



# Board of Building Standards

## EDUCATION COMMITTEE MEETING AGENDA (AMENDED MARCH 24, 2021)

DATE: MARCH 25, 2021  
TIME: 10:00 AM

LOCATION: [VIDEOCONFERENCE](#)  
DIAL-IN 614-721-2972,  
PHONE CONFERENCE ID: 359 068 511#

### Guest and Staff 'Check-in'

### Call to Order

### Consent Agenda

### Course Applications

- [ER-1](#) How to Use the 2020 NEC (Ohio Certificate Renewal)  
ESI, BO, MPE, BPE, EPE, BI, FPI, NRIUI, RBO, RPE, RBI, RIUI (4 hours)  
Staff Notes:  
ESIAC Recommendation:  
Committee Recommendation:
- [ER-2](#) Motor Circuits Article 430 (Ohio Certificate Renewal)  
ESI, BO, MPE, BPE, EPE, BI, FPI, NRIUI, RBO, RPE, RBI, RIUI (4 hours)  
Staff Notes:  
ESIAC Recommendation:  
Committee Recommendation:
- [ER-3](#) Plan Examiner Monthly Round Table (Columbus)  
All Certifications (12 session of one hour each)  
Staff Notes: Round Table, no slides  
Committee Recommendation:
- [ER-4](#) Cincinnati Inspector Cross Training Part 1 (BFCA)  
Provider: Building and Fire Code Academy  
RBI, RMI (1 three hour session)  
Staff Notes: The series of courses is intended to cross train City of Cincinnati property maintenance inspectors and residential building inspectors. Part 1 is the intro - 3 hour course.  
Committee Recommendation:

[ER-5](#)

Cincinnati Inspector Cross Training Part 2 (BCFA)

Provider: Building and Fire Code Academy

RBI, RMI (4 sessions, three hours each)

Staff Notes: The series of courses is intended to cross train City of Cincinnati property maintenance inspectors and residential building inspectors. This portion is focused on the International Property Maintenance Code, which is not Ohio Code.

Committee Recommendation:

[ER-6](#)

Cincinnati Inspector Cross Training Part 3 (BCFA)

Provider: Building and Fire Code Academy

RBI, RMI (6 sessions, three hours each)

Staff Notes: The series of courses is intended to cross train City of Cincinnati property maintenance inspectors and residential building inspectors. This portion is focused on the Residential Code of Ohio: there may be an issue with the first class, which covers Chapter 1.

Committee Recommendation:

[ER-7](#)

Cincinnati Inspector Cross Training Part 4 (BCFA)

Provider: Building and Fire Code Academy

RBI, RMI (4 sessions, three hours each)

Staff Notes: The series of courses is intended to cross train City of Cincinnati property maintenance inspectors and residential building inspectors. The final four sessions focus on the Mechanical Code

Committee Recommendation:

**Old Business**

**New Business**

**Adjourn**

**EDUCATION COMMITTEE MEETING  
CONSENT AGENDA**

**Course Applications**



**File Attachments for Item:**

ER-1 How to Use the 2020 NEC (Ohio Certificate Renewal)

ESI, BO, MPE, BPE, EPE, BI, FPI, NRIUI, RBO, RPE, RBI, RIUI (4 hours)

Staff Notes:

ESIAC Recommendation:

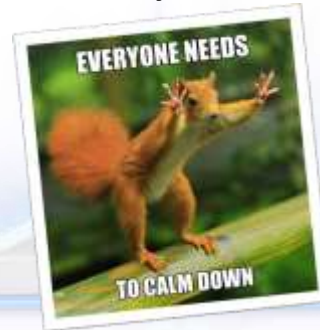
Committee Recommendation:

## Understanding How to Use the National Electrical Code

Awareness of the theory, design,  
and arrangement of the National  
Electrical Code

1

## Why Create This Class?



2

## Recognized “Facts” of the NEC

The National Electrical Code is just dreadful!  
Its one giant conglomeration of rules and regulations!  
No way you could imagine reading this monstrosity?  
No story, No theory, No plot!  
The perfect sleep aid!

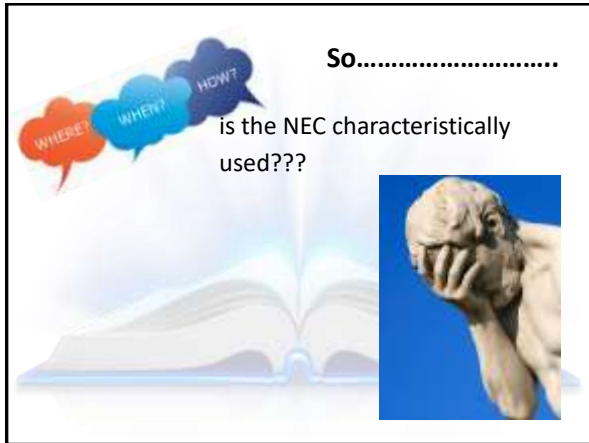
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## Want Some Good News?

The Code is actually understandable, accessible,  
and yes fun!

Well, maybe just understandable and accessible,  
we’re going to try real hard to make it fun.


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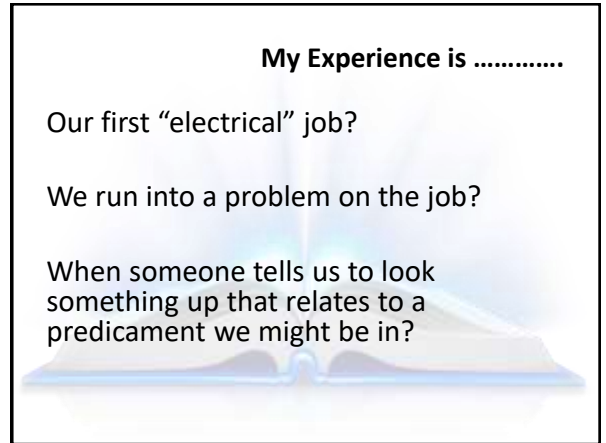
**So.....**

is the NEC characteristically used???

WHERE? WHEN? HOW?



5



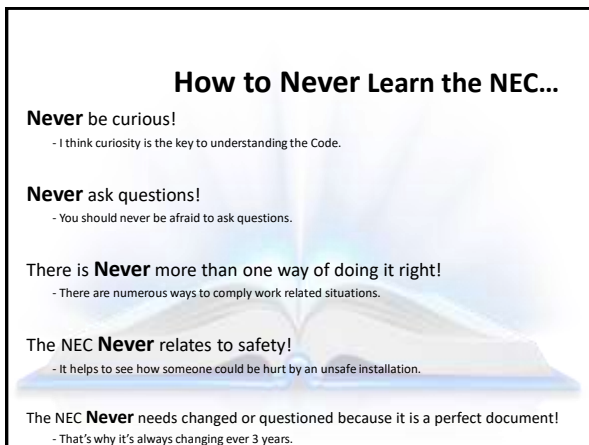
**My Experience is .....**

Our first “electrical” job?

We run into a problem on the job?

When someone tells us to look something up that relates to a predicament we might be in?

6



**How to Never Learn the NEC...**

**Never** be curious!  
- I think curiosity is the key to understanding the Code.

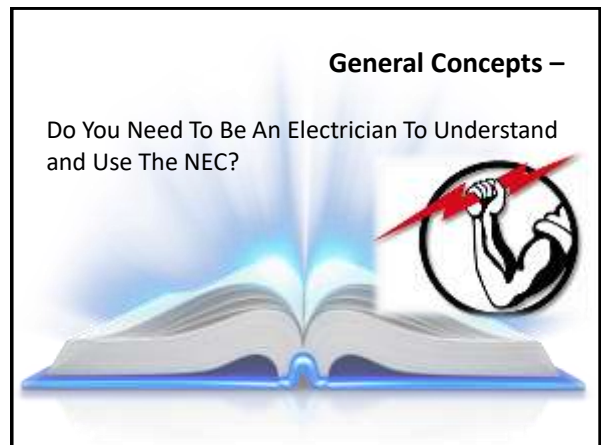
**Never** ask questions!  
- You should never be afraid to ask questions.

There is **Never** more than one way of doing it right!  
- There are numerous ways to comply work related situations.

The NEC **Never** relates to safety!  
- It helps to see how someone could be hurt by an unsafe installation.


The NEC **Never** needs changed or questioned because it is a perfect document!  
- That's why it's always changing ever 3 years.

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**General Concepts –**

Do You Need To Be An Electrician To Understand and Use The NEC?




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**But ...**

The rules of the National Electrical Code are written for people who have a basic knowledge of electricity. In order to make sense of the Code, you must first understand basic electrical concepts such as voltage, amperage, resistance, Ohm's law, wattage, circuit theory and others.

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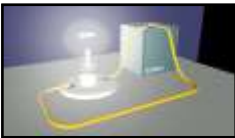


**THREE PRIMARY FORCES-**

**Voltage –**  
The force that pushes the current through electrical circuits. The scientific name for voltage is electromotive force, and is represented in formulas with the capital letter “E” (sometimes also represented as V). It is measured in volts.

Voltage is comparable to water pressure. The higher the pressure, the faster water will flow through a system. With electricity, the higher the voltage (electrical pressure), the more current will flow through a system.

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**THREE PRIMARY FORCES-**

**Current –**  
The rate of flow of electrical current. The scientific description for current is intensity of current flow, and is represented in formulas with the capital letter “I” and measured in amps.

“I” compares with the rate of flow in a water system, which is typically measured in gallons per minute. In simple terms, electricity is thought to be the flow of electrons through a conductor.

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**THREE PRIMARY FORCES-**

**Impedance –**  
Total opposition to the flow of electricity. Impedance is measured in ohms and represented by the letter “Z.” Ohms are represented by the capital Greek letter omega ( $\Omega$ ).

Impedance or resistance is like the pipe size in a water piping system. Let’s say you increase the diameter of the hose and all of the fittings to the tank. You probably guessed that this also makes more water come out of the hose.

This is like decreasing the resistance in an electrical system, which increases the current flow.

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### Impedance vs Resistance-

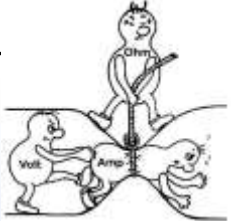
Resistance is the more frequently used term in the electrical industry. **Unfortunately, it is also the less-accurate term.** Impedance is the term for total resistance in an alternating current circuit.

An alternating current circuit contains normal resistance but may also contain certain other types of resistance called reactance, which are found only in AC (alternating current) circuits.

This reactance comes mainly from the use of magnetic coils, called inductive reactance; and capacitors, called capacitive reactance.

Like impedance, resistance is also measured in ohms, and represented by the letter "R."

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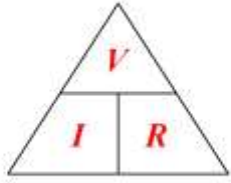


### Ohm's Law-

States that the current through a conductor between two points is directly proportional to the voltage across the two points. ...

More specifically, Ohm's law states that the R in this relation is constant, independent of the current.

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$V = I R$

$I = \frac{V}{R}$

$R = \frac{V}{I}$

**Formula -**

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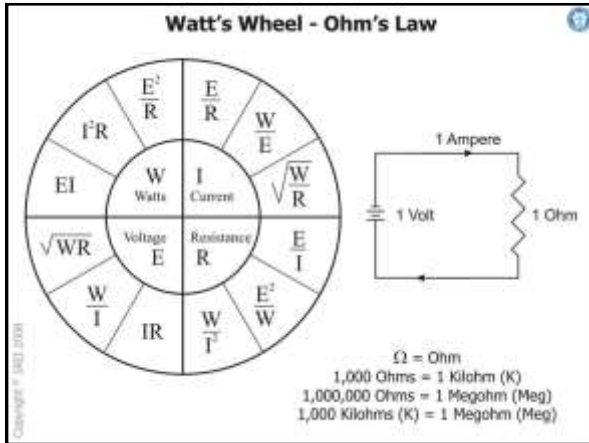
### General Concepts -

Electrical power is measured in watts. In an electrical system power (P) is equal to the voltage multiplied by the current.

**WATTS = VOLTS X AMPS**

The water analogy still applies. Take a hose and point it at a waterwheel like the ones that were used to turn grinding stones in watermills. You can increase the power generated by the waterwheel in two ways. If you increase the pressure of the water coming out of the hose, it hits the waterwheel with a lot more force and the wheel turns faster, generating more power. If you increase the flow rate, the waterwheel turns faster because of the weight of the extra water hitting it.

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### How does an electric current work?

The direction of an electric current is by convention the direction in which a positive charge would move. Thus, the current in the external circuit is directed away from the positive terminal and toward the negative terminal of the battery. Electrons would actually move through the wires in the opposite direction.

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### How About Simpler?

You MUST have a complete circuit...

**and**

You MUST have a difference in potential...

**before**

Current can flow!

**but**

What about resistance or a load?

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### So Whatcha Think Now—



20

Ultimately we just want the answer...right?



So how do we simplify this giant conglomeration of rules and regulations?

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What About Memorization?



22

How About the all Inclusive and Omnipotent Index?



23

Oh Great and Powerful Index Please Hear Me!

Typically the Index is used as a means of **hunting and hoping and praying** that we can find that "rule in a haystack" which will give us a clue what to do next...



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## Effective Use of the Index Requires you to Know the Key Word!

The use of the “key word” identifier is so simple they sell a book to make better use of this tool when needed.



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## How Can We Learn To Use The NEC –

Perhaps by.....

- Understanding the guiding principles of the code?
- Understanding the general lay-out of the code?
- Elimination of superfluous Articles not typically used?

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## What are the pieces, parts, and players of the NEC?



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## Ever Thought of the NEC as a Risk Management Tool?

### Risk Assessment –

A systematic examination of a task, job or process that you carry out at work for the purpose of; Identifying the significant hazards that are present (a hazard is something that has the potential to cause someone harm or ill health)

### Purpose Of Risk Management –

Identify potential problems before they occur so that risk-handling activities may be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives.

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### Article 90 – Why is this Article essential to managing this book?

#### Article 90.1(B) Adequacy

This Code contains provisions that are considered necessary for safety. Compliance therewith and proper maintenance results in an installation that is essentially free from hazard but not necessarily efficient, convenient, or adequate for good service or future expansion of electrical use.

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### Article 90 – Why is this Article essential to managing this book?

#### Article 90.1(A) Practical Safeguarding

The purpose of this Code is the practical safeguarding of persons and property from hazards arising from the use of electricity. This Code is not intended as a design specification or an instruction manual for untrained persons.

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### Ever heard of the NEC Style Manual?



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### 1.1 Purpose –

The National Electrical Code (NEC) Style Manual is prepared under the guidance of the NEC Correlating Committee and is used to advise members of the Code-Making Panels on the required editorial style and arrangement of the NEC. It is intended to be used as a practical working tool to assist in making the NEC as clear, usable, and unambiguous as possible.

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## 1.2 Scope –

This Manual provides editorial and administrative requirements for writing the National Electrical Code (NFPA 70®) and the Standard for Electrical Safety in the Workplace® (NFPA 70E®). Except as otherwise specified in this manual, the NEC and the Standard for Electrical Safety in the Workplace shall comply with the Manual of Style for NFPA Technical Committee Documents.

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## Example –

2.6 Exceptions.

2.6.1 Placement and Order.

Exceptions shall immediately follow the main rule to which they apply. Where exceptions are made to items within a numbered list, the exception shall clearly indicate the items within the list to which it applies.

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## Example –

3.2 Word Choices.

3.2.1 Unenforceable Terms.

The NEC shall not contain references or requirements that are unenforceable or vague. The terms contained in Table 3.2.1 shall be reviewed in context, and, if the resulting requirement is unenforceable or vague, the term shall not be used.

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## Table 3.2.1 Possibly Unenforceable and Vague Terms –

Acceptable, Adequate, Adjacent, Appreciable, Appropriate, Approximate(ly), Available, Avoid(ed), Can, Care, Careful(ly), Consider(ed)(ation), Could, Designed for the purpose, Desirable, Easy(ily), Equivalent(ly), Familiar, Feasible, Few, Frequent(ly), Firmly, Generally, Good, Lightly...

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### Example –

#### 2.4.1 Parallel Numbering Within Similar Articles.

To the extent possible, Code-Making Panels are encouraged to use the same section numbers (and part numbers, where applicable) for the same purposes within articles covering similar subjects.

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### Example: A typical family of articles might be organized as follows:

#### Article 399 Future Products

##### I. General

- 399.1 Scope.
- 399.2 Definition.
- 399.3 Other Articles.

##### II. Installation

- 399.10 Uses Permitted.
- 399.11 Uses Not Permitted.
- 399.13 Bends.

##### III. Construction Specifications

- 399.20 General.
- 399.21 Sizes.
- 399.22 Marking.

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### The Table of Contents – knowing this small piece is critical to effectively using the NEC

- Chapter 1 ~ General
- Chapter 2 ~ Wiring and Protection
- Chapter 3 ~ Wiring Methods and Materials
- Chapter 4 ~ Equipment for General Use
- Chapter 5 ~ Special Occupancies
- Chapter 6 ~ Special Equipment
- Chapter 7 ~ Special Conditions
- Chapter 8 ~ Communications Systems
- Chapter 9 ~ Tables

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### Remember the NEC Style Manual????

#### 2.1.2 Chapters.

Chapters are major subdivisions of the NEC that cover broad areas and are divided into articles. Chapters shall be organized as follows:

40

**Chapter 1 General**  
 Article 100 — Definitions  
 Article 110 — Requirements for Electrical Installations

**Chapter 2 Wiring and Protection**  
 Articles 200 – 299

**Chapter 3 Wiring Methods and Materials**  
 Articles 300 – 399

**Chapter 4 Equipment for General Use**  
 Articles 400 – 499

**Chapter 5 Special Occupancies**  
 Articles 500 – 599

**Chapter 6 Special Equipment**  
 Articles 600 – 699

**Chapter 7 Special Conditions**  
 Articles 700 – 799

**Chapter 8 Communications Systems**  
 Articles 800 – 899

**Chapter 9 Tables**

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## The concept of General to Specific –

How does this simple principle govern the use of the NEC?



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## Example-

**It starts out pretty general, right ?**

*Article 90-1 Purpose*

*Article 90-2 Scope*

*Article 90-3 Code Arrangement*

**Then it gets more specific...**

*Article 90-4 Enforcement*

*Article 90-5 Mandatory Rules And Explanatory material*

*Article 90-6: Formal Interpretations*

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## More-

**And then it gets even more specific...**

*Article 90-7 Examination Of Equipment For Safety*

*Article 90-8 Wiring And Planning*

*Article 90-9 Metric Units Of Measurement*

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### And Even More-

**This General to Specific theme is so prevalent in the Code that the entire book can be split in half.**

That's right, the first half of the Code deals with General areas.

*Chapter 1 General*

*Chapter 2 Wiring And Protection*

*Chapter 3 Wiring Method And Materials*

*Chapter 4 Equipment For General Use*

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### Shall I Continue?

**The last half of the Code deals with Special areas.**

*Chapter 5 Special Occupancies*

*Chapter 6 Special Equipment*

*Chapter 7 Special Conditions*

*Chapter 8 Communications*

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### The concept of utilizing the Outline Method –

How does this basic organizational method supports the guiding principal of General to Specific?

Outline  
Outline  
Outline  
Outline

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### Example-

**Chapter (1 - 9)**

**Article (100 - 800)**

**Part (1 -?)**

**Section (A - Z)**

**Subdivision (1), (2), (3)...**

**Exception (1,2,3...)**

**Informational note (1,2,3...)**

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## The concept of Plan-It, Build-It, Use-It.

### Chapter 2 –

**Plan-It** chapter. This chapter includes articles on calculating what size branch circuits, feeders and service we'll need along with the grounding requirements before we start the job.



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## The Concept of Plan-It, Build-It, Use-It.

### Chapter 3 –

**Build-It** chapter. This chapter includes articles on the use of materials and installation of the same.



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## The Concept of Plan-It, Build-It, Use-It.

### Chapter 4 –

**Use-It** chapter. This chapter includes articles on equipment such as lighting fixtures, appliances, motors, etc.



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## Article 90 – Why is this Article essential to managing this book?

Article 90.2 Scope –

*What is Covered?*

**& equally important**


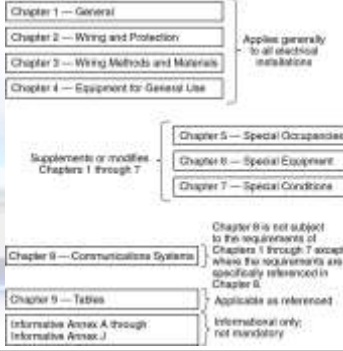
*What is not Covered?*



52

### Article 90 – Why is this Article essential to managing this book?

Article 90.3 – Code Arrangement

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### Article 90 – Why is this Article essential to managing this book?

Article 90.5(A-D) Mandatory Rules, Permissive Rules, and Explanatory Material

**Mandatory Rules** - identify actions that are specifically required or prohibited - **shall or shall not**.

**Permissive Rules** - identify actions that are allowed but not required - **shall be permitted or shall not be required**.


**Explanatory Material** - Explanatory material - in the form of informational notes. Such notes are **informational only and are not enforceable** as requirements of this Code.

**Informative Annexes** - Informative annexes are not part of the enforceable requirements - **included for information purposes only**.

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### Definitions - Why they are So Critical for Understanding and Successfully Applying the NEC?


Where in the NEC are definitions located?  
 Are they located in more than a single location?  
 WHY?



55

### Can we make the book “smaller”?

How about the elimination of superfluous Articles not typically used?



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## Chapter 2 - Wiring and Protection

How many of these 10 Articles do we really need to know?



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## Chapter 2 - Wiring and Protection

Article 210 - Branch Circuits

**versus**

Article 215 - Feeders

**versus**

Article 230 - Services

How do we differentiate between these articles?  
Why is this essential?

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## Chapter 2 - Wiring and Protection

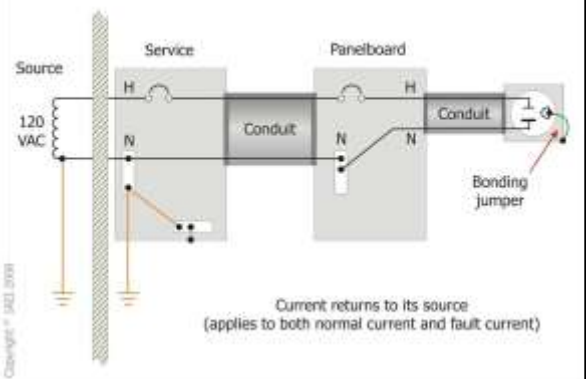
Article 240 Overcurrent Protection

- **What** is Overcurrent protection?
- **How** do we provide Overcurrent protection?
- **Why** do we provide Overcurrent protection?



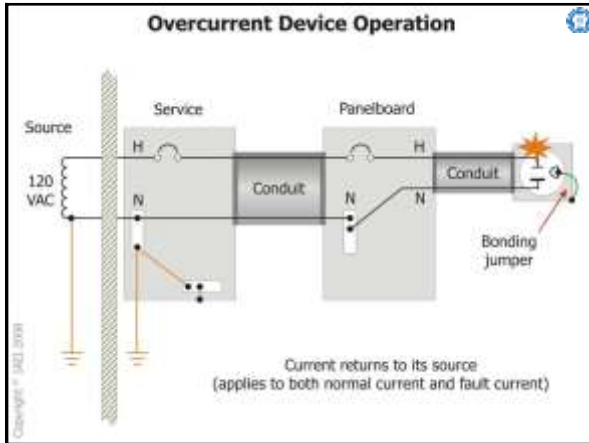
59

## Overcurrent Device Operation

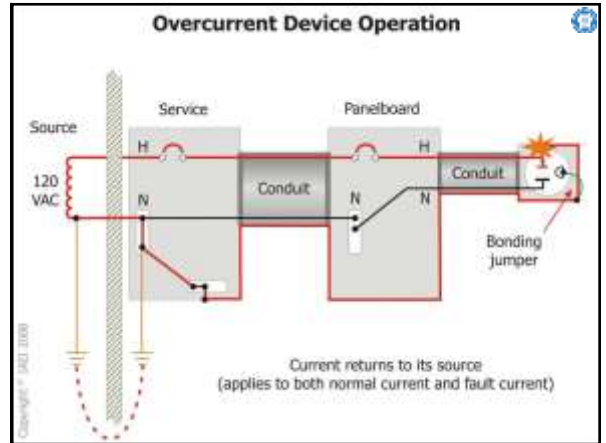


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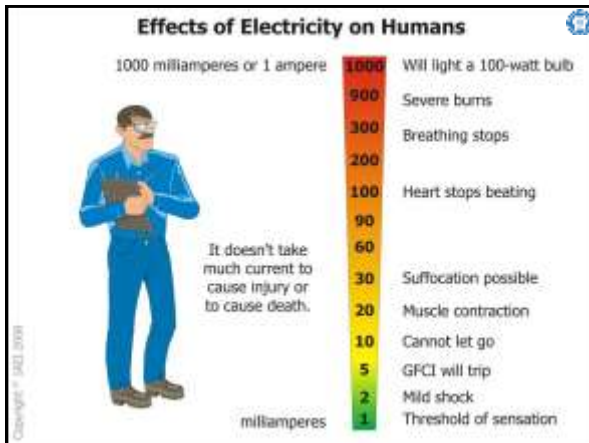




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63

**Chapter 2 - Wiring and Protection**

Article 250 Grounding Versus Bonding

- **What** is Grounding and Bonding?
- **Why** do we Ground and Bond?
- **How** do we Ground and Bond?

**WHY**  
 **WHAT**  
 **HOW**

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## 250.4 General Requirements for Grounding and Bonding

The following general requirements identify what grounding and bonding of electrical systems are **required** to accomplish. The **prescriptive** methods contained in Article 250 shall be followed to comply with the performance requirements of this section.

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## Grounding

- 1. Electrical System Grounding.** Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operation.
- 2. Grounding of Electrical Equipment.** Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected to earth so as to limit the voltage to ground on these materials.

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## Bonding

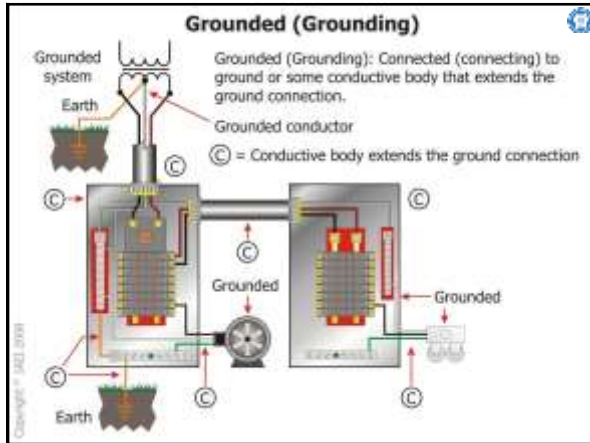
- 3. Bonding of Electrical Equipment.** Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.
- 4. Bonding of Electrically Conductive Materials and Other Equipment.** Normally non-current-carrying electrically conductive materials that are likely to become energized shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

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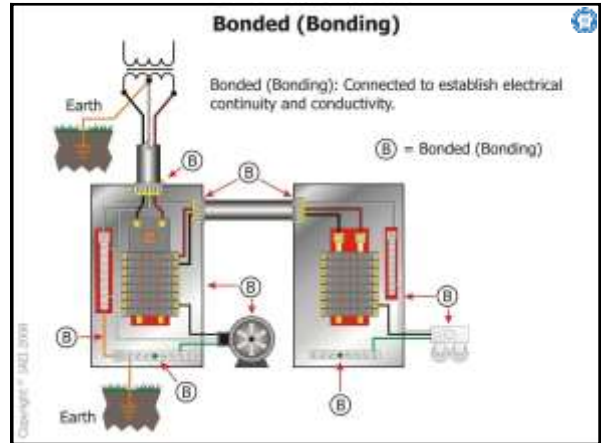
## Grounding Versus Bonding

- 5. Effective Ground-Fault Current Path.** Electrical equipment and wiring and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit **facilitating the operation of the overcurrent device** or ground detector for high-impedance grounded systems. It shall be capable of safely carrying the maximum ground-fault current likely to be imposed on it from any point on the wiring system where a ground fault may occur to the electrical supply source. The earth shall not be considered as an effective ground-fault current path.

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**Table 250.66 Grounding Electrode Conductor for Alternating Current Systems**

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 <sup>†</sup>
2 or smaller	1/0 or smaller	0	0
1 or 1/0	2/0 or 1/0	0	0
2/0 or 1/0	4/0 or 250	4	2
Over 1/0	Over 250	2	1/0
Over 300	Over 250	1/0	3/0
Over 400	Over 300	2/0	4/0
Over 1100	Over 1750	3/0	250

*Note.* This table also applies to the desired conductor of separately derived systems.

*Note.* See conductor restrictions in 250.66(C).

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**Table 250.66(B)(1) Grounded Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply-Side Bonding Jumper for Alternating Current Systems**

Size of Largest Ungrounded Conductor or Equivalent Area for Parallel Conductors (AWG, kcmil)		Size of Grounded Conductor or Bonding Jumper* (AWG, kcmil)	
Copper	Aluminum or Copper-Clad Aluminum	Copper	Aluminum or Copper-Clad Aluminum
2 or smaller	1/0 or smaller	0	0
1 or 1/0	2/0 or 1/0	0	0
2/0 or 1/0	4/0 or 250	4	2
Over 1/0	Over 250	2	1/0
Over 300	Over 250	1/0	3/0
Over 400	Over 300	2/0	4/0
Over 1100	Over 1750	See Note 1(B)(2)	See Note 1(B)(2)

*Note.*

- If the ungrounded supply conductors are larger than 250 kcmil copper or 350 kcmil aluminum, the grounded conductors of bonding jumpers shall have an area not less than 25 percent of the area of the largest ungrounded supply conductor or equivalent size for parallel supply conductors. The grounded conductor or bonding jumper shall also be required to be larger than the largest ungrounded conductor if an ungrounded conductor is:
- If the ungrounded supply conductor is an 800 kcmil (300 kcmil) copper or 1000 kcmil (400 kcmil) aluminum conductor.
- If the ungrounded supply conductor of the same material as the grounded conductors of bonding jumpers and will have an equivalent restriction to that of the largest ungrounded supply conductor.
- If multiple sets of ungrounded conductors are used as permitted in 250.66(B)(2), the size of the ungrounded supply conductors are required to be a separately derived system, the equivalent size of the largest ungrounded supply conductor(s) shall be determined by the largest one of the sizes of the corresponding conductors of each set.
- If there are no ungrounded conductors, the supply conductor size shall be determined by the equivalent size of the largest ungrounded conductor required for the load to be served.

*Note.* The purpose of listing the other listed metals, the corresponding jumper sizes in steel bonding jumpers, special listing jumpers, and equivalent bonding jumper is:


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**Table 306-113 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment**

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conductor, etc., Not Exceeding (Amperes)	Size (AWG or kcmil)	
	Copper	Aluminum or Copper-Clad Aluminum*
15	14	12
20	12	10
30	10	8
40	8	6
60	6	4
100	4	3
200	3	1
300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0
1000	2/0	4/0
1200	3/0	250
1600	4/0	300
2000	250	400
2500	300	500
3000	350	600
4000	500	750
5000	750	1200
6000	1000	1500

From 30 to any number to complete with 000, X, A, or S) or (100), the equipment grounding conductor shall be sized larger than given in this table.  
\*See Table 306-110 for aluminum and copper-clad aluminum.

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## Chapter 3: Wiring Methods

How many of these 46 Articles do we really need to know?

- Article 300 - Wiring Methods and Materials
- Article 310 - Conductors for General Wiring

**But what about the remaining Articles?**

74

**Table 306-113 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment**

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conductor, etc., Not Exceeding (Amperes)	Size (AWG or kcmil)	
	Copper	Aluminum or Copper-Clad Aluminum*
15	14	12
20	12	10
30	10	8
40	8	6
60	6	4
100	4	3
200	3	1
300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0
1000	2/0	4/0
1200	3/0	250
1600	4/0	300
2000	250	400
2500	300	500
3000	350	600
4000	500	750
5000	750	1200
6000	1000	1500

From 30 to any number to complete with 000, X, A, or S) or (100), the equipment grounding conductor shall be sized larger than given in this table.  
\*See Table 306-110 for aluminum and copper-clad aluminum.

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**Table 306-113 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment**

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conductor, etc., Not Exceeding (Amperes)	Size (AWG or kcmil)	
	Copper	Aluminum or Copper-Clad Aluminum*
15	14	12
20	12	10
30	10	8
40	8	6
60	6	4
100	4	3
200	3	1
300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0
1000	2/0	4/0
1200	3/0	250
1600	4/0	300
2000	250	400
2500	300	500
3000	350	600
4000	500	750
5000	750	1200
6000	1000	1500

From 30 to any number to complete with 000, X, A, or S) or (100), the equipment grounding conductor shall be sized larger than given in this table.  
\*See Table 306-110 for aluminum and copper-clad aluminum.

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Table 310.15(B)(5)(a) Adjustment Factors for More Than Three Current-Carrying Conductors

Number of Conductors <sup>2</sup>	Percent of Values in Table 310.15(B)(16) Through Table 310.15(B)(19) as Adjusted for Ambient Temperature if Necessary
4-6	80
7-9	70
10-20	50
21-30	40
31-40	30
41 and above	25

<sup>2</sup>Number of conductors is the total number of conductors in the raceway or cable, including spare conductors. The count shall be adjusted in accordance with 310.15(B)(3) and (5). The count shall not include conductors that are connected to electrical components that cannot be simultaneously energized.

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## Chapter 4: Equipment for General Use

So how many of these 21 Articles do we really need to know?

- Article 400 Flexible Cords and Cables
- Article 404 Switches
- Article 406 Receptacles, Cord Connectors, and Attachment Plugs (Caps)
- Article 408 Switchboards, Switchgear, and Panelboards
- Article 410 Luminaires, Lampholders, and Lamps
- Article 422 Appliances
- Article 424 Fixed Electric Space-Heating Equipment
- Article 430 Motors, Motor Circuits, and Controllers
- Article 440 Air-Conditioning and Refrigerating Equipment
- Article 445 Generators

**What about the remaining articles?**

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## Chapter 5: Special Occupancies

How many of these 28 Articles do we really need to intuitively know?

- Article 500 Hazardous (Classified) Locations
  - Article 501-503 Classes I, II, and III, Divisions 1 and 2
- Article 511 Commercial Garages, Repair and Storage
- Article 514 Motor Fuel Dispensing Facilities
- Article 516 Spray Application, Dipping, and Coating Process
- Article 517 Health Care Facilities
- Article 518 Assembly Occupancies
- Article 520 Theaters, Audience Areas of Motion Picture and Television Studios, Performance Areas, and Similar Locations
- Article 590 Temporary Installations

**What about the remaining articles?**

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## Chapter 6: Special Equipment

How many of these Articles do we really need to intuitively recognize?

- Article 600 Electric Signs and Outline Lighting
- Article 605 Office Furnishings
- Article 620 Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts
- Article 680 Swimming Pools, Fountains, and Similar Installations
- Article 682 Natural and Artificially Made Bodies of Water
- Article 690 Solar Photovoltaic (PV) Systems
- Article 695 Fire Pumps

**What about the remaining articles?**

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## Chapter 7: Special Conditions

How many of these 12 Articles do we really need to intuitively know exist?

- Article 700 Emergency Systems
- Article 701 Legally Required Standby Systems
- Article 702 Optional Standby Systems

**What about the remaining articles?**



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## Chapter 8: Communications Systems

How often do we really use this Chapter?

**Remember the guiding principle for using this Chapter?**



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## Chapter 9: Tables

How many of these 12 tables do we really need to intuitively know exist?

- Table 1 – Percent of Cross Section of Conduit and Tubing for Conductors
- Table 4 – Percent of Cross Section of Conduit and Tubing for specific raceways
- Table 5 – Dimensions of Insulated Conductor and Fixture Wires
- Table 8 – Conductor Properties

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## Chapter 9: Tables

How about the remaining tables?

**What is the guiding principle allowing the use of this Chapter?**



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**Annex Material – What is it and when is it permissible to use this material?**

Annex A ~ Product Safety Standards

Annex B ~ Application Information for Ampacity Calculation

**Annex C ~ Conduit and Tubing Fill Tables for Conductor and Fixture Wires of the Same Size**

**Annex D ~ Examples**

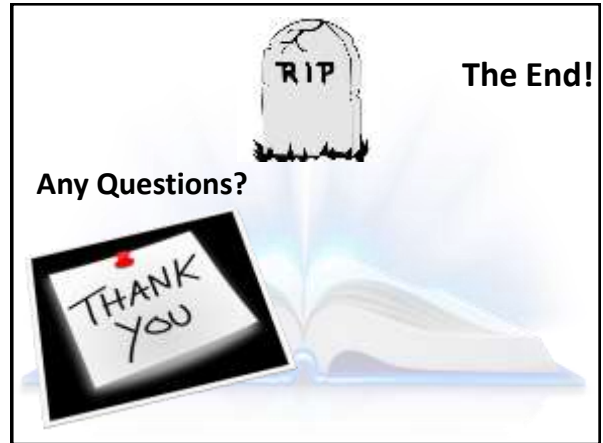
Annex E ~ Types of Construction

Annex F ~ COPS

Annex G ~ SCADA

Annex H ~ Administration and Enforcement

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# APPLICATION

## FOR Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.



## Board of Building Standards

6606 Tussing Road, P.O. Box 4009

Reynoldsburg, Ohio 43068-9009

(614) 644-2613 Fax: (614) 644-3147

dic.bbs@com.state.oh.us

www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER: **OHIO CERTIFICATE RENEWAL (OCR)**

Course Submitter: HAROLD PLANT ( by MAYDA SANCHEZ SHINGLER )

(Contact Name)

Organization: OHIO CERTIFICATE RENEWAL ( aka OCR )

(Organization/Company)

Address: P. O. BOX 211102

(Include Room Number, Suite, etc.)

City: COLUMBUS

State: OHIO

Zip: 43221-1102

E-Mail: halplant2112@outlook.com / mayda@ohiocertificate.com

Telephone: (614)451-9003

Fax: ALT MOBILE 614.395.9689

Course Sponsor: OHIO CERTIFICATE RENEWAL

### COURSE INFORMATION:

Course Title: How to Use the NEC (4)

New Course Submittal:

Update Course:

Prior Approval Number: \_\_\_\_\_

**Purpose and Objective:** INSTRUCTOR (J.D. WHITE / ALT - R J SCHUTZ / ALT Sam Cronk ) DIRECTED SEMINAR UTILIZING POWER POINT EITHER FROM CLASSROOM PLATFORM FOR ON-SITE PARTICIPANTS OR REMOTE INSTRUCTION VIA INTERNET E-LEARNING PLATFORM RELATING ELECTRICAL SYSTEMS DESIGN, INSTALLATION AND INSPECTION PRACTICES BY DIRECT REFERENCE TO THE LATEST EDITIONS OF THE OHIO BUILDING CODE (OBC) AND NFPA STANDARD 70 - NATIONAL ELECTRICAL CODE (NEC - 2020). Enable participants to better understand the scope, structure and use of the NEC.

Number of Instructional Contact Hours that can be obtained upon completion: 4.0

If Multi-Session, Number of Instructional Contact Hours Per Session: n/a

### Program Applicable for the Following Participants:

Building Official  Master Plans Examiner  Building Inspector  Fire Protection Inspector  Mechanical Inspector   
 Building Plans Exam.  Plumbing Inspector   
 Plumbing Plans Exam.  Non-Res IU Inspector   
 Electrical Plans Exam.   
 Mechanical Plans Exam.   
 Fire Protect. Plans Exam.

Res Building Official  Res Plans Examiner  Res Building Inspector  Res Mechanical Inspector  Res IU Inspector

Electrical Safety Inspectors

Location of ESI Course: OCR Classroom / Interactive Webinar

Date(s) of ESI Course(s): 06/25/2021

### SUBMITTAL CHECKLIST: Make Sure all of the Following Information is Submitted:

	Check Off
<b>Course Submitter:</b>	
Name of contact person and their certification numbers, organization, address, fax, phone	X
Organization sponsoring or requesting the program (if any)	X
<b>Course Title:</b>	
Name of course (related to content)	X
<b>Purpose/Objective:</b>	
Describe purpose and how course will improve competency of certification(s) listed	X
<b>Contact Hours:</b>	
Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	X
<b>Participants:</b>	
Check off each certification for which credit is requested (for which course relates to certification)	X
<b>Content of Program:</b>	
Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	X
<b>Course Materials:</b>	
Collated workbooks, handouts, hard copy or electronic versions of program is available	X
<b>Instructor(s) Info.:</b>	
Resume of professional/educational qualifications & teaching/training experience/BBS certifications	X
<b>Test Materials:</b>	
<b>Completed Application:</b>	X

**NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.**



# Ohio Certificate Renewal

(614) 451-9003

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



## How to Use the NEC

Outline Presented by Ohio Certificate Renewal

**Course Title:** How to Use the NEC

**Course Hours:** 4.0 Four 50-minute segments / Interactive Webinar or Classroom

**Course Description:** This course is designed for both the beginning Electrician and experienced Journeyman. It will familiarize both with the Definitions, as well as methods of locating specific information. Class participants will learn default rules and circumstances, which modify those rules. They will gain an appreciation of the National Electrical Codes' structure, tables, appendix, and index.

**Course Objective:** Enable class participants to better understand the scope and structure of the NEC. The course will familiarize participants on how to navigate the Chapters, Articles, and Sections. Participants will learn the importance of terms and definitions as well as how to find needed information within the NEC.

### Outline:

- |      |   |          |            |
|------|---|----------|------------|
| I.   | Why the NEC is a required Standard                                      | 7:30 AM  | 50 Minutes |
| II.  | How the NEC is structured Definitions, Chapters, Articles, and Sections |          | 50 Minutes |
| III. | How to apply the NEC  |          | 50 Minutes |
| IV.  | The necessity of learning and applying electrical fundamentals          |          |            |
| V.   | How to locate needed Information within the NEC Resources               |          | 50 Minutes |
| VI.  | When to use Supporting Resources, outside of the NEC                    |          |            |
| VII. | Q & A   | 11:20 AM |            |

# JD White

6048 Astor Avenue  
Columbus, OH 43232

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

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**Objective:** To provide timely and informative teaching relative to Electrical Theory/Fundamentals, Electrical Practices, and National Electric Code Compliance. Most teaching is geared for licensed contractors, architects, engineers, electrical inspectors, and electrician apprentices. I also provide Electrical Design and Drafting of small to moderate sized projects, using AutoCAD.

## Teaching Experience:

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

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

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

06/2020 – Present  
OCILB, BBS, 8 seminars per year  
Ohio Certificate Renewal 614-451-9003

# JD White

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## Trade & Other

### Experience:

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

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

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

09/1982 - 08/1989  
Delphos Wesleyan Church – Delphos, OH  
Mansfield Wesleyan Church – Mansfield, OH  
Title: Senior Pastor

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**

# Sam Cronk

**Sam Cronk** has extensive knowledge and experience with the interpretation and application of the National Electrical Code. Sam has been involved in all aspects of the residential, commercial, and industrial electrical industry since 1985. His previous employment includes work as an electrical foreman, project manager, and estimator. He has held numerous certifications and licenses including electrical journeyman by the State of South Carolina, journeyman wireman with the International Brotherhood of Electrical Workers (I.B.E.W.), and electrical contractor with the State of Ohio. Sam currently holds certifications as an Electrical Safety Inspector and Electrical Plans Examiner.



Sam has instructed a variety of adult education and professional continuing education classes, including with Columbus Public Schools, NECA-IBEW Joint Apprenticeship Training Committee (J.A.T.C.), International Association of Electrical Inspectors (I.A.E.I.), and the International Code Council (I.C.C.).

## Robert J. Schutz, P.E.

**Robert J. Schutz, P.E.** is the retired Chief Building Official of the City of Powell (OH) and is currently a Consulting Engineer serving as the contract Plans Examiner and Inspector for several municipalities in central Ohio. He is a civil engineering graduate of the Ohio Northern University with post-graduate studies at the Ohio State University and the University of Southern California.



Bob is a registered Professional Engineer and Professional Surveyor in the State of Ohio; where is also certified as a Building Official, Plans Examiner, Mechanical Inspector, Plumbing Inspector and Electrical Safety Inspector. Bob previously served as the Chief Engineer with the State of Ohio Health Department where he supervised the Plumbing Inspection program, was the Chairman of the Plumbing Advisory Board and was a member of the Ohio Board of Building Standards. Bob instructs nationally and internationally for the International Code Council (ICC), as well as for OCR on Mechanical, Fuel Gas, Plumbing and Building codes.

**File Attachments for Item:**

ER-2 Motor Circuits Article 430 (Ohio Certificate Renewal)

ESI, BO, MPE, BPE, EPE, BI, FPI, NRIUI, RBO, RPE, RBI, RIUI (4 hours)

Staff Notes:

ESIAC Recommendation:

Committee Recommendation:



## Motor Circuits Article 430

Ohio Certificate Renewal

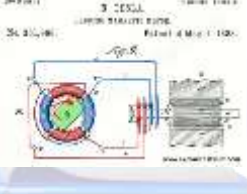
88

## So who invented the induction motor?

**Nikola Tesla (1856-1943)**

A physicist and prolific inventor whose many amazing contributions to science and technology have never been fully acknowledged. He was born to a Serbian family in Smiljan, then part of the Austrian Empire and now a part of Croatia. After he arrived in the United States at the age of 28, he began working for the famous electrical pioneer Thomas Edison. But the two men fell out disastrously and soon became bitter rivals. Tesla firmly believed that alternating current (AC) was far superior to direct current (DC), while Edison thought the opposite.

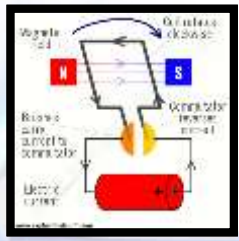
Tesla's patent, below, was granted in May 1888



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## How does an ordinary DC motor work?


In a DC motor, the magnet (and its magnetic field) is fixed in place and forms the outside, static part of the motor (the stator), while a coil of wire carrying the electric current forms the rotating part of the motor (the rotor). The magnetic field comes from the stator, which is a permanent magnet, while you feed the electric power to the coil that makes up the rotor. The interaction between the permanent magnetic field of the stator and the temporary magnetic field produced by the rotor is what makes the motor spin.



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## How does an AC induction motor work?

In an AC motor, there's a ring of electromagnets arranged around the outside (called the stator), which are designed to produce a rotating magnetic field. Inside the stator, there's a solid metal axle, a loop of wire, a coil, a squirrel cage made of metal bars and interconnections - like the rotating cages people sometimes get to amuse pet mice. The coils are energized in pairs, in sequence, producing a magnetic field that rotates around the outside of the motor.



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### How does this rotating field make the motor move?

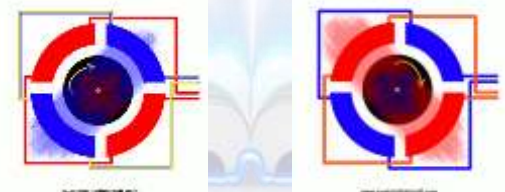
The rotor, suspended inside the magnetic field, is an electrical conductor. The magnetic field is constantly changing (because it's rotating) so, according to the laws of electromagnetism (Faraday's law, to be precise), the magnetic field produces (or induces, to use Faraday's own term) an electric current inside the rotor. The induced current produces its own magnetic field and, according to another law of electromagnetism (Lenz's law) tries to stop whatever it is that causes it—the rotating magnetic field—by rotating as well. (You can think of the rotor frantically trying to "catch up" with the rotating magnetic field in an effort to eliminate the difference in motion between them.) Electromagnetic induction is the key to why a motor like this spins—and that's why it's called an induction motor.

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### How does an AC induction motor work?

As the coils are energized, the magnetic field they produce between them induces an electric current in the rotor. This current produces its own magnetic field that tries to oppose the thing that caused it (the magnetic field from the outer coils).


As the magnetic field alternates between the red and blue coils, it effectively rotates around the motor. The rotating magnetic field makes the rotor spin in the same direction and (in theory) at almost the same speed.



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### Advantages of induction motors


The biggest advantage of AC induction motors is their sheer simplicity. They have only one moving part, the rotor, which makes them low-cost, quiet, long-lasting, and relatively trouble free. DC motors, by contrast, have a commutator and carbon brushes that wear out and need replacing from time to time. The friction between the brushes and the commutator also makes DC motors relatively noisy (and sometimes even quite smelly).



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### Disadvantages of induction motors

Since the speed of an induction motor depends on the frequency of the alternating current that drives it, it turns at a constant speed unless you use a variable-frequency drive; the speed of DC motors is much easier to control simply by turning the supply voltage up or down. Though relatively simple, induction motors can be fairly heavy and bulky because of their coil windings. Unlike DC motors, they can't be driven from batteries or any other source of DC power (solar panels, for example) without using an inverter (a device that turns DC into AC). That's because they need a changing magnetic field to turn the rotor.



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## Squirrel-Cage Rotor

A squirrel-cage rotor is the rotating part (rotor) used in the most common form of AC induction motor. It consists of a cylinder of steel with aluminum or copper conductors embedded in its surface. An electric motor with a squirrel-cage rotor is termed a squirrel-cage motor.



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## Wound Rotor Motor

A wound-rotor motor is a type of induction motor where the rotor windings are connected through slip rings to external resistances. Adjusting the resistance allows control of the speed/torque characteristic of the motor. Wound-rotor motors can be started with low inrush current, by inserting high resistance into the rotor circuit; as the motor accelerates, the resistance can be decreased.

Compared to a squirrel-cage rotor, the rotor of the slip ring motor has more winding turns; the induced voltage is then higher, and the current lower, than for a squirrel-cage rotor. An important advantage over squirrel-cage motors is higher starting torque.



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## Synchronous motor

A synchronous electric motor is an AC motor in which the rotation of the shaft is synchronized with the frequency of the supply current; the rotation period is exactly equal to an integral number of AC cycles. Synchronous motors contain multiphase AC electromagnets on the stator of the motor that create a magnetic field which rotates in time with the oscillations of the line current. The rotor with permanent magnets or electromagnets turns in step with the stator field at the same rate and as a result, provides the second synchronized rotating magnet field of any AC motor.

The difference between the two types is that the synchronous motor rotates in exact synchronism with the line frequency. The synchronous motor does not rely on current induction to produce the rotor's magnetic field. By contrast, the induction motor requires "slip", the rotor must rotate slightly slower than the AC current alternations, to induce current in the rotor winding.

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## 430.7(A) Marking on Motors and Multimotor Equipment.

A motor shall be marked with the following information:

1. Manufacturer's name.
2. Rated volts and full-load current. For a multispeed motor, full-load current for each speed, except shaded-pole and permanent-split capacitor motors where amperes are required only for maximum speed.
3. Rated frequency and number of phases if an ac motor.
4. Rated full-load speed.
5. Rated temperature rise or the insulation system class and rated ambient temperature.
6. Time rating. The time rating shall be 5, 15, 30, or 60 minutes, or continuous.
7. Rated horsepower if 1/8 hp or more. For a multispeed motor 1/8 hp or more, rated horsepower for each speed, except shaded-pole and permanent-split capacitor motors 1/8 hp or more where rated horsepower is required only for maximum speed. Motors of arc welders are not required to be marked with the horsepower rating.



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### 430.7(A) Marking on Motors and Multimotor Equipment.

A motor shall be marked with the following information (cont'd):

8. Code letter or locked-rotor amperes if an alternating-current motor rated 1/2 hp or more. On polyphase wound-rotor motors, the code letter shall be omitted. Informational Note: See 430.7(B).
9. Design letter for design B, C, or D motors.  
*Informational Note: Motor design letter definitions are found in ANSI/NEMA MG 1-1993, Motors and Generators, Part 1, Definitions, and in IEEE 100-1996, Standard Dictionary of Electrical and Electronic Terms.*
10. Secondary volts and full-load current if a wound-rotor induction motor.
11. Field current and voltage for dc excited synchronous motors.
12. Winding—straight shunt, stabilized shunt, compound, or series, if a dc motor. Fractional horsepower dc motors 175 mm (7 in.) or less in diameter shall not be required to be marked.
13. A motor provided with a thermal protector complying with 430.32(A)(2) or (B)(2) shall be marked "Thermally Protected." Thermally protected motors rated 100 watts or less and complying with 430.32(B)(2) shall be permitted to use the abbreviated marking "T.P."
14. A motor complying with 430.32(B)(4) shall be marked "Impedance Protected." Impedance-protected motors rated 100 watts or less and complying with 430.32(B)(4) shall be permitted to use the abbreviated marking "Z.P."
15. Motors equipped with electrically powered condensation prevention heaters shall be marked with the rated heater voltage, number of phases, and the rated power in watts.

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### 430.7(B) Marking on Motors and Multimotor Equipment

Locked-Rotor Indicating Code Letters. Code letters marked on motor nameplates to show motor input with locked rotor shall be in accordance with Table 430.7(B).

The code letter indicating motor input with locked rotor shall be in an individual block on the nameplate, properly designated.

*~ When AC motors are started with full voltage (Across-the-Line Starting), they draw line amperage 300% to 600% greater than their full load running current. The magnitude of the "inrush current" (also called locked rotor amps or LRA) is determined by motor horsepower and design characteristics.*



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### 430.7(B) Marking on Motors and Multimotor Equipment



Table 430.7(B) Locked-Rotor Indicating Code Letters

Code Letter	Kilovolt-Amperes per Horsepower with Locked Rotor
A	0-2.14
B	3.15-3.54
C	3.55-4.00
D	4.0-4.40
E	4.5-4.99
F	5.0-5.50
G	5.6-6.29
H	6.3-7.00
J	7.1-7.99
K	8.0-8.99
L	9.0-9.99
M	10.0-11.99
N	12-13.99
P	14-15.99
R	16.0-17.99
S	18.0-19.99
T	20.0-22.99
U	23.0-24.99
V	25.0 and up


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### 430.8 Marking on Controllers.

A controller shall be marked with the manufacturer's name or identification, the voltage, the current or horsepower rating, the short-circuit current rating, and other necessary data to properly indicate the applications for which it is suitable.



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### 430.12(E) Motor Terminal Housings


#### Equipment Grounding Connections.

A means for attachment of an equipment grounding conductor termination in accordance with 250.8 shall be provided at motor terminal housings for wire-to-wire connections or fixed terminal connections. The means for such connections shall be permitted to be located either inside or outside the motor terminal housing.

*Exception: Where a motor is installed as a part of factory-wired equipment that is required to be grounded and without additional connection being required at the motor terminal housing during equipment installation, a separate means for motor grounding at the motor terminal housing shall not be required.*

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### 430.12(E) Motor Terminal Housings



**250.8 Grounding and Bonding Connections**

(A) Permitted Methods. Equipment grounding conductors, grounding electrode conductors, and bonding jumpers shall be connected by one or more of the following means:

- Listed pressure connectors
- Terminal bars
- Pressure connectors listed as grounding and bonding equipment
- Machine screw-type fasteners engaging two threads minimum or secured by a nut
- Thread-forming screws engaging not less than two threads
- Electrode welding process
- Connectors part of listed assembly
- Other listed means


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### 430.14(A) Location of Motors

#### Ventilation and Maintenance.

Motors shall be located so that adequate ventilation is provided and so that maintenance, such as lubrication of bearings and replacing of brushes, can be readily accomplished.

*Exception: Ventilation shall not be required for submersible types of motors.*




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### 430.14(B) Location of Motors

#### Open Motors.

Open motors that have commutators or collector rings shall be located or protected so that sparks cannot reach adjacent combustible material.

*Exception: Installation of these motors on wooden floors or supports shall be permitted.*



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### 430.16 Exposure to Dust Accumulations.

In locations where dust or flying material collects on or in motors in such quantities as to seriously interfere with the ventilation or cooling of motors and thereby cause dangerous temperatures, suitable types of enclosed motors that do not overheat under the prevailing conditions shall be used.



*Informational Note: Especially severe conditions may require the use of enclosed pipe-ventilated motors, or enclosure in separate dusttight rooms, properly ventilated from a source of clean air.*



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### Wake-up!



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### Motor Circuit Conductors

#### 430.22 Single Motor.

Conductors that supply a single motor used in a continuous duty application shall have an ampacity of not less than 125 percent of the motor full-load current rating, as determined by 430.6(A)(1), or not less than specified in 430.22(A) through (G).



**Reciprocal of N**  
 $1 \div N$     A fraction  
 $N^{-1}$      $\frac{3}{4} \rightarrow \frac{4}{3}$

110

### Motor Circuit Conductors

#### 430.22 Single Motor...

- A. Direct-Current Motor-Rectifier Supplied
- B. Multispeed Motor.
- C. Wye-Start, Delta-Run Motor.
- D. Part-Winding Motor.
- E. Other Than Continuous Duty.
- F. Separate Terminal Enclosure.
- G. Conductors for Small Motors.



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## Motor Circuit Conductors

### 430.22(E) Other Than Continuous Duty.

Conductors for a motor used in a short-time, intermittent, periodic, or varying duty application shall have an ampacity of not less than the percentage of the motor nameplate current rating shown in Table 430.22(E), unless the authority having jurisdiction grants special permission for conductors of lower ampacity.



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## Motor Circuit Conductors

Table 430.22(E) Duty-Cycle Service

Type/Description of Service	Percentage Current Rating Percentage			
	5-Minute Rated Motor	10-Minute Rated Motor	20- & 30-Minute Rated Motor	Continuous Rated Motor
Short-time duty (starting motor, hoisting or lowering cable, etc.)	100	100	100	—
Intermittent duty (single and multiple circuits, test loads, pumps, compressors, load-lifts, etc. [for use with the 430.22(E)])	85	85	90	100
Periodic duty (hoists, cranes, saws, overhead cranes, etc.)	85	85	85	100
Varying duty	100	100	100	100

Note: Any motor application shall be considered as continuous duty unless the nature of the application is shown to mark that the motor will not operate continuously with load under any condition of use.

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S1	Continuous duty	The motor works at a constant load for enough time to reach temperature equilibrium.
S2	Short-time duty	The motor works at a constant load, but not long enough to reach temperature equilibrium. The rest periods are long enough for the motor to reach ambient temperature.
S3	Intermittent periodic duty	Sequential, identical run and rest cycles with constant load. Temperature equilibrium is never reached. Starting current has little effect on temperature rise.
S4	Intermittent periodic duty with starting	Sequential, identical start, run and rest cycles with constant load. Temperature equilibrium is not reached, but starting current affects temperature rise.
S5	Intermittent periodic duty with electric braking	Sequential, identical cycles of starting, running at constant load and running with no load. No rest periods.
S6	Continuous operation with intermittent load	Sequential, identical cycles of running with constant load and running with no load. No rest periods.
S7	Continuous operation with electric braking	Sequential identical cycles of starting, running at constant load and electric braking. No rest periods.
S8	Continuous operation with periodic changes in load and speed	Sequential, identical duty cycles run at constant load and given speed, then run at other constant loads and speeds. No rest periods.

**IEC**  
(the International Electrotechnical Commission) uses eight duty cycle designations to describe electrical motor operating conditions:

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## Motor Circuit Conductors

### 430.23 Wound-Rotor Secondary.

**A) Continuous Duty.** For continuous duty, the conductors connecting the secondary of a wound-rotor ac motor to its controller shall have an ampacity not less than 125 percent of the full-load secondary current of the motor.

**OR**

**B) Other Than Continuous Duty.** For other than continuous duty, these conductors shall have an ampacity, in percent of full-load secondary current, not less than that specified in Table 430.22(E).

**OR**

**C) Resistor Separate from Controller.** Where the secondary resistor is separate from the controller, the ampacity of the conductors between controller and resistor shall not be less than that shown in Table 430.23(C).

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## Motor Circuit Conductors

### 430.24 Several Motors or a Motor(s) and Other Load(s).

Conductors supplying several motors, or a motor(s) and other load(s), shall have an ampacity not less than the sum of each of the following:

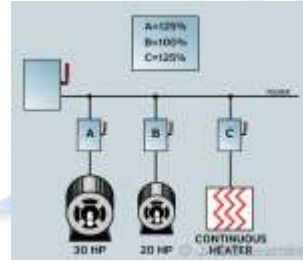
1. 125 percent of the full-load current rating of the highest rated motor, as determined by 430.6(A)
2. Sum of the full-load current ratings of all the other motors in the group, as determined by 430.6(A)
3. 100 percent of the noncontinuous non-motor load
4. 125 percent of the continuous non-motor load.

*Informational Note: See Informational Annex D, Example No. D8.*

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## Motor Circuit Conductors

**EXAMPLE**



Motor	FLC (A)	FLC (B)	FLC (C)	FLC (D)	FLC (E)	FLC (F)	FLC (G)	FLC (H)	FLC (I)	FLC (J)	FLC (K)	FLC (L)	FLC (M)	FLC (N)	FLC (O)	FLC (P)	FLC (Q)	FLC (R)	FLC (S)	FLC (T)	FLC (U)	FLC (V)	FLC (W)	FLC (X)	FLC (Y)	FLC (Z)														
M1	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150												
M2	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150											
M3	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150										
M4	3	5	7	10	13	17	21	26	31	36	41	46	51	56	61	66	71	76	81	86	91	96	101	106	111	116	121	126	131	136	141	146	151							
M5	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
M6	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
M7	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	15.5	16	16.5	17	17.5	18	18.5	19	19.5	20
M8	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.25	3.5	3.75	4	4.25	4.5	4.75	5	5.25	5.5	5.75	6	6.25	6.5	6.75	7	7.25	7.5	7.75	8	8.25	8.5	8.75	9	9.25	9.5	9.75	10

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## Motor Circuit Conductors

**Exception No. 1:** Where one or more of the motors of the group are used for short-time, intermittent, periodic, or varying duty, the ampere rating of such motors to be used in the summation shall be determined in accordance with 430.22(E). For the highest rated motor, the greater of either the ampere rating from 430.22(E) or the largest continuous duty motor full-load current multiplied by 1.25 shall be used in the summation.

**Exception No. 2:** The ampacity of conductors supplying motor-operated fixed electric space-heating equipment shall comply with 424.3(B).

**Exception No. 3:** Where the circuitry is interlocked so as to prevent simultaneous operation of selected motors or other loads, the conductor ampacity shall be permitted to be based on the summation of the currents of the motors and other loads to be operated simultaneously that results in the highest total current.

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## Motor Circuit Conductors

### 430.28 Feeder Taps.

Feeder tap conductors shall have an ampacity not less than that required by Part II, shall terminate in a branch-circuit protective device, and, in addition, shall meet one of the following requirements:

1. Be enclosed either by an enclosed controller or by a raceway, be not more than 3.0 m (10 ft) in length, and, for field installation, be protected by an overcurrent device on the line side of the tap conductor, the rating or setting of which shall not exceed 1000 percent of the tap conductor ampacity.
2. Have an ampacity of at least one-third that of the feeder conductors, be suitably protected from physical damage or enclosed in a raceway, and be not more than 7.5 m (25 ft) in length.
3. Have an ampacity not less than the feeder conductors.

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## Motor Circuit Conductors

**Exception:** Feeder taps over 7.5 m (25 ft) long. In high-bay manufacturing buildings [over 11 m (35 ft) high at walls], where conditions of maintenance and supervision ensure that only qualified persons service the systems, conductors tapped to a feeder shall be permitted to be not over 7.5 m (25 ft) long horizontally and not over 30.0 m (100 ft) in total length where all of the following conditions are met:

1. The ampacity of the tap conductors is not less than one-third that of the feeder conductors.
2. The tap conductors terminate with a single circuit breaker or a single set of fuses complying with (1) Part IV, where the load-side conductors are a branch circuit, or (2) Part V, where the load-side conductors are a feeder.
3. The tap conductors are suitably protected from physical damage and are installed in raceways.
4. The tap conductors are continuous from end-to-end and contain no splices.
5. The tap conductors shall be 6 AWG copper or 4 AWG aluminum or larger.
6. The tap conductors shall not penetrate walls, floors, or ceilings.
7. The tap shall not be made less than 9.0 m (30 ft) from the floor.

**EXCEPTION**

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## Ready For The Most Exciting Part?

first and foremost

121

## ARTICLE 100 Definitions

### Overcurrent -

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.

*Informational Note: A current in excess of rating may be accommodated by certain equipment and conductors for a given set of conditions.*

*Therefore, the rules for overcurrent protection are specific for particular situations.*



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## ARTICLE 100 Definitions

### Ground Fault -

An unintentional, electrically conductive connection between an ungrounded conductor of an electrical circuit and the normally non-current-carrying conductors, metallic enclosures, metallic raceways, metallic equipment, or earth.



123



## ARTICLE 100 Definitions

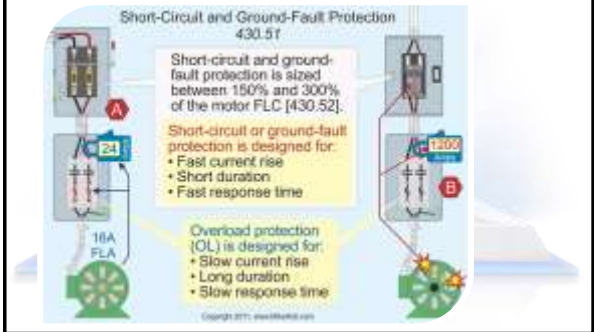
### Overload -

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.



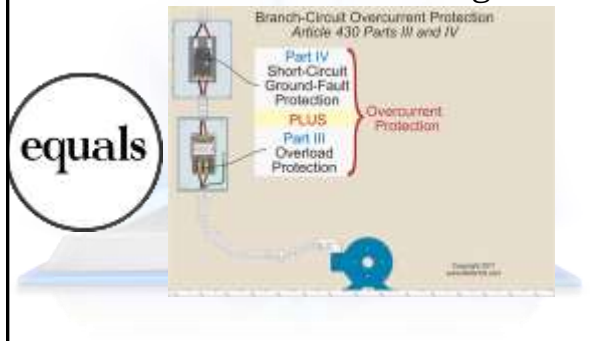
124

## Ground-fault or Short-circuit versus Overload Protection?



125

## When Both Are Combined Together?



126

## 430.6(A) Ampacity and Motor Rating Determination.

### General Motor Applications.

For general motor applications, current ratings shall be determined based on (A)(1) and (A)(2).

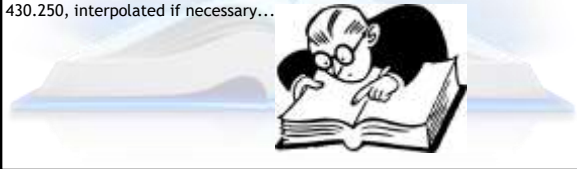


127

### 430.6(A)1 Ampacity and Motor Rating Determination.

**Table Values.**

...the values given in Table 430.247, Table 430.248, Table 430.249, and Table 430.250 shall be used to determine the ampacity of conductors or ampere ratings of switches, branch-circuit short-circuit and ground-fault protection, instead of the actual current rating marked on the motor nameplate. Where a motor is marked in amperes, but not horsepower, the horsepower rating shall be assumed to be that corresponding to the value given in Table 430.247, Table 430.248, Table 430.249, and Table 430.250, interpolated if necessary...



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### 430.6(A)2 Ampacity and Motor Rating Determination.

**Nameplate Values.**

Separate motor overload protection shall be based on the motor nameplate current rating.

129

### Motor and Branch-Circuit Overload Protection



**430.31 General.**

Part III specifies overload devices intended to protect motors, motor-control apparatus, and motor branch-circuit conductors against excessive heating due to motor overloads and failure to start.

*Informational Note No. 1: See Informative Annex D, Example No. D8.*

*Informational Note No. 2: See the definition of Overload in Article 100.*

These provisions shall not require overload protection where a power loss would cause a hazard, such as in the case of fire pumps.

*Informational Note: For protection of fire pump supply conductors, see 695.7.*

The provisions of Part III shall not apply to motor circuits rated over 1000 volts, nominal.

*Informational Note: For over 1000 volts, nominal, see Part XI.*

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### Motor and Branch-Circuit Overload Protection

**430.32(A) Continuous-Duty Motors More Than 1 Horsepower.**

Each motor used in a continuous duty application and rated more than 1 HP shall be protected against overload by one of the means in 430.32(A)(1) through (A)(4).

...Based Off Type Of Protection Being Provided...Lets See What I Mean...Ready?



131

## Motor and Branch-Circuit Overload Protection

### 430.32(A)1 Separate Overload Device.

A separate overload device that is responsive to motor current. This device shall be selected to trip or shall be rated at no more than the following percent of the motor nameplate full-load current rating:

Motors with a marked service factor 1.15 or greater	125%
Motors with a marked temperature rise 40 °C or less	125%
All other motors	115%

Modification of this value shall be permitted as provided in 430.32(C).



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## Motor and Branch-Circuit Overload Protection

### 430.32(A)2 Thermal Protector.

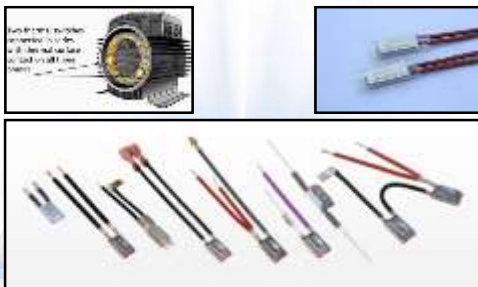
A thermal protector integral with the motor, approved for use with the motor it protects on the basis that it will prevent dangerous overheating of the motor due to overload and failure to start. The ultimate trip current of a thermally protected motor shall not exceed the following percentage of motor full-load current given in Table 430.248, Table 430.249, and Table 430.250:

Motor full-load current 9 amperes or less	170%
Motor full-load current from 9.1 to, and including, 20 amperes	156%
Motor full-load current greater than 20 amperes	140%

*If the motor current-interrupting device is separate from the motor and its control circuit is operated by a protective device integral with the motor, it shall be arranged so that the opening of the control circuit will result in interruption of current to the motor.*

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## Motor Thermal Protector



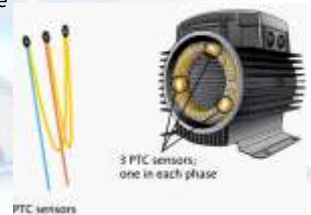
134

## Motor and Branch-Circuit Overload Protection

### 430.32(A)3 Integral with Motor.

A protective device integral with a motor that will protect the motor against damage due to failure to start shall be permitted if the motor is part of an approved assembly that does not normally subject the motor to overloads.

- Thermal switches  
CANNOT protect against  
locked- rotor  
conditions.



135

### And Then If That's Not Big Enough...

**430.32(C) Selection of Overload Device.**

Where the sensing element or setting or sizing of the overload device selected in accordance with 430.32(A)(1) and 430.32(B)(1) is **not sufficient** to start the motor or to carry the load, higher size sensing elements or incremental settings or sizing shall be permitted to be used, provided the trip current of the overload device does not exceed the following percentage of motor nameplate full-load current rating:

Motors with marked service factor 1.15 or greater	140%
Motors with a marked temperature rise 40 °C or less	140%
All other motors	130%

*If not shunted during the starting period of the motor as provided in 430.35, the overload device shall have sufficient time delay to permit the motor to start and accelerate its load.*



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### Motor Branch-Circuit Short-Circuit and Ground-Fault Protection

**430.51 General.**

Part IV specifies devices intended to protect the motor branch-circuit conductors, the motor control apparatus, and the motors against overcurrent due to short circuits or ground faults. These rules add to or amend the provisions of Article 240. The devices specified in Part IV do not include the types of devices required by 210.8, 230.95, and 590.6.

*Informational Note: See Informative Annex D, Example D8.*



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### Motor Branch-Circuit Short-Circuit and Ground-Fault Protection

**430.52 Rating or Setting for Individual Motor Circuit.**

A. General. The motor branch-circuit short-circuit and ground-fault protective device shall comply with 430.52(B) and either 430.52(C) or (D), as applicable.



138

### Motor Branch-Circuit Short-Circuit and Ground-Fault Protection

**430.52(B) All Motors.**

The motor branch-circuit short-circuit and ground-fault protective device **shall be** capable of carrying the starting current of the motor.



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## Motor Branch-Circuit Short-Circuit and Ground-Fault Protection

### 430.52(C) Rating or Setting.

1. In Accordance with Table 430.52.
2. Overload Relay Table.
3. Instantaneous Trip Circuit Breaker.
4. Multispeed Motor.
5. Power Electronic Devices.
6. Self-Protected Combination Controller.
7. Motor Short-Circuit Protector.



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## Motor Branch-Circuit Short-Circuit and Ground-Fault Protection

Table 430.52 Minimum Rating or Setting of Motor Branch-Circuit Short-Circuit and Ground-Fault Protective Devices

Type of Motor	Percentage of Full-Load Current			
	Inrush Current (Locked Rotor)	Starting Current	Overload Relay	Instantaneous Trip
AC polyphase motor	175	115	115	115
AC polyphase motor with overload relay	175	115	115	115
DC motor	175	115	115	115
DC motor with overload relay	175	115	115	115
DC motor with instantaneous trip	175	115	115	115
DC motor with overload relay and instantaneous trip	175	115	115	115



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## And Then If That's Not Big Enough Still...

### 430.52(C)1

*Exception No. 1: Where the values for branch-circuit short-circuit and ground-fault protective devices determined by Table 430.52 do not correspond to the standard sizes or ratings of fuses, nonadjustable circuit breakers, thermal protective devices, or possible settings of adjustable circuit breakers, a higher size, rating, or possible setting that does not exceed the next higher standard ampere rating shall be permitted.*



### 240.6 Standard Ampere Ratings.

#### A) Fuses and Fixed-Trip Circuit Breakers.

The standard ampere ratings for fuses and inverse time circuit breakers shall be considered 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250, 300, 350, 400, 450, 500, 600, 700, 800, 1000, 1200, 1600, 2000, 2500, 3000, 4000, 5000, and 6000 amperes. Additional standard ampere ratings for fuses shall be 1, 2, 6, 10, and 501. The use of fuses and inverse time circuit breakers with nonstandard ampere ratings shall be permitted.

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## And Then If That's Not Big Enough Still...

*Exception No. 2: Where the rating specified in Table 430.52, or the rating modified by Exception No. 1, is not sufficient for the starting current of the motor:*

- A. The rating of a nontime-delay fuse not exceeding 600 amperes or a time-delay Class CC fuse shall be permitted to be increased but shall in no case exceed 400 percent of the full-load current.
- B. The rating of a time-delay (dual-element) fuse shall be permitted to be increased but shall in no case exceed 225 percent of the full-load current.
- C. The rating of an inverse time circuit breaker shall be permitted to be increased but shall in no case exceed 400 percent for full-load currents of 100 amperes or less or 300 percent for full-load currents greater than 100 amperes.
- D. The rating of a fuse of 601-6000 ampere classification shall be permitted to be increased but shall in no case exceed 300 percent of the full-load current.



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## Motor Branch-Circuit Short-Circuit and Ground-Fault Protection

### 430.52(D) Torque Motors.

Torque motor branch circuits shall be protected at the motor nameplate current rating in accordance with 240.4(B).

- A torque motor is a specialized form of electric motor which can operate indefinitely while stalled, that is, with the rotor blocked from turning, without incurring damage. In this mode of operation, the motor will apply a steady torque to the load (hence the name).



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## Motor Branch-Circuit Short-Circuit and Ground-Fault Protection

### 430.53 Several Motors or Loads on One Branch Circuit.

Two or more motors or one or more motors and other loads shall be permitted to be connected to the same branch circuit under conditions specified in 430.53(D) and in 430.53(A), (B), or (C). The branch-circuit protective device shall be fuses or inverse time circuit breakers.

- Simply too much information to try to cover in this class but be aware of the fact that it can be done if and only if you adhere to the identified requirements.



145

## Motor Feeder Short-Circuit and Ground-Fault Protection

### 430.61 General.

Part V specifies protective devices intended to protect feeder conductors supplying motors against overcurrents due to short circuits or grounds.

*Informational Note: See Informative Annex D, Example D8.*

See also...

430.62 Rating or Setting – (A) Specific Load

430.62 Rating or Setting – (B) Other Installations

430.63 Rating or Setting – Motor Load and Other Load(s).

- Again simply too much information to try to cover this class but be aware of the fact that it can be done if and only if you adhere to the identified requirements.



146


## Motor Disconnecting Means

### 430.102 Location.

**B) Motor.** A disconnecting means shall be provided for a motor in accordance with (B)(1) or (B)(2).


- 1. Separate Motor Disconnect.** A disconnecting means for the motor shall be located in sight from the motor location and the driven machinery location.
- 2. Controller Disconnect.** The controller disconnecting means required in accordance with 430.102(A) shall be permitted to serve as the disconnecting means for the motor if it is in sight from the motor location and the driven machinery location.

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## Definitions Article 100

**In Sight From (Within Sight From, Within Sight).**  
 Where this Code specifies that one equipment shall be “in sight from,” “within sight from,” or “within sight of,” and so forth, another equipment, the specified equipment is to be visible and not more than 15 m (50 ft) distant from the other.




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## Motor Disconnecting Means

**Exception to (1) and (2):** The disconnecting means for the motor shall not be required under either condition (a) or condition (b), which follow, provided that the controller disconnecting means required in 430.102(A) is lockable in accordance with 110.25.


- A. Where such a location of the disconnecting means for the motor is impracticable or introduces additional or increased hazards to persons or property **Informational Note:** Some examples of increased or additional hazards include, but are not limited to, motors rated in excess of 100 hp, multimotor equipment, submersible motors, motors associated with adjustable speed drives, and motors located in hazardous (classified) locations.
- B. In industrial installations, with written safety procedures, where conditions of maintenance and supervision ensure that only qualified persons service the equipment



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## Motor Disconnecting Means


**430.103 Operation.**  
 The disconnecting means shall open all ungrounded supply conductors and shall be designed so that no pole can be operated independently. The disconnecting means shall be permitted in the same enclosure with the controller. The disconnecting means shall be designed so that it cannot be closed automatically.



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## Motor Disconnecting Means

**430.104 To Be Indicating.**  
 The disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position.



151

## Motor Disconnecting Means

### 430.107 Readily Accessible.

At least one of the disconnecting means shall be readily accessible.

#### Accessible, Readily (Readily Accessible).

Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to actions such as to use tools, to climb over or remove obstacles, or to resort to portable ladders, and so forth.



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## Motor Disconnecting Means

### 430.109 Type.

The disconnecting means shall be a type specified in 430.109(A), unless otherwise permitted in 430.109(B) through (G), under the conditions specified.

#### A) General.

1. Motor Circuit Switch.
2. Molded Case Circuit Breaker.
3. Molded Case Switch.
4. Instantaneous Trip Circuit Breaker.
5. Self-Protected Combination Controller.
6. Manual Motor Controller.
7. System Isolation Equipment.

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## Motor Disconnecting Means

### 430.109 Type.

The disconnecting means shall be a type specified in 430.109(A), unless otherwise permitted in 430.109(B) through (G), under the conditions specified.

- A. B Stationary Motors of 1/8 Horsepower or Less.
- B. C Stationary Motors of 2 Horsepower or Less.
- C. D Autotransformer-Type Controlled Motors
- D. E Isolating Switches.
- E. F Cord-and-Plug-Connected Motors.
- F. G Torque Motors.

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## Motor Grounding

### 430.241 General.

Part XIII specifies the grounding of exposed non-current-carrying metal parts, likely to become energized, of motor and controller frames to prevent a voltage aboveground in the event of accidental contact between energized parts and frames. Insulation, isolation, or guarding are suitable alternatives to grounding of motors under certain conditions.



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## Motor Grounding

### 430.242 Stationary Motors.

The frames of stationary motors shall be grounded under any of the following conditions:

1. Where supplied by metal-enclosed wiring
2. Where in a wet location and not isolated or guarded
3. If in a hazardous (classified) location
4. If the motor operates with any terminal at over 150 volts to ground

Where the frame of the motor is not grounded, it shall be permanently and effectively insulated from the ground.

156

## 430.245 Method of Grounding

### A. Grounding Through Terminal Housings.

Where the wiring to motors is metal-enclosed cable or in metal raceways, junction boxes to house motor terminals shall be provided, and the armor of the cable or the metal raceways shall be connected to them in the manner specified in 250.96(A) and 250.97.

### B. Separation of Junction Box from Motor.

The junction box required by 430.245(A) shall be permitted to be separated from the motor by not more than 1.8 m (6 ft), provided the leads to the motor are stranded conductors within Type AC cable...

157

## 250.122 Size of Equipment Grounding Conductors

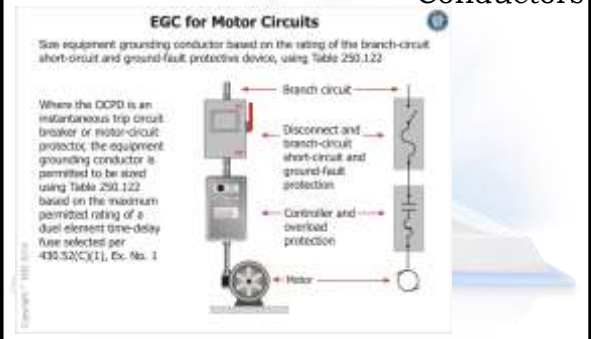
### D) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (D)(1) or (D)(2).

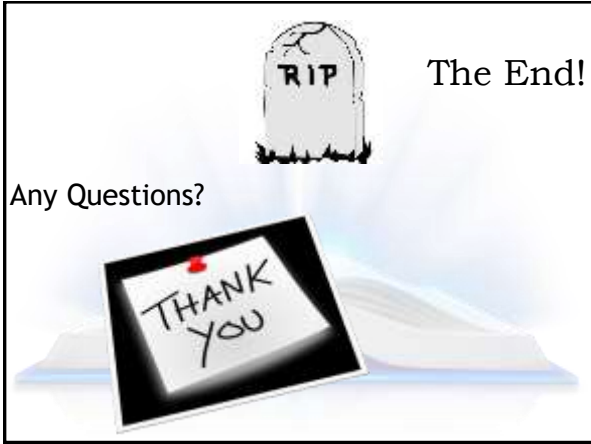
1. **General.** The equipment grounding conductor size shall not be smaller than determined by 250.122(A) based on the rating of the branch-circuit short-circuit and ground-fault protective device.
2. **Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.** Where the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by 250.122(A) using the maximum permitted rating of a dual element time-delay fuse selected for branch-circuit short-circuit and ground-fault protection in accordance with 430.52(C)(1), Exception No. 1.

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## 250.122 Size of Equipment Grounding Conductors



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# APPLICATION

## FOR Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.



## Board of Building Standards

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(Organization/Company)

Address: P. O. BOX 211102

(Include Room Number, Suite, etc.)

City: COLUMBUS

State: OHIO

Zip: 43221-1102

E-Mail: halplant2112@outlook.com / mayda@ohiocertificate.com

Telephone: (614)451-9003

Fax: ALT MOBILE 614.395.9689

Course Sponsor: OHIO CERTIFICATE RENEWAL

### COURSE INFORMATION:

Course Title: Motor Circuits Article 430 (4)

New Course Submittal:

Update Course:

Prior Approval Number: \_\_\_\_\_

**Purpose and Objective:** INSTRUCTOR (J.D. WHITE / ALT - R J SCHUTZ / ALT Sam Cronk ) DIRECTED SEMINAR UTILIZING POWER POINT EITHER FROM CLASSROOM PLATFORM FOR ON-SITE PARTICIPANTS OR REMOTE INSTRUCTION VIA INTERNET E-LEARNING PLATFORM RELATING ELECTRICAL SYSTEMS DESIGN, INSTALLATION AND INSPECTION PRACTICES BY DIRECT REFERENCE TO THE LATEST EDITIONS OF THE NFPA STANDARD 70 -NATIONAL ELECTRICAL CODE (NEC - 2020).

Enable participants to better understand the OCPD, conductor sizing, raceway type and size and how to determine feeder sizing for multiple motors.

Number of Instructional Contact Hours that can be obtained upon completion: 4.0

If Multi-Session, Number of Instructional Contact Hours Per Session: n/a

### Program Applicable for the Following Participants:

Building Official  Master Plans Examiner  Building Inspector  Fire Protection Inspector  Mechanical Inspector   
 Building Plans Exam.  Plumbing Inspector   
 Plumbing Plans Exam.  Non-Res IU Inspector   
 Electrical Plans Exam.   
 Mechanical Plans Exam.   
 Fire Protect. Plans Exam.

Res Building Official  Res Plans Examiner  Res Building Inspector  Res Mechanical Inspector  Res IU Inspector

Electrical Safety Inspectors

Location of ESI Course: OCR Classroom / Interactive Webinar

Date(s) of ESI Course(s): 06/25/2021

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:

	Check Off
<b>Course Submitter:</b>	Name of contact person and their certification numbers, organization, address, fax, phone
	Organization sponsoring or requesting the program (if any)
<b>Course Title:</b>	Name of course (related to content)
<b>Purpose/Objective:</b>	Describe purpose and how course will improve competency of certification(s) listed
<b>Contact Hours:</b>	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)
<b>Participants:</b>	Check off each certification for which credit is requested (for which course relates to certification)
<b>Content of Program:</b>	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered
<b>Course Materials:</b>	Collated workbooks, handouts, hard copy or electronic versions of program is available
<b>Instructor(s) Info.:</b>	Resume of professional/educational qualifications & teaching/training experience/BBS certifications
<b>Test Materials:</b>	
<b>Completed Application:</b>	

**NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.**

## Ohio Certificate Renewal

(614) 451-9003

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



## Motor Circuits Article 430

Outline Presented by Ohio Certificate Renewal

**Course Hours:** 4.0 Four 50-minute segments / Interactive Webinar or Classroom

**Course Description:** A course designed to instruct on the NEC requirements for wiring and protecting Motors, Conductors, and Related Equipment. NEC Article 430 and related sections will be leveraged for instruction of providing aforementioned items.

**Course Objective:** To enable the learner a better understanding of the NEC requirements for conductor sizing, raceway type and size and how to determine feeder sizing for multiple motors. Students will understand the functions of OCPD as well as how to determine OCPD type and size.

### Outline:

I.	FLC vs FLA	7:30 AM	50 Minutes
II.	Conductor Sizing Requirements		
III.	Raceway Type and Size		50 Minutes
IV.	Equipment Grounding Conductor Size		
V.	Functions of OCPD		50 Minutes
VI.	Determining OCPD Type and Size		
VII.	Determining Feeder Size for Multiple Motors		50 Minutes
VIII.	Q & A	11:20 AM	

# JD White

6048 Astor Avenue  
Columbus, OH 43232

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

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**Objective:** To provide timely and informative teaching relative to Electrical Theory/Fundamentals, Electrical Practices, and National Electric Code Compliance. Most teaching is geared for licensed contractors, architects, engineers, electrical inspectors, and electrician apprentices. I also provide Electrical Design and Drafting of small to moderate sized projects, using AutoCAD.

## Teaching Experience:

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

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

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

06/2020 – Present  
OCILB, BBS, 8 seminars per year  
Ohio Certificate Renewal 614-451-9003

# JD White

6048 Astor Avenue  
Columbus, OH 43232

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

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## Trade & Other

### Experience:

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

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

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

09/1982 - 08/1989  
Delphos Wesleyan Church – Delphos, OH  
Mansfield Wesleyan Church – Mansfield, OH  
Title: Senior Pastor

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

# JD White

6048 Astor Avenue  
Columbus, OH 43232

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

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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**

# Sam Cronk

**Sam Cronk** has extensive knowledge and experience with the interpretation and application of the National Electrical Code. Sam has been involved in all aspects of the residential, commercial, and industrial electrical industry since 1985. His previous employment includes work as an electrical foreman, project manager, and estimator. He has held numerous certifications and licenses including electrical journeyman by the State of South Carolina, journeyman wireman with the International Brotherhood of Electrical Workers (I.B.E.W.), and electrical contractor with the State of Ohio. Sam currently holds certifications as an Electrical Safety Inspector and Electrical Plans Examiner.



Sam has instructed a variety of adult education and professional continuing education classes, including with Columbus Public Schools, NECA-IBEW Joint Apprenticeship Training Committee (J.A.T.C.), International Association of Electrical Inspectors (I.A.E.I.), and the International Code Council (I.C.C.).



## Robert J. Schutz, P.E.

**Robert J. Schutz, P.E.** is the retired Chief Building Official of the City of Powell (OH) and is currently a Consulting Engineer serving as the contract Plans Examiner and Inspector for several municipalities in central Ohio. He is a civil engineering graduate of the Ohio Northern University with post-graduate studies at the Ohio State University and the University of Southern California.



Bob is a registered Professional Engineer and Professional Surveyor in the State of Ohio; where is also certified as a Building Official, Plans Examiner, Mechanical Inspector, Plumbing Inspector and Electrical Safety Inspector. Bob previously served as the Chief Engineer with the State of Ohio Health Department where he supervised the Plumbing Inspection program, was the Chairman of the Plumbing Advisory Board and was a member of the Ohio Board of Building Standards. Bob instructs nationally and internationally for the International Code Council (ICC), as well as for OCR on Mechanical, Fuel Gas, Plumbing and Building codes.

**File Attachments for Item:**

ER-3 Plan Examiner Monthly Round Table (Columbus)

All Certifications (12 session of one hour each)

Staff Notes: Round Table, no slides

Committee Recommendation:

**From:** Richardson, James A. <[JARichardson@columbus.gov](mailto:JARichardson@columbus.gov)>

**Sent:** Tuesday, March 09, 2021 3:23 PM

**To:** Lane, Michael <[Michael.Lane@com.state.oh.us](mailto:Michael.Lane@com.state.oh.us)>

**Subject:** RE: City of Columbus CEU Course Submission for Monthly Plan Examiner Roundtable

Michael,

Thank you for the response and assistance, if you'd like me to amend the Jan form and resubmit I can do that. As far as an outline, I may need some guidance on how to write that up. After speaking with Mark Heckenmuller, he is the Supervisor for the plan examination staff, he indicated he'd like to be able to have these sessions and base them on some typical plan discrepancies/errors that have been made during plan review and are identified by the inspectors during an inspection. In some cases, the Supervisor from the different inspection trades would put together a presentation based on those discrepancies/errors to better educate our plan examination staff in an effort to get the best plan examination possible. Potentially we could have any number of moderators/presenters, or if you just want to identify a single "moderator", that would be Mark Heckenmuller in my opinion. I can have him provide me with a bio and experience to forward to you.

What are your thoughts?

Regards,

*James A. Richardson Jr.*, CPD

**City of Columbus**

Building and Zoning Services

Plumbing Inspection Supervisor

[plumbinginfo@columbus.gov](mailto:plumbinginfo@columbus.gov)

<http://www.columbus.gov/bzs/inspections/Plumbing/>



DEPARTMENT OF BUILDING  
AND ZONING SERVICES

**Mark A. Heckenmueller, P.E.**  
2137 Sawgrass Street  
Grove City, OH 43123  
Mobile: (513) 680-0688; Work: (614) 645-1887  
Email: mheckenmueller@gmail.com

## **PROFESSIONAL EXPERIENCE**

**Supervisor of Commercial Plans Examiners, PEIII**, City of Columbus Department of Building and Zoning Services, July 2020 - present.

**Chief Building Official (CBO)**, City of Mason Engineering and Building Department, Mason, Ohio, 2014-2020

**Master Plans Examiner and Building Inspector**, City of Mason Engineering and Building Department, Cincinnati, Ohio, June 2006 - Present

**Master Plans Examiner**, Hamilton County Department of Building Inspections (HCDBI), Cincinnati, Ohio, February 2002-June 2006

**Project Team Leader and Structural Engineer**, PEDCo E & A Services, Inc., Consulting Engineers, Cincinnati, Ohio, May 1992 to February 2002

## **ACADEMIC EXPERIENCE**

**Master of Science**, University of Cincinnati, 1992  
Major: Civil Engineering with emphasis on Structural Design  
Teaching and Research Assistant, University of Cincinnati, 1990-1992.

**Bachelor of Science**, University of Cincinnati, 1990  
Major: Civil Engineering with emphasis on Structural Design  
Ranked 4 in a class of 34.  
Golden Key National Honor Society.

## **CERTIFICATIONS/LICENSES**

Professional Engineer, P.E. in the State of Ohio, No. E-60445  
Building Official, Ohio Board of Building Standards (OBBS), No. 612  
Master Plans Examiner, OBBS No. 612  
Building Inspector, OBBS No. 612  
Residential Building Official, OBBS No. 612



## **CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS**

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

**Instructors:** Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications 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 shall not disclose improper approval information to the public.

**Course sponsors/co-sponsors:** 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.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

**Participants:** Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

**Board approval:** Remains in effect during the current code edition. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

**Facility/training area:** Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

# APPLICATION

FOR

## Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.



## Board of Building Standards

6606 Tussing Road, P.O. Box 4009

Reynoldsburg, Ohio 43068-9009

(614) 644-2613 Fax: (614) 644-3147

dic.bbs@com.state.oh.us

www.com.state.oh.us/dic/dicbbs.htm

COURSE SUBMITTER:

Course Submitter: Mark Heckenmueller

(Contact Name)

Organization: City of Columbus

(Organization/Company)

Address: 111 N. Front St.

(Include Room Number, Suite, etc.)

City: Columbus

State: OH

Zip: 43215

E-Mail: maheckenmuller@columbus.gov

Telephone: 614-645-1887

Fax: \_\_\_\_\_

Course Sponsor: \_\_\_\_\_

COURSE INFORMATION:

Course Title: Plan Examiner Monthly Roundtable

New Course Submittal:  Update Course:  Prior Approval Number: \_\_\_\_\_

**Purpose and Objective:** Monthly meeting to discuss common issues related to plan approval related to the specific trades. Each sessions will be based on plan discrepancies/errors that have been made during plan review and are identified by the inspectors during an inspection. In some cases, the Supervisor from the different inspection trades will put together a presentation based on those discrepancies/errors to better educate our plan examination staff in an effort to get the best plan examination possible.

Number of Instructional Contact Hours that can be obtained upon completion: 1

If Multi-Session, Number of Instructional Contact Hours Per Session: 12 sessions - 1 CEU for each

Program Applicable for the Following Participants:

Building Official  Master Plans Examiner  Building Inspector  Fire Protection Inspector  Mechanical Inspector   
 Plumbing Plans Exam.  Plumbing Inspector   
 Electrical Plans Exam.  Non-Res IU Inspector   
 Mechanical Plans Exam.

Res Building Official  Res Plans Examiner  Res Building Inspector  Res Mechanical Inspector  Res IU Inspector

Electrical Safety Inspectors

Location of ESI Course: \_\_\_\_\_ Date(s) of ESI Course(s): \_\_\_\_\_

SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:

	Check Off
<b>Course Submitter:</b> Name of contact person and their certification numbers, organization, address, fax, phone	<input checked="" type="checkbox"/>
<b>Course Sponsor:</b> Organization sponsoring or requesting the program (if any)	<input checked="" type="checkbox"/>
<b>Course Title:</b> Name of course (related to content)	<input checked="" type="checkbox"/>
<b>Purpose/Objective:</b> Describe purpose and how course will improve competency of certification(s) listed	<input checked="" type="checkbox"/>
<b>Contact Hours:</b> Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	<input checked="" type="checkbox"/>
<b>Participants:</b> Check off each certification for which credit is requested (for which course relates to certification)	<input checked="" type="checkbox"/>
<b>Content of Program:</b> Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	<input checked="" type="checkbox"/>
<b>Course Materials:</b> Collated workbooks, handouts, hard copy or electronic versions of program is available	<input checked="" type="checkbox"/>
<b>Instructor(s) Info.:</b> Resume of professional/educational qualifications & teaching/training experience/BBS certifications	<input checked="" type="checkbox"/>
<b>Test Materials:</b> Copy of quizzes or tests to be given	<input checked="" type="checkbox"/>
<b>Completed Application:</b>	<input checked="" type="checkbox"/>

**NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.**

**File Attachments for Item:**

ER-4 Cincinnati Inspector Cross Training Part 1 (BFCA)

Provider: Building and Fire Code Academy

RBI, RMI (1 three hour session)

Staff Notes: The series of courses is intended to cross train City of Cincinnati property maintenance inspectors and residential building inspectors. Part 1 is the intro - 3 hour course.

Committee Recommendation:

**B F C A**®

Building & Fire Code Academy

**WELCOME!**



# BFC A<sup>®</sup>

## Building & Fire Code Academy

### City of Cincinnati Inspection Cross Training ©

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### Part 1 - Introduction

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2021

## Learning Objectives / Learning Outcomes

Students will to explain the scope an intent of the training program.

Students will compare and contrast the position of residential inspector with the position of property maintenance inspector.

The student will be able to explain the layout and purpose of the International Property Maintenance Code and the Residential Code of Ohio.



## ◆ Curriculum Content

- \* Part 1 – Introduction
- \* Part 2 – 2018 International Property Maintenance Code
- \* Part 3 – 2019 Residential Code of Ohio – Building Planning and Construction
- \* Part 4 – 2019 Residential Code of Ohio – Mechanical
- \* Part 5 – Residential framing and Soil reports

## ◆ Purpose of Curriculum

- \* Cross train inspectors
  - Property maintenance inspectors as residential building inspectors
  - Residential building inspectors as property maintenance inspectors
- \* Assist in the development of staff for the City of Cincinnati
- \* Explain the code requirements for each

## ◆ Course layout

- \* Tuesday and Thursday
- \* 8:30 – 11:30 1st session
- \* 1:00 – 4:00 2nd session
- \* Mid-session break
- \* Same content each daily session (AM verse PM)
- \* Time each day for questions or real time situations
- \* Send pictures for discussion at a future class session

- \* Discussion during class
  - Encouraged
  - Ask questions

## ◆ Course materials

- \* Workbook - City of Cincinnati Inspection Cross Training
  - Will expand as additional information is added
- \* 2018 International Property Maintenance Code
- \* 2019 Residential Code of Ohio
- \* Handouts, problems for use in class

## ◆ Instructors

- \* Richard A. Piccolo - Master Code Official
- \* Ken Garrett – Master Code Official
- \* Greg Sengstock – Illinois licensed architect



## ◆ Course layout

- \* Lecture format using a work book with a power presentation as an instructional tool
- \* Work book and power point utilize pictures and drawing to illustrate the code
- \* Problems and case studies will be used to reinforce knowledge

# ◆ First code International Property Maintenance Code

**April 6** Class 1 – General description of the program, explanation of the different jobs including differences and similarities, legal aspects of right of entry for each

**April 8** Class 2 - IPMC Chapters 1, 2, & start of Chapter 3

**April 13** Class 3 - Complete Chapter 3, Chapter 4

**April 15** Class 4 - Case studies Chapter 5

**April 20** Class 5 - Chapters 6 and 7, Group Case studies

## ◆ Second code Residential Code of Ohio – Building Chapters

**April 22** Class 6 – Overview of Code, Chapter 1, Chapter 2, start Chapter 3 Administration, Definitions, & Building planning

**April 27** Class 7 - Chapter 3 Building planning

**April 29** Class 8 - Chapter 3 Building planning

**May 4** Class 9 - Chapter 4, start Chapter 5 Foundations, & floors

**May 6** Class 10 - Chapter 6 and Chapter 7 Walls, wall coverings

**May 11** Class 11 - Chapter 8, 9, 10 Roofs, roof-ceilings, Chimneys and fireplaces

## ◆ Second code - Residential Code of Ohio – Mechanical Chapters

**May 13** Class 12 - Chapter 12, 13 - Administration, general mechanical systems

**May 18** Class 13 – Chapters 14, 15 - Heating and cooling, equipment, exhaust systems

**May 20** Class 14 – Chapters 16, 17, 18, 19 Duct construction, combustion air, chimneys and vents Special appliances

**May 25** Class 15 - Chapter 20, 21, 22, 23, 24 Boilers, hydronic piping, special piping, solar, fuel gas

- May 27*    Class 18 - Complete fuel gas, case studies and problems
- June 1*    Class 19 – General framing
- June 3*    Class 20 – Soil reports , additional problems and additional case studies

# Position of Property Maintenance Inspector

- ◆ Property maintenance inspections
  - \* Respond to complaints
    - Make a list of typical complaints

- \* Perform random or scheduled PM inspections in your district
- \* Includes Concentrated Code Enforcement (CCE)
  - Make a list of typical violations





# Position of Residential Building Inspector

- ◆ Residential building inspector
  - \* Perform called inspections
    - Make a list of typical called inspections
  
- ◆ See attached list of inspections

- \* Perform status inspections
  - Inspect progress of project
  
- \* Other inspections as assigned
  - Make a list of other inspections performed

# Position of Residential Mechanical Inspector

- ◆ Residential mechanical inspector
  - \* Perform called inspections
    - Make a list of typical called inspections

- \* Perform status inspections
  - Inspect progress of project
  
- \* Other inspections as assigned
  - Make a list of other inspections performed

## ◆ Property Maintenance Inspector verse residential inspector

### ◆ Similarities

- \* Assigned to a District
- \* Municipal employees
- \* Enforce a code
- \* Both have ICC certifications available
- \* Understand their inspection role

- \* Knowledge of the applicable code/codes
- \* Act as an educator
- \* Possess good people skills

- \* Similar missions
  - Protect health, safety and quality of life of:
  - People who live, work or play within the City
  - Provide safe housing
    - Residential inspector - safe construction
    - PM Inspector Maintain construction, sanitary conditions
- \* Re-inspect when there are violations or no compliance

## ◆ Differences

### \* Building Inspector

- Enforce one edition of the code
- Are called to the site for the inspection by contractor or owner
  - Person requesting the inspection needs the inspector to continue
- Inspect new construction
- Work cannot progress without an inspection approval
- Work from a list of required inspections ie;
  - Footings, foundations, floors, walls, roughs
  - See attached list of inspections
  - Let's review the list



- Have specific requirements for compliance ie:
  - Bored holes to large, improper anchor bolt spacing, proper treads and risers
- Inspector's decisions:
  - Does it comply with the code
    - Building / mechanical
  - Can occupancy be allowed
- Works from a set of plans

- \* Property maintenance inspector
  - Enforce one edition of the IPMC but have knowledge of previous editions
    - Decide which code requirements to follow
    - Decide – would a repair comply
    - Decide – How compliance can be achieved
  - Are on site because of complaints or CCE

- Most cases the owner or agent is not aware of the upcoming inspection
- In some cases the person being inspected can be uncooperative
- Inspect existing buildings
- Inspector decides if the structure is safe to occupy
- Consider inspector safety
- Does not work from a set of plans

\* Types of Code Enforcement Inspections

- Initial – within 5 days of receiving the complaint
- Service of Notice – post if no contact within 10 days
- Compliance inspection – after the expiration of the compliance dead line
- Pre-prosecution hearing inspection – day before hearing
- Final notice inspection at the end of any extensions
- Pre-civil fine hearing – before fine hearing

- Final inspection – when all work complete
- No pre-established list of items to inspect
  - May work from a property maintenance inspection checklist
- Focus on the complaint Requirements for compliance may vary ie:
  - Repair handrail or replace handrail
- Inspector's decision may be more practical
  - Always correct a hazardous situation

- \* Other Code Enforcement Inspections – Special programs
  - Tax Abatement Maintenance Inspections
  - Vacant Foreclosed Residential Property Registration
  - DSS and DNS Surveys
    - Decent, safe and Sanitary – 10 item list
  - Fire Escape Examinations

- Zoning Condition Inspection
- Police Liaison Inspection
- Residential Rental Property Inspections (RRI)
- Residential Rental Registration (RRR)
- Single Incident Emergency Call Out

## ◆ Inspection approach and skills

- \* Customer service
- \* As an educator
- \* As a good listener
- \* Property Maintenance Inspector
  - Problem solver
  - Resource for tenants, landlords and property owners
- \* Building inspector
  - Expert knowledge of the IRC



## ◆ Right of entry

### \* Building inspector

- To perform an inspection
  - All areas subject to the permit
  - Example duplex where one unit is being renovated
- Probable cause to believe a hazard exists
- Reasonable times

- If occupied - Proper credentials
- If unoccupied – attempt to contact owner or their representative
- If an addition
  - Only areas covered by or affected by the permit
- If refused follow local procedure

\* Property Maintenance Inspector

- To perform an inspection to enforce provisions of the code
  - Entry can be refused
- Probable cause to believe a hazard exists
- Reasonable times
- If occupied - Proper credentials
- If unoccupied – attempt to contact owner or their representative
- If refused follow local procedure

- Where can the property maintenance inspector legally go:
  - Public sidewalk
  - Sidewalk to front door unless blocked by a fence with signage
  - Into the building if allowed
  - Only to areas allowed
  - View into the back yard if unobstructed and no extraordinary means
    - Can view from neighbors yard or house if allowed
  - Public or common areas in an apartment
  - Storage rooms if allowed by tenant

- Where can the property maintenance inspector not legally go:
  - On the property without permission
  - Look through windows
  - Anywhere where extraordinary means are required
  - Boiler rooms, maintenance areas
  - Roommates bedroom

- \* Who can allow entry
  - Anyone who is in control
    - Owner or their agent
  - Over 18 years of age
    - Make sure they have the authority
- \* Pictures can be taken with permission

- \* What if you are asked to leave?
- \* Inspection reporting
  - City of Cincinnati forms
- \* Inspection procedures
  - Established by the City

## ◆ Layout of the Codes

### \* Preface

- Basic on code adoption and the process
- Marginal Markings in Property Maintenance Code
  - Vertical line in margin – something changed
  - Arrow – something deleted
  - Single and double asterisk something moved
- Marginal markings not in Residential Code of Ohio
  - Difference from base code - italics



- \* Effective use of the code – explanation of each chapter – both codes
- \* Table of Contents
- \* Text of the code
  - Includes chapter on referenced standards
- \* Appendix or appendices in the IPMC
  - Not part of the code
  - Have to be adopted
  - Not in the Residential Code of Ohio
- \* Index

- ◆ Preparing for the next six class sessions
  - \* Read or review the International Property Maintenance Code
  - \* Write down any questions for class discussion

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Questions?

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## Building & Fire Code Academy

**Website:** [bfcacademy.com](http://bfcacademy.com)

**Email:** [info@bfcacademy.com](mailto:info@bfcacademy.com)

**Voice:** (800) 488-7057 (847) 428-2951

**Fax:** (847) 428-2911



## **CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS**

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

**Instructors:** Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications 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 shall not disclose improper approval information to the public.

**Course sponsors/co-sponsors:** 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.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

**Participants:** Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

**Board approval:** Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

**Facility/training area:** Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

# APPLICATION

## FOR Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.



### Board of Building Standards

6606 Tussing Road, P.O. Box 4009

Reynoldsburg, Ohio 43068-9009

(614) 644-2613 Fax: (614) 644-3147

dic.bbs@com.state.oh.us

www.com.state.oh.us/dic/dicbbs.htm

#### COURSE SUBMITTER:

Course Submitter: George Sweeney  
(Contact Name)  
 Organization: Building and Fire Code Academy  
(Organization/Company)  
 Address: 2420 Vantage Drive  
(Include Room Number, Suite, etc.)  
 City: Elgin State: IL Zip: 60124  
 E-Mail: GSweeney@bfcacademy.com  
 Telephone: (847) 428-2951 Fax: (847) 428-2911  
 Course Sponsor: Richard A. Piccolo, Building and Fire Code Academy

#### COURSE INFORMATION:

Course Title: City of Cincinnati Cross Training Program - Introduction

New Course Submittal:  Update Course:  Prior Approval Number: \_\_\_\_\_

**Purpose and Objective:** The City will be cross training the Residential and Property Maintenance Inspectors. This introductory program will be used to introduce the current inspector into the program. It will expose them to the roles of each inspector. It will include the required inspection with an explanation of each code and how it is applied.

Number of Instructional Contact Hours that can be obtained upon completion: 3

If Multi-Session, Number of Instructional Contact Hours Per Session: NA

#### Program Applicable for the Following Participants:

Building Official  Master Plans Examiner  Building Inspector  Fire Protection Inspector  Mechanical Inspector   
 Building Plans Exam.  Plumbing Inspector   
 Plumbing Plans Exam.  Non-Res IU Inspector   
 Electrical Plans Exam.   
 Mechanical Plans Exam.   
 Fire Protect. Plans Exam.

Res Building Official  Res Plans Examiner  Res Building Inspector  Res Mechanical Inspector  Res IU Inspector

Electrical Safety Inspectors   
 Location of ESI Course: \_\_\_\_\_ Date(s) of ESI Course(s): \_\_\_\_\_

SUBMITTAL CHECKLIST: <b>Make Sure</b> all of the Following Information is <b>Submitted</b> :		Check Off
<b>Course Submitter:</b>	Name of contact person and their certification numbers, organization, address, fax, phone	
	Organization sponsoring or requesting the program (if any)	
<b>Course Title:</b>	Name of course (related to content)	
<b>Purpose/Objective:</b>	Describe purpose and how course will improve competency of certification(s) listed	
<b>Contact Hours:</b>	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
<b>Participants:</b>	Check off each certification for which credit is requested (for which course relates to certification)	
<b>Content of Program:</b>	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
<b>Course Materials:</b>	Collated workbooks, handouts, hard copy or electronic versions of program is available	
<b>Instructor(s) Info.:</b>	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
<b>Test Materials:</b>		
<b>Completed Application:</b>		

**NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.**

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## Building & Fire Code Academy

### City of Cincinnati Inspection Cross Training ©

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### Part 1 - Introduction

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2021

## Learning Objectives / Learning Outcomes

Students will to explain the scope an intent of the training program.

Students will compare and contrast the position of residential inspector with the position of property maintenance inspector.

The student will be able to explain the layout and purpose of the International Property Maintenance Code and the Residential Code of Ohio.



## ◆ Curriculum Content

- \* Part 1 – Introduction
- \* Part 2 – 2018 International Property Maintenance Code
- \* Part 3 – 2019 Residential Code of Ohio – Building Planning and Construction
- \* Part 4 – 2019 Residential Code of Ohio – Mechanical
- \* Part 5 – Residential framing and Soil reports

## ◆ Purpose of Curriculum

- \* Cross train inspectors
  - Property maintenance inspectors as residential building inspectors
  - Residential building inspectors as property maintenance inspectors
- \* Assist in the development of staff for the City of Cincinnati
- \* Explain the code requirements for each

## ◆ Course layout

- \* Tuesday and Thursday
- \* 8:30 – 11:30 1st session
- \* 1:00 – 4:00 2nd session
- \* Mid-session break
- \* Same content each daily session (AM verse PM)
- \* Time each day for questions or real time situations
- \* Send pictures for discussion at a future class session

- \* Discussion during class
  - Encouraged
  - Ask questions

## ◆ Course materials

- \* Workbook - City of Cincinnati Inspection Cross Training
  - Will expand as additional information is added
- \* 2018 International Property Maintenance Code
- \* 2019 Residential Code of Ohio
- \* Handouts, problems for use in class

## ◆ Instructors

- \* Richard A. Piccolo - Master Code Official
- \* Ken Garrett – Master Code Official
- \* Greg Sengstock – Illinois licensed architect



## ◆ Course layout

- \* Lecture format using a work book with a power presentation as an instructional tool
- \* Work book and power point utilize pictures and drawing to illustrate the code
- \* Problems and case studies will be used to reinforce knowledge

# ◆ First code International Property Maintenance Code

**April 6** Class 1 – General description of the program, explanation of the different jobs including differences and similarities, legal aspects of right of entry for each

**April 8** Class 2 - IPMC Chapters 1, 2, & start of Chapter 3

**April 13** Class 3 - Complete Chapter 3, Chapter 4

**April 15** Class 4 - Case studies Chapter 5

**April 20** Class 5 - Chapters 6 and 7, Group Case studies

## ◆ Second code Residential Code of Ohio – Building Chapters

**April 22** Class 6 – Overview of Code, Chapter 1, Chapter 2, start Chapter 3 Administration, Definitions, & Building planning

**April 27** Class 7 - Chapter 3 Building planning

**April 29** Class 8 - Chapter 3 Building planning

**May 4** Class 9 - Chapter 4, start Chapter 5 Foundations, & floors

**May 6** Class 10 - Chapter 6 and Chapter 7 Walls, wall coverings

**May 11** Class 11 - Chapter 8, 9, 10 Roofs, roof-ceilings, Chimneys and fireplaces

## ◆ Second code - Residential Code of Ohio – Mechanical Chapters

**May 13** Class 12 - Chapter 12, 13 - Administration, general mechanical systems

**May 18** Class 13 – Chapters 14, 15 - Heating and cooling, equipment, exhaust systems

**May 20** Class 14 – Chapters 16, 17, 18, 19 Duct construction, combustion air, chimneys and vents Special appliances

**May 25** Class 15 - Chapter 20, 21, 22, 23, 24 Boilers, hydronic piping, special piping, solar, fuel gas

- May 27** Class 18 - Complete fuel gas, case studies and problems
- June 1** Class 19 – General framing
- June 3** Class 20 – Soil reports , additional problems and additional case studies

# Position of Property Maintenance Inspector

- ◆ Property maintenance inspections
  - \* Respond to complaints
    - Make a list of typical complaints

- \* Perform random or scheduled PM inspections in your district
- \* Includes Concentrated Code Enforcement (CCE)
  - Make a list of typical violations

- \* Other assigned inspections
  - Make a list of other inspections

- \* Other functions
  - Attend court or adjudication hearings
  - Other duties as signed



# Position of Residential Building Inspector

- ◆ Residential building inspector
  - \* Perform called inspections
    - Make a list of typical called inspections
  
- ◆ See attached list of inspections

- \* Perform status inspections
  - Inspect progress of project
  
- \* Other inspections as assigned
  - Make a list of other inspections performed

# Position of Residential Mechanical Inspector

- ◆ Residential mechanical inspector
  - \* Perform called inspections
    - Make a list of typical called inspections

- \* Perform status inspections
  - Inspect progress of project
  
- \* Other inspections as assigned
  - Make a list of other inspections performed

## ◆ Property Maintenance Inspector verse residential inspector

### ◆ Similarities

- \* Assigned to a District
- \* Municipal employees
- \* Enforce a code
- \* Both have ICC certifications available
- \* Understand their inspection role

- \* Knowledge of the applicable code/codes
- \* Act as an educator
- \* Possess good people skills

- \* Similar missions
  - Protect health, safety and quality of life of:
  - People who live, work or play within the City
  - Provide safe housing
    - Residential inspector - safe construction
    - PM Inspector Maintain construction, sanitary conditions
- \* Re-inspect when there are violations or no compliance

## ◆ Differences

- \* Building Inspector
  - Enforce one edition of the code
  - Are called to the site for the inspection by contractor or owner
    - Person requesting the inspection needs the inspector to continue
  - Inspect new construction
  - Work cannot progress without an inspection approval
  - Work from a list of required inspections ie;
    - Footings, foundations, floors, walls, roughs
    - See attached list of inspections
    - Let's review the list



- Have specific requirements for compliance ie:
  - Bored holes to large, improper anchor bolt spacing, proper treads and risers
- Inspector's decisions:
  - Does it comply with the code
    - Building / mechanical
  - Can occupancy be allowed
- Works from a set of plans

- \* Property maintenance inspector
  - Enforce one edition of the IPMC but have knowledge of previous editions
    - Decide which code requirements to follow
    - Decide – would a repair comply
    - Decide – How compliance can be achieved
  - Are on site because of complaints or CCE

- Most cases the owner or agent is not aware of the upcoming inspection
- In some cases the person being inspected can be uncooperative
- Inspect existing buildings
- Inspector decides if the structure is safe to occupy
- Consider inspector safety
- Does not work from a set of plans

\* Types of Code Enforcement Inspections

- Initial – within 5 days of receiving the complaint
- Service of Notice – post if no contact within 10 days
- Compliance inspection – after the expiration of the compliance dead line
- Pre-prosecution hearing inspection – day before hearing
- Final notice inspection at the end of any extensions
- Pre-civil fine hearing – before fine hearing

- Final inspection – when all work complete
- No pre-established list of items to inspect
  - May work from a property maintenance inspection checklist
- Focus on the complaint Requirements for compliance may vary ie:
  - Repair handrail or replace handrail
- Inspector's decision may be more practical
  - Always correct a hazardous situation

- \* Other Code Enforcement Inspections – Special programs
  - Tax Abatement Maintenance Inspections
  - Vacant Foreclosed Residential Property Registration
  - DSS and DNS Surveys
    - Decent, safe and Sanitary – 10 item list
  - Fire Escape Examinations

- Zoning Condition Inspection
- Police Liaison Inspection
- Residential Rental Property Inspections (RRI)
- Residential Rental Registration (RRR)
- Single Incident Emergency Call Out

## ◆ Inspection approach and skills

- \* Customer service
- \* As an educator
- \* As a good listener
- \* Property Maintenance Inspector
  - Problem solver
  - Resource for tenants, landlords and property owners
- \* Building inspector
  - Expert knowledge of the IRC



## ◆ Right of entry

### \* Building inspector

- To perform an inspection
  - All areas subject to the permit
  - Example duplex where one unit is being renovated
- Probable cause to believe a hazard exists
- Reasonable times

- If occupied - Proper credentials
- If unoccupied – attempt to contact owner or their representative
- If an addition
  - Only areas covered by or affected by the permit
- If refused follow local procedure

\* Property Maintenance Inspector

- To perform an inspection to enforce provisions of the code
  - Entry can be refused
- Probable cause to believe a hazard exists
- Reasonable times
- If occupied - Proper credentials
- If unoccupied – attempt to contact owner or their representative
- If refused follow local procedure

- Where can the property maintenance inspector legally go:
  - Public sidewalk
  - Sidewalk to front door unless blocked by a fence with signage
  - Into the building if allowed
  - Only to areas allowed
  - View into the back yard if unobstructed and no extraordinary means
    - Can view from neighbors yard or house if allowed
  - Public or common areas in an apartment
  - Storage rooms if allowed by tenant

- Where can the property maintenance inspector not legally go:
  - On the property without permission
  - Look through windows
  - Anywhere where extraordinary means are required
  - Boiler rooms, maintenance areas
  - Roommates bedroom

- \* Who can allow entry
  - Anyone who is in control
    - Owner or their agent
  - Over 18 years of age
    - Make sure they have the authority
- \* Pictures can be taken with permission

- \* What if you are asked to leave?
- \* Inspection reporting
  - City of Cincinnati forms
- \* Inspection procedures
  - Established by the City

## ◆ Layout of the Codes

### \* Preface

- Basic on code adoption and the process
- Marginal Markings in Property Maintenance Code
  - Vertical line in margin – something changed
  - Arrow – something deleted
  - Single and double asterisk something moved
- Marginal markings not in Residential Code of Ohio
  - Difference from base code - italics



- \* Effective use of the code – explanation of each chapter – both codes
- \* Table of Contents
- \* Text of the code
  - Includes chapter on referenced standards
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**RICHARD A. PICCOLO**

Master Code Professional

PRESIDENT

B & F CONSTRUCTION CODE SERVICES, INC.  
BUILDING & FIRE CODE ACADEMY

**CERTIFICATIONS**

- |                                   |  |
|-----------------------------------|--|
| Certified Building Official       | Certified Property Maintenance Inspector |
| Certified Fire Official II        | Certified Plans Examiner                 |
| Certified Fire Fighter III        | Certified Building Inspector             |
| ICC® Certified Fire Inspector     | Certified Fire Service Instructor IV     |
| Illinois Certified Fire Inspector | Certified Energy Inspector               |
| Certified Accessibility Inspector | Certified Master Code Professional       |

**AUTHOR/  
INSTRUCTOR**

- Understanding the International Building Code (2000, 2003, 2006, 2009, 2012)
- Understanding the International Fire Code (2000, 2003, 2006, 2009, 2012)
- Fire Resistive Construction Requirements
- Understanding Non Structural Plan Review
- Understanding the International Mechanical Code (2006, - 2012)
- Understanding the International Plumbing Code –(2009 – 2012)
- Kitchen Hood and Duct System Plan Review
- Understanding the BOCA® National Building Code (1990 – 1999)
- Advanced Decision Making
- Managing Special Events
- Sprinkler System Plan Review
- Understanding the 1990 – 1999 BOCA® National Fire Prevention Code
- Understanding the 1996 – 1999 BOCA® National Building Code
- Understanding the 2002 – 2012 NFPA 101

**INSTRUCTOR**

- 1984 BOCA® Fire Prevention Code
- National Certification For Construction Code Inspectors Workshop
- Fire Prevention Principles - Levels I & II
- Principles of the 1987 BOCA® National Building Code
- Principles of the 1984 BOCA® National Building Code

**ADJUNCT FACULTY**

- William Rainey Harper College – Palatine, IL (1984 – 1999)
- Course Title: BOCA® National Building Code
- Course Title: Basic Code Enforcement
- Course Title: Fire Inspection Principles

**BACKGROUND**

Elk Grove Village Fire Department – 19 Years  
Public Education Office  
President, Illinois Institutional Fire Training, Inc. 23 Years

**EDUCATION &  
TRAINING**

Northeastern University B.A.  
Harper College, Palatine IL A.S. Fire Science  
240 Hour Inspectors Training Course  
Fire Instructor Training: Levels I & II

**COURT CERTIFIED  
CODE EXPERT**

Designated Court Certified expert on Building Codes in 1995  
*Provided trial testimony for the County of Kankakee, IL (Plaintiff) in County of Kankakee vs Tim Harrington, U.S. District Court No. 940 V 134*

*Provided deposition for Village of Schiller Park, IL (Plaintiff), Village of Schiller Park vs SP Club, Inc. U.S. District Court No. 94 C 1422*

*Deposition for Village of Addison (Defendant), Hispanics of United DuPage County vs Village of Addison, IL U.S. District Court 94 C 6075 & 95 C 3926*

*Deposition for Village of Good Field, IL (Defendant), Clark v. Village of Good Field, et al., Case No. 03 L 96*

*Deposition for Charles Gaston, Jr. (Plaintiff), Charles Gaston v. City of Danville, et al., Case No.06 L 35*

**PROFESSIONAL  
AFFILIATIONS**

North West Building Officials Association  
Suburban Building Officials  
National Fire Protection Association (NFPA)  
International Association of Continuing Education & Training (IACET)  
Illinois Fire Inspectors Association  
Chairman, Codes and Standards Committee 1983 - Current

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CLASSES**

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Pennsylvania  
Ohio Fire Academy  
AIA Presentation w/National Gypsum Association  
Army Corps of Engineers

**MILITARY SERVICE**

US Army 2 years – Honorable Discharge

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/2015-international-codes-and-references.html)

Certified Professional Information:

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 Certified under this name: Richard Piccolo  
 Company: B & F Construction Code Services Inc  
 City, State Zip: Elgin, IL 60124-7867  
 Phone: 847-428-7010

- Certification Type(s): Accessibility Inspector/Plans Examiner (expires 06/29/2018)  
 Building Inspector (expires 06/29/2018)  
 Building Plans Examiner (expires 06/29/2018)  
 Commercial Building Inspector (expires 06/29/2018)  
 Commercial Energy Inspector (expires 06/29/2018)  
 Commercial Energy Plans Examiner (expires 06/29/2018)  
 Fire Inspector I (expires 06/29/2018)  
 Fire Prevention I - NFPC (expires 06/29/2018)  
 ICC/AACE Property Maintenance & Housing Inspector (expires 06/29/2018)  
 Master Code Professional (expires 06/29/2018)

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**BUILDING & FIRE PROTECTION PLAN REVIEW**  
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## Kenneth J. Garrett

### BACKGROUND

Kenneth J. Garrett has been employed by B & F Construction Code Services for 17 years as Vice President and Instructor. Ken is responsible for managing the daily operation of B & F Construction Code Services, Inc. and is positioned to provide leadership, guidance and effect teamwork for the technical staff. Ken reviews training materials, outlines and objectives for existing and new curriculum, for both internal training and classes offered externally. He develops new outlines, objectives and learning outcomes for new curriculum for company courses and serves as an instructor for Academy courses. Ken, in conjunction with the President of B & F Construction Code Services, Inc., oversees the current and future operation of training services provided by the company and shall evaluate the effectiveness and instructional technique of instructors.

Prior to working at B & F Construction Code Services, Ken was employed by the City of Zion, IL as the Assistant Director of Community Development. Ken was responsible for overseeing all functions of the building department, supervising a staff of nine employees.

### EDUCATION / TRAINING

- 2012 Master's Degree – Public Administration, Governors State University
- 1995 Bachelor's Degree- Public Administration, Governors State University
- 1990 Code Enforcement Certificate Program, William Rainey Harper College
- 1983 Associate Degree- Fire Science Technology, William Rainey Harper College

### CERTIFICATIONS / LICENSES / REGISTRATIONS

Certified as a Master Code Professional through the International Code Council

### PREVIOUS TEACHING / TRAINING EXPERIENCE

#### Author and Instructor

Understanding the International Property Maintenance Code  
Understanding the Basics of Code Enforcement  
Management I and II  
Inspection Challenges & Solutions

#### Instructor

Understanding the International Residential Code  
Understanding the International Residential Code-Plan Review  
Understanding the International Building Code – Parts I, II, III  
Understanding the International Fire Code  
Understanding the International Mechanical & Fuel Gas Codes  
Fire Resistive Construction Requirements

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Certification and Testing (<http://www.iccsafe.org/education-certification/certification-and-testing/>)



(<https://shop.iccsafe.org/codes>)

/2015-international-codes-and-references.html)

Certified Professional Information:

Last, First MI: Garrett, Kenneth J  
 Certified under this name: Kenneth J Garrett  
 City, State Zip: Palatine, IL 60195-2089  
 Certification Type(s): Accessibility Inspector/Plans Examiner (expires 08/26/2017)  
 Building Inspector (expires 08/26/2017)  
 Certified Building Official (expires 08/26/2017)  
 Commercial Building Inspector (expires 08/26/2017)  
 Commercial Energy Inspector (expires 08/26/2017)  
 Master Code Professional (expires 08/26/2017)  
 Residential Energy Inspector/Plans Examiner (expires 08/26/2017)

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## Gregory D. Sengstock

(630) 770-5348

1037 Ash Street, St. Charles, IL 60174

Greg@SengstockArchitects.com

Licensed Architect with a wide variety of residential and light commercial experience. Able to create and document cost-efficient, practical designs resulting in high client satisfaction. Results-oriented, creative problem-solver.

### Industry Experience

**Architectural Firms**, 12 years experience including:

Sengstock Architects, Owner / Architect

OKW Architects, Senior Architect

Bloodgood Sharp Buster Architects and Planners, Project Architect

Nelson Associates Architects, Job Captain

**Homebuilders / Remodeling**, 15 years experience including:

Greenscape Homes, Director of Architecture

Airoom Architects and Builders, Project Architect

Pinehurst Homes, Director of Architecture and Construction

Town and Country Homes, Director of Architecture

Pulte Home Corporation, Assistant Director of Architecture

Neumann Homes, Project Architect

**Environmental Engineering and Education**, 6 years experience including:

Building & Fire Code Academy, Adjunct Instructor

Westwood College, Adjunct Instructor

Law Associates, Staff Architect

University of Illinois, Teaching Assistant

### Education

Master of Architecture, University of Illinois, May 1989

Master of Business Administration, University of Illinois, May 1989

Bachelor of Science, Architectural Studies, University of Illinois, May 1986

Continuing Education including:

Value Engineering

Sales and Construction techniques

Building Science / Quality Management

Green Building and Energy Conservation

Hiring, Teambuilding, and Supervisory skills

Code Updates



Gregory D. Sengstock is a Licensed Architect in private practice with a wide variety of residential and light commercial experience. As proprietor of Sengstock Architects, Greg specializes in the design of new custom and production homes, additions, accessibility renovations, disaster remediation, and commercial build-outs. With over 30 years of experience working with large and small builders and architectural firms, he has an in-depth understanding of project program scope creation, efficient yet elegant design, construction documentation, building codes, and construction permitting. As an effective project manager and team leader, Greg has simultaneously guided multiple developments from several clients. His interest in Value Engineering reduces building costs while Green Building and Building Science techniques have reduced operational and maintenance costs for his clients. Greg has been responsible for dozens of Key Award winning projects.

Greg earned his Bachelor of Science, Architectural Studies as well as Master of Architecture and Master of Business Administration degrees from the University of Illinois. He is an Adjunct Instructor at the Building & Fire Code Academy and has taught courses in the Construction Management program at Westwood College. He has been a Professional Member of the Association of Licensed Architects and the International Code Council. Greg lives in St. Charles, IL with his wife and two children.

**File Attachments for Item:**

ER-5 Cincinnati Inspector Cross Training Part 2 (BFCA)

Provider: Building and Fire Code Academy

RBI, RMI (4 three hour sessions)

Staff Notes: The series of courses is intended to cross train City of Cincinnati property maintenance inspectors and residential building inspectors. This portion is focused on the International Property Maintenance Code, which is not Ohio Code.

Committee Recommendation:

## Part 2 Session Break Down

12 hours of instructional time The class will be instructed in 3-hour sessions.

Session 1 IPMC Chapters 1, 2 and 3

Session 2 IPMC Complete Chapter 3

Session 3 IPMC Chapters Complete 5

Session 4 IPMC Chapters 6 and 7



## **CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS**

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

**Instructors:** Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications 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 shall not disclose improper approval information to the public.

**Course sponsors/co-sponsors:** 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.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

**Participants:** Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

**Board approval:** Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

**Facility/training area:** Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

# APPLICATION

FOR

## Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.



## Board of Building Standards

6606 Tussing Road, P.O. Box 4009

Reynoldsburg, Ohio 43068-9009

(614) 644-2613 Fax: (614) 644-3147

dic.bbs@com.state.oh.us

www.com.state.oh.us/dic/dicbbs.htm

### COURSE SUBMITTER:

Course Submitter: George Sweeney

(Contact Name)

Organization: Building and Fire Code Academy

(Organization/Company)

Address: 2420 Vantage Drive

(Include Room Number, Suite, etc.)

City: Elgin

State: IL

Zip: 60124

E-Mail: GSweeney@bfcacademy.com

Telephone: (847) 428-2951

Fax: (847) 428-2911

Course Sponsor: Richard A. Piccolo, Building and Fire Code Academy

### COURSE INFORMATION:

Course Title: City of Cincinnati Cross Training Program - Understanding the International Property Maintenance Code

New Course Submittal:

Update Course:

Prior Approval Number: \_\_\_\_\_

**Purpose and Objective:** The City will be cross training the Residential and Property Maintenance Inspectors. This class will provide an explanation of the intent and proper application of the Property Maintenance Code. It explains the interrelation between to ORC and the maintenance. The class is based on 2018 edition of the Property Maintenance Code. The audience for this class is the current Residential Building Inspectors and the current Property Maintenance Inspectors.

The class consists of lecture with a PowerPoint presentation, and related problem solving activities.

Number of Instructional Contact Hours that can be obtained upon completion: 12

If Multi-Session, Number of Instructional Contact Hours Per Session: 3

### Program Applicable for the Following Participants:

Building Official  Master Plans Examiner  Building Inspector  Fire Protection Inspector  Mechanical Inspector   
 Building Plans Exam.  Plumbing Inspector   
 Plumbing Plans Exam.  Non-Res IU Inspector   
 Electrical Plans Exam.   
 Mechanical Plans Exam.   
 Fire Protect. Plans Exam.

Res Building Official  Res Plans Examiner  Res Building Inspector  Res Mechanical Inspector  Res IU Inspector

Electrical Safety Inspectors

Location of ESI Course: \_\_\_\_\_

Date(s) of ESI Course(s): \_\_\_\_\_

### SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**:

Check  
Off

<b>Course Submitter:</b>	Name of contact person and their certification numbers, organization, address, fax, phone	
	Organization sponsoring or requesting the program (if any)	
<b>Course Title:</b>	Name of course (related to content)	
<b>Purpose/Objective:</b>	Describe purpose and how course will improve competency of certification(s) listed	
<b>Contact Hours:</b>	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
<b>Participants:</b>	Check off each certification for which credit is requested (for which course relates to certification)	
<b>Content of Program:</b>	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
<b>Course Materials:</b>	Collated workbooks, handouts, hard copy or electronic versions of program is available	
<b>Instructor(s) Info.:</b>	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
<b>Test Materials:</b>		
<b>Completed Application:</b>		

**NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.**



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Building & Fire Code Academy

**WELCOME!**



Building & Fire Code Academy

Understanding the 2018  
International Property  
Maintenance Code.

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Chapter 5  
Plumbing Facilities and Fixture  
Requirements

## ◆ General 501

### \* Scope 501.1

- Minimum plumbing systems, facilities and plumbing fixtures to be provided



## ◆ Responsibility 501.2

- Owner shall provide and maintain plumbing facilities and fixtures
- \* A person shall not:
  - Occupy as owner-occupant, or
  - Permit another person to occupy any structure or premises not in compliance with this chapter



## ◆ Required Facilities 502

### ◆ Dwelling Units 502.1

- \* Each dwelling unit shall contain the following:
  - Bathtub or shower
  - Lavatory
  - Water closet
  - Kitchen sink
- \* All facilities shall be maintained in a safe, sanitary working condition
- \* Lavatory shall be placed in the same room as water closet or in close proximity
- \* Kitchen sink shall not be a substitute for the required lavatory

## ◆ Rooming Houses 502.2

- \* One water closet, lavatory and bathtub or shower shall be provided for each 4 rooming units

## ◆ Hotels 502.3

- \* Where private bathroom facilities are not provided they shall be provided by access from a public hallway for each 10 occupants



## ◆ Employers' Facilities 502.4

- \* Minimum of 1 water closet, lavatory and drinking facility shall be available to employees
- \* Drinking facilities 502.4.1 shall be as follows:
  - Drinking fountain
  - Water cooler
  - Bottled water cooler
  - Disposable cups next to a sink or water dispenser
  - Shall not be located in toilet rooms or bathrooms



## ◆ Public Toilet Facilities 502.5

*Premises*: A lot, plot, or parcel of land, easement or public way, including any structures thereon

\* Shall be maintained:

- Safe
- Sanitary
- Working condition per **IPC**

\* Public access and use shall be provided at all times during occupancy of the *premises*

- Except for periodic maintenance or cleaning





◆ Toilet Rooms 503

◆ Privacy 503.1

- \* Toilet rooms and bathrooms
- \* Shall not be the only passageway to hall, the exterior or other space
- \* Provide door and interior locking device in a multiple dwelling



## ◆ Location 503.2

- \* Access shall not exceed 1 flight of stairs
- \* Access shall be from a common hall or passageway

## ◆ Location of Employee Toilet Facilities 503.3

- \* Access from regular work area
- \* Not more than 1-story above or below work area
- \* Travel distance shall not exceed 500'
- \* Can be either separate or public facilities
- \* Facilities located in adjacent building shall not exceed 500'



## ◆ Floor Surface 503.4

- \* Other than dwelling units, toilet rooms shall be:
  - Smooth
  - Hard
  - Non-absorbent surface



## ◆ Plumbing Systems and Fixtures 504

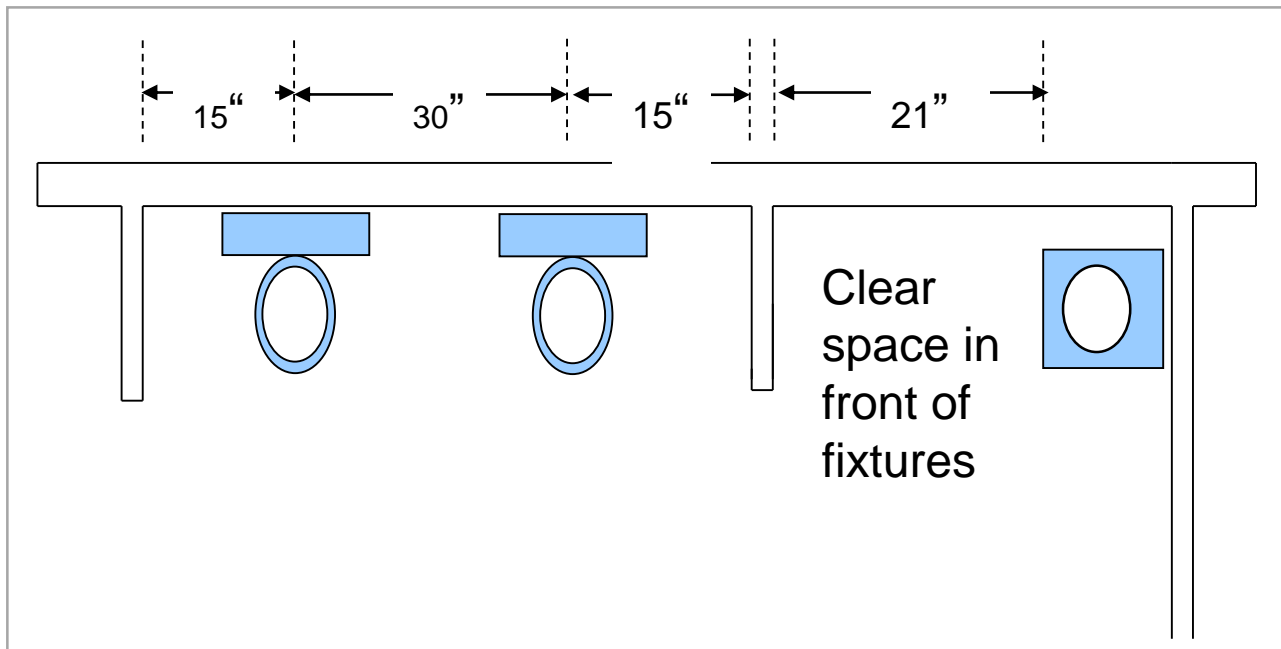
### ◆ General 504.1

- \* Perform the function they were designed for
- \* Properly installed and maintained
- \* Free from obstructions, leaks and defects



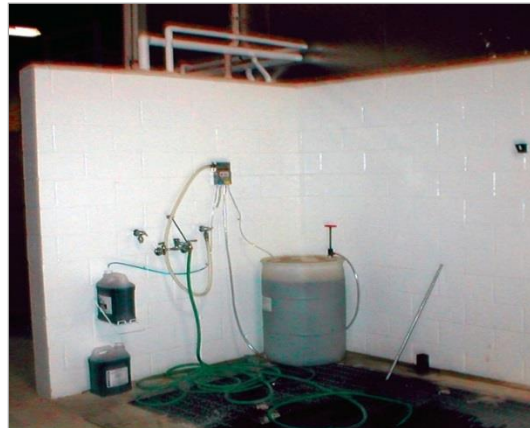
## ◆ Fixture Clearances 504.2

- \* Adequate clearances for usage and cleaning
- \* No confined spaces
- \* Water closets, urinals, lavatories – clearances **P405.3.1**



## ◆ Plumbing System Hazards 504.3

- \* Plumbing system creates a hazard
  - Inadequate service or venting
  - Cross connection and back-siphonage
  - Improper installation, deterioration or damage



## ◆ Water System 505

### ◆ General 505.1

- \* Plumbing fixtures shall be connected properly to public water system or private water system
- \* Sinks, lavatories, laundry facilities, bathtubs and showers must have hot or tempered and cold water



## ◆ Contamination 505.2

- \* Water supply shall be free from contamination
- \* Water inlets must be located above the flood level rim of the fixture
- \* Faucets which have hoses attached and left in place shall be protected by atmospheric-type vacuum breaker

## ◆ Supply 505.3

- \* Water supply shall have sufficient volume and pressure to enable the fixtures to function properly



## ◆ Water Heating Facilities 505.4

- \* Hot water not less than 110°F
- \* Required sinks, lavatories, bathtub/shower, laundry
- \* Water heater shall not be located in the following locations:
  - Bathroom
  - Toilet
  - Bedroom
- \* Combination temp and relief valve
- \* Relief discharge pipe



## ◆ Water Heaters Installed in Garages P2801.6

- \* Water heaters installed in garages having an ignition source shall be elevated such that the source of ignition is not less than 18" above the garage floor. New 2012 (exception for units listed as flammable vapor ignition – resistant)

## ◆ Sanitary Drainage System Section 506

### ◆ General 506.1

- \* Plumbing fixtures properly connected to public sewer system or an approved private sewage system
- \* Stack, vent, waste and sewer line kept free from obstructions and defects
- \* Grease interceptors maintained expanded 2012 (to include records of maintenance shall be available for inspection by the code official)

## ◆ Grease Interceptors 506.3

- \* Maintained
- \* Regularly serviced
- \* Records of maintenance and service made available for inspection by the code official

- ◆ Storm Drainage 507

- ◆ General 507.1

- \* Drainage shall discharge so as not to create a nuisance



\* Drainage 302.2





- \* Drainage 302.2
  - Slab on grade

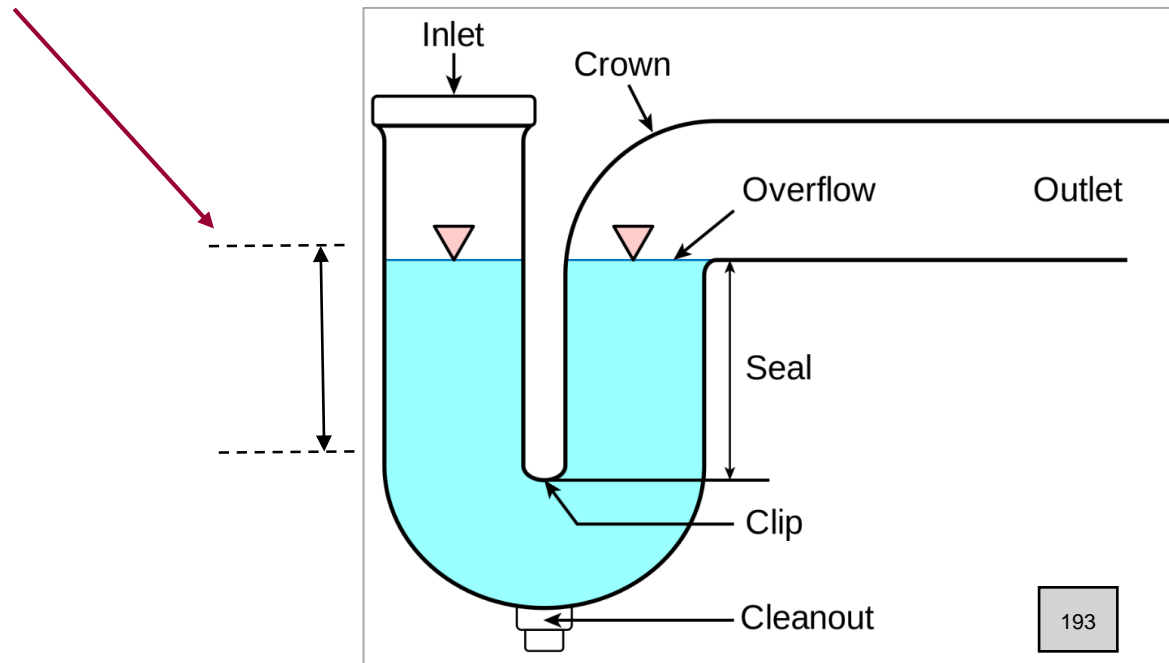


Sloped away minimum  
10'  
from house

## ◆ Fixture Traps P3201.1

- Traps shall be of standard design, have a smooth, uniform internal waterway, be self-cleaning and shall not have interior partitions except where integral with the fixture
- Traps shall be constructed of lead, cast iron or drawn brass or approved plastic
- Trap seals shall not be less than 2" or more than 4"

### P3201.2



**TABLE P3105.1**  
**MAXIMUM DISTANCE OF FIXTURE TRAP FROM VENT**

SIZE OF TRAP (inches)	SLOPE (inch per foot)	DISTANCE FROM TRAP (feet)
1 1/4	1/4	5
1 1/2	1/4	6
2	1/4	8
3	1/8	12
4	1/8	16

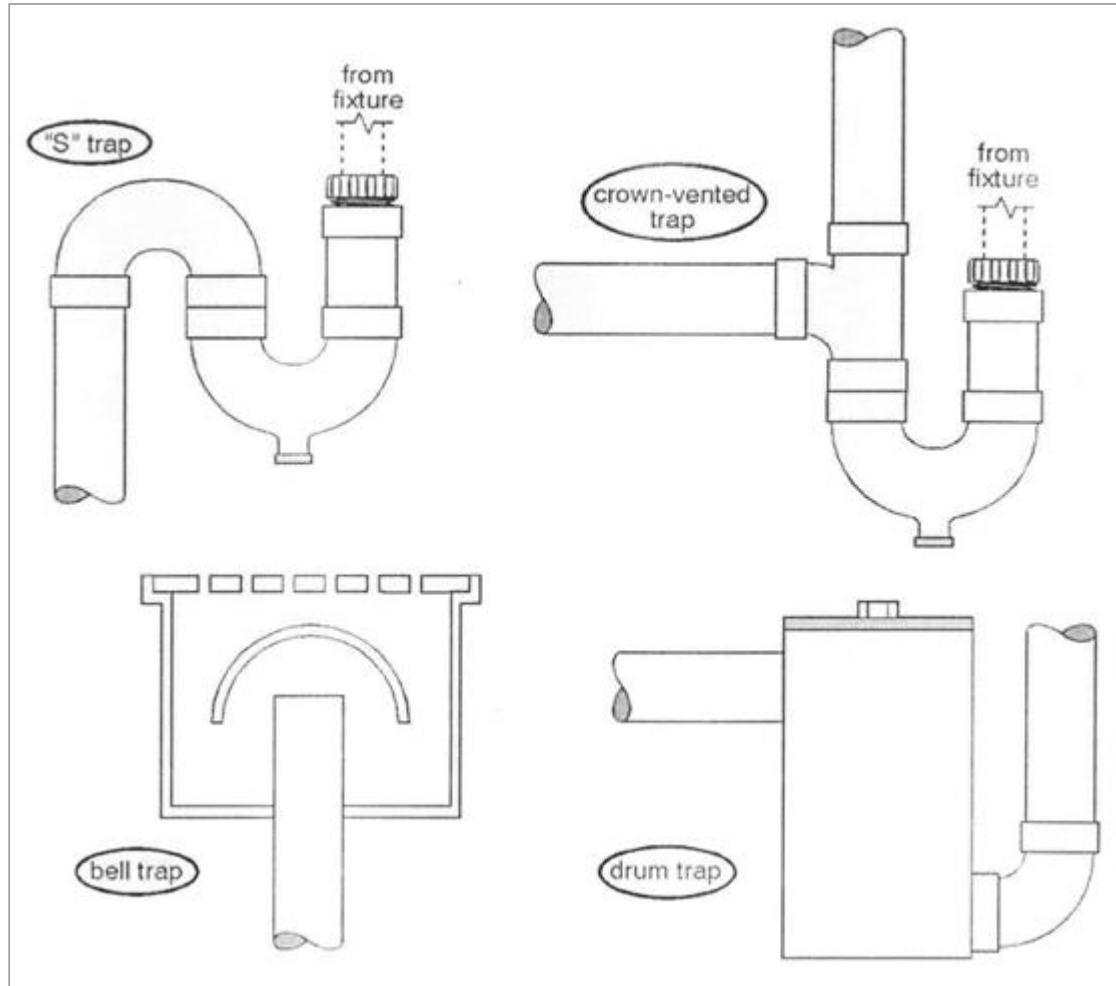
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 inch per foot = 83.3 mm/m



- \* Building traps prohibited
  - Except:
    - In special cases where sewer gases are extremely corrosive or noxious, or
    - As directed by the Building Official
- \* The following types of traps are prohibited:
  - Bell traps
  - Separate fixture traps with interior partitions, except those lavatory traps made of plastic, stainless steel or other corrosion-resistant material

- \* Prohibited traps (*continued*)
  - “S” traps
  - Drum traps
  - Trap designs with moving parts
- \* Each plumbing fixture shall be separately trapped by a water seal trap as close as possible to the fixture outlet
- \* The vertical distance from the fixture outlet to the trap weir shall not exceed 24” **P3201.6**

\* Older, troublesome trap designs



\* Fixture traps

- The distance of a clothes washer standpipe above the trap shall conform to **P2706.1.2.1**
- Fixtures shall not be double trapped
- Exceptions to the separate trapping requirements shall conform to **P3201.6** exceptions



- \* Fixture trap size shall be sufficient to drain the fixture rapidly and not less than the size indicated in **Table P3201.7**
- \* A trap shall not be larger than the drainage pipe into which the trap discharges

**TABLE P3105.1**

**MAXIMUM DISTANCE OF FIXTURE TRAP FROM VENT**

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 inch per foot = 83.3 mm/m

SIZE OF TRAP (inches)	SLOPE (inch per foot)	DISTANCE FROM TRAP (feet)
1 1/4	¼	5
1 1/2	¼	6
2	¼	8
3	1/8	12
4	1/8	16

**TABLE P3201.7  
SIZE OF TRAPS FOR PLUMBING FIXTURES**

PLUMBING FIXTURE	TRAP SIZE MINIMUM (inches)
Bathtub (with or without shower head and/or whirlpool attachments)	1 1/2
Bidet	1 1/4
Clothes washer standpipe	2
Dishwasher (on separate trap)	1 1/2
Floor drain	2
Kitchen sink (one or two traps, with or without dishwasher and food waste disposer)	1 1/2
Laundry tub (one or more compartments)	1 1/2
Lavatory	1 1/4
Shower (based on the total flow rate through showerheads and bodysprays) Flow rate:	
5.7 gpm and less	1 1/2
More than 5.7 gpm up to 12.3 gpm	2
More than 12.3 gpm up to 25.8 gpm	3
More than 25.8 gpm up to 55.6 gpm	4

## ◆ Chapter 5: Case Study

- \* A complaint is received that a tenant has no hot water and it has been this way for about a week. Your inspection reveals the water heater is only able to provide lukewarm water.
- \* Answer the following:
  - Who is responsible to provide hot water?
  - The landlord states the tenants are abusing the appliances and he refuses to complete the repair.
  - What steps should you take?

# BFC A<sup>®</sup>

## Building & Fire Code Academy

### Understanding the 2018 International Property Maintenance Code<sup>©</sup>

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### Chapter 6

## Mechanical and Electrical Requirements

## ◆ General 601

### ◆ Scope 601.1

- \* Govern the minimum mechanical and electrical facilities and equipment to be provided

### ◆ Responsibility 601.2

- \* Owner shall provide and maintain mechanical and electrical facilities
- \* A person shall not occupy or permit another to occupy without complying with these requirements



## ◆ Heating Facilities 602

### ◆ Residential Occupancies 602.2

- \* Heating facilities able to maintain a room temperature of 68°F in all habitable rooms
  - Exception – see 602.2
- \* Cooking appliances shall not be used, nor shall portable unvented fuel-burning space heaters be used as a means to provide required heating



## ◆ Heat Supply 602.3

- \* Owner / Operator shall furnish heat not less than 68° F
- \* Select months that heat is required
- \* Exception: Appendix D of **IPC** areas where average monthly temperature is above 30°- 65°F shall be maintained

**APPENDIX D**  
**DEGREE DAY AND DESIGN TEMPERATURES**

*This appendix is informative and is not part of the code.*

TABLE D101  
DEGREE DAY AND DESIGN TEMPERATURES<sup>a</sup> FOR CITIES IN THE UNITED STATES

STATE	STATION <sup>b</sup>	HEATING DEGREE DAYS (yearly total)	DESIGN TEMPERATURES			DEGREES NORTH LATITUDE <sup>c</sup>
			Winter 97 <sup>1</sup> / <sub>2</sub> %	Summer		
				Dry bulb 2 <sup>1</sup> / <sub>2</sub> %	Wet bulb 2 <sup>1</sup> / <sub>2</sub> %	
AL	Birmingham	2,551	21	94	77	33°30'
	Huntsville	3,070	16	96	77	34°40'
	Mobile	1,560	29	93	79	30°40'
	Montgomery	2,291	25	95	79	32°20'
AK	Anchorage	10,864	-18	68	59	61°10'
	Fairbanks	14,279	-47	78	62	64°50'

## ◆ Occupiable Work Spaces 602.4

- \* Maintain temperature of not less than 65° F
- \* Select months heat is required
- \* Exceptions:
  - Vigorous physical activities
  - Processing, storage and operations areas – special temperature conditions

## ◆ Room Temperature Measurement 602.5

- \* Room temperatures shall be measured as follows:
  - 3' above the floor near the center of room, and
  - 2' inward from center of each exterior wall

- ◆ Mechanical Equipment 603
- ◆ Mechanical Appliances 603.1
  - \* Includes fireplaces and solid fuel burning appliances
  - \* Properly installed and maintained in a safe working condition
    - Also see upcoming slides: **M1307**, **M1901.1**, and **G2422**
  - \* Capable of performing the intended function

## ◆ Appliance Installation M1307

- \* Per manufacturer's installation instructions
- \* Attached to appliance
- \* Anchored in an approved manner – seismic considerations
- \* Ignition source elevated 18" in garages
- \* Within a garage **M1307.3**
- \* Protected from vehicular impact **M1307.3.1**



## ◆ Ranges and Ovens M1901.1

- \* 30" vertical clearance to combustibles over cooking appliances
- \* Listed and labeled for household use M1901.2
- \* Installed so as not to interfere with combustion air and servicing



## ◆ Appliance Connections G2422

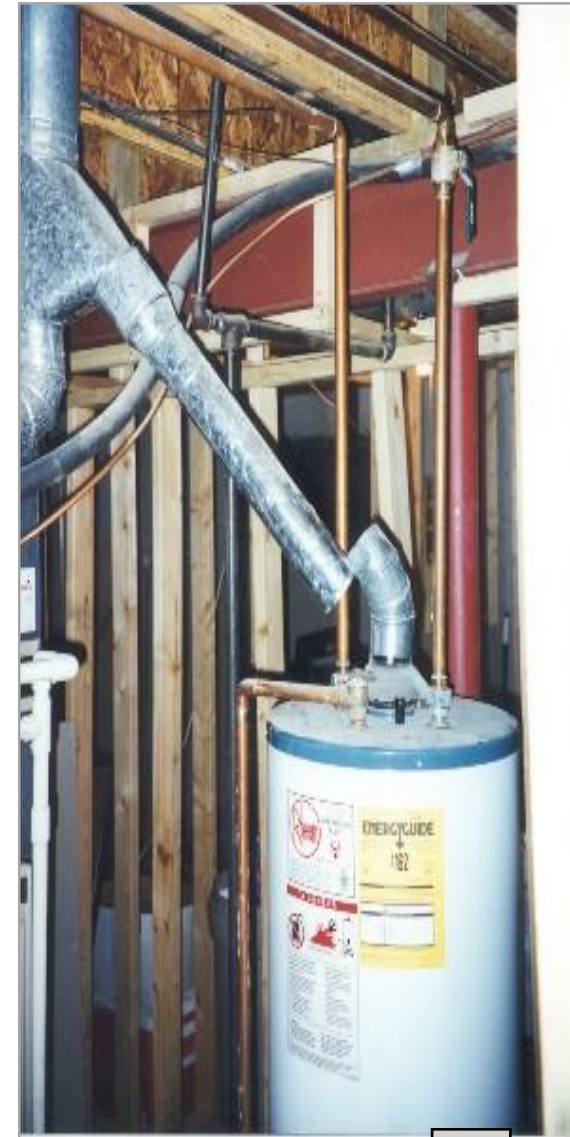
- \* Line pressure regulators required when appliances operate at pressure lower than supply system
- \* Protected from damage G2422.1.1
- \* Not over 6' G2422.1.2.1
- \* Not in or through walls G2422.1.2.3
- \* Shut off valve before connector G2422.1.2.4





## ◆ Removal of Combustion Products 603.2

- \* Fuel burning equipment and appliances must be connected to an approved chimney or vent
- \* Exception:
  - Equipment labeled for un-vented operation



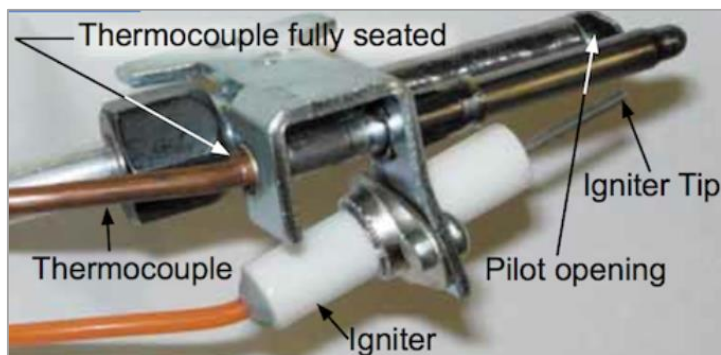


## ◆ Clearances 603.3

- \* Clearances shall be maintained

## ◆ Safety Controls 603.4

- \* Controls shall be maintained properly

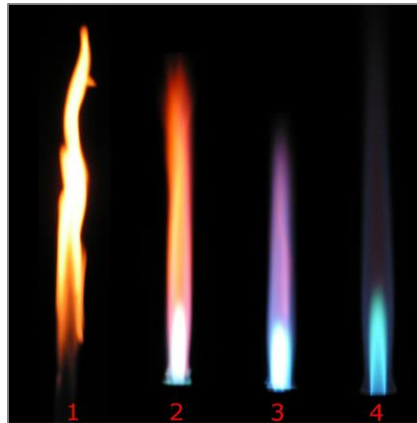


## ◆ Combustion Air 603.5

- \* Combustion air shall be provided for the appliance
- \* Ventilation air shall be provided

## ◆ Combustion Air 603.5 (*continued*)

- \* Effects of inadequate combustion air
  - Produces poisonous, corrosive and combustible by-products when combustion is incomplete
  - Creates environment that leads to oxygen depletion
  - Inadequate cooling of appliance causes appliance to work harder, leading to shorter appliance life

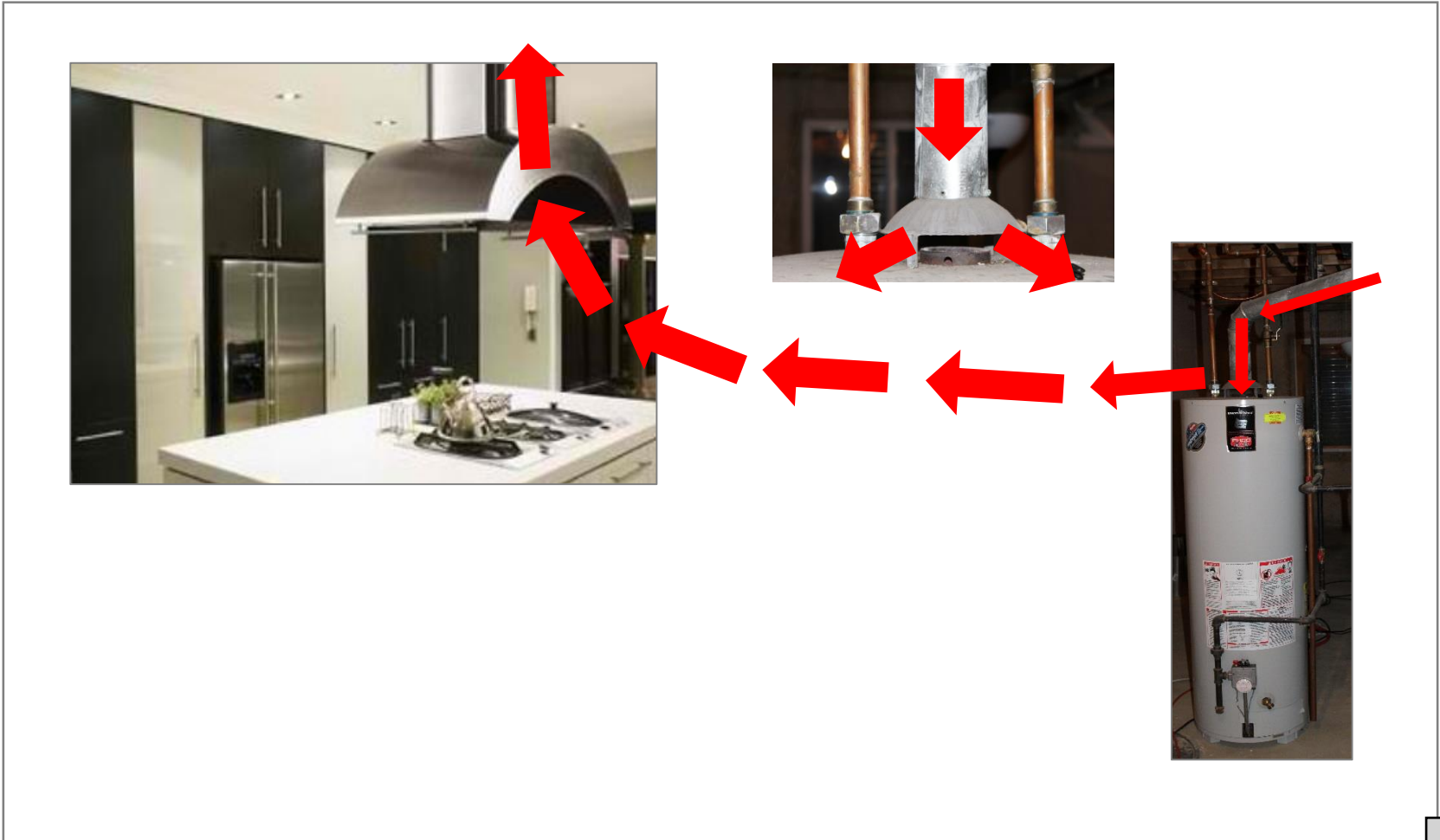


Low Combustion Air → Adequate Combustion Air

- Incomplete combustion causes soot, increased levels of carbon monoxide, appliance malfunction and risk of fire
- Appliances shall be installed to allow the free circulation of air within the space
- Simultaneous operation of all appliances shall be considered when determining combustion air



- \* Avoid “going negative” due to excessive exhaust CFM with inadequate makeup air



## ◆ Combustion Air (*continued*)

- \* Combustion air louvers and grills
  - Ventilation based on net free opening
  - Wood louvers 25%
  - Metal 75%
  - Manufacturer's specifications
  - Motorized grills interlocked with equipment



## ◆ Energy Conservation Devices 603.6

- \* Devices intended to reduce fuel consumption
- \* May be attached to:
  - Fuel burning appliance
  - Fuel supply line
  - Vent outlet or vent piping
- \* Must be labeled and installed as specifically approved

## ◆ M1307 Appliance Installation

- \* Per manufacturer installation instructions
- \* Attached to appliance
- \* Anchored in an approved manor – Seismic considerations
- \* Ignition source elevated 18” in garages (see exception)
- \* Within a garage **M1307.3**
- \* protected from vehicular impact M1307.3.1

## ◆ M1901 Ranges and Ovens

- \* 30" vertical clearance to combustibles over cooking appliances
- \* Listed and labeled **M1901.2**
- \* Installed so as not to interfere with combustion air and servicing



## ◆ G2422 Appliance Connectors

- \* Line pressure regulators required when appliances operate at pressure lower than supply system
- \* Protected from damage G2422.1.1
- \* Not over 6' G2422.1.2.1
- \* Not in or through walls G2422.1.2.3
- \* Shut off valve before connector G2422.1.2.4

## ◆ Electrical Facilities 604

### ◆ Facilities Required 604.1

- \* Occupied Building

- \* See Section 605 electrical equipment

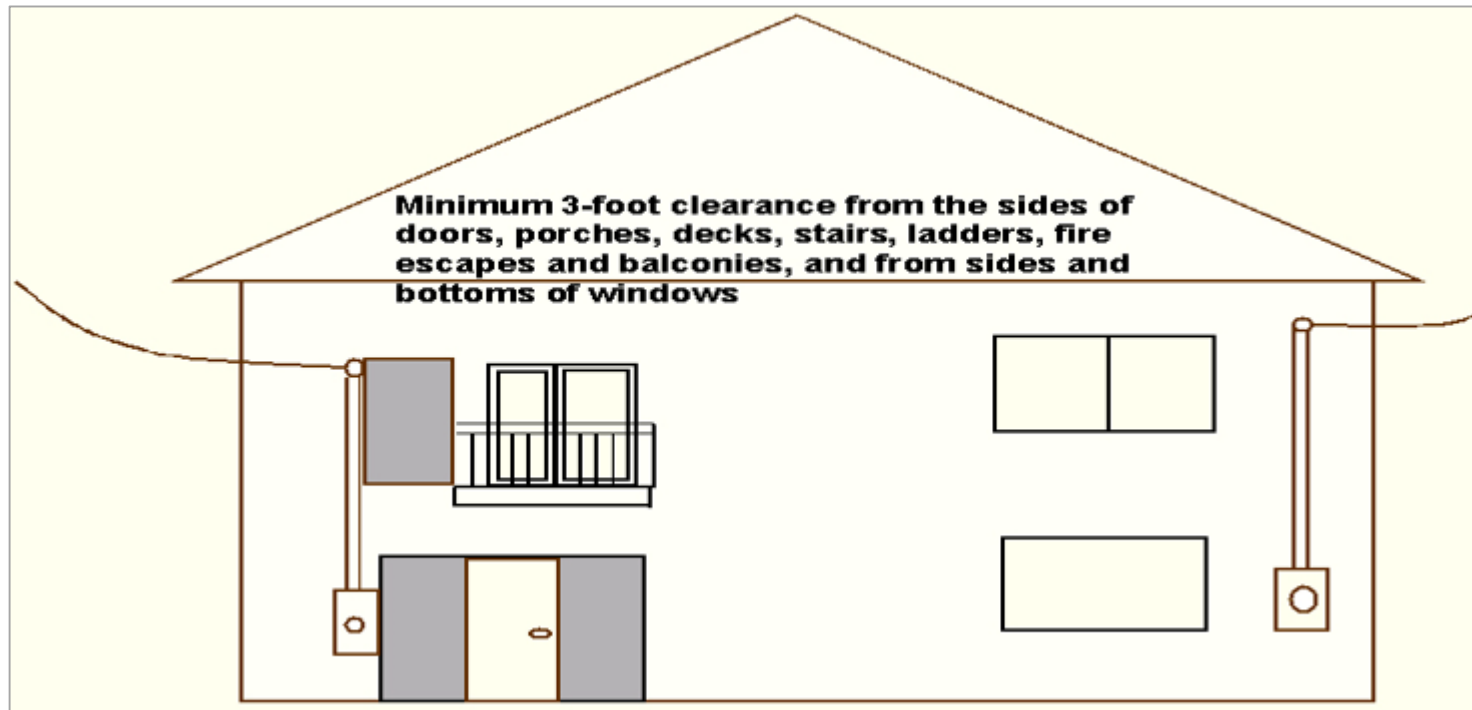
### ◆ Service 604.2

- \* Minimum size of main shall be 60 amps three wire

- \* Size and usage of appliances shall determine service size

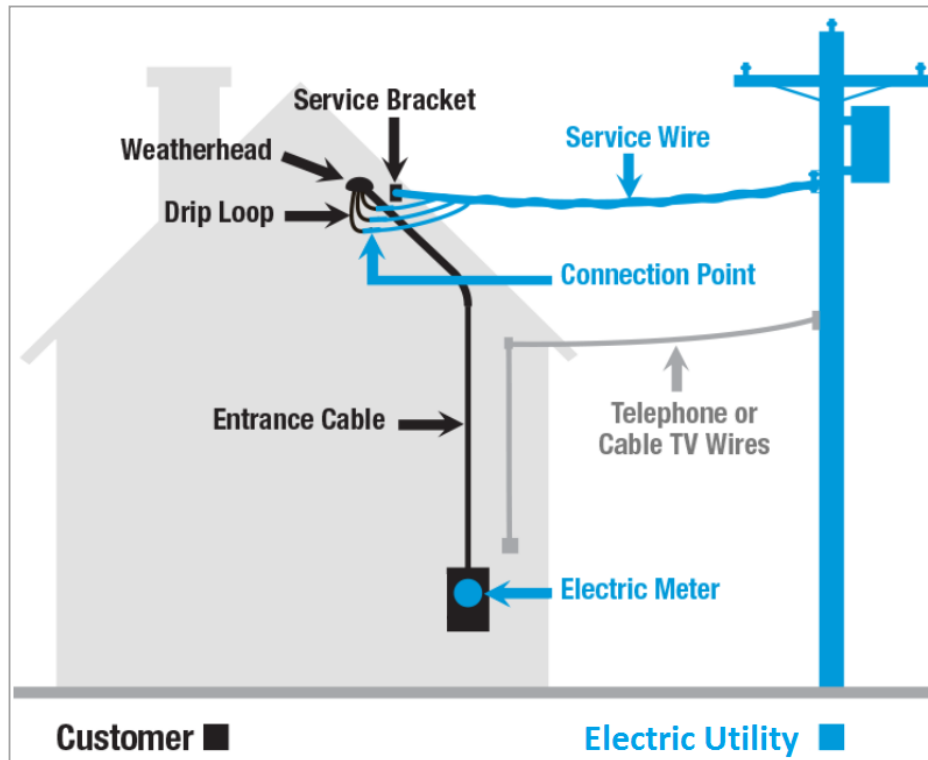
## ◆ E3604 Overhead Services

- \* Conductor clearances



## ◆ E3604.2 Overhead Services

- \* Point of attachment – minimum 8' above roof or 12' above property or driveways
- \* Service mast permitted as support when adequately supported or raceway type mast



## ◆ Electrical System Hazards 604.3

- \* Code official shall require the following hazards to be eliminated:
  - Inadequate service
  - Improper fusing
  - Insufficient outlets
  - Improper wiring or installation
  - Deterioration or damage



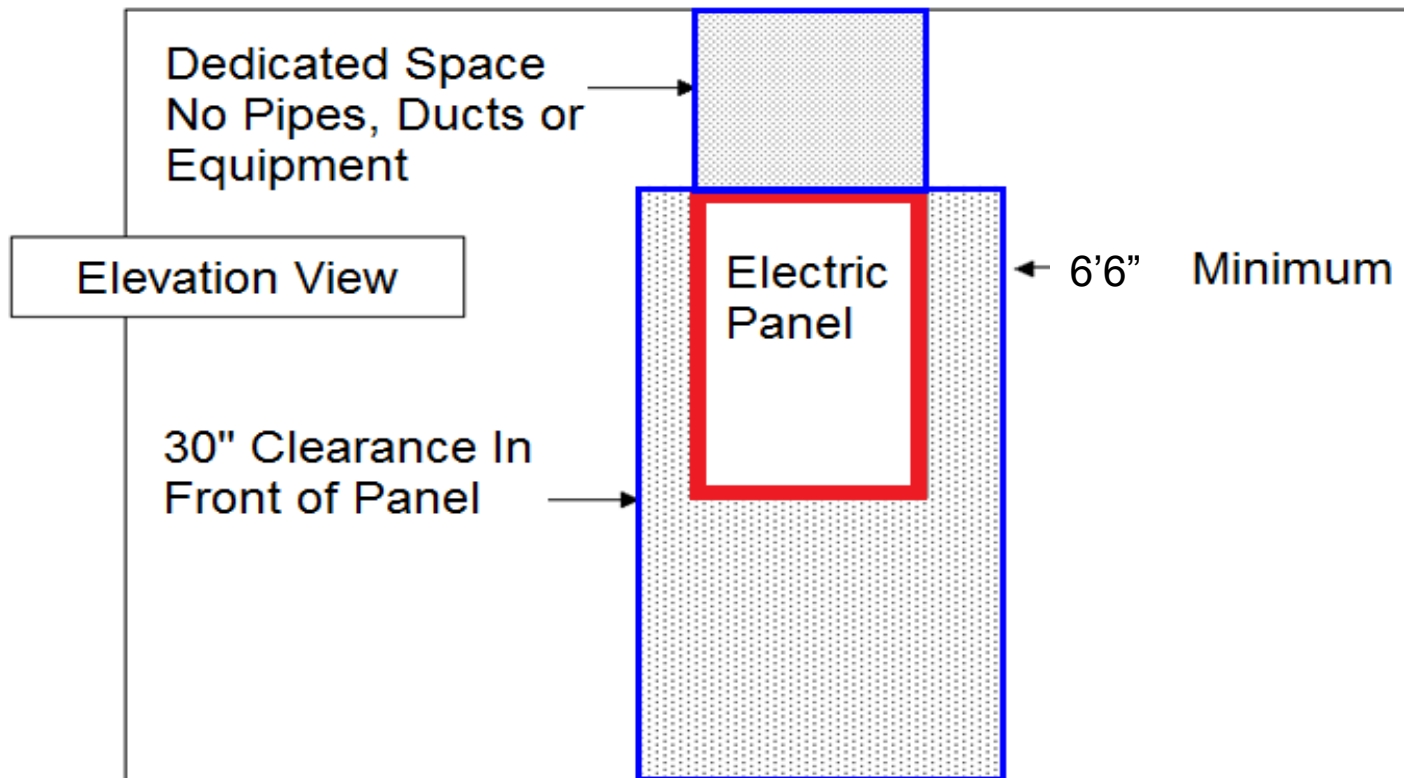
## ◆ Installation 605.1

- \* Equipment, wiring and appliances shall be properly installed and maintained in a safe and approved manner



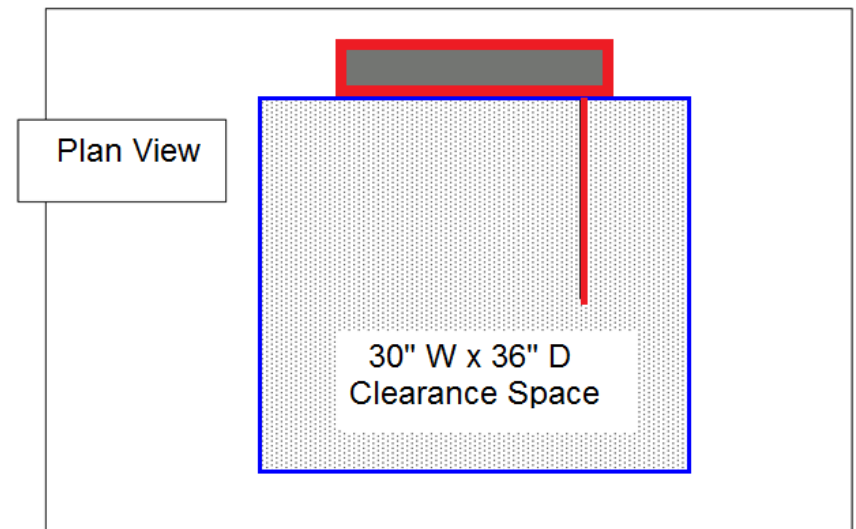
## ◆ Equipment Location and Clearances E3405

- \* Access and working space to allow safe operation and maintenance
- \* Shall be sized to facilitate 90° door opening





- \* Space above panel board dedicated for electrical equipment
- \* Panel boards and over-current devices not permitted in clothes closets or bathrooms
- \* Working space shall be provided with access
- \* Artificial lighting provided for indoor equipment
- \* 6.5' of headroom required  
new exception 2012  
(existing services less than 200 amp can have height clearance less than 6.5' E3405.2 except 1)





## ◆ Receptacles 605.2

\* Required receptacles in a dwelling unit:

- Every habitable space at least 2 (remote)
- Laundry area (grounded type or GFCI)
- Existing bathroom (at least one receptacle)
- New bathroom receptacle (must be GFCI)
- New in 2012 (all receptacle outlets shall have the appropriate faceplate for the location)
- Every receptacle outlet shall have the appropriate faceplate



## ◆ Receptacles E4002

### \* Rating

- Single receptacle – same as branch circuit
- Two or more – per **Table E4002.1.2**

<b><i>Circuit Rating</i></b>	<b><i>Receptacle Rating</i></b>
15	15
20	15 or 20
30	30
40	40 or 50
50	50

- \* Grounding type receptacles required on 15 and 20 amp circuits
- \* Labeled CO/ALR when using copper / or aluminum conductors and rated 20 amps or less
- \* Metal enclosures grounded

## ◆ Luminaires 605.3

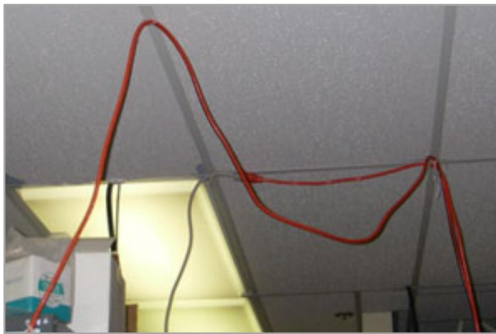
\* The following rooms shall contain at least one electrical luminaire:

- Public hall
- Interior stairway
- Toilet room
- Kitchen
- Bathroom
- Laundry room
- Boiler room
- Furnace room
- Pool and spa luminaries over 15V shall have ground fault circuit interrupter protection

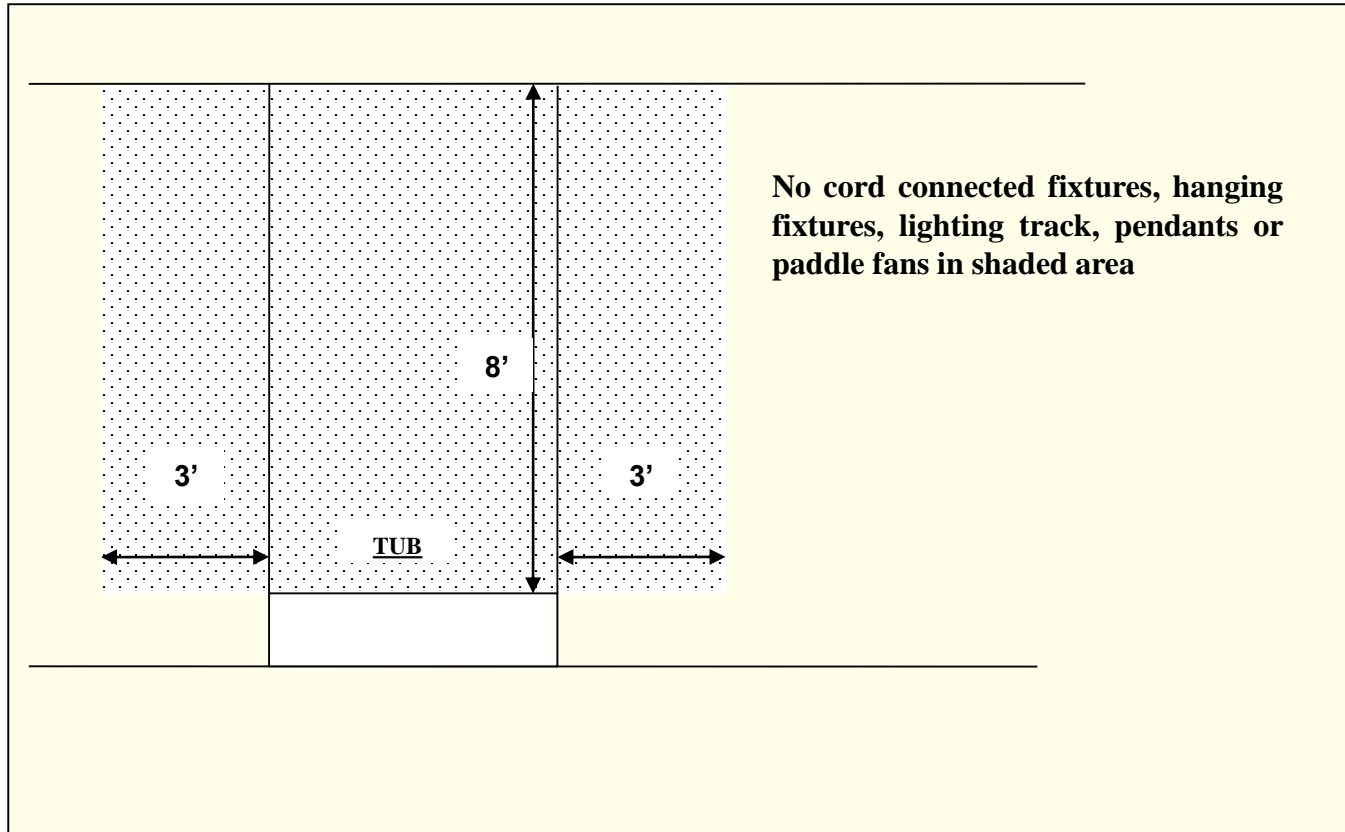


## ◆ Wiring 605.4

- \* Flexible cords shall not be used for permanent wiring or for running through doors, windows, cabinets, or concealed within walls, floors, or ceilings

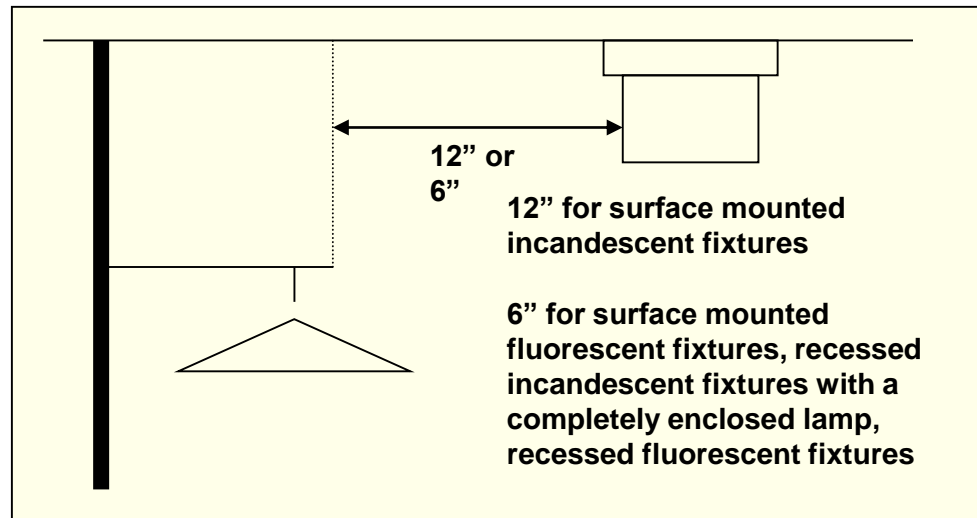


◆ E4003.11 Fixtures in Bathtub and Shower Areas



## ◆ E4003.12 Fixtures in Clothes Closets

- \* Limited to surface mounted or recessed incandescent fixture with enclosed lamps, or fluorescent



## ◆ E4003.13 Fixture Wiring

- \* Not exposed to physical damage
- \* Not subject to temperatures above rating
- \* Fixtures not permitted as raceways unless listed

- ◆ Elevators, Escalators and Dumbwaiters 606
- ◆ General 606.1
  - \* Maintained to safely sustain all imposed loads
  - \* Operate properly and free from physical and fire hazards
  - \* Display most current Certificate of Inspection

**NCDOL**  
N.C. Department of Labor  
Elevator and Amusement Device Bureau

**CERTIFICATE OF OPERATION**  
*This permit is to be posted in a conspicuous place in each unit.*

This certifies that this PASSENGER ELEVATOR

No. 28160 Maximum Capacity 3,500 LBS

Located at 46 VALLEY STREET

Owned by BUNCOMBE CO BOARD OF COMMISSIONER

Operated by BUNCOMBE COUNTY COURTHOUSE LSA

Was originally tested on 4/16/2012  
and found to be in compliance with the rules and regulations of the Elevator Bureau of the North Carolina Department of Labor.

Date of Last Inspection	Inspector
<u>4-18-2012</u>	<u>G. Moore</u>
<u>4-18-2013</u>	<u>G. Moore</u>



## ◆ Elevators 606.2

- \* At least one passenger elevator shall be operable at all times
  - Building with one elevator shall be permitted to be temporarily out of service for testing or service

## ◆ Duct Systems 607

### ◆ General 607.1

- \* Duct systems shall be maintained free of obstructions and shall be capable of performing the required function

## ◆ Chapter 6: Case Study 1

- \* You receive a complaint that the furnace is not operating properly and the apartment is 65° F based on the thermostat. Upon inspection the oven is on with the door open and water is boiling on the stove. The temperature outside is 0° F and will drop to -10° F in the evening. The furnace is running and producing heat.
- \* Answer the following:
  - Is there a violation?
  - What suggestion(s) do you have for the tenant?

## ◆ Chapter 6: Case Study 2

- \* Upon conducting an annual rental inspection you observe the electrical panel cover is off of the panel and the wires are exposed. The panel looks like a spaghetti dinner with wires everywhere.
- \* Answer the following:
  - What is your first question to the tenant?
  - What steps should you take and consider?



Building & Fire Code Academy

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2018 International  
Property Maintenance Code®

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Chapter 7  
Fire Safety Requirements

## ◆ General 701

### ◆ Scope 701.1

- \* Govern minimum conditions and standards for fire safety relating to:
  - Structures
  - Exterior premises, including fire safety facilities and equipment to be provided

### ◆ Responsibility 701.2

- \* Owner shall provide and maintain facilities and equipment
- \* Shall not occupy as owner-occupant or permit another person to occupy any premises not in compliance with this chapter

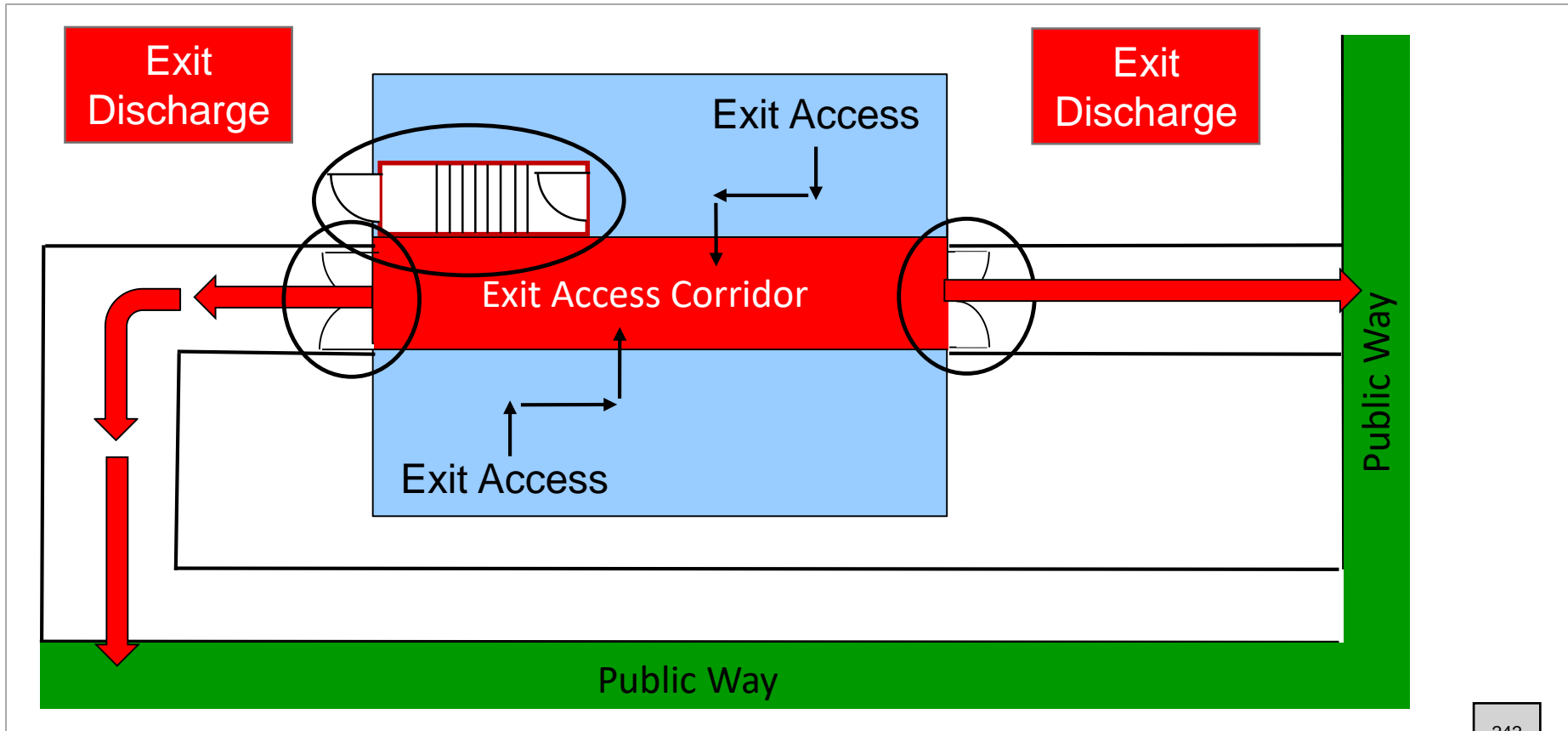
## ◆ Means of Egress 702

### ◆ General 702.1

- \* Safe, continuous and unobstructed path of travel shall be provided to the public way -- Shall comply with **IFC**
- \* Exiting system – (3 parts) continuous path
  - Exit Access
    - Leads to the exit, walkways, parts of rooms, corridors, passageways, lobbies
  - Exit
    - High level of protection, usually single direction exterior doors, stairways, exits, horizontal exits

- Exit discharge
  - Between the exit and public way, courts, yards, exterior areas at grade
- \* Public way
  - Dedicated for public use
  - Minimum 10' wide and 10' clear overhead
  - Open to the outside air

- \* Exit Access
- \* Exit
- \* Exit Discharge





## 1. Exit Access

- Your first step toward exit discharge from anywhere in the building
- Leads to the exit, walkways, parts of rooms, corridors, passageways, lobbies



## 2. Exit

- High level of protection, usually single direction
- Exterior doors, stairways, exits, horizontal exits
- That 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 and horizontal exits



### 3. Exit Discharge

- Portion of means of egress system between termination of an exit and public way, courts, yards, exterior areas at grade

#### \* Public way

- Dedicated for public use
- Minimum 10' wide and 10' clear overhead
- Open to outside air

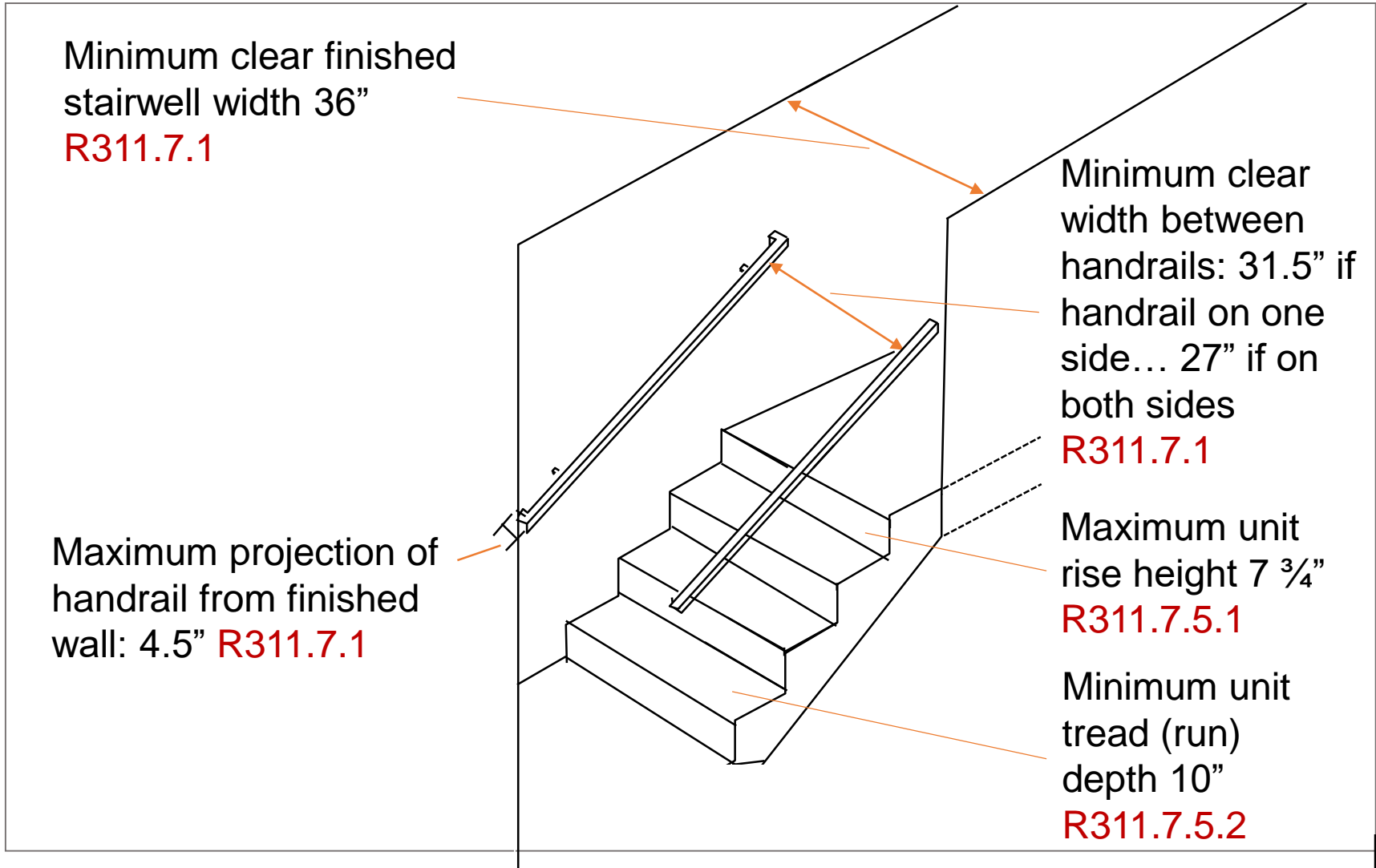


## ◆ Means of Egress R311

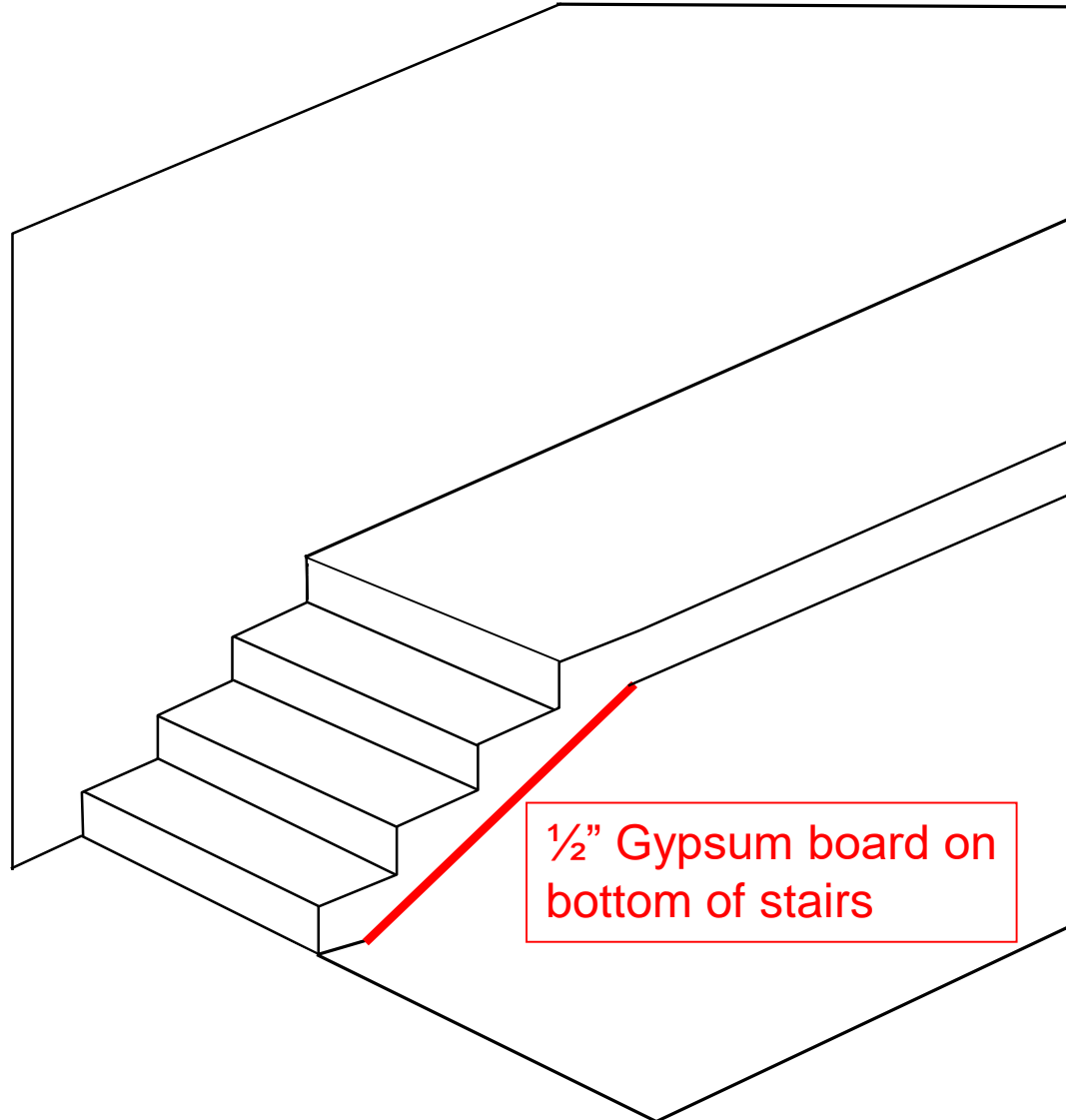
- \* Permanently attached to structure
- \* Stairs, ramps, exterior exit balconies, hallways, and doors
- \* Exterior exit balconies, stairs, and similar exit facilities positively attached to primary structure
- \* Under-stair protection



\* Handrails **R311.7.8**



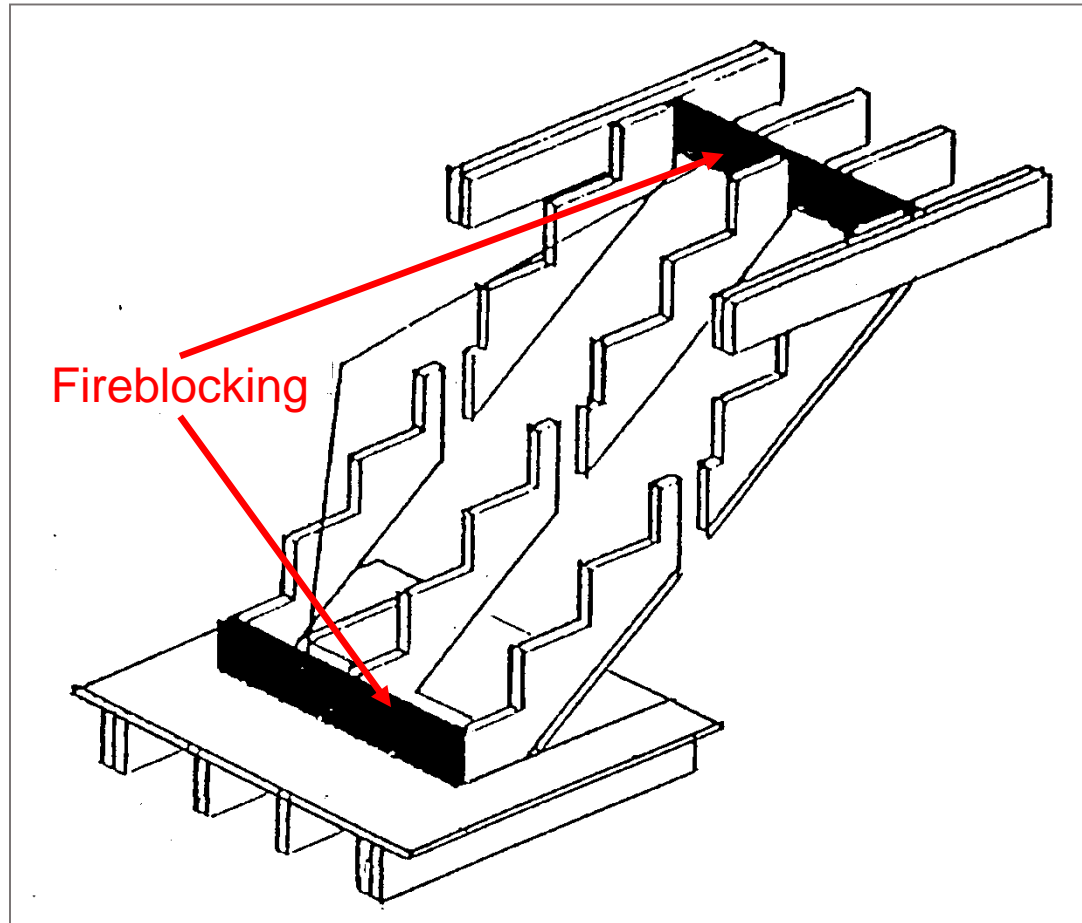
- \* Under stair protection **R302.7**





\* Fireblocking **R302.11**

- Top and bottom of stair runs if concealed



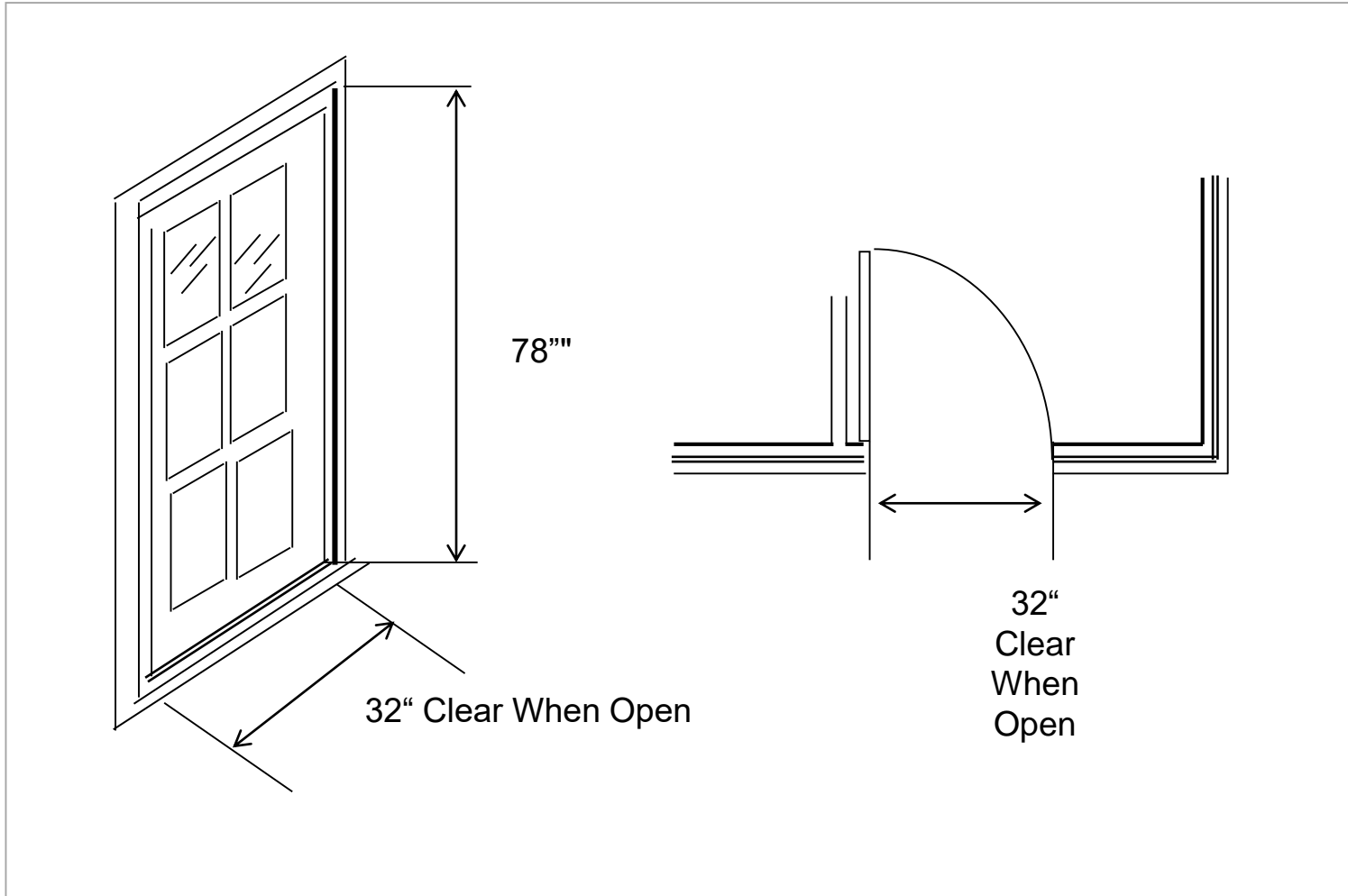
- \* Halls

- 3' – 0" minimum in width

- \* Doors

- One (1) required to meet conditions of code
- Not allowed through garage
- Required type and size
- Side hinged not less than 32" wide when fully open
- Non-exit exterior doors
- Interior doors





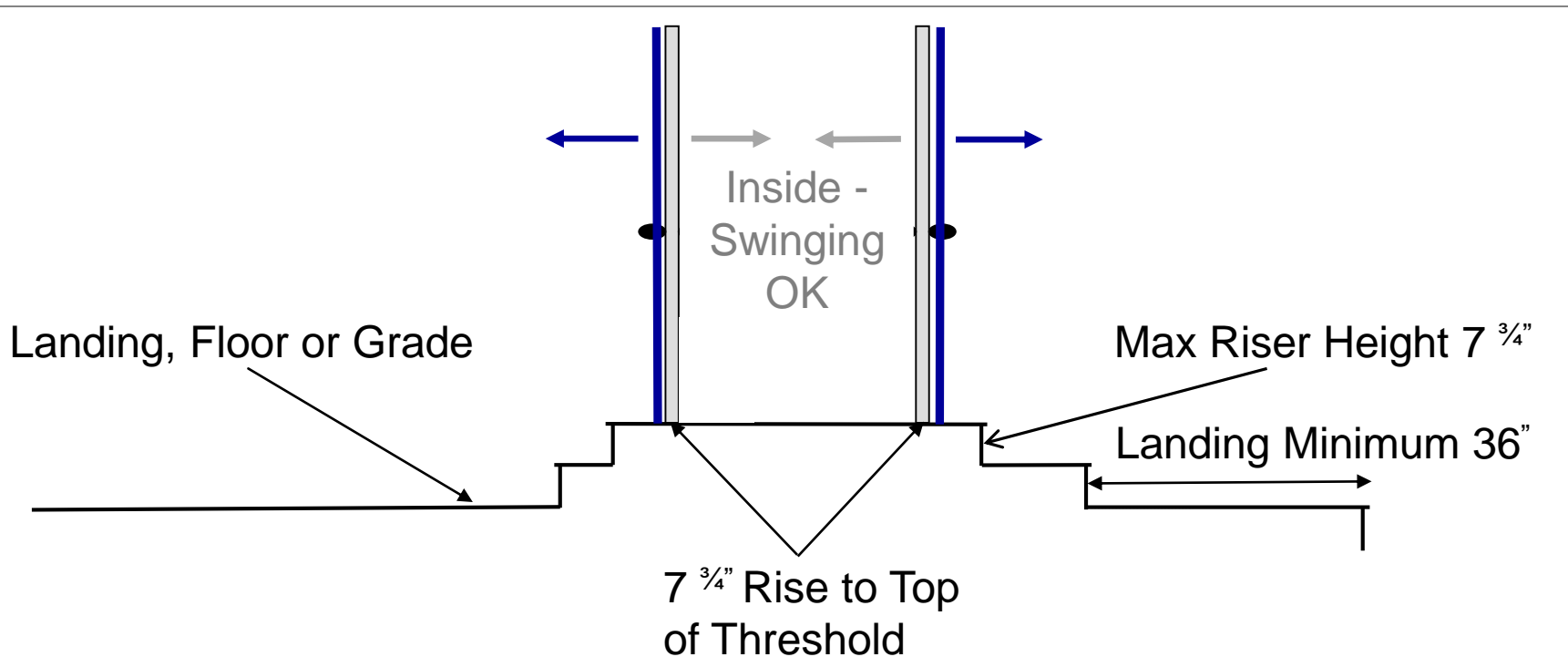
- \* Landings at door **R311.3**
  - Size required and where
  - Width of door served
  - 36" out in direction of travel
  - On each side of door
  - Landing not required when 2 or fewer risers at interior side



- \* Location in relation to door threshold
  - 1-1/2" at required exit door
    - Exceptions:
      - 2 or fewer risers (non-required exit door)
      - 7-3/4" below top of threshold provided door (other than storm or screen door) does not swing over landing



- \* Swinging egress doors may NOT swing out over stair or landing **R311.2**



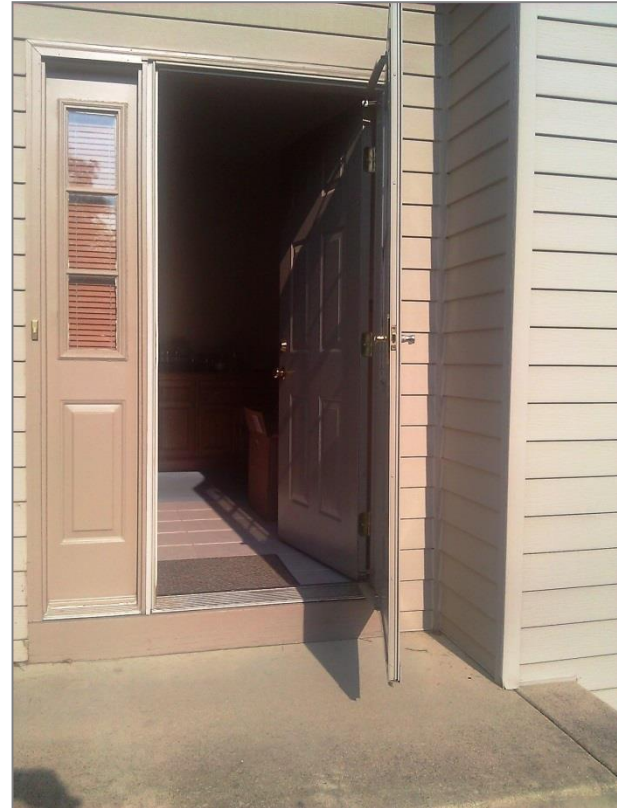
Screen and storm doors may swing over all exterior stairs and landings **R311.3.3**

\* Exceptions to **R311.3.2**

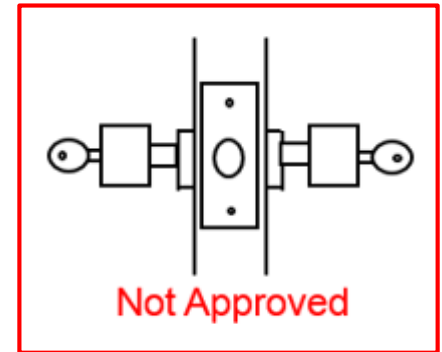
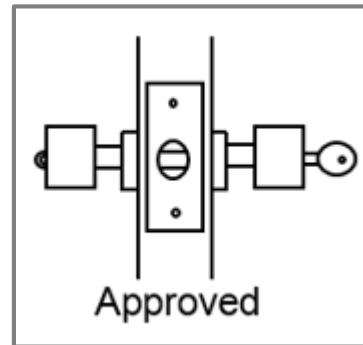
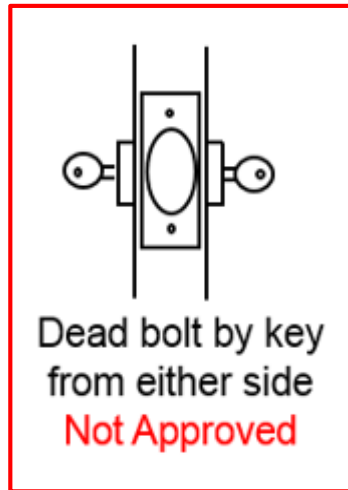
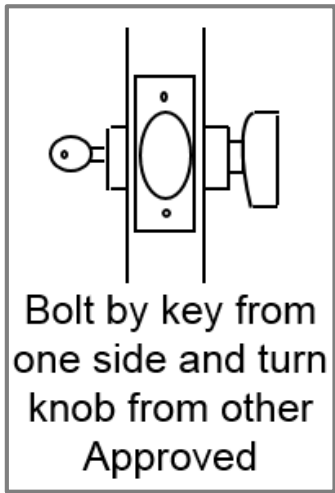
7 <sup>3</sup>/<sub>4</sub>" max below top of threshold  
if egress door does not swing  
over landing **R311.3.1**



Storm/screen door may  
swing over landing **R311.3.3**



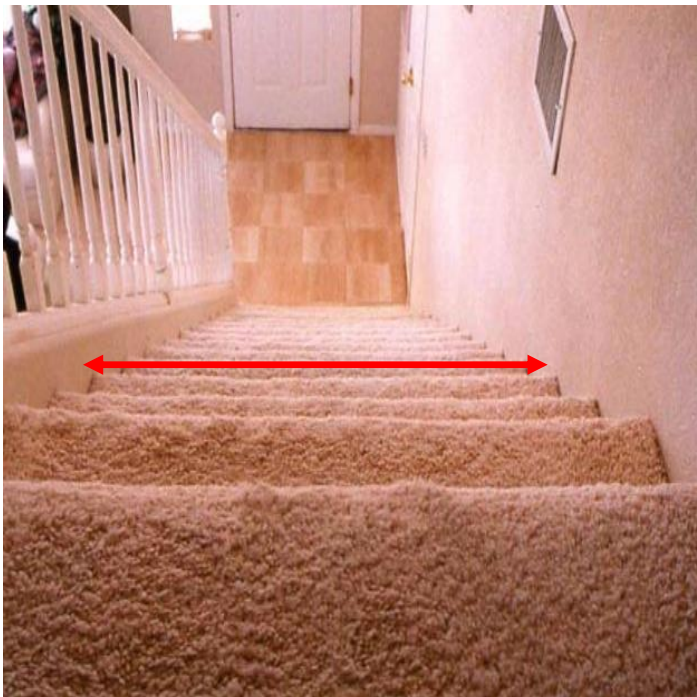
- \* Egress door type of lock or latch **R311.2**
  - Openable from egress side without use of a key or special knowledge or effort





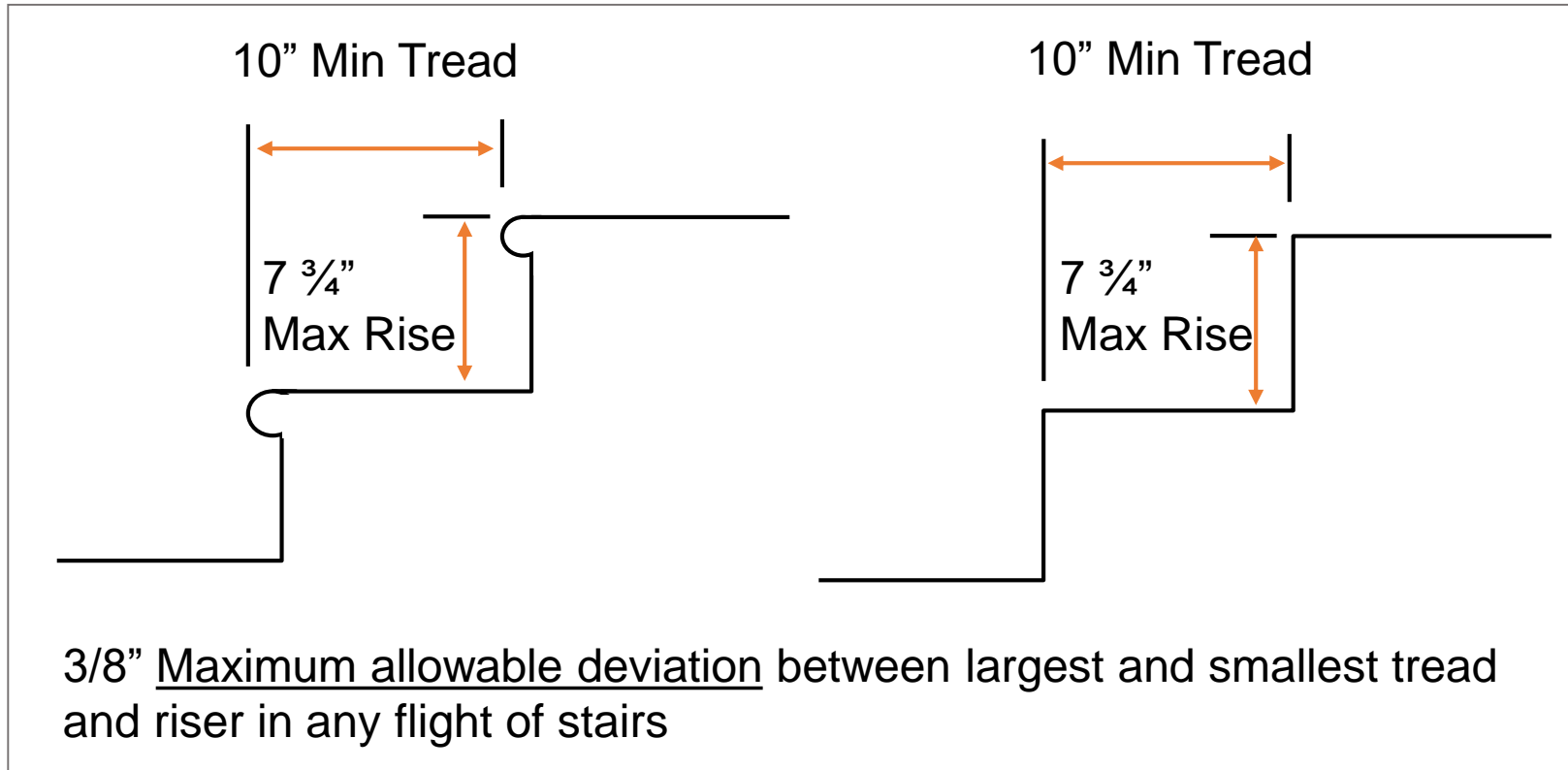
\* Stairways **R311.7**

- Width **R311.7.1**
- Headroom **R311.7.2**
- Vertical rise **R311.7.3**



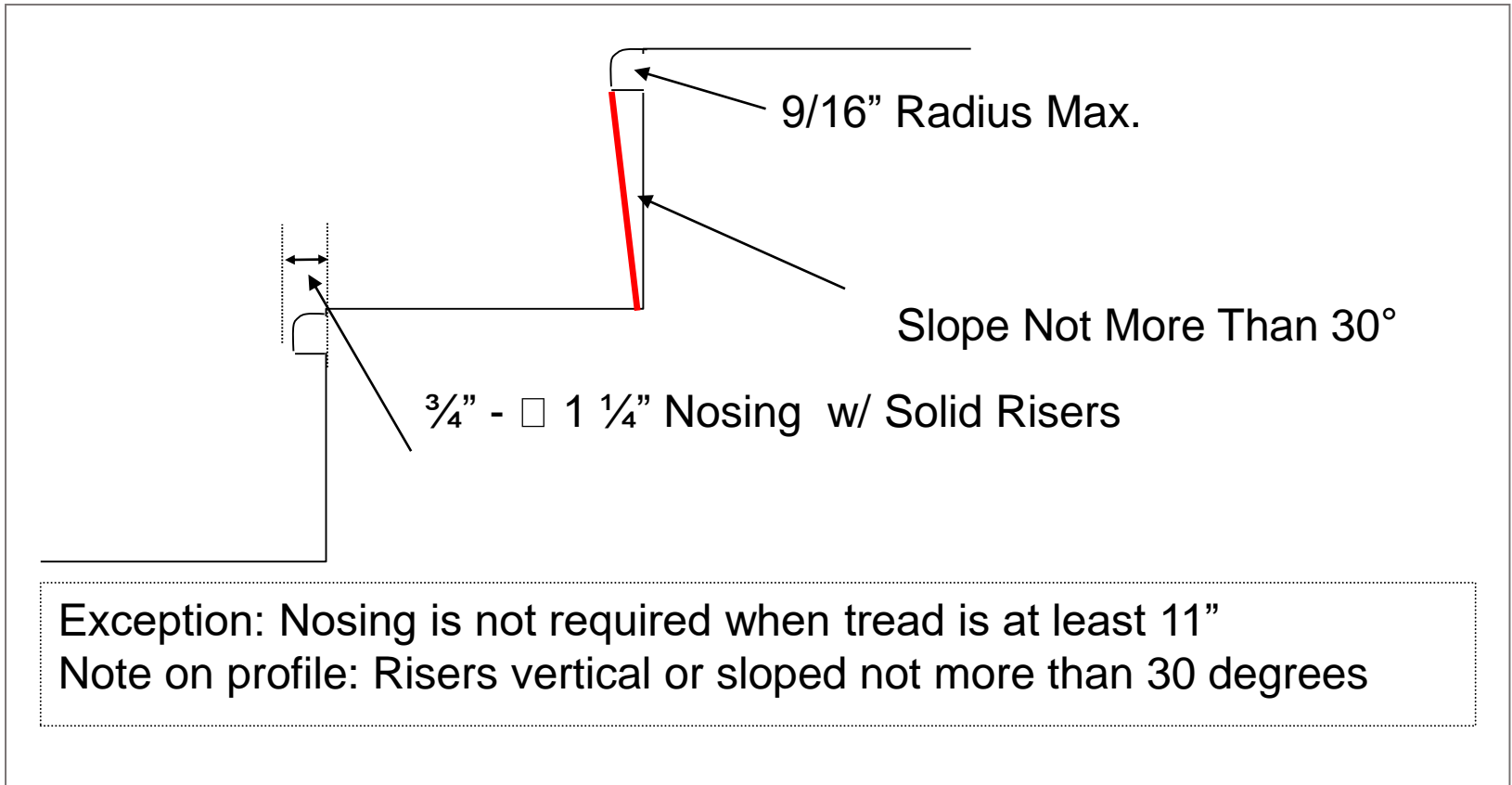
- Walkline **R311.7.4**
- Treads and risers **R311.7.5**

\* Stair treads & risers **R311.7.5**

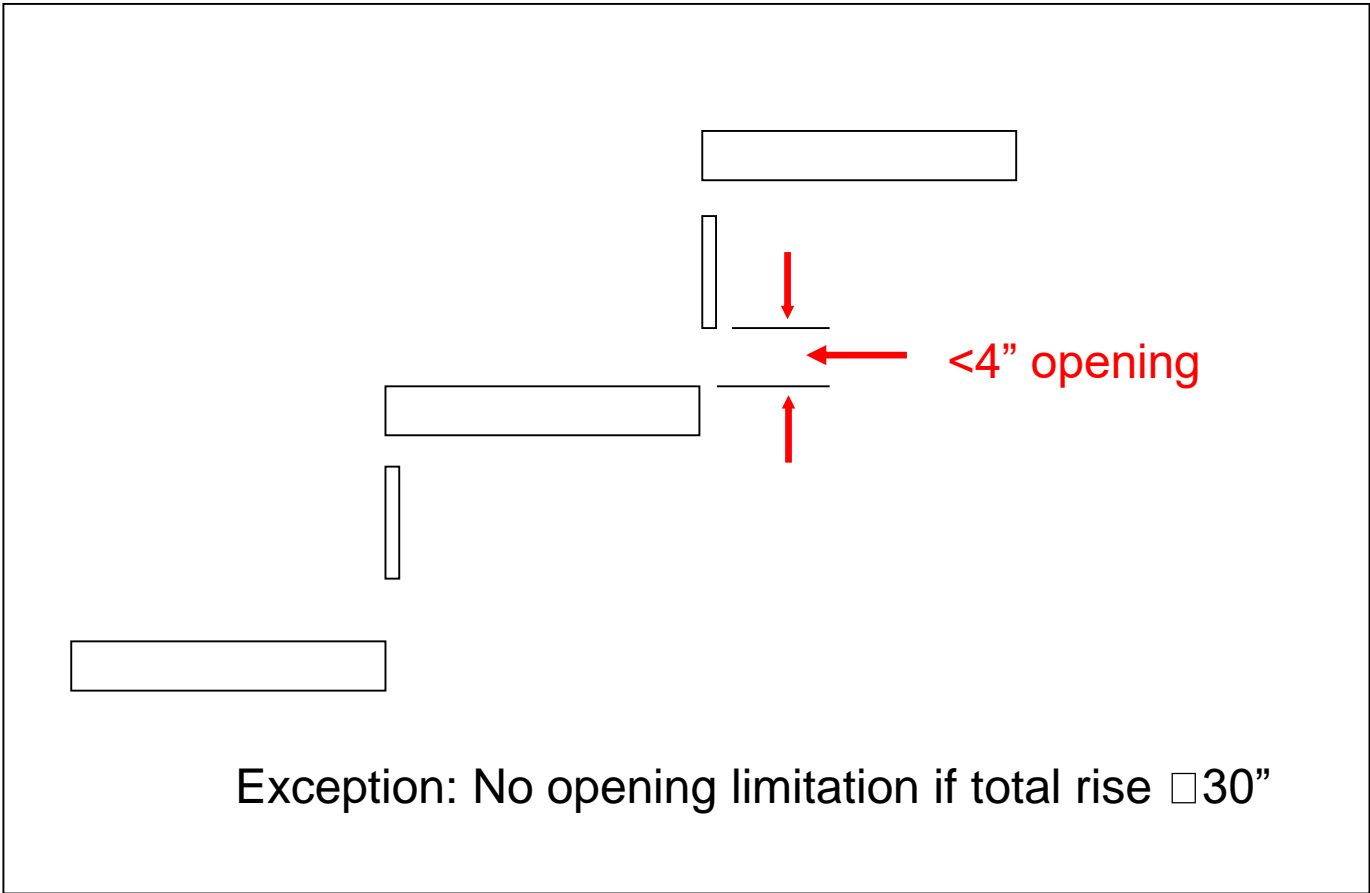




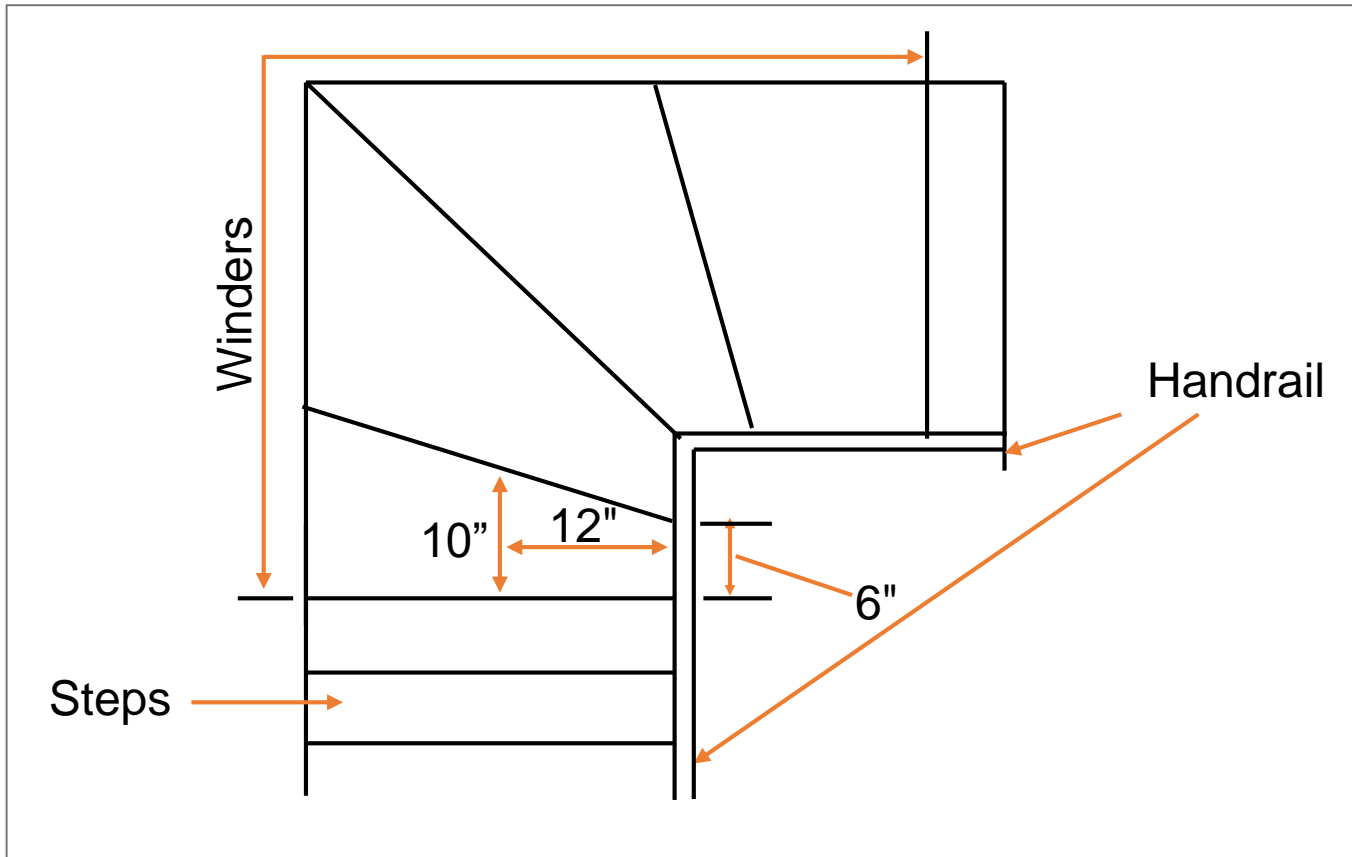
\* Nosings R311.7.5.3



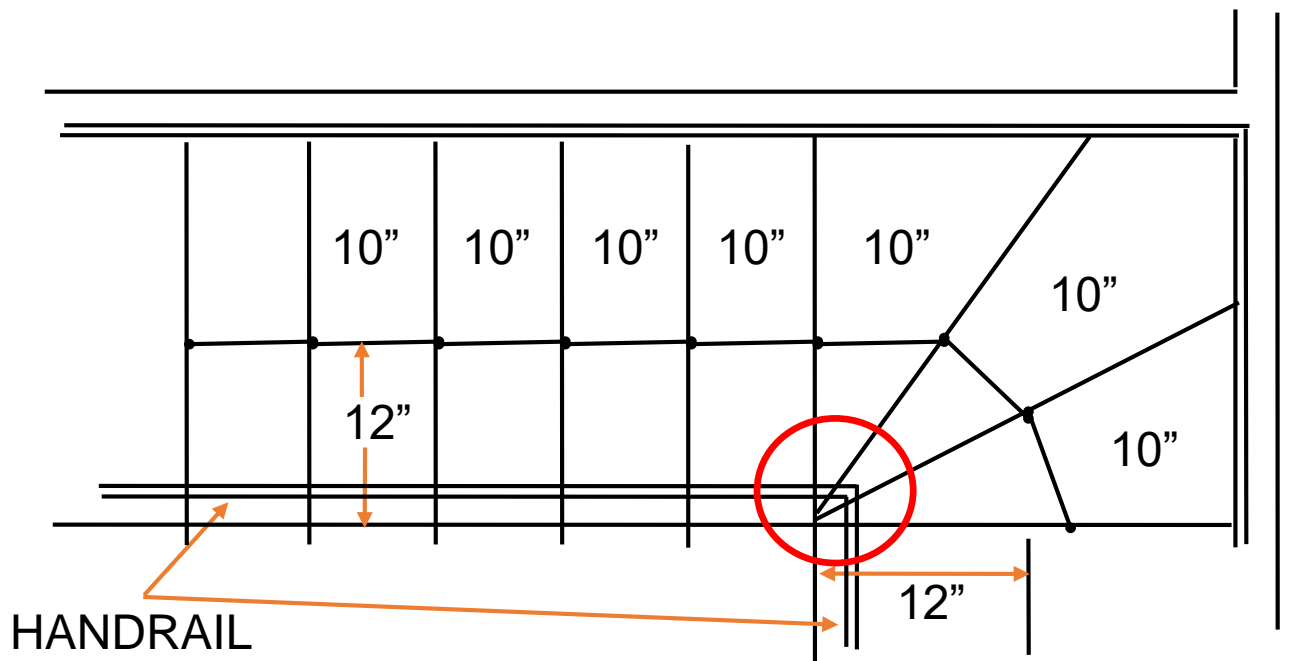
\* Risers exception R311.7.5.1



\* Winders R311.7.5.2.1



\* Winders R311.7.5.2.1

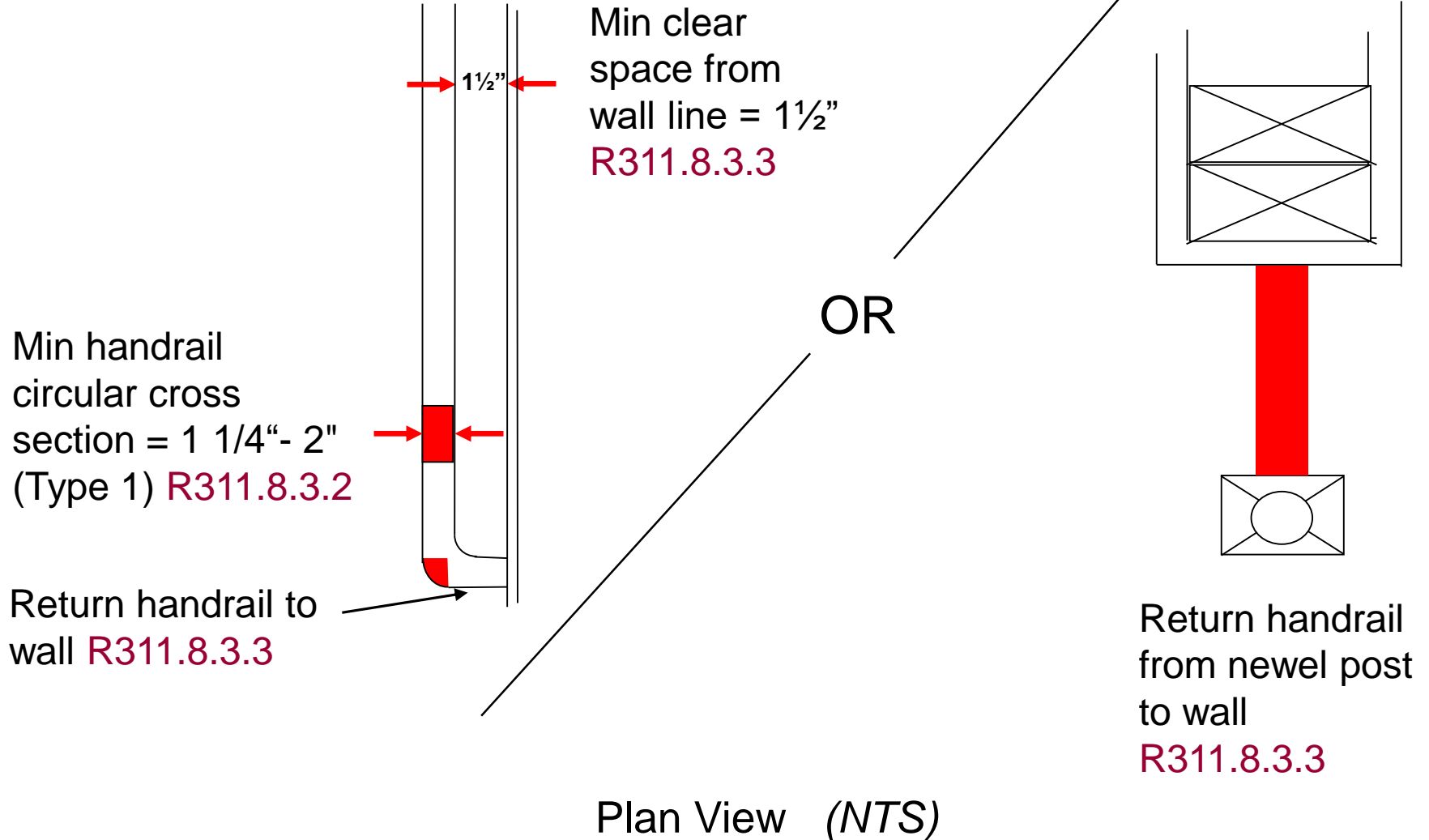


**Incorrectly constructed winders.** Note lack of minimum required tread width!

- \* Stairway walking surface maximum slope 1:48 (1/4" per foot) **R311.7.7**

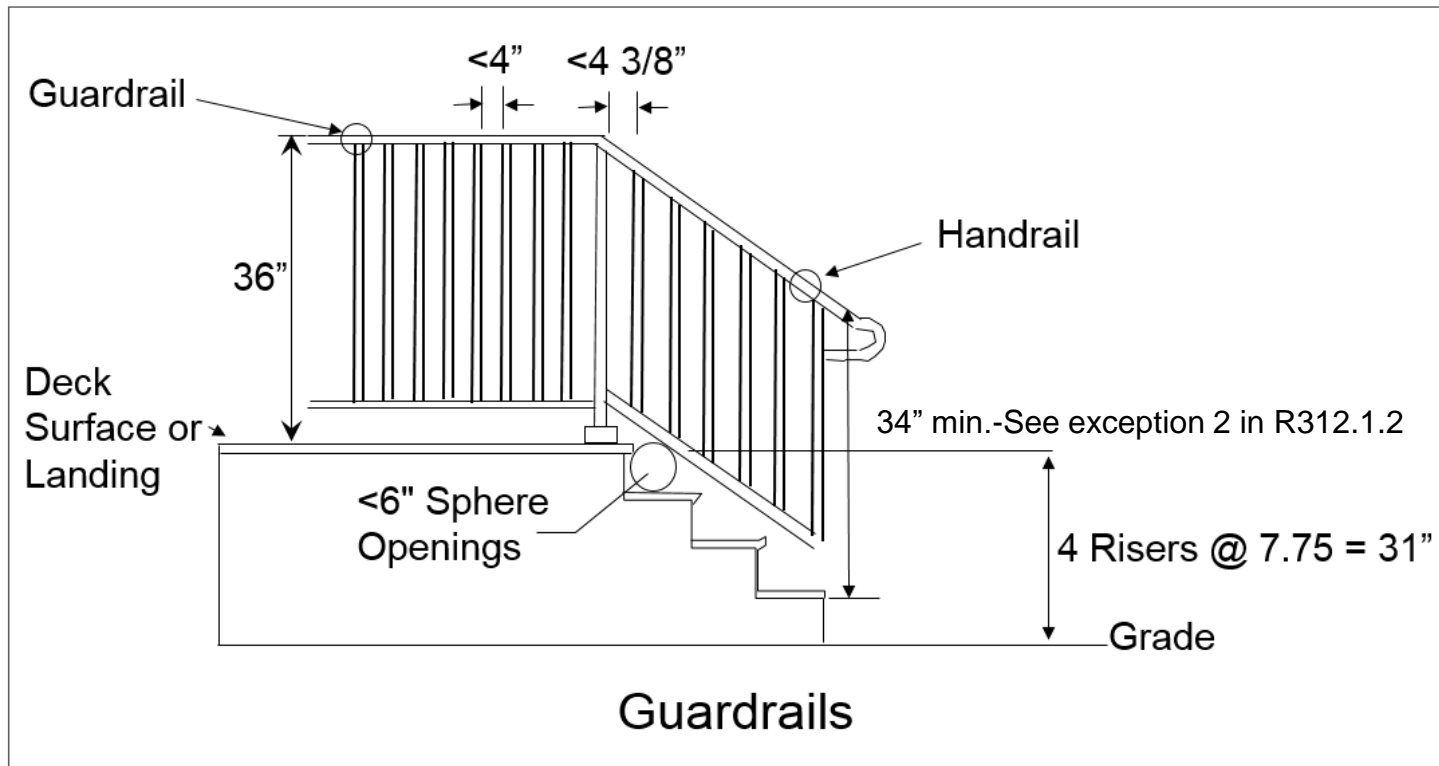


\* Handrails R311.7.8

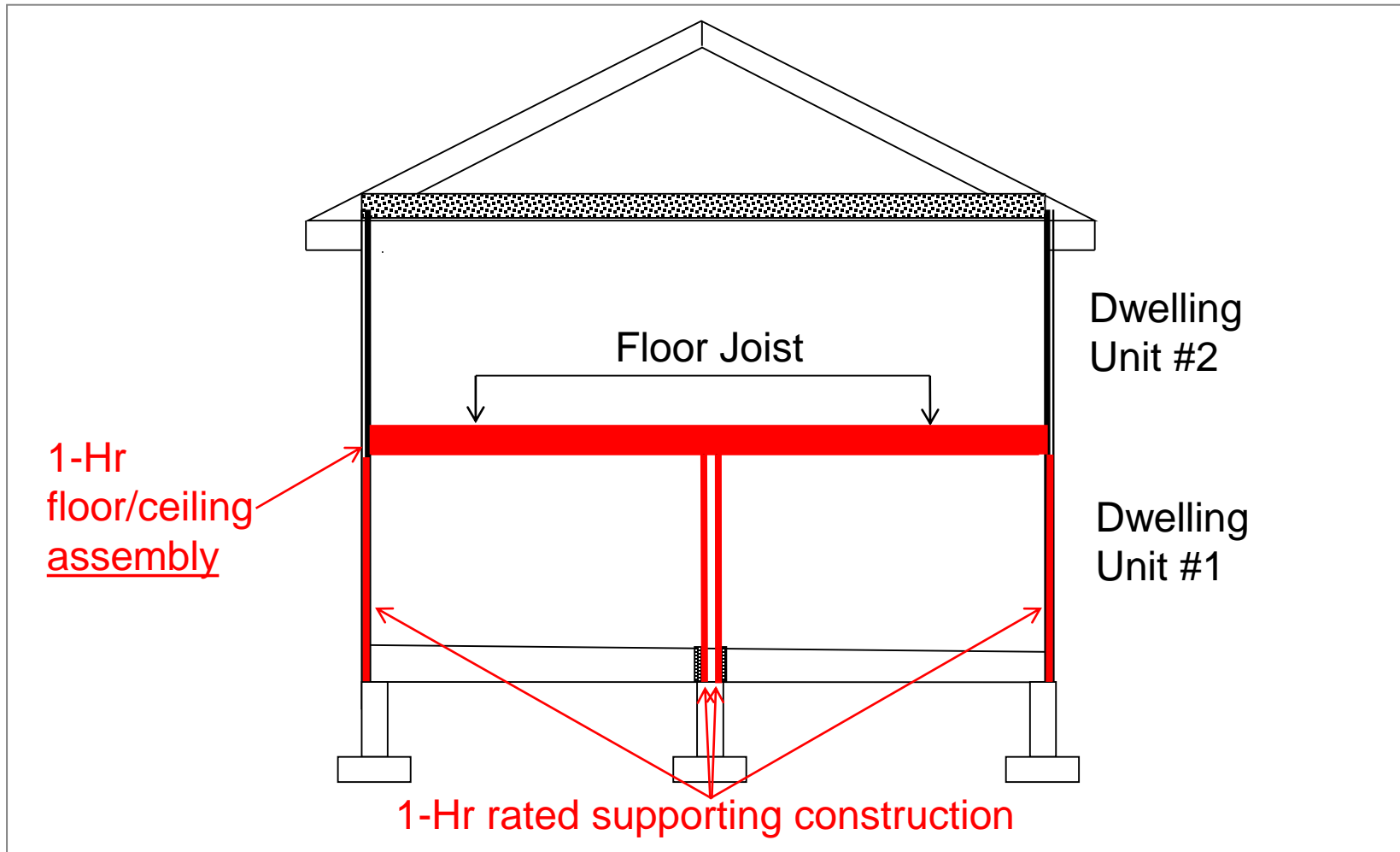


\* Guards **R312.1.1**

- Guard details cover porches, balconies, ramps or raised floors surfaces  $>30''$  above the floor require guards  $\geq 36''$  high
- Guard opening limitations



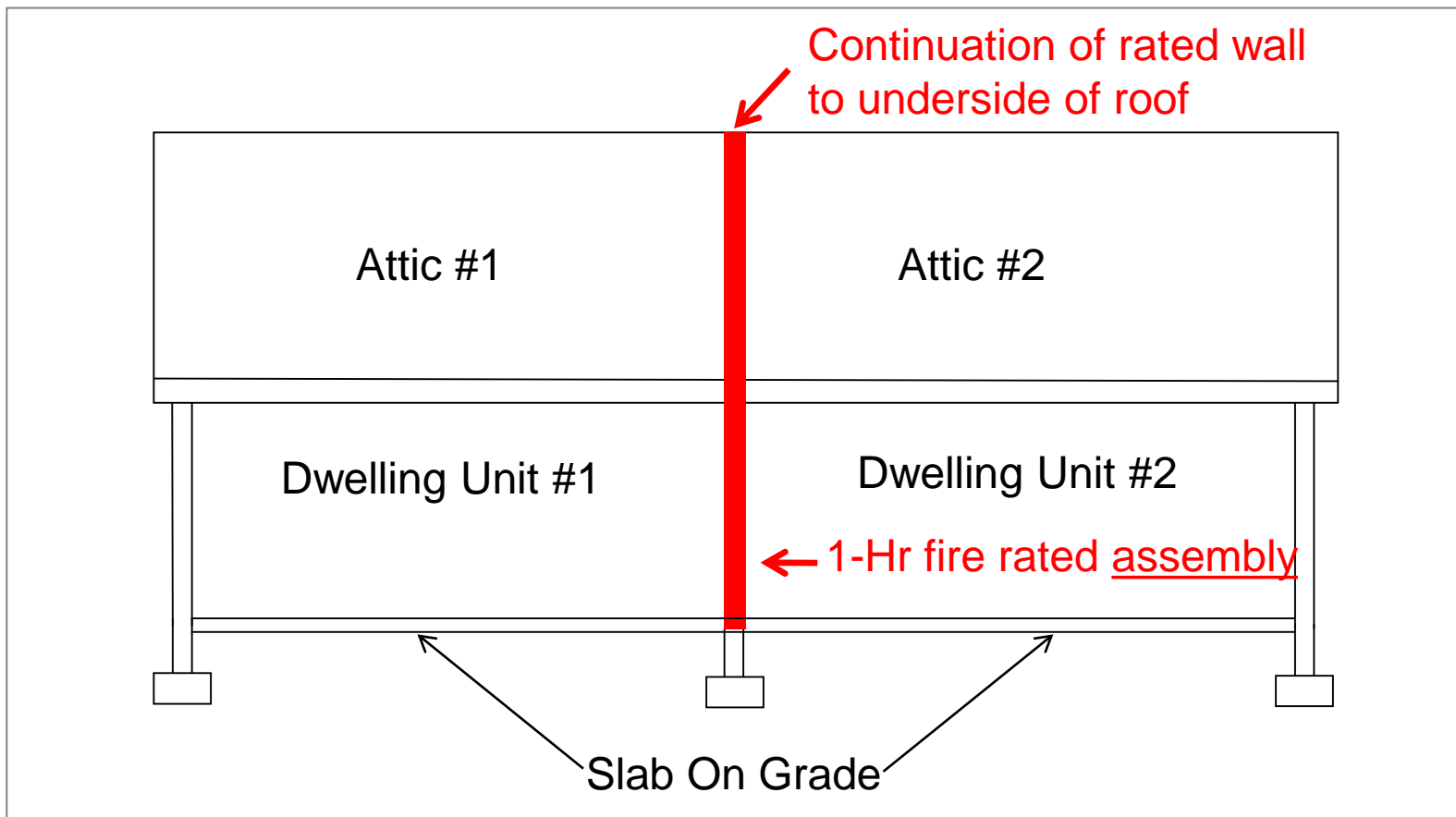
- \* Two-family required fire separation **R302.3**



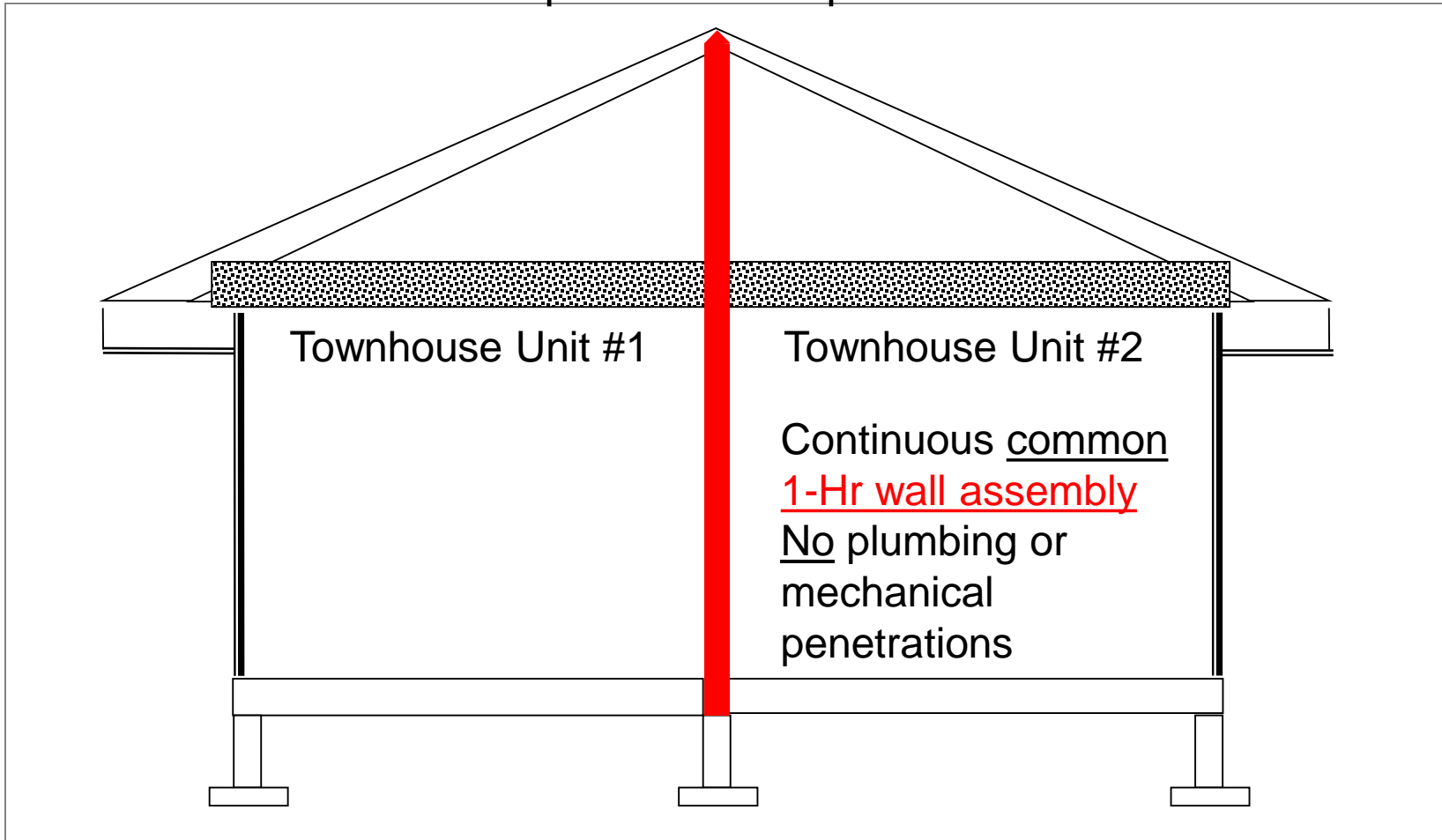


\* Two-family required fire separation **R302.3**

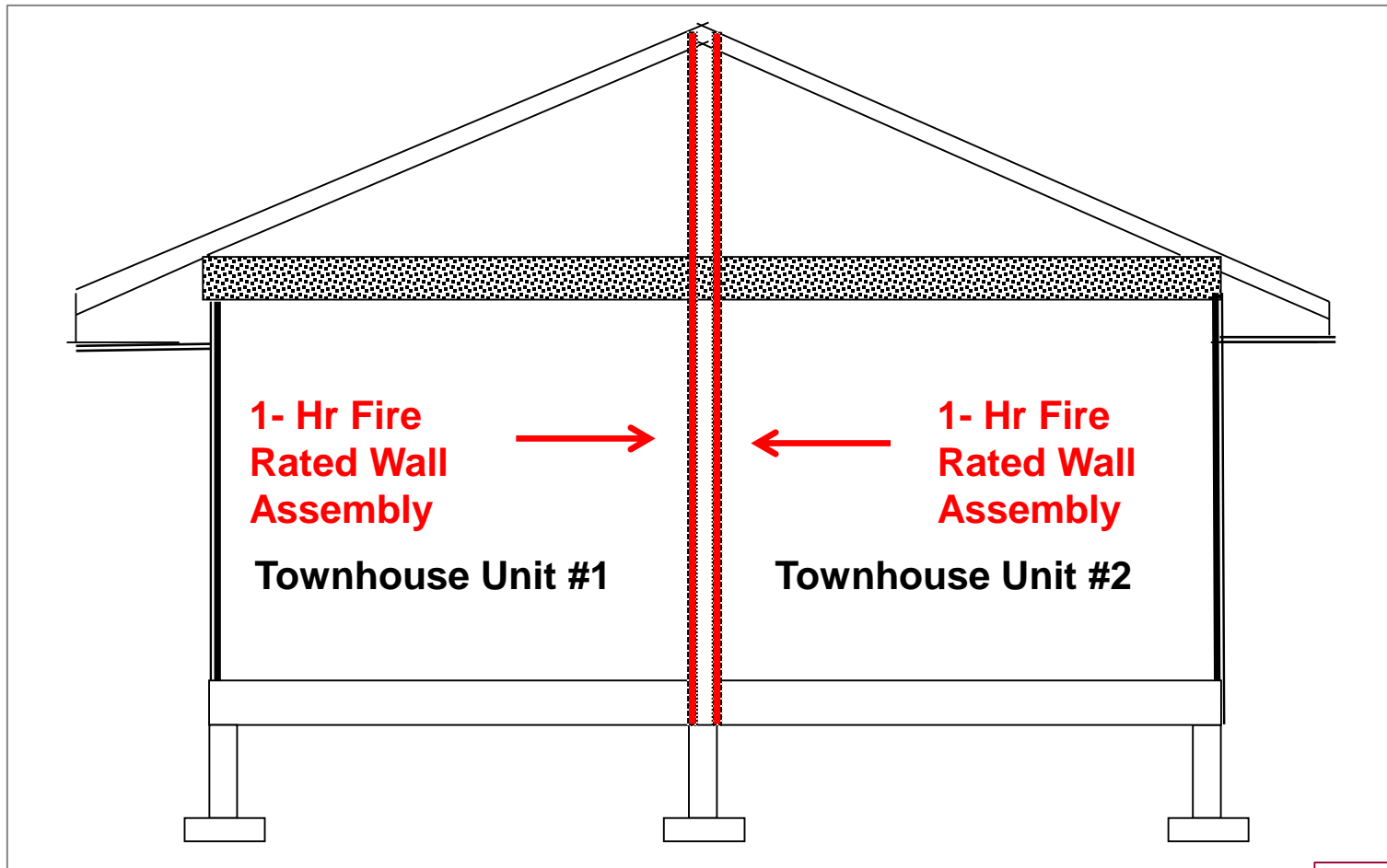
- Townhouse separations
- Parapets
- Continuity
- Structural Independence



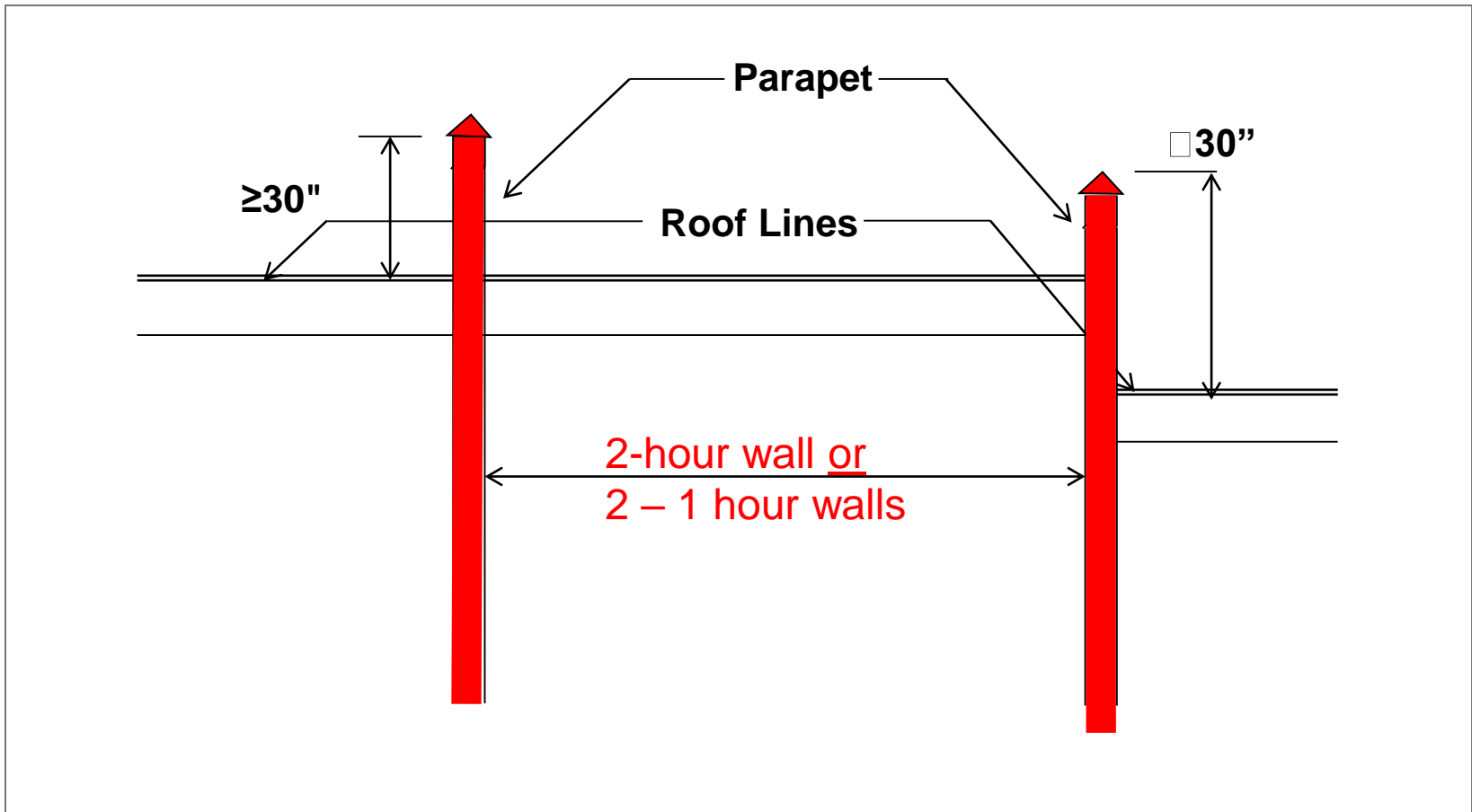
\* Townhouse fire separation exception **R302.2**



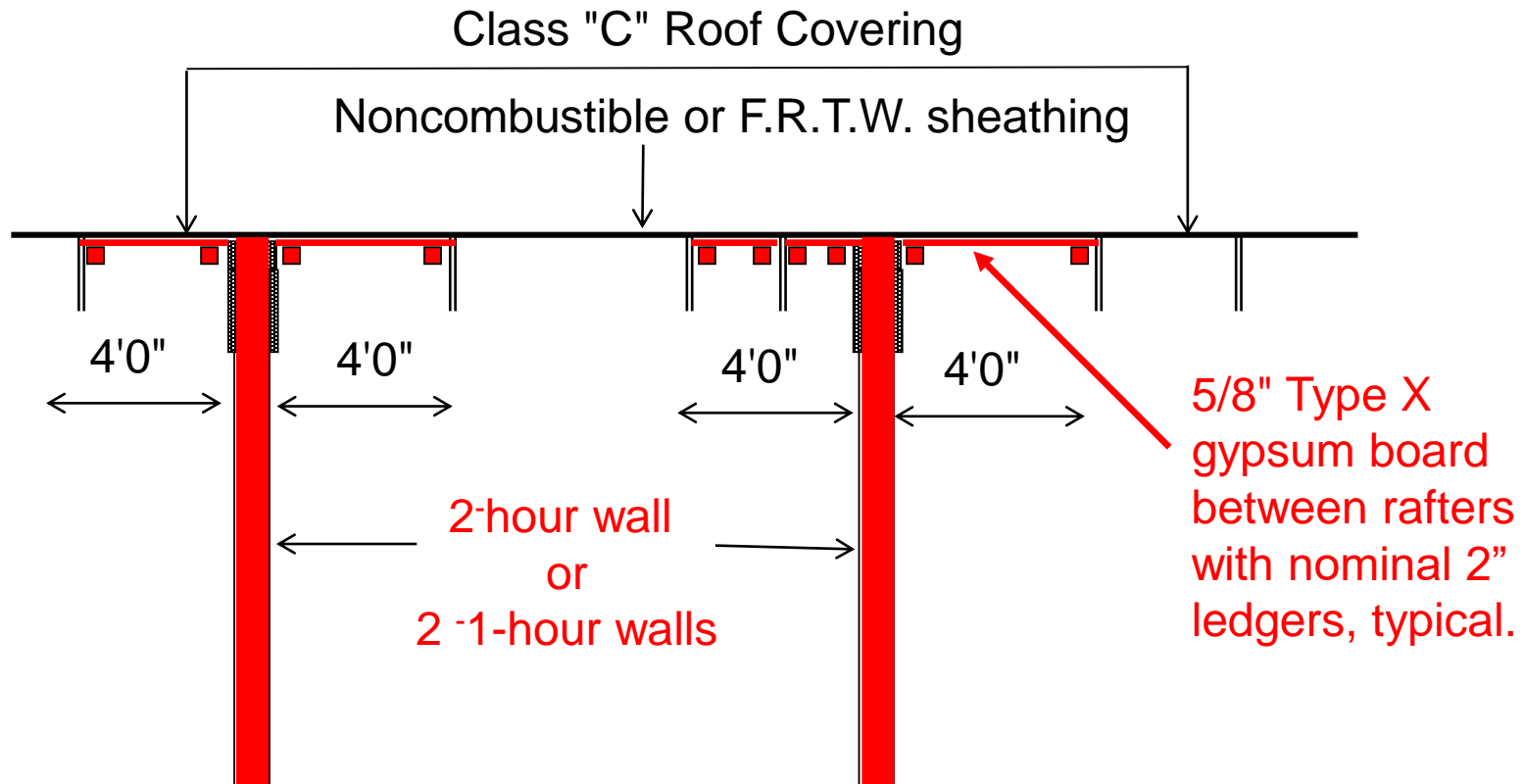
- \* Townhouse separations **R302.2**
  - Continuity of fire separation maintaining structural independence



\* Parapets R302.2.2



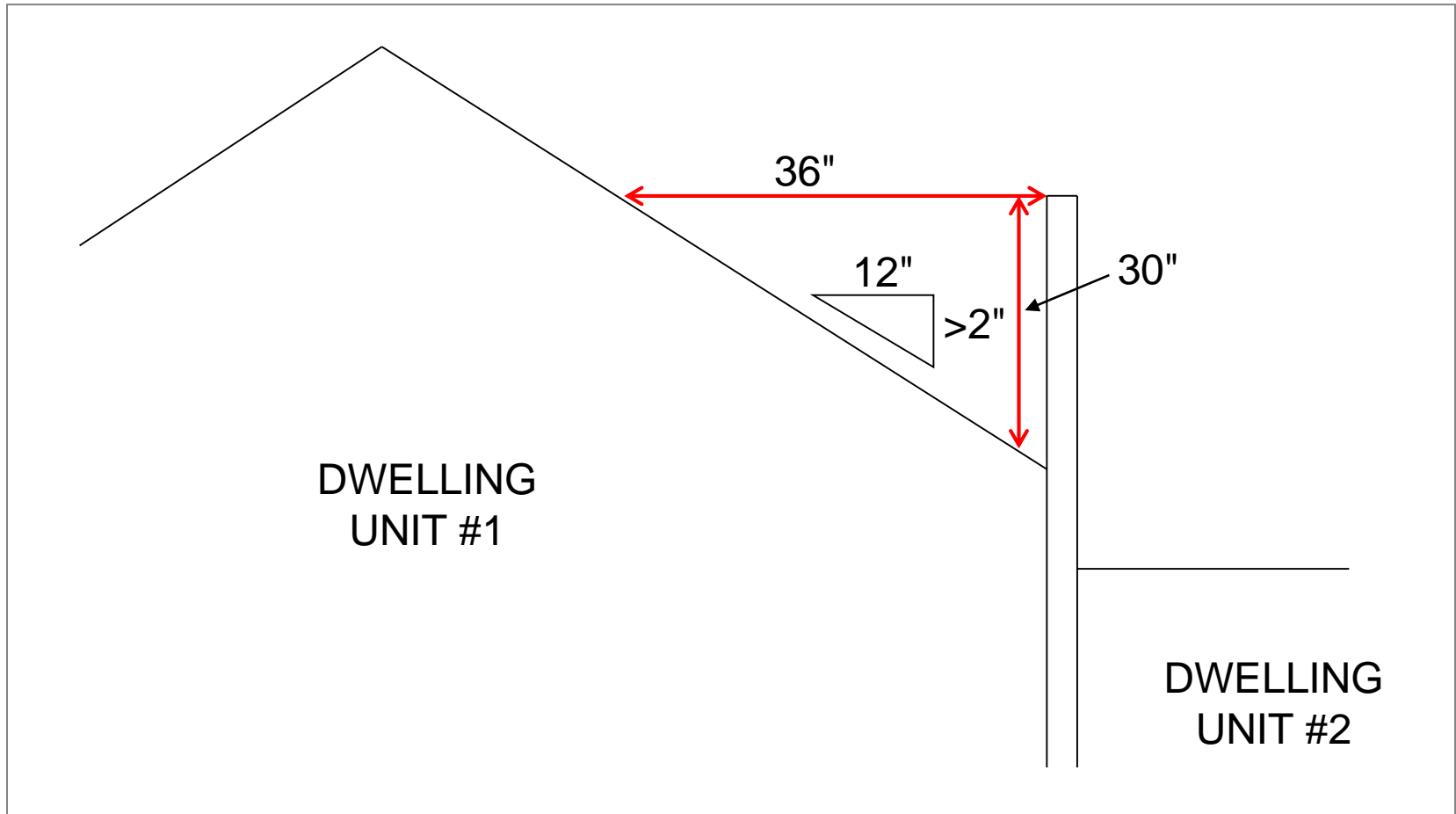
\* Parapets exception **R302.2.2**



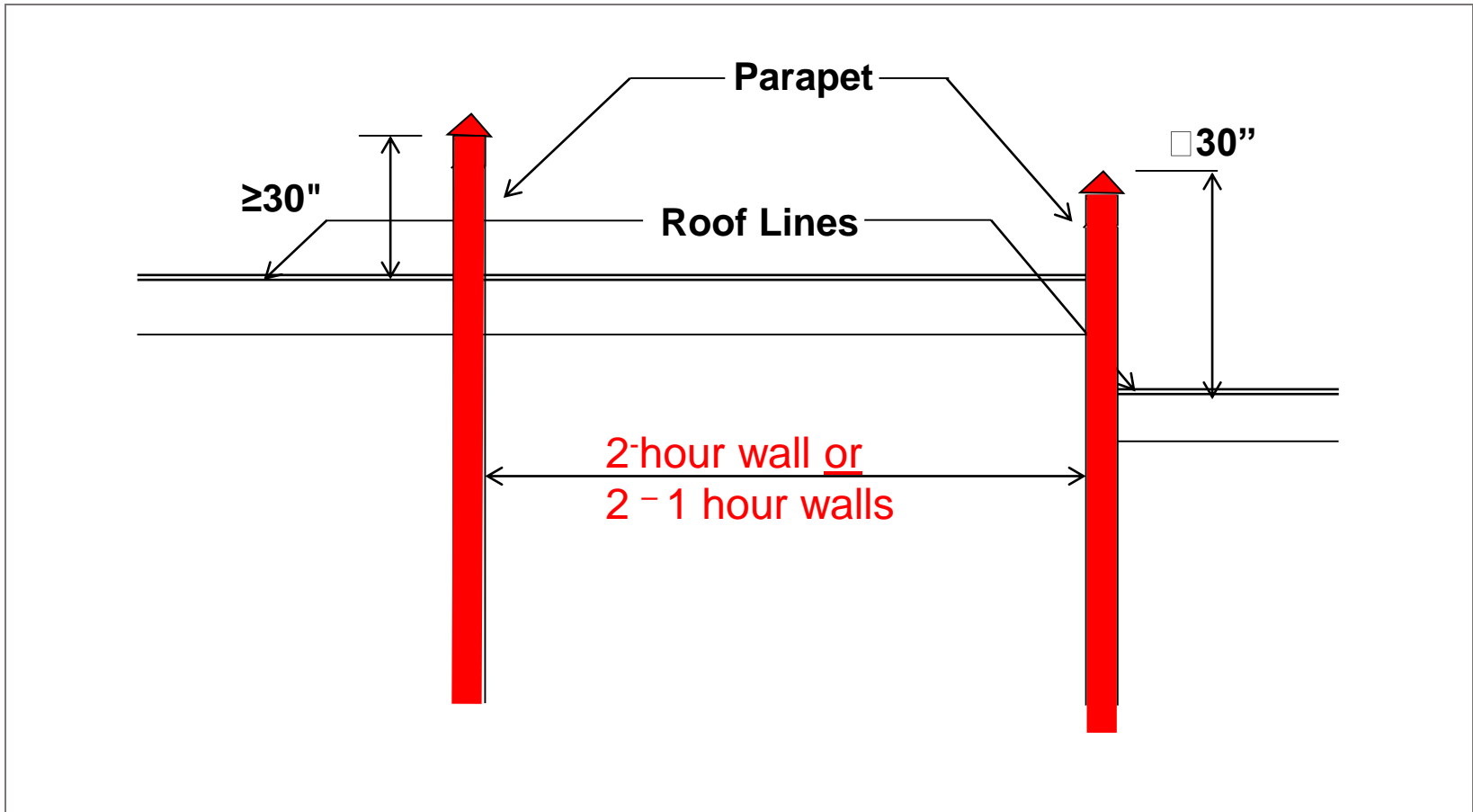
- \* Drywall placed under roof sheathing



\* Parapets R302.2.2



\* Parapets R302.2.2



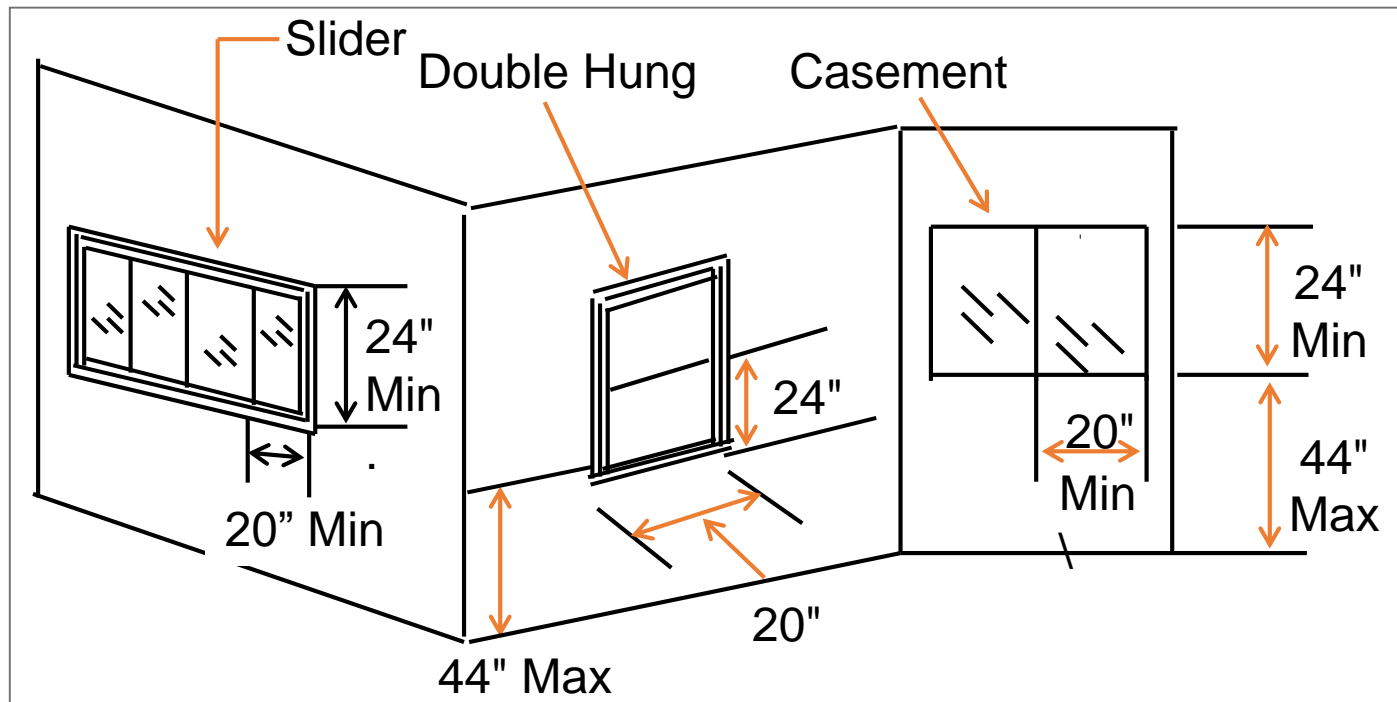


## ◆ Emergency Escape and Rescue Openings R310

- \* Emergency and escape route required **R310.1**
  - All basement bedrooms
- \* Requires emergency escape and rescue openings to open directly into public street, alley, yard or court
  - Windows
  - Below grade escape doors
  - Grade floor window (see definition)
  - Bars, grills and screens



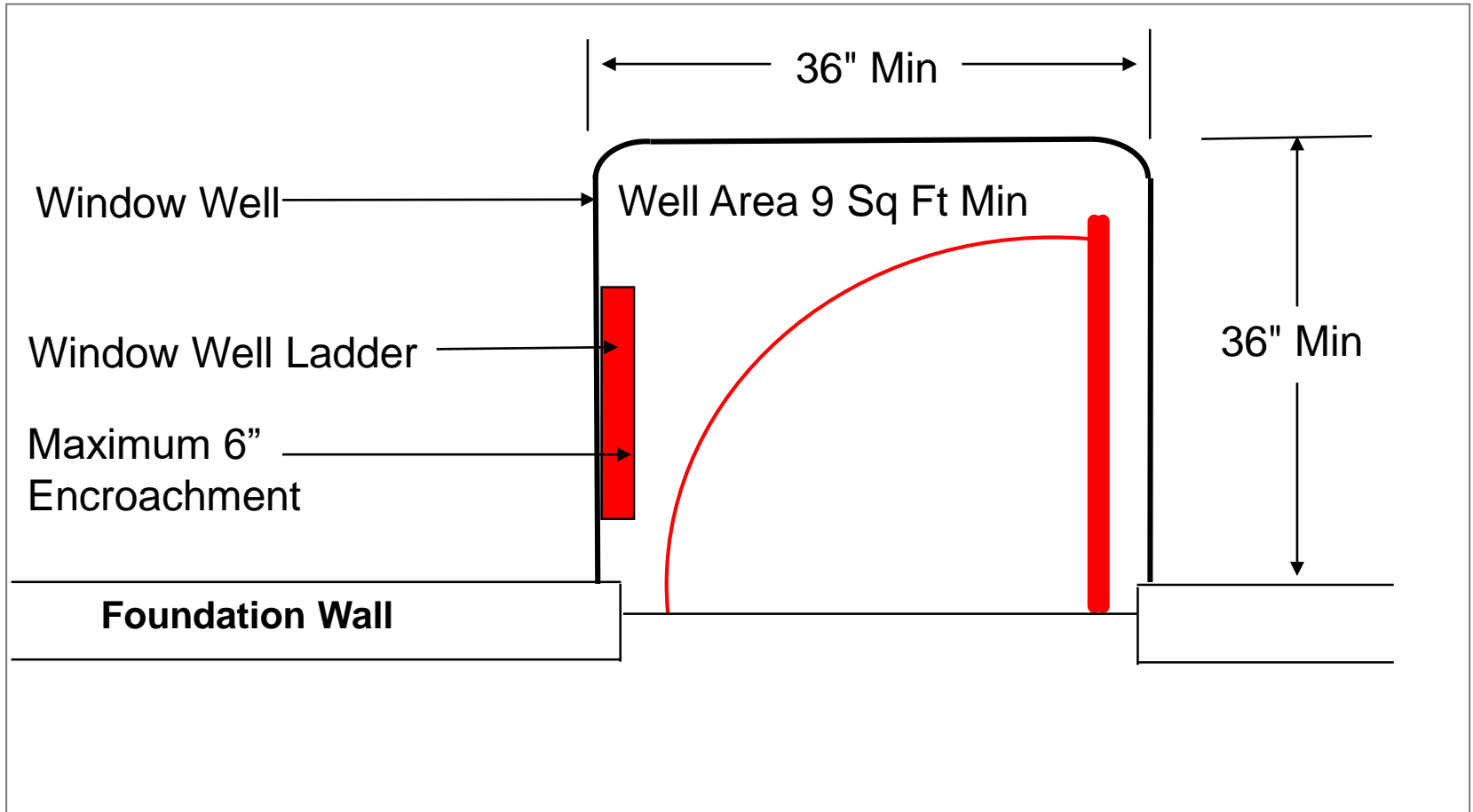
- \* Opening square feet
- \* Opening width and height
- \* Sill height



- \* Window well 310.2
  - Required if greater than 44” below grade
  - Permanently affixed
  - Usable with door or window fully open
  - 12” wide ladder rungs and project 3” from window well wall
  - Not more than 18” on center vertically for full height of well



\* Window Wells **R310.2**



## ◆ Fire-Resistance Ratings 703

### ◆ Fire-Resistance-Rated Assemblies 703.1

- \* Maintenance of materials, systems and assemblies used for fire resistance and fire-resistance-rated construction
- \* To safeguard against the spread of fire and smoke within a building and to or from buildings

### ◆ Unsafe Conditions 703.2

- \* Components or portions thereof shall be deemed unsafe conditions in accordance with **Section 111.1.1** of the **IFC**
  - Where the condition of components presents an imminent danger to the occupants, the Fire Code Official shall act in accordance with **Section 111.2** of the **IFC**

## ◆ Maintenance 703.3

- \* Maintenance of fire-resistance rating of fire-resistance-rated construction, including:
  - Walls
  - Firestops
  - Shaft enclosures
  - Partitions
  - Smoke barriers
  - Floors
- \* Fire-resistive coatings

- \* Maintenance of fire-resistance rating of fire-resistance-rated construction, including (*continued*):
  - Sprayed fire-resistant materials
  - Such elements shall be visually inspected by the annually by the owner and repaired, restored or replaced
  - Fire blocking and draft stopping **703.3.1**
  - Smoke barriers and smoke partitions **703.3.2**
  - Fire walls, fire barriers, and fire partitions **703.3.3**

## ◆ Opening Protectives 703.4

- \* Shall be maintained in accordance with **NFPA 80**
- \* Signs **703.4.1**
  - Permanently displayed on or near each fire door in letters not less than 1 inch high to read as follows:
    1. For doors designed to be kept normally open:  
FIRE DOOR – DO NOT BLOCK
    2. For doors designed to be kept normally closed:  
FIRE DOOR – KEEP CLOSED



- \* Hold-open devices and closers 703.4.2
  - Hold-open devices and automatic door closers shall be maintained
    - Door operation
- \* Ceilings 703.5
- \* Testing 703.6

## ◆ Vertical Shafts 703.7

- \* Interior vertical shafts which connect two or more stories of a building shall be protected as required in **Chapter 11** of the **IFC**. New floor openings in existing buildings shall comply with the **IBC**.

## ◆ Opening Protective Closers 703.8

- \* Shall be maintained as self-closing or automatic-closing by smoke detection

- ◆ Fire Protection Systems 704

- ◆ General 704.1

- \* Systems, devices, equipment that detect a fire, set off an alarm, suppress or control fire shall be maintained

## ◆ Standards 704.2

- \* Fire protection systems shall be inspected, tested and maintained in accordance with the referenced standards listed in **Table 704.2** and as required in this section

**TABLE 704.2  
FIRE PROTECTION SYSTEM MAINTENANCE STANDARDS**

SYSTEM	STANDARD
Portable fire extinguishers	NFPA 10
Carbon dioxide fire-extinguishing system	NFPA 12
Halon 1301 fire-extinguishing systems	NFPA 12A
Dry-chemical extinguishing systems	NFPA 17
Wet-chemical extinguishing systems	NFPA 17A
Water-based fire protection systems	NFPA 25
Fire alarm systems	NFPA 72
Smoke and heat vents	NFPA 204
Water-mist systems	NFPA 750
Clean-agent extinguishing systems	NFPA 2001



- \* Records information **704.2.2**
  - Name of installation contractor
  - Type of components installed
  - Manufacturer
  - Location and number of components per floor
  - Operation and maintenance instruction manuals
  - Maintained for the life of the installation

## ◆ Fire Systems Out of Service 704.3

- \* Fire department and Fire Code Official shall be notified immediately
- \* Either the building shall be evacuated or an approved fire watch shall be provided for all occupants left unprotected by shutdown
- \* Actions shall be taken in accordance with **Section 901** of the **IFC** to bring systems back in service
- \* Emergency impairments **704.3.1**
  - Appropriate emergency action shall be taken to minimize injury and damage
  - Impairment coordinator shall implement steps outlined in **Section 901.7.4** of the **IFC**

## ◆ Removal of or Tampering with Equipment 704.4

- \* It shall be unlawful to remove, tamper with or otherwise disturb any fire hydrant, fire detection and alarm system, fire suppression system
- \* Removal of or tampering with appurtenances 704.4.1
- \* Removal of existing occupant-use hose lines 704.4.2
  - The Fire Code Official is authorized to permit the removal of existing hose lines where all of the following apply:
    1. The installation is not required by the IFC or IBC
    2. The hose line would not be utilized by trained personnel or the fire department
    3. The remaining outlets are compatible with local fire department fittings



- \* Termination of monitoring service **704.4.3**
  - Notice shall be made to the fire code official in writing by the provider of the monitoring service whenever alarm monitoring services are terminated

## ◆ Fire Department Connection 704.5

- \* The fire department connection shall be indicated by an *approved* sign
- \* Fire department connection access 704.5.1
  - Exception:
    - Fences, with an access gate and sign complying with **Section 912.5** of the **IFC** and a means of emergency operation
- \* Clear space around connections 704.5.2



## ◆ Single- and Multiple-Station Smoke Alarms 704.6

### \* Interconnection 704.6.2

- Smoke alarms shall be interconnected
- Alarm shall be audible in all background noise levels

### \* Interconnection not required:

- Buildings not undergoing alterations, repairs, or construction
- Alterations or repairs do not result in exposing the structure



## ◆ Smoke Alarms 704.2

- \* Single or multiple station smoke alarms shall be installed in use group R, and I-1 occupancies
- \* Locations:
  - Ceiling or wall outside each separate sleeping area and by bedrooms
  - Each room used for sleeping purposes
  - In each story within a dwelling unit

- \* Power source **704.6.3** and **IBC 907.2.11.6**
  - Building and commercial source with battery back-up
  - Emit a signal when batteries are low
  - All wiring shall be without disconnecting switch other than overcurrent protection
  - Retrofit
    - Exception:

Battery operated may remain if no construction taking place

May be solely battery operated in buildings that are not served from a commercial power source

- \* Single- and multiple-station smoke alarms **704.7**
  - Shall be tested and maintained according to manufacturer
  - Those that do not function shall be replaced

## ◆ Carbon Monoxide Alarms and Detection **705**

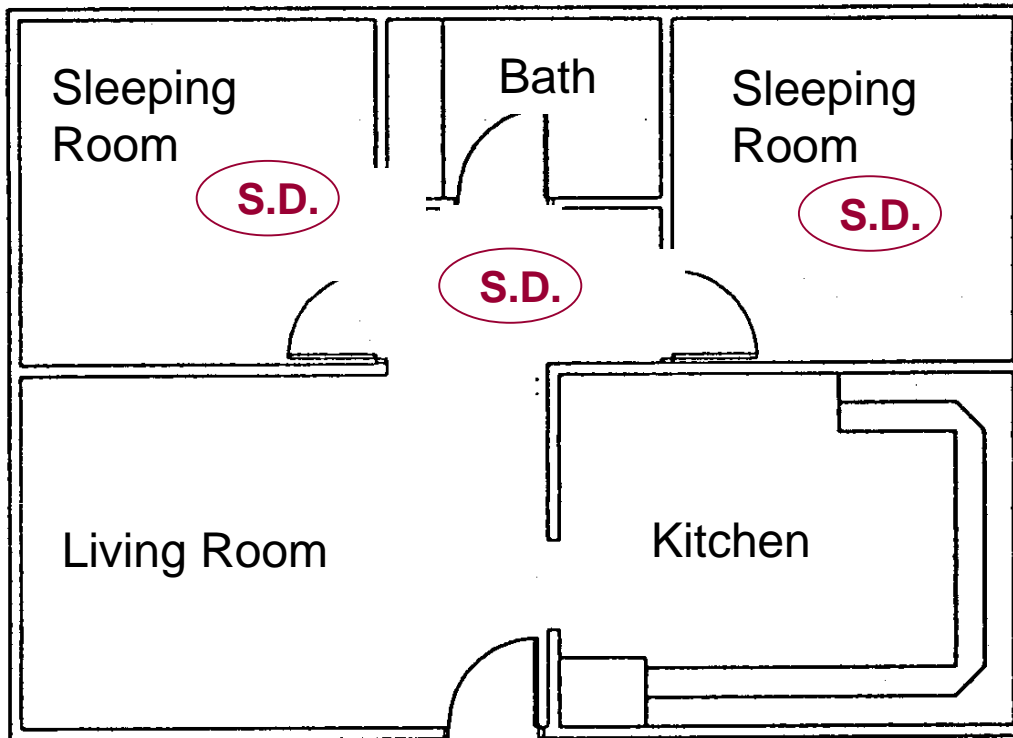
### ◆ General **705.1**

- \* Carbon monoxide alarms shall be installed in dwellings in accordance with **Section 1103.9** of the **IFC**
- \* Exception:
  - Alarms in dwellings covered by the **IRC** shall be installed in accordance with **Section R315**

## ◆ Smoke Alarms R314

\* Number and locations required

Sleeping Area <b>R-1</b> <b>S.D.</b>	Common Areas Within Suite <b>R-1</b> <b>S.D.</b>	Each level if multiple levels R-1 Except: Split-levels w/o intervening doors
--------------------------------------	--	---



Groups **R-2, R-3, R-4** and **I-1**

All sleeping areas  
 Immediate vicinity of bedrooms  
 All stories including basements

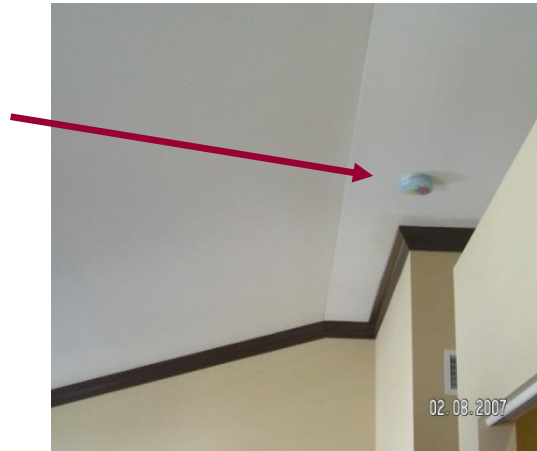
**S. D. = Smoke Detector**

Except:  
 Split-levels without  
 intervening doors

- \* Single- or multiple-station smoke alarms shall be installed in use group R-2, R-3, R-4 & in dwellings
- \* Locations:
  - Ceiling or wall outside of each separate sleeping area and bedrooms
  - Each room used for sleeping purposes
  - Each story within a dwelling unit
  - All other groups in accordance with the IFC

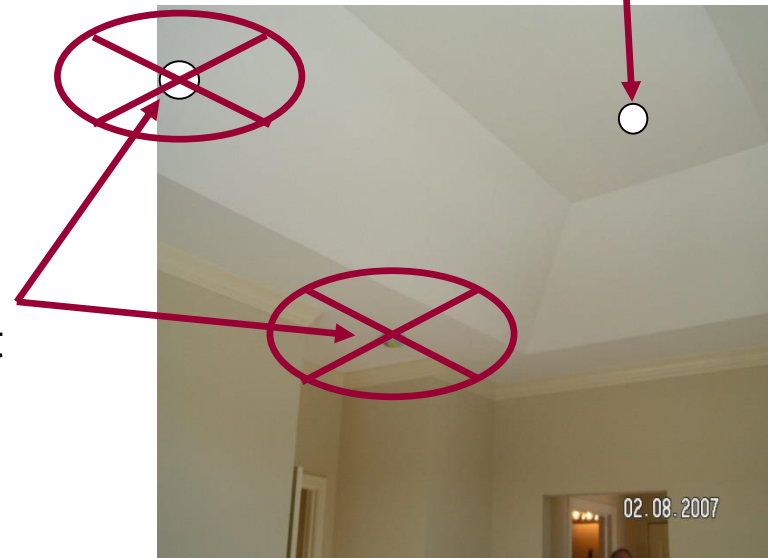


- \* Sloped ceiling...  
Smoke Alarm placed  
at high point - OK



Move Smoke Alarm  
to here

Soffited ceiling Smoke Alarm  
needs to be placed at high point



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### CASE STUDIES

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## ◆ Class Case Study Number 1

- \* Inspector Bob receives a complaint regarding an in ground swimming pool being installed at 101 Main Street. No other information is given. The Building Department records are checked for permit information. No pool permits have been issued or applied for at this address. Inspector Bob arrives at the property and observes a truck parked in the driveway. The truck has a sign on it, “Pools R Us.” Inspector Bob proceeds to the backyard upon hearing construction equipment.
- \* Answer the following:
  - Does Inspector Bob need permission from the owner to proceed to the backyard?
  - Can Inspector Bob instruct the contractor to stop work at once?
  - Could there be circumstances that the Inspector would allow the contractor to continue to work?

## ◆ Class Case Study Number 2

- \* Inspector Joe receives a complaint regarding a rental house at 111 Lee St being overcrowded. The property is zoned as single family detached. Inspector Joe arrives and observes the following:
  - a) There are 6 vehicles in the driveway.
  - b) Numerous car parts are scattered throughout the yard.
- \* Answer the following:
  - What is the first thing Inspector Joe should do?
  - How can Inspector Joe find out who lives there?
  - How can Inspector Joe determine how many people are allowed to live there?
  - Could there be any exterior indications that would verify an overcrowding condition or more than one dwelling unit?

## ◆ Class Case Study Number 3

- \* Over the past 2 years you have been working with the Smith's on numerous code violations such as:
  - Tall grass and weeds
  - Automobiles in disrepair on the property
  - Piles of construction lumber in the rear yard waiting for the right time to be used
  - Peeling paint on the house and eaves
  - Eaves are rotted out
  - Window framing is rotted out
  - Roof leaks
  - Numerous debris scattered throughout the yard

## ◆ Class Case Study Number 3 (*continued*)

- \* The homeowner has been working on these things when money and time allows. You have informed them that they must show they are working on these issues or a ticket will be issued. The neighbors have been complaining about this house for years.
- \* Over the weekend the roof was completely redone, shingles were installed over the existing 2 layers. The City's local ordinance does not allow more than 2 layers of shingles on the roof.
- \* The neighbors have filed a formal complaint that the roof was repaired without a building permit as required by the City. The neighbors are unaware of the ordinance regarding the number of layers of shingles permitted.
- \* Answer the following:
  - What should you, as the Inspector, do or not do?

## ◆ Class Case Study Number 4

- \* Neighbor B complains to Inspector Mike, “They are at it again, neighbor A’s yard is always a mess and I want it cleaned up.”
- \* Neighbor A is a single mother with eight children. Inspector Mike has received numerous complaints over the past three years regarding tall grass, peeling paint on the house, and overcrowding. Upon arriving at the residence, he observes:
  - In the front yard there are 5 bikes laying on their side and numerous dolls and dollhouses.
  - In the rear yard there are 3 big wheels and numerous toys strewn throughout the yard which go to the 2’ inflatable pool.
  - The garbage cans are overflowing in the rear yard at the alley and the shed has a 2’ x 2’ hole in the side. It appears that the children were using the shed as a backstop when playing baseball.

## ◆ Class Case Study Number 4 (*continued*)

- \* The children range in age from 14 years to 1 year old.
- \* There is no fence separating neighbor A from neighbor B.
- \* What action should Inspector Mike make at first?
  - Does the Property Maintenance Code address clutter or a property in disorder?
  - The mother is at work and the 14 year old is in charge, can Inspector Mike enter the property?



## ◆ Class Case Study Number 5

- \* A renter complains that the landlord has turned their water off for not paying the rent.
- \* You, the Inspector, schedule a time to meet the renter and inspect the dwelling.
- \* The dwelling is a 2-story home with a basement in a zoning district that allows up to two units per zoning lot. The renter you meet rents a portion of the first floor.
- \* The building has been remodeled into 4 dwelling units. There are 2 units on the first floor, 1 upstairs and 1 in the basement.
- \* Access into the building is through the front door; there is a rear stairway for the 2nd floor tenant and a rear exit for 1 tenant on the 1st floor. The renter offers to take you through the entire building.

## ◆ Class Case Study Number 5 (*continued*)

\* Answer the following:

- Can the renter take you through the entire building?
- All tenants have given keys to the renter you are meeting with to go through their units.
- The utility room with the electrical panel, water meter and HVAC is in the basement. You must go through the basement tenant's area to get to the utility room. Can you go with the renter or not?
- The plumbing system has been redone so water for each unit can be shut off.
- The utility room is locked but the tenant has a knife to open the door.
- What steps should you, as the Inspector, take to resolve the complaint?

## ◆ Chapter 7: Case Study 1

- \* During a re-occupancy inspection of a 3 story apartment building which has 6 units on each floor, you observe that the stairway doors have glass in them which was not there during the last inspection.
- \* Answer the following:
  - The building manager indicates that they had a couple of problems with people being hit by the doors so they installed the glass for vision. Is there a problem with the doors?
  - The building manager states that they thought of removing the doors entirely since the building was sprinklered. Is this an option?
  - In another building all of the stairway doors are held open by door shims. Is there a problem with this, and if so, why?

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Questions?

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**Thank You For Your Time**

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This concludes the American Institute of Architects  
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**WELCOME!**

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Inspection Cross Training ©**

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**International Property  
Maintenance Code**



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CONTINUING EDUCATION<sup>®</sup>



315

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## Learning Objectives / Learning Outcomes

Students will identify and discuss the minimum requirements for plumbing, mechanical system, and basic fire safety.

Students will compare and contrast procedures for administration of property maintenance programs based on data resulting from both well-demined and poorly managed communities.

Students will analyze and apply enhanced property maintenance skills to code enforcement officials, inspectors, property managers and real estate assessments.



# Layout of the Code

Preface.....	iii - vi
Effective Use of the Property Maintenance Code.....	vii - ix
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## ◆ Marginal Markings

█ Bold line in margin indicates change from previous editions of IPMC

➔ Arrow in margin indicates deletion of:

Entire section

Paragraph

Exception, or

Table

\* Single asterisk in margin indicates text or table relocated in code

\*\*Double asterisk in margin indicates text or table immediately following has been relocated from elsewhere in the code

## ◆ Code Development Committee Responsibilities

- \* Letter designations in front of section numbers
  - [A] Administrative Code Development Committee
  - [F] International Fire Code Development Committee
  - [P] International Plumbing Code Development Committee
  - [BE] IBC – Means of Egress Code Development Committee
  - [BG] IBC – General Code Development Committee

# Table of Contents

- \* Scope and Administration .....Chapter 1
  - Part 1 - Scope and Application
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- \* Definitions ..... Chapter 2
- \* General Requirements ..... Chapter 3
- \* Light, Ventilation and Occupancy Requirements ..... Chapter 4
- \* Plumbing Facilities and Fixture Requirements ..... Chapter 5
- \* Mechanical and Electrical Requirements .....Chapter 6
- \* Fire Safety Requirements ..... Chapter 7
- \* Referenced Standards ..... Chapter 8
- \* Boarding Standard ..... Appendix A
- \* Index



Building & Fire Code Academy

Understanding the 2018  
International Property  
Maintenance Code®

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Chapter 1  
Administration

## ◆ General 101

## ◆ Scope 101.2

- \* All existing residential / non-residential structures and premises
- \* Responsibility of owners, an owner's authorized agent, operators and occupants
- \* Regulates minimum maintenance standards

## ◆ Intent 101.3

- \* Ensure public health, safety and welfare as affected by continued occupancy and maintenance of structures and premises

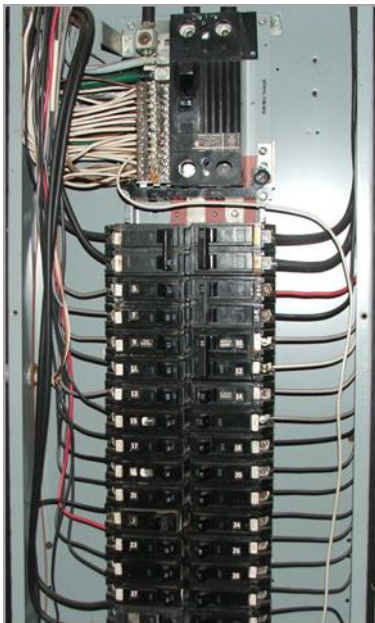




## ◆ Applicability 102

### \* Maintenance 102.2

- “No owner, owner’s authorized agent, operator or occupant shall cause any service facility equipment or utility to be removed or shut off or disconnected for any occupied dwelling except for temporary interruption as necessary while repairs or alterations are in progress.”



## ◆ Application of other codes 102.3

- Previously, the **International Existing Building Code** was the governing code
- Now, repairs, additions, or alterations to a structure or changes of occupancy shall be done in accordance with:
  - **International Building Code**
  - **International Existing Buildings Code**
  - **International Energy Conservation Code**
  - **International Fire Code**
  - **International Fuel Gas Code**

- Now repairs, additions, or alterations to a structure or changes of occupancy shall be done in accordance with: *(continued)*
  - International Mechanical Code
  - International Residential Code
  - International Plumbing Code and NFPA 70 (Electric Code)

## PART 2 – ADMINISTRATION AND ENFORCEMENT

- ◆ Department of Property Maintenance Inspection 103
  - \* Details and authorizes the creation of the department
  - \* Authorizes appointment of an official and deputies
  - \* Contains liability indemnification clause
  - \* Provides for creation and charging of fees for services



## ◆ Liability 103.4

- \* BO, BOA members, department employees enforcing this code:
  - Acting in good faith, and
  - Without malice
- \* Not rendered liable civilly or criminally liable personally
- \* Relieved from all personal liability as a result of an act or omission arising from discharge of official duties for any damage to:
  - Persons
  - Property



## ◆ Legal defense 103.4.1

- \* Jurisdiction's legal representative to represent any employee until final determination against:
  - Any suit or
  - Criminal complaint arising from lawful discharge of official duties



## ◆ Duties and Powers of the Code Official 104

\* **Section 104** establishes the authority to:

- Create rules necessary to protect public health, safety, and welfare
- Conduct inspections
- Issue notices and orders
- Keep official records of the department





## 4<sup>th</sup> Amendment to the U.S. Constitution

“The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no warrants shall issue but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.”





## ◆ Right of Entry 104.3

- \* Access into vacant premises
  - Reasonable effort to locate, request entry
  - Added “owner’s authorized agent” to description of whom shall be the subject of such reasonable effort to locate



Send	To...	Absentee P. Owner
	CC...	Agent of Absentee P. Owner
	Subject	Official Request To Enter Premises

In reference to property located at 1234 North 5<sup>th</sup> Street, Qurtown, USA

Dear Mr. Absentee P. Owner:

We have received numerous complaints regarding the condition of the interior of the above captioned premises, which official tax records indicate you own.

Please contact this office within the next 10 days to arrange access to the above captioned premises for the purpose of an interior inspection.

If we do not hear from you within 10 days we will pursue other legal action to obtain access.

Thank you.

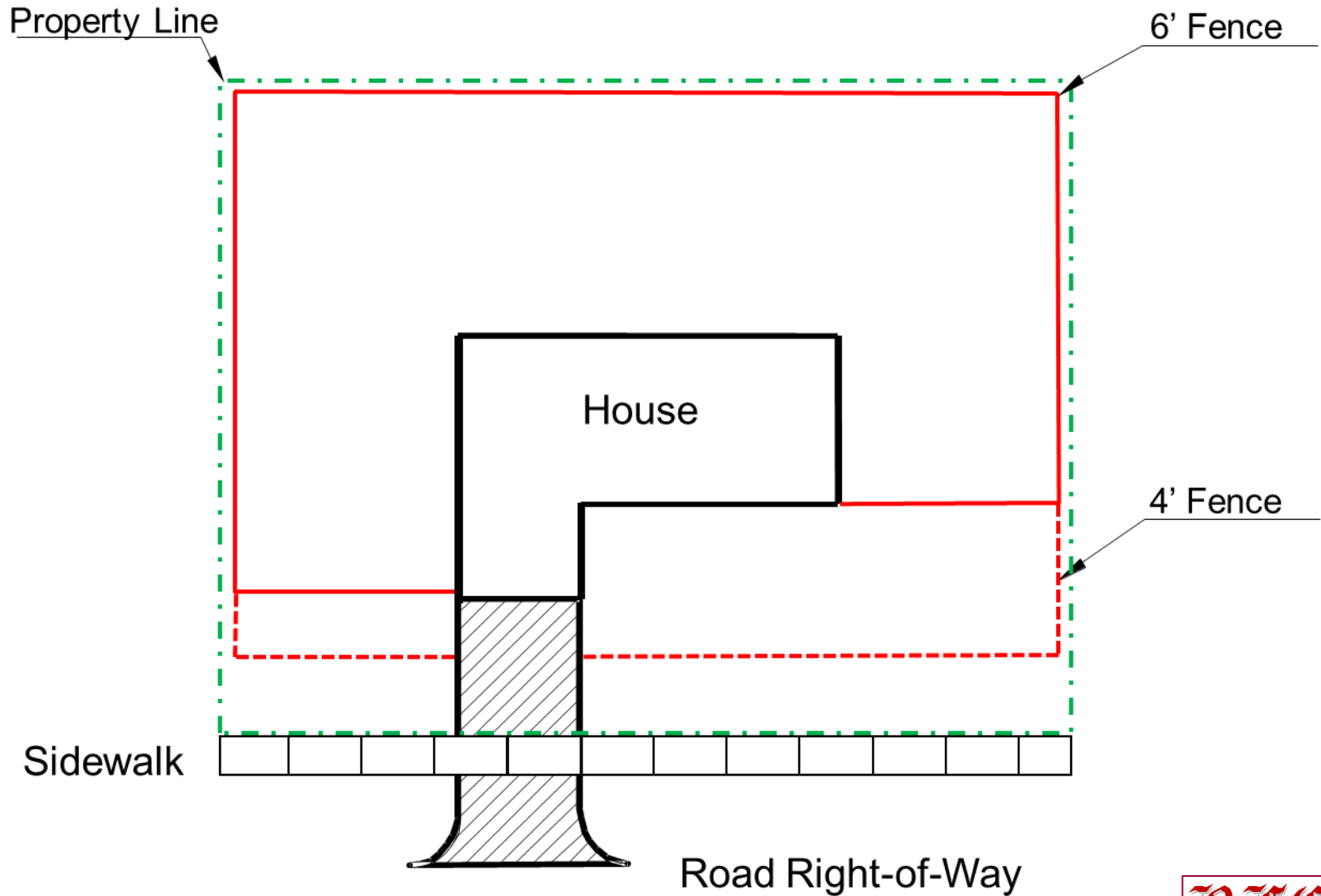
Bill Dinn, Inspector

## ◆ Right of Entry 104.3

- \* Authority to enter any structure or premises
- \* Inspect during normal working hours
- \* Court order required when entry has been refused
- \* All persons protected by the 4th Amendment



◆ Site Plan



## ◆ Approval 105

- \* Alternate materials, design and methods of construction and equipment
- \* Applications shall be in writing
- \* Code Official may approve alternative materials, design and methods of construction if equivalent to what is prescribed:
  - Quality
  - Strength
  - Effectiveness
  - Fire resistance
  - Durability
  - Safety
- \* Permanent record of modification
- \* May require tests, inspection, research reports to verify compliance at owner's expense
- \* If not approved, Code Official shall respond in writing, stating the reason(s) the alternative was not approved

## ◆ Used Material and Equipment 105.4

- \* Used materials meeting requirements of this code for new materials is permitted
- \* Materials, equipment, and devices shall not be reused unless:
  - Such elements are in good repair, or
  - Have been reconditioned and tested and, where necessary, placed in good and proper working condition, and
  - Approved by the Code Official



- ◆ Violations 106
- ◆ Unlawful Acts 106.1
  - \* Unlawful for a person, firm or corporation to be in conflict with or violation of this code
- ◆ Notice of Violation 106.2
  - \* Code Official shall serve notice of violation or order per Section 107

## ◆ Prosecution of Violation 106.3

- \* Strict liability offense
- \* Code Official shall institute appropriate proceeding

## ◆ Issue Violation Notices and Orders to Abate/Correct

- \* Action taken charged against property (lien)



## ◆ Notices and Orders 107

### ◆ Form 107.2

- \* Must be in writing
- \* Description of real estate
- \* Statement as to why notice is being sent
- \* Order to correct
  - Reasonable time to correct
- \* Appeal rights – Added “or owner’s authorized agent”
- \* Right to file a lien per 106.3



**Village of Tree Forest  
Department of Property Maintenance  
300 West Pine Street  
Tree Forest, Oregon 97201  
321.341.3333**

Notice of Violation and Order to Correct Conditions of Premises  
MM/DD/YYYY

Owner's Name  
Address

Re: (PROPERTY ADDRESS)

This is in reference to the Village's primary goal to improve the quality of housing and to maintain property values within the community.

An inspection of the above captioned property conducted on MM/DD/YYYY revealed that the dwelling has significant peeling paint on the exterior siding, fascia and soffit.

This condition is in violation of section 304.6 of the 2015 International Property Maintenance Code as adopted by the Village of Tree Forest:

‘Exterior walls shall be free from holes, breaks, loose or rotting materials; and maintained weatherproof and properly surface coated where required to prevent deterioration.’

Please have the dwelling painted in the next thirty (30) days.

A re-inspection of your property will be performed after thirty (30) days have passed to verify compliance with the Village Code.

Failure to comply with this notice may result in further legal action, including a lien being placed against your property as provided in subsection 106.3 of the International Property Maintenance Code as adopted by the Village of Tree Forest, Oregon:

“Any person failing to comply with a notice of violation or order served in accordance with Section 107 shall be deemed guilty of misdemeanor or civil infraction as determined by the local municipality, and the violation shall be deemed a strict liability offense. If the notice of violation is not complied with, the code official shall institute the appropriate proceeding law or in equity to restrain, correct or abate such violation, or to require the removal or termination of the unlawful occupancy of the structure in violation of the provisions of this code or of the order or direction made pursuant thereto. Any action taken by the authority having jurisdiction on such premises shall be charged against the real estate upon which the structure is located and shall be lien upon such real estate.”

Should you wish to appeal the decision of the Code Official you have the right to a hearing provided that a written application for appeal is filed within 20 days after the day the decision, notice or order was served.

Your cooperation in this matter will be greatly appreciated.

If you have any questions regarding this matter, I can be reached at (xxx-xxx-xxxx).

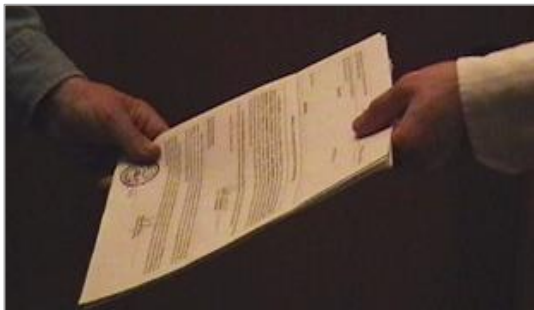
Sincerely,

(Name)

(Title)

## ◆ Method of Service 107.3

- \* Personal service
- \* Certified mail (return receipt)
- \* Posting of notice on structure



## ◆ Unauthorized Tampering 107.4

- \* Signs, tags or seals posted or affixed by the Code Official shall not be mutilated, destroyed or tampered with, or removed without authorization from the code official

## ◆ Transfer of Ownership 107.6

- \* Unlawful to transfer property with active enforcement proceedings unless:
  - Signed and notarized statement from buyer to Code Official acknowledging receipt of such compliance order or notice of violation and fully accepting responsibility without condition for making corrections



## ◆ Unsafe Structures and Equipment 108

### ◆ General 108.1

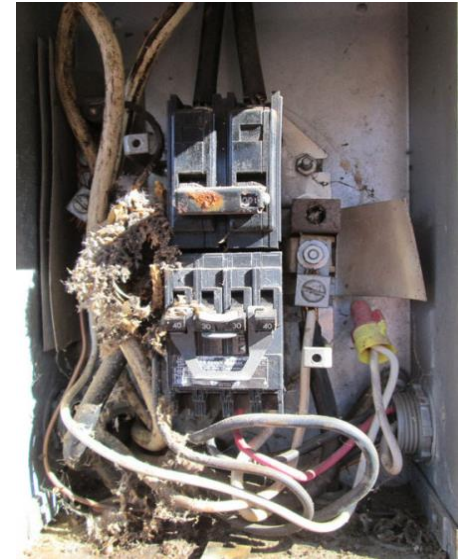
- \* Condemnation authorization
- \* Unsafe Structures 108.1.1
  - Four conditions requiring condemnation:
    - Building or equipment that endanger
      - Life
      - Health
      - Property
      - Safety
    - Lacks protection from fire
    - Contains unsafe equipment
    - All or part of the building likely to collapse

## Unsafe structures:





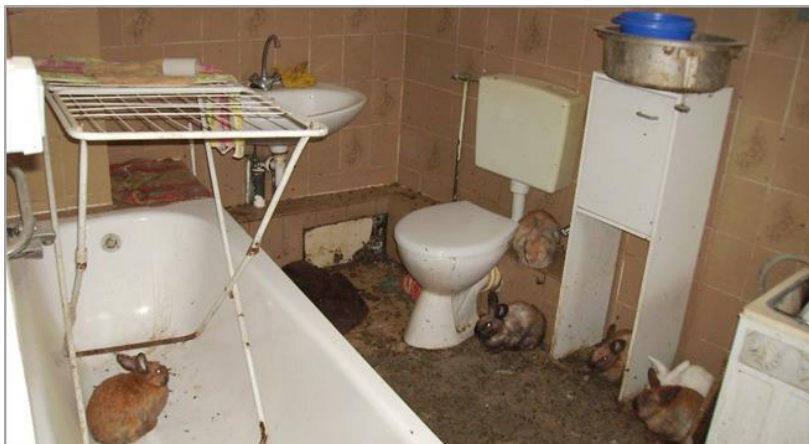
- \* Unsafe equipment **108.1.2**
  - Boilers
  - Heating equipment
  - Electrical equipment
  - Flammable liquid containers
  - Other equipment





\* Structure unfit for human occupancy 108.1.3

- Unsafe
- Unlawful
- Structure in major disrepair
- Unsanitary
  - Lacks ventilation, illumination, heating facilities or is unsanitary



## ◆ Unlawful structure 108.1.4

- Occupied by more persons than allowed by code
- Erected, altered or occupied contrary to law



- \* Eleven criteria established for dangerous structure or premises **108.1.5**
  1. Means of egress component not in compliance with adopted code provisions of the jurisdiction for existing buildings
  2. Walking surface of the means of egress, worn, torn, loose or otherwise compromised
  3. Building or portion compromised by fire, earthquake, wind, flood, neglect, abandonment, vandalism to extent where partial or complete collapse or detachment is likely.



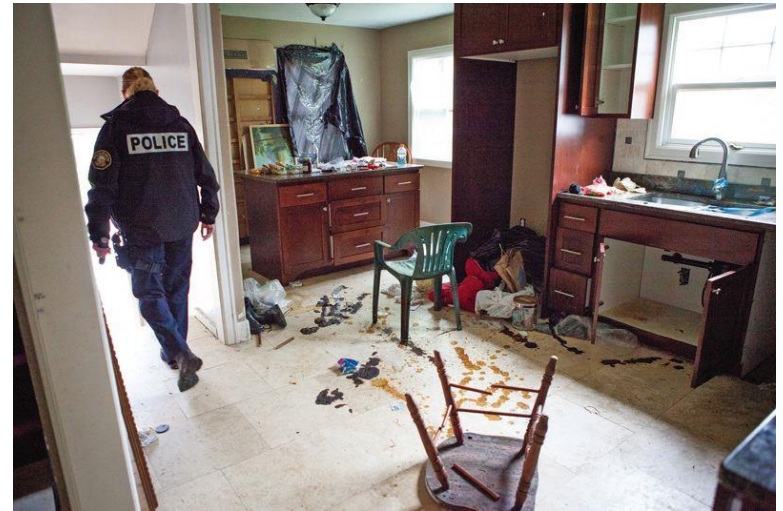
4. Structural strength, attachment, or stability is compromised
5. Any part of structure likely to partially or completely collapse, or some portion of the foundation or underpinning of the building or structure is likely to fail or give way due to:
  - Dilapidation
  - Deterioration
  - Decay
  - Faulty construction
  - Removal or movement of some portion of the ground necessary for the support, or
  - For any other reason



6. Clearly unsafe

7. Building or structure is:

- Neglected
- Damaged
- Dilapidated
- Unsecured or abandoned so as to become:
  - An attractive nuisance to children who might play in the building or structure to their danger
  - A harbor for vagrants, criminals or immoral persons, or
  - Enables persons to resort to the building or structure for committing a nuisance or an unlawful act





8. Structure in violation of any code, requirement, or prohibition that leads to risk of fire, collapse, or risk to life and limb

9. Unsanitary or causing sickness or disease

10. Lack of sufficient or proper:

- Fire-resistance-rated construction
- Fire protection systems
- Electrical system
- Fuel connections
- Mechanical system\plumbing system or other cause
- Is determined by the code official to be a threat to life or health



## 11. Any portion of building remains after:

- Demolition
- Destruction of the building or structure
- Whenever any building or structure is abandoned so as to constitute such building or portion thereof as an attractive nuisance or hazard to the public



- \* Authority to disconnect service utilities 108.2.1
  - Code official can authorize disconnection
    - Immediate hazard to life
    - Connection has been made without approval
- \* Notify:
  - Serving utility
  - Whenever possible and prior to disconnection:
    - Owner or owner's authorized agent
    - Occupant
  - IF: Unable to notify prior
  - THEN: Notify in writing as soon as possible thereafter



## ◆ Placarding 108.4

By Order of the Code Official of the Village of Tree Forest this structure, portion of structure or equipment has been found unsafe, or unsanitary and is hereby

### **CONDEMNED FOR HUMAN HABITATION, OCCUPANCY OR USE**

It is unlawful to enter upon these premises without first obtaining written permission from the Code Official.

● **KEEP OUT** ●

Property Address \_\_\_\_\_

IT IS UNLAWFUL TO REMOVE THIS NOTICE OR OCCUPY THIS DWELLING UNIT.

Tampering with this placard will RESULT IN PROSECUTION BY THE VILLAGE OF TREE FOREST AND MAY RESULT IN FINES UP TO \$750.00 PER DAY, AT THE DISCRETION OF THE COURT.

DATE POSTED \_\_\_\_\_ CODE SECTION(S) \_\_\_\_\_

CODE OFFICIAL \_\_\_\_\_

ANY PERSON AFFECTED BY A DECISION OF THE CODE OFFICIAL OR A NOTICE OR ORDER ISSUED UNDER THIS CODE SHALL HAVE THE RIGHT TO APPEAL TO THE BOARD OF APPEALS, PROVIDED THAT A WRITTEN APPLICATION FOR APPEAL IS FILED WITHIN 20 DAYS AFTER THE DAY THE DECISION, NOTICE OR ORDER WAS SERVED.

## ◆ Prohibited occupancy 108.5

- An occupied structure condemned and placarded shall be vacated as ordered by the code official
- Failure to comply is subject to penalties as provided in this code



## ◆ Emergency Measures 109

### \* Imminent danger 109.1

- Failure or collapse of a building/structure which endangers life
- A structure or part thereof that has fallen and life is endangered by occupancy of the structure
- Actual or potential danger to the building occupants or those in proximity of the structure



- \* Code Official authorized and empowered to order and require the occupants to vacate the building
- \* Building shall be posted at each entrance: “The Structure is Unsafe and its Occupancy has been prohibited by the Code Official”



Photo courtesy of Better Housing for Tompkins County

## ◆ Temporary Safeguards 109.2

- The Code Official has the right to order temporary repairs that are necessary to render the building safe
- Immediate action without regard to due process
- Failure of building must be readily apparent and immediate



## ◆ Demolition 110

### \* General 110.1

- \* A building or structure that is unsafe and dangerous and the owner fails to make the necessary repairs shall be slated for demolition when it has become:
  - Deteriorated or dilapidated
  - Dangerous
  - Unsafe
  - Unsanitary
  - Unfit for human habitation
  - Unreasonable to repair
  - Cessation of normal construction for a period of more than two years
- \* Boarding of a building for future repair not to extend more than one year



- \* IF: Reasonable to repair
- \* THEN: Repair within 2 years
- \* Boarding of a building for future repair not extend more than 1 year



\* Condemnation placard - Demolition

By Order of the Code Official of the Village of Tree Forest this structure, portion of structure or equipment has been found unreasonable to repair and is hereby

**CONDEMNED FOR DEMOLITION**

It is unlawful to enter upon these premises without first obtaining written permission from the Code Official.

● **KEEP OUT** ●

Property Address

IT IS UNLAWFUL TO REMOVE THIS NOTICE OR OCCUPY THIS DWELLING UNIT.

Tampering with this placard will RESULT IN PROSECUTION BY THE VILLAGE OF TREE FOREST AND MAY RESULT IN FINES UP TO \$750.00 PER DAY, AT THE DISCRETION OF THE COURT.

DATE POSTED \_\_\_\_\_ CODE SECTION(S) \_\_\_\_\_

CODE OFFICIAL \_\_\_\_\_

ANY PERSON AFFECTED BY A DECISION OF THE CODE OFFICIAL OR A NOTICE OR ORDER ISSUED UNDER THIS CODE SHALL HAVE THE RIGHT TO APPEAL TO THE BOARD OF APPEALS, PROVIDED THAT A WRITTEN APPLICATION FOR APPEAL IS FILED WITHIN 20 DAYS AFTER THE DAY THE DECISION, NOTICE OR ORDER WAS SERVED.



## ◆ Notices and Orders 110.2

- All owners or others with a vested interest shall be advised of the action
- Take caution in advising all owners – “Title Search”

## ◆ Failure to Comply 110.3

- Failure of an individual to comply with the demolition order shall result in the Code Official taking action
- Action is hiring a contractor, Public Works or other party to remove structure
- The cost of the demolition shall be charged against the real estate and a lien shall be placed upon such

## ◆ Salvage Materials 110.4

- The governing body shall have the right to sell the salvage or other materials at the highest price
- Any revenue shall be deducted from the expense of the demolition
- If a surplus remains, it shall be returned to the entitled individual
- In all cases, an itemized expense and income account shall be reported

## ◆ Means of Appeal 111

### ◆ Application for Appeal 111.1

- \* Any person directly affected by a decision of the code official or a notice or order has right to appeal
- \* Written application for appeal must be filed within 20 days after the decision, notice, or order was served
- \* Application for appeal shall be based on:
  - Claim that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted
  - Provisions of this code do not fully apply
  - Requirements of this code are adequately satisfied by other means

## ◆ Membership of the Board 111.2

- \* Three (3) member minimum
- \* Qualified to evaluate such issues
- \* Two (2) alternate members
- \* Code official “ex officio” member of the BOA
  - Ex Officio is Latin for “From Office”
  - It means the CO is on the BOA by virtue of being the CO, not because the CO was elected or appointed by the BOA
  - Code Official cannot vote on issues before the BOA
- \* Chairman selected by Board
- \* Secretary appointed

## ◆ Actions by the Board 111.4 – 111.6

- \* May overturn or modify Code Official's decision
- \* Majority vote of board members present
- \* Open meeting
- \* Quorum 2/3 of board
- \* Hearing procedure
- \* Decision shall be recorded
- \* Maintain minutes of meeting



## ◆ Court Review 111.7

- \* Anyone can apply to court for a writ of certiorari (“certiorari review”)
- \* Certiorari review by court only looks at procedures of BOA, not the comments of arguments made in appeal – a check to see if BOA’s process followed the law

## ◆ Stays of Enforcement 111.8

- \* When an appeal is applied for, enforcement is suspended pending outcome of appeal
- \* EXCEPT: Enforcement actions pertaining to conditions of imminent danger

## ◆ Chapter 1: Case Study 1

- \* Inspector Smith is conducting an inspection at 123 Main St and notices the house at 119 Main Street to be abandoned with the living room window broken out and the front door wide open.
- \* Answer the following:
  1. Can Inspector Smith enter the dwelling on her own?
  2. What concerns might be present in entering the dwelling?
- \* The owner arrives while Inspector Smith is inside the dwelling and demands that Smith leave the premises immediately.
  1. Has Inspector Smith violated the owner's 4<sup>th</sup> Amendment rights?
  2. Is Inspector Smith required to leave the premises as demanded by the owner?

## ◆ Chapter 1: Case Study 2

- \* Inspector Lee has received a complaint from a tenant that since they moved into the rental unit three months ago, everyone in the family has experienced flu-like symptoms. They have been to the doctor several times and the doctor has requested they have a health inspection of the building.
- \* The inspection reveals that the furnace flu pipe entering the chimney is completely rusted through.
- \* Answer the following:
  1. Can Inspector Lee make an assumption as to what may be causing the problem?
  2. Can Inspector Lee condemn the building?
  3. What steps should Inspector Lee take to resolve the problem?





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Chapter 2  
Definitions

## ◆ General 201

## ◆ Parts 201.5

\* Whenever the following text reads:

- Dwelling unit
  - Dwelling premises
  - Building
  - Rooming house
  - Rooming unit
  - Housekeeping unit
  - Story
- These words shall be construed as though they were followed by the words, “or any part thereof”

## ◆ General Definitions 202

- \* Found in **Chapter 2** of the Code
- \* IF: Terms not defined
- \* THEN SEE:
  - **IBC, IFC, IZC, IPC, IMC** or **NFPA 70, NEC 2014**
  - Dictionary
  - Reference standard – **Chapter 8**
  - Text books
  - Nationally recognized publications

- \* Added the following new definitions in the 2018 edition:
  - \* Definition of [A] **ANCHORED**. Secured in a manner that provides a positive connection
  - \* Definition of [A] **DETACHED**. When a structural element is physically connected from another and that connection is necessary to provide a positive connection
  - \* Definition of [A] **EQUIPMENT SUPPORT**. Those structural members or assemblies of members or manufactured elements transmit gravity load, lateral load, and operating load
  - \* Definition of [A] **LABELED** changed to include “approved agency or other organization concerned with product evaluation”

- \* Definition of [A] **STRUCTURE** changed to “That which is built or constructed”
- \* Definition of [A] **NEGLECT**. The lack of proper maintenance for a building or structure
- \* Definition of [A] **PEST ELIMINATION**. The control and elimination of insects, rodents or other pests by eliminating their harborage places by removing or making inaccessible materials that serve as food or water; by other pest elimination means
- \* Definition of [A] **ULTIMATE DEFORMATION**. The deformation at which failure occurs and which shall be deemed to occur if the sustainable load reduces to 80% or less of the maximum strength



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Chapter 3  
General Requirements

## ◆ General 301

## ◆ Responsibility 301.2

- \* Owner of property
- \* Premise must be in sanitary and safe condition
- \* Comply with these requirements
- \* Occupants must maintain the premises which they occupy and control which includes:
  - Dwelling unit
  - Rooming unit
  - Housekeeping unit

## ◆ Vacant Structures and Land 301.3

\* Maintain in following condition:

- Clean
- Safe
- Secure
- Sanitary
- Not causing blight
- Not adversely affecting public health or safety

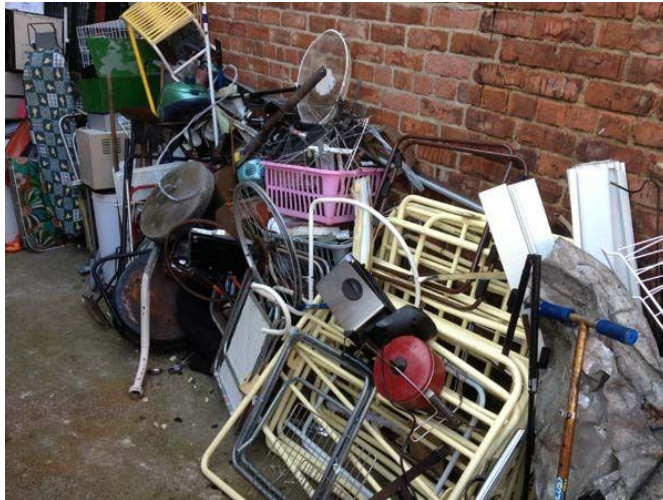




## ◆ Exterior Property Areas 302

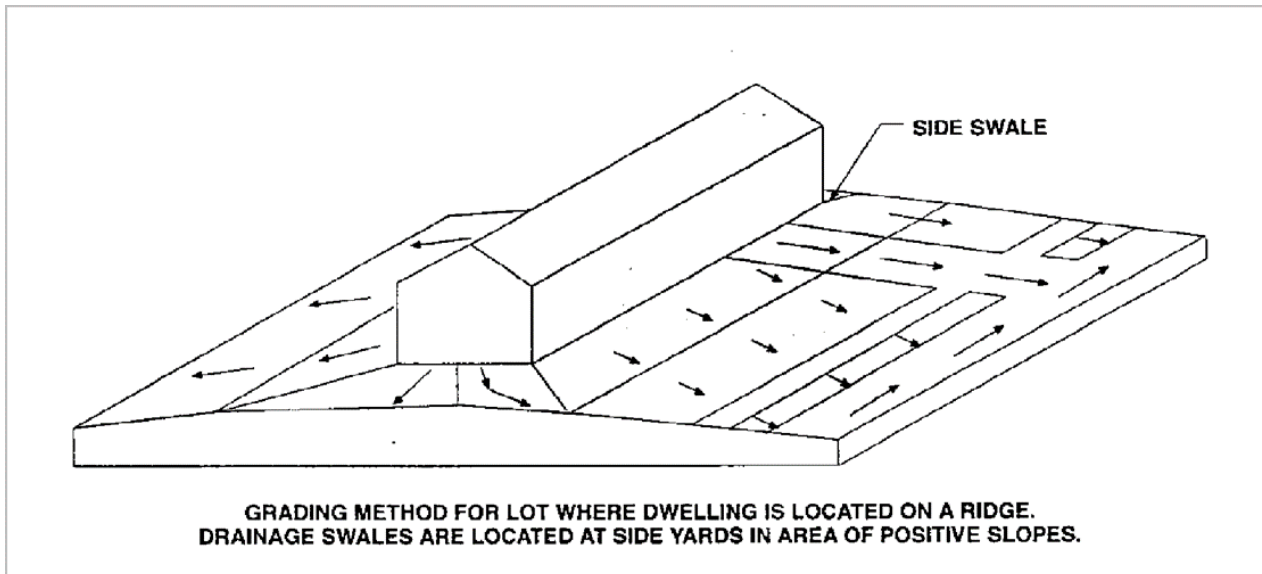
### ◆ Sanitation 302.1

- \* Exterior property and premises
- \* Occupants shall keep area that they occupy or control clean and sanitary
- \* Free from rubbish and garbage



## ◆ Grading and Drainage 302.2

- \* Eliminate ponding water
- \* Mold problem
- \* Can cause decay of wood on structure
- \* Attractive nuisance to children



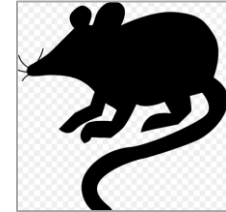
- ◆ Maintain All Sidewalks and Driveways 302.3
- ◆ Weeds 302.4
  - \* Not to exceed \_\_\_\_\_ (Insert height in inches, varies by municipality)
  - \* Reduces rodent and dust problems
  - \* Noxious weeds are prohibited
  - \* Cultivated flowers and gardens OK
    - Cultivate – “to loosen or dig around growing plants”

- \* Authority to enter property to cut and destroy weeds
- \* Cost shall be paid by owner or agent responsible for the property



## ◆ Rodent Harborage 302.5

- \* Rats carry disease
- \* Exterminate
- \* Remove garbage, rubbish and inoperable vehicles
- \* Store garbage in barrels with tight fitting lids





## ◆ Exhaust Vents 302.6

- \* Odor problems
- \* Noise problems
- \* Hazardous or potentially hazardous discharges
- \* Prohibit discharging onto abutting or adjacent public and private property



## ◆ Accessory Structures 302.7

- \* Maintain structurally sound and in good repair
- \* Common areas in disrepair; detached garages, fences and walls



## ◆ Motor Vehicles 302.8

- \* No inoperative or unlicensed motor vehicles
- \* No vehicle in state of disassembly, disrepair or in the process of being dismantled
- \* Blighting impact on neighborhood
- \* Running business out of home (mechanic)
- \* May be stored in structure designed and approved for such use
- \* Attractive to children and rats





## ◆ Defacement of Property 302.9

- \* Marking of property
- \* Carving of property
- \* Graffiti
- \* Owner responsible to restore property



- ◆ Swimming Pools, Spas and Hot Tubs 303
- ◆ Swimming Pools 303.1
  - \* Maintained in clean and sanitary condition
  - \* Shall be maintained in good repair



## ◆ Enclosures 303.2

- \* Swimming pools, hot tubs and spas >24" deep water
  - Completely surrounded by 48" high fence or barrier
  - Where do you measure the 48" from on this pool?
    - Barrier height measured on side of barrier away from pool



**Exception:**  
Spas or hot tubs with an  
**ASTM F1346**  
compliant  
cover

- \* Swimming pools, hot tubs and spas >24" deep water (*continued*)
  - Self-closing, self-latching gate or door
    - Self-latching device <54" above bottom of gate or door, release mechanism on pool side of gate
    - Positively close and latch from 6" open position

- \* Existing pool enclosures shall not be removed, replaced or changed in a manner that decreases its effectiveness as a safety barrier





- \* Spa or hot tub as defined in **IRC E4208**
  - Hydro-massage pool, or tub for recreational or therapeutic use
  - Not located in healthcare facilities
  - Designed for immersion of users and usually having:
    - A filter, heater, and motor driven blower
  - Installed:
    - Indoors or outdoors
    - On ground or supporting structure
    - In ground
    - Generally, spa or hot tub not designed to have contents drained or discharged after each use

- \* GFCI protected integral protection permitted **IRC E4209.1**
- \* Loads to heating elements shall not exceed 48 amperes and over current not to exceed 60 amperes **IRC E4206.12**
- \* Branch circuit conductors sized at 125% of name-plate
- \* Emergency switch for spas and hot tubs **IRC E4208.4**
  - Provide clearly labeled emergency shut-off
  - Readily accessible to users
  - Adjacent to and within sight of users
  - Not <5' away from spa or hot tub
    - Exception: Single-family dwellings



## ◆ Exterior Structure 304

### ◆ General 304.1

- \* Maintain exterior structure in good repair
- \* Structurally sound and sanitary
- \* Not a threat to the public health, safety, or welfare
- \* References compliance with Existing Building (**International Building Code** and **International Existing Code**)

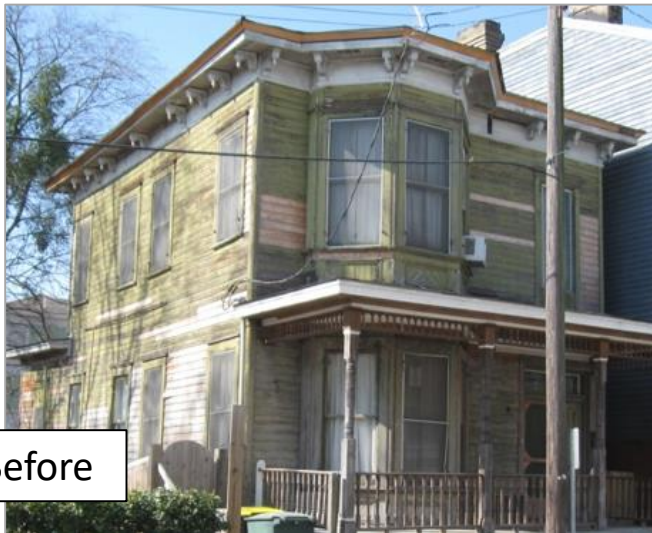




- \* Unsafe conditions 304.1.1
  - Established 13 exterior envelope unsafe conditions
    1. Strength of structural members exceeded by conditions
    2. Anchorage methods not capable of resisting loads
    3. Structures or components reaching their limit state
    4. Open siding and masonry joints including joints at windows and doors



- \* Unsafe conditions **304.1.1** (*continued*)
  5. Deteriorating structural members
  6. Foundation defects including out-of-plumb members, cracks, improper anchorage
  7. Exterior walls not anchored, plumb, free of holes and cracks or breaks, loose or rotting materials
  8. Roofing defects



Before

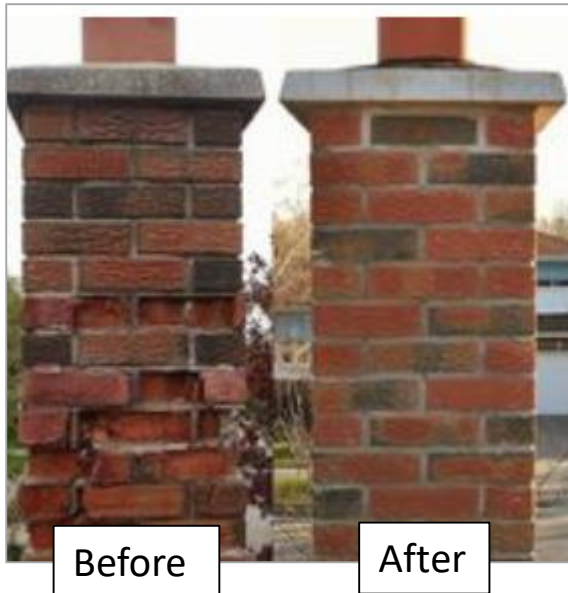


After

- \* Unsafe conditions **304.1.1** (*continued*)
  9. Flooring defects, deterioration, fatigue, improperly anchored, or unable of supporting normal loading
  10. Defects in architectural details like veneers, cornices, trim, and other decorative features
  11. Defects in overhangs and projections, e.g., trash chutes, canopies, awnings, fire escapes, stand pipes, and exhaust equipment



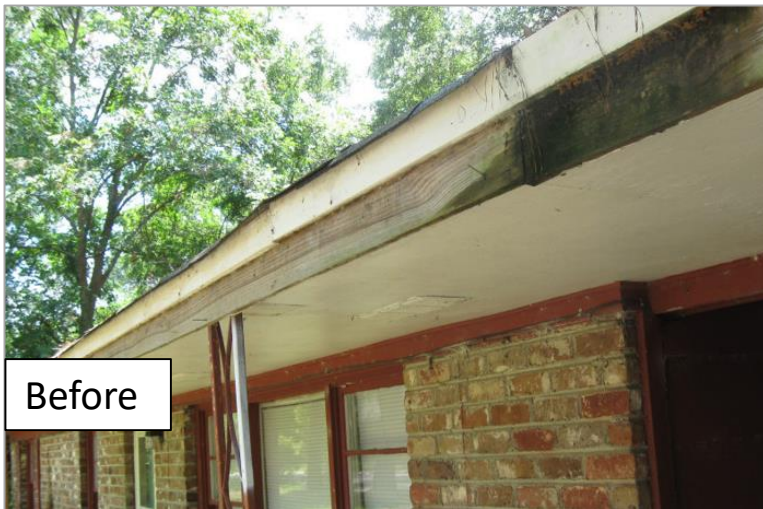
- \* Unsafe conditions **304.1.1** (*continued*)
  12. Defects in exterior stairs, porches, decks, and balconies and related components, e.g., railings, screening and weather protection
  13. Chimneys, cooling towers, cupolas, smokestacks, and other similar structures structurally unsound





## ◆ Protective Treatment 304.2

- \* Exterior surfaces shall be maintained in good condition such as:
  - Doors
  - Door and window frames
  - Cornices



- \* Porches
- \* Trim
- \* Balconies
- \* Decks
- \* Metal surfaces



Before



After

- \* These areas can have a blighting effect on a neighborhood if not maintained



## ◆ Premises Identification 304.3

- \* Easy for emergency personnel to recognize
- \* Easily observed and readable from the public right of way
- \* Arabic numerals at least 4" in height and 1/2" stroke

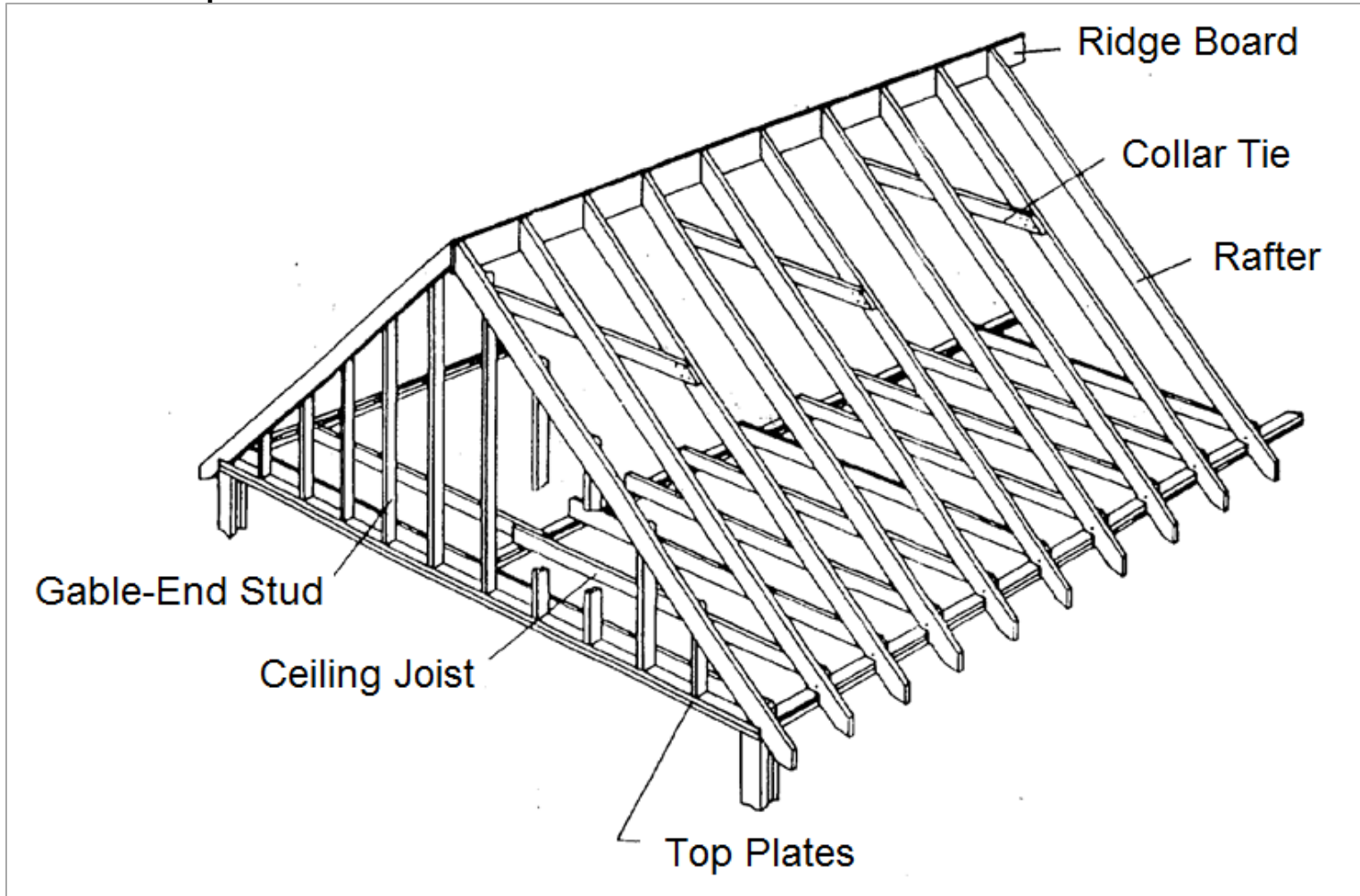




## ◆ Structural Members 304.4

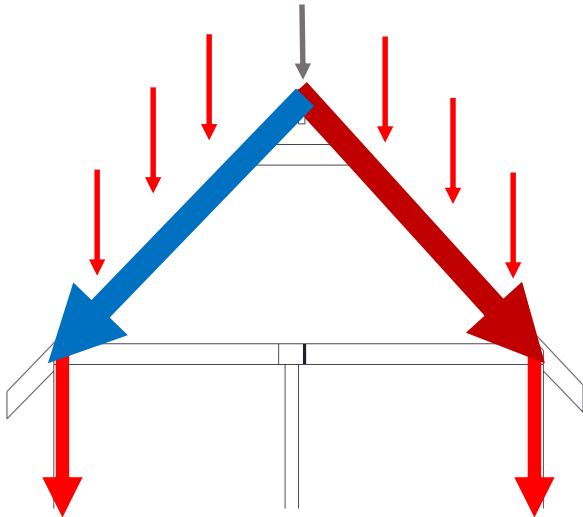
- \* Free from deterioration
- \* Capable of safely supporting imposed live and dead loads
- \* Dead loads are the loads created by structure
- \* Live loads are the loads added to the structure
- \* Different uses of a structure than what its intended use was is critical
- \* Possible structural defects shall be evaluated by an architect or engineer and the Code Official has the final approval authority

\* Components of wood-frame roof

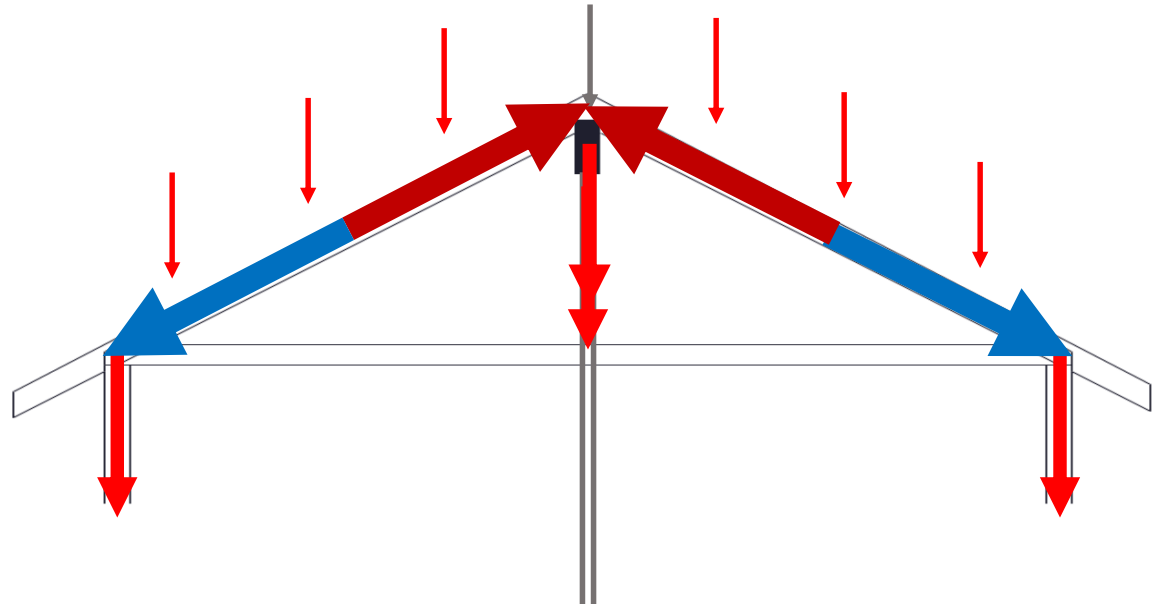


- \* Roof load transference to bearing
  - Ridge board for carpenter's framing convenience only
  - Ridge beam accepts, distributes roof loads

Ridge Board



Ridge Beam



- \* Eccentric load with resulting pier footing/structural failure in progress



## ◆ Foundation Walls 304.5

- \* Walls shall be maintained plumb
- \* Free from open cracks
- \* Must safely support the entire structure
- \* Water is a major problem to foundations if left uncorrected
- \* Poor soils and poor construction can create similar problems
- \* Rat entry must be corrected
- \* Sound engineering analysis is necessary to evaluate source of problem

- \* Structural failure – foundation



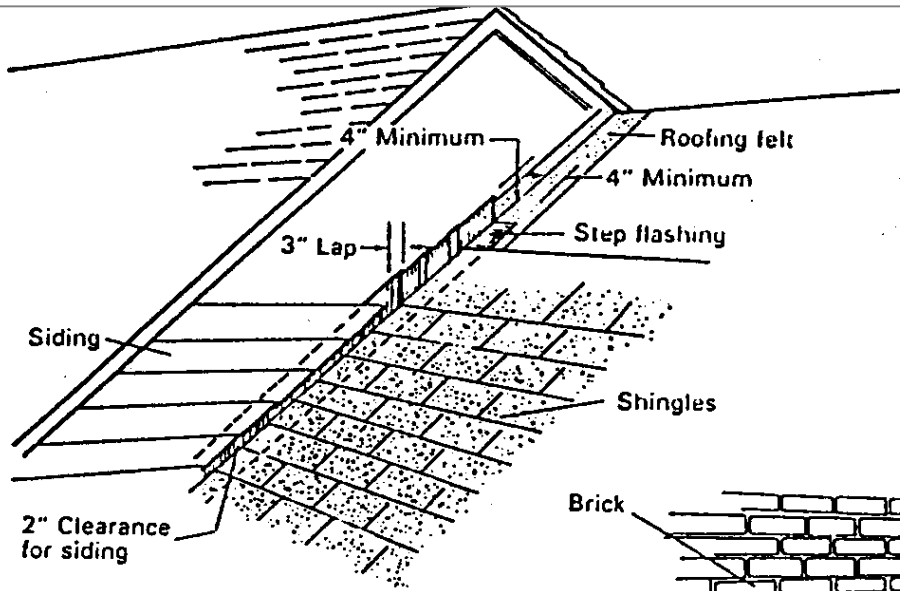


## ◆ Exterior Walls 304.6

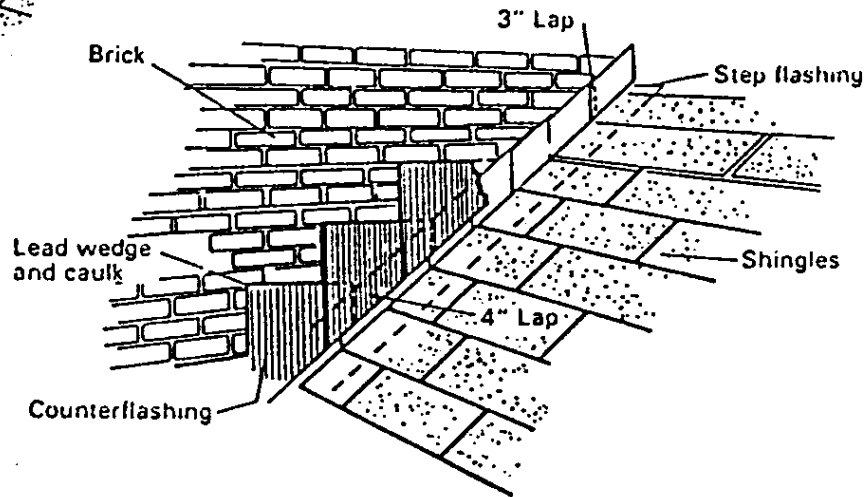
- \* Walls shall be free from holes, breaks, loose or rotting materials
- \* Weatherproof and properly surface coated
- \* Lack of maintenance can cause structural defects



\* Flashing (at wall and roof intersections) **R703.8**



A, Wood siding on wall

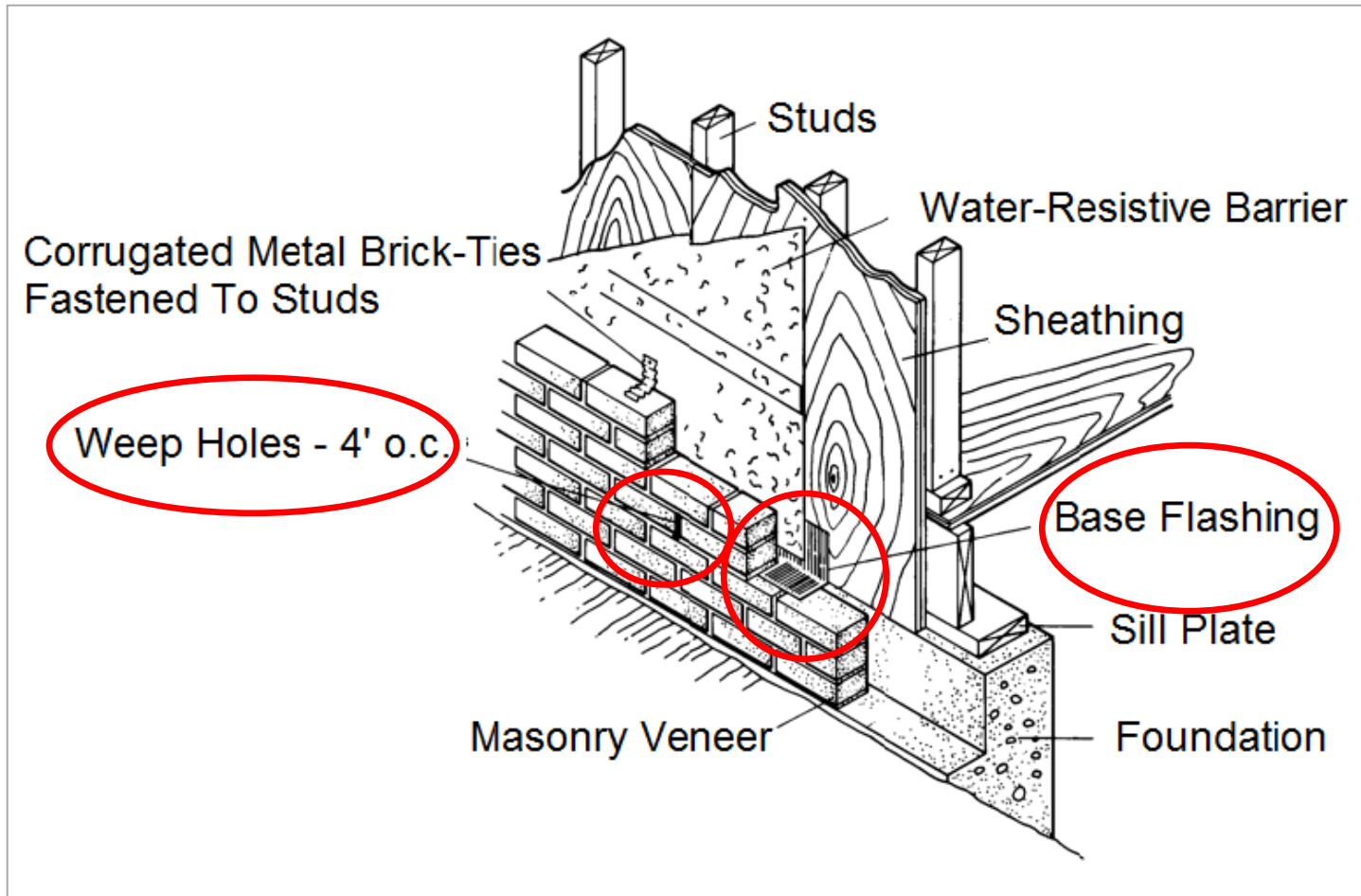


B, Brick wall

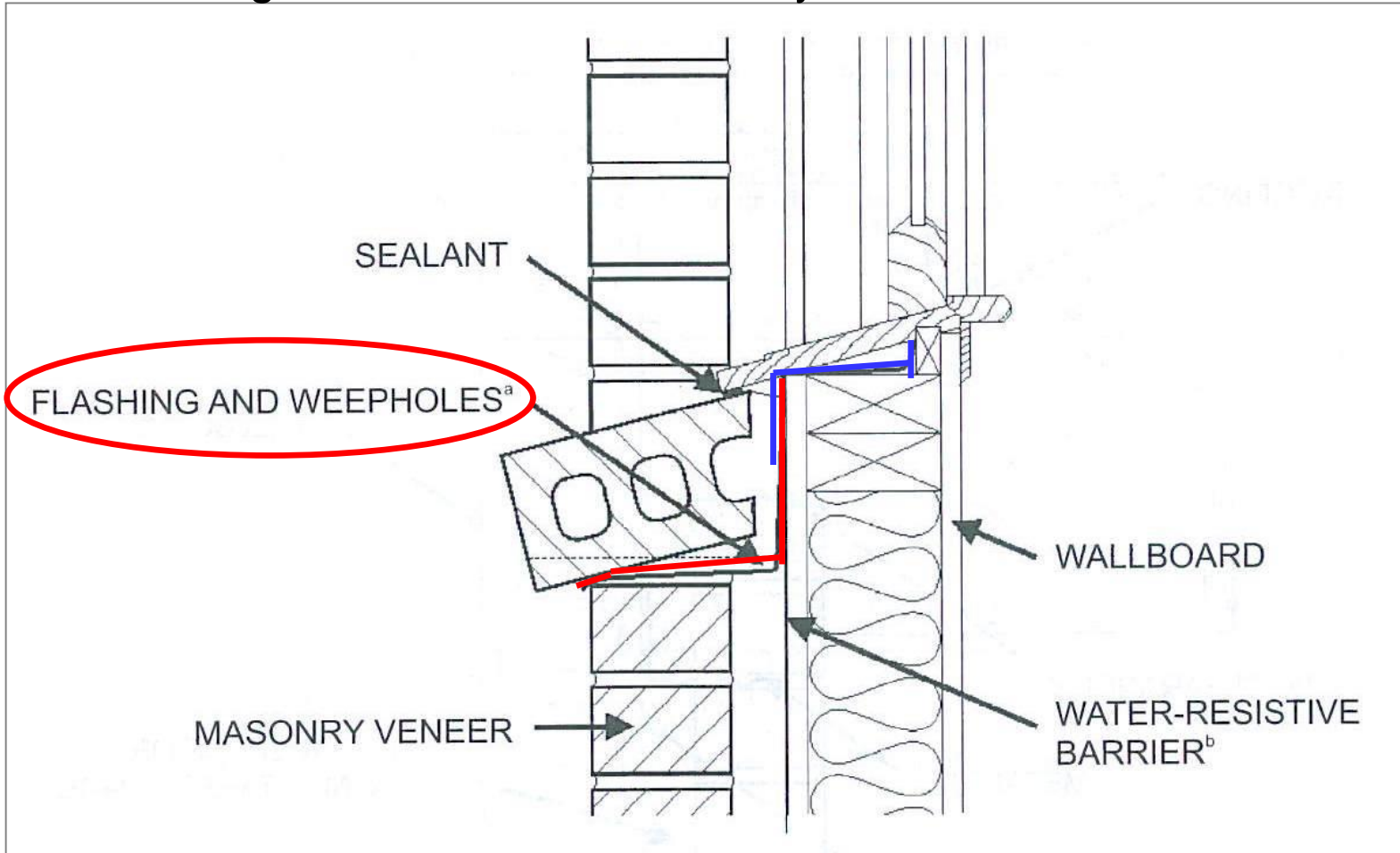




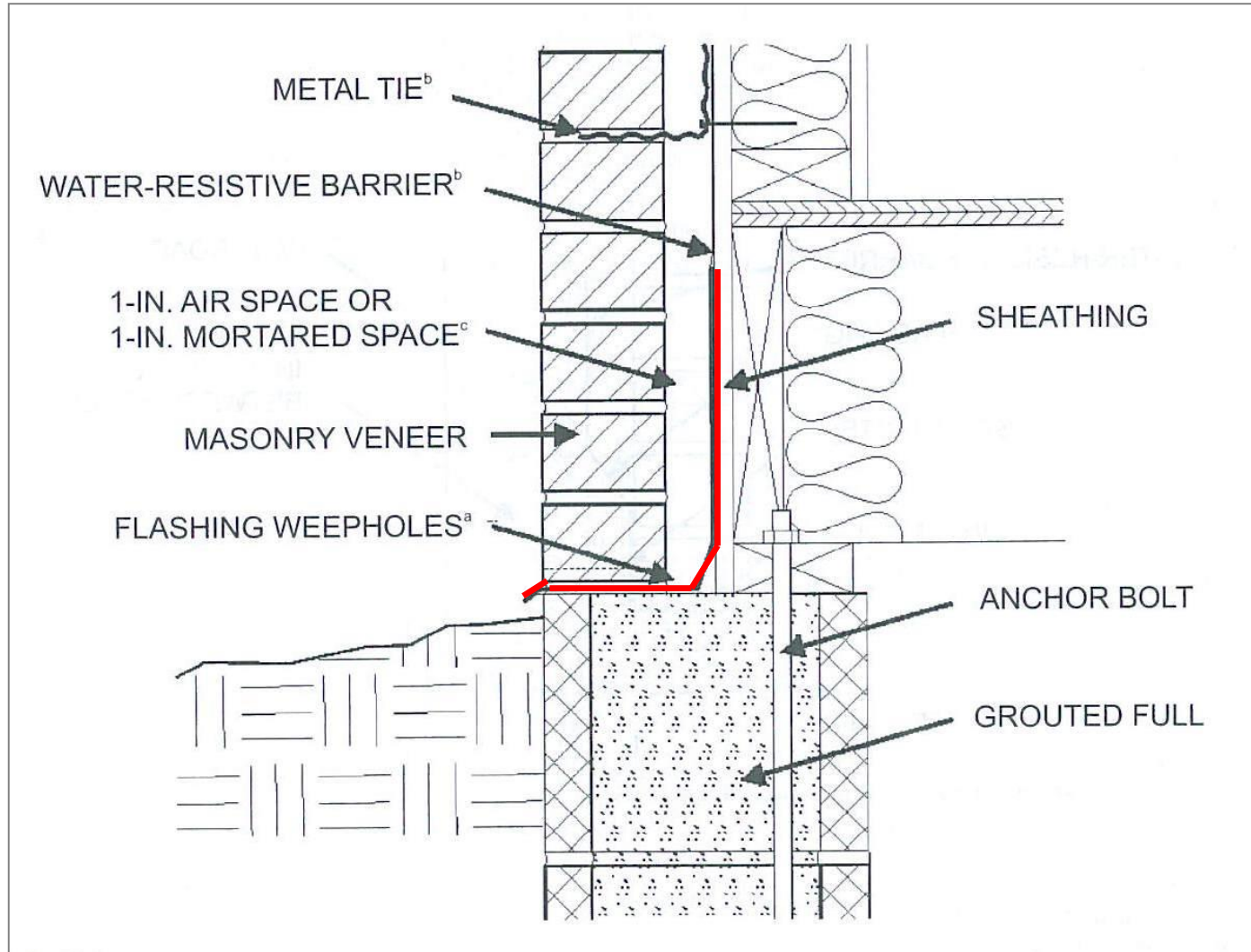
\* Flashing and weep holes



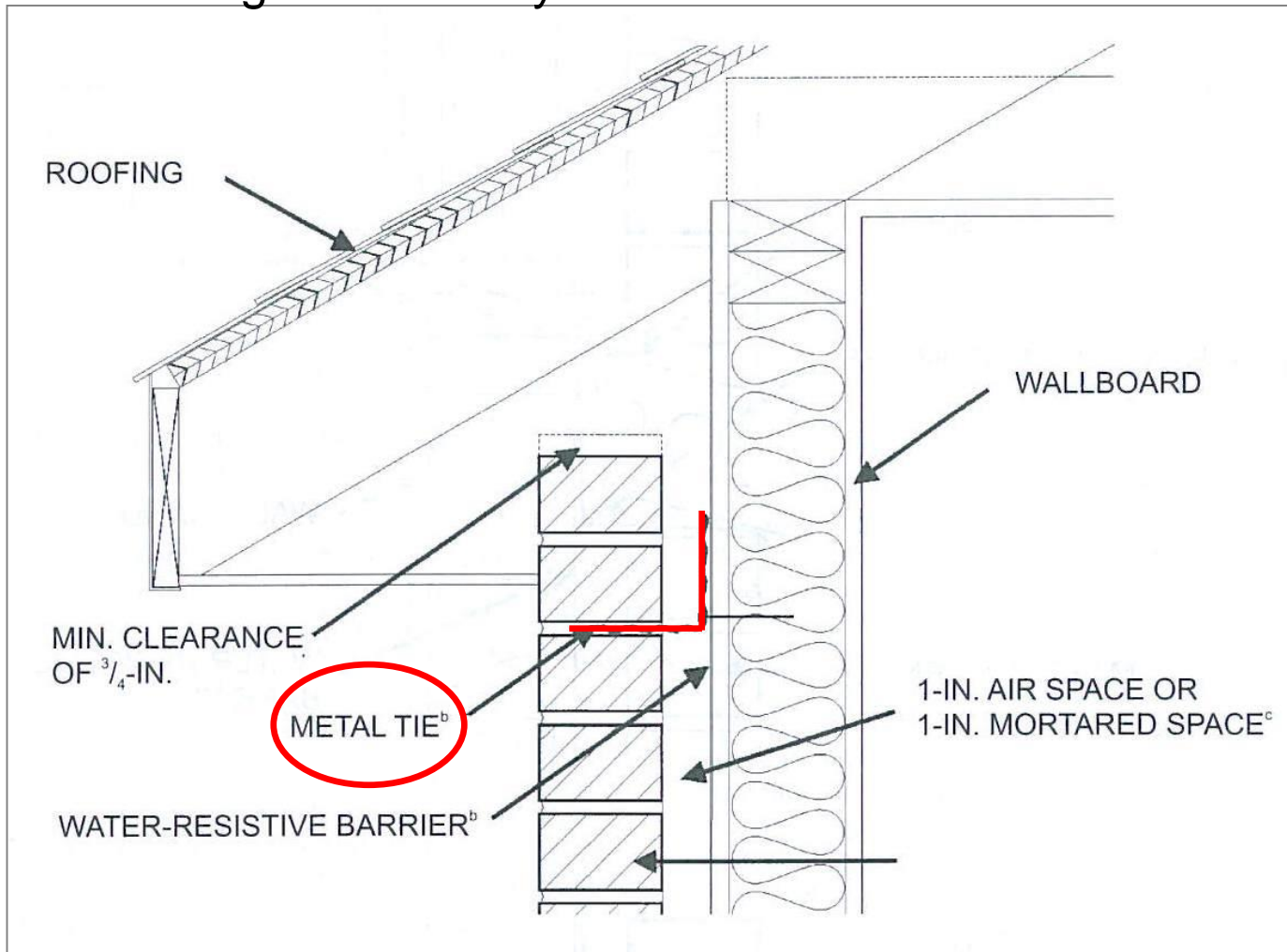
\* Flashing under window – masonry veneer



\* Flashing at base of masonry veneer



\* Anchorage of masonry veneers



## ◆ Roofs and drainage 304.7

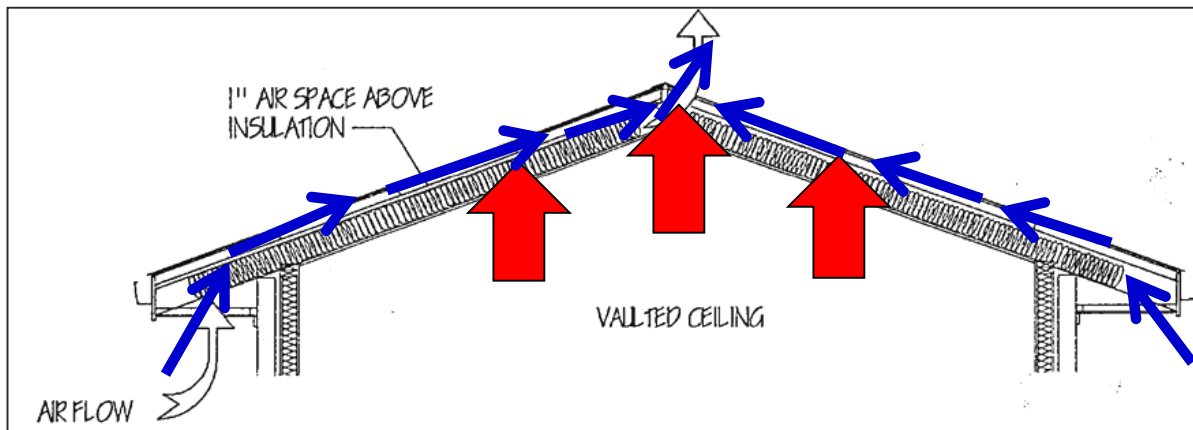
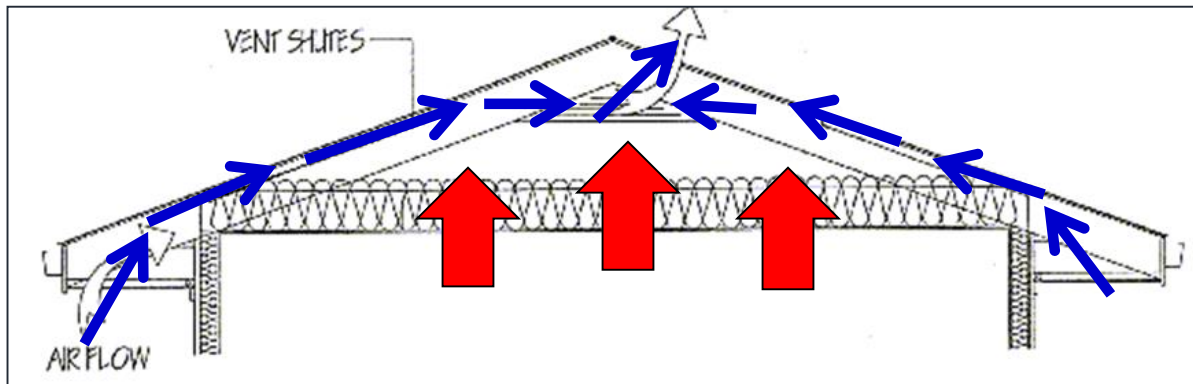
- \* Roofing and flashing shall be sound, tight, and not admit rain
- \* Roof drainage shall be maintained
- \* Prevent dampness or deterioration to the structure
- \* Roof water shall not discharge in such a way as to create a public nuisance



- \* Common roof failures:
  - Improperly sized rafters
  - Improper roof sheathing
  - Collar ties missing or inadequate
  - Flashing not maintained or missing
  - Trusses or rafters cut or bored holes
  - Poor connections
  - Storage in attic
  - Poor ventilation
  - Ice dams



\* Roof ventilation

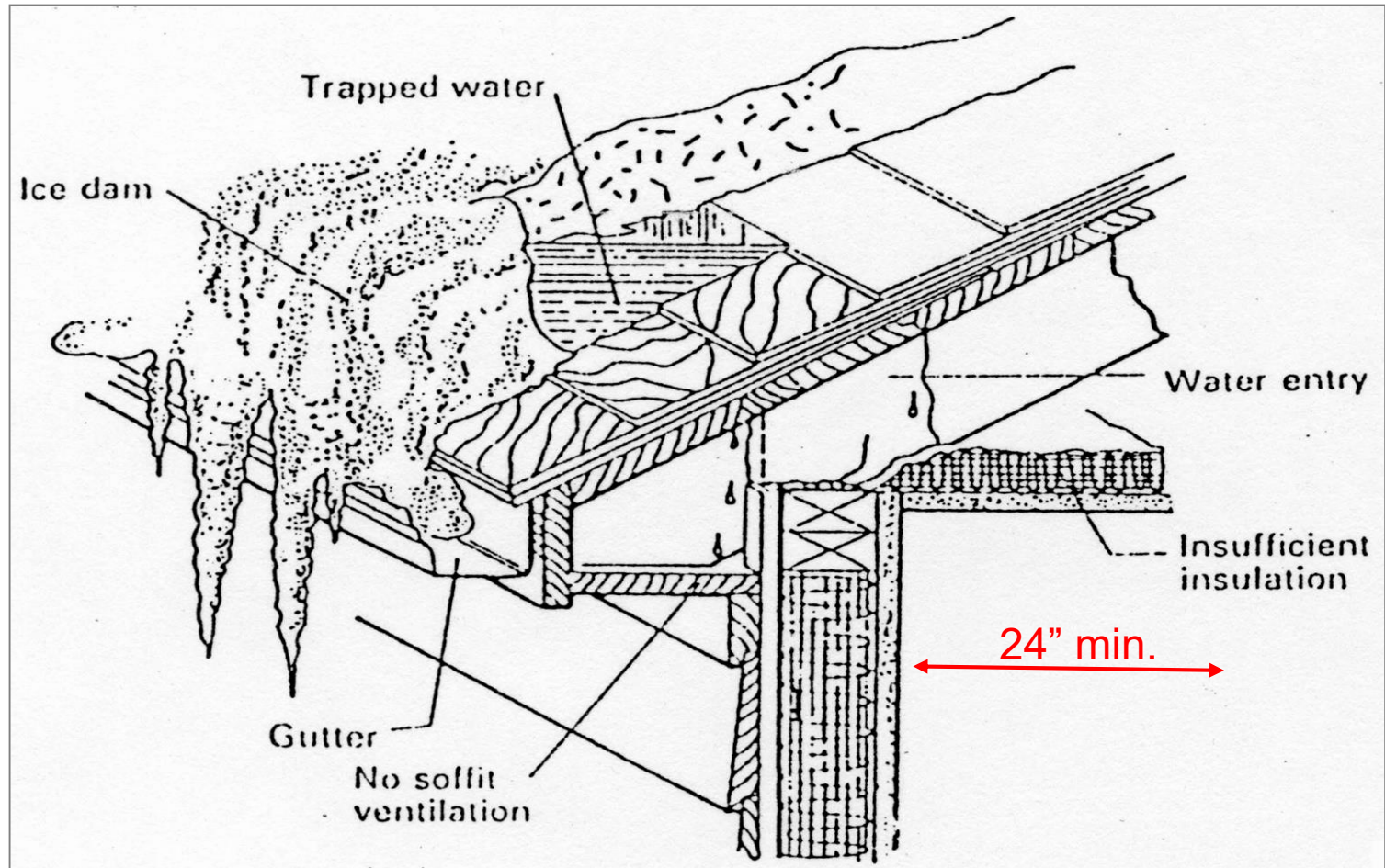


- \* Poor ventilation and insulation = ice dams
  - Remedies include:
    - Add attic insulation
    - Add attic ventilation
    - Add ice-and-water shield under shingles

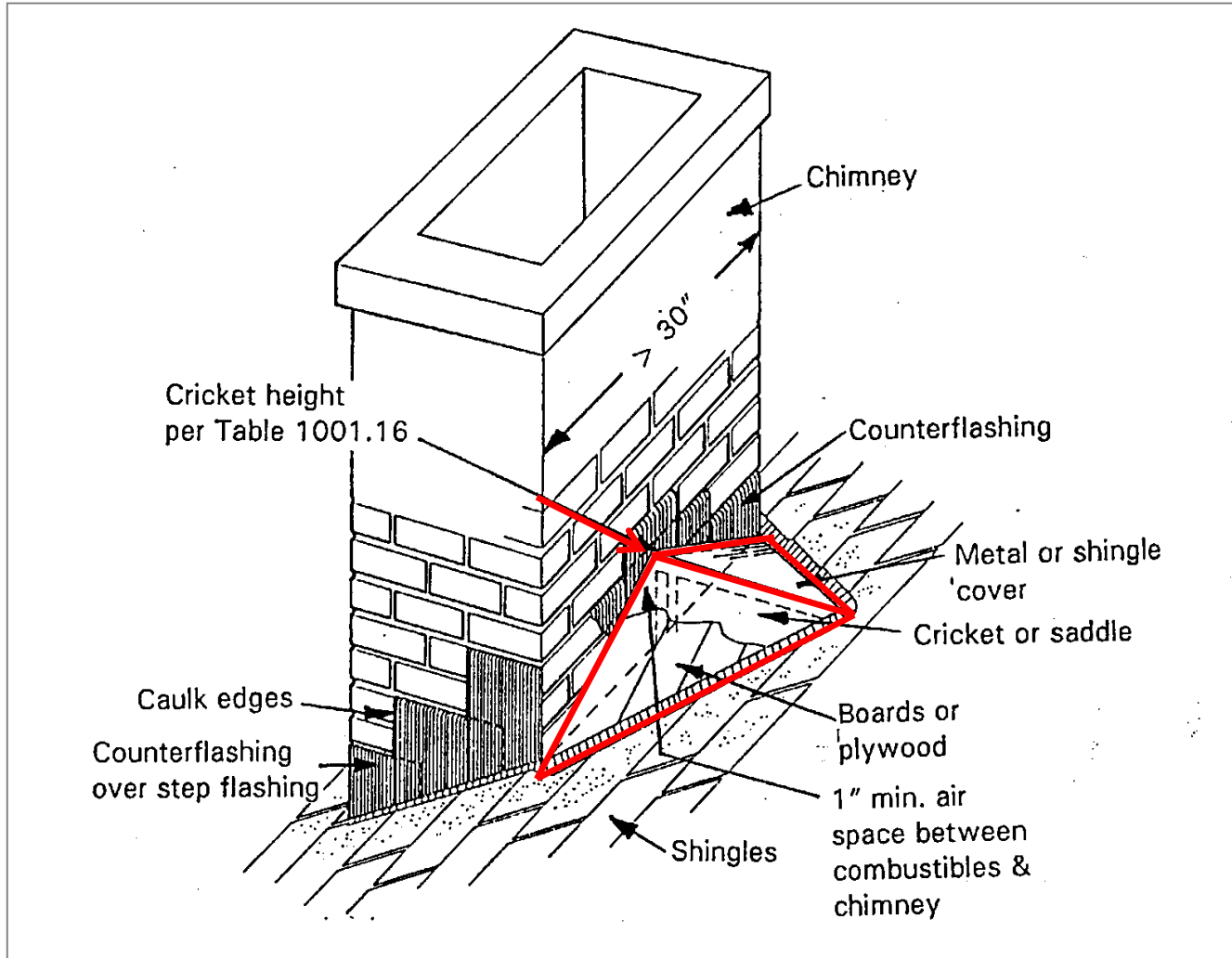




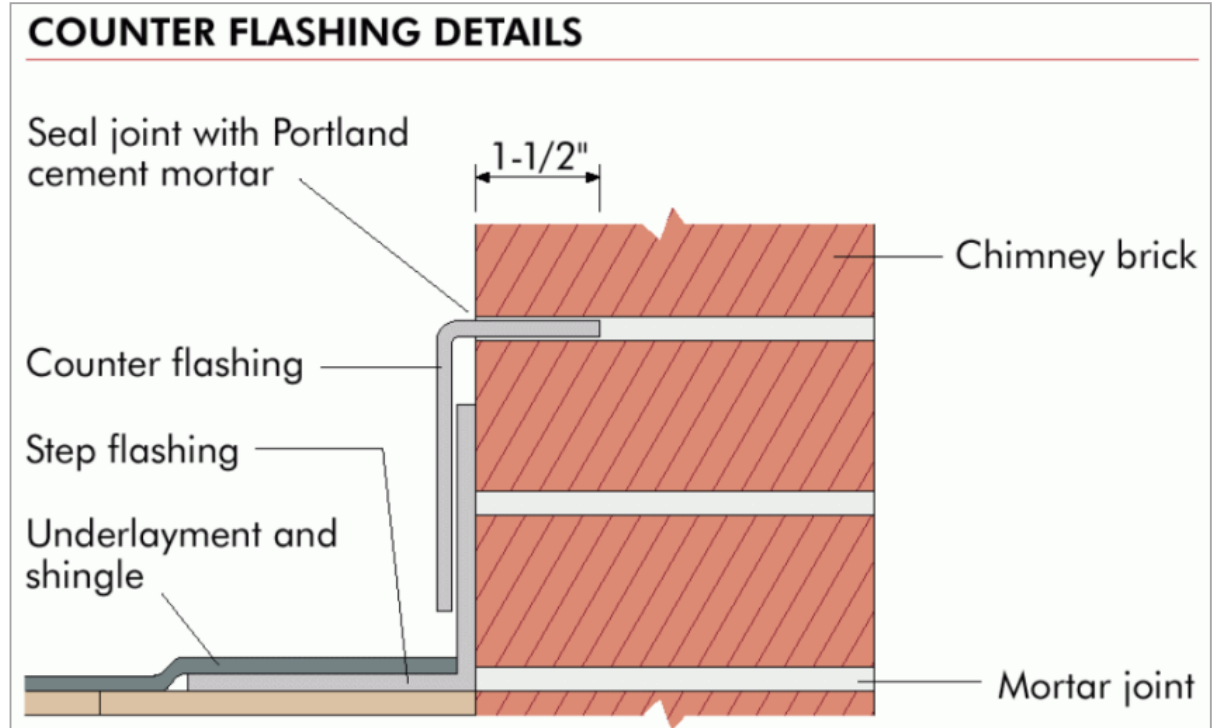
\* Ice barrier R905.2.7



\* Chimney cricket and flashing at roofline



\* Counter-flashing chimney at roof line



## ◆ Stairways, Decks, Porches, and Balconies 304.10

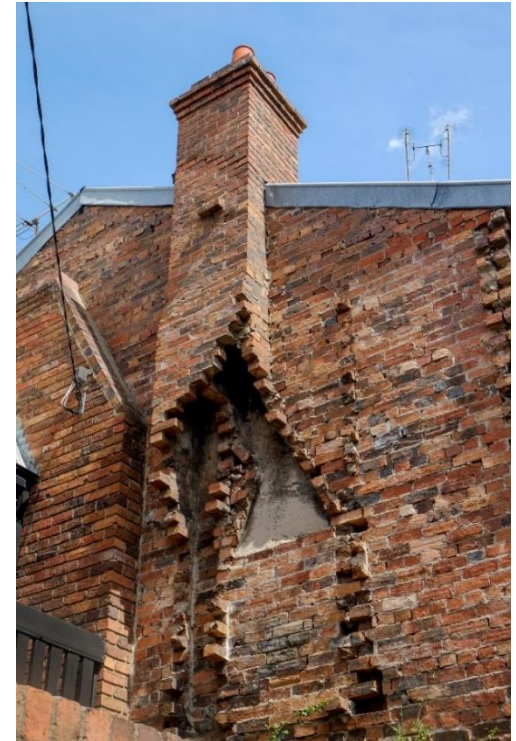
- \* Structurally sound
- \* Good repair
- \* Proper anchorage
- \* Capable of supporting imposed loads





## ◆ Chimneys and Towers 304.11

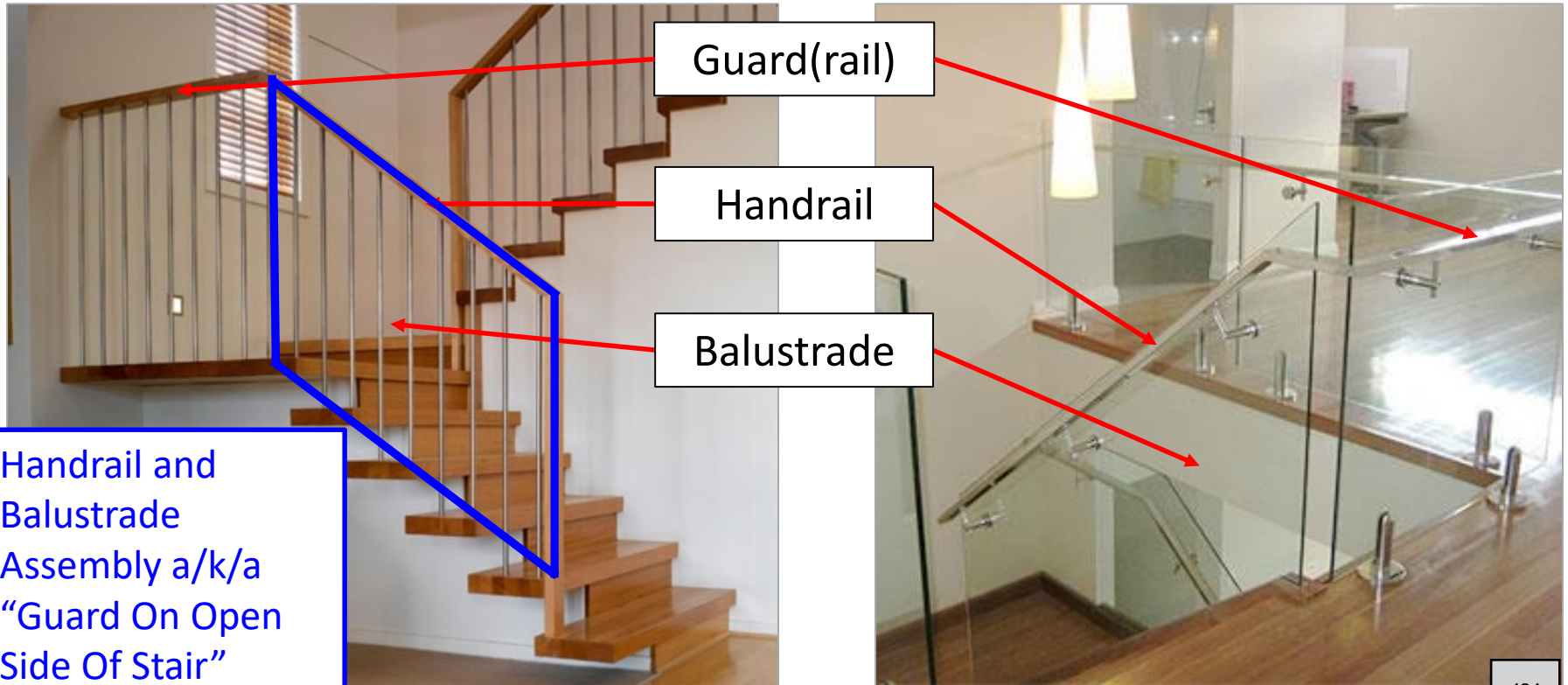
- \* Structurally sound
- \* Deteriorate from the inside due to gases
- \* Excessive rust
- \* Loose or missing mortar
- \* Cracked or disintegrating bricks



## ◆ Handrails and Guards 304.12

- \* Firmly fastened
- \* Capable of supporting imposed loads

Identifying: Guard(rail), Handrail and Balustrade



## ◆ Windows, Skylight and Door Frames 304.13

- \* Sound condition
- \* Good repair
- \* Weather tight
- \* Glazing materials free from cracks and holes
- \* Windows shall be easily openable and can hold position
- \* Bad window hardware can cause injury and prevent escape



## ◆ Insect Screens 304.14

- \* Screens shall be provided to prevent insect infestation
- \* Screen doors used for insect control shall have a self-closing device
- \* Each municipality shall establish the time frame screens are to be installed
- \* Screens shall be tight fitting
- \* Exceptions:
  - Air curtains
  - Insect repellent fans





## ◆ Doors 304.15

- \* Exterior doors
- \* Door assemblies
- \* Operator systems if provided (added 2012)
- \* Hardware
- \* Locks (see [Section 702.3](#))
- \* Maintain doors and hardware for proper use to keep out the elements



## ◆ Basement Hatchways 304.16

- \* Maintain
- \* Prevent rodents, rain and water



## ◆ Guards for Basement Windows 304.17

- \* Rodent shields
- \* Storm windows
- \* Protection against entry of rodents



## ◆ Building Security 304.18

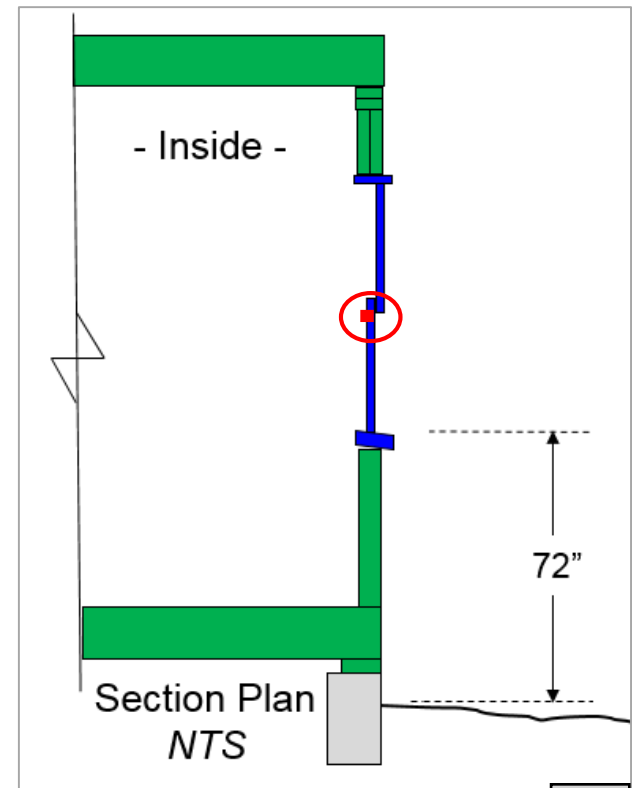
- \* Doors, windows, or hatchways shall be provided with devices to provide security
- \* Doors **304.18.1**
  - Doors providing access to a dwelling unit, rooming unit, or housekeeping unit that is rented, leased, or let shall be equipped with a deadbolt
  - Operable from inside with out use of a key, tool, or combination thereof or special knowledge or effort
  - Locks shall have a throw of not less than 1”
  - Prohibit sliding bolt

- \* Windows **304.18.2**
  - Operable windows that are rented, leased, or let and are within 6' above ground over a walking surface below shall be equipped with a window sash locking device

- \* Basement hatchways **304.18.3**
  - Shall be equipped with devices that secure the units from unauthorized entry that are rented, leased, or let

◆ **Gates 304.19**

- \* All exterior gates and assemblies shall be maintained including latches.
- \* Latches shall tightly secure the gates





◆ Interior Structure 305

◆ General 305.1

- \* Maintain structure and equipment
- \* Structurally sound
- \* Sanitary
- \* Occupant to maintain area under his/her control
- \* Owner shall keep common areas clean and sanitary



- \* Unsafe conditions – established 6 conditions concerning the interior building elements **305.1.1**
  - Comply with **IBC** or **IEBC**, as required
    1. Strength of structural members exceeded by conditions
    2. Anchorage insufficient of supporting and resisting applied loads
    3. Structures or components reaching their limit state



\* Unsafe conditions **305.1.1** (*continued*)

4. Structural members incapable of supporting applied loads

5. Stairs, balconies, and similar walking surfaces including guards and handrails not structurally sound or properly anchored

6. Foundation defects including out-of-plumb members, cracks, and improper anchorage





## ◆ Structural Members 305.2

- \* Structurally sound
- \* Capable of supporting imposed loads
- \* Common structural failures:
  - Undersized components
  - Poor materials
  - Improper fasteners
  - Improper notches and holes
  - Poorly installed
  - Cracking and sagging
  - Defective original construction



\* Basements can easily be inspected

- Many are unfinished
- Check:
  - Beams
  - Columns
  - Joists
  - Bearing walls
  - Foundations



- \* Defective floor issues
  - Concrete floor drops
  - Concrete floor broken apart
  - Wood floors
    - Poorly located support posts
    - Warped or broken floor joists
    - Improperly installed girders
    - Overloaded cantilever
    - Sagging floor
    - Spongy floor

## ◆ Interior Surfaces 305.3

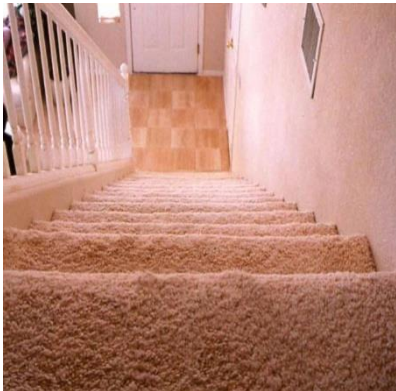
- \* Peeling paint – Lead 1978
- \* Cracked or loose plaster
- \* Decayed wood
- \* Always require correction
  - Remember to check for source of problem such as:
    - Moisture
    - Tenant's actions

- \* Lead-based paint hazard
- \* Since April 22, 2010, federal law requires contractors performing:
  - Renovation
  - Painting projects
  - Repair work that disturbs lead-based paint in homes built before 1978 must be EPA certified and follow specific work practices to prevent lead contamination



\* Stairs and walking surfaces **305.4**

- Maintain the following items:
  - Interior stairs
  - Ramps
  - Balconies
  - Porches
  - Decks





\* Inspecting to prevent deck failures







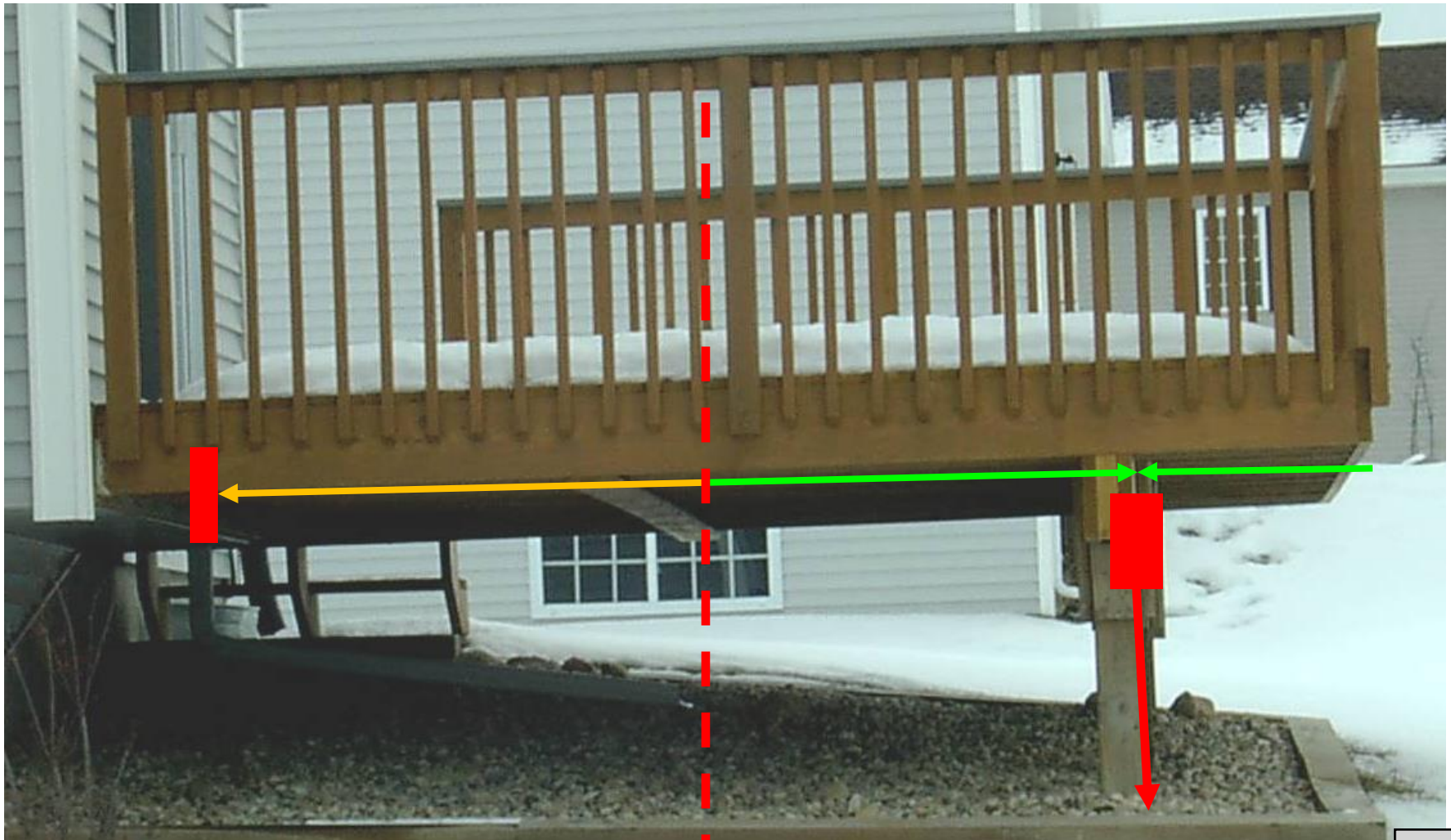
\* What is a “live” load?



- \* Typical wooden patio deck
- \* Repetitive and point loading



\* Load distribution





- \* Loading and safe distribution of loads to soil
  - Start at the top and follow the loads to the soil
  - Repetitive loading vs. point loading
  - Make sure load pathways – including footings and soils are able to safely distribute loads
    - “Snow shoes” example!

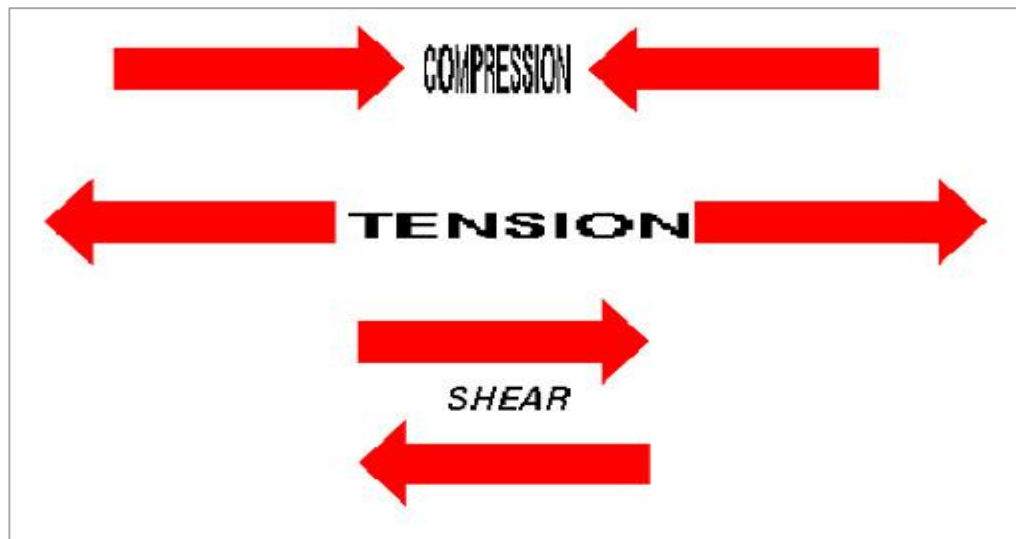
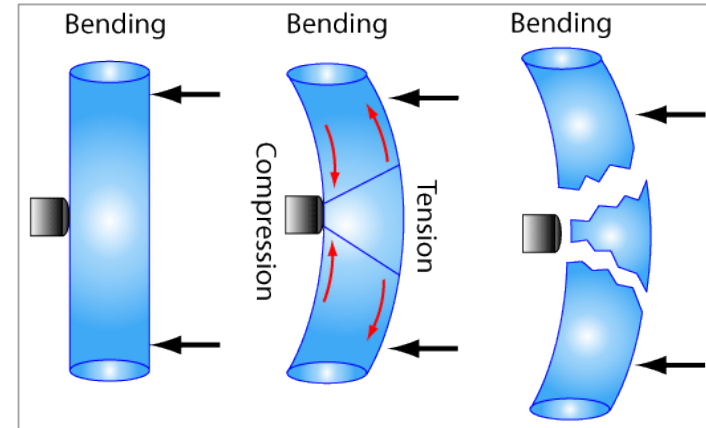
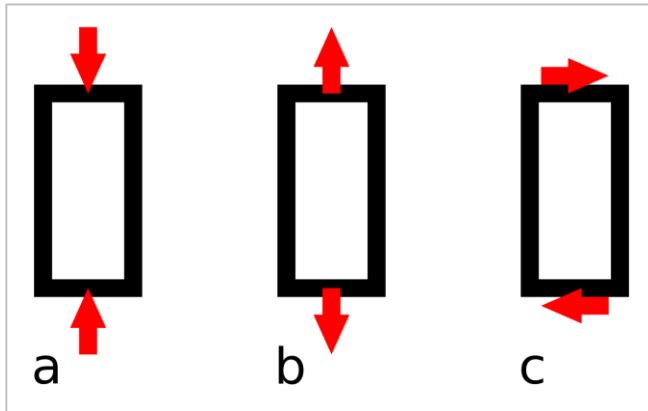


- \* Deck framing and posts
  - \* Look for overloading of:
    - \* Columns
    - \* Connection to columns
    - \* Deck pier footings
    - \* Connection to main structure

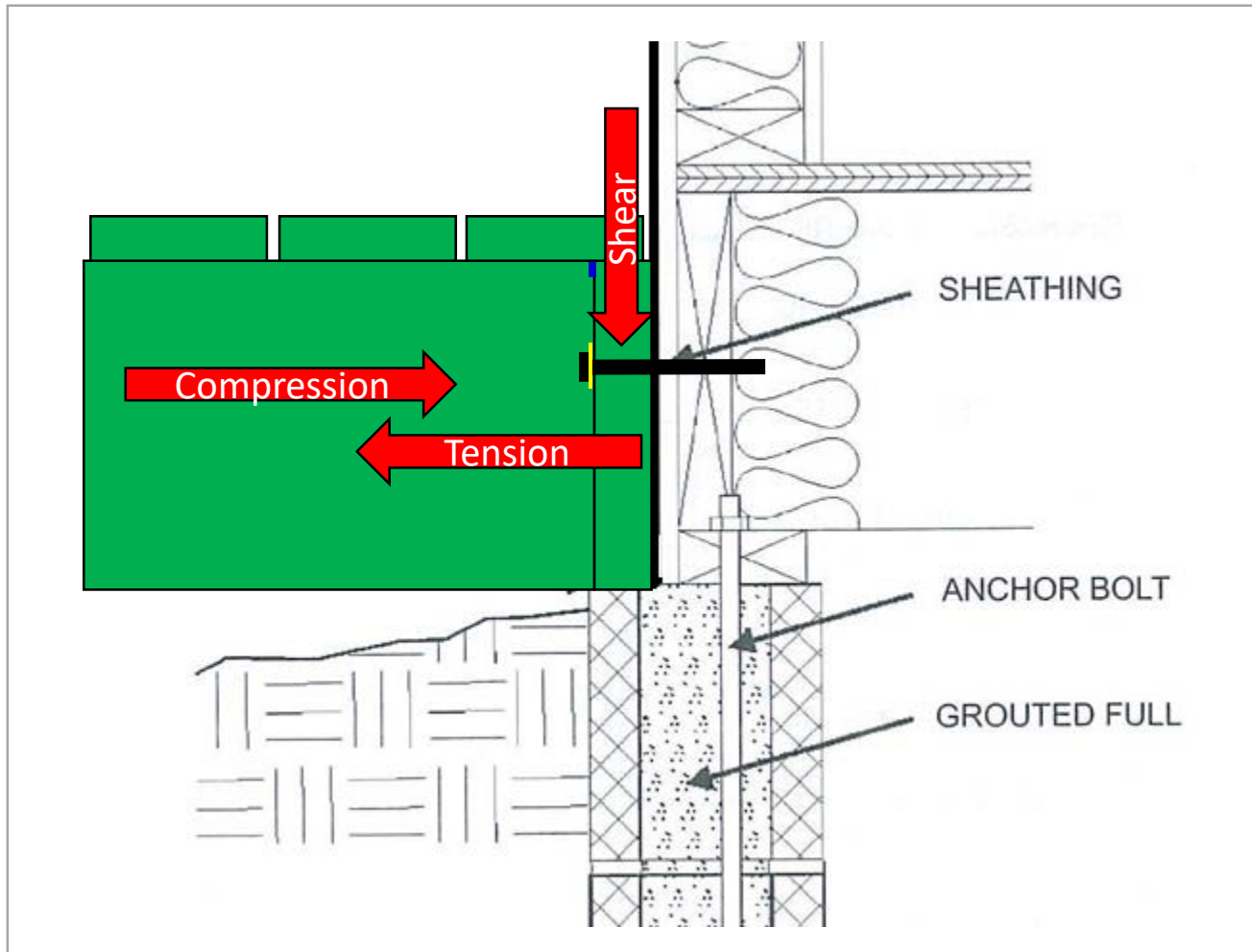
! ?



- \* Decks subject to compression, tension, shear, and bending forces



\* Compression, shear, and tension forces



## ◆ Handrails and Guards 305.5

- \* Firmly fastened
- \* Capable of supporting imposed loads





## ◆ Interior Doors 305.6

- \* Fits in its frame
- \* Capable of being opened and closed
- \* Securely attached as intended by the manufacturer of the attached hardware



## ◆ Component Serviceability 306

### ◆ General 306.1

- \* Components of structure must be maintained:
  - In good repair
  - Structurally sound
  - In sanitary condition

\* Unsafe conditions 306.1.1

- Soils

- Must resist collapse of footing or foundation system
- Be resistant to soil expansion
- Foundation must resist adverse chemical from contact with soils
- Provide adequate strength
- Resist ground water table effects

\* Unsafe conditions **306.1.1** (*continued*)

- Concrete
  - Deterioration
  - Ultimate deformation
  - Fractures
  - Fissures
  - Spalling
  - Exposed reinforcement
  - Detached, dislodged, or failing connections



\* Unsafe conditions 306.1.1 (*continued*)

- Aluminum

- Deterioration
- Corrosion
- Elastic deformation
- Ultimate deformation
- Stress cracks
- Joint fatigue
- Detached, dislodged, or failing connections



- \* Unsafe conditions 306.1.1 (*continued*)
  - Masonry
    - Deterioration
    - Ultimate deformation
    - Fractures and fissures in masonry or mortar joints
    - Spalling
    - Exposed reinforcement
    - Detached, dislodged, or failing connections



\* Unsafe conditions **306.1.1** (*continued*)

- Steel

- Deterioration
- Elastic deformation
- Ultimate deformation
- Metal fatigue
- Detached, dislodged, or failing connections

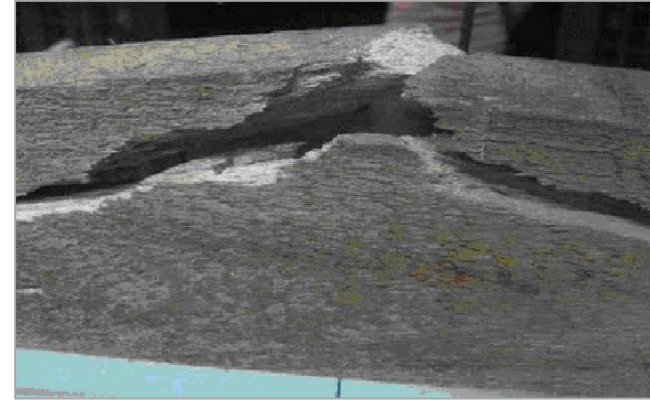




\* Unsafe conditions **306.1.1** (*continued*)

- Wood

- Ultimate deformation
- Deterioration
- Damage from insects, rodents, and vermin
- Fire damage beyond charring
- Significant splits and checks
- Horizontal and vertical shear cracks
- Inadequate support
- Detached, dislodged, or failing connections
- Excessive cutting and notching





## ◆ Handrails and Guardrails 307.1

- \* Stairs of >4 risers require handrail
- \* Open portion of a stair, landing, balcony, porch, deck, or ramp >30" above floor or grade shall have handrails



◆ Rubbish and Garbage 308

◆ Accumulation of Rubbish or Garbage 308.1

- \* No accumulation either inside or outside
- \* Prevent unsanitary conditions
- \* Condemnation possible
- \* Stability of individual
- \* Other government organizations may need to be called – Health Department, DCFS, social worker



## ◆ Disposal of Rubbish 308.2

- \* Rubbish includes all waste materials except garbage
- \* Occupants are responsible for disposing of own rubbish
- \* Owner responsible for providing approved covered containers and removal of rubbish
- \* Occupant responsible for placing rubbish properly in containers
- \* Refrigerator or similar must remove doors
- \* Code Official's dilemma is to determine responsible party: occupant or owner

## ◆ Disposal of Garbage 308.3

- \* Occupant is responsible to dispose of garbage
- \* Garbage shall be placed in approved containers
- \* Owner shall provide one of the following:
  - An approved mechanical food waste grinder in each dwelling unit
  - An approved incinerator unit in the structure available to all occupants
  - An approved leak proof, covered, outside garbage container

- \* Improper containment of garbage can attract rodents, insects, animals, and vermin. Causes of this can be related to the following:
  - Poor disposal techniques
  - Insufficient containers
  - Infrequent garbage pick-up
  - Mechanical food waste grinder inoperable

## ◆ Pest Elimination 309

### ◆ Infestation 309.1

- \* Structure shall be kept free of insect and rodent infestation
- \* Infestation shall be eliminated
- \* Two types of insect infestation
  - Nuisance: Flies, cockroaches, silverfish
  - Wood-destroying: Termites, powder post beetles, carpenter ants
- \* Must prevent re-infestation

## ◆ Owner 309.2

- \* Responsible for extermination prior to renting or leasing the structure
- \* Occupant is responsible after occupancy begins
- \* Difficult in determining responsible party since infestation may not be noticed by the occupant right away

## ◆ Single Occupant 309.3

- \* Occupant of a one-family dwelling or a single tenant non-residential structure is responsible for extermination

## ◆ Multiple Occupancy 309.4

- \* Owner responsible for extermination of the public or shared areas:
  - Two or more dwelling units
  - Multiple occupancy
  - Rooming house
  - Non-residential structure

IF: Tenant/occupant causes infestation

THEN: Tenant/occupant responsible



## ◆ Occupant 309.5

- \* Occupant is responsible for continued rodent free and pest free condition of structure
- \* Owner is responsible for defects in structure that are the source of infestation

## ◆ Chapter 3: Case Study 1

- \* Inspector Debbie receives a complaint that the neighbors moved out of their house and every piece of furniture and debris is in the backyard, which backs up to an alley.
  - Answer the following:
    - What conditions may have lead to this situation?
    - Who is responsible to clean up this mess?

## ◆ Chapter 3: Case Study 2

- \* Upon conducting your routine exterior inspection you observe the house at 101 Lee Street has a significant dip or depression in the roof.
  - Answer the following:
    - What could cause this condition?
    - What action, if any, should you take?

## ◆ Chapter 3: Case Study 3

- \* A property owner has had a leaky roof for some time now. He knows he is going to get a ticket if he doesn't do something soon. Over the weekend the owner had installed a pitched roof. The owner has been contacted to inform him that a permit is required. He states he installed the roof over the existing flat roof. The rafters are nailed through the flat roof into the top plate.
  - Answer the following:
    - Is there a problem with this installation?
    - Should the lack of a permit issue even come up or should you be glad the roof is being repaired?



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Understanding the International  
Property Maintenance Code®  
2018

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Chapter 4  
Light, Ventilation, and  
Occupancy Limitations

## ◆ General 401

- \* Owner responsible to provide and maintain:
  - Light
  - Ventilation
  - Space conditions
- \* Occupancy of a structure lacking any of above is non-complying and cannot be occupied

- ◆ Light 402
- ◆ Habitable Spaces 402.1 (see definition Chapter 2)
  - \* Minimum of one window
  - \* Window faces directly to outside or to a court
  - \* 8% of floor area
  - \* Obstruction within 3' and higher than ceiling – not included in calculation



- \* Obstruction more than 3' away from window – OK
- \* Obstruction less than 3' away – cannot be counted for natural light



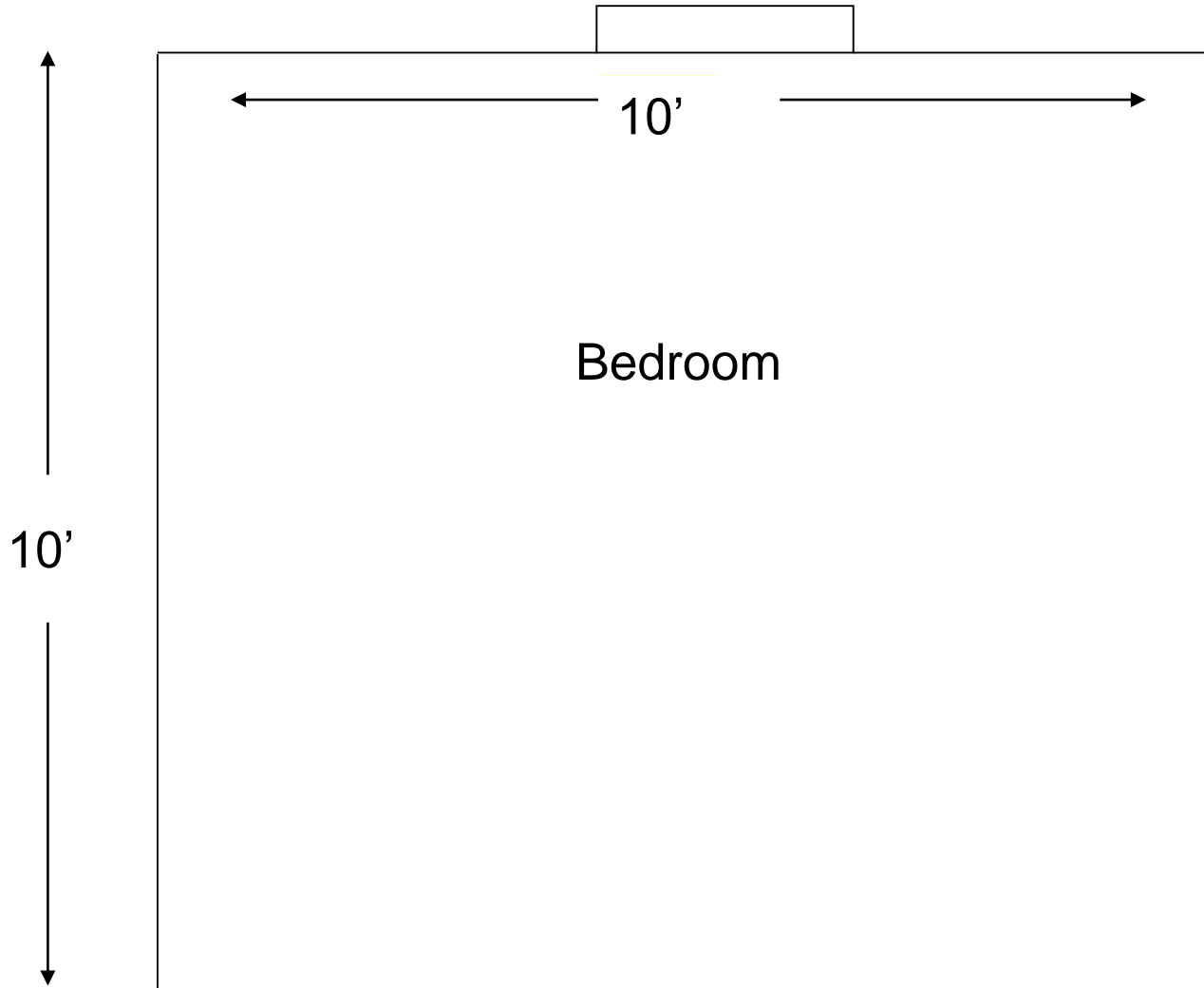


\* Exception:

- Artificial light
- Natural light from adjacent room (a/k/a “borrowed light”)
- Still 8% of room served
- Minimum 25 square feet



4'-0" H x 2'-6" W



10' x 10' = 100 square feet

Window size 4' x 2.5' = 10 square feet

Actual glazed area is 3' 9" (3.75 feet) x 2' 3" (2.25 feet) = 8.44 square feet

8% for light = 8 square feet

Ventilation is 45% of minimum required glazed area

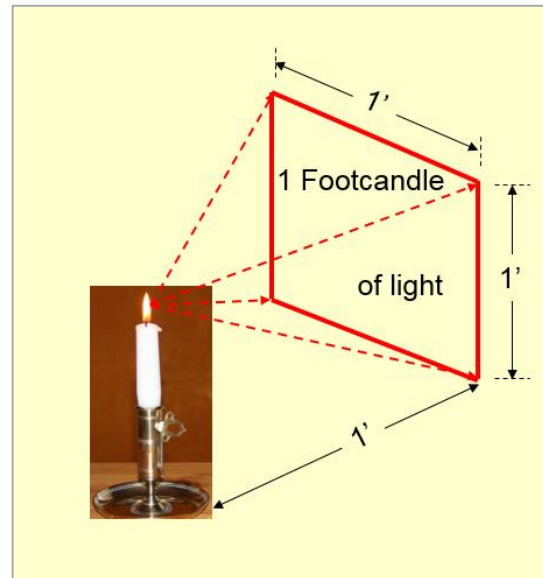
Window 8 square feet x 45% = 3.6 square feet

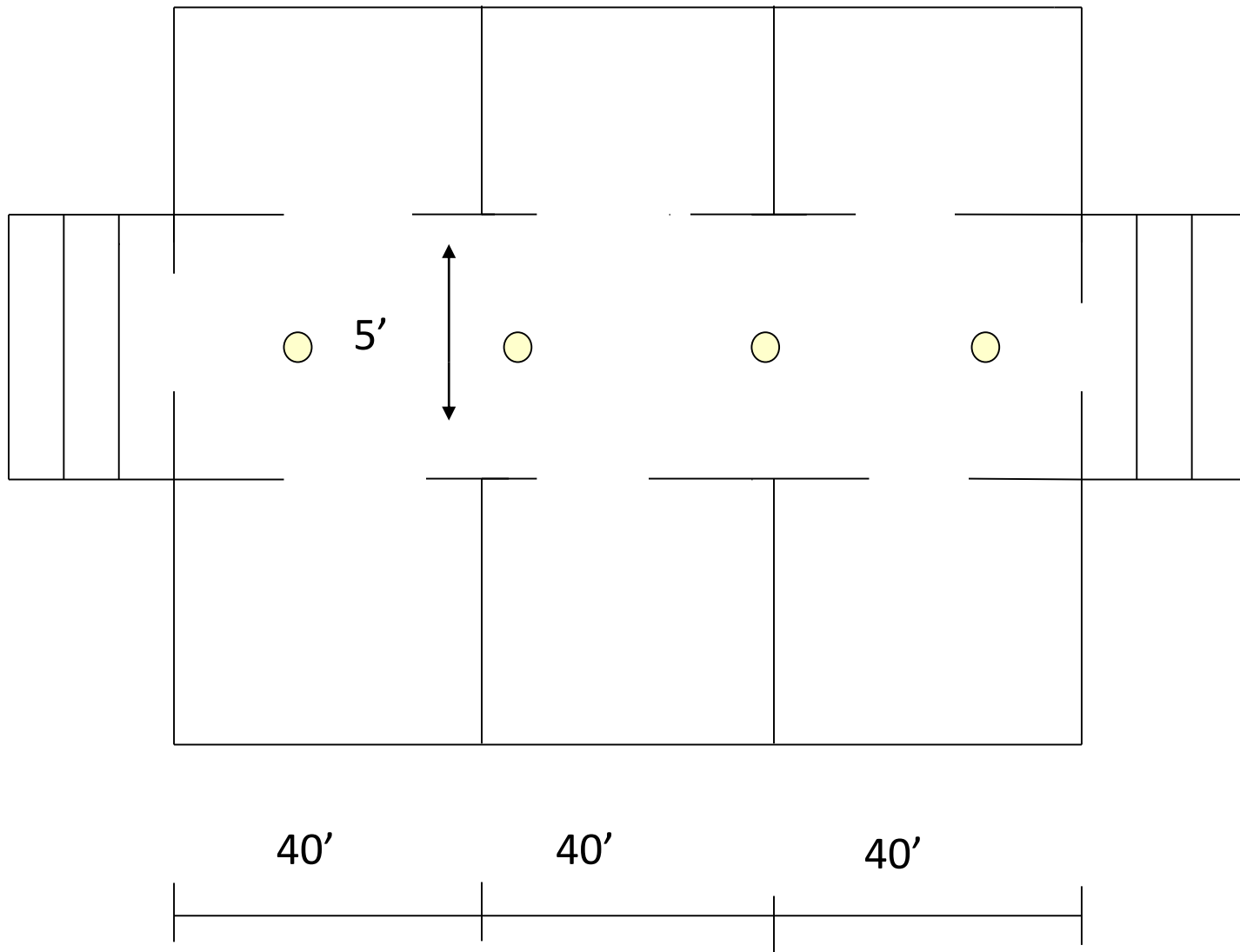
Actual 3.75 x 2.25 = 8.44 square feet

for light x 45% (.45) = 3.8 square feet

## ◆ Common Halls and Stairways 402.2

- \* Lighting with a minimum of 60W bulb (for each 200 square feet)
- \* Spacing between lights not greater than 30'
- \* Illumination of 1 foot-candle for means of egress and at each exterior means of egress stairway





## Calculation

Length of Corridor = 120'

Width of Corridor = 5'

Total Area = 600 square feet

Light shall provide illumination for each 200 sq ft

Total number of light fixtures required 600 sq ft divided by 200 feet

$600/200 =$  3 light fixtures

Each fixture shall be spaced no more than 30' apart

4 fixtures required

## ◆ Other Spaces 402.3

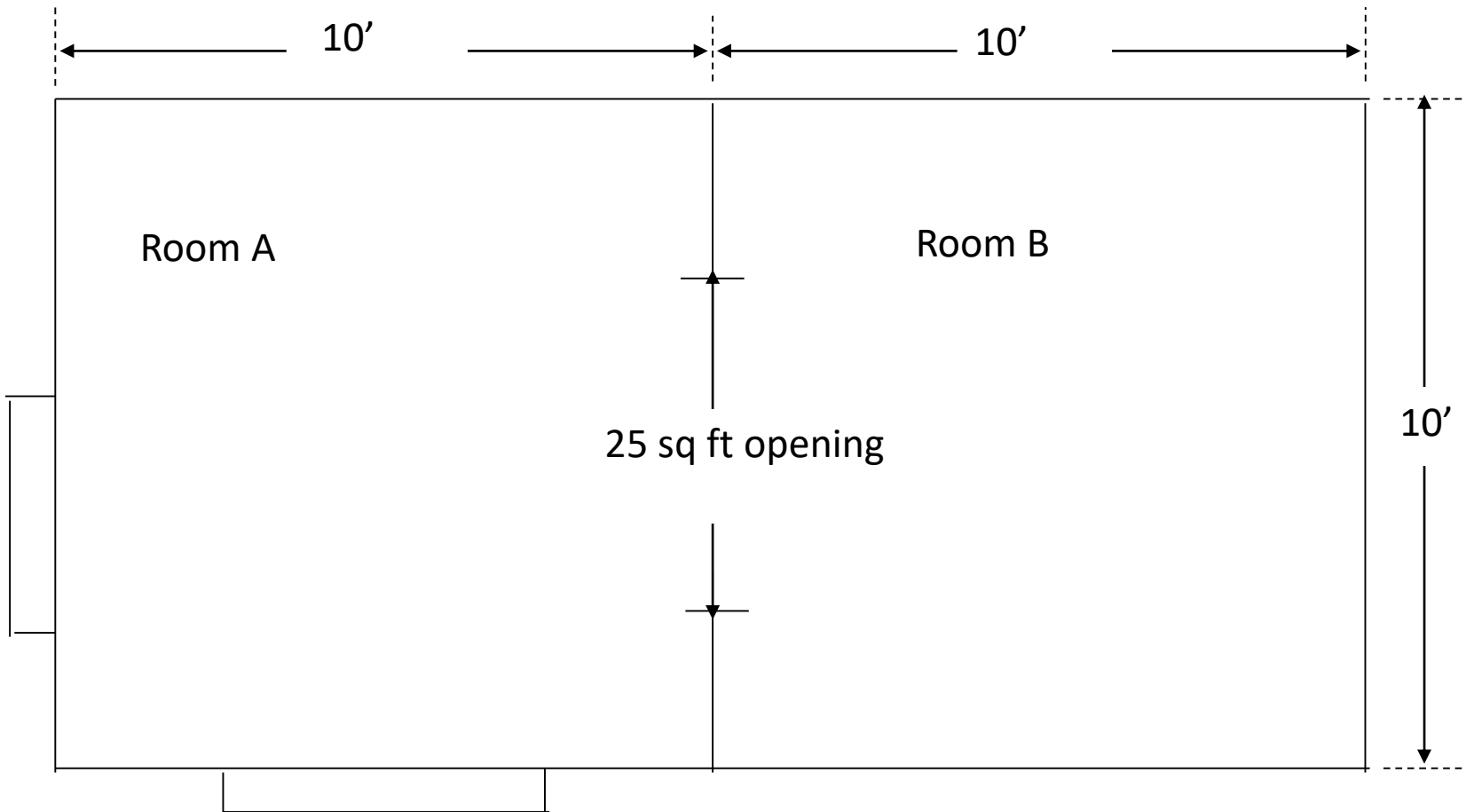
- \* Natural or artificial light sufficient for:
  - Maintenance of sanitary conditions
  - Safe occupancy of the space
  - Utilization of appliances, equipment and fixtures

## ◆ Ventilation 403

### ◆ Habitable Spaces 403.1

- \* At least one operable window
- \* Total operable area of window shall be at least 45% of the required glazed area
- \* May be ventilated through the adjoining space if it is without any openings





Window 4'h x 2'.6"w = 10 square feet

Actual glazed area is 3' 9" x 2' 3" = 8.44

2 windows at 8.44 = 16.88 square feet

Borrow light and ventilation

8% min. opening between spaces but not less than 25 square feet

Room A 10 x 10 = 100 square feet

Room B 10 x 10 = 100 square feet

Total 200 square feet x 8% = 16 square feet of glazed area for light

45% for ventilation 16 x 45% = 7.2

## ◆ Bathrooms and Toilet Rooms 403.2

- \* Must have a window for required natural ventilation
- \* Exception for mechanical ventilation
  - Exhaust to exterior and shall not be re-circulated
  - Must not terminate in any attic or closed space



## ◆ Cooking Facilities 403.3

- \* Must be approved by the Certificate of Occupancy
- \* Prohibited in dormitory or rooming units
- \* Exceptions:
  - Permitted only when approved in writing by the code official
  - Coffee pots and microwave ovens shall not be considered cooking appliances

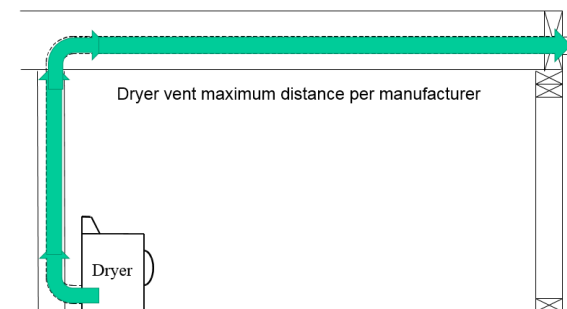


## ◆ Process Ventilation 403.4

- \* Hazardous fumes, gases or dust must be exhausted by mechanical means
- \* The air shall be exhausted to the exterior
- \* No re-circulation shall be permitted
- \* Protection of exterior air may be required



- ◆ **Clothes Dryer Exhaust 403.5 IRC M1502.4**
  - \* Venting systems shall be independent of other systems
  - \* Minimum 28 gage with minimum 4" diameter **M1502.4.1**
  - \* Must be vented in accordance with manufacturer instructions
  - \* Improper venting can cause fire and health hazard
  - \* New codes require vent length be posted if concealed in wall or ceiling
  - \* 35' maximum length **M1502.4.4.1** see **Table 1502.4.4.1** for reductions
  - \* Length Identification for concealed installed exhaust duct. Label or tag installed within 6' of the exhaust duct connection **M1502.4.5**



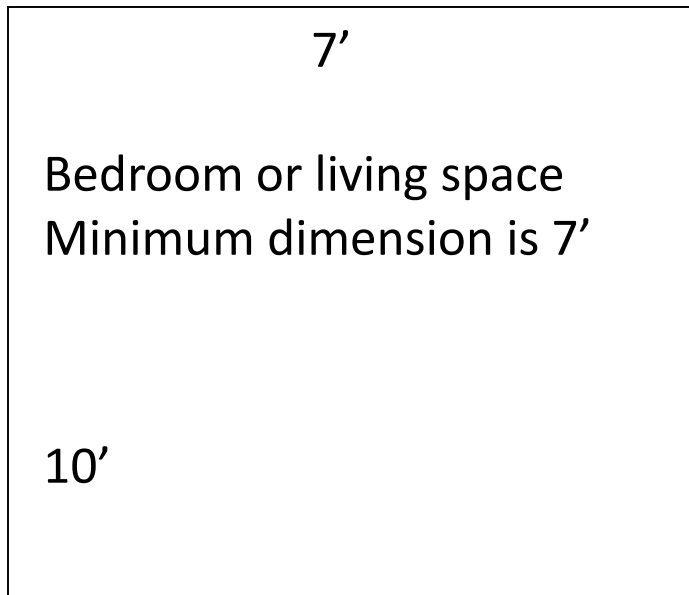
## ◆ Occupancy Limitations 404

### ◆ Privacy 404.1

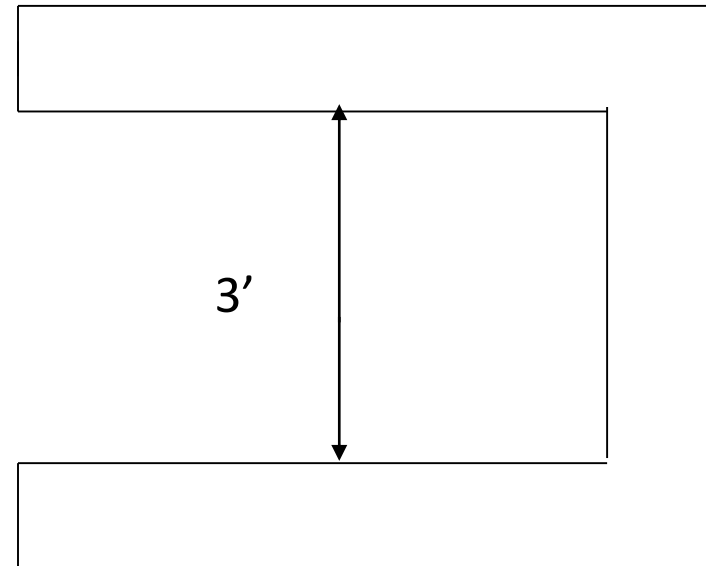
- \* Dwelling, hotel, rooming, or dormitory units shall be separate from common and public areas

### ◆ Minimum Room Widths 404.2

- \* Habitable room 7' other than kitchen
- \* Kitchens not <3' between countertops and appliances or walls



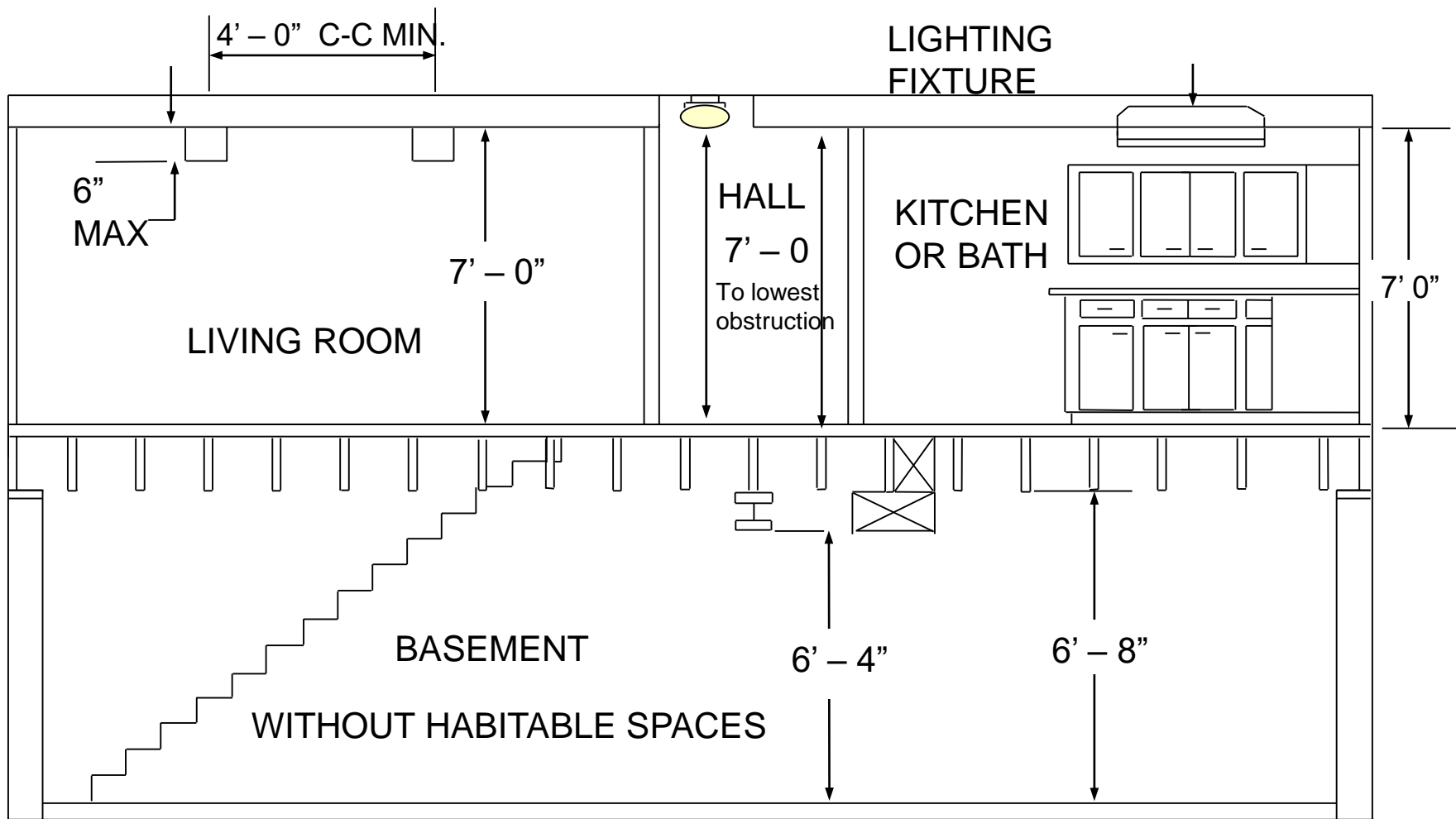
### Minimum Kitchen Dimensions



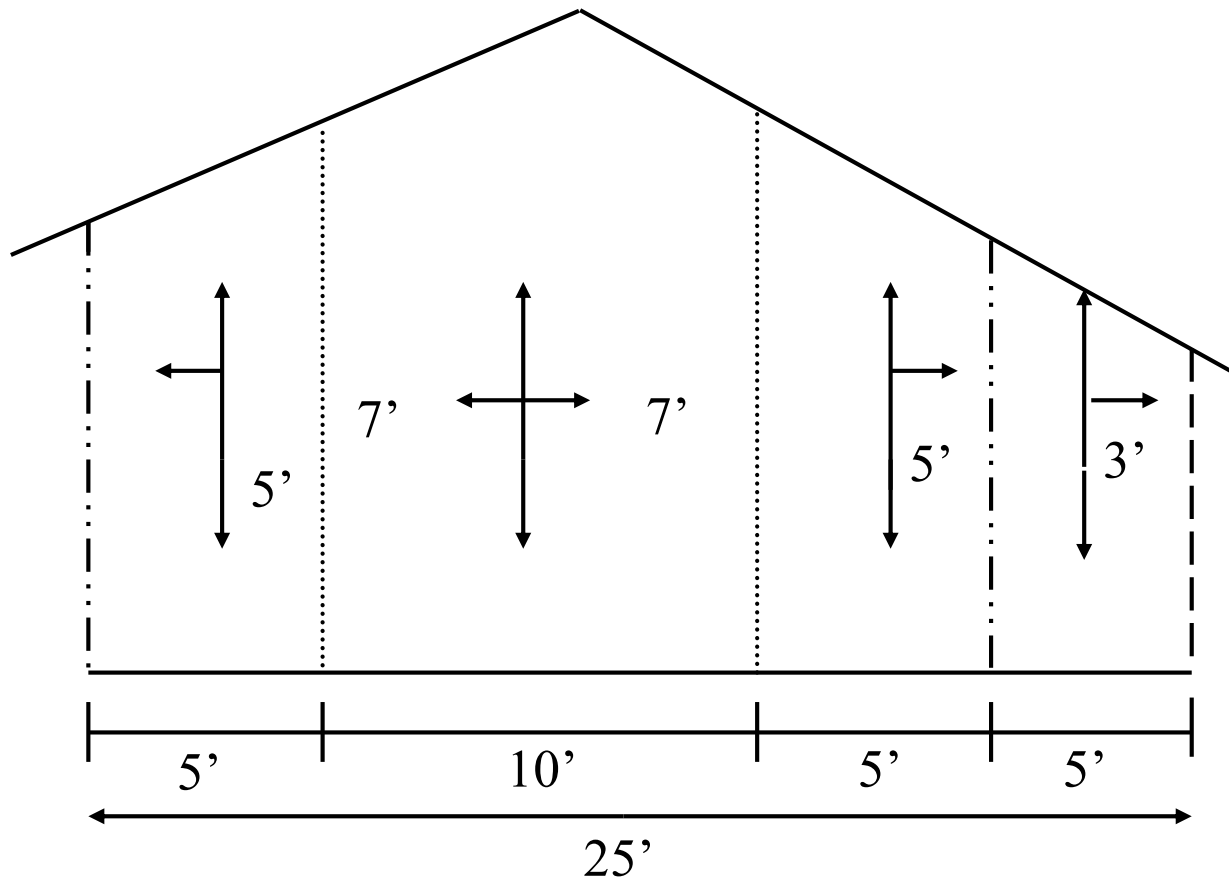


## ◆ Minimum Ceiling Heights 404.3

- \* Habitable spaces not <7'
- \* Exceptions
  - Beams and girders (spaced <4') not >6" (1 & 2 family dwellings)
  - Basements used for laundry, study, or recreation 6'-8" beams and girders 6'-4" (1 & 2 family dwellings)
  - Sleeping, study or similar rooms with a ceiling height of 7' for a least 1/3 of the required floor area
    - Ceiling height shall be a minimum of 5' to be included in required floor area

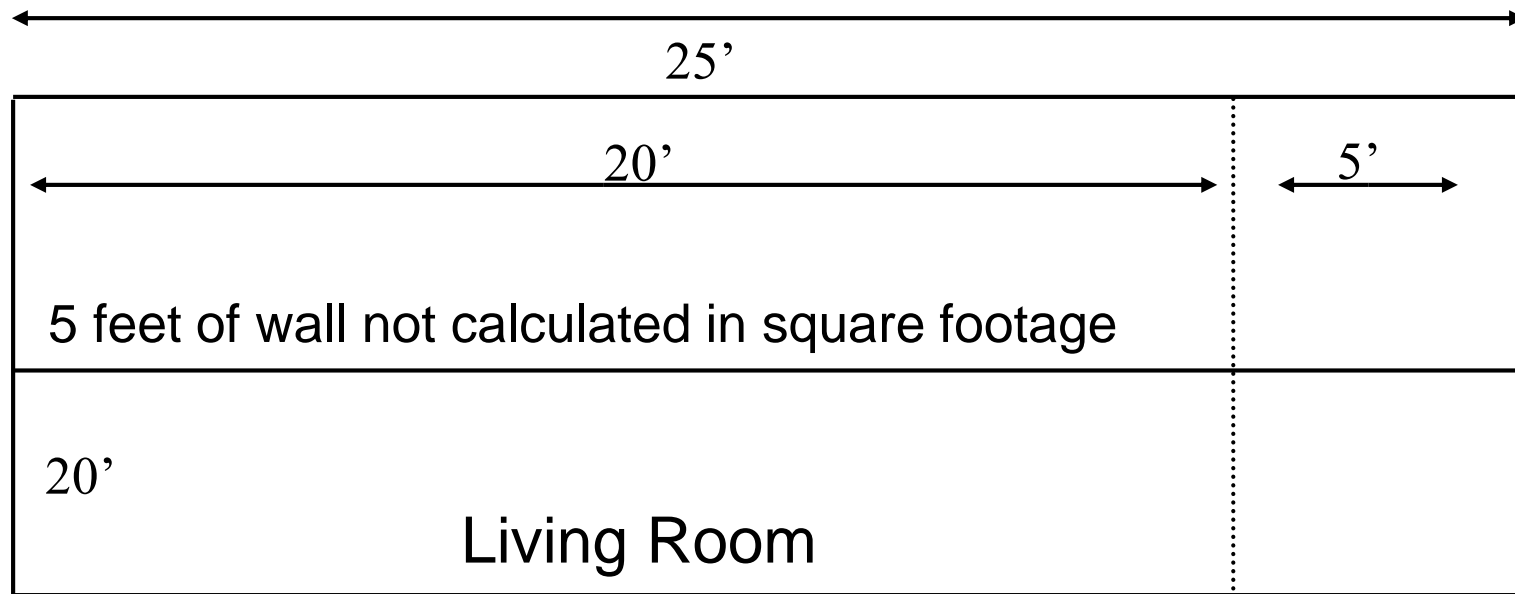


All measurements are minimum numbers



Walls must be a minimum of 5' to qualify as square footage

Ceiling height must be a minimum of 7' for at least 1/3 of the square footage



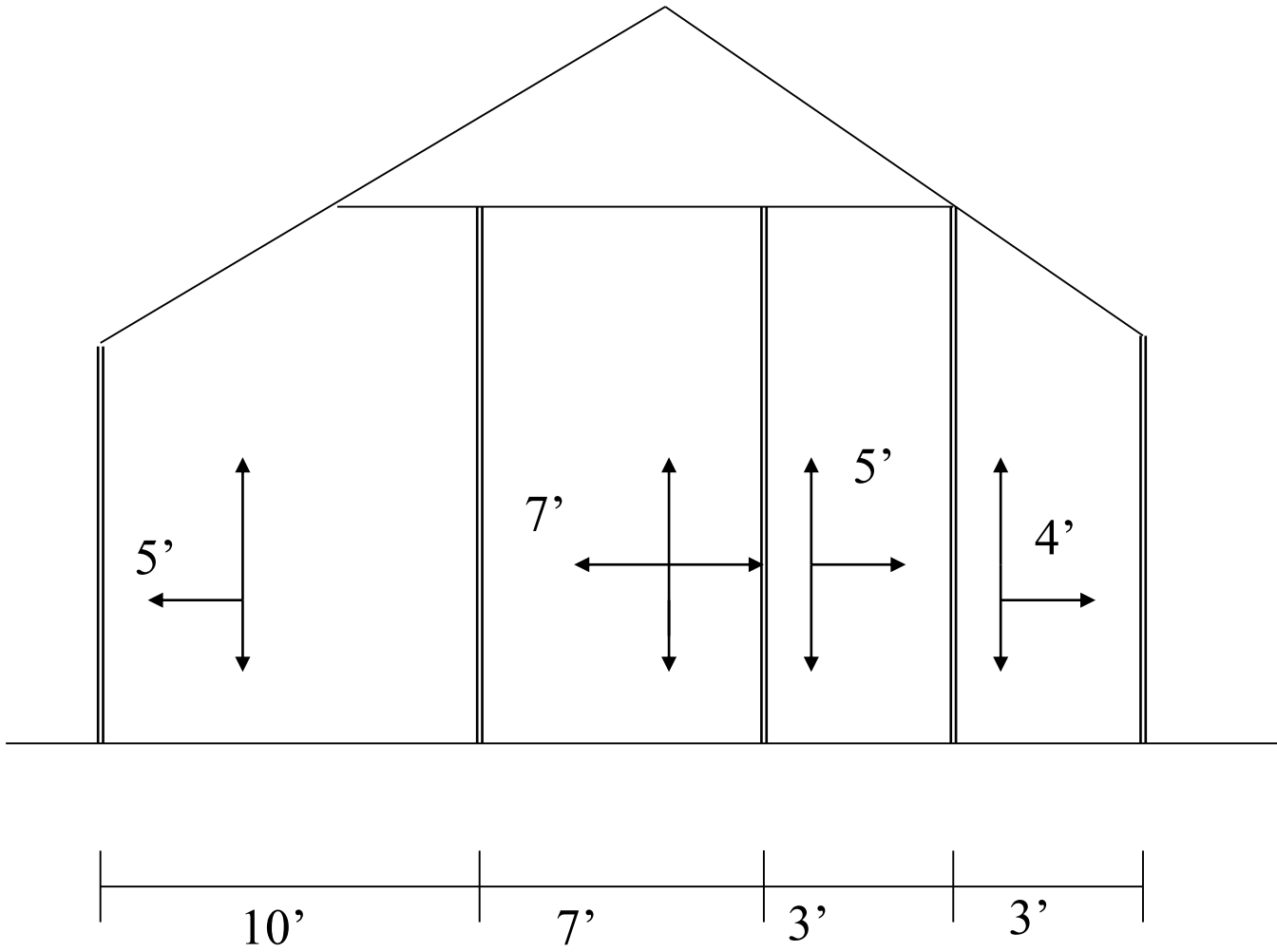
Total square feet  $25' \times 20' = \underline{500 \text{ square feet}}$

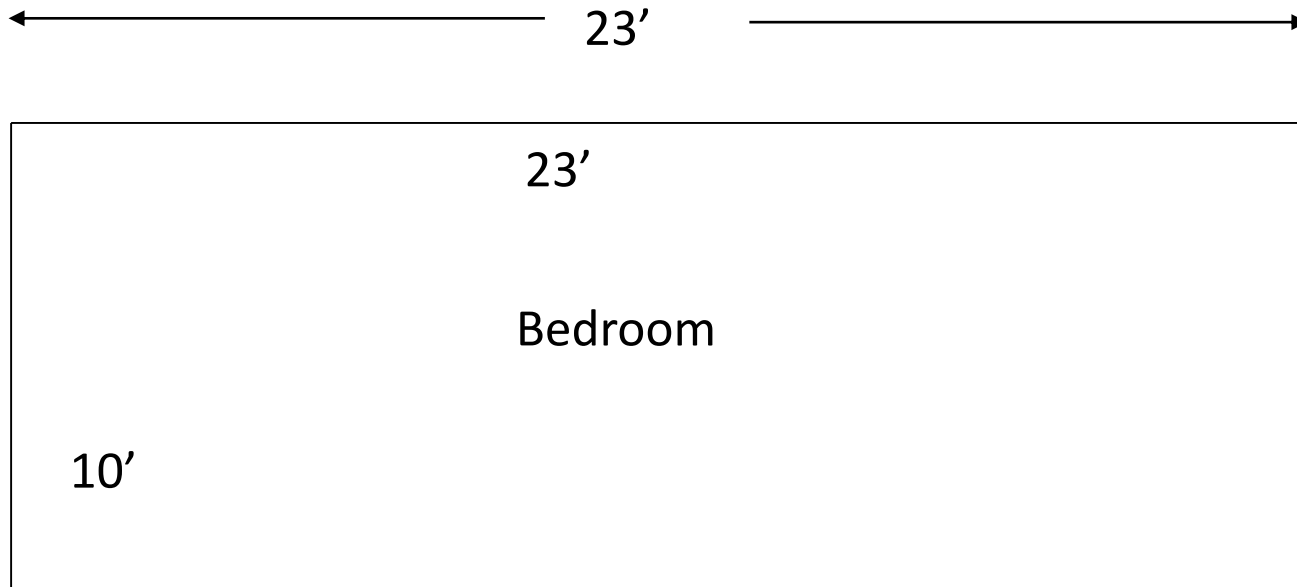
Habitable square footage  $20' \times 20' = \underline{400 \text{ square feet}}$

Ceiling height of 7' is  $10' \times 10' = \underline{100 \text{ square feet}}$

Required 7' ceiling height 40 square feet

Is ceiling height 7' for 1/3 of the required floor area?





Total square footage	230
Habitable square footage	200
7 foot ceiling height	70
Required 7 foot ceiling height	23.33

Is ceiling height 7' for at least 1/3 of the allowable floor area?

- ◆ **Bedroom and Living Room Requirements 404.4**
  - \* Every bedroom occupied by one person must be a minimum of 70 square feet
  - \* Every living room shall contain minimum 120 square feet
  - \* More than 1 person – 50 square feet per person
  - \* Bedrooms shall not constitute the only means of egress
  - \* Access to at least one water closet and lavatory without passing through another bedroom
  - \* Kitchens and non-habitable spaces are prohibited sleeping areas
  - \* Occupancy is limited to minimum area requirements

## ◆ Overcrowding 404.5

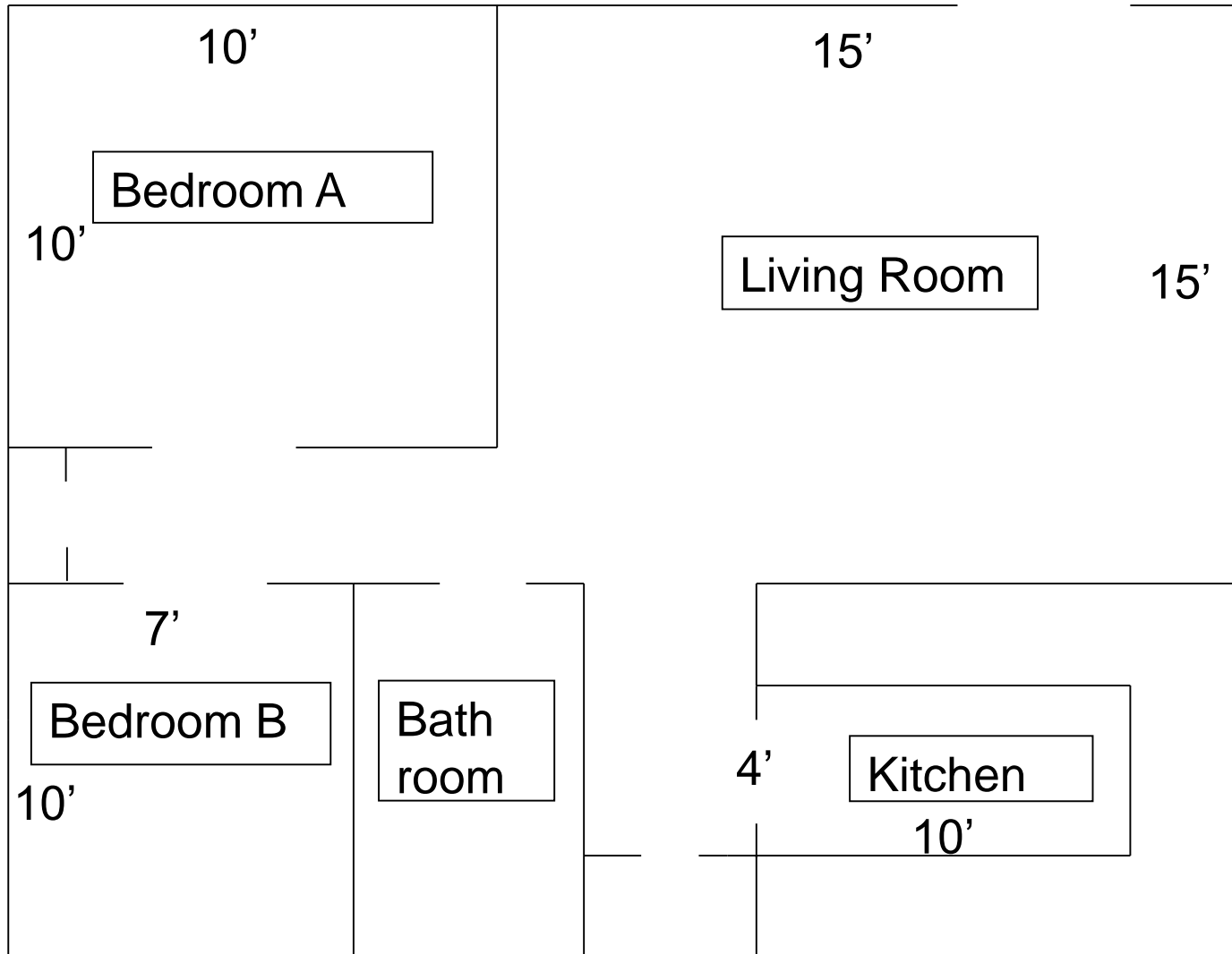
- \* The number of persons occupying a dwelling unit shall not exceed the minimum area requirements shown in **Table 404.5**

**TABLE 404.5  
MINIMUM AREA REQUIREMENTS**

SPACE	MINIMUM AREA IN SQUARE FEET		
	1-2 occupants	3-5 occupants	6 or more occupants
Living room <sup>a, b</sup>	120	120	150
Dining room <sup>a, b</sup>	No requirement	80	100
Bedrooms	Shall comply with Section <a href="#">404.4.1</a>		







## Occupant Load

<u>Room</u>	<u>Square Feet</u>	<u>Occupant Load</u>
Bedroom A	<u>100</u>	<u>2</u>
Bedroom B	<u>70</u>	<u>1</u>

## Sleeping Areas Vs. Occupiable Rooms

Bedroom A and B total 3

\* Sleeping area **404.5.1**

- Minimum occupancy area required by **Table 404.5** shall not be included as a sleeping area in determining the minimum occupancy area for sleeping purposes
- Sleeping areas shall comply with **Section 404.4**

\* Combined spaces **404.5.2**

IF: Total area is equal to that required for separate rooms

AND IF: Space is located so as to function as a combination living room/dining room.

THEN: Combined living room and dining room spaces per **Table 404.5**

## ◆ Efficiency Unit 404.6

- \* Efficiency unit must meet the following criteria:
  - Unit occupied by not more than 1 person 120 square feet
  - 2 persons shall have clear floor area of not less than 220 square feet
  - Three occupants shall have 320 square feet plus kitchen and bathroom



\* Efficiency unit **404.6** (*continued*)

- Unit must have a kitchen sink, cooking appliance and refrigeration, each having not less than 30” in front
- Light and ventilation shall be provided
- Unit shall have a separate bathroom that contains a water closet, lavatory, and bathtub or shower
- Maximum number of occupants shall be 3



## ◆ Food preparation 404.7

- \* Space shall be suitable to store, prepare and serve foods in a sanitary manner
- \* Adequate facilities for the sanitary disposal of food wastes, refuse, and temporary storage



## Chapter 4: Case Study 1

- \* The neighbors have been complaining about the number people living at the house at 1414 Smith Street. The complaints have claimed that there are six to eight cars in the driveway all of the time. The police have been out numerous times on noise complaints. You have been directed by the Village Manager's office to remedy this problem as soon as possible.
  - Answer the following:
    - How can you determine the number of people allowed to live there?
    - The zoning ordinance defines a family as no more than 2 people not related by blood.
    - Does this have any impact on your response to this complaint?

## Chapter 4: Case Study 1 (*continued*)

- \* Should you attempt to establish relationships amongst the people living there?
- \* What other resources can you utilize to establish who lives there?
- \* What steps should you take to prevent discrimination issues from being brought against yourself or the village?



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## Questions?

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**Thank You For Your Time**

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This concludes the American Institute of Architects  
Continuing Education System Program



## Building & Fire Code Academy

**Website:** [bfcacademy.com](http://bfcacademy.com)

**Email:** [info@bfcacademy.com](mailto:info@bfcacademy.com)

**Voice:** (800) 488-7057 (847) 428-2951

**Fax:** (847) 428-2911

**File Attachments for Item:**

ER-6 Cincinnati Inspector Cross Training Part 3 (BFCA)

Provider: Building and Fire Code Academy

RBI, RMI (6 classes, 3 hours each)

Staff Notes: The series of courses is intended to cross train City of Cincinnati property maintenance inspectors and residential building inspectors. This portion is focused on the Residential Code of Ohio: there may be an issue with the first class, which covers Chapter 1.

Committee Recommendation:

### Part 3 Session Break Down

18 hours of instructional time The class will be instructed in 3-hour sessions.

Session 1 RCO Chapters Overview 1, Complete Chapter 2 and start 3

Session 2 RCO Chapter 3

Session 3 RCO Chapter 3

Session 4 RCO Chapters 4 and start Chapter 5

Session 5 RCO Chapters 6 and 7

Session 6 RCO Chapter 8, 9, 10



## **CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS**

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

**Instructors:** Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications 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 shall not disclose improper approval information to the public.

**Course sponsors/co-sponsors:** 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.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

**Participants:** Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

**Board approval:** Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

**Facility/training area:** Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

# APPLICATION

## FOR Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.



### Board of Building Standards

6606 Tussing Road, P.O. Box 4009

Reynoldsburg, Ohio 43068-9009

(614) 644-2613 Fax: (614) 644-3147

dic.bbs@com.state.oh.us

www.com.state.oh.us/dic/dicbbs.htm

#### COURSE SUBMITTER:

Course Submitter: George Sweeney  
(Contact Name)  
Organization: Building and Fire Code Academy  
(Organization/Company)  
Address: 2420 Vantage Drive  
(Include Room Number, Suite, etc.)  
City: Elgin State: IL Zip: 60124  
E-Mail: GSweeney@bfcacademy.com  
Telephone: (847) 428-2951 Fax: (847) 428-2911  
Course Sponsor: Richard A. Piccolo, Building and Fire Code Academy

#### COURSE INFORMATION:

Course Title: \_\_\_\_\_

New Course Submittal:  Update Course:  Prior Approval Number: \_\_\_\_\_

Purpose and Objective: The City will be cross training the Residential and Property Maintenance Inspectors. This class will provide an explanation

The class is based on the 2019 edition of the Residential Code of Ohio. The audience for this class is the current Residential Building Inspectors and the current property maintenance.

The class consists of lecture with a Power Point presentation with related problem-solving activities.

Number of Instructional Contact Hours that can be obtained upon completion: 18

If Multi-Session, Number of Instructional Contact Hours Per Session: 3

#### Program Applicable for the Following Participants:

Building Official  Master Plans Examiner  Building Inspector  Fire Protection Inspector  Mechanical Inspector   
 Building Plans Exam.  Plumbing Inspector   
 Plumbing Plans Exam.  Non-Res IU Inspector   
 Electrical Plans Exam.   
 Mechanical Plans Exam.   
 Fire Protect. Plans Exam.

Res Building Official  Res Plans Examiner  Res Building Inspector  Res Mechanical Inspector  Res IU Inspector

Electrical Safety Inspectors

Location of ESI Course: \_\_\_\_\_ Date(s) of ESI Course(s): \_\_\_\_\_

SUBMITTAL CHECKLIST: <b>Make Sure</b> all of the Following Information is <b>Submitted</b> :		Check Off
<b>Course Submitter:</b>	Name of contact person and their certification numbers, organization, address, fax, phone	
	Organization sponsoring or requesting the program (if any)	
<b>Course Title:</b>	Name of course (related to content)	
<b>Purpose/Objective:</b>	Describe purpose and how course will improve competency of certification(s) listed	
<b>Contact Hours:</b>	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
<b>Participants:</b>	Check off each certification for which credit is requested (for which course relates to certification)	
<b>Content of Program:</b>	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
<b>Course Materials:</b>	Collated workbooks, handouts, hard copy or electronic versions of program is available	
<b>Instructor(s) Info.:</b>	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
<b>Test Materials:</b>		
<b>Completed Application:</b>		

**NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.**

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**WELCOME!**



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## Building & Fire Code Academy

### City of Cincinnati Inspection Cross Training ©

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### Residential Code of Ohio

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2021

*Building Better With Our Greatest Resource...Education®*



## Course Description

A multi day program based on the 2019 Residential Code® of Ohio, assimilating the use and application of basic building planning requirements for wall, floor, ceiling, roof framing, and materials. In addition to the first 10 chapters of The Code, students will use a well-illustrated workbook that provides examples of common code situations with practical problem-solving applications. Instructors will emphasize intent and rationale while working with difficult or unusual field situations, assisting students in distinguishing alternatives that satisfy the overall objective.



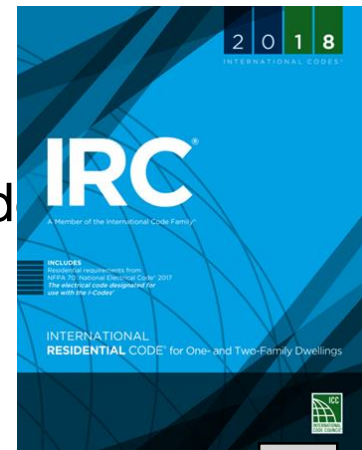
# Learning Objectives / Learning Outcomes

Students successfully completing this course will be able to:

- \* Describe and interpret the duties and powers of a code official.
- \* Utilize the IRC to appraise building permit application submittal requirements.
- \* Read and interpret graphs located in the IRC determine climactic and geographic design criteria for their region.
- \* Utilize the IRC to illustrate minimum requirements related to residential building planning, design, and construction.
- \* Utilize the IRC to devise minimum egress and emergency rescue opening requirements.

## ◆ General Information

- \* Guide to effective use of code – page v
- \* Complete code covering all disciplines
- \* One- two and three family dwellings
- \* Three-story height limit
- \* Prescriptive code with some performance language
- \* Many opportunities for alternative compliance methods
- \* Presented in ordered format consistent with normal progression of construction
- \* Based on the 2018 edition of the International Residential Code Scope section and summary of each chapter



## ◆ Structure of the International Residential Code

- \* Part I – Administrative
  - Chapter 1 – Scope and Administration
- \* Part II – Definitions
  - Chapter 2 – Definitions
- \* Part III – Building Planning and Construction
  - Chapter 3 – Building Planning
  - Chapter 4 – Foundations
  - Chapter 5 – Floors
  - Chapter 6 – Wall Construction
  - Chapter 7 – Wall Covering
  - Chapter 8 – Roof-Ceiling Construction
  - Chapter 9 – Roof Assemblies
  - Chapter 10 – Chimneys and Fireplaces

- \* Part IV – Energy Conservation
  - Chapter 11 – Energy Efficiency
- \* 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

- \* Part V – Mechanical (*continued*)
  - Chapter 18 – Chimneys and Vents
  - Chapter 19 – Special Appliances, Equipment 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
  
- \* Part VI – Fuel Gas
  - Chapter 2 – Fuel Gas



\* Part VII - Plumbing

- Chapter 25 – Plumbing Systems
- Chapter 26 – 28 Not used Requirements
- Chapter 29 – Water Supply and Distribution
- Chapter 30 – 33 Not used

- \* Part VIII – Electrical
  - Chapter 34 – Electrical
  - Chapter 35 – 43 Not used
- \* Part IX – Referenced Standards
  - Chapter 44 – Referenced Standards



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**Understanding the 2019  
Residential Code of Ohio**

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**Chapter 1  
Administration**

## Part I – Administration – an overview

### ◆ General 101

#### \* Scope 101.2

- Provisions of the **RCO** apply to one- two- and three family dwellings
- Construction, alteration, movement, enlargement, replacement, repair, equipment, use, and occupancy, location, removal and demolition
- One- two and three family dwellings not >3 stories above grade plane in height with separate means of egress, and their accessory structures
- Exccetions: 116 specific exceptions



\* Intent 101.3

- Minimum requirements to safeguard the public safety, health and general welfare
  - Structural strength
  - Means of egress facilities
  - Stability
  - Sanitation
  - Light and ventilation
  - Energy conservation

## ◆ Applicability and jurisdictional Authority

- \* Conflicts over specific – strictest shall apply
- \* Specific requirements take precedence over general requirements
- \* Other local, state and federal codes, standards or laws may apply

- ◆ Certified Residential Building Departments, Personnel and appeals Boards 103
  - \* Per Division 4101:7 of the Administrative Code
- ◆ Duties and Responsibilities
  - \* Lists for building official, plan reviewers and inspectors



## ◆ Approvals 105

- \* Approval requirements





- ◆ Construction Documents 106
  - \* Lists requirements from construction documents
- ◆ Processes 107 and 108
  - \* Describes the process for review and inspections
- ◆ Orders, Violations and Unsafe Buildings 109
- ◆ Appeals 110
- ◆ Certificate of Occupancy and Certificate of Completion 111
- ◆ Changes to the Code 112
- ◆ Existing Buildings and Structures 113
- ◆ Products and Materials 114
- ◆ Board Organization 115



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2019 Residential Code of Ohio**

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**Chapter 2  
Definitions**

## ◆ Definitions 202

- \* Alphabetical listing of terms used throughout the code
- \* Meanings indicated in this chapter
- \* Defined in other codes
- \* Referenced by the Board of Standards
- \* Ordinary accepted meanings such as the context implies



\* *Accessory structure*

- Structure that is accessory to and is incidental to the dwelling that is located on the lot.



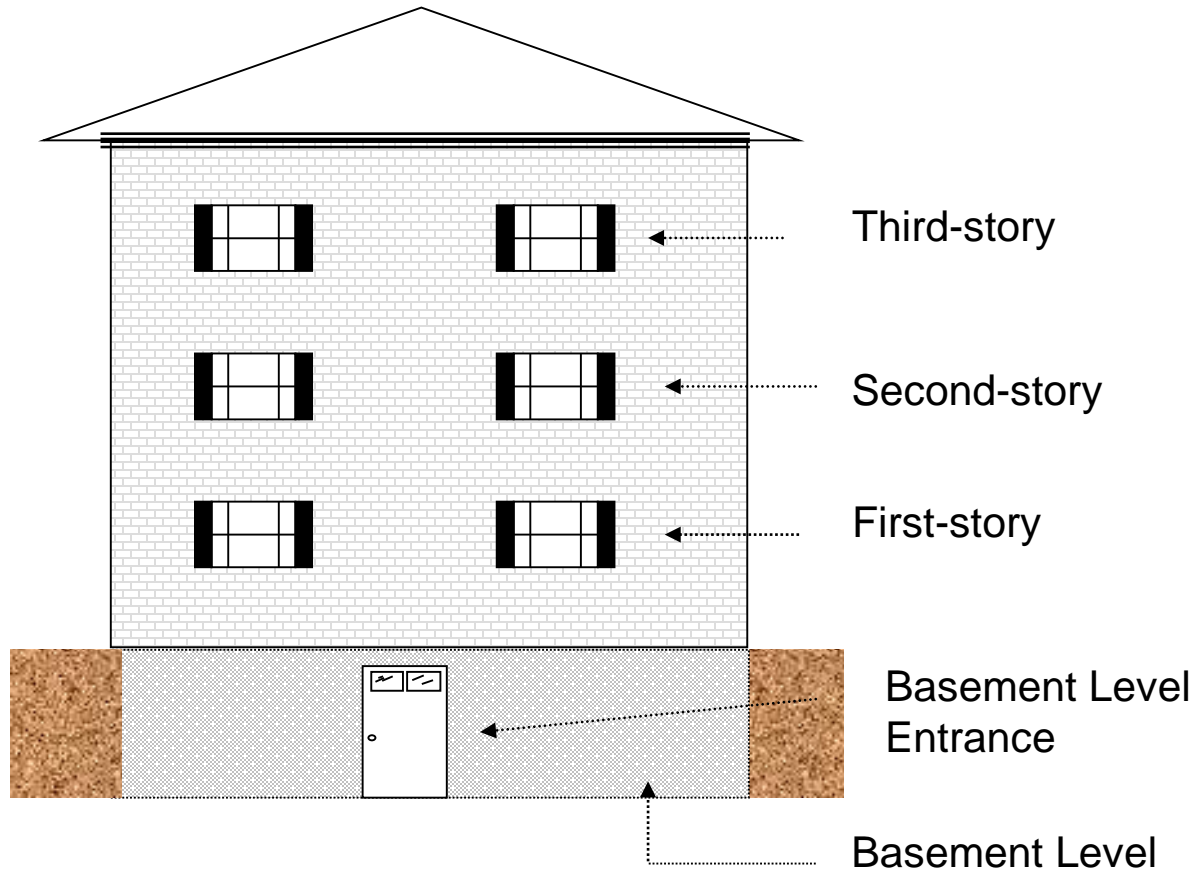
- \* *Basic wind speed*: Three second gust speed at 33' above the ground in Exposure C per **Figure 301.2(5)A**
- \* *Guestroom*: Any room or rooms used or intended to be used by one or more guests for living or sleeping purposes
- \* *Lodging house*: A one-family dwelling where one or more occupants are primarily permanent in nature, and rent is paid for guestrooms
- \* *Photovoltaic shingles*: A roof covering composed of flat-plate photovoltaic modules fabricated into shingles

- \* *Windborn debris region: Deleted*



- \* *Story* is the portion of the building between the upper surface of a floor and the upper surface of the floor or roof next above
  - Any story having its finished floor surface entirely above grade plane is considered as a story above grade plane if:
    - >6' above grade plane
    - >12' above finished ground level

# Three-story building





- \* *Structural composite lumber* – Structural members manufactured using wood elements bonded together with exterior adhesives:
  - Laminated Veneer Lumber (LVL)
  - Parallel Strand Lumber (PSL)
  - Laminated Strand Lumber (LSL)
  - Oriented Strand Lumber (OSL)



- \* *Third-party certification agency:* deleted
  
- \* *Third-party certified:* deleted
  
- \* *Whole-house mechanical ventilations system:* An exhaust system, supply system or combination thereof that is designed to mechanically exchange indoor air for outdoor air when operating continuously or through a programmed intermittent schedule to satisfy the whole-house ventilation

- \* Access (to) That which enable a device, an appliance, or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel, door or similar obstruction.
- \* Accessible Admitting close approach as a result of not being guarded by locked doors, elevation or other effective means (See readily accessible)
- \* Readily accessible Capable of being reached quickly for operation, removal or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or resort to portable ladders or access equipment (See Accessible)
- \* Reay access (to)That which enables a device, appliance or equipment to be directly reached, without requiring the removal or movement of any panel , door or similar obstruction.

# BFC A<sup>®</sup>

## Building & Fire Code Academy

### Understanding the 2019 Residential Code of ohio

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### Chapter 3 Building Planning

## ◆ Design Criteria 301

- \* **RCO** design criteria are requirements for functional and safety features of one- and two-family dwellings and townhouses
- \* Application **301.1**
  - Criteria for new structure built to the provisions of the **RCO** must meet the basic requirements for the transference of the loads to the foundation
- \* Alternative provisions **301.1.1**
- \* Alternate load path design provisions
  - WFCM 2015 Wood Frame Construction Manual
  - AISI S230-2015 Standard for Cold Formed Steel Framing
  - ICC-400 Log Structures
- \* Design per the Ohio Building Code when outside the scope

- \* Climactic and geographical design criteria 301.2
  - Table 301.2(1) – page 46
  - Establish criteria based on local conditions
  - Information to complete table from notes and local conditions
    - Local official or state should complete the table

- \* Sunrooms **301.2.1.1.1**
  - Permit applicant must choose from 5 sunroom categories



- Sunroom Category I
  - Thermally isolated
  - Walls open or enclosed with screening or max .5 MM (20 mil) plastic film
  - Non-habitable and unconditioned (a “screen porch”)
  
- Sunroom Category II
  - Thermally isolated
  - Walls enclosed
  - Wall openings enclosed with translucent or transparent plastic or glass
  - Non-habitable and unconditioned





- Sunroom Category III
  - Thermally isolated
  - Walls enclosed
  - Wall openings enclosed with translucent or transparent plastic or glass
  - Sunroom fenestration complies with additional requirements for air infiltration resistance and water penetration resistance
  - Non-habitable and unconditioned

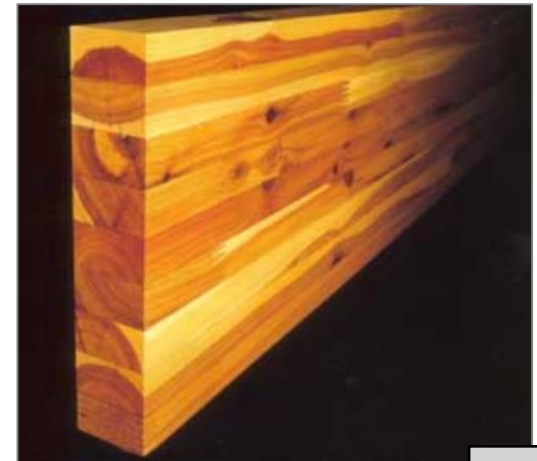


- Sunroom Category IV
  - Thermally isolated from primary structure
  - Walls enclosed
  - Designed to be heated or cooled by a separate temperature control or system
  - Sunroom fenestration complies with additional requirements for air infiltration resistance and water penetration resistance and thermal performance
  - Non-habitable and conditioned

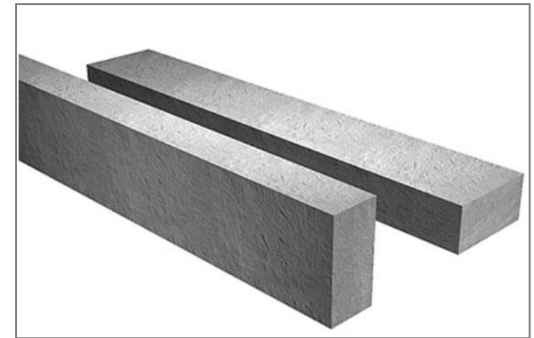
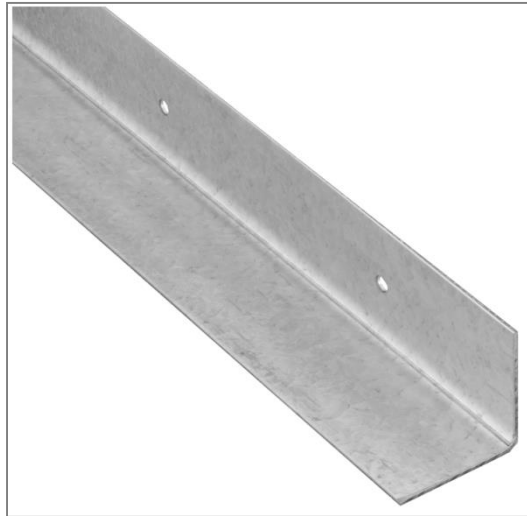
- Sunroom Category V
  - Walls enclosed
  - Designed to be heated or cooled
  - Open to main structure
  - Sunroom fenestration complies with additional requirements for air infiltration resistance and water penetration resistance and thermal performance
  - Habitable and conditioned



- \* All about matching capability with load
- \* Under-sizing results in failure
- \* Over-sizing results in waste



- \* Tables help us match capability of:
  - Materials and
  - Installation methods
  - To do the “work” we ask them to do



- \* The “work” we ask them to do is to safely hold up and keep together:
  - Foundation
  - Floor(s)
  - Walls
  - Ceiling
  - Roof
- \* Specify required fire separations
- \* Establish setback distances



- \* Identify correct table by asking:
  - What “work” are we asking material to do
  - What type of material are we using
- \* Check table name to make sure you are in right place
- \* Read all footnotes
- \* Footnotes can change what is in table



## ◆ Example # 1

- \* What is minimum size steel lintel required to support two stories of masonry veneer over a 6'-6" span?

TABLE 703.8.3.1 ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER<sup>a, b, c, d</sup>

SIZE OF STEEL ANGLE <sup>a, c, d</sup> (inches)	NO STORY ABOVE	ONE STORY ABOVE	TWO STORIES ABOVE	NO. OF 1/2-INCH OR EQUIVALENT REINFORCING BARS IN REINFORCED LINTEL <sup>b, d</sup>
3 × 3 × 1/4	6'-0"	4'-6"	3'-0"	1
4 × 3 × 1/4	8'-0"	6'-0"	4'-6"	1
5 × 3 1/2 × 5/16	10'-0"	8'-0"	<del>6'-0"</del>	2
6 × 3 1/2 × 5/16	14'-0"	9'-6"	7'-0"	2
2-6 × 3 1/2 × 5/16	20'-0"	12'-0"	9'-6"	4

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

- a. Long leg of the angle shall be placed in a vertical position.
- b. Depth of reinforced lintels shall not be less than 8 inches and all cells of hollow masonry lintels shall be grouted solid. Reinforcing bars shall extend not less than 8 inches into the support.
- c. Steel members indicated are adequate typical examples; other steel members meeting structural design requirements may be used.
- d. Either steel angle or reinforced lintel shall span opening.

\* **Answer: 6 x 3 1/2 x 5/16**

## ◆ Example # 2

- Identify maximum span for 2x12 – 16” o.c.
- Hem-fir Select Structural floor joist
- In residential sleeping area
- With design dead load of 10 psf

TABLE 502.3.1(1) FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES (Residential sleeping areas, live load = 30 psf, L/Δ = 360)<sup>a</sup>

JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf				DEAD LOAD = 20 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
			Maximum floor joist spans							
			(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)
12	Douglas fir-larch	SS	12-6	16-6	21-0	25-7	12-6	16-6	21-0	25-7
	Douglas fir-larch	#1	12-0	15-10	20-3	24-8	12-0	15-7	19-0	22-0
	Douglas fir-larch	#2	11-10	15-7	19-10	23-0	11-6	14-7	17-9	20-7
	Douglas fir-larch	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Hem-fir	SS	11-1	15-7	19-10	24-2	11-10	15-7	19-10	24-2
	Hem-fir	#1	11-7	15-3	19-5	23-7	11-7	15-2	18-6	21-6
	Hem-fir	#2	11-0	14-6	18-6	22-6	11-0	14-4	17-6	20-4
	Hem-fir	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Southern pine	SS	12-3	16-2	20-8	25-1	12-3	16-2	20-8	25-1
	Southern pine	#1	12-0	15-10	20-3	24-8	12-0	15-10	20-3	24-8
	Southern pine	#2	11-10	15-7	19-10	24-2	11-10	15-7	18-7	21-9
	Southern pine	#3	10-5	13-3	15-8	18-8	9-4	11-11	14-0	16-8
	Spruce-pine-fir	SS	11-7	15-3	19-5	23-7	11-7	15-3	19-5	23-7
	Spruce-pine-fir	#1	11-3	14-11	19-0	23-0	11-3	14-7	17-9	20-7
	Spruce-pine-fir	#2	11-3	14-11	19-0	23-0	11-3	14-7	17-9	20-7
	Spruce-pine-fir	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
16	Douglas fir-larch	SS	11-4	15-0	19-1	23-3	11-4	15-0	19-1	23-0
	Douglas fir-larch	#1	10-11	14-5	18-5	21-4	10-8	13-6	16-5	19-1
	Douglas fir-larch	#2	10-9	14-1	17-2	19-11	9-11	12-7	15-5	17-10
	Douglas fir-larch	#3	8-5	10-8	13-0	15-1	7-6	9-6	11-8	13-6
	Hem-fir	SS	10-9	14-2	18-5	21-11	10-9	14-2	18-0	21-11
	Hem-fir	#1	10-8	13-10	17-8	20-9	10-4	13-1	16-0	18-7
	Hem-fir	#2	10-0	13-2	16-10	19-8	9-10	12-5	15-2	17-7
	Hem-fir	#3	8-5	10-8	13-0	15-1	7-6	9-6	11-8	13-6
	Southern pine	SS	11-2	14-8	18-9	22-10	11-2	14-8	18-9	22-10
	Southern pine	#1	10-11	14-5	18-5	22-5	10-11	14-5	17-11	21-4

- \* Climatic and geographic design criteria **301.2**
  - Climatic and geographic design criteria **Table 301.2(1)** to include local information regarding the requirements listed in the table notes
    - Ground snow loads
    - Wind pressure
    - Seismic zone
    - Roof design
    - Wall bracing requirements
    - Damage from weathering
    - Concrete strength and air entrainment
  - Use Table notes and code text to determine requirements

**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

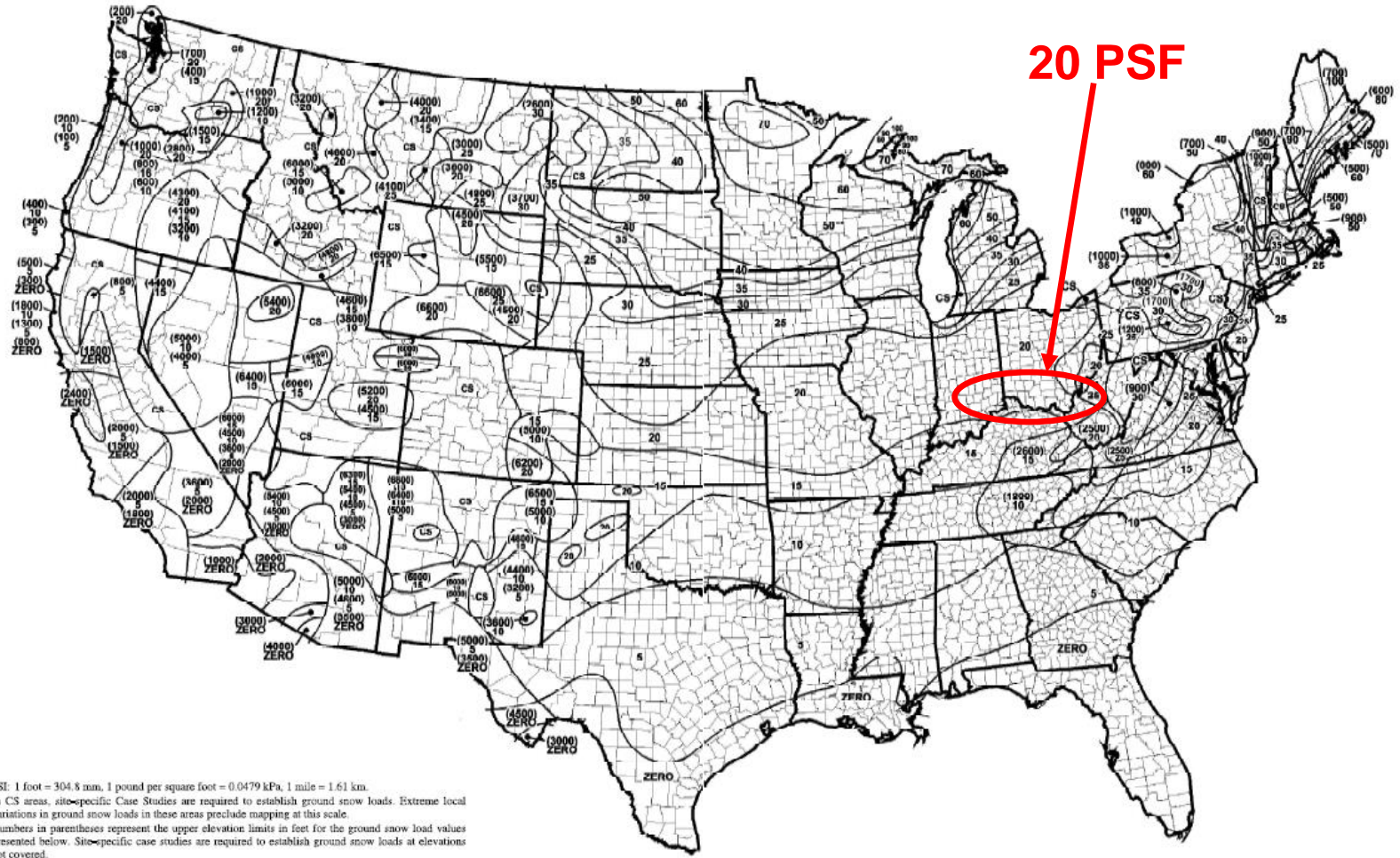
GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>g</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	<i>115</i>		<i>severe</i>		<i>Moderate to heavy</i>		<i>Yes</i>			
<b>MANUAL J DESIGN CRITERIA<sup>n</sup></b>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

\* Ground snow load from **Figure 301.2.6**

**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>g</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115		<i>severe</i>		<i>Moderate to heavy</i>		<i>Yes</i>			
<b>MANUAL J DESIGN CRITERIA<sup>n</sup></b>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

\* Ground snow loads for the United States,  $P_g$ , (lb/ft<sup>2</sup>)  
 [B] Figure 301.2(6)



For SI: 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 mile = 1.61 km.  
 a. In CS areas, site-specific Case Studies are required to establish ground snow loads. Extreme local variations in ground snow loads in these areas preclude mapping at this scale.  
 b. Numbers in parentheses represent the upper elevation limits in feet for the ground snow load values presented below. Site-specific case studies are required to establish ground snow loads at elevations not covered.

FIGURE R301.2(6)—continued  
 GROUND SNOW LOADS,  $P_g$ , FOR THE UNITED STATES (lb/ft<sup>2</sup>)

\* Ground snow load from **Figure 301.2.6**

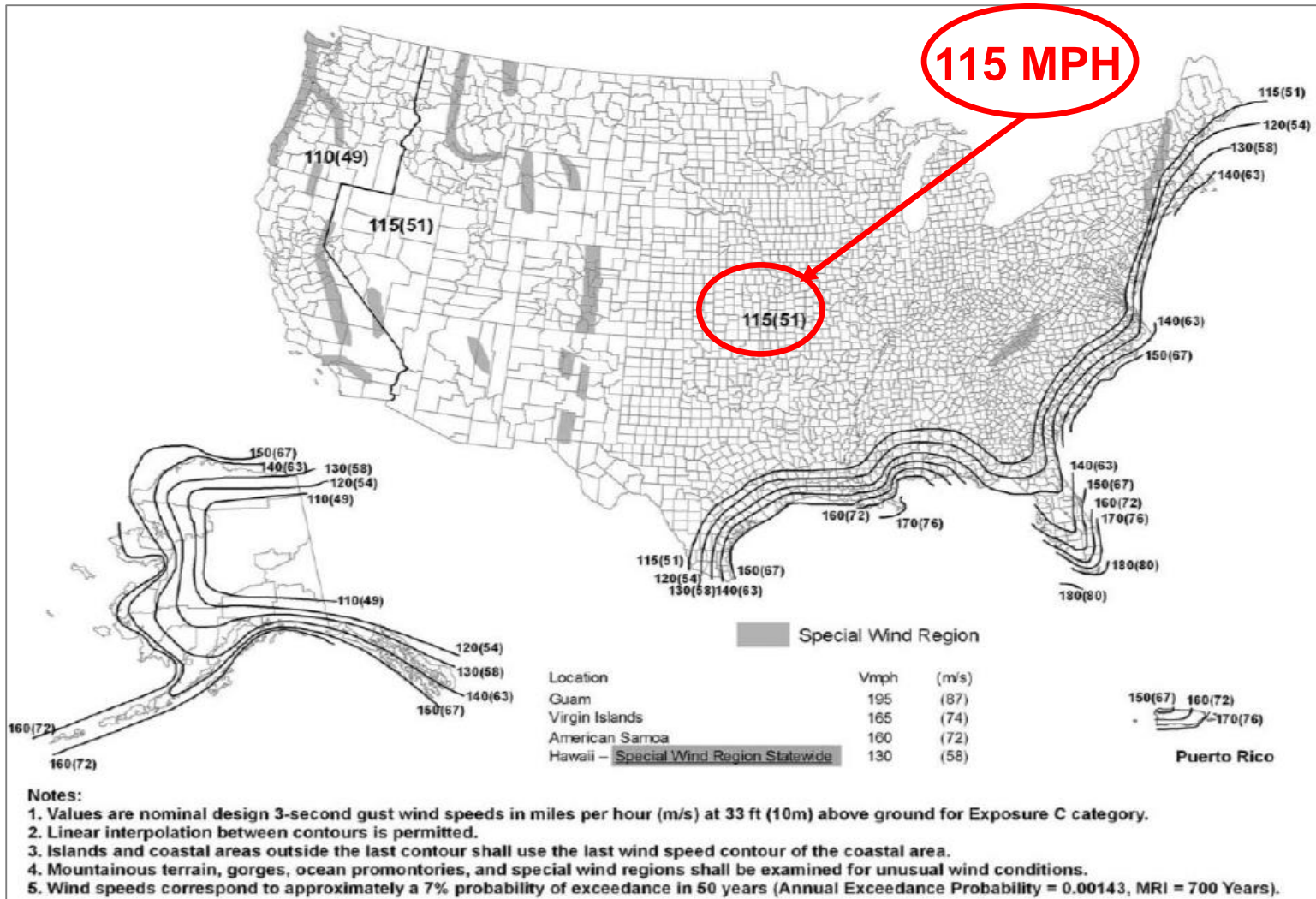
**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>g</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
<b>20</b>	115		<i>severe</i>		<i>Moderate to heavy</i>		<i>Yes</i>			
<b>MANUAL J DESIGN CRITERIA<sup>n</sup></b>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

- \* Basic wind speed set 115
- \* Figure 301.2.(5)A



- \* Basic wind speeds for 50-year mean recurrence interval  
Figure 301.2(5)A



\* Wind speed 115

TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>g</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
20	115		<i>severe</i>		<i>Moderate to heavy</i>		<i>Yes</i>			
MANUAL J DESIGN CRITERIA <sup>n</sup>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

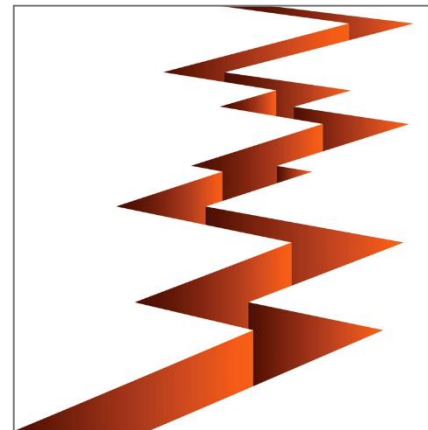
\* Seismic provisions **301.2.2**

- Section figures, tables and maps are updated

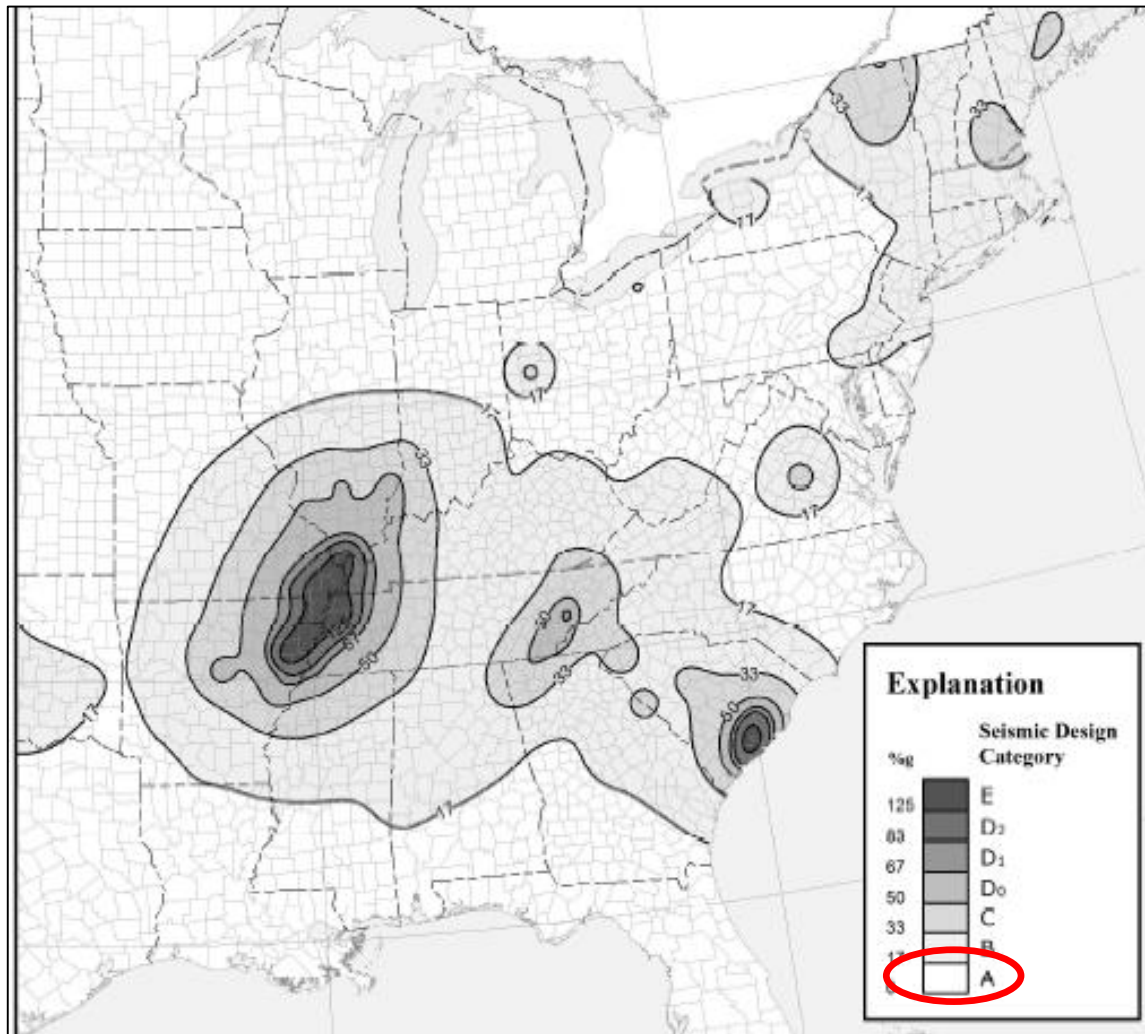


- Special considerations for veneers, masonry construction, concrete construction, irregular buildings and steel construction
- Existing seismic maps were revised to make them compatible with those used in the **IBC** and **ASCE 7**

- \* Determination of seismic design categories **301.2.2.1** and **Figure 301.2(2)**
  - New seismic design category  $D_0$  created to include a more descriptive category for buildings in C,  $D_1$ ,  $D_2$
  - Seismic design category (SDC) has updated maps for seismic risk for many regions of the U.S. and Puerto Rico in the following:
    - Seismic design categories Figures A, B C,  $D_0$ ,  $D_1$ ,  $D_2$ , E see **301.2.2(2)**



\* Seismic design – Regional **Figure 301.2(2)**



**FIGURE R301.2(2)—continued  
SEISMIC DESIGN CATEGORIES**

- \* Seismic design criteria **Table 301.2(1)**

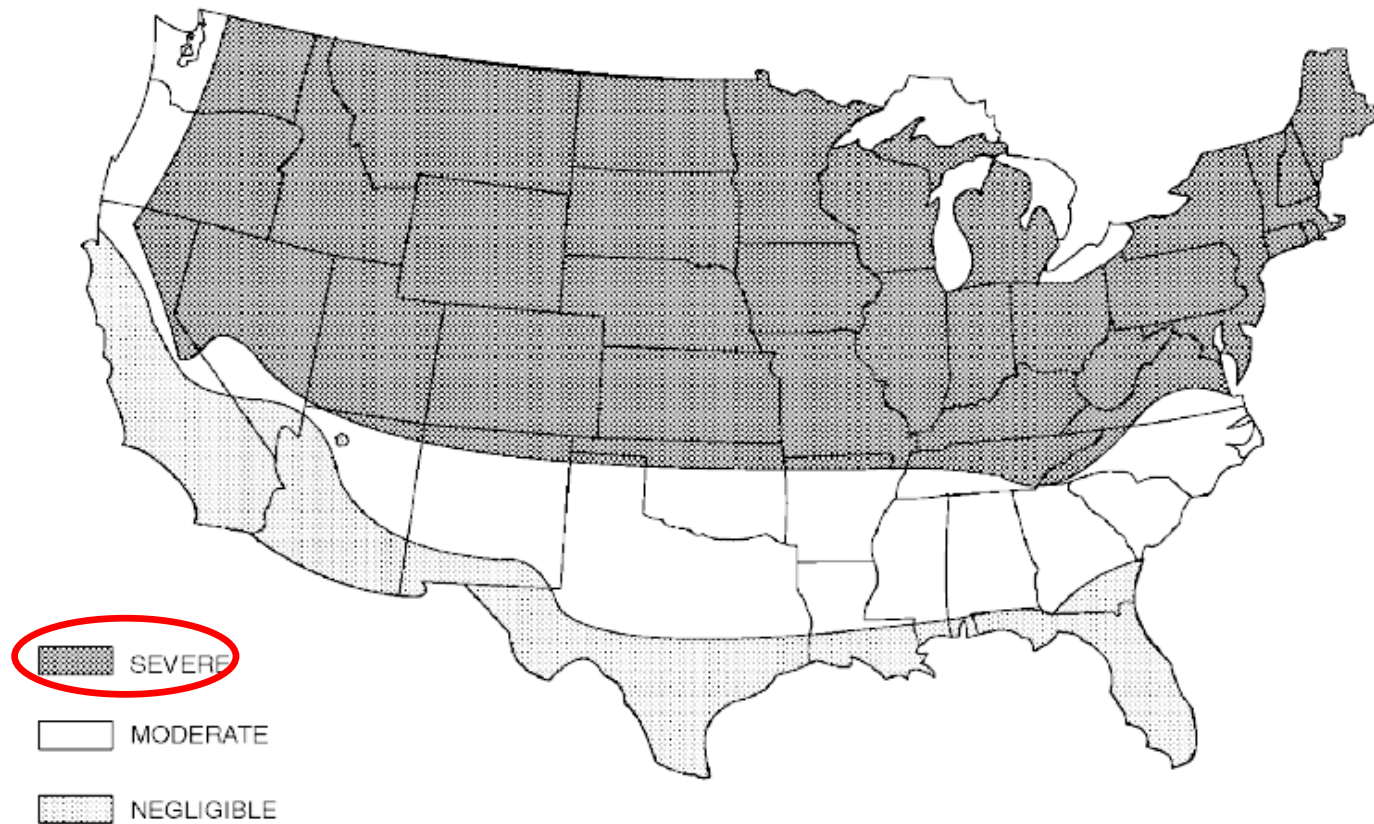
**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>g</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115	<b>A</b>	<i>severe</i>		<i>Moderate to heavy</i>		<i>Yes</i>			
<b>MANUAL J DESIGN CRITERIA<sup>n</sup></b>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

- \* f. The jurisdiction shall fill in this part of the table with the seismic design category determined from Section **301.2.2.1**



\* Weathering probability map for concrete **Figure 301.2(4)**



- A. Alaska and Hawaii are classified as severe and negligible, respectively
- B. Lines defining areas are approximate only. Local conditions may be more or less severe than indicated by the region classification. A severe classification is where weather conditions result in significant snowfall combined with extended periods during which there is little or no natural thawing causing deicing salts to be used extensively.

\* Weathering design criteria **Table 301.2(1)**

**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>e</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115		<i>severe</i>		<i>Moderate to heavy</i>		<i>Yes</i>			
<b>MANUAL J DESIGN CRITERIA<sup>n</sup></b>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

- Weathering may require a higher strength concrete or grade of masonry than necessary to satisfy the structural requirements of this code. The weathering column shall be filled in with the weathering index (i.e., "negligible," "moderate," or "severe") for concrete as determined from the Weathering Probability Map **[Figure 301.2(4)]**. The grade of masonry units shall be determined from ASTM C34, C55, C62, C73, C90, C129, C145, C216 or C652.



\* Frost line depth

- Due to local weather conditions, local jurisdiction may determine that footings must be deeper than the minimum of 12” required by 403.1.4
- The frost line depth may require deeper footings than indicate in Figure 403.1(1). The jurisdiction shall fill in the frost depth line column with the minimum depth of footing below finish grade

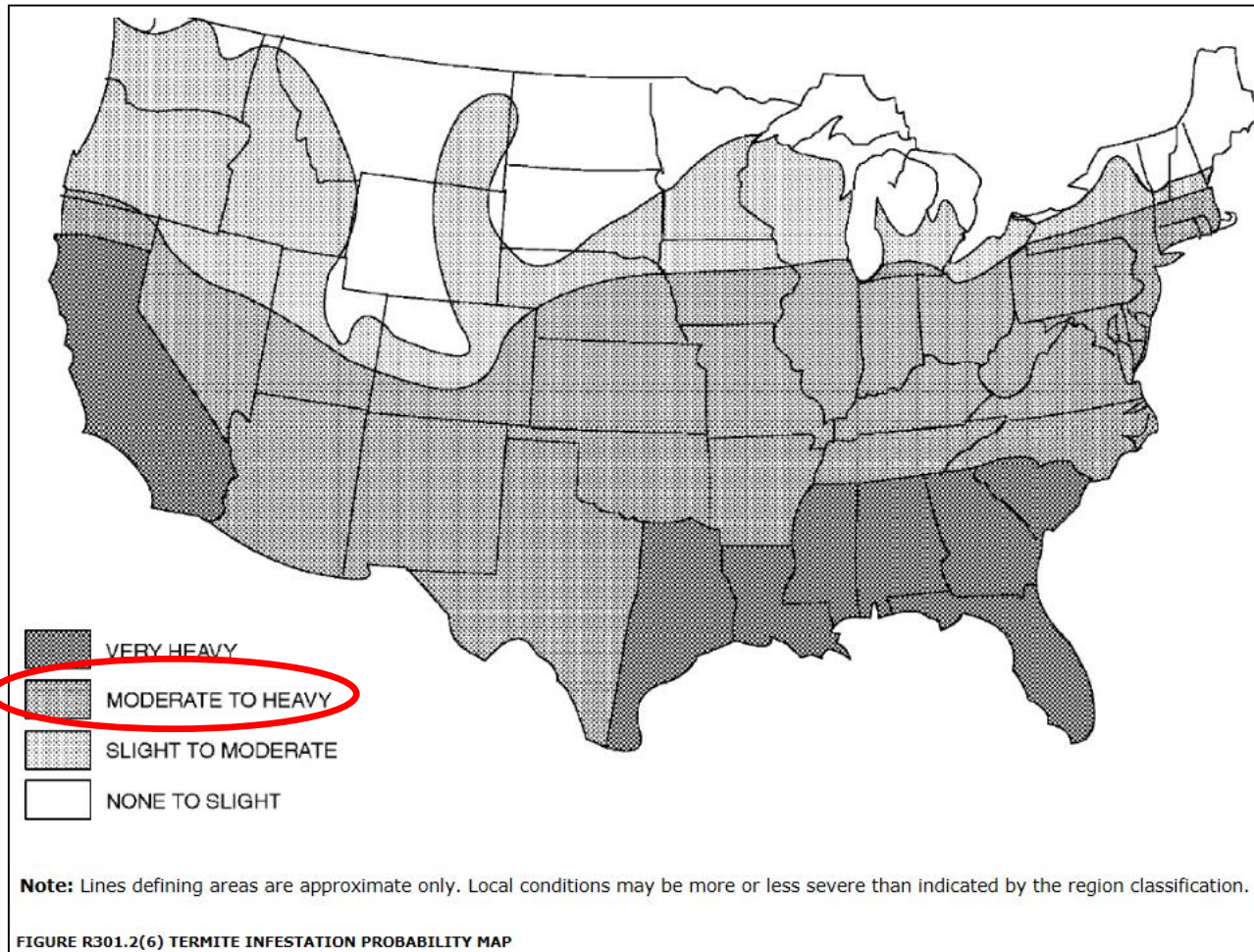
\* Climatic and geographic design criteria **Table 301.2(1)**

**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>r</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>a</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115		severe	??	Moderate to heavy		Yes			
MANUAL J DESIGN CRITERIA <sup>n</sup>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

- The frost line depth may require deeper footings than indicated in **Figure R403.1(1)**. The jurisdiction shall fill in the frost line depth column with the minimum depth of footing below finish grade.

\* Termite infestation probability map **Figure 301.2(7)**



- \* Tweremit Winter design temperature from **Table 301.2(1)**

**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>g</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115		<i>severe</i>		<i>Moderate to heavy</i>		<i>Yes</i>			
<b>MANUAL J DESIGN CRITERIA<sup>n</sup></b>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

- The jurisdiction shall fill in this part of the table to indicate the need for protection depending on whether there has been a history of local subterranean termite damage.

- \* Winter design temperature from **Table 301.2(1)**

**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>g</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115		<i>severe</i>		<i>Moderate to heavy</i>		<i>Yes</i>			
<b>MANUAL J DESIGN CRITERIA<sup>n</sup></b>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

\* Table from text for 301.2(1)

STATION	HEATING DEGREE DAYS (Yearly Total)	DESIGN TEMPERATURES	DEGREES NORTH LATITUDE
<i>Akron-Canton</i>	6,037	6°	41°00' – 40°50'
<i>Cincinnati</i>	4,410	6°	39°10'
<i>Cleveland</i>	6,351	5°	41°30'
<i>Columbus</i>	5,660	5°	40°00'
<i>Dayton</i>	5,622	4°	39°50'
<i>Mansfield</i>	6,403	5°	40°50'
<i>Sandusky</i>	5,796	6°	41°30'
<i>Toledo</i>	6,494	1°	41°40'
<i>Youngstown</i>	6,417	4°	41°10'

Deviations from the *tabulated* temperatures shall be permitted to reflect local climates or local weather experience as *documented* by the building official

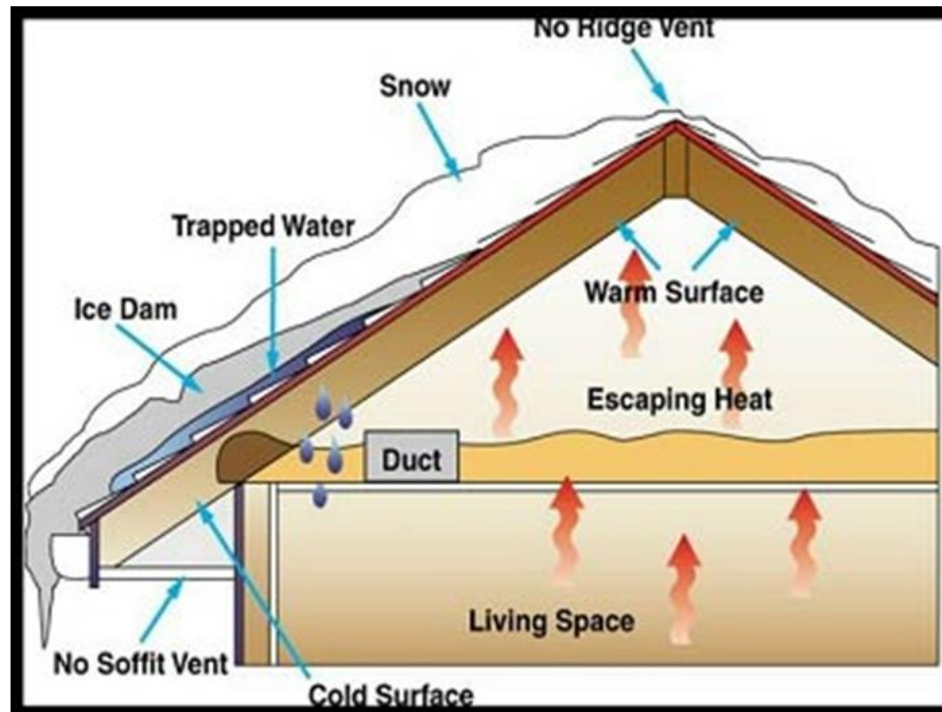
◆ Winter design temperatures

TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>g</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115		severe		Moderate to heavy	6	Yes			
MANUAL J DESIGN CRITERIA <sup>n</sup>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

\* Ice barrier underlayment

- Due to local damage by ice damming
- Local jurisdiction determines if ice barrier underlayment required





**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>g</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115		<i>severe</i>		<i>Moderate to heavy</i>		Yes			
<b>MANUAL J DESIGN CRITERIA<sup>n</sup></b>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

\* Flood hazards

- Local jurisdiction determines if flood hazard exists, may elect to participate in the NFIP (National Flood Insurance Program)
- FIRM (Flood Insurance Rate Map) designates areas with probabilities of flooding
- Date of local ordinance authorizing participation is start date



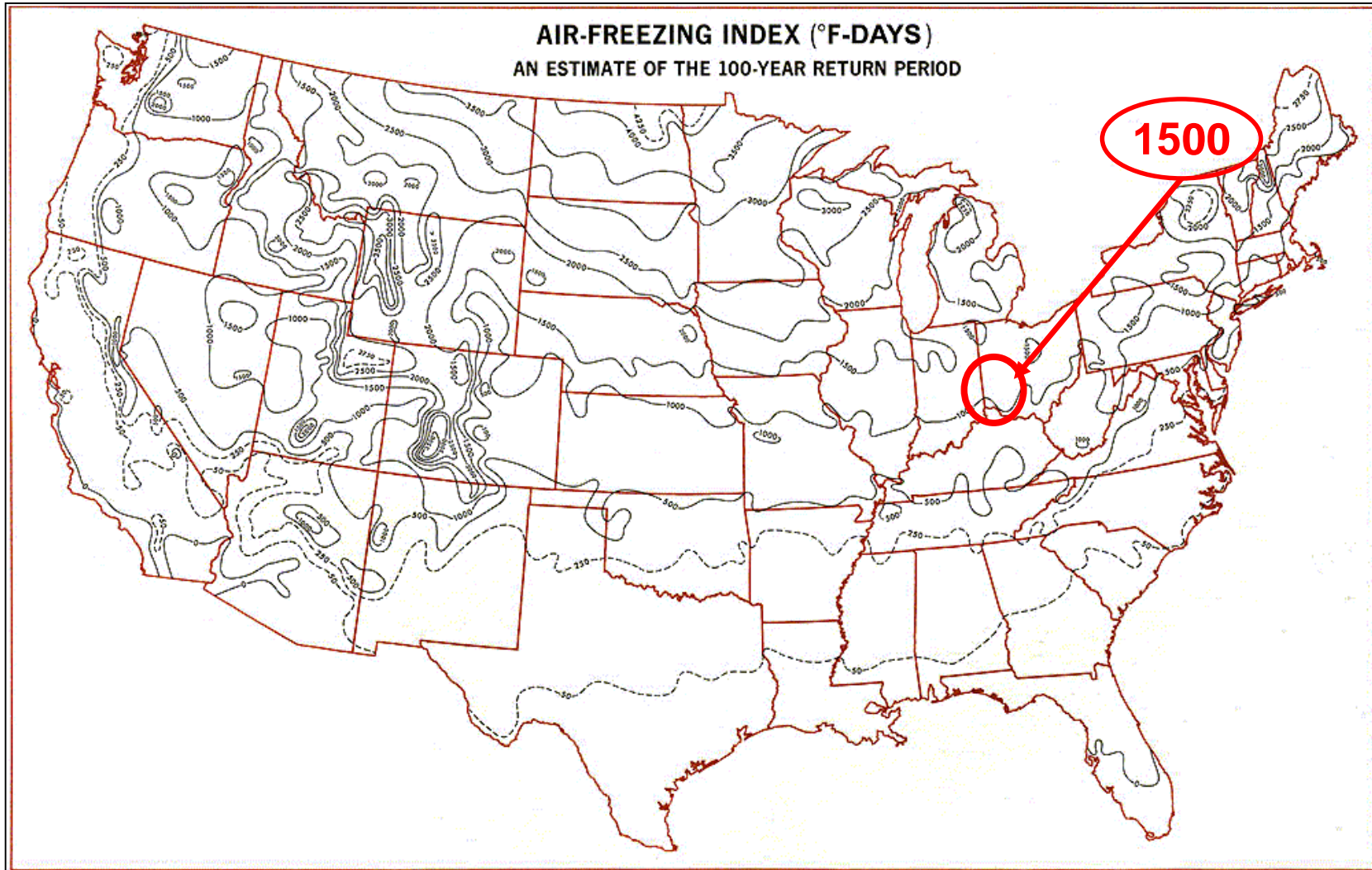
\* Flood hazard **Table 301.2(1)**

**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>r</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>a</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>n</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115		severe		Moderate to heavy		Yes			
<b>MANUAL J DESIGN CRITERIA<sup>n</sup></b>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

Note g: The jurisdiction shall fill in this part of the table with (a) the date of the jurisdiction’s entry into the National Flood Insurance Program (date of adoption of the first code or ordinance for management of flood hazard areas), (b) the date(s) of the Flood Insurance Study and (c) the panel numbers and dates of all currently effective FIRMs and FBFMs or other flood hazard map adopted by the authority having jurisdiction, as amended.

\* Air freezing index (Source: NOAA) Figure 403.3(2) (page 107)



\* Climatic and geographic design criteria **Table 301.2(1)**

**TABLE 403.3(2)  
AIR-FREEZING INDEX FOR U.S. LOCATIONS BY COUNTY**

STATE	AIR-FREEZING INDEX					
	500 or less	2000	2500	3000	3500	4000
Ohio	All counties not listed	Ashland, Crawford, Defiance, Holmes, Huron, Knox, Licking, Morrow, Paulding, Putnam, Richland, Seneca, Williams	—	—	—	—

**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>e</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115		severe		Moderate to heavy		Yes		<b>1500</b>	

MANUAL J DESIGN CRITERIA<sup>n</sup>

*Deleted portion of table – owners shall use manual J when required by this code*

- \* Mean Annual temperature **Table 301.2(1)**

**TABLE 301.2(1)  
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA**

GROUND SNOW LOAD <sup>o</sup>	WIND DESIGN SPEED <sup>d</sup> (mph)	SEISMIC DESIGN CATEGORY <sup>f</sup>	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP <sup>e</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARDS <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
			Weathering <sup>a</sup>	Frost line depth <sup>b</sup>	Termite <sup>c</sup>					
	115		<i>severe</i>		<i>Moderate to heavy</i>		Yes			
<b>MANUAL J DESIGN CRITERIA<sup>n</sup></b>										
<i>Deleted portion of table – owners shall use manual J when required by this code</i>										

- \* Note j: “The jurisdiction shall fill in this part of the table with the mean annual temperature from the National Climatic data Center table “Air Freezing Index - USA Method (Base 32°F)”
- \* Use Manual J when required by the code

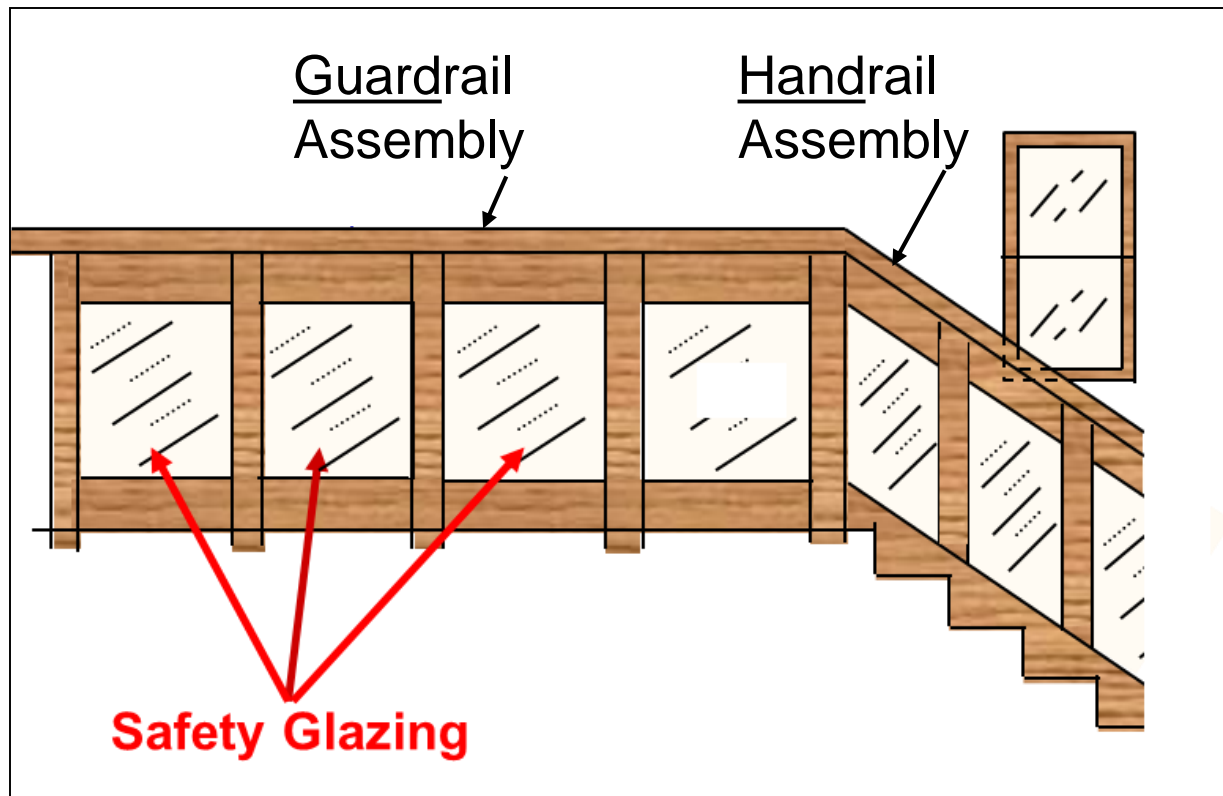
- \* Minimum uniformly distributed live loads **Table 301.5**
  - Important notes to the Table

**TABLE 301.5**  
**MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS**  
 (in pounds per square foot)

USE	LIVE LOAD
Uninhabitable attics without storage <sup>b</sup>	10
Uninhabitable attics with limited storage <sup>b, g</sup>	20
Habitable attics and attics served with fixed stairs	30
Balconies (exterior) and decks <sup>e</sup>	40
Fire escapes	40
Guards and handrails <sup>d</sup>	200 <sup>h</sup>
Guard in-fill components <sup>f</sup>	50 <sup>h</sup>
Passenger vehicle garages <sup>a</sup>	50 <sup>a</sup>
Rooms other than sleeping rooms	40
Sleeping rooms	30
Stairs	40 <sup>c</sup>

For SI: 1 pound per square foot = 0.0479 kPa. 1 square inch = 645 mm<sup>2</sup>.

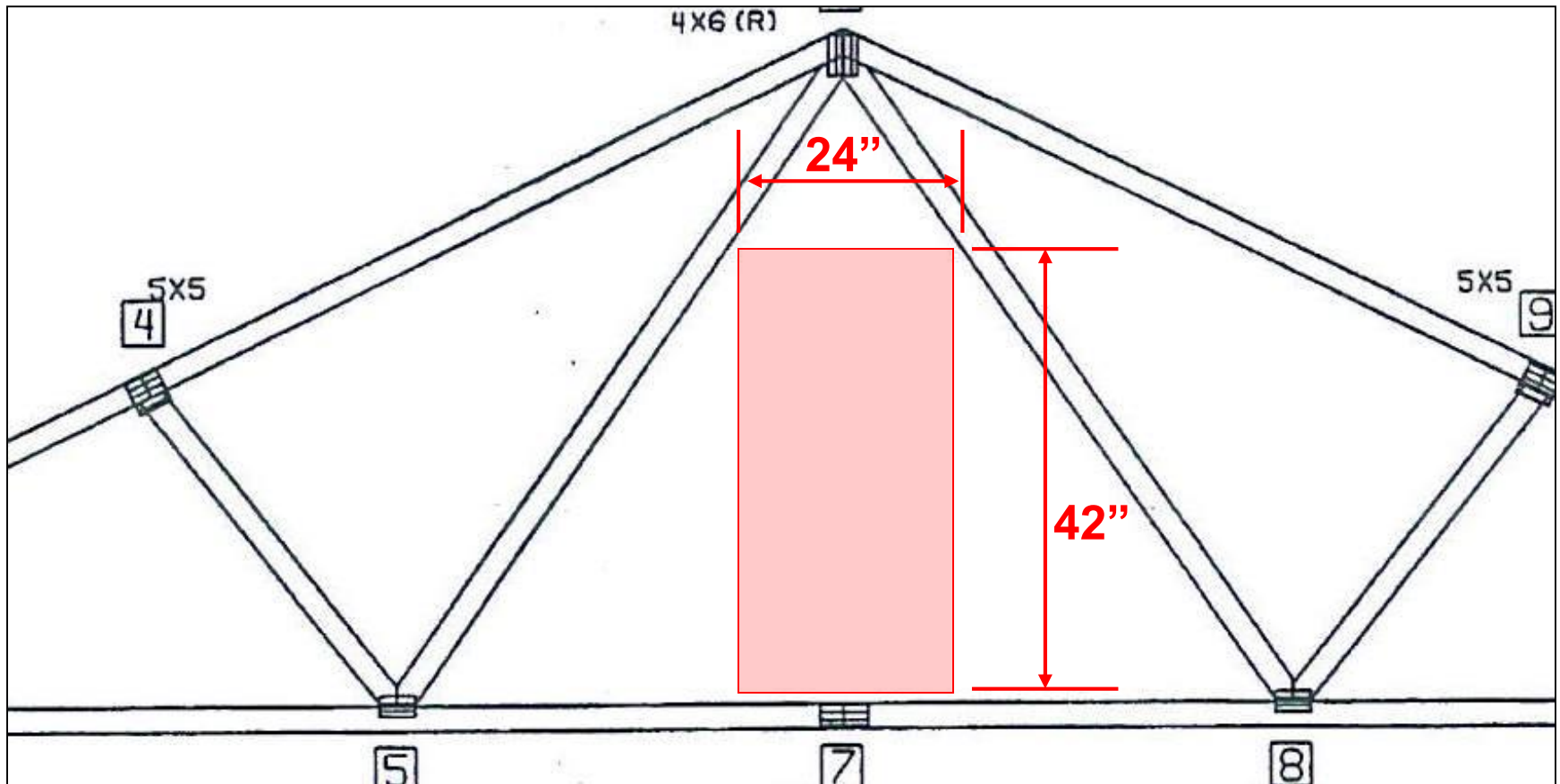
- Includes safety factor for glazing in handrail and guard assemblies





- \* Minimum uniformly distributed live loads **Table 301.5**
  - Minimum truss live load design requirement: 10 psf
  - Minimum live load requirement when storage loads do not apply, and access is for a small space or maintenance: 20 psf
  - A clear space dimension threshold at which significant storage could occur: 20 psf live load design required
  - Attic spaces served by a fixed stair shall be designed to support live loads for sleeping rooms designed as sleeping floor rooms: 30 psf

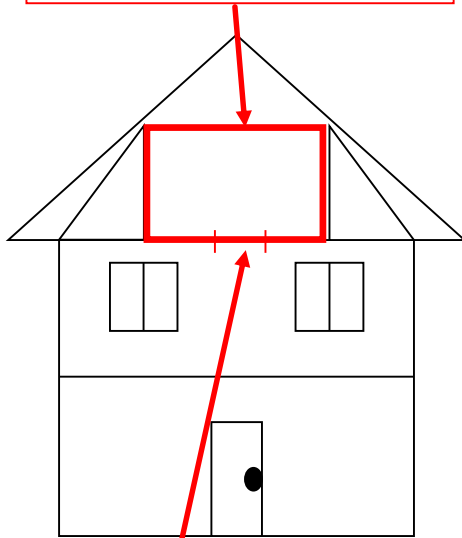
- \* Minimum uniformly distributed live loads **Table 301.5 Note b**



- \* Between any two adjacent trusses with similar chord configuration, with a level bottom cord and having an access, a design of 20 pound live load on bottom chord is required

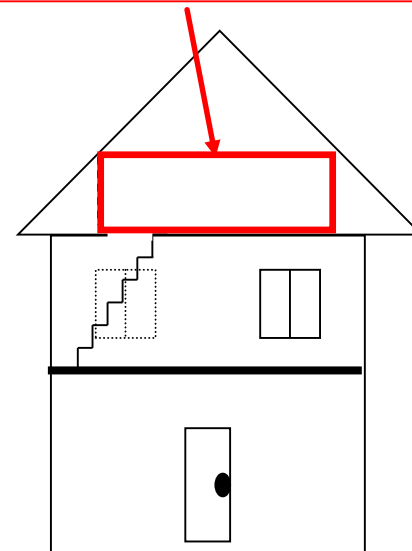
- \* Minimum uniformly distributed live loads **Table R301.5**

Attic space  
used for storage



Ladder or  
access system only

Attic space designed for  
sleep room live loads



- \* Live load design per **Table 301.5**
  - Roof live loads per ground snow or **Table 301.6**



- \* Minimum roof loads pounds-force per square feet of horizontal projection **Table 301.6**

**TABLE 301.6  
MINIMUM ROOF LIVE LOADS IN POUNDS-FORCE PER  
SQUARE FOOT OF HORIZONTAL PROJECTION**

ROOF SLOPE	TRIBUTARY LOADED AREA IN SQUARE FEET FOR ANY STRUCTURAL MEMBER		
	0 to 200	201 to 600	Over 600
Flat or rise less than 4 inches per foot (1:3)	20	16	12
Rise 4 inches per foot (1:3) to less than 12 inches per foot (1:1)	16	14	12
Rise 12 inches per foot (1:1) and greater	12	12	12

For SI: 1 square foot = 0.0929 m<sup>2</sup>, 1 pound per square foot = 0.0479 kPa, 1 inch per foot = 83.3 mm/m

\* Allowable deflection of structural members **Table 301.7**

**TABLE 301.7**  
**ALLOWABLE DEFLECTION OF STRUCTURAL MEMBERS<sup>b, c</sup>**

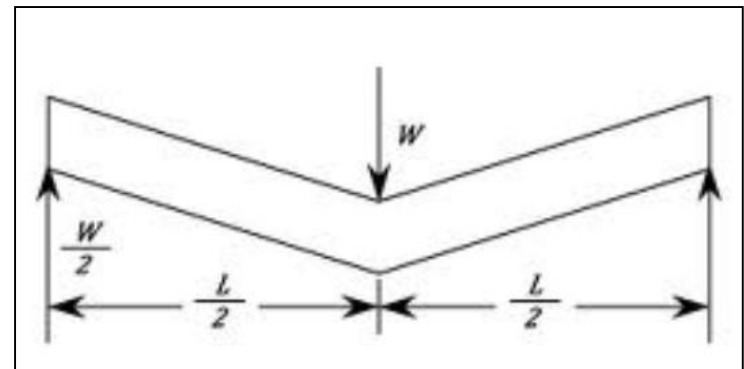
STRUCTURAL MEMBER	ALLOWABLE DEFLECTION
Rafters having slopes greater than 3:12 with finished ceiling not attached to rafters	$L/180$
Interior walls and partitions	$H/180$
Floors	$L/360$
Ceilings with brittle finishes (including plaster and stucco)	$L/360$
Ceilings with flexible finishes (including gypsum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

Note:  $L$  = span length,  $H$  = span height.

a. For the purpose of the determining deflection limits herein, the wind load

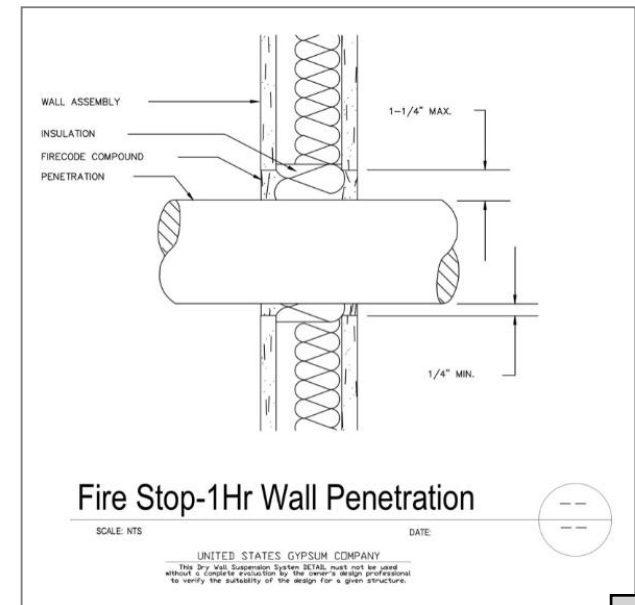
\* DEFLECTION:

The degree to which a structural element is displaced under a load



## ◆ Fire-Resistant Construction 302

- \* Exterior wall requirements
- \* Construction projections
- \* Openings and penetrations of exterior walls of dwellings and accessory buildings
- \* **Table 302.1(1) Unsprinklered**
- \* **Table 302.1(2) Sprinkled**





- \* Distance to lot line – no sprinklers **Table 302.1(1)**
- \* Exterior walls unsprinklered **Table 302.1(1)**



- Exterior walls – Sprinkled reduction of fire separation distance for non-rated exterior from 5' to 3' **Table 302.1(2)**



Table 302.1(1) page 60

302.1(1)  
EXTERIOR WALLS

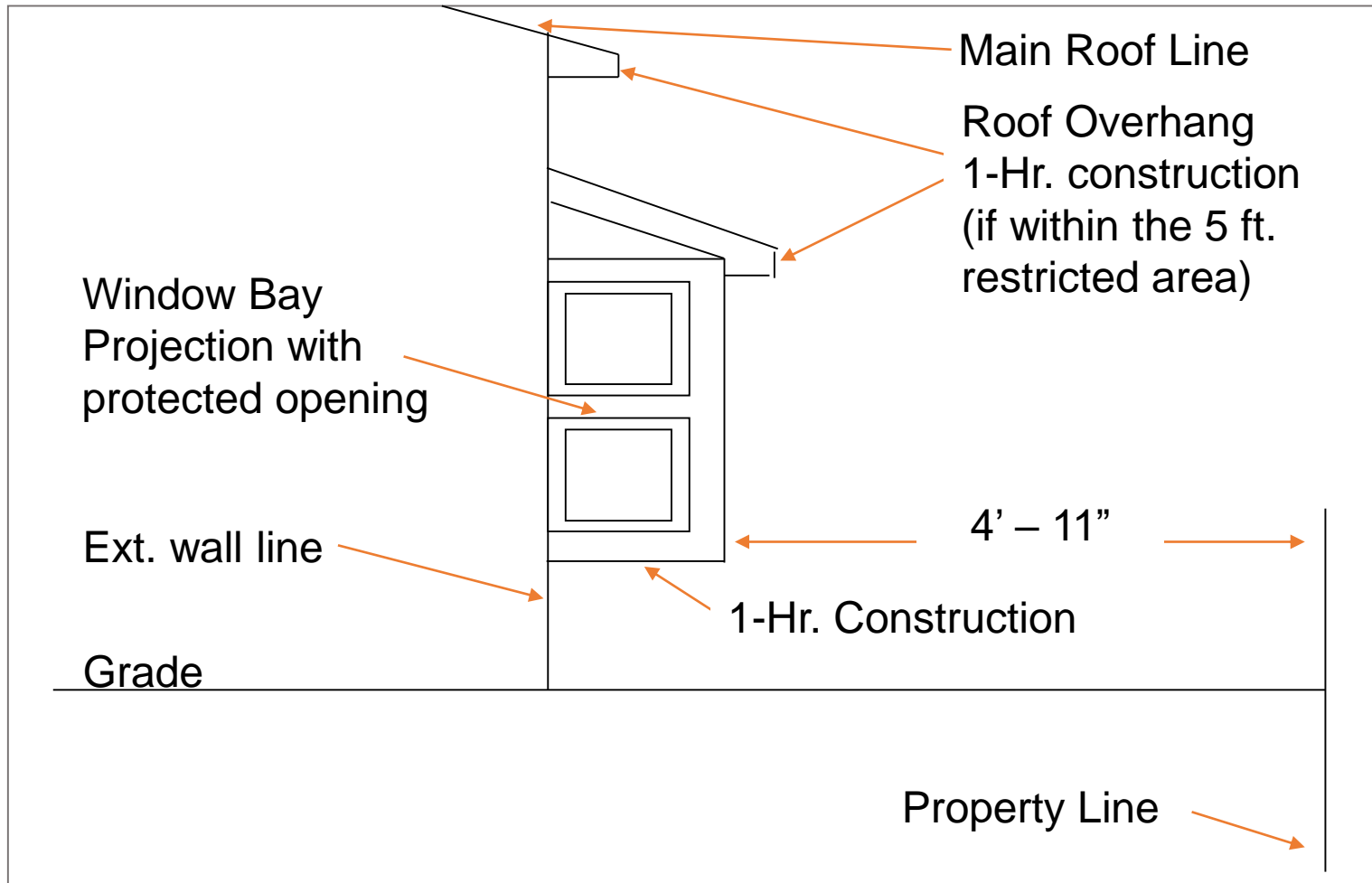
EXTERIOR WALL ELEMENT		MINIMUM FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E119, UL 263 or Section 703.3 of the <i>International Building Code</i> with exposure from both sides	0 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Projections	Not allowed	NA	< 2 feet
	Fire-resistance rated	1 hour on the underside, or heavy timber, or fire-retardant-treated wood <sup>a, b</sup>	≥ 2 feet to < 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Openings in walls	Not allowed	NA	< 3 feet
	25% maximum of wall area	0 hours	3 feet
	Unlimited	0 hours	5 feet
Penetrations	All	Comply with Section R302.4	< 3 feet
		None required	3 feet

For SI: 1 foot = 304.8 mm.

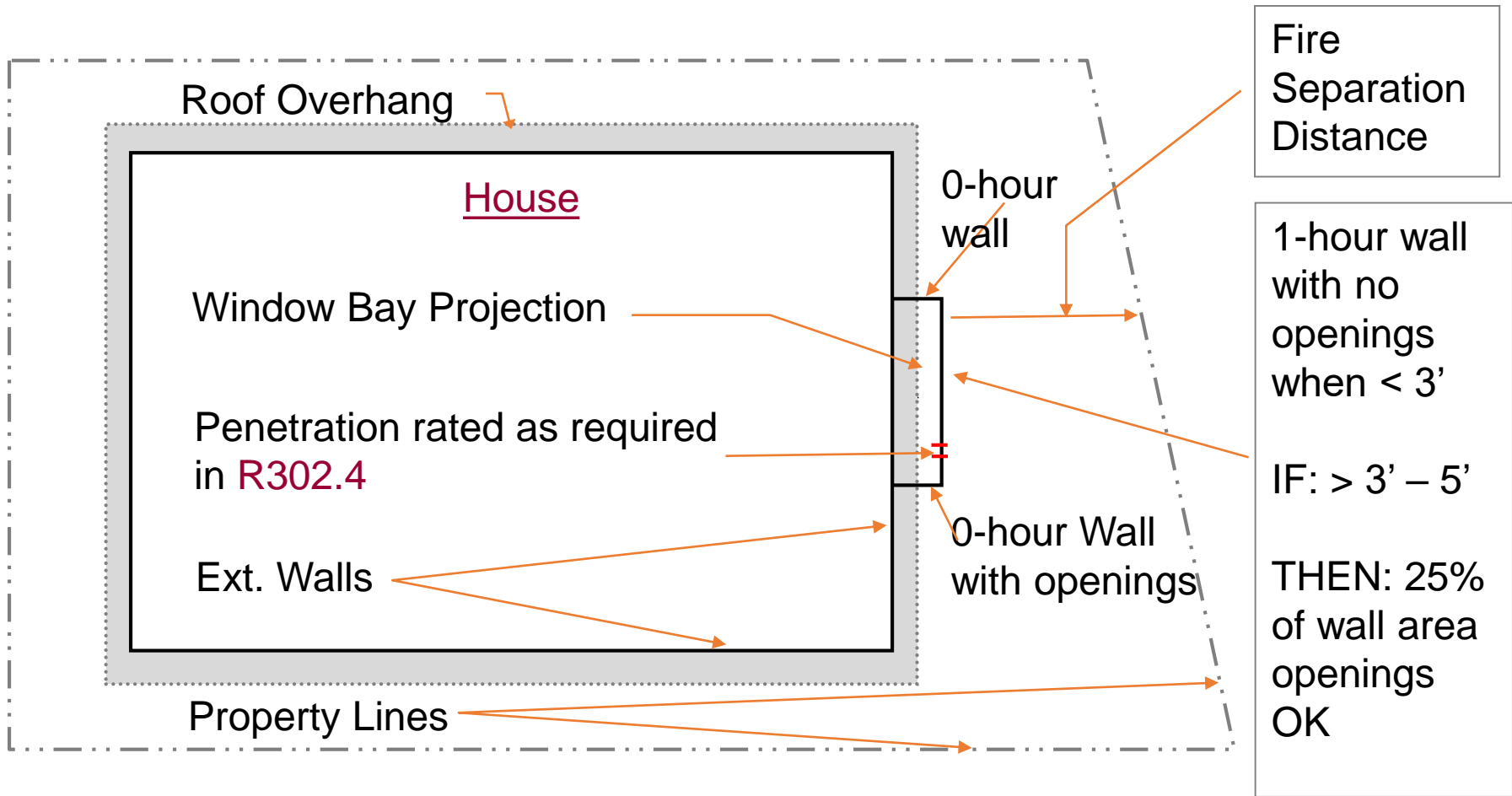
NA = Not Applicable.

- a. The fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave overhang if fireblocking is provided from the wall top plate to the underside of the roof sheathing.
- b. The fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the rake overhang where gable vent openings are not installed.

\* Distance to lot line no sprinklers **Table 302.1(1)**



\* Exterior walls no sprinklers **Table 302.1(1)**

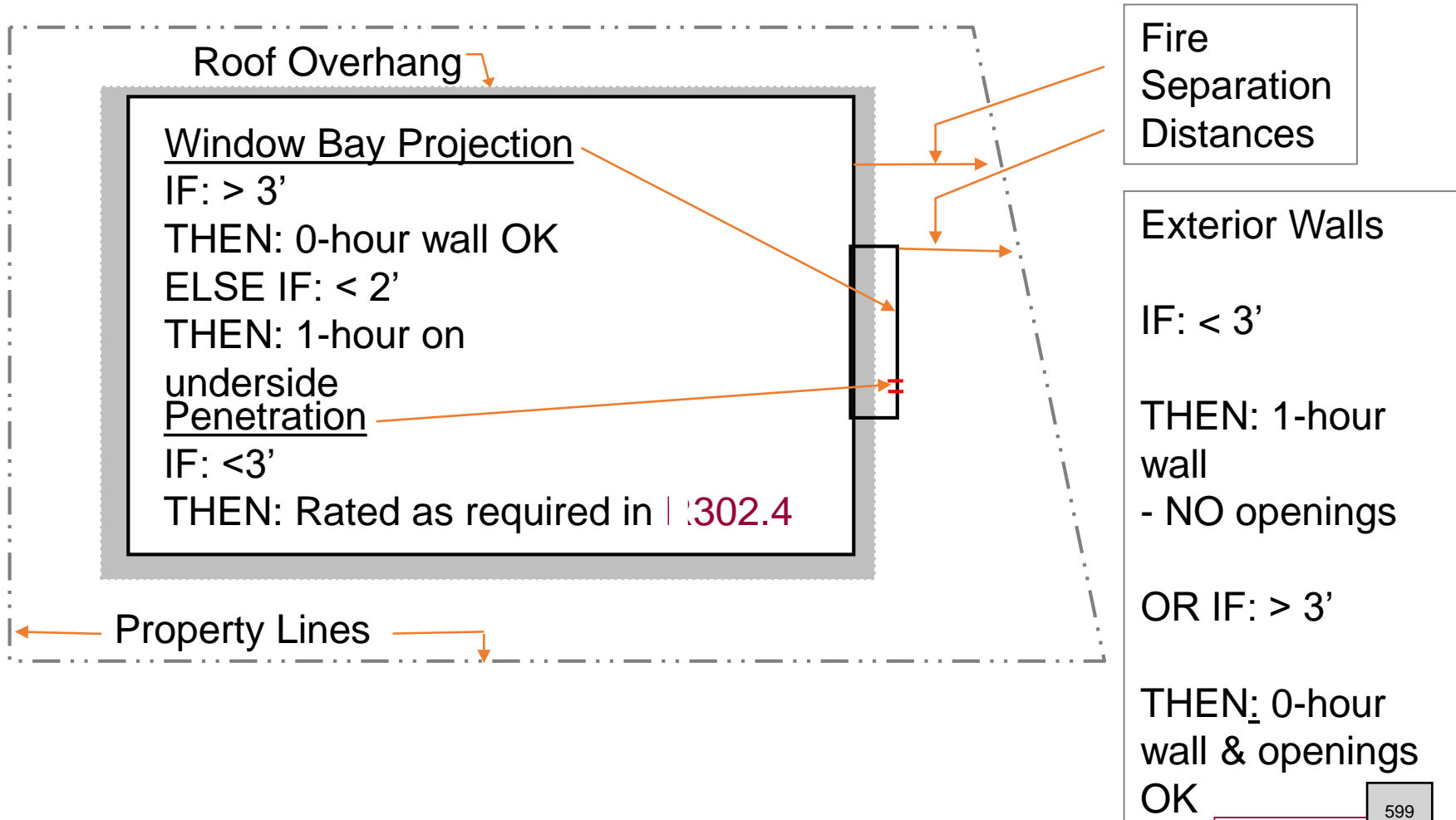


- \* Reduced fire separation distances – with sprinklers **Table 302.1(2)**

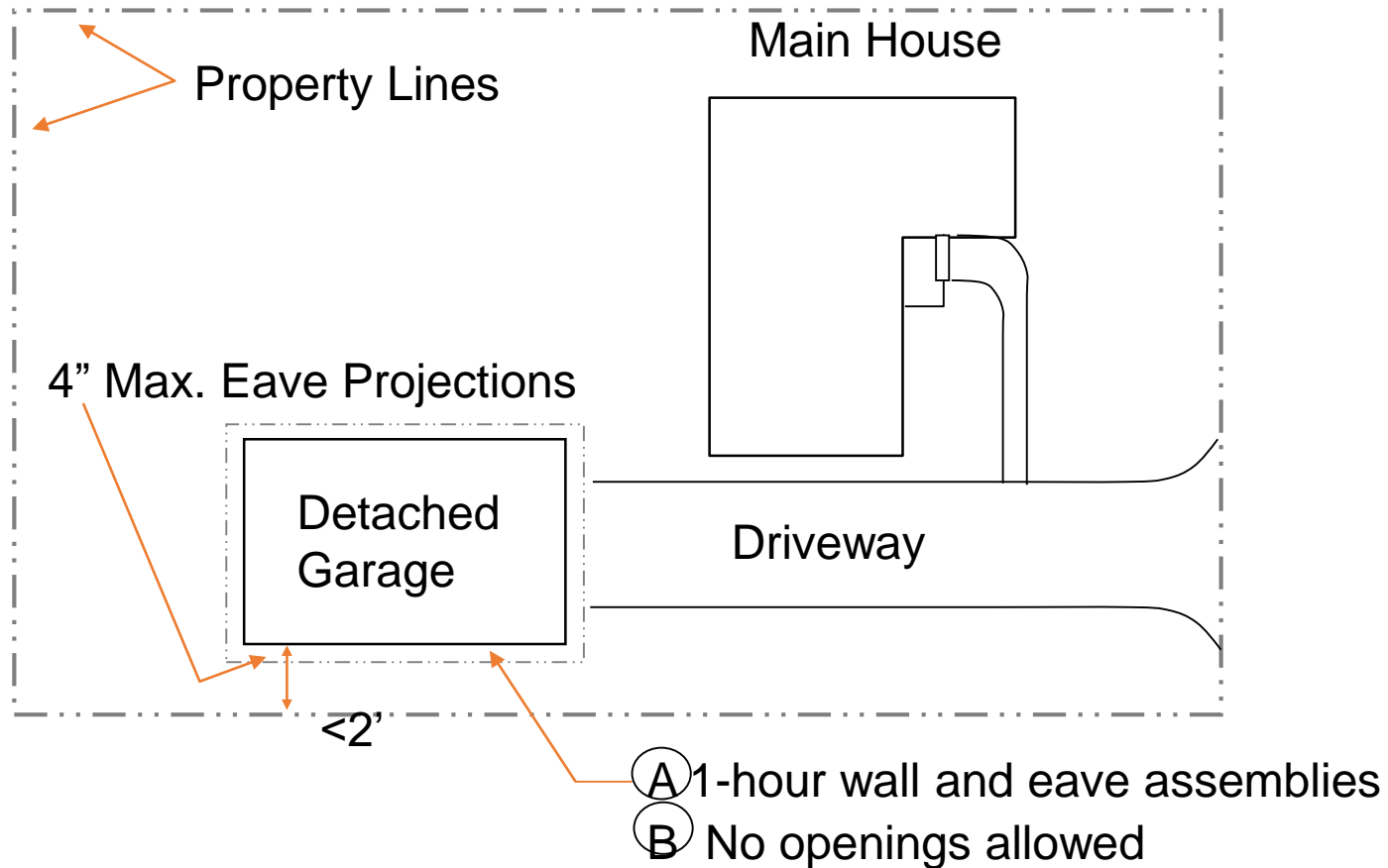
**302.1(2)  
EXTERIOR WALLS—DWELLINGS WITH FIRE SPRINKLERS**

EXTERIOR WALL ELEMENT		MINIMUM 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 <i>International Building Code</i> with exposure from the outside	0 feet
	Not fire-resistance rated	0 hours	3 feet <sup>a</sup>
Projections	Not allowed	NA	< 2 feet
	Fire-resistance rated	1 hour on the underside, or heavy timber, or fire-retardant-treated wood <sup>b, c</sup>	2 feet <sup>a</sup>
	Not fire-resistance rated	0 hours	3 feet
Openings in walls	Not allowed	NA	< 3 feet
	Unlimited	0 hours	3 feet <sup>a</sup>
Penetrations	All	Comply with Section R302.4	< 3 feet
		None required	3 feet <sup>a</sup>

\* Distance to lot line with sprinklers **Table 302.1(2)**



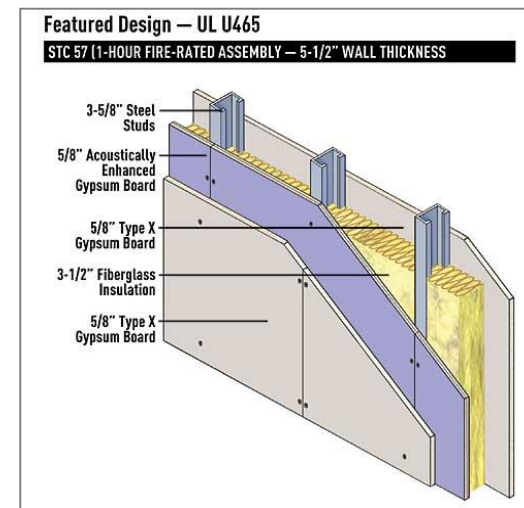
- \* Exemption: Tool-sheds, playhouses, & similar structures not requiring permits by 105.2; Walls, projection perpendicular to lot line



\* Other exceptions

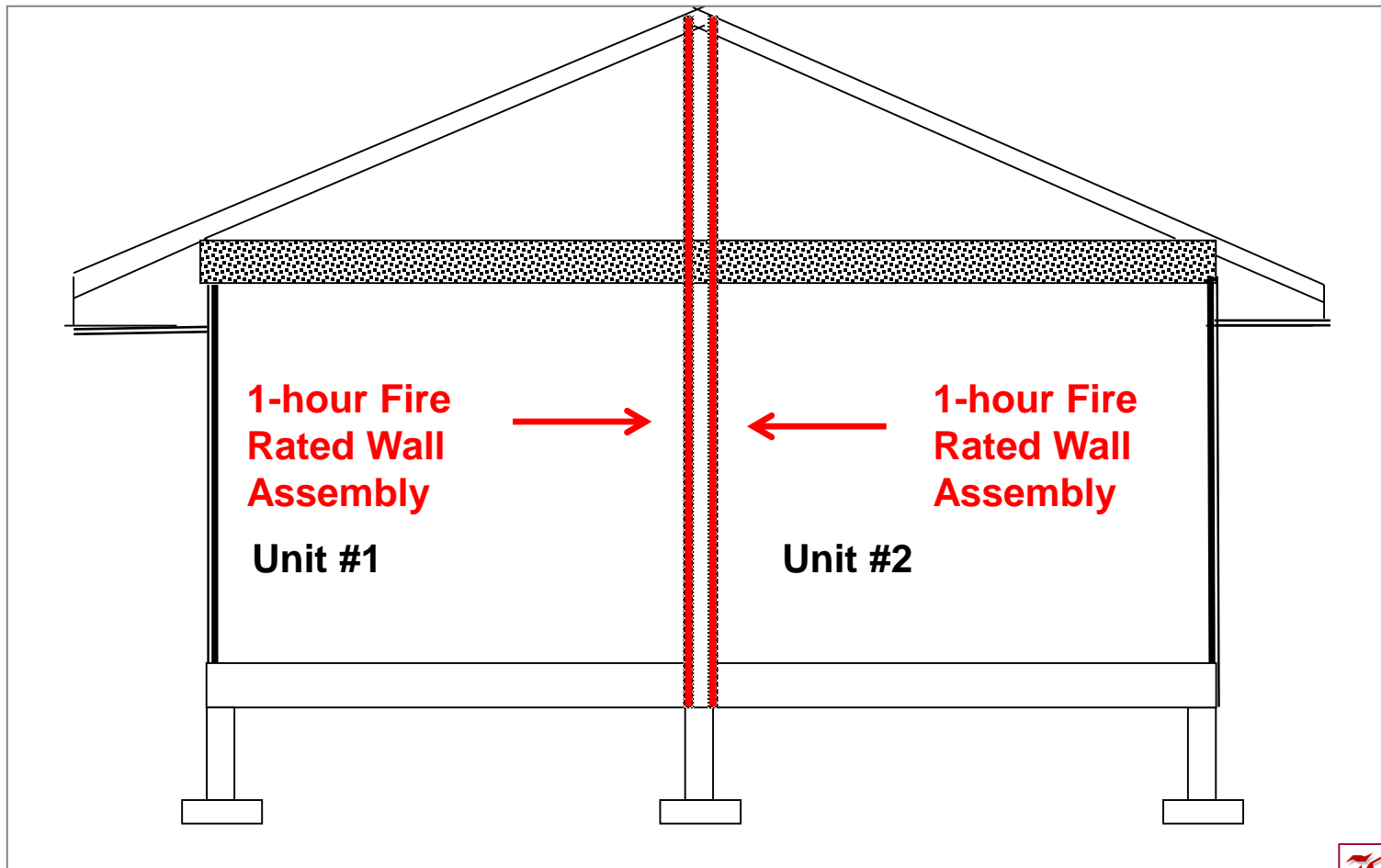
- Accessory structures on same
- Detached garages within 2' of lot line
- In compliance foundation vents

- \* Fire separations:
  - Residential structure with more than 2 dwelling units **302.2**
    - Each group of two separated
    - Two wall assemblies
    - Each with a one hour rating
    - Floor assemblies two hour fire rating





- \* Unit separations 302.2
  - \* Continuity of fire separation maintaining structural independence



- Alternate

- Two hour common wall

- No plumbing or mechanical in wall

- Rated from fire on both sides

- Tight to underside of roof and exterior wall

- Two hour floor ceiling assemblies

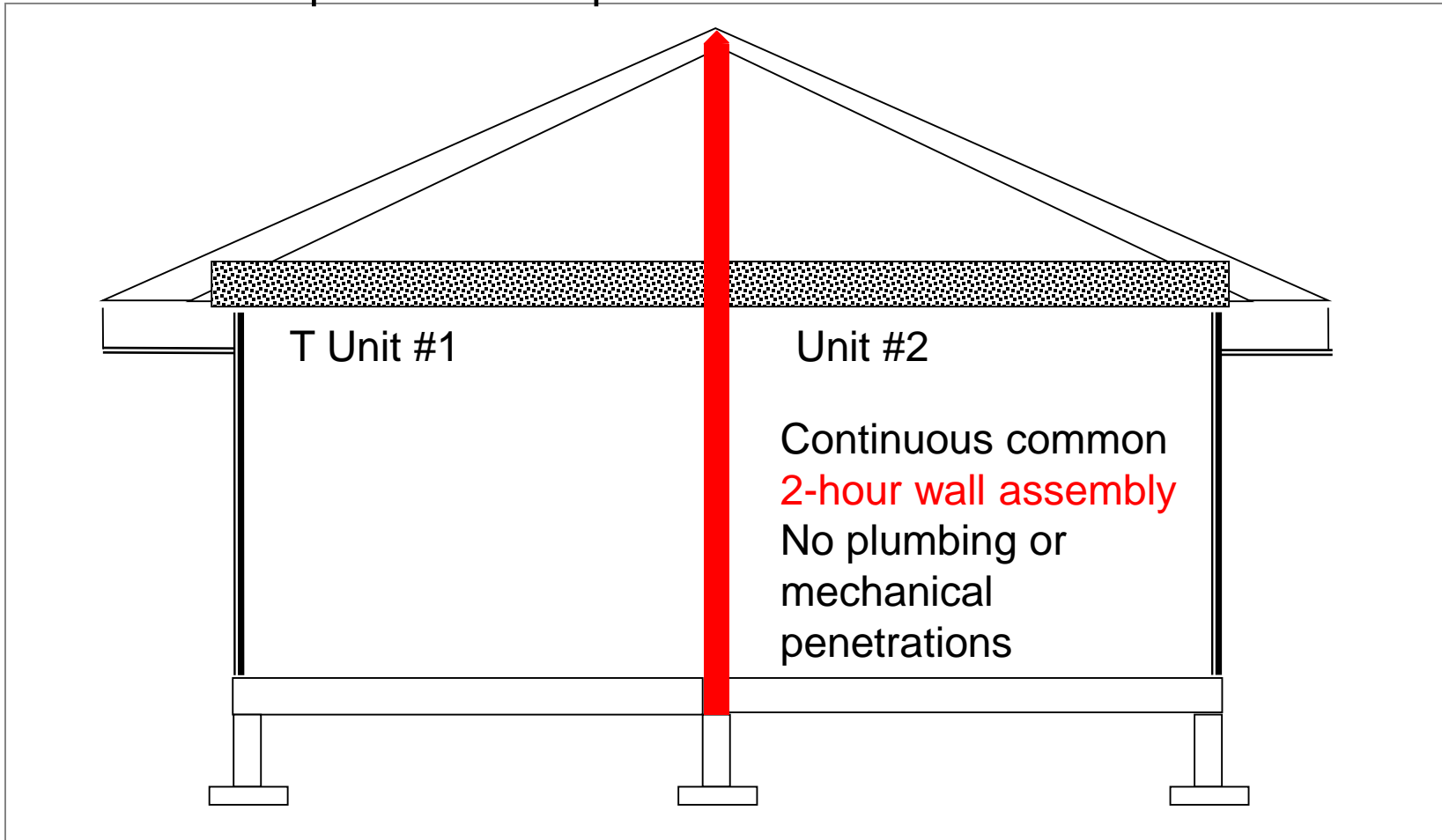
- All supporting construction equals the rating

- \* Continuity Fire rated wall or assembly separating town units

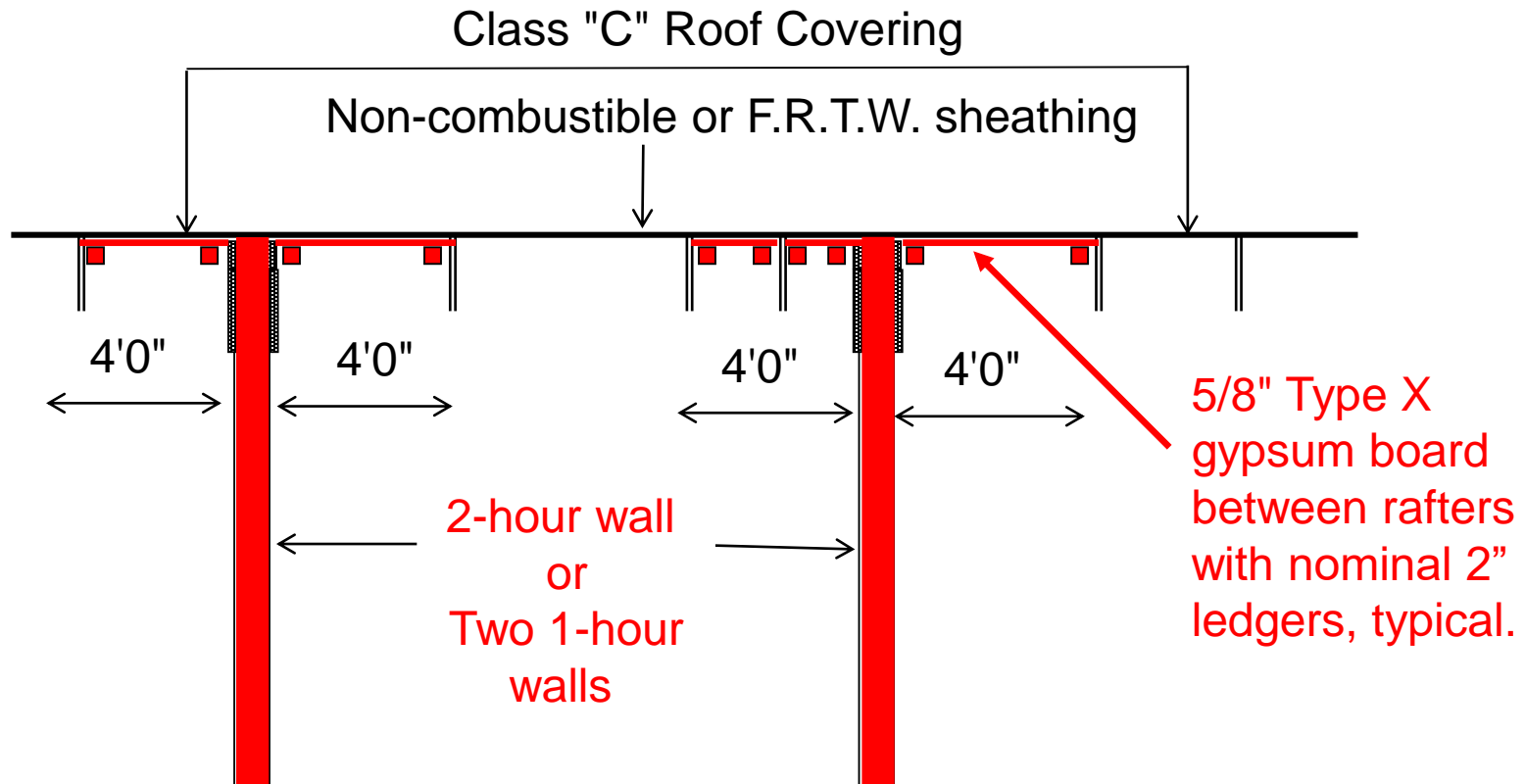


**Example of continuous walls**

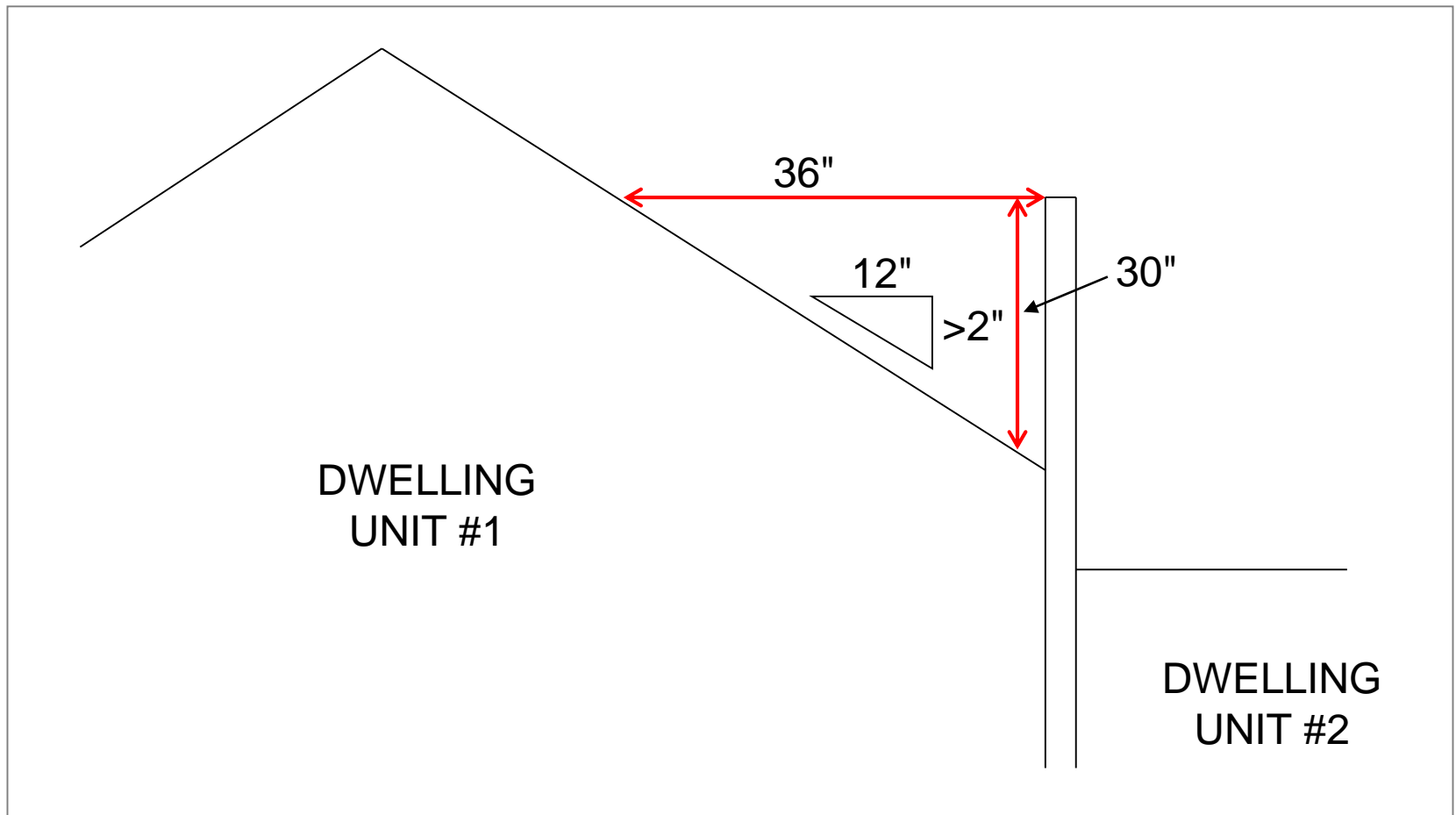
\* Fire separation exception 302.



\* Parapets exception 302.2.4

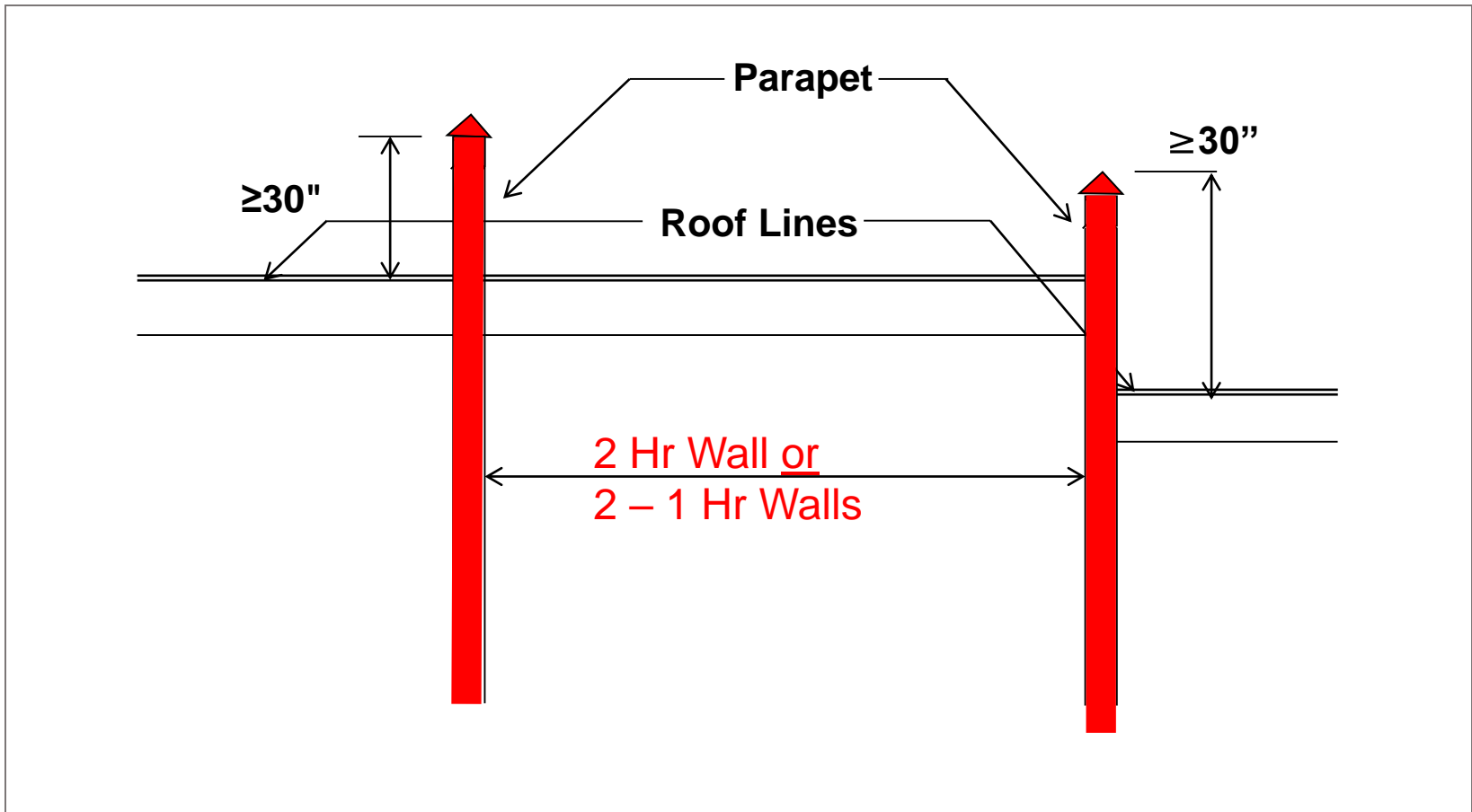


\* Parapets 302.2.4



\* Parapets construction same rating as the wall 302.2.5

\* Parapets 302.2.4



\* Structural independence **302.2.6**

- Required at townhouse separation
  - Exception: Five items can be attached to common wall

1. Foundations supporting exterior walls or common walls
2. Structural roof and wall sheathing from each unit fastened to the common wall framing
3. Nonstructural wall and roof coverings
4. Flashing at termination of roof covering over common wall
5. Townhouses separated by a common wall as provided in Section **302.2**
6. Units stacked vertically

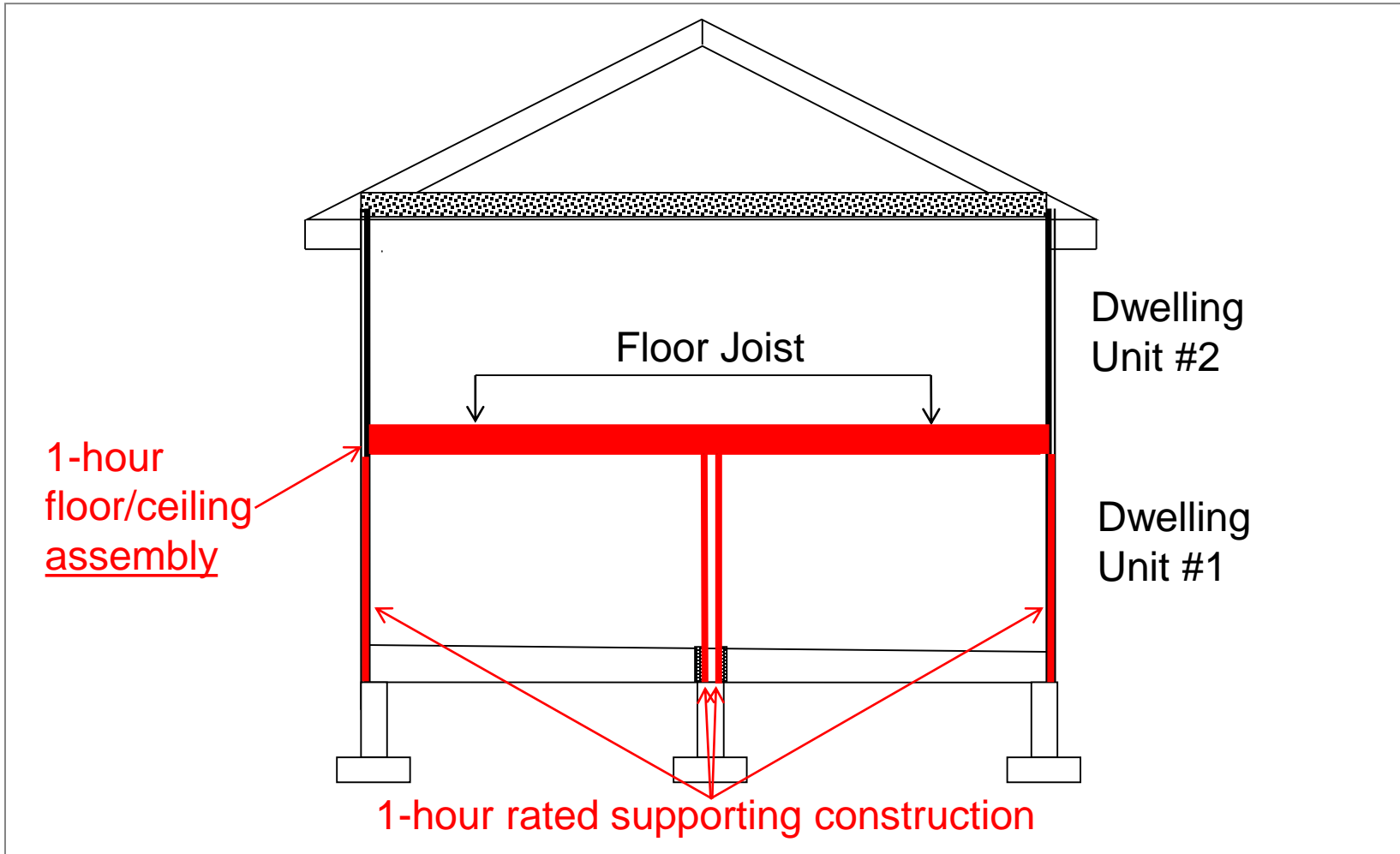


Courtesy of The Gypsum Association

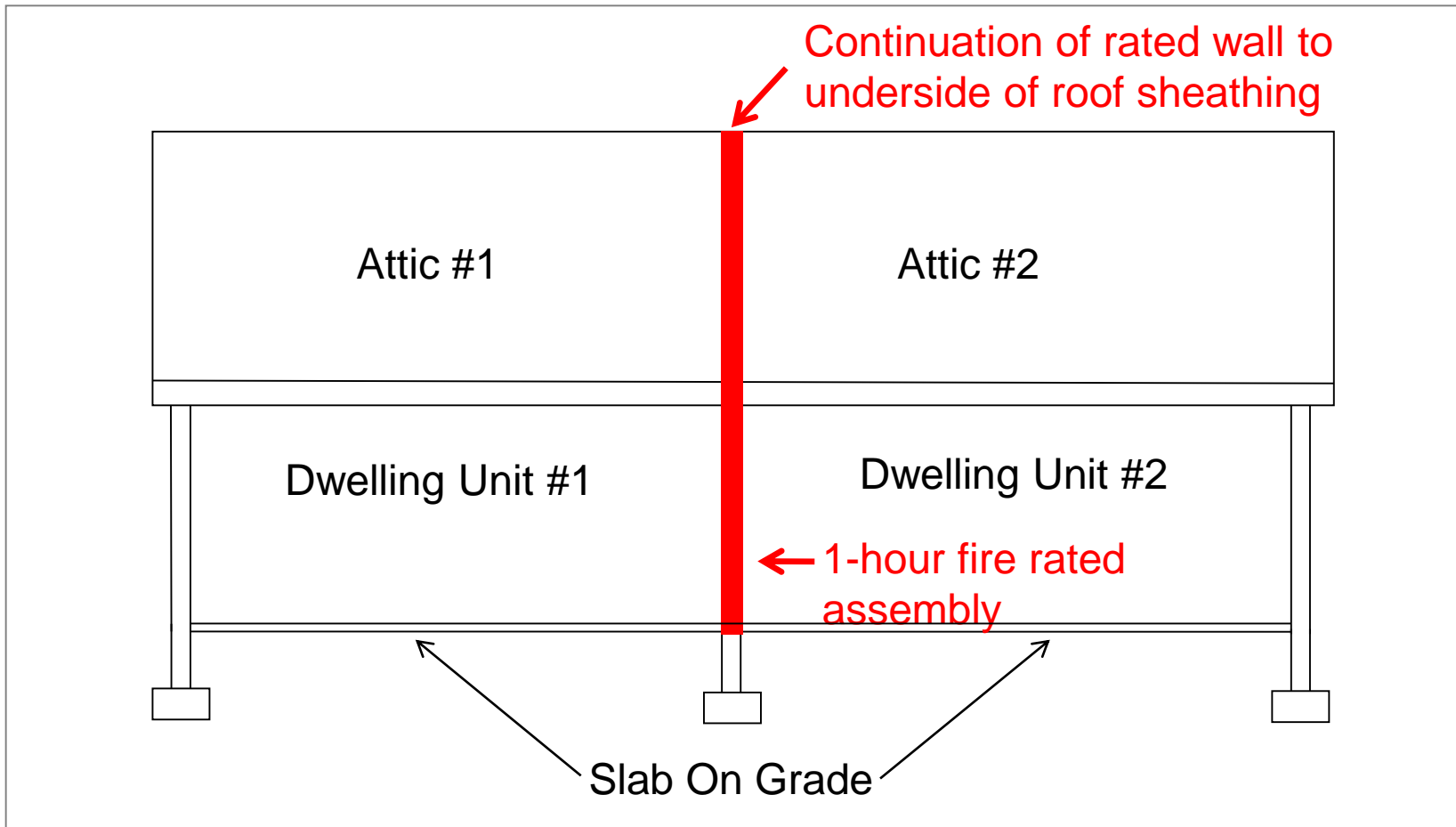




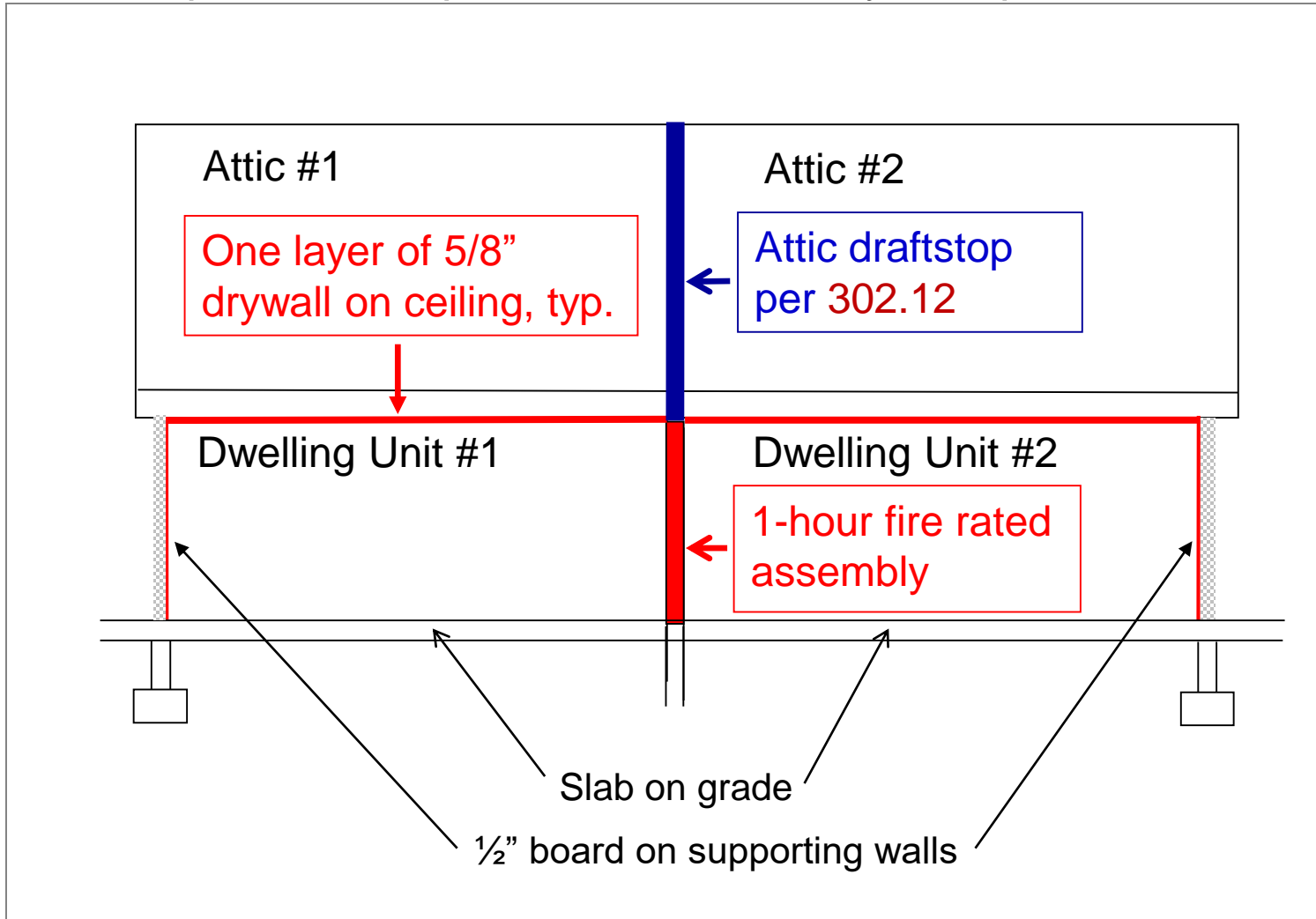
\* Two-family required fire separation **302.3**



- \* Two-family required fire separation 302.3



\* Required fire separation – Two-family exception 302.3



\* Two-family dwellings **302.3**

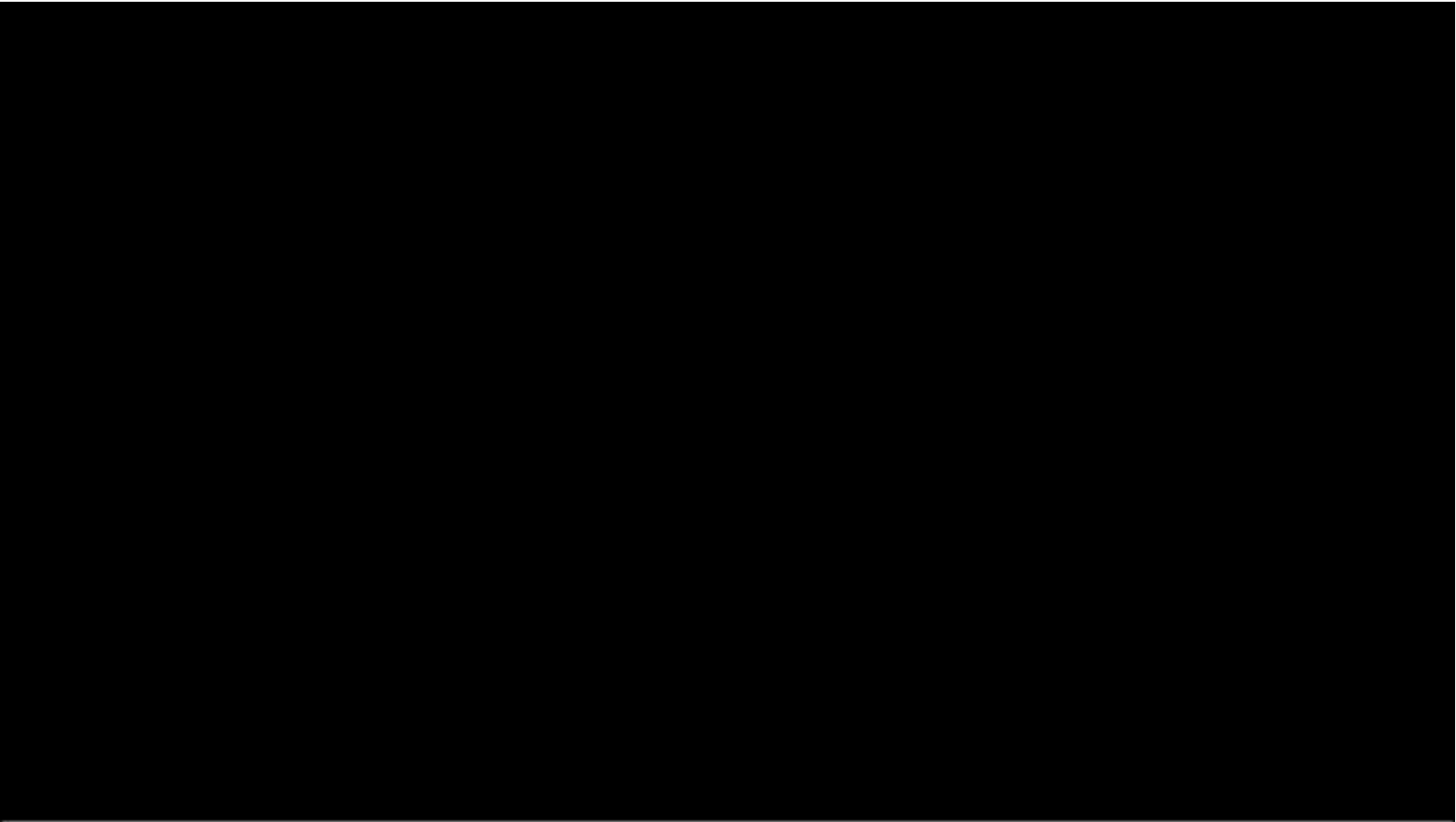
- Exception 1
  - IF: Full NFPA 13 Sprinkler System
  - THEN: ½-hour fire resistive ceiling of each unit OK
- Exception 2:
  - IF: Ceiling protected by minimum 5/8” Type X gypsum board,
  - AND: Attic draftstop built above and along the separation wall,
  - AND: Structural framing supporting the ceiling is protected by minimum ½” gypsum board
  - THEN: Wall assemblies need not extend through the attic



- \* Dwelling unit penetrations 302.4
- \* Through penetrations
  - Membrane penetrations for 2-hour rated walls and less
  - Steel electrical boxes
    - Maximum 16 square inches
    - Maximum 100 square inches per 100 square feet
  - Distance between boxes on opposite sides of wall



- \* Dwelling unit penetrations **302.4** (*continued*)
  - Through penetrations
  - Protected by approved through penetration firestop system **ASTM E814** or **UL 1479 R302.4.1.2**
  - Two exceptions for non-combustible pipe:
    - Installed as tested per **ASTM E119**
    - Grout full thickness of wall with limitations and fill annular space



\* Garage / Dwelling door opening protection **302.5.1**

- Not into a room used for sleeping
- 1-3/8" solid wood
- 20 minute fire rated
- 1-3/8" solid or honeycomb core steel
- Self closing device (*New*)



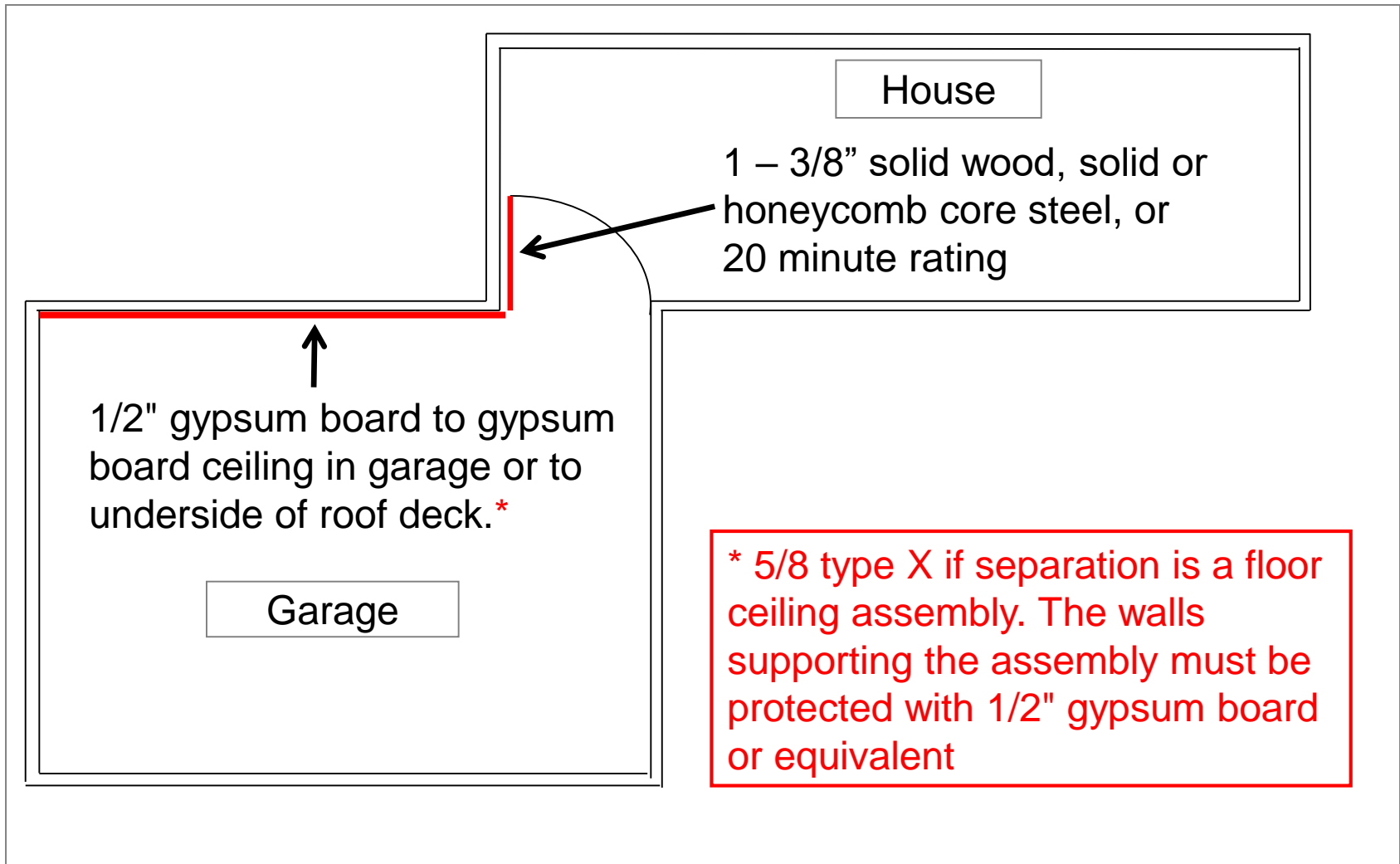
\* Duct penetrations **302.5.2**

- 26 gage minimum thickness
- No openings into garage

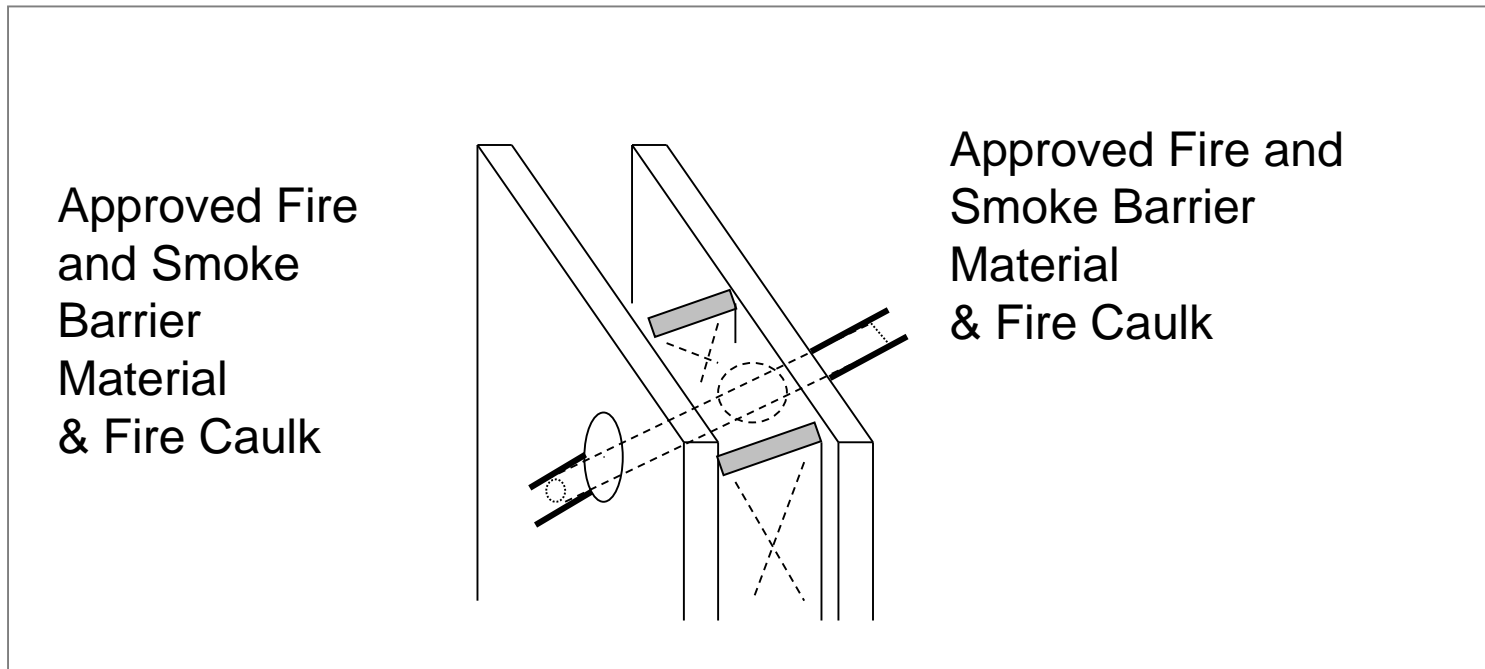




\* Garage / Dwelling door opening protection 302.5.1



- \* Other penetrations – garages and carports **302.5.3**
  - This section permits items to penetrate the common wall between the house and the garage if the annular space is then filled with approved fire resistant materials



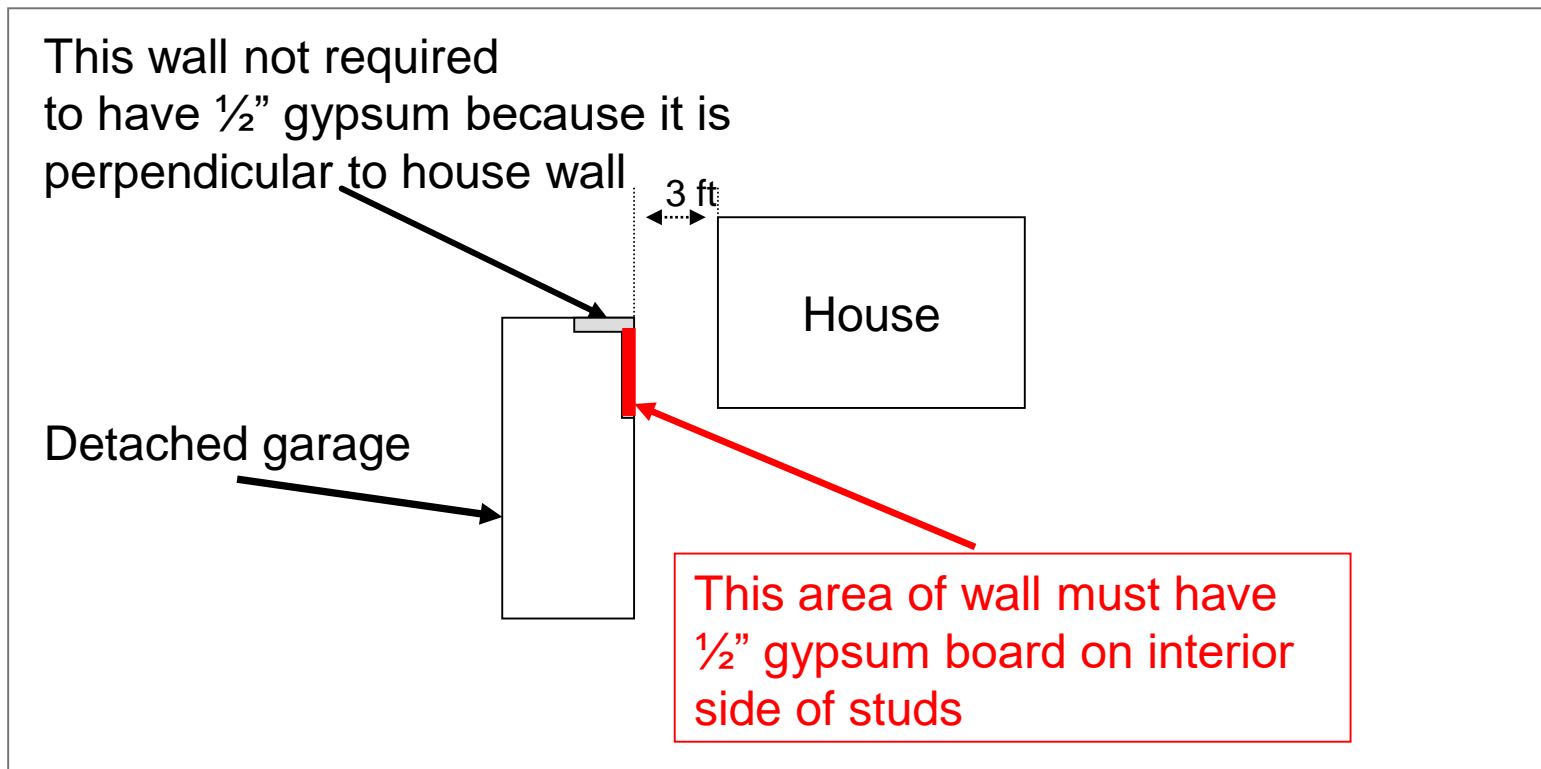
- \* Dwelling / Garage separation **Table 302.6**
  - Not applicable to garage walls perpendicular to dwelling wall

**TABLE 302.6  
DWELLING-GARAGE SEPARATION<sup>1</sup>**

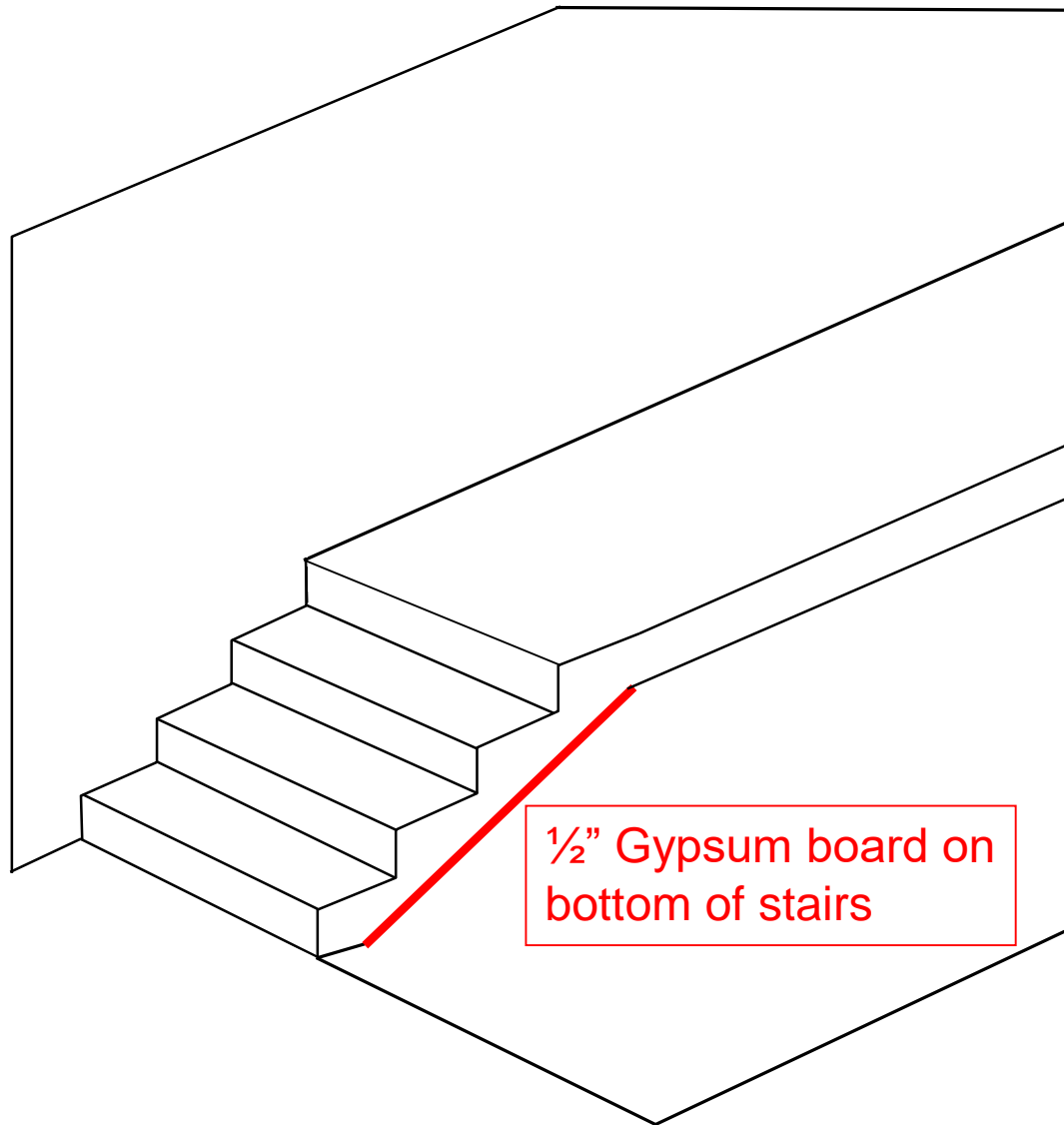
SEPARATION	MATERIAL
From the residence and attics	Not less than 1/2-inch gypsum board or equivalent applied to the garage side
From habitable rooms above the garage	Not less than 5/8-inch Type X gypsum board or equivalent
Structure(s) supporting floor/ceiling assemblies used for separation required by this section	Not less than 1/2-inch 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 interior side of exterior walls that are within this area

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

- \* Garage / Dwelling fire separation required **302.6**
  - Gypsum board interior side of exterior walls
  - Not required perpendicular wall  $\geq 3'-0''$  from dwelling



- \* Under stair protection 302.7



- \* Flame spread and smoke developed 302.9
  - Walls and ceilings flame spread  $\leq 200$
  - Smoke developed index R315.2  $\leq 450$



\* Testing 302.9.3 / 302.9.4

- Standards: ASTM E 84 / UL 723 302.9.3 / 302.9.4
- Alternate testing per NFPA 286
  - 40 KW exposure:
    - No flame spread to ceiling
  - 160 KW exposures:
    - No flame spread to outer extremities of sample
    - No flash over



\* Insulation **302.10**

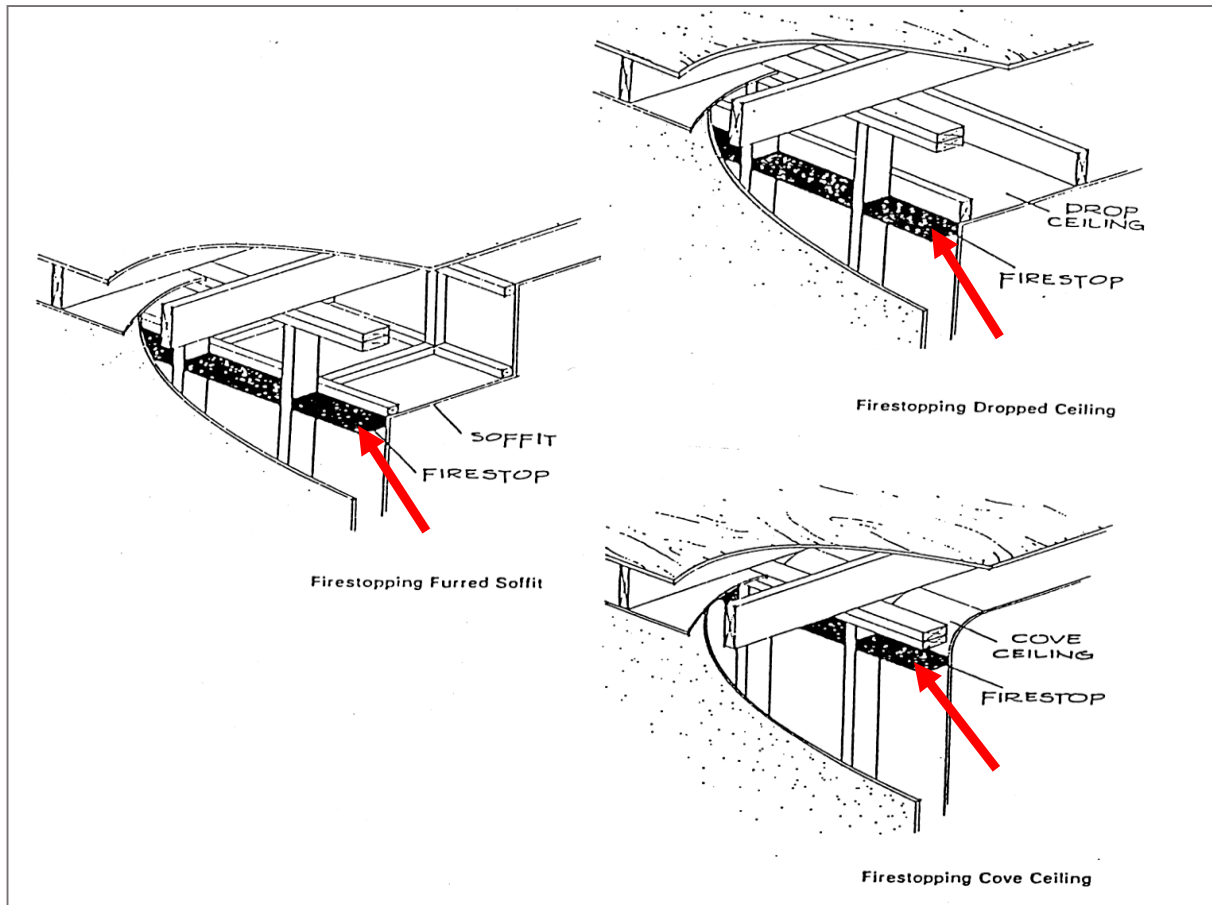
- Floor/ceiling assemblies
- Roof/ceiling assemblies
- Wall assemblies
- Crawl spaces, attics



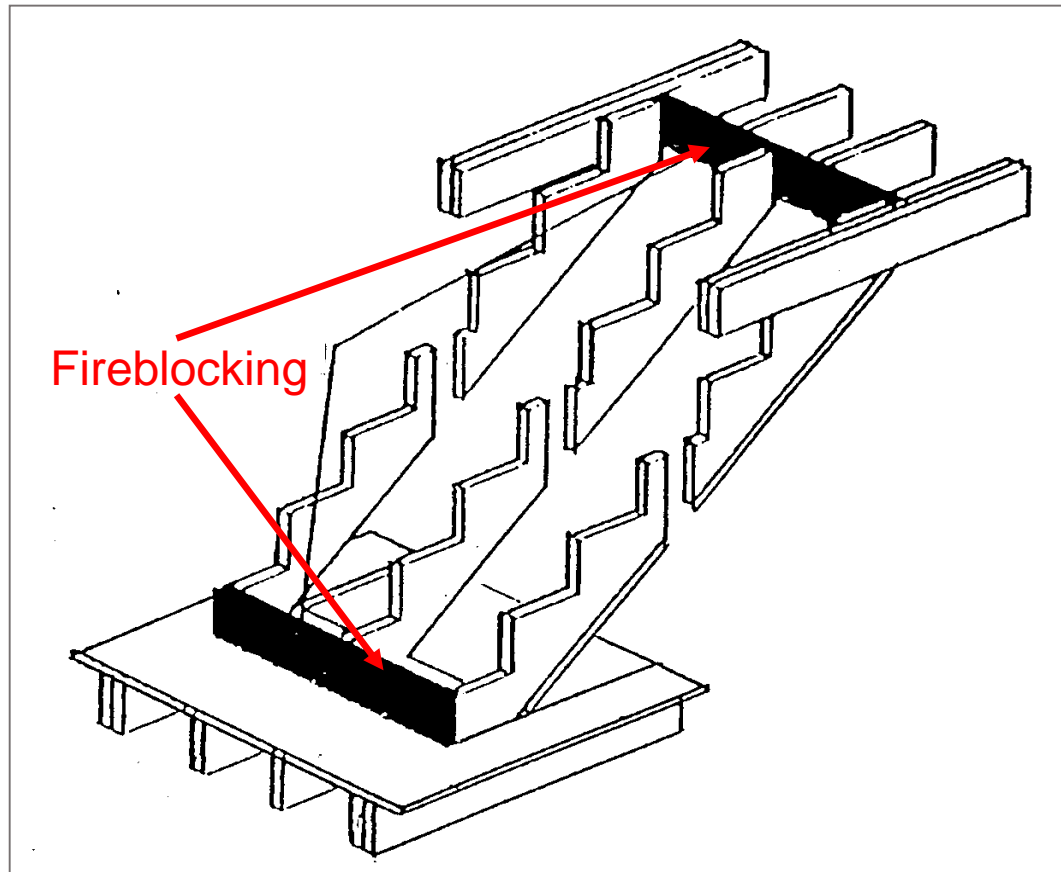


- Flame spread  $\leq 200$
- Smoke developed index  $\leq 450$
- Exceptions
  - Concealed in wall cavity
  - Cellulose louse loose fiber not sprayed no flame spread smoke developed shall comply
- Exposed in attic floor
- Critical radiant flux less than 0.12 watts per sq ft

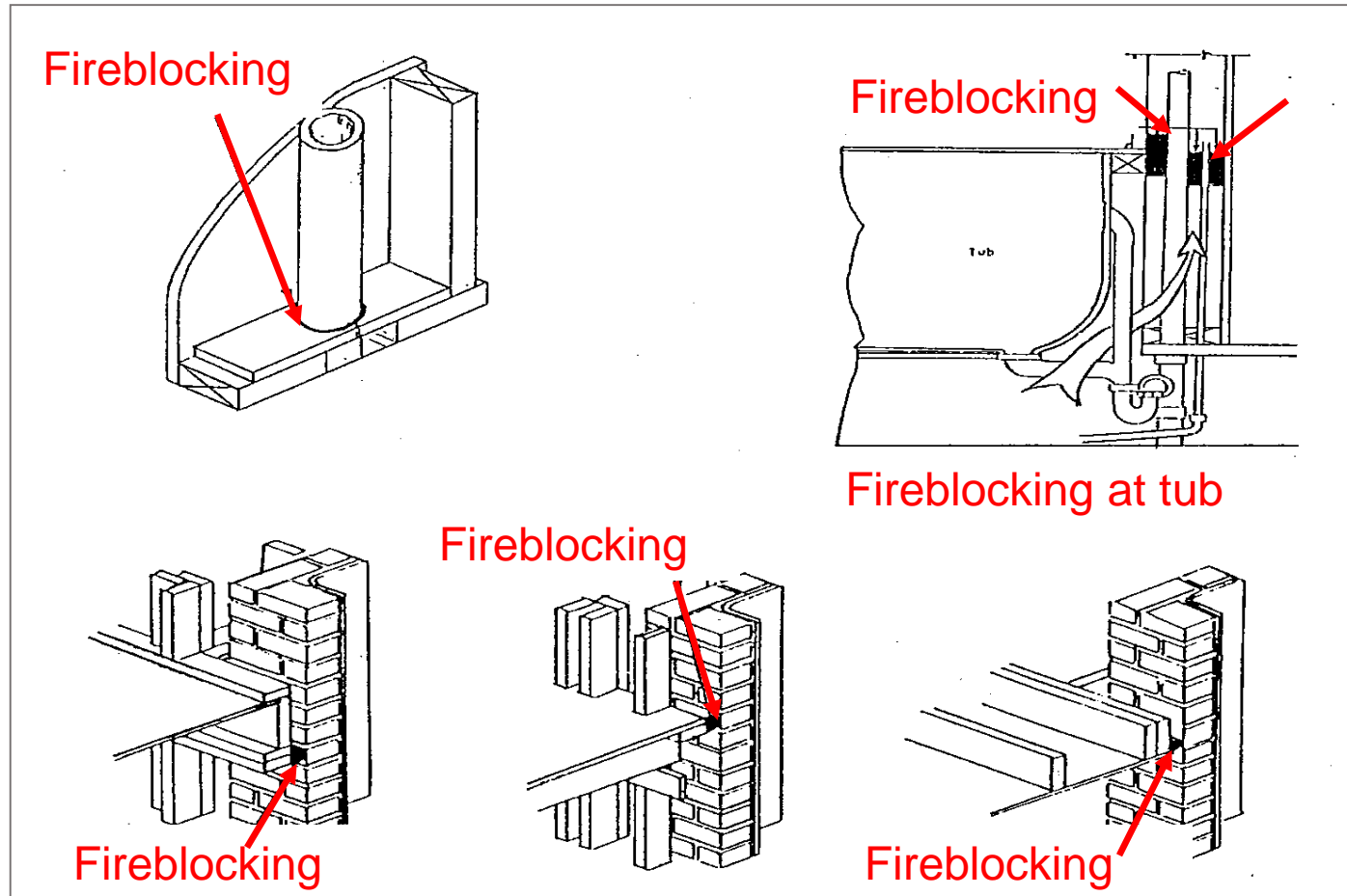
- \* Fireblocking **302.11**
  - At vertical and horizontal intersections



- \* Fireblocking **302.11** (*continued*)
  - Top and bottom of stair runs if concealed

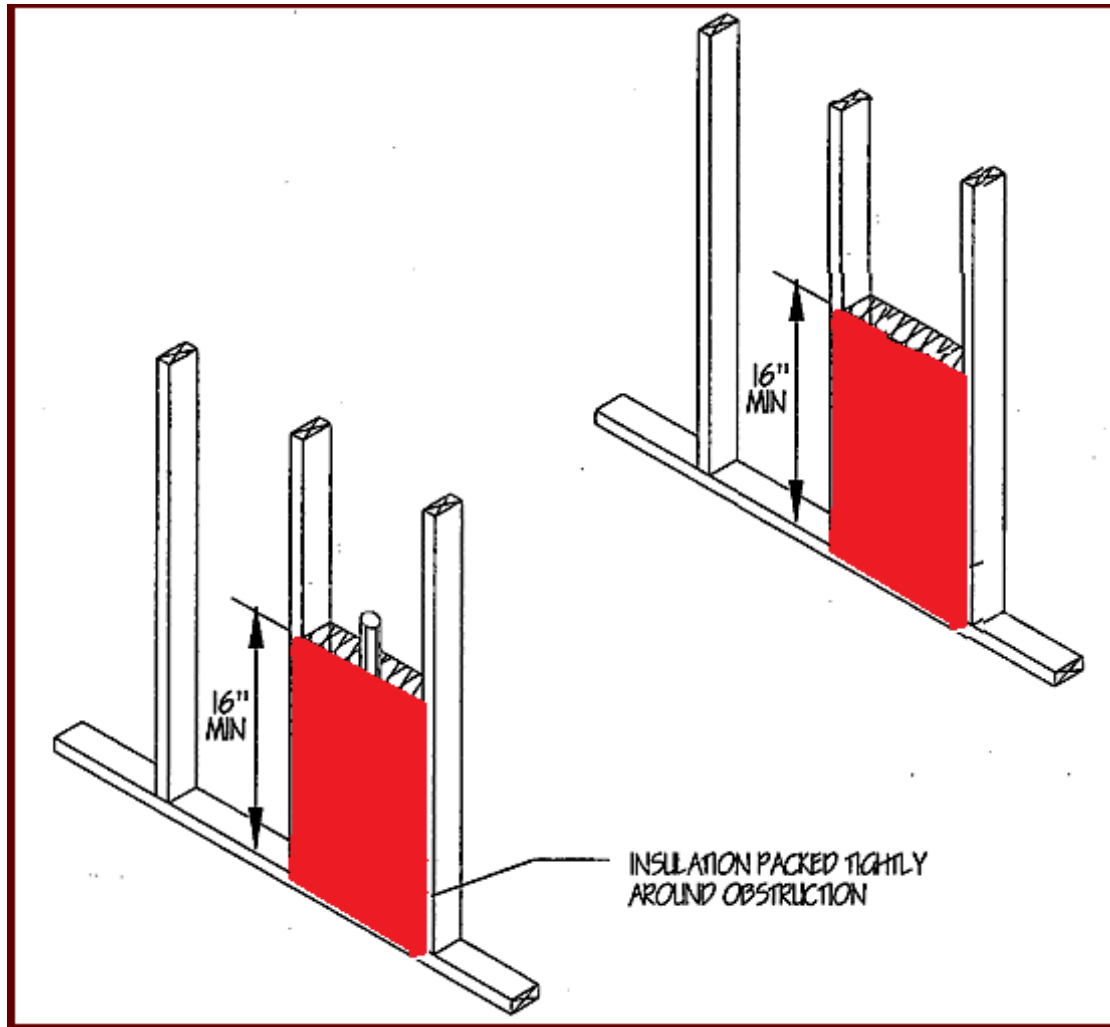


- At floors and ceilings for openings around vents, pipes, ducts, chimneys and fireplaces

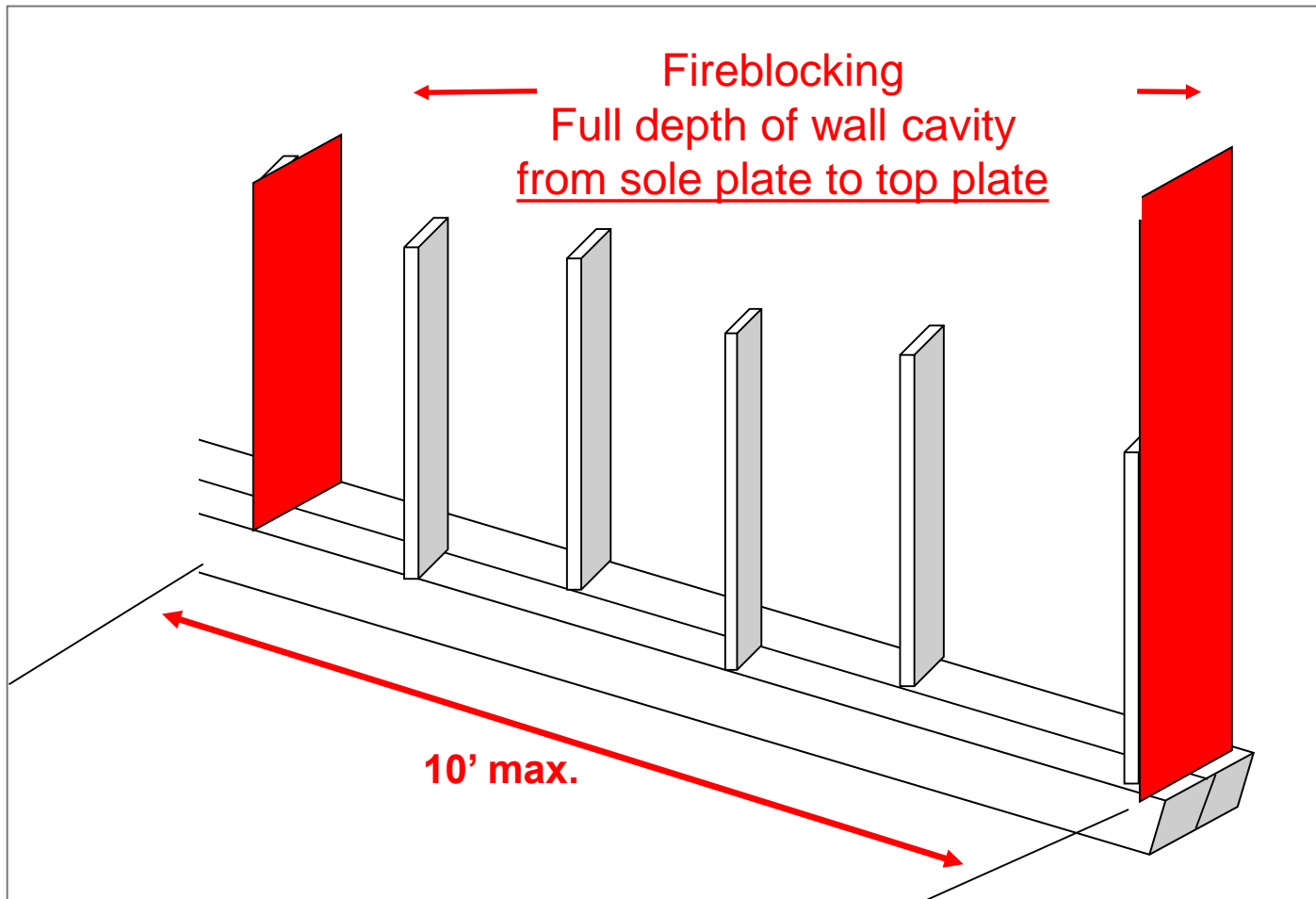


- \* Fireblocking material **302.11.1**
  - 2 x lumber, 2 layers of 1 x lumber, 23/32" Wood structural panel
  - 1/2" gypsum board, 1/4" cement-based millboard
  - Un-faced insulation (mineral wool or fiberglass)
  - Approved materials around cables & pipes, vents and ducts
  - Concealed wall spaces at floors and ceilings

\* Fireblocking 302.11.1.2

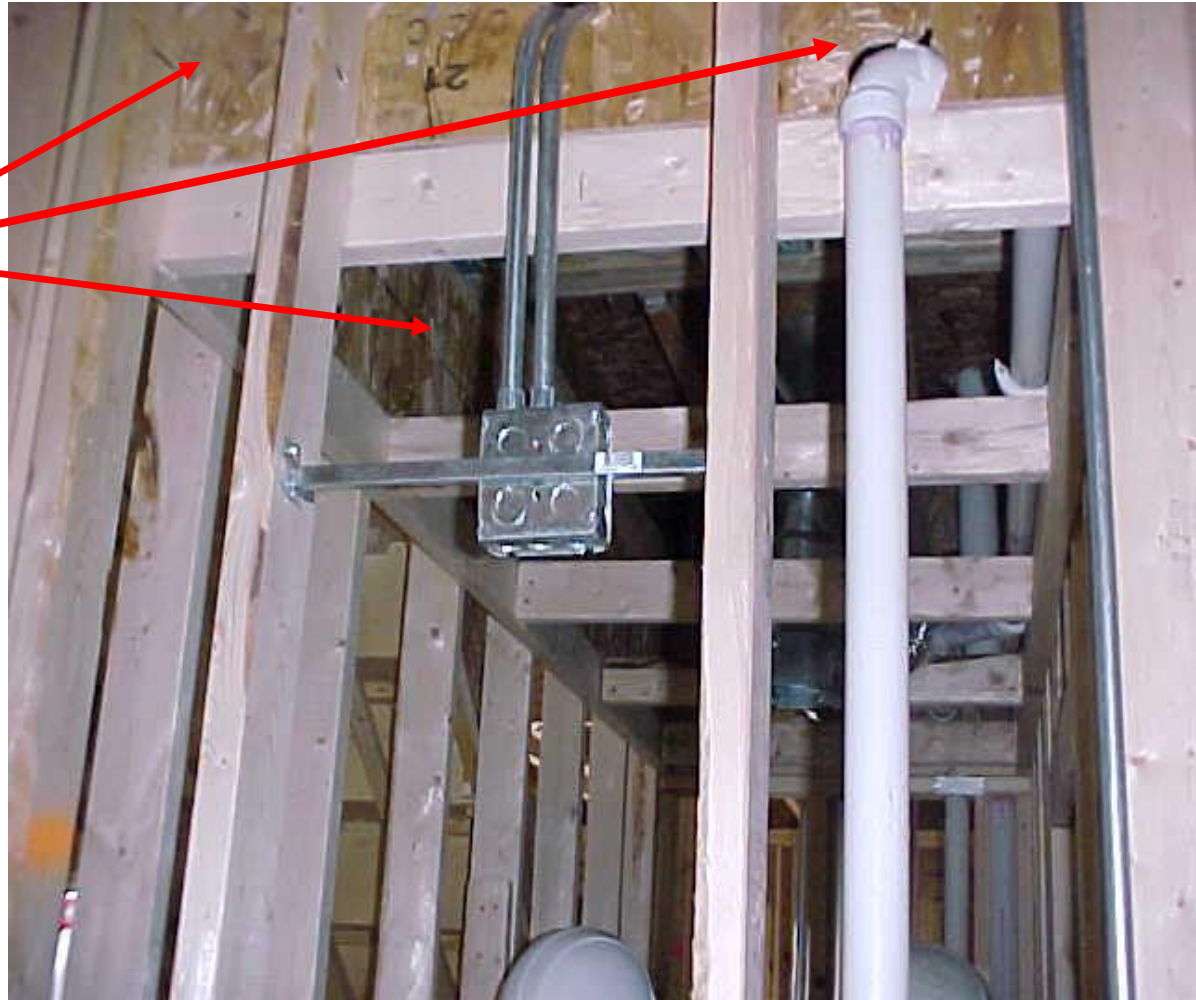


- \* Fireblocking 302.11
  - Horizontal spacing – maximum 10'
  - Parallel rows of studs or staggered studs



\* Fireblocking 302.11

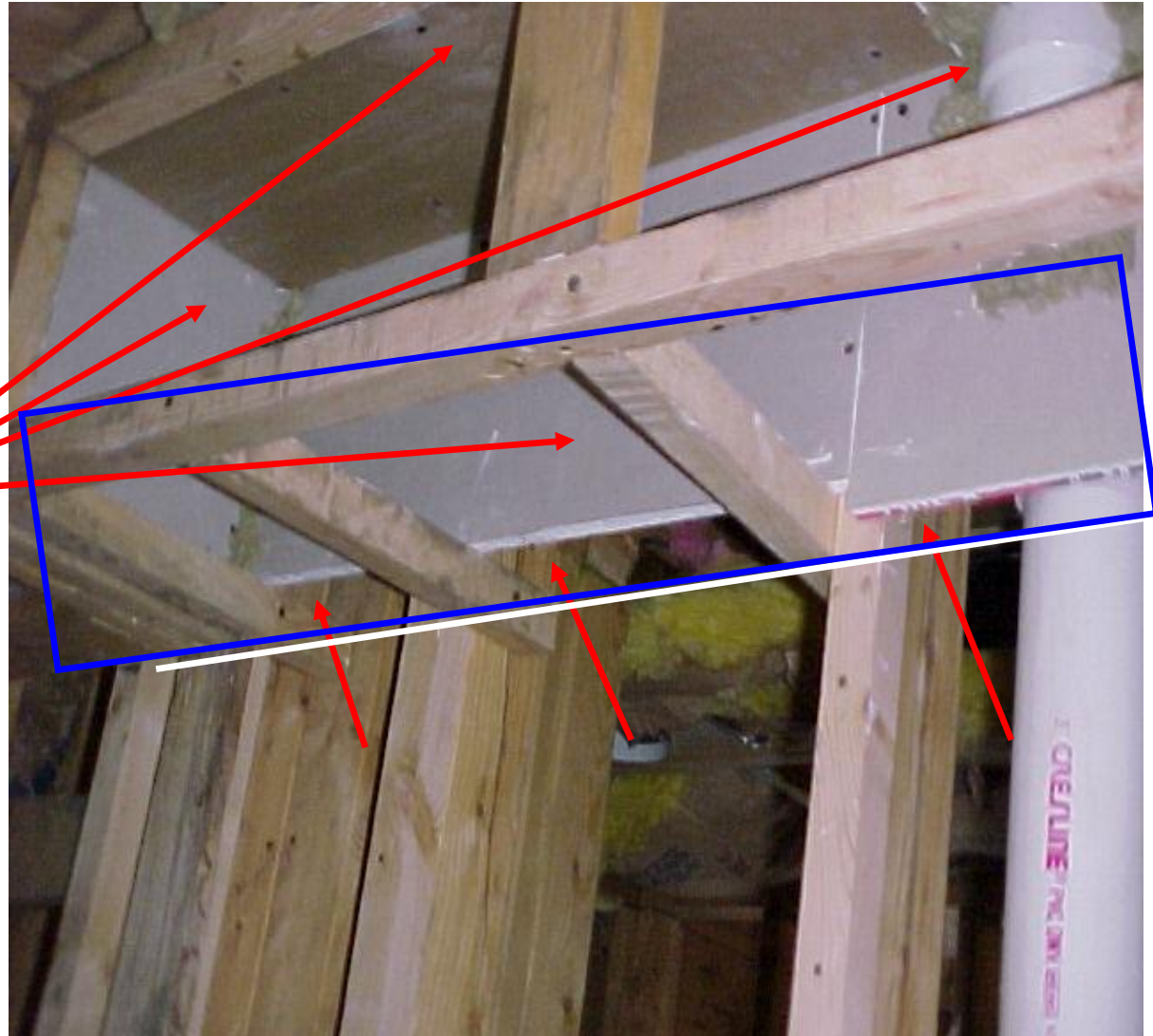
Fireblocking





\* Fireblocking 302.11

Fireblocking



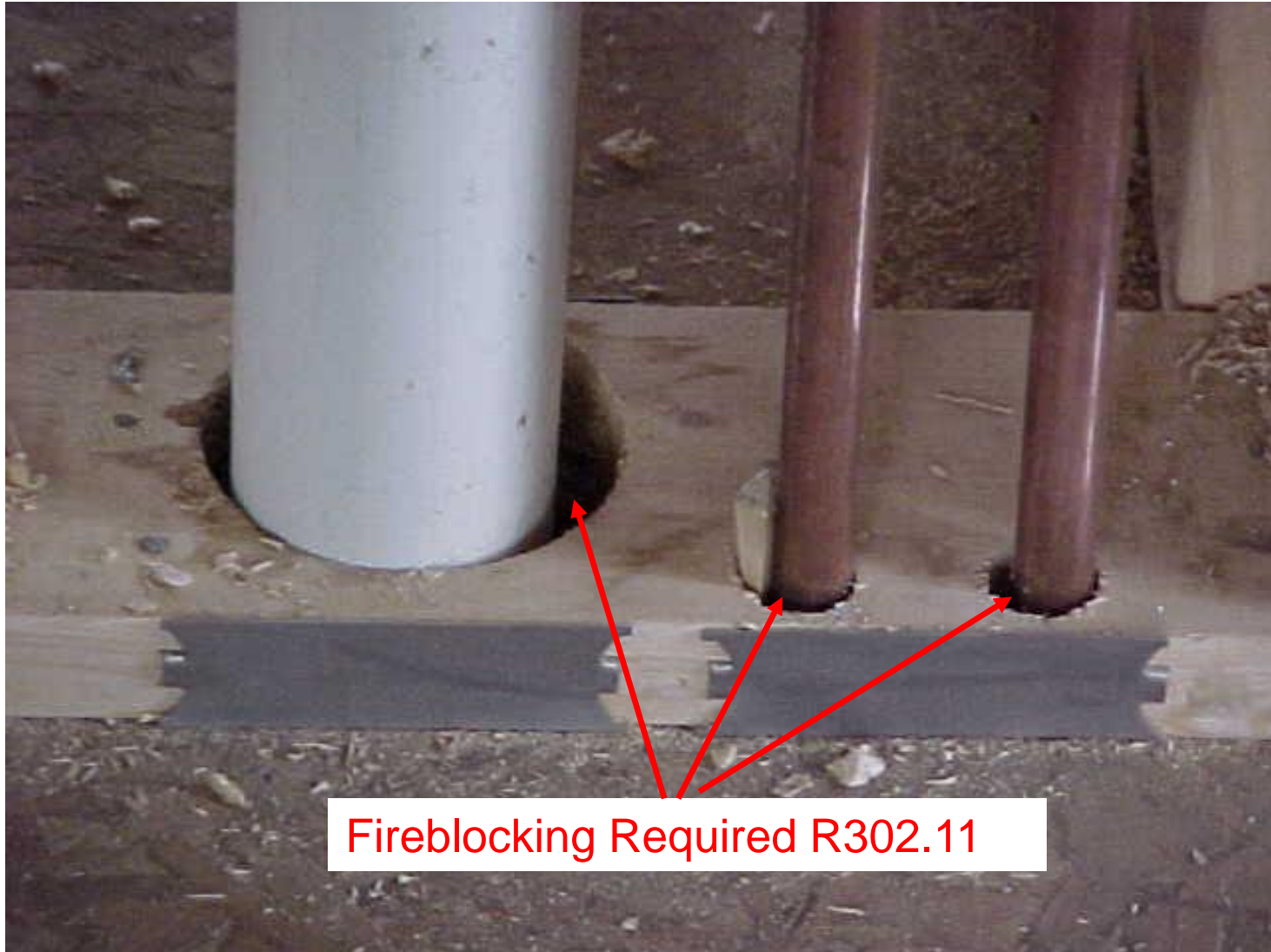
Is this dropped ceiling soffit fireblocked properly?

\* Fireblocking 302.11

Fireblocking



\* Fireblocking 302.11



Fireblocking Required R302.11

\* Fireblocking 302.11





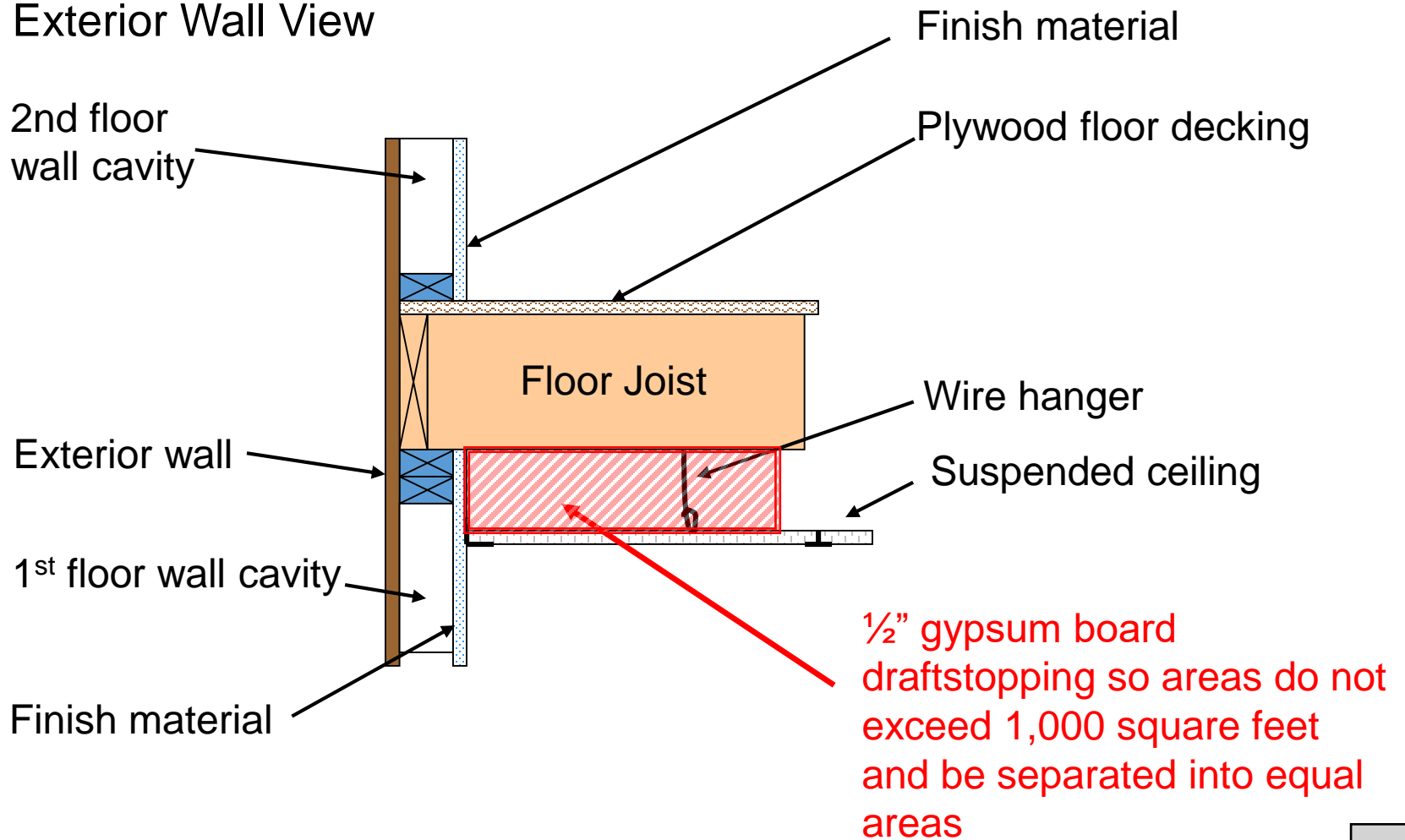
\* Fireblocking 302.11



Fireblocking OK? R302.11

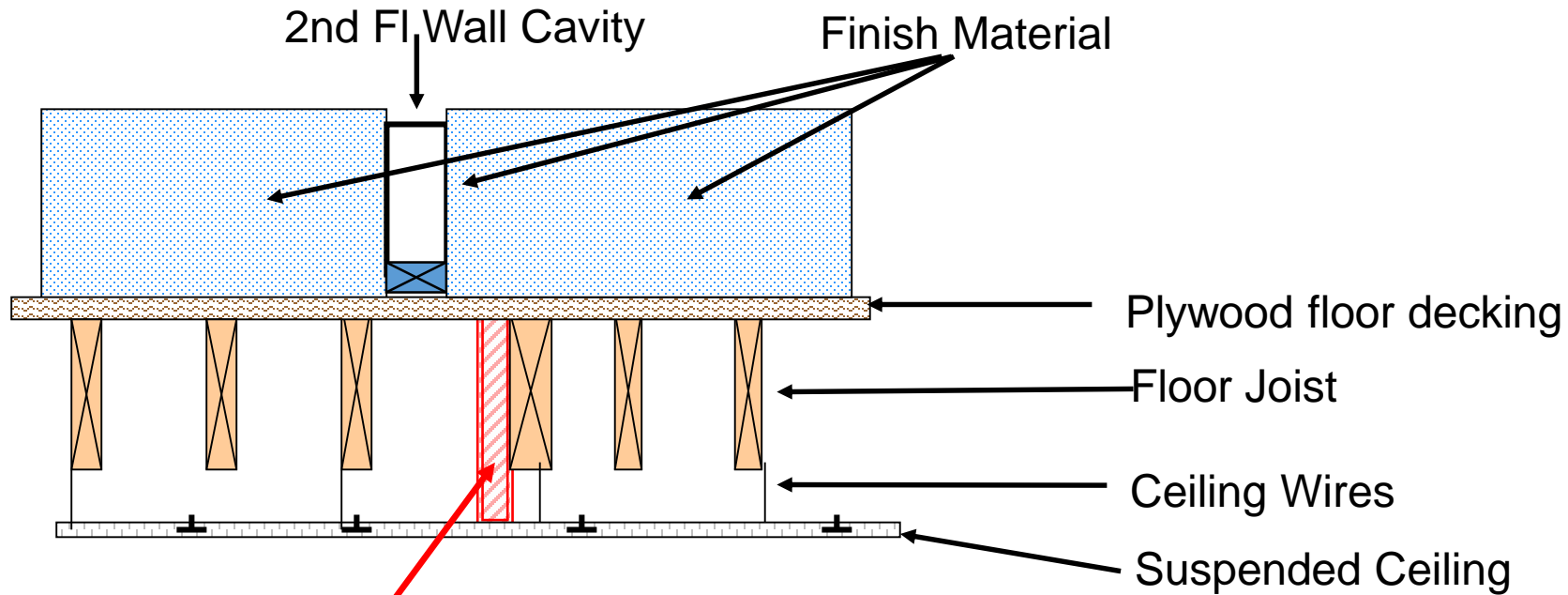
\* Draftstopping **302.12**

Exterior Wall View

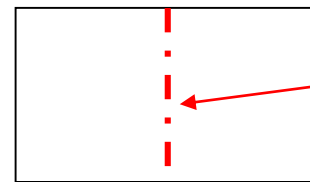


\* Draftstopping 302.12

Interior floor view



1/2" gypsum board draftstopping so areas do not exceed 1,000 square feet and are separated into equal areas



Plan View

Location of draftstopping so areas appear equal

- \* Draftstopping 302.12
  - Draftstopping materials 302.12.1
    - 1/2" Gypsum board
    - 3/8" wood structural panels
    - Other approved materials



- \* Fire protection of floors **302.13**
  - Moved from 501.3 in 2012 IRC



- \* Fire protection of floors **302.13** (*continued*)
  - Materials
    - 1/2" gypsum / 5/8" structural wood panel
  - Exceptions
    - Sprinklers / Over a crawl space with no mechanicals / Less than 80 square feet / Composite lumber  $\geq 2 \times 10$  / Approved equivalent
  
- \* Combustible insulation clearance **302.14**
  - Minimum 3" from luminaires, fan motors and other heat producing devices unless listed

## ◆ Light, Ventilation and Heating 303

### \* Habitable rooms 303.1

- Natural
  - Windows minimum 8% of floor area
  - Minimum openable 4%

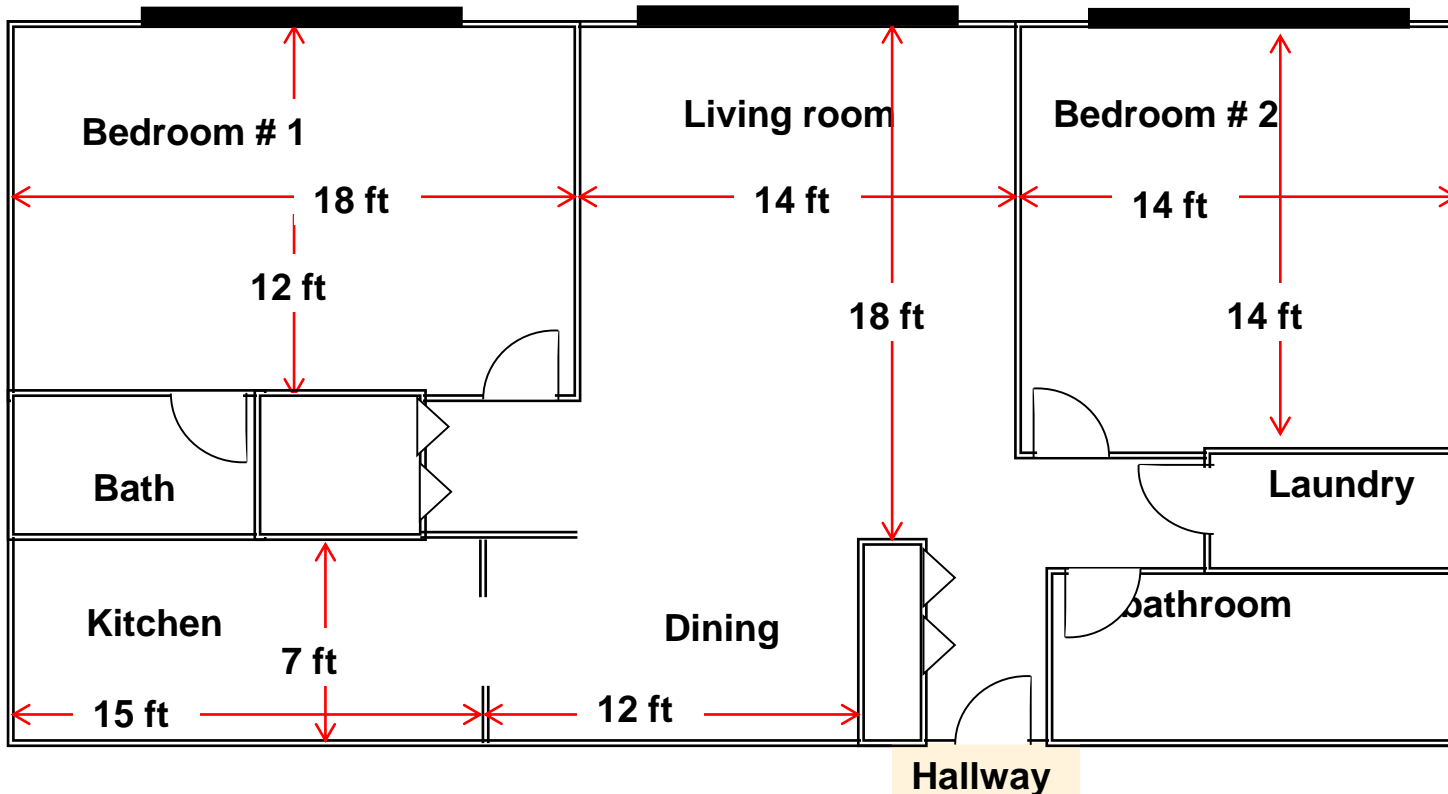
### \* Adjoining rooms 303.2

- $\frac{1}{2}$  of common wall no less than  $\frac{1}{10}$  of room or 25 square feet

### \* Bathrooms 303.3

- 3 square feet window – 1/2-openable or vent to exterior





Bdrm # 1 18 x 12 = 216 x .04 = 8.64 sq ft of opening

Bdrm # 2 14 x 14 = 196 x .04 = 7.84 sq ft of opening

Kitchen 15 x 7 = 105 x .08 = 8.4 sq ft of opening / min. 25 sq. ft.

Dining 12 x 7 = 84 + 105 = 189 x .08 = 15.12 sq ft of opening

Living Rm 14 x 18 = 252 + 105 + 84 = 441 x .04 = 17.64 sq ft of opening

Bathrooms Exhaust fans 50 cfm Intermittent or 20 cfm continuous

- \* Mechanical ventilation **303.4, 303.5, 303.6**
  - 5 air changes per hour or less during test
  - Whole house ventilation required
  - Intake not less than 10' from a hazard
    - Dwelling unit toilet, bathrooms and kitchens not considered
    - Not applied if 3' or greater below
    - Vents, chimneys, clothes dryer exhaust per code
    - Protected with corrosion resistant screens
    - Protected from local weather
    - Protected as an exterior wall opening per code

\* Stairway illumination **303.7**

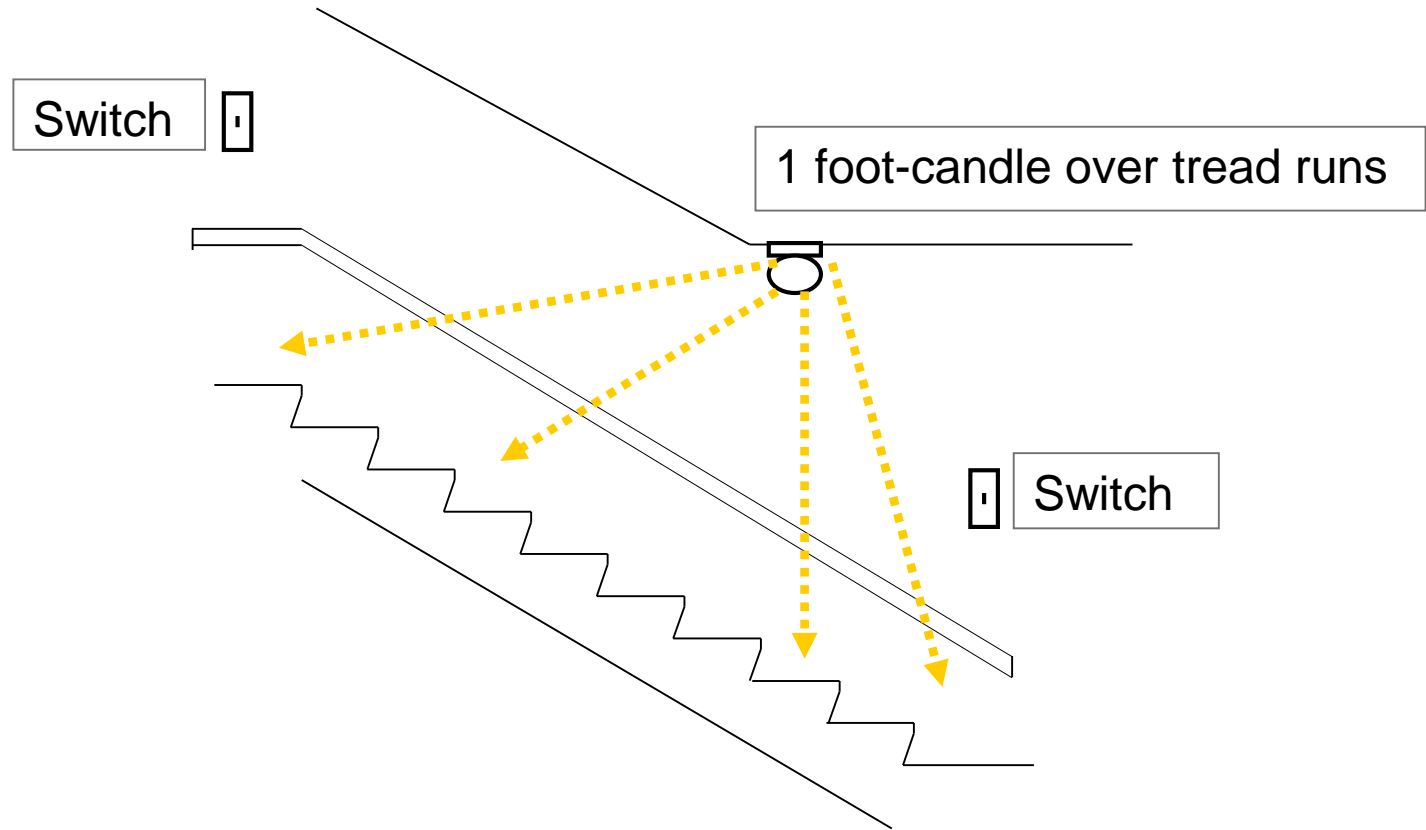
- Light location
  - Interior stairs
  - Exterior stairs

\* Light activation **303.7.1**

- Top and bottom of interior stairs
- Inside structure at top landing exterior stairs

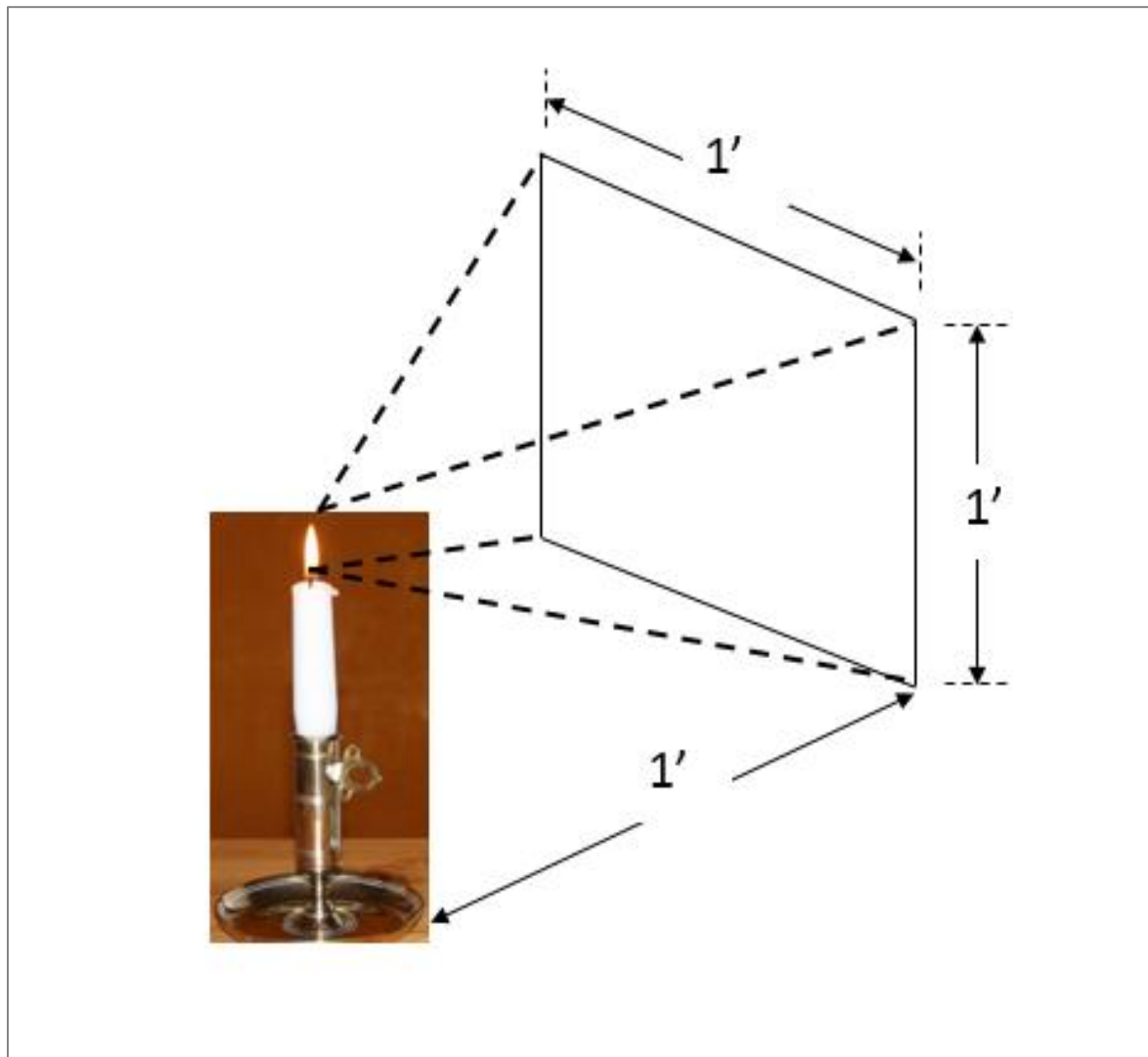


\* Stairway illumination 303.7.1



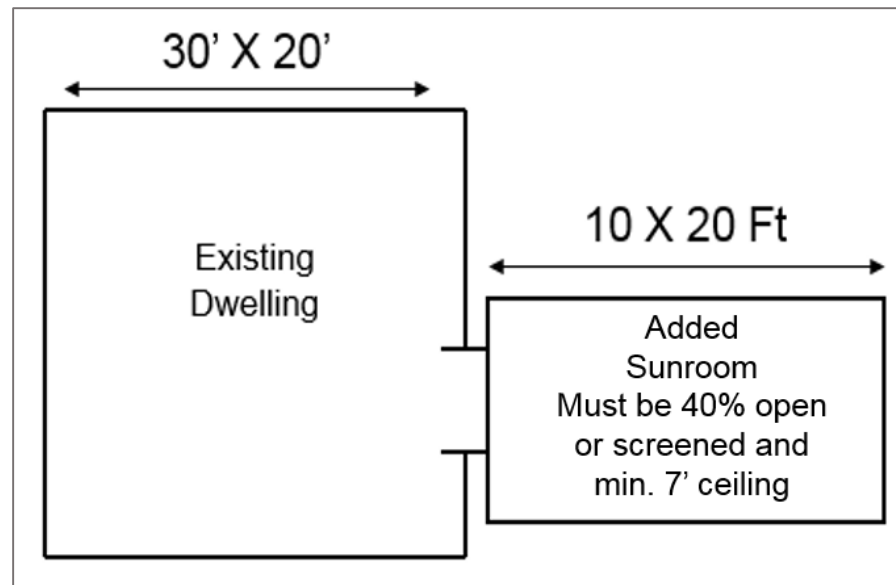
Illumination of exterior stairways shall be controlled from inside dwelling

\* 1 foot-candle of light





- \* Sunroom additions **303.9.1**
  - IF: 40% or more of sunroom is open or enclosed with insect screening
  - AND: Ceiling height is  $\geq 7'$
  - THEN: Required glazed openings into sunroom or covered patio that abut a street or court OK



- \* Required heating **303.10**
  - Winter design below 60°
  - Maintain 68°
    - 3' above the floor
    - 2' from exterior wall
    - Space heaters cannot be used

## ◆ Minimum Room Areas 304

- \* Habitable rooms must be at least 70 square feet
- \* Minimum – except kitchens
- \* Sloped area <5' not in habitable room area calculation
- \* Minimum horizontal dimension 7' except kitchen

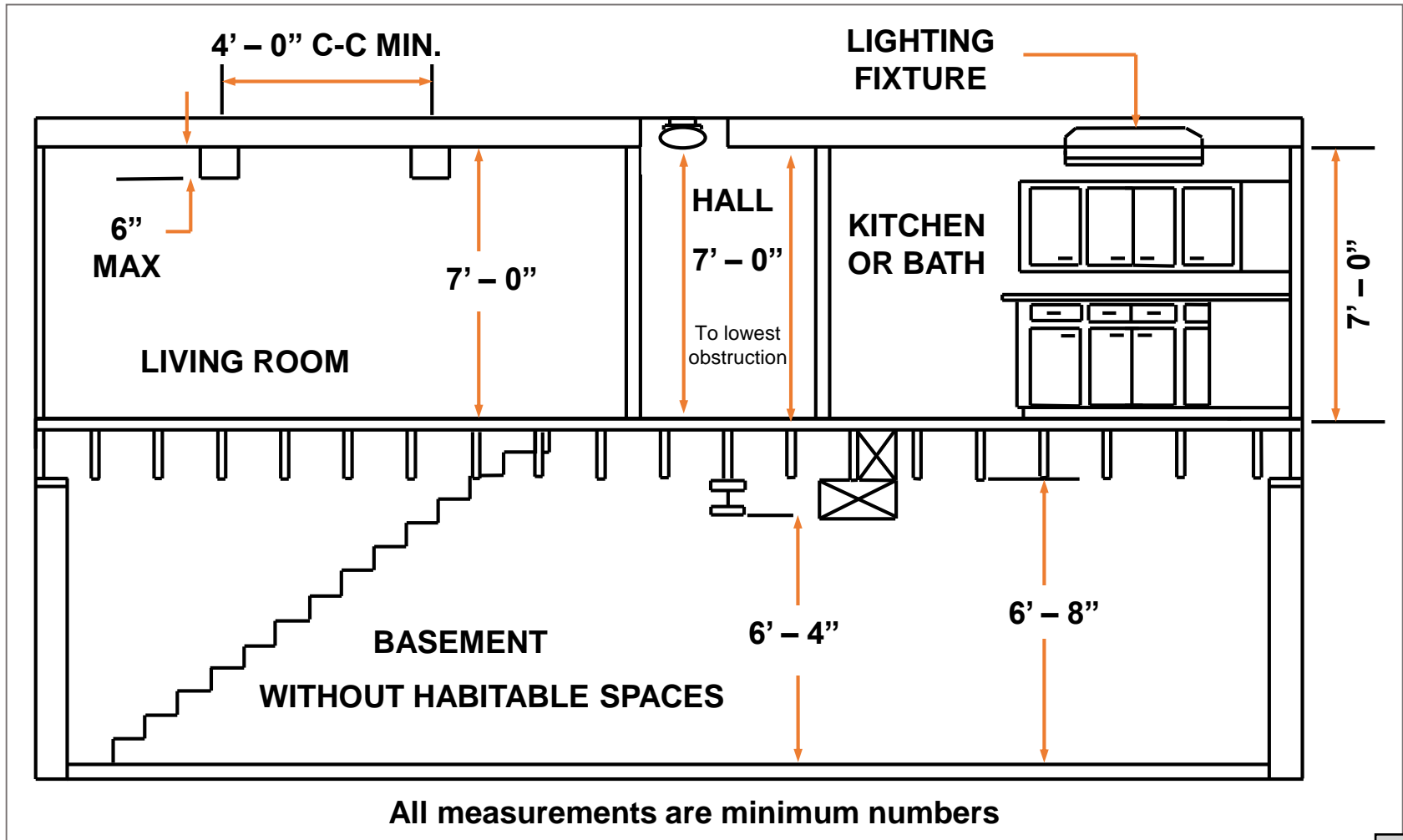


## ◆ Ceiling Height 305

- \* Minimum height 7' 305.1
- \* Bathrooms, toilet rooms and laundries not less than 6' 8"

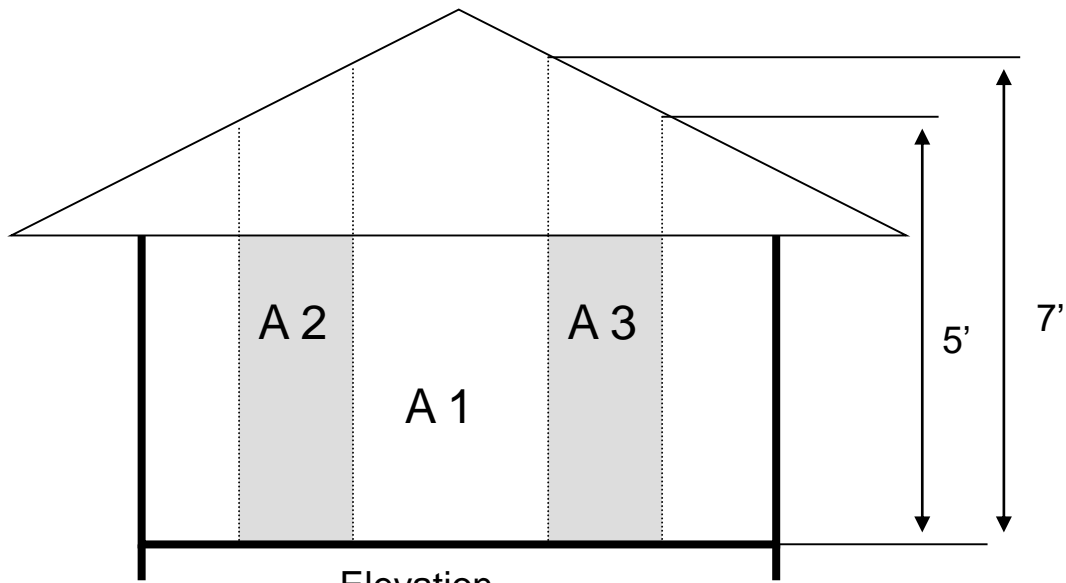


\* Ceiling heights 305

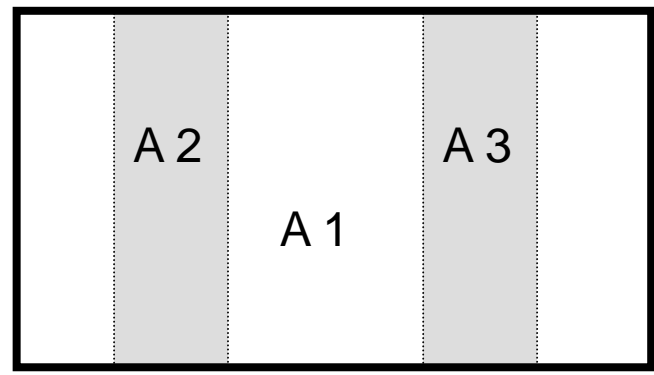


- \* Sloped ceilings – minimum height **305.1**
  - Exception is used to properly calculate ceiling height for spaces with sloped roofs
  - 50% of the room area needs to be at least 7' high
  - 6' 8" at plumbing fixture areas
  - See **Figure 307.1**





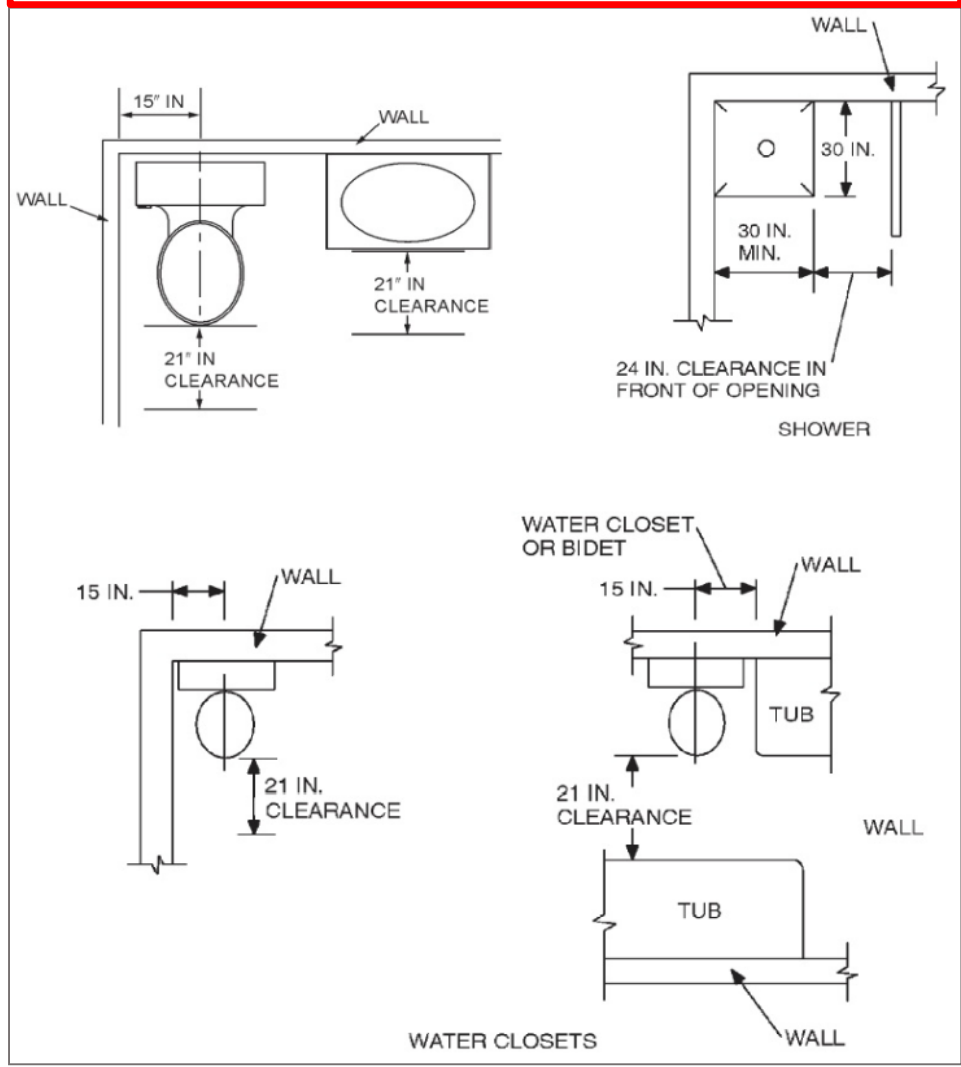
Elevation



Plan

**$A1 + A2 + A3 \geq$  required Room floor area per Section R304**  
 **$A1 \geq 50\%$  of required room floor area per section R304**

FIGURE 307.1 Space Required



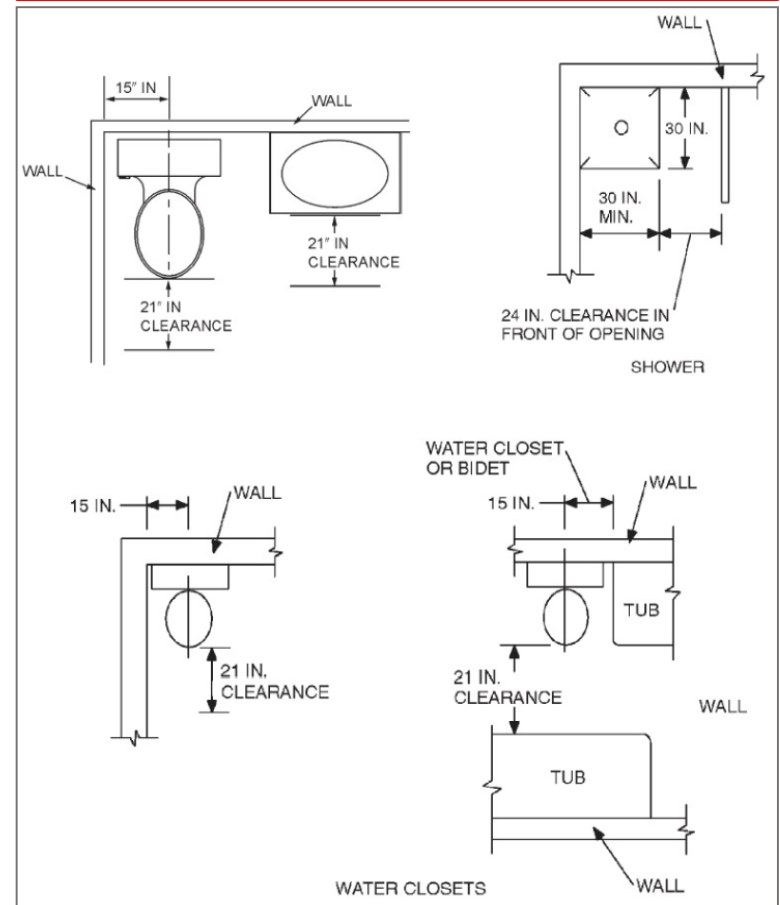


## ◆ Sanitation 306

- \* Every dwelling unit provides a water closet, lavatory, and bathtub or shower
- \* Every kitchen area shall have a sink
- \* All plumbing fixtures connected to an approved water supply
- \* Hot & cold water:
  - Kitchen sinks
  - Lavatories
  - Bathtubs
  - Showers
  - Laundry tubs and washing machine outlets
- \* Plumbing fixtures connected to a sewage disposal system

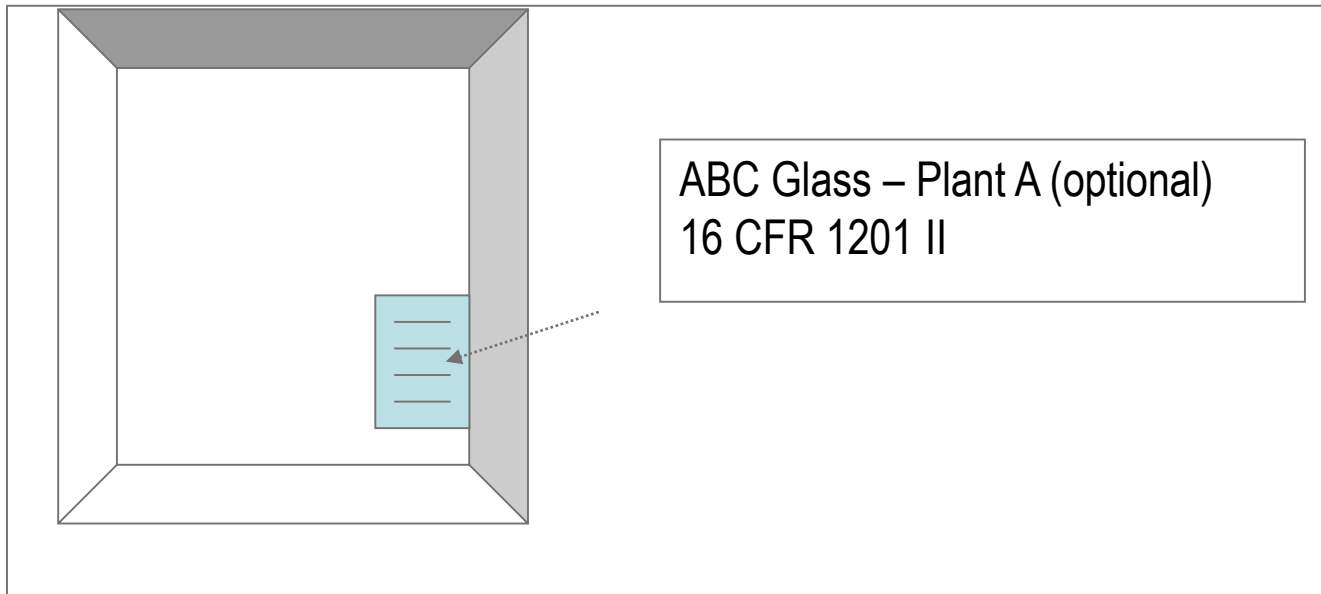
- \* Toilet, bath, shower spaces **307.1**
  - Spacing at fixtures per **Figure 307.1**
  - Bathtub and shower areas to have a non-absorbent surface to 6' in height

**FIGURE 307.1 Space Required**



## ◆ Glazing 308

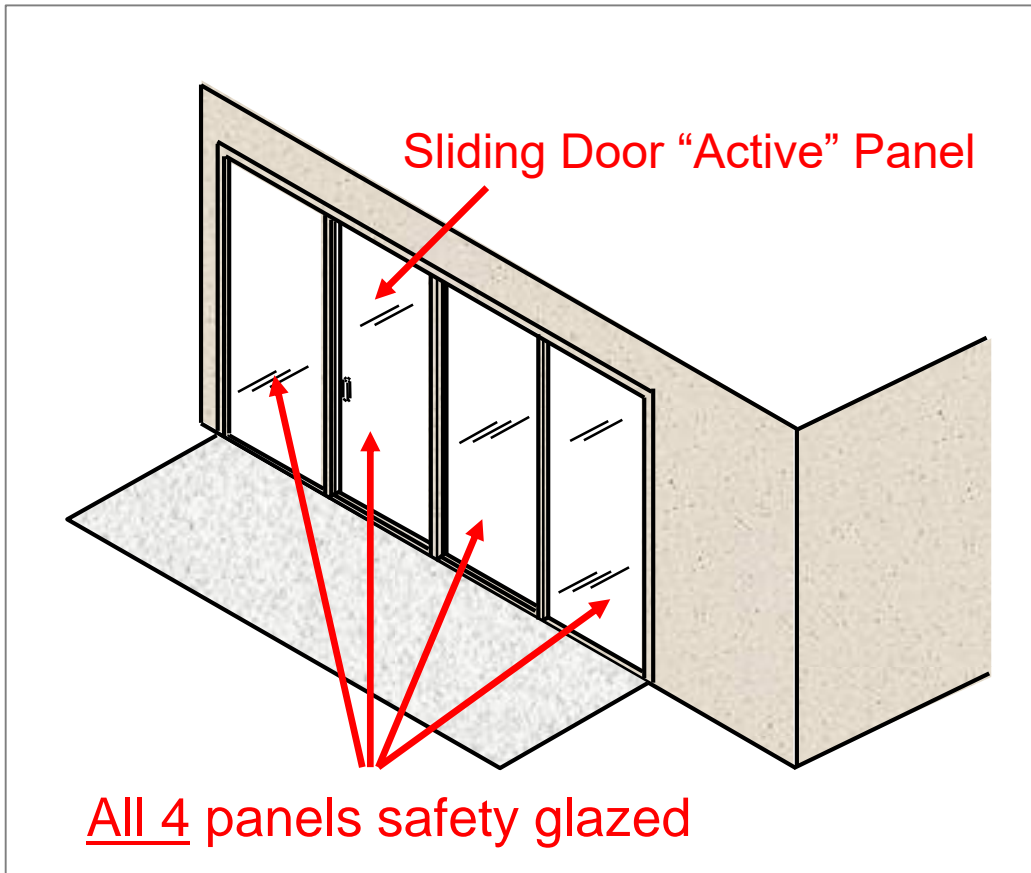
- \* Identification 308.1
- \* Manufacturer's designation etched on surface or label
- \* Type and standards for glazing used
- \* Glass and glazing testing and labeling based on CPSC 16, 16CFR 1201 or ANSI Z97.1



- \* Hazardous locations – glazing 308.4
- \* Subsections 308.4.1 through 308.4.7
  - Each location given descriptive title / Section
  - Glazing in doors 308.4.1
  - Glazing in all fixed and operable panel doors:  
Hazardous



\* Glazing in doors 308.4.1



- \* Glazing adjacent doors **308.4.2**
  - Glazing in individual or operable panels

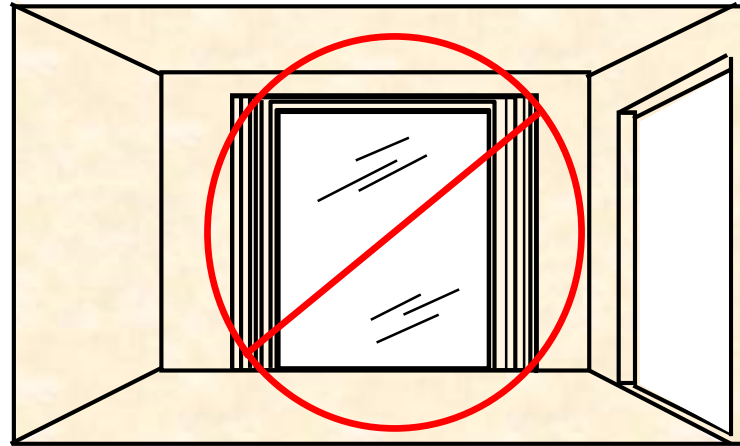


Does glazing in this door and sidelights need to be safety glazing?

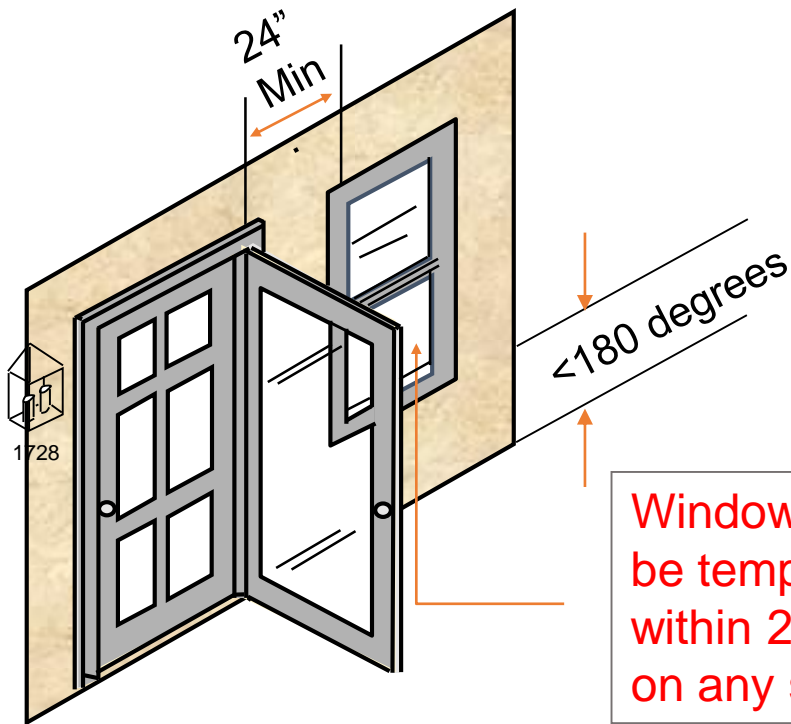
No.  
See exception for decorative glazing.

\* Safety glazing doors & windows

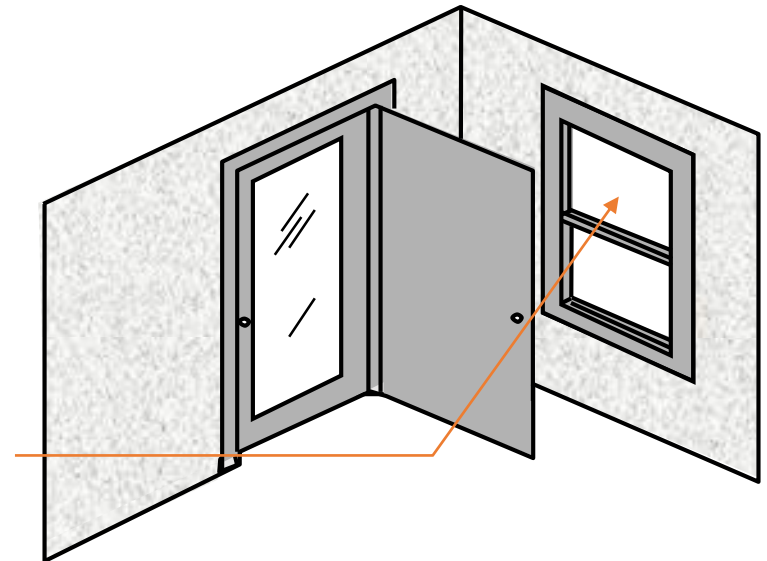
- 308.4.1
- 308.4.2
- 308.4.3



Glazed Panel



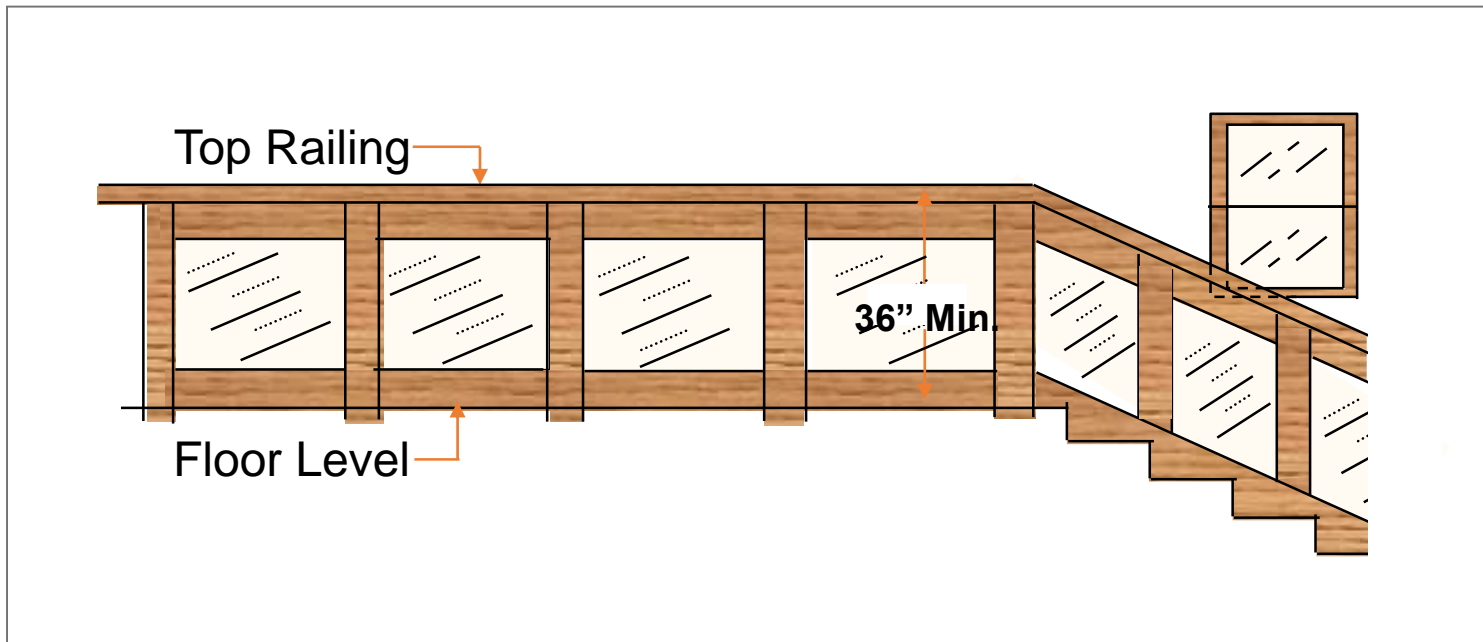
Windows must be tempered if within 24" of door on any side



- \* Glazing in windows – hazardous 308.4.3
  - In individual fixed or operable panel meeting all of the following requirements:
    - Exposed area of individual pane larger than 9 square feet
    - Bottom edge of glazing is <18” above floor
    - Top edge of glazing is >36” above floor
    - One or more walking surfaces are within 36”, measured horizontally and in straight line
    - Exceptions:
      - Decorative glazing
      - Horizontal rail is provided placed on accessible side of glazing 34” to 38” above walking surface
      - Outboard panes in insulating glass  $\geq$ 25’ high



- \* Glazing in guards and railings hazardous **308.4.4**
  - Attached top rail and handrail
  - Supported by not less than 3 glass baluster panels
  - Regardless of area or height above walking surface



\* Glazing and wet surfaces 308.4.5

- Where hazardous:

- Walls or enclosures or fences containing:

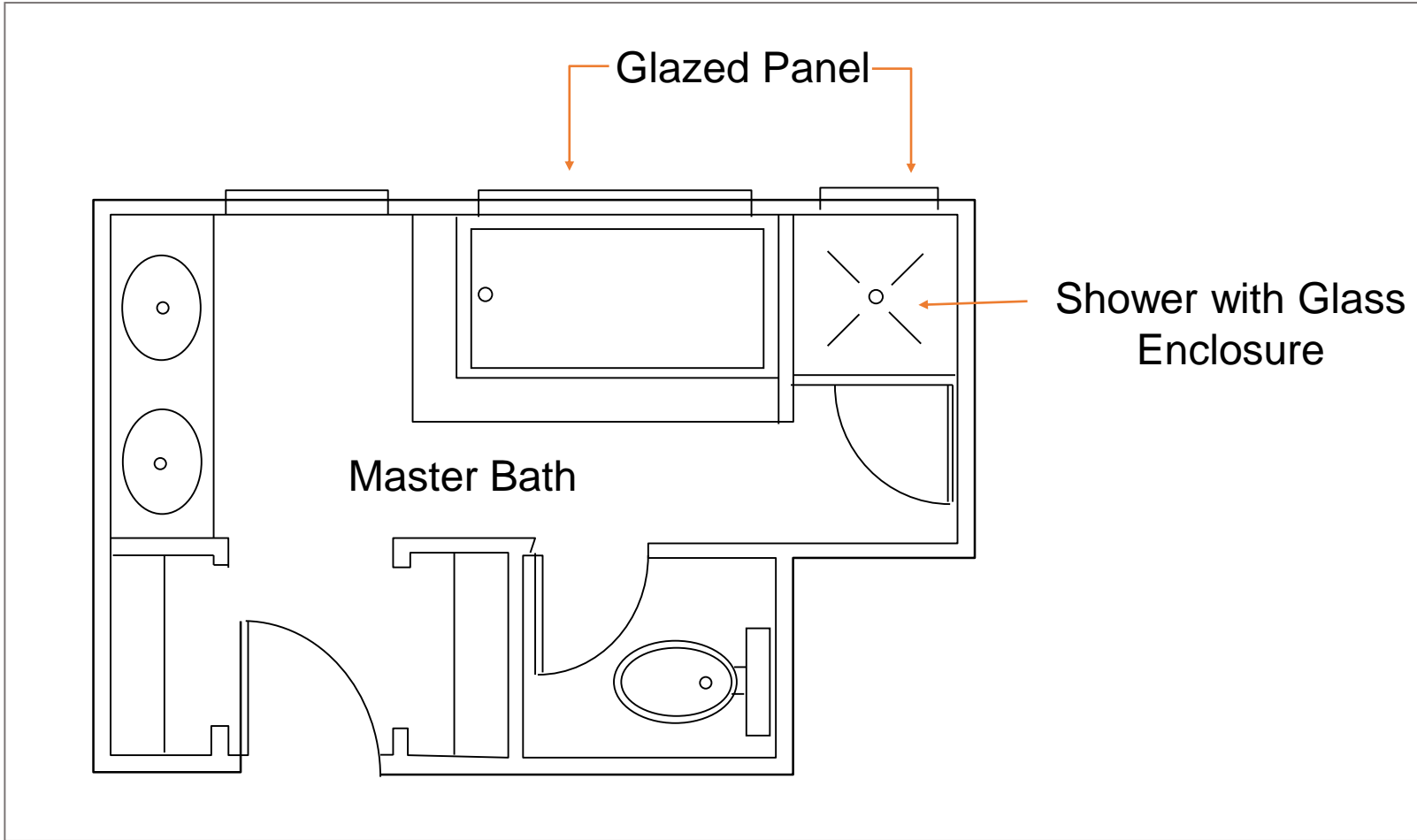
- Hot tubs, spas,
    - Whirlpools, saunas,
    - Steam rooms,
    - Bathtubs, showers,
    - Indoor/outdoor pools



- Where bottom edge of glazing <60” measured vertically above any standing or walking surface

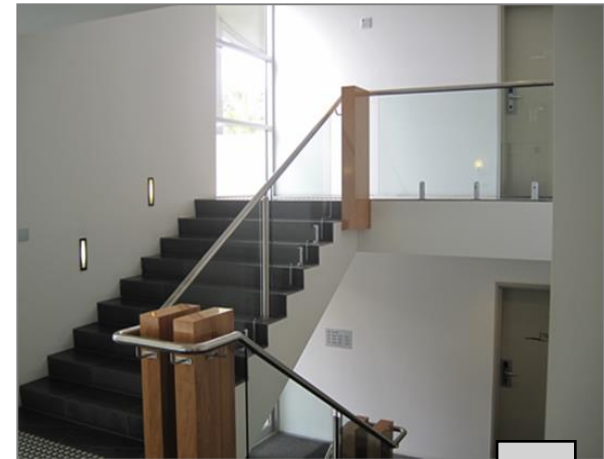
- EXCEPTION: Glazing >60” measured horizontally in straight line from the water’s edge of bathtub, hot tub, spa, whirlpool, or swimming pool

\* Showers and tubs 308.4.5

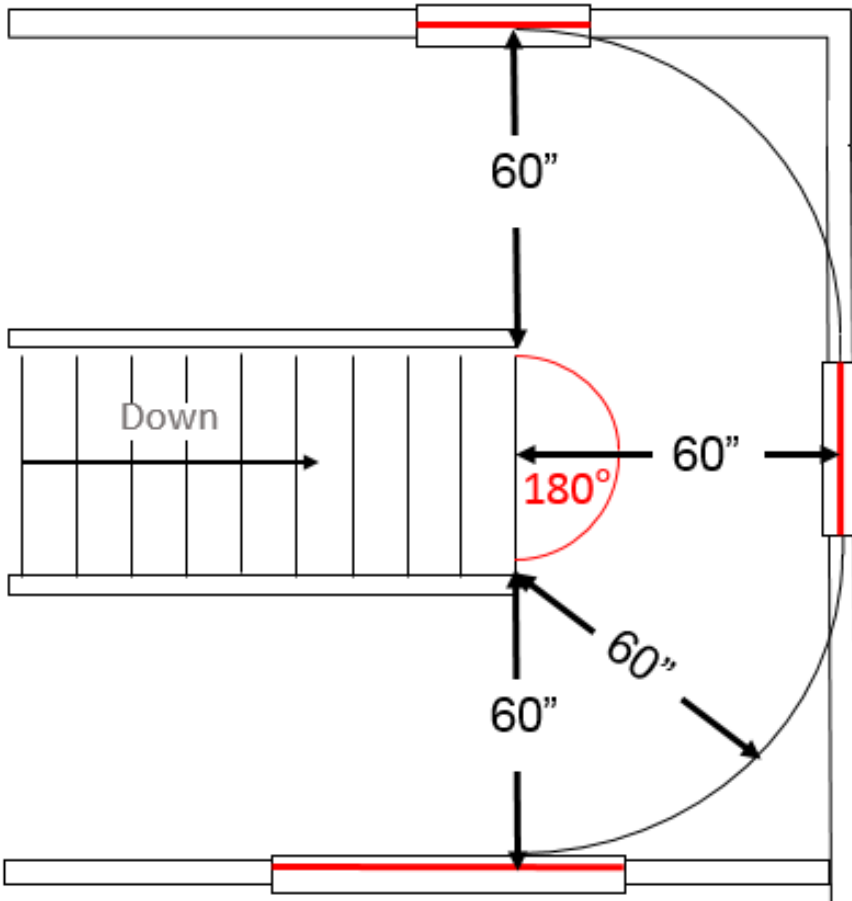


- \* Glazing hazardous adjacent stairs and ramps 308.4.6
  - Exceptions NOT considered hazardous when at the side of stairs if:
    - Rail meeting the loading and dimension requirements is installed at 34” to 38”
    - Bottom exposed edge of glazing not <36” above walking surface of a tread

- \* Glazing hazardous adjacent to bottom of stair landing  
**308.4.7**
  - Adjacent to landing at bottom of stairway where glazing is <36” above landing and within a 60” horizontal arc less than 180 degrees from the bottom tread nosing
  - Exceptions:
    - Glazing protected by guard complying with **R312**
    - Plane of glass >18” from guard



- \* Safety glazing adjacent to bottom stair landing 308.4.7



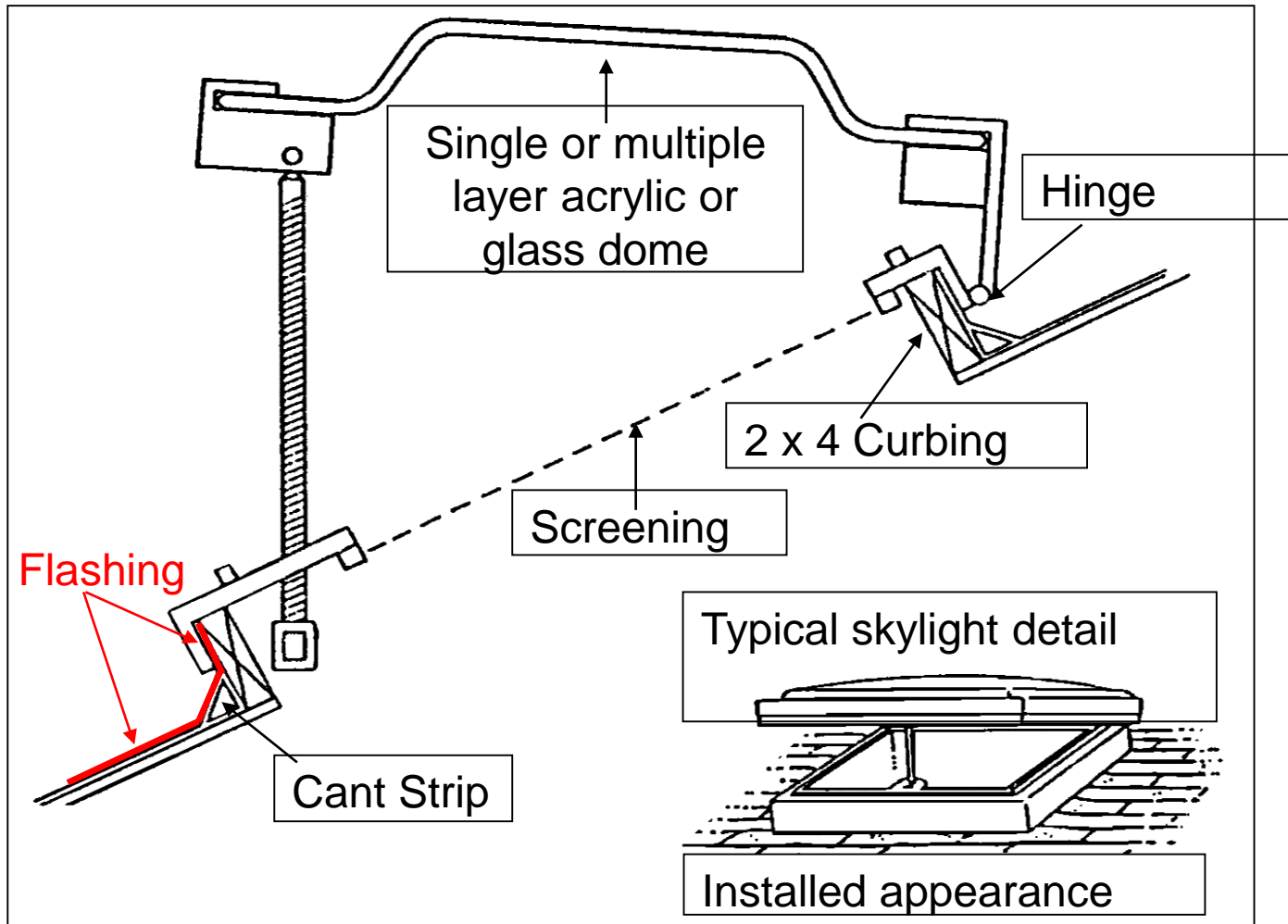
Exposed surface of window glass is hazardous when within:

- 60" horizontally of bottom nosing at 180° arc
- and
- Within 36" of floor

- \* Glass and glazing applications 308.6
  - Glazing materials and installation:
    - Glass in greenhouses 308.6.6
    - Screen characteristics 308.6.7
    - Curbs for skylights on roofs with slope less than 3/12 308.6.8



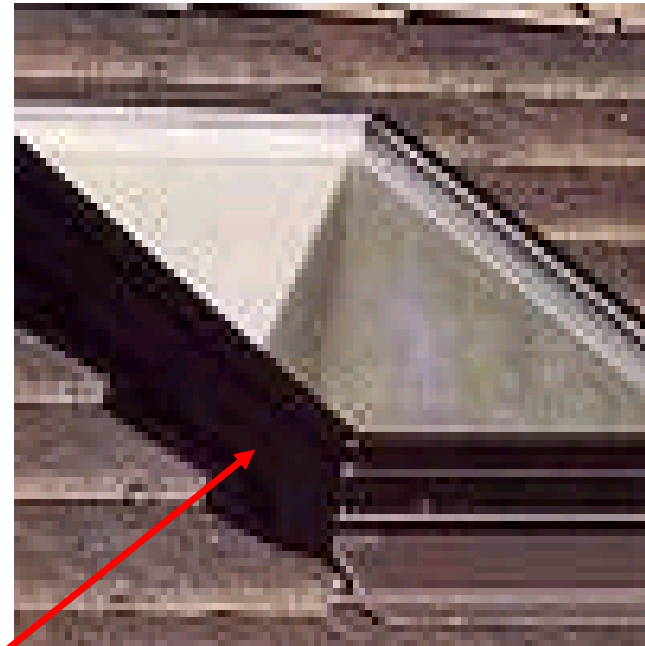
\* Skylights and sloped glazing 308.6





\* Skylights and sloped glazing 308.6

Installed Appearance



Curb extending 4" above roof plane  
on roof flatter than 3 & 12 R308.6.8

## ◆ Garages and Carports 309

- \* Non-combustible floor
- \* Sloped floor to move liquids towards overhead door
- \* Carport open minimum 2 sides
- \* Asphalt floor on carports OK
- \* Openers per **UL 325**
- \* Garage fire sprinklers **309.5**
  - Allow non-fire-rated exterior walls for garages with zero clearance to a lot line. In subdivision where all homes are sprinkled, non-fire-rated exterior walls of garages can be built on a lot line when the garage is sprinkled in addition to requirements of **R302.1**



## ◆ Emergency Escape and Rescue Openings 310

### \* Emergency and escape route required 310.1

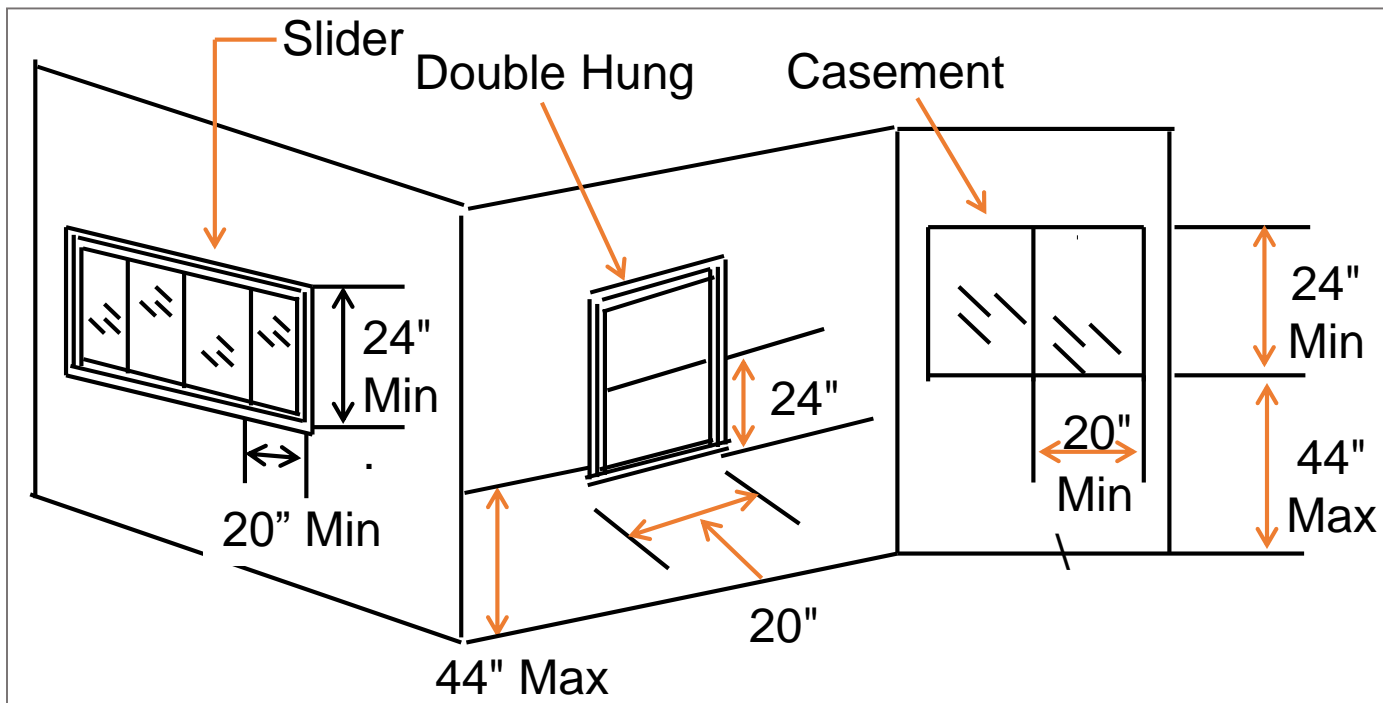
- Basements, habitable attics, every sleeping room
- Exception:
  - if: House is equipped with approved sprinkler system
  - THEN: Emergency escape windows not required in basement sleeping room if:

One emergency escape and one means of egress, or

Two means of egress

- \* Requires emergency escape and rescue openings to open directly into public street, alley, yard or court

- \* Opening size 5.7 square feet minimum
- \* Opening width and height
- \* Sill height



- \* Grade floor window 310.2.1
  - 5 square feet
- \* Emergency escape windows
  - No operational constraints
  - No tools or special knowledge needed

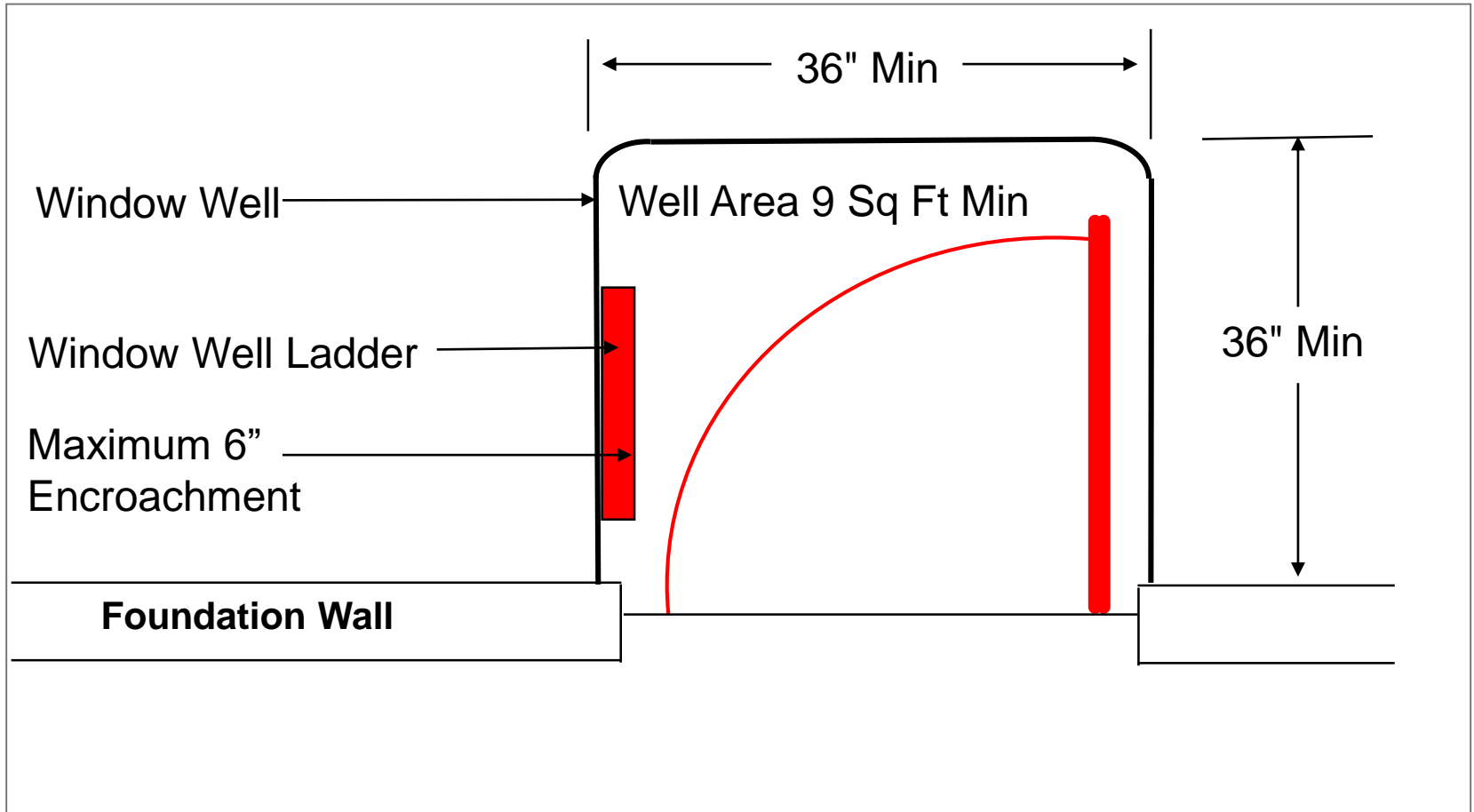
- \* Habitable rooms in basements 310.1
  - Emergency egress and rescue openings required
    - All basement bedrooms



\* Window wells 310.2.3



\* Window wells **310.2.3**





- \* Grade floor window
- \* Emergency escape windows **310.1.4**
  - NO operational constraints
  - NO tools or special knowledge needed
- \* Below grade escape doors **310.3**



\* Window well **310.2.3**

- Ladder or steps required when depth >44" **310.23..1**

- Permanently affixed
- Usable with door or window fully open
- 12" wide rungs:

Project 3" from well wall

Spaced not >18" on center vertically for full height of well

\* Window well drainage **310.2.3.2**

- Direct surface water to foundation drainage system

\* Window wells 310.2.3



\* Window wells 310.2.3



\* Window wells 310.2.3

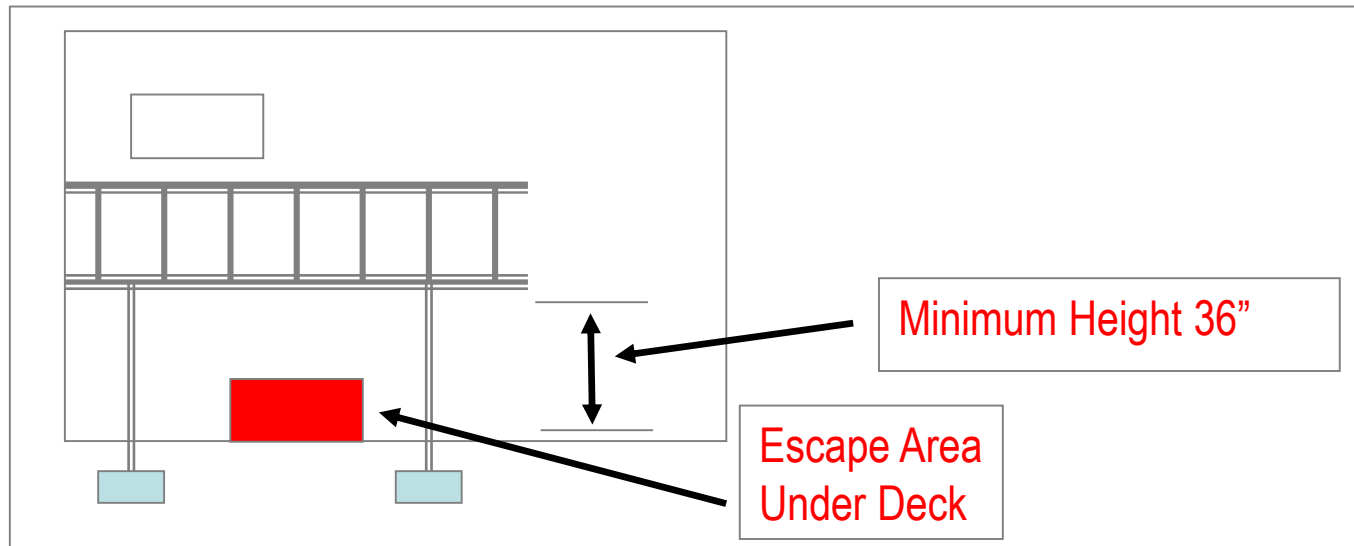


\* Emergency escape windows under decks and porches  
310.2.4

– OK IF:

Escape window can be fully opened

Provides a path not <36" in height to adjacent yard or court escape area



\* Replacement window 310.2.5

- Exempt from size and height requirements
  - Largest size that will fit in existing opening
  - Same style or
  - Style with larger opening
  - Not part of a change of occupancy

## ◆ Emergency escape and rescue doors 310.3

- \* Same dimensional requirements as a window
- \* Area well minimum width 36"
- \* Same ladder requirements
- \* Drainage requirements
  - Ladder or steps required
  - Ladder same as a window well
  - No specific step dimensions



- ◆ Bars, grilles, and screens 310.4
  - \* Cannot require use of a key, tools or special knowledge
  - \* Maintain minimum clear width
  - \* Emergency escape windows under decks and porches 310.45
  - \* OK if:
    - Escape window can be fully opened

◆ Additions 310.5

- \* Contain bedrooms
- \* Escape windows required

◆ Alterations or repairs to existing basements 310.6

- \* Escape windows not required
- \* If bedrooms added escape windows are required

## ◆ Means of Egress 311

- \* Stairs, ramps, exterior exit balconies, hallways & doors, handrails
- \* Exterior exit balconies, stairs & similar exit facilities positively attached to primary structure
- \* Additional requirement in section 502.2
- \* Hallways 311.6
- \* 3' minimum width

\* Floor elevations at required egress doors 311.3.1



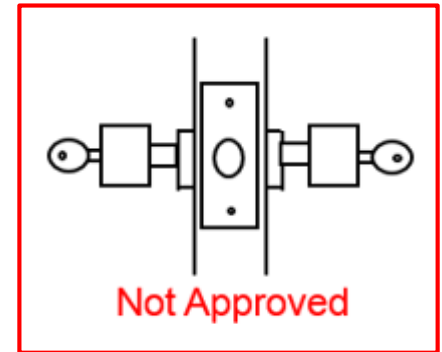
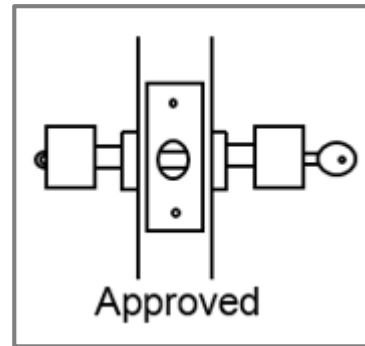
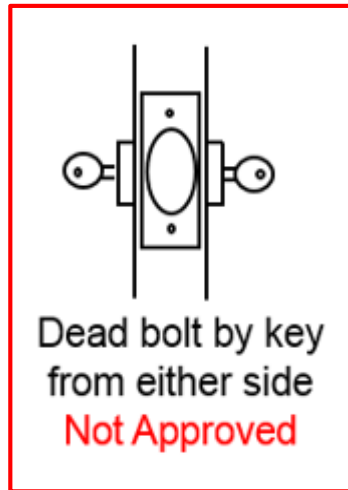
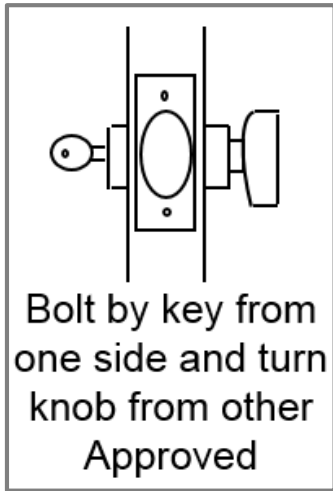
- \* Egress door **311.2**
  - One (1) required per unit
  - Side hinged
  - Minimum clear width 32”
  - Minimum clear height 78”
  - Not allowed through garage
  - Open from inside with no tools or special knowledge
  - Garages require a side hinged door – door through unit can be used
    - 2 feet 6 inches wide – 6 feet 8 inches clear height



- e



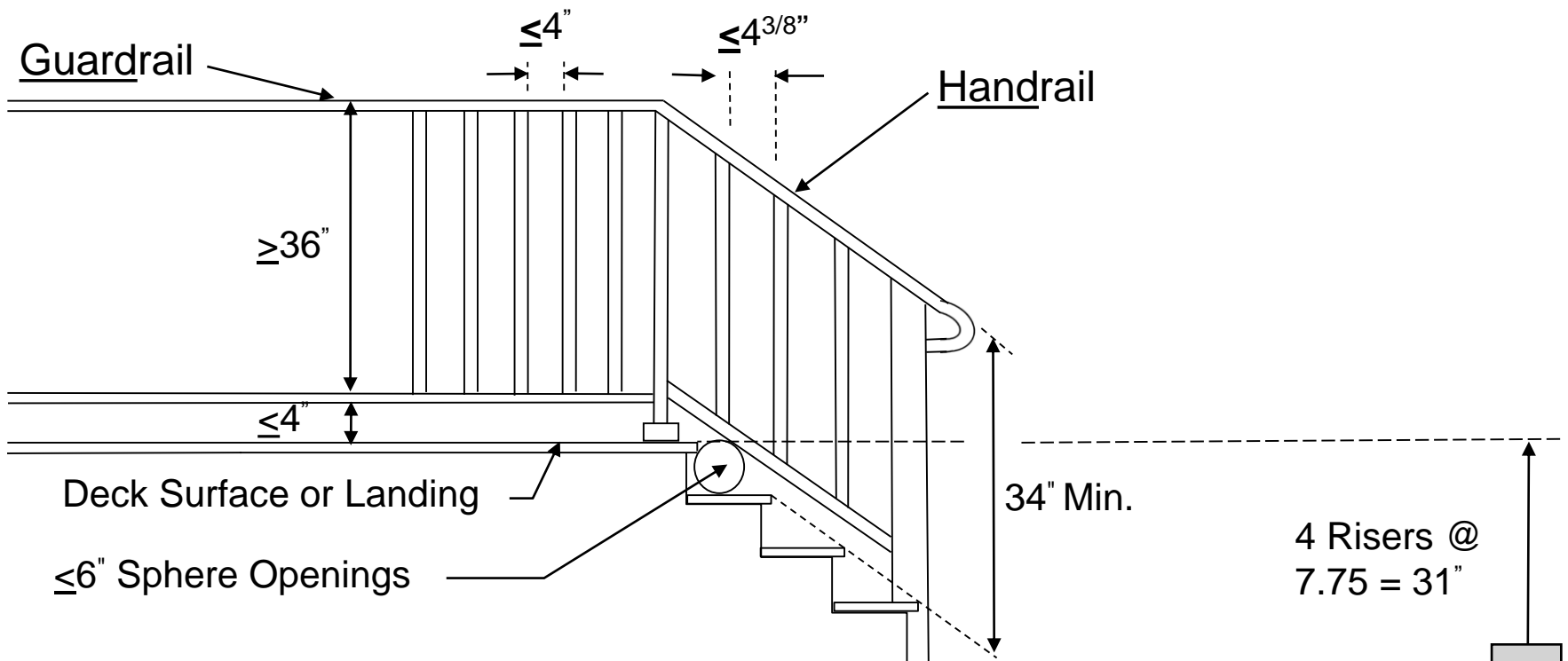
- \* Egress door type of lock or latch **311.2**
  - Openable from egress side without use of a key or special knowledge or effort



- \* Floor and landings at exterior doors **311.3**
  - Size required and where
  - Width of door served
  - 36" minimum out in direction of travel
  - On each side of door

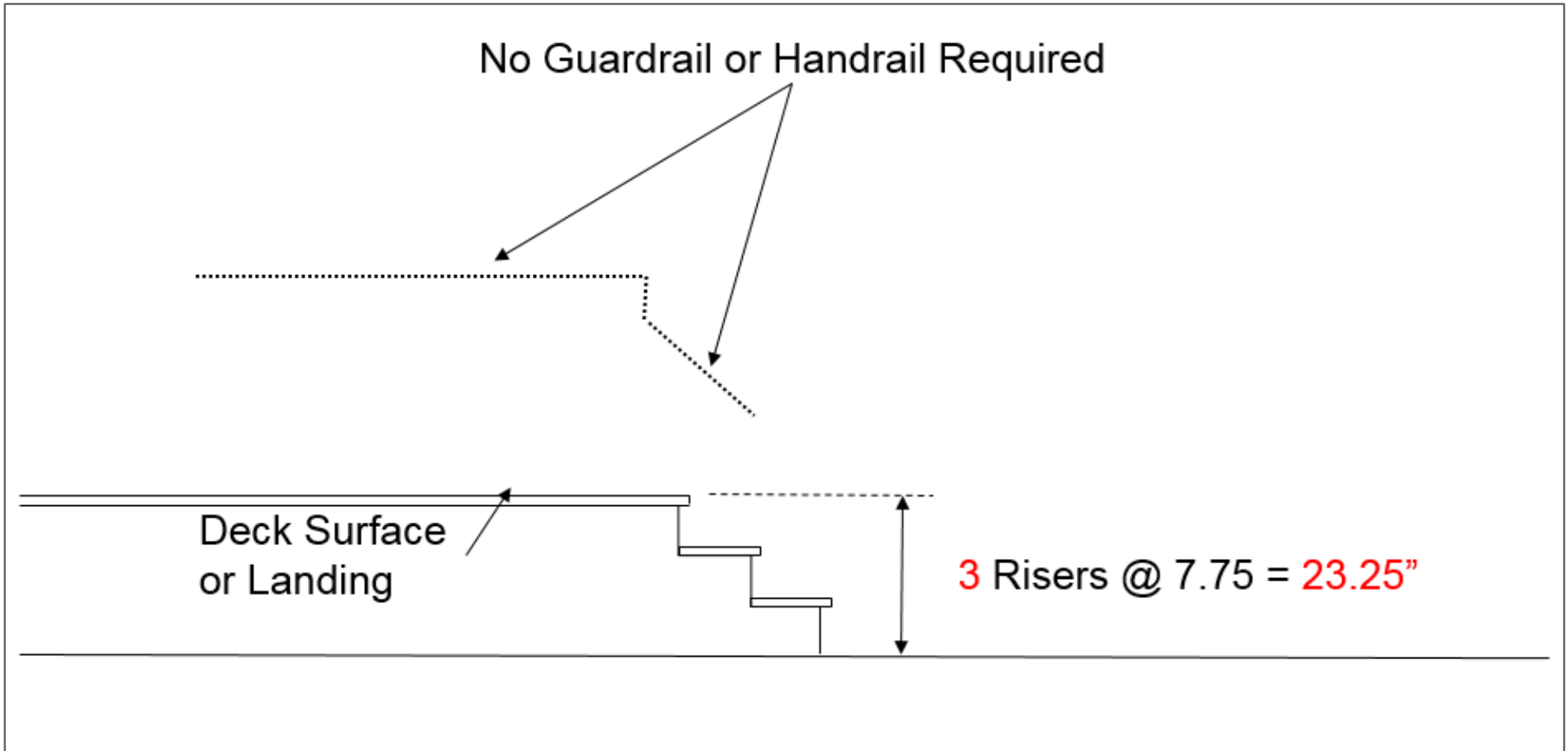


- \* Handrails – where required **311.7.8**
  - Open sided walking surfaces
  - Measured more than 30" from grade
  - At any point within 36" to edge of open side





- \* No guardrail or handrail required **311.7.8 & 312.1.1**

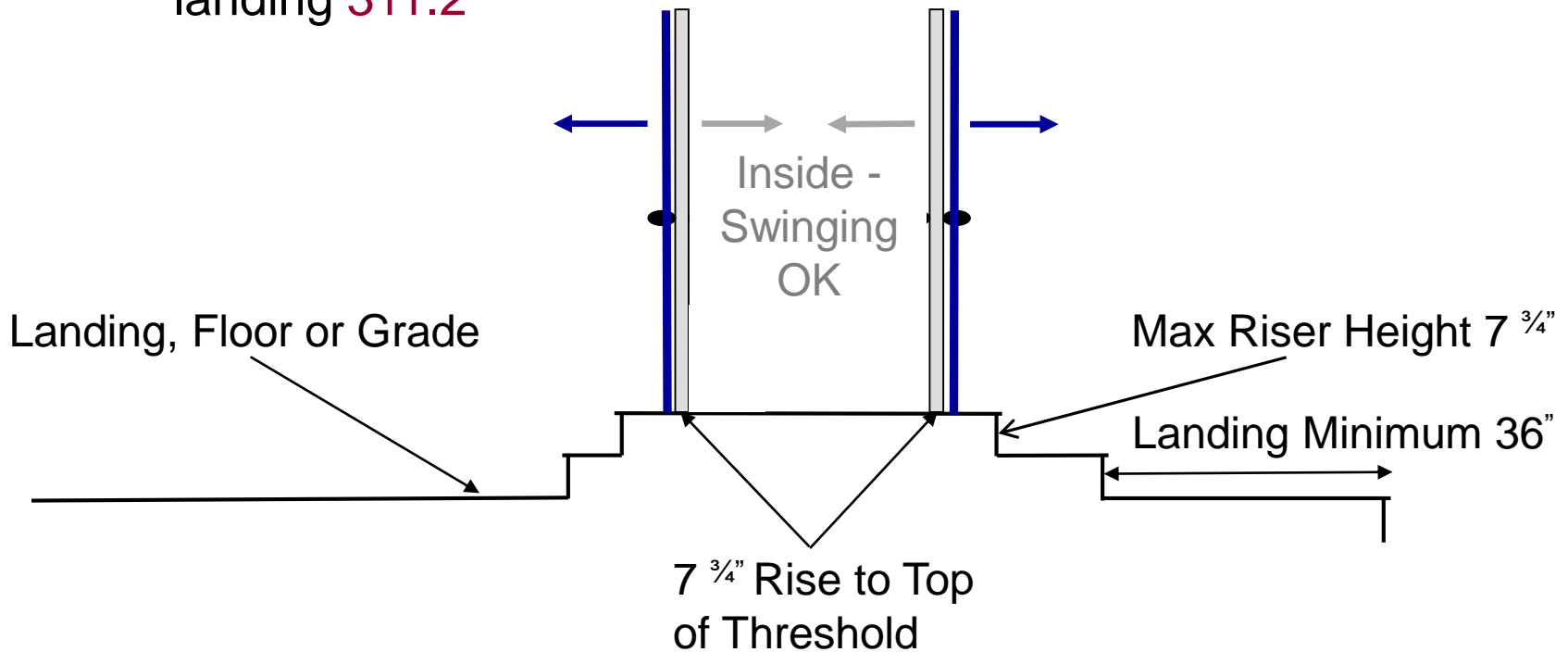


- \* Floor elevations at exterior doors **311.3.1**
  - 1 step down landing at required egress door OK **311.3.1**
  - 2 step entry OK at other exterior doors **311.3.2**

Does this stair require a handrail?



- \* Swinging egress doors may NOT swing out over stair or landing **311.2**



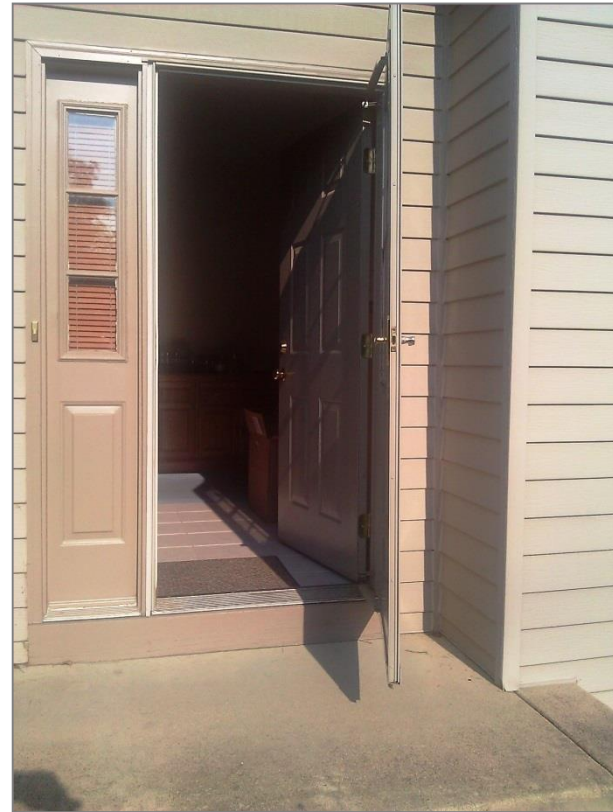
- \* Screen and storm doors may swing over all exterior stairs and landings **311.3.3**

\* Exceptions to 311.3.2

7 <sup>3</sup>/<sub>4</sub>" max below top of threshold  
if egress door does not swing  
over landing 311.3.1



Storm/Screen door may  
swing over landing 311.3.3



- \* Floors and landings at exterior doors **311.3**



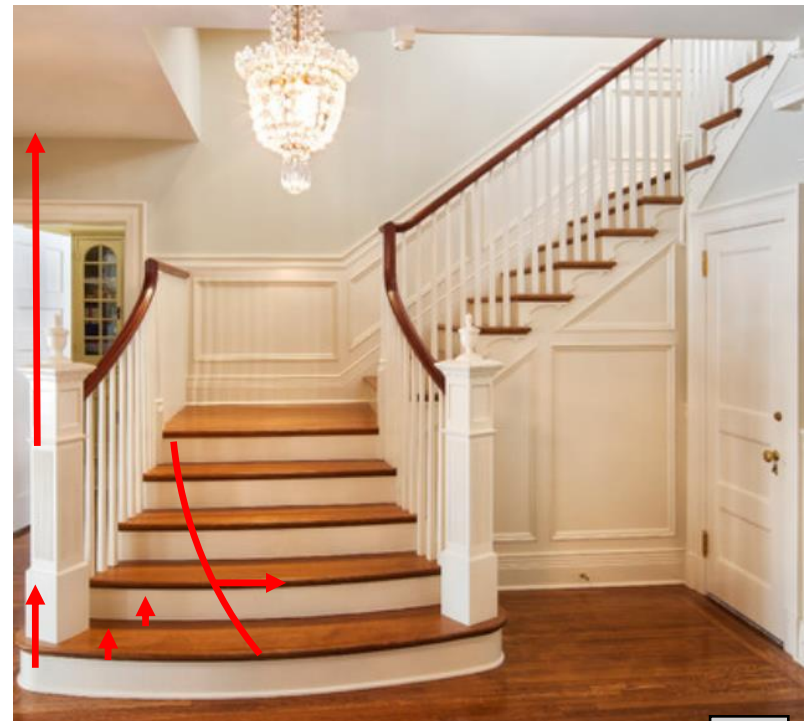
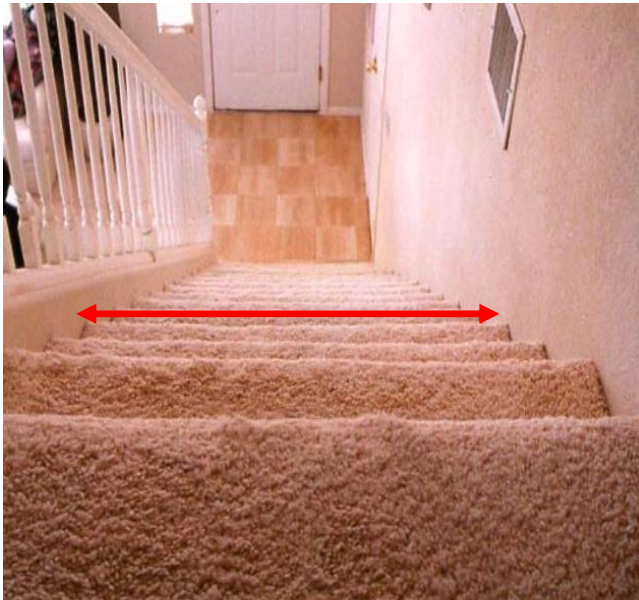
*Photo courtesy of Artistic Railings,  
Inc. Garfield, New Jersey*

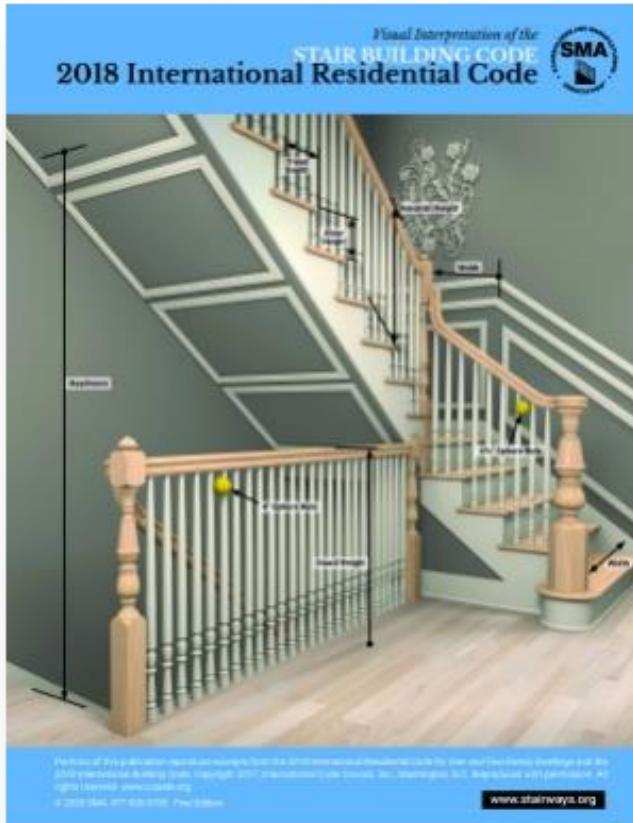
- \* Vertical egress **311.4**
  - Stair or ramp
  - Properly attached
    - Support vertical load
    - No nails used to support load
  
- \* Hallways **311.6**
  - Minimum width 3'



\* Stairways 311.7

- Width – 36” 311.7.1
- Headroom – 6’ 8” 311.7.2
- Vertical rise – max 151” 311.7.3
- Walkline 311.7.4
- Treads and risers 311.7.5





**THE MISSION OF THE SMA IS:**

To be the Greatest Resource of Knowledge and Tools Contributing to the Success of our Members and the Stair Industry

The Stairbuilders and Manufacturers Association is dedicated to the prospect that safety and aesthetics, with respect to stairs, are not mutually exclusive.

The SMA is a broad based industry association founded in 1988. Our members include stair builders, stair parts manufacturers, installers, millwork distributors, dealers and interested building products professionals. We are an industry organization run by industry people. Our primary focus is to serve the Stair Industry.

Because the SMA represents the people who build, install and sell stair parts and stairways in this country, it is our purpose to defend, test, evaluate and promote products and standards that insure safety in conjunction with the growth and prosperity of our industry. For more information about the association or becoming a member visit our website, write, call, or [Click Here](#).

The Stairbuilders and  
Manufacturers Association  
Toll Free: 877-500-5759  
Website: [www.stairways.org](http://www.stairways.org)  
Email: [SMA@stairways.org](mailto:SMA@stairways.org)



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**Reference the Stairbuilders & Manufacturers Association™ Visual Interpretation**

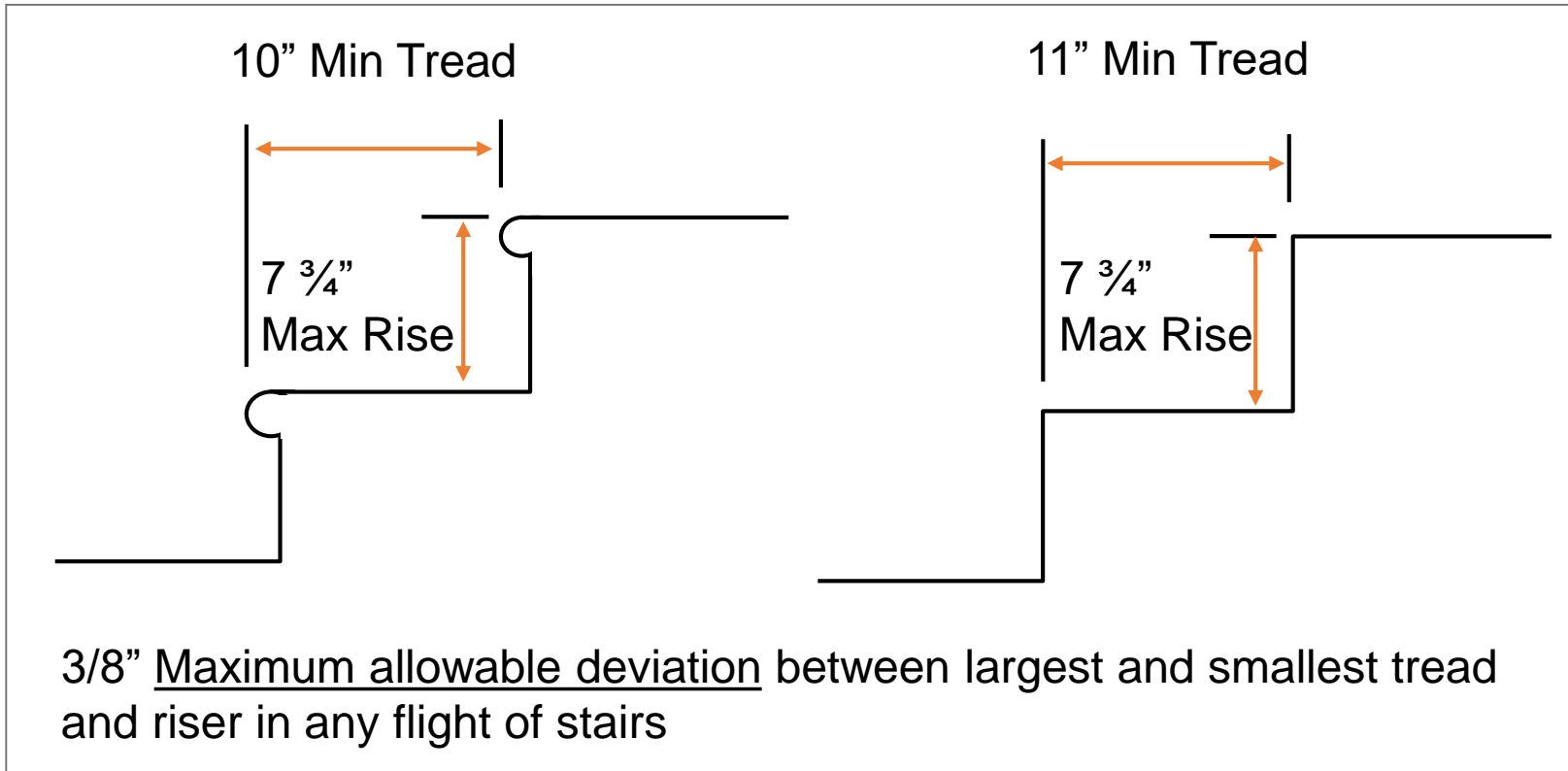
**877-500-5759**



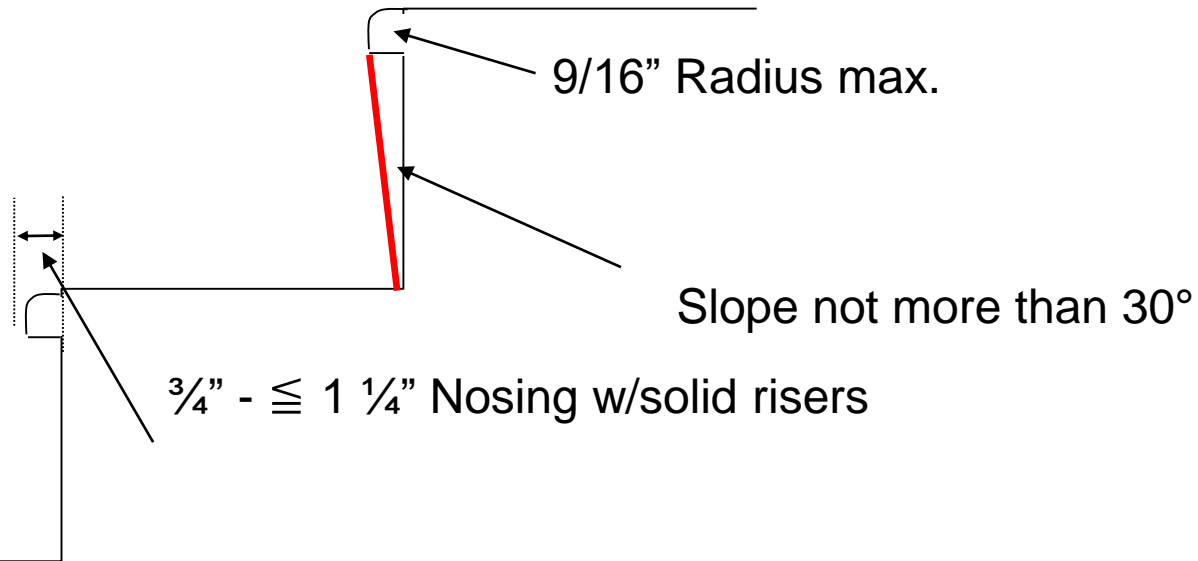
- \* Vertical rise (stairway) **311.7.3**
  - Increased to max 151”



\* Stair Treads & Risers 311.7.5

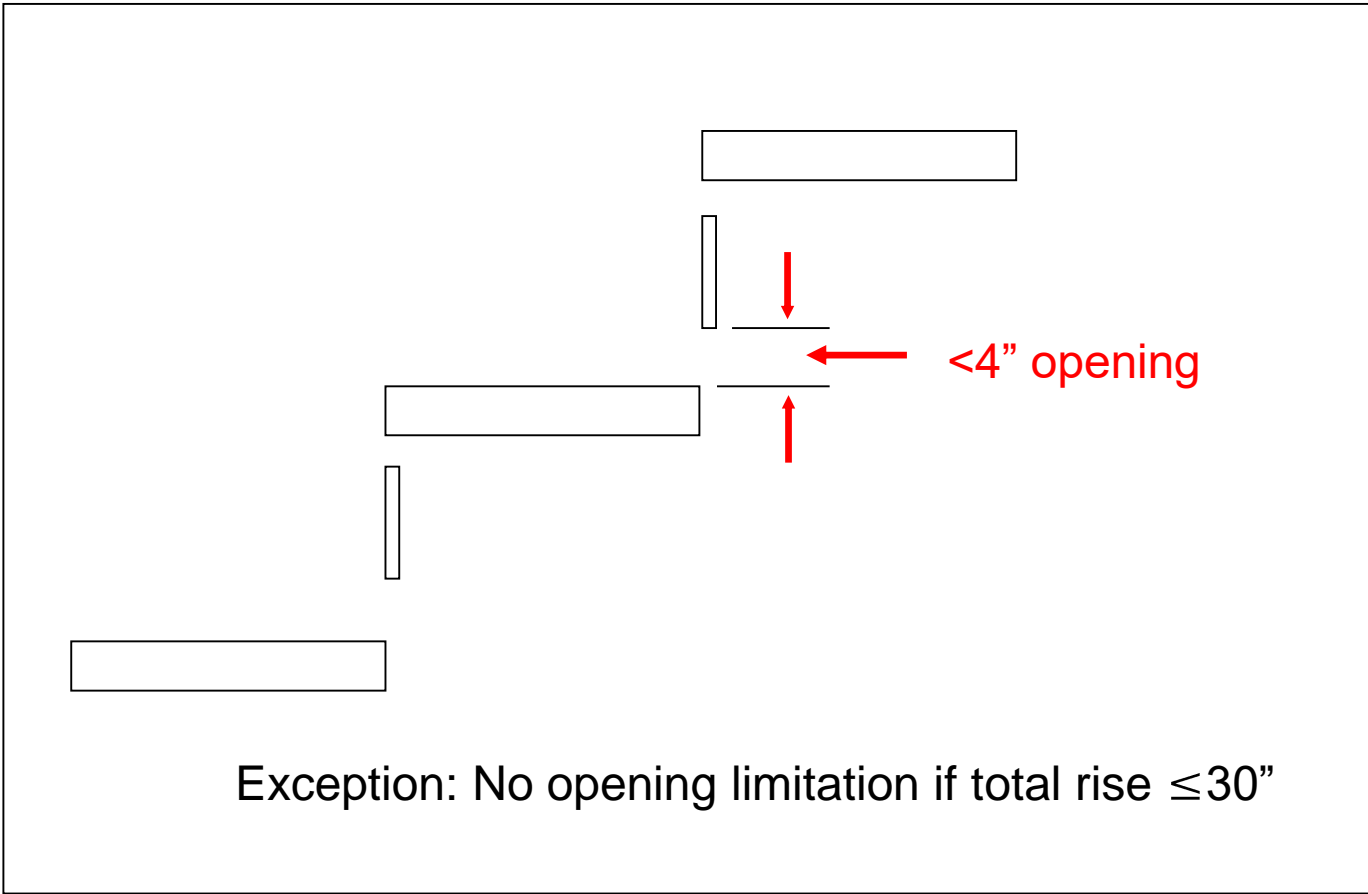


\* Nosings 311.7.5.3

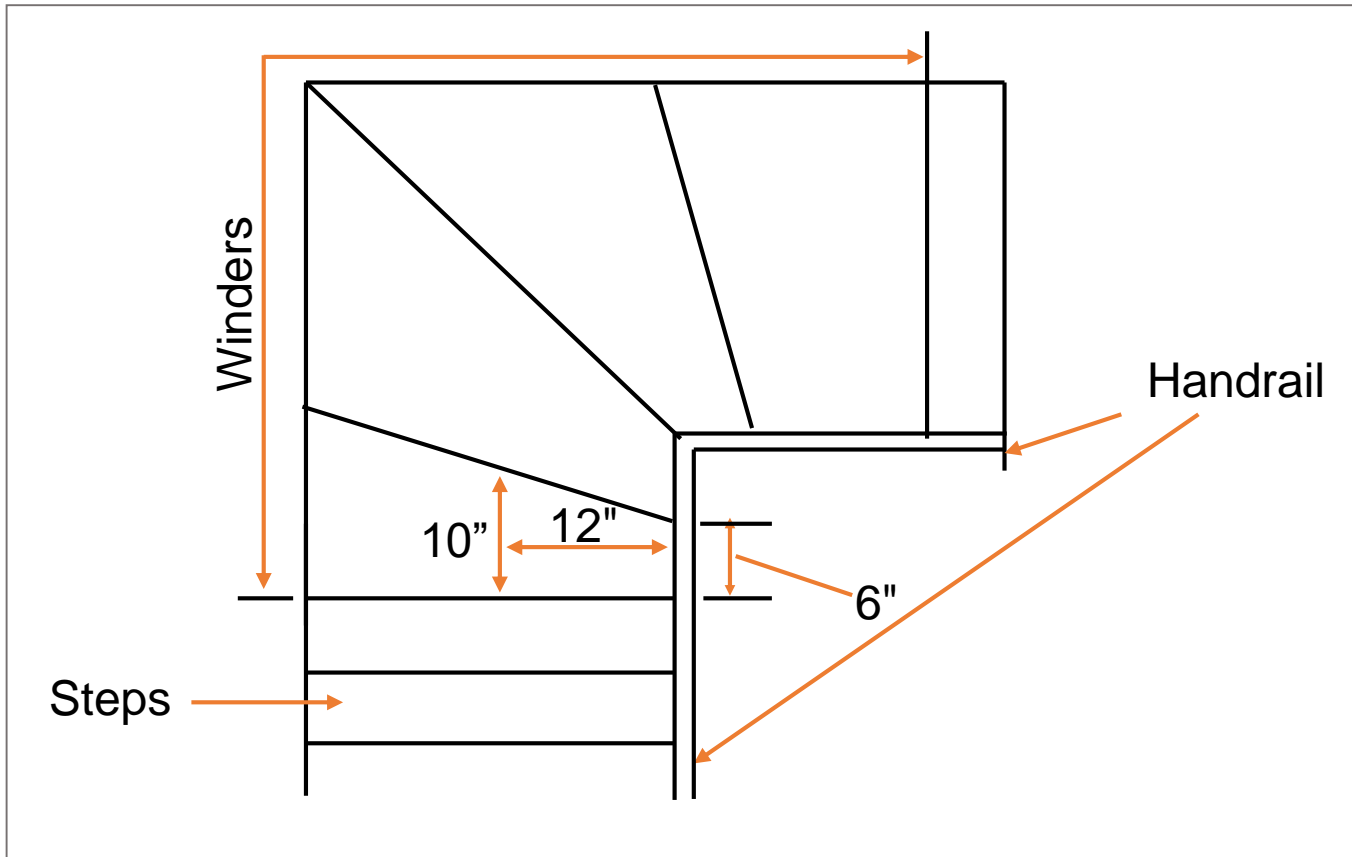


Exception: Nosing is not required when tread is at least 11"  
Note on profile: Risers vertical or sloped not more than 30 degrees

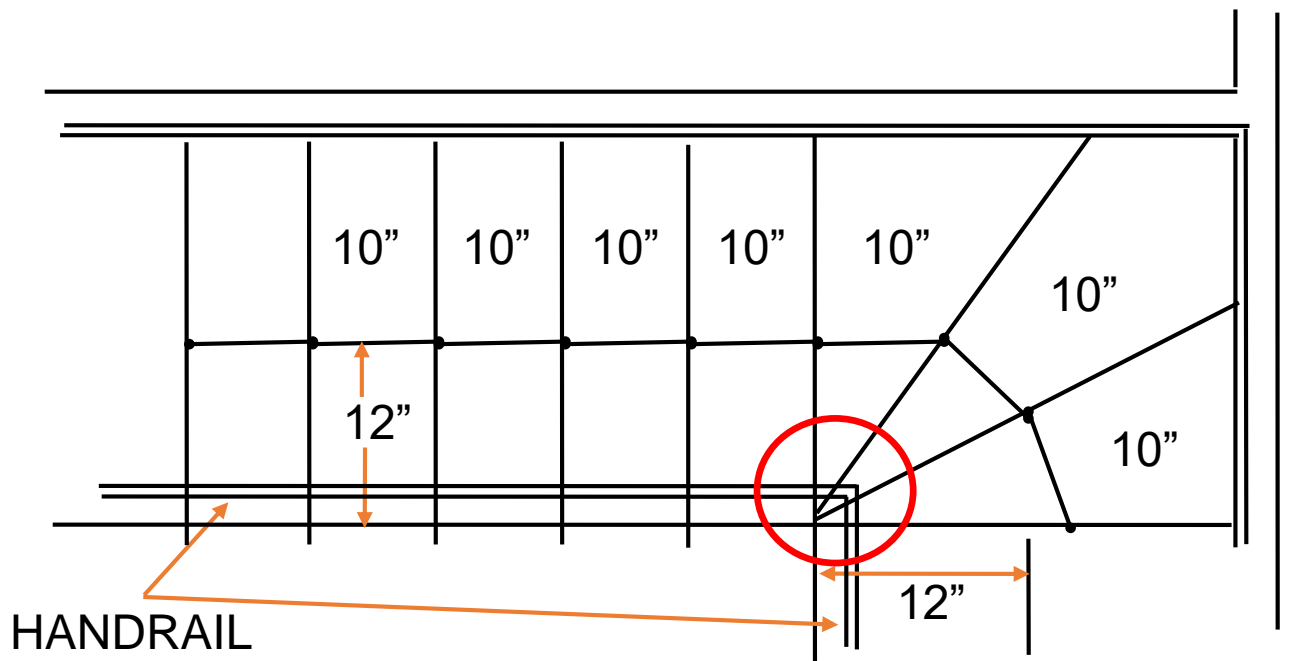
\* Open Risers 311.7.5.1



\* Winders 311.7.5.2.1



\* Winders 311.7.5.2.1



**Incorrectly constructed winders.** Note lack of minimum required tread width!

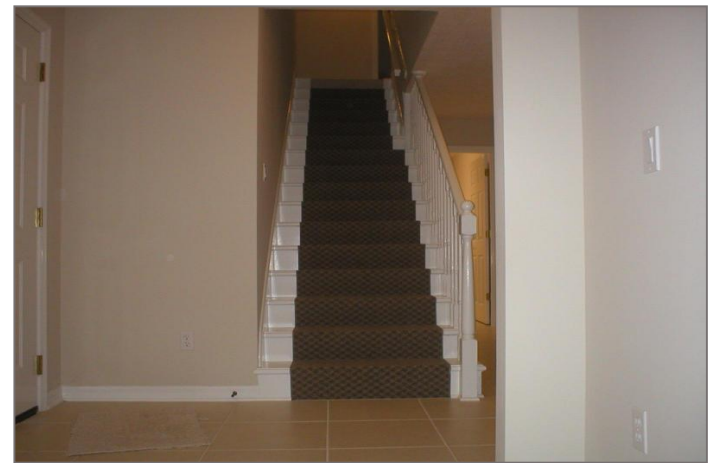
Not minimum 6" treads

- \* Landings for stairways **311.7.6**
  - Landing at top and bottom of each stair
  - Exception: Not required at top of interior stair if door doesn't swing over stair
  - Landing size:
    - Width of stair served
    - 36" min. in direction of travel
  - Permits shapes other than square or rectangular landings. Angular or curved may be less than 36" in the direction of travel with additional criteria **311.7.6**



- \* Is this stair code compliant?
  - No. Where is the handrail?

- \* Stairway walking surface maximum slope 1:48 (1/4" per foot) **311.7.7**





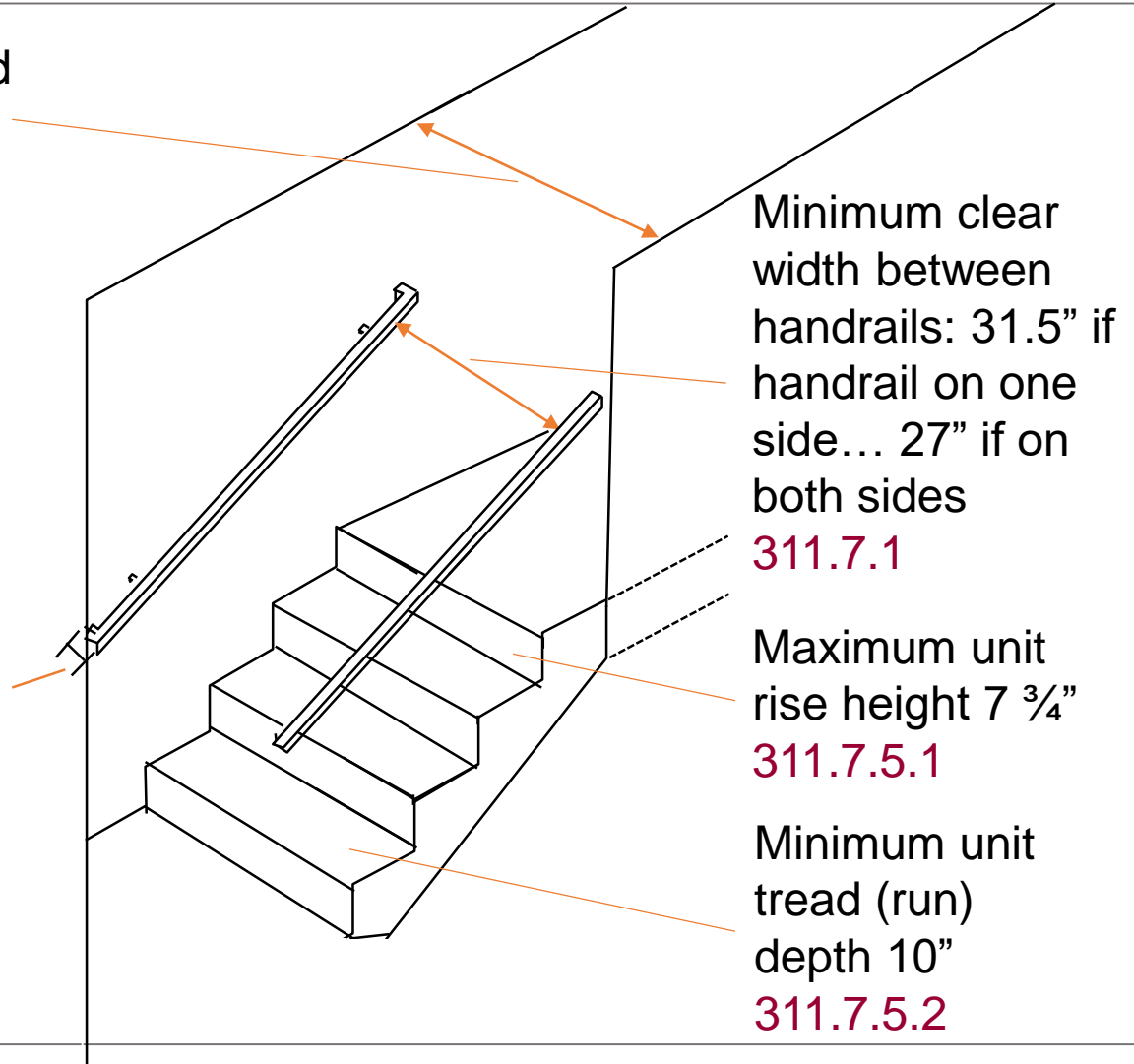
\* Handrails 311.7.8



\* Handrails 311.7

Minimum clear finished  
stairwell width 36"  
R311.7.1

Maximum projection of  
handrail from finished  
wall: 4.5" 311.7.8.2



Minimum clear  
width between  
handrails: 31.5" if  
handrail on one  
side... 27" if on  
both sides  
311.7.1

Maximum unit  
rise height  $7 \frac{3}{4}$ "  
311.7.5.1

Minimum unit  
tread (run)  
depth 10"  
311.7.5.2

\* Handrails 311.7.8

- Continuous at least one side
- Ok if termination is over one tread and no more than 4 inches
- Height: 34" - 38" above nosing
- Return to wall
- Maximum projection into stair 4-1/2" - 6-1/2" at landing nosings
- Handrail heights do not apply to fittings or bendings

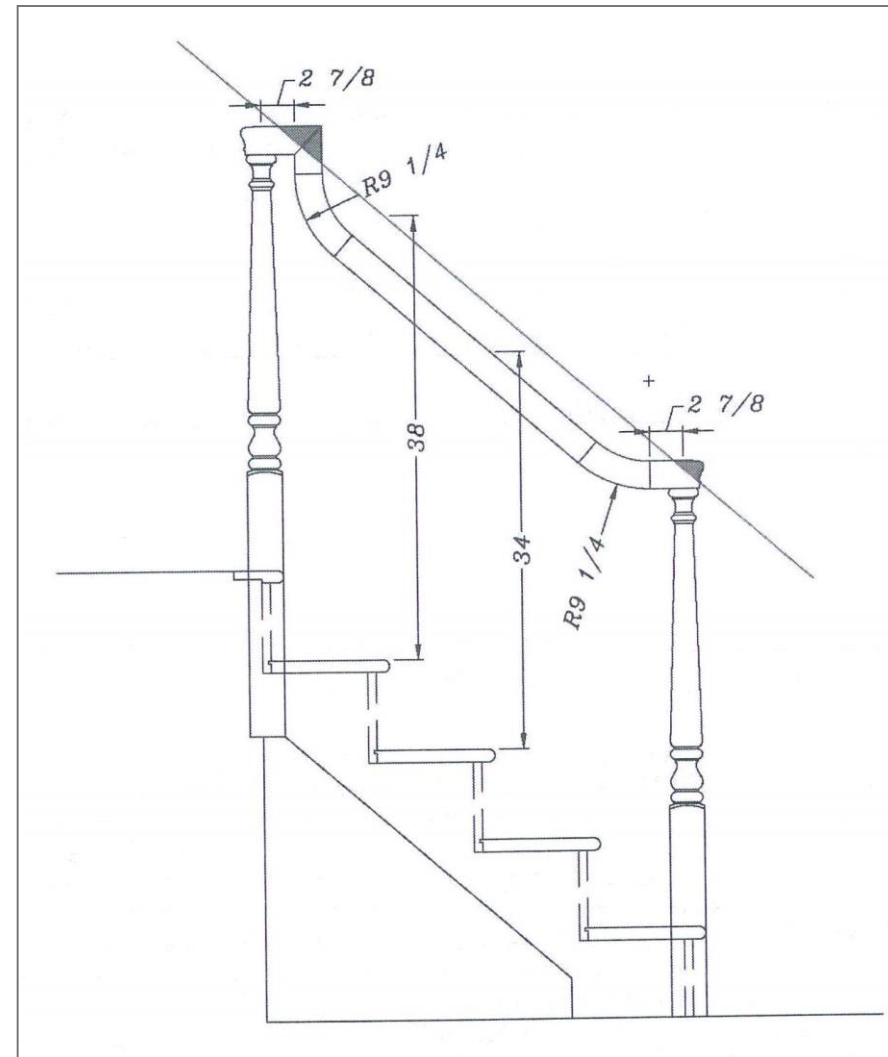
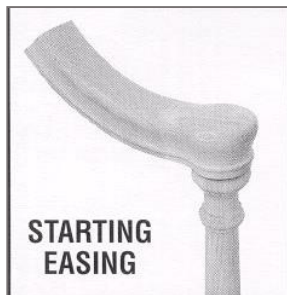
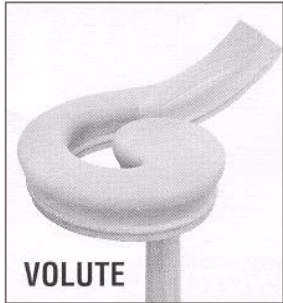


Image used by permission of the Stair Manufacturers Association

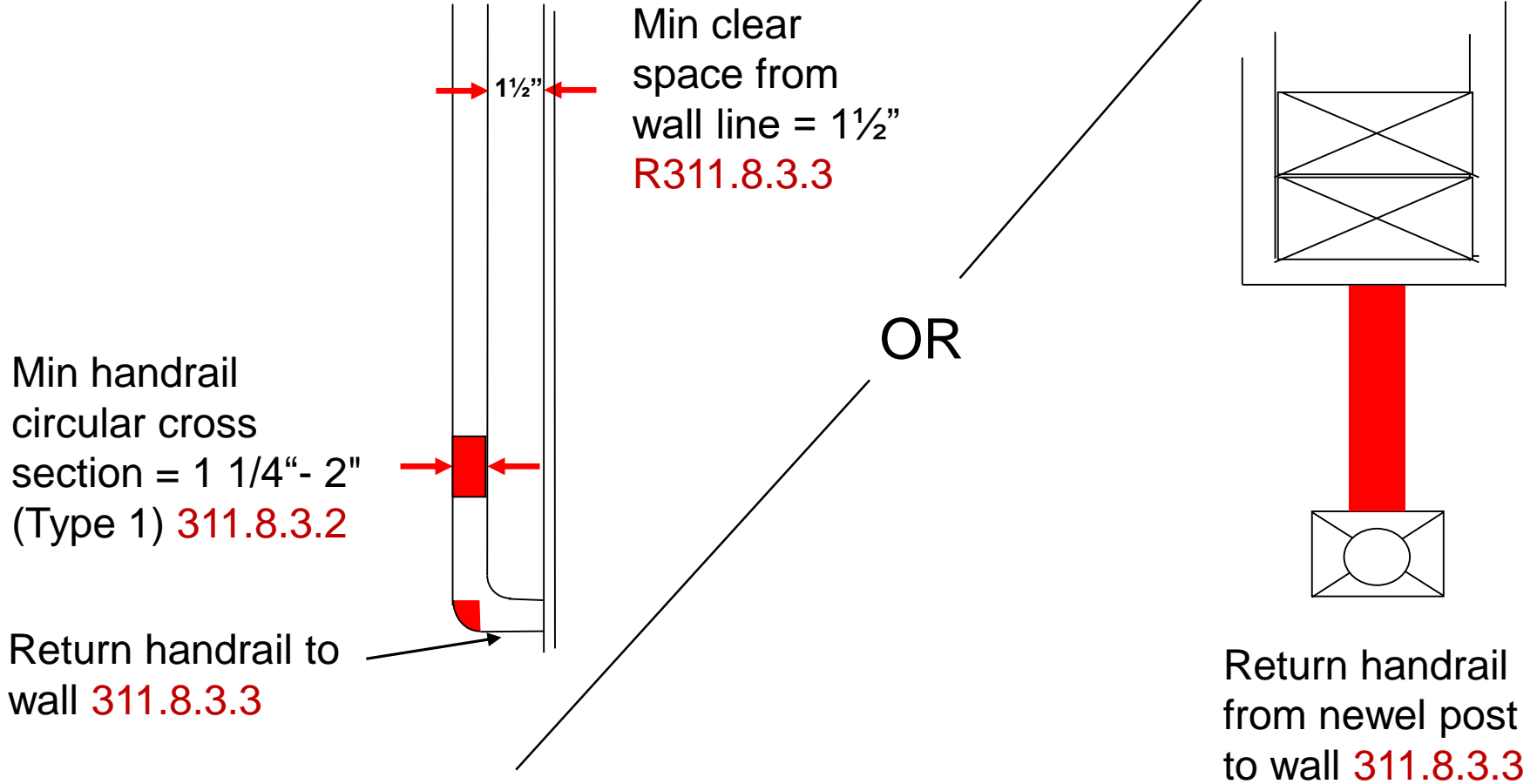
- \* Height exception – volute **311.7.8.1**



Volutes, turnouts & starting easings are allowed over the lowest tread

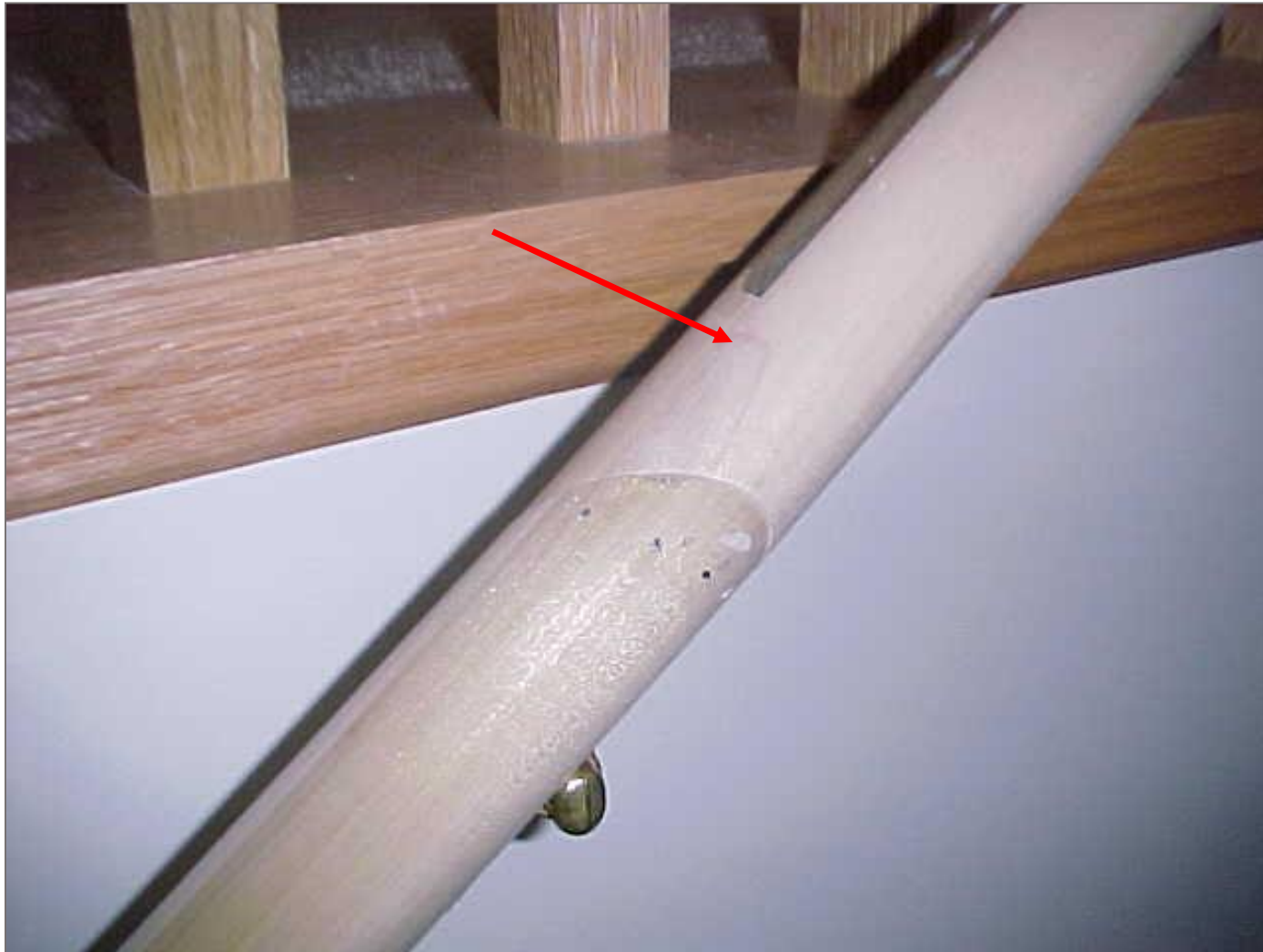


\* Handrails 311.7.8



Plan View (NTS)

\* Handrails 311.7.8





\* Handrails 311.7.8



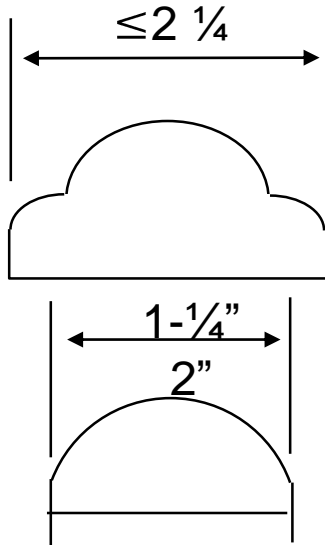
\* Handrails 311.7.8



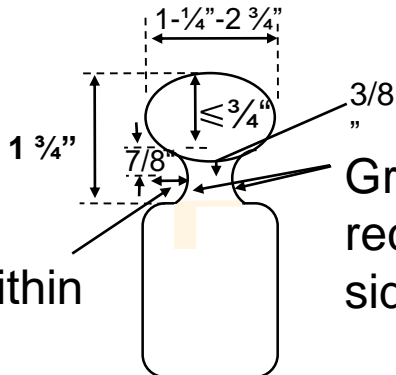


- \* Handrail grip size **311.7.8.3**
  - Must have “graspability”
    - Type 1: Circular cross section 1- $\frac{1}{4}$ ” - 2”
    - Non-circular perimeter of  $\geq 4$ ” to  $\leq 6\text{-}\frac{1}{4}$ ” with maximum cross section dimension of 2- $\frac{1}{4}$ ”
    - Type 2: Perimeter  $> 6\text{-}\frac{1}{4}$ ” with grasping requirements

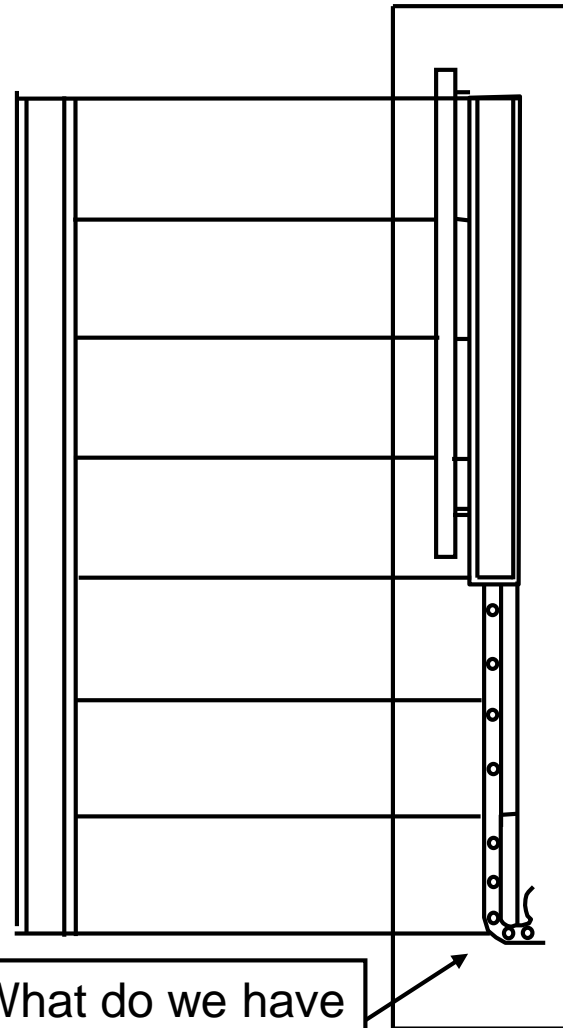
\* Grip size **311.7.8.3**



Perimeter  
not greater  
than 6 1/4"

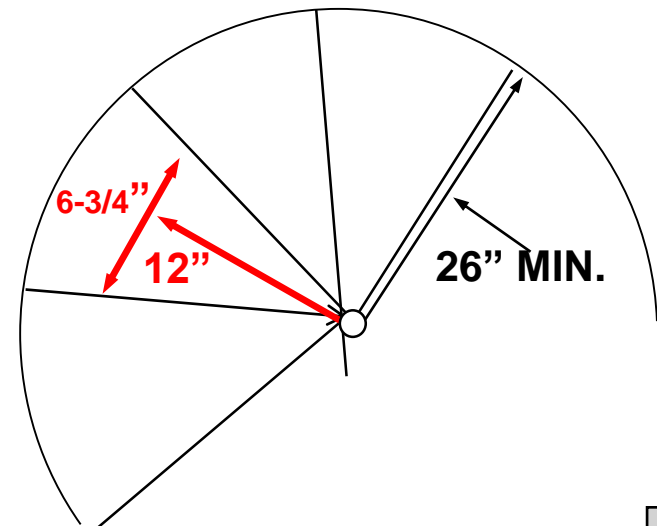


Graspable finger  
recess area on both  
sides



What do we have  
to do here?  
**311.8.3.3**

- \* Illumination at stairs **311.7.9**
- \* Special stairs **311.7.10**
- \* Spiral stairs **311.7.10.1**
  - Treads depth 6-3/4" at 12" from narrow edge
  - Identical rise no greater than 9-1/2"
  - Headroom minimum 6' 6"



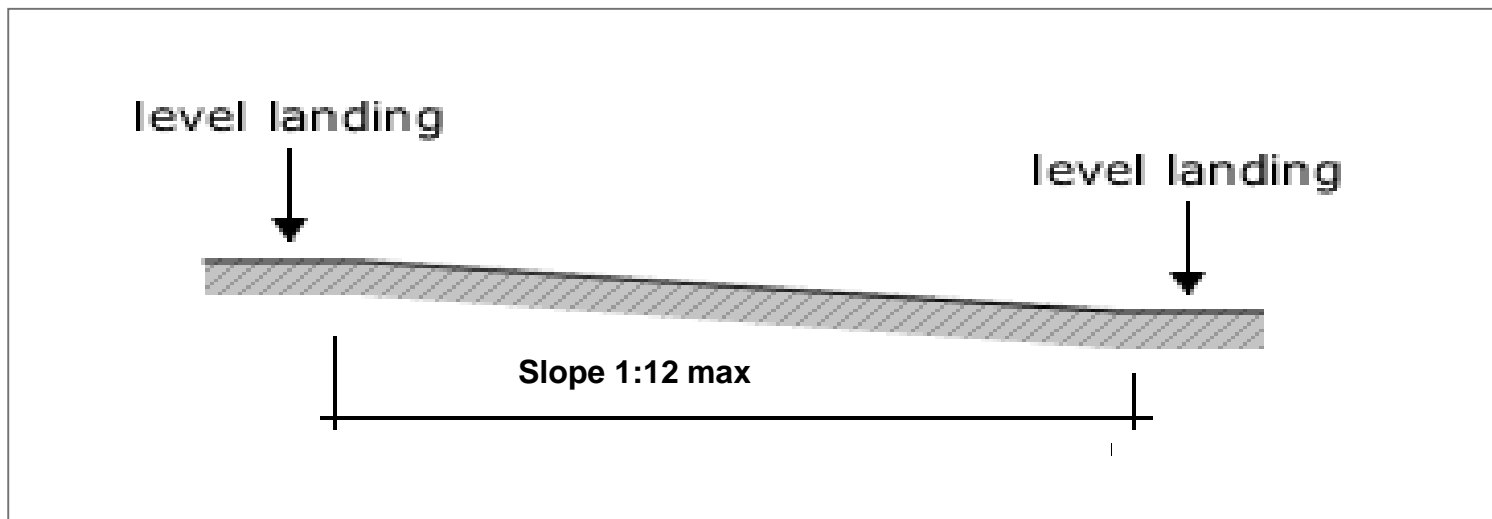
- \* Bulkhead enclosure stairs **311.7.10.2**
  - Not part of required building egress
  - Max  $\leq 8'$  from basement floor to grade
  - Exempt from:
    - Landings at doors
    - Stair widths
    - Headroom
    - Tread and riser sizes
    - Nosing profile
    - Landings for stairs
    - Walking surface
    - Handrails
    - Illumination



- \* Alternating tread devices and ladders **311.7.11**, **311.7.12**
  - Can be used for egress
    - Lofts, mezzanines less than 200 square feet
    - Not exclusive to bathrooms or kitchens



- \* Ramps – maximum slope **311.8.1**
  - Max slope 1 unit vertical in 12 units horizontal (1:12)
  - Exception: When it is technically infeasible to comply because of site constraints, max slope can be 1 unit vertical in 8 units horizontal (1:8)



- \* Ramps – maximum slope **311.8.1**
  - Max slope 1:12



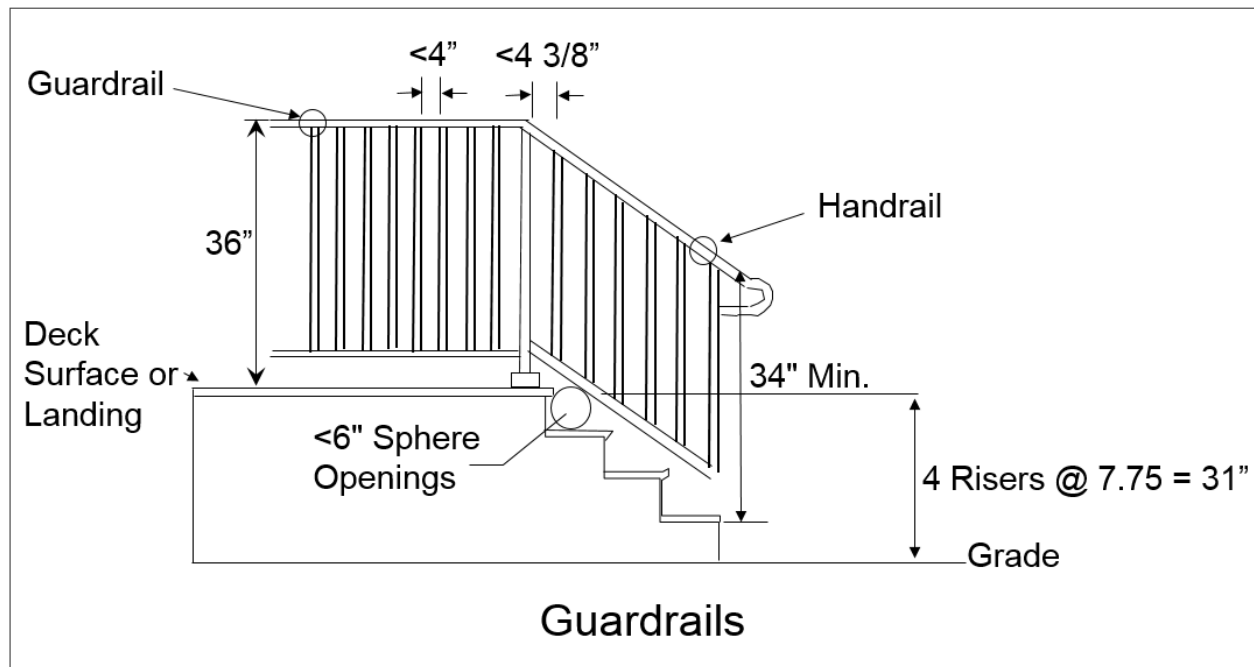
- Exception: where technically infeasible, 1:8 OK

Is 1:12 technically infeasible here?



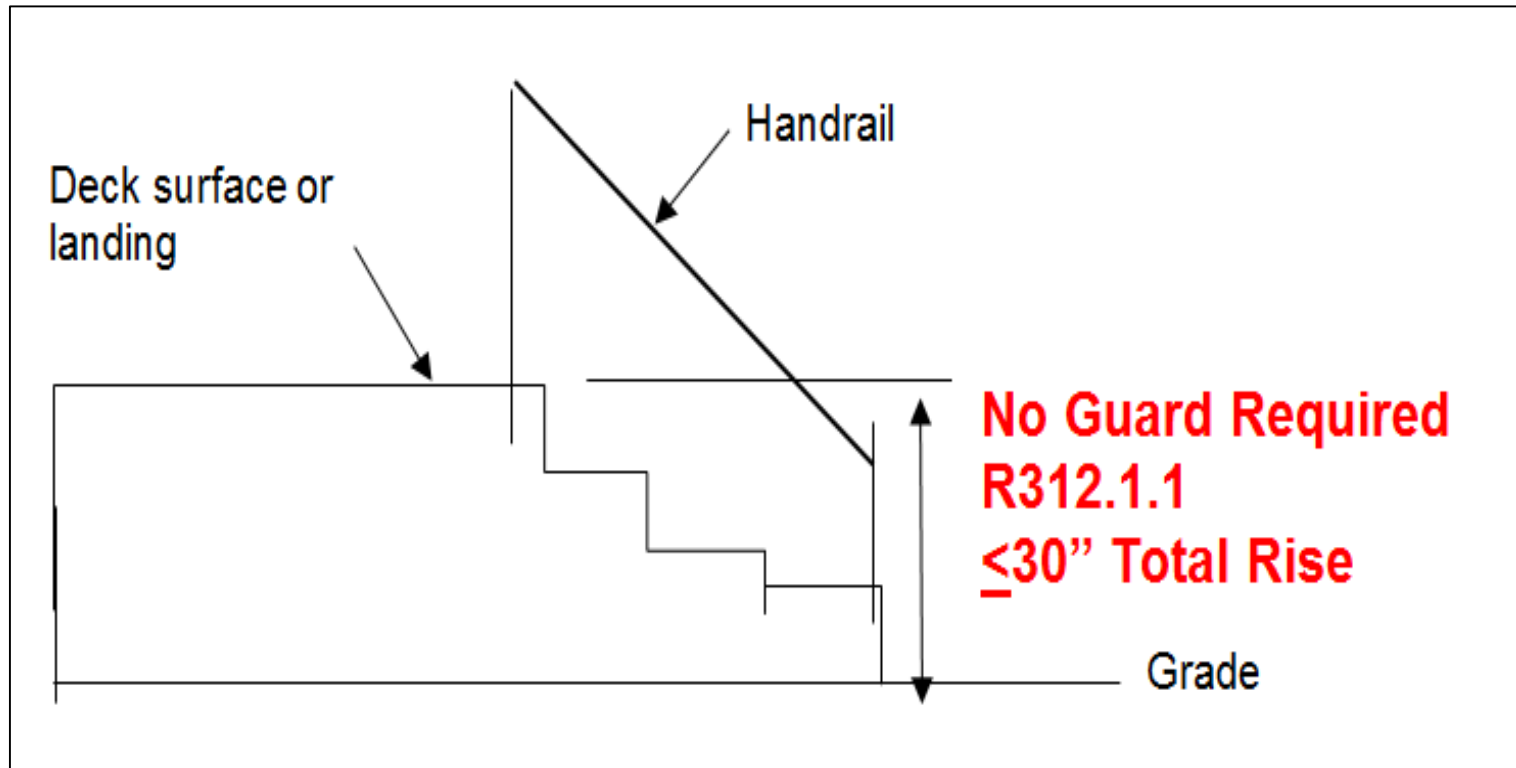
## ◆ Guards and Window Fall Protection 312

- \* Guard details cover porches, balconies, ramps or raised floors surfaces  $>30''$  above the floor require guards  $>36''$  high
- \* Guard opening limitations
- \* Ladder effect design removed

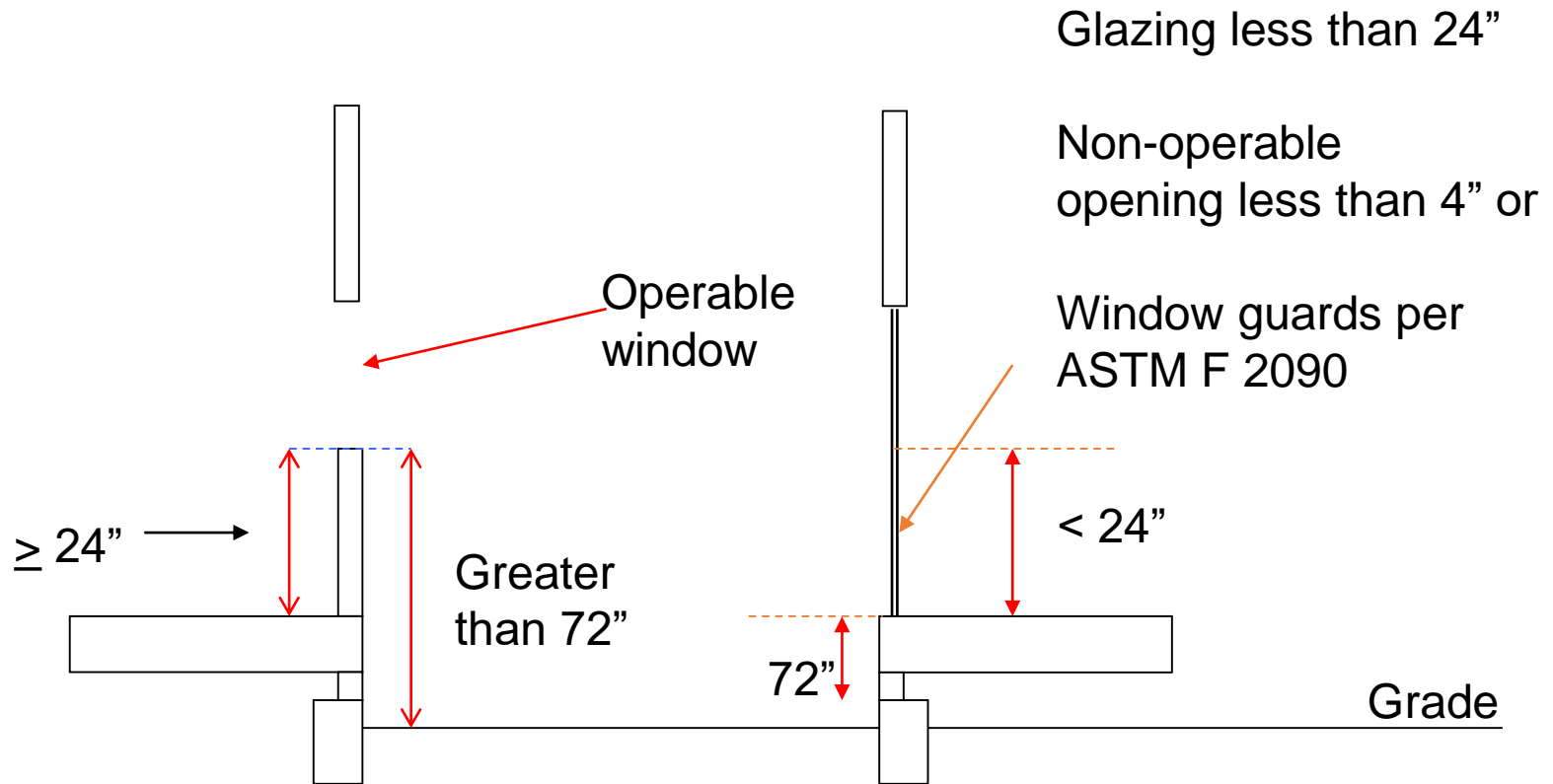




◆ Guards and Window Fall Protection 312



\* Window fall protection 312.2



Windows Opening Control Device (WOCD)

## ◆ General requirements – window fall protection 312.2.2.1

- \* Self acting
- \* Prohibit passage of a 4 inch sphere

## ◆ Operation of emergency escape 312.2.2

- \* Release mechanisms
  - Max 13 pounds of force
  - In all weather
  - Clearly identified
  - Not reduce the clear width

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Building & Fire Code Academy

Questions?

## ◆ Automatic Fire Suppression 313

- \* An automatic residential fire sprinkler system is not required in buildings with four more units shall be installed in townhouses **313.1**
- \* An automatic residential fire sprinkler system is not required to be installed in one- two- or three family dwellings **313.2**
- \* Sprinkler systems installed per **2904, NFPA 13, 13D, 13R**



- ◆ Sprinkler Requirements from Plumbing Portions of the IRC 2904
  - \* Considered by the code to be equivalent to NFPA 13D
  - \* Key definitions in the general section
    - Stand-alone system has separate and independent water for domestic and sprinkler
    - Multipurpose system supplies both fire protection and domestic with one water supply
    - Backflow protection not required on stand-alone sprinkler system
  - \* All areas covered – 4 exceptions for unoccupied attics and crawlspaces, closets and pantries <24 square feet, bathrooms <55 square feet, garages and unheated areas adjacent to an exterior door
  - \* Listed residential sprinkler heads 135°-170° temperature rating. Higher temperature ratings closer to heat source

- \* 400 square feet coverage per head
- \* Hydraulic demand based on two head activation
- \* Nonmetallic supply piping acceptable
- \* Flow rate, pressure loss calculation, water capacity (volume) and pipe sizing all need to be calculated
- \* No fire department connection required
- \* Supervised valves and alarms not required

## ◆ Smoke Alarms 314

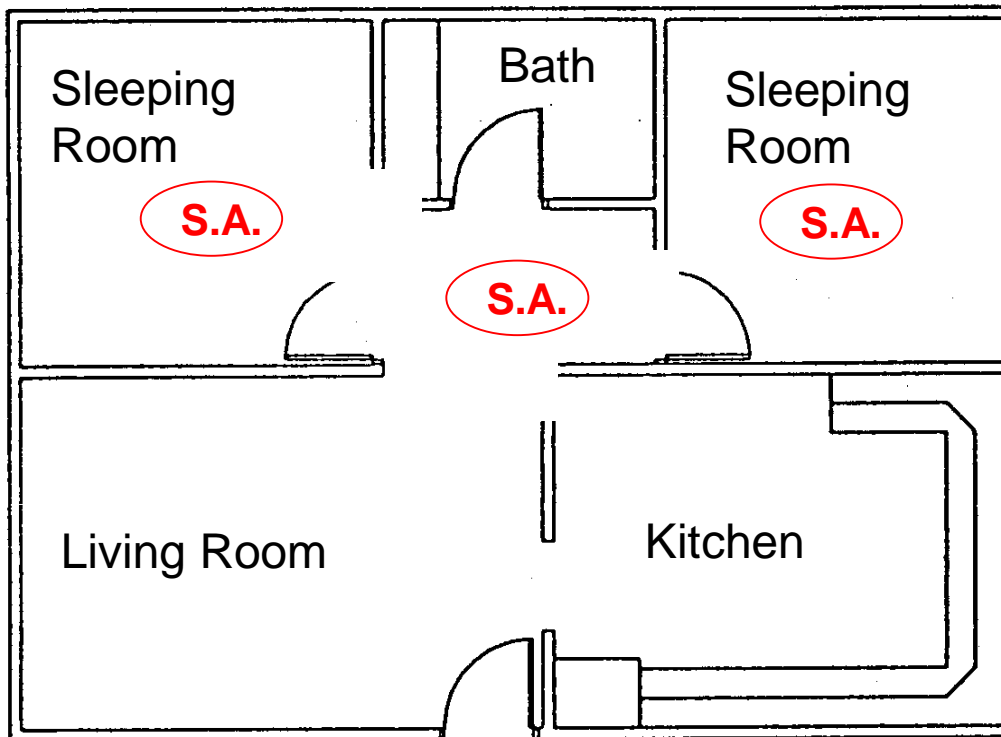
- \* Comply with NFPA 72 and this section the code
- \* Comply with UL 217
- \* Combination smoke and CO detectors UL 217 and UL2034
- \* Smokes – photoelectric and ionization
- \* Two detectors or combinations





- \* Where required **314.2**
  - All new construction
  - Alterations, repairs, additions requiring an approval
    - Not required for exterior permits
    - Not for plumbing and mechanical systems

- \* Number and locations required
  - Not within 3 feet of bathroom doors with tub or shower



All sleeping areas  
Immediate vicinity of bedrooms  
All stories including basements

**S. A. = Smoke Alarm**

Exceptions:  
Split-levels without  
intervening doors

- \* Locations per
- \* Sloped ceiling –  
Smoke Alarm placed  
at high point – OK
- \* Allowed on wall within  
12” of ceiling



Move smoke alarm  
to here



Soffited ceiling smoke alarm needs  
to be placed at high point

- \* Installation near cooking appliances **314.3.1**. Smoke alarms shall not be installed in the following locations unless this would prevent placement of a smoke alarm in a location required by Section **314.3**.
  - Ionization smoke alarms shall not be installed less than 20' (6096 mm) horizontally from a permanently installed cooking appliance
  - Ionization smoke alarms with an alarm-silencing switch shall not be installed less than 10' (3048 mm) horizontally from a permanently installed cooking appliance
  - Photoelectric smoke alarms shall not be installed less than 6' (1828 mm) horizontally from a permanently installed cooking appliance

\* Interconnection **R314.4**

- Smoke detector device must be interconnected and hardwired into the electrical system
- Wireless alarms are approved for new and existing dwellings
- Electric not required when renovation does not remove walls or ceilings
  - Unless access from crawlspace, basement or attic

- \* Fire alarm system 314.7
  - Per this code and NFPA 72 for households
  - Smoke detectors per UL 268
  - Location per previous section
  - Become permanent fixtures
  - Combination smoke and CO detectors allowed
    - Per UL 268 and UL 2975

## ◆ Carbon Monoxide Detectors 315

- \* Listed per **UL 2034** and **UL 217**
- \* Where required
  - All new construction – either or both
    - Dwelling contains fuel fired equipment
    - Attached communicating garage
  - Alterations, repairs, additions requiring a permit

- \* Outside each sleeping area in immediate vicinity of bedrooms
  - If equipment in bedroom or attached bath – within bedroom
  - Combination CO and smoke alarm allowed
- \* Carbon monoxide detection systems **R315.7**
  - Must be listed to **UL 2075** and installed per **NFPA 720**
  - Location same as above
  - Become permanent fixture
  - Combination detectors allowed

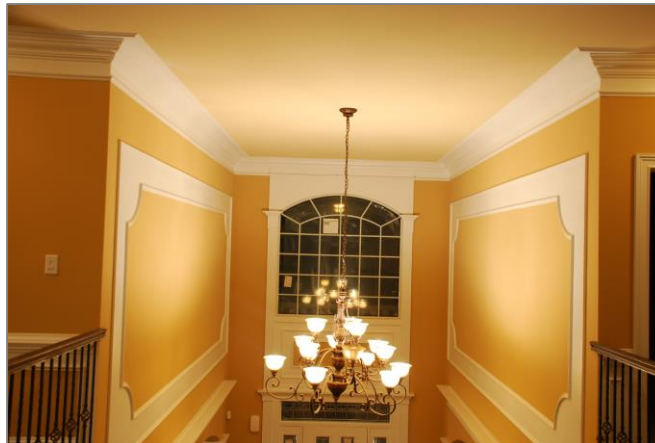


## ◆ Foam Plastic 316

- \* Surface burning characteristics 316.3
  - Flame spread <75
  - Smoke developed <450
- \* Thermal barrier 316.4
  - ½" Gypsum board
  - Approved equivalent

- \* Specific requirements – foam plastic 316.5
  - Masonry / Concrete 316.5.1
  - Roofing 316.5.2
  - Attics 316.5.3
  - Crawl spaces 316.5.4
  - Foam-filled doors 316.5.5 & 316.5.6
  - Foam backer board 316.5.7
  - Sill plates and headers 316.5.11

- \* Interior trim **316.5.9**
  - Not >10% of the aggregate wall and ceiling area of any room or space
  - The interior trim/ Foam plastic must be separated from the thermal barrier **316.4** by wallboard or specific finished material
  - Use of foam plastics in areas of “heavy termite infestation” in accordance with **318.4**



Foam Plastic Moulding

## ◆ Protection Against Decay 317

- \* Location required 317.1
- \* Seven locations listed for decay protection
  - Posts, poles & columns
  - In basements
  - 1" above floor
  - 6" above exposed earth
  - In crawl spaces
  - On concrete pier
  - 8" above grade
  - Impervious moisture barrier

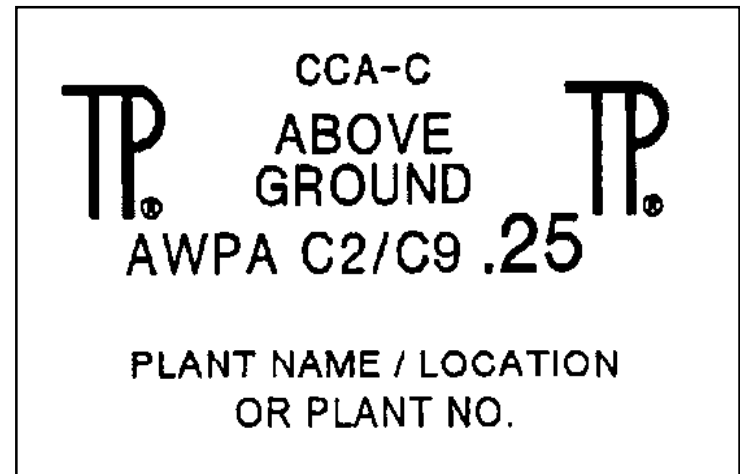
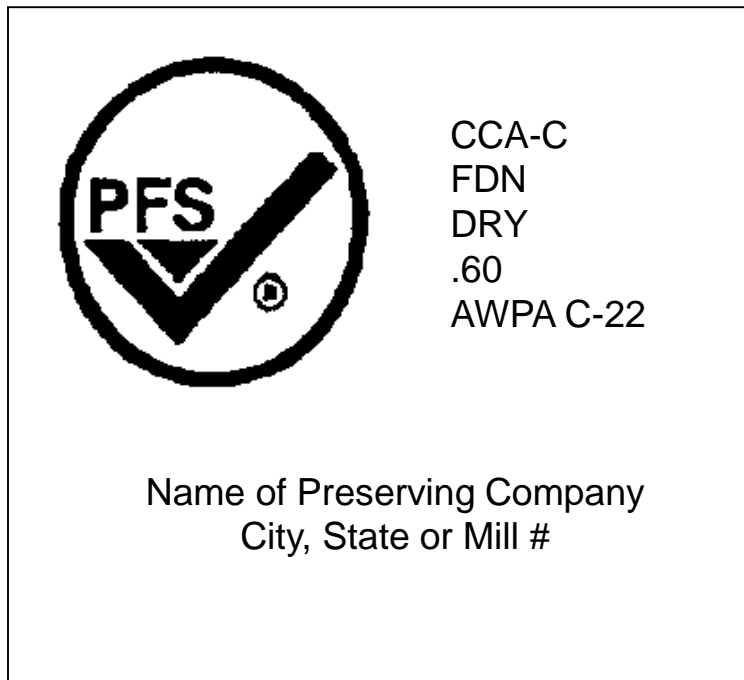
◆ Protection Against Decay 317



- \* Field treatment **317.1.1**
  - Field treat cut ends, notches and drilled holes for preservative treated woods, referenced standard AWPA M4
  
- \* Ground contact **317.1.2**
  - All wood in contact with the ground, embedded in concrete, or in concrete exposed to the weather in structures intended for human occupation must be pressure-preservative-treated wood
    - Exception: Wood below ground water level or under water line in freshwater lake

- \* Wood columns **317.1.4**
  - Approved natural decay resistant wood or pressure-preservative treated wood
  - Two exceptions:
    - Column is exposed to the weather
    - Used as a support by a concrete pier in a basement or crawl space
  
- \* Exposed glued-laminated timbers **317.1.5**
  - Glued and laminated timbers forming structural support of building must be pressure treated when exposed to the weather, not covered by roof, eave, or similar covering

- \* Quality mark **317.2**
  - Treated in accordance with AWPA U1, prescriptive to be listed in Section 4 of AWPA U1





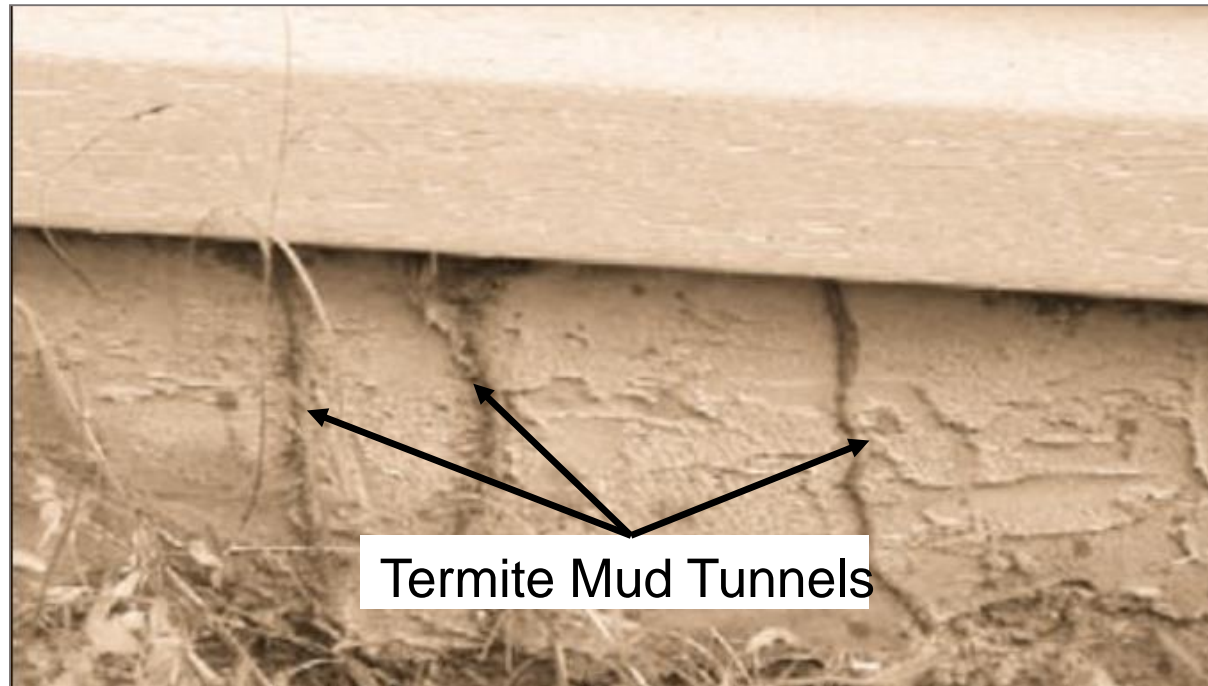
- \* Fasteners and connectors **317.3**
  - Hot-dipped, zinc-coated galvanized steel
  - Stainless steel
  - Silicon bronze
  - Copper

Note: Need to be aware of hanger requirements. Listing sheets show types of hangers that need to be used with certain pressure treated materials

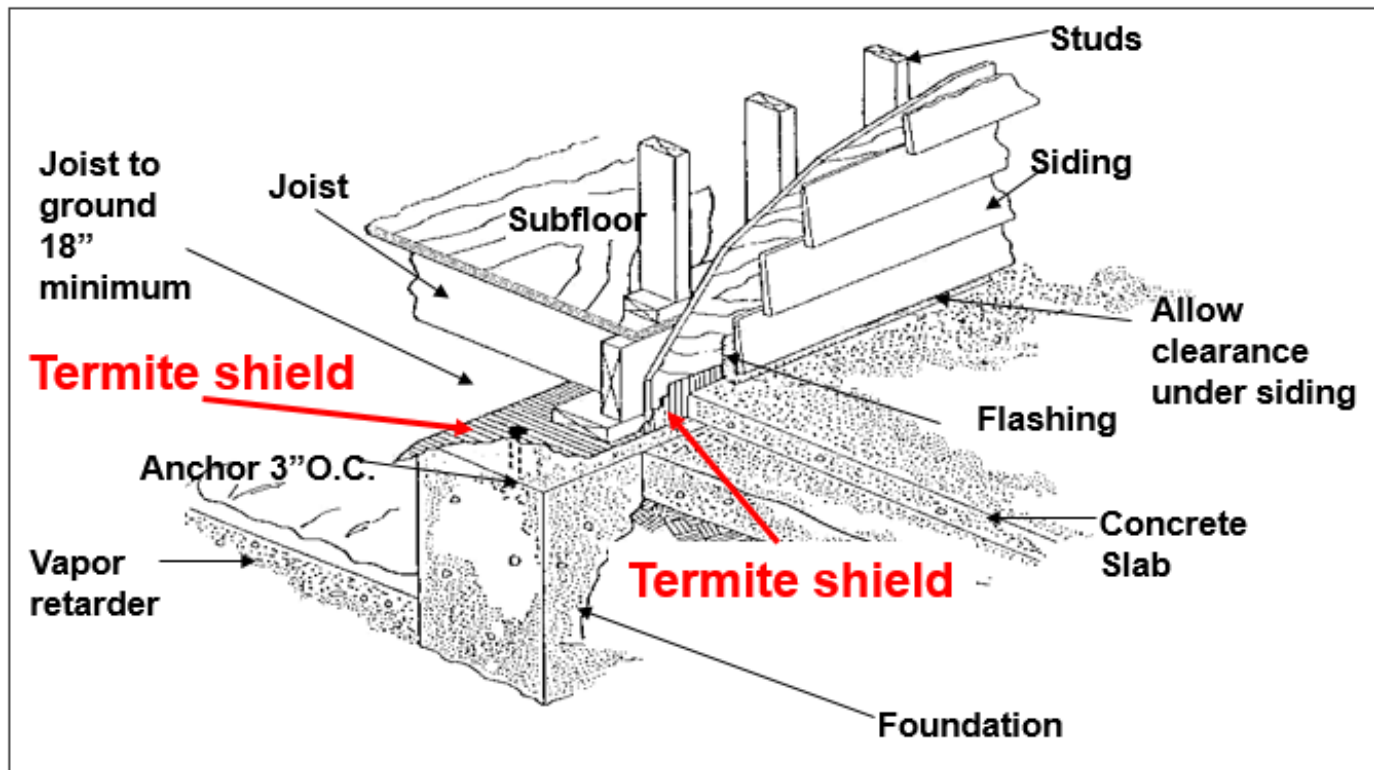


## ◆ Protection Against Termites 318

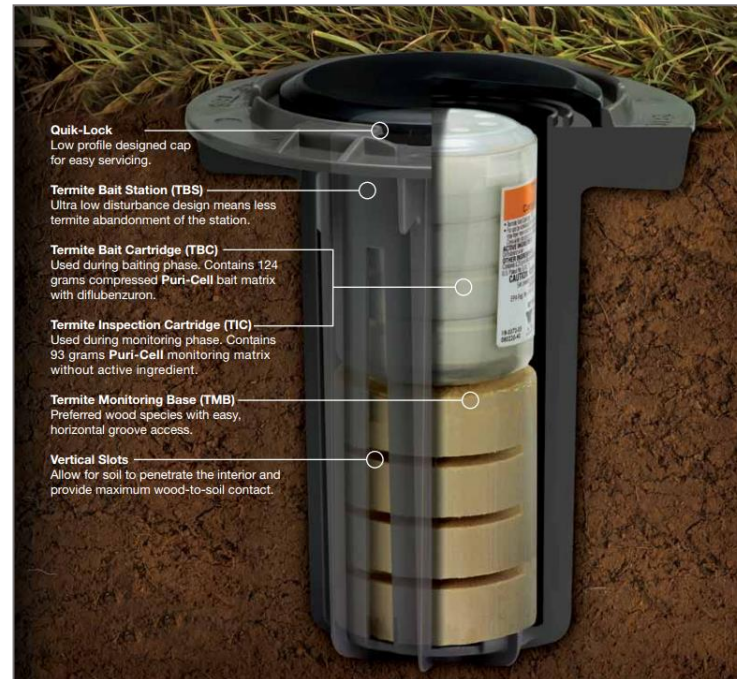
- \* Subterranean termite control methods 318.1
  - Field treatment must meet the American Wood Preservers Association (AWPA) M4 standard
  - Naturally termite-resistant wood R318.1, Condition #4



- \* Quality mark 318.1.1
  - Pressure-treated wood quality mark



- \* Chemical termiticide treatment **318.2**
  - Sample treatment process
  - Bait system in ground
  - Loading system – termites are exposed to bait, return to nest with chemical



## ◆ Site Address 319

- \* Address numbers
- \* Approved building identification sign
- \* Contrast with background
- \* Visibility from street fronting the property
- \* Maintained



## ◆ Accessibility 320

- \* 4 or more dwelling units or sleeping units in a single structure
- \* Not required for 1, 2 or 3 unit buildings
  - If units provided per ICCA117.1
- \* **OIBC** for R-3 groups
  - Owner-occupied lodging with five or fewer guests



## ◆ Elevators and Platform Lifts 321

- \* When provided
- \* Provides guidance for these pieces of equipment that will allow them to meet safety standards **ASME A17.1** and **ASME A18.1** and **ICC A117.1**
- \* Elevators or lifts that are part of accessible route must comply with **ICC A117.1**



## ◆ Flood-Resistant Construction 322

- \* New specifications for buildings and structures in flood hazard areas
- \* Local jurisdictions provides geographic information on flood plains and waterways that impact flood construction issues

- \* Specific requirements for construction issues expanded for flood resistant construction
  - Flood-resistant materials **322.1.8**
  - Manufactured housing **322.1.9**
  - Foundation design and construction **322.2.3**





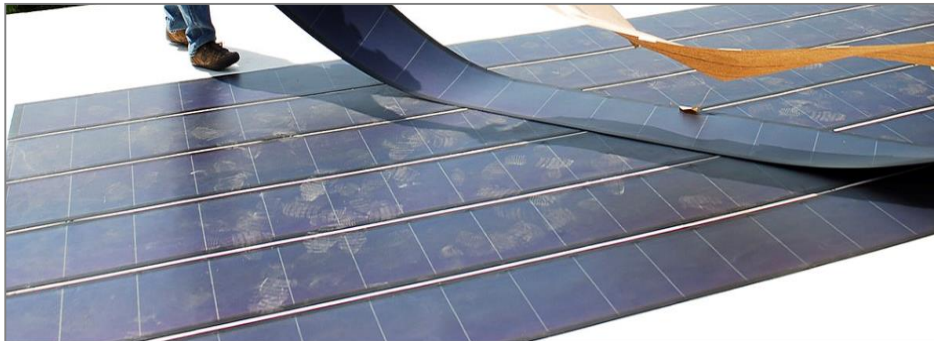
- \* Must be identified in **Table 301.2(1)**
- \* Structural systems
- \* Lowest floor
- \* Protection of mechanical and electrical systems
- \* Protection of water supply and sanitary systems
- \* As-built elevation certifications
- \* Flood hazard areas
- \* Coastal high hazard areas
- \* Construction documents sealed

## ◆ Storm Shelters 323

- \* Separate shelters or within the dwellings units
- \* If constructed per ICC / NSSA – 500

## ◆ Solar Energy Systems 324

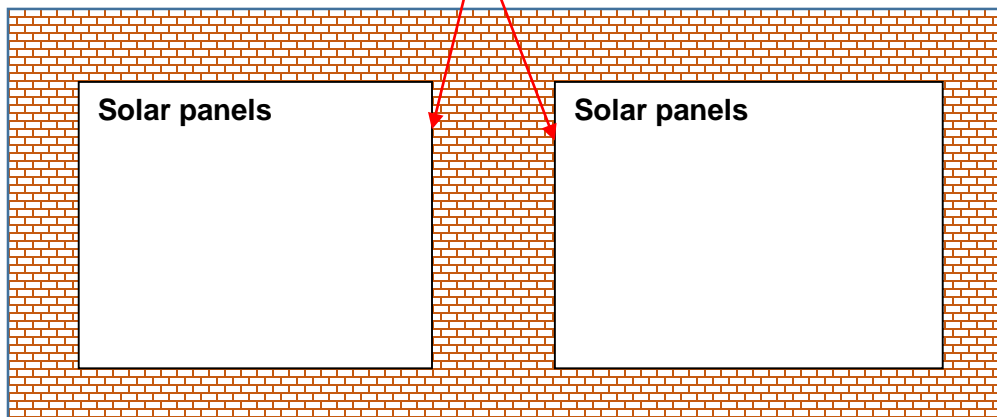
- \* Solar thermal systems per Chapter 23 and FC, 324.2
- \* Photovoltaic systems 324.3
  - Per this code and NFPA 70
- \* Listed and labeled per UL 1741
- \* Equipment listed and labeled per UL 1703 324.3.1
- \* Rooftop mounted per Section R907 324.4



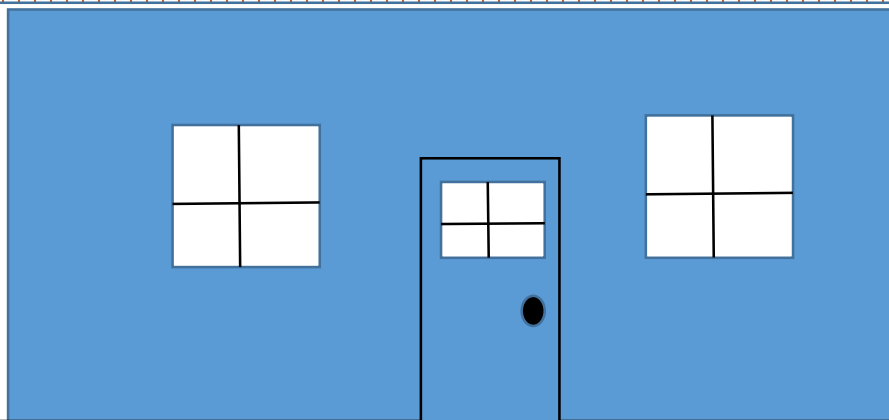
- Areas with no panels – follow code
- Areas with panels
  - Dead load (including cell) and snow
  - Dead load (excluding panel) plus live load or snow load whichever is greater
  - Designed for wind load
- \* Same fire classification as roof
- \* Roof penetrations properly sealed

- \* Roof access and pathways 324.6
- \* Required except:
  - Non-habitable buildings,
  - Code official no roof top operations
  - Slope <2 :12

Pathways – minimum two on different planes  
Minimum 36" wide edge to ridge



Minimum one on street or driveway side  
Pathways on same plane, adjacent plane, straddling same  
Area capable of supporting FF  
Minimal obstructions



- \* Setback at ridge
  - <33% of plan view roof area – 18” setback on both sides
  - >33% of plan view roof area – 36” on both sides
- \* Sprinklers
  - <66% of plan view roof area – 18” setback on both sides
  - >66% of plan view roof area – 36” on both sides
- \* Not below escape window – provide 36” path to window



Are these PV arrays OK?

No... 3' wide access between each, and from eave to ridge



- ◆ Mezzanines 325 - deleted
- ◆ Swimming pools and spas - deleted

## ◆ Stationary Storage Batteries 327

- \* System per **UL 9540**
- \* Per manufacturer
- \* Not within the dwelling
- \* Per **NFPA 70**
- \* If connected to grid – proper inverter per the utility
- \* If produce flammable vapors ventilation per **1307.4**
- \* Protected from vehicular impact (see **FC**)

- ◆ **Post Framed Accessory structures 328**
  - \* Minimum standards with following structure limitations
    1. *Residential accessory structures,*
    2. *Single story,*
    3. *Solid exterior structural sheathing or metal roof, and solid wall panels,*
    4. *No attic storage,*
    5. *Maximum building width of thirty six feet including the overhang,*
    6. *Maximum wall height of sixteen feet,*
    7. *Maximum mean roof height of twenty feet, and*
    8. *Maximum post spacing of eight feet.*

- \* When outside the above
  - Structural calculations per the BCO
  - Comply with the RCO
- \* Wood primary and secondary members
  - Transfer all loads to footings
- \* Footings and foundations
  - Comply with 402
  - Top of footing 48 inches below finished grade
  - Sized per Table 328.3

**TABLE 328.3**  
**POST FRAME PIER FOOTING DIAMETERS<sup>1, 2, 3, 4</sup>**

	<i>BUILDING WIDTH (length of truss) INCLUDING OVERHANG (feet)</i>			
	<i>24</i>	<i>28</i>	<i>32</i>	<i>36</i>
<i>Diameter (inches) 20# roof snow load</i>	<i>18</i>	<i>20</i>	<i>22</i>	<i>22</i>
<i>Diameter (inches) 30# roof snow load</i>	<i>18</i>	<i>22</i>	<i>24</i>	<i>26</i>

- 1. Pier footing thickness shall be a minimum one-half of the diameter of the footing.*
- 2. Based upon 2000 PSF soil bearing capacity and truss loads of 20 or 30 PSF live or snow load top chord, 10 PSF dead load top chord, 5 PSF dead load on the bottom chord and no live load on the bottom chord.*
- 3. Fractional widths shall be rounded to the next higher pier footing diameter.*
- 4. Table not to be used in Ohio case study areas.*

## ◆ Post and wall construction 328.4

- \* Three (3) ply unspliced, reinforced splices or solid wood
- \* Not less than 4 inch by 6 inch
- \* Comply with 317 – protection against decay
- \* Uplift protection
  - Two – 2 x 6 x12 blocks on posts
  - 12 inch concrete collar of footing with rebar

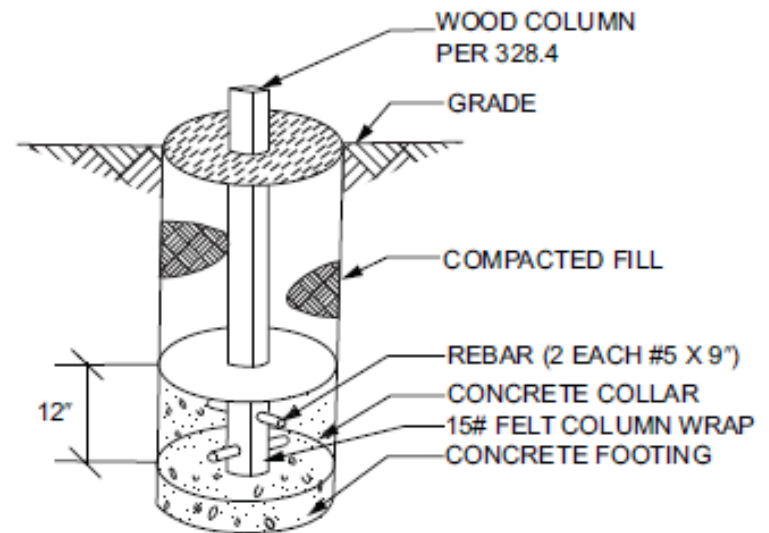
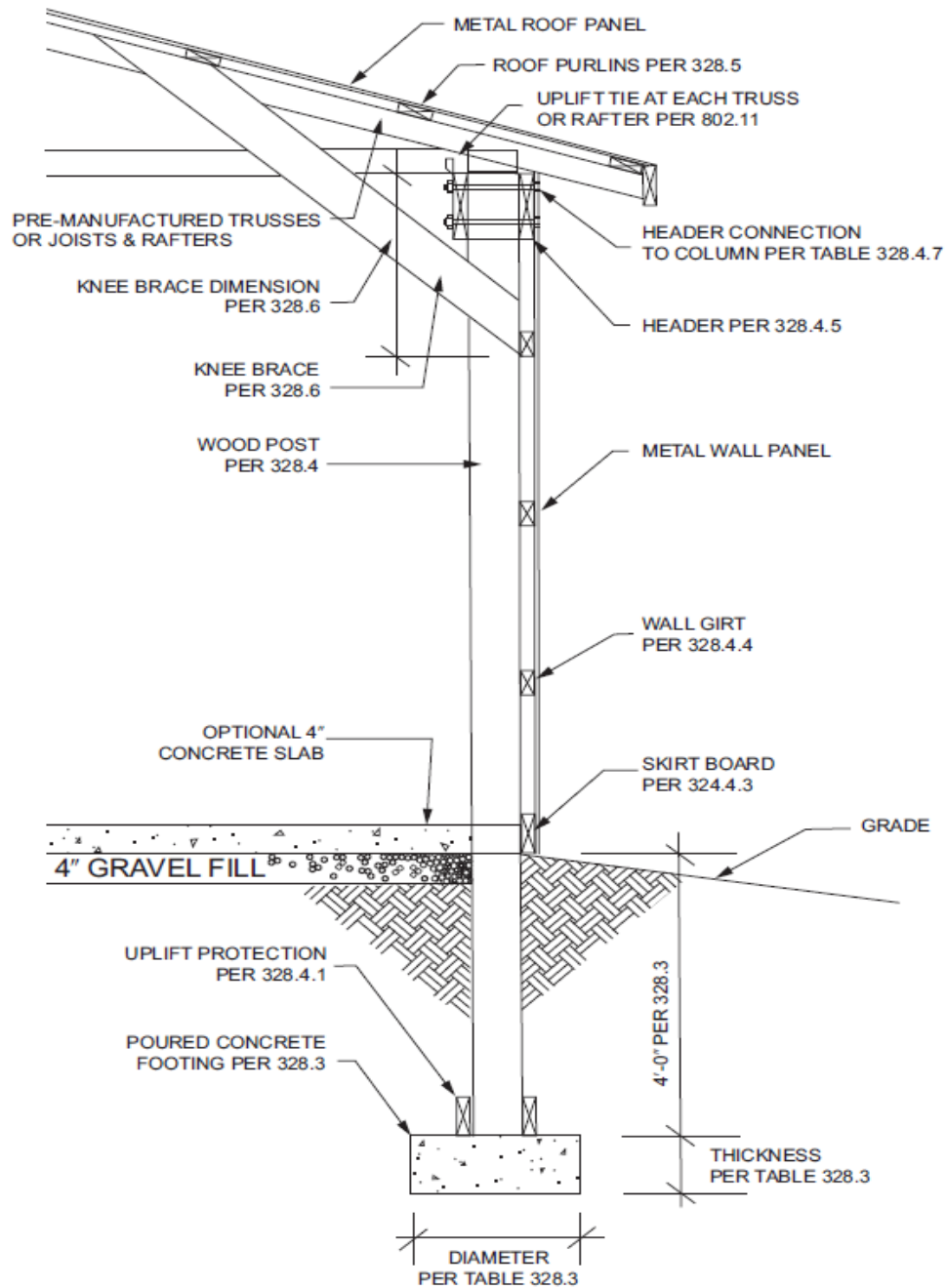


FIGURE 328.1  
POST UPLIFT PROTECTION EXCEPTION  
(NO SCALE)

- \* Post spacing - maximum spacing 8 feet
- \* Skirt boards
  - Treated lumber
  - Fastened per Table 328.7
- \* Wall girts
  - Not less than 2 x 4
  - Spaced not more than 24 inches

**TABLE 328.7  
STRUCTURAL FASTENERS**

<b>FASTENER SCHEDULE FOR STRUCTURAL MEMBERS</b>		
<i>Description of Building Element</i>	<i>Number and Type of Fastener</i>	<i>Attachment type</i>
<i>Uplift blocking to post</i>	<i>5-16d Hot Dipped Galvanized</i>	<i>Each block</i>
<i>Skirt board to post</i>	<i>2-16d Hot Dipped Galvanized</i>	<i>Face nail</i>
<i>Wall girt to post</i>	<i>2-16d Hot Dipped Galvanized</i>	<i>Face nail</i>
<i>Diagonal cross bracing to post</i>	<i>2-16d Hot Dipped Galvanized</i>	<i>Face nail</i>
<i>Diagonal cross bracing to skirt board</i>	<i>2-10d Hot Dipped Galvanized</i>	<i>Face nail</i>
<i>Diagonal cross bracing to wall girts, beam, or header</i>	<i>2-10d</i>	<i>Face nail</i>
<i>Knee brace to post</i>	<i>3-16d Hot Dipped Galvanized</i>	<i>Face nail</i>
<i>Knee brace to top chord of truss or rafter</i>	<i>3-10d</i>	<i>Face nail</i>
<i>Knee brace to bottom chord of truss or ceiling joist</i>	<i>3-10d</i>	<i>Face nail</i>
<i>Roof purlin to truss or rafter with span of 2' or 4'</i>	<i>2-16d</i>	<i>Face nail</i>
<i>Roof purlin to truss or rafter with span of 8'</i>	<i>Mechanical fastener with uplift protection greater than 225 pounds.</i>	<i>Per manufacturer installation manual</i>





- \* Wall girts
  - Not less than 2 x 4
  - Spaced not more than 24 inches
- \* Load bearing beams and headers per Table 502.5(1)
- \* Bracing 328.4.6
  - Per 602.10
  - 2 x 6 cross bracing
  - Installed per this section
- \* Beams supporting trusses or rafter and ceiling joist attachment to columns
  - ½ inch diameter to side of post
  - ½ inch diameter to post notch
  - Per Table 328.4.7

- \* Roof purlins
  - 4 x2 SPF 2 laid flat –spans up to 4 feet
  - 4 X2 SPF # 2 on edge – spans up to 8 feet
  - Maximum spacing 24 inches
- \* Knee brace
  - 2x 6
  - Post to the top chord of the truss
  - 45 degree angle
  - Location per Table 328.6

**TABLE 328.6  
KNEE BRACE VERTICAL DISTANCE**

<i>Wall Height</i>	<i>Vertical Dimension</i>
<i>8'-0" and 9'-0"</i>	<i>1'-6"</i>
<i>10'-0" and 11'-0"</i>	<i>2'-0"</i>
<i>12'-0" and 13'-0"</i>	<i>3'-0"</i>
<i>14'-0" through 16'-0"</i>	<i>4'-0"</i>



Building & Fire Code Academy

# Understanding the 2019 Residential Code of Ohio

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## Chapter 4 Foundations

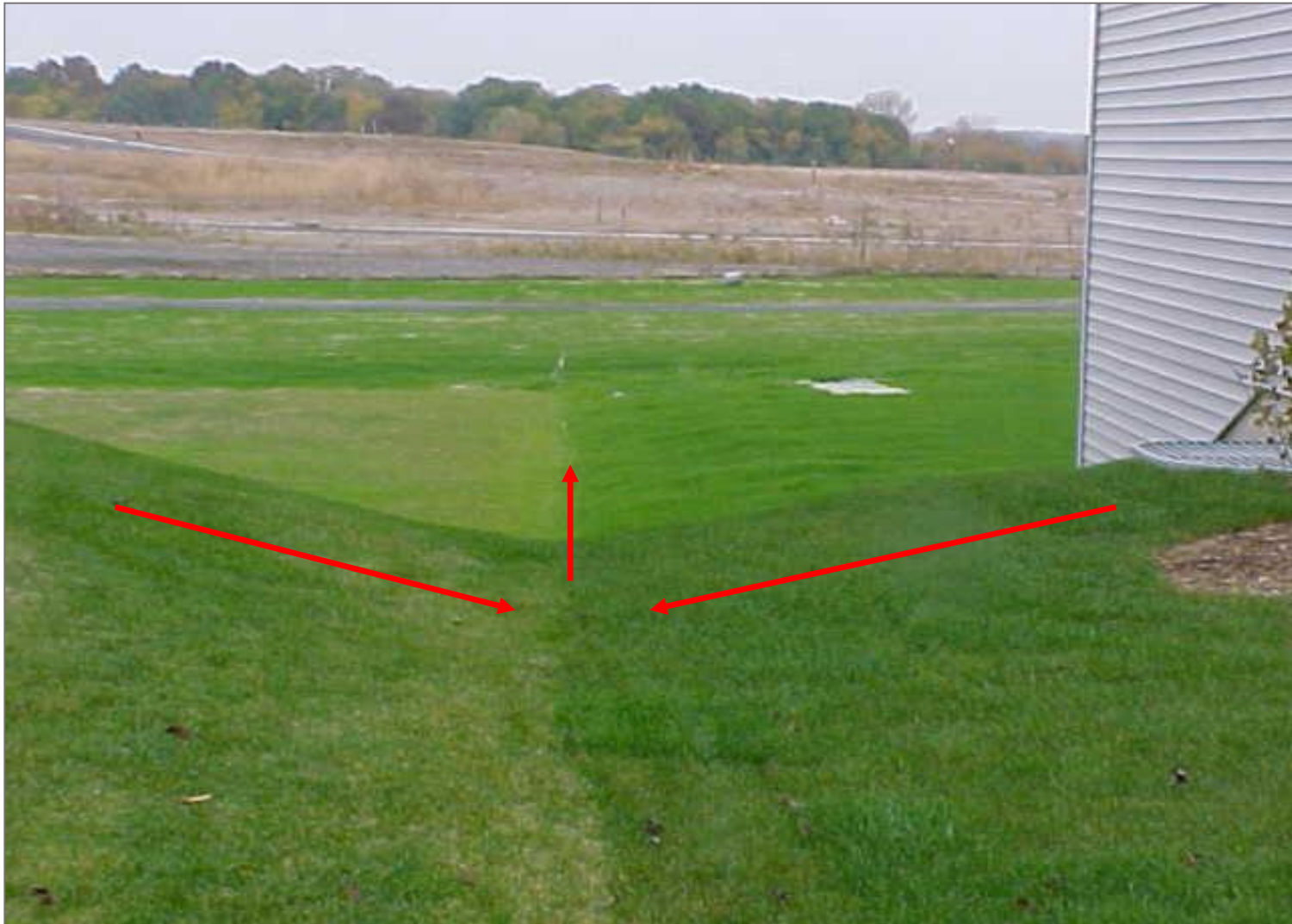
## ◆ General 401

- \* Application 401.1
- \* Requirements 401.2
- \* Drainage 401.3
  - Drainage requirements:
  - 6" slope in first 10' away from the foundations
  - 2% slope for swales and impervious surfaces within 10' of the foundation

\* Drainage 401.3



\* Drainage 401.3





\* Drainage 401.3



Sloped away minimum 10'  
from house

- \* Soil tests 401.4
  - Geo-technical evaluation
  - Compressible or shifting soils
  - See Table 401.4.1 presumptive load-bearing values of foundation materials

**TABLE 401.4.1  
PRESUMPTIVE LOAD-BEARING VALUES OF FOUNDATION MATERIALS <sup>a</sup>**

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 siltclay (CL, ML, MH and CH)	1,500 <sup>b</sup>

For SI: 1 pound per square foot = 0.0479 kPa.

a. Where soil tests are required by Section 401.4, the allowable bearing capacities of the soil shall be part of the recommendations.

b. Where the building official determines that in-place soils with an allowable bearing capacity of less than 1,500 psf are likely to be present at the site, the



## ◆ Materials 402

- \* Minimum specified compressive strength of concrete **Table R402.2**
- \* **Table 402.2** Footnote "f" permits a reduction of the total air content when steel trowel finish is to be provided for garage floors with a minimum strength of 4,000 psi



\* Minimum Specified Compressive Strength of Concrete  
**Table 402.2**

**TABLE 402.2  
 MINIMUM SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE**

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

For SI: 1 pound per square inch = 6.895 kPa.

a. Strength at 28 days psi.

b. See Table 301.2(1) for weathering potential.

c. Concrete in these locations that is subject to freezing and thawing during construction shall be air-entrained concrete in accordance with Footnote d.

d. Concrete shall be air-entrained. Total air content (percent by volume of concrete) shall be not less than 5 percent or more than 7 percent.

e. See Section 402.2 for maximum cementitious materials content.

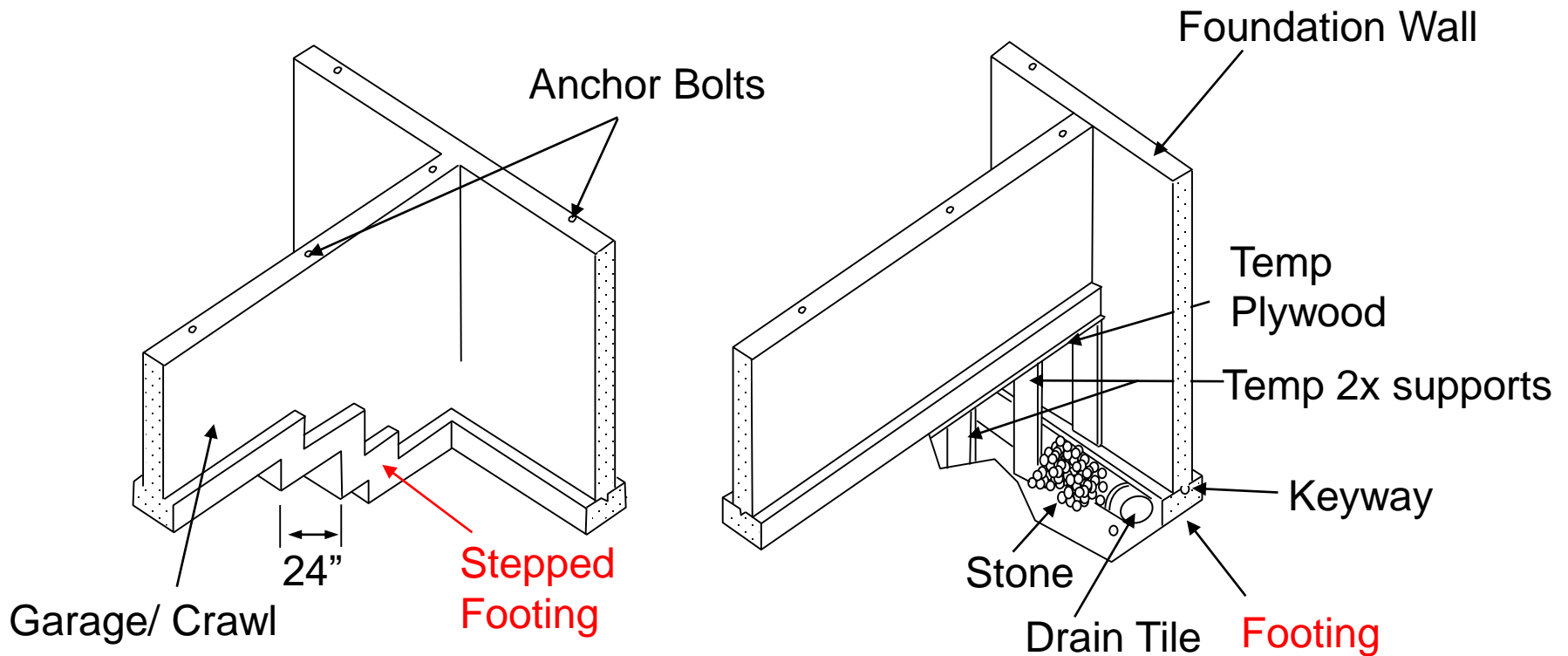
f. For garage floors with a steel-troweled finish, reduction of the total air content (percent by volume of concrete) to not less than 3 percent is permitted if the specified compressive strength of the concrete is increased to not less than 4,000 psi.

## ◆ Footings 403

### \* General 403.1

- All exterior walls shall be supported on a continuous solid or fully grouted masonry, concrete footing, crushed stone footings, wood foundations or other *approved* structural systems
- Design sufficient to accommodate all loads per section 301
- Footings supported on undisturbed natural soils or engineered fill
- Seismic reinforcing 403.1.3
  - Plain concrete footings for foundation walls of detached one- and two-family dwellings in certain zones is no longer permitted

◆ Footings 403



- Minimum size **403.1.1**
  - Three tables for footing sizes:
    - Table 403.1(1)** Footings for light frame
    - Table 403.1(2)** Footings for light frame / Brick veneer
    - Table 403.1(3)** Footings for cast-in-place or fully grouted concrete walls



TABLE 403.1(1)

MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS FOR LIGHT-FRAME CONSTRUCTION (inches)<sup>a, b</sup>

SNOW LOAD OR ROOF LIVE LOAD	STORY AND TYPE OF STRUCTURE WITH LIGHT FRAME	LOAD-BEARING VALUE OF SOIL (psf)					
		1500	2000	2500	3000	3500	4000
20 psf	1 story—slab-on-grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	18 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	16 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—plus basement	22 × 6	16 × 6	13 × 6	12 × 6	12 × 6	12 × 6
	3 story—slab-on-grade	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—with crawl space	19 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—plus basement	25 × 8	19 × 6	15 × 6	13 × 6	12 × 6	12 × 6
30 psf	1 story—slab-on-grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	19 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	12 × 6	12 × 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

What is minimum concrete footing width and thickness for light-frame construction with snow load or roof live load of 20 psf for a 2-story plus basement building with soil bearing capacity of 2,500 psf?



TABLE | 103.1(2)

MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS FOR LIGHT-FRAME CONSTRUCTION WITH BRICK VENEER (inches)<sup>a, b</sup>

SNOW LOAD OR ROOF LIVE LOAD	STORY AND TYPE OF STRUCTURE WITH BRICK VENEER	LOAD-BEARING VALUE OF SOIL (psf)					
		1500	2000	2500	3000	3500	4000
20 psf	1 story—slab-on-grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	21 × 6	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	20 × 6	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—plus basement	26 × 8	20 × 6	16 × 6	13 × 6	12 × 6	12 × 6
	3 story—slab-on-grade	20 × 6	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—with crawl space	26 × 8	19 × 6	15 × 6	13 × 6	12 × 6	12 × 6
	3 story—plus basement	32 × 11	24 × 7	19 × 6	16 × 6	14 × 6	12 × 6
30 psf	1 story—slab-on-grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	16 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	22 × 6	16 × 6	13 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	16 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	22 × 6	16 × 6	13 × 6	12 × 6	12 × 6	12 × 6
	2 story—plus basement	27 × 9	21 × 6	16 × 6	14 × 6	12 × 6	12 × 6
	3 story—slab-on-grade	21 × 6	16 × 6	13 × 6	12 × 6	12 × 6	12 × 6
	3 story—with crawl space	27 × 8	20 × 6	16 × 6	13 × 6	12 × 6	12 × 6
	3 story—plus basement	33 × 11	24 × 7	20 × 6	16 × 6	14 × 6	12 × 6

**TABLE 403.1(3)**  
**MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS**  
**WITH CAST-IN-PLACE CONCRETE OR FULLY GROUTED MASONRY WALL CONSTRUCTION (inches)<sup>a, b</sup>**

SNOW LOAD OR ROOF LIVE LOAD	STORY AND TYPE OF STRUCTURE WITH CMU	LOAD-BEARING VALUE OF SOIL (psf)					
		1500	2000	2500	3000	3500	4000
20 psf	1 story—slab-on-grade	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	19 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	25 × 8	19 × 6	15 × 6	13 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	23 × 7	18 × 6	14 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	29 × 9	22 × 6	17 × 6	14 × 6	12 × 6	12 × 6
	2 story—plus basement	35 × 12	26 × 8	21 × 6	17 × 6	15 × 6	13 × 6
	3 story—slab-on-grade	32 × 11	24 × 7	19 × 6	16 × 6	14 × 6	12 × 6
	3 story—with crawl space	38 × 14	28 × 9	23 × 6	19 × 6	16 × 6	14 × 6
	3 story—plus basement	43 × 17	33 × 11	26 × 8	22 × 6	19 × 6	16 × 6
30 psf	1 story—slab-on-grade	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	20 × 6	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	26 × 8	20 × 6	16 × 6	13 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	24 × 7	18 × 6	15 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	30 × 10	22 × 6	18 × 6	15 × 6	13 × 6	12 × 6
	2 story—plus basement	36 × 13	27 × 8	21 × 6	18 × 6	15 × 6	13 × 6
	3 story—slab-on-grade	33 × 12	25 × 7	20 × 6	17 × 6	14 × 6	12 × 6
	3 story—with crawl space	39 × 14	29 × 9	23 × 7	19 × 6	17 × 6	14 × 6
	3 story—plus basement	44 × 17	33 × 12	27 × 8	22 × 6	19 × 6	17 × 6
	1 story—slab-on-grade	17 × 6	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6



## FOOTING SIZE Case Study

- \* Example: 2-story brick veneer house with basement and attached garage
  - Sandy soil
  - Severe weathering conditions
  - Sand =
  - Question: What is the minimum required footing width?

- Minimum footing widths by soils **Table R401.4.1**

**TABLE | 401.4.1  
PRESUMPTIVE LOAD-BEARING VALUES OF  
FOUNDATION MATERIALS<sup>a</sup>**

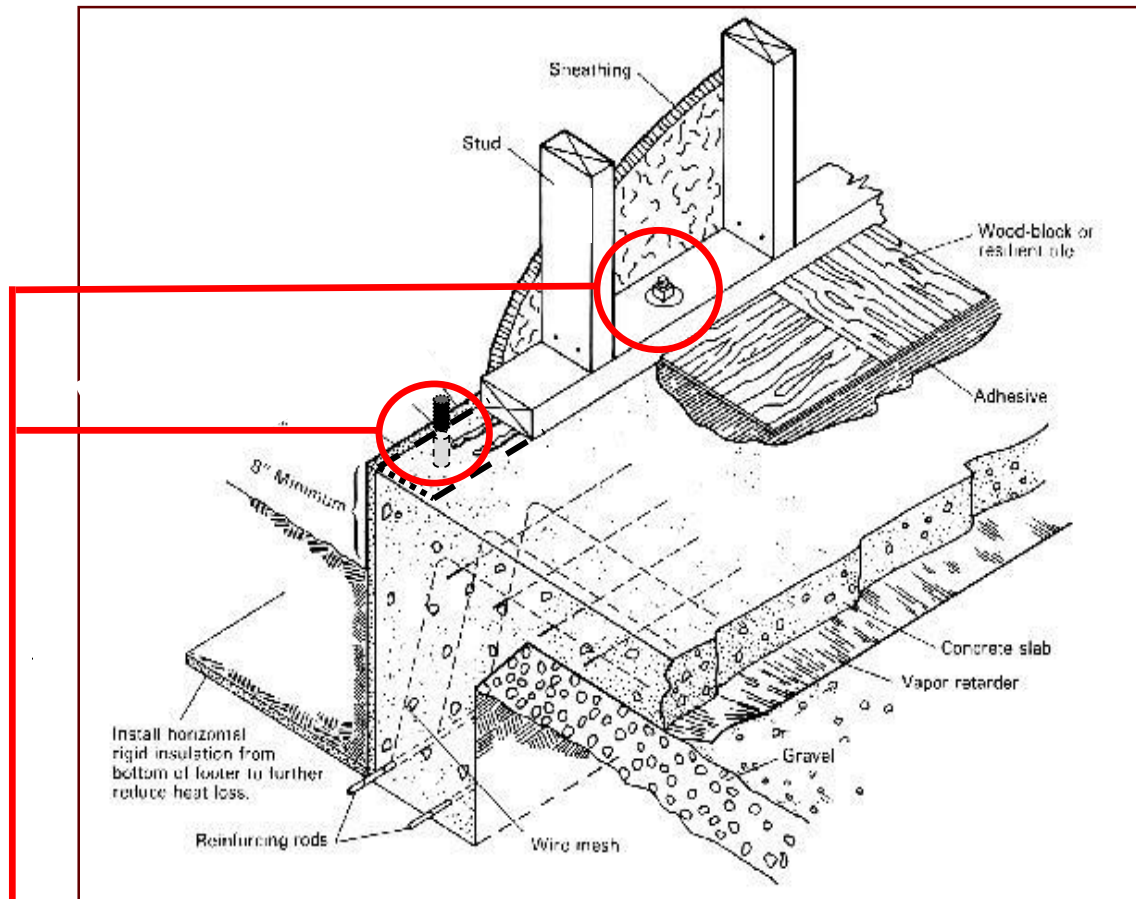
CLASS OF MATERIAL	LOAD-BEARING PRESSURE (pounds per square foot)
Crystalline bedrock	12,000
Sedimentary and foliated rock	4,000
Sandy gravel and/or gravel (GW and GP)	3,000
Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000
Clay, sandy, silty clay, clayey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

<sup>a</sup> Where soil tests are required by Section [R401.4](#), the allowable bearing capacities of the soil shall be part of the recommendations.

<sup>b</sup> Where the building official determines that in-place soils with an allowable bearing capacity of less than 1,500 psf are likely to be present at the site, the allowable bearing capacity shall be determined by a soils investigation.

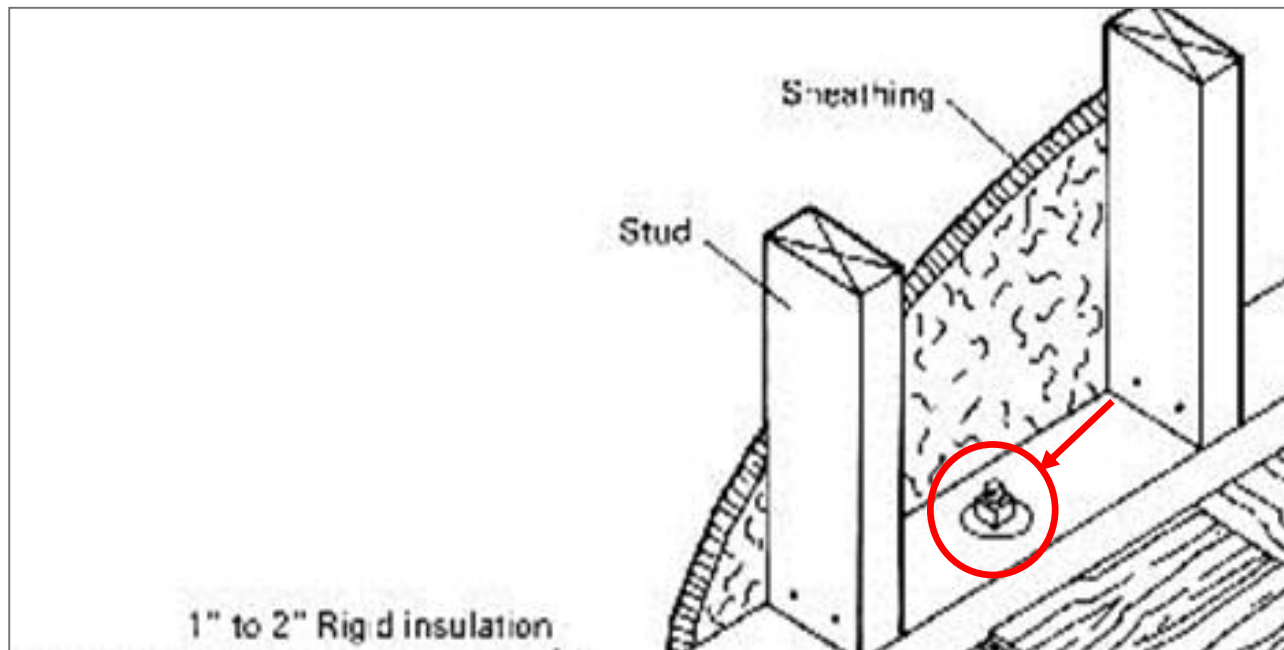
- Depth **403.1.4**
  - 12” below undisturbed ground
  - Below known frost line
  - Frost protected footing – see **403.1.4.1**
- Slope **403.1.5**
  - Maximum slope at bottom of footing = 1:10

\* Foundation anchorage §403.1.6



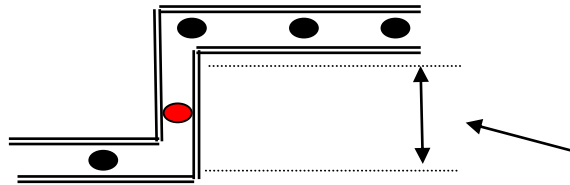
Note: 1/2" minimum anchor bolts 6' O.C., 2 bolts per section of plate minimum, one bolt w/in 12" of end of plate but not less than 7 bolt diameters from end

- Foundation anchorage 403.1.6
  - Anchor bolts in center 1/3 of sole plate



- Foundation anchorage .403.1.6
  - Properly sized cut washers for walls without braced wall panels
  - Interior braced wall panel plates shall have anchor bolts spaced at not more than 6' on center and within 12" from ends when supported on a continuous foundation
  - Exceptions 2 & 3 have been added to address anchorage for wall length of 24" or shorter

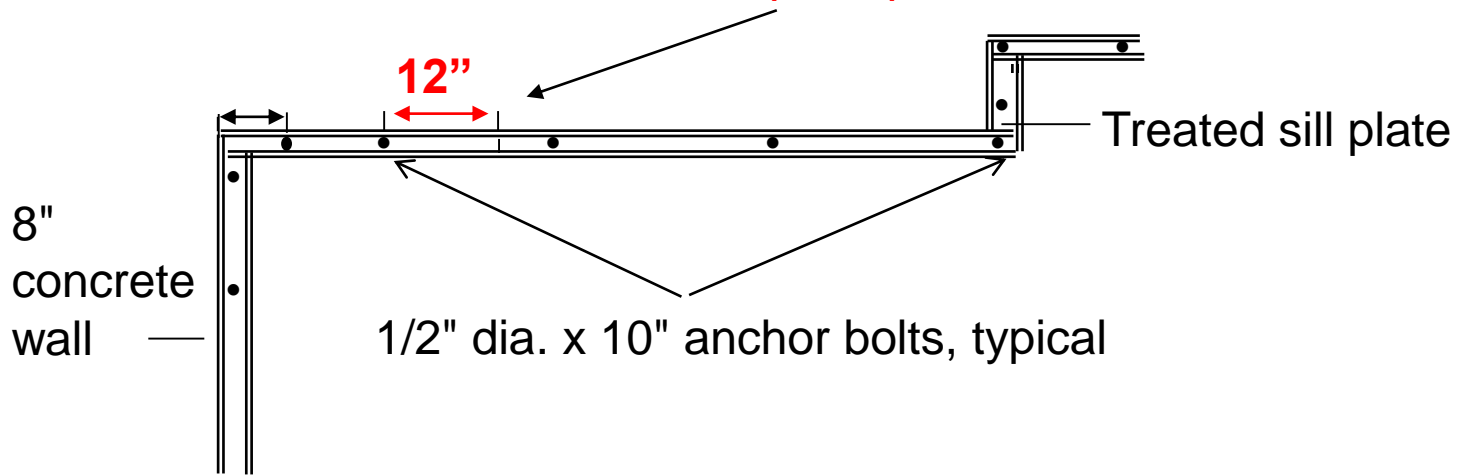
\* Foundation anchorage **403.1.6**



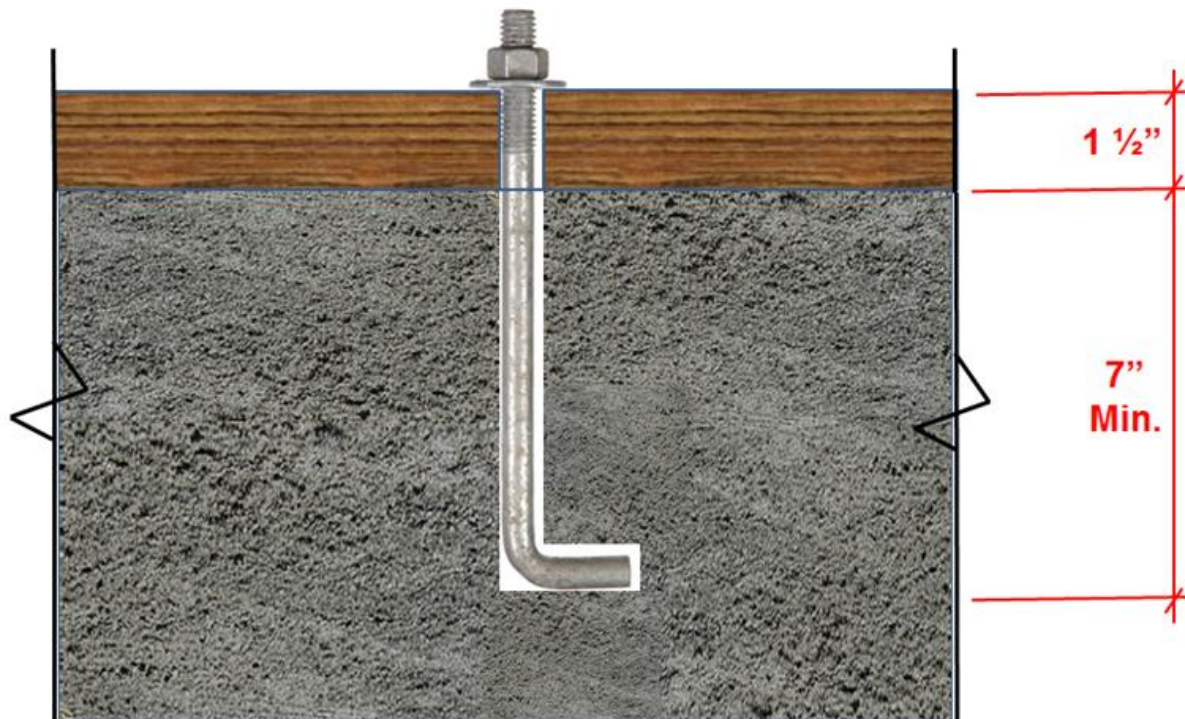
24" or less at braced wall lines

No anchor bolt required when less than 12" (Exception #2)

Bolts no more than 12" to end of sill plate piece



- Foundation anchorage **403.1.6** (*continued*)
  - Min. ½" diameter
  - Min. 7" into concrete or 7" into grouted cell of top CMU



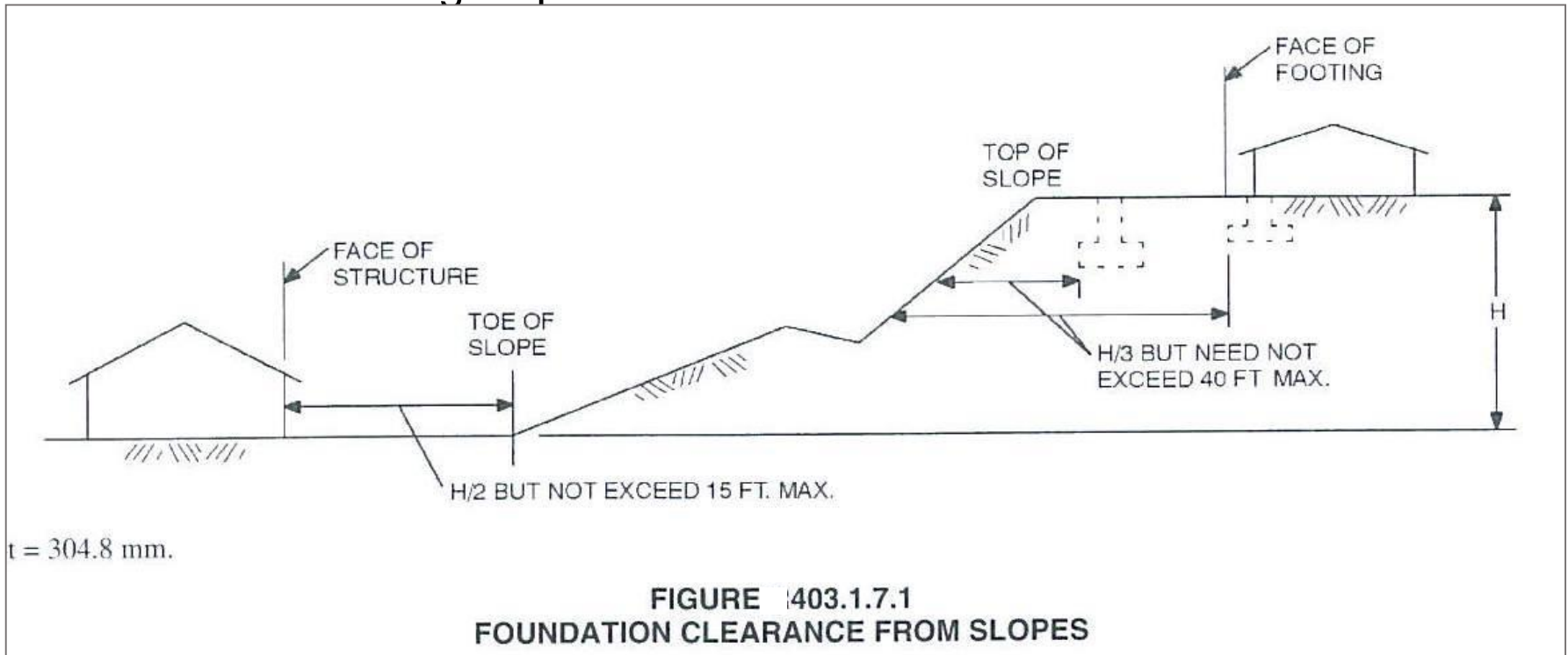
Foundation Anchorage | **403.1.6**



- Footings on or adjacent to slopes 403.1.7
  - Steeper than 1:3 elevation
  - Ascending slopes 403.1.7.1

Note: If ascending slope is 1:1 use imaginary 45° line from top of foundation to top of slope to determine elevation

\* Descending slopes 403.1.7.2



Note: If descending slope is 1:1 use imaginary 45° line from bottom of slope to top of slope to determine setback distance

- Foundation elevation **403.1.7.3**
  - Top of exterior foundation to street gutter minimum 12" + 2% or approved alternate
- \* Frost protected shallow foundations **403.3**
  - Heated buildings with 64°F minimum
  - See **Table 403.3(1)** Air Freezing Index for minimum horizontal vertical insulation requirements

- \* Minimum insulation requirements for frost-protected footings in heated buildings<sup>a</sup> **Table 403.3(1)**

**TABLE 403.3(1)**

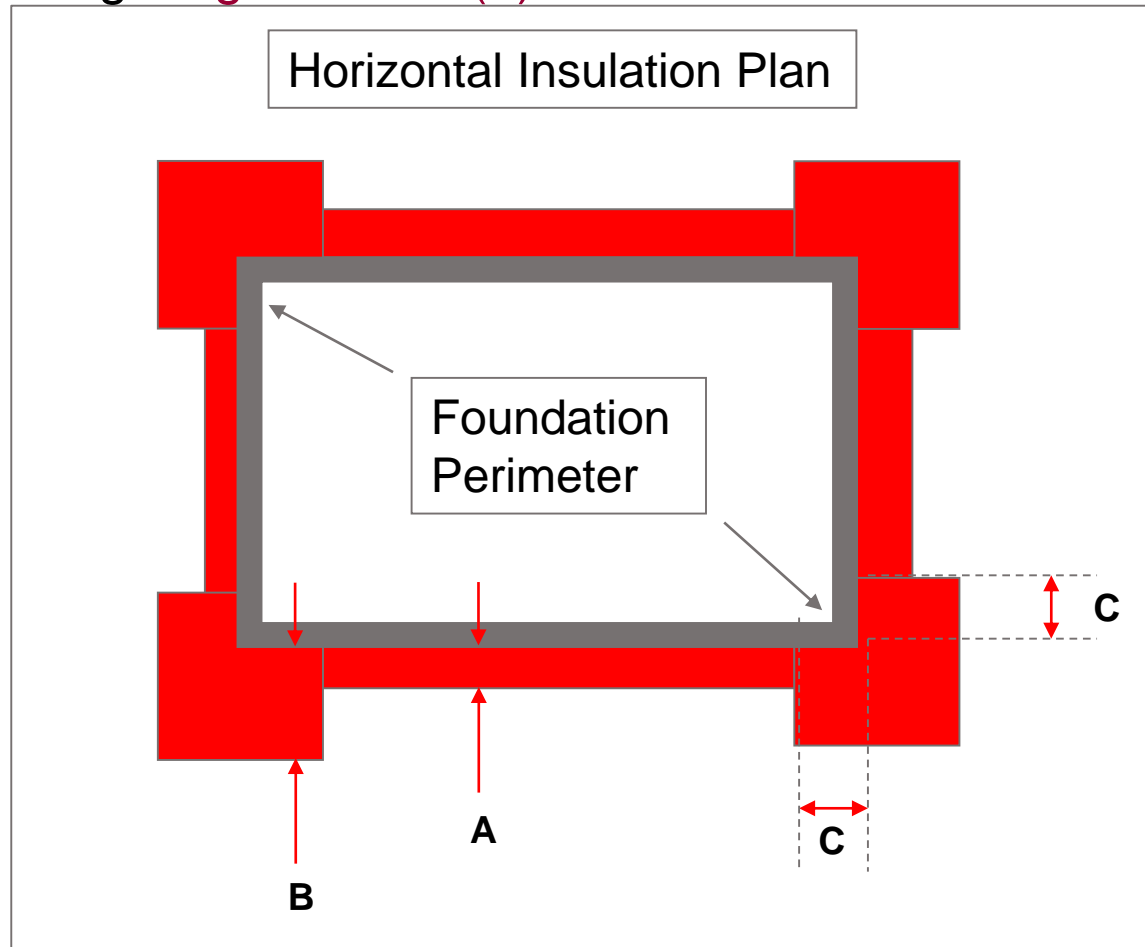
**MINIMUM FOOTING DEPTH AND INSULATION REQUIREMENTS FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS<sup>a</sup>**

AIR FREEZING INDEX (°F-days) <sup>b</sup>	MINIMUM FOOTING DEPTH, <i>D</i> (inches)	VERTICAL INSULATION R-VALUE <sup>c, d</sup>	HORIZONTAL INSULATION R-VALUE <sup>c, e</sup>		HORIZONTAL INSULATION DIMENSIONS PER FIGURE 403.3(1) (inches)		
			Along walls	At corners	A	B	C
1,500 or less	12	4.5	Not required	Not required	Not required	Not required	Not required
2,000	14	5.6	Not required	Not required	Not required	Not required	Not required

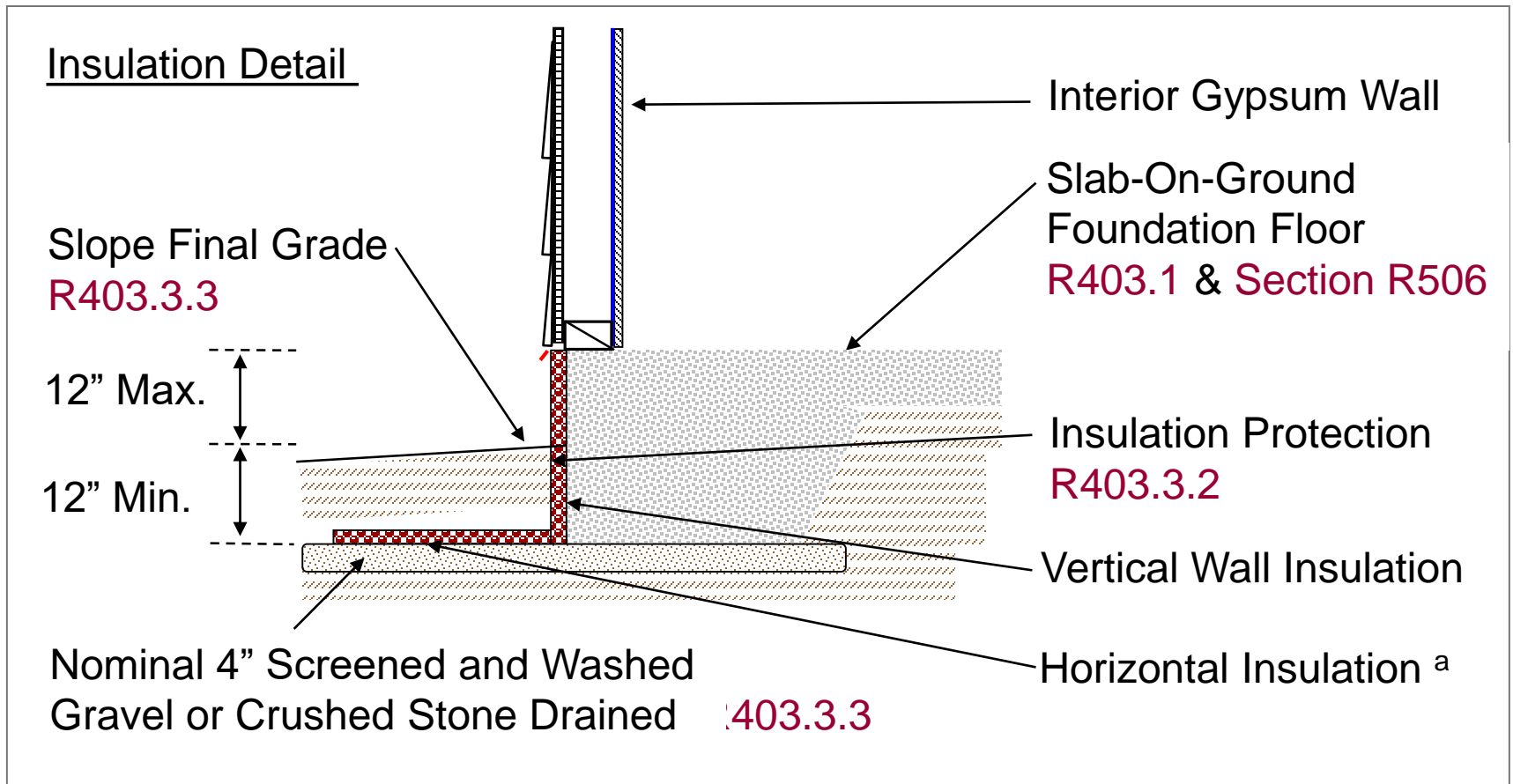
For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.

- Insulation requirements are for protection against frost damage in heated buildings. Greater values could be required to meet energy conservation standards.
- See Figure 403.3(2) or Table 403.3(2) for Air Freezing Index values.
- Insulation materials shall provide the stated minimum R-values under long-term exposure to moist, below-ground conditions in freezing climates. The following R-values shall be used to determine insulation thicknesses required for this application: Type II expanded polystyrene (EPS)-3.2 R per inch for vertical insulation and 2.6 R per inch for horizontal insulation; Type IX expanded polystyrene (EPS)-3.4 R per inch for vertical insulation and 2.8 R per inch for horizontal insulation; Types IV, V, VI, VII, and X extruded polystyrene (XPS)-4.5 R per inch for vertical insulation and 4.0 R per inch for horizontal insulation.
- Vertical insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.
- Horizontal insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.

- \* Insulation placement for frost-protected footings in heated buildings **Figure 403.3(1)**



- \* Insulation placement for frost protected footings In heated buildings **Figure R03.3(1)**



## ◆ Foundation and Retaining Walls 404

- \* Concrete and masonry foundation walls **R404.1**
  - Design per TMS 402 (The Masonry Society) or this code **404.1.2**
  - Project drawings and details to be sealed if not per code
- \* Masonry foundations per **Tables 404.1.1(1)** through **404.1.1(4)**
  - Rubble stone masonry requirements in **404.1.8**
  - Unbalanced fill – the portion of the height of a wall which fill on the opposite side

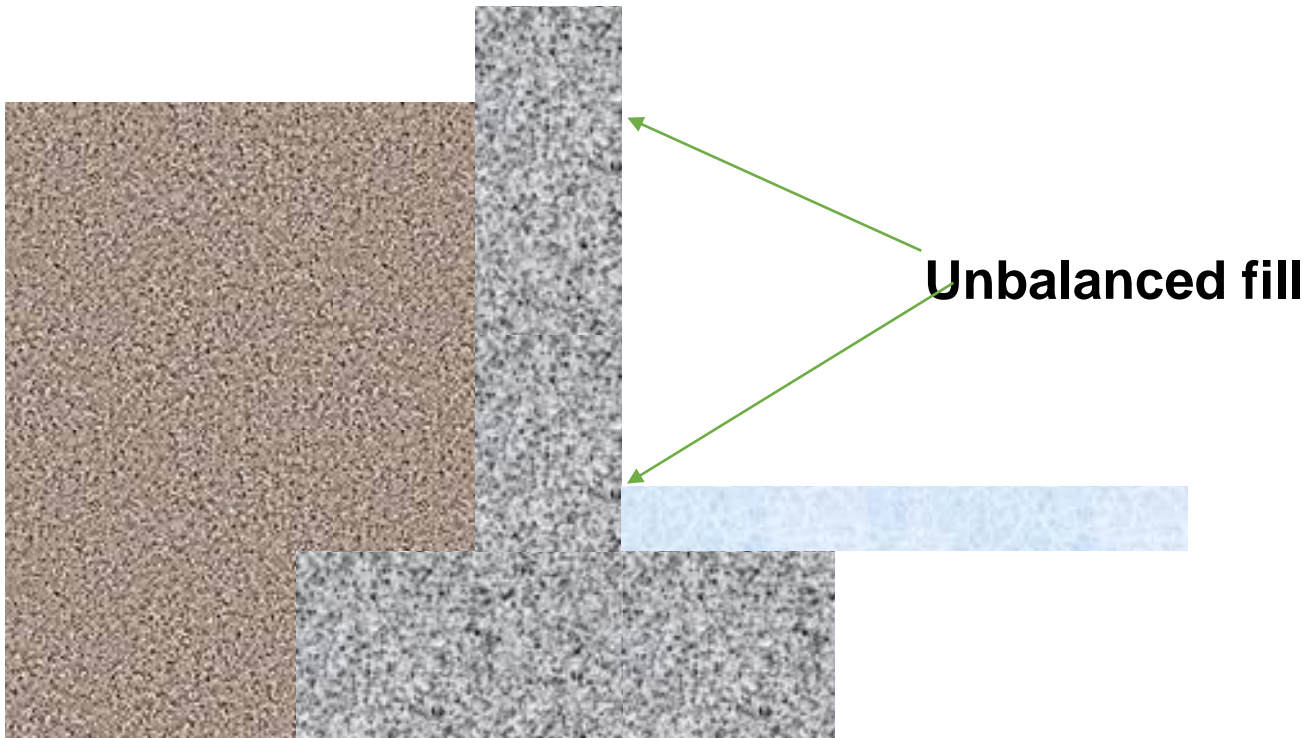
**TABLE 404.1.1(1)  
PLAIN MASONRY FOUNDATION WALLS<sup>1</sup>**

MAXIMUM WALL HEIGHT (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT <sup>c</sup> (feet)	PLAIN MASONRY <sup>a</sup> MINIMUM NOMINAL WALL THICKNESS (inches)		
		Soil classes <sup>b</sup>		
		GW, GP, SW and SP	GM, GC, SM, SM-SC and ML	SC, MH, ML-CL and inorganic CL
5	4	6 solid <sup>d</sup> or 8	6 solid <sup>d</sup> or 8	6 solid <sup>d</sup> or 8
	5	6 solid <sup>d</sup> or 8	8	10
6	4	6 solid <sup>d</sup> or 8	6 solid <sup>d</sup> or 8	6 solid <sup>d</sup> or 8
	5	6 solid <sup>d</sup> or 8	8	10
	6	8	10	12
7	4	6 solid <sup>d</sup> or 8	8	8
	5	6 solid <sup>d</sup> or 8	10	10
	6	10	12	10 solid <sup>d</sup>
	7	12	10 solid <sup>d</sup>	12 solid <sup>d</sup>
8	4	6 solid <sup>d</sup> or 8	6 solid <sup>d</sup> or 8	8
	5	6 solid <sup>d</sup> or 8	10	12
	6	10	12	12 solid <sup>d</sup>
	7	12	12 solid <sup>d</sup>	Footnote e
	8	10 grout <sup>d</sup>	12 grout <sup>d</sup>	Footnote e
9	4	6 grout <sup>d</sup> or 8 solid <sup>d</sup> or 12	6 grout <sup>d</sup> or 8 solid <sup>d</sup>	8 grout <sup>d</sup> or 10 solid <sup>d</sup>
	5	6 grout <sup>d</sup> or 10 solid <sup>d</sup>	8 grout <sup>d</sup> or 12 solid <sup>d</sup>	8 grout <sup>d</sup>
	6	8 grout <sup>d</sup> or 12 solid <sup>d</sup>	10 grout <sup>d</sup>	10 grout <sup>d</sup>
	7	10 grout <sup>d</sup>	10 grout <sup>d</sup>	12 grout
	8	10 grout <sup>d</sup>	12 grout	Footnote e
	9	12 grout	Footnote e	Footnote e



**TABLE .404.1.1(2)**  
**8-INCH MASONRY FOUNDATION WALLS WITH REINFORCING WHERE  $d \geq 5$  INCHES<sup>a, c, f</sup>**

WALL HEIGHT	HEIGHT OF UNBALANCED BACKFILL <sup>e</sup>	MINIMUM VERTICAL REINFORCEMENT AND SPACING (INCHES) <sup>b, c</sup>		
		Soil classes and lateral soil load <sup>d</sup> (psf per foot below grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM-SC and ML soils 45	SC, ML-CL and inorganic CL soils 60
6 feet 8 inches	4 feet (or less)	#4 at 48	#4 at 48	#4 at 48
	5 feet	#4 at 48	#4 at 48	#4 at 48
	6 feet 8 inches	#4 at 48	#5 at 48	#6 at 48
7 feet 4 inches	4 feet (or less)	#4 at 48	#4 at 48	#4 at 48
	5 feet	#4 at 48	#4 at 48	#4 at 48
	6 feet	#4 at 48	#5 at 48	#5 at 48
	7 feet 4 inches	#5 at 48	#6 at 48	#6 at 40
8 feet	4 feet (or less)	#4 at 48	#4 at 48	#4 at 48
	5 feet	#4 at 48	#4 at 48	#4 at 48
	6 feet	#4 at 48	#5 at 48	#5 at 48
	7 feet	#5 at 48	#6 at 48	#6 at 40
	8 feet	#5 at 48	#6 at 48	#6 at 32
8 feet 8 inches	4 feet (or less)	#4 at 48	#4 at 48	#4 at 48
	5 feet	#4 at 48	#4 at 48	#5 at 48
	6 feet	#4 at 48	#5 at 48	#6 at 48
	7 feet	#5 at 48	#6 at 48	#6 at 40
	8 feet 8 inches	#6 at 48	#6 at 32	#6 at 24
9 feet 4 inches	4 feet (or less)	#4 at 48	#4 at 48	#4 at 48
	5 feet	#4 at 48	#4 at 48	#5 at 48
	6 feet	#4 at 48	#5 at 48	#6 at 48
	7 feet	#5 at 48	#6 at 48	#6 at 40
	8 feet	#6 at 48	#6 at 40	#6 at 24
	9 feet 4 inches	#6 at 40	#6 at 24	#6 at 16
10 feet	4 feet (or less)	#4 at 48	#4 at 48	#4 at 48
	5 feet	#4 at 48	#4 at 48	#5 at 48
	6 feet	#4 at 48	#5 at 48	#6 at 48
	7 feet	#5 at 48	#6 at 48	#6 at 32
	8 feet	#6 at 48	#6 at 32	#6 at 24
	9 feet	#6 at 40	#6 at 24	#6 at 16
	10 feet	#6 at 32	#6 at 16	#6 at 16



\* Concrete foundation walls 404.1.3



- \* Concrete foundation walls **404.1.3**
  - In accordance with this code or ACI318, ACI 332, or PCA 100
  - Reinforcement **Tables 404.1.2(2)** through **404.1.2(7)** when upper stories are concrete per **608.2**
  - Basement walls **404.1.2(8)** with no above grade concrete walls
  - Horizontal reinforcement required per **404.1.3.2** & **Table 404.1.2(1)**
- \* Minimum horizontal reinforcement for concrete basement walls **Table 404.1.2(1)**

**TABLE 404.1.2(2)**  
**MINIMUM VERTICAL REINFORCEMENT FOR 6-INCH NOMINAL FLAT CONCRETE BASEMENT WALLS<sup>b, c, d, e, g, h, i, j, k</sup>**

MAXIMUM UNSUPPORTED WALL HEIGHT (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT <sup>f</sup> (feet)	MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches)		
		Soil classes <sup>a</sup> and design lateral soil (psf per foot of depth)		
		GW, GP, SW, SP 30	GM, GC, SM, SM-SC and ML 45	SC, ML-CL and inorganic CL 60
8	4	NR	NR	NR
	5	NR	6 @ 39	6 @ 48
	6	5 @ 39	6 @ 48	6 @ 35
	7	6 @ 48	6 @ 34	6 @ 25
	8	6 @ 39	6 @ 25	6 @ 18
9	4	NR	NR	NR
	5	NR	5 @ 37	6 @ 48
	6	5 @ 36	6 @ 44	6 @ 32
	7	6 @ 47	6 @ 30	6 @ 22
	8	6 @ 34	6 @ 22	6 @ 16
	9	6 @ 27	6 @ 17	DR
10	4	NR	NR	NR
	5	NR	5 @ 35	6 @ 48
	6	6 @ 48	6 @ 41	6 @ 30
	7	6 @ 43	6 @ 28	6 @ 20
	8	6 @ 31	6 @ 20	DR
	9	6 @ 24	6 @ 15	DR
	10	6 @ 19	DR	DR

- \* Vertical reinforcement for concrete basement walls **Table 404.1.2(2)**
  - Additional requirements per Tables
  - Stem wall connection reinforcement
  - Vertical reinforcement in center of wall
  - Vertical reinforcement at wall opening within 12" of each side
  - 1-½" of cover in forms for #5 and smaller, 2" for all others
  
- \* Grade 60 assumed, **Table 494.1.2(9)** for conversion to other grades



\* Minimum horizontal reinforcement for concrete basement

TABLE 404.1.2(1)  
MINIMUM HORIZONTAL REINFORCEMENT FOR CONCRETE BASEMENT WALLS<sup>a, b</sup>

MAXIMUM UNSUPPORTED HEIGHT OF BASEMENT WALL (feet)	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.

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa.

a. Horizontal reinforcement requirements are for reinforcing bars with a minimum yield strength of 40,000 psi and concrete with a minimum concrete compressive strength of 2,500 psi.

b. See Section 404.1.3.2 for minimum reinforcement required for foundation walls supporting above-grade concrete walls.



- \* Minimum vertical reinforcement for 6", 8", 10" and 12" nominal flat basement walls **Table 404.1.2(8)**

**TABLE 404.1.2(8)**  
**MINIMUM VERTICAL REINFORCEMENT FOR 6-, 8-, 10- AND 12-INCH NOMINAL FLAT BASEMENT WALLS<sup>b, c, d, e, f, h, i, k, n, o</sup>**

MAXIMUM WALL HEIGHT (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT <sup>g</sup> (feet)	MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches)											
		Soil classes <sup>a</sup> and design lateral soil (psf per foot of depth)											
		GW, GP, SW, SP 30				GM, GC, SM, SM-SC and ML 45				SC, ML-CL and inorganic CL 60			
		Minimum nominal wall thickness (inches)											
		6	8	10	12	6	8	10	12	6	8	10	12
5	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
6	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR <sup>l</sup>	NR	NR	4 @ 35	NR <sup>l</sup>	NR	NR
	6	NR	NR	NR	NR	5 @ 48	NR	NR	NR	5 @ 36	NR	NR	NR
7	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR	NR	NR	5 @ 47	NR	NR	NR
	6	NR	NR	NR	NR	5 @ 42	NR	NR	NR	6 @ 43	5 @ 48	NR <sup>l</sup>	NR
	7	5 @ 46	NR	NR	NR	6 @ 42	5 @ 46	NR <sup>l</sup>	NR	6 @ 34	6 @ 48	NR	NR
8	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	4 @ 38	NR <sup>l</sup>	NR	NR	5 @ 43	NR	NR	NR
	6	4 @ 37	NR <sup>l</sup>	NR	NR	5 @ 37	NR	NR	NR	6 @ 37	5 @ 43	NR <sup>l</sup>	NR
	7	5 @ 40	NR	NR	NR	6 @ 37	5 @ 41	NR <sup>l</sup>	NR	6 @ 34	6 @ 43	NR	NR
	8	6 @ 43	5 @ 47	NR <sup>l</sup>	NR	6 @ 34	6 @ 43	NR	NR	6 @ 27	6 @ 32	6 @ 44	NR
	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR



- \* Grade 60 assumed, minimum spacing for alternate bar size and/or alternate grade of steel **Table 404.1.2(9)**

**TABLE 404.1.2(9)**  
**MINIMUM SPACING FOR ALTERNATE BAR SIZE AND/OR ALTERNATE GRADE OF STEEL<sup>a, b, c</sup>**

BAR SPACING FROM APPLICABLE TABLE IN SECTION <a href="#">R404.1.3.2</a> (inches)	BAR SIZE FROM APPLICABLE TABLE IN SECTION <a href="#">R404.1.3.2</a>														
	#4					#5					#6				
	Alternate bar size and/or alternate grade of steel desired														
	Grade 60		Grade 40			Grade 60		Grade 40			Grade 60		Grade 40		
	#5	#6	#4	#5	#6	#4	#6	#4	#5	#6	#4	#5	#4	#5	#6
	Maximum spacing for alternate bar size and/or alternate grade of steel (inches)														
8	12	18	5	8	12	5	11	3	5	8	4	6	2	4	5
9	14	20	6	9	13	6	13	4	6	9	4	6	3	4	6
10	16	22	7	10	15	6	14	4	7	9	5	7	3	5	7
11	17	24	7	11	16	7	16	5	7	10	5	8	3	5	7
12	19	26	8	12	18	8	17	5	8	11	5	8	4	6	8
13	20	29	9	13	19	8	18	6	9	12	6	9	4	6	9
14	22	31	9	14	21	9	20	6	9	13	6	10	4	7	9
15	23	33	10	16	22	10	21	6	10	14	7	11	5	7	10
16	25	35	11	17	23	10	23	7	11	15	7	11	5	8	11
17	26	37	11	18	25	11	24	7	11	16	8	12	5	8	11
18	28	40	12	19	26	12	26	8	12	17	8	13	5	8	12
19	29	42	13	20	28	12	27	8	13	18	9	13	6	9	13
20	31	44	13	21	29	13	28	9	13	19	9	14	6	9	13
21	32	46	14	22	31	14	29	9	14	20	10	15	6	10	14

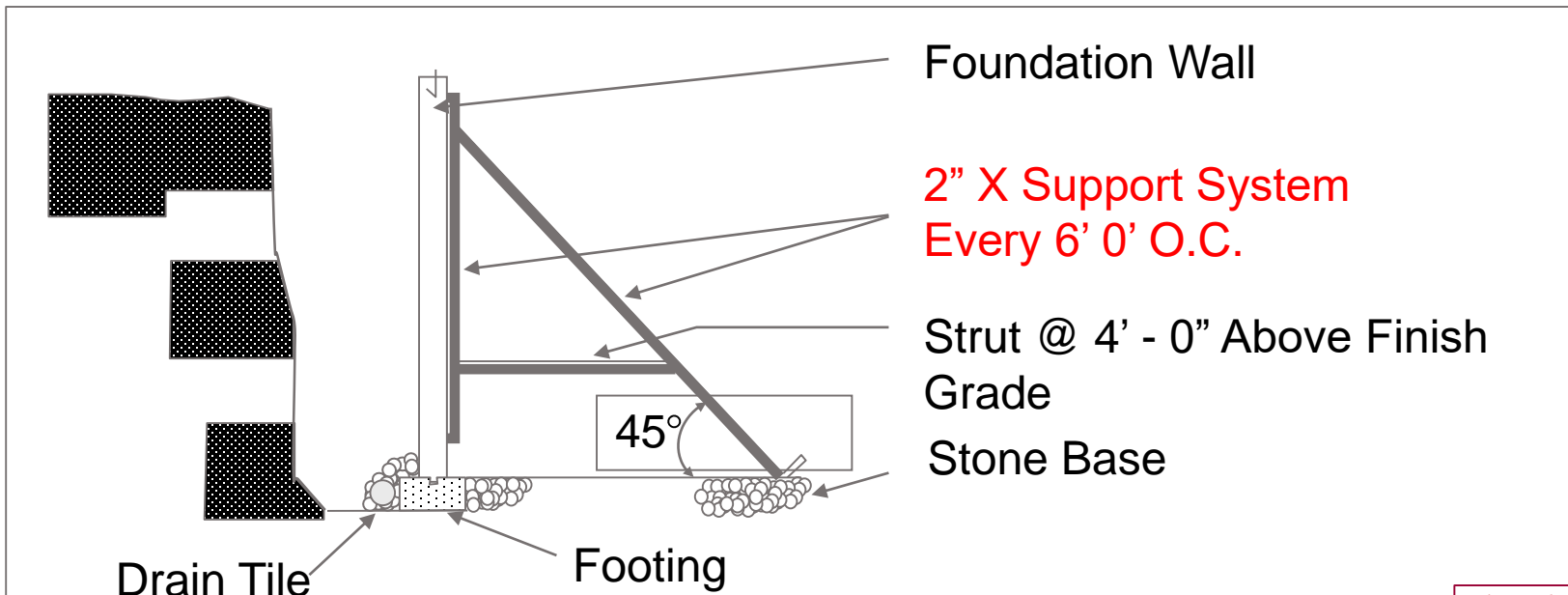
- \* Lap splices [404.1.3.3.7.5](#) / [608.5.4.1](#)
  - Lap splice length: see [Table 608.5.4\(1\)](#)
  - Gap between rebars not to exceed the smaller of 1/5 lap length and 6"
  - Rebars are permitted to be in contact with each other



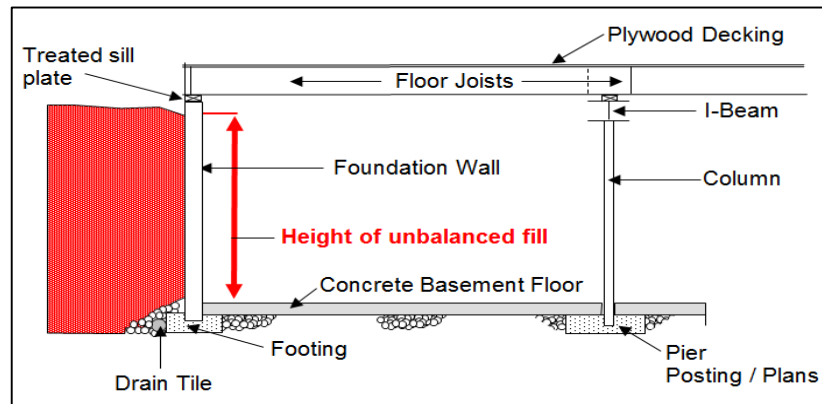
- \* Concrete, materials for concrete, and forms **404.1.3.3**
  - Per **ACI 318**
  - 2,500 psi at 28 days minimum Seismic Zone A, B and C
  - 3,000 psi in all D zones
  - Maximum aggregate  $\frac{1}{5}$  narrowest form dimension or  $\frac{3}{4}$  the spacing between reinforcement and formwork
  - Slump not to exceed 6" when using removable forms
  - Form material requirements **R404.1.3.3.6**

- \* Requirements for seismic design category C 404.1.3.4  
404.1.4
  - Seismic design category D0, D1 or D2 404.1.4
  - Backfill, wall thickness, wall height limitations
- \* Foundation wall thickness based on walls supported 404.1.5
  - Concrete
    - As thick as wall supported
    - Corbelled, bracketing or projecting walls must be engineered
  - Masonry
    - As thick as wall supported
    - 8" minimum thickness

- \* Height above finished grade **404.1.6**
  - 4" above grade for masonry veneer, 6" elsewhere
  - Not to be backfilled prior to support
- \* Backfill placement **404.1.7**
  - 4" above grade for masonry veneer, 6" elsewhere
  - Not to be backfilled prior to support

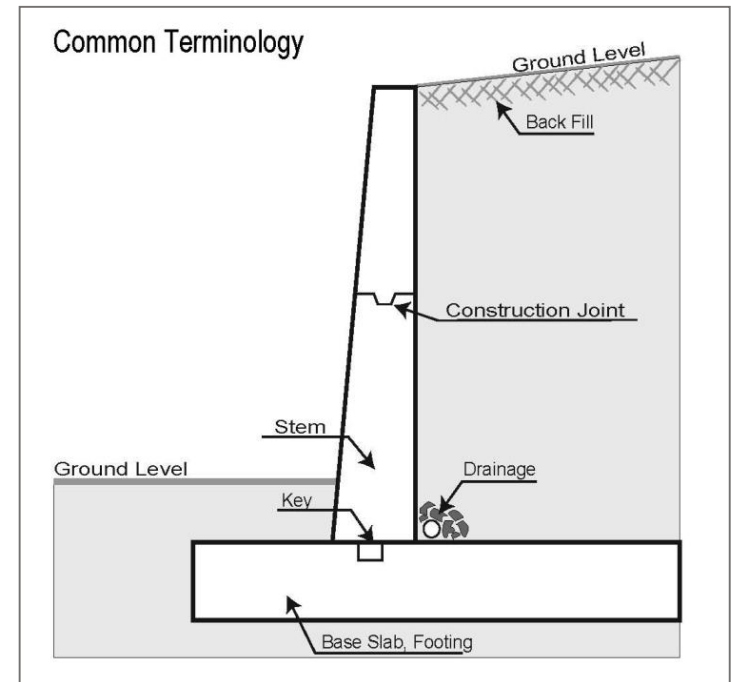


- \* Design required **404.1.1**
  - Wood, precast and ICF when:
    - Hydrostatic pressure
    - Supporting >48” of unbalanced backfill w/o permanent lateral support at top or bottom
- R404.1.3.2**
- \* Isolated masonry piers **404.1.9**
  - Provides prescriptive requirements for isolated masonry pier foundations supporting raised floor systems

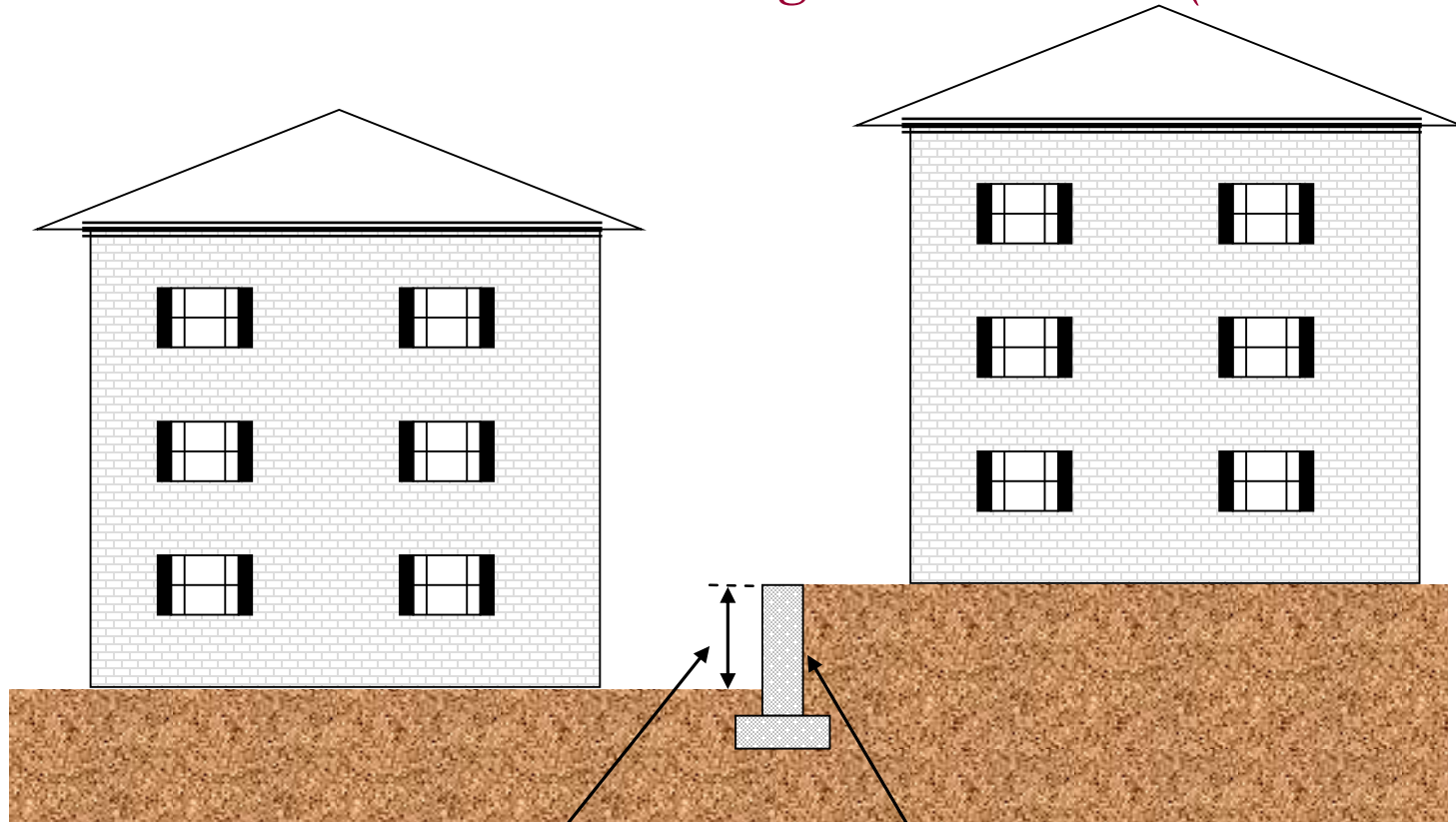


\* Retaining walls 404.4

- Designates when a wall is a retaining wall and provides specific design criteria
- IF: Retaining walls not laterally supported at top
- AND: >48" of unbalanced fill or more than 24" in height
- THEN: Design to ensure stability against overturning, sliding, excessive foundation pressure and water uplift
- Design for 1.5x safety factor against lateral sliding and overturning



◆ Foundation and Retaining Walls R404 (*continued*)



Height  $\geq 24''$   
And resists  
additional  
loads

Design to Safety  
Factor of 1.5

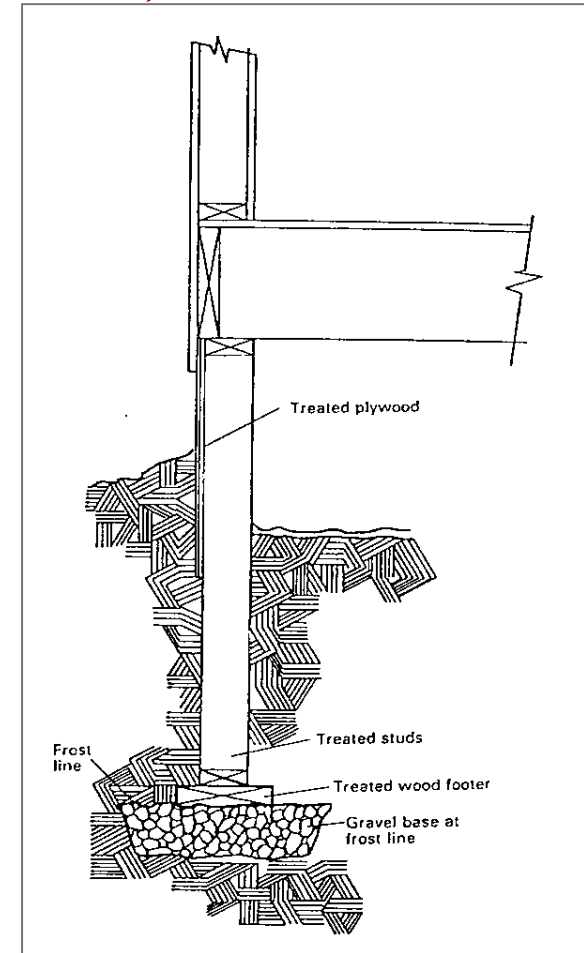
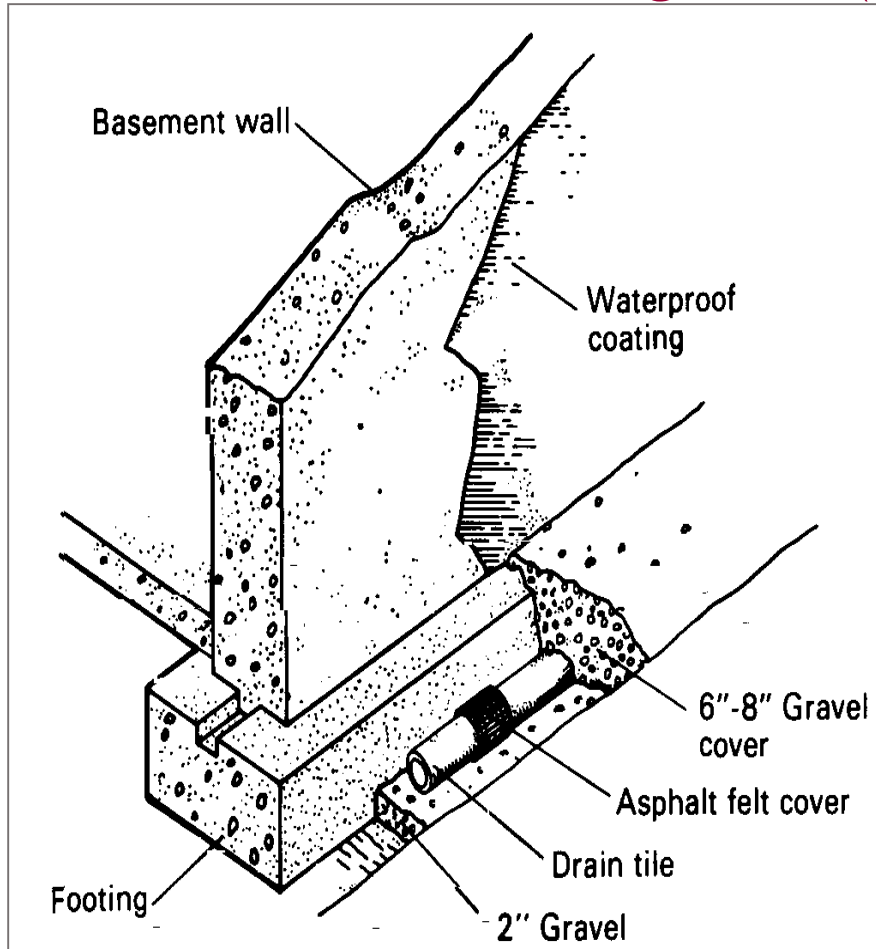


## ◆ Foundation Drainage 405

- \* Wood foundations 405.2
- \* Concrete or masonry foundations 405.1
- \* Drainage tiles; gravel or crushed stone, perforated pipe or other approved means
- \* Filter membrane is required for perforated pipe unless covered w/washed gravel or rock



◆ Foundation Drainage 405 (continued)



- \* Concrete and masonry foundation dampproofing 406.1
  - Foundation walls retaining earth and enclosing interior spaces & floors below grade
  - Dampproofed from top of footing to finished grade
  - Includes concrete walls

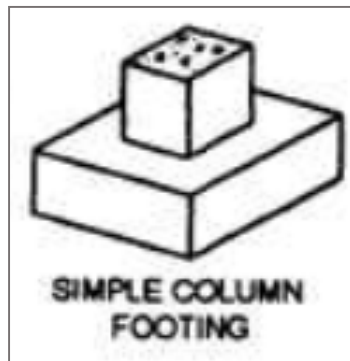


- \* Waterproofing **406.2**
  - Prescriptive specifications for waterproofing foundation walls only required with a high water table



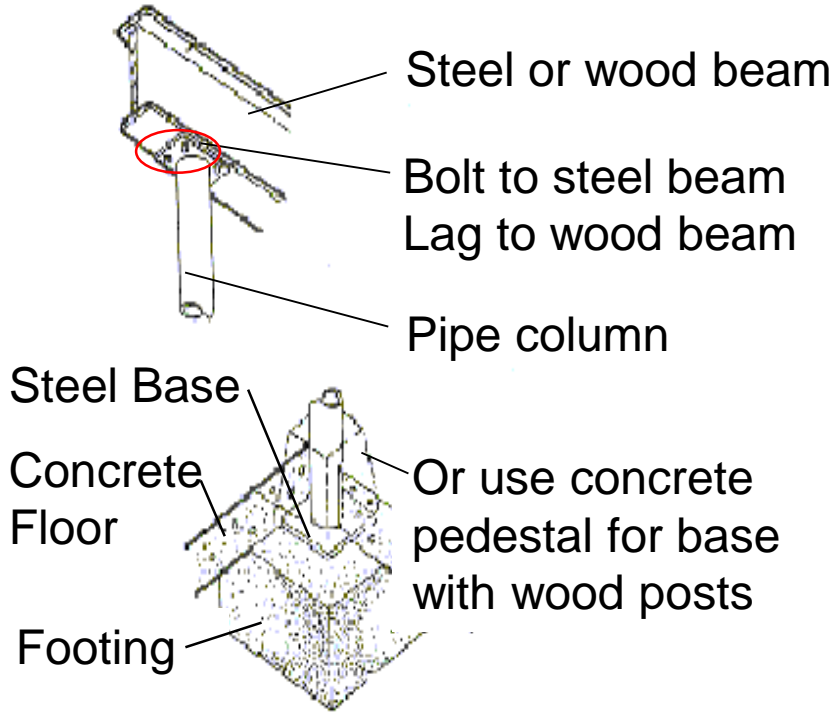
## ◆ Columns 407

- \* Wood column protection 407.1
  - Minimum 4 x 4 and protected from decay
- \* Steel column protection 407.2
  - Protected from corrosion
- \* Structural requirements 407.3
  - Restrained to prevent movement at bottom



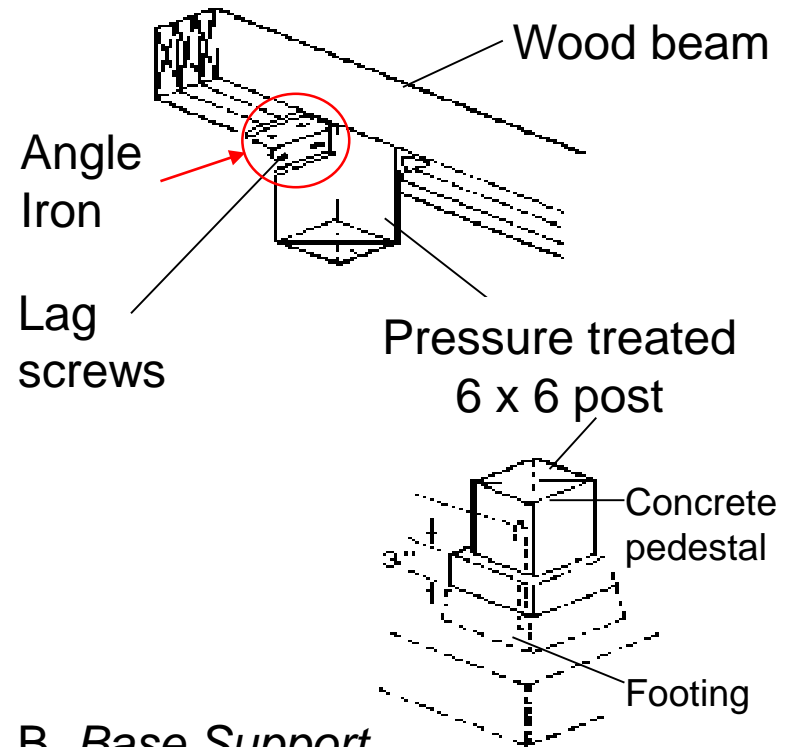
## ◆ Columns 407 (*continued*)

### A. Connection To Beam



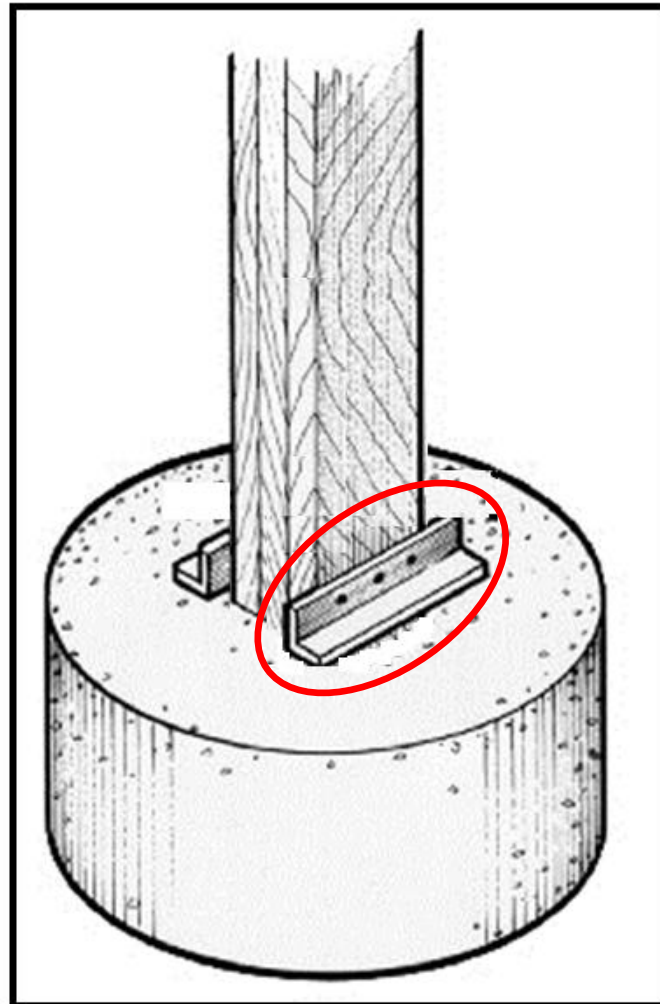
### B. Base Support

### A. Connection To Beam



### B. Base Support

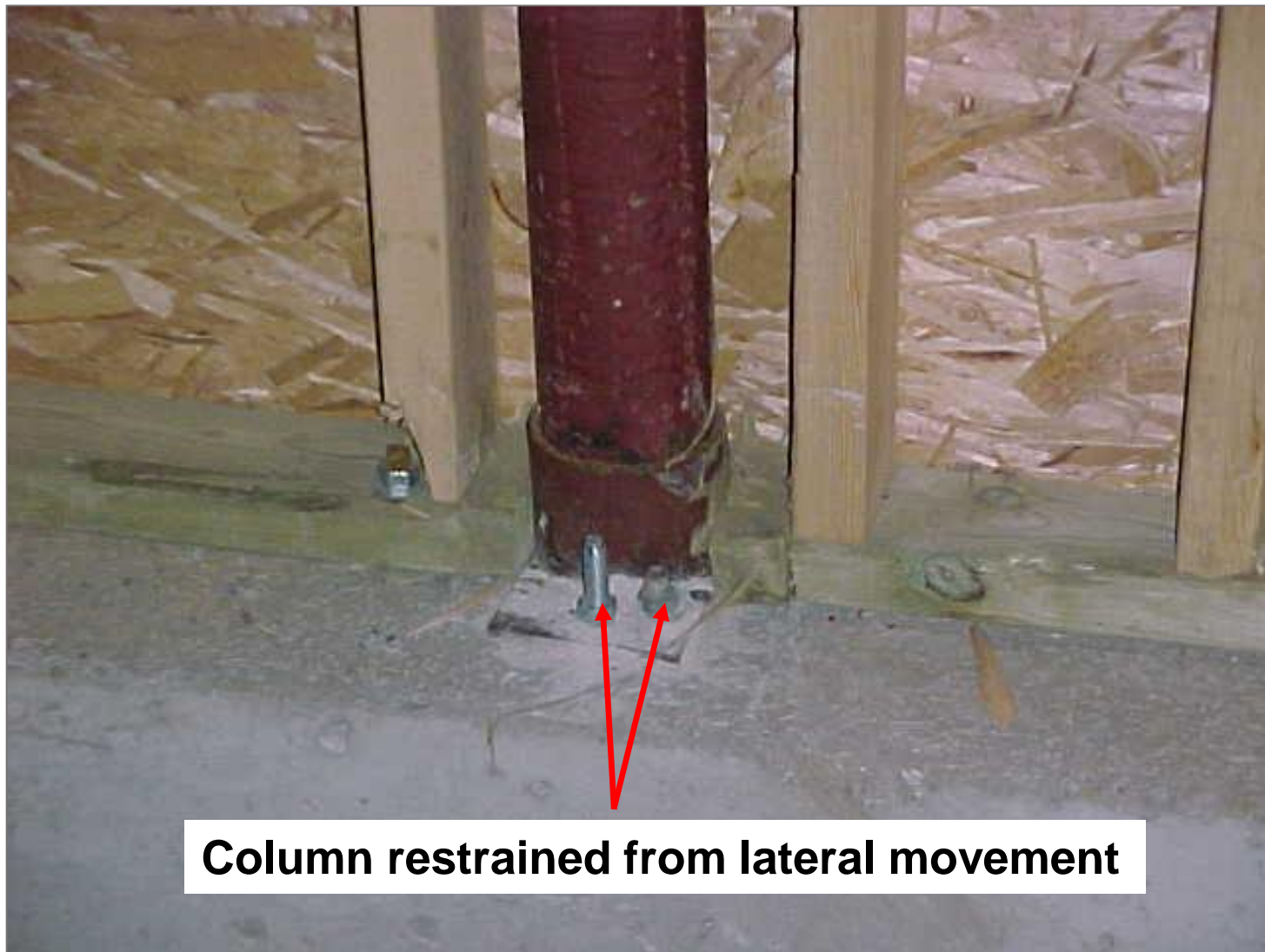
◆ Columns 407 (*continued*)



**Restrained at the  
bottom**



\* Structural requirements 407.3

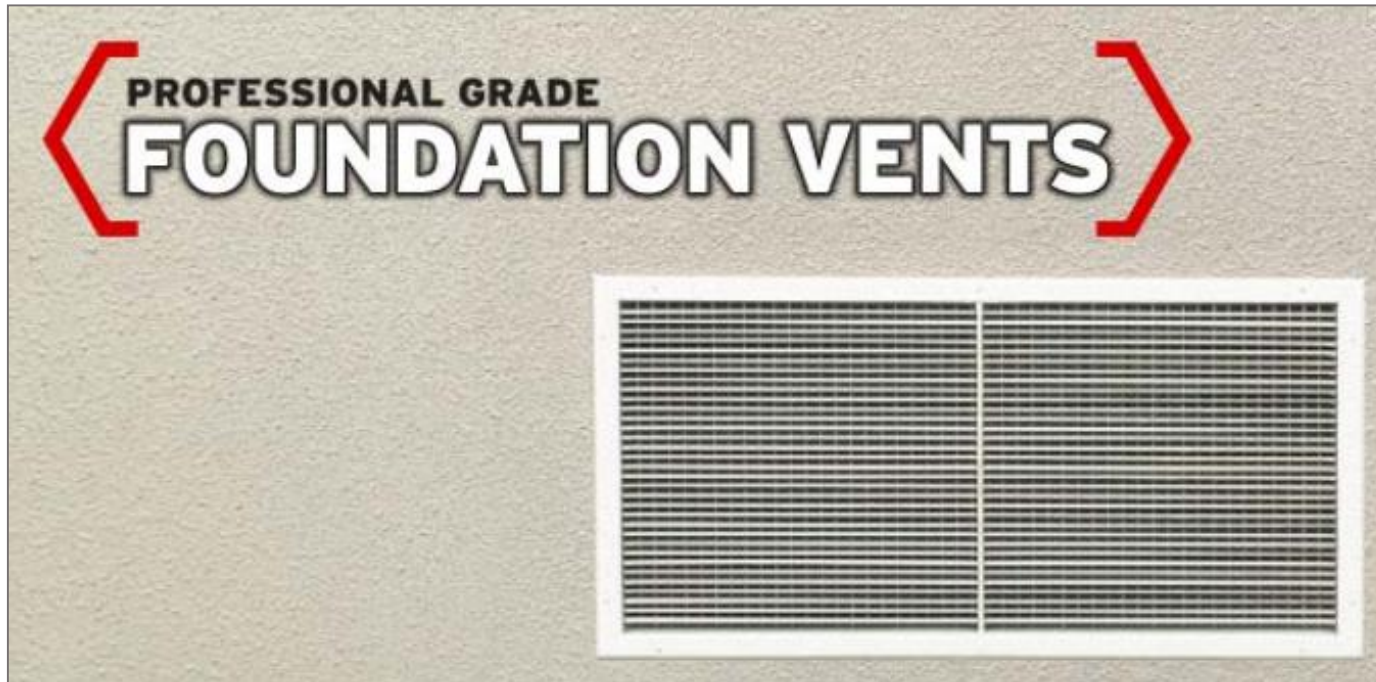


**Column restrained from lateral movement**

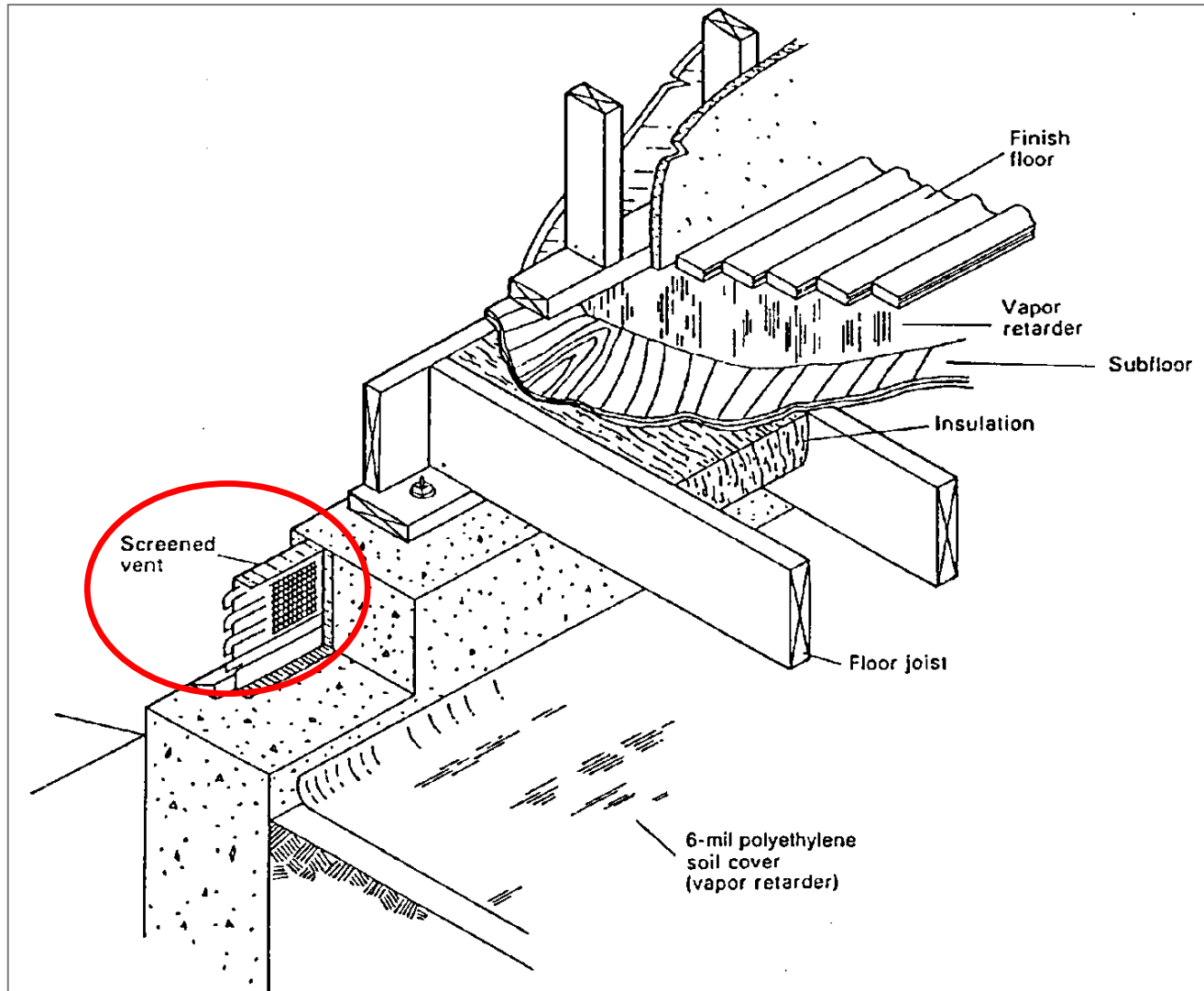


## ◆ Under-Floor Space 408

- \* Vents are mandatory
- \* Openings for under-floor ventilation **408.2**
- \* Ventilation – 1 square foot per 150 square feet
- \* At least 3' from each corner of the building



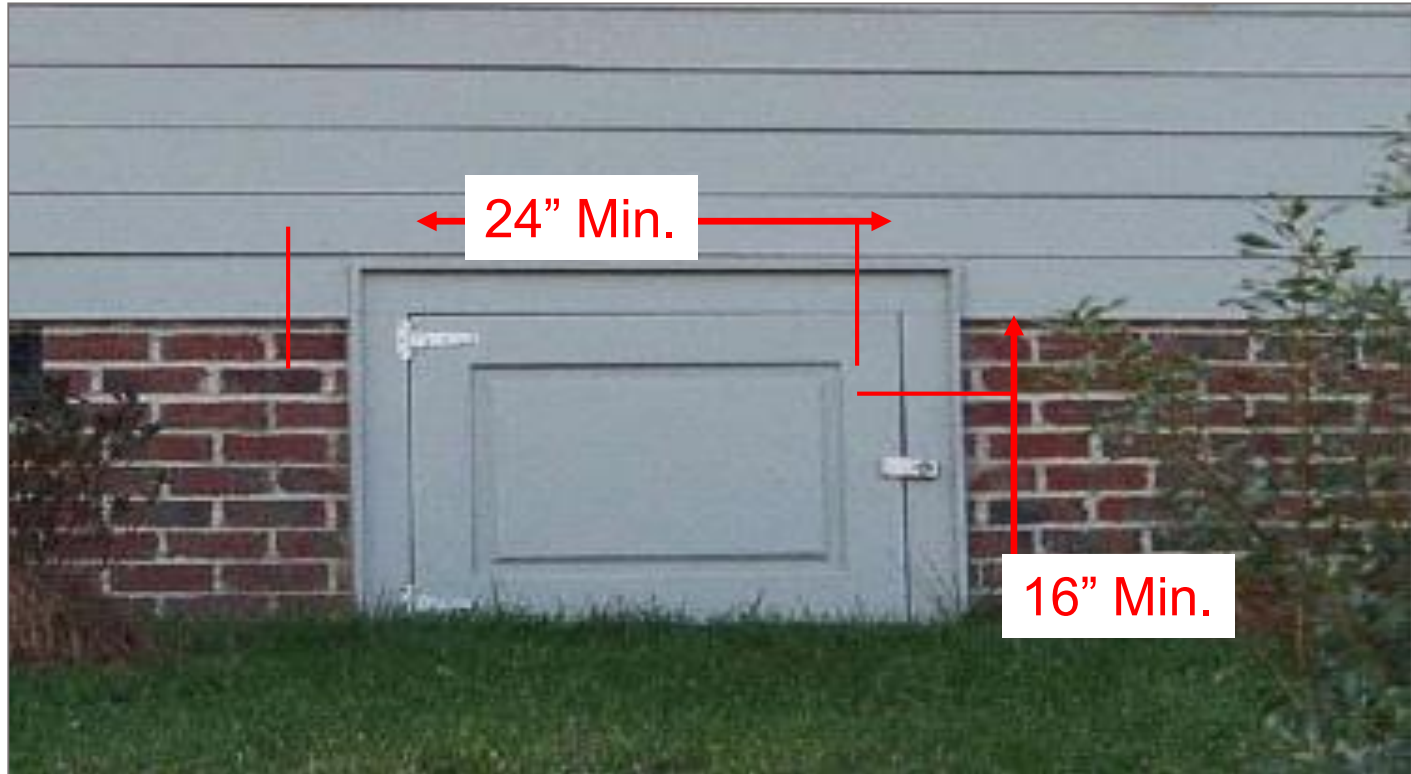
\* Ventilation 408.2



- \* Unvented crawl spaces **408.3**
  - Designed to improve health and energy conservation
  - Exposed earth needs a vapor retardant barrier:
    - 6” laps on barrier
    - Edges extend up on the wall
    - Taped and sealed on the wall
  - OR one of the following conditions:
    - Continuously operated mechanical exhaust system
    - Conditioned air supply sized to deliver 1 cfm to under- floor area
    - Plenum complying with **M1601.4** if under-floor space is used as plenum

- \* Access **408.4**
  - Provide access to all under-floor areas
  - Through floor: 18" x 24"
  - Through perimeter walls: 16" x 24"
  - Below grade access areaway: 16" x 24"
  - Bottom of areaway must be below threshold of access opening
- \* Finished grade of under-floor surface **R408.6**
- \* Flood resistance **R408.7**

\* Access 408.4



\* Foundation Insulation exposed 409

- Rigid, exposed, weather resistant – 6 inches below grade

# BFC<sup>®</sup>A

## Building & Fire Code Academy

### Understanding the 2019 Residential Code of Ohio

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### Chapter 5 Floors

## ◆ General R501

- \* Includes all floors including attics for mechanical and plumbing
- \* Transmit all loads to structure

## ◆ Wood Floor Framing 502

- \* Sawn lumber requires a grade stamp
- \* Design values per DOC PS 2 (Department of Commerce)
- \* End jointed lumber can be used – same size and species
  - Marked as HRA (Heat resistant adhesive) if in a rated assembly



- \* Prefabricated I joists per **ASTM D5055**
- \* Structural glue laminated timbers per **ANSI A190.1, ANSI 117, ASTM D3737**
- \* Structural log members per **ICC 400**
- \* Cross-laminated timbers per **ANSI/APA PRG 320**
- \* Engineered rim boards per appropriate standard

- \* Design and construction **502.2**
  - Framing at braced wall lines
    - Load path to connect braced wall lines to floor
    - Blocking of the floor framing at braced wall lines, see **Section 602.10.6**
    - Must determine / Identify method of bracing used
    - Framing requirements must meet transfer of lateral loads by means of blocking and rim joists for proper continuity of load path

\* Blocking and sub-flooring

- Fastening panel edges or fixtures not less than utility grade lumber
- Certificate of Inspection can substitute for grade mark on log member

- \* Sleeping area and attic joists **502.3.1**
  - **Table 502.3.1(1)** is used to determine maximum allowable span of floor joists that support sleeping areas and attics accessed by a fixed stairway
  - Reference to **311.7** for live loads does not exceed 30 psf, and designed load is 20 psf
  - See **Table 502.3.1(1)**

**TABLE . 502.3.1(1)**  
**FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES**  
 (Residential sleeping areas, live load = 30 psf, L/Δ = 360)<sup>a</sup>

JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf				DEAD LOAD = 20 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
			Maximum floor joist spans							
			(ft - in.)	(ft - in.)	(ft - n.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)
12	Douglas fir-larch	SS	12-6	16-6	21-0	25-7	12-6	16-6	21-0	25-7
	Douglas fir-larch	#1	12-0	15-10	20-3	24-8	12-0	15-7	19-0	22-0
	Douglas fir-larch	#2	11-10	15-7	19-10	23-0	11-6	14-7	17-9	20-7
	Douglas fir-larch	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Hem-fir	SS	11-10	15-7	19-10	24-2	11-10	15-7	19-10	24-2
	Hem-fir	#1	11-7	15-3	19-5	23-7	11-7	15-2	18-6	21-6
	Hem-fir	#2	11-0	14-6	18-6	22-6	11-0	14-4	17-6	20-4
	Hem-fir	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Southern pine	SS	12-3	16-2	20-8	25-1	12-3	16-2	20-8	25-1
	Southern pine	#1	12-0	15-10	20-3	24-8	12-0	15-10	20-3	24-8
	Southern pine	#2	11-10	15-7	19-10	24-2	11-10	15-7	18-7	21-9
	Southern pine	#3	10-5	13-3	15-8	18-8	9-4	11-11	14-0	16-8
	Spruce-pine-fir	SS	11-7	15-3	19-5	23-7	11-7	15-3	19-5	23-7
	Spruce-pine-fir	#1	11-3	14-11	19-0	23-0	11-3	14-7	17-9	20-7
	Spruce-pine-fir	#2	11-3	14-11	19-0	23-0	11-3	14-7	17-9	20-7
	Spruce-pine-fir	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Douglas fir-larch	SS	11-4	15-0	19-1	23-3	11-4	15-0	19-1	23-0
	Douglas fir-larch	#1	10-11	14-5	18-5	21-4	10-8	13-6	16-5	19-1
	Douglas fir-larch	#2	10-9	14-1	17-2	19-11	9-11	12-7	15-5	17-10
	Douglas fir-larch	#3	8-5	10-8	13-0	15-1	7-6	9-6	11-8	13-6
	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	20-9	10-4	13-1	16-0	18-7
	Hem-fir	#2	10-0	13-2	16-10	19-8	9-10	12-5	15-2	17-7

- \* Other floor joists 502.3.2
  - Table 502.3.1(2) is used to determine maximum allowable span of floor joists that support other living areas
  - Live load does not exceed 40 psf designed load is 20 psf
  - See Table 502.3.1(2)

**TABLE 502.3.1(2)**  
**FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES**  
 (Residential living areas, live load = 40 psf, L/Δ = 360)<sup>b</sup>

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

- \* Floor joist cantilevers **502.3.3**
  - Not exceed the normal depth of wood floor joists
  - See **Table 502.3.3(1)**
  - Balcony cantilevers
  - See **Table 502.3.3(2)**



**TABLE . 502.3.1(1)**  
**FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES**  
 (Residential sleeping areas, live load = 30 psf, L/Δ = 360)<sup>a</sup>

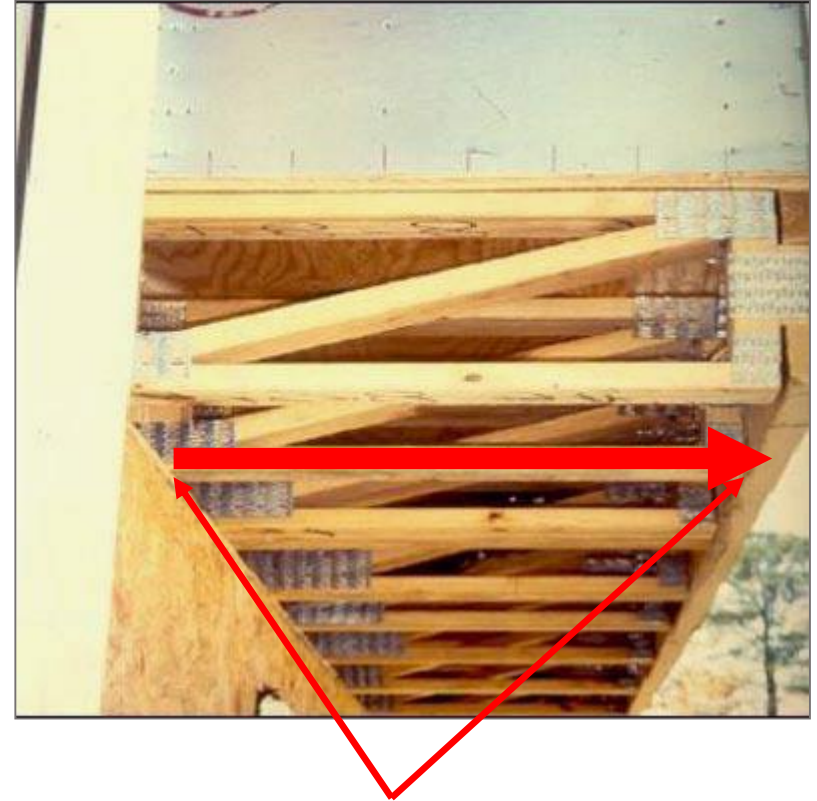
JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf				DEAD LOAD = 20 psf			
			2 x 6	2 x 8	2 x 10	2 x 12	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum floor joist spans							
			(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)
12	Douglas fir-larch	SS	12-6	16-6	21-0	25-7	12-6	16-6	21-0	25-7
	Douglas fir-larch	#1	12-0	15-10	20-3	24-8	12-0	15-7	19-0	22-0
	Douglas fir-larch	#2	11-10	15-7	19-10	23-0	11-6	14-7	17-9	20-7
	Douglas fir-larch	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Hem-fir	SS	11-10	15-7	19-10	24-2	11-10	15-7	19-10	24-2
	Hem-fir	#1	11-7	15-3	19-5	23-7	11-7	15-2	18-6	21-6
	Hem-fir	#2	11-0	14-6	18-6	22-6	11-0	14-4	17-6	20-4
	Hem-fir	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Southern pine	SS	12-3	16-2	20-8	25-1	12-3	16-2	20-8	25-1
	Southern pine	#1	12-0	15-10	20-3	24-8	12-0	15-10	20-3	24-8
	Southern pine	#2	11-10	15-7	19-10	24-2	11-10	15-7	18-7	21-9
	Southern pine	#3	10-5	13-3	15-8	18-8	9-4	11-11	14-0	16-8
	Spruce-pine-fir	SS	11-7	15-3	19-5	23-7	11-7	15-3	19-5	23-7
	Spruce-pine-fir	#1	11-3	14-11	19-0	23-0	11-3	14-7	17-9	20-7
	Spruce-pine-fir	#2	11-3	14-11	19-0	23-0	11-3	14-7	17-9	20-7
	Spruce-pine-fir	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Douglas fir-larch	SS	11-4	15-0	19-1	23-3	11-4	15-0	19-1	23-0
	Douglas fir-larch	#1	10-11	14-5	18-5	21-4	10-8	13-6	16-5	19-1
	Douglas fir-larch	#2	10-9	14-1	17-2	19-11	9-11	12-7	15-5	17-10
	Douglas fir-larch	#3	8-5	10-8	13-0	15-1	7-6	9-6	11-8	13-6
	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	20-9	10-4	13-1	16-0	18-7
	Hem-fir	#2	10-0	13-2	16-10	19-8	9-10	12-5	15-2	17-7

- \* Floor joist cantilevers **502.3.3**
  - Normal depth of wood floor joists **Table 502.3.3(1)**
  - Balcony cantilevers **Table 502.3.3(2)**

Cantilevered  
joists at exterior  
wall



\* Floor joist cantilevers – exterior view



Floor joists cantilevered out over exterior wall line



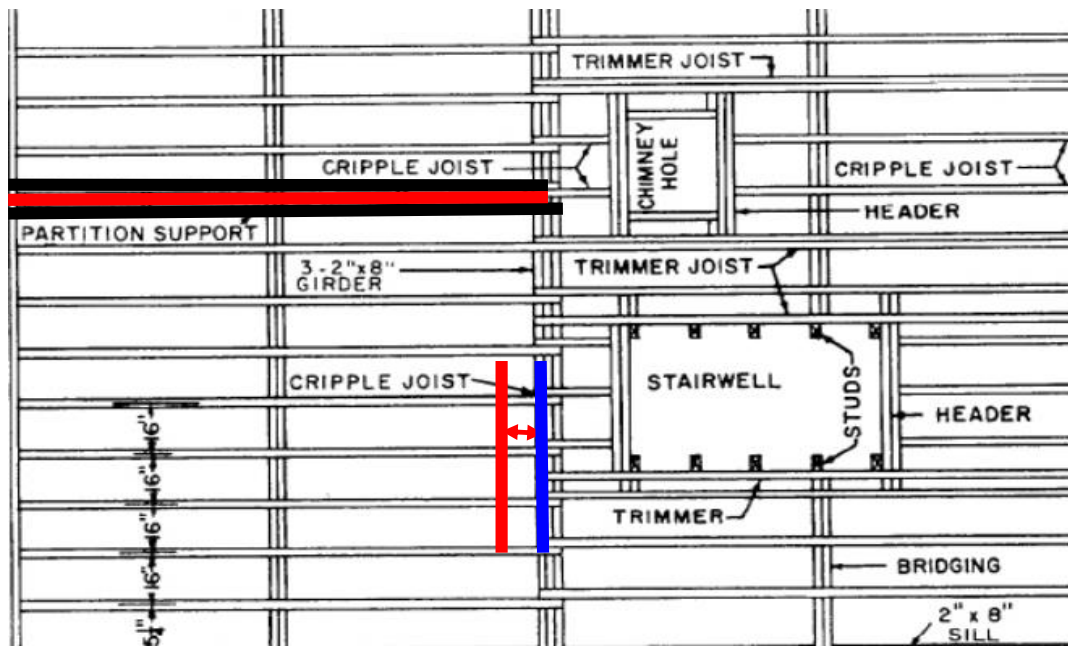
**TABLE 502.3.3(1)**  
**CANTILEVER SPANS FOR FLOOR JOISTS SUPPORTING LIGHT-FRAME EXTERIOR BEARING WALL AND ROOF ONLY<sup>a, b, c, f, g, h</sup>**  
**(Floor Live Load ≤ 40 psf, Roof Live Load ≤ 20 psf)**

Member & Spacing	Maximum Cantilever Span (Uplift Force at Backspan Support in Lbs.) <sup>d, e</sup>											
	Ground Snow Load											
	≤ 20 psf			30 psf			50 psf			70 psf		
	Roof Width			Roof Width			Roof Width			Roof Width		
	24 ft	32 ft	40 ft	24 ft	32 ft	40 ft	24 ft	32 ft	40 ft	24 ft	32 ft	40 ft
2 × 8 @ 12"	20" (177)	15" (227)	—	18" (209)	—	—	—	—	—	—	—	—
2 × 10 @ 16"	29" (228)	21" (297)	16" (364)	26" (271)	18" (354)	—	20" (375)	—	—	—	—	—
2 × 10 @ 12"	36" (166)	26" (219)	20" (270)	34" (198)	22" (263)	16" (324)	26" (277)	—	—	19" (356)	—	—
2 × 12 @ 16"	—	32" (287)	25" (356)	36" (263)	29" (345)	21" (428)	29" (367)	20" (484)	—	23" (471)	—	—
2 × 12 @ 12"	—	42" (209)	31" (263)	—	37" (253)	27" (317)	36" (271)	27" (358)	17" (447)	31" (348)	19" (462)	—
2 × 12 @ 8"	—	48" (136)	45" (169)	—	48" (164)	38" (206)	—	40" (233)	26" (294)	36" (230)	29" (304)	18" (379)

**TABLE 502.3.3(2)**  
**CANTILEVER SPANS FOR FLOOR JOISTS SUPPORTING EXTERIOR BALCONY<sup>a, b, e,</sup>**

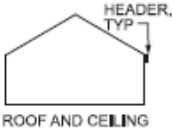
Member Size	Spacing	Maximum Cantilever Span (Uplift Force at Backspan Support in lb) <sup>c, d</sup>		
		Ground Snow Load		
		≤ 30 psf	50 psf	70 psf
2 × 8	12"	42" (139)	39" (156)	34" (165)
2 × 8	16"	36" (151)	34" (171)	29" (180)
2 × 10	12"	61" (164)	57" (189)	49" (201)
2 × 10	16"	53" (180)	49" (208)	42" (220)
2 × 10	24"	43" (212)	40" (241)	34" (255)
2 × 12	16"	72" (228)	67" (260)	57" (268)
2 × 12	24"	58" (279)	54" (319)	47" (330)

- \* Joists under bearing partitions 502.4
  - Parallel – sized to carry load
  - Special provisions under plumbing wall – full depth blocking – minimum 2”
  - Perpendicular – offset from girder no more than 1 joist depth



- \* Allowable girder and header span 502.5
  - Exterior walls Table 602.7(1)
  - Interior walls Table 602.7(2)
  - Open porches Table 602.7(3)

**TABLE 602.7(1)**  
**GIRDER SPANS<sup>a</sup> AND HEADER SPANS<sup>b</sup> FOR EXTERIOR BEARING WALLS**  
 (Maximum spans for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir<sup>b</sup> and required number of jack studs)

GIRDERS AND HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD (psf) <sup>c</sup>																	
		30						50						70					
		Building width <sup>c</sup> (feet)																	
		12		24		36		12		24		36		12		24		36	
Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>	Span <sup>f</sup>	NJ <sup>d</sup>
Roof and ceiling 	1-2 × 6	4-0	1	3-1	2	2-7	2	3-5	1	2-8	2	2-3	2	3-0	2	2-4	2	2-0	2
	1-2 × 8	5-1	2	3-11	2	3-3	2	4-4	2	3-4	2	2-10	2	3-10	2	3-0	2	2-6	3
	1-2 × 10	6-0	2	4-8	2	3-11	2	5-2	2	4-0	2	3-4	3	4-7	2	3-6	3	3-0	3
	1-2 × 12	7-1	2	5-5	2	4-7	3	6-1	2	4-8	3	3-11	3	5-5	2	4-2	3	3-6	3
	2-2 × 4	4-0	1	3-1	1	2-7	1	3-5	1	2-7	1	2-2	1	3-0	1	2-4	1	2-0	1
	2-2 × 6	6-0	1	4-7	1	3-10	1	5-1	1	3-11	1	3-3	2	4-6	1	3-6	2	2-11	2
	2-2 × 8	7-7	1	5-9	1	4-10	2	6-5	1	5-0	2	4-2	2	5-9	1	4-5	2	3-9	2
	2-2 × 10	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
	2-2 × 12	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
	3-2 × 8	9-5	1	7-3	1	6-1	1	8-1	1	6-3	1	5-3	2	7-2	1	5-6	2	4-8	2
	3-2 × 10	11-3	1	8-7	1	7-3	2	9-7	1	7-4	2	6-2	2	8-6	1	6-7	2	5-6	2
	3-2 × 12	13-2	1	10-1	2	8-6	2	11-3	2	8-8	2	7-4	2	10-0	2	7-9	2	6-6	2
	4-2 × 8	10-11	1	8-4	1	7-0	1	9-4	1	7-2	1	6-0	1	8-3	1	6-4	1	5-4	2
	4-2 × 10	12-11	1	9-11	1	8-4	1	11-1	1	8-6	1	7-2	2	9-10	1	7-7	2	6-4	2
4-2 × 12	15-3	1	11-8	1	9-10	2	13-0	1	10-0	2	8-5	2	11-7	1	8-11	2	7-6	2	

- Spans are given in feet and inches.
- Spans are based on minimum design properties for No. 2 grade lumber of Douglas fir-larch, hem-fir, Southern pine, and spruce-pine-fir.
- Building width is measured perpendicular to the ridge. For widths between those shown, spans are permitted to be interpolated.
- NJ = Number of jack studs required to support each end. Where the number of required jack studs equals one, the header is permitted to be supported by an approved framing anchor attached to the full-height wall stud and to the header.
- Use 30 psf ground snow load for cases in which ground snow load is less than 30 psf and the roof live load is equal to or less than 20 psf.
- Spans are calculated assuming the top of the header or girder is laterally braced by perpendicular framing. Where the top of the header or girder is not laterally braced (for example, cripple studs bearing on the header), tabulated spans for headers consisting of 2 × 8, 2 × 10, or 2 × 12 sizes shall be multiplied by 0.70 or the header or girder shall be designed.



**TABLE 602.7(2)**  
**GIRDER SPANS<sup>a</sup> AND HEADER SPANS<sup>a</sup> FOR INTERIOR BEARING WALLS**  
 (Maximum spans for Douglas fir-larch, hem-fir, southern pine and spruce-pine-fir<sup>b</sup> and required number of jack studs)

HEADERS AND GIRDERS SUPPORTING	SIZE	BUILDING Width <sup>c</sup> (feet)					
		12		24		36	
		Span <sup>e</sup>	NJ <sup>d</sup>	Span <sup>e</sup>	NJ <sup>d</sup>	Span <sup>e</sup>	NJ <sup>d</sup>
One floor only	2-2 × 4	4-1	1	2-10	1	2-4	1
	2-2 × 6	6-1	1	4-4	1	3-6	1
	2-2 × 8	7-9	1	5-5	1	4-5	2
	2-2 × 10	9-2	1	6-6	2	5-3	2
	2-2 × 12	10-9	1	7-7	2	6-3	2
	3-2 × 8	9-8	1	6-10	1	5-7	1
	3-2 × 10	11-5	1	8-1	1	6-7	2
	3-2 × 12	13-6	1	9-6	2	7-9	2
	4-2 × 8	11-2	1	7-11	1	6-5	1
	4-2 × 10	13-3	1	9-4	1	7-8	1
4-2 × 12	15-7	1	11-0	1	9-0	2	

- a. Spans are given in feet and inches.
- b. Spans are based on minimum design properties for No. 2 grade lumber of Douglas fir-larch, hem-fir, Southern pine, and spruce-pine-fir.
- c. Building width is measured perpendicular to the ridge. For widths between those shown, spans are permitted to be interpolated.
- d. NJ = Number of jack studs required to support each end. Where the number of required jack studs equals one, the header is permitted to be supported by an approved framing anchor attached to the full-height wall stud and to the header.
- e. Spans are calculated assuming the top of the header or girder is laterally braced by perpendicular framing. Where the top of the header or girder is not laterally braced (for example, cripple studs bearing on the header), tabulated spans for headers consisting of 2 × 8, 2 × 10, or 2 × 12 sizes shall be multiplied by 0.70 or the header or girder shall be designed.

**TABLE | 602.7(3)**  
**GIRDER AND HEADER SPANS<sup>a</sup> FOR OPEN PORCHES**  
 (Maximum span for Douglas fir-larch, hem-fir, southern pine and spruce-pine-fir<sup>b</sup>)

SIZE	SUPPORTING ROOF						SUPPORTING FLOOR	
	GROUND SNOW LOAD (psf)							
	30		50		70			
	DEPTH OF PORCH <sup>c</sup> (feet)							
	8	14	8	14	8	14	8	14
2-2 × 6	7-6	5-8	6-2	4-8	5-4	4-0	6-4	4-9
2-2 × 8	10-1	7-7	8-3	6-2	7-1	5-4	8-5	6-4
2-2 × 10	12-4	9-4	10-1	7-7	8-9	6-7	10-4	7-9
2-2 × 12	14-4	10-10	11-8	8-10	10-1	7-8	11-11	9-0

- a. Spans are given in feet and inches.
- b. Tabulated values assume #2 grade lumber, wet service and incising for refractory species. Use 30 psf ground snow load for cases in which ground snow load is less than 30 psf and the roof live load is equal to or less than 20 psf.
- c. Porch depth is measured horizontally from building face to centerline of the header. For depths between those shown, spans are permitted to be interpolated.

\* Bearing **502.6**

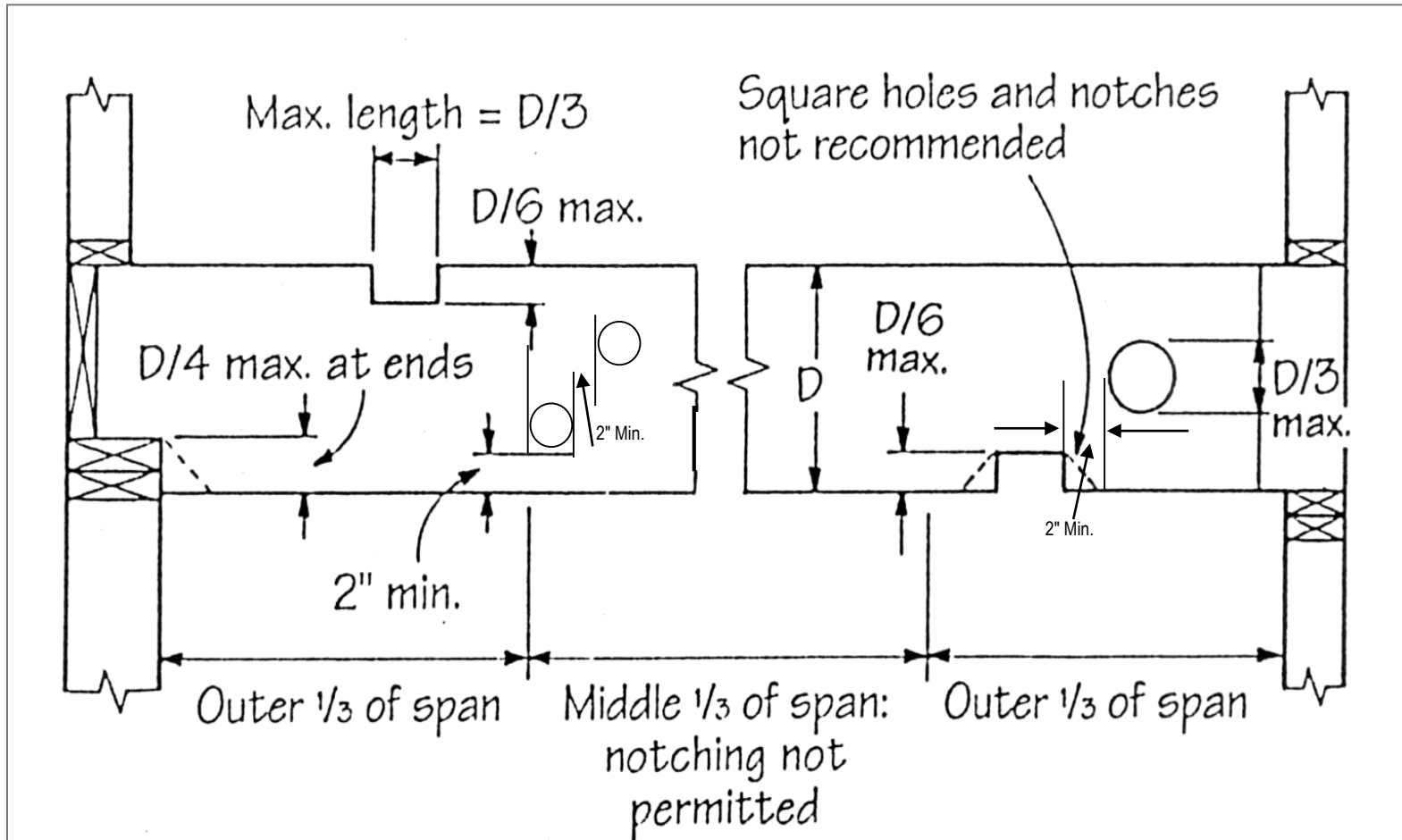
- Bearing 1-1/2" on wood; 3" on masonry or concrete unless ribbon strip and approved hangers
- 3" minimum overlap of floor joists
- Hangars when framed into side of girder
- Bearing over a wall with joist from opposite ends – minimum overlap 3" – nailed with three #10 face nails
- Framing into wood girder – approved anchors or 2 x 2 ledger strip

- \* Lateral restraint at supports **502.7**
  - Joists supported at ends
  - Bridging when exceed 2 x 12

- \* Cutting, drilling and notching **502.8**

GUIDE FOR CUTTING, NOTCHING AND BORING JOISTS			
Joist Size	Maximum Hole	Maximum Notch Depth	Maximum End Notch
2x4	None	None	None
2x6	1-13/16"	7/8"	1-3/8"
2x8	2-1/2"	1-1/4"	1-7/8"
2x10	3-1/8"	1-9/16"	2-3/8"
2x12	3-13/16"	1-7/8"	2-7/8"

\* Cutting, drilling and notching 502.8



\* Cutting, drilling and notching **502.8**



- \* Cutting, drilling and notching 502.8





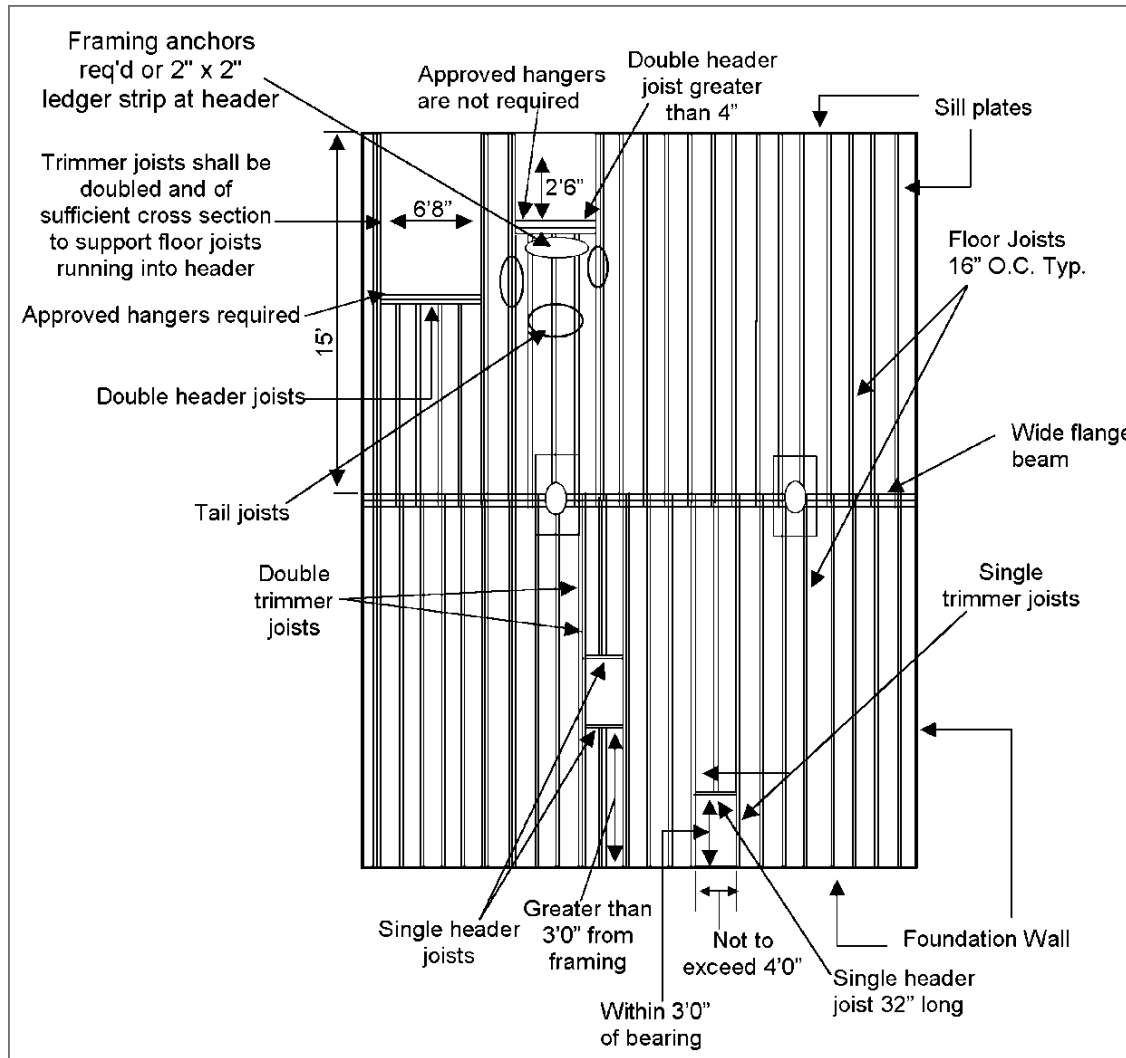
- \* Engineered wood products **502.8.2**
  - Cuts, notches and bored holes not permitted unless allowed by the manufacturer's installation instructions or by registered design professional
  
- \* Fastening per **Table 602.3(1)**
  - Fastener schedule for structural members **Table 602.3.1**
  - Revised to provide a 200 pound maximum uplift capacity where the rafter or truss spaced not more than 24" on center and other changes

**TABLE R802.3(1)  
FASTENING SCHEDULE**

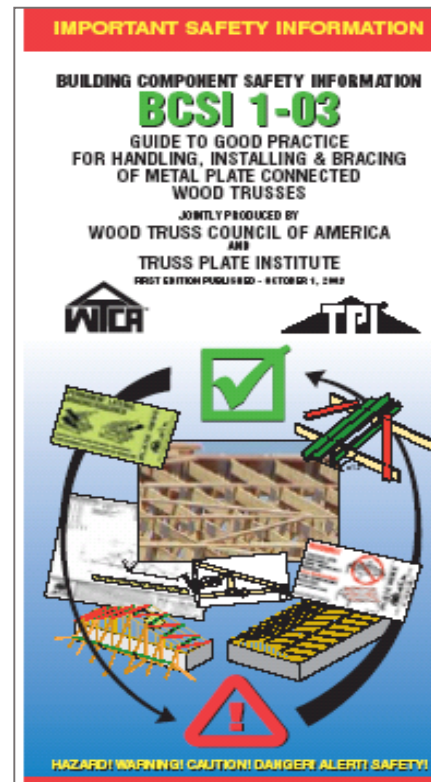
ITEM	DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER <sup>a, b, c</sup>	SPACING AND LOCATION
<b>Roof</b>			
1	Blocking between ceiling joists or rafters to top plate	4-8d box ( $2\frac{1}{2}$ " × 0.113") or 3-8d common ( $2\frac{1}{2}$ " × 0.131"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	Toe nail
2	Ceiling joists to top plate	4-8d box ( $2\frac{1}{2}$ " × 0.113"); or 3-8d common ( $2\frac{1}{2}$ " × 0.131"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	Per joist, toe nail
3	Ceiling joist not attached to parallel rafter, laps over partitions [see Sections R802.3.1, R802.3.2 and Table	4-10d box (3" × 0.128"); or 3-16d common ( $3\frac{1}{2}$ " × 0.162"); or	Face nail

- a. Nails are smooth-common, box or deformed shanks except where otherwise stated. Nails used for framing and sheathing connections shall have minimum average bending yield strengths as shown: 80 ksi for shank diameter of 0.192 inch (20d common nail), 90 ksi for shank diameters larger than 0.142 inch but not larger than 0.177 inch, and 100 ksi for shank diameters of 0.142 inch or less.
- b. Staples are 16 gage wire and have a minimum  $\frac{7}{16}$ -inch on diameter crown width.
- c. Nails shall be spaced at not more than 6 inches on center at all supports where spans are 48 inches or greater.

\* Framing of floor openings 502.10, Figure 5022



- \* Wood truss 502.11
  - Wood truss bracing 502.11.2
  - Section references the current Guide for Truss Bracing (BCSI 1-03)

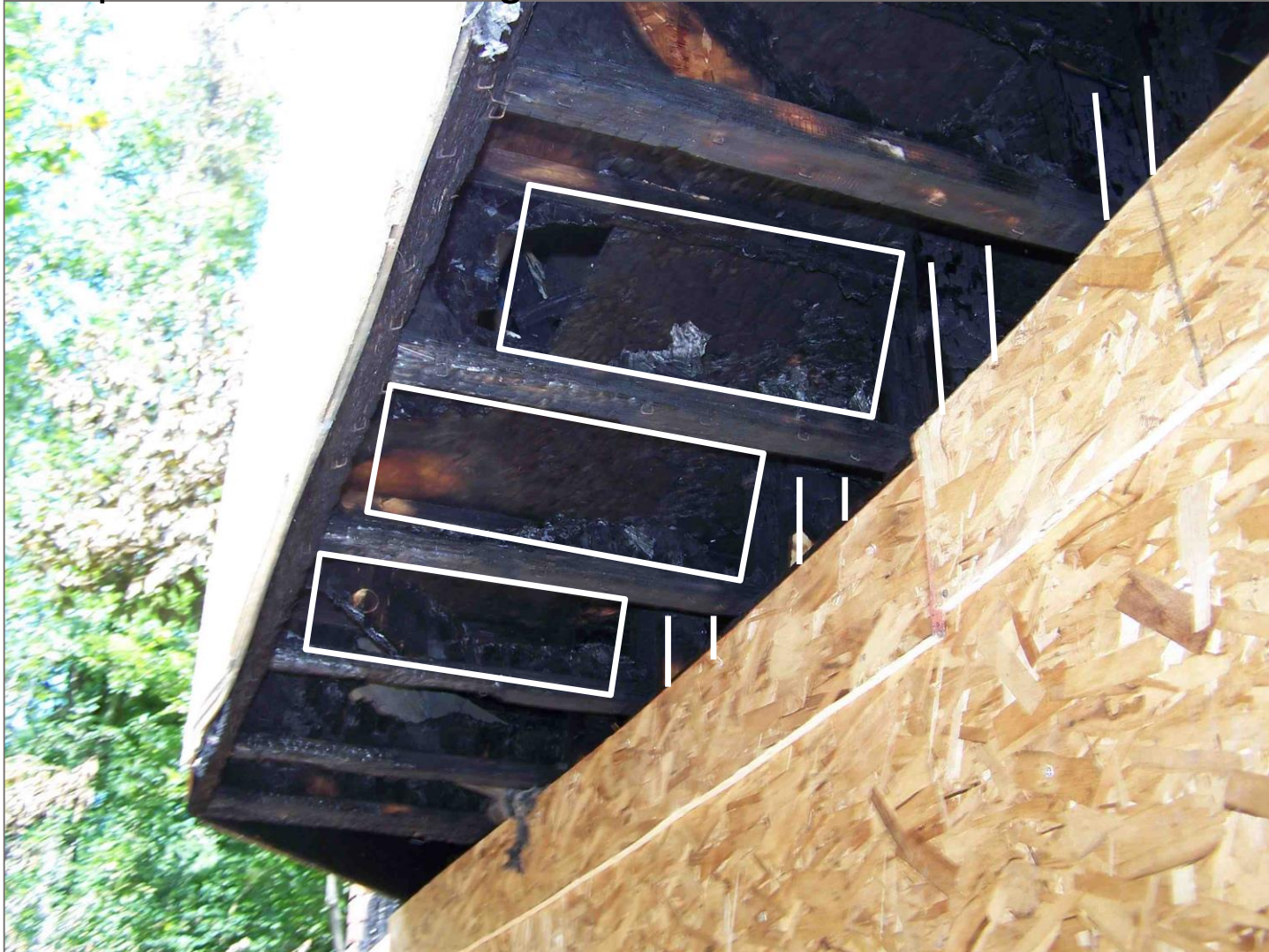


\* Importance of “Bearing Blocks” or “Web Stiffeners”





\* Importance of “Bearing Blocks” or “Web Stiffeners”



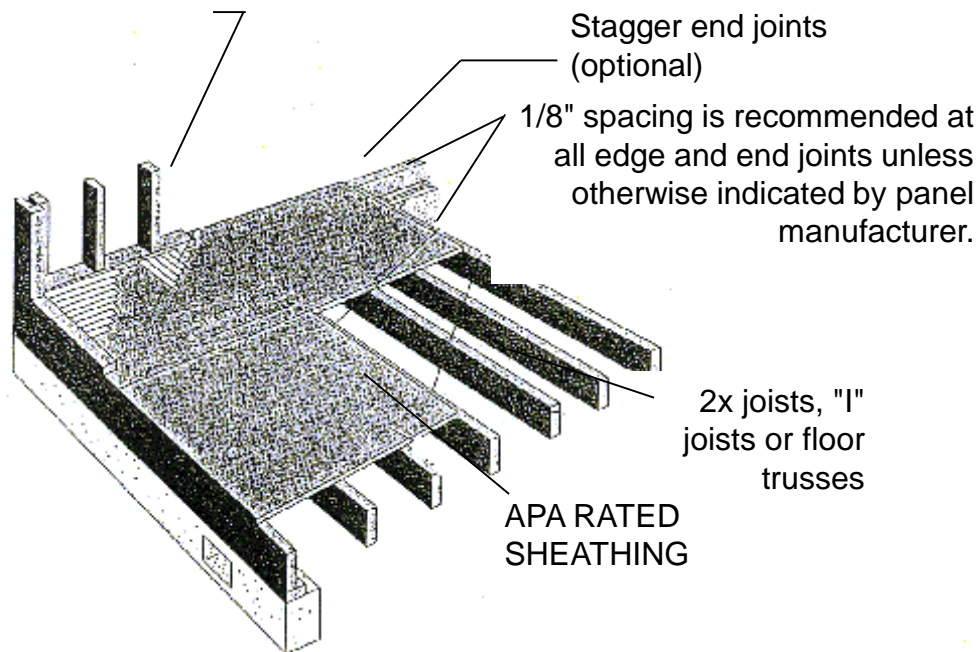
\* Inspection items

- Bearing 1.5" on wood; 3" on masonry or concrete unless ribbon strip and approved hangers
- 3" overlap of floor joists
- Hangers when framed into side of girder
- Lateral support of ends required
- Floor trusses
- Draft stopping
- Materials
- Fireblocking

## ◆ Floor Sheathing

- \* Lumber sheathing
- \* Wood structural panel sheathing
- \* Particleboard
- \* Identification and grade
- \* Allowable spans **Table 503.2.1.1(1)**





**Note:**

Provide adequate ventilation and use ground cover vapor retarder in crawl space. Subfloor must be dry before applying subsequent layers.

**Note:** For buildings with wood or steel framed walls, provide  $\frac{3}{4}$ " expansion joints with separate floor framing members and discontinuous wall plates over the joints, at intervals that limit continuous floor areas to 8' maximum in length or width, to allow for accumulated expansion during construction in wet weather conditions.

- \* Allowable spans and loads for wood structural panels for roof and subfloor sheathing and combination subfloor underlayment **Table 503.2.1.1(1)**

**TABLE R503.2.1.1(1) ALLOWABLE SPANS AND LOADS FOR WOOD STRUCTURAL PANELS FOR ROOF AND SUBFLOOR SHEATHING AND COMBINATION SUBFLOOR UNDERLAYMENT<sup>a, b, c</sup>**

SPAN RATING	MINIMUM NOMINAL PANEL THICKNESS (inch)	ALLOWABLE LIVE LOAD (psf) <sup>h, i</sup>		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 <sup>d</sup>	Without edge support	Total load	Live load	
<b>Sheathing<sup>e</sup></b>		<b>Roof<sup>f</sup></b>						<b>Subfloor<sup>j</sup></b>
16/0	3/8	30	—	16	16	40	30	0
20/0	3/8	50	—	20	20	40	30	0
24/0	3/8	100	30	24	20 <sup>g</sup>	40	30	0
24/16	7/16	100	40	24	24	50	40	16
32/16	15/32, 1/2	180	70	32	28	40	30	16 <sup>h</sup>
40/20	19/32, 5/8	305	130	40	32	40	30	20 <sup>h, i</sup>
48/24	23/32, 3/4	—	175	48	36	45	35	24
60/32	7/8	—	305	60	48	45	35	32
<b>Underlayment, C-C plugged, single floor<sup>e</sup></b>		<b>Roof<sup>f</sup></b>						<b>Combination subfloor underlayment<sup>k</sup></b>
16 o.c.	19/32, 5/8	100	40	24	24	50	40	16 <sup>l</sup>
20 o.c.	19/32, 5/8	150	60	32	32	40	30	20 <sup>l, j</sup>
24 o.c.	23/32, 3/4	240	100	48	36	35	25	24
32 o.c.	7/8	—	185	48	40	50	40	32
48 o.c.	13/32, 1 1/8	—	290	60	48	50	40	48

### 1.4.1 Span Rating

The Span Rating used on sheathing panels is a measure of plywood stiffness and strength parallel to the face grain. It consists of two numbers presented in a manner similar to a fraction. The number on the left in the Span Rating gives the maximum spacing for roof supports

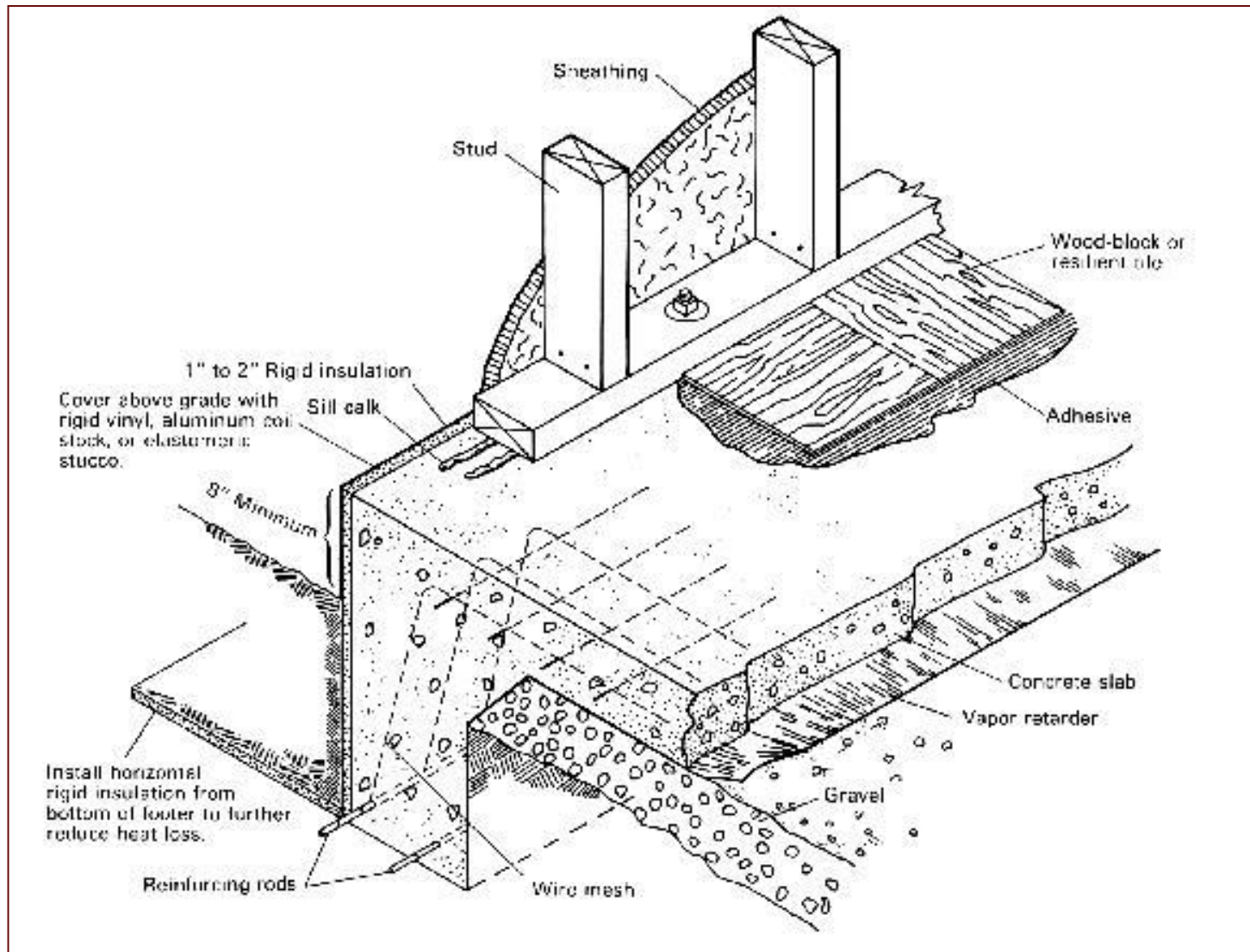
under average loading conditions (good for 30 psf live load, or better). The number on the right of the slash shows the maximum spacing for floor supports, again under average residential loading.

Source: *APA Plywood Design Specification, 1/1997 Pg. 5,6*

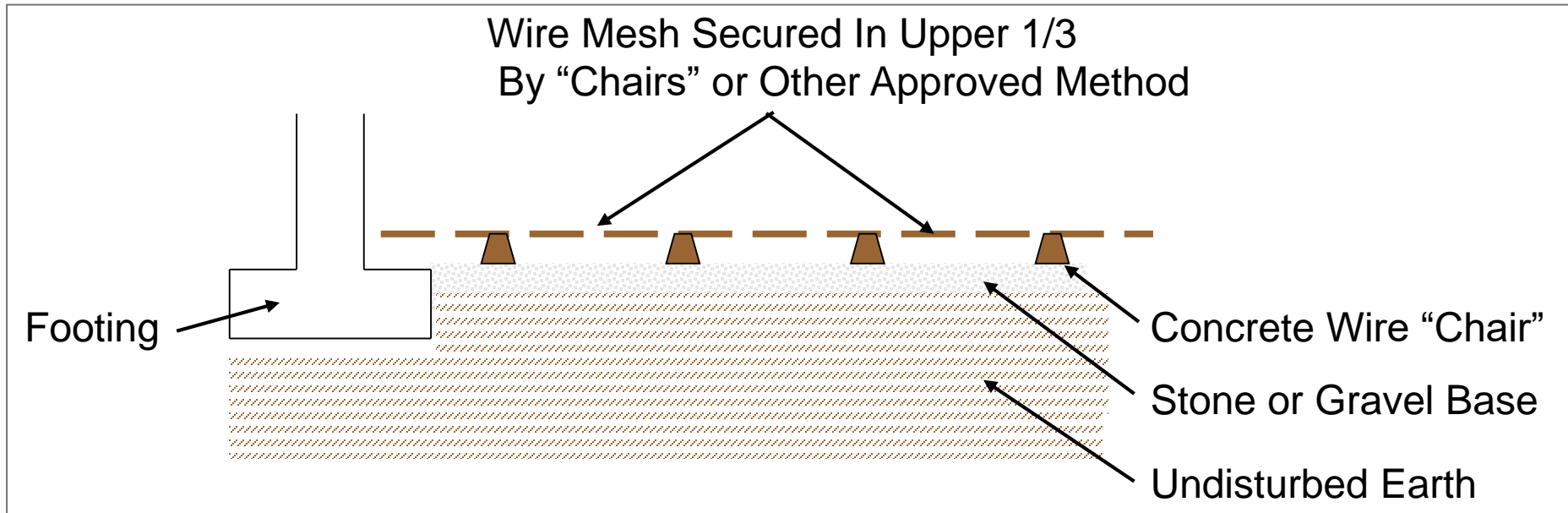
## ◆ Concrete Floors 506

- \* Fill 506.2.1
  - Free of vegetation
  - Uniformly compacted
  - Maximum 24" clean fill – 8" for gravel
- \* Base 506.2.2
  - 4" – sand, gravel, crushed stone or concrete
- \* Vapor retarder 506.2.3
  - Minimum 6 millimeters
  - 6" lapped joints





\* Reinforcement support **506.2.4**





\* Reinforcement support 506.2.4



## ◆ Exterior Decks 507

### \* Materials 507.2

- No. 2 grade or better
- Preservative treated or naturally durable

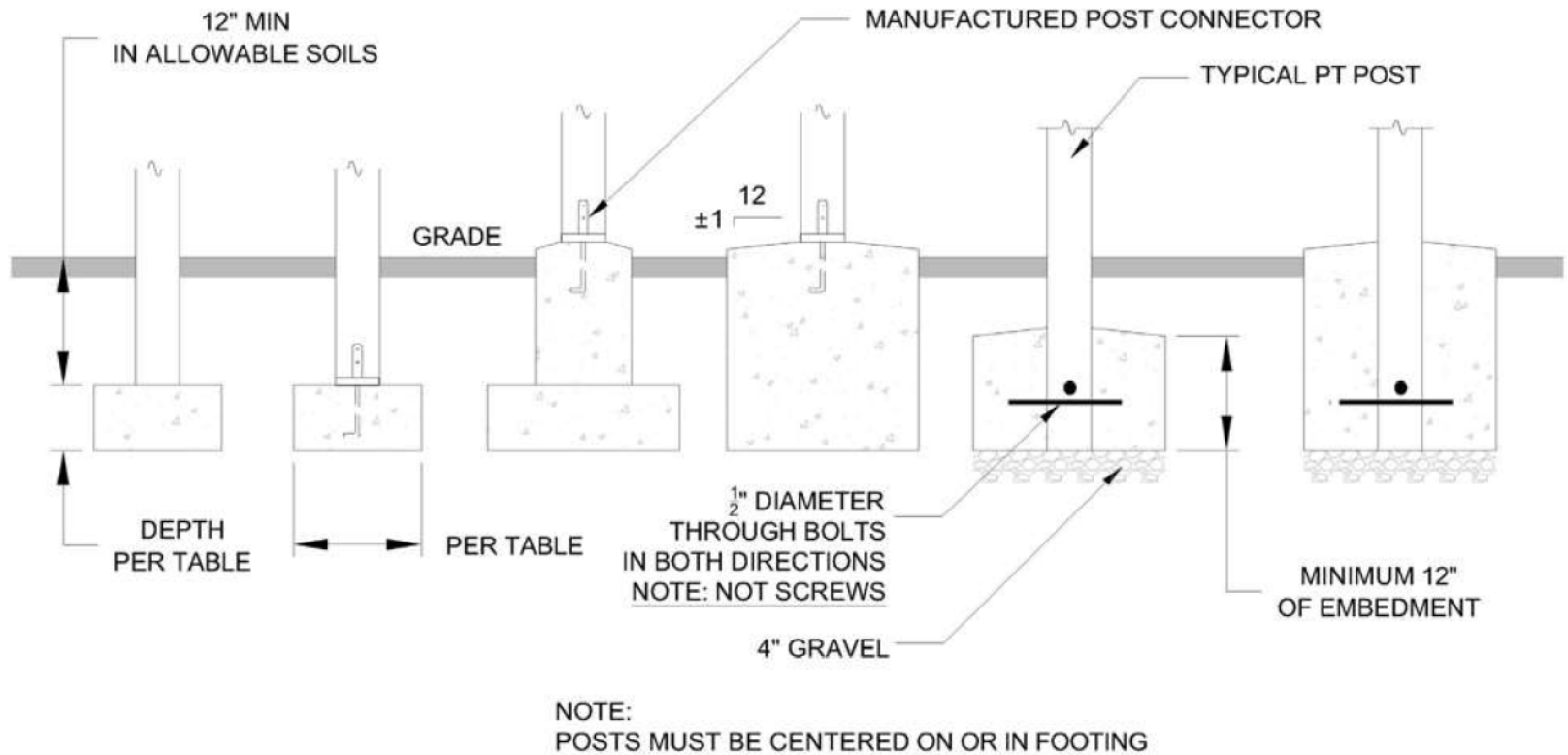


- \* Plastic per **ASTM D7032**
  - Decks, treads, handrails and guards – label showing spans
  - Maximum flame spread 200
  - Decay and termite resistant per **ASTM D7032**
  - Installed per manufacturer
- \* Fasteners and connectors **507.2.3**
  - Per **Table 507.2.3**
- \* Flashing **507.2.4**
  - Corrosion resistant – minimum 09.019” thick



- \* Footings 507.3
- \* Concrete sized per Table 507.3.1
- \* Per Figure 07.3
  - Soil bearing value per 401.4.1
- \* Minimum depth – frost depth – unless free standing 507.3.2
  - Pre-cast piers
  - Less than 200 square feet
  - Not more than 20” above grade

\* Figure 507.3



For SI: 1 inch = 25.4 mm.

FIGURE R507.3  
DECK POSTS TO DECK FOOTING CONNECTION

**TABLE 507.3.1  
MINIMUM FOOTING SIZE FOR DECKS**

LIVE OR GROUND SNOW LOAD <sup>b</sup> (psf)	TRIBUTARY AREA (sq. ft.)	LOAD BEARING VALUE OF SOILS <sup>a, c, d</sup> (psf)											
		1500 <sup>a</sup>			2000 <sup>a</sup>			2500 <sup>a</sup>			≥ 3000 <sup>a</sup>		
		Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness (inches)	Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness (inches)	Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness (inches)	Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness (inches)
40	20	12	14	6	12	14	6	12	14	6	12	14	6
	40	14	16	6	12	14	6	12	14	6	12	14	6
	60	17	19	6	15	17	6	13	15	6	12	14	6
	80	20	22	7	17	19	6	15	17	6	14	16	6
	100	22	25	8	19	21	6	17	19	6	15	17	6
	120	24	27	9	21	23	7	19	21	6	17	19	6
	140	26	29	10	22	25	8	20	23	7	18	21	6
	160	28	31	11	24	27	9	21	24	8	20	22	7
50	20	12	14	6	12	14	6	12	14	6	12	14	6
	40	15	17	6	13	15	6	12	14	6	12	14	6
	60	19	21	6	16	18	6	14	16	6	13	15	6
	80	21	24	8	19	21	6	17	19	6	15	17	6
	100	24	27	9	21	23	7	19	21	6	17	19	6
	120	26	30	10	23	26	8	20	23	7	19	21	6
	140	28	32	11	25	28	9	22	25	8	20	23	7
	160	30	34	12	26	30	10	24	27	9	21	24	8
60	20	12	14	6	12	14	6	12	14	6	12	14	6
	40	16	19	6	14	16	6	13	14	6	12	14	6
	60	20	23	7	17	20	6	16	18	6	14	16	6
	80	23	26	9	20	23	7	18	20	6	16	19	6
	100	26	29	10	22	25	8	20	23	7	18	21	6
	120	28	32	11	25	28	9	22	25	8	20	23	7
	140	31	35	12	27	30	10	24	27	9	22	24	8
	160	33	37	13	28	32	11	25	29	10	23	26	9

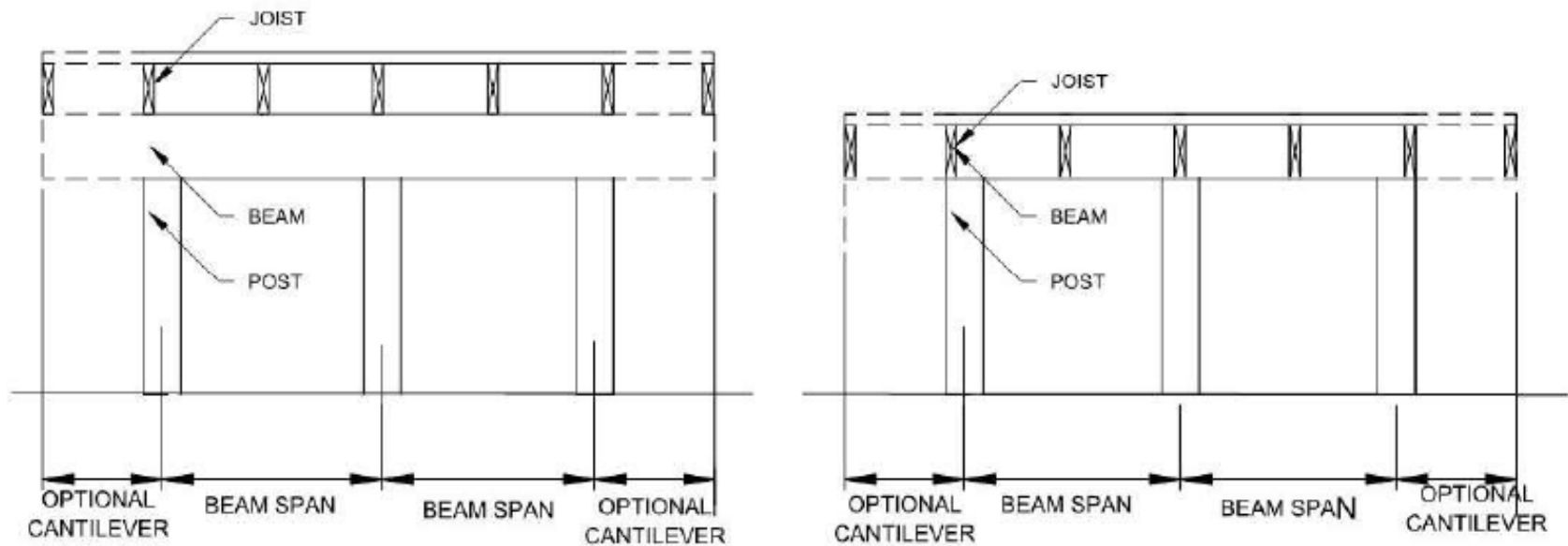
- \* Deck posts **507.4**
  - Single level decks
- \* Sized per **Table 507.4**
  - Connected to concrete to prevent movement



**TABLE 507.4  
DECK POST HEIGHT<sup>a</sup>**

DECK POST SIZE	MAXIMUM HEIGHT <sup>a, b</sup> (feet-inches)
4 × 4	6-9 <sup>c</sup>
4 × 6	8
6 × 6	14
8 × 8	14

- \* Deck beams **507.5**
- \* Spans per **Table 507.5 & Figure 507.5**
  - Fastened together – 2 rows #10's
  - 16" on center along each edge
  - Maximum cantilever  $\frac{1}{4}$  of span at each end



DROPPED BEAM

FIGURE R507.5  
TYPICAL DECK JOIST SPANS

FLUSH BEAM

**TABLE . 507.5  
DECK BEAM SPAN LENGTHS<sup>a, b, g</sup> (feet - inches)**

SPECIES <sup>c</sup>	SIZE <sup>d</sup>	DECK JOIST SPAN LESS THAN OR EQUAL TO: (feet)						
		6	8	10	12	14	16	18
Southern pine	1 - 2 x 6	4-11	4-0	3-7	3-3	3-0	2-10	2-8
	1 - 2 x 8	5-11	5-1	4-7	4-2	2-10	3-7	3-5
	1 - 2 x 10	7-0	6-0	5-5	4-11	4-7	4-3	4-0
	1 - 2 x 12	8-3	7-1	6-4	5-10	5-5	5-0	4-9
	2 - 2 x 6	6-11	5-11	5-4	4-10	4-6	4-3	4-0
	2 - 2 x 8	8-9	7-7	6-9	6-2	5-9	5-4	5-0
	2 - 2 x 10	10-4	9-0	8-0	7-4	6-9	6-4	6-0
	2 - 2 x 12	12-2	10-7	9-5	8-7	8-0	7-6	7-0
	3 - 2 x 6	8-2	7-5	6-8	6-1	5-8	5-3	5-0
	3 - 2 x 8	10-10	9-6	8-6	7-9	7-2	6-8	6-4
	3 - 2 x 10	13-0	11-3	10-0	9-2	8-6	7-11	7-6
3 - 2 x 12	15-3	13-3	11-10	10-9	10-0	9-4	8-10	
Douglas fir-larch <sup>e</sup> , hem-fir <sup>e</sup> , spruce-pine-fir <sup>e</sup> , redwood, western cedars, ponderosa pine <sup>f</sup> , red pine <sup>f</sup>	3 x 6 or 2 - 2 x 6	5-5	4-8	4-2	3-10	3-6	3-1	2-9
	3 x 8 or 2 - 2 x 8	6-10	5-11	5-4	4-10	4-6	4-1	3-8
	3 x 10 or 2 - 2 x 10	8-4	7-3	6-6	5-11	5-6	5-1	4-8
	3 x 12 or 2 - 2 x 12	9-8	8-5	7-6	6-10	6-4	5-11	5-7
	4 x 6	6-5	5-6	4-11	4-6	4-2	3-11	3-8
	4 x 8	8-5	7-3	6-6	5-11	5-6	5-2	4-10
	4 x 10	9-11	8-7	7-8	7-0	6-6	6-1	5-8
	4 x 12	11-5	9-11	8-10	8-1	7-6	7-0	6-7
	3 - 2 x 6	7-4	6-8	6-0	5-6	5-1	4-9	4-6
	3 - 2 x 8	9-8	8-6	7-7	6-11	6-5	6-0	5-8
	3 - 2 x 10	12-0	10-5	9-4	8-6	7-10	7-4	6-11
	3 - 2 x 12	13-11	12-1	10-9	9-10	9-1	8-6	8-1

\* Bearing **R507.5.1**

- Minimum 1½” on wood – 3” on concrete or masonry
- Full width of beam / Multiple spans – center bearing shall comply
- Proper connection to post see **Figures R507.5.1(1)** and **R507.5.1(2)**
- All bolts shall have washers

\* Figure 507.5.1(1)

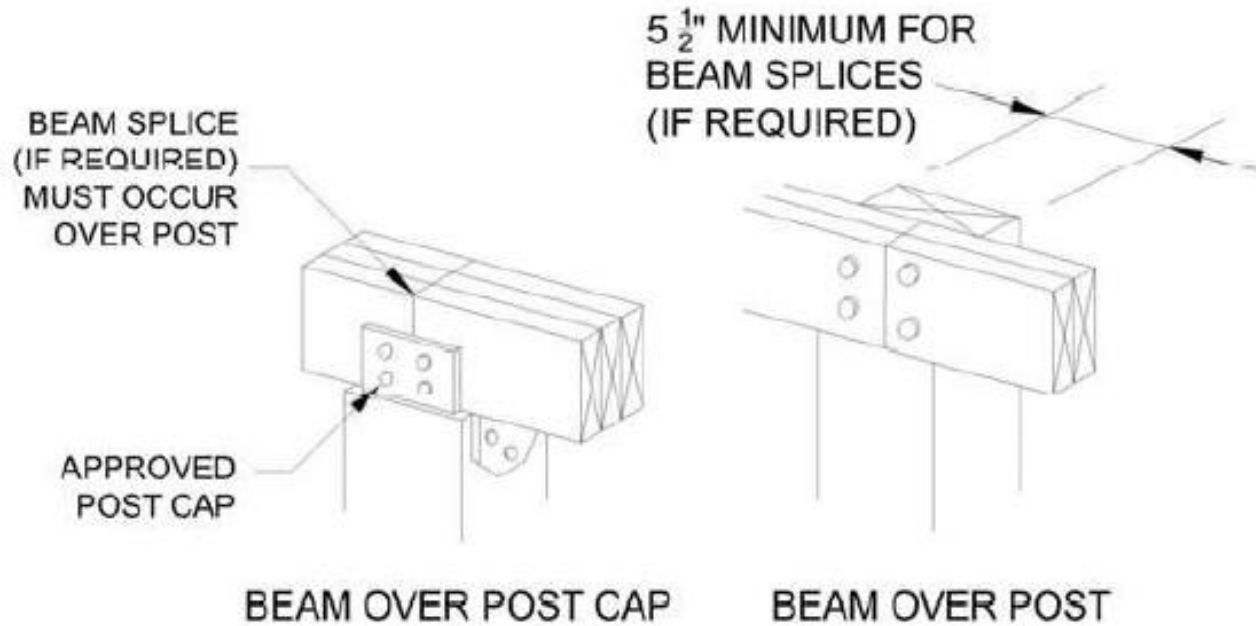
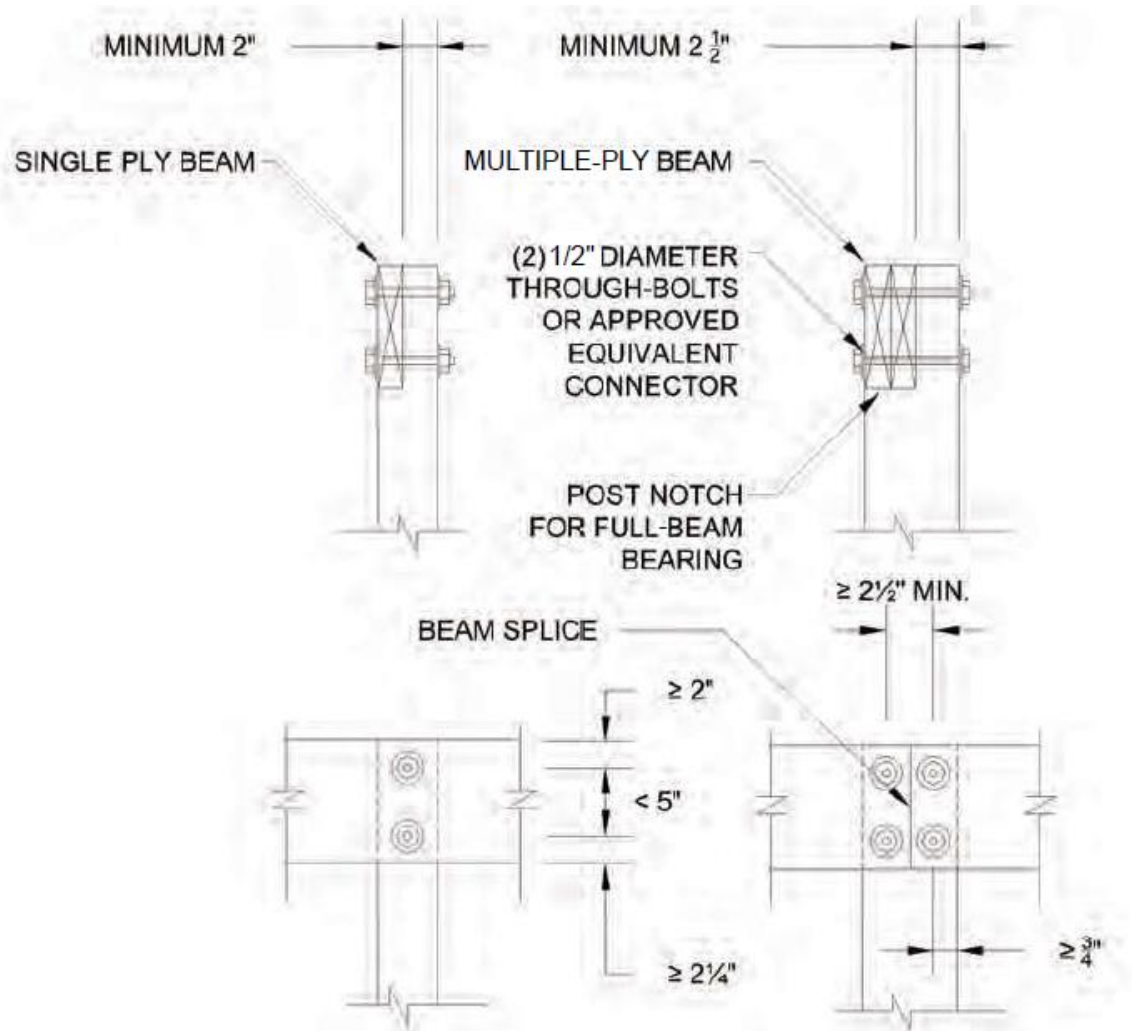


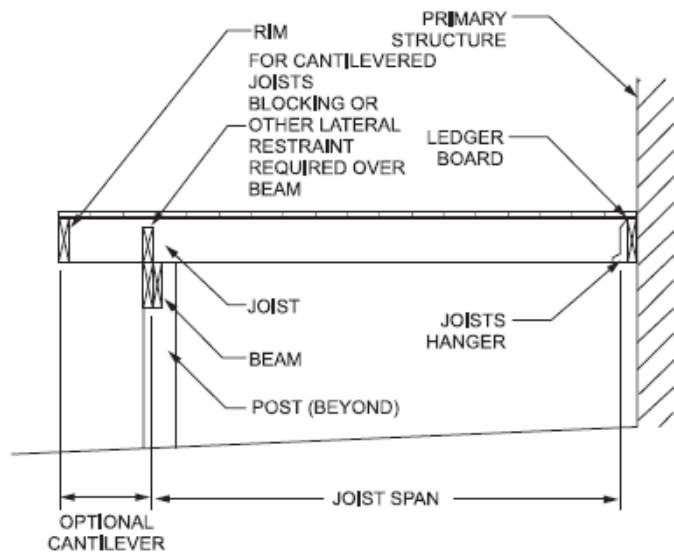
FIGURE 507.5.1(1)  
DECK BEAM TO DECK POST



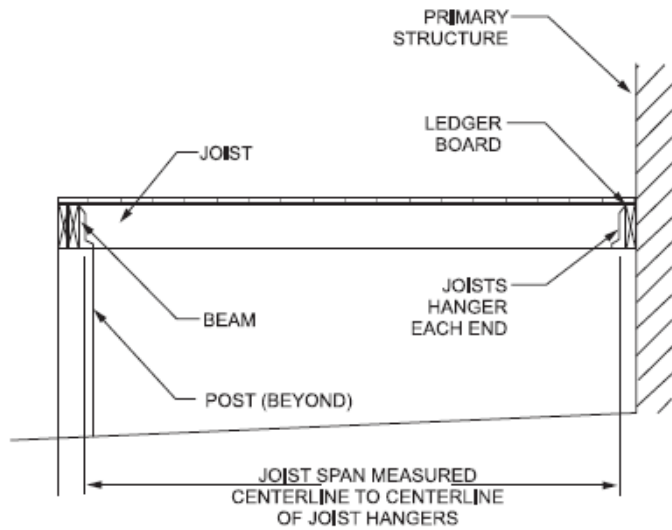


**FIGURE R507.5.1(2)**  
**NOTCHED POST-TO-BEAM CONNECTION**

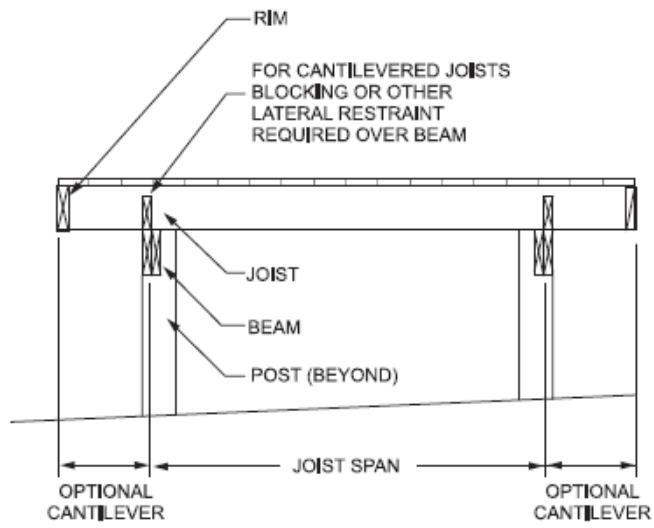
- \* Deck joists 507.6
  - Sized per Table 507.6 and Figure 507.6
  - Maximum spacing shall be limited by material
  - Maximum cantilever based on most restrictive



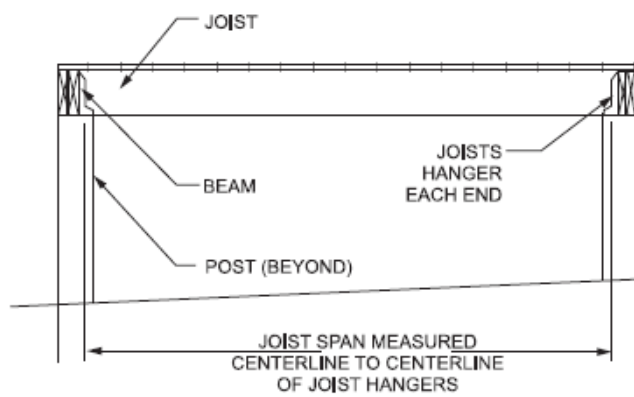
CANTILEVERED JOISTS WITH DROPPED BEAM



JOISTS WITH FLUSH BEAM



JOISTS ON FREE-STANDING DECK WITH DROPPED BEAM



JOISTS ON FREE-STANDING DECK WITH FLUSH BEAM

TYPICAL DECK JOIST SPANS

**TABLE .507.6  
DECK JOIST SPANS FOR COMMON LUMBER SPECIES (ft. - in.)**

SPECIES <sup>a</sup>	SIZE	ALLOWABLE JOIST SPAN <sup>b</sup>			MAXIMUM CANTILEVER <sup>c, f</sup>		
		SPACING OF DECK JOISTS (inches)			SPACING OF DECK JOISTS WITH CANTILEVERS <sup>e</sup> (inches)		
		12	16	24	12	16	24
Southern pine	2 × 6	9-11	9-0	7-7	1-3	1-4	1-6
	2 × 8	13-1	11-10	9-8	2-1	2-3	2-5
	2 × 10	16-2	14-0	11-5	3-4	3-6	2-10
	2 × 12	18-0	16-6	13-6	4-6	4-2	3-4
Douglas fir-larch <sup>d</sup> , hem-fir <sup>d</sup> spruce-pine-fir <sup>d</sup> ,	2 × 6	9-6	8-8	7-2	1-2	1-3	1-5
	2 × 8	12-6	11-1	9-1	1-11	2-1	2-3
	2 × 10	15-8	13-7	11-1	3-1	3-5	2-9
	2 × 12	18-0	15-9	12-10	4-6	3-11	3-3
Redwood, western cedars, ponderosa pine <sup>e</sup> , red pine <sup>e</sup>	2 × 6	8-10	8-0	7-0	1-0	1-1	1-2
	2 × 8	11-8	10-7	8-8	1-8	1-10	2-0
	2 × 10	14-11	13-0	10-7	2-8	2-10	2-8
	2 × 12	17-5	15-1	12-4	3-10	3-9	3-1

- \* Deck joist bearing **507.6.1**
  - Minimum 1½” on wood – 3” on concrete or masonry
  - Multiple beams fastened per **602.3(1)**
  - Single beam – mechanical fastener
  - Lateral restraint
    - Joist hanger or blocking – minimum 60% of depth



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- \* Decking 507.7
  - Sized per Table 507.7 and Figure 507.6
    - Wood fastening with two No. 8 threaded nails or screws
    - Other per manufacturer

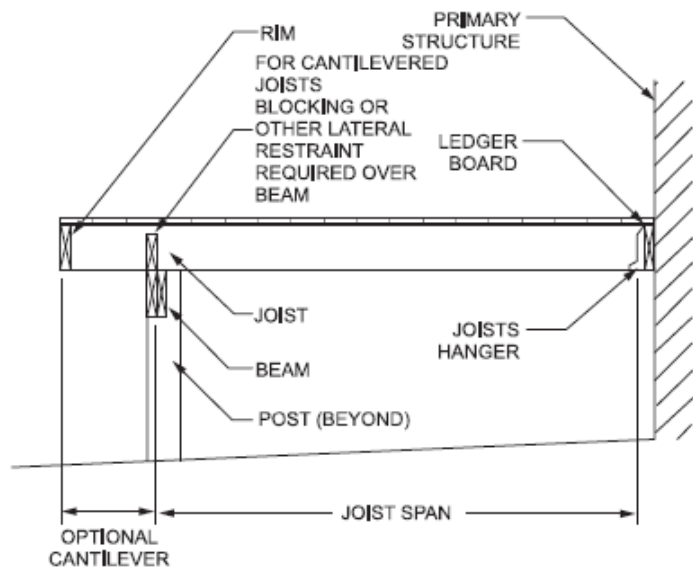
**TABLE I507.7  
MAXIMUM JOIST SPACING FOR DECKING**

DECKING MATERIAL TYPE AND NOMINAL SIZE	MAXIMUM ON-CENTER JOIST SPACING	
	Decking perpendicular to joist	Decking diagonal to joist <sup>a</sup>
1 <sup>1</sup> / <sub>4</sub> -inch-thick wood	16 inches	12 inches
2-inch-thick wood	24 inches	16 inches
Plastic composite	In accordance with Section R507.2	In accordance with Section R507.2

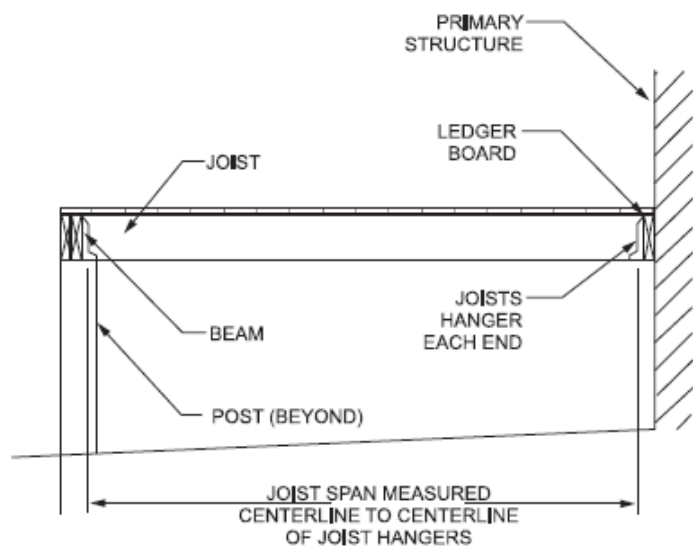
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.01745 rad.

a. Maximum angle of 45 degrees from perpendicular for wood deck boards.

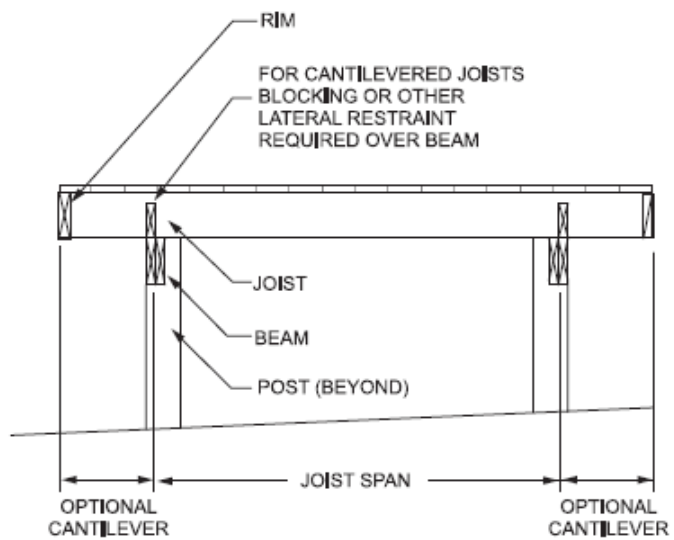




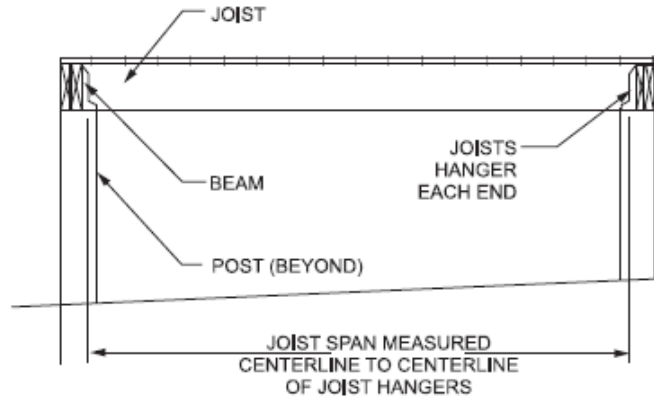
CANTILEVERED JOISTS WITH DROPPED BEAM



JOISTS WITH FLUSH BEAM



JOISTS ON FREE-STANDING DECK WITH DROPPED BEAM



JOISTS ON FREE-STANDING DECK WITH FLUSH BEAM

FIGURE R507.6  
TYPICAL DECK JOIST SPANS

- \* Vertical and lateral support **507.8**
  - Decks self-supporting if proper attachment is not verifiable
  - Not attached with nails
  - Cantilevers support full uplift load

- \* Vertical and lateral support **507.8**
  - Deck ledgers to band joist
    - Ledger to be minimum 2 x 8" Southern Pine or Hem-Fir
    - Not support girder or beams
    - Not supported by masonry
  - Band joist
    - Minimum 2 x 9 1/2" SPF or better
    - Bear full on structure

- \* Ledger to band joist 507.9.1.3
  - Per Table 507.9.1.3(1)
  - Hot dipped galvanized or stainless steel
  - Installed per Table 507.9.1.3(2), Figures 507.9.1.3(1) and 507.9.1.3(2)

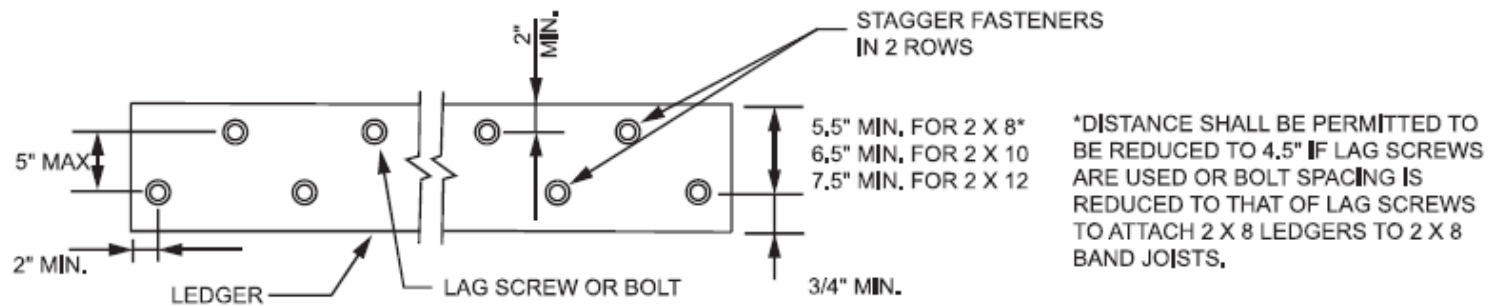


**TABLE R507.9.1.3(1)**  
**DECK LEDGER CONNECTION TO BAND JOIST<sup>a, b</sup>**  
 (Deck live load = 40 psf, deck dead load = 10 psf, snow load ≤ 40 psf)

CONNECTION DETAILS	JOIST SPAN						
	6' and less	6'1" to 8'	8'1" to 10'	10'1" to 12'	12'1" to 14'	14'1" to 16'	16'1" to 18'
	On-center spacing of fasteners						
1/2-inch diameter lag screw with 1/2-inch maximum sheathing <sup>c, d</sup>	30	23	18	15	13	11	10
1/2-inch diameter bolt with 1/2-inch maximum sheathing <sup>d</sup>	36	36	34	29	24	21	19
1/2-inch diameter bolt with 1-inch maximum sheathing <sup>e</sup>	36	36	29	24	21	18	16

**TABLE R507.9.1.3(2)**  
**PLACEMENT OF LAG SCREWS AND BOLTS IN DECK LEDGERS AND BAND JOISTS**

MINIMUM END AND EDGE DISTANCES AND SPACING BETWEEN ROWS				
	TOP EDGE	BOTTOM EDGE	ENDS	ROW SPACING
Ledger <sup>a</sup>	2 inches <sup>d</sup>	$\frac{3}{4}$ inch	2 inches <sup>b</sup>	$1\frac{5}{8}$ inches <sup>b</sup>
Band Joist <sup>c</sup>	$\frac{3}{4}$ inch	2 inches	2 inches <sup>b</sup>	$1\frac{5}{8}$ inches <sup>b</sup>



For SI: 1 inch = 25.4 mm.

FIGURE R507.9.1.3(1)  
PLACEMENT OF LAG SCREWS AND BOLTS IN LEDGERS

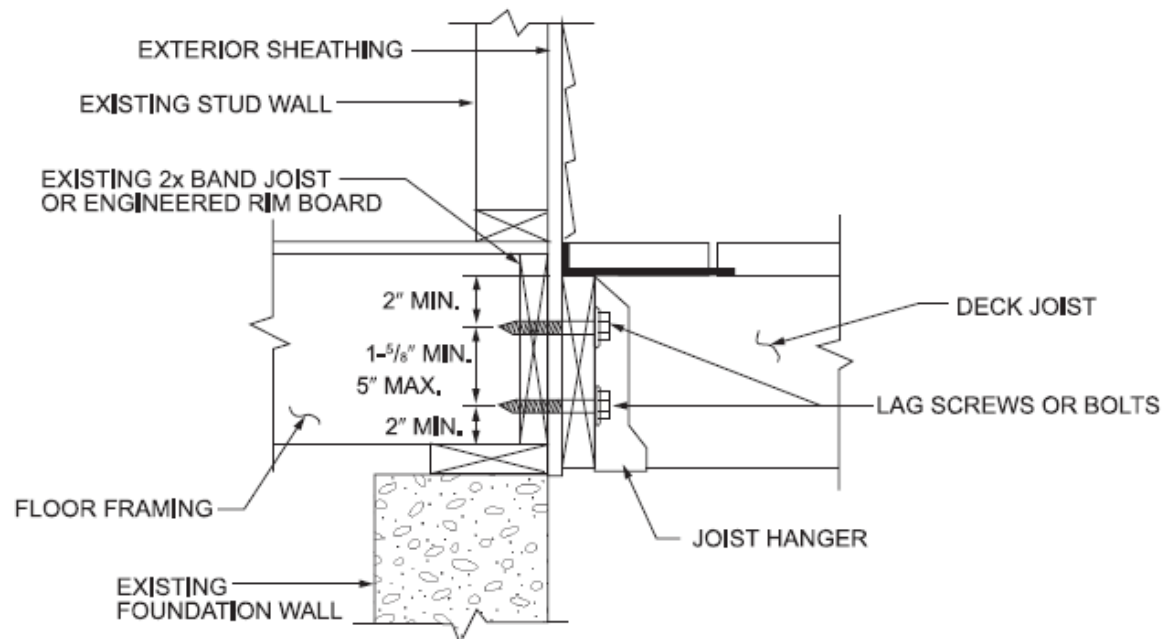
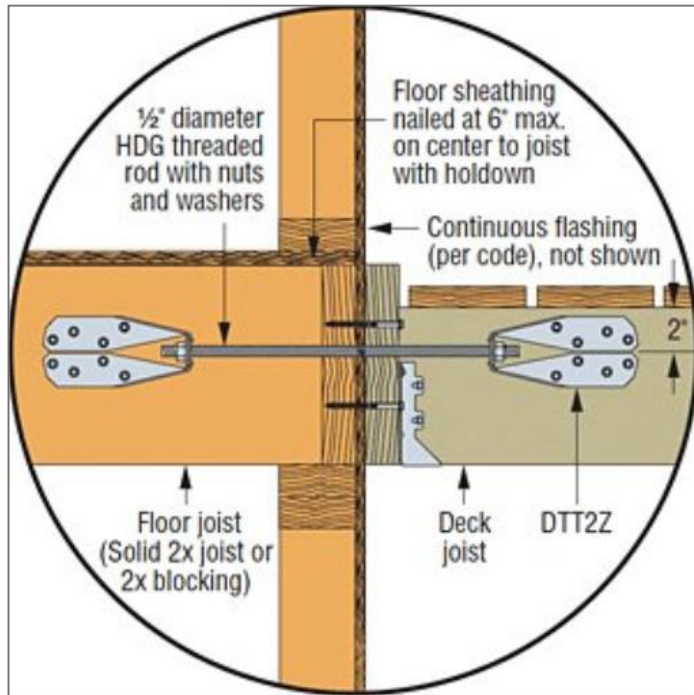


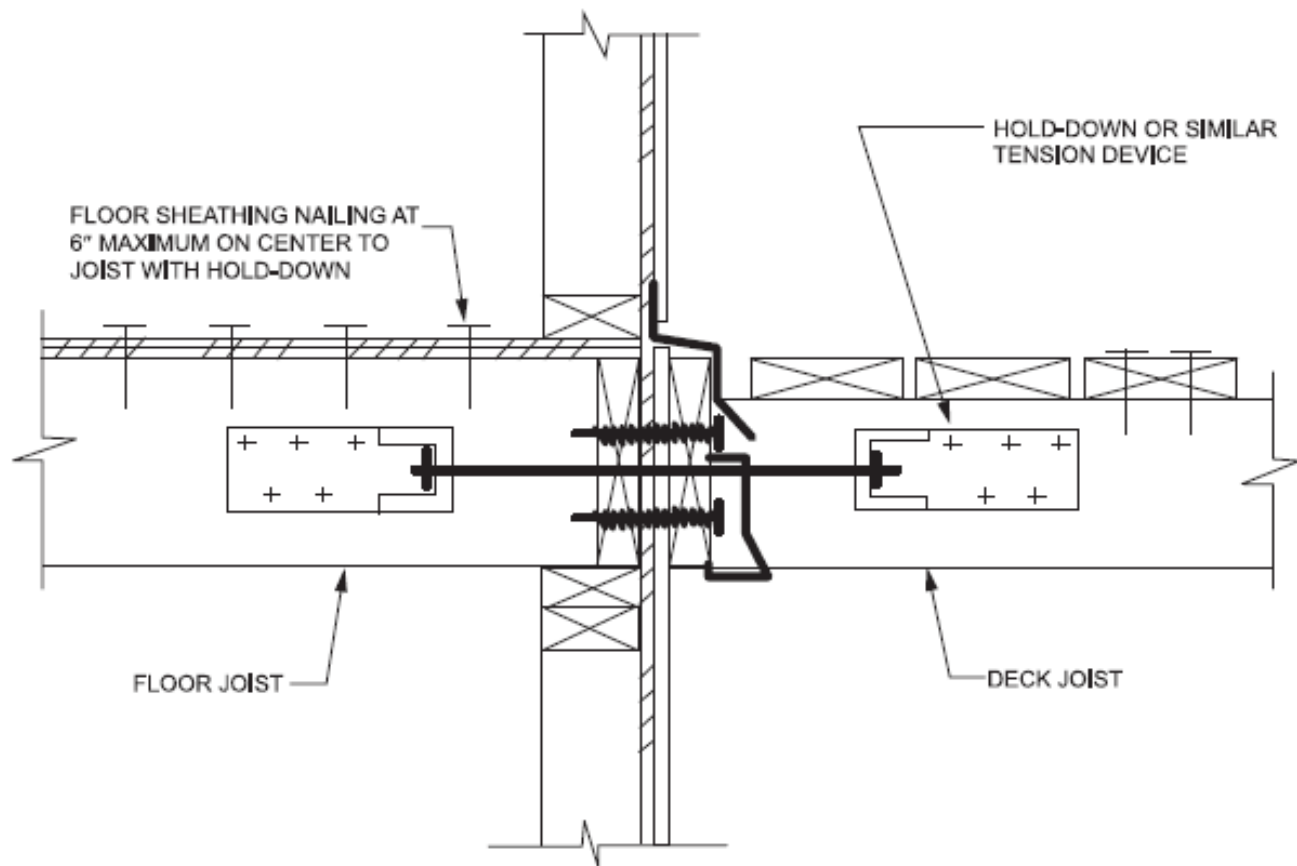
FIGURE R507.9.1.3(2)  
PLACEMENT OF LAG SCREWS AND BOLTS IN BAND JOISTS



- \* Lateral connection
  - Transfer load to ground or structure
  - Per **Figure R507.9.2(1)**
  - Two connections per deck
  - With 24" of end
  - Per **Figure 507.9.2(2)**
  - Four connections per deck

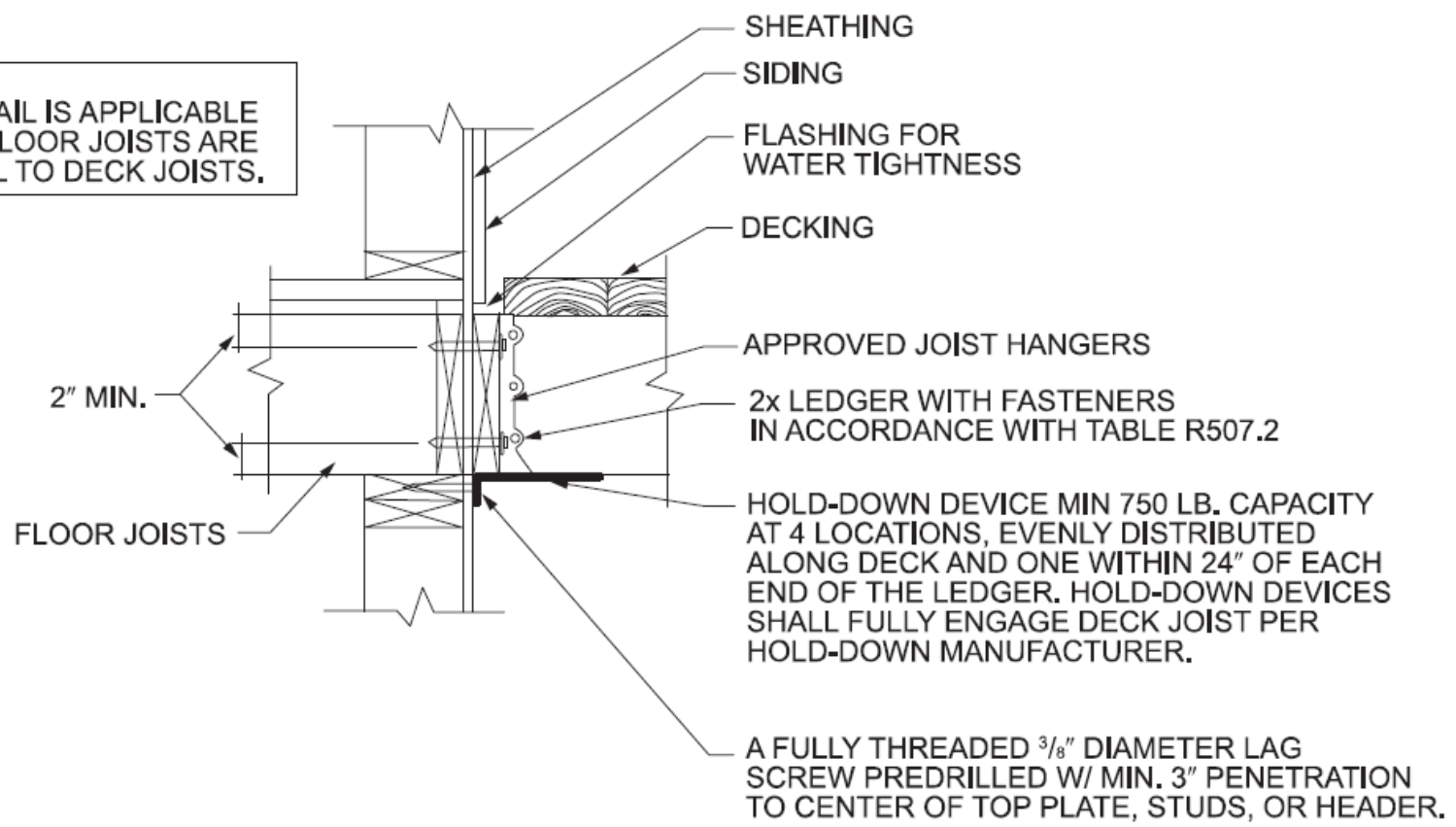
\* Deck lateral load connection **507.2.3**





**FIGURE R507.9.2(1)**  
**DECK ATTACHMENT FOR LATERAL LOADS**

**NOTE:**  
THIS DETAIL IS APPLICABLE  
WHERE FLOOR JOISTS ARE  
PARALLEL TO DECK JOISTS.



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

**FIGURE R507.9.2(2)**  
**DECK ATTACHMENT FOR LATERAL LOADS**

# BFC A<sup>®</sup>

## Building & Fire Code Academy

### Understanding the 2019 Residential Code of Ohio

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### Chapter 6 Wall Construction

## ◆ General R601

- \* Lists the requirements and standards for types of lumber

## ◆ Wood Wall Framing R602

### \* Grade R602.2

- Studs minimum No.3 standard or stud grade lumber
- Exception for bearing studs not supporting floor and non bearing studs can be utility grade

- \* Design and construction 602.3
  - Per Figures 602.3(1) and 602.3(2)
  - Fastened per Table 602.3(1)
  - Studs – continuous from sole plate to top plate
  - Exception #2 goes to 12' from 8'

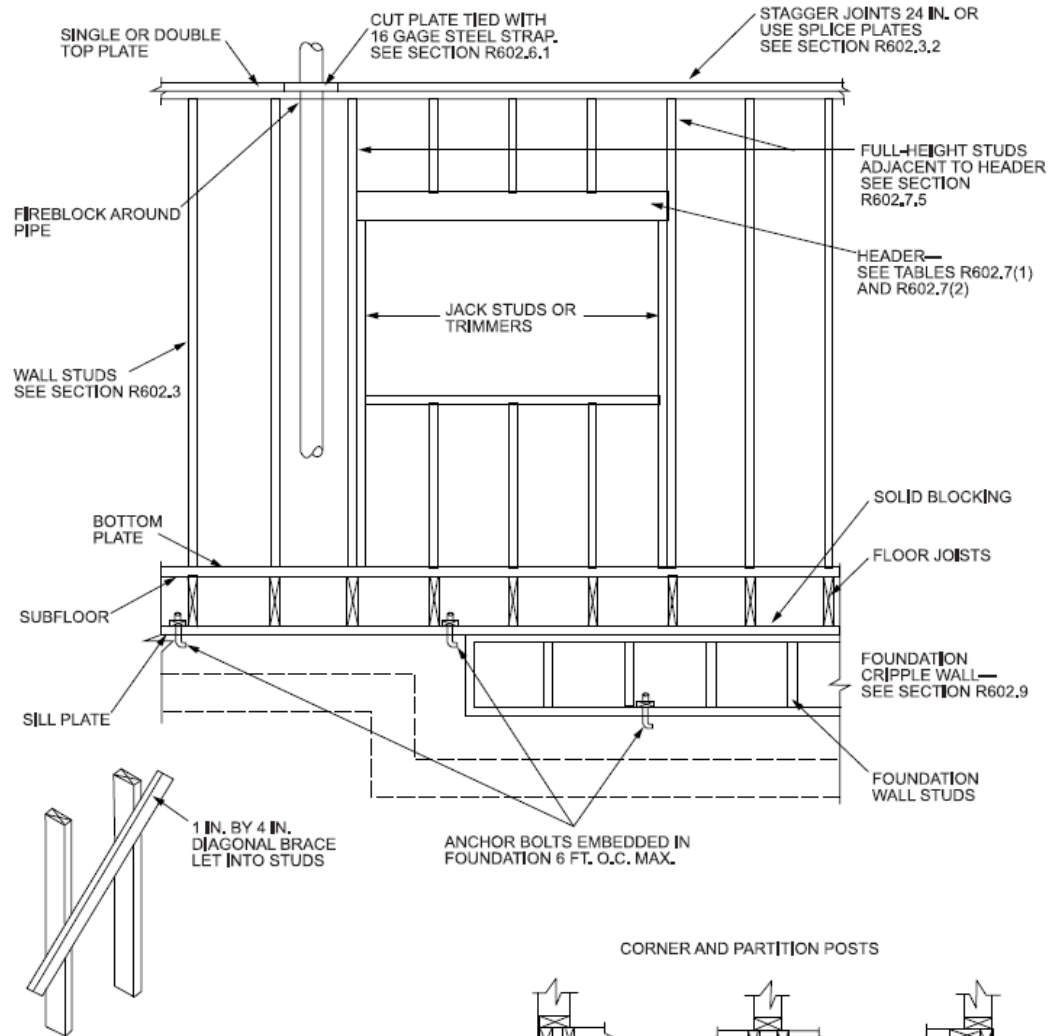
- \* Stud size, height & spacing **602.3.1**
  - Per **Table 602.3(5)**











**FIGURE R602.3(2)  
FRAMING DETAILS**



**TABLE | 602.3(1)  
FASTENING SCHEDULE**

ITEM	DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER <sup>a, b, c</sup>	SPACING AND LOCATION
<b>Roof</b>			
1	Blocking between ceiling joists or rafters to top plate	4-8d box (2½" × 0.113") or 3-8d common (2½" × 0.131"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	Toe nail
2	Ceiling joists to top plate	4-8d box (2½" × 0.113"); or 3-8d common (2½" × 0.131"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	Per joist, toe nail
3	Ceiling joist not attached to parallel rafter, laps over partitions (see Section R802.5.2 and Table R802.5.2)	4-10d box (3" × 0.128"); or 3-16d common (3½" × 0.162"); or 4-3" × 0.131" nails	Face nail
4	Ceiling joist attached to parallel rafter (heel joint) (see Section R802.5.2 and Table R802.5.2)	Table R802.5.2	Face nail
5	Collar tie to rafter, face nail or 1¼" × 20 ga. ridge strap to rafter	4-10d box (3" × 0.128"); or 3-10d common (3" × 0.148"); or 4-3" × 0.131" nails	Face nail each rafter
6	Rafter or roof truss to plate	3-16d box nails (3½" × 0.135"); or 3-10d common nails (3" × 0.148"); or 4-10d box (3" × 0.128"); or 4-3" × 0.131" nails	2 toe nails on one side and 1 toe nail on opposite side of each rafter or truss <sup>d</sup>
7	Roof rafters to ridge, valley or hip rafters or roof rafter to minimum 2" ridge beam	4-16d (3½" × 0.135"); or 3-10d common (3" × 0.148"); or 4-10d box (3" × 0.128"); or 4-3" × 0.131" nails	Toe nail
		3-16d box 3½" × 0.135"); or 2-16d common (3½" × 0.162"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	End nail

**TABLE 602.3(5)**  
**SIZE, HEIGHT AND SPACING OF WOOD STUDS<sup>a</sup>**

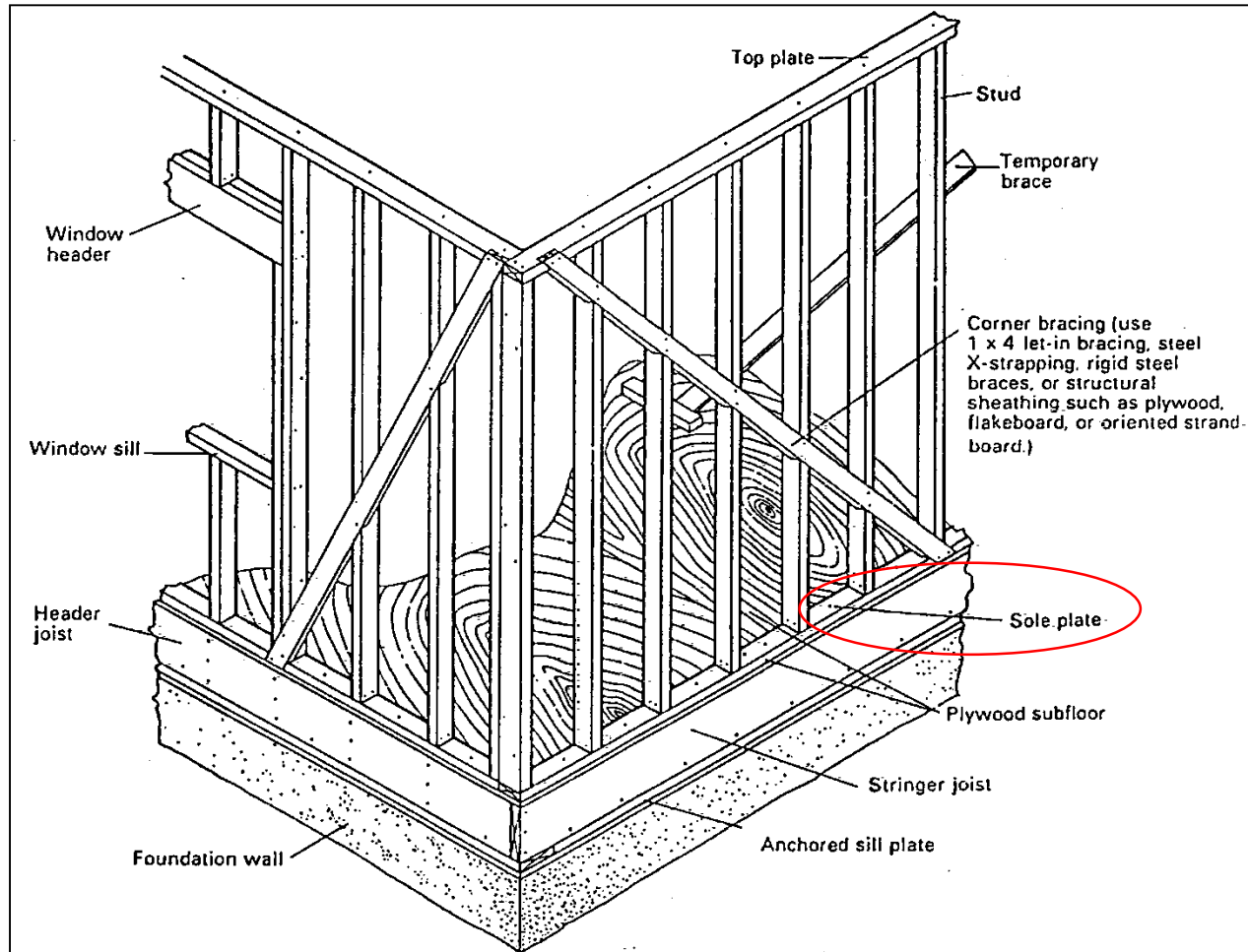
STUD SIZE (inches)	BEARING WALLS					NONBEARING WALLS	
	Laterally unsupported stud height <sup>a</sup> (feet)	Maximum spacing when supporting a roof-ceiling assembly or a habitable attic assembly, only (inches)	Maximum spacing when supporting one floor, plus a roof- ceiling assembly or a habitable attic assembly (inches)	Maximum spacing when supporting two floors, plus a roof- ceiling assembly or a habitable attic assembly (inches)	Maximum spacing when supporting one floor height <sup>a</sup> (inches)	Laterally unsupported stud height <sup>a</sup> (feet)	Maximum spacing (inches)
							
2 x 3 <sup>b</sup>	—	—	—	—	—	10	16
2 x 4	10	24 <sup>c</sup>	16 <sup>c</sup>	—	24	14	24
3 x 4	10	24	24	16	24	14	24
2 x 5	10	24	24	—	24	16	24
2 x 6	10	24	24	16	24	20	24

- a. Listed heights are distances between points of lateral support placed perpendicular to the plane of the wall. Bearing walls shall be sheathed on not less than one side or bridging shall be installed not greater than 4 feet apart measured vertically from either end of the stud. Increases in unsupported height are permitted where in compliance with Exception 2 of Section [R602.3.1](#) or designed in accordance with accepted engineering practice.
- b. Shall not be used in exterior walls.
- c. A habitable attic assembly supported by 2 x 4 studs is limited to a roof span of 32 feet. Where the roof span exceeds 32 feet, the wall studs shall be increased to 2 x 6 or the studs shall be designed in accordance with accepted engineering practice.

- \* Top plate **602.3.2**
  - Plates not less than 2” nominal thickness and width at least equal to width of the stud
  - Added that joints in plates need not occur over studs
  - Single top plate permitted when intersecting walls are tied at corners with galvanized plate
- \* Bearing studs **602.3.3**
  - Within 5” of bearing members above if 24” on center

\* Bottom (sole) plate 602.3.4

- 2" x width of wall

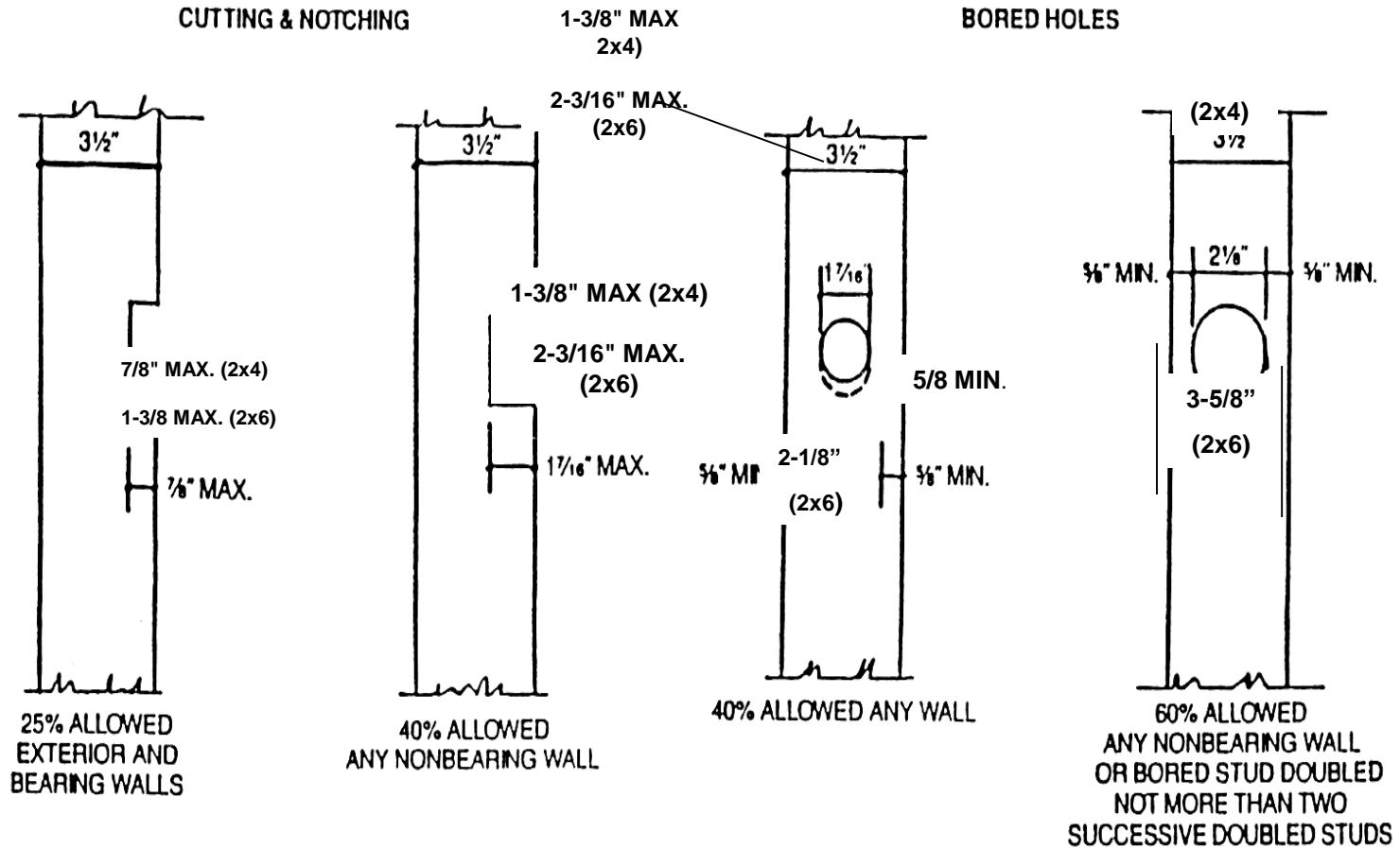


- \* Interior load-bearing partitions **602.4**
  - Framed & fire blocked as exterior walls
- \* Interior non-bearing partitions **602.5**
  - 2" x 3" x 24" on center when not part of braced wall line
  - 2" x 4" by flat studs 16" on center
  - Capped with single top plate
  - Fireblocked

- \* Drilling and notching of studs – cut or notched studs 602.6
  - Notching bearing =  $\leq 25\%$  of width
  - Non-bearing =  $\leq 40\%$  of single stud width
  - Drilling non-bearing =  $\leq 60\%$  and no closer than 5/8" from edge
  - Drilling on bearing =  $\leq 40\%$  and no closer than 5/8" from edge
  - Or double the stud when the stud is located on an exterior wall, bearing partition, drilled  $\geq 40\%$  and up to 60%. Not in double successive studs
  - Use a fastener across the top plate to each side of the opening
  - Use not less than eight 10d nails at each side or equivalent



\* Sample stud notching sketch



MAXIMUM ALLOWED NOTCHING AND DRILLING  
FOR NORMAL CONSTRUCTION WITH  
2 x 4 STUD

- \* Drilling and notching of studs 602.6



- \* Drilling and notching of studs 602.6 (*continued*)
  - Exterior walls or bearing partitions can cut / Notch 25% or less
  - Equivalent allowable bearing wall stud width cutting / Notching (25% or less)
  - Non-bearing partitions
    - 40% or less of its width
    - 2" x 4" nominal stud size = 1-3/8"
    - 2" x 6" nominal stud size = 2-3/16"

- Non-bearing partitions
  - IF: Exterior wall or bearing studs are doubled
  - AND IF: Are not more than 2 successive studs are bored
  - AND IF: Approved stud shoes are used
  - THEN: OK to bore or drill 60% of stud width
  - 2" x 4" nominal stud size = 2-1/8" maximum hole
  - 2" x 6" nominal stud size = 3-3/8" maximum hole

\* Drilling and notching of studs 602.6

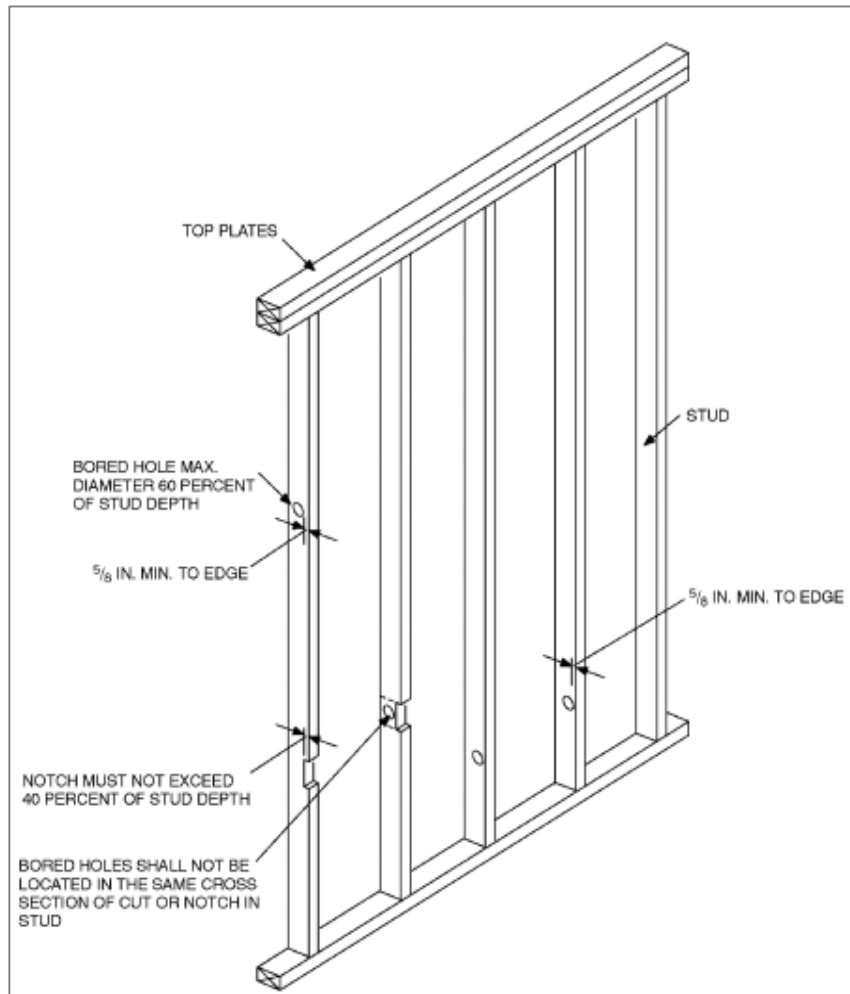


FIGURE R602.6(2)  
NOTCHING AND BORED HOLE LIMITATIONS FOR INTERIOR NONBEARING WALLS

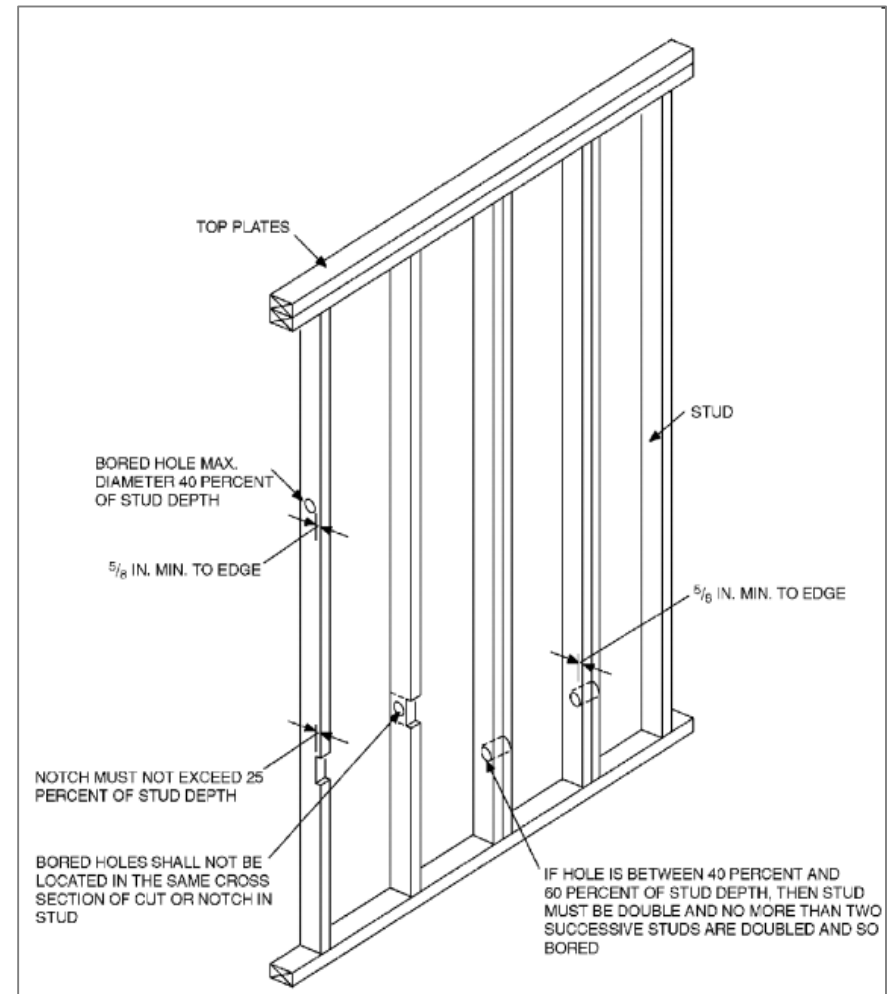
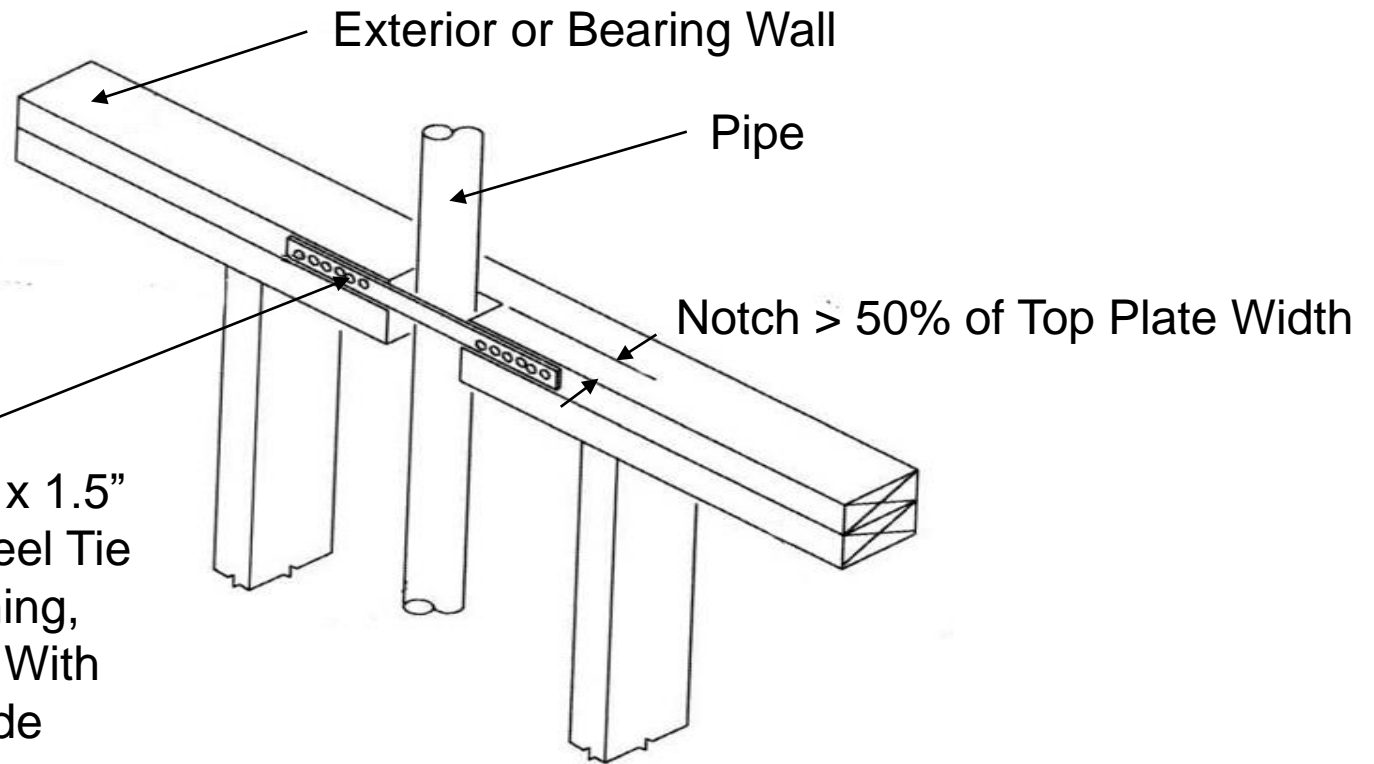


FIGURE R602.6(1)  
NOTCHING AND BORED HOLE LIMITATIONS FOR EXTERIOR WALLS AND BEARING WALLS

- \* Drilling and notching top plate **602.6.1**
  - Exterior wall or bearing interior wall
  - IF:                   Notched or bored >50% width of top plate
  - THEN:             Install a 0.054" thick galvanized metal strap
    - Min 6" past the opening with min
    - Use eight 10d nails (min 1-1/2" long) and 0.148" diameter each side
  - 2" x 4" top plate = 1-7/8"
  - 2" x 6" top plate = 2-1/4"

\* Drilling and notching top plate 602.6.1





\* Drilling and notching top plate 602.6.1



Does this meet minimum code requirements?

No: Not 6" past notch on both sides and less than 8 – 10d nails each side.



\* Drilling and notching top plate 602.6.1

Is this framing ok if this is a bearing wall?



\* Headers 602.7

- Prescriptive provisions for single-member headers  
Tables 602.7(1) & 602.7(2)
  - Wall plate not less in width than members above & below
- Rim board headers per Table 602.7(1) and Figure 602.7.3
  - Number of support studs not less than studs replaced by  $\frac{1}{2}$  the header
  - Concentrated loads designed
  - Table 602.7(1) note f, 602.7(2) note e
  - Multiply by .7 with no perpendicular bracing

- \* Plywood box headers – maximum spans: [Table 602.7.3](#) & [Figure 602.7.3](#)

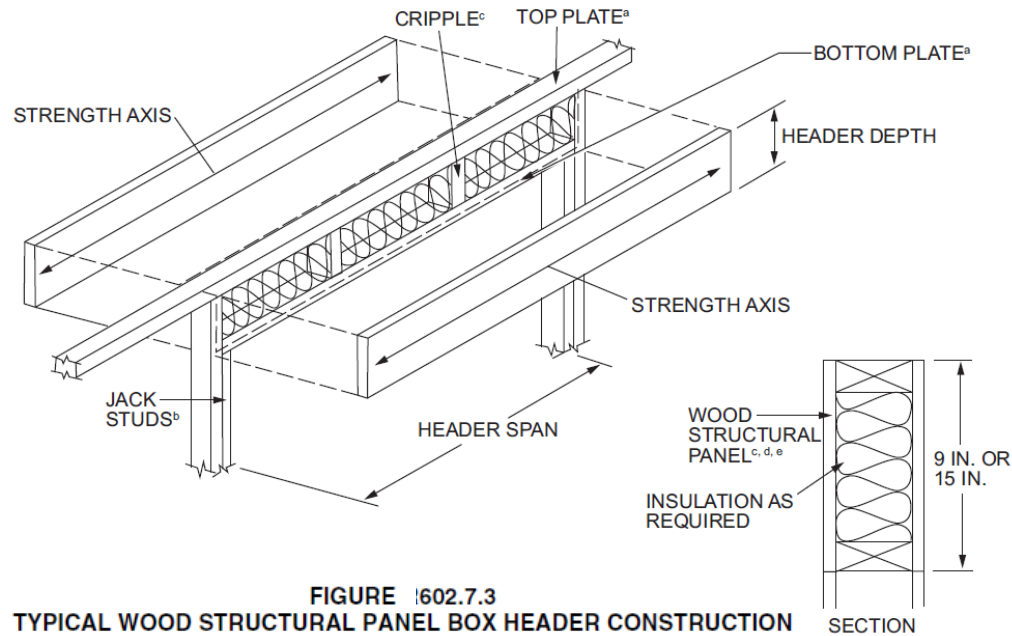


FIGURE 602.7.3  
TYPICAL WOOD STRUCTURAL PANEL BOX HEADER CONSTRUCTION

**TABLE | 602.7.3**  
**MAXIMUM SPANS FOR WOOD STRUCTURAL PANEL BOX HEADERS<sup>a</sup>**

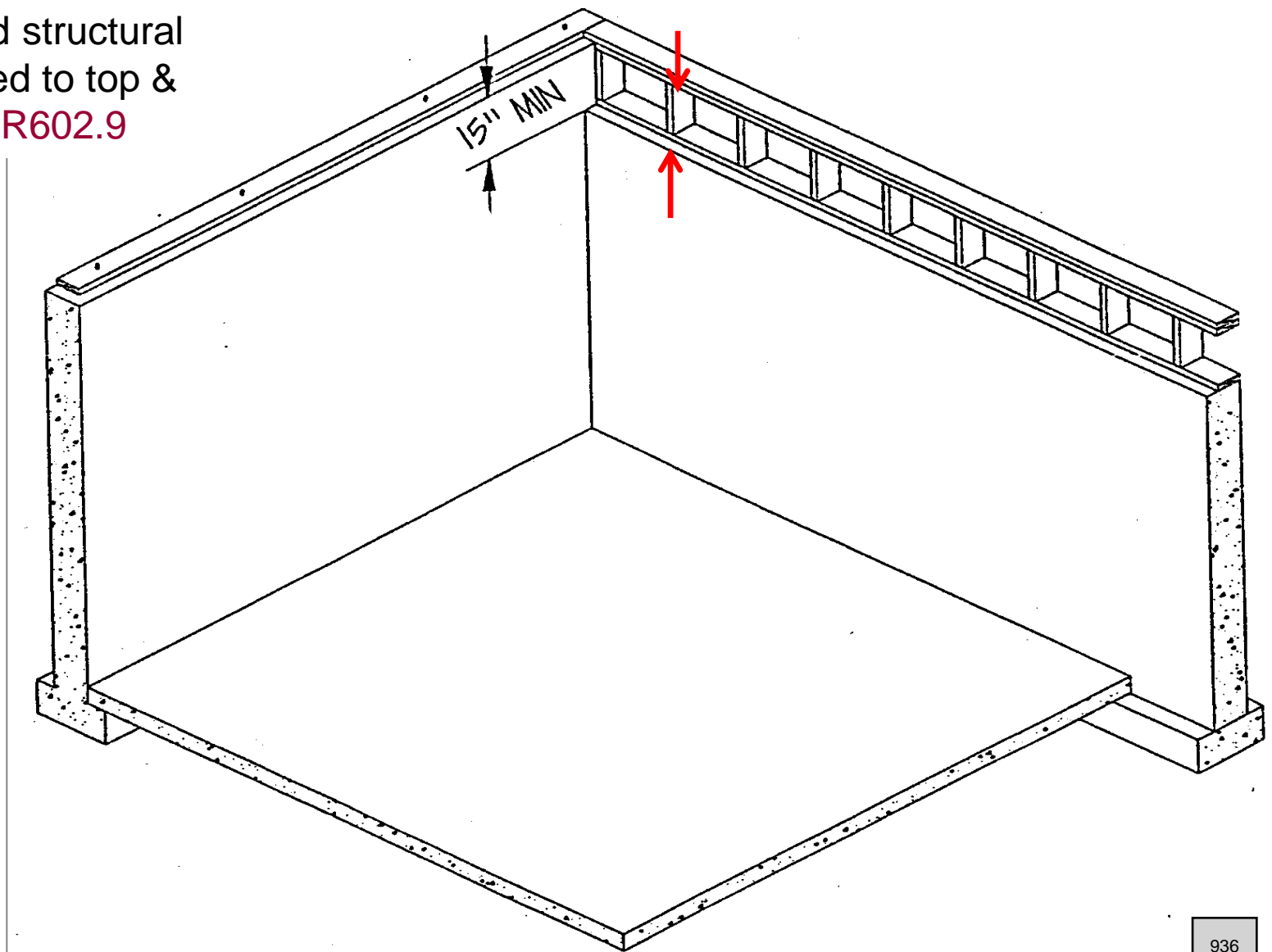
HEADER CONSTRUCTION <sup>b</sup>	HEADER DEPTH (inches)	HOUSE DEPTH (feet)				
		24	26	28	30	32
Wood structural panel—one side	9	4	4	3	3	—
	15	5	5	4	3	3
Wood structural panel—both sides	9	7	5	5	4	3
	15	8	8	7	7	6

- a. Spans are based on single story with clear-span trussed roof or two story with floor and roof supported by interior-bearing walls.  
b. See Figure | [602.7.3](#) for construction details.

\* Non-bearing walls – no header required for openings up to ‘

- \* Support for headers 602.7.5
  - Jack studs per Tables 602.7(1) or 602.7(2)
  - Full height studs per Table 602.7.5
    - Full height stud next to header nailed end of header – four 16d

<14" **STUD** Height shall be continuously sheathed on 1 side with wood structural panels fastened to top & bottom plates **R602.9**



Wall bracing requirements have been reorganized and revised in past several code editions

WHY?

- \* Market forces that have changed the way we design and construct houses
- \* Are houses larger or smaller than before?
- \* Do larger walls/roofs = >wind load?
- \* Does >wind load require >wind bracing?

## ◆ Typical Home Construction in 1940s Through 1980s

- \* Prescriptive bracing requirements in the model codes
- \* Smaller homes
- \* Greater number of interior walls
- \* Seldom over two stories
- \* Fewer windows
- \* Single story living spaces
- \* Simple rectangular building footprints



\* We went from this...



\* To this:






## ◆ New Construction

- \* Homes about four times larger
- \* Multiple stories
- \* Two-story entrances and living spaces
- \* Window walls
- \* Three car garages
- \* Complex roof lines
- \* Complex load transfer path
- \* Dramatic stairways



- \* Wall panel sheathing reorganized **602.7.3(3)**
- \* Fastener and spacing requirements added to Table **602.10.2**
- \* Fastener and spacing requirements, bracing methods, thickness and connection criteria reorganized for clarity **Table R602.10.4**

TABLE R602.10.4 BRACING METHODS					
METHODS, MATERIAL		MINIMUM THICKNESS	FIGURE	CONNECTION CRITERIA <sup>a</sup>	
				Fasteners	Spacing
	<b>LIB</b> Let-in-bracing	1 × 4 wood or approved metal straps at 45° to 60° angles for maximum 16" stud spacing		Wood: 2-8d common nails or 3-8d (2½" long × 0.113" dia.) nails	Wood: per stud and top and bottom plates
	<b>DWB</b> Diagonal wood boards	¾" (1" nominal) for maximum 24" stud spacing		2-8d (2½" long × 0.113" dia.) nails or 2 - 1¾" long staples	Metal: per manufacturer Per stud
	<b>WSP</b> Wood structural panel (See Section R604)	⅜"		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
	<b>BV-WSP<sup>e</sup></b> Wood Structural Panels with Stone or Masonry Veneer (See Section R602.10.6.5)	7/16"	See Figure R602.10.6.5	8d common (2½" × 0.131) nails	4" at panel edges 12" at intermediate supports 4" at braced wall panel end posts

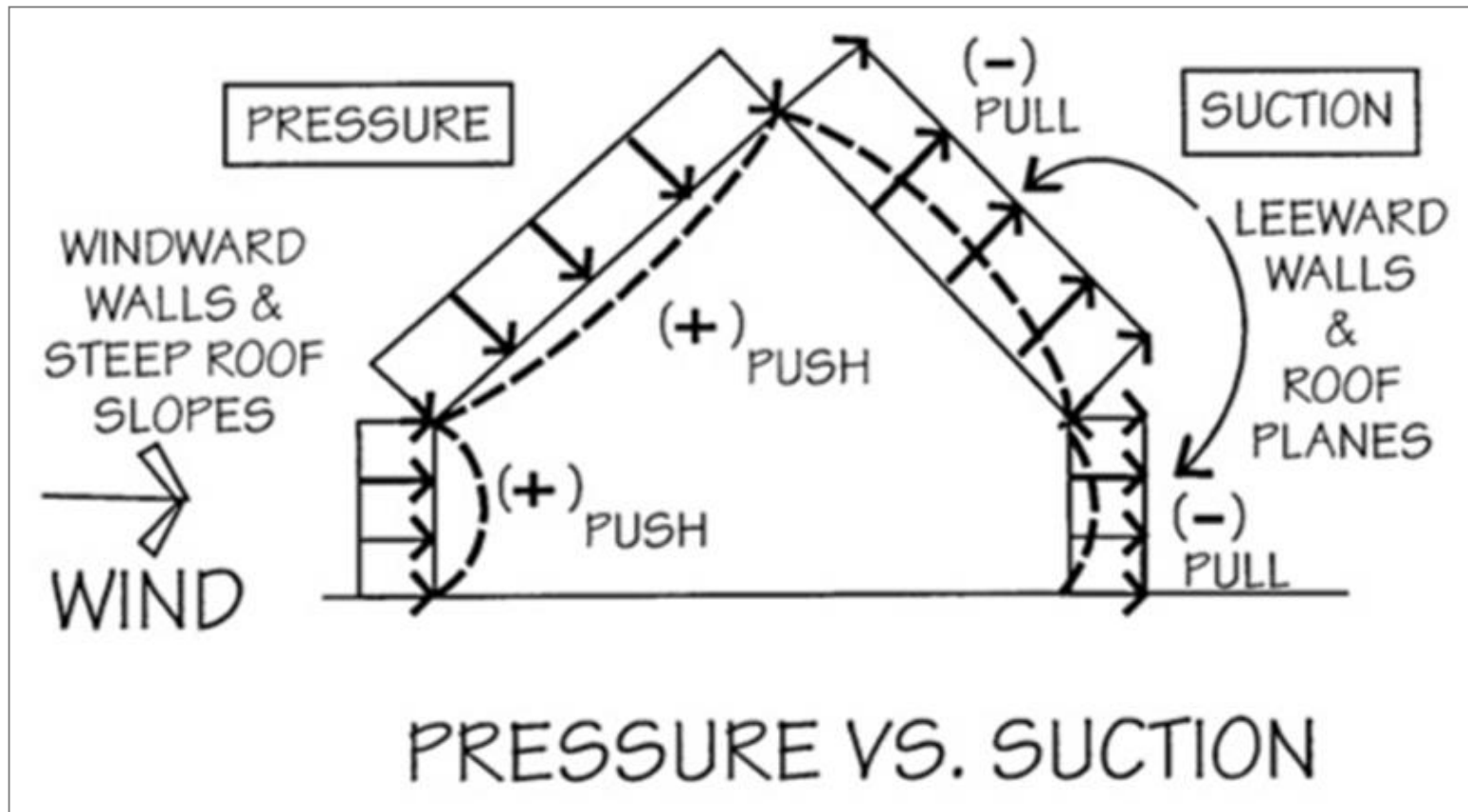
**Fastener and Spacing Requirements Added Table R602.10.4**

- \* Wall bracing 602.10

## ◆ Bracing Definitions Section 202

- \* *BRACED WALL LINE*: A straight line through the building plan that represents the location or the lateral resistance provided by the wall bracing
- \* *BRACED WALL PANEL*: A full height section of wall constructed to resist in plane shear loads through interaction of framing members, sheathing materials 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 per R602.10.2





- \* Wall bracing **602.10**
  - Major revisions: Existing tables
  - New provisions: Tables and text
  - Bracing requirements reorganized
- \* Braced wall lines **602.10.1**
  - Length of braced wall lines **602.10.1.1**
  - Offsets in walls
  - Spacing of wall lines
  - Angled walls




## ◆ Braced wall panels 602.10.2

- Up lift load path
- Location of wall panels
- Minimum number of wall panels
- Required length of wall panels 602.10.3
  - Per Tables 602.10.3(1), 602.10.3(2), 602.10.3(3)
- Construction method of braced wall panels 602.10.4








**TABLE .602.10.3(1)  
BRACING REQUIREMENTS BASED ON WIND SPEED**

<ul style="list-style-type: none"> <li>• EXPOSURE CATEGORY B</li> <li>• 30-FOOT MEAN ROOF HEIGHT</li> <li>• 10-FOOT WALL HEIGHT</li> <li>• 2 BRACED WALL LINES</li> </ul>			MINIMUM TOTAL LENGTH (FEET) OF BRACED WALL PANELS REQUIRED ALONG EACH BRACED WALL LINE <sup>a</sup>			
Ultimate Design Wind Speed (mph)	Story Location	Braced Wall Line Spacing <sup>c</sup> (feet)	Method LJB <sup>b</sup>	Method GB	Methods DWB, WSP, SFB, PBS, PCP, HPS, BV-WSP, ABW, PFH, PFC, CS-SFB	Methods CS-WSP, CS-G, CS-PF
≤ 110		10	3.5	3.5	2.0	1.5
		20	6.0	6.0	3.5	3.0
		30	8.5	8.5	5.0	4.5
		40	11.5	11.5	6.5	5.5
		50	14.0	14.0	8.0	7.0
		60	16.5	16.5	9.5	8.0
		10	6.5	6.5	3.5	3.0
		20	11.5	11.5	6.5	5.5
		30	16.5	16.5	9.5	8.0
		40	21.5	21.5	12.5	10.5
		50	26.5	26.5	15.5	13.0
		60	31.5	31.5	18.0	15.5
		10	NP	9.5	5.5	4.5
		20	NP	17.0	10.0	8.5
		30	NP	24.5	14.0	12.0
		40	NP	32.0	18.5	15.5
		50	NP	39.5	22.5	19.0
		60	NP	46.5	26.5	23.0

**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 <sup>a, b</sup> [multiply length from Table R602.10.3(1) by this factor]	APPLICABLE METHODS
1	Exposure category <sup>d</sup>	One-story structure	B	1.00	All methods
			C	1.20	
			D	1.50	
		Two-story structure	B	1.00	
			C	1.30	
			D	1.60	
		Three-story structure	B	1.00	
			C	1.40	
			D	1.70	
2	Roof eave-to-ridge height	Roof only	≤ 5 feet	0.70	All methods
			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	
		Roof + 2 floors	≤ 5 feet	0.90	
			10 feet	1.00	
			15 feet	1.10	
			20 feet	Not permitted	
3	Story height (Section R301.3)	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) <sup>e</sup>	Any story	2	1.00	All methods
			3	1.30	
			4	1.45	
			≥ 5	1.60	

**TABLE 602.10.4 BRACING METHODS**

METHODS, MATERIAL		MINIMUM THICKNESS	FIGURE	CONNECTION CRITERIA <sup>a</sup>	
				Fasteners	Spacing
<b>LIB</b> Let-in-bracing		1 × 4 wood or approved metal straps at 45° to 60° angles for maximum 16" stud spacing		Wood: 2-8d common nails or 3-8d (2½" long × 0.113" dia.) nails	Wood: per stud and top and bottom plates
				Metal strap: per manufacturer	Metal: per manufacturer
<b>DWB</b> Diagonal wood boards		¾"(1" nominal) for maximum 24" stud spacing		2-8d (2½" long × 0.113" dia.) nails or 2 - 1¾" long staples	Per stud
<b>WSP</b> Wood structural panel (See <a href="#">Section R604</a> )		¾"		Exterior sheathing per Table R602.3(3)	6" edges 12" field
				Interior sheathing per Table R602.3(1) or R602.3(2)	Varies by fastener
<b>BV-WSP<sup>e</sup></b> Wood Structural Panels with Stone or Masonry Veneer (See <a href="#">Section R602.10.6.5</a> )		7/16"	See Figure R602.10.6.5	8d common (2½" × 0.131) nails	4" at panel edges 12" at intermediate supports 4" at braced wall panel end posts

## ◆ Determining Wall Bracing Requirements

### \* STEP 1

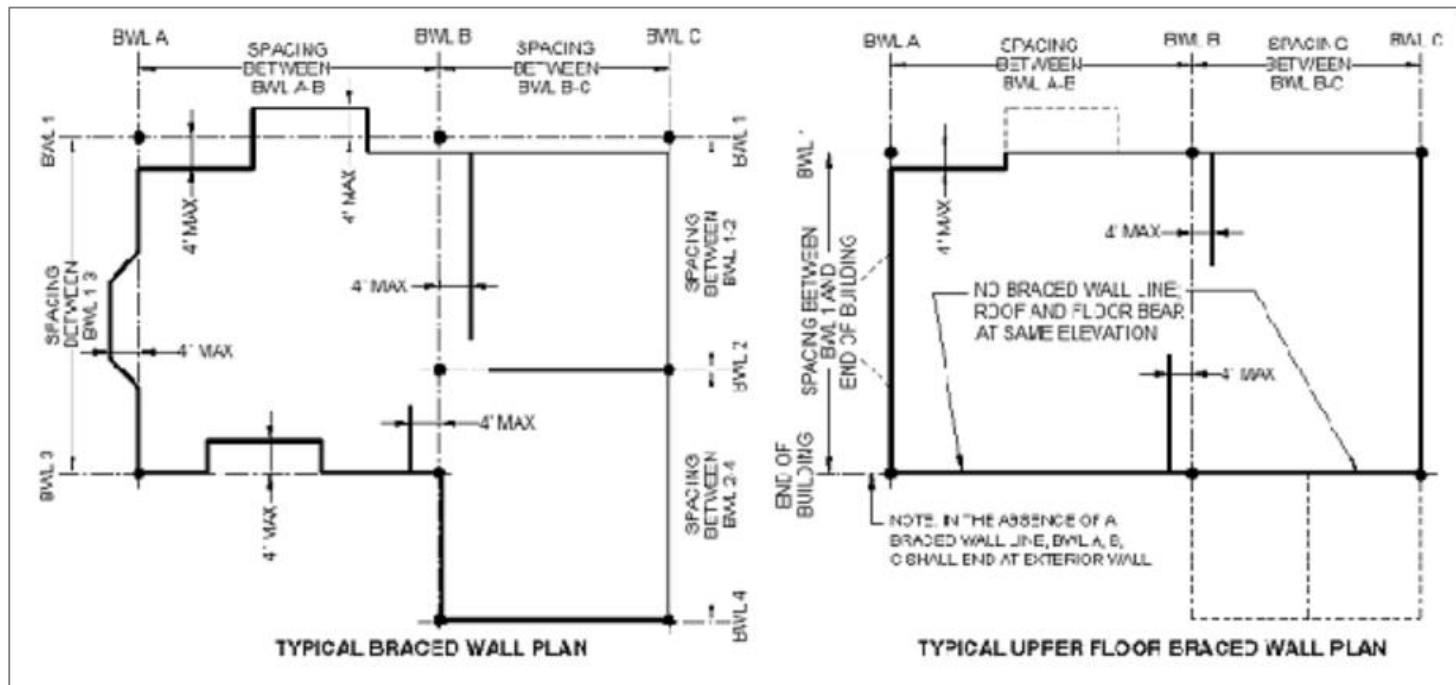
- Determine locations of braced wall lines
- Plans to clearly show braced wall lines **106.1.1**

### \* STEP 2

- Determine method of bracing
- 12 methods of intermittent bracing **Table 602.10.4**
- 4 continuous sheathing methods **Table 602.10.4**
- Wood structural panel
- Wood structural panel adjacent to garage openings
- Portal frame
- Structural fiberboard

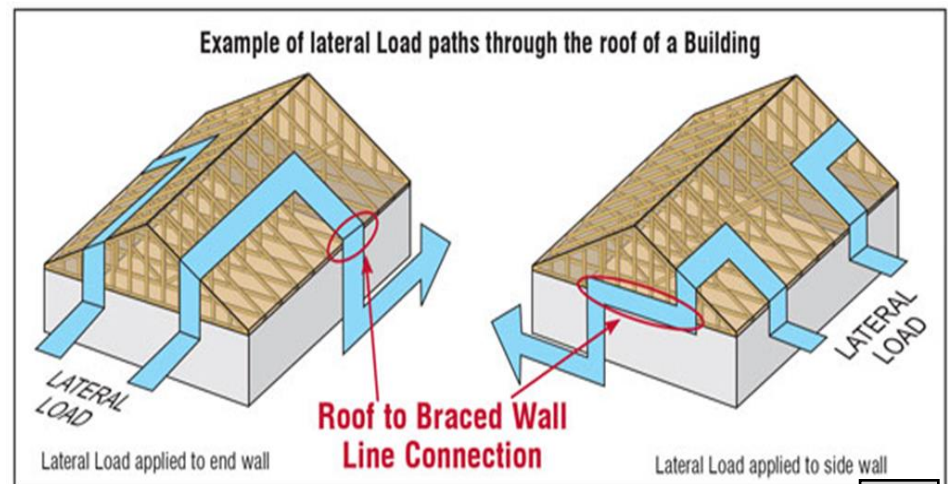
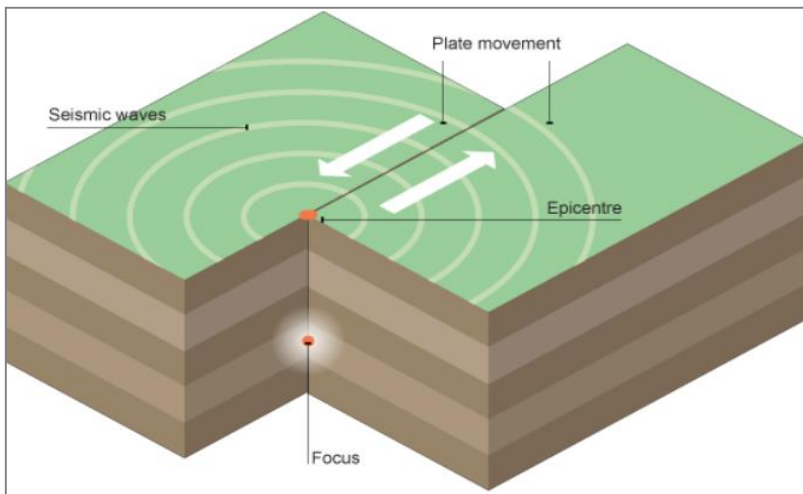
\* STEP 3

- Review offsets in braced wall line for compliance with section **602.10.1.2**
- Determine distance between braced wall lines



\* STEP 4

- Determine: bracing spacing required, or how much of the wall needs bracing
- In seismic design categories A and B bracing, length is based on wind factor from **Table 602.10.3(1)**



\* STEP 4 (*continued*)

- NOTE: In seismic risk areas other than A and B – compare bracing requirements from seismic loads based on **Table 602.10.1.3**
- SEE:
  - Differences in table layouts
  - **Table 602.10.1.3** vs **Table 602.10.3(1)**
  - Bracing requirements
  - Table column headings



\* STEP 5

- Adjust braced wall line length per notes in wind and seismic tables
- Wind adjustment considerations
  - Exposure condition (wind speed, 1st, 2nd, 3rd story)
  - Roof eave to ridge height
  - Wall height
  - Number of braced wall lines
  - Additional hold down devices
  - Gypsum board factor
  - Gypsum board fastening



\* STEP 5 (*continued*)

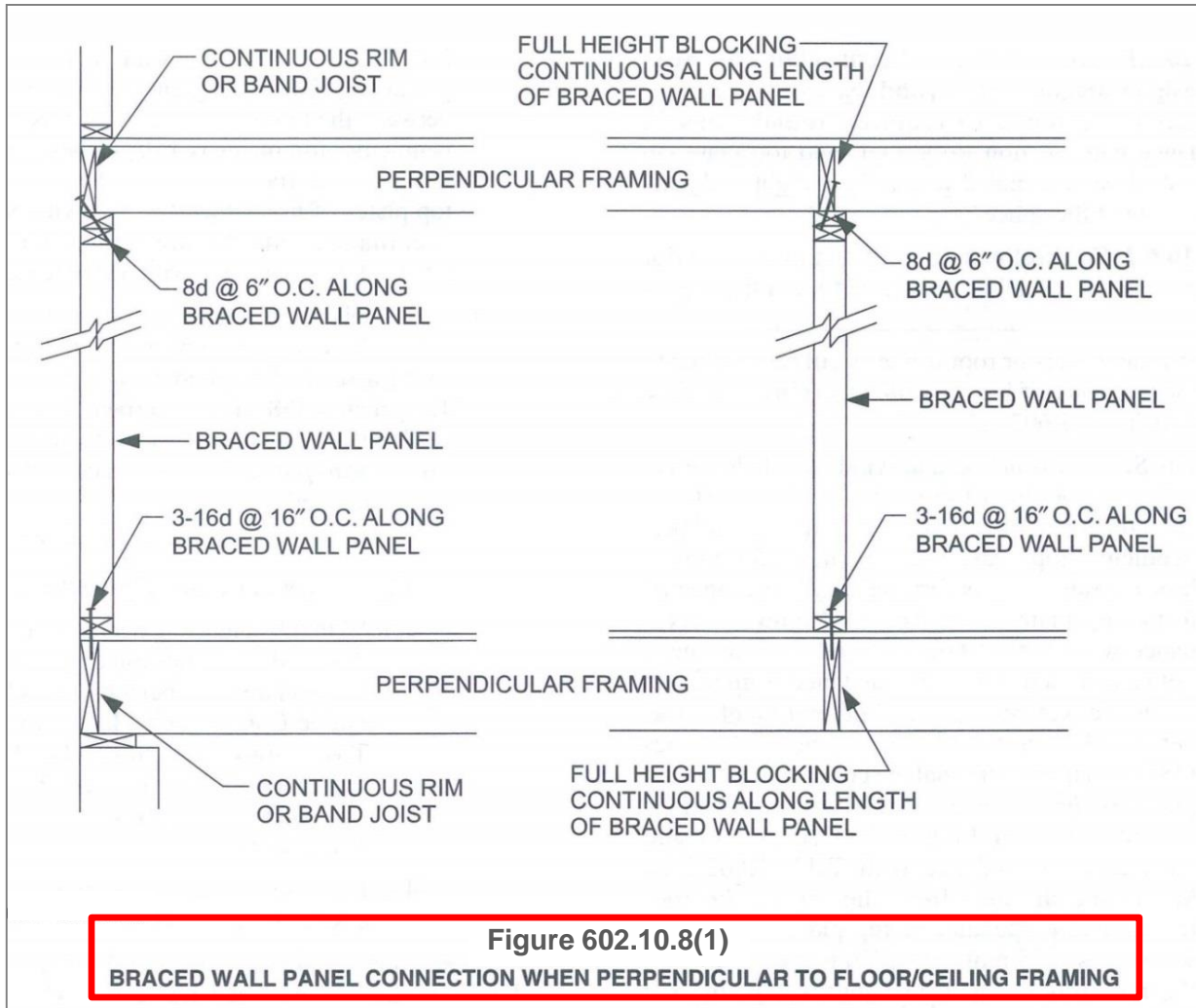
- Seismic adjustment considerations:
  - Story height
  - Braced wall spacing in townhouses in seismic design Category C
  - Braced wall line spacing in seismic design Categories D<sub>0</sub>, D<sub>1</sub>, D<sub>2</sub>



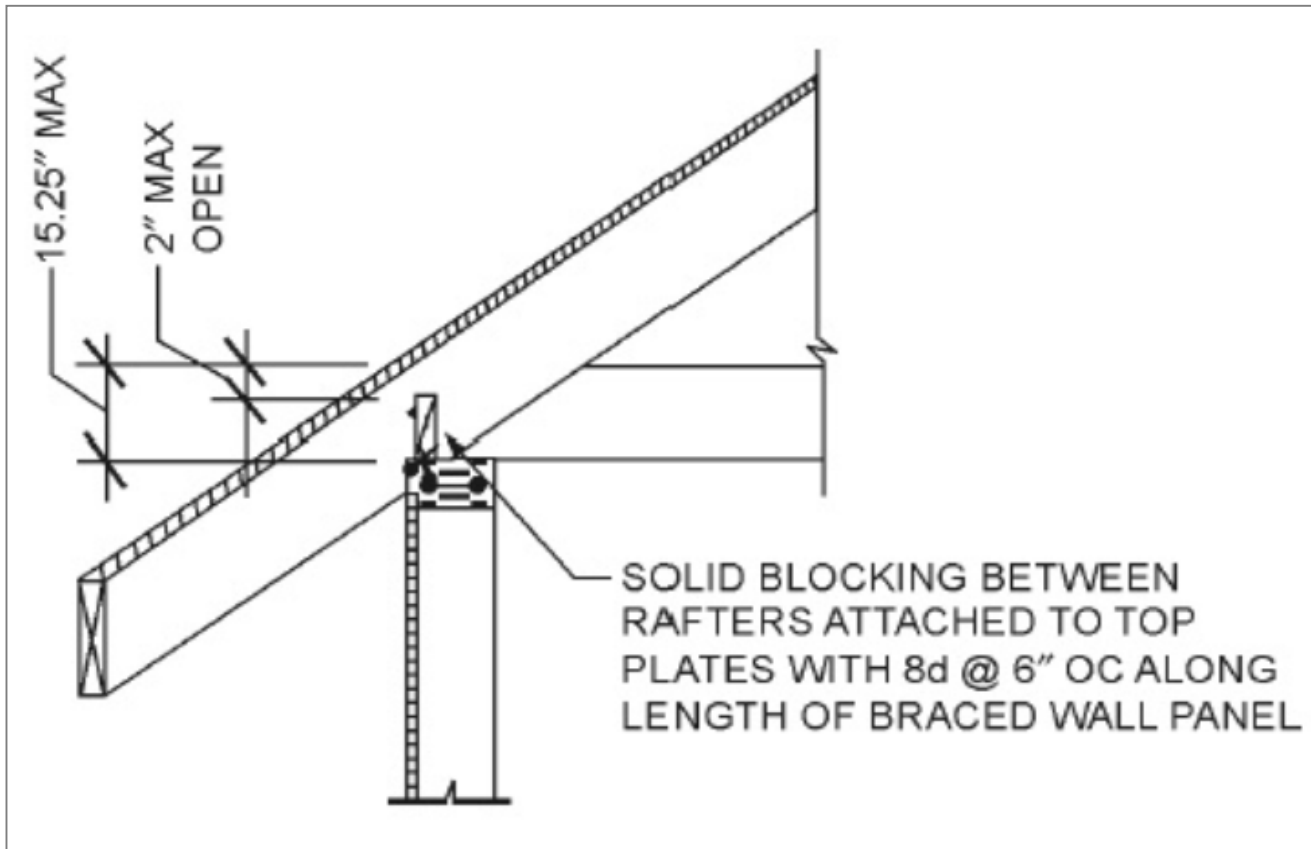
- Seismic adjustment considerations (*continued*):
  - Wall dead load
  - Roof / Ceiling dead load
  - Detached dwellings
  - Detached One- and Two-family with stone veneer
  - Townhomes with stone veneer
  - Gypsum board interior

- \* Additional bracing considerations
  - Angled corners
  - Length of full panels
  - Special considerations for portal frame connections and hold downs
  - Bracing panels located not more than 25' apart and not more than 12'- 6" from ends of walls

- \* Additional wall bracing changes:
  - Detail corner frame for continuous sheathing
  - Detail braced walls when parallel and perpendicular to floor and roof framing
  - Seismic design category C, Two-story masonry veneer requires additional sheathing see [Table 602.12.1](#)

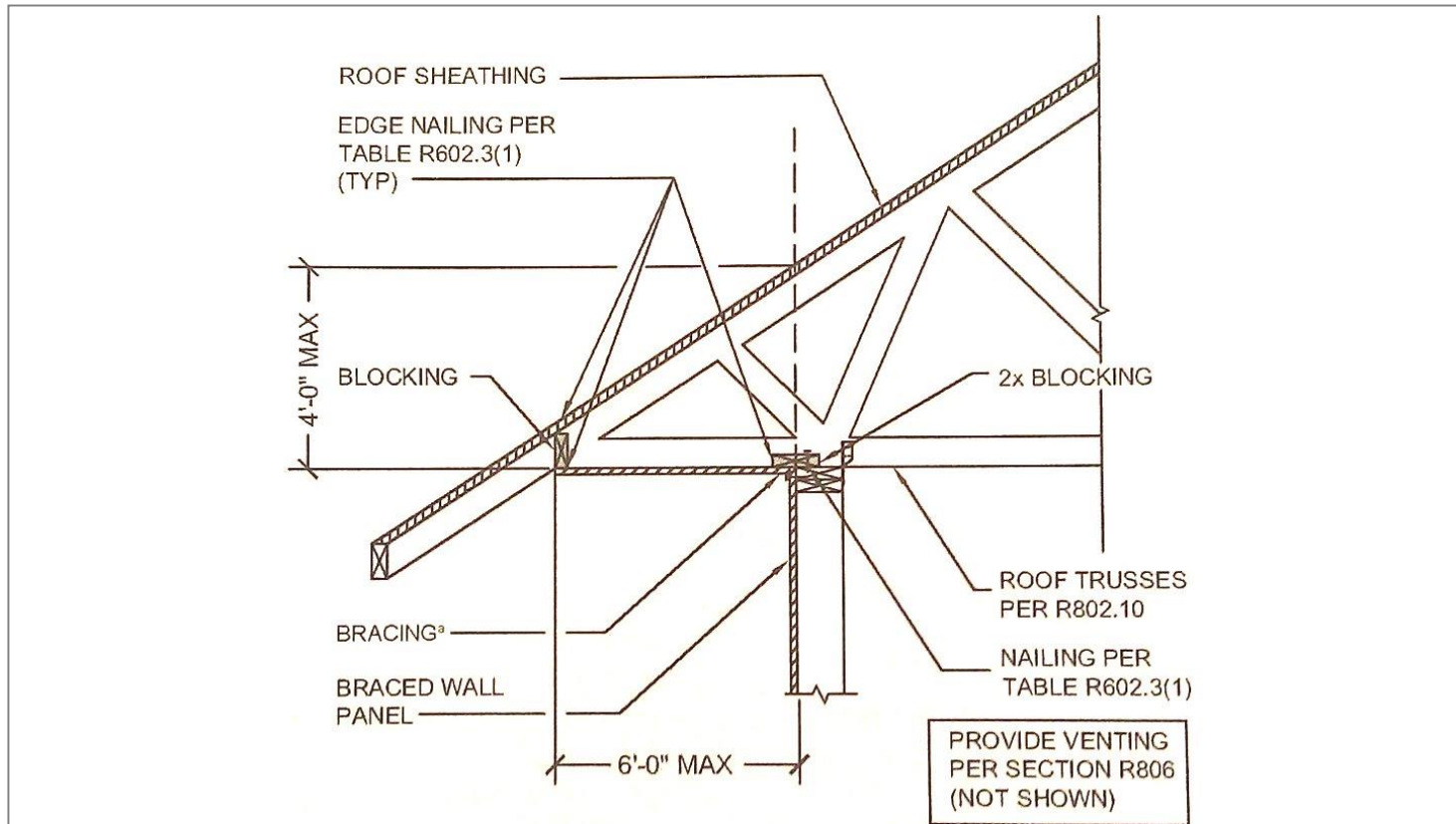


- \* Connection to roof framing R602.10.8.2



Braced Wall Panel Connection To Perpendicular Rafter  
Figure 602.10.8.2(1)

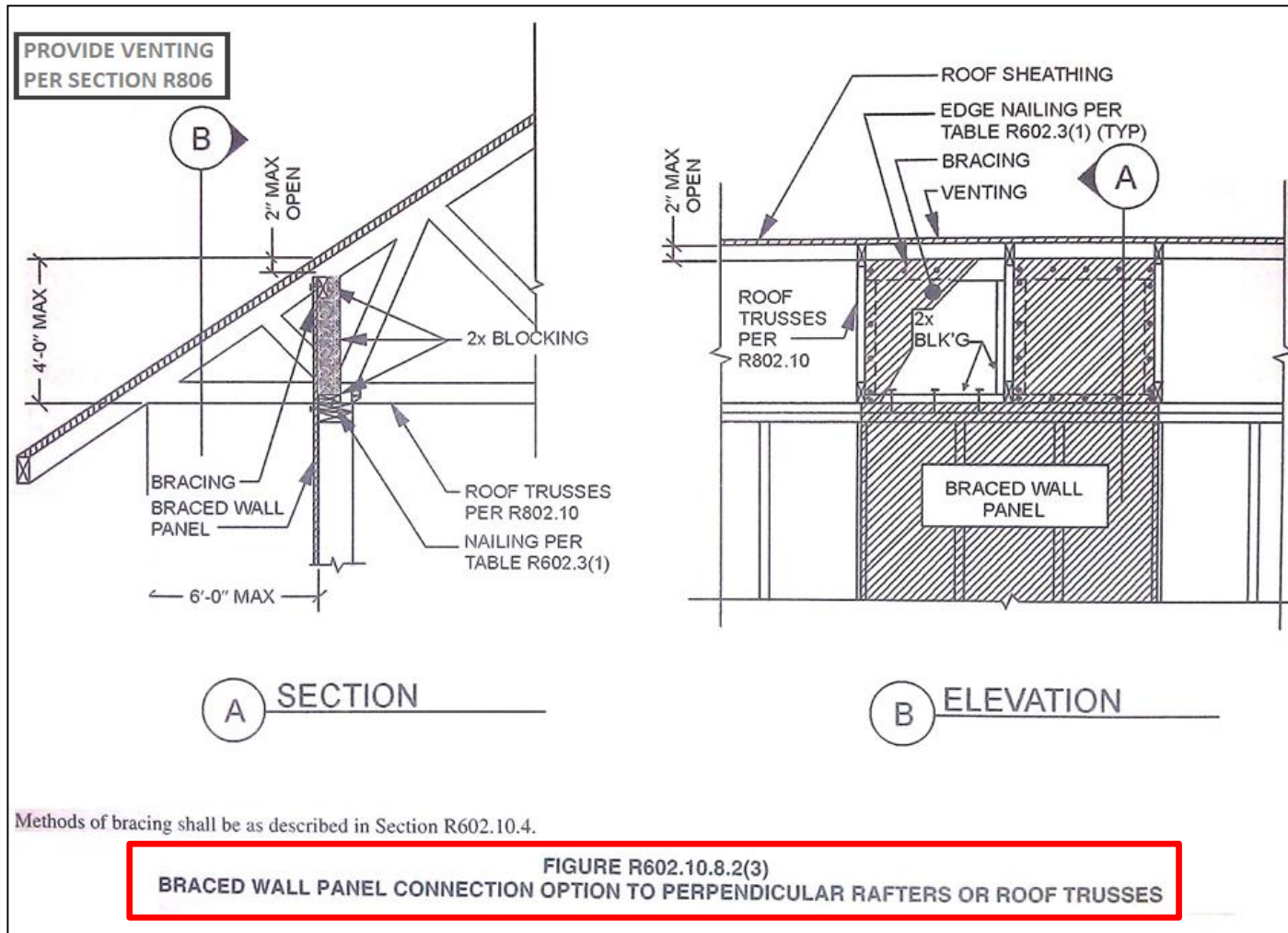
\* Connection to roof framing **R602.10.8.2**



.4 mm, 1 foot = 304.8 mm.  
ing shall be as described in Section R602.10.4.

**FIGURE 602.10.8.2(2)**  
**BRACED WALL PANEL CONNECTION OPTION TO PERPENDICULAR RAFTERS OR ROOF TRUSSES**

- \* Braced wall panel connection option to perpendicular rafters or roof trusses **R602.10.8.2(3)**





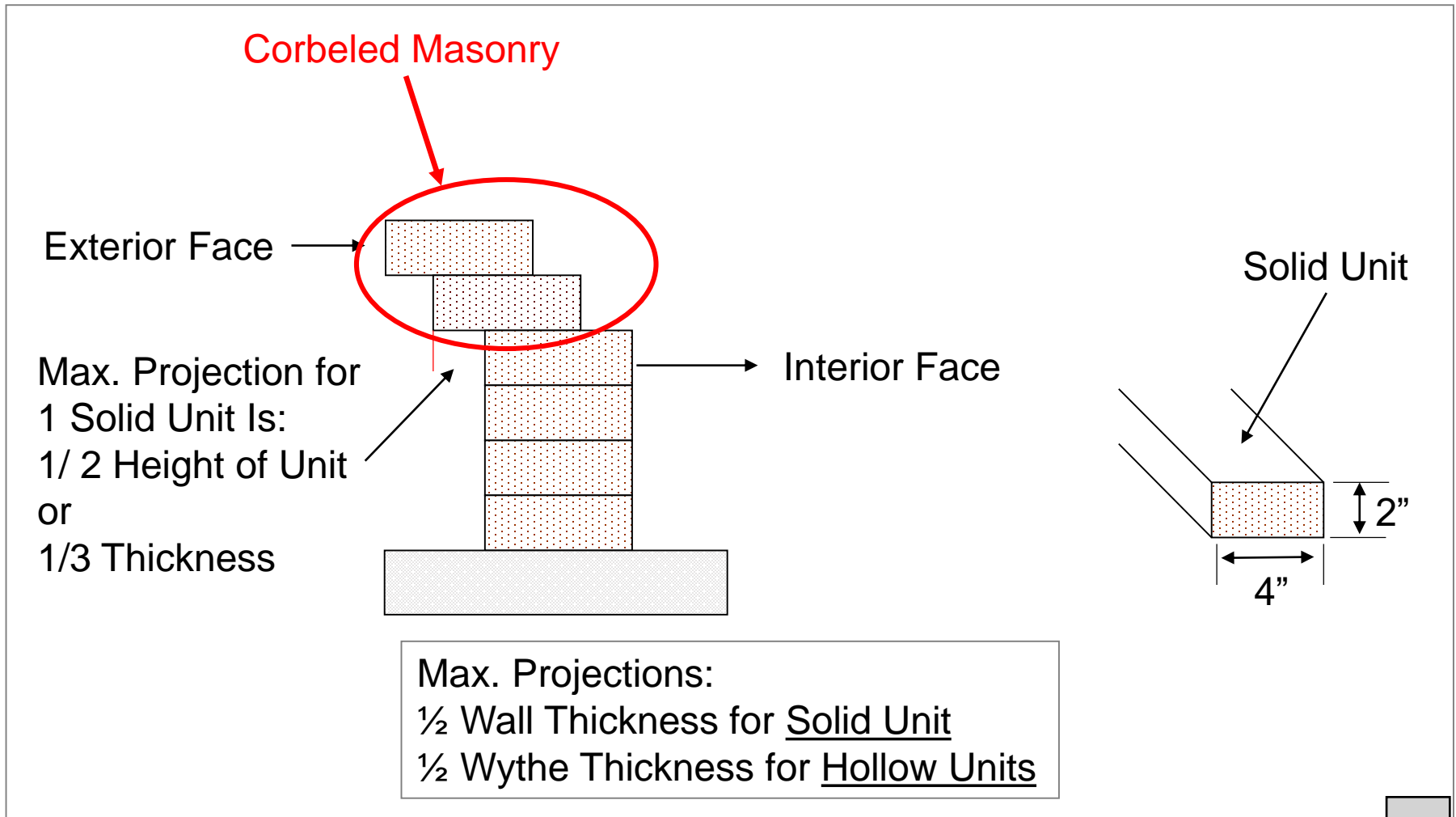
## ◆ General Masonry Construction 606

- \* Professional registration not required if standards (ACI530 / ASCE 5 / TMS 402 Chapter 5) or provisions of this section followed 606.1.1
- \* The standards and the requirements for masonry construction materials 602
- \* Requirements for grout, installation & wall ties 603
- \* Thickness of masonry 606.4
  - Minimum thickness of walls 606.4.1
    - Masonry bearing walls more than one story – 8”
  - Laterally supported either horizontally or vertically

- \* Change of thickness **606.4.3**
  - Requires a course of solid masonry between the wall below and thinner wall above
- \* Parapet walls **606.4.4**
  - Un-reinforced solid masonry walls
    - 8” minimum width
    - Cannot exceed 4x width for their height
  - Un-reinforced hollow masonry walls
    - 8” thick
    - Cannot exceed 3x width for their height

- \* Corbeled masonry 606.5
  - Solid masonry unit for corbelling  $\frac{1}{2}$  wall thickness
  - Maximum projection:  $\frac{1}{2}$  wythe thickness for hollow walls
  - Maximum projection of a unit
    - $\frac{1}{2}$  the unit height or  $\frac{1}{3}$  the thickness

- \* Top course of corbel shall be a header course when used to support floor or roof members



- \* Bearing on support **606.6.1**
  - Each masonry wythe to be supported by at least 2/3 of the wythe thickness is now required - Stacked bonded masonry, unit masonry, multiple wythe masonry, masonry veneer
  - Lateral support for masonry walls **Table 606.6.4**
  - Laterally supported vertically or horizontally
  - **Table 606.6.4**
    - Note: An additional unsupported height of 6' is permitted for gable end walls
    - Example: 8" wall,  $20 \times 8" = 13.2'$ , 13.2' maximum spacing of supports

- \* Spacing of lateral support for masonry walls **Table 606.6.4**

Construction	Maximum Wall Length to Thickness or Wall Height to Thickness <sup>a,b</sup>
--------------	--

**Bearing Walls**

Solid or solid grouted	20
All others	18

**Nonbearing Walls**

Exterior	18
Interior	36

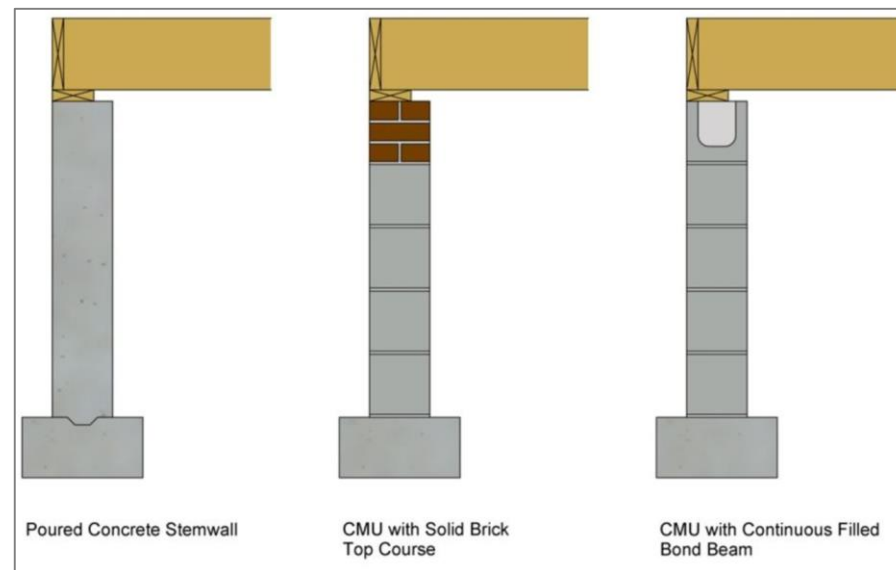


Note: An additional unsupported height of 6' is permitted for gable end walls

**Example:** 8" wall  
 $20 \times 8" = 13.2'$   
 13.2' max. spacing of supports

\* Beam supports **606.6.3**

- Beam, girders minimum bearing:
  - 3” on solid masonry wall >4” thick, or
  - Metal bearing plate, or
  - Continuous reinforced masonry projecting not <4” from face of wall



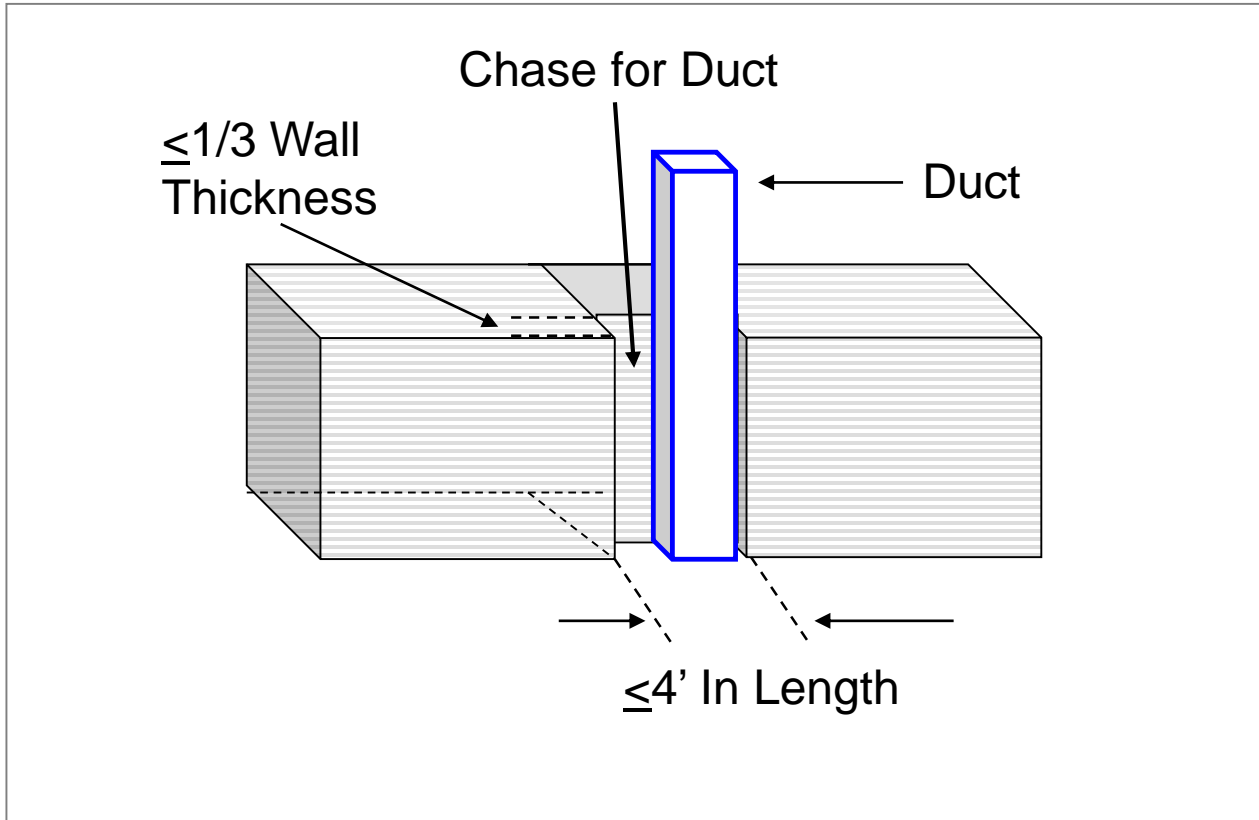
- \* Piers 606.7
  - Maximum height 10x their least dimension
  - Hollow pier cap 4" solid concrete or top course filled solid



\* Chases **606.8**

- No deeper than  $\frac{1}{3}$  the wall thickness
- Maximum length 4'
- Shall be at least 8" of masonry in back of chases and recesses between adjacent chases and recesses
- Masonry above chases in excess of 12" to be supported on non-combustible lintels

\* Chases 606.8

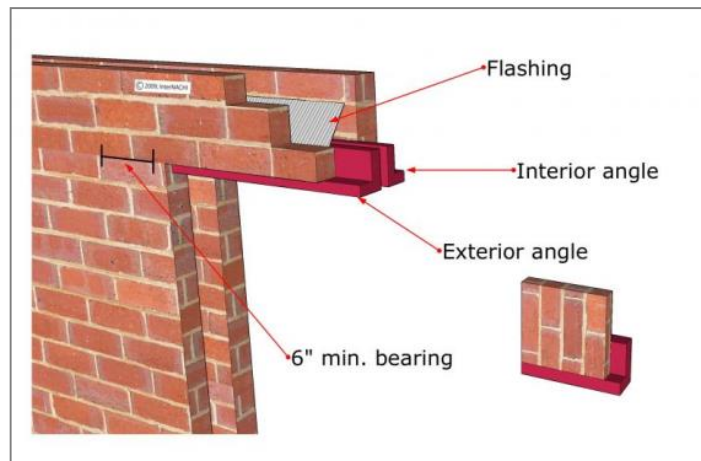
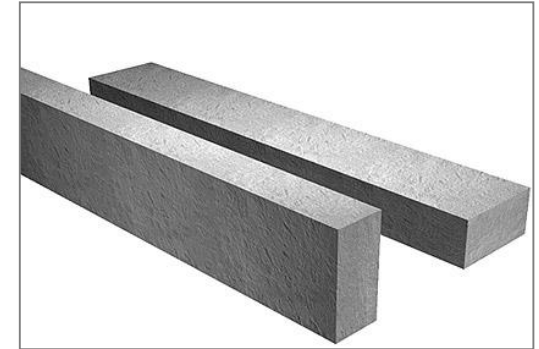


\* Lintels **606.10**

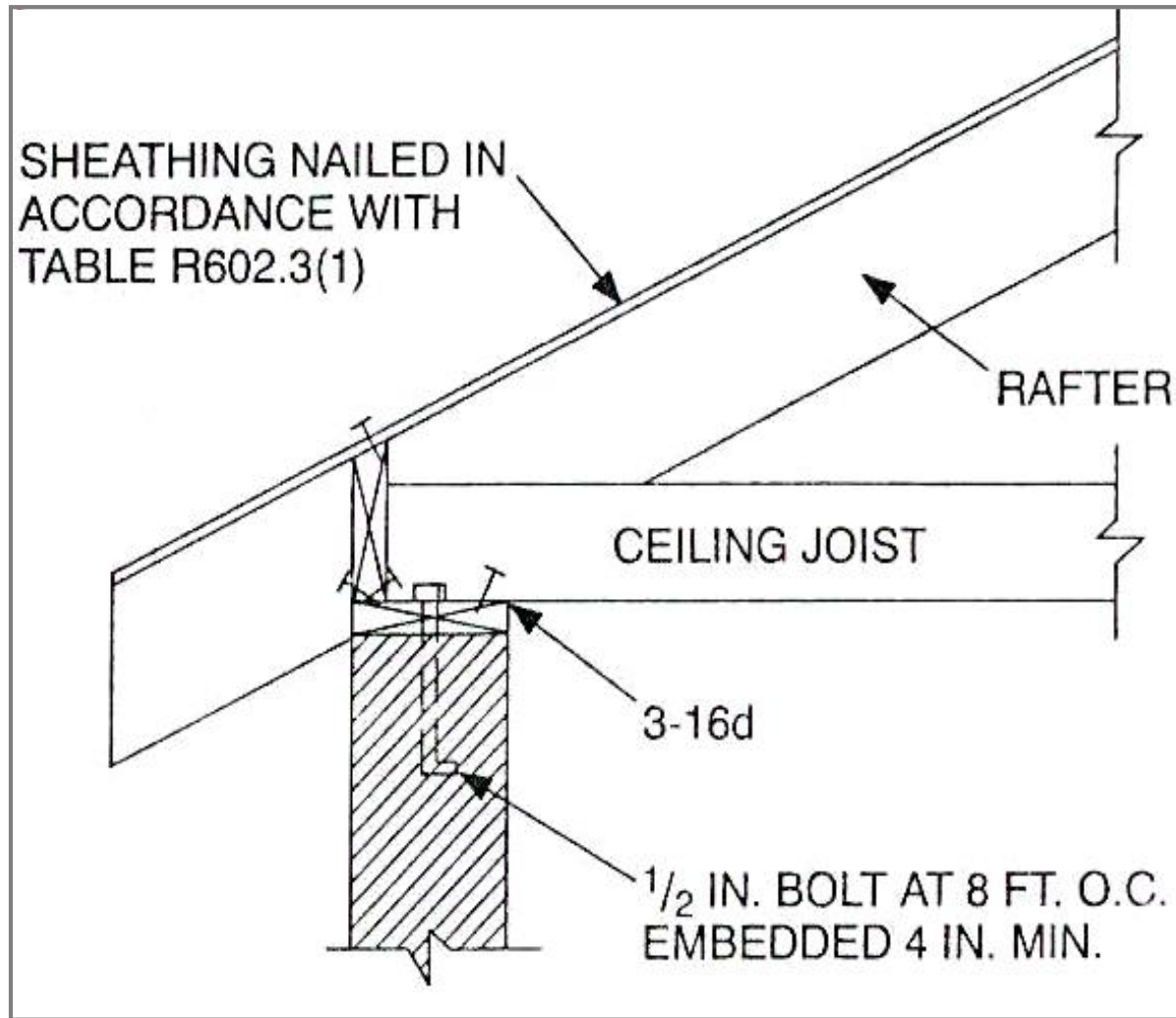
- Steel lintel, reinforced concrete or masonry lintels or masonry arches over openings

\* Anchorage **606.11**

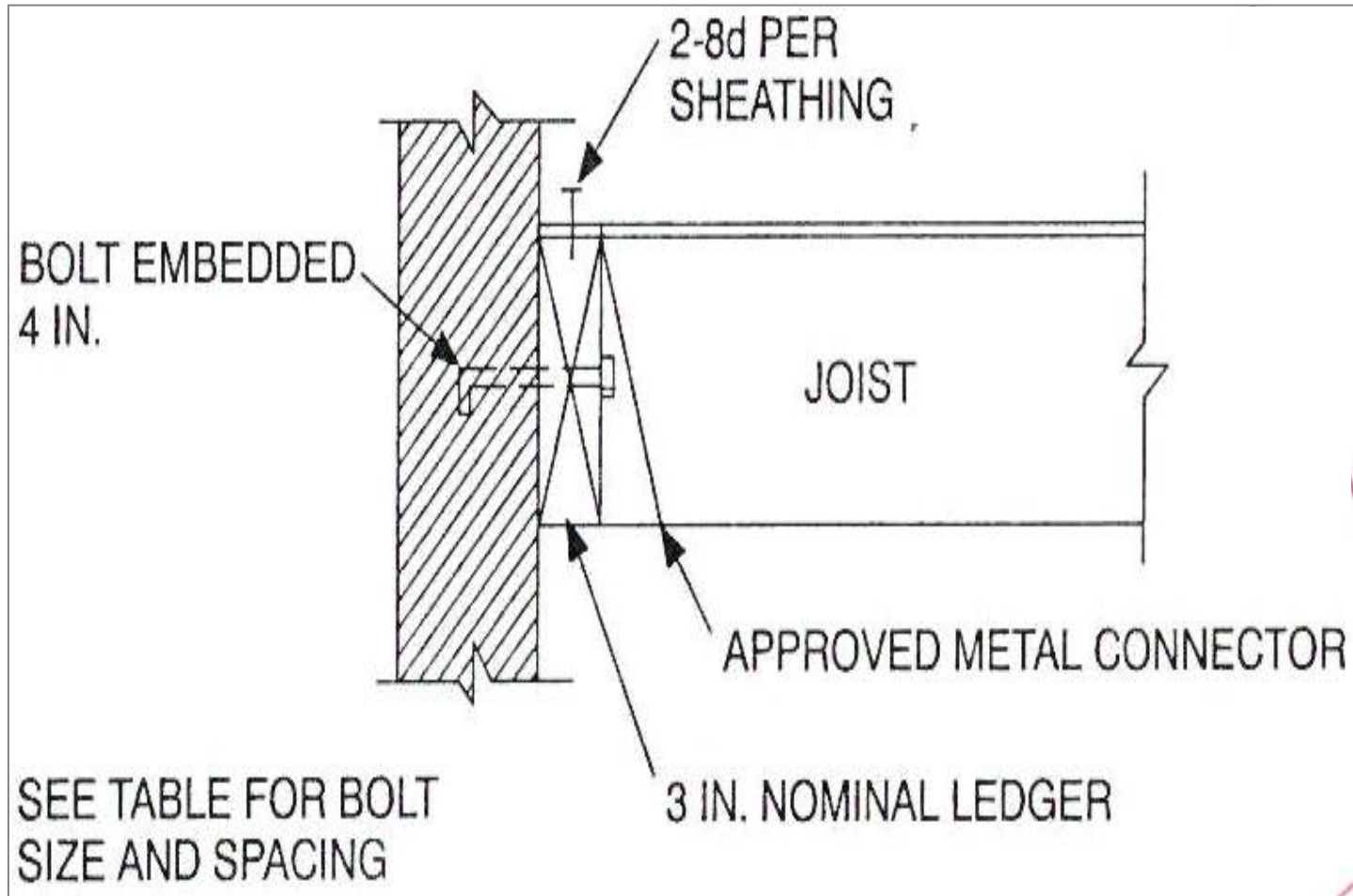
- According to **Figure 606.11(1)**
- Anchored to floor and roof systems
- 1/2" bolts 8' on center embedded 4" minimum



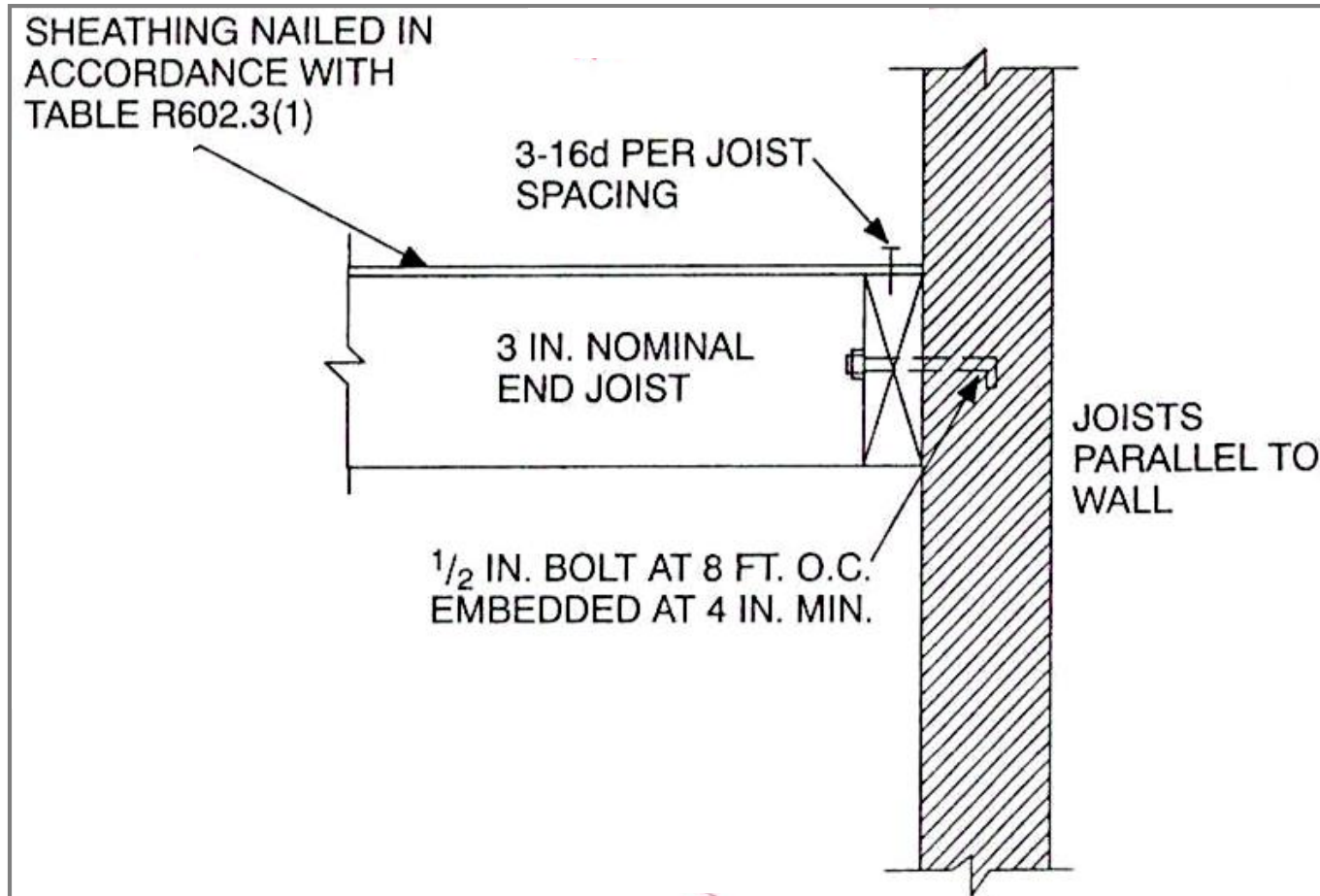
- \* Attaching roof structure **Figure 606.11(1)**



- \* Perpendicular to wall **Figure 606.11(1)**



- \* Parallel to wall **Figure 606.11(1)**

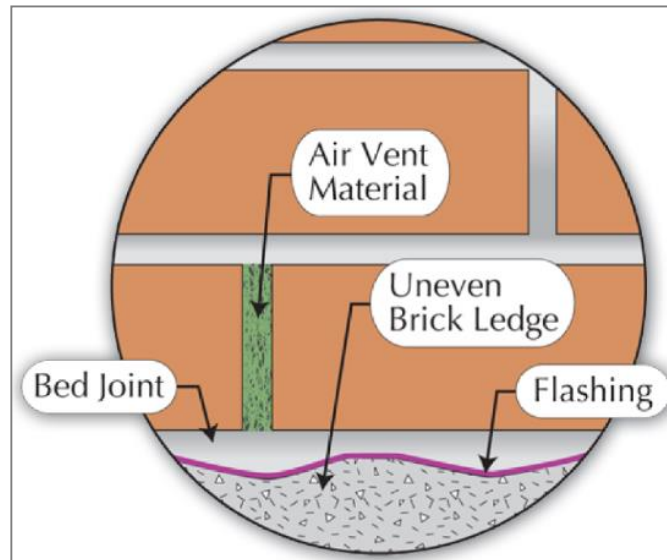


- \* Ledger bolts **Figure 606.11(1)**

LEDGER BOLT SIZE AND SPACING		
JOIST SPAN	BOLT SIZE AND SPACING	
	ROOF	FLOOR
10 FT.	1/2 AT 2 FT. 6 IN. 7/8 AT 3 FT. 6 IN.	1/2 AT 2 FT. 0 IN. 7/8 AT 2 FT. 9 IN.
10-15 FT.	1/2 AT 1 FT. 9 IN. 7/8 AT 2 FT. 6 IN.	1/2 AT 1 FT. 4 IN. 7/8 AT 2 FT. 0 IN.
15-20 FT.	1/2 AT 1 FT. 3 IN. 7/8 AT 2 FT. 0 IN.	1/2 AT 1 FT. 0 IN. 7/8 AT 1 FT. 6 IN.

- \* Table imbedded in **Figure 606.11(1)**

- \* Multiple wythe masonry and grouted masonry **606.13**
  - Facing and backing minimum of 3” each; backing thick as face units
  - Wall cavity not to exceed specific bonding requirements





## ◆ Exterior Concrete Wall Construction 608

- \* Light-framed construction
- \* Materials
- \* Concrete
- \* Aggregate size, proportioning and slump of mix compression strength regulated
- \* Consolidated and/or vibrated during placement



\* Applicability limits **608.2**

- Interior walls, floors, roof
- Light construction
  - Max 60' x 60'
- Max floor clear spans <32'
- Max roof clear spans <40'
- Max 35" high or 2-stories above grade
- Floor/ceiling dead load <10 psf
- Roof/ceiling dead load < 15psf
- Max roof overhang 2'



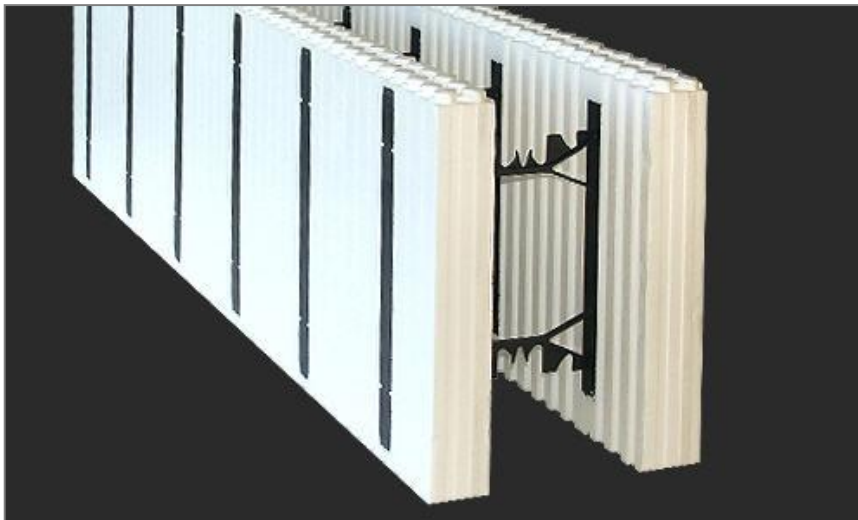
- \* Types of ICF 608.3
  - Flat (ICF)
  - Waffle – Grid (ICF)
  - Screen – Grid (ICF)

- \* Stay-in-place forms 608.4



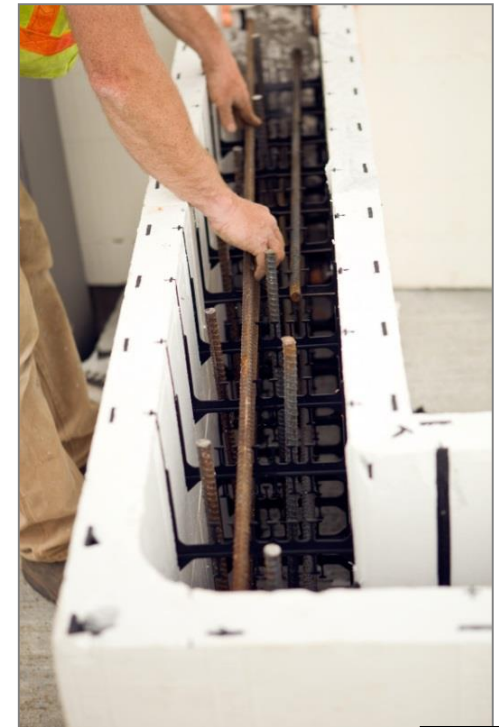
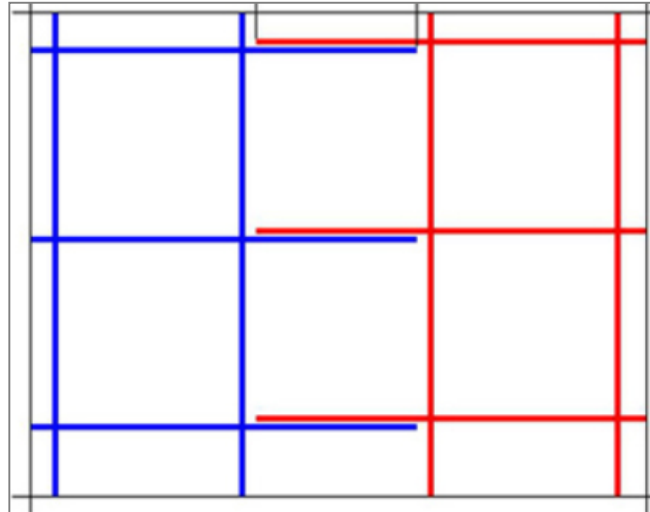
\* Stay-in-place forms **608.4**

- Flame spread and smoke developed indexes regulated per **Section 302.9**, except foam plastics
- Thermal barrier
- Flat ICF wall systems **608.4.4**

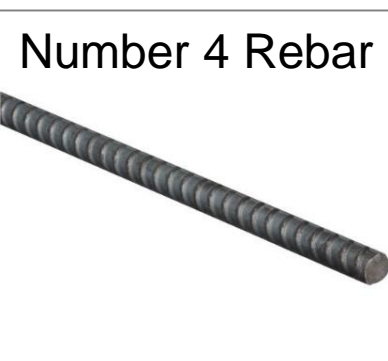




- \* Reinforcement and anchor bolts **608.5.2**
  - Product standards for rebar and anchor bolts
  - Cover requirement
  - Lap splices
  - Construction joints



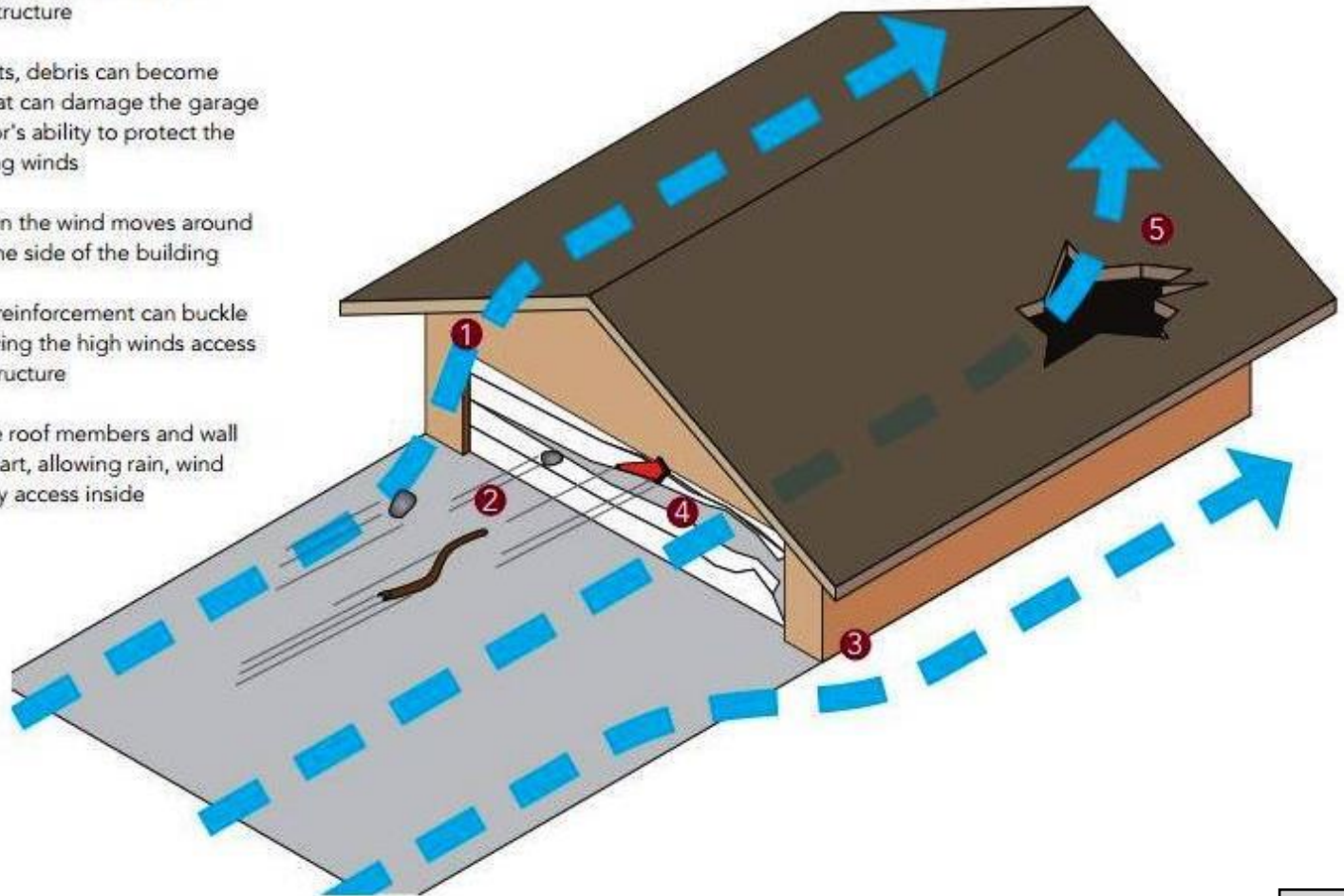
- \* Above-grade wall requirements 608.6
  - Wall reinforcement for wind 608.6.2
  - Continuity of reinforcement between stories 608.6.3
  - Termination and location of reinforcement 608.6.4 & 608.6.5
    - Vertical reinforcement / Solid wall segments at corners
    - Openings in wall / Connection with interior members
    - Reliance on code text and illustrations



## ◆ Exterior Windows and Doors 609

### Wind-structure interaction

- 1 High winds first create pressure against the windward side of the structure
- 2 During high wind events, debris can become powerful projectiles that can damage the garage door, reducing the door's ability to protect the home against damaging winds
- 3 Pressure increases when the wind moves around the corner and down the side of the building
- 4 Garage doors with no reinforcement can buckle under the pressure, giving the high winds access to the interior of the structure
- 5 This often results in the roof members and wall panels being blown apart, allowing rain, wind and debris to have easy access inside





- \* Requires that the window manufacturer provide installation instructions and that windows be installed, flashed, and fastened in accordance with instructions
- \* Covers wind borne debris, vehicular access doors, and garage doors

\* General 609.1

- Window manufacturer must provide installation instructions
- Flashing per instructions
- Windows be installed and fastened in accordance with instructions



- \* Testing and labeling of exterior doors **609.3**
  - Exterior side hinged doors be tested and labeled in accordance with **AAMA / WDMA / CSA**
  - Need to protect from wind borne debris
- \* Garage door **609.4**
  - Vehicular access doors (garage doors) need to be labeled in accordance with **ASTM E330**, or **ANSI / DASMA 108**, and meet the performance requirements provided by the manufacturer
  - OH garage doors must pass **ASTM E330** or **ANSI / DASMA 108**
- \* Wind borne debris protection **609.6**



- \* Anchorage methods **609.7**
  - Connections with interior members
    - Solid wall length (bracing)
    - Openings in wall
  - Per manufacturer





Building & Fire Code Academy

Understanding the 2019  
Residential Code of Ohio

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Chapter 7  
Wall Covering

## ◆ General 701

### \* Installation 701.2

- Products sensitive to weather shall be protected; exterior sheathing shall be dry

## ◆ Interior Covering 702

### \* Comply with Tables 702.1(1), 702.1(2), 702.1(3), 701.2.3.5

- Different sections for different finishes



- \* Gypsum board **702.3**
  - Application **702.3.5**
    - Wood framing – minimum 2” studs except furring -
    - Type "W" or "S" screws
    - Steel framing – minimum thickness 1-1/4“ studs -
    - Type "S" screws
  - Attach per **Tables 702.3.5 & 702.3.6**

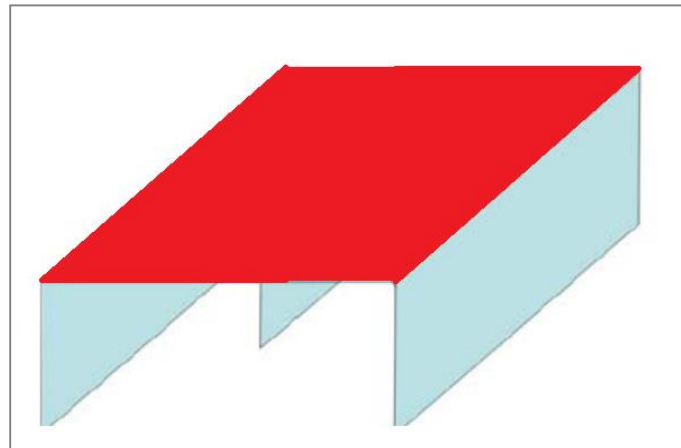


\* Fastening Gypsum Table 702.3.5 and Table 702.3.6

**TABLE 702.3.5  
MINIMUM THICKNESS AND APPLICATION OF GYPSUM BOARD AND GYPSUM PANEL PRODUCTS**

THICKNESS OF GYPSUM BOARD OR GYPSUM PANEL PRODUCTS (inches)	APPLICATION	ORIENTATION OF GYPSUM BOARD OR GYPSUM PANEL PRODUCTS TO FRAMING	MAXIMUM SPACING OF FRAMING MEMBERS (inches o.c.)	MAXIMUM SPACING OF FASTENERS (inches)		SIZE OF NAILS FOR APPLICATION TO WOOD FRAMING <sup>c</sup>
				Nails <sup>a</sup>	Screws <sup>b</sup>	
<b>Application without adhesive</b>						
$\frac{3}{8}$	Ceiling <sup>d</sup>	Perpendicular	16	7	12	13 gage, $1\frac{1}{4}$ " long, $\frac{19}{64}$ " head; 0.098" diameter
	Wall	Either direction	16	8	16	$1\frac{1}{4}$ " long, annular-ringed; or 4d cooler nail, 0.080" diameter, $1\frac{3}{8}$ " long, $\frac{7}{32}$ " head.
$\frac{1}{2}$	Ceiling	Either direction	16	7	12	13 gage, $1\frac{3}{8}$ " long, $\frac{19}{64}$ " head; 0.098" diameter
	Ceiling <sup>d</sup>	Perpendicular	24	7	12	$1\frac{1}{4}$ " long, annular-ringed; 5d cooler nail, 0.086" diameter, $1\frac{5}{8}$ " long, $\frac{15}{64}$ " head; or gypsum
	Wall	Either direction	24	8	12	board nail, 0.086" diameter, $1\frac{5}{8}$ " long, $\frac{9}{32}$ "
	Wall	Either direction	16	8	16	head.

- Horizontal gypsum board diaphragm ceilings **702.3.6**
  - Allows the use of gypsum board ceiling to create a horizontal diaphragm to resist lateral loads
  - When applied correctly, the finished surface can resist both horizontal shear and wind forces



- ◆ Water-resistant gypsum backing board 702.3.7
  - When on ceiling 12” maximum centers for framing material when using ½”
  - 16” o.c. requires a 5/8” thickness
  - Not to be used over a Class I or II vapor retarder
  - Cut and exposed edges to be sealed
  - Cannot be used where there is direct exposure to water



- \* Backer boards **702.4.2**
  - Requires cement, fiber-cement or glass mat gypsum backer for ceramic tile in tub and shower
  - See **Table 702.4.2** for standards for different material standards



**TABLE 702.4.2  
BACKER BOARD MATERIALS**

<b>MATERIAL</b>	<b>STANDARD</b>
Glass mat gypsum backing panel	ASTM C1178
Fiber-reinforced gypsum panels	ASTM C1278
Nonasbestos fiber-cement backer board	ASTM C1288 or ISO 8336, Category C
Nonasbestos fiber mat-reinforced cementitious backer units	ASTM C1325

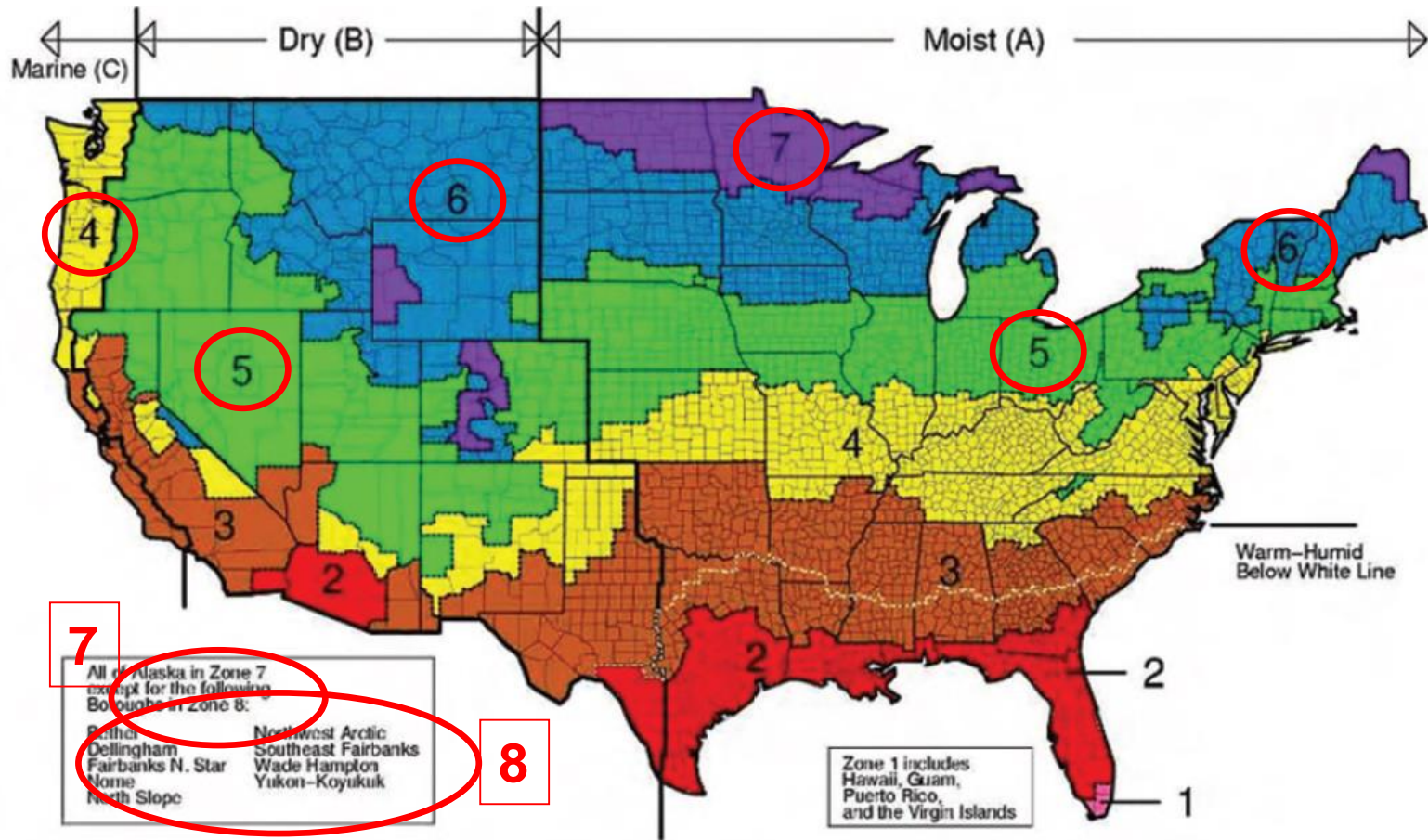
\* Other finishes **702.5**

- Wood veneer and hardboard paneling not less than  $\frac{1}{4}$ " for direct contact to studs, 16" max spacing for studs
- $<\frac{1}{4}$ " must have no less than  $\frac{3}{8}$ " gypsum backer

- \* Vapor retarders **702.7**
  - Required in climate zones 5, 6, 7, 8 and Marine 4
  - **Table 702.7.1**
  - On inside surface of frame walls
  - Class I or Class II required
    - Class I sheet polyethylene, unperforated aluminum foil
    - Class II Kraft-faced fiberglass batts
    - Class III latex or enamel paint
    - See exceptions

\* Vapor retarders 702.7

- Where required





## ◆ Exterior Covering 703

### \* General 703.1

- Weather resistant exterior wall envelope to be covered so as to provide barrier against weather and insects
- Weather-resistant barrier behind the covering
- Method of draining moisture to the exterior
- Properly flashed
- Resist wind loads from Chapter 3



- \* Water-resistive barrier **703.2**
  - One layer No. 15 asphalt paper / Free from holes
  - Applied horizontal with a 2” overlap
  - At joints 6” overlap
  - Continuous to top of wall
  - Other approved material
  - Continuous from top of wall / Properly terminated at openings
  - Not required on accessory buildings

\* Thickness and attachment **703.3**

- Per **Table 703.3(1)**
- Per manufacturer
- Based on 16" stud spacing
- Fasteners per **Table 703.3(2)**
  - Aluminum, galvanized, stainless steel, rust-preventative coating, nails or staples
  - Fiberboard, foam or gypsum sheathing, nails into studs
  - Wood sheathing into stud, per manufacturer, **Table 703.3(1)**



**TABLE R703.3(1)**  
**SIDING MINIMUM ATTACHMENT AND MINIMUM THICKNESS**

SIDING MATERIAL	NOMINAL THICKNESS (inches)	JOINT TREATMENT	TYPE OF SUPPORTS FOR THE SIDING MATERIAL AND FASTENERS						
			Wood or wood structural panel sheathing into stud	Fiberboard sheathing into stud	Gypsum sheathing into stud	Foam plastic sheathing into stud <sup>1</sup>	Direct to studs	Number or spacing of fasteners	
Anchored veneer: brick, concrete, masonry or stone (see Section <a href="#">R703.8</a> )	2	Section <a href="#">R703.8</a>	Section <a href="#">R703.8</a>						
Adhered veneer: concrete, stone or masonry (see Section <a href="#">R703.12</a> )	—	Section <a href="#">R703.12</a>	Section <a href="#">R703.12</a>						
Fiber cement siding	Panel siding (see Section <a href="#">R703.10.1</a> )	$\frac{5}{16}$	Section <a href="#">R703.10.1</a>	6d common (2" × 0.113")	6d common (2" × 0.113")	6d common (2" × 0.113")	6d common (2" × 0.113")	4d common ( $\frac{1\frac{1}{2}}{2}$ " × 0.099")	6" panel edges 12" inter. sup.
	Lap siding (see Section <a href="#">R703.10.2</a> )	$\frac{5}{16}$	Section <a href="#">R703.10.2</a>	6d common (2" × 0.113")	6d common (2" × 0.113")	6d common (2" × 0.113")	6d common (2" × 0.113")	6d common (2" × 0.113") or 11 gage roofing nail	Note f

- Soffit installations **703.3.1**
  - Wood
    - Minimum thickness 3/8"
    - Fastened to minimum 2 x 2 strips
    - Maximum fastener spacing 6" at edges, 12" at center
  - Vinyl
    - Fastened at fascia and wall end
    - Maximum unsupported span -16"

- Minimum length and penetration **703.3.4**
  - Not less than 1½” into framing or per manufacturer – horizontal aluminum siding, steel siding, particle board panel siding, wood structure panel
  - Not less than 1½” into framing – based on sheathing
  - Vinyl siding, insulated vinyl siding – based on sheathing
  - Not less than 1½” into studs, studs back by sheathing and blocking- vertical and horizontal wood siding
  - Foam sheathing – foam thickness plus above

\* Flashing **703.4**

- Flashing to be installed in shingle-fashion and must extend to the surface of the exterior of the wall finish or to the water-resistive barrier
- Windows and doors to water-resistant barrier
- Per manufacturer

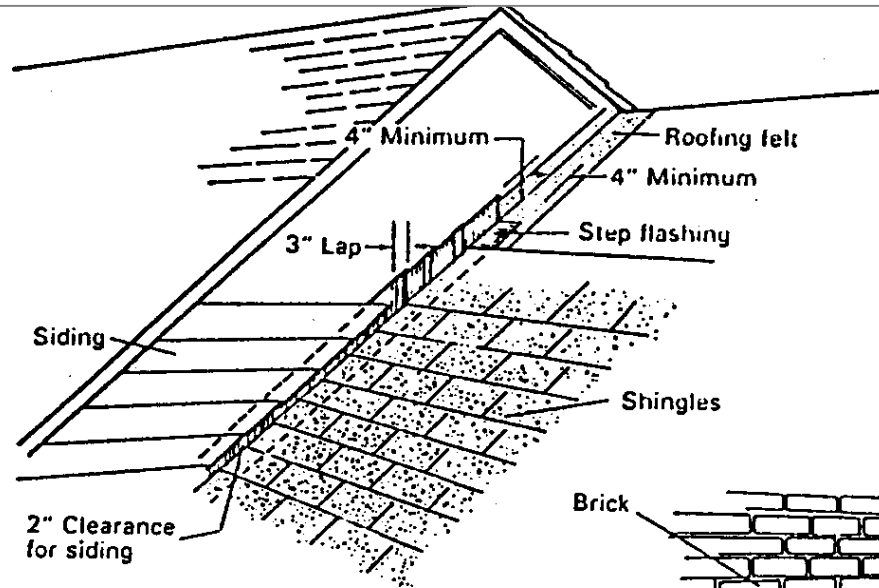


- \* Flashing **703.4** (*continued*)
  - Chimney or masonry construction and wood and stucco walls with projecting lips on both sides under stucco copings
  - Under and at ends of masonry, wood or metal copings and sills
  - Continuously above all projecting wood trim
  - Where exterior porches, decks or stairs attach to wall or floor assembly of wood frame
  - Code has generic installation criteria

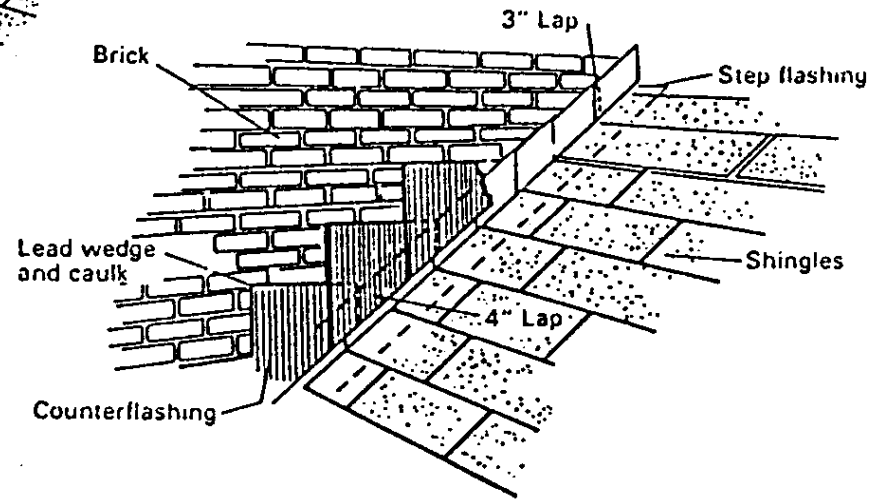




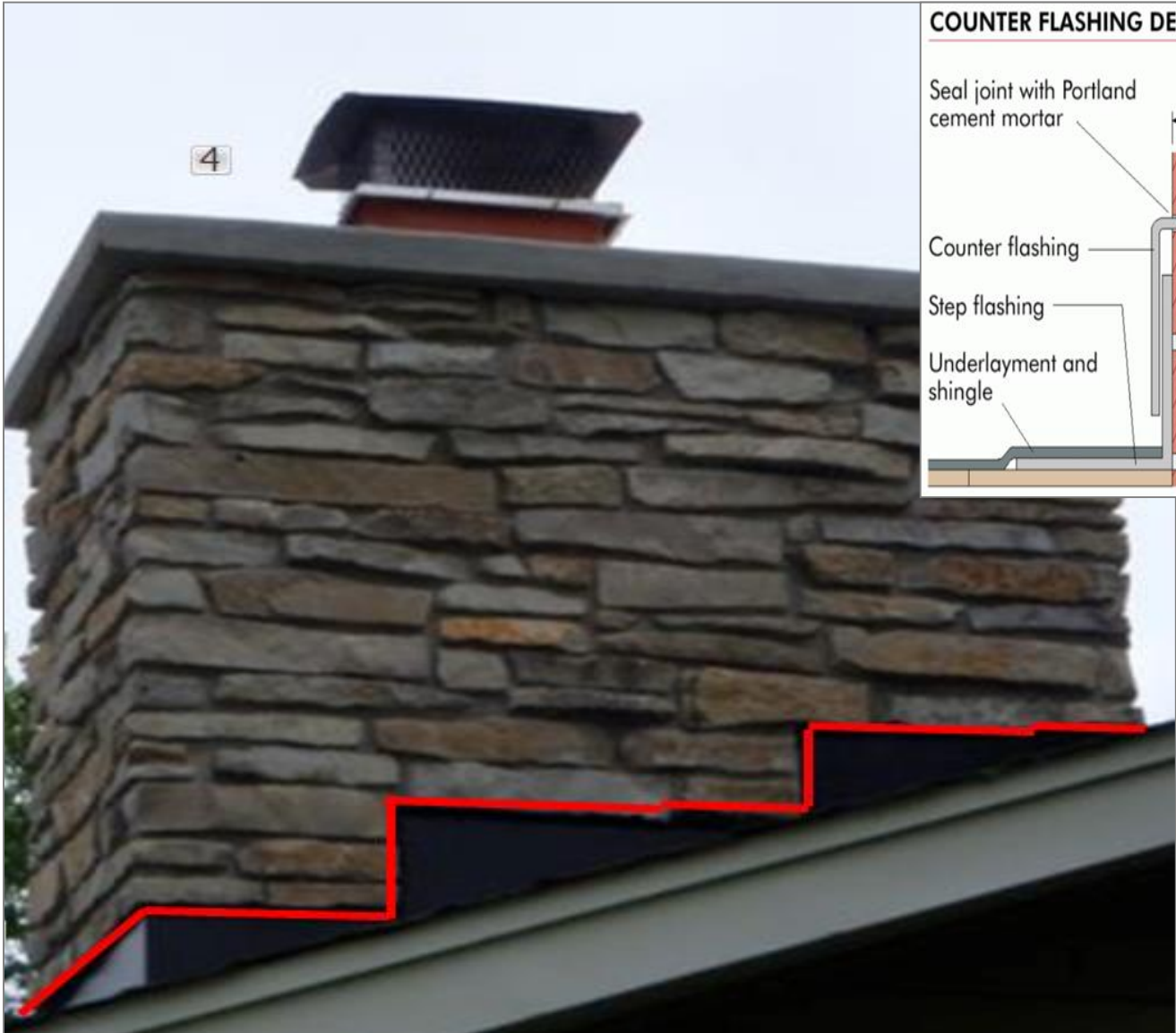
\* Flashing (at wall and roof intersections)



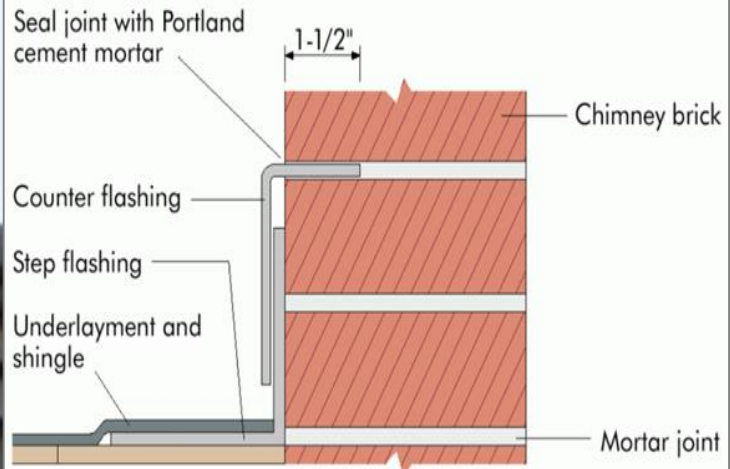
A, Wood siding on wall

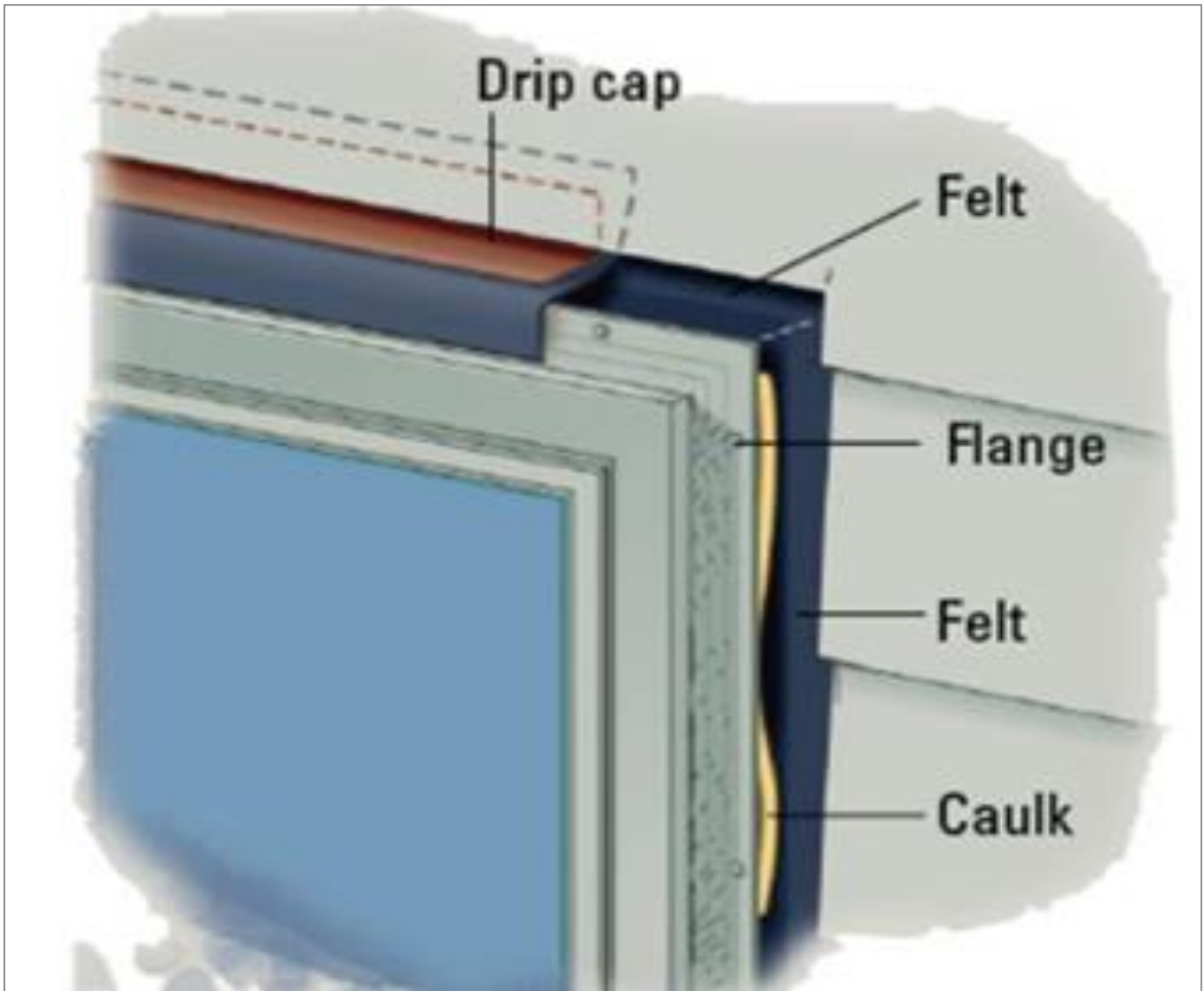


B, Brick wall



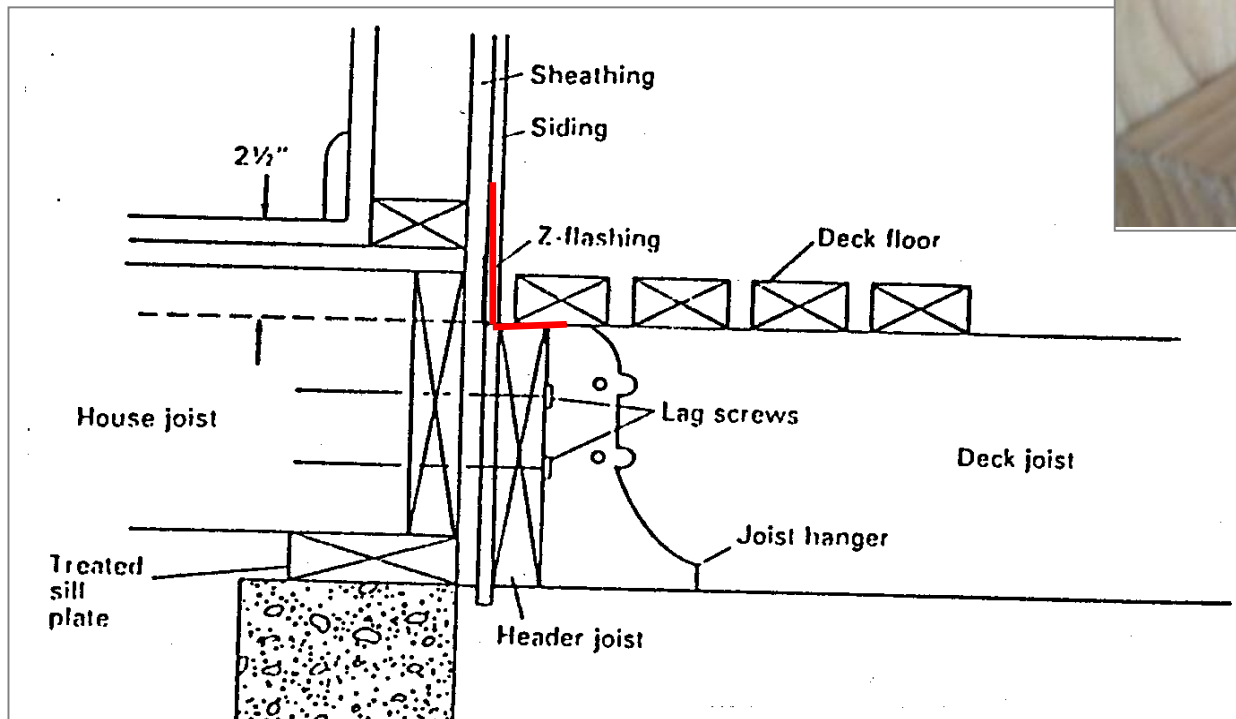
### COUNTER FLASHING DETAILS





\* Flashing 703.4 (continued)

- Where exterior porches, decks or stairs attach to a wall or floor assembly of wood-frame
- At wall and roof intersections



## ◆ Specific Sections for Different Coverings

- \* 703.5 – Wood, hardboard and wood structural panel
- \* 703.6 – Wood shakes and shingles
- \* 703.7 – Exterior plaster
- \* 703.8 – Anchored stone or masonry veneer
- \* 703.9 – EIFS
- \* 703.10 – Fiber cement siding
- \* 703.11 – Vinyl siding
- \* 703.12 – Adhered masonry veneer siding
- \* 703.13 – Insulated vinyl siding
- \* 703.14 – Polypropylene siding

- \* Anchored stone and masonry veneer 703.8
  - One-story limit, or per Table 703.8(1) or (2) based on seismic zone
  - Maximum 5" thick
  - Maximum 40 pounds per square foot
  - Movement joint between wood wall with barrier and the veneer
  - Can be supported by a steel angle 703.8.2.1
  - Flashing and weeps

- \* Anchored stone and masonry veneer **703.8** (*continued*)
  - Lintels over openings to support masonry **703.8.3**
    - Minimum 4” of bearing
    - Shop coat of rust inhibitive paint
    - Spans per **Table 703.8.3.1**
    - Maximum height above lintel per **Figure 703.8.3.2**
    - Wall ties 2” through insulation
    - Follow **Table 703.8.4(1)**

**TABLE 703.8.3.1**  
**ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER<sup>a, b, c, d</sup>**

SIZE OF STEEL ANGLE <sup>a, c, d</sup> (inches)	NO STORY ABOVE	ONE STORY ABOVE	TWO STORIES ABOVE	NO. OF $\frac{1}{2}$ -INCH OR EQUIVALENT REINFORCING BARS IN REINFORCED LINTEL <sup>b, d</sup>
$3 \times 3 \times \frac{1}{4}$	6'-0"	4'-6"	3'-0"	1
$4 \times 3 \times \frac{1}{4}$	8'-0"	6'-0"	4'-6"	1
$5 \times 3 \frac{1}{2} \times \frac{5}{16}$	10'-0"	8'-0"	6'-0"	2
$6 \times 3 \frac{1}{2} \times \frac{5}{16}$	14'-0"	9'-6"	7'-0"	2
$2-6 \times 3 \frac{1}{2} \times \frac{5}{16}$	20'-0"	12'-0"	9'-6"	4

- a. Long leg of the angle shall be placed in a vertical position.
- b. Depth of reinforced lintels shall be not less than 8 inches and all cells of hollow masonry lintels shall be grouted solid. Reinforcing bars shall extend not less than 8 inches into the support.
- c. Steel members indicated are adequate typical examples; other steel members meeting structural design requirements shall be permitted to be used.
- d. Either steel angle or reinforced lintel shall span opening.

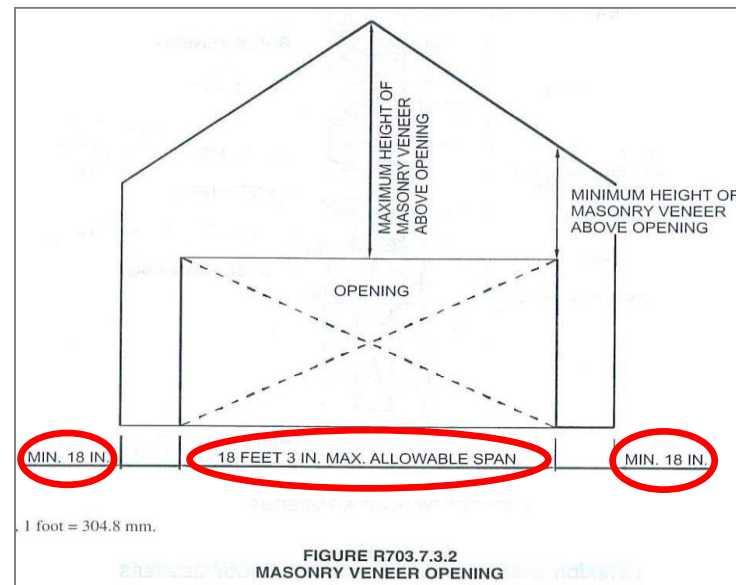


- \* Lintels over openings to support masonry **703.8.3** (*continued*)
  - Maximum span **703.8.3.2**
    - Max span 18'- 3"
    - 18" of support on each side of opening
    - Double wire joint reinforcement 12" beyond each side of opening

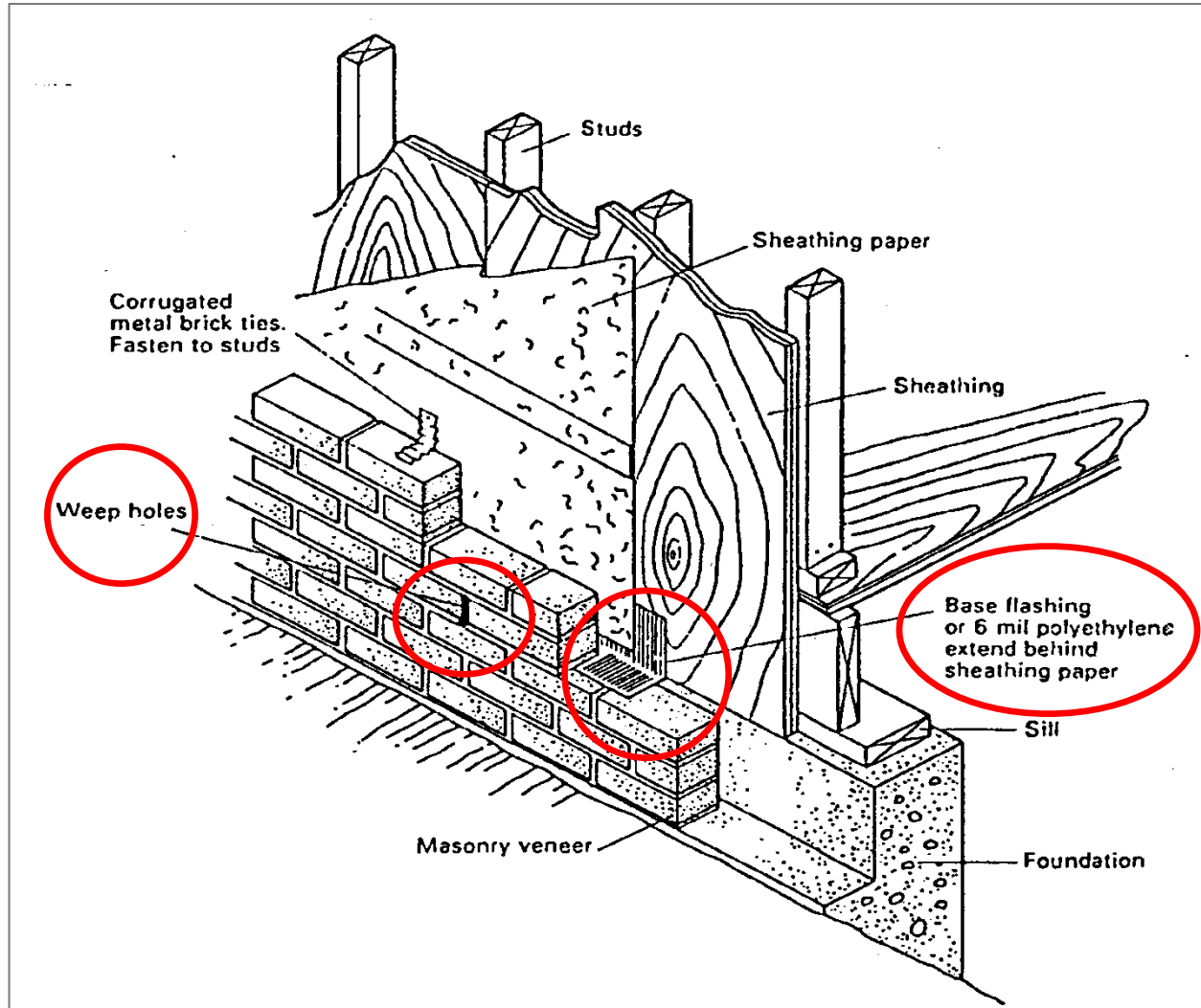
**TABLE R703.8.3.2  
HEIGHT OF MASONRY VENEER ABOVE OPENING**

MINIMUM HEIGHT OF MASONRY VENEER ABOVE OPENING (INCH)	MAXIMUM HEIGHT OF MASONRY VENEER ABOVE OPENING (FEET)
13	< 5
24	5 to < 12
60	12 to height above support allowed by Section R703.8

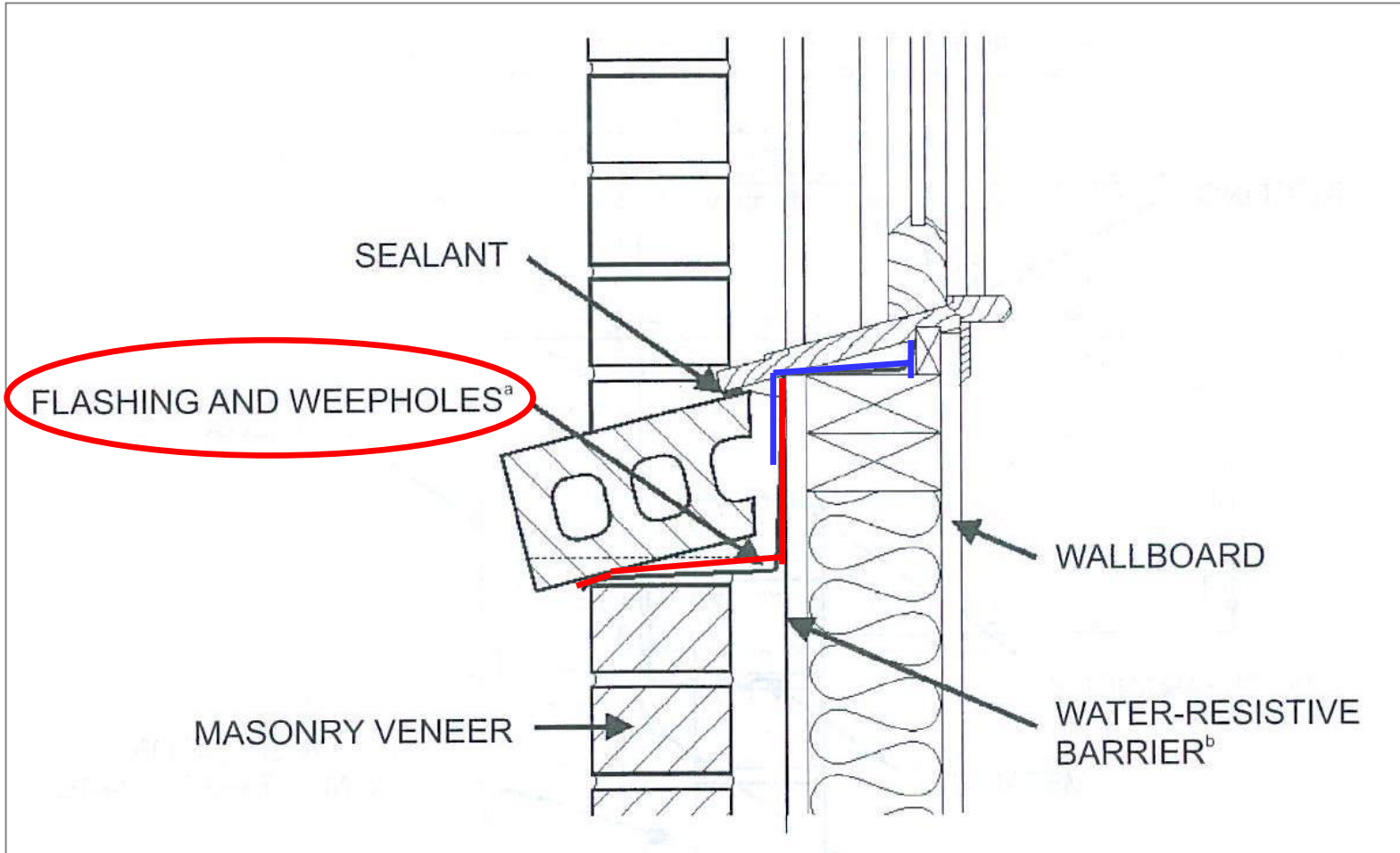
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.



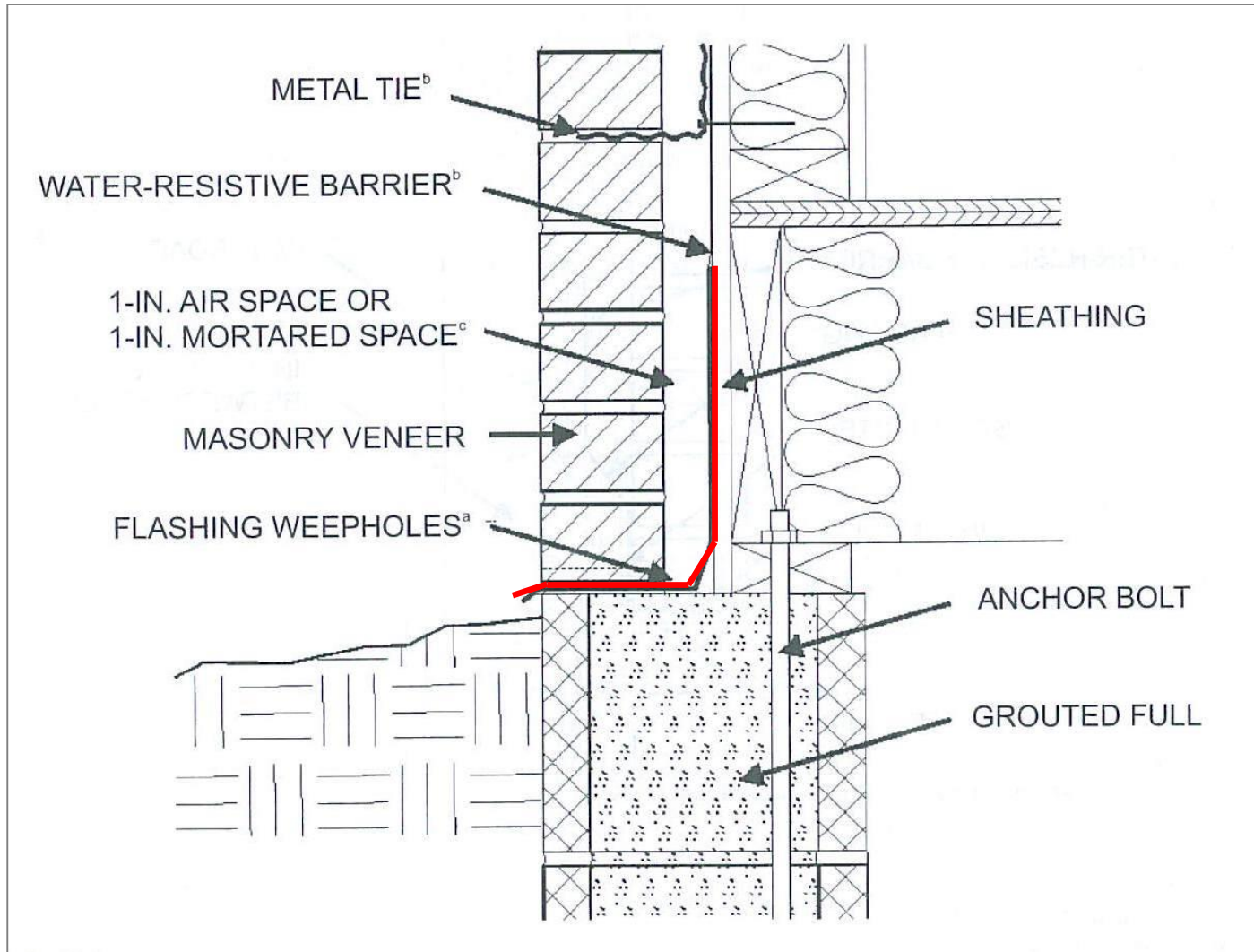
\* Flashing R703.8.5 and Weepholes 703.8.6



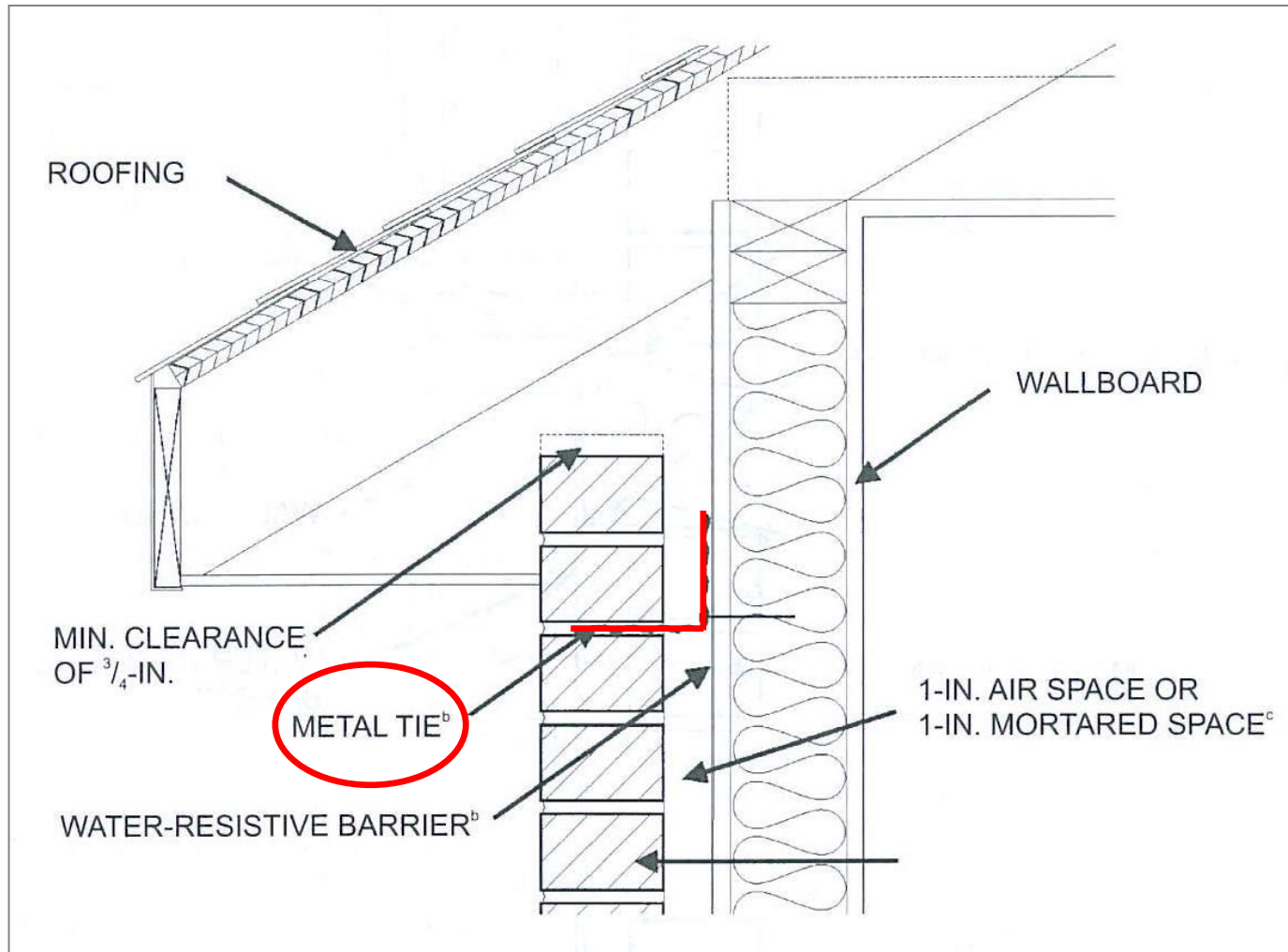
\* Figure 703.8



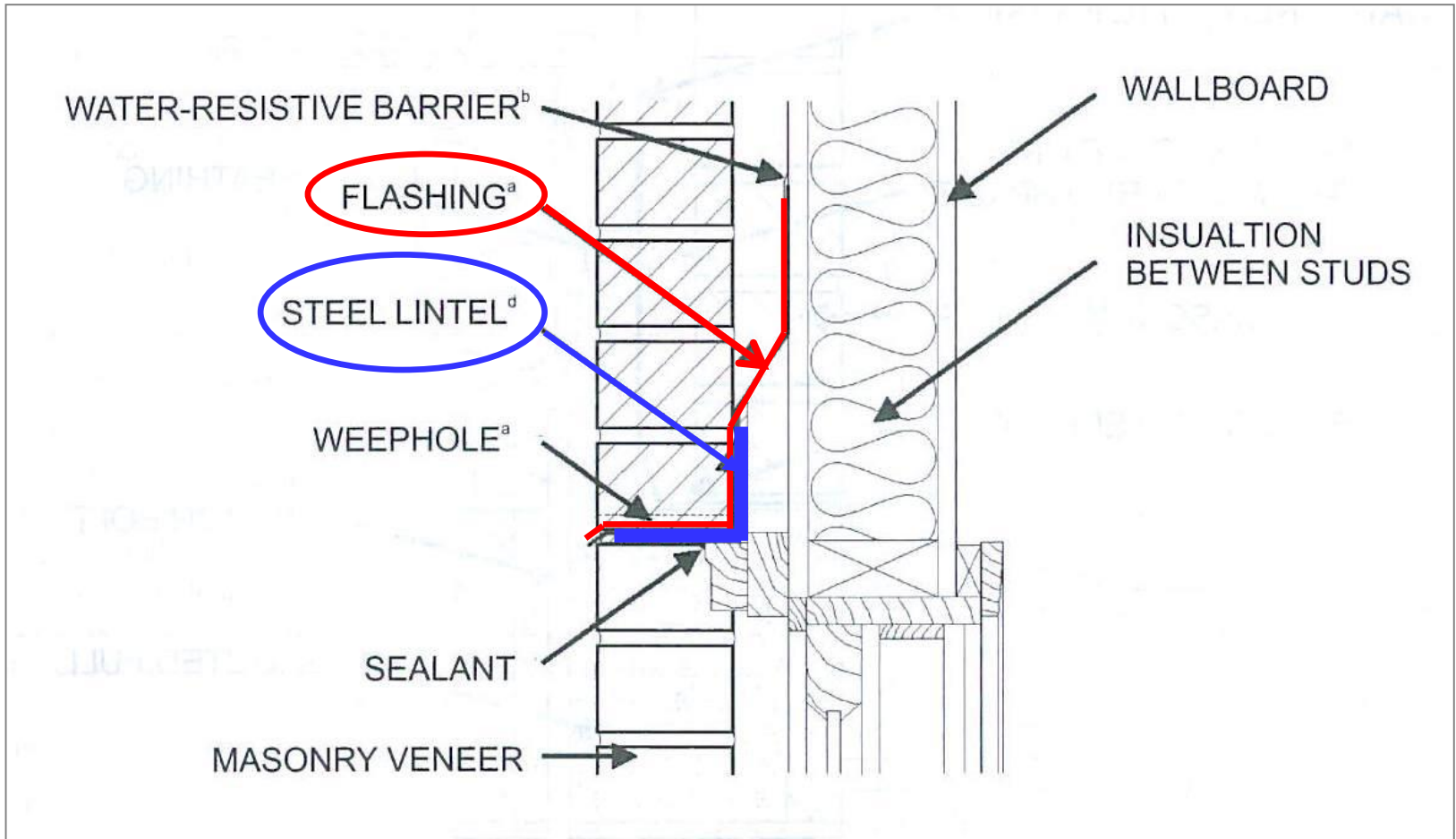
\* Figure 703.8 (continued)



\* Figure R03.8 (continued)

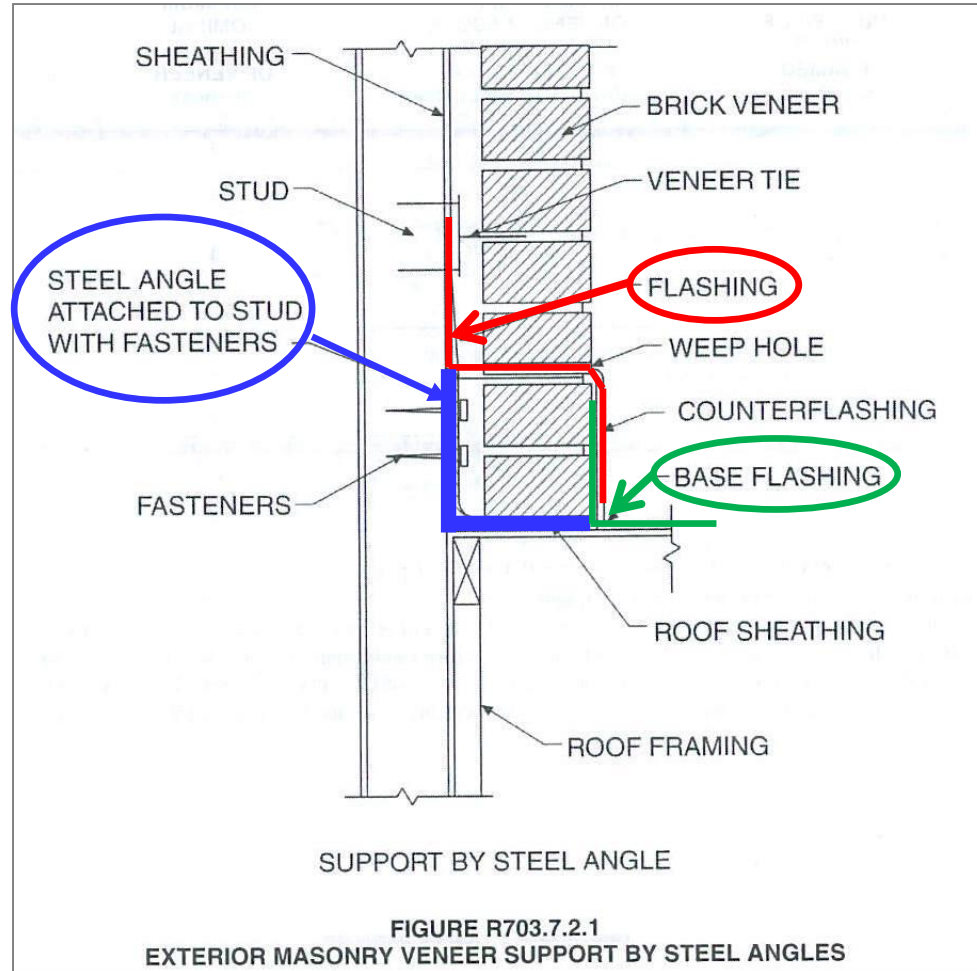


\* Figure 703.8 (continued)





\* Figure 703.8.2.1

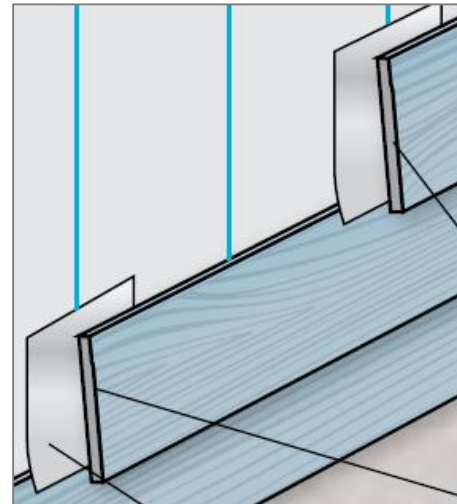
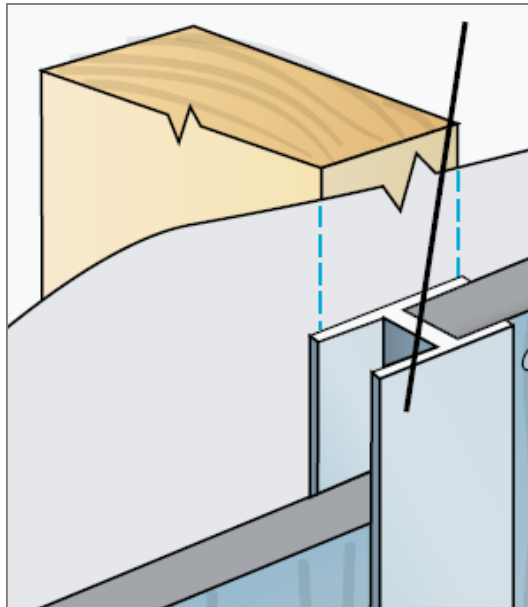
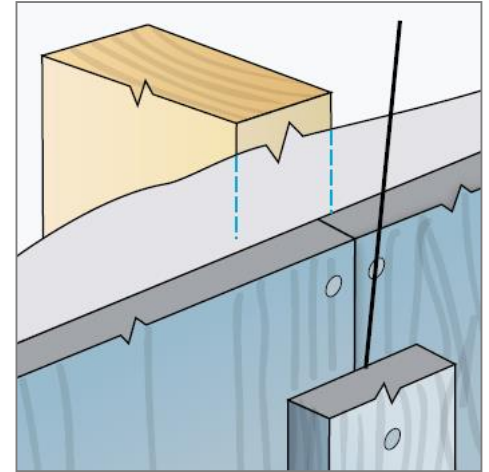


- \* Exterior insulation finish system (EIFS) 703.9
  - Installation according to manufacturer
  - Decorative trim not nailed through face of EIFS
  - Terminate 6" above grade
  - Weather resistive barrier and flashings





- \* Fiber cement siding 703.10
  - ASTM C1186
  - Caulked seams or H molding
  - 1¼” minimum lap
  - Seams over a strip of flashing



\* Fiber cement siding **703.10**

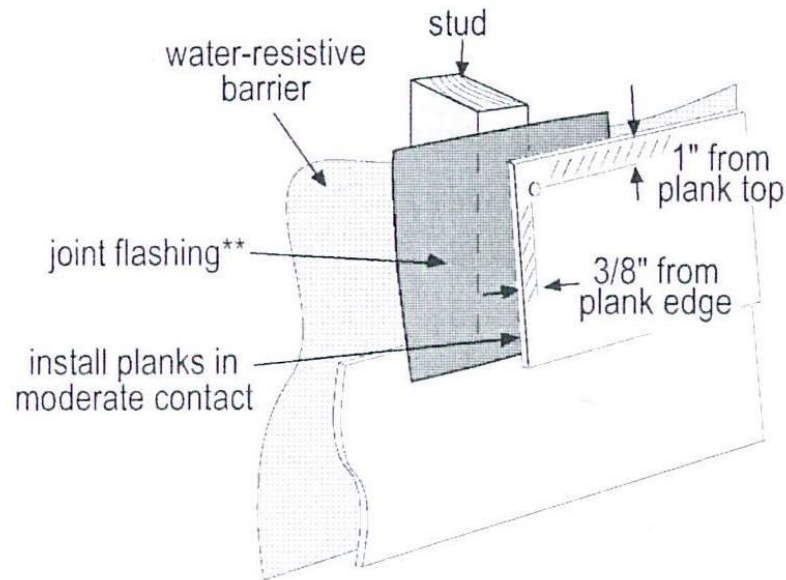
**INSTALLATION:**

**JOINT TREATMENT\***

*(Required for ColorPlus® Finish, Recommended for Primed product)*

James Hardie does not recommend the use of caulk at field butt joints.

**Figure 2**



Install factory finished edges together at butt joints.

Courtesy of James Hardie

- \* Vinyl siding 703.11
  - Vinyl siding must be certified and labeled
  - ASTM D3679



- \* Adhered masonry veneer installation **703.12**
  - Clearances **703.12.1**
  - Flashing at foundation **703.12.2**



# BFC A<sup>®</sup>

## Building & Fire Code Academy

### Understanding the 2019 Residential Code of Ohio

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### Chapter 8 Roof-Ceiling Construction

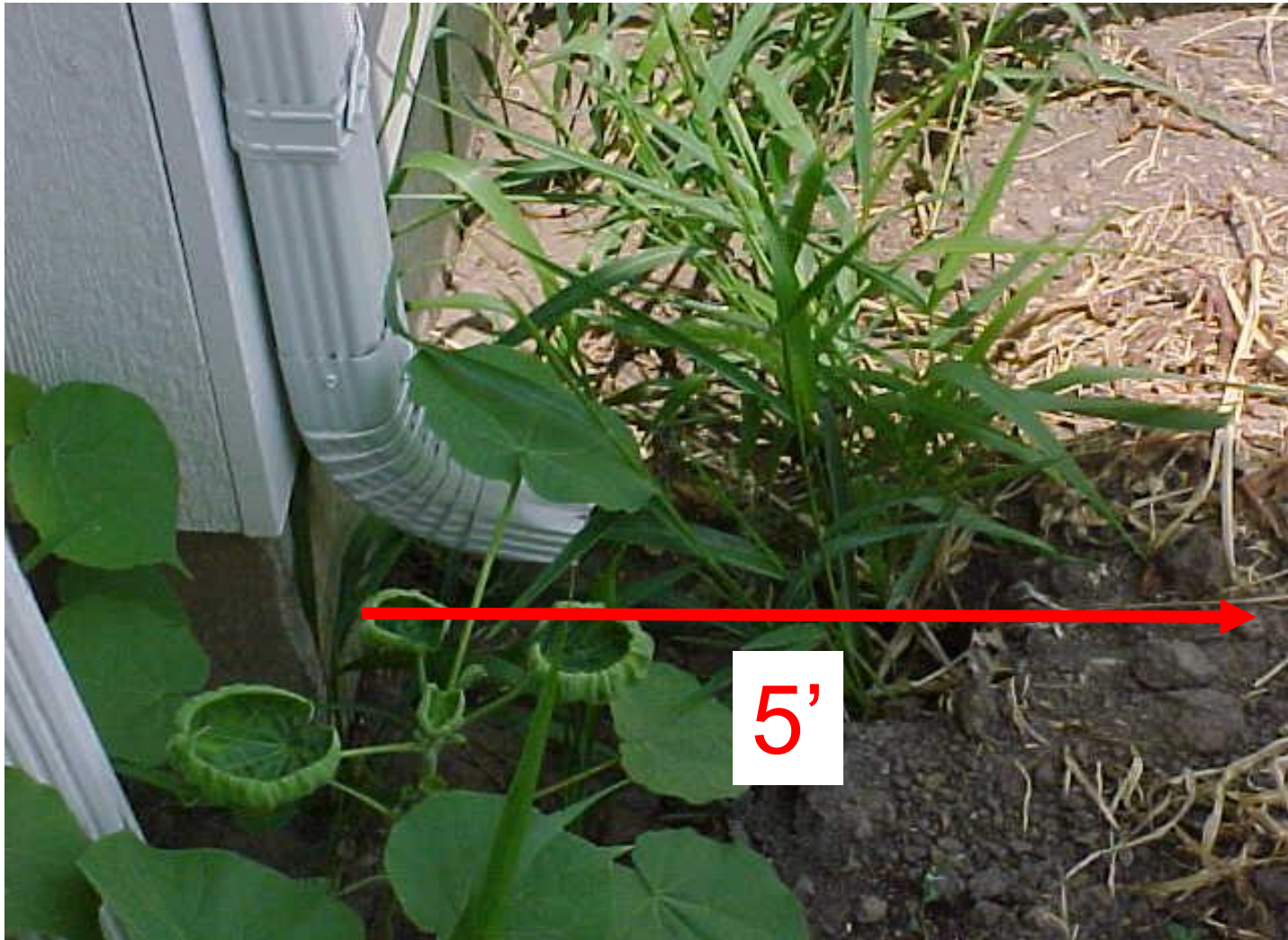


## ◆ General 801

- \* Roof drainage dependent on soil – controlled method to 5' from foundation **801.3**



\* Roof Drainage 801.3





## ◆ Wood Roof Framing 802

### \* General R802.1

- All lumber requires grade stamp

### \* Blocking

- Minimum utility grade lumber

### \* End jointed lumber 802.1.1.1 (Same as 502.1.1.2)

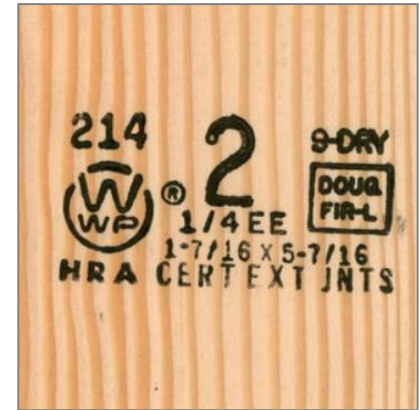
- Identified with grade mark
- Fire rated designation
- Heat Resistant Adhesive or “HRA”

### \* Structural glue laminated timbers 802.1.2

- Per ANSI 190.1, ANSI 117, ASTM D3737

### \* Structural log members R802.1.3

- Per ICC 400 801.3





- \* Structural composite lumber 802.1.4
  - Referenced standard established stresses for non-rectangular shape structural log members
  - ASTM D 5456
- \* Fire-retardant-treated wood 802.1.5
  - Labeled
  - Strength adjustments require additional data
  - Exposure to weather

- \* Design and construction **802.2**
  - Design requirements for roofs and roof-ceiling assemblies
  - Hips and valleys supported at ridge down to bearing
  - Slope less than 3:12 designed as beams
  - Per **Figures 606.11(1), 606.11(2), 606.11(3)** or AWC NDS (American Wood Council – National Design Standard)



\* Ridge 802.3

- Ridge board – minimum 1”
- Not less than the depth of the cut
- If joist or rafter is not continuous across the structure, a ridge beam shall be provided



\* Rafters 802.4

- Rafter spans for common lumber species
- For other grades, species and other loading conditions refer to AWC STJR (American Wood Council – Span Tables for Rafters and Joists)
- Measured along horizontal projection of rafter
- Allowable rafter spans see: Table 802.4.1(1) through Table R802.4.1(8)

**TABLE .802.4.1(1)**  
**RAFTER SPANS FOR COMMON LUMBER SPECIES**  
 (Roof live 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 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans <sup>a</sup>									
			(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)
12	Douglas fir-larch	SS	11-6	18-0	23-9	Note b	Note b	11-6	18-0	23-9	Note b	Note b
	Douglas fir-larch	#1	11-1	17-4	22-5	Note b	Note b	10-6	15-4	19-5	23-9	Note b
	Douglas fir-larch	#2	10-10	16-10	21-4	26-0	Note b	10-0	14-7	18-5	22-6	26-0
	Douglas fir-larch	#3	8-9	12-10	16-3	19-10	23-0	7-7	11-1	14-1	17-2	19-11
	Hem-fir	SS	10-10	17-0	22-5	Note b	Note b	10-10	17-0	22-5	Note b	Note b
	Hem-fir	#1	10-7	16-8	22-0	Note b	Note b	10-4	15-2	19-2	23-5	Note b
	Hem-fir	#2	10-1	15-11	20-8	25-3	Note b	9-8	14-2	17-11	21-11	25-5
	Hem-fir	#3	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
	Southern pine	SS	11-3	17-8	23-4	Note b	Note b	11-3	17-8	23-4	Note b	Note b
	Southern pine	#1	10-10	17-0	22-5	Note b	Note b	10-6	15-8	19-10	23-2	Note b
	Southern pine	#2	10-4	15-7	19-8	23-5	Note b	9-0	13-6	17-1	20-3	23-10
	Southern pine	#3	8-0	11-9	14-10	18-0	21-4	6-11	10-2	12-10	15-7	18-6
	Spruce-pine-fir	SS	10-7	16-8	21-11	Note b	Note b	10-7	16-8	21-9	Note b	Note b
	Spruce-pine-fir	#1	10-4	16-3	21-0	25-8	Note b	9-10	14-4	18-2	22-3	25-9
	Spruce-pine-fir	#2	10-4	16-3	21-0	25-8	Note b	9-10	14-4	18-2	22-3	25-9
	Spruce-pine-fir	#3	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6

\* Rafters **802.4** (*continued*)

- Maximum offset 1-1/2" to ridge board
  - If opposite, with collar ties or gusset plate
- Nailed to top of wall per **602.3(1)**
- Hips and valleys – minimum 2", and not less than depth of cut
- Hips and valleys supported at the ridge down to bearing
- Slope less than 3:12 supports designed as beams

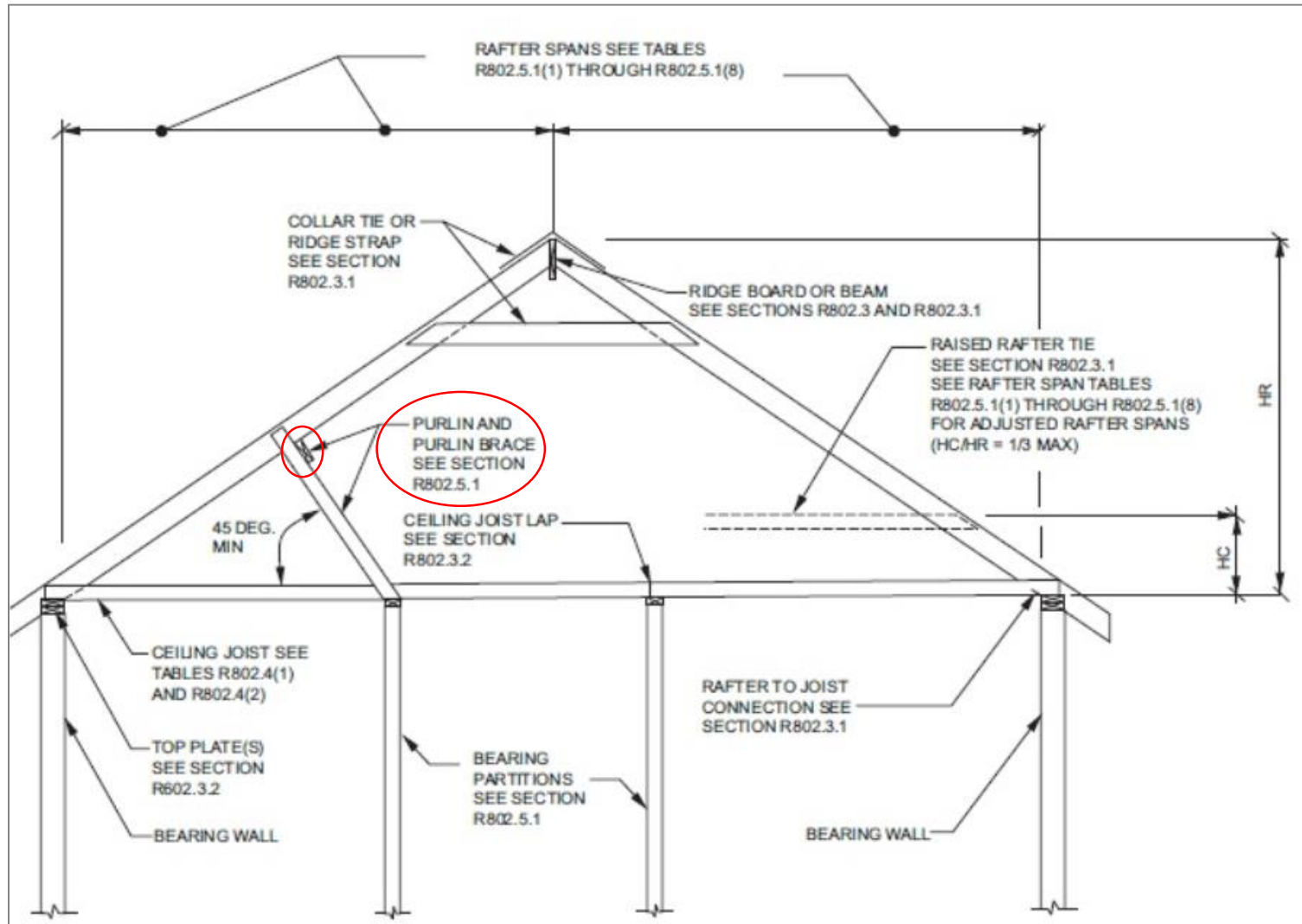


\* Rafters **802.4** (*continued*)

• Purlins **802.4.5**

- Reduce rafter span
- Not less than rafter size
- Continuous
- Supported by 2 x 4 braces at bearing points
- Maximum 4' on center
- Unbraced lengths not to exceed 8'
- Per **Figure R802.4.5**

\* Purlins 802.4.5





\* Rafters 802.4 (continued)

- Collar ties 802.4.6

- If rafters are opposing – collar ties locate in upper third of attic
- Not less than 1 x 4
- Maximum spacing 4'
- Ridge straps per R602.3(1) can be used

\* Ceiling joists **R=802.5**

- Allowable ceiling joist spans **Tables 802.5(1) and 802.5(2)**
- For other grades, species, and loading conditions – refer to AWC ST JR “Span Tables for Joists and Rafters”
  - **Table 802.5(1)** – Ceiling joist spans for common lumber species (uninhabitable attics without storage, live load = 10 psf)

**TABLE 802.5.1(1)**  
**CEILING JOIST SPANS FOR COMMON LUMBER SPECIES**  
(Uninhabitable attics without storage, live load = 10 psf, L/Δ = 240)

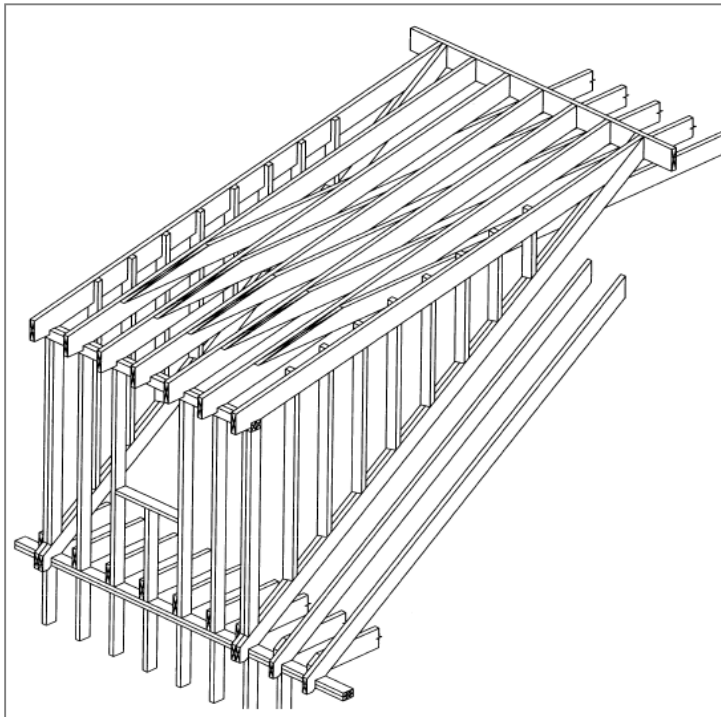
CEILING JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 5 psf			
			2 x 4	2 x 6	2 x 8	2 x 10
			Maximum ceiling joist spans			
			(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)
12	Douglas fir-larch	SS	13-2	20-8	Note a	Note a
	Douglas fir-larch	#1	12-8	19-11	Note a	Note a
	Douglas 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

\* Ceiling joists **802.5** (*continued*)

- Joists run parallel to rafters – connect per **Table 802.5.2**
- Joists not connected to top plate – attach in bottom third per **Figure 802.4.5**
- Ceiling joist in bottom third – supports designed as a beam
- Ceiling joists not parallel to rafter – connect to top plate per **Table 602.3(1)**
- Ceiling joist lapped minimum 3” or butted over a bearing partition
- Joist used to prevent thrust joints per **Table 802.5.2**
- Ties minimum 2 x 4 – per **Table 802.5.2**
- Blocking not less than utility grade

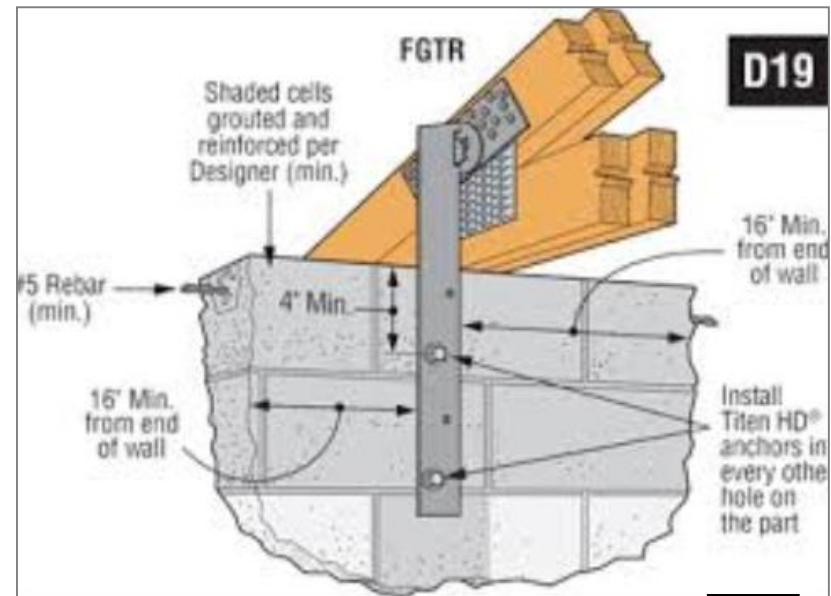
\* Allowable ceiling joist spans

- See **Table 802.4(1)** and **Table 802.4(2)**
- For other grades, species and loading conditions refer to AF&PA “Span Tables for Joists and Rafters”

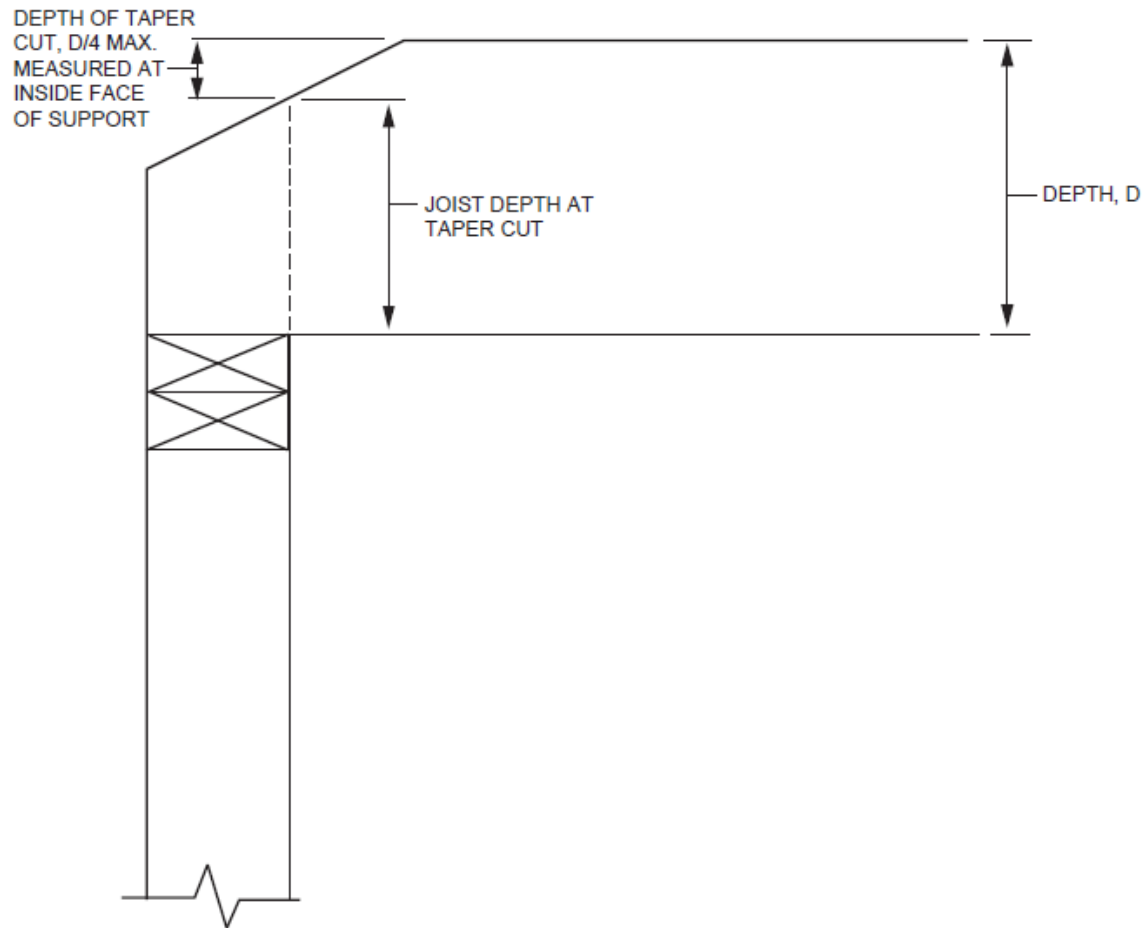


\* Bearing **802.6**

- On wood or metal – 1½”
- On masonry – 3” – Direct or with sill plate
- Sill plate minimum bearing – 48 square inches

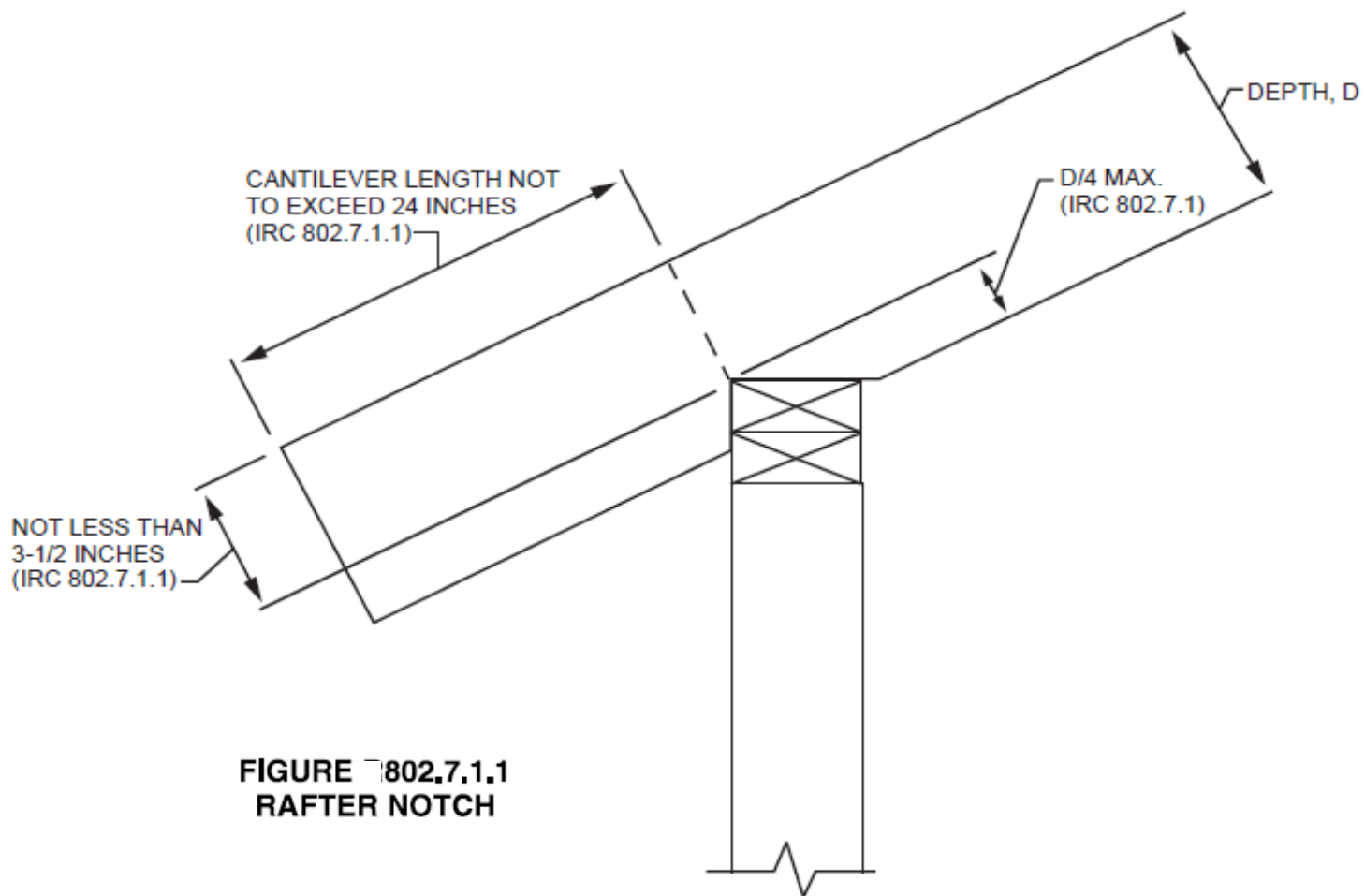


- \* Cutting, drilling, and notching 802.7
  - Sawn lumber 802.7.1
    - Per Section 502.8.1
    - Figure 802.7.1.1 cantilever of rafters
    - Actual diameter of 3½” replaced a nominal 4” dimension describing the portion of rafter remaining after notching at the wall top plate
    - Ceiling joist taper cut 802.7.1.2
    - Added provisions for limits of taper cuts on ends of ceiling joists



**FIGURE R802.7.1.2  
CEILING JOIST TAPER CUT**



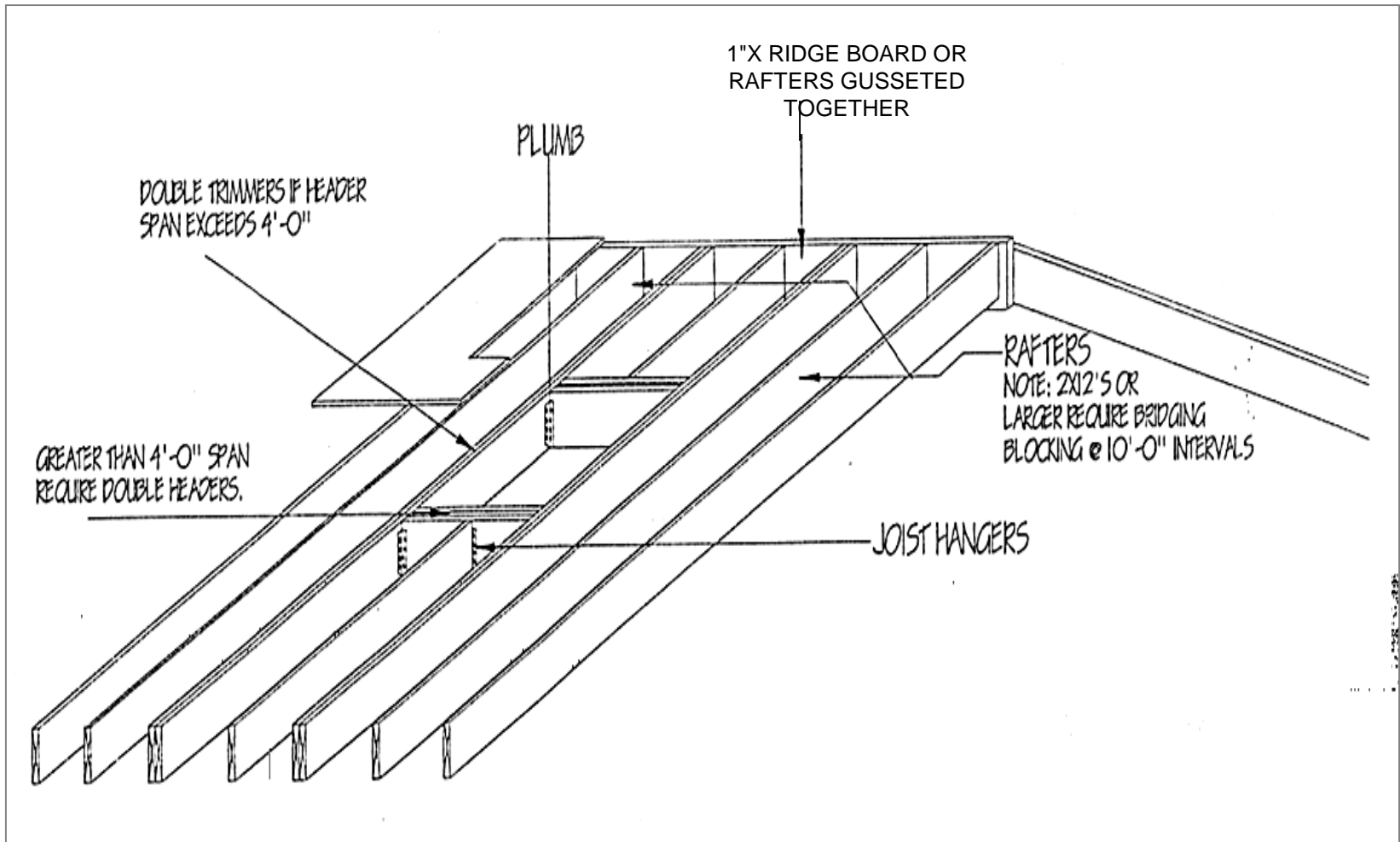


**FIGURE 802.7.1.1  
RAFTER NOTCH**

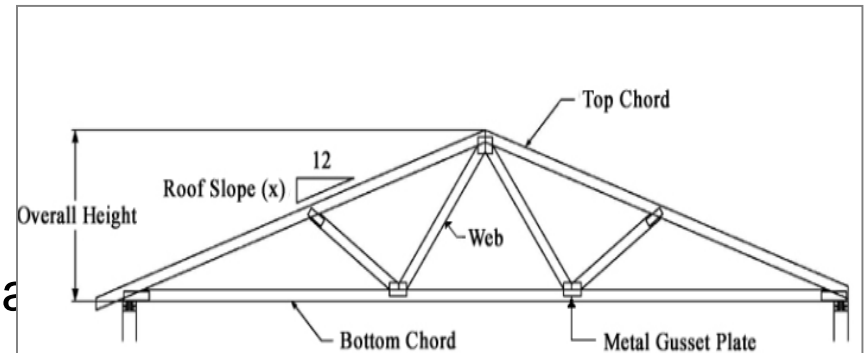
- \* Lateral support **802.8**
  - Require support at points of bearing if in excess of 5:1 depth-to-thickness ratio
  - Bridging **802.8.1**
    - Greater than 6:1 requires bridging at 8' intervals

- \* Framing of openings **802.9**
  - Roofs and ceiling
  - Headers spanning up to 4' may be single member, same size as the ceiling joist or rafter
  - Header spans greater than 4' require the header and trimmer joist and rafters to be doubled
  - Hangers required
    - Header to trimmer with header over 6'
  - Tail joist over 12' with framing anchors or on a 2" ledger

\* Framing of openings (roof) 802.9

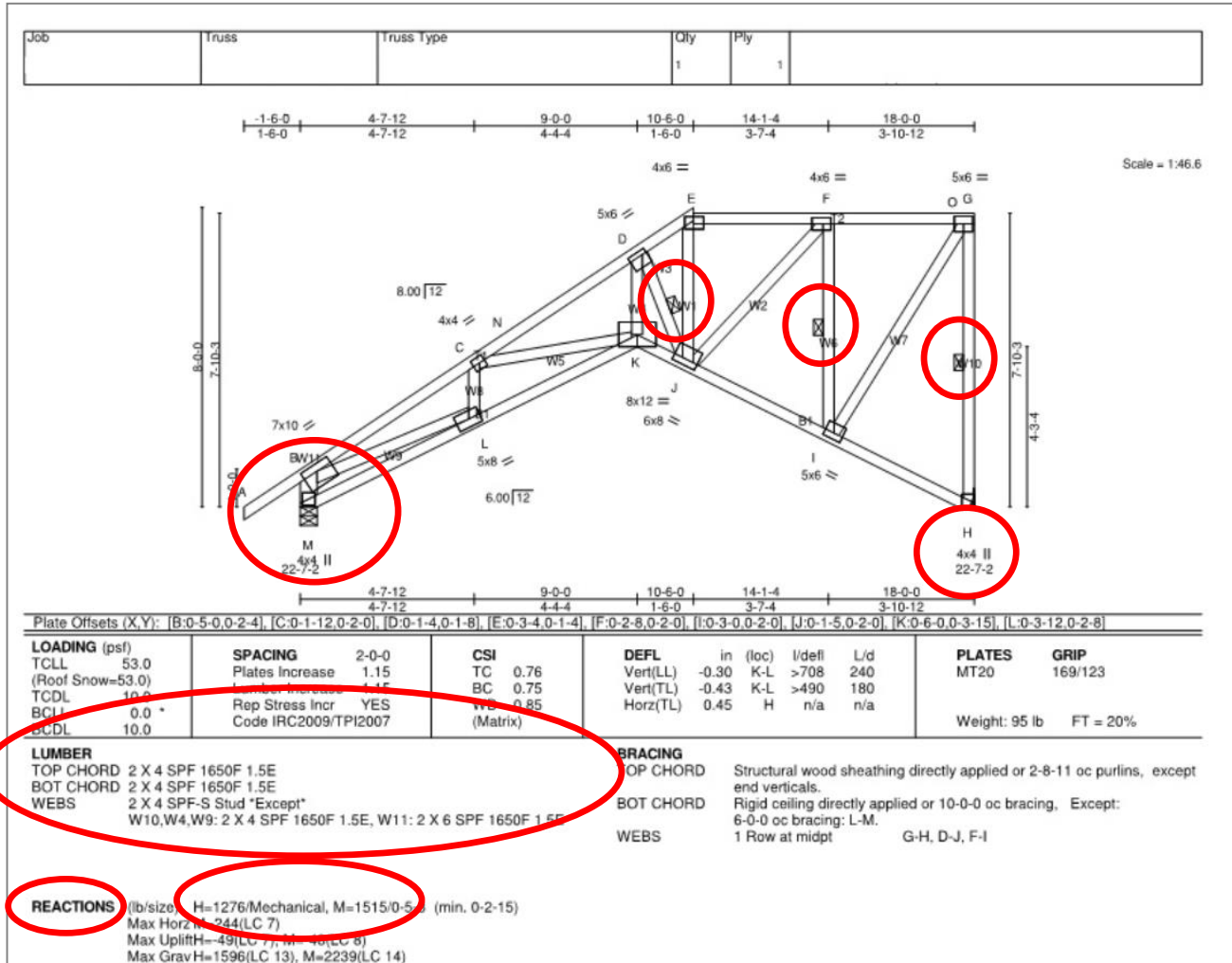


- \* Wood trusses 802.10
  - Truss drawings required 802.10.1
    - Slope, span, spacing
    - Joint location
    - Bearing widths
    - Design loads
    - Top chord live and dead
    - Bottom chord live and dead loads
    - Concentrated loads
    - Wind and earthquake loads

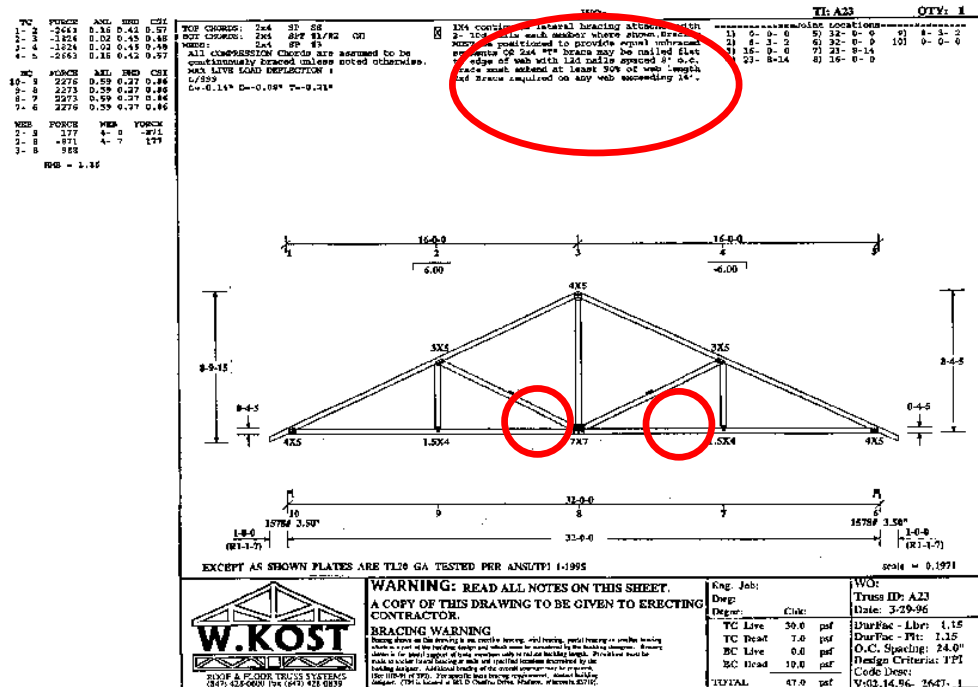


- Truss drawings required **802.10.1** (*continued*)
  - Reaction force and direction
  - Joint connector type
  - Adjustment to lumber and joint design values
  - Lumber size and species
  - Connection requirements
  - Compression forces
  - Bracing locations

\* Truss design & applicability limits 802.10.2 and 802.10.2.1



- Bracing 802.10.3
  - Per construction documents
  - BCSI (*Building Component Safety Information*) (1-03)





- Alterations to trusses **802.10.4**
  - Not allowed without engineering approval
  - Additional HVAC loads with engineering approval

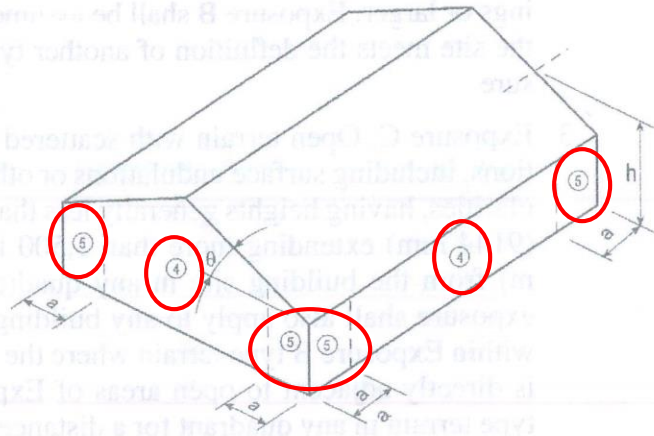
\* Roof tie-down **802.11**

- Revised and improves roof uplift provisions
- Provides maximum uplift capacity of 200 pounds where rafter or truss is spaced not >24" o.c.
- Table addresses higher sloped roofs (5:12 or greater) permitted under several conditions described in the section
- Provisions allow use of nailing rather than a manufactured uplift connector for more cases than allowed before
- **Table 301.2(1)**
- **Table 802.11**
- **Figure 301.2(5)A**

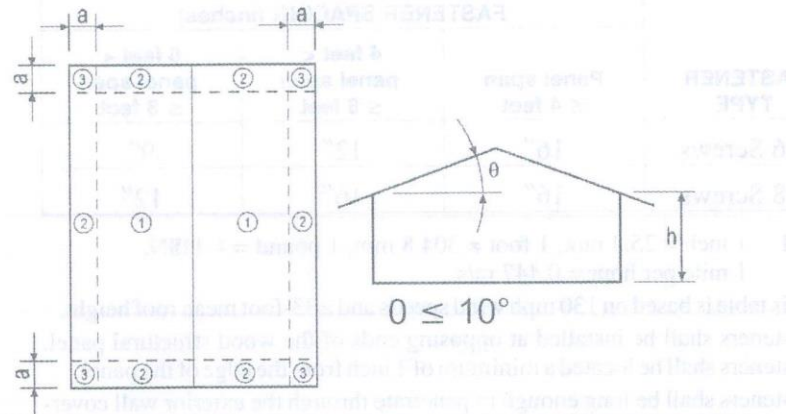
TABLE 802.11

RAFTER OR TRUSS UPLIFT CONNECTION FORCES FROM WIND (ASD) (POUNDS PER CONNECTION)<sup>a, b, c, d, e, f, g, h</sup>

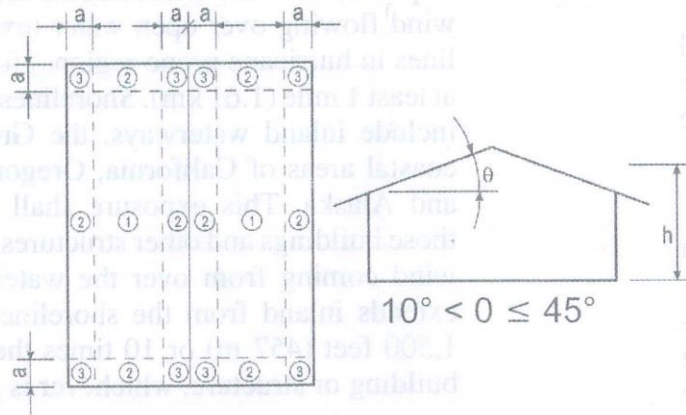
RAFTER OR TRUSS SPACING	ROOF SPAN (feet)	EXPOSURE B									
		Ultimate Design Wind Speed $V_{ULT}$ (mph)									
		110		115		120		130		140	
		Roof Pitch		Roof Pitch		Roof Pitch		Roof Pitch		Roof Pitch	
		< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12
12" o.c.	12	48	43	59	53	70	64	95	88	122	113
	18	59	52	74	66	89	81	122	112	157	146
	24	71	62	89	79	108	98	149	137	192	178
	28	79	69	99	88	121	109	167	153	216	200
	32	86	75	109	97	134	120	185	170	240	222
	36	94	82	120	106	146	132	203	186	264	244
	42	106	92	135	120	166	149	230	211	300	278
	48	118	102	151	134	185	166	258	236	336	311
16" o.c.	12	64	57	78	70	93	85	126	117	162	150
	18	78	69	98	88	118	108	162	149	209	194
	24	94	82	118	105	144	130	198	182	255	237
	28	105	92	132	117	161	145	222	203	287	266
	32	114	100	145	129	178	160	246	226	319	295
	36	125	109	160	141	194	176	270	247	351	325
	42	144	122	188	160	224	200	306	284	390	370
	48	162	138	216	180	252	228	354	332	450	430



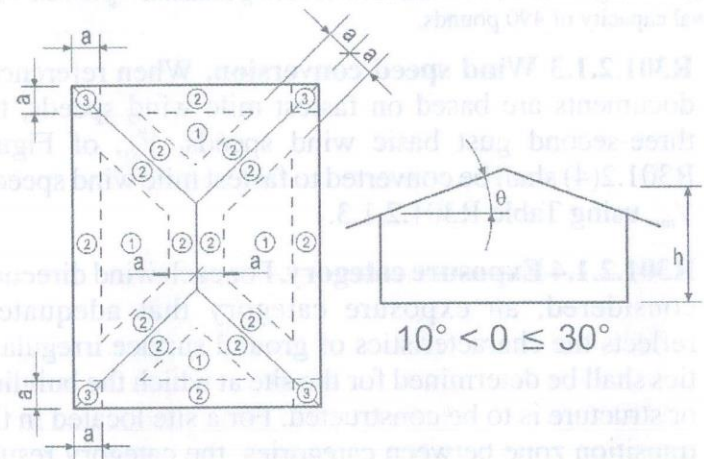
WALLS



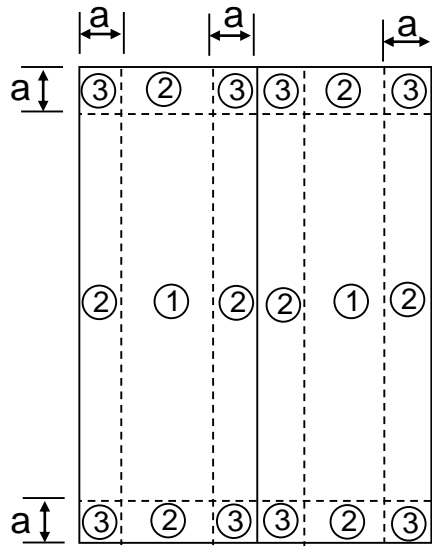
GABLE ROOFS  
 $0 \leq \theta \leq 10^\circ$



GABLE ROOFS  
 $10^\circ < \theta \leq 45^\circ$

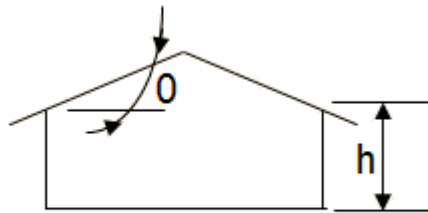


HIP ROOFS  
 $10^\circ < \theta \leq 30^\circ$

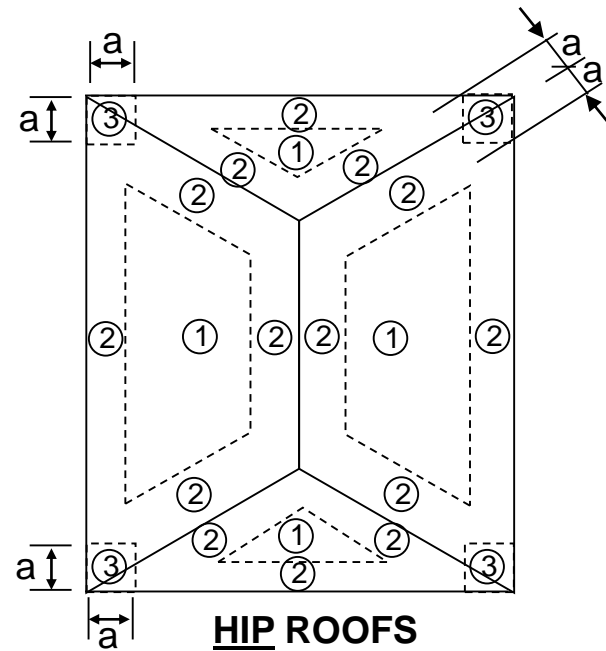


**GABLE ROOFS**

$0 \leq \theta \leq 45$

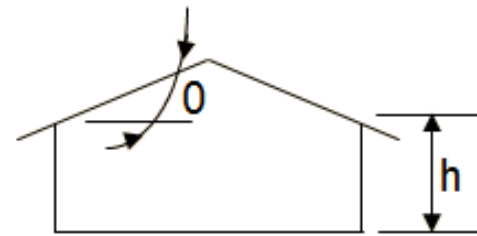


$0 \leq \theta \leq 45$



**HIP ROOFS**

$10^\circ < \theta \leq 30^\circ$



$10^\circ < \theta \leq 30^\circ$

**Note:**  $a = 4' - 0''$  in all cases

For SI: 1 foot = 304.8 mm, 1 degree = 0.009 rad.

**TABLE 1301.2(2)**  
**COMPONENT AND CLADDING LOADS FOR A BUILDING WITH A MEAN**  
**ROOF HEIGHT OF 30 FEET LOCATED IN EXPOSURE B (ASD) (psf)<sup>a, b, c, d, e</sup>**

	ZONE	EFFECTIVE WIND AREA (feet <sup>2</sup> )	ULTIMATE DESIGN WIND SPEED, $V_{ULT}$ (mph)																	
			110		115		120		130		140		150		160		170		180	
Roof 0 to 7 degrees	1	10	10.0	-13.0	10.0	-14.0	10.0	-15.0	10.0	-18.0	10.0	-21.0	9.9	-24.0	11.2	-27.0	12.6	-31.0	14.2	-35.0
	1	20	10.0	-12.0	10.0	-13.0	10.0	-15.0	10.0	-17.0	10.0	-20.0	9.2	-23.0	10.6	-26.0	11.9	-30.0	13.3	-34.1
	1	50	10.0	-12.0	10.0	-13.0	10.0	-14.0	10.0	-17.0	10.0	-19.0	8.5	-22.0	10.0	-26.0	10.8	-29.0	12.2	-32.9
	1	100	10.0	-11.0	10.0	-13.0	10.0	-14.0	10.0	-16.0	10.0	-19.0	7.8	-22.0	10.0	-25.0	10.0	-28.0	11.3	-32.0
	2	10	10.0	-21.0	10.0	-23.0	10.0	-26.0	10.0	-30.0	10.0	-35.0	9.9	-40.0	11.2	-46.0	12.6	-52.0	14.2	-58.7
	2	20	10.0	-19.0	10.0	-21.0	10.0	-23.0	10.0	-27.0	10.0	-31.0	9.2	-36.0	10.6	-41.0	11.9	-46.0	13.3	-52.4
	2	50	10.0	-16.0	10.0	-18.0	10.0	-19.0	10.0	-23.0	10.0	-26.0	8.5	-30.0	10.0	-34.0	10.8	-39.0	12.2	-44.1
	2	100	10.0	-14.0	10.0	-15.0	10.0	-16.0	10.0	-19.0	10.0	-22.0	7.8	-26.0	10.0	-30.0	10.0	-33.0	11.3	-37.9
	3	10	10.0	-33.0	10.0	-36.0	10.0	-39.0	10.0	-46.0	10.0	-53.0	9.9	-61.0	11.2	-69.0	12.6	-78.0	14.2	-88.3
	3	20	10.0	-27.0	10.0	-29.0	10.0	-32.0	10.0	-38.0	10.0	-44.0	9.2	-50.0	10.6	-57.0	11.9	-65.0	13.3	-73.1
	3	50	10.0	-19.0	10.0	-21.0	10.0	-23.0	10.0	-27.0	10.0	-32.0	8.5	-36.0	10.0	-41.0	10.8	-47.0	12.2	-53.1
	3	100	10.0	-14.0	10.0	-15.0	10.0	-16.0	10.0	-19.0	10.0	-22.0	7.8	-26.0	10.0	-30.0	10.0	-33.0	11.3	-37.9

- \* **Table 301.2(3)** height and exposure adjustment coefficients for **Table 301.2(2)**

MEAN ROOF HEIGHT	EXPOSURE		
	B	C	D
15	1.00	1.21	1.47
20	1.00	1.29	1.55
25	1.00	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84
60	1.22	1.62	1.87

## ◆ Roof Sheathing 803

- \* Lumber or structural panels
- \* Spans
  - Table 803.1
  - Table 503.2.1(1)
  - APA E30
- \* Comply with 905.7 and 905.8
  - Staggered joints per Table 602.3(1) or APA E30
  - Exposed in outdoor applications
    - Exposure 1: No exposure
    - Exposure 2: Limited to some moderate weather exposure
    - Maximum sheathing cantilever 9” past gable end wall



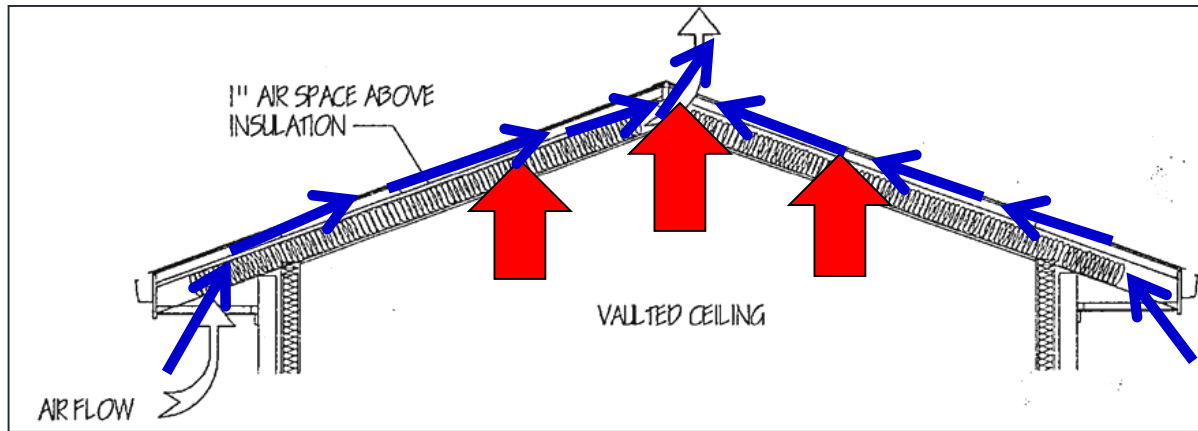
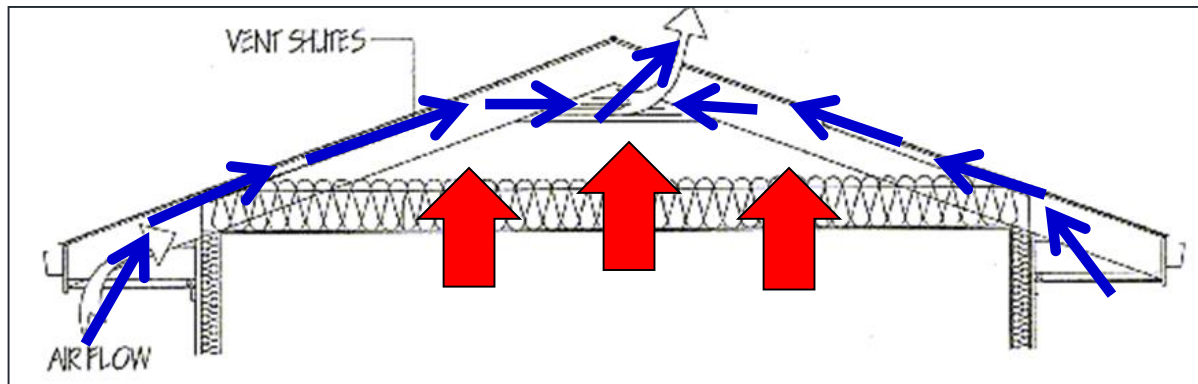
## ◆ Ceiling Finishes 805

- \* Ceiling finishes per 702

## ◆ Roof Ventilation 806

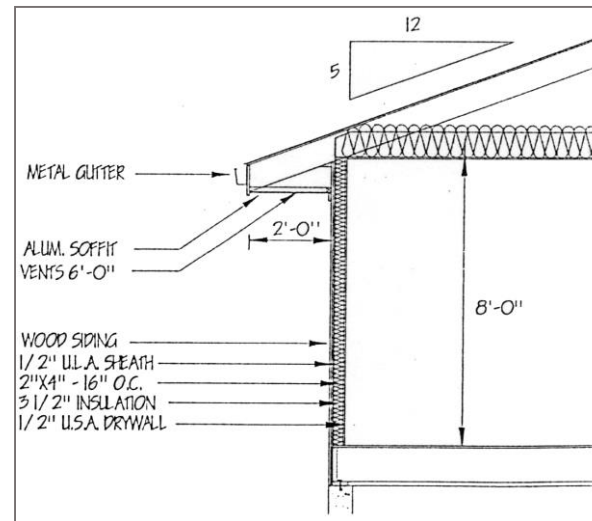
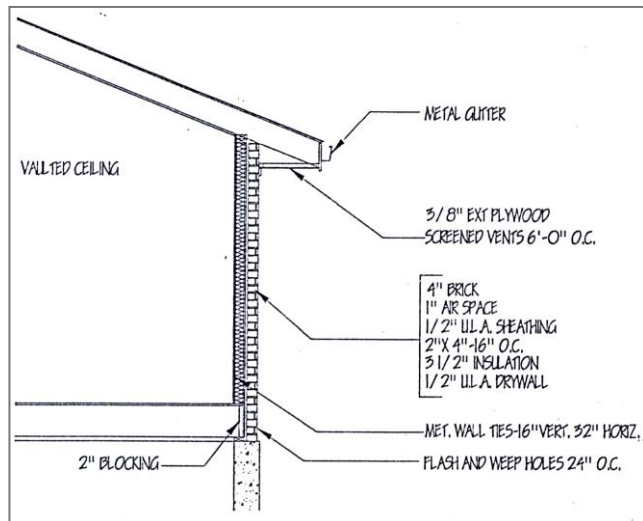
- \* Ventilation required R806.1
  - 1" vent and insulation clearance between insulation and roof sheathing throughout enclosed attic and enclosed rafter spaces

◆ Roof Ventilation 806 (continued)

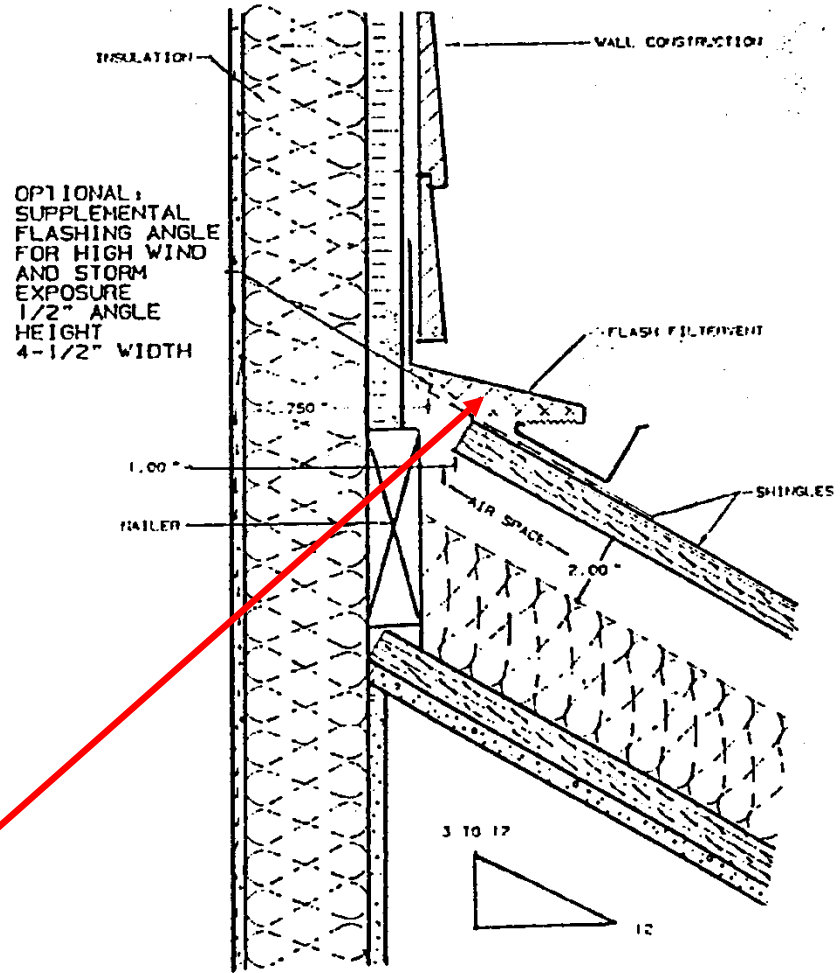


\* Minimum vent area **806.2**

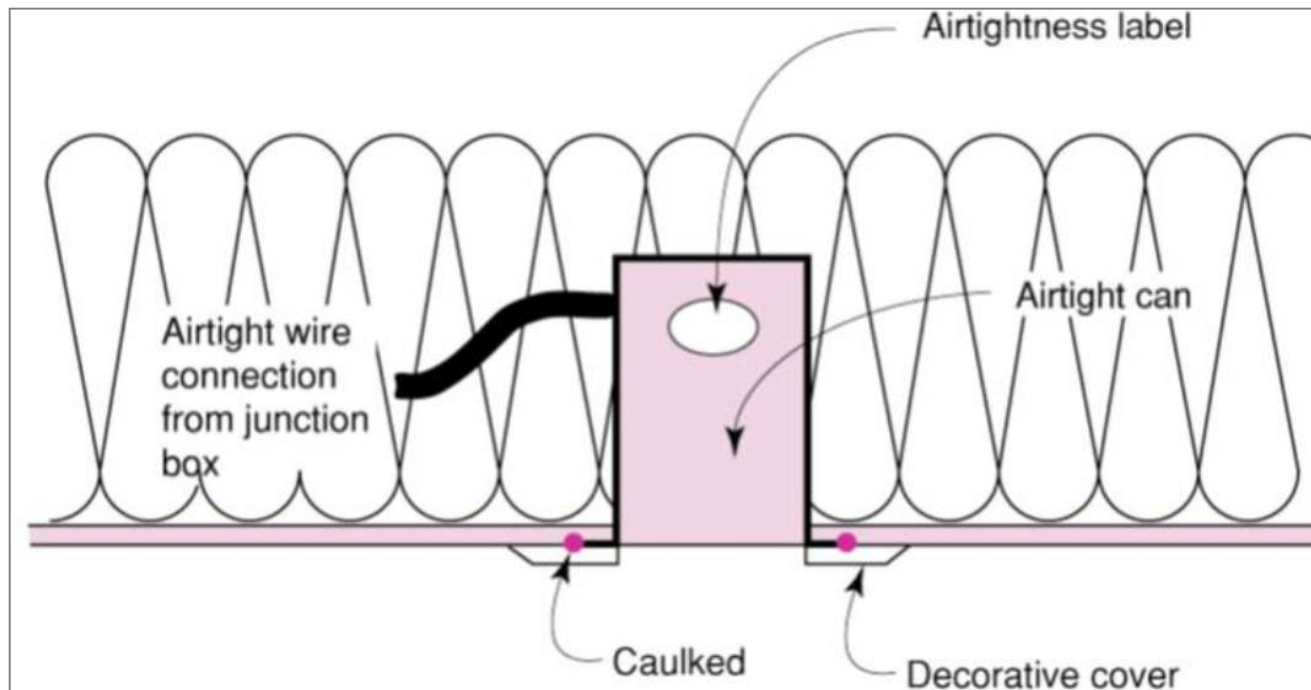
- 1:150 natural ventilation - reduce to 1:300 total net area when more than 40% but not more than 50% via ventilators located in space not more than 3' below the ridge – remainder in bottom third
- Allowed as 1:300 when vapor barrier not exceeding 1 perm on warm side of insulation



Flashing Filter Vent



- \* Vent and insulation clearance **806.3**
  - Lists luminaries, fan motors and heat producing devices, need to be separated by a minimum of 3”
  - See **Section 1102.4.3.5** (Energy efficiency – building thermal envelope)

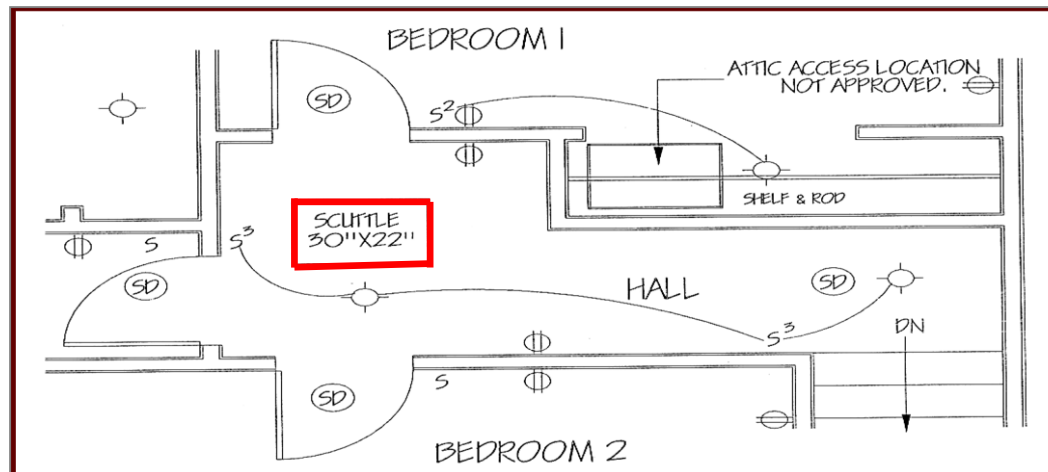


\* Unvented attic and unvented enclosed rafter assemblies  
Section **R806.5**

- Specifies the conditions under which a conditioned attic assembly is permitted to be unvented
- Unvented attic provisions also apply to rafter assemblies typically used for vaulted or cathedral ceilings with additional information

## ◆ Attic Access R=807

- \* Ready access – hallway or other location with ready access
- \* 22" x 30" minimum
- \* Height: >30" in height at opening and exceeding 30 square feet
- \* See **M1305.1.3** when mechanicals are located in the attic



\* Attic access 807







Building & Fire Code Academy

**Understanding the 2019  
Residential Code of Ohio**

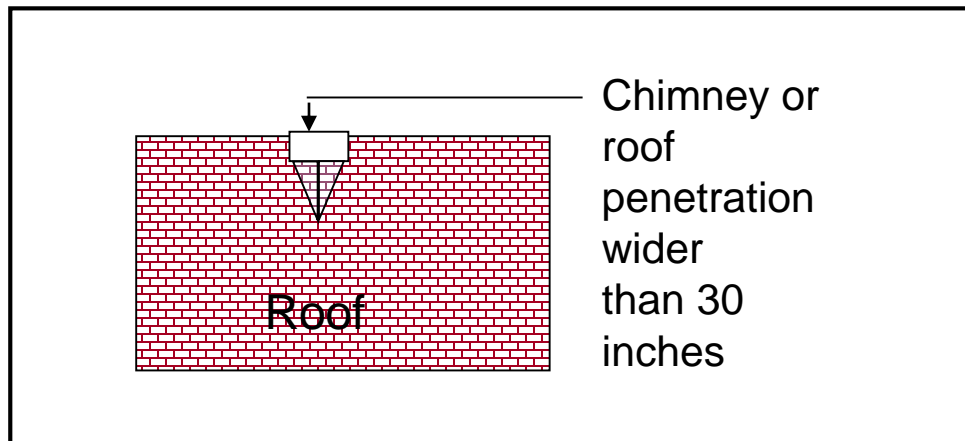
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**Chapter 9  
Roof Assemblies**

- ◆ Roof Covering Classification 902
  - \* Class A, B, or C as required
  - \* Fire retardant shakes and shingles per **AWPA C1**
  - \* Building-integrated photovoltaic product
  - \* Rooftop – mounted photovoltaic panel systems

## ◆ Weather Protection 903

- \* Roof coverings required
- \* Flashings required
  - Where horizontal meets vertical
  - Where chimney or penetration exceeds 30 " – roof cricket **R1003.20**



- \* Copings at top of walls
- \* Roof drainage
  - Scuppers may be required with ponding

## ◆ Requirements for Roof Coverings 905

- \* Installation per the section and manufacturer's requirements
- \* Underlayment based on the materials on Tables 905.1.1(1) and 905.1.1(2)
- \* 905.2 – R905.16 – specific requirements based on materials

**TABLE .905.1.1(2)  
UNDERLAYMENT APPLICATION**

ROOF COVERING	SECTION	MAXIMUM ULTIMATE DESIGN WIND SPEED, $V_{ult} < 140$ MPH	MAXIMUM ULTIMATE DESIGN WIND SPEED, $V_{ult} \geq 140$ MPH
Asphalt shingles	R905.2	<p>For roof slopes from two units vertical in 12 units horizontal (2:12), up to four units vertical in 12 units horizontal (4:12), underlayment shall be two layers applied in the following manner: apply a 19-inch strip of underlayment felt parallel to and starting at the eaves. Starting at the eave, apply 36-inch-wide sheets of underlayment, overlapping successive sheets 19 inches. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. End laps shall be 4 inches and shall be offset by 6 feet.</p> <p>For roof slopes of four units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied in the following manner: underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches, Distortions in the underlayment shall not interfere with the ability of the shingles to seal. End laps shall be 4 inches and shall be offset by 6 feet.</p>	<p>Same as Maximum Ultimate Design Wind Speed, <math>V_{ult} &lt; 140</math> mph except all laps shall be not less than 4 inches.</p>

\* Asphalt shingles **905.2**

- Fastened to solidly sheathed decks – no sawn lumber
- Slopes 2:12 and greater
- Slopes 2:12 up to 4:12
- Underlayments
  - 2 layers of underlayment 2:12 or greater
  - 1 layer underlayment 2:12 to 4:12

Follow **R905.1.1**



- \* Asphalt shingles **905.2** (*continued*)
  - Wind resistance of asphalt shingles **905.2.4.1**
    - Wind resistance of asphalt shingles **ASTM D3161** includes classes for wind resistance. Class F indicates the shingles have been tested and passed at 110 mph
    - Class F asphalt shingles are acceptable where special fastening is required See **ASTM D3161**
  - Attachment **905.2.6**
    - Used when special methods of fastening are required, asphalt shingle wrappers must be labeled to indicate compliance with **ASTM D3161 Class F**

- \* Asphalt shingles **905.2** (*continued*)
  - Ice barrier **905.2.7**
    - Refer to **905.1.2**
    - Criteria for an ice barrier based on previous history of locale
    - See **Table 301.2(1)**
    - Ice protection 2-layers of underlayment or self-adhering polymer modified bitumen sheet to 24” inside of wall line





\* Climatic and geographic design criteria **Table 301.2(1)**

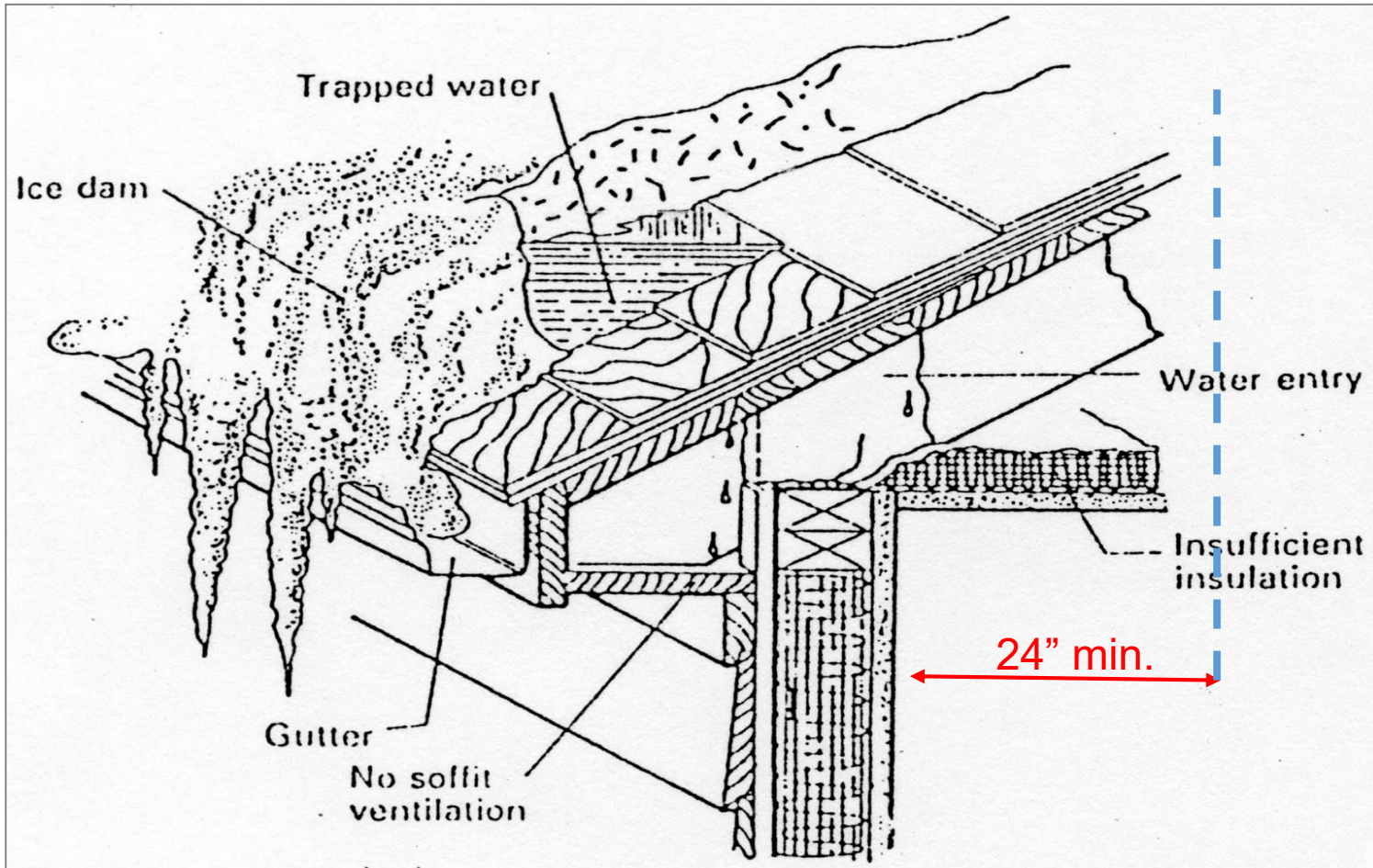
WINTER DESIGN TEMP <sup>e</sup>	ICE BARRIER UNDERLAYMENT REQUIRED <sup>h</sup>	FLOOD HAZARD <sup>g</sup>	AIR FREEZING INDEX <sup>i</sup>	MEAN ANNUAL TEMP <sup>j</sup>
- 4	YES			

h. In accordance with Sections [R905.1.2](#), [R905.4.3.1](#), [R905.5.3.1](#), [R905.6.3.1](#), [R905.7.3.1](#) and [R905.8.3.1](#), where there has been a history of local damage from the effects of ice damming, the *jurisdiction* shall fill in this part of the table with "YES." Otherwise, the *jurisdiction* shall fill in this part of the table with "NO."

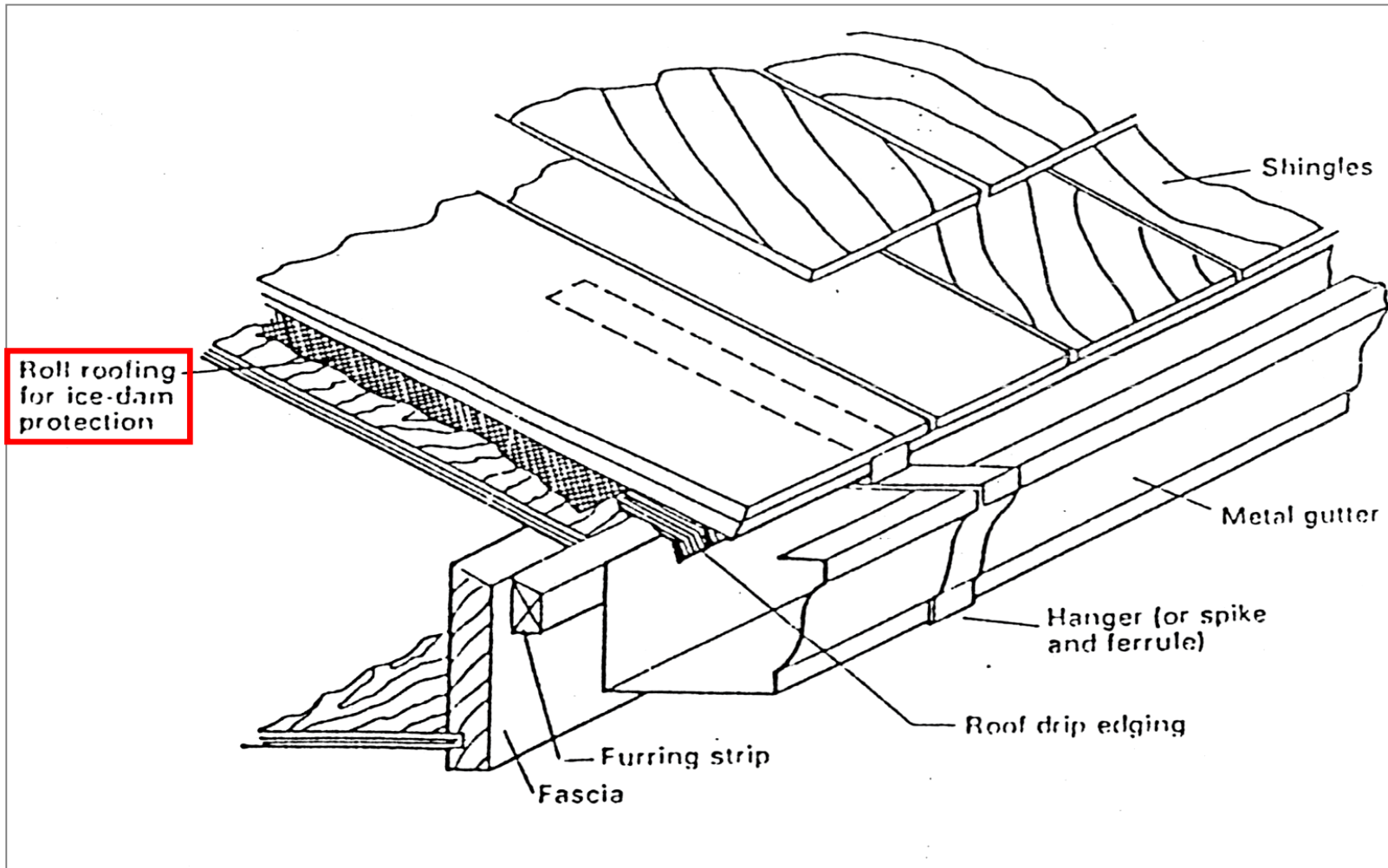
\* Ice barrier 905.2.7



\* Ice barrier 905.2.7



\* Ice barrier 905.2.7



- \* Ice protection applications
  - Flashings installed according to asphalt shingle manufacturer's printed instructions 905.2.8 & 905.1.2
  - Clay and concrete tile (Slope 2½:12) 905.3
  - Metal roof shingles (Slope 3:12 or greater) 905.4.3.1
  - Slate and slate-type shingles (Slope 4:12 or greater) 905.6.3.1
  - Wood shakes (Slope 3:12 or greater) 905.8.3.1
  - Built-up roofs (Slope ¼":12 or greater) 905.9.1
  - Metal roof panels (Slope 3:12 or greater unsoldered ½:12 soldered) 905.10.3



- \* Ice protection applications (*continued*)
  - Modified bituminous roofing (Slope ¼":12 or greater) 905.11.1
  - Thermoset single-ply roofing (Slope ¼":12 or greater) 905.12.1
  - Thermoplastic single-ply roofing (Slope ¼":12 or greater) 905.13.1
  - Sprayed polyurethane foam roofing (Slope ¼":12 or greater) 905.14.1
  - Liquid-applied coatings (Slope ¼":12 or greater) 905.15.1
  - Photovoltaic shingles ( Slope 2:12 or greater) 905.16.1
  - Building integrated photovoltaic roof panels applied directly to roof deck (Slope 2:12 or greater) 905.17.2

- \* Ice protection applications (*continued*)
  - Flashing 905.2.8
    - Base and cap
    - Valleys
    - Sidewalls
    - Other – horizontal meets the vertical

- Drip edge **905.2.8.5**
  - Required eaves and rake edges
  - 2” overlap between sections
  - Extend ¼” below sheathing
  - 2” up roof deck
  - Mechanically fastened every 12”
  - Under underlayment at edge
  - Over underlayment at rake
  - New section adds requirement for a roof drip edge for asphalt shingles and provides direction for its proper installation





\* Building-integrated photovoltaic roof panels applied directly to roof deck **905.17**

- Solid or tight fitting roof deck
- 2:12 or greater
- Ice barrier protection
- **UL 1703**
- Per manufacturer
- Wind per **UL 1897**



## ◆ Rooftop Mounted Photovoltaic Panel Systems **907**

\* **324** and **NFPA 70**

◆ Reroofing 908



1093

\* Roof replacement **908.3**

- Structural and component load
  - Able to support roof loads
  - Material and equipment during construction
  - Roof replacement – removal of existing layers down to roof deck
  - Roof recover – new roof covering over existing roof covering



- \* Recover restrictions **908.3.1.1**
  - Water soaked
  - Slate, clay, cement or asbestos-cement tile
  - 2 or more applications
- \* Do not create combustible concealed spaces
- \* No cracked, damaged or broken tile, flashing, edging, outlets or flashing can be reused



# BFCOA<sup>®</sup>

## Building & Fire Code Academy

### Understanding the 2019 Residential Code of Ohio

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### Chapter 10 Chimneys and Fireplaces



## ◆ Masonry Fireplaces 1001

- \* Summary of requirements for masonry fireplaces and chimneys, see **Table 1001.1**
- \* Footing: solid masonry or concrete 12" thick – 6" beyond exterior sides **1001.2**
- \* Undisturbed soil – below frost line **1001.2**
- \* Not to support other loads unless designed

\* Construction details

- Summary of requirements for masonry fireplaces and chimneys **Table 1001.1**
- Fireplace and chimney details **Figure 1001.1**



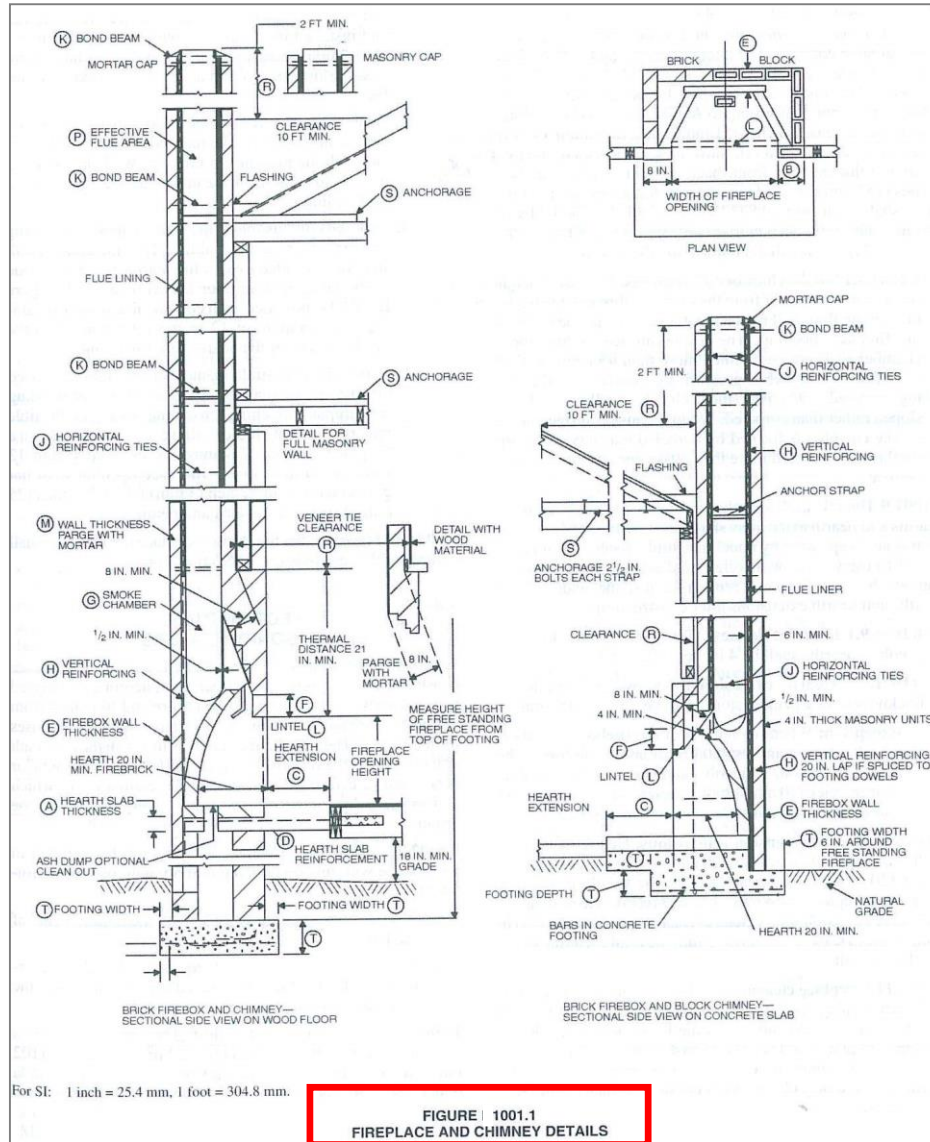


- \* Ash dump cleanout within foundation walls 1001.2.1
  - Opening located within foundation walls below fireboxes
  - Equipped with:
    - Ferrous metal doors or masonry doors
    - Constructed to remain tightly closed
  - Accessible and located so that removal of ash is not a hazard

**TABLE 1001.1 SUMMARY OF REQUIREMENTS FOR MASONRY FIREPLACES AND CHIMNEYS**

ITEM	LETTER <sup>a</sup>	REQUIREMENTS
Hearth slab thickness	A	4"
Hearth extension (each side of opening)	B	8" fireplace opening < 6 square foot. 12" fireplace opening ≥ 6 square foot.
Hearth extension (front of opening)	C	16" fireplace opening < 6 square foot. 20" fireplace opening ≥ 6 square foot.
Hearth slab reinforcing	D	Reinforced to carry its own weight and all imposed loads.
Thickness of wall of firebox	E	10" solid brick or 8" where a firebrick lining is used. Joints in firebrick <sup>1</sup> / <sub>4</sub> " maximum.
Distance from top of opening to throat	F	8"
Smoke chamber wall thickness Unlined walls	G	6" 8"
Chimney Vertical reinforcing <sup>b</sup>	H	Four No. 4 full-length bars for chimney up to 40" wide. Add two No. 4 bars for each additional 40" or fraction of width or each additional flue.
Horizontal reinforcing	J	<sup>1</sup> / <sub>4</sub> " ties at 18" and two ties at each bend in vertical steel.
Bond beams	K	No specified requirements.
Fireplace lintel	L	Noncombustible material.

\* Fireplace and chimney details **Figure 1001.1**



- \* Seismic reinforcing **1001.3**
  - Vertical and horizontal reinforcement required in seismic zones D<sub>0</sub>, D<sub>1</sub> and D<sub>2</sub>
- \* Seismic anchorage **1001.4**
  - Anchored at each floor ceiling or roofline more than 6' above grade
    - Exception:  
Where constructed completely within exterior walls

\* Firebox walls **1001.5**

- With 2" firebrick – 8" minimum
- No fire brick – 10" solid masonry
  - Steel fireplace units **1001.5.1**

Firebox lining allowed – Must be encased with total of 8" masonry back and sides

- Summary of requirements for masonry fireplaces and chimneys **Table 1001.1**



- \* Firebox dimensions **1001.6**
  - Minimum depth 20"
  - Throat 8" above opening
  - Not less than 4" in depth
  - Passageway above firebox including throat, damper, and smoke chamber not less than cross section of flue



- \* Firebox floor minimum thickness of 4" and supported on non-combustible footing
- \* Seismic reinforcing details, see 1002.4 and meet specifications for the chimney per Section 1003



## ◆ Construction Details 1002

### \* Lintel and throat 1001.7

- Must be non-combustible
- Minimum bearing each end 4"
- Damper required – not less than 8" above the lintel 1001.7.1

### \* Smoke chamber 1001.8

- With 2" firebrick or 5/8" vitrified clay, front, backed sidewalls – 6" minimum

– Materials must be:

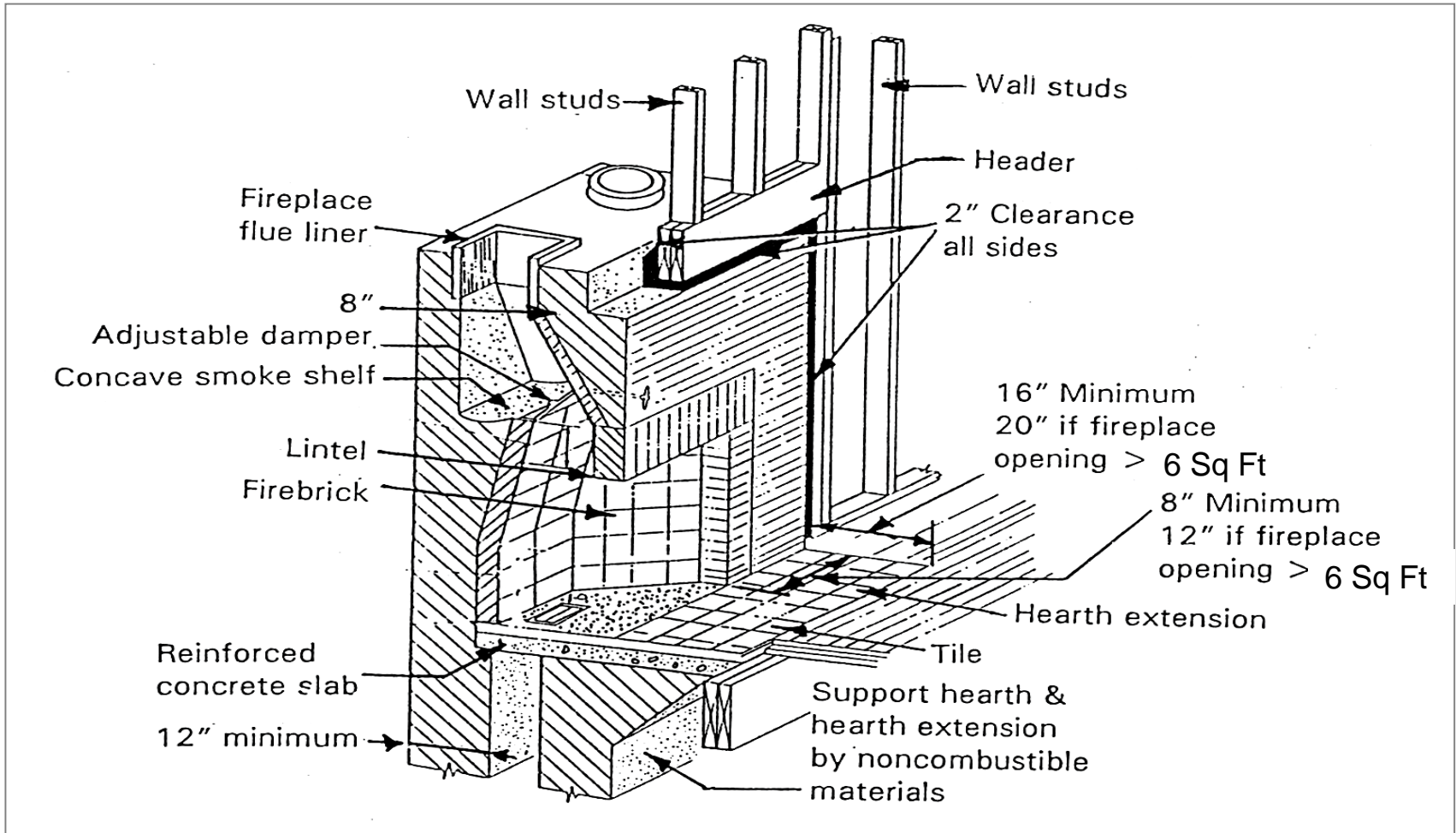
Solid masonry units

Hollow masonry units

Stone or concrete



- \* Firebrick not required if smoke chamber is 8" solid masonry  
1001.8



\* Hearths and hearth extensions 1001.9



- \* Hearths and hearth extensions 1001.9
  - Hearths – minimum thickness 4” 1001.9.1
  - Hearth extensions – minimum thickness 2” 1001.9.2
  - 16” in front and 8” beyond each side of fireplace opening 1001.10
  - Openings 6 square feet or larger require 20” in front and 12” to side 1001.10



- \* Fireplace clearance **1001.11**
  - 2” clearance to wood joists, beams or headers front face and side
  - 4” clearance from back side
- \* Air space not to be filled except with fire block material described in **R1001.12**

## ◆ Masonry Heaters 1002

- \* Heating appliance constructed of concrete or solid masonry
- \* Designed to absorb and store heat from solid fuel fire built in firebox
- \* Comply with **ASTM E1602** or **UL 1482** and installed per manufacturer's instructions



## ◆ Masonry Chimneys 1003

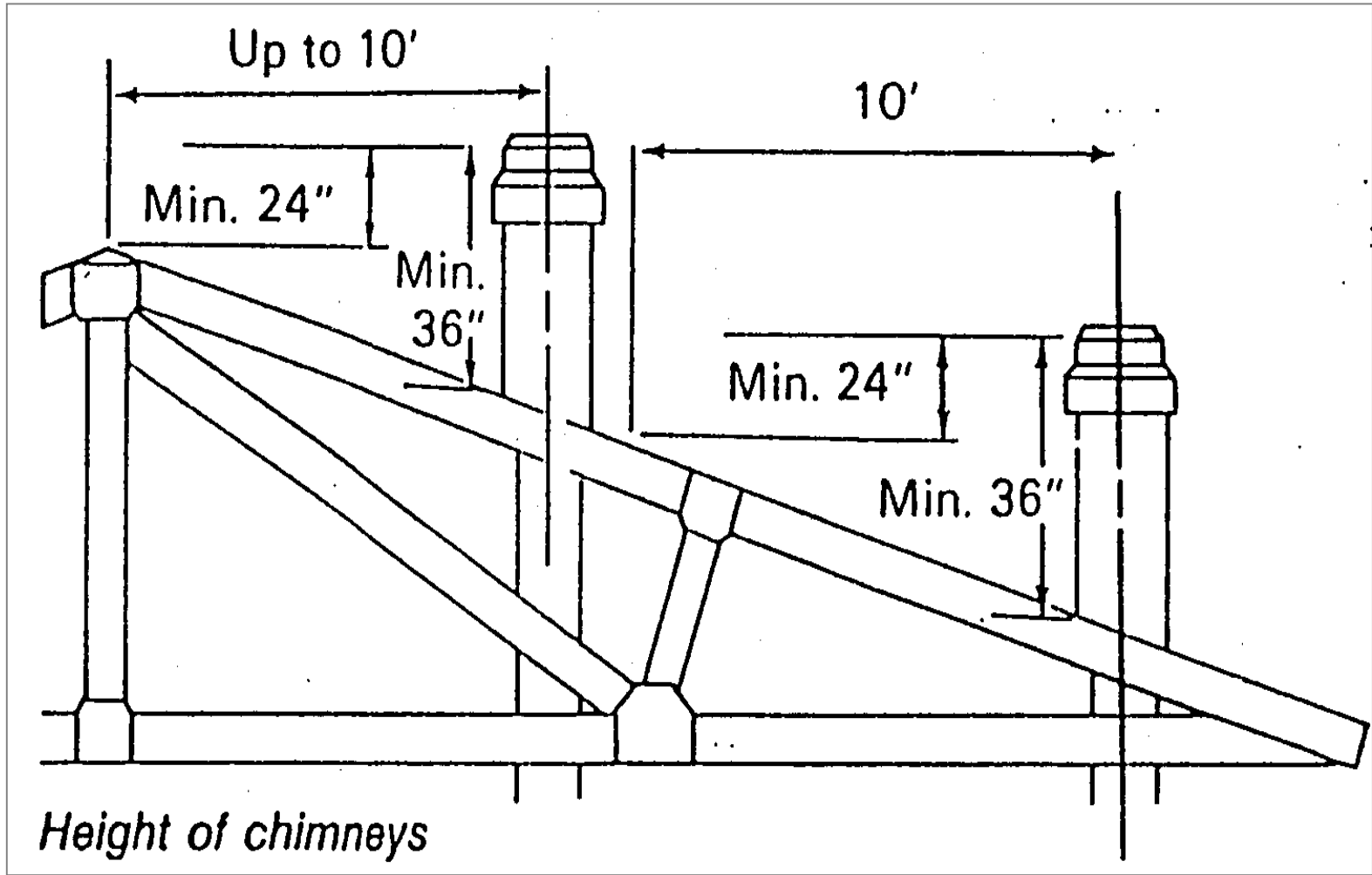
- \* Masonry or concrete 12" thick – 6" beyond exterior sides  
R1003.2
- \* Undisturbed soil – below frost line 1003.2
- \* Reinforcement required in seismic zones D1 and D2  
R1003.3
  - Not to support other loads unless designed



\* Termination 1003.9

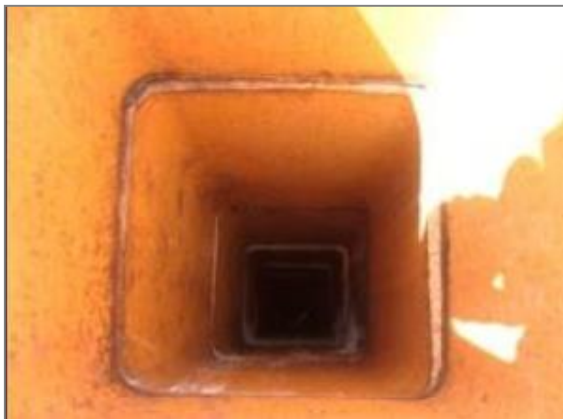


\* Termination 1003.9





- \* Termination **1003.9**
  - Chimney caps required on masonry chimneys **1003.9.1**
    - Rain caps are NOT required but when provided must comply with **1003.9.3**
- \* Wall thickness – 4” **1003.10**
- \* Flue lining (material) **1003.11**
  - Consistent with appliance installed



- Spark arrestors **1003.9.2**
  - Net free area x 4 of the chimney outlet
  - Heat and corrosion resistance
  - Opening limitations
  - Accessible for cleaning and removable to allow chimney flue to be cleaned

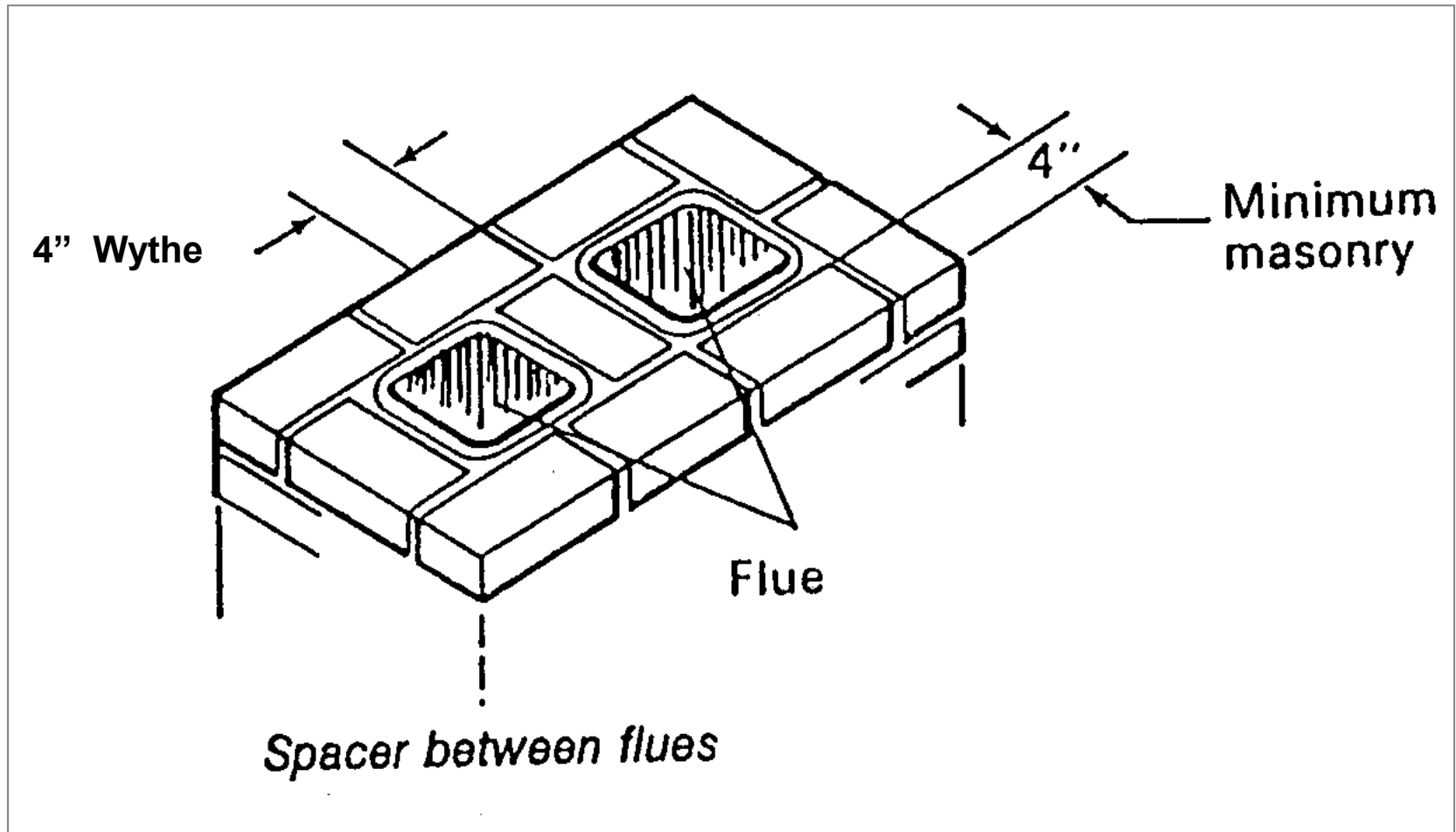




- \* Flue lining (material) 1003.11 (*continued*)
  - Notice of usage 1003.11.6
    - Certain circumstances require a notice to be posted as to use and type of appliance to be connected

**THIS CHIMNEY FLUE IS FOR USE ONLY WITH (TYPE OR CATEGORY OF APPLIANCE) APPLIANCES THAT BURN (TYPE OF FUEL). DO NOT CONNECT OTHER TYPE OF APPLIANCES**

\* Multiple flues 1003.13



- \* Flue area **1003.14**
  - Round flue sizes **Table 1003.14 (1)**
  - Square flue sizes **Table 1003.14 (2)**
- \* Masonry chimney cleanout openings **1003.17**
  - Within 6" of base of each chimney flue and 6" below each connector
- \* Chimney clearances **1003.18**
  - Interior chimneys require 2" air space from combustibles
  - Exterior chimneys require 1" air space clearance

**TABLE 1003.14(1)  
NET CROSS-SECTIONAL AREA OF ROUND FLUE SIZES<sup>a</sup>**

<b>FLUE SIZE, INSIDE DIAMETER (inches)</b>	<b>CROSS-SECTIONAL AREA (square inches)</b>
6	28
7	38
8	50
10	78
10 <sup>3</sup> / <sub>4</sub>	90
12	113
15	176
18	254

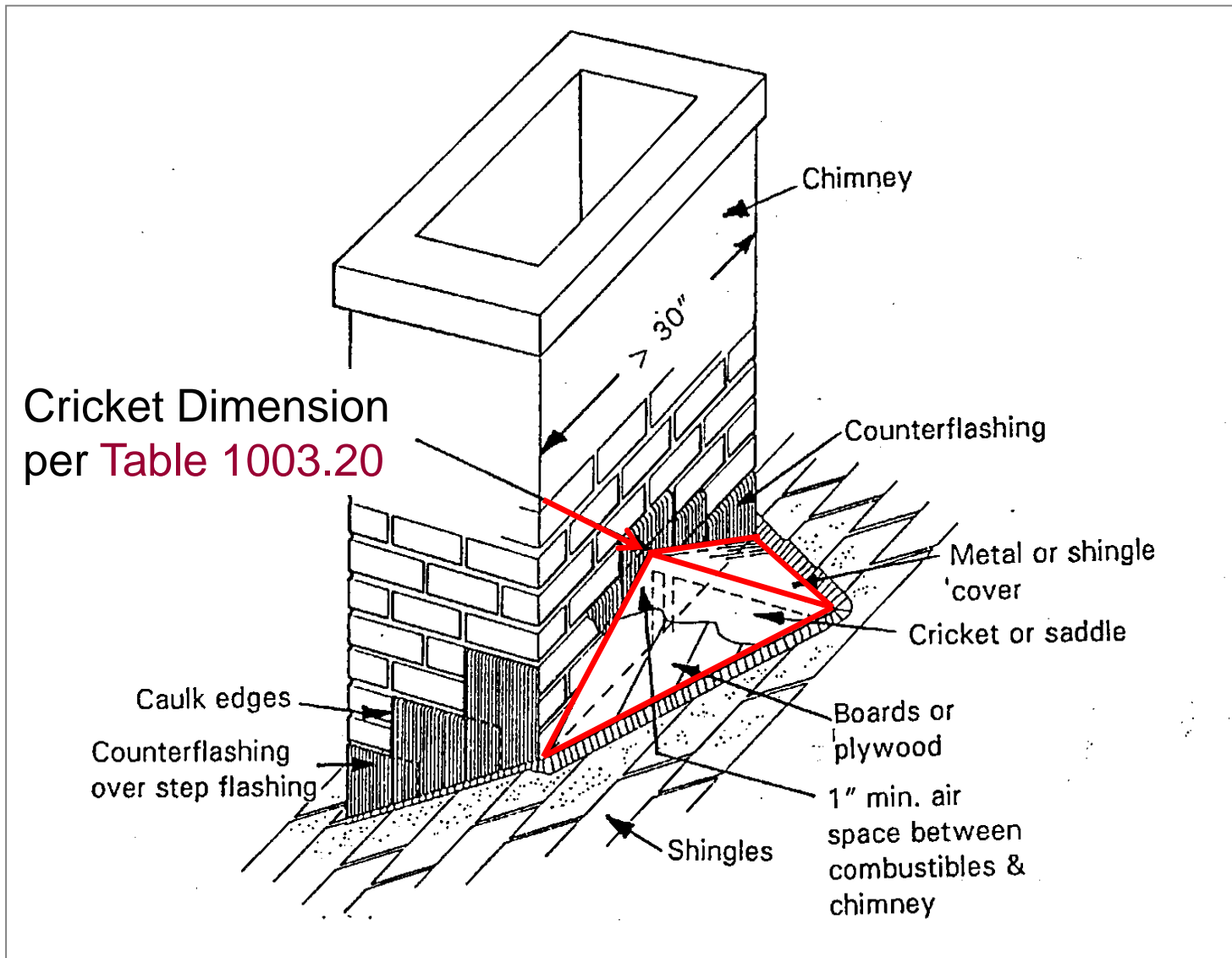
**TABLE 1003.14(2)  
NET CROSS-SECTIONAL AREA OF SQUARE  
AND RECTANGULAR FLUE SIZES**

<b>FLUE SIZE, OUTSIDE NOMINAL DIMENSIONS (inches)</b>	<b>CROSS-SECTIONAL AREA (square inches)</b>
4.5 × 8.5	23
4.5 × 13	34
8 × 8	42
8.5 × 8.5	49
8 × 12	67
8.5 × 13	76
12 × 12	102
8.5 × 18	101
13 × 13	127
12 × 16	131
13 × 18	173
16 × 16	181
16 × 20	222
18 × 18	233
20 × 20	298
20 × 24	335
24 × 24	431



- \* Chimney fireblocking **1003.19**
  - Require fire blocked with non-combustible material securely fastened in place
  - Spaces between wood joists, beams or headers shall be to a depth of 1" and shall be on metal strips laid across the spaces
  
- \* Chimney crickets **1003.20**
  - Required when greater than 30" wide
  - Sized based on **Table 1003.20**

\* Chimney crickets 1003.20



**TABLE 1003.20  
CRICKET DIMENSIONS**

ROOF SLOPE	H
12:12	$\frac{1}{2}$ of W
8:12	$\frac{1}{3}$ of W
6:12	$\frac{1}{4}$ of W
4:12	$\frac{1}{6}$ of W
3:12	$\frac{1}{8}$ of W

## ◆ Factory-Built Fireplaces 1004

- \* Follow manufacturer's installation instructions

## ◆ Factory-Built Chimneys 1005

- \* Factory-built chimney offsets **1005.7**
  - Adds provisions for offsets in factory built chimneys
  - No portion of chimney may exceed 30° from vertical
  - Four elbow fittings allowed maximum



## ◆ Exterior Air Supply 1006

- \* Required for factory-built and masonry fireplaces
  - Factory built – duct component of unit
  - Masonry – listed ductwork
- \* Outside air or from spaces ventilated by outside air – not from garage or basement
- \* Not higher than fire box
- \* Minimum of 1" of clearance, 6" minimum <55 square inches
- \* Allowed on sides of firebox or within 24" of firebox opening on or near the floor
- \* Closable
- \* Designed to prevent burning material from dropping into concealed combustible spaces

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Building & Fire Code Academy

Questions?

**BFC A<sup>®</sup>**

**Building & Fire Code Academy**

**Thank you**

---

**Email: [Info@bfcacademy.com](mailto:Info@bfcacademy.com)**

**Voice: (847) 428-2951 (800) 488-7057**

**Fax: (847) 428-2911**

**File Attachments for Item:**

ER-7 Cincinnati Inspector Cross Training Part 4 (BCFA)

Provider: Building and Fire Code Academy

RBI, RMI (four sessions, three hours each)

Staff Notes: The series of courses is intended to cross train City of Cincinnati property maintenance inspectors and residential building inspectors. The final four sessions focus on the Mechanical Code

Committee Recommendation:





## **CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS**

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

**Instructors:** Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications 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 shall not disclose improper approval information to the public.

**Course sponsors/co-sponsors:** 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.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

**Participants:** Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

**Board approval:** Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

**Facility/training area:** Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

# APPLICATION

## FOR Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.



### Board of Building Standards

6606 Tussing Road, P.O. Box 4009

Reynoldsburg, Ohio 43068-9009

(614) 644-2613 Fax: (614) 644-3147

dic.bbs@com.state.oh.us

www.com.state.oh.us/dic/dicbbs.htm

#### COURSE SUBMITTER:

Course Submitter: George Sweeney  
(Contact Name)  
Organization: Building and Fire Code Academy  
(Organization/Company)  
Address: 2420 Vantage Drive  
(Include Room Number, Suite, etc.)  
City: Elgin State: IL Zip: 60124  
E-Mail: GSweeney@bfcacademy.com  
Telephone: (847) 428-2951 Fax: (847) 428-2911  
Course Sponsor: Richard A. Piccolo, Building and Fire Code Academy

#### COURSE INFORMATION:

Course Title: \_\_\_\_\_

New Course Submittal:  Update Course:  Prior Approval Number: \_\_\_\_\_

Purpose and Objective: The City will be cross training the Residential and Property Maintenance Inspectors. This class will provide an explanation

The class is based on the 2019 edition of the Residential Code of Ohio. The audience for this class is the current Residential Building Inspectors and the current property maintenance.

The class consists of lecture with a Power Point presentation with related problem-solving activities.

Number of Instructional Contact Hours that can be obtained upon completion: 12

If Multi-Session, Number of Instructional Contact Hours Per Session: 3

#### Program Applicable for the Following Participants:

Building Official  Master Plans Examiner  Building Inspector  Fire Protection Inspector  Mechanical Inspector   
 Building Plans Exam.  Plumbing Inspector   
 Plumbing Plans Exam.  Non-Res IU Inspector   
 Electrical Plans Exam.   
 Mechanical Plans Exam.   
 Fire Protect. Plans Exam.

Res Building Official  Res Plans Examiner  Res Building Inspector  Res Mechanical Inspector  Res IU Inspector

Electrical Safety Inspectors

Location of ESI Course: \_\_\_\_\_ Date(s) of ESI Course(s): \_\_\_\_\_

SUBMITTAL CHECKLIST: <b>Make Sure</b> all of the Following Information is <b>Submitted</b> :		Check Off
<b>Course Submitter:</b>	Name of contact person and their certification numbers, organization, address, fax, phone	
	Organization sponsoring or requesting the program (if any)	
<b>Course Title:</b>	Name of course (related to content)	
<b>Purpose/Objective:</b>	Describe purpose and how course will improve competency of certification(s) listed	
<b>Contact Hours:</b>	Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs)	
<b>Participants:</b>	Check off each certification for which credit is requested (for which course relates to certification)	
<b>Content of Program:</b>	Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered	
<b>Course Materials:</b>	Collated workbooks, handouts, hard copy or electronic versions of program is available	
<b>Instructor(s) Info.:</b>	Resume of professional/educational qualifications & teaching/training experience/BBS certifications	
<b>Test Materials:</b>		
<b>Completed Application:</b>		

**NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.**



**RICHARD A. PICCOLO**

Master Code Professional

PRESIDENT

B & F CONSTRUCTION CODE SERVICES, INC.  
BUILDING & FIRE CODE ACADEMY

**CERTIFICATIONS**

- |                                   |  |
|-----------------------------------|--|
| Certified Building Official       | Certified Property Maintenance Inspector |
| Certified Fire Official II        | Certified Plans Examiner                 |
| Certified Fire Fighter III        | Certified Building Inspector             |
| ICC® Certified Fire Inspector     | Certified Fire Service Instructor IV     |
| Illinois Certified Fire Inspector | Certified Energy Inspector               |
| Certified Accessibility Inspector | Certified Master Code Professional       |

**AUTHOR/  
INSTRUCTOR**

- Understanding the International Building Code (2000, 2003, 2006, 2009, 2012)
- Understanding the International Fire Code (2000, 2003, 2006, 2009, 2012)
- Fire Resistive Construction Requirements
- Understanding Non Structural Plan Review
- Understanding the International Mechanical Code (2006, - 2012)
- Understanding the International Plumbing Code –(2009 – 2012)
- Kitchen Hood and Duct System Plan Review
- Understanding the BOCA® National Building Code (1990 – 1999)
- Advanced Decision Making
- Managing Special Events
- Sprinkler System Plan Review
- Understanding the 1990 – 1999 BOCA® National Fire Prevention Code
- Understanding the 1996 – 1999 BOCA® National Building Code
- Understanding the 2002 – 2012 NFPA 101

**INSTRUCTOR**

- 1984 BOCA® Fire Prevention Code
- National Certification For Construction Code Inspectors Workshop
- Fire Prevention Principles - Levels I & II
- Principles of the 1987 BOCA® National Building Code
- Principles of the 1984 BOCA® National Building Code

**ADJUNCT FACULTY**

- William Rainey Harper College – Palatine, IL (1984 – 1999)
- Course Title: BOCA® National Building Code
- Course Title: Basic Code Enforcement
- Course Title: Fire Inspection Principles

**BACKGROUND**

Elk Grove Village Fire Department – 19 Years  
Public Education Office  
President, Illinois Institutional Fire Training, Inc. 23 Years

**EDUCATION &  
TRAINING**

Northeastern University B.A.  
Harper College, Palatine IL A.S. Fire Science  
240 Hour Inspectors Training Course  
Fire Instructor Training: Levels I & II

**COURT CERTIFIED  
CODE EXPERT**

Designated Court Certified expert on Building Codes in 1995  
*Provided trial testimony for the County of Kankakee, IL (Plaintiff) in County of Kankakee vs Tim Harrington, U.S. District Court No. 940 V 134*

*Provided deposition for Village of Schiller Park, IL (Plaintiff), Village of Schiller Park vs SP Club, Inc. U.S. District Court No. 94 C 1422*

*Deposition for Village of Addison (Defendant), Hispanics of United DuPage County vs Village of Addison, IL U.S. District Court 94 C 6075 & 95 C 3926*

*Deposition for Village of Good Field, IL (Defendant), Clark v. Village of Good Field, et al., Case No. 03 L 96*

*Deposition for Charles Gaston, Jr. (Plaintiff), Charles Gaston v. City of Danville, et al., Case No.06 L 35*

**PROFESSIONAL  
AFFILIATIONS**

North West Building Officials Association  
Suburban Building Officials  
National Fire Protection Association (NFPA)  
International Association of Continuing Education & Training (IACET)  
Illinois Fire Inspectors Association  
Chairman, Codes and Standards Committee 1983 - Current

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Army Corps of Engineers

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Certified Professional Information:

Last, First MI: Piccolo, Richard  
 Certified under this name: Richard Piccolo  
 Company: B & F Construction Code Services Inc  
 City, State Zip: Elgin, IL 60124-7867  
 Phone: 847-428-7010

- Certification Type(s): Accessibility Inspector/Plans Examiner (expires 06/29/2018)  
 Building Inspector (expires 06/29/2018)  
 Building Plans Examiner (expires 06/29/2018)  
 Commercial Building Inspector (expires 06/29/2018)  
 Commercial Energy Inspector (expires 06/29/2018)  
 Commercial Energy Plans Examiner (expires 06/29/2018)  
 Fire Inspector I (expires 06/29/2018)  
 Fire Prevention I - NFPC (expires 06/29/2018)  
 ICC/AACE Property Maintenance & Housing Inspector (expires 06/29/2018)  
 Master Code Professional (expires 06/29/2018)

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E-MAIL [bfces@bfces.org](mailto:bfces@bfces.org)

## Kenneth J. Garrett

### BACKGROUND

Kenneth J. Garrett has been employed by B & F Construction Code Services for 17 years as Vice President and Instructor. Ken is responsible for managing the daily operation of B & F Construction Code Services, Inc. and is positioned to provide leadership, guidance and effect teamwork for the technical staff. Ken reviews training materials, outlines and objectives for existing and new curriculum, for both internal training and classes offered externally. He develops new outlines, objectives and learning outcomes for new curriculum for company courses and serves as an instructor for Academy courses. Ken, in conjunction with the President of B & F Construction Code Services, Inc., oversees the current and future operation of training services provided by the company and shall evaluate the effectiveness and instructional technique of instructors.

Prior to working at B & F Construction Code Services, Ken was employed by the City of Zion, IL as the Assistant Director of Community Development. Ken was responsible for overseeing all functions of the building department, supervising a staff of nine employees.

### EDUCATION / TRAINING

- 2012 Master's Degree – Public Administration, Governors State University
- 1995 Bachelor's Degree- Public Administration, Governors State University
- 1990 Code Enforcement Certificate Program, William Rainey Harper College
- 1983 Associate Degree- Fire Science Technology, William Rainey Harper College

### CERTIFICATIONS / LICENSES / REGISTRATIONS

Certified as a Master Code Professional through the International Code Council

### PREVIOUS TEACHING / TRAINING EXPERIENCE

#### Author and Instructor

Understanding the International Property Maintenance Code  
Understanding the Basics of Code Enforcement  
Management I and II  
Inspection Challenges & Solutions

#### Instructor

Understanding the International Residential Code  
Understanding the International Residential Code-Plan Review  
Understanding the International Building Code – Parts I, II, III  
Understanding the International Fire Code  
Understanding the International Mechanical & Fuel Gas Codes  
Fire Resistive Construction Requirements

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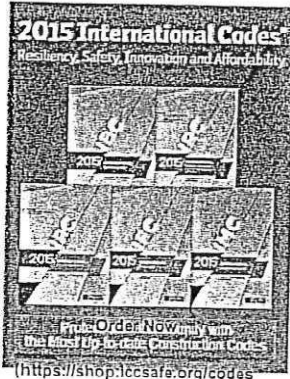
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Certified Professional Information:

Last, First MI: Garrett, Kenneth J  
 Certified under this name: Kenneth J Garrett  
 City, State Zip: Palatine, IL 60195-2089  
 Certification Type(s): Accessibility Inspector/Plans Examiner (expires 08/26/2017)  
 Building Inspector (expires 08/26/2017)  
 Certified Building Official (expires 08/26/2017)  
 Commercial Building Inspector (expires 08/26/2017)  
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Licensed Architect with a wide variety of residential and light commercial experience. Able to create and document cost-efficient, practical designs resulting in high client satisfaction. Results-oriented, creative problem-solver.

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OKW Architects, Senior Architect

Bloodgood Sharp Buster Architects and Planners, Project Architect

Nelson Associates Architects, Job Captain

**Homebuilders / Remodeling**, 15 years experience including:

Greenscape Homes, Director of Architecture

Airoom Architects and Builders, Project Architect

Pinehurst Homes, Director of Architecture and Construction

Town and Country Homes, Director of Architecture

Pulte Home Corporation, Assistant Director of Architecture

Neumann Homes, Project Architect

**Environmental Engineering and Education**, 6 years experience including:

Building & Fire Code Academy, Adjunct Instructor

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Continuing Education including:

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Code Updates





Gregory D. Sengstock is a Licensed Architect in private practice with a wide variety of residential and light commercial experience. As proprietor of Sengstock Architects, Greg specializes in the design of new custom and production homes, additions, accessibility renovations, disaster remediation, and commercial build-outs. With over 30 years of experience working with large and small builders and architectural firms, he has an in-depth understanding of project program scope creation, efficient yet elegant design, construction documentation, building codes, and construction permitting. As an effective project manager and team leader, Greg has simultaneously guided multiple developments from several clients. His interest in Value Engineering reduces building costs while Green Building and Building Science techniques have reduced operational and maintenance costs for his clients. Greg has been responsible for dozens of Key Award winning projects.

Greg earned his Bachelor of Science, Architectural Studies as well as Master of Architecture and Master of Business Administration degrees from the University of Illinois. He is an Adjunct Instructor at the Building & Fire Code Academy and has taught courses in the Construction Management program at Westwood College. He has been a Professional Member of the Association of Licensed Architects and the International Code Council. Greg lives in St. Charles, IL with his wife and two children.



Building & Fire Code Academy

**CITY OF CINCINNATI  
INSPECTION  
CROSS TRAINING  
PROGRAM  
INTERNATIONAL  
PROPERTY  
MAINTENANCE CODE  
&  
RESIDENTIAL CODE  
OF OHIO**

**CITY OF CINCINNATI  
INSPECTION  
CROSS TRAINING PROGRAM**

**UNDERSTANDING THE  
2019 RESIDENTIAL CODE OF OHIO  
MECHANICAL**

## INTRODUCTION

This workbook, including all illustrations, is designed to enhance general knowledge and understanding and is not intended as a substitute for the code. Neither this text nor the course are endorsed by the International Code Council and represent the sole project of the author.

The text, including illustrations and course content, represent the opinion of the author and instruct based on accepted industry practices, formal interpretations, research and analysis as to the application, intent and rationale. It is not intended as a design manual but rather to serve as an educational guide.

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# Understanding the 2018 International Residential Code - Mechanical

## Course Description

Mechanical requirements of the 2019 Residential Code of Ohio ® are notated and defined, illustrating code requirements for the proper installation of mechanical systems. Instructors identify and discuss code requirements for furnaces, combustion air, gas piping, and proper installation of different types of residential appliances. Additional components include venting and fuel gas requirements for residential mechanical systems.

## Learning Objectives

Students will demonstrate problem solving by utilizing given calculations to determine code compliance for residential mechanical systems.

Students will recognize and employ the venting and fuel gas requirements for residential mechanical systems demonstrated by calculating given examples and defending the decision.

Students will determine confined and unconfined areas, utilizing given examples and situations.

# Understanding the 2019 Residential Code of Ohio

## CHAPTER 12 – ADMINISTRATION

- \* Administrative provision of Chapter 12 apply to mechanical requirements of Chapters 13-24
- \* Non-gas fired appliances Chapters 13-23
- \* Gas fired appliances Chapter 24
- \* Covers permanently installed mechanical systems installed to regulate environmental conditions within buildings, including:
  - Design
  - Installation
  - Maintenance
  - Alteration and inspection
- \* Administrative Sections in Chapter 1 apply
- \* Regulates system specifically addressed in code
  - Items not covered – official must use other methods
  - Experience referenced standards, other codes
- ◆ Existing systems 1202
  - \* Additions, alterations, etc. shall comply as if new
    - Not to be detrimental to existing equipment
  - \* Existing systems can remain – lawfully installed
  - \* Maintenance required
    - Kept in proper operating condition in accordance with the original design, including safety devices
  - \* Make a list of fuels for Chapters 13 – 23
  - \* Make a list of fuels for Chapter 24

# Understanding the 2019 Residential Code of Ohio

## CHAPTER 13 – GENERAL MECHANICAL SYSTEM REQUIREMENTS

- \* Refer to 2018 IFGC and 2018 IMC for items not covered
- \* General 1301
- \* Identification 1301.2
  - Pipe, tubing and fittings
  - Each length of pipe shall bear the identification of the manufacturer
- \* Installation of materials 1301.3
  - Materials installed per standard
  - No standard instruction – follow manufacturer’s instructions
  - If manufacturer or standard does meet code – follow code
  - Plastic pipe per NSF14 (National Sanitary Foundation) 1301.3
- \* Third party testing or certification 1301.4
  - Pipe, tubing and fitting – tested or certified
- ◆ Approval 1302
  - \* All appliances listed and labeled for application and use or approved per 104.11
- ◆ Labeling of Appliances 1303
  - \* All appliances shall be labeled 1303.1
    - Label requirements
      - Manufacturer’s name and trademark
      - Model and serial number / Testing agency identification
      - Electrical information / BTU/h ratings for absorption units
      - Input BTU/h ratings – fuel type / clearances
      - Electric comfort heating – maintenance instructions
- ◆ Type of Fuel 1304
  - \* Fuel types 1304.1

# Understanding the 2019 Residential Code of Ohio

- Appliance designed for type of fuel to be used
  - Design for high altitude when applicable
  - No increase or decrease beyond rating
- ◆ Appliance Access 1305
- \* Appliance access for inspection, service, repair and replacement 1305.1
- Sufficient size for service, repair, maintenance, replacement, and inspection without removal of permanent construction
  - 30" x 30" working space in front of control side for service
  - Appliances in rooms 1305.1.1
    - Access via minimum 24" wide door
    - Large enough to permit removal of appliance
    - 30" deep working space and height of appliance
  - Appliances in attics 1305.1.2
    - Access openings (30"h x 20"w) and passageway (30"h x 22"w) large enough to allow removal after disassembly minimum
    - Not more than 20' from attic access
    - Solid flooring from access to appliance and at service space 24" wide
    - Level service space front and/or side 30" x 30"
    - Illumination via switched light at opening, service outlet required per Chapter 38
    - Exception #2 – Passageway increased to 50' when unobstructed 6' in height and minimum 22" clear width
  - Appliances under floors 1305.1.3
    - Same access requirements as attic
    - Protect walls if greater than 12" below grade
    - Supported level on concrete slab or approved material or suspended from structure



# Understanding the 2019 Residential Code of Ohio

- 6" clearance to grade
  - Illumination via switched light at openings, service outlet required
  - Not more than 20' from crawlspace access
  - Exception: passageway unlimited in length when unobstructed 6' height and minimum 22" in clear width
- ◆ Clearance from Combustible Construction 1306
- \* Appliance clearance 1306.1
    - Per appliance manufacturer
    - Clearance reduction per Table 1306.2
    - Not permitted for solid fuel appliances with listed clearance of 12" or less
    - Table differs from IMC Table 308.6
    - When ventilated air space is required – 1" clearance on all sides of assembly
  - \* Reduce Clearance to Combustibles Table 1306.2
    - See Figure 1306.1
- ◆ Appliance Installation 1307
- \* Per manufacturer's installation instructions
  - \* Attached to appliance
  - \* Anchored in an approved manner – seismic considerations
  - \* Ignition source elevated minimum 18" in garages
  - \* Protected from vehicular impact
    - Elevation or see International Fire Code
  - \* Hydrogen Generating and Refueling 1307.4
    - Maximum floor area 850 square feet
    - Communicate directly to the outdoors
    - 2 openings in garage, within 12" top and bottom, directly to outdoors

# Understanding the 2019 Residential Code of Ohio

- Minimum free openings 0.5 sq. ft. per 1,000 Cu Ft. of garage volume
- Louvers or grills- net free area – 25% or 75%
- Mechanical ventilation per the IMC

## ◆ Mechanical Systems Installation 1308

\* Drilling and notching per Sections 502.8, 602.6, 602.6.1, 802.7, 505.3.5, 603.3.4, 804.3.5

\* Drilling and Notching of Studs – Cut or Notched Studs 602.6

- Notching bearing = < 25% of width
- Non-bearing = < 40% of single stud width
- Drilling non-bearing = < 60% and no closer than 5/8" from edge
- Drilling on bearing = < 40% and no closer than 5/8" from edge
- Double the stud when the stud is located on an exterior wall, bearing partition, drilled  $\geq$  40% and up to 60%. Not in double successive studs
- Use a fastener across the top plate to each side of the opening
- Use not less than eight 10d nails at each side or equivalent

\* Exterior Walls or Bearing Partitions can cut/notch 25% or less

\* Equivalent allowable bearing wall stud width cutting / notching (25% or less)

- 2" x 4" nominal stud size = 7/8"
- 2" x 6" nominal stud size = 1-3/8"

\* Equivalent allowable non-bearing partitions stud width cutting / notching (40% or less)

- 2" x 4" nominal stud size = 1-3/8"
- 2" x 6" nominal stud size = 2-3/16"

IF: Exterior wall or bearing studs are doubled

AND IF: Not more than 2 successive studs are bored

# Understanding the 2019 Residential Code of Ohio

AND IF: Approved stud shoes are used

THEN: OK to bore or drill 60% of stud width

- 2" x 4" nominal stud size = 2 1/8" maximum hole
- 2" x 6" nominal stud size = 3-3/8" maximum hole

\* Exterior wall or bearing interior wall

IF: Notched or bored > 50% width of top plate

THEN: Install a 0.054" thick galvanized metal strap

\* Min 6" past the opening with min

\* Use 8 – 10 D nails (minimum 1 1/2 "long) and 0.148" dia.) each side

- 2" x 4" top plate = 1-7/8"

- 2" x 6" top plate = 2 3/4 "

\* Engineered wood products 502.8.2

- Cuts, notches, and bored holes not permitted unless allowed by the manufacturer's installation instructions or by registered design professional

\* Protection from physical damage 1308.2

- Concealed piping shall be protected
- Piping less than 1 1/2 inch from edge protected
- Width of pipe and inches past framing member
  - Stud – above bottom plate and below top plate
  - Shield plate not less than 0.0575 inches (No. 16 gage)

# Understanding the 2019 Residential Code of Ohio

## CHAPTER 14 – HEATING AND COOLING EQUIPMENT

- ◆ General 1401
  - \* Installation 1401.1
    - Per the manufacturer and this code installation instructions
  - \* Access 1401.2
    - Located to provide access for service, replacement, cleaning, and maintenance
    - Equipment size based on Air Conditioning Contractors of America (ACCA) manual, J&S calculation
  - \* Equipment and appliance size 1401.3
    - Must be sized per ACCA Manual S or other approved methodologies
      - Except: Multi-stage unit or variable refrigerant flow w/loads properly calculated are within manufacturer's published capacities
    - Specified equipment cannot satisfy published total and sensible heat gains properly calculated, thus next larger standard size is specified
  - \* Outdoor equipment listed and labeled for outdoor installation 1401.4
  - \* Supports level, prevent settlement and vibration 1401.4
  - \* Flood hazards per Section 1401.5 and 322.1.6
  - \* Note: General requirements in Chapter 12 apply
- ◆ Central Furnace 1402
  - \* Maintain listed clearances
  - \* Provide combustion air – minimum 6" in front of openings
- ◆ Heat Pumps 1403
  - \* UL 1995
  - \* Minimum 6 square in of return duct per 1,000 BTU/h output rating – removed in 2018
  - \* Outdoor support raised 3" above grade – removed in 2018
- ◆ Electric Baseboard Convectors 1405

# Understanding the 2019 Residential Code of Ohio

- \* Shall be installed per Chapters 33-42 and manufacturer's instructions

## ◆ Radiant Heat 1406

- \* Installed per Chapters 33-43, manufacturer's instructions 1406.1
- \* Panels installed parallel to framing members 1406.3
- \* No field cutting of panels – unless listed
- \* Fastened in place through unheated portions of panels
- \* Concrete and masonry installations 1406.4
- \* Labeled for concrete/masonry installation
- \* Not installed across expansion joints
- \* On gypsum panels – operating temps not to exceed 125° F
- \* Finish materials installed per installation instructions 1406.5
- \* Fasteners shall not pierce heating element



## ◆ Duct Heaters 1407

- \* Not create fire hazard 1407.2
- \* Class 1 ducts, covers, and liners interrupted at heater to provide clearances
- \* Fan shall be listed and labeled when within 4' of a heat pump or air conditioner 1407.3
- \* Accessible for maintenance 1407.4
- \* Fan interlock required to prevent heater operation when fan is not operating 1407.5

## ◆ Vented Floor Furnaces 1408

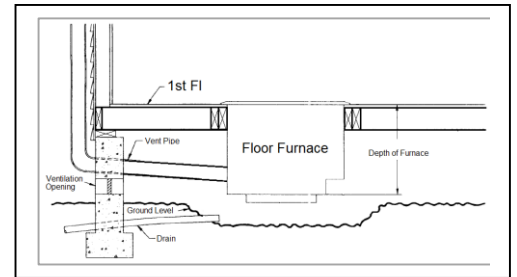
- \* Clearance per manufacturer 1408.2
- \* Location 1408.3

# Understanding the 2019 Residential Code of Ohio

- Registers and burner assemblies
- Wall registers minimum 6" from corner
- Floor register minimum 6" from wall
- 12" from door and combustibles
- 5' below projecting combustibles
- Burner assembly shall not project into an occupied under-floor area
- Not installed in concrete slab on grade
- No door swing within 12" of grill

\* Access opening 1408.4

- 18" x 24" in foundation wall
- 22" x 30" in floor (trap door)
- Large enough to replace any part



\* General installation requirements 1408.5

- Thermostats located in the same room
- Furnace supported independently of the register
- 6 inches above ground – 2 inches if sealed unit
- Maintain 30" service clearance area – 12 inches on other sides
- Not supported from ground

# Understanding the 2019 Residential Code of Ohio

## ◆ Vented Wall Furnaces 1409

### \* Location 1409.2

- Located not to cause fire hazard
- Not circulate air from bathrooms to other parts of building
- Not located within 12" of a door swing

### \* Installation 1409.3

- Wall thickness per manufacturer
- No ducts attached
- Manual shut off required

### \* Access required 1409.4



## ◆ Vented Room Heaters 1410

### \* Fuel – pellet, oil, solid

### \* Installed on non-combustible floors – minimum clearances required

#### Exception:

- Listed appliances per installation instructions

## ◆ Heating and Cooling Equipment 1411

### \* Coils in warm air furnace 1411.2

- Blower rated 0.5" water column static pressure
- Labeled for use upstream of heat exchanger
- Condensate disposal
  - Drain to approved location in an approved manner
  - Not create a hazard nuisance
- Approved material: Cast iron, galvanized steel, copper, polybutylene, polyethylene, ABS, CPVC, PVC
- Based on temperature and pressure rating

# Understanding the 2019 Residential Code of Ohio

- Minimum  $\frac{3}{4}$ " pipe
  - Horizontal pipe at uniform alignment and pitch not less than 1/8 unit vertical in 12 units horizontal 1% slope
  - Installed so it can be maintained
  - Trapped when required by manufacturer – no double traps
- \* Auxiliary or secondary system required where damage to structure is likely 1411.3
- Minimum  $\frac{3}{4}$  inch pipe
  - Method 1
    - Auxiliary and secondary drain systems 1411.3.1
    - Discharge to a conspicuous location
    - Minimum depth 1.5"
    - Minimum 3" larger than unit or coils
    - Corrosion resistant materials
    - Metallic pan minimum – 0.0276"
    - Non-metallic pan minimum – 0.0625"
  - Method 2
    - Separate overflow from unit drain pan with equipment 1411.3.1
    - Discharge to a conspicuous location – alert occupants
    - Connected higher than the primary drain
  - Method 3
    - Auxiliary pan without separate drain line
    - Detection and shut off device required conforming to UL 508
    - Constructed same as Method 1
  - Method 4
    - Water level detection device conforming to UL 508 that will shut off the equipment served in the event that the primary drain is blocked
    - Device in the primary drain line, overflow drain line, or the equipment supplied drain pan



# Understanding the 2019 Residential Code of Ohio

- Device located at a point higher than the primary drain line connection and below the overflow rim of pan
- Down flow furnaces
  - Only method allowed is an overflow device installed in the drain pan
- \* Condensate pumps 1411.4
  - IF: In uninhabitable spaces
  - THEN: Connected so that appliance or equipment served is prevented from operating if pump fails
  - Install per manufacturer's instructions
- \* Refrigeration piping 1411.6 – 1411.8
  - Piping and fittings for refrigerant vapor lines shall be insulated minimum R-4
  - Within 1½ inches of roof deck – protected from nails
  - Access port caps secured in outside or not protected
- ◆ Absorption Cooling Equipment 1412
  - \* Condensation drain to approved location in an approved manner
  - \* Refrigerant piping insulated
  - \* Pressure relief device required, located as not to create hazard
  - \* Per UL 1995
- ◆ Evaporative Cooling Equipment 1413
  - \* Install in accordance with manufacturer's instructions
  - \* Level platform 3" above grade
  - \* Water for cooling
    - Backflow protection of potable water per Section 2902
  - \* Exterior wall openings sealed

# Understanding the 2019 Residential Code of Ohio

- \* Air intake openings per Chapter 3
- ◆ Fireplace Stoves Section 1414
  - \* Per manufacturer
  - \* Hearth extensions per listing 1414.2
    - Supports same level as hearth
    - Distinguishable from surrounding floor

# Understanding the 2019 Residential Code of Ohio

## CHAPTER 15 – EXHAUST SYSTEMS

Definition:

- \* Means of transferring fumes, moisture, and products from the interior of the building

### ◆ General 1501

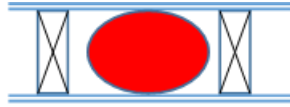
- \* Mechanical exhaust cannot discharge air to attic, soffit, ridge vent, or crawl space
  - Except:
    - Whole house ventilation type fans for private attics

### ◆ Clothes Dryer Exhaust 1502

- \* Independent of all other systems
- \* Exhaust duct terminate outdoors
- \* Per manufacturer
- \* If no instructions are available, terminate a minimum of 3' from building opening 1502.3
- \* Back draft damper installed
- \* Dryer exhaust ducts 1502.4
  - Smooth duct construction and installation
  - Minimum 4 inch duct
  - No screens in duct or termination
  - Back draft damper required
  - No sheet metal screw which protrude more than 1/8 inch
    - Section 2439.7.2 allows screws not to exceed 1/8" into duct
  - Minimum thickness of exhaust duct – 0.0157" rigid metal
  - Smooth interior finish
  - Joints running in direction of flow 1502.4.2
  - Supported at 12' intervals
  - Transitions duct maximum 8' – listed per UL 2158A M1502.4.3

# Understanding the 2019 Residential Code of Ohio

- When concealed shall not deform duct



2 x 4 stud – 4 inch duct

Correct?

- Dryer exhaust duct power ventilators 1502.4.4
  - Conform to UL 705
  - Install per manufacturer's directions
- Duct length 1502.4.5
  - Maximum length 35' or manufacturer's instruction 1502.4.5.1
  - Does not include the transition fitting
  - Fitting length per Table 1502.4.5.1
  - Duct length and size can conform to manufacturer
  - Catalog cut available at concealment inspection
  - Equivalent length of concealed duct permanently identified within 6' of dryer vent connection 1502.4.6
  - Length of duct with power exhaust per manufacturer
- Duct to be provided at every dryer space 1502.4.7

## ◆ Domestic Cooking Exhaust Equipment 1503

### \* Domestic kitchen equipment 1503.2

- Required when exhaust equipment is provided 1503.2
- Applies to range hoods and down draft appliances
  - When not integral to appliance – UL 507

# Understanding the 2019 Residential Code of Ohio

- Integral equipment shall comply – UL 507
- Integral downdraft – ANSI Z21.1 or UL858
- Microwave over cooking with exhaust – UL 923
- Open-top broilers 1503.2.1
  - Metal exhaust
  - Minimum thickness 0.0157 inches thick (No. 28 gage)
  - ¼ inch clearance around hood
  - 24 inch clearance above cook top
  - Hood width equal to unit and extend over entire cook top
- \* Exhaust discharge 1503.3
  - Discharge to the outdoors (not attic, crawl space or inside building)
  - Smooth interior finish and air tight
  - Back draft damper required
  - Independent of all other systems
- \* Duct material 1503.4
  - Duct material can be: galvanized steel, stainless steel, aluminum, or copper
    - Some down drafts can use PVC – 4 criteria
- \* Kitchen exhaust rates 1503.5
  - Per Table 1504.2
- \* Make-up air required 1503.6
  - Equipment not direct vent or mechanical draft venting
  - When exhausting > 400 CFM
  - Passive or mechanical make up required
  - Rate equal the exhaust rate
  - Location 1503.6.1

# Understanding the 2019 Residential Code of Ohio

- Air shall discharge into room with exhaust or
- Rooms that connect with permanent openings
- Dampers 1503.6.2
  - Damper to be gravity or electrically operated
  - Damper to automatically open when exhaust hood operates
  - Access for inspection without removing permanent construction
  - Gravity or barometric damper not used
  - Provide airflow at a pressure differential of 0.01" of w.c.
- ◆ Exhaust Ducts and Exhaust Openings 1504
  - \* Follow this Chapter or Chapter 16
  - \* Duct length per Table 1504.2
    - Exception: Per manufacturer or flow rate verified
  - \* Termination:
    - > 3' from property line
    - > 3' from operable or non-operable openings
    - > 10' from mechanical air intakes – or 3" above
- ◆ Mechanical Ventilation 1505
  - \* Where local or whole house mechanical is provided follow this chapter
  - \* Exhaust air from bathrooms and toilet rooms not to be re-circulated
  - \* Exhaust air from bathrooms and toilet rooms not to be exhausted into attic, crawl space, or other area inside the building
  - \* Not prohibit ductless range hoods
  - \* Equipment per ANSI/AMCA 210 – ANSI/ASHRAE 51
  - \* Whole-house mechanical ventilation system M1505.4
    - One or more supply or exhaust fans
    - Outdoor air ducts connected to the returns can be the supply
    - Manual controls required
    - Mechanical ventilation rates 1505.4.3

## Understanding the 2019 Residential Code of Ohio

- Rates per Table 1505.4.3(1) or
  - Per calculation of equation #1
  - Ventilation rate in cubic feet minute =  $(0.01 \times \text{total square foot area of house}) + [7.5 \times (\text{number of bedrooms} + 1)]$
  - Exception: Operate intermittently with controls for 25% for each 4 hour segment with a rate per Table M 1505.4.3(1) adjusted per Table M 1505.4.3(2)
- Local exhaust systems designed per Table 1505.4.4

# Understanding the 2019 Residential Code of Ohio

## CHAPTER 16 – DUCT SYSTEMS

### ◆ Duct Construction 1601

#### \* Duct design 1601.1

- Per ACCA Manual D or
- Manufacturer's instruction
- Other approved methods
- Above-ground duct systems 1601.1.1
  - Temperature limit 250°F
  - Factory made ducts comply with UL 181 and installed per manufacturer's instructions
  - Fibrous ducts conform to SMACNA or NAIMA
  - Field or shop fabricated per SMACNA except as allowed by Table 1601.1.1
  - Gypsum return air ducts limited to 125°F and not subject to condensation
  - Maximum flame spread of 200
  - Stud cavity and joist space plenums
    - Not permitted as plenum for supply air
    - Not part of rated assembly
    - Not to convey air from more than one floor
    - Fire-blocking per the building code
    - Stud space in outside walls not as a plenum
    - All dampers and controls require access
- Underground duct systems
  - Approved concrete, clay, metal or plastic



## Understanding the 2019 Residential Code of Ohio

- Plastic duct – maximum temperature 150 degrees F
  - Metal duct – protected from corrosion or encased in concrete – 2”
  - Slope to drainage point with access
  - Sealed or taped before encased and tested
  - Tightness per 1103.3
  - Metal duct with approved coatings or non-metallic per manufacturer
- \* Duct insulation material 1601.3
- Maximum flame spread 25, smoke developed < 50 per ASTM E 84
  - Not flame, glow, smolder or smoke at operating temperatures
  - External reflective insulation labeled every 36”
  - Spray insulation with special criteria
  - Maximum flame spread 25, smoke developed 450
  - Ignition barrier
  - Comply with 316 (Foam Plastics)
- \* Installation 1601.4
- Joints and seams per SMACNA HVAC Duct standards – Metal and Flexible, and NAIMA Fibrous Glass Duct Construction Standards
    - Longitudinal, transvers and connections
    - Per UL 1 A-P based on the type of system
  - Duct lap
    - Round and oval – minimum of one inch in direction of flow  
Plastic joint per the manufacturer
    - Supported per manufacturer’s instructions
    - Field fabricated ducts supported per SMACNA Fibrous Glass Duct Construction Standards, and NAIMA Fibrous Glass Duct Construction Standards

# Understanding the 2019 Residential Code of Ohio

- Fire-blocking 1601.4.5 per section R602.8
- Insulated when installed in non-conditioned spaces 1601.4.6
- Insulation not penetrate fire blocked wall or floor
- 4" separation from earth 1601.4.8
- When penetrate garage, 26 gauge, no openings 1601.4.9 and 302.5.2
- \* Under Floor Plenums 1601.5
  - Prohibited in new construction
  - Modification to existing must comply with current code
  - Loose combustible scrap removed – tightly enclosed
  - Ground covered with moisture barrier – Minimum 4 mils 1601.5.1
  - Plumbing waste cleanouts and gas pipe not permitted in space
  - Maximum flame spread 200 1601.5.2
  - Furnace duct to extend 6" below combustibles
  - Access via 18" x 24" opening
  - Start fan when reach 150°F max
  - Furnace outlet temp limit switch at 200°F max 1601.5.5
- \* Systems that supply living space shall not supply or return to garage M1601.6
- ◆ Return Air Section 1602
  - \* Outdoor air openings 1602.1
    - Located per 303.5.1 and protected per 303.6
  - \* Return air openings 1602.2
    - Not closer than 10' from appliance in room
    - Return not greater than supply
    - Return and supply sized per manual D

## Understanding the 2019 Residential Code of Ohio

- Not from closets, bathrooms, kitchens, garages, mechanical and furnace rooms, other dwelling units
- Not from a swimming pool area
- Cannot discharge into another dwelling unit
- Return air taken from any room or space shall be not greater than the flow rate of supply air
- Direct vent – OK
- Outdoor air inlets screened –  $\frac{1}{4}$ " to  $\frac{1}{2}$ " Per 303.6 (Outside opening protection)

# Understanding the 2019 Residential Code of Ohio

## CHAPTER 17 – COMBUSTION AIR

### ◆ General 1701

- \* Solid fuel appliances per manufacturers' installation instructions
- \* Combustion air for gas fired appliances 2407
- \* Oil appliances per NFPA 31
  - Lowest floor minimum 1' above base foot elevation 1701.2, 322.2.2.1 and 322.3.2

Note: This chapter does not apply to fireplaces, fire place stoves, and direct vent appliances

### ◆ Effects of Inadequate Combustion Air

- \* Produces poisonous, corrosive, and combustible by-products when combustion is incomplete
- \* Creates environment that leads to oxygen depletion
- \* Inadequate cooling of appliance causes appliance to work harder, leading to shorter appliance life
- \* Incomplete combustion causes soot, increased levels of carbon monoxide, appliance malfunction, and risk of fire
- \* Appliances shall be installed to allow the free circulation of air within the space
- \* Simultaneous operation of all appliances shall be considered when determining combustion air
- \* Avoid "going negative" due to excessive exhaust CFM with inadequate makeup air

# Understanding the 2019 Residential Code of Ohio

## CHAPTER 18 – CHIMNEY AND VENTS

### ◆ General 1801

- \* Fuel burning appliances to be vented per manufacturer
- \* Listed unvented appliances can be used
- \* Gas fired per Chapter 24
- \* Draft requirements 1801.2
  - Create a positive flow to convey combustion products to outside
- \* Existing Chimneys 1801.3
  - Resizing required when adding or removing an appliance
  - Free of obstructions, cracks, perforations, gaps, other damage, and cleaned
  - Masonry requires a cleanout per 1003.17
    - Clearances per manufacturer
      - Except: Chimney lining systems listed and labeled for contact with combustibles
  - Using existing masonry chimney as raceway for DVSCC appliance vents
- \* Space around flue cannot be used to vent other appliances 1801.4
- \* Masonry chimneys and factory built fireplaces constructed per the International Building Code, International Residential Code
- \* Mechanical draft only for appliances listed for mechanical draft 1801.5
- \* Vent system adequately supported 1801.7
- \* Not through a return, supply, duct or plenum 1801.8
- \* Properly fire-blocked 1801.9
- \* Unused openings to be closed or capped 1801.10
- \* Natural gas burning appliance vent connection to double-wall Type “B” gas vent
- \* Multiple appliance venting system 1801.11
  - Appliances on the same floor

# Understanding the 2019 Residential Code of Ohio

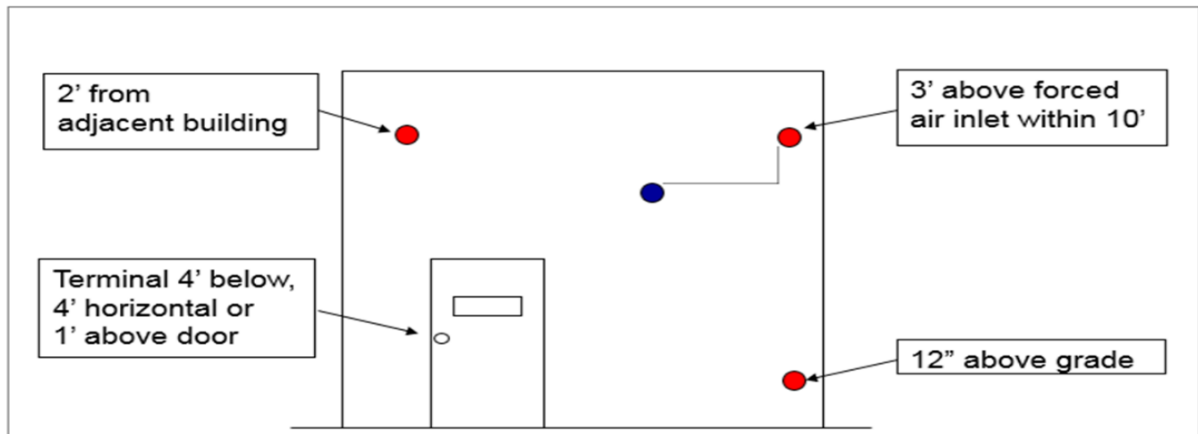
- Inlets offset
- Natural draft appliance shall be connected to mechanical draft system under positive pressure
- \* Solid fuel-burning vent cannot connect to a vent for another appliance 1801.12
  
- ◆ Vent Components 1802
  - \* Draft hoods in the same room as appliance 1802.1
    - Manually operated dampers permitted on solid fuel appliances only 1802.2.1
    - Automatic dampers per UL 17 1802.2.2
      - Interlocked with burner
  
- ◆ Chimney and Vent Connectors 1803
  - \* Connectors - connect appliance to vertical chimney or vent
  - \* Thickness per Table 1803.2
  - \* Within space where appliance located
  - \* Installation per manufacturer 1803.3
  - \* Connectors sloped ¼" per foot
  - \* Short and straight as possible
  - \* Properly supported and fastened with screws or rivets
  - \* Connector shall not pass through a floor or ceiling
  - \* Connector shall not pass through wall or partition unless a listed device is used
    - Length 1803.3.2
      - Uninsulated horizontal connector shall not exceed 75% of height of the vertical portion of vent above the connector
    - Connector at least the size of appliance flue collar 1803.3.3
    - Clearance to combustibles per Table 1803.3.4

# Understanding the 2019 Residential Code of Ohio

- Connector accessible entire length 1803.3.5
- \* Connection to fireplace flue 1803.4
  - Non-combustible seal below point of connection 1803.4.1
  - Access for inspection and cleaning
  - Listed appliance connected to the flue 1803.4.2
  - Connector from appliance to flue 1805.3.1
    - Minimum size of flue
    - Maximum 3 times the area
- ◆ Vents 1804
  - \* Listed and labeled venting systems required per Table M804.1
  - \* Termination per manufacturer
  - \* Termination 1804.2
    - Decorative shrouds at termination of vents listed and installed per manufacturer 1804.2.2
    - Natural draft appliances 5' above highest connected appliance 1804.2.3
    - Natural draft gas vented wall furnaces 12' above bottom of furnace 1804.2.3
    - Type L vents 2-10 rule 1804.2.4
      - Minimum 2' above highest point
    - Direct vent appliances 1804.2.5
      - Per manufacturers' specifications

# Understanding the 2019 Residential Code of Ohio

- Mechanical draft 1804.2.6



\* Installation Type L and pallet vents 1804.3

- Individual vent equal to the size of the connector not less than 7 square inches

\* Door swing 1804.4

- Appliance and equipment vent terminals placed so that doors cannot swing within 12" of vent terminal

◆ Masonry and Factory Built Chimneys 1805

\* Installed per Section 1003 and Section 1005

\* Chimney connector enter masonry chimney 6" above lowest part of flue

\* Sized not less than largest connector plus 50% of remaining chimney connectors

Exception: Oil-fired appliances per NFPA 31



# Understanding the 2019 Residential Code of Ohio

## CHAPTER 19 – SPECIAL APPLIANCES, EQUIPMENT AND SYSTEMS

### ◆ Ranges and Ovens 1901

#### \* Clearances 1901.1

- 30" vertical clearance to combustibles over cooking appliances
  - Reduced per listing



#### \* Ranges and ovens listed and labeled for household use 1901.2

- Installed not to interfere with combustion air and servicing
- Commercial cooking equipment installed in a dwelling unit

### ◆ Sauna Heaters 1902

- \* Protected against accidental contact – not effect operation of heater
- \* Installed per manufacturers' installation instructions
- \* Provide combustion air
- \* Room temperature limit 194°F
- \* Sensor when not integral within 6" of ceiling
- \* Comply with UL 875

### ◆ Stationary Fuel Cell Power Plants 1903

- \* Power output less than 1,000 KW per NFPA 853 & ANSI fc-1Z21.83

### ◆ Gaseous Hydrogen Systems 1904

- \* Installed per 1307.4, 1903.1, IFC, IFGC, IBC

### ◆ Engine and Gas-Turbine Powered Equipment and Appliances 1905

- \* Engine Driven equipment and appliance
  - Powered by engine driven

## Understanding the 2019 Residential Code of Ohio

- Permanently installed
  - Per manufacturer's installation instructions
  - Per NFPA 37 – Installation and Use of Stationary Combustion Engines and Gas Turbines
- \* Fuel tanks
- Engine mounted
  - Located inside buildings
  - Outside the building
  - On a roof
- \* Engine mounted
- Vented per NFPA 30
  - Adequate clearance
    - Fillings, maintenance, testing
    - Protected from public access and impact
  - Other tanks similar requirements

# Understanding the 2019 Residential Code of Ohio

## CHAPTER 20 – BOILERS AND WATER HEATERS

### ◆ Boilers 2001

- \* Per manufacturer's installation instruction 2001.1
  - Label Information
    - Rating data
    - Operating instructions
    - Nameplate permanently attached
  - Flood zone per 322.1.6
  - Provide combustion air
  - Shutoff valve in supply & return
  - Clearance per listing and label
  - Control diagram and operating instructions on site

### ◆ Operating and Safety Controls 2002

- \* Safety controls listed and labeled 2002.1
  - Hot water and steam boilers
- \* Pressure and temperature gauges required; must operate in normal range of boiler 2002.2 and M2002.3
- \* Steam boiler water gauge and pressure gauge 2002.3
  - Pressure relief valve required
- \* Discharge by gravity within 18" of floor or receptor 2002.4
- \* Low water cut-off required 2002.5
- \* Operation 2002.6
  - Low water and flow sensing control automatically stop combustion

### ◆ Expansion Tanks 2003

- \* Hot water boilers expansion take required 2003.1
  - Fastened to structure or boiler

# Understanding the 2019 Residential Code of Ohio

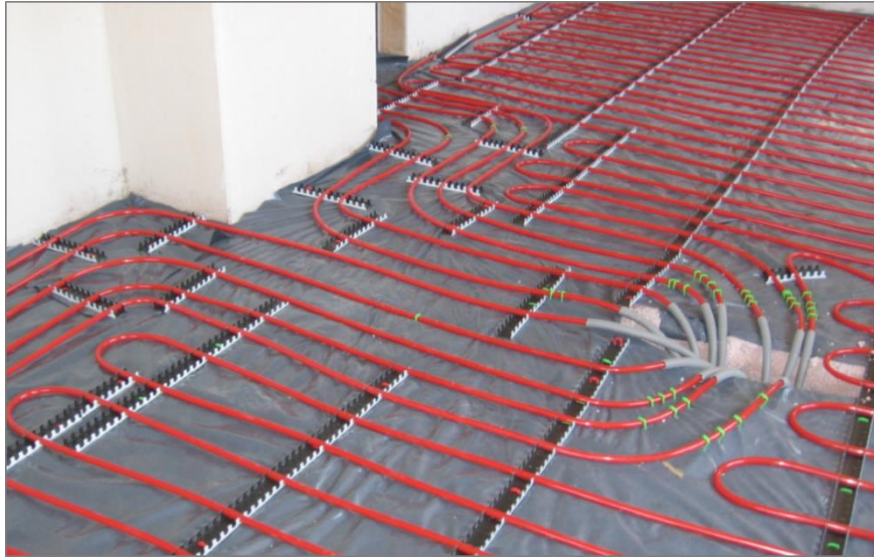
- Support the twice the weight of the tank filled
  - Drain non-pressurized tanks without emptying the system
  - Capacity requirements in code per Table 2003.2
- ◆ Water Heaters Used for Space Heating 2004
- \* Used for both, comply with both
  - \* Installed per chapters 24, 28, and manufacturer's installation requirements
- ◆ Water Heaters 2005
- \* Various listings – UL
  - \* In attics per 1305.1.3
  - \* Fuel fired water heaters locations
    - Not in storage closets
    - When in bedroom or baths – with sealed enclosure – outside combustion air
    - Not applicable to direct vent heaters
    - Provide service access and combustion air
- ◆ Pool Heaters 2006
- \* Per manufacturers' installation instructions
  - \* Oil per UL 726, Electric per UL 1261
  - \* Clearances not interfere with combustion air, draft hood service access, or flue terminal relief
  - \* Temperature and pressure relief valves required
  - \* Bypass line and valve required

## **CHAPTER 21 – HYDRONIC PIPING**

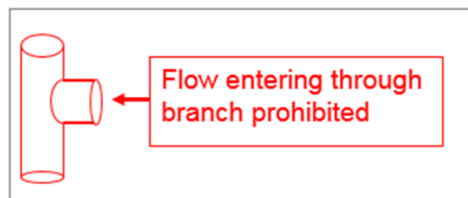
- ◆ General 2101
- \* Definition: Hydronic piping includes piping, fitting, and valves used in building space conditioning systems

# Understanding the 2019 Residential Code of Ohio

- \* Allowable hydronic piping materials Table 2101



- \* Valves, fittings, and connection approved, listed for use, and installed per manufacturer
- \* Provide system drain down 2101.2
- \* Backflow protection M2101.3 per 2902
- \* Openings through concrete or masonry sleeved 2101.4
- \* Protected against corrosion and physical damage 2101.5
- \* Drilling and notching per other code sections 2101.6
- \* Use of tee fittings 2101.7



- \* Provisions for expansion, contraction, shrinkage, and settlement 2101.8
  - \* Piping support per Table 2101.9
  - \* Systems hydrostatically tested at 100 psi not < 15 minutes 2101.10
- ◆ Floor Heating Requirements 2103
- \* Embedment of pipe in concrete or gypsum products
  - \* Materials

# Understanding the 2019 Residential Code of Ohio

- Steel, copper, cross-linked polybutylene, PCVC, cross-linked polyethylene, polypropylene
  - Rated 100 psi at 180°F
  - Steel piping joints welded
  - Copper tubing brazed, melting point > 1,000°F
  - Polybutylene socket type heat fused fittings
  - Must be tested at 100 psi for 30 minutes
- ◆ Low Temperature Piping 2104
    - \* Approved materials per Table 2101.1
  - ◆ Ground-Source Heat-Pump System Loop Piping 2105
    - \* Used materials prohibited 2105.2
    - \* Piping, tubing, and fittings rated for operating temperatures 2105.3
    - \* Piping and tubing materials per Table 2105.4
      - Fitting materials per Table M2105.5
      - 2105.4 – 2105.14 – information on different pipe types
    - \* Shut offs required 2105.15
      - Supply and return for heat exchangers
      - Supply and return central utility system
      - Connection to a pressure vessel
      - Both side of a pressure reducing valve
      - Connection to mechanical equipment
      - Connection to non-diaphragm-type expansion tanks
    - \* Installation per manufacturer's instructions 2105.17
    - \* Protection of potable water 2105.18
      - Backflow protection per Section 2902
    - \* Pipe penetrations must be sleeved 2105.19



# Understanding the 2019 Residential Code of Ohio

- Protect annular space per 2606.1
- \* Clearance from combustibles
  - IF: Exterior of piping > 250° F
  - THEN: Provide minimum 1" clearance to combustibles
- Protect from corrosion and degradation of material
- Protect from stress, strains, expansion and contraction
- \* Pipe properly supported per section 2101.9
  - Water velocity based on type of pipe
- \* Label and mark piping: "Ground-Source Heat Pump Loop System" 2105.25
  - Label whether antifreeze is in system
    - Label all chemicals in system
  - Testing – 100 psi for 15 minutes – no leaks
  - Embedded pipe pressurized before and during concrete placement

## CHAPTER 22 – SPECIAL PIPING AND STORAGE SYSTEMS

- ◆ Oil Tanks 2201
  - \* Fuel oil and diesel storage piping systems
  - \* Above ground tanks – 2201.2
    - Fuel supply tanks labeled per UL 58 and UL 80 2201.1
    - Maximum fuel storage inside or above ground: 660 gallons
      - For space or water heating sized per NFPA 31
      - Greater than 660 gallons per NFPA 37
    - Tanks supported on rigid non-combustible
    - Tanks inside sized to be removable without cutting 2201.2.1
    - Larger than 10 gallons at least 5' from flame
    - Outdoor above-ground tanks minimum 5' from property line 2201.2.2

# Understanding the 2019 Residential Code of Ohio

- \* Underground tanks 2201.3
  - Not undermine footing or foundation
  - Underground tanks minimum 1' from property line, basement or wall
  - Minimum cover 1' of inert material
  - Corrosion protection required
- \* Maximum 2 tanks cross connected 660 gallon total per 2201.4 and 2203.6
- \* Oil gauge required on indoor tank – no glass – unbreakable 2201.5
- \* Tank abandonment 2201.7 and removal per IFC
- ◆ Oil Piping, Fittings, and Connections 2202
  - \* Steel pipe, copper piping or tubing listed for oil piping 2201.1
  - \* Compatible fittings – no cast iron 2202.2
    - Not allowed:
      - Unions requiring gaskets, right or left couplings, solder melting point less than 1,000°F
      - Listed and labeled flexible connections – UL 536
- ◆ Installation 2203
  - \* Pipe size and type 2203.2
    - 3/8" pipe, tubing 3/8" outside diameter
    - Copper pipe and tubing type L or heavier
  - \* Fill piping terminal at least 2' from openings 2203.3
    - Vent pipe minimum 1 ¼ "
      - Drain back to tank
      - Not cross connected to fill
      - Enter tank at top
    - Corrosion-resistant coatings
- ◆ Oil Pumps and Valves 2204
  - \* Positive displacement pumps with automatic shut-offs 2204.1



## Understanding the 2019 Residential Code of Ohio

- \* Manual shut-off between tank and burner with ready access 2204.2
- \* Pressure relief valve when shut-off in discharge
- \* Maximum inlet pressure – 3 psi 2204.3
- \* Fuel oil lines with heaters require relief valves back to return line piping when excess pressure exists 2204.4

# Understanding the 2019 Residential Code of Ohio

## CHAPTER 23 – SOLAR THERMAL ENERGY SYSTEMS

- ◆ Solar Thermal Energy Systems 2301
  - \* Solar energy for space heating or cooling, hot water heating and swimming pool heating 2301.1
  - \* Design and installation 2301.2
    - Accessible 2301.2.1
      - Not obstruct doors or windows or other roof mounted equipment
      - Roof to be constructed to support imposed loads 2301.2.2.1
        - Collectors as roof covering – comply as a roof
        - Above the roof – noncombustible or fire retardant treated
        - Protected from degradation per ICC900/SRCC 300
    - Systems with fluid – pressure, temperature, and vacuum relief required 2301.2.3
    - Piping insulation
      - Per Chapter 11
      - Protected from ultraviolet degradation
      - Insulate entire loop
    - Protect from freezing 2301.2.6
    - Provide drain back in areas subject to freezing
    - Drain back not create a hazard
    - Penetrations to be properly sealed 2301.2.9
    - Solar loops 2301.2.11
      - Isolation valves required
      - Drain and fill valves labeled
      - Warning sign for a discharge at high temperature or pressure
      - Maximum water temperature 180°F 2301.2.12
  - \* Collectors and panels must be listed and labeled 2301.3
  - \* Heat transfer gases or liquids and heat exchangers 3201.4
    - Flammable gas and liquids not used

## Understanding the 2019 Residential Code of Ohio

- Heat exchangers to comply with Section 2902.5.2 and SRCC 100 or SRCC 901600
  - Flash point not less than 50° F above system operating temperature
- \* Backflow protection required 2301.5

# Understanding the 2019 Residential Code of Ohio

## CHAPTER 24 – FUEL GAS

- ◆ General 2401 (101)
  - \* Fuel gas piping, utilization equipment and related accessories, venting systems, and combustion air configurations commonly encountered in the construction of one and two family dwellings 2401.1 (101.2)
  - \* Piping system: All fuel piping, valves, and fittings from the outlet of the point of delivery to the outlets of the appliance shut-off valves
  - \* Point of delivery to appliance shutoff
- ◆ General Definitions 2403 (202)
  - \* Terms not defined in this code shall have meanings as ascribed in other codes 2403.3 (201.3) This chapter has its own definitions
- ◆ General G2404 (301)
  - \* Listed and labeled equipment 2404.3 (301.3)
  - \* Vibration isolation 2404.1 (301.8)
  - \* Repairs to maintain original listing or approval requirements 2404.5 (301.9)
  - \* Installed to meet expected wind loads 2404.6 (301.10)
  - \* Flood zones 2404.7 (301.11)
  - \* Seismic resistance 2404.8 (301.12)
  - \* Rodent proofing 2404.9 (301.14)
  - \* Category IV condensation appliances shall be provided with an auxiliary drain pan 2404.10 (307.5)
    - Exception: Appliances that have auto shut down operation in the event of a stoppage in the drain system
  - \* Condensate pump failure will prevent operation of connected appliance or equipment 2404.11 (307.6)
- ◆ Structural Safety 2405 (302)
  - \* Building not to be weakened by installation of gas piping

# Understanding the 2019 Residential Code of Ohio

- \* Truss members not to be cut, drilled, notched, or spliced
- \* No additional loads without verification of being capable of supporting the load
- \* Prohibits cuts, holes, notches, in engineered wood products, including: trusses, glue-laminated members, I-joists, and structural composite components
  - Exceptions permitted by manufacturer or engineer design
- ◆ Appliance Location 2406 (303)
  - \* Per code and listing
  - \* Prohibited locations 2406.2 (303.3)
    - Sleeping rooms, bathrooms, toilet rooms
    - Storage closets, surgical rooms or a space that opens only into the room
    - Exceptions as apply
  - \* Outdoor locations 2406.3 (303.6)
    - Listed or provided adequate protection
- ◆ Combustion, Ventilation, and Dilution Air 2407 (304)
  - \* Provide adequate combustion air
  - \* Appliance not interfere with air flow
  - \* Draft hoods in same room as appliance 2407.3 (304.3)
  - \* Make-up air 2407.4 (304.4)
    - Exhaust fans shall be considered in calculations
    - Kitchen ventilation, exhaust fans, dryers, fireplaces
  - \* Indoor combustion air 2407.5 (304.5)
    - Total required sum of all appliances in area
    - Rooms communicating directly with doors to be counted
    - Standard method for minimum require volume
      - 50 Cu Ft. per 1,000 BTU input rating
      - Provides the minimum volume without outside air

# Understanding the 2019 Residential Code of Ohio

- Typical appliance information tag use input BTU

# Understanding the 2019 Residential Code of Ohio

👉 Class Exercise: What is the maximum minimum square footage without outside combustion air?

Equipment 80,000 BTU water heater / 120,000 BTU furnace

10 foot ceiling

Calculation

Water heater BTU \_\_\_\_\_

Furnace BTU \_\_\_\_\_

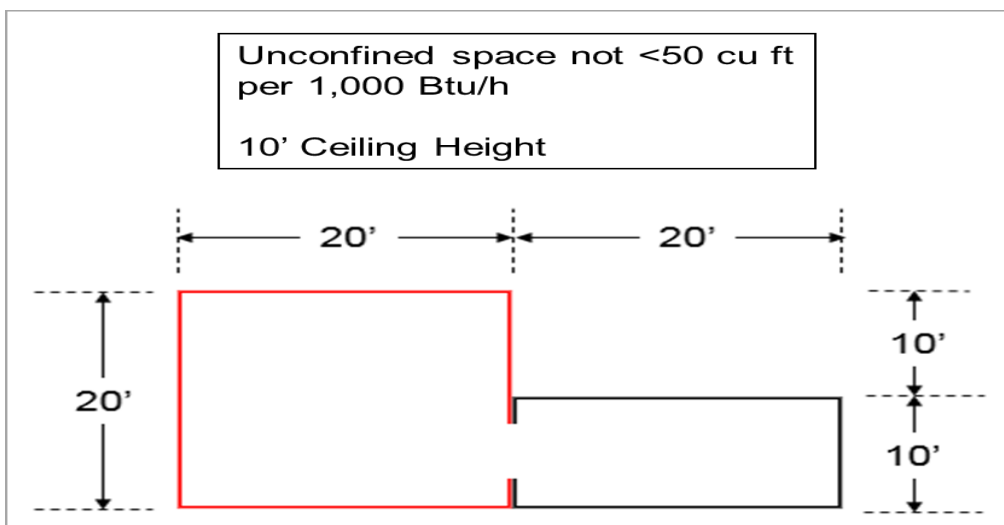
Total BTU \_\_\_\_\_

Divide by 1,000 \_\_\_\_\_

Dividend times 50 \_\_\_\_\_ cubic feet

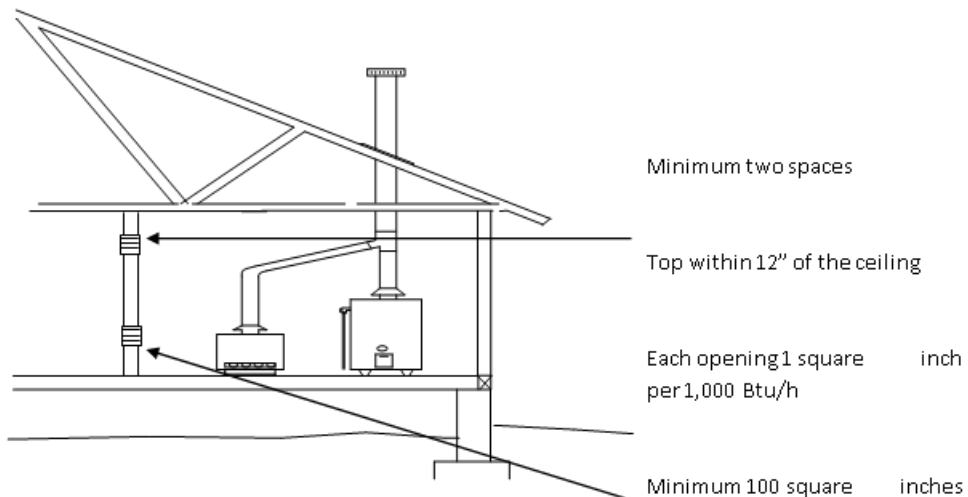
Cubic feet ÷ ceiling height \_\_\_\_\_ - Minimum required square footage

👉 Class Exercise: What is the maximum allowable Btu/h for each area before outdoor air is required?



# Understanding the 2019 Residential Code of Ohio

- \* Known air infiltration method allows a performance based proof of sufficient air 2407.5.2 (304.5.2)
  - Method for fan assisted and non-assisted units
  - Not used when air infiltration rate is  $> 0.60$ .ACH (ACH = Air Changes per Hour)
- \* Indoor opening size and location 2407.5.3 (304.5.3)
- \* Combining spaces on the same story 2407.5.3.1 (304.5.3.1)
  - Free area of 1 square inch per 1,000 Btu not less than 100 square inch
    - For each opening
  - Two openings – 12" from top / 12" from bottom
  - Minimum size not less than 3"



- \* Combining spaces on different stories 2407.5.3 (304.5.3)
- \* One or more permanent openings in doors or floors
- \* From other stories – openings 2 square inch per 1.000 Btu
- \* 2 openings commencing with 12" of ceiling and floor
- \* Outdoor combustion air 2407.6 (304.6)
  - Two permanent openings
    - 12" top and bottom
    - Calculates net free area for each opening



## Understanding the 2019 Residential Code of Ohio

- Direct to outdoors vertically 1 square inch per 4,000 Btu/h
  - Communicate directly or by ducts
  - Horizontal ducts 1 square inch per 2,000 Btu/h
  - Calculate the total BTU being supplied
- \* One opening method 2407.6.2 (304.6.2)
- 12" within the top of the enclosure
  - Appliance clearances
    - 1 inches from sides and back
    - 6 inches from the front
  - Direct to outdoors or through a duct
  - 1 square inch per 3,000 BTU
  - Duct not less than the sum of all vent connectors

# Understanding the 2019 Residential Code of Ohio

## Class Exercise

- \* 2 – 34,000 Btu/h water heaters
- \* 1 – 120,000 Btu/h furnace
- \* Calculate combustion air opening sizes using the 2 opening method for outdoor air with the openings on an outdoor wall

## Class Exercise

- \* 2 – 34,000 Btu/h water heaters
- \* 1 – 120,000 Btu/h furnace
- \* Calculate combustion air opening sizes using the 2 opening method for outdoor air supplied by a horizontal duct

## Class Exercise

- \* 2 – 34,000 Btu/h water heaters
- \* 1 – 120,000 Btu/h furnace
- \* Calculate combustion air opening sizes using the one opening method

# Understanding the 2019 Residential Code of Ohio

- \* Combination indoor and outdoor 2407.7 (304.7)
  - Indoor openings as per indoor air
  - Outdoor openings as per outdoor combustion air
  - Indoor spaces
    - Ratio of available volume of all communicating spaces divided by required volume
    - Reduction factor = 1 minus ratio of interior spaces
    - Minimum outdoor size = full size of openings calculated x reduction factor
    - Minimum dimension or air openings < 3"
  
- \* Example 2407.7 (304.7)
  - 160,000 Btu input requires 8,000 cu. Ft. for "indoor air only"
  - 240 square feet adjacent space with 8' ceiling (8 x 240) = 1920 cu. Ft.
  - $1,920 = .24$
  - 8,000
  - Reduction factor  $1 - .24 = .76$
  - Outdoor air required
  - 1" per 4,000 Btu/h
  - $160,000 = 40$  square inch
  - 4,000
  - Outdoor air required  $76 \times 40 = 30.4$  square inch
  
- \* Engineered combustion air 2407.8 (304.8)
  
  
- \* Mechanical combustion air 2407.9 (304.9)
  - 0.35 cu. Ft. per 1,000 Btu/h of total input rating all appliances
  - Appliance interlockIF: Mechanically supplied combustion air

# Understanding the 2019 Residential Code of Ohio

THEN: System must also supply required ventilation air

\* Louvers and grills G2407.10 (304.10)

- Ventilation based on net-free opening
  - Wood louvers 25%
  - Metal 75%
- Manufacturer's specifications
- Motorized grills interlocked with equipment



\* Combustion air ducts 2407.11 (304.11)

- Duct must use galvanized steel for the ducts or material having equivalent corrosion resistance, strength, and rigidity
- Terminate in obstructed space
- Serve a single enclosure
- Separate upper and lower duct – not screened in attic area
- Not as part of the masonry, metal or factory built chimney assembly
- Except direct vent appliances
- Low opening – bottom not less than 12" above grade
- Protected from fumes and vapors
- Disperse fumes
- Installed per manufacturer

◆ Installation 2408 (305)

- \* Listings or manufacturer's instructions
- \* Available on job site

# Understanding the 2019 Residential Code of Ohio

- \* Follow stricter code or manufacturer's instruction
- \* Many sections same as mechanical Part V
- \* Ignition source 18" above grade in garage
- \* Installation 6' or higher in private garage unless protected from vehicle impact
- \* Equipment installed at grade on a level pad or suspended 6" above grade
- \* Clearance to combustibles be maintained
- \* Consider temporary items such as drawers or doors
- ◆ Clearance Reduction 2409 (308)
  - \* Reductions only per Table 2409.2 unless prohibited by listing
  - \* Includes distance to drywall
  - \* Reductions only per Table 2409.2 unless prohibited by listing
  - \* Clearance to indoor air conditioning 2409.3 (308.3)
  - \* Per manufacturer
  - \* Can use clearance Table 2409.2
  - \* Clearance from supply ducts 2409.3.4 (308.3.4)
- ◆ Electrical 2410 (309)
  - \* Gas piping not to be used as a grounding electrode
- ◆ Electrical Bonding 2411 (310)
  - \* Gas pipe likely to become energized shall be bonded
  - \* Exception: connection to equipment that is part of an electrical circuit shall be considered bonded
  - \* Corrugated Stainless Steel Tubing (CSST) 2411.1.1 (310.1.1)
    - Bonded to electric service grounding electrode system
    - Bonded to metallic pipe or fitting
    - Bonding jumper not smaller than 6 AWG
    - All segments of system bonded

# Understanding the 2019 Residential Code of Ohio

## ◆ General 2412 (401)

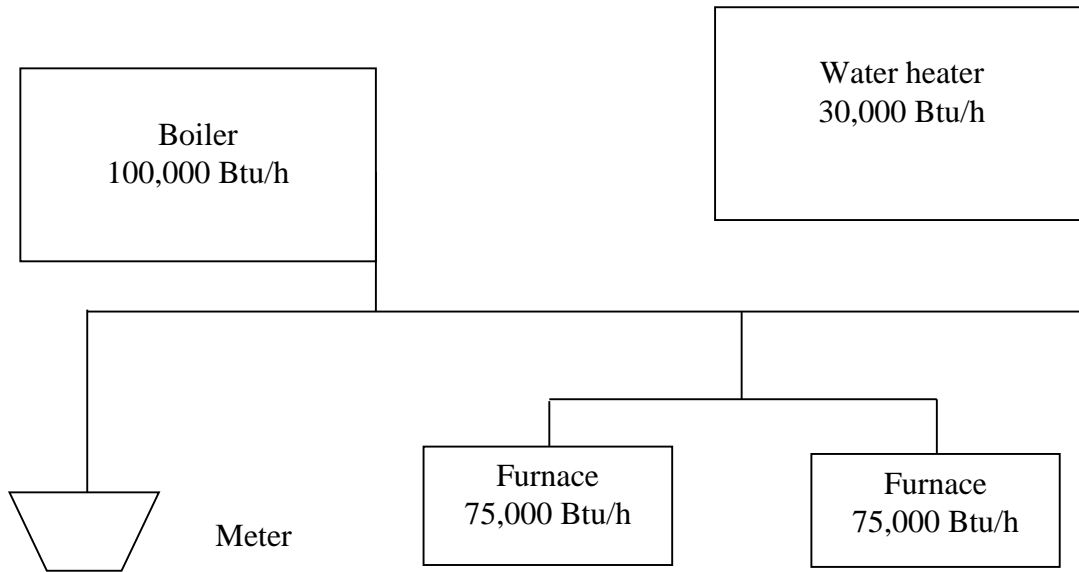
- \* Point of delivery to connection to equipment
- \* LP gas per Fire Code
- \* Modification to gas pipe system requires resizing
- \* Yellow identifying color with black lettering unless black metallic pipe – every 5'
- \* 2 meters not to be interconnected
- \* Meter labeled indicating area served
- \* Pipe sized to serve all connected appliances
- \* All pipe identified
  - Exceptions
    - Pipe length less than 2 feet and from same pipe
    - Steel fitting 2 inches and less
    - On product packaging
    - Other approved documentation
- \* All pipe 3<sup>rd</sup> party tested or certified

## ◆ Pipe Sizing 2413 (402)

- \* Based on appliance input rating
- \* When rating is unknown, the manufacturer shall be consulted
- \* Assume all appliances operating simultaneously
- \* 1 cube foot of natural gas = 1,000 Btu
- \* Maximum capacity of pipe in feet of gas per hour for gas pressure less than 2 psi. and a pressure drop of 0.5" water column Table 2413.4(1)
- \* Tables are based on pressure, type of piping or tubing, pressure drop

# Understanding the 2019 Residential Code of Ohio

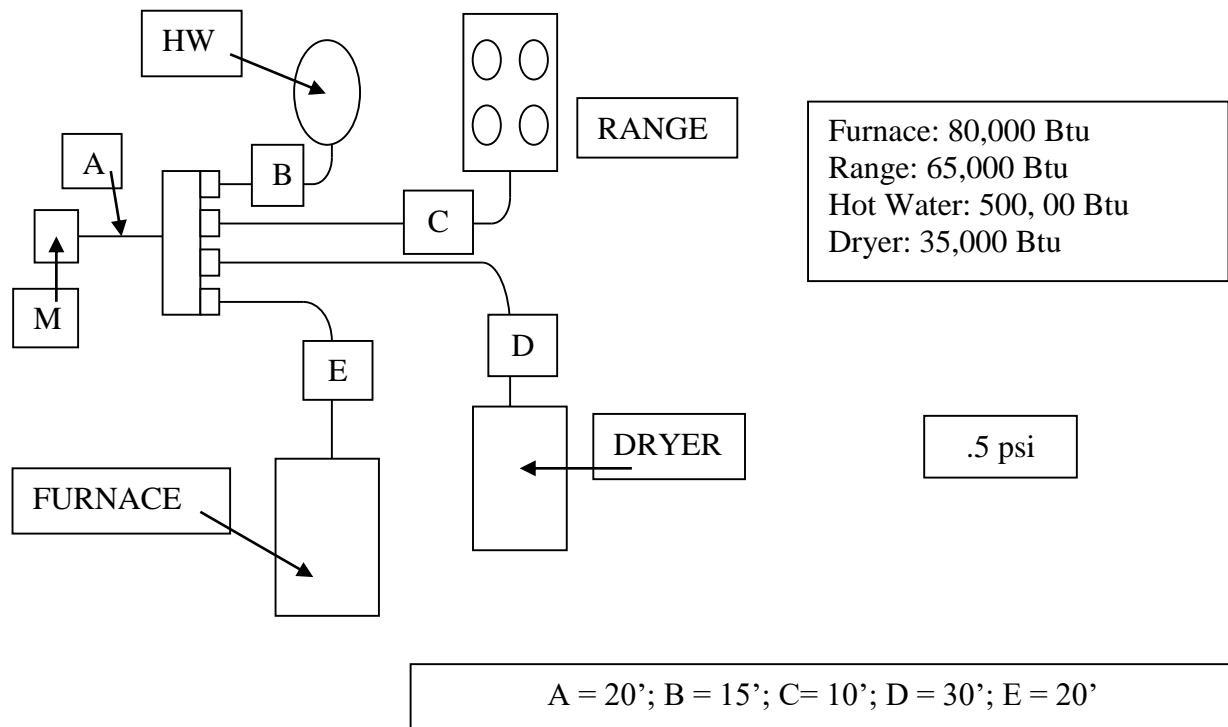
- \* Table 2413.4(1) – maximum capacity of pipe in feet of gas per hour for gas pressure less than 2 psi. and a pressure drop of 0.5” water column – schedule 40 metallic pipe



- \* Longest length method 2413.4.1, (402.4.1)
- \* **Step One:** Determine the length of pipe from the point of delivery to the most remote appliance.
  - *Example:* Furthest appliance is 50' from the meter.
- \* **Step Two:** Enter the table in the 50' row. Entire system will be sized based on the values in this row.
- \* **Step Three:** Size the branch feeding the most remote appliance
  - *Example:* 30,000 Btu/h water heater requires ½” pipe. If the actual demand falls between tabular values, use the larger pipe size.
- \* **Step Four:** Working towards the meter, size the branch feeding the two furnaces.

# Understanding the 2019 Residential Code of Ohio

- *Example:* 75,000 Btu/h furnace requires  $\frac{3}{4}$ " pipe to each appliance. Since the total demand upstream of the tee is less than 151, the portion of the branch that serves both appliances is permitted to be  $\frac{3}{4}$ "
- \* **Step Five:** Size the main from the unit heater branch to the dual furnace branch
  - *Example:* The total demand on this portion of the main is 180,000 Btu/h; required pipe size is 1".
- \* **Step Six:** Size the branch serving the boiler.
  - *Example:* Demand on branch is 100,000 Btu/h; required pipe size is  $\frac{3}{4}$ "
- \* **Step Seven:** Size the remainder of the main.



Copper Tubing

Calculate the tubing sizes

- *Example:* Total system demand is 280,000 Btu/h; required pipe size is 1"

👉 Class Exercise – Branch length method – Calculate tubing sizes

- \* Solve the problem for TYPE "K" copper



# Understanding the 2019 Residential Code of Ohio

1. Find the longest branch line:

2. Total input:

3. Line A is to be:

4. B, C, D, and E are sized from manifold

$$B = 20' + 15' = \underline{\quad} ' \text{ Size } \underline{\quad} " \quad C = 20' + 10' = \underline{\quad} ' \text{ Size } \underline{\quad} "$$

$$D = 20' + 30' = \underline{\quad} ' \text{ Size } \underline{\quad} " \quad E = 20' + 20' = \underline{\quad} ' \text{ Size } \underline{\quad} "$$

# Understanding the 2019 Residential Code of Ohio

- ◆ Pipe Materials 2414 (403)
  - \* Used materials evaluated prior to re-use 2414.2 (403.2)
  - \* Other materials 2414.3 (403.3)
  - \* Metallic pipe 2414.4 (403.4)
    - Cast iron / Steel
  - \* Metallic tubing 2414.5 (403.5)
    - Copper / Aluminum / Steel
    - Corrugated stainless
  - \* Plastic pipe, tubing and fittings 2414.6 (403.6)
  - \* Workmanship and defects G2414.7 (403.7)
    - Free of burrs and defects
    - Thoroughly brushed and chip-free
  - \* Protected from corrosion 2414.8 (403.8)
  - \* Metallic pipe threads 2414.9 (403.9)
    - Stripped or damaged threads not used
    - 10-11 threads cut
    - Table G2414.9.2 (403.9.2)
    - Threaded, flanged, brazed, or welded joints permitted 2414.10.1 (403.10.1)
- ◆ Piping System Installation 2415 (404)
  - \* Installed per the standards or the manufacturer's installation instructions 2415.1 (404.1)
  - \* Not in or through air duct, clothes chute, chimney, vent or elevator shaft 2415.3 (404.3)
    - Not in solid partitions or walls unless in a chase
  - \* Fitting in concealed locations – no unions, tubing fittings, right and left couplings G2415.5 (404.5)
    - Allowed threaded, brazed welded, listed to ANSI LC-1-1CSA 26

# Understanding the 2019 Residential Code of Ohio

- \* Sleeved through foundations – annular space to be filled 2415.6 (404.6)
- \* Protection from physical damage 2415.7 (404.7)
  - Shield plate on all piping other than black or galvanized steel at notches or holes 2415.7.1 (404.7.1)
- \* Piping in solid floors 2415.8 (404.8)
  - Ends extend into space
    - Open ends
    - Inside extend minimum 2"
    - Outside extend a minimum of 6"
- \* Above ground piping 2415.9 (404.9)
  - Protected when installed above ground and outdoors
    - 3 ½" minimum height clearance – roof
    - Protected from corrosion
- \* Protected from corrosion 2415.11 (404.11)
  - Exposed piping protection
  - Galvanizing not adequate
  - Protection methods 2415.11.2
    - Corrosion resistant material based on soil condition
    - Factory applied, electrically insulated coating
    - Monitored cathodic protection
  - Dissimilar metals require insulated couplings or fittings
  - Protection of risers 2415.11.4 (404.11.4)
    - Steel risers to plastic pipe – cathodically protected with an anode
  - Prohibited – uncoated threaded or socket welded joints
- \* Minimal burial depth 2415.12 (404.12)
  - 12" burial depth

# Understanding the 2019 Residential Code of Ohio

- Exceptions: grills, lights at 8" G2415.12.1
- Trenches 2415.13 (404.13)
  - Graded for a firm continuous bearing bottom
- \* Piping underground or beneath building 2415.14
  - Prohibited unless encased in a listed product
  - Ends extend into space
  - Open ends
    - Inside extend minimum 2"
    - Outside extend a minimum 6"
- \* Unused outlets closed 2415.15 (404.15)
- \* Location 2414.16 (404.16)
  - Outlets to extend 1" beyond walls and ceilings and 2" above floors
  - Not to be installed behind doors
  - Located in the room or space where appliance is installed
- \* Plastic pipe 2415.17 (404.17)
  - Outside underground only
  - Not within or under buildings
  - Proper metallic to plastic fittings 2415.17.2 (404.17.2)
  - Tracer wire required with non-metallic piping, yellow insulated copper, minimum 18 AWG 2415.17.2 (404.17.3)
- ◆ Inspection, Testing, and Purging Section 2417 (406)
  - \* Prior to acceptance to be inspected and tested 2417.1 (406.1)
    - Repair and new branches require testing
    - Permitted to be tested in sections 2417.1.4 (406.1.4)
    - Regulators and valves assemblies can be tested independently

# Understanding the 2019 Residential Code of Ohio

- Oxygen is a prohibited test medium
- \* Test preparation 2417.3 (496.3)
  - Pipe joints and welds exposed for testing
  - Appliances and equipment – disconnected a test blank
    - Required when test pressure higher than allowable for the equipment
- \* Test pressure measurement 2147.4 (406.4)
  - Device ability to measure loss
  - Source isolated before test
  - Gauge upper pressure 5 times less than test pressure
    - Pressure to be not less than 1 ½ times the maximum working pressure, but not less than 3 psi. G2417.4.1 (406.4.1)
    - Duration not less than 10 minutes
- \* Detection of leaks and defects 2417.5 (406.5)
  - Reduction in pressure indicates a leak
  - Detection by gas detector, noncorrosive fluid or other approved means
  - Affected portions repaired or replaced
- \* Piping system and equipment leakage 2417.6 (406.6)
  - System properly tested
  - Check for open valves or pipes
  - No appliances in operation before system checked and purged
- \* Purging 2417.7 (406.7)
  - Required to be purged outdoors when system meets either of the following:
    - Pressure greater than 2 psi OR
    - Contains in excess of Table 2417.7.1.1
  - Removed from service
    - Gas piping isolated and filled with inert gas

# Understanding the 2019 Residential Code of Ohio

- When placed in operation displace with inert air and then gas
  - Purge to outside
    - Controlled by a valve
    - 10 feet from ignition source, building openings, 25 feet from intakes
    - Open end monitored
    - Terminated when gas 90% by volume
    - All other persons 10 feet away
  - Listed combustible gas indicator
  - Can be purged indoors when system meets either of the following:
    - Pressure less than 2 psi OR
    - Contains less than Table 2417.7.1.1
  - Purging procedure
    - Discharge to outside
    - Indoors or outdoors through an appliance burner with continuous source
    - Equipment designed for purpose
    - Monitored by a gas detector, stopped when gas detected
    - Follow written procedure
  - Listed combustible gas indicator
  - Appliances purged before being placed in service
- ◆ Piping Support 2418 (407)
- \* Components suitable for the piping material
  - \* Spaced per Section 2424
  - \* Allow pipe to expand and contract
  - \* Underground plastic gas line with yellow #18 AWG tracer line

# Understanding the 2019 Residential Code of Ohio

- \* Residential clothes dryer gas line with shutoff valve, capped
- \* 1" black iron residential gas line hanging from floor joists
- ◆ Drips and Sloped Piping 2419 (408)
  - \* ¼" in 15'
  - \* Sediment traps or drips required near appliance inlet as close as possible – with ready access
  - \* Not required for illuminating appliances, ranges, clothes dryers, decorative vented appliances within fireplaces or outdoor grills
- ◆ Shutoff Valves 2420 (409)
  - \* Not in furnace plenums or concealed locations
  - \* Accessible / shutoff side of each meter
  - \* Each building / permanently identified
  - \* At each MP regulator
  - \* Appliance shutoff valve 2420.5
    - At each appliance
      - In same room – maximum 6' away
      - Vented decorated fireplaces per manufacturer
      - Serve no other appliance
      - Can be in a remote room if readily accessible
      - Permanently identified
- ◆ Flow Controls 2421 (409)
  - \* Line pressure regulators required when appliances operate at pressure lower than the supply system
  - \* Accessible
  - \* Protected from physical damage
  - \* Vent regulators to the outside
  - \* Excess flow valves listed, sized and installed per manufacturer
  - \* Listed flash back arrestor when used with oxygen 2421.5 (410.5)

# Understanding the 2019 Residential Code of Ohio

- ◆ Appliance Connectors 2422 (411)
  - \* Listed and labeled
  - \* Protected from damage
  - \* Dryers and ranges 6'
  - \* Not concealed in or through walls
  - \* Shut off valve before connector
- ◆ Piping Support Intervals 2424 (415)
  - \* Table 2424.1 for interval
- ◆ General 2425 (501)
  - \* Chimneys, liners, vents, and connectors
  - \* Vent to the outside
  - \* Abandoned outlets to be sealed
  - \* Positive pressure or induce draft designed for positive pressure
  - \* Unvented appliances allowed 2425.8 (501.8)
    - When aggregate amount exceeds 20 Btu per hour per cu. Ft. of room volume, needs to be vented
    - Adjacent rooms permitted to count
    - Masonry chimney minimum 12" above lowest point
- ◆ Fuel Gas Appliance Definitions 2403 (202)
  - \* Category I
    - DEFINITION:
      - An appliance that operates with a non-positive vent static pressure and with a vent gas temperature that avoids excessive condensation production in the vent
    - EXAMPLES:
      - Water Heaters / room heaters
      - Furnaces / Unit heaters
      - Boilers



# Understanding the 2019 Residential Code of Ohio

- \* Category II
  - DEFINITION:
    - An appliance that operates with a non-positive vent static pressure and with a vent gas temperature that is capable of causing excessive condensation production in the vent
  - EXAMPLE
    - Forced draft or induced draft heaters
- \* Category III
  - DEFINITION:
    - An appliance that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent
  - EXAMPLE:
    - Direct vent furnace
- \* Category IV
  - DEFINITION:
    - An appliance that operates with a positive vent static pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent
  - EXAMPLE:
    - Sealed draft units with draft temperatures low enough to permit condensation
- \* Existing chimneys or vents 2425.15 (501.15)
  - Resizing required to control condensation and provide proper draft
  - Passageway free from obstructions, cracks etc.
  - Masonry chimney requires cleanout 2425.15.3 (501.15.3)
  - Clearance from combustibles as per Chapter 10 2425.15.1 (501.14.4)
- ◆ Vents Section 2426 (502)
  - \* Listings required
    - B and BW – UL 441
    - L – UL 641
    - Category II and III vents – UL 1738
  - \* Connectors required – connect appliance to vertical chimney or vent 2426.2 (502.2)

# Understanding the 2019 Residential Code of Ohio

- \* Insulation shield required
- \* Adequate support 2426.6 (502.6)
- \* Shield plates required
- ◆ Venting of Appliances 2427 (503)
  - \* All equipment to be vented 2427.2 (503.2)
  - \* Direct and integral vent equipment per manufacturer
  - \* Design and construction 2427.3 (503.3)
    - Designed to prevent leakage of fumes into building
    - Mechanical draft per listing
  - \* Not to be combined with natural draft appliances
  - \* Exit terminal 7' above grade at public walkways
  - \* No portion extend into or through ducts or furnace plenums
  - \* Types of venting to be used 2427.4 (503.4)
    - See Table 2427.4 (503.4)
    - Plastic piping – used for venting equipment listed for use with such venting materials shall be approved
    - Special gas vent – shall be listed and installed in accordance with the terms of the special gas vent listing and the manufacturer's instructions
  - \* Chimney termination 2427.5.3 (503.5.4)
    - 3' above roof penetration
    - 2' higher than any portion of building within 10'
    - 5' above highest connected draft hood
  - \* Size of chimneys 2427.5.4 (503.5.5)
    - Per Section 2428 (504)
    - Single appliance not less than appliance flue collar greater than 7 times the draft hood outlet
    - 2 or more – not less than the largest draft hood plus 50% of the smaller, or greater than 7 times the outlet

# Understanding the 2019 Residential Code of Ohio

- \* Inspection of masonry chimney before connecting a new appliance shall be made 2427.5.5 (503.5.6)
  - Unsafe chimneys to be repaired, rebuilt, relined, or replaced
  - Lining 2427.5.5.1 (503.5.6.1)
  - Cleanouts secured
  - Gas and solid fuel not to be interconnected 2427.5.6.1 (503.7.1)
  - Combination equipment requires certain safeguards
  
- \* Gas vents 2427.6 (503.6)
  - Installed per listing and manufacturer's instructions
  - Roof penetrations – flashed, listed termination cap
  - One 60° offset allowed, balance not to exceed 45° - single wall vent connectors not more than 75% of vertical height of vent
  - Gas vent termination 2427.6.4 (503.6.5)
    - Figure 2427.6.4 for vents under 12" with listed caps – vent 8' from wall
    - All other 2' above roof penetration and 2' above building portion within 10'
    - Decorative shrouds only with listing
  
- \* Minimum vent height 2427.6.4 (503.6.5)
  - Type B or L – 5' above draft hood or flue collar G2427.6.4 (503.6.5)
  - Type B-W vent 12' above bottom of wall furnace
  - Not to terminate adjacent to wall or below eaves or parapets except as provided G2427.6.7 (503.6.8)
  
- \* Size of gas vents 2427.6.8 (503.6.9)
  - Category I with Type B gas vent
    - Provisions of Section 2428 (504)
    - Individual appliance – not less than area of draft hood or greater than 7 times draft hood outlet area

# Understanding the 2019 Residential Code of Ohio

- 2 or more appliances – area of draft hood plus 50% area of smaller hood not greater than 7 times smaller hood
- Category II, III, IV – sizing in accordance with manufacturer’s instructions G2427.6.8.3 (503.6.9.3)
  - Supported per listing
  - Special signage at vent – could be required by code official
  - Example:

“This gas vent is for appliances that burn gas. Do NOT connect to solid or liquid fuel-burning appliances or incinerators.”
- \* Single wall pipe 2427.7 (503.7)
  - Not to be used in cold climates for venting gas utilization equipment
  - Terminate 5’ above highest connected draft hood outlet
  - 2’ above roof and 2’ within a horizontal distance of 10’ with an approved cap
  - Limited to runs direct from roof or exterior wall to the outdoor atmosphere 2427.7.4 (503.7.4)
  - Penetrations to be protected 2427.7.5 (503.7.5)
  - Thimble 18” above / 6” below roof
  - Not in concealed spaces
  - Same sizing requirements
- \* Vent system termination 2427.8 (503.8)
  - See Appendix C for illustration
  - Mechanical draft system 3’ above any forced air within 10’
- \* Vent connectors for Category I appliance 2427.10 (503.10)
  - Non-combustible corrosion resistant material 2427.10.2.1 (503.10.2.1)
  - Unconditioned spaces require B or L listed material 2427.10.2.2 (503.10.2.1)
  - Approved connection material for conditioned spaces

# Understanding the 2019 Residential Code of Ohio

- B or L vent material
- Single-wall pipe
  - Aluminum / Stainless Steel / Galvanized pipe
  - Smooth interior / corrosion resistant
  - Listed vent connector
  - Thickness per 2427.10.2.4 (503.10.2.4)
- \* Size of vent connector 2427.10.3 (503.10.3)
  - Single draft hood and fan assisted section
  - Multiple hoods – engineering methods or combined area of flue collars or draft hood outlets, minimum rise 1'
  - Common connector 2427.10.3.4 (503.10.3.4)
  - Highest level consistent with headroom and required clearance
  - Size increase at draft hood outlet 2427.10.3.5 (503.10.3.5)
- \* Joints 2427.10.6 (503.10.6)
  - Screws or other connectors as listed per listing sheet
  - Slope
    - Without dips, rise ¼" per foot
  - Length – as short as possible 2427.10.8 (503.10.8)
  - 75% of chimney or vent height maximum
    - Type B double wall permitted – 100% height of chimney or vent
- \* Properly supported 2427.10.9 (503.10.9)
- \* Draft Hoods 2427.12 (503.12)
  - Vented equipment to have draft hoods
  - Installed exactly as furnished
  - Dampers
- \* Manually operated dampers not part of approved installation 2427.13 (503.13)
  - Devices that obstruct flow of flue gas not to be installed

# Understanding the 2019 Residential Code of Ohio

- ◆ Sizing of Category I Appliance Venting Systems Section 2428 (504)
  - \* DEFINITIONS:
    - Appliance categorized vent diameter / area – minimum vent area / diameter permissible for Category I appliances to maintain a non-positive vent static pressure when tested in accordance with nationally recognized standards.
    - Fan assisted combustion system / Fan Min / Fan Max / Nat Max / Fan + Fan / Fan + Nat / NA / Nat + Nat
  - \* Type B Double-wall vent
    - Single Category I appliance connected directly to vent Table 2428.2(1) (504.2.1)
  - \* Type B Double-wall vent Table G2428.2(2) (504.2.2)
    - Single Category I appliance with single-wall metal connector
  - \* Connection to a masonry chimney shall meet the requirements of the 2015 International Fuel Gas Code (IFGC) Tables per Appendix B
  - \* IFGC TABLE 504.2(3) Masonry Chimney
    - Single Category I appliance with Type B double-wall connector
  - \* IFGC TABLE 504.2(4) Masonry Chimney
    - Single Category I appliance with single-wall connector
  - \* IFGC Table 504.2(5) Single-wall metal pipe or Type B asbestos cement pipe
    - Single draft hood equipped connected directly to pipe or vent
  - \* Vent offsets 2428.2.3 (504.2.3)
    - Zero lateral length – no elbows
    - Tables include 2, 90° as part of numbers
    - Each elbow to 45° reduces vent table 5%
    - Each elbow to 90° reduces tables 10%
  - \* Zero lateral only to straight vertical vent attached directly to draft hood or flue collar 2428.2.4
  - \* Multiple rate appliances need to meet both minimum and maximum numbers 2428.2.6 (504.2.6)

# Understanding the 2019 Residential Code of Ohio

- \* Vent connectors not more than 2 sizes greater than listed appliance categorized vent diameter, draft hood or flue collar 2428.2.11 (504.2.11)
- \* Multiple Appliance Vent Tables 2428.3 (504.3)
  - Comply with 2428.3.1 – 2428.3.23
  - No obstruction installed in system
  - Connector length per Table 504.3.2 or 1 ½ feet per inch of connector
  - Reduce vent capacity 10% for each multiple length of connector
  - Each elbow to 45° reduces vent table 5% 2428.3.6 (504.3.6)
  - Each elbow to 90° reduces tables 10%
- \* Common vent – equal to or greater than largest connector 2428.3.8 (504.3.8)
- \* Connector rise from the appliance connector to the centerline of vent gas streams G428.3.11 (504.3.11)
- \* Vent height measure from highest draft hood outlet
- \* Vent height size not more than 7 times smallest listed vent area 2428.3.13 (504.3.17)
- \* Vent extends more than 5' above roof – additional enclosure requirements 2428.3.16 (504.3.20)
  - Where the actual height of a vent falls between entries in the height column, either interpolation must be used or the lower input rating must be used for the FAN MAX and NAT MAX G2428.3.22 (504.2.25)
- \* Type B Double-wall vent Table 2428.3(1)
  - 2 or more Category I appliances with Type B double-wall pipe
- \* Type B Double-wall vent Table 2428.3(2)
  - 2 or more Category I appliances with single-wall connector
- \* Masonry Chimney Table 2428.3.(3)
  - 2 or more Category I appliances with Type B double-wall pipe
- \* Masonry Chimney IFGC Table 504.3.(4)
  - 2 or more Category I appliances with single-wall metal connector

# Understanding the 2019 Residential Code of Ohio

- \* Single-wall metal pipe or Type B asbestos cement vent IFGC Table 504.3(5)
    - 2 or more draft hood equipped direct to pipe or vent
  - \* Exterior Masonry Chimney IFGC Table 504.3(7a)
    - 2 or more appliances NAT + NAT Type B double-wall connector
  - \* Exterior Masonry Chimney IFGC Table 504.3(7b)
    - 2 or more appliances NAT + NAT Type B double-wall connector
  - \* Exterior Masonry Chimney Table 504.3(8a)
    - 2 or more appliances FAN + NAT Type B double-wall connector
  - \* Exterior Masonry Chimney IFGC Table 504.3(8b)
    - 2 or more appliances FAN + NAT Type B double-wall connector
- ◆ Vents and Connectors – Definitions 202
- \* Vent is defined:
    - “A passageway for conveying flue gases from fuel-fired appliances or their vent connectors to the outside atmosphere.”
  - \* Vent connector is defined:
    - “That portion of a venting system that connects the flue collar or draft hood of an appliance to a vent.”
  - \* Draft is defined:
    - “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.” Section R202
    - Mechanical or induced draft is the pressure difference by the action of a fan blower or ejector between the appliance and the chimney or vent termination.
    - Natural draft is created by the vent or chimney because of height and temperature difference between the flue gas and atmosphere.



# Understanding the 2019 Residential Code of Ohio



## Class Exercise - Vent sizing for natural draft pool heater

- \* Determine Btu/h input rating from appliance label
- \* When rating is unknown, the manufacturer shall be consulted
- \* 1,000 Btu = 1 cube foot of natural gas
- \* Reference Type B double-wall vent system serving a single appliance with Type B double-wall vent
- \* Table G2428.2(2)
  - Category I Natural Draft Pool Heater
  - 225,000 Btu input – 1' lateral / 20' height
  - Other appliances



## Class Exercise – Maximum and minimum vent sizing

- \* What is the maximum effective vent area allowed?
- \* Not greater than 7x draft hood outlet area
- \* Fan assisted 100,00 Btu/h furnace – 15' lateral / 30' height
- \* What is the maximum vent size allowed?
- \* What is the minimum size allowed?



## Determining minimum capacity of a vertical Type B vent larger than a single vent size connecting to it

- \* Size of chimneys Type B vents 2427.5.4 (503.5.5)

# Understanding the 2019 Residential Code of Ohio

- “For sizing an individual chimney venting system for a single appliance with a draft hood, the effective areas of the vent connector and chimney flue collar or draft hood outlet, nor greater than 7 times the draft hood outlet area.”

- \* Where do we start?
- \* Type B double-wall gas vent TABLE 2428.2(1)
- \* 100,000 Btu/h / 1,000 = appliance input rating in thousands
- \* Fan assisted 100,000 Btu/h furnace – 15’ lateral / 30’ height
- \* What is the maximum vent size allowed?
- \* What is the minimum vent size allowed? (Not greater than 7x draft hood outlet area)



Sizing an individual chimney venting system for a single appliance with a draft hood  
2427.5.4

- \* The effective areas of the vent connector and chimney flue shall be:
  - Not less than the area of the appliance flue collar or draft hood outlet
  - Nor greater than 7 times the draft hood outlet area
- \* Where:
  - Area of circle:  $A = \pi r^2$
  - $\pi = 3.14$
  - Vent connector = 4” diameter
- \* Thus:

# Understanding the 2019 Residential Code of Ohio

- 4" diameter = 2" radius
- Radius squared  $2" \times 2" = 4"$
- Flow area of vent connector =  $3.14 \times 4"$ , or 12.56 square inch

\* Check for 7 times the size limit

- $12.56 \text{ square inch} \times 7 = 87.96 \text{ square inch}$
- $87.96 \text{ square inch} / 3.14 = 28 \text{ square inch}$
- Square root of 28 square inch = 5.29"

\* Answer: Vertical vent maximum size = 5" diameter



Class Exercise – Determine 2 single-wall connector vent sizes and Type B double-wall vent size accepting the 2 single-wall vents

\* Reference TABLE 2428.3(1) vent system serving 2 or more appliances with a Type B double-wall common vent and single-wall vent connectors

\* Equipment common-vented into a 20' high Type B vent chimney:

- 100,000 Btu/h Fan assisted furnace
  - 10' lateral / 2' rise
- 50,000 Btu/h Water heater
  - 4' lateral / 3' rise

◆ STEP ONE:

\* Determine size of single-wall vents from each appliance

\* Type B double-wall vent TABLE 2428.3(2)

\* 100,000 Btu/h Fan assisted furnace, lateral 2' rise / 20' chimney

# Understanding the 2019 Residential Code of Ohio

- \* Type B double-wall vent TABLE 2428.3(1)
- \* 50,000 Btu/h Water heater, lateral 2' rise / 20' chimney
- \* Type B double-wall vent TABLE 2428.3(1)
- \* Common vent diameter requirement for Type B double-walled vent
- \* Size of Type B double-wall common vent is 5"

# Understanding the 2019 Residential Code of Ohio

## Specific Appliances 2431 – 2453

- ◆ Decorative Appliances For Installation In Fireplaces 2432 (602)
  - \* Flame safeguard device, pilot flame or ignition
- ◆ Log Lighters 2433 (603)
  - \* Per CSA 8
- ◆ Vented Gas Fireplace Heaters 2435 (605)
  - \* Access panels not to be attached to building  
Vented gas fireplace heaters per ANSI Z21.88
  - \* Natural gas log lighter
  - \* Gas shutoff valve within 6' 2420.5.1 (409.5.1)
- ◆ Vented Wall Furnaces 2436 (607)
  - \* Not circulate air from or between bathrooms
  - \* 12" clearance for doors; doorstops and door closer not allowed as clearance device
  - \* Not ducted
  - \* Access for cleaning and service
- ◆ Floor Furnaces 2437 (609)
  - \* Specific clearance requirements
  - \* Thermostats in same room
  - \* Protection if suspended into habitable spaces
- ◆ Clothes Dryers and Exhaust 2438 - 2439 (613-614)
  - \* Fire resistance rating of construction to be maintained
  - \* Access for cleaning of all vertical ducts
  - \* Exhausted outside of the building
  - \* Many same requirements as mechanical section
- ◆ Sauna Heaters 2440 (615)
  - \* 194° – room temperature

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- \* One hour maximum timer – required
- ◆ Forced Warm Air Furnaces 2442 (618)
  - \* Outside and return air ducts not less than 2 sq. in. per 1,000 Btu or as manufacturer's instructions
  - \* Many same requirements as mechanical section
- ◆ Unit Heaters 2444 (620)
  - \* Properly supported
  - \* No duct work unless listed
  - \* Clearance to combustibles
- ◆ Unvented Room Heaters 2445 (621)
  - \* Not sole source of heat
  - \* Aggregate total 20 Btu per cube foot – venting required
  - \* Oxygen depletion service
- ◆ Vented Room Heaters 2446 (622)
  - \* Per ANSI Z21.86 / CSA 2.32
- ◆ Cooking Appliances 2247 (623)
  - \* Commercial cooking appliances not to be installed in dwelling units or areas where domestic cooking will occur
  - \* Domestic appliances to be listed and labeled for use
- ◆ Water Heaters 2448
  - \* Safety devices per code
  - \* Listed accordingly if supplying space heating and domestic
- ◆ Air Conditioning Appliances 2449 (627)
- ◆ Illuminating Appliances 2450 (628)
- ◆ Infrared Radiant Heaters 2451 (630)
- ◆ Chimney Damper Opening Area 2453 (634)

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Chapter 12  
Administration

# Course Description

Mechanical requirements of the 2019 Residential Code® of Ohio are notated and defined, illustrating code requirements for the proper installation of mechanical systems. Instructors identify and discuss code requirements for furnaces, combustion air, gas piping, and proper installation of different types of residential appliances. Additional components include venting and fuel gas requirements for residential mechanical systems.



# Learning Objectives / Learning Outcomes

Students successfully completing this course will be able to:

Students will demonstrate problem solving by utilizing given calculations to determine code compliance for residential mechanical systems.

Students will recognize and employ the venting and fuel gas requirements for residential mechanical systems demonstrated by calculating given examples and defending the decision.

Students will determine confined and unconfined areas, utilizing given examples and situations.



## ◆ Chapter 12 Administration

- \* Administrative provisions of Chapter 12 apply to mechanical requirements of Chapters 13 - 24
- \* Non-gas fired appliances Chapters 13 – 23
- \* Gas fired appliances Chapter 24

## ◆ Chapter 12 Administration

- \* Covers permanently installed mechanical systems installed to regulate environmental conditions within buildings, including:
  - Design
  - Installation
  - Maintenance
  - Alteration and inspection
- \* Administrative sections in **Chapter 1** apply
- \* Regulates systems specifically addressed in code
  - Items not covered — official must use other methods
  - Experience, referenced standards, other codes

## ◆ Existing Systems 1202

- \* Additions, alterations or repairs 1202.1
  - Shall comply as if new
  - Not to be detrimental to existing equipment
- \* Existing installations 1202.2
  - Systems can remain – lawfully installed
- \* Maintenance 1202.3
  - Kept in proper operating condition in accordance with the original design, including safety devices

- \* Make a list of fuels for Chapters 13 – 23

- \* Make a list of fuels for Chapter 24



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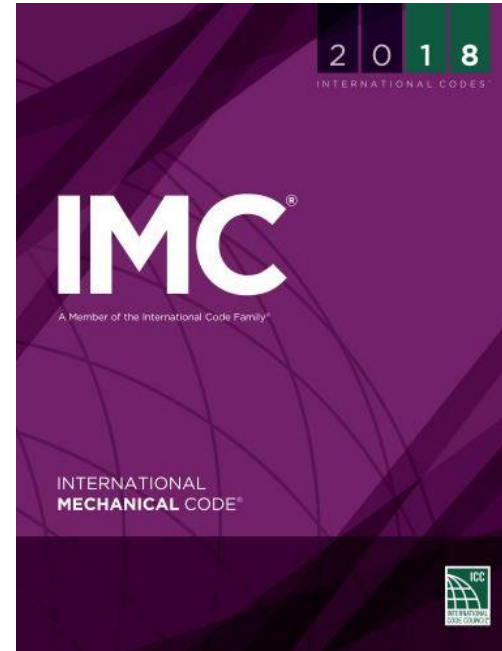
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**Chapter 13  
General Mechanical System Requirements**



- \* Refer to 2018 International Fuel Gas Code and 2018 International Mechanical Code for installation of mechanical appliances, equipment, and systems not addressed by this code



## ◆ General 1301

### \* Identification 1301.2

- Pipe, tubing, fittings
- Each length of pipe shall bear the identification of the manufacturer

### \* Installation of materials 1301.3

- Materials installed per standard
- No standard instructions – follow manufacturer's instructions
- If manufacturer or standard does not meet code – follow code

## ◆ General 1301 (*continued*)

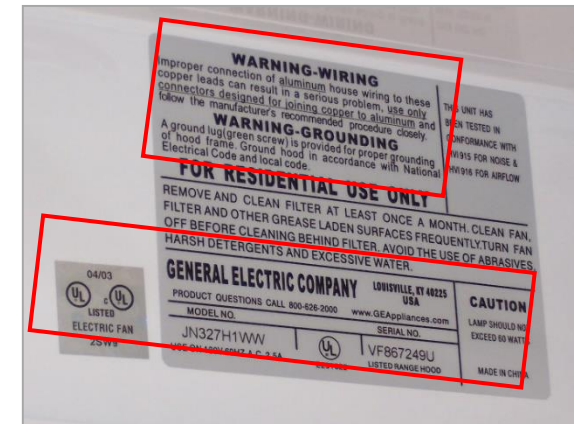
- \* Installation of materials **1301.3**
  - Plastic pipe per NSF14 (National Sanitary Foundation)
- \* Third party testing or certification **1301.4**
  - Pipe, tubing and fitting – tested or certified

## ◆ Approval 1302

- \* All appliances listed and labeled for application and use or approved per **104.11**

## ◆ Labeling of Appliances 1303

- \* All appliances shall be labeled **M1303.1**
  - Label requirements
    - Manufacturer's name and trademark
    - Model and serial numbers
    - Testing agency identification
    - Electrical information
    - Btu/h ratings for absorption units
    - Input BTU/h ratings fuel type/clearances
    - Electric comfort heating maintenance instructions



## ◆ Type of Fuel 1304

### \* Fuel types 1304.1

- Appliance designed for type of fuel to be used
- Design for high altitude when applicable
- No increase or decrease beyond rating



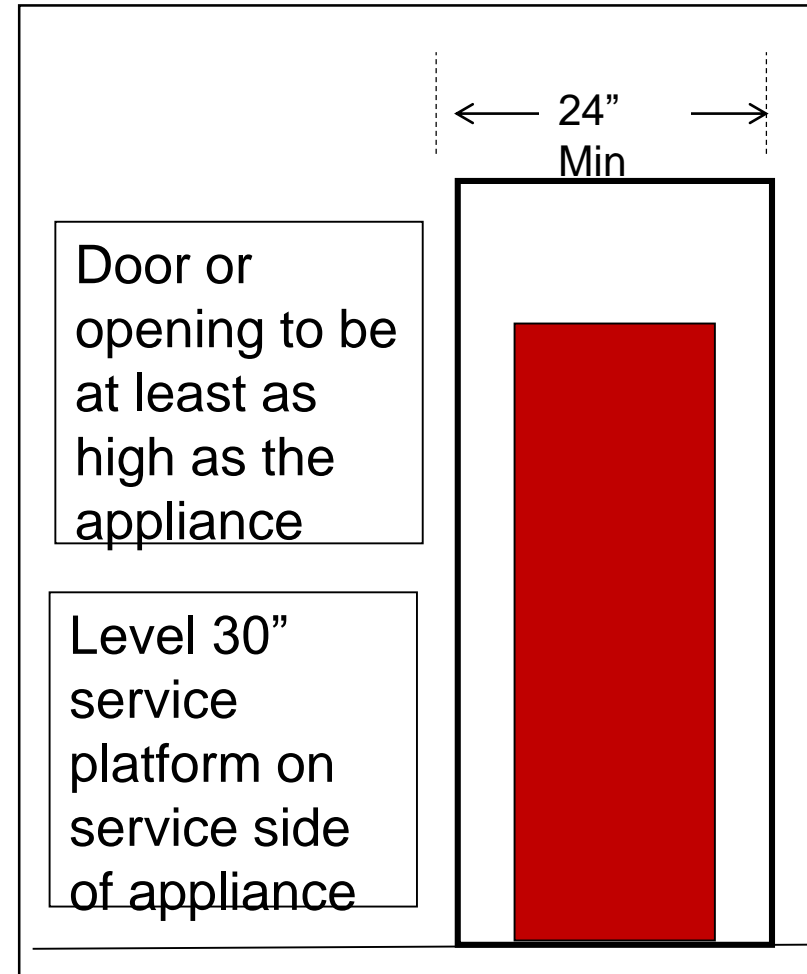
## ◆ Appliance Access 1305

- \* Appliance access for inspection, service, repair and replacement **1305.1**
  - Sufficient size for service, repair, maintenance, replacement, and inspection without removal of permanent construction
  - 30" x 30" working space in front of control side for service



## ◆ Appliance Access 1305

- \* Appliance access for inspection, service, repair and replacement **1305.1**
  - Appliances in rooms **1305.1.1**
    - Access via minimum 24" wide door
    - Large enough to permit removal of appliance
    - 30" deep working space and height of appliance



## ◆ Appliance Access 1305

- \* Appliance access for inspection, service, repair and replacement **1305.1**
  - Appliances in attics **M305.1.2**
    - Access opening (30”h x 20”w) and passageway (30”h x 22”w) large enough to allow removal after disassembly minimum
    - Not more than 20’ from attic access
    - Solid flooring from access to appliance and at service space 24” wide
    - Level service space front and/or side 30” x 30”
    - Illumination via switched light at opening, service outlet required per Chapter 38
    - Exception # 2 – Passageway increased to 50’ when unobstructed 6’ in height and minimum 22” clear width



## ◆ Appliance Access 1305 (*continued*)

- \* Appliance access for inspection, service, repair and replacement **1305.1**
  - Appliances under floors **1305.1.3**
    - Same access requirements as attic
    - Protect walls if greater than 12” below grade
    - Supported level on concrete slab or approved material or suspended from structure
    - 6” clearance to grade
    - Illumination via switched light at opening, service outlet required
    - Not more than 20’ from crawlspace access
    - Exception: Passageway unlimited in length when unobstructed 6’ height and minimum 22” in clear width

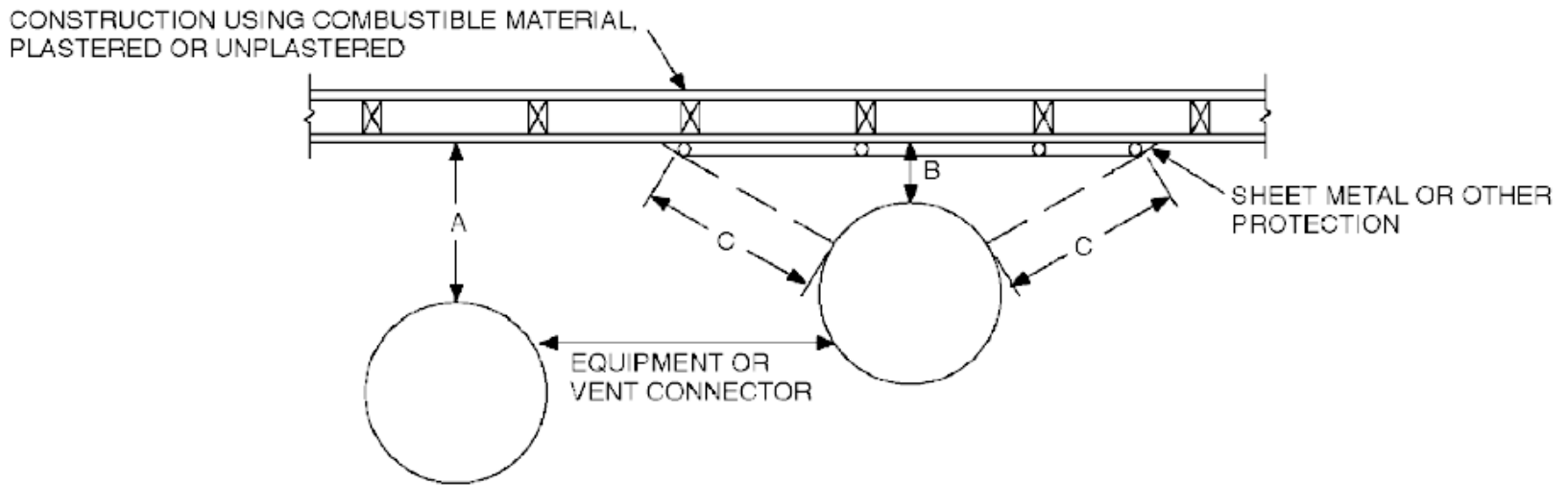
## ◆ Clearance from Combustible Construction M1306

- \* Appliance clearance 1306.1
  - Per appliance manufacturer
  - Clearance reduction per Table 1306.2
  - Not permitted for solid fuel appliances with listed clearance of 12” or less
  - Table differs from IMC Table 308.6
  - When ventilated air space is required – 1” clearance on all sides of assembly
  - Reduce clearance to combustibles Table 1306.2
    - See Figure M1306.1

**TABLE 1306.2**  
**REDUCTION OF CLEARANCES WITH SPECIFIED FORMS OF PROTECTION<sup>a,c,d,e,f,g,h,i,j,k,l</sup>**

TYPE OF PROTECTION APPLIED TO AND COVERING ALL SURFACES OF COMBUSTIBLE MATERIAL WITHIN THE DISTANCE SPECIFIED AS THE REQUIRED CLEARANCE WITH NO PROTECTION (See Figures M1306.1 and M1306.2)	WHERE THE REQUIRED CLEARANCE WITHOUT PROTECTION FROM APPLIANCE, VENT CONNECTOR, OR SINGLE WALL METAL PIPE IS:									
	36 inches		18 inches		12 inches		9 inches		6 inches	
	Allowable clearances with specified protection (Inches) <sup>b</sup>									
	Use column 1 for clearances above an appliance or horizontal connector. Use column 2 for clearances from an appliance, vertical connector and single-wall metal pipe.									
	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2
3½-inch-thick masonry wall without ventilated air space	—	24	—	12	—	9	—	6	—	5
½-inch insulation board over 1-inch glass fiber or mineral wool batts	24	18	12	9	9	6	6	5	4	3
Galvanized sheet steel having a minimum thickness of 0.0236-inch (No. 24 gage) over 1-inch glass fiber or mineral wool batts reinforced with wire or rear face with a ventilated air space	18	12	9	6	6	4	5	3	3	3
3½-inch-thick masonry wall with ventilated air space	—	12	—	6	—	6	—	6	—	6
Galvanized sheet steel having a minimum thickness of 0.0236-inch (No. 24 gage) with a ventilated air space 1-inch off the combustible assembly	18	12	9	6	6	4	5	3	3	2
½-inch-thick insulation board with ventilated air space	18	12	9	6	6	4	5	3	3	3
Galvanized sheet steel having a minimum thickness of 0.0236-inch (No. 24 gage) with ventilated air space over 24 gage sheet steel with a ventilated space	18	12	9	6	6	4	5	3	3	3
1-inch glass fiber or mineral wool batts sandwiched between two sheets of galvanized sheet steel having a minimum thickness of 0.0236-inch (No. 24 gage) with a ventilated air space	18	12	9	6	6	4	5	3	3	3

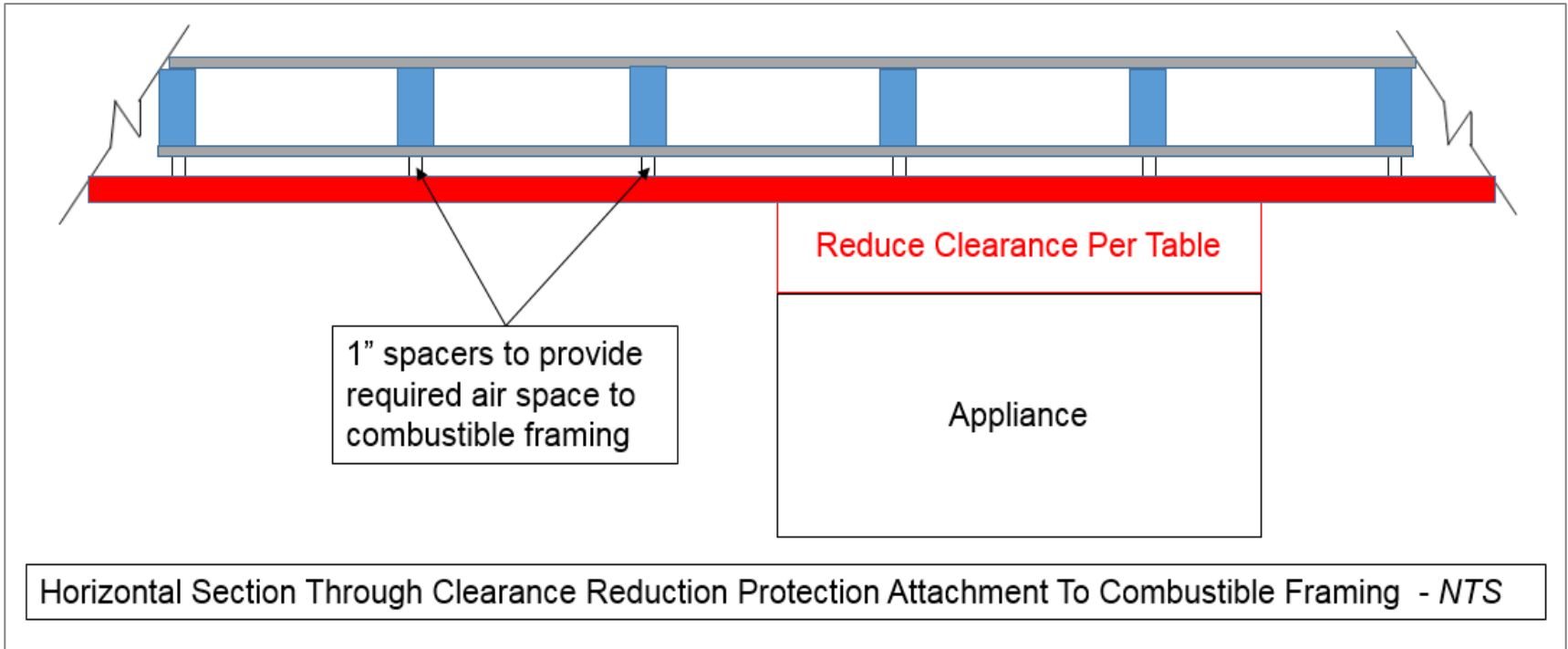
\* Figure 1306.1



Note: "A" equals the required clearance with no protection. "B" equals the reduced clearance permitted in accordance with Table M1306.2. The protection applied to the construction using combustible material shall extend far enough in each direction to make "C" equal to "A."

**FIGURE 1306.1**  
**REDUCED CLEARANCE DIAGRAM**

- \* Reduce clearance to combustibles **Table 1306.2**



## ◆ Appliance Installation 1307

- \* Per manufacturer's installation instructions
- \* Attached to appliance
- \* Anchored in an approved manner – seismic considerations
- \* Ignition source elevated minimum 18" in garages
- \* Protected from vehicular impact
  - Elevation or see **International Fire Code**



## ◆ Appliance Installation 1307

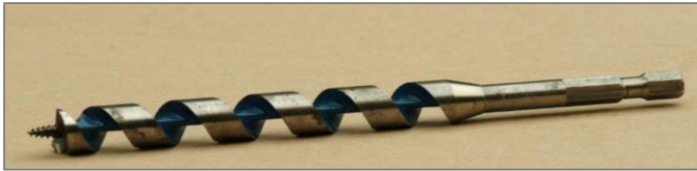
### \* Hydrogen generating and refueling **M1307.4**

- Maximum floor area 850 square feet
- Communicate directly to the outdoors
- 2 openings in garage, within 12" top and bottom, directly to outdoors
- Minimum free opening 0.5 square feet per 1,000 cu ft of garage volume
- Louvers or grilles – net free area – 25% or 75%
- Mechanical ventilation per the **IMC**



## ◆ Mechanical Systems Installation 1308

- \* Drilling and notching per sections 502.8, 602.6, 602.6.1, 802.7, 505.3.5, 603.3.4, 804.3.5

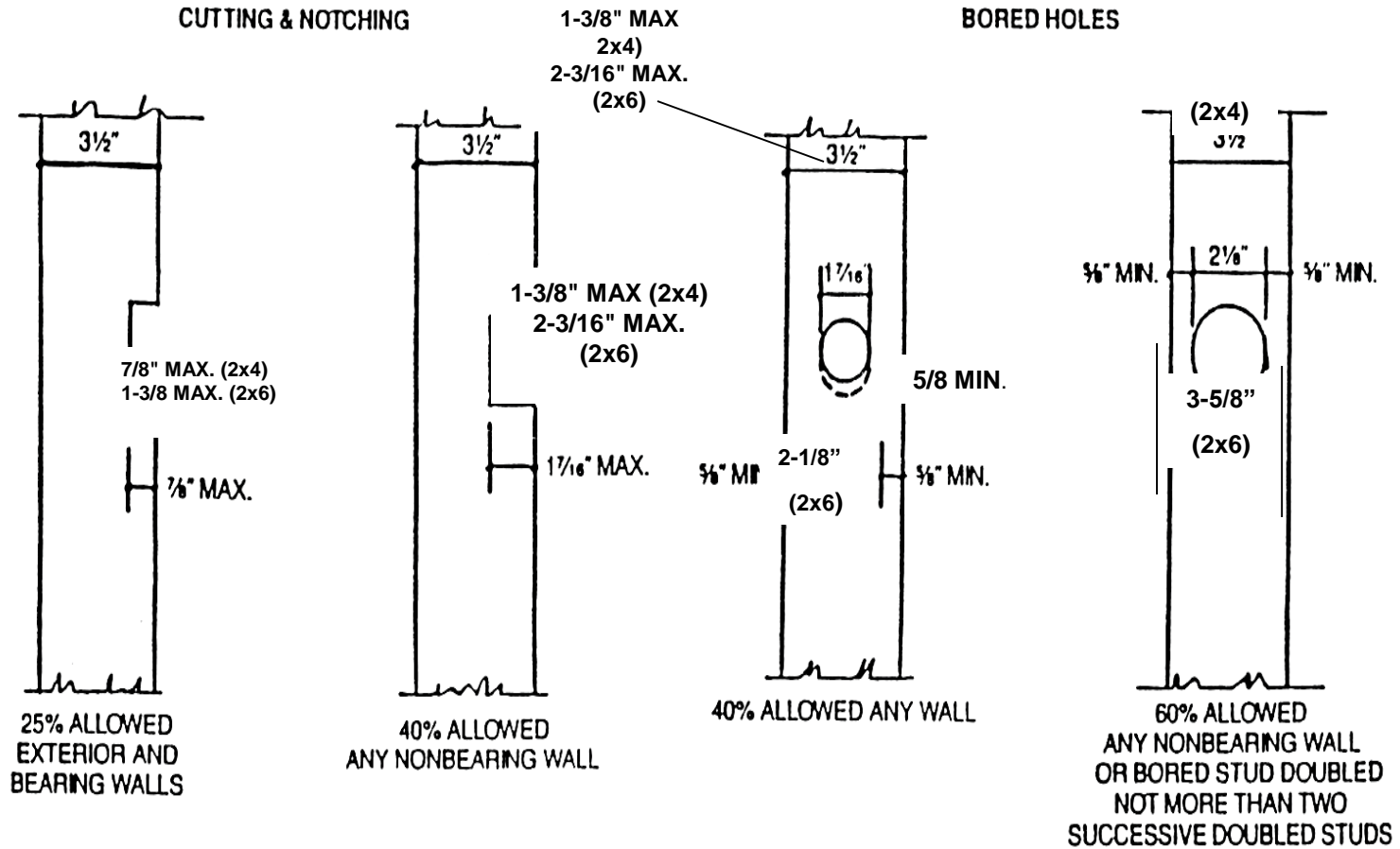




## ◆ Drilling and Notching of Studs – Cut or Notched Studs 602.6

- \* Notching bearing = < 25% of width
- \* Non-bearing = < 40% of single stud width
- \* Drilling non-bearing = < 60% and no closer than 5/8" from edge
- \* Drilling on bearing = < 40% and no closer than 5/8" from edge, or
- \* Double the stud when the stud is located on an exterior wall, bearing partition, drilled  $\geq$  40% and up to 60%. Not in double successive studs
- \* Use a fastener across the top plate to each side of the opening
- \* Use not less than eight 10d nails at each side or equivalent

# \* Sample Stud Notching Sketch



MAXIMUM ALLOWED NOTCHING AND DRILLING FOR NORMAL CONSTRUCTION WITH 2 x 4 STUD

\* Drilling and notching of studs 602.6



## ◆ Drilling and Notching of Studs 602.6

- \* Exterior walls or bearing partitions can cut/notch 25% or less
  - Equivalent allowable bearing wall stud width cutting/notching (25% or less)
    - 2"x 4" nominal stud size = 7/8"
    - 2"x 6" nominal stud size = 1-3/8"
- \* Equivalent allowable non-bearing partitions stud width cutting/notching (40% or less)
  - 2"x 4" nominal stud size = 1-3/8"
  - 2"x 6" nominal stud size = 2-3/16"

\* Drilling and notching of studs 602.6

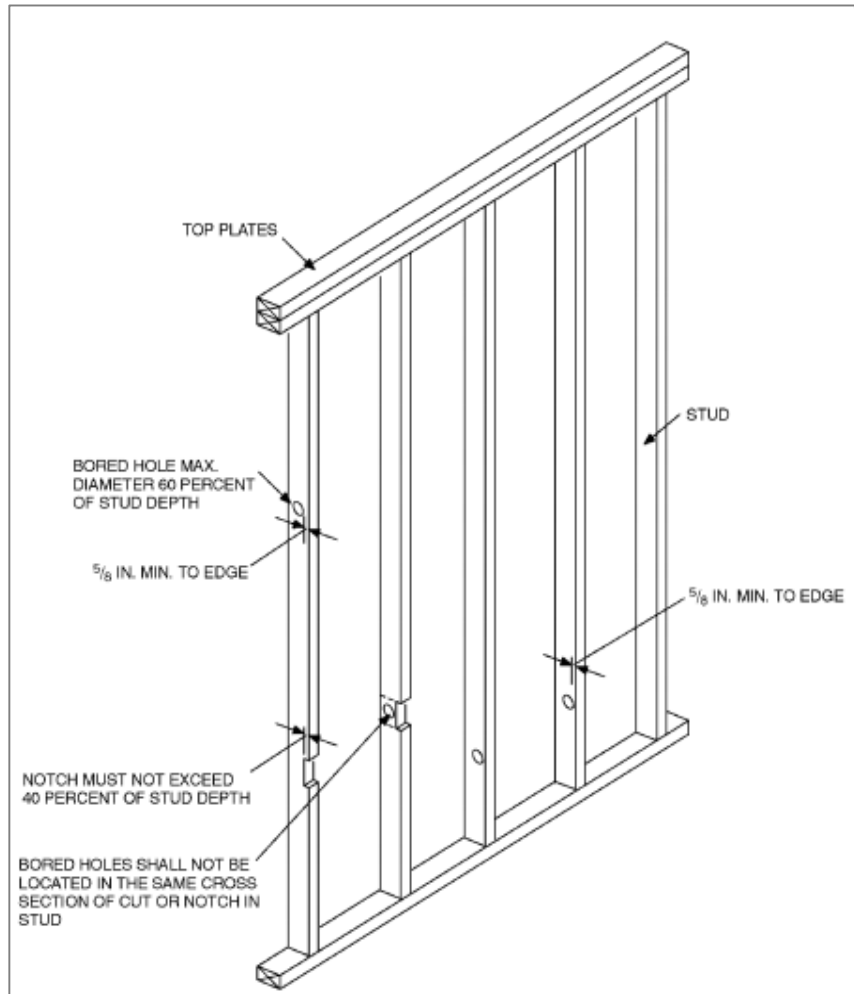


FIGURE R602.6(2)  
NOTCHING AND BORED HOLE LIMITATIONS FOR INTERIOR NONBEARING WALLS

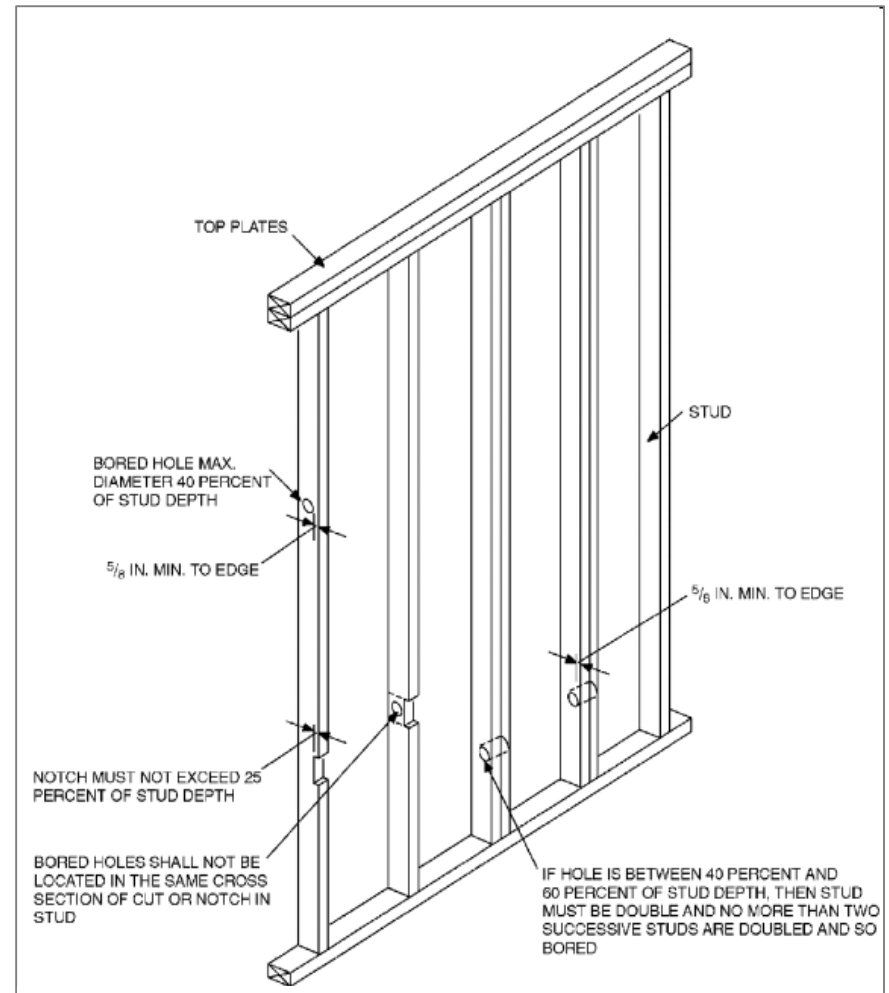


FIGURE R602.6(1)  
NOTCHING AND BORED HOLE LIMITATIONS FOR EXTERIOR WALLS AND BEARING WALLS



\* Drilling and notching of studs 602.6



## ◆ Drilling and Notching of Studs 602.6

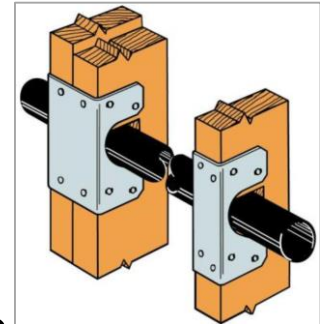
IF: Exterior wall or bearing studs are doubled

AND IF: Not more than 2 successive studs are bored

AND IF: Approved stud shoes are used

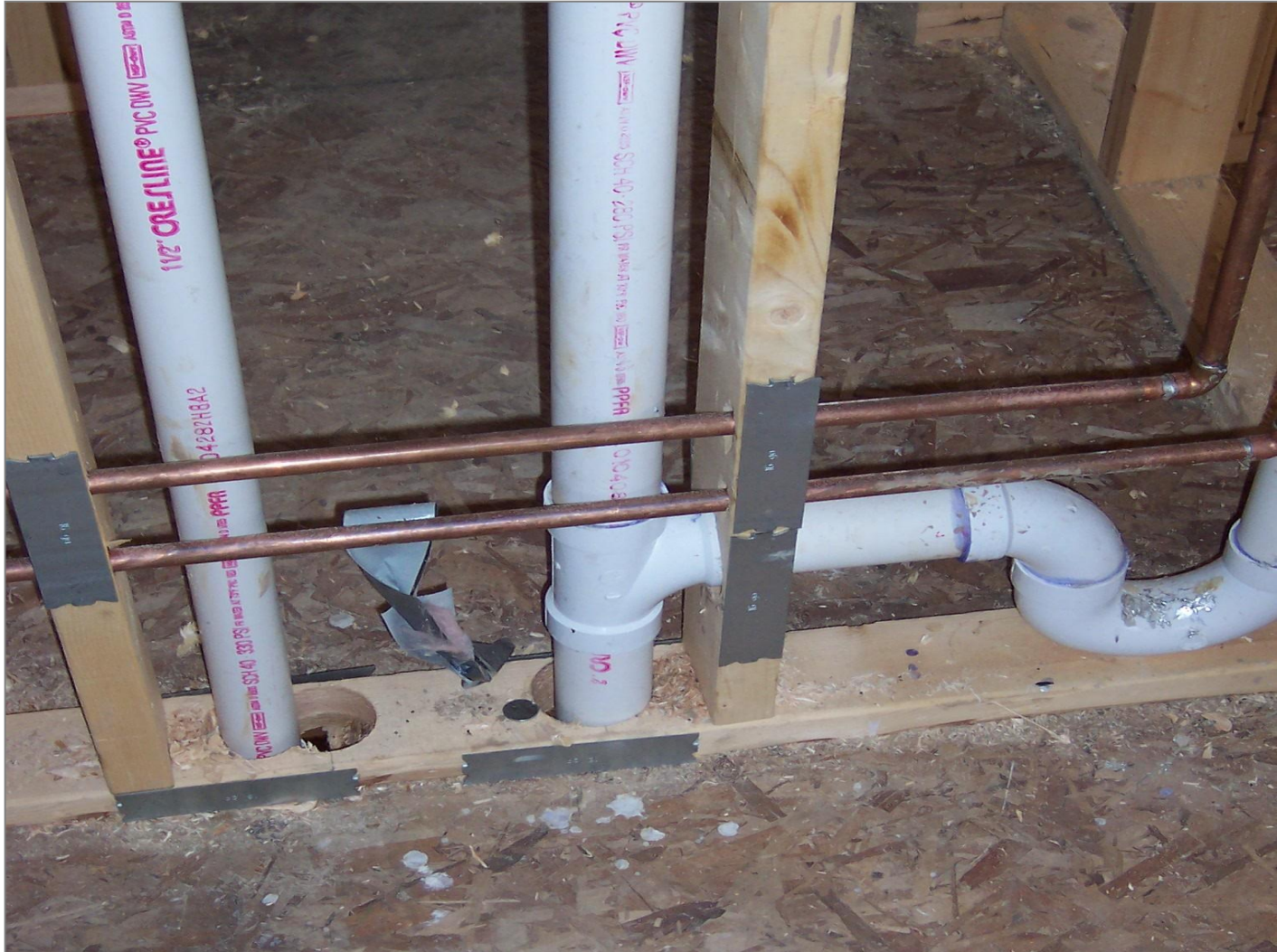
THEN: OK to bore or drill 60% of stud width

- 2"x 4" nominal stud size = 2-1/8" maximum hole
- 2"x 6" nominal stud size = 3-3/8" maximum hole





\* Drilling and notching of studs 602.6





## ◆ Drilling and Notching of Studs 602.6

### \* Drilling and notching top plate 602.6.1

- Exterior wall or bearing interior wall

IF: Notched or bored >50% width of top plate

THEN: Install a 0.054" thick galvanized metal strap

- Min 6" past the opening with min
- Use 8 – 10d nails (min 1 ½" long) and 0.148" dia) each side
  - 2"x 4" top plate = 1-7/8"
  - 2"x 6" top plate = 2-3/4"

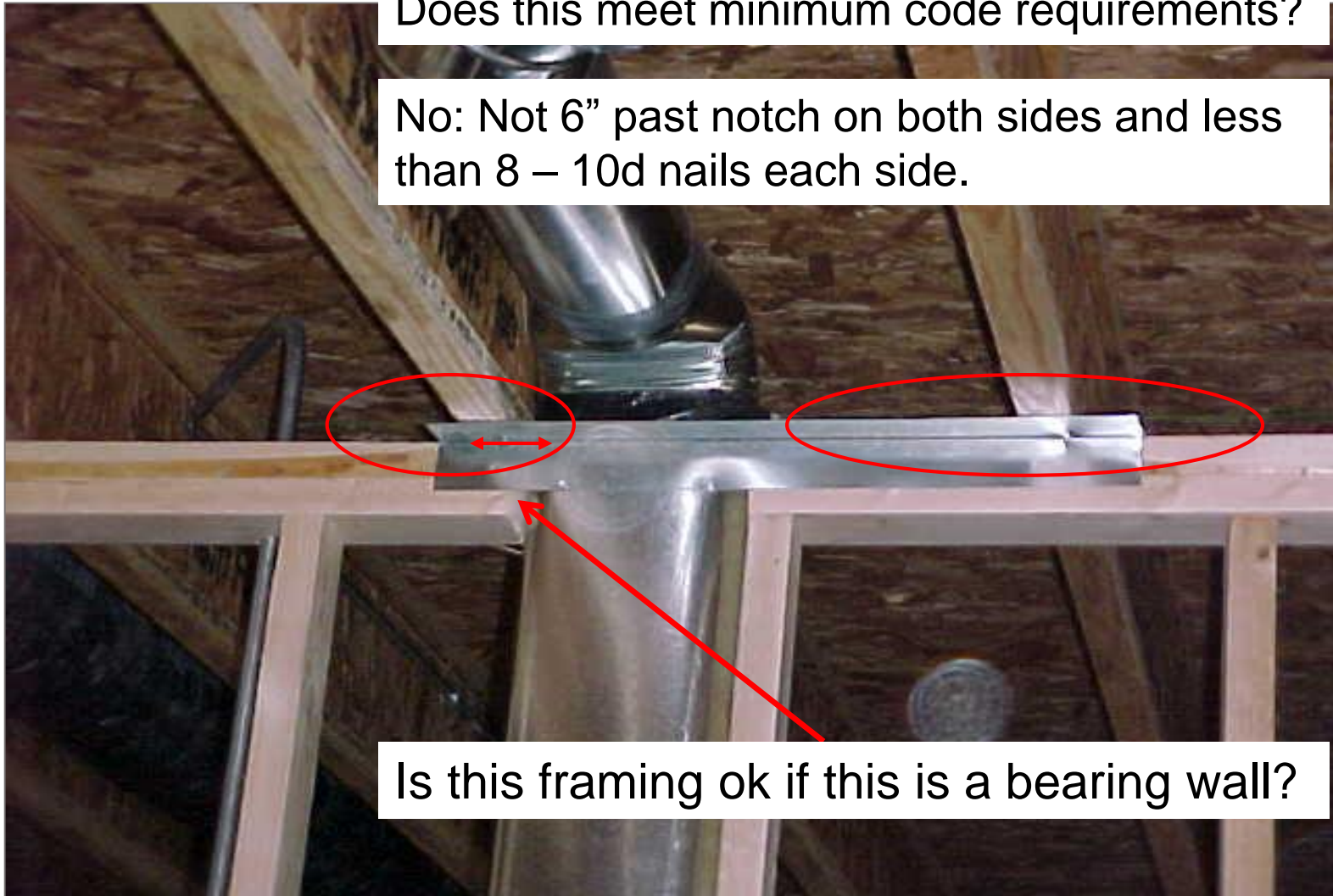
- \* Drilling and notching top plate 602.6.1



\* Drilling and notching top plate **602.6.1**

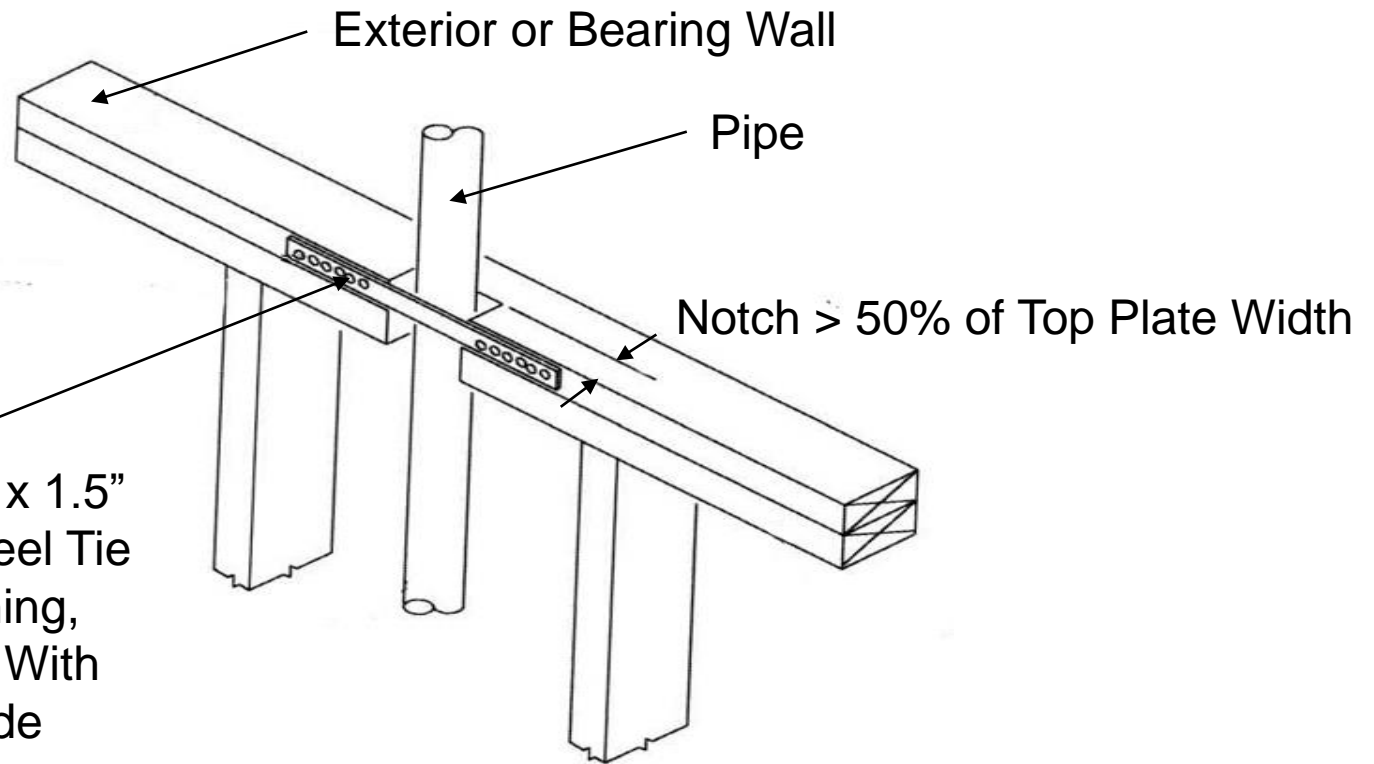
Does this meet minimum code requirements?

No: Not 6" past notch on both sides and less than 8 – 10d nails each side.



Is this framing ok if this is a bearing wall?

\* Drilling and notching top plate **602.6.1**





- \* Drilling and notching top plate 602.6.1

Is this framing ok if this is a bearing wall?

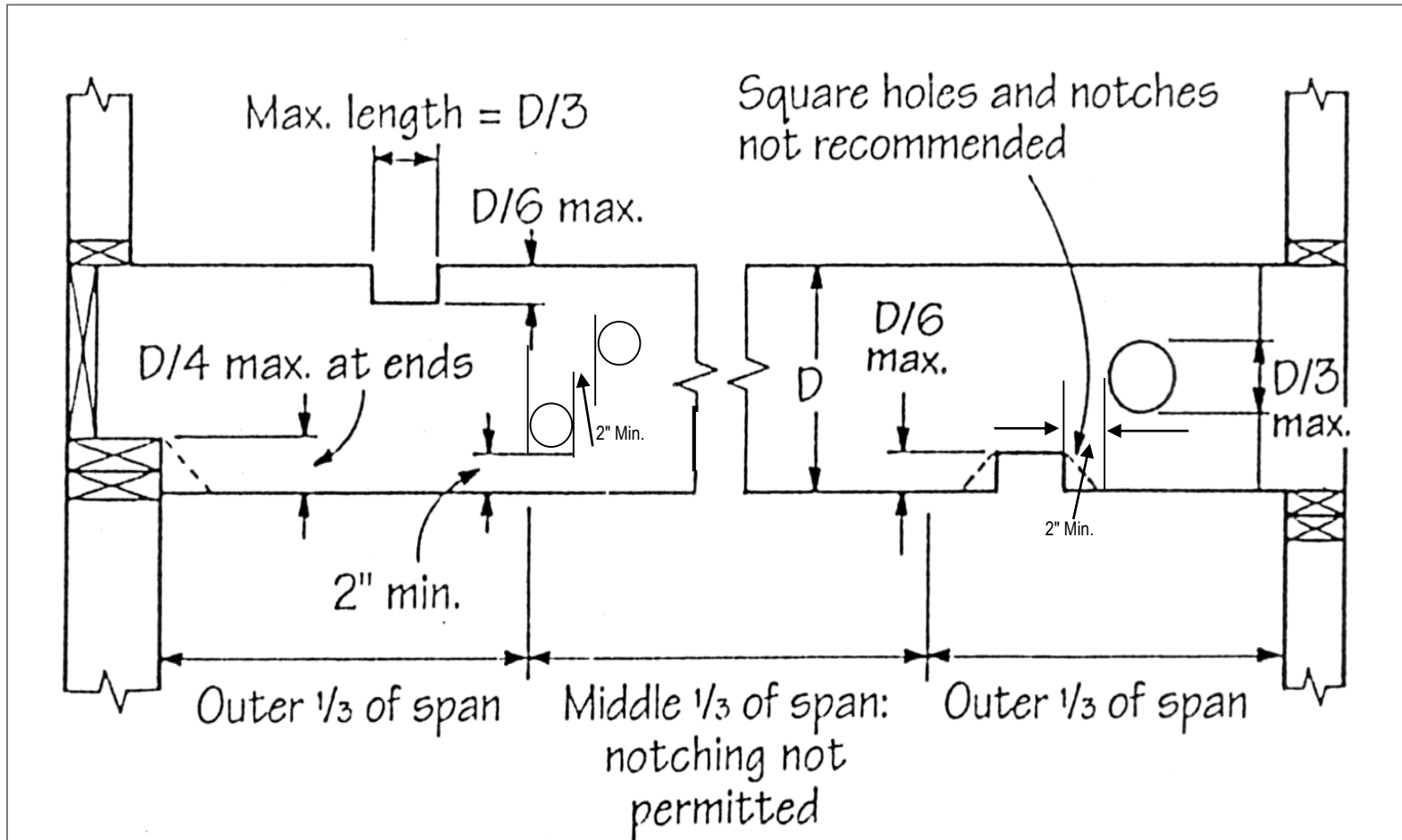


- \* Bridging **502.7.1**
- \* When joists exceed 2x12

◆ **Cutting, Drilling and Notching 502.8**

GUIDE FOR CUTTING, NOTCHING AND BORING JOISTS			
Joist Size	Maximum Hole	Maximum Notch Depth	Maximum End Notch
2x4	None	None	None
2x6	1-13/16"	7/8"	1-3/8"
2x8	2-1/2"	1-1/4"	1-7/8"
2x10	3-1/8"	1-9/16"	2-3/8"
2x12	3-13/16"	1-7/8"	2-7/8"

\* Cutting, drilling and notching 502.8



\* Cutting, drilling and notching **502.8**





\* Cutting, drilling and notching **502.8**



## ◆ Cutting, Drilling and Notching 502.8

- \* Engineered wood products 502.8.2
  - Cuts, notches and bored holes not permitted unless allowed by the manufacturer's installation instructions or by registered design professional



## ◆ Mechanical Systems Installation 1308

### \* Protection from physical damage 1308.2

- Concealed piping shall be protected
- Piping less than 1 ½ inch from edge protected
- Width of pipe and inches past framing member
  - Stud – above bottom plate and below top plate
  - Shield plate not less than 0.0575 inches (No. 16 gage)



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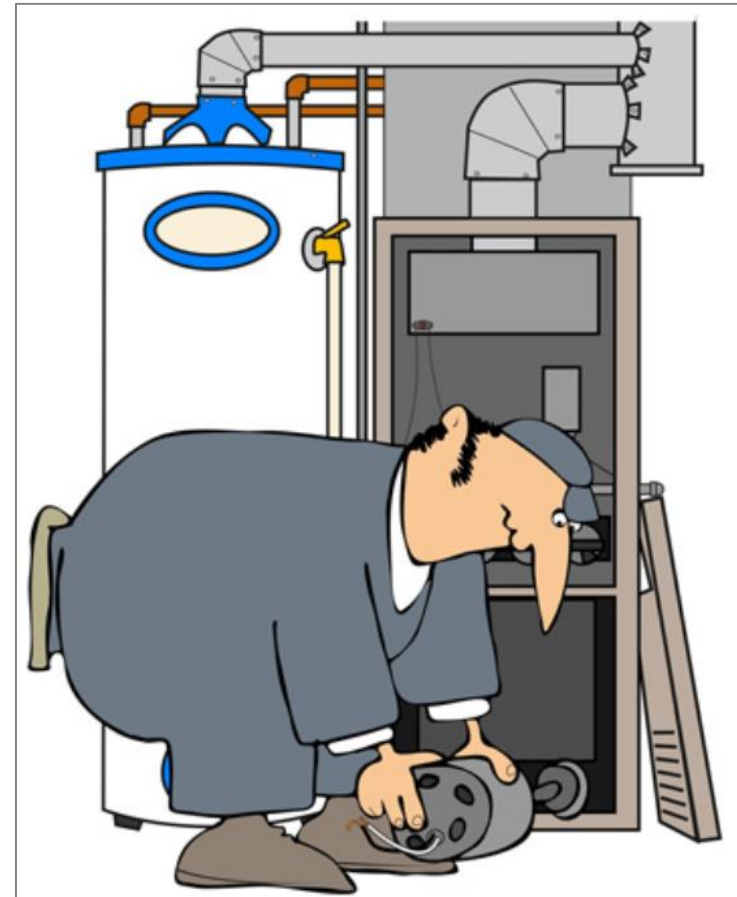
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Chapter 14 – Heating and Cooling  
Equipment and Appliances

◆ General 1401

- \* Installation 1401.1
  - Per the manufacturer and this code
- \* Access 1401.2
  - Located to provide access for service, replacement, cleaning and maintenance
- \* Equipment and appliance sizing 1401.3
  - Equipment size based on Air Conditioning Contractors of America (ACCA) Manual, J & S calculation



## ◆ General 1401

### \* Equipment and appliance sizing 1401.3

- Must be sized per ACCA Manual S or other approved methodologies

- Except:

Multi-stage unit or variable refrigerant flow w/loads properly calculated are within manufacturer's published capacities

- Specified equipment cannot satisfy published total and sensible heat gains properly calculated, thus next larger standard size is specified





◆ *General 1401 (continued)*

- \* Outdoor equipment listed for outdoor installation 1401.4
- \* Supports level, prevent settlement and vibration 1401.4
- \* Flood hazards per section 1401.5 and 322.1.6
- \* Listed and labeled for outdoor installation 1401.4
- \* Note: General requirements in Chapter 12 apply



<b>Equipment</b>	<b>Standard/Listing</b>
Electric Furnaces	UL 1995
Oil Fired Central Furnaces	ANSI/UL 727
Heat pumps	UL 1995
Duct heaters	UL 1995
Vented floor furnaces	ANSI/UL 729
Vented wall furnaces	ANSI/UL 730
Vented room heaters	UL 1482 or UL 896
Refrigeration equipment	ANSI/ASHRAE34
Fireplace stoves	UL 737



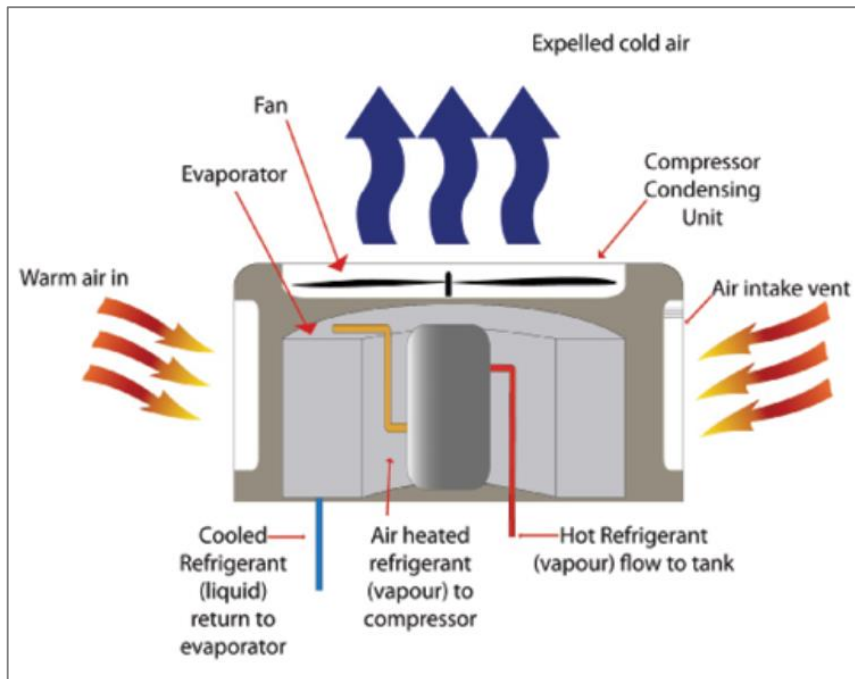
## ◆ Central Furnaces 1402

- \* Maintain listed clearances
- \* Provide combustion air – minimum 6” in front of openings



## ◆ Heat Pump Equipment 1403

- \* UL 1995
- \* Minimum 6 square in of return duct per 1,000 Btu/h output rating – removed in 2018
- \* Outdoor support raised 3” above grade – removed in 2018



## ◆ Electric Baseboard Convectors 1405

- \* Shall be installed per **Chapters 33-42** and manufacturer's instructions



## ◆ Radiant Heat 1406

- \* Installed per **Chapters 33-43**, manufacturer's installation Instructions **1406.1**
- \* Panels installed parallel to framing members **1406.3**
- \* No field cutting of panels – unless listed
- \* Fastened in place through unheated portions of panels

## ◆ Radiant Heat 1406

- \* Concrete and masonry installations 1406.4
- \* Labeled for concrete/masonry installation



- \* Not installed across expansion joints
- \* On gypsum panels – operating temps not to exceed 125° F
- \* Finish materials installed per installation instructions 1406.5
- \* Fasteners shall not pierce heating element

## ◆ Duct Heaters 1407

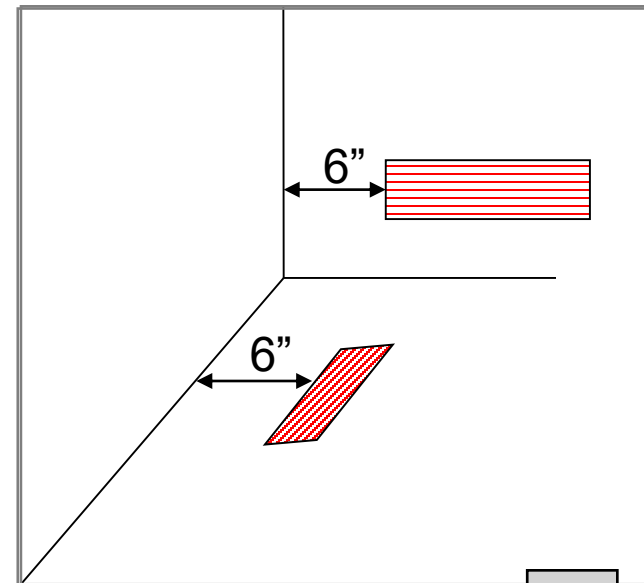
- \* Shall not create fire hazard



- \* Class 1 ducts, covers, and liners interrupted at heater to provide clearances
- \* Fan shall be listed and labeled when within 4' of a heat pump or air conditioner **1407.3**
- \* Accessible for maintenance **1407.4**
- \* Fan interlock required to prevent heater operation when fan is not operating **1407.5**

## ◆ Vented Floor Furnaces 1408

- \* Clearances per manufacturer **1408.2**
- \* Location **1408.3**
  - Registers and burner assemblies
  - Wall registers minimum 6" from corner
  - Floor register minimum 6" from wall
  - 12" from door and combustibles
  - 5' below projecting combustibles



## ◆ Vented Floor Furnaces 1408

### \* Location 1408.3

- Burner assembly shall not project into an occupied under-floor area
- Not installed in concrete slab on grade
- No door swing within 12" of grill

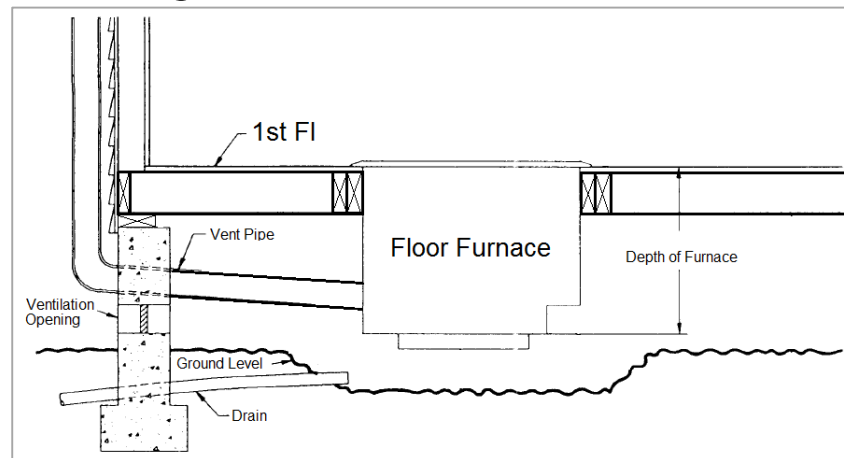
### \* Access 1408.4

- 18" x 24" in foundation wall
- 22" x 30" in floor (trap door)
- Large enough to replace any part

## ◆ Vented Floor Furnaces 1408

### \* General installation requirements 1408.5

- Thermostats located in the same room
- Furnace supported independently of the register
- 6 inches above ground – 2 inches if sealed unit
- Maintain 30" service clearance area – 12 inches on other side
- Not supported from ground





## ◆ Vented Wall Furnaces 1409

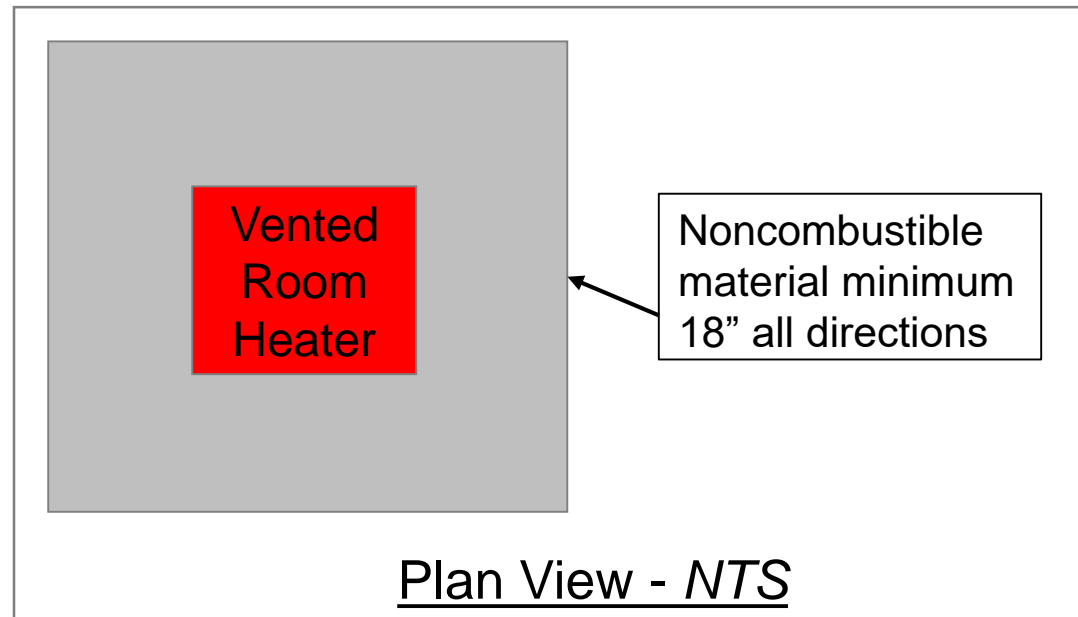
- \* Location 1409.2
  - Located not to cause fire hazard 1409.2
  - Not circulate air from bathrooms to other parts of building
  - Not located within 12" of a door swing
- \* Installation 1409.3
  - Wall thickness per manufacturer
  - No ducts attached
  - Manual shut off required
- \* Access required 1409.4



## ◆ Vented Room Heaters 1410

### \* General 1410.1

- Fuel – pellet, oil, solid
- Installed on non-combustible floors – minimum clearances required



- Exception:
  - Listed appliances per installation instructions

## ◆ Heating And Cooling Equipment 1411

### \* Coils in warm air furnace 1411.2

- Blower rated 0.5" water column static pressure
- Labeled for use upstream of heat exchanger
- Condensation drain to approved location in an approved manner
  - Not create a hazard nuisance



## ◆ Heating And Cooling Equipment 1411

### \* Condensate disposal 1411.3

- Drain to an approved location in an approved manner
- Not create a hazard
- Approved material: Cast iron / galvanized steel / copper / polybutylene / polyethylene / ABS / CPVC / PVC
- Based on temperature and pressure rating
- Minimum 3/4" pipe
- Horizontal pipe at uniform alignment and pitch not less than 1/8 unit vertical in 12 units horizontal 1% slope
- Installed so it can be maintained

## ◆ Heating And Cooling Equipment 1411

- \* Auxiliary or secondary system required where damage to structure is likely – 4 methods
  - Minimum  $\frac{3}{4}$  inch pipe
  - Method 1
    - Auxiliary and secondary drain systems 1411.3.1
    - Discharge to a conspicuous location
    - Minimum depth 1.5”
    - Minimum 3” larger than unit or coils
    - Corrosion resistant materials
    - Metallic pan minimum – .0276”
    - Non-metallic pan minimum – .0625”

## ◆ Heating And Cooling Equipment 1411

- \* Auxiliary or secondary system required where damage to structure is likely – 4 methods
  - Method 2
    - Separate overflow from unit drain pan with equipment **1411.3.1**
    - Discharge to a conspicuous location – alert occupants
    - Connected higher than the primary drain



1280

## ◆ Heating And Cooling Equipment 1411

- \* Condensate disposal **1411.3**
- \* Auxiliary or secondary system required where damage to structure is likely – 4 methods
  - Method 3
    - Auxiliary pan without separate drain line  
Detection and shut off device required  
conforming to UL 508
    - Constructed same as Method 1

## ◆ Heating And Cooling Equipment 1411

- \* Condensate disposal **1411.3**
- \* Auxiliary or secondary system required where damage to structure is likely – 4 methods
  - Method 4
    - Water level detection device conforming to UL 508 that will shut off the equipment served in the event that the primary drain is blocked
    - Device in the primary drain line, overflow drain line or the equipment-supplied drain pan
    - Device located at a point higher than the primary drain line connection and below the overflow rim of pan
  - Down flow furnaces – only method allowed is an overflow detector installed in the drain pan



## ◆ Heating And Cooling Equipment 1411 (

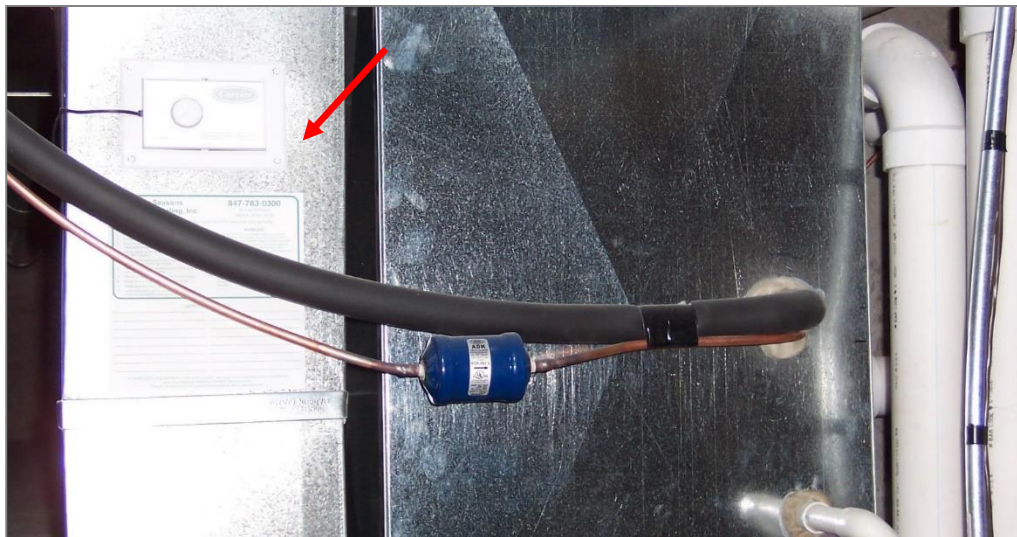
- \* Condensate pumps 1411.4
  - IF: In uninhabitable spaces
  - THEN: Connected so that appliance or equipment served is prevented from operating if pump fails
  - Install per manufacturer's instructions



## ◆ Heating And Cooling Equipment 1411

### \* Refrigeration piping 1411.6 – 1411.8

- Piping and fittings for refrigerant vapor lines shall be insulated minimum R-4 1411.6
- Within 1½ inches from roof deck – protected from nails
- Access port caps secured if outside or not protected



## ◆ Absorption Cooling Equipment 1412

- \* Condensation drain to approved location in an approved manner
- \* Refrigerant piping insulated to prevent condensation
- \* Pressure relief device required, located as not to create hazard
- \* Per UL 1995

## ◆ Evaporative Cooling Equipment 1413

- \* Install in accordance with manufacturer's instructions
- \* Level platform 3" above grade
- \* Water for cooling
  - Backflow protection of potable water per **Section 2902**
- \* Exterior wall openings sealed
- \* Air intake openings per Chapter 3

## ◆ Fireplace Stoves 1414

- \* General 1414.1
  - Per manufacturer
- \* Hearth extensions per listing M414.2
  - Supports same level as hearth
  - Distinguishable from surrounding floor





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Chapter 15  
Exhaust Systems

## ◆ General 1501

- \* Exhaust system: Means of transferring – fumes, moisture, products – from the interior of the building
- \* Outdoor discharge **1501.1**
  - Mechanical exhaust cannot discharge air to attic, soffit, ridge vent or crawl space.
    - Except: Whole house ventilation-type fans for private attics



## ◆ Clothes Dryer Exhaust 1502

- \* Independent of all other systems
- \* Exhaust duct terminate outdoors
- \* Per manufacturer
- \* If no instructions are available terminate a minimum of 3' from building opening **1502.3**
- \* Back draft damper installed





## ◆ Clothes Dryer Exhaust 1502

- \* Dryer exhaust ducts 1502.4
  - Smooth duct construction and installation
  - Minimum 4 inch duct
  - No screens in duct or termination
  - Back draft damper required
  - No sheet metal screw which protrude more than 1/8 inch
    - Section 2439.7.2 allows screws not to exceed 1/8” into duct work
  - Minimum thickness of exhaust duct – .0157” rigid metal

## ◆ Clothes Dryer Exhaust 1502

- \* Dryer exhaust ducts **1502.4**
  - Smooth interior finish
  - Joints running in direction of flow **1502.4.2**
  - Supported at 12' intervals
  - Transitions duct maximum 8' – listed per UL 2158A **1502.4.3**
  - When installed concealed will not deform duct



2 x 4 stud – 4 inch duct

Correct?

## ◆ Clothes Dryer Exhaust 1502

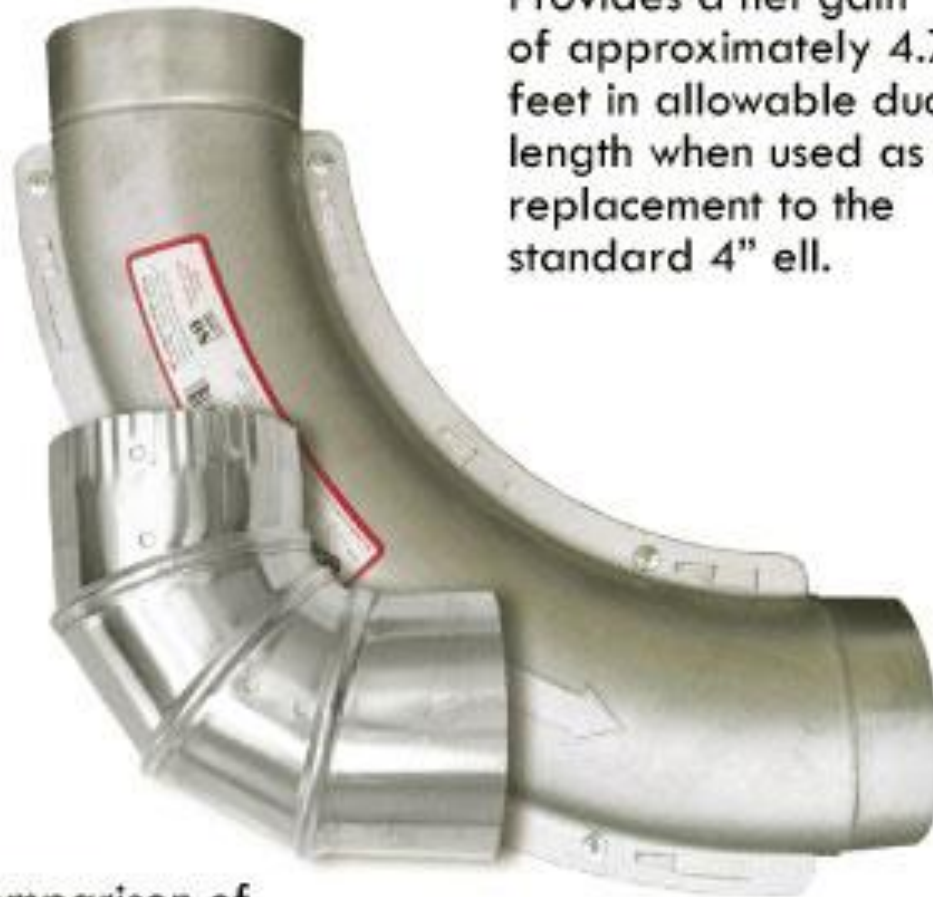
- \* Dryer exhaust ducts 1502.4
  - Dryer exhaust duct power ventilators 1502.4.4
    - Conform to UL 705
    - Install per manufacturer's directions



## ◆ Clothes Dryer Exhaust 1502

- \* Dryer exhaust ducts 1502.4
  - Duct length 1502.4.5
  - Maximum length 35' or manufacturer's instruction 1502.4.5.1
    - Does not include the transition fitting
    - Fitting length per Table 1502.4.5.1
    - Duct length and size can conform to the manufacturer
    - Catalog cut available at the concealment inspection
    - Equivalent length of concealed duct permanently identified within 6' of dryer vent connection 1502.4.6
    - Length of duct with power exhaust per manufacturer

Provides a net gain  
of approximately 4.7  
feet in allowable duct  
length when used as a  
replacement to the  
standard 4" ell.



comparison of  
two ells



- \* Duct to be provided at every dryer space 1502.4.7



# ZIGGY

by Tom Wilson & TOM II



## ◆ Domestic Cooking Exhaust Equipment 1503

- \* Domestic kitchen equipment **1503.2**
  - Required when exhaust equipment is provided
  - Applies to range hoods and down-draft appliances
    - When not integral with appliance – UL 507
    - Integral equipment shall comply – UL 507
    - Integral downdraft – ANSI Z 21.1 or UL 858
    - Microwave over cooktop with exhaust – UL 923



## ◆ Domestic Cooking Exhaust Equipment 1503

### \* Domestic kitchen equipment 1503.2

#### • Open-top broilers 1503.2.1

- Metal exhaust
- Minimum thickness 0.0157 inches thick (No. 28 gage)
- ¼ inch clearance around hood
- 24 inch clearance above cook top
- Hood width equal to unit and extend over entire cook top

## ◆ Domestic Cooking Exhaust Equipment 1503 *(continued)*

### \* Exhaust discharge 1503.3

- Discharge to the outdoors (not attic, crawl space or inside building)
- Smooth interior finish and air tight
- Backdraft damper required
- Independent of all other systems

## ◆ Domestic Cooking Exhaust Equipment 1503

### \* Duct material 1503.4

- Duct material can be galvanized steel, stainless steel, aluminum or copper
  - Some down drafts can use PVC – 4 criteria

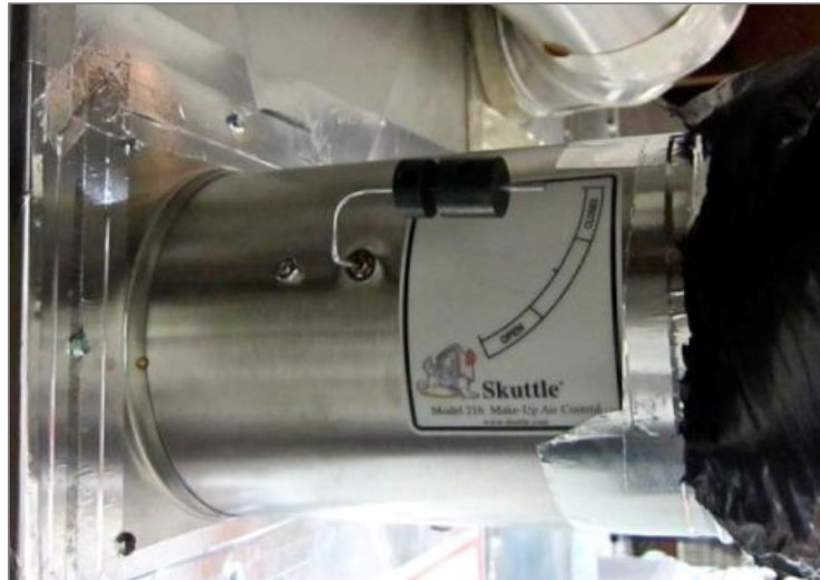
### \* Kitchen exhaust rates 1503.5

- Per Table 1504.2

TABLE 1504.2  
DUCT LENGTH

DUCT TYPE	FLEX DUCT								SMOOTH-WALL DUCT							
Fan airflow rating (CFM @ 0.25 inch wc <sup>a</sup> )	50	80	100	125	150	200	250	300	50	80	100	125	150	200	250	300
Diameter <sup>b</sup> (inches)	Maximum length <sup>c, d, e</sup> (feet)															
3	X	X	X	X	X	X	X	X	5	X	X	X	X	X	X	X
4	56	4	X	X	X	X	X	X	114	31	10	X	X	X	X	X
5	NL	81	42	16	2	X	X	X	NL	152	91	51	28	4	X	X
6	NL	NL	158	91	55	18	1	X	NL	NL	NL	168	112	53	25	9
7	NL	NL	NL	NL	161	78	40	19	NL	NL	NL	NL	NL	148	88	54
8 and above	NL	NL	NL	NL	NL	189	111	69	NL	NL	NL	NL	NL	NL	198	133

- ◆ Domestic Cooking Exhaust Equipment 1503
- ◆ Make-up air required 1503.6
  - Equipment not direct vent or mechanical draft venting
  - When exhausting  $> 400$  CFM
  - Passive or mechanical make up required
  - Rate equal the exhaust rate



## ◆ Domestic Cooking Exhaust Equipment 1503

### \* Make-up air required 1503.6

#### • Location 1503.6.1

- Air shall discharge into room with exhaust or
- Rooms that connect with permanent openings

#### • Dampers 1503.6.2

- Damper to be gravity or electrically operated
- Damper to automatically open when exhaust hood operate
- Access for inspection without removing permanent construction
- Gravity or barometric damper not used
- Provide air flow at a pressure differential of 0.01" of wc

- ◆ Exhaust Ducts and Exhaust Openings 1504
  - \* Follow this Chapter or Chapter 16
  - \* Duct length per Table 1504.2
    - Exception: Per manufacturer or flow rate verified
  - \* Termination:
    - > 3' from property line
    - > 3' from operable or non-operable openings
    - > 10' from mechanical air intakes – or 3" above

## ◆ Mechanical Ventilation 1505

- \* Where local or whole house mechanical is provided follow this chapter
- \* Exhaust air from bathrooms and toilet rooms not to be re-circulated



- \* Exhaust air from bathrooms and toilet rooms not to be exhausted into attic, crawl space or other area inside the building
- \* Not prohibit ductless range hoods
- \* Equipment per ANSI/AMCA 210 – ANSI/ASHARE 51

## ◆ Mechanical Ventilation 1505

- \* Whole-house mechanical ventilation system 1505.4
  - One or more supply or exhaust fan
  - Outdoor air ducts connected to the returns can be the supply
  - Manual controls required



## ◆ Mechanical Ventilation 1505

### \* Whole-house mechanical ventilation system 1505.4 (continued)

- Mechanical ventilation rates 1505.4.3
  - Rates per Table 1505.4.3(1) or
  - Per calculation of equation #1

Ventilation rate in cubic feet minute =  
(0.01 x total square foot area of house) +  
[7.5x (number of bedrooms + 1) ]

Exception: Operate intermittently with controls  
for 25% for each 4 hour segment with a rate per  
Table M 1505.4.3(1) adjusted per Table M  
1505.4.3(2)

## ◆ Mechanical Ventilation 1505

- \* Whole-house mechanical ventilation system 1505.4
  - Local exhaust systems designed per Table 1505.4.4
  - Table 1505.4.4
    - Minimum Required Local Exhaust Rates for One- and Two-Family Dwellings

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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**Chapter 16  
Duct Systems**

## ◆ Duct Construction 1601

### \* Duct design 1601.1

- Per ACCA Manual D, or
- Manufacturer's instruction or
- Other approved methods
- Above-ground duct systems 1601.1.1
  - Temperature limit 250° F
  - Factory made ducts comply with UL 181 and installed per manufacturer's instructions



## ◆ Duct Construction 1601

### \* Duct design M1601.1

- Above-ground duct systems M1601.1.1
  - Fibrous ducts conform to SMACNA or NAIMA
  - Field or shop fabricated per SMACNA except as allowed by Table 1601.1.1
  - Gypsum return air ducts limited to 125° F and not subject to condensation
  - Maximum flame spread of 200



\* **Table 1601.1.1** Duct Construction Minimum Sheet Metal Thickness for Single Dwelling Units

ROUND DUCT DIAMETER (inches)	STATIC PRESSURE			
	$\frac{1}{2}$ inch water gage		1 inch water gage	
	Thickness (inches)		Thickness (inches)	
	Galvanized	Aluminum	Galvanized	Aluminum
≤ 12	0.013	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			
	$\frac{1}{2}$ inch water gage		1 inch water gage	
	Thickness (inches)		Thickness (inches)	
	Galvanized	Aluminum	Galvanized	Aluminum
≤ 8	0.013	0.018	0.013	0.018
9 to 10	0.013	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

## ◆ Duct Construction 1601

### \* Duct design 1601.1

#### • Above-ground duct systems 1601.1.1

##### – Stud cavity and joist space plenums

Not permitted for supply air

Not part of rated assembly

Not to convey air from more than one floor

Fire-blocking per the building code

Stud space in outside walls not as a plenum

All dampers and controls require access

## ◆ Duct Construction 1601

### \* Duct design 1601.1

- Underground duct systems
  - Approved concrete, clay, metal or plastic
  - Plastic duct – maximum temperature 150 degrees F
  - Metal duct – protected from corrosion or encased in concrete – 2”
  - Slope to drainage point with access
  - Sealed or taped before encased and tested
  - Tightness per 1103.3
  - Metal duct with approved coatings or non metallic per manufacturer



## ◆ Duct Construction 1601

### \* Duct in 1601.3

- Maximum flame spread 25, smoke developed <50 per ASTM E 84
- Not flame. Smolder or smoke at operating temperature
- External reflective insulation labeled every 36"
- Spray applied polyurethane foam in attics and crawl spaces permitted with conditions

## ◆ Duct Construction 1601

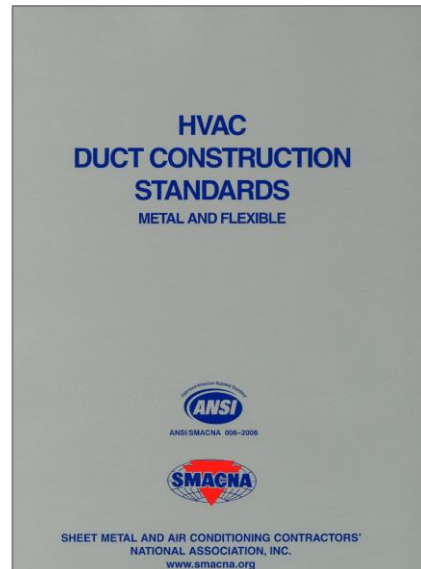
- \* Duct insulation material **1601.3**
  - Maximum flame spread 25, smoke developed 450
  - Ignition barrier
  - Complies with **Section 316** (Foam Plastics)



## ◆ Duct Construction 1601

### \* Installation 1601.4

- Joints and seams per SMACNA HVAC Duct Construction Standards – Metal and Flexible, and NAIMA Fibrous Glass Duct Construction Standards
  - Longitudinal, transvers, connections
  - Per UL 181 A-P based on type of system



## ◆ Duct Construction 1601

### \* Installation 1601.4

#### • Duct lap 1601.4.2

- Round and oval – minimum of one inch in direction of flow

Plastic joint per manufacturer

- Supported per manufacturer's instructions
- Field fabricated ducts supported per SMACNA Fibrous Glass Duct Construction Standards, and NAIMA Fibrous Glass Duct Construction Standards

## ◆ Duct Construction 1601

### \* Installation 1601.4

- Fire-blocking 1601.4.5 per Section 602.8
- Insulated when installed in non-conditioned spaces 1601.4.6
- Insulation not penetrate fire blocked wall or floor
- 4" separation from earth 1601.4.8
- When penetrate garage, 26 gage, no openings 1601.4.9 and 302.5.2

## ◆ Duct Construction 1601

### \* Under floor plenums 1601.5

- Prohibited in new construction
- Modification to existing – comply with current code
- Loose combustible scrap removed / tightly enclosed
- Ground covered with moisture barrier / Min. 4 mils  
1601.5.1
- Plumbing waste cleanouts and gas pipe not permitted in space
- Maximum flame spread 200 1601.5.2

## ◆ Duct Construction 1601

- \* Under floor plenums 1601.5
  - Furnace duct to extend 6" below combustibles
  - Access via 18" x 24" opening
  - Start fan when reach 150°F max
  - Furnace outlet temp limit switch at 200°F max 1601.5.5
- \* Systems that supply living space shall not supply or return to garage 1601.6

## ◆ Return Air 1602

- \* Outdoor air openings 1602.1
  - Located per 303.5.1 and protected per 303.6
- \* Return air openings 1602.2
  - Not closer than 10' from appliance in room
  - Return not greater than supply
  - Return and supply per manual D
  - Flammable vapors present or located within 10' of public way, driveway or sidewalk



## ◆ Return Air 1602

- \* Return air openings 1602.2
  - Not from closets, bathrooms, kitchens, garages, mechanical and furnace rooms, other dwelling units
  - Not from a swimming pool area
  - Cannot discharge into another dwelling unit
  - Return air taken from any room or space shall be not greater than the flow rate of supply air
  - Direct vent OK
  - Outdoor air inlets screened – ¼” to ½” per 303.6



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**Chapter 17  
Combustion Air**

## ◆ General 1701

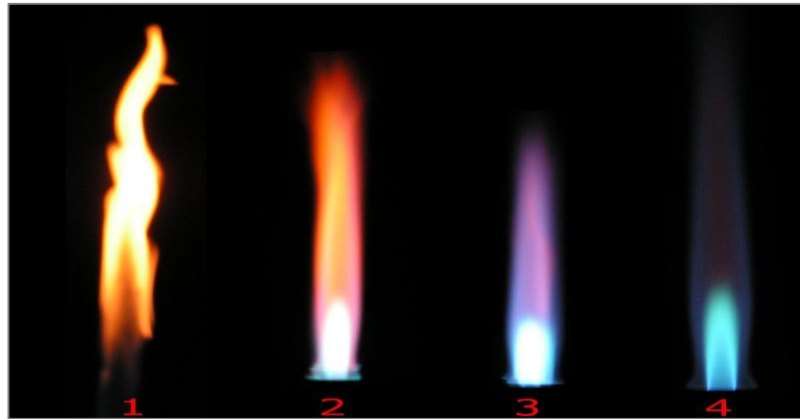
- \* Solid fuel appliances per manufacturers' installation instructions
- \* Combustion air for gas fired appliances **2407**
- \* Oil appliances per NFPA 31
  - Air in flood hazard areas
  - Lowest floor minimum 1' above base foot elevation  
**1701.2, 322.2.2.1 and 322.3.2**



Note: This chapter does not apply to fireplaces, fire place stoves and direct vent appliances

## ◆ Effects of Inadequate Combustion Air

- \* Produces poisonous, corrosive and combustible by-products when combustion is incomplete
- \* Creates environment that leads to oxygen depletion
- \* Inadequate cooling of appliance causes appliance to work harder, leading to shorter appliance life



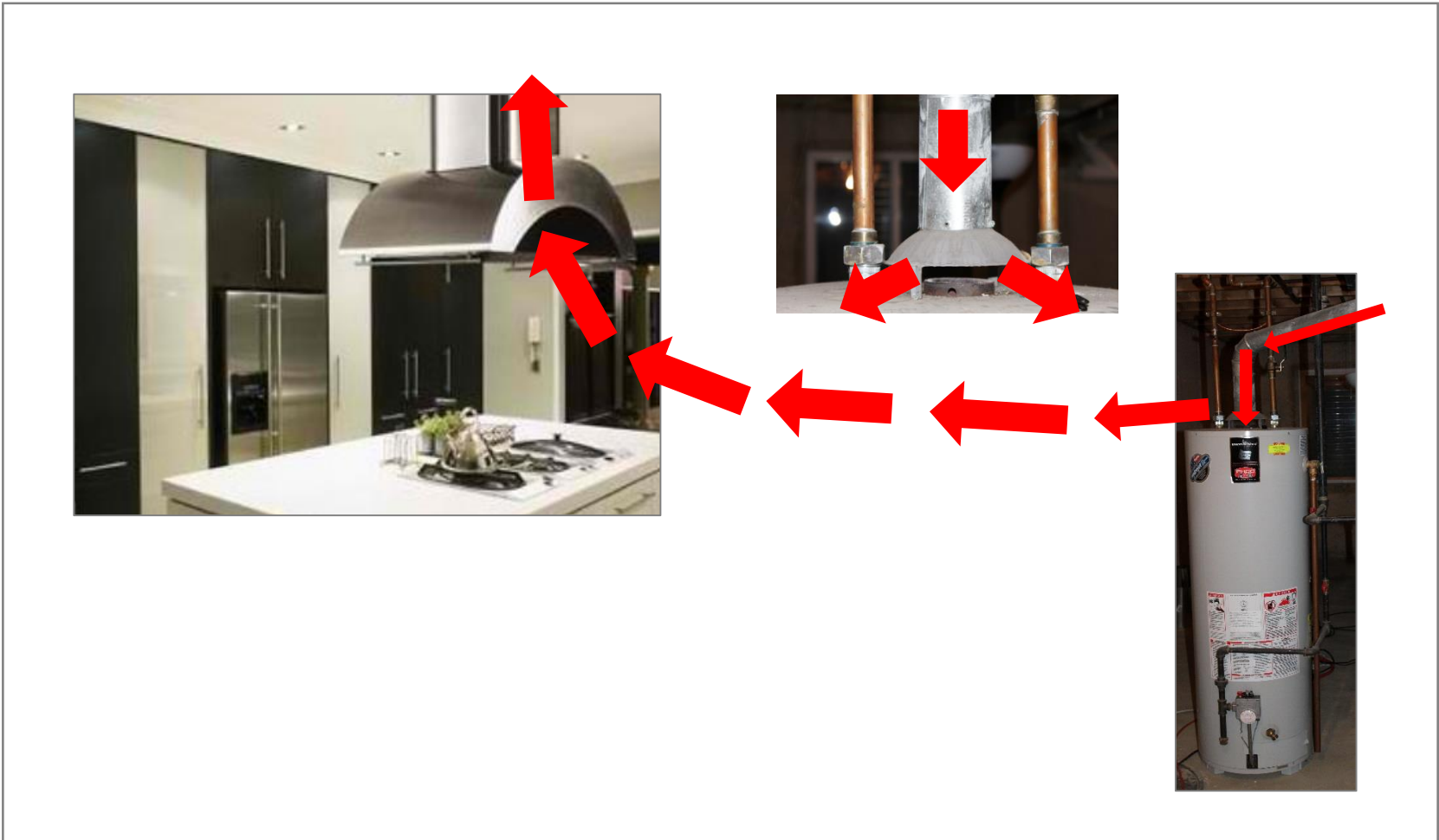
Low Combustion Air → Adequate Combustion Air

## ◆ Effects of Inadequate Combustion Air (*continued*)

- \* Incomplete combustion causes soot, increased levels of carbon monoxide, appliance malfunction and risk of fire
- \* Appliances shall be installed to allow the free circulation of air within the space
- \* Simultaneous operation of all appliances shall be considered when determining combustion air



- \* Avoid “going negative” due to excessive exhaust CFM with inadequate makeup air





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**Chapter 18  
Chimneys and Vents**

## ◆ General 1801

- \* Fuel burning appliances to be vented per manufacturer
- \* Listed unvented appliances can be used
- \* Gas fired per **Chapter 24**
- \* Draft requirements **1801.2**
  - Create a positive flow to convey combustion products to outside



## ◆ General 1801

### \* Existing chimneys 1801.3

- Resizing required when adding or removing an appliance
- Free of obstructions, cracks, perforations, gaps and other damage and cleaned
- Masonry requires a cleanout per 1003.17
  - Clearances per manufacturer

Except: Chimney lining systems listed and labeled for contact with combustibles

## ◆ General 1801

- \* Existing chimneys **1801.3**
  - Using existing masonry chimney as raceway for DVSCC appliance vents
- \* Space around flue cannot be used to vent other appliances **1801.4**



## ◆ General 1801

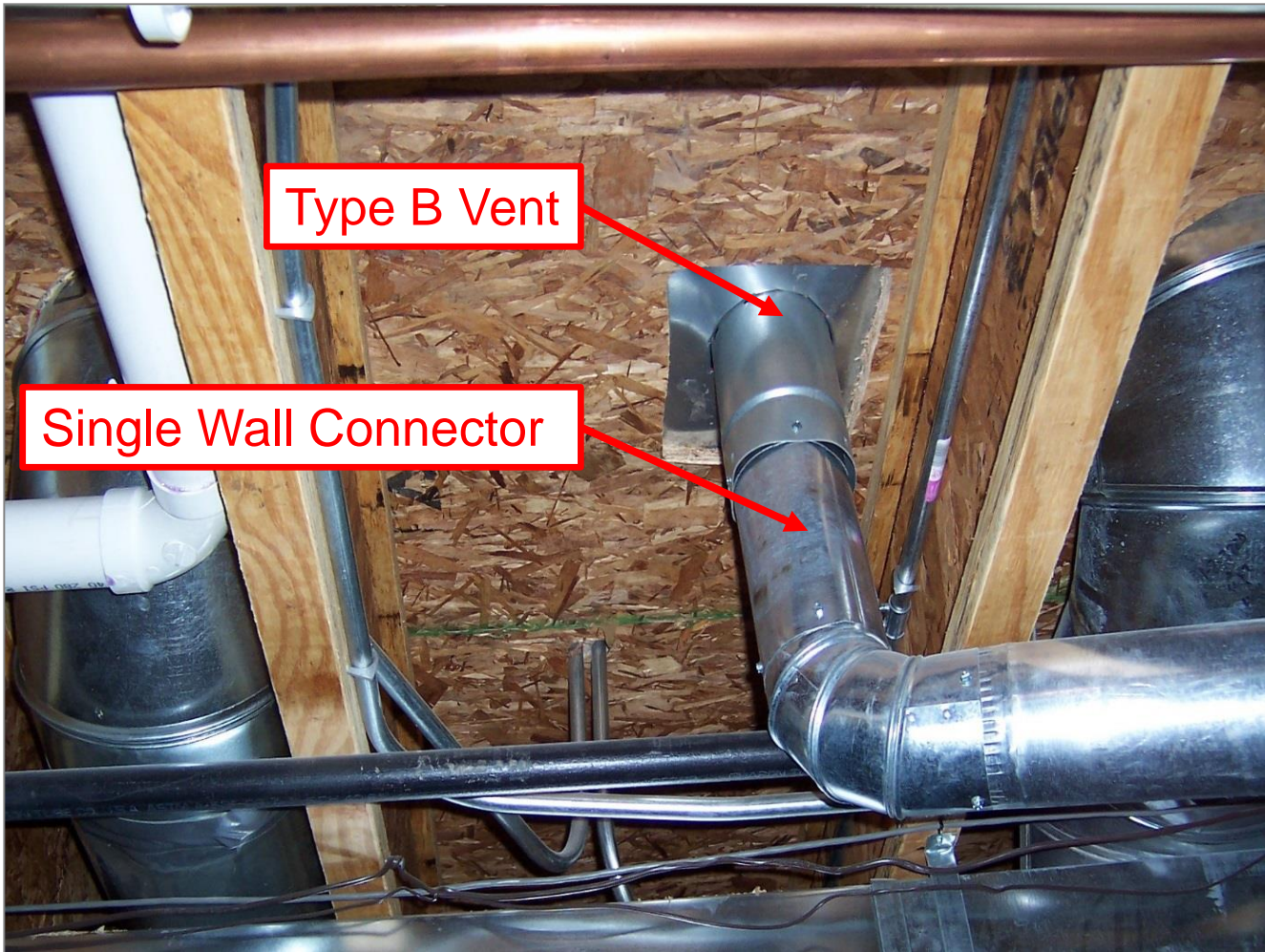
- \* Masonry chimneys and factory-built fireplaces constructed per the **International Building Code / International Residential Code**



## ◆ General 1801

- \* Mechanical draft only for appliances listed for mechanical draft **1801.5**
- \* Vent system adequately supported **1801.7**
- \* Not through a return or supply / duct or plenum **1801.8**
- \* Properly fire-blocked **1801.9**
- \* Unused openings to be closed or capped **801.10**
  - Solid-fuel burning vent cannot connect to a vent for another appliance **1801.12**

- \* Natural gas burning appliance vent connection to double-wall Type "B" gas vent





## ◆ General 1801

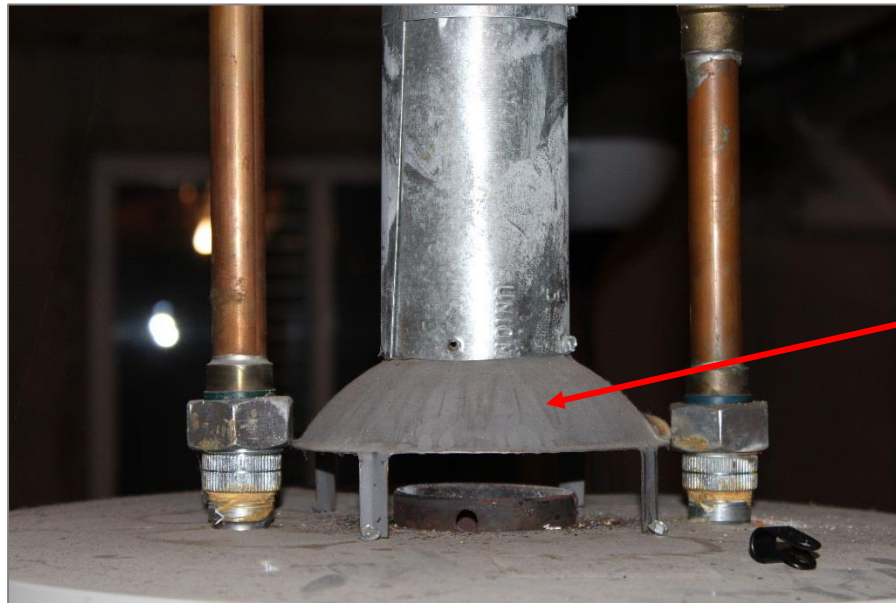
- \* Multiple appliance venting system **1801.11**
  - Appliances on the same floor
  - Inlets offset
  - Natural draft appliance shall not be connected to mechanical draft system under positive pressure



- \* Solid fuel-burning vent cannot connect to a vent for another appliance **1801.12**

## ◆ Vent Components 1802

- \* Draft hoods in the same room as appliance **1802.1**
  - Manually operated dampers permitted on solid fuel appliances only **1802.2.1**
  - Automatic dampers per UL 17 **1802.2.2**
    - Interlocked with burner



Draft hood on  
natural gas  
water heater

## ◆ Chimney and Vent Connectors 1803

- \* Connectors – connect appliance to vertical chimney or vent
- \* Thickness per **Table 1803.2**
- \* Within space where appliance located
- \* Installation per manufacturer **1803.3**
- \* Connectors sloped 1/4” per foot
- \* Short and straight as possible
- \* Properly supported and fastened with screws or rivets
- \* Connector shall not pass through floor or ceiling
- \* Connector shall not pass through wall or partition unless a listed device is used



## ◆ Chimney and Vent Connectors 1803

### \* Installation 1803.3

- Length 1803.3.2
  - Uninsulated horizontal connector shall not exceed 75% of the height of the vertical portion of vent above the connector
- Connector at least the size of appliance flue collar 1803.3.3
- Clearance to combustibles per Table 1803.3.4
- Connector accessible entire length 1803.3.5



## ◆ Chimney and Vent Connectors 1803

- \* Connection to fireplace flue 1803.4
  - Non-combustible seal below point of connection 1803.4.1
  - Access for inspection and cleaning
  - Listed appliance connected to the flue 1803.4.2
  - Connector from appliance to flue 1805.3.1
    - Minimum size of flue
    - Maximum 3 times the area

## ◆ Vents 1804

- \* Listed and labeled venting systems required per **Table 1804.1**
- \* Termination per manufacturer



## ◆ Vents 1804

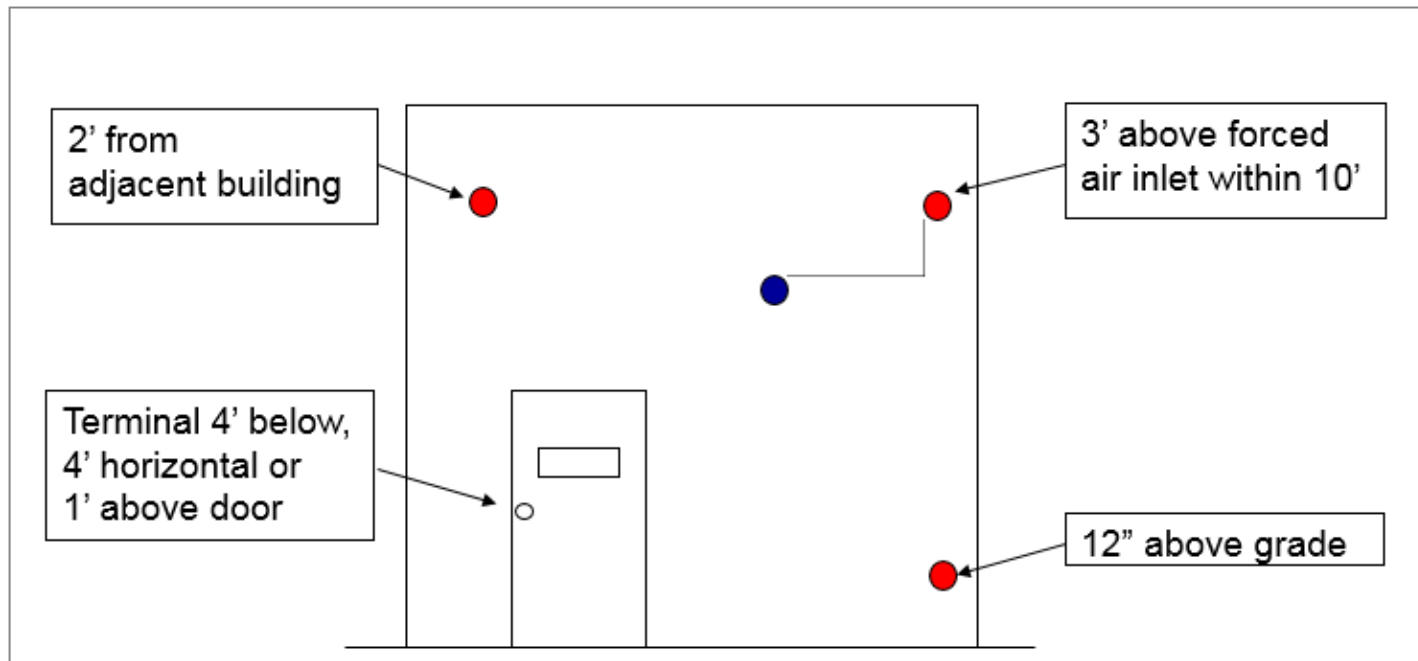
### \* Termination 1804.2

- Decorative shrouds at termination of vents listed and installed per manufacturer 1804.2.2
- Natural draft appliances 5' above highest connected appliance 1804.2.3
- Natural draft gas vented wall furnaces 12' above bottom of furnace 1804.2.3
- Type L vents 2-10 rule 1804.2.4
  - Minimum 2' above highest point



## ◆ Vents 1804

- \* Termination 1804.2
  - Direct vent appliances 1804.2.5
    - Per manufacturer's specifications
  - Mechanical draft 1804.2.6



## ◆ Vents 1804

- \* Installation Type L and pellet vents **1804.3**
  - Individual vent equal to the size of the connector not less than 7 square inches
- \* Door swing **1804.4**
  - Appliance and equipment vent terminals placed so that doors cannot swing with 12"

## ◆ Masonry and Factory Built Chimneys 1805

- \* Installed per **Section 1003** and **Section 1005**
- \* Chimney connector enter masonry chimney 6" above lowest part of flue
- \* Sized not less than largest connector plus 50% of remaining chimney connectors
  - Exception: Oil-fired appliances per NFPA 31



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**Chapter 19  
Special Appliances,  
Equipment and Systems**

## ◆ Ranges and Ovens 1901

### \* Clearances 1901.1

- 30" vertical clearance to combustibles over cooking appliances
  - Reduce per listing

### \* Ranges and ovens listed and labeled for household use 1901.2

- Installed to not to interfere with combustion air and servicing
- Commercial cooking equipment not installed in a dwelling unit





## ◆ Sauna Heaters 1902

- \* Protected against accidental contact
- \* Not affect operation of heater
- \* Installed per manufacturer's installation instructions
- \* Provide combustion air
- \* Room temperature limit 194° F
- \* Sensor when not integral within 6" of ceiling
- \* Comply with UL 875



## ◆ Stationary Fuel Cell Power Plants 1903

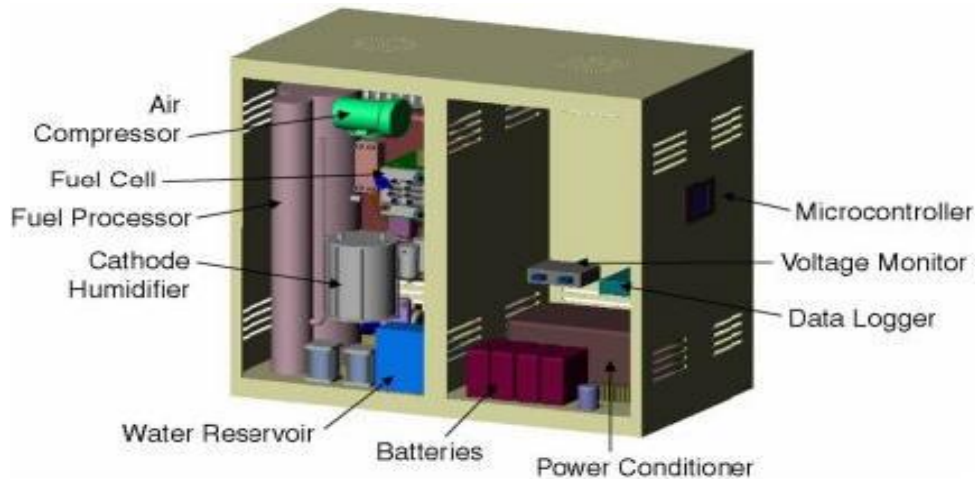
### \* General 1903.1

- Power output less than 1000kW per NFPA 853 & ANSI fc-1Z21.83

## ◆ Gaseous Hydrogen Systems M1904

### \* Installation 1904.1

- Installed per 1307.4; 1903.1; IFC; IFGC; IBC



## ◆ Engine and Gas-Turbine Powered Equipment and Appliances 1905

- \* Engine Driven equipment and appliance
  - Powered by engine driven
  - Permanently installed
  - Per manufacturer's installation instructions
  - Per NFPA 37 – Installation and Use of Stationary Combustion Engines and Gas Turbines

- \* Fuel tanks
  - Engine mounted
  - Located inside buildings
  - Outside the building
  - On a roof
- \* Engine mounted
  - Vented per NFPA 30
  - Adequate clearance
    - Fillings, maintenance, testing
    - Protected from public access and impact
  - Other tanks similar requirements



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**Chapter 20  
Boilers and Water Heaters**

## ◆ Boilers 2001

- \* Per manufacturer's installation instructions **2001.1**
  - Label information
    - Rating data
    - Operating instructions
    - Nameplate permanently attached
  - Flood zone per **322.1.6**
  - Provide combustion air
  - Shut off valve in supply & return
  - Clearance per listing and label
  - Control diagram and operating instructions on site



## ◆ Operating and Safety Controls 2002

- \* Safety controls listed and labeled 2002.1
  - Hot water and steam boilers
- \* Pressure and temperature gages required; must operate in normal range of boiler 2002.2 and 2002.3
- \* Steam boiler water gauge glass and pressure gauge 2002.3
  - Pressure relief valve required
- \* Discharge by gravity to within 18" of floor or receptor 2002.4
- \* Low water cut-off required 2002.5
- \* Operation 2002.6
  - Low water and flow sensing controls automatically stop combustion process

## ◆ Expansion Tanks 2003

- \* Hot water boilers expansion tank required **2003.1**
  - Fastened to structure or boiler
  - Support twice the weight of the tank filled
  - Drain non-pressurized tanks without emptying system
  - Capacity requirements in code
  - Per **Table 2003.2**





## ◆ Water Heaters Used for Space Heating 2004

- \* Used for both, comply with both
- \* Installed per **Chapter 24**, **Chapter 28**, and manufacturer's installation requirements

## ◆ Water Heaters 2005

- \* Various listings – UL
- \* In attics per **1305.1.3**
- \* Fuel fired water heaters locations
  - Not in storage closets
  - When in bedroom or baths – with sealed enclosure – outside combustion air
  - Not applicable to direct vent heaters
  - Provide service access and combustion air



## ◆ Pool Heaters 2006

- \* Per manufacturer's installation instructions
- \* Oil per UL 726, Electric per UL 1261
- \* Clearances not interfere with combustion air, draft hood service access or flue terminal relief
- \* Temperature and pressure relief valves required
- \* Bypass line and valve required





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**Chapter 21  
Hydronic Piping**

- \* Hydronic piping includes piping, fitting and valves used in building space conditioning systems



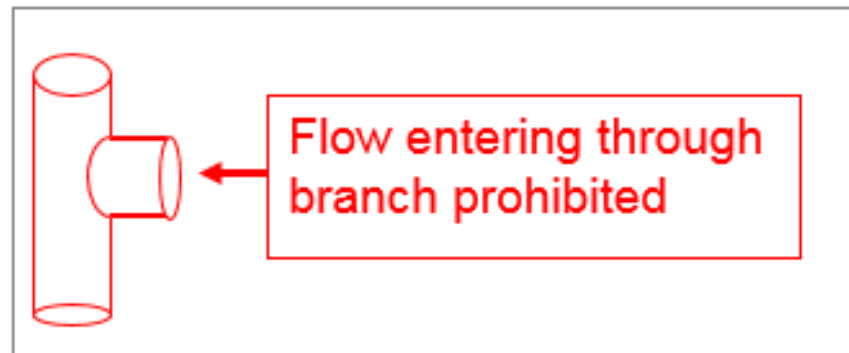
\* Allowable hydronic piping materials **Table** Fuel tanks

**TABLE | 2101.1**  
**HYDRONIC PIPING AND FITTING MATERIALS**

MATERIAL	USE CODE <sup>a</sup>	STANDARD <sup>b</sup>	JOINTS	NOTES
Acrylonitrile butadiene styrene (ABS) plastic pipe	1, 5	ASTM D1527 ASTM F2806 ASTM F2969	Solvent cement joints	—
Chlorinated poly (vinyl chloride) (CPVC) pipe and tubing	1, 2, 3	ASTM D2846	Solvent cement joints, compression joints and threaded adapters	—
Copper and copper-alloy pipe	1	ASTM B42, B43, B302	Brazed, soldered and mechanical fittings threaded, welded and flanged	—
Copper and copper-alloy tubing (Type K, L or M)	1, 2	ASME B16.51, ASTM B75, B88, B135, B251, B306	Brazed, soldered, press-connected and flared mechanical fittings	Joints embedded in concrete shall be brazed
Cross-linked polyethylene (PEX)	1, 2, 3	ASTM F876	(See PEX fittings)	Install in accordance with manufacturer's instructions
Cross-linked polyethylene/ aluminum/cross-linked polyethylene (PEX-AL-PEX) pressure pipe	1, 2	ASTM F1281 or CAN/ CSA B137.10	Mechanical, crimp/insert	Install in accordance with manufacturer's instructions
PEX fittings		ASTM F877 ASTM F1807 ASTM F1960 ASTM F2098 ASTM F2159 ASTM F2735	Copper crimp/insert fittings, cold expansion fittings, stainless steel clamp, insert fittings	Install in accordance with manufacturer's instructions

## ◆ General 2101

- \* Valves, fittings and connection approved, listed for use and installed per manufacturer **2101.1**
- \* Provide system drain down **2101.2**
- \* Backflow protection **2101.3** per **2902**
- \* Openings through concrete or masonry sleeved **2101.4**
- \* Protected against corrosion and physical damage **2101.5**
- \* Drilling and notching per other code sections **2101.6**
- \* Use of tee fittings **2101.7**



## ◆ General 2101

- \* Provisions for expansion, contraction, shrinkage and settlement **2101.8**
- \* Piping support per **Table 2101.9**

**TABLE 2101.9  
HANGER SPACING INTERVALS**

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
ABS	4	10 <sup>a</sup>
CPVC ≤ 1-inch pipe or tubing	3	5 <sup>a</sup>
CPVC ≥ 1 <sup>1</sup> / <sub>4</sub> inches	4	10 <sup>a</sup>
Copper or copper alloy pipe	12	10
Copper or copper alloy tubing	6	10
PB pipe or tubing	2.67	4
PE pipe or tubing	2.67	4

- \* Systems hydrostatically tested at 100 psi not <15 minutes **2101.10**



## ◆ Floor Heating Requirements 2103

- \* Embedment of pipe in concrete or gypsum products
- \* Materials
  - Steel, copper, crossed linked polybutylene, CPVC, cross-linked polyethylene, polypropylene
  - Rated 100 psi at 180° F
  - Steel pipe joints welded
  - Copper tubing brazed, melting point >1,000° F
  - Polybutylene socket type heat fused fittings
  - Must be tested at 100 psi for 30 minutes





- ◆ Low Temperature Piping 2104
  - \* Approved materials per table
- ◆ Ground-Source Heat-Pump System Loop Piping 2105
  - \* Used materials prohibited **M2105.2**
  - \* Piping, tubing and fittings rated for operating temperatures **2105.3**
  - \* Piping and tubing materials per **Table 2105.4**
    - Fitting materials per **Table 2105.5**
      - **2105.4 – 2105.14** info on different pipe type

**TABLE 2105.4  
GROUND-SOURCE LOOP PIPE**

MATERIAL	STANDARD
Chlorinated polyvinyl chloride (CPVC)	ASTM D2846; ASTM F437; ASTM F438; ASTM F439; ASTM F441; ASTM F442; CSA B137.6
Cross-linked polyethylene (PEX)	ASTM F876; CSA B137.5
High-density polyethylene (HDPE)	ASTM D2737; ASTM D3035; ASTM F714; AWWA C901; CSA B137.1; CSA C448; NSF 358-1
Polyethylene/aluminum/polyethylene (PE-AL-PE) pressure pipe	ASTM F1282; AWWA C 903; CSA B137.9
Polypropylene (PP-R)	ASTM F2389; CSA B137.11, NSF 358-2
Polyvinyl chloride (PVC)	ASTM D1785; ASTM D2241; CSA 137.3
Raised temperature polyethylene (PE-RT)	ASTM F2623; ASTM F2769, CSA B137.18

**TABLE 2105.5  
GROUND-SOURCE LOOP PIPE FITTINGS**

PIPE MATERIAL	STANDARD
Chlorinated polyvinyl chloride (CPVC)	ASTM D2846; ASTM F437; ASTM F438; ASTM F439; ASTM F1970; CSA B137.6
Cross-linked polyethylene (PEX)	ASTM F877; ASTM F1807; ASTM F1960; ASTM F2080; ASTM F2159; ASTM F2434; CSA B137.5
High-density polyethylene (HDPE)	ASTM D2683; ASTM D3261; ASTM F1055; CSA B137.1; CSA C448; NSF 358-1
Polyethylene/aluminum/polyethylene (PE-AL-PE)	ASTM F1282; ASTM F2434; CSA B137.9
Polypropylene (PP-R)	ASTM F2389; CSA B137.11; NSF 358-2
Polyvinyl chloride (PVC)	ASTM D2464; ASTM D2466; ASTM D2467; ASTM F1970, CSA B137.2; CSA B137.3
Raised temperature polyethylene (PE-RT)	ASTM D2683; ASTM D3261; ASTM F1055; ASTM F1807; ASTM F2098; ASTM F2159; ASTM F2735; ASTM F2769; CSA B137.1; CSA B137.18

## ◆ Ground-Source Heat-Pump System Loop Piping 2105

- \* Shut offs required **2105.15**
  - Supply and return for heat exchangers
  - Supply and return central utility system
  - Connection to a pressure vessel
  - Both side of a pressure reducing valve
  - Connection to mechanical equipment
  - Connection to non-diaphragm-type expansion tanks

## ◆ Ground-Source Heat-Pump System Loop Piping 2105

- \* Installation per manufacturer's instructions 2105.17
- \* Protection of potable water 2105.18 per 2606.1
- \* Pipe penetrations must be sleeved 2105.19
  - Protect annular space per 2606.1
- \* Clearance from combustibles
  - IF: Exterior of piping  $>250^{\circ}$  F
  - THEN: Provide minimum 1" clearance to combustibles
  - Protect from corrosion and degradation of material
  - Protect pipe from stress, strains, expansion and contraction

## ◆ Ground-Source Heat-Pump System Loop Piping 2105

- \* Pipe properly supported per **Section 2101.9**
  - Water velocity based on type of pipe
- \* Label and mark piping: “Ground-Source Heat Pump Loop System” **2105.25**
  - Label whether antifreeze is in system
    - Label all chemicals in system
  - Testing 100 psi for 15 minutes – no leaks
  - Embedded pipe pressurized before and during placement of concrete



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**Chapter 22  
Special Piping and Storage Systems**

## ◆ Oil Tanks M2201

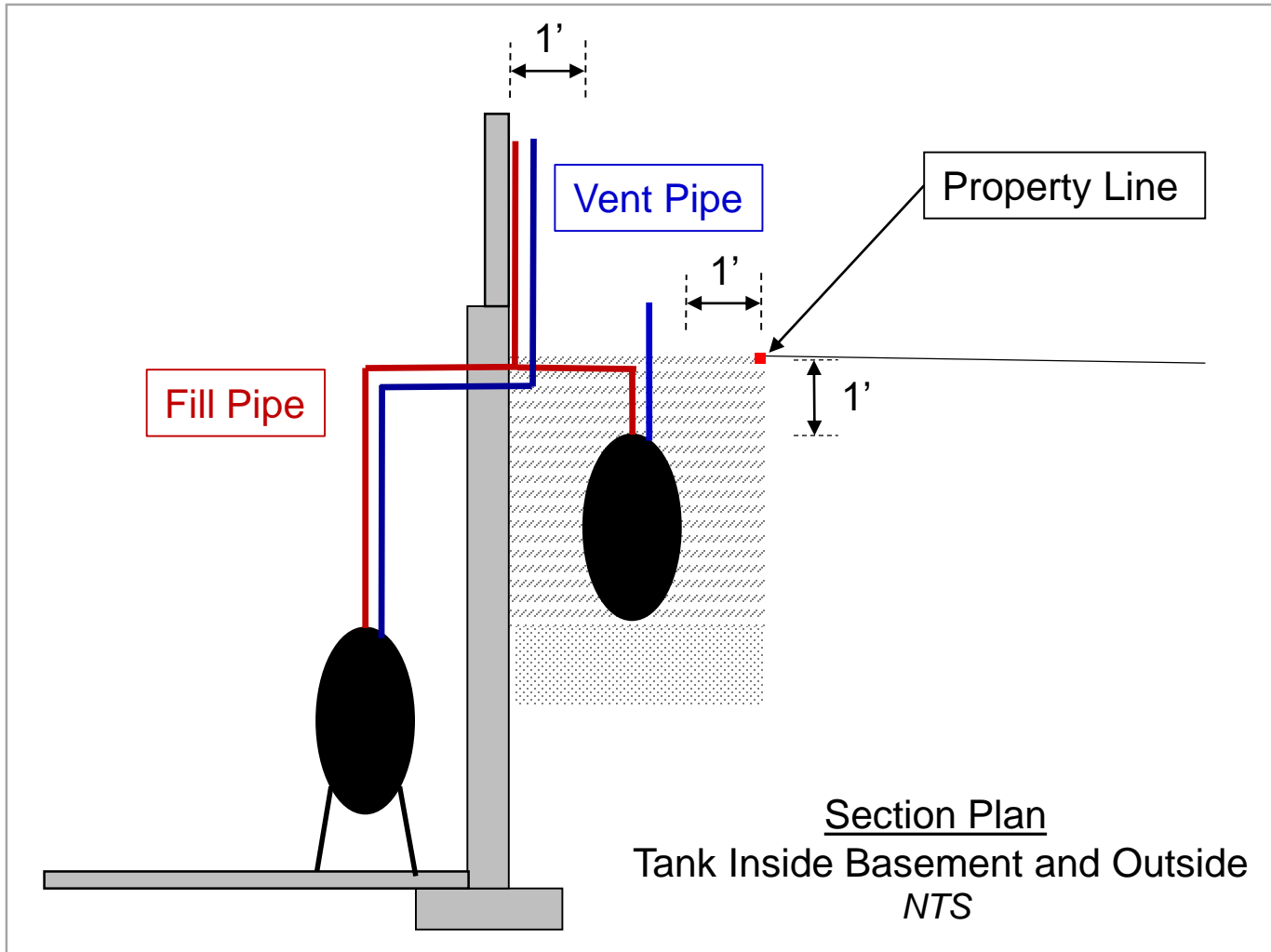
- \* Fuel oil and diesel storage and piping systems
- \* Above ground tanks **2201.2**
  - Fuel supply tanks labeled per UL 58 and UL 80 **2201.1**
  - Maximum fuel storage inside or above ground: 660 gallons
    - For space or water heating sized per NFPA 31
    - Greater than 660 gallons per NFPA 37
  - Tanks supported on rigid non-combustible
  - Tanks inside sized to be removable without cutting **2201.2.1**
  - Larger than 10 gallons at least 5' from flame
  - Outdoor above-ground tanks minimum 5' from property line **2201.2.2**

## ◆ Oil Tanks 2201

- \* Underground tanks 2201.3
  - Not undermine footing foundation
  - Underground tanks minimum 1' from property line, basement or wall
  - Set on and surrounded by inert material
  - Minimum cover 1 foot of inert material
  - Set on and surrounded by inert material
  - Corrosion protection required



- \* Tanks within buildings and underground tanks 2201.2.1 and 2201.3



## ◆ Oil Tanks 2201

- \* Oil gauge required on indoor tank – no glass – unbreakable **2201.5**
- \* Maximum 2 tanks cross connected 660 gal total per **2201.4** and **2201.4.6**
- \* Tank abandonment **2201.7** and removal per **IFC**

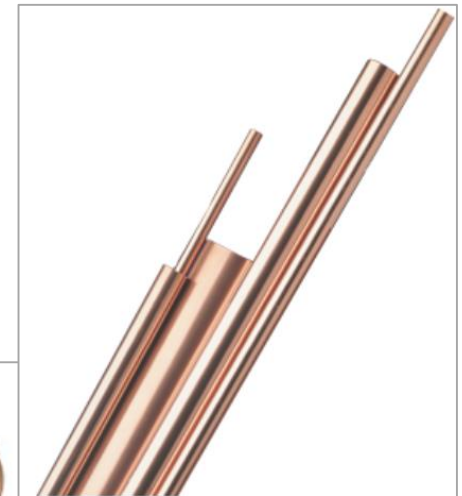


## ◆ Oil Piping, Fittings and Connections 2202

- \* Steel pipe, copper piping or tubing listed for oil piping  
2201.1
- \* Compatible fittings – no cast iron 2202.2
  - Not allowed:
    - Unions requiring gaskets, right or left couplings, solder melting point less than 1,000°F
    - Listed and labeled flexible connections – UL 536

## ◆ Installation 2203

- \* Pipe size and type 2203.2
  - 3/8" pipe, tubing 3/8" outside diameter
  - Copper pipe and tubing type L or heavier
- \* Fill piping terminal at least 2' from openings 2203.3
  - Vent pipe min 1¼"
    - Drain back to tank
    - Not cross connected to fill
    - Enter tank at top
  - Corrosion-resistant coatings



## ◆ Oil Pumps and Valves 2204

- \* Positive displacement pumps with automatic shut-offs  
2204.1
- \* Manual shut-off between tank and burner with ready access  
2204.2
- \* Pressure relief valve when shut-off in discharge
- \* Maximum inlet pressure – 3 psi 2204.3
- \* Fuel oil lines with heaters require relief valves back to return line piping – when excess pressure exists 2204.4



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**Chapter 23  
Solar Thermal Energy Systems**

## ◆ Solar Thermal Energy Systems 2301

- \* Solar energy for space heating or cooling, hot water heating and swimming pool heating 2301.1
- \* Design and installation 2301.2
  - Accessible 2301.2.1
    - Not obstruct doors or windows or other roof mounted equipment



## ◆ Solar Thermal Energy Systems 2301

### \* Design and installation 2301.2

#### • Accessible 2301.2.1

- Not obstruct doors or windows or other roof mounted equipment
- Roof to be constructed to support imposed loads

#### 2301.2.2.1

Collectors as roof covering – comply as a roof

Above the roof – noncombustible or fire retardant treated

Protected from degradation per ICC 900 / SRCC 300



## ◆ Solar Thermal Energy Systems 2301

### \* Design and installation 2301.2

- Piping insulation 2301.2.5
  - Per Chapter 11
  - Protected from ultraviolet degradation
  - Insulate entire loop
- Protect from freezing 2301.2.6

## ◆ Solar Thermal Energy Systems 2301

### \* Design and installation 2301.2

- Drain back not create hazard
- Expansion tanks
  - Installed per section 2003 if contain fluid
  - Per ICC 900/ SRCC 300
- Penetrations to be properly sealed 2301.2.9
- Systems with fluid – pressure, temperature, and vacuum relief required 2301.2.3

## ◆ Solar Thermal Energy Systems 2301

- \* Design and installation 2301.2
  - Solar loops 2301.2.11
    - Isolation valves required
    - Drain and fill valves labeled
    - Warning sign for a discharge at high temperature or pressure
    - Maximum water temperature 180° 2301.2.12
- \* Collectors and panels must be listed and labeled 2301.3



## ◆ Solar Thermal Energy Systems 2301

- \* Heat transfer gases or liquids and heat exchangers 3201.4
  - Flammable gas and liquids shall not be used
  - Heat exchangers to comply with Section 2902.5.2 and SRCC 100 or SRCC 901600
  - Flash point not less than 50° F above system operating temperature
- \* Backflow protection required 2301.5



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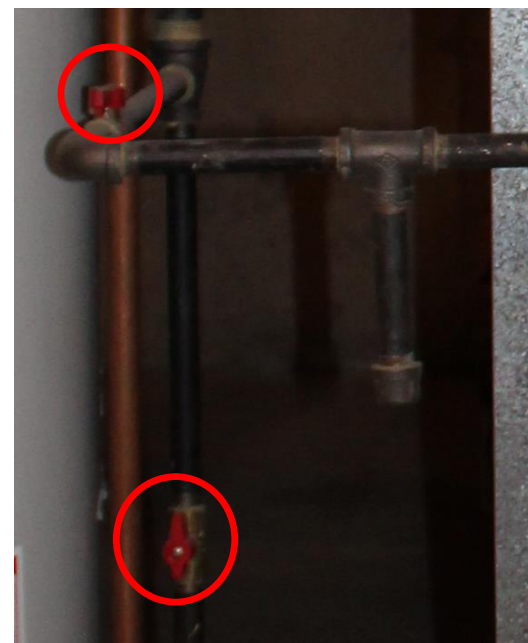
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**Chapter 24  
Fuel Gas**

## ◆ General 2401

- \* Fuel gas piping, utilization equipment and related accessories, venting systems, and combustion air configurations commonly encountered in the construction of one and two family dwellings **2401.1**
- \* Piping system: All fuel piping, valves and fittings from the outlet of the point of delivery to the outlets of the appliance shutoff valves
- \* Point of delivery to appliance shut off



## ◆ General Definitions 2403

- \* Terms not defined in this code shall have meanings as ascribed in other codes 2403.3
- \* This chapter has its own definitions

## ◆ General 2404

- \* Listed and labeled equipment 2404.3
- \* Vibration isolation 2404.4 (
- \* Repairs to maintain original listing or approval requirements 2404.5
- \* Installed to meet expected wind loads 2404.6
- \* Flood zones 2404.7

## ◆ General 2404

- \* Seismic resistance 2404.8
- \* Rodent proofing 2404.9
- \* Category IV condensation appliances shall be provided with an auxiliary drain pan 2404.10
  - Exception: Appliances that have auto shut down operation in the event of a stoppage in the drain system
- \* Condensate pump failure will prevent operation of connected appliance or equipment 2404.11



## ◆ Structural Safety 2405

- \* Building not to be weakened by installation of gas piping
- \* Truss members not to be cut, drilled, notched or spliced
- \* No additional loads without verification of being capable of supporting the load
- \* Prohibits cuts, holes, notches, in engineered wood products including: trusses, glue-laminated members, I-joists and structural composite components
  - Exceptions permitted by manufacturer or engineer design



## ◆ Appliance Location 2406

- \* Per code and listing
- \* Prohibited locations **2406.2**
  - Sleeping rooms / Bathrooms / Toilet rooms
  - Storage closets / Surgical rooms / A space that opens only into the room
  - Exceptions as apply
- \* Outdoor locations **2406.3**
  - Listed or provided adequate protection

## ◆ Combustion, Ventilation and Dilution Air 2407

- \* Provide adequate combustion air
- \* Appliance not interfere with air flow
- \* Draft hoods in same room as appliance **2407.3**
- \* Make-up air **2407.4**
  - Exhaust fans shall be considered in calculations
  - Kitchen ventilation / exhaust fans / dryers / fireplaces



## ◆ Combustion, Ventilation and Dilution Air 2407

### \* Indoor combustion air 2407.5

- Total required sum of all appliances in area
- Rooms communicating directly without doors to be counted
- Standard method for minimum required volume
  - 50 cu ft. per 1,000 Btu input rating
  - Provides minimum volume without outside air
  - Typical appliance information tag – Use input BTU

- \* Class Exercise What is the maximum allowable Btu/h for each area before outside air is required?

10' Ceiling Height



80,000 BTU/hr  
Water Heater



120,000 BTU/hr  
Furnace

80,000 Btu/h  
+ 120,000 Btu/h  
200,000 Btu/h Total

Thus:

$$200,000 \text{ Btu/h} \div 1,000 = 200$$

$$200 \times 50 \text{ cu ft} = \underline{\underline{10,000 \text{ cu ft}}}$$

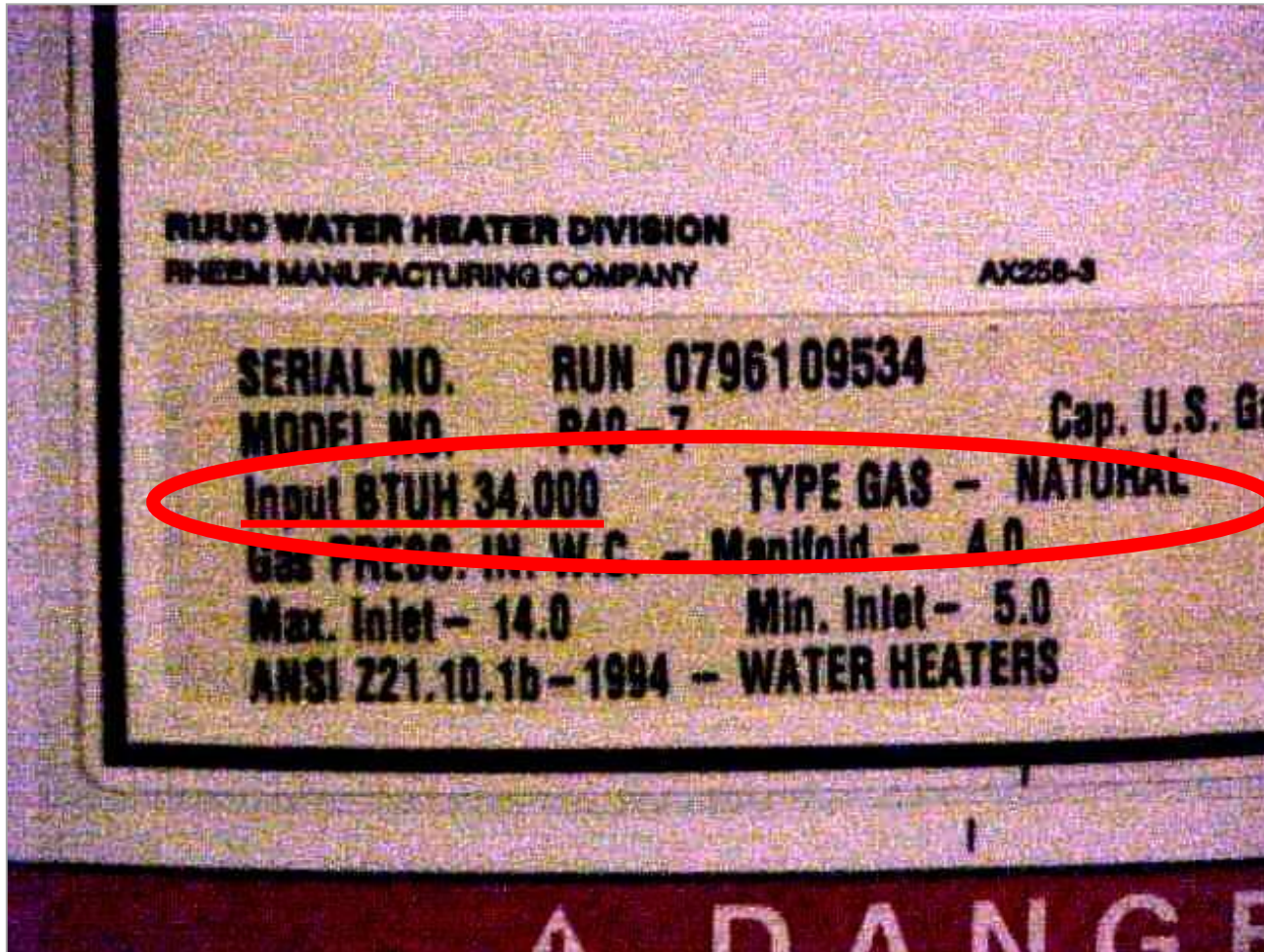
10' High Ceiling

$$10,000 \text{ cu ft} \div 10 = ?$$

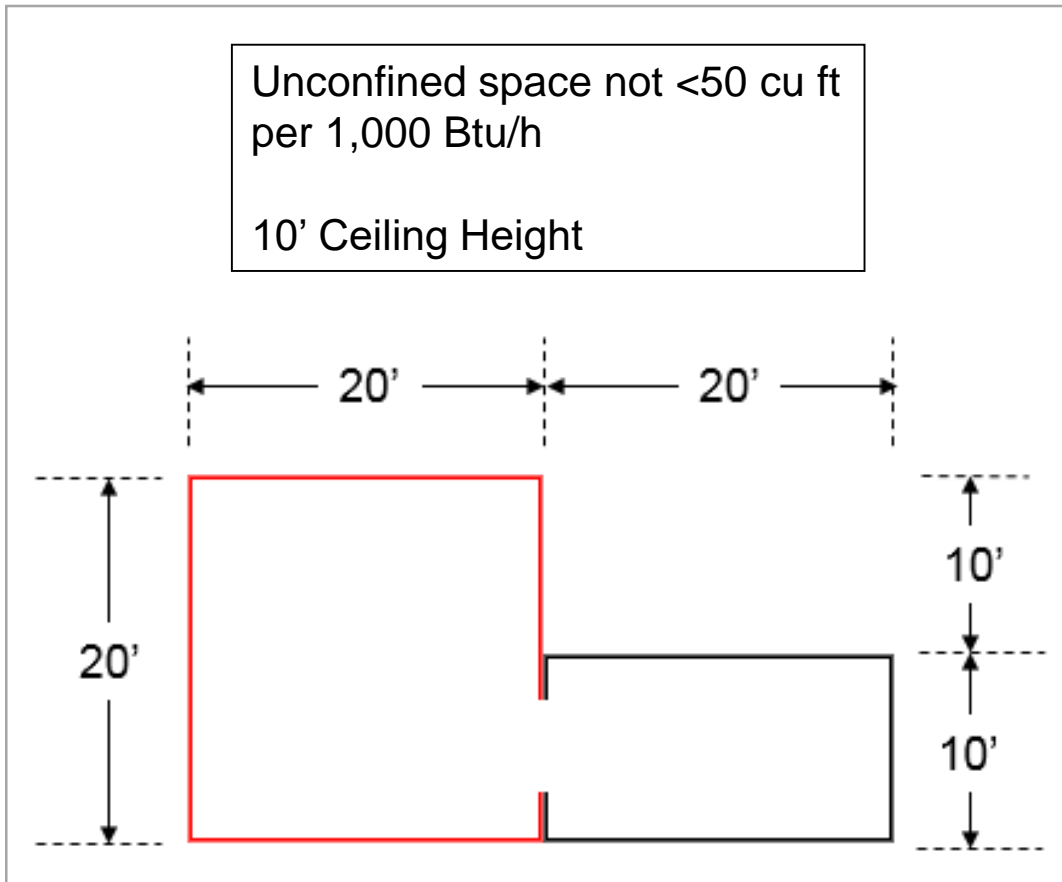
**1,000 sq ft Minimum Req'd**



- \* Typical appliance information tag



- \* Class Exercise – What is maximum allowable Btu/h for each area before outdoor air is required?

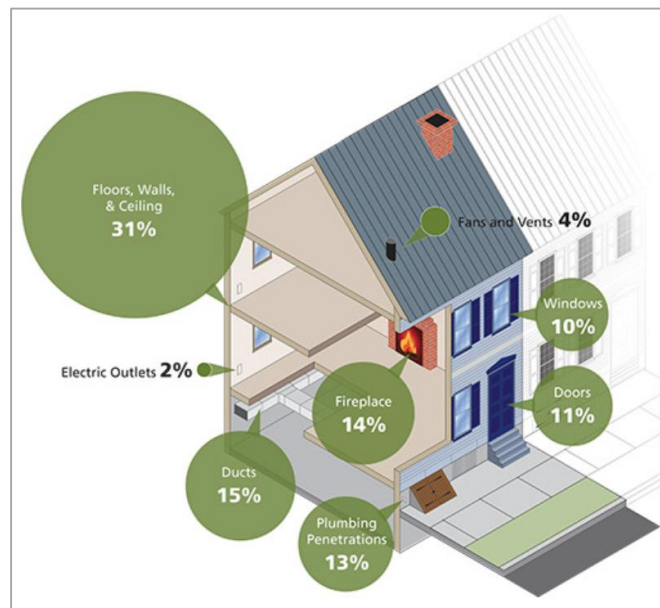


Area 1  
 $20' \times 20' \times 10' = 4,000 \text{ cu ft}$   
 $4,000 / 50 = 80$   
 $1,000 \times 80 = \underline{\underline{80,000 \text{ Btu/h}}}$

Area 2  
 $20' \times 10' \times 10' = 2,000 \text{ cu ft}$   
 $2,000 / 50 = 40$   
 $1,000 \times 40 = \underline{\underline{40,000 \text{ Btu/h}}}$

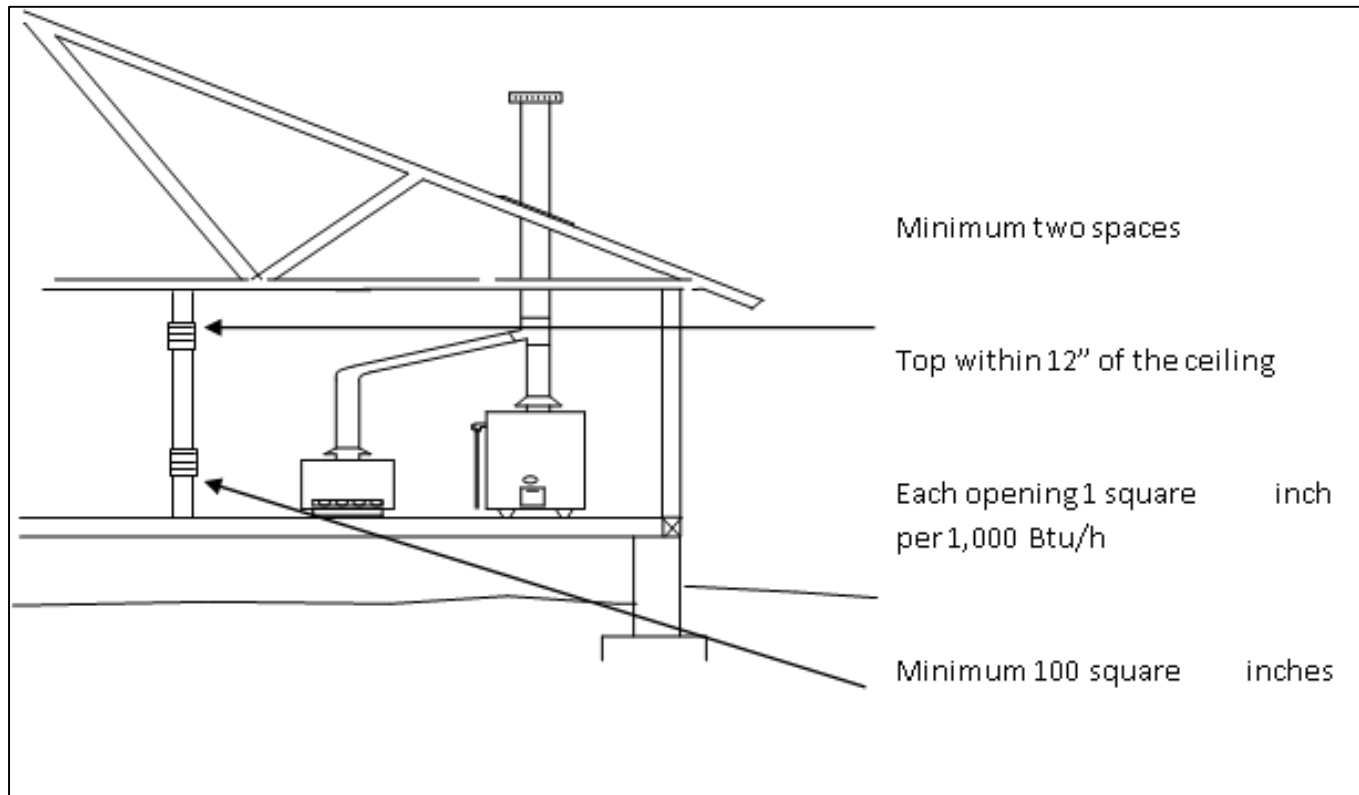
## ◆ Combustion, Ventilation and Dilution Air 2407

- \* Known air infiltration method allows a performance-based proof of sufficient air **2407.5.2**
  - Method for fan assisted and non-assisted units
  - Not used when air infiltration rate is  $>0.60$  ACH (ACH = Air Changes per Hour)





- ◆ Combustion, Ventilation and Dilution Air 2407
  - \* Indoor openings size and location 2407.5.3
  - \* Combining spaces on the same story 2407.5.3.1
    - Free area of 1 square inch per 1,000 Btu not less than 100 square inch
      - For each opening
    - Two openings – 12 inches from top / 12 inches from bottom
    - Minimum size not less than 3 inches

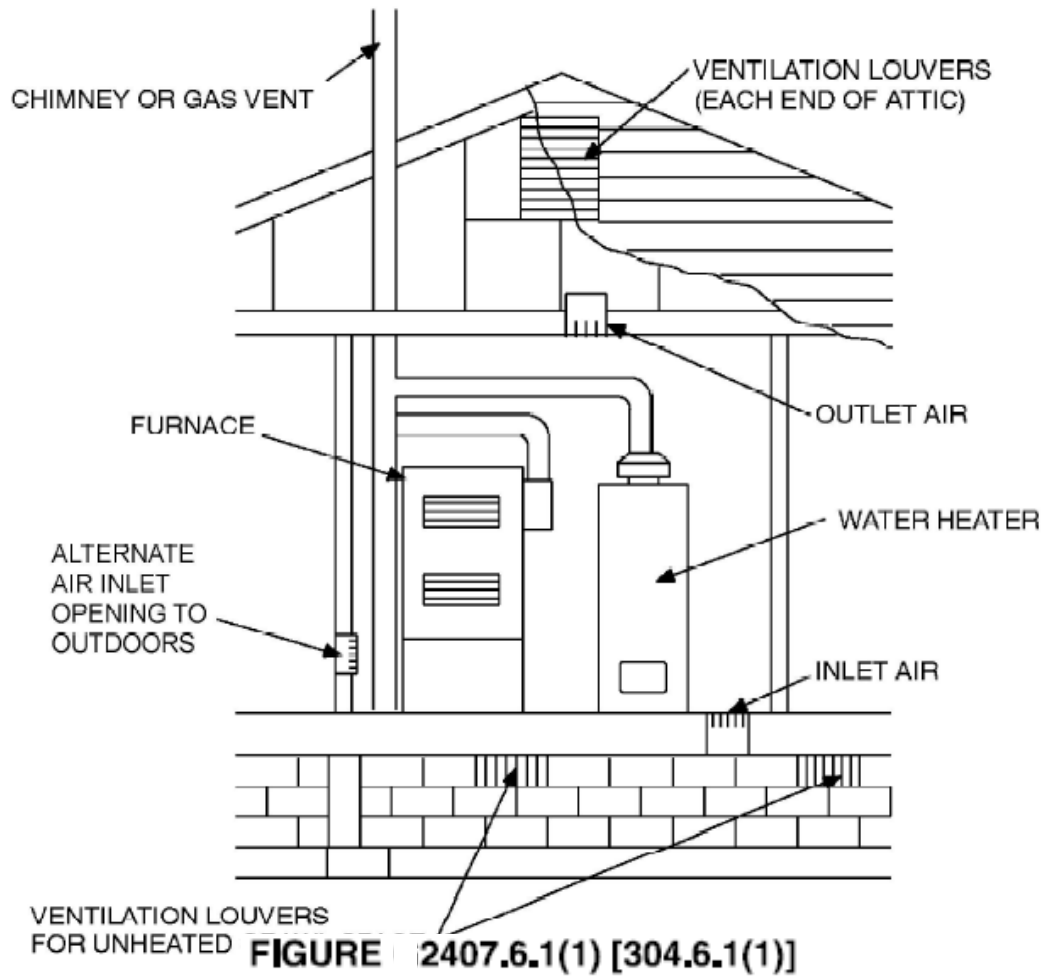


## ◆ Combustion, Ventilation and Dilution Air 2407

### \* Indoor openings size and location 2407.5.3

- Combining spaces on different stor
- One or more permanent openings in doors or floors
- From other stories – openings 2 square inch per 1,000
- 2 openings commencing within 12” of ceiling and floor

\* Figure 2407.6.1



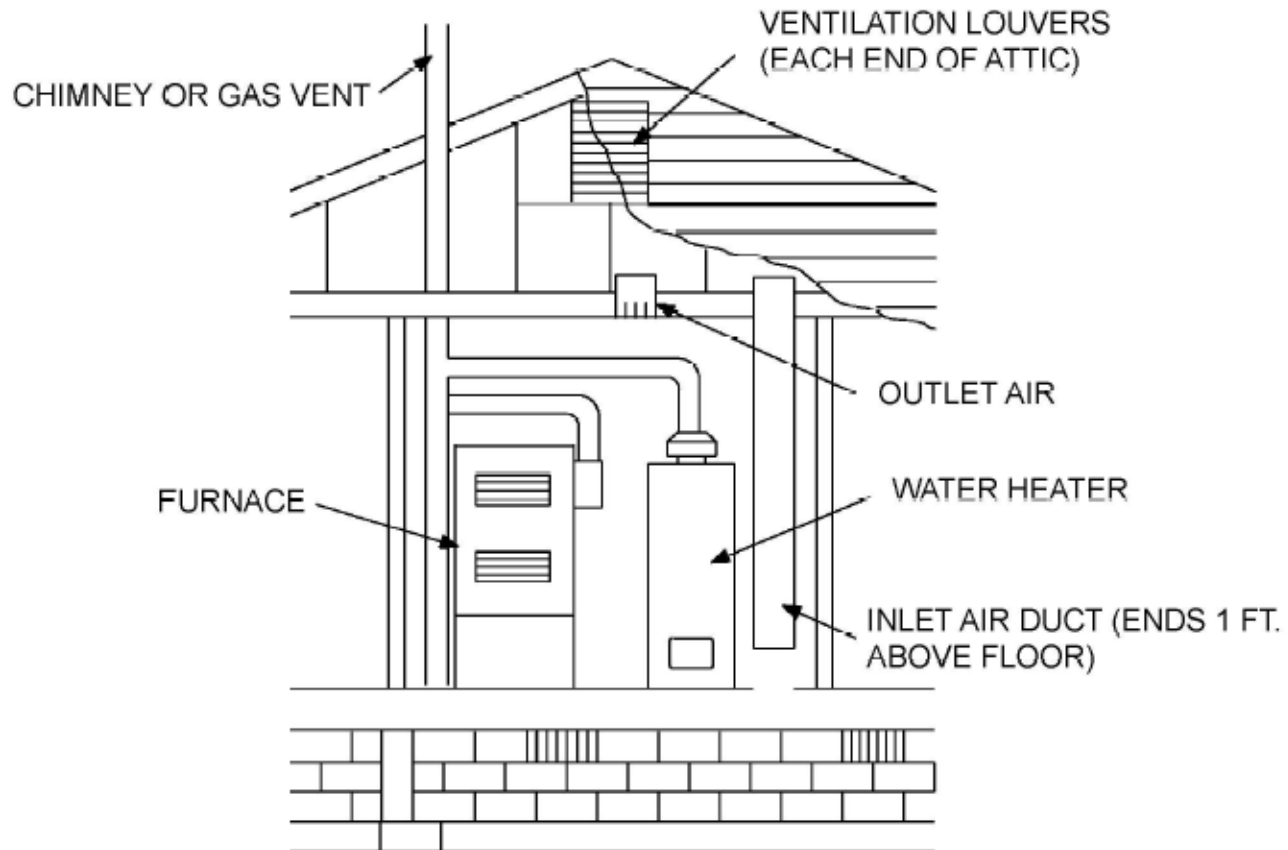
ALL AIR FROM OUTDOORS—INLET AIR FROM VENTILATED CRAWL SPACE AND OUTLET AIR TO VENTILATED ATTIC

## ◆ Combustion, Ventilation and Dilution Air 2407

### \* Outdoor combustion air 2407.6

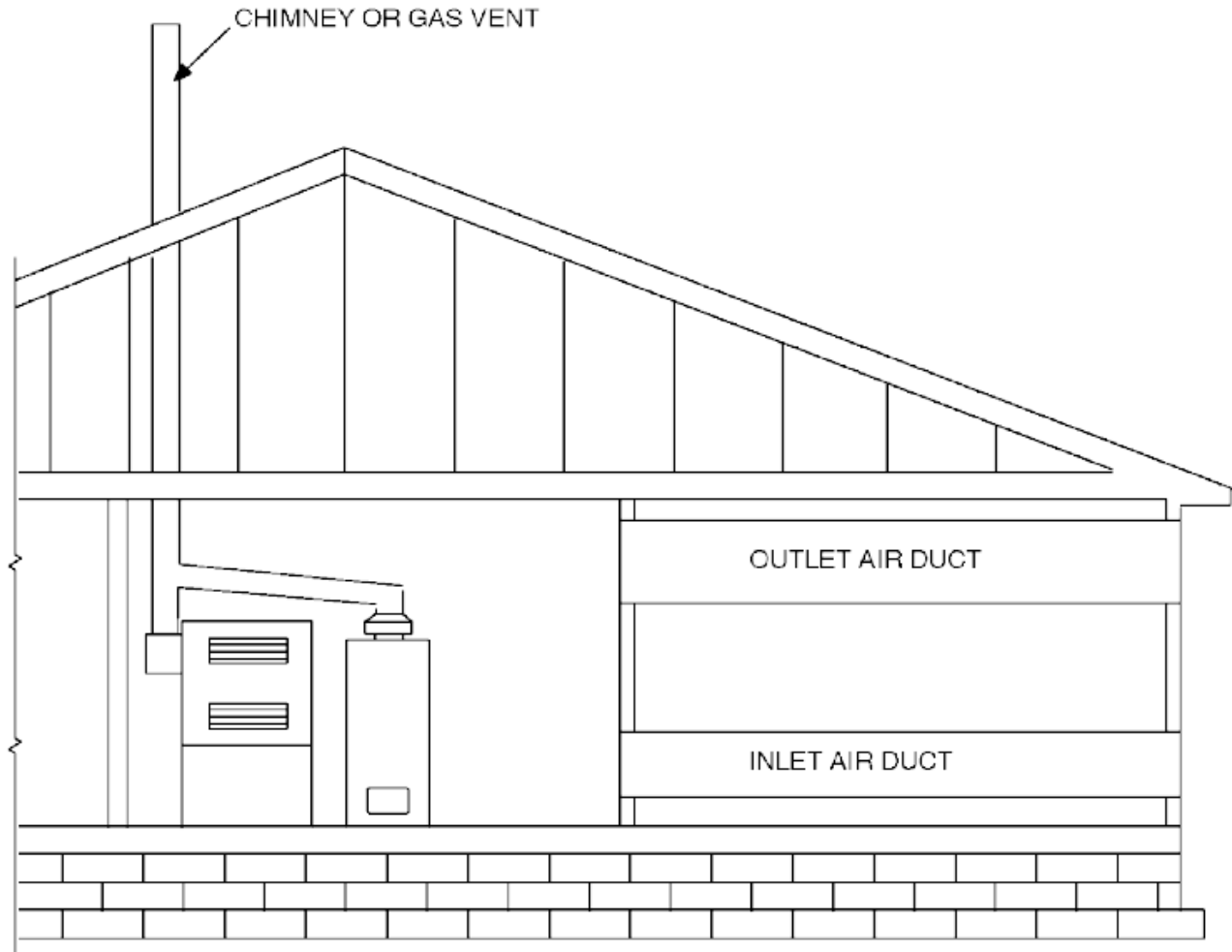
- Two permanent openings
  - 12" top and bottom
  - Calculates net free area for each opening
  - Direct to outdoors vertically 1 square inch per 4,000 Btu/h
  - Communicate directly or by ducts
  - Horizontal ducts 1 square inch per 2,000 Btu/h
  - Calculate the total BTU being supplied

\* Figure 2407.6.1(2)



**FIGURE 2407.6.1(2) [304.6.1(2)]**  
**ALL AIR FROM OUTDOORS THROUGH VENTILATED ATTIC (see Section G2407.6.1)**

\* Figure G2407.6.1(3)



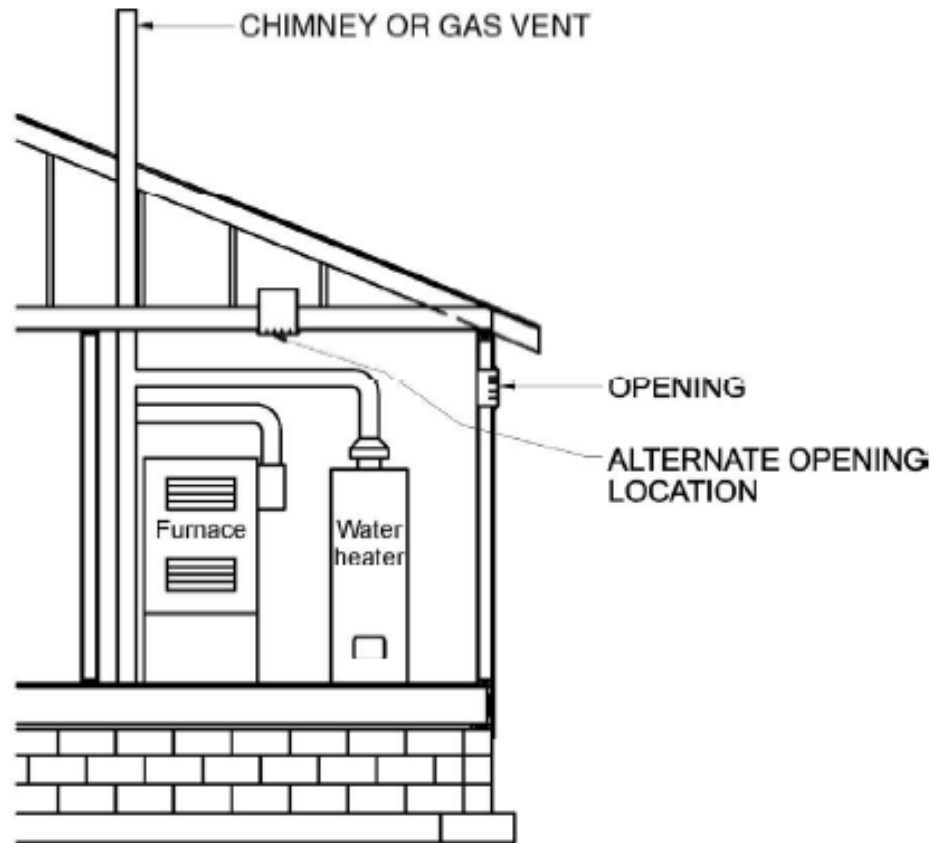
**FIGURE G2407.6.1(3) [304.6.1(3)]  
ALL AIR FROM OUTDOORS (see Section G2407.6.1)**

## ◆ Combustion, Ventilation and Dilution Air G2407 (304) *(continued)*

- \* One opening method **G2407.6.2**
  - 12” within the top of the enclosure
  - Appliance clearances
    - 1 inches from sides and back
    - 6 inches from the front
  - Direct to outdoors or through a duct
  - 1 square inch per 3,000 BTU
  - Duct not less than the sum of all vent connectors



\* Figure G2407.6.2 page 548



**FIGURE | 2407.6.2 (304.6.2)  
SINGLE COMBUSTION AIR OPENING,  
ALL AIR FROM OUTDOORS**

- \* Class Exercise
  - 2- 34,000 Btu/h water heaters
  - 1- 120,000 Btu/h furnace
- \* Calculate combustion air opening sizes using the 2 opening method for outdoor air with the openings on an outdoor wall

34,000
34,000
<u>120,000</u>
188,000 Btu/h appliance load

$188,000 / 2,000 = 94$ sq in net free for each opening
--

\* Class Exercise

- 2- 34,000 Btu/h water heaters
- 1- 120,000 Btu/h furnace
- Calculate combustion air opening sizes using the 2 opening method for outdoor air supplied by a horizontal duct

34,000
34,000
<u>120,000</u>
188,000 Btu/h appliance load

$188,000/2,000 =$
94 sq in net free
for the one
opening

- \* Class Exercise
  - 2- 34,000 Btu/h water heaters
  - 1- 120,000 Btu/h furnace
- \* Calculate combustion air opening sizes using the one opening method

34,000
34,000
<u>120,000</u>
188,000 Btu/h appliance load

$188,000/3,000 =$ 62.67 sq in net free for each opening
---

## ◆ Combustion, Ventilation and Dilution Air 2407

### \* Combination indoor and outdoor 2407.7

- Indoor openings as per indoor air
- Outdoor openings as per outdoor combustion air
- Indoor Spaces
  - Ratio of available volume of all communicating spaces divided by required volume
  - Reduction factor = 1 minus ratio of interior spaces
  - Minimum outdoor size = full size of openings calculated x reduction factor
  - Minimum dimension of air openings not < 3”

## ◆ Example 2407.7

- \* 160,000 Btu input requires 8,000 cube foot for “Indoor Air only”
- \* 240 square feet adjacent space with 8’ ceiling (8 x 240) = 1920 cube foot
- \*  $1,920 = .24$
- \* 8,000
- \* Reduction Factor  $1 - .24 = .76$
- \* Outdoor air required
- \* 1” per 4,000 Btu/h
- \*  $160,000 = 40$  square inch
- \* 4,000
- \* Outdoor air required:  $.76 \times 40 = 30.4$  square inch

## ◆ Combustion, Ventilation and Dilution Air 2407

- \* Engineered combustion air 2407.8
- \* Mechanical combustion air 2407.9,
  - 0.35 cu ft. per 1,000 Btu/h of total input rating all appliances
  - Appliance interlock

IF: Mechanically supplied combustion air

THEN: System must also supply required ventilation air

## ◆ Combustion, Ventilation and Dilution Air 2407

### \* Louvers and grills 2407.10

- Ventilation based on net free opening
  - Wood louvers 25%
  - Metal 75%
- Manufacturer's specifications
- Motorized grills interlocked with equipment





## ◆ Combustion, Ventilation and Dilution Air 2407

### \* Combustion air ducts 2407.11

- Duct must use galvanized steel for the ducts or material having equivalent corrosion resistance, strength, and rigidity
- Terminate in unobstructed space
- Serve a single enclosure
- Separate upper and lower duct – not screened in attic area
- Not as part of the masonry, metal or factory built chimney assembly
- Except direct vent appliances

## ◆ Combustion, Ventilation and Dilution Air 2407

- \* Combustion air ducts 2407.11
  - Low opening – bottom not less than 12”above grade
  - Protected from fumes and vapors
  - Disperse fumes
  - Installed per manufacturer

## ◆ Installation 2408

- \* Listings or manufacturer’s instructions
- \* Available on the job site
- \* Follow stricter code or manufacturer
- \* Many sections same as mechanical Part V

## ◆ Installation 2408

- \* Ignition source 18" above grade in garage
- \* Installation 6' or higher in private garage unless protected from vehicle impact
- \* Equipment installed at grade on a level pad or suspended 6" above grade
- \* Clearance to combustibles to be maintained
- \* Consider temporary items such as drawers or doors

## ◆ Clearance Reduction 2409

- \* Reductions only per **Table 2409.2** unless prohibited by listing
- \* Includes distance to drywall
- \* Reductions allowed only per **Table 2409.2** unless prohibited by listing
- \* Clearance to indoor air conditioning **2409.3**
- \* Per manufacture
- \* Can use clearance **Table 2409.2**
- \* Clearance from supply ducts **2409.3.4**

## ◆ Electrical 2410

- \* Gas piping not to be used as a grounding electrode

## ◆ Electrical Bonding 2411

- \* Pipe and tubing other than CSST **21411.1**
  - Gas pipe likely to become energized shall be bonded
    - Exception: Connection to equipment that is part of an electrical circuit shall be considered bonded

## ◆ Electrical Bonding 2411

- \* Corrugated stainless steel tubing (CSST) 2411.1.1 (310.1.1)
  - Bonded to electric service grounding electrode system
  - Bonded to metallic pipe or fitting
  - Bonding jumper not smaller than 6 AWG
  - All segments of system bonded

## ◆ General 2412

- \* Point of delivery to connection to equipment
- \* LP gas per **Fire Code**
- \* Modification to gas pipe system requires resizing
- \* Yellow identifying color with black lettering unless black metallic pipe – every 5'
- \* 2 meters not to be interconnected
- \* Meter labeled indicating area served
- \* Pipe sized to serve all connected appliances

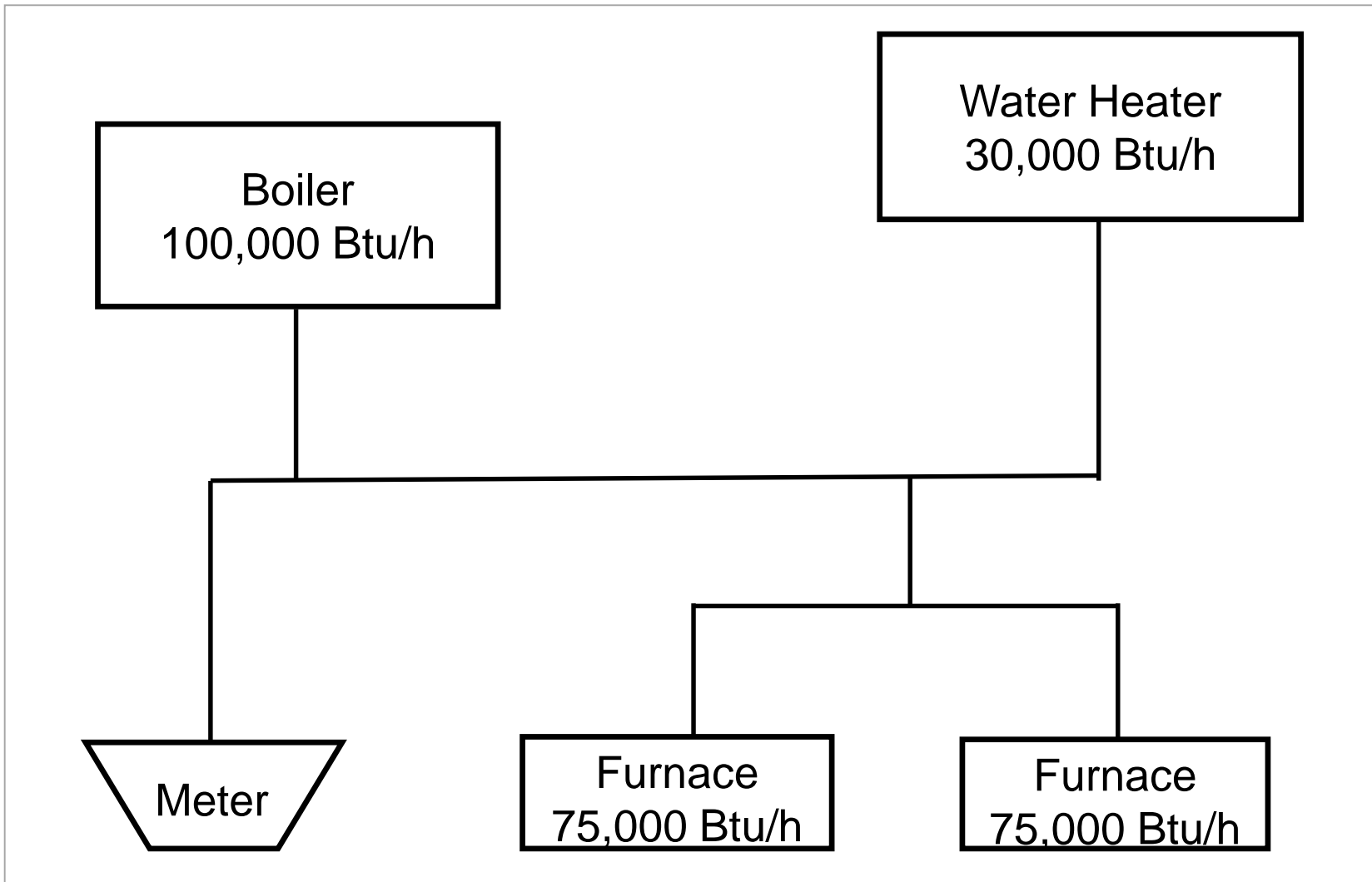
## ◆ General 2412

- \* Meter labeled indicating area served
- \* Pipe sized to serve all connected appliances
- \* All pipe identified
  - Exceptions:
    - Pipe length less than 2 feet and from same pipe
    - Steel fitting 2 inches and less
    - On product packaging
    - Other approved documentation
- \* All pipe third party tested or certified



## ◆ Pipe Sizing 2413

- \* Based on appliance input rating
- \* When rating is unknown, the manufacturer shall be consulted
- \* Assume all appliances operating simultaneously
- \* 1 cube foot of natural gas = 1,000 Btu
- \* Maximum design pressure 5 psig or exceptions
- \* Size is per code tables
- \* Tables are based on pressure, type of pipe or tubing, pressure drop
- \* Maximum capacity of pipe in feet of gas per hour for gas pressure less than 2 psi and a pressure drop of 0.5" water column **Table 2413.4(1)**



## ◆ Pipe Sizing 2413

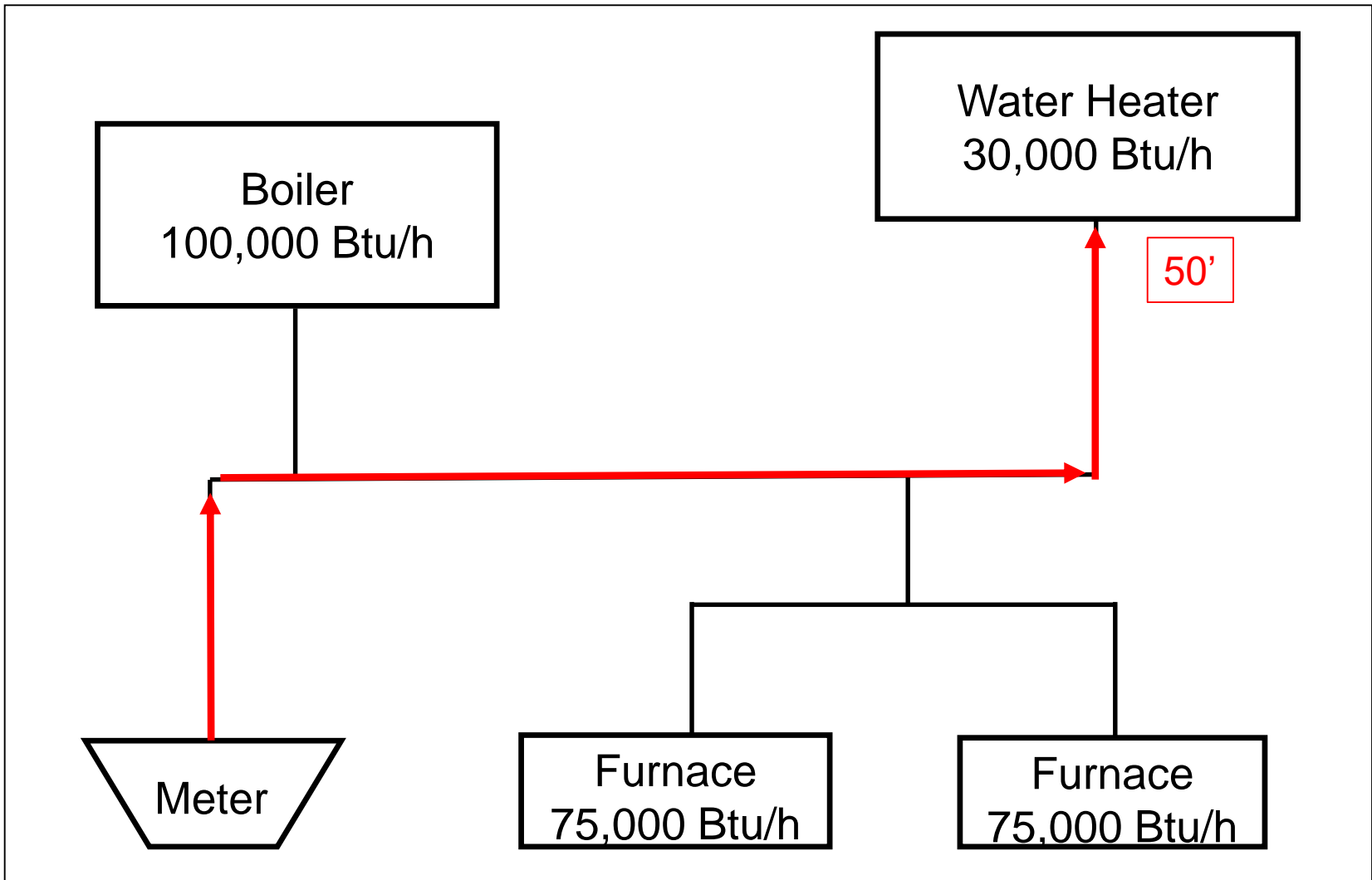
- \* Longest length method **2413.4.1**

- \* **Step One**

- Determine the length of pipe from the point of delivery to the most remote appliance
  - Example: Furthest appliance is 50' from the meter

- \* **Step Two**

- Enter the table in the 50' row
- Entire system will be sized based on the values in this column



## ◆ Pipe Sizing 2413

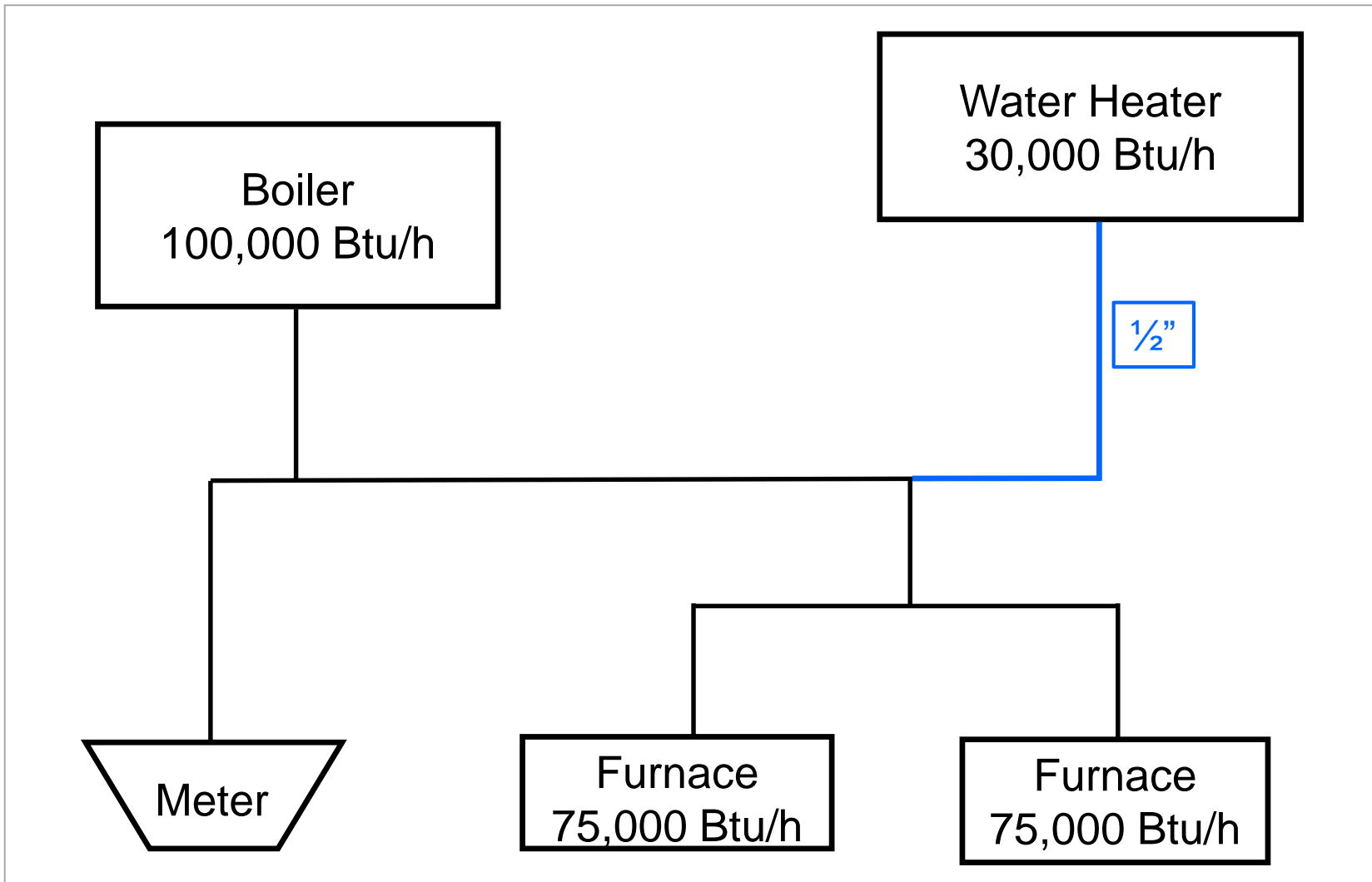
### \* Step Three

- Size the branch feeding the most remote appliance
- Example: 30,000 Btu/h water heater
  - Divide 30,000 Btu/h/1,000 Btu/h per cu ft of gas
  - equals 30 cube foot of natural gas required by this water heater
  - Look in Table G2413.4(1) on 50' length row
  - Find cube foot of gas equal to or higher than 30
  - ½" pipe delivers 72 cube foot of gas per hour
  - Answer: ½" pipe required
- If the actual demand falls between tabular values, use the larger pipe size

\* Schedule 40 Metallic Pipe **Table 2413.4(1)**

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 inch WC
Specific Gravity	0.60

PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.824	0.824	1.049	1.380	1.610	2.067
Length (ft)	Maximum Capacity in Cubic Feet of Gas per Hour					
10		360	678	1,390	2,090	4,020
20		247	466	957	1,430	2,760
30		199	374	768	1,150	2,220
40		170	320	657	985	1,900
50	72	151	284	583	873	1,680
60	65	137	257	528	791	1,520



## ◆ Pipe Sizing 2413

### \* Step Four

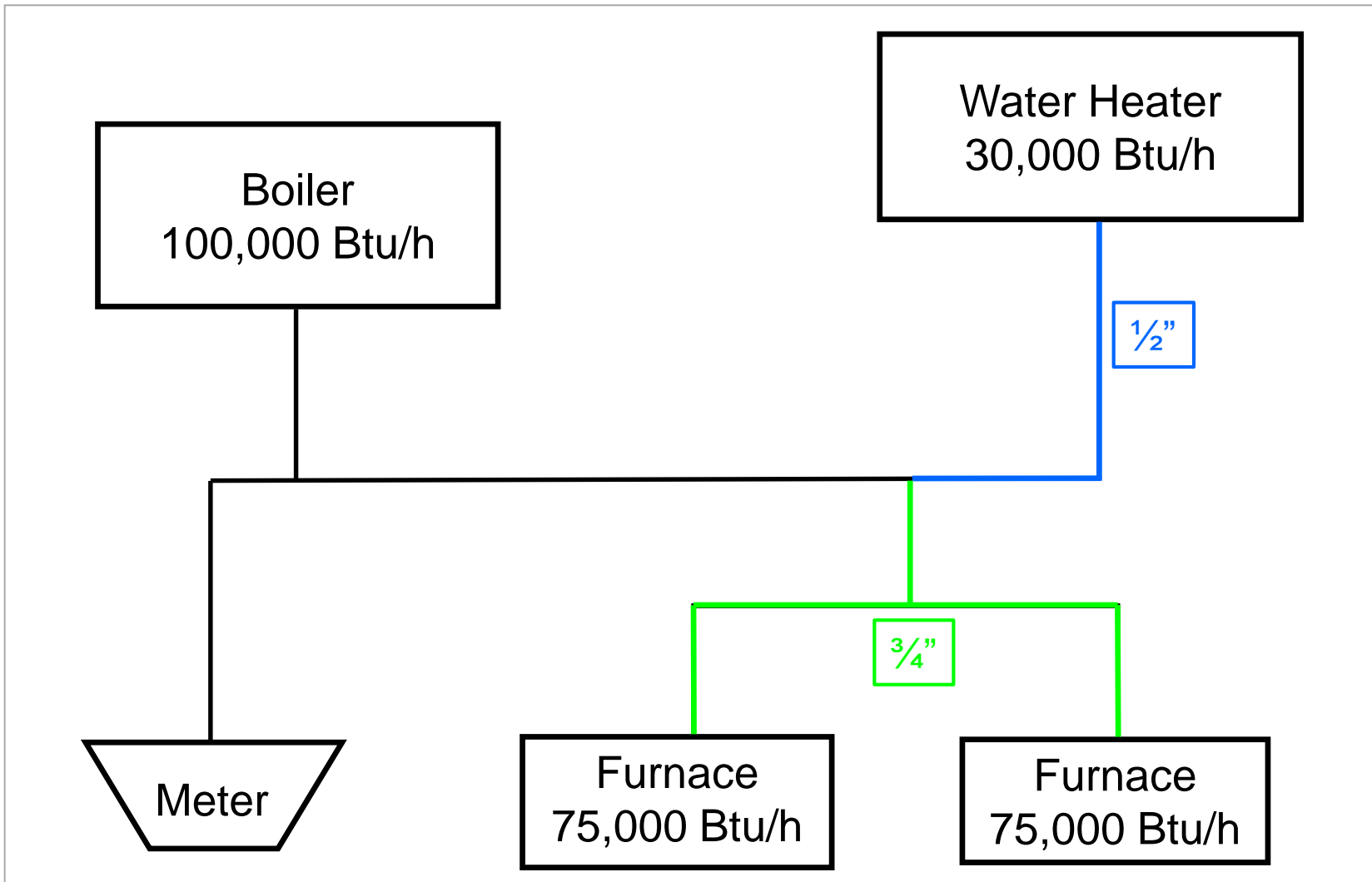
- Working towards the meter, size the branch feeding the 2 furnaces
- Example:
  - 75,000 Btu/h furnace requires 3/4" pipe to each appliance
  - Since the total demand upstream of the tee is less than 151, the portion of the branch that serves both appliances is permitted to be 3/4"



\* Schedule 40 Metallic Pipe **Table 2413.4(1)**

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 inch WC
Specific Gravity	0.60

PIPE SIZE (inches)						
Nominal	1/2	3/4	1	1 1/4	1 1/2	2
Actual ID	0.622	0.84	1.049	1.380	1.610	2.067
Length (ft)	Maximum Capacity in Cubic Feet of Gas per Hour					
10	172	210	678	1,390	2,090	4,020
20	118	147	466	957	1,430	2,760
30	95	118	374	768	1,150	2,220
40	81	100	320	657	985	1,900
50	72	151	284	583	873	1,680
60	65	137	257	528	791	1,520



## ◆ Pipe Sizing 2413

### \* Step Five

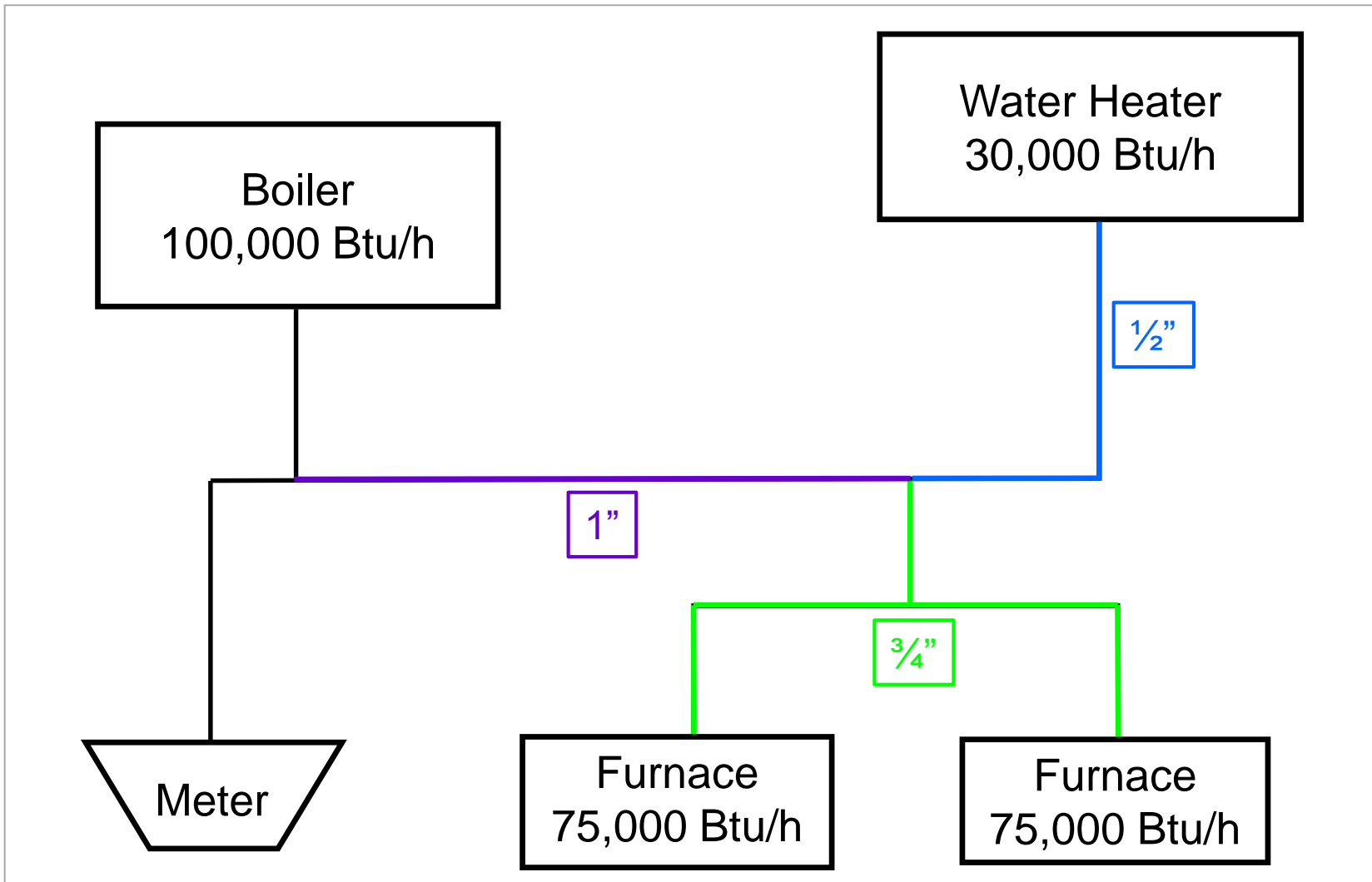
- Size the main from the unit heater branch to the dual furnace branch
- Example:
  - The total demand on this portion of the main is 180,000 Btu/h

Required pipe size is 1”

\* Schedule 40 Metallic Pipe **Table 2413.4(1)**

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 inch WC
Specific Gravity	0.60

PIPE SIZE (inches)						
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)	Maximum Capacity in Cubic Feet of Gas per Hour					
10	172	360	520	1,390	2,090	4,020
20	118	247	346	957	1,430	2,760
30	95	199	274	768	1,150	2,220
40	81	170	220	657	985	1,900
50	72	151	284	583	873	1,680
60	65	137	257	528	791	1,520



# ◆ Pipe Sizing 2413

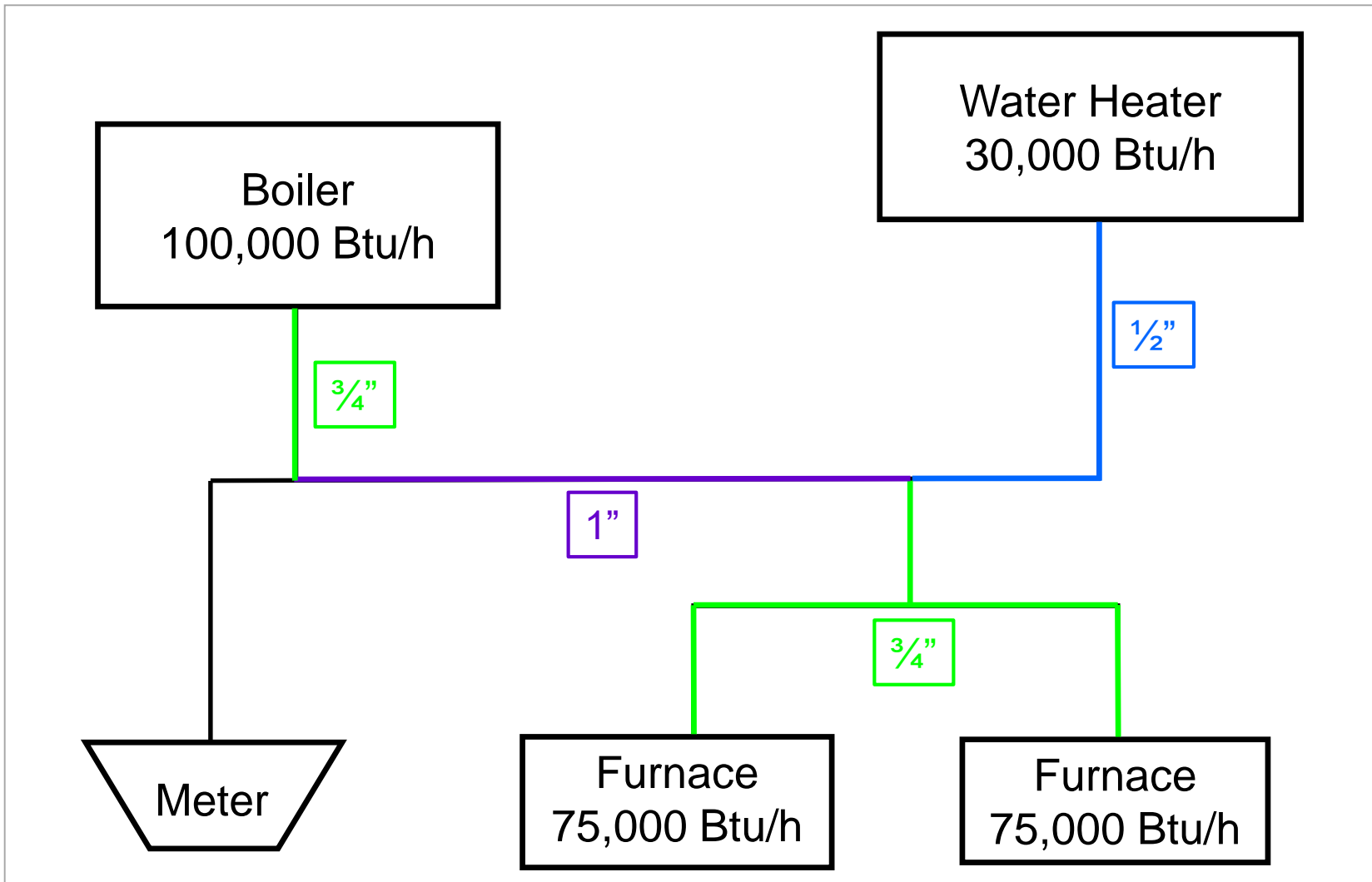
## \* Step Six

- Size the branch serving the boiler
- Example
  - Demand on branch is 100,000 Btu/h
  - Required size is 3/4"

Schedule 40 Metallic Pipe  
Table G2413.4(1)

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 inch WC
Specific Gravity	0.60

PIPE SIZE (inches)						
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)	Maximum Capacity in Cubic Feet of Gas per Hour					
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
60	65	137	257	528	791	1,520



## ◆ Pipe Sizing 2413

### \* Step Seven

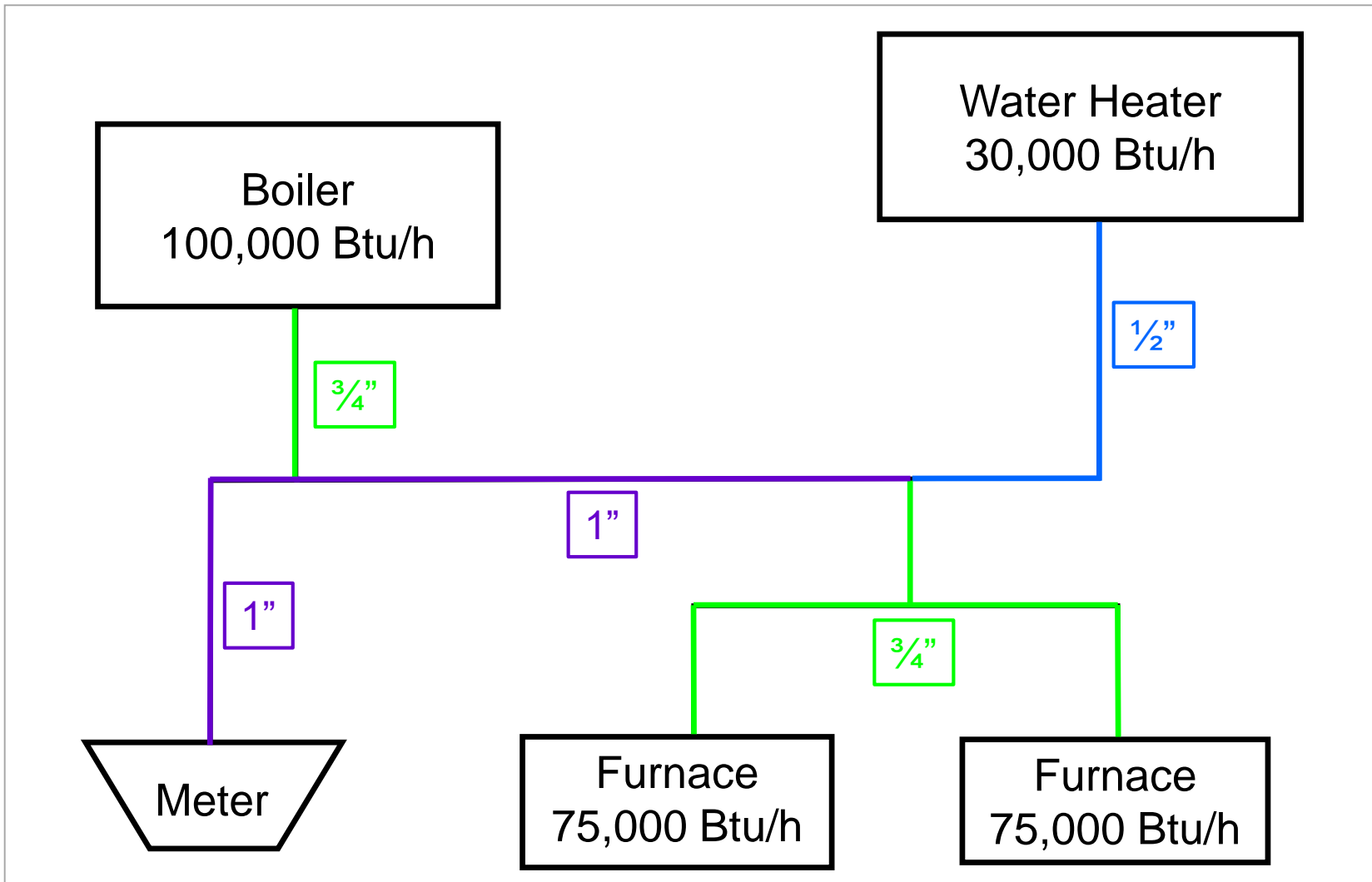
- Size the remainder of the main
- Example
  - Total system demand is 280,000 Btu/h
  - Pipe size required is 1”

Schedule 40 Metallic Pipe  
Table G2413.4(1)

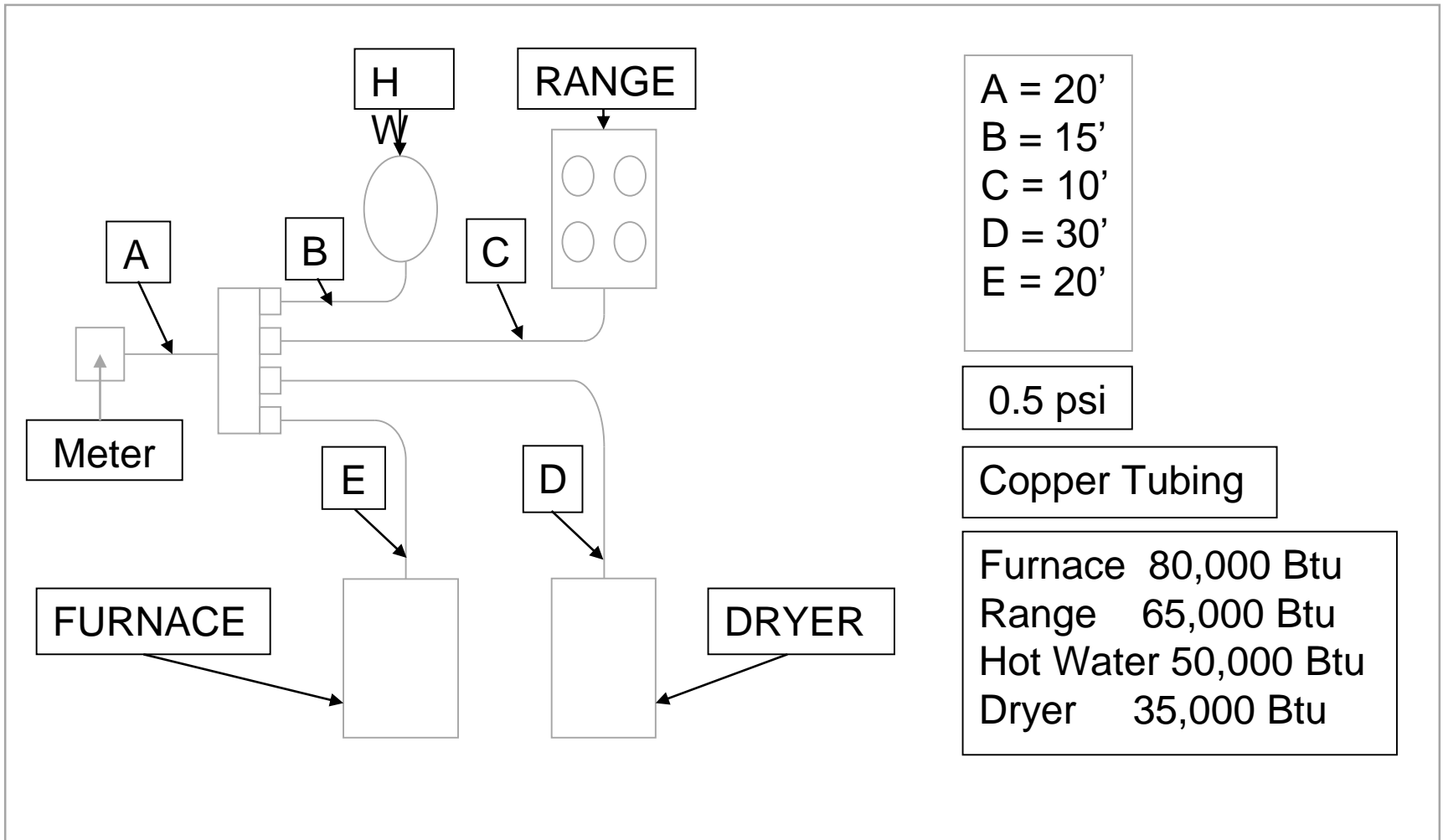
Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 inch WC
Specific Gravity	0.60

PIPE SIZE (inches)						
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)	Maximum Capacity - Cubic Feet of Gas per Hour					
10	172	360	520	1,390	2,090	4,020
20	118	247	350	957	1,430	2,760
30	95	199	275	768	1,150	2,220
40	81	170	235	657	985	1,900
50	72	151	215	583	873	1,680
60	65	137	195	528	791	1,520

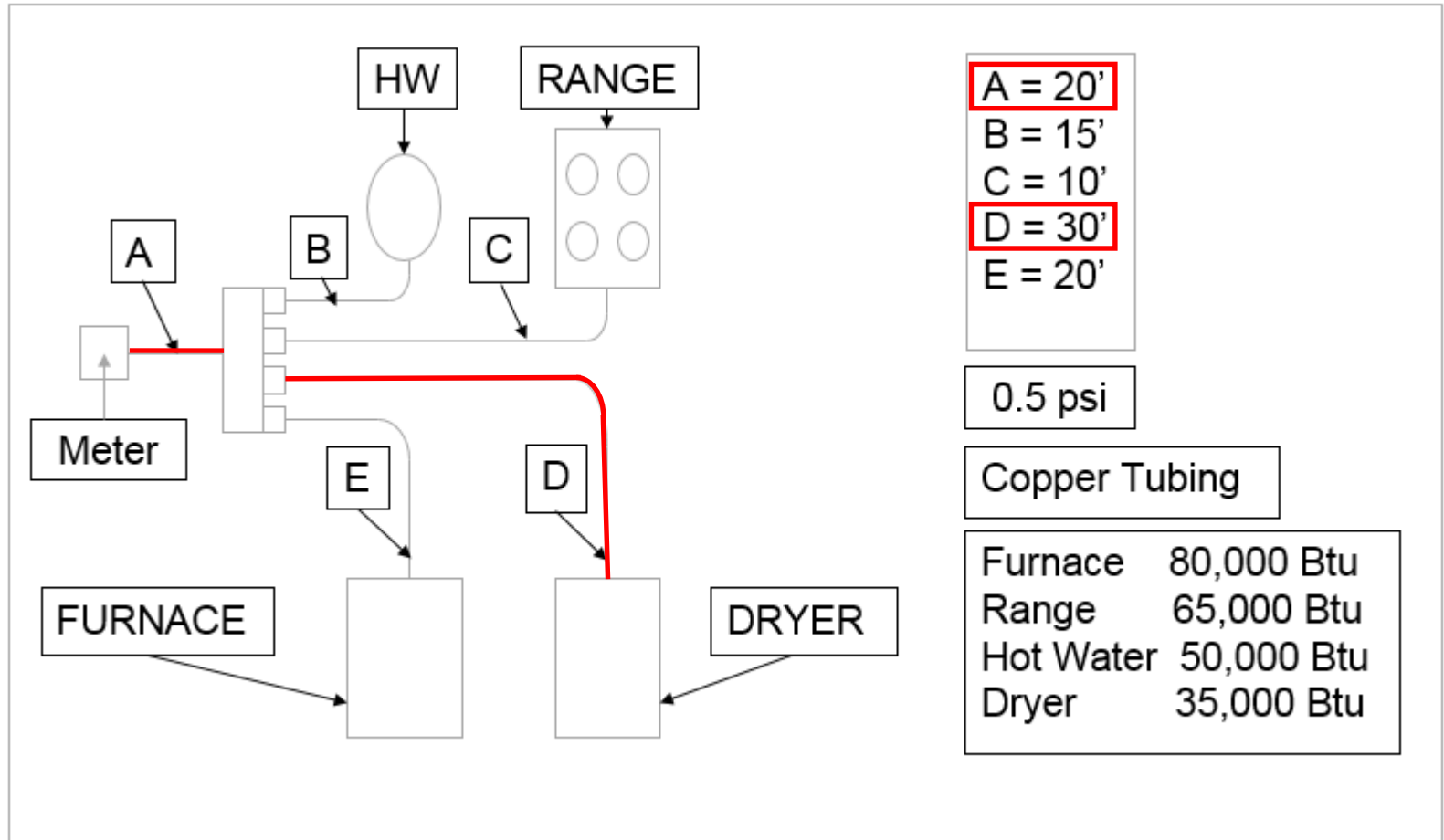




\* Class Exercise – Branch length method – Calculate tubing sizes



- \* Class Exercise - Solve the problem for Type K copper
  1. Find longest branch line:



\* Class Exercise - Solve the problem for Type K copper

2. Total input:

Furnace	80,000 Btu
Range	65,000 Btu
Hot Water	50,000 Btu
Dryer	<u>35,000 Btu</u>
	<b>230,000 Btu</b>

Use expected 230,000 Btu/h

\* Class Exercise - Solve the problem for Type K copper

3. Line A is to be: **1"**

Semirigid Copper Tubing  
Table 2413.4(3)

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60

		TUBE SIZE (inches)								
Nominal	K & L	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2
	ACR	3/8	1/2	5/8	3/4	7/8	1 1/8	1 3/8	—	—
Outside		0.375	0.500	0.625	0.750	0.875	1.000	1.375	1.625	2.125
Inside		0.305	0.402	0.527	0.652	0.745	0.875	1.245	1.481	1.959
Length (ft)		Capacity in Cubic Feet of Gas per Hour								
10		27	55	111	195	276	357	1,060	1,680	3,490
20		18	38	77	134	190	246	730	1,150	2,400
30		15	30	61	107	152	197	586	925	1,930
40		13	26	53	92	131	170	502	791	1,650
50		11	22	44	77	109	141	445	701	1,460
60		10	21	42	74	105	137	403	635	1,320

\* Class Exercise - Solve the problem for Type K copper

3. Line A 20' + Line B 15' = 35' Line B is to be:  $\frac{1}{2}$ "

Semirigid Copper Tubing  
Table 2413.4(3)

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60

Nominal	TUBE SIZE (inches)									
	K & L	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2
	ACR	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	$1\frac{1}{8}$	$1\frac{3}{8}$	—	—
Outside		0.375	0.500	0.625	0.750	0.875	1.125	1.375	1.625	2.125
Inside		0.305	0.402	0.47	0.652	0.745	0.995	1.245	1.481	1.959
Length (ft)	Capacity in Cubic Feet of Gas per Hour									
10		27	55	81	195	276	590	1,060	1,680	3,490
20		18	38	54	134	190	406	730	1,150	2,400
30		15	30	43	107	152	326	586	925	1,930
40		12	24	34	92	131	279	502	791	1,650
50		11	23	33	82	116	247	445	701	1,460
60		10	21	30	74	105	224	403	635	1,320

\* Class Exercise - Solve the problem for Type K copper

3. Line A 20' + Line C 10' = 30' Line C is to be:  $\frac{1}{2}$ "

Semirigid Copper Tubing  
Table 2413.4(3)

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60

Nominal	TUBE SIZE (inches)									
	K & L	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2
	ACR	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	$1\frac{1}{8}$	$1\frac{3}{8}$	—	—
Outside		0.375	0.500	0.625	0.750	0.875	1.125	1.375	1.625	2.125
Inside		0.305	0.402	0.47	0.652	0.745	0.995	1.245	1.481	1.959
Length (ft)	Capacity in Cubic Feet of Gas per Hour									
10		27	55	61	195	276	590	1,060	1,680	3,490
20		18	38	42	134	190	406	730	1,150	2,400
<u>30</u>		13	26	<u>61</u>	107	152	326	586	925	1,930
40		11	23	53	92	131	279	502	791	1,650
50		10	21	47	82	116	247	445	701	1,460
60		10	21	42	74	105	224	403	635	1,320

\* Class Exercise - Solve the problem for Type K copper

3. Line A 20' + Line D 30' = 50'    Line D is to be:  $\frac{1}{2}$ "

Semirigid Copper Tubing  
Table 2413.4(3)

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60

		TUBE SIZE (inches)								
Nominal	K & L	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2
	ACR	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	$1\frac{1}{8}$	$1\frac{3}{8}$	—	—
Outside		0.375	0.500	0.625	0.750	0.875	1.125	1.375	1.625	2.125
Inside		0.305	0.402	0.47	0.652	0.745	0.995	1.245	1.481	1.959
Length (ft)	Capacity in Cubic Feet of Gas per Hour									
10		27	55	82	195	276	590	1,060	1,680	3,490
20		18	38	55	134	190	406	730	1,150	2,400
30		15	30	47	107	152	326	586	925	1,930
40		13	26	42	92	131	279	502	791	1,650
<u>50</u>		11	21	<u>47</u>	82	116	247	445	701	1,460
60		10	21	42	74	105	224	403	635	1,320



\* Class Exercise - Solve the problem for Type K copper

3. Line A 20' + Line E 20' = 40' Line E is to be: **5/8"**

Semirigid Copper Tubing  
Table 2413.4(3)

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60

		TUBE SIZE (inches)								
Nominal	K & L	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2
	ACR	3/8	1/2	5/8	3/4	7/8	1 1/8	1 3/8	—	—
Outside		0.375	0.500	0.625	0.750	0.875	1.125	1.375	1.625	2.125
Inside		0.305	0.402	0.527	0.622	0.745	0.995	1.245	1.481	1.959
Length (ft)		Capacity Cubic Feet of Gas per Hour								
10		27	55	111	157	276	590	1,060	1,680	3,490
20		18	38	77	107	190	406	730	1,150	2,400
30		15	30	61	85	152	326	586	925	1,930
40					92	131	279	502	791	1,650
50		11	23	47	65	116	247	445	701	1,460
60		10	21	42	58	105	224	403	635	1,320

\* Class Exercise - Solve the problem for Type K copper

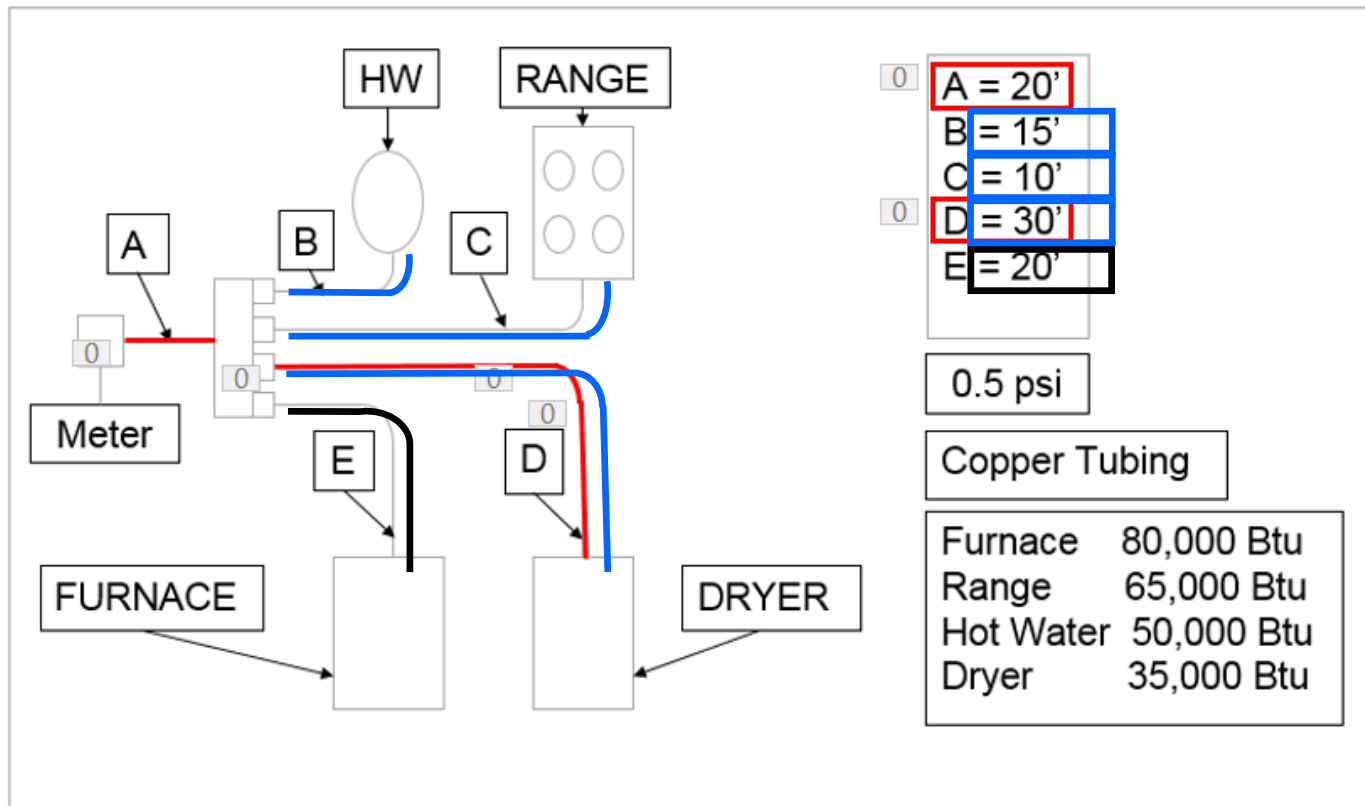
4. B, C, D and E are sized from manifold

B = 1/2

D = 1/2

C = 1/2

E = 5/8



## ◆ Pipe Materials 2414

- \* Used materials evaluated prior to re-use 2414.2
- \* Other materials 2414.3
- \* Metallic pipe 2414.4
  - Cast iron / Steel
- \* Metallic tubing 2414.5
  - Copper / Aluminum / Steel
  - Corrugated stainless
- \* Plastic pipe, tubing and fittings 2414.6

## ◆ Pipe Materials 2414

- \* Workmanship and defects 2414.7
  - Free of burrs and defects
  - Thoroughly brushed and chip-free
- \* Protected from corrosion 2414.8
- \* Metallic pipe threads 2414.9
  - Stripped and damaged threads not used
  - 10 - 11 threads cut
  - Table 2414.9.2
  - Threaded, flanged, brazed or welded joints permitted 2414.10.1

## ◆ Piping System Installation 2415

- \* Installed per the standards or the manufacturer's installation instructions **2415.1**
- \* Not in or through air duct, clothes chute, chimney, vent or elevator shaft **2415.3**
  - Not in solid partitions or walls unless in a chase
- \* Fitting in concealed locations – no unions, tubing fittings, right and left couplings **2415.5 (**
  - Allowed threads, brazed, welded listed to ANSI LC-1 CSA26
- \* Sleeved through foundations – annular space to be filled **2415.6**

## ◆ Piping System Installation 2415

- \* Protection from physical damage 2415.7
  - Shield plate on all piping other than black or galvanized steel at notches or holes 2415.7.1
- \* Piping in solid floors 2415.8
  - Accessible in solid floors
  - Ends extend into space
    - Open ends
    - Inside - extend a minimum 2 inches
    - Outside – extend a minimum of 4 inches

## ◆ Piping System Installation 2415

- \* Above ground piping 2415.9
  - Protected when installed above ground and outdoors
    - 3 1/2” minimum height clearance – roof
    - Protected from corrosion 2415.9
- \* Protected from corrosion 2415.11
  - Exposed piping protection
  - Galvanizing not adequate

## ◆ Piping System Installation 2415

### \* Protected from corrosion 2415.11

- Protection methods
  - Corrosion resistant material based on soil condition
  - Factory applied, electrically insulated coating
  - Monitored cathodic protection
- Dissimilar metals require insulated couplings or fittings
- Protection of risers 2415.11.4
  - Steel risers to plastic pipe – cathodically protected with an anode
- Prohibited – uncoated threaded or socket welded joints



## ◆ Piping System Installation 2415

- \* Minimum burial depth **2415.12**
  - 12” burial depth-see exceptions
    - Exceptions: grills, lights at 8”
  - Trenches **2415.13**
    - Graded for a firm continuous bearing bottom
- \* Piping underground or beneath buildings **2415.14**
  - Prohibited unless encased in a listed product
  - Ends extend into space
  - Open ends
    - Inside – extend minimum 2 inches
    - Outside – extend a minimum of 6 inches

## ◆ Piping System Installation 2415

- \* Unused outlets closed 2415.15
- \* Location 2414.16
  - Outlets to extend 1” beyond walls and ceilings and 2” above floors
  - Not to be installed behind doors
  - Located in the room or space where appliance is installed

## ◆ Piping System Installation 2415

### \* Plastic pipe 2415.17

- Outside underground only
- Not within or under buildings
- Proper metallic to plastic fittings 2415.17.2
- Tracer wire required with non-metallic piping, yellow insulated copper, minimum 18 AWG 2415.17.3

## ◆ Inspection, Testing and Purging 2417

- \* Prior to acceptance to be inspected and tested 2417.1
  - Repair and new branches require testing
  - Permitted to be tested in sections 2417.1.4
  - Regulators and valve assemblies tested independently
  - Oxygen is a prohibited test medium
- \* Test preparation 2417.3
  - Pipe joints and welds exposed for the testing
  - Appliances and equipment – disconnected or a test blank
    - Required when test pressure higher than allowed for equipment

## ◆ Inspection, Testing and Purging G2417

- \* Test pressure measurement 2417.4
  - Device ability to measure loss
  - Source isolated before test
  - Gauge upper pressure 5 times less than test pressure
    - Pressure to be not less than 1 ½ times the maximum working pressure, but not less than 3 psig 2417.4.1
    - Duration not less than 10 minutes
- \* Detection of leaks and defects 2417.5
  - Reduction in pressure indicates a leak
  - Detection by gas detector, noncorrosive leak detection fluid or other approved means
  - Affected portions repaired or replaced

## ◆ Inspection, Testing and Purging 2417

### \* Piping system and equipment leakage 2417.6

- System properly tested
- Check for open valves or pipes
- No appliances in operation before system checked and purged

### \* Purging 2417.7

- Required to be purged outdoors when system meets either of the following:
  - Pressure greater than 2 psi, OR
  - Contains in excess of **Table 2417.7.1.1**
- Removed from service
  - Gas piping isolated and filled with inert gas

## ◆ Inspection, Testing and Purging 2417

### \* Purging 2417.7

- When placed in operation displace with inert air and then gas
- Purge to outside
  - Controlled by a valve
  - 10 feet from ignition source, building openings, 25 feet from intakes
  - Open end monitored
  - Terminated when gas 90% by volume
  - All other persons 10 feet away
- Listed combustible gas indicator

## ◆ Inspection, Testing and Purging 2417

### \* Purging 2417.7

- Can be purged indoors when system meets either of the following:
  - Pressure less than 2 psi, OR
  - Contains less than **Table 2417.7.1.1**
- Purging procedure
  - Discharge to outside
  - Indoors or outdoors through an appliance burner with continuous source
  - Equipment designed for purpose
  - Monitored by a gas detector, stopped when gas detected
  - Follow written procedure



## ◆ Inspection, Testing and Purging 2417

### \* Purging 2417.7

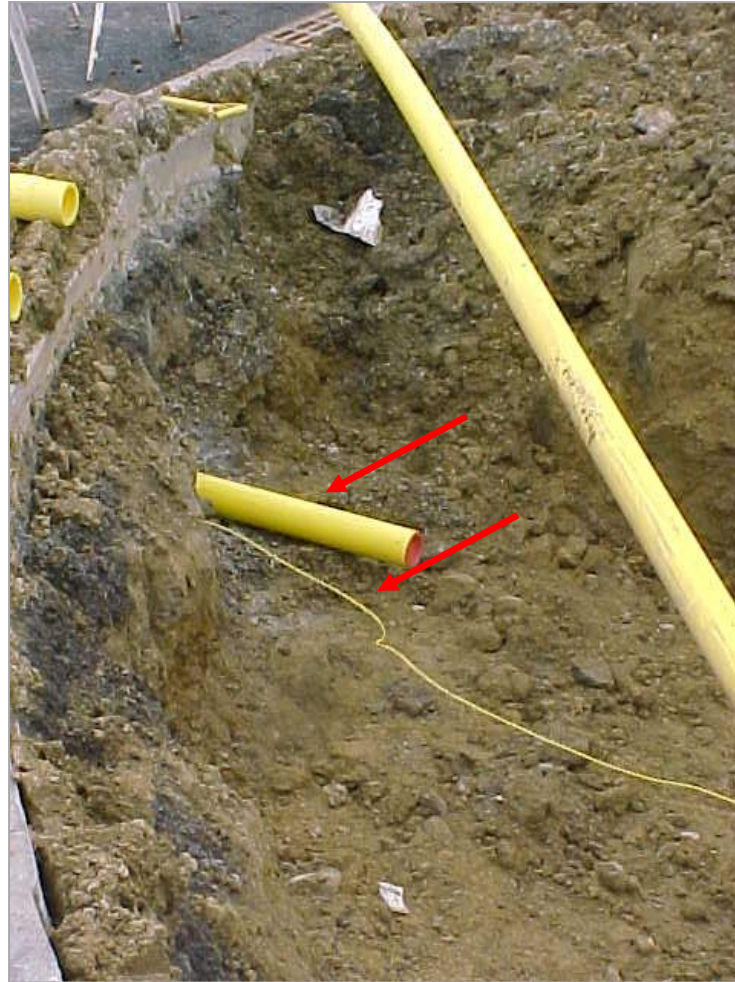
- Listed combustible gas indicator
- Appliances purged before being placed in service

## ◆ Piping Support 2418

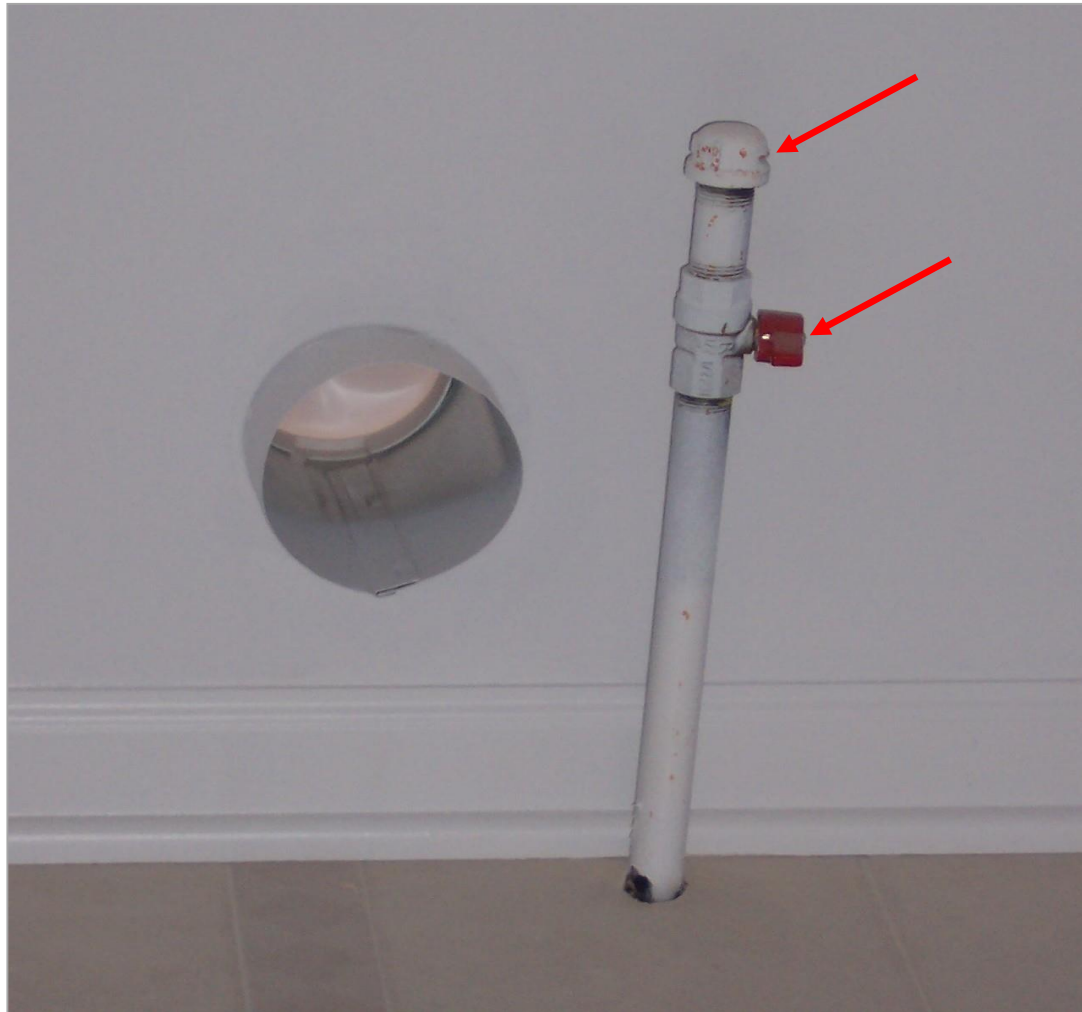
- \* Components suitable for the piping material
- \* Spaced per **Section 2424**
- \* Allow pipe to expand and contract



- \* Underground plastic gas line with yellow #18 AWG tracer line



- \* Residential clothes dryer gas line with shut off valve, capped



- \* 1" Black iron residential natural gas line hanging from floor joists





## ◆ Drips and Sloped Piping 2419

- \*  $\frac{1}{4}$ " in 15'
- \* Sediment traps or drips required near appliance inlet as close as possible
- \* Not required for illuminating appliances, ranges, clothes dryers, decorative vented appliances within fireplaces or outdoor grills



## ◆ Shutoff Valves 2420

- \* Not in furnace plenums or concealed locations
- \* Accessible
- \* Shut off side of each meter
- \* Each building
- \* At each MP regulator



## ◆ Shutoff Valves 2420

- \* Appliance shutoff valve 2420.5
  - At each appliance
    - In same room – maximum 6' away
    - Vented decorative fireplaces per manufacturer
    - Serve no other appliance
    - Can be in a remote room if readily accessible
    - Permanently identified



## ◆ Flow Controls 2421

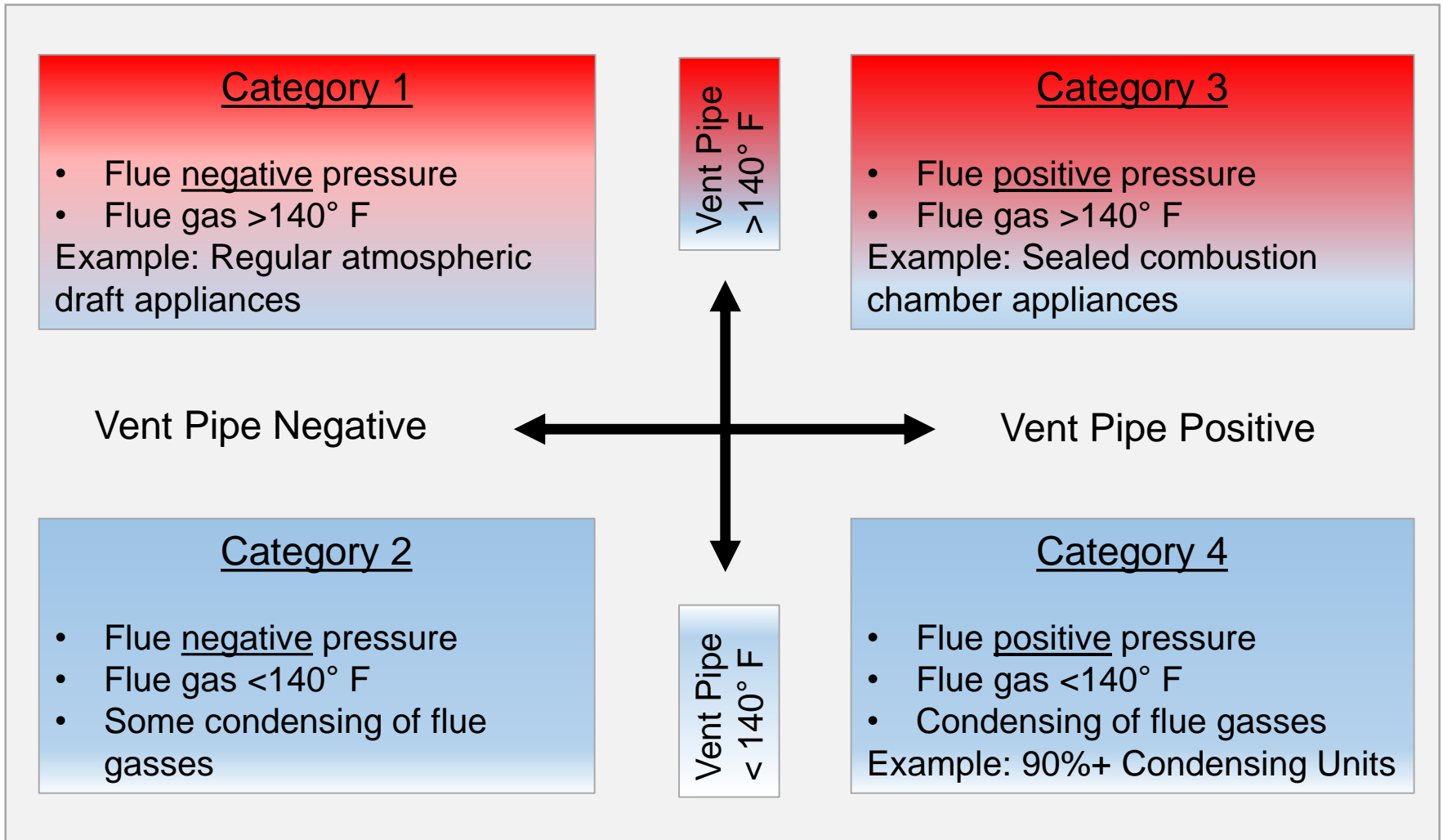
- \* Line pressure regulators required when appliances operate at pressure lower than supply system
- \* Accessible
- \* Protected from physical damage
- \* Vent regulators to the outside
- \* Excess flow valves listed, sized and installed per manufacturer
- \* Listed flash back arrestor when used with oxygen **2421.5**

- ◆ **Appliance Connectors 2422**
  - \* Listed and labeled
  - \* Protected from damage
  - \* Dryers and ranges 6'
  - \* Not concealed in or through walls
  - \* Shut off valve before connector
  
- ◆ **Piping Support Intervals 2424**
  - \* **Table 2424.1** for interval

## ◆ General 2425

- \* Chimneys, liners, vents and connectors
- \* Vent to outside
- \* Abandoned outlets to be sealed
- \* Positive pressure or induce draft designed for positive pressure
- \* Unvented appliances allowed **2425.8**
  - When aggregate amount exceeds 20 Btu per hour per cu ft. of room volume, need to be vented
  - Adjacent rooms permitted to count
  - Masonry chimney minimum 12" above lowest point

\* Fuel Gas Appliance Definitions 2403



## ◆ Fuel Gas Appliance Definitions 2403

### \* Category I

- DEFINITION: An appliance that operates with a non-positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent
- EXAMPLES:
  - Water heaters
  - Room heaters
  - Furnaces
  - Unit heaters
  - Boilers



## ◆ Fuel Gas Appliance Definitions 2403

### \* Category II

- DEFINITION: An appliance that operates with a non-positive vent static pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent
- EXAMPLE: Forced draft or induced draft heaters

## ◆ Fuel Gas Appliance Definitions 2403

### \* Category III

- DEFINITION: An appliance that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent
- EXAMPLE: Direct vent furnace



## ◆ Fuel Gas Appliance Definitions 2403

### \* Category IV

- DEFINITION: An appliance that operates with a positive vent static pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent
- EXAMPLE: Sealed draft units with draft temperatures low enough to permit condensation



## ◆ General 2425

- \* Existing chimneys or vents **2425.15**
  - Resizing required to control condensation and provide proper draft
  - Passageway free from obstructions; cracks etc.
  - Masonry chimney requires cleanout **2425.15.3**
  - Clearance from combustibles as per **Chapter 10 2425.15.4**

## ◆ Vents 2426

- \* Listings required
  - B and BW – UL 441
  - L – UL 641
  - Category II and III Vents – UL 1738
- \* Connectors required – connect appliance to vertical chimney or vent 2426.2
- \* Insulation shield required
- \* Adequate support 2426.6
- \* Shield plates required

## ◆ Venting of Appliances 2427

- \* All equipment to be vented 2427.2
- \* Direct and integral vent equipment per manufacturer
- \* Design and construction 2427.3
  - Designed to prevent leakage of fumes into building
  - Mechanical draft listing

## ◆ Venting of Appliances 2427

- \* Not to be combined with natural draft appliances
- \* Exit terminal 7' above grade at public walkways
- \* No portion extend into or through ducts or plenums
- \* **Table 2427.4** provides for type of venting to be used

**TABLE 2427.4 (503.4)**  
**TYPE OF VENTING SYSTEM TO BE USED**

APPLIANCES	TYPE OF VENTING SYSTEM
<p>Listed Category I <i>appliances</i>  <i>Listed appliances</i> equipped with draft hood  <i>Appliances</i> listed for use with Type B gas vent</p>	<p>Type B gas <i>vent</i> (Section G2427.6)  <i>Chimney</i> (Section G2427.5)            Single-wall metal pipe (Section G2427.7)  <i>Listed</i> chimney lining system for gas venting (Section G2427.5.2)            Special gas <i>vent</i> listed for these appliances (Section G2427.4.2)</p>
<p><i>Listed</i> vented wall furnaces</p>	<p>Type B-W gas vent (Sections G2427.6, G2436)</p>
<p>Category II, Category III and Category IV <i>appliances</i></p>	<p>As specified or furnished by manufacturers of <i>listed appliances</i>            (Sections G2427.4.1, G2427.4.2)</p>

## ◆ Venting of Appliances 2427

- \* Type of venting system to be used 2427.4
  - Plastic piping – used for venting equipment listed for use with such venting materials shall be approved
  - Special gas vent – shall be listed and installed in accordance with the terms of the special gas vent listing and the manufacturer's instructions



## ◆ Venting of Appliances 2427

### \* Chimney termination 2427.5.3

- 3' above roof penetration
- 2' higher than any portion of building within 10'
- 5' above highest connected draft hood

### \* Size of chimneys 2427.5.4

- Per Section 2428
- Single appliance not less than appliance flue collar or greater than 7 times the draft hood outlet
- 2 or more – not less than the largest draft hood plus 50% of the smaller or greater than 7 times the outlet

## ◆ Venting of Appliances 2427

- \* Inspection of masonry chimney before connecting a new appliance shall be made **2427.5.5**
  - Unsafe chimneys to be repaired, rebuilt, relined or replaced
  - Lining **2427.5.5.1**
  - Cleanouts secured
  - Gas and solid fuel not to be interconnected **2427.5.6.1**
  - Combination equipment requires certain safeguards

## ◆ Venting of Appliances 2427

### \* Gas vents 2427.6

- Installed per listing and manufacturer's instructions
- Roof penetrations – flashed, listed termination cap
- One 60° offset allowed, balance not to exceed 45° – single-wall vent connectors not more than 75% of vertical height of vent
- Gas vent termination 2427.6.4
  - Figure 2427.6.4 for vents under 12" with listed caps
    - vent 8' from wall
  - All other 2' above roof penetration and 2' above building portion within 10'
  - Decorative shrouds only with listing



## ◆ Venting of Appliances 2427

- \* Minimum vent height **2427.6.4**
  - Type B or L - 5' above draft hood or flue collar **2427.6.4**
  - Type B-W Vent 12' above bottom of wall furnace
  - Not to terminate adjacent to wall or below eaves or parapets except as provided **2427.6.7**

## ◆ Venting of Appliances 2427

- \* Size of gas vents **G2427.6.8 (503.6.9)**
  - Category I with Type B gas vent
    - Provisions of **Section 2428**
    - Individual appliance – not less than area of draft hood or greater than 7 times draft hood outlet area
    - 2 or more appliances – area of larger draft hood plus 50% area of smaller hood not greater than 7 times smaller hood

## ◆ Venting of Appliances 2427

### \* Size of gas vents 2427.6.8

- Category II, III, IV – Sizing in accordance with manufacturer's instructions 2427.6.8.3
  - Supported per listing
  - Special signage at vent – could be required by code official

Example:

“This gas vent is for appliances that burn gas. Do not connect to solid or liquid fuel-burning appliances or incinerators.”

## ◆ Venting of Appliances 2427

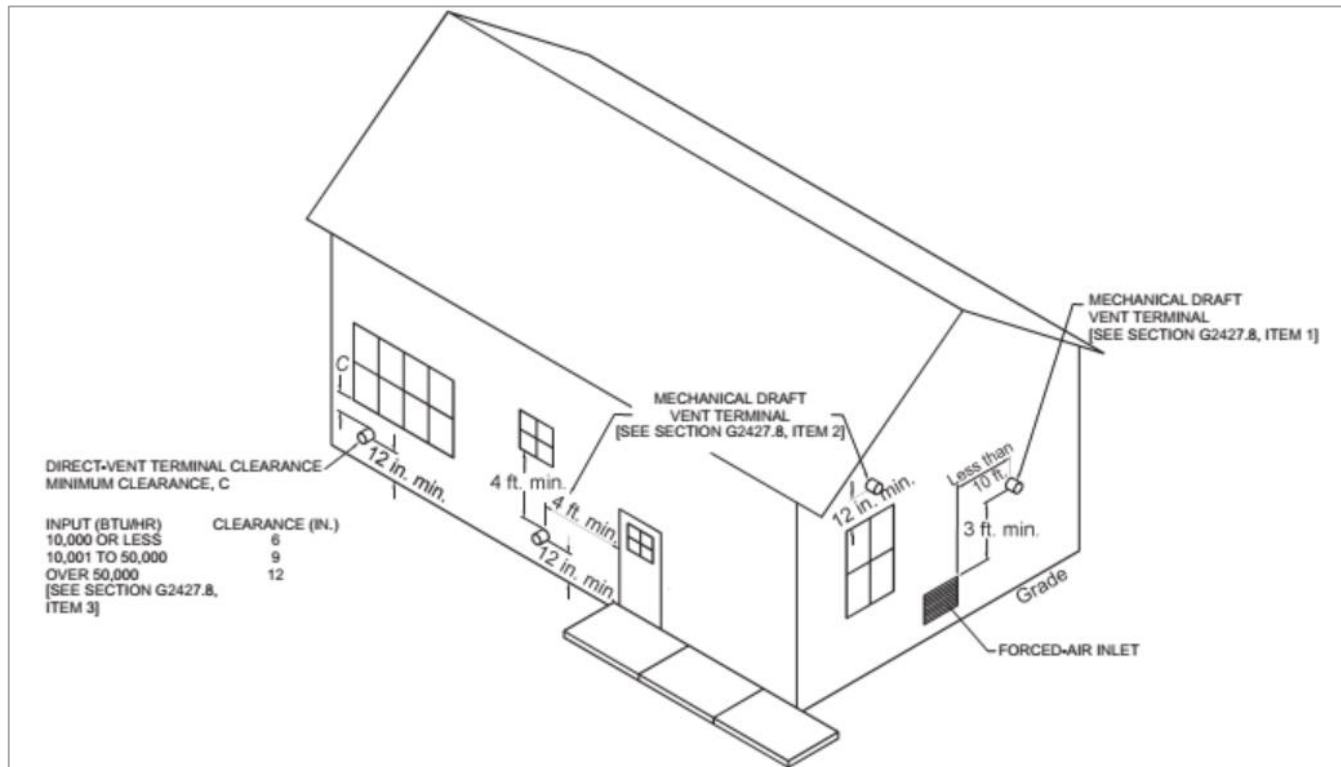
### \* Single wall pipe 2427.7

- Not to be used in cold climates for venting gas utilization equipment
- Terminate 5' above highest connected draft hood outlet
- 2' above roof and 2' within a horizontal distance of 10' with an approved cap
- Limited to runs direct from roof or exterior wall to the outdoor atmosphere 2427.7.4
- Penetrations to be protected 2427.7.5
- Thimble 18" above / 6" below roof
- Not in concealed spaces
- Same sizing requirements

## ◆ Venting of Appliances 2427

### \* Vent system termination 2427.8

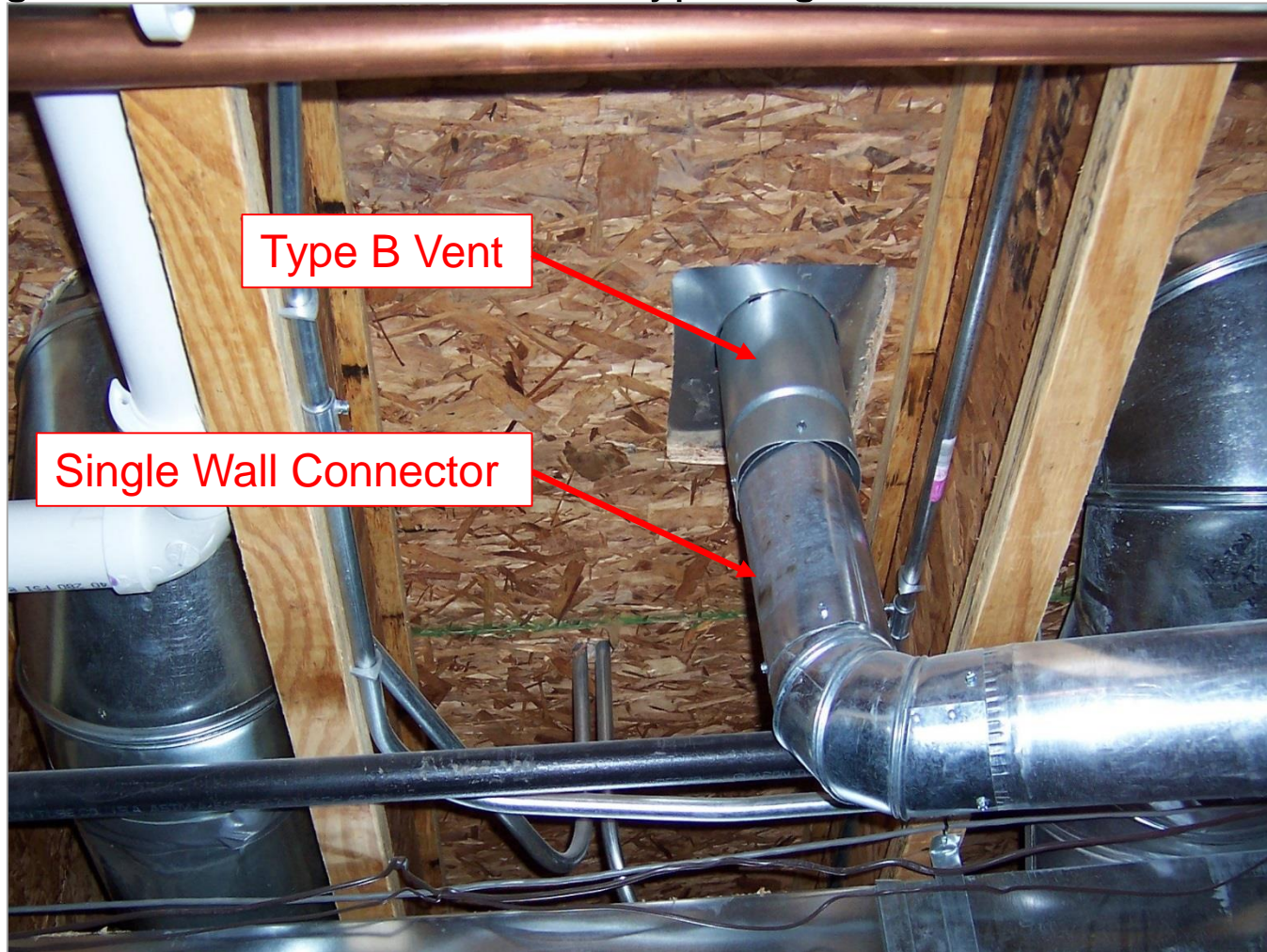
- See Appendix C for illustration
- Mechanical draft system 3' above any forced air within 10'



## ◆ Venting of Appliances 2427

- \* Vent connectors for Category I appliance 2427.10
  - Non-combustible corrosion resistant material 2427.10.2.1
  - Unconditioned spaces require B or L listed material 2427.10.2.2
  - Approved connection material for conditioned spaces
  - B or L vent material
  - Single-wall pipe
    - Aluminum / Stainless steel / Galvanized pipe
    - Smooth interior / corrosion resistant
    - Listed vent connector
    - Thickness per 2427.10.2.4

- \* Single wall vent connector into Type B gas vent



## ◆ Venting of Appliances 2427

- \* Size of vent connector **2427.10.3**
  - Single draft hood and fan assisted Section **2428**
  - Multiple hoods – engineering methods or combined area of flue collars or draft hood outlets; minimum rise 1'
  - Common connector **2427.10.3.4**
  - Highest level consistent with headroom and required clearance
  - Size increase at draft hood outlet **2427.10.3.5**



## ◆ Venting of Appliances 2427

### \* Joints 2427.10.6

- Screws or other connectors as listed per listing sheet
- Slope
  - Without dips; rise  $\frac{1}{4}$ " per foot
- Length – as short as possible 2427.10.8
- 75% of chimney or vent height maximum
  - Type B double wall permitted 100% height of chimney or vent

### \* Properly supported 2427.10.9

## ◆ Venting of Appliances 2427

### \* Draft hoods 2427.12

- Vented equipment to have draft hoods
- Installed exactly as furnished
- Dampers

### \* Manually operated dampers not part of approved installation 2427.13

- Devices that obstruct flow of flue gas not to be installed
- Exception: Draft control 2427.15

## ◆ Sizing of Category I Appliance Venting Systems 2428

- \* DEFINITIONS: Appliance categorized vent diameter/area – Minimum vent area/diameter permissible for Category I appliances to maintain a non-positive vent static pressure when tested in accordance with nationally recognized standards
- \* Fan assisted combustion system / Fan Min / Fan Max / Nat Max / Fan + Fan / Fan + Nat / NA / Nat + Nat

## ◆ Sizing of Category I Appliance Venting Systems 2428

- \* Type B Double-Wall Vent **Table 2428.2(1)**
  - Single Category 1 appliance connected directly to vent
- \* Type B Double-Wall Vent **Table 2428.2(2)**
  - Single Category 1 appliance with single-wall metal connector
- \* Connection to a masonry chimney shall meet the requirements of the 2018 International Fuel Gas Code (**IFGC**) Tables per Appendix B

## ◆ Sizing of Category I Appliance Venting Systems 2428

- \* IFGC **Table 504.2(3)** Masonry Chimney
  - Single Category 1 appliance with Type B double-wall connector
- \* IFGC **Table 504.2(4)** Masonry Chimney
  - Single Category 1 appliance with single-wall connector
- \* IFGC **Table 504.2(5)** Single-Wall Metal Pipe or Type B Asbestos Cement Pipe
  - Single draft hood equipped connected directly to pipe or vent

## ◆ Sizing of Category I Appliance Venting Systems 2428

- \* Vent offsets **2428.2.3**
  - Zero lateral length – no elbows
  - Tables include 2, 90° as part of numbers
  - Each elbow to 45° reduces vent table 5%
  - Each elbow to 90° reduces tables 10%
- \* Zero lateral only to straight vertical vent attached directly to draft hood or flue collar **2424.2.4**
- \* Multiple rate appliances need to meet both minimum and maximum numbers **2428.2.6**

## ◆ Sizing of Category I Appliance Venting Systems 2428

- \* Vent connectors not more than 2 sizes greater than listed appliance categorized vent diameter, draft hood or flue collar **2428.2.11**
- \* Multiple Appliance Vent **Tables 2428.3**
  - Comply with **2428.3.1 – 2428.3.23**
  - No obstructions in system
  - Connector length per Table 504.3.2 or 1 ½ feet per inch of connector
  - Reduce vent capacity 10% for each multiple length of connector

## ◆ Sizing of Category I Appliance Venting Systems 2428

### \* Multiple Appliance Vent **Tables G2428.3**

- Each elbow to 45° reduces vent table 5% G2428.3.6 (504.3.6)
- Each elbow to 90° reduces tables 10%
- Elbows in connectors **2428.3.7**
- Each elbow to 45° reduces vent table 5%
- Each elbow to 90° reduces tables 10%



## ◆ Sizing of Category I Appliance Venting Systems 2428

- \* Common vent – equal to or greater than largest connector  
2428.3.8
- \* Connector rise from the appliance connector to the centerline of vent gas streams 2428.3.11
- \* Vent height measure from highest draft hood outlet
- \* Vent height size not more than 7 times smallest listed vent area 2428.3.13

## ◆ Sizing of Category I Appliance Venting Systems 2428

- \* Vent extends more than 5' above roof additional enclosure requirements **2428.3.16**
  - Where the actual height of a vent falls between entries in the height column either interpolation must be used of the lower input rating must be used for the FAN MAX and NAT MAX **2428.3.22**

## ◆ Sizing of Category I Appliance Venting Systems 2428

- \* Type B Double-Wall Vent **Table 2428.3(1)**
  - 2 or more Category I appliances with Type B double-wall pipe
- \* Type B Double-Wall Vent **Table 2428.3(2)**
  - 2 or more Category I appliances with single-wall connector
- \* Masonry Chimney **Table 2428.3(3)**
  - 2 or more Category I appliances with Type B double-wall pipe

## ◆ Sizing of Category I Appliance Venting Systems 2428

- \* Masonry Chimney IFGC **Table 504.3(4)** 2 or more Category I appliances with single wall metal connector
- \* Single-Wall Metal Pipe or Type B Asbestos Cement Vent IFGC **Table 504.3(5)**
  - 2 or more draft hood equipped direct to pipe or vent
- \* Exterior Masonry Chimney IFGC **Table 504.3(7a)**
  - 2 or more appliances Nat + Nat Type B double-wall connector

## ◆ Sizing of Category I Appliance Venting Systems 2428

- \* Exterior Masonry Chimney **Table 504.3(7b)**
  - 2 or more appliances Nat + Nat Type B double-wall connector
- \* Exterior Masonry Chimney **Table 504.3(8a)**
  - 2 or more appliances fan + Nat Type B double-wall connector
- \* Exterior Masonry Chimney **Table 504.3(8b)**
  - 2 or more appliances Fan + Nat Type B double-wall connector

## ◆ Vents and Connectors – Definitions 202

### \* Vent is defined:

- “A passageway for conveying flue gases from fuel-fired appliances or their vent connectors to the outside atmosphere.”

### \* Vent connector is defined:

- “That portion of a venting system that connects the flue collar or draft hood of an appliance to a vent.”

## ◆ Vents and Connectors – Definitions 202

\* Draft is defined:

- “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.”

Section R202

Mechanical or induced draft is the pressure difference by the action of a fan blower or ejector between the appliance and the chimney or vent termination

Natural draft is created by the vent or chimney because of height and temperature difference between the flue gas and atmosphere

## Class Exercise – Vent sizing for natural draft pool heater

- \* Determine Btu/h input rating from appliance label
- \* When rating is unknown, the manufacturer shall be consulted
- \* 1,000 Btu = 1 cube foot of natural gas
- \* Reference Type B double-wall vent system serving a single appliance with Type B double-wall vent
- \* Table G2428.2(2)
  - Category I Natural Draft Pool Heater
  - 225,000 Btu input – 1' lateral – 20' height
  - Other Appliances



\* Type B Double-Wall Gas Vent **Table 2428.2(2)**

What size vent is allowed?

HEIGHT (H) (feet)	LATERAL (L) (feet)	VENT												
		3			4			5			6			
		APPLIANCE INPL												I
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min		
6	0	38	77	45	59	151	85	85	249	140	126	373	204	165
	2	39	51	36	60	96	66	85	156	104	123	231	156	159
	4	NA	NA	33	74	92	63	102	152	102	146	225	152	187
	6	NA	NA	31	83	89	60	114	147	99	163	220	148	207
8	0	37	83	50	58	164	93	83	273	154	123	412	234	161
	2	39	56	39	59	108	75	83	176	119	121	261	179	155
	5	NA	NA	37	77	102	69	107	168	114	151	252	171	193
	8	NA	NA	33	90	95	64	122	161	107	175	243	163	223
10	0	37	87	53	57	174	99	82	293	165	120	444	254	158
	2	39	61	41	59	117	80	82	193	128	119	287	194	153
	5	52	56	39	76	111	76	105	185	122	148	277	186	190
	10	NA	NA	34	97	100	68	132	171	112	188	261	171	237
15	0	36	93	57	56	190	111	80	325	186	116	499	283	153
	2	38	69	47	57	136	93	80	225	149	115	337	224	148
	5	51	63	44	75	128	86	102	216	140	144	326	217	182
	10	NA	NA	39	95	116	79	128	201	131	182	308	203	228
	15	NA	NA	NA	NA	NA	72	158	186	124	220	290	192	272
20	0	35	96	60	54	200	118	78	346	201	114	537	306	149
	2	37	74	50	56	148	99	78	248	165	113	375	248	144
	5	50	68	47	73	140	94	100	239	158	141	363	239	178
	10	NA	NA	41	93	129	86	125	223	146	177	344	224	222
	15	NA	NA	NA	NA	NA	80	155	208	136	216	325	210	264



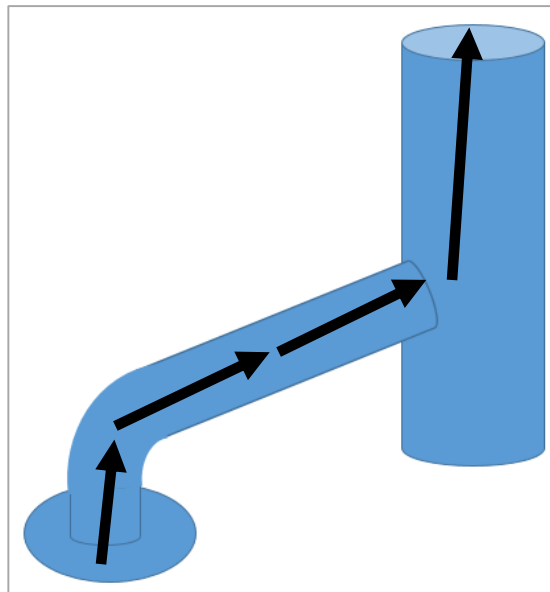
- \* Class Exercise – Maximum and minimum vent sizing
  - \* What is the maximum effective vent area allowed?
  - \* Not greater than 7x draft hood outlet area
  - \* Fan Assisted 100,000 Btu/h Furnace – 15 feet lateral – 30 feet height
  - \* What is the maximum vent size allowed? 4"
  - \* What is the minimum vent size allowed? 4"

- \* Determining minimum capacity of a vertical Type B vent larger than a single vent size connecting to it
  - Size of chimneys Type B vents 2427.5.4
    - “For sizing an individual chimney venting system for a single appliance with a draft hood, the effective areas of the vent connector and chimney flue shall be not less than the area of the appliance flue collar or draft hood outlet, nor greater than seven times the draft hood outlet area.”

- \* Where do we start?
- \* Type B Double-Wall Gas Vent Table 2428.2(1)
- \* 100,000 Btu/h/1,000 = Appliance input rating in thousands
  - Fan Assisted 100,000 Btu/h Furnace – 15 feet lateral, 30 feet height
  - What is the maximum vent size allowed?
  - What is the minimum vent size allowed? (Not greater than 7x draft hood outlet area) Please see next slide

HEIGHT (H) (feet)	LATERAL (L) (feet)	VENT DIAMETER—(D) inches											
		3			4			5			6		
		APPLIANCE INPUT RATING IN THOUSANDS											
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Max	
30	0	0	100	64	0	213	128	0	374	220	0	587	336
	2	9	81	56	13	166	112	14	283	185	18	432	280
	5	21	77	54	28	160	108	36	275	176	45	421	273
	10	27	70	50	37	156	102	48	262	171	59	405	261
	15	33	64	NA	44	141	96	57	249	163	70	389	249
	20	56	58	NA	53	132	90	66	237	154	80	374	237
	30	NA	NA	NA	73	113	NA	88	214	NA	104	346	219

- \* Sizing an individual chimney venting system for a single appliance with a draft hood **2427.5.4**
- \* The effective areas of the vent connector and chimney flue shall be:
  - Not less than the area of the appliance flue collar or draft hood outlet
  - Not greater than seven times the draft hood outlet area



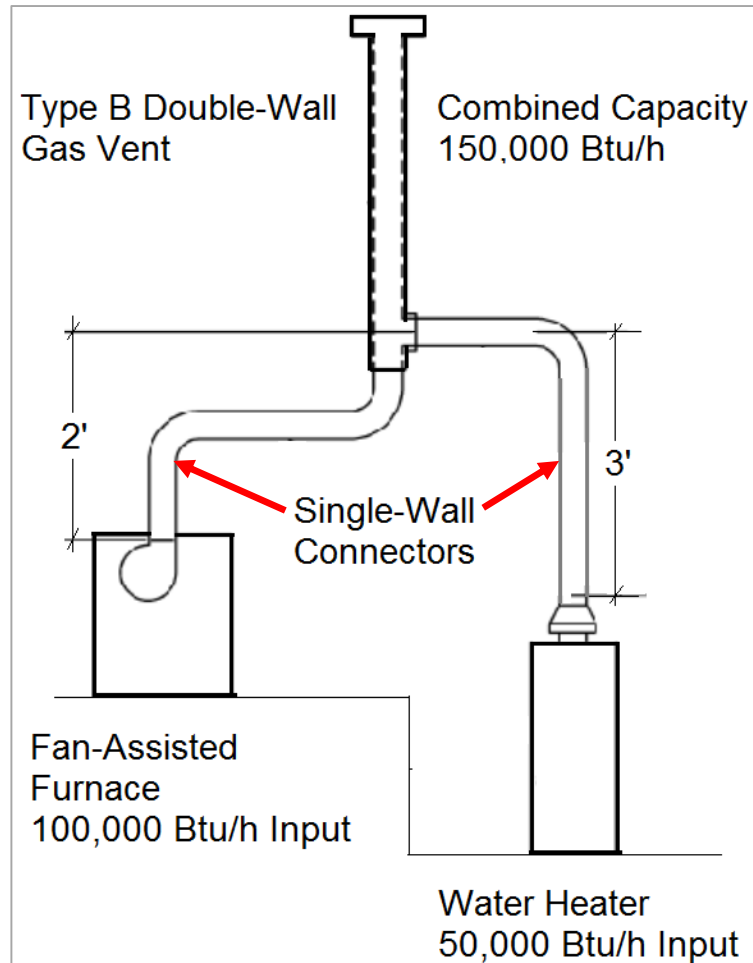
- \* Where:
  - Area of circle:  $A = \pi r^2$
  - $\pi = 3.14$
  - Vent connector = 4" diameter
  - Thus:
  - 4" diameter = 2" radius
  - Radius squared  $2" \times 2" = 4"$
  - Flow area of vent connector =  $3.14 \times 4"$ , or
    - 12.56 square inch
- \* Check for 7 times size limit
  - $12.56 \text{ square inch} \times 7 = 87.96 \text{ square inch}$
  - $87.96 \text{ square inch} / 3.14 = 28 \text{ square inch}$
  - Square root of 28 square inch = 5.29"
- \* Answer: Vertical vent maximum size = 5" diameter

Class Exercise – Determine 2 single wall connector vent sizes and Type B double wall vent size accepting the 2 single wall vents

- Reference Table 2428.3(1) vent system serving 2 or more appliances with a Type B double-wall common vent and single-wall vent connectors
- Equipment common-vented into a 20' high Type B vent chimney:
  - 100,000 Btu/h Fan assisted furnace  
10' lateral – 2' rise
  - 50,000 Btu/h Water heater  
4' lateral - 3' rise

\* Step One

- Determine size of single wall vents from each appliance





\* Type B Double-Wall Vent **Table 2428.3(2)**

- 100,000 Btu/h Fan assisted furnace, lateral 2' rise – 20' chimney

		VENT CO								
		SINGLE-W/								
VENT HEIGHT (H) (feet)	CONNECTOR RISE (R) (feet)	3			4			5		
		APPLIA								
		FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	NA	NA	26	NA	NA	46	NA	NA	71
	2	NA	NA	31	NA	NA	55	NA	NA	85
	3	NA	NA	34	NA	NA	62	121	131	95
8	1	NA	NA	27	NA	NA	48	NA	NA	75
	2	NA	NA	32	NA	NA	57	125	126	89
	3	NA	NA	35	NA	NA	64	130	138	100
10	1	NA	NA	28	NA	NA	50	119	121	77
	2	NA	NA	33	84	85	59	124	134	91
	3	NA	NA	36	89	91	67	129	144	102
15	1	NA	NA	29	79	87	52	116	138	81
	2	NA	NA	34	83	94	62	121	150	97
	3	NA	NA	39	87	100	70	127	160	109
20	1	49	56	30	78	97	54	115	152	84
	2	52	59	36	82	103	64	120	163	101
	3	55	62	40	87	107	72	125	172	113
	4	47	60	34	77	110	57	119	175	80

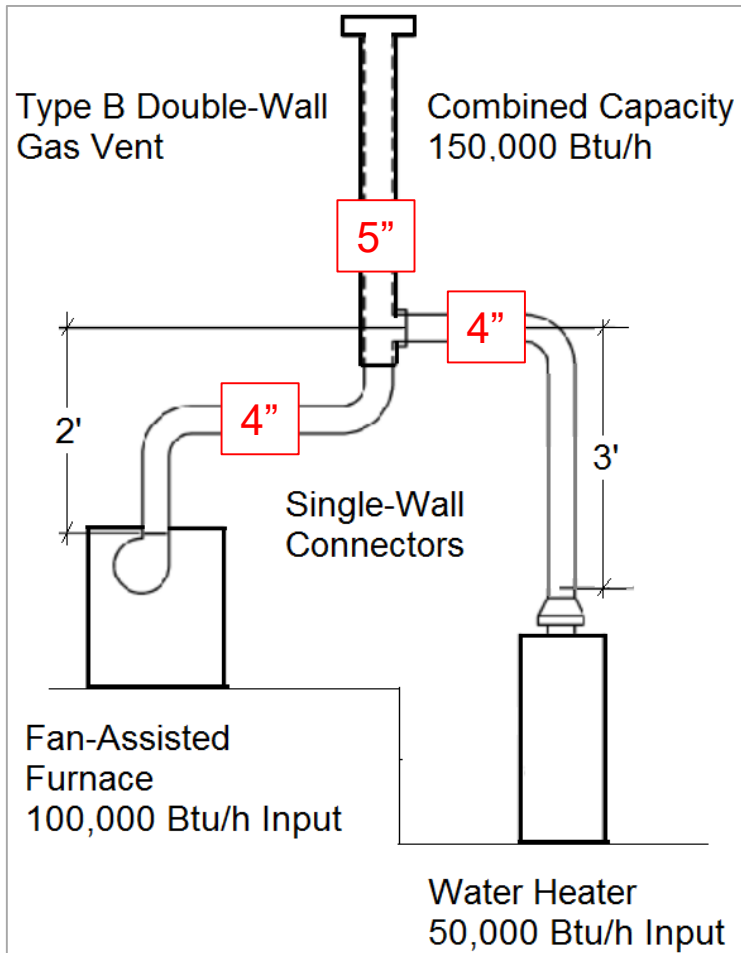
- \* Type B Double-Wall Vent Table 2428.3(1)
- \* 50,000 Btu/h Water heater, lateral 3' rise – 20' chimney

VENT HEIGHT (H) (feet)	CONNECTOR RISE (R) (feet)	3		4		5		6	
		FAN		NAT	FAN		NAT	FAN	
		Min	Max	Max	Min	Max	Max	Min	Max
6	1	NA	NA	26	NA	NA	46	NA	NA
	2	NA	NA	31	NA	NA	55	NA	NA
	3	NA	NA	34	NA	NA	62	NA	12
8	1	NA	NA	27	NA	NA	48	NA	NA
	2	NA	NA	32	NA	NA	57	NA	12
	3	NA	NA	35	NA	NA	64	NA	13
10	1	NA	NA	28	NA	NA	50	NA	11
	2	NA	NA	33	84	85	59	NA	12
	3	NA	NA	36	89	91	67	NA	12
15	1	NA	NA	29	79	87	52	NA	11
	2	NA	NA	34	83	94	62	NA	12
	3	NA	NA	39	87	100	70	NA	12
20	1	49	56	30	78	97	54	NA	11
	2	52	59	36	82	103	64	NA	12
	3	55	62	40	87	107	72	NA	12

- \* Type B Double-Wall Vent **Table 2428.3(1)**
- \* Common vent diameter requirement for Type B double-walled vent

COMMON VENT CAPACITY									
VENT HEIGHT (H) (feet)	TYPE B DOUBLE WALL VENT								
	4			5			6		
	COMBINED AREA								
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	NA	78	64	NA	113	99	200	158	NA
8	NA	87	71	NA	126	111	218	173	NA
10	NA	94	76	163	137	120	237	189	NA
15	121	108	88	189	159	140	275	221	150
20	131	118	98	208	177	156	305	247	165
30	145	132	113	236	202	180	350	286	180
50	159	145	128	268	233	208	406	337	200

\* Size of Type B Double-Wall common vent is 5"

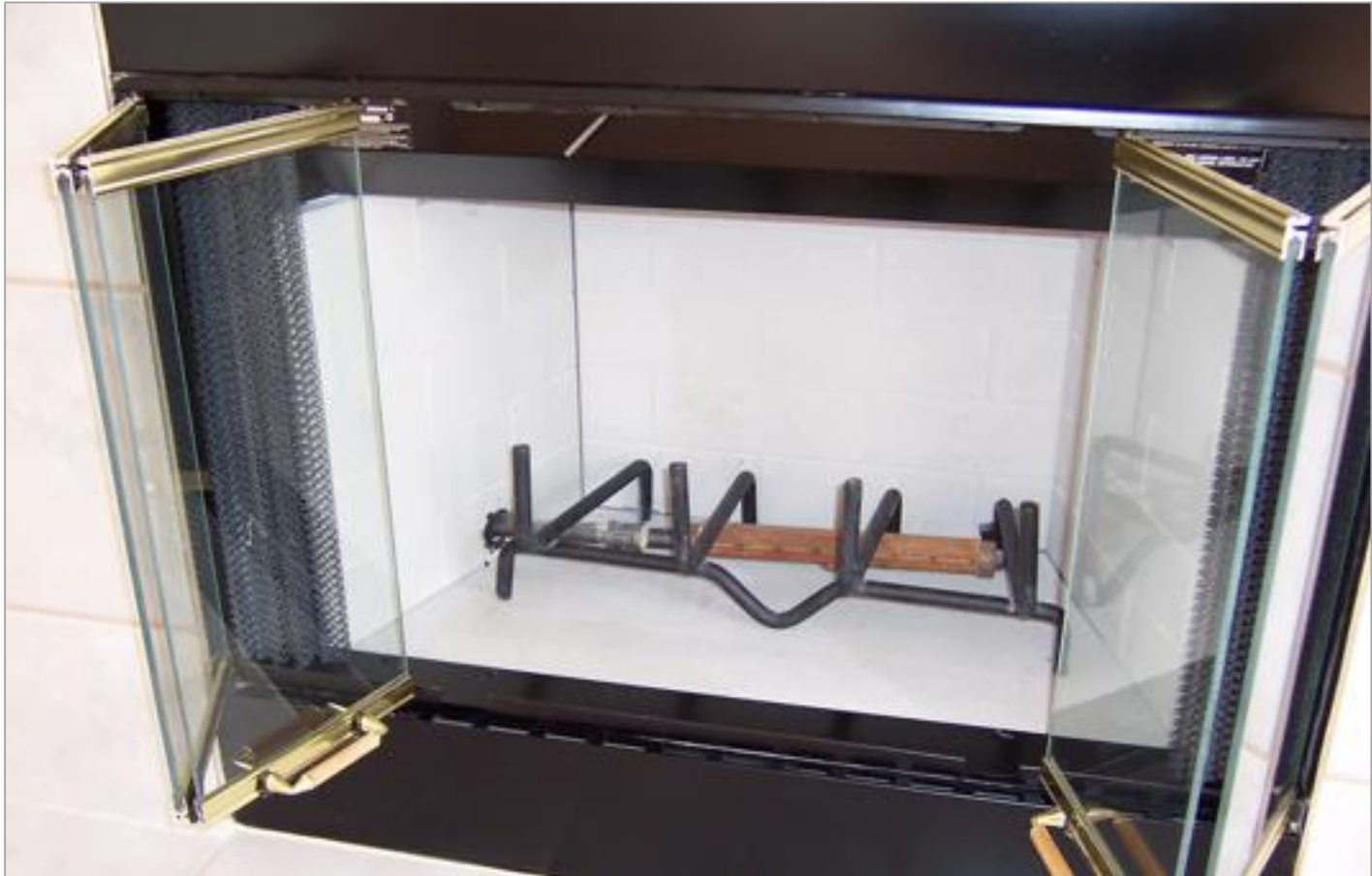


Connector Diameters	
150,000 Btu/h Furnace	4"
50,000 Btu/h Water Heater	4"
Combined Type B Vent	5"

## Specific Appliances 2431 – G2453

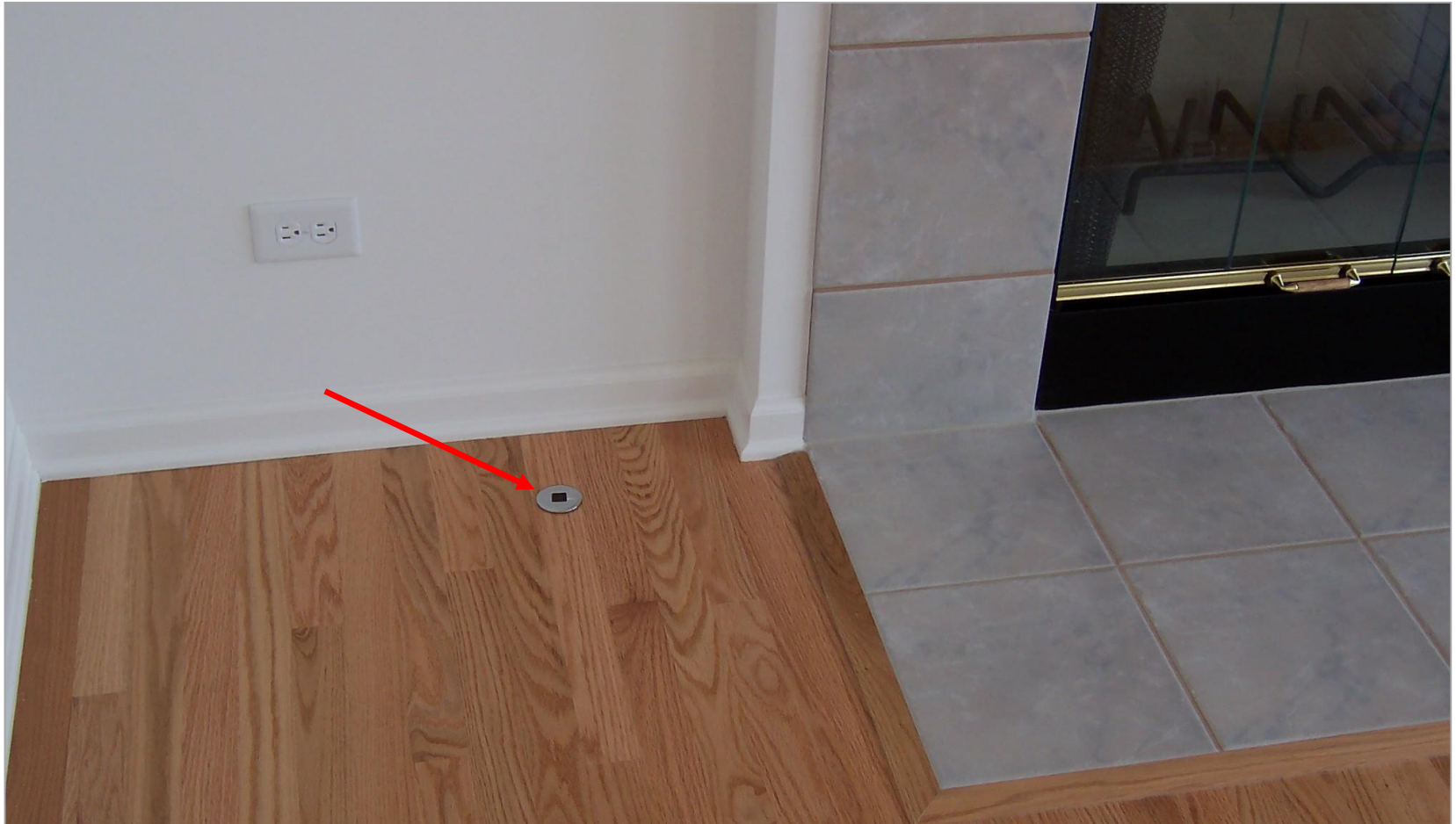
- ◆ **Decorative Appliances for Installation in Fireplaces 2432**
  - \* Flame safeguard device, pilot flame or ignition
- ◆ **Log Lighters**
  - \* Per CSA 8
- ◆ **Vented Gas Fireplace Heaters 2435**
  - \* Access panels not to be attached to building
  - \* Vented gas fireplace heaters per ANSI Z21.88

- \* Natural gas log lighter





- \* Gas shutoff valve within 6' 2420.5.1



## ◆ Vented Wall Furnaces 2436

- \* Not circulate air from or between bathrooms
- \* 12" clearance for doors; doorstops and door closers not allowed as clearance device
- \* Not ducted
- \* Access for cleaning and service

## ◆ Floor Furnaces 2437

- \* Specific clearance requirements
- \* Thermostats in same room
- \* Protection if suspended into habitable spaces



## ◆ Clothes Dryers and Exhaust Sections 2438-2439

- \* Fire resistance rating of construction to be maintained
- \* Access for cleaning of all vertical ducts
- \* Exhausted outside the building
- \* Many same requirements as mechanical section

## ◆ Sauna Heaters 2440

- \* 194° – room temperature
- \* One hour maximum timer – required

## ◆ Forced Warm Air 2442

- \* Outside and return air ducts not less than 2 sq. in per 1,000 Btu or as per manufacturer's instructions
- \* Many same requirements as mechanical section

## ◆ Unit Heaters 2444

- \* Properly supported
- \* No duct work unless listed
- \* Clearance to combustibles

## ◆ Unvented Room Heaters 2445

- \* Not sole source of heat
- \* Aggregate total 20 Btu per cube foot – venting required
- \* Oxygen depletion device

## ◆ Vented Room Heaters 2446

- \* Per ANSI Z21.86 / CSA 2.32

## ◆ Cooking Appliances 2447

- \* Commercial cooking appliances not to be installed in dwelling units or areas where domestic cooking will occur
- \* Domestic appliances to be listed and labeled for use

- ◆ Water Heaters 2448
  - \* Safety devices per code
  - \* Listed accordingly if supplying space heating and domestic
- ◆ Air Conditioning Appliances 2449
- ◆ Illuminating Appliances 2450
- ◆ Infrared Radiant Heaters 2451
- ◆ Boilers Section 2452
- ◆ Chimney Damper Opening Area 2453

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# Questions?

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**Thank You For Your Time**

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