 inches	8 inches	7 inches	6 inches
What is the minimum amount of time required to perform a smoke test on a plumbing system to check for gas tightness?		IRC P2503.5.2(2.1)	IRC P2503	3	30 minutes	25 minutes	15 minutes	10 minutes
What is the maximum drainage fixture unit load for a 3" wet vent?		IRC Table P3108.3	IRC P3108	2	6 d.f.u.	12 d.f.u.	32 d.f.u.	4 d.f.u.
A 4 inch diameter pipe shall have identification provided for a length of _____ for the background and _____ for the letter sizes.		IRC Table P2901.2.2.2	IRC P2901	4	12 inches, 0.75 inches	8 inches, 0.5 inches	2.5 inches, 2.5 inches	12 inches, 1.25 inches
What is the minimum size of a trap provided for a 1.6 gpm bidet?		IRC Table 3201.7	IRC P3201	3	2	1 1/2	1 1/4	1
What are the minimum dimensions for a sump?		IRC P3007.3.2	IRC P3007	2	18" deep and 24" in diameter	18" in diameter and 24" deep	18" wide and 24" deep	18" deep and 24" in wide
A water heater used for space heating shall have a maximum temperature not greater than _____ for domestic uses.		IRC P2803.2	IRC P2803	4	110°F	120°F	130°F	140°F
What is the maximum slope permitted for a combination vent and waste pipe?		IRC P3111.2.1	IRC P3111	2	2:12 (16%)	1/2:12 (4%)	1:12 (8.3%)	1/4:12 (2%)
Which of the following fixtures can have a supply with a flow rate of 6 gpm at the point of outlet discharge?		IRC Table P2903.1	IRC P2903	2	Bathtub	Water closet	Shower	Sink
What is the minimum distance that a vent terminating through a wall shall be above the highest grade within 10 feet of the termination point?		IRC P3103.1.4	IRC P3103	2	8 feet	10 feet	12 feet	15 feet
The minimum clearance required in front of a lavatory to any wall or door shall be:		IRC P2705.1(5)	IRC P2705	3	27 inches	25 inches	21 inches	15 inches

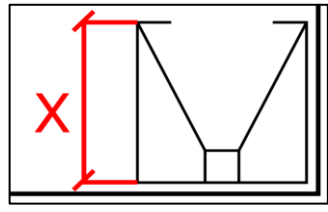
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If the developed length of pipe is 60 feet and the pressure is 40 psi then the distribution line shall be not less than ____ inches in diameter.	IRC P2903.8.2	IRC P2903	1	3/8 inch	1/2 inch	5/8 inch	1 inch
GIVEN: (1) 1.8 gpf full bath groups, (2) 1.8 gpf half bath groups, (2) kitchen groups, (2) laundry groups, and (2) bar sinks. What is the building drain size required for this home, if it is sloped at 1/2" per foot?	IRC Table 3005.4.2 Footnote b	IRC P3005	4	4"	3"	2 1/2"	2"
Which of the following vent type is not permitted to terminate with an air admittance valve?	IRC P3114.3	IRC P3114	3	Individual Vent	Branch Vent	Vent Stack	Stack Vent
What is the minimum size of a shower compartment?	IRC P2708.1	IRC P2708	1	900 sq inches	1,024 sq inches	1,156 sq inches	1,200 sq inches
Which of the following traps is permitted to be used by code?	IRC P3201.5	IRC P3201	3	Bell trap	Drum trap	P-trap	S-trap
Copper or copper-alloy traps shall not be less than No. ____ gage thickness.	IRC P2902.4.1	IRC P2902	3	1/4 inch	1/2 inch	1 inch	2 inches
What is the maximum vertical distance a trap can be located from the centerline of a fixture outlet of the trap inlet?	IRC P3201.6	IRC P3201	4	48"	36"	30"	24"
What is the maximum hanger spacing, for a 1-inch copper alloy tube water line horizontally?	IRC P2605.1	IRC P2605	2	7 feet	6 feet	5 feet	4 feet
What is the maximum vertical distance a trap can be located from the centerline of a fixture outlet of the trap inlet?	IRC P3104.5	IRC P3104	3	10 inches	7 inches	6 inches	5 inches
For outlets with an effective opening that is not greater than 1 inch, the minimum air gap close to a wall shall be ____.	IRC Table P2902.3.1	IRC P2902	4	2 times the diameter of the effective opening	2 inches	3 times the diameter of the effective opening	3 inches
What is the maximum permitted slope per 100 feet of distribution piping?	IRC P3009.11	IRC P3009	2	5	4	3	2
How many times larger than the pipe should the sleeve be when passing through a foundation wall?	IRC P2603.4	IRC P2603	2	1 pipe size	2 pipe size	3 pipe size	4 pipe size
What is the maximum total discharge for the stack for a 3" waste stack vent?	IRC Table P3109.4	IRC P3109	1	24	8	4	2
GIVEN: (3) 1.6 gpf full bath groups, (4) 1.6 gpf half bath groups, (2) bidets 1 1/4" traps, (2) kitchen groups, (2) laundry groups, and (4) bar sinks. What is the building drain size required for this home, if it is sloped at 1/4" per foot?	IRC Table P3005.4.2	IRC P3005	4	2"	2 1/2"	3"	4"
What is the minimum size required for a below grade drainage pipe?	IRC P3005.4.1	IRC P3005	3	1/2"	1"	1 1/2"	2"
A water heater drain pan shall have a minimum drain pipe of what size?	IRC P2801.6.1	IRC P2801	2	.50"	.75"	1.0"	1.25"
What is the minimum coverage area for a single sprinkler?	IRC P2904.2.4.1	IRC P2904	3	200 sq ft	350 sq ft	400 sq ft	600 sq ft

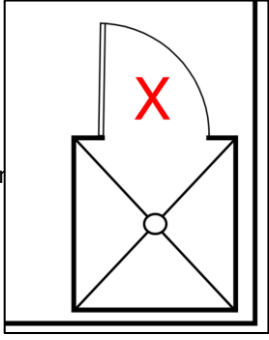
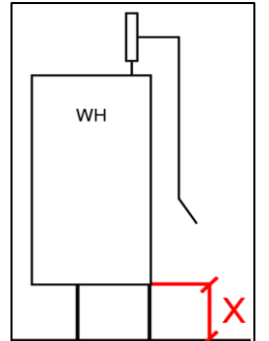
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Under what conditions is it permitted to have a back-to-back water closet connection with a double sanitary tee?	IRC P3005.1.1 Exception	IRC P3005	3	It is always permitted.	Where the horizontal developed length between the outlet of the water closet and the connection to the double sanitary tee is 18 inches or less.	Where the horizontal developed length between the outlet of the water closet and the connection to the double sanitary tee is 18 inches or greater.	It is never permitted.
What is the hot water-supply fixture-unit value for a laundry standpipe and tub?	IRC Table P2903.6	IRC P2903	2	1.9 w.s.f.u.	1.8 w.s.f.u.	1.4 w.s.f.u.	1.0 w.s.f.u.
Water service pipe shall be installed not less than _____ deep and not less than _____ below the frost line.	IRC P2603.5	IRC P2603	3	6 inches, 18 inches	18 inches, 12 inches	12 inches, 6 inches	6 inches, 12 inches
The maximum vertical hanger spacing for a 1 1/2 inch cast iron pipe is:	IRC P2605.1	IRC P2605	2	20 feet	15 feet	10 feet	5 feet
What is the maximum working pressure required for water service piping?	IRC P2906.4.1	IRC P2906	4	130 psi	140 psi	150 psi	160 psi
What is the drainage fixture unit value for a full bath group with greater than 1.6 gpm per flush?	IRC Table P3004.1	IRC P3004	4	3	4	5	6
The ignition source of a water heater located in a garage shall be not less than _____ above the garage floor.	IRC P2801.7	IRC P2801	3	36 inches	24 inches	18 inches	12 inches
What is the maximum flow rate for a shower head?	IRC Table 2903.2	IRC P2903	1	2.5 gpm	2.2 gpm	1.6 gpm	0.8 gpm
GIVEN: (1) 1.8 gpf full bath groups, (2) 1.8 gpf half bath groups, (2) kitchen groups, (2) laundry groups, and (2) bar sinks. What is the total drainage fixture unit value for this home?	IRC Table P3004.1	IRC P3004	2	21	28	37	46
What is the minimum weight of sheet lead liners?	IRC P2709.3.1	IRC P2709	1	4 lbs per sq foot	5 lbs per sq foot	8 lbs per sq foot	12 lbs per sq foot
Factory-built chimneys for fuel gas appliances having a temperature not greater than _____ °F shall be listed and labeled in accordance with _____.	IRC P2430.1	IRC P2430	3	1000, UL 102	1200, UL 102	1000, UL 103	1200, UL 103
Motor fuel-dispensing facilities for CNG fuel shall be in accordance with _____.	IRC G2423.1	IRC G2423	2	IRC G2412	IFGC 413	IRC 2415	IFGC 409
For natural gas piping a vent connect shall be installed without dips or sags and shall slope upward toward the vent not less than _____ inch per foot.	IRC G2427.10.8	IRC G2427	2	1/8	1/4	1/2	3/4
What is the minimum opening size for combustion air for a furnace that is 190,000 Btu and a 45,000 Btu water heater within the same story?	IRC G2407.5.3.1	IRC G2407	1	24" x 10"	10" x 12"	20" x 6"	36" x 15"

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Fuel gas water heaters shall be listed in accordance with any of the following requirements except for:	IRC G2448.1	IRC G2448	2	ANSI Z21.10.1	CSA 2.92	CSA 4.1	CSA 4.3	
The floor and receptor area shall be filled with potable water to a depth of not less than ____ inches measured at the threshold.	IRC P2503.6	IRC P2503	2	1	2	3	4	
DWV test with a water test shall be filled with water to a point not less than ____ feet above the highest fitting connection in that section, or to the highest point in the completed system.	IRC P2503.1	IRC P2503	2	5	10	15	20	
For a water supply test where the pipe is of a material other than plastic an air test of not less than ____ psi may be used to test the completed portion of the completed portion of the pipe.	IRC P2503.7	IRC P2503	3	5	25	50	80	
Test equipment, material, and labor shall be furnished by the _____.	IRC P2503.3	IRC P2503	4	Inspector	Architect	Owner	Permittee	
A test gauge testing a pressure of 120 psi shall have _____.	IRC P2503.9	IRC P2503	1	increments of 2 psi or less	increments of 1 psi or less	increments of 0.25 psi or less	increments of 0.10 psi or less	
What is the maximum horizontal space for PVC piping between supports?	IRC Table P2605.1	IRC Table P2605	3	10 feet	5 feet	4 feet	2 feet	
Which materials are not permitted for flashing for pipe that penetrates a roof?	IRC P2607.1	IRC P2607	3	Lead	Copper	Tin	Galvanized Steel	
Loose earth shall be carefully placed in a trench in ____ inch layers and tamped in place.	IRC P2604.3	IRC P2604	1	6	4	3	2	
A pipe that passes through a foundation wall shall be provided with a _____ into the foundation wall	IRC P2603.4	IRC P2603	4	A. relieving arch	B. piping sleeve	C. tunnel	A and B	
placed in direct contact with steel framing members?	IRC P2603.3	IRC P2603	2	Cast iron	Lead pipe	Ductile iron	Galvanized steel	
what standard shall household disposers conform to?	IRC Table P2701.1	IRC Table P2701	1	ASSE 1008	ASSE 1052	ASSE 1023	ASSE 1062	
What is the minimum dimension of X?		IRC P2708.1	IRC P2708	2	24 inches	30 inches	36 inches	42 inches

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<p>What is the minimum dimension a shower door opening width shall be?</p>		<p>IRC P2708.1.1</p>	<p>IRC P2708</p>	<p>4</p>	<p>36 inches</p>	<p>30 inches</p>	<p>24 inches</p>	<p>22 inches</p>
<p>Sinks shall be provided with waste outlets not less than less than ____ in diameter.</p>		<p>IRC P2714.1</p>	<p>IRC P2714</p>	<p>3</p>	<p>1/2 inch</p>	<p>1 inch</p>	<p>1 1/2 inches</p>	<p>2 inches</p>
<p>The discharge water temperature from a bidet fitting shall be limited to not greater than ____ degrees Fahrenheit by a water-temperature-limiting device.</p>		<p>IRC P2721.2</p>	<p>IRC P2721</p>	<p>2</p>	<p>100</p>	<p>110</p>	<p>120</p>	<p>90</p>
<p>When a water heater with an ignition source is installed in a garage, what is the minimum dimension (X) that the ignition source is to be above the floor?</p>		<p>IRC P2801.7</p>	<p>IRC P2801</p>	<p>3</p>	<p>12 inches</p>	<p>16 inches</p>	<p>18 inches</p>	<p>24 inches</p>
<p>A hot water heater drain pan is made of aluminum, what is the minimum thickness?</p>		<p>IRC P2801.6</p>	<p>IRC P2801</p>	<p>1</p>	<p>0.0236 inches</p>	<p>0.036 inches</p>	<p>0.01 inches</p>	<p>0.25 inches</p>
<p>Where a combination water heater-space heating system required water for space heating at temperatures exceeding ____ degrees Fahrenheit, a temperature-actuated mixing valve complying with ASSE 1017 shall be installed to temper the water to a temperature of not greater than ____ degrees Fahrenheit for domestic uses.</p>		<p>IRC P2803.2</p>	<p>IRC P2803</p>	<p>4</p>	<p>110, 110</p>	<p>120, 120</p>	<p>130, 130</p>	<p>140, 140</p>
<p>Temperature relief valves shall have a relief rating compatible with the temperature conditions of the appliances or equipment protected and shall be set to open at a temperature of not greater than ____ degrees Fahrenheit.</p>		<p>IRC P2804.4</p>	<p>IRC P2804</p>	<p>2</p>	<p>240</p>	<p>210</p>	<p>120</p>	<p>110</p>

2021 Residential Plumbing Inspector Practice Exam

Bottom fed tank-type water heaters and bottom fed tanks connected to water heaters shall have a vacuum relief valve installed that complies with ANSI ____.	IRC P2804.7	IRC P2804	3	Z17.15	Z18.19	Z21.22	Z22.28
Piping for reclaimed water, rainwater, and graywater distribution systems shall be of what color?	IRC P2901.2.2.1	IRC P2901	4	Green	Orange	White	Purple
What is the total cold w.s.f.u. for a clothes washer, lavatory, and a bathtub?	IRC Table P2903.6	IRC Table P2903	1	2.5	2	1.5	1
Drinking water treatment units shall meet the requirements of all except for the following:	IRC P2909.1	IRC P2909	2	NSF 62	NSF 47	NSF 44	CSA B483.1
Below-grade storage tanks, located outside of the building, shall be provided with a manhole either not less than ____ inches square or with an inside diameter not less than ____ inches.	IRC P2910.9.7	IRC P2910	3	16, 16	18, 18	24, 24	30, 30
What is the minimum horizontal distance for a storage tank from a septic tank?	IRC Table P2911.7.1	IRC Table P2911	2	2 feet	5 feet	10 feet	50 feet
A house has one full bathroom with a bathtub and a toilet with at 1.6 gallons per flush, a full kitchen, a bar sink, and a laundry tub. What is the total D.F.U.s?	IRC Table P3004.1	IRC Table P3004	1	10	8	5	3
A cleanout for a pipe 4 inches in size shall be provided with a clearance of ____ inches from, and perpendicular to, the face of the opening to any obstruction.	IRC P3005.2.9	IRC P3005	2	12	18	24	36
Required cleanouts shall not be installed in concealed locations. Concealed locations include crawlspaces where the height from the crawl space floor to the nearest obstruction along the path from the crawl space opening to the clean out location is less than ____.	IRC P3005.2.10	IRC P3005	3	12 inches	18 inches	24 inches	30 inches
The sump shall be fitted with a gastight removable cover that is installed not more than ____ inches below grade or floor level.	IRC P3007.3.2	IRC P3007	2	1.5	2	2.5	3
Relining of piping shall not be permitted when what of the following exists?	IRC P3011.5	IRC P3011	1	Defects have been found in the recorded video.	The pipe appears to be free from any defects in the recorded video.	The piping is clean and installed correctly as seen in the recorded video.	Proper slope is observed in the recorded video.
A vent shall not be installed within ____ pipe diameters of the trap weir.	IRC P3105.3	IRC P3105	4	five	four	three	two
What is the wet vent size for a vent serving 12 drainage fixture units?	IRC Table P3108.3	IRC Table P3108	4	1 1/2	2	2 1/2	3

2021 Residential Plumbing Inspector Practice Exam

The slope of horizontal combination waste and vent piping shall not be greater than ____ percent slope.	IRC P3111.2.1	IRC P3111	2	2	4	8	24
Individual and branch air admittance valves shall be located not less than ____ inches above the horizontal branch drain or fixture drain being vented.	IRC P3114.4	IRC P3114	2	6	4	2	0
A dry vent shall rise vertical to not less than ____ inches above the flood level rim of the highest trap or trapped fixture being vented.	IRC P3104.4	IRC P3104	3	12	8	6	4
Which trap is permitted to be installed?	IRC P3201.5	IRC P3201	4	Bell traps	S traps	Drum traps	P Traps
Each plumbing fixture shall be ____ trapped by a water seal trap.	IRC P3201.5	IRC P3201	2	uniformly	separately	collectively	mutually
What is the minimum size of a trap for a floor drain?	IRC Table P3201.7	IRC Table P3201	1	2 inches	1 1/2 inches	1 1/4	4 inches
What is the maximum vertical distance from the fixture outlet to the trap weir?	IRC P3201.6	IRC P3201	2	1 foot	2 feet	3 feet	4 feet
Copper or copper-alloy traps shall not be less than No. ____ gage thickness.	IRC P3201.1	IRC P3201	3	16	18	20	24
Subsoil drain cast iron pipes shall conform to all the following standards except for:	IRC Table P3302.1	IRC Table P3302	2	ASTM A74	ASTM F405	ASTM A888	ASTM CISPI 301
The sump shall be not less than ____ inches in diameter and ____ inches deep.	IRC P3303.1.2	IRC P3303	4	16, 20	24, 16	24, 18	18, 24
Discharge piping shall include an _____ full-flow check valve.	IRC P3303.1.4	IRC P3303	1	accessible	inaccessible	open	aerated
Stainless steel drainage systems type 316L for the subsoil drain pipe shall comply with what standard?	IRC Table P3302.1	IRC Table P3302	3	ASTM D2729	ASTM A74	ASME 112.3.1	ASTM C4
Pipe and fittings shall be _____ the pump discharge tapping.	IRC P3303.1.4	IRC P3303	1	the same size or larger than	the same size or smaller than	a different size but larger than	a different size but smaller than



George Williams

MCP, CBO

SENIOR PLAN REVIEW EXAMINER

EDUCATION

**MASTER OF SCIENCE
CONSTRUCTION MANAGEMENT**
Brigham Young University, 2015

**BACHELOR OF SCIENCE
CONSTRUCTION MANAGEMENT**
Weber State University, 2008

LICENSES | CERTIFICATIONS

LICENSES

Combination Inspector
Utah 6048299-5601

ICC CERTIFICATIONS

Master Code Professional
Certified Building Official
Commercial Combination Inspector
Residential Combination Inspector
Building Plans Examiner
Plumbing Code Official
Plumbing Plans Examiner
Mechanical Code Official
Mechanical Plans Examiner
Commercial Energy Inspector
Commercial Energy Plans Examiner
Residential Energy Inspector/Plans
Examiner
Accessibility Inspector/Plans
Examiner
Housing Code Official
Property Maintenance & Housing
Inspector

And several more...

AFFILIATIONS

Beehive Chapter of ICC
Vice President & Member

IAEI Utah Chapter
Member

AWARDS

Utah Chapter ICC
2016 Chapter Service Award
Eagle Scout - 1998

Mr. Williams has worked on a contract basis for numerous jurisdictions in California, Nevada, Washington, Utah, Wyoming and North Dakota throughout his 13-year career in the industry. From 2009 through mid-2014 he acted as the contract building official for City of Holladay as well as the resort town of Alta, both in Utah. He was also responsible for start-up of two county building departments in North Dakota, including the adopting of codes, implementation of permitting processes, and the development of policies and procedures in a part of the country where no previous form of building or construction regulatory processes existed. In addition to substantial municipal work, Mr. Williams has acted and continues to act as Lead Inspector for a number of multi-million-dollar projects for Utah's Division of Facilities and Construction Management (DFCM). Mr. Williams has numerous ICC certifications and received his ICC Master Code Professional certification in 2009. Currently he performs complex commercial plan reviews for clients in California, Nevada, Wyoming and Utah, as well as commercial inspections.

EXPERIENCE

SENIOR INSPECTOR / PLAN REVIEWER

West Coast Code Consultants, Inc. / 2014 – Present

Provides plan reviews and inspections services for a variety of commercial projects. Specializes in several code disciplines including, building, mechanical, plumbing, electrical, accessibility, energy and green codes. Familiar with both the International and Uniform codes, as plan review and inspection work encompassing numerous municipalities in multiple states. Regularly responsible for overseeing code compliance and inspection of large-scale state-owned buildings; including oversight of special inspection firms.

BUILDING OFFICIAL / INSPECTOR

Forsgren Associates / 2005 – 2014

Developed, maintained, administered, organized and oversaw building departments for various municipalities. Responsible for all aspects of building department administration, including creating policies and procedures, commercial and residential plan reviews, calculating permit fees, meeting with architects and engineers, performing field inspections, reviewing special inspection reports, interpreting codes and local ordinances, data and document management, and many other diverse tasks. Responsible for managing 2-4 field inspectors on a daily basis. Clients included numerous municipalities in multiple states, school districts, architects, law firms, and private entities.

PUBLICATIONS

Graduate Thesis: (2015) *Assessing the Repercussions of a Mass Departure of Building Inspectors from the Code Professional Industry.* Brigham Young University, Provo, Utah.

Article: (2015) *Construction Challenges Associated with the Sudden Population Growth in the Willison Basin Oil Boom,* presented at ASC Annual International Conference, College Station, TX: Associated Schools of Construction.

Article: (2019) *Understanding the Impacts of the Aging Population of Code Professionals in Utah,* presented at ASC Annual International Conference, Denver, CO: Associated Schools of Construction.

File Attachments for Item:

EC-1 2021 IBC Update (West Coast)

All certifications (5 hours)

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *

Brittany Allen

Organization

West Coast Code Consultant

Email *

brittanya@wc-3.com

Phone Number *

(385) 237-3722

Address *

9131 S Monroe St Unit A

City *

Sandy

State *

Utah

Zip Code *

84070

Website

https://www.pathlms.com/w

Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e.

BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

2021 IBC Update

Course instructor

Chris Kimball

Course description

Course Description: This 5-module course focuses on the updates to the 2021 International Building Code (IBC). It teaches the practical application of the IBC, focusing on the difference between the 2018 and 2021 versions of the codes. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 45-65 min. in length.

Course Objectives: This course is designed to make those already familiar with older versions of the IBC aware of the changes that have been made to the 2021 version of the codes. You will learn what has been added, what has been removed, and what has been changed.

Instructional hours per session

5

Number of Sessions

Course Date

Course Location

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction
- Plumbing Instruction

Conference Course

Conference Name

Conference location

Course to be offered online?

On Demand

Webinar

Course Website

1034

Yes

No

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):

Quizzes: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. Topics in the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video and complete each quiz. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hrs. of personal study, for each module. You can progress through this course at your own pace; however, you only have access for 120 days.

Course applicable for the following certifications *

Residential Certifications Only

Administrative Course, All Certifications

Commercial and Residential Certifications

Application materials included *

Course Outline or Course Learning Objectives

Presentation Materials/Slides (not required for roundtable courses)

Assessment Materials (for online courses)

Presenter Bio

Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
2021 IBC Updates Course Submittal Documents.pdf	25.53 MB

Applicant Full Name *

Brittany Allen

Date of Submission

06/06/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



2021 IBC Update

Course Outline

Cost: \$57, allowing 120 days of access.

Course Description: This 5-module course focuses on the updates to the *2021 International Building Code (IBC)*. It teaches the practical application of the IBC, focusing on the difference between the 2018 and 2021 versions of the codes. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 45-65 min. in length.

Course Objectives: This course is designed to make those already familiar with older versions of the IBC aware of the changes that have been made to the 2021 version of the codes. You will learn what has been added, what has been removed, and what has been changed.

Texts and Readings: The *2021 International Building Code (IBC)* is the textbook for this course. It is highly recommended that you purchase a paper-back copy of these codes, which are available online at www.iccsafe.org and serve as a valuable reference for in the field inspections.

Course Outline of Topics:

Module:	Topics:	Readings:	Quiz:	Duration:
1	IBC Updates Chapters 1 through 3	2021 IBC Chapters 1 through 3	Y	45 min.
2	IBC Updates Chapters 4 through 9	2021 IBC Chapters 4 through 9	Y	66 min.
3	IBC Updates Chapters 10 through 15	2021 IBC Chapters 10 through 15	Y	43 min.
4	IBC Updates Chapters 16 through 26	2021 IBC Chapters 16 through 26	Y	44 min.
5	IBC Updates Chapters 27 through Appendices	2021 IBC Chapters 27 through Appendices	Y	18 min.
	5 Quizzes 50 Questions, 2 min. each	2021 IBC		100 min.
	Total Course Hours			5 hours

Quizzes: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. Topics in the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video and complete each quiz. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hrs. of personal study, for each module. Marking, tabbing, and highlighting in the code book is highly recommended. We have laid out a plan and method to help you learn the material, but it's up to you to put in the work necessary for you to master the material. You can progress through this course at your own pace; however, you only have access for 120 days.



2021 IBC Update

Continuing Education Credits: Completion of this course results in **0.5 CEU's** being provided by ICC, as West Coast Code Consultants is a Preferred Provider.

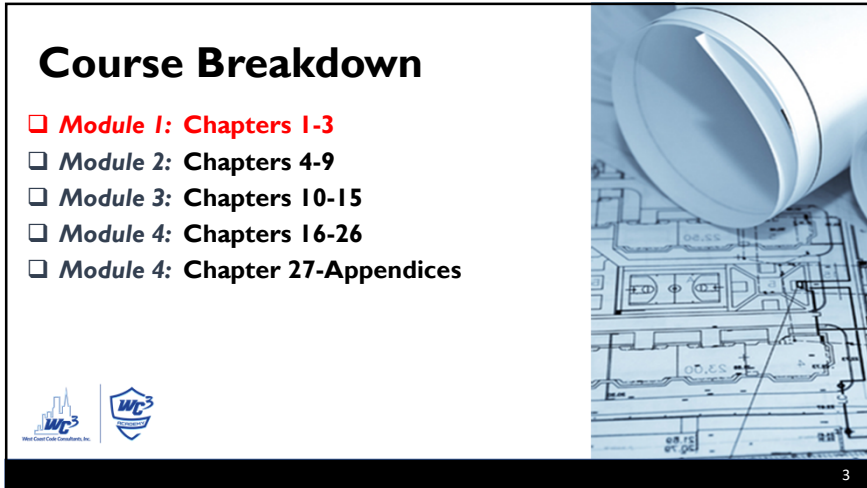
Instructor:



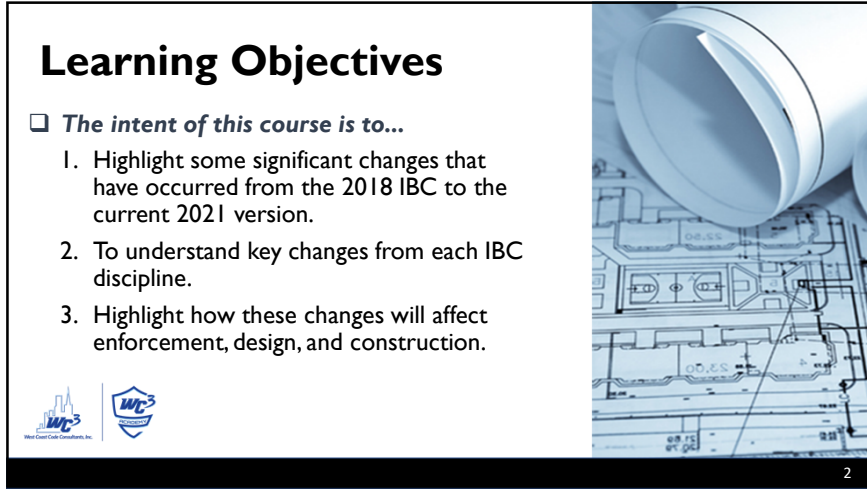
Chris Kimball, PE, SE, MCP, CBO is one of WC3's Vice Presidents. He is a licensed structural engineer, ICC Master Code Professional, Certified Building Official, fire code official, combination plans examiner, and combination building inspector. He has performed plan reviews for thousands of projects throughout the western states. In addition, Chris has provided numerous training classes to help design professionals, building officials, and contractors alike to understand the requirements of the adopted building codes. Chris regularly teaches for ICC and has been involved in assisting ICC with various publications.



1




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2




4





Code Development


- ☐ Represents changes approved by the **ICC Code Development Process** through 2019.



- ☐ Visit iccsafe.org for more information.

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Code Development


- ☐ **IBC Code Development Committees:**

[A] = Administrative Code Development Committee
 [BE] = IBC—Egress Code Development Committee
 [BF] = IBC—Fire Safety Code Development Committee
 [BG] = IBC—General Code Development Committee
 [BS] = IBC—Structural Code Development Committee
 [E] = International Commercial Energy Conservation Code Development Committee or International Residential Energy Conservation Code Development Committee
 [EB] = International Existing Building Code Development Committee
 [F] = International Fire Code Development Committee
 [FG] = International Fuel Gas Code Development Committee
 [M] = International Mechanical Code Development Committee
 [P] = International Plumbing Code Development Committee

International Code Council, 2021 IBCD






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Code Development

- ☐ **IBC Code Development Committees:**
 - Evaluate and make recommendations regarding proposed changes to the codes
 - Recommendations are subject to public comment and council-wide votes
 - ICC governmental members cast the final votes on proposed changes
 - 11 different code development committees

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Code Development

- ☐ **Code Hearings:**
 - Groups A & B

Group A Codes (Heard in 2021, Code Change Proposals Deadline: January 11, 2021)	Group B Codes (Heard in 2022, Code Change Proposals Deadline: January 10, 2022)
International Building Code – Egress (Chapters 10, 11, Appendix E) – Fire Safety (Chapters 7, 8, 9, 14, 26) – General (Chapters 2–6, 12, 27–33, Appendices A, B, C, D, K, N)	Administrative Provisions (Chapter 1 of all codes except IECC, IRC and IgCC; IBC Appendix O; the appendices titled "Board of Appeals" for all codes except IECC, IRC, IgCC, ICCPC and IZC; administrative updates to currently referenced standards; and designated definitions)
International Fire Code	International Building Code – Structural (Chapters 15–25, Appendices F, G, H, I, J, L, M)

International Code Council, 2021 IBCD

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Marginal Markings

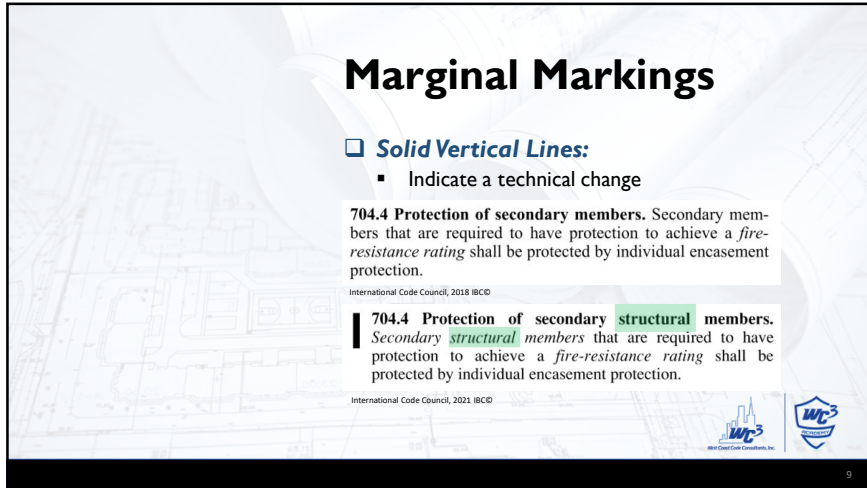
- ❑ **Solid Vertical Lines:**
 - Indicate a technical change

704.4 Protection of secondary members. Secondary members that are required to have protection to achieve a *fire-resistance rating* shall be protected by individual encasement protection.

International Code Council, 2018 IBC®

704.4 Protection of secondary structural members. Secondary structural members that are required to have protection to achieve a *fire-resistance rating* shall be protected by individual encasement protection.

International Code Council, 2021 IBC®



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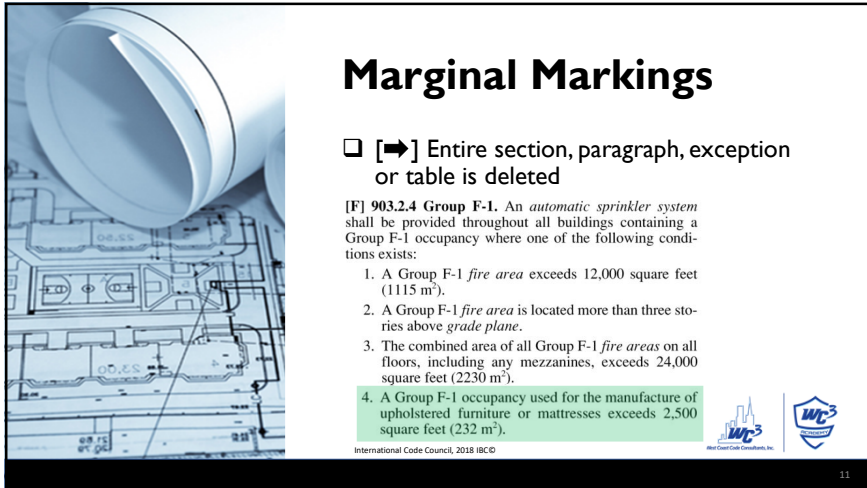
Marginal Markings

- ❑ **[➡]** Entire section, paragraph, exception or table is deleted

[F] 903.2.4 Group F-1. An automatic sprinkler system shall be provided throughout all buildings containing a Group F-1 occupancy where one of the following conditions exists:

1. A Group F-1 fire area exceeds 12,000 square feet (1115 m²).
2. A Group F-1 fire area is located more than three stories above grade plane.
3. The combined area of all Group F-1 fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m²).
4. A Group F-1 occupancy used for the manufacture of upholstered furniture or mattresses exceeds 2,500 square feet (232 m²).

International Code Council, 2018 IBC®



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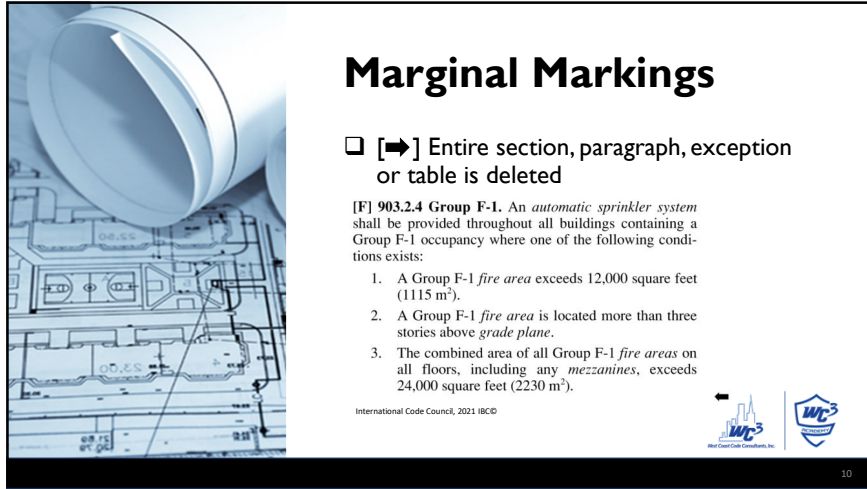
Marginal Markings

- ❑ **[➡]** Entire section, paragraph, exception or table is deleted

[F] 903.2.4 Group F-1. An automatic sprinkler system shall be provided throughout all buildings containing a Group F-1 occupancy where one of the following conditions exists:

1. A Group F-1 fire area exceeds 12,000 square feet (1115 m²).
2. A Group F-1 fire area is located more than three stories above grade plane.
3. The combined area of all Group F-1 fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m²).

International Code Council, 2021 IBC®



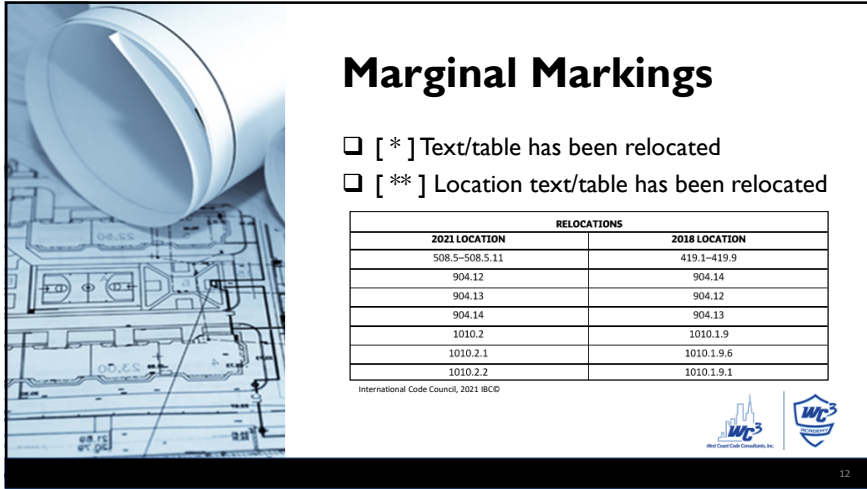
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Marginal Markings

- ❑ **[*]** Text/table has been relocated
- ❑ **[**]** Location text/table has been relocated

RELOCATIONS	
2021 LOCATION	2018 LOCATION
508.5-508.5.11	419.1-419.9
904.12	904.14
904.13	904.12
904.14	904.13
1010.2	1010.1.9
1010.2.1	1010.1.9.6
1010.2.2	1010.1.9.1

International Code Council, 2021 IBC®





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Italicized Terms

- ❑ *Code-specified* definitions





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Arrangement

- ❑ Beneficial to understand the arrangement
- ❑ Arranged and organized to follow sequential steps

CHAPTER TOPICS	
Chapters	Subjects
1-2	Administration and definitions
3	Use and occupancy classifications
4, 31	Special requirements for specific occupancies or elements
5-6	Height and area limitations based on type of construction
7-9	Fire resistance and protection requirements
10	Requirements for evacuation
11	Specific requirements to allow use and access to a building for persons with disabilities
12-13, 27-30	Building systems, such as lighting, HVAC, plumbing fixtures, elevators
14-26	Structural components—performance and stability
32	Encroachment outside of property lines
33	Safeguards during construction
35	Referenced standards
Appendices A-O	Appendices

International Code Council, 2021 IBC®

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Italicized Terms

- ❑ *Definitions often trigger code requirements...*

[BS] FLOOD HAZARD AREA. The greater of the following two areas:

1. The area within a flood plain subject to a 1-percent or greater chance of *flooding* in any year.
2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

International Code Council, 2021 IBC®

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Arrangement

Chapter 1 Scope and Administration

Chapter 1 establishes the limits of applicability of the code and describes how the code is to be applied and enforced. Chapter 1 is in two parts, Part 1—Scope and Application (Sections 101-102) and Part 2—Administration and Enforcement (Sections 103-116). Section 101 identifies which buildings and structures come under its purview and references other I-Codes as applicable. Standards and codes are scoped to the extent referenced (see Section 102.4).

The building code is intended to be adopted as a legally enforceable document and it cannot be effective without adequate provisions for its administration and enforcement. The provisions of Chapter 1 establish the authority and duties of the building official appointed by the authority having jurisdiction and also establish the rights and privileges of the design professional, contractor and property owner.



Chapter 2 Definitions

All terms that are defined in the code are listed alphabetically in Chapter 2. While a defined term may be used in one chapter or another, the meaning provided in Chapter 2 is applicable throughout the code.

Where understanding a term's definition is especially key to or necessary for understanding a particular code provision, the term is shown in italics. This is true only for those terms that have a meaning that is unique to the code. In other words, the generally understood meaning of a term or phrase might not be sufficient or consistent with the meaning prescribed by the code; therefore, it is essential that the code-defined meaning be known.

Guidance regarding tense, gender and plurality of defined terms as well as guidance regarding terms not defined in this code is provided.

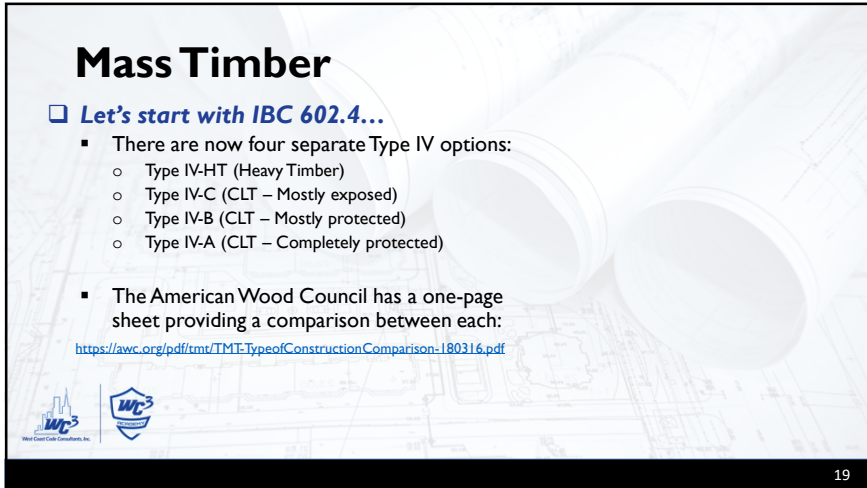
International Code Council, 2021 IBC®

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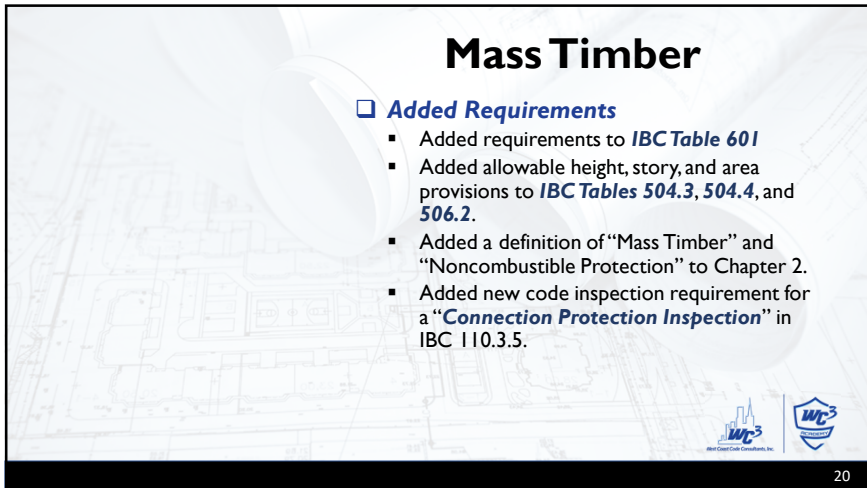
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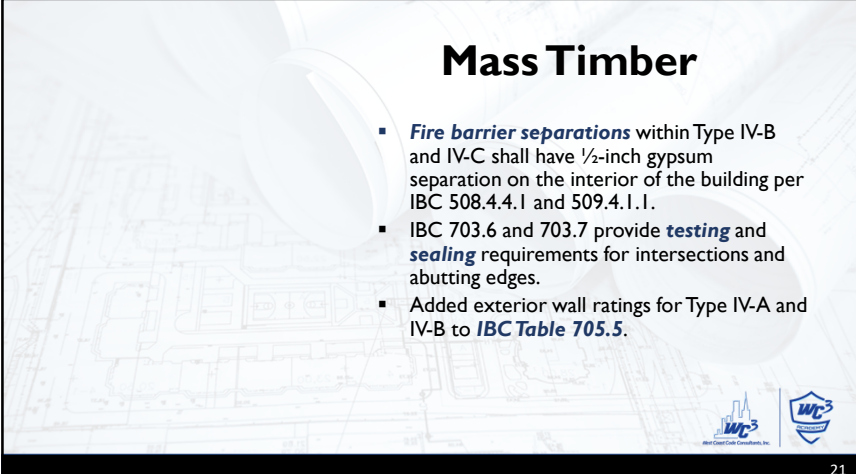

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Mass Timber

- **Fire barrier separations** within Type IV-B and IV-C shall have ½-inch gypsum separation on the interior of the building per IBC 508.4.4.1 and 509.4.1.1.
- IBC 703.6 and 703.7 provide **testing** and **sealing** requirements for intersections and abutting edges.
- Added exterior wall ratings for Type IV-A and IV-B to **IBC Table 705.5**.

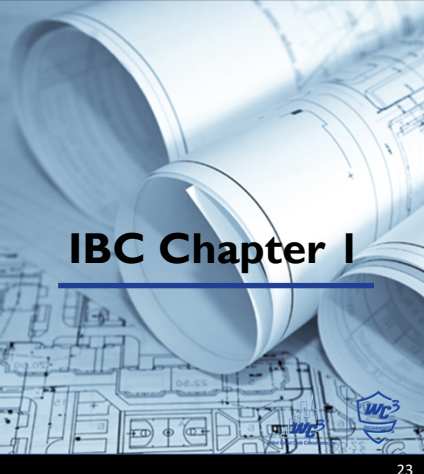




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21



IBC Chapter I






23

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Mass Timber

- Added **prescriptive** fire-resistance requirements for Mass Timber to IBC 722.7.
- Added **special inspection** requirements via IBC Table 1705.5.2.
- IBC 2304.10.1 lists how mass timber **connection protection** can be approved via testing or engineering calculations.
- IBC 403.3.2 adds Type IV-A and IV-B buildings > 120-feet to the **redundant water supply** requirement.
- **There is a lot to study on Mass Timber!**



22

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Terminology

- ❑ **IBC 103: Department of Building Safety-Code Compliance Agency**
- ❑ **IBC 107: Submittal-Construction Documents**
 - Clarified that that these can be submitted in digital format where allowed.
 - Relocatable buildings per IBC 3112.

REVISED






24

24

Terminology

- ❑ **IBC 113: ~~Board Means of Appeals~~**
 - Notes that decisions must be made in writing and provided in duplicate to owner and building official.
 - Requires the building official to take immediate action.
 - Appendix 'O' has been revised to add much more clarity on the process.



REVISED

25

25

Balconies

- ❑ **IBC 110.3.7: Weather-Exposed Balcony and Walking Surface Waterproofing**
 - Clarified that this is for “**weather-exposed surfaces**” only.
 - “...all elements of the impervious moisture barrier system shall not be concealed until inspected and approved.”



REVISED

27

27

Balconies

- ❑ **IBC 107.2.5: Exterior Balconies and Elevated Walking Surfaces**
 - Where weather-exposed surfaces exist, “...have **weather-exposed surfaces**, and the structural framing is protected by an impervious moisture barrier, the construction documents...”

REVISED

26

26

Type IV Inspection

- ❑ **IBC 110.3.5: Types IV-A, IV-B and IV-C Connection Protection Inspection**
 - “In buildings of Types IV-A, IV-B and IV-C construction, where connection fire-resistance ratings are provided by wood cover calculated to meet the requirements of Section 2304.10.1, inspection of the wood cover shall be made after the cover is installed, but before any other coverings or finishes are installed.”



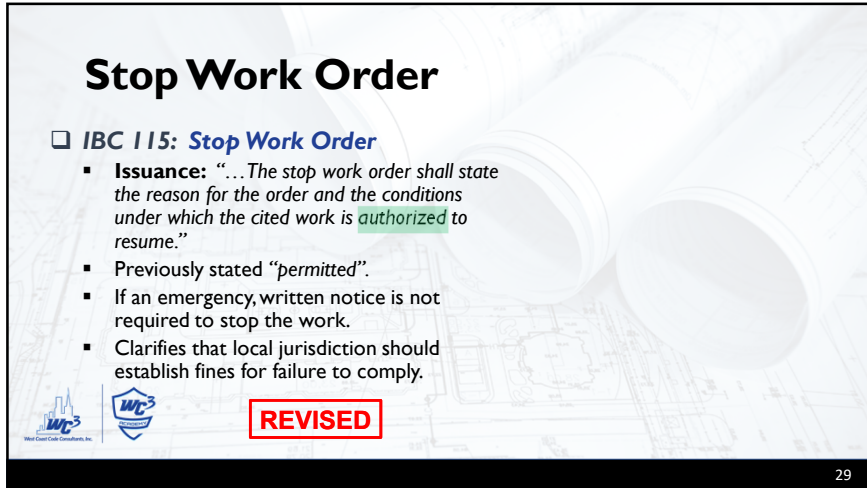

ADDED

28



28

Stop Work Order

- IBC 115: **Stop Work Order**
 - Issuance:** "...The stop work order shall state the reason for the order and the conditions under which the cited work is **authorized** to resume."
 - Previously stated "permitted".
 - If an emergency, written notice is not required to stop the work.
 - Clarifies that local jurisdiction should establish fines for failure to comply.



REVISED

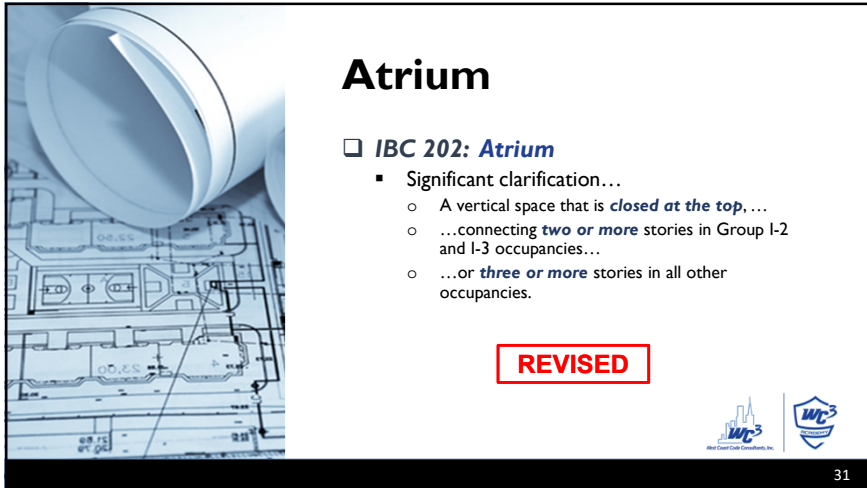



29



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Atrium

- IBC 202: **Atrium**
 - Significant clarification...
 - A vertical space that is **closed at the top**, ...
 - ...connecting **two or more** stories in Group I-2 and I-3 occupancies...
 - ...or **three or more** stories in all other occupancies.




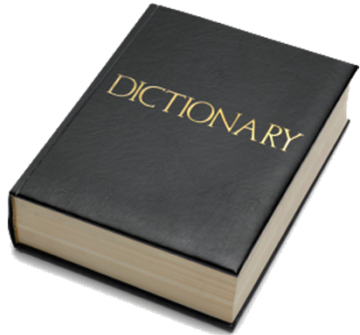
REVISED



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IBC Chapter 2

REVISED

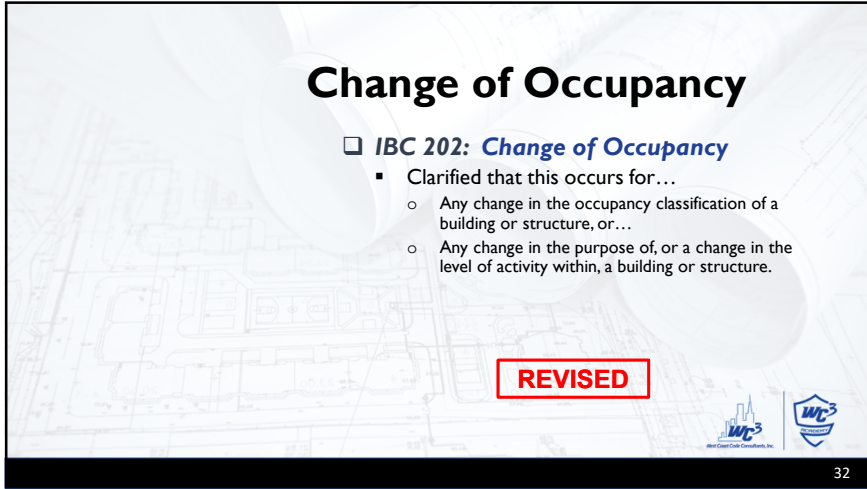



30



30

Change of Occupancy

- IBC 202: **Change of Occupancy**
 - Clarified that this occurs for...
 - Any change in the occupancy classification of a building or structure, or...
 - Any change in the purpose of, or a change in the level of activity within, a building or structure.



REVISED

32

32

Change of Occupancy

- ❑ **IBC 202: Dangerous**
 - Clarified loads to be considered...
 - Previously noted "service" loads
 - Now lists permanent, routine, or frequent loads in addition to...
 - Snow, wind, rain, flood, earthquake or other environmental loads.

REVISED



33

33

Change of Occupancy

- ❑ **IBC 202: Fire Protective Curtain Assembly**
 - "An assembly consisting of a fabric curtain, a bottom bar, guides, a coil, and an operating and closing system."
 - Added new Section 716.4.

ADDED



35

35

Change of Occupancy

- ❑ **IBC 202: Dwelling Unit, Efficiency**
 - "A dwelling unit where all permanent provisions for living, sleeping, eating and cooking are contained in a single room."



34

34

Change of Occupancy

- ❑ **IBC 202: Gypsum Panel Product**
 - Previously simply referred to sheet products consisting of gypsum.
 - Now clarifies...
 - "...complying with the standards specified in Table 2506.2 and Table 2507.2, and Chapter 35."

REVISED



36

36

Shipping Container

- ❑ **IBC 202: Intermodal Shipping Container**
 - “A six-sided steel unit originally constructed as a general cargo container used for the transport of goods and materials.”



ADDED




37

37

Shipping Container

- ❑ **IBC 202: Mechanical-Access Open Parking Garage**
 - “An enclosed parking garage that employs parking machines, lifts, elevators or other mechanical devices for vehicle moving from and to street level and in which public occupancy in the garage is prohibited in all areas except the vehicle access bay.”

ADDED



39

39

Shipping Container

- ❑ **IBC 202: Mass Timber**
 - “Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross-section dimensions of Type IV construction.”

ADDED




38

38

Shipping Container

- ❑ **IBC 202: Noncombustible Protection (For Mass Timber)**
 - “Noncombustible material, in accordance with Section 703.6, designed to increase the fire-resistance rating and delay the combustion of mass timber.”

ADDED





40

40

Penthouse

- ❑ **IBC 202: Penthouse**
 - Added stairways to the definition...
 - “An enclosed, unoccupied rooftop structure used for sheltering mechanical and electrical equipment, tanks, elevators and related machinery, stairways, and vertical shaft openings.”

REVISED

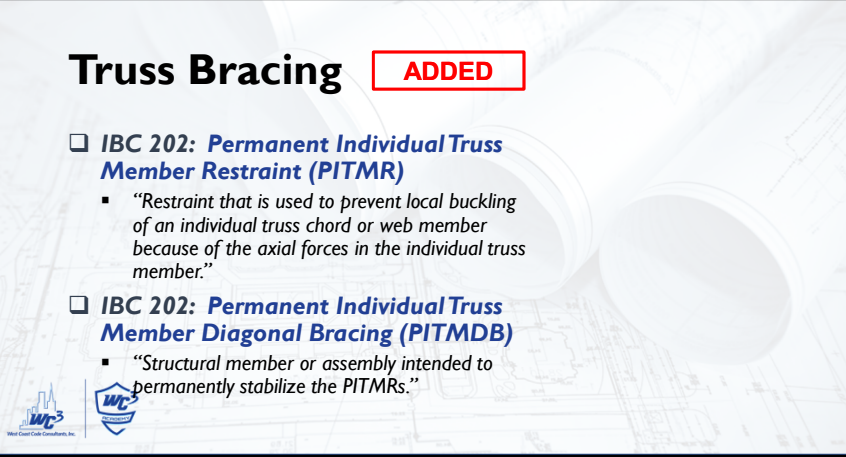

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41

Truss Bracing

ADDED

- ❑ **IBC 202: Permanent Individual Truss Member Restraint (PITMR)**
 - “Restraint that is used to prevent local buckling of an individual truss chord or web member because of the axial forces in the individual truss member.”
- ❑ **IBC 202: Permanent Individual Truss Member Diagonal Bracing (PITMDB)**
 - “Structural member or assembly intended to permanently stabilize the PITMRs.”

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Perimeter Fire...

- ❑ **IBC 202: Perimeter Fire Containment System**
 - Referenced in “F Rating” definition.
 - Required at curtainwalls and fire-rated floor assemblies (IBC 715.4)
 - “An assemblage of specific materials or products that is designed to resist for a prescribed period of time the passage of fire through voids created at the intersection of exterior curtain wall assemblies and fire-resistance-rated floor or floor/ceiling assemblies.”

ADDED





42

42


Puzzle Room

- ❑ **IBC 202: Puzzle Room**
 - “A puzzle room is a type of special amusement area in which occupants are encouraged to solve a challenge to escape from a room or series of rooms.”

ADDED



Sony Pictures Entertainment, Escape Room, 2019







44

44

Storage Racks

- IBC 202: **Storage Racks, Steel Cantilevered**
 - “...primarily in the form of vertical columns, extended bases, horizontal arms projecting from the faces of the columns, and longitudinal (down-aisle) bracing between columns. ...”

ADDED








45

45

DESCRIPTION	GROUP(S)
Assembly	A-1, A-2, A-3, A-4 & A-5
Business	B
Educational	E
Factory	F-1 & F-2
Hazardous	H-1, H-2, H-3, H-4 & H-5
Mercantile	M
Residential	R-1, R-2, R-3 & R-4
Storage	S-1 & S-2
Utility	U

IBC Chapter 3




47

47

Underpinning

- IBC 202: **Underpinning**
 - “The alteration of an existing foundation to transfer loads to a lower elevation using new piers, piles or other permanent structural support elements installed below the existing foundation.”
 - Noted several times in Chapter 18 when excavating near existing foundations.
 - IBC 1804.2.1 requires sequencing of the underpinning.

ADDED


46

46

Special Cases

- Clarifies when special cases apply...
 - 303.1.5: Special amusement areas → IBC 411
 - 304.2: Air traffic control towers → IBC 412.2
 - 304.3: Ambulatory care facilities → IBC 422
 - 304.4: Higher education labs → IBC 428
 - 305.3: Storm Shelters in Group E → IBC 423.5
 - 306.2.1: Aircraft manufacturing → IBC 412.6

ADDED





48



48

Special Cases

☐ **Continued...**

- 309.3: Motor fuel-dispensing → IBC 406.7
- 311.2.1: Aircraft hangars → IBC 412.3
- 311.2.2: Repair garages → IBC 406.8
- 311.3.1: Public parking garages → IBC 406
- 312.2: Private garages & carports → IBC 406.3
- 312.3: Residential aircraft hangars → IBC 412.4

ADDED

49


49

High Hazard


☐ **IBC 307.1.1: Uses other than Group H**

- Item 18: Distilling or brewing of beverages (per IFC)
- Item 19: Storage of beer, distilled spirits and wines in barrels or casks (per IFC)

ADDED



The Bulletin: "Where Beer Barrels are Stashed in bend"



51


51

Group F-1



☐ **IBC 306.2: Moderate-hazard (Group F-1)**

- Added the following to the list of example uses:
 - Water/sewer treatment facilities
 - Energy Storage Systems (ESS) in dedicated use buildings

REVISED



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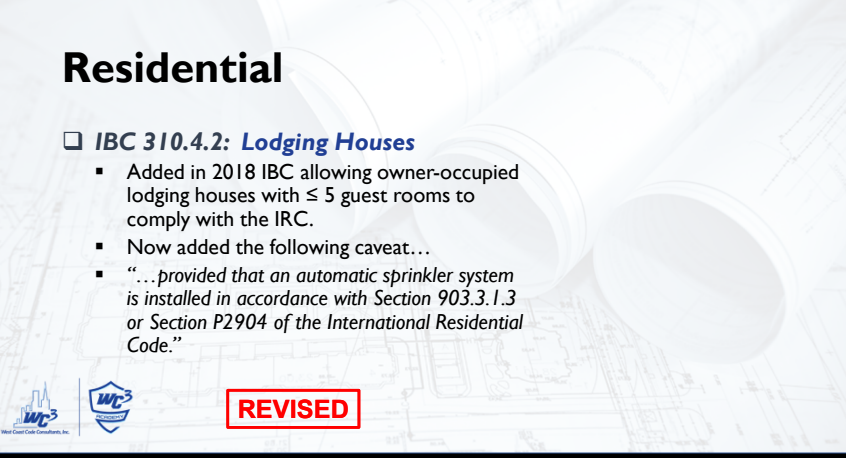

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Residential

☐ **IBC 310.4.2: Lodging Houses**

- Added in 2018 IBC allowing owner-occupied lodging houses with ≤ 5 guest rooms to comply with the IRC.
- Now added the following caveat...
- "...provided that an automatic sprinkler system is installed in accordance with Section 903.3.1.3 or Section P2904 of the International Residential Code."

REVISED

52

52

Storage

- ❑ **IBC 311.1.2: Combustible Storage**
 - Added a new provision requiring combustible storage areas to also comply with IBC 413.
 - “High-piled stock or rack storage, or attic, under-floor and concealed spaces used for storage of combustible materials, shall be in accordance with Section 413.”

ADDED

53

Utility

- ❑ **IBC 312.1: General**
 - Added example use:
 - Fences more than 7-feet in height

REVISED

55

Storage

- ❑ **IBC 311.2: Moderate-hazard (Group S-1)**
 - Added example use:
 - Beverages over 16% alcohol content
- ❑ **IBC 311.3: Low-hazard (Group S-2)**
 - Revised the following example uses:
 - Beverages up to and including 16% alcohol in metal, glass or ceramic containers
 - Public parking garages, open or enclosed

ADDED / REVISED



54

2021 IBC Update

56

Learning Objectives

- ❑ *The intent of this course is to...*
 1. Highlight some significant changes that have occurred from the 2018 IBC to the current 2021 version.
 2. To understand key changes from each IBC discipline.
 3. Highlight how these changes will affect enforcement, design, and construction.


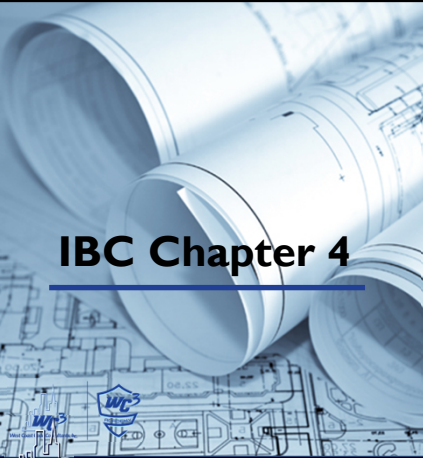



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IBC Chapter 4

SPECIAL






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Course Breakdown

- ❑ *Module 1: Chapters 1-3*
- ❑ **Module 2: Chapters 4-9**
- ❑ *Module 3: Chapters 10-15*
- ❑ *Module 4: Chapters 16-26*
- ❑ *Module 4: Chapter 27-Appendices*


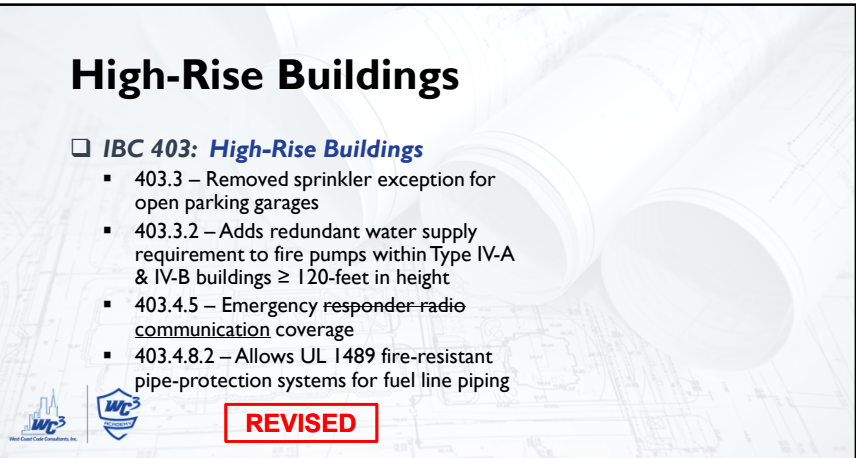
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High-Rise Buildings

- ❑ **IBC 403: High-Rise Buildings**
 - 403.3 – Removed sprinkler exception for open parking garages
 - 403.3.2 – Adds redundant water supply requirement to fire pumps within Type IV-A & IV-B buildings ≥ 120-feet in height
 - 403.4.5 – Emergency responder radio communication coverage
 - 403.4.8.2 – Allows UL 1489 fire-resistant pipe-protection systems for fuel line piping

REVISED

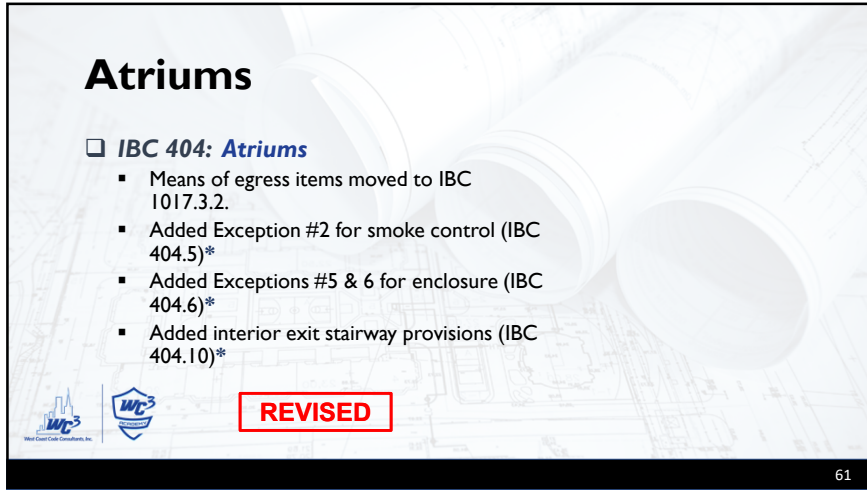
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Atriums

- IBC 404: *Atriums*
 - Means of egress items moved to IBC 1017.3.2.
 - Added Exception #2 for smoke control (IBC 404.5)*
 - Added Exceptions #5 & 6 for enclosure (IBC 404.6)*
 - Added interior exit stairway provisions (IBC 404.10)*

REVISED

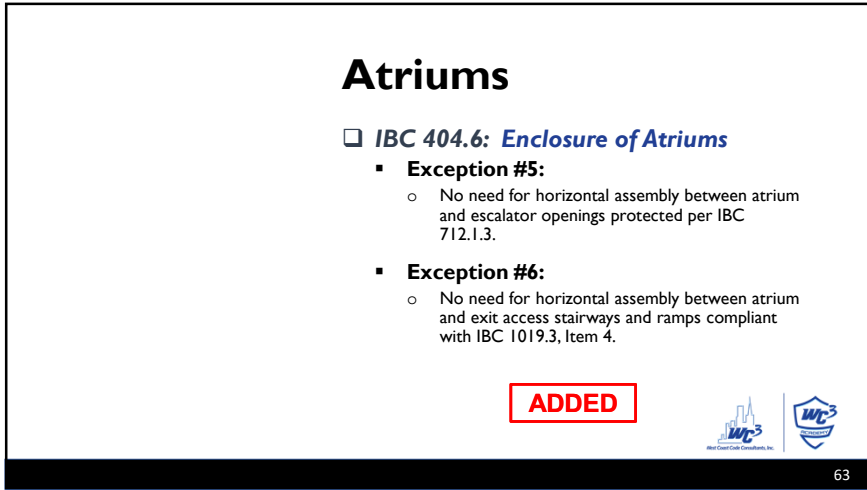


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Atriums

- IBC 404.6: *Enclosure of Atriums*
 - Exception #5:**
 - No need for horizontal assembly between atrium and escalator openings protected per IBC 712.1.3.
 - Exception #6:**
 - No need for horizontal assembly between atrium and exit access stairways and ramps compliant with IBC 1019.3, Item 4.

ADDED

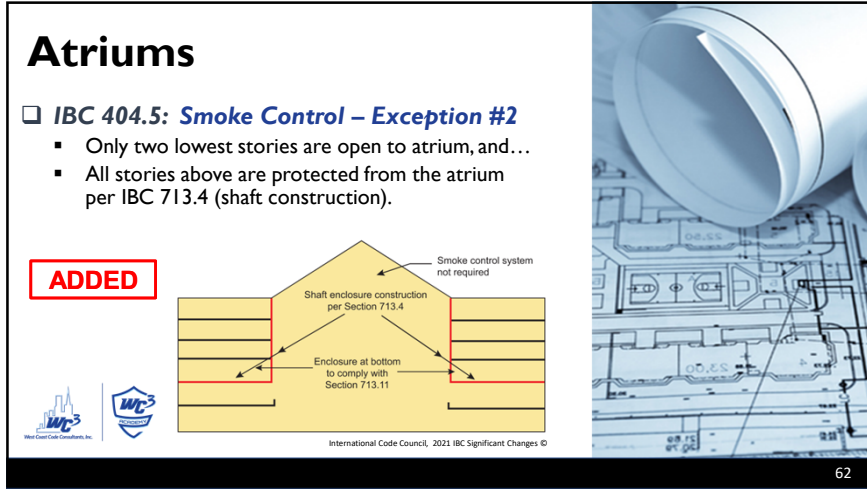


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Atriums

- IBC 404.5: *Smoke Control – Exception #2*
 - Only two lowest stories are open to atrium, and...
 - All stories above are protected from the atrium per IBC 713.4 (shaft construction).

ADDED



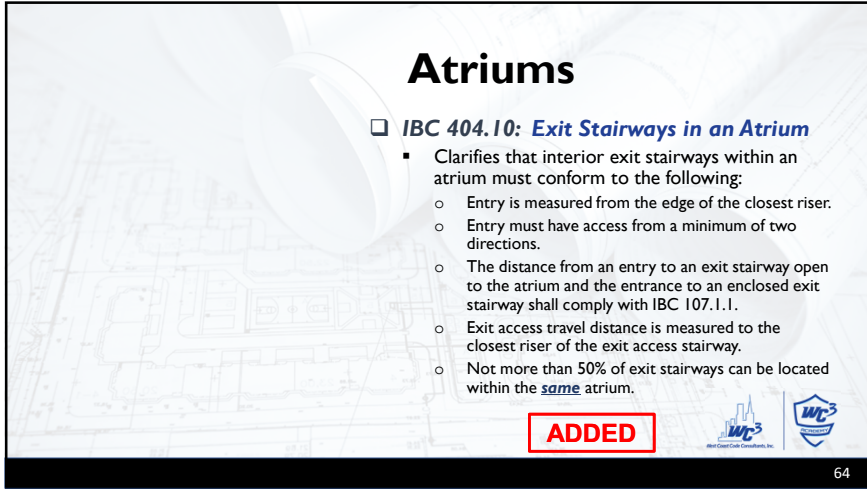
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Atriums

- IBC 404.10: *Exit Stairways in an Atrium*
 - Clarifies that interior exit stairways within an atrium must conform to the following:
 - Entry is measured from the edge of the closest riser.
 - Entry must have access from a minimum of two directions.
 - The distance from an entry to an exit stairway open to the atrium and the entrance to an enclosed exit stairway shall comply with IBC 107.1.1.
 - Exit access travel distance is measured to the closest riser of the exit access stairway.
 - Not more than 50% of exit stairways can be located within the same atrium.

ADDED




64

Motor Vehicles

- ❑ **IBC 406.6.4: Mechanical-Access Enclosed Parking Garages**
 - New definition in IBC 202
 - 2-hour separation from other occupancies
 - A mechanical smoke removal system is required
 - Fire control equipment room is required
 - Fire department access doors provided per IBC 3206.7 of the IFC (125-foot CC)

ADDED





65

Group I-2

- ❑ **IBC 407.3.1.1: Door Construction**
 - If corridor doors not required to be rated:
 - **Solid doors** shall have close-fitting operational tolerances, head and jamb stops.
 - **Dutch-style doors** shall have an interlocking edge between the upper and lower door sections, latching hardware is required for both sections, and must have hardware that allows it to function as a single leaf.
 - Doors are permitted to have **louvers** or a 2/3-inch **clearance** at the bottom if make-up air from the corridor is required per IBC 1020.7, Exception 1.

ADDED

67

Group I-2

Also added to 420.9 for Group I-1 occupancies

- ❑ **IBC 407.2.7: Domestic Cooking Appliances**
 - **Group I-2** domestic cooking appliances shall comply with the following:
 - Limited to ovens, cooktops, ranges, warmers and microwaves
 - Domestic hoods shall be provided over cooktops and ranges and shall comply with IMC 505
 - Protected per IBC 904.14 (*Extinguishing & ignition prevention*)
 - A shut-off for fuel and electrical power shall be provided in a location where only staff has access.
 - A timer which automatically deactivates appliances within a period not more than 120 minutes.
 - A portable fire extinguisher within 30-feet of appliance(s).

ADDED





66


Group I-2

- ❑ **IBC 407.4.4.3: Access to Corridor**
 - Now requires that...
 - Every **care suite** have a door leading to an exit access corridor or a horizontal exit, and...
 - Movement from **habitable rooms** within the care suite will not require more than 100-feet of travel with the suite to a door leading to the exit access corridor or a horizontal exit, and...
 - Where a care suite requires **more than one exit** access door, the additional door shall lead directly to an exit access corridor, exit, or an adjacent suite.

REVISED

68




Group I-2 ADDED

IBC 407.6.1: Activation of Automatic-Closing Doors

- Historically, the code only required these doors to close upon actuation of smoke detectors, or loss of power.
- Door closing must now also occur upon activation of the fire alarm system or automatic sprinkler system.

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HazMat REVISED

IBC 414.2.3: Number (Control Areas)

- Huge Change!**
- For calculating control areas, each portion of a building separated by one or more fire walls shall be considered a separate building.



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Amusement REVISED

IBC 411: Special Amusement Areas

- Special Amusement **Buildings Areas**
- Fire prevention has been revised somewhat. Requires suppression, alarms, and voice/alarm communication system.
- Added provisions for **Puzzle Rooms** (IBC 411.5).
 - Exiting per Chapter 10.
 - An alternative design approved by B.O.
 - Open and available upon activation of fire alarm, sprinkler system, or manual control.

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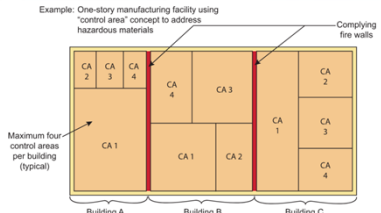


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HazMat REVISED


IBC 414.2.3: Number (Control Areas)

Example: One-story manufacturing facility using "control area" concept to address hazardous materials



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HazMat

- ❑ **IBC Table 414.2.5(1):** REVISED
 - Group M & S control areas for nonflammable solids and nonflammable or noncombustible liquids
 - Added footnote 'k' → applies to solid toxic materials
 - Can now be increased from 1,000 to 10,000 pounds where individual packages are in the original, sealed containers, and...
 - Toxic classification is exclusively based on the LC threshold (not LD).




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Ambulatory Care

- ❑ **IBC 422.7: Domestic Cooking**
 - Domestic cooking appliances are allowed, provided:
 - Limited to ovens, cooktops, ranges, warmers and microwaves
 - Domestic hoods shall be provided over cooktops and ranges and shall comply with IMC 505
 - A shut-off for fuel and electrical power shall be provided in a location where only staff has access.
 - A timer which automatically deactivates appliances within a period not more than 120 minutes.
 - A portable fire extinguisher within 30-feet of appliance(s).

ADDED



75

Live/Work

- ❑ **IBC 419: Live/Work Units**
 - Criteria moved to IBC 508.
 - IBC 419 is now **“Artificial Decorative Vegetation”**
 - Applies if...
 - It is > 6-feet, and...
 - Located outdoors and is within 5-feet of building, or...
 - Is located on the roof of a building.
 - Requires compliance with IFC 321.1.


REMOVED / ADDED





74

Storm Shelters

- ❑ **IBC 423: Storm Shelters**
 - Clarifies that the design must conform to ICC 500, even if it is being provided voluntarily.
 - Adds a new **“Occupancy Classification”** section which is divided between **“dedicated”** storm shelters and those located within **“host buildings”**.



REVISED

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Play Structures

IBC 424: Children's Play Structures

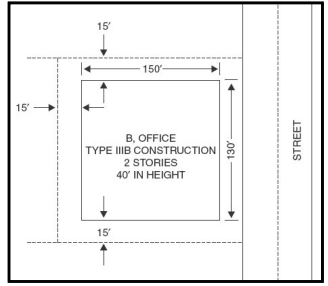
- Added Condition 10:
 - Applies to structures > 600ft², or > 10-feet in height
 - Interior finishes shall have a flame spread index ≤ value in Table 803.13 for occupancy served.



ADDED

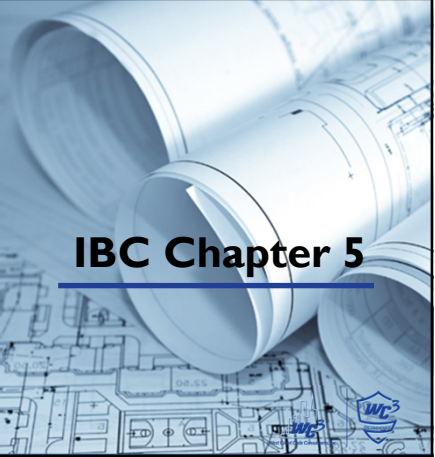


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International Code Council, IBC Code and Commentary, Figure 503.1 ©

IBC Chapter 5



Play Structures

IBC 424: Children's Play Structures

- Area Limits: Changed from 300 ft² to a maximum of 600 ft², unless a special investigation is provided.
- If > 600ft², or > 10-feet in height...
- Designed in accordance with Chapter 16

REVISED / ADDED



Occupied Roofs

IBC 503.1.4: Occupied Roofs

- Previously noted that it does not affect the building area, but now clarifies...
- Does not affect **building height** or **# of stories**
- If the building requires an **emergency voice/alarm communication** system, it must also be provided at the roof.

REVISED



Table Updates REVISED

**TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE^a**

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION												
		Type I		Type II		Type III			Type IV			Type V		
		A	B	A	B	A	B	C	HT	A	B	A	B	
A, B, E, F, M, S, U	NS ^b	UL	160	65	55	65	55	65	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60	
H-1, H-2, H-3, H-5	NS ^b	UL	160	65	55	65	55	120	90	65	65	50	40	
	S	UL	180	85	75	85	75	140	100	85	85	70	60	
H-4	NS ^b	UL	160	65	55	65	55	65	65	65	65	50	40	
	S	UL	180	85	75	85	75	140	100	85	85	70	60	
I-1 Condition 1, I-3	NS ^b	UL	160	65	55	65	55	65	65	65	65	50	40	
	S	UL	180	85	75	85	75	180	120	85	85	70	60	
I-1 Condition 2, I-2	NS ^{c,1}	UL	160	65		65	55	65	65	65	65	50	40	
	S	UL	180	85		85	75	180	120	85	85	70	60	
I-4	NS ^b	UL	160	65	55	65	55	65	65	65	65	50	40	
	S	UL	180	85	75	85	75	180	120	85	85	70	60	
R ¹	NS ^b	UL	160	65	55	65	55	65	65	65	65	50	40	
	S13D	60	60	60	60	60	60	60	60	60	60	50	40	
	S13R	60	60	60	60	60	60	60	60	60	60	50	40	
	S	UL	180	85	75	85	75	270	180	85	85	70	60	

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Table Updates REVISED

**TABLE 506.2
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET^a**

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV			Type V		
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	SM	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	UL	37,500	21,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000

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Table Updates REVISED

**TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE^a**

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III			Type IV			Type V	
		A	B	A	B	A	B	C	HT	A	B	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2

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Single-Occupancy

REVISED

- IBC 506.2.1: Single-Occupancy Buildings
 - Combines previous Sections 506.2.1 & 506.2.3
 - One-Story:** $A_o = A_t + (NS \times I_p)$
 - Multistory:** $A_o = [A_t + (NS \times I_p)] \times S_o$
 - It now clarifies that $S_a = \dots$
 - 3, unless sprinklered
 - 4, if NFPA 13R sprinklers

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Mixed-Occupancy

- IBC 506.2.2: *Mixed-Occupancy Buildings*
 - Combines previous Sections 506.2.2 & 506.2.4
 - Just as single-occupancy buildings, maximum allowable area cannot exceed...
 - 3, unless sprinklered
 - 4, if NFPA 13R sprinklers

REVISED



Frontage Increase

- IBC 506.3.3.1: *Section 507 Buildings* **REVISED**
 - Previously an exception that allowed a W = 60-feet
 - Now, if the 60-foot requirement cannot be met, but otherwise it complies with the unlimited area requirements...
 - Use Table 506.3.3.1

PERCENTAGE OF BUILDING PERIMETER	OPEN SPACE (feet)					
	30 to less than 35	35 to less than 40	40 to less than 45	45 to less than 50	50 to less than 55	55 to less than 60
0 to less than 25	0	0	0	0	0	0
25 to less than 50	0.29	0.33	0.38	0.42	0.46	0.50
50 to less than 75	0.58	0.67	0.75	0.83	0.92	1.00
75 to 100	0.88	1.00	1.13	1.25	1.38	1.50

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Frontage Increase

- IBC 506.3.2: *Minimum Frontage Distance* **REVISED**
 - The average "W" no longer needs to be determined.
 - All sides that have ≥ 20-foot open space considered
- IBC 506.3.3: *Amount of Increase*
 - The calculation is removed → see Table 506.3.3.

REVISED

PERCENTAGE OF BUILDING PERIMETER	OPEN SPACE (feet)			
	0 to less than 20	20 to less than 25	25 to less than 30	30 or greater
0 to less than 25	0	0	0	0
25 to less than 50	0	0.17	0.21	0.25
50 to less than 75	0	0.33	0.42	0.50
75 to 100	0	0.50	0.63	0.75

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Separated Occupancies

- IBC 508.4.1: *Separated Occupancies*
 - Filled in IBC Table 508.4 as dashed lines caused some to interpret there was no requirement.

OCCUPANCY	A,E	F1,F3,F4	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15
A,E	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
F1,F3,F4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H10	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H11	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H15	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

International Code Council, 2018 IBC ©

REVISED



Separated Occupancies

- IBC 508.4.4.1: **Construction**
 - If Type IV-B or IV-C, and...
 - Mass timber elements serve as fire barriers or horizontal assemblies for required separation...
 - Shall be separated by 1/2-inch gypsum board or other material tested per NFPA 275

ADDED





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Incidental Uses

- Table 509: **Incidental Uses**
 - Removed “**Storage Battery Systems**” as comprehensive requirements are provided in IFC 1207.

REVISED





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Incidental Uses

- IBC 509.4.1.1: **Type IV-B and IV-C Construction**
 - Same requirements, if mass timber serves as separation of incidental uses...
 - Shall be separated by 1/2-inch gypsum board or other material tested per NFPA 275

ADDED

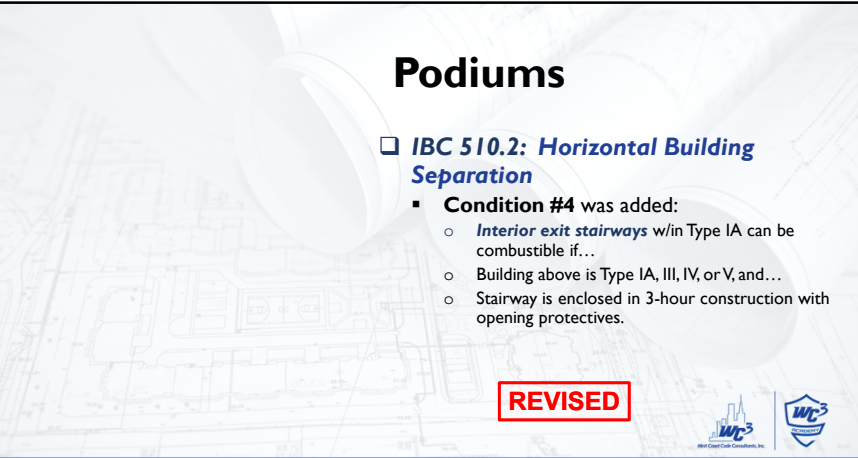

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Podiums

- IBC 510.2: **Horizontal Building Separation**
 - Condition #4** was added:
 - Interior exit stairways w/in Type IA can be combustible if...
 - Building above is Type IA, III, IV, or V, and...
 - Stairway is enclosed in 3-hour construction with opening protectives.

REVISED

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Podiums

- ❑ **IBC 510.5: Group R-1 and R-2 Buildings of Type III-A Construction**
 - Previously allowed 6-stories and 75-feet in height
 - Now adds 10-feet to Table 504.3. & one-story to Table 504.4
 - Could be as much as 95-feet with NFPA 13
 - Still limited to 6-stories with NFPA 13

REVISED

Table 601 REVISED

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame ^a (see Section 202)	3 ^{h,3}	2 ^{h,3}	1 ^{h,3}	0 ^c	1 ^{h,3}	0	3 ^e	2 ^e	2 ^e	HT	1 ^{h,3}	0
Bearing walls												
Exterior ^f	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3 ^e	2 ^e	1	0	1	0	3	2	2	1/HT ^g	1	0
Nonbearing walls and partitions	See Table 705.5											
Exterior												
Nonbearing walls and partitions												
Interior ^d	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	1 1/2 ^h	1 ^h	1 ^h	0 ^c	1 ^h	0	1 1/2 ^e	1	1	HT	1 ^h	0

For SI: 1 foot = 304.8 mm.
 a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
 b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
 c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members where a 1-hour or less fire-resistance rating is required.
 d. Not less than the fire-resistance rating required by other sections of this code.
 e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).
 f. Not less than the fire-resistance rating as referenced in Section 704.10.
 g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a fire resistance rating of not less than 1 hour.

REVISED

IBC Chapter 6

Combustible
↓
Non-Combustible

Type V Combustible Construction
Type IV Heavy Timber Construction
Type III Non-Combustible Exterior
Type II Non-Combustible Exterior and Components
Type I Non-Combustible Materials and Structure

Type IV Construction

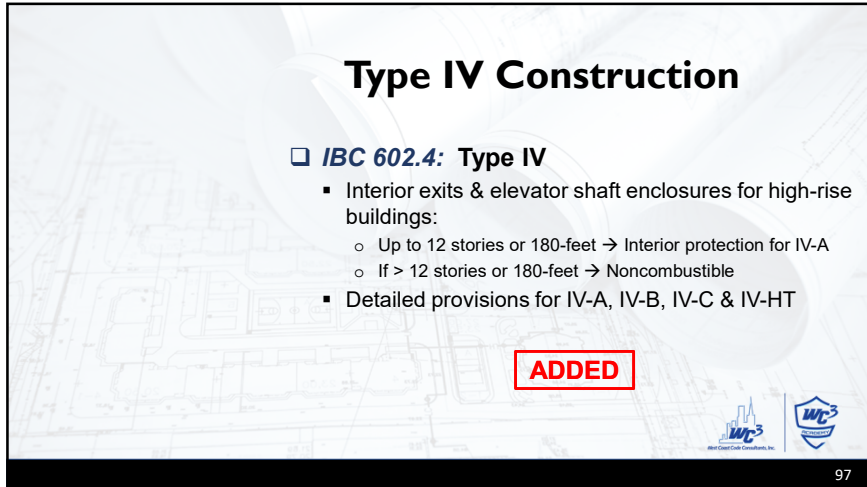

- ❑ **IBC 602.4: Type IV**
 - Building elements are mass timber
 - Fire-resistance ratings per Table 601
 - Types IV-A, IV-B or IV-C have noncombustible protection applied directly to mass timber
 - CLT → labeled per ANSI/APA PRG 320
 - Concealed spaces are not permitted

ADDED / REVISED

Type IV Construction

- **IBC 602.4: Type IV**
 - Interior exits & elevator shaft enclosures for high-rise buildings:
 - Up to 12 stories or 180-feet → Interior protection for IV-A
 - If > 12 stories or 180-feet → Noncombustible
 - Detailed provisions for IV-A, IV-B, IV-C & IV-HT

ADDED

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IBC Chapter 7

Fire & Smoke Protection Features

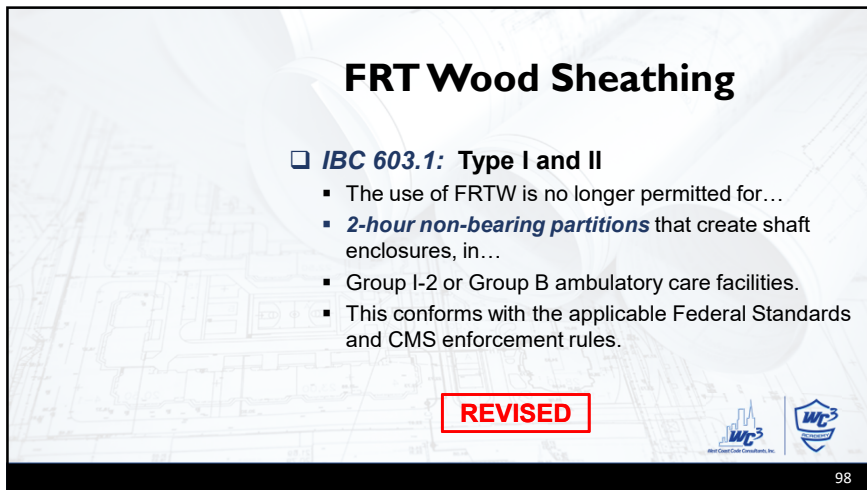




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FRT Wood Sheathing

- **IBC 603.1: Type I and II**
 - The use of FRTW is no longer permitted for...
 - **2-hour non-bearing partitions** that create shaft enclosures, in...
 - Group I-2 or Group B ambulatory care facilities.
 - This conforms with the applicable Federal Standards and CMS enforcement rules.

REVISED


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Fire Resistance

- **IBC 703.2: Fire Resistance**
 - This section has been re-organized, but the options are the same.
 1. Tested assemblies (703.2.1)
 2. Analytical methods (703.2.2)
 3. Approved alternate method (703.2.3)

REVISED



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Fire Resistance

- ❑ **IBC 703.6: Determination of Noncombustible Protection Time Contribution**
 - Testing provisions for mass timber protection
 - ASTM E119 or UL 263
 - Identical in construction, loading & materials
 - Two separate assemblies must be tested

ADDED



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Fireproofing

- ❑ **IBC 704.6.1: Secondary Attachments to Structural Members**
 - If primary or secondary steel is required to be protected, **secondary steel attachments** must also be protected for **12-inches beyond** the structural member.



ADDED



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Fire Resistance


- ❑ **IBC 703.7: Sealing of Adjacent Mass Timber Elements**
 - Required in IV-A, IV-B or IV-C
 - Adhesive that resists the passage of air
 - Identical in construction, loading & materials
 - At abutting panel edges and intersections
 - ASTM C920 or ASTM D3498

ADDED



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Projections

- ❑ **Table 705.2: Minimum Distance of Projection**

FIRE SEPARATION DISTANCE (FSD) (feet)	MINIMUM DISTANCE FROM LINE USED TO DETERMINE FSD
0 to less than 2	Projections not permitted
2 to less than 3	24 inches
3 to less than 5	Two-thirds of FSD
5 or greater	40 inches


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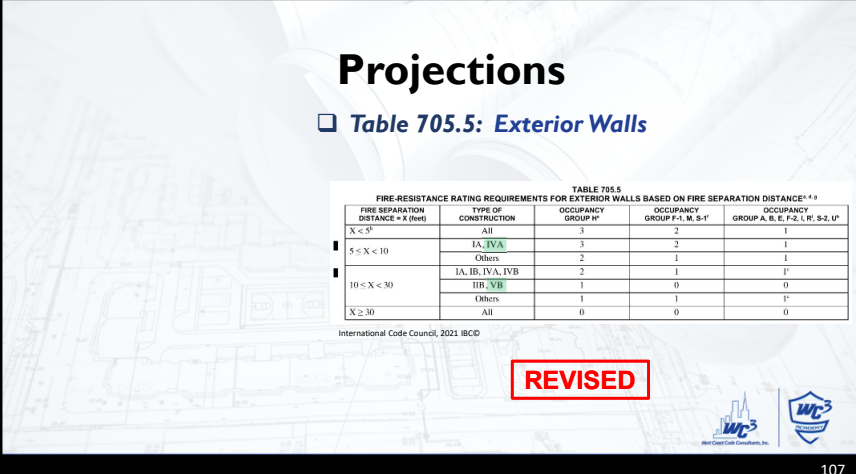
Projections

- **Table 705.2: Minimum Distance of Projection**
 - Previously stated “24 inches plus 8 inches for every foot of FSD beyond 3 feet or fraction thereof.”
 - Example: Assume the FSD is 4-feet
 - Previously → 48”-24”-8” = 16” projection
 - Now → 48” x 0.333 = 16” projection



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Projections

- **Table 705.5: Exterior Walls**

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP I ^c	OCCUPANCY GROUP F-1, M, S-1 ^d	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U ^e
X < 5 ^f	All	3	2	1
5 ≤ X < 10	IA, IVA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB, IVA, IVB	2	1	1 ^g
	IB, VR	1	0	0
X ≥ 30	Others	1	1	1 ^g
	All	0	0	0

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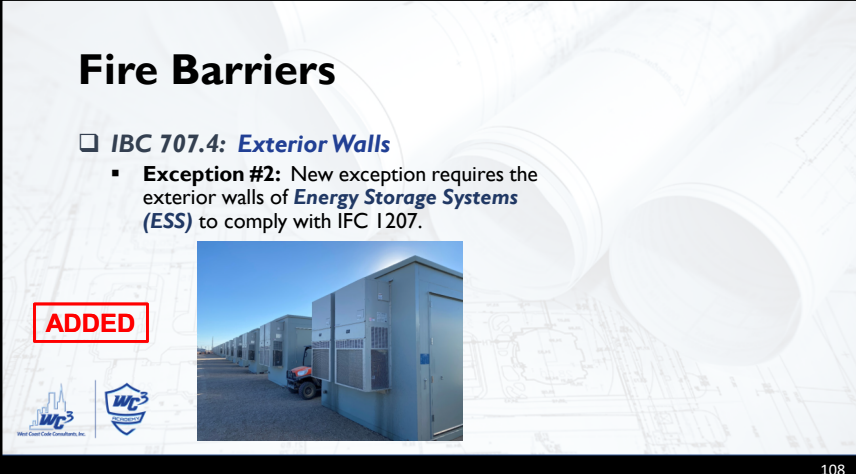
Projections

- **IBC 705.2.3: Projection Protection**
 - Provides a list of approved protection
 - Previously this was included within the body of the text, but now new items are included in list.
 - If w/in 5-feet of lot line...
 - Noncombustible materials, or...
 - 1-Hour construction, or...
 - Type IV-HT construction, or...
 - Fire-retardant-treated wood, or...
 - Per IBC 705.2.3.1




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Fire Barriers

- **IBC 707.4: Exterior Walls**
 - **Exception #2:** New exception requires the exterior walls of **Energy Storage Systems (ESS)** to comply with IFC 1207.



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Fire Barriers

ADDED

- ❑ **IBC 707.5: Enclosure of Exit Passageways**
 - **Exception #3:** Now does not need to terminate at the underside of the roof slab so long as a rated lid is provided.

Labels in diagram: Floor or roof above, Enclosure at top with enclosure of same fire-resistance rating of exit passageway, Exit Passageway.

Walls do not extend to underside of overhead slab or deck above.

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Smoke Barriers

REVISED

- ❑ **IBC 709.4.1: Smoke Barrier Walls Assemblies Separating Smoke Compartments**
 - Clarified that continuity does not need to be to an exterior wall or roof, but...
 - Can be to another smoke barrier.

Labels in diagram: Exterior walls, Smoke barrier, Horizontal assembly smoke barrier, Roof, Exterior wall, Smoke barrier.

PLAN SECTION

International Code Council, 2021 IBC Significant Changes ©

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Fire Partitions

REVISED

- ❑ **IBC 708.1: General**
 - Provides areas that must comply with fire partition provisions.
 - Added three new locations...
 6. Walls separating ambulatory care facilities
 7. Walls separating Group R-1 or R-2 dwelling or sleeping units
 8. Vestibules in accordance with IBC 1028.2

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Smoke Partitions

ADDED

- ❑ **IBC 710.5.3: Pass-Through Openings in Group I-2, Condition 2**
 - Pass-through openings shall...
 1. Not have patient care suites or sleeping rooms within the smoke compartment
 2. Cannot occur if a fire-resistance rating is required
 3. Located max. of 48-inches above floor
 4. Aggregate area ≤ 80 in²

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Shaft Enclosure

- ❑ IBC 713.12: **Enclosure at Top**
 - Re-organized this section...
 1. Shall extend to underside of the roof sheathing, deck or slab
 2. If it terminates below the roof → enclosed at top by rated construction equal to floor penetrated but not less than shaft enclosure rating.
 3. If it extends past the roof → IBC 1511

REVISED



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Opening Protectives

- ❑ Table 716.1(2): **Opening Fire Protection Assemblies**
 - Added doors in Double Fire Walls

TABLE 716.1(2) OPENING FIRE PROTECTION ASSEMBLIES, RATINGS AND MARKINGS

TYPE OF ASSEMBLY	REQUIRED WALL ASSEMBLY RATING (hours)	MINIMUM FIRE DOOR AND FIRE SHUTTER ASSEMBLY RATING (hours)	DOOR VISION PANEL REE ¹	FIRE-RATED GLAZING TRANSOM ASSEMBLY RATING (hours) ²	MINIMUM SMOKE/ DRAFT ASSEMBLY RATING (hours)		FIRE-RATED GLAZING MARKING SIDE-LIGHT/TRANSOM PANEL		
					Fire protection	Fire resistance	Fire protection	Fire resistance	
Double fire walls constructed in accordance with NFPA 221	4	3	3	See Note a	D-H-W-180	Not Permitted	3	Not Permitted	W-180
	3	2	1 1/2	100 sq. in. ≤ D-H-W-90 >100 sq. in. ≤ D-H-W-90	Not Permitted	2	Not Permitted	W-120	
	2	1	1	100 sq. in. ≤ D-H-W-60 >100 sq. in. ≤ D-H-W-60	Not Permitted	1	Not Permitted	W-60	
	2	1	1	100 sq. in.	Not Permitted	1	Not Permitted	W-60	

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Joints & Voids

- ❑ IBC 715: **Fire-Resistant Joint Systems Joints and Voids**
 - Several clarifications
 - Not just joints → Voids
 - Cannot be dislodged or loosened
 - Must also be installed per listing
 - Sealed/Protected



REVISED



Owens Corning®, Perimeter Fire Containment and Engineering Judgements

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Terminated Stops

- ❑ IBC 716.2.2.1.1: **Smoke and Draft Control**
 - Now prohibits use of Terminated Stops
 - Cannot be in door frames for doors providing **smoke or draft control** protection at **elevator lobbies**.




REVISED



ld@hardware.com, "Hospital Stops", by Lori Greene, February 3, 2011


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Curtains

- ❑ **IBC 716.4: Fire-protective Curtain Assemblies**
 - Added definition in IBC 202
 - Provides labeling, testing, and installation requirements



ADDED




Smoke Guard®, <https://smokeguard.com/>

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Dampers

- ❑ **IBC 717.4: Access to Dampers**
 - Dampers with fusible links, internal operators, or both require a minimum access door or removable duct section of **12in²**.
 - If restricted access – must be single- or multi-blade type damper – and **remote inspections** per NFPA 80 or NFPA 105 can be provided.

REVISED




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Dampers

- ❑ **IBC 717.2.3 & 717.6.2.1: Static Dampers**
 - Fire or ceiling radiation dampers installed in static systems...
 - Can only be installed in heating, ventilation and air-conditioning systems that are **automatically shut down** in the event of a fire.
 - **UL 555C** now has provisions to test dampers under dynamic or static conditions.

ADDED




118

Calculated Resistance

- ❑ **IBC 722.1: General**
 - Now refers to PCI 124 for fire-resistance of precast or prestressed assemblies
- ❑ **IBC 722.2.2.1.4: Hollow-Core Slabs**
 - Flat plate concrete slabs with uniformly spaced hollow voids
 - Use Table 722.2.2.1, and calculate an equivalent thickness

REVISED




120

Calculated Resistance

- ❑ **IBC 722.7: Mass Timber**
 - Added provisions for calculating mass timber fire resistance
 - Resistance of unprotected element + ...
 - Resistance of noncombustible protection
 - Divided by requirements for interior and exterior surfaces



ADDED



121

IBC Chapter 8

Interior Finishes

123


Calculated Resistance

REQUIRED FIRE-RESISTANCE RATING OF BUILDING ELEMENT PER TABLE 601 AND TABLE 705.5 (hours)	MINIMUM PROTECTION REQUIRED FROM NONCOMBUSTIBLE PROTECTION (minutes)
1	40
2	80
3 or more	120

NONCOMBUSTIBLE PROTECTION	PROTECTION CONTRIBUTION (minutes)
1/2-inch Type X gypsum board	25
3/4-inch Type X gypsum board	40

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Lockers

- ❑ **IBC 806.9: Combustible Lockers**
 - If lockers are of combustible materials, they shall be considered interior finish materials (**IBC 803**).
 - Exception allows combustible lockers whenever interior finish materials are only required to meet **Class C**.

ADDED



124

IBC Chapter 9
Fire Protection & Life Safety Systems

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Distilled Spirits **REVISED**

- IBC 903.2.4.3: **Group F-I Upholstered Furniture or Mattresses**
 - Fire sprinklers are required if > 2,500ft²
- IBC 903.2.7.2: **Group M Upholstered Furniture or Mattresses**
 - Fire sprinklers are required if > 5,000ft²
- IBC 903.2.9.4: **Group S-I Upholstered Furniture or Mattresses**
 - Fire sprinklers are required if > 2,500ft²

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Distilled Spirits

- IBC 903.2.4.2: **Group F-I Distilled Spirits**
 - Fire sprinklers are required throughout fire areas where distilled spirits are manufactured.
- IBC 903.2.9.3: **Group S-I Distilled Spirits**
 - Fire sprinklers are required throughout distilled spirit or wine bulk storage areas.

ADDED

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Parking Garages

- IBC 903.2.10: **Group S-2 Parking Garages**
 - Fire sprinklers are now required in **open parking garages** that exceed 48,000ft² or if the building exceeds 55-feet.
- IBC 903.2.11.3: **Buildings ≥ 55-feet**
 - Removed Exception #1 – Open parking garages

REVISED

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Parking Garages

- **IBC 903.2.10.2: Mechanical-access Enclosed Parking Garages**
 - Added definition and requirements in IBC 406.6.4.
 - Fire sprinklers required throughout, and specially engineered systems in mechanical-access areas.

ADDED








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NFPA 13R

- **IBC 903.3.1.2.2: Corridors and Balconies in the Means of Egress**
 - Sprinklers now required in any of the following situations even if not required by the NFPA 13R standard:
 - Corridors with combustable walls or floors, or...
 - Corridors with an interior change of direction > 45°, or...
 - Corridors that are less than 50 percent open to outside, or...
 - Open-ended corridors and ramps as specified in IBC 1027.6, Exception 3.
 - Egress balconies not complying with IBC 1021.2 & 1021.3.

ADDED




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NFPA 13R

- **IBC 903.3.1.2: NFPA 13R Sprinklers**
 - Revised provisions. Now allowed if...
 - No more than 4 stories (*same*), or...
 - Highest floor level is ≤ 30-feet above the lowest fire department vehicle access, or...
 - Lowest floor level is ≤ 30-feet below the lowest fire department vehicle access.
 - In addition, for podiums, this height is now measured from grade plane (previously it was the podium).

REVISED


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Extinguishers

- **IBC 906.1: Where Required**
 - Added a new exception for Group S occupancies...
 - If primary occupants are on powered industrial trucks or powered carts, and...
 - Extinguishers are located on the industrial trucks or powered carts.
 - Proper training & inspections required.


ADDED





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Extinguishers

- ❑ **IBC 906.1: Where Required**
 - While not previously required, an exception is now provided for Group U occupancies.
 - Must be normally unoccupied, and...
 - An extinguisher must be provided on the vehicle of visiting personnel.

ADDED



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Initiating Devices

- ❑ **IBC 907.4: Initiating Devices**
 - Clarified that initiating devices shall be one or more of the following:
 - Manual fire alarm boxes
 - Automatic fire detectors
 - Automatic sprinkler waterflow devices
 - Automatic fire-extinguishing systems.
 - This information was previously included under Occupant Notification (IBC 907.5)

REVISED

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Manual Alarms

- ❑ **IBC 907.2.10: Group S**
 - Manual Alarms in Group S are now required in **self-storage facilities** that are **three stories or more** and have interior corridors.



ADDED




Trachte Building Systems,
<https://www.trachte.com/>



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Occupant Notification

REVISED

- ❑ **IBC 907.5: Occupant Notification**
 - Clarifies that occupant notification by fire alarms shall comply with IBC 907.5.1 through 907.5.2.3.3.
 - Notification by smoke alarms in Groups R-1 & R-2 shall comply with IBC 907.5.2.1.3.2.
- ❑ **IBC 907.5.2.1.2: Maximum Sound Pressure**
 - Shall be not exceed 110dBA
 - If average ambient noise is greater than 95 dBA visible required

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Occupant Notification

- ❑ **IBC 907.5.2.1.3.1: Fire Alarm System Signal**
 - Audible alarm in sleeping rooms of Groups R-1 and R-2 shall be 520-Hz low frequency
- ❑ **IBC 907.5.2.1.3.2: Smoke Alarm Signal in Sleeping Rooms**
 - Sleeping rooms of Groups R-1 & R-2 shall be 520Hz.
 - If smoke alarm is incapable a listed notification appliance is required.




ADDED

137

137

Smokeproof

- ❑ **IBC 909.20.6: Pressurized Stair and Vestibule Alternative**
 - Specifies:
 - Vestibule door requirements
 - Pressurization requirements for both stair & vestibule
 - Pressure difference between the stair and vestibule
 - Controlled relief vent requirements




ADDED



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139

Smokeproof

- ❑ **IBC 909.20: Smokeproof Enclosures**
 - Previously only considered the following as smokeproof enclosures...
 - Interior exit stairway/ramp that is enclosed per IBC 1023, or...
 - Open exterior balcony meeting this section, or...
 - Ventilated vestibule meeting this section.
 - Now **pressurized stairs and pressurized entrance** has been added.




REVISED

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Command Center

- ❑ **IBC 911: Fire Command Center**
 - Previously only required for high-rise buildings.
 - Now required in F-I and S-I occupancies exceeding 500,000ft².



ADDED



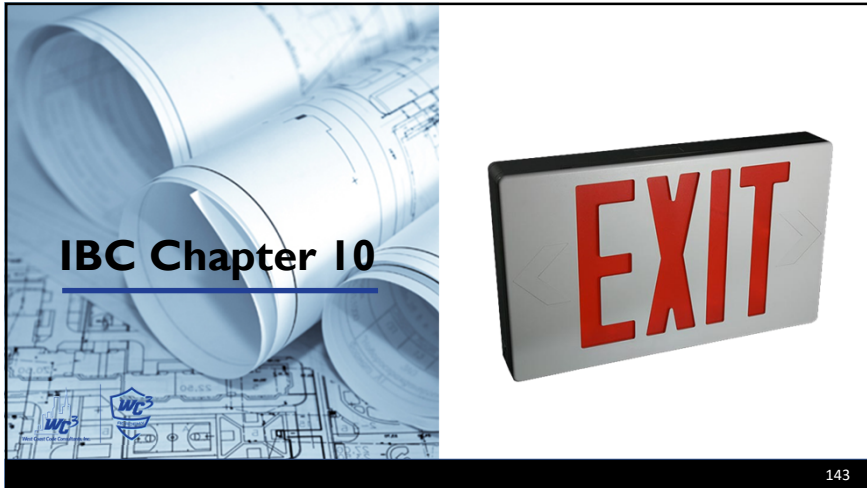


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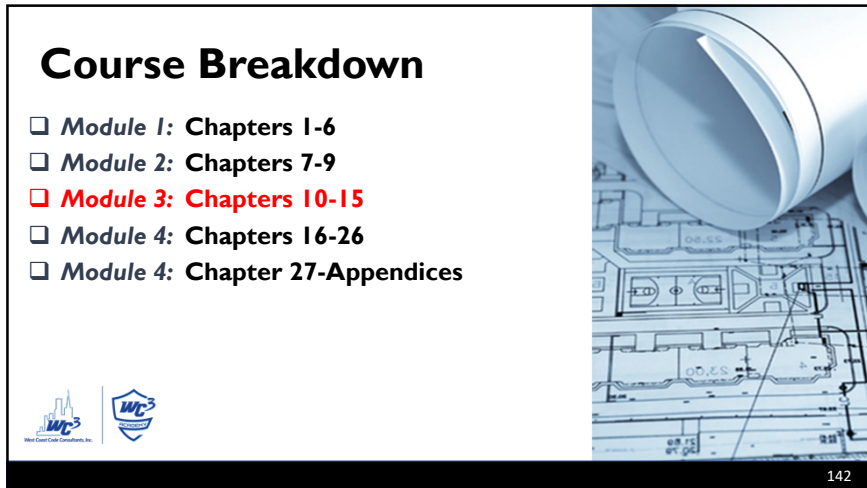
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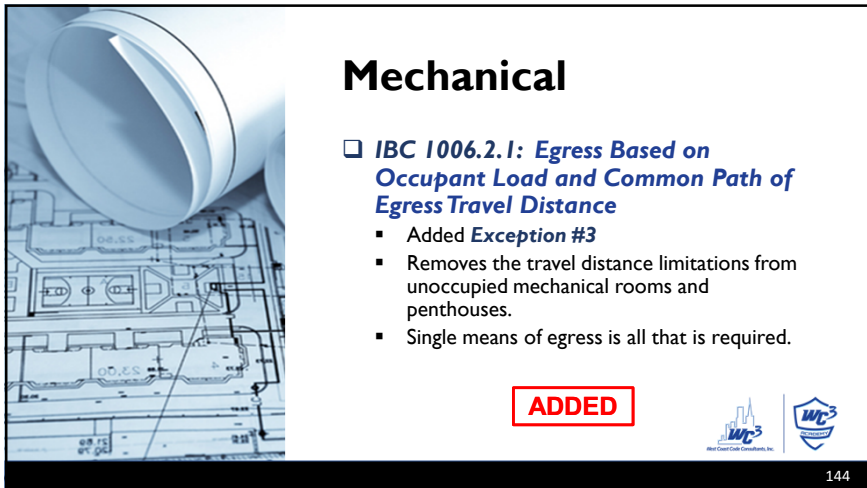
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142






144

Electrical Room

- **IBC 1006.2.2.4: Electrical Rooms**
 - # and location of exit doors must comply with...
 - ≤1,000 volts → NEC 110.26
 - >1,000 volts → NEC 110.33
 - **Panic hardware** per IBC 1010.2.9.2










145



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Stairway Illumination

- **IBC 1008.2.1: Illumination Level Under Normal Power**
 - Increased from 1-foot candle to 10-foot candles at exit access stairways, exit stairways, and their landings.
 - This only applies “...when the stairway is in use”.
 - Other means of egress components still only require 1-foot candle.











147

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Egress from Stories

- **IBC 1006.3.2: Path of Egress Travel**
 - Default → Shall not pass through more than one adjacent story
 - Added two new exceptions...
 - #3 – Exit access stairways and ramps within an atrium.
 - #7 – Exterior exit access stairways and ramps between occupied roofs.




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Occupied Roofs

- **IBC 1009.2.1: Elevators Required**
 - Revised this section to note that **occupied roofs** also require an elevator if...
 - Located **four or more stories above** the level of exit discharge.








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Areas of Refuge

- ❑ **IBC 1009.6.2: Stairway or Elevator Access**
 - This section requires each *area of refuge* to have direct access to a stairway.
 - An exception has been added for *interior areas of refuge* that are located at the *level of exit discharge*...
 - In this case the area of refuge must have direct access to an *exterior exit door*.
 - As usual, it still must have proper separation, two-way communication, signage, etc.





REVISED

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Door, Gates & Turnstiles

- ❑ **IBC 1010.1: General**
 - Reworded this section to clarify...
 - Doors → IBC 1010.1.1 – 1010.3.4
 - Exterior Doors → Also IBC 1022.2
 - Gates → IBC 1010.4 & 1010.4.1
 - Turnstiles → IBC 1010.5 – 1010.5.4





REVISED

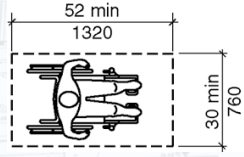
151

151

Areas of Refuge

- ❑ **IBC 1009.6.3 & IBC 3008.6.4: Size**
 - Required wheelchair spaces previously required a space = 30" x 48"
 - The required space is now = **30" x 52"**
 - This was done to match the **2017 ICC A117.1**.



REVISED





150

150


Door Widths

- ❑ **IBC 1010.1.1: Size of Doors**
 - Removed the maximum width provision for swinging doors (was 48").
 - Doors serving nonaccessible single-user showers or saunas, toilet stalls, dressing/fitting/changing rooms can now have a minimum clear opening width of **20-inches**.



REVISED


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Projections

- **IBC 1010.1.1.1: Projections into Clear Opening**
 - Added overhead door stops, power door operators, and electromagnetic door locks to exception.
 - Per exception, still limited to **78"** above the floor.



REVISED



Revolar.com, "The Best Electromagnetic Door Locks for Access Control Doors", July 27, 2021, by John Peters.


153

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Opening Force

- **IBC 1010.1.3: Forces to Unlatch & Open**
 - The force to **open** doors :
 - Interior swinging egress doors (non-fire-rated) = **5 pounds**
 - Other doors:
 - Set in motion = **30 pounds**
 - Move to full-open position = **15 pounds**

REVISED




155

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Opening Force

- **IBC 1010.1.3: Forces to Unlatch & Open**
 - Divided into separate sections to match **2017 ICCA 17.1:**
 - Forces to **unlatch**:
 - Push-Pull = **15 pounds**
 - Rotational operational force = **28 inch-pounds**



Operational force for door hardware.

REVISED




154

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Opening Force

- **IBC 1010.2.4: Locks and Latches**
 - **Locked doors** are now allowed in the egress system under the following conditions (Previously 6 exceptions now 10):
 - **Group I-2** where persons receiving care require containment or pose a security threat.
 - Egress from an **exterior space** through the building.
 - Balconies, decks or other exterior spaces serving **individual dwelling or sleeping units**.
 - Balconies, decks or other exterior spaces ≤ 250ft² serving a **private office**.

ADDED



156

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Panic/Fire Hardware

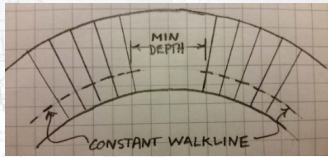
- ❑ **IBC 1010.2.9: Panic & Fire Exit Hardware**
 - Added 2 new exceptions...
 - #3 – Exit access doors serving occupied exterior areas are permitted to be locked in accordance with IBC 1010.2.4, Item #8.
 - Courtrooms shall be permitted to be locked per IBC 1010.2.13, Item #3.

REVISED

157

Stairway Landings

- ❑ **IBC 1011.6: Stairway Landings**
 - Added 2 new exceptions...
 - #2 – Intermediate landings at curved stairways of constant radius.



REVISED

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Panic/Fire Hardware

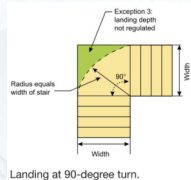
- ❑ **IBC 1010.2.9: Panic & Fire Exit Hardware**
 - Added 2 new exceptions...
 - #3 – Exit access doors serving occupied exterior areas are permitted to be locked in accordance with IBC 1010.2.4, Item #8.
 - #4 – Courtrooms shall be permitted to be locked per IBC 1010.2.13, Item #3.

REVISED

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Stairway Landings

- ❑ **IBC 1011.6: Stairway Landings**
 - #3 – If landing turns 90-degrees or more, ...
 - The maximum landing dimension shall be equal to an arc having a radius of the width of the flight served.



Exception 3: landing depth not regulated

Radius equals width of stair

Landing at 90-degree turn.

International Code Council, 2021 IBC Significant Changes ©

REVISED

160

Guards

- IBC 1015.2: Where Required
 - Added Exception #8
 - On the loading side of station platforms on fixed guideway transit or passenger rail systems.



REVISED



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Atriums

- IBC 1017.3.2: Atriums
 - Clarifies that the exit access travel distance to areas open to an atrium shall comply with the following:
 - If not through the atrium → IBC 1017.2
 - If at the level of exit discharge → IBC 1017.2
 - At other than level of exit discharge → ≤ 200-feet

ADDED

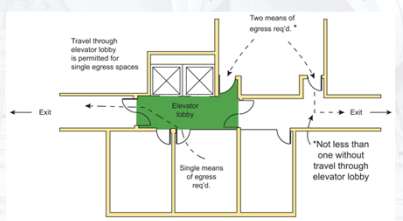


163

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Intervening Spaces

- IBC 1016.2: Egress Through Intervening Spaces
 - Egress through an elevator lobby is now allowed in certain instances if only one means of egress.



REVISED



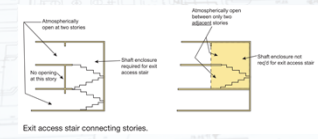
162

162

Exit Access

- IBC 1019.3: Occupancies Other Than Groups I-2 and I-3
 - Enclosure of exit access stairways or ramps is now the default. The “conditions” are now exceptions.
 - Exception #1 now lists “...two adjacent stories”.

REVISED



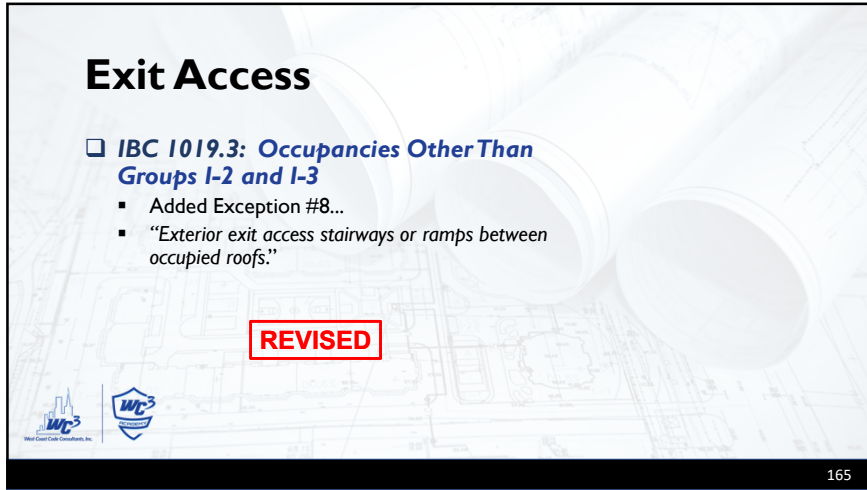
164

164

Exit Access

- IBC 1019.3: Occupancies Other Than Groups I-2 and I-3
 - Added Exception #8...
 - “Exterior exit access stairways or ramps between occupied roofs.”

REVISED



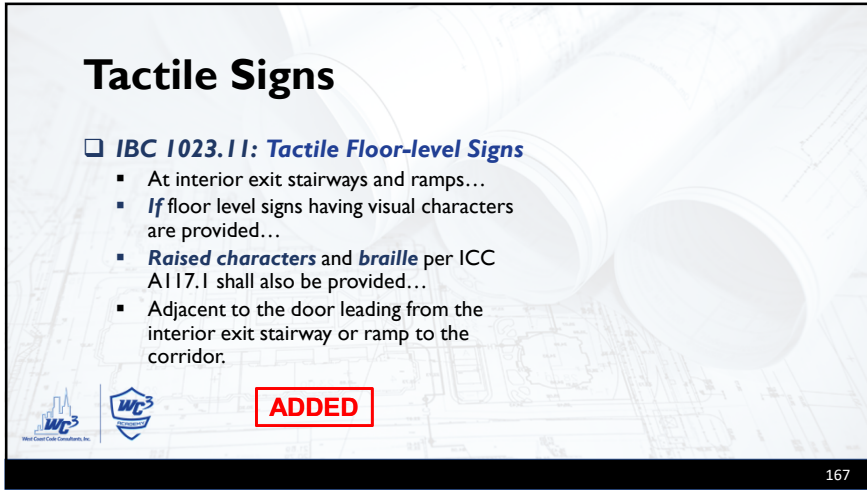
165

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Tactile Signs

- IBC 1023.11: Tactile Floor-level Signs
 - At interior exit stairways and ramps...
 - If floor level signs having visual characters are provided...
 - Raised characters and braille per ICC A117.1 shall also be provided...
 - Adjacent to the door leading from the interior exit stairway or ramp to the corridor.

ADDED



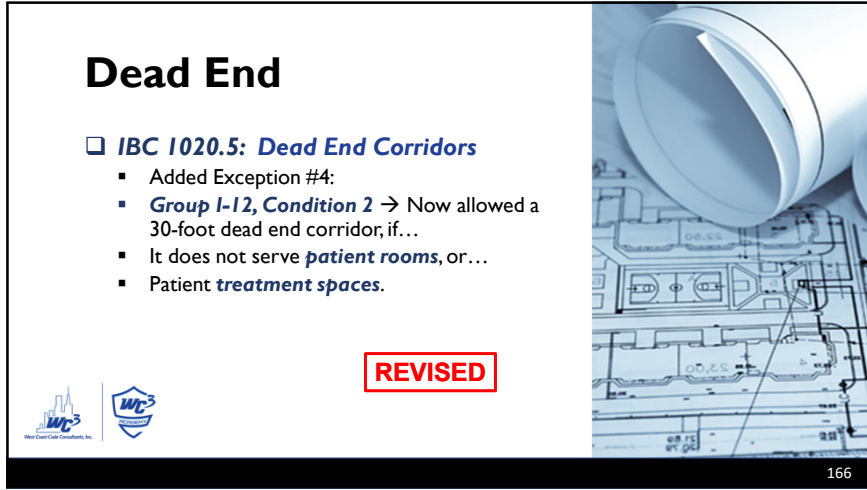
167

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Dead End

- IBC 1020.5: Dead End Corridors
 - Added Exception #4:
 - Group I-12, Condition 2 → Now allowed a 30-foot dead end corridor, if...
 - It does not serve patient rooms, or...
 - Patient treatment spaces.

REVISED



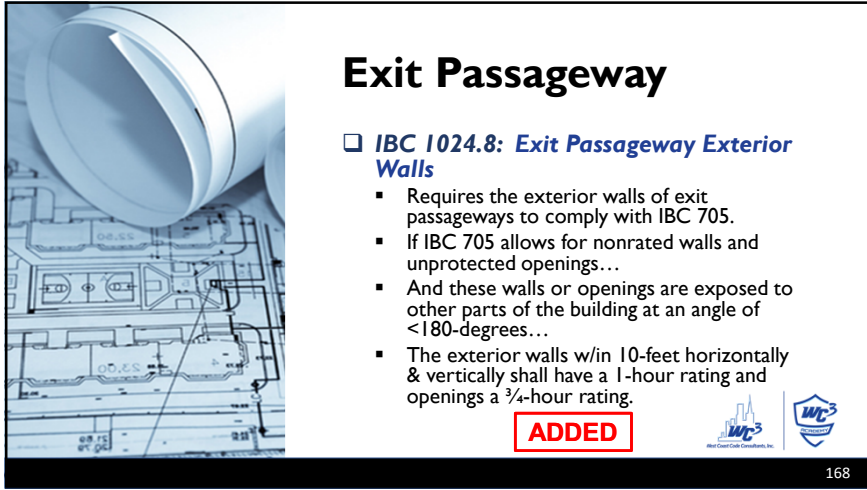
166

166

Exit Passageway

- IBC 1024.8: Exit Passageway Exterior Walls
 - Requires the exterior walls of exit passageways to comply with IBC 705.
 - If IBC 705 allows for nonrated walls and unprotected openings...
 - And these walls or openings are exposed to other parts of the building at an angle of <180-degrees...
 - The exterior walls w/in 10-feet horizontally & vertically shall have a 1-hour rating and openings a 3/4-hour rating.

ADDED

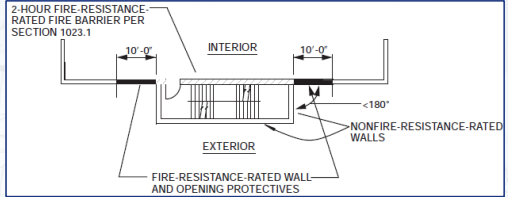


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Exit Passageway

- IBC 1024.8: Exit Passageway Exterior Walls
 - Similar to IBC 1023.7 related to stairways.



ADDED



Assembly

- Table 1030.13.2.1: Smoke-Protected or Open-Air Assembly Aisle Accessways

TOTAL NUMBER OF SEATS IN THE SMOKE-PROTECTED OR OPEN-AIR ASSEMBLY SEATING	SMOKE-PROTECTED OR OPEN-AIR ASSEMBLY AISLE ACCESSWAYS			
	MAXIMUM NUMBER OF SEATS PER ROW PERMITTED TO HAVE A MINIMUM 12-INCH CLEAR WIDTH AISLE ACCESSWAY			
	Aisle or doorway at both ends of row		Aisle or doorway at one end of row only	
	Seats with backrests	Seats without backrests	Seats with backrests	Seats without backrests
Less than 4,000	14	21	7	10
4,000	15	22	7	10
7,000	16	23	8	11
10,000	17	24	8	11
13,000	18	25	9	12
16,000	19	26	9	12
19,000	20	27	10	13
22,000 and greater	21	28	11	14

International Code Council, 2018 IBC

ADDED



Assembly

- IBC 1030.6.3.1: Automatic Sprinklers
 - Added requirement for automatic sprinklers at...
 - Enclosed areas within buildings, or open-air seating.



- Exceptions:
 - Used for entertainment & roof > 50 & low fire hazards
 - Press boxes or storage < 1,000ft²
 - Open-air assembly seating where seating and egress is essentially open

ADDED



Assembly


- Table 1030.13.2.1: Smoke-Protected or Open-Air Assembly Aisle Accessways

NUMBER OF SEATS IN THE SMOKE-PROTECTED OR OPEN-AIR ASSEMBLY SEATING	SMOKE-PROTECTED OR OPEN-AIR ASSEMBLY AISLE ACCESSWAYS			
	MAXIMUM NUMBER OF SEATS PER ROW PERMITTED TO HAVE A MINIMUM 12-INCH CLEAR WIDTH AISLE ACCESSWAY			
	Aisle or doorway at both ends of row		Aisle or doorway at one end of row only	
	Seats with backrests	Seats without backrests	Seats with backrests	Seats without backrests
Less than 4,000	14	21	7	10
4,000 to 6,999	15	22	7	10
7,000 to 9,999	16	23	8	11
10,000 to 12,999	17	24	8	11
13,000 to 15,999	18	25	9	12
16,000 to 18,999	19	26	9	12
19,000 to 21,999	20	27	10	13
22,000 and greater	21	28	11	14

International Code Council, 2021 IBC

ADDED






Social Stairs

- **IBC 1030.16: Handrails**
 - Added the following at the end of section... "Where stepped aisles have seating on one side and the aisle width is **74 inches** or greater, **two handrails** are required. Where two handrails are required, one of the handrails shall be **within 30 inches** horizontally of the stepped aisle."
- **IBC 1030.16.1: Discontinuous Handrails**
 - Added the following language... "Where a stepped aisle is required to have two handrails, the mid-aisle handrails shall be discontinuous."


REVISED



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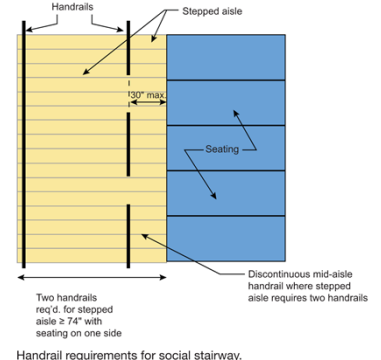
EERO REVISED

- **IBC 1031: Emergency Escape & Rescue**
 - Reorganization to coordinate IBC and IRC provisions
 - **EER Doors** (IBC 1031.4):
 - Emergency escape and rescue doors are now addressed.
 - Allows for either a swinging or sliding door.
 - **Area Well Steps** (IBC 1031.5.2.2):
 - Inside width of $\geq 12"$
 - Treads $> 5"$ in depth
 - Riser height $\leq 18"$




175

Social Stairs



Handrail requirements for social stairway.

International Code Council, 2021 IBC Significant Changes ©



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IBC Chapter 11

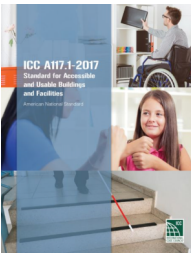



176

A117.1


IBC 1102: Compliance

- The 2017 version of ICC A117.1 is now referenced.
- Includes items that are not scoped or required by the IBC
 - An example is improved communications for persons using sign language.



International Code Council, ICC A117.1-2017®

REVISED



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Pay Stations

IBC 1106.8: Parking Meters & Pay Stations

- If parking meters or pay stations serve accessible parking spaces...
- They shall be accessible.

ADDED



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Public Entrances

IBC 1105.1.1: Automatic Doors

- If occupant load exceeds values in Table 1105.1.1...
- Accessible public entrances shall have at least one power-operated door.


ADDED

TABLE 1105.1.1
PUBLIC ENTRANCE WITH POWER-OPERATED DOOR*

OCCUPANCY	BUILDING OCCUPANT LOAD GREATER THAN
A-1, A-2, A-3, A-4	300
B, M, R-1	500

a. In mixed-use facilities where the total sum of the building occupant load is greater than those listed, the most restrictive building occupant load shall apply.

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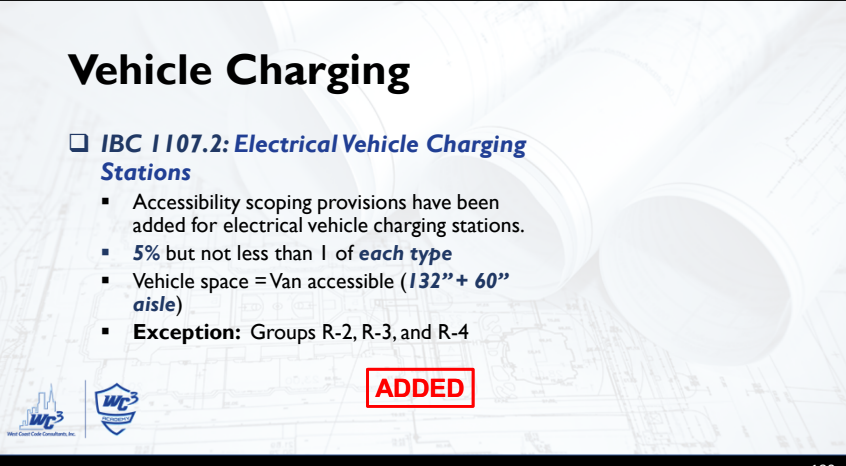
178

Vehicle Charging

IBC 1107.2: Electrical Vehicle Charging Stations


- Accessibility scoping provisions have been added for electrical vehicle charging stations.
- 5% but not less than 1 of **each type**
- Vehicle space = Van accessible (**132" + 60" aisle**)
- Exception:** Groups R-2, R-3, and R-4

ADDED





180

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Group I REVISED

- **IBC 1108.5: Accessible Units**
 - Several changes to allow **assisted use toilet and bathing facilities** in assisted living and nursing home facilities, rather than independent use which is intended by ICC A117.1.
 - **Group I-1:** Not more than 50% of accessible units.
 - **Group I-2, nursing homes:** Not more than 90% of accessible units.
 - **Group I-2, rehabilitation:** Not more than 50%.



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Assisted

- **IBC 1110.2.2: Water Closets Designed for Assisted Toileting**
 - Added scoping provisions for water closets that are designed for assisted use.
- **IBC 1110.2.3: Standard Roll-in-type Shower Compartment Designed for Assisted Bathing**
 - Added scoping provisions for roll-in-type showers that are designed for assisted bathing.

ADDED



183

183

Toilet Rooms

- **IBC 1110.2.1.6: Privacy**
 - Family or assisted-use toilet and bathing rooms...
 - Shall be secured from within, and...
 - Provided with an **“occupied” indicator**



REVISED




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Bottle Filling ADDED

- **IBC 1110.6: Bottle-filling Stations**
 - Clarifies that where bottle-filling stations are provided...
 - They shall be accessible.



- **Exception:** If over drinking fountains, they are not required to be accessible provided bottle-filling stations are also provided over accessible drinking fountains.


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Operable Parts

- ❑ **IBC 1110.15: Controls, Operating Mechanisms and Hardware**
 - Several exceptions removed but are included in the new ICC A117.1 provisions.

REVISED

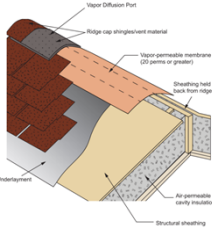
185

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Unvented Attics

- ❑ **IBC 1202.3: Unvented Attic & Unvented Enclosed Rafter Assemblies**
 - New option for Climate Zones 1, 2, or 3 for...
 - Unvented attics with air-permeable insulation and vapor diffusion ports

REVISED



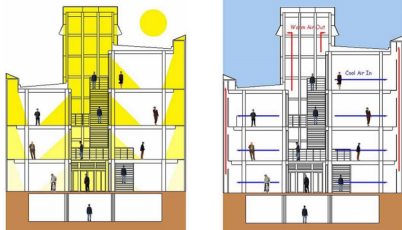
Vapor diffusion ports above an unvented attic.
International Code Council, 2021 IBC Significant Changes ©



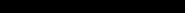




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IBC Chapter 12




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Acoustics

- ❑ **IBC 1207: Enhanced Classroom Acoustics**
 - New section requires enhanced acoustics for...
 - Classrooms having a **volume > 20,000ft³**
 - Example: Assume 10-foot ceiling → 2,000 ft² classroom – 45'x45'

ADDED


188

188

Efficiency Units

IBC 1208.4: Efficiency Dwelling Units

- Added definition to IBC 202
 - Includes living, sleeping, eating & cooking in a single room)
- Reduced minimum floor area from 220ft² to 190ft²
- Also removed provision that required an extra 100ft² per occupant above two.

REVISED



IBC Chapter 14

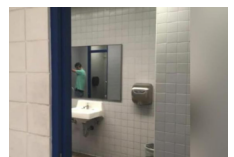
Building Science Corporation, High R-Value Wall Assembly, www.buildingscience.com ©

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Privacy

IBC 1210.3: Privacy

- Added the requirement to *screen the entry* or exit to a restroom.
- Also applies to the placement of *mirrors* that may compromise personal privacy.



REVISED

KKTIV 11 News, "Students want doors reinstalled on restrooms at Florida School"



Water-Resistive

IBC 1403.2: Water-resistive Barrier

- Now describes more options for water-resistive barriers...
 - No. 15 felt complying with ASTM D226, Type I
 - *ASTM E2556, Type I or II* (vapor permeable)
 - *IBC 1402.2 & ASTM E331* (weather protection)
 - Other approved materials

REVISED



Weather Covering

- IBC Table 1404.2: **Weather Covering**
 - The *minimum required thicknesses* of masonry and stone veneer weather coverings have been updated to align with current industry standards.

REVISED

TABLE 1404.2
MINIMUM THICKNESS OF WEATHER COVERINGS

COVERING TYPE	MINIMUM THICKNESS (inches)
Adhered masonry veneer	0.25
Aluminum siding	0.019
Anchored masonry veneer	
Stone (natural)	2.0
Architectural cast stone	2.5
Other	2.0



International Code Council, 2021 IBC ©

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Adhered Veneer

REVISED

- IBC 1404.10.2: **Exterior Adhered Masonry Veneers – Porcelain Tile**
 - Rewrote section
 - > 3.5 psf (6psf max):
 - ≤ 48-inches, or...
 - ≤ 9 ft²
 - ≤ 3.5 psf:
 - ≤ 72-inches, or...
 - ≤ 17.5 ft²



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Water-Resistive

REVISED

- IBC 1404.3: **Vapor Retarders**
 - Overall reorganization and several clarifications
 - This includes:
 - Table 1404.3(1) – Vapor Retarder materials & classes
 - Table 1404.3(2) – Vapor Retarder options
 - IBC 1404.3.1 – Class II Vapor Retarders in combination with foam plastic insulating sheathing → See Table 1404.3.1
 - IBC 1404.3.2 – Revised table and new text to assist designers in selecting appropriate Class III vapor retarders – also clarifies use with foam sheathing.



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Metal Cladding

REVISED


- IBC 1406.10: **Types I, II, III & IV Construction**
 - Section has been simplified as well as limited due to the deletion of alternate conditions.
 - ≤ 40-feet: Must comply with surface-burning (ASTM E84 or UL 723) & thermal barrier requirements
 - > 40-feet: Must also comply with full-scale testing in accordance with NFPA 285.



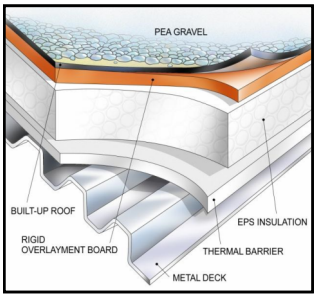
Petersen, Pac-Clad®, <https://www.pac-clad.com>

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IBC Chapter 15




Harbor Foam Inc., www.harborfoam.com

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Ballasted

- IBC 1504.5: **Ballasted Low-slope Single-ply Roof Systems**
 - Removed reference to IBC 1507.3 for installation requirements, and...
 - To IBC 1504.8 for design requirements.
 - Now simply refers to ANSI SPRI RP-4 for installation and design.



REVISED

199



Parapet Walls

- IBC 1503.3: **Parapet Walls**
 - If parapets are required at exterior walls per IBC 705.11...
 - They shall be properly *coped* or covered with *weatherproof* materials.
 - Fire-resistant Parapets:** Cannot reduce the fire-resistance rating

ADDED

198

Aggregate-Surfaced

- IBC 1504.9: **Wind Resistance of Aggregate-surfaced Roofs**
 - Now requires a minimum parapet height in accordance with **IBC Table 1504.9**.
 - Based on wind speed, exposure, aggregate size & mean roof height.
 - Aggregate size (**ASTM D1863**):
 - No. 7 = 1/2" to #4
 - No. 67 = 3/4" to #4
 - No. 6 = 3/4" to 3/8"

ADDED

200

Aggregate-Surfaced

17-inch Parapet

TABLE 1504.9
MINIMUM REQUIRED PARAPET HEIGHT (INCHES) FOR AGGREGATE SURFACED ROOFS^{a,b,c}
WIND EXPOSURE AND BASIC DESIGN WIND SPEED (MPH)

AGGREGATE SIZE	MEAN ROOF HEIGHT (ft)	Exposure B										Exposure C ^d																																																																																																																																																																																																																																													
		≤95	100	105	110	115	120	130	140	150	≤95	100	105	110	115	120	130	140	150																																																																																																																																																																																																																																						
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Roof Coatings

IBC 1509: Roof Coatings

- Added requirements for roof coatings placed over roof coverings.
- Provided roof coating material requirements...

MATERIAL	STANDARD
Acrylic coating	ASTM D6083
Asphaltic emulsion coating	ASTM D1227
Asphalt coating	ASTM D2823
Asphalt roof coating	ASTM D4479
Aluminum-pigmented asphalt coating	ASTM D2824
Silicone coating	ASTM D6694
Moisture-cured polyurethane coating	ASTM D6947

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Single-Ply Roofing

IBC 1507.12: Single-Ply Roofing

- Combined “Thermoset” and “Thermoplastic” single-ply roofing into one section.
- Added table of approved materials...

MATERIAL	MATERIAL STANDARD
Chlorosulfonated polyethylene (CSPE) or polyisobutylene (PIB)	ASTM D5019
Ethylene propylene diene monomer (EPDM)	ASTM D4637
Ketone Ethylene Ester (KEE)	ASTM D6754
Polyvinyl Chloride (PVC) or (PVC/KEE)	ASTM D4434
Thermoplastic polyolefin (TPO)	ASTM D6878

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202

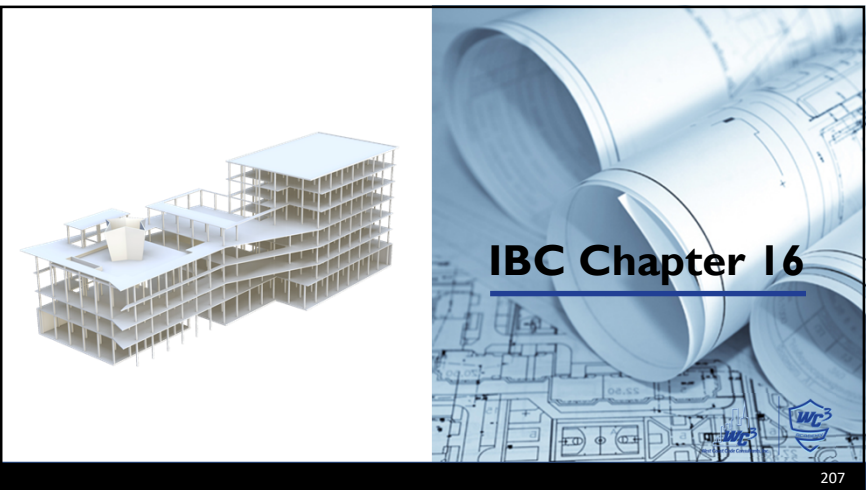
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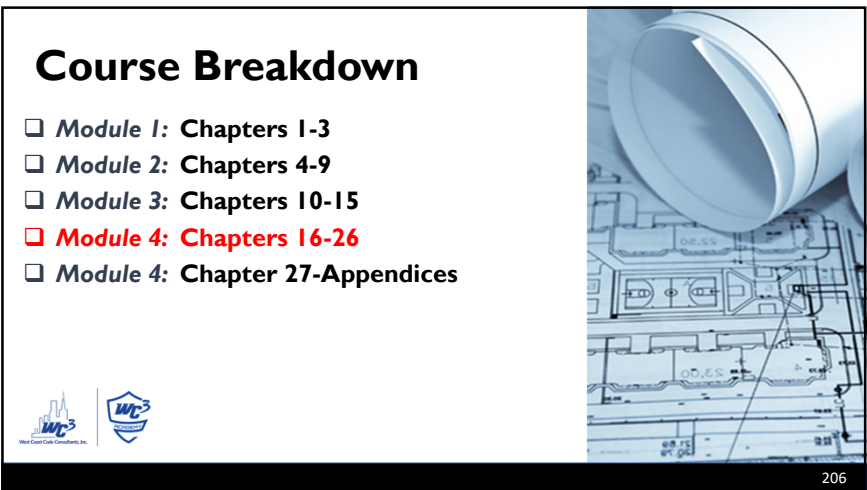
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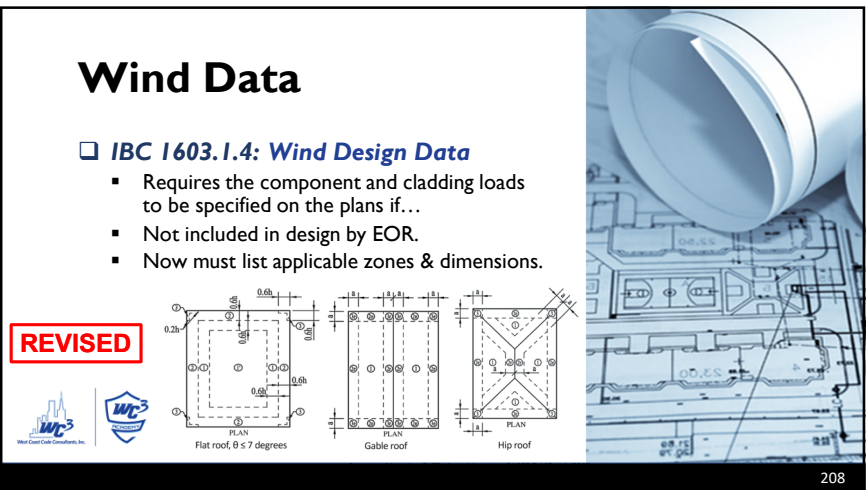
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207



206





208

Risk Category

IBC Table 1604.5: Risk Category

- Assemblies:
 - Primary Occupancy** and overall building has > 300 occupants → Risk Category III
 - ADDED:** Multiple assembly spaces, each > 300 occupants, and combined occupant load > 2,500 → Risk Category III
- Day Care:** Added to Group E requirement, if > 250 occupants → Risk Category III

REVISED


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Dead Loads



IBC 1606: Dead Loads

- Clarifies what should be considered as dead load at the roof.
- Materials, fixed-service equipment, PV arrays, and vegetative roofs.
- ADDED PV considerations.**
- ADDED vegetative roof considerations.**



Livingroofs.org, "Biosolar Green Roofs - Combining Solar Panels and Green Roofs"

ADDED

211

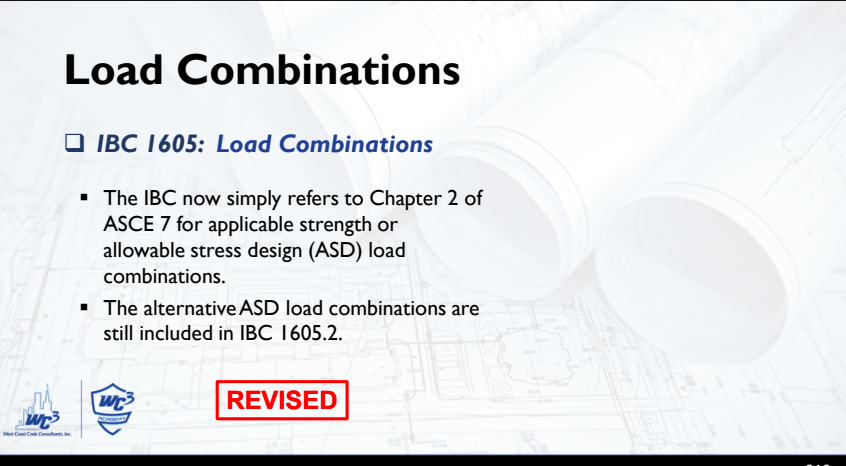

211

Load Combinations

IBC 1605: Load Combinations

- The IBC now simply refers to Chapter 2 of ASCE 7 for applicable strength or allowable stress design (ASD) load combinations.
- The alternative ASD load combinations are still included in IBC 1605.2.

REVISED

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Live Loads

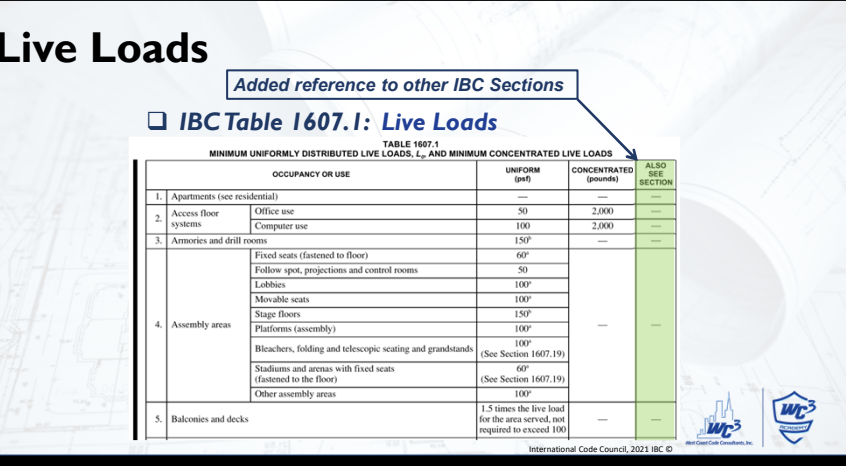

Added reference to other IBC Sections

IBC Table 1607.1: Live Loads

TABLE 1607.1
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_u , AND MINIMUM CONCENTRATED LIVE LOADS

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (pounds)	ALSO SEE SECTION
1. Apartments (see residential)	—	—	—
2. Access floor systems	Office use	2,000	—
	Computer use	2,000	—
3. Armories and drill rooms	—	150'	—
	Fixed seats (fastened to floor)	60'	—
4. Assembly areas	Fellow spot, projections and control rooms	50	—
	Lobbies	100'	—
	Movable seats	100'	—
	Stage floors	150'	—
	Platforms (assembly)	100'	—
	Bleachers, folding and telescopic seating and grandstands (See Section 1607.19)	100'	—
	Stadiums and arenas with fixed seats (fastened to the floor) (See Section 1607.19)	50'	—
	Other assembly areas	100'	—
5. Balconies and decks	1.5 times the live load for the area served, not required to exceed 100	—	—

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Live Loads

Previously under "Recreational Uses"

IBC Table 1607.1: Live Loads

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (pounds)	ALSO SEE SECTION
1. Apartments (see residential)	—	—	—
2. Access floor systems	Office use	2,000	—
	Computer use	2,000	—
3. Armories and drill rooms	—	—	—
	—	—	—
4. Assembly areas	Fixed seats (fastened to floor)	60*	—
	Follow spot, projections and control rooms	50	—
	Lobbies	100*	—
	Movable seats	100*	—
	Stage floors	150*	—
	Platforms (assembly)	100*	—
	Bleachers, folding and telescopic seating and grandstands (See Section 1607.19)	100*	—
	Stadiums and arenas with fixed seats (fastened to the floor) (See Section 1607.19)	60*	—
Other assembly areas	100*	—	
5. Balconies and decks	1.5 times the live load for the area served, not required to exceed 100		—

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Live Loads

IBC 1607.7: Passenger Vehicle Garages

- You can use the values in IBC Table 1607.1, or...
- Passenger vehicles = 3,000# uniform load acting on an area of 4.5" x 4.5"
 - Limited to 9 passengers
- Mechanical parking structures = 2,250# per wheel
 - Structures without a slab/deck

ADDED




215

Live Loads

ADDED

- Most footnotes removed and new Sections created at end of IBC 1607.
 - IBC 1607.19: Seating for Assembly Areas
 - IBC 1607.20: Sidewalks, Vehicular Driveways and Yards Subject to Trucking
 - IBC 1607.21: Stair Treads
 - IBC 1607.22: Residential Attics




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Fixed Ladders

IBC 1607.17: Fixed Ladders

- Added fixed ladder provisions to IBC 1607.7.
- Concentrated Load = 300# per rung

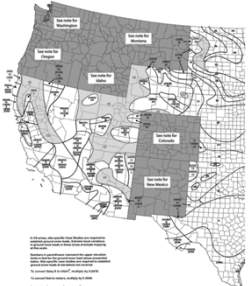
ADDED




216


Snow Loads

❑ **IBC Figure 1608.2(1-2): Ground Snow Loads**



- Now matches Figures in ASCE 7-16


REVISED



217

217

IBC Chapter 17




219

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Soil Loads

❑ **IBC 1610: Soil Loads & Hydrostatic Pressure**

- Previously entitled "Soil Lateral Loads"
- Added **IBC 1610.2...**
- Basement floors, slabs-on-ground, foundations, etc.
- are now required to be designed for hydrostatic pressure and uplift from expansive soils.



REVISED



218


218

Observations

❑ **IBC 1704.6: Structural Observations**

- Clarified that:
 - "...shall visually observe representative locations of structural systems, details and load paths for general conformance to the approved construction documents."
- Revised to now require for...
 - **Risk Category III** or IV structures

REVISED



220

220

Precast Concrete

REVISED

IBC Table 1705.3: Concrete Construction

- Now requires continuous inspection of precast diaphragm connections in SDC 'C-F', and installation tolerances per ACI 550.5.

TYPE	CONTINUOUS SPECIAL INSPECTION	PERIODIC SPECIAL INSPECTION	REFERENCED STANDARD*	IBC REFERENCE
11. For precast concrete diaphragm connections or reinforcement at joints classified as moderate or high deformability elements (MDE or HDE) in structures assigned to Seismic Design Category C, D, E or F, inspect such connections and reinforcement in the field for: <ul style="list-style-type: none"> a. Installation of the embedded parts b. Completion of the continuity of reinforcement across joints. c. Completion of connections in the field. 	X	—	ACI 318: 26.13.1.3 ACI 550.5	—
	X	—		
	X	—		
	X	—		
12. Inspect installation tolerances of precast concrete diaphragm connections for compliance with ACI 550.5.	—	X	ACI 318: 26.13.1.3	—

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Deep Foundations

ADDED

IBC 1705.10: Structural Integrity of Deep Foundation Elements

- Whenever there is reasonable doubt... an engineering assessment shall be required.
- Shall include tests in accordance with...
 - ASTM D4945
 - ASTM D5882
 - ASTM D6760
 - ASTM D7949
 - Or other approved method



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Mass Timber

ADDED

IBC 1705.5.3: Mass Timber Const.

- Now requires special inspections for Types IV-A, IV-B & IV-C per Table 1705.5.3...

TYPE	CONTINUOUS SPECIAL INSPECTION	PERIODIC SPECIAL INSPECTION
1. Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.	—	X
2. Inspect erection of mass timber construction.	—	X
3. Inspection of connections where installation methods are required to meet design loads.	Verify use of proper installation equipment.	—
	Verify use of pre-drilled holes where required.	—
Threaded fasteners	Inspect screws, including diameter, length, head type, spacing, installation angle and depth.	—
	Inspect screws, including diameter, length, head type, spacing, installation angle and depth.	—
Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads.	X	—
Adhesive anchors not defined in preceding cell.	—	X
Bolted connections.	—	X
Concealed connections.	—	X

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222

Storage Racks

REVISED

IBC 1705.13.7: Storage Racks

- Clarified that it applies to both steel *storage racks* and steel *cantilevered storage racks*.
- Added IBC Table 1705.13.7:

TYPE	CONTINUOUS INSPECTION	PERIODIC INSPECTION	REFERENCED STANDARD	IBC REFERENCE
1. Materials used, to verify compliance with one or more of the material test reports in accordance with the approved construction documents.	—	X	—	—
2. Fabricated storage rack elements.	—	X	—	Section 1704.2.5
3. Storage rack anchorage installation.	—	X	ANSI/MH16.1 Section 7.3.2	—
4. Completed storage rack system, to indicate compliance with the approved construction documents.	—	X	—	—

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Penetrations

- IBC 1705.18: Fire-resistant Penetrations**
 - Previously high-rise or Risk Category III or IV were the only to require these inspections.
 - Now includes **Group R** if > 250 occupants.

REVISED



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Impact Protection

- IBC 1709.5.3: Windborne Debris Protection**
 - New glazing standards for windborne debris regions.
 - Testing by an "approved" testing agency:
 - Impact resistance per ASTM E1886/ASTM E1996
 - Wind pressure per ASTM E339
 - Labeling:
 - Must list manufacturer, product designation, performance characteristics, and approved inspection agency.

ADDED

227

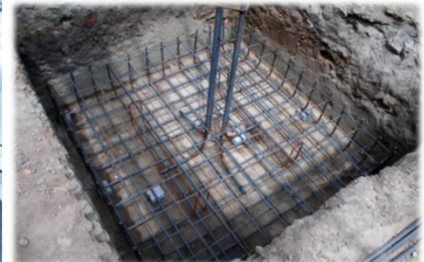
Mass Timber

- IBC 1705.20: Sealing of Mass Timber**
 - Periodic inspection of sealants or adhesives applied to mass timber elements.
 - In accordance with approved construction documents.

ADDED

226

IBC Chapter 18



228

Retaining Walls

- **IBC 1807.2.4: Segmental Retaining Walls**
 - Requires conformance with ASTM C1372

ADDED








229


229



Precast Piles

- **IBC 1810.3.8: Precast Concrete Piles**
 - Now simply refers to **ACI 318-19**.
 - **Two exceptions** are included to revise ACI 318 spiral or hoop requirements in SDC 'C-F'.



REVISED



231

231

Lateral Soil Loads

- **IBC 1809.5.1: Frost Protection at Exits**
 - Frost protection required at landings of required exits.
 - Must be provided so as not to impeded outward swinging exit doors.

ADDED







230

230

IBC Chapter 19





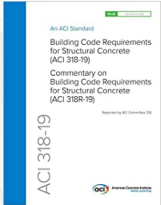


232


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ACI 318-19

- ❑ **IBC 1901.2: Plain & Reinforced Concrete**
 - Now references the 2019 version of **ACI 318**
 - Several items **removed** from this chapter as the information is now simply located within ACI 318.



UPDATED STANDARD




233

Terminology

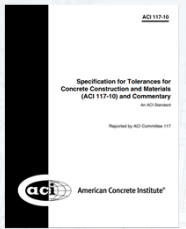

- ❑ **IBC 1902: Coordination of Terminology**
 - While “Definitions” are included in Chapter 2, this new section clarifies terms used in both the IBC and ACI 318.
 - Design Displacement (IBC 1902.1.1)
 - Special Structural Wall (IBC 1902.1.2)

ADDED




235

Tolerances

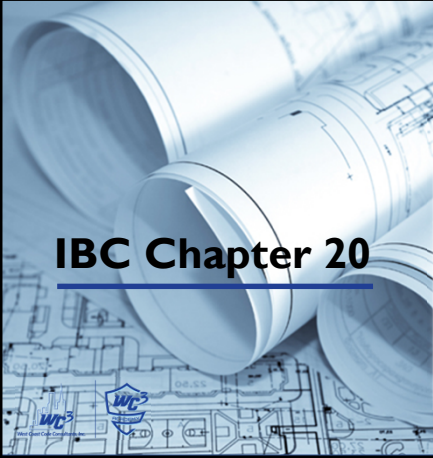



- ❑ **IBC 1901.7: Tolerances for Structural Concrete**
 - Now refers to ACI 117 for cast-in-place, and...
 - ACI ITG-7 for precast tolerances.

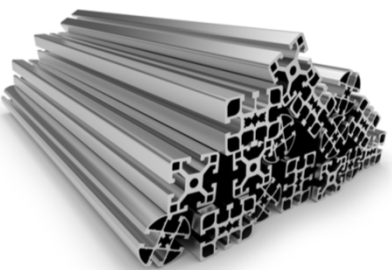
REVISED




234



IBC Chapter 20








236

ADM - 2020 UPDATED STANDARD

IBC 2002.1: General

- Now references the 2020 version of **AA ADM**
- Change include:
 - Weld-affected tensile strengths
 - Pull-out strength of screw chases
 - Changes to flexural strength checks
 - Many, many more!


237

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Adobe Construction

IBC 2109.2.4.8: Exterior Finish

- Clarified to allow plaster as an exterior finish.
- Differing requirements are provided for cement-lime, lime, and clay plaster.



REVISED

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IBC Chapter 21









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IBC Chapter 22

240

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Design Standards

- ❑ **Steel Joists & Girders**
 - SJI 100-20
- ❑ **Cold-Formed**
 - AISI S202-20
 - AISI S220-20
 - AISI S230-19
 - AISI S240-20
 - AISI S400-20

UPDATED STANDARDS

<https://steeljoist.org/ansi/>
<https://cfsei.memberclicks.net/free-publications>

241

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Storage Racks

- ❑ **IBC 2209.3: Certification**
 - Added requirements for racks \geq 8-feet, and...
 - Located within SDC 'D-F'...
 - To provide a *certificate of compliance* to...
 - The owner?

ADDED

243

243

ACI 358

- ❑ **IBC 2205.2.1: Structural Steel SFRS**
 - SDC "B & C" now requires *prequalified* moment connections for...
 - *Special* or *intermediate* moment frames per...
 - Sections K1 or K2 of AISC 341, or...
 - Per AISC 358
 - Also required for SDC "D-F", but this was already inherently required.

REVISED

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IBC Chapter 23

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Design Standards

- **ASD or LRFD Design**
 - 2021 version of ANSI/AWC SDPWS



View-only:
<http://www.awc.org/codes-standards/publications>

UPDATED STANDARDS



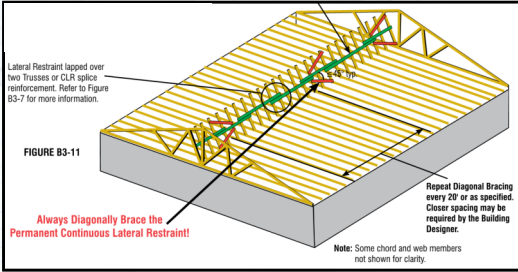
American Wood Council, 2021 AWC SDPWS

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Truss Bracing

- **IBC 2303.4.1.2: PITMR & PITMDB**
 - Diagonal bracing (PITMDB) at each PITMR in "red"

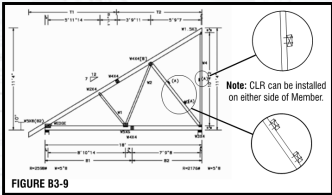


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Truss Bracing

- **IBC 2303.4.1.2: PITMR & PITMDB**
 - **PITMR** = Permanent Individual Truss Member Restraint
 - **PITMDB** = Permanent Ind. Truss Member Diagonal Bracing
 - Truss design drawings call for PITMR as shown...



ADDED


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Truss Bracing

- **IBC 2303.4.1.2: PITMR & PITMDB**
 - When the truss plans call for PITMR, it must be provided by one of following...
 1. PITMR & PITMDB shall be provided using standard industry lateral restraint and diagonal bracing details **per TPI, accepted engineering practice, or Figures 2303.4.1.2(1), (3), and (5).**
 2. Buckling reinforcement is added to individual truss **per truss drawings, or per Figures 2303.4.1.2 (2) and (4).**
 3. **Project-specific** PITMR and PITMDB design by EOR.

ADDED



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Truss Bracing

IBC – Option #1(a): One Row

ELEVATION VIEW OF TRUSS WITH SINGLE ROW, PTMR

SECTION (EXAMPLE OF SINGLE ROW OF PTMR WITH FITMRS ON WEB MEMBERS)

FIGURE 2303.4.1.1 (1)
PTMR AND PITMB FOR TRUSS WEB MEMBERS REQUIRING ONE ROW OF PTMR

For S1: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

249

Truss Bracing

IBC – Option #1(c): Piggyback Bracing

SECTION AT A

FIGURE 2303.4.1.2 (1)
PTMR AND PITMB FOR FLAT PORTION OF TOP CHORD IN A PIGGYBACK BRACE

For S1: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

251

Truss Bracing

IBC – Option #1(b): Two Rows

ELEVATION VIEW OF TRUSS WITH DOUBLE ROW, PTMR

SECTION (EXAMPLE OF DOUBLE ROW OF PTMR WITH FITMRS ON WEB MEMBERS)

FIGURE 2303.4.1.2 (2)
PTMR AND PITMB FOR TRUSS WEB MEMBERS REQUIRING TWO ROWS OF PTMR

For S1: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

250

Truss Bracing

IBC – Option #2(a): One Row

ELEVATION VIEW OF L, T OR SCAB REINFORCEMENT

TYPES OF WEB MEMBER BUCKLING REINFORCEMENT

NUMBER OF ROWS OF PTMR SPECIFIED ON WEB MEMBER	SIZE OF TRUSS WEB	TYPE AND SIZE OF WEB REINFORCEMENT* FOR T, L OR SCAB [†]	GRADE OF WEB REINFORCEMENT	MINIMUM LENGTH OF WEB REINFORCEMENT	MINIMUM CONNECTION OF WEB REINFORCEMENT TO WEB
ONE	2x4	2x4	Same species and grade or better than web member	90% of web to extend to within 6" of end of web member, whichever is greater	(Ø) 131" x 7" nails at 6" on-center [‡]
	2x6	2x6			
	2x8	2x8			

*Minimum allowable web length is 14"
[†]Scab reinforcement to web with two rows of minimum Ø 131" x 7" nails at 6" on-center

FIGURE 2303.4.1.2 (2)
ALTERNATIVE INSTALLATION USING BUCKLING REINFORCEMENT FOR TRUSS WEB MEMBERS IN LIEU OF ONE ROW OF PTMR

For S1: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

252

Truss Bracing

IBC – Option #2(b): Two Rows

ELEVATION VIEW OF I OR U REINFORCEMENT

TYPES OF WEB MEMBER BUCKLING REINFORCEMENT

NUMBER OF ROWS OF REINFORCEMENT SPECIFIED ON WEB MEMBER	SIZE OF TRUSS WEB	TYPE AND SIZE OF WEB MEMBER REINFORCEMENT	GRADE OF WEB REINFORCEMENT	MINIMUM LENGTH OF WEB REINFORCEMENT	MINIMUM CONNECTION OF WEB REINFORCEMENT TO WEB
TWO	2x4	(2) 2x4	Same species and grade or better than web member	90% of web or extend to within 6" of end of web member, whichever is greater	(0.111" x 3") nails at 6" oncenter
	2x6	(2) 2x6			
	2x8	(2) 2x8			

Maximum allowable web length is 14'

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

FIGURE 2303.4.1.2(4)
ALTERNATIVE INSTALLATION USING BUCKLING REINFORCEMENT FOR TRUSS WEB MEMBERS IN LIEU OF TWO ROWS OF PITMR

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Fasteners

IBC Table 2304.10.2: Fastening Schedule

- Sheathing Fasteners → Tighter spacing required in several instances
- Examples:
 - Item 30 (3/8"-1/2"): 8d common → was 6:12, now 6:6
 - Item 31 (19/32"-3/4"): 8d common → was 6:12, now 6:6
- Added footnotes e, f & g
 - Wind speed limitations for select connections
 - Nails and staples assume carbon steel complying with ASTM F1667, other connections or materials shall follow acceptable engineering practice.

REVISED

255

Fasteners

IBC 2304.10.1: Connection Fire-Resistance Rating

- For Type IV-A, IV-B & IV-C shall be determined by...
 - Testing (per IBC 703.2)
 - Engineering analysis
 - Avg. temperature rise = 250 degrees
 - Max. temperature rise = 325 degrees

ADDED

254

Balconies

IBC 2304.12.2.5: Ventilation

- This applies to balconies and elevated walking surfaces. It states as follows...
 - "Enclosed framing in exterior balconies and elevated walking surfaces that have **weather-exposed surfaces** shall be provided with openings that provide a net free cross-ventilation area not less than 1/150 of the area of each separate space."

ADDED

256

ASD Standards

ADDED

- IBC Table 2306.1: Standards for Design and Construction of Wood Elements in Structures Using Allowable Stress Design

STANDARD'S PROMULGATOR	STANDARD	TITLE
American Wood Council	ANSI/AWC NDS	National Design Specification for Wood Construction
	SDPWS	Special Design Provisions for Wind and Seismic
American Society of Agricultural and Biological Engineers	ASABE EP 484.3	Diaphragm Design of Metal-clad, Wood Frame Rectangular Buildings
	ASABE EP 486.3	Shallow Post and Pier Foundation Design
	ASABE EP 559.1	Design Requirements and Bending Properties for Mechanically Laminated Wood Assemblies
APA—The Engineered Wood Association		Standard Specifications for Structural

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IBC Chapter 24

259

Rafter Ties

REVISED

- IBC Table 2308.7.3.1: Rafter Tie Connections
 - Changed spans, spacing & connections reduced

RAFTER SLOPE	TIE SPACING (inches)	LIVE LOAD ONLY*													
		30 pounds per square foot						50 pounds per square foot							
		12	16	20	24	30	36	12	16	20	24	30	36		
3:12	12	3	5	8	10	12	14	16	18	20	22	24	26	28	30
	16	4	7	10	13	16	19	22	25	28	31	34	37	40	43
	19.2	4	8	12	15	19	22	26	29	33	36	39	42	45	48
	24	5	10	15	19	24	28	32	36	40	44	48	52	56	60
	32	7	13	20	26	32	38	44	50	56	62	68	74	80	86

RAFTER SLOPE	TIE SPACING (inches)	GROUND SNOW LOAD (pound per square foot)													
		NO SNOW LOAD						30 pounds per square foot							
		12	16	20	24	30	36	12	16	20	24	30	36		
3:12	12	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	16	5	7	10	13	16	19	22	25	28	31	34	37	40	43
	19.2	5	9	13	17	21	25	29	33	37	41	45	49	53	57
	24	7	11	15	19	24	28	32	36	40	44	48	52	56	60
	32	10	14	19	24	29	34	39	44	49	54	59	64	69	74

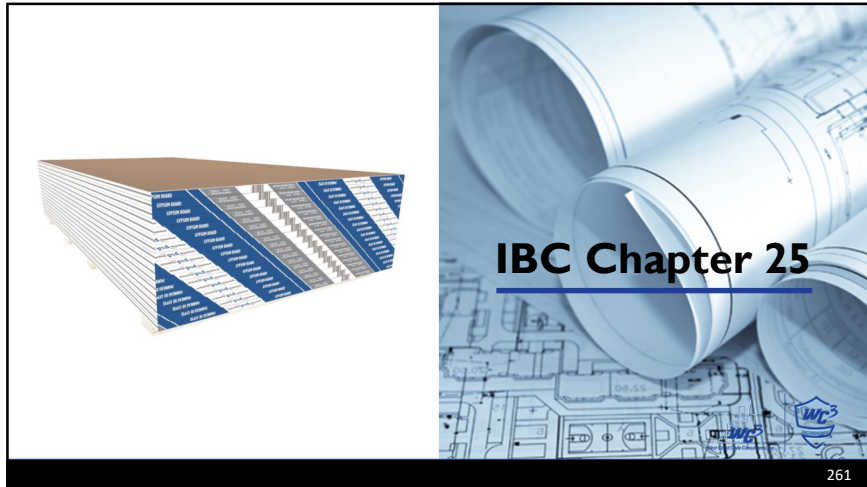
258

Glass Supports

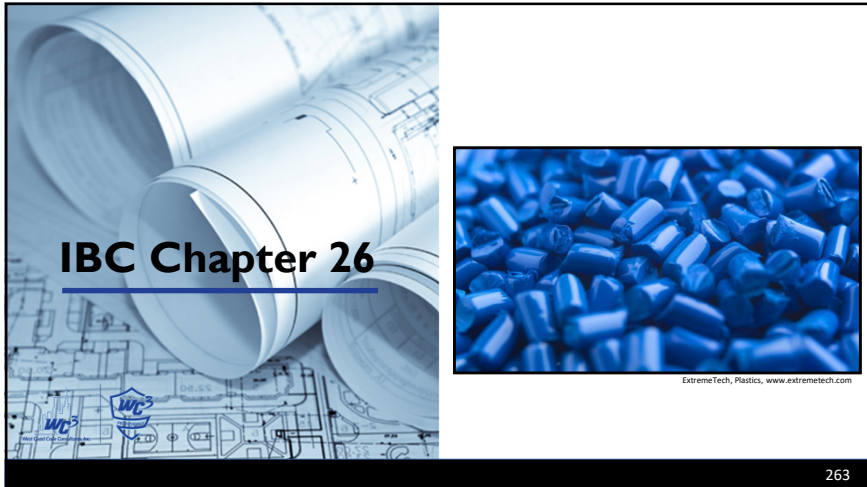
REVISED

- IBC 2403.3: Glass Framing
 - Revised to match requirements of IBC 1604.3.7
 - Deflection of glass support members is limited to...
 - l/175 for members ≤ 13'-6"
 - l/240 + 1/4 inch for members > 13'-6"

260



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Water-Resistive

- IBC 2510.6: **Water-resistive Barriers**
 - Divided the requirements into “Dry” or “Moist or Marine” climate requirements.

REVISED

Marine (C) Dry (B) Moist (A)

Warm-Humid below white line

All of Alaska is in Zone 7 except for the following boroughs in Zone 8: Bethel, Northwest Arctic, Dillingham, Southeast Fairbanks, Fairbanks N Star, Wade Hampton, Nome, Yukon-Koyukuk, North Slope

Zone 1 includes Hawaii, Guam, Puerto Rico, and the Virgin Islands

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Spray-Applied

- IBC 2603.1.1: **Spray-applied Foam Plastic**
 - Added the requirement for spray-applied foam plastic to comply with IBC 2603 as well as **ICC 1100-2018**.

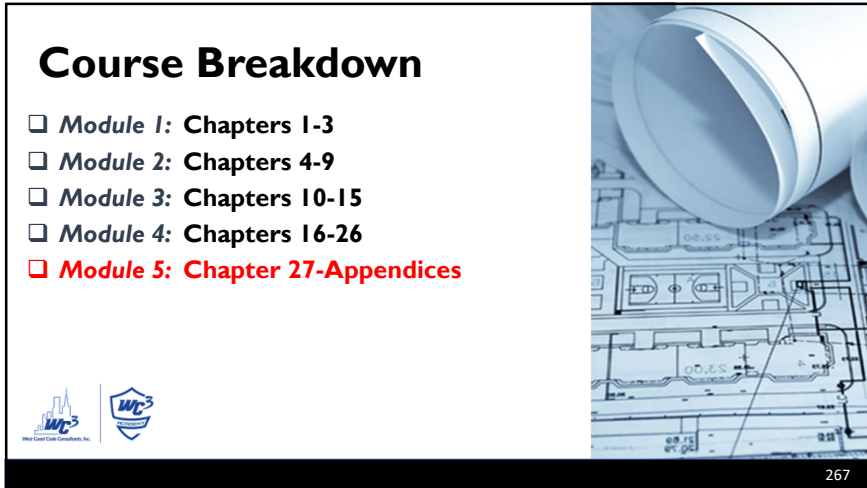
ADDED

ICC 1100-2018 Standard for Spray-applied Polyurethane Foam Plastic Insulation

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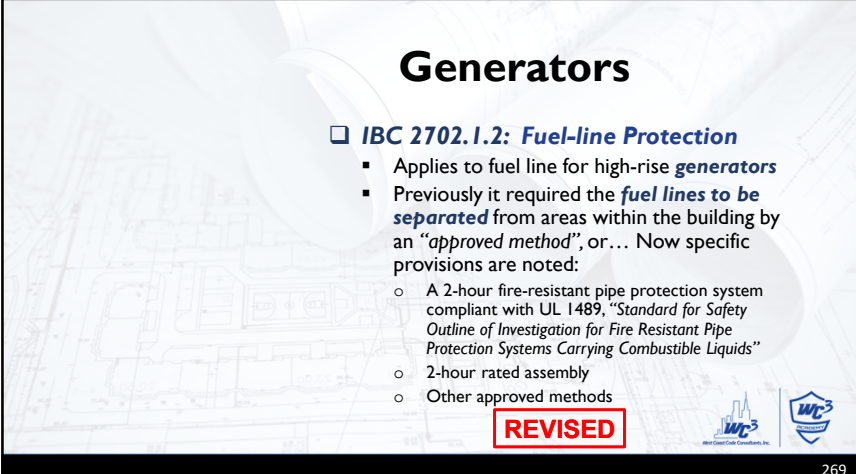



268

Generators

- ❑ **IBC 2702.1.2: Fuel-line Protection**
 - Applies to fuel line for high-rise **generators**
 - Previously it required the **fuel lines to be separated** from areas within the building by an “approved method”, or... Now specific provisions are noted:
 - A 2-hour fire-resistant pipe protection system compliant with UL 1489, “Standard for Safety Outline of Investigation for Fire Resistant Pipe Protection Systems Carrying Combustible Liquids”
 - 2-hour rated assembly
 - Other approved methods

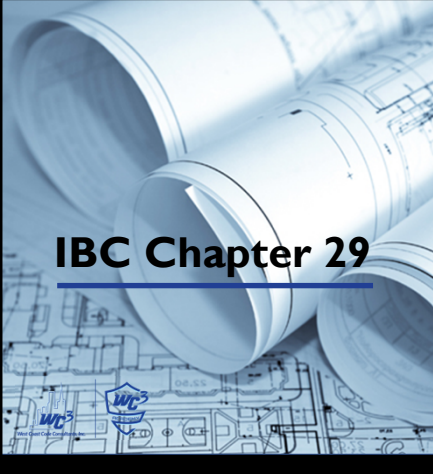


REVISED

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IBC Chapter 29






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Hydrogen ADDED

- ❑ **IBC 2702.2.12: Hydrogen Fuel Gas Room**
 - Now requires standby power to be provided to hydrogen fuel gas rooms and refers to the IFC.



Air Liquide, Storing Hydrogen, <https://energies.airliquide.com>



270

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Minimum Fixtures

- ❑ **IBC 2902: Minimum Plumbing Facilities**
 - Many changes based upon gender equality concerns
 - **Example:** New Exceptions #2 & 3
 - **Exception #1:** If designed to serve all genders, 100% based on total occupant load. Each fixture shall comply with ICCA 117.1 and urinals must be located within a stall.
 - **Exception #2:** Distribution of the exes is not required for single-user water closet and bathing room fixtures.

REVISED

272

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Location

- ❑ **IBC 2902.3.3: Location of Toilet Facilities in Occupancies other than Malls**
 - Added **Exception #2**:
 - The maximum travel to employee toilet facilities in **Group S** are no longer need to be met if approved by the building official.

ADDED



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273

Installation

- ❑ **IBC 2903: Installation of Fixtures**
 - This entire section is new to the 2021 IBC.
 - Requires fixtures to be set **level** and in **proper alignment** with adjacent walls.
 - Specific **dimensional** requirements for water closets, urinals, lavatories and bidets.
 - Specific criteria for public lavatories, fixtures & piping, water closet compartments, and urinal partitions.

ADDED



275

275

Location

- ❑ **IBC 2902.7: Service Sink Location**
 - **Covered Mall** → Not required within individual tenant space, but...
 - Must be located within **300-feet** of most remote location of tenant space, and...
 - Not more than **one story** above or below the tenant space.
 - It must be located on an **accessible route**.

ADDED



274

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IBC Chapter 30

All-Types Elevators, Inc., www.alltypeselevators.com





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Emergency Comm.

- ❑ **IBC 3001.2: Emergency Elevator Communication Systems for the Deaf, Hard of Hearing and Speech Impaired.**
 - Additional communication capabilities are now required in accessible elevators to enhance the usability of the two-way communication system by individuals with varying degrees of hearing, vision, or speech impairments.

REVISED

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Special Events **REVISED**

- ❑ **IBC 3103.1: General**
 - Added “*special event structures*” to list of temporary structures.
 - A definition for “special event structures” has also been added to Chapter 2.
 - “Any ground-supported structure, platform, stage, stage scaffolding or rigging, canopy, tower or similar structure supporting entertainment-related equipment or signage.”




Engineering News Record (ENR), "Lowland Living Planet Aquarium", November 13, 2019. By Brian Fyfe




279

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IBC Chapter 31



Yurts of Hawaii!, Mountainside Yurt, www.yurtsofhawaii.com





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Solar Energy

- ❑ **IBC 3111: Solar Energy Systems**
 - Previously panels were only allowed to be listed per **UL 1703**...
 - Now allows to be listed with both **UL 61730-1** and **UL 61730-2**.

REVISED

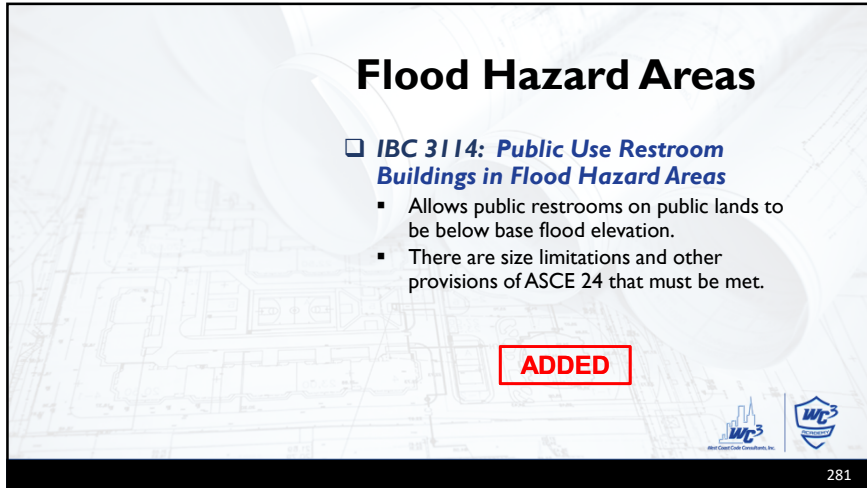
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Flood Hazard Areas

- ❑ **IBC 3114: Public Use Restroom Buildings in Flood Hazard Areas**
 - Allows public restrooms on public lands to be below base flood elevation.
 - There are size limitations and other provisions of ASCE 24 that must be met.

ADDED



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281

Shipping Containers

- ❑ **IBC 3115: Intermodal Shipping Containers**
 - Requirements provided for...
 - Construction documents
 - Data plate information
 - Health & safety
 - Fire-resistance
 - Structural



ADDED






283

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Shipping Containers

- ❑ **IBC 3115: Intermodal Shipping Containers**
 - Applies to shipping containers that are repurposed for use as buildings or structures.
 - Several exceptions → Very common to use these for relocatable buildings, ESS, hydrogen fueling, etc.



ADDED






282

282



Construction Safety Management, www.construction-safety-management.com

IBC Chapter 33








284

284

Adjoining Property ADDED

- ❑ **IBC 3307.2: Excavation Retention Systems**
 - Retention systems are finally addressed in the code!
 - Clarifies the following:
 - Requires licensed design professional and shall consider both vertical and lateral loads.
 - Monitoring of the system and adjacent structures for both horizontal and vertical movement.
 - Should not be removed unless adequate support exists.






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Fire Watch REVISED

- ❑ **IBC 3314: Fire Watch**
 - Previously this had only one trigger, buildings of combustible construction **>40-feet**.
 - It now limits it to combustible buildings **>40-feet** and having an aggregate building area **>50,000ft²**
 - **Construction Fire Safety Coalition** - <https://www.constructionfiresafety.org/codes-standards>






287

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Water Supply REVISED

- ❑ **IBC 3313: Water Supply for Fire Protection**
 - This section has been completely re-worked. Previously only required an **“approved”** supply when combustible materials arrived onsite.
 - Now clarifies that this should be provided when...
 1. Combustible materials arrive, and...
 2. On commencement of vertical combustible construction, and...
 3. On installation of standpipe system in buildings under construction.





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APPENDIX



Appendices



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Appendix O

- Performance-Based Application
 - Adds the use of the ICC Performance Code as an allowed alternate means and methods.

ADDED



International Code Council, 2021 ICCPC©



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**Thank you for using
the WC³ Academy**

Please contact us with any questions

Email: Academy@WC-3.com

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END OF MODULE

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Module 1 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4	Answer 5
True or False: Per the 2021 IBC, jurisdictions must allow constructions documents to be submitted in a digital format.	IBC 107.1, construction documents can be submitted in a digital format where allowed by the building official.	IBC Chapter 1	2	TRUE	FALSE			
True or False: Atrium spaces shall be closed at the top.	IBC 202, definition of atrium	IBC Chapter 2	1	TRUE	FALSE			
An arrow in the margin of the IBC means _____.	IBC Preface	IBC Preface	3	the entire section, paragraph, exception or table has been added	a technical change has been made to the section, paragraph, exception or table	the entire section, paragraph, exception or table has been deleted	the text or table has been relocated	
True or False: Distilling or brewing of beverages conforming to the requirements of the International Fire Code is classified as Group H.	IBC 307.1.1, items shall NOT be classified as Group H	IBC 307	2	TRUE	FALSE			
The function of the _____ shall be the implementation, administration and enforcement of the provisions of the IBC.	IBC 103.1	IBC Chapter 1	3	Department of Building Safety	Building Department	Code Compliance Agency	Code Enforcement Agency	
True or False: An escape room is a type of special amusement area in which occupants are encouraged to solve a challenge to escape from a room or series of rooms.	IBC 202, definition of puzzle room. Escape room is not defined in the IBC.	IBC Chapter 2	2	TRUE	FALSE			
Energy Storage Systems (ESS) in dedicated use buildings are classified as Group _____.	IBC 306.2	IBC 306	3	S	H	F-1	F-2	
A sprinklered, owner-occupied lodging house with four guest rooms and 8 total occupants shall conform to the provisions of the IBC for a Group R-3 Occupancy.	IBC 310.4.2, shall be permitted to be constructed in accordance with the IRC.	IBC 310	2	TRUE	FALSE			
Special amusement areas shall comply with _____.	IBC 303.1.5	IBC 303	1	IBC 411	IBC 412	IBC 428	IBC 423	
Mass Timber is categorized as Type _____ construction.	IBC 202, definition of mass timber	IBC Chapter 2	4	I	II	III	IV	V

Module 2 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4	Answer 5	Answer 6
True or False: A horizontal assembly is required between the atriums and openings for escalators.	IBC 404.6 Exception #5	IBC 404	2	TRUE	FALSE				
Exterior walls of Energy Storage Systems shall comply with _____.	IBC 707.4 Exception 2	IBC 707	4	IBC 705	IBC 706	IBC 707	IFC 1207		
True or False: An open parking garage that is 40,000 square foot and 60 feet in height does not require fire sprinklers.	IBC 903.2.11.3 (2021 IBC removed the exception for open parking garages)	IBC 903	2	TRUE	FALSE				
In Group I-2 occupancies, every care suite shall have a door leading directly to _____.	IBC 407.4.4.3	IBC 407	5	an exit access	an exit access corridor	a horizontal exit	either a or b	either b or c	
True or False: A pressurized stair can be used to provide a smokeproof enclosure.	IBC 909.20.6	IBC 909	1	TRUE	FALSE				
An occupied roof shall not be included in the _____ as regulated by Section 504.	IBC 503.1.4	IBC 503	6	building area	building height	number or stories	all of the above	both a and b	both b and c
Where pass-through openings are provided in smoke partitions in Group I-2, Condition 2 occupancies, such openings shall comply with all of the following, except:	IBC 710.5.3	IBC 710	4	The aggregate area of all such pass-through openings within a single room shall not exceed 80 square inches.	Pass-through openings are installed in a wall, door or vision panel that is not required to have a fire-resistance rating.	The smoke compartment in which the pass-through openings occur does not contain a patient care suite or sleeping room.	The top of the pass-through opening is located a maximum of 60 inches above the floor.		
Where an atrium contains an interior exit stairway, not more than _____ of the exit stairways shall be located in the same atrium.	IBC 404.10 #5	IBC 404	3	1/4	1/3	1/2	2/3		
Assuming a Fire Separation Distance of 48 inches, the minimum distance of projections shall be _____.	IBC Table 705.2	IBC 705	3	24 inches	24 inches plus 8 inches for every foot of FSD beyond 3 feet or fraction thereof	two-thirds of FSD	40 inches		
In buildings greater than _____ or _____ above grade plane, interior exit and elevator hoistway enclosures shall be constructed of noncombustible materials.	IBC 604 (last paragraph)	IBC Chapter 6	2	12 stories, 120 feet	12 stories, 180 feet	18 stories, 180 feet	20 stories, 200 feet		

Module 3 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Each area of refuge shall be sized to accommodate one wheelchair space of ____ inches by ____ inches for each 200 occupants.	IBC 1009.6.3	IBC 1009	2	30, 48	30, 52	34, 48	34, 52
True or False: Doors to family or assisted-use toilet and bathing rooms shall be provided with an "In Use" indicator.	IBC 1110.1.6, "occupied" indicator	IBC 1110	2	TRUE	FALSE		
Accessible vehicle spaces for Electrical Vehicle Charging Stations shall be ____ inches minimum in width, with an adjoining access aisle that is ____ inches in width.	IBC 1107.2.2	IBC 1107	3	96, 60	96, 96	132, 60	132, 96
The minimum required parapet height for a 30-foot high aggregate surfaced roof with No. 6 aggregate in Wind Exposure B with a Basic Design Wind Speed of 115 MPH is _____.	IBC Table 1504.9	IBC 1504	1	12 inches	15 inches	19 inches	24 inches
In a surgery center that requires more than one exit, the length of a dead-end corridor serving patient rooms shall not exceed ____ feet.	IBC 1020.5 (Exception #4 only applies to corridors that do not serve patient rooms.)	IBC 1020	1	20	30	40	50
True or False: Electrical rooms containing electrical equipment rated less than 1,000 volts are not required to have panic hardware.	IBC 1006.2.2.4	IBC 1006	2	TRUE	FALSE		
True or False: An 1,100 square foot press box shall be protected with an approved automatic sprinkler system.	IBC 1030.6.3.1 (Exception #2 applies only to press boxes less than 1,000 square feet.)	IBC 1030	1	TRUE	FALSE		
Adhered stone veneer shall have a minimum nominal thickness of ____ inches to be acceptable as an approved weather covering.	IBC Table 1404.2 (Adhered masonry veneer)	IBC 1404	1	0.25	2.00	2.25	2.50
Public restrooms shall be _____ from outside entry or exit doorways to ensure _____.	IBC 1209.3	IBC 1209	2	protected, access is not gained while in use	visually screened, user privacy	separated, user privacy	locked, access is not gained while in use
When the stairway is in use, exit stairways and their required landings shall have an illumination level no less than _____.	IBC 1008.2.1	IBC 1008	3	1 foot candle	5 foot candles	10 foot candles	11 foot candles

Module 4 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4	Answer 5
True or False: Frost protection shall be provided at exterior landings for all required exits.	IBC 1809.5.1 (only required if the exit has an outward-	IBC 1809	2	TRUE	FALSE			
Which of the following is NOT required to be on construction documents?	IBC 603.1.4 (only required if NOT specifically designed by the registered design professional)	IBC 1603	1	Design wind pressures and their applicable zones with dimensions to be used for exterior component and cladding materials specifically designed by the registered design professional responsible for the design of the structure, pounds per square foot.	Wind exposure. Applicable wind direction if more than one wind exposure is utilized.	Applicable internal pressure coefficient	Risk category.	
Special inspections for fire-resistant penetrations and joints are required in fire areas containing Group R occupancies with an occupant load greater than ____.	IBC 1705.18	IBC 1705	3	200	225	250	300	
Rack storage structures that are ____ feet in height or greater and assigned to Seismic Design Category D, E, or F require a certificate of compliance be submitted to the owner at completion.	IBC 2209.3	IBC 2209	2	6	8	10	12	
Fixed ladders with rungs shall be designed to resist a single concentrated load of ____ pounds.	IBC 1607.17	IBC 1607	3	200	250	300	350	
Balconies that have _____ surfaces shall be provided with ventilation.	IBC 2304.12.2.5	IBC 2304	1	weather-exposed	wood	combustible	impermeable	
Spray-applied foam plastic shall comply with the provisions of _____.	IBC 2603.1.1	IBC 2603	3	IBC 2603	ICC 1100-2018	both a and b	either a or b	
_____ special inspections are required for precast concrete diaphragm connections classified as moderate or high deformability elements in structures assigned to Seismic Design Category C through F.	IBC Table 1705.3	IBC 1705	1	Continuous	Periodic			
Which of the following shall be considered in the dead load of a roof?	IBC 1606.3, 1606.4, 1606.5	IBC 1606	5	photovoltaic panel systems	fixed service equipment	vegetative roofs	landscaped roofs	all of the above
Design displacement at each level shall be the total _____ deflection at the level calculated for the design earthquake.	IBC 1902.1.1	IBC 1902	2	load	lateral	relative	horizontal	

Module 5 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A water closet, urinal, lavatory or bidet shall not be set closer than ____ inches from its center to any side wall, partition, vanity or other obstruction.	IBC 2903.1.1	IBC 2903	2	12	15	16	18
Excavation retention systems shall _____.	IBC 3307	IBC Chapter 33	3	be removed or decommissioned in such a matter as to protect the property the system is located on	only be removed or decommissioned in order to be replaced by a new excavation retention system	include requirements for monitoring of the system and adjacent structures	be designed by a registered design professional to provide horizontal support
Fuel lines supplying a generator set inside a high-rise building shall be separated from other areas of the building by _____.	IBC 2702.1.2	IBC 2702	4	an approved method	an assembly that has a fire-resistance rating of not less than 2 hours	a fire-resistant pipe-protection system that has been tested in accordance with UL 1489	any of the above
True or False: Toilet rooms located in child day care facilities and containing two or more water closets shall be permitted to have one water closet without an enclosing compartment.	IBC 2903.1.4 Exception 2	IBC 2903	1	TRUE	FALSE		
Temporary structures include all of the following except _____.	IBC 3103.1	IBC 3103	1	firework stands	special event structures	tents	umbrella structures
True or False: The ICC Performance Code has been added to the IBC to be used in conjunction with the Alternate Methods provisions of IBC Chapter 1.	Appendix O, O101.1	Appendices	1	TRUE	FALSE		
True or False: The required public and employee toilet facilities in a self-service storage facility shall be located not more than one story above or below the space required to be provided with toilet facilities, and the path of travel to such facilities shall not exceed a distance of 500 feet.	IBC 2902.3.3 Exception 2	IBC 2902	2	TRUE	FALSE		
_____ shall be provided for hydrogen fuel gas rooms as required by the IFC.	IBC 2702.12	IBC 2702	2	Emergency power	Standby power	both a and b	either a or b
Photovoltaic panels shall be listed and labeled in accordance with _____.	IBC 3111.3.1	IBC 3111	4	UL 61730-1 and UL 61730-2	UL 1703	both a and b	either a or b
Where multiple-user facilities are designed to serve all genders, how many of each fixture type shall be in accordance with ICC A117.1?	IBC 2902.1.1 Exception 2	IBC 2902	4	1 per 10 occupants	1 per 15 occupants	1 per 25 occupants	all of them



Chris Kimball

PE, SE, MCP, CBO

VICE PRESIDENT / PROJECT MANAGER

EDUCATION

**MASTER OF ENGINEERING
STRUCTURAL EMPHASIS**
Utah State University, 2001

**BACHELOR OF SCIENCE
CIVIL ENGINEERING**
Utah State University, 2000

LICENSES | CERTIFICATIONS

LICENSES

Professional Engineer

Washington 53117
California C 67857
Nevada 019503
Arizona 48503

Structural Engineer

Utah 4775874-2203

CERTIFICATES

ICC Certified:

Master Code Professional
Certified Building Official
Certified Fire Code Official
Combination Plans Examiner
4-Way Commercial Inspector
Residential Plans Examiner
Residential Energy
4-Way Residential Inspector
Accessibility Plans Examiner/Insp.
Fire Plans Examiner
Fire Inspector I & II

AFFILIATIONS

SEAU

Past President

Beehive Chapter of ICC

Past President

Utah Chapter of ICC

Member

Bonneville Chapter of ICC

Member

AWARDS

SEAU

2014 Engineer of the Year

ICC Utah Chapter

Industry Award for Excellence 2010

Mr. Kimball is a licensed engineer and an ICC Master Code Professional. He is also certified by ICC as a building official, fire code official, combination plans examiner, combination building inspector, fire plans examiner/inspector, and as an accessibility plans examiner/inspector. He received his Master's degree with an emphasis in structural engineering and currently serves as the Vice President of West Coast Code Consultants, Inc. He has performed plan reviews for thousands of projects throughout the Western United States and is an ICC approved instructor. Mr. Kimball has provided code training classes to building official, design professional and contractor organizations all over the United States.

EXPERIENCE

VICE PRESIDENT

West Coast Code Consultants, Inc. / 2009 – Present

Oversee the plan review and building inspection services provided by numerous WC3 offices. This includes the management of administrative, plan review, and inspection staff. Accountable for the complete plan review of projects which are seeking a building permit to ensure that designs are safe and in compliance with the adopted building codes. Responsible for providing technical training classes to clients, building officials, design professionals, contractors, and owners.

PRESIDENT / OWNER

Kimball Engineering / 2005 – 2009

Provided structural and complete plan review services to local jurisdictions throughout Utah, Arizona, Nevada, and Wyoming. Often provided training with regards to the structural building code requirements for both new and existing buildings to building official, design professional, and contractor organizations.

STRUCTURAL PLANS EXAMINER

Salt Lake City Corporation / 2005 - 2007

Performed structural review of plans, specifications, calculations, and engineering reports to ensure compliance with the adopted building codes. Met with clients, design professionals, contractors, and owners to discuss projects during the design-development stage and throughout the construction process. Provided training classes to design professionals to help them understand the structural requirements of the code. Provided engineering design and consulting services for city-owned projects.

CIVIL ENGINEER

U.S. Bureau of Reclamation / 2003 – 2005

Responsible for the structural design of a wide variety of projects including the retrofit of power plants, design of new buildings, and repairs to concrete and earthen dams. Prepared construction documents, including drawings and detailed project specifications for solicited work. Reviewed designs performed by the Technical Services Center, Area offices, and private consultants. Participated in several value engineering studies.

CIVIL ENGINEER

C.A. Dept. of Water Resources / 2002 – 2003

Provided preliminary designs for the repair of levees and other flood mitigation measures. Reviewed proposals and work performed by consultants. Developed required hydrology for modeling purposes. Reviewed hydraulic modeling efforts. Involved in writing/reviewing a joint EIR/EIS. Prepared construction cost estimates.

File Attachments for Item:

EC-2 Commercial Building Inspector and Plans Examiner (2021 IBC) (West Coast Code Consultants)

All certifications (19.5 hours)

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

Name *

Brittany Allen

Organization

West Coast Code Consultant

Email *

brittanya@wc-3.com

Phone Number *

(385) 237-3722

Address *

9131 S Monroe St Unit A

City *

Sandy

State *

Utah

Zip Code *

84070

Website

https://www.pathlms.com/w

Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e. BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

2021 Commercial Building Inspector and Plans Examiner

Course instructor

George Williams and Chris Kimball

Course description

Course Description: This 15-module course, followed by a two-hour practice examination, is based on the 2021 International Building Code (IBC). It teaches the practical application of the IBC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 30 to 80 minutes in length.
Course Objectives: This course is designed to prepare you for the International Code Council's (ICC) Commercial Building Inspector (B2) and/or Building Plans Examiner (B3) exam, utilizing the 2021 IBC. This course also serves as a review for those already familiar with the IBC and may serve as an update course for those unfamiliar with the 2021 edition of the codes.

Instructional hours per session

19.5

Number of Sessions

1

Course Date

Course Location

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction
- Plumbing Instruction

Conference Course

Conference Name

Conference location

Course to be offered online?

Yes

On Demand

Webinar

Course Website

https://www.pathlms.com/wc3-academy/courses/47

1119

No

Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration

to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video

modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. You can progress through this course at your own pace; however, you only have access for 120 days.

Course applicable for the following certifications *

- Residential Certifications Only
- Administrative Course, All Certifications
- Commercial and Residential Certifications

Application materials included *

- Course Outline or Course Learning Objectives
- Presentation Materials/Slides (not required for roundtable courses)
- Assessment Materials (for online courses)
- Presenter Bio
- Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
2021 Commercial Building Course Submittal Docs.pdf	14.19 MB

Applicant Full Name *

Brittany Allen

Date of Submission

06/05/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



2021 Commercial Building Inspector and Plans Examiner

Course Outline

Cost: \$247, allowing for 120 days of access.

Course Description: This **15-module** course, followed by a two-hour practice examination, is based on the *2021 International Building Code (IBC)*. It teaches the practical application of the IBC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 30 to 80 minutes in length.

Course Objectives: This course is designed to prepare you for the *International Code Council's (ICC)* Commercial Building Inspector (B2) and/or Building Plans Examiner (B3) exam, utilizing the *2021 IBC*. This course also serves as a review for those already familiar with the IBC and may serve as an update course for those unfamiliar with the 2021 edition of the codes.

Texts and Readings: The *2021 International Building Code* is the textbook for this course. It is highly recommended that you purchase a paper-back copy of this code, which is available online at www.iccsafe.org. A physical copy can be utilized during the actual exams, which are open book, and serves as a valuable reference for in the field inspections.

Course Outline of Topics:

Module:	Topics:	Readings:	Quiz:	Duration:
1	Scope, Administration & Definitions	IBC Ch. 1 & 2	Y	58 min.
2	Occupancy Classification & Use	IBC Ch. 3	Y	41 min.
3	Special Requirements & Types of Construction	IBC Ch. 4 & 6	Y	41 min.
4	Building Heights and Areas	IBC Ch. 5	Y	42 min.
5	Fire and Smoke Protection- Part 1	IBC Ch. 7	Y	80 min.
6	Fire and Smoke Protection- Part 2	IBC Ch. 7	Y	69 min.
7	Means of Egress	IBC Ch. 10	Y	62 min.
8	Accessibility	IBC Ch. 11	Y	63 min.
9	Interior Finishes & Fire Protection/Life Safety Systems	IBC Ch. 8 & 9	Y	58 min.
10	Interior Environment, Exterior Walls & Roof Assemblies	IBC Ch. 12, 14, 15	Y	49 min.
11	Structural Design, Special Inspections & Soils/Foundations	IBC Ch. 16-18	Y	41 min.
12	Concrete, Aluminum, Masonry, Steel & Wood Construction	IBC Ch. 19-23	Y	66 min.
13	Glass & Glazing	IBC Ch. 24	Y	28 min.
14	Gypsum Board, Plastic, Electrical, Mechanical, Plumbing, Elevators, Special Construction, Encroachments, Safeguards & Referenced Standards	IBC Ch. 25-35	Y	44 min.
15	Plan Review Considerations	IBC	N	36 min.
	<i>14 Quizzes</i>			
	<i>142 Questions, 2 min. each</i>	<i>2021 IBC</i>		<i>284 min.</i>
	<i>Practice Exam (60 Questions)</i>	<i>2021 IBC</i>		<i>120 min.</i>
	Total Course Hours			19.5 hours



2021 Commercial Building Inspector and Plans Examiner

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. Marking, tabbing, and highlighting in the code book is highly recommended. We have laid out a plan and method to help you learn the material, but it's up to you to put in the work necessary for you to master the material. You can progress through this course at your own pace; however, you only have access for 120 days.

Continuing Education Credits: Completion of this course results in **1.95 CEU's** (19.5 hours) being provided by ICC, as West Coast Code Consultants is a Preferred Provider.

Instructors:



Chris Kimball, PE, SE, CBO is one of WC3's Vice Presidents. He is a licensed structural engineer, ICC Master Code Professional, Certified Building Official, fire code official, combination plans examiner, and combination building inspector. He has performed plan reviews for thousands of projects throughout the western states. In addition, Chris has provided numerous training classes to help design professionals, building officials, and contractors alike to understand the requirements of the adopted building codes. Chris regularly teaches for ICC and has been involved in assisting ICC with various publications.



Todd Snider, PE, SE has experience as both a design engineer, as well as a lead commercial plan reviewer, specializing in large complex commercial projects. Todd is the Regional Manager of the Utah region, supervising a large staff of plans examiners. He has performed plan reviews for thousands of projects throughout the western United States. Todd is a licensed structural engineer, has a master's degree in Structural Engineering, and maintains ICC Certifications as a commercial building, mechanical, energy, and accessibility plans examiner. Todd teaches code classes in several states on a variety of topics.



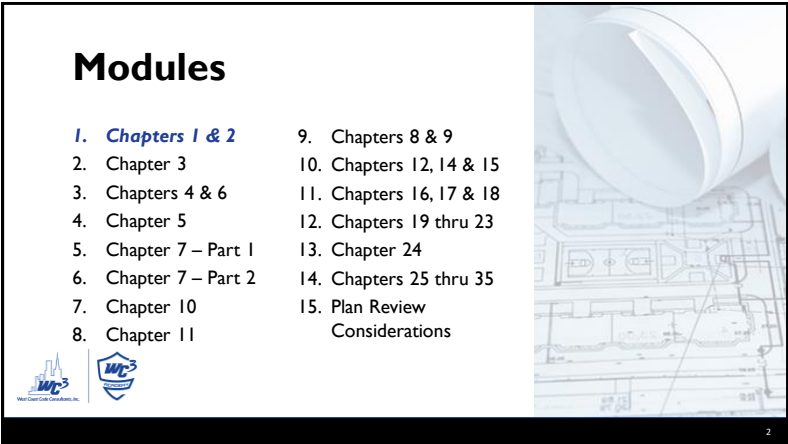


2021 International Building Code
Inspector/Plans Examiner






1

1



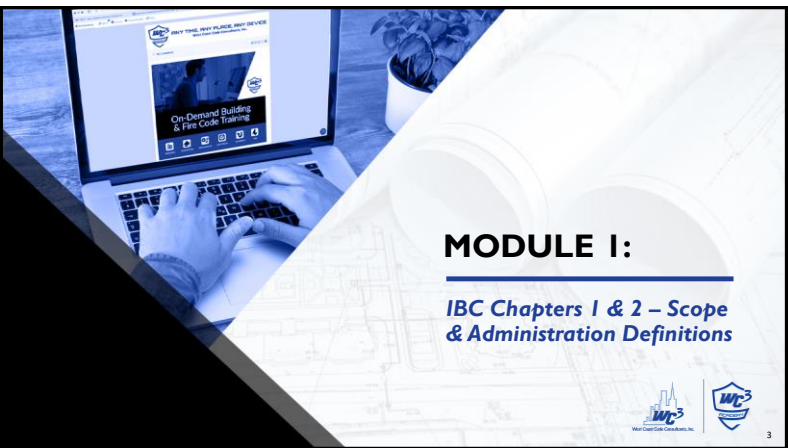
Modules

1. <i>Chapters 1 & 2</i>	9. Chapters 8 & 9
2. Chapter 3	10. Chapters 12, 14 & 15
3. Chapters 4 & 6	11. Chapters 16, 17 & 18
4. Chapter 5	12. Chapters 19 thru 23
5. Chapter 7 – Part 1	13. Chapter 24
6. Chapter 7 – Part 2	14. Chapters 25 thru 35
7. Chapter 10	15. Plan Review Considerations
8. Chapter 11	






2

2

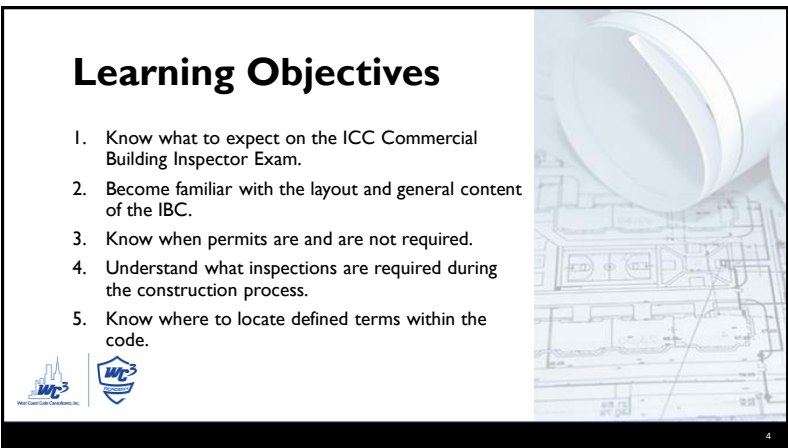


MODULE 1:
IBC Chapters 1 & 2 – Scope & Administration Definitions



3

3



Learning Objectives

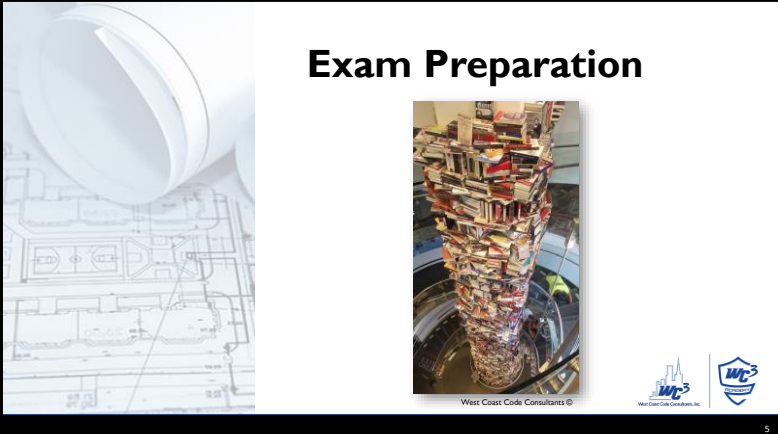
1. Know what to expect on the ICC Commercial Building Inspector Exam.
2. Become familiar with the layout and general content of the IBC.
3. Know when permits are and are not required.
4. Understand what inspections are required during the construction process.
5. Know where to locate defined terms within the code.


4

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Exam Preparation



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Exam Breakdown

Commercial Building Inspector Exam (B2)

• General Administration	6%
• Building Planning	20%
• Footings and Foundations	8%
• Floor Construction	8%
• Wall Construction and Coverings	21%
• Roof/Ceiling Construction	6%
• Public Safety and Special Construction	31%

For a more detailed breakdown of the test visit <https://www.iccsafe.org/certification-exam-catalog/>




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Exam Breakdown

Building Plans Examiner Exam (B3)

• General Administration	5%
• Building Planning	21%
• Footings and Foundations	8%
• Floor Construction	4%
• Wall Construction and Coverings	12%
• Roof/Ceiling Construction	4%
• Public Safety and Special Construction	46%

For a more detailed breakdown of the test visit <https://www.iccsafe.org/certification-exam-catalog/>




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Exam Breakdown

	<u>B2</u>	<u>B3</u>
• General Administration	6%	5%
• Building Planning	20%	21%
• Footings and Foundations	8%	8%
• Floor Construction	8%	4%
• Wall Construction and Coverings	21%	12%
• Roof/Ceiling Construction	6%	4%
• Public Safety and Special Construction	31%	46%

For a more detailed breakdown of the test visit <https://www.iccsafe.org/certification-exam-catalog/>





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Preparation

- Both are listed as 80 questions and 3.5 hours
- What to study?
 - Review the ICC website for topics covered and reference materials.
- Plan on personal study of at least 2-hours for every 1-hour of course time.
- Highlight important sections or values so that your eyes are quickly drawn to them.






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Preparation

- Tab your book so you can quickly find frequently referenced sections.
- Make sure to sleep well the night before and to wear comfortable clothing.
- Feel comfortable with the WC3 practice exam.
- You may want to consider having a magnifying glass, an architect's scale, and a nonprogrammable calculator.





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Register for Exam

- Pronto Exams
 - We suggest taking Pronto 101 – Available FREE through ICC
- Visit www.iccsafe.org to find out more.
- See additional links in the course materials.



www.iccsafe.org

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IBC Organization




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Key Items

- **Marginal Markings**
 - Solid vertical lines
 - [→] Entire section, paragraph, exception is deleted
 - [*] indicates text/table has been relocated elsewhere
 - [**] indicates text/table has been relocated there
- **Italicized Terms**
- **Referenced Codes & Standards**
- **Appendices**

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□ **This section should be tabbed.**

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104 Duties and Powers of Building Official..... 1-2	402 Covered Mall and Open Mall Buildings..... 4-1
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□ **This section should be tabbed.**

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Assembly..... 1009.1, 1109.2, 1110.12, 1111	Technical standard..... 1102.1, E101.2
	Telephone..... E108

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IBC Chapters


1. **Scope & Administration**
2. **Definitions**
3. **Occupancy Classification & Use**
4. **Special Detailed Requirements**
5. **General Building Heights & Areas**
6. **Types of Construction**
7. **Fire & Smoke Protection Features**

Etc...




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Commercial Building Inspector (B2) → 6%
 Building Plans Examiner (B3) → 5%

IBC Chapter I

Scope & Administration

International Code Council, 2021 IBC ©






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Scope

IBC 101.2



- ❑ "...construction, alteration, relocation, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures."
- ❑ Appendices do not apply unless specifically adopted.

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Referenced Codes



- ❑ **IBC 101.4**
 - "...shall be considered part of the requirements of this code..."
- ❑ **IFGC, IMC, IPC, IPMC, IFC, IECC, IEBC**

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Conflicts

- ❑ **IBC 102.1**
 - Where there is a conflict between a general requirement and a specific requirement, the **specific requirement** shall be applicable.
- ❑ **IBC 102.4.1 – Referenced Codes & Standards**
 - Where conflicts occur between provisions of this code and referenced codes and standards, the provisions of **this code** shall apply.

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Existing Structures

IBC 102.6

- ❑ "...permitted to continue without change, except as" addressed within the IEBC, IPMC, or IFC.

This does not apply to buildings that:

- ❑ Have not been previously occupied, or
- ❑ Have not been used for its intended purpose.




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Building Official

IBC 104

- ❑ "The building official is hereby authorized and directed to enforce the provisions of this code."
 - Render interpretations
 - Adopt policies & procedures
 - Receive applications
 - Review construction documents
 - Issue permits
 - Inspect premises
 - Enforce compliance




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Building Official

IBC 104.7 - Records

- ❑ "Records shall be retained for "the period required for retention of public records."
 - Applications
 - Permits
 - Certificates issued
 - Fees collected
 - Inspection reports
 - Notices & orders




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Building Official

IBC 104.8 - Liability

- ❑ "The building official, member of the board of appeals, or employee... (are) **relieved from personal liability**..."
- ❑ This assumes that they are acting in "good faith" and "without malice".
- ❑ Legal defense shall be provided by the jurisdiction.



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Building Official

IBC 104.10 - Modifications

- ❑ When the strict letter of the code is impractical.
- ❑ Must comply with the *intent* of the code while not lessening the health, accessibility, life and fire safety, or structural requirements.

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Building Official

IBC 104.11 – Alternative Materials, Design & Methods

- ❑ Materials, designs, or methods not prescribed by the code.
- ❑ They must be *approved*.
- ❑ To approve, it must meet the intent of the code and be no less equivalent in relation to quality, strength, effectiveness, fire resistance, durability, and safety.





www.es.com ©

www.iapmo.org ©



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Building Official

IBC 104.11 - Alternative Materials, Design & Methods

- ❑ **Tests:** Whenever there is insufficient evidence of compliance the B.O. may require tests.

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Permits


IBC 105.2 – Building Exemptions

- ❑ 1-story detached accessory structure ≤ 120ft²
- ❑ Fences ≤ 7-feet high
- ❑ Oil derricks
- ❑ Retaining walls ≤ 4-feet
- ❑ Water tanks ≤ 5,000 gal. on grade
- ❑ Sidewalks and driveways ≤ 30" above grade
- ❑ Painting, papering, tiling, carpeting, cabinets, counter tops and similar finish work.

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Permits


IBC 105.2 – Building Exemptions (cont.)

- Temporary motion picture, television and stage sets and scenery.
- Prefab swimming pools < 24-inches deep
- Shade cloth nursery/agriculture buildings
- Playground equipment for one- and two-family dwellings
- Window awnings in Group R-3 and U occupancies that project ≤ 54-inches
- Nonfixed fixtures, cases, racks, counters and partitions ≤ 5'-9" in height



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Permits

Electrical Exemptions


- Minor repair work
- Radio and television transmission stations
- Temporary testing systems

Gas Exemptions

- Portable heating appliance
- Replacement of any minor part

Plumbing Exemptions

- Stopping of leaks
- Clearing of stoppages





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Permits


Mechanical Exemptions

- Portable heating appliance.
- Portable ventilation equipment.
- Portable cooling unit.
- Water piping within equipment.
- Replacement of any part.
- Portable evaporative cooler.
- Self-contained refrigeration system (≤10# refrigerant)

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Permits


IBC 105.2.1 – Emergency Repairs

- “Where equipment replacements and repairs must be performed in an emergency situation...”
- Next working business day to the building official**



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Permits

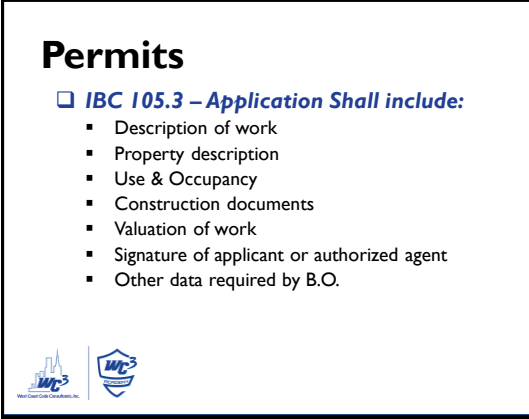
IBC 105.2.2 – Public Service Agencies

- ❑ A permit shall **not be required** for the “installation, alteration or repair of generation, transmission, distribution or metering or other related equipment that is under the ownership and control of public service agencies by established right.”



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Permits

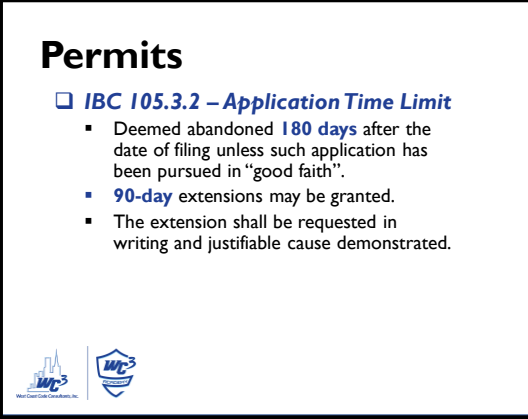
IBC 105.3 – Application Shall include:

- ❑ Description of work
- ❑ Property description
- ❑ Use & Occupancy
- ❑ Construction documents
- ❑ Valuation of work
- ❑ Signature of applicant or authorized agent
- ❑ Other data required by B.O.



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Permits

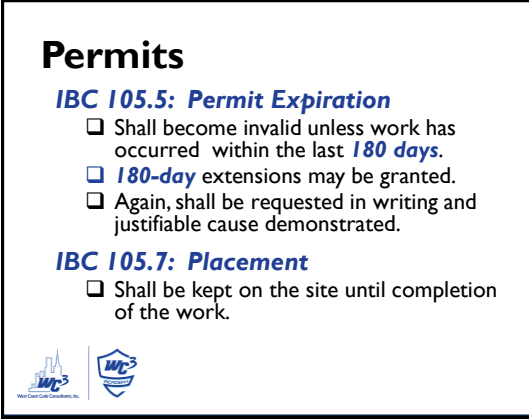
IBC 105.3.2 – Application Time Limit

- ❑ Deemed abandoned **180 days** after the date of filing unless such application has been pursued in “good faith”.
- ❑ **90-day** extensions may be granted.
- ❑ The extension shall be requested in writing and justifiable cause demonstrated.



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Permits

IBC 105.5: Permit Expiration

- ❑ Shall become invalid unless work has occurred within the last **180 days**.
- ❑ **180-day** extensions may be granted.
- ❑ Again, shall be requested in writing and justifiable cause demonstrated.

IBC 105.7: Placement

- ❑ Shall be kept on the site until completion of the work.



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**NOTICE
FLOOR LOAD
CAPACITY LBS.
PER SQUARE FOOT**

Floor & Roof Design Loads


IBC 106.1 – Live Load Posting

- If commercial & industrial building, and...
- Design live load > 50 psf, then...
- “Live loads shall be conspicuously posted by the owner or the owner’s authorized agent in that part of each story in which they apply.”



37


37



Submittal Documents

IBC 107 – Submittal Documents

- Construction Documents
- Statement of Special Inspections
- Geotechnical Report
- Other Data



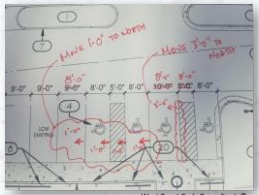

38

38

Submittal Documents

IBC 107.2 – Construction Documents

- Dimensioned & drawn on suitable material.


39

39

Submittal Documents

IBC 107.2 – Construction Documents

- “...of sufficient clarity to indicate the location, nature, and extent of the work proposed and show in detail that it will conform to the provisions of the code...”
 - Fire protection shop drawings
 - Means of egress
 - Exterior wall envelope
 - Exterior balconies & elevated surfaces
 - Site plan
 - Structural information



40



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Submittal Documents

IBC 107.4 - Amended Construction Documents

- Work shall be performed per the **approved** construction documents.
- Changes made during construction... shall be resubmitted for approval.
- Re-issued as amended set of approved construction documents.

What if the construction cost significantly increases as a result of the changes made?



45

45

Submittal Documents

IBC 107.5 – Document Retention

- 180 days** after completion of permitted work, or...
- As required by **state or local laws**

46



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Temporary Structures

IBC 108 – Time of Service (≤180 days)

Must conform to...

- Structural strength
- Fire safety
- Means of egress
- Accessibility
- Light
- Ventilation
- Sanitary requirements

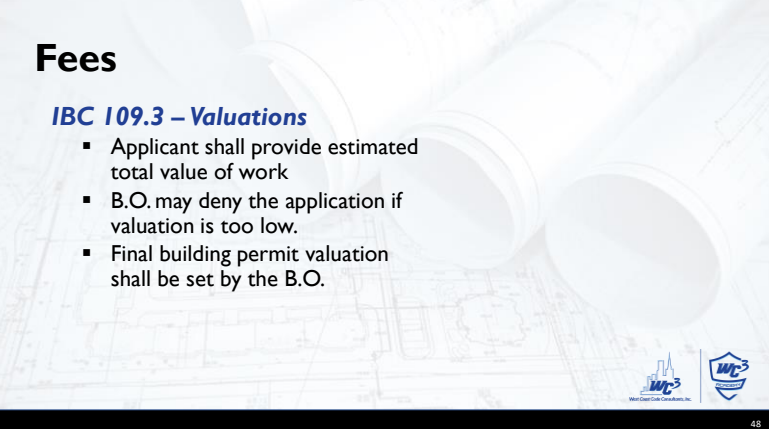

47

47

Fees

IBC 109.3 – Valuations

- Applicant shall provide estimated total value of work
- B.O. may deny the application if valuation is too low.
- Final building permit valuation shall be set by the B.O.



48

48

Inspections

IBC 110.3 – Required Inspections

- Footing & foundation
- Concrete slab & underfloor
- Lowest floor elevation
- Framing
- Types IV-A, IV-B, IV-C connections
- Lath & gypsum
- Weather-exposed balconies
- Fire- and smoke-penetrations
- Energy efficiency
- Other inspections

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Inspections

Special Inspections

- Per IBC Chapter 17

Final Inspection



- Made after "all work" is completed.

Inspection Requests

- Permit holder to notify the B.O. when work is ready for inspection.

Approval Required

- Work shall not be done beyond the point indicated. Do not cover until authorized.

50



Certificate of Occupancy

IBC 111.1

- "Shall not be used or occupied..." until B.O. has issued.

IBC 111.2

- Shall include...
 - Permit number
 - Code edition
 - Address of structure
 - Use & occupancy
 - Name & address of owner
 - Type of construction
 - Description
 - Design occupant load
 - Compliance statement
 - Sprinklered?
 - Name of B.O.
 - Special stipulations

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T.C.O.

IBC 111.3

- B.O. may issue a T.C.O. provided...
 - Such portions may be occupied safely, and...
 - An expiration date is established for the T.C.O.

Salt Lake City Building Services
www.slcdocs.com

401 South State Street, Room 215 Salt Lake City, Utah 84111

401 West 14th Street Salt Lake City, Utah 84115-2400

Office only Updated 06/2012



Issue	Received by
Project Address	Date
Building permit #	Validation
Per collection #	

Temporary Certificate of Occupancy Agreement

Request is hereby being made to Building Services and Licensing Inspection Department for a 30-day Temporary Certificate of Occupancy. It is understood that this building project is not completely finished and that...

A Temporary Certificate of Occupancy is for a specified period of time (30 days). This certificate is valid. It is also temporary and expires on 06/15/2012. It will be voided if no request for extension is received by 05/31/2012.

Salt Lake City Corporation, T.C.O. Agreement, www.slcdocs.com





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Means of Appeals

IBC 113 – Means of Appeals

- Board of appeals can be established
- Appointed by jurisdiction
- Members shall be qualified by experience and training pertaining to building construction
- Shall adopt rules of procedure
- No authority to waive a code requirement
- Must render all decisions and findings in writing to appellant
- IBC Appendix 'B' provides more information.




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IBC Chapter 2

Definitions

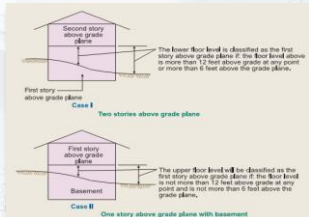


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Definitions

Example: Story Above Grade Plane

- ❑ > 6-feet above grade plane, or ...
- ❑ > 12-feet above finished ground level



International Code Council, Figure 202-21 ©



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END OF MODULE I



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2021 International Building Code
Inspector/Plans Examiner






1

1

Modules

- 1. Chapters 1 & 2
- 2. **Chapter 3**
- 3. Chapters 4 & 6
- 4. Chapter 5
- 5. Chapter 7 – Part 1
- 6. Chapter 7 – Part 2
- 7. Chapter 10
- 8. Chapter 11
- 9. Chapters 8 & 9
- 10. Chapters 12, 14 & 15
- 11. Chapters 16, 17 & 18
- 12. Chapters 19 thru 23
- 13. Chapter 24
- 14. Chapters 25 thru 35
- 15. Plan Review Considerations






2

2

MODULE 2:

IBC Chapters 3 – Occupancy Classification & Use






3

3

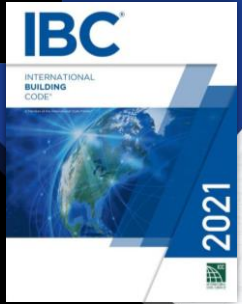
Learning Objectives

- 1. Know the various occupancy use groups found in the code
- 2. Be able to properly classify buildings into their respective use groups
- 3. Understand the differences between the various High Hazard use groups
- 4. Know where to find the allowable quantities of materials associated with High Hazard use groups.

4


4



Commercial Building Inspector (B2) → 5%
 Building Plans Examiner (B3) → 4%

IBC Chapter 3



Occupancy Classification & Use



5

IBC Chapter 3



DESCRIPTION	GROUP(S)
Assembly	A-1, A-2, A-3, A-4 and A-5
Business	B
Educational	E
Factory and Industrial	F-1 and F-2
High Hazard	H-1, H-2, H-3, H-4 and H-5
Institutional	I-1, I-2, I-3 and I-4
Mercantile	M
Residential	R-1, R-2, R-3 and R-4
Storage	S-1 and S-2
Utility and Miscellaneous	U

6

Classification

- Structures shall be classified with respect to **occupancy** in one or more of the listed **groups**.
- If the purpose of the structure is not specifically provided, it shall be *“classified in the group that the occupancy most nearly resembles, according to the fire safety and relative hazard involved.”*



7

Assembly (Group A)


Assembly Group A:

For the gathering of persons for purposes such as civic, social or religious functions; recreation, food or drink consumption or awaiting transportation.

- Group B if...
- Occupant load < 50, or...
- < 750ft² and accessory to another occupancy


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Assembly (Group A)

Assembly Group A-1:
Production and viewing of performing arts or motions pictures.

- Motion picture theaters
- Symphony and concert halls
- Television and radio studios admitting an audience
- Theaters




Valley Fair Mall Regal Theater, West Valley, UT

9

9



Assembly (Group A)

Assembly Group A-2:
Assembly uses intended for food and/or drink consumption.

- Banquet halls
- Casinos (gaming areas)
- Nightclubs
- Restaurants, cafeterias, etc.
- Bars



The Cheesecake Factory, City Center, UT




10

10



Assembly (Group A)


Assembly Group A-3:
Assembly uses intended for worship, recreation or amusement and other assembly uses not classified elsewhere in Group A.

<ul style="list-style-type: none"> ▪ Amusement arcades ▪ Art galleries ▪ Bowling alleys ▪ Community halls ▪ Courtrooms ▪ Dance halls ▪ Exhibition halls ▪ Funeral parlors 	<ul style="list-style-type: none"> ▪ Greenhouses ▪ Gymnasiums* ▪ Indoor swimming pools* ▪ Indoor tennis courts* <p style="font-size: x-small;">*(w/o spectator seating)</p>
---	---




11



11



Assembly (Group A)


Assembly Group A-3 (cont.):

- Lecture halls
- Libraries
- Museums
- Places of religious worship
- Pool and billiard parlors
- Waiting areas in transportation terminals

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12



Assembly (Group A)


Assembly Group A-4:
 Assembly intended for viewing indoor sporting events.

- Arenas
- Skating rinks
- Swimming pools
- Tennis courts



13


13



Assembly (Group A)

Assembly Group A-5:
 Assembly uses intended for viewing outdoor activities.

- Amusement park structures
- Bleachers
- Grandstands
- Stadiums





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Business (Group B)

Business Group B:
 The use of a building or structure for office, professional or service-type transactions, including storage of records and accounts.

- Airport traffic control towers
- Ambulatory care facilities
- Animal hospitals, kennels and pounds
- Banks
- Barber and beauty shops
- Car wash



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Business (Group B)

Business Group B (cont.):

- Civic Administration
- Clinic outpatient
- Dry cleaning and laundries
- Educational occupancies (students above 12th grade)
- Electronic data processing
- Food processing establishments and commercial kitchens *not associated with restaurants*, cafeterias and similar dining facilities not more than 2,500 sq. ft.
- Laboratories: testing/research





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Business (Group B)

Business Group B (cont.):

- Motor vehicle showrooms
- Post offices
- Print Shops
- Professional services
- Radio and television stations
- Telephone exchanges





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Educational (Group E)

Educational Group E:

- ❑ The use of a building or structure by **six or more** persons at any one time for educational purposes through the **12th grade**.




18

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Educational (Group E)

Educational Group E:

- ❑ Day care facilities
 - > 5 children, 2.5 years of age who receive education or supervision for fewer than 24 hours per day.
 - Religious worship – same as primary occupancy
 - ≤ 5 children – same as primary occupancy
- ❑ Accessory to religious worship and < 100 occupants per room or space = Group A-3






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Factory (Group F)

❑ The use of a building or structure for **“assembling, disassembling, fabricating, finishing, manufacturing, packaging, repair or processing operations”** that are not classified as Group H or Group S.

H-Occupancy




20

20

Factory (Group F)

Moderate-Hazard, Group F-1:
 Factory industrial uses that are not classified as Low-Hazard Group F-2.

- Aircraft (manufacturing, not repair)
- Appliances
- Athletic equipment
- Automobiles and other motor vehicles
- Bakeries
- Beverages (> 16% alcohol)



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Factory (Group F)

Moderate-Hazard, Group F-1 (cont.):

- Bicycles
- Boats
- Brooms and brushes
- Business machines
- Cameras and photo equipment
- Canvas or similar fabric
- Carpets and rugs
- Clothing
- Etc.



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Factory (Group F)

Low-Hazard, Group F-2:
 Factory industrial uses that involve **noncombustible** materials that do not involve significant fire hazard.

- Beverages (≤ 16% alcohol)
- Brick and masonry
- Ceramic products
- Foundries
- Glass products
- Gypsum
- Ice
- Metal products (fabrication and assembly)



23

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High-Hazard (Group H)

High Hazard Group H:

- ❑ The use of a building or structure that “involves the manufacturing, processing, generation or storage of materials that constitute a **physical or health hazard** in quantities in excess of those allowed in control areas...”
- ❑ If stored or used on top of roofs or canopies shall be classified as outdoor storage and shall comply with the IFC.

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High-Hazard (Group H)

High Hazard Group H:

☐ Group H if quantities of materials exceed those allowed by Tables 307.1(1) and 307.1(2)

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE ⁵				USE-CLOSED SYSTEM ⁶		USE-OPEN SYSTEM ⁷	
			Solid pounds (cubic feet)	Liquid gallons (cubic feet)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (cubic feet)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (cubic feet)
Combustible dust	NA	H-2	See Note g	NA	NA	See Note g	NA	NA	See Note g	NA
Combustible flue ⁸	Loose Bulk ⁹	H-3	(100)	NA	NA	(100)	NA	NA	(20)	NA
			(1,000)			(1,000)			(200)	

MATERIAL	STORAGE ⁵			USE-CLOSED SYSTEM ⁶		USE-OPEN SYSTEM ⁷	
	Solid pounds ⁸	Liquid gallons (cubic feet) ⁹	Gas (cubic feet at NTP) (pounds) ¹⁰	Solid pounds ⁸	Liquid gallons (cubic feet) ⁹	Solid pounds ⁸	Liquid gallons (cubic feet) ⁹
Corrosives	5,000	500	5,000	500	Corrosives H1P ¹¹ Liquified (150)	1,000	100
Highly Toxic	10	(10)	10	(10)	Corrosives H2P ¹¹ Liquified (4P)	3	(3)

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High-Hazard (Group H)

Group H-1: Detonation Hazard

- Detonable pyrophoric materials
- Explosives (Division 1.1-1.6)
- Organic peroxides, unclassified detonable
- Oxidizers, Class 4
- Unstable reactive materials, Class 3 detonable and Class 4




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High-Hazard (Group H)

Group H-2: Deflagration Hazard

- Class I, II, IIIA flammable/combustible liquids (>15psi)
- Combustible dusts
- Cryogenic fluids, flammable
- Flammable gases
- Organic peroxides, Class I
- Oxidizers, Class 3
- Pyrophoric liquids, solids and gases, non-detonable
- Unstable (reactive) materials, Class 3, non-detonable
- Water-reactive materials, Class 3




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High-Hazard (Group H)

Group H-3: Support combustion or pose a physical hazard

- Class I, II, or IIIA flammable/combustible liquids (≤15psi)
- Combustible fibers
- Consumer fireworks, 1.4G (Class C, Common)
- Cryogenic fluids, oxidizing
- Flammable solids
- Organic peroxides, Class II and III
- Oxidizers, Class 2
- Oxidizers, Class 3 (≤15psi)
- Oxidizing gases
- Water-reactive materials, Class 2



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High-Hazard (Group H)

Group H-4: Health Hazards

- Corrosives
- Highly toxic materials
- Toxic materials

IBC Commentary:

“The data sheets for these chemicals, which are furnished by the applicant, will need considerable subjective evaluation.”

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High-Hazard (Group H)

Group H-5: Hazardous Production Materials



- Semiconductor fabrication
- Research and development

IBC Commentary:

“It is intended that the quantities of materials permitted in Table 415.11.1.1.1 will take precedence over Tables 307.1(1) and 307.1(2).”

[F] TABLE 415.11.1.1.1 QUANTITY LIMITS FOR HAZARDOUS MATERIALS IN A SINGLE FABRICATION AREA IN GROUP H-5 ^a				
HAZARD CATEGORY	SOLIDS (pounds per square foot)		LIQUIDS (gallons per square foot)	GAS (cubic feet @ 1/2 square foot)
	PHYSICAL HAZARD MATERIALS			
Combustible dust	Note b		Not Applicable	Not Applicable
	Loose	Note b	Not Applicable	Not Applicable
Combustible fiber	Notes b and c		Not Applicable	Not Applicable
	Baled	Notes b and c	Not Applicable	Not Applicable

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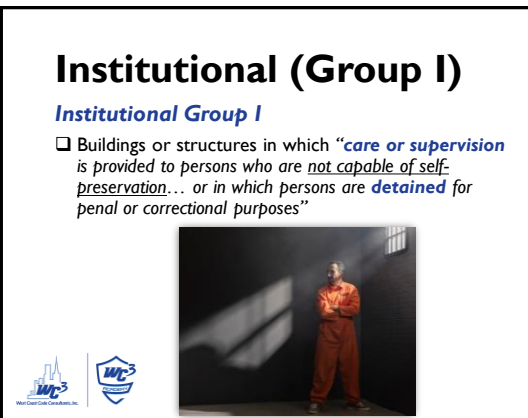

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Institutional (Group I)

Institutional Group I

Buildings or structures in which “*care or supervision is provided to persons who are not capable of self-preservation... or in which persons are detained for penal or correctional purposes*”

31

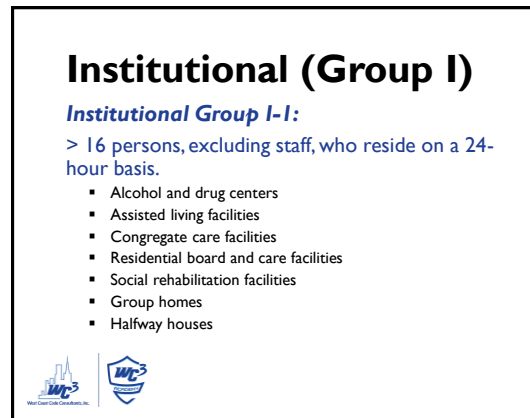

31

Institutional (Group I)

Institutional Group I-1:

> 16 persons, excluding staff, who reside on a 24-hour basis.

- Alcohol and drug centers
- Assisted living facilities
- Congregate care facilities
- Residential board and care facilities
- Social rehabilitation facilities
- Group homes
- Halfway houses



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Institutional (Group I)

Institutional Group I-1 (cont.):

- ❑ **Condition 1:** Persons receiving custodial care that *are capable* of responding to an emergency situation without any assistance.
- ❑ **Condition 2:** Persons receiving custodial care require *limited verbal or physical assistance* in an emergency situation.
- ❑ **≤ 5 Persons:** Group R-3
- ❑ **6 – 16 Persons:** Group R-4

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Institutional (Group I)

Institutional Group I-2:

Medical care to > 5 persons on a 24-hour basis

- Foster care facilities
- Detoxification facilities
- Hospitals
- Nursing homes
- Psychiatric hospitals



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Institutional (Group I)

Institutional Group I-2 (cont.):

- ❑ **Condition 1:** Nursing and medical care but *not* emergency care, surgery, obstetrics or in-patient stabilization units.
- ❑ **Condition 2:** Includes emergency care, surgery, obstetrics or in-patient stabilization units.
- ❑ **≤ 5 Persons:** Group R-3

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Institutional (Group I)

Institutional Group I-3:

> 5 persons under restraint or security

- Correctional centers
- Detention centers
- Jails
- Pre-release centers
- Prisons
- Reformatories



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Institutional (Group I)

Institutional Group I-3 (cont.):

- ❑ **Condition 1:** Free movement allowed from sleeping areas and other spaces and access to the exterior is permitted.
- ❑ **Condition 2:** Free movement allowed from sleeping areas and other spaces but egress to the exterior is impeded by locked exits.
- ❑ **Condition 3:** Free movement is allowed within individual compartments, such as sleeping areas and group activity spaces, but egress is impeded.



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Institutional (Group I)

Institutional Group I-3 (cont.):

- ❑ **Condition 4:** Free movement is restricted from an occupied space. Remote-controlled release is provided to permit movement.
- ❑ **Condition 5:** Free movement is restricted from an occupied space. Staff-controlled manual release is provided to permit movement.




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Institutional (Group I)

Institutional Group I-4:

- > 5 persons who receive custodial care for < 24 hours.
 - Adult day care
 - Child day care
 - Group E: > 5 but < 100 children, 2.5 years of age or less and: Rooms are located on level of exit discharge and have an exit door directly to exterior.

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Institutional (Group I)

Institutional Group I-4 (cont.):

Same as Primary Occupancy if:


- Within a religious facility and care is provided during religious functions, or...
- ≤ 5 persons receiving custodial care

Group R-3: ≤ 5 persons receiving custodial care and located within a dwelling unit.

40




40



Mercantile (Group M)

Group M:
The use of a building or structure for the “**display and sale** of merchandise, and involves stocks of goods... incidental to such purposes and accessible to the public”

- Department stores
- Retail or wholesale stores
- Drug stores
- Markets
- Motor fuel-dispensing
- Sales rooms

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Residential (Group R)

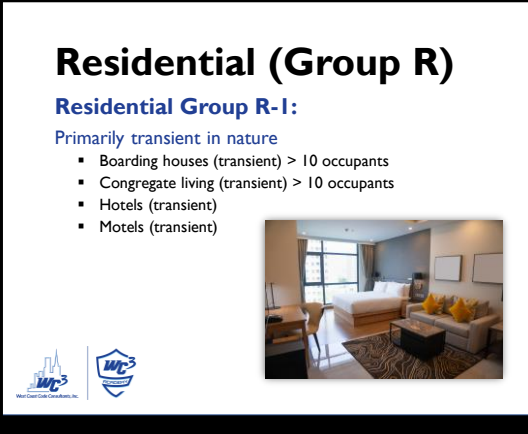
Residential Group R:
□ The use of a building or structure for “**sleeping purposes** when not classified as a Group I”





42




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Residential (Group R)


Residential Group R-1:
Primarily transient in nature

- Boarding houses (transient) > 10 occupants
- Congregate living (transient) > 10 occupants
- Hotels (transient)
- Motels (transient)

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Residential (Group R)

Residential Group R-2:
> 2 dwelling units and primarily permanent in nature.

- Apartment houses
- Boarding houses (non-transient) > 16 occupants
- Congregate living (non-transient) > 16 occupants
- Convents/monasteries
- Dormitories
- Fraternities/sororities
- Hotels/motels (non-transient)
- Live/work units
- Vacation timeshare properties

44




44

Residential (Group R)

Residential Group R-3:

Primarily permanent in nature and not classified as R-1, R-2, R-4 or I

- ≤ 2 dwelling units
- Boarding houses (non-transient) ≤ 16 occupants
- Boarding houses (transient) ≤ 10 occupants
- Congregate living (non-transient) ≤ 16 occupants
- Congregate living (transient) ≤ 10 occupants
- Lodging houses with ≤ 5 guest rooms




45

Residential (Group R)

Residential Group R-4:

> 5 but ≤ 16 persons who reside on a 24-hour basis in a supervised residential

- Alcohol and drug centers
- Assisted living facilities
- Congregate care
- Group homes
- Halfway houses
- Residential board and care facilities
- Social rehabilitation facilities





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Storage (Group S)

Storage Group S:

The use of a building or structure for “storage that is not classified as a hazardous occupancy”

☐ Accessory Spaces: if < 100ft² shall be classified as part of the primary occupancy

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Storage (Group S)

Storage Group S-1:


Not classified as S-2

- Aerosols, Levels 2 and 3
- Aircraft hanger
- Bags: cloth, burlap and paper
- Baskets
- Belting: canvas and leather
- Books and paper in rolls or packs
- Boots and shoes
- Buttons









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Storage (Group S)


Storage Group S-2:
Noncombustible materials

- Asbestos
- Beverages up to 16% alcohol
- Cement in bags
- Chalk and crayons
- Dairy products
- Dry cell batteries
- Electrical coils
- Electrical motors

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49



Utility (Group U)

Utility Group U:
Buildings and structures of an “*accessory character and miscellaneous structures not classified in any specific occupancy*”

- Agricultural buildings
- Aircraft hangars (accessory to one- or two- family residence)
- Barns
- Carports
- Fences
- Grain silos

50

50



END OF MODULE 2




51

51



2021 International Building Code
Inspector/Plans Examiner




1

Modules

- 1. Chapters 1 & 2
- 2. Chapter 3
- 3. **Chapters 4 & 6**
- 4. Chapter 5
- 5. Chapter 7 – Part 1
- 6. Chapter 7 – Part 2
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- 12. Chapters 19 thru 23
- 13. Chapter 24
- 14. Chapters 25 thru 35
- 15. Plan Review Considerations

2

MODULE 3:



*IBC Chapters 4 & 6 –
Special Requirements and
Types of Construction*




3

Learning Objectives

- 1. Distinguish between each of 5 primary construction types, and their sub-categories.
- 2. Recognize the differences between primary and secondary structural members.
- 3. Know what specific uses require special code considerations.
- 4. Become familiar with the code requirements for special uses.

4



Commercial Building Inspector (B2) → 1%
Building Plans Examiner (B3) → 0%

IBC Chapter 6

Types of Construction

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5

IBC Chapter 6

Combustible **Type V** Combustible Construction

Type IV Heavy Timber Construction

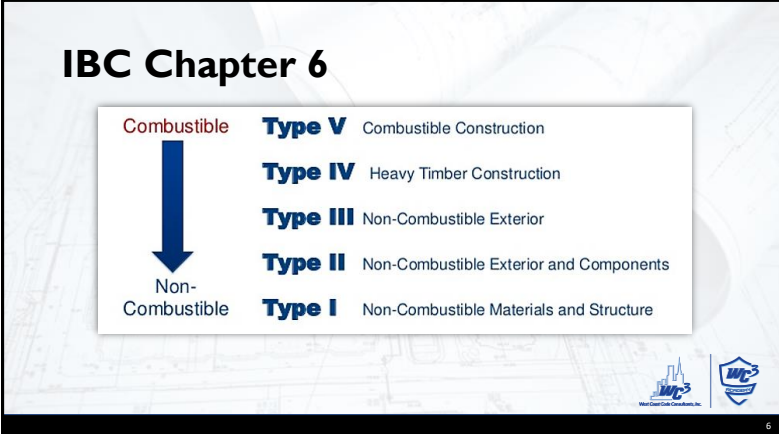
Type III Non-Combustible Exterior

Type II Non-Combustible Exterior and Components

Type I Non-Combustible Materials and Structure

Non-Combustible

↓



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6

IBC Chapter 6

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III			TYPE IV			HT	TYPE V	
	A	B	A	B	A	B	C	A	B	C		A	B
Primary structural frame ^a (see Section 202)	3 ^b	2 ^{b,c}	1 ^{b,c}	0 ^c	1 ^{b,c}	0		3 ^a	2 ^a	2 ^a	HT	1 ^{b,c}	0
Bearing walls													
Exterior ^{a,f}	3	2	1	0	2	2	3	2	2	2		1	0
Interior	3 ^a	2 ^a	1	0	1	0	3	2	2	1/HT ^a		1	0
Nonbearing walls and partitions	See Table 705.5												
Exterior													
Nonbearing walls and partitions Interior ^a	0	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2		HT	1	0
Roof construction and associated secondary structural members (see Section 202)	1 1/2 ^b	1 ^{b,c}	1 ^{b,c}	0 ^c	1 ^{b,c}	0	1 1/2	1	1		HT	1 ^{b,c}	0

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IBC Chapter 6

Beware of the Footnotes!

- Heavy Timber allowed for 1-hour roof construction
- Exterior bearing walls → Not less than that required for FSD

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP ^d	
		F-1, M, S-1	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U ^e
X < 5'	All	2	1
	IA, IVA	3	2
5' ≤ X < 10'	Others	2	1
	IA, IB, IVA, IVB	2	1
10' ≤ X < 30'	IB, VB	1	0
	Others	1	1
X ≥ 30'	All	0	0

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Table 601

Primary Structural Frame – Includes:

- Columns.
- Structural members having direct connections to the columns, including: girders, beams, trusses, and spandrels.
- Members of the floor and roof construction having direct connection to the columns.
- Bracing members that are essential to the vertical stability of the primary structural frame under gravity loading.



9

9





Table 601


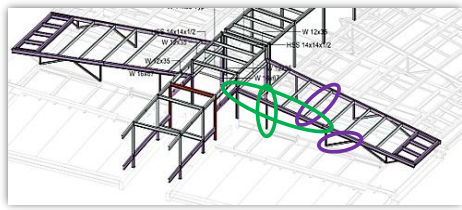
Secondary Members – Includes:

- Structural members not directly connected to the columns.
- Member of floor or roof construction not having direct connection to columns.
- Bracing members that are not part of a primary structural frame or a bearing wall.




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- Primary Structural Members**
- Secondary Structural Members**



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Table 601

Bearing Wall (Wall, Load-Bearing)

- Metal or wood stud wall that supports **more than 100 pounds per linear foot** of vertical load in addition to its own weight.
- Any masonry or concrete wall that supports **more than 200 pounds per linear foot** of vertical load in addition to its own weight.

Nonbearing Wall (Wall, Nonload-Bearing)

- Not a bearing wall.





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Construction Type

Types I and II (602.2)

- Elements notes in Table 601 are...
- Noncombustible
- Exception: Items listed in Section 603

http://franklinandmerrill.com/industry/10000.html
construction.com

www.wc3.com

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Construction Type



Type III (602.3)

Exterior Walls:

- Noncombustible*

Interior elements

- Any material permitted

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Construction Type

Type III (602.3)

Exterior Wall Exception:

- Fire-retardant-treated wood exterior wall (2-hour or less)



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Construction Type

Types IV (602.4)

- Perhaps biggest change in 2021 IBC!
- There are now four separate Type IV options:
 - Type IV-HT (Heavy Timber)
 - Type IV-C (CLT – Mostly exposed)
 - Type IV-B (CLT – Mostly protected)
 - Type IV-A (CLT – Completely protected)
- Cross-Laminated Timber (CLT)
 - Prefabricated, not less than 3 layers



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Construction Type

Types IV (602.4)

- ❑ Elements are either mass timber or noncombustible.
- ❑ Even non-bearing exterior and interior walls shall be mass timber or noncombustible.
- ❑ Combustible concealed spaces are not permitted.
- ❑ Minimum dimensions → per IBC 2304.11
- ❑ Types IV-A, IV-B & IV-C require noncombustible protection.

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Construction Type

Types IV (602.4)

- ❑ Type IV-A:
 - Exterior → 40 minutes min.
 - Interior → 80 minutes min.
 - Floors → Noncombustible covering ≥ 1-inch
 - Roofs → Same as interior provisions

REQUIRED FIRE-RESISTANCE RATING OF BUILDING ELEMENT PER TABLE 601 AND TABLE 703.3 (hours)	MINIMUM PROTECTION REQUIRED FROM NONCOMBUSTIBLE PROTECTION (minutes)
1	40
2	80
3 or more	120

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Construction Type

Types IV (602.4)

- ❑ Type IV-B:
 - Exterior → 40 minutes min.
 - Interior → 80 minutes min. (Several exceptions!)
 - Allows for mixed unprotected area calculation
 - Floors → Noncombustible covering ≥ 1-inch
 - Roofs → Same as interior provisions



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Construction Type

Types IV (602.4)

- ❑ Type IV-C:
 - Exterior → 40 minutes min.
 - Interior → Unprotected
 - Floors → No requirement
 - Roofs → No requirement
- ❑ Example: A-2, sprinklered occupancy
 - IV-A → 18 stories, 135,000 ft²
 - IV-B → 12 stories, 90,000 ft²
 - IV-C → 6 stories, 56,250 ft²




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Construction Type

Type V (602.5)

- Any material permitted.



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Construction Type

BUILDING ELEMENT	TYPE I			TYPE II			TYPE IV			TYPE V	
	A	B	A	B	A	B	C	HT	A	B	
Primary structural frame ^a (see Section 202)	3 ^h	2 ^h	1 ^h	0 ^h	1 ^h	0	3 ^h	2 ^h	2 ^h	HT	1 ^h
Exterior walls	3	2	1	0	2	2	3	2	2	2	1
Interior walls	3 ^a	2 ^a	1	0	1	0	3	2	2	1/HT ^a	1
Nonbearing walls and partitions	See Table 705.5										
Nonbearing walls and partitions	See Section 2304.11.2										
Interior ^d	0	0	0	0	0	0	0	0	0	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1
Roof construction and associated secondary structural members (see Section 202)	1 1/2 ^b	1 ^h	1 ^h	0 ^h	1 ^h	0	1 1/2 ^b	1	1	HT	1 ^h

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Types I & II → Combustible

- Fire retardant treated wood
- Insulation (FSI < 25)
- Trim and Finishes (See Chapter 8)
- Millwork
- 6 ft. partitions
- Stages/Platforms
- Exterior wall coverings
- Blocking
- Plastics (Ch. 26)
- Sealants (ext. wall)
- Furring strips (See Chapter 8)
- Heavy Timber
- Materials used for fire protection
- Concealed spaces (IBC 718.5)
- Materials in Plenums
- Freezers < 1,000 ft2
- Ducts/piping/electrical

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Commercial Building Inspector (B2) → 0%

Building Plans Examiner (B3) → 0%

IBC Chapter 4

Special Requirements








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Chapter 4: Special Uses

- ❑ 402 – Open & closed malls
- ❑ 403 – High rise buildings
- ❑ 404 – Atriums
- ❑ 405 – Underground buildings
- ❑ 406 – Motor vehicle - Private/Public/Repair/Fuel
- ❑ 407 – Group I-2
- ❑ 408 – Group I-3
- ❑ 409 – Movie Theaters
- ❑ 410 – Stages/Platforms












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Chapter 4: Special Uses

- ❑ 411 – Special amusement buildings
- ❑ 412 – Aircraft related
- ❑ 413 – Combustible storage
- ❑ 414 – Hazardous materials
- ❑ 415 – Group H occupancies
- ❑ 416 – Spray rooms
- ❑ 417 – Drying rooms
- ❑ 418 – Organic coating
- ❑ 419 – Artificial decorative vegetation
- ❑ 420 – Group I-I and R












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Chapter 4: Special Uses

- ❑ 421 – Hydrogen fuel gas
- ❑ 422 – Ambulatory care centers
- ❑ 423 – Storm shelters
- ❑ 424 – Play structures
- ❑ 425 – Hyperbaric facilities
- ❑ 426 – Combustible dusts & Grain processing & storage
- ❑ 427 – Medical gas systems
- ❑ 428 – Higher education labs




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IBC 402: Covered Malls


Definitions

- ❑ **Mall** – A roofed or covered common pedestrian area that serves as access for two or more tenants and does not exceed three levels that are open to each other.
- ❑ **Open Mall** – An unroofed pedestrian way serving a number of tenants not exceeding three levels. Circulation at levels above grade shall be permitted to include open exterior balconies leading to exits discharging at grade.

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IBC 402: Covered Malls


Definitions

- Covered Mall Building** – A single building enclosing a number of tenants, wherein two or more tenants have a main entrance into one or more malls. Includes “Open Mall Buildings”. Cannot include “Anchor Buildings”.
- Open Mall Building** – Structures housing a number of tenants and opening into an Open Mall. Cannot include “Anchor Buildings”.



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IBC 402: Covered Malls


Definitions

- Anchor Building** – An exterior perimeter building having direct access to a covered or open mall building but having means of egress independent of the Mall. Cannot include Group H.

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IBC 402: Covered Malls

Limited Stories


- 3 stories above grade plane
- 3 levels at any point

Perimeter Line

- Shall define extent of open mall buildings
- Anchor buildings and parking structures should be outside of perimeter line and not considered part of open mall


Open Space

- Covered mall buildings, anchor buildings, parking structures shall be surrounded, on all sides, by 60-feet of open space



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IBC 402: Covered Malls

No Type V construction

Allowable area

- Mall – Unlimited
- Anchor Building – Chapter 5
- Parking Garage – IBC 406



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IBC 402: Covered Malls

Fire separation


- Tenant/Mall: No separation
- Tenant/Tenant: 1-hour Fire Partition
- Anchor/Mall Building: Fire Wall (exceptions) typically 3-hr
- Parking Garage/Mall: 2-hour Fire Barrier

Pedestrian walkways ≥ 20-feet wide



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IBC 402: Covered Malls

Additional provisions include:

- Shall be sprinklered
- Interior Finishes
- Emergency Systems
- Means of Egress






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IBC 403: High Rise

- High Rise:** Building with an occupied floor located more than 75 feet above lowest level of fire department vehicle access.
- Does not include:**
 - Air traffic control towers
 - Open parking garages
 - A-5 Use Groups
 - Special Industrial Buildings
 - Use Groups H-1, H-2, or H-3







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IBC 404: Atriums

- Atrium:** A vertical space that is closed at the top and connects three or more stories. (*Two or more for I-2 & I-3*)
- Special Provision:**
 - Use (404.2)
 - Fire sprinklers (404.3)
 - Fire alarm (404.4)
 - Smoke Control (404.5)
 - 1hr separation (404.6)
 - Class B finish (404.8)
 - 200 ft. travel distance (404.9)

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IBC 406: Motor Vehicles


406.3 – Private Garages & Carports

- Up to 1,000 ft²
- 7-foot clear height
- Separation from dwelling units
- Carports – Open on two sides
 - Not considered garages



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IBC 406: Motor Vehicles


406.4 – Public Garages (Group S-2)

- Either open or enclosed
- 7-foot clear height
- Vehicle barriers
- Floors – Non-combustible and Non-absorbent.
- Ramps – not allowed as exits unless pedestrian facilities provided




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IBC 406: Motor Vehicles

- 406.5 – Open Parking Garages**
- 406.6 – Enclosed Garages**
- 406.7 – Motor Fuel Dispensing**
- 406.8 – Repair Garages**



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END OF MODULE 3



40

40

2021 International Building Code
Inspector/Plans Examiner






1

1

Modules

- 1. Chapters 1 & 2
- 2. Chapter 3
- 3. Chapters 4 & 6
- 4. **Chapter 5**
- 5. Chapter 7 – Part I
- 6. Chapter 7 – Part 2
- 7. Chapter 10
- 8. Chapter 11
- 9. Chapters 8 & 9
- 10. Chapters 12, 14 & 15
- 11. Chapters 16, 17 & 18
- 12. Chapters 19 thru 23
- 13. Chapter 24
- 14. Chapters 25 thru 35
- 15. Plan Review Considerations

2

2

MODULE 4:

IBC Chapter 5 – Building Heights and Areas






3

3

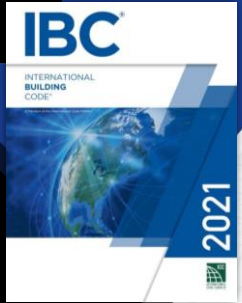
Learning Objectives

- 1. Be able to determine building areas and building heights.
- 2. Successfully navigate and understand **Table 504.3**
- 3. Know how to verify frontage increases.
- 4. Distinguish between separated and non-separated uses, and how these designations impact code compliance.
- 5. Become familiar with incidental uses.

4

4



Commercial Building Inspector (B2) → 7%
 Building Plans Examiner (B3) → 2%

IBC Chapter 5

Building Heights and Areas

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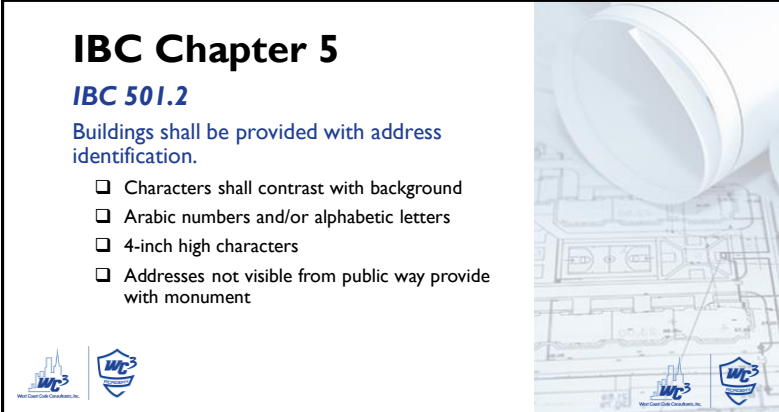

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IBC Chapter 5

IBC 501.2

Buildings shall be provided with address identification.



- Characters shall contrast with background
- Arabic numbers and/or alphabetic letters
- 4-inch high characters
- Addresses not visible from public way provide with monument

6

Definitions

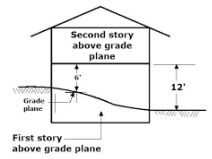


- Building Area** – Area within exterior walls and fire walls or below roof and floor projections.
- Building Height** – From grade plane to average height of the highest roof surface.
- Grade Plane** – A reference plane representing finished ground level.


7

Definitions

- Story above grade plane**
 - Finished floor 100% above grade plane, or...
 - Floor above is:
 - > 6 feet above grade plane; or
 - > 12 feet above finished grade at any point


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IBC 503: Height and Area

General (503.1)

- Buildings separated with **fire walls** are only considered separate buildings in relation to...
 - Area limitations
 - Height limitations
 - Type of construction



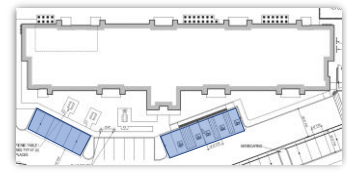

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IBC 503: Height and Area

Buildings on Same Lot (503.1.2)

- Separate Buildings, or
- Single building





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IBC 505: Mezzanines

Mezzanine (505.2)

- Part of story below, but not part of Building Area
- Requirements:**
 - 7-foot clear height (above & below)
 - 1/3 Area of room located in
 - 1/2 Area of room if Type I and II Construction w/ NFPA 13 and Voice Alarm
 - 2/3 Area of room if Type I and II Construction in Industrial Occupancies




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IBC 505: Mezzanines

Mezzanine (505.2)

- Openness
 - Open to room
 - Walls < 42 high
- Exceptions to Openness
 - < 10 occupants
 - At least 2 means of egress
 - < 10% enclosed
 - Groups H & I → NFPA 13 w/ (2) means of egress






12

Equipment Platforms

Equipment Platform (505.3)

- Not included in building or fire area or # of stories
- Not part of a mezzanine
- Access independent of building egress
- Limitations
 - 2/3 Area of room
 - In sprinklered buildings provide above and below, and guards are required



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Building Height & Stories



Building Height (Table 504.3)

- NS – Entire building not sprinklered
- S – Entire building NFPA 13 Sprinklers
- SI3D – Entire building NFPA 13D Sprinklers
- SI3R – Entire building NFPA 13R Sprinklers
- UL – Unlimited

Number of Stories (Table 504.4)

Mixed Occupancies – No individual occupancy shall exceed the height & number of stories





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**TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE^a**



OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV			HT	Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS ^b	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1, H-2, H-3, H-5	NS ^{c,d}	UL	160	65	55	65	55	120	90	65	65	50	40
	S	UL	160	65	55	65	55	120	90	65	65	50	40
H-4	NS ^{c,d}	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1 Condition 1, I-1-3	NS ^{e,f}	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1 Condition 2, I-2	NS ^{e,f}	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-4	NS ^{c,d}	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
R ^b	NS ^c	UL	160	65	55	65	55	65	65	65	65	50	40
	SI3D	60	60	60	60	60	60	60	60	60	60	50	40
	SI3R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

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**TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE^a**

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV			HT	Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2

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Building Area

Building Area (Table 506.2)

- NS – Entire building not sprinklered
- S1 – One-story & NFPA 13 sprinklers
- SM – Building 2+ stories & NFPA 13
- S13D – Entire building NFPA 13D sprinklers
- S13R – Entire building NFPA 13R sprinklers
- UL – Unlimited
- NP – Not permitted

Frontage increase* & single-occupancy or mixed-occupancy determinations.



TABLE 506.2—continued
ALLOWABLE AREA FACTOR (A_a = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET^a

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION												
		Type I		Type II		Type III		Type IV			Type V			
		A	B	A	B	A	B	A	B	C	HT	A	B	
I-1	NS ¹	UL	UL	35,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	18,000	10,500	4,500
	S1	UL	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000	42,000	18,000
	SM	UL	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000	31,500	13,500
I-2	NS ¹	UL	UL	15,000	11,000	12,000	NP	NP	36,000	24,000	12,000	12,000	9,500	NP
	S1	UL	UL	60,000	44,000	48,000	NP	NP	144,000	96,000	48,000	48,000	38,000	NP
	SM	UL	UL	45,000	33,000	36,000	NP	NP	108,000	72,000	36,000	36,000	28,500	NP
I-3	NS ¹	UL	UL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000	7,500	5,000	
	S1	UL	UL	60,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000	30,000	20,000	
	SM	UL	UL	45,000	30,000	31,500	22,500	108,000	72,000	36,000	36,000	22,500	15,000	
I-4	NS ¹	UL	UL	60,500	26,500	13,000	23,500	13,000	76,500	51,000	25,500	25,500	18,500	9,000
	S1	UL	UL	121,000	106,000	52,000	94,000	52,000	306,000	204,000	102,000	102,000	74,000	36,000
	SM	UL	UL	181,500	79,500	39,000	70,500	39,000	229,500	153,000	76,500	76,500	55,500	27,000
M	NS	UL	UL	21,500	12,500	18,500	12,500	61,500	41,000	26,625	20,500	14,000	9,000	
	S1	UL	UL	86,000	50,000	74,000	50,000	246,000	164,000	102,500	82,000	48,000	36,000	
	SM	UL	UL	64,500	37,500	55,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000	
R-1 ^b	NS ²	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000	
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000	
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000	

Example: Warehouse with office space, Type II-B

Per Floor!

TABLE 506.2
ALLOWABLE AREA FACTOR (A_a = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET^a

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION												
		Type I		Type II		Type III		Type IV			Type V			
		A	B	A	B	A	B	A	B	C	HT	A	B	
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500	
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000	
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	43,000	34,500	16,500	
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000	
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000	
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000	
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000	
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000	
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000	
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000	
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000	
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000	
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	
	S1	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	
	SM	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000	
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000	
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000	
S-2	NS	UL	UL	79,000	39,000	26,000	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500
	S1	UL	UL	316,000	156,000	109,000	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
	SM	UL	UL	237,000	117,000	78,000	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500


IBC 506: Allowable Area

- Single or Mixed-Occupancy (506.2)
 - Allowable Area (A_a) = [A_t + (NS x I_f)]
 - A_t = Tabular area
 - NS = Tabular considering nonsprinklered
 - I_f = Frontage increase factor
 - If > 3 stories...
 - Sum of the ratios for all stories ≤ 3.0
 - Example: 10-story office building (A_a = 57,000ft²)
 - 1 Floor = 27,500 ft² → 27,500/57,000 = 0.48
 - 2-10 Floor = 15,000 ft² → 15,000/57,000 = 0.26
 - Total = 0.48 + (9 floors) × 0.26 = 2.82 < 3.0

IBC 506.3: Frontage

To qualify for a frontage increase (I_f)...

- > 25% of building perimeter shall be located on a public way or open space.
- Open space must be on same lot, or...
- Dedicated for public use and accessed from a street or approved fire access lane.
- Open space must be \geq 20-feet



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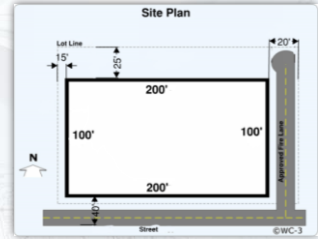

IBC 506.3: Frontage

Width of Public Way or Open Space

- ❑ Limited to **30 feet maximum**
- ❑ < 20 feet not included
- ❑ Measured perpendicular from building
 - To far side of public way or open space
- ❑ Where varies use weighted average
 - Do not include width < 20 feet in average

$$(200 \times 25) + (100 \times 20) + (30 \times 200) / (500)$$

$$= 26$$

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IBC 506.3: Frontage

Frontage increase determination:

- Example: Group I-2, Type IIA, 3-story, NFPA 13 sprinklers
- Determine: Tabular area per floor (A_a) & Tabular are without sprinklers (NS)

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV		HT	Type V		
		A	B	A	B	A	B	A	B		C	A	B
I-1	NS ^a	UL	55,000	19,000	10,000	16,500	11,000	54,000	36,000	18,000	18,000	10,500	4,500
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000	42,000	18,000
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000	31,500	13,200
I-2	NS ^a	UL	LL	15,000	11,000	12,000	NSP	36,000	24,000	12,000	42,000	9,500	NSP
	S1	UL	LL	60,000	44,000	48,000	NSP	144,000	96,000	48,000	48,000	38,000	NSP
	SM	UL	LL	45,000	33,000	36,000	NSP	108,000	72,000	36,000	36,000	28,500	NSP
I-3	NS ^a	UL	LL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000	7,500	3,000
	S1	UL	LL	60,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000	30,000	20,000
	SM	UL	LL	45,000	30,000	31,500	23,500	108,000	72,000	36,000	36,000	23,500	15,000



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IBC 506.3: Frontage

Frontage increase determination:

- Per Table 506.3.3
- Example: $A_a = 45,000 \text{ ft}^2$; NS = 15,000
- 70% open perimeter
- Open space distance average of 25-feet
- Frontage increase = $NS * I_f = 15,000 * 0.42 = 6,300 \text{ ft}^2$
- Adjusted Area = $45,000 \text{ ft}^2 + 6,300 \text{ ft}^2 = 51,300 \text{ ft}^2$

PERCENTAGE OF BUILDING PERIMETER	OPEN SPACE (feet)			
	0 to less than 20	20 to less than 25	25 to less than 30	30 or greater
0 to less than 25	0	0	0	0
25 to less than 50	0	0.17	0.21	0.25
50 to less than 75	0	0.33	0.42	0.50
75 to 100	0	0.50	0.63	0.75

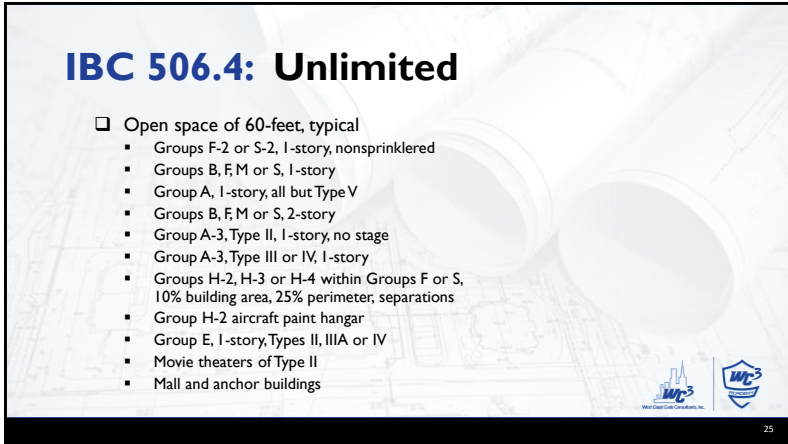


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IBC 506.4: Unlimited

- ❑ Open space of 60-feet, typical
 - Groups F-2 or S-2, 1-story, nonsprinklered
 - Groups B, F, M or S, 1-story
 - Group A, 1-story, all but Type V
 - Groups B, F, M or S, 2-story
 - Group A-3, Type II, 1-story, no stage
 - Group A-3, Type III or IV, 1-story
 - Groups H-2, H-3 or H-4 within Groups F or S, 10% building area, 25% perimeter, separations
 - Group H-2 aircraft paint hangar
 - Group E, 1-story, Types II, IIIA or IV
 - Movie theaters of Type II
 - Mall and anchor buildings



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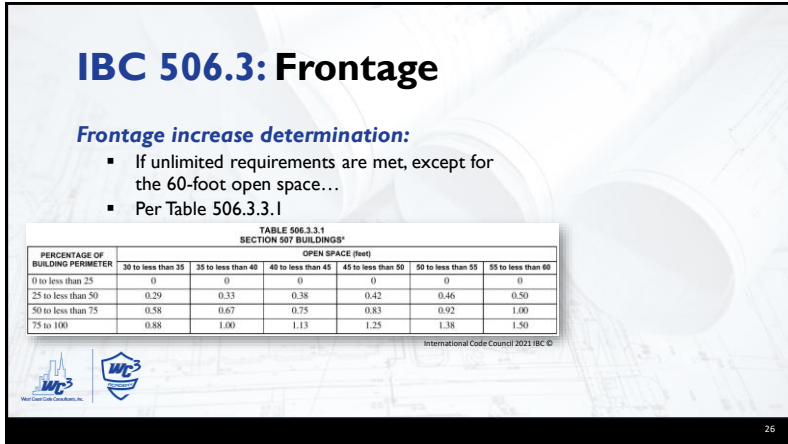
IBC 506.3: Frontage

Frontage increase determination:

- If unlimited requirements are met, except for the 60-foot open space...
- Per Table 506.3.3.1

PERCENTAGE OF BUILDING PERIMETER	OPEN SPACE (feet)					
	30 to less than 35	35 to less than 40	40 to less than 45	45 to less than 50	50 to less than 55	55 to less than 60
0 to less than 25	0	0	0	0	0	0
25 to less than 50	0.29	0.33	0.38	0.42	0.46	0.50
50 to less than 75	0.58	0.67	0.75	0.83	0.92	1.00
75 to 100	0.88	1.00	1.13	1.25	1.38	1.50

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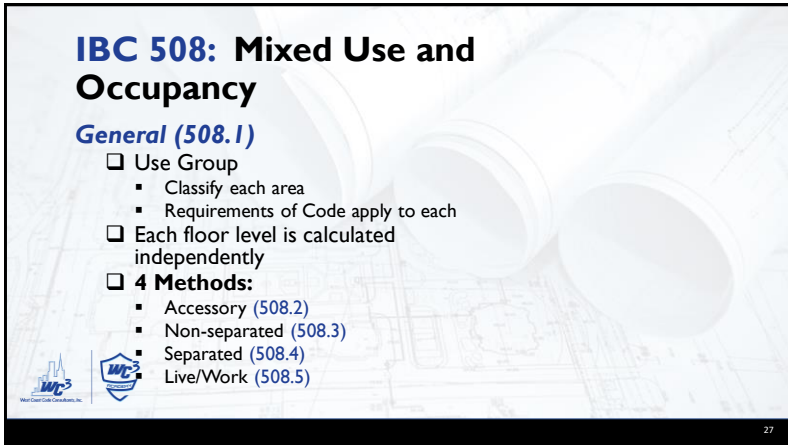


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IBC 508: Mixed Use and Occupancy

General (508.1)

- ❑ Use Group
 - Classify each area
 - Requirements of Code apply to each
- ❑ Each floor level is calculated independently
- ❑ **4 Methods:**
 - Accessory (508.2)
 - Non-separated (508.3)
 - Separated (508.4)
 - Live/Work (508.5)

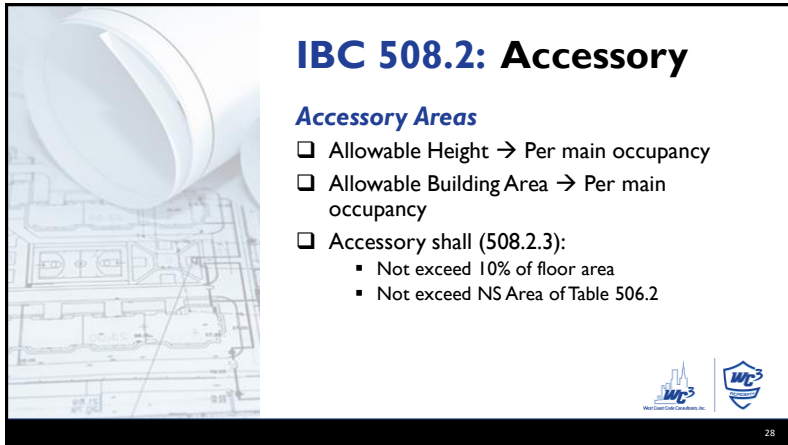


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IBC 508.2: Accessory

Accessory Areas

- ❑ Allowable Height → Per main occupancy
- ❑ Allowable Building Area → Per main occupancy
- ❑ Accessory shall (508.2.3):
 - Not exceed 10% of floor area
 - Not exceed NS Area of Table 506.2

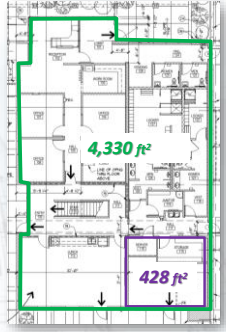



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Example: Accessory

Section 508.2

- Area
 - **Green (Main Use)**
 - Use Group B
 - **Purple (Ancillary)**
 - Use Group S-2
- 428 ft² < 10% of 4,330 ft²
- Table 506.2, Use Group S-2
 - Use Group S-2
 - Construction Type II-B
 - NS → 26,000 ft² > 428 ft²





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IBC 508.3: Nonseparated

Nonseparated Occupancies

- Use groups not separated by fire-rated construction.
- Most stringent requirement applies to whole building.
 - Chapter 9 – Fire protection systems
 - Chapter 5 – Height and area
 - Section 403 High rise buildings
 - Different Use Groups may control for different Sections




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IBC 508.4: Separated

Separated Use Groups (Table 508.4)

- Different Use groups separated by:
 - Fire Barriers
 - Horizontal assemblies
- Allowable Area
 - Determined for each use.
 - Sum of ratio actual/allowable < 1.0*
- Allowable height
 - Each use limited by **Section 503**




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Example: Separated


- **Mixed-Occupancy: Groups S-2 & B, Sprinklered**
- **Separation → Table 508.4**

OCCUPANCY	A, E		S-1, I-3, I-4		I-2		R*		F-2, S-2, U		F, P, M, S-1		H-1		H-2		H-3, H-4		H-5	
	B	NB	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A, E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP	3	4	2	3	2	NP
I-1, I-3, I-4	1	2	N	N	2	NP	1	NP	1	2	1	2	NP	NP	3	NP	2	NP	2	NP
I-2	2	NP	2	NP	N	N	2	NP	2	NP	2	NP	NP	NP	3	NP	2	NP	2	NP
R*	1	2	1	NP	2	NP	N	N	1	2	1	2	NP	NP	3	NP	2	NP	2	NP
F-2, S-2, U	N	1	1	2	2	NP	1	2	N	N	1	2	NP	NP	3	4	2	3	2	NP
F, P, M, S-1	1	2	1	2	2	NP	1	2	1	2	N	N	NP	NP	2	3	1	2	1	NP
H-1	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
H-2	3	4	3	NP	3	NP	3	NP	3	4	2	3	NP	NP	NP	NP	NP	NP	NP	NP
H-3, H-4	2	3	2	NP	2	NP	2	NP	2	3	1	2	NP	NP	1	NP	1	NP	1	NP
H-5	2	NP	2	NP	2	NP	2	NP	2	NP	1	NP	NP	NP	1	NP	1	NP	N	NP

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Example: Separated

- Allowable Area
 - Use Group B = 78,200 ft² (Actual = 4,330 ft²)
 - 4,330 / 78,200 = 0.06
 - Use Group S-2 = 88,400 ft² (Actual = 17,250 ft²)
 - 17,250 / 88,400 = 0.20
 - 0.20 + 0.06 = 0.26 < 1.0 **GOOD!**



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IBC 508.5: Live/Work


Live/Work Units

- Not applicable if office is < 10% area
- Allowable Area ≤ 3,000 ft²
- Nonresidential Area < 50%
- Nonresidential limited to first/main floor
- ≤ 5 nonresidential workers
- Groups H or S not allowed



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IBC 508.5: Live/Work

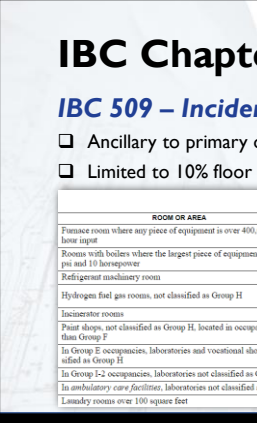
Live/Work Units (cont.)

- Group R-2 – no separation required
- Floor openings permitted without enclosure
- Fire sprinklers & monitored fire alarm
- Nonresidential shall provide minimum number of plumbing fixtures & comply with accessibility



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IBC Chapter 5

IBC 509 – Incidental Uses

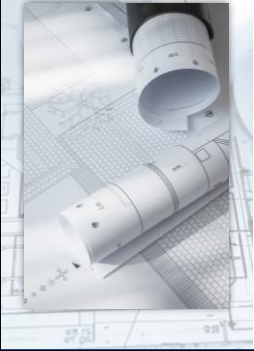
- Ancillary to primary occupancy
- Limited to 10% floor area

TABLE 509.1 INCIDENTAL USES	
ROOM OR AREA	SEPARATION AND/OR PROTECTION
Furnace room where any piece of equipment is over 400,000 Btu per hour input	1 hour or provide automatic sprinkler system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower	1 hour or provide automatic sprinkler system
Refrigerant machinery room	1 hour or provide automatic sprinkler system
Hydrogen fuel gas rooms, not classified as Group H	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.
Incinerator rooms	2 hours and provide automatic sprinkler system
Paint shops, not classified as Group H, located in occupancies other than Group F	2 hours; or 1 hour and provide automatic sprinkler system
In Group E occupancies, laboratories and vocational shops not classified as Group H	1 hour or provide automatic sprinkler system
In Group I-2 occupancies, laboratories not classified as Group H	1 hour and provide automatic sprinkler system
In ambulatory care facilities, laboratories not classified as Group H	1 hour or provide automatic sprinkler system
Laundry rooms over 100 square feet	1 hour or provide automatic sprinkler system



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IBC 510: Special Provisions

Modified Allowable Height and Area

- ❑ Podium Structure (510.2)
 - 3-hour lid
 - Type I-A below
- ❑ Group S-2 parking (510.3)
- ❑ Parking beneath R (510.4)
- ❑ R-1 & R-2, Type IIIA (510.5)
 - 3,000 sq. ft. areas
- ❑ R-1 & R-2 Type IIA (510.6)
- ❑ Open parking below (510.7)
 - A, I, B, M, and R
- ❑ Group B or M (510.8)
 - Over open parking
- ❑ Multiple buildings over Lid (510.9)

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END OF MODULE 4




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2021 International Building Code
Inspector/Plans Examiner






1

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Modules

- 1. Chapters 1 & 2
- 2. Chapter 3
- 3. Chapters 4 & 6
- 4. Chapter 5
- 5. **Chapter 7 – Part 1**
- 6. Chapter 7 – Part 2
- 7. Chapter 10
- 8. Chapter 11
- 9. Chapters 8 & 9
- 10. Chapters 12, 14 & 15
- 11. Chapters 16, 17 & 18
- 12. Chapters 19 thru 23
- 13. Chapter 24
- 14. Chapters 25 thru 35
- 15. Plan Review Considerations






2

2

MODULE 5:

*IBC Chapter 7 –
Fire and Smoke Protection Features*






3

3


Learning Objectives

- 1. Know the difference between tested and prescriptive fire resistive assemblies.
- 2. Understand how to deal with multiple buildings located on the same lot.
- 3. Understand the limitations of both protected and unprotected openings in exterior walls.
- 4. Know the proper use and application of Fire Walls, Fire Barriers and Fire Partitions.
- 5. Understand the difference between structural stability and continuity in fire-rated assemblies.

4

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Commercial Building Inspector (B2) → 8%
 Building Plans Examiner (B3) → 19%

IBC Chapter 7

Fire and Smoke Protection Features

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Scope

IBC 701.1: Scope

□ "...this chapter shall govern the materials, systems and assemblies used for **structural fire resistance** and fire-resistance-rated construction **separation of adjacent spaces** to safeguard against the spread of fire and smoke within a building and the spread of fire to or from buildings."

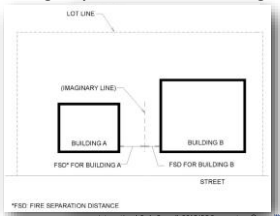


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Key Words

□ **Fire Separation Distance (FSD):**

- Closest interior lot line.
- Centerline of street, alley or public way.
- Imaginary line between buildings.



*FSD FIRE SEPARATION DISTANCE



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Key Words

□ **Fire-Resistance Rating:**

- Building elements, components or assemblies
- Per **ASTM E 119** or **UL 263**
- Prescriptive Method per **IBC 721**
- Calculated Method per **IBC 722**

□ **Flame Spread Index:**

- Specific to materials (*typically interior finish materials*).
- Per **ASTM E 84** or **UL 723**

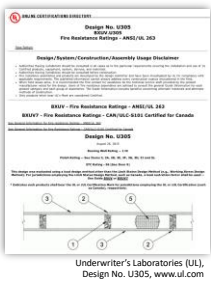


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Fire-Resistance Rating

Example: UL U305

- 1. Wood Studs
- 2. Joints & Nail Heads
- 3. Gypsum Board
- 4. Steel Corner Fasteners
- 5. Batts & Blankets

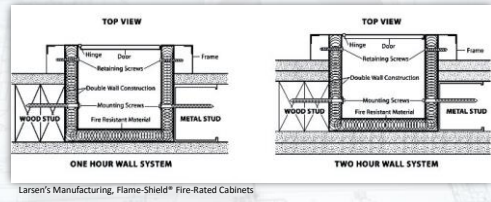


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Fire-Resistance Rating

IBC 703.2.1.4: Supplemental Features

- ❑ "Where materials, systems or devices have not been tested as part of the fire-resistance-rated assembly..."
- ❑ "...sufficient data shall be made available to the B.O."



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Fire-Resistance Rating

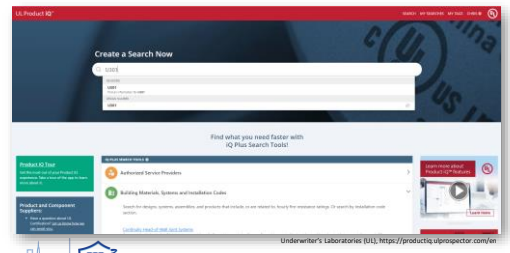
IBC 703.2.2: Methods for Determining

- ❑ Designs documented from approved sources
- ❑ Prescriptive designs per IBC 721
- ❑ Calculated per IBC 722
- ❑ Engineering analysis
- ❑ Alternative protection methods (IBC 104.11)
- ❑ Designs certified by an approved agency



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Fire-Resistance Rating




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Fire-Resistance Rating

Gypsum Association Manual

- ❑ Pay special attention to the “General Explanatory Notes” at the beginning of the manual



Gypsum Association, <https://www.gypsumpublications.com/>

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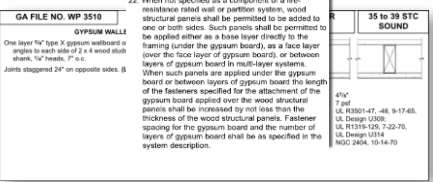
Fire-Resistance Rating

Gypsum Association Manual

- ❑ As an example, consider WVP 3510 which is also used as a shear wall and includes wood sheathing.

GENERAL EXPLANATORY NOTES

22. When not specified as a component of a fire-resistance rated wall or partition system, wood structural panels shall be permitted to be applied to one or both sides. Such panels shall be permitted to be applied either as a base layer directly to the framing (under the gypsum board), as a face layer (over the face layer of gypsum board), or between layers of gypsum board in multi-layer systems. When such panels are applied under the gypsum board or between layers of gypsum board the length of the fasteners specified for the attachment of the panels shall be increased by not less than the thickness of the wood structural panels. Fastener spacing for the gypsum board and the number of layers of gypsum board shall be as specified in the system description.



Gypsum Association, <https://www.gypsumpublications.com/>

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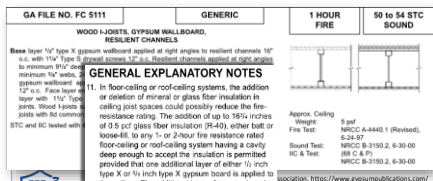
Fire-Resistance Rating

Gypsum Association Manual

- ❑ Let's consider FC 5111 and insulation is added...

GENERAL EXPLANATORY NOTES

11. In floor-ceiling or roof-ceiling systems, the addition or omission of mineral or glass fiber insulation in ceiling joint spaces could possibly reduce the fire-resistance rating. The addition of up to 1 1/2 inches of 0.8 gfi glass fiber insulation (9-4-0), either batt or loose-fill, to any 1- or 2-hour fire resistance rated floor-ceiling or roof-ceiling system having a cavity deep enough to accept the insulation is permitted provided that one additional layer of either 1/2 inch type X or 1/4 inch type K gypsum board is applied to the ceiling. The additional layer of gypsum board shall be applied as described for the face layer of the listed system except that the fastener length shall be increased by not less than the thickness of the additional layer of gypsum board.



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Fire-Resistance Rating

IBC 703.4: Fire-Resistance Rated Glazing

- ❑ ASTM E119 or UL 263
- ❑ Limitation on Openings
- ❑ Must be labeled per IBC Table 716.1(I)

TABLE 716.1(I) MARKING FIRE-RATED GLAZING ASSEMBLIES		
FIRE TEST STANDARD	MARKING	DEFINITION OF MARKING
ASTM E119 or UL 263	W	Meets wall assembly criteria.
ASTM E119 or UL 263	FC	Meets floor/ceiling criteria
NFPA 257 or UL 9	OH	Meets fire window assembly criteria including the hose stream test.
	D	Meets fire door assembly criteria.
NFPA 252 or UL 10B or UL 10C	H	Meets fire door assembly hose stream test.
	T	Meets 450°F temperature rise criteria for 30 minutes
	XXX	The time in minutes of the fire resistance or fire protection rating of the glazing assembly.

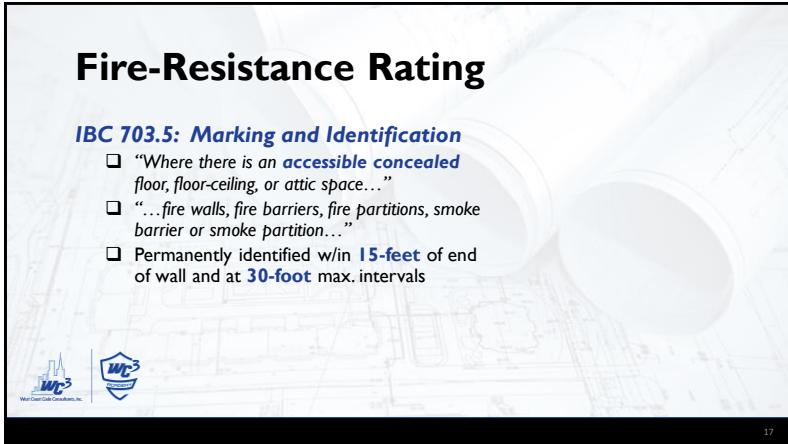
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Fire-Resistance Rating

IBC 703.5: Marking and Identification

- ❑ “Where there is an **accessible concealed floor, floor-ceiling, or attic space...**”
- ❑ “...**fire walls, fire barriers, fire partitions, smoke barrier or smoke partition...**”
- ❑ Permanently identified w/in **15-feet** of end of wall and at **30-foot** max. intervals



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Structural Members

IBC 704.1: Requirements

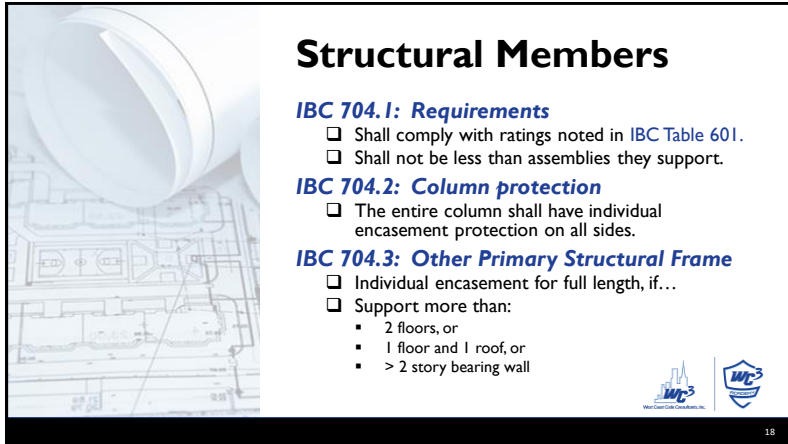
- ❑ Shall comply with ratings noted in IBC Table 601.
- ❑ Shall not be less than assemblies they support.

IBC 704.2: Column protection

- ❑ The entire column shall have individual encasement protection on all sides.

IBC 704.3: Other Primary Structural Frame

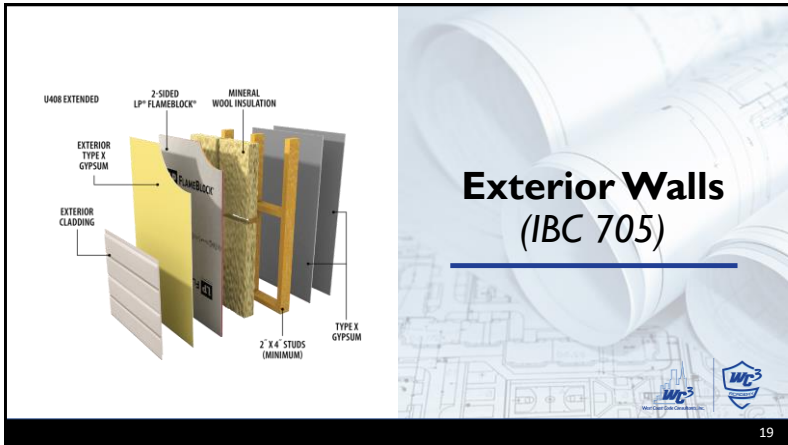
- ❑ Individual encasement for full length, if...
 - 2 floors, or
 - 1 floor and 1 roof, or
 - > 2 story bearing wall



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Exterior Walls (IBC 705)




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Exterior Walls

IBC 705: Exterior Walls

- ❑ Projections
- ❑ Buildings on Same Lot
- ❑ Fire-Resistance Ratings
- ❑ Structural Stability
- ❑ Openings
- ❑ Ducts & Air Transfer Openings
- ❑ Parapets



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Exterior Walls



IBC 705.2: Projections

☐ “Cornices, eave overhangs, exterior balconies and similar projections...”

TABLE 705.2 MINIMUM DISTANCE OF PROJECTION	
FIRE SEPARATION DISTANCE (FSD) (feet)	MINIMUM DISTANCE FROM LINE USED TO DETERMINE FSD
0 to less than 2	Projections not permitted
2 to less than 3	24 inches
3 to less than 5	Two-thirds of FSD
5 or greater	40 inches

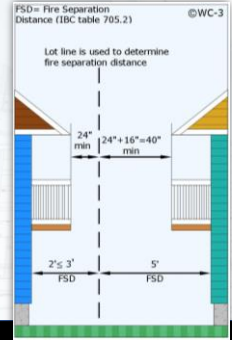
For SI: 1 foot = 304.8 mm; 1 inch = 25.4 mm.

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Exterior Walls



FSD= Fire Separation Distance (IBC table 705.2) ©WC-3

Lot line is used to determine fire separation distance



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Exterior Walls

IBC 705.2.3: Combustible Projections

☐ If w/in **5-feet** of lot line...

- Noncombustible materials
- 1-Hour construction
- Type IV-HT construction
- Fire-retardant-treated wood



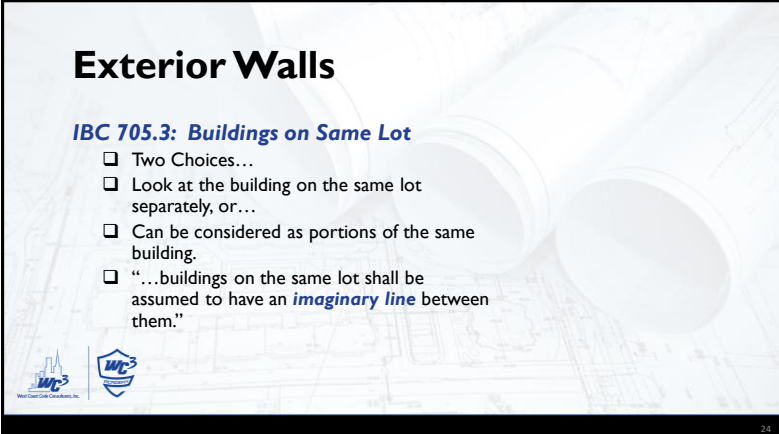


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Exterior Walls

IBC 705.3: Buildings on Same Lot

☐ Two Choices...

- ☐ Look at the building on the same lot separately, or...
- ☐ Can be considered as portions of the same building.
- ☐ “...buildings on the same lot shall be assumed to have an **imaginary line** between them.”

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Exterior Walls

IBC 705.3: Buildings on Same Lot

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Exterior Walls

IBC 705.5: Fire Resistance Ratings

- ❑ Per IBC Table 601 and **IBC Table 705.5**
- ❑ FSD > **10-feet** → "...rated for exposure to fire from the inside."
- ❑ FSD ≤ **10-feet** → "...rated for exposure to fire from both sides."

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Exterior Walls

**TABLE 705.5
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE^{a, b, c}**

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP ^d	
		GROUP F-1, M, S-1 ^e	GROUP A, B, E, F-2, I, R, S-2, U ^f
X < 5 ^g	All	3	2
	IA, IVA	3	2
5 ≤ X < 10	Others	2	1
	IA, IB, IVA, IVB	2	1
10 ≤ X < 30	III, V/B	1	0
	Others	1	1 ^h
X ≥ 30	All	0	0

For SI: 1 foot = 304.8 mm.
 a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
 b. See Section 706.1.1 for party walls.
 c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
 d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
 e. For special requirements for Group H occupancies, see Section 415.6.
 f. For special requirements for Group S aircraft hangars, see Section 412.3.1.
 g. Where Table 705.5 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
 h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.
 i. For a Group B-1 building of Type II or Type V-B construction, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

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Example:
What is the exterior wall fire-resistance rating for...

- Retail store
- Type V-B
- Bearing wall
- FSD = 8'-0"

1-hour required!

**TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)**

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III			TYPE IV		TYPE V	
	A	B	A	B	A	B	C	HT	A	B	
Primary structural frame ^a (see Section 202)	3 ^{b, c}	2 ^{b, c, d}	1 ^{b, c}	0 ^e	1 ^{b, c}	0	3 ^b	2 ^b	2 ^b	HT	1 ^{b, c}
Bearing walls											
Exterior ^{f, g}	3	2	1	0	3	2	3	2	2	2	1
Interior	3 ^h	2 ^h	1	0	1	0	3	2	2	1 ^{h, i}	1
Nonbearing walls and partitions	See Table 705.5										
Exterior											
Nonbearing walls and partitions											
Interior ^g	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1
Roof construction and associated secondary structural members (see Section 202)	1 ^{1/2}	1 ^h	1 ^h	0 ^e	1 ^h	0	1 ^{1/2}	1	1	HT	1 ^{h, i}

**TABLE 705.5
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE^{a, b, c}**

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP ^d	
		GROUP F-1, M, S-1 ^e	GROUP A, B, E, F-2, I, R, S-2, U ^f
X < 5 ^g	All	3	2
	IA, IVA	3	2
5 ≤ X < 10	Others	2	1
	IA, IB, IVA, IVB	2	1
10 ≤ X < 30	III, V/B	1	0
	Others	1	1 ^h
X ≥ 30	All	0	0

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Exterior Walls

IBC 705.6: Structural Stability

- ❑ Interior elements that brace the exterior wall and are not within the plane of the wall → IBC Table 601
- ❑ Exterior elements that brace the exterior wall, or within the plane of the exterior wall → IBC Table 601 or IBC Table 705.5



Exterior Walls

IBC 705.8: Openings

- ❑ Max. Openings → per IBC Table 705.8
- ❑ Exceptions:
 - If not required to be fire-resistance rated, or...
 - **Other than Group H** in 1st story if...
 - Walls facing the street and FSD > 15-feet
 - Walls facing unoccupied space > 30-feet and access to a posted fire lane



Exterior Walls

**TABLE 705.8
MAXIMUM AREA OF EXTERIOR WALL OPENINGS BASED ON
FIRE SEPARATION DISTANCE AND DEGREE OF OPENING PROTECTION**

FIRE SEPARATION DISTANCE (ft/ft)	DEGREE OF OPENING PROTECTION	ALLOWABLE AREA ^a
0 to less than 3 ^{b, c, d}	Unprotected, Nonsprinklered (UP, NS)	Not Permitted ^e
	Unprotected, Sprinklered (UP, S)	Not Permitted ^e
	Protected (P)	Not Permitted ^e
3 to less than 5 ^{b, c, d}	Unprotected, Nonsprinklered (UP, NS)	Not Permitted
	Unprotected, Sprinklered (UP, S)	15%
	Protected (P)	15%
5 to less than 10 ^{b, c, d}	Unprotected, Nonsprinklered (UP, NS)	10% ^a
	Unprotected, Sprinklered (UP, S)	25%
	Protected (P)	25%
10 to less than 15 ^{b, c, d}	Unprotected, Nonsprinklered (UP, NS)	15% ^a
	Unprotected, Sprinklered (UP, S)	45%
	Protected (P)	45%
15 to less than 20 ^{b, c, d}	Unprotected, Nonsprinklered (UP, NS)	25%
	Unprotected, Sprinklered (UP, S)	75%
	Protected (P)	75%

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Exterior Walls

IBC 705.8.3: Unprotected Openings

- ❑ Shall be constructed of approved materials (IBC Chapters 24 & 26)
- ❑ **Example:** An unsprinklered office building located 7-feet from the property line. What % of wall area is acceptable for unprotected openings?
- ❑ **Answer:** 10% per IBC Table 705.8



Exterior Walls

IBC 705.8.2: Protected Openings

☐ Fire doors & shutters → per IBC 716.1(2)

TABLE 716.1(2)—continued OPENING FIRE PROTECTION ASSEMBLIES, RATINGS AND MARKINGS								
TYPE OF ASSEMBLY	REQUIRED WALL ASSEMBLY RATING (hours)	MINIMUM FIRE DOOR AND FIRE SHUTTER ASSEMBLY RATING (hours)	DOOR VISION PANEL SIZE ^a	FIRE-RATED GLAZING MARKING DOOR VISION PANEL ^a	MINIMUM SIDELIGHT/TRANSOM ASSEMBLY RATING (hours)		FIRE-RATED GLAZING MARKING SIDE-LIGHT/TRANSOM PANEL	
					Fire protection	Fire resistance	Fire protection	Fire resistance
Exterior walls	3	1½	100 sq. in. ^a	≤100 sq. in. = D-H-90 > 100 sq. in. = D-H-W-90	Not Permitted	3	Not Permitted	W-180
	2	1½	Maximum size tested	D-H 90 or D-H-W-90	1½ ^b	2	D-H-OH-90 ^b	W-120
	1	¾	Maximum size tested	D-H-45	Fire protection		D-H-45 ^b	

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Exterior Walls

IBC 705.8.2: Protected Openings (cont.)

☐ Fire windows → per IBC 716.1(3)

TABLE 716.1(3) FIRE WINDOW ASSEMBLY FIRE PROTECTION RATINGS			
TYPE OF WALL ASSEMBLY	REQUIRED WALL ASSEMBLY RATING (hours)	MINIMUM FIRE WINDOW ASSEMBLY RATING (hours)	FIRE-RATED GLAZING MARKING
Interior walls			
Fire walls	All	NP ^a	W-XXX ^a
Fire barriers	>1	NP ^a	W-XXX ^a
	1	NP ^a	W-XXX ^a
Atrium separations (Section 707.3.6), Incidental use areas (Section 707.3.7), ^c Mixed occupancy separations (Section 707.3.9)	1	¾	OH-45 or W-60
Fire partitions	1	¾	OH-45 or W-60
	0.5	¾	OH-20 or W-30
Smoke barriers	1	¾	OH-45 or W-60
	>1	1½	OH-90 or W-XXX ^a
Exterior walls	1	¾	OH-45 or W-60
	0.5	1½	OH-20 or W-30
Party wall	All	NP	Not Applicable

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Exterior Walls

IBC 705.8.4: Mixed Openings

☐ Max. area permitted for unprotected openings?

Example: Unsprinklered exterior wall located 12-feet from an interior lot line.

$$\frac{A_p}{a_p} + \frac{A_u}{a_u} \leq 1.0$$

$$\frac{83}{(45\%)(18 \times 40)} + \frac{A_u}{(15\%)(18 \times 40)} = 1.0$$

$$\frac{83}{324} + \frac{A_u}{108} = 1.0$$

$$\frac{A_u}{108} = 0.744$$

$$A_u = 81 \text{ ft}^2$$

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Exterior Walls

IBC 705.8.5: Vertical Separation

☐ Does not apply to...

- Buildings 3-stories or less above grade
- Sprinklered buildings
- Open parking garages

☐ If lower floor openings are unprotected, then...

- Upper floor openings must be > 5-feet away, or...
- Fire-rated exterior wall, spandrel, etc. of 3-feet, or...
- Fire-rated flame barrier of 30-inches

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Exterior Walls

Vertical separation of openings ©WC-3

Openings in story above and within 5 FT. laterally

30"

Listed Horizontal Flame Barrier

Floor

Unprotected openings in story below

36"

Listed Vertical Flame Barrier

Floor

*Barriers not less than 1-hour rated. Flame barriers not required in sprinklered buildings, in buildings three stories or less in height or in open parking garages

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Exterior Walls

IBC 705.8.6: Vertical Exposure

- ❑ Does not apply to...
 - Buildings on the same lot that are considered one building
 - Roof assembly of adjacent building has 1-hour fire rating for a minimum of 10-feet
- ❑ Applies to buildings on the same lot, and the imaginary property line is <15-feet.
- ❑ Openings <15-feet above the roof shall be protected

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Exterior Walls

Vertical Exposure Of Openings ©WC-3

Openings required to be protected

<15 FT.

<10 FT.

Openings not required to be protected where roof is 1-hour rated or more

<15 FT.

Property Line

Openings not required to be protected when buildings are considered as portions of one building per section 704.3 (IBC)

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Exterior Walls

IBC 705.11: Parapets


- ❑ Parapets shall be provided (30" min.)
- ❑ If slope > 2:12, "...the parapet shall extend to the same height as any portion of the roof within a FSD where protection of wall openings is required."

Parapet height requirements with sloped FSD roof

Parapet

Same height as peak

40




Exterior Walls

IBC 705.11: Parapets


❑ Exceptions:

- Not required to be fire-rated per IBC Table 705.5.
- Area ≤ 1,000ft² on any floor.
- Noncombustible roof construction or fire-rated ≥ 2-hr.
- Where wall may have ≥ 25% unprotected openings.
- Two more options...



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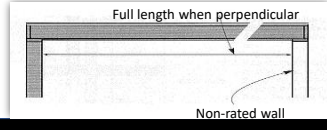



Exterior Walls

IBC 705.11: Parapets


❑ Exceptions (cont.):

- 1-hour exterior walls that terminate at the underside of the roof sheathing, deck or slab, provided...
 - Roof/ceiling framing have 1-hour rating for 10-feet (4-feet for Groups R & U), and...
 - Entire span is rated if perpendicular, and...
 - Roof openings are > 10-feet (5-feet for R & U), and...
 - Class 'B' roof covering

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Exterior Walls

IBC 705.11: Parapets

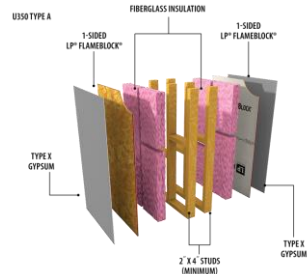
❑ Exceptions (cont.):

- Groups R-2 and R-3 having a Class 'C' roof covering, and...
- Type III, IV or V construction...
- The exterior wall can **terminate at the underside** of the sheathing or deck, provided...
 - Roof sheathing or deck consists of noncombustible or fire-retardant treated wood for 4-feet; or...
 - 5/8" Type 'X' is applied directly beneath the underside of the sheathing or deck for 4-feet.




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Fire Walls (IBC 706)



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Fire Walls

IBC 706: Fire Walls

- Used to separate buildings.
- "...shall provide a complete separation".

IBC Table 506.2
R-1
Type V-B
One-Story
Sprinklered

Firewalls ©WC-3

28,000 SF Max

45

Fire Walls

IBC 706.2: Structural Stability

- "...sufficient structural stability...to allow **collapse** of construction **on either side** without collapse of the wall..."
- How is this done?
- The IBC refers to NFPA 221.

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Fire Walls

IBC 706.2: Structural Stability

Fire Wall Structural Stability

Fire wall must be structurally independent to prevent collapse during fire.

Concrete Masonry Fire Wall

Break Away Connectors

Roof Deck

Reinforcement As Required

Steel Column

©WC-3

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Fire Walls

IBC 706.4: Fire-Resistance Rating

- Ratings are based upon occupancy...

GROUP	FIRE-RESISTANCE RATING (hours)
A, B, E, H-4, I, R-1, R-2, U	3 ^a
F-1, H-3b, H-5, M, S-1	3
H-1, H-2	4 ^b
F-2, S-2, R-3, R-4	2

a. In Type II or V construction, walls shall be permitted to have a 2-hour fire-resistance rating.
b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.7 and 415.8.

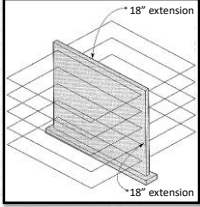
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Fire Walls

IBC 706.5: Horizontal Continuity

- "...continuous from exterior wall to exterior wall..."



The diagram shows a cross-section of a fire wall assembly. It consists of a central vertical wall with two horizontal layers of sheathing extending outwards from both sides. Each extension is labeled as "18" extension".



 

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Fire Walls

Exception #1:

- May terminate at interior surface of combustible sheathing provided the exterior wall has **1-hour** rating for at least **4-feet** on either side of fire wall
- Openings in this area are to be protected for **¾-hour** minimum.

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Fire Walls

Exception #2:

- May terminate at interior surface of noncombustible sheathing provided sheathing extends 4-feet on either side.

Exception #3:

- May terminate at interior surface of noncombustible sheathing where the building on both sides is sprinklered.

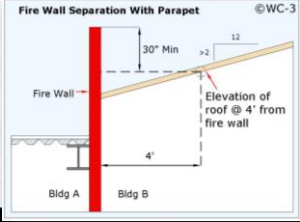
 

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Fire Walls

IBC 706.6: Vertical Continuity

- "...from the foundation to...at least **30-inches** above both adjacent roofs."



The diagram, titled "Fire Wall Separation With Parapet" (©WC-3), shows a vertical fire wall separating two buildings, Bldg A and Bldg B. The fire wall extends above the roofline of both buildings. A parapet is shown on the roof of Bldg B, with a height of "30" Min" above the roof surface. The roof of Bldg B is sloped, and the fire wall extends to a height of "Elevation of roof @ 4' from fire wall". A horizontal dimension of "4'" is shown at the base of the fire wall. A vertical dimension of "12'" is shown for the parapet height above the roof surface. A note indicates ">2" for the parapet height above the roof surface.

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Fire Walls

Exception #1:

- Stepped Buildings:
 - 1-hour rating for...
 - Height of 15-feet, and...
 - 45-minute openings

0-hour construction above 15-foot level with no protected openings

1-hour construction for 15 ft. above roof with protected openings

Fire wall extends 30 inches above lower roof

The Code Corner, www.specsandcodes.typepad.com

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Fire Walls

Exception #2:

- 2-Hour Walls:** May terminate at sheathing provided...
 - Lower roof assembly is 1-hour rated for 4-feet, and...
 - Openings are not located in roof w/in 4-feet, and...
 - Each building provided w/ Class 'B' roof covering

Fire Wall Termination at Roof

No Openings Permitted

4 FT

4 FT

Class B Roof Covering

1-Hour Protection For Structural Support

1-Hour Assembly

2-Hour Fire Wall

Roof Sheathing, Deck, or Slab

©WC-3

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Fire Walls

Exception #3:

- Noncombustible sheathing** may terminate at sheathing provided...
 - Openings are not located in roof w/in 4-feet, and...
 - Each building is provided w/ Class 'B' roof covering

Fire Walls Terminating At Noncombustible Sheathing

No Openings Permitted

4 FT

4 FT

Class B Roof Covering

Noncombustible Roof Sheathing, Deck, or Slab

Fire Wall

©WC-3

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Fire Walls

Exception #4:

- Type III, IV and V:** May terminate at combustible sheathing provided...
 - Openings not located w/in 4-feet, and...
 - Each building has Class 'B' roofing, and...
 - Fire-retardant-treated sheathing for 4-feet on each side of wall, or...
 - 5/8-inch Type 'X' gypsum is applied for a distance of 4-feet on each side of wall.

Fire Wall Termination Roof with combustible sheathing

No Openings Permitted

4 FT

4 FT

Class B Roof Covering

1-Hour Protection For Structural Support

1-Hour Assembly

2-Hour Fire Wall

Fire-Retardant-Treated Roof Sheathing or Deck, or 5/8\" Type 'X' Gypsum Board

Support Edges with 2x Ledgers



©WC-3

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Fire Walls

IBC 706.8: Openings


- ❑ Shall be protected per **IBC 716**
- ❑ ≤ 156ft² max. per opening (unless sprinklered), and...
- ❑ ≤ 25% length of wall
- ❑ Not allowed in party walls (see IBC 706.1.1)

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TYPE OF ASSEMBLY	REQUIRED WALL ASSEMBLY RATING	MINIMUM FIRE DOOR AND-FIRE RESISTANCE ASSEMBLY RATING		MINIMUM GLASS BLOCK OR GLASS DOOR VISION PANELS*	MINIMUM SIDE-LIGHT PROTECTION ASSEMBLY RATING (SEE IBC 716)		FIRE-RATED GLASS BLOCKING SIDE-LIGHT PROTECTION PANELS		
		Fire protection	Fire resistance		Fire protection	Fire resistance	Fire protection	Fire resistance	
Fire walls and fire barriers having a required fire resistance rating greater than 1 hour	4	3	See Note 2	D-44 W-240	Not Permitted	4	Not Permitted	W-240	
	3	2	See Note 2	D-44 W-180	Not Permitted	3	Not Permitted	W-180	
	2	1 1/2	100 sq. in.	≥100 sq. in. D-44-60	Not Permitted	2	Not Permitted	W-120	
Double fire walls (constructed in accordance with NFPA 221)	4	3	3	See Note 2	D-44 W-180	Not Permitted	3	Not Permitted	W-180
	3	2	1 1/2	100 sq. in.	≥100 sq. in. D-44-60	Not Permitted	2	Not Permitted	W-120
Horizontal exits in fire walls	4	3	3	100 sq. in.	≥100 sq. in. D-44-60	Not Permitted	4	Not Permitted	W-240
	3	2	1 1/2	100 sq. in.	≥100 sq. in. D-44-60	Not Permitted	3	Not Permitted	W-180

*Memorandum Code Council 2021 IBC ©



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Fire Barriers (IBC 707)







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Fire Barriers

Simpler than “Fire Walls”

- ❑ IBC 707.3: Fire-Resistance Ratings
 - Shaft enclosures (IBC 713.4)
 - Interior exit stairways/ramps (IBC 1023.1)
 - Enclosures for exit access stairways (IBC 713.4)
 - Exit passageways (IBC 1024.3)
 - Horizontal exits (IBC 1026.1)
 - Atriums (IBC 404.6)
 - Incidental uses (IBC Table 509.1)
 - Control areas (IBC 414.2.4)
 - Separated occ. (IBC Table 508.4)
 - Fire areas (IBC Table 707.3.10)

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**TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)**


OCCUPANCY	REQUIRED SEPARATION OF OCCUPANCIES (HOURS) ^a													
	A, E	I-1, I-3, I-4		I-2	R ^b	F-2, S-2, U		F-1, M, S-1	H-1	H-2	H-3, H-4	H-5		
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A, E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP
I-1, I-3, I-4	1	2	N	N	2	NP	1	NP	1	2	NP	NP	3	NP
I-2	2	NP	2	NP	N	N	2	NP	2	NP	NP	NP	3	NP
R ^b	1	2	1	NP	2	NP	N	N	1	2	1	2	NP	NP
F-2, S-2, U	N	1	1	2	2	NP	1	2	N	1	2	NP	NP	3
F-1, M, S-1	1	2	1	2	2	NP	1	2	N	N	NP	NP	2	3
H-1	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
H-2	3	4	3	NP	3	NP	3	4	2	3	NP	NP	1	NP
H-3, H-4	2	3	2	NP	2	NP	2	3	1	2	NP	NP	1	NP
H-5	2	NP	2	NP	2	NP	2	NP	1	NP	NP	NP	1	NP

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**TABLE 707.3.10
FIRE-RESISTANCE-RATING
REQUIREMENTS FOR FIRE BARRIERS, FIRE WALLS
OR HORIZONTAL ASSEMBLIES BETWEEN FIRE AREAS**

OCCUPANCY GROUP	FIRE-RESISTANCE RATING (hours)
H-1, H-2	4
F-1, H-3, S-1	3
A, B, E, F-2, H-4, H-5, L, M, R, S-2	2
U	1

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Fire Barriers

IBC 707.5: Continuity

- ❑ "...shall extend from the top of the foundation or floor-ceiling assembly below to the underside of the floor or roof sheathing, slab or deck above and be **securely attached** thereto."
- ❑ Continuous through concealed spaces.




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Fire Barriers

IBC 707.6: Openings

- ❑ Similar to "Fire Walls" with a few added exceptions
- ❑ ≤ 25% length of wall
- ❑ ≤ 156ft² max. per opening
- ❑ Openings in enclosures shall also comply with Chapter 10.
- ❑ **Exceptions:** Sprinklered, fire doors, opening protectives, fire windows



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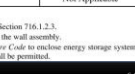
Fire Barriers

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**TABLE 716.1(3)
FIRE WINDOW ASSEMBLY FIRE PROTECTION RATINGS**

TYPE OF WALL ASSEMBLY	REQUIRED WALL ASSEMBLY RATING (hours)	MINIMUM FIRE WINDOW ASSEMBLY RATING (hours)	FIRE-RATED GLAZING MARKING
Interior walls			
Fire walls	All	NP ^a	W-XXX ^b
Fire barriers	>1	NP ^a	W-XXX ^b
	1	NP ^a	W-XXX ^b
Atrium separations (Section 707.3.6), Incidental use areas (Section 707.3.7), ^c Mixed occupancy separations (Section 707.3.9)	1	1/2	OH-45 or W-60
Fire partitions	1	1/2	OH-45 or W-60
	0.5	1/2	OH-20 or W-30
Smoke barriers	1	1/2	OH-45 or W-60
	>1	1/2	OH-90 or W-XXX ^b
Exterior walls	1	3/4	OH-45 or W-60
	0.5	1/3	OH-20 or W-30
Party wall	All	NP	Not Applicable

NP = Not Permitted
a. Not permitted except fire-resistance-rated glazing assemblies tested to ASTM E119 or UL 263, as specified in Section 716.1.2.3.
b. XXX = The fire rating duration period in minutes, which shall be equal to the fire-resistance rating required for the wall assembly.
c. Fire-resistance-rated glazing is not permitted for fire barriers required by Section 1207 of the International Fire Code to enclose energy storage systems. Fire-resistance-rated glazing assemblies tested to ASTM E119 or UL 263, as specified in Section 716.1.2.3, shall be permitted.



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Fire Barriers

IBC 707.9: Voids at Intersections

- ❑ Voids shall be filled with approved materials and securely installed.

© WCA 3
WCA 3
WCA 3

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Fire Partitions (IBC 708)

© WCA 3
WCA 3

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Fire Partitions

- ❑ **IBC 708.1: Used for...**
 - Separating dwelling units (IBC 420.2)
 - Separating sleeping units (IBC 420.2)
 - Separating tenant spaces (IBC 402.4.2.1)
 - Corridor walls (IBC 1020.3)
 - Elevator lobby separation (IBC 3006.3)
 - Egress balconies (IBC 1021.2)
 - Ambulatory care suites (IBC 422.2)
 - Vestibules (IBC 1028.2)

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WCA 3

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Fire Partitions

- ❑ **IBC 708.3: Fire-Resistance Rating**
 - ❑ Not less than **1-hour**
 - ❑ **Exceptions:**
 - Corridor walls may be ½-hour (Table 1020.1)
 - Dwelling and sleeping unit separations in Types IIB, IIIB and VB construction may be ½-hour if sprinklered (IBC 903.3.1.1)

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WCA 3

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Fire Partitions

IBC 708.4: Continuity

- “...shall extend from the top of the foundation or floor-ceiling assembly below and securely attached to the following:
 - The underside of the floor or roof sheathing, deck or slab above.
 - The underside of a rated floor or roof assembly.

©WC-3

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Fire Partitions

IBC 708.4: Continuity

- Exception #1:** Crawl space below rated floor.

1-hr floor
Extension not required in crawl space

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Fire Partitions

IBC 708.4: Continuity

- Exception #2:** Corridor membrane can end at corridor ceiling with equivalent membrane. *(Must be sprinklered.)*

Room-side membrane to rated floor
Corridor ceiling 1-hr

©WC-3

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Fire Partitions

IBC 708.4: Continuity

- Exception #3:** Can end at ceiling if ceiling is constructed as corridor wall.

Corridor ceiling constructed same as walls

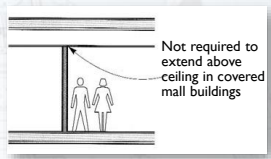
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Fire Partitions

IBC 708.4: Continuity

- ❑ **Exception #4:** Not required to go above ceiling in covered or open mall buildings.



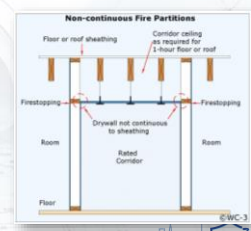
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Fire Partitions

IBC 708.4.2: Continuity

- ❑ If not continuous to the sheathing in *combustible* construction... **fire blocking** and **draft stopping** is required.



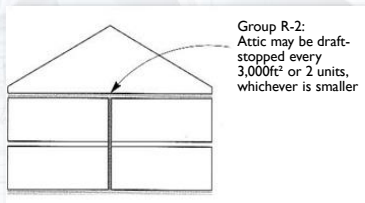
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Fire Partitions

IBC 708.4: Continuity

- ❑ Several exceptions, but one main one to be aware of...



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Comparison

Requirements	Wall Types		
	Firewalls	Fire Barriers	Fire Partitions
Fire-resistance-rated materials	X	X	X
Protected openings	X	X	X
Wall assembly	X	X	X
Vertical continuity	X	X	
Structural stability	X		

Simpson Strong-Tie Blog:
<https://blog.simpsonstrongtie.com/2016/07/firewalls-wood-construction/>



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2021 International Building Code
Inspector/Plans Examiner






1

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Modules

1. Chapters 1 & 2	9. Chapters 8 & 9
2. Chapter 3	10. Chapters 12, 14 & 15
3. Chapters 4 & 6	11. Chapters 16, 17 & 18
4. Chapter 5	12. Chapters 19 thru 23
5. Chapter 7 – Part I	13. Chapter 24
6. Chapter 7 – Part 2	14. Chapters 25 thru 35
7. Chapter 10	15. Plan Review Considerations
8. Chapter 11	






2

2

MODULE 6:

*IBC Chapter 7 –
Fire and Smoke Protection
Features (cont.)*






3

3


Learning Objectives

1. Know the proper use and application of smoke barriers, smoke partitions, and horizontal assemblies.
2. Understand code requirements associated with vertical openings inside of buildings.
3. Understand the required fire ratings and construction requirements of shafts.
4. Become familiar with requirements associated with penetrations in fire rated assemblies.
5. Understand the principles of draftstopping and fire blocking.

4

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Commercial Building Inspector (B2) → 8%
Building Plans Examiner (B3) → 19%


IBC Chapter 7

Fire and Smoke Protection

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Smoke Barriers (IBC 709)



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Smoke Barriers

The intent is to divide areas of a building into separate smoke compartments

- IBC 709: Used for...
 - Underground Buildings (IBC 405.4.2)
 - Group I-2 (IBC 407.5)
 - Group I-3 (IBC 408.6)
 - Group I-1 (IBC 420.4)
 - Ambulatory Care (IBC 422.3)
 - Part of Smoke Control System (IBC 909.5)
 - Areas of Refuge (IBC 1009.6.4)

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Smoke Barriers

IBC 709.1: Both vertical & horizontal

IBC 709.3: Fire-Resistance Rating → 1-hr

IBC 709.4: Continuity

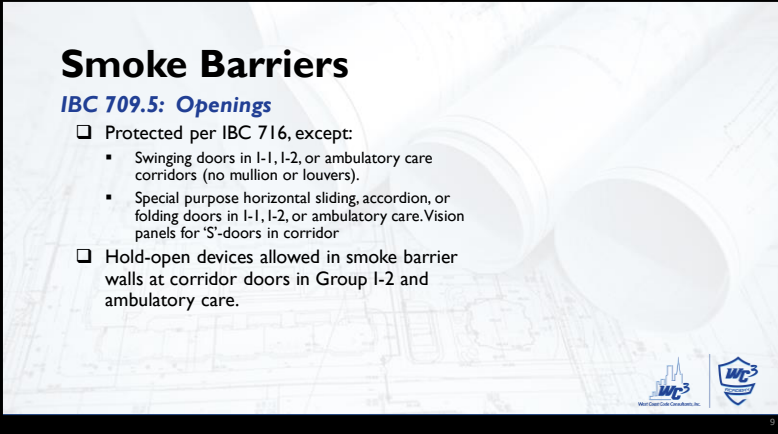

- "...shall form an effective membrane continuous from outside wall to outside wall and from the top of the foundation or floor/ceiling below to the underside of the floor or roof sheathing..."
- Includes continuity through **concealed spaces**.

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Smoke Barriers

IBC 709.5: Openings

- ❑ Protected per IBC 716, except:
 - Swinging doors in I-1, I-2, or ambulatory care corridors (no mullion or louvers).
 - Special purpose horizontal sliding, accordion, or folding doors in I-1, I-2, or ambulatory care. Vision panels for 'S'-doors in corridor
- ❑ Hold-open devices allowed in smoke barrier walls at corridor doors in Group I-2 and ambulatory care.


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Smoke Partitions (IBC 710)





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Smoke Partitions

- ❑ **Simpler than "Smoke Barriers"**
- ❑ **Nonrated walls** that serve to resist the spread of fire and the unmitigated movement of smoke
- ❑ Provides less protection than a "smoke barrier" and is not required to be continuous





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Smoke Partitions

- ❑ **Application is fairly limited...**
 - Atriums (IBC 404.6)
 - I-2 → Corridor walls (IBC 407.3)
 - I-2 → Care suites (IBC 407.4.4)


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Smoke Partitions

IBC 710.5: Openings

- Windows: **Sealed** to resist free passage of smoke
- Doors:
 - **Louvers** are not allowed
 - Smoke/draft control doors → **UL 1784**
 - Self- or **automatic-closing** doors → per IBC 716.5.9.3



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Smoke Partitions

IBC 710.6: Penetrations


- Annular space filled to limit passage of smoke

IBC 710.7: Joints

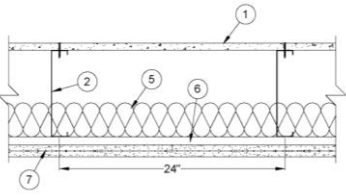
- Filled to prevent passage of smoke

IBC 710.8: Duct & Air Transfer Openings


- Annular space filled to limit passage of smoke
- Smoke damper



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Horizontal Assemblies (IBC 711)





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Horizontal Assemblies

IBC 711.2.4: Fire-Resistance Rating

- Type of construction (IBC Table 601)
- Mixed occupancies (IBC 508.4)
- Fire area separation (IBC 707.3.10)
- Dwelling unit separation (IBC 420.3)
- Sleeping unit separation (IBC 420.3)
- Smoke compartment separation (IBC 709)
- Incidental use separation (IBC 509)

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Horizontal Assemblies

IBC 711.2.2: Continuity

- ☐ Continuous w/out openings (except IBC 712)

IBC 711.2.3: Supporting Construction

- ☐ Shall have same fire-resistance rating.
- ☐ Exception: Type IIB, IIIB, VB not required if...
 - At incidental use area separations (1-hr min.)
 - At separations in dwelling or sleeping units
 - At smoke barriers

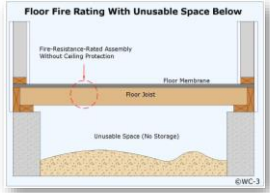


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Horizontal Assemblies

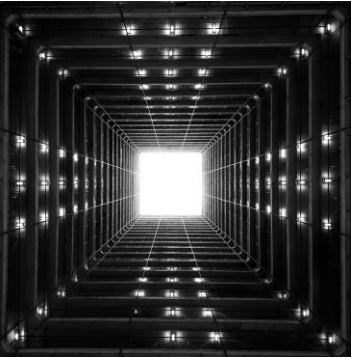
IBC 711.2.6: Unusable Space

- ☐ Ceiling membrane not required for 1-hour assemblies at **unusable attic and crawl spaces.**







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Vertical Openings (IBC 712)

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Vertical Openings

- ☐ **Shaft Enclosures** → IBC 713
- ☐ **Individual Dwelling Units**
 - "Unconcealed vertical openings totally within an individual residential dwelling unit and connecting four stories or less shall be permitted."
- ☐ **Masonry Chimneys**
 - Annular space must be fire blocked at each floor.




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Vertical Openings

- ❑ **Penetrations** → IBC 714
- ❑ **Ducts & Air Transfer** → IBC 717
- ❑ **Joints:**
 - At horizontal assemblies → IBC 715
 - At non-rated floors → shall be...
 - Concealed in wall cavity, or...
 - Located above ceiling, or...
 - Sealed, treated, or covered with approved material to resist the passage of flame or smoke.






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Vertical Openings

- ❑ **Parking Garages (IBC 406):**
 - Automobile ramps
 - Elevators if only serving garage
 - Duct systems only serving garage
- ❑ **Atriums (IBC 404):**
 - 2+ stories in Groups I-2 or I-3
 - 3+ for all other occupancies (*not Group H*)



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Vertical Openings

Two-Story Openings:

- ❑ Other than Group I-2 and I-3 if...
 - Does not connect > 2 stories
 - Does not penetrate a rated horizontal assembly that *separates* fire areas or smoke compartments.
 - Not concealed within wall or floor/ceiling assembly.
 - Not open to a corridor in Group I or R.
 - Not open to corridor on nonsprinklered floors.
- Is separated from floor openings and air transfer openings.





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Vertical Openings

- ❑ **Mezzanines (IBC 505):**
 - If between mezzanine and floor below.
- ❑ **Exit Access Stairways & Ramps** → IBC 1019
- ❑ **Group I-3** → IBC 408.5
- ❑ **Floor Fire & Access Doors:**
 - Fire Door: Tested per NFPA 288 & labeled
 - Access Door: ASTM E119 or UL 263 as horizontal assembly





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Vertical Openings

Skylights:

- ❑ Continuous w/out openings, penetrations or joints
- ❑ Unprotected skylights are allowed when...
 - Separated from adjacent structures, and...
 - The integrity of the roof is maintained
- ❑ Supporting construction shall have same fire-resistance rating





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Vertical Openings

Escalator Openings

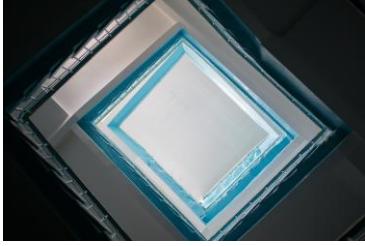
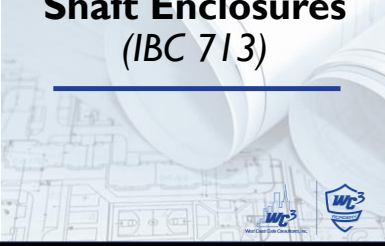

- ❑ Building shall be sprinklered and...
- ❑ Draft curtains and closely spaced sprinklers, or...
- ❑ Automatic shutters ≥ 1.5 hours



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Shaft Enclosures (IBC 713)

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Shaft Enclosures

Prevent fire from spreading to other levels.

❑ **Vertical shafts enclosing...**

- Vertical exhaust ducts
- Gas flues
- Metal chimneys
- Vertical supply ducts
- Return & outdoor air ducts
- Elevator hoistways
- Linen chutes
- Trash chutes

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Shaft Enclosures

- ❑ Two types of shafts are not covered in IBC 713...
 - Exit Access Stairways → IBC 1019
 - Interior Stairways and Ramps → IBC 1023.1



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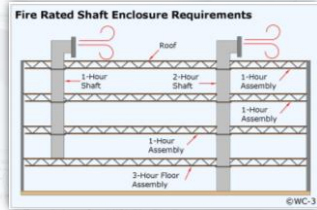
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Shaft Enclosures

“...shall be constructed as fire barriers... or horizontal assemblies... or both.”

IBC 713.4: Fire-Resistance Rating

- ❑ ≥ 4 stories → 2-hour rating
- ❑ < 4 stories → 1-hour rating
- ❑ Shall include basements
- ❑ Mezzanines not included



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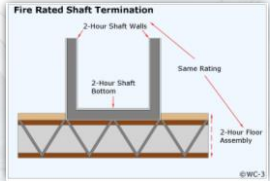
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Shaft Enclosures

IBC 713.11: Enclosure at the Bottom

Shafts that do not extend to the bottom...

- ❑ Enclosed at the lowest level with same rating as lowest floor through which the shaft passes, but not less than the shaft rating.
- ❑ Shall terminate in a room related to purpose of shaft.
- ❑ Protected by approved fire dampers at the lowest floor level within the enclosure.



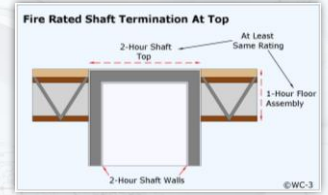
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Shaft Enclosures

IBC 713.12: Enclosure at the Top

- ❑ Must extend to underside of roof sheathing, deck, or slab, or...
- ❑ Extend past the roof assembly and comply with IBC 1511, or...
- ❑ Must have the same rating as the topmost floor penetration, but not less than shaft rating.



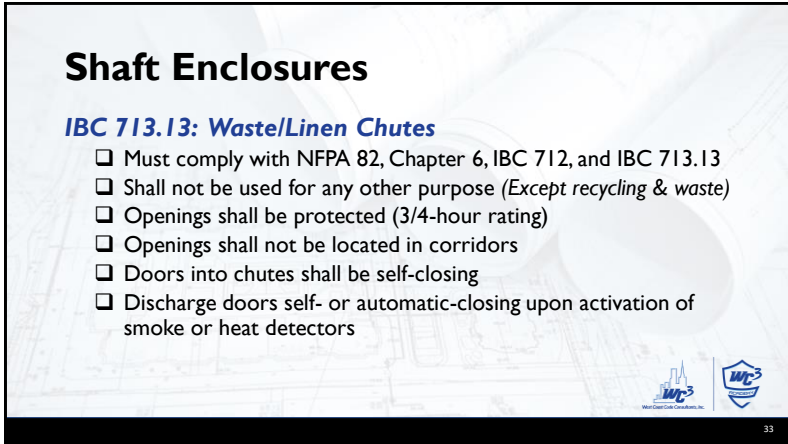
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Shaft Enclosures

IBC 713.13: Waste/Linen Chutes

- Must comply with NFPA 82, Chapter 6, IBC 712, and IBC 713.13
- Shall not be used for any other purpose (*Except recycling & waste*)
- Openings shall be protected (3/4-hour rating)
- Openings shall not be located in corridors
- Doors into chutes shall be self-closing
- Discharge doors self- or automatic-closing upon activation of smoke or heat detectors



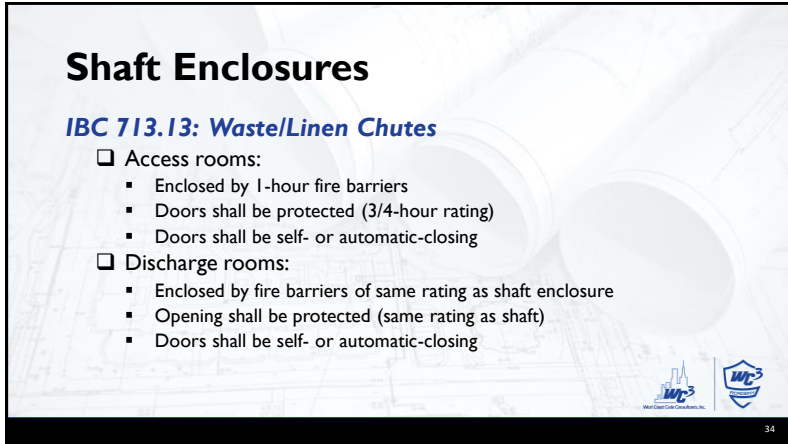





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Shaft Enclosures

IBC 713.13: Waste/Linen Chutes

- Access rooms:
 - Enclosed by 1-hour fire barriers
 - Doors shall be protected (3/4-hour rating)
 - Doors shall be self- or automatic-closing
- Discharge rooms:
 - Enclosed by fire barriers of same rating as shaft enclosure
 - Opening shall be protected (same rating as shaft)
 - Doors shall be self- or automatic-closing



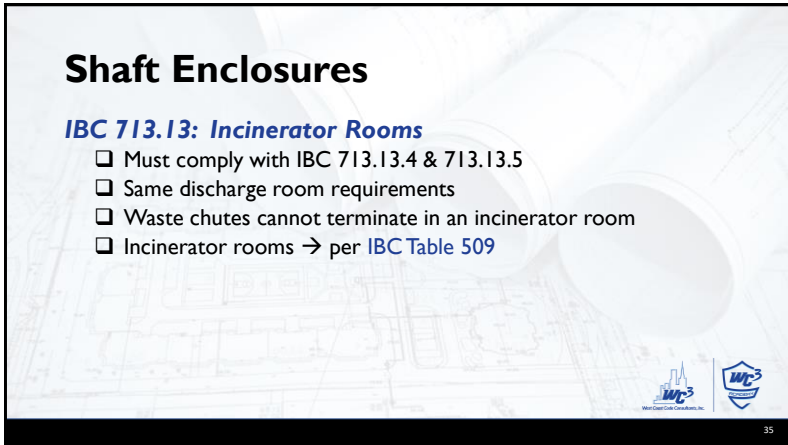





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Shaft Enclosures

IBC 713.13: Incinerator Rooms

- Must comply with IBC 713.13.4 & 713.13.5
- Same discharge room requirements
- Waste chutes cannot terminate in an incinerator room
- Incinerator rooms → per [IBC Table 509](#)



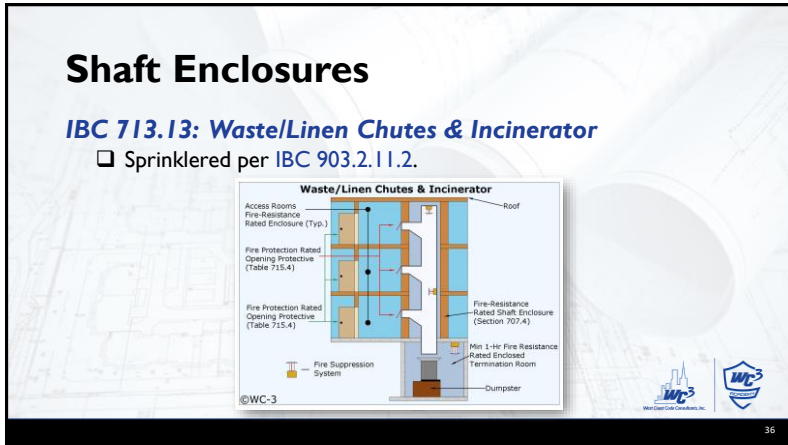





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Shaft Enclosures

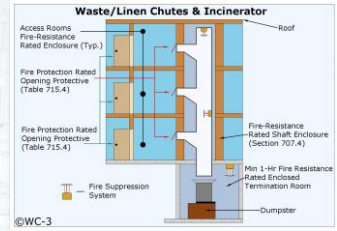
IBC 713.13: Waste/Linen Chutes & Incinerator


- Sprinklered per [IBC 903.2.11.2](#).



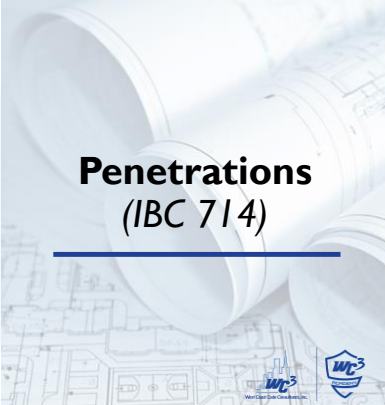





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Penetrations (IBC 714)

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Penetrations

General Items:

- Ducts and air transfer openings protected with dampers → IBC 717
- Ducts in rated walls not protected by dampers → IBC 714.3 & 714.4
- Penetrations in horizontal assemblies that are not protected by shafts or dampers → IBC 714.5 & 714.6

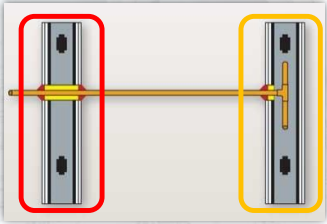
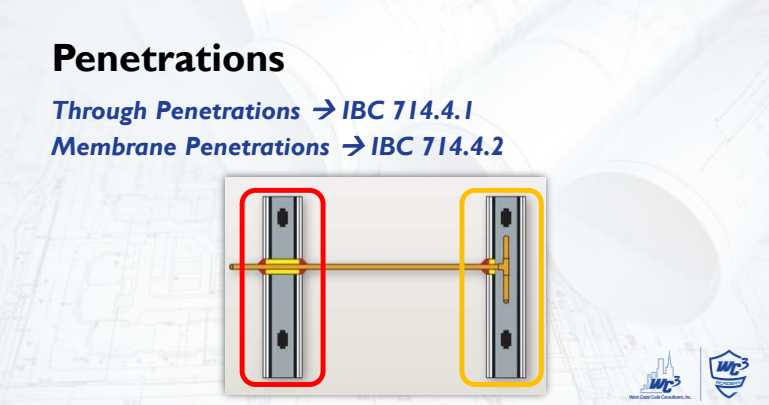





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Penetrations

Through Penetrations → IBC 714.4.1
Membrane Penetrations → IBC 714.4.2

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Penetrations

IBC 714.4.1.2: Through Penetrations

- Fire-rated assembly:
 - Installed as tested in the approved fire-rated assembly.
- Firestop system:
 - Per ASTM E814 or UL 1479
 - F-rating ≥ wall penetrated
 - Horizontal Assemblies also require a T-rating of not less than 1-hour

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Penetrations

Exceptions:

- ❑ Steel, ferrous or copper pipes, tubes or conduits...
 - Annular space shall be filled with material that prevents the passage of flame and hot gases.
 - Concrete/Masonry: Filled with concrete, grout or mortar.

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Penetrations

IBC 714.4.2: Membrane Penetrations

- ❑ Same requirements as "Through Penetrations".
- ❑ Recessed fixtures shall be installed so as not to reduce the fire-resistance-rating.

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Penetrations

Exceptions:

- ❑ Steel boxes:
 - ≤ 2-hr wall
 - ≤ 16in²
 - ≤ 100in² in 100ft²
 - Maximum 1/8" annular space
 - Separated from boxes on opposite sides of wall
 - If > 16in² → listed putty pads


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Penetrations

Exceptions (cont.):

- ❑ Listed boxes: Tested per fire-rated assembly
- ❑ Sprinklers: Metal escutcheon plate

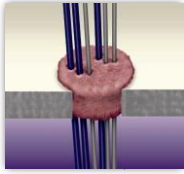
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Penetrations

IBC 714.5.4: Smoke Barriers


- Only approved through-penetration firestop system.
- Must be tested per UL 1479 for air leakage.
- L-rating vs. F-rating



Abasco Fire LLC, www.abasco.com

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Penetrations


Non-rated Horizontal Assemblies

- Shall comply with IBC 713 or IBC 714.6.1 or IBC 714.6.2
- Connect ≤ 5 stories, where:
 - Non-combustible
 - Annular space:
 - prevents passage of hot gasses, or...
 - listed through penetration.
- Connect 2 stories, where:
 - Annular space filled to prevent passage of hot gasses

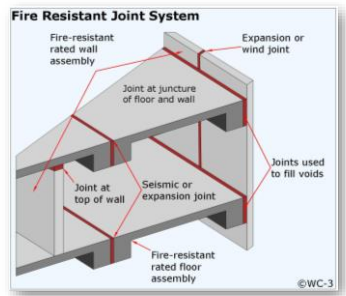


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Joints & Voids (IBC 715)



Fire Resistant Joint System


- Fire-resistant rated wall assembly
- Expansion or wind joint
- Joint at juncture of floor and wall
- Joint at top of wall
- Seismic or expansion joint
- Joints used to fill voids
- Fire-resistant rated floor assembly

©WC-3




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Joint Systems

- Joints between horizontal and vertical assemblies.
- Materials or systems must be securely installed for its entire length
- Must be able to accommodate building movements, and to...
- Resist the passage of fire and smoke for a period not less than assembly f-rating.
- Be aware of the exceptions! (IBC 715.3)





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Joint Systems

- ❑ Tested per [ASTM E 1966](#) or [UL 2079](#)
- ❑ Exterior curtain wall & rated floor
 - Requires approved fire containment system
 - Tested per [ASTM E2307](#)
 - Installed per MFR [and](#) listing
- ❑ Exterior curtain wall & nonrated floor
 - Voids filled with approved material
- ❑ Exterior curtain wall & rated wall
 - Voids filled with approved material

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Opening Protectives (IBC 716)





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Opening Protectives

IBC 716.1.2: Glazing

- Safety glazing → IBC Chapter 24
- Marking/Identification in accordance with Tables 716.1(1), 716.1(2), and 716.1(3)



FIRE TEST STANDARD	MARKING	DEFINITION OF MARKING
ASTM E119 or UL 263	W	Meets wall assembly criteria.
ASTM E119 or UL 263	FC	Meets floor/ceiling criteria ^a
NFPA 257 or UL 9	OH	Meets fire window assembly criteria including the hose stream test.
	D	Meets fire door assembly criteria.
NFPA 252 or UL 10B or UL 10C	H	Meets fire door assembly hose stream test.
	T	Meets 450°F temperature rise criteria for 30 minutes
---	XXX	The time in minutes of the fire resistance or fire protection rating of the glazing assembly.

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TYPE OF ASSEMBLY	REQUIRED WALL ASSEMBLY RATING (hours)	MINIMUM FIRE DOOR AND FIRE SHUTTER ASSEMBLY RATING (hours)	DOOR VISION PANEL SIZE ^a	FIRE-RATED GLAZING MARKING SIDE-LIGHT/TRANSOM PANEL ^b	MINIMUM SIDELIGHT/TRANSOM ASSEMBLY RATING (hours)		FIRE-RATED GLAZING MARKING SIDE-LIGHT/TRANSOM PANEL	
					Fire protection	Fire resistance	Fire protection	Fire resistance
Fire walls and fire barriers having a required fire-resistance rating greater than 1 hour	4	3	See Note a	D-H-W-240	Not Permitted	4	Not Permitted	W-240
	3	3 ^a	See Note a	D-H-W-180	Not Permitted	3	Not Permitted	W-180
	2	1½	100 sq. in.	≤100 sq. in. = D-H-90	Not Permitted		Not Permitted	
	1½	1½	100 sq. in.					

TYPE OF WALL ASSEMBLY	REQUIRED WALL ASSEMBLY RATING (hours)	MINIMUM FIRE WINDOW ASSEMBLY RATING (hours)	FIRE-RATED GLAZING MARKING
Interior walls			
Fire walls	All	NP ^a	W-XXX ^b
Fire barriers	>1	NP ^a	W-XXX ^b
	1	NP ^a	W-XXX ^b
atrium separations (Section 707.3.6), incidental use areas (Section 707.3.7), ^c mixed occupancy separations (Section 707.3.9)	1	½	OH-45 or W-60
Fire partitions	1	½	OH-45 or W-60
	0.5	½	OH-20 or W-30
Smoke barriers	1	½	OH-45 or W-60
	>1	½	OH-60 or W-XXX ^b
Exterior walls	1	¾	OH-45 or W-60
	0.5	½	OH-20 or W-30
Party wall	All	NP ^a	Not Applicable

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Opening Protectives

IBC 716.2: Fire Doors

- Tested per NFPA 252, or UL 10B, or UL 10C
- Transoms per NFPA 257 or UL 9
- Smoke & Draft Control Doors per UL1784
- Tin-clad fire doors → UL 10A, UL 14B & UL 14C
- Frames are also required to meet fire-rating
- Table 716.1(2) is the key!



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TABLE 716.1(2)
OPENING FIRE PROTECTION ASSEMBLIES, RATINGS AND MARKINGS

TYPE OF ASSEMBLY	REQUIRED WALL ASSEMBLY RATING (hours)	MINIMUM FIRE DOOR AND FIRE SHUTTER ASSEMBLY RATING (hours)	DOOR VISION PANEL SIZE*	FIRE-RATED GLAZING MARKING DOOR VISION PANEL**	MINIMUM SIDELIGHT/TRANSOM ASSEMBLY RATING (hours)		FIRE-RATED GLAZING MARKING SIDE-LIGHT/TRANSOM PANEL	
					Fire protection	Fire resistance	Fire protection	Fire resistance
Fire walls and fire barriers having a required fire-resistance rating greater than 1 hour	4	3	See Note a	D-H-W-240	Not Permitted	4	Not Permitted	W-240
	3	3 ^a	See Note a	D-H-W-180	Not Permitted	3	Not Permitted	W-180
	2	1½	100 sq. in.	≤100 sq. in. = D-H-90 >100 sq. in. = D-H-W-90	Not Permitted	2	Not Permitted	W-120
	1½	1½	100 sq. in.	≤100 sq. in. = D-H-90 >100 sq. in. = D-H-W-90	Not Permitted	1½	Not Permitted	W-90

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Opening Protectives

IBC 716.4: Fire Protective Curtains

- Tested without hose stream per UL 10D
- Labeled by an approved agency, permanently affixed, and comply with NFPA 80
- If part of smoke and draft control assemblies, must comply with UL 1784
- Installed per NFPA 80



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Ducts & Air Transfer Openings (IBC 717)



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Duct & Air Transfer

- Protection is typically provided by dampers
- IBC requirements duplicated in IMC 607
- IBC 717 addresses both ducted and un-ducted
- Key damper requirements include:
 - Tests standards
 - Actuation
 - Access
 - Type & location



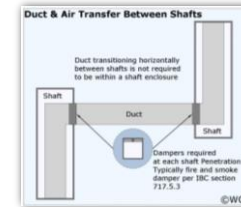
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Duct & Air Transfer

IBC 717.5: Where are dampers required?

- Fire Walls
- Fire Barriers
- Fire Partitions
- Shaft Enclosures
- Corridors
- Smoke Barriers



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Duct & Air Transfer

What types of dampers are considered?



Fire Damper



Smoke Damper

Ceiling
Radiation
Damper

Corridor Damper

Combination Fire &
Smoke Damper

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Duct & Air Transfer

Damper Test Standards:

- Fire dampers – UL 555
- Smoke dampers – UL 555S
- Combination damper – UL 555 and UL 555S
- Ceiling radiation dampers – UL 555C or tested as part of rated horizontal assembly
- Corridor dampers – UL 555 and UL 555S






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Duct & Air Transfer

Damper Test Standards: (cont.)

- ❑ All dampers must be listed and have a label
- ❑ Must be installed in accordance with manufacturer's installation instructions
- ❑ Where smoke and fire dampers are required, may use separate dampers or combination damper

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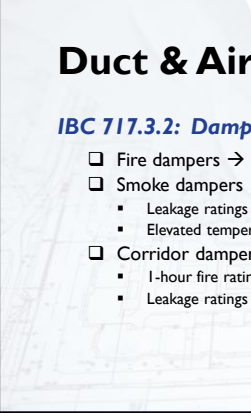


Duct & Air Transfer

IBC 717.3.2: Damper Ratings

- ❑ Fire dampers → per Table 717.3.2.1
- ❑ Smoke dampers
 - Leakage ratings → Class I or II
 - Elevated temperature rating ≥ 250°F
- ❑ Corridor dampers
 - 1-hour fire rating
 - Leakage ratings → Class I or II

TYPE OF PENETRATION	MINIMUM DAMPER RATING (hours)
Less than 3-hour fire-resistance-rated assemblies	1.5
3-hour or greater fire-resistance-rated assemblies	3

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Duct & Air Transfer

IBC 717.3.3: Actuation

- ❑ Fire dampers
 - Operating temp = normal temp + 50°F, but ≥ 160°F, or...
 - Operating temp ≤ 350°F where located w/in smoke control system
- ❑ Ceiling radiation damper
 - Operating temp = normal temp + 50°F, but ≥ 160°F




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Duct & Air Transfer


IBC 717.3.3: Actuation (cont.):

- ❑ Smoke dampers (IBC 717.3.3.2)
 - Shall close upon actuation of *listed detector*
 - Installed within a duct:
 - Within 5-feet of damper
 - No outlets or air
 - Above smoke barrier door → spot-type detector
 - Air transfer opening in wall → spot-type detector
 - In corridor → smoke detection system
 - Total-coverage smoke detection system can also activate damper

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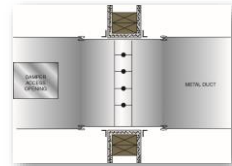


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Duct & Air Transfer


IBC 717.4: Access and Identification

- ❑ "...shall be provided with an approved means of access..."
- ❑ Must be large enough to permit inspection and provide maintenance to operating parts.
- ❑ Exception: Single- or multi-blade dampers that allow for remote inspection per NFPA 80 or 105.

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Duct & Air Transfer


IBC 717.4: Access and Identification (cont.):

- ❑ Access opening shall not reduce the fire-resistance-rating
- ❑ Shall be permanently identified with 1/2-inch letters reading "FIRE/SMOKE DAMPER", "SMOKE DAMPER" OR "FIRE DAMPER".

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66



Duct & Air Transfer


IBC 717.6: Horizontal Assemblies

- ❑ Exception: ≤ 3 Stories, no damper; where all:
 - 26 Ga. w/in cavity of wall
 - Open to only one dwelling/sleeping unit
 - ≤ 4" dia.; 100 in² per 100 ft²
 - Annular space prevent passage of hot gasses
 - Grille opening not in rated wall

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Duct & Air Transfer

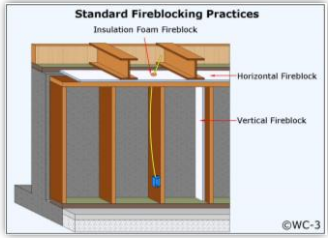
IBC 717.6.3: Nonfire Rated Floor Assemblies

- ❑ Protected by one of the following:
 - Shaft enclosure
 - 2 stories;
 - annular space non-combustible material
 - 3 stories; all of the following:
 - annular space non-combustible material
 - Fire Damper each floor
 - Not required w/in individual dwelling units

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Concealed Spaces (IBC 718)

©WC-3

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Concealed Spaces

“Fireblocking and draftstopping shall be installed in **combustible concealed locations...**”

IBC 718.2.1: Fireblocking Materials

- 1) 2” nominal lumber
- 2) Two layers of 1” lumber
- 3) Two layers of 23/32” wood sheathing
- 4) Two layers of 3/4” particle board
- 5) 1/2” gypsum board
- 6) 1/4” cement-based millboard
- 7) Batts of mineral wool or glass fiber
- 8) Cellulose insulation
- 9) Mass timber

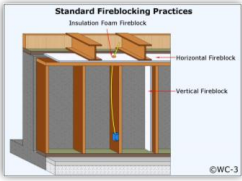
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Concealed Spaces

Fireblocking Locations:

- **Concealed wall spaces**
 - Vertically at the ceiling and floor levels
 - Horizontally ≤ 10-feet



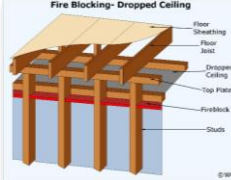
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71


Concealed Spaces

Fireblocking Locations:

- Interconnections of vertical & horizontal concealed spaces “...such as occur at **soffits, drop ceilings and cove ceilings.**”



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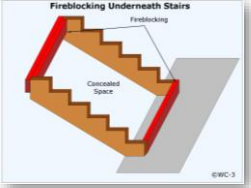


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Concealed Spaces

Fireblocking Locations:

- ❑ Top & bottom of **stair stringers & enclosed space** under stairs.







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Concealed Spaces

Fireblocking Locations:

- ❑ Openings around **vents, pipes, ducts, cables** and wires at the ceiling and floor level.
 - Approved material to resist the free passage of flame and products of combustion







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Concealed Spaces

Fireblocking Locations:

- ❑ **Exterior wall coverings** and other architectural elements.
 - ≤ 20ft spacing & max. 100ft² concealed space

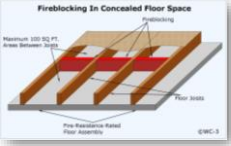






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Concealed Spaces

Fireblocking Locations:

- ❑ In all **concealed sleeper spaces** of wood flooring on masonry or concrete fire-rated floors.
 - ≤ 100ft² concealed space
 - Filled solidly under permanent partitions

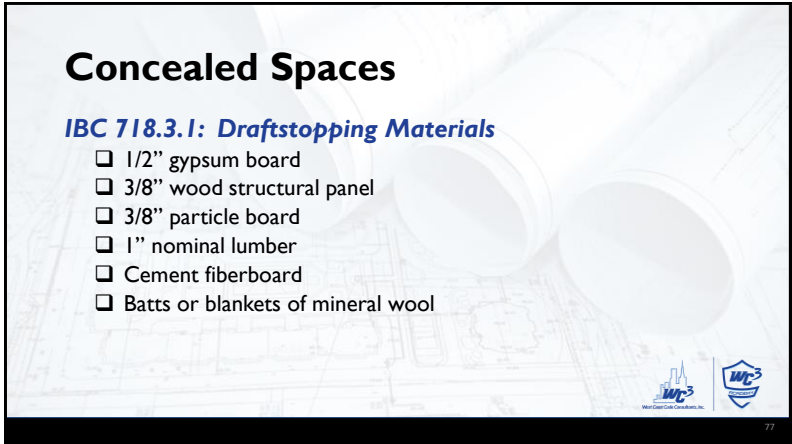





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Concealed Spaces

IBC 718.3.1: Draftstopping Materials

- 1/2" gypsum board
- 3/8" wood structural panel
- 3/8" particle board
- 1" nominal lumber
- Cement fiberboard
- Batts or blankets of mineral wool

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Concealed Spaces

Draftstopping Locations:

- "...shall be installed to subdivide **floor/ceiling assemblies**"
- Where...
 - Above and in line with dwelling and sleeping units
 - Horizontal floor areas $\leq 1,000ft^2$


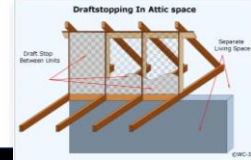




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Concealed Spaces

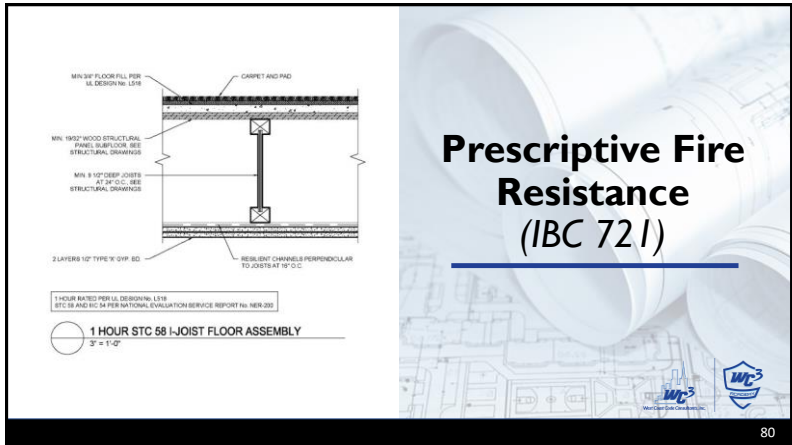

Draftstopping Locations:

- "...shall be installed to subdivide **attic spaces** and concealed roof spaces"
- Where...
 - Dwelling/sleeping units
 - Max. horizontal area of **3,000ft²**

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Prescriptive Fire Resistance (IBC 721)

80

Prescriptive Fire Rating

IBC Table 721.1(1): Structural Parts

Prescriptive Fire Rating
Structural Parts to be Protected
Table 721.1(1)

8" X 8" Steel Column

Siliceous Aggregate Concrete

Rebar Part of Protected Members To Be Solidly Filled

Min Thickness Per Table

STRUCTURAL PARTS TO BE PROTECTED	ITEM NUMBER	INSULATING MATERIAL USED	MINIMUM THICKNESS OF INSULATING MATERIAL FOR THE FOLLOWING FIRE-RESISTANCE PERIODS (inches)			
			4 hours	3 hours	2 hours	1 hour
	1-1.1	Carbonate, lightweight and sand-lightweight aggregate concrete, members 6" x 6" or greater (not including sandstone, granite and siliceous gravel). ^a	2 1/2	2	1 1/2	1
	1-1.2	Carbonate, lightweight and sand-lightweight aggregate concrete, members 8" x 8" or greater (not including sandstone, granite and siliceous gravel). ^a	2	1 1/2	1	1
	1-1.3	Carbonate, lightweight and sand-lightweight aggregate concrete, members 12" x 12" or greater (not including sandstone, granite and siliceous gravel). ^a	1 1/2	1	1	1

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Prescriptive Fire Rating

IBC Table 721.1(2): Walls/Partitions

Prescriptive Fire Rating For Walls IBC Table 721.1(2)

Face to Face Thickness Indicates Fire Rating

Solid Concrete Wall

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE ^b (inches)			
			4 hours	3 hours	2 hours	1 hour
		Siliceous aggregate concrete.	7.0	6.2	5.0	3.5
		Carbonate aggregate concrete.	6.6	5.7	4.6	3.2
		Sand-lightweight concrete.	5.4	4.6	3.8	2.7
		Lightweight concrete.	5.1	4.4	3.6	2.5

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Prescriptive Fire Rating

IBC Table 721.1(3): Floors/Roofs

- Example: Item 21-1

Prescriptive Fire Rating IBC Table 721.1(3)

Wood Joist, Floor Truss Or Roof Truss Spaced 24" O.C.

1/2" Wood Structural Panels With Exterior Glue Applied At Right Angles To Top Of Joist Or Truss With 8d Nails. The Thickness Shall Not Be Less Than 1/2" And Not Less Than Required by Chapter 23

Base Layer: 5/8" Type X Gypsum Wallboard Applied At Right Angles To Joist Or Truss 24" O.C. With 1-1/4" Type S Or W Drywall Screws 24" O.C.

Face Layer: 5/8" Type X Gypsum Wallboard Or Veneer Base Applied At Right Angles To Joist Or Truss Through Base Layer With 1-7/8" Type S Or W Drywall Screws 12" O.C. At Joints And Intermediate Joist Or Truss

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Calculated Fire Resistance

(IBC 722)

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Calculated Fire Rating

IBC 722: Procedures for calculating fire ratings of specific materials.

- Concrete & Masonry → ACI 216.1
- Steel → ASCE 29, Chapter 5
- Wood → ANSI/AF&PA NDS, Chapter 16

Calculating Fire Rating of Concrete Deck

Neglect Shaded Area in Calculation of Equivalent Thickness

S = Spacing of Ribs or Undulations
t = Minimum thickness
t = Equivalent thickness of the slab (never exceed 2t)

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Calculated Fire Rating

Examples:

FINISH DESCRIPTION	TIME (minutes)
Gypsum wallboard	
1/2 inch	10
5/8 inch	15
3/4 inch	20
2 layers of 1/2 inch	25
1 layer of 1/2 inch, 1 layer of 5/8 inch	35
2 layers of 3/4 inch	40

CONCRETE TYPE	MINIMUM SLAB THICKNESS (inches) FOR FIRE-RESISTANCE RATING OF				
	1 hour	1 1/2 hours	2 hours	3 hours	4 hours
Siliceous	3.5	4.3	5.0	6.2	7.0
Carbonate	3.2	4.0	4.6	5.7	6.6
Sand-lightweight	2.7	3.3	3.8	4.6	5.4
Lightweight	2.5	3.1	3.6	4.4	5.1

TYPE OF AGGREGATE	FIRE-RESISTANCE RATING (hours)															
	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	
Pumice or expanded slag	1.5	1.9	2.1	2.5	2.7	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.5	4.7	
Expanded shale, clay or slate	1.8	2.2	2.6	2.9	3.3	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	4.9	5.1	
Limestone, cinders or unexpanded slag	1.9	2.3	2.7	3.1	3.4	3.7	4.0	4.3	4.5	4.8	5.0	5.2	5.5	5.7	5.9	
Calcareous or siliceous gravel	2.0	2.4	2.8	3.2	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.5	5.8	6.0	6.2	

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END OF MODULE 6

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2021 International Building Code
Inspector/Plans Examiner

1

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Modules

- 1. Chapters 1 & 2
- 2. Chapter 3
- 3. Chapters 4 & 6
- 4. Chapter 5
- 5. Chapter 7 – Part 1
- 6. Chapter 7 – Part 2
- 7. **Chapter 10**
- 8. Chapter 11
- 9. Chapters 8 & 9
- 10. Chapters 12, 14 & 15
- 11. Chapters 16, 17 & 18
- 12. Chapters 19 thru 23
- 13. Chapter 24
- 14. Chapters 25 thru 35
- 15. Plan Review Considerations

2

2

MODULE 7:
IBC Chapter 10 – Means of Egress

3


3

Learning Objectives

- 1. Familiarize with the organization and use of Ch. 10.
- 2. Understand occupant loads and their calculation.
- 3. Determine number of means of egress and their separation.
- 4. Learn about travel distance and exit access.
- 5. Introduce the various exit components.

4

4




Commercial Building Inspector (B2) → 11%
Building Plans Examiner (B3) → 21%

IBC Chapter 10

Means of Egress

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IBC 202: Definitions

Means of Egress:

- ❑ A continuous and unobstructed path of vertical and horizontal travel from any occupied portion of a building or structure to a public way.
- ❑ A means of egress consists of three separate and distinct parts:
 - (1) the exit access,
 - (2) the exit, and
 - (3) the exit discharge.

6

IBC 202: Definitions

Exit Access:


- ❑ That portion of a means of egress system that leads from an occupied portion of a building or structure to an exit.

Exit:

- ❑ The portion of a means of egress system between the exit access and the exit discharge or public way. Exit components include:
 - Exterior exit doors at the level of exit discharge,
 - Interior exit stairways and ramps
 - Exit passageways
 - Exterior exit stairways and ramps
 - Horizontal exits.

Exit Discharge:

- ❑ That portion of a means of egress system between the termination of an exit and a public way.



7

Organization


Which Sections of the code apply?

- Indicated in 1003.1, 1016.1, and 1022.1
- ❑ Exit Access – Sections 1016 - 1021
- ❑ Exits – Sections 1022 - 1027
- ❑ Exit Discharge – Sections 1028 - 1029

- General Provisions
- Sections 1003-1015
- Apply to all 3 portions

Additional Sections

- ❑ 1030 – Assembly
- ❑ 1031 – Emergency Escape and Rescue





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IBC 1004: Occupant Load

- Areas without fixed seating (1004.5)
- Posting of assembly occupant load (1004.9)
- Fixed Seating (1004.6)
 - 18" per occupant
- Outdoor areas (1004.7)

AUDITORIUM 5
OCCUPANT LOAD
37 PEOPLE



9

9

Table 1004.5

TABLE 1004.5 MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT	
FUNCTION OF SPACE	OCCUPANT LOAD FACTOR ¹
Accessory storage areas, mechanical equipment room	300 gross
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal	
Baggage claim	20 gross
Baggage handling	300 gross
Concourse	100 gross
Waiting areas	15 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Exhibit gallery and museum	3 net
Assembly with fixed seats	See Section 1004.6
Assembly without fixed seats	

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IBC 1004: Occupant Load

Difference between Use Group and Function




- Use Group (occupancy) – Chapter 3:A, B, F, etc.
- Function (occupancy) – Use of the space

Restaurant dining:

- Use Group (Chapter 3):
 - A (Assembly)
- Function (1004.5)
 - Assembly without fixed seats unconcentrated

Break room: (<50 occ. or <750ft²)

- Use Group (303.1.2):
 - B (Business)
- Function (1004.5)
 - Assembly without fixed seats unconcentrated

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IBC 202: Definitions

Gross Floor Area

- Floor within exterior walls.
 - Includes:
 - Corridors, bathrooms, stairways, closets, interior walls, etc.
 - Does not include:
 - Enclosed shafts or courts

Net Floor Area

- The occupied floor space
 - Includes:
 - Occupied floor area
 - Does not include:
 - Bathrooms, corridors, walkways, mechanical rooms, closets, etc.

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Example: Occupant Load

520ft² Net
15ft²/ Occ.
= 35 Occ.

3,500 ft² Gross Business
150 ft²
= 24 occupants

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IBC 1006.3: Exits/Story

- Occupied Roofs same as stories
- Number of Exits per Table 1006.3.3

OCCUPANT LOAD PER STORY	MINIMUM NUMBER OF EXITS OR ACCESS TO EXITS FROM STORY
1-500	2
501-1,000	3
More than 1,000	4

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- Egress Access through only (1) adjacent story, per 1006.3.2
- Stories with Single Exit per 1006.3.4

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IBC 1006.3: Exits/Story

2,243 ft² / 150 ft² per Occ.
= 15 Occupants

75 ft +

STORY	OCCUPANCY	MAXIMUM OCCUPANT LOAD PER STORY	MAXIMUM EXIT ACCESS TRAVEL DISTANCE (feet)
First story above or below grade plane	A, B ¹ , E, E ² , M, U	49	75
	H-2, H-3	3	25
	H-4, H-5, I, R-1, R-2 ¹	10	75
	S ¹⁻⁴	29	75
Second story above grade plane	B, F, M, S ¹	29	75
Third story above grade plane and higher	NP	NA	NA

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IBC 1006.2: Two Exits

- 1006.2 – (2) means of egress required for any of the following:
 - Occupant Load
 - Common Path
 - Special uses:
 - Boiler rooms
 - Refrigeration
 - Cold rooms
 - Electrical Room

OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)			
		Without Sprinkler System (feet)		With Sprinkler System (feet)	
		Occupant Load	Occupant Load	Occupant Load	Occupant Load
A, E, M	49	75	75	75	75
B	49	100	75	100	100
E	49	75	75	100	100
H-1, H-2, H-3	3	NP	NP	25	25
H-4, H-5	10	NP	NP	75	75
I, J, L-2, L-4	10	NP	NP	75	75

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Number of Exits

OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)	
		Without Sprinkler System (One)	With Sprinkler System (One)
A, E, M	40	75	100
B	40	100	150

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1007.1.1: Exit Location

1/2 or 1/2 longest diagonal between exit or exit access doorways

Cold Storage 9 occ **No Good!!**

Warm Storage 9 occ 133 ft

Dock 9 occ 166 ft **No Good!!**

EXIT 40 ft

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IBC 1016: Exit Access

- Intervening Spaces (1016.2)
- Travel Distance (1017.2)
- Aisles (1018)
- Exits Access Stairways (1019)
- Corridors (1020)
- Egress Balconies (1021)

75 ft

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IBC 1017: Travel Distance

OCCUPANCY	WITHOUT SPRINKLER SYSTEM (feet)	WITH SPRINKLER SYSTEM (feet)
A, E, F-1, M, R, S-1	200'	250'
I-1	Not Permitted	250'
B	200	300'
F-2, S-2, U	300	400'
H-1	Not Permitted	75'
H-2	Not Permitted	100'
H-3	Not Permitted	150'
H-4	Not Permitted	175'
H-5	Not Permitted	200'
I-2, I-3	Not Permitted	200'
I-4	150	200'

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Lookout for the footnotes!!

We're Good!!



197 ft

20

IBC 1019: Access Stairs

1019.3: Other than I-2 or I-3, Unenclosed:

- Open to only 2 floors
- Within Group R dwelling unit
- Within R-3 or R-4
- Draft Curtain W/NFPA 13
 - Other than B and M limited to 4 stories
- Within Atriums
- Open Parking garages
- Open air seating areas
- Serving balconies or galleries in theaters or auditoriums
- Between occupied roofs

21

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IBC 1020: Corridors



- Rated corridors continuous to an exit (1020.7)
- Not used for transfer air (1020.6)
- Above ceiling plenums restricted (1020.6.1)

OCCUPANCY	OCCUPANT LOAD SERVICE		REQUIRED FIRE RESISTANCE RATING (minutes)	
	Minimum	Maximum	With sprinkler system	Without sprinkler system
B-1, H-2, H-3	All	Not Permitted	1"	1"
B-2, B-3	Greater than 50	Not Permitted	1"	1"
A, R, E, F, M, S, U	Greater than 10	Not Permitted	1"	0
R	Greater than 10	Not Permitted	0.5"/1"	0
I-2	All	Not Permitted	0	0
I-1, I-3	All	Not Permitted	1"	1"
I-4	All	Not Permitted	1"	0

OCCUPANCY	MINIMUM WIDTH (feet)
All facilities not listed in this table	44
Access to and utilization of non-vented, plumbing or electrical systems or equipment	24
Within an occupant load of less than 50	36
Within a dwelling unit	36
In Group R with a corridor serving an occupant load of 100 or more	72
In corridors and areas serving stretcher traffic in ambulatory care facilities	72
Group I-2 in areas where required for bed movement	96

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Lookout for dead end corridors!

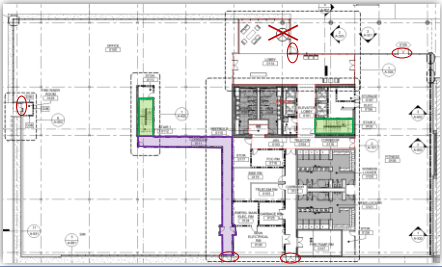




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IBC 1022: Exits

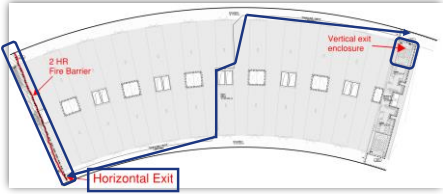

- Exit Doors (1022)
- Interior Exit Stairs or Ramps (1023)
- Exit Passageways (1024)
- Luminous Path (1025)
- Horizontal Exits (1026)
- Exterior Exit Stairs (1027)

23

23

Apple Campus II

24

24

IBC 1028: Exit Discharge

To Public Way (1028.1)

- (3) exceptions
 - 50% may reenter building

Egress Court (1029)

- >44" wide
- < 10 feet 1 hr fire rated

Option: Safe Dispersal Area

25

25

IBC 1003: General Req'ts

1003 – General requirements

- Protruding objects, floor surface, changes in elev.

1005 – Means of egress size

- 0.3" per occupant for stairs
- 0.2" other elements

1008 – Exit illumination

- Battery backup in:
 - Aisles, corridors, exterior egress, exterior landings

1009 – Accessible Means of Egress

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IBC 1010: Doors

IBC 1010 – Door requirements

- Door Swing (1010.1.2)
 - Side swing doors only
 - >50 occupants open in direction of travel
- Landing on each side of door (1010.1.5)
- 48" between doors in series (1010.1.7)
- Door operation (1010.2)
 - Open with single motion (1010.2.1)
 - Exception for locks and latches (1010.2.4)
 - Exception for bolts (1010.2.5)
- Panic Hardware (1010.2.9)
 - H occupancies
 - Refrigerated rooms
 - A or E with >50 occupants
 - Electrical rooms

27

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IBC 1010.2.4: Locks

IBC 1010.2.4 – Item 3 must meet all requirements:

- Doors in only in:
 - Group A, < 300 occupants
 - Group B, F, M, or S
- Key-operated from **EGRESS** side
- Readily distinguishable as locked
- "This door to remain unlocked when this space is occupied"




28

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IBC 1011: Stairways

IBC 1011 – General Stair Requirements

- ❑ 44" Wide (1011.2)
- ❑ 6'8" (or 80") Headroom (1011.3)
- ❑ 7:11 Rise: Run (1011.5.2)
- ❑ Solid Risers (1011.5.5.3)
- ❑ 48" Landings (1011.6)
- ❑ Fire rate enclosures under stairs (1011.7.3)
- ❑ 12-foot vertical rise w/out landing (1011.8)
- ❑ Handrails each side (1011.11)

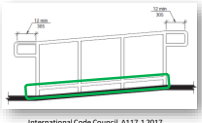
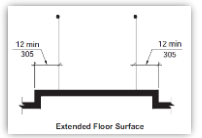






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IBC 1012: Ramps:

IBC 1012 – Ramps

- ❑ 1:12 (8%) max slope (1012.2)
- ❑ 30" max vertical rise (1012.4)
- ❑ 36" wide (1012.5.1)
- ❑ 60" long landings (1012.6.3)
- ❑ Construction same as building type (1012.7)
- ❑ Handrails both sides (1012.8)
- ❑ Edge protection (1012.10)
 - Curb, rail, wall, or barrier
 - Or extend floor 12" beyond handrail

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IBC 1013: Exit Signs

Where required:

- ❑ 2 Exits
- ❑ Within Exits
- ❑ Continuous to exterior exit door

Where NOT required:

- ❑ Obvious Main Exit
- ❑ Group U Occupancies
- ❑ Within Group R
- ❑ Sleeping rooms in I-3
- ❑ Groups A-4 and A-5 on seating side of vomitories


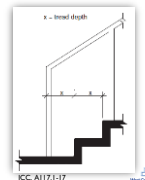






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IBC 1014: Handrails

IBC 1014 – Handrails

- Between 34 and 38 inches high (1014.2)
- Graspability 1-1/4"-2" Dia. (1014.3)
- Continuous – no interruptions (1014.4)
- Handrail extensions (1014.6)

32

IBC 1015: Guards

Required guard locations



- 30" change in grade
- Mechanical equipment <10 feet from edge of roof
- Roof access within 10 feet of edge of roof

General requirements:

- 42 inches high

Opening limits:


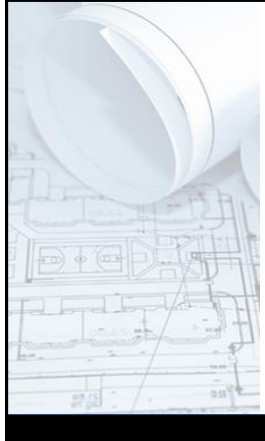
- 4" sphere
- 6" sphere at stair
- Other exceptions

33

IBC 1030: Assembly

- Not just Group A – many requirements for assembly uses.
- Main exit requirements (1030.2)
- Special requirements for seating
 - Smoke and non smoke protected (1030.6.1 and 1030.6.2)
- Aisle requirements (1030.9)
- Aisle accessways (1030.13)
- Special handrail provisions (1030.16)
- Assembly guard provisions (1030.17)






34

IBC 1031: Escape and Rescue

Similar to requirements in IRC

- R-2, R-3, and R-4 occupancies only
 - Not required in stories w/ (2) means of egress.
- Windows in basement and below 4th story
- Opening size:
 - > 5.7 ft² net opening
 - > 24 inches tall
 - > 20 inches wide
- 44-inch maximum sill height

35



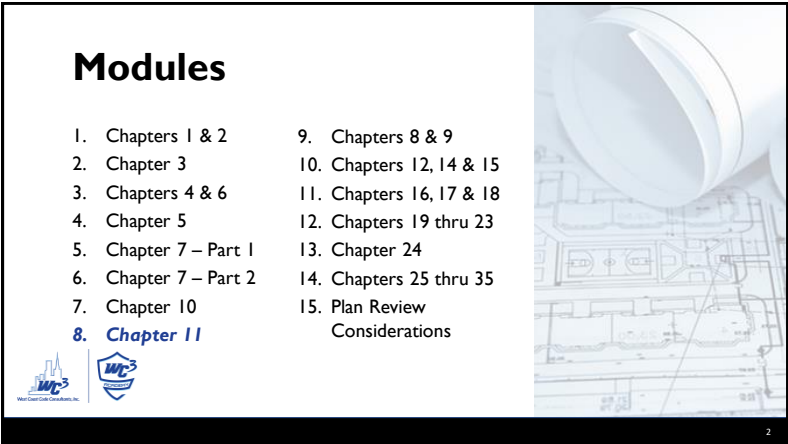
END OF MODULE 7



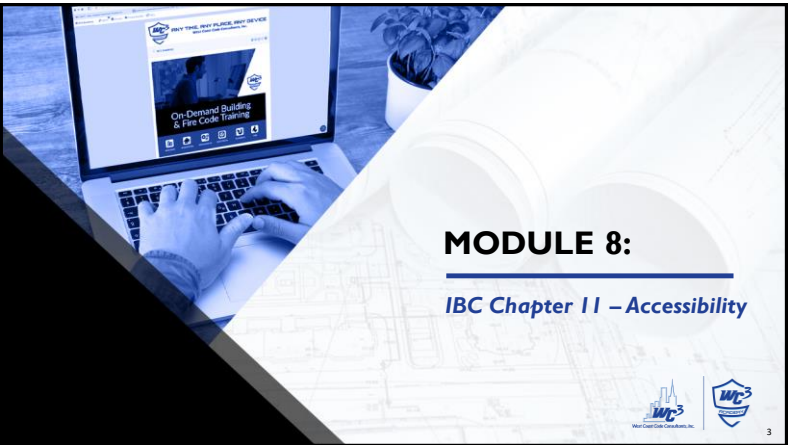
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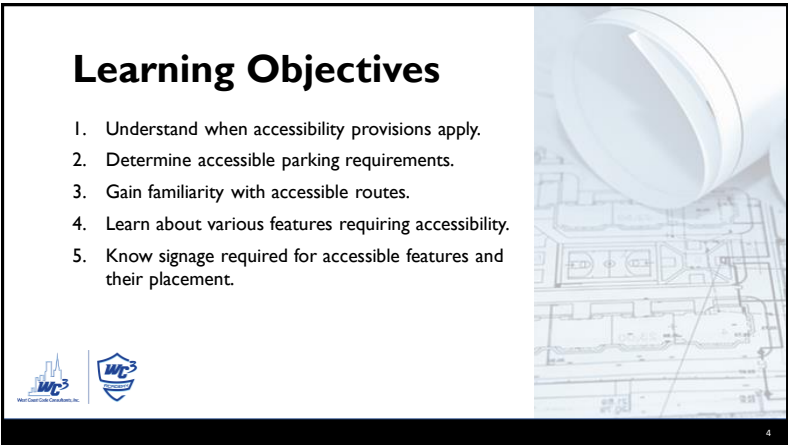
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IBC
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2021

Commercial Building Inspector (B2) → 1%
Building Plans Examiner (B3) → 2%

IBC Chapter 11



Accessibility

International Code Council, 2021 IBC ©



5

Introduction





BUILDING CODE

- 2021 IBC
 - Scoping
 - 102.4 – Only portions of standards referenced in the code shall apply

REFERENCE STANDARD

- ICC A117.1 - 2017
 - Stairs
 - ATM
 - Type C Units




6

IBC 1103: Scoping

- All sites, buildings, structures, facilities, elements, and spaces, temporary or permanent shall be accessible to persons with disabilities





7



IBC 1103: Exceptions

Employee work areas

- Approach, enter, exit
- Detached dwellings
- Group U Buildings
- Construction sites
- Raised areas
- Limited access spaces
- Limited areas in religious worship
- Equipment storage
- Tollbooths
- Residential Group R-1

Daycare facilities in R

- (Residential Portion)
- Detention facilities
- Walk in coolers

8



IBC 1103.2: Non-Accessible

IBC 1103.2.9: Equipment spaces

- Spaces frequented by maintenance personnel only are not required to **comply with this Chapter.**

IBC 1103.2.10 Highway Tollbooths

- Booths where access is provided only by bridges above or tunnels below vehicular traffic.

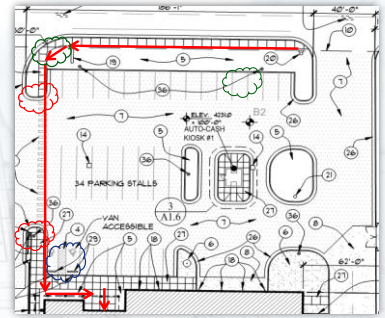



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IBC 1104: Accessible Route

At least one route within site to the accessible entrance from all the following:




- Public transit
- Access. parking
- Loading zone
- Public streets
- Sidewalks



10

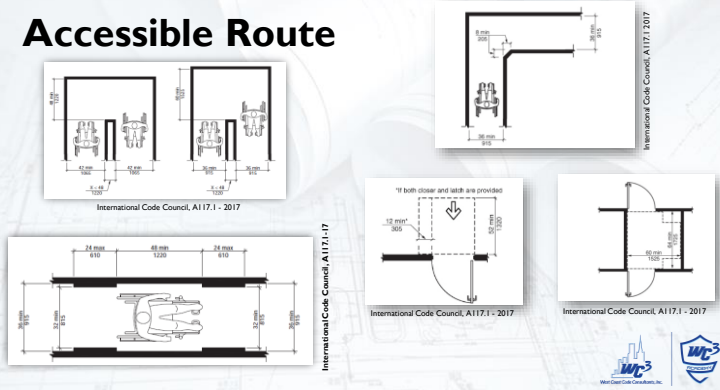
IBC 1104: Accessible Route

- IBC 202 A:** Continuous unobstructed path that complies with Chapter 11
- IBC 1101.2:** In accordance with IBC and ICC A117.1
- 402.1 of ICC A117.1:**
 - Accessible Routes required by the provision (IBC) shall comply with Chapter 4 of ICC A117.1

11

Accessible Route





International Code Council, A117.1 - 2017

International Code Council, A117.1 - 2017

International Code Council, A117.1 - 2017

International Code Council, A117.1 - 2017



12

IBC 1104.4: Multi-story

Elevator or ramp required, except:

- Mezzanines or stories
 - < 3,000 ft² aggregate
 - Locate above or below accessible floor
- Levels not containing accessible elements
- Air traffic control towers
- 2 story building with < 5 occupants on story

❖ These exceptions apply to the accessible route only. All other accessibility requirements must be met on these floors!



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IBC 1104.5: Route Location

Location of Accessible Route

- Same as Circulation Path
- Stay inside
- May not pass through:
 - Kitchens
 - Storage Rooms
 - Restrooms
 - Closets


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IBC 1105: Entrances

Public Entrance (1105.1)

- 60% of all Public Entrances
- All Entrances from Parking Garages
- At Least One Entrance for:
 - Each Tunnel
 - Each Elevated Walkway
 - Restricted Entrances
 - Inmates or Detainees
 - Tenant Spaces
 - Dwelling/Sleeping Units


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IBC 1106: Parking

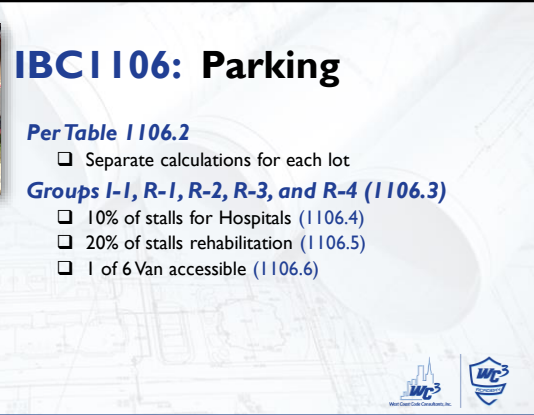

Per Table 1106.2

- Separate calculations for each lot
- Groups I-1, R-1, R-2, R-3, and R-4 (1106.3)**
 - 10% of stalls for Hospitals (1106.4)
 - 20% of stalls rehabilitation (1106.5)
 - 1 of 6 Van accessible (1106.6)



Layton, Utah

TOTAL PARKING SPACES PROVIDED IN PARKING FACILITIES	REQUIRED MINIMUM NUMBER OF ACCESSIBLE SPACES
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	2% of total
1,001 and over	2% plus one for each 100, or fraction thereof, over 1,000




16

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IBC 1106.7: Location of Parking

Location of Parking (1106.7)

- Along shortest route to entrance
 - Where no building closest to accessible route
- Multiple Entrances
 - Disperse parking near all entrances








17

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IBC 1107: EVCS

- Electric Vehicle Charging Stations**
 - Except serving R-2, R-3, or R-4
- Accessible Stations (1107.2.1)**
 - Not less than 5%
 - At least one of each type
- Vehicle Space(1107.2.2)**
 - Same as Van Accessible
 - 132" Space w/ 60" Aisle

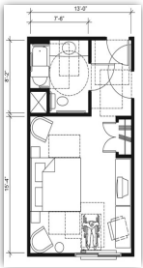






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IBC 1108: Dwelling Units

- Accessible Units**
 - Required in Group I, R-1, R-2*, R-4
- Type A Units**
 - Only in R-2 (Apartments)
- Type B Units**
 - > 4 units all others (except...)
- Exceptions to Type B (1108.7)**
 - Building without elevators
 - Multi-Story Units
 - Elevator to lowest story only
 - Sloped sites
 - Flood elevations

19

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IBC 1109: Special Occ.

1109.2 – Assembly Area Seating


- General seating
- Luxury box
- Team/player seating
- Companion seats
- Assistive listening systems
- Dining and drinking areas

1109.3 – Self Service Storage




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IBC 1109.4: Judicial


Courtrooms (1109.4.1)

- ❑ Jury box
 - Wheelchair space
- ❑ Gallery seating
 - Table 1109.2.2.1
- ❑ Assistive Listening
- ❑ Employee work areas
 - Accessible route




ICCA 117.1-17 §807

- ❑ Turning Space (807.2)
 - Each raised/depressed area
- ❑ Clear floor space (807.3)



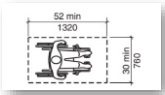
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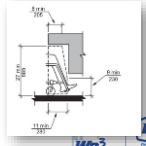



ICCA 117.1-17

- ❑ Clear Floor Space (305.3)
 - 30" x 52"




- ❑ Knee and Toe Clearance (306)
 - Toe: 9" high, 17"-25" deep
 - Knee: 27" high for 8" deep


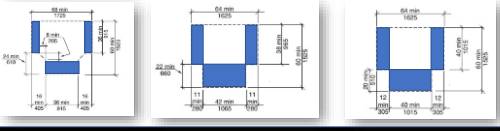

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ICCA 117.1-17

- ❑ Circular Turning Spaces (304.3)
 - 67" Circle
 - Knee and toe clearance for 10" depth
- ❑ T-Shaped Clearance
 - 3 Options
 - Knee and toe in either base or arm

23

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IBC 1110.2: Toilet & Bathing

Each room and one of each fixture

- ❑ Exceptions:
 - Private Offices
 - Per ICCA 117.1-17
 - Within dwelling units
 - 50% of single user toilets
 - Single urinal
 - Critical or intensive care units
 - Bariatric patient areas
 - Toilets primarily for Children
 - Per ICCA 117.1-17





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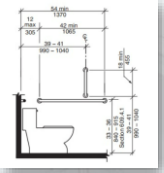
IBC 1110.2.4: Toilet Stalls

Wheelchair accessible compartment

- 5% of Stalls
- At least 1




Syracuse, Utah




International Code Council, A117.1-2017

Ambulatory Stalls

- 6 or more stalls, 5%
- In addition to Wheelchair



Syracuse, Utah



WC3

25

IBC 1110.2.1: Family Restroom

Family or assisted-use toilet room required

- In Group A or M
- Aggregate of > 5 men or women W.C. required
- In all recreational facilities w/bathing facilities

Family or assisted bathing

- Where family toilet room is required and a bathing facilities are provided.
 - Exception: only one bathing fixture
- May be combined with toilet room



WC3

26

IBC 1110: Other Features

Lavatories (1110.2.5)

- 5% accessible
- > 6 – use enhanced reach

Sinks (1110.3)

- 5% (not including mop sink)

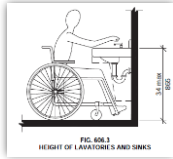



FIG. 606.1
HEIGHT OF LAVATORIES AND SINKS
International Code Council, A117.1-09



WC3

27



IBC 1110: Other Features

Kitchens (1110.4)

- Kitchens and Kitchenettes

Drinking fountains (1110.5)


- Minimum 2 (standing and wheelchair)

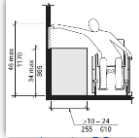
WC3

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IBC 1110: Other Features



International Code Council, A117.1-17





- ❑ **Saunas and Steam rooms (1110.7)**
 - Provide a bench and turn-around radius
- ❑ **Elevators (1110.8)**
- ❑ **Storage (1110.10)**
- ❑ **Detectable warnings (1110.11)**
 - Truncated domes at transit platforms
- ❑ **Seating at tables (1110.12)**
 - Minimum 5%
- ❑ **Operating Controls (1110.15)**

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IBC 1110.9: Lifts

Restricted to following:


1. Group A: Performing Areas
2. Group A: Dispersed Seating
3. Limited Access < 5 people
4. Dwelling/Sleeping unit
5. Courtrooms
6. Amusement Rides
7. Playgrounds
8. Player Seating (sports)
9. Boating or fishing piers
10. Exterior w/Site Conditions



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IBC 1110.13: Service



- ❑ **Checkout aisles (1110.13.1)**
 - 1 of 4 (first 20)
- ❑ **Point of sale counter(1110.13.2)**
 - 1 of each type
 - 1 per location
- ❑ **Food service lines (1110.13.3)**
 - 50% of self serve shelves
- ❑ **Queue and Lines (1110.13.4)**
- ❑ **Dressing/Locker rooms (1110.14)**
 - 5% of stalls or lockers
 - Minimum 1 per cluster

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IBC 1111: Recreation

Recreational Facilities in R-2, R-3, and R-4

- Buildings with Accessible Units
 - All recreational facilities accessible
- Buildings with Type A or Type B
 - 25% of all recreational facilities
 - One of each type accessible


All other Use Groups

- All recreational facilities accessible




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IBC 1111.4: Recreation

Area of sport activity (1111.4.1)

- Accessible route to area
- Area not accessible

Bowling Lanes (1111.4.3)



- 5% of lanes

Amusement Rides (1111.4.8)

- Load and unload areas
- Minimum one seat per ride


Boating facilities (1111.4.9)

- Accessible boat slips
- Accessible slips dispersed
- 5% of boat launches

33

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IBC 1111.4: Recreational Facilities

Exercise machines (1111.4.10)

- One of each type

Fishing piers (1111.4.11)



Miniature golf (1111.4.12)

- 50% of holes
- Accessible holes together
- On accessible route

Swimming Pools (1111.4.14)

Shooting facilities (1111.4.15)

- 5% of firing positions
- One of each type

34

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IBC 1112: Signage

Signs for Accessible Elements

- Parking and passenger loading
- Areas of refuge
- Family/Assisted-use bathrooms
- Where only some are accessible
 - Bathrooms, entrances, checkout aisles, dressing rooms



Directional Signage

- To Family bathroom from single bathroom
- At elevators not part of accessible route
- At inaccessible features to accessible

Special Signs




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END OF MODULE 8

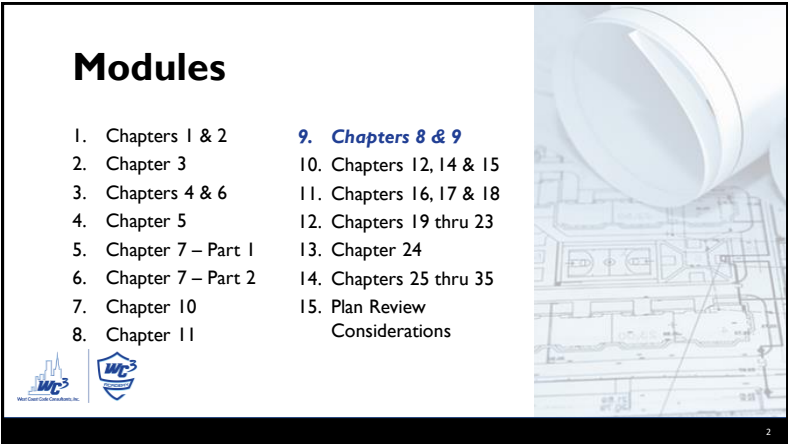



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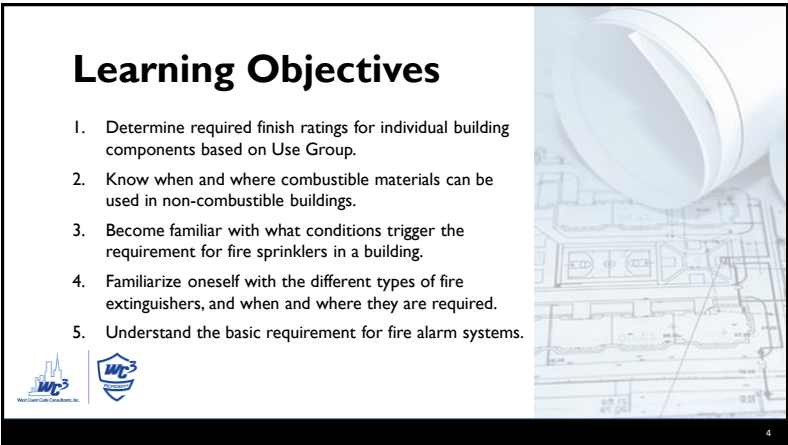
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Commercial Building Inspector (B2) → 4%
 Building Plans Examiner (B3) → 6%

IBC Chapter 8

Interior Finishes



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5

Interior Finishes

Chapter 8 deals with...

6

Key Words

Fire-Resistance Rating:


- ❑ Building elements, components, assemblies
- ❑ Per ASTM E 119 or UL 263

Flame Spread Index:

- ❑ Specific to materials (typically finish materials)
- ❑ Per ASTM E 84 or UL 723

Smoke-Developed Index:

- ❑ Same as Flame Spread Index



7


Wall & Ceiling Finishes

IBC 803: Interior Finish Indexes

Class A: F.S.I. = 0-25
S.D.I. = 0-450

Class B: F.S.I. = 26-75
S.D.I. = 0-450

Class C: F.S.I. = 76-200
S.D.I. = 0-450



8


Wall & Ceiling Finishes

Pay attention to the footnotes!

TABLE 803.13
INTERIOR WALL AND CEILING FINISH REQUIREMENTS BY OCCUPANCY*

GROUP	SPRINKLERED			NON-SPRINKLERED		
	Interior exit stairways and ramps and exit passageways ^{a,2}	Corridors and enclosure for exit access stairways and ramps	Rooms and enclosed spaces ³	Interior exit stairways and ramps and exit passageways ⁴	Corridors and enclosure for exit access stairways and ramps	Rooms and enclosed spaces ⁵
A-1 & A-2	B	B	C	A	A ¹	B ¹
A-3 ¹ , A-4, A-5	B	B	C	A	A ¹	C
B, E, M, R-1	B	C ⁶	C	A	B	C
R-4	B	C	C	A	B	B
F	C	C	C	B	C	C
H	B	B	C ²	A	A	B
I-1	B	C	C	A	B	B
I-2	B	B	B ^{1,1}	A	A	B
I-3	A	A ¹	C	A	A	B
I-4	B	B	B ^{1,1}	A	A	B
R-2	C	C	C	B	B	C
R-3	C	C	C	C	C	C
S	C	C	C	B	B	C
U	No restrictions			No restrictions		

International Code Council, 2021. IBC®






9

Wall & Ceiling Finishes

Exemptions:

- NFPA 286 – Room corner test, walls & ceilings
- NFPA 265 – Room corner test, vinyl & textile coverings
- Thickness exemption ≤ 0.036 inch
- Heavy timber (Type IV-HT)








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Wall & Ceiling Finishes

Other Considerations:

- Cannot become detached at temperatures of 200°F (IBC 803.14)
- IBC 803.15: Special provisions when...
 - Attached to fire-resistance rated assemblies, or...
 - Attached to members required to be noncombustible elements

11


Interior Floor Finish

IBC 804.2: Classification

- Per ASTM E648 or NFPA 253
- Testing should include underlayment
- Class I: ≥ 0.45 watts/cm², or...
- Class II: ≥ 0.22 watts/cm²

IBC 804.3: Testing & Identification

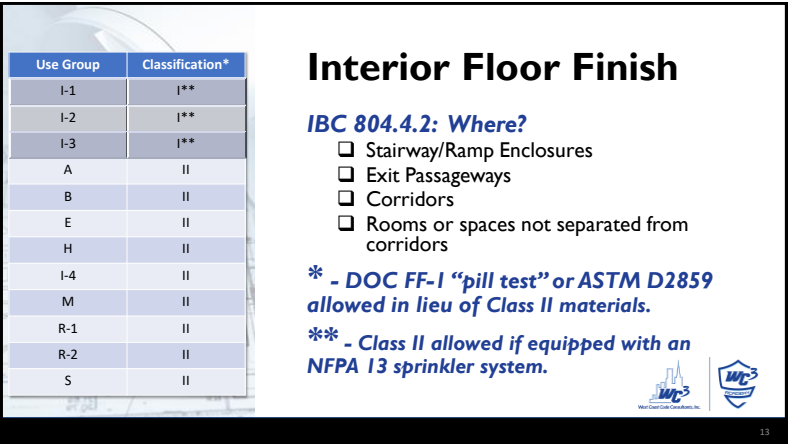
- Hang tag or other method
 - Manufacturer
 - Style
 - Classification



NFPA 253 – Radiant Floor Panel Test




12



Use Group	Classification*
I-1	I**
I-2	I**
I-3	I**
A	II
B	II
E	II
H	II
I-4	II
M	II
R-1	II
R-2	II
S	II


Interior Floor Finish

IBC 804.4.2: Where?

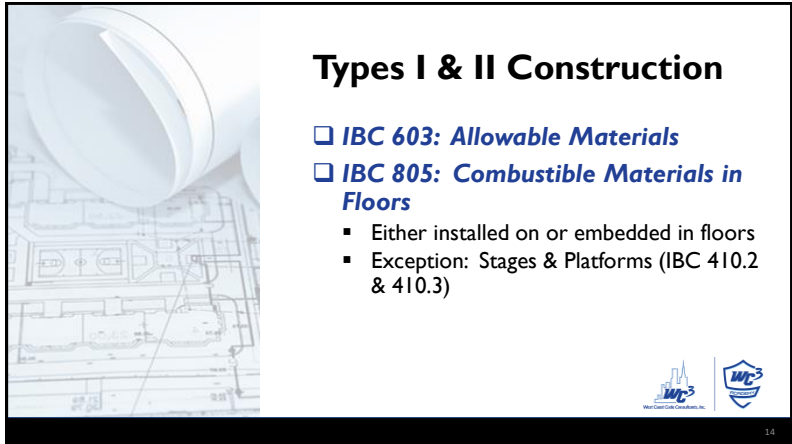
- Stairway/Ramp Enclosures
- Exit Passageways
- Corridors
- Rooms or spaces not separated from corridors

*** - DOC FF-I "pill test" or ASTM D2859 allowed in lieu of Class II materials.**

**** - Class II allowed if equipped with an NFPA 13 sprinkler system.**




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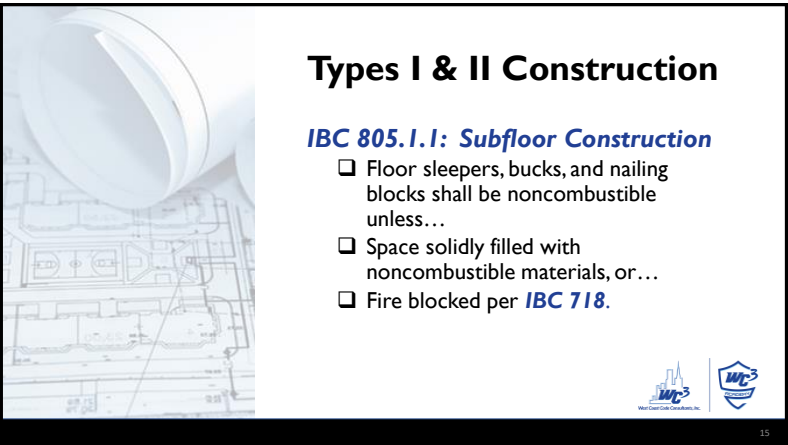


Types I & II Construction

- IBC 603: Allowable Materials**
- IBC 805: Combustible Materials in Floors**
 - Either installed on or embedded in floors
 - Exception: Stages & Platforms (IBC 410.2 & 410.3)




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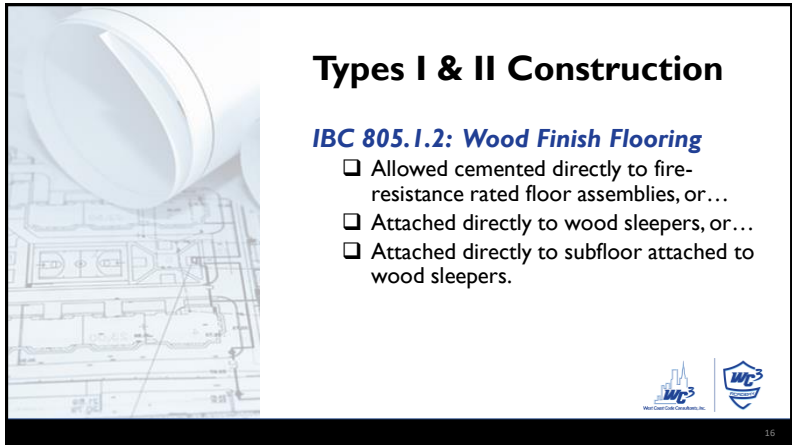
Types I & II Construction

IBC 805.1.1: Subfloor Construction

- Floor sleepers, bucks, and nailing blocks shall be noncombustible unless...
- Space solidly filled with noncombustible materials, or...
- Fire blocked per **IBC 718**.




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Types I & II Construction

IBC 805.1.2: Wood Finish Flooring

- Allowed cemented directly to fire-resistance rated floor assemblies, or...
- Attached directly to wood sleepers, or...
- Attached directly to subfloor attached to wood sleepers.




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Types I & II Construction

IBC 805.1.3: Insulating Boards

- ❑ Combustible insulating boards are allowed if ≤ ½-inch thick and...
 - Covered with finished flooring, and...
 - Attached directly to noncombustible floor assembly, or...
 - Attached directly to wood subflooring attached to sleepers.





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Decorative Materials

IBC 806.2: Groups A, B, E, I, M, R-1, and R-2 dormitories...

- ❑ Curtains
- ❑ Draperies
- ❑ Fabric Hangings
- ❑ Similar Combustible Decorative Materials
- ❑ ≤ 10% of wall or ceiling area
- ❑ Test 1 or 2 of NFPA 701, or...
- ❑ Max. heat release of 100kW (NFPA 289)



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Decorative Materials

Exceptions:

- ❑ Sprinklered 'Group A' auditoriums ≤ 75%
- ❑ Sprinklered 'Group R-2' dormitories, w/in sleeping units ≤ 50%
- ❑ Group B & M combustible fabric partitions suspended from ceiling → Unlimited
- ❑ 10% limit does not apply to curtains, draperies, or fabric hangings used as window coverings.

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Decorative Trim

Foam Plastic:

- ❑ Any foam plastic used as trim → IBC 2604.2
- ❑ Pyroxylin Plastic → not allowed in Group A
- ❑ Foam Plastic as Interior Trim:
 - Shall have Class 'C' flame spread and smoke-developed index per ASTM E 84 or UL 273.
 - Excludes handrails and guardrails
 - ≤ 10% of wall or ceiling area





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Decorative Trim

Combustible Lockers:

- ❑ Shall be considered interior finish (IBC 803)
- ❑ Shall be permitted anytime **Class C** interior finish is allowed



Utah State University, Campus Risk Mitigation, December 2, 2019








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Acoustical Ceiling Systems

- ❑ Shall comply with **IBC 803**
- ❑ Installed per ASTM C635 & ASTM C636
 - Also required to comply with ASCE 7-16
 - SDC 'C or above' → ASTM E580
- ❑ If part of fire-rated assembly, shall be installed in same manner as tested assembly

22

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IBC
INTERNATIONAL BUILDING CODE
2021

Commercial Building Inspector (B2) → 4%
Building Plans Examiner (B3) → 3%

IBC Chapter 9

Fire Protection/Life Safety Systems




International Code Council, 2021 IBC ©




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Chapter 9

Fire Protection Systems:

- ❑ Suppression
- ❑ Standpipes
- ❑ Extinguishers
- ❑ Alarms
- ❑ Smoke Control
- ❑ Emergency Responder Communication

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Fire Sprinklers

When are fire sprinklers required?

Use Group	Fire Area (ft²)	Occupant Load	Above Exit Discharge	Other
A-1	12,000	300	Yes	Multi-theater complex
A-2	5,000	100	Yes	
A-3	12,000	300	Yes	
A-4	12,000	300	Yes	
A-5	1,000	---	---	Enclosed areas under grandstands and bleachers
A	---	A-1 > 100 Others > 300	Yes	Occupiable roofs --> all floors between roof and level of exit discharge (Ex: Open parking garages)
E	12,000	300	Yes	Areas below level of exit discharge

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Fire Sprinklers

Where else?...

Use Group	Fire Area (ft²)	Occupant Load	Above Exit Discharge	Other
F-1	12,000	---	---	<ul style="list-style-type: none"> • Located > 3 stories above grade • Woodworking operations > 2,500ft² • Upholstered furniture/mattresses > 2,500ft² • Distilled spirits of any size • High-piled storage areas
M	12,000	---	---	<ul style="list-style-type: none"> • Upholstered furniture/mattresses > 5,000ft² • Repair garages > 12,000ft² (5,000ft² for commercial vehicles)
S-1	12,000	---	---	<ul style="list-style-type: none"> • Bulk tire storage > 20,000ft³ (volume) • Storage of commercial vehicles > 5,000ft² • Distilled spirits • Upholstered furniture/mattresses > 2,500ft² • 12,000ft² (enclosed) - 48,000ft² (open) • If located beneath other Use Groups
S-2	12,000	---	---	<ul style="list-style-type: none"> • Commercial vehicles > 5,000ft² • Mechanical-access parking garages

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Fire Sprinklers

Where else?...

- Group H (IBC 903.2.5)
- Group I (IBC 903.2.5)
- Group R (IBC 903.2.8)
- Ambulatory Care (IBC 903.2.2)
- Stories w/out openings (IBC 903.2.11.1)
- Rubbish & linen chutes (IBC 903.2.11.2)
- Buildings > 55-feet (IBC 903.2.11.3)
- Ducts containing HazMat exhaust (IBC 903.2.11.4)
- Commercial cooking operations (IBC 903.2.11.5)

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Fire Sprinklers

Where else?...

- As listed in Table 903.2.11.6

TABLE 903.2.11.6 ADDITIONAL REQUIRED PROTECTION SYSTEMS	
SECTION	SUBJECT
402.5, 402.6.2	Covered and open mall buildings
404.3	High-rise buildings
404.3	Atriums
405.3	Underground structures
407.7	Group I-2
410.6	Stages
411.3	Special amusement buildings
412.2.4	Airport traffic control towers
412.3.6, 412.3.6.1, 412.5.6	Air-ridg buildings
415.11.11	Group II-5 HPM exhaust ducts
416.5	Flammable finishes
417.4	Drying rooms
424.3	Play structures
428	Buildings containing laboratory noise
507	Uninhabited area buildings
508.5.7	Live/work units
509.4	Incidental uses
1030.6.2.3	Smoke-protected assembly seating
IPC	Sprinkler system requirements as set forth in Section 903.2.11.6 of the International Fire Code

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Fire Sprinklers

What types of fire sprinkler systems are there?

- NFPA 13 (IBC 903.3.1.1)
- NFPA 13R (IBC 903.3.1.2)
- NFPA 13D (IBC 903.3.1.3)

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Fire Sprinklers

Important items...

- IBC Tables 307.1(1) & 307.1(2), footnotes 'd':**
 - An increase is only allowed for NFPA 13 systems.
- IBC Tables 504.3, 504.4 & 506.2:**
 - Allowable height, number of stories, and allowable areas are greater for full NFPA 13 systems. (S, S13R, S13D)
- IBC Table 508.4 (Mixed Occupancies):**
 - Reduction in occupancy separation requirements only applies to full NFPA 13 systems.
- IBC Table 705.8 (Protected Openings):**
 - Increase in allowable area is only for NFPA 13.

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Alternative Automatic Fire-Extinguishing Systems (IBC 904)

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Alternate Suppression

What types of alternate fire-extinguishing systems are there?

- Wet-chemical systems (IBC 904.5)
- Dry-chemical systems (IBC 904.6)
- Foam systems (IBC 904.7)
- Carbon dioxide systems (IBC 904.8)
- Halon systems (IBC 904.9)
- Clean agent systems (IBC 904.10)
- Water mist systems (IBC 904.11)
- Aerosol systems (IBC 904.12)
- Commercial cooking systems (IBC 904.13)
- Domestic cooking systems (IBC 904.14)



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Alternate Suppression

IBC 904.2: Where permitted

- When approved by fire code official

IBC 904.3: Installation

- Electrical per NEC
- Automatic & manual actuation
- System interlocks as necessary
- Distinctive audible & visual alarms
- Monitored if fire alarm system installed



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Alternate Suppression

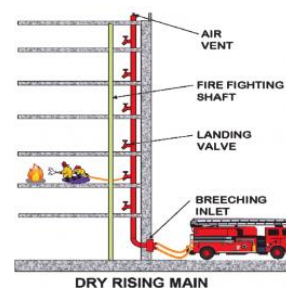
IBC 904.13: Commercial Cooking System

- Type I hoods required by...
 - IFC, Section 609
 - IMC, Chapter 5
- Dry- or wet-chemical systems per UL 300
- Installed per NFPA 96, listing & MFR
- Other systems must be listed specifically for commercial cooking operations



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Standpipe Systems (IBC 905)



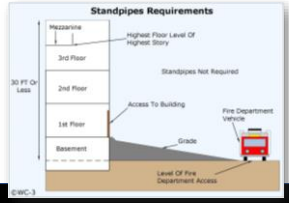
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Standpipes

IBC 905.3: Required Installations

- ☐ ≥ 4 or more stories (above or below)
- ☐ Highest or lowest floor level is >30-feet from fire department vehicle access



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Standpipes

IBC 905.3: Required Installations

- ☐ Group A : Nonsprinklered and > 1,000 occupants
- ☐ Covered & Open Mall Buildings
- ☐ Stages > 1,000ft²
- ☐ Underground Buildings
- ☐ Helistops & Heliports
- ☐ Marinas & Boatyards
- ☐ Roof Gardens & Landscaped Roofs



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Standpipes

Key Requirements

- ☐ Must comply with NFPA 14
- ☐ Fire Department Connections per IBC 912
- ☐ Located within protective enclosures
- ☐ Valve supervision
- ☐ Located at each floor-level landing, unless otherwise approved by fire code official



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Portable Fire Extinguishers (IBC 906)





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Fire Extinguishers

IBC 906.1: Where Required

- Groups A, B, E, F, H, I, M, R-1, R-2, R-4 & S
- Within 30-feet of commercial cooking equip.
- Domestic cooking equip. (I-1, I2- & R-2 dorms)
- Flammable or combustible liquids
- On each floor under construction.
- Special-hazard areas (*laboratories, computer rooms, generator rooms, or per fire code official*)
- Where required by **IBC Table 906.1**






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Fire Extinguishers

IBC TABLE 906.1 ADDITIONAL REQUIRED PORTABLE FIRE EXTINGUISHERS IN THE INTERNATIONAL FIRE CODE

IFC SECTION	SUBJECT
303.5	Asphalt kettles
307.5	Open burning
308.1.3	Open flames—torches
309.4	Powered industrial trucks
1204.10	Portable Generators
2005.2	Aircraft towing vehicles
2005.3	Aircraft welding apparatus
2005.4	Aircraft fuel-servicing tank vehicles
2005.5	Aircraft hydrant fuel-servicing vehicles
2005.6	Aircraft fuel-dispensing stations
2007.7	Helipads and helosteps
2108.4	Dry cleaning plants
2305.5	Motor fuel-dispensing facilities
2310.6.4	Marine motor fuel-dispensing facilities
2311.6	Repair garages
2404.4.1	Spray-finishing operations
2405.4.2	Dip-tank operations
2406.4.2	Powder-coating areas
2804.3	Lumberyards/woodworking facilities
2808.8	Recycling facilities
2809.5	Exterior lumber storage
2903.5	Organic-coating areas
3006.5	Industrial ovens
3107.9	Tens and membrane structures
3206.10	High-piled storage
3315.1	Buildings under construction or demolition
3318.3	Roofing operations
3408.2	Tire rebuilding/storage
3504.2.6	Welding and other hot work
3604.4	Marinas
3703.6	Combustible fibers
5703.2.1	Flammable and combustible liquids, general
5704.3.3.1	Indoor storage of flammable and combustible liquids
5704.3.7.5.2	Liquid storage rooms for flammable and combustible liquids
5705.4.9	Solvent distillation units
5706.2.7	Farms and construction sites—flammable and combustible liquids storage
5706.4.10.1	Bulk plants and terminals for flammable and combustible liquids
5706.5.4.5	Commercial, industrial, governmental or manufacturing establishments—fuel dispensing
5706.6.4	Tank vehicles for flammable and combustible liquids
5906.5.7	Flammable solids
6108.2	LP-gas






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Fire Extinguishers

Fire Hazard Classes...

- Class 'A':** *Ordinary combustible materials* like paper, wood, fabrics and rubber.
- Class 'B':** Mostly involves flammable *liquids or gases*.
- Class 'C':** Live *electrical equipment* like motors, generators and other appliances.
- Class 'D':** *Combustible metals* such as magnesium, sodium, lithium potassium, etc.
- Class 'K':** *Vegetable or animal oils and fats*

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Fire Extinguishers



Size & Distribution:

- Class 'A' → Table 906.3(1)
- Class 'B' → Table 906.3(2)
- Maximum Travel Distance of 75-feet

TABLE 906.3(1) FIRE EXTINGUISHERS FOR CLASS A FIRE HAZARD'S

	LIGHT (Low) HAZARD OCCUPANCY	ORDINARY (Moderate) HAZARD OCCUPANCY	EXTRA (High) HAZARD OCCUPANCY
Minimum-rated single extinguisher	2-A*	2-A	4-A*
Maximum floor area per unit of A	3,000 square feet	1,500 square feet	1,000 square feet
Maximum floor area for extinguisher*	11,250 square feet	11,250 square feet	11,250 square feet
Maximum distance of travel to extinguisher	75 feet	75 feet	75 feet

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Fire Extinguishers

IBC 906.5: Conspicuous Location

- Horizontal projections ≤ 4" (IBC 1003.3.3)

IBC 906.9: Installation

- ≤ 40 lbs. → Top ≤ 5-feet
- > 40 lbs. → Top ≤ 3.5-feet
- Min. 4" clearance between bottom and floor



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Fire Alarm & Detection Systems (IBC 907)



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Use Group	Occupant Load	Above/Below Exit Discharge	Other
A	300	100	Emergency voice/alarm communication system if > 1,000 occupants
B	500	100	Contains ambulatory care facility
E	50	---	Emergency voice/alarm communication system required
F	---	500	And ≥ 2 stories
H-5	All	All	Also required where highly toxic gases, organic peroxides & oxidizers exist.
I	All	All	
M	500	100	
R-1	All	All	Not required if... • ≤ 2 stories in height with units and attic separated • Sprinklered, notification appliances, one manual fire alarm box
R-2	500	100	• Any dwelling/sleeping unit is ≥ 3 stories • Any dwelling/sleeping unit > 1 story above or below • > 16 dwelling/sleeping units
S	All	All	Public & self-storage ≥ 3 stories






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Fire Alarms

IBC 907.2: When Required

- Special Amusement Buildings
- High-rise Buildings
- Atriums
- High-piled Combustible Storage
- Aerosol Storage
- Lumber mills
- Underground Buildings
- Mall Buildings
- Residential Aircraft Hangars
- Airport Traffic Control Towers
- Energy Storage Systems

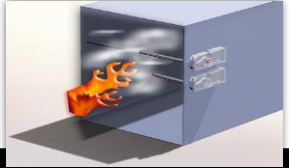



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Fire Alarms

IBC 907.3.1: Duct Detectors

- Air-handling systems > 2,000cfm (per IMC)
- Shall...
 - Shutdown system upon activation, and...
 - Be connected to building fire alarm system



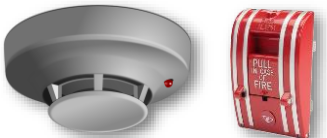
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Fire Alarms

IBC 907.4: Initiating Devices

- Manual fire alarm boxes
- Automatic smoke/heat detection
- Automatic waterflow devices
- Automatic fire-extinguishing systems



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Fire Alarms

IBC 907.5: Occupant Notification

- Audible alarms
- Emergency voice/alarm, communication
- Visible alarms
 - Public use areas
 - I-1, R-1, R-2

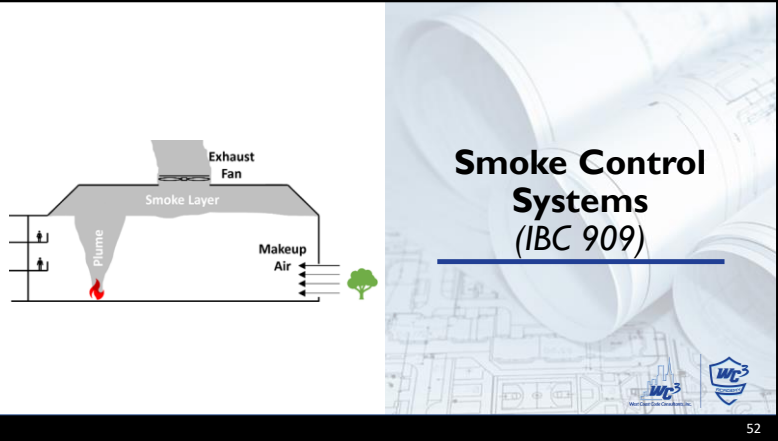
[F] TABLE 907.5.2.2 VISIBLE ALARMS	
NUMBER OF SLEEPING UNITS	SLEEPING ACCOMMODATIONS WITH VISIBLE ALARMS
6 to 25	2
26 to 50	4
51 to 75	7
76 to 100	9
100 to 150	12
151 to 200	14
201 to 300	17
301 to 400	20
401 to 500	22
500 to 1,000	9% of total
1,001 and over	50 plus 3 for each 100 over 1,000

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Smoke Control Systems (IBC 909)



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Smoke Control


When is smoke control required?

- Covered malls w/ atriums > 2 stories (§402.7.2)
- Atriums connecting > 2 stories (§404.5)
- Underground buildings (§405.5)
- Windowless buildings (§408.9)
- Stages > 1,000ft² (§410.2.7)



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Smoke Control

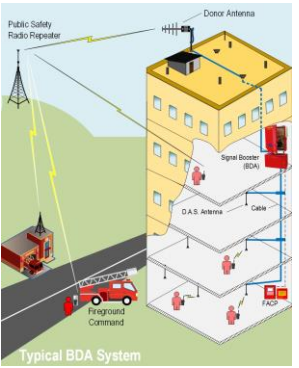
Items to consider...

- IBC 909.2: General Design**
 - "...sufficient information and detail... for the proper implementation of the smoke control systems."
- IBC 909.18: Acceptance Testing**
 - Detection devices, ducts, dampers, inlets & outlets, fans, smoke barriers and controls.
- IBC 909.3: Special Inspection**
- IBC 909.18.9: Identification & Documentation**




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Emergency Responder Communication Coverage (IBC 918)





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Communication

When is it required?

- In all new buildings per *IFC 510*
- Based on existing coverage levels of public safety communication systems
- Also required retroactively in existing buildings other than Group R-3 (*IFC 510.2 & 1103.2*)

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Communication

DEFERRED SUBMITTAL

1. FIRE ALARM SYSTEM
2. AUTOMATIC SPRINKLER SYSTEM

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END OF MODULE 9

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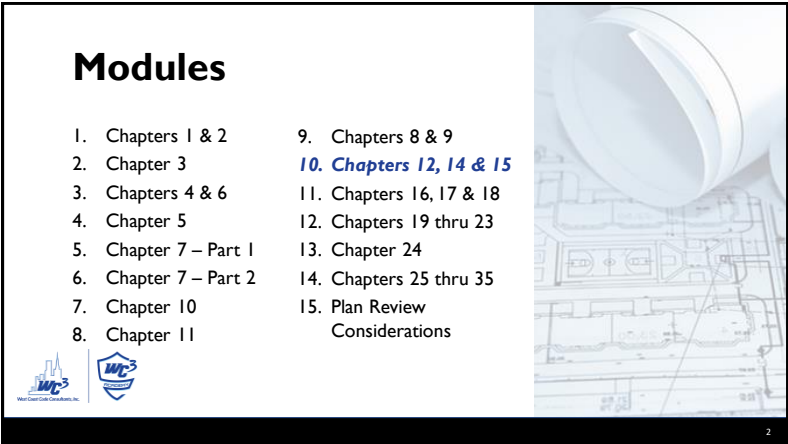


2021 International Building Code
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Modules

- 1. Chapters 1 & 2
- 2. Chapter 3
- 3. Chapters 4 & 6
- 4. Chapter 5
- 5. Chapter 7 – Part 1
- 6. Chapter 7 – Part 2
- 7. Chapter 10
- 8. Chapter 11
- 9. Chapters 8 & 9
- 10. **Chapters 12, 14 & 15**
- 11. Chapters 16, 17 & 18
- 12. Chapters 19 thru 23
- 13. Chapter 24
- 14. Chapters 25 thru 35
- 15. Plan Review Considerations






2

2

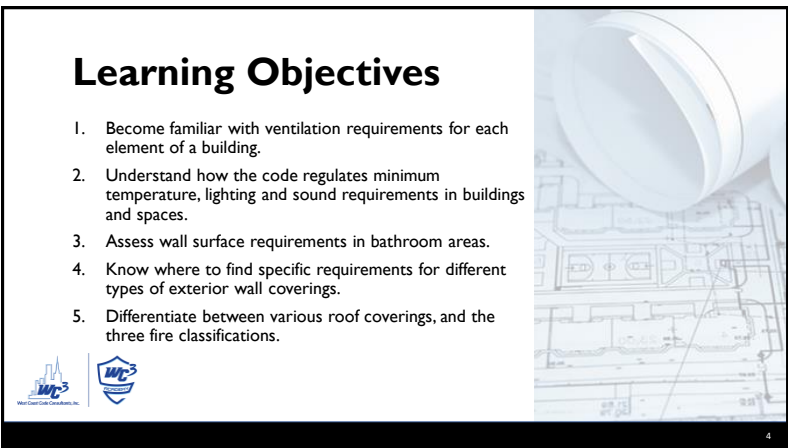


MODULE 10:
*IBC Chapters 12, 14 & 15–
Interior Environment, Exterior Walls, and Roof Assemblies*



3

3



Learning Objectives

- 1. Become familiar with ventilation requirements for each element of a building.
- 2. Understand how the code regulates minimum temperature, lighting and sound requirements in buildings and spaces.
- 3. Assess wall surface requirements in bathroom areas.
- 4. Know where to find specific requirements for different types of exterior wall coverings.
- 5. Differentiate between various roof coverings, and the three fire classifications.

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Building Plans Examiner (B3) → 3%

IBC Chapter 12

Interior Environment

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Interior Environment

IBC 1201.1: Scope

- Ventilation
- Temperature Control
- Lighting
- Yards & Courts
- Sound Transmission
- Room Dimensions
- Surrounding Materials
- Rodent Proofing

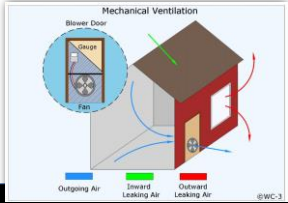





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Ventilation

IBC 1202.1: General

- Natural Ventilation or...
- Mechanical Ventilation
 - If < 5 air changes per hour mechanical required

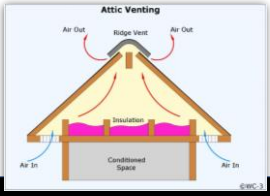






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Ventilation

IBC 1202.2.1: Attic Ventilation

- Enclosed attics and rafter spaces shall have **cross ventilation** for each separate space







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Ventilation

IBC 1202.2.1: Attic Ventilation

- ❑ An air space of $\geq 1"$ between insulation and sheathing
- ❑ Ventilating area shall $\geq 1/150$ of the area of the space





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Ventilation

Example:

- ❑ Attic Area = $22' \times 50' = 1,100 \text{ ft}^2$
- ❑ $\text{Vent}_{\text{req}} = 1,100/150 = 7.3 \text{ ft}^2 \rightarrow 1,050 \text{ in}^2$
- ❑ Cross ventilation:
 - 1/2 through soffit vents
 - 1/2 through ridge/turtle vents

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Ventilation

IBC 1202.4: Under-Floor Space

- ❑ Unoccupied space between floor joists and the earth shall be ventilated.
 - Ventilating area shall $\geq 1/150$ of crawl space area
 - Shall be covered with openings $\leq 1/4"$







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Ventilation

IBC 1202.5: Natural Ventilation

- ❑ "Shall be through windows, doors, louvers, or other openings to the outdoors."
- ❑ Shall be controllable by the building occupants
- ❑ Openable area $\geq 4\%$ of floor area
- ❑ Adjoining Spaces \rightarrow Opening to adjoining room $\geq 8\%$ of space, but $\geq 25 \text{ ft}^2$

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Ventilation

Calculating Natural Ventilation ©WC-3

Window Area $5' \times 3' = 15'$

Floor Area = (Width) X (Length)
 $20' \times 25' = 500\text{ft}^2$

Window Area
 $3 * [(5' \times 3') / 2] = 22.5 \text{ft}^2$

Required Window Area
 $500\text{ft}^2 * .04 = 20\text{ft}^2$

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Ventilation

Opening Below Grade

- ❑ Shall extend out 1.5 * depth of opening

Below Grade Ventilation

Required Outside Horizontal Clear Space = $1.5 \times d$

Depth Below Average Grade (d)

Floor Area = $L \times W$

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Temperature Control

- ❑ Occupied spaces shall have space-heating systems capable of maintaining an indoor temperature of $\geq 68^\circ\text{F}$.
- ❑ Not required for a space that is not designed for human comfort.


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Lighting

IBC 1204.1: General

- ❑ Occupied spaces shall provide...
 - Natural light through exterior glazed openings, or...
 - Artificial light per IBC 1205.3
- ❑ **Natural Light:** Glazing $\geq 8\%$ of floor area
 - $\frac{1}{2}$ area of common wall is open & provides an opening of $\frac{1}{10}$ the floor area or 25ft^2
- ❑ **Artificial Light:** Illumination of 10 foot-candles or 107 Lux


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Lighting

IBC 1204.4: Stairway Illumination

- ❑ Within dwelling units or exterior stairways serving dwelling units (*Other occupancies per Chapter 10*)
- ❑ Illumination on treads \geq 1 foot-candle (11 Lux)




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Yards & Courts

IBC 1205.1: General

- ❑ Areas on the same lot which are adjacent to exterior openings and provide natural light or ventilation.
- ❑ **Yards:** 3-feet for \leq two-stories. Add 1-foot per additional story.
- ❑ **Courts:** 3-feet in width, but not less than 6-feet if openings on both sides. Not less than 10-feet in length (unless bounded by a public way). Add 1-foot in width and 2-feet in length for 3rd story and above.



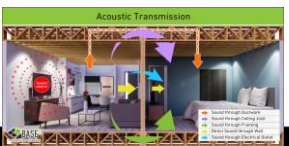

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Sound Transmission

IBC 1206.1: Scope

- ❑ Walls, partitions & floor/ceiling assemblies between dwelling and sleeping units, or...
- ❑ Between dwelling/sleeping units and public areas (corridors, stairways, etc.)





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Sound Transmission

- ❑ **Air-borne Sound**
 - STC \geq 50
 - Penetrations or openings are sealed/insulated
- ❑ **Structure-borne Sound**
 - Floor/ceiling assemblies only
 - Impact Insulation Class (IIC) \geq 50



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Sound Transmission

UL 14407	Fire Rating	System Thickness	STC
Interior Partition - Wood Stud (Grid Bearing)	0.5 Hours	5.25 in.	45

ASSEMBLY DETAILS

Gypsum Panel: 1 layer 5/8" (15.9 mm) Sheetrock® Ecoment Ffacecode 308 Gypsum Panel (UL Type FC30)

Wood Stud: 1 layer 2" x 4" (51 x 89 mm) Wood Studs, 16" (406 mm) O.C.

Insulation: 1 layer 1 1/2" (38 mm) Fiberglas Insulation

Resilient Channel: 1 layer 1/2" (12.7 mm) resilient channel, 21 ga. 05.038", 24" (605 mm) O.C.

Gypsum Panel: 1 layer 5/8" (15.9 mm) Sheetrock® Ecoment Ffacecode 308 Gypsum Panel (UL Type FC30)

UL 14493	Fire Rating	System Thickness	STC
Chase Wall - Steel Stud (Non Load-Bearing)	1 Hours	7.875 in.	59

ASSEMBLY DETAILS

Gypsum Board: 1 layer 5/8" Thick Gypsum Board (UL Type G120*)

Gypsum Board: 1 layer 5/8" Thick Gypsum Board (UL Type G120*)

Steel Studs: 1 layer 2 1/2" (64 mm) steel studs, E200 (0.038"), staggered, 16" (406 mm) O.C.


Insulation: 1 layer 2 1/2" (64 mm) Fiberglas Insulation

Air Space: 1 layer 2" (51.4 mm) Air Space


Steel Studs: 1 layer 2 1/2" (64 mm) steel studs, E200 (0.038"), staggered, 16" (406 mm) O.C.

Insulation: 1 layer 2 1/2" (64 mm) Fiberglas Insulation

UL Corporation, Design Studio, Wall Assembly





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Classroom Acoustics

Group E classrooms ≤ 20,000 ft³

- Enhanced acoustics per Section 808 of ICCA 117.1.
- Reverberation Time
 - Per Performance or Prescriptive Method
- Ambient Sound Level
 - Based on both outside and inside sound sources





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Interior Space Dimensions

IBC 1208.1: Minimum Dimensions

- Min. Room Width = 7-feet *(Except kitchens)*
 - Kitchens shall have 3-foot passageway
- Min. Ceiling Height = 7.5-feet
 - Bathrooms, toilet rooms, kitchens, laundry, storage ≥ 7-feet
 - Sloped ceilings
 - Prescribed ceiling height for 1/2 the room area
 - Any portion < 5-feet is not considered in minimum area tabulation



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Interior Space Dimensions

IBC 1208.3: Room Area

- Habitable Space (§202):

“A space in a building for living, sleeping, eating or cooking. Bathrooms, toilet rooms, closets, halls, storage or utility spaces and similar areas are not considered habitable spaces.”
- Habitable Rooms ≥ 70 ft²
- Dwelling Units: 1 room of 120 ft²






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Interior Space Dimensions

IBC 1208.4: Efficiency Dwelling Unit

- Dwelling Unit, Efficiency (§202):
"A dwelling unit where all permanent provisions for living, sleeping, eating and cooking are contained in a single room."
- Living Room ≥ 190 ft²
- Shall have separate closet
- Kitchen sink, cooking appliance & refrigerator (30-inches of working space)
- Separate bathroom with water closet, lavatory & bathtub or shower

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Access to Unoccupied Spaces

IBC 1209.1: Crawl Spaces

- Size: 18" x 24"

IBC 1209.2: Attic Spaces

- Required at any area w/ clear height > 30"
- Size: 20" x 30"

Mechanical access per IMC






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Toilets & Bathrooms



IBC 1210.1: Required Fixtures

- Number & type per IBC Chapter 29

IBC 1210.2: Finish Materials

- Floors & Wall Bases
 - Smooth, hard, nonabsorbent surface
 - 4" smooth, hard, nonabsorbent base

"In other than dwelling units"



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Toilets & Bathrooms

IBC 1210.2.2: Walls & Partitions

- Within **2 feet** of service sinks, urinals and water closets...
- Smooth, hard, nonabsorbent surface, to a height of not less than **4 feet**
- Exceptions:
 - Dwelling/sleeping units
 - Non-public & no more than one water closet

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Toilets & Bathrooms

IBC 1210.2.3: Showers

- ❑ Smooth, nonabsorbent surface ≥ 72"

IBC 1210.2.4: Waterproof Joints

- ❑ Waterproof joints at tubs wit showers between the tub and adjacent wall.


IBC 1210.3: Privacy

- ❑ Visually screened from outside entry or exit doorways to ensure privacy
- ❑ Mirrors should not compromise personal privacy



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Toilets & Bathrooms

IBC 1210.3: Privacy

- ❑ **Water Closet Compartment**
 - If used by the public or employees...
 - Each water closet shall be enclosed by walls and a door to ensure privacy
 - **Exceptions:**
 - Not required in single-occupant
 - Child day cares can have one without enclosing compartment
 - Not applicable to Group I-3



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Toilets & Bathrooms

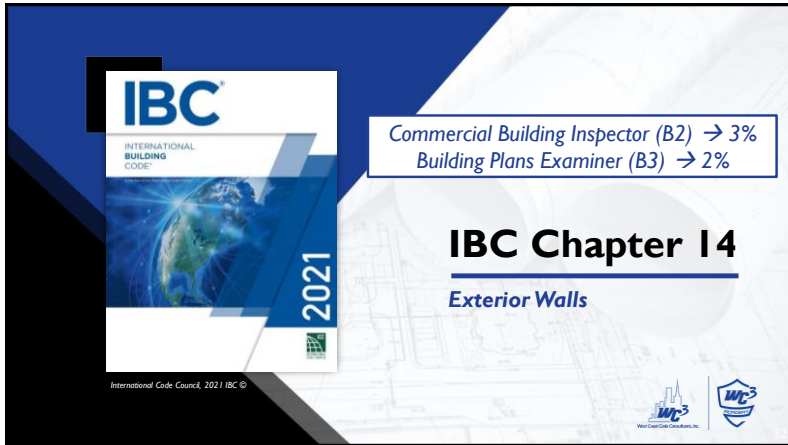
IBC 1210.3: Privacy

- ❑ **Urinal Partitions**
 - Height ≥ 60" from floor ; Begin ≤ 12" from floor
 - Extend from 18" from urinal or 6" beyond outermost lip, whichever is greater.
 - **Exceptions:**
 - Not required in single-occupant
 - Child day cares can have one without enclosing compartment

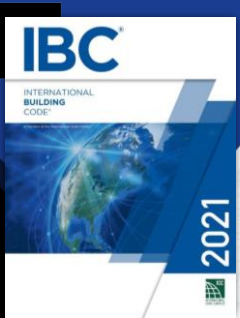


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Building Plans Examiner (B3) → 2%



IBC Chapter 14

Exterior Walls



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Exterior Walls

IBC 1402.2: Weather Protection

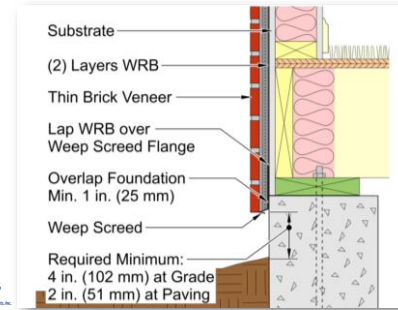
- ❑ Designed & constructed to prevent the accumulation of water within the assembly by...
 - Providing a water-resistive barrier behind exterior veneer
 - Allows water that enters assembly to drain to the exterior



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Exterior Walls



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Exterior Walls

IBC 1402.5: Water-Resistive Barrier

- ❑ If Type I, II, III, or IV, and...
- ❑ > 40 feet in height, and...
- ❑ Has a combustible water-resistive barrier, then...
- ❑ Shall be tested per NFPA 285
- ❑ Some exceptions if WRB is only combustible component.



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Materials

IBC 1403.2: Water-Resistive Barrier

- ❑ Not fewer than one layer
- ❑ Installed with flashing per IBC 1404.4
- ❑ Shall comply with one of the following:
 - No. 15 Felt (ASTM D226, Type I)
 - ASTM E2556, Type I or II
 - ASTM E331
 - Other "approved" materials




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Installation

IBC 1404.2: Weather Protection

COVERING TYPE	MINIMUM THICKNESS (inches)
Adhered masonry veneer	0.25
Aluminum siding	0.019
Anchored masonry veneer	
Stone (natural)	2.0
Architectural cast stone	2.5
Other	2.0
Asbestos-cement boards	0.125
Asbestos shingles	0.156
Cold-rolled copper ^a	0.0216 nominal
Copper shingles ^a	0.0162 nominal
Exterior plywood (with sheathing)	0.313
Exterior plywood (without sheathing)	See Section 2304.6




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Installation

IBC 1404.3: Vapor Retarders

- ❑ Shall be classified per Table 1404.3(1)
- ❑ Placed on interior side of frame walls
- ❑ Alternate → Hygrothermal analysis
- ❑ Climate Zone per the IECC



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Installation

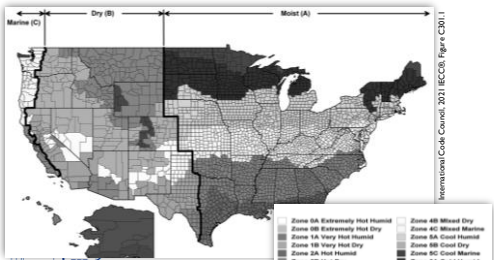
VAPOR RETARDER CLASS	ACCEPTABLE MATERIALS
I	Sheet polyethylene, nonperforated aluminum foil, or other approved materials with a perm rating of less than or equal to 0.1
II	Kraft-faced fiberglass bats or vapor retarder paint or other approved materials, applied in accordance with the manufacturer's instructions for a perm rating greater than 0.1 and less than or equal to 1.0
III	Latex paint, enamel paint, or other approved materials, applied in accordance with the manufacturer's instructions for a perm rating of greater than 1.0 and less than or equal to 10

CLIMATE ZONE	VAPOR RETARDER CLASS		
	I	II	III ^a
1, 2	Not permitted	Not Permitted	Permitted
3, 4 (except Marine 4)	Not permitted	Permitted	Permitted
Marine 4, 5, 6, 7, 8	Permitted	Permitted	See Table 1404.3(3)



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Installation



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Installation

IBC 1404.4: Flashing

- ❑ Shall prevent moisture from entering the wall, or redirect it to the exterior wall surface or to a WRB
- ❑ **Locations:**
 - Perimeters of exterior doors & windows
 - Penetrations and terminations of exterior wall assemblies
 - Intersections with roofs, chimneys, porches, decks, balconies and similar projections

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Installation

Masonry/Stone Veneers

- ❑ IBC 1404.6 – Anchored Masonry Veneer
- ❑ IBC 1404.7 – Stone Veneer
- ❑ IBC 1404.8 – Slab-type Veneer
- ❑ IBC 1404.9 – Terra Cotta
- ❑ IBC 1404.10 – Adhered Masonry Veneer



Hohmann & Barnard, Inc., www.h-b.com







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Combustible Materials

IBC 1405.1: Exterior Wall Coverings

- ❑ Types I, II, III, IV
 - ≤ 10% wall area if FSD ≤ 5-feet (*FRT no limit*)
 - ≤ 40-feet in height (*FRT ≤ 60-feet*)
- ❑ When furred out (≤1-5/8”) from exterior wall it shall be **fire blocked**.



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Metal Composite Materials

IBC 1406.10: Types I, II, III & IV

- ❑ ≤ 40-feet: Must comply with surface-burning (ASTM E84 or UL 723) & thermal barrier requirements
- ❑ > 40-feet: Must also comply with full-scale testing in accordance with NFPA 285.

NFPA 285 COMPLIANT WALL ASSEMBLY IN FULL HEIGHT

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Exterior Walls

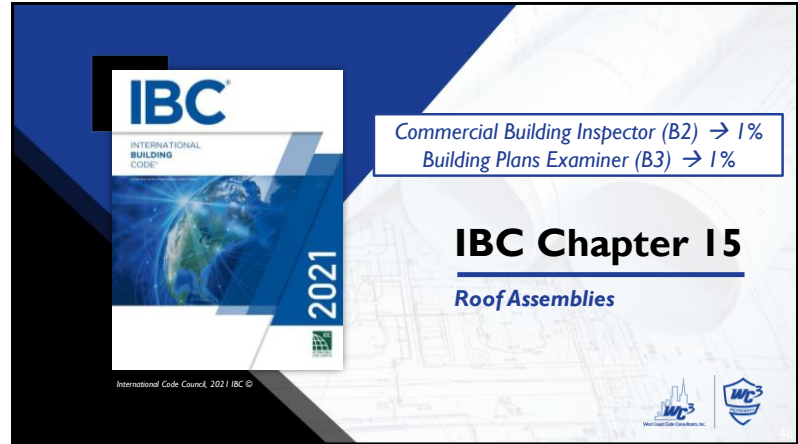
IBC 1407: EIFS

- Shall meet ASTM E 2568
- Installed per MFR's instructions
- Special inspections per **IBC 1704.2 & 1705.16**





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Building Plans Examiner (B3) → 1%



IBC Chapter 15

Roof Assemblies


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Roof Assemblies

IBC 1502: Roof Drainage

- Must also comply with I 611 & the IPC
- Secondary Drains:
 - If water can be entrapped for any reason
- Scuppers:
 - May be used as secondary drains
 - Opening dimensions ≥ 4 inches



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Roof Assemblies

IBC 1503: Weather Protection

- Roof decks shall be covered with approved coverings secured to the building
- Flashing:
 - Shall prevent water from entering the wall through roof joints
 - Installed at wall and roof intersections, gutters, and changes in roof slope around openings.

Metal flashing shall be corrosion-resistant metal of ≥ 0.019" (No. 26)

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Roof Assemblies

IBC 1503.3: Parapet Walls

- Shall be coped or covered
- Shall maintain fire-resistance rating

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Roof Assemblies

IBC 1503.5: Crickets or Saddles

- Shall be installed at ridge side of any chimney or penetration > 30-inches
- Shall be sheet metal or same material as roof covering

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Roof Assemblies

IBC 1504: Performance Requirements

- Asphalt Shingles:
 - Tested per ASTM D7158
 - Classified per IBC Table 1504.2
 - Packaging shall have label noting testing & classification

MAXIMUM BASIC WIND SPEED, V, FROM FIGURES 1609.3(1)-(8) OR ASCE 7(mph)	MAXIMUM ALLOWABLE STRESS DESIGN WIND SPEED, V _s , FROM TABLE 1609.3.1 (mph)	ASTM D7158 CLASSIFICATION	ASTM D3161 or UL 7103 CLASSIFICATION
110	85	D, G or H	A, D or F
116	90	D, G or H	A, D or F
129	100	G or H	A, D or F
142	110	G or H	F
155	120	G or H	F

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Roof Assemblies

IBC 1504: Performance Requirements

- Clay & Concrete Tile:
 - Wind loads per IBC 1609.5.3
 - Testing per SBCCI SSTT 11 or ASTM C1568

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Roof Assemblies

IBC 1504: Performance Requirements

- ❑ Nonballasted Roofs:
 - Mechanically attached or adhered
 - Component & cladding (IBC 1609.5.2)
 - Metal standing seam roofing → ASTM E1592 or FM 4474
 - Through-fastened metal roofing → ASTM E1592, FM 4474, or UL 580
 - Other systems (built-up, single-ply, etc.) → FM 4474, UL 580 or UL 1897



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Roof Assemblies

IBC 1504: Performance Requirements

- ❑ Ballasted Low-Slope Single-Ply Roofs:
 - Refers to ANSI SPRI RP-4 for installation and design.



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Roof Assemblies

IBC 1504: Performance Requirements

- ❑ Wind-Resistance of Aggregate Surfaced:
 - Requires a minimum parapet height in accordance with IBC Table 1504.9.
 - Based on wind speed, exposure, aggregate size & mean roof height.
 - Aggregate size (ASTM D1863):
 - No. 7 = 1/2" to #4
 - No. 67 = 3/4" to #4
 - No. 6 = 3/4" to 3/8"



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17-inch Parapet

TABLE 1504.9 MINIMUM REQUIRED PARAPET HEIGHT (INCHES) FOR AGGREGATE SURFACED ROOFS^{a, b, c}

WIND EXPOSURE AND BASIC DESIGN WIND SPEED (MPH)


AGGREGATE SIZE	MEAN ROOF HEIGHT (ft)	Exposure B																Exposure C ^d											
		≤ 99								100								≤ 99				100							
		115	120	125	130	135	140	145	150	115	120	125	130	135	140	145	150	115	120	125	130	135	140	145	150				
ASTM D1863 (No. 7 or No. 67)	15	2	2	2	2	12	12	16	20	24	2	13	15	18	20	23	27	32	37	2	13	15	18	20	23	27	32	37	
	20	2	2	2	2	12	14	18	22	26	12	15	17	19	22	24	29	34	39	12	15	17	19	22	24	29	34	39	
	30	2	2	2	13	15	17	21	25	30	14	17	19	22	24	27	32	37	42	14	17	19	22	24	27	32	37	42	
	50	12	12	14	16	18	21	25	30	35	17	19	22	25	28	30	36	41	47	17	19	22	25	28	30	36	41	47	
	100	14	16	19	21	24	27	32	37	42	21	24	27	29	32	35	41	47	53	19	22	25	28	30	36	41	47	53	
ASTM D1863 (No. 6)	150	17	19	22	25	27	30	36	41	46	23	26	29	32	35	38	44	50	56	23	26	29	32	35	38	44	50	56	
	15	2	2	2	2	12	12	12	15	18	2	2	2	13	15	17	22	26	30	2	2	2	13	15	17	22	26	30	
	20	2	2	2	2	12	12	13	17	21	2	2	12	15	17	19	23	28	32	2	2	12	15	17	19	23	28	32	
	30	2	2	2	2	12	12	16	20	24	2	12	14	17	19	21	26	31	35	2	12	14	17	19	21	26	31	35	
	50	12	12	12	12	14	16	20	24	28	12	15	17	19	22	24	29	34	39	12	15	17	19	22	24	29	34	39	
100	12	12	14	16	19	21	26	30	35	16	18	21	24	26	29	34	39	45	12	14	16	19	21	24	26	29	34	39	
150	12	14	17	19	22	24	29	34	39	18	21	23	26	29	32	37	43	48	12	14	17	19	22	24	29	32	37	43	48

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Roof Assemblies

IBC 1505: Fire Classification


- Roof Coverings: Per IBC Table 1505.1
- Class 'A' → severe fire exposure
- Class 'B' → moderate fire exposure
- Class 'C' → light fire exposure

IA	IB	IIA	IIB	IIIA	IIIB	IV	VA	VB
B	B	B	C ^c	B	C ^c	B	B	C ^c

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Roof Assemblies

IBC 1505.8: Building-integrated PV


- Tested, listed and labeled for fire classification for roof covering per **IBC 1505.1**.

IBC 1505.9: PV Panels

- Tested, listed and labeled per UL 1703 & **IBC 1505.1**.



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Roof Assemblies

IBC 1507: Roof Coverings


- Asphalt Shingles
- Clay & Concrete Tiles
- Metal Roof Panels
- Built-up
- Modified Bitumen
- Single-ply
- Polyurethane foam
- Liquid-applied
- Vegetative
- Photovoltaic
- Building-integrated PV

Requirements for...

- Materials
- Decking
- Minimum Slopes
- Underlayment
- Ice Barrier
- Attachment
- Flashing




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Rooftop Structures

IBC 1511: Rooftop Structures

- Area Limitations:
 - ≤ 1/3 area of supporting roof deck
 - Not considered in building area or # of stories
- Penthouses
 - Other than Type I → ≤ 18-feet in height
 - Type I → No limit
 - Shall only be used for the shelter of mechanical or electrical equipment, tanks, or vertical shaft openings





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Roof Structures

IBC 1511.3: Tanks

- > 500 gallons supported on masonry, reinforced concrete, steel or Type IV-HT construction but shall meet fire-resistance requirements of Type I-A construction
- Shall not be placed over stairway or elevator shaft



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Roof Structures

IBC 1511.4: Cooling Towers

- If the roof is > 50-feet above grade plane, and...
- If > 250ft² in base area & > 15-feet in height...
- Shall be of noncombustible construction, and...
- Shall be ≤ 1/3 the area of the supporting roof deck.


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Roof Structures

IBC 1511.5: Towers, Spires, Domes, Cupolas

- Same type of construction as supporting structure
- If > 85-feet in height, and...
- > 200ft² in horizontal area, or...
- Used for purpose other than architectural embellishment...
- Shall be of Type I or II construction





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Roof Structures

IBC 1511.6: Mechanical Equipment Screens

- Same type of construction as exterior walls, unless...
- Fire separation distance > 5-feet
- ≤ 18-feet in height (No limit for Type I-A)

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2021 International Building Code

Inspector/Plans Examiner






1

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Modules

1. Chapters 1 & 2	9. Chapters 8 & 9
2. Chapter 3	10. Chapters 12, 14 & 15
3. Chapters 4 & 6	11. Chapters 16, 17 & 18
4. Chapter 5	12. Chapters 19 thru 23
5. Chapter 7 – Part 1	13. Chapter 24
6. Chapter 7 – Part 2	14. Chapters 25 thru 35
7. Chapter 10	15. Plan Review Considerations
8. Chapter 11	

2

2

MODULE II:

IBC Chapters 16, 17 & 18– Structural Design, Special Inspection & Soils/Foundations






3

3

Learning Objectives

1. Be able to identify appropriate risk categories for buildings, based on use and occupant load.
2. Understand the differences between live and dead loads.
3. Know how to determine appropriate design wind speed and exposure.
4. Become familiar with when, and to what level, special inspections are required.
5. Recognize design considerations related to soils and foundations.

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 Building Plans Examiner (B3) → 1%

IBC Chapter 16

Structural Design

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Design Criteria

IBC 1603: What does this include?

- 1) Floor & Roof Live Loads
- 2) Roof Snow Loads
- 3) Wind Design Data
- 4) Earthquake Design Data
- 5) Geotechnical Info
- 6) Flood Design Data
- 7) Special Loads
- 8) Roof Rain Load Data



6

Serviceability

IBC 1604.3:

☐ “Structural systems and members thereof shall be designed to have adequate stiffness to limit deflections and lateral drift.”

CONSTRUCTION	TABLE 1604.3 DEFLECTION LIMITS (L/1000)		
	E or L	S or W	D or L ¹
Roof members ²			
Supporting plaster or stucco ceiling	L/360	L/360	L/240
Supporting nonplaster ceiling	L/240	L/240	L/180
Non-supporting ceiling	L/180	L/180	L/120
Floor members	L/360	—	L/240
Exterior walls	—	—	—
With plaster or stucco finishes	—	L/360	—
With other brittle finishes	—	L/240	—
With flexible finishes	—	L/120	—
Interior partitions ³	—	—	—
With plaster or stucco finishes	L/360	—	—
With other brittle finishes	L/240	—	—
With flexible finishes	L/120	—	—
Frame buildings	—	—	L/180
Cracked concrete	—	—	L/240



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Risk Category

IBC 1604.5:

“Each building and structure shall be assigned a risk category in accordance with Table 1604.5.”

TABLE 1604.5 RISK CATEGORY OF BUILDINGS AND OTHER STRUCTURES	
RISK CATEGORY	NATURE OF OCCUPANCY
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: <ul style="list-style-type: none"> • Agricultural facilities. • Certain temporary facilities. • Minor storage facilities.
II	Buildings and other structures except those listed in Risk Categories I, III and IV.


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Risk Category

Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to:

- Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300.
- Buildings and other structures containing one or more public assembly spaces, each having an occupant load greater than 300 and a cumulative occupant load of the public assembly spaces of greater than 2,500.
- Buildings and other structures containing Group E or Group I-4 occupancies or combination thereof, with an occupant load greater than 250.
- Buildings and other structures containing educational occupancies for students above the 12th grade with an occupant load greater than 500.
- Group I-2, Condition 1 occupancies with 50 or more care recipients.
- Group I-2, Condition 2 occupancies not having emergency surgery or emergency treatment facilities.
- Group I-3 occupancies.
- Any other occupancy with an occupant load greater than 5,000.*
- Power-generating stations, water treatment facilities for potable water, wastewater treatment facilities and other public utility facilities not included in Risk Category IV.
- Buildings and other structures not included in Risk Category IV containing quantities of toxic or explosive materials that:
 - Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and
 - Are sufficient to pose a threat to the public if released.†

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Risk Category

Buildings and other structures designated as essential facilities, including but not limited to:

- Group I-2, Condition 2 occupancies having emergency surgery or emergency treatment facilities.
- Ambulatory care facilities having emergency surgery or emergency treatment facilities.
- Fire, rescue, ambulance and police stations and emergency vehicle garages
- Designated earthquake, hurricane or other emergency shelters.
- Designated emergency preparedness, communications and operations centers and other facilities required for emergency response.
- Power-generating stations and other public utility facilities required as emergency backup facilities for Risk Category IV structures.
- Buildings and other structures containing quantities of highly toxic materials that:
 - Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and
 - Are sufficient to pose a threat to the public if released.†
- Aviation control towers, air traffic control centers and emergency aircraft hangars.
- Buildings and other structures having critical national defense functions.
- Water storage facilities and pump structures required to maintain water pressure for fire suppression.

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Live Loads

IBC 1607:

“A load produced by the use and occupancy of the building or other structure that does not include construction or environmental loads... or dead load.”

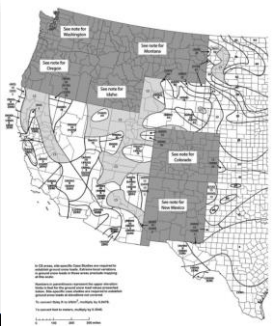
OCCUPANCY OR USE	UNIFORM	CONCENTRATED	ALSO SEE SECTION
	(psf)	(pounds)	
1. Apartments (see residential)	—	—	—
2. Access floor systems	Office use	2,000	—
	Computer use	100	2,000
3. Annexes and drill rooms	—	150†	—
	Fixed seats (fastened to floor)	60†	—
4. Assembly areas	Follow spot, projections and control rooms	50	—
	Lofters	100†	—
	Movable seats	100†	—
	Stage floors	150†	—
4. Assembly areas	—	100†	—
	Platforms (accessibility)	100†	—

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Ground Snow Load



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Wind Speed

Basic Wind Speed (V)

- See **Figures 1609.3(1) thru 1609.3(12)**
- Can be determined based on regional climatic data
- Can convert to ASD
- Windborne debris regions → glazing shall be impact resistant or protected by impact-resistant covering (ASTM E1996)




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Wind Exposure

Surface Roughness B:

- “Urban and suburban areas, wooded or other terrain with numerous closely spaced obstructions having the size of a single-family dwelling or greater.”

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Wind Exposure

Surface Roughness C:

- “Open terrain with scattered obstructions having heights generally less than 30 feet.”

Surface Roughness D:

- “Flat, unobstructed areas and water surfaces.”

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Seismic Design Category

- IBC 1613.2:** Ground Motions
 - Must check for both short-period and one-second period [IBC Tables 1613.2.5(1) & (2)].
 - The largest SDC controls.
 - Short-Period: What is the SDC for a Risk Category II structure with a short period of 0.60g?

VALUE OF S_{ps}	RISK CATEGORY			
	I or II	III	IV	IV
$S_{ps} < 0.167g$	A	A	A	A
$0.167g \leq S_{ps} < 0.33g$	B	B	C	C
$0.33g \leq S_{ps} < 0.50g$	C	C	D	D
$0.50g \leq S_{ps}$	D	D	D	D

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Building Plans Examiner (B3) → 0%


IBC Chapter 17

Special Inspections

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Special Inspections

What are special inspections?

- Performed by “approved” third-parties
- Paid for by the owner
- Includes observations and material testing
- Reports must be filed with the building official




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Special Inspections

IBC 1704.3: SSI

- Shall be prepared by the Registered Design Professional in Responsible Charge.
- Shall identify the following:
 - Work required to have special inspection/testing
 - Type & extent of special inspection/testing
 - Frequency → **continuous** or **periodic**




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Special Inspections

General special inspection requirements:

Description	2021 IBC Location
Qualifications	1704.2.1
Report Requirements	1704.2.4
Fabricated Items	1704.2.5
Statement of Special Inspections	1704.3
Contractor Responsibility	1704.4
Structural Observations	1704.6





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Special Inspections

Structural special inspections:

Description	2021 IBC Location
Special Cases	1705.1.1
Steel Construction	1705.2
Concrete Construction	1705.3
Masonry Construction	1705.4
Wood Construction	1705.5
Soils & Deep Foundations	1705.6 - 1705.10
Fabricated Items	1705.11
Special Inspection for Wind	1705.12
Special Inspection for Seismic	1705.13
Testing & Qualification - Seismic	1705.14






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Special Inspections

Non-structural special inspections:

Description	2021 IBC Location
Architectural & MEP Components	1705.13.5 - 1705.13.6
Sprayed Fire-Resistant Materials	1705.15
Fire-Resistant Coatings	1705.16
EIFS	1705.17
Fire Penetrations & Joints	1705.18
Testing for Smoke Control	1705.19
Sealing of Mass Timber	1705.2






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Special Inspections

Exemptions

- Not required for construction of minor nature.
- Group U occupancies accessory to R-3.
- Construction per conventional construction provisions.
- Approved fabricators (Certificate of Compliance)
- Isolated footings supporting 3-stories or less.
- Continuous footings supporting 3-stories or less of light-frame construction and designed using a concrete strength (f'_c) of 2,500psi.
- Nonstructural slabs on grade, driveways, and sidewalks.


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Building Plans Examiner (B3) → 9%

IBC Chapter 18

Soils & Foundations

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Geotechnical Report

Is a soils report required? (IBC 1803)

- Questionable soils
 - Expansive soils
 - High water table
 - Deep foundations
 - Variable rock
 - Excavation near foundations
 - Compacted fill
 - CLSM
 - Alternate setbacks
 - S.D.C. 'C-F'.
- Exception in certain circumstances...



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Geotechnical Report

Report Requirements (IBC 1803.6)

- A plot showing locations of borings
- Complete record of soil borings
- Record of soil profile
- Elevation of water table
- Recommendations for foundation type, bearing capacity, mitigation measures
- Expected total & differential settlement
- Compacted fill properties



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Geotechnical Report

Deep Foundations (IBC 1803.5.5)...

- Recommended deep foundation types
- Recommended center-to-center spacing
- Driving criteria
- Installation procedures
- Field inspection & reporting procedures
- Load test requirements
- Suitability of materials
- Designation of bearing strata
- Reductions for group action



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Dampproofing

IBC 1805

- Walls that retain earth & enclose interior space below grade...
- Shall be waterproofed & dampproofed, unless...
- Areas serving other than residential and institutional uses where such omission is not detrimental to the building or occupants.



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Dampproofing

IBC 1805.2 - Dampproofing

- If hydrostatic pressure **will not** occur...
- Floors and walls shall be dampproofed.
- Floors → Between floor & base coarse
 - 6-mil with joints lapped 6-inches
- Walls → Exterior from footing to above ground level
 - Bituminous material
 - Acrylic modified cement
 - Surface-bonding mortar
 - Other approved materials



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Dampproofing

IBC 1805.3 - Waterproofing

- Where hydrostatic pressure **does** exist...
- Floors and walls shall be waterproofed.
- Floors → Shall be concrete with membrane of...
 - Rubberized asphalt
 - Butyl rubber
 - HDPE or polyolefin composite membrane
 - 6-mil PVC with joints lapped



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Dampproofing

IBC 1805.3 - Waterproofing

- Walls → Shall be concrete or masonry designed to withstand hydrostatic pressures.
- Waterproofing shall be applied to 12-inches above maximum water table & joints lapped.
 - Two-ply hot-mopped felts
 - 6-mil PVC
 - 40-mil polymer-modified asphalt
 - 6-mil polyethylene
 - Other approved materials



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Dampproofing

IBC 1805.4 – Subsoil Drainage System

- If hydrostatic pressure **will not** occur...
- Dampproofing shall be applied, and a base installed under the floor which drains to the foundation perimeter.
- Base coarse → 4-inches (unless well-drained)
- Foundation drain → Around perimeter of foundation
- Drainage discharge → by gravity or mechanical means



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Presumptive Values

Presumptive Load-Bearing Values of Soils (IBC 1806)

CLASS OF MATERIALS	TABLE 1806.2 PRESUMPTIVE LOAD-BEARING VALUES			
	VERTICAL FOUNDATION PRESSURE (psf)	LATERAL BEARING PRESSURE (psf/ft below natural grade)	LATERAL SLIDING RESISTANCE	
			Coefficient of friction ^a	Cohesion (psf) ^b
1. Crystalline bedrock	12,000	1,200	0.70	—
2. Sedimentary and foliated rock	4,000	400	0.35	—
3. Sandy gravel and gravel (GW and GP)	3,000	200	0.35	—
4. Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000	150	0.25	—
5. Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1,500	100	—	130

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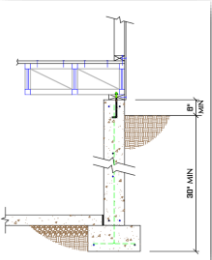


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Foundation Walls

Prescriptive Foundation Walls

- Concrete and masonry foundation walls that are laterally supported at the top and bottom (IBC 1807.1.6)




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Foundation Walls

Sample → IBC Table 1807.1.6.2

- Concrete thickness based on backfill
- Vertical reinforcement shall be placed nearest the inside face of the wall
- Smaller reinforcement allowed (rho)
- Concrete cover to inside face = 3/4 inch
- Concrete cover to outside face = 1-1/2 inches for No. 5 bars and smaller, and not less than 2 inches for larger bars.
- $f'c \leq 2,500$ psi



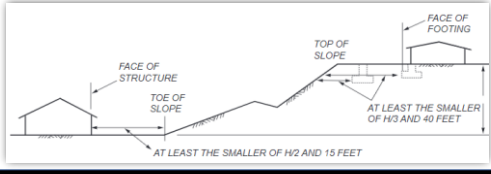
35

Foundation Walls


Footings on Slopes

IBC Figure 1808.7.1

- Descending: $H/3$, but not greater than 40-feet
- Ascending: $H/2$, but not greater than 15-feet



36

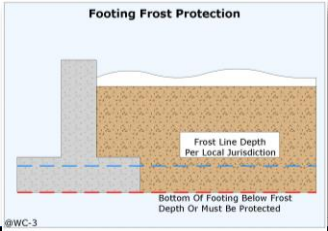


Shallow Foundations

Frost Protection (IBC 1809.5)

- Verify footings meet required frost depth.

Footing Frost Protection



Frost Line Depth
Per Local Jurisdiction

Bottom Of Footing Below Frost
Depth Or Must Be Protected

@WC-3

37



END OF MODULE II

38

2021 International Building Code
Inspector/Plans Examiner






1

1

Modules

1. Chapters 1 & 2	9. Chapters 8 & 9
2. Chapter 3	10. Chapters 12, 14 & 15
3. Chapters 4 & 6	11. Chapters 16, 17 & 18
4. Chapter 5	12. Chapters 19 thru 23
5. Chapter 7 – Part 1	13. Chapter 24
6. Chapter 7 – Part 2	14. Chapters 25 thru 35
7. Chapter 10	15. Plan Review Considerations
8. Chapter 11	

2

2

MODULE 12:
*IBC Chapters 19-23 –
Concrete, Aluminum, Masonry,
Steel & Wood Construction*






3

3

Learning Objectives

1. Become familiar with basic requirements associated with the use of concrete in buildings.
2. Understand the proper application of masonry materials in fireplace and chimney construction.
3. Know where to find, and how to navigate the span charts and other wood framing tables.
4. Be able to interpret when structural members are allowed to be notched or cut, and to what extent.
5. Know where to find requirements related to the use of aluminum and steel in buildings.

4

4



Commercial Building Inspector (B2) → 8%
Building Plans Examiner (B3) → 4%

IBC Chapter 19

Concrete

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5

Concrete

Construction Documents (IBC 1901.5)

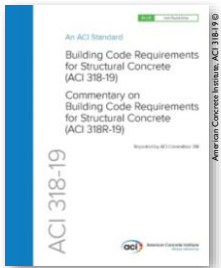
- Specified compressive strength
- Strength & grade of reinforcement
- Size & location of structural elements
- Magnitude & location of prestressing forces
- Anchorage and *lap lengths* of reinforcement
- Type & location of mechanical splices
- Details & locations of contraction/isolation joints
- Stressing sequence of posttensioning
- SDC 'D-F' – Is SOG a diaphragm?



6


Concrete

Design & Materials



Specialty Items

- GFRC → PCI MNL 128
- ICF → ASTM E2634



7

Concrete


Durability (IBC 1904)

- Structural concrete → ACI 318
 - Exception: Groups R-2 & R-3 and ≤ 3 stories

Category	Class	Exposure
Freezing and thawing (FT)	F0	Concrete not exposed to freezing and thawing cycles.
	F1	Concrete exposed to freezing and thawing cycles with limited exposure to water.
	F2	Concrete exposed to freezing and thawing cycles with frequent exposure to water.
Sulfate (S)	S0	Water-soluble sulfate (WSS) < 0.10% by mass of cement.
	S1	0.10 to 0.20% WSS < 0.20% SO ₄ ²⁻ < 1,000 or none.
	S2	0.20 to 0.50% WSS < 2.00% SO ₄ ²⁻ < 10,000.
	S3	SO ₄ ²⁻ > 2.00% SO ₄ ²⁻ > 10,000.
In contact with water (W)	W0	Concrete dry in service.
	W1	Concrete in contact with water and impermeability is not required.
Corrosion (C)	C0	Concrete dry or protected from moisture.
	C1	Concrete exposed to moisture but not to an external source of chlorides from deicing chemicals, salt, brackish water, seawater, or other deleterious agents.

*Percent sulfate by mass and shall be determined by ASTM C1180.
†Concentration of dissolved sulfate in water, in ppm, shall be determined by ASTM D1613 or ASTM D4922.


8




Concrete

Plain Concrete Footings (IBC 1906)

- If Group R-3, light frame, and < 2 stories above grade...
- Thickness = 6-inches
- Stems \geq 4-inches on either side





9




Concrete

Slab Provisions (IBC 1907)

- The thickness of concrete floor slabs supported directly on the ground shall not be less than 3.5"


10




Concrete

Placement: ACI 318-19 (§ 26.5.2)

- Debris & ice shall be removed
- Standing water shall be removed, unless a tremie is used
- Method of placement shall not allow segregation or loss of materials
- Without interruptions to limit loss of workability between successive placements to limit cold joints




11




Concrete

Curing: ACI 318-19 (§ 26.5.3)

- Maintained at a temperature of \geq 50°F and in a moist condition for 7 days
- High-early strength concrete: \geq 50°F and in a moist condition for 3 days
- High-pressure steam or other accelerated curing methods can be used to reduce curing time.




12




Concrete

Cold Weather: ACI 318-19 (§ 26.5.4)

- ❑ Forms, fillers, and ground shall be free from frost and ice
- ❑ Adequate material provided to heat and protect concrete materials during freezing or near-freezing weather
- ❑ Must be protected from freezing until it has reached a compressive strength of 500psi (50% strength loss possible).




13




Concrete

Hot Weather: ACI 318-19 (§ 26.5.5)

- ❑ Concrete temperature should be ≤ 95°F at time of discharge
- ❑ Handling, placing, protection, and curing procedures shall limit concrete temperatures and water evaporation which could reduce strength, serviceability, and durability.




14



Concrete

Cover: ACI 318-19 (§ 20.5.1)

- ❑ Cast against earth: 3"
- ❑ Exposed to weather:
 - ≤ #5 – 1.5"
 - ≥ #6 – 2"
- ❑ Not exposed:
 - Slabs, joists, walls:
 - ≤ #11 – 0.75"
 - ≥ #14 – 1.5"
 - Beams & columns: 1.5"



15





Commercial Building Inspector (B2) → 0%

Building Plans Examiner (B3) → 0%

IBC Chapter 20

Aluminum







16

Aluminum

Materials (IBC 2002)

- Aluminum used for structural purposes in building and structures shall comply with AA ASM 35-2000 and AA ADM-2020.

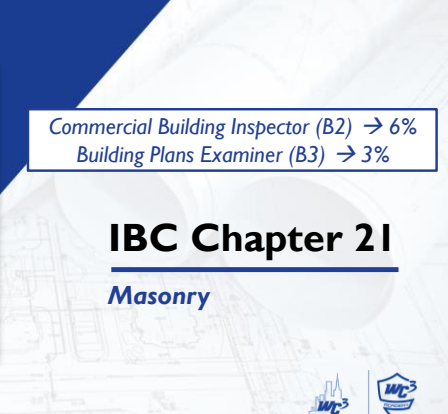
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Commercial Building Inspector (B2) → 6%
Building Plans Examiner (B3) → 3%

IBC Chapter 21

Masonry









18

Masonry

Design (IBC 2101):

Specialty Items

- TMS 403 → Direct Design Handbook
- TMS 404 → Architectural Cast Stone










19

Masonry

Construction Materials (IBC 2103):

- Masonry Units
- Mortar
- Grout
- Metal Reinforcement

20

Masonry

Empirical Design - Adobe (IBC 2109):

- Per TMS 402 – Appendix A
- Not allowed in SDC “D-F”
- Considered Type V construction
- Limited to one story unless engineered
- 10-inch walls (8-inch interior)
- Laterally supported within 24-feet
- Height $\leq 10^*$ thickness of wall



21

Masonry Fireplaces

Footings & Foundations (IBC 2111.3)

- Concrete or solid masonry ≥ 12 " thick extending ≥ 6 " beyond the face.



22

Masonry Fireplaces

Seismic (IBC 2111.4 & 5):

- Applies to SDC “C-F”
- Chimney ≤ 40 " wide \rightarrow (4) #4 vertical bars anchored into foundation
- Chimney > 40 " wide \rightarrow two additional #4 for each additional 40"
- Horizontal ties at 18" o.c.
- Anchored at each floor, ceiling, or roof line > 6 -feet above grade



23

Masonry Fireplaces

Firebox Walls (IBC 2111.6):

- Masonry fireboxes shall be solid masonry units, hollow masonry grouted solid, stone or concrete.
- When a lining of firebrick at least 2" thick is provided minimum thickness of back and sidewalls shall be 8" of solid masonry, including the lining.

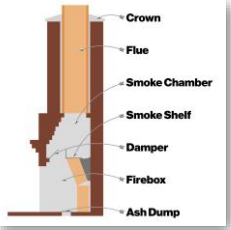


24

Masonry Fireplaces

Firebox (IBC 2111.7):

- Minimum depth of 20"
- Throat \geq 8"
- The area of the passageway above the firebox shall not be less than the cross-sectional area of the flue



25

Masonry Chimneys

Masonry Chimneys (IBC 2113):

- Loading
 - Shall not support loads other than their own weight.
- Cleanout Openings
 - Within 6" of the base of each flue
- Chimney Clearances
 - Minimum airspace clearance of 2-inches to combustibles
 - 1-inch if located entirely outside and pass through a soffit or cornice.

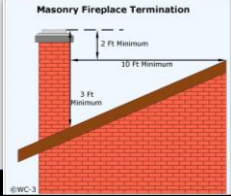


26

Masonry Chimneys

Termination (IBC 2113):

- Shall extend \geq 2-feet higher than any portion of the building within 10-feet, but not less than 3-feet above the highest point where the chimney passes through the roof



27

Masonry

Dry-Stack Masonry (IBC 2114):

- Not allowed in Risk Category IV
- Construction per ASTM C946
- Requires surface bonding on each face of wall to increase flexural capacity






28

Masonry

Cold Weather: TMS 602-16 (§ 1.8C)

- Applies when ambient air < 40°F
- Masonry units having visible ice or snow should not be laid
- Remove visible ice or snow from top surface of foundation and masonry to receive new construction
- Protect newly constructed masonry by covering with weather-resistive membrane for 24 hours








29

Masonry

Hot Weather: TMS 602-16 (§ 1.8D)

- Applies when ambient air > 100°F
- Maintain temperature of mortar and grout < 120°F
- Use mortar within 2 hours of initial mixing
- Fog spray newly constructed masonry until damp at least three times a day for three days


30



Commercial Building Inspector (B2) → 3%
Building Plans Examiner (B3) → 3%

IBC Chapter 22

Steel







31


Steel

Numerous Standards:

- AISC 360, 341, 358 (structural steel)
- AISI S100, S202, S220, S240, S400 (cold-formed)
- SJI 100, 200 (steel joists)
- ANSI/SDI-NC1.0, RD1.0, C (steel deck)
- ASCE 19 (steel cable structures)
- RMI ANSI/MHI 6.1, MHI 6.3 (racking)
- ACI 318 (composite construction)


32



Steel

Identification & Protection:

- Steel having a structural load-carrying purpose shall be identified (grade, member size, etc.)
- Where not identifiable, shall be tested.
- Shall be protected against corrosion



33



Commercial Building Inspector (B2) → 13%
Building Plans Examiner (B3) → 7%

IBC Chapter 23

Wood





34

Wood Construction

Design Options (IBC 2302)

- Allowable stress design
- Load and resistance factor design
- Conventional construction
- AWC WFCM (Risk Category I, II)
- ICC 400 (Log structures)






35

Wood Construction

Minimum Standards (IBC 2303)

- Section 2303 covers lumber types, structural panels, sheathing, I-joists, **preservative-treated wood***, fire-treated wood, log members, **truss design***, hangers, nails, and staples.






36

Wood Construction

Preservative-treated (IBC 2303.1.9)

- Conform to AWPA UI and M4
- Identification:
 - Manufacturer
 - Type of preservative
 - Minimum preservative retention (pcf)
 - End use
 - AWPA standard
 - Accredited inspection agency






37

Wood Construction

Trusses (IBC 2303.4)

- Truss design drawings of each individual truss as well as placement diagram
- B.O. may require this to be sealed
- The anchorage of truss to the principal structure is responsibility of registered design professional in responsible charge

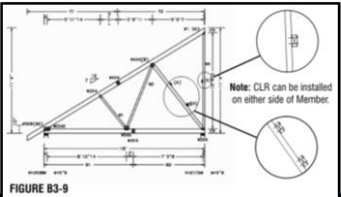





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Wood Construction

PITMR & PITMDB (IBC 2303.4.1.2)

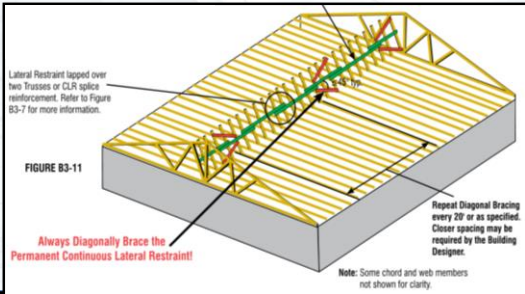
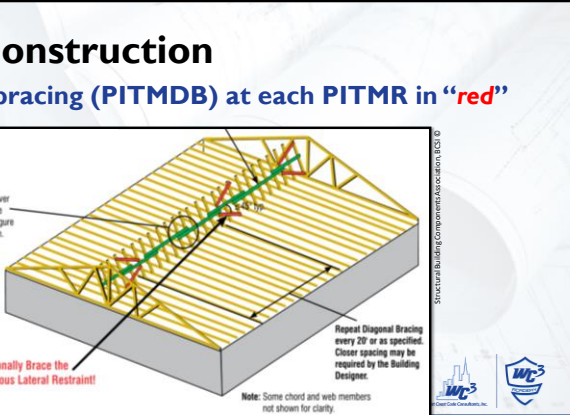

- PITMR = Permanent Individual Truss Member Restraint
- PITMDB = Perm. Ind.Truss Member Diagonal Bracing
- Truss design drawings call for PITMR...

39

Wood Construction

Diagonal bracing (PITMDB) at each PITMR in "red"

40

Wood Construction

PITMR & PITMDB (IBC 2303.4.1.2)

When the truss plans call for PITMR, it must be provided by one of following...

- 1. PITMR & PITMDB shall be provided using standard industry lateral restraint and diagonal bracing details **per TPI, accepted engineering practice, or IBC Figures 2303.4.1.2(1), (3), and (5).**
- 2. Buckling reinforcement is added to individual truss **per truss drawings, or per IBC Figures 2303.4.1.2 (2) and (4).**
- 3. **Project-specific PITMR and PITMDB design by EOR.**

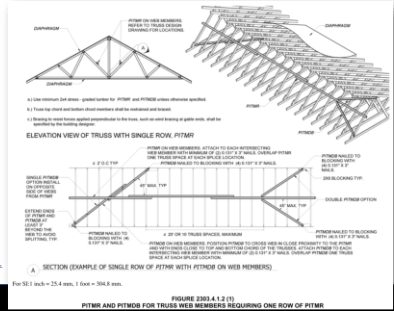


41

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Wood Construction

IBC - Option #1(a): One Row

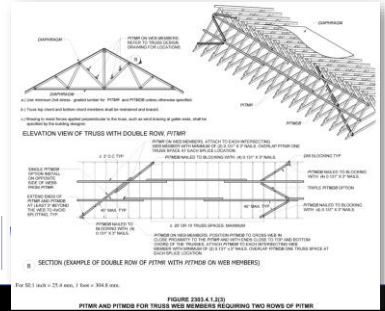


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Wood Construction

IBC - Option #1(b): Two Rows

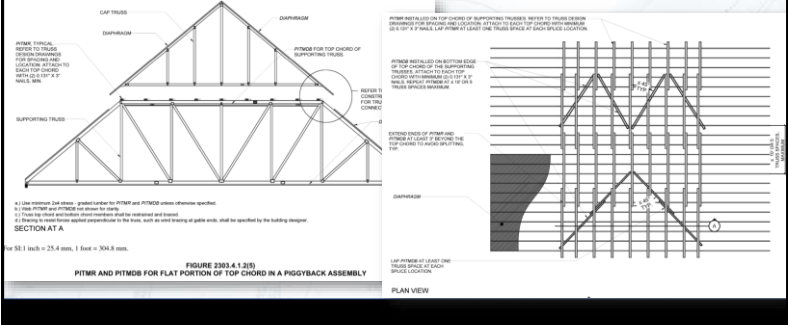


43

43

Wood Construction

IBC - Option #1(c): Piggyback Bracing



44

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Wood Construction

IBC – Option #2(a): One Row

ELEVATION VIEW OF L OR SCAP REINFORCEMENT

TYPES OF WEB MEMBER BUCKLING REINFORCEMENT

a) Truss top chord and bottom chord members shall be stabilized and braced.
 b) Bracing to resist forces applied perpendicular to the truss, such as wind bracing at gable ends, shall be specified by the building designer.
 c) Use the table below unless project specific web member reinforcement is provided on the truss design drawing or supplemental truss buckling reinforcement details are provided by the truss designer.

NUMBER OF ROWS OF FITMRS SPECIFIED ON WEB MEMBER	SIZE OF TRUSS WEB	TYPE AND SIZE OF WEB REINFORCEMENT* FOR L, F OR SCAP†	GRADE OF WEB REINFORCEMENT	MINIMUM LENGTH OF WEB REINFORCEMENT	MINIMUM CONNECTION OF WEB REINFORCEMENT TO WEB
ONE	2x4	2x4	Same species and grade or better than web member.	90% of web or extend to within 6" of end of web member, whichever is greater.	@ 131" x 3" nails at 6" on-center
	2x6	2x6			
	2x8	2x8			

*Minimum allowable web length is 14".
 †Attach SCAP reinforcement to web with two rows of minimum 0.131" x 3" nails at 6" on-center.

For S1-1 inch = 25.4 mm, 1 foot = 304.8 mm.

FIGURE 2303.4.1.2(2)
ALTERNATIVE INSTALLATION USING BUCKLING REINFORCEMENT FOR TRUSS WEB MEMBERS IN LIEU OF ONE ROW OF FITMRS

45

Wood Construction

IBC – Option #2(b): Two Rows

ELEVATION VIEW OF I OR U REINFORCEMENT

TYPES OF WEB MEMBER BUCKLING REINFORCEMENT

a) Truss top chord and bottom chord members shall be stabilized and braced.
 b) Bracing to resist forces applied perpendicular to the truss, such as wind bracing at gable ends, shall be specified by the building designer.
 c) Use the table below unless project specific web member reinforcement is provided on the truss design drawing or supplemental truss buckling reinforcement details are provided by the truss designer.

NUMBER OF ROWS OF FITMRS SPECIFIED ON WEB MEMBER	SIZE OF TRUSS WEB	TYPE AND SIZE OF WEB REINFORCEMENT	GRADE OF WEB REINFORCEMENT	MINIMUM LENGTH OF WEB REINFORCEMENT	MINIMUM CONNECTION OF WEB REINFORCEMENT TO WEB
TWO	2x4	(2)-2x4	Same species and grade or better than web member.	90% of web or extend to within 6" of end of web member, whichever is greater.	@ 131" x 3" nails at 6" on-center
	2x6	(2)-2x6			
	2x8	(2)-2x8			

*Maximum allowable web length is 14".

For S1-1 inch = 25.4 mm, 1 foot = 304.8 mm.

FIGURE 2303.4.1.2(4)
ALTERNATIVE INSTALLATION USING BUCKLING REINFORCEMENT FOR TRUSS WEB MEMBERS IN LIEU OF TWO ROWS OF FITMRS

46

Wood Construction

Shrinkage (IBC 2304.3.3)

- ❑ Wood walls supporting more than two floors and a roof must provide an analysis of the potential shrinkage.
- ❑ The analysis should show that it will not cause an adverse effect on the...
 - Structure
 - MEP equipment and systems
 - Roof drainage

FIGURE 2304.3.3
ANALYSIS OF POTENTIAL SHRINKAGE EFFECTS ON STRUCTURE, MEP EQUIPMENT AND SYSTEMS, AND ROOF DRAINAGE

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Wood Construction

Wood structural panel wall sheathing per...

TABLE 2304.6.1
MAXIMUM ALLOWABLE STRESS DESIGN WIND SPEED, V_{AS} , PERMITTED FOR WOOD STRUCTURAL PANEL WALL SHEATHING USED TO RESIST WIND PRESSURES^{a, b, c}

Size	Penetration (inches)	MINIMUM WOOD STRUCTURAL PANEL SPAN RATING	MINIMUM NOMINAL PANEL THICKNESS (inches)	MAXIMUM WALL STUD SPACING (inches)	PANEL NAIL SPACING		MAXIMUM ALLOWABLE STRESS DESIGN WIND SPEED, V_{AS} (MPH)		
					Edges (inches o.c.)	Field (inches o.c.)	Wind exposure category		
							B	C	D
6d common (2.0" x 0.113")	1.5	24/0	7/8	16	6	12	110	90	85
						12	110	100	90
		24/16	7/16	16	6	6	150	125	110
						12	130	110	105
8d common (2.5" x 0.131")	1.75	24/16	7/8	16	6	6	150	125	110
						12	110	90	85
		24	6	6	110	90	85		
				6	110	90	85		

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Wood Construction

Floor and roof sheathing per...

SPAN (inches)	TABLE 2304.8(1) ALLOWABLE SPANS FOR LUMBER FLOOR AND ROOF SHEATHING MINIMUM NET THICKNESS (inches) OF LUMBER PLACED			
	Perpendicular to supports		Diagonally to supports	
	Surfaced dry*	Surfaced unseasoned	Surfaced dry*	Surfaced unseasoned
	Floors			
24	3/4	27/32	3/4	27/32
16	7/8	11/16	7/8	11/16
	Roofs			
24	3/4	11/16	3/4	27/32

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Wood Construction

Fastening (IBC Table 2304.10.2)

TABLE 2304.10.2 FASTENING SCHEDULE		
DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER*	SPACING AND LOCATION
Roof		
1. Blocking between ceiling joists, rafters or trusses to top plate or other framing below	4-8d box (2 7/8" x 0.131") or 3-8d common (2 1/2" x 0.131") or 3-10d box (3" x 0.128") or 3-3" x 0.131" nails or 3-3" x 14 gage staples, 1/2" crown	Each end, toenail
Blocking between rafters or truss not at the wall top plate, to rafter or truss	2-8d common (2 1/2" x 0.131") 2-3" x 0.131" nails 2-3" x 14 gage staples	Each end, toenail
Flat blocking to truss and web filler	2-16 d common (3 7/8" x 0.162") 3-3" x 0.131" nails 3-3" x 14 gage staples	Face nail
2. Ceiling joists to top plate	4-8d box (2 7/8" x 0.131") or 3-8d common (2 1/2" x 0.131") or 3-10d box (3" x 0.128") or 3-3" x 0.131" nails or 3-3" x 14 gage staples, 1/2" crown	Each joist, toenail

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Wood Construction

Fasteners in Treated (IBC 2304.10.6)

- ❑ Includes fastener, nuts, washer and connectors
- ❑ For both preservative-treated and fire-retardant-treated
 - Zinc-coated
 - Stainless steel
 - Silicone bronze
 - Copper

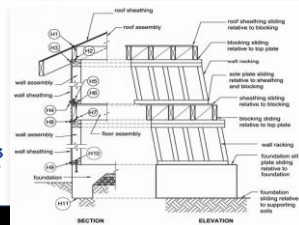


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Wood Construction

Load Path (IBC 2304.10.7)

- ❑ Members shall be secured to ensure a continuous load path



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Wood Construction

Heavy Timber (IBC 2304.11)

☐ To meet Type IV-HT...

SUPPORTING	HEAVY TIMBER STRUCTURAL ELEMENTS	MINIMUM NOMINAL SOLID SAWN SIZE		MINIMUM GLUED-LAMINATED NET SIZE		MINIMUM STRUCTURAL COMPOSITE LUMBER NET SIZE	
		Width, inch	Depth, inch	Width, inch	Depth, inch	Width, inch	Depth, inch
Floor loads only or combined floor and roof loads	Columns: Framed sawn or glued-laminated timber arches that spring from the floor line; Framed timber trusses	8	8	6 1/2	8 1/2	7	7 1/2
	Wood beams and girders	6	10	5	10 1/2	5 1/2	9 1/2
Roof loads only	Columns (roof and ceiling loads): Lower half of wood-frame or glued-laminated arches that spring from the floor line or from grade	6	8	5	8 1/2	5 1/2	7 1/2
	Upper half of wood-frame or glued-laminated arches that spring from the floor line or from grade	6	6	5	6	5 1/2	5 1/2
	Framed timber trusses and other roof framing: Framed or glued-laminated arches that spring from the top of walls or wall abutments	4	6	3	6 1/2	3 1/2	5 1/2




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Wood Construction

Decay & Termites (IBC 2304.12)

☐ Treated or naturally durable:

- Crawl space: joists = 18", girders = 12"
- Supported on foundation wall ≤ 8" grade
- In contact with concrete/masonry below grade or girders entering such walls
- Sleepers or sills
- Wood siding ≤ 6" from grade
- Posts & columns in direct contact
- Exposed to weather
- In contact with ground or fresh water




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Wood Construction

Conventional Construction (IBC 2308)

☐ Limitations:

- Dead loads ≤ 15psf
- Live loads ≤ 40 psf
- Ground snow ≤ 50 psf
- Wind speed ≤ 130 mph
- Not allowed for Risk Category IV



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Wood Construction

Foundation Plates or Sills (IBC 2308.3.1)

☐ 1/2" diameter anchor bolts

☐ 7" embedment

☐ Placed in middle third of plate


☐ Spaced no more than 6'-0" o.c.

☐ Minimum of two per plate

☐ Within 12" of end

☐ No closer than 4" from end

☐ 0.229x3x3 plate washer required in Seismic Design Category D.



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Wood Construction

Floor Framing (IBC 2308.4)

❑ Make sure you are reading tables correctly!

TABLE 2308.4.1(1)
HEADER AND GIRDER SPANS* FOR EXTERIOR BEARING WALLS
(Maximum spans for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir and required number of jack studs)

GIRDERS AND HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD (psf)																
		30				50				70								
		BUILDING WIDTH (feet)																
12		24		36		12		24		36		12		24		36		
Span*	NJ*	Span*	NJ*	Span*	NJ*	Span*	NJ*	Span*	NJ*	Span*	NJ*	Span*	NJ*	Span*	NJ*	Span*	NJ*	
1-6 x 6	4-0	1	3-1	2	2-7	2	2-3	1	2-6	2	2-1	1	2-0	2	2-4	2	2-0	2
1-2 x 8	5-1	2	3-11	2	3-3	2	4-4	2	3-4	2	3-0	2	3-0	2	3-0	2	3-6	1
1-2 x 10	6-0	2	4-8	2	3-11	2	3-2	2	4-0	2	3-4	2	3-7	2	3-6	1	3-0	1
1-2 x 12	7-1	2	5-5	2	4-7	2	4-1	2	4-4	2	3-11	2	3-5	2	4-2	1	3-6	1
2-2 x 4	4-0	1	3-1	2	2-7	1	3-3	1	2-7	1	3-2	1	3-0	1	2-4	1	2-6	1
2-2 x 6	4-0	1	4-7	1	3-10	1	3-1	1	3-3	1	3-3	1	4-4	1	3-6	2	3-0	2
2-2 x 8	4-0	1	4-7	1	3-10	1	3-1	1	3-3	1	3-3	1	4-4	1	3-6	2	3-0	2
2-2 x 10	4-0	1	4-7	1	3-10	1	3-1	1	3-3	1	3-3	1	4-4	1	3-6	2	3-0	2
2-2 x 12	4-0	1	4-7	1	3-10	1	3-1	1	3-3	1	3-3	1	4-4	1	3-6	2	3-0	2
3-2 x 8	5-1	1	5-9	1	4-10	2	4-3	1	5-0	2	4-2	2	5-9	1	4-5	2	3-6	2
3-2 x 10	6-0	1	6-10	2	5-8	2	5-11	2	4-11	2	4-9	2	5-5	2	4-5	2	4-5	2
3-2 x 12	6-0	1	6-10	2	5-8	2	5-11	2	4-11	2	4-9	2	5-5	2	4-5	2	4-5	2
3-2 x 8	6-0	1	6-10	2	5-8	2	5-11	2	4-11	2	4-9	2	5-5	2	4-5	2	4-5	2
3-2 x 10	6-0	1	6-10	2	5-8	2	5-11	2	4-11	2	4-9	2	5-5	2	4-5	2	4-5	2
3-2 x 12	6-0	1	6-10	2	5-8	2	5-11	2	4-11	2	4-9	2	5-5	2	4-5	2	4-5	2
4-2 x 8	7-1	1	7-1	1	6-1	1	6-1	1	6-3	1	5-3	2	7-2	1	5-6	2	4-8	2
4-2 x 10	8-1	1	8-7	1	7-3	2	8-7	1	7-4	2	6-2	2	8-6	1	6-7	2	5-6	2
4-2 x 12	8-1	1	8-7	1	7-3	2	8-7	1	7-4	2	6-2	2	8-6	1	6-7	2	5-6	2
5-2 x 8	9-1	1	9-1	1	8-1	2	9-1	1	8-1	2	7-1	2	9-1	1	7-1	2	6-1	2
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6-2 x 10	12-1	1	12-1	1	11-1	2	12-1	1	11-1	2	10-1	2	12-1	1	10-1	2	6-1	2
6-2 x 12	13-1	1	13-1	1	12-1	2	13-1	1	12-1	2	11-1	2	13-1	1	11-1	2	6-1	2

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Wood Construction

TABLE 2308.4.1(2)
HEADER AND GIRDER SPANS* FOR INTERIOR BEARING WALLS
(Maximum spans for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir and required number of jack studs)

HEADERS AND GIRDERS SUPPORTING	SIZE	BUILDING WIDTH (feet)					
		12		24		36	
		Span*	NJ*	Span*	NJ*	Span*	NJ*
One floor only	2-2 x 4	4-1	1	2-10	1	2-4	1
	2-2 x 6	6-1	1	4-4	1	3-6	1
	2-2 x 8	7-9	1	5-5	1	4-5	2
	2-2 x 10	9-2	1	6-6	2	5-3	2
	2-2 x 12	10-9	1	7-7	2	6-3	2
	3-2 x 8	9-8	1	6-10	1	5-7	1
	3-2 x 10	11-5	1	8-1	1	6-7	2
	3-2 x 12	13-6	1	9-6	2	7-9	2
	4-2 x 8	11-2	1	7-11	1	6-5	1
	4-2 x 10	13-3	1	9-4	1	7-8	1
4-2 x 12	15-7	1	11-0	1	9-0	2	

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Wood Construction

TABLE 2308.4.2(1)
FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES
(Residential living areas, live load = 40 psf, L/Δ = 360)

JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 psf															
		2 x 6		2 x 8		2 x 10		2 x 12		2 x 6		2 x 8		2 x 10		2 x 12	
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
12	Douglas Fir-Larch	SS	11-4	15-0	19-1	23-3	11-4	15-0	19-1	23-3							
	Douglas Fir-Larch	#1	10-11	14-5	18-5	22-0	10-11	14-2	17-4	20-1							
	Douglas Fir-Larch	#2	10-9	14-2	17-9	20-7	10-6	13-3	16-3	18-10							
	Douglas Fir-Larch	#3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3							
	Hem-Fir	SS	10-9	14-2	18-0	21-11	10-9	14-2	18-0	21-11							
	Hem-Fir	#1	10-6	13-10	17-8	21-6	10-6	13-10	16-11	19-7							
	Hem-Fir	#2	10-0	13-2	16-10	20-4	10-0	13-1	16-0	18-6							
	Hem-Fir	#3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3							
	Southern Pine	SS	11-2	14-8	18-9	22-10	11-2	14-8	18-9	22-10							
	Southern Pine	#1	10-9	14-2	18-0	21-11	10-9	14-2	18-0	21-11							
	Southern Pine	#2	10-3	13-6	16-2	19-1	9-10	12-6	14-9	17-5							
	Southern Pine	#3	8-2	10-3	12-6	14-9	7-5	9-5	11-5	13-6							
Spruce-Pine-Fir	SS	10-6	13-10	17-8	21-6	10-6	13-10	17-8	21-6								
Spruce-Pine-Fir	#1	10-3	13-6	17-3	20-7	10-3	13-3	16-3	18-10								
Spruce-Pine-Fir	#2	10-3	13-6	17-3	20-7	10-3	13-3	16-3	18-10								
Spruce-Pine-Fir	#3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3								

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Wood Construction

Notching (2308.4.2.4)

Notches:

- ❑ Ends of joists ≤ 1/4 joist depth
- ❑ Top or bottom ≤ 1/6 joist depth and cannot be located within middle third

Holes:

- ❑ Not within 2" of the top or bottom
- ❑ Ø ≤ 1/3 joist depth

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Wood Construction

Wall Construction (IBC 2308.5)

☐ Stud height table based on conventional construction.

STUD SIZE (inches)	BEARING WALLS				NONBEARING WALLS	
	Laterally unsupported stud height* (feet)	Supporting roof and ceiling only	Supporting one floor, roof and ceiling		Laterally unsupported stud height* (feet)	Spacing (inches)
			Spacing (inches)			
2 × 3"	—	—	—	—	10	16
2 × 4	10	24	16	—	14	24
3 × 4	10	24	24	16	14	24
2 × 5	10	24	24	—	16	24
2 × 6	10	24	24	16	20	24

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Top Plates (2308.5.3.2)

Double Top Plates:

- ☐ Shall be capped with double top plates
- ☐ Overlapped at corners and at intersections of other partitions
- ☐ End joints offset ≥ 48"
- ☐ Attached using 16d at 16"o.c. or 10d at 12"o.c.

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Notching (2308.5.9)

Notches:

- ☐ Exterior ≤ 25% width
- ☐ Bearing ≤ 25% width
- ☐ Partition ≤ 40% width

Drilling:

- ☐ Edge ≥ 5/8"
- ☐ Ø ≤ 40% width (single)
- ☐ Ø ≤ 60% width (double)

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Braced Walls

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Braced Walls

TABLE 2308.6.3(1) BRACING METHODS				
METHODS, MATERIAL	MINIMUM THICKNESS	FIGURE	CONNECTION CRITERIA*	
			Fasteners	Spacing
LIB Let-in-bracing	1" x 4" wood or approved metal straps attached at 45° to 60° angles to studs at maximum of 16" o.c.		Table 2304.10.2 Metal strap, installed in accordance with manufacturer's recommendations	Wood: per stud plus top and bottom plates Metal strap, installed in accordance with manufacturer's recommendations
DWB Diagonal wood boards	1/2" thick (1" nominal) x 6" minimum width to studs at maximum of 24" o.c.		Table 2304.10.2	Per stud
WSP Wood structural panel	1/2" in accordance with Table 2308.6.3(2) or 2308.6.3(3)		Table 2304.10.2	6" edges 12" field
SFB Structural fiber-board sheathing	1/2" in accordance with Table 2304.10.2 to studs at maximum 16" o.c.		Table 2304.10.2	3" edges 6" field

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Braced Walls

TABLE 2308.6.1 WALL BRACING REQUIREMENTS*						
SEISMIC DESIGN CATEGORY	STORY CONDITION (SEE SECTION 2308.7)	MAXIMUM SPACING OF BRACED WALL LINES	BRACED PANEL LOCATION, SPACING (O.C.) AND MINIMUM PERCENTAGE (X)			MAXIMUM DISTANCE OF BRACED WALL PANELS FROM EACH END OF BRACED WALL LINE
			Bracing method ^b			
			LIB	DWB, WSP	SFB, PBS, PCP, HPS, GB ^c	
A and B		35' - 0"	Each end and ≤ 25' - 0" o.c.	Each end and ≤ 25' - 0" o.c.	Each end and ≤ 25' - 0" o.c.	12' - 6"
		35' - 0"	Each end and ≤ 25' - 0" o.c.	Each end and ≤ 25' - 0" o.c.	Each end and ≤ 25' - 0" o.c.	12' - 6"
		35' - 0"	NP	Each end and ≤ 25' - 0" o.c.	Each end and ≤ 25' - 0" o.c.	12' - 6"

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Ceiling Joist & Rafters

Key is to find the right table.

TABLE 2308.7.1(1) CEILING JOIST SPANS FOR COMMON LUMBER SPECIES (Uninhabitable Attics Without Storage, Live Load = 10 psf, L/Δ = 240)
TABLE 2308.7.1(2) CEILING JOIST SPANS FOR COMMON LUMBER SPECIES (Uninhabitable Attics With Limited Storage, Live Load = 20 psf, L/Δ = 240)
TABLE 2308.7.2(1) RAFTER SPANS FOR COMMON LUMBER SPECIES (Roof Live Load = 20 psf, Ceiling Not Attached to Rafters, L/Δ = 180)
TABLE 2308.7.2(2) RAFTER SPANS FOR COMMON LUMBER SPECIES (Roof Live Load = 20 psf, Ceiling Attached to Rafters, L/Δ = 240)
TABLE 2308.7.2(3) RAFTER SPANS FOR COMMON LUMBER SPECIES (Ground Snow Load = 30 psf, Ceiling Not Attached to Rafters, L/Δ = 180)
TABLE 2308.7.2(4) RAFTER SPANS FOR COMMON LUMBER SPECIES (Ground Snow Load = 50 psf, Ceiling Not Attached to Rafters, L/Δ = 180)

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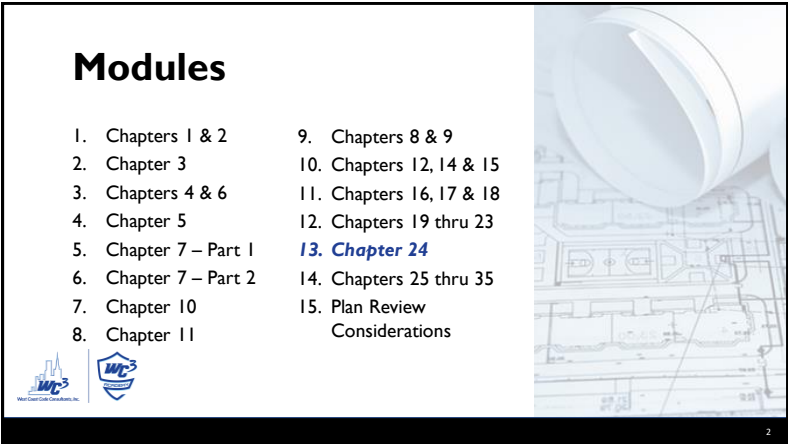
END OF MODULE 12

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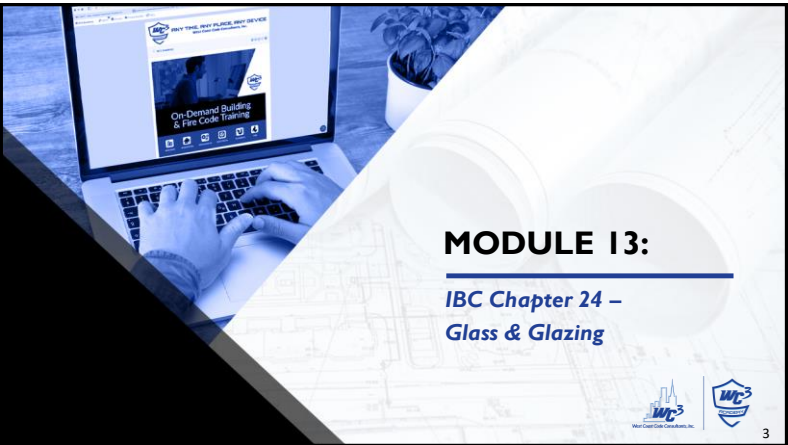
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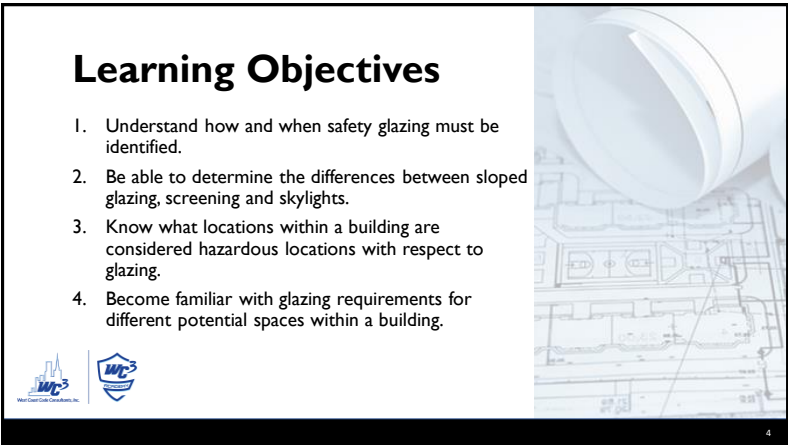
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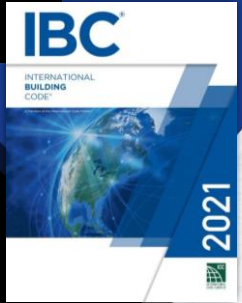
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Commercial Building Inspector (B2) → 4%
Building Plans Examiner (B3) → 0%

IBC Chapter 24

Glass & Glazing

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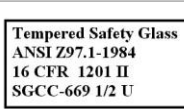




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Glass & Glazing

IBC 2403.1: Identification

- Each pane shall bear manufacturer's mark noting **type** and **thickness**
- Shall not be omitted unless approved
- Tempered glass - **permanently** marked
 - Exception: Spandrel glass

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Glass & Glazing

IBC 2403.2: Glass Supports

- "When one or more sides of any pane are not firmly supported..."
- Detailed construction documents, analysis, or test data ensuring performance is required
 - i.e. → Requires Design Professional






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Glass & Glazing

IBC 2403.3 (1604.3.7): Framing

- To be "firmly supported" edge deflection must be lesser of...
 - ≤13'-6" span → L/175
 - > 13'-6" span → L/240 + 1/4-inch

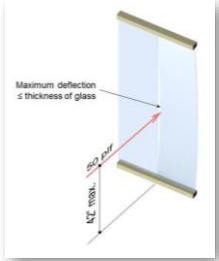




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Glass & Glazing

IBC 2403.4: Interior

- ❑ Two adjacent unsupported edges
- ❑ Max deflection = thickness of glass
- ❑ 50plf any point up to 42 inches


9

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Glass & Glazing

IBC 2404: Wind, Snow, Seismic, Dead Loads

- ❑ Glass sloped $\leq 15^\circ$ from vertical \rightarrow wind loads – components & cladding
- ❑ Curtain walls, glazed storefronts, and glazed partitions \rightarrow seismic loads
- ❑ Glass supporting uniform load \rightarrow ASTM E1300
- ❑ Glass sloped $> 15^\circ$ from vertical \rightarrow wind, snow & DL



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Glass & Glazing

IBC 2405: Sloped Glazing & Skylights

- ❑ Glass & other transparent glazing sloped $> 15^\circ$
- ❑ Type of glazing:
 - Laminated w/ polyvinyl butyral interlayer
 - Wired glass
 - Light-transmitting plastic (IBC 2607)
 - Heat-strengthened glass
 - Fully tempered glass





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Glass & Glazing

IBC 2405.3: Screening

- ❑ Monolithic glazing consisting of annealed, heat-strengthened, fully tempered, and wireless glass...
- ❑ Shall have retention screens below

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Glass & Glazing

IBC 2405.3: Screening Design

1. Able to support 2x weight of glass.
2. Substantially fastened to framing members.
3. Located w/in 4-inches of glass.
4. Consist of noncombustible materials

Multiple Exceptions!





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Glass & Glazing

IBC 2405.3: Screening




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Glass & Glazing

IBC 2405.3: Screening

□Exception #2:





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Glass & Glazing


IBC 2405.3: Screening

- Not required for **greenhouses** < 30-feet high which are not open to the public.
- Individual **R-2, R-3 & R-4** dwelling units when fully tempered and...
 - Each pane is ≤ 16ft²
 - ≤ 12-feet above walking surface
 - **Maximum** of 3/16-inch in thickness
- Laminated glass having 15-mil polyvinyl butyral interlayer in **R-2, R-3 & R-4** and...
 - Each pane is ≤ 16ft²
 - ≤ 12-feet above walking surface

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Glass & Glazing

IBC 2405.4: Skylight Framing

- ❑ Type I & II Construction → noncombustible materials
- ❑ Must resist roof loads of Chapter 16
- ❑ If set at an angle < 45° from horizontal plane must be installed on curb at least 4-inches above plane of roof
 - Exception: Group R-3 → curb is not required unless slope of roof is < 14° (3:12)




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Glass & Glazing

IBC 2405.5: Unit Skylights

- ❑ Tested per AAMA/WDMA/CSA 101/I.S./A440
- ❑ Label shall note manufacturer, testing agency, product designation, and performance grade rating.
- ❑ This section includes “Tubular Daylighting Devices”.




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Glass & Glazing

IBC 2406: Safety Glazing

- ❑ Individual glazed areas in hazardous locations shall pass the impact test requirements. *(includes mirrors!)*
- ❑ Impact Test → CPSC 16 CFR Part 1201, Category II




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Glass & Glazing


IBC 2406: Safety Glazing

EXPOSED SURFACE AREA OF ONE SIDE OF ONE LITE	GLAZING IN STORM OR COMBINATION DOORS (Category class)	GLAZING IN DOORS (Category class)	GLAZED PANELS REGULATED BY SECTION 2406.4.3 (Category class)	GLAZED PANELS REGULATED BY SECTION 2406.4.2 (Category class)	DOORS AND ENCLOSURES REGULATED BY SECTION 2406.4.5 (Category class)	SLIDING GLASS DOORS PATIO TYPE (Category class)
9 square feet or less	I	I	No requirement	I	II	II
More than 9 square feet	II	II	II	II	II	II

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Wet areas, other than doors → ANSI Z97.1

EXPOSED SURFACE AREA OF ONE SIDE OF ONE LITE	GLAZED PANELS REGULATED BY SECTION 2406.4.3 (Category class)	GLAZED PANELS REGULATED BY SECTION 2406.4.2 (Category class)	DOORS AND ENCLOSURES REGULATED BY SECTION 2406.4.5* (Category class)
9 square feet or less	No requirement	B	A
More than 9 square feet	A	A	A





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Glass & Glazing

IBC 2406: Safety Glazing

- ❑ Identification shall be provided on each pane noting manufacturer, testing agency, safety glazing standard
- ❑ Shall be acid etched, sand-blasted, ceramic fired, laser-etched, embossed or other **permanent** method.
- ❑ **Exception:** Multi-pane assemblies where individual panes ≤ 1ft², at least one pane shall be labeled.

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Glass & Glazing

IBC 2406.4: Hazardous Locations

- ❑ In **Doors**, unless...
 - < 3-inch Ø sphere
 - Decorative glazing
 - Curved glazing in revolving doors
 - Commercial refrigerators cabinet doors




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Glass & Glazing

IBC 2406.4: Hazardous Locations

- ❑ **Doors**, unless...
 - < 3-inch Ø sphere
 - Decorative glazing
 - Curved glazing in revolving doors
 - Commercial refrigerators cabinet doors





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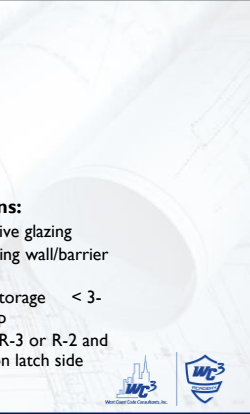

Glass & Glazing

IBC 2406.4: Hazardous Locations

- ❑ **Adjacent to doors** (w/in 24-inch arc)



- **Exceptions:**
 - Decorative glazing
 - Intervening wall/barrier between
 - Closet/storage < 3-feet deep
 - Groups R-3 or R-2 and glazing on latch side

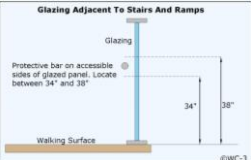

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Glass & Glazing

IBC 2406.4: Hazardous Locations

- Windows, that comply with the following...
 - Individual panes > 9ft², and...
 - Bottom edge is < 18-inches from the floor, and...
 - Top edge is > 36-inches above the floor, and...
 - Walking surface is within 36-inches measured horizontally
- Exceptions:
 - Decorative glazing
 - Horizontal rail is provided between 34-38 inches (50plf)





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Glass & Glazing

IBC 2406.4: Hazardous Locations

- Guards & Railings, regardless of area or height above walking surface
- Wet Surfaces, near hot tubs, spas, whirlpools, saunas, steam rooms, bathtubs, showers, and swimming pools, unless...
 - > 60-inches vertically from a walking surface, or...
 - > 60-inches horizontally from the waters edge






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Glass & Glazing

IBC 2406.4: Hazardous Locations

- Adjacent to **Stairway & Ramps**, where the bottom exposed edge is < 60-inches from walking surface, unless...
 - > 18-inches from an approved guardrail
 - Begins > 36-inches above walking surface






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Glass & Glazing

IBC 2406.4: Hazardous Locations

- Adjacent to **Bottom Stairway Landing**, where < 60-inches above the landing, and...
- Within a 60-inch arc that is < 180° from the bottom tread nosing.
- Exception:
 - > 18-inches from an approved guardrail

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Glass & Glazing

IBC 2407: Handrails & Guards

- ❑ Laminated fully tempered or heat-strengthened glass.
 - **Category II**, CPSC 16 CFR Part 1201, or...
 - **Class A**, ANSI Z97.1, and...
 - Minimum thickness of **1/4-inch**
- ❑ Designed per IBC 1607.8 with **F.S. = 4**
- ❑ Each section shall be supported by three glass balusters, or as necessary to allow one to fail.
- ❑ Not allowed in parking garages.





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Glass & Glazing

IBC 2408: Glazing in Athletic Facilities

- ❑ Impact tested at 59" above playing surface.




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Glass & Glazing

IBC 2409: Walkways & Elevators

- ❑ Walkways → Laminated
- ❑ Hoistway
 - Laminated glass
 - Fire-rated per IBC 716
- ❑ Elevator Vision Panels
 - 1/4 min. thickness
 - 24 in² min., 85 in² max.
- ❑ Glass in Elevator Cars
 - Laminated glass





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END OF MODULE 13



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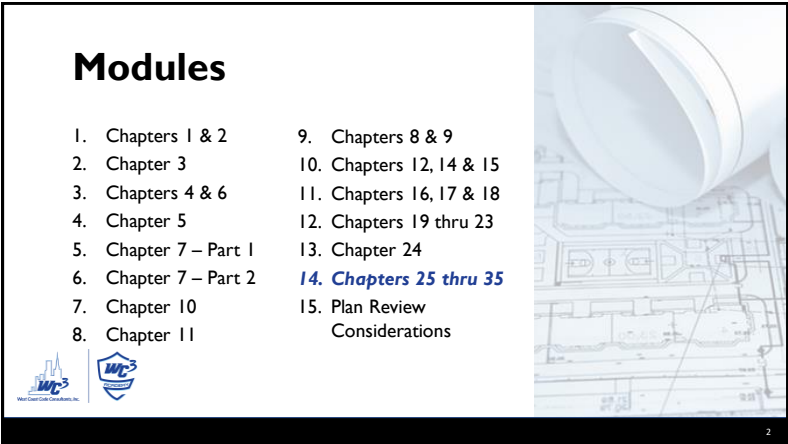


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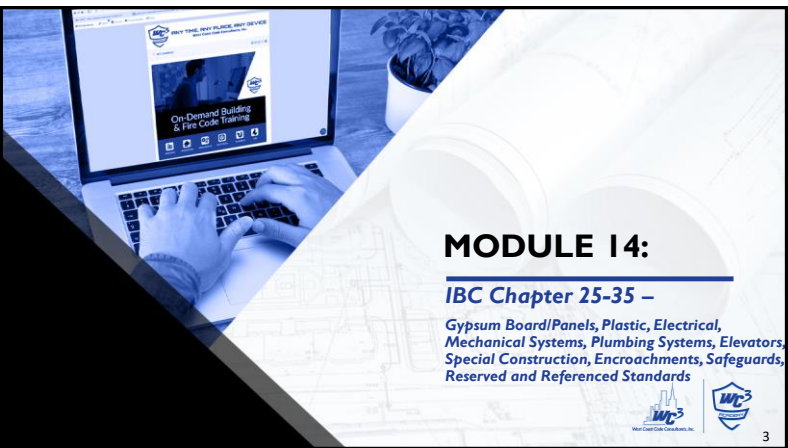
Modules

- 1. Chapters 1 & 2
- 2. Chapter 3
- 3. Chapters 4 & 6
- 4. Chapter 5
- 5. Chapter 7 – Part 1
- 6. Chapter 7 – Part 2
- 7. Chapter 10
- 8. Chapter 11
- 9. Chapters 8 & 9
- 10. Chapters 12, 14 & 15
- 11. Chapters 16, 17 & 18
- 12. Chapters 19 thru 23
- 13. Chapter 24
- 14. **Chapters 25 thru 35**
- 15. Plan Review Considerations



2

2



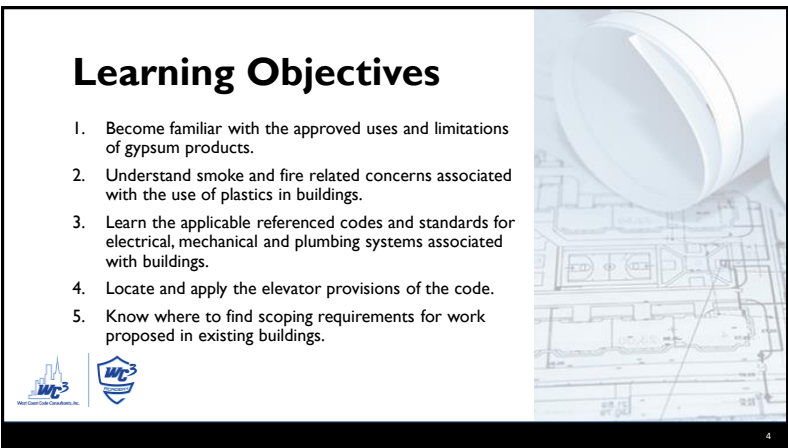
MODULE 14:

IBC Chapter 25-35 –
Gypsum Board/Panels, Plastic, Electrical, Mechanical Systems, Plumbing Systems, Elevators, Special Construction, Encroachments, Safeguards, Reserved and Referenced Standards



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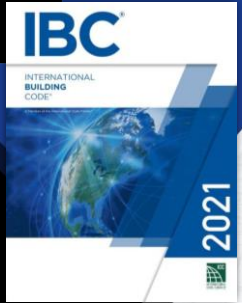
Learning Objectives

- 1. Become familiar with the approved uses and limitations of gypsum products.
- 2. Understand smoke and fire related concerns associated with the use of plastics in buildings.
- 3. Learn the applicable referenced codes and standards for electrical, mechanical and plumbing systems associated with buildings.
- 4. Locate and apply the elevator provisions of the code.
- 5. Know where to find scoping requirements for work proposed in existing buildings.

4

4




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INTERNATIONAL BUILDING CODE
2021

Commercial Building Inspector (B2) → 0%
Building Plans Examiner (B3) → 0%

IBC Chapter 25

Gypsum Products

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5

Gypsum Board & Plaster

IBC 2503 & 110.3.6: Inspection

- Once in place
- Prior to plastering or joints and fasteners are taped & finished.





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6

Gypsum Board & Plaster

IBC 2505: Shear Wall Construction

- Wood → Per IBC 2306.3
- Cold-Formed → Per IBC 2211.1.1
- Seismic Loads: Per limitations of Section 12.2.1 of ASCE 7
 - Not allowed in SDC 'E' or 'F' (ASCE 7)
 - 30% value of wood sheathed





7

Gypsum Board & Plaster

IBC 2506: Materials

TABLE 2506.2 GYPSUM BOARD AND GYPSUM PANEL PRODUCTS MATERIALS AND ACCESSORIES	
MATERIAL	STANDARD
Accessories for gypsum board	ASTM C1042
Adhesives for fastening gypsum board	ASTM C557
Cold-formed steel studs and track, structural	AISI S240
Cold-formed steel studs and track, nonstructural	AISI S220
Elastomeric joint sealants	ASTM C920
Expandable foam adhesives for fastening gypsum wallboard	ASTM D6464
Factory-laminated gypsum panel products	ASTM C1766
Fiber-reinforced gypsum panels	ASTM C1278
Glass mat gypsum backing panel	ASTM C1178
Glass mat gypsum panel 5	ASTM C1658
Glass mat gypsum substrate	ASTM C1177
Joint reinforcing tape and compound	ASTM C474, C475
Nails for gypsum boards	ASTM C514, F547, F1667
Steel screws	ASTM C854, C1082
Standard specification for gypsum board	ASTM C1396
Testing gypsum and gypsum products	ASTM C22; C472; C473



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8

Gypsum Board & Plaster

IBC 2508: Gypsum Construction

- ❑ **Limitations:**
 - Shall not be used where subject to weather, direct exposure to water, or continuous high humidity conditions.
- ❑ **Single-Ply Application:**
 - Edges shall occur on the framing members, except those edges and ends that are perpendicular to the framing members.
- ❑ **Joint Treatment:**
 - Fire-rated assemblies: joints and fasteners treated.
 - Several exceptions...



Gypsum Board & Plaster

IBC 2508: Gypsum Construction

- ❑ **Diaphragms:**
 - May not be used to resist forces for masonry or concrete.
 - Maximum ratio of 1.5:1.0
 - Cantilever conditions are not permitted.

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TABLE 2508.6
SHEAR CAPACITY FOR HORIZONTAL WOOD-FRAME GYPSUM BOARD DIAPHRAGM CEILING ASSEMBLIES

MATERIAL	THICKNESS OF MATERIAL (MINIMUM) (inches)	SPACING OF FRAMING MEMBERS (inches)	"SHEAR VALUE" (PLF OF CEILING)	MINIMUM FASTENER SIZE
Gypsum board or gypsum panel product	1/2	16 o.c.	90	5d cooler or wallboard nail; 1 1/2-inch long; 0.086-inch shank; 3/16-inch head
Gypsum board or gypsum panel product	1/2	24 o.c.	70	5d cooler or wallboard nail; 1 1/2-inch long; 0.086-inch shank; 3/16-inch head

Gypsum Board & Plaster

IBC 2509: Showers & Water Closets

- ❑ **Base for Tile:**
 - Tub & shower areas → per IBC Table 2509.2
 - Water closets → water-resistant gypsum
 - Water-resistant gypsum not okay where...
 - Over vapor retarder in shower & tub areas
 - Where subject to continuous high humidity

TABLE 2509.2
BACKERBOARD MATERIALS

MATERIAL	STANDARD
Glass mat gypsum backing panel	ASTM C1178
Nonasbestos fiber-cement backer board	ASTM C1288 or ISO 8336, Category C
Nonasbestos fiber-mat reinforced cementitious backer unit	ASTM C1325



Stucco Systems

IBC 2510: Stucco



- ❑ Installed ASTM C 926 & ASTM C 1063
- ❑ Metal lath & fasteners corrosion resistant
- ❑ Water resistive barrier per IBC 1403.2
- ❑ Masonry & Concrete
 - Clean, rough, and damp for a proper bond
 - Smooth surfaces may require bonding agent
 - Bond coat shall be kept moist and cured for ≥ 24 hours



Exterior Plaster

IBC 2512: Exterior Plaster

- ❑ Not less than **3 coats** over metal lath, metal fabric lath or gypsum backing
- ❑ Not less than **2 coats** over masonry or concrete
- ❑ **Weep Screeds:**
 - No. 26 gage, corrosion-resistant
 - Installed at or below foundation plate line per ASTM C 926
 - Minimum of **4-inches** above earth, **2-inches** above paving
 - Water-resistive barrier shall lap attachment flange
 - Exterior lath shall attach and terminate on flange

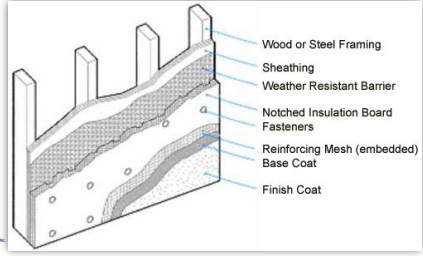





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Exterior Plaster

IBC 2512: Exterior Plaster

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Gypsum Board & Plaster

IBC 2512: Exterior Plaster

- ❑ Ambient temp $\geq 40^{\circ}\text{F}$
- ❑ Protected from freezing for 24-hours
- ❑ Second Coat:
 - Floated to provide rough surface for finish coat
 - No variation $> 1/4$ -inch over 5-feet

COAT	MINIMUM PERIOD MOIST CURING	MINIMUM INTERVAL BETWEEN COATS
First	48 hours ^a	48 hours ^b
Second	48 hours	7 days ^c
Finish	—	Note c

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Gypsum Board & Plaster

IBC 2514: Reinforced Gypsum Concrete

- ❑ Per ASTM C 317 and ASTM C 956
- ❑ Minimum thickness = 2-inches
- ❑ 1.5-inches is allowed if...
 - Overall thickness, including formboard is not less than 2-inches, and...
 - Clear span between supports is ≤ 33 -inches
 - Diaphragm action is not required
 - Design Live Load is ≤ 40 psf

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Commercial Building Inspector (B2) → 0%
Building Plans Examiner (B3) → 0%


IBC Chapter 26

Plastic

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Plastic

IBC 2601.1: Scope

- Foam plastic
- Foam plastic insulation
- Plastic veneer
- Interior plastic finish & trim
- Light-transmitting plastics
- Plastic composites, including plastic lumber




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Plastic

IBC 2603: Foam Plastic Insulation

- Identification:**
 - Shall include label noting mfr., product listing, product identification, etc.
- Surface-Burning Characteristics:**
 - Foam plastic insulation & foam plastic cores shall have a F.S.I. ≤ 75 and S.D.I. ≤ 450
 - Multiple Exceptions!
- Thermal Barrier:**
 - Shall be separated from the interior by ½" gypsum wallboard or acceptable alternative
 - Multiple Exceptions!



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Plastic

IBC 2603.5: Exterior Walls


- Type I, II, III or IV construction
 - Fire-Rated → ASTM E 119 or UL 263
 - Insulation, coatings & facings → FSI ≤ 25; SDI ≤ 450
 - Vertical or lateral fire propagation per NFPA 285

IBC 2603.6: Roofing

- Foam plastic insulation allowed so long as it is included as part of a Class 'A, B, or C' roof assembly per ASTM E 108 or UL 790



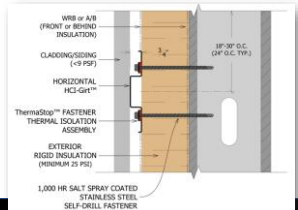

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Plastic

Cladding Attachment over Foam

- To concrete or masonry → IBC 2603.11
- To metal studs → IBC 2603.12
- To wood framing → IBC 2603.13

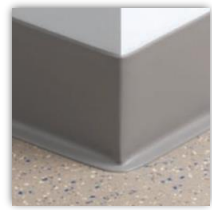

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Plastic

IBC 2604: Interior Finish & Trim

- Density = 20 pcf
- Thickness = 1/2-inch maximum
- Width ≤ 8-inch
- Area ≤ 10% of wall or ceiling area
- F.S.I. ≤ 75


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Plastic

IBC 2612: Plastic Composites

- Labeling:**
 - Manufacturer
 - Product identification
 - Performance level (*exterior applications*)
 - Loading (*decks, stair treads, handrails & guards*)
- F.S.I. ≤ 200
- Only allowed in buildings of Type V-B construction!



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Commercial Building Inspector (B2) → 0%

Building Plans Examiner (B3) → 0%

IBC Chapter 27

Electrical



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Electrical

IBC 2701.1: Scope

- “Electrical components, equipment and systems shall be designed and constructed in accordance with... NFPA 70.”
- NFPA 70 = 2020 NEC



NFPA 70[®]
National Electrical Code
2020
nec
NFPA[®]

National Fire Protection Agency, 2020 NFPA 70 ©



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INTERNATIONAL BUILDING CODE
2021
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Commercial Building Inspector (B2) → 0%
Building Plans Examiner (B3) → 0%

IBC Chapter 28

Mechanical Systems




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Mechanical Systems


IBC 2801.1: Scope

- “Mechanical appliances, equipment and systems shall be constructed, installed and maintained in accordance with the (IMC) and (IFGC).”



IMC
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IFGC
INTERNATIONAL FUEL GAS CODE
2021
International Code Council, 2021 IFGC ©



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Commercial Building Inspector (B2) → 0%
Building Plans Examiner (B3) → 0%

IBC Chapter 29

Plumbing Systems





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Plumbing Systems

IBC 2901.1: Scope

- “...The (IPC) shall govern the erection, installation, alteration, repairs, relocation, replacement, addition to, use or maintenance of plumbing equipment and systems.”


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Commercial Building Inspector (B2) → 0%
Building Plans Examiner (B3) → 1%

IBC Chapter 30

Elevators & Conveyors



30

Elevators

IBC 3001.2: Communication Systems

- A two-way emergency communication system must be provided.
- Shall provide visible text and audible modes.



Schneider Two-Way Emergency Communications, at Schneider.com




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Elevators

IBC 3001.3: Referenced Standards

TABLE 3001.3 ELEVATORS AND CONVEYING SYSTEMS AND COMPONENTS	
TYPE	STANDARD
Automotive lifts	ALI ALCTV
Belt manlifts	ASME A90.1
Conveyors and related equipment	ASME B20.1
Elevators, escalators, dumbwaiters, moving walks, material lifts	ASME A17.1/CSA B44, ASME A17.7/CSA B44.7
Industrial scissor lifts	ANSI MH29.1
Platform lifts, stairway chairlifts, wheelchair lifts	ASME A18.1

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Elevators

IBC 3002: Hoistway Enclosures

- Shaft Enclosures per **IBC 713**
- 4 or more elevator cars serving all or same portion of building.
 - Located in ≥ 2 separate hoistways
- ≤ 4 cars in a single hoistway enclosure
- Cannot be in common shaft enclosure with a stairway.
- Pictorial emergency sign posted adjacent to each elevator call station on all floors.


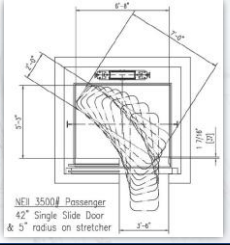
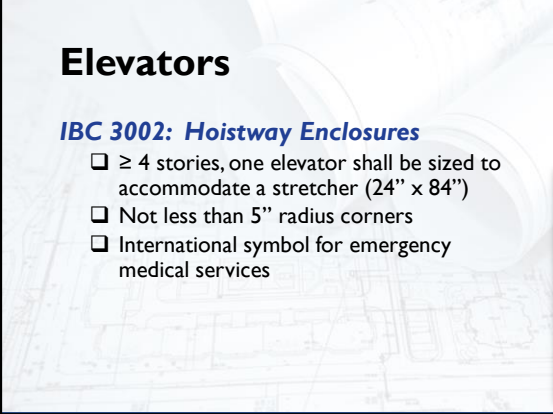

33

33

Elevators

IBC 3002: Hoistway Enclosures

- ≥ 4 stories, one elevator shall be sized to accommodate a stretcher (24" x 84")
- Not less than 5" radius corners
- International symbol for emergency medical services

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Elevators

IBC 3002: Hoistway Enclosures

- No plumbing or mechanical systems in hoistway

IBC 3003: Emergency Operations

- Elevators serving as part of the means of egress are required to have standby power.
 - This is required for buildings ≥ 4 stories
 - Manually transferable
 - Automatic transfer within 60 seconds of failure
- Fire Protection features \rightarrow **IBC 3003.2 & IBC 3003.3**



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Elevators

IBC 3005: Machine Rooms

- Independent ventilation and air-conditioning system
- Pressurize upon activation of heat or smoke detector
- Enclosed w/ fire barriers or horizontal assemblies
- Shunt trip – power shutdown prior to sprinkler flow
- Plumbing systems shall not be located within the elevator equipment rooms.




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Elevators

IBC 3006: Lobbies & Openings

- ❑ If > 3 stories → Protect hoistway door openings (*unsprinklered, highrise, or Group I*)
 - Enclosed elevator lobby
 - Additional smoke & draft control doors can be installed
 - Hoistway shall be pressurized

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Elevators

IBC 3007: Fire Service Access Elevator

- ❑ Occupiable floor above 120-feet above street level
- ❑ 150 ft² lobby enclosed by smoke barriers
- ❑ Symbol on each side of hoistway
- ❑ Shall be continuously monitored
- ❑ Standby power







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Commercial Building Inspector (B2) → 1%
 Building Plans Examiner (B3) → 1%

IBC Chapter 31

Special Construction







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Special Construction

IBC 3101.1: Scope

- Membrane Structures
- Temporary Structures
- Pedestrian Walkways & Tunnels
- Awnings & Canopies
- Marquees
- Signs
- Telecommunication & Broadcast Towers
- Swimming Pool Enclosures & Safety
- Automatic Vehicular Gates
- Solar Energy Systems
- Greenhouses
- Relocatable Buildings
- Public Restrooms in FHA
- Intermodal Shipping Containers


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Special Construction

IBC 3105: Awnings & Canopies

- Wind, lateral loads, and live loads per Chapter 16
- Protected to prevent deterioration
- Frames of noncombustible material, fire-retardant treated wood, Type IV construction, or 1-hour const.
- Canopies shall have approved covering that has a flame spread index ≤ 25




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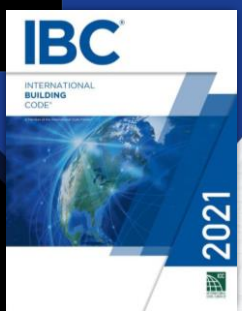
Special Construction

IBC 3113: Relocatable Buildings

- Does not apply to manufactured housing.
- If undergoing alteration, addition, change of occupancy, or relocation shall comply with Chapter 14 of the IBC.
- Supplemental information:
 - Manufacturer's name and address
 - Date of manufacture
 - Serial number
 - Design drawings
 - Type of construction
 - Design loads




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Commercial Building Inspector (B2) → 0%
Building Plans Examiner (B3) → 0%

IBC Chapter 32

Encroachments in Right-of-Way



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Encroachment

Scope:



- Encroachment of structures into the public right-of-way

Measurement:

- Distance measured horizontally from the lot line to the outermost point of the structural projection.

Drainage:

- Water collected from a roof, awning, canopy or marquee, and condensate from mechanical equipment shall not flow over a public walking surface.

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Commercial Building Inspector (B2) → 1%
Building Plans Examiner (B3) → 3%

IBC Chapter 33

Construction Safeguards

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Construction Safeguards

□ **Scope:** Safety during construction and protection of adjacent properties.

- Demolition
- Site Work
- Sanitary
- Pedestrian protection
- Protection of adjoining property
- Temporary use of streets
- Fire extinguishers
- Means of egress
- Standpipes
- Automatic sprinkler system
- Water supply for fire protection
- Fire watch



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Commercial Building Inspector (B2) → 0%
Building Plans Examiner (B3) → 0%

IBC Chapter 34

Reserved

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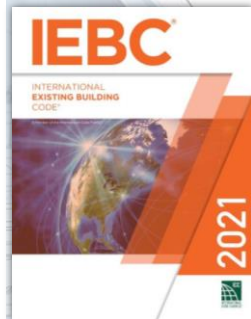


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Existing Buildings

Chapter 34 has been removed and now simply references the IEBC

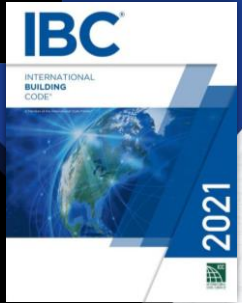
- Additions
- Alterations
- Repairs
- Change of Occupancy
- Historic Buildings
- Moved Structures



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IBC
INTERNATIONAL BUILDING CODE
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Commercial Building Inspector (B2) → 1%
Building Plans Examiner (B3) → 0%

IBC Chapter 35

Referenced Standards

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Referenced Standards

IBC 102.4: Referenced standards shall be considered part of the code



50

50



Miscellaneous

Inspector Training Thoughts




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Inspector Training

Do not rely solely on certifications!

- Shadow experienced inspectors
- Consider checklists
- Use your knowledge & your voice
- Creating a collaborative environment is important



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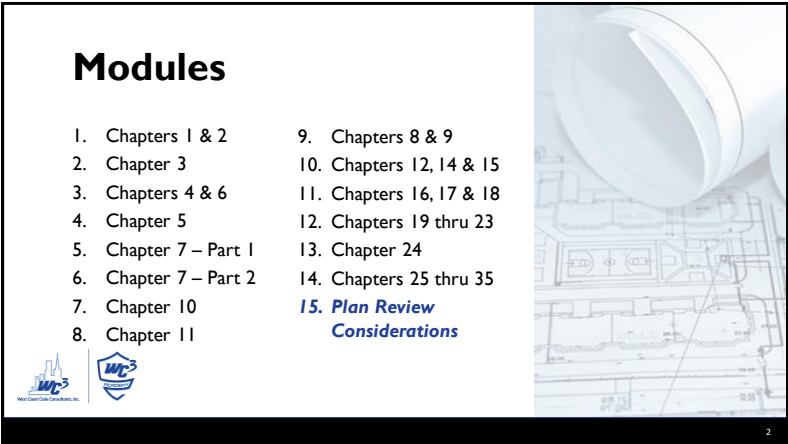
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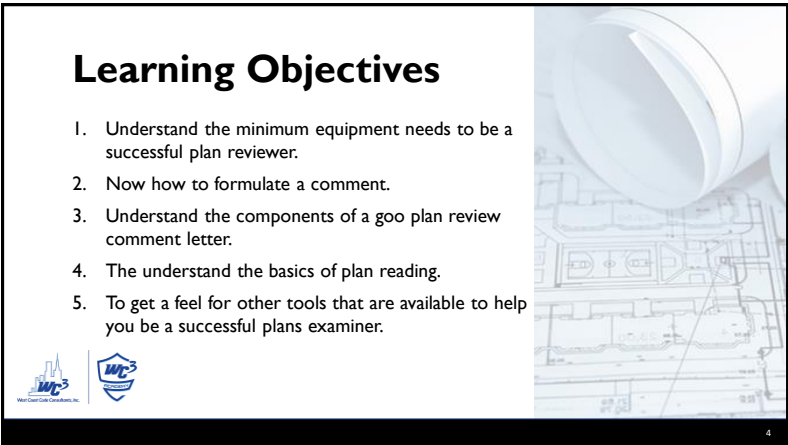
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3



4






Time, Space, & Equipment




5

Time, Space, & Equip

- The modules thus far have provided a general overview and can assist for preparing to take an ICC exam.
- Once you have an ICC certification are you prepared to perform a plan review?
- How can you prepare to be successful?








6

Time, Space, & Equip

Manage Your Time

- Allocate time in blocks.
- One 4-hour block is not equivalent to four 1-hour blocks.
- Phone calls can be returned, and emails answered once the block ends.
- May want to establish counter hours.

7

Time, Space, & Equip

Sufficient Space?

- Can you lay out plans and code books as necessary?
- Is there space for large monitors, other equipment, notepads, and code books?





8

Time, Space, & Equip

Equipment

- Large-format Monitors → at least two
- Electronic Codes are Helpful
- PDFViewer → Bluebeam® is the best
- Standing or Sitting → Healthier
- Quality Chair

→ We perform better when we feel good




9

Comment Letters

How to Write






10

Comment Letters

Keep in mind your audience

- Remember that while you will spend a short time on this project, the design team and owners have spent countless hours. Have empathy!
- Avoid making demands and use kind words such as “please” to soften the blow.

11

Comment Letters

The Letter

- Reference the applicant and permit number
- Include received date, and date of comments
- Follow a logical order
- Provide contact information

April 4, 2017 SECOND REVIEW
WCC Project #: 227-149-012
Sparks Project #: SBL217-20238

City of Sparks
Building Division Permit Services
611 Drake Way
Sparks, Nevada 89411
Phone: (775) 353-2213


Attention: Mark Meranda, Chief Building Official
Subject: Gateway Childcare - Plan Review Comments (2nd Review)


Re: Meranda

West Coast Code Consultants has completed the second review of the proposed Gateway Childcare project located in Sparks, NV. This review was based upon the following:

1. Architectural drawings by Pacific West Design/Build Services, LLC, sealed and signed by Donald James Burke, Licensed Architect. An Envelope Compliance Certificate (ECC) was also provided.
2. Civil drawings by Wood Rodgers, Inc. sealed and signed by Dale J. Forbes, Professional Engineer.
3. Structural drawings and calculations by ESI.
4. Mechanical and plumbing drawings by Alexander Scharif & Assoc, sealed and signed by Alexander S Scharif, Professional Engineer.
5. Electrical drawings by McKinnamy Electric, Inc.
6. Geotechnical investigation report (G) by Wood Rodgers, Inc.

© West Coast Code Consultants





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Comment Letters

Key Elements

- Number your comments
- Reference a plan sheet
- Include a code reference
- Write clearly, use spell check, be specific
- Provide direction



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Comment Letters

Example:

The code requires a 3" gap at can lights.

Bad

- I. **Sheet EI:** IRC R302.13 requires a 3" gap to be placed between canned lighting or ceiling fan motors to any combustibile insulation. Please indicate how this is being addressed for the main floor ceiling framing. Provide a note or detail on the plans.

Good!



14

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Comment Letters

Other Considerations:

- Does your plan review ignore the experience level of your inspector(s)? (*Know your inspectors, involve them*)
- Do your plan review comments add value to the project? If so, how?
- Does the cost (*time is money*) of adjusting the plans exceed the cost of making the correction in the field if missed?
- Are you enforcing this in the field? If not, you might be wasting your time.
- More comments **does not** = higher quality



15

15

Comment Letters

Other Considerations:

- "Reviewed For Code Compliance" certifies that the plans were reviewed, not that they fully comply with the code.
- Our authority to enforce the code is never weakened due to plan review acceptance.
- Plans examiners and inspectors must communicate regularly.
- The same plan review comment on 100 plans, may easily be eliminated with one staff meeting.
- You should establish as a department what is important.






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Comment Letters

Signs of a Good Review

- Minimal phone calls and emails asking for clarification
- Responses resolve the original comments
- Over time, submittals from regular applicants get cleaner.
- Can a different reviewer perform the re-check easily and quickly?


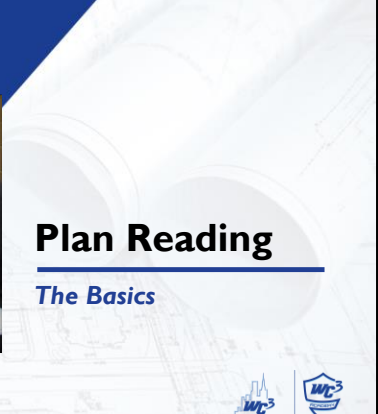





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Plan Reading

The Basics









18

18

Plan Reading

- **Plan View:** View from above w/ x-ray vision
- **Elevation:** Side view from the ground
- **Section:** Cut through the building
- **Detail:** Specific assembly instructions, with notes
- **Symbols/Legends:** Shapes and line combinations with meaning
- **General Notes:** Where most information is hidden

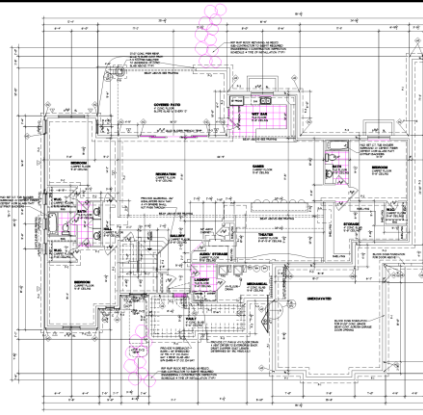




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Plan View

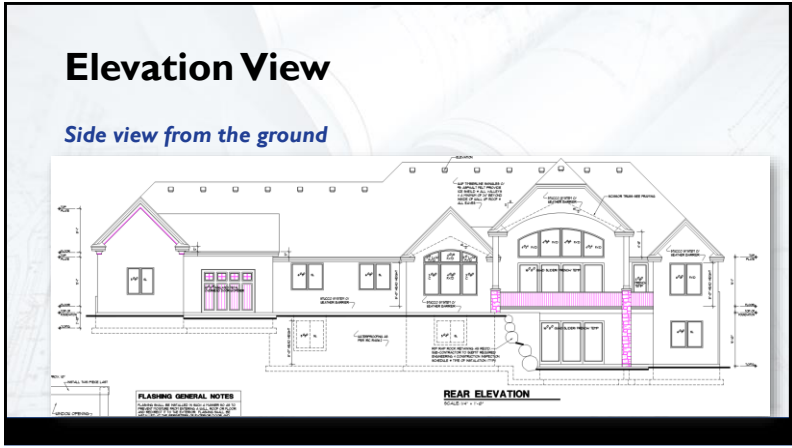
View from above w/ x-ray vision



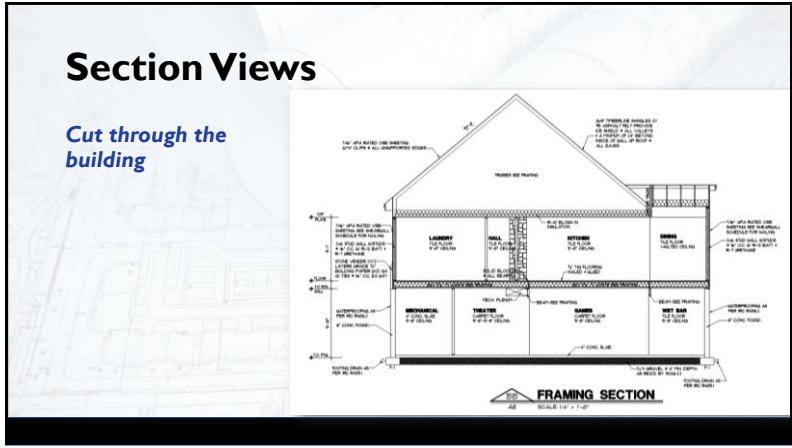
LOWER LEVEL FLOOR PLAN & FOOTING/ FOUNDATION

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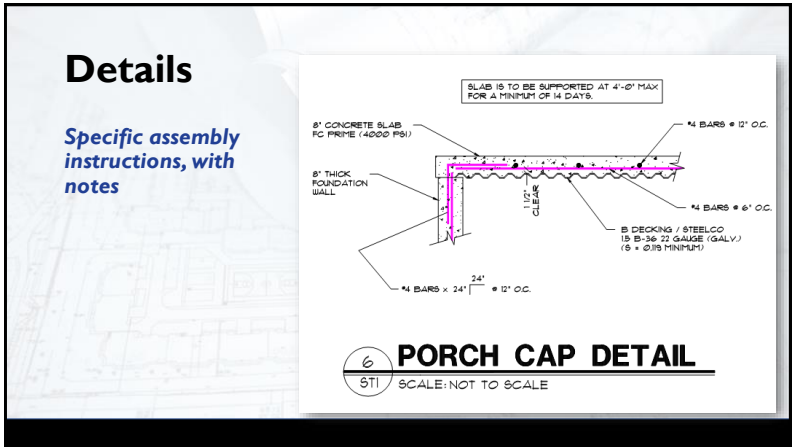
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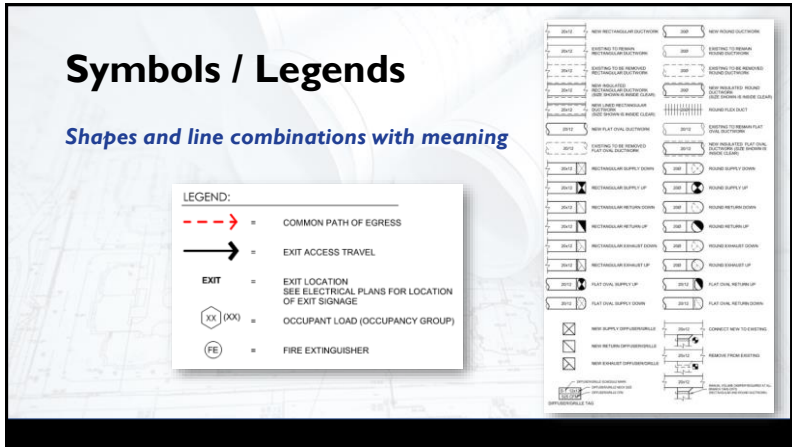
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24

General Notes

Where most information is hidden

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Typical Layout

1. General (G) – Cover, general notes, life safety, accessibility
2. Civil (C) – Site plan, grading, drainage, utilities
3. Landscape (L) – Vegetation, irrigation, hardscape, details
4. Architectural (A) – Plan views, elevations, sections, details
5. Structural (S) – General notes, plan views, elevations, details
6. Mechanical (M) – General notes, schedules, plan views, details
7. Plumbing (P) – General notes, calculations, plan views, details
8. Electrical (E) – General notes, energy compliance, plan views, details

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Other Tools

Mentors, Checklists, CEUs, ICC Chapters

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Other Tools

Mentors

- Find a mentor, within your jurisdiction or without
- Job shadow other plan reviewers from time to time
- Self Evaluations, or Formal Evaluations
- Don't Plateau – Most reviewers only get "good enough"
- Consider rotations with inspectors

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Other Tools

Checklists

- Is it okay to use?
- ICC & jurisdictions have numerous sample checklists
- They help to ensure something was not missed
- Outlines serve as a guide and are better than a checklist

Code Outline Checklist

I. Chapter 1 - Scope A. Site Plan (107.2.5) B. Egress Plans (107.2.3) C. Deferred Submittal (107.3.4.1) D. Code Analysis (Ch. 3, 5, 6, 10) E. Supporting documents (107.1) 1. (Calculations, Geotech report, COMchecks, etc.)	F. Emergency Escape and rescue (1029) G. Doors (1008) 1. Door Swing (1008.1.2) 2. Locks (1008.1.9.3) H. Stairs (1009) I. Ramps (1010) J. Exit signs (1011) 1. Tactile Exit signs (1011.4) K. Handrails (1012) L. Guards (1013) 1. Roof Top Guards (1013.2) 2. Operable Windows (1013.4)
II. Chapter 3 - Use Groups A. Verify Use Groups B. Small Assembly Areas (303.1.2) C. Hazardous materials in Factories or Storage (Table 307.1(1), 307.1(2))	VII. Chapter 11 - Accessibility A. Site Accessibility 1. Parking (1106.1) 2. Loading Zones (1106.7) 3. Site route/entry (1105) B. Accessible Route (1104) 1. Doors 2. Elevators C. Assembly Seating (1108.2) D. Dwelling Units (1107) E. Bathrooms (1109)
III. Chapter 4 - Special Uses A. See if any of these Sections apply. 1. Atriums are defined by architect a) if Atrium is defined check all existing requirements!	
IV. Chapter 5 - Allowable Height and area A. Address identification (501.2) B. Height and area analysis (503)	

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Other Tools

CEU's - Be Selective!

- Three-year renewal period
- Options:
 - On-site student or instructor
 - eLearning
 - Participation in ICC development hearings
 - Participation in ICC technical session
 - New ICC certification
 - Code-related accredited academic course
 - Formal in-house training
 - Service on ICC Chapter or Board
 - Publication of paper, book, or article

Number of Certifications Being Renewed	Total Number of CEUs Required	Min. Number of CEUs Required Through ICC or PPN Training (50% of total)
1	1.5	0.8
2 through 5	3	1.5
6 through 10	4.5	2.3
11 or more	6	3.0
MCP, CBO, CFM	6	3.0

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Other Tools

ICC Chapters

- Nearly 400 chapters around the world
- Code officials and industry professionals
- Provide training
- Assist in code-development process
- Local legislation & industry issues
- Networking & employment resources



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END OF MODULE 15

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Module 1 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Which of the following is not included in the scope of the IBC?	IBC 101.2	IBC 101	2	Restaurant Alteration	One-Family Dwelling	Building Relocation	Structural Repair
Which of the following is exempt from requiring a permit?	IBC 105.2	IBC 105	4	5-foot Retaining Wall	6-foot High Racking	New Water Heater	120 ft² Shed
Which of the following is not required to be on the Certificate of Occupancy?	IBC 111.2	IBC 111	1	Date Issued	Name of B.O.	Code Edition	Building Address
Which of the following requires a permit?	IBC 105.2	IBC 105	3	120ft² Detached Garage	Electrical Substation	Fixed Heating/Cooling Appliance	Portable Heating/Cooling Appliance
A permit for a temporary structure is limited as to time of service, but shall not be allowed for more than _____ days.	IBC 108.1	IBC 108	4	30	60	90	180
Inspection reports shall be retained in the official records for what minimum period?	IBC 104.7	IBC 104	3	Until after the C.O. is issued.	180 days after the report is issued.	The time required for the retention of public records.	180 days after the certificate of occupancy is issued.
Which of the following is not defined by the IBC?	IBC 202	IBC 202	2	Factory-built chimney	Double-wall chimney	Masonry chimney	Metal chimney
Which of the following is a Designated Seismic System?	IBC 202	IBC 202	3	Steel moment frame	Wood shear wall	Nonstructural components with $I_p > 1.0$	Masonry wall
The purpose of this code is to establish the _____ requirements to safeguard the public health, safety and general welfare.	IBC 101.3	IBC 101	1	minimum	most strict	most restrictive	common
It shall be the duty of the _____ to provide access to and means for inspections.	IBC 110.5	IBC 110	4	building official	building inspector	plans examiner	permit holder

Module 2 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Which primary occupancy classification pertains to a McDonald's Restaurant?	IBC 303.3	IBC 303	3	Group M	Group A-1	Group A-2	Group B
A motion picture theater is an example of a Group _____ occupancy.	IBC 303.2	IBC 303	4	A-4	A-3	A-2	A-1
An area housing 25 pounds of an organic peroxide shall have what occupancy classification?	IBC Table 307.1(1)	IBC 307	4	Group F-1	Group F-2	Group H-2	Group H-3
Buildings that contain materials that pose a detonation hazard shall be classified as Group _____.	IBC 307.3	IBC 307	2	H-2	H-1	F-1	F-2
Which of the following is not one of the occupancy classifications?	IBC 302.1	IBC 302	3	B - Business	H - High Hazard	C - Commercial	R - Residential
Places of religious worship and bowling alleys are examples of Group _____ occupancies.	IBC 303.4	IBC 303	1	A-3	B	A-1	M
Which occupancy classification pertains to a portion of the building providing day care services for a total of 6 care recipients?	IBC 305.2	IBC 305	3	Group B	Group M	Group E	Same as primary occupancy
A food processing establishment not associated with dining facilities is considered a Group B occupancy where not more than _____ square feet in area.	IBC 304.1	IBC 304	2	1,500	2,500	2,000	3,000
Which occupancy classification will a building containing multiple smoke compartments, occupants are under restraint, and egress is impeded by locks to the exterior?	IBC 308.4.2	IBC 308	2	Group I-3 Condition 5	Group I-3 Condition 2	Group I-3 Condition 3	Group I-3 Condition 4
Which primary occupancy classification pertains to a dance studio having a total occupant load of 45?	IBC 303.1.2	IBC 303	1	Group B	Group A-1	Group A-3	Group M

Module 3 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
In a high-rise building, every required interior exit stairway serving floors more than 75 feet above the lowest level of the fire department vehicle access shall be a _____.	IBC 403.5.4	IBC 403	4	smoke damper	tamper-resistant access	soundproof enclosure	smokeproof enclosure
Interior bearing walls are to be 2 hour rated in which of the following construction types?	IBC Table 601	IBC 601	1	Type I-B	Type III-A	Type III-B	Type IV
In a building with a 4-story atrium, the following separation is permitted between the atrium and the adjacent spaces:	IBC 404.6	IBC 404	2	A non-rated wall	¼ hour rated glass block wall	A 1-hour rated smoke barrier	A smoke partition
A heavy timber solid-sawn wood beam or girder supporting floor framing shall have a minimum dimension of not less than:	IBC 602.4.4	IBC 602	2	5 inches wide by 8 ¼ inches deep	6 inches wide by 10 inches deep	8 inches wide by 8 inches deep	2 inches wide by 10 inches deep
In a covered mall building, the wall between the mall and the tenant space is:	IBC 402.4.2	IBC 402	3	A 1-hour rate fire barrier	A 1-hour rated fire partition	Not required to be fire rated	A 2-hour rated fire barrier
An open parking garage is not permitted to be constructed of which type of construction:	IBC 406.5.1	IBC 406	4	Type I	Type II	Type IV	Type V
Which of the following combustible materials are not permitted in Type I or Type II construction?	IBC 603.1 Item 1.3	IBC 603	1	3 hour rated nonbearing partitions	Roofs of fire retardant treated wood with a vertical distance of 25 feet	Doors, door frames, window frames	Heavy timber construction
In Group I-2 occupancies, which of the following areas is not permitted to be open to the corridor?	IBC 407.2.5	IBC 407	2	Waiting and similar areas	Resident sleeping areas	Care providers' stations	Gift shops
What fire-resistance rating is required for the structural columns of a two-story building of Type I-B construction?	IBC Table 601	IBC 601	3	1 hour	1 1/2 hours	2 hours	3 hours
When a tenant space in an open or covered mall building has an occupant load of _____ or more, not less than two means of egress shall be provided.	IBC 402.8.3	IBC 402	1	50	60	40	75

Module 4 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
For the frontage of a building, the width of public way or open space is limited to _____ feet maximum.	IBC 506.3	IBC 506	4	40	25	20	30
The means of egress for mezzanines shall comply with the applicable provisions of which chapter?	IBC 505.2.2	IBC 505	2	Chapter 9	Chapter 10	Chapter 7	Chapter 5
Towers, spires and steeples made of combustible materials shall not exceed _____ feet above the allowable building height.	IBC 504.3	IBC 504	2	15	20	30	25
Which of the following areas is not considered an incidental use?	IBC Table 509	IBC 509	3	Patient rooms with padded surfaces	Laundry rooms 90 square feet	Equipment over 300,000 BTU/hour	Boilers over 15psi and 10 horsepower
Incidental uses shall not occupy more than _____ of the building area of the story in which they are located.	IBC 509.3	IBC 509	4	25%	20%	15%	10%
Buildings separated with fire walls are only considered separate buildings in relation to all of the following except:	IBC 503.1	IBC 503	3	area limitations	height limitations	occupancy	type of construction
A building containing a Use Group M and an A-2 is designed as separated occupancies. The building is provided with NFPA 13 Automatic Fire Sprinklers. What is the minimum fire rating required for the separation of these uses?	IBC Table 506.2	IBC 506	2	No Separation Required	1 Hour	2 Hour	Not permitted
A R-1 Building is permitted to be 6 stories in height when which of the following conditions is met?	IBC 510.5	IBC 510	4	Type II-A, 70 foot separation, exits separated by 3-hour construction.	Type II-A, 50 foot separation, exits separated by 2-hour construction.	Type III-A, floor assembly is 2 hours, floor area is subdivided by 3 hour construction into 3,000 sq ft	Type III-A, floor assembly is 3 hours, floor area is subdivided by 2 hour construction into 3,000 sq ft
A Use Group R-1 of Type V-B construction is provided with NFPA 13R sprinklers. What is tabular allowable area with no increase due to frontage?	IBC 510.5	IBC 510	1	7,000 Square Feet	12,000 Square Feet	21,000 Square Feet	28,000 Square Feet
In a building of Type II construction for special industrial use, the aggregate area of mezzanines is limited to what floor area?	IBC 505.3.1	IBC 505	3	1/3 of the room	1/2 of the room	2/3 of the room	No Limit

Module 5 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What type of fire-rated assembly is used to separate mixed occupancies?	IBC 707.3.9	IBC 707	2	Fire Walls	Fire Barriers	Fire Partitions	Smoke Barriers
What type of fire-rated assembly is used to create separate buildings?	IBC 706.1	IBC 706	1	Fire Walls	Fire Barriers	Fire Partitions	Smoke Barriers
What percentage of unprotected openings are allowed at the exterior wall of an A-2 sprinklered building that is 17-feet from the property line?	IBC Table 705.8	IBC 705	4	Not Permitted	25%	45%	75%
When is an exterior wall required to be rated from both the outside and the inside?	IBC 705.5	IBC 705	3	Never	≤ 20-feet from property line	≤ 10-feet from property line	Always
A projection along the exterior wall of an office building that is 9-feet from the property line, must maintain a distance of at least _____ from the property line.	IBC Table 705.2	IBC 705	3	not permitted	24 inches	72 inches	40 inches
How high should a parapet for a fire-rated exterior wall project above the roof surface?	IBC 705.11.1	IBC 705	4	Not required	18 inches	24 inches	30 inches
What fire-resistance rating is required for a fire wall separating an F-1 and a B occupancy?	IBC Table 706.4	IBC 706	1	3 hours	4 hours	2 hours	1 hour
What does SFRM stand for?	IBC 704.13	IBC 704	2	Smoke and flame resistant materials	Sprayed fire-resistant materials	Smoke and flame retardant minerals	Spray foam resistant material
Each opening through a fire wall shall be protected in accordance with Section 716 and shall not exceed _____ square feet.	IBC 706.8	IBC 706	3	160	204	156	185
Unless required elsewhere in the code, _____ partitions are not required to have a fire-resistance rating.	IBC 710.3	IBC 710	3	barrier	flame	smoke	drywall

Module 6 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What prescriptive fire-resistance rating is allowed for an interior wood partition of 2x4 studs at 16" o.c. and 2 layers 1/2" gypsum wall board on each side?	IBC Table 721.1(2) Item 14-1.2	IBC 721	1	1 hour	2 hours	3 hours	No rating
What minimum fire-rating is required for a fire door located within a 1-hour smoke barrier?	IBC Table 716.1(2)	IBC 716	4	1 hour	45 minutes	30 minutes	20 minutes
In other than R occupancies, draftstopping shall be installed to subdivide combustible floor/ceiling assemblies so that horizontal floor areas do not exceed _____ square feet.	IBC 718.3	IBC 718	3	800	1,200	1,000	1,400
Which of the following materials is not approved for fireblocking?	IBC 718.2.1	IBC 718.2	3	2" nominal lumber	1/2" gypsum board	1/2" wood structural sheathing	Mineral wool
A horizontal assembly is not required to be supported by fire rated construction in all of the following instances except _____.	IBC 711.2.3	IBC 711	3	Dwelling Units in Type II-B	Incidental Uses in Type V-B	Smoke barrier in Type II-A	Smoke Barrier in Type III-B
Shaft enclosures shall have a fire-resistance rating of not less than 2 hours where connecting _____ stories or more.	IBC 713.4	IBC 713	4	one (1)	two (2)	three (3)	four (4)
Fire doors shall be _____ - or _____ - closing.	IBC 716.2.6.1	IBC 716	2	solid, safe	self, automatic	spring, solid	spring, self
For fire-resistance purposes, _____ inch of unsanded gypsum plaster shall be deemed equivalent to 3/4 inch of one-to-three gypsum sand plaster or 1 inch of Portland cement sand plaster.	IBC 719.2	IBC 719	1	one-half	1	one-third	one-fourth
Unfaced fiberglass batt insulation used as fireblocking shall fill the entire cross section of the wall cavity to a minimum height of _____ inches measured vertically.	IBC 718.2.1.2	IBC 718	1	16	18	12	24
What minimum fire-rating is required for a fire window assembly within a 2-hour fire-resistance rated exterior wall?	IBC Table 716.1(3)	IBC 716	2	2 hours	1.5 hours	1 hour	45 minutes

Module 7 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Emergency escape and rescue openings shall have a minimum net clear opening height of ____ inches and a minimum net clear opening width of ____ inches.	IBC 1031.3.2	IBC 1031	3	20, 44	24, 48	24, 20	20, 26
Which of the following items is not considered an exit component?	IBC 202	IBC 202	2	Interior Exit Stair	Occupant Evacuation Elevator	Exterior Exit Ramp	Exit Passageway
What is the minimum ceiling height for the means of egress of a building?	IBC 1003.2	IBC 1003	3	8'-0"	7'-0"	7'-6"	6'-8"
The maximum riser height for exterior stairs serving multiple units of an apartment complex is _____.	IBC 1011.5.2	IBC 1011	2	7 3/4"	7"	6"	8"
What is the maximum running slope of a pedestrian ramp which is not part of the means of egress?	IBC 1012.2	IBC 1012	4	1:12 (8%)	1:20 (5%)	1:48 (2%)	1:8 (12.5%)
What is the minimum fire separation distance required from the edge of an exterior exit stair to a property line?	IBC 1027.5	IBC 1027	2	5-feet	10-feet	15-feet	30-feet
What is the maximum permitted exit access travel distance for a A-2 sprinklered building?	IBC Table 1017.2	IBC 1017	2	200-feet	250-feet	300-feet	400-feet
When sizing an egress elements, a sizing factor of 0.15 is permitted when:	IBC 1005.3.2 Exception 1	IBC 1005	1	the building is sprinklered and provided with an emergency voice alarm system	the building is sprinklered and provided with a fire alarm system	the building is sprinklered	the value of 0.15 is always permitted to be used
What is the maximum exit separation required for a non-sprinklered building?	IBC 1007.1.1	IBC 1007	2	1/4 diagonal distance	1/2 diagonal distance	1/3 diagonal distance	
What is the maximum door speed of a power operated revolving door with a diameter of 11-0?	IBC Table 1010.3.1 (2)	IBC 1010	4	7.2 RPM	6.4 RPM	5.7 RPM	5.2 RPM
What is the maximum common path of egress travel for a non-sprinklered, S-1 use group?	IBC Table 1006.2.1	IBC 1006	1	75-feet	100-feet	125-feet	
What are the capacity requirements for a refuge area for a horizontal exit?	IBC 1026.4	IBC 1026	2	2-feet per occupant	3-feet per occupant	4-feet per occupant	5-feet per occupant

Module 8 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Each assembly area required to comply with Section 1109.2.7 shall provide a sign notifying patrons of the availability of _____.	IBC 1112.4 Item 1	IBC 1112	4	accessible restrooms	accessible seating	wheelchair spaces	assistive listening systems
An ambulatory stall shall be provided in a bathroom that has _____ water closets and urinals total?	IBC 1110.2.4	IBC 1110	1	6	5	3	4
Where the total number of parking spaces provided is ____ or less, identification of accessible parking spaces is not required.	IBC 1112.1 Exception 1	IBC 1112	2	3	4	5	6
One out of how many accessible parking stalls is required to be van accessible?	IBC 1106.6	IBC 1106	3	2	4	6	8
In a multistory building an accessible route is required to be provided to a story for which of the following conditions:	IBC 1104.4	IBC 1104	2	the cab of an air traffic control tower	mezzanines with health care offices	the second story of a building with only 5 occupants	a story not containing accessible elements
A movie theater with 250 fixed seats shall have _____ accessible wheelchair spaces.	IBC Table 1109.2.2.1	IBC 1109	2	4	5	6	7
In an R-2 apartment house or monastery, how many units or dwelling units can be provided before a Type A unit is required?	IBC 1108.6.2.2.1	IBC 1108	3	10	15	20	Type A units are always required
An accessible route shall not be required to pass boxes in bleachers that have a single point of entry from the bleachers, provided that the aggregate area of all press boxes for each playing field is not more than _____ square feet.	IBC 1104.3.2 Exception 1	IBC 1104	3	300	400	500	600
Work areas that are less than _____ square feet in area and located _____ inches or more above or below the ground or finished floor where the change in elevation is essential to the function of the space shall be exempt from all requirements.	IBC 1103.2.2	IBC 1103	2	300, 6	300, 7	250, 7	250, 6
Which of the following recreational facilities is not required to be accessible?	IBC 1111.4.5	IBC 1111	2	Swimming Pools	Raised boxing rings	Shooting facilities	Miniature Golf Courses

Module 9 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
How many rooms in an 85-room hotel are required to have visible notification appliances?	IBC Table 907.5.2.3.2	IBC 907	3	4	7	9	12
Interior floor-wall base that is 6 inches or less in height shall be not less than _____.	IBC 806.8	IBC 806	2	Class I	Class II	Class III	Class IV
Which of the following does not require a standpipe connection be provided?	IBC 905.3.2	IBC 905	1	Group A having 600 occupants	1,200 sq. ft. Stage	Hospital rooftop helipad	Boat docks
Portable fire extinguishers shall be installed within _____ distance of travel from domestic cooking equipment in R-2 college dormitory	IBC 906.1 Item 2	IBC 906	3	10 feet	15 feet	30 feet	35 feet
Which of the following exceeds the allowable amount of combustible decorative materials and trim?	IBC 806.2 and 806.7	IBC 806	2	10% wood trim in sprinklered R-1	18% draperies in sprinklered Group I-3	60% fabric hangings in sprinklered Group A auditorium	30% fabric partition in sprinklered Group B
What class of interior finish is required for the interior exit ramps of a nonsprinklered B occupancy?	IBC Table 803.13	IBC 803	1	Class A	Class B	Class C	None
Which of the following requires fire sprinkler protection?	IBC 903.2.9	IBC 903	4	Group A-4: Having 250 occupants	Group F-1: 2,400 sq. ft. of wood-working operations	Group M: 10,000 sq. ft. on the 2nd floor	Group S-1: 9,000 sq. ft. two-story repair garage
What class of interior finish is required for an enclosed space within a three-story H-occupancy that is sprinklered?	IBC Table 803.13 Footnote g	IBC 803	2	Class A	Class B	Class C	None
Which of the following occupancies does not require the building to be sprinklered?	IBC 903.2.1.1	IBC 903	4	High-piled storage	E, 2-stories, 150 occupants, 12,000 sq. ft.	F-1, 1-story, 75 occupants, 14,000 sq. ft.	A-1, 1-story, 200 occupants, 10,000 sq. ft.
In which of the following cases is combustible material not allowed in the floors of a building of Type I or II construction?	IBC 805.1.1 and 805.1.2	IBC 805	4	Space is solidly filled with mineral wool	Space is fireblocked	Cemented directly to top of rated floor	5/8-inch insulating boards attached noncombustible floor

Module 10 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What minimum thickness of natural stone is required to meet the weather protection requirements for an exterior wall?	IBC Table 1404.2	IBC 1404	3	.25 inches	1.5 inches	2 inches	There is no minimum thickness.
What is the minimum required ventilation for a 40-foot by 20-foot enclosed attic space?	IBC 1202.2.1	IBC 1202	2	1,066 square inches	768 square inches	800 square inches	576 square inches
What is the required access opening into a crawl space through a foundation wall?	IBC 1209.1	IBC 1209	2	16" x 24"	18" x 24"	20" x 30"	22" x 30"
How much natural ventilation is required for a room that is 25-feet by 15-feet?	IBC 1202.5.1	IBC 1202	3	30 square feet	56 square feet	15 square feet	19 square feet
Urinal partitions shall have a minimum height of _____ and start within _____ of the floor.	IBC 1210.3.2	IBC 1210	4	4 feet, 18 inches	5 feet, 18 inches	4 feet, 12 inches	5 feet, 12 inches
What class of roof covering is required for a Group R-3 occupancy having a fire separation distance of 10-feet?	IBC Table 1505.1 footnote b	IBC 1505	4	Class A	Class B	Class C	Nonclassified
Which of the following uses is not allowed for a rooftop penthouse?	IBC 1511.2.2	IBC 1511	4	mechanical equipment	vertical shaft openings	tanks	plumbing equipment
Which of the following types of fasteners are not allowed for the attachment of asphalt shingles?	IBC 1507.2.5	IBC 1507	1	nickel	stainless steel	aluminum	galvanized
How shall clay roof tiles weighing 8psf be fastened where the nominal wind speed is 90mph, the mean roof height is 35-feet and the roof slope is 4:12?	IBC Table 1507.3.7	IBC 1507	2	one fastener per tile	two fasteners per tile	fasteners are not required	the head of all tiles shall be nailed
Which of the following Climate Zones requires a Class III vapor retarder where vented cladding is used over wood structural panels?	IBC Table 1404.4(3)	IBC 1404	3	Zone 1	Zone 3	Zone 5	Zone 7

Module 11 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the required reinforcement for an 8'-0" tall, 7.5" thick concrete foundation wall supporting a 7-foot backfill with a soil load of 45 psf?	IBC Table 1807.1.6.2	IBC 1807	3	#5 bars at 48"	#4 bars at 39"	#5 bars at 41"	#6 bars at 48"
A partition load, where applicable, shall not be less than a uniformly distributed live load of ____?	IBC 1607.5	IBC 1607	3	5 psf	10 psf	15 psf	20 psf
What is the minimum required distance from a descending slope from the bottom of the foundation?	IBC Figure 1808.7.1	IBC 1808	1	40 feet	15 feet	25 feet	35 feet
A subsurface soil investigation shall be performed to determine whether the existing ground-water table is above or within _____ below the elevation of the lowest floor level.	IBC 1803.5.4	IBC 1803	3	2 feet	3 feet	5 feet	10 feet
The statement of special inspections shall include all of the following except:	IBC 1704.3.1	IBC 1704	2	The type and extent of each special inspection.	Additional requirements for special inspects for soil conditions and/or liquefaction.	The materials, and work required to have special inspections.	Identification of how often special inspections shall be performed.
What is the deflection limit for exterior walls with flexible finishes?	IBC Table 1604.3	IBC 1604	1	l/120	l/240	l/360	l/180
Erection of mass timber construction shall be inspected _____.	IBC Table 1705.5.3	IBC 1705	2	continuous	periodic	in accordance with the notation used in the reference standard	
L _r is the notation for _____.	IBC 1602.1	IBC Chapter 16	2	live load	roof live load	rain load	rain live load
The structural supports of roofs shall be designed to resist:	IBC 1607.14	IBC 1607	4	the dead load of construction and live loads	snow and earthquake loads	wind loads	all of the above
Which of the following items shall be included in a Geotechnical Report?	IBC 1803.6	IBC 1803	2	Slope instability	Water table elevation	Site preparation	Liquefaction study

Module 12 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
The thickness of concrete floor slabs supported directly on the ground shall not be less than ____ inches.	IBC 1907.1	IBC 1907	2	3	3 1/2	4	4 1/2
Cleanout openings shall be provided within ____ inches of the base of each flue within a masonry chimney.	IBC 2113.18	IBC 2113	4	2	3	4	6
Footings for masonry fireplaces and their chimneys shall be constructed of concrete or solid masonry at least ____ inches thick.	IBC 2113.2	IBC 2113	4	6	8	10	12
What is the maximum span of a 2x8 Douglas-fir Larch #2 rafter spaced at 12" with a ground snow load of 30 psf, ceiling attached, and 20 psf dead load?	IBC Table 2308.7.2(5)	IBC 2310	3	17'-5"	13'-6"	15'-7"	18'-2"
What is the minimum height that a chimney must extend above the highest point that it penetrates the roof?	IBC 2113.9	IBC 2113	3	2 feet	10 feet	3 feet	4 feet
What is the maximum spacing of braced wall lines of the second floor of a three-story building in Seismic Design Category B?	IBC Table 2308.6.1	IBC 2309	3	12 feet 6 inches	25 feet	35 feet	40 feet
What is the maximum spacing of 1/2" diameter anchor bolts?	IBC 2308.3.1	IBC 2308	4	2 feet	3 feet	4 feet	6 feet
What is the minimum thickness of masonry wythes installed between two flues?	IBC 2113.14	IBC 2113	3	2 inches	3 inches	4 inches	6 inches
What is the maximum span of a Douglas-fir Larch header of (2) 2x10's in an interior wall supporting two floors of a 24-foot wide structure?	IBC Table 2308.4.1.1(2)	IBC 2308	3	6'-6"	5'-3"	4'-4"	3'-7"
What is the maximum span of a Douglas-fir Larch header of 3-2x8's in an exterior bearing wall, supporting a roof, ceiling, and one center-bearing floor, for a 28-foot wide structure with a Ground Snow Load of 30 psf?	IBC Table 2308.4.1.1(1)	IBC 2308	2	4'-5"	5'-1"	5'-6"	6'-0"

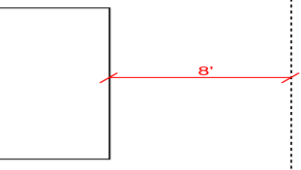
Module 13 Quiz Questions

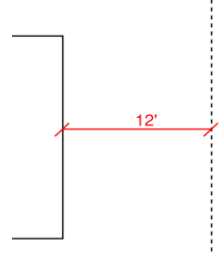
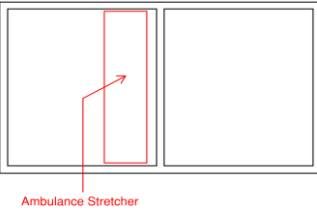
Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Glass handrails and guards shall be designed using a factor of safety of ____.	IBC 2407.1.1	IBC 2407	3	2	3	4	5
When glass balusters are used in a guard, there shall be no fewer than ____ glass balusters supporting the top rail or handrail.	IBC 2407.1.2	IBC 2407	2	2	3	4	5
Glass in glass elevator doors shall be not less than ____ of the visible door panel.	IBC 2409.2.2	IBC 2409	1	60%	70%	45%	55%
True or False: Tempered spandrel glass shall be provided with a permanent marking by the manufacturer.	IBC 2403.1	IBC 2403	2	TRUE	FALSE		
Which of the following conditions requires safety glazing?	IBC 2406.4.6, 2406.4.1 exceptions, 2406.4.7	IBC 2406	3	A stained glass window in a door.	Curved glazed panels in revolving doors.	A window 32" above stair tread.	A window 60 inches from the bottom stairway landing.
For which of the following scenarios is safety glazing not required?	IBC 2406.4.5	IBC 2406	4	A window with a sill height of 48" that is located in a wall, facing a pool, that is 60" away horizontally from a pool.	A window in a wall containing a shower that has a sill height of 36" and is located 60" from the edge of the shower.	A window above a bath tub, with a sill height of 48".	A window with a sill height of 60" that is located in a wall, facing a hot tub, that is 48" horizontally away from the hot tub.
Glazing shall comply with the test criteria for _____ unless otherwise indicated.	IBC 2406.2	IBC 2406	2	Category I	Category II	Category III	Category IV
Which of the following does not apply to louvered windows?	IBC 2403.5	IBC 2403	1	wired glass with wire exposed	no thinner than 3/16"	no longer than 48 inches	exposed edges shall be smooth
What is required for skylights set an angle of < 45°?	IBC 2405.4	IBC 2405	3	Installed per Manufacturer's instructions.	Requires screening 4 inches below glazing.	Mounted on a curb 4 inches above roof.	May be mounted directly to roof surface.
True or False: Fire Department glass access panels shall be tempered.	IBC 2406.5	IBC 2406	1	TRUE	FALSE		

Module 14 Quiz Questions

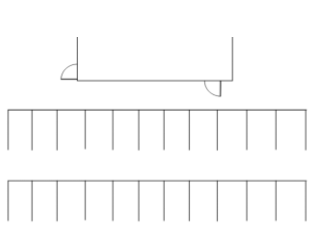
Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
"Temporary structures" applies to structures that are erected for a period of less than _____ days.	IBC 3103.1	IBC Chapter 31	2	90	180	270	360
What is the maximum flame spread index allowed for interior plastic and trim?	IBC 2604.2.4	IBC 2604	4	25	450	200	75
How many coats of exterior plaster are required when applied over masonry walls?	IBC 2512.1	IBC 2512	2	1 coat	2 coats	3 coats	4 coats
Exterior plaster shall only be applied when ambient temperature is above _____ and protected from freezing for a period of _____.	IBC 2512.4	IBC 2512	3	32 degrees F, 24 hours	32 degrees F, 48 hours	40 degrees F, 24 hours	40 degrees F, 48 hours
Weep screeds shall be installed in exterior plaster systems a minimum of _____ above the earth.	IBC 2512.1.2	IBC 2512	2	2 inches	4 inches	6 inches	8 inches
What is the maximum area for a skylight having plastic glazing?	IBC 2610.4	IBC 2610	1	100 square feet	75 square feet	200 square feet	50 square feet
Which ASTM standard is applicable to elastomeric joint sealants used for gypsum applications?	IBC Table 2506.2	IBC 2506	4	ASTM C1047	ASTM C474	ASTM C1278	ASTM C920
Which of the following is not a code-required construction safeguard?	IBC 3302.1, 3305.1, 3306.1	IBC Chapter 33	1	accessibility	fire safety	pedestrian protection	sanitation
Which of the following is not a requirement for elevator machine rooms?	IBC 3005	IBC Chapter 30	2	proper ventilation	standby power	fire barriers	shunt strip
How many separate elevator hoistways are required for a building having six elevator cars?	IBC 3002.2	IBC 3002	2	one	two	three	four

Practice Exam Questions

Question Text	Description	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A building containing a Use Group M and an I-2 is designed as separated occupancies. The building is provided with NFPA-13 Automatic Fire Sprinklers. What is the minimum fire rating required for the separation of these uses?		IBC Table 508.4	IBC 508	3	Not Permitted	2 hours	1 hour	No Separation Required
A cold-form steel truss has a span of 65 feet. Which of the following shall be required to be special inspected?		IBC 1705.2.4	IBC 1705	4	A. Temporary installation of restraint/ bracing	B. Fastener connections	C. Permanent individual truss member restraint/ bracing	A and C
A stand alone commercial kitchen is 1,750 square feet in size. What would the occupancy be for this building?		IBC 304.1	IBC 304	3	F-1	F-2	B	A-2
A cricket or saddle shall be installed on the ridge side of any chimney or penetration greater than ____ inches wide, measured perpendicular to the slope.		IBC 1503.5	IBC 1503	4	16	18	24	30
A deep foundation element is permitted to be spliced. What percentage of bending strength is permitted in the weaker section?		IBC 1810.3.6	IBC 1810	1	50%	45%	40%	35%
A hair salon is shown 8 feet from the property line, the building is of V-B construction. What is the required fire resistance of the wall adjacent to the property line?		IBC Table 705.5	IBC 705	3	No fire resistance required.	If the building has fire sprinklers, no fire resistance required.	1-hour	2-hours
A hole not greater than ____ of the stud is permitted to be bored in conventional light-frame construction.		IBC 2308.5.10	IBC 2308	4	25%	45%	50%	40%
A horizontal assembly is not required to be supported by fire rated construction under which circumstance?		IBC 711.2.3	IBC 711	4	Dwelling Units in Type II-B	Incidental Uses in Type V-B	Smoke Barrier in Type III-B	Smoke barrier in Type II-A
A partition load, where applicable, shall not be less than a uniformly distributed live load of ____ psf.		IBC 1607.5	IBC 1607	3	5 psf	10 psf	15 psf	20 psf
A retail store has an occupant load of 83 occupants. What is the minimum amount of water closets required?		IBC 2902.2 Exception 3	IBC 2902	1	1 water closet	2: 1 water closet for males and 1 water closet for females	3: 1 unisex water closet, 1 water closet for males, and 1 for females	4: 2 water closets for males and 2 water closets for females
A roof area has an area of 4,500 square feet. What is the minimum size for required ventilation?		IBC 1202.2.1	IBC 1202	3	20 square feet	25 square feet	30 square feet	35 square feet
A sign shall be provided with each floor landing in an interior exit stairway and ramp connecting more than three stories designating each ____.		IBC 1023.9	IBC 1023	1	floor level	stairway	exit location	fire department access
A two-story building of light-frame construction is permitted to have footings of ____ wide and ____ thick.		IBC 1809.7	IBC 1809	4	12 inches, 6 inches	18 inches, 8 inches	15 inches, 8 inches	15 inches, 6 inches


Aggregate accessory occupancies shall not occupy more than ____ percent of the floor area of the story in which they are located and shall not exceed the tabular values for the nonsprinklered buildings in Table 506.2 for each such accessory occupancy.		IBC 508.2.3	IBC 508	1	10	15	20	25
An adhered terra cotta siding has been provided. How many inches minimum must it be?		IBC Table 1404.2	IBC 1404	2	0.125	0.25	0.625	0.825
An apartment building is sprinklered with an NFPA 13R system. What is the allowable opening where the exterior wall is within 12 feet from the property line?		IBC Table 705.8	IBC 705	4	75%	45%	25%	15%
An apartment building is five stories in height. What is the required dimension required to accommodate an ambulance stretcher?		IBC 3002.4	IBC 3002	2	20 inches by 96 inches	24 inches by 84 inches	28 inches by 72 inches	32 inches by 60 inches
An art gallery has a fire area with 10,500 square feet, 250 occupants, and is located on the second story. Are fire sprinklers required?		IBC 903.2.1.3	IBC 903	4	No, the fire area is less than 12,000 square feet.	No, the occupant load is less than 300.	No, the fire area is less than 15,000 square feet.	Yes the fire area is located on a floor other than a level of exit discharge.
An automatic sprinkler system is required for Group A-2 occupancies where the occupant load exceeds ____ occupants.		IBC 903.2.1.2	IBC 903	4	50	200	150	100
An electronics store is being constructed. What is the minimum thickness of the concrete slab when supported directly on the ground?		IBC 1907.1	IBC 1907	2	3 inches	3.5 inches	4 inches	4.5 inches
A(n) _____ is an individual, heirs, executors, administrators or assigns, and also includes a firm, partnership, or corporation, its or their successors or assigns, or the agent of any of the aforesaid.		IBC 202	IBC 202	1	person	owner's agent	occupant	registered design professional
An office building shall have a uniformly distributed partition load of ____ psf.		IBC 1607.5	IBC 1607	4	5 psf	10 psf	12 psf	15 psf
An open parking garage with perimeter wall area of 784 square feet total and a standard wall height of 14 feet is required to provide openings in exterior walls with a minimum area of _____?		IBC 406.5.2	IBC 406	1	156.8 square feet	313.6 square feet	317.5 square feet	2,195.2 square feet
Artificial light shall be provided that is adequate to provide an average illumination of ____ footcandles over the area of the room at a height of ____ inches above the floor level.		IBC 1204.3	IBC 1204	1	10, 30	30, 10	20, 20	15, 25
Carports shall be open on at least ____ sides.		IBC 406.3.3	IBC 406	3	four	three	two	one

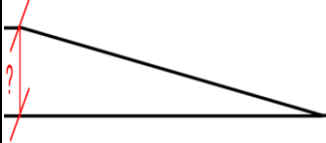
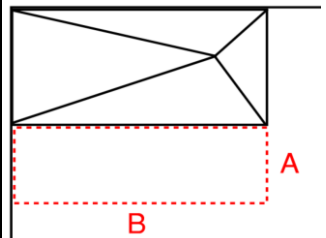
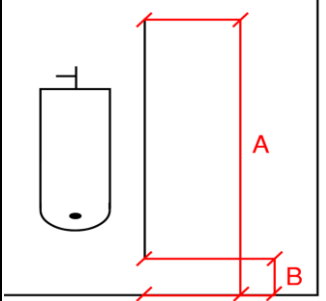
Chimney's shall extend not less than ___ higher than any portion of the building withing 10 feet, but shall be not less than 3 feet above the highest point where the chimney passes through the roof.	IBC 2113.9	IBC 2113	4	10 feet	4 feet	3 feet	2 feet
Cleanout openings shall be provided within ___ inches of the base of each flue within a masonry chimney.	IBC 2113.18	IBC 2113	1	6	4	3	2
Construction documents for structural concrete construction shall include all but which of the following:	IBC 1901.5	IBC 1901	2	The specified strength of reinforcement	The color of concrete	Minimum concrete compressive strength at time of posttensioning	Stressing sequence for posttensioning tendons
Costal A zones within a special flood hazard area, landward of a V zone or landward of an open coast without mapped coastal high-hazard areas. In a costal A zone, the principal source of flooding must be astronomical tides, storm surges, seiches or tsunamis, not riverine flooding. During the base flood conditions the potential for breaking wave height shall be greater than or equal to ___ feet. The inland limit of the coastal A zone is (a) the Limit of Moderate Wave Action if delineated on a FIRM, or (b) designated by the authority having jurisdiction.	IBC 202	IBC 202	2	1	1.5	2	2.5
Crawl spaces shall be provided with a minimum of one access opening not less than _____ inches by _____ inches.	IBC 1209.1	IBC 1209	2	16, 24	18, 24	30, 20	22, 30
Doors handles, pulls, latches, locks and other operating devices on doors required to be accessible by chapter 11 shall not require tight _____, tight _____, or _____ of the wrist to operate.	IBC 1010.2.2	IBC 1010	1	grasping, pinching, twisting	gestures, movements, flexing	grasping, iconic, rolling	pinching, gestures, dislocation
Doors to family or assisted-use toilet and bathroom rooms shall be securable from within the room and provided with a(n) _____ indicator.	IBC 1110.2.1.6	IBC 1110	2	inhabited	occupied	engaged	preserved
Each owner of a covered mall building or of an open mall building shall provide both the building and fire departments with a lease plan showing the location of each _____ and its exits after the certificate of occupancy has been issued.	IBC 402.3	IBC 402	2	tenant space	occupancy	exit corridors	exit access stairways
Every permit issued shall become invalid unless the work on the site authorized by such permit is commenced within _____ days after its issuance.	IBC 105.5	IBC 105	3	90	120	180	365
Exterior plaster has been installed, the required weep screed is installed a minimum of ___ inches above the ground or ___ inches above paved areas.	IBC 2512.1.2	IBC 2512	3	2, 4	4, 3.5	4, 2	3.5, 4

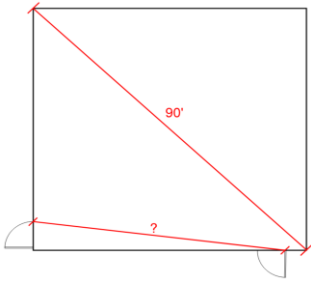
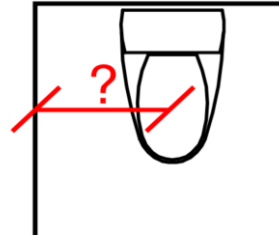

Exterior walls on buildings of Type I, II, III, or IV construction that are greater than ____ feet in height above grade plan and contain a combustible water-resistant barrier shall be tested in accordance with and shall comply with the acceptance criteria of NFPA 285.		IBC 1402.5	IBC 1402	4	100	75	50	40
Fire walls shall be continuous from exterior wall to exterior wall and shall extend at least ____ beyond the exterior surface of exterior walls.		IBC 706.5	IBC 706	2	12 inches	18 inches	24 inches	36 inches
Footings for masonry fireplaces and their chimneys shall be constructed of concrete or solid masonry at least ____ inches thick.		IBC 2113.2	IBC 2113	1	12	6	18	24
For a deck used as a primary means of egress for a type II-B building, which of the following is permitted in the construction of the deck?		IBC 603.1 Item 1.4	IBC 603	3	A. Fire treated wood	B. Pressure treated wood	C. Steel	A and C
For a type IV-C building constructed 35 feet from the property line for a daycare, what is the minimum assigned noncombustible protection time of the exterior walls?		IBC 602.4.3.1	IBC 602	3	0 hours	30 minutes	40 minutes	1 hour
Glass-block assemblies having a fire protection rating not less than ____ hours shall be permitted as opening protectives in accordance with Section 716 in fire barriers, fire partitions, and smoke barriers that have a required fire-resistance rating of 1 hour or less and do not enclose exit stairways and ramps or exit passageways.		IBC 2110.1.1 Exception 1	IBC 2110	2	0.5	0.75	1	1.25
How high should a parapet for a fire-rated exterior wall project above the roof surface?		IBC 705.11.1	IBC 705	1	30 inches	24 inches	18 inches	Not required
How many accessible parking stalls are required for a bank?		IBC Table 1106.2	IBC 1106	1	1	2	3	4
What is the minimum required ventilation for a 30-foot by 20-foot enclosed attic space?		IBC 1202.2.1	IBC 1202	4	1,066 square inches	768 square inches	800 square inches	576 square inches
How much natural ventilation is required for a room that is 20-feet by 15-feet?		IBC 1202.5.1	IBC 1202	4	24 square feet	30 square feet	15 square feet	12 square feet
A projection along the exterior wall of an office building that is 3-feet from the property line, must maintain a distance of at least ____ from the property line.		IBC Table 705.2	IBC 705	2	not permitted	24 inches	36 inches	40 inches
How shall clay roof tiles weighing 8 psf be fastened where the nominal wind speed is 90 mph, the mean roof height is 35-feet, and the roof slope is 4:12?		IBC Table 1507.3.7	IBC Table 1507	3	one fastener per tile	fasteners are not required	two fasteners per tile	

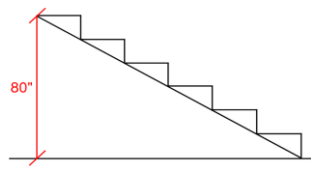
Identification and marking of fire separation walls, if required, shall be located within _____ feet of the end of the wall and at intervals not exceeding _____ feet.		IBC 703.5	IBC 703	1	15, 30	30, 15	15, 15	30, 30
In a building of Type II Construction for special industrial use, the aggregate area of mezzanines is limited to what floor area?		IBC 505.2.1	IBC 505	3	1/3 of the room	1/2 of the room	2/3 of the room	no limit
In a multistory building an accessible route is required to be provided to a story for which of the following conditions?		IBC 1104.4	IBC 1104	3	The cab of an air traffic control tower.	The second story of a building with only 5 occupants.	Mezzanines with health care offices.	A story not containing accessible elements.
In an R-2 apartment house or monastery, how many units or dwelling units can be provided before a Type A unit is required?		IBC 1108.6.2.2 .1	IBC 1108	1	20	15	10	3
In conventional light-frame construction, the maximum span of a 2x6 purlin shall be _____ feet.		IBC 2308.7.7	IBC 2308	3	4	5	6	8
In group A-1 and A-2 occupancies having occupant loads exceeding _____ persons, hose connections shall be located on each side of any stage, on each side of the rear of the auditorium, on each side of the balcony, and on each tier of dressing rooms.		IBC 905.5.1	IBC 905	3	300	750	1,000	1,200
In public parking garages, vehicle barriers, where required, must be a minimum of _____ in height.		IBC 406.4.2	IBC 406	1	33 inches	36 inches	30 inches	32 inches
Incidental uses shall not occupy more than _____ percent of the building area of the story in which they are located.		IBC 509.3	IBC 509	2	5	10	15	25
Inspection reports shall be retained in the official records for what minimum period?		IBC 104.7	IBC 104	2	Until after the C.O. is issued.	The time required for the retention of public records.	180 days after the report is issued.	180 days after the certificate of occupancy is issued.
Interior spaces intended for human occupancy shall be provided with active or passive space heating systems capable of maintaining an indoor temperature of not less than _____ degrees Fahrenheit at a point 3 feet above the floor on the design heating day.		IBC 1203.1	IBC 1203	2	65	68	72	75
Masonry foundation walls shall have a vertical reinforcement minimum yield strength of _____ psi.		IBC 1807.1.6.3	IBC 1807	4	40,000	45,000	50,000	60,000
No fewer than _____ drinking fountains shall be provided. Exceptions ignored.		IBC 1110.5.1	IBC 1110	2	one	two	three	four
Openings in nonbearing partitions are permitted to be framed with single studs and headers. Each end of a lintel or header shall have a bearing length of not less than _____ inches for the full width of the lintel.		IBC 2308.5.5.3	IBC 2308	4	4	3	2.5	1.5
Shower compartments and walls above bathtubs with installed shower heads shall be finished with a smooth, nonabsorbent surface to a height not less than _____ above the drain inlet.		IBC 1210.2.3	IBC 1210	2	48 inches	72 inches	60 inches	96 inches
Stages greater than _____ square feet in area shall be equipped with a Class III wet standpipe system.		IBC 905.3.4	IBC 905	3	120	750	1,000	2,000

Stairways shall have a clear width of _____ inches minimum between handrails. Exceptions ignored.	IBC 1009.3.2	IBC 1009	2	56	48	44	36
Storage racks made of cold-formed or hot-rolled steel members shall comply with which reference standard?	IBC 2209.2	IBC 2209	1	RMI/SNASH MH 16.1	ASCE 7	ANSI/SDI-NCI.0	AISI S214
The aggregate area of a mezzanine or mezzanines within a room shall be not greater than _____ of the floor area of that room or space in which they are located. Exceptions ignored.	IBC 505.2.1	IBC 505	3	one-eighth	one-fourth	one-third	one-half
The aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls, or horizontal assemblies of a building. Areas of the building not provided with surrounding walls shall be included in the fire area if such areas are included within the horizontal projection of the roof or floor next above is a _____.	IBC 202	IBC 202	3	Fire Damper	Fire Command Center	Fire Area	Fire Door
The building official shall carry proper _____ when inspecting structures or premises in the performances of duties under this code.	IBC 104.5	IBC 104	1	identification	tools	personal protective equipment	inspection reports
The emergency power system shall provide power for the duration of not less than _____ and shall consist of storage batteries, unit equipment, or an on-site generator.	IBC 1008.3.4	IBC 1008	4	30 minutes	45 minutes	60 minutes	90 minutes
The ends of beams or girders supported on masonry shall not have less than _____ of bearing.	IBC 2308.4.1	IBC 2308	2	4 inches	3 inches	2 inches	1 1/2 inches
The ends of each joist shall have not less than _____ inches of bearing on wood or metal, or not less than _____ inches on masonry, except where supported on a 1-inch by 4-inch ribbon strip and nailed to the adjoining stud.	IBC 2308.4.2.2	IBC 2308	1	1.5, 3	2, 5	1.5, 2.5	2.5, 3.5
The exit discharge shall provide a direct and unobstructed access to a _____. Exceptions ignored.	IBC 1028.5	IBC 1028	4	street	sidewalk	walking trail	public way
The minimum openable area to the outdoors for natural ventilation of an occupied space shall be _____ percent of the floor area being ventilated.	IBC 1202.5.1	IBC 1202	2	8%	4%	10%	6%
The minimum thickness of an exterior wall in one-story buildings shall be _____.	IBC 2109.2.4.4	IBC 2109	1	10 inches	12 inches	15 inches	20 inches
The permitted thickness of a footing shall be _____ inches for a 2-story, light-frame, R-3 building, given the footing does not extend more than _____ inches on either side of the supported wall.	IBC 1906.1	IBC 1906	1	6, 4	6, 3 1/2	4, 6	4, 3 1/2
The surface of a footing is required to be level. The bottom surface is permitted to slope. The slope of the footing shall not exceed one unit in _____ units.	IBC 1809.3	IBC 1809	3	48	12	10	8
The thickness of concrete floor slabs supported directly on the ground shall not be less than _____ inches.	IBC 1907.1	IBC 1907	4	4 1/2	4	3	3 1/2

The thickness of thin exterior structural glass veneer shall not be less than _____ inches.		IBC 1404.12.2	IBC 1404	3	0.25	0.33	0.344	0.375
Unless otherwise specified by the code, the concentration of a uniformly distributed live load over an area of ___ feet by ___ feet shall be located to produce the maximum load effects of structural members.		IBC 1607.4	IBC 1607	4	2, 2.5	2.5, 2	2, 2	2.5, 2.5
Unless required elsewhere in the code, _____ are not required to have a fire-resistance rating.		IBC 710.3	IBC 710	1	smoke partition	smoke barrier	fire partition	fire barrier
Walls separating sleeping units in the same building from other occupancies contiguous to them in the same building shall be constructed as _____.		IBC 420.2	IBC 420	1	fire partitions	fire barriers	fire walls	smoke barriers
Water treatment facilities shall be classified as what occupancy?		IBC 306.2	IBC 306	4	B	H-2	F-2	F-1
What ASME standard must a belt manlift comply with for elevators and conveying systems and components?		IBC Table 3001.3	IBC 3001	3	ASME B20.1	ASME A17.1	ASME A90.1	ASME A18.1
What class of interior finish is required for an enclosed space within a three-story H-occupancy that is sprinklered?		IBC Table 803.13	IBC 803	2	Class A	Class B	Class C	none
What is required for skylights set at an angle of < 45°?		IBC 2405.4	IBC 2405	2	Installed per Manufacturer's instructions.	Mounted on a curb 4 inches above roof.	Requires screening 4 inches below glazing.	May be mounted directly to roof surface.
What is the allowable span for a 2x8 Hem-Fir #2 floor joist spaced at 16 inches on-center located within a residential living area and having a dead load of 10 psf?		IBC Table 2308.4.2.1 (1)	IBC 2308	4	6'-3"	5'-2"	10'-2"	13'-2"
What is the allowable span for a double 2x8 Douglas Fir-Larch exterior bearing wall header for a single-story building where the ground snow load is 50 psf, and the building width is 28 feet?		IBC Table 2308.4.1.1 (1)	IBC 2308	2	5'-9"	4'-2"	2'-8"	6'-2"
What is the deflection limit for exterior walls and interior partitions with flexible finishes?		IBC Table 1604.3	IBC 1604	3	l/240	l/360	l/120	l/180
What is the maximum height the handrail is permitted to be placed from the tread nosing?		IBC 1014.2	IBC 1014	3	34 inches	36 inches	38 inches	40 inches
What is the maximum required distance from a descending slope from the bottom of the foundation?		IBC Figure 1808.7.1	IBC 1808	4	15 feet	25 feet	35 feet	40 feet
What is the maximum running slope of a pedestrian ramp that is not part of the means of egress?		IBC 1012.2	IBC 1012	1	1:8 (12.5%)	1:12 (8%)	1:20 (5%)	1:48 (2%)

What is the maximum spacing of ½" diameter anchor bolts?		IBC 2308.3.1	IBC 2308	1	6'	4'	3'	2'
What is the maximum spacing of braced wall lines of the second floor of a three-story building in Seismic Design Category B?		IBC Table 2308.6.1	IBC 2308	1	35 feet	40 feet	25 feet	10 feet
What is the maximum span of a 2x8 Douglas-fir Larch #2 rafter spaced at 12" with a ground snow load of 30 psf, ceiling attached, and 20 psf dead load?		IBC Table 2308.7.2(5)	IBC 2308	1	15'-7"	17'-5"	13'-6"	18'-2"
What is the maximum span of a Douglas-fir Larch header of (3) 2x8's in an interior wall supporting one floor of a 28-foot wide structure?		IBC Table 2308.4.1.1 (2)	IBC 2308	1	5'-7"	6'-3"	6'-5"	6'-10"
What is the maximum that is permitted for a ramp between landings?		IBC 1012.4	IBC 1012	2	24 inches	30 inches	36 inches	144 inches
What is the minimum ceiling height for the means of egress of a building?		IBC 1003.2	IBC 1003	2	8'-0"	7'-6"	7'-0"	6'-8"
What is the minimum clearance length and width for a roll-in type shower for assisted bathing? (Lines A and B respectively)		IBC 1110.2.3.2	IBC 1110	3	30 inches by 30 inches	36 inches by 48 inches	30 inches by 60 inches	36 inches by 60 inches
What are the minimum dimensions for "A" and "B" for the urinal pictured?		IBC 2903.1.5	IBC 2903	2	48, 12	60, 12	48, 18	60, 18

What is the minimum distance for a bank type V-B construction where two exits are required. No fire sprinklers have been provided.		IBC 1007.1.1	IBC 1007	3	90 feet	50 feet	45 feet	30 feet
What is the minimum distance from the centerline of the toilet to the wall for assisted toileting?		IBC 1110.2.2.1	IBC 1110	4	15 inches	16 inches	18 inches	24 inches
What is the minimum fire separation distance for a Group A occupancy of Type I-A construction having 1-hour fire-resistance rated exterior walls?		IBC Table 705.5	IBC 705	4	30 feet	12 feet	7 feet	5 feet
What is the minimum interior wall finish requirement for an interior exit stairway for an apartment complex?		IBC Table 803.13	IBC 803	3	Class A	Class B	Class C	Class D
What is the minimum thickness of masonry wythes installed between two flues.		IBC 2113.14	IBC 2113	1	4 inches	3 inches	2 inches	6 inches
What is the minimum width of the landing to be provided on either side of a 36 inch wide door?		IBC 1010.1.5	IBC 1010	4	44"	48"	32"	36"
What is the required fire resistance rating separating the two occupancies where constructed as fire barriers.		IBC Table 707.3.10	IBC 707	3	1-hour	2-hours	3-hours	4-hours
What is the required reinforcement for an 8'0" tall, 7.5" thick concrete foundation wall supporting a 7-foot backfill with a soil load of 45 psf?		IBC Table 1807.1.6.2	IBC 1807	4	#5 bars at 48"	#4 bars at 39"	#6 bars at 48"	#5 bars at 41"
What minimum fire-rating is required for a fire door located within a 1-hour smoke barrier?		IBC Table 716.1(2)	IBC 716	3	1 hour	30 minutes	20 minutes	45 minutes
What type of fire-rated assembly is used to separate mixed occupancies?		IBC 508.4.4.1	IBC 508	2	Fire Walls	Fire Barriers	Fire Partitions	Smoke Partition
When construction is over 8 feet in height and less than 5 feet from the lot line, what the type of protection for the public is required?		IBC Table 3306.1	IBC 3306	4	A. Construction railings	B. Barrier	C. Covered Walkway	Both B and C

Where dressing rooms, fitting rooms, or locker rooms are provided, at least _____ percent, but not less than one, of each type of use in each cluster provided shall be accessible.		IBC 1110.14	IBC 1110	2	2%	5%	10%	15%
Where lockers constructed of combustible materials are used, the lockers shall be considered to be _____ and shall comply with section 803.		IBC 806.9	IBC 806	2	Building component	Interior Finish	Accessory to the building structure	Furniture
Where staircases are less than 80 inches located in the circulation path. A barrier shall be provided _____ inches maximum above the finished floor.		IBC 1003.3.1	IBC 1003	3	18	24	27	36
Which occupancy classification pertains to a portion of the building providing day care services for a total of 6 care recipients?		IBC 305.2	IBC 305	3	Group B	Group M	Group E	Same as primary use
Which occupancy classification will a building containing multiple smoke compartments, occupants are under restraint, and egress is impeded by locks to the exterior?		IBC 308.4	IBC 308	1	Group I-3, Condition 2	Group I-3 Condition 5	Group I-3 Condition 3	Group I-3 Condition 4
Which of the following combustible materials are not permitted in Type I or Type II construction?		IBC 603.1	IBC 603	4	FRT nonbearing partitions rated less than 2 hours	Doors, door frames, window frames	Heavy timber construction	Roofs of FRT wood in a 1A building with a vertical distance of 15 feet
Which of the following conditions requires safety glazing?		IBC 2406.4.6	IBC 2406	3	Stained glass in a door	Curved panels in doors	32 inches above stair tread	60 inches from bottom landing
Which of the following does not require a standpipe connection be provided?		IBC 905.3.2	IBC 905	2	1,200 sq. ft. Stage	Group A having 600 occupants	Hospital rooftop helipad	Boat docks
Which of the following is a fire extinguisher not required?		IBC 906.1	IBC 906	2	R-4	R-3	R-2	R-1
Which of the following is an enclosed exit access component that defines and provides a path of egress travel to an exit?		IBC 202	IBC 202	2	Exit Passageway	Corridor	Horizontal Exit	Interior Stairs
Which of the following is exempt from requiring a permit?		IBC 105.2	IBC 105	3	5-foot Retaining Wall	6-foot High Racking	120 ft ² Shed	New Water Heater
Which of the following is not defined by the IBC?		IBC 202	IBC 202	3	Factory-built chimney	Masonry chimney	Double-wall chimney	Metal chimney
Which of the following is not included in the scope of the IBC?		IBC 101.2	IBC 101	2	Restaurant Alteration	One-Family Dwelling	Building Relocation	Structural Repair
Which of the following is not true in regards to drinking fountains?		IBC Table 2902.1	IBC 2902	2	One per 500 in Group A	One per 500 in Group B	One per 100 in I-3	One per 1,000 in S
Which of the following is not true in regards to emergency escape and rescue openings.		IBC 1031.3.2	IBC 1031	3	24" opening height	20" opening width	Net clear opening width ≥ 24	5.7 square feet opening
Which of the following items is not considered an exit component.		IBC 202	IBC 202	4	Interior Exit Stair	Exterior Exit Ramp	Exit Passageway	Occupant evacuation elevator
Which of the following items shall be included in a Geotechnical Report?		IBC 1803.6	IBC 1803	2	Slope Instability	Water Table Elevation	Site Preparation	Liquefaction Study

Which of the following materials is not approved for fire blocking?		IBC 718.2.1	IBC 718	3	2" nominal lumber	1/2" gypsum board	1/2 wood structural sheathing	Mineral wool
Which of the following occupancies does not required two means of egress?		IBC 1006.2.1	IBC 1006	3	Conference room with 50 occupants	Theatre with 750 seats	Care Suites in I-2	Dwelling unit with 12 occupants
Which of the following recreational facilities is not required to be accessible?		IBC 1111.4.5	IBC 1111	2	Swimming Pools	Raised Boxing Rings	Shooting Facilities	Miniature Golf Courses
Which of the following types of fasteners are not allowed for the attachment of asphalt shingles?		IBC 1507.2.5	IBC 1507	2	Galvanized	Nickel	Stainless Steel	Aluminum
Which of the following uses is not allowed for a rooftop penthouse?		IBC 1511.2.2	IBC 1511	4	Mechanical Equipment	Vertical Shaft Openings	Tanks	Dwelling Units
Within the dwelling unit of a Use Group R-2 the maximum riser height of a stair is?		IBC 1011.5.2	IBC 1011	4	6"	7"	8"	7 3/4"
Wood girders entering exterior masonry or concrete walls shall be provided with a ___ inch airspace on top, sides, and end.		IBC 2304.12.2.1	IBC 2304	4	2"	1 1/2"	1"	1/2"
Wood joists or the bottom of a wood structural floor closer than _____ inches or wood girders that are closer than _____ inches to the exposed ground		IBC 2304.12.1.1	IBC 2304	1	18, 12	12, 18	18, 10	10, 12
When a space has over 50 occupants, is the door required to swing in the direction of egress travel?		IBC 1010.1.2	IBC 1010	1	YES	NO		
What is the maximum permitted opening for a guardrail?		IBC 1015.4	IBC 1015	1	4-inch sphere	6-inch sphere	8-inch sphere	21-inch sphere
What is the minimum width of the landing to be provided on either side of a 36 inch wide door?		IBC 1010.1.6	IBC 1010	4	44"	48"	32"	36"



Chris Kimball

PE, SE, MCP, CBO

VICE PRESIDENT / PROJECT MANAGER

EDUCATION

**MASTER OF ENGINEERING
STRUCTURAL EMPHASIS**
Utah State University, 2001

**BACHELOR OF SCIENCE
CIVIL ENGINEERING**
Utah State University, 2000

LICENSES | CERTIFICATIONS

LICENSES

Professional Engineer

Washington 53117
California C 67857
Nevada 019503
Arizona 48503

Structural Engineer

Utah 4775874-2203

CERTIFICATES

ICC Certified:

Master Code Professional
Certified Building Official
Certified Fire Code Official
Combination Plans Examiner
4-Way Commercial Inspector
Residential Plans Examiner
Residential Energy
4-Way Residential Inspector
Accessibility Plans Examiner/Insp.
Fire Plans Examiner
Fire Inspector I & II

AFFILIATIONS

SEAU

Past President

Beehive Chapter of ICC

Past President

Utah Chapter of ICC

Member

Bonneville Chapter of ICC

Member

AWARDS

SEAU

2014 Engineer of the Year

ICC Utah Chapter

Industry Award for Excellence 2010

Mr. Kimball is a licensed engineer and an ICC Master Code Professional. He is also certified by ICC as a building official, fire code official, combination plans examiner, combination building inspector, fire plans examiner/inspector, and as an accessibility plans examiner/inspector. He received his Master's degree with an emphasis in structural engineering and currently serves as the Vice President of West Coast Code Consultants, Inc. He has performed plan reviews for thousands of projects throughout the Western United States and is an ICC approved instructor. Mr. Kimball has provided code training classes to building official, design professional and contractor organizations all over the United States.

EXPERIENCE

VICE PRESIDENT

West Coast Code Consultants, Inc. / 2009 – Present

Oversee the plan review and building inspection services provided by numerous WC3 offices. This includes the management of administrative, plan review, and inspection staff. Accountable for the complete plan review of projects which are seeking a building permit to ensure that designs are safe and in compliance with the adopted building codes. Responsible for providing technical training classes to clients, building officials, design professionals, contractors, and owners.

PRESIDENT / OWNER

Kimball Engineering / 2005 – 2009

Provided structural and complete plan review services to local jurisdictions throughout Utah, Arizona, Nevada, and Wyoming. Often provided training with regards to the structural building code requirements for both new and existing buildings to building official, design professional, and contractor organizations.

STRUCTURAL PLANS EXAMINER

Salt Lake City Corporation / 2005 - 2007

Performed structural review of plans, specifications, calculations, and engineering reports to ensure compliance with the adopted building codes. Met with clients, design professionals, contractors, and owners to discuss projects during the design-development stage and throughout the construction process. Provided training classes to design professionals to help them understand the structural requirements of the code. Provided engineering design and consulting services for city-owned projects.

CIVIL ENGINEER

U.S. Bureau of Reclamation / 2003 – 2005

Responsible for the structural design of a wide variety of projects including the retrofit of power plants, design of new buildings, and repairs to concrete and earthen dams. Prepared construction documents, including drawings and detailed project specifications for solicited work. Reviewed designs performed by the Technical Services Center, Area offices, and private consultants. Participated in several value engineering studies.

CIVIL ENGINEER

C.A. Dept. of Water Resources / 2002 – 2003

Provided preliminary designs for the repair of levees and other flood mitigation measures. Reviewed proposals and work performed by consultants. Developed required hydrology for modeling purposes. Reviewed hydraulic modeling efforts. Involved in writing/reviewing a joint EIR/EIS. Prepared construction cost estimates.



EDUCATION

**MASTER OF ENGINEERING
STRUCTURAL EMPHASIS**
Utah State University, 2010

**BACHELOR OF SCIENCE
CIVIL ENGINEERING**
Utah State University, 2006

LICENSES | CERTIFICATIONS

LICENSES

Professional Engineer
California C 80941
Texas 107991
Washington 53396

Structural Engineer
Utah 7697949-2203
California S6311
Washington 53396
Nevada 24835
Arizona 65835

CERTIFICATES

ICC Certified:
Building Official
Building Plans Examiner
Mechanical Plans Examiner
Accessibility Plans
Examiner/Inspector
Commercial Energy Plans Examiner
Commercial Building Inspector
Commercial Mechanical Inspector
Residential Energy Plans Examiner
Residential Energy Plans
Examiner/Inspector

AFFILIATIONS

Utah Chapter of ICC
Member

Bonneville Chapter of ICC
Member

**Structural Engineering Association
of Utah (SEAU)**
Member

Todd Snider PE, SE, CBO

UTAH REGIONAL MANAGER / SENIOR PLAN REVIEW ENGINEER

Mr. Snider is a licensed structural engineer and an ICC certified building official, in addition to being a certified building, mechanical, energy, and accessibility plans examiner. He received his Master's degree from the University of Utah with an emphasis in structural engineering and has served as the Chairman of the Residential Building Committee for the Structural Engineer's Association of Utah (SEAU). He provides plan review services to many jurisdictions throughout the Western United States and has had multiple years of experience in the structural design of a variety of building types. His expertise and knowledge are frequently sought out as an approved ICC instructor and Todd is regularly invited to teach code classes to building official, design professional, and contractor organizations throughout the United States.

EXPERIENCE

UTAH REGIONAL MANGER / SENIOR PLAN REVIEW ENGINEER

West Coast Code Consultants. Inc. / 2019 – Present

Leads a diverse team of plan reviewers, inspectors and other professionals located in our Layton and Sandy, Utah offices. Manages all inter-office plan review coordination between a variety of WC³ offices, located in multiple states. Regularly trains jurisdictions and other professional organizations throughout the United States in code compliance. Provides code consultation for architects to address code concerns on large projects.

PLAN REVIEW SUPERVISOR / SENIOR PLAN REVIEW ENGINEER

West Coast Code Consultants. Inc. / 2011 – 2019

Managed plan review services for the Utah Office. Supervised the plan review and provided quality control of various projects. Performed complete plan reviews including, architectural, structural, energy, and Green Code. Trained and mentored staff as well as new plan reviewers in the standards of the company. Established and maintained WC³ standards for plan review services. Provided customer service and oversaw overall customer satisfaction.

PROJECT ENGINEER

Ward Engineering Group / 2006 – 2011

Performed structural design including preparing structural drawings and calculations for various projects. Designed multiple buildings and structures including houses, tilt-up buildings, foundations for metal buildings and LNG tanks, masonry structures, parking garages, hotels, business, and other structures.

ENGINEERING INTERN

United Engineering Group / 2005 - 2005

Designed preliminary plats and final plat layouts for future subdivisions. Prepared drainage reports and studies for various developments. Performed feasibility studies for the development of various properties.

File Attachments for Item:

EC-3 Commercial Mechanical Inspector and Plans Examiner (2021 IMC)

All certifications (13 hours)

Application for Continuing Education Course Approval

Provider Information:

Name: Brittany Allen
Organization: West Cost Code Consultants, Inc. / WC-3 Academy
Address: 9131 S Monroe St Unit A, Sandy, Utah 84070
E-mail: brittanya@wc-3.com Telephone: 385-237-3722
Website: https://www.wc-3.com/ and https://www.pathlms.com/wc3-academy
Conference Sponsor (if applicable) _____ Conference Email: _____

Check here if Course Renewal: _____ Prior course number _____ (i.e. BBS2018-429)
*Renewals will only be granted for identical content and certifications, within the current code cycle.
Attach a copy of prior course approval letter for confirmation. No further information is required.*

New Course Information:

Course title: 2021 Commercial Mechanical Inspector and Plans Examiner
Course instructor: George Williams
Course description: This 15-module course, followed by a 60-question practice examination, is based on the 2021 International Mechanical Code (IMC), as well as portions of the 2021 International Fuel Gas Code (IFGC). It teaches the practical application of the IMC & IFGC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 15 to 55 minutes in length. This course is designed to prepare you for the International Code Council's (ICC) Commercial Mechanical Inspector (M2) and/or Mechanical Plans Examiner (M3) exam, utilizing the 2021 IMC & IFGC. This course also serves as a review and update course.
Instructional hours per session: 13 Number of Sessions: _____
Course Date(s) and Location: _____

Special Content:

Code Administration: Conference Course: _____
Existing Buildings: Conference Name: _____
Electrical Instruction: Conference location: _____
Plumbing Instruction:

Course to be offered online? On Demand Webinar

Course Website: https://www.pathlms.com/wc3-academy/courses/45253
Detail online course participation confirmation method (i.e. test, quizlets, participant activity confirmation):
Passing score of 75% on quiz at end of each module and 75% on practice exam end of course

Course applicable for the following certifications

Residential Certifications Only: Commercial Certifications:
Administrative Course, All Certifications:

Application materials included:

- Course Outline or Course Learning Objectives
- Presentation Materials/Slides (not required for roundtable courses)
- Assessment Materials (for online courses)
- Presenter Bio

Please submit application and materials in .pdf format to: michael.lane@com.ohio.gov or BBS@com.ohio.gov



2021 Commercial Mechanical Inspector and Plans Examiner

Course Outline

Cost: \$247, allowing for 120 days of access.

Course Description: This **15-module course**, followed by a **60-question practice examination**, is based on the *2021 International Mechanical Code (IMC)*, as well as portions of the *2021 International Fuel Gas Code (IFGC)*. It teaches the practical application of the IMC & IFGC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 15 to 55 minutes in length.

Course Objectives: This course is designed to prepare you for the *International Code Council's (ICC)* Commercial Mechanical Inspector (M2) and/or Mechanical Plans Examiner (M3) exam, utilizing the *2021 IMC & IFGC*. This course also serves as a review for those already familiar with the IMC & IFGC and may serve as an update course for those unfamiliar with the 2021 edition of the codes.

Texts and Readings: The *2021 International Mechanical Code*, as well as the *2021 International Fuel Gas Code* are the textbooks for this course. It is highly recommended that you purchase a paper-back copy of these codes, which are available online at www.iccsafe.org. A physical copy can be utilized during the actual exams, which are open book, and serves as a valuable reference for in the field inspections.

Course Outline of Topics:

Module:	Topics:	Readings:	Quiz:	Duration:
1	Administration and Definitions	IMC Chapters 1 & 2	Y	54 min.
2	General Regulations and Water Heaters	IMC Chapters 3 & 10	Y	36 min.
3	Ventilation and Exhaust Systems	IMC Chapters 4 & 5	Y	34 min.
4	Commercial Kitchens	IMC Chapter 5	Y	29 min.
5	Duct Systems	IMC Chapter 6	Y	48 min.
6	Combustion Air	IMC Ch 7 & IFGC Ch 3	Y	40 min.
7	Chimneys and Vents	IMC Chapter 8	Y	20 min.
8	Chimneys, Vents, Appliances	IMC Chapters 8 & 9	Y	18 min.
9	Refrigeration and Piping	IMC Chapters 11 & 12	Y	33 min.
10	Fuel Oil Systems and Solar Thermal	IMC Chapters 13 & 14	Y	14 min.
11	Gas Piping	IFGC Chapter 4	Y	55 min.
12	Gas Chimneys, Vents, and Specific	IFGC Chapters 5 & 6	Y	30 min.
13	Mechanical Plan Basics & Comment Writing Techniques		N	38 min.
14	Mechanical Review Methodology		N	18 min.
15	Supplemental Module – Gas Line Sizing		N	46 min.
	12 Quizzes 73 Questions, 2 min. each	2021 IMC & IFGC		146 min.
	Practice Exam – 60 Questions	2021 IMC & IFGC		120-150 min.
	Total Course Hours			13 hours



2021 Commercial Mechanical Inspector and Plans Examiner

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. Marking, tabbing, and highlighting in the code book is highly recommended. We have laid out a plan and method to help you learn the material, but it's up to you to put in the work necessary for you to master the material. You can progress through this course at your own pace; however, you only have access for 120 days.

Continuing Education Credits: Completion of this course results in **1.3 CEU's** (13 hours) being provided by ICC, as West Coast Code Consultants is a Preferred Provider.

Instructor:



George Williams, MCP, CBO is the Director of WC3 Academy, but primarily identifies as a commercial plans examiner and building inspector. He has been a building inspector since 2005, has a master's degree in construction management, and has been ICC Master Code Professional since 2009. George has been instrumental in the start-up of multiple building departments including the adoption of codes, implementation of permit processes, development of policies and procedures, as well as the hiring and training of staff.



Module 1 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Which of the following is the code official not authorized to do?	IMC 104.1	IMC 104	3	Render interpretations of the code	Review construction documents	Waive requirements of the code	Issue Permits
Permits are required for which of the following?	IMC 106.2	IMC 106	2	Portable cooling units	Installing a new water heater	Portable evaporative coolers	Replacing minor parts of an appliance
An owner shall apply for a permit for which of the following?	IMC 106.1	IMC 106	2	The installation of chilled water piping contained within cooling equipment	Self-contained refrigeration systems that have more than 10 lbs of refrigerant	Heating appliances or cooling units that are portable	The replacement of any part of equipment that does not alter the approval of such equipment
Where the code official finds insufficient evidence for a modification request for approval under alternative materials and equipment, all but which of the following may be required?	IMC 105.3	IMC 105	3	Test methods specified by the code or other recognized standards	Test reports shall be kept for a period required for retention of public records	Test sampling of actual product installation characteristics to assure code compliance	All testing shall be performed by an approved testing agency
After a permit has been issued that permit becomes invalid if work has not occurred within the last ____ days. An extension may be granted valid for ____ days.	IMC 106.4.3	IMC 106	3	90, 180	180, 90	180, 180	270, 90
In general, a member of the board of appeals is appointed to a ____ year term?	IMC C101.3	IMC C101	4	2	3	4	5
An enclosed portion of the building structure that is designed to allow air movement and , thereby, serve as part of an air distribution system is known as a:	IMC 202	IMC 202	1	Plenum	Concealed location	Return air system	Confined space
A pilot that operates during the lighting cycle and discontinues during main burning operations is defined as:	IFGC 202	IFGC 202	4	Log Lighter	Main Burner	Ignition Source	Ignition Pilot
The label required on all fuel-burning appliances shall contain the following information except:	IMC 301.9	IMC 301	4	Required clearances	Hourly rating in Btu/h	The seal or mark of the approved agency	The year of mechanical code used for appliance evaluation

Module 2 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
When equipment requiring service is less than 10 feet from a roof edge, guards shall be provided that meet all but which one of the following requirements?	IMC 304.11	IMC 304	2	Prevent the passage of a 21" diameter sphere	Extend not less than 30" in front of the service of the equipment	Be located not less than 42" above the roof surface	Be designed to meet loading in accordance with the International Building Code
Heating and cooling calculations shall be designed in accordance to procedures and parameters of all of the following except the:	IMC 312.1	IMC 312	3	International Mechanical Code	International Energy Conservation Code	International Building Code	ASHREA/ACCA Standard 183
Interior spaces intended for human occupancy shall be provided with space heating systems capable of maintaining 68F at a point of _____ feet above the floor.	IMC 309.1	IMC 309	2	2	3	4	6
Appliances located in attics shall have clear access opening dimensions a minimum of:	IMC 306.3	IMC 306	4	18" x 24"	24" x 24"	30" x 30"	20" x 30"
Boilers shall be mounted on floors of _____ construction.	IMC 1004.5	IMC 1004	4	Stainless Steel	Masonry	Combustible	Noncombustible
Steam boilers shall be equipped with bottom _____ valve(s).	IMC 1008.1	IMC 1008	2	Relief	Blow off	Drain	Safety
The minimum size of a closed-type expansion tank shall be based on the _____ of the hot-water-heating system:	IMC 1009.2	IMC 1009	4	Manufacturer	Listing	Rating	Capacity
Open-type expansion tanks shall be located not less than _____ feet above the highest heating element.	IMC 1009.3	IMC 1009	2	6	4	8	2
A wood stud located in an exterior wall is permitted to be cut or notched _____ percent.	IMC 302.3.2	IMC 302	1	25	50	75	15

Module 3 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
An outdoor intake opening may be located closer than 10 feet horizontally from an alley way when the opening is _____?	IMC 401.4	IMC 401	3	Adjacent an alley closed to vehicular traffic	10 feet vertically from finish grade	25 feet vertically from finish grade	Intake openings are not allowed to be closer than 10 feet horizontally to an alley way under any circumstances
The occupant load and people outdoor airflow rate for a conference room type occupancy is?	IMC TABLE 403.3.1.1	IMC 403	2	7 persons per 1,000 sq.ft. at 5 CFM per person	50 persons per 1,000 sq.ft. at 5 CFM per person	30 persons per 1,000 sq.ft. at 7.5 CFM per person	60 persons per 1,000 sq.ft. at 15 CFM per person
What is the equivalent duct length for a dryer duct running 20 linear feet with (2) 90 degree mitered elbows and (1) 45 degree mitered elbow? (assume 4" radius)	IMC TABLE 504.9.4.1	IMC 504	4	27' -6"	32' -6"	35' -0"	46' -6"
What is the equivalent duct length for a dryer duct running 24 linear feet with (1) 90 degree smooth elbow and (2) 45 degree smooth elbows? (assume 8" radius)	IMC TABLE 504.9.4.1	IMC 504	1	35'-7"	29' -7"	26' -7"	25' -7"
Openings within louvers in a Single Family Dwelling shall be not less than ____ inch and not greater than ____ inch.	IMC 501.3.2	IMC 501	2	1/2, 1/4	1/4, 1/2	1/2, 1/8	1/8, 1/4

Module 4 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the minimum clearance to combustible materials for a Type I exhaust hood duct?	IMC 506.3.6	IMC 506	4	24 inches	12 inches	6 inches	18 inches
For a Type I hood exhaust termination, what is the minimum clearance elevation above the roof surface?	IMC 506.3.13.1	IMC 506	1	40 inches	32 inches	18 inches	34 inches
What is the minimum required clearance between the grease filter and the cooking surface of an appliance with exposed flame and burners?	IMC Table 507.2.8	IMC 507	3	32 inches	18 inches	24 inches	6 inches
A chimney is only required for hazardous exhaust flues with a temperature that exceeds?	IMC 511.2	IMC 511	2	400 degrees F	600 degrees F	800 degrees F	500 degrees F
Makeup air shall be provided by _____ or _____ means or both.	IMC 508.1	IMC 508	1	Gravity, Mechanical	Mechanical, Exfiltration	Exfiltration, Ventilation	Gravity, Capture

Module 5 Quiz Questions

Question Text	Import ID	Page	Question Type	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Return air shall not be taken from the_____?	3405	1	multiple_choice	IMC 601.5 #7	IMC 601	1	kitchen	bedroom	basement	attic space
For Air dispersion systems all of the following are true except?	3405	2	multiple_choice	IMC 603.17	IMC 603	3	Not pass through or penetrate fire-resistant rated construction	Installed entirely in exposed location	Listed and labeled in compliance with UL 904	Utilized in systems under positive pressure
Ducts Shall have a minimum slope of _____ per foot when installed underground to allow drainage to a point?	3405	3	multiple_choice	IMC 603.8.1	IMC 603	1	1/8 inch	1/4 inch	3/8 inch	1/2 inch
Round metallic ducts shall be mechanically fastened by means of not less than _____ sheet metal screws or rivets spaced equally around the joint.	3405	4	multiple_choice	IMC 603.4.1	IMC 603	2	two	three	four	five
Tapes and mastics used to seal metallic and flexible air connectors shall comply with _____.	3405	5	multiple_choice	IMC 603.9	IMC 603	4	UL 183D	UL 182C	UL 184A	UL 181B

Module 6 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
The standard method for calculating indoor combustion air can't be used where the air infiltration rate is know to be less than____ air changes per hour (ACH).	IFGC 304.5	IFGC 304	4	0.55	0.50	0.45	0.40
What is the minimum required volume of combustion air for a fuel fired appliance?	IFGC 304.5.1	IFGC 304	3	40 cubic feet per 1000 BTU	40 cubic feet per 10000 BTU	50 cubic feet per 1000 BTU	50 cubic feet per 10000 BTU
When Combustion air openings are provided with a smoke damper in rated construction, a shaft is required.	IMC 701.2	IMC 701	2	TRUE	FALSE		
An appliance listed as flammable vapor ignition resistant is installed in a garage. What is the minimum height required for the ignition source to be installed above the floor in a parking garage?	IFGC 305.3 Exception	IFGC 305	4	24"	18"	6"	Not Required
What is the assumed percentage of the free area when the free area of metallic louvers are not known?	IFGC 304.10	IFGC 304	1	75	25	50	20

Module 7 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
The cross-sectional area of a flue serving a solid-fuel-burning appliance shall not be greater than ____ times the cross-sectional area of the appliance flue collar.	IMC 801.7	IMC 801	3	1.5	2	3	4
Connectors shall connect to a chimney flue at a point not less than ____ inches above the lowest portion of the interior chimney flue.	IMC 801.12	IMC 801	3	6 inches	8 inches	12 inches	18 inches
What is the minimum height of a chimney flue cleanout?	IMC 801.13	IMC 801	2	4 inches	6 inches	8 inches	10 inches
Type L vents shall terminate not less than ____ feet above the highest point of the roof penetration.	IMC 802.5	IMC 802	4	1	3	5	2
What is the maximum horizontal length of a single-wall connector?	IMC 803.10.2	IMC 803	2	8 feet	75% of the height of the chimney or vent.	3 feet	100% of the height of the chimney or vent.
What is the minimum pitch for connectors?	IMC 803.10.5	IMC 803	3	6 inches in 10 feet	Must maintain a positive slope	1/4 unit vertical in 12 units horizontal	1/8 unit vertical in 12 units horizontal

Module 8 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Bottom of the vent termination shall be located at least ____ above grade.	IMC 804.3.4	IMC 804	2	6 inches	12 inches	3 feet	5 feet
What is the minimum distance a floor furnace can be placed to a wall or corner?	IMC 910.2	IMC 910	1	6 inches	12 inches	18 inches	24 inches
What is the minimum distance a vented wall furnace can be installed from a door swing?	IMC 909.3	IMC 909	2	6 inches	12 inches	18 inches	24 inches
What is the minimum clearance of a floor furnace on the control side?	IMC 910.4	IMC 910	3	6 inches	12 inches	18 inches	24 inches
What is the maximum allowable temperature of sauna heater?	IMC 914.4	IMC 914	3	212 degrees F	212 degrees K	194 degrees F	120 degrees F
Offset in factory-built chimneys shall have a maximum angle of ____ degrees?	IMC 805.3	IMC 805	1	30	45	25	50

Module 9 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A certificate of test for Refrigerant piping shall have all of the following except one:	IMC 1110.8	IMC 1110	4	Signed by the installer	Name of refrigerant and pressure applied	Part of public record	Provided when more than 55 lbs. of Refrigerant
Machinery Rooms shall be mechanically ventilated to the outdoors:	IMC 1105.6-1105.6.3.1	IMC 1105	1	Not less than 20 ft. property lines or openings	More than 30 ft. from openings into buildings	At an exhaust rate of no more than .5 cfm per square foot	At a maximum ventilation rate of 30 ACH
All are true for mixing refrigerants except:	IMC 1102.2.1	IMC 1102	2	Refrigerant blends in ASHRAE 34 shall not be mixed in a system	Addition of a 2nd refrigerant is not permitted to improve oil return at high temperatures	Added refrigerant must be in accordance with manufacturer's instructions	Refrigerants not identified in Table 1103.1 shall be approved before use
Hydronic testing requires all but which of the following?	IMC 1208.1	IMC 1208	3	A test at 1.5 times maximum design pressure	A test no less than 100 psi	A test lasting minimum of 10 minutes	A test lasting not less than 15 minutes
Hydronic piping systems require all but which of the following:	IMC 1206.10	IMC 1206	2	Minimum clearance of 1 inch to combustibles when temperature exceeds 250 degrees F	Support according to section 315	Flow velocity controlled with a water hammer arrestor when a quick closing valve creates a water hammer	Protection surrounding annular space during penetrations
A pressure relief valve shall be installed:	IMC 1210.7.7	IMC 1210	1	Low-pressure side of hydronic piping system	High-Pressure side of hydronic piping system	Set at the minimum pressure of the system design	Installed in accordance with section 1003
All is true for pipe insulation installed in buildings except:	IMC 1204.1	IMC 1204	4	Maximum flame spread index of 25	Maximum smoke developed index not exceeding 450	Installation conforms to the International Energy Conservation Code	Applies to both IMC and IRC

Module 10 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
All of the following is true with respect to fuel oil systems except:	IMC 1305.1	IMC 1305	3	Minimum supply line sizes are 3/8 in. inside diameter nominal pipe or outside diameter tubing	Return lines shall be 1/4 in. inside diameter nominal pipe or 5/16 in. outside diameter tubing	Copper tubing shall have 1/4 inch nominal and .20 in. minimum wall thickness	Minimum thickness for copper tubing is .035 in. nominal and .32 wall thickness
Liquid fuel vent pipes shall terminate outside of buildings at a point not less than _____ feet measured vertically or horizontally from any building opening	IMC 1305.7	IMC 1305	1	2	3	4	5
What type of fittings in fuel oil piping are not to be used?	IMC 1303.1	IMC 1303	2	Non-metallic	Cast Iron	Copper	Steel
Exterior grade fill piping shall be removed:	IMC 1301.5	IMC 1301	3	After fuel pipe testing	When fuel pipe is contaminated	When fuel tanks are abandoned or removed	If support pressure exceeds amounts in accordance with Table 305.4
Equipment exposed to vehicular traffic shall be installed ___ feet above the finished floor	IMC 1402.6	IMC 1402	2	4	6	8	10
The flash point of the actual heat transfer fluid utilized in a solar system shall be not less than ___ degrees Fahrenheit above the design maximum non-operating temperature of the fluid attained in the collector	IMC 1403.1	IMC 1403	4	28	48	68	50

Module 11 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Which of the following is an approved gas piping material for a system containing 0.4 grains of hydrogen sulfide per 100 standard cubic feet of gas?	IFGC 403.5	IFGC 403	1	Polyethylene (PE) Plastic Pipe	Cast Iron Pipe	Schedule 30 Steel Pipe	Copper and Copper Alloy Pipe
What is the minimum test pressure for a 1" CSST gas line on a 4 oz. system?	IFGC 406.4.1	IFGC 406.4	4	6 oz.	2 P.S.I.	5 in. w.c.	3 P.S.I.
Refrigeration piping shall not:	IFGC 404.3	IFGC 404	3	Have manufacturer identification	Be seismically restrained	Be installed in an elevator shaft	Be installed downstream of the point of delivery
Shield plates shall be provided for piping located ____ inches from the member to the wall for a distance of not less than ____ inches to each side of the framing member.	IFGC 404.7.2	IFGC 404	4	4, 1 1/2	4, 4	1 1/4, 4	1 1/2, 4
A fuel connector installed to an appliance system shall be permitted to be 6 feet or greater in length, provided which sections are complied with:	IFGC 411.1.3.1	IFGC 411	2	IMC 402 and IMC 409.5	IFGC 402 and IFGC 409.5	IFGC 405.9 and IMC 404	IFGC 402 and IMC 409.5

Module 12 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
For a 30,000 Btu direct-vent appliance, what is the minimum vent termination clearance from an opening into a building?	IFGC 503.8(3)	IFGC 503	3	6 inches	3 feet	9 inches	12 inches
What is the maximum horizontal length of a double-walled vent connector if tied into a chimney measuring 23' in height?	IFGC 503.10.9	IFGC 503	4	18' - 6"	6' - 0"	17' - 3"	23' - 0"
A forced air heating system services 12,500 cubic feet of volume, return air can be taken from which of the following rooms? (Assume 8' ceiling heights)	IFGC 618.3	IFGC 618	3	24' x 16'	32' x 10'	22' x 18'	14' x 26'
What is the minimum required clearance above a cooking top for a microwave oven when an exception are applied?	IFGC 623.7	IFGC 623	1	24 inches	30 inches	Manufacturer Specific	18 inches
For a single wall metal vent connector 7 inches in diameter, 8 feet in height with a rise of 3 feet, has an input rating of ____ thousands of BTU/H.	IFGC Table 504.3.2	IFGC 504	2	264 min, 145 max	266 min, 376 max	258 min, 343 max	225 min, 316 max

2021 Commercial Mechanical Inspector & Plans Examiner Exam Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
What is the minimum clearance to combustibles for a Type I exhaust hood duct?	IMC 506.3.6	IMC 506	3	6 inches	12 inches	18 inches	24 inches
Which of the following is the code official not authorized to do?	IMC 104.1	IMC 104	2	Render interpretations of the	Waive requirements of the	Review construction documents.	Issue Permits.
Machinery rooms shall be mechanically ventilated to the outdoors _____.	IMC 1105.6 1105.6.3.1	IMC 1105	2	more than 30 ft. from openings into buildings	not less than 20 ft. property lines or openings	at an exhaust rate of no more than .5 cfm per square foot	at a maximum ventilation rate of 30 ACH
Type L vents shall terminate not less than ____ feet above the highest point of the roof penetration.	IMC 802.5	IMC 802	2	1 foot	2 feet	3 feet	5 feet
Where the surface temperature of a device is ____ °F, in a room containing more than 6.6 pounds of refrigerant, it shall be provided with exhaust combustion to the exterior of the building.	IMC 1104.3.4	IMC 1104	3	400°F	600°F	800°F	1000°F
What is the assumed percentage of the free area when the free area of metallic louvers are not known?	IFGC 304.10	IFGC 304	4	0.2	0.25	0.5	0.75
A louver in a retail space shall have an opening of not less than ____ inches and not more than ____ inch.	IMC Table 401.5	IMC 401	1	1/4, 1	1, 1/4	1/4, 1/2	1/2, 1/4
Ducts shall have a minimum slope of ____ per foot when installed underground to allow drainage to a point?	IMC 603.8.1	IMC 603	4	3/8 inch	1/2 inch	1/4 inch	1/8 inch
Combustible materials shall be discharged to a vent when entering a building. A clearance of _____ between vent terminals and any opening shall be provided for appliances using forced draft venting.	IMC 804.2.1	IMC 804	4	6 inches	8 inches	10 inches	12 inches
Connectors shall connect to a chimney flue at a point not less than ____ above the lowest portion of the interior chimney flue.	IMC 801.12	IMC 801	2	18 inches	12 inches	8 inches	6 inches
What is the maximum horizontal length of a double-walled vent connector if tied into a chimney measuring 23" in height?	IFGC 503.10.9	IFGC 503	3	18' - 6"	6' - 0"	23' - 0"	17' - 3"
What is the minimum distance a vented wall furnace can be installed from a door swing?	IMC 909.3	IMC 909	3	24 inches	18 inches	12 inches	6 inches
An enclosed portion of the building structure that is designed to allow air movement and, thereby, serve as part of an air distribution system is known as a:	IMC 202	IMC 202	4	Concealed location	Return air system	Confined space	Plenum
An outdoor intake opening may be located closer than 10 feet horizontally from an alley way when the opening is _____.	IMC 401.4 #2	IMC 401	2	adjacent an alley closed to vehicular traffic	25 feet vertically from finish grade	10 feet vertically from finish grade	Intake openings are not allowed to be closer than 10 feet horizontally to an alley way under any circumstances.
Return air shall not be taken from the _____.	IMC 601.5	IMC 601	4	bedroom	basement	attic space	kitchen
Exterior grade fill piping shall be removed:	IMC 1301.5	IMC 1301	2	After fuel pipe testing	When fuel tanks are abandoned or removed	When fuel pipe is contaminated	If support pressure exceeds amounts in accordance with Table 305.4
Solar Equipment exposed to vehicular traffic shall be installed ____ above the finished floor.	IMC 1402.6	IMC 1402	3	10 feet	8 feet	6 feet	4 feet
Permits are required for which of the following?	IMC 106.2	IMC 106	2	Portable cooling units	Installing a new water heater	Portable evaporative coolers	Replacing minor parts of an appliance

Combustion air is permitted to be supplied from any of the following locations except?	IMC 303.3	IMC 303	4	Offices	Corridors	Conference Rooms	Surgical Suites
When equipment requiring service is less than 10 feet from a roof edge, guards shall be provided that meet all but which of the following requirements?	IMC 304.11	IMC 304	2	Prevent the passage of a 21" diameter sphere	Extend not less than 30" in front of the service of the equipment	Be located not less than 42" above the roof surface	Be designed to meet loading in accordance with the International Building Code
The occupant load and outdoor airflow rated for a conference room type occupancy is?	IMC Table 403.3.1.1	IMC 403	3	7 persons per 1,000 sq.ft. at 5 CFM per person	30 persons per 1,000 sq.ft. at 7.5 CFM per person	50 persons per 1,000 sq.ft. at 5 CFM per person	60 persons per 1,000 sq.ft. at 15 CFM per person
Steam boilers shall be equipped with bottom _____ valve(s).	IMC 1008.1	IMC 1008	2	relief	blowoff	drain	safety
What is the maximum horizontal length of a single-wall connector?	IMC 803.10.2	IMC 803	4	3 feet	8 feet	100% of the height of the chimney or vent.	75% of the height of the chimney or vent.
What type of fittings in fuel oil piping are not to be used?	IMC 1303.1	IMC 1303	1	Cast Iron	Non-metallic	Copper	Steel
A wood stud located in an exterior wall is permitted to be cut or notched _____.	IMC 302.3.2	IMC 302	3	75%	50%	25%	15%
What is the minimum required clearance between the grease filter and the cooking surface of an appliance with exposed flame and burners?	IMC Table 507.2.8	IMC 507	2	32 inches	24 inches	18 inches	6 inches
Boilers shall be mounted on floors of _____ construction.	IMC 1004.5	IMC 1004	1	noncombustible	stainless steel	masonry	combustible
An owner shall apply for a permit for which of the following?	IMC 106.2	IMC 106	3	The installation of chilled water piping contained within cooling equipment.	Heating appliances or cooling units that are portable.	Self-contained refrigeration systems that have more than 10 lbs. of refrigerant.	Replacement of any part of equipment that does not alter the approval of such equipment.
For air dispersion systems all of the following are true except?	IMC 603.17	IMC 603	4	Not pass through or penetrate fire-resistant rated construction	Installed entirely in exposed location	Utilized in systems under positive pressure	Listed and labeled per UL 904
For a 30,000 BTU direct-vent appliance, what is the minimum vent termination clearance from an opening into a building?	IFGC Table 503.8(3)	IFGC 503	1	9 inches	12 inches	6 inches	36 inches
Oil appliances shall be provided in compliance with which of the following standards?	IMC 701.1	IMC 701	3	NFPA 32	NFPA 13	NFPA 31	NFPA 3
What is the equivalent duct length for a dryer duct running 20 linear feet with (2) 90 degree mitered elbows and (1) 45 degree mitered elbow? (assume a 4 inch radius)	IMC Table 504.9.4.1	IMC 504	2	35'-0"	32'-6"	40'-0"	27'-6"
Open-type expansion tanks shall be located not less than _____ feet above the highest heating element.	IMC 1009.3	IMC 1009	3	8	6	4	2
All of the following is true with respect to fuel oil systems except:	IMC 1305.1	IMC 1305	1	Copper tubing shall have ¼ inch nominal and .20 inch minimum wall thickness.	Minimum supply line sizes are 3/8 in. inside diameter nominal pipe or outside diameter tubing.	Return lines shall be 1/4 in. inside diameter nominal pipe or 5/16 in. outside diameter tubing.	Minimum thickness for copper tubing is .035 in. nominal and .032 wall thickness.
A pressure relief valve shall be installed:	IMC 1210.7.7	IMC 1210	1	Low-pressure side of hydronic piping system	High-Pressure side of hydronic piping system	Set at the minimum pressure of the system design	Installed in accordance with section 1003
A corridor shall not serve as a source for supply air unless which of the following exceptions is met?	IMC 601.2	IMC 601	2	Tenant space that is 1,200 square feet	Located in, where it is not the primary source of supply air to a room in a pressurized health care room	Corridors in R-2 buildings	Toilet rooms that open into an office space
What is the minimum pitch for connectors?	IMC 803.10.5	IMC 803	3	1/8 unit vertical in 12 units horizontal	6 inches in 10 feet	1/4 unit vertical in 12 units horizontal	Must maintain a positive slope

with (1) 90 degree smooth elbow and (2) 45 degree smooth elbows? (assume an 8 inch radius)	IMC Table 504.8.4.1	IMC 504	2	29' - 7"	27'-7"	25' - 7"	26' - 7"
A furnace shall have a work space of not less than ____ inches along the front of the combustion chamber.	IMC 306.1	IMC 306	1	6 inches	3 inches	12 inches	30 inches
The minimum size of a closed-type expansion tank shall be based on the ____ of the hot water heating system.	IMC 1009.2	IMC 1009	1	Capacity	Rating	Listing	Manufacturer
Shield plates shall be provided for piping located ____ inches from the member to the wall for a distance of not less than ____ inches to each side of the framing member.	IFGC 404.7.1	IFGC 404	2	4, 1 1/2	1 1/2, 4	4, 4	1 1/4, 4
For a Type I hood exhaust termination, what is the minimum clearance elevation above the roof surface?	IMC 506.3.13.1	IMC 506	1	40 inches	34 inches	32 inches	18 inches
Where the code official finds insufficient evidence for a modification request for approval under alternative materials and equipment, all but which of the following may be required?	IMC 105.3	IMC 105	2	Test methods specified by the code or other recognized standards	Test sampling of actual product installation characteristics to assure code compliance	Test reports shall be kept for a period required for retention of public records	All testing shall be performed by an approved testing agency
A combustion chamber shall not have return air openings within ____ measured in any direction.	IMC 601.5	IMC 601	4	4 feet	5 feet	8 feet	10 feet
A forced air heating system services 12,500 cubic feet of volume, return air can be taken from which of the following rooms? (assume an 8 foot ceiling height)	IFGC 618.3	IFGC 618	3	14' x 26'	32' x 10'	22' x 18'	24' x 16'
What is the minimum height of a chimney flue cleanout?	IMC 801.13	IMC 801	2	4 inches	6 inches	8 inches	10 inches
The flash point of the actual heat transfer fluid utilized in a solar system shall not be less than ____ degrees Fahrenheit above the design maximum non-operating temperature of the fluid attained in the collector.	IMC 1403.1	IMC 1403	1	50	68	48	28
Smoke detectors shall be provided when air-handling systems shall return air ducts when the capacity is greater than ____.	IMC 606.2.2	IMC 606	2	200 cfm	2,000 cfm	500 cfm	5,000 cfm
An R-4, 3 story building shall be provided with a ____ local exhaust rate for the bathroom.	IMC Table 403.3.2.3	IMC 403	1	50 cfm intermittent	25 cfm intermittent	20 cfm intermittent	100 cfm intermittent
Bottom of the vent termination shall be located at least ____ above grade.	IMC 804.3.4	IMC 804	3	3 feet	5 feet	12 inches	6 inches
All are true for mixing refrigerants except:	IMC 1102.2.1	IMC 1102	4	Refrigerant blends in ASHRAE 34 shall not be mixed in a system	Added refrigerant must be in accordance with manufacturer's instructions	Refrigerants not identified in Table 1103.1 shall be approved before use	Addition of a 2nd refrigerant is permitted by the manufacturer to improve oil return at low temperatures
After a permit has been issued, that permit becomes invalid if work has not occurred within the last ____ days. An extension may be granted	IMC 106.4.3	IMC 106	2	90, 180	180, 180	180, 90	270, 90
A ____ hood shall be provided where appliances do not produce grease or smoke as a result of the processes.	IMC 507.3	IMC 507	2	Type I	Type II	Type III	
The cross-sectional area of a flue serving a solid-fuel-burning appliance shall not be greater than ____ times the cross-sectional area of the appliance flue collar.	IMC 801.7	IMC 801	1	3	4	1.5	2
What is the minimum required volume of combustion air for a fuel fired appliance?	IFGC 304.5.1	IFGC 304	3	40 cubic feet per 1000 BTU	40 cubic feet per 10000 BTU	50 cubic feet per 1000 BTU	50 cubic feet per 10000 BTU

A fire damper activation device shall have an operating temperature of not more than ____ °F.	IMC 607.3.3.1	IMC 607	4	50	150	300	350
A chimney is only required for hazardous exhaust flues with a temperature that exceeds ____.	IMC 510.8.2	IMC 510	2	400°F	600°F	800°F	500°F
A certificate of test for refrigerant piping shall have all of the following except:	IMC 1110.8	IMC 1110	1	Provided when more than 50 lbs. of Refrigerant	Signed by the installer	Name of refrigerant and pressure applied	Part of public record
Liquid fuel vent pipes shall terminate outside of buildings at a point not less than ____ feet measured vertically or horizontally from any building opening.	IMC 1305.7	IMC 1305	4	5	4	3	2
Underground inspection shall be made after trenches or ditches are excavated and bedded, piping installed, and _____ backfill is put in place.	IMC 108.2, Item 1	IMC 108	2	after	before	no	clean
Air removed from an approved conditioned space or location and recirculated or exhausted is _____.	IMC 202 General	IMC Chapter 2	3	exhaust air	intake air	return air	conditioned air
Copper tubing shall be supported every ____ feet when in a horizontal position.	IMC Table 305.4	IMC 305	2	5	8	3	6
Rooms containing appliances shall be provided with an unobstructed passageway measuring not less than ____ inches wide and ____ inches high.	IMC 306.2	IMC 306	4	24, 72	28, 66	32, 78	36, 80
The amount of supply air shall be approximately ____ to the amount of return and exhaust air.	IMC 403.1	IMC 403	1	equal	double	one and a half times	half
Recirculation of air from which of the following spaces to other unrelated spaces is prohibited?	403.3.1.1 Footnote b	IMC 403	3	meet processing	swimming pools	beauty salons	gambling casinos
What is the nominal thickness of domestic clothes dryer exhaust ducts?	IMC 504.9.1	IMC 504	2	0.024 inches	0.016 inches	0.018 inches	0.02 inches
Domestic downdraft kitchen appliances exhausting 400 CFM shall be _____.	IMC 505.3 Exception 2	IMC 505	2	provided with makeup air	schedule 40 PVC	constructed of aluminum	flexible duct
The temperature differential between makeup air in a commercial kitchen and the air in the conditioned space shall not exceed ____.	IMC 508.1.1	IMC 508	1	10	20	15	30
Return air shall not be taken from any of the following areas, except:	IMC 601.5 Item 7	IMC 601	4	unconditioned attic space	closet	kitchen	dining room
Ducts installed underground shall have a minimum slope of ____ inch per foot to allow for drainage to a point provided with access.	IMC 603.8.1	IMC 603	3	8.2 mm/m	5.1 mm/m	10.4 mm/m	7.2 mm/m
One permanent opening, commencing within ____ inches of the top of the enclosure shall be provided for outdoor combustion air.	IFGC 304.6.2	IFGC 304	1	12	16	8	10
Rungs on a permanent exterior ladder shall have a diameter not less than ____ inches and capable of withstanding a load of ____ pounds.	IFGC 306.5	IFGC 306	4	0.75, 400	1, 300	0.5, 250	0.75, 300
Vents shall terminate not less than ____ feet in vertical height above the highest connect appliance flue collar.	IMC 802.6	IMC 802	1	5	4	3	6
Galvanized steel vent connectors shall have a minimum thickness of ____ inch (No. ____ gage)	IMC 803.8	IMC 803	3	0.025; 30	0.018; 32	0.0136; 28	0.0118; 26
Cooking appliances that are designed for permanent installation shall be _____, _____, and installed in accordance with manufacturer's instructions.	IMC 917.1	IMC 917	2	tried, tested	listed, labeled	cleaned, sanitized	secured, grounded

What is the minimum distance of plume discharges above and away between cooling towers and any ventilation inlet to a building?	IMC 908.3	IMC 908	4	4 feet above, 20 feet away	8 feet above, 15 feet away	6 feet above, 15 feet away	5 feet above, 20 feet away
Refrigerant circuit access ports located _____ shall be fitted with locking-type tamper-resistant caps.	IMC 1101.9	IMC 1101	4	in controlled areas	in the attic	in the mechanical room	outdoors
For locations of refrigerating systems, a large mercantile occupancy is that portion of premises where more than _____ persons congregate on levels above or below street level to purchase personal merchandise.	IMC 1103.2	IMC 1103	1	100	200	50	250
All exterior above-grade fill piping for fuel oil piping and storage systems shall be _____ when tanks are abandoned or removed.	IMC 1301.5	IMC 1301	3	filled	destroyed	removed	recycled
A(n) _____ valve shall be installed on fuel-oil piping at the connection to each appliance where more than one fuel-oil-burning appliance is installed.	IMC 1307.2	IMC 1307	4	intermittent	condenser	regulator	shutoff
Which of the following is not a code requirement for metallic fittings?	IFGC 403.9.5 Item 1	IFGC 403	1	Threaded fittings larger than 3 inches shall not be used.	Cast iron flanges shall be permitted.	Zinc aluminum-alloy fittings shall not be used in systems containing flammable gas-air	Aluminum-alloy fitting threads shall not form the joint seal.
Piping shall be supported with all the following methods, except:	IFGC 407.2	IFGC 407	4	metal pipe straps	metal hooks	metal brackets	metal nails
The following appliances are not required to be vented, except:	IFGC 501.8	IFGC 501	4	hot plates	ranges	refrigerators	wall furnaces
Clothes dryer exhaust ducts shall terminate outside of the building and shall be equipped with:	IFGC 614.4	IFGC 614	2	bug screens	backdraft dampers	metal screws and fasteners	listed vent covers
Assuming (2) mitered 90's and (1) mitered 45-degree elbow, what is the equivalent length of the dryer duct shown. (Account for 5' of vertical duct)	IMC Table 504.8.4.1	IMC 504	2	32 feet	37 feet	24.5 feet	39.5 feet
How much exhaust air is required from the restroom shown if the fan runs continuously?	IMC Table 403.3.1.1	IMC 403	4	60 CFM	50 CFM	30 CFM	20 CFM
How much working clearance is required in front of FD-A1 if the adjacent door is in the closed position?	IMC 306.1	IMC 306	3	17 inches	24 inches	30 inches	36 inches
What type of damper is required where the supply air penetrates the mechanical shaft wall? Assume a Type B occupancy, no subducts, no sprinklers.	IMC 607.5.5	IMC 607	3	Ceiling Radiation Damper	Fire Damper	Fire and Smoke Damper	Smoke Damper
Assuming a 5,500 SF parking garage area, what are the minimum and maximum exhaust rates required for exhaust, assuming CO/NO2 protection throughout?	IMC 404.1	IMC 404	1	275/4125	325/4450	500/5225	445/3675
Assuming a dryer that exhausts 250 CFM, what is the minimum width for the makeup air opening in a laundry room closet door.	IMC 504.6	IMC 504	3	20"	24"	17"	11"

File Attachments for Item:

EC-4 Commercial Plumbing Inspector and Plans Examiner (2021 IPC) (West Coast Code Consultants)

All certifications (11 hours)

Application for Continuing Education Course Approval

Application for Continuing Education Course Approval

Provider Information

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Conference Sponsor (if applicable)

Conference Email

Check here if Course Renewal

Prior course number(s)' (i.e. BBS2018-429)

Renewals will only be granted for identical content and hours, within the current code cycle. Attach a copy of prior course approval letter for confirmation. No further information is required

New Course Information

Course title

2021 Commercial Plumbing Inspector and Plans Examiner

Course instructor

George Williams

Course description

Course Description: This 13-module course, followed by a 60-question practice examination, is based on the 2021 International Plumbing Code (IPC), as well as portions of the 2021 International Fuel Gas Code (IFGC). It teaches the practical application of the IPC & IFGC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 15 to 45 minutes in length.

Course Objectives: This course is designed to prepare you for the International Code Council's (ICC) Commercial Plumbing Inspector (P2) and/or Plumbing Plans Examiner (P3) exam, utilizing the 2021 IPC & IFGC. This course also serves as a review for those already familiar with the IPC & IFGC and may serve as an update course for those unfamiliar with the 2021 edition of the codes.

Instructional hours per session

11

Number of Sessions

Course Date

Course Location

Special Content

- Code Administration
- Existing Buildings
- Electrical Instruction
- Plumbing Instruction

Conference Course

Conference Name

Conference location

On Demand

Webinar

Course to be offered online?

Yes

No

Course Website

<https://www.pathlms.com/wc3-academy/courses/46>

Detail online course participation confirmation method (i.e. test, quizzes, participant activity confirmation):

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. You can progress through this course at your own pace; however, you only have access for 120 days.

Course applicable for the following certifications *

Residential Certifications Only

Administrative Course, All Certifications

Commercial and Residential Certifications

Application materials included *

Course Outline or Course Learning Objectives

Presentation Materials/Slides (not required for roundtable courses)

Assessment Materials (for online courses)

Presenter Bio

Prior Course Approval Letter

Upload less than 100mb (Please attach PDF files only) *

File Name	Size
2021 Commercial Plumbing Submittal Documents.pdf	15.92 MB

Applicant Full Name *

Brittany Allen

Date of Submission

06/06/2023

Instructions for new Continuing Education Approval form

Provider Information

1. Please include all contact information.
2. If course is not part of a conference, leave conference sponsor and email blank.

Course Renewal

1. Indicate if the course is being submitted for renewal. Include prior approval letter and write in prior course number.
2. Certification approval for courses has now changed: all existing courses being renewed will be approved within the new classification system.
 - a. Courses previously approved for only residential certifications will be approved for all residential certifications.
 - b. Courses previously approved for at least one commercial certification will now be approved for all commercial certifications and all residential certifications.
 - c. Courses on required instruction topics, Ohio Ethics, Code Administration and Existing Buildings, will be noted as Administrative Courses and be approved for all certifications.
3. Courses being renewed should skip the New Course information section and are not required to submit outline, agenda, slides or other instructional materials for review.

Skip to Special Content, and mark any item that applies to the course.

New Course Information

1. Enter course title, name of instructor, and a brief description of the course content.
Learning objectives may be substituted for course description, if desired.
2. Number of instructional hours per session is the length of instructional time.
3. Number of sessions: can be 1 or the number of sessions planned.
4. Course date(s) and location: not necessary at this time, enter if known.

Special Content

1. Indicate if the course will meet instructional time in Code Administration or Existing Buildings.
2. Indicate if the course is a plumbing or electrical course, for ESIAC review and trainee course tracking.
3. If the course is associated with a conference, indicate the conference name and location, as this will allow BBS to coordinate approvals with the conference provider.
4. If the course will be offered online, specify whether it will be on demand or offered as a virtual webinar, or both. Include website where the course will be provided.



2021 Commercial Plumbing Inspector and Plans Examiner

Course Outline

Cost: \$247, allowing 120 days of access.

Course Description: This **13-module course**, followed by a **60-question practice examination**, is based on the *2021 International Plumbing Code (IPC)*, as well as portions of the *2021 International Fuel Gas Code (IFGC)*. It teaches the practical application of the IPC & IFGC. Each module consists of an integrated video presentation, including presentation slides, explanation, examples, and review quizzes. Modules are designed to be 15 to 45 minutes in length.

Course Objectives: This course is designed to prepare you for the *International Code Council's (ICC) Commercial Plumbing Inspector (P2) and/or Plumbing Plans Examiner (P3) exam*, utilizing the *2021 IPC & IFGC*. This course also serves as a review for those already familiar with the IPC & IFGC and may serve as an update course for those unfamiliar with the 2021 edition of the codes.

Texts and Readings: The *2021 International Plumbing Code*, as well as the *2021 International Fuel Gas Code* are the textbooks for this course. It is highly recommended that you purchase a paper-back copy of these codes, which are available online at www.iccsafe.org. A physical copy can be utilized during the actual exams, which are open book, and serves as a valuable reference for in the field inspections.

Course Outline of Topics:

Module:	Topics:	Readings:	Quiz:	Duration:
1	Administration and Definitions	IPC Chapters 1 & 2	Y	34 min.
2	General regulations	IPC Chapter 3	Y	30 min.
3	Fixtures, Faucets & Fittings	IPC Chapter 4	Y	45 min.
4	Water Heaters, Water Supply & Distribution	IPC Chapter 5 & 6	Y	31 min.
5	Sanitary Drainage	IPC Chapter 7	Y	21 min.
6	Indirect/Special Waste & Vents	IPC Chapters 8 & 9	Y	33 min.
7	Traps, Interceptors & Separators; Storm Drainage; Special Piping & Storage	IPC Chapters 10 - 12	Y	22 min.
8	Nonpotable Water Systems	IPC Chapter 13	Y	13 min.
9	Gas Piping Installations	IFGC Chapter 4	Y	42 min.
10	Plumbing Accessibility	ICC A117.1-2017	Y	18 min.
11	Plumbing Plan Basics & Comment Writing Techniques			45 min.
12	Plumbing Review Methodology			23 min.
13	Supplemental Module – Gas Line Sizing			46 min.
	<i>10 Quizzes</i>			
	<i>69 Questions, 2 min. each</i>	<i>2021 IPC & IFGC</i>		<i>138 min.</i>
	<i>Practice Exam – 60 Questions</i>	<i>2021 IPC & IFGC</i>		<i>120-150 min.</i>
	Total Course Hours			11 hours



2021 Commercial Plumbing Inspector and Plans Examiner

Quizzes and Exams: Each module associated with this course will be followed by an assessment quiz of varying length. A passing score of 75% is required in order to advance to the next module. At the conclusion of the course is a timed practice exam. The exam is similar in length, content, and duration to the actual ICC exams, with 60 questions selected at random from a larger pool of questions. A passing score of 75% is required in order to obtain a certificate of completion from WC3 for this course. Topics in both the exam and the quizzes may or may not have been covered in the video modules. A thorough reading of the code may be necessary in order to progress through this course.

Expectation of Participants: This course requires that you to watch each training video, complete each quiz, as well as the exam. You are expected to read portions of the applicable code and become familiar with its layout and organization. We recommend 2 hours of personal study, for each module. Marking, tabbing, and highlighting in the code book is highly recommended. We have laid out a plan and method to help you learn the material, but it's up to you to put in the work necessary for you to master the material. You can progress through this course at your own pace; however, you only have access for 120 days.

Continuing Education Credits: Completion of this course results in **1.1 CEU's** (11 hours) being provided by ICC, as West Coast Code Consultants is a Preferred Provider.

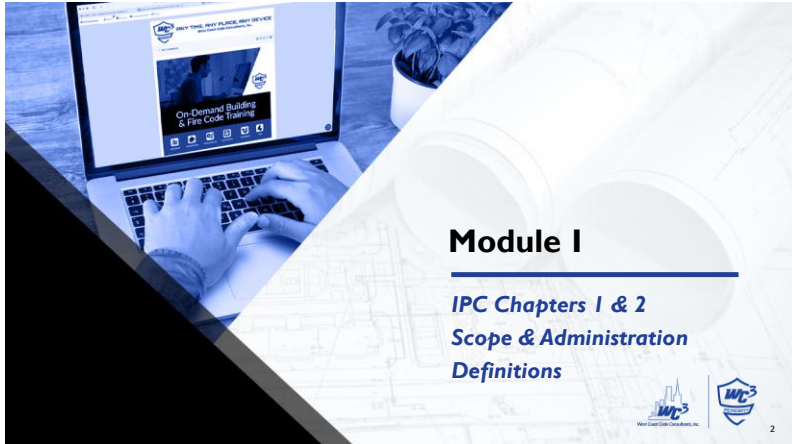
Instructor:



George Williams, MCP, CBO is the Director of WC3 Academy, but primarily identifies as a commercial plans examiner and building inspector. He has been a building inspector since 2005, has a master's degree in construction management, and has been ICC Master Code Professional since 2009. George has been instrumental in the start-up of multiple building departments including the adoption of codes, implementation of permit processes, development of policies and procedures, as well as the hiring and training of staff.



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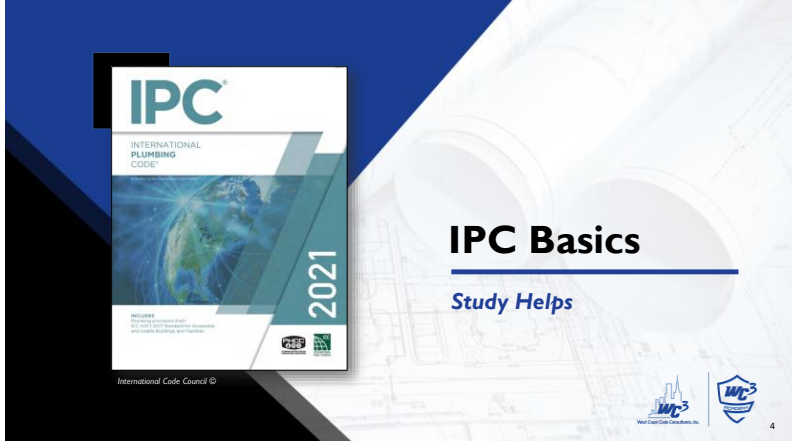


LEARNING OBJECTIVES

1. Become familiar with the subject matter covered in the ICC Commercial Plumbing Inspector Exam.
2. Understand the organization of the IPC with respect to layout, topics and chapters.
3. Know the administrative requirements of the IPC related to plumbing permits and required inspections.
4. Be able to locate defined terms in the IPC.



3



4

2021 Exam Breakdowns

	Commercial Plumbing Inspector Exam	Commercial Plumbing Plans Examiner Exam
General Requirements	8%	5%
Fixtures	15%	15%
Water Heaters	12%	10%
Water Supply and Distribution	18%	19%
Sanitary Drainage	13%	18%
Vents	15%	15%
Traps, Interceptors, Separators, Special Piping, and Storage Systems	9%	11%
Storm Drainage	5%	7%



2021 Exam References

- 2021 International Plumbing Code
- 2021 International Fuel Gas Code
- ICCA 117.1-2017 Accessible and Usable Buildings and Facilities



Preparation

- IPC and IFGC are not lengthy books
- Personal study: **2-hrs.** for every **1-hr. of class time**
- Highlight important sections
- Write key numbers in large print
- Tab your book



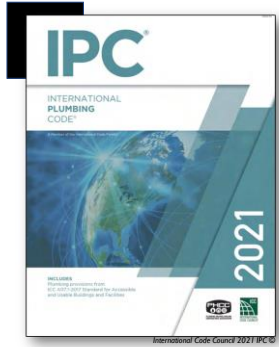
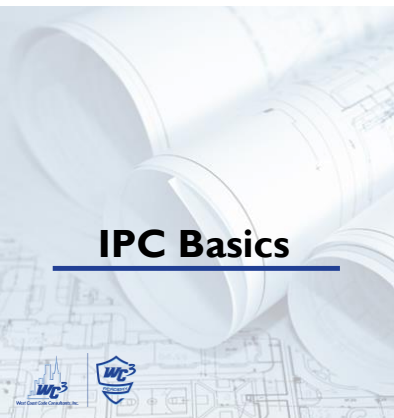
Examples

601.4 Intake opening location. Air intake openings shall comply with all of the following:

1. Intake openings shall be located not less than 10 feet (3048 mm) from lot lines or buildings on the same lot.
2. Mechanical and gravity exhaust air intake openings shall be located not less than 10 feet (3048 mm) horizontally from any hazardous or noxious contaminant source, such as vents, streets, alleys, parking lots and loading docks, except as specified in Item 3 or Section 501.3.1. Outdoor air intake openings shall be permitted to be located less than 10 feet (3048 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such location. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.
3. Intake openings shall be located not less than 3 feet (914 mm) below contaminant sources where such sources are located within 10 feet (3048 mm) of the opening.

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Key Items

- Marginal Markings
 - Solid vertical lines- New or modified
 - [] Entire section, paragraph, exception is deleted
 - [*] indicates text/table has been relocated elsewhere
 - [**] indicates text/table has been relocated there
- Italicized Terms (Definitions)
- Referenced Standards (Chapter 15)
- Appendices (A-F)
- Excerpts from the ICCA117.1-2019

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- 1. Scope and Administration
 - Scope and Application
 - Administration and Enforcement
- 2. Definitions
- 3. General Regulations
- 4. Fixtures, Faucets and Fixture Fittings
- 5. Water Heaters
- 6. Water Supply and Distribution
- 7. Sanitary Drainage
- 8. Indirect/Special Waste
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- 10. Traps, Interceptors and Separators
- 11. Storm Drainage



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- 12. Special Piping and Storage Systems
- 13. Nonpotable Water Systems
- 14. Subsurface Graywater Soil Absorption Systems
- 15. Referenced Standards
 - Appendix A – Plumbing Permit Fee Schedule
 - Appendix B – Rates of Rainfall for Various Cities
 - Appendix C – Structural Safety
 - Appendix D - Degree Day and Design Temperatures
 - Appendix E – Sizing of Water Piping System
 - Appendix F – Board of Appeals
 - Index
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IPC
INTERNATIONAL
PLUMBING
CODE
2021

IPC Chapter I
Administration

International Code Council 2021 / IPC ©

15



Intent

IPC 101.3

- To establish minimum standards to provide a reasonable level of:
 - Safety
 - Health
 - Property Protection
 - Public Welfare
- *“by regulating... design, construction, installation, quality of materials, location, operation and maintenance or use of plumbing equipment and systems.”*



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Applicability

IPC 102.1 – General

- Where there is a conflict between General and Specific
 - Specific governs.
 - The most restrictive applies.

IPC 102.8.2 – Referenced Codes

- Where the extent of a referenced standard includes subject matter that is within the scope of the IPC, the provisions of the IPC take precedence over the provisions in the referenced standard.



Applicability

IPC 102.10 – Other Laws

- Shall not nullify any other laws of local, state or federal.



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Duties & Powers

IPC 104.1

- The Code Official is authorized
 - and directed to enforce the code provisions
 - to render interpretations
 - to adopt policies and procedures
- The Code Official is not authorized
 - to waive the code provisions



Modifications

IPC 105.1

- Where practical difficulties are involved the building official has the authority to grant modifications.

IPC 105.2

- Alternative materials, methods, may be approved where information is provided, and approved by the Building Official
 - Research Reports
 - Testing





Permits

IPC 106.1 & 106.2

- Permits are required for everything unless exempted
 - Stopping of leaks
 - Clearing of stoppages
- May not do work in violation of the code

IPC 106.5.2

- Issuance of a permit does not permit or approve violation of the provisions of the code or ordinances.

IPC 106.5.3

- Permits expire if work has not commenced (180 days) or is abandoned (180 days)



Time limits

IPC 106.5.3 – 106.5.5

- Applications for Permits- Rules to Remember
 - Abandoned after 180 days
 - Extension can be given for periods not exceeding 180 days
 - Extension request must have "good and satisfactory reasons"



Temporary Equipment

IPC 107.1

- A permit for temporary equipment shall be limited as to time of service and shall not be permitted for longer than 180 days



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Required Inspections

IPC 108.2

"Underground inspection shall be made after trenches or ditches are excavated and bedded, piping installed, and before any backfill is put in place."



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Required Inspections

IPC 108.2

- Rough-in inspection:
 - "...after the roof, framing, fireblocking, firestopping, draftstopping, and bracing is in place..."
 - after "all sanitary, storm and water distribution piping is roughed-in,
 - and prior to the installation of wall or ceiling membranes."



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Disconnecting Utilities

IPC 115.6.2

- Authority given to the code official
- To eliminate an **immediate danger** to life or property
- Notification must be given to owner and occupant A.S.A.P



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IPC
INTERNATIONAL PLUMBING CODE
2021

IPC Chapter 2
Definitions

International Code Council 2021 / IPC ©

Definitions

- Terms with specific meanings are defined in Chapter 2
- Terms defined are placed in italics
- IPC 201.4: Terms not defined shall have ordinarily accepted meanings

"The beginning of wisdom is the definition of terms."
— *Socrates*



Chapter 2 – General Definitions

All Definitions are found in Section 202

- "ACCEPTED ENGINEERING PRACTICE. That which conforms to accepted principles, tests or standards of nationally recognized technical or scientific authorities."
- "BACKFLOW PREVENTER. A backflow prevention assembly, a backflow prevention device or other means or method to prevent backflow into the potable water supply."
- "CODE. These regulations, subsequent amendments thereto or any emergency rule or regulation that the administrative authority having jurisdiction has lawfully adopted"
- "CODE OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative."



Chapter 2 – General Definitions

All Definitions are found in Section 202

- "CONDUCTOR. A pipe inside the building that conveys storm water from the roof to a storm or combined building drain."
- "EXISTING INSTALLATION. Any plumbing system regulated by this code that was legally installed prior to the effective date of this code, or for which a permit to install has been issued."
- "GRAYWATER. Waste discharged from lavatories, bathtubs, showers, clothes washers and laundry trays."
- "HOT WATER. Water at a temperature greater than or equal to 110°F (43°C)."




Chapter 2 – General Definitions

All Definitions are found in Section 202

- "POTABLE WATER. Water free from impurities present in amounts sufficient to cause disease or harmful physiological effects and conforming to the bacteriological and chemical quality requirements of the Public Health Service Drinking Water Standards or the regulations of the public health authority having jurisdiction."
- "SEWAGE. Any liquid waste containing animal or vegetable matter in suspension or solution, including liquids containing chemicals in solution."
- "STACK. A general term for any vertical line of soil, waste, vent or inside conductor piping that extends through not fewer than one story with or without offsets."
- "TRAP. A fitting or device that provides a liquid seal to prevent the emission of sewer gases without materially affecting the flow of sewage or wastewater through the trap."




END OF MODULE




MODULE 2:

IPC Chapter 3- General Regulations




1



LEARNING OBJECTIVES

1. Understand general requirements for the installation of plumbing piping in a variety of locations and circumstances.
2. Know how to adequately protect plumbing piping from damage due to temperature and other physical hazards.
3. Become familiar with structural consideration related to the installation of plumbing systems in new and existing buildings.
4. Be able to identify necessary test methods and procedures associated with various plumbing systems.



2



Chapter 3

General Regulations



3



General Regulations

IPC 301.1

- This chapter governs the **general regulations** regarding the installation of plumbing not specific to other chapters.

IPC 301.2

- “Plumbing shall be installed with due regard to:”
 - Preservation of **structural strength**
 - Prevention of **damage**
 - ...to walls and other surfaces through fixture usage”

4

Connection to Drainage

IPC 301.3

- Plumbing fixtures, drains, and appliances that receive or discharge liquid wastes or sewage shall be directly connected to the sanitary drainage system as per the requirements of this code.

Exceptions:

- Indirect Waste System (Chapter 8)
- Gray water systems



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Prohibited Locations of Plumbing Systems

IPC 301.6

- Elevator Shaft
- Elevator Equipment Room

Exception for Base of Elevator Shafts

- Floor drains
- Sumps
- Sump Pumps



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Conflicts

IPC 301.7

Where conflicts occur between the code and manufacturer the most restrictive applies.



V.S.



7

Title

IPC 302.1

Detrimental or dangerous materials shall not to be deposited into the sewer system

- Ashes, cinders or rags
- Flammable, poisonous or explosive liquids or gases
- Insoluble material capable of obstructing, damaging or overloading the system
- Materials capable of interfering with the sewage treatment processes



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Pipe Identification

IPC 303.1

“Each length of pipe, and each pipe fitting, trap, fixture, material and device... shall bear the identification of the manufacturer and any markings required by the referenced standards.”



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Installation of Materials

IPC 303.2

Installed in strict accordance with:

- Installation procedures
- Manufacturer's instructions
- Referenced standards



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Installation of Materials

IPC 303.4

All plumbing products and materials shall be listed by a third-party certification agency.



upcviolence.org



Rodentproofing

IPC 304.1

- Shall be designed and installed to prevent rodents entering structures
 - Strainer plates on drains (1/2" max)
 - Meter boxes



Photo by youn0815 on Unsplash





Openings around Pipes

IPC 304.4

The annular space between pipes and the sides of openings shall be sealed with caulking materials or gasketing systems compatible with the piping materials.



13

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Protection Against Contact

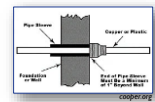
IPC 305.1

Metallic pipes passing through steel framing members, concrete or cinder walls and floors or other corrosive material shall have:

- A protective sheathing or wrapping (8 mil)
- Sheathing or wrapping shall allow for movement

Exceptions:

- Cast Iron
- Ductile Iron
- Galvanized Steel



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Stress and Strain

IPC 305.2

- Piping "shall be installed so as to prevent strains and stresses that exceed the structural strength of the pipe"
- "...provisions shall be made to protect piping from damage resulting from expansion, contraction and structural settlement."

IPC 305.3

- "Any pipe that passes through a foundation wall shall be provided with a relieving arch" or... "Pipe sleeve two pipe sizes greater than the pipe."



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Freeze Protection

IPC 305.4

- Water, soil and waste pipes shall not be installed in any place subjected to freezing temperatures. (Provisions can be made to protect such pipes by insulation or heat)
- Exterior water supply system piping shall be installed:
 - 6 inches below the frost line and
 - At least 12 inches below grade

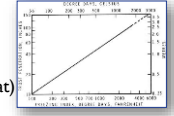


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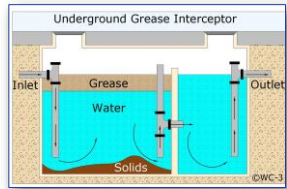
16

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Sewer Depth

IPC 305.4.1

Private sewage disposal system connections to septic tanks, as well as standard building sewer connections shall be installed at a depth determined by the jurisdiction.



Physical Damage

IPC 305.6

- Not required for cast iron and galvanized
- Nail plates if less than 1-1/4" from framing member edge
- Always ask- "Could it be punctured if left unprotected?"



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Trenching, Excavation & Backfill

IPC 306.2.1 Support of piping

"Buried piping shall be supported throughout its entire length."



IPC 306.2.1 Trenching and bedding

- Bottom of the trench forms the bed for the pipe
- "Bell holes, hub holes and coupling holes shall be provided at points where the pipe is joined."
- Not be supported on blocks to grade
- Check manufacturer's instructions.



Trenching, Excavation & Backfill

IPC 306.2.1 Over excavation

- Sand or fine gravel placed in layers not greater than 6 inches in depth.
- Backfill shall be compacted after each placement.

IPC 306.2.2 Rock Removal

- "...the rock shall be removed to not less than 3 inches below the installation level of the bottom of the pipe, and the trench shall be backfilled to the installation level of the bottom of the pipe with sand tamped in place so as to provide uniform load-bearing support for the pipe between joints
- The pipe, including the joints, shall not rest on rock at any point.



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Backfill Materials

IPC 306.3

- Free from discarded construction material and debris.
- Free from rocks, broken concrete and frozen chunks.
- Shall be placed in 6-inch layers and tamped in place until covered by 12 inches of earth.
- The backfill under and beside the pipe shall be compacted.
- Backfill shall be brought up evenly.



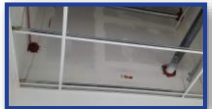
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Structural Safety

IPC 307.1

- When installing or repairing any part of a plumbing system all parts of the building or premises that must be changed or replaced shall be left in a safe structural condition in accordance with the IBC.



IPC 307.3

- Penetrations of fire-resistance-rated assemblies shall be protected in accordance with the IBC.



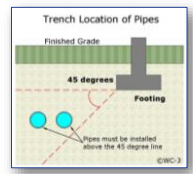
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Trench Location

IPC 307.5

Trenches installed parallel to footings shall not extend below the 45-degree bearing plane of the footing or wall.



Piping Supports

IPC 308.2

Where earthquake loads are applicable, piping supports shall be designed and installed for the seismic forces in accordance with the IBC.



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Hanger Spacing

Table 308.5

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
ABS pipe	4	10*
Aluminum tubing	10	15
Brass pipe	10	10
Cast-iron pipe	5*	15
Copper or copper-alloy pipe	12	10

a. The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed.
 b. Mid-story guide for sizes 2 inches and smaller.



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Sway Bracing

IPC 308.6

- Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for pipe sizes 4 inches and larger.

IPC 308.7.1

- For pipe > 4 inches, restraints shall be provided at all changes in direction and at changes in diameter greater than two pipe sizes.



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Parallel Distribution

IPC 308.9

When bundled with cold water piping, hot water piping must be insulated.



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Washroom & Toilet Room

IPC 310.1

“Washrooms and toilet rooms shall be illuminated and ventilated in accordance with the IBC and IMC.”



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Toilet Facilities for Workers

IPC 311.1

“Toilet facilities shall be provided for construction workers and such facilities shall be maintained in a sanitary condition.”



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Tests & Inspections

IPC 312

- All plumbing systems need to be tested.
- Permit holder must provide all materials and labor to perform the test.



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Test Gauges

IPC 312.1.1

Pressures	Increments
10 psi and less	.1 psi or less
> 10 psi to 100 psi	1 psi or less
> 100 psi	2 psi or less

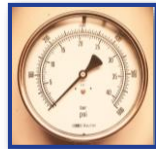


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Test Pressures & Durations

Section	Test	Method	Duration
IPC 312.2	DWV- Water	10' Head of Water	15 Minutes
IPC 312.3	DWV- Air*	5 psi Air	
IPC 312.4	DWV- Final	1" w.c. of Smoke	
IPC 312.5	Water Supply	Working Pressure <u>or</u> 50 psi Air*	
IPC 312.6	Gravity Sewer	10' Head of Water	
IPC 312.7	Forced Sewer	5 psi + Pump Rating	
IPC 312.8	Storm Drain	10' Head of Water <u>or</u> 5 psi Air	
IPC 312.9	Shower Liner/Pan	2" Water Depth	
IPC 312.10	Backflow Assembly	Annual Inspections per Standards	

*Plastic piping not to be pressure tested with air

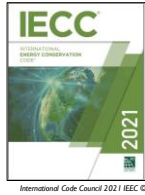




Equipment Efficiencies

IPC 313.1

“Equipment efficiencies shall be in accordance with the International Energy Conservation Code.”



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Condensate Disposal

IPC 314.1

Condensation shall be collected and discharged to approved plumbing fixture or disposal area in accordance with the manufacturer’s instructions.

- Shall be of approved corrosion-resistant material.
- Shall not be smaller than the drain connection on the appliance.
- Shall maintain a horizontal slope in the direction of discharge with a 1% slope.



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Condensate Drain Sizing

Table 314.2.2

EQUIPMENT CAPACITY	MINIMUM CONDENSATE PIPE DIAMETER
Up to 20 tons of refrigeration	3/4 inch
Over 20 tons to 40 tons of refrigeration	1 inch
Over 40 tons to 90 tons of refrigeration	1 1/4 inch
Over 90 tons to 125 tons of refrigeration	1 1/2 inch
Over 125 tons to 250 tons of refrigeration	2 inch



Alternate Engineered Design


IPC 316.1

- Conform to the intent
- Clearly indicate on the application
- Provide technical data
- Subject to Code Official approval






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MODULE 3:
 IPC Chapter 4- Fixtures,
 Faucets & Fittings



1



LEARNING OBJECTIVES

1. Understand minimum plumbing fixture requirements for various uses and occupancies.
2. Be able to correctly calculate required fixtures for each sex based on calculated occupant loads.
3. Know where public toilet facilities are required, and prohibited from being located.
4. Become familiar with code requirements specific to common plumbing fixtures.



2



Chapter 4
 Fixtures, Faucets & Fittings



3

Minimum Plumbing Facilities

IPC 403.1

- Plumbing fixtures shall be provided, based on the actual use of the building or space, in the minimum number shown in Table 403.1
- Uses not shown in Table 403.1 shall be considered individually by the code official.
- The number of occupants shall be determined by the International Building Code.
- Same as Chapter 29 of the IBC.



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IPC Table 403.1

NO.	CLASSIFICATION	DESCRIPTION	WATER CLOSETS (URINALS: SEE SECTION 424.2)		LAVATORIES		BATHTUBS SHOWERS	DRINKING FOUNTAIN (SEE SECTION 410)	OTHER
			MALE	FEMALE	MALE	FEMALE			
1	Assembly	Theaters and other buildings for the performing arts and motion pictures ¹	1 per 125	1 per 65	1 per 200	—	1 per 500	1 service sink	
		Nightclubs, bars, taverns, dance halls and buildings for similar purposes ²	1 per 40	1 per 40	1 per 75	—	1 per 500	1 service sink	
		Restaurants, banquet halls and food courts ³	1 per 75	1 per 75	1 per 200	—	1 per 500	1 service sink	

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Table 403.1 Footnotes

- a. The fixtures shown are based on one fixture being the minimum required for the number of persons indicated or any fraction of the number of persons indicated. The number of occupants shall be determined by the International Building Code.
- b. Toilet facilities for employees shall be separate from facilities for inmates or care recipients.
- c. A single-occupant toilet room with one water closet and one lavatory serving not more than two adjacent patient sleeping units shall be permitted provided that each patient sleeping unit has direct access to the toilet room and provision for privacy for the toilet room user is provided.
- d. The occupant load for seasonal outdoor seating and entertainment areas shall be included when determining the minimum number of facilities required.
- e. For business and mercantile classifications with an occupant load of 15 or fewer, service sinks shall not be required.
- f. The required number and type of plumbing fixtures for outdoor public swimming pools shall be in accordance with Section 609 of the International Swimming Pool and Spa Code.



Fixture Calculations

IPC 403.1.1

- "To determine the occupant load of each sex, the total occupant load shall be divided in half."
 - "Exception: The total occupant load shall not be required to be divided in half where approved statistical data indicates a distribution of the sexes of other than 50 percent of each sex."
- "To determine the required number of fixtures, the fixture ratio or ratios for each fixture type shall be applied to the occupant load of each sex in accordance with Table 403.1."
- Fractional numbers shall be rounded up to the next whole number.
- For multiple occupancies, fractional numbers for each occupancy shall first be added together and then rounded up.



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Example:
242 Total Occupants =
121 Males & 121 Females



Family or Assisted-Use

IPC 403.1.2

- Fixtures located within family or assisted-use toilet and bathing rooms are permitted to be included in the number of required fixtures for either the male or female occupants

(Only in Assembly or Mercantile Use Groups)



Separate Sex Facilities

IPC 403.2

"Where plumbing fixtures are required, separate facilities shall be provided for each sex."

Exceptions:

- 1. Not be required for dwelling units and sleeping units.
- 2. Not be required when the total occupant load, including employees and customers is **15 or fewer**.
- 3. Not required in mercantile occupancies with a maximum occupant load of **100 or fewer**.
- 4. Not required in business occupancies with an occupant load of **25 or fewer**.
- 5. Not required to be designated by sex if single-user toilet room are provided in accordance with 403.1.2.
- 6. Not required where rooms that are designed for use by both sexes (with privacy in accordance with Section 405.3.4) have both water closets and lavatory fixtures.



Substitutions

IPC 403.2.1

- Family or assisted-use toilet facilities serving as separate sex facilities
- **Situation**-Where a space requires separate sex facilities and requires **only one** water closet per facility
- **Substitution**- **Two** family or assisted-use toilet facilities shall be permitted to serve as the required separate facilities.

(Does not require gender identification)



Public Facilities

IPC 403.3

- Body Customers, patrons and visitors shall be provided with **public** toilet facilities in structures and tenant spaces intended for public utilization.
- The number of plumbing fixtures located within the required toilet facilities shall be provided in accordance with Section 403 for all users.



Employee Toilet Facilities

IPC 403.3

- Employees shall be provided with toilet facilities in all occupancies.
- Employee toilet facilities shall be either separate or combined employee and public toilet facilities.

Exceptions:

- Toilet facilities not required in parking garages where there are no parking attendants.
- Toilet facilities are not required in spaces intended for quick transactions (takeout, pickups, or drop-offs) where the public access area is **300 sq. ft. or less**.





Public Toilet Access & Location

IPC 403.3.1

- Routes to public toilet facilities shall not pass through kitchens, storage rooms or closets



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IPC 403.3.2

- Toilet rooms shall not open directly into a room used for the preparation of food for the public



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Location in Building

IPC 403.3.3

- In occupancies other than mall buildings, public and employee toilet facilities shall be located not more than one story above or below the space required to have the toilet facilities (Travel distance to such facilities shall not exceed 500 feet.)

Exceptions:

- In factory and industrial occupancies distances are permitted to exceed 500 feet, provided the distances are approved
- In Group S occupancies distances are permitted to exceed 500 feet, provided the distances are approved



Restroom Signage

IPC 403.4.1

- "Directional signage indicating the route to the required public toilet facilities shall be posted in a lobby, corridor, aisle or similar space..."
- Sign to be readily seen from the main entrance to the building or tenant space



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Drinking Fountain Locations

IPC 403.5

- Not required in individual tenants provided that public drinking fountains are located within 500 feet of the most remote location in the tenant space and not more than one story above or below
- When in a covered or open mall, such distance shall not exceed 300 feet



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Accessible Facilities

IPC 404.1

- Shall be provided in accordance with Chapter 11 of the International Building Code
- Fixtures shall be in accordance with ICC A117.1



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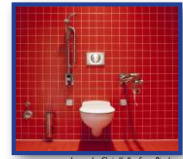
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Access for Cleaning

IPC 405.2

Installed to afford easy access for cleaning the fixture and the surrounding area



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Fixture Installation

IPC 405.3.1

Clearances for Water Closets, Urinals, Lavs and Bidets:

- 15" from center to side walls
- 30" from center to center of fixture
- 21" from front to any other obstruction



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Installation Requirements

IPC 405.3.2

- "In employee and public toilet rooms, the required lavatory shall be located in the same room as the required water closet"

IPC 405.3.3

- Piping, fixtures or equipment shall not interfere with the operation of windows, doors or means of egress openings



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20

Water Closet Compartments

IPC 405.3.4
"Each water closet utilized by the public or employees shall occupy a separate compartment with walls or partitions and a door enclosing to ensure privacy."

- Exceptions:**
- Not required in a single-occupant toilet room with lockable door.
 - In child day care facilities and containing two or more water closets shall be permitted to have one water closet without an enclosing compartment.
 - Not applicable to toilet areas located within Group I-3 housing areas.



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Urinal Partitions

IPC 405.3.5

- "Each urinal utilized by the public or employees shall occupy a separate area with walls or partitions to provide privacy"
- "The walls or partitions shall begin at a height not greater than 12 inches from and extend not less than 60 inches above the finished floor surface"
- "The walls or partitions shall extend from the wall surface at each side of the urinal not less than 18 inches or to a point not less than beyond the outermost front lip of the urinal, whichever is greater"



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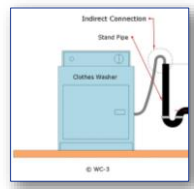
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Clothes Washers

IPC 406.1
• The water supply shall be protected by an air gap that is integral with the machine or a backflow preventer.

IPC 406.2
• Waste shall discharge through an air break into a standpipe or into a laundry sink. The trap shall connect to a 2-inch or larger diameter fixture branch or stack.



Bathtub Waste & Overflows

IPC 407.2

- Waste shall be connected to waste tubing or piping not less than 1 1/2 inches in diameter
- When overflow is provided, not less than 1 1/2 inches in diameter

IPC 407.3

- Windows and doors within a bathtub enclosure shall comply with safety glazing requirements of the IBC



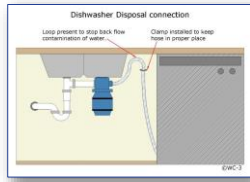
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Dishwashers

IPC 409.1 – 409.3

- *“Commercial dishwashing machines shall conform to ASSE 1004 and NSF 3”*
- The water supply shall be protected against backflow by an air gap or backflow preventer
- Waste connections need to comply with Section 802.1.6 of the IPC (Indirect Waste)



Drinking Fountains

IPC 410.3- 410.5

- Not fewer than 2 drinking fountains shall be provided. One for people who use wheelchairs, and one for standing persons.
- For drinking fountains required in occupancies other than restaurants, water dispensers shall be permitted to be substituted for **no more than 50%** of the required number.
- May not be installed in public restrooms.



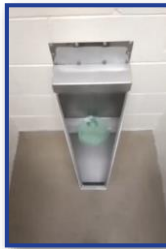
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Water Consumption

IPC 412.1.1

“Faucets and supply fittings shall conform to the water consumption requirements of Section 604.4”



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PLUMBING FIXTURE OR FIXTURE FITTING	MAXIMUM FLOW RATE OR QUANTITY*
Lavatory, private	2.2 gpm at 60 psi
Lavatory, public (metering)	0.25 gallons per metering cycle
Lavatory, public (other than metering)	0.5 gpm at 60 psi
Shower head ¹	2.5 gpm at 80 psi
Sink faucet	2.2 gpm at 60 psi
Urinal	1.0 gallons per flushing cycle
Water closet	1.6 gallons per flushing cycle

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Bathtub Valves

IPC 412.5

- Maximum temperature limit of **120°F**.
- Regulated by a device that conforms to ASSE 1070/ASME A112.1070/CSA B125.3



Floor & Trench Drains

IPC 413.2

- Shall have removable strainers. Access shall be provided and drains must be capable of being cleaned

IPC 413.3

- Drain outlet shall be not less than **2 inches** in diameter

IPC 413.4

- Public laundries and central washing rooms containing clothes washers shall be provided with floor drains capable of draining the entire floor area and sized not less than **3 inches** in diameter



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Flushing Devices

IPC 415

- Required for water closets, urinals, clinical sinks, etc.
- Shall be provided with a flushometer valve, flushometer tank or flush tank

Intent is to:

- Flush the contents of the fixture.
- Cleanse the fixture.
- Refill the fixture trap



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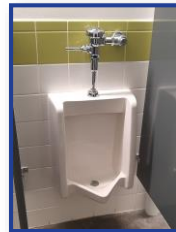
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Flush Valves

IPC 415.2

- Shall be of the water conservation type
- Shall automatically complete the cycle of operation, opening fully and closing positively
- Must have a means for regulating the flow through the valve
- The trap seal to the fixture shall be automatically refilled



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Flush Tanks

IPC 415.3

- Shall refill the tank after each discharge and shut off water flow completely when the tank is full.
- Automatic flushing devices shall be controlled by a timer or sensor.
- Shall be equipped with an anti-siphon valve
- The fill valve backflow preventer shall be at least 1 inch above the opening of the overflow pipe



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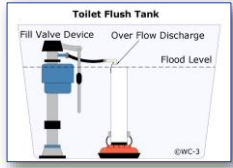
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Overflows

IPC 415.3

- Shall be sized to prevent flooding the tank at the maximum rate at which the tanks are supplied.
- Shall be located above the floor level rim of the water closet or urinal or above a secondary overflow in the flush tank.



Food Waste Disposers

IPC 416.2 & 416.4

- Shall be connected to a drain not less than 1-1/2" in diameter
- Water supply required
 - Cold water
 - Protected against backflow with air gap or backflow preventer



Lavatories

IPC 419.3

- Lavatory waste outlets shall not be less than 1 1/4 inches in diameter
- A strainer, pop-up stopper, crossbar or other device shall be provided to restrict the clear opening



Water Temperature

IPC 419.5

- Tempered water shall be delivered from lavatories and group wash fixtures located in public toilet facilities

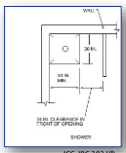
IPC 607.1.2

- Tempered water shall be supplied through a temperature limiting device for 110°F max water temp



Shower Compartments

- IPC 421.4**
- 900 square inch minimum interior area
 - No less than 30" between interior finishes
 - Height no less than 70"



- Exception:**
- If shower has only 25" clearance from interior finishes, total area of shower must be 1300 in²



Showers

- IPC 421.4.1**
- The walls of showers and above built-in tubs with shower heads shall be constructed of smooth, nonabsorbent waterproof materials to a height of no less than 6 feet above the floor level.



Sinks

- IPC 422.2**
- Sinks shall be provided with waste outlets having a diameter not less than 1 1/2 inches
 - A strainer or crossbar shall be provided to restrict the clear opening



Specialty Fixtures

- IPC 423.1**
- Water connections for baptisteries, ornamental and lily pools, aquariums, ornamental fountain basins, swimming pools, etcetera, with water supplies, shall be protected against backflow as per IPC 608
- IPC 423.3**
- The water supplied to specialty plumbing fixtures such as pedicure chairs having an integral foot bathtub, footbaths, and head shampoo sinks shall be limited to a maximum temperature of 120°F





Urinals

IPC 424.2

Urinals shall not be substituted for more than **67%** of the **required** water closets in assembly and educational occupancies



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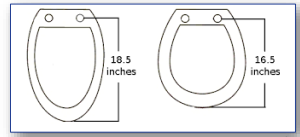
Water Closets

IPC 425.2

- Water closet bowls for public or employee toilet facilities shall be of the elongated type
 - Seats shall be of a smooth nonabsorbent material

IPC 425.4

- "A 4-inch by 3-inch closet bend shall be acceptable. Where a 3-inch bend is utilized on water closets, a 4-inch by 3-inch flange shall be installed to receive the fixture horn"



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Whirlpool Bathtubs

IPC 426.2

- Must be installed in accordance with the manufacturer's instructions
- The pump shall be located above the weir of the fixture trap



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Whirlpool Pumps

IPC 426.5

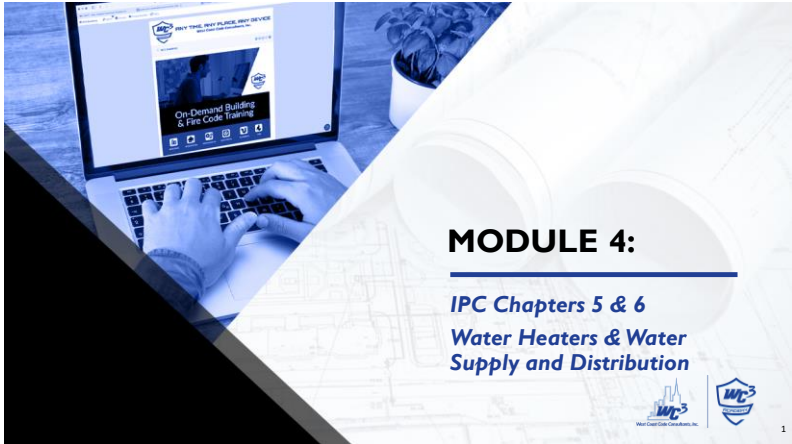
- Access shall be provided to in accordance with the manufacturer's installation instructions
- Where it is not specified, an opening of not less than 12x12 inches shall be installed
- If located more than 2 feet from the access, and opening 18x18 inches is required



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MODULE 4:

*IPC Chapters 5 & 6
Water Heaters & Water
Supply and Distribution*



1

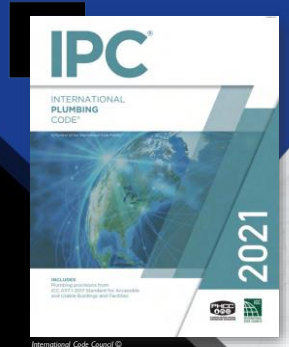


LEARNING OBJECTIVES

1. Become familiar with the specific installation requirements and considerations associated with both gas and electric water heaters.
2. Understand the acceptable sources of, use and distribution of potable water.
3. Know how to adequately protect the potable water system from contamination from other sources.
4. Explain basic code requirements related to the location and code compliant construction of individual water supplies.




2



Chapter 5

Water Heaters



3



General Requirements

IPC 501.2:

Combination Space/Water Heating

- Space heating requiring $>140^{\circ}F$ require temperature-actuating mixing valve to limit potable water to $140^{\circ}F$ max

IPC 501.4:

- Shall be accessible for observation, maintenance, servicing & replacement

IPC 501.6:

- Tankless Water Heaters $140^{\circ}F$ max



4



Installation

IPC 502.4:

- Where earthquake loads are applicable, supports shall be designed and installed for the seismic forces

IPC 502.5:

- A level working space not less than 30 inches x 30 inches shall be provided in front of the control side



5



Water Connections

IPC 503.1:

- Cold water branch lines "shall be provided with a valve, located near the equipment and serving only the hot water storage tank or water heater"
- Shall be provided with access on the same floor level as the water heater served

IPC 503.2:

- Shall provide circulation of water through the water heater



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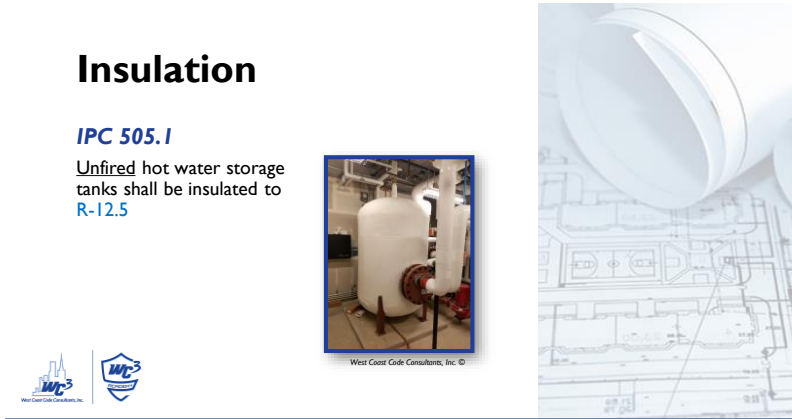
Required Pans

IPC 504.7:

- Where installed in a location where water leakage from the tank will cause damage, the tank shall be installed in a pan constructed of:
 - galvanized steel or aluminum having a thickness of not less than 0.0236 inch (24 gage) or
 - Plastic having a thickness of not less than 0.036 inch or
 - Other approved materials.



7




Insulation

IPC 505.1

Unfired hot water storage tanks shall be insulated to R-12.5



8




Chapter 6

Water Supply & Distribution

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9




Required Water

IPC 602.2:

- Only potable water shall be supplied to plumbing fixtures that provide water for:
 - Drinking
 - Bathing
 - Culinary Purposes
 - Processing of Food
 - For Medical or Pharmaceutical Products

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Individual Water Supply

IPC 602.3:

“Where a potable public water supply is not available, individual sources of potable water supply shall be utilized”




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Individual Water Supply

IPC 602.3.1:

Dependent upon the geological and soil conditions and the amount of rainfall, individual water supplies are the following:

Drilled Well	Spring
Driven Well	Stream*
Dug Well	Cistern*
Bored Well	




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*Surface bodies of water and land cisterns must be properly treated

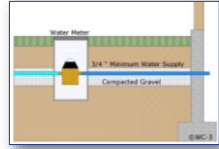
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Water Service Sizing

IPC 603.1:

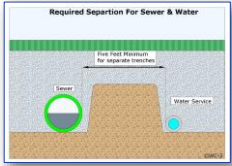
Shall be sized to supply water in the quantities and pressures required in the code.
(Not less than 3/4 inch in diameter)



Required Separations

IPC 603.2:

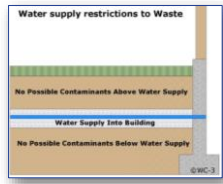
- Where located in the same trench as the building sewer, the sewer must be constructed of materials listed in Table 702.2.
- Where not constructed as per Table 702.2 “the water service pipe and the building sewer shall be separated horizontally by not less than 5 feet of undisturbed or compacted earth.”



Contaminants

IPC 603.2.1:

“Potable water service pipes shall not be located in, under or above cesspools, septic tanks, septic tank drainage fields or seepage pits”



Water Distribution Design

Table 604.3

TABLE 604.3 WATER DISTRIBUTION SYSTEM DESIGN CRITERIA REQUIRED CAPACITY AT FIXTURE SUPPLY PIPE OUTLETS		FLOW RATE (gpm)	FLOW PRESSURE (psi)
FIXTURE SUPPLY OUTLET SERVING			
Bathub, balanced-pressure, thermostatic or combination balanced-pressure/thermostatic mixing valve	4	20	8
Bidet, thermostatic mixing valve	2	20	8
Combination fixture	4	8	8
Dishwasher, residential	2.75	8	8
Drinking fountain	0.75	8	8
Laundry tray	4	8	8
Lavatory, private	0.8	8	8
Lavatory, private, mixing valve	0.8	8	8
Lavatory, public	0.4	8	8
Shower	2.5	8	8
Shower, balanced-pressure, thermostatic or combination balanced-pressure/thermostatic mixing valve	2.5 ^a	20	8
Sillcock, hose bibb	5	8	8
Sink, residential	1.75	8	8
Sink, service	3	8	8
Urinal, valve	12	25	25
Water closet, blow out, flushometer valve	25	45	45
Water closet, flushometer tank	1.6	20	20
Water closet, siphonic, flushometer valve	25	35	35
Water closet, tank, close coupled	3	20	20
Water closet, tank, one piece	6	20	20



Maximum Flow Rates

Table 604.4

TABLE 604.4 MAXIMUM FLOW RATES AND CONSUMPTION FOR PLUMBING FIXTURES AND FIXTURE FITTINGS	
PLUMBING FIXTURE OR FIXTURE FITTING	MAXIMUM FLOW RATE OR QUANTITY ^a
Lavatory, private	2.2 gpm at 60 psi
Lavatory, public (metering)	0.25 gallon per metering cycle
Lavatory, public (other than metering)	0.5 gpm at 60 psi
Shower head ^b	2.5 gpm at 80 psi
Sink faucet	2.2 gpm at 60 psi
Urinal	1.0 gallon per flushing cycle
Water closet	1.6 gallons per flushing cycle

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Minimum Supply Lines

IPC 604.5:
Lavatories shall have a minimum of 3/8 inch water supply pipes.

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Minimum Supply Lines

Table 604.4

TABLE 604.4 MINIMUM SIZES OF FIXTURE WATER SUPPLY PIPES			
FIXTURE	MINIMUM PIPE SIZE (inch)		
Bathtubs ^a (60" x 32" and smaller)	1/2	Shower, single head ^b	1/2
Bathtubs ^a (larger than 60" x 32")	3/4	Sinks, flushing rim	1/4
Bidet	1/2	Sinks, service	1/2
Combination sink and tray	1/2	Urinal, flush tank	1/2
Dishwasher, domestic ^c	1/2	Urinal, flushometer valve	1/2
Drinking fountain	1/2	Wall hydrant	1/2
Hose bibbs	1/2	Water closet, flush tank	1/2
Kitchen sink ^d	1/2	Water closet, flushometer tank	1/2
Laundry, 1, 2 or 3 compartments ^e	1/2	Water closet, flushometer valve	1
Lavatory	3/8	Water closet, one piece ^f	1/2

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Water Pressure

IPC 604.6:
"Where street water main pressures fluctuate, the... system shall be designed for the minimum pressure available"

IPC 604.7:
Where water pressure from the street is insufficient to provide flow pressures as required under Table 604.3, a water pressure booster system shall be installed

20

Parallel Water Distribution

IPC 604.10:

Hot water and cold water manifolds installed with gridded or parallel connected individual distribution lines to each fixture or fixture fitting shall be designed in accordance with Section 604.10.1 through 604.10.3.

TABLE 604.10.1
MANIFOLD SIZING

NOMINAL SIZE INTERNAL DIAMETER (inches)	MAXIMUM DEMAND (gpm)	
	Velocity at 4 feet per second	Velocity at 8 feet per second
1/2	2	5
3/4	6	11
1	10	20
1 1/4	15	31
1 1/2	22	44

Foot Note: 1 inch = 2.54 centimeters. 1 gallon per minute = 3.785 liters. 1 foot per second = 0.915 m/s.

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Manifolds

IPC 604.10.2:

“Individual fixture shutoff valves installed at the manifold shall be identified as to the fixture being supplied”



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Lead Content of Piping

IPC 605.2:

Pipe and pipe fittings, including valves and faucets, shall have not more than **8 percent lead content**.
(Non-Drinking/Cooking Water)



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Drinking Water Pipes

Drinking or cooking water pipes shall have a weighted average lead content of **0.25% or less**.



Image by Rony Michael on Pixabay

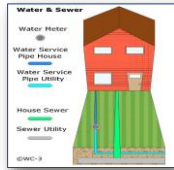


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Water Service Pipes

IPC605.3:
Water service pipe or tubing, installed underground or outside must have a minimum working pressure rating of 160 psi.



Water Distribution Pipe

IPC 605.4:
All hot water distribution pipe and tubing must have a minimum pressure rating of 100 psi at 180°F.



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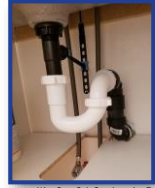
Prohibited Joints

IPC 605.9:
For water service piping, cement, or concrete joints shall be prohibited.



Prohibited Joints

- Any joint not specifically approved
- Solvent-Cemented joints between different types of plastic pipes
- Saddle-type fittings



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Shutoff Valves

IPC 606.2:

- The supply to each fixture (with exceptions)
- The supply to each sillcock
- The supply pipe to each appliance or mechanical equipment



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Booster Pump Tanks

IPC 606.5.7:

- A valved pipe is required at the lowest point of each tank to permit emptying
- The drainpipe shall not be smaller in size than specified in Table 606.5.7

TANK CAPACITY (gallons)	DRAIN PIPE (inches)
Up to 750	1
751 to 1,500	1½
1,501 to 3,000	2
3,001 to 5,000	2½
5,000 to 7,500	3
Over 7,500	4

For SI: 1 inch = 25.4 mm, 1 gallon = 3.785 L.

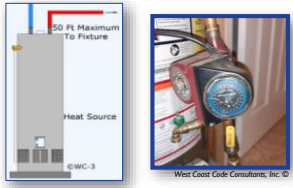
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Hot or Tempered Water

IPC 607.2:

- The developed length of hot or tempered water piping, from the source shall not exceed 50 feet
 - See IECC requirements
- Recirculating system piping and heat-traced piping shall be considered sources



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Hot Water Controls

IPC 607.4:

The hot water supply shall be on the left-hand side.



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Pipe Insulation

IPC 607.5:

- For most occupancies, piping for water heated by a water heater shall be insulated in accordance with C404.4 of the IECC
- For Group R2, R3 and R4 occupancies that are **three stories or less**, piping for water heated by a water heater shall be insulated in accordance with Section R403.5.3 of the IECC



Pipe Insulation

- Commercial: Table C403.11.3
- Residential: **R-3** insulation 3/4" and larger, and for recirculation lines

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY (in inches) ^{1, 2}		NOMINAL PIPE OR TUBE SIZE (inches)			
	Conductivity Btu · in · hr · ft ² · °F ⁻¹	Mean Rating Temperature, °F	< 1	1 1/2 to < 4	4 to < 8	≥ 8
> 200	0.02 - 0.04	200	4.5	6.0	6.0	6.0
201 - 250	0.20 - 0.30	200	3.0	4.5	4.5	4.5
201 - 250	0.27 - 0.30	190	2.5	2.5	2.5	3.0
141 - 200	0.25 - 0.29	125	1.5	1.5	2.0	2.0
105 - 140	0.21 - 0.23	100	1.0	1.0	1.5	1.5
65 - 95	0.21 - 0.27	75	0.5	0.5	1.0	1.0
< 40	0.20 - 0.26	50	0.5	1.0	1.0	1.5

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Protection of Potable Water

IPC 608.1:

Potable water systems shall be designed, installed and maintained to prevent contamination from non-potable liquids, solids, or gases being introduced through cross connections or other connections to the system.



Cross Connections

IPC 608.7:

- Cross connections shall be prohibited, except where approved backflow prevention assemblies, devices or other means are installed
- Cross connections between a private and a potable public supply shall be prohibited



Identification of Non-potable Water

IPC 608.9:

- Piping conveying non-potable water shall be identified:
 - Color marking
 - Metal tags
 - Tape



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Required Signage

IPC 608.9.1:

Nonpotable water outlets shall be identified with signage that reads as follows:

“Nonpotable water is utilized for [application]. CAUTION: NONPOTABLE WATER – DO NOT DRINK”



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Labeling and Marking

IPC 608.9.2

- Non-potable water distribution systems shall be identified
- Lettering Stating “CAUTION: NONPOTABLE WATER – DO NOT DRINK”



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608.9.2.1 - Color

608.9.2.1 – Color

“The COLOR of the pipe identification shall be discernable and consistent throughout the building”



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Lettering Size

IPC 608.9.2.2:

Background color and lettering size shall as per Table 608.9.2.2

PIPE DIAMETER (inches)	LENGTH BACKGROUND COLOR FIELD (inches)	SIZE OF LETTERS (inches)
1/4 to 1 1/4	8	0.5
1 1/2 to 2	8	0.75
2 1/2 to 6	12	1.25
8 to 10	24	2.5
over 10	32	3.5

For SI: 1 inch = 25.4 mm.

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Coloring

IPC 608.9.2.3:

- Tape shall be 3" wide
- White or Black lettering on a purple field (or purple)
- Marked every 10 feet

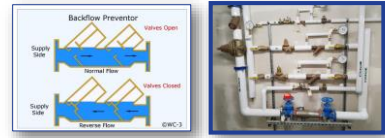


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Backflow Protection

IPC 608.14:

Protection against backflow shall be provided in accordance with IPC 608.14.1 through 608.14.9.



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Backflow Protection Options

- Air Gap (608.14.1)
- Reduced Pressure Principle Backflow (608.14.2)
- Backflow Preventer with Intermediate Atmospheric Vent (608.14.3)
- Barometric Loop (608.14.4)
- Pressure Vacuum Breaker Assemblies (608.14.5)



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Backflow Protection Options

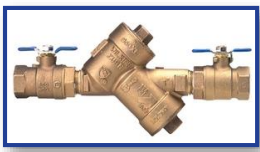
- Atmospheric-type Vacuum Breakers (608.14.6)
- Double Check Backflow Preventer (608.14.7)
- Chemical Dispenser Backflow Device (608.14.8)
- Dual Check Backflow Preventer (608.14.9)



Location of Backflow Preventers

IPC 608.15:

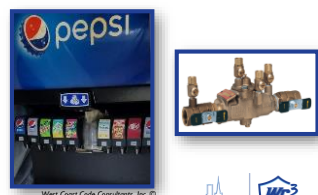
Access to backflow preventers shall be provided as specified by the manufacturer's instructions.



Connections to Potable Water

IPC 608.17:

- Beverage dispensers (608.17.1)
- Boilers (608.17.2)
- Heat exchangers (608.17.3)
- Automatic fire sprinkler and standpipe systems (608.17.4)
- Lawn irrigation systems (608.17.5)



Connections to Potable Water

IPC 608.16:

- Connections subject to backpressure (608.17.6)
- Chemical dispensers (608.17.7)
- Portable cleaning equipment (608.17.8)
- Dental pump equipment (608.17.9)
- Humidifiers (608.17.10)





Protection of Individual Water Supplies

IPC 608.18:

“An individual water supply shall be located and constructed as to be safeguarded against contamination in accordance with Sections 608.18.1 through 608.18.8”



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Location

IPC 608.18.1:

- Separated from contamination based on distances, as per Table 608.18.1

IPC 608.18.2 & 608.18.8

- Elevation higher than sources of contamination, surface must drain away

IPC 608.18.3

- Potable water shall not be taken where water table is less than 10 feet below the surface



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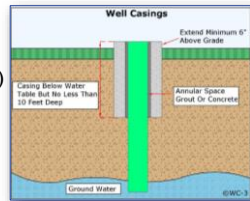
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Casings

IPC 608.18.4 – 608.18.6:

- Casings 10' minimum in depth
- Extend at least 6" above the platform
- Annular space shall be grouted (rock formations)
- Extend below water table (dug or bored)



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Covers

IPC 608.18.7

- Wells shall be equipped with overlapping water-tight covers
- Covers shall extend not less than 2" over the outside of the casing
- Must have a pipe sleeve



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MODULE 5:

IPC Chapter 7- Sanitary Drainage

1

Chapter 7



Sanitary Drainage




2

LEARNING OBJECTIVES

1. Understand the acceptable means and methods for constructing drainage piping in plumbing systems.
2. Know when and where cleanouts are required in sanitary drainage piping.
3. Be able to properly size required drainage outlets for various fixtures.
4. Become familiar with drainage fixture units, how to calculate them and their impact on required drainage pipe sizing.






3

Sanitary Drainage

IPC 701:

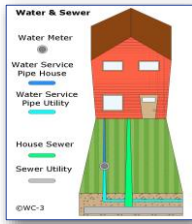
This chapter governs the materials, construction, design, and installation of sanitary drainage.

4

Sewer Required

IPC 701.2:
Buildings where plumbing fixtures are installed shall be connected to a public sewer, or an approved private sewage disposal system.



5

Changes in Size

IPC 704.2:
The size of the drainage piping shall not be reduced in size in the direction of the flow.
(4-inch by 3-inch water closet connections are not to be considered a reduction)*
*See other exceptions



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Pipe Joints

- IPC 705.1 – 705.20:**
- Types of joints include but are not limited to:
 - Mechanical joints
 - Threaded joints
 - Solder joints
 - Welded joints
 - Caulked joints
 - Heat-fusion joints
 - Drainage slip joints



7

Threaded Joints

IPC 705.8.1:
For galvanized steel pipe joints, pipe-joint compound or tape shall be applied on the male threads.



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Connections Between Piping and Fittings

IPC 706:

Connections and changes in direction for sanitary drainage system shall be made with approved drainage fittings as per Table 706.3.

TYPE OF FITTING OR FITTINGS	CHANGE IN DIRECTION		
	Horizontal to vertical	Vertical to horizontal	Horizontal to horizontal
Sixteenth bend	X	X	X
Eighteen bend	X	X	X
Sixth bend	X	X	X
Quarter bend	X	X ^a	X ^a
Short sweep	X	X ^b	X ^b
Long sweep	X	X	X
Sanitary tee	X	—	—
Wye	X	X	X
Combination wye and eighth bend	X	X	X

For 1/2, 1 inch <= 2 1/2 inch.
 a. The fittings shall only be permitted for a 2 inch or smaller drain.
 b. These include or larger.
 c. For a limitation on electric sanitary tees, see Section 706.3.



9



Prohibited Connections

IPC 707:

The following types of joints and connections are prohibited:

- Cement or concrete joints
- Mastic or hot-pour bituminous joints
- Joints made with fittings not approved for the specific installation
- Joints between different diameter pipes made with elastomeric rolling O-rings
- Solvent-cement joints between different types of plastic pipe
- Saddle-type fittings



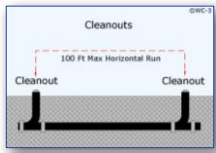
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Horizontal Drains and Building Drains

IPC 708.1.1:

Horizontal drainage pipes in buildings shall have cleanouts not more than 100 feet apart.



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Building Sewers

IPC 708.1.2:

- Building sewers < 8 inches shall have cleanouts located at intervals of not more than 100 feet
- Building sewers > 8 inches shall have a manhole located not more than 200 feet from the junction of the building drain and building sewer and at intervals of not more than 400 feet



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Continuous and Semicontinuous Flow

IPC 709.3:

Shall be computed based on 1 gpm is equal to 2 fixture units.



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Drainage System Sizing

IPC 710.1

- The maximum number of drainage fixture units connected to:
 - Building Sewer
 - Building Drain
 - Horizontal Branch- Building Drain
- ...determined per [Table 710.1\(1\)](#)



Table 710.1(1)

DIAMETER OF PIPE (Inches)	TABLE 710.1(1) BUILDING DRAINS AND SEWERS			
	MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS CONNECTED TO ANY PORTION OF THE BUILDING DRAIN OR THE BUILDING SEWER, INCLUDING BRANCHES OF THE BUILDING DRAIN*			
	Slope per foot			
	1/4 inch	1/8 inch	1/2 inch	3/4 inch
1 1/4	---	---	1	1
1 1/2	---	---	3	3
2	---	---	21	26
2 1/2	---	---	24	31
3	---	36	42	50
4	---	180	216	250
5	---	390	480	575
6	---	700	840	1,000
8	1,400	1,600	1,920	2,300
10	2,500	2,900	3,500	4,200
12	3,900	4,600	5,600	6,700
15	7,000	8,300	10,000	12,000

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Drainage System Sizing

IPC 710.1

- The maximum number of drainage fixture units connected to:
 - Horizontal Branch or
 - Vertical Soil Stack
 - Vertical Waste Stack
- ...determined using [Table 710.1\(2\)](#)





Table 710.1(2)

**TABLE 710.1(2)
HORIZONTAL FIXTURE BRANCHES AND STACKS***

DIAMETER OF PIPE (inches)	MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS (DFU)			
	Total for horizontal branch	Total discharge into one branch interval	Stacks Total for stack of three branch intervals or less	Total for stack greater than three branch intervals
1 1/2	3	2	4	8
2	6	6	10	24
2 1/2	12	9	20	42
3	20	20	48	72
4	160	90	240	500
5	360	200	540	1,100
6	620	350	960	1,900
8	1,400	600	2,200	3,600
10	2,500	1,000	3,800	5,600
12	3,900	1,500	6,000	8,400
15	7,000	Note c	Note c	Note c

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Sump Pits

IPC 712.3.2:

Shall be not less than **18 inches** in diameter and **24 inches** in depth.



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Computerized Design

IPC 713.1

The sizing, design and layout of drainage systems are permitted to be designed by **approved** computer design methods



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Backwater Valves

IPC 714:

- Required for fixtures installed **below the elevation** of the next upstream manhole cover.
- Fixtures installed **above the elevation** of the manhole cover shall **not** discharge through a backwater valve.



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Replacement of Underground Sewers

IPC 716:

- Replacement by pipe-bursting methods limited to **6" and smaller**
- Replacement pipe shall be same nominal size as the existing

IPC 716.7:

- Must be video inspected prior to pressure testing



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Relining Building Sewers

IPC 717.2:

- Limited to **4" diameter** and larger
- Other requirements similar to pipe-bursting requirements

IPC 717.9:

- Certificate shall be provided to the Building Official



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MODULE 6:

*IPC Chapter 8 & 9 -
Indirect/Special Waste &
Vents*




1



LEARNING OBJECTIVES

1. Understand what types of fixtures require indirect waste.
2. Distinguish between the various types of indirect waste.
3. Become familiar with the purpose of plumbing vents, as well as where they required in drainage systems.
4. Understand the various type of vents, as well as terminology associated with plumbing venting.
5. Be able to properly size stacks, vents and combination waste and vent piping.



2

Chapter 8

Indirect/Special Waste




3



Indirect Waste

IPC 802.1

Food-handling equipment, clear-water waste, humidifiers, dishwashing machines and utensils, pots and pans and dishwashing sinks shall discharge through an indirect waste pipe as specified in Sections 802.1.1 through 802.1.7.



4



Food Handling

IPC 802.1.1:

Equipment utilized for the storage, preparation and handling of food shall discharge through an indirect waste pipe by means of an air gap.



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Commercial Dishwashers

IPC 802.1.6:

“The discharge from a commercial dishwashing machine shall be through an air gap or air break into a waste receptor in accordance with Section 802.3.”

AIR BREAK (Drainage System). A piping arrangement in which a drain from a fixture, appliance or device discharges indirectly into another fixture, receptacle or interceptor at a point below the flood level rim and above the trap seal.

AIR GAP (Drainage System). The unobstructed vertical distance through the free atmosphere between the outlet of the waste pipe and the flood level rim of the receptacle into which the waste pipe is discharging.

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Dish Sinks

IPC 802.1.7:

Shall discharge indirectly through an air gap or an air break.



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Special Waste

IPC 802.1:

Fixtures not required to be indirectly connected shall be directly connected per Chapter 7.



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Required Traps

IPC 802.3:

- Indirect waste piping that exceeds **30 inches** in developed length measured horizontally
- Indirect waste piping that exceeds **54 inches** in total developed length



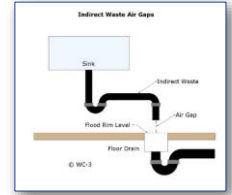
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Air Gaps

IPC 802.3.1:

Air gaps between the indirect waste pipe and the flood level rim of the waste receptor shall not be less than **twice** the effective opening of the indirect waste pipe.



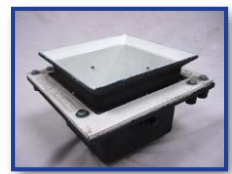
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Hub Drains

IPC 802.4.2:

"A hub drain shall be in the form of a hub or a pipe extending not less than **1 inch** above a water-impervious floor."



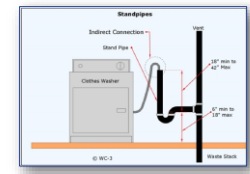
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Standpipes

IPC 802.4.3:

Standpipes shall extend **18 inches - 42 inches** above the trap weir.

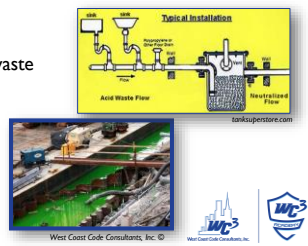


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Corrosive Waste

IPC 803.1:

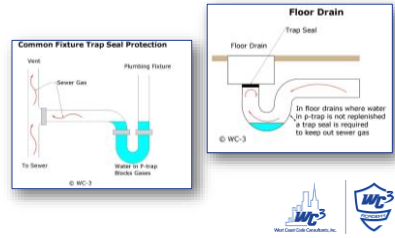
- Waste that may:
 - Destroy or injure a drain, sewer, soil, or waste pipe
 - Creates noxious or toxic fumes
 - Interfere with sewage treatment process
- ...shall not be discharged with out being thoroughly diluted, neutralized or treated.



Trap Seal Protection

IPC 901.2:

“Plumbing systems shall be provided with a system of vent piping that will permit the admission or emission of air so that the seal of any fixture trap shall not be subjected to a pressure differential of more than 1 inch of water column.”

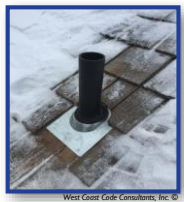


Roof Extension

IPC 903.1:

Where used for assembly or as a promenade, restaurant, bar, observation deck, sunbathing deck, or similar purposes, vent pipes shall terminate at least 7 feet above the roof.

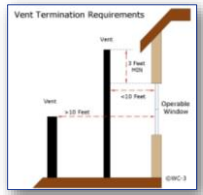
(Otherwise the required height is determined by the jurisdiction.)



Location of Vent Terminals

IPC 903.5:

Vent terminals shall not be within 10 feet horizontally of a building opening unless it is 3 feet or more above.



Extensions Outside a Structure

IPC 903.6:

Where the 97.5-percent outside design temperature is less than 0-deg. F, vent pipes outside the structure must be protected against freezing by insulation, heat or both.



Vent Extension

IPC 904.2:

- The vent system serving each building shall have at least one vent pipe that extends to the outdoors
- The required vent shall be a dry vent that connects to a building drain or extension of a drain
- Shall not be an island fixture vent



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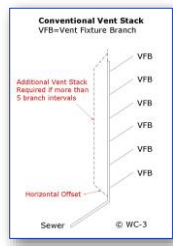


Vent Stack Required

IPC 904.2:

Required for every drainage stack with 5 branch intervals or more.

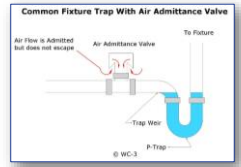
Exception: Stacks installed per IPC 913.



Vent Termination

IPC 904.3

“Vent stacks or stack vents shall terminate outdoors to the open air or to a stack-type air admittance valve...”



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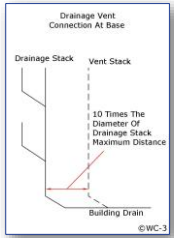
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Connections at Base

IPC 904.4

“Where the vent stack connects to the building drain, the connection shall be located downstream of the drainage stack and within a distance of 10 times the diameter of the drainage stack.”

Note: 10 times the diameter and not the vent stack diameter.



22

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Vertical Rise

IPC 905.4

Every dry vent shall rise vertically to a minimum of 6 inches above the flood level rim of the highest trap or trapped fixture being vented.

Exception: Vents for interceptors located outdoors

VERTICAL PIPE. Any pipe or fitting that makes an angle of 45 degrees (0.79 rad) or more with the horizontal.

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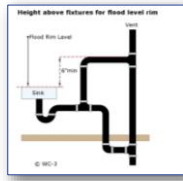
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Height above Fixtures

IPC 905.5

Connections between a vent pipe and a vent stack or stack vent shall be made at not less than 6 inches above the flood level rim of the highest fixture served by the vent.



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Vent Pipe Sizing

IPC 906

“Minimum required diameter of stack vents and vent stacks shall be determined per Table 906.1, but cannot be less than one-half the diameter of the drain served or less than 1 ¼”

DIAMETER OF BOWL OR VENTS IN STACK (inches)	SIZE AND DEVELOPED LENGTH OF STACK VENTS AND VENT STACKS	TABLE 906.1											
		MINIMUM DEVELOPED LENGTH OF VENT PIPES		MINIMUM DEVELOPED LENGTH OF VENT STACKS									
UNITS SERVED	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	6"	8"	10"	12"	14"	16"	
2	30	—	—	—	—	—	—	—	—	—	—	—	
4	60	150	—	—	—	—	—	—	—	—	—	—	
6	90	300	—	—	—	—	—	—	—	—	—	—	
8	120	450	—	—	—	—	—	—	—	—	—	—	
10	150	600	—	—	—	—	—	—	—	—	—	—	
12	180	750	200	—	—	—	—	—	—	—	—	—	
14	210	900	300	150	—	—	—	—	—	—	—	—	
16	240	1050	300	300	—	—	—	—	—	—	—	—	
18	270	1200	300	450	150	—	—	—	—	—	—	—	
20	300	1350	300	600	300	150	—	—	—	—	—	—	
22	330	1500	300	750	450	300	150	—	—	—	—	—	
24	360	1650	300	900	600	450	300	150	—	—	—	—	
26	390	1800	300	1050	750	600	450	300	150	—	—	—	
28	420	1950	300	1200	900	750	600	450	300	150	—	—	
30	450	2100	300	1350	1050	900	750	600	450	300	150	—	

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Other Vents

IPC 906.2

(not stack vents or vent stacks)

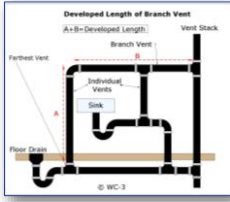
- Vent pipes shall not be < 1 ¼” in diameter
- “Vents exceeding 40 feet in developed length shall be increased by one nominal pipe size for the entire developed length of the vent pipe”



Developed Length

IPC 906.3

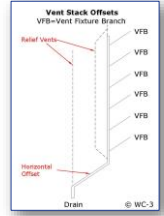
Developed lengths “shall be measured from the farthest point of vent connection to the drainage system to the point of connection to the vent stack, stack vent or termination outside of the building.”



Vents for Stack Offsets

IPC 907.1

- “Horizontal offsets of drainage stacks shall be vented where five or more branch intervals are located above the offset”
- “The offset shall be vented by venting the upper section of the drainage stack and the lower section of the drainage stack”





Upper Section

IPC 907.2

- **Upper Section** “shall be vented as a separate stack with a vent stack connection installed per Section 904.4”
- The offset shall be considered the base of the stack



Lower Section

IPC 907.3

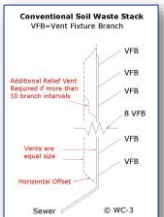
- **Lower Section** “shall be vented by a yoke vent connecting between the offset and the next lower horizontal branch”
- The size of the yoke vent and connection shall be a minimum of the size required for the vent stack



Relief Vents

IPC 908

- “Soil and waste stacks in buildings having more than 10 branch intervals shall be provided with a relief vent at each tenth interval installed, beginning with the top floor”
- “The size of a relief vent shall be equal to the size of the vent stack to which it connects”



Fixture Vents

IPC 909.1

Each fixture trap shall have a protecting vent located so that the slope and the developed length are the distances required in Table 909.1

SIZE OF TRAP (inches)	SLOPE (inches per foot)	DISTANCE FROM TRAP (feet)
1 1/2	1/4	5
1 1/2	1/4	5
2	1/4	8
3	1/4	12
4	1/4	16

FIG. 909.1: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 inch per foot = 81.3 mm/ft.
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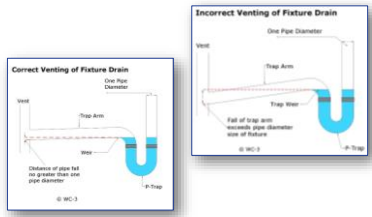
Exception: Self-siphoning fixtures, such as water closets, shall not be limited.



Venting of Fixture Drains

IPC 909.2

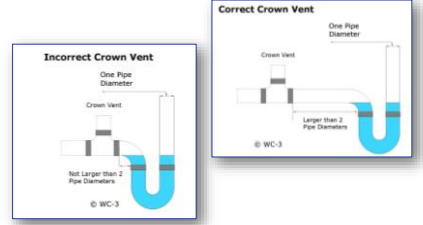
- The total fall due to pipe slope shall not exceed the diameter of the fixture drain
- The vent connection shall not be below the weir of the trap (except for water closets)



Crown Vents

IPC 909.3

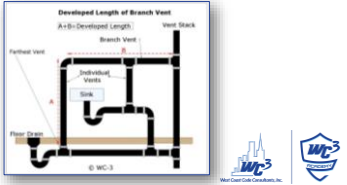
"A vent shall not be installed within two pipe diameters of the trap weir"



Individual Vents

IPC 910.1

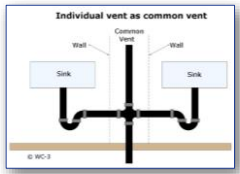
- "Each trap and trapped fixture is permitted to be provided with an individual vent."
- The individual vent shall connect to the fixture drain.



Individual Vents as Common Vents

IPC 911.1

"An individual vent is permitted to vent two traps or trapped fixtures as a common vent" (Must be located on the same floor level.)



Connection at Different Levels

IPC 911.3

- "Where the fixture drains connect at different levels, the vent shall connect as a vertical extension of the vertical drain"
 - "The vertical drain pipe connecting the two fixture drains shall be considered the vent for the lower fixture drain, and shall be sized per Table 911.3"
- (The upper fixture shall not be a water closet)

PIPE SIZE (INCHES)	MAXIMUM SEPARATION FROM UPPER FIXTURE DRAIN (FEET)
1 1/2	1
2	4
2 1/2, 3	6

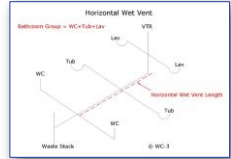
For 3/4 inch = 25.4 mm.
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Horizontal Wet Vents

IPC 912.1

Any combination of fixtures within **two bathroom groups** on the same floor level is permitted to be vented by a horizontal wet vent.



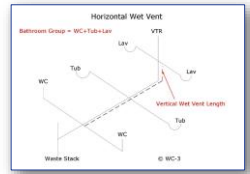
(Only the fixtures within the bathroom groups shall be connected, additional fixtures shall discharge downstream.)



Vertical Wet Vents

IPC 912.1.1

Any combination of fixtures within **two bathroom groups** on the same floor level is permitted to be vented by a vertical wet vent.



Waste Stack Vent

IPC 913.1

- "A waste stack shall be considered a vent for all the fixtures discharging to the stack..."

IPC 913.2

- "The waste stack shall be vertical, and both horizontal and vertical offsets shall be prohibited between the lowest fixture drain connection and the highest fixture drain connection"
- Fixture drains shall connect separately
- Shall not receive the discharge of water closets or urinals



Stack Sizing

IPC 913.14

- “The waste stacks shall be sized based on the total discharge to the stack and the discharge within a branch interval in accordance with Table 913.4”
- “The stack shall be the same size throughout its length”

STACK SIZE (inches)	MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS (FU) Total discharge into one branch interval	Total discharge for stack (FU)
1 1/2	2	2
2	4	4
2 1/2	8	8
3	No limit	24
4	No limit	50
5	No limit	75
6	No limit	100

For SI: 1 inch = 25.4 mm.

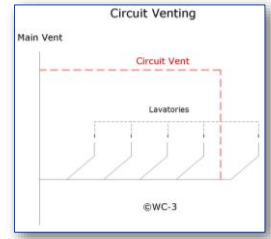
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Relief Vent

IPC 914.4

“A relief vent shall be provided for circuit-vented horizontal branches receiving the discharge of four or more water closets and connecting to a drainage stack that receives the discharge of soil or waste from upper horizontal branches”



Additional Fixtures

IPC 914.5

- “Fixtures, other than the circuit-vented fixtures, are permitted to discharge to the horizontal branch drain”
- “Such fixtures shall be located on the same floor as the circuit-vented fixtures and shall be either individually or common vented”



Combination Waste and Vent

IPC 915.1:

- Shall not receive the discharge of a clinical sink
- Shall not serve fixtures other than floor drains, sinks, lavatories, and drinking fountains



Combination Waste Sizing

IPC 915.2.2:

- Shall be sized per Table 915.2.2
- The horizontal length shall be unlimited

**TABLE 915.2.2
SIZE OF COMBINATION WASTE AND VENT PIPE**

DIAMETER PIPE (inches)	MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS (dfu)	
	Connecting to a horizontal branch or stack	Connecting to a building drain or building subdrain
2	3	4
2 1/2	6	26
3	12	31
4	20	50
5	160	250
6	360	575

For SI, 1 inch = 25.4 mm.

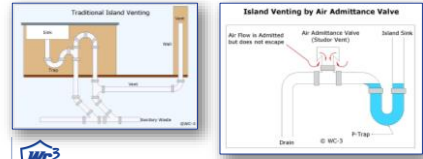
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Island Fixture Venting

IPC 916

Shall not be permitted for fixtures other than sinks and lavatories.



Single Stack Vent System

IPC 917

“A drainage stack shall serve as a single-stack vent system where sized and installed in accordance with Sections 917.2 through 917.9.”



Stack Size

IPC 917.2

Stacks shall be sized per Table 917.2 and be uniformly sized based on total connected drainage fixture unit load.

**TABLE 917.2
SINGLE STACK SIZE**

STACK SIZE (inches)	MAXIMUM CONNECTED DRAINAGE FIXTURE UNITS		
	Stacks less than 75 feet in height	Stacks 75 feet to less than 160 feet in height	Stacks 160 feet and greater in height
3	24	NP	NP
4	225	24	NP
5	480	225	24
6	1,015	480	225
8	2,280	1,015	480
10	4,500	2,280	1,015
12	8,100	4,500	2,280
15	13,600	8,100	4,500

NP = Not permitted.

For SI, 1 inch = 25.4 mm, 1 foot = 304.8 mm.

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Air Admittance Valves

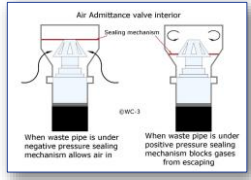
- IPC 918.1**
- "Stack-type air admittance valves shall conform to ASSE 1050."
 - "Individual and branch-type air admittance valves shall conform to ASSE 1051"

- IPC 918.5**
- "Access shall be provided to all air admittance valves."
 - "Shall be located within a ventilated space"



Location

- IPC 918.4**
- Individual and branch-type air admittance valves shall be not less than 4" above horizontal branch or fixture drains
 - Stack-type air admittance valves shall be not less than 6" above the flood level rim of the highest fixture being vented
 - Air admittance valves shall be installed a minimum of 6 inches above insulation materials



Engineered Vent Systems

IPC 919.1
 Engineered vent systems shall comply with this section and the requirements of Section 316.



Engineered Vent Systems

IPC 919.2
 "The maximum developed length of individual fixture vents to vent branches and vent headers shall be determined in accordance with Table 919.2 for the minimum pipe diameters at the indicated vent airflow rates"

Equation 9-1

$$Q_{d,max} = N_{fa} Q_v$$

For SE: $Q_{d,max} = N_{fa} Q_v (0.4719 L)$

where:

- N_{fa} = Number of fixtures per header (or vent branch) + total number of fixtures connected to vent main.
- Q_v = Vent flow to or vent header surface area (cfm).
- Q_v = Total vent stack airflow rate (cfm).
- $Q_v (open) = 27.8 \sqrt{H} - 1.1 - 1.2 D^{0.75}$
- $Q_v (closed) = 0.134 Q_v (open)$

where:

- D = Drainage stack diameter (inches).
- Q_v = Design discharge load (gpm).
- r_v = Wastewater flow area to total area.

$$r_v = \frac{Q_v}{27.8 D^{0.75}}$$

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Table 919.2

TABLE 919.2
MINIMUM DIAMETER AND MAXIMUM LENGTH OF INDIVIDUAL BRANCH FIXTURE VENTS AND INDIVIDUAL FIXTURE HEADER VENTS FOR SMOOTH PIPES


DIAMETER OF VENT PIPE (inches)	INDIVIDUAL VENT AIRFLOW RATE (cubic feet per minute)																			
	Maximum developed length of vent (feet)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
3/8	95	25	13	8	5	4	3	2	1	1	1	1	1	1	1	1	1	1	1	1
1/2	100	88	47	30	20	15	10	9	7	6	5	4	3	3	2	2	2	2	1	1
1	---	---	100	94	65	48	37	29	24	20	17	14	12	11	9	8	7	7	6	6
1 1/4	---	---	---	---	---	---	100	87	73	62	53	46	40	36	32	29	26	23	21	21
1 1/2	---	---	---	---	---	---	---	---	---	---	100	96	84	75	65	60	54	49	45	45
2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	100

For SI: 1 inch = 25.4 mm, 1 cubic foot per minute = 0.4719 L/s, 1 foot = 304.8 mm.

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END OF MODULE



MODULE 7:

IPC Chapters 10 through 12 – Traps, Interceptors & Separators; Storm Drainage; Special Piping & Storage



1

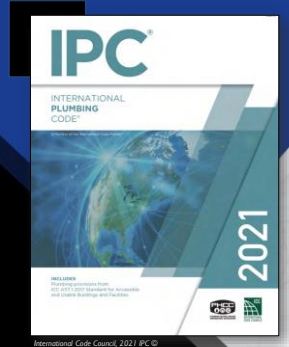


LEARNING OBJECTIVES

1. Understand the purpose of fixture traps, and what types are permissible per the IPC.
2. Become familiar with methods of sizing fixture traps for various plumbing fixtures.
3. Recognize the different types of interceptors and when they are required.
4. Be able to evaluate storm drainage pipe for number of required drains, configuration and pipe sizing.
5. Locate requirements for special piping and storage within the Code.




2



Chapter 10

Traps, Interceptors & Separators

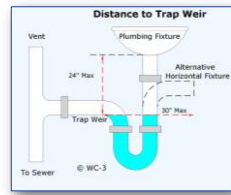


3

Fixture Traps

IPC 1002.1

The distance from the fixture outlet to the trap weir (dam) shall not exceed **24 inches** (vertical distance) or **30 inches** (horizontal distance).



4

Capacity of Grease Interceptors

IPC Table 1003.3.5.1

Shall have a grease retention capacity indicated on Table 1003.3.5.1 for the flow-through rates indicated.

TOTAL FLOW THROUGH RATING (gpm)	GREASE RETENTION CAPACITY (gallons)
4	5
6	12
7	14
9	18
10	20
12	24
14	28
15	30
18	36
20	40
25	50
35	70
50	100
75	150
100	200

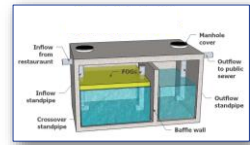
For 10: 1 gallon per minute = 3.785 L, 1 gal. = 0.454 kg.
 For total flow-through ratings greater than 100 gpm, double the flow-through rating to determine the grease retention capacity (gallons).
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Oil separators

IPC 1003.4

At locations "where oily and flammable liquid wastes are produced and in hydraulic elevator pits, oil separators shall be installed into which all oil-bearing, grease-bearing or flammable wastes shall be discharged before emptying into the building drainage system or other point of disposal"



Materials, Joints & Connections

IPC 1004

- The materials and methods shall comply with this chapter and the applicable provisions of Chapters 4 & 7
- Fittings shall not have ledges, shoulders, or reductions capable of retarding or obstructing flow



Chapter 11

Storm Drainage



Prohibited Drains

IPC 1101.3

"Storm water shall not be drained into sewers intended for sewage only"



13

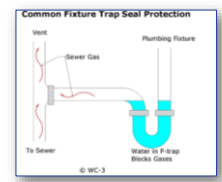
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Traps

IPC 1103.1

- "Leaders and storm drains connected to a combined sewer shall be trapped"
- "Individual storm water traps shall be installed on the storm water drain branch serving each conductor, or a single trap shall be installed in the main storm drain just before its connection with the combined building sewer or the public sewer"



14

14

Roof Drains

IPC 1105

- "Roof drains shall be installed in accordance with the manufacturer's instructions"
- "The inside opening for the roof drain shall not be obstructed by the roofing membrane material"



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15

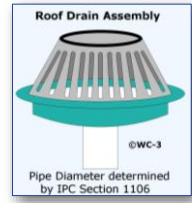
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Roof Drain Flow Rate

IPC 1105.2

- "The published roof drain flow rate, based on the head of water above the roof drain, shall be used to size the storm drainage system in accordance with Section 1106."
- "The flow rate used for sizing the storm drainage piping shall be based on the maximum anticipated ponding at the roof drain."



16

16



Sizing Storm Drains

IPC 1106.2

Vertical and horizontal storm drain piping shall be sized based on the flow rate through the roof drain.

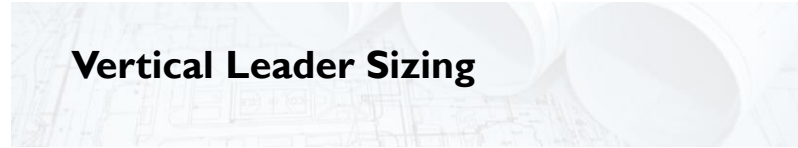
(See Tables 1106.2 and 1106.3 for sizing)

1106.2.1 Rainfall rate conversion method. The rainfall rate falling on a roof surface shall be converted to a gallon per minute (L/m) flow rate in accordance with Equation 11-1.

$$GPM = R \times A \times 0.0104 \quad \text{(Equation 11-1)}$$

where:
 R = Rainfall intensity in inches (mm) per hour.
 A = Roof area in square feet (m²).

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Vertical Leader Sizing

IPC 1106.3

- “Vertical leaders shall be sized based on the flow rate from horizontal gutters or the maximum flow rate through roof drains”
- “The flow rate through vertical leaders shall not exceed that specified in Table 1106.3”

SIZE OF LEADER (INCHES)	CAPACITY (GPM)
2	30
2 1/2	30
2 1/2, w/2"	30
2 1/2, w/3"	54
2 1/2, w/4"	54
3	92
3 w/4"	92
3 w/3"	92
4	192
4 w/4"	192
4 w/3"	192
4 w/2"	192
5	300
5 w/4"	300
5 w/3"	300
5 w/2"	300
6	563
6 w/4"	563
6 w/3"	563
6 w/2"	563
8	1,208

Note: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/min.

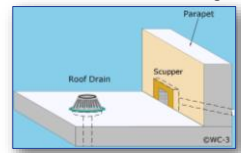
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Parapet Wall Scupper Location

IPC 1106.5

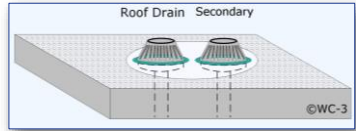
- Parapet wall roof drainage scupper (outlet in the side of a building) and overflow scupper location shall comply with the requirements of Section 1611.1 of the IBC
- Shall not be less than 4" in height



Secondary (Emergency) Roof Drains

IPC 1108

Where roof drains are required, secondary roof drains (emergency overflow) or scuppers shall be provided where the roof construction will entrap water if the primary drains are blocked any reason



Sizing of Secondary Drains

IPC 1108.3

“Secondary (emergency) roof drain systems shall be sized in accordance with Section 1106 based on the rainfall rate for which the primary system is sized”



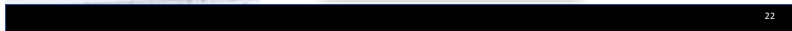
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Combined Sanitary and Storm

IPC 1109

“Where the public sewer is a combined system for both sanitary and storm water, the storm sewer shall be connected independently to the public sewer”



Controlled Flow Roof Drains

IPC 1110.1

“The roof of a structure shall be designed for the storage of water where the storm drainage system is engineered for controlled flow”



23



Controlled Flow Roof Drain Systems

IPC 1110.2

- “The control devices shall be installed so that the rate of discharge of water per minute shall not exceed the values for continuous flow...”

IPC 1110.4

- Not less than **2 roof drains** - roofs up to 10,000 square feet
- Not less than **4 roof drains** - roofs over 10,000 square feet



24

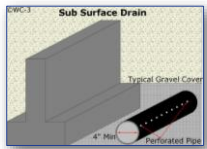




Subsoil Drains

IPC 1111.1

- Subsoil drains for storm water shall be open-jointed, horizontally split or perforated pipe, and shall not be less than 4 inches in diameter
- Shall discharge to a trapped area drain, sump, dry well or approved location above ground



Building Subdrains

IPC 1112:

"Building subdrains located below the public sewer level shall discharge into a sump or receiving tank, the contents of which shall be automatically lifted and discharged into the drainage system as required for building sumps"

(Sump and pumping equipment shall comply with Section 1113.1)



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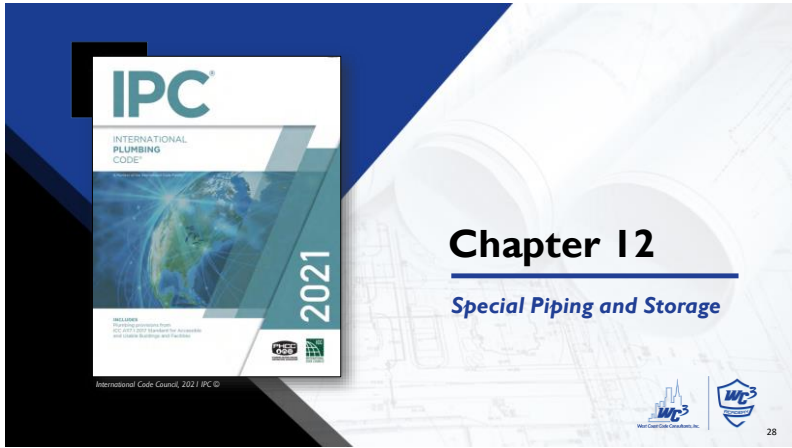
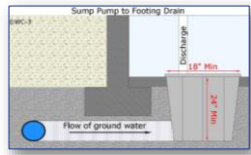


Sumps and Pumping Systems

IPC 1113.1.2.

Sump pits shall be:

- Not be less than 18 inches in diameter and
- Not less than 24 inches in depth, unless otherwise approved
- Accessible, located so that all drainage flows into the pit by gravity
- Constructed of tile, steel, plastic, cast iron, concrete, or other approved material
- Have removable cover adequate to support anticipated loads
- Provide a solid floor for permanent support for the pump





Nonflammable Medical Gas

IPC 1202.1

Unless covered by an exception, nonflammable medical gas systems, inhalation anesthetic systems and vacuum piping systems shall be designed and installed in accordance with **NFPA 99**.

(This standard is adopted by reference and applicable as stated in IPC 102.8)

“Exceptions:

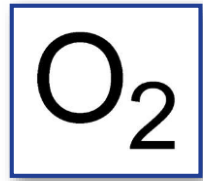
1. This section shall not apply to portable systems or cylinder storage.
2. Vacuum system exhaust terminations shall comply with the International Mechanical Code.”




Oxygen Systems

IPC 1203

“Nonmedical oxygen systems shall be designed and installed in accordance with **NFPA 55** and **NFPA 51**”





END OF MODULE



MODULE 8:

IPC Chapter 13
Non-Potable Water Systems

1



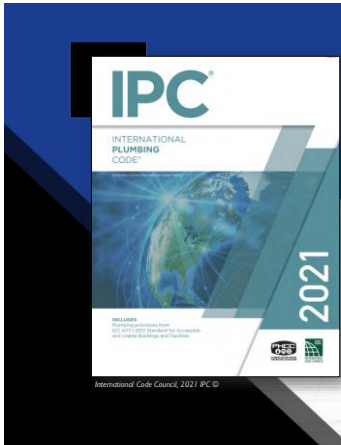
LEARNING OBJECTIVES

1. Be aware of specific identification and labeling requirements for non-potable water systems.
2. Understand what type of waste can discharge into a non-potable water reuse system.
3. Become familiar with rainwater collection systems, how they work and related code requirements.
4. Know the pressure limitations applicable to gray water and reclaimed water systems.





2

2



Chapter 13

Non-Potable Water Systems

3



Water Quality

IPC 1301.2

- Non-potable water shall meet the minimum water quality requirements for the intended application by the laws, rules, and ordinances applicable in the jurisdiction
- Where non-potable water from different sources is combined in a system, the system shall comply with the most stringent requirements of the code



Image by rony mechalot from Pixabay



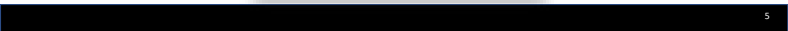
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4

Residual Disinfectants

IPC 1301.2.1

- "Where chlorine is used for disinfection, the non-potable water shall contain not more than 4 ppm of chloramines or free chlorine when tested in accordance with ASTM D 1253"
- "Where ozone is used for disinfection, the non-potable water shall not contain gas bubbles having elevated levels of ozone at the point of use"
 - "Exception: Reclaimed water sources shall not be required to comply with these requirements"



5

Signage

IPC 1301.3

"Non-potable water outlets such as hose connections, open-ended pipes and faucets shall be identified at the point of use for each outlet..."

**"Non-potable water is utilized for [use].
CAUTION: NONPOTABLE WATER – DO NOT DRINK"**



6

Insect and Vermin Control

IPC 1301.7
"The system shall be protected to prevent the entrance of insects and vermin into storage tanks and piping systems."



7

Freeze Protection

IPC 1301.8
"Where sustained freezing temperatures occur, provisions shall be made to keep storage tanks and the related piping from freezing."



8



Storage Tanks

IPC 1301.9
"Non-potable water storage tanks shall comply with Section 1301.9.1 through 1301.9.10."



9



Overflow

IPC 1301.9.5

- Non-potable water storage tanks shall be equipped with an overflow pipe
- For on-site nonpotable water reuse systems, a backwater valve is required for overflow pipes (See Section 1302.8.2)



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Sources

IPC 1302.2

- Unless otherwise approved, onsite nonpotable water reuse systems shall collect waster discharge from only the following plumbing fixtures:
- Bathtubs
- Showers
- Lavatories
- Clothes Washers
- Laundry Trays



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11

Filtration

IPC 1302.5

- "Untreated water collected for reuse shall be filtered as required for the intended end use"
- "...shall utilize a pressure gauge or other approved method to provide indication when a filter requires servicing or replacement"
- "...shutoff valves immediately upstream and downstream to allow for isolation during maintenance"



12



Gray Water

IPC 1302.6

What is Gray Water?

GRAY WATER. Waste discharged from lavatories, bathtubs, showers, clothes washers and laundry trays.

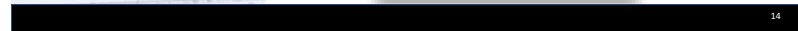
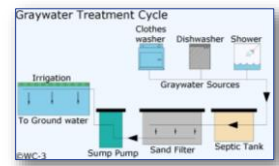
International Code Council, International Plumbing Code 2021©



Gray Water

IPC 1302.6.1

- “Gray water used for flushing water closets and urinals shall be disinfected...”
- “...shall be treated by an on-site water reuse treatment system complying with NSF 350”



Valves

IPC 1302.8

- “Valves shall be supplied on on-site non-potable water reuse systems in accordance with Sections 1302.8.1 and 1302.8.2”
 - o 1302.8.1 Bypass valve
 - o 1302.8.2 Backwater valve



Pressure-reducing Valve or Regulator

IPC 1302.10

- Water pressure supplied by the pumping system exceeding 80 psi requires a pressure-reducing valve
- “...shall be installed to reduce the pressure in the non-potable water distribution system piping to 80 psi static or less”



Rainwater Collection

IPC 1303.2

"Rainwater shall be collected only from above-ground impervious roofing surfaces constructed from approved materials and where approved, vehicular parking or pedestrian walking surfaces"



17

17



Debris Excluders

IPC 1303.3

Downspouts and leaders of a non-potable rainwater collection system shall be equipped with a debris excluder or equivalent device to prevent leaves, sticks, pine needles, and similar material from entering the system.



18

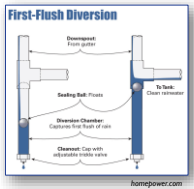
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First-Flush Diverter

IPC 1303.4

- Shall operate automatically.
- "Diverted rainwater shall not be drained to the roof surface and shall be discharged in a manner consistent with the storm water runoff requirements of the jurisdiction."
- Shall be provided with access.



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Roof Gutters & Downspouts

IPC 1303.5

- "Gutters and downspouts shall be constructed of materials that are compatible with the collection surface and the rainwater quality for the desired end use"
- "Joints shall be watertight"



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20

20



Roof Gutters & Downspouts

- **Slope:** Not less than *1/8 inch* per foot along the entire length and shall not permit the collection/pooling of water at any point
- **Size:** "Gutters and downspouts shall be installed and sized in accordance with Section 1106.6 and local rainfall rates"
- **Cleanouts:** Shall be provided in the water conveyance system to allow access to all filters, flushes, pipes, and downspouts



21

Reclaimed Water Systems

IPC 1304.2

- "Where the reclaimed water pressure supplied to the building exceeds **80 psi** static...
 - a pressure-reducing valve shall be installed to reduce the pressure in the reclaimed water distribution system piping to **80 psi** static or less"
 - "Pressure-reducing valves shall be specified and installed in accordance with Section 604.8"

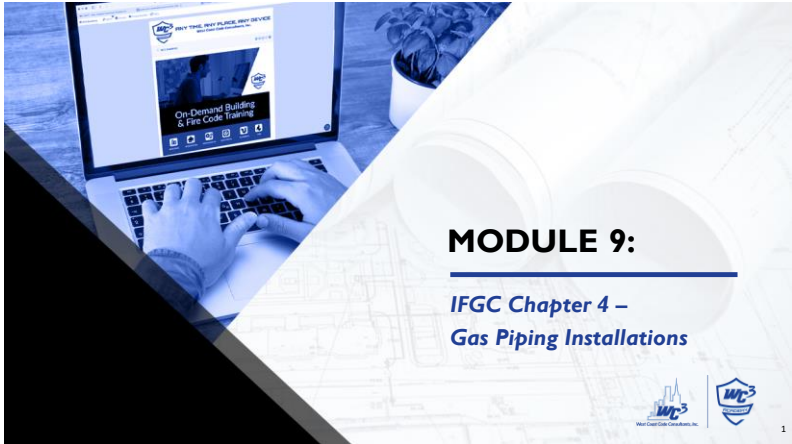


22




END OF MODULE

23



MODULE 9:

IFGC Chapter 4 – Gas Piping Installations



1




LEARNING OBJECTIVES

1. Become familiar with the two standard methods of sizing gas lines, and how to perform the calculations.
2. Understand gas piping requirements; including, identification, support, and acceptable materials.
3. Understand the required pressure testing, and inspection procedures for gas lines.




2



Chapter 4

Gas Piping Installations



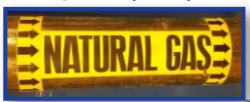
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Identification

IFGC 401.5

- “For other than steel pipe and CSST:*
- Exposed piping shall be identified by a yellow label marked “Gas” in black letters
 - The marking shall be spaced at intervals not exceeding 5 feet
 - The marking shall not be required on piping located in the same room as the appliance served
- (CSST shall be identified as required by ANSI LC 1/CSA 6.26)*



4

Identification

IFGC 401.9

“Each length of pipe and tubing and each pipe fitting, utilized in a fuel gas system, shall bear the identification of the manufacturer.”

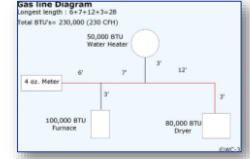


5

Maximum Gas Demand

IFGC 402.2

“The volumetric flow rate of gas to be provided shall be the sum (+) of the maximum input of the appliances served”



80 + 50 + 100 = 230 CFH



6

Sizing Tables

402.3 Sizing. Gas piping shall be sized in accordance with one of the following:

1. Pipe sizing tables or sizing equations in accordance with Section 402.4 or 402.5 as applicable.
2. The sizing tables included in a listed piping system's manufacturer's installation instructions.
3. Engineering methods.

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37 Tables



7

Two Methods

IFGC 402.4.1- Longest Length (Simple)

- Use longest length value in the tables for all line sizing
- Method will slightly oversize your piping.

IFGC 402.4.2- Branch Length

- Adjust length value in tables based on location



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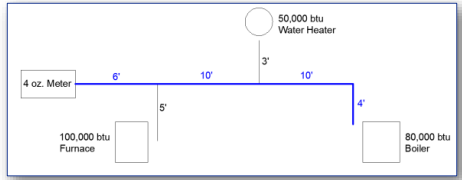
Precautions

- No danger in oversizing the line size, but there is danger supplying too much pressure
- Under sizing gas lines results in reduced equipment life, increased condensation, delayed ignition and reduced performance (Minimal Safety Risk)



Example:

Longest Length = 30'
Total btu's = 230,000 (230 CFH)



General Rules:

Pressure Drop:

- 4 oz. System- Use 0.5 in. w.c.
- 2 lb. System- Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz.
- Commercial- 2 P.S.I.

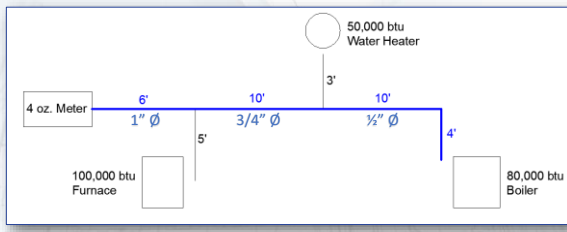
Gas: Natural						
Inlet Pressure	Less than 2 psi					
Pressure Drop	0.5 in. w.c.					
Specific Gravity	0.60					
International Code Council 2021 IBC®						
TABLE 402.4(2) SCHEDULE 40 METALLIC PIPE						
Nominal	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067
Length (ft)	10	172	360	678	1,390	2,090
	20	118	247	466	957	1,430
	30	95	199	371	768	1,150
	40	81	170	320	657	985
						1,900

Make sure you're in the right table and verify values!

1 P.S.I. = 16 oz.



Example:

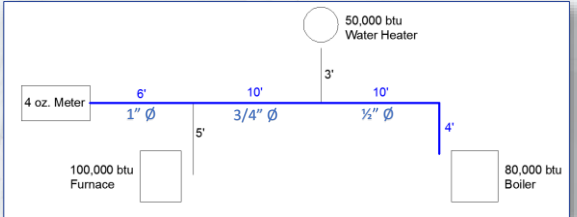


Next Sections:

Longest Length = 30' (Does Not Change)
Total btu's = 130,000 (130 CFH)



Example:



Last Section:
 Longest Length = 30' (Does Not Change)
 Total btu's = 80,000 (80 CFH)



Maximum Pressure

IFGC 402.7

- Maximum design operating pressure for piping systems located inside buildings shall not exceed **5 pounds** per square inch (see **8 exceptions**).
 - Welded pipe, pipe in ventilated chases, industrial purposes, temporary piping, agricultural purposes, LP-gas, etc.



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Allowable Materials

IFGC 403.3 – 403.5

- Metallic Pipe: **Steel**, Copper, Aluminum
- Metallic Tubing: **Steel**, Stainless Steel, Copper, Aluminum
- Corrugated Stainless Steel Tubing: CSST
- Plastic Pipe/Tubing: **Polyethylene PE**, Polyamide



Cast Iron

IFGC 403.3.1

- Cast-iron pipe shall not be used
- #### IFGC 403.5
- PVC and **CPVC** shall not be used



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Copper and Copper Alloy

IFGC 403.3.3

"Copper and copper alloy pipe shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet of gas."



Photo by Rio Dragon on Unsplash



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Plastics

IFGC 403.5

- Polyethylene plastic pipe, tubing and fittings shall conform to ASTM D 2513 and marked "GAS" and "ASTM D 2513"
- Polyamide pipe, tubings and fittings shall conform to ASTM F2945 and marked "GAS" and "ASTM F2945"



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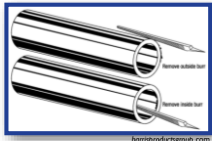


18

Pipe Defects

IFGC 403.6

- Pipe shall be free from cutting burrs and defects in structure or threading.
- "...shall be thoroughly brushed, and chip and scale blown."
- Defects shall not be repaired, must be replaced.



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Metallic Pipe & Fittings

IFGC 403.9

- "...shall be suitable for the pressure-temperature conditions and
- shall be selected giving consideration to tightness and mechanical strength under the service conditions."



20



Metallic Pipe & Fittings

IFGC 403.9

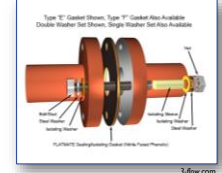
- The joint shall be able to sustain end forces caused by internal pressure and forces caused by:
 - Temperature
 - Expansion
 - Contraction
 - Vibration
 - Fatigue
 - Weight of Pipe and Contents



Flange Gaskets

IFGC 403.12

- Gaskets shall be capable of withstanding:
 - Design temperature and pressure
 - Chemical constituents of the gas
 - Effects of fire exposure to the joint



Acceptable Materials

IFGC 403.12

- Metal
- Composition
- Aluminum "O" rings
- Spiral wound metal gaskets
- Rubber-faced phenolic and elastomeric



"Where a flanged joint is opened, the gasket shall be replaced."



CSST

IFGC 404.2

"...installed in accordance with the terms of their approval, the conditions of listing, the manufacturer's instructions and this code."

Corrugated Stainless Steel Tubing



Piping in Solid Partitions and Walls

IFGC 404.4

“Concealed piping shall not be located in solid partitions and solid walls, unless installed in a chase or casing.”



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25

Concealed Joints

IFGC 404.5

- “Fittings installed in concealed locations shall be limited to the following types:”
 - Threaded
 - Brazed
 - Welded
 - Listed to ANSI LC-1/CSA 6.26 or ANSI LC-4/CSA 6.32



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26

26

Underground Penetrations

IFGC 404.6

- “Gas piping shall not penetrate building foundation walls at any point below grade.
- ...annular space between the pipe and the wall shall be sealed.”



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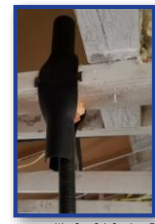
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Shield Plates

IFGC 404.7.1

- Piping through holes or notches in framing members <math>< 1 \frac{1}{2}</math> inches from the face of the member shall be protected by shield plates.
- Plates shall cover the width of the pipe and the framing member and extend not less than 4 inches to each side of the member.



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Shield Plates

IFGC 404.7.1

Where the framing member is a bottom plate/track or top plate/track the shield plates shall cover the framing member and extend not less than **4 inches** above/below the member.

Exception: Black steel piping and galvanized steel piping.



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Minimum Burial Depth

IFGC 404.12

“Underground piping systems shall be installed a minimum depth of **12 inches** below grade, except as provided for in Section 404.12.1.”



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Individual Outside Appliances

IFGC 404.12.1

“Individual lines to outdoor lights, grills and other appliances shall be installed not less than **8 inches** below finished grade...”



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Plastic Pipe Limitations

IFGC 404.17.1

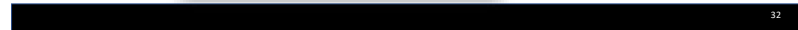
- Shall be installed **outdoors underground only.**
- “...shall not be used within or under any building or slab or be operated at pressures greater than:
 - **100 psig** for natural gas
 - **30 psig** for LP-gas.”



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LIQUEFIED PETROLEUM GAS or LPG (LP-GAS). Liquefied petroleum gas composed predominately of propane, propylene, butanes or butylenes, or mixtures thereof that is gaseous under normal atmospheric conditions, but is capable of being liquefied under moderate pressure at normal temperatures.

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Tracer Wire

IFGC 404.17.3

- A yellow insulated copper tracer wire shall be installed adjacent to underground nonmetallic piping.
- “shall not be less than 18 AWG and the insulation type shall be suitable for direct burial.”



33

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Pipe Bends

IFGC 405.2 #5

- Metallic pipe: Inside radius shall not be less than six times the outside diameter of the pipe (uncommon).

IMC 405.3 #3

- Plastic pipe bend: Inside radius shall be not less than 25 times the inside diameter of the pipe.



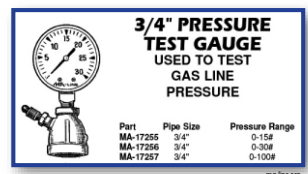
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Inspections and Testing

IFGC 406.1

Prior to acceptance and initial operation, pipe shall be visually inspected, and pressure tested.



35

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Test Pressure Measurement

IFGC 406.4

Test pressure shall be measured with a pressure-measuring device with a range not greater than five times the test pressure.



Example: 5 P.S.I.
Test = 25 P.S.I.
Maximum Gauge



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Pressure

IFGC 406.4.1

"The test pressure to be used shall be not less than 1 1/2 times the proposed maximum working pressure, but not less than 3 psig"



Example: 2 lb. System = 3 P.S.I. Test



Discharge of Purged Gases

IFGC 406.7.1.3

The open end shall discharge directly to an outdoor location.

Req. #2

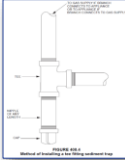
"The point of discharge shall be located not less than 10 feet from sources of ignition, not less than 10 feet from building openings and not less than 25 feet from mechanical air intake openings."



Sediment Trap

IFGC 408.4

Where "...not incorporated as part of the appliance, a sediment trap shall be installed downstream of the appliance shutoff valve as close to the inlet of the appliance as practical."



Shutoff Valves

IFGC 409.5.1

"Shall be located in the same room as the appliance ... shall be within 6 feet of the appliance, and shall be installed upstream of the union, connector or quick disconnect device it serves."





Pressure Regulators

IFGC 410.1

- Installed where appliance is designed to operate at a **lower pressure** than the supply pressure.
- Access shall be provided.
- Protected from **physical damage**.
- If on the exterior of the building shall be approved for outdoor use.



41

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Required Unions

IFGC 410.2:

#7: "Where connected to rigid piping, a union shall be installed **within 1 foot** of either side of the MP regulator."

REGULATOR, MEDIUM-PRESSURE (MP Regulator). A line pressure regulator that reduces gas pressure from the range of greater than 0.5 psig (3.4 kPa) and less than or equal to 5 psig (34.5 kPa) to a lower pressure.

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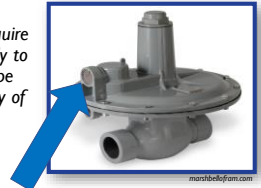
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Venting of Regulators

IFGC 410.3

"Pressure regulators that require a vent shall be vented directly to the outdoors. The vent shall be designed to prevent the entry of insects, water and foreign objects."



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Connecting Appliances

IFGC 411.1

- "...appliances shall be connected to the piping system by one of the following:"
 - Rigid metal pipe
 - CSST
 - Semirigid metallic tubing- **6 foot max.**
 - Other listed connectors



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44

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Fueling of Motor Vehicles

IFGC 412.9

- “Self-service LP-gas dispensing systems... shall be limited to the filling of permanently mounted containers providing fuel to the LP-gas-powered vehicle.”
- Provided with an emergency shutoff switch between 20 and 100 feet from dispensers.



Residential CNG Fueling

IFGC 413.2.3

- Residential fueling appliances must be listed.
- The capacity shall not exceed 5 cubic feet per minute.



Supports

IFGC Table 415.1

- Piping shall be supported per Table 415.1.
- CSST shall be supported in accordance with the manufacturer's instructions.



Table 415.1

TABLE 415.1 SUPPORT OF PIPING			
STEEL PIPE, NOMINAL SIZE OF PIPE (inches)	SPACING OF SUPPORTS (feet)	NOMINAL SIZE OF TUBING (SMOOTH-WALL) (inch O.D.)	SPACING OF SUPPORTS (feet)
1/2	6	1/2	4
3/4 or 1	8	5/8 or 3/4	6
1 1/4 or larger (horizontal)	10	7/8 or 1 (horizontal)	8
1 1/4 or larger (vertical)	Every floor level	1 or larger (vertical)	Every floor level

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.
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MODULE 10:
ICC A117.1-2017 – Plumbing Accessibility



1

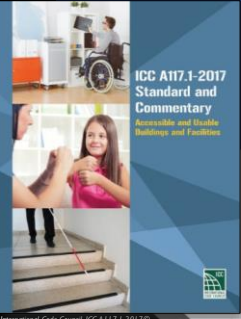


LEARNING OBJECTIVES


1. Gain a basic understanding of plumbing related accessibility requirements.
2. Become familiar with the layout of the ICC A117.1-2017.
3. Understand how plumbing fixture installation impacts accessibility compliance.
4. Be aware of Resource A in the 2021 IPC.



2




ICC A117.1-2017
Plumbing Accessibility



3

2021 Exam Breakdowns

	Commercial Plumbing Inspector Exam	Commercial Plumbing Plans Examiner Exam
General Requirements	8%	5%
Fixtures	15%	15%
Water Heaters	12%	10%
Water Supply and Distribution	18%	19%
Sanitary Drainage	13%	13%
Vents	15%	15%
Traps, Interceptors, Separators, Special Piping, and Storage Systems	9%	11%
Storm Drainage	5%	7%



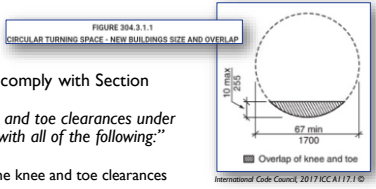
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Turning Space

Section 304.3.1.1:

Circular Turning Spaces for New Buildings:

- 67" circle
- Includes toe & knee clearances, must comply with Section 306
- "Where the turning space includes knee and toe clearances under an obstruction' the overlap shall comply with all of the following:"
 - Depth not more than 10"
 - Depth shall not exceed the depth of the knee and toe clearances provided
 - The overlap shall be permitted only in the shaded area of Figure 304.3.1

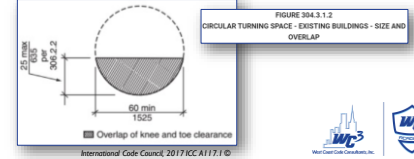


Turning Space

Section 304.3.1.2:

Circular Turning Spaces for Existing Buildings:

- 60" circle
- Permitted to include knee and toe clearances complying with Section 306

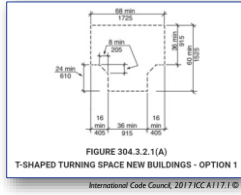


Turning Radius

Section 304.3.2:

T-Shaped Turning Spaces for New Buildings – Option 1:

- Clear of obstruction
- Fits within an area 68" wide and 60" deep
- Two arms and one base, all 36" minimum in width
- Each arm extending 16" minimum from each side of the base located opposite the other
- The base extending 24" minimum from the arms
- Interior corners chamfered along both the arm and the base for 8" at the intersection of each arm and the base.

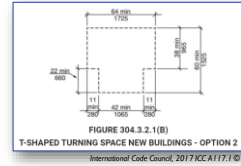


Turning Radius

Section 304.3.2:

T-Shaped Turning Spaces for New Buildings – Option 2:

- Clear of obstruction
- Fits within an area 64" wide and 60" deep
- Two arms 38" minimum in width
- Base 42" minimum in width
- Each arm extending 11" minimum from each side of the base located opposite the other
- The base extending 22" minimum from the arms



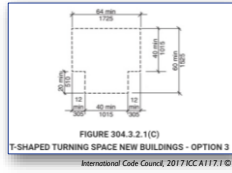


Turning Radius

Section 304.3.2:

T-Shaped Turning Spaces for New Buildings – Option 3:

- Clear of obstruction
- Fits within an area 64" wide and 60" deep
- Two arms and one base 42" minimum in width
- Each arm extending 12" minimum from each side of the base
- The base extending 20" minimum from the arms

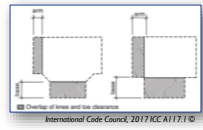


Turning Radius

Section 304.3.2.1.1 (new buildings):

- T-shaped turning spaces permitted to include knee and toe clearances
- Must comply with Section 306
- Overlap permitted: Either the base or one arm
- For Option 1, the base or arm is the portion beyond the chamfer

FIGURE 304.3.2.1.1
T-SHAPED TURNING SPACE NEW BUILDINGS - OVERLAP
International Code Council, 2017 ICC A117.1 ©

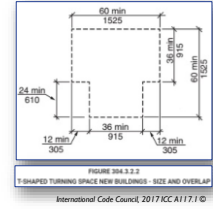


Turning Radius

Section 304.3.2.2:

T-Shaped Turning Spaces for Existing Buildings:

- Within a 60" minimum square
- Arms and base 36" minimum in width
- Each arm clear of obstructions 12" minimum in each direction
- Base clear of obstructions 24" minimum



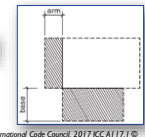
Turning Radius

Section 304.3.2.2.1:

T-Shaped Turning Spaces for Existing Buildings:

- Permitted to include knee and toe clearances.
- Must comply with Section 306.
- Only at the end of either the base or one arm

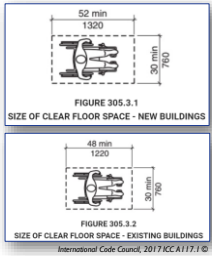
FIGURE 304.3.2.2.1
T-SHAPED TURNING SPACE - EXISTING BUILDINGS OVERLAP
International Code Council, 2017 ICC A117.1 ©



Clear Floor Space

Section 305.3:

- New buildings
 - 52" minimum length x 30" minimum width
- Existing buildings
 - 48" minimum length x 30" minimum width
- Both Include knee and toe clearance, complying with Section 306

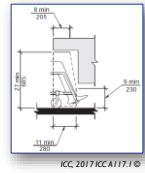
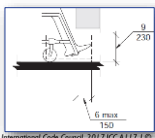


13

Section 306 – Knee and Toe Clearance

Knee and Toe Clearances

- Toe Clearance
 - Height: 9"
 - Depth: 17"-25" under an element **or** 6" beyond the knee clearance
- Knee Clearances
 - Height: **9"-27"**
 - Depth:
 - At 9" above the floor: 11" minimum
 - At 27" above the floor: 8" minimum
 - Between 9" and 27" above the floor, clearance can be reduced at a rate of 1" in depth for each 6" in height

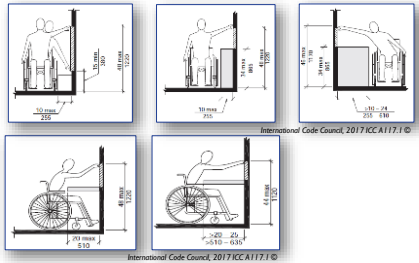


14

Section 308 - Reach Ranges

Reach Ranges

- Operable Parts
- Clear floor space
 - Not permitted:
 - Pinching
 - Tight Grasping
 - Twisting of wrist

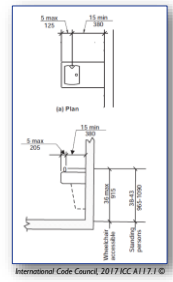


15

Drinking Fountains

Section 602:

- Clear Floor Space (602.2)
 - Forward approach – knee & toe clearance
 - Centered
- Spout Height (602.2.3)
 - Wheelchair – 36" maximum
 - Standing – 38"-43"
- Spout Location (602.2.4)
 - 15-inches minimum from wall
 - 5-inches maximum from front

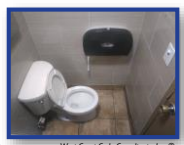


16

Toilet and Bathing Rooms

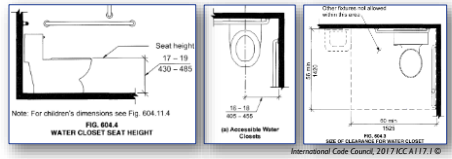
Section 603.2:

- Turning space in room not in stall
 - Door swing
 - Not into clear floor space
- Exception: single user toilet rooms*



Section 604 – Water Closets & Toilet Compartments

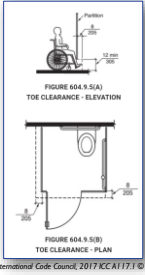
- Water Closets (604.1)
 - Located 16"-18" from wall
 - 60"x 56" Clearance
 - Items permitted in clearance: Grab bars, TP dispenser, etc.
- Lip 17"-19" AFF



Section 604.9 – Wheelchair Accessible Compartments

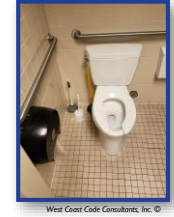
- Compartment Size (604.9.2)
 - Wall Hung- 60" wide x 56" deep
 - Floor Mount- 60" wide x 59" deep

(IPC 405.3.1 requires 60" deep for floor mounted)
- Doors shall be self-closing (604.9.3)
- Toe Clearance: (604.9.5)
 - 12" vertical (front partition and at least one side)
 - Extend 8" around the compartment



Other Water Closet Requirements

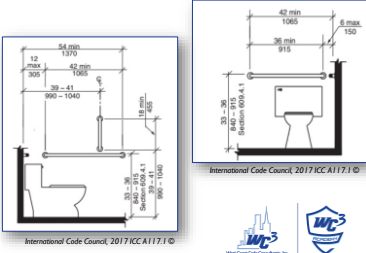
- Flush controls shall be on the open side of the water closet (604.6)
- Coat Hooks/Shelves (604.8)
 - Hooks 48" AFF
 - Shelves 40"-48" AFF



Grab Bars

Section 604.5:

- Side Wall Grab Bars (604.5.1.1)
 - 42" minimum in length, 12" maximum from rear wall extends 54"
- Vertical Grab Bars (604.5.1.2)
 - 18" in length, located 39"-41" from rear wall, 39"-41" above the floor
- Rear Wall Grab Bars (604.5.2)
 - 36" in length, 6" maximum from the side wall, extend 42" minimum from the side wall

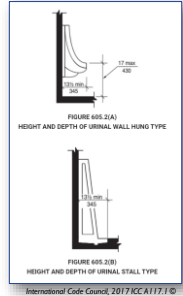


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Urinals

Section 605.2:

- Height and Depth
 - Hung at 17" maximum above floor
 - 13.5" minimum in depth from outer face of urinal rim

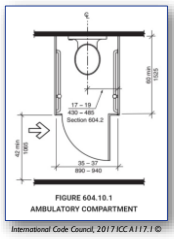


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Ambulatory Stalls

Section 604.10:

- 60" minimum depth, 35" - 37" width
- Doors are self-closing
- Doors cannot swing into the required minimum area of the compartment
- Side grab bars both sides



23

END OF MODULE

24

MODULE II:



Plumbing Plan Basics & Comment Writing Techniques




1

LEARNING OBJECTIVES

1. Become familiar with common plumbing plan symbols.
2. Understand common sequencing of plumbing plan sheets and what information they contain.
3. Learn how to write effective review comments.

2

2021 Commercial Plumbing Review



Plumbing Plan Review Basics




3

2021 Exam Breakdowns

	Commercial Plumbing Inspector Exam	Commercial Plumbing Plans Examiner Exam
General Requirements	8%	5%
Fixtures	15%	15%
Water Heaters	12%	10%
Water Supply and Distribution	18%	19%
Sanitary Drainage	13%	13%
Vents	15%	15%
Traps, Interceptors, Separators, Special Piping, and Storage Systems	9%	11%
Storm Drainage	5%	7%

4

Layout of Plumbing Plans

There is substantial variety in the way in which design professionals organize a set of plumbing plans.

- Common sequencing may include:
 - General Notes, with Legends and Index of Sheets
 - Fixture Schedules
 - Floor Plans- Underground to Roof
 - Drain, Waste and Vent
 - Water Distribution
 - Enlarged plans
 - Details and Isometrics
 - Specifications and Additional Notes



Index

SHEET INDEX			
SHEET NUMBER	PLUMBING & FIRE PROTECTION SHEET TITLE	SHEET SCALE	SHEET ISSUED
P-000	PLUMBING COVER SHEET - LEGEND, GENERAL NOTES AND SHEET INDEX	NONE	
P-111	PLUMBING FLOOR PLANS	1/8" = 1'-0"	
P-113	ROOF PLUMBING PLAN	1/8" = 1'-0"	
P-115	MECHANICAL PLUMBING PLAN	1/8" = 1'-0"	
P-100	PLUMBING DETAILS	NONE	
P-101	PLUMBING SCHEDULES	NONE	
P-102	PLUMBING SPECIFICATIONS	NONE	



Applicable Codes

APPLICABLE CODES	
2019	CALIFORNIA BUILDING STANDARDS ADMINISTRATIVE CODE PART 1, TITLE 24, CALIFORNIA CODES OF REGULATIONS (CCR)
2019	CALIFORNIA BUILDING CODE (CBC) PART 2, TITLE 24, CCR
2019	CALIFORNIA ELECTRICAL CODE (CEC) PART 3, TITLE 24, CCR
2019	CALIFORNIA MECHANICAL CODE (CMC) PART 4, TITLE 24, CCR
2019	CALIFORNIA PLUMBING CODE (CPC) PART 5, TITLE 24, CCR
2019	CALIFORNIA ENERGY CODE (CEC) PART 6, TITLE 24, CCR
2019	CALIFORNIA FIRE CODE (CFC) PART 9, TITLE 24, CCR



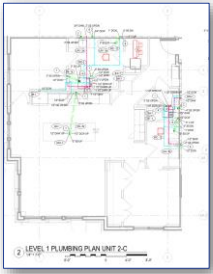
Plumbing Plan General Notes

PLUMBING GENERAL NOTES	
1.	FIELD VERIFY EXACT LOCATION OF ALL CONNECTION PRIOR TO CONSTRUCTION.
2.	PROVIDE AND FINAL CONNECT ALL FIXTURES EQUIPMENT, ETC.
3.	CONTRACTOR SHALL VERIFY SIZE TO INDIVIDUALS & SHALL VERIFY SIZES WITH THE AREA OF WORK. THE CONTRACTOR SHALL VERIFY THESE SIZES AND THE CONDITIONS SHALL BE REPORTED TO THE ARCHITECT IMMEDIATELY UPON DISCOVERY. NO EXTRA SHALL BE ALLOWED FOR THE CORRECTION OF SUCH CONDITIONS.
4.	ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH ALL APPLICABLE PERMITS AND REGULATIONS.
5.	PROVIDE ALL VALVES ON ALL BRANCHES FOR ALL SOLUTIONS UNLESS OTHERWISE NOTED OTHERWISE.
6.	PROVIDE A WORK DRAWING FOR EACH LOCATION OF ALL FIXED EQUIPMENT INCLUDING PLUMBING, MECHANICAL, ELECTRICAL AND OTHER CONNECTIONS AND PLUMBING CODES FOR REQUIREMENTS.
7.	ALL DISCHARGE OPENING BEHIND THE SCOURAGES OF THE BUILDING SHALL BE SLICED AT 1/4" FOR FOOT AND/OR OVERHANG NOTES.
8.	ALL WORK THROUGH THE ROOF SYSTEMS SHALL BE PERFORMED IN ACCORDANCE WITH ALL APPLICABLE PERMITS AND REGULATIONS.
9.	PROVIDE ARCHITECTURAL, ENGINEERING FOR LOCATION OF ALL FIRE RATED WALLS, ALL FIRE STOPPING, THROUGH THE MECHANICAL ROOMS, BE SIZES IN ACCORDANCE WITH THE BUILDING CODES.
10.	PROTECT ALL PERMS BEING USED TO AVOID STRUCTURAL MEMBERS, CHASES, PLUMBING, MECHANICAL, ELECTRICAL EQUIPMENT.
11.	PROTECT CONCRETE IN ALL SET FORMS TYPE STRUCTURES AT ALL EXPOSED FIRE PENETRATIONS THROUGH WALLS AND ROOFING.
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15.	PLUMBING CONTRACTOR SHALL PROVIDE ALL NECESSARY PERMS, MECHANICAL, ELECTRICAL CONNECTIONS THROUGH EXISTING PERMS, ETC. VERIFY FIELD AND LOCATIONS FOR ALL EXPOSED FIRE PENETRATIONS THROUGH WALLS AND ROOFING.
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Floor Plans



Floor plans typically show:

- Building footprint
- Wall layouts
- Rated assemblies
- Grid Lines
- Pipe Layouts
- Drops and Risers
- Pipe Sizes
- Proposed Pipe Slopes
- Fixture Locations



17

Proper Plan Review

Comment Writing Techniques

18



Plan Review Considerations

- Does your plan review ignore the experience level of your inspector(s)? ([Know your inspectors, involve them](#))
- Do your plan review comments add value to the project? If so, how?
- Does the cost (time is money) of adjusting the plans exceed the cost of making the correction if missed?
- Don't make inspection-based comments, in the plan review!
- Are we enforcing this in the field? If not, you're wasting time.
- More comments [does not = higher quality](#)



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Contractor Expectations/ Considerations

- What are contractors consistently missing? [Ask the inspectors!](#)
- What's new in the code that contractors aren't used to?
- Is the permit for an owner-builder, production builder, or small-time builder? [Adjust accordingly!](#)
- Will the plans really make a difference for a particular issue or item? Obscure notes in random places help no one.
- The plans aren't our backstop- [The Code Is!](#)



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Building Department Communication

- Plans examiners and inspectors must communicate regularly.
- The same plan review comment on 100 plans, may easily be eliminated with one staff meeting.
- You have to establish as a department what is important, you can't be divided.



21

Pet Peeves

- Just because something happened once in 1997, doesn't mean every permit applicant should pay for it for the next 30 years!
- The plans are a guide, not literal representation of the home.



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Practical Tips

- Allocate sufficient time, in blocks not small chunks
- Ensure adequate space (paper based)
- Ensure proper equipment (electronic)

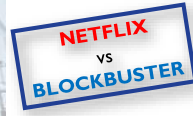


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Electronic Plan Reviews

- Blockbuster vs. Netflix- Who's still in business?
- Electronic plans, electronic correction letters
 - Never type a comment twice- Get organized!
 - Never hand-write comments- They can't be used again.
- Be professional, raise the profile of our industry.



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A Good Plan Review Comment:

Key Elements:

- Number your comments
- Reference a plan sheet
- Include a code reference
- Write clearly, use spell check, be specific
- Provide direction

It may take more time initially but remember you're only typing it once!

1. Sheet E1: IRC R302.13 requires a 3" gap to be placed between canned lighting or ceiling fan motors to any combustible insulation. Please indicate how this is being addressed for the main floor ceiling framing. Provide a note or detail on the plans.

Good!

The code requires a 3" gap at can lights. Bad

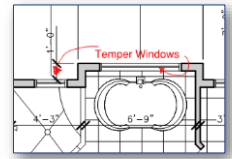


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Redlines can Save Time

- You can redline on electronic plans
- It does save time
- Be careful, you're not the designer
- Stick to notes
- Inform the applicant
- Protect the documents



26

26

Importance Analysis

Evaluate Common Comments:

- Determine level of importance on a scale of 1-10 or similar
- Eliminate inconsequential comments
- Identify most critical comments (Bold or underlined)
- Revise methodology regularly



27

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Organization of Comment Letter

- Reference the applicant and permit number
- Include received date, and date of comments
- Follow a logical order- Based on sheet numbers
- Provide contact information of the reviewer



28

28



Key Indicators of a Good Review

- Minimal phone calls and emails asking for clarification
- Responses resolve the original comments. If not, did the original comment make sense and give proper direction?
- Over time are submittals from regular applicants getting cleaner. Consistency pays off.
- Can a different reviewer perform the re-check easily and quickly?



29

29



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MODULE 12:
Plumbing Review Methodology






1

1

LEARNING OBJECTIVES

1. Become familiar with the various topics associated with a plumbing plan review.
2. Establish a sequence for ensuring each topic is reviewed.
3. Help develop a methodology for performing plumbing and fuel gas reviews.






2

2

IPC
Chapter-by-Chapter Method

We suggest the chapter-by-chapter method as a guide to performing mechanical plan review. The following steps, and attached outline, serve as a guide.

3

3



Step 0: Familiarization

- Understand the scope of work.
- Flip through the plan set to see what information has been included.
- What codes are being referenced on the cover sheets? Are they correct?

BUILDING CODES:

ALL CONSTRUCTION IN ASSOCIATION WITH THIS PROJECT SHALL COMPLY WITH THE STATE ADOPTED CODES LISTED BELOW:

- 2018 EDITION OF THE INTERNATIONAL BUILDING CODE (IBC), INCLUDING APPENDIX J
- 2017 EDITION OF THE NATIONAL ELECTRICAL CODE (NEC)
- 2018 EDITION OF THE INTERNATIONAL PLUMBING CODE (IPC)
- 2018 EDITION OF THE INTERNATIONAL MECHANICAL CODE (IMC)
- 2018 EDITION OF THE INTERNATIONAL ENERGY CONSERVATION CODE (IECC)
- 2018 EDITION OF THE INTERNATIONAL FUEL GAS CODE (IFGC)
- 2018 INTERNATIONAL FUEL GAS CODE (ICC/ANSI A117.1-2009)

4

4



Step 1: Scoping/Documents

Chapter 1 – IPC - Scope

- Scope of the Code (101.2)
- Permit Required? (106.2)

[A] 106.2 Exempt work. The following work shall be exempt from the requirement for a permit:

1. The stopping of leaks in drains, water, soil, waste or vent pipe provided, however, that if any concealed trap, drainage, water, soil, waste or vent pipe becomes defective and it becomes necessary to remove and replace the same with new material, such work shall be considered as new work and a permit shall be obtained and inspection made as provided in this code.
2. The clearing of stoppages or the repairing of leaks in pipes, valves or fittings, and the removal and reinstallation of water closets, provided that such repairs do not involve or require the replacement or re-arrangement of valves, pipes or fittings.

Exemption from the permit requirements of this code shall not be deemed to grant authorization for any work to be done in violation of the provisions of this code or any other laws or ordinances of this jurisdiction.

[A] 101.2 Scope. The provisions of this code shall apply to the erection, installation, alteration, repair, relocation, replacement, addition to, use or maintenance of plumbing systems within this jurisdiction. This code shall regulate nonflammable medical gas, inhalation anesthesia, vacuum piping, nonmedical oxygen systems and sanitary and condensate vacuum collection systems. The installation of fuel gas, distribution piping and equipment, fuel-gas-fired water heaters and water heater venting systems shall be regulated by the International Fuel Gas Code. Provisions in the appendices shall not apply unless specifically adopted.



Step 1: Scoping/Documents

- Complete Plans & Documents (106.5)
 - Stamped Plans (State Law)
 - General notes, Plan Sheets, Details, Schedules
 - Water Distribution Calculations (604)
 - Drainage Fixture Loads (710)
 - Storm Drain Calculations (1106)
 - Site Plan for Utility Connections

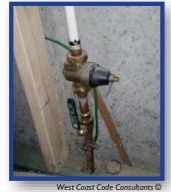
Fixture	Category	Number	Water	Drainage	Sanitary	Gas	Other
1	Water	1	1.0	0.0	0.0	0.0	0.0
2	Water	2	1.0	0.0	0.0	0.0	0.0
3	Water	3	1.0	0.0	0.0	0.0	0.0
4	Water	4	1.0	0.0	0.0	0.0	0.0
5	Water	5	1.0	0.0	0.0	0.0	0.0
6	Water	6	1.0	0.0	0.0	0.0	0.0
7	Water	7	1.0	0.0	0.0	0.0	0.0
8	Water	8	1.0	0.0	0.0	0.0	0.0
9	Water	9	1.0	0.0	0.0	0.0	0.0
10	Water	10	1.0	0.0	0.0	0.0	0.0
11	Water	11	1.0	0.0	0.0	0.0	0.0
12	Water	12	1.0	0.0	0.0	0.0	0.0
13	Water	13	1.0	0.0	0.0	0.0	0.0
14	Water	14	1.0	0.0	0.0	0.0	0.0
15	Water	15	1.0	0.0	0.0	0.0	0.0
16	Water	16	1.0	0.0	0.0	0.0	0.0
17	Water	17	1.0	0.0	0.0	0.0	0.0
18	Water	18	1.0	0.0	0.0	0.0	0.0
19	Water	19	1.0	0.0	0.0	0.0	0.0
20	Water	20	1.0	0.0	0.0	0.0	0.0
21	Water	21	1.0	0.0	0.0	0.0	0.0
22	Water	22	1.0	0.0	0.0	0.0	0.0
23	Water	23	1.0	0.0	0.0	0.0	0.0
24	Water	24	1.0	0.0	0.0	0.0	0.0
25	Water	25	1.0	0.0	0.0	0.0	0.0
26	Water	26	1.0	0.0	0.0	0.0	0.0
27	Water	27	1.0	0.0	0.0	0.0	0.0
28	Water	28	1.0	0.0	0.0	0.0	0.0
29	Water	29	1.0	0.0	0.0	0.0	0.0
30	Water	30	1.0	0.0	0.0	0.0	0.0
31	Water	31	1.0	0.0	0.0	0.0	0.0
32	Water	32	1.0	0.0	0.0	0.0	0.0
33	Water	33	1.0	0.0	0.0	0.0	0.0
34	Water	34	1.0	0.0	0.0	0.0	0.0
35	Water	35	1.0	0.0	0.0	0.0	0.0
36	Water	36	1.0	0.0	0.0	0.0	0.0
37	Water	37	1.0	0.0	0.0	0.0	0.0
38	Water	38	1.0	0.0	0.0	0.0	0.0
39	Water	39	1.0	0.0	0.0	0.0	0.0
40	Water	40	1.0	0.0	0.0	0.0	0.0
41	Water	41	1.0	0.0	0.0	0.0	0.0
42	Water	42	1.0	0.0	0.0	0.0	0.0
43	Water	43	1.0	0.0	0.0	0.0	0.0
44	Water	44	1.0	0.0	0.0	0.0	0.0
45	Water	45	1.0	0.0	0.0	0.0	0.0
46	Water	46	1.0	0.0	0.0	0.0	0.0
47	Water	47	1.0	0.0	0.0	0.0	0.0
48	Water	48	1.0	0.0	0.0	0.0	0.0
49	Water	49	1.0	0.0	0.0	0.0	0.0
50	Water	50	1.0	0.0	0.0	0.0	0.0
51	Water	51	1.0	0.0	0.0	0.0	0.0
52	Water	52	1.0	0.0	0.0	0.0	0.0
53	Water	53	1.0	0.0	0.0	0.0	0.0
54	Water	54	1.0	0.0	0.0	0.0	0.0
55	Water	55	1.0	0.0	0.0	0.0	0.0
56	Water	56	1.0	0.0	0.0	0.0	0.0
57	Water	57	1.0	0.0	0.0	0.0	0.0
58	Water	58	1.0	0.0	0.0	0.0	0.0
59	Water	59	1.0	0.0	0.0	0.0	0.0
60	Water	60	1.0	0.0	0.0	0.0	0.0
61	Water	61	1.0	0.0	0.0	0.0	0.0
62	Water	62	1.0	0.0	0.0	0.0	0.0
63	Water	63	1.0	0.0	0.0	0.0	0.0
64	Water	64	1.0	0.0	0.0	0.0	0.0
65	Water	65	1.0	0.0	0.0	0.0	0.0
66	Water	66	1.0	0.0	0.0	0.0	0.0
67	Water	67	1.0	0.0	0.0	0.0	0.0
68	Water	68	1.0	0.0	0.0	0.0	0.0
69	Water	69	1.0	0.0	0.0	0.0	0.0
70	Water	70	1.0	0.0	0.0	0.0	0.0
71	Water	71	1.0	0.0	0.0	0.0	0.0
72	Water	72	1.0	0.0	0.0	0.0	0.0
73	Water	73	1.0	0.0	0.0	0.0	0.0
74	Water	74	1.0	0.0	0.0	0.0	0.0
75	Water	75	1.0	0.0	0.0	0.0	0.0
76	Water	76	1.0	0.0	0.0	0.0	0.0
77	Water	77	1.0	0.0	0.0	0.0	0.0
78	Water	78	1.0	0.0	0.0	0.0	0.0
79	Water	79	1.0	0.0	0.0	0.0	0.0
80	Water	80	1.0	0.0	0.0	0.0	0.0
81	Water	81	1.0	0.0	0.0	0.0	0.0
82	Water	82	1.0	0.0	0.0	0.0	0.0
83	Water	83	1.0	0.0	0.0	0.0	0.0
84	Water	84	1.0	0.0	0.0	0.0	0.0
85	Water	85	1.0	0.0	0.0	0.0	0.0
86	Water	86	1.0	0.0	0.0	0.0	0.0
87	Water	87	1.0	0.0	0.0	0.0	0.0
88	Water	88	1.0	0.0	0.0	0.0	0.0
89	Water	89	1.0	0.0	0.0	0.0	0.0
90	Water	90	1.0	0.0	0.0	0.0	0.0
91	Water	91	1.0	0.0	0.0	0.0	0.0
92	Water	92	1.0	0.0	0.0	0.0	0.0
93	Water	93	1.0	0.0	0.0	0.0	0.0
94	Water	94	1.0	0.0	0.0	0.0	0.0
95	Water	95	1.0	0.0	0.0	0.0	0.0
96	Water	96	1.0	0.0	0.0	0.0	0.0
97	Water	97	1.0	0.0	0.0	0.0	0.0
98	Water	98	1.0	0.0	0.0	0.0	0.0
99	Water	99	1.0	0.0	0.0	0.0	0.0
100	Water	100	1.0	0.0	0.0	0.0	0.0



Step 2: General Regulations

Chapter 3 – IPC – General Regulations

- Connections to Drainage (301.3)
- Connections to Water Supply (301.4)
- Prohibited Lactations (301.6)



Step 2: General Regulations

- Detrimental Materials (302)
- Proper Materials (303)
- Trenching and Excavation (306)
- Pipe Support & Bracing (308)
- Flood Hazard Resistance (309)
- Condensate Disposal (314)



Step 3: Fixtures

Chapter 4 – IPC – Fixtures, Faucets and Fittings

- Minimum Plumbing Facilities (403)
 - Determine Occupant Loads (IBC)
 - Apply the provisions of Table 403.1
 - Check all applicable footnotes

NO.	CLASSIFICATION	DESCRIPTION	WATER CLOSURE SYSTEMS (See Section 403.3.1)		LAVATORIES		SINKS/ FOUNTAINS	SHOWER BATHS	OTHER
			MALE	FEMALE	MALE	FEMALE			
1	Assembly	Theaters and other buildings for the performing arts and similar purposes	1 per 125	1 per 65	1 per 200	—	1 per 200	—	1 service sink
		Rights halls, bars, taverns, clubs, halls and buildings for similar purposes	1 per 60	1 per 60	1 per 75	—	1 per 200	—	1 service sink
		Restrooms, lounge halls and food courts	1 per 75	1 per 75	1 per 200	—	1 per 200	—	1 service sink

(continued)



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Step 3: Fixtures

- Separate Sex Facilities (403.2)
 - Gender Neutral Provision (Ex. 6)
- Access to Required Fixtures (403.3.1)
- Prohibited Locations (403.3.2)
 - Rooms used for Food Preparation
- Location and Distances (403.3.3)
 - Less than 500' travel
 - One story above or below



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Step 3: Fixtures

- Accessible Facilities (404)
 - See Step 13
- Setting of Fixtures (405.3)
 - Clearance to walls- 15"
 - Clearance CL to CL – 30"



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Step 3: Fixtures

- Compartments/Partitions (405.3.4 & 405.3.5)
- Specific Fixtures (406 – 426)
 - Drinking Fountains (410.3)
 - Required Floor Drains (413)
 - Mixing Valves- ASSE 1070 (412 & 419.5)
 - Shower Compartments (421.4)
 - Urinal Substitutions (424.2)
 - Toilet Bowls/Seats (425.2 & 425.3)
 - Whirlpool Pump Access (426.5)



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Step 4: Water Heaters

Chapter 5 – IPC – Water Heaters

- Combo Water/Space Heating (501.2)
- Location in Attic (502.3)
- Prohibited Locations (IMC 303.3)
- Seismic Supports (502.4)



13

13

Step 4: Water Heaters

- Access and Maintenance (502.5)
- Safety Devices (504)
- Required Pan (504.7)



14

14

Step 5: Water Supply and Distribution

Chapter 6 – IPC – Water Supply and Dist.

- Water Service Sizing (603)
- Maximum Flow Rates (Table 604.4)
- Minimum Fixture Supply (Table 604.5)
- Proper Pressure (604.7 or 604.8)



15

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Step 5: Water Supply and Distribution

- Water Hammer Arrestors (604.9)
- Hot Water Supply (607)
 - Developed Length 50' (607.2, IECC)
 - Pipe Insulation (607.5, IECC)
- Backflow Prevention (608 & 608.14)
- Health Care Plumbing (609)



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Step 6: Sanitary Drainage

Chapter 7 – IPC – Sanitary Drainage

- Chemical Waste (702.6)
- Drainage Pipe Slope (704.1)
- No Pipe Size Reductions (704.2)
- Connections to Branches and Stacks (704.3)



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Step 6: Sanitary Drainage

- Directional Fittings (706.3)
- Required Cleanouts (708)
- Sewer Line Sizing (701 & Table 709)
- Sumps & Ejectors (712)
- Backwater Valves (714)
- Replacement of Building Sewers (716 & 717)



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Step 7: Indirect/Special Waste

Chapter 8 – IPC – Indirect/Special Waste

- Where Required? (802.1)
- Proper Installation (802.3)
 - Air Gap (802.3.1)
 - Air Break (802.3.2)
- Waste Receptors (802.4)
 - Laundry Waste (802.4.3.1)
- Special Waste (803)



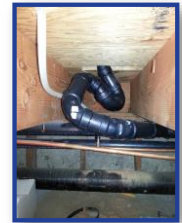
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Step 8: Vents

Chapter 9 – IPC – Vents

- Trap Seal Protection (901.2 & 1002.4)
- Separate Vent for Chemical Waste (901.3)
- Vent Terminations (903.1 & 903.2)
 - Separation from air intakes (903.5)



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Step 8: Vents

- Extensions and Connections (904 & 905)
- Vent Pipe Sizing (906)
- Stack Offsets (907)
- Relief Vents – 10 + Intervals (908)



Step 8: Vents

- H. Venting Methods (909-918)
 - Fixture Vents (909)
 - Individual Vents (910)
 - Common Vents (911)
 - Wet Vents (912)
 - Waste Stack Vents (913)
 - H. Circuit Vents (914)
 - Combination Waste/Vent (915)
 - Island Fixture Venting (916)
 - Single Stack Vents (917)
 - Air Admittance Valves (918)



Step 9: Traps and Interceptors

Chapter 10 – IPC – Traps and Interceptors

- Fixture Traps (1002)
- Grease Interceptors (1003)
- Oil Interceptors (1003.4)
- Clothes Washer Wire Basket (1003.6)
- Venting of Interceptors (1003.9)



Step 10: Storm Drainage

Chapter 11 – IPC – Storm Drainage

- Proper Disposal (1101.2 & 1101.3)
- Roof Drainage Calculations (1101.7 & 1105)
- Roof Drainage Sizing (1106)



Step 10: Storm Drainage

- Emergency Roof Drains (1108)
- Subsoil Drains (1111)
- Sumps (1113)



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Step 11: Special Piping and Storage

Chapter 12 – IPC – Special Piping and Storage

- Med Gas - NFPA 99 (1202)
- Oxygen Systems - NFPA 51/55 (1203)



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Step 12: Nonpotable Water Systems

Chapter 13 – IPC – Nonpotable Water Systems

- Water Quality (1301.2)
- Required Signage (1301.3)
- Nonpotable Storage Tanks (1301.9)
- Trenching Requirements (1301.11)
- Reuse Systems (1302)
 - Prohibited Sources (1302.2.1)
 - Required Bypass Valve (1302.8.1)
 - Labeling and Marking (608.9)



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Step 12: Nonpotable Water Systems

- Rainwater Collection (1303)
 - Minimum Slopes (1303.5.1)
 - Collection (1303.7)
 - Filtration (1303.8)
- Reclaimed Water Systems (1304)



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Step 13: Subsurface Graywater Absorption

Chapter 14 – IPC – Subsurface Graywater Absorption

- Design and Sizing (1402)
- Percolation Test (1402.2)
- Installation (1403)



Step 14: Accessibility Provisions

Chapter 11 – IBC & A117.1-2017

- Drinking Fountains (602)
- Toilet Compartments (604)
 - Location (604.2)
 - Fixture Height (604.4)
 - Flush Controls (604.6)
 - Ambulatory Stalls (604.10)



Step 14: Accessibility Provisions

- Urinals (605)
- Lavatories and Sinks (606)
 - Height (606.3)
- Bathtubs (607)
- Showers (608)



Step 15: Energy Code Provisions

IECC C404

- Water Heater Efficiency (C404.2)
- Insulation of Piping (C404.4)
- Maximum Pipe Length (Table C404.5.1)
- Recirculation Controls (C404.6.1)





33



Supplement

Gas Line Sizing Sample Questions



1

LEARNING OBJECTIVES

1. Practice multiple sizing examples to better understand gas pipe sizing.
2. Understand how to use the tables in the IFGC to accurately answer gas line sizing questions.
3. Work through the equations step-by-step to ensure arrival at the correct answer.



2

Three Sizing Options


IFGC 402.4:

402.4 Sizing tables and equations. This section applies to piping materials other than noncorrugated stainless steel tubing. Where Tables 402.4(1) through 402.4(37) are used to size piping or tubing, the pipe length shall be determined in accordance with Section 402.4.1, 402.4.2 or 402.4.3.

Key Factors:

1. Length of Pipe
2. Pressure of System
3. Btu's Served (Loads)

1. Longest Length 402.4.1
2. Branch Length 402.4.2
3. Hybrid Pressure 402.4.3



3



IFGC


Gas Line Sizing – Question #1

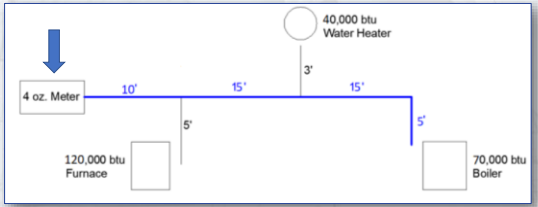


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Question #1:

Size the blue sections of steel natural gas pipe using the longest length method. Assume 0.3 in. w.c. pressure drop.

4 oz. Meter 




40,000 btu Water Heater

120,000 btu Furnace

70,000 btu Boiler

4 oz. Meter

10' 15' 3' 15' 5'

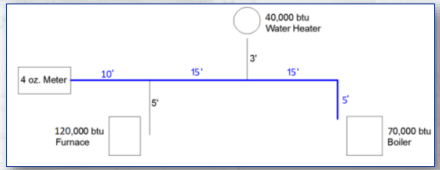


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Longest Length Method

IFGC 402.4.1: (Also see A103.1)

402.4.1 Longest length method. The pipe size of each section of gas piping shall be determined using the longest length of piping from the point of delivery to the most remote outlet and the load of the section.




40,000 btu Water Heater

120,000 btu Furnace

70,000 btu Boiler

4 oz. Meter

10' 15' 3' 15' 5'



6

General Rules:

Pressure Drop:

- 4 oz. System- Use 0.3 in. w.c.
- 2 lb. System- Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Step 1: Find the Right Table


Make sure you're in the right table and verify values!

TABLE 402.4.11 SCHEDULE 40 METALLIC PIPE

Nominal Actual ID	PIPE SIZE (in.)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
0.822	0.824	1.049	1.310	1.610	2.067	2.469	3.068	4.026	
Length (ft)	10	131	273	514	1,000	1,360	3,050	4,860	17,500
	20	90	188	353	726	1,090	2,090	3,340	12,000
	30	72	151	284	583	873	1,680	2,680	9,000
	40	62	129	243	489	747	1,440	2,290	8,270
	50	55	114	213	442	662	1,280	2,030	7,330
	60	50	104	195	400	600	1,160	1,740	6,640

Capacity (in cubic feet of gas per hour)

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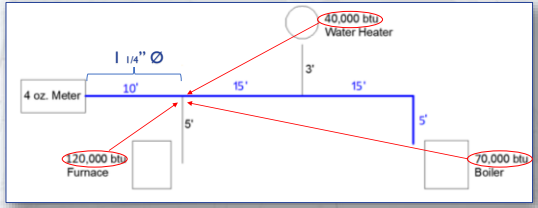
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Question #1:

First Section:
Longest Length = 45' (10+15+15+5)
Total btu's = 230,000 btu (120k + 40k + 70k) 230,000/1,000 = 230 CFH

CFH = +/- 1,000 BTU
*real world application- adjust per local conditions

1/4" Ø




40,000 btu Water Heater

120,000 btu Furnace

70,000 btu Boiler

4 oz. Meter

10' 15' 3' 15' 5'



8

Impact of Gas Content

Check with gas utility- btu's per CFH vary from location to location and are affected by altitude

Code	Derated Factor (Maximum %)	Derated Factor (Minimum %)	Derated Factor (Specific Gravity)	BTU/cubic ft.
Backfield (cont.)	75	88	0.900	810
Chicago	75	88	1.100	810
Florida	75	88	0.915	810
Georgia	75	88	0.900	810
Illinois	75	88	0.900	810
Indiana	75	88	0.900	810
International	75	88	0.900	810
Michigan	75	88	0.900	810
Minnesota	75	88	0.900	810
Missouri	75	88	0.900	810
Nebraska	75	88	0.900	810
Nevada	75	88	0.900	810
New York	75	88	0.900	810
North Carolina	75	88	0.900	810
Ohio	75	88	0.900	810
Oklahoma	75	88	0.900	810
Pennsylvania	75	88	0.900	810
Rhode Island	75	88	0.900	810
Texas	75	88	0.900	810
Virginia	75	88	0.900	810
Washington	75	88	0.900	810
West Virginia	75	88	0.900	810
Wisconsin	75	88	0.900	810
Wyoming	75	88	0.900	810

Depending upon the utility provider:
1 CFH = +/- 1,000 btu's
or
1 CFH = 800 - 1,000 btu's

Nominal Length (ft)	PIPE SIZE (inches)			
	1/2	3/4	1	1 1/4
10	131	273	514	1,000
20	90	180	353	726
30	72	151	284	583
40	62	129	243	489
50	55	114	213	442
60	50	104	191	400

International Code Council 2021 IFGC, Table 402.4(1)(b)

9

Question #1:

Next Section:
Longest Length = 45' (Doesn't change)
Total btu's = 110,000 btu (40k + 70k) 110,000/1,000 = 110 CFH

Nominal Length (ft)	PIPE SIZE (inches)			
	1/2	3/4	1	1 1/4
10	131	273	514	1,000
20	90	180	353	726
30	72	151	284	583
40	62	129	243	489
50	55	114	213	442
60	50	104	191	400

CFH = +/- 1,000 BTU
***real world application- adjust per local conditions**

10

Question #1:

Final Section:
Longest Length = 45' (Doesn't change)
Total btu's = 70,000 (70k) 70,000/1,000 = 70 CFH

Nominal Length (ft)	PIPE SIZE (inches)			
	1/2	3/4	1	1 1/4
10	131	273	514	1,000
20	90	180	353	726
30	72	151	284	583
40	62	129	243	489
50	55	114	213	442
60	50	104	191	400

CFH = +/- 1,000 BTU
***real world application- adjust per local conditions**

11

Question #1:

Branch Lines:
Longest Length = 45'
Total btu's = 120,000 btu (120k) 120,000/1,000 = 120 CFH

Nominal Length (ft)	PIPE SIZE (inches)			
	1/2	3/4	1	1 1/4
10	131	273	514	1,000
20	90	180	353	726
30	72	151	284	583
40	62	129	243	489
50	55	114	213	442
60	50	104	191	400

CFH = +/- 1,000 BTU
***real world application- adjust per local conditions**

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Question #1:

Branch Lines:
Longest Length = 45'
Total btu's = 40,000 btu (40k) $40,000/1,000 = 40$ CFH

Nominal	PIPE SIZE (inch)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.822	0.824	1.049	1.315	1.610	2.067	2.468	3.068	3.825
Length (ft)	10	131	273	514	1,090	1,580	2,050	2,400	2,800
	20	90	188	353	728	1,090	1,440	1,740	2,000
	30	12	151	304	583	873	1,160	1,400	1,600
	40	42	129	263	489	717	940	1,120	1,270
	60	114	217	442	862	1,280	1,630	1,930	2,130
	80	150	304	617	1,210	1,740	2,100	2,360	2,540

International Code Council 2021 IFGC, Table 402.4(1)(B)

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

13

IFGC

Gas Line Sizing – Question #2

14

Question #2:

Size the blue sections of steel natural gas pipe using the longest length method. Assume 1.0 in. w.c. pressure drop.

2 lb. Meter ★

Note: Standard natural gas appliances are designed for 4 oz. pressures. This system would require a regulator at each appliance.

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General Rules:

TABLE 402.4(1) SCHEDULE 40 METALLIC PIPE	
Gas	Natural
Inlet Pressure	1.0 psi
Pressure Drop	1.0 psi
Specific Gravity	0.60

International Code Council 2021 IFGC ©

Nominal	PIPE SIZE (inch)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	0.822	0.824	1.049	1.315	1.610	2.067	2.468	3.068	3.825
Length (ft)	10	1,510	3,040	5,560	11,400	17,100	21,000	24,000	26,000
	20	1,070	2,150	3,930	8,070	12,100	14,700	16,800	18,100
	30	869	1,760	3,210	6,590	9,880	12,100	13,800	14,900
	40	753	1,520	2,780	5,710	8,550	10,400	11,900	12,800
	50	673	1,360	2,490	5,110	7,650	9,300	10,600	11,400
	60	615	1,240	2,270	4,660	6,900	8,300	9,500	10,200
	70	569	1,150	2,100	4,320	6,470	7,800	8,900	9,500
	80	532	1,080	1,970	4,040	6,050	7,300	8,300	8,900
	90	502	1,010	1,850	3,810	5,700	6,900	7,900	8,400

International Code Council 2021 IFGC ©

Pressure Drop:

- 1 lb. System - Use 0.3 in. w.c.
- 2 lb. System - Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

1 P.S.I. = 16 oz. or 28 in. w.c.
 4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

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Question #2:

First Section:
Longest Length = 80' (20 + 25 + 25 + 10)
Total btu's = 210,000 (75k + 35k + 100k) $210,000/1,000 = 210$ CFH

Nominal Actual ID	PIPE SIZE (inches)			
	1/2"	3/4"	1"	1 1/4"
Length (ft)	Capacity in Cubic Feet of Gas			
10	1,310	1,040	1,560	11,400
20	1,270	1,150	1,930	8,270
30	980	1,760	2,250	6,960
40	751	1,520	2,760	5,150
50	671	1,360	2,490	3,110
60	611	1,240	2,270	4,660
70	560	1,150	2,100	4,470
80	521	1,080	1,970	4,040

International Code Council 2021 IFGC, Table 402.4(5) ©

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

* Gas utility companies may require 3/4" minimum lines to support the gas meter. Check local requirements

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Question #2:

Next Section:
Longest Length = 80' (Doesn't change)
Total btu's = 135,000 (35k + 100k) $135,000/1,000 = 135$ CFH

Nominal Actual ID	PIPE SIZE (inches)			
	1/2"	3/4"	1"	1 1/4"
Length (ft)	Capacity in Cubic Feet of Gas			
10	1,310	1,040	1,560	11,400
20	1,270	1,150	1,930	8,270
30	980	1,760	2,250	6,960
40	751	1,520	2,760	5,150
50	671	1,360	2,490	3,110
60	611	1,240	2,270	4,660
70	560	1,150	2,100	4,470
80	521	1,080	1,970	4,040

International Code Council 2021 IFGC, Table 402.4(5) ©

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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Question #2:

Final Section:
Longest Length = 80' (Doesn't change)
Total btu's = 100,000 (100k) $100,000/1,000 = 100$ CFH

Nominal Actual ID	PIPE SIZE (inches)			
	1/2"	3/4"	1"	1 1/4"
Length (ft)	Capacity in Cubic Feet of Gas			
10	1,310	1,040	1,560	11,400
20	1,270	1,150	1,930	8,270
30	980	1,760	2,250	6,960
40	751	1,520	2,760	5,150
50	671	1,360	2,490	3,110
60	611	1,240	2,270	4,660
70	560	1,150	2,100	4,470
80	521	1,080	1,970	4,040

International Code Council 2021 IFGC, Table 402.4(5) ©

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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IFGC

Gas Line Sizing – Question #3

International Code Council 2021 IFGC ©

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Question #3:

Size the blue sections of steel propane gas pipe using the longest length method. Assume 1.0 in. w.c. pressure drop.

Propane ★

INTENDED USE	Pipe sizing between single- or second-stage (low pressure) regu				
	PIPE SIZE (inch)				
Nominal	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.622	0.824	1.048	1.315	1.610
Length (ft)	Capacity in Thousands of Btu per Hour				
10	291	608	1,150	2,350	6,790
20	200	418	787	1,620	4,660

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General Rules:

Pressure Drop:
 See table- 0.5 in. w.c.

Specific Gravity:
 Natural Gas- 0.6
 Propane- 1.5

Inlet Pressure:
 From storage tank- likely 10.5 in. W.C.
 1 P.S.I. = 16 oz. or 28 in. w.c.
 4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

22

Question #3:

First Section:
 Longest Length = 20' (3+3+5+1+5+3)
 Total btu's = (50,000 + 65,000 + 120,000 + 100,000 + 80,000) = 415,000 btu's
 (Divide by 1,000 = 415 kbtu/h)

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Question #3:

Second Section:
 Longest Length = 20' (Doesn't change)
 Total btu's = 365,000 (Divide by 1,000 = 365)

24

Question #3:

Third Section:
Longest Length = 20' (Doesn't change)
Total btu's = 300,000 (Divide by 1,000 = 300)

INTENDED USE	Pipe sizing between single- or second-stage (low pressure) regulators					
	PIPE SIZE (INCH)					
Nominal	1/2	3/4	1	1 1/2	1 3/4	2
Actual ID	0.825	0.924	1.048	1.315	1.616	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	408	1,150	2,350	2,520	6,790
20	581	816	2,300	4,700	5,040	13,580

International Code Council 2021 IFGC, Table 402.4(28) ©

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Question #3:

Fourth Section:
Longest Length = 20' (Doesn't change)
Total btu's = 180,000 (Divide by 1,000 = 180)

INTENDED USE	Pipe sizing between single- or second-stage (low pressure) regulators					
	PIPE SIZE (INCH)					
Nominal	1/2	3/4	1	1 1/2	1 3/4	2
Actual ID	0.825	0.924	1.048	1.315	1.616	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	408	1,150	2,350	2,520	6,790
20	581	816	2,300	4,700	5,040	13,580

International Code Council 2021 IFGC, Table 402.4(28) ©

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Question #3:

Final Section:
Longest Length = 20' (Doesn't change)
Total btu's = 80,000 (Divide by 1,000 = 80)

INTENDED USE	Pipe sizing between single- or second-stage (low pressure) regulators					
	PIPE SIZE (INCH)					
Nominal	1/2	3/4	1	1 1/2	1 3/4	2
Actual ID	0.825	0.924	1.048	1.315	1.616	2.067
Length (ft)	Capacity in Thousands of Btu per Hour					
10	291	408	1,150	2,350	2,520	6,790
20	581	816	2,300	4,700	5,040	13,580

International Code Council 2021 IFGC, Table 402.4(28) ©

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IFGC

Gas Line Sizing – Question #4

International Code Council 2021 IFGC ©

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Question #4:

Size all pipe sections of **natural gas pipe** using the **branch length method**. Assume **0.3 in. w.c. pressure drop**.

Branch Length ★

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Branch Length Method

IFGC 402.4.2: (Also see A103.2)

402.4.2 Branch length method. Pipe shall be sized as follows:

1. Pipe size of **each section** of the longest pipe run from the **point of delivery** to the most remote **outlet** shall be determined using the longest run of piping and the load of the section.
2. The pipe size of each section of branch piping not previously sized shall be determined using the length of piping from the **point of delivery** to the most remote **outlet** in each branch and the load of the section.

30

General Rules:

Pressure Drop:

- ❑ 4 oz. System- Use 0.3 in. w.c.
- ❑ 2 lb. System- Use 1 in. w.c.

Specific Gravity:

- ❑ Natural Gas- 0.6
- ❑ Propane- 1.5

Inlet Pressure:

- ❑ Residential- 4 oz. (typ.) 2 lb. available
- ❑ Commercial- 2 lb. (typ.) 5 lb. available

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Step 1: Find the Right Table

Make sure you're in the right table and verify values!

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Question #4:

Branch #3:

Branch Length (Section I) = 45' (10+15+15+5)

Total Branch btu's = 230,000 btu (120k + 40k + 70k) 230,000/1,000 = 230 CFH

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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Question #4:

Branch #3:
Branch Length (Section 2) = 45'
Total Branch btu's = 110,000 btu (40k + 70k) $110,000/1,000 = 110$ CFH

Nominal Actual ID	PIPE SIZE (inch)							
	1/2	3/4	1	1 1/4	1 1/2	2	3	4
0.822	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	131	293	514	1,000	1,500	3,050	4,500
	20	90	188	333	726	1,090	2,090	3,140
	30	72	151	264	583	873	1,680	2,680
	40	62	129	243	499	747	1,440	2,290
	50	55	114	213	442	662	1,280	2,030
	60	50	104	197	400	600	1,100	1,740

Capacity in Cubic Feet of Gas Per Hour

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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Question #4:

Branch #3:
Branch Length (Section 3) = 45'
Total Branch btu's = 70,000 btu (70k) $70,000/1,000 = 70$ CFH

Nominal Actual ID	PIPE SIZE (inch)							
	1/2	3/4	1	1 1/4	1 1/2	2	3	4
0.822	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	131	293	514	1,000	1,500	3,050	4,500
	20	90	188	333	726	1,090	2,090	3,140
	30	72	151	264	583	873	1,680	2,680
	40	62	129	243	499	747	1,440	2,290
	50	55	114	213	442	662	1,280	2,030
	60	50	104	197	400	600	1,100	1,740

Capacity in Cubic Feet of Gas Per Hour

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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Question #4:

Branch #2:
Branch Length = 28' (10 + 15 + 3)
Total Branch btu's = 110,000 btu (40k) $40,000/1,000 = 40$ CFH

Nominal Actual ID	PIPE SIZE (inch)							
	1/2	3/4	1	1 1/4	1 1/2	2	3	4
0.822	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	131	293	514	1,000	1,500	3,050	4,500
	20	90	188	333	726	1,090	2,090	3,140
	30	72	151	264	583	873	1,680	2,680
	40	62	129	243	499	747	1,440	2,290
	50	55	114	213	442	662	1,280	2,030
	60	50	104	197	400	600	1,100	1,740

Capacity in Cubic Feet of Gas Per Hour

CFH = +/- 1,000 BTU
 *real world application- adjust per local conditions

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Question #4:

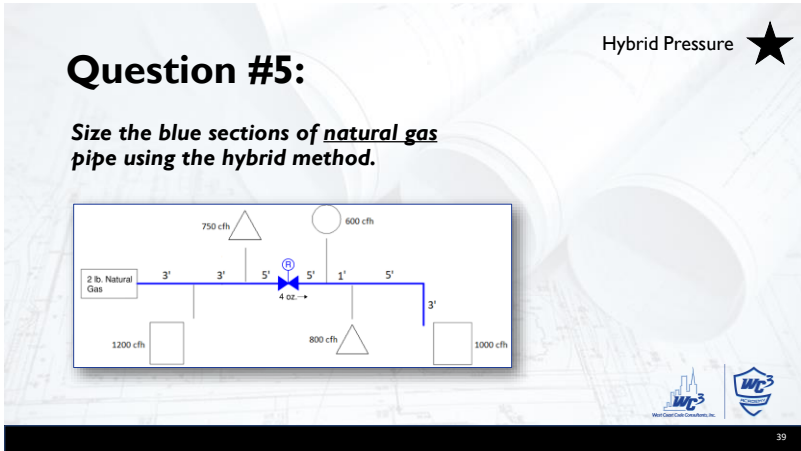
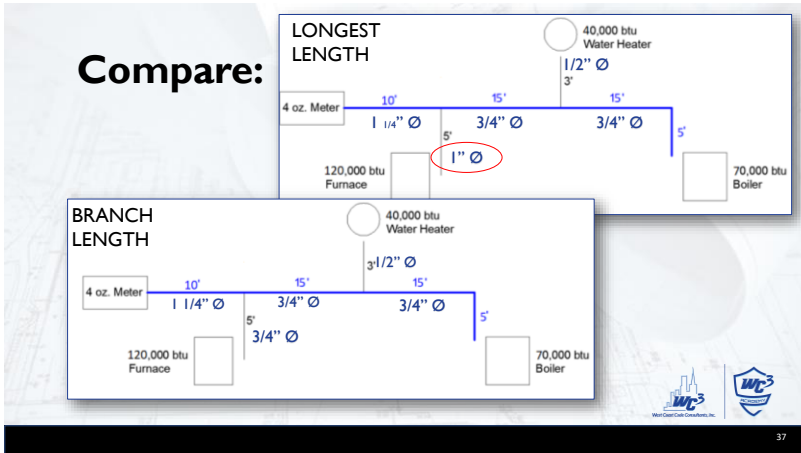
Branch #1:
Branch Length = 15' (10 + 5)
Total btu's = 120,000 (120k) $120,000/1,000 = 120$ CFH

Nominal Actual ID	PIPE SIZE (inch)							
	1/2	3/4	1	1 1/4	1 1/2	2	3	4
0.822	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	10	131	293	514	1,000	1,500	3,050	4,500
	20	90	188	333	726	1,090	2,090	3,140
	30	72	151	264	583	873	1,680	2,680
	40	62	129	243	499	747	1,440	2,290
	50	55	114	213	442	662	1,280	2,030
	60	50	104	197	400	600	1,100	1,740

Capacity in Cubic Feet of Gas Per Hour

CFH = +/- 1,000 BTU
 Largest branch requirement governs

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Hybrid Pressure Method

IFGC 402.4.3: (Also see A103.3)

402.4.3 Hybrid pressure. The pipe size for each section of higher pressure gas piping shall be determined using the longest length of piping from the point of delivery to the most remote line pressure regulator. The pipe size from the line pressure regulator to each outlet shall be determined using the length of piping from the regulator to the most remote outlet served by the regulator.

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General Rules:

TABLE 402.4(5) SCHEDULE 40 METALLIC PIPE					
Nominal	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.622	0.824	1.049	1.315	1.610
Length (ft)	1,510	3,040	5,560	11,400	17,100
	20	1,070	2,150	3,930	8,070
	30	869	1,760	3,210	6,590
	40	753	1,520	2,780	5,710
	50	673	1,360	2,490	5,110
	60	615	1,240	2,270	4,660
	70	569	1,150	2,100	4,320
	80	532	1,080	1,970	4,040
	90	502	1,010	1,850	3,810

International Code Council 2021 IFGC ©

Pressure Drop:

- 1 lb. System - Use 0.3 in. w.c.
- 2 lb. System - Use 1 in. w.c.

Specific Gravity:

- Natural Gas- 0.6
- Propane- 1.5

Inlet Pressure:

- Residential- 4 oz. (typ.) 2 lb. available
- Commercial- 2 lb. (typ.) 5 lb. available

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

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Question #5:

First Section:

Longest Length to Regulator = 11' (3+3+5) i.e. Length 1

Longest Length from Regulator = 14' (5+1+5+3) i.e. Length 2

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Question #5:

First Section:

Longest Length = 11' (Length 1)

Total btu's = 4,350 cfh (1,200 + 750 + 800 + 600 + 1,000)

PIPE SIZE (inch)					
Nominal	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.622	0.824	1.049	1.315	1.610
Length (ft)	1,510	3,040	5,560	11,400	17,100
	20	1,070	2,150	3,930	8,070
	30	869	1,760	3,210	6,590
	40	753	1,520	2,780	5,710
	50	673	1,360	2,490	5,110
	60	615	1,240	2,270	4,660
	70	569	1,150	2,100	4,320
	80	532	1,080	1,970	4,040
	90	502	1,010	1,850	3,810

International Code Council 2021 IFGC, Table 402.4(5) ©

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Question #5:

Next Section:

Longest Length = 11' (Length 1- again)

Total btu's = 3,150 cfh (750 + 600 + 800 + 1000)

PIPE SIZE (inch)					
Nominal	1/2	3/4	1	1 1/4	1 1/2
Actual ID	0.622	0.824	1.049	1.315	1.610
Length (ft)	1,510	3,040	5,560	11,400	17,100
	20	1,070	2,150	3,930	8,070
	30	869	1,760	3,210	6,590
	40	753	1,520	2,780	5,710
	50	673	1,360	2,490	5,110
	60	615	1,240	2,270	4,660
	70	569	1,150	2,100	4,320
	80	532	1,080	1,970	4,040
	90	502	1,010	1,850	3,810

International Code Council 2021 IFGC, Table 402.4(5) ©

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Question #5:

End Section:
Longest Length = 11' (Length 1 - again)
Total btu's = 2,400 cfh (600 + 800 + 1000)

Nominal	PIPE SIZE (inches)			
	1/2"	3/4"	1"	1 1/4"
Actual ID	0.822	0.824	1.049	1.310
Length (ft)	1,510	3,040	5,560	11,000
Capacity in Cubic Feet of Gas Per Hour	20	1,070	2,150	8,670
30	360	1,760	3,510	4,300
40	755	1,520	3,740	5,710
50	875	1,340	2,490	5,110
60	815	1,240	2,370	4,960
70	549	1,130	2,100	4,320
80	532	1,080	1,970	4,050

International Code Council 2021 IFGC, Table 402.4(5) ©

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Question #5:

End Section:
Longest Length = 14' (Length 2)
Total btu's = 2,400 cfh (600 + 800 + 1000)

Nominal	PIPE SIZE (inches)			
	1/2"	3/4"	1"	1 1/4"
Actual ID	0.822	0.824	1.049	1.310
Length (ft)	1,510	3,040	5,560	11,000
Capacity in Cubic Feet of Gas Per Hour	20	1,070	2,150	8,670
30	360	1,760	3,510	4,300
40	755	1,520	3,740	5,710
50	875	1,340	2,490	5,110
60	815	1,240	2,370	4,960
70	549	1,130	2,100	4,320
80	532	1,080	1,970	4,050

International Code Council 2021 IFGC, Table 402.4(5) ©

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Pressure Regulators:

Check with Manufacturer Regarding:

- **Outlet Pressure (0.5 psi is common)**
- **Pressure Drop (+/- 0.5 in w.c. common)***

**Use the 3.0 in. w.c. table*

Model Number	Pipe Size	Outlet Pressure Set Point	Operating Inlet Pressure		
			1/2 psi (0.4 MPa)	3/4 psi (0.5 MPa)	1 psi (0.7 MPa)
125-847	1/2" x 1/2"	0.5 psi	125 (1.5)	125 (1.5)	125 (1.5)
	1/2" w.c.	1.00 (12.4)	125 (1.5)	125 (1.5)	125 (1.5)

7" w.c. = 0.25 psi

Adjustable to +/- 0.5 psi

Model Number	Pipe Size	Pressure Drop	
		7" w.c. (1.7 MPa)	3/4 psi (0.5 MPa)
125-847	1/2" x 1/2"	0.25 (3.0)	0.25 (3.0)

Conversions:
 In w.c. divided by 27.708 = psi
 Psi x 27.708 = in. w.c.

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General Rules:

Pressure Drop:
 Manufacturer- Use 3.0 in. w.c.

Specific Gravity:
 Natural Gas- 0.6
 Propane- 1.5

Inlet Pressure:
 2 PSI- Given in Example

Step I: Find the Right Table

1 P.S.I. = 16 oz. or 28 in. w.c.
4 oz. meter = 7 in. w.c.

Make sure you're in the right table and verify values!

Nominal	PIPE SIZE (inches)			
	1/2"	3/4"	1"	1 1/4"
Actual ID	0.822	0.824	1.049	1.310
Length (ft)	1,510	3,040	5,560	11,000
Capacity in Cubic Feet of Gas Per Hour	20	1,070	2,150	8,670
30	360	1,760	3,510	4,300
40	755	1,520	3,740	5,710
50	875	1,340	2,490	5,110
60	815	1,240	2,370	4,960
70	549	1,130	2,100	4,320
80	532	1,080	1,970	4,050

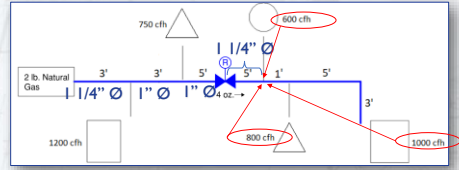
48

Question #5:

Ist Section:
Longest Length = 14' (Length 2)
Total btu's = 2,400 cfh (600 + 800 + 1000)

Nominal Length (ft)	PIPE SIZE (inch)					
	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.824	1.049	1.315	1.615	2.067
Capacity in Gallons Per Foot of Gas Pipe Hour						
15	454	949	1,790	3,035	5,500	10,000
20	312	652	1,250	2,200	3,780	7,000
30	205	524	965	1,700	3,030	5,840
40	154	448	844	1,750	2,800	5,000
50	130	397	748	1,540	2,500	4,450
60	112	360	678	1,390	2,290	4,020

International Code Council 2021 IFGC, Table 402.4(3) ©

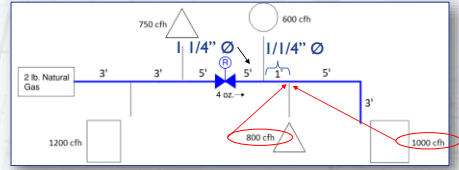


Question #5:

Next Section:
Longest Length = 14' (Length 2)
Total btu's = 1,800 cfh

Nominal Length (ft)	PIPE SIZE (inch)					
	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.824	1.049	1.315	1.615	2.067
Capacity in Gallons Per Foot of Gas Pipe Hour						
15	454	949	1,790	3,035	5,500	10,000
20	312	652	1,250	2,200	3,780	7,000
30	205	524	965	1,700	3,030	5,840
40	154	448	844	1,750	2,800	5,000
50	130	397	748	1,540	2,500	4,450
60	112	360	678	1,390	2,290	4,020

International Code Council 2021 IFGC, Table 402.4(3) ©

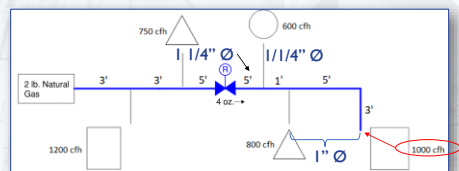


Question #5:

End Section:
Longest Length = 14' (Length 2)
Total btu's = 1,000 cfh

Nominal Length (ft)	PIPE SIZE (inch)					
	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.824	1.049	1.315	1.615	2.067
Capacity in Gallons Per Foot of Gas Pipe Hour						
15	454	949	1,790	3,035	5,500	10,000
20	312	652	1,250	2,200	3,780	7,000
30	205	524	965	1,700	3,030	5,840
40	154	448	844	1,750	2,800	5,000
50	130	397	748	1,540	2,500	4,450
60	112	360	678	1,390	2,290	4,020

International Code Council 2021 IFGC, Table 402.4(3) ©



Materials not Covered:

- **CSST (Corrugated Stainless Steel Tubing)-**
 - Similar process, use Tables 402.4(15), (16), (17), (18), (19) Natural Gas
 - Similar process, use Tables 402.4(32), (33), (34) Propane
 - Check with CSST manufacturer for additional sizing tables!
 - o Examples: TracPipe, Gastite, Proflex, Wardflex, etc. (Check manufacturer's websites)
- **PE Pipe (Polyethylene Plastic)**
 - Similar process, use Tables 402.4(20), (21), (22)
- **PE Tubing (Polyethylene Plastic)**
 - Similar process, use Tables 402.4(23), (24)
- **Semirigid Copper Tubing**
 - Similar process, use Tables 402.4(29), (30), (31)





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Module 1 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
If work has not commenced or has been abandoned for a period of _____ days, the permit for the work will expire.	IPC 106.5.3	IPC 106	3	60	90	180	That is left to the discretion of the Authority Having Jurisdiction(AHJ)
The building official has the authority to _____ utility services to buildings, structures, or any system regulated by the codes in the case of an emergency, eliminate an immediate danger to life or property, or where necessary.	IPC 112.3	IPC 112	4	cut off	detach	remove	disconnect
Once all storm, sanitary, and water distribution piping is roughed-in, an inspection shall take place prior to the installation of _____ or _____ membranes.	IPC 108.2 Item 2	IPC 108	1	wall, ceiling	ceiling, wall	floor, wall	ceiling, floor
Trenches shall be inspected after they are _____ and _____, the piping is installed, and before any _____ is placed.	IPC 108.2 Item 1	IPC 108	4	bedded, excavated, backfill	backfilled, bedded, excavation	excavated, backfilled, bedding	excavated, bedded, backfill
The provisions of the _____ shall take precedence over the provisions in the referenced standard.	IPC 102.8.2	IPC 102	2	International Building Code	International Plumbing Code	Uniform Plumbing Code	
The holder of the permit shall be responsible for scheduling of all except for which of the following.	IPC 112.2	IPC 112	3	Underground inspection shall be made after trenches or ditches are excavated and bedded, piping installed, and before any backfill is put in place.	Rough-in inspection shall be made after the roof, framing, fireblocking, firestopping, draft stopping, and bracing is in place and all sanitary, storm and water distribution piping is roughed-in, and prior to the installation of wall or ceiling membranes.	Before appliances and after wall and ceiling membranes are installed to include but not limited to the following dishwashers, laundry equipment, and bathtubs.	Final inspection shall be made after the building is complete, all plumbing fixtures are in place and properly connected, and the structure is ready for occupancy.

Module 2 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Plumbing pipes installed parallel to footings shall not extend below a _____ degree plane from the bottom of the footing.	IPC 307.5	IPC 307	4	Pipes can't be below the footing when running parallel.	15	30	45
Exterior water supply lines shall be at least _____ below the frost line.	IPC 305.4	IPC 305	1	6 inches	12 inches	18 inches	24 inches
In a concealed space, a plastic pipe that is installed through a stud that is within _____ of the edge of the stud is required to have a steel protective plate.	IPC 305.6	IPC 305	3	3/4"	1"	1 1/4"	1 1/2"
A 30 foot section of cast iron pipe shall have horizontal supports at least every _____ feet.	IPC Table 308.5	IPC 308	4	4	5	6	10
The minimum size of a condensate drain line for a refrigeration unit 70 tons shall be _____ inch.	IPC Table 314.2.2	IPC 314	2	3/4	1 1/4	1 1/2	2
All plumbing systems shall be tested with either _____ or _____ for systems other than plastic.	IPC 312.1	IPC 312	2	air, water	water, air	gas, water	air, gas
The maximum horizontal spacing to support copper or copper-alloy tubing 1 1/2 inches in diameter is _____ feet.	IPC Table 308.5	IPC 308	1	10	8	6	4

Module 3 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Water closet compartments must be not less 30 inches wide and _____ inches in depth for a floor mounted water closet.	IPC 405.3.1	IPC 405	2	56	60	66	72
A domestic food waste disposer shall be connected to a drain not less than _____.	IPC 416.2	IPC 416	4	3/4"	1"	1 1/4"	1 1/2"
A church with an occupant load of 1,000 people would require a total of _____ water closets.	IPC Table 403.1	IPC 403	2	9	11	15	21
The top of walls of a urinal partition shall not be less than _____ inches.	IPC 405.3.1	IPC 405	3	48	50	60	72
Urinals shall not be substituted for more than _____ of the required water closets in assembly and educational occupancies.	IPC 424.2	IPC 424	4	25%	33%	50%	67%
All shower compartments shall have a minimum of _____ square inches?	IPC 424.4	IPC 424	2	600	900	1200	1500
A shampoo sink shall be limited to a maximum temperature of _____?	IPC 412.10	IPC 412	4	98°	105°	116°	120°
Manual food and beverage dispensing equipment shall conform with the requirements of _____?	IPC 420.1	IPC 420	1	NSF 18	ASME 111.6.4	CSA B45.15	ASSE A112.5

Module 4 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Water heaters that are installed in attics shall have a pathway not less than ____ inches in height and ____ inches wide?	IPC 502.3	IPC 502	2	20, 30	30, 22	30, 24	48, 24
The water service pipe to any building shall not be sized less than ____?	IPC 603.1	IPC 603	3	Dependent on the fixtures of the building.	1"	3/4"	1/2"
A working space of ____ inches in length and ____ inches in width shall be provided in front of the control side of the appliance.	IPC 502.5	IPC 502	4	30, 20	24, 30	20, 30	30, 30
The flow rate to a blow out, flushometer valve shall be _____?	IPC Table 604.3	IPC 604	4	1.6 gpm	6 gpm	12 gpm	25 gpm
Discharge piping from a water heater shall terminate not more than ____ inches above and not less than ____ times the discharge pipe diameter above the floor or flood level rim of the waste receptor.	IPC 1113.4	IPC 1113	1	6, 2	2, 6	4, 6	2, 4
The same blow out, flushometer valve shall have a minimum _____ supply line?	IPC Table 604.5	IPC 604	4	1/2"	3/8"	3/4"	1"
What minimum thickness of pan shall be provided for a water heater storage tank?	IPC 504.7	IPC 504	2	0.601	0.0236	0.0352	0.0112
What color is used to identify nonpotable water distribution piping?	IPC 608.9.2.1	IPC 608	3	yellow	blue	purple	green

Module 5 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Building sewers not larger than 8 inches shall have cleanouts located at intervals of not more than ____ feet?	IPC 708.1.2	IPC 708	2	50	100	200	400
Five fixture units shall drain into a trap sized ____ inches in diameter.	IPC Table 709.2	IPC 709	1	3	2 1/2	2	1 1/2
An above ground PVC pipe shall be in compliance with all of the following standards except?	IPC Table 702.1	IPC 702	2	ASTM F 1488	ASTM F 1448	ASTM D 2665	ASTM F 891
The minimum clearance for a pipe 20 inches in diameter shall be not less than ____ inches from the face of the cleanout opening to any obstruction.	IPC 708.1.10	IPC 708	3	18	24	36	48
Caulking ferrules of red brass pipe sized 3 inches shall be ____ inches in length	IPC Table 705.18	IPC 705	4	2 1/4	3 1/2	4 1/4	4 1/2
A horizontal drainage pipe 5 inches in diameter shall slope a minimum of ____ inches per foot.	IPC Table 704.1	IPC 704	2	1/4	1/8	1/16	1/32
A vertical offset of ____ shall be provided for a 6 inch pipe with 3 intervals	IPC Table 710.1(2)	IPC 710	1	960	600	540	620

Module 6 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Standpipes shall extend not more than ____ inches but not less than ____ inches above the trap weir.	IPC 802.4.3	IPC 802	2	18, 42	42, 18	36, 18	32, 42
How far from a fixture trap can a vent be, if the trap is 3 inches and the slope is 1/8?	IPC Table 909.1	IPC 909	4	18 feet	16 feet	14 feet	12 feet
An air gap shall be provided for indirect waste pipes and the waste receptor. This air gap shall be ____ the effective opening of the indirect waste pipe.	IPC 802.3.1	IPC 802	3	three times	four times	twice	not less than
The slope of a horizontal combination waste and vent pipe shall not exceed what slope?	IPC 915.2.1	IPC 915	4	1:48 (2%)	1:6 (16%)	1:12 (8%)	0.5:12 (4%)
Waste piping shall be trapped if the piping exceeds a total of ____ in total developed length.	IPC 802.3	IPC 802	1	54 inches	30 inches	60 inches	45 inches
Where a vent stack is connected to a building drain, the connection shall be located downstream of the stack and within a distance of ____ times the diameter of the stack.	IPC 904.4	IPC 904	1	10	8	4	2
A trap 8 feet from a vent is permitted to be sized ____.	IPC Table 909.1	IPC 909	2	1 1/2 inches	2 inches	3 inches	4 inches
Indirect waste piping that exceeds ____ inches in developed length measured horizontally, or ____ inches in total developed length, shall be trapped.	IPC 802.3	IPC 802	4	18, 48	24, 48	24, 54	30, 54

Module 7 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Hydromechanical grease interceptors and other devices shall be sized in accordance with all of the following except?	IPC 1003.3.5	IPC 1003	4	ASME 112.14.4	ASME 112.14.3	ASME 112.14.6	ASME 122.3.4
Nonmedical oxygen systems shall be designed and installed in accordance with NFPA _____ and _____.	IPC 1203.1	IPC 1203	3	70, 99	13, 80	51, 55	101, 55
In sizing roof drains and storm drainage pipes, _____% of the area of any vertical wall that diverts rain water to the roof shall be added to the projected roof area when calculating the size of storm drainage piping.	IPC 1106.4	IPC 1106	3	25	33	50	66
The discharge piping from a grease interceptor shall be directly connected to the _____.	IPC 1003.3.8	IPC 1003	2	public drainage system	sanitary drainage system	sanitary supply system	building's irrigation system
What is the minimum number of roof drains if the roof is 10,500 square feet?	IPC 1110.4	IPC 1110	4	2	1	3	4
Storm drainage systems shall be provided with a _____ as required for sanitary drainage system in accordance with section 714.	IPC 1101.9	IPC 1101	3	pressure relief valve	butterfly valve	backwater valve	check valve
Which of the following is not a standard when using a PVC Pipe for a storm sewer?	IPC Table 1102.4	IPC 1102	3	ASTM D 2665	ASTM D 3311	ASTM D 2661	ASTM F 1866
What is the capacity of a gutter that is 5 x 8 inches?	IPC Table 1106.6	IPC 1106	1	651 gpm	1055 gpm	472 gpm	331 gpm

Module 8 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
A pressure reducing valve shall be installed to a reclaimed water distribution system if the water pressure exceeds _____ psi.	IPC 1304.2	IPC 1304	1	80	75	50	25
If chlorine is used to disinfect a nonpotable water system. What is the permitted amount of chloramines permitted when tested?	IPC 1301.2.1	IPC 1301	4	1 ppm	2 ppm	3 ppm	4 ppm
All of the following are permitted to collect waste discharge except:	IPC 1302.2.1	IPC 1302	2	bathtubs	dishwashers	lavatories	laundry trays
Gutters shall be tested by pouring not less than _____ of water into the end at the opposite of the collection point.	IPC 1303.15.1	IPC 1303	3	2.9 Liters	10 Gallons	1 Gallon	3.6 Liters
Downspouts and leaders shall be connected to a debris excluder device that is designed to remove all but which of the following:	IPC 1303.3	IPC 1303	3	leaves	sticks	grease	pine needles
What is the maximum storage time permitted for grey water that has not been treated?	IPC 1302.6	IPC 1302	3	8 hours	12 hours	24 hours	36 hours

Module 9 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Which of the following is an approved gas piping material for a system containing 0.4 grains of hydrogen sulfide per 100 standard cubic feet of gas?	IFGC 403.5	IFGC 403	1	Polyethylene (PE) Plastic Pipe	Cast Iron Pipe	Schedule 30 Steel Pipe	Copper and Copper Alloy Pipe
What is the minimum test pressure for a 1" CSST gas line on a 4 oz. system?	IFGC 406.4.1	IFGC 406	4	6 oz.	2 P.S.I.	5 in. W.C.	3 P.S.I.
For other than steel pipe and CSST, exposed piping shall be identified by a yellow label marked "Gas" in black letters. The marking shall be spaced at intervals not exceeding _____ feet.	IFGC 401.5	IFGC 401	2	3	5	10	12
The minimum size wire to be used as a trace wire shall be _____ AWG.	IFGC 404.17.3	IFGC 404	2	16	18	20	24
Fittings in concealed locations shall be of all of the following except:	IFGC 404.5	IFGC 404	2	threaded elbows	cast-iron	brazed fittings	welded fittings
Purged gases shall be discharged a point located not less than _____ feet from sources ignition, not less than _____ feet from building openings and not less than _____ feet from mechanical air intake openings.	IFGC 406.7.1.3 Item 2	IFGC 406	2	25, 10, 10	10, 10, 25	10, 25, 10	15, 10, 25

Module 10 Quiz Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
The spout of an accessible drinking fountain shall provide a flow of water _____ inches minimum in height.	ICC A117.1-17 Section 602.2.5	ICC A117.1-17 Section 602	3	2	3	4	5
A standard roll-in-type shower shall have an inside clear width of _____ inches and clear depth of _____ inches.	ICC A117.1-17 Section 608.2.2.1	ICC A117.1-17 Section 608	1	60, 30	36, 60	36, 36	36, 56
Ambulatory accessible toilet compartments shall be _____ inches wide.	ICC A117.1-17 Figure 604.10.1	ICC A117.1-17 Section 604	1	35-37	46-48	56	60
In new buildings and facilities, the turning space shall be a circular space with a _____ inch minimum diameter.	ICC A117.1-17 Section 304.3.1.1	ICC A117.1-17 Section 304	4	48	57	60	67
The centerline of the water closet located in an ambulatory accessible toilet compartment shall be _____ inches from the sidewall or partition.	ICC A117.1-17 Section 604.2	ICC A117.1-17 Section 604	3	at least 15	16-18	17-19	at least 16

2021 Commercial Plumbing Inspector & Plans Examiner Practice Exam Questions

Question Text	Rationale for correct answer	Rationale for incorrect answer	Correct Answer	Answer 1	Answer 2	Answer 3	Answer 4
Waste piping shall be trapped if the piping exceeds a total ____ in developed length.	IPC 802.3	IPC 802	2	60 inches	54 inches	45 inches	30 inches
Gutters shall be tested by pouring not less than _____ of water into the end at the opposite of the collection point.	IPC 1303.15.1	IPC 1303	1	1 Gallon	10 Gallons	3.6 Liters	2.9 Liters
Exterior water supply lines shall be at least _____ below the frost line.	IPC 305.4	IPC 305	3	18 inches	12 inches	6 inches	24 inches
What is the maximum length permitted from a hot water source to a fixture?	IPC 607.2	IPC 607	4	10 feet	15 feet	25 feet	50 feet
The top of walls of a urinal partition shall not be less than _____.	IPC 405.3.1	IPC 405	1	60 inches	66 inches	56 inches	72 inches
Five fixture units shall drain into a trap _____.	IPC Table 709.2	IPC 709	3	1 1/2 inches	2 inches	3 inches	3 1/2 inches
Vent pipes that extend through a roof shall terminate not less than ____ above the roof.	IPC 903.1	IPC 903	1	Authority having Jurisdiction to decide	6 inches	12 inches	18 inches
In sizing roof drains and storm drainage pipes, _____ of the area of any vertical wall that diverts rain water to the roof shall be added to the projected roof area when calculating the size of storm drainage piping.	IPC 1106.4	IPC 1106	1	50%	54%	33%	25%
A pressure reducing valve shall be installed to a reclaimed water distribution system if the water pressure exceeds _____ psi.	IPC 1304.2	IPC 1304	3	50	75	80	25
Purged gases shall be discharged a point located not less than _____ feet from sources ignition, not less than _____ feet from building openings and not less than _____ feet from mechanical air intake openings.	IFGC 406.7.1.3	IFGC 406	3	25, 10, 10	10, 25, 10	10, 10, 25	15, 10, 25
The working pressure of a relief valve of a water heater shall have a temperature that shall not exceed _____°F.	IPC 504.5	IPC 504	1	210	120	220	150
What should be the minimum pressure maintained for a water closet containing a flushometer tank?	IPC Table 604.3	IPC 604	3	10 psi	5 psi	20 psi	15 psi
The minimum cleanout clearance for a pipe 20 inches in diameter shall be not less than _____ from the face of the opening of any obstruction.	IPC 708.1.10	IPC 708	4	18 inches	24 inches	48 inches	36 inches
The slope of a horizontal combination waste and vent pipe shall not exceed what slope?	IPC 915.2.1	IPC 915	1	.5:12 (4%)	1:48 (2%)	1:6 (16%)	1:12 (8%)
The pressure rating of a plastic pipe shall be reduced to _____ when Schedule 80 pipe is threaded.	IPC 605.21.4	IPC 605	4	45%	25%	75%	50%
Where a vent stack is connected to a building drain, the connection shall be located downstream of the stack and within a distance of ____ the diameter of the stack.	IPC 904.4	IPC 904	3	8 times	4 times	10 times	2 times
Standpipes shall extend not greater than _____ inches but not less than _____ inches above the trap weir.	IPC 802.4.3	IPC 802	4	18, 42	36, 18	32, 42	42, 18
Nonflammable medical gases shall be designed and installed in accordance with which reference standard?	IPC 1202.1	IPC 1202	2	NFPA 51	NFPA 99	NPFA 55	NFPA 100
Which of the following nonpotable reuse systems are not permitted to collect waste discharge?	IPC 1302.2	IPC 1302	4	bathtubs	lavatories	laundry trays	dishwashers
What color is used to identify nonpotable water distribution piping?	IPC 608.9.2.1	IPC 608	3	yellow	blue	purple	red
Water closet compartments must be not less than 30 inches wide and _____ inches in depth for a floor mounted water closet.	IPC 405.3.1	IPC 405	4	72	56	66	60
A water closet compartment shall be not less than _____ inches in width and not less than _____ inches in length.	IPC 405.3.1	IPC 405	2	60, 30	30, 60	56, 30	30, 56
In a concealed space, a plastic pipe that is installed through a stud that is within _____ inches of the edge of the stud is required to have a steel protective plate.	IPC 305.6	IPC 305	4	3/4	1 1/2	1	1 1/4

A vent for a fixture shall not be installed within _____ pipe diameters of the trap weir.	IPC 909.3	IPC 909	1	two	three	four	five
Urinals shall not be substituted for more than _____ of the required water closets in assembly and educational occupancies.	IPC 424.2	IPC 424	2	1/3	2/3	1/2	1/4
Rainwater collection systems shall be equipped with a _____ or equivalent device.	IPC 1303.3	IPC 1303	2	debris collector	debris excluder	roof washer	bleed off pipe
The minimum size of a condensate drain line for a refrigeration unit of 70 tons shall be _____ inch.	IPC Table 314.2.2	IPC 314	4	1/2	1 1/2	2	1 1/4
What is the maximum storage time permitted for grey water that has not been treated?	IPC 1302.6	IPC 1302	1	24 hours	36 hours	12 hours	8 hours
A shampoo sink shall be limited to a maximum temperature of _____?	IPC 412.10	IPC 412	2	116°	120° F	105°	98°
Water heaters that are installed in attics shall have a pathway not less than _____ inches in height and _____ inches wide?	IPC 502.3	IPC 502	1	30, 22	20, 30	30, 24	22, 30
If chlorine is used to disinfect a nonpotable water system, what is the permitted amount of chloramines permitted when tested?	IPC 1301.2.1	IPC 1301	3	1 ppm	2 ppm	4 ppm	3 ppm
Circulation systems serving Groups R2, R3, and R4 that are 3 stories in height shall comply with which of the following sections?	IPC 607.2.1	IPC 607	4	R404.6	R403.5.1	C404.6	R403.5.1
A horizontal drainage pipe 5 inches in diameter shall slope a minimum of _____ inches per foot.	IPC Table 704.1	IPC 704	1	1/8	1/4	1/16	1/32
How far from a fixture trap can a vent be, if the trap is 3 inches and the slope is 1/8?	IPC Table 909.1	IPC 909	2	14 feet	12 feet	18 feet	16 feet
The water service pipe to any building shall not be sized less than _____?	IPC 603.1	IPC 603	3	1/2 inch	1 inch	3/4 inch	Dependent on the fixtures in the building.
Deck drains shall discharge through an _____ for an indirect waste pipe.	IPC 802.1.4	IPC 802	3	air break	air valve	air gap	air filter
A vertical offset of _____ shall be provided for a 6 inch pipe with 3 intervals.	IPC Table	IPC 710	1	960 dfu	600 dfu	540 dfu	620 dfu
Building sewers not larger than 8 inches shall have cleanouts located at intervals of not more than _____ feet?	IPC 708.1.2	IPC 708	3	400	200	100	50
A trap 8 feet from a vent is permitted to be sized _____.	IPC Table 909.1	IPC 909	2	1 1/2 inches	2 inches	3 inches	4 inches
All dry vents shall have a vertical rise of _____ inches minimum above the floor level rim of the highest trap or trapped fixture being vented.	IPC 905.4	IPC 905	3	3	4	6	12
Hydromechanical grease interceptors and other devices shall be sized in accordance with all of the following except?	IPC 1003.3.4	IPC 1003	1	ASME 122.3.4	ASME 112.14.3	ASME 112.14.6	ASME 112.14.4
Discharge piping is required to have which of the following in a single family dwelling?	IPC 1113.4	IPC 1113	4	gate valve	deluge valve	shut-off valve	check valve
Caulking ferrules red brass pipe sized 3 inches shall be _____ in length.	IPC Table	IPC 705	4	2 1/4 inches	3 1/2 inches	4 1/4 inches	4 1/2 inches
The flow rate to a blow out, flushometer valve shall be _____?	IPC Table 604.3	IPC 604	1	25 gpm	1.6 gpm	6 gpm	12 gpm
Neutralizing devices are required for all of the following except?	IPC 803.1	IPC 803	4	sanitary waste	grey waste	toxic waste	biological waste
If work has not commenced or has been abandoned for a period of _____ days, the permit for the work will expire.	IPC 106.5.3	IPC 160	3	60	90	180	That is left to the discretion of the Authority Having Jurisdiction(AHJ).
A working space of _____ inches in length and _____ inches in width shall be provided in front of the control side of the appliance.	IPC 502.5	IPC 502	4	30, 20	24, 30	20, 30	30, 30
Plumbing pipes installed parallel to footings shall not extend below a _____ plane from the bottom of the footing.	IPC 307.5	IPC 307	2	30°	45°	15°	Pipes can't be below the footing when running parallel.
Which of the following traps is not prohibited by the International Plumbing Code?	IPC 1002.3	IPC 1002	4	Crown-vented traps	bell traps	S traps	drum traps
A 30 foot section of cast iron pipe shall have horizontal supports at least every _____ feet.	IPC Table 308.5	IPC 308	3	5	6	10	4

The minimum spacing for gas piping identification shall be at intervals not exceeding ____ feet.	IFGC 401.5	IFGC 401	4	10 Feet	15 Feet	25 Feet	5 feet
Discharge piping from a water heater shall terminate not more than ____ inches above and not less than ____ times the discharge pipe diameter above the floor or flood level rim of the waste receptor.	IPC 504.6 Item 10	IPC 504	2	2, 4	6, 2	2, 6	4, 6
The same blow out, flushometer valve shall have a minimum ____ supply line?	IPC Table 604.5	IPC 604	2	3/4 inch	1 inch	1/2 inch	3/8 inch
Air admittance valves, either individual or branch-type, shall be located a minimum of ____ inches above the horizontal branch drain or fixture drain to be vented.	IPC 918.4	IPC 918	2	2	4	6	8
What is the minimum number of roof drains if the roof is 10,500 square feet?	IPC 1110.4	IPC 1110	2	3	4	1	2
What minimum thickness of pan shall be provided for a water heater storage tank?	IPC 504.7	IPC 504	4	0.601 inches	0.0352 inches	0.0112 inches	0.0236 inches
An above ground PVC pipe shall be in compliance with all of the following standards except:	IPC Table 702.1	IPC 702	1	ASTM F 1448	ASTM D 2949	ASTM D 2665	ASTM F 891
A full-open valve located on the makeup water supply line, inlets to the storage tank is controlled by a ____.	IPC 1301.9.4	IPC 1301	3	flow valve	inlet valve	fill valve	relief valve
What is the maximum design operating pressure for piping located inside buildings shall not exceed ____ psig.	IFGC 402.7	IFGC 402	1	5	20	15	10
A pressure reducing valve shall be installed to a reclaimed water distribution system is the water pressure exceeds ____ psi.	IPC 1304.2	IPC 1304	3	75	50	80	25
A percolation test for clay soils shall be have a minimum water depth of _____. This depth shall be maintained above the bottom of the hole for ____ hours.	IPC 1402.2.1.3	IPC 1402	2	16 inches, 4 hours	12 inches, 4 hours	4 inches, 12 hours	12 inches, 6 hours
What is the minimum test pressure for a 1" CSST gas line on a 4 oz. system?	IFGC 406.4.1	IFGC 406	3	6 oz.	2 psi	3 psi	5 in WC
Grease interceptors with total flow-through ratings of 122 gpm shall have a grease retention capacity of what?	IPC Table 1003.3.5.1	IPC 1003	1	244 gpm	122 gpm	100 gpm	60 gpm
Cleanouts shall be installed where there a multiple changes in direction shall occur within ____ feet of that length of pipe.	IPC 708.1.4	IPC 708	4	400	100	50	40
A domestic food waste disposer shall be connected to a drain not less than ____ inches.	IPC 416.2	IPC 416	4	1/2 inch	1 inch	1 1/4 inches	1 1/2 inches
What is the 1 hour rainfall rating of Northern Illinois?	IPC Figure	IPC 1106	1	3 inches	4 inches	2.5 inches	3.5 inches
What is the condensate drain capacity for a pipe 1 1/4" in diameter?	IPC Table	IPC 314	3	250 tons of refrigerant	hot water manifold	90 tons of refrigerant	cold water manifold
Work shall not be ____ beyond the point indicated in each successive inspection without first obtaining the approval of the code official.	IPC 112.2.3	IPC 112	3	scheduled	inspected	done	documented
For new plumbing, testing is not required in which of the following cases?	IPC 112.4.1	IPC 112	1	In any case that does not include addition to, replacement, alteration or relocation of an water supply, drainage, or vent piping.	In cases that include addition to, replacement, alteration or relocation of an water supply, drainage, or vent piping.	In any case that does not include plumbing equipment set up temporarily for exhibition purposes.	In any case that does include plumbing equipment set up temporarily for private event purposes.
The holder of the permit shall be responsible for scheduling of all except for which of the following.	IPC 112.2	IPC 112	3	Underground inspection shall be made after trenches or ditches are excavated and bedded, piping installed, and before any backfill is put in place.	Rough-in inspection shall be made after the roof, framing, fireblocking, firestopping, draft stopping, and bracing is in place and all sanitary, storm and water distribution piping is roughed-in, and prior to the installation of wall or ceiling membranes.	Before appliances and after wall and ceiling membranes are installed to include but not limited to the following dishwashers, laundry equipment, and bathtubs.	Final inspection shall be made after the building is complete, all plumbing fixtures are in place and properly connected, and the structure is ready for occupancy.

When a permit has expired and a new permit must be obtained. The fee for this permit shall be ____ of the amount required for a new permit for such work, provided that changes have not been made and will not be made in the original construction documents for such work, and provided further that such suspension or abandonment has not exceeded 1 year.	IPC 106.5.3	IPC 106	1	one-half	one-third	one-fourth	an amount appropriate per the Building Official
Any surface of a plumbing fixture that is not readily visible and not scoured or cleansed with each fixture operation is known as:	IPC 202	IPC Definitions	2	Open Scouring Device	Concealed Fouling Surface	Combination Waste and Vent System	Concealed Scouring Surface
A type of joint made by means of a washer or a special type of packing compound in which one pipe is slipped into the end of an adjacent pipe.	IPC 202	IPC Definitions	4	Expansion Joint	Flexible Joint	Mechanical Joint	Slip Joint
A water supply pipe that extends one full story or more to convey water to branches or to a group of fixtures.	IPC 202	IPC Definitions	2	Water distribution pipe	Water riser	Water service pipe	Water command pipe
A pipe connecting upward from a soil or waste stack to a vent stack for the purpose of preventing pressure changes in the stacks.	IPC 202	IPC Definitions	3	Stack Vent	Studor Vent	Yoke Vent	Sump Vent
Where rocks are encountered while trenching, the rock shall be removed to not less than _____ below the installation level of the bottom of the pipe.	IPC 306.2.2	IPC 306	1	3 inches	3 feet	6 inches	8 inches
Piping materials exposed within plenums shall comply with the provisions of the _____.	IPC 307.6	IPC 307	2	International Building Code	International Plumbing Code	International Mechanical Code	International Fuel Gas Code
What is the maximum horizontal spacing for cast iron pipe when installed in 10-foot lengths of pipe.	IPC Table 308.5 footnote a	IPC 308	4	5 feet	6 feet	8 feet	10 feet
Ductless mini-split equipment that produces condensation shall be provided with an in-line _____ located in the drain line or a trap.	IPC 314.2.4.1	IPC 314	4	trap	butterfly valve	gate valve	check valve
How many water closets are required for dance halls with an occupant load of 381?	IPC Table 403.1	IPC 403	1	10: 5 for males and 5 for females	9: 4 for males 4 for females and 1 unisex	12: 6 for males and 6 for females	6: 3 for males and 3 for females
What is the minimum amount of water closets are required for a retail store with 88 occupants?	IPC 403.2 Exception 3	IPC 403	4	4: 2 for males and 2 for females	3: 3 unisex bathrooms are permitted	2: 1 for males and 1 for females	1: 1 unisex bathroom is permitted
Bathtubs shall conform to all of the following standards except:	IPC 407.1	IPC 407	4	ASME A112.19.1	ASME A112.19.2	ASME A112.19.3	ASME A112.19.4
The wash outlet for lavatories and group wash fixtures shall not be less than _____ inch(es) in diameter.	IPC 419.3	IPC 419	2	1	1 1/4	1 1/2	2
Water heaters and storage tanks shall be located and connected so as to provide access for all of the following except:	IPC 501.4	IPC 501	3	observation	maintenance	regular inspections	servicing
The maximum temperature setting of the temperature relief valve shall be set to _____.	IPC 504.5	IPC 504	4	120 degrees	150 degrees	200 degrees	210 degrees
The pan shall not be less than _____ inch(es) in depth and shall be of sufficient size and shape to receive all dripping or condensate from the tank or water heater.	IPC 504.7.1	IPC 504	3	1	1 1/4	1 1/2	2
For electric water heaters an approved disconnecting means complying with NFPA ____ shall be provided.	IPC 502.1	IPC 502	1	70	75	13	13R
What is the minimum pipe size for a water closet flushometer valve?	IPC Table 604.5	IPC 604	3	1/2	3/8	1	3/4
What is the standard for PEX-AL-HDPE water service pipe?	IPC Table 605.3	IPC 605	1	ASTM F1986	ASTM A52	ASTM F1282	ASTM A1785
The solvent cement that conforms to ASTM F656 shall be what color?	IPC 605.21.3	IPC 605	3	clear	blue	purple	red
Barometric loops shall precede the point of connection and shall extend vertically to a height of _____ feet.	IPC 608.14.4	IPC 608	4	10	20	25	35
What is the minimum slope of a 12 inch pipe?	IPC Table 704.1	IPC 704	3	1/4	1/8	1/16	1/32
What are the total drainage units for a dental lavatory, kitchen sink, and a service sink?	IPC Table 709.1	IPC 709	3	2 dfus	4 dfus	5 dfus	6 dfus
Where manholes are used in lieu of cleanout for horizontal drainage pipes, the manholes shall be located at intervals of _____ feet.	IPC 708.1.10	IPC 708	4	100	200	300	400

What is the minimum diameter of a drainpipe serving a lavatory and a private water closet?	IPC 710.1(1)	IPC 710	2	4 inches	3 inches	1 1/2 inches	1 1/4 inches
Where a floor drain is located in a walk in freezer that is subject to freezing, the waste line service floor drain shall not be _____ and shall indirectly discharge into a waste receptor located outside of the area subject to freezing.	IPC 802.1.2	IPC 802	3	protected	insulated	trapped	covered
The air gap between the indirect waste pipe and the flood level rim of the waste receptor shall not be less than twice the _____ of the indirect waste pipe.	IPC 802.3.1	IPC 802	1	effective opening	trap size	diameter of the pipe	flood level rim
The standpipe shall extend not less than _____ inches above the weir of the standpipe trap and shall extend above the flood level rim of the laundry tray. The outlet of the laundry tray shall not be greater than _____ inches horizontal distance from the side of the standpipe.	IPC 802.4.3.1	IPC 802	4	18, 18	18, 30	30, 42	30, 30
Indirect waste piping that exceeds _____ inches in developed length measured horizontally, or _____ inches in total developed length, shall be trapped.	IPC 802.3	IPC 802	2	18, 48	30, 54	24, 54	24, 48
Vent terminals extending through the wall shall terminate not less than _____ feet from the lot line above the highest grade within _____ feet horizontally of the vent terminal.	IPC 903.1.4	IPC 903	2	5, 5	10, 10	5, 10	10, 5
A vent shall not be installed within two pipe diameters of the _____.	IPC 909.3	IPC 909	1	trap weir	vent stack	pipe	drainage fixture units
Any combination of fixtures within two bathroom groups located _____ is permitted to be vented by a vertical wet vent.	IPC 912.1.1	IPC 912	3	within two floors	within one floor above or below the main floor level	within the same floor level	on any floor
Stack-type air admittance valves shall be located not less than _____ inches above the flood level rim of the highest fixture being vented.	IPC 918.4	IPC 918	2	4	6	8	10
Bottling plants shall discharge process wastes into an interceptor that will provide for the separation of _____ or other solids before discharging waste into the drainage system.	IPC 1003.7	IPC 1003	4	cleaned glass	tinted glass	clear glass	broken glass
The discharge piping from a grease interceptor shall be directly connected to the _____.	IPC 1003.3.8	IPC 1003	2	public drainage system	sanitary drainage system	sanitary supply system	building's irrigation system
Sand and similar interceptors for heavy solids shall be designed and located so as to be provided with a ready access for cleaning, and shall have a water seal of not less than _____.	IPC 1003.5	IPC 1003	2	4 inches	6 inches	8 inches	12 inches
Water-supplied trap seal primer valves shall conform to ASSE _____.	IPC 1002.4.1.1	IPC 1002	1	1018	1044	1072	1045
Storm drainage systems shall be provided with a _____ as required for sanitary drainage system in accordance with section 714.	IPC 1101.9	IPC 1101	3	pressure relief valve	butterfly valve	backwater valve	check valve
Plastic pipe fittings shall conform to ASTM _____.	IPC Table	IPC 1102	2	D3034	F409	A112.3.1	D2751
A cleanout shall be installed on the _____ of the trap and shall be provided with access.	IPC 1103.4	IPC 1103	3	most accessible side	main floor level	building side	exterior side
What is the capacity of a gutter that is 5 x 8 inches?	IPC Table	IPC 1106	1	651 gpm	1055 gpm	472 gpm	331 gpm
The provisions of this chapter shall govern the design and installation of piping and storage systems for nonflammable medical gas systems and nonmedical oxygen systems shall comply with the International Plumbing Code, all maintenance and operations of such systems shall be in accordance with the _____.	IPC 1201.1	IPC 1201	4	International Mechanical Code	International Fuel Gas Code	National Electrical Code	International Fire Code
Nonflammable medical gas systems, _____ and vacuum piping systems shall be installed, tested and labeled in accordance with NFPA 99.	IPC 1202.1	IPC 1202	2	exhalation anesthetic system	inhalation anesthetic system	Medical respiration system	Intravenous anesthetic system
Cylinder storage shall comply with NFPA 99.	IPC 1202.1 Exception 1	IPC 1202	2	TRUE	FALSE		

Nonmedical oxygen systems shall be designed and installed in accordance with NFPA _____ and _____.	IPC 1203.1	IPC 1203	3	70, 99	13, 80	51, 55	101, 55
Below-grade storage tanks, located outside of the building, shall be provided with a manhole either not less than _____ inches square or with an inside diameter not less than _____ inches.	IPC 1301.9.6	IPC 1301	4	18, 24	24, 18	18, 18	24, 24
Graywater used for flushing water closets and urinals shall be disinfected and treated by an on-side water reuse treatment system complying with _____.	IPC 1302.6.1	IPC 1302	2	NSF 300	NSF 350	NSF 400	NSF 450
Downspouts and leaders shall be connected to a debris excluder device that is designed to remove all but which of the following:	IPC 1303.3	IPC 1303	3	leaves	sticks	grease	pine needles
Where the water pressure supplied by the pumping system exceeds _____ psi static, a pressure-reducing valve shall be installed to reduce the pressure in the rainwater distribution system to _____ psi or less.	IPC 1303.13	IPC 1303	2	120	80	75	50
Not fewer than _____ percolation tests in each system shall be conducted.	IPC 1402.2.1.3	IPC 1402	3	one	two	three	four
The absorption field for streams and lakes shall be _____ feet.	IPC Table	IPC 1402	1	50	100	5	10
Not less than _____ inches in depth of aggregate, ranging in size from 1/2 inches to 2 1/2 inches shall be laid into the trench below the distribution piping elevation.	IPC 1403.1.5	IPC 1403	3	3	4	6	8
What is the design loading factor when there is a percolation rate of 57?	IPC Table	IPC 1403	4	1.2	0.8	0.72	0.4
The angle of the water stream from spouts within 3 inches of the front of the drinking fountain shall be _____ degrees maximum.	ICC A117.1-17 Section 602.2.5	ICC A117.1-17 Section	2	15	30	45	90
Accessible water closets shall have a clearance of _____ inches minimum in width.	ICC A117.1-17 Section 604.3.1	ICC A117.1-17 Section	4	36	56	48	60
The width between the urinal partitions shall be a minimum of _____ inches when the depth of the partitions are 18 inches.	ICC A117.1-17 Sections 305.3.1 and	ICC A117.1-17 Sections 305 and 605	1	30	36	48	60
A transfer type shower shall have an inside clear width of _____ inches and clear depth of _____ inches.	ICC A117.1-17 Section	ICC A117.1-17 Section	3	30, 30	36, 60	36, 36	36, 56
The minimum size wire to be used as a trace wire shall be _____ AWG.	IFGC 404.17.3	IFGC 404	2	16	18	20	24
Individual lines to outdoor lights, grills and other appliances shall be installed not less than _____ inches below finished grade, provided that such installations is approved and installed in locations not susceptible to physical damage.	IFGC 404.12.1	IFGC 404	3	4	6	8	12
What is the maximum length for a gas line using propane gas with an inlet pressure of 10 psi with a pressure drop of 1 with a CFH of 10,300 and a pipe size of 1 1/2 inches?	IFGC Table 402.4(25)	IFGC 402	1	125	100	80	50
Where piping is installed through holes or notches in framing members and the piping is located less than _____ inches from the member face to which wall, ceiling or floor membranes will be attached, the pipe shall be protected by shield plates that cover the width of the pipe and the framing member and that extend not less than 4 inches.	IFGC Table 404.7.1	IFGC 404	3	1	1 1/4	1 1/2	2
What is the minimum required opening size for an opening within 12 inches of the top of the enclosure with a 120,000 BTU furnace?	IFGC 304.6.2	IFGC 304	4	80 sq in	120 sq in	60 sq in	40 sq in
What is the minimum spacing of support for 2 inch steel pipe?	IFGC Table	IFGC 415	2	6 feet	10 feet	8 feet	4 feet
For other than steel pipe and CSST, exposed piping shall be identified by a yellow label marked "Gas" in black letters. The marking shall be spaced at intervals not exceeding _____ feet.	IFGC 401.5	IFGC 401	2	3	5	10	12
The duration a pressure test for a single family dwelling shall be for _____ minutes minimum.	IFGC 406.4.2	IFGC 406	1	10	15	30	60



George Williams

MCP, CBO

SENIOR PLAN REVIEW EXAMINER

EDUCATION

**MASTER OF SCIENCE
CONSTRUCTION MANAGEMENT**
Brigham Young University, 2015

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Weber State University, 2008

LICENSES | CERTIFICATIONS

LICENSES

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ICC CERTIFICATIONS

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Mechanical Plans Examiner
Commercial Energy Inspector
Commercial Energy Plans Examiner
Residential Energy Inspector/Plans
Examiner
Accessibility Inspector/Plans
Examiner
Housing Code Official
Property Maintenance & Housing
Inspector

And several more...

AFFILIATIONS

Beehive Chapter of ICC
Vice President & Member

IAEI Utah Chapter
Member

AWARDS

Utah Chapter ICC
2016 Chapter Service Award
Eagle Scout - 1998

Mr. Williams has worked on a contract basis for numerous jurisdictions in California, Nevada, Washington, Utah, Wyoming and North Dakota throughout his 13-year career in the industry. From 2009 through mid-2014 he acted as the contract building official for City of Holladay as well as the resort town of Alta, both in Utah. He was also responsible for start-up of two county building departments in North Dakota, including the adopting of codes, implementation of permitting processes, and the development of policies and procedures in a part of the country where no previous form of building or construction regulatory processes existed. In addition to substantial municipal work, Mr. Williams has acted and continues to act as Lead Inspector for a number of multi-million-dollar projects for Utah's Division of Facilities and Construction Management (DFCM). Mr. Williams has numerous ICC certifications and received his ICC Master Code Professional certification in 2009. Currently he performs complex commercial plan reviews for clients in California, Nevada, Wyoming and Utah, as well as commercial inspections.

EXPERIENCE

SENIOR INSPECTOR / PLAN REVIEWER

West Coast Code Consultants, Inc. / 2014 – Present

Provides plan reviews and inspections services for a variety of commercial projects. Specializes in several code disciplines including, building, mechanical, plumbing, electrical, accessibility, energy and green codes. Familiar with both the International and Uniform codes, as plan review and inspection work encompassing numerous municipalities in multiple states. Regularly responsible for overseeing code compliance and inspection of large-scale state-owned buildings; including oversight of special inspection firms.

BUILDING OFFICIAL / INSPECTOR

Forsgren Associates / 2005 – 2014

Developed, maintained, administered, organized and oversaw building departments for various municipalities. Responsible for all aspects of building department administration, including creating policies and procedures, commercial and residential plan reviews, calculating permit fees, meeting with architects and engineers, performing field inspections, reviewing special inspection reports, interpreting codes and local ordinances, data and document management, and many other diverse tasks. Responsible for managing 2-4 field inspectors on a daily basis. Clients included numerous municipalities in multiple states, school districts, architects, law firms, and private entities.

PUBLICATIONS

Graduate Thesis: (2015) *Assessing the Repercussions of a Mass Departure of Building Inspectors from the Code Professional Industry.* Brigham Young University, Provo, Utah.

Article: (2015) *Construction Challenges Associated with the Sudden Population Growth in the Willison Basin Oil Boom,* presented at ASC Annual International Conference, College Station, TX: Associated Schools of Construction.

Article: (2019) *Understanding the Impacts of the Aging Population of Code Professionals in Utah,* presented at ASC Annual International Conference, Denver, CO: Associated Schools of Construction.