Board of Building Standards

EDUCATION COMMITTEE MEETING
AGENDA (REVISED 3/23/22)

DATE: MARCH 24, 2022
TIME: 10:00 AM
LOCATION: TRAINING ROOM 3, 6606 TUSSING ROAD, REYNOLDSBURG, OHIO

Call to Order

Consent Agenda

Course Applications

ER-1 2022 Group B Committee Action Hearing - ADMIN (International Code Council)
All certifications (9 hours)
Staff Notes: Recommend approval for all certifications, encouraging code development engagement.
Committee Recommendation:

ER-2 2022 Group B Committee Action Hearing - IEBC (International Code Council)
All certifications (8.5 hours)
Staff Notes: Recommend approval for all certifications, encouraging code development engagement.
Committee Recommendation:

ER-3 2022 Group B Committee Action Hearing IEBC-S, IBC-S (International Code Council)
All certifications (39 hours)
Staff Notes: Recommend approval for all certifications, encouraging code development engagement.
Committee Recommendation:

ER-4 2022 Group B Committee Action Hearing IRC-B (International Code Council)
All certifications (47 hours)
Staff Notes: Recommend approval for all certifications, encouraging code development engagement.
Committee Recommendation:

ER-5 Continuous Load Path Connections for Wood-Framed Structures (Simpson Strong-Tie)
BO, MPE, BPE, BI, NRIUI, RBO, RPE, RBI, RIUI (5 hours)
Staff Notes: Based on 2021 IRC and IBC. While the application also indicates 3, 2, and 1-hour versions, the submitter has decided to apply only for the 5-hour version for now. Recommend approval.
Committee Recommendation:

ER-6 HyperSpike (Miami Valley Building Officials Council)
All certifications except plumbing and IU (1 hour)
Staff Notes: Product introduction by Sales Application Manager in the company. I don't see anything about codes in the slides.
ESIAC Recommendation:
Committee Recommendation:

ER-7 NEC 2020 Changes (Electrical League of Ohio)
BO, MPE, EPE, ESI, BI, RBO, RPE, RBI (2 hours)
Staff Notes: This course was approved in February as BBS2022-489 for one hours. The submitter, Terri Hanna-Wiehn, contacted us to say it should have been submitted for two hours and provided an amended outline (the slide set was correct as submitted). With Terry and Tim's permission, we administratively approved the course for two hours and are now asking the Committee to recommend that the Board ratify this approval.
Committee Recommendation:

ER-8 Overview of the 2017 OMC (Ohio Certificate Renewal)
Add FPPE, FPI (4 hours, 8 hours)
Staff Notes: These are two courses already renewed for 2022. The submitter would like to add FPPE and FPI to the certifications. Slides 15, 21, 53, 55, 58, 68, 71, 72, 75, 76, 78, and 83 pertain to fire protection.
Committee Recommendation:

Old Business

New Business

Adjourn

EDUCATION COMMITTEE MEETING
CONSENT AGENDA

Course Applications

File Attachments for Item:

ER-1 2022 Group B Committee Action Hearing - ADMIN (International Code Council)

All certifications (9 hours)

Staff Notes: Recommend approval for all certifications, encouraging code development engagement.

Committee Recommendation:

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.

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

COURSE SUBMITTER:

Course Submitter: Laura Morris (Contact Name)
Organization: International Code Council (Organization/Company)
Address: 4051 W. Flossmoor Road (Include Room Number, Suite, etc.)
City: Country Club Hills State: IL Zip: 60478
E-Mail: lmorris@iccsafe.org
Telephone: 708-799-2300 ext 4523 Fax: 708-799-2651
Course Sponsor: International Code Council

COURSE INFORMATION:

Course Title: 2022 Group B Committee Action Hearing - ADMIN

New Course Submittal: ☒ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Public hearings of the Code Development Committees are open meetings. Any interested person may attend and participate in the Floor Discussion and Assembly Consideration portions of the hearing. All ICC Members are eligible to vote on Assembly Considerations. The intent of the public hearing is to permit interested parties to present their views including the cost and benefits on the code change proposals on the published agenda.

Number of Instructional Contact Hours that can be obtained upon completion: 9 hours

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

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

Electrical Safety Inspectors ☐
Electrical Safety Inspector Trainee Part I - Fundamentals of Electricity (Theory) ☐
Electrical Safety Inspector Trainee Part II – ESI Refresher Course ☐
Location of ESI Course: _____ Date(s) of ESI Course(s): March 27, 2022

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

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

File Attachments for Item:

ER-2 2022 Group B Committee Action Hearing - IEBC (International Code Council)

All certifications (8.5 hours)

Staff Notes: Recommend approval for all certifications, encouraging code development engagement.

Committee Recommendation:

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.

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

COURSE SUBMITTER:

Course Submitter: Laura Morris (Contact Name)
Organization: International Code Council (Organization/Company)
Address: 4051 W. Flossmoor Road (Include Room Number, Suite, etc.)
City: Country Club Hills State: IL Zip: 60478
E-Mail: lmorris@iccsafe.org
Telephone: 708-799-2300 ext 4523 Fax: 708-799-2651
Course Sponsor: International Code Council

COURSE INFORMATION:

Course Title: 2022 Group B Committee Action Hearing - IEBC

New Course Submittal: ☐ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective:
Public hearings of the Code Development Committees are open meetings. Any interested person may attend and participate in the Floor Discussion and Assembly Consideration portions of the hearing. All ICC Members are eligible to vote on Assembly Considerations. The intent of the public hearing is to permit interested parties to present their views including the cost and benefits on the code change proposals on the published agenda.

Number of Instructional Contact Hours that can be obtained upon completion: 8.5 hours

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

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 Bldg Official ☐	Res Plans Examiner ☐	Res Building Inspector ☐	Res Mechanical Inspector ☐	Res IU Inspector ☒

Electrical Safety Inspectors ☐
Electrical Safety Inspector Trainee Part I - Fundamentals of Electricity (Theory) ☐
Electrical Safety Inspector Trainee Part II – ESI Refresher Course ☐
Location of ESI Course: _____ Date(s) of ESI Course(s): March 27, 2022

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

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

File Attachments for Item:

ER-3 2022 Group B Committee Action Hearing IEBC-S, IBC-S (International Code Council)

All certifications (39 hours)

Staff Notes: Recommend approval for all certifications, encouraging code development engagement.

Committee Recommendation:

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.

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COURSE SUBMITTER:

Course Submitter: Laura Morris (Contact Name)
Organization: International Code Council (Organization/Company)
Address: 4051 W. Flossmoor Road (Include Room Number, Suite, etc.)
City: Country Club Hills State: IL Zip: 60478
E-Mail: lmorris@iccsafe.org
Telephone: 708-799-2300 ext 4523 Fax: 708-799-2651
Course Sponsor: International Code Council

COURSE INFORMATION:

Course Title: 2022 Group B Committee Action Hearing - IEBC - S / IBC - S

New Course Submittal: ☒ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Public hearings of the Code Development Committees are open meetings. Any interested person may attend and participate in the Floor Discussion and Assembly Consideration portions of the hearing. All ICC Members are eligible to vote on Assembly Considerations. The intent of the public hearing is to permit interested parties to present their views including the cost and benefits on the code change proposals on the published agenda.

Number of Instructional Contact Hours that can be obtained upon completion: 39 hours

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

Program Applicable for the Following Participants:

Building Official	☒	Master Plans Examiner	☒	Building Inspector	☒	Fire Protection Inspector	☒
		Plumbing Plans Exam.	x				
		Electrical Plans Exam.	x				
		Mechanical Plans Exam.	☒				

Mechanical Inspector	☒	Plumbing Inspector	☐	Non-Res IU Inspector	x				

Res Bldg Official	☒	Res Plans Examiner	☒	Res Building Inspector	☒	Res Mechanical Inspector	☒	Res IU Inspector	X

Electrical Safety Inspectors ☐
Electrical Safety Inspector Trainee Part I - Fundamentals of Electricity (Theory) ☐
Electrical Safety Inspector Trainee Part II – ESI Refresher Course ☐
Location of ESI Course: _____ Date(s) of ESI Course(s): April 2 - 6, 2022

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

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

File Attachments for Item:

ER-4 2022 Group B Committee Action Hearing IRC-B (International Code Council)

All certifications (47 hours)

Staff Notes: Recommend approval for all certifications, encouraging code development engagement.

Committee Recommendation:

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.

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COURSE SUBMITTER:

Course Submitter: Laura Morris (Contact Name)
Organization: International Code Council (Organization/Company)
Address: 4051 W. Flossmoor Road (Include Room Number, Suite, etc.)
City: Country Club Hills State: IL Zip: 60478
E-Mail: lmorris@iccsafe.org
Telephone: 708-799-2300 ext 4523 Fax: 708-799-2651
Course Sponsor: International Code Council

COURSE INFORMATION:

Course Title: 2022 Group B Committee Action Hearing - IRC - B

New Course Submittal: ■ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Public hearings of the Code Development Committees are open meetings. Any interested person may attend and participate in the Floor Discussion and Assembly Consideration portions of the hearing. All ICC Members are eligible to vote on Assembly Considerations. The intent of the public hearing is to permit interested parties to present their views including the cost and benefits on the code change proposals on the published agenda.

Number of Instructional Contact Hours that can be obtained upon completion: 47 hours

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

Program Applicable for the Following Participants:

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

Res Bldg Official ■ Res Plans Examiner ■ Res Building Inspector ■ Res Mechanical Inspector ■ Res IU Inspector x

Electrical Safety Inspectors ☐
Electrical Safety Inspector Trainee Part I - Fundamentals of Electricity (Theory) ☐
Electrical Safety Inspector Trainee Part II – ESI Refresher Course ☐
Location of ESI Course: _____ Date(s) of ESI Course(s): March 29 - April 2, 2022

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

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

File Attachments for Item:

ER-5 Continuous Load Path Connections for Wood-Framed Structures (Simpson Strong-Tie)

BO, MPE, BPE, BI, NRIUI, RBO, RPE, RBI, RIUI (5 hours)

Staff Notes: Based on 2021 IRC and IBC. While the application also indicates 3, 2, and 1-hour versions, the submitter has decided to apply only for the 5-hour version for now. Recommend approval.

Committee Recommendation:

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.

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

COURSE SUBMITTER:

Course Submitter: Greg Wujcik
(Contact Name)
Organization: Simpson Strong-Tie
(Organization/Company)
Address: 2600 International St
(Include Room Number, Suite, etc.)
City: Columbus State: OH Zip: 43228
E-Mail: gwujcik@strongtie.com
Telephone: 440-263-2490 Fax: _____
Course Sponsor: _____

COURSE INFORMATION:

Course Title: Continuous Load Path Connections for Wood Framed Structures

New Course Submittal: ☒ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Explain the requirements and solutions to the numerous codes and standards as they relate to the complete and continuous load path. Identify the parts of a wood structure that need mechanical reinforcement to satisfy the continuous load path requirements of the code and recognize which products and methods satisfy those requirements. Enable participants to locate installation instructions of mechanical connectors and discuss the importance of correct installation. Discuss the importance of various fasteners and be able to identify the different fastener sizes and types.

Number of Instructional Contact Hours that can be obtained upon completion: 5, 3, 2, or 1

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

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

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

Presenter Biography

Jim Mailey, Training Manager, Simpson Strong-Tie
Jim Mailey is the Midwest, Northeast and Mid-Atlantic market training manager for Simpson Strong-Tie – a company that for more than 50 years has developed structural products to help people build safer and stronger buildings, homes and decks. Joining Simpson Strong-Tie in 1992, Jim has given hundreds of presentations to more than 20,000 design professionals, building officials, builders, contractors and dealers. He has developed numerous programs designed to educate industry professionals about how to install Simpson Strong-Tie® products as well as how these products meet various building code requirements. Jim is considered an expert in safe, outdoor wood deck construction and provides economical product solutions to satisfy structural code requirements for wood decks. He has written articles about deck safety and has been quoted in deck contractor and home inspector publications. His program entitled "Deck Framing Connections Seminar" reviews the correct and incorrect structural methods for building a deck, shows why commonly accepted practices should not be used and provides informative tips that the novice to the most experienced deck builder will find useful. Jim earned a B.A. from Bloomsburg University in Bloomsburg, Pennsylvania, in 1980.

Greg Wujcik, Territory Manager, Simpson Strong-Tie
Greg Wujcik is the Territory Manager for the state of Ohio for Simpson Strong-Tie - – a company that for more than 50 years has developed structural products to help people build safer and stronger buildings, homes and decks. Greg has been with Simpson Strong-Tie since 2000, and has given numerous presentations to design professionals, building officials, builders, contractors, and dealers. Greg also works with these same groups educating them on the proper use and installation of Simpson Strong-Tie products in order to provide economic solutions to satisfy building code requirements. Greg earned a B.A. from Baldwin-Wallace College in Berea, Ohio in 2000.

Simpson Strong-Tie is committed to helping customers succeed by providing exceptional products, full-service engineering and field support, product testing and training. For more information, visit the company's website at www.strongtie.com.

SIMPSON Strong-Tie®
Continuous Load Path Connections (Structural) for Wood-Framed Structures

7:30 Registration 8:00 Introduction/Outline of Seminar agenda 8:15 "Continuous Load Path" basics 8:30 General Information on Fastener and Connector Options 8:40 Foundation Sill Plate Anchoring - Cast-in Place Anchor Bolts - Cast-in Place Strap-Type products - Post-Installed Sill Plate Anchors-Retrofits-Mechanical Anchors 9:30 General Wood Wall Framing - A review of all methods to transfer uplift loads 10:15 -- Break – 10:30 Wall Bracing – Overview 11:15 Shear Walls -Lateral Systems - Holdowns - Post-Installed Structural Anchoring Adhesives - Pre-fabricated shear walls - 12:00 -- Lunch – 1:00 Roof Construction - Roof Deflection - "Strong" Roof Framing - Roof Uplift – Rafter-to-top Plate connection, Toenailing performance - Suggestions for Selecting a Hurricane Tie 1:50-2:00 Closing/Questions	**2022 – 5 hours** For; Architects, Engineers, Building Inspectors, Home Inspectors Builders, Contractors, Dealers, & Distributors
Course Description: A detailed review of the structural code requirements for a wood-framed building to satisfy primarily the uplift requirements based on the International Residential Code and the International Building Code, followed by an overview of Simpson Strong-Tie products, developed to satisfy those requirements and do so at the lowest installed cost. This workshop will provide 5 Professional Development Hours.	

Course Outline;

- Introduction
  - ✓ Outline, Resources
- Continuous Load Path Basics for a Wood-Framed Structure
- General Information on Fastener and Connector Options
- Foundation Sill Plate Anchoring – Cast-in Place
  - ✓ Strap-type products
  - ✓ Anchor bolts
- Post-Installed Sill Plate Anchors
  - ✓ Retrofit for the sill plate
  - ✓ Mechanical anchors
- General Wood Wall Framing
  - ✓ Uplift – review of various methods to transfer uplift loads
- Wall Bracing – Overview
- Shear Walls – Lateral Systems
  - ✓ Holdowns
  - ✓ Post-installed structural anchoring adhesives
  - ✓ Pre-fabricated shear walls
- Roof Construction
  - ✓ Roof deflection
  - ✓ Roof uplift – rafter/truss-to-top plate connection

Resources: Simpson Strong-Tie – Literature

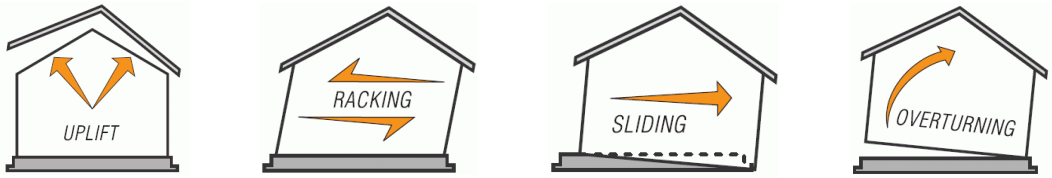
- Wood Connector catalog (C-C-2021)
  - ➢ Pocket Installers Guide-Connectors (S-C-INSTALL)
- Fastening Systems Technical Guide (C-F-2019TECHSUP)
- Fastening Systems catalog (C-F-2019)
- Concrete & Masonry Anchoring Systems catalog (C-A-2021)
- High Wind catalog (F-C-HWG20)

Resources: Simpson Strong-Tie – Software

- ➢ Drawing Finder
- ➢ Code Report Finder
- ➢ Joist Hanger Selector App

Continuous Load Path Basics

Forces to be Resisted;



Resource: NOAA Storm Prediction Center, Annual Severe Weather Report
Resource: ICC 600 Standard for Residential Construction in High Wind Regions

Code Guide;
"R" before the numbers indicates the section is from the International Residential Code.
If the entire section is in black – started as a code requirement in 2000, same requirement currently.
The following colors identify when there was a significant change in the code;
Red – 2009, Green – 2012, Purple – 2015, **Bold Brown – 2018, Bold Dark Red – 2021**

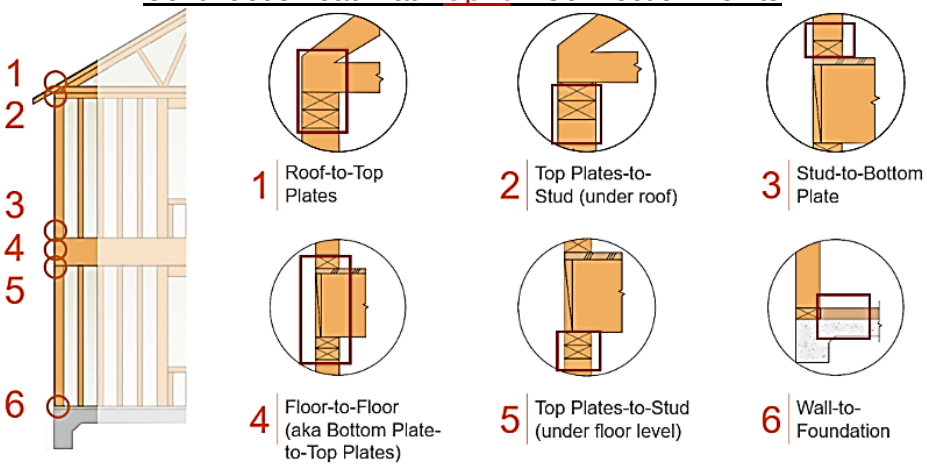
Resource: International Code Council **–** **www.iccsafe.org**

- International Residential Code® (IRC®) – 2000-2021
- International Building Code® (IBC®) – 2000-2021

IRC®: R301.1 Application. …The construction of buildings and structures in accordance with the provisions of this code shall result in a system that provides a complete load path that meets the requirements for the transfer of all loads from their point of origin through the load-resisting elements to the foundation.
Buildings and structures constructed as prescribed by this code are deemed to comply with the requirements of this section.
R301.2.1 Wind Design Criteria. A continuous load path shall be provided to transmit the applicable uplift forces in Section R802.11.1 from the roof assembly to the foundation.

IRC applies to Detached one- and two-family dwellings and townhouses not more than 3 stories above grade plane with a separate means of egress.
Limitations – wind speed ≥ 140 mph (see Figure R301.2.1.1), buildings in SDC E,
snow loads > 70 psf, buildings and structures in floodways use ASCE 24, other-see section R301

Continuous Load Path-Uplift – Connection Points



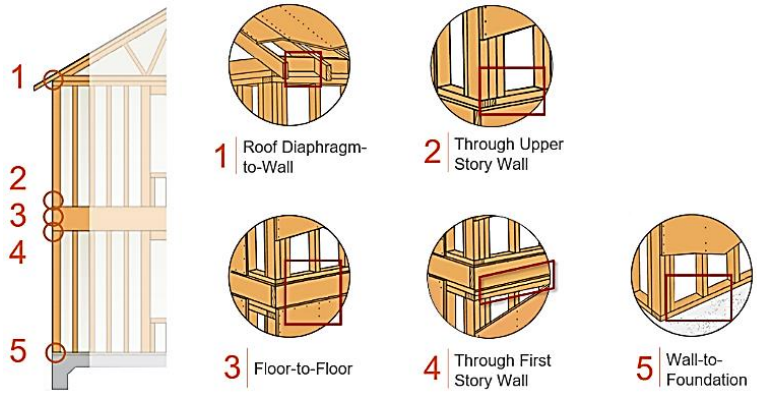
Flood Resistant Construction

IRC®: R322.1 Flood-Resistant Construction. Buildings and structures constructed in flood hazard areas (including A or V Zones **and Coastal A**) …shall be designed and constructed in accordance with this section.
R301.2.4/R322.1…Exception: buildings and structures in floodways shall be designed and constructed in accordance with ASCE 24.
R322.1.2 Structural systems. …of all buildings and structures shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement due to structural loads and stresses from flooding equal to the design flood elevation (DFE).
IBC®: 1612.4/1612.2 Design and construction. …flood hazard areas, coastal high hazard areas, Coastal A zones …in accordance with Chapter 5 of ASCE 7 and with ASCE 24.
ASCE24-05/14: 1.5 Basic Design and Construction Requirements
1.5.1 General. New construction or substantial improvements (50% or greater) shall be designed, constructed, connected and anchored to resist flotation, collapse or permanent lateral movement…

Course Name	CEUs	AIA	ICC
Buildings, Homes & Decks in Flood Hazard Areas Connections At or Below the Design Flood Elevation	0.5	**In-person (5-hour)**	
Buildings, Homes in a Flood Hazard Area - Connections (online)	0.1	✓	✓
Decks, Porches in a Flood Hazard Area – Connections (online)	0.1	✓	✓

IBC®: 1604 General Design Requirements
1604.4 Analysis. …Any system or method of construction to be used shall be based on a rational analysis in accordance with well-established principles of mechanics. Such analysis shall result in a system that provides a complete load path capable of transferring loads from their point of origin to the load resisting elements…
1604.9 *('06-'15)* Counteracting structural actions. Structural members, systems, components and cladding shall be designed to resist forces due to earthquake and wind, with consideration of overturning, sliding and uplift. Continuous load paths shall be provided for transmitting these forces to the foundation.
1604.4 Every structure shall be designed to resist the effects caused by the forces specified in this chapter, including overturning, uplift and sliding.

Continuous Load Path to Resist In Plane – Connection Points



Resource: **Institute for Business and Home Safety (IBHS) – www.disastersafety.org**

- **Fortified for Safer Living®, Fortified Home™ -** The **Fortified** program offers a package of "code-plus" upgrades that greatly increases a new home's resistance to natural perils.

Connection Methods;

Traditional options include common fasteners, sheathing, rods and cables, and metal connectors. The use of screws for continuous load path connections are a newer technology.

Common fasteners	Traditional, low-cost option for areas with a low risk of seismic or wind activity. Load capacity is limited, and may not be a viable solution for all connections. **Nails:** Strength – Widely available, no pre-drilling, cost efficient, minimal labor. Weakness – Limited applications, limited shear capacity, low or no withdrawal capacity. **Wood Screws:** Strength – Widely available, threads provide more withdrawal than nails, minimal labor. Weakness – Predrilling required (laterally loaded), minor diameter limits shear strength, no withdrawal capacity from the end grain, possibly wrong types are used **Lag Screws:** Strength – Maximum shear and withdrawal due to larger diameter, withdrawal through the end grain, able to be inspected. Weakness – 2 pre-drilled holes required, pre-drilling removes a significant amount of wood, minimum penetration of 4 diameters required. **Bolts:** Strength – Maximum shear capacity, large tension capacity, able to be inspected. Weakness – Pre-drilling required, pre-drilling removes a significant amount of wood, must have access to both sides for installation
Sheathing	Resists both lateral and uplift loads. Sheathing connects the top plate directly to the foundation. For more information, see SDPWS Section 4.4: Wood Structural Panels Designed to Resist Combined Shear and Uplift from Wind.
Restraint rod systems	Continuous rod tiedown systems consist of a combination of connectors, rods, coupler nuts, bearing plates and shrinkage compensation devices. These all work together to create a continuous load path to the foundation.
Metal connectors	A proven, widely available economical solution to strengthen connection points. Typical connectors for continuous load path connections include seismic or hurricane ties, holdowns and straps.
Engineered structural screws	Designed, engineered, structural screws that provide easier installation, flexibility in framing, and do not interfere with finish materials. Limits reviewed in each section.

Resource: **American Wood Council (AWC) – www.awc.org**

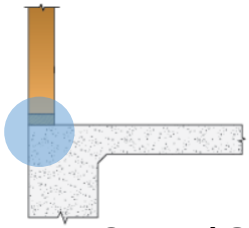
- National Design Specification for Wood Construction
- Online Span and Connections Calculator – **www.awc.org/calculators**

Resource: Showalter, John. Nov. 2016 Design of Bolted Connections per the 2015 NDS, Structure Magazine

Sill Plate-to-Foundation Connection

Foundation Code Requirements

Sill plate to foundation connection: describe mudsill to foundation requirements and identify various anchorage methods.



Sill plate to foundation connections anchor the bottom of the wall into the foundation.

These connections transfer both uplift and lateral loads.

General Sill Plate Anchoring Requirements

IRC®: R403.1.6 Foundation Anchorage. ... wood sill plate shall be anchored to the foundation with anchor bolts spaced a maximum of 6 feet on center or approved anchors or anchor straps spaced as required to provide equivalent anchorage to ½ -inch-diameter anchor bolts. There shall be a minimum of two bolts per plate section with one bolt located not more than 12 inches from each end *(and not less than 7 bolt diameters from the end – '03- '18)* of the plate section. Bolts shall be at least ½" in diameter and shall extend a minimum of 7 inches into grouted cells of masonry units or concrete. The bolt shall be located in the middle third of the width of the plate. Interior bearing wall sole plates on monolithic slab foundations shall be positively fastened with approved fasteners. A nut and washer shall be tightened on each bolt to the plate.

IBC®: 2308.3.1 / 2308.6 Foundation plates or sills. … Foundation plates or sills shall be bolted or anchored with not less than ½-inch diameter steel bolts or approved anchors (spaced to provide equivalent anchorage to steel bolts – '09- '18). Bolts shall be embedded at least 7 inches into concrete or masonry, and spaced not more than 6 feet apart. **The bolt shall be located in the middle third of the width of the plate.** There shall be a minimum of two bolts or anchor straps per piece with one bolt or anchor strap located not more than 12 inches or less than 4 inches from each end of each piece. A properly sized nut and washer shall be tightened on each bolt to the plate.

2308.6.7.3 / 2308.6.7.3 & 2308.3.1, Exception 2 / 2308.3.3 Sill anchorage. … braced wall line sills shall be anchored to concrete or masonry foundations. Such anchorage shall conform to the requirements of Section 2308.6, except that such anchors shall be spaced at not more than 4 feet for structures over two stories above grade plane. Other anchor devices having equivalent capacity are permitted.

2308.3.1.2 / 2308.3.1 Exception 1 / 2308.12.9 …Steel bolts with a minimum nominal diameter of ⅝" shall be used on Seismic Design Category E or approved anchor straps load rated in accordance with Section 1711.1 and spaced to provide equivalent anchorage shall be used.

International Residential Code/International Building Code Summary

- ✓ **6 feet on center spacing, maximum (some exceptions)**
- ✓ **7" embedment (anchor bolts), concrete or grouted masonry units**
- ✓ **Maximum of 12" from the end of each plate**
- ✓ **Minimum of 7 diameters (4"-IBC) from the end of each plate**
- ✓ **Located in the middle third of the width of the plate**
- ✓ **Minimum of 2 bolts per plate (some exceptions)**
- ✓ **½" anchor bolt minimum (⅝" – SDC E & some high wind applications)**
- ✓ **A nut and washer must be installed on each bolt**

Sill Plate *Anchor Bolts* – Factors to Consider

- ✓ Does the bolt line up in the correct location?
- ✓ Are the anchor bolts embedded properly?
  - Minimum of 7 inches of embedment.
- ✓ Does the bolt line up in an accessible location?
- ✓ Is there 1½" of wood or more (minimum 2x) under the washer?
  - IRC**:** R602.3.4 Bottom (sole) plate. IBC: 2308.5.3.1 / 2308.9.2.4 Bottom plates or sill. Studs shall have full bearing on a nominal 2-by or larger plate or at least equal to the width of the studs.
- ✓ Is the drilled hole in the plate oversized properly?
  - 1/32" to 1/16" for a drilled hole – AWC NDS 11.1.2- '97/ '01/'05, 12.1.3.2- '15
- ✓ Is the **minimum EDGE** distance of the anchor bolt in the wood sill plate met?
  - Middle third of the plate
- ✓ Is the **minimum END** distance of the anchor bolt in the wood sill plate met?
  - International Residential Code-'03- '21 – R403.1.6 – 7 diameters
  - International Building Code – 2308.6 – 4 inches
- ✓ Is the **maximum END** distance of the anchor bolt in the wood sill plate met?
  - 12 inches from the end of each plate
- ✓ Are the nut and washer installed or installed properly to resist the loads?

Bearing Plate Requirements

- **IRC®:** R403.1.6.1 Foundation anchorage in Seismic Design Categories (D_0 – *'06- '21*), D_1 and D_2. … Plate washers a minimum of 2 inches by 2 inches by 3/16-inch-thick shall be used on each bolt. Plate washers conforming to R602.11.1 shall be provided for all anchor bolts over the full length of required braced wall lines… *('09- '21).*
  R602.11.1 Wall anchorage. For all buildings in Seismic Design Categories (D_0 – *('06- '21),* D_1 and D_2 and townhouses in Seismic Design Category C, plate washers, a minimum of (0.229 inch by 3 inch by 3 inch – *('06- '21*) 3/16 inch by 2 inches by 2 inches in size, shall be provided between the foundation sill plate and the nut. A hole in the plate washer is permitted to be diagonally slotted with a width of up to 3/16" larger than the bolt diameter and a slot length not to exceed 1¾", provided a standard cut washer is placed between the plate washer and nut. – *('09- '21*).
  R301.2.1.1 Wind Design criteria. ... Construction … where the basic wind … equal or exceed XXX (depends on the code) shall be designed in accordance with one of the following: ICC 600 ('09- '21)

- **ICC 600 Standard for Residential Construction in High Wind Regions**
- **AWC Wood-Frame Construction Manual**
  When using sheathing for uplift, sill plate anchors, ⅝" diameter, with square plate washers, 3"x3"x0.229", are required @ xx-inches on center, maximum.

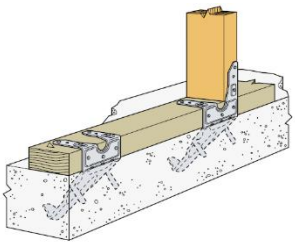
- **IBC®: 2308.3.1.1, 2308.3.1.2** / 2308.3.2 / 2308.12.8 Additional requirements for conventional construction in Seismic Design Category D or E. Steel plate washers. Steel plate washers shall be placed between the foundation sill plate and the nut. Such washers shall be a minimum of (0.229 inch by 3 inch by 3 inch *('06- '21*), 3/16 inch by 2 inches by 2 inches in size.
  (See R602.11.1 to reference diagonally slotted holes.)
  2305.1 …Structures using wood shear walls and diaphragms to resist wind, seismic and other lateral loads shall be (permitted to be-'06) designed and constructed in accordance with AWC **SDPWS (Special Design Provisions for Wind and Seismic**) …

SST Solution: **BP, BPS** (bearing plates) Literature: C-C-2021, pp. 46-47

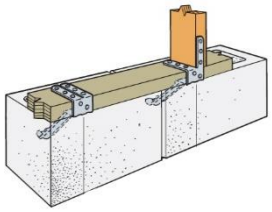
Sill Plate-to-Foundation Connection (cont.)

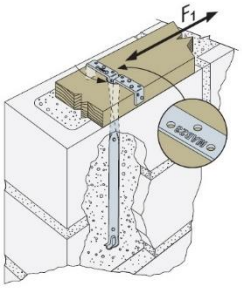
Resource: T-A-SILPLANCH21 (Simpson sill plate anchorage solutions) **–** **www.strongtie.com**

Cast-in Place Sill Plate Strap-Type Products



- ✓ **Installed with 1 or 2 legs up**
- ✓ **Can be installed over sheathing**
- ✓ **Use with 2x4 through 2x10 plate**
- ✓ **Can be installed with a double 2x**
- ✓ **Tested for cracked and uncracked concrete**





CONCRETE FOUNDATIONS

BLOCK FOUNDATIONS

	MASA / MASAP		MASB / MAB15	
Literature:				
C-C-2021	**pp. 28-29**		**pp. 30-31**	**pp. 30-31**
T-A-SILLPLANCH	**pp. 4-6**		**pp. 11-12**	**pp. 11-12**

Sill Plate *Strap-Type Product* Installation Questions

- ✓ Is the sill plate a single 2x, single 3x, double 2x or something else?
  - Most strap-type products are for single 2x or single 3x sill plates.
- ✓ Is the product tested for cracked and non-cracked concrete?
- ✓ Is the anchor to be used for panelized or pre-fabricated/pre-sheathed walls?
  - Most strap anchors should not be installed over pre-sheathed or panelized walls.
- ✓ Can the legs be attached to a stud for proper installation?
  - MAB-type strap should not be attached to a stud.
- ✓ Are the straps embedded properly?
  - Embedment varies with the manufacturer.
    - Simpson Strong-Tie MAB15 requires 7” of embedment.
- ✓ What is the proper spacing when compared to an anchor bolt?
  - Simpson Strong-Tie uses the parallel-to-plate load direction. However, the most restrictive or unity equation should be used.
  - See spacing comparison in the current Wood Construction Connector catalog.

Sill Plate-to-Foundation Connection (cont.)

Sill Plate Anchors – *Post-Installed – Mechanical Anchors*






Wedge Anchor **Strong-Bolt®2** **THD Zinc-Plated** **Titen HD (THD)…WH** **Titen HD MG** **Titen HD 304 / 316 SS**

Literature: C-A-2021;
pp. 123-135 pp. 108-122 pp. 78-91 (THD Hex-Washer & Flat-Washer Heads) pp. 92-103
T-A-SILLPLANCH;
N/A N/A pp. 2-3 (concrete), pp. 7-8 (Grout-Filled CMU and Header Block)

Titen HD as a 1:1 replacement for equivalent diameter sill bolts in concrete

Titen HD Hex-Washer Head and Flat-Washer Head as 1:1 Replacement for Cast-in-Place Anchor Bolts

Detail	Anchor Bolt to Replace	Sill Plate Nominal Thickness	Titen HD Model[3]	Drill Bit Diameter (in.)	Min. Nominal Embed. Depth (in.)	Min. Edge Distance (in.)	Min. End Distance (in.)
1	½" diameter with 7" embedment	2x	THD50600H[4] or THD50600WH	½	4¼	1¾	6
		Double 2x, 3x	THD50800H[4] or THD50800WH	½	4¾	1¾	6
1	⅝" diameter with 7" embedment	2x, 3x	THDB62100H[5] or THDB62100WH[5]	⅝	7	1¾	9⅜

Titen HD as a replacement for equivalent diameter sill bolts in Grout-Filled CMU

Prescriptive Spacing for Titen HD Hex-Washer Head and Flat-Washer Head to Replace Cast-in-Place Anchor Bolts in GFCMU and to Replace Cast-in-Place Anchor Bolts in Header Block

	Detail	Anchor Bolt to Replace	Titen HD Model[2]	Sill Plate Nominal Thickness	Drill Bit Diameter (in.)	Min. Nominal Embed. Depth (in.)	Min. Edge Distance (in.)	Min. End Distance (in.)	Min. Spacing (in.)	Titen HD Spacing to Replace ½" Anchor Bolts at 6'-0" o.c.
GFCMU	11[5]	½" diameter with 7" embedment	THD50600H[3,7] or THD50600WH[3]	2x	½	4½	1¾	8	8	4'-8" o.c.[4]
			THD50800H[7] or THD50800WH	3x						
	12[5]		THD50800H[7] or THD50800WH	Double 2x						
Header Block	13[6]	½" diameter with 7" embedment	THD50600H[3,7] or THD50600WH[3]	2x	½	4½	1¾	NA	16	4'-0" o.c.[4]
			THD50800H[7] or THD50800WH	3x						
	14[6]		THD50800H[7] or THD50800WH	Double 2x						

Other Foundation-to-Framing Connections

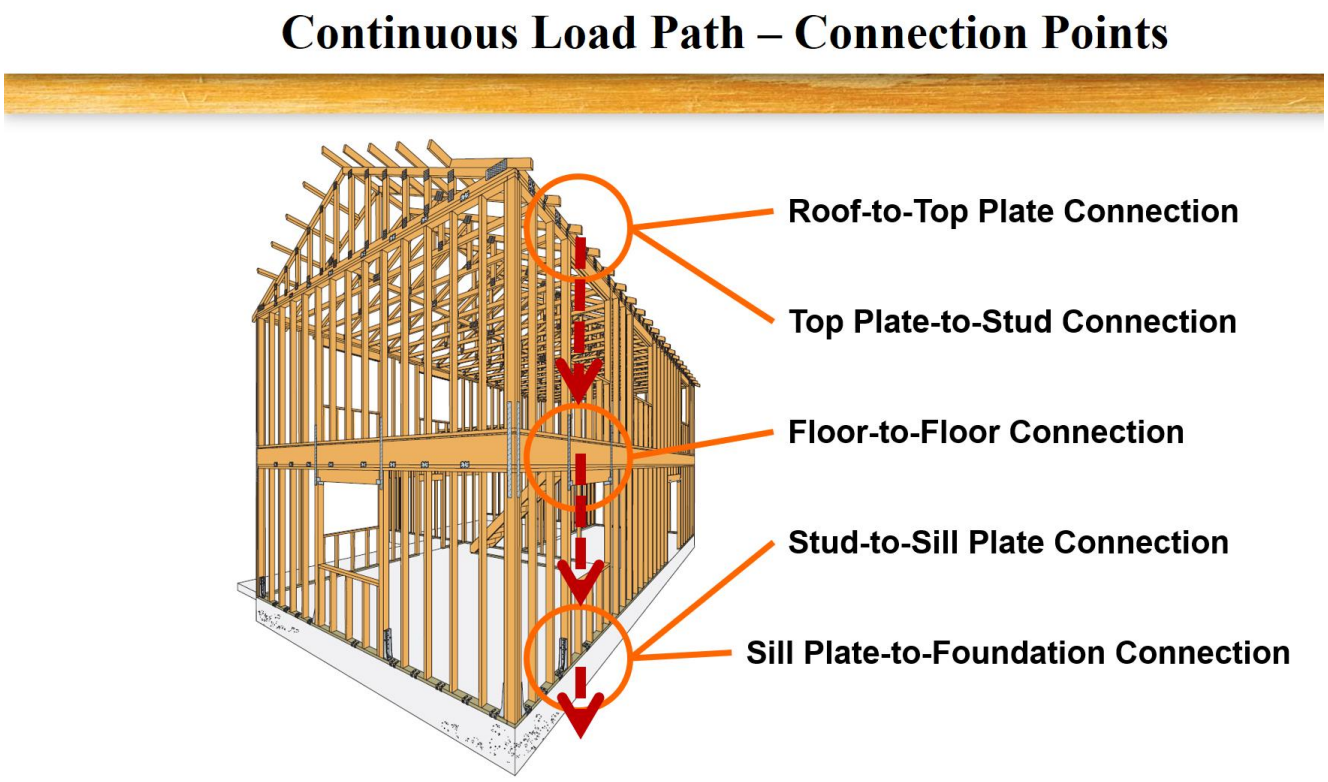



C-C-2021; **FJA_ p. 25** **FSA p. 25** **URFP p. 24** **FRFP p. 24**

Wall Framing;

- **IRC®: R301.1** Application. …The construction of buildings and structures in accordance with the provisions of this code shall result in a system that provides a complete load path that meets the requirements for the transfer of all loads from their point of origin through the load-resisting elements to the foundation.
  Buildings and structures constructed as prescribed by this code are deemed to comply with the requirements of this section.
  R301.2.1 Wind Design Criteria. A continuous load path shall be provided to transmit the applicable uplift forces in Section R802.11.1 from the roof assembly to the foundation.

- **IBC®: 1604.4** Analysis. …Any system or method of construction to be used shall be based on a rational analysis in accordance with well-established principles of mechanics. Such analysis shall result in a system that provides a complete load path capable of transferring loads from their point of origin to the load resisting elements…
  1604.9 *(’06-‘15)* Counteracting structural actions. Structural members, systems, components and cladding shall be designed to resist forces due to earthquake and wind, with consideration of overturning, sliding and uplift. Continuous load paths shall be provided for transmitting these forces to the foundation. …
  1604.4 (’18-’21) **Every structure shall be designed to resist the effects caused by the forces specified in this chapter, including overturning, uplift and sliding.**



Resource: **Institute for Business and Home Safety (IBHS) – www.disastersafety.org**
Resource: **T-C-TORNADO – www.strongtie.com**

Braced Walls – Uplift Load Path

- **IRC®: R602.10.1.2.1** Braced wall panel uplift load path. Braced wall panels located at exterior walls that support roof rafters or trusses (including stories below the top story) shall have framing members connected in accordance with one of the following:
  R602.10.2.1 Braced wall panel uplift load path. The bracing lengths…apply only when the uplift loads are resisted in accordance with R602.3.5:
  R602.3.5 (see 1, 2 and 3 below):
  1. Fastening with Table R602.3 (1) *(basic fastening schedule)* where:
     1.1…wind does not exceed 90 mph (ultimate design wind speed does not exceed 115 mph), exp. B, pitch 5:12, roof span 32 feet or less
     1.2. Where net uplift at the top of the wall does not exceed 100 plf…in accordance with Section R802.11, reduced by 60 plf for each full wall above.
  2. Where net uplift value at the top of a wall exceeds 100 plf, installing approved uplift framing connectors to provide a continuous load path from the top of the wall to the foundation or to a point where the uplift force is 100 plf or less….
  3. Wall sheathing and fasteners designed in accordance with accepted engineering practice to resist combined uplift and shear forces.

Using Wood Structural Panel (WSP) Sheathing for Combined Shear and Uplift from Wind

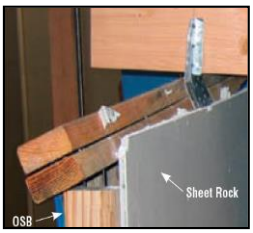
- **IRC®: R301.2.1.1** Wind Design criteria. ...where wind design is required it shall be designed in accordance with one of the following ***(prescriptive)*** methods:
  - AF&PA/AWC WFCM
  - ASCE-7
  - SSTD10 (‘06) /ICC 600 (’09-’21)
  - International Building Code

- **IBC®: 2305.** General Design Requirement for Lateral Force Resisting System
  2305.1 (’06-’21) …Structures using wood shear walls and diaphragms to resist wind, seismic and other lateral loads shall be (permitted to be – *’06*) **designed** and constructed in accordance with AWC SDPWS (Special Design Provisions for Wind and Seismic) …

Wall Framing (cont.)

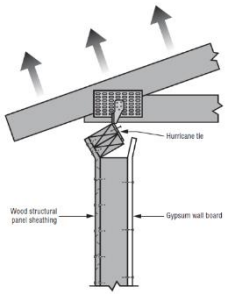
Using Wood Structural Panel (WSP) Sheathing for Combined Shear and Uplift from Wind

- **ICC 600-'08 section 307.1.5, b /** not in ICC 600-'20**, see AWC WFCM-'18 section 3.2.3.7**
- **AWC SDPWS-'08 section 4.3.7.1(1) / '15 section 4.4.1.3**
  All horizontal joints shall occur over common framing members or common blocking.



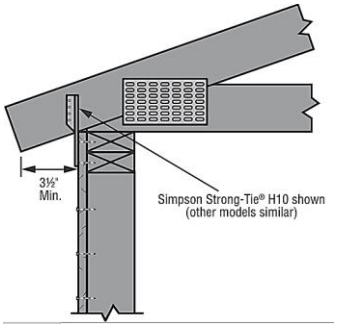
- **ICC 600-'08 section 3.4.1 /** not in ICC 600-'20, **see AWC WFCM**
- **AWC SDPWS-'08 / '15 section 4.4.1.5(2)**
  Top plate rotation due to eccentric loading must be prevented.

Eccentric Loading and Top Plate Roll



Eccentric loading at the connection that ties the roof framing, top plate and stud together can cause significantly reduced connection loads. Eccentric loading occurs when points of application of a set of forces are not in a line vertically. Specifically, this can occur in wood-frame construction when the roof framing-to-top plate connection is made on the inside of the wall and the top plate-to-stud connection is made on the outside of the wall. For example, when a hurricane tie connects roof framing to a top plate and wood structural panel (WSP) sheathing is used to make the plate-to-stud connection.

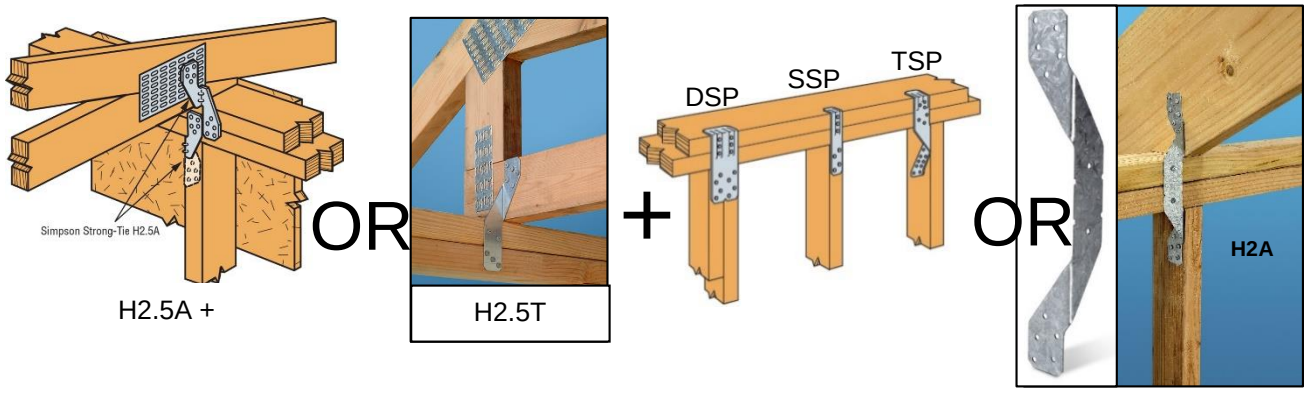
Top-plate roll is only dependent upon the location of the connections and is independent of connector model or manufacturer. Furthermore, recent testing demonstrated that gypsum wall board on the inside of the wall does not provide adequate load path resistance to prevent this effect as shown in this figure.



Solution for eccentric loading and top plate roll?

1. Install roof-to-top plate connectors on the same side of the wall as the sheathing or,

2. If roof-to-top plate connectors are on the inside of the wall, install top plate-to-stud connectors on the inside of the wall, or use a single roof-to-wall connector.



H2.5A +

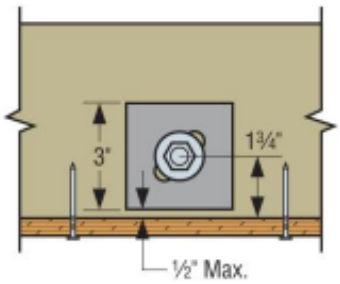
H2.5T

SST Solution: **H2.5A, H2.5T, H2A** (hurricane ties)	Literature: C-C-2021, pp. 276-278
SST Solution: **DSP, SSP, TSP** (stud-to-plate ties)	Literature: C-C-2021, pp. 280-282

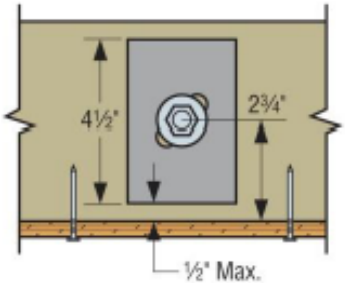
Wall Framing (cont.)

Using Wood Structural Panel (WSP) Sheathing for Combined Shear and Uplift from Wind

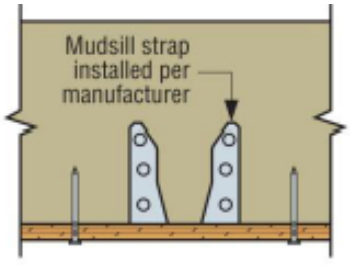
- **ICC 600-'08 section 307.1.5, e /** not in ICC 600-'20, **see AWC WFCM**
- **AWC SDPWS-'08 / '15 section 4.4.1.4**
  Where windows and doors interrupt wood structural panel sheathing or siding, framing anchors or connectors shall be provided to resist and transfer the appropriate uplift loads around the opening and into the foundation.
- **ICC 600-'08 section 307.1, 307.1.5 /** not in ICC 600-'20, **see AWC WFCM**
- **AWC SDPWS-'08 / '15 section 4.4.1.6**
  Sill plate anchors shall be spaced a maximum 16"- 42"o.c.[1],
  1. 2015 AWC-SDPWS (16"- 42"), previous versions anchor bolts shall be spaced at 16" o.c.
  Where anchor bolts are used, a minimum of a 0.229"x3"x3" square plate washers shall be installed on each anchor bolt location.
  Washer must be within ½" of the edge on the sheathed side.



½" or ⅝" anchor bolt with 3x3 washer (BPS½ or ⅝-3)



½" or ⅝" anchor bolt with 3x4½" plate washer (BPS½ or ⅝-6)



MASA(P) installed on the same side as the sheathing

- **ICC 600-'08 section 307.1, Table 307(1) /** not in ICC 600-'20**, see AWC WFCM Tables 3.17A-3.17E**
- **AWC SDPWS-'08 / '15 section 4.4.1**
  Walls sheathed with wood structural panel sheathing or siding shall be permitted to be designed for simultaneously resisting shear and uplift from wind forces. The unit (ASD/LRFD) uplift capacity shall be determined…in Table 4.4.1 (similar to Table 307.(1)).

TABLE 307(1)
UPLIFT CAPACITY OF WOOD STRUCTURAL PANEL SHEATHING OR SIDING WHEN USED FOR BOTH SHEARWALLS AND UPLIFT SIMULTANEOUSLY OVER GROUP III FRAMING[a,b,c]
(plf uplift on wall)

	NAIL SPACING REQUIRED FOR SHEARWALL DESIGN											
	6d @ 6″ & 12″			8d @ 6″ & 12″			8d @ 4″ & 12″			10d @ 6″ & 12″		
	ALTERNATE NAIL SPACING AT TOP AND BOTTOM PANEL EDGES[a,c]											
	6″	4″	3″	6″	4″	3″	6″	4″	3″	6″	4″	3″
	UPLIFT CAPACITY (plf)[c] OF 15/32″ WOOD STRUCTURAL PANEL SHEATHING OR SIDING											
Nails-Single Row[d]	0	94	189	0	118	237	NP	0	118	0	142	285
Nails-Double Row[e]	189	377	566	237	474	710	118	355	592	285	570	855

For SI: 1 inch = 25.4 mm, 1 pound per lineal foot = 14.59 N/m.
a. $^{7}/_{16}$ inch wood structural panels shall be permitted when supported by vertical framing at 16 inches on center.
b Anchor bolts shall be installed in accordance with this section.
c. For all Group II framing, divide uplift values listed in above table by 0.92.

Wall Framing (cont.)

Stud-to-Plate Connections;

We're discussing two important connections here because both of them involve attaching the wall stud to the top or bottom of the wall (the top plate or the sole plate). The IRC requirements are similar for each connection.

Top Plate to Stud	Stud to Bottom Plate
Transfer forces from the top of the wall to the wall stud.	**Transfer forces from the wall stud to the bottom of the wall (sole plate or mudsill).**

- **IRC®: Table R602.3(1)** Fastening Schedule Excerpt: Top or bottom plate to stud

4-8d box (21/2" × 0.113"); or 3-16d box (31/2" × 0.135"); or 4-8d common (21/2" × 0.131"); or 4-10d box (3" × 0.128"); or 4-3" × 0.131" nails	**Toe nail**
3-16d box (31/2" × 0.135"); or 2-16d common (31/2" × 0.162"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	**End nail**

- **AWC NDS 11.2.3.2-'01 / '05, 12.2.3.5-'15** Nails and spikes loaded in withdrawal from the end grain of the wood has been prohibited since the 1944 edition of the AWC NDS.

Top Plate to Stud Connector Problems

Connector at the End of the Wall

Unless otherwise noted, bending steel in the field may cause fractures at the bend line. Fractured steel may not carry load and must be replaced.

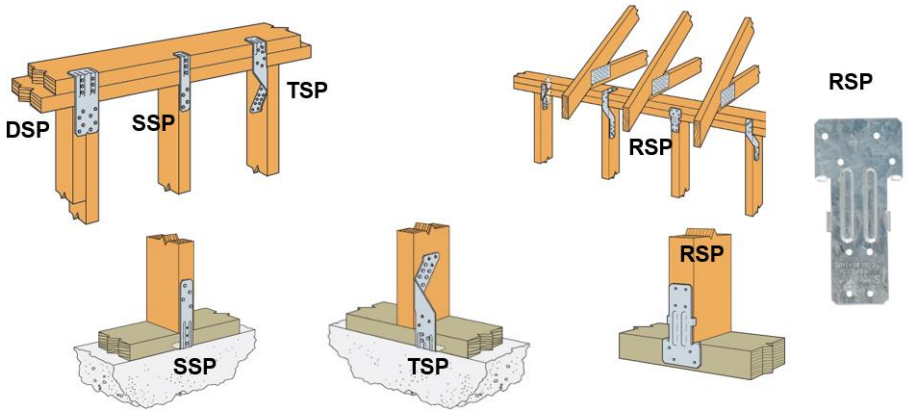
Connector Overlap

Options to make this work include using a different connector, like twist straps or installing a hurricane tie on the other side instead of on the left.

Wall Framing (cont.)

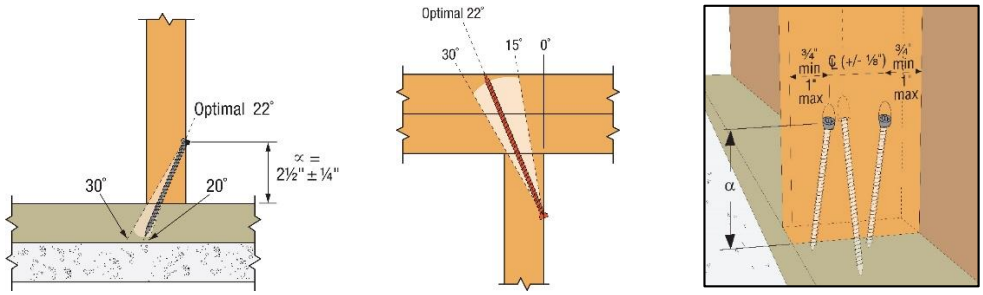
Stud-to-Top or Bottom Plate(s) Connector Solutions

Metal connectors can be used to make the connection from the wall stud to the bottom plate.



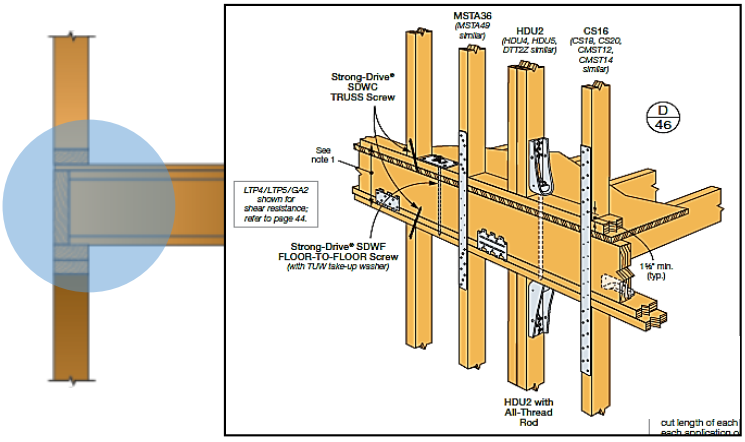
SST Solution: DSP, SSP, TSP, RSP (stud-to-plate ties) Literature: C-C-2021, pp. 280-282

Stud-to-Top or Bottom Plate(s) Fastener Solution

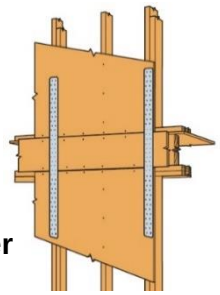


SST Solution: **SDWC15450, SDWC15600** (stud-to-plate) Literature: C-F-2019TECHSUP, pp. 54-55

Floor to Floor connection

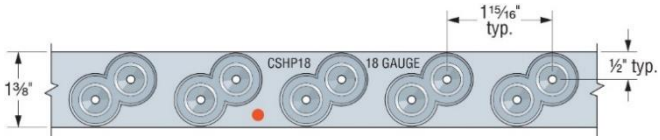


- **The studs must line up for holdowns (e.g.-DTT2), coil strap, or pre-cut straps.**
- **For straps, use half of the required nails in each member being connected to achieve the listed load.**
- **When nailing the strap over wood structural panel sheathing, use a 2½" long nail-minimum.**
  1½" nails are not acceptable.



Wall Framing (cont.)

High-Performance Coiled Strap (CSHP)



Fastener feature results in fewer nails, shorter straps and lower installed cost.
Designed to be installed with a standard framing nailer.
Does not require a special nail hole locating mechanism.
Easier for inspectors to verify.
Colored dots and stamp indicate nailing face and strap model.
Achieves higher load value per nail due to the strap design.
CSHP requires fewer nails with the same or better loads as CS;

(16) 0.131 x 2½" nails-DF – CSHP18 = 1,540
(18) 0.131 x 2½" nails-DF – CS18 = 1,370
(12) 0.131 x 2½" nails-DF – CSHP20 = 1,160
(14) 0.131 x 2½" nails-DF – CS20 = 1,030

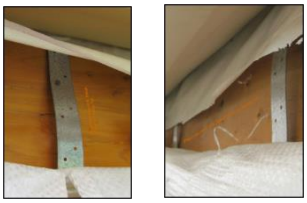
SST Solution: **CSHP** (floor-to-floor) Literature: C-C-2021, pp. 272-274

Resource: Coil Strap Calculator – www.strongtie.com/webapps

Common Problems with Straps

Can be field modified

Unaligned studs = strap chaos



Straps bow out when shrinkage or compression

Floor to floor connection – strap installation issues.

Solution #1: Fill the nail holes in the rim joist area to limit bowing.
Solution #2: Fill the nail holes in the top stud before the roof is installed and then fill bottom stud nails after the roof is installed.
Solution #3:

- Pre-engineered screw connects plate to plate
- Faster to install than other methods
- Installs from inside the structure before or after the exterior sheathing is applied.
- Framing alignment at each floor not needed.
- Shrinkage compensation (up to ¾" per story).
- The threaded portion under the head of the screw ratchets up through the tabs of the TUW ICC ES AC316 (shrinkage compensating devices)
- For floor joist depths up to 24" (30" SDWF screw)

Alternative Connection Method: Floor to Floor Screw

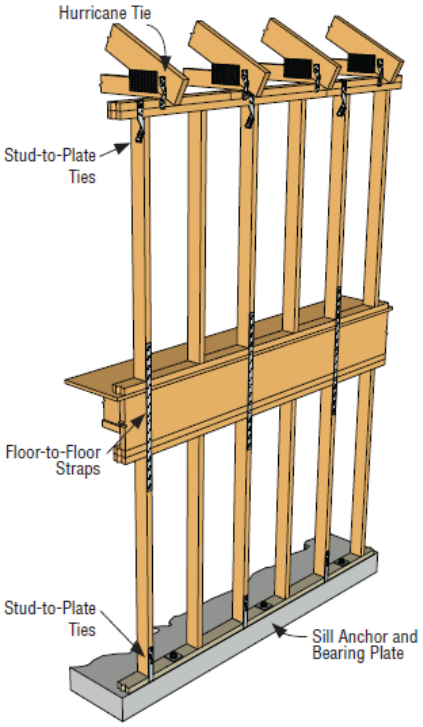
Strong-Drive FLOOR-TO-FLOOR screw (SDWF) with the Take-Up Washer (TUW)

Stud-to-plate connections are required to complete the load path.

SDWC15450 or SDCW15600

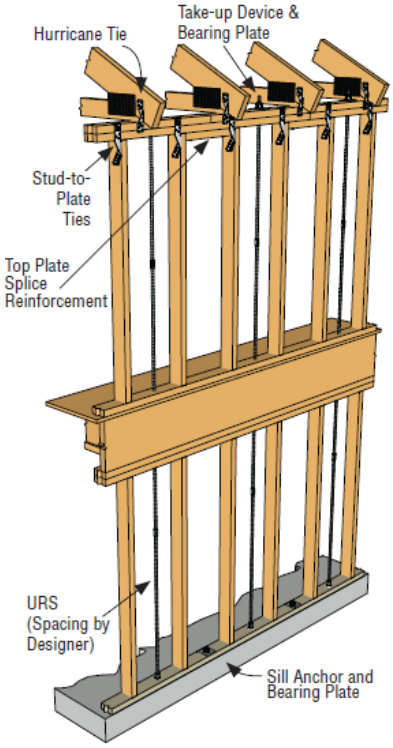
SST Solution: **SDWF w/ TUW** (floor-to-floor) Literature: C-F-2019TECHSUP, pp. 80-83

Connector Systems



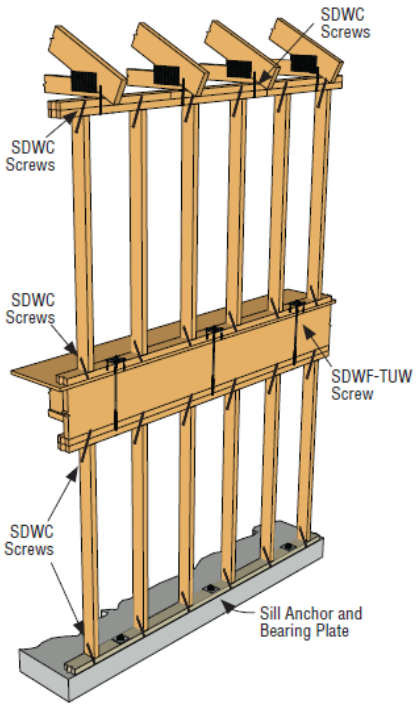
- **Widely available**
- **Most code listed products with unmatched quality**
- **Lowest hardware cost**
- _____
- _____
- _____
- _____

Strong-Rod™ Uplift Restraint Systems



- **High strength**
- **Ease of installation**
- **Available in 4 rod diameters**
- **Framing flexibility**
- **SST has a code listed rod system that has been evaluated based on wood framing limitations.**
- _____
- _____
- _____
- _____
- _____

Strong-Drive® Fastening Systems



- **Eliminates interference with finish materials**
- **Ease of installation, faster to install than other methods**
- **Floor-to-floor alignment-not critical**
- **Framing flexibility**
- **Lowest installed cost**
- **All products are code listed**
- **All work is done from the inside**
- **Multiple screws per connection provide higher load resistance**
- **Shrinkage/compression compensator**
- _____
- _____
- _____
- _____

Wall Bracing

R602.10 (see IBC 2308.6 – similar): a system of specially constructed wall segments attached to the roof, floor and foundation that resist lateral (horizontal) loads from wind and earthquakes.

Overview of Steps for Designing Wall Bracing;

1. Locate all Braced Wall Lines (BWL)
2. Calculate the Required Length of Bracing for each BWL
3. Locate qualifying Braced Wall Panels (BWP) in each BWL

General Rules Applicable to Braced Wall Lines;

1. All exterior walls must be part of a braced wall line.
2. Braced wall lines are spaced a maximum of 60' o.c.
3. 4' maximum braced wall panel offset from designated braced wall line.

Types of Braced Wall Panels;

Intermittent Braced Wall Panels Alternatives

LIB	1x4 Let-in-Bracing
DWB	Diagonal Wood Boards
WSP	**Wood Structural Panels**
BV-WSP	WSP with Veneer
SFB	Structural Fiberboard Shthing
GB	**Gypsum Board**
PBS	Particleboard Sheathing
PCP	Portland Cement Plaster
HPS	Hardboard Panel Siding

- Minimum of 4’ of wall length

Continuously Sheathed

CS-WSP	**Continuously sheathed wood structural panel**
CS-PF	**Continuously sheathed portal frame**
CS-G	**Continuously sheathed garage**

- 4 to 1 max. aspect ratio (CS-WSP)
- 6 to 1 max. aspect ratio (CS-PF)
- 24” min. length for 8’ wall (CS-G).
  Other wall heights similar.

Narrow

ABW	**Alternate Braced Wall** (R602.10.6.1)
PFH	**Portal Frame with Hold-Downs** (R602.10.6.2)
PFG	**Portal Frame at Garage Opening** (R602.10.6.3)
CS-PF	Continuous Sheathed Portal Frame (R602.10.6.4)
CS-G	Continuous Sheathed at Garage Opening (R602.10.4)

- ABW – min. length = 28” with an 8’ tall wall.
- PFH – min. width = 16”-1 story, 24”-2 story
- PFG – min width = 16”-8’ wall 18”-9’ wall, 20”-10’ wall

Rules for Where to Place Braced Wall Panels;

1. Use at least the minimum amount of bracing required with adjustment factors applied.
2. Do not exceed the maximum braced wall panel spacing requirement.
3. Place panels a maximum of 10’ from each end of a braced wall line.

Problem areas;

- ✓ Garage Fronts – Minimum width or aspect ratio limitations
- ✓ Narrow 1st or 2nd story walls
- ✓ 2 story Great Rooms
- ✓ Home with very little wall for bracing

Evaluating Alternative Bracing Options;

1. Design the home using the IBC.
2. Use a pre-fabricated narrow shear wall.
3. Design a solution for the problem area.

Resource: Wall Bracing Length Calculator
Resource: Strong-Wall Bracing Selector

Helps navigate IRC wall-bracing requirements.

- Calculates the required length of wall bracing to resist the prescriptive lateral loads in accordance with the IRC.
- Includes all adjustment factors for both wind and seismic loading.

Helps choose a wall-bracing replacement where code-defined bracing methods are not adequate.

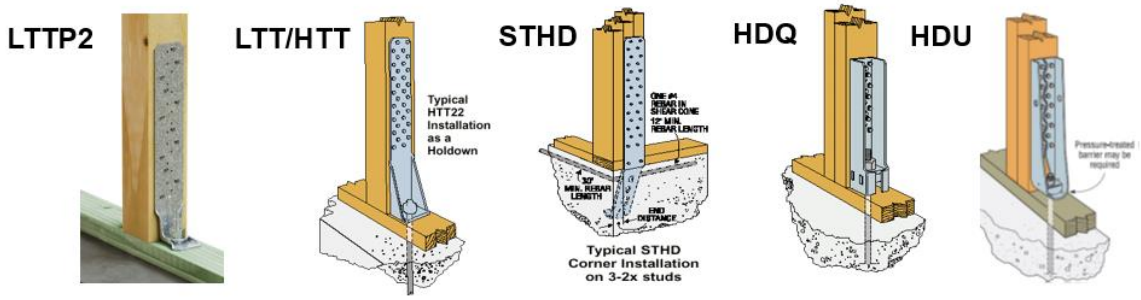
- Identifies prescriptive and pre-engineered solutions to site-built shear-walls, allowing designers to quickly select space efficient panels.

Shear Wall Solutions

What's the Difference Between a Braced Wall Panel and Shear Wall?

Braced walls and shear walls each serve the same purpose in the lateral load path.
Both provide racking resistance to lateral loads.
Wall bracing comes from prescriptive building code. Very few calculations are needed.
From the designer's and builder's perspective, there is no "engineering".
Shear walls are used in portions of structures that do not meet the prescriptive limits and conventional construction parameters of the IRC.
Shear walls are designed or "engineered" by a design professional.
Shear walls usually require manufactured holdowns to resist overturning.
They are generally associated with the design provisions of the IBC.
Resource: APA & ICC, A Guide to the 2015 IRC® Wood Wall Bracing Provisions

- **IBC®: 1604.4** Analysis. …Any system or method of construction to be used shall be based on a rational analysis in accordance with well-established principles of mechanics. Such analysis shall result in a system that provides a complete load path capable of transferring loads from their point of origin to the load resisting elements…**Every structure shall be designed to resist the overturning effects caused by the lateral forces…**
  1604.4 …Every structure shall be designed to resist the effects caused by the forces specified in this chapter, including overturning, uplift and sliding.



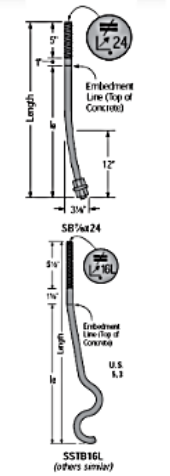
SST Solution: **Holdowns** Literature: C-C-2021, pp. 50-60

Resource: Site-Built Shearwall Designer

Resource: Holdown Selector

Resource: Post-to-Foundation Designer
Designs holdowns and anchors that resist uplift loads per the latest building codes.

Shear Wall Anchorage Solutions;



Typical SSTB Installation in Concrete Foundation

Table 2 — Anchorage Selection Guide for Holdowns Attached to SPF/HF Lumber

Holdown on SPF/HF Lumber	Stemwall					Slab on Grade			
	Stemwall Width (in.)	Wind and Seismic Design Category A&B		Seismic Design Category C–F		Wind and Seismic Design Category A&B		Seismic Design Category C–F	
		Midwall/Corner	End Wall	Midwall/Corner	End Wall	Midwall/Corner	Garage Curb	Midwall/Corner	Garage Curb
HDU2	6	SSTB16		SSTB16		SSTB16		SSTB16	
HDU4	6	SSTB16		SSTB24		SSTB16		SSTB16	SSTB24
HDU5	6	SSTB24* (4,295)		SB5/8X24		SSTB16	SSTB24* (4,295)	SSTB20	SB5/8X24
HDU8	8	SSTB28		SSTB28	SSTB28* (6,395)	SSTB28		SSTB28	SSTB28
HDQ8	8	SSTB28		SSTB28	SSTB28* (6,395)	SSTB28		SSTB28	SSTB28
HDU11	8	SB1X30* (9,505)	PAB8	PAB8	PAB8	SB1x30		SB1x30	
HHDQ11	8	SB1X30	PAB8	PAB8					
HDU14	—	PAB8		PAB8		SB1x30		SB1x30	
HHDQ14	—								
LTTP2	6	SSTB16		SSTB16		SSTB16		SSTB16	
LTTI31	6								
HTT4	6	SSTB20		SB5/8X24		SSTB16	SSTB20	SSTB16* (3,780)	SB5/8X24
HTT5	6	SB5/8X24		SB5/8X24		SSTB20	SB5/8X24	SSTB24	SB5/8X24
HD3B	6	SSTB16		SSTB24		SSTB16		SSTB16	SSTB20* (2,960)
HD5B	6	SSTB24		SB5/8X24		SSTB16	SSTB24	SB5/8X24	
HD7B	8	SSTB28		SSTB28		SSTB28		SSTB28	
HD9B	8	SSTB28* (8,360)	PAB7	PAB7		SSTB28* (8,360)	PAB7	SSTB28	PAB7
HD12	—	PAB8		PAB8		SB1x30		SB1x30	

SST Solution: **SSTB, SB, PAB** anchorage — Literature: C-C-2021, p. 44

Post Size (min)	Holdown Model	Holdown Allow...	Deflection at D...	Holdown Faste...	Anchor Product
(2) 2x4	DTT2Z-SDS2.5	2,145	0.104	(8) ¼" x 2½" SD...	Titen HD
(1) 2x4	HTT4	3,000	0.052	(18) 0.148" x 1½...	Titen HD
(2) 2x4	HDU2-SDS2.5	3,075	0.05	(6) ¼" x 2½" SD...	Titen HD
(1) 3x4	HD3B	2,525	0.117	(2) ⅝" Machine ...	Titen HD

SST Solution: **Titen HD** anchorage — Literature: See Post-to-Foundation Designer

SST Anchor catalog (General Instructions for the Designer):
Note l. Mechanical anchors should not be installed into concrete that is less than 7 days old.
Note q. ACI 318 states that adhesive anchors should not be installed into concrete that is less than 21 days old. *(Referenced in ACI 318-11 which came into the 2012 codes)*

Installation into Green Concrete (less than 21 days old)

Products	Concrete Age When Installed	Concrete Age When Loaded	Bond Strength Factor
SET-3G SET-XP AT-XP ET-HP	14 days	21 days	1.0
		14 days	0.9
	7 days	21 days	1.0
		7 days	0.7

Shear Wall Anchorage Solutions;

Side-by-side cartridges require a special tool

- ✓ Cracked concrete
- ✓ Highest performance
- ✓ 40°F minimum base material temperature

- ✓ Cracked concrete
- ✓ ***Hollow and Grout-Filled CMU***
- ✓ 50°F minimum base material temperature

- ✓ Cracked concrete
- ✓ Hollow and Grout-Filled CMU
- ✓ ***URM***
- ✓ 50°F minimum base material temperature

- ✓ Cracked concrete
- ✓ Hollow and Grout-Filled CMU
- ✓ ¾" ATR, #5 & #6 rebar in URM
- ✓ Minimum base material temperature (0°F)

SET-3G Cure Schedule

Concrete Temperature		Gel Time	Cure Time
(°F)	(°C)	(min.)	(hr.)
40	4	120	192
50	10	75	72
60	16	50	48
70	21	35	24
90	32	25	24
100	38	15	24

For SI: 1°F = (°C x ⅘) + 32.
1. For water-saturated concrete and water-filled holes, the cure times should be doubled.
2. For installation of anchors in concrete where the temperature is below 70°F (21°C), the adhesive must be conditioned to a minimum temperature of 70°F (21°C).

- The reactants need to go through an energy barrier for a reaction.
- When the temperature is too low (<40° or <50°), the reactants do not have a high enough energy to create a reaction (go over the barrier).

Resource: Simpson Strong-Tie® Anchor Designer™ software

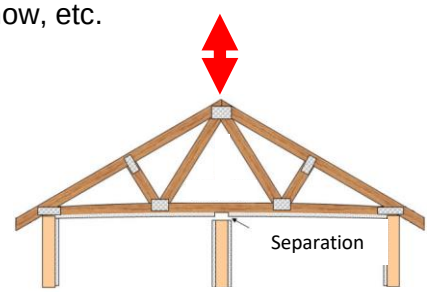
Pre-Fabricated Shearwalls;

Resource: Strong-Wall® Shearwall Selector

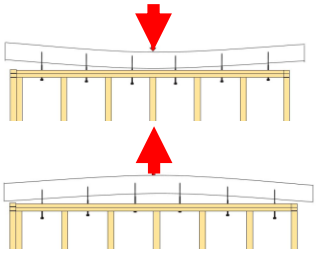
Roof and Floor Deflection

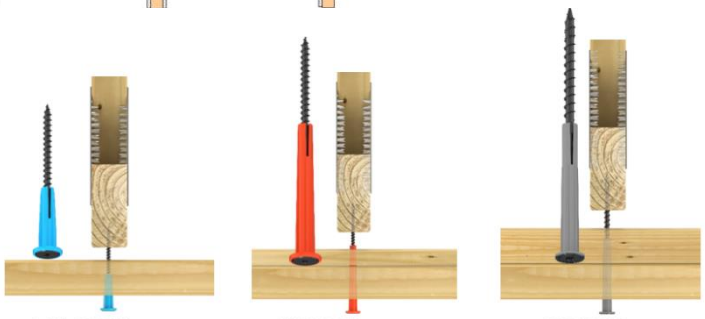
Why does deflection occur?

Roof Systems deflect up and down with atmospheric changes, wind, snow, etc.



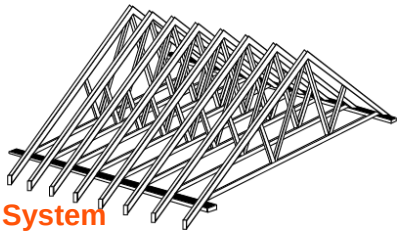
Floors deflect up and down with loading conditions (heavy objects and live loads)





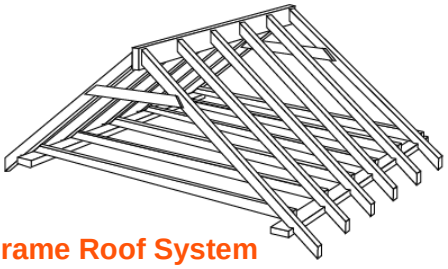
L-F-SDPWSCREW20
Engineering Letter
SDPW14312
SDPW14500
SDPW14600

Roof Construction Methods:



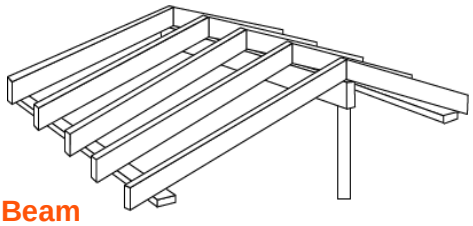
Truss Roof System

- Engineered building component designed for a specific project.
- Quick installation.
- Consistent quality control.
- Important to follow bracing guidelines.



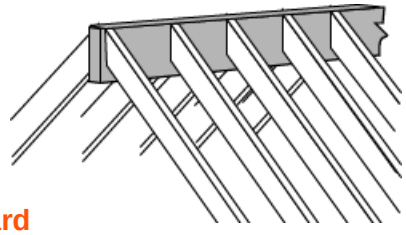
Stick-Frame Roof System

- Work is completed from lumber on site to prescriptive requirements.
- Can be easier to get complex shapes.
- Space within the structure can be used for storage or living.



Ridge Beam

- Structural member: supports the weight of the rafters.
- Must be specifically designed for the project.
- Requires bearing at each end.



Ridge Board

- Held up by rafters.
- Does not support the weight of rafters, force is from the opposing rafters.
- Can be a 1-by since it's non-structural.

Roof Framing Bearing;

- **IRC®: R802.6** Bearing. The ends of each rafter or ceiling joist shall have not less than 1½" of bearing on wood or metal and not less 3 inches on masonry or concrete.
  R802.4.4 & **R802.3**…Where the roof pitch is less than 3:12, structural members that support rafters and ceiling joists, such as ridge beams, hips, valleys, shall be designed as beams…
- **IBC®: 2308.7** / 2308.7.3.1 / 2308.10.4.1 Ceiling joist and rafter connections. Ceiling joists and rafters shall be nailed to each other and the assembly shall be nailed to the top wall plate in accordance with Tables 2304.9.1 and 2308.10.1. Ceiling joists shall be continuous or securely joined where they meet over interior partitions and fastened to adjacent rafters… Ceiling joists shall have a bearing surface of not less than 1½ inches on the top plate at each end.

Field Adjustable Jack Hanger

Model # **LSSJ**

Slopeable/Skewable Rafter Hanger

Model # **LSSR**

Common Rafter Hanger

Model # **LRU**

SST Solution: **LSSJ, LSSR, LRU** Literature: C-C-2021, pp. 117, 118-119, 115-116

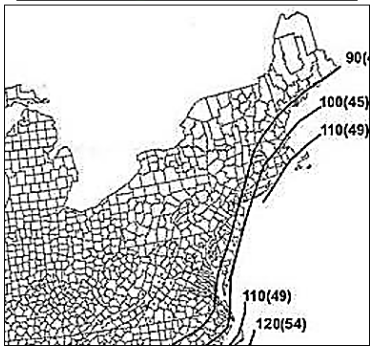
When Bearing is not Needed;

Connection Application	FASTENER QUANTITIES			
	IRC		IBC	
	Nails per Table R602.3 (1)	Equivalent SDWS Framing Screws	Nails per Table 2304.9.1	Equivalent SDWS Framing Screws
Roof rafter to plate (toe screw)	(3) 10d common	(3) SDWS16212	(3) 8d common	(3) SDWS16212
Roof rafter to 2x ridge board (toe screw)	(4) 16d box	(4) SDWS16212	(2) 16d common	(2) SDWS16300
Jack rafter to hip (toe screw)	(4) 16d box	(4) SDWS16212	(3) 10d common	(3) SDWS16300

SST Solution: **SDWS framing screws** Literature: C-F-2019TECHSUP, p. 29

Wind Speed Maps

Basic Design Wind Speed-2012



Ultimate Design Wind Speed-2015 (-2021)

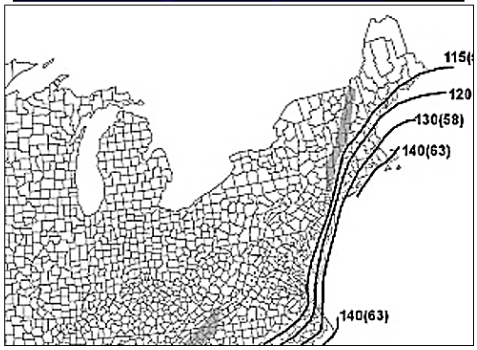


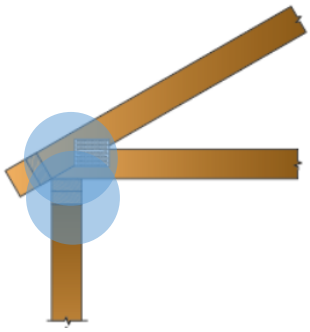
TABLE R301.2.1.3
WIND SPEED CONVERSIONS

V_{ult}	110	115	120	130	140
V_{asd}	85	89	93	101	108

Roof to Top Plate Connection

Uplift Resistance Code Requirements

- **IRC®: R301.1** Application. …The construction of buildings and structures in accordance with the provisions of this code shall result in a system that provides a complete load path that meets the requirements for the transfer of all loads from their point of origin through the load-resisting elements to the foundation.
  Buildings and structures constructed as prescribed by this code are deemed to comply with the requirements of this section.
  R301.2.1 Wind Design Criteria. A continuous load path shall be provided to transmit the applicable uplift forces in Section R802.11.1 from the roof assembly to the foundation.



  R802.11.1 Uplift Resistance-'03-'09, R802.11-*'00* Roof tie-down. Roof assemblies subject to wind uplift pressures of 20 pounds per square foot or greater, as established in Table R301.2(2) (Components and Cladding Loads table), adjusted for height and exposure per Table R301.2 (3), shall have rafter or truss ties to their supporting wall assemblies in accordance with Table 802.11. Wind uplift pressures on roof assemblies shall be determined using an effective wind area of 100 square feet and Zone 1 in Table 301.2(2).
  A continuous load path shall be provided to transmit the uplift forces from the rafter or truss ties to the foundation.
  R802.11.1 ('12-**'21**) Uplift resistance. Where the uplift force does not exceed 200 pounds, rafters and trusses spaced not more than 24" o.c. …shall be permitted to be attached to their supporting wall assemblies in accordance with Table R602.3(1). (*Basic nailing table)*
  R802.11.1 & R802.11.2 / R802.11.1.1 & R802.11.1.2 / R802.11.1.2 & R802.11.1.3
  Uplift forces are permitted to be determined as specified by Table R802.11
  R802.10.5 ('03-'09) Truss to wall connection. Trusses shall be connected to wall plates by the use of approved connectors having a resistance to uplift of not less than 175 pounds.
- **IBC®: 2308.7.5 / 2308.10.1** Wind uplift. Roof construction-'09-'21 (assemblies-'00-'06) shall have rafter or truss ties to the wall below. Resultant uplift loads shall be transferred to the foundation using a continuous load path.

Roof to Top Plate Connection

Uplift Resistance Code Requirements

Table R802.11 Rafter or Truss Uplift Connection Forces from Wind (lbs. per connection):

TABLE R802.11
RAFTER OR TRUSS UPLIFT CONNECTION FORCES FROM WIND (ASD) (POUNDS PER CONNECTION)[a,b,c,d,e,f,g,h]

RAFTER OR TRUSS SPACING	ROOF SPAN (feet)	EXPOSURE B							
		Ultimate Design Wind Speed V_{ult} (mph) – 2015/2018/2021							
		110	115		120		130		140
			Roof Pitch		Roof Pitch		Roof Pitch		Roof Pitch
			< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12
16" o.c.	12		78	70	93	85	126	117	162	150
	18		98	88	118	108	162	149	209	194
	24		118	105	144	130	198	182	255	237
	28		132	117	161	145	222	203	287	266
	32		145	129	178	160	246	226	319	295
	36		160	141	194	176	270	247	351	325
	42		180	160	221	198	306	281	399	370
	48		201	178	246	221	343	314	447	414
24" o.c.	12		118	106	140	128	190	176	244	226
	18		148	132	178	162	244	224	314	292
	24		178	158	216	196	298	274	384	356
	28		198	176	242	218	334	306	432	400
	32		218	194	268	240	370	340	480	444
	36		240	212	292	264	406	372	528	488
	42		270	240	332	298	460	422	600	556
	48		302	268	370	332	516	472	672	622

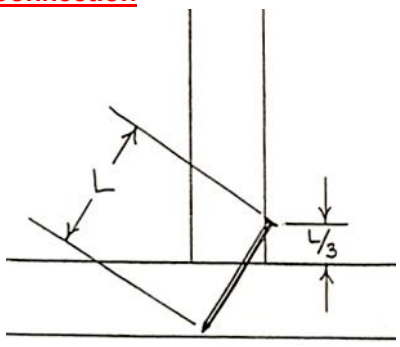
Table R602.3(1) Excerpt:

BUILDING ELEMENT	NUMBER AND TYPE OF FASTENER	SPACING AND LOCATION
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

Toe-nailing to Satisfy the Rafter/Truss-to-Top Plate Connection

AWC – National Design Specification for Wood Manual **12.1.6.4**-'15/**11.1.5.4**-'01/'05 Fabrication & Assembly. Nails shall be driven approximately 30º to the face of the member being attached and started approximately 1/3 the length of the nail from the member end. **12.1.6.6**-'15/**11.1.5.6**-'01/'05 Absence of splitting. Edge distances, end distances and spacing shall be sufficient to prevent splitting of the wood.

Performance values apply as long as the nails are driven at the correct angle, the wood is not split, and they are spaced properly.



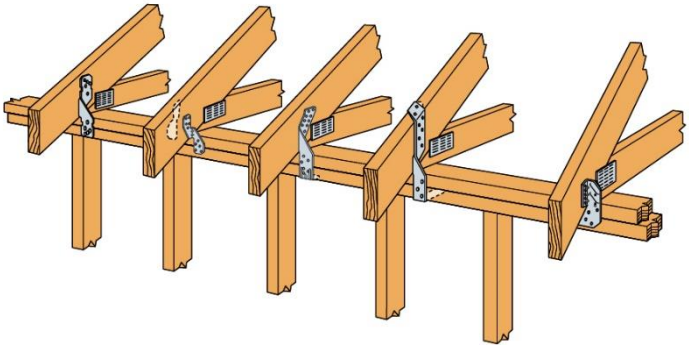
Note: The withdrawal value is taken from the lowest performing species of wood between the rafter and the top plate. For example, if the truss is Southern Pine and the wall top plates are Spruce-Pine-Fur, then the withdrawal value for the nails would be taken from the values for SPF.

Commonly available nails used in pneumatic nail tools for this connection.

Nail Type & Size	No. of Toenails	Uplift Capacity SPF (0.42)/1.60 Load Duration
0.131 x 3.5" (16d (pneumatic))	3	
	4	
0.131 x 3" (10d (pneumatic))	3	
	4	
0.120 x 3" (10d (pneumatic)	3	
	4	

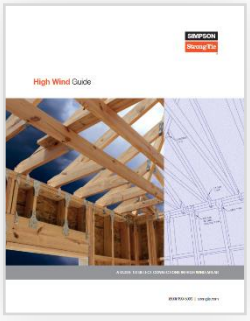
When uplift is less than 200 lbs.	*When uplift is greater than 200 lbs.*
Refer to fastening schedule Table R602.3.1.	A designed connection must be provided beyond the basic requirement for toenails. Use a metal connector matching the capacity shown in Table R802.11 or the designed capacity.

Seismic and hurricane ties



Allowable loads differ based on type of wall configuration or type of wood. See manufacturer for allowable loads and fastening requirements.
Connectors are available for single top plate applications.

Resource: F-C-HWG20 (High Wind Guide)



Resource: Connector Selector

Roof to Top Plate Connection

What to look for…

WHAT IS THE PROBLEM?
ENERGY HEEL, 2X4 BOTTOM CHORD BEARING TRUSS

SOLUTION? **H2.5T**

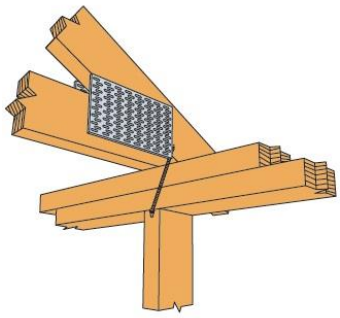
WHAT IS THE PROBLEM?
I-JOIST ROOF SYSTEM

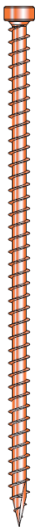
SOLUTION? **H8, MTS30**

SST Solution: **H2.5T, H8, MTS30** Literature: C-C-2021, pp. 276-278, 283 (MTS)

Engineered truss screws (SDWC15600)

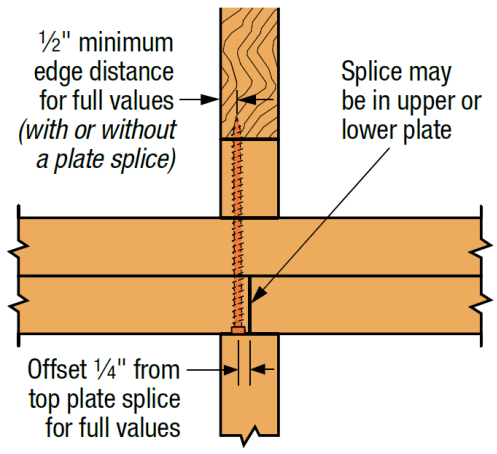
- Tested for uplift and lateral loads
  - ICC-ES AC233 (screw)
  - ICC-ES AC13 (wall assembly and roof-to-wall assembly)
- Fully threaded screw providing a connection from the roof to the top plate.
- Could be used instead of a hurricane tie for the roof to top plate connection. A rod system can take the uplift from here, or screws or connectors can be used from plate to stud and floor to floor.

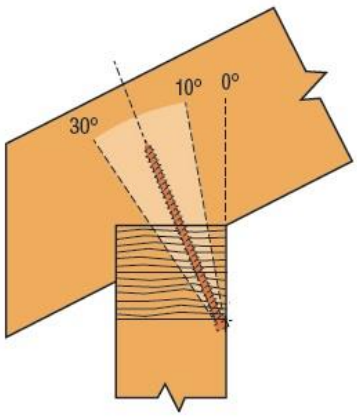




SST Solution: **SDWC15600** Literature: C-F-2019TECHSUP, pp. 54-72

What to look for…





Check for:

- Edge distance
- Offset from splice
- Angle of installation
- _____

Roof to Wall Connection

IRC®: R301.1 Design. "…complete load path…
R301.2.1 Wind design criteria…A continuous load path shall be provided to transmit the applicable uplift forces in Section R802.11.1 from the roof assembly to the foundation.
R602.10.1.2.1 Braced wall panel uplift load path. Braced wall panels located at exterior walls that support roof rafters or trusses (including stories below the top story) shall have framing members connected in accordance with one of the following:
R602.10.2.1 Braced wall panel uplift load path. The bracing lengths…apply only when the uplift loads are resisted in accordance with R602.3.5:
R602.3.5 (see 1, 2 and 3 below):

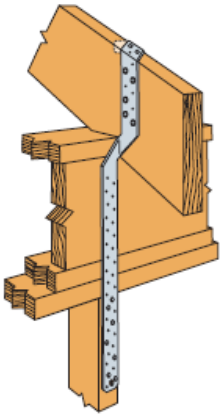
1. Fastening with Table R602.3 (1) where:
1.1…wind does not exceed 90 mph (ultimate design wind speed does not exceed 115 mph), exp. B, pitch 5:12, roof span 32 feet or less
1.2. …net uplift at the top of the wall does not exceed 100 plf…in accordance with Section R802.11, reduced by 60 plf for each full wall above.
2. Where net uplift value at the top of a wall exceeds 100 plf, installing approved uplift framing connectors to provide a continuous load path from the top of the wall to the foundation or to a point where the uplift force is 100 plf or less….

- **IBC®: 1604.4** Analysis. …Any system or method of construction to be used shall be based on a rational analysis in accordance with well-established principles of mechanics. Such analysis shall result in a system that provides a complete load path capable of transferring loads from their point of origin to the load resisting elements…
1604.4 …Every structure shall be designed to resist the effects caused by the forces specified in this chapter, including overturning, uplift and sliding.
2308.7.5/2308.10.1 Wind uplift. Roof construction-'09-'21 (assemblies-'00-'06) shall have rafter or truss ties to the wall below. Resultant uplift loads shall be transferred to the foundation using a continuous load path.
- **AWC-National Design Specification (NDS®) for Wood Construction**
12.2.3.5-'15/11.2.3.2-'01/'05 Nails & spikes loaded in withdrawal from the end grain of the wood has been prohibited since the 1944 edition.

Roof to Wall Connection Options;

H2A

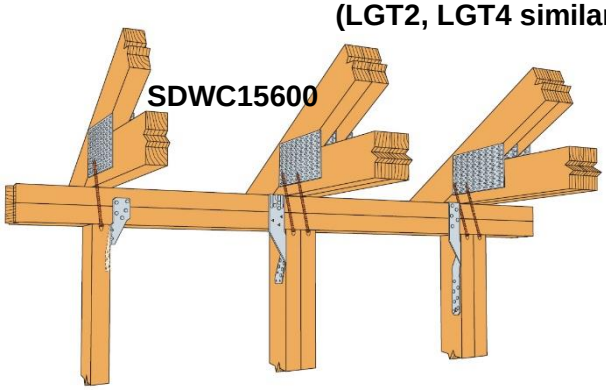
H10S



MTS30

LGT3
(LGT2, LGT4 similar)

These installations show examples of using truss screws for roof to wall connections, and connectors for top plate to stud. The wall top plate alone does not offer sufficient resistance to roof uplift forces, and therefore must be tied to the studs or framing below. This connection may be made with structural sheathing designed for uplift or a metal connector installed on the same side of the wall as the screw connection; however, the fasteners of the sheathing or connector must not interfere with the truss screw. The hurricane ties shown here are all good options.

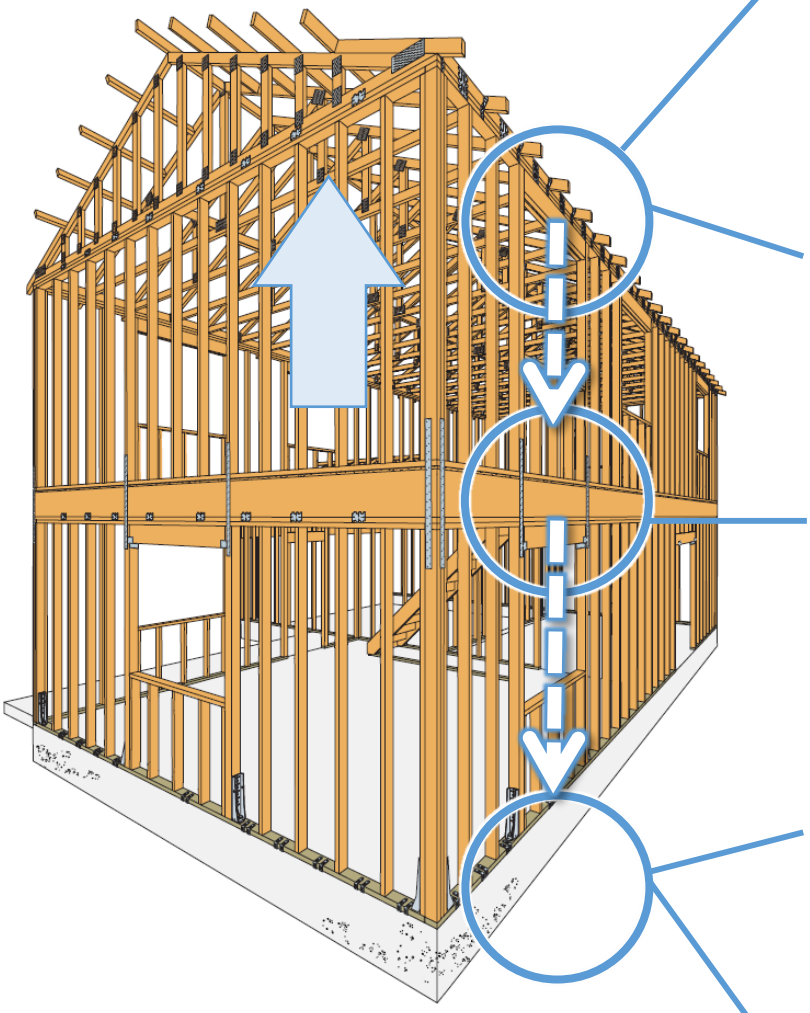


SDWC15600

SST Solution: **H2A, H10S, MTS30, LGT2, LGT3, LGT4** Literature: C-C-2021, pp. 276-278, 284-285 (LGT)

Continuous Load Path Basics

Connection Points: Fill in the blank



Starting at the top of the structure, forces are transferred from the roof truss or rafter to the top plate of the wall

The top of the wall must be connected to the wall stud

In multi-story structures, forces must be transferred from the story above to the story below

The wall stud is connected to the bottom plate of the wall, or sill plate

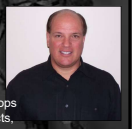
The sill plate must be anchored to the foundation

Continuous Load Path Connections (Structural) for Wood-Framed Structures

Simpson Strong-Tie Co., Inc.

Greg Wujcik
Territory Manager, Ohio

- 21 years with SST
- Provides education to local building officials, architects and engineers.



Jim Mailey
Training Specialist / Outreach Coordinator
Mid-Atlantic/Northeast/Midwest

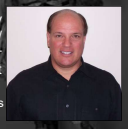
- 30 years with SST
- Conducted over 500 workshops to more than 35,000 architects, engineers, building officials, contractors, dealers

Continuous Load Path Connections (Structural) for Wood-Framed Structures

Simpson Strong-Tie Co., Inc.

Mike Wolfe
Territory Manager
Virginia, Wash., D.C.

- 19 years with SST
- Provides education to local building officials, architects and engineers.



Jim Mailey
Training Specialist / Outreach Coordinator
Mid-Atlantic/Northeast/Midwest

- 30 years with SST
- Conducted over 500 workshops to more than 35,000 architects, engineers, building officials, contractors, dealers

- Everyone will be muted.
- To keep the program moving, if you have questions, please put them in the Q & A box. If you have other comments or questions please email Mike Wolfe at mwolfe@strongtie.com

Course Outline

Continuous Load Path Connections for Wood Framed Structures

Course Contents;
Introduction - Course Credits, Additional Online and Instructor-Led courses
Continuous Load Path (code requirements and Institute for Business & Home Safety video)
General Information on Fastener and Connector Options
Foundation Sill Plate Anchoring – Cast-in Place - Strap-type Products, Anchor Bolts
Post-Installed Sill Plate Anchors – Retrofits and Mechanical Anchors
Wood Wall Framing – Continuous Load Path for Uplift
Wall Bracing – Brief Overview
Shear Walls – Holdowns, Post-Installed Structural Anchoring Adhesives, Pre-fab Shear Walls
Roof Construction – Roof Deflection, General Roof Framing and Various Rafter/Truss-to-Top Plate Connections
Wrap Up / Questions — Participant Handout – p. 1

Course Outline – 3-hour Program

Continuous Load Path-Wood Framed Structures

Course Contents;
General Introduction
Continuous Load Path Requirements
Foundation Sill Plate Anchoring – Strap-type products, anchor bolts
Mechanical & Structural Adhesive Anchors – Post-Installed Anchors, Sill plate retrofits
Wood Wall Framing – Continuous Load Path
Roof Connection Requirements – General Roof Construction, Various Rafter/Truss-to-Top Plate Connections
There will be two-5 minute breaks (about ⅓ and ⅔ of the way through the program)

Participant Handout – p. 1

Learning Objectives

Upon completion of this seminar, you will be able to:

- ✓ **Identify and explain the parts of a wood-framed structure that needs mechanical reinforcement to satisfy the Continuous Load Path requirements of the International Residential Code® (IRC®) and International Building Code® (IBC®) and recognize which products and methods satisfy those requirements.**

p. 1

Learning Objectives and Resources

Additionally, you will be able to:

- ✓ **Identify which catalogs, products and software are used for various applications.**

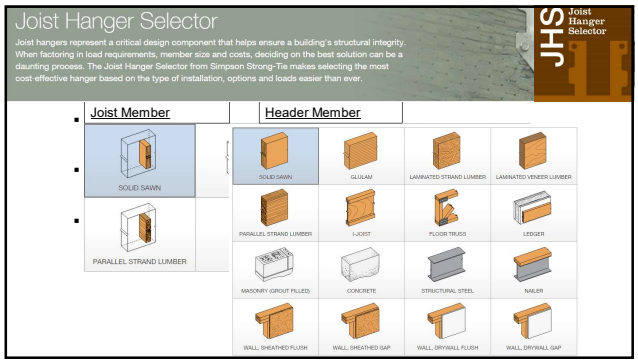
C-C-2021 

C-A-2021 

C-F-2019 

For Revit®, AutoCAD®, and Bluebeam®

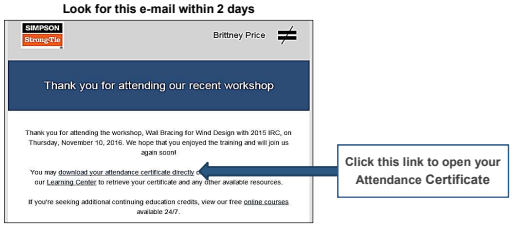
p. 1



Education & Training Services Course Credit

- **5 Professional Development Hours (PDH)**
- **90% 'Attendance' is required (both in-person or virtual attendance).**

Look for this e-mail within 2 days



Education & Training Services Course Credit

- **For those required to earn Continuing Education Units (CEU's), Simpson Strong-Tie is accredited by the International Association for Continuing Education and Training (IACET) and is approved to issue the IACET CEU.**

  Simpson Strong-Tie complies with the ANSI/IACET standard, which is recognized internationally as a standard of excellence in instructional practices.

ACCREDITED IACET PROVIDER

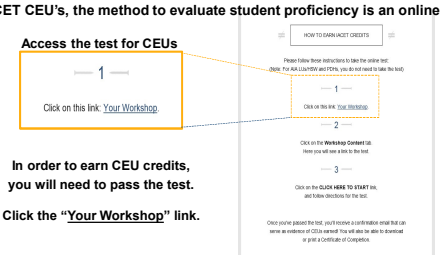
This course offers 0.5 CEU's (5 hours of credit).

- ✓ **0.5 CEU's are equivalent to 5 contact hours. 10 contact hours = 1.0 CEU**
- ✓ **5.0 PDH's are equivalent to 5 contact hours. 10 contact hours = 10 PDH**

Education & Training Services Course Credit

- **For IACET CEU's, the method to evaluate student proficiency is an online test.**

Access the test for CEUs



In order to earn CEU credits, you will need to pass the test.

Click the "Your Workshop" link.

Attn: Training Department
5956 W. Las Positas Blvd.
Pleasanton, CA 94588
www.strongtie.com

Exits

Restrooms

Cell Phones

Please put your phones on vibrate or turn them off.

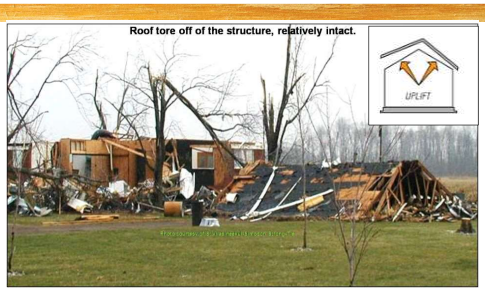
Simpson Strong-Tie Online & Instructor-Led Training

Additional Credit Offerings (Online and Instructor-Led)

Course Name	CEUs	AIA	ICC
Deck Building 101 ('12, '15 or '18 codes versions)	0.1	✓	✓
Deck Inspection for New & Existing Construction ('12, '15 or '18 codes versions)	0.1	✓	✓
Boring and Notching in Wood Frame Construction ('12, '15 or '18 codes version – all are the same)	0.1	✓	✓
Code Requirements for Conventionally Framed Roofs	0.1	✓	✓
Wall Bracing for Wind-2015 IRC	0.1	✓	✓
Wall Bracing for Wind-2018 IRC	0.1	✓	✓
Introduction to Wind Design and the Wood Frame Construction Manual	0.1	✓	✓

Visit strongtie.com/workshops for more information

Continuous Load Path – Forces To Be Resisted



Roof tore off of the structure, relatively intact.

Participant Handout – p. 2

Continuous Load Path – Forces To Be Resisted

Over the last 30 years, the U.S. has sustained 266 weather and climate disasters where overall damages and costs reached or exceeded $1 billion. The total cost of these 266 events exceeds $1.75 trillion.

Where Is the Bracing to Prevent Racking in the next video?

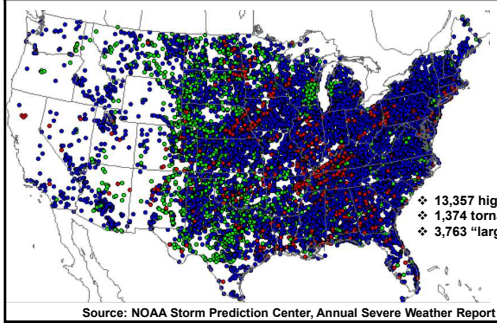
Where Is the Bracing to Prevent Racking?

Continuous Load Path – Forces To Be Resisted

Participant Handout – p. 2

Continuous Load Path – Forces To Be Resisted

Severe Weather Reports – 2021 (18,494 Total)



- 13,357 high wind events (•)
- 1,374 tornadoes (•)
- 3,763 "large hail" reports (•)

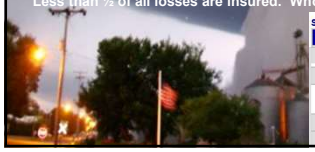
Source: NOAA Storm Prediction Center, Annual Severe Weather Report Summary

Natural Disaster Losses

Wind damage to constructed facilities is in the billions each year and is rising. **"Much of the damage can be attributed to inadequate resistance of nonengineered buildings to high winds."**
Source: ICC 600 – Preface

Average insured thunderstorm losses have increased sevenfold since 1980.
Since 1975 the cumulative underwriting deficit is over $510 billion.

Less than ⅛ of all losses are insured. Who pays the other ⅞?



State Tabulation - 2021

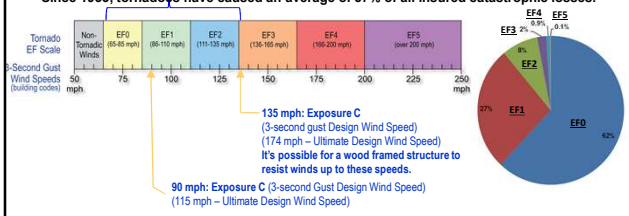
State	Total	Torn	Hail	Wind
SD	577	19	218	340
VT	68	2	2	64
VA	835	9	67	759
WV	230	2	21	207
WI	474	27	119	328
DC	22	2	0	20

State Tabulation - 2021

State	Total	Torn	Hail	Wind
CT	96	8	3	85
DE	44	2	2	40
IL	597	80	64	453
IN	370	19	40	311
IA	491	70	95	325
KY	382	57	27	298
ME	69	0	7	62
MD	403	11	16	376
MA	188	7	11	170
MI	517	17	51	449
MN	445	37	147	261
NE	707	53	225	429
NH	120	0	35	85
NJ	306	13	25	268
NY	715	14	39	662
ND	405	21	158	226
OH	464	37	27	400
PA	1043	44	43	956
RI	16	2	0	14

Tornado Wind Speed Estimates

~97% of all tornadoes
Since 1953, tornadoes have caused an average of 57% of all insured catastrophic losses.



135 mph: Exposure C
(3-second gust Design Wind Speed)
(174 mph – Ultimate Design Wind Speed)
It's possible for a wood framed structure to resist winds up to these speeds.

90 mph: Exposure C (3-second Gust Design Wind Speed)
(115 mph – Ultimate Design Wind Speed)

EF – Tornado scale = Enhanced Fujita (EF) scale

Tornado/High Wind Resilience

The American Society of Civil Engineers (ASCE), FEMA, building science engineers and leading academic researchers have published a research-informed document to provide designers reasonable targets to resist high winds associated with tornadoes.

Their work, published as the *Dual-Objective-Based Tornado Design Philosophy*, is landmark in that it defies traditional assertions that, "there is nothing that you can do to affordably build to withstand tornadoes".

Homes built to these newer guidelines will have the advantage of better wall-bracing, improved roof tie-downs, and overall stronger connections.

Resources

- **International Code Council** – **www.iccsafe.org**
  - **International Residential Code® – 2000-2021 (IRC®)**
  - **International Building Code® – 2000-2021 (IBC®)**

  Code Guide;

  "R" before the numbers indicates International Residential Code
  If the entire section is in black – it was a code requirement in 2006 or prior codes and is the same requirement currently.

  The following colors identify when there was a significant change in the code;

  Red – 2009, Green – 2012, Purple – 2015,

  Bold Brown – 2018, Bold Dark Red – 2021

Participant Handout – p. 2

Complete or Continuous Load Path

R301.1 …The construction of buildings and structures…shall result in a system that provides a complete load path…
Buildings and structures constructed as prescribed by this code are deemed to comply with the requirements of this section.

In other words, transferring all loads through the home with a "Continuous Load Path" is NOT required in a "Complete Load Path".

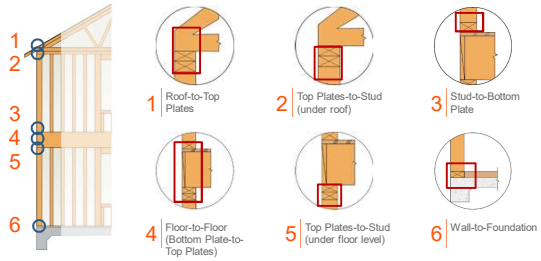
R301.2.1…A continuous load path shall be provided to transmit the applicable uplift forces in Section R802.11.1 from the roof assembly to the foundation. *In ALL wind zones.*

IRC: Detached one- and two-family dwellings and townhouses not more than 3 stories above grade plane with a separate means of egress.
Limitations – wind speed ≥ 140 mph (see Figure R301.2.1.1), buildings in SDC E, snow loads > 70 psf, buildings and structures in floodways use ASCE 24, other-see section R301

How do you strap down a house from the roof to the ground in a Continuous Load Path?

Continuous Load Path – "Strap Tie-Downs"

Continuous Load Path to Resist Uplift – Connection Points



Participant Handout – p. 2

Complete/Continuous Load Path

R301.1 …The construction of buildings and structures…shall result in a system that provides a complete load path…
Buildings and structures constructed as prescribed by this code are deemed to comply with the requirements of this section.

The IRC requires a "Continuous Load Path" for uplift, only. unless the building is in a Flood Hazard Area.

IRC: section R322.1.2 or
ASCE 24 (flood document for all IBC structures and all (IRC) structures in floodways), section 1.5.1:
…structures shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement due to structural loads and stresses from flooding equal to the design flood elevation (DFE).

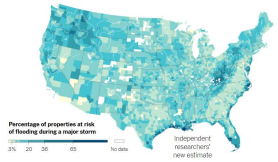
Participant Handout – p. 3

Flood Courses

Course Name	CEUs	AIA	ICC
Buildings, Homes & Decks in Flood Hazard Areas Connections At or Below the Design Flood Elevation	0.5	In-person (5-hour)	
Buildings, Homes in a Flood Hazard Area - Connections (online)	0.1	✓	✓
Decks, Porches in a Flood Hazard Area – Connections (online)	0.1	✓	✓

p. 3

Flood Risk



- ✓ According to a 2020 study by First Street Foundation, there are more than 21 million properties at risk of flooding.
  And, more than 14 million of those properties are at substantial risk.
- ✓ [1]Homeowners insurance typically does not cover flood loss costs.

[1]Cigler, Beverly A. 2017.
U.S. Floods: The Necessity of Mitigation

Flood Frequency – Illinois

Historical Flood Impact

- ✓ Every county in Illinois has experienced flooding.
- ✓ 47 counties have had more than 50 recorded flood events.

Market Statistics for Flood Resistant Construction

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
IL	451,700/748,100	1.1M	378,800	Chicago	154,824
				Joliet	7,438
				Calumet City	6,562
				Harvey	6,357
				Rockford	5,742

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Indiana

Historical Flood Impact

- ✓ Every county in Indiana has experienced flooding.

Market Statistics for Flood Resistant Construction

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
IN	282,500/440,800	104,900	158,300	Indianapolis	34,124
				Ft. Wayne	11,210
				Hammond	10,339
				Gary	9,568
				South Bend	7,654

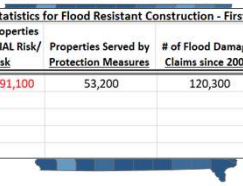
- ✓ The Design Flood Elevation (DFE) was changed from Base Flood Elevation (BFE) + 1' to BFE + 2" (Indiana)

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Iowa

- ✓ Almost every county in Iowa has experienced significant and repeated flooding since 1996.

Historical Flood Impact



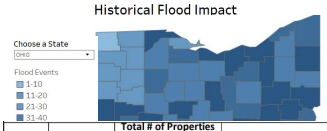
Market Statistics for Flood Resistant Construction - First Street Foundation Study

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
IA	294,000/391,100	53,200	120,300	Council Bluffs	10,989
				Des Moines	9,328
				Waterloo	9,245
				Sioux City	6,148
				Cedar Rapids	5,809

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Ohio

Historical Flood Impact



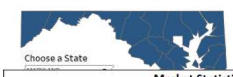
- ✓ Every county in Ohio has experienced flooding.
- ✓ 47 counties have had more than 50 recorded flood events.
- ✓ Over 600 municipalities and 86 counties participate in the NFIP.

State	TM	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
OH	Wujcik	493,000/708,400	78,400	143,000	Cincinnati	21,236
					Columbus	17,728
					Cleveland	12,261
					Toledo	12,166
					Dayton	10,770

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Maryland

Historical Flood Impact



- ✓ Every county in Maryland has experienced flooding.
- ✓ 19 counties have had more than 50 recorded flood events since 1996.

Market Statistics for Flood Resistant Construction

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
MD	133,700/202,600	144,900	15,700	Baltimore	13,705
				Ocean City	6,319
				Ocean Pines	4,148
				Dundalk	2,123
				West Ocean City	2,020

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Massachusetts

Historical Flood Impact

- ✓ Every county has had 50 or more recorded flood events since 1996.

Market Statistics for Flood Resistant Construction - First Street Foundation Study

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
MA	193,300/336,200	34,200	88,000	Boston	19,177
				Worcester	5,424
				Springfield	4,766
				Lawrence	4,685
				Quincy	4,618

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Michigan

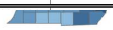
Historical Flood Impact

- ✓ Every county in Michigan has experienced flooding.
- ✓ Damage from flooding exceeds $60-$100 million annually.
- ✓ ~650 communities that have flood-prone areas participate in the NFIP

Choose a State

State	TM	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
MI	Tuggle	315,600/531,800	29,600	238,900	Detroit	39,744
					Warren	11,916
					Grand Rapids	9,448
					Sterling Heights	5,485
					Lansing	5,164

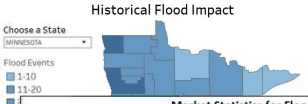
Wayne Co. – 85 events
Macomb Co. – 57 events
Washtenaw Co. – 49 events



https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Minnesota

Historical Flood Impact



- ✓ Every county in Minnesota has experienced flooding.
- ✓ 11 counties have had more than 41 recorded flood events.

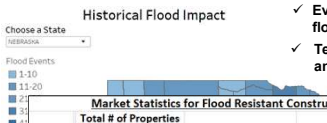
Market Statistics for Flood Resistant Construction

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
MN	215,600/322,300	26,200	22,600	Minneapolis	10,730
				St. Paul	7,345
				Duluth	5,445
				Rochester	5,088
				Winona	4,567

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Nebraska

Historical Flood Impact



- ✓ Every county in Nebraska has experienced flooding.
- ✓ Ten counties have experienced significant and repeated flooding more than 50 times.

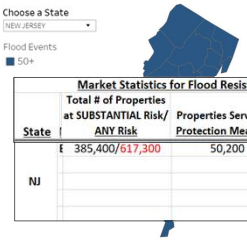
Market Statistics for Flood Resistant Construction - First Street Foundation Study

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
NE	102,000/149,300	38,600	25,300	Omaha	12,616
				Lincoln	7,923
				Columbus	4,171
				Freemont	4,092
				Grand Island	2,991

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – New Jersey

Historical Flood Impact



- ✓ New Jersey is the only state in a 24 state region of the Mid-Atlantic, Midwest, and Northeast where every county has experienced significant and repeated flooding more than 50 times since 1996.

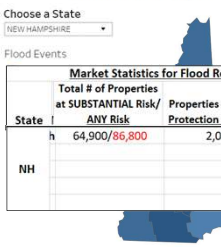
Market Statistics for Flood Resistant Construction - First Street Foundation Study

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
NJ	385,400/617,300	50,200	588,700	Ocean City	17,255
			Superstorm Sandy accounted for 208,639	Toms River	11,675
				Sea Isle City	11,495
				Avalon	10,055
				Atlantic City	9,726

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – New Hampshire

Historical Flood Impact



- ✓ Every county in New Hampshire has experienced flooding.
- ✓ Six counties have experienced significant and repeated flooding more than 50 times.

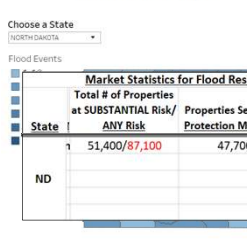
Market Statistics for Flood Resistant Construction - First Street Foundation Study

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
NH	64,900/86,800	2,000	13,800	Manchester	4,184
				Nashua	2,648
				Keene	1,643
				Concord	1,483
				Laconia	1,481

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – North Dakota

Historical Flood Impact



- ✓ Every county in North Dakota has experienced flooding.
- ✓ Seven counties have experienced significant and repeated flooding more than 50 times.

Market Statistics for Flood Resistant Construction - First Street Foundation Study

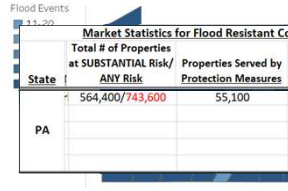
State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
ND	51,400/87,100	47,700	30,400	West Fargo	5,428
				Fargo	3,891
				Grand Forks	2,567
				Bismark	2,297
				Minot	1,252

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Pennsylvania

Historical Flood Impact

- ✓ Every county in Pennsylvania has experienced flooding.
- ✓ 43 counties have experienced significant and repeated flooding more than 50 times.



Market Statistics for Flood Resistant Construction - First Street Foundation Study

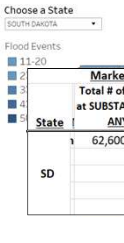
State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
PA	564,400/743,600	55,100	257,100	Philadelphia	53,387
				Pittsburgh	21,803
				Harrisburg	7,395
				Wilkes-Barre	6,919
				Williamsport	5,039

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – South Dakota

Historical Flood Impact

- ✓ Every county in South Dakota has experienced flooding.
- ✓ Twenty counties have experienced significant and repeated flooding more than 50 times.



Market Statistics for Flood Resistant Construction - First Street Foundation Study

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
SD	62,600/83,400	17,400	13,100	Rapid City	4,594
				Sioux Falls	3,150
				Sturgis	1,267
				Watertown	1,221
				Spearfish	1,093

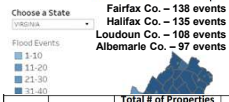
https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Virginia

Historical Flood Impact

Fairfax Co. – 138 events
Halifax Co. – 135 events
Loudoun Co. – 108 events
Albemarle Co. – 97 events

- ✓ Every county in Virginia has experienced flooding.
- ✓ Several counties experience significant and repeated flooding.



State	TM	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
VA	Wolfe	344,400/570,800	17,600	95,900	Virginia Beach	28,943
					Norfolk	18,042
					Hampton	16,820
					Chesapeake	16,543
					Portsmouth	8,543

https://www.fema.gov/data-visualization-floods-data-visualization

Flood Frequency – Wisconsin

Historical Flood Impact

- ✓ Every county in Wisconsin has experienced flooding.
- ✓ Twenty-three counties have experienced significant and repeated flooding more than 50 times since 1996.

Market Statistics for Flood Resistant Construction - First Street Foundation Study

State	Total # of Properties at SUBSTANTIAL Risk/ ANY Risk	Properties Served by Protection Measures	# of Flood Damage Claims since 2000	Top 5 Municipalities (Market Focus)	# of Properties at Risk
WI	273,400/389,700	3,600	124,500	Milwaukee	12,203
				Madison	5,755
				La Crosse	5,699
				Fon Du Lac	4,963
				Eau Claire	4,270

https://www.fema.gov/data-visualization-floods-data-visualization

Continuous Load Path

IBC: 1604.4 Analysis. …Any system or method of construction to be used shall be based on a rational analysis in accordance with well-established principles of mechanics. Such **analysis shall result in a system that provides a complete load path capable of transferring loads from their point of origin to the load resisting elements**…

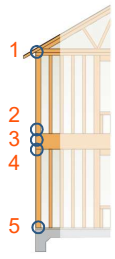
1604.9 ('06-'15). ~~Structural members, systems, components and cladding shall be designed to resist forces due to earthquake and wind with consideration of overturning, sliding and uplift. Continuous load paths shall be provided.~~…

1604.4 Every structure shall be designed to resist the effects caused by the forces specified in this chapter, including overturning, uplift and sliding.

The IBC and the part of buildings & structures equal to or below the DFE in Flood Hazard Areas require a "Continuous Load Path" for uplift and lateral loads.

Participant Handout – p. 3

Continuous Load Path to Resist In-Plane – Connection Points



1 Roof Diaphragm-to-Wall

2 Through Upper Story Wall

3 Floor-to-Floor

4 Through First Story Wall

5 Wall-to-Foundation

A continuous load path is an important part of a structures ability to withstand Mother Nature's forces. ?

Participant Handout – p. 3

Question mark indicates a question on the test. ?

1. A Continuous Load Path is an important part of what?
   - A. Do-It-Yourself patio cover plan designed by SST.
   - B. An essential piece of designing with mechanical anchors.
   - C. A structures ability to withstand Mother Nature's forces.
   - D. The process followed when ordering a modified hanger.

The following IBHS video explains "Continuous Load Path"

Continuous Load Path Resource

Resource: Institute for Business and Home Safety (IBHS) – www.disastersafety.org

- **Fortified for Safer Living®, Fortified Home™ -** The **Fortified** program offers a package of "code-plus" upgrades that greatly increases a new home's resistance to natural perils.

p. 4

Connection Methods

Common fasteners	**Traditional, low-cost option for areas with a low risk of seismic or wind activity. Load capacity is limited, and may not be a viable solution for all connections.**

p. 4

Generic Dowel-Type Fasteners – Common Types

- **AWC – National Design Specification (NDS)**
  - **As a calculation approach for both lateral and withdrawal of generic fasteners.**
  - **Can be complicated and time consuming.**

Many Factors to Consider;

- **Wood specific gravity**
- **Fastener diameter and length**
- **Load direction with respect to the wood grain**
- **Member thickness**
- **Load duration**
- **Service conditions (moisture and temperature)**
- **Geometry of the fasteners on the wood member.**


Nails


Lag Screws


Wood Screws


Bolts

Resource: American Wood Council (AWC) – www.awc.org

- **National Design Specification for Wood Construction**
- **Online Span and Connections Calculator – www.awc.org/calculators**

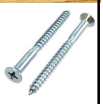
p. 4

Generic Dowel-Type Fasteners – Nails

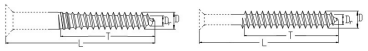
- **Strengths**
  - ✓ **Widely available.**
  - ✓ **No predrilling required.**
  - ✓ **Cost efficient.**
  - ✓ **Minimal labor – Only a hammer and minimal skill needed.**
  - ✓ **Some lengths and diameters can be installed with a pneumatic nailer.**
- **Weaknesses**
  - **Limited applications due to length available (3½" is the limit of typical nails, though longer lengths exist).**
  - **Relatively small diameter limits shear capacity per fastener.**
  - **Relatively low withdrawal capacity – No withdrawal values through the end grain.**
  - **Some improper types are used. Roofing nails or finish nails are not appropriate.**

p. 4

Generic Dowel-Type Fasteners – Generic Wood Screws



- Strengths
  - Widely available.
  - Threads provide significantly more withdrawal capacity than nails.
  - Minimal labor – Basic equipment and minimal skill needed.
- Weaknesses
  - NDS requires predrilling if laterally loaded; also for some withdrawal cases.
  - Screw minor diameter (D_r) of the threads limits the shear strength.
  - No withdrawal values through the end grain.
  - Some improper types are used, such as drywall screws.



Cut Thread[2] Rolled Thread[3]

Generic Dowel-Type Fasteners – Lag Screws

- Strengths
  - Larger diameter and threads means maximum shear and withdrawal capacity.
  - Permitted in application of withdrawal through the end grain (reductions apply).
  - Able to verify during inspection.
- Weaknesses
  - NDS requires predrilling with (2) different bit diameters
    - One size for the smooth shank
    - One size for the threaded portion
  - For larger diameters, predrilling removes a significant volume of wood.
  - Strict minimum penetration requirement of 4x diameter into the main member:
    - e.g. – ½" diameter lag screw must penetrate at least 2" into the main member.

p. 4

Generic Dowel-Type Fasteners – Bolts

- Strengths
  - Larger diameter means maximum shear capacity.
  - Large tension capacity can be obtained when used with plate washers (no withdrawal for the bolt itself).
  - Able to verify during inspection.
- Weaknesses
  - NDS requires predrilling.
  - For larger diameters, predrilling removes a significant volume of wood.
  - Must have access on both sides for installation.

Machine Bolt

Generic Dowel-Type Fasteners – Bolts

Wood failure; Tearing perpendicular-to-grain at the bolt holes

[1]Due to critical edge and end distances, wood connections are stronger when the load is spread out over a number of fasteners. To accomplish this, designers should consider using smaller fasteners and use multiple fasteners when possible.

p. 4

[1]Resource:
Showalter, John. Nov. 2016 Design of Bolted Connections per the 2015 NDS, Structure Magazine[1].

Connection Methods

Common fasteners	Traditional, low-cost option for areas with a low risk of seismic or wind activity. Load capacity is limited, and may not be a viable solution for all connections.
Sheathing	Resists both lateral and uplift loads. Sheathing connects the top plate directly to the foundation. We'll review the SDPWS Section 4.4: Wood Structural Panels Designed to Resist Combined Shear and Uplift from Wind.

p. 4

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Restraint rod systems	Continuous rod tiedown systems consist of a combination of connectors, rods, coupler nuts, bearing plates and shrinkage compensation devices. These all work together to create a continuous load path to the foundation.

p. 4

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p. 4

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Restraint rod systems	Continuous rod tiedown systems consist of a combination of connectors, rods, coupler nuts, bearing plates and shrinkage compensation devices. These all work together to create a continuous load path to the foundation.
Metal connectors	A proven, widely available economical solution to strengthen connection points. Typical connectors for continuous load path connections include seismic or hurricane ties, holdowns and straps.
Engineered structural screws	**Designed, engineered, structural screws that provide easier installation, flexibility in framing, and do not interfere with finish materials.**

Questions?

Sill Plate-to-Foundation Connection

Modular home survived a direct hit from an EF2 tornado (135 mph wind) - Lapeer County, MI

1st floor box to sill plate & sill plate to foundation connections failed.

p. 5

Sill Plate-to-Foundation Connection

R403.1.6 / 2308.3.1 Foundation plates or sills

- ✓ **6 feet on center spacing, maximum (some exceptions)**
- ✓ **7" embedment (anchor bolts), concrete or grouted masonry units**
- ✓ **Maximum of 12" from the end of each plate**
- ✓ **Minimum of 7 diameters (4"-IBC) from the end of each plate**
- ✓ **Located in the middle third of the width of the plate ('15 IRC, '18 IBC)**
- ✓ **Minimum of 2 bolts per plate (some exceptions)**
- ✓ **½" anchor bolt minimum (⅝" – SDC E & some high wind applications)**
- ✓ **Nut and washer must be installed on each bolt**

?

The following slide is a demonstration of a ½" x 8" L-type anchor bolt pullout test with 6" of embedment (8,650 lbs. ultimate). Demonstration, only.

p. 5

Sill Plate Anchor Bolts – Factors to Consider

p. 6

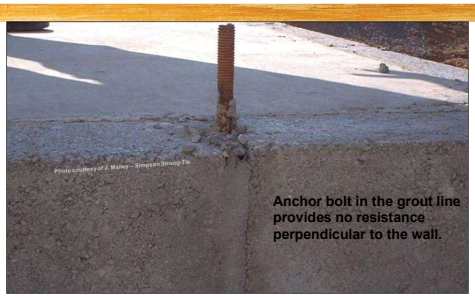
Does the bolt line up in the correct location?

Sill Plate Anchor Bolts – Factors to Consider

p. 6

Does the bolt line up in the correct location?

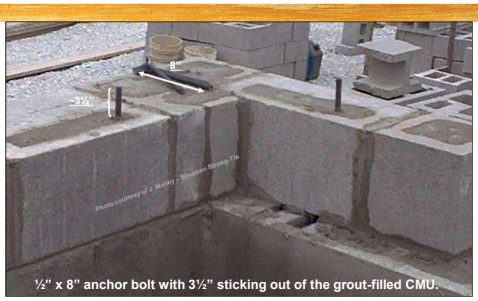
Sill Plate Anchor Bolts – Factors to Consider



p. 6

Does the bolt line up in the correct location?

Sill Plate Anchor Bolts – Factors to Consider



Are the anchor bolts embedded properly?

Sill Plate Anchor Bolts – Factors to Consider

IRC: R602.3.4, IBC:2308.9.2.4/2308.5.3.1 – **Studs shall have full bearing…**

p. 6

Does the bolt line up in an accessible location?

Sill Plate Anchor Bolts – Factors to Consider

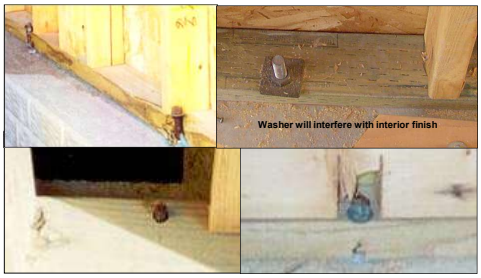
p. 6

Is there 1½" of wood under the washer? Less wood reduces the sill plate uplift capacity.

Sill Plate Anchor Bolts – Factors to Consider

Is the drilled hole in the plate oversized correctly? Anchor bolt hole must be no greater than 1/32"-1/16" oversized.

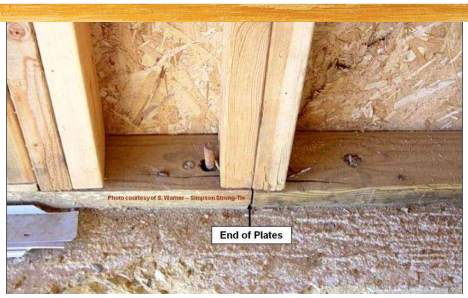
Sill Plate Anchor Bolts – Factors to Consider



p. 6

Is the minimum EDGE distance met? Middle third of the plate.

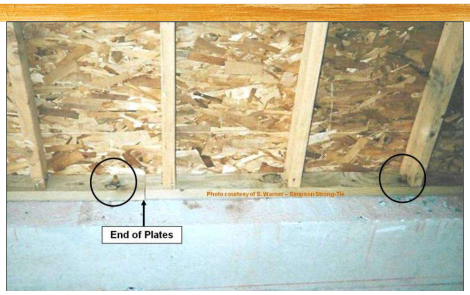
Sill Plate Anchor Bolts – Factors to Consider



p. 6

Is the minimum END distance met? 7 diameters-IRC, 4 inches-IBC

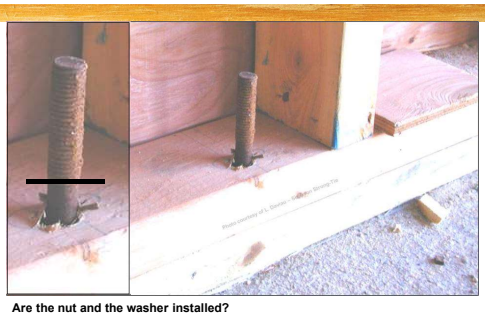
Sill Plate Anchor Bolts – Factors to Consider



p. 6

Is the maximum END distance met? 12 inches from the end of each plate.

Sill Plate Anchor Bolts – Factors to Consider



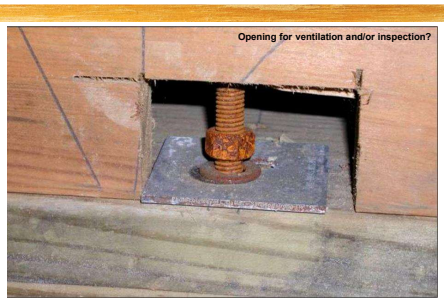
p. 6

Are the nut and the washer installed?

Sill Plate Anchor Bolts – Factors to Consider

Can the washer be installed?

Sill Plate Anchor Bolts – Factors to Consider



Are the nut and the washer installed, correctly?

p. 6

Sill Plate Anchor Bolts – Bearing Plate Requirements

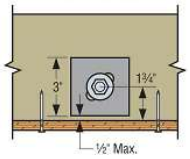
- R403.1.6.1 SDC (D_0 – '06-'21), D_1 & D_2 and townhouses in SDC-C, plate washers conforming to R602.11.1 , a minimum of 0.229"x3"x3" ('06-'21), shall be provided…over the full length of required braced wall lines…
- R301.2.1.1 Wind Design criteria (IRC: '09-'21).
  …where the basic wind speed… equal or exceed "X" (depends on the code) shall be designed in accordance with one of the following:
  - ICC 600-Standard for Residential Construction in High Wind Regions
  - AWC-Wood Frame Construction Manual
    - When using sheathing for uplift, sill plate anchors, *shall have* square plate washers, 3"x3"x0.229"...

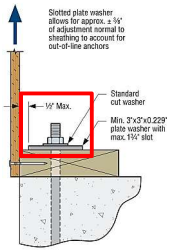
- 2308.3.1.1, 2308.3.1.2/2308.3.2/2308.12.8… SDC D or E.
  Steel plate washers …shall be a minimum of 0.229x3"x3" ('06-'21)...
- 2305.1 ('06-'21) …wood shear walls & diaphragms *for* wind, seismic & other lateral loads shall be designed and constructed in accordance with AWC-Special Design Provisions for Wind & Seismic (SDPWS)…

p. 6

Sill Plate Anchor Bolts – Bearing Plates

BPS½-3
BPS⅝-3

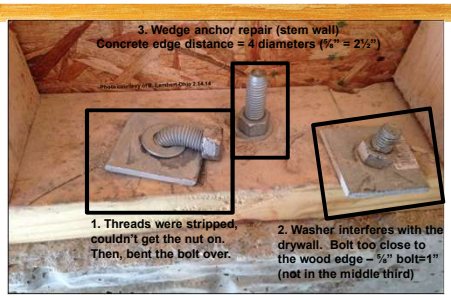




C-C-2021, pp. 46-47

p. 6

Sill Plate Anchor Bolts – An Attempt to Meet ALL the Requirements



Washers should be within ½" of the sheathed edge.

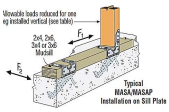
Sill Plate Anchors

Cast-in Place Sill Plate Strap-Type Products

p. 7

Sill Plate Strap-Type Product Cast-in Place – MASA / MASAP

- ✓ Can be installed with 1 or 2 legs up.
- ✓ Can be installed over ½" sheathing or directly to the rim joist or blocking.
- ✓ Use with 2x4 through 2x10 sill plate.
- ✓ Good when using sheathing for uplift or bearing plate edge distance is difficult to place.
- ✓ As a 'performance' alternative to anchor bolts (R104.11, 104.11) Therefore, does not need 7" of embedment.



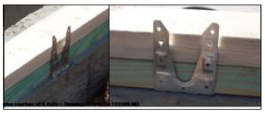
C-C-2021, pp. 28-29

T-A-SILPLANCH21, pp. 4-6

p. 7

Sill Plate Strap-Type Product Cast-in Place – MASA / MASAP

- ✓ Can be installed with a double 2x plate.
- ✓ MASAP is good when the concrete is not level with the top of the form.



- ✓ Tested to ICC-ES AC398 for cracked & uncracked concrete.
- ✓ May be equivalent to ½" anchor bolts at 6' on center.

Prescriptive Spacing for MASA/MASAP to Replace Cast-in-Place Anchor Bolts

Detail	Sill Plate Size	Anchor Bolt to Replace	Anchor Bolt Spacing to Replace	MASA/MASAP Spacing			
				DF/SP		HF	
				Wind and SDC A&B	SDC C-E	Wind and SDC A&B	SDC C-E
5*	2x4, x6, x8, x10	½" diameter with 7" embedment	6' o.c.	6'-0"	6'-0"	6'-0"	6'-0"
			4' o.c.	4'-0"	4'-0"	4'-0"	4'-0"
5*	2x4, x6, x8, x10	⅝" diameter with 7" embedment	6' o.c.	5'-4"	4'-6"	5'-1"	4'-4"
			4' o.c.	3'-6"	3'-1"	3'-5"	2'-11"
3	2x4	½" diameter with 7" embedment	6' o.c.	6'-0"	—	6'-0"	—
4	Double 2x4		6' o.c.	3'-9"	—	3'-6"	—
3	2x4	⅝" diameter with 7" embedment	6' o.c.	4'-3"	—	4'-2"	—
4	Double 2x4		6' o.c.	2'-4"	—	2'-3"	—

C-C-2021, pp. 28-29

T-A-SILPLANCH21, pp. 4-6

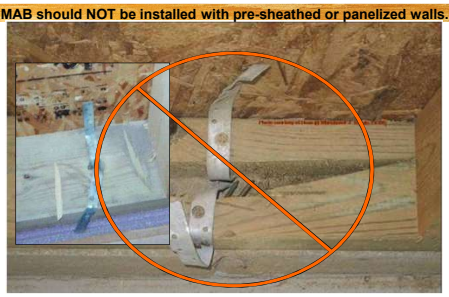
Sill Plate Strap-Type Products – Factors to Consider

p. 7

- ✓ Is the anchor to be used for panelized or pre-fabricated or pre-sheathed walls?

Sill Plate Strap-Type Products – Factors to Consider (MAB)

MAB should NOT be installed with pre-sheathed or panelized walls.



- ✓ Is the anchor to be used for panelized or pre-fabricated or pre-sheathed walls?

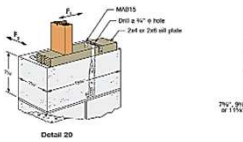
Sill Plate Strap-Type Products – Factors to Consider (MAB)

MAB-type strap should NOT be installed up along the side of the stud.

- ✓ Can the legs be attached to a stud for proper installation?

Sill Plate Strap-Type Products – Factors to Consider (MAB)

Plate Must be Drilled



Correct Location?

- Are the straps embedded properly?

C-C-2021, pp. 30-31

T-A-SILPLANCH21, pp. 11-12

p. 7

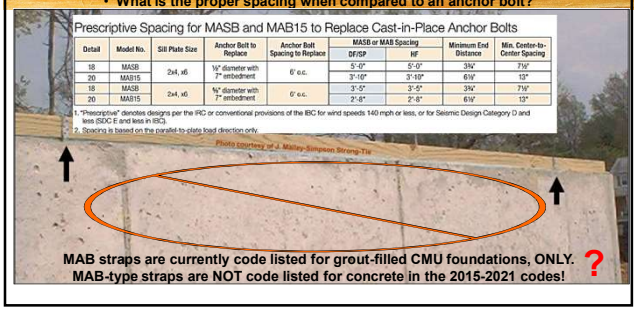
Sill Plate Strap-Type Products – Factors to Consider

- What is the proper spacing when compared to an anchor bolt?

Prescriptive Spacing for MASB and MAB15 to Replace Cast-in-Place Anchor Bolts

Detail	Model No.	Sill Plate Size	Anchor Bolt to Replace	Anchor Bolt Spacing to Replace	MASB or MAB Spacing		Minimum End Distance	Min. Center-to-Center Spacing
					DF/SP	HF		
18	MASB	2x4, x6	½" diameter with 7" embedment	6' o.c.	5'-0"	5'-0"	3⅜"	7⅛"
20	MAB15				3'-10"	3'-10"	6⅛"	13"
18	MASB	2x4, x6	⅝" diameter with 7" embedment	6' o.c.	3'-5"	3'-5"	3⅜"	7⅛"
20	MAB15				2'-8"	2'-8"	6⅛"	13"

1. "Prescriptive" denotes designs per the IRC or conventional provisions of the IBC for wind speeds 140 mph or less, or for Seismic Design Category D and less (SDC E and less in IBC).
2. Spacing is based on the parallel-to-plate load direction only.



MAB straps are currently code listed for grout-filled CMU foundations, ONLY.
MAB-type straps are NOT code listed for concrete in the 2015-2021 codes! ?

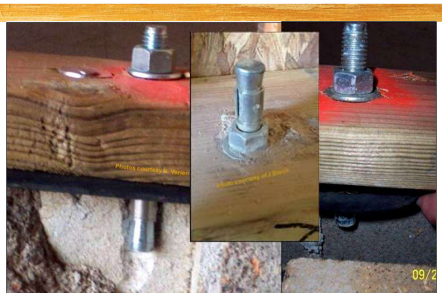
Cast-In Place Sill Plate Anchor Questions?

Sill Plate Anchors

Post Installed Anchors for Concrete & GFCMU
Mechanical Anchors

p. 8

Mechanical Anchor in Hollow CMU?



Wedge anchors should NOT be installed into hollow block. The clip end needs to be in the concrete, not upside down!

Post-Installed Mechanical Anchors

Strong-Bolt® 2 Wedge-type, Expansion Anchor

- Code-listed in concrete (ICC-ES ESR-3037) for:
  - Cracked Concrete (Stainless Steel and Carbon Steel (CS))
  - Horizontal, Vertical and Overhead applications
- Code-listed in Grout-Filled CMU (CS) (IAPMO UES ER-240)
- Category 1 torque-controlled expansion anchor
  - ✓ Highest attainable anchor category for reliability
- Available in 316 stainless steel (SS) and carbon steel (CS)

Cracked Concrete

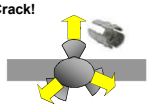
p. 8

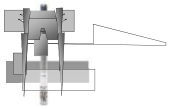
C-A-2021, pp. 108-122

Strong-Bolt® 2 Wedge-type, Expansion Anchor

Why the Strong-Bolt® 2 Works in a Crack!

- Tri-segmented clip design
  - Grabs at least 2 sides of the crack
  - Distributes loads more uniformly
    - For more redundancy
- 2 Teeth per segment
  - Creates ledges when installed
  - Provides 'secondary' expansion as the crack cycles
- Clip metal matches the body
  - When clip and body do NOT match, corrosion is accelerated.





C-A-2021, pp. 108-122

Wedge-type, Expansion Mechanical Anchor – Strong-Bolt® 2

Carbon-Steel Strong-Bolt 2 Installation Information and Additional Data[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter, d_a (in.)					
			¼[4]	⅜[4]	½[4]		⅝[4]	
Installation Information								
Nominal Diameter	d_a	in.	¼	⅜	½		⅝	
Drill Bit Diameter	d_{bit}	in.	¼	⅜	½		⅝	
Baseplate Clearance Hole Diameter[2]	d_c	in.	9/32	11/32	9/16		11/16	
Installation Torque	T_{inst}	ft-lbf	4	30	60		90	
Nominal Embedment Depth	h_{nom}	in.	1⅛	1⅝	2⅛	3⅛	3⅛	5⅛
Effective Embedment Depth	h_{ef}	in.	1⅛	1⅝	2⅛	3⅛	2⅛	4⅛
Minimum Hole Depth	h_{hole}	in.	1⅝	2	3	4⅛	3⅛	5⅛
Minimum Overall Anchor Length	ℓ_{anch}	in.	2⅛	2¾	3½	3¾	5⅛	4⅛	6
Critical Edge Distance	c_{ac}	in.	2½	6⅛	6	6	7⅛	7⅛	9
Minimum Edge Distance	c_{min}	in.	1⅝	6	6	4	4	6⅛	6⅛	6⅛
	for $s \geq$	in.	—	—	6	4	4	—	5	5
Minimum Spacing	s_{min}	in.	2¼	3	2⅛	2⅛	2⅛	5	2⅛	2⅛
	for $c \geq$	in.	—	—	12	12	12	—	8	8
Minimum Concrete Thickness	h_{min}	in.	3¼	3½	4	5½	6	3½	6	7⅛

IBC, using Strength Design Method Strong-Bolt® 2 (C-A-2021, p. 111)

Minimum edge distance is a function of concrete thickness but, not less than 4 inches.

Therefore, cannot be used for a sill plate application where the sill plate is at the edge of the concrete.

Wedge-type, Expansion Mechanical Anchor – Wedge-All®

Edge Distance Tension (f_c)

Edge Dist.	Size	¼	⅜	½	⅝
	c_{cr}	2½	3¾	5	6¼
c_{act} (in.)	c_{min}	1	1½	2	2½
	f_{cmin}	0.70	0.70	0.70	0.70
1		0.70			
1⅛		0.80	0.70		
2		0.90	0.77	0.70	
2½		1.00	0.83	0.75	0.70
3			0.90	0.80	0.74
3½			0.97	0.85	0.78
3¾			1.00	0.88	0.80
4				0.90	0.82
4½				0.95	0.86
5				1.00	0.90
5½					0.94
6					0.98
6¼					1.00
6½					
7					
7½					
8					
8½					
8¾					
10					
12½					
15					

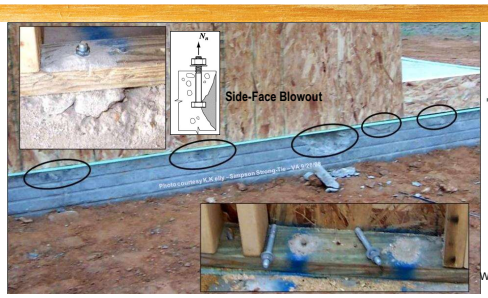
See footnotes below.

Non-IBC applications
Wedge-All® (C-A-2021, p. 131)

Minimum edge distance is 4D.
A ½" diameter anchor shall be no closer to the edge than 2 inches.

Contractor goes to the hardware store, buys a ½" wedge anchor for a 2x4 plate, what happens?

Wedge-type, Expansion Mechanical Anchor



½" wedge-type anchor is NOT permitted closer than 4D (WA) or 4" (½" STB2) to the edge of concrete.

Titen Heavy Duty High Strength, Threaded Concrete Screw Anchor

- **Code-listed in concrete (ICC-ES ESR-2713) for:**
  - **Cracked Concrete**
  - **Horizontal, Vertical and Overhead**
- **Code-listed in Grout-Filled CMU (ICC-ES ESR-1056)**
- **Head Stamp for Easy Length Identification**
- **Zinc-plated and Mechanically Galvanized to ASTM B695, class 65**
- **¼", ⅜", ½", ⅝" & ¾" sizes**

The following slide is a demonstration of a ¾" x 4" Titen HD with 3⅜" embedment. Demonstration, only. Failure could be typical of these tests performed during a SST workshop. p. 8

C-A-2021, pp. 78-91

Titen HD High Strength, Threaded Mechanical Anchor

- ✓ **New construction or to retrofit misplaced anchor bolts or misinstalled mudsill anchor straps.**
- ✓ **As a 1:1 replacement for equivalent diameter sill bolts in concrete,** unless conditions exist to cause the concrete to crack.

Titen HD Hex-Washer Head and Flat-Washer Head as 1:1 Replacement for Cast-in-Place Anchor Bolts

Detail	Anchor Bolt to Replace	Sill Plate Nominal Thickness	Titen HD Model[1]	Drill Bit Diameter (in.)	Min. Nominal Embed. Depth (in.)	Min. Edge Distance (in.)	Min. End Distance (in.)
1	½" diameter with 7" embedment	2x	THD50600H[4] or THD50600WH	½	4¼	1¾	6
		Double 2x, 3x	THD50800H[4] or THD50800WH	½	4¼	1¾	6
1	⅝" diameter with 7" embedment	2x, 3x	THDB62100H[5] or THDB62100WH[5]	⅝	7	1¾	9⅛

p. 8

T-A-SILPLANCH21, p. 2 (spacing)

CMU Foundation-to-Wall Failure

Titen HD High Strength, Threaded Mechanical Anchor

- ✓ **As a replacement for equivalent diameter sill bolts in GFCMU.**
- ✓ **New construction or to retrofit misplaced anchor bolts or misinstalled mudsill anchor straps.**

Prescriptive Spacing for Titen HD Hex-Washer Head and Flat-Washer Head to Replace Cast-in-Place Anchor Bolts in GFCMU and to Replace Cast-in-Place Anchor Bolts in Header Block

	Detail	Anchor Bolt to Replace	Titen HD Model[2]	Sill Plate Nominal Thickness	Drill Bit Diameter (in.)	Min. Nominal Embed. Depth (in.)	Min. Edge Distance (in.)	Min. End Distance (in.)	Min. Spacing (in.)	Titen HD Spacing to Replace ½" Anchor Bolts at 6'-0" o.c.
GFCMU	11[3]	½" diameter with 7" embedment	THDS0600HH[7] or THDS0600WH[8]	2x	⅝	4½	1¾	8	8	4'-8" o.c.[4]
			THDS0800H or THDS0800WH	3x						
	12[3]		THDS0800H or THDS0800WH	Double 2x						
Header Block	13[5]	½" diameter with 7" embedment	THDS0600H[7] or THDS0600WH[8]	2x	⅝	4½	1¾	NA	16	4'-0" o.c.[4]
			THDS0800H or THDS0800WH	3x						
	14[6]		THDS0800H or THDS0800WH	Double 2x						

p. 8

T-A-SILPLANCH21, p. 8 (spacing)

Shall be INSTALLED in Grout-Filled CMU, NOT Hollow CMU!

Concrete/CMU Screw Anchors

Can the zinc-plated, coated (blue) or THD Mechanically Galvanized screw anchors be used for outdoor applications such as a deck ledger attachment or for a post base anchor on an outdoor deck?

Hydrogen-Assisted Stress-Corrosion Cracking

Some hardened fasteners may experience premature failure if exposed to moisture as a result of hydrogen-assisted stress-corrosion cracking (HASCC). These fasteners are recommended specifically for use in dry, interior locations.

All concrete screw manufacturers code reports have the same recommendation.

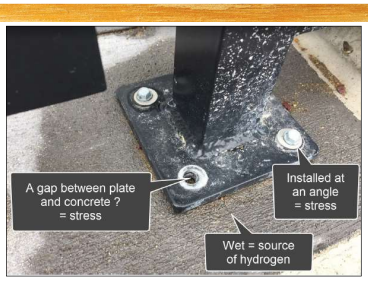
?

What's needed for HASCC failure?
Stress + Hydrogen + a Fastener that is Susceptible

C-A-2021, p. 261

Concrete/CMU Screw Anchor: Environmental Hydrogen Embrittlement

Zinc-plated or MG Concrete & Masonry Screws



Cast-in Place Anchor Bolt Corrosion

- ✓ **This is what was left of an anchor bolt in a corrosive environment.**

CAN be seen

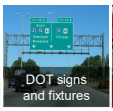
CANNOT be seen

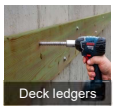
Concrete & Masonry Screw Anchors

The 304 and 316 stainless-steel Titen HD, screw anchor solution combines the corrosion resistance of stainless steel with the undercutting ability of heat-treated carbon steel.

Must be a designed solution as the effective embedment is less than the Titen HD Zinc Plated or Mechanically Galvanized.

- ➢ **⅜", ½", ⅝" & ¾" sizes**





THDSS 304 Stainless Steel

THDSS 316 Stainless Steel

C-A-2021, pp. 92-103

p. 8

The following video is about the 316 stainless steel Titen HD.

Screw Anchor vs. Wedge (Expansion) Anchor

VS.

Titen-HD
Screw-type anchor

Strong-Bolt 2
Wedge-type expansion anchor

Wedge Anchor

- ✓ Drill the hole.
- ✓ Clean the hole so the anchor doesn't bottom out.
- ✓ Hammer the anchor into the hole.
- ✓ Tighten to a specific torque with a torque wrench.

Titen HD Screw Anchor

- ✓ Drill the hole.
- ✓ Clean the hole so the anchor doesn't bottom out.
- ✓ Drive the anchor into the hole with an impact wrench.

Titen HD High Strength, Threaded Mechanical Anchor

- Higher load capacity and tested for vibration resistance
- Good for pumps and vibratory loads
- Less spacing and edge distance required than wedge anchors
  Can be installed 1¾" from the edge

Spacing and edge distance are critical with expansion anchors

The mechanical interlock of the THD allows a closer spacing and edge distance than wedge anchors

- Installs with 50% less torque requiring less installation time
- ½" anchor would be installed with a ½" carbide drill bit
  Minor diameter = ½" Therefore, no special drill bit is needed

Can You Solve this Problem Before it Happens?

Sill Plate Anchoring without Interference

Titen HD with a Washer Head
(THD…WH – ½" & ⅝)

C-A-2021, pp. 79-91
T-A-SILPLANCH21, pp. 2-3

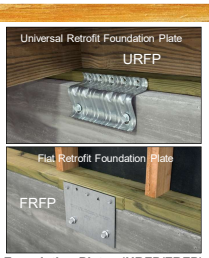
p. 8

Raise and Re-Connect

Can't Install the Titen HD?

Sill Plate Retrofits

Foundation-to-Joist or Stud Attachment Connectors
FJA FSA
Uplift loads



Foundation Plates (URFP/FRFP)
Parallel-to-Plate loads

C-C-2021, p. 24 (URFP), p. 25 (FJA, FSA)

p. 8

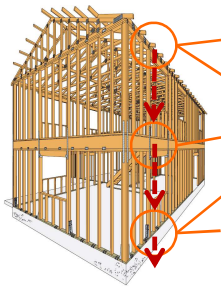
Sill Plate Anchor Questions?

Wall Framing

- **R301.2.1 Wind design criteria…A continuous load path shall be provided to transmit the applicable uplift forces in Section R802.11.1 from the roof assembly to the foundation.**
  In ALL wind zones.
- 1604.4 Analysis. …Any system or method of construction to be used shall be based on a rational analysis in accordance with well-established principles of mechanics. Such **analysis shall result in a system that provides a complete load path capable of transferring loads from their point of origin to the load resisting elements**…
- ~~**1604.8 ('06 '15)…Structural members, systems, components and cladding shall be designed to resist forces due to earthquake and wind with consideration of overturning, sliding and uplift. Continuous load paths shall be provided…**~~
- **1604.4 Every structure shall be designed to resist the effects caused by the forces specified in this chapter, including overturning, uplift and sliding.**

p. 9

Continuous Load Path – Connection Points



Roof-to-Top Plate Connection

Top Plate-to-Stud Connection

Floor-to-Floor Connection

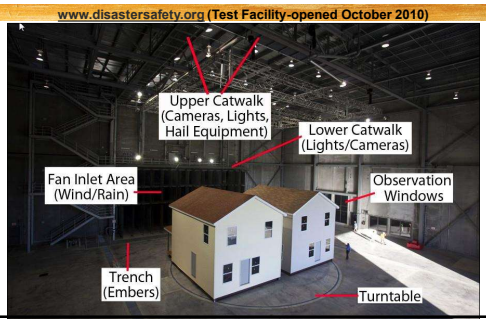
Stud-to-Sill Plate Connection

Sill Plate-to-Foundation Connection

p. 9

Institute for Business and Home Safety (IBHS)

www.disastersafety.org **(Test Facility-opened October 2010)**



Institute for Business and Home Safety (IBHS)

Whole House Wind Testing

p. 9

IBHS – "Fortified Home"

How much does it cost to strengthen a home for wind speeds up 135 mph?

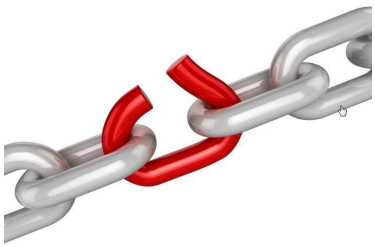
IBHS estimates – upgrades added $3,700 to their home.
- ✓ **Primarily upgrades are for roofing & siding materials.**
- ✓ **Structural hardware would add $500-$700.**

[1]To increase the wind uplift resistance from an EF0 to an EF2[2] would cost about $1,500[3] for a 2000 square foot home (75 cents/sq. ft.)

1. Building Codes: The Foundation to Resilience-Federal Alliance for Safe Homes, May 2014.
2. See SST technical bulletin – T-C-TORNADO
3. Increased from $1,000 to $1,500 for 2022 to account for product increase.

www.disastersafety.org

Load Path Follows the Chain-Link Theory – "Only as Strong as the Weakest Link"



Option 1: Chain the house down.

Braced Walls – Uplift Load Path

- R602.10.1.2.1 Braced wall panel uplift load path…connected in accordance with one of the following:
  1. Fastening with Table R602.3(1) *(basic fastening schedule)* where:
     1.1…wind ≤ 90 mph (≤ 115 mph), exp. B, pitch 5:12 or greater, roof span ≤ 32 feet…

  2. Where net uplift value at the top of a wall exceeds 100 plf, installing approved uplift framing connectors to provide a continuous load path from the top of the wall to the foundation or to a point where the net uplift force is 100 plf.

100 plf is exceeded at a 90/115 mph wind speed with pitch < 5:12, 32' roof span, Exposure B.

- IRC®: R602.10.1.2.1, R602.3.5

p. 10

Wall Framing – Continuous Load Path – Braced Walls

R602.3.5 #3. Wall sheathing and fasteners can be used to resist combined uplift and shear forces.

Is there a standard for using the Wood Structural Panel sheathing to resist combined uplift and lateral forces?

p. 10

WSP Sheathing for Combined Shear and Uplift from Wind

- R301.2.1.1 Wind Design criteria. … *(prescriptive)*
  - ✓ ICC 600-Standard for Residential Construction in High Wind Areas
  - ✓ AWC WFCM (Wood-Frame Construction Manual)
- 2305.1 … *(designed)*
  - ✓ AWC SDPWS (Special Design Provisions for Wind and Seismic)…

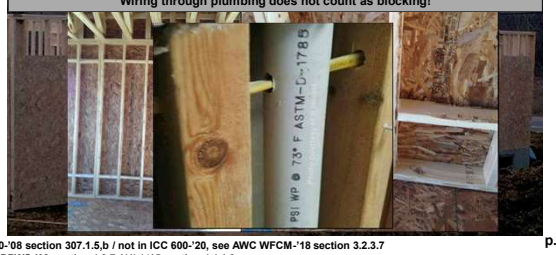
p. 10

WSP Sheathing for Combined Shear and Uplift from Wind

- All horizontal joints must occur over framing or blocking.

Wiring through plumbing does not count as blocking!

?



ICC 600-'08 section 307.1.5,b / not in ICC 600-'20, see AWC WFCM-'18 section 3.2.3.7
AWC SDPWS-'08 section 4.3.7.1(1) / '15 section 4.4.1.3

p. 11

WSP Sheathing for Combined Shear and Uplift from Wind

How does the load transfer from the rafter or truss into the wall system?

Eccentric Loading of Top Plates

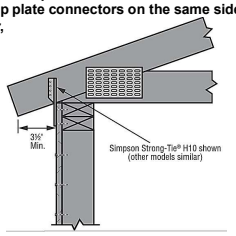
When roof-framing-to-top-plate connectors are installed on the inside of the wall opposite the sheathing, the eccentric load results in the top plate rotating and the system failing prematurely.

This is known as "top plate roll". ?

p. 11

WSP Sheathing for Combined Shear and Uplift from Wind

- Top plate rotation must be prevented.
  1. Install roof-to-top plate connectors on the same side of the wall as the sheathing or,

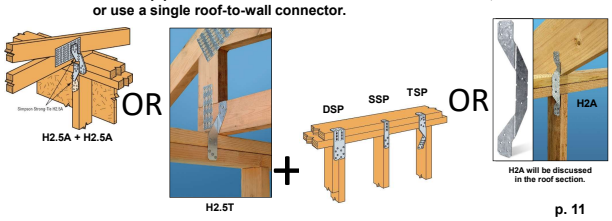


p. 11

ICC 600-'08 section 3.4.1 / not in ICC 600-'20, see AWC WFCM
AWC SDPWS-'08 / '15 section 4.4.1.5(2)

WSP Sheathing for Combined Shear and Uplift from Wind

- Top plate rotation must be prevented.
  2. If roof-to-top plate connectors are on the inside of the wall, install top plate-to-stud connectors on the inside of the wall, or use a single roof-to-wall connector.

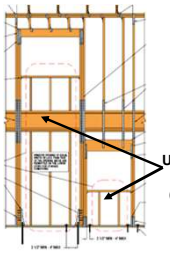


p. 11

C-C-2021, pp. 276-278 (H2,5A, H2.5T, H2A), pp. 280-282 (DSP, SSP, TSP)

WSP Sheathing for Combined Shear and Uplift from Wind

- Connectors are required at window and door openings. ?



p. 12

ICC 600-'08 section 307.1.5, e / not in ICC 600-'20, see AWC WFCM
AWC SDPWS-'08 / '15 section 4.4.1.4

WSP Sheathing for Combined Shear and Uplift from Wind

- Sill plate anchors shall be spaced a maximum 16"- 42"o.c.[1], Where anchor bolts are used, a minimum of a 0.229"x3"x3" square plate washers shall be installed on each anchor bolt location. ?

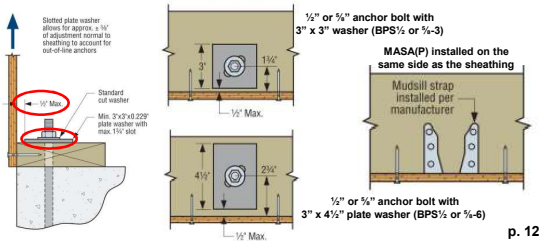
1. 2015 AWC-SDPWS (16"- 42"), previous versions anchor bolts shall be 16" o.c.

- Brittle failure of the sill plate can occur if the sill plate anchors are spaced too far apart and are not restrained with plate washers to prevent cross-grain bending.

ICC 600-'08 section 307.1, 307.1.5 / not in ICC 600-'20, see AWC WFCM Table 3.2B (½" max = 31", ⅝" max = 48")
SDPWS-'08 / '15 section 4.4.1.6

WSP Sheathing for Combined Shear and Uplift from Wind

- Washer must be within ½" of the edge on the sheathed side.



p. 12

C-C-2021, pp. 46-47 (BPS) / pp. 28-29 (MASA)

WSP Sheathing for Combined Shear and Uplift from Wind

- The building designer must choose nail size, spacing, etc…

Table 4.4.1 Nominal Uplift Capacity of 7/16" (Nominal) Minimum Wood Structural Panel Sheathing or Siding When Used for Both Shear Walls and Wind Uplift Simultaneously over Framing with a Specific Gravity of 0.42 or Greater [1]

	Nail Spacing Required for Shear Wall Design											
	6d Common Nail 6" panel edge spacing 12" field spacing			8d Common Nail 6" panel edge spacing 12" field spacing			8d Common Nail 4" panel edge spacing 12" field spacing			10d Common Nail 6" panel edge spacing 12" field spacing		
	Alternate Nail Spacing at Top and Bottom Plate Edges											
	6"	4"	3"	6"	4"	3"	6"	4"	3"	6"	4"	3"
	Uplift Capacity (plf) of Wood Structural Panel Sheathing or Siding [1,2]											
Nails-Single Row [3]	0	168	336	0	216	432	NA	0	216	0	262	524
Nails-Double Row [3]	336	672	1008	432	864	1296	216	648	1080	524	1048	1572

The standard 6 and 12 nailing, in a single row, provides no additional uplift. Nailing must decrease to 4" o.c. or nail a double row to provide uplift.

p. 12

ICC 600-'08, section 307.1, Table 307(1) / not in ICC 600-'20, see AWC WFCM Table 3.4B
AWC SDPWS-'08 / '15, Table 4.4.1

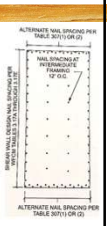
WSP Sheathing for Combined Shear and Uplift from Wind

- The building designer must choose nail size, spacing, etc…

TABLE 307(1)
UPLIFT CAPACITY OF WOOD STRUCTURAL PANEL SHEATHING OR SIDING WHEN USED FOR BOTH SHEARWALLS AND UPLIFT SIMULTANEOUSLY OVER GROUP III FRAMING[a,b,c]
(plf uplift on wall)

	NAIL SPACING REQUIRED FOR SHEARWALL DESIGN											
	6d @ 6" & 12"			8d @ 6" & 12"			8d @ 4" & 12"			10d @ 6" & 12"		
	ALTERNATE NAIL SPACING AT TOP AND BOTTOM PANEL EDGES[a,c]											
	6"	4"	3"	6"	4"	3"	6"	4"	3"	6"	4"	3"
	UPLIFT CAPACITY (psf) OF 15/32" WOOD STRUCTURAL PANEL SHEATHING OR SIDING											
Nails-Single Row[d]	0	94	189	0	118	237	NP	0	118	0	142	285
Nails-Double Row[d]	189	377	566	237	474	710	118	355	592	285	570	855

For SI: 1 inch = 25.4 mm, 1 pound per lineal foot = 14.59 N/m.
a. $\frac{7}{16}$ inch wood structural panels shall be permitted when supported by vertical framing at 16 inches on center.
b Anchor bolts shall be installed in accordance with this section.
c. For all Group II framing, divide uplift values listed in above table by 0.92.



The standard 6 and 12 nailing, in a single row, provides no uplift.

Nail spacing must decrease to 4" o.c. or nail a double row to provide uplift.

p. 12

ICC 600-'08, section 307.1, Table 307(1) / not in ICC 600-'20, see AWC WFCM Tables 3.4B, 3.17D
AWC SDPWS-'08 / '15, Table 4.4.1

Stud-to-Plate Connections

Top Plate to Stud	Stud to Bottom Plate
Transfer forces from the top of the wall to the wall stud.	Transfer forces from the wall stud to the bottom of the wall (sole plate or mudsill).

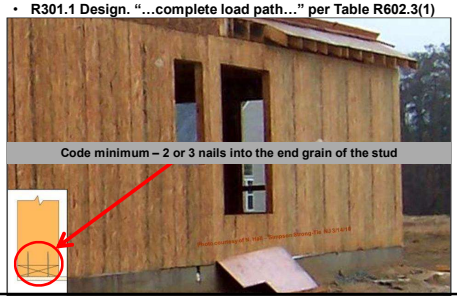
- IRC®: **Table R602.3(1)** Fastening Schedule Excerpt: Top or bottom plate to stud

4-8d box (21/2" × 0.113"); or 3-16d box (31/2" × 0.135"); or 4-8d common (21/2" × 0.131"); or 4-10d box (3" × 0.128"); or 4-3" × 0.131" nails	Toe nail
3-16d box (31/2" × 0.135"); or 2-16d common (31/2" × 0.162"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	End nail

p. 13

Stud-to-Plate Connection

- R301.1 Design. "…complete load path…" per Table R602.3(1)



Code minimum – 2 or 3 nails into the end grain of the stud

p. 13

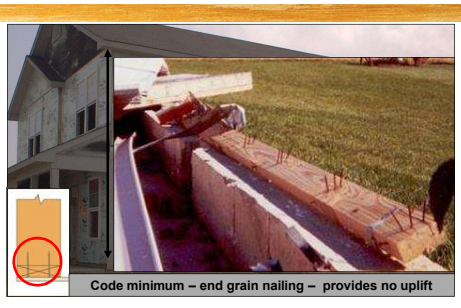
Stud-to-Plate Connection

Nails and spikes loaded in withdrawal from the end grain of the wood has been prohibited since the 1944 edition of the AWC NDS.

Even with structural sheathing, code minimum (end grain nailing) did not resist 70 mph winds in this wall failure.

p. 13

Stud-to-sill/sole plate – Is this a "Continuous" Load Path?



Code minimum – end grain nailing – provides no uplift

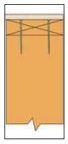
Stud-to-Plate Connection

Code minimum – Nails into the end grain of the stud (top and bottom)

"Complete Load Path"
Design & build per the IRC and you've deemed to "complete the load path"

Garage doors blow out, side wall then follows.

Top plates-to-Wall Connection – Is this a Continuous Load Path?



IRC minimum – end grain nailing

Top Plates-to-Stud Connector Problems

Top plate-to-stud connector problems:

Connector at the End of the Wall

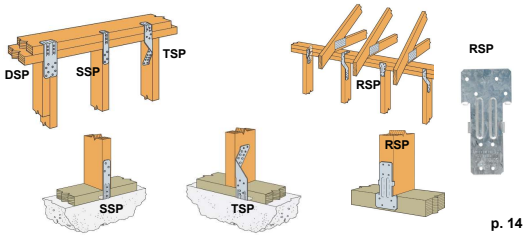
Unless otherwise noted, bending steel in the field may cause fractures at the bend line. Fractured steel may not carry load and must be replaced.

Connector Overlap

Options to make this work include using a different connector, like twist straps or installing a hurricane tie on the other side instead of on the left.

p. 13

Stud-to-Top or Bottom Plate(s) Connector Solutions



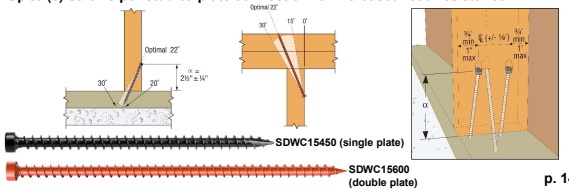
p. 14

C-C-2021, pp. 280-282

Stud-to-Top or Bottom Plate(s) Fastener Solution

Strong-Drive SDWC15450 or SDWC15600 – Structural Wood Screws for Stud-to-Plate

- **Can use the same fastener and installation guide as the roof to wall SDWC connections.**
- **Reduces confusion in the field for multiple types of connectors.**
- **Up to (3) screws per stud-to-plate connection for increased load resistance.**



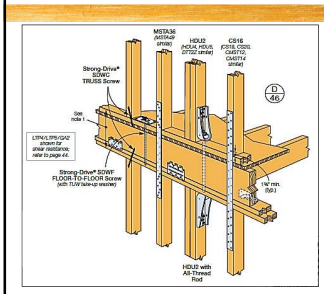
p. 14

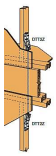
C-F-2019TECHSUP, pp. 54-55

Floor-to-Floor Connection

Floor-to-Floor Connection

Floor-to-Floor Connection





DTT2 tension ties

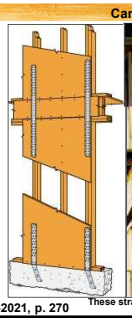
- As an alternative to coil strap.
- All work is done from inside.

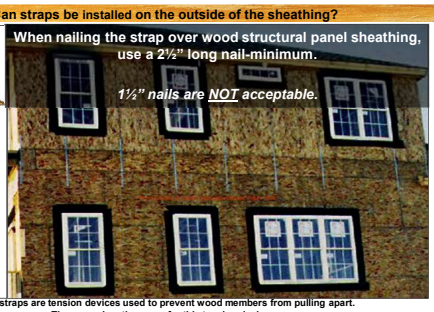
- The studs must line up for holdowns, coil strap, or pre-cut straps.
- For straps, use half of the required nails in each member being connected to achieve the listed load.

p. 14

Coil (CS) or Flat (MSTA) Strap Installation

Can straps be installed on the outside of the sheathing?





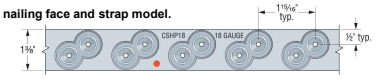
C-C-2021, p. 270

These straps are tension devices used to prevent wood members from pulling apart. There may be other uses for this tension device.

An Improved Coiled Strap

Coiled Strap – High-Performance (CSHP)

- Fastener feature results in fewer nails, shorter straps and lower installed cost.
- Designed to be installed with a standard framing nailer. Does not require a tool with a special nail hole locating mechanism.
- Easier for inspectors to verify.
  - Colored dots and stamp indicate nailing face and strap model.
  - CSHP18 — Color Dot in Orange
  - CSHP20 — Color Dot in Black



p. 15

C-C-2021, pp. 272-274

CSHP and CS Strap Load Comparison

- Achieves higher load value per nail due to the strap design.
- CSHP requires fewer nails with the same or better loads as CS;

Suggested Substitutions:

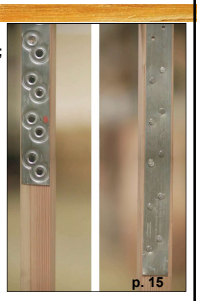
Model No.	Allowable Tension Loads (160) (lb.)
CS14	2,490
CS16	1,705
CS18*	1,370
CS20	1,030
CS22*	845

Model No.	Allowable Tension Loads (160) (lb.)
CSHP18	1,540
CSHP20	1,160

*CS18 and CS22 discontinued in 2019

(16) 0.131 x 2½" nails-DF – CSHP18 = 1,540
(18) 0.131 x 2½" nails-DF – CS18 = 1,370

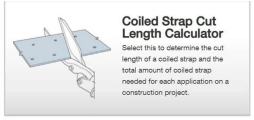
(12) 0.131 x 2½" nails-DF – CSHP20 = 1,160
(14) 0.131 x 2½" nails-DF – CS20 = 1,030

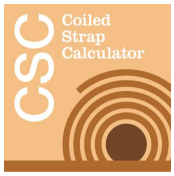


p. 15

Coiled Strap Apps – Coil Strap Calculator

There are two web applications available at **strongtie.com/webapps**

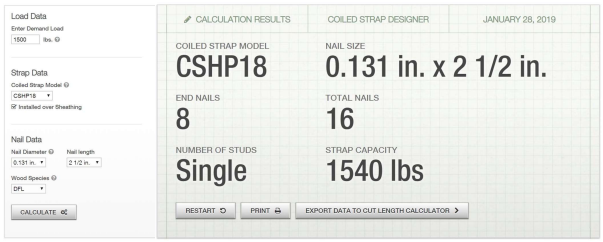




p. 15

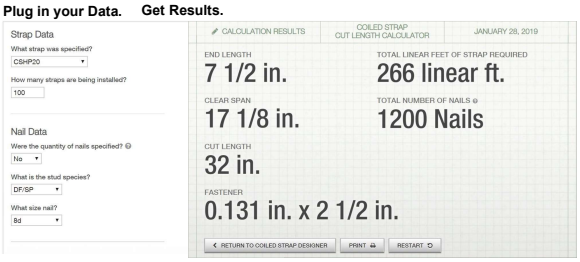
Coiled Strap Designer

Plug in your Data. **Get Results.**



Coiled Strap Cut Length Calculator

Plug in your Data. **Get Results.**



Common Problems with Strap Installation

Can be field modified.

Unaligned studs = strap chaos

p. 15

Common Problems with Strap Installation

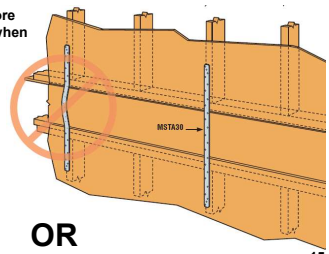
p. 15

Coil (CS) or Flat (MSTA) Strap Installation

Problem: All stud nails are filled before the roof is installed, straps bow out when shrinkage or compression occurs.

Solution #1: Fill the nail holes in the rim joist area to limit the bowing. ?

Solution #2: Fill the nail holes in the top stud before the roof is installed and then fill bottom stud nails after.

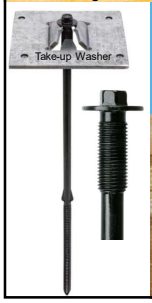


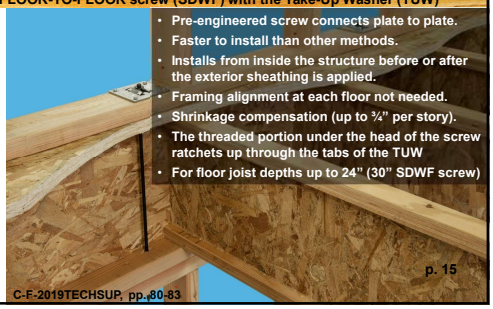
OR

p. 15

Solution #3: Floor-to-Floor Connection – Structural Screws

Strong-Drive FLOOR-TO-FLOOR screw (SDWF) with the Take-Up Washer (TUW)





- Pre-engineered screw connects plate to plate.
- Faster to install than other methods.
- Installs from inside the structure before or after the exterior sheathing is applied.
- Framing alignment at each floor not needed.
- Shrinkage compensation (up to ¾" per story).
- The threaded portion under the head of the screw ratchets up through the tabs of the TUW
- For floor joist depths up to 24" (30" SDWF screw)

p. 15

C-F-2019TECHSUP, pp. 80-83

Floor-to-Floor Connection – Structural Screws

Strong-Drive FLOOR-TO-FLOOR screw (SDWF) with the Take-Up Washer (TUW)

SDWF-TUW Floor-to-Floor Screw — On-Center Spacing for Uniform Uplift Loads

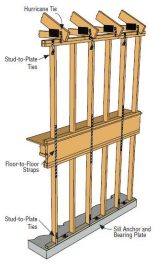
Maximum SDWF Screw Spacing (in.) Along Wall Bottom Plate for Wind Uplift											
Bottom Plate	Interstory Unit Wind Uplift, Lb. per Lineal Foot (plf)										
Single 2x4	100 plf	150 plf	200 plf	250 plf	300 plf	350 plf	400 plf	450 plf	500 plf	550 plf	600 plf
SP	46	40	36	34	30	28	26	24	24	22	22
DFL	48	42	38	34	32	30	30	26	24	22	20
SPF	46	40	36	34	32	30	26	22	20	18	16
Single 2x6	100 plf	150 plf	200 plf	250 plf	300 plf	350 plf	400 plf	450 plf	500 plf	550 plf	600 plf
SP	56	48	44	40	38	36	34	34	32	30	28
DFL	56	48	44	40	38	34	30	26	24	22	20
SPF	52	46	42	38	34	30	26	22	20	18	16

3. **Stud-to-plate connections are required to complete the load path (e.g. SDWC, RSP).**

C-F-2019TECHSUP, p. 81

Unmatched Variety of Wind Uplift Resisting Systems

Tried and True Connector Systems



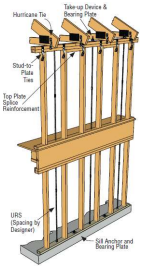
- Widely available
- Most code listed products with unmatched quality
- Lowest hardware cost
- Mis-installs created by incorrect fasteners, bending steel, overlap, & incorrect application
- Stud alignment with floor-to-floor straps required
- Higher labor cost
- Lack of a shrinkage/compression compensator

5 people plus the rental of an aerial lift.

p. 16

Unmatched Variety of Wind Uplift Resisting Systems

Strong-Rod™ Uplift Restraint Systems

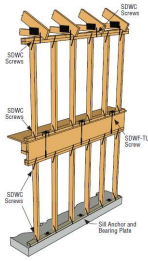


- High strength
- Ease of installation
- Available in 4 rod diameters
- Framing flexibility
- SST has a code listed rod system that has been evaluated based on wood framing limitations.
- Roof-to-wall connection is required
- The effects of wood shrinkage needs to be accounted for thereby requiring a take-up device
- When installed correctly, higher than expected material, design and labor cost
- Drilling through wood members
- Wood framing limitation may not always be considered.

p. 16

Unmatched Variety of Wind Uplift Resisting Systems

Strong-Drive® Fastening Systems (SDWF + SDWC)

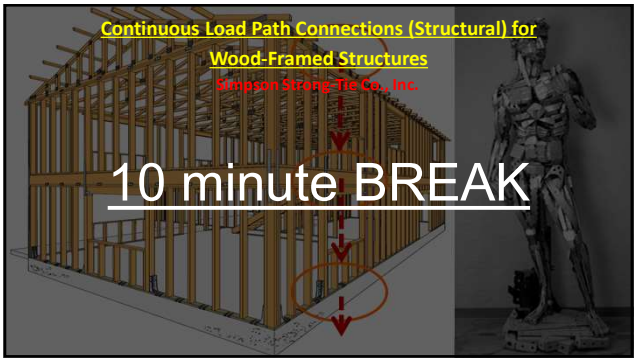


- Eliminates interference with finish materials
- Ease of installation, faster to install than other methods
- Floor-to-floor alignment is not critical
  - ✓ Framing flexibility
- Lowest installed cost
- All products are code listed
- All work is done from the inside
- Multiple screws per connection provides higher load resistance
- Shrinkage compression compensator
- Mis-installs created by edge distance, incorrect angle, offset from splice, & screw penetration
- Higher material cost than connectors
- Inspection is more difficult
- As a new system, it has the greatest learning curve

?

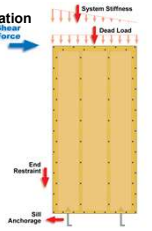
p. 16

Wall Framing



What is Wall Bracing?

IRC: R602.10 (see IBC 2308.6 – similar): a system of specially constructed wall segments attached to the roof, floor and foundation that resist lateral (horizontal) loads from wind and earthquakes.



…and why do we need it?

p. 17

Properly braced walls may have helped with the structure in the next video.

A Structures **Reactions** to Lateral Loads

Racking
When lateral forces engage the side of a structure, the load may cause it to lean over (rack) to one side.

Sliding
Lateral forces exerted against the side of a structure can also cause it to slide off of its foundation.

Overturning
When the structure is anchored in place to limit racking or sliding, the lateral force of wind or seismic loading causes the structure to rotate or overturn.

History of Wall Bracing

1927 – Uniform Building Code-12 words

Section 2205:
"All exterior walls and partitions shall be thoroughly and effectively angle braced."


BUILDING STANDARDS

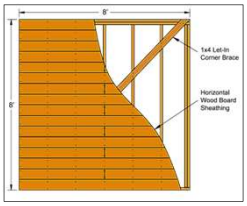
UNIFORM BUILDING CODE
1927 Edition

International Conference of Building Officials

History of Wall Bracing

1949 – FHA Technical Circular #12[1] (a temporary standard)

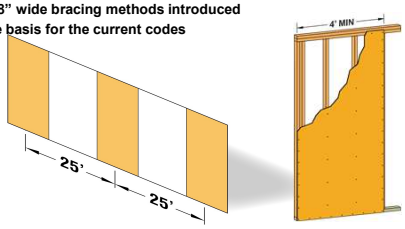
- Baseline using diagonally braced walls
- 5,200 pounds was established as the ultimate per 8' wall panel



History of Wall Bracing

1970 – Uniform Building Code

- Braced wall panels required at the ends of wall lines and spaced every 25'
- Multiple 48" wide bracing methods introduced
- This is the basis for the current codes



History of Wall Bracing

2009 IRC
- Complete re-write with consideration to historical performance and long standing customs.
- Authorized Building Officials to require bracing information on submittal documents.
- Separated wind and seismic bracing amount tables.

2012 IRC
- Simplified method was introduced.
- Clarifications and options for braced wall lines.

2015 IRC
- Change from basic wind speed to ultimate design wind speed.
- More clarifications and more options for mixing methods.

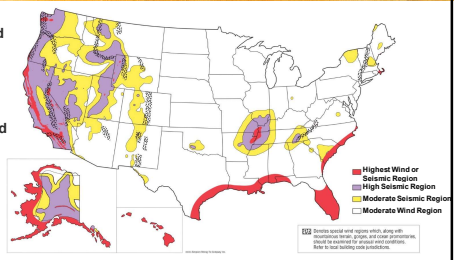
2018 & 2021 (33 pages) IRC
- Minor clarifications and modifications

Prescriptive-Wall Bracing vs. Engineered Design

Applies in prescriptive design markets governed by wind or low seismic.

Limits:

- ✓ 3 stories – max.
- ✓ Ult. Design Wind Speed < 140 mph
- ✓ SDC A-D_2
- ✓ Others-see Chap 3

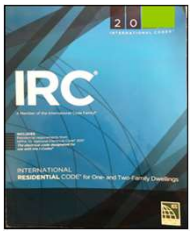


Overview of Steps for Designing Wall Bracing

Step One
Locate all Braced Wall Lines (BWL)

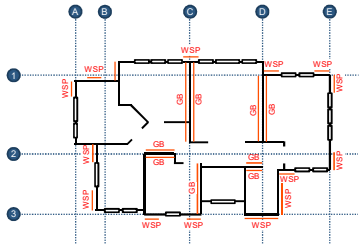
Step Two
Calculate the Required Length of Bracing for each BWL

Step Three
Locate qualifying Braced Wall Panels (BWP) in each BWL



p. 17

Bracing Information on Construction Documents



General Rules Applicable to Braced Wall Lines

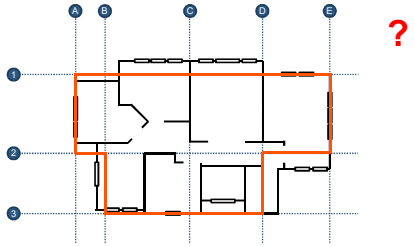
Rule 1
All exterior walls must be part of a braced wall line.

Rule 2
Braced wall lines are spaced a maximum of 60' o.c.

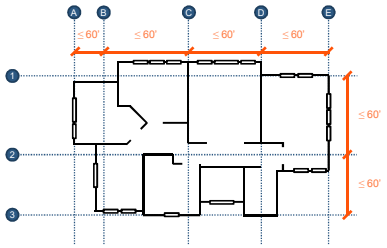
Rule 3
4' maximum braced wall panel offset from a designated braced wall line.

p. 17

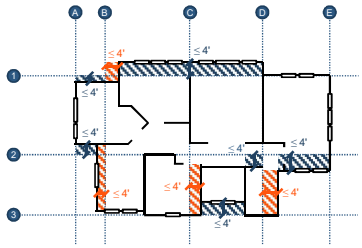
Rule 1: All Exterior Walls Must Be Part of a BWL



Rule 2: BWLs Are Spaced a Maximum of 60' o.c.

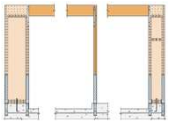


Rule 3: 4' Maximum Braced Wall Panel Offset



Types of Braced Wall Panels

INTERMITTENT	CONTINUOUSLY SHEATED	NARROW ALTERNATIVES



p. 17

Construction Methods: Intermittent Braced Wall Panels

Standard Construction Methods
for Intermittent Braced Wall Panels

LIB	**1x4 Let-in-Bracing**
DWB	**Diagonal Wood Boards**
WSP	**Wood Structural Panels**
BV-WSP	WSP with Veneer
SFB	Structural Fiberboard Sheathing
GB	**Gypsum Board**
PBS	Particleboard Sheathing
PCP	Portland Cement Plaster
HPS	Hardboard Panel Siding

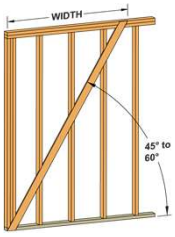
Intermittent Braced Wall Line

p. 17

Intermittent Method: Let-in-bracing

1x4 Let-In-Brace (LIB)
(or Approved Metal Strap Device)

- 45°-60° Angle
- **Wall Length > 4'-7"**
- Nailed to plates and studs
- ½" GB installed on one side with edge fasteners at 8" O.C.
- Top two stories only (wind)
- Seismic limitations
- Actual contributing length

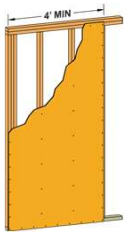


Braced Wall Panels – Diagonal Wood Boards (DWB)

Intermittent Method: Wood Structural Panel

Wood Structural Panels (WSP)

- 3/8" minimum plywood or OSB
- **Wall length = 4' minimum**
- 6" o.c. edge nailing
- 12" o.c. field nailing
- **Actual contributing length**



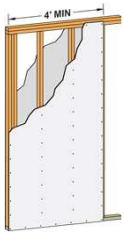
Intermittent Method: Gypsum Board

Gypsum Board: Double-Sided (GB)

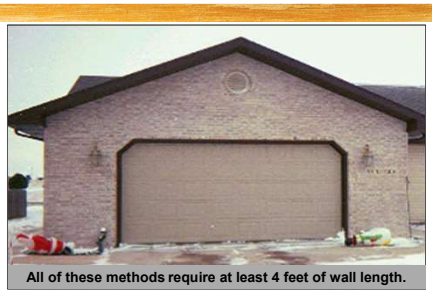
- **Wall length = 4' minimum**
- 7" o.c. edge and field nailing
- **Actual contributing length**

Gypsum Board: Single-Sided (GB)

- **Wall length = 4' minimum**
- 7" o.c. edge and field nailing
- **0.5x actual contributing length**



Braced Wall Panels



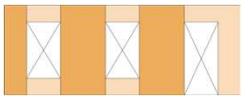
All of these methods require at least 4 feet of wall length.

Are there any alternatives if you don't have at least 4 feet?

Construction Methods: Continuously Sheathed Bracing

Standard Construction Methods
for Continuously Sheathed Braced Wall Panels

CS-WSP	**Continuously sheathed wood structural panel**
CS-PF	**Continuously sheathed portal frame**
CS-G	**Continuously sheathed garage**



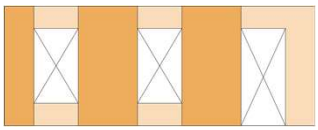
Continuously Sheathed Braced Wall Line

p. 17

Continuous Method: Sheathed Wood Structural Panel

Sheathed Wood Structural Panels (CS-WSP)

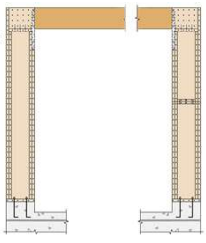
- 3/8" WSP sheathing (or ½" SFB)
- 6"/12" o.c. nailing (3"/6" for CS-SFB)
- Above and below all openings
- **4:1 maximum aspect ratio** (taller walls need wider panels)
- **Actual contributing length**



Continuous Method: Sheathed Portal Frame

Sheathed Portal Frames (CS-PF)

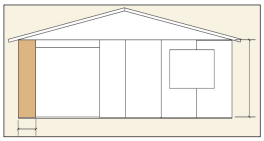
- Must be fully sheathed above and below openings and at gable ends
- 7/16" minimum sheathing thickness
- No holdowns required
- **Maximum aspect ratio of 6:1**
- May be used on any story and on elevated floors
- No more than four portal frames in a single wall line
- **Contributing length 1.5x actual**



Continuous Method: Sheathed Garage

Sheathed Panels Adjacent to Garage Openings (CS-G)

- **Supporting gable end wall or roof only**
- Adjacent to a garage opening with header
- 3/8" minimum CS-WSP



Wall Height	Min. Length
8-ft	24-in
9-ft	27-in
10-ft	30-in
11-ft	33-in
12-ft	36-in

Construction Methods: Narrow Alternatives

Standard Construction Methods
for Narrow Alternatives

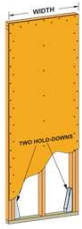
ABW	**Alternate Braced Wall** (R602.10.6.1)
PFH	**Portal Frame with Hold-Downs** (R602.10.6.2)
PFG	**Portal Frame at Garage Opening** (R602.10.6.3)
Covered under Continuously Sheathed methods but, also considered Narrow Alternatives: CS-PF	Continuous Sheathed Portal Frame (R602.10.6.4)
CS-G	Continuous Sheathed at Garage Opening (R602.10.4)

p. 17

Narrow Alternative: Alternate Braced Wall

Alternate Braced Wall (ABW)
Replace 4' BWP

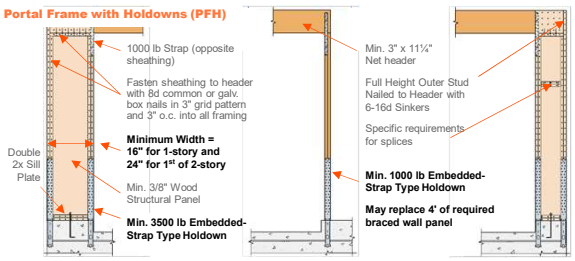
- **Used when there is not enough space to fit a 4' braced wall panel**
- **Minimum length = 28" with 8' tall wall**
- **Contributing length is 48"**
- Minimum thickness 3/8" WSP with 8d common nails
- 6" o.c. edge nailing (4" if first of two-story)
- 12" o.c. field nailing
- **2 tie-downs**
- 2 anchor bolts



Typical Garage Return Wall – 16", 18", and 21"

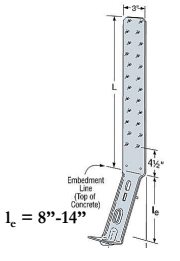
Narrow Alternative: Portal Frame with Holdowns

Portal Frame with Holdowns (PFH)



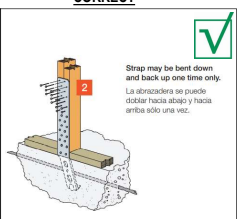
There's a chance the installation of the holdown may not be fully understood.

Embedded-Strap-Type Hold-Down

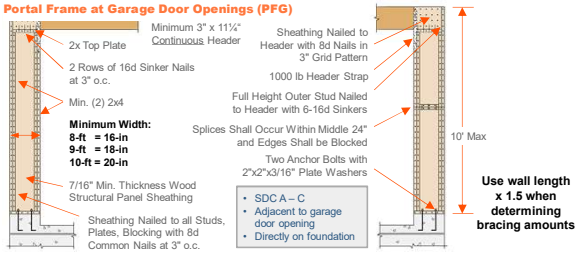


l_e = 8"-14"

Embedded-Strap-Type Hold-Down

INCORRECT	CORRECT
	
STHD has not been installed where it attaches to a stud. Installed into the house sheathing, only.	Install studs in locations where the STHD is located.

Narrow Alternative: Portal Frame at Garage Door Openings



Rules for Where to Place Braced Wall Panels

Rule 1

Use at least the minimum amount of bracing required with adjustment factors applied.

Rule 2

Do not exceed the maximum braced wall panel spacing requirement.

Rule 3

Place panels a maximum of 10' from each end of a braced wall line.

p. 17

Problem Areas

Evaluating Alternative Bracing Options

When IRC requirements cannot be satisfied with prescriptive methods: ?

Option 1

Design the home using the IBC.

Option 2

Use a pre-fabricated narrow shear wall.

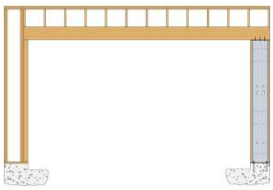
Option 3

Design a solution for the problem area.

p. 17

Pre-engineered Shear Wall Bracing

- Some manufacturers offer narrow pre-engineered shear wall alternatives
- Meet job specific requirements and provide the narrowest bracing solutions possible
- Allow for more openings in a structure
- Help streamline quality, consistency and performance
- Reduces design and labor time



Prefabricated Shearwalls – Strong-Wall® Shearwalls

- Narrow widths
- High capacity
- Tested as an assembly
- Code listed
- Quick and easy to install

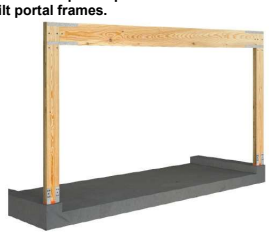
Steel Strong-Wall®

Strong-Wall® Wood Shearwall

Strong-Wall® Site-Built Portal Frame System (PFS)

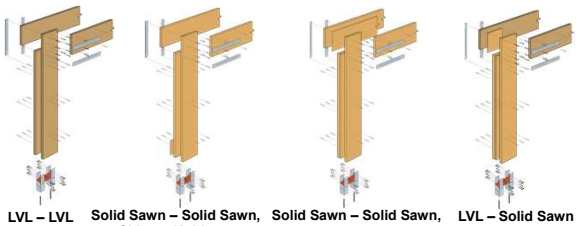
Provides designers, builders and contractors in prescriptive markets with a new alternative to traditional site-built portal frames.

- ✓ Narrow wall width – 10" or 12"
- ✓ Easy to assemble
- ✓ Maximize equivalent wall length
- ✓ Cost-effective



Strong-Wall® Site-Built Portal Frame System (PFS)

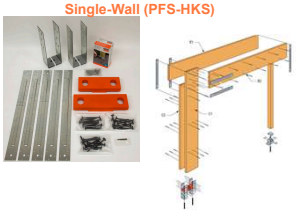
Framing Options;



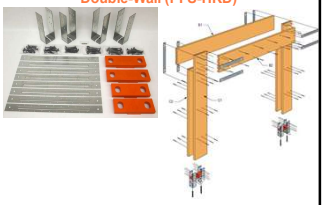
LVL – LVL | Solid Sawn – Solid Sawn, Shim at Holdown | Solid Sawn – Solid Sawn, Shim Throughout | LVL – Solid Sawn

Strong-Wall® Site-Built Portal Frame System (PFS)

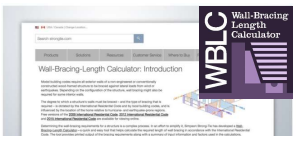
Site-Built Portal Frame System
Single-Wall (PFS-HKS)



Site-Built Portal Frame System
Double-Wall (PFS-HKD)



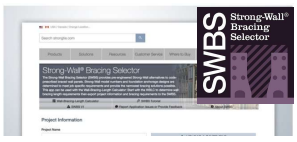
Free Design Software



Wall-Bracing Length Calculator

Helps navigate IRC wall-bracing requirements.

- **Calculates the required length of wall bracing to resist the prescriptive lateral loads in accordance with the IRC.**
- **Includes all adjustment factors for both wind and seismic loading.**



Strong-Wall Bracing Selector

Helps choose a wall-bracing replacement where code-defined bracing methods are not adequate.

- **Identifies prescriptive and pre-engineered solutions to site-built shear-walls, allowing designers to quickly select space efficient panels.**

p. 17

Additional Wall Bracing Course Credit Offerings

Course Name	CEUs
Wall Bracing for Wind-2015 IRC (1 hour)	0.1
Wall Bracing workshop-2015 IRC, Wind (4 hours)	0.4
Wall Bracing by the Book (3 hours)	0.3
Shear Walls and Lateral Bracing in Light Frame Construction (1 hour)	0.1

Visit

strongtie.com/workshops

for more information

Questions

What's the Difference Between a Braced Wall Panel and Shear Wall?

Braced walls and shear walls each serve the same purpose in the lateral load path. Both provide racking resistance to lateral loads.

Wall bracing comes from the prescriptive building code. Very few calculations are needed. From the designer's and builder's perspective, there is no "engineering".

Shear walls are used in portions of structures that do not meet the prescriptive limits and conventional construction parameters of the IRC.
Shear walls are designed or "engineered" by a design professional.
Shear walls usually require manufactured holdowns to resist overturning.
They are generally associated with the design provisions of the IBC.

Resource: **APA & ICC, A Guide to the 2015 IRC© Wood Wall Bracing Provisions**

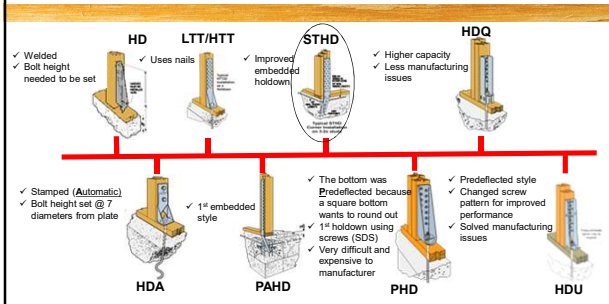
p. 18

Lateral Resisting System Requirements

- **1604.4** Analysis. ~~**…Every structure shall be designed to resist the overturning effects caused by the lateral forces…**~~
  …Every structure shall be designed to resist the effects caused by the forces specified in this chapter, including overturning, uplift and sliding.

p. 18

Evolution of Holdowns



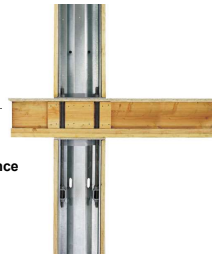
Cast-in Place Holdown – STHD

- ✓ **Shake table test video – Akashi, Japan.**
- ✓ **2 identical wooden homes built to the 1981 Japanese Building Code.**
- ✓ **Difference – one has about $200 of hardware to prevent overturning and sliding.**

Site-Built vs. Pre-Fabricated Shearwall

Site-Built Shear Walls
- Most common lateral resisting system for light-framed structures
- Usually the most economical solution

Pre-Fabricated Shear Walls
- Allows for more openings in a structure
- Helps streamline quality, consistency and performance
- Reduces design and labor time



Site-Built Shear Walls – Pros and Cons

Pros	Cons
• Uses typical framing materials	• 3½:1 maximum aspect ratio
• Simple to modify load capacity by adjusting the nail pattern and sheathing thickness	• Variation in construction quality may lead to inconsistent performance
• Usually most cost-effective solution	• Calculations can be tedious and time-consuming without software
• Use up to six stories	

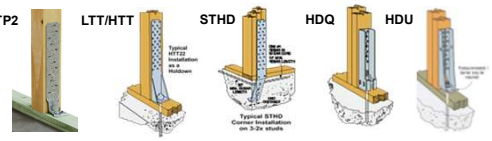
Resource: Site-Built Shearwall Designer

p. 18

- IBC: 2305.1 Refer to AF&PA/AWC SDPWS
- Table 4.3.3 (4.3.4-'15) – AWC-SDPWS Special Design Provisions for Wind & Seismic (Max. Shear Wall Aspect Ratios)

Holdowns for Site-Built Shearwalls

LTTP2 LTT/HTT STHD HDQ HDU



Resource: Holdown Selector

p. 18

C-C-2021, pp. 50-60

Issues with Bolted Holdowns – What's Wrong?

Wood Construction Connector catalog, General Notes, note h:
All references to bolts or machine bolts (MB's) are for structural quality through bolts *(not lag screws or carriage bolts)…*

?

Holdowns for Site-Built Shearwalls

- Post-Installed Holdown Solution (HDU)
  - Attaches with SDS screws-supplied with holdown
  - Easier to install than bolts
  - Saves time – no bolt takeoff (no stud bolts)
  - Uses fewer fasteners than previous screw-installed holdowns, results in lower installed cost
  - Wood member retains capacity because no material is removed for the fasteners
- One family of holdowns – Consistent product recognition for the framer

p. 18

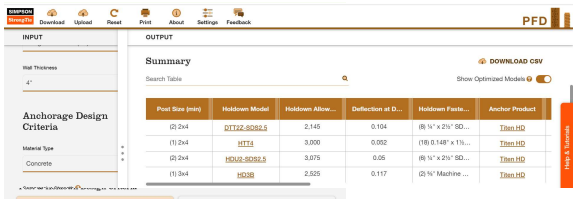
C-C-2021, pp. 50-60

Holdown and Anchorage Solutions

Resource: Post-to-Foundation Designer

Designs holdowns and anchors that resist uplift loads per the latest building codes.

- Input design criteria • Select anchorage • See results



Cast-in Place Anchorage with Holdowns

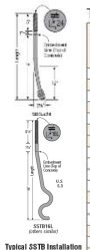


Table 2 — Anchorage Selection Guide for Holdowns Attached to SPF/HF Lumber

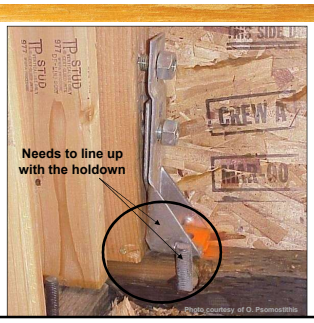
Holdown on SPF/HF Lumber	Stemwall						Slab on Grade			
	Stemwall Width (in.)	Wind and Seismic Design Category A&B		Seismic Design Category C–F			Wind and Seismic Design Category A&B		Seismic Design Category C–F	
		Midwall/Corner	End Wall	Midwall/Corner	End Wall		Midwall/Corner	Garage Curb	Midwall/Corner	Garage Curb
HDU2	6	SSTB16		SSTB16			SSTB16		SSTB16	
HDU4	6	SSTB16		SSTB24			SSTB16		SSTB16	SSTB24
HDU5	6	SSTB24* (4,295)		SBS/BX24			SSTB16	SSTB24* (4,295)	SSTB20	SBS/BX24
HDU8	8	SSTB28		SSTB28	SSTB28* (6,395)		SSTB28		SSTB28	SSTB28
HDQ8	8	SSTB28		SSTB28	SSTB28* (6,395)		SSTB28		SSTB28	SSTB28
HDU11	8	S81X30* (9,505)	PAB8	PAB8	PAB8		S81x30		S81x30	
HHDQ11	8	S81X30	PAB8	PAB8						
HDU14	—	PAB8		PAB8			S81x30		S81x30	
HHDQ14	—									
LTTP2	6	SSTB16		SSTB16			SSTB16		SSTB16	
LTTI31	6									
HTT4	6	SSTB20		SBS/BX24			SSTB16	SSTB20	SSTB16* (3,780)	SBS/BX24
HTT5	6	SBS/BX24		SBS/BX24			SSTB20	SBS/BX24	SSTB24	SBS/BX24
HD3B	6	SSTB16		SSTB24			SSTB16		SSTB16	SSTB20* (2,960)
HD5B	6	SSTB24		SBS/BX24			SSTB16	SSTB24	SBS/BX24	
HD7B	8	SSTB28		SSTB28			SSTB28		SSTB28	
HD9B	8	SSTB28* (8,360)	PAB7	PAB7			SSTB28* (8,360)	PAB7	SSTB28	PAB7
HD12	—	PAB8		PAB8			S81x30		S81x30	

Typical SSTB Installation in Concrete Foundation

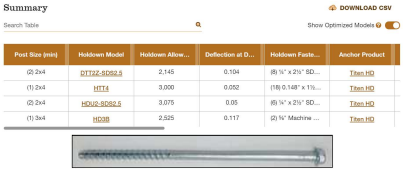
C-C-2021, p. 44

p. 19

Issues with Cast-in Place Anchorage



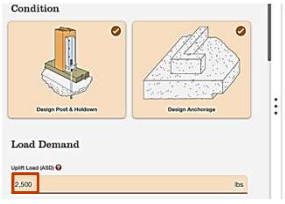
Post-Installed Mechanical Anchor – Titen HD

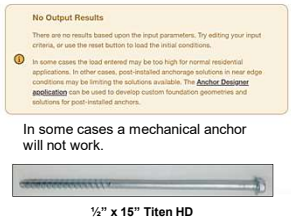


½" x 15" Titen HD

p. 19

Post-Installed Mechanical Anchor – Titen HD



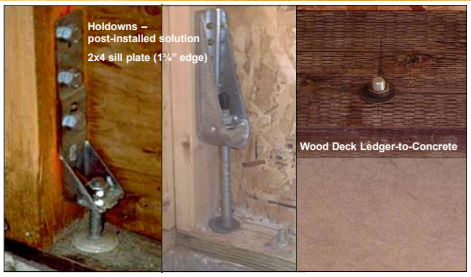


In some cases a mechanical anchor will not work.

½" x 15" Titen HD

p. 19

Structural Adhesives – Post-Installed Anchorage
AT-XP®, SET-3G™ & SET-XP®



AT-XP® , SET-3G™ & SET-XP® Adhesive

Close-to-Edge Conditions

AT-XP Installation Information and Additional Data for Threaded Rod and Rebar[1]

Characteristic		Symbol	Units	Nominal Anchor Diameter d_a (in.) / Rebar Size							
				⅜ / #3	½ / #4	⅝ / #5	¾ / #6	⅞ / #7	1 / #8	1¼ / #10
Installation Information										
Drill Bit Diameter for Threaded Rod		d_{bolt}	in.	7/16	9/16	11/16	13/16	1	1⅛	1⅜
Drill Bit Diameter for Rebar		d_{bolt}	in.	½	⅝	¾	⅞	1	1⅛	1⅜
Maximum Tightening Torque		T_{inst}	ft.-lb.	10	20	30	45	60	80	125
Permitted Embedment Depth Range[2]	Minimum	h_{ef}	in.	2⅛	2¾	3⅛	3½	3¾	4	5
	Maximum	h_{ef}	in.	7½	10	12½	15	17½	20	25
Minimum Concrete Thickness		h_{min}	in.	h_{ef} + 1¼		h_{ef} + $2d_{hole}$				
Critical Edge Distance[2]		c_{ac}	in.	See foonote 2						
Minimum Edge Distance		c_{min}	in.	1¾						2⅝
Minimum Anchor Spacing		s_{min}	in.	3						6

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 and ACI 318-11.

C-A-2021, p. 55

General Instruction for the Designer

- **Note l. Mechanical anchors should not be installed into concrete that is less than 7 days old.**
- **Note q. ACI 318 states that adhesive anchors should not be installed into concrete that is less than 21 days old.**
  (Referenced in ACI 318-11 which came into the 2012 codes)

?

Installation into Green Concrete (less than 21 days old)

Products	Concrete Age When Installed	Concrete Age When Loaded	Bond Strength Factor
SET-3G SET-XP AT-XP ET-HP	14 days	21 days	1.0
		14 days	0.9
	7 days	21 days	1.0
		7 days	0.7

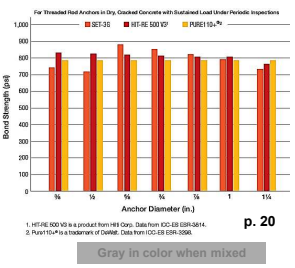
p. 19

C-A-2021, p. 16, 264

SET-3G® High Strength, Epoxy Anchoring Adhesive

- **Tested to ICC-ES AC308**
- ***Highest bond strength available from SST***
- **Code-listed (ICC-ES ESR-4057) in concrete**
  - **Cracked concrete**
  - **Dry, Water-Saturated, Water-Filled or Submerged (underwater) holes**
  - **NSF/Standard 61 Certification**
    - (Drinking Water System Component
- **Suitable for the SpeedClean™ system**
- ***40°F minimum base-material temperature***

RFB#5x8HDG
RFB#4x7HDG



1. HIT-RE 500 V3 is a product from Hilti Corp. Data from ICC-ES ESR-3814.
2. Pure110+ is a trademark of DeWalt. Data from ICC-ES ESR-3298.

p. 20

Gray in color when mixed

C-A-2021, p. 22

When would you NOT use an epoxy-type product?

Side-by-side cartridges require a special tool

- ✓ **Cracked concrete**
- ✓ **Highest performance**
- ✓ **40°F minimum base material temperature**

- ✓ **Cracked concrete**
- ✓ ***Hollow and Grout-Filled CMU***
- ✓ **50°F minimum base material temperature**

- ✓ **Cracked concrete**
- ✓ **Hollow and Grout-Filled CMU**
- ✓ ***URM***
- ✓ **50°F minimum base material temperature**

p. 20

When would you NOT use an epoxy-type product?

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- ✓ **50°F minimum base material temperature**

- ✓ **Cracked concrete**
- ✓ **Hollow and Grout-Filled CMU**
- ✓ ***URM***
- ✓ **50°F minimum base material temperature**

- ✓ **Cracked concrete**
- ✓ **Hollow and Grout-Filled CMU**
- ✓ **¾" ATR, #5 & #6 rebar in URM**
- ✓ **Minimum base material temperature (0°F)**

SET-3G™, ET-HP™, SET-XP® Cure Schedule

SET-3G™

Concrete Temperature		Gel Time	Cure Time
(°F)	(°C)	(min.)	(hr.)
40	4	120	192
50	10	75	72
60	16	50	48
70	21	35	24
90	32	25	24
100	38	15	24

For SI: 1°F = (°C x 9/5) + 32.
1. For water-saturated concrete and water-filled holes, the cure times should be doubled.
2. For installation of anchors in concrete where the temperature is below 70°F (21°C), the adhesive must be conditioned to a minimum temperature of 70°F (21°C).

ET-HP™, SET-XP®

Base Material Temperature		Gel Time (minutes)	Cure Time[1] (hrs.)
°F	°C		
50	10	45	72
60	16	30	24
80	27	20	24
100	38	15	24

1. For water-saturated concrete, the cure times must be doubled.

Effects of Cold Temperatures

- **The reactants need to go through an energy barrier for a reaction.**
- **When the temperature is too low (<40° or <50°), the reactants do not have a high enough energy to create a reaction (go over the barrier).**

?

p. 20

Test for concrete temperature – drill hole, put water in hole, let normalize, and measure temperature.

C-A-2021, p. 23 (SET-3G), p. 31 (SET-XP), p. 45 (ET-HP)

Acrylic-Tie® High Strength Anchoring Adhesive

Base Material Temperature °F	Base Material Temperature °C	Cure Time (hrs.)
14	-10	24
32	0	8
50	10	3
68	20	1
86	30	30 min.
100	38	20 min.

For water-saturated concrete, the cure times must be doubled.

- ✓ Cracked concrete
- ✓ Hollow and Grout-Filled CMU
- ✓ ¾" ATR, #5 & #6 rebar in URM
- ✓ 12 month shelf life – (AT-XP13, AT-XP30)
- ✓ 18 month shelf life – (AT-XP10)
- ✓ Minimum base material temperature (0°F)

AT-XP Cure Schedule

Concrete Temperature Range °F	Concrete Temperature Range °C	Gel Time (minutes)	Cure Time (hrs.)
0 to 14	-18 to -10	30	24

- ✓ No reduction
- ✓ C-A-2021, p. 267

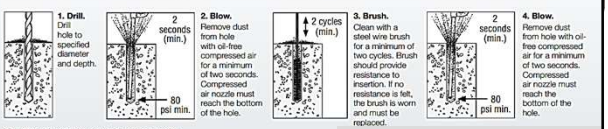
Includes one nozzle

C-A-2021, p. 55

Epoxy	Acrylic
Longer gel times & longer cure times	Shorter gel times and shorter cure times
Long shelf life (2 years)	Shorter shelf life (1 Year)
High storage temperature	Low storage temperature (14°F) High-end storage temperature is capped at 80°F (product quality may be compromised when storage temperatures exceed 80°F)
Good damp-hole performance	Reduced damp-hole performance
Higher bond strengths	Bond strengths are usually lower
Low temperature is restricted to 40°F	Low temperature installations (14°F/0°F)
Difficult to dispense at temperatures < 60°F	Good pump-ability at low temperatures
Reduced performance at elevated temperatures	Very good performance at elevated temperature
Adhesive does not shrink, allowing it to be used in oversized holes	More of a gel consistency, making the use in horizontal and overhead applications easier

≠

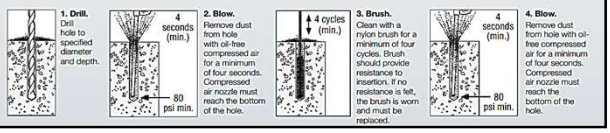
1A Hole Preparation — Horizontal, Vertical and Overhead Applications (SET-3G™ for anchor installation)



Visit **strongtie.com** for proper brush part number.

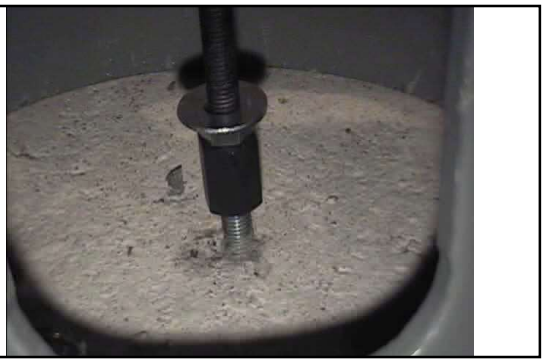
C-A-2021, p. 64

Hole Preparation — Horizontal, Vertical and Overhead Applic
(SET-XP®, AT-XP®, ET-HP®) and (SET-3G only for post-installed r



The following slide is a demonstration of a properly prepared hole using Acrylic-Tie adhesive.

Demonstration, only. Failure could be typical of these tests performed during a SST workshop.



Proper Installation – Structural Adhesives

- ➢ Adhesives must be installed through the proper mixing nozzle.

- ➢ Holes must be cleaned with the proper nylon or wire brush or SpeedClean DXS system.

Failure to follow hole cleaning directions could result in premature failure.

The following demonstration is for an IMPROPERLY prepared hole using AT.

Anchor Designer™ Software

Given the complexity of strength design calculations, designers may find Simpson Strong-Tie® Anchor Designer™ software to be a great time saver for computing anchor design strengths using the tabulated design data.

Project Files
- Create default user settings
- Save individual design files

Help Features
- Help file and popups provide insight and code references

Load Wizard
- Enter service loads, software calculates factored loads

Output
- Save detailed calculation packages in PDF format

AD Anchor Designer™

Free Download
www.strongtie.com

p. 20

C-A-2021, p. 19

Pre-Fabricated Shearwalls – Pros and Cons

Pros	Cons
• Reduces design and labor time • Fully tested • Validated performance • Hardware is pre-attached • Predesigned anchorage solutions and templates available	• Overall cost is higher for most applications • Limited to two story stacked applications

When To Use Pre-Fabricated Shearwalls

When you need sheathing and holdowns pre-attached or can't meet the minimum aspect ratio requirements with site-built shearwalls ?

When increased productivity is necessary to finish the job on time

When your structure contains multiple large openings

When a client specifies a code-listed ready-made shear wall that conforms to ICC-ES Acceptance Criteria

Simpson Strong-Tie® Factory Built Shearwalls

Steel Strong-Wall(SSW)
- ✓ Code listed – ICC-ES ESR-1679
- ✓ Loads 2-3 times the original wood Strong-Wall
- ✓ Fastest installation time
- ✓ Widths as narrow as 12"
- ✓ Maximum width = 24"
- ✓ Height: 6'8"-to-12'9¼"
- ✓ Ideal for standard installations, shearwall on a wood floor and 2-story stacked applications

Wood Strong-Wall (WSW)
- ✓ Code listed – ICC-ES ESR-2652
- ✓ Field trim-able for custom applications and rake walls.
- ✓ Width: 12⅛", 18", and 24"
- ✓ Height: 6'-2½"-to-20'-0"
- ✓ Ideal for garage front and balloon framing

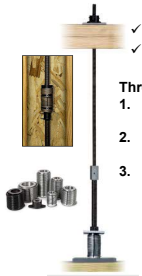
SWSS Strong-Wall® Shearwall Selector

Resource: Strong-Wall® Shearwall Selector

p. 20

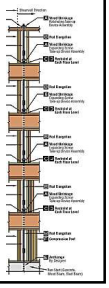
Strong-Rod™ ATS Systems Assemblies

Anchor Tiedown Systems (ATS) with Take-Up Devices (TUD)



- ✓ High capacity, multi-story shearwall tie-down system
- ✓ Code listed ICC-ES ESR-2320 (Take-Up devices)

Three Methods for Specifying;
1. We partner with the design engineer during the design phase.
2. Use the Strong-Rod™ ATS design guide to specify run ID callouts.
3. The designer provides general specifications and loads on construction documents. The contractor submits deferred design calculations and shop drawings.



Questions

Continuous Load Path Connections (Structural) for Wood-Framed Structures

Simpson Strong-Tie Co., Inc.

10 minute BREAK

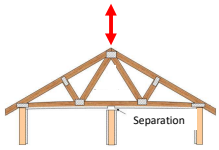
Continuous Load Path Connections (Structural) for Wood-Framed Structures

Simpson Strong-Tie Co., Inc.

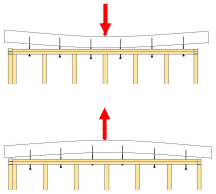
LUNCH BREAK

Roof & Floor Deflection

Roof Systems deflect up and down with atmospheric changes, wind, snow, etc.



Floors deflect up and down with loading conditions (heavy objects and live loads)



p. 21

Roof & Floor Deflection

Current Practice – Slotted Clips

Single Slotted Truss Clip (STC)

Double Slotted Truss Clip (DTC)

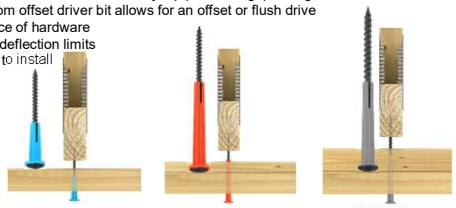
1. Frequently nails are installed tight not allowing the nails to slide in the clip.
2. Problems occur with I-joists.
3. Requires a ladder for installation.
   - Simpson does not recommend STC or DTC for floor systems.

Slotted Truss Clip Installation

3:55 to install 10 slotted clips

An Alternative – A Deflector Screw (SDPW)

- A simpler solution for roof and floor systems
- 3 screw sizes to address many top plate and gap configurations
- Custom offset driver bit allows for an offset or flush drive
- 1 piece of hardware
- High deflection limits
- Easy to install



3.5" SDPW screw *Single Top Plate*

5" SDPW screw *Built-up Top Plates*

6" SDPW screw *Double Top Plates*

p. 21

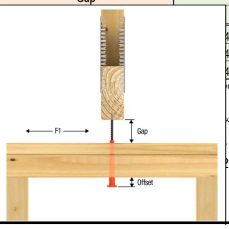
Deflector Screw (SDPW) – Spacing

TABLE 3. Maximum SDPW DEFLECTOR Screw Spacing for 8-ft and 10-ft Tall Residential Walls

Model No.	Top Plate	On-Center Spacing (in.)		
		Offset = 0" Gap	Offset = 3/4" Gap	
			1/2"	3/4"	1 1/2"
SDPW14312	2x		48 / 48	NA	NA
SDPW14500	2x +3/4" WSP		48 / 48	48 / 42	24 / 18
SDPW19600	(2) 2x		48 / 48	48 / 48	42 / 36

1. Spacings are maximums (inches
durations, adjust loads and spacin
2. In each cell: spacing (in.) for 8' ta
3. Cells with "NA" represent condit
4. Spacing for wall heights between
5. Spacing for other loads and wall

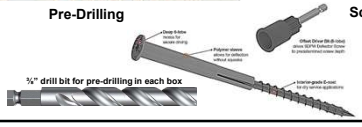
n (Cᴅ=1.6) allowable loads. For other



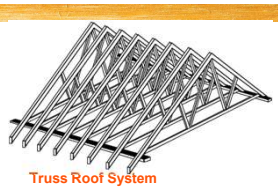
SDPW Deflector Screw Installation

2:06 to install 10 SDPW deflector screws

Pre-Drilling **Screw Driving**

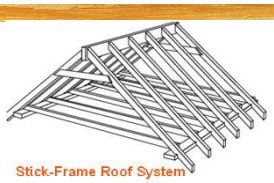


Roof Construction Methods



Truss Roof System

- Engineered building component designed for a specific project.
- Quick installation.
- Consistent quality control.
- Important to follow bracing guidelines.

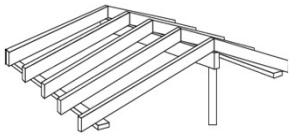


Stick-Frame Roof System

- Work is completed from lumber on site to prescriptive requirements.
- Note: Collar ties in upper third.
- Can be easier to get complex shapes.
- Space within the structure can be used for storage or living.

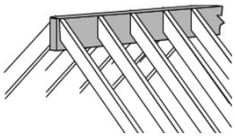
p. 21

Ridge Beam vs. Ridge Board



Ridge Beam

- Structural member: supports the weight of the rafters.
- Must be specifically designed for the project.
- Requires bearing at each end.



Ridge Board

- Held up by rafters.
- Does not support the weight of rafters, force is from the opposing rafters.
- Can be a 1-by since it's non-structural.

p. 21

Roof Framing – Ridge Beams

- R802.6. …The ends of rafter or ceiling joists shall have not less than 1½" of bearing on wood or metal… *(applies to rafters attached to ridge beams)*.
- R802.3 & R802.4.4 …Where the roof pitch is less than 3:12, structural members that support rafters and ceiling joists, such as ridge beams, hips, valleys, shall be designed as beams… *(1½" bearing is required)*.

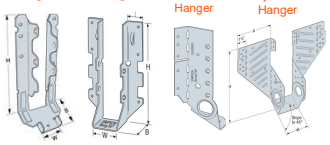
- **IRC®: R802.6, R802.3 & R802.4.4**
- **IBC®: 2308.7 / 2308.7.1, 2308.10.4.1**

p. 22

Roof Framing Bearing

R802.6 – An engineered solutions such as hangers, are needed when there is less than 1½" bearing on wood.

Slope-able Hanger | Flat Bottom Hanger | Skewed Adjustable Hanger | Heavy Adjustable Hanger



Evolution of Field Adjustable Sloped/Skewed Hangers

LSU / LSSU | LSSUI | Not always understood how to install

DISCONTINUED IN 2021

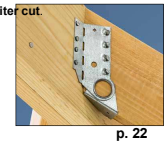
LSSJ (replaces LSU/LSSU) Field-Adjustable Jack Hanger

Feature	Benefit
Swivel seat	Easily adjusts to all typical rafter slopes
Retrofittable	Can be installed after jack rafters are in place.
Fasteners install on open side only	Easy nailing surface
Seat grip	Temporary support, frees up a hand
Split header flange	Easier to bend two smaller flanges
Nail pattern – highest nail reaches high on support member	Helps spread the load across the height of the carrying member (reduces local stress)
Installs with common nails or Strong-Drive® SD connector screws	Higher downloads

LSSJ28LZ

Joists must be miter cut.

LSSJ**26**LZ
LSSJ**26**RZ
LSSJ**28**LZ
LSSJ**28**RZ
LSSJ**210**LZ
LSSJ**210**RZ



C-C-2021, p. 117

p. 22

LSSR (replaces LSSU & LSSUI) Slopeable/Skewable Rafter Hanger

- Suitable for retrofit applications
- Swivel seat and flange design allows for a slope up or down 0°-45° and/or a skew of 0°-45°
- Solid Sawn, I-Joist, Structural Composite Lumber
- Accepts plumb cut or mitered cut joists
- Installs with common nails or Strong-Drive SD connector screws

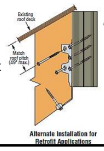
C-C-2021, p. 118-119

p. 22

LRU…Z Common Rafter Hanger

- Common rafter connection
- Field slope-able 0°-45° up or down
- Can be installed before or after the rafter & roof sheathing are in place.
- Fasteners on the face of the hanger are placed higher on the flange allowing the bottom of the rafter to hang below the ridge beam.
- Installs with nails or Strong-Drive® SD structural connector screws.

Alternate-Retrofit with SD screws

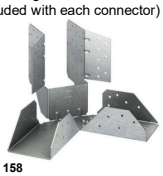


C-C-2021, pp. 115-116

p. 22

HHRC Hip-Ridge Connector

- Heavy, field slope-able connector that attaches hip and roof beams to the end of a ridge beam.
- Wide variety of available sizes to fit job needs for Solid Sawn, Glulam and SCL
- Installs with Strong-Drive SD Connector screws (included with each connector)



C-C-2021, pp. 121, 158

A Complete Roof System – A "Strong" Roof

LSSJ Light **S**lopeable and **S**kewable **J**ack Hanger

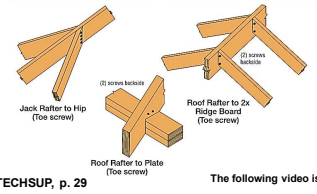
HHRC **H**eavy (Higher loads) **H**ip **R**idge **C**onnector

LRU **L**ight **R**after Hanger **U**-shaped (face mount)

LSSR **L**ight **S**lopeable and **S**kewable **R**after Hanger

When Bearing is Not Needed

Connection Application	FASTENER QUANTITIES			
	IRC		IBC	
	Nails per Table R602.3 (1)	Equivalent SDWS Framing Screws	Nails per Table 2304.9.1	Equivalent SDWS Framing Screws
Roof rafter to plate (toe screw)	(3) 10d common	(3) SDWS16212	(3) 8d common	(3) SDWS16212
Roof rafter to 2x ridge board (toe screw)	(4) 16d box	(4) SDWS16212	(2) 16d common	(2) SDWS16300
Jack rafter to hip (toe screw)	(4) 16d box	(4) SDWS16212	(3) 10d common	(3) SDWS16300



SDWS Framing Screw

- 0.160" diameter
- 2½" and 3" length
- Head countersinks flush
- Sawtooth™ Type 17 point ensures fast starts

C-F-2019TECHSUP, p. 29

The following video is about the SDWS Framing screw. p. 22

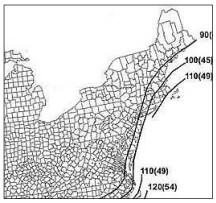
[redacted]

Videos Available in Portuguese

[redacted]

Wind Speed Maps

Basic Design Wind Speed-2012



Ultimate Design Wind Speed-2015 (-2021)

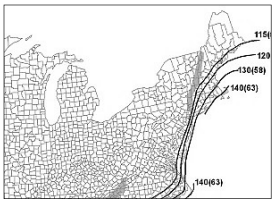


TABLE R301.2.1.3
WIND SPEED CONVERSIONS

V_{ult}	110	115	120	130	140
V_{asd}	85	89	93	101	108

p. 23

Roof Uplift Resistance

- R802.11.1 ('03-'09) …Roof assemblies subject to wind uplift pressures of 20 psf … shall have rafter or truss ties…determined using an effective wind area of 100 sq. ft., Zone 1 in Table R301.2(2)…

  Based on Table R301.2(2), toenailing is permitted because you don't get to the 20 psf trigger where a mechanical connector would be required in the 90, 100, or 105 mph (ASCE 7-05) wind zones.

- R802.11.1 ('12-'**21**) …Where the uplift force does not exceed 200 lbs., rafters and trusses spaced not more than 24" o.c. …shall be permitted to be attached to their supporting wall assemblies in accordance with Table R602.3(1) (*Basic nailing table)*

  R802.11.1 & R802.11.2 / R802.11.1.1 & R802.11.1.2 / R802.11.1.2 & R802.11.1.3
  Uplift forces permitted to be determined as specified by Table R802.11

  Toenailing is permitted when the uplift force is less than or equal to 200 lbs.

p. 23

When is the Uplift Force ≤ to 200 lbs.?

TABLE R802.11
RAFTER OR TRUSS UPLIFT CONNECTION FORCES FROM WIND (ASD) (POUNDS PER CONNECTION)[a,b,c,d,e,f,g,h]

RAFTER OR TRUSS SPACING	ROOF SPAN (feet)	EXPOSURE B							
		Ultimate Design Wind Speed V_{ult} (mph) – 2015/2018/2021							
		110		115		120		130	
				Roof Pitch		Roof Pitch		Roof Pitch	
				< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12
16" o.c.	12			78	70	93	85	126	117
	18			98	88	118	108	162	149
	24			118	105	144	130	198	182
	28			132	117	161	145	222	203
	32			145	129	178	160	246	226
	36			160	141	194	176	270	247
	42			180	160	221	198	306	281
	48			201	178	246	221	343	314
24" o.c.	12			118	106	140	128	190	176
	18			148	132	178	162	244	224
	24			178	158	216	196	298	274
	28			198	176	242	218	334	306
	32			218	194	268	240	370	340
	36			240	212	292	264	406	372
	42			270	240	332	298	460	422
	48			302	268	370	332	516	472

RAFTER OR TRUSS SPACING	ROOF SPAN (feet)	EXPOSURE B	
		Ultimate Design Wind Speed V_{ult} (mph) – 2015/2018/2021	
		140	
		Roof Pitch	
		< 5:12	≥ 5:12
16" o.c.	12	162	150
	18	209	194
	24	255	237
	28	287	266
	32	319	295
	36	351	325
	42	399	370
	48	447	414
24" o.c.	12	244	226
	18	314	292
	24	384	356
	28	432	400
	32	480	444
	36	528	488
	42	600	556
	48	672	622

f. For wall-to-wall, wall-to-foundation, reduce uplift force by 60 plf for each full wall above.

p. 24

Table R602.3.1 – When Toenailing is Permitted

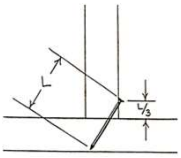
ITEM	DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER[a, b, c]	SPACING AND LOCATION
	Roof		
1	Blocking between ceiling joists or rafters to top plate	4-8d box (2½" × 0.113"); or 3-8d common (2½" × 0.131"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	Toe nail
2	Ceiling joists to top 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 Sections R802.3.1, R802.3.2 and Table R802.3.1(9)]	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 Sections R802.3.1 and R802.3.2 and Table R802.3.1(9)]	Table R802.5.1(9)	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[i]

p. 24

| 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[i] |

Correct Installation of Toenailing per the AWC-NDS

12.1.6.4 – Nails shall be driven approximately 30° to the face of the member being attached and started approximately 1/3 the length of the nail from the member end.

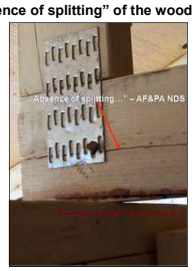


AWC NDS – 12.1.6.4-'15 / 11.1.5.4-'01 & '05, Fabrication & Assembly.

p. 24

Toenailing per the AWC-NDS

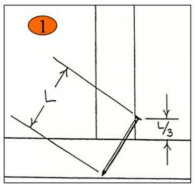
12.1.6.6/11.1.5.6 – Values are based on "absence of splitting" of the wood members.

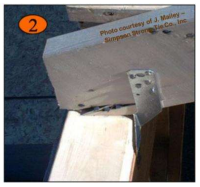


Toenailing per the AWC-NDS

- **Performance values apply as long as they:**
  - **are installed at the correct angle**
  - **the wood is not split**
  - **AND they are spaced properly**

? **How common is that?**





p. 24

The following video shows what might happen to a roof if it's not tied down properly

"If we can put a man on the moon, we can keep a roof on a house, and our research demonstrates that it's possible to design and build houses that protect people and structures from deadly winds…"

Dr. David Prevatt, Associate Professor, University of Florida, Dept. of Civil and Coastal Engineering
Building Codes: The Foundation for Resilience, Federal Alliance for Safe Homes, May 2014

How much Uplift Capacity will Toenails Provide?

Commonly available nails used in pneumatic nail tools for this connection

	Nail Type & Size	No. of Toenails	Uplift Capacity SPF (0.42)/1.60 Load Duration
	0.131 x 3.5" (16d (pneumatic))	3	144 lbs.
		4	192 lbs.
Most common	0.131 x 3" (10d (pneumatic))	3	115 lbs.
		4	154 lbs.
	0.120 x 3" (10d (pneumatic))	3	106 lbs.
		4	140 lbs.

Toenailed connection should be designed. Number of nails, size and type

p. 25

When will 3 perfectly installed 0.131 x 3" toe-nails meet the load (115 lbs.)?

TABLE R802.11
RAFTER OR TRUSS UPLIFT CONNECTION FORCES FROM WIND (ASD) (POUNDS PER CONNECTION)[a,b,c,d,e,f,g,h]

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
			< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12
16" o.c.	12		78	70	93	85	126	117	162	150
	18		98	88	118	108	162	149	209	194
	24		118	105	144	130	198	182	255	237
	28		132	117	161	145	222	203	287	266
	32		145	129	178	160	246	226	319	295
	36		160	141	194	176	270	247	351	325
	42		180	160	221	198	306	281	399	370
	48		201	178	246	221	343	314	447	414
24" o.c.	12		118	106	140	128	190	176	244	226
	18		148	132	178	162	244	224	314	292
	24		178	158	216	196	298	274	384	356
	28		198	176	242	218	334	306	432	400
	32		218	194	268	240	370	340	480	444
	36		240	212	292	264	406	372	528	488
	42		270	240	332	298	460	422	600	556
	48		302	268	370	332	516	472	672	622

Roof-to-Top Plate Connection – Toenailing

Roof-to-Top Plate Connection – Toenailing

Institute for Business and Home Safety

Roof Uplift Testing

- One house built to the minimum code standards (IRC-90/115 mph).
- One house built to the IBHS "Fortified" standards

When is a Mechanical Connector Required?

When the Uplift Force > 200 lbs.

TABLE R802.11
RAFTER OR TRUSS UPLIFT CONNECTION FORCES FROM WIND (ASD) (POUNDS PER CONNECTION)[a,b,c,d,e,f,g,h]

RAFTER OR TRUSS SPACING	ROOF SPAN (feet)	EXPOSURE B							
		Ultimate Design Wind Speed V_{ult} (mph) – 2015/2018/2021							
		110	115		120		130		140
			Roof Pitch		Roof Pitch		Roof Pitch		Roof Pitch
			< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12
16" o.c.	12		78	70	93	85	126	117	162	150
	18		98	88	118	108	162	149	209	194
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	32		145	129	178	160	246	226	319	295
	36		160	141	194	176	270	247	351	325
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	48		201	178	246	221	343	314	447	414
24" o.c.	12		118	106	140	128	190	176	244	226
	18		148	132	178	162	244	224	314	292
	24		178	158	216	196	298	274	384	356
	28		198	176	242	218	334	306	432	400
	32		218	194	268	240	370	340	480	444
	36		240	212	292	264	406	372	528	488
	42		270	240	332	298	460	422	600	556
	48		302	268	370	332	516	472	672	622

p. 24

When is a Mechanical Connector Required?

When 3 or 4 perfectly installed toenails DO NOT meet the load required.

TABLE R802.11
RAFTER OR TRUSS UPLIFT CONNECTION FORCES FROM WIND (ASD) (POUNDS PER CONNECTION)[a,b,c,d,e,f,g,h]

RAFTER OR TRUSS SPACING	ROOF SPAN (feet)	EXPOSURE B											
		Ultimate Design Wind Speed V_{ult} (mph) – 2015/2018/2021											
		110	115		120		130		140		Nail Type & Size	No. of Toenails	Uplift Capacity SPF (0.42)/1.60 Load Duration
			Roof Pitch		Roof Pitch		Roof Pitch						
			< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12					
16" o.c.	12		78	70	93	85	126	117			0.131 x 3" (10d (pneumatic))	3	115 lbs.
	18		98	88	118	108	162	149					
	24		118	105	144	130	198	182				4	154 lbs.
	28		132	117	161	145	222	203					
	32		145	129	178	160	246	226					
	36		160	141	194	176	270	247	351	325			
	42		180	160	221	198	306	281	399	370			
	48		201	178	246	221	343	314	447	414			
24" o.c.	12		118	106	140	128	190	176	244	226			
	18		148	132	178	162	244	224	314	292			
	24		178	158	216	196	298	274	384	356			
	28		198	176	242	218	334	306	432	400			
	32		218	194	268	240	370	340	480	444			
	36		240	212	292	264	406	372	528	488			
	42		270	240	332	298	460	422	600	556			
	48		302	268	370	332	516	472	672	622			

p. 24

Roof Uplift Resistance

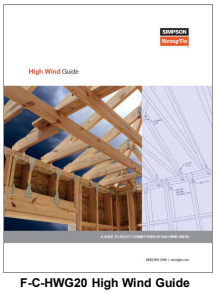
- ***A mechanical connector is required for the IRC when the uplift force is greater than 200 lbs. based on Table R802.11 or***
- ***the toenails are insufficient and***
- ***for the buildings designed and built under the IBC.***

When uplift is less than 200 lbs.	When uplift is greater than 200 lbs.
Refer to fastening schedule Table R602.3.1	A designed connection must be provided beyond the basic requirement for toenails. Use a metal connector matching the capacity shown in Table R802.11. or design capacity.

- IRC®: R802.10.5 ('03-'09), R802.11.1 ('12-'21)
- IBC®: '00-'21, 2308.7.5/2308.10.5.1

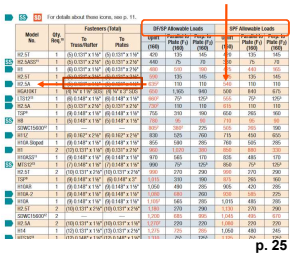
p. 24

Finding the Right Connector (High Wind Guide)



F-C-HWG20 High Wind Guide

Truss/Rafter to Wood Double Top Plates



p. 25

Fasteners through Metal Truss Plates

Do not drive nails through the plates on the opposite side of single-ply trusses which could force the plate off of the truss.

n. Fasteners are permitted through metal truss plates when approved by the truss designer…

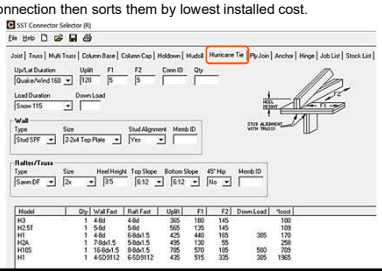
Installation of the SST SDS Heavy Duty Connector screws …require the plates to be pre-drilled…5/32" drill bit.

SDS Heavy Duty Connector screw

C-C-2021, p. 18, footnote n – General Instructions for the Installer

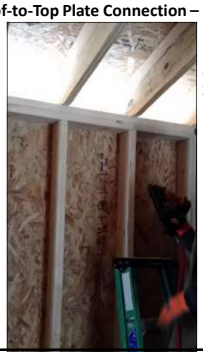
Finding the Right Connector (Connector Selector)

Helps you determine which products are appropriate for your connection then sorts them by lowest installed cost.



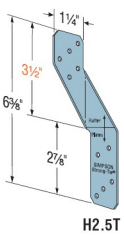
p. 25

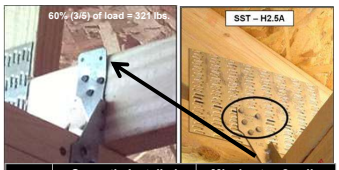
Roof-to-Top Plate Connection – H2.5A



Correctly installed: 20-25 seconds

Energy Heel or 2x4 Bottom Chord Bearing Truss





	Correctly Installed	Missing top 2 nails
H2.5A	615 lbs.	260 lbs. (42%)
H2.5T	565 lbs.	

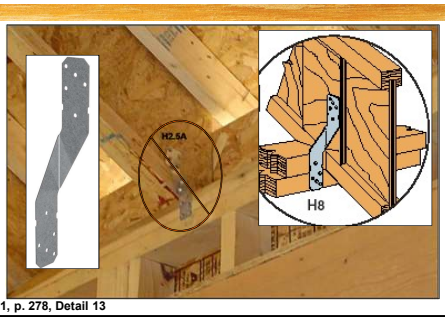
C-C-2021, pp. 276-278

p. 26

I-joist Roof

Blew off from 45 M.P.H. winds. No mechanical connectors.

I-joist Roof



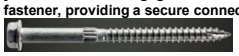
C-C-2021, p. 278, Detail 13

p. 26

Roof-to-Top Plate Connection–Structural Wood Screws

Strong-Drive SDWC Truss Screw

- ✓ **The FIRST screw fully TESTED & evaluated to ICC-ES AC233 and tested for roof-to-wall assemblies in accordance with ICC-ES AC13.**
- ✓ **No pre-drilling**
- ✓ **Fully-threaded shank engages the entire length of the fastener, providing a secure connection.**



SDS shank is NOT fully threaded.

- ✓ **Cap-style head countersinks fully into the side of the stud to avoid interference with drywall or finish trades.**

C-F-2019TECHSUP, pp. 54-72

p. 26

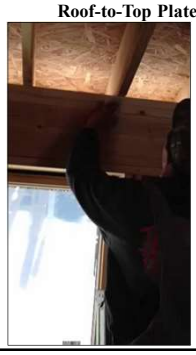
Roof-to-Top Plate Connection–Structural Wood Screws

Strong-Drive SDWC Truss Screw

- Tested to the widest range in the industry
  - Angles from 10°-30°
    - ❖ Brand "X"(Screw A) = 15° to 30°
    - ❖ Brand "X"(Screw B) = 20° to 30°
    - ❖ Brand "Y" = 23° ± ½°
- Metal installation guide tool helps ensure proper installation.
- Matched tolerance, T-30, driver bit reduces cam out, enabling easier driving.
- Guide tool and T-30 bit FREE in every box.

C-F-2019TECHSUP, pp. 54-72

Roof-to-Top Plate Connection – SDWC



Correctly installed:
8-10 seconds

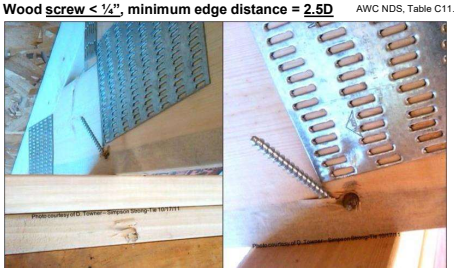
✓ What happens when the screw is installed at 45° vs. the manufacturers approved angles (10°or 15° to 30°)?

- ➢ Not published, but a SIGNIFICANT reduction

✓ How do you inspect for proper edge distance and angle of installation?

Roof-to-Top Plate Connection–Structural Wood Screws – What to Look For;

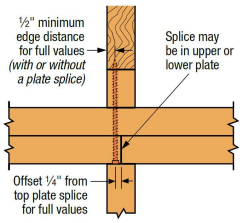
✓ Edge Distance – Installation tolerance to get any capacity is very tight.
Wood screw < ¼", minimum edge distance = 2.5D AWC NDS, Table C11.1.4.7



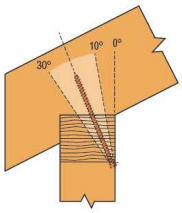
p. 26

Roof-to-Top Plate Connection–Structural Wood Screws – What to Look For;

✓ Offset from splice



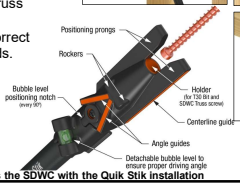
✓ Angle of installation



p. 26

Roof-to-Top Plate Connection–SST Quik Stik

- **Drill/Driver Attachment -** Connect to the customer's existing cordless drill.
- **Guidelines -** Directional guidelines provide visual feedback for positioning the tool at proper SDWC installation angle.
- **Versatile Installation -** Approved for **5** convenient top plate to rafter/truss installation scenarios.
- **Bubble Level -** Helps identify correct angle over window blocks & studs.



C-F-2019TECHSUP, pp. 69-72

The following video shows the SDWC with the Quik Stik installation

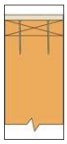
Videos Available in Polish

Roof to Wall Connection

- R301.2.1 Wind design criteria…A continuous load path shall be provided to transmit the applicable uplift forces in Section R802.11.1 from the roof assembly to the foundation.
- 2308.7.5/2308.10.1 Wind uplift. Roof construction-'09-'21 (assemblies-'00-'06) shall have rafter or truss ties to the wall below. Resultant uplift loads shall be transferred to the foundation using a continuous load path.

p. 27

Top plates-to-Wall Connection – Is this a Continuous Load Path?



Nails and spikes loaded in withdrawal from the end grain of the wood has been prohibited since the 1944 edition of the NDS.

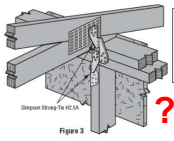
AWC NDS 11.2.3.2-'01/'05, 12.2.3.5-'15

IRC minimum – end grain nailing

p. 27

Roof-to-Wall Connection – Continuous Load Path

Hurricane Ties on the Inside of the Wall



6. Hurricane Ties are shown on…the outside of the wall for clarity… installation on the inside of the wall is acceptable. For uplift Continuous Load Path, connections in the same area must be on the same side of the wall.

? A continuous load path requires a method of transferring the load from the roof to the stud (not just the top plates).

p. When installing hurricane ties on the inside of the wall special considerations must be taken to prevent condensation on the inside of the completed structure in cold climates.

OR

C-C-2021, p. 277, footnote #6
C-C-2021, p. 18, General Instruction for the Installer, note p

Roof-to-Wall Connection – Continuous Load Path

A single connector that connects the roof directly to the wall.

- H2A and H10S ties wall stud directly below the rafter/truss
- H10S allows up to a 1" offset with a slight load reduction ?

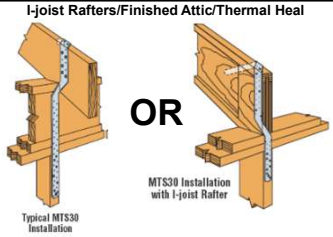
OR

p. 28

C-C-2021, p. 278, Detail 2 (H2A), Details 16-17 (H10S)

Roof-to-Wall Connection – Continuous Load Path

A single connector that connects the roof directly to the wall.
I-joist Rafters/Finished Attic/Thermal Heal

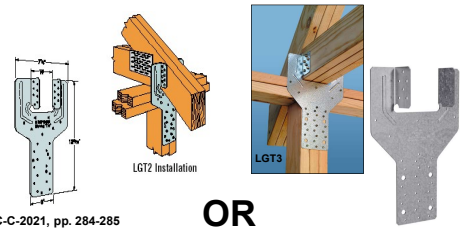


C-C-2021, p. 277

p. 28

Roof-to-Wall Connection – Continuous Load Path

A single connector that connects the roof directly to the wall.
2-ply (LGT2), 3-ply (LGT3) or 4-ply (LGT4)



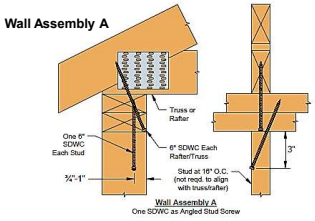
C-C-2021, pp. 284-285

OR

p. 28

Roof-to-Wall Connection – Continuous Load Path

Use SDWC15600 Truss Screw to connect the roof-to-top plates and top plates-to-stud.



p. 28

Can Hurricane-Ties Resist Roof Wind Uplift Forces?

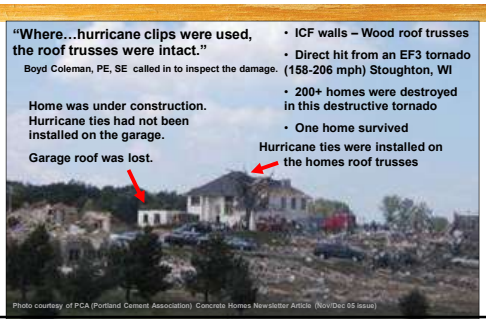
"Where…hurricane clips were used, the roof trusses were intact."
Boyd Coleman, PE, SE called in to inspect the damage.

- **ICF walls – Wood roof trusses**
- **Direct hit from an EF3 tornado (158-206 mph) Stoughton, WI**
- **200+ homes were destroyed in this destructive tornado**
- **One home survived**

Home was under construction. Hurricane ties had not been installed on the garage.

Garage roof was lost.

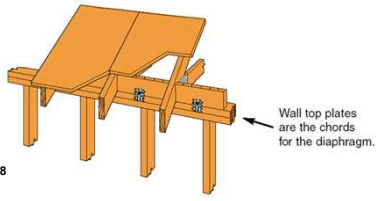
Hurricane ties were installed on the homes roof trusses



Roof-to-Wall Connection – Continuous Load Path

Roof blocking at the plate line performs three functions:

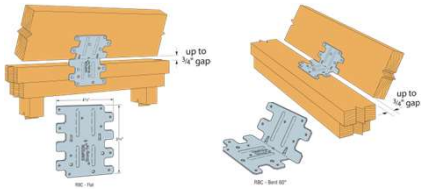
- **Provides boundary nailing for roof sheathing panel edges**
- **Provides rotation and lateral displacement restraint of the rafter/truss**
- **Transfers shear load from the roof diaphragm to the wall top plates (chords)**



C-C-2021, p. 288

Roof-to-Wall Connection – Continuous Load Path

The RBC was designed to connect the roof blocking to the top plates



For more information including how to meet ventilation requirements when meeting blocking requirements see flyer F-C-RBC.

Roof Construction – Components & Cladding

Roof sheathing is the first structural layer of the building that uplift forces act upon. It provides support not only to the roof covering, but provides lateral support to the roof trusses and rafters. **Resource: Bracing for the Future, FEMA-DR-1444-OH**

Roof Construction – Components & Cladding

Roof sheathing-to-framing;

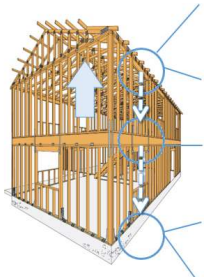
- Table R602.3(1) #30, #31:
- Table 2304.10.1 (#31-#33) (#30-#32) – similar

✓ **⅜" - ½"; 8d common nail (0.131 x 2½") @ 6" (edge) & 12" (intermediate supports) or Roof Sheathing Ring Shank nail (0.113 x 2⅜") @ 6" & 12"**

✓ **19/32" - 1"; 8d common nail (0.131 x 2½") @ 6" (edge) & 12" (intermediate supports) or Roof Sheathing Ring Shank nail (0.113 x 2⅜") @ 6" & 12"**

Roof Construction

Continuous Load Path – Wood-Framed Structures



H2.5A, H2.5T, SDWC, etc.

w/ SSP, SDWC or H2A, MTS30, etc.

DTT2, CSHP, SDWF w/ SDWC, etc.

SSP, RSP, SDWC, or Sheathing (SDPWS, ICC 600, AWC WFCM), etc.

MASA, THD

p. 29

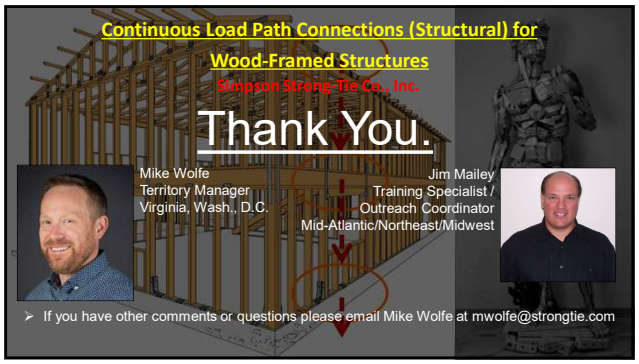
Why should we build to a Continuous Load Path?

According to studies by FEMA, $1 spent in mitigation will save $4-$5 in future economic losses.

[1.] …the "greenest" home is the one that does not get torn down and replaced post-disaster.

1. Building Codes: The Foundation to Resilience-Federal Alliance for Safe Homes, May 2014.

If you design & build to a Continuous Load Path you will be as impressed with how well a building performs after Mother Nature's fury as you will be with the person in the next video.


Continuous Load Path Connections (Structural) for Wood-Framed Structures
Simpson Strong-Tie Co., Inc.
Thank You.
Mike Wolfe
Territory Manager
Virginia, Wash., D.C.
Jim Mailey
Training Specialist / Outreach Coordinator
Mid-Atlantic/Northeast/Midwest
If you have other comments or questions please email Mike Wolfe at mwolfe@strongtie.com


Thank You.
SIMPSON
Strong-Tie
We are what we repeatedly do.
Excellence, therefore, is not an act, but a habit.
- Aristotle

File Attachments for Item:

ER-6 HyperSpike (Miami Valley Building Officials Council)

All certifications except plumbing and IU (1 hour)

Staff Notes: Product introduction by Sales Application Manager in the company. I don't see anything about codes in the slides.

ESIAC Recommendation:

Committee Recommendation:

Chris Mastrino

From: Joe Dellicarpini <Joe.Dellicarpini@ultra-ussi.com>
Sent: Friday, March 4, 2022 8:27 AM
To: Chris Mastrino
Subject: RE: Hyperspike

Joe DelliCarpini – Sales Application Manager

I have been with HyperSpike for 5 years and have over 25 years of Mass Notification experience in design and implementation of Outdoor and Indoor Communication systems. I have over 35 years of experience in the Distribution and OEM market space.

Joe DelliCarpini
Sales Application Manager – HyperSpike Products

HYPERSPIKE

Ultra Maritime
10 Lapworth Circle
Hopedale, MA 01747
Joe.dellicarpini@ultra-ussi.com
Tel: +1-260-438-5738
www.ultra-hyperspike.com
www.ultra.group

From: Chris Mastrino <cmastrino@vandaliaohio.org>
Sent: Friday, March 4, 2022 8:04 AM

Chris Mastrino

137 Littlejohn Road

Troy, Ohio 45373

937-477-1057

cmastrino@vandaliaohio.org

Notable Accomplishments:

- State of Ohio Certified Chief Building Official, Residential Building Official, Building Inspector and Residential Building Inspector.
- Past treasure Miami Valley Building Officials Council
- Past Board of Director for Miami Valley Building Officials Council
- Past Education Chairman Miami Valley Building Officials Council
- Past Board of Director TV5 Troy, Ohio

Employment History:

Building Inspector City of Vandalia 1991 – Current

Engineering Technician City of Vandalia 1990-1991

Lockwood Jones and Beals, Engineering Technician 1986-1990

United States Air Force, 1982-1986

Education:

Alpina Community College

Sinclair Community College

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: Hyperspike

Course Submitter: Chris Mastrino (Contact Name)

Organization: MVBOC/ SWFOC (Organization/Company)

Address: 333 James Bohanan (Include Room Number, Suite, etc.)

City: Vandalia State: Ohio Zip: 45377

E-Mail: cmastrino@vandaliaohio.org

Telephone: 937-415-2322 Fax: 937-415-2319

Course Sponsor: MVBOC/ SWOFC

COURSE INFORMATION:

Course Title: Hyperspike

New Course Submittal: ■ Update Course: ☐ Prior Approval Number: _____

Purpose and Objective: Introduction highly intellligible UL listed High Powered speakers for indoor and outdoor applications covering Campus/ Universities Communications, Industrial and Infrastructures, Fire and Life Safety, Airports and parking structures.

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

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

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 [XX]

Location of ESI Course: Washington Township Fire Department Date(s) of ESI Course(s): TBD, once class has been approved

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

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

HYPERSPIKE

HyperSpike
2021 Product Overview

Who is Hyperspike®?

Our passion for acoustics combined with a focus on why we are in business makes HyperSpike special. We truly believe that the message matters.

Messages broadcast over emergency notification systems must be reliable and intelligible and must be heard regardless of the environment. A message that is clearly heard and understood is critical to getting people out of harm's way and ensuring public safety and security.

HyperSpike is special because we are all passionate about our purpose and mission - to save lives.

Why HyperSpike®?

HYPERSPIKE

SUPERIOR SOLUTIONS

Revolutionary Sound Quality & Intelligibility that exceeds NFPA industry mandates and standards

PARTNERSHIP

Customer Driven Solutions

VALUE

Better Performance.

Less Hardware.

Saves Lives.

HyperSpike®

Trusted from the Start

US Army C-RAM Program

Counter Rocket/Artillery/Mortar Early Warning Network

2000+ Units Deployed in Iraq/Afghanistan starting 2009

- Integrated into Early-Warning Network
- Mesh Network Powered

Original Units Still in Operation Today

Hundreds of Saved Lives

BIG VOICE. BIG VALUE. SAVES LIVES.

The Challenge

- Need for voice messaging capabilities vs tones – **BIG VOICE**
- Reduce manufacturing downtime and installation costs – **BIG VALUE**
- High ambient noise in Safety Critical Environment – **SAVES LIVES**

The HyperSpike® Difference

- 1,000,000 SF Auto Manufacturing Plant
  - Historical Solutions = **700 x 15W speakers** (10,000W)
  - HyperSpike® Solution = **22 x 100W Speakers**. (2200W)
- **Increased speech intelligibility** by using fewer, higher quality speakers and significantly less hardware – **over $1M in Savings**
  - Less manufacturing downtime
  - Less hardware = lower installation costs & long -term maintenance costs
  - Higher efficiency speakers = higher annual energy savings.

Line workers **hear and understand** emergency messages and navigate **out of harms way**.

The Bose® Of Notification Systems

Higher quality, evenly distributed sound with unsurpassed intelligibility.

Cost Study Performed in Allentown, PA

Quoted with Cooper-Wheelock Solution

- 450,000 Square Foot Building
- 244 15W Speakers (3600W)
- **Total Cost $105,000**

244

Quoted with HyperSpike TCPA-Omni

- 450,000 Square Foot Building
- 3 TCPA-Omni's (600W)
- **Total Cost $30,000**

3

Savings

- Significantly Less Installation Labor/Material Cost
- Lower Material Cost/Requirement for Battery Back-up, etc.

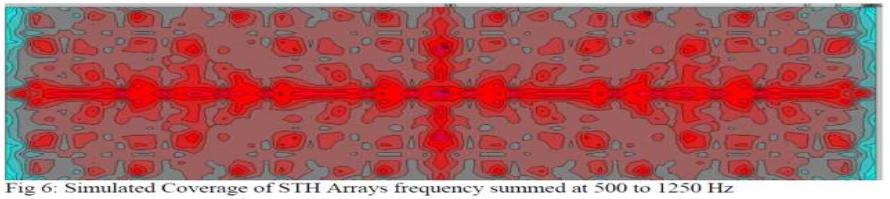
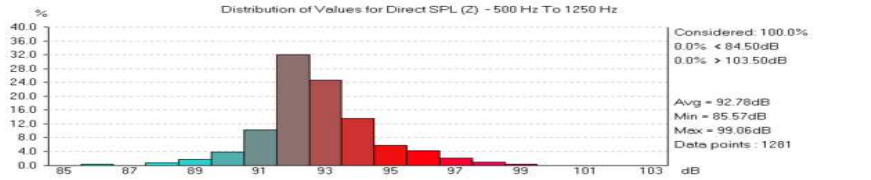


Fig 6: Simulated Coverage of STH Arrays frequency summed at 500 to 1250 Hz



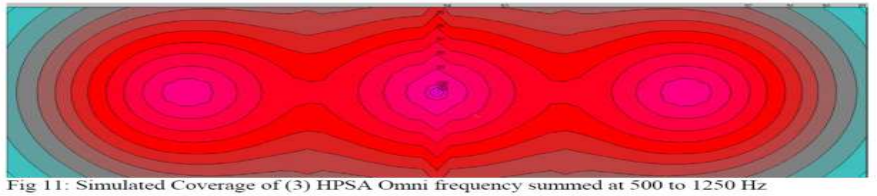


Fig 11: Simulated Coverage of (3) HPSA Omni frequency summed at 500 to 1250 Hz

HyperSpike®

HIGHLY VERSATILE AND UNIQUE PRODUCT FAMILY

The Bose Speaker of the Emergency Notification Market. Patented and carefully engineered to produce intelligible voice commands that cut through the noise.





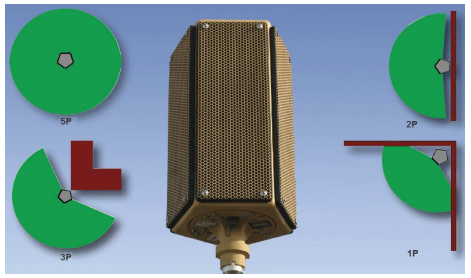


Markets	TCPA-10	TCPA-Omni	LineWave	Encompass System	Encompass LT 300/600W	Acoustic Hailing Devices	HS-10
Fire & Life Safety	X	X	X	X	X		X
Civil & Defense	X			X	X	X	X
Security	X		X	X	X	X	X

MA Series

Outdoor Mass Notification

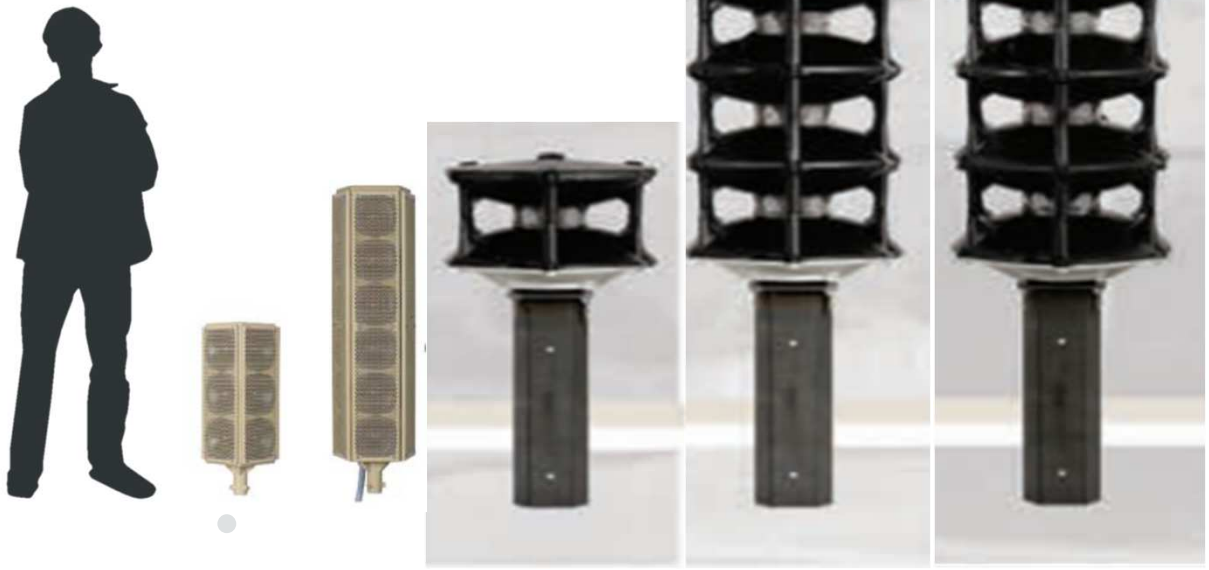
	MA-1	MA-2
Weight	48 lbs Max	36 - 100 lbs
Dimensions	12.8” DIA x 25.25” H	12.8” DIA x 45.5” H
Range	1.13 mile radius	2 mile radius
Input Voltage	41 VRMS Multi Channel 90 VRMS Single Channel	
Input Power	320W max per side, continuous alert tone	640W max per side, continuous alert tone
Frequency Response	125 Hz – 8 kHz	100 Hz – 7 kHz
Peak Acoustic Output	143 dB SPL (STI 0.91)	148 dB SPL (STI 0.91)
Environmental	-20°C - 60°C	
Certifications	CID2 – Groups A, B, C, and D UL1480A Listed CSA C22.2 No. 205 CAN/CSA C22.2 No. 213-15 ANSAI/ISA 12.12.01-2015 CE Listed	



MA Series

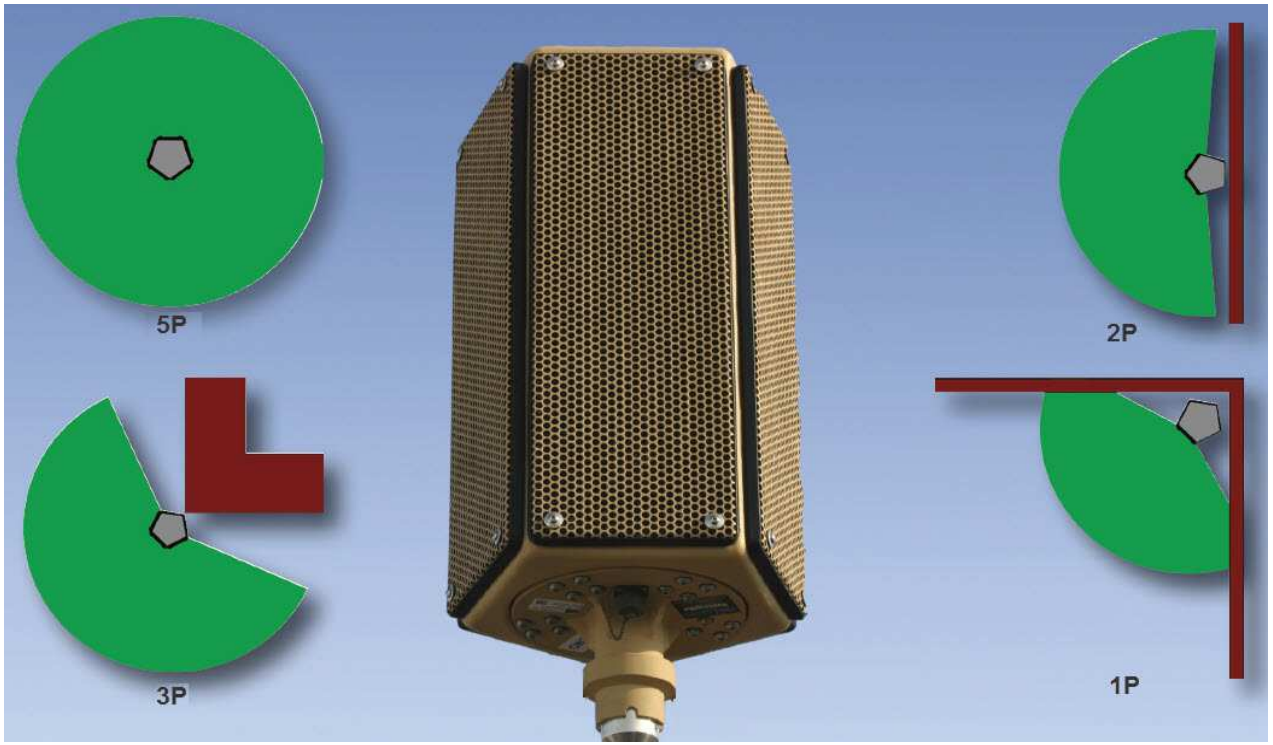
Outdoor Mass Notification

	WP2901	WP2904	MA-1	WP2908	MA-2
Power	400W	1600W	1600W	3200W	3200W
Weight	119	266	50	487	100
Height	49.3	74.1	26.2	136.1	45.5
Width	33.4	33.4	12.8	33.4	12.8



MA Series

Outdoor Mass Notification



Encompass System

Indoor/Outdoor Mass Notification

MA-Micro

- UL1480A, CID2
- CE Listed
- CSA C22.2 No. 205, CAN/CSA C22.2 No. 213-15
- 650W
- 134 dB SPL peak acoustic output
- 0.4Mile Radius
- 20 lbs
- 12.8” Diameter x 8” H
- Transformer required for use with fire panel

Encompass System

Intelligent Mass Notification System

Power

- Up to 3200W (up to 12 sq miles)
- 120-230VAC Primary Power
- Functions off of VDC (Primary or Secondary)
  - Primary Example = Solar
  - Secondary Example = Battery Backup

Audio Input Options

- 1Vrms Line level Audio
- 25/70/100V distributed audio
- IP Addressable (SIP, Web Interface, API)
- Internal space for external interfaces

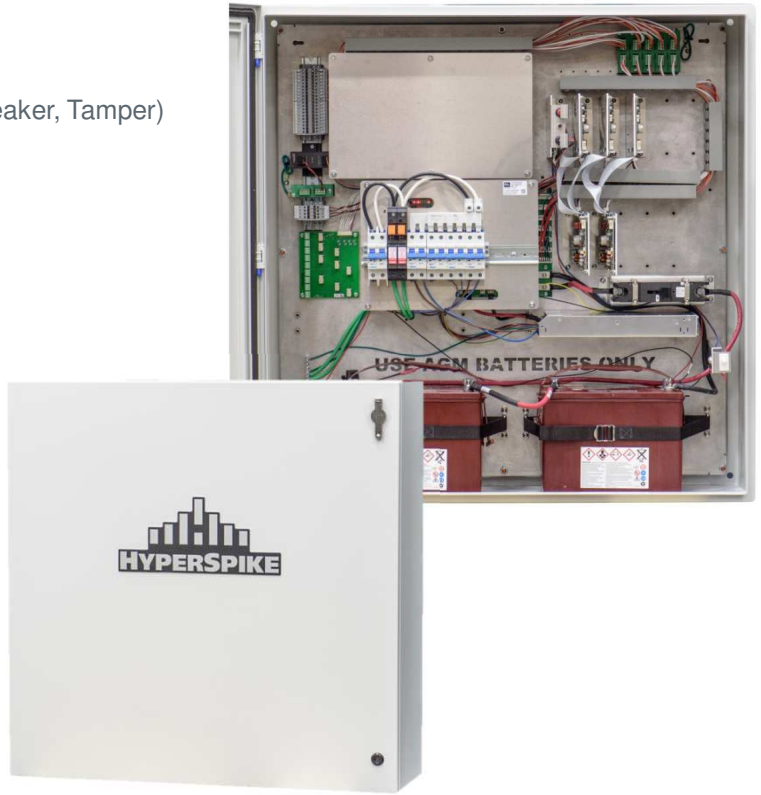
Environmental

- -40 – 60C Temperature Range
- NEMA 4 Enclosure

Feature/Health Status

- Thermal fold back protection
- Monitoring (Master, AC, DC, Amp, Speaker, Tamper)
- High Fidelity Class D Amplification

UL 62368-1
CE Listed



Encompass System

Outdoor Mass Notification

Proven Technology Focused on Voice Notification and Warnings in Critical Environments

Early Warning Notification – CRAM US Army DoD Program of Record

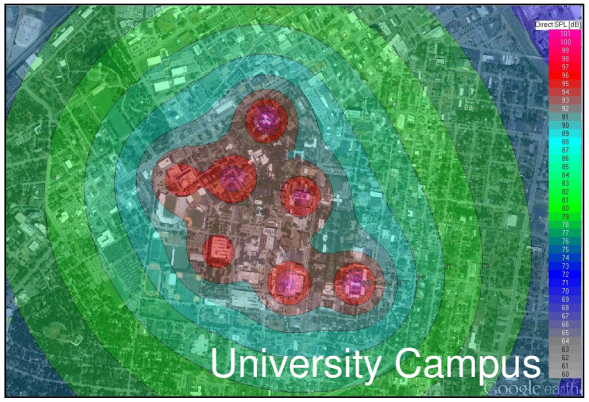
Suncor Shell Facility – Fort McMurray, Canada

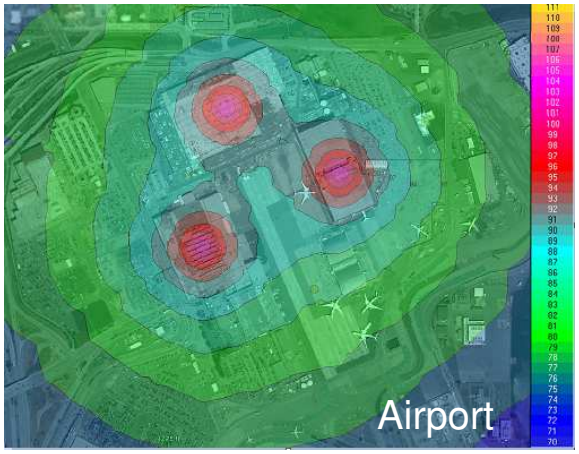
Applicable Installations:

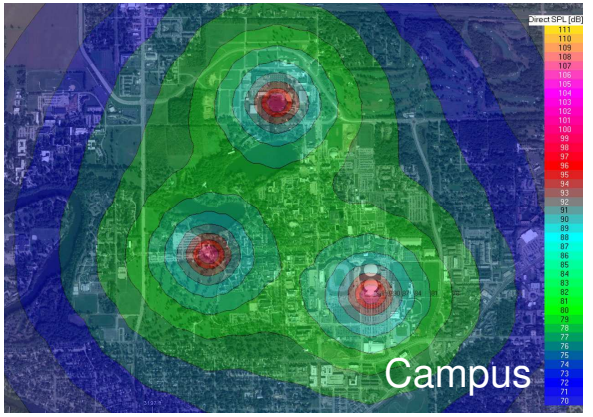
- DOW St. Charles Operations (SCO)
- Suncor Fort McMurray Shell
- CP Chem
- Alabama Power
- Suncor Daniel Electric Generation Plant
- Connexus Entergy
- US Army CRAM Program

Encompass System

Outdoor Mass Notification







Encompass System

Intelligent Mass Notification System

Oil & Gas

Campus Communication

Military Bases

Municipalities/Parks

Transportation

Parking Garages

Outdoor Amphitheatres

Mobile Mass Notification Vehicles

Airports

TCPA 10

Indoor/Outdoor Notification

Big Voice, Big Savings

HyperSpike #1 selling speaker

UL1480, CSFM

CE Listed

CID2 Certified for Hazardous Environments

ULC S541

Easily adjustable tap settings from 0.5W

25, 70, 100 VRMS

Excels in high ambient environments

Usable range at 80 dB up to 1040 ft

Weight 9 lbs.

Dimensions 10" H x 10" W x 10.7" L

Distributed Audio		
Voltage	Watts	dB SPL (Peak)
25	0.5	119
25	1	122
25	1.5	124
25	2	126
25	3	128
70	4	129
70/100	8	131
70	12	133
70/100	16	134
70/100	24	136
100	32	137
100	45	139

Indoor/Outdoor Applications

Emergency Notifications

Campus Communications

K-12

Manufacturing Facilities (85 dB+)

Warehouses

Corporate Campuses

Airports

Arenas/Stadiums/Natatoriums

Parking Structures

Outdoor Playing Fields

Parking Lots

Eddie Bauer® EST. 1920

Whirlpool

LOCKHEED MARTIN

HONDA

TCPA-10

Beating the Gold Standard – 1600 ft^2 automotive manufacturing facility template

Challenge

- Reduce the number of speakers and outperform the current specified speakers.
- Ambient sound pressure level 80 dB, target 95 dB.

Solution

- 8 TCPA-10 speakers tapped at 24W (192W total) placed at an approximate mounting height of 25 feet
- 95 dB Achieved

Value

- Less labor required for installation = $$$$
- Significant additional savings in minimal disruption to the production line during installation, and less life-cycle maintenance.
- HyperSpike® industry leading speech clarity (>.88 CIS/.75 STI score) enabled facility employees to clearly understand emergency voice messages and alert tones in a high ambient environment.

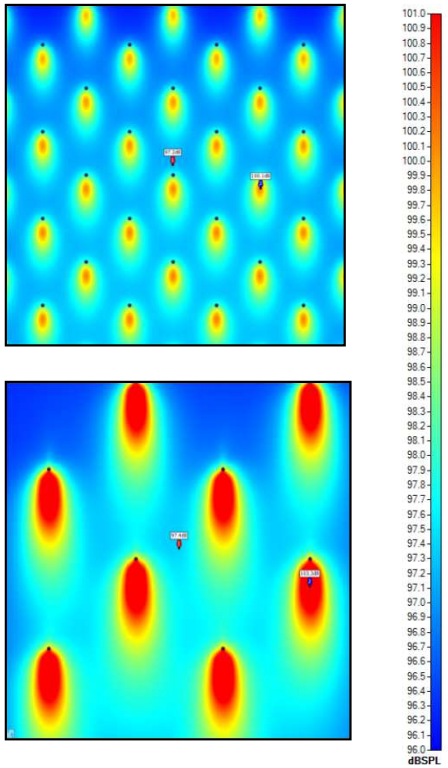
The "Gold Standard"

41 speakers

7.5W each

Total 307.5W

15 ft mounting height



HyperSpike® TCPA-10

8 speakers

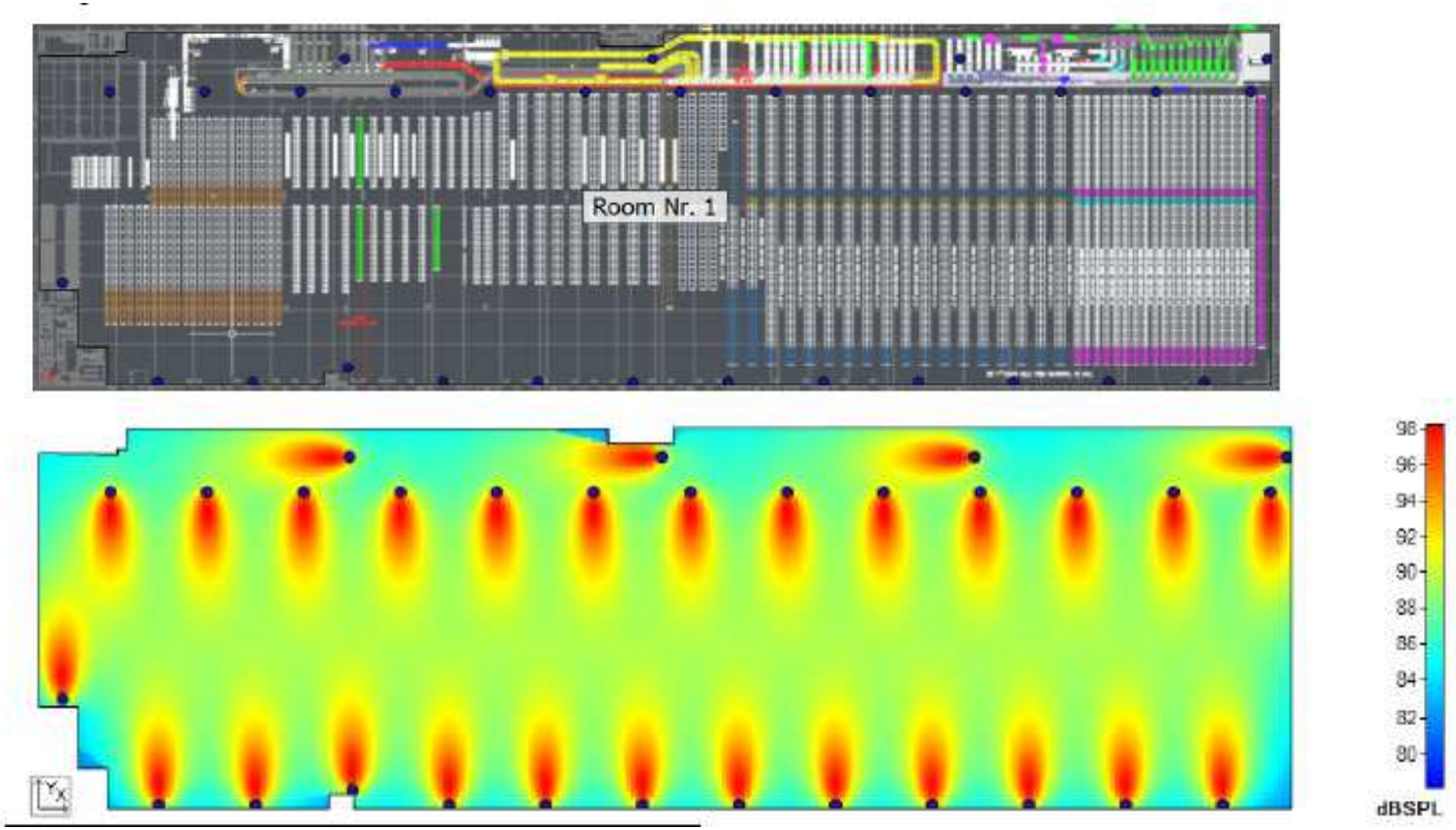
24W each

Total 192W

25 ft mounting height

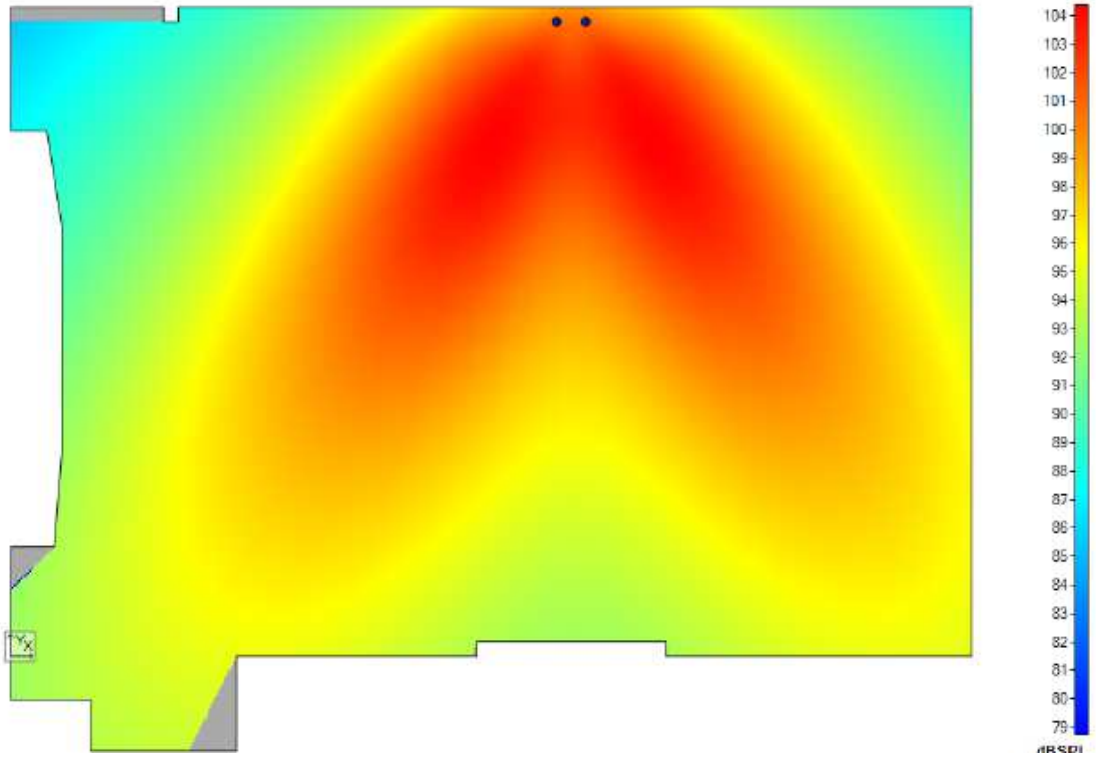
TCPA-10

Warehouse Application



TCPA-10

Athletic Complex (6 Soccer Fields)



TCPA Omni

Indoor/Outdoor Notification

- UL1480 Indoor Damp, Outdoor Wet
- ULC S541
- CE Listed
- CSFM
- 129 dBA @ 1m Max RMS Broadband
- 0.85 STI
- Frequency Range 500Hz – 5 kHz
- 70V Drive Voltage (not 100V compatible)
- 19 lbs
- 18.36” x 9.93”

Tap Setting (Watts)	SPL (dBA) @ 1m
50	116
100	119
200	122

Indoor/Outdoor Applications

- Emergency Notifications
- Campus Communications
- Manufacturing Facilities
- Warehouses
- Military Indoor Space
- Airports
- Arena’s/Stadiums
- Parking Structures
- Gymnasiums
- Natatoriums
- Parking Lots

TCPA Omni

Case Study - Value

Cost Study Performed in Allentown, PA

Quoted with Cooper-Wheelock Solution

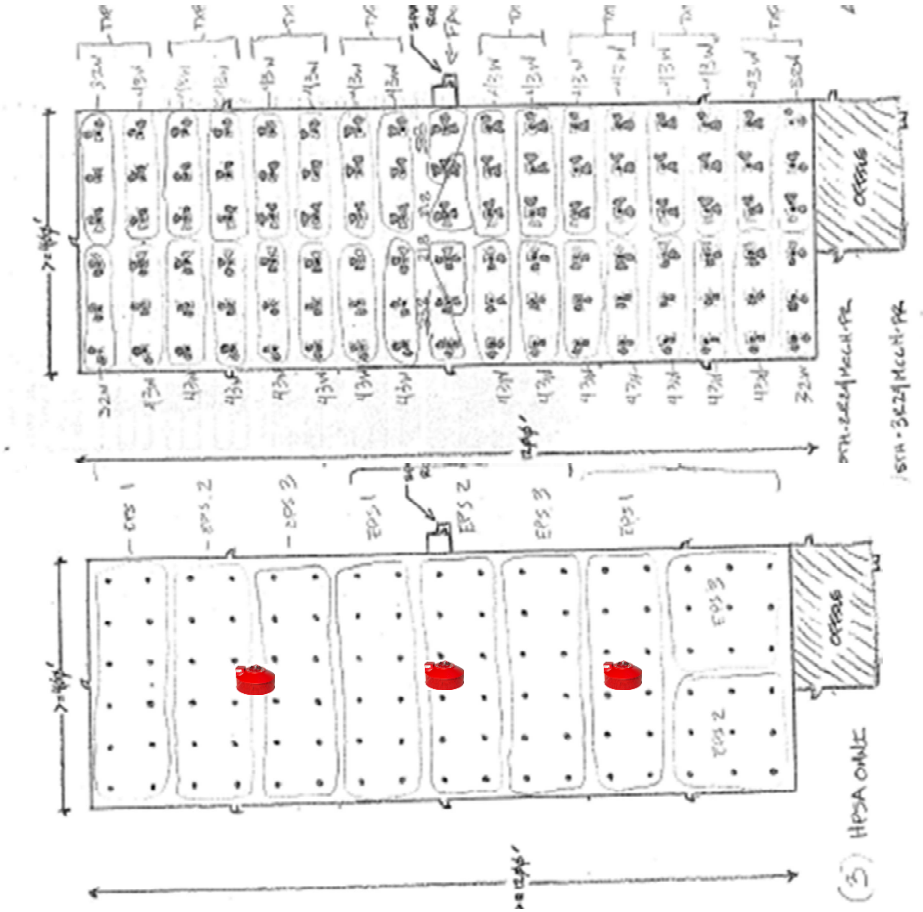
- 450,000 Square Foot Building
- 244 15W Speakers
- **Total Cost $105,000**

Quoted with HyperSpike TCPA-Omni

- 450,000 Square Foot Building
- 3 TCPA-Omni's
- **Total Cost $30,000**

Savings

- Significantly Less Installation Labor/Material Cost
- Lower Material Cost/Requirement for Battery Back-up, etc.



TCPA Omni

Case Study - Value

244

3

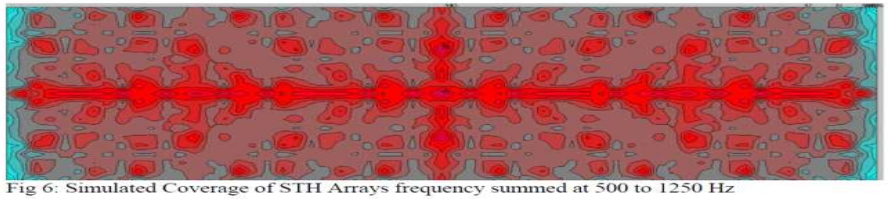


Fig 6: Simulated Coverage of STH Arrays frequency summed at 500 to 1250 Hz

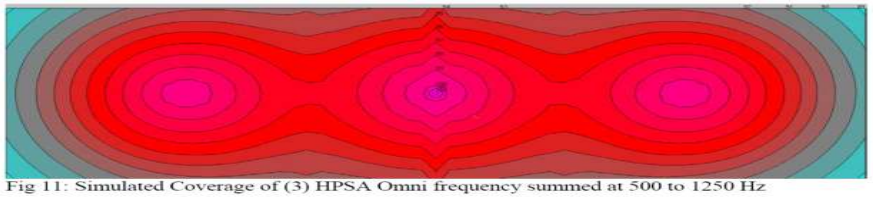


Fig 11: Simulated Coverage of (3) HPSA Omni frequency summed at 500 to 1250 Hz

TCPA Omni

Case Study – Vehicle Manufacturing Plant

Quoted with Typical Design 15w horns

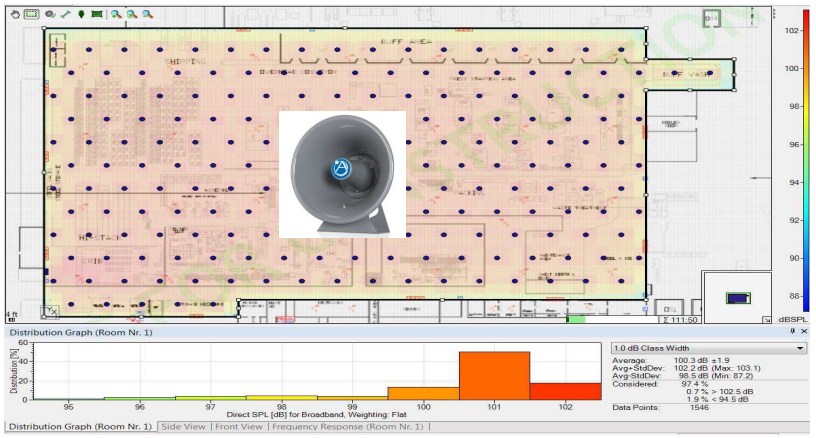
- 300,00 Square Foot Building
- 187 15W Speakers (2800W)
- $140,000 total cost Installed

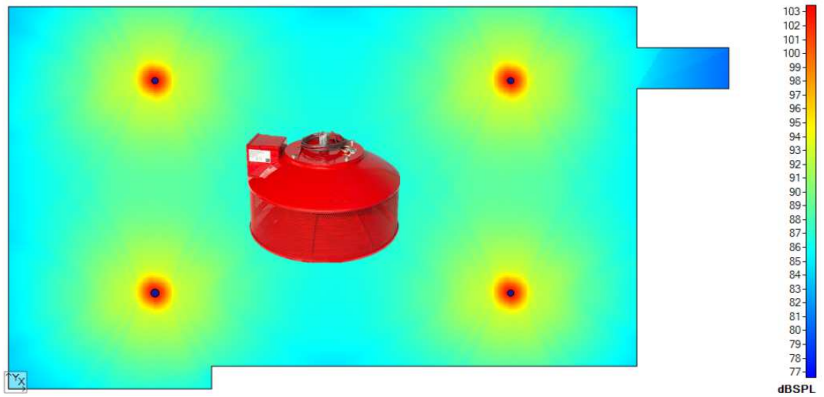
Quoted with TCPA-Omni

- 300,000 Square Foot Building
- 4 TCPA-Omni's (400W)
- $40,000 total cost installed

Savings

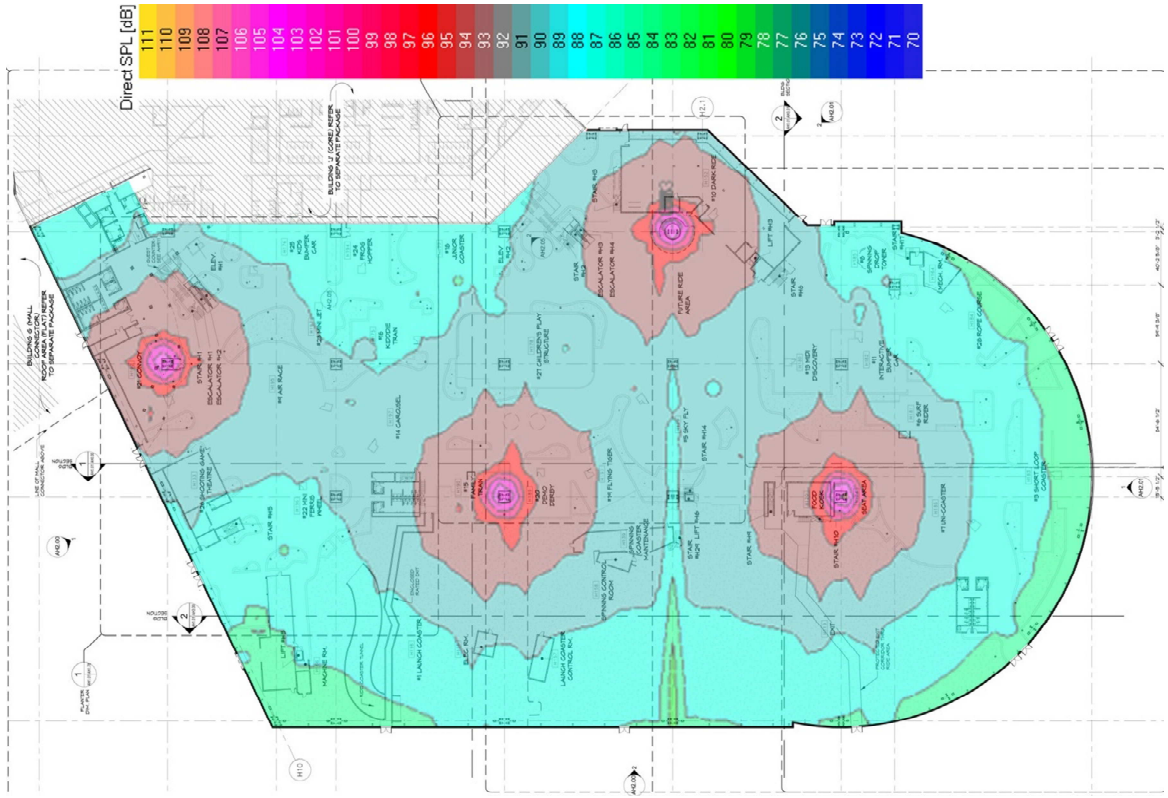
- **$100,000 Savings**
- Significantly Less Installation Labor/Material Cost
- Less Power Consumption
- Lower Material Cost/Requirement for Battery Back-up, etc





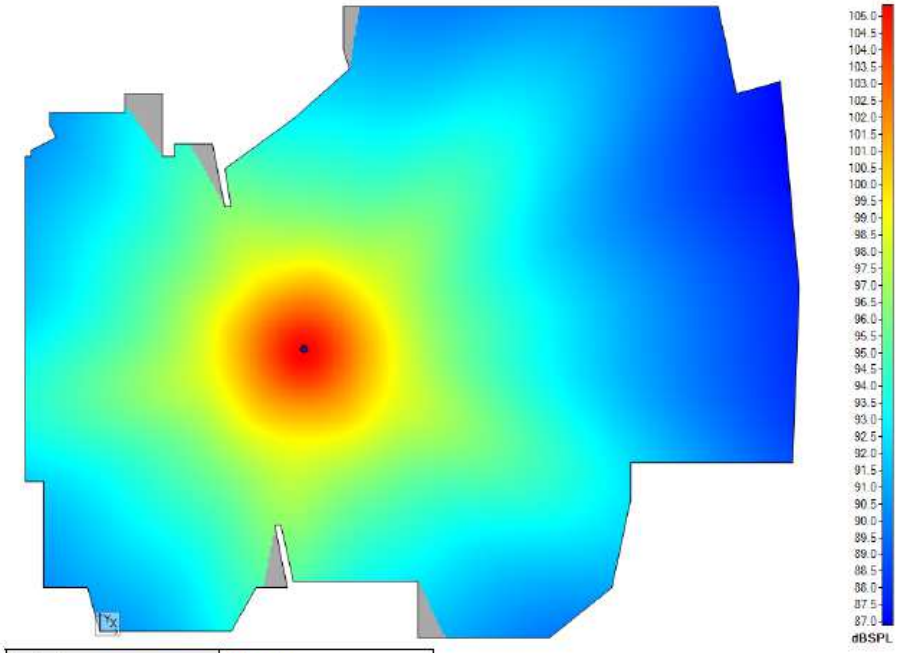
TCPA Omni

American Dream Mall



TCPA Omni

Theatre



Label:	**Theater**
Room Height:	**25.00 ft**
Ear Height:	**5.58 ft**
Network Voltage:	**70.7 V**

LineWave

Intelligibility in Challenging Environments

Industry Leading Voice Intelligibility for Reverberant Environments

UL1480 Type F

CSFM

ULC S541

CE Listed

123dB Max SPL @ 1M

250Hz – 15kHz

Rated for Indoor or Outdoor Applications

Universal Mounting Interface

25/70/100V or 4/8/16Ω Configurable

Available in Black, Red, White and Silk Grey

LineWave

Intelligibility in Challenging Environments

A line array speaker is engineered to produce clear and authoritative commands and powerful tones within reverberant environments.

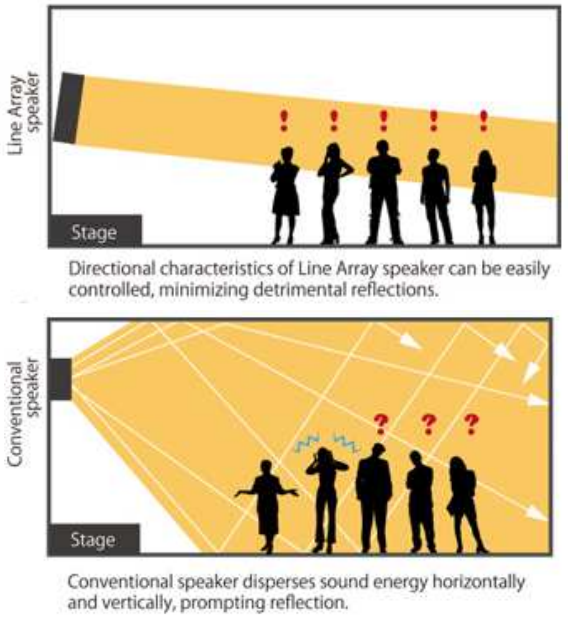
- Controls vertical dispersion by focusing sound away from reflective surfaces
- Aims the sound where needed – at listener's ears
- Highly efficient distribution of power and sound away from the loudspeaker.

Not your typical speaker. Not your typical Line Array

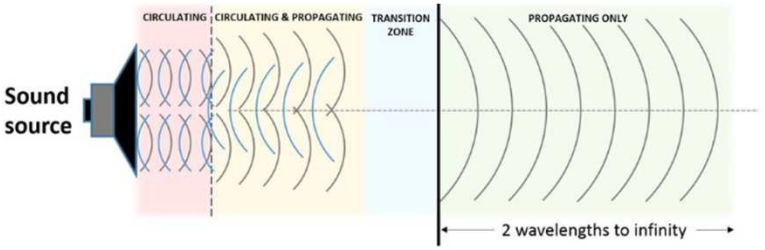
- Typical Line Arrays are used in professional audio applications – not ENS
- Typically used for Music – Not PA and ENS

Cuts Through the Noise – Highly Intelligible Voice!

- Low Frequency background noise of 500 Hz or Less
  - Crowds, air handlers, machinery, traffic, severe weather, fork trucks, etc.
- Mechanically tuned to cut through the noise, regardless of amplification



Near Field
You're not overwhelmed by audio



Far Field
Sounds like you are next to the source.

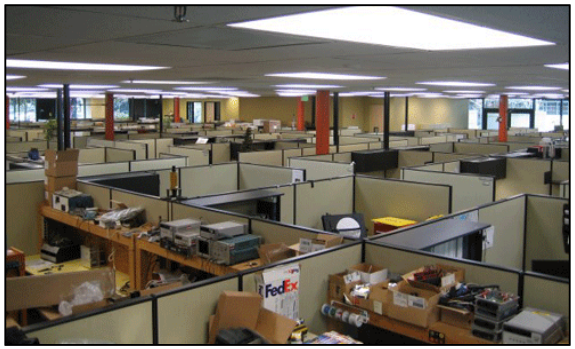
LineWave

Challenging Acoustic Spaces

Small Indoor Spaces

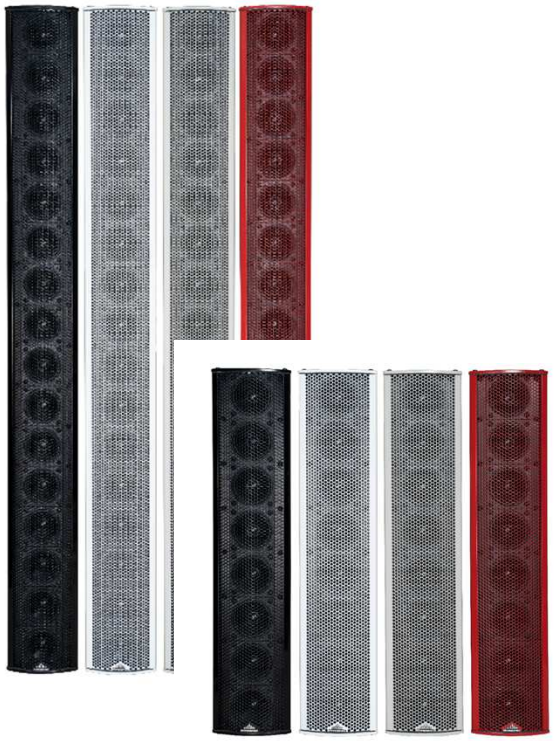
Communication with One Voice

Aesthetically Pleasing



LineWave

Large Indoor Spaces



Large Indoor/Outdoor Spaces

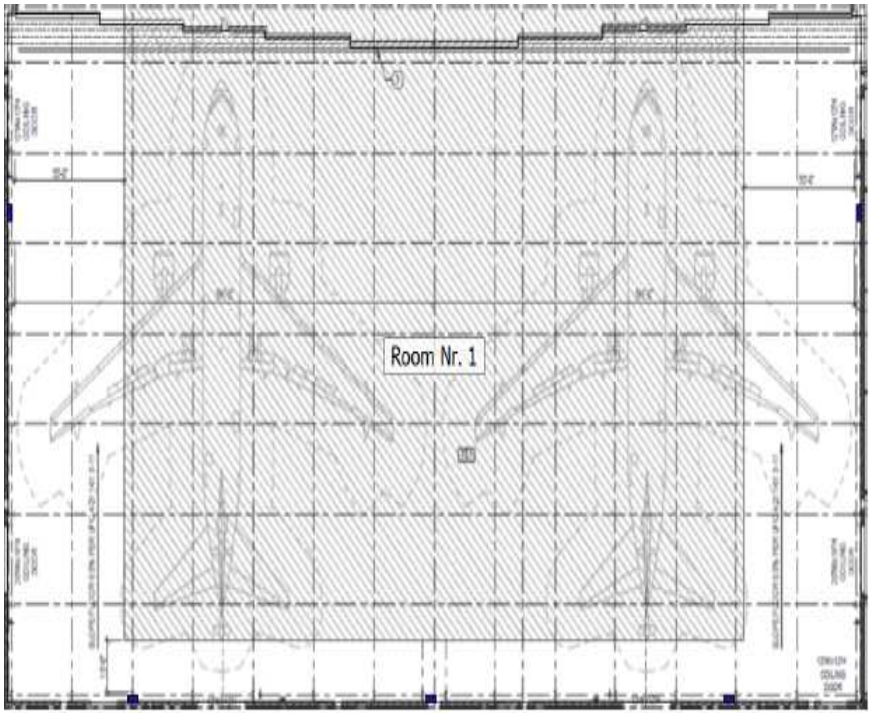
Cavernous areas and obstructions

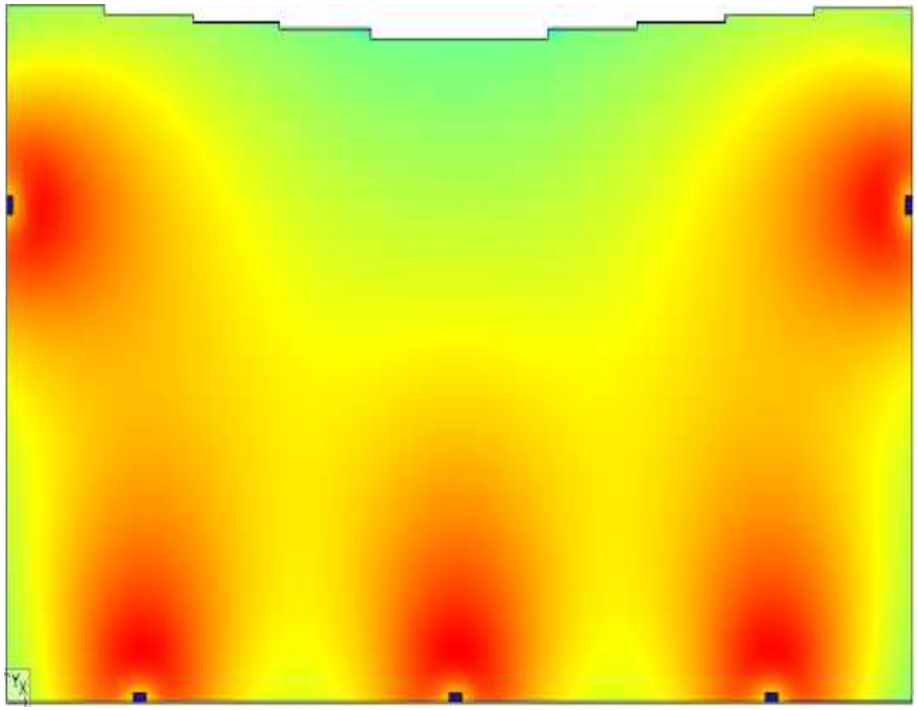
Highly reverberant spaces

Big Box Retail Centers

LineWave

Air Force Hangar





The HyperSpike®
IP Addressable solution

HyperSpike® clarity and intelligibility in a POE speaker

Communicate clearly and effectively in wide area or challenging acoustic environments

A UL/CE certified general notification option.

Unmatched intelligibility that cuts through ambient noise

More coverage/less hardware

Lower installation cost (fewer units per sq ft, less wiring, etc)

Lower maintenance costs (fewer units to inspect and test)

HyperSpike IP Addressability

Available on 3 UL1480/CE listed speakers: 8Ω TCPA-10, LineWave 4x and 8x.

Uses Multicast (Unicast) SIP and auto registration with common ENS platforms (Informacast, Syn-apps, etc.)

Integration with ENS System = total solution

Compatible across all POE platforms and additional **24V backup power**

Why 24V is Unique in the Market
- DC Backup Power
- Trailer and vehicle Applications
- 40W output with optional Wall Charger

Graphic user interface for easy setup and control

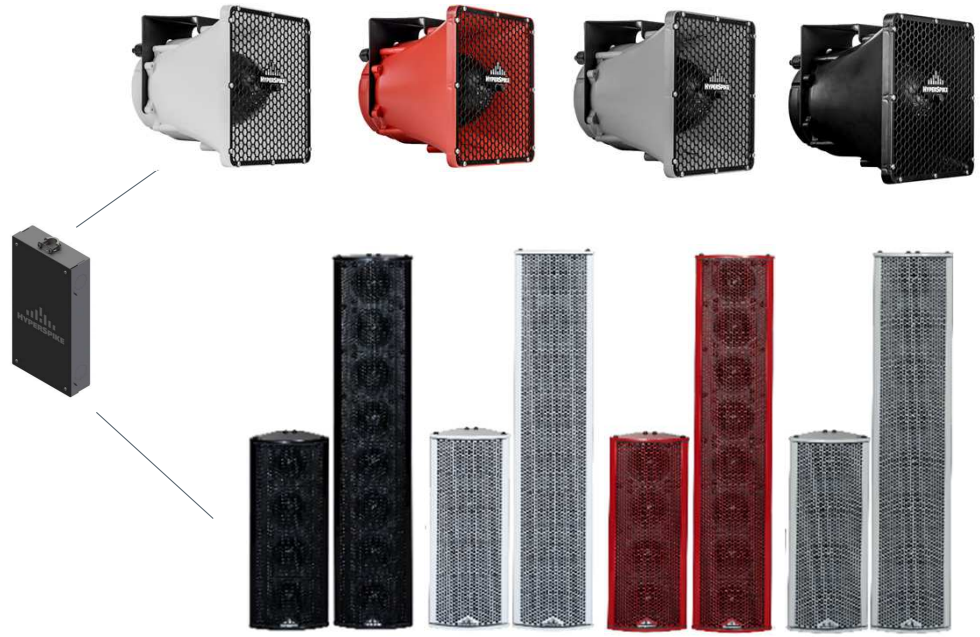
Stored message playback

LED status lights

1 GB storage

Indoor Rated (Speaker is rated for outdoor)

8.78”H x 4.65”W x 1.56”D and less than 2 lbs

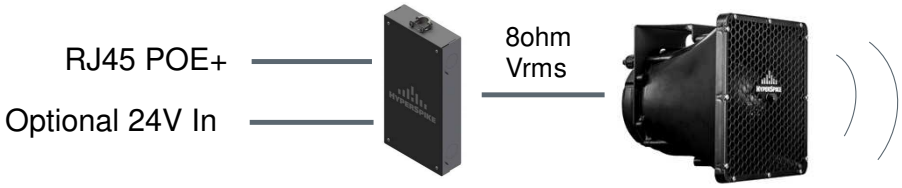


POE Platform	Max Power Output
POE (Auto Negotiates)	10W
POE+	25W
POE++	30W
With additional 24V backup	40W

HyperSpike IP Addressability

TCPA-10 Speaker (8Ω)

- Easily cuts through high ambient noise
- Clear and authoritative voice and tones
- UL 1480 Type F and CID2 Certified Speaker
- Highly efficient
- Available in Black, Grey, Red, White
- Outdoor rated – ideal for outdoor or wide area indoor applications



Power and SPL Specifications

Model	Input Power (V)	Power Draw (W)	SPL Max @ 1m	Usable Range (ft) 80dB Ambient
TCPA-10 (8Ω)	24V	40	131	1246
	POE+	20	128	880

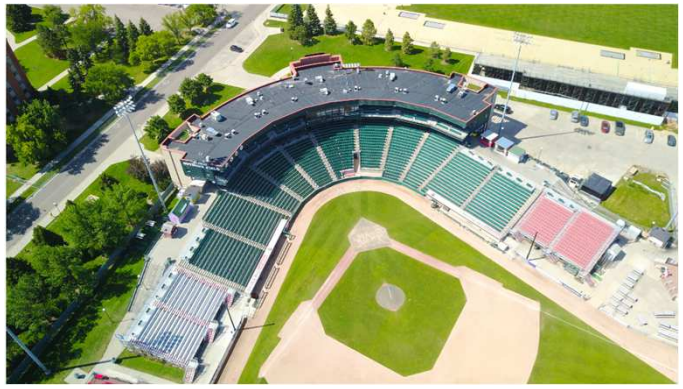
**POE is less 3 dB – 125 SPL Max @1m*

HyperSpike IP Addressability

TCPA-10 Speaker (8Ω)

Ideal Applications

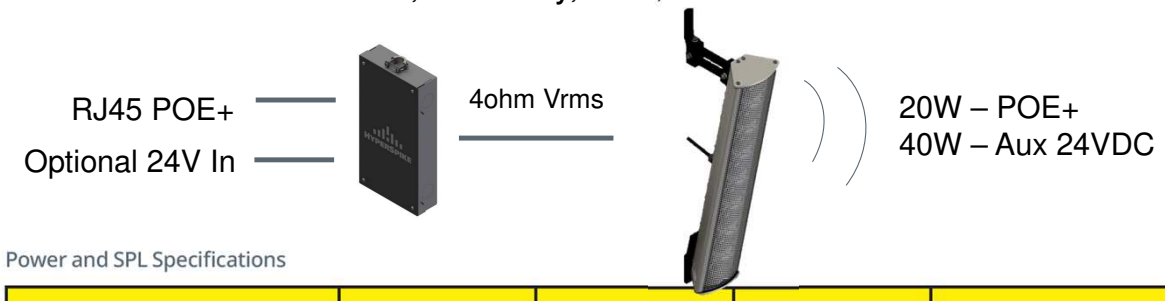
Outdoor or wide area indoor
High ambient environments
Industrial environments
Rugged/hazardous environments
Mobile and vehicle/trailer applications



HyperSpike IP Addressability

LineWave (4x, 8x)

- Improved intelligibility especially in highly reverberant areas
- Ideal for indoor or covered environments
- Aesthetically pleasing to blend in with decor
- Clear and authoritative voice and tones
- Can be used to play background music (i.e., retail locations)
- UL 1480 Type F Speaker
- Available in Black, Silk Grey, Red, White



Power and SPL Specifications

Model	Input Power (V)	Power Draw (W)	SPL Max @ 1m	Usable Range (ft) 80dB Ambient
LineWave 4X	24V	40	110	105
	POE+	20	107	74
LineWave 8X	24V	40	114	160
	POE+	20	111	112

**POE is less 3 dB*

HyperSpike IP Addressability – LineWave (4x, 8x)

Ideal Applications

Indoor locations
Highly reverberant or acoustically challenging environments
Commercial locations







HYPERSPIKE

https://youtu.be/HN3mZBqxIrc

Changing the face of mass notification

2022 New Product TCPA-10 Array

Game Changer: K-12 mass notification applications with significant advantages over all major competitors

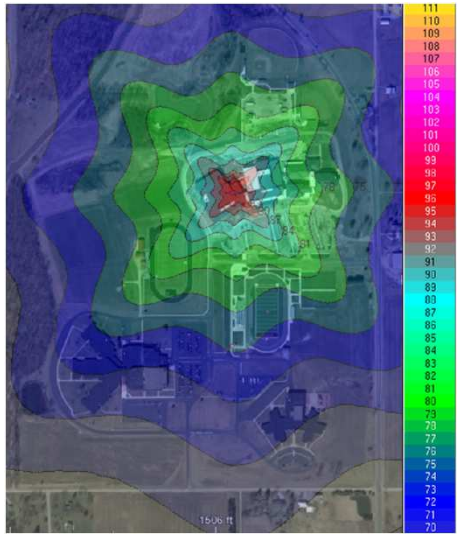
Better performance, smaller package, higher efficiency at a lower cost.

Half of the price of our current outdoor notification offering. ($10k vs $20k)

Opens new markets in global security and domestic mass notification.

IP Addressability allows for direct connection to mass notification software (i.e., Informacast and Synapps)

VS



Outdoor Model of Local Columbia City High School: 2000'x2800' campus

70-75dB of coverage throughout outdoor K-12 campus.

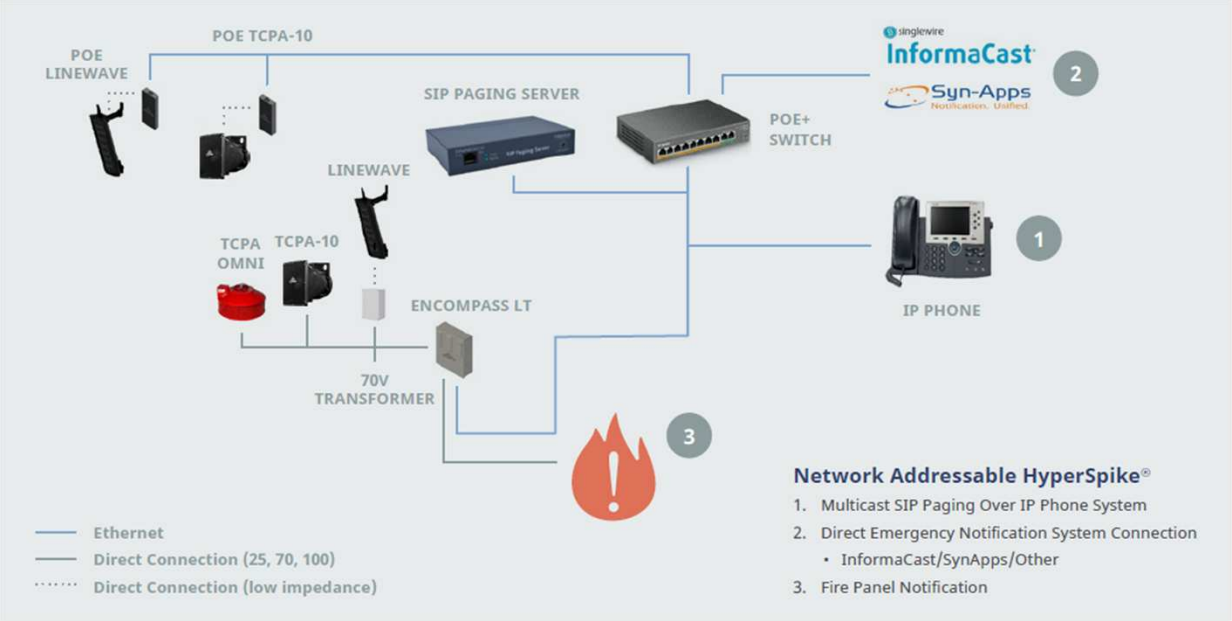
2022 Release
ENCOMPASS LT

Game Changer – Bridges the Fire Alarm and General Notification Systems into One Solution.

Replaces current antiquated amplification solutions.

Provides low-cost option for wide area outdoor notification.

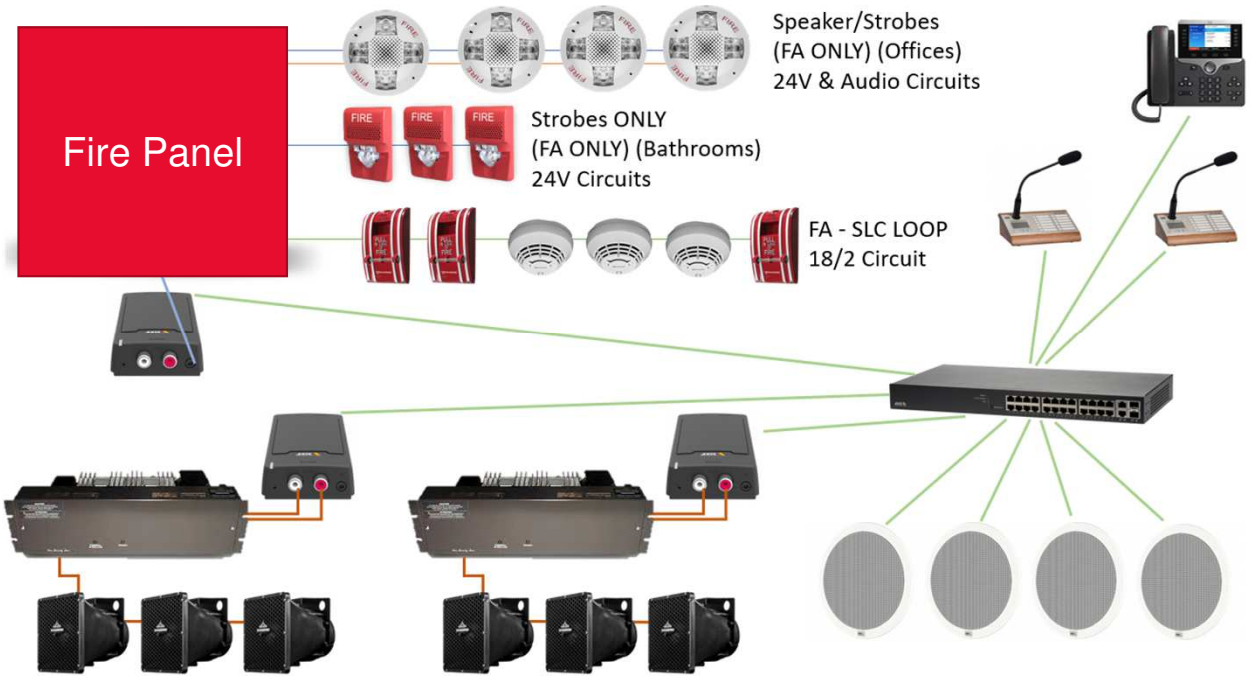
Necessary component for most Fire and Life Safety Systems with very little competition.



- Optimized for HyperSpike medium power speakers
- Smart self-protection, speaker monitoring and fault reporting
- Access to back-up power
- Continuous full-volume AC operation wile switching to/from DC backup power
- Auto switches between IP and Fire Panel Analog Audio
- SNMP for simple health and status checks = lower maintenance costs
- 300/600 Watts of IP addressable amplification (with battery back-up)
- 1V or 25/70/100V input
- Volume control and test tone button
- 53 lbs not including batteries
- 27.25” H x 17.35” W x 7.5” D

HYPERSPIKE

Current Integrated System

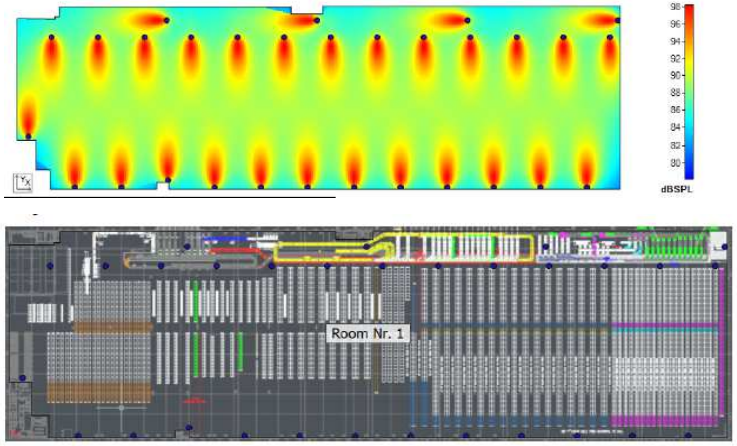


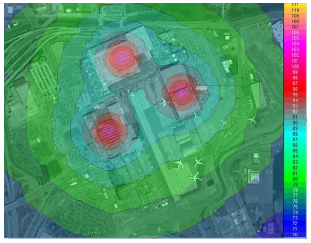
Challenges

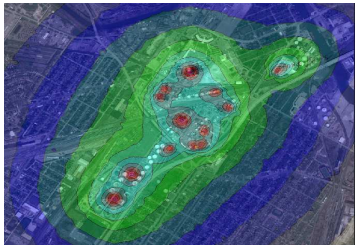
- Latency
- Monitoring
- Increased Costs
- Back Up Power

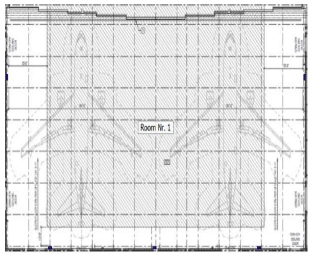
Ease Modeling Services

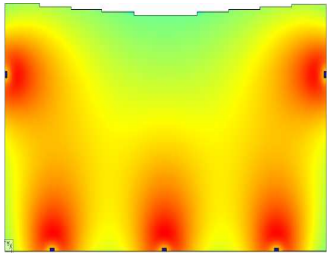
- EASE/EVAC Acoustic Model
- SUGGESTIVE ONLY!! Too many unknown factors
- Best for single floor or low level of complexity
- Common Application and Spaces – not highly reverberant
- Examples:
  - Warehouses
  - Outdoor Municipalities
  - Large indoor recreation areas
  - Average or lower ambient manufacturing areas and distribution centers











HyperSpike® Product Overview

Videos and Demonstrations

HS-10

- Demonstration Video https://youtu.be/0fPGNb3IKf0
- Marketing Video https://youtu.be/GS6KvBt53dU

TCPA-10

- Demonstration Video https://youtu.be/aZ1dlvl8mvE
- Marketing Video https://youtu.be/jaTA_cgFicc

MA-1

- Demonstration Video https://youtu.be/pvPORa3-8h4
- Marketing Video https://youtu.be/pb0Acl400yc
- On-site Demo Video https://youtu.be/LpjQ8Sp2gjM

LineWave

- Demo Video https://youtu.be/eSKnKO0zKE8
- Training video https://youtu.be/uXMSR1zCRZA

Encompass Training Video https://youtu.be/W_9BJ5C9QSE

File Attachments for Item:

ER-7 NEC 2020 Changes (Electrical League of Ohio)

BO, MPE, EPE, ESI, BI, RBO, RPE, RBI (2 hours)

Staff Notes: This course was approved in February as BBS2022-489 for one hours. The submitter, Terri Hanna-Wiehn, contacted us to say it should have been submitted for two hours and provided an amended outline (the slide set was correct as submitted). With Terry and Tim's permission, we administratively approved the course for two hours and are now asking the Committee to recommend that the Board ratify this approval.

Committee Recommendation:

Outline
2020 NEC Changes

Instructors: Jack Lyons, NEMA Northeast Field Rep & Tim McClintock, NEMA Midwest Field Rep

Course Description

This course is scheduled for a two-hour presentation that will include an overview of top significant changes to 2020 NEC. The slide presentation will include the IAEI Analysis of Changes program. Review of new articles and revised requirements addressing industry trends in new technology and delivery and generation of electric power are key highlights included in the program. Speakers will provide the background and rationale behind key changes to the 2020 NEC and will engage with the audience on the impact and application/methods of compliance.

1. Overview of the four new Articles and Code-wide changes in the 2020 NEC
   15 minutes

2. Review of changes impacting electrical worker safety:
   a. 110.26 – requirements related to working space requirements for non-dwelling unit large electrical equipment installations.
      10 minutes
   b. 230.71 – Revisions to service disconnect requirements
      10 minutes
   c. 240.67 & 240.87 – Revised requirements for arc energy reduction
      10 minutes

3. Article 220 – Extensively revised to reflect improvements in energy efficiency and impact related to load calculations
   15 minutes

4. Review of broader changes that impact residential installations:
   a. 210.8 – Revisions to GFCI protection
      10 minutes
   b. 210.52(C) – Receptacle outlet requirements
      10 minutes
   c. 406.9(C) – Receptacles in bathrooms
      10 minutes
   d. 230.67 – Surge Protection for dwelling units
      10 minutes
   e. 230.85 – Exterior disconnect requirements
      10 minutes
   f. 314.27(C) – Boxes at ceiling suspended paddle fans
      10 minutes

File Attachments for Item:

ER-8 Overview of the 2017 OMC (Ohio Certificate Renewal)

Add FPPE, FPI (4 hours, 8 hours)

Staff Notes: These are two courses already renewed for 2022. The submitter would like to add FPPE and FPI to the certifications. Slides 15, 21, 53, 55, 58, 68, 71, 72, 75, 76, 78, and 83 pertain to fire protection.

Committee Recommendation:

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: Harold L. Plant, Ohio Certificate Renewal

Course Submitter: Harold L. Plant (Contact Name)

Organization: Ohio Certificate Renewal (Organization/Company)

Address: P.O. Box 211102 (Include Room Number, Suite, etc.)

City: Columbus State: OH Zip: 43221

E-Mail: HalPlant2112@outlook.com

Telephone: 614-451-9003 Fax:

Course Sponsor: Ohio Certificate Renewal

COURSE INFORMATION:

Course Title: Overview of the 2017 OMC 8

New Course Submittal: ☐ Update Course: ■ Prior Approval Number: BBS2022-267

Purpose and Objective: As previously approved. Add FPI and FPPE.

Number of Instructional Contact Hours that can be obtained upon completion: 8

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

Program Applicable for the Following Participants:

Building Official	■	Master Plans Examiner	■	Building Inspector	■	Fire Protection Inspector	■
		Building Plans Exam.	✔				
		Plumbing Plans Exam.	☐				
		Electrical Plans Exam.	■				
		Mechanical Plans Exam.	■				
		Fire Protect. Plans Exam.	✔				

Mechanical Inspector	■	Plumbing Inspector	☐	Non-Res IU Inspector	■				
Res Building Official	■	Res Plans Examiner	■	Res Building Inspector	■	Res Mechanical Inspector	☐	Res IU Inspector	■

Electrical Safety Inspectors X

Location of ESI Course: n/a Date(s) of ESI Course(s): tbd

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

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

Overview of the 2017 Ohio Mechanical Code

Presented by:

Robert J. Schutz, P.E., P.S., CBO

BBS approved course No. BBS2019-319 for 4 hours continuing education credit for BO, MPE, BPE, MechPE, BI, MI, NRIUI, RBO, RPE, RBI, RMI, RIUI

Developed by: Yeong T. Jiang, P.E., CBO, BI
Plans Examiner Supervisor
Ohio Department of Commerce

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Overview of the 2017 Ohio Mechanical Code

Presented by:

Robert J. Schutz, P.E., P.S., CBO

BBS approved course No. BBS2019-318 for 8 hours continuing education credit for BO, MPE, BPE, MechPE, BI, MI, RBO, RPE, RBI, RMI, NRIUI, RIUI

Developed by: Yeong T. Jiang, P.E., CBO, BI
Plans Examiner Supervisor
Ohio Department of Commerce

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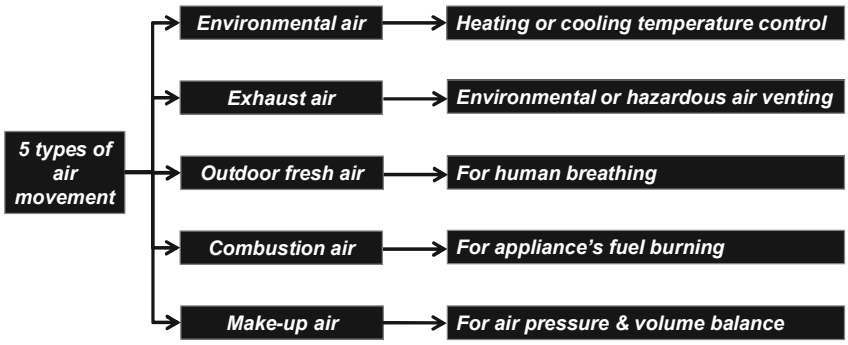
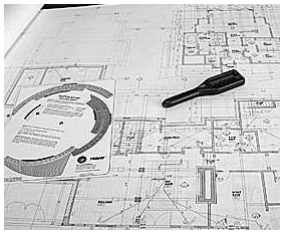
The BIG picture: What is in the Ohio Mechanical Code?



Ohio Mechanical Code (OMC) provides minimum standards for the design and installation of mechanical appliances, equipment and associated piping and ducts to manage, not to prevent, risks produced by these activities to acceptable levels for occupants' safety.



Chapter 1 Scope and Administration

- ***Scope, applicability, jurisdictional authority;***
- ***Certified building department and personnel duties and responsibilities;***
- ***Construction documents, inspections, approvals and certificates of occupancy;***
- ***Violations, notices, and appeals; and***
- ***Materials and products.***

Section 101.2 Scope
The provisions of this code shall apply to the design, installation, maintenance, alteration, repair, relocation, replacement, addition to, use and inspection of mechanical systems within buildings. This code shall also apply to those systems, system components, equipment and appliances specifically addressed herein.

Section 101.3 Administrative and enforcement.
For administrative and enforcement provisions of this code, refer to building code Sections 101.2 to 115.4.
Section 101.4 Referenced standards.
When a reference is made within the mechanical code to . . . any . . . technical publication, the specific date and title of the publication and the promulgating agency are listed in Chapter 15 of this code.

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102.10.2 Minor repairs.
Minor repairs to structures may be made without application or notice to the building official. Such repairs shall not include the cutting away of any wall, …….; nor shall minor repairs include addition to, alteration of, replacement or relocation of any standpipe, water supply, sewer, drainage, drain leader, gas, soil, waste, vent or similar piping, electric wiring or mechanical or other work affecting public health or general safety.

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OBC Section 102.10: Work exempt from approval.
Approval shall not be required for the following work; however this work shall comply with the applicable provisions of the rules of the board:

Mechanical:

1. ***Portable heating appliances, ventilation equipment, cooling units and evaporative coolers;***
2. ***Replacement of any part which does not alter its approval or make it unsafe;***
3. ***Process equipment and associated piping. For combination . . piping systems . . . piping located downstream of the control valve which separates the process and building services piping is exempt.***
4. ***Distribution piping . . . by public / municipal utilities.***

NOTE: Also see Electrical, Gas and Plumbing

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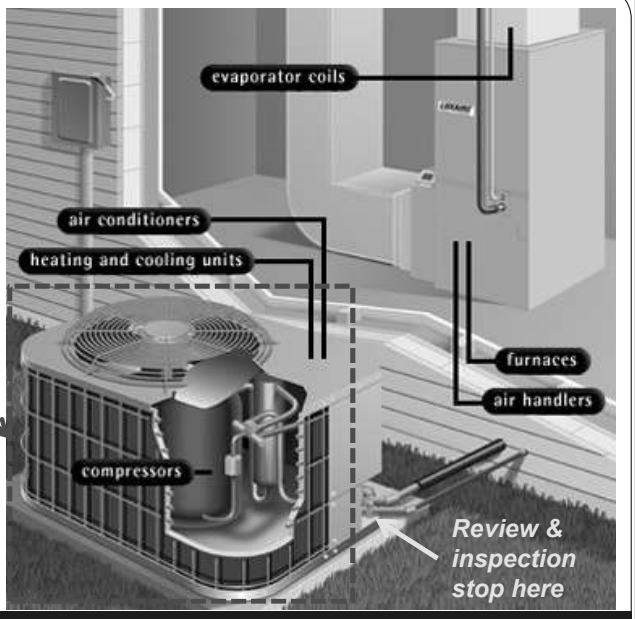
102.10: Work exempt from approval: Mechanical Item #6



Equipment itself & piping/wiring inside are exempt from approval

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Commonly asked question:
We would like to replace our rooftop HVAC units. They are all one-for-one and like-for-like replacements. Do we need a permit for this?

- ***Yes, a building permit is required.***
- ***101.2 OMC states "The provisions of this code shall apply to the . . . replacement . . . of mechanical systems***
- ***102.10 exemption #4 provides an exception to allow replacement of "any part" only; not whole equipment***
- ***This does not meet the "Minor repairs" definition in section 102.10.2 OBC – Mechanical Permit is required and may require a technical analysis by a design professional including structural load, electrical load, sizing, outdoor air analysis, and similar which affect health and safety.***

Section 102.5 Applicability.

- ***When there is conflict between Ohio Mechanical Code (OMC) and other referenced codes, standards, and rules (listed in Chapter 15), the provisions of OMC supersede.***
- ***Exception (102.3) is for rules and orders issued by the fire marshal pursuant to Chapter 3743, ORC (for fireworks facilities).***

Section 106: Construction Documents

- **What are the requirements for construction documents to be submitted for mechanical plan review?**

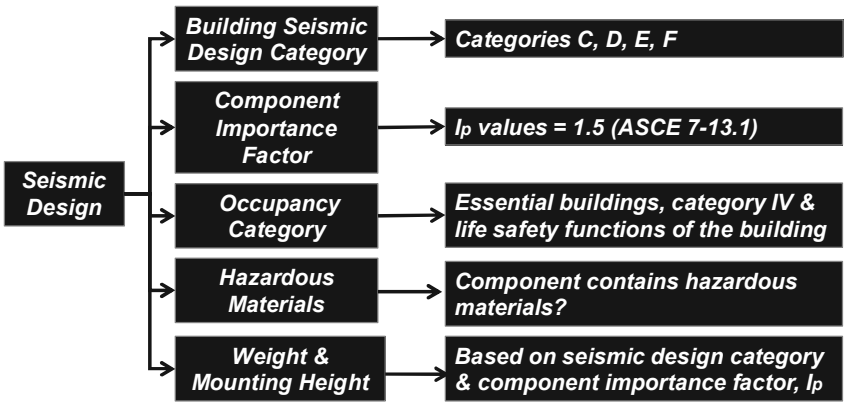
Site Plan and Index	Location of the building & drawing index
Building Information	Use group, construction type, occupant load, height and area, fire protection, DFE
Floor Plans	Building configuration, rooms, work layout in room(s), fire rated assemblies
Proposed Details	System description, layout, new/existing materials & products, dimensions, clearances, sections, connections, dampers, fire stopping, outdoor air, and installation instructions
Evidence of Responsibility	Documents must bear the seal of an Ohio registered design professional per 106.2.1. OBC / 3791.04 ORC

Section 106.1.1 / 2.1: Buildings or structures in flood hazard areas.

Construction documents submitted for buildings or structures located in communities with identified flood hazard areas, pursuant to Section 1612, shall include the current FEMA "Flood Hazard Boundary Map" (FHBM), "Flood Insurance Rate Map" (FIRM) or "Flood Boundary Floodway Map" (FBFM) for the project location. The required site plan shall include building elevations using the same datum as the related flood hazard map. The owner shall be responsible for the compliance with local flood damage prevention regulations for additional critical elevation information for the project site.

Seismic design: 1613.6.8 OBC & 13.6 ASCE 7

Seismic design requirements for the design and installation of mechanical components are important based on the following factors:



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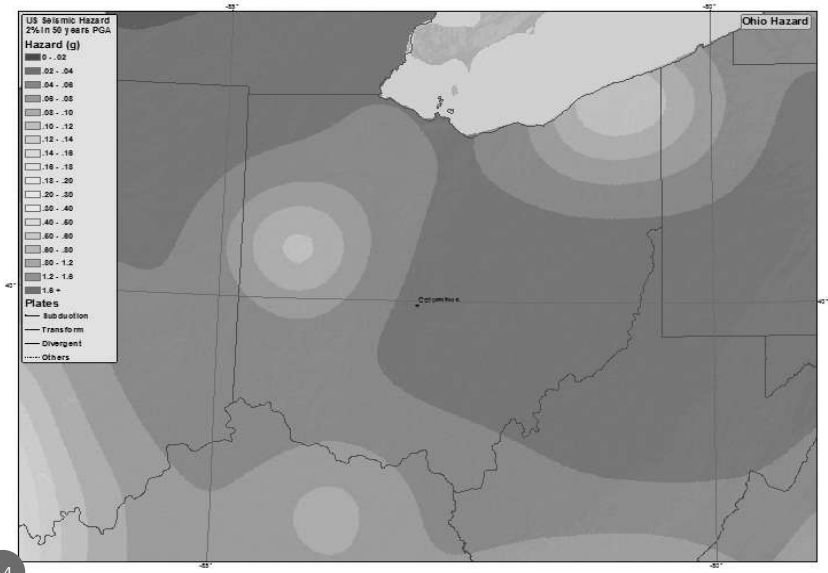
Ohio Seismic Hazard Map



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Section 106.5: Alternative Engineering Design

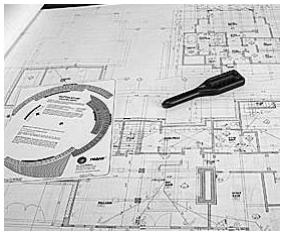
The design, documentation, inspection, testing and approval of an alternative engineered system shall comply with Sections 106.5.1 to 106.5.3 of this rule

Design Criteria	Conform to the intent of code and provide equivalent level of quality, strength, fire resistance, effectiveness, durability, & safety
Submittals	Drawings should indicate that an alternative design has been submitted.
Technical Data	Sufficient technical data should be submitted to prove that the alternative design meets the intent of this code.

Section 114.2: Alternative Products and Materials

- **114.2.1 Research reports.**
  A valid research report from an evaluation service listed in "Appendix P" shall be submitted.

- **114.2.2 Board approval.**
  Any material, product, assembly or method of construction not specifically provided for in this code may be approved by the board of building standards upon application under the procedures prescribed by the board.



Chapter 2
General Definitions

- ***Establishes the meanings of key words and terms used in this code.***
- ***Where terms are not defined through the methods authorized by this section, such terms shall have ordinarily accepted meanings such as the context implies.***

Section 202: General Definition Example

MEDIUM-DUTY COOKING APPLIANCE.
Medium-duty cooking appliances include electric discrete element ranges (with or without oven), electric and gas hot-top ranges, electric and gas griddles, electric and gas double-sided griddles, electric and gas fryers (including open deep fat fryers, donut fryers, kettle fryers and pressure fryers), electric and gas conveyor pizza ovens, electric and gas tilting skillets (braising pans) and electric and gas rotisseries.

Clarification:

Cooking appliances must be verified per the definition in this section. For example, the required flow rate capacity in section 507.13.3 OMC must be verified for hoods serving these appliances.

Chapter 3
General Requirements

- ***General requirements for protection of structure, equipment and appliance location, installation, piping support,***
- ***Access and service space, condensate disposal,***
- ***Clearance reduction, temperature control, etc.***

Section 301.4: Listed and Labeled

301.4 Listed and labeled.
Appliances regulated by this code shall be listed and labeled for the application in which they are installed and used, unless otherwise approved in accordance with Section 114 of the building code.

Clarifications:

1. ***Equipment must have a label by the manufacturer listing all criteria and testing information per 301.6 OMC.***
2. ***Examples of common mistakes:***
   - ***Furnace in attic is not listed for attic installation,***
   - ***Appliance installed outdoor not listed for outdoor installation.***

Section 302.2: Penetrations

Penetrations of floor/ceiling assemblies and assemblies required to have a fire-resistance rating shall be protected in accordance with the building code (Section 713.4 OBC)

Clarifications:

1. **All penetrations of floor/ceiling assemblies, fire resistance rated or not, shall be protected per building code.**
2. **All penetrations of a fire-resistance rated wall assemblies shall be protected per building code.**

21

21

Section 303.3: Prohibited appliance locations

Fuel-fired appliances shall not be located in, or obtain combustion air from, any of the following rooms or spaces:

1. **sleeping rooms,**
2. **bathrooms,**
3. **toilet rooms,**
4. **storage closets,**
5. **surgical rooms.**

Clarifications:

1. **The intent is prevent the combustion gases from building up and cause harm to the occupants.**
2. **See section 303.3 OMC for exceptions**

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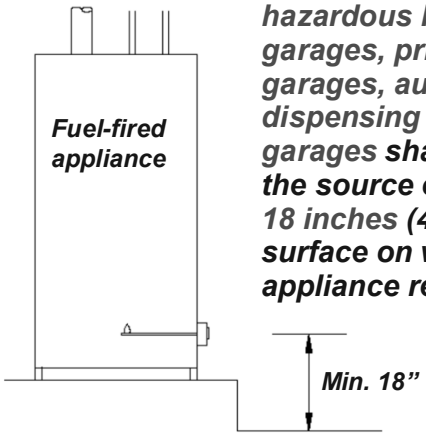
Section 304.3: Elevation of ignition source



Equipment and appliances having an ignition source and located in hazardous locations and public garages, private garages, repair garages, automotive motor fuel-dispensing facilities and parking garages shall be elevated such that the source of ignition is not less than 18 inches (457 mm) above the floor surface on which the equipment or appliance rests

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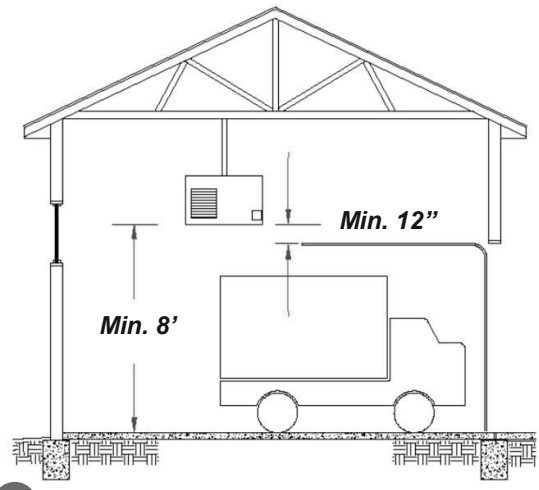
Section 304.6: Public Garages



Appliances located in public garages, motor fueling-dispensing facilities, repair garages or other areas frequented by motor vehicles

24

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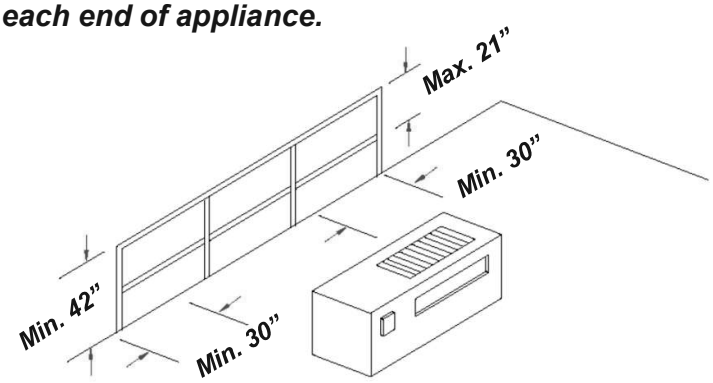
Section 304.11: Guards for appliance on roof

- Guard is required for appliance <10' from roof edge, or open side of walking surface > 30" in height,
- Guard shall meet the loading requirements,
- Guard shall be installed at a minimum 30" beyond each end of appliance.



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An Overview of the Ohio Mechanical Code 2017

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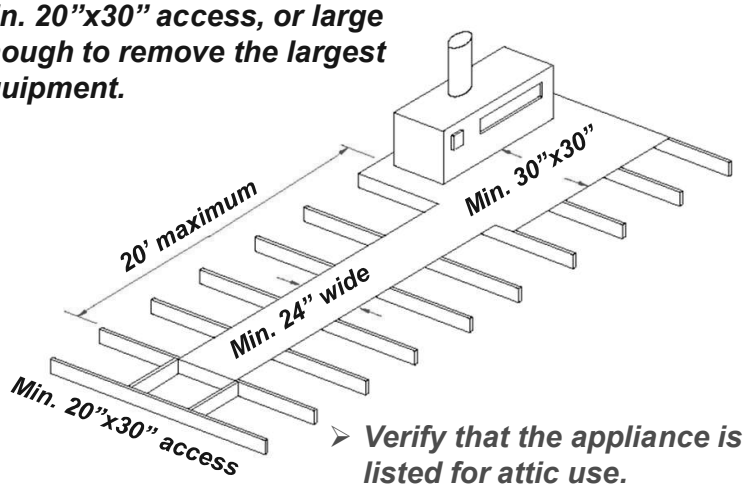
Section 306.3: Appliance in attics

- Min. 30" clearance in height,
- Min. 20"x30" access, or large enough to remove the largest equipment.



- Verify that the appliance is listed for attic use.

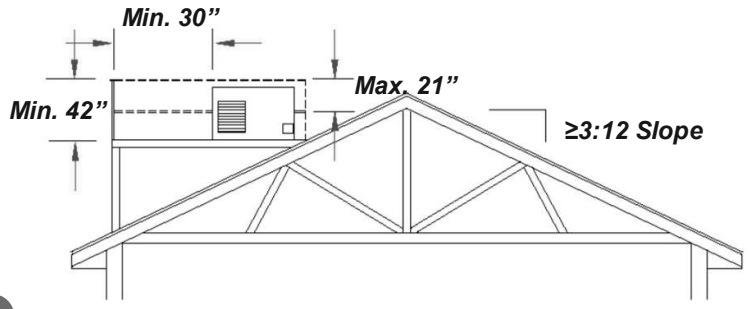
26

An Overview of the Ohio Mechanical Code 2017

26

Section 306.5.1: Appliance on sloped roof

- A level platform must be provided,
- Guards shall meet the loading requirements,
- Access to platform shall not require walking on sloped roofs > 4:12 in pitch,
- Shall not require to climb over obstructions higher than 30", otherwise, a ladder or stair shall be provided.



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Section 306.5.1: Appliance on sloped roof

- Something like one of these?

28

Section 307: Condensate disposal

- ***The minimum condensate pipe slope 1/8" per foot, i.e., is 1%.***
- ***The minimum size for a condensate pipe is ¾" internal diameter; shall not decrease in size down flow.***

TABLE 307.2.2 CONDENSATE DRAIN SIZING

EQUIPMENT CAPACITY	MINIMUM CONDENSATE PIPE DIAMETER
Up to 20 tons of refrigeration	$^3/_4$ inch
Over 20 tons to 40 tons of refrigeration	1 inch
Over 40 tons to 90 tons of refrigeration	$1^1/_4$ inch
Over 90 tons to 125 tons of refrigeration	$1^1/_2$ inch
Over 125 tons to 250 tons of refrigeration	2 inch

29

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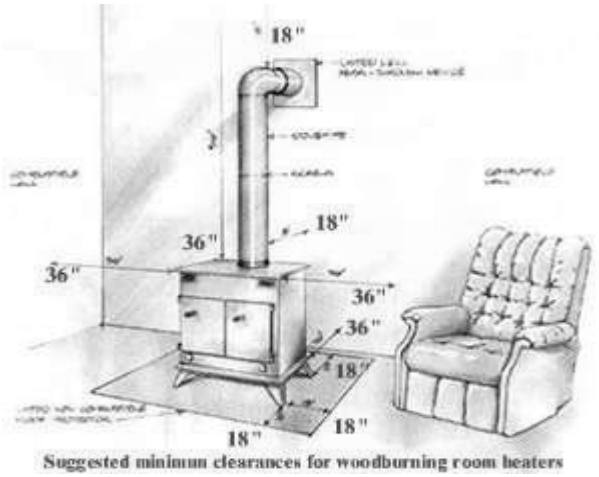
Section 308: Clearance Reduction

- ***Clearance to combustible surfaces shall be based on the manufacturer's instructions in listing label.***



Suggested minimum clearances for woodburning room heaters

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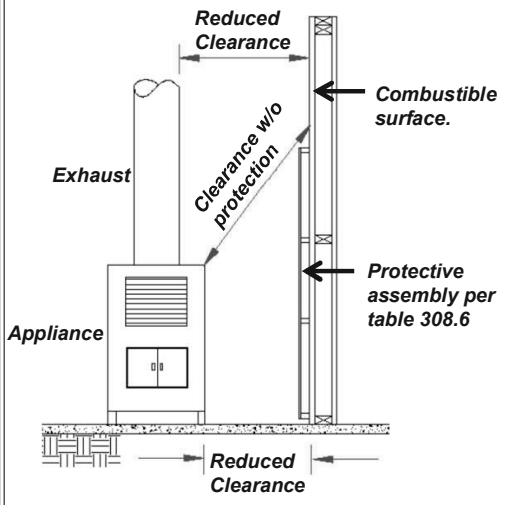
Section 308.2.1: Clearance Reduction



- ***Clearance distance is measured from the heat source to the combustible surface** even if that combustible surface is not visible.*
- ***The listed clearance to combustible surfaces can be reduced based on the types of protective assembly listed in table 308.6 OMC.***
- ***Clearance reduction in table 308.6 OMC** can not be used **if the manufacturer's listing or label** prohibits **the** reduction. (308.2 OMC)*

31

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Section 309: Temperature Control

- ***What is the minimum indoor temperature for space or room designed for human occupancy? Can portable space heaters be used to accomplish this?***

Section 309.1 OMC:
Interior spaces intended for human occupancy shall be provided with active or passive space-heating systems capable of maintaining a minimum indoor temperature of** 68°F (20°C) at a point 3 feet (914 mm) above floor **on the design heating day. The installation of portable space heaters** shall not **be used to achieve compliance with this section.

32

32

Chapter 4
Ventilation

- ***General requirements for the ventilation of spaces within a building intended to be occupied.***

Section 401: General Requirements

- ***Ventilation shall be provided during the periods that the room or space is occupied.***
- ***Every occupied space shall be ventilated by:***
  - ***Natural means (Section 402) or,***
  - ***Mechanical means (Section 403).***

Question:

- ***Can a designer use a combination of natural and mechanical ventilations in the same building?***
- ***The requirement is to use either natural ventilation or mechanical ventilation for each occupied space. So, use combination of two methods in the same building is not prohibited. However, spaces using natural ventilation still need to meet the requirement of minimum temperature. Also, temperature and pressure balance for the whole building will need to be verified.***

Section 401: General Requirements

- **Section 401.4: Intake opening locations**
  - **Min. 10' from lot lines or building on same lot,**
  - **Min. 10' horizontally from any hazardous or noxious contaminant source such as vents, streets, alleys, parking lots, loading docks,**
  - **If within 10', intake opening must be minimum 3' below contaminant source**
  - **Intake opening must be at or above the design flood level**

Section 402: Natural ventilation

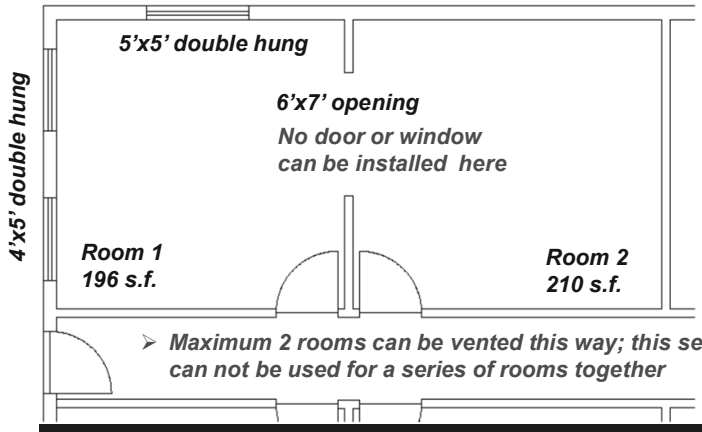
- **Natural ventilation shall be through windows, doors, louvers, vents, skylights, or other openings to the outdoors.**
- **The minimum openable area to the outdoors shall be 4% of the floor area being ventilated.**

Clarification:

1. **Only openable portion of a window, door, or other opening can be calculated into the ventilation area. Fixed window or storefront, etc., can not be used.**
2. **For example, a 4'x3' double hung window can be calculated as 6 square feet openable area because only ½ of the window leafs can be open at one time.**
3. **If any window or door is used for natural ventilation purpose, the location must be in compliance with 401.4 OMC.**

Section 402.3: Natural ventilation thru adjoining space

- 6'x7' opening = 42 s.f. > (210 s.f. x 8% = 16.8 s.f.) and min. 25 s.f. …… O.K.
- Total openable area: 5'x5'/2 + 4'x5'/2 + 4'x5'/2 = 32.5 s.f.
- Openable area 32.5 s.f. > (196 s.f. + 210 s.f.) x 4% = 16.24 s.f. …….. O.K.
- Natural ventilation for room 2 through room 1 is acceptable.



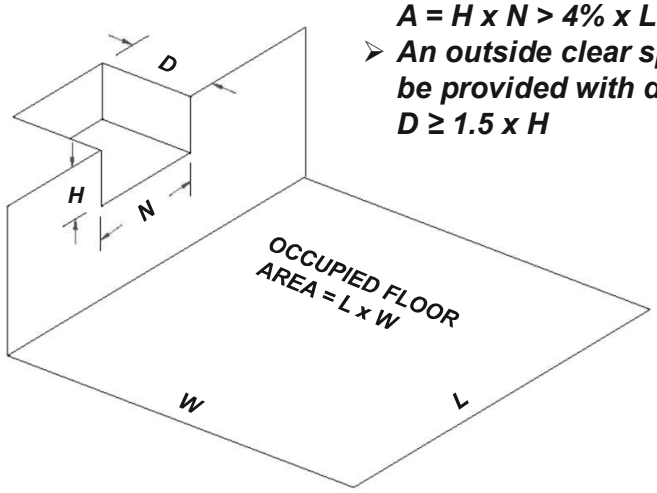
- Maximum 2 rooms can be vented this way; this section can not be used for a series of rooms together

37

37

Section 402.4: Natural ventilation opening below grade

- Openable area (A)
  A = H x N > 4% x L x W
- An outside clear space must be provided with depth
  D ≥ 1.5 x H



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38

Section 403: Mechanical ventilation

403.2 Outdoor air required.
The minimum outdoor airflow rate shall be determined in accordance with Section 403.3. Ventilation supply systems shall be designed to deliver the required rate of outdoor airflow to the breathing zone within each occupiable space.

Exception: The registered design professional may use ASHRAE 62.1 or ASHRAE 62.2, as applicable, as an alternative engineered ventilation system design provided that the registered design professional demonstrates compliance with all applicable sections of the ASHRAE standard.

39

39

Section 403: Mechanical ventilation

What are some of differences between ASHRAE 62.1 or ASHRAE 62.2 and provisions in OMC?

- ***The minimum ventilation rate table and notes in ASHRAE are slightly different from OMC,***
  - ***Occupancy classifications are slightly different,***
  - ***Re-circulation allowance based on zone air class in ASHRAE,***
  - ***ASHRAE table has "combined outdoor air rates".***
- ***The tables for zone air distribution effectiveness (Ez) and ventilation efficiency (Ev) are slightly different,***
- ***ASHRAE has provisions for reduced outdoor air rates based on varying operating conditions such as variable occupant load conditions short term occupancy conditions (intermittent use).***

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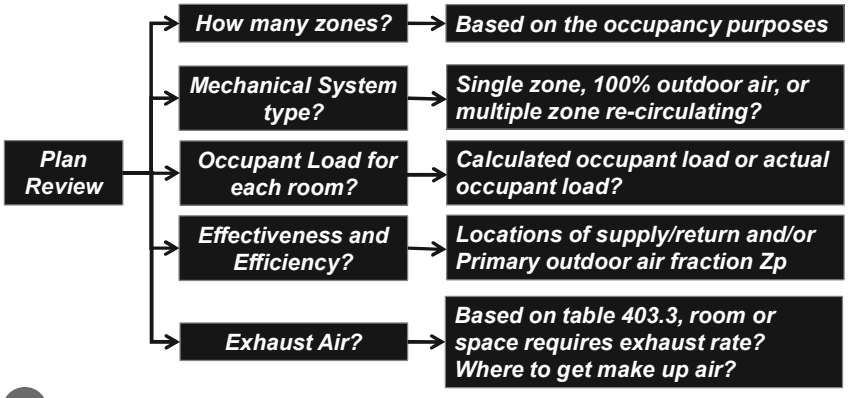
40

Section 403: Mechanical ventilation

The following factors of building mechanical ventilation system must be verified to review the total required outdoor air rates for a building:



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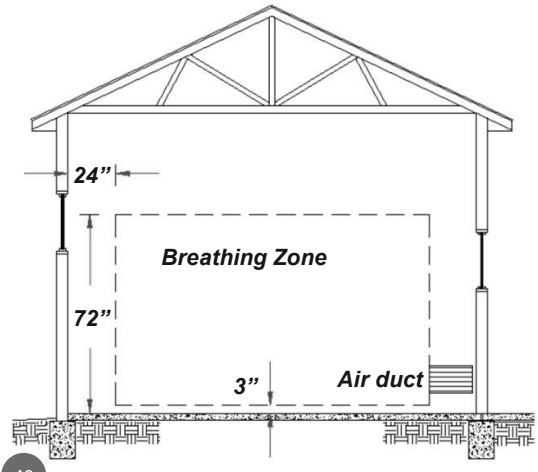
Section 202: Breathing zone definition

The region within an occupied space between planes 3 and 72 inches above the floor and more than 2 feet from the walls of the space or from fixed air-conditioning equipment.



Section 202 OMC:
Definition of ZONE
One occupiable space or several occupiable spaces with similar occupancy classification (see Table 403.3), occupant density, zone air distribution effectiveness and zone primary airflow rate per unit area.

42

42

Section 403.3.1: Zone outdoor airflow

The minimum outdoor airflow required to be supplied to each zone shall be determined as a function of occupancy classification and space air distribution effectiveness in accordance with Sections 403.3.1.1 through 403.3.1.3.

- **Section 403.3.1.1: Breathing zone outdoor air rate (V_{bz})**

  $V_{bz} = R_p P_z + R_a A_z$

  P_z = Zone population A_z = Zone floor area
  R_p = From table 403.3 R_a = From table 403.3

- **Section 403.3.1.2: Zone air distribution effectiveness (E_z)**
  - **E_z values taken from table 403.3.1.2**
  - **If cooling mode and heating mode effectiveness values are different, use the most restrictive value (smaller value)**

- **Section 403.3.1.3: Zone outdoor air rate (V_{oz})**
  $V_{oz} = V_{bz} / E_z$

43

43

TABLE 403.3 MINIMUM VENTILATION RATES (Partial table shown)

OCCUPANCY CLASSIFICATION	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_a CFM/FT² [a]	DEFAULT OCCUPANT DENSITY #/1000 FT² [a, i]	EXHAUST AIRFLOW RATE CFM/FT² [a]
Correctional facilities				
Cells				
without plumbing fixtures	5	0.12	25	—
with plumbing fixtures[g]	5	0.12	25	1.0
Dining halls (see food and beverage service)	—	—	—	—
Guard stations	5	0.06	15	—
Day room	5	0.06	30	—
Booking/waiting	7.5	0.06	50	—
Dry cleaners, laundries				

- **Mechanical exhaust is required where indicated in the table,**
- **Re-circulated air is prohibited in areas listed & in section 403.2.1,**
- **The total occupant load calculated by "Default Occupant Density" shall be less than that determined by section 1004 of the Ohio Building Code.**

44

44

Section 403.3.2: System outdoor airflow

The total system outdoor airflow rate (V_{ot}) for a building shall be summarized in accordance with section 403.3.2.

- **Section 403.3.2.1: Single zone system**
  - $V_{ot} = V_{oz}$
- **Section 403.3.2.2: 100% outdoor air system**
  - $V_{ot} = \Sigma_{\text{all zones}} V_{oz}$
- **Section 403.3.2.3: Multiple zone recirculating systems**
  - System with outdoor air and re-circulated return air
  - $V_{ot} = V_{ou} / E_z$ where E_z is taken from table 403.3.2.3.2
  - $V_{ou} = D \Sigma_{\text{all zones}} R_p P_z + \Sigma_{\text{all zones}} R_a A_z$
  - $D = P_s / \Sigma_{\text{all zones}} P_z$ where P_s is total occupant load expected to be concurently in all zones.

45

45

Section 403.2: Recirculation of air

- The outdoor air required by Section 403.3 shall not be re-circulated.
- Air in excess of that required by Section 403.3 shall not be prohibited from being re-circulated as a component of supply air to building spaces, except:
  - Re-circulation from one dwelling to another or dissimilar occupancies,
  - Swimming pool, must be dehumidified to ≤ 60% and ≤ 10% re-circulated air.
  - Re-circulation is prohibited by notes b and g in table 403.3 where mechanical exhaust is required.

Clarification:

- Only the required outdoor air rates are not allowed to be re-circulated.

46

46

403.4 Exhaust ventilation.
Exhaust airflow rate shall be provided in accordance with the requirements in Table 403.3. Exhaust makeup air shall be permitted to be any combination of outdoor air, re-circulated air and transfer air, except as limited in accordance with Section 403.2.

Clarification:

1. ***Where the exhaust rate is required in the room or space listed in table 403.3 OMC, the makeup air must be evaluated.***
2. ***Makeup air for the required mechanical exhaust may be included in the required outdoor ventilation rate calculation or from other means.***

47

47

403.5 System operation.
The minimum flow rate of outdoor air that the ventilation system must be capable of supplying during its operation shall be permitted to be based on the rate per person indicated in Table 403.3 and the actual number of occupants present.

Clarification:

1. ***Designer may use the actual number of occupants for the required outdoor ventilation air calculation in those rooms that has "default occupant density" in table 403.3 OMC.***
2. ***This rule does not apply to the room or space that is required to have exhaust rate only.***

48

48

Chapter 5
Exhaust Systems

- ***General requirements for the mechanical exhaust systems serving:***
  - ***Clothes dryers,***
  - ***Cooking appliances,***
  - ***Hazardous exhaust system,***
  - ***Dust, stock, and refuse conveyor,***
  - ***Sub-slab soil exhaust system,***
  - ***Smoke control system,***
  - ***Other exhaust systems.***

49

49

Section 501.2: Exhaust discharge

- ***The air removed by every mechanical exhaust system shall be discharged outdoors at a point where it will not cause a nuisance and not less than the distances specified in Section 501.2.1.***
- ***The air shall be discharged to a location from which it cannot again be readily drawn in by a ventilating system.***
- ***Air shall not be exhausted into an attic or crawl space.***

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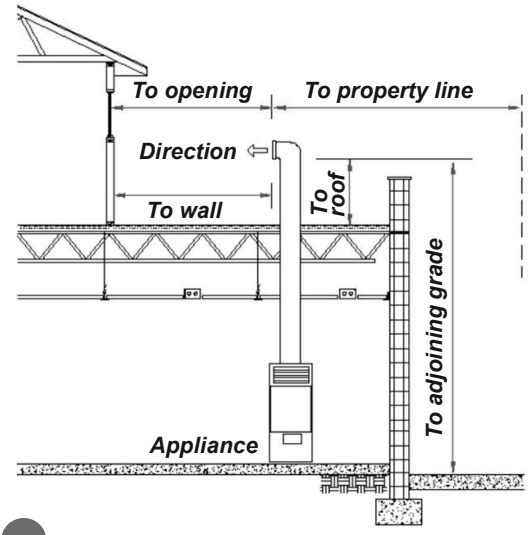
Section 501.2.1: Locations of exhaust outlets



Factors that determine the proper locations of exhaust air termination:

- *Type of exhaust air*
  - *Explosive*
  - *Flammable*
  - *Product conveying*
  - *Environmental air*
- *Flow direction*
- *Distance to:*
  - *Building openings*
  - *Exterior walls / roof*
  - *Combustible walls*
  - *Property line*
  - *Adjoining grade*
  - *Mechanical intakes*

51

An Overview of the Ohio Mechanical Code 2017

51

Section 501.3: Pressure equalization

Where exhaust air rate is required

- **Other than R-3 or dwelling unit in R-2** → **All rooms must be maintained with a natural or negative pressure**
- **Supply rate > Exhaust rate** → **Excessive air must be removed by an adequate mean.**
- **Exhaust rate > Supply rate** → **Adequate make up air rate must be provided to neutralize pressure by the possible means of:**
  - **Supply air**
  - **Transfer air**
  - **outdoor air**
- **Calculated building infiltration air rate can not be used to neutralize the pressure balance requirements.**

52

An Overview of the Ohio Mechanical Code 2017

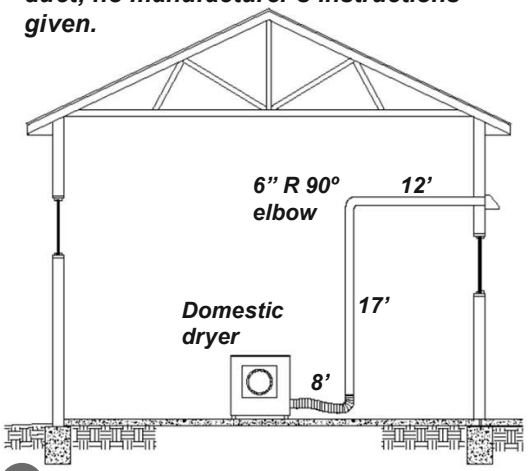
52

Section 504: Clothes Dryer Exhaust

- Exhaust ducts shall not penetrate or located within any fire-blocking, draft-stopping, or any wall, floor ceiling assembly required to be fire resistance rated unless such duct is constructed of galvanized steel or aluminum of the thickness specified in section 603.4.
- Fire dampers, combination fire/smoke dampers, and any similar devices that will obstruct the exhaust flow shall be prohibited in dryer exhaust ducts.
- Make up air shall be provided for clothes dryer exhausting more than 200 cfm.
- Domestic clothes dryer ducts requirements are in section 504.6.

Section 504.6.4: Domestic Clothes Dryer Exhaust

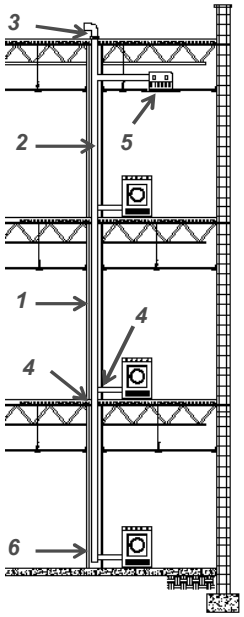
Domestic clothes dryer uses 4" Ø smooth metal ducts with 8' transition duct; no manufacturer's instructions given.



- The maximum exhaust duct length shall be per manufacturer's instructions.
- When not available, the maximum exhaust duct length should be 35'
- One 6" radius, 90º elbows reduces 1.75' per table 504.6.4.1
- Maximum length allowed = 35' – 1.75' = 33.25'
- Total length of exhaust ducts = 17'+12' = 29'
- 29' < 33.25' ….. O.K.
- The length of transition duct should not be included in calculation.

504.8: Common dryer exhaust in multi-story buildings

1. Protected by a fire rated shaft enclosure construction per OBC.
2. Min. 26 GA. Rigid metal duct without any offsets. Min. 6" clearance to combustible materials. No sheet metal screws shall be used (504.4 OMC).
3. Exhaust fan motor shall be designed per section 503.2 and located outside of air stream. It shall be interlocked with dryer operation and have standby power and be monitored.
4. No damper is allowed in exhaust duct,
5. Other exhaust system shall be prohibited from connecting to the dryer exhaust duct. (504.1 OMC)
6. A clean out & 12"x12" access shall be provided at the base of shaft.



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Section 505.2: Domestic Kitchen Exhaust Equipment

New code provisions:

Exhaust hood systems capable of exhausting in excess of 400 cfm (0.19 m^3/s) shall be provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with a means of closure and shall be automatically controlled to start and operate simultaneously with the exhaust system.

Clarification:

This provision applies to all residential buildings. We can no longer make the assumption that residential units do not require make up air for kitchen hoods.

56

56

Section 506: Commercial Kitchen Exhaust Equipment

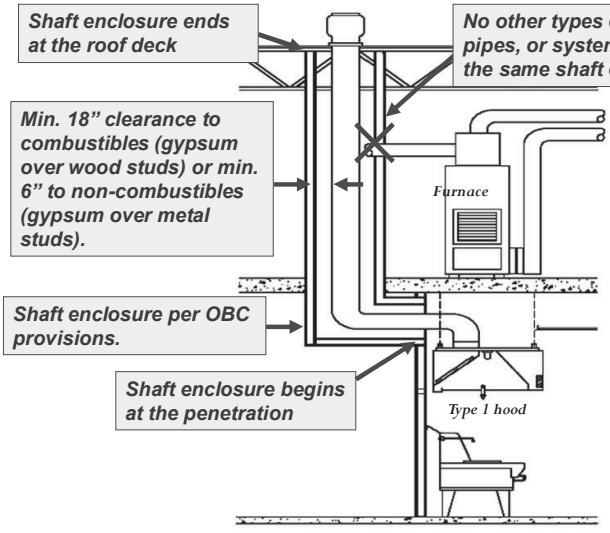
Type I hood grease duct requirements:

- Minimum thickness of 0.0575" (No. 16 gage) or stainless steel not less than 0.0450" (No. 18 gage).
- Continuous liquid-tight weld or braze made on the external surface of the duct system.
- Air velocity not less than 500 feet per minute (2.5 m/s)
- Duct bracing/supports shall be of non-combustible materials designed to carry the load
- Vibration isolation connectors are required
- Cleanouts are required with tight-fitting access doors; horizontal cleanouts shall not be more than 20' apart and the opening at minimum 12" on each side.

57

57

❖ Grease duct enclosure requirements: 506.3.10 OMC



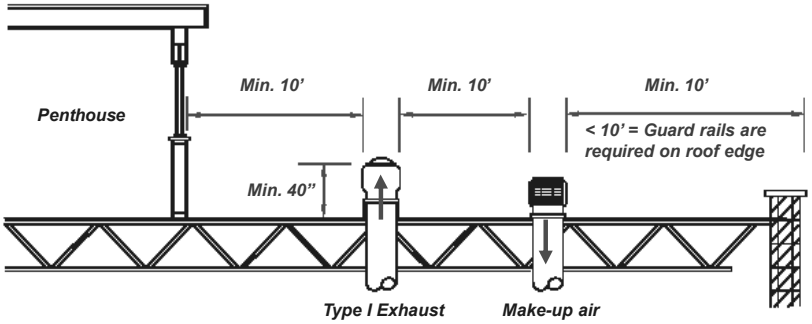
Grease duct enclosures:

1. Shaft enclosures per Ohio Building Code.
2. Penetration protected by approved fire stop system, (duct wrap per ASTM E2336)
3. Prefabricated grease duct enclosure system per UL 2221.
4. Penetrated only one non-fire rated roof /ceiling assembly.

58

506.3.12 OMC: Grease duct termination on roof

- Discharge at minimum 40" above roof surface
- Minimum 10' from parts of the same building, contiguous buildings, adjacent building, adjacent property lines, and air intakes to any building
  - Exception: Required clearance reduced to 5' if exhaust outlet discharged away from the above locations.
- Minimum 3' above air intake openings into any building

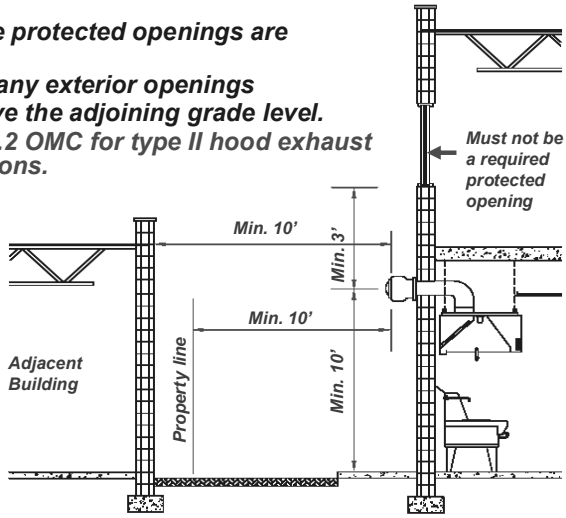


59

506.3.12 OMC: Grease duct termination on wall

- Shall not create a public nuisance or a fire hazard
- Not located where protected openings are required
- Minimum 3' from any exterior openings
- Minimum 10' above the adjoining grade level.
- See section 506.4.2 OMC for type II hood exhaust termination locations.

Grease duct shall not discharge over a walkway, an occupied space, or below a building soffit.



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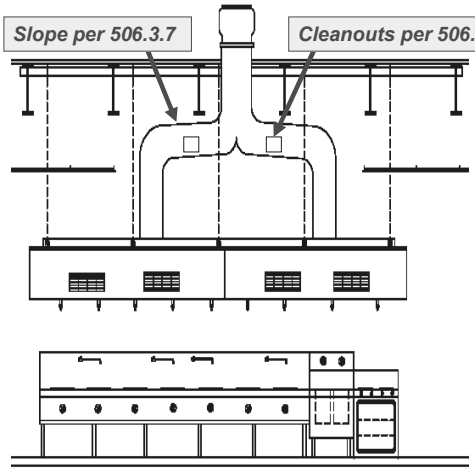
➢ 506.3.5 OMC: Separation of grease duct system

A separate grease duct system shall be provided for each type I hood.



Exceptions:

1. ***All interconnected hoods are on the same story***
2. ***All interconnected hoods are in the same room or adjoining rooms***
3. ***Ducts do not penetrate fire rated assemblies***
4. ***No solid fuel cooking appliances served by the hoods.***

61

➢ 507 OMC: Commercial Kitchen Hoods

- ***Section 507.2.1:*** ***Type I hoods shall be installed where cooking appliances produce grease or smoke, such as occurs with griddles, fryers, broilers, ovens, ranges, wok ranges, salamanders, tilting skillets, and rotisseries.***
- ***Section 507.2.2:*** ***Type II hoods shall be installed where cooking or dishwashing appliances produce heat, steam, or products of combustion and do not produce grease or smoke, such as steamers, kettles, pasta cookers, cheese-melters, ovens, and dishwashing machines.***
- ***Section 507.2.3:*** ***Domestic cooking appliances utilized for commercial purposes shall be provided with Type I or Type II hoods as required for the type of appliances and processes in accordance with Sections 507.2, 507.2.1 and 507.2.2.***
- ***Misconception:*** ***Domestic cooking appliances utilized in commercial buildings shall automatically require a type I hood. NO. It depends on the cooking appliance and process.***

62

62

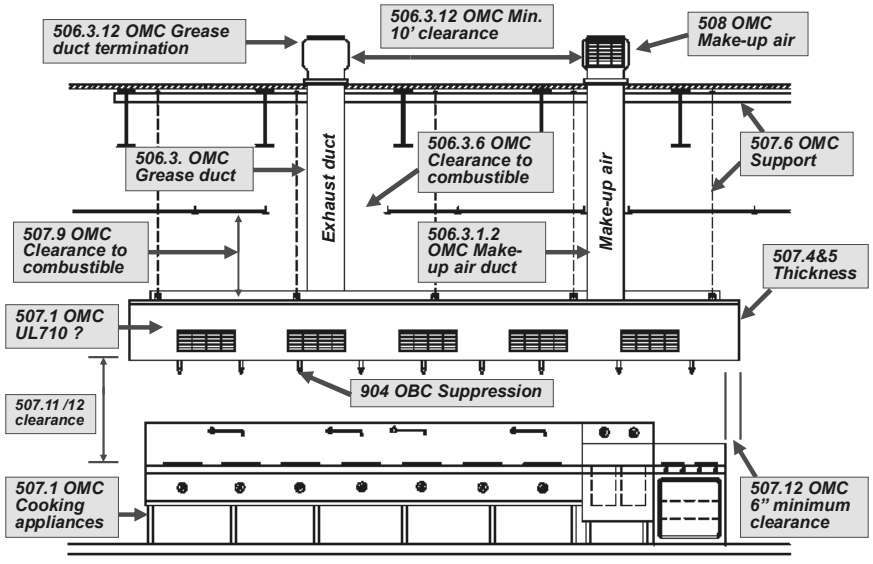
507 OMC: Commercial Kitchen Hoods

- Sections 507.4 through 507.15 have general requirements for type I and II hoods regarding the materials and installation.
- Misconception: A factory built UL 710 type I or II hood is exempt from all these requirements.
  - NO, only exemptions applicable are 507.4, 507.7, 507.11, 507.12, 507.13, 507.14, and 507.15. (Section 507.1 Exception 1)
- Misconception: A factory built UL 710B type I or II recirculating hood is exempt from all these requirements.
  - NO, only exemptions applicable are 507.4, 507.5, 507.7, 507.12, 507.13, 507.14, and 507.15. (Section 507.1 Exception 2)

63

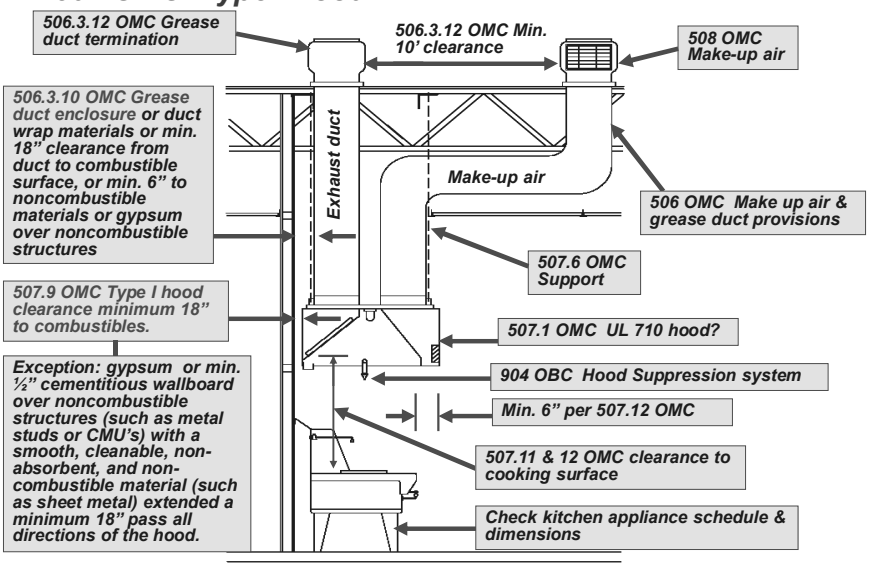
63

507 OMC: Type I hood



64

➢ 507 OMC: Type I hood



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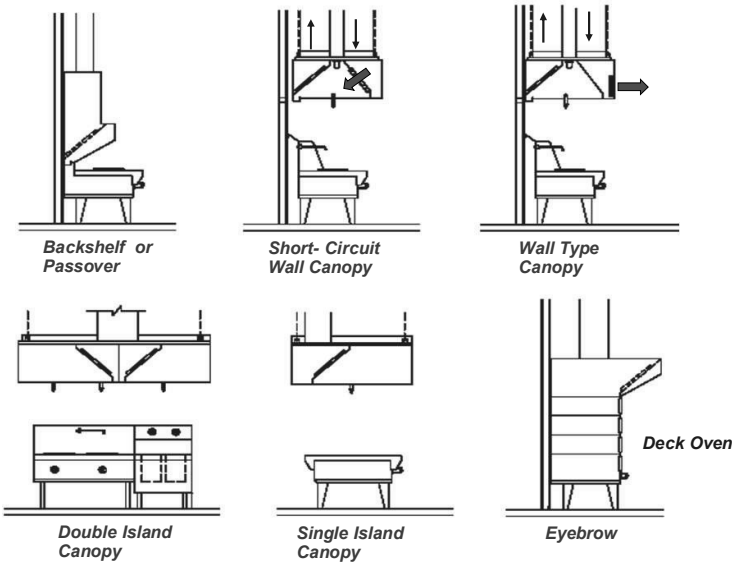
❖ Type I hoods in section 507.13 of Ohio Mechanical Code:



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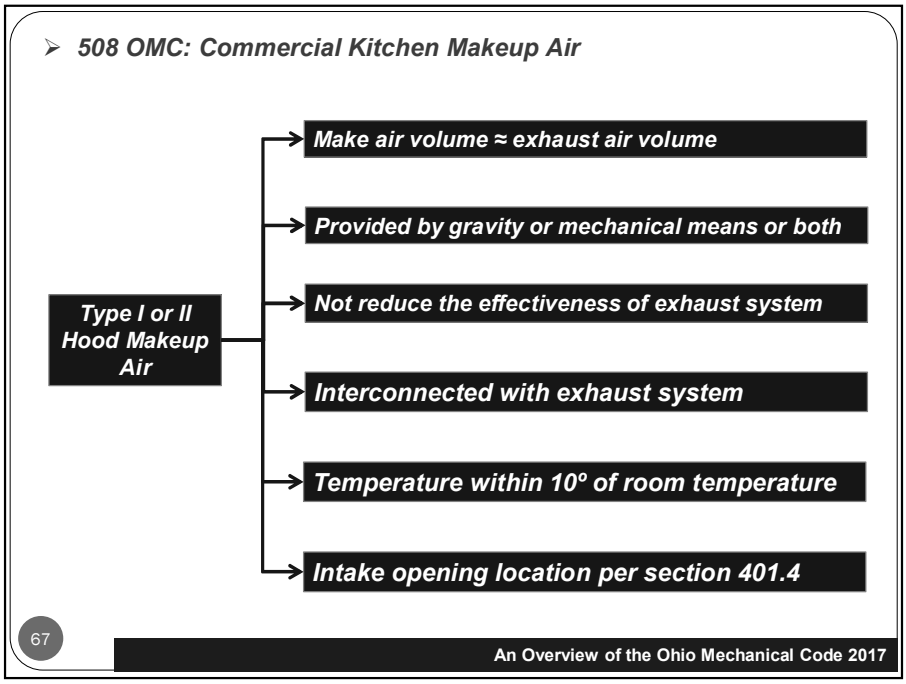
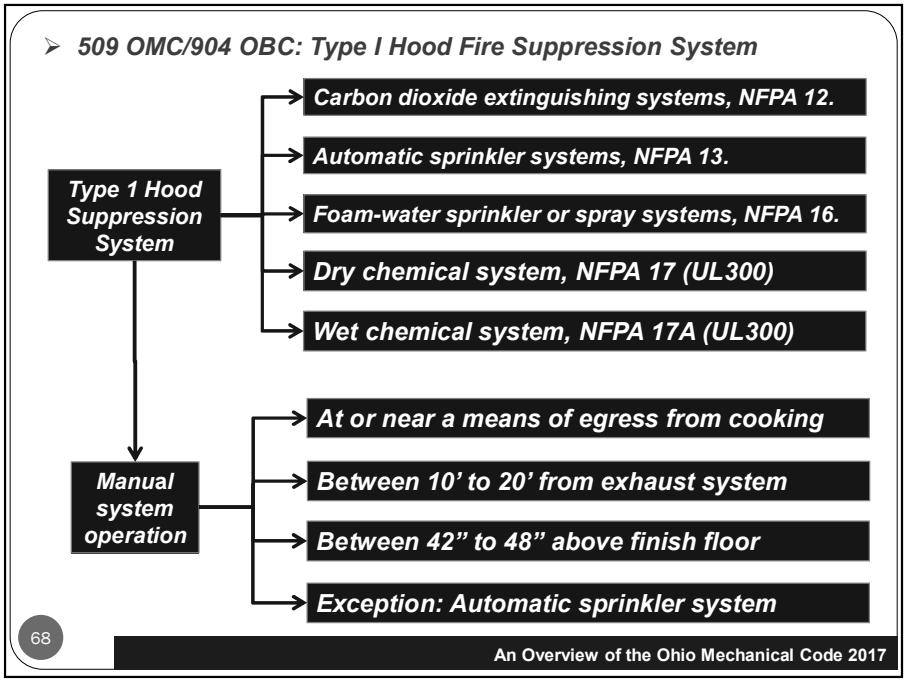
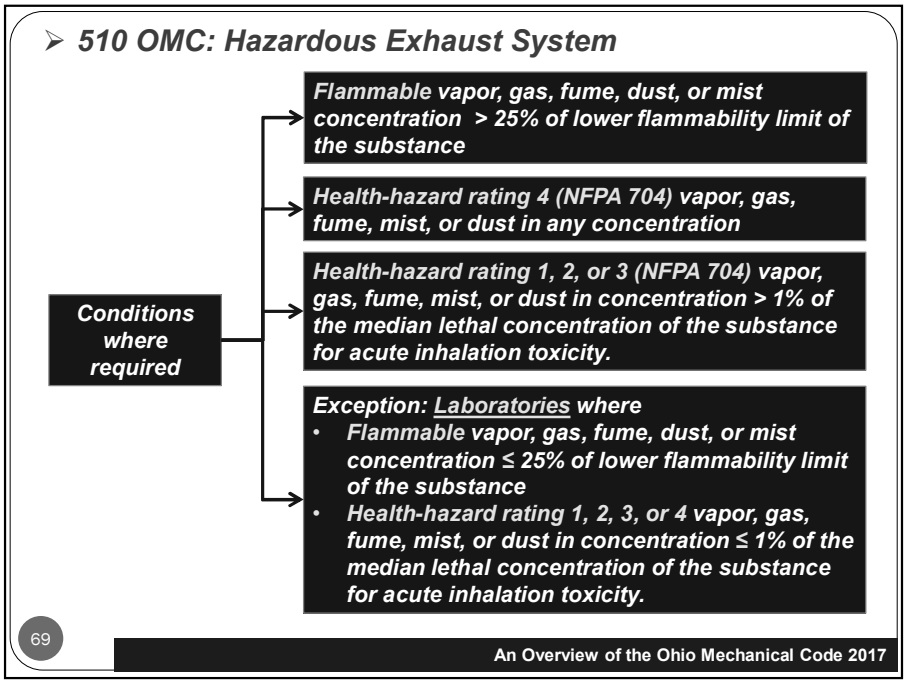

508 OMC: Commercial Kitchen Makeup Air
Type I or II Hood Makeup Air
Make air volume ≈ exhaust air volume
Provided by gravity or mechanical means or both
Not reduce the effectiveness of exhaust system
Interconnected with exhaust system
Temperature within 10º of room temperature
Intake opening location per section 401.4
67
An Overview of the Ohio Mechanical Code 2017

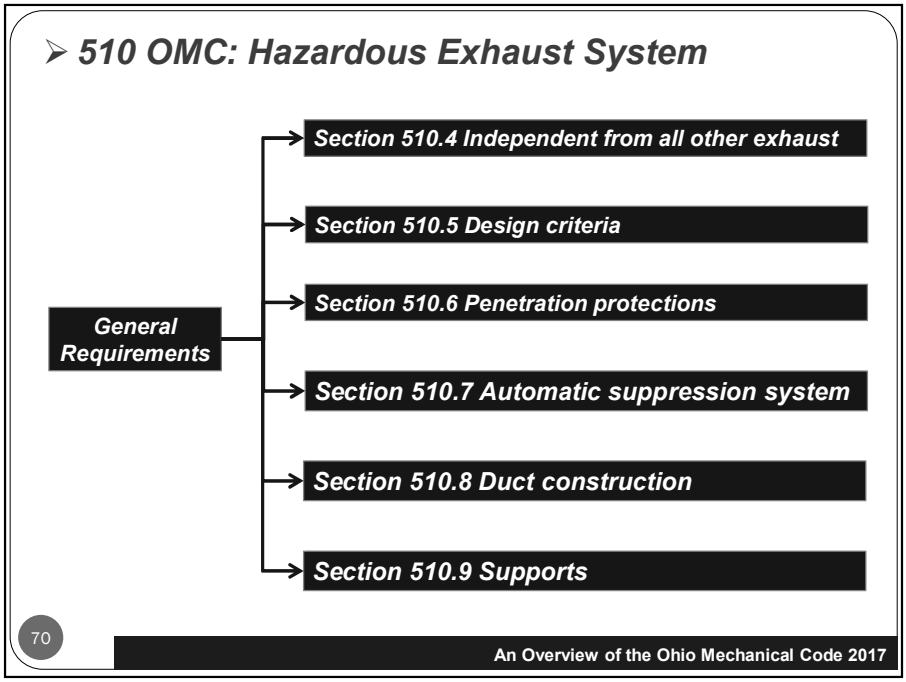
67


509 OMC/904 OBC: Type I Hood Fire Suppression System
Type 1 Hood Suppression System
Carbon dioxide extinguishing systems, NFPA 12.
Automatic sprinkler systems, NFPA 13.
Foam-water sprinkler or spray systems, NFPA 16.
Dry chemical system, NFPA 17 (UL300)
Wet chemical system, NFPA 17A (UL300)
Manual system operation
At or near a means of egress from cooking
Between 10' to 20' from exhaust system
Between 42" to 48" above finish floor
Exception: Automatic sprinkler system
68
An Overview of the Ohio Mechanical Code 2017

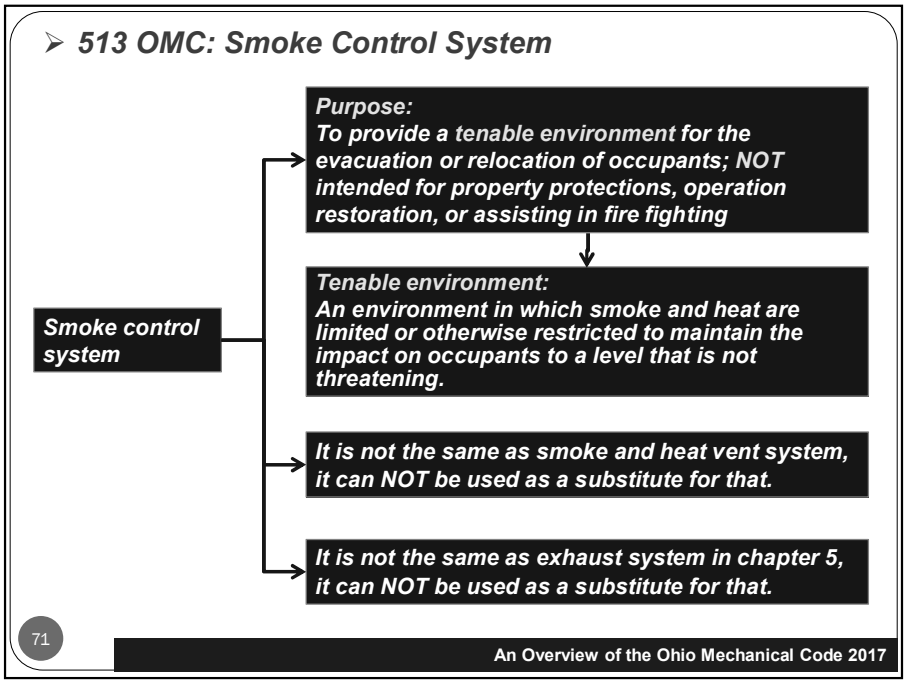
68


510 OMC: Hazardous Exhaust System
Conditions where required
Flammable vapor, gas, fume, dust, or mist concentration > 25% of lower flammability limit of the substance
Health-hazard rating 4 (NFPA 704) vapor, gas, fume, mist, or dust in any concentration
Health-hazard rating 1, 2, or 3 (NFPA 704) vapor, gas, fume, mist, or dust in concentration > 1% of the median lethal concentration of the substance for acute inhalation toxicity.
Exception: Laboratories where
• Flammable vapor, gas, fume, dust, or mist concentration ≤ 25% of lower flammability limit of the substance
• Health-hazard rating 1, 2, 3, or 4 vapor, gas, fume, mist, or dust in concentration ≤ 1% of the median lethal concentration of the substance for acute inhalation toxicity.
69
An Overview of the Ohio Mechanical Code 2017

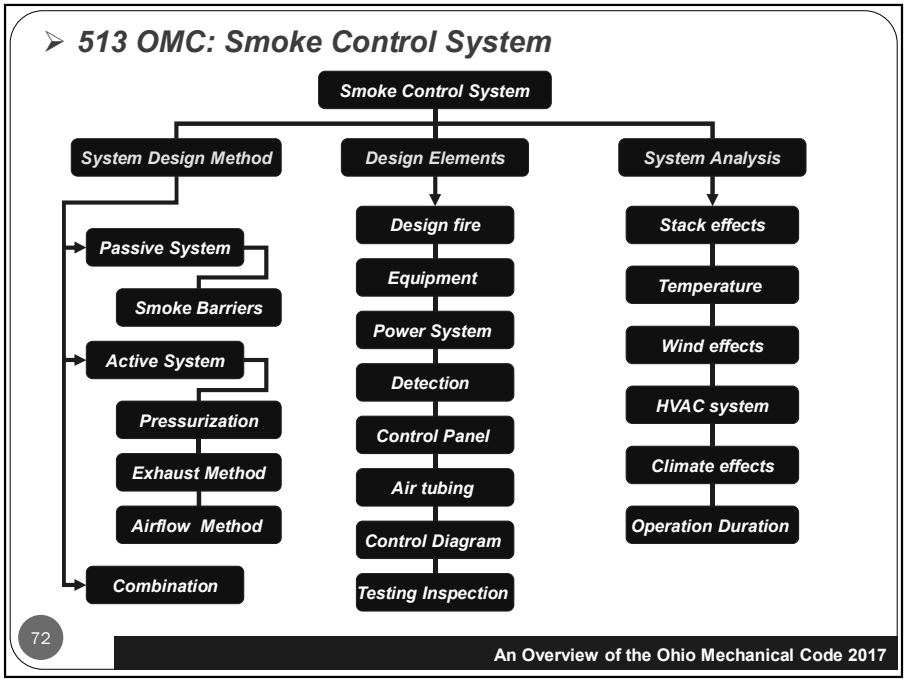
69


510 OMC: Hazardous Exhaust System
General Requirements
Section 510.4 Independent from all other exhaust
Section 510.5 Design criteria
Section 510.6 Penetration protections
Section 510.7 Automatic suppression system
Section 510.8 Duct construction
Section 510.9 Supports
70
An Overview of the Ohio Mechanical Code 2017

70


513 OMC: Smoke Control System
Smoke control system
Purpose:
To provide a tenable environment for the evacuation or relocation of occupants; NOT intended for property protections, operation restoration, or assisting in fire fighting
Tenable environment:
An environment in which smoke and heat are limited or otherwise restricted to maintain the impact on occupants to a level that is not threatening.
It is not the same as smoke and heat vent system, it can NOT be used as a substitute for that.
It is not the same as exhaust system in chapter 5, it can NOT be used as a substitute for that.
71
An Overview of the Ohio Mechanical Code 2017

71


513 OMC: Smoke Control System
Smoke Control System
System Design Method
Design Elements
System Analysis
Passive System
Smoke Barriers
Active System
Pressurization
Exhaust Method
Airflow Method
Combination
Design fire
Equipment
Power System
Detection
Control Panel
Air tubing
Control Diagram
Testing Inspection
Stack effects
Temperature
Wind effects
HVAC system
Climate effects
Operation Duration
72
An Overview of the Ohio Mechanical Code 2017

72

Chapter 6
Duct Systems

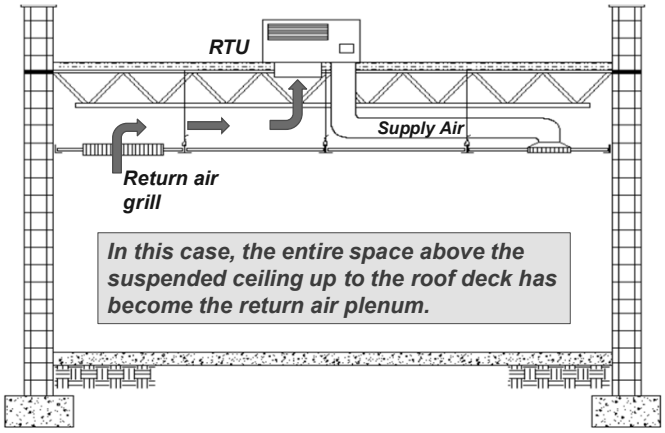
- ***General requirements for the mechanical duct systems:***
  - ***Plenums,***
  - ***Duct materials and installation,***
  - ***Duct insulation,***
  - ***Air filters,***
  - ***Duct smoke detection system,***
  - ***Duct and transfer openings***

73

73

- ***602 OMC: Plenums***

Section 202: Definition
An enclosed portion of the building structure, other than an occupiable space being conditioned, that is designed to allow air movement, and thereby serve as part of an air distribution system.



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➢ *602 OMC: Plenums*

General Requirements

- *Plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces and mechanical equipment rooms*
- *Plenums shall be limited to one fire area*
- *Fuel-fired appliances shall not be installed within a plenum*
- *Use of gypsum boards to form plenums shall be limited to systems where the air temperatures ≤ 125°F and above air stream dew-point temperature*
- *Materials within plenums shall be noncombustible or shall have a flame spread index of ≤ 25 and a smoke-developed index of ≤ 50 when tested in accordance with ASTM E 84 or UL 723.*
- *Wiring within plenum must be plenum rated.*

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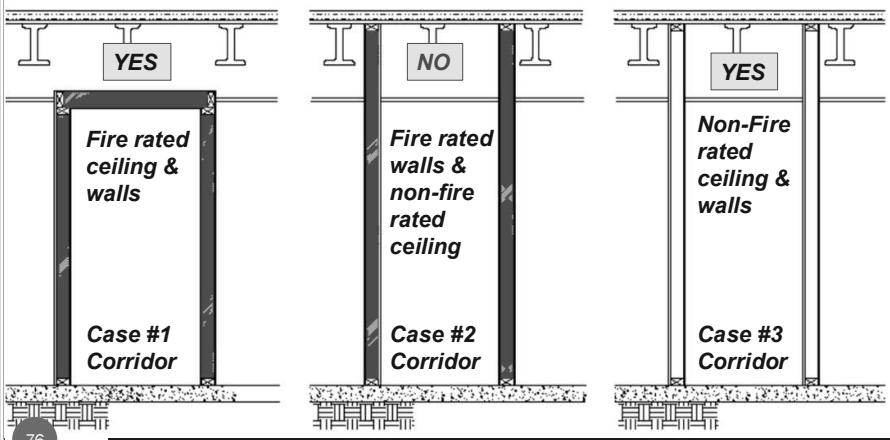
➢ *Section 601.2.1: Corridor ceiling space*

Can the ceiling space above the corridor be used as a part of return air plenum?

See also Section 602 for other requirements for air plenums.



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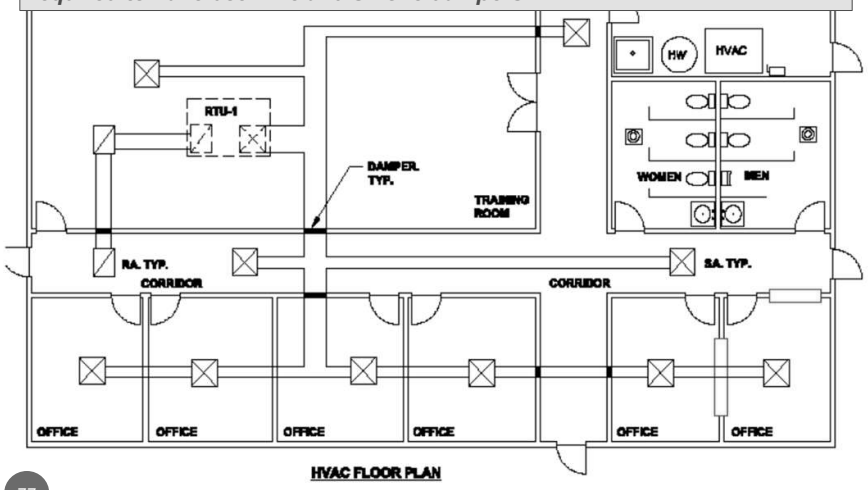
➢ Section 601.2: Air movement in corridor

Corridors shall not serve as supply, return, exhaust, relief or ventilation air ducts. Ducts are allowed to penetrate the rated corridor walls but are required to have both fire and smoke dampers.



HVAC FLOOR PLAN

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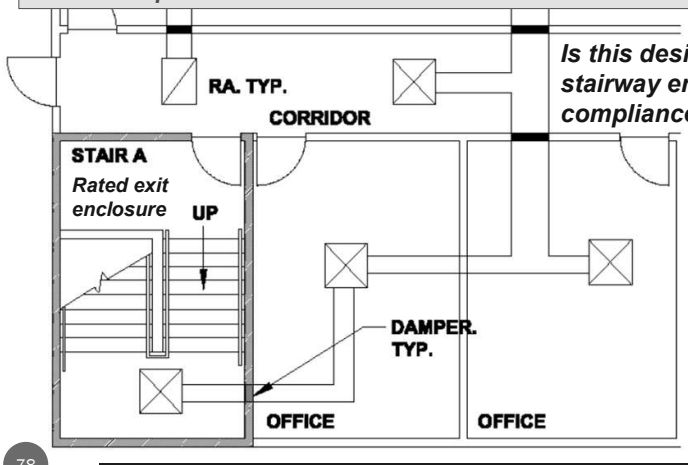
➢ Section 601.3: Ventilation in Exits

Equipment and ductworks serving the exit stairway enclosure shall be independent from the remainder of building ventilation systems to prevent smoke or fire spreading into the exit enclosure. See also Section 1022 OBC for other requirements.



Is this design for exit stairway enclosure code compliance?

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- ***603.6 OMC: Flexible air ducts & flexible air connectors***

603.6.1 OMC: Flexible air ducts.
Flexible air ducts, both metallic and nonmetallic, shall be tested in accordance with UL 181. Such ducts shall be listed and labeled as Class 0 or Class 1 flexible air ducts and shall be installed in accordance with Section 304.1.

603.6.2 OMC: Flexible air connectors.
Flexible air connectors, both metallic and nonmetallic, shall be tested in accordance with UL 181. Such connectors shall be listed and labeled as Class 0 or Class 1 flexible air connectors and shall be installed in accordance with Section 304.1.

- ***What are the differences?***

79

79

- ***603.6 OMC: Flexible air ducts & flexible air connectors***
- ***The differences are in the UL 181 test items:***

Test items	*Flexible duct*	*Flexible connector*
Surface burning characteristics	*Yes*	*Yes*
Flame penetration	*Yes*	*No*
Burning	*Yes*	*Yes*
Corrosion	*Yes*	*Yes*
Mold growth and humidity	*Yes*	*Yes*
Temperature	*Yes*	*Yes*
Puncture	*Yes*	*No*
Impact	*Yes*	*No*
Erosion	*Yes*	*Yes*
Pressure	*Yes*	*Yes*
Collapse	*Yes*	*Yes*
Tension	*Yes*	*Yes*
.....	*Yes*	*Yes*

We must pay attention to marking or labeling of materials.

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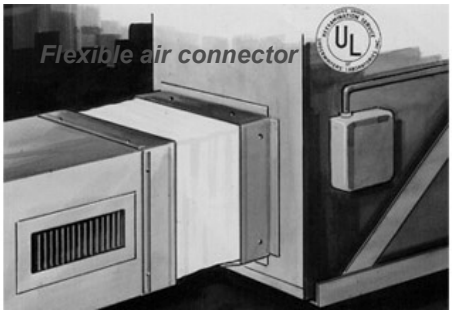
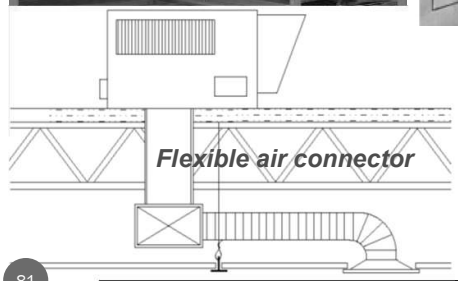
- 603.6 OMC: Flexible air ducts & flexible air connectors





- Are these considered flexible air ducts or flexible air connectors?
- Flexible air connector has 14 feet length limitation (603.6.2 OMC), flexible air duct does not.

81

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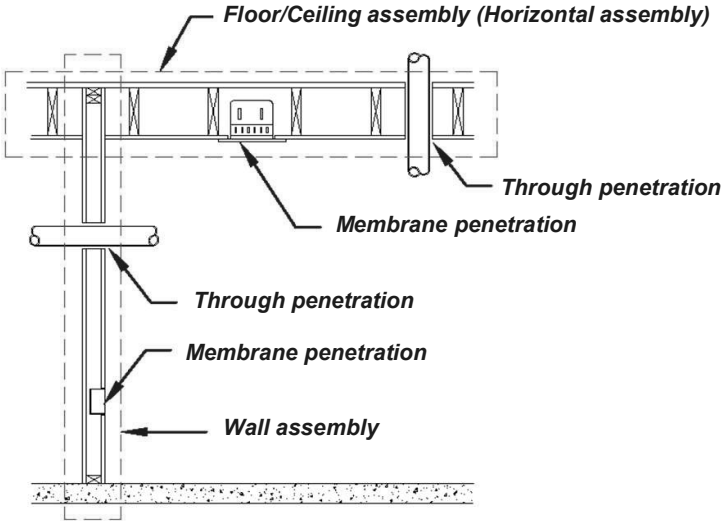
- 607 OMC: Ducts penetrations and transfer openings



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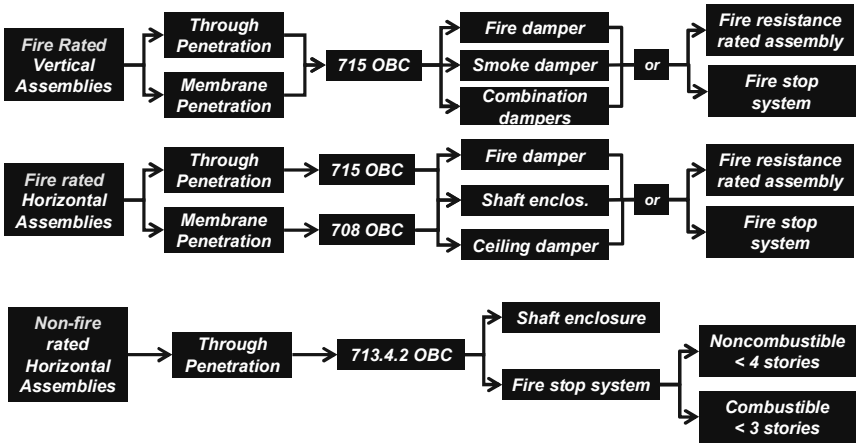
- 607 OMC: Ducts penetrations and transfer openings



- No protection is required for penetrations in non-fire rated vertical assemblies except smoke partitions per 710 OBC.

83

83

Chapter 7 Combustion Air

- General requirements for combustion air:
  - Solid fuel-burning appliances
  - Oil-fired appliances
  - Gas-fired appliances
- Combustion air is not the same as outdoor air required in chapter 4 of OMC or makeup air required for any exhaust systems.

84

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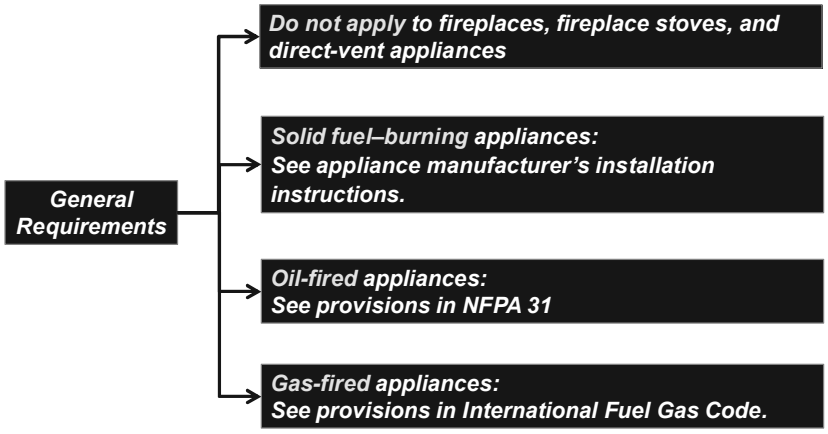
- *701.1 Scope for Combustion air requirements:*



- *Insufficient combustion air supply will cause incomplete combustion result in appliance malfunction and excessive carbon monoxide.*

85

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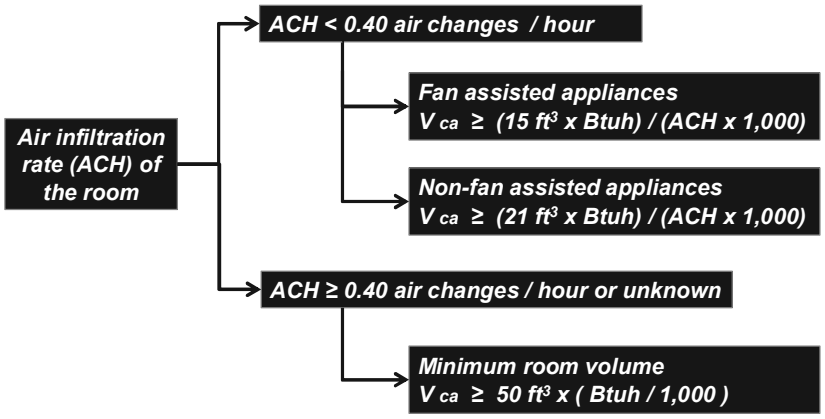
85

- *304.5 IFGC: Combustion air for Gas-fired appliances*
- *Verify if the required combustion air can be taken from the room volume where the appliances are located.*



86

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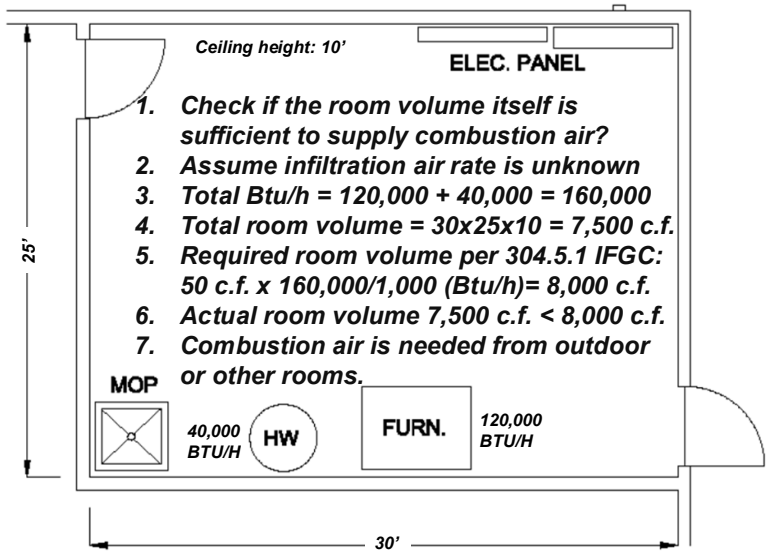
86

➢ 304.5 IFGC: Combustion air for Gas-fired appliances



1. Check if the room volume itself is sufficient to supply combustion air?
2. Assume infiltration air rate is unknown
3. Total Btu/h = 120,000 + 40,000 = 160,000
4. Total room volume = 30x25x10 = 7,500 c.f.
5. Required room volume per 304.5.1 IFGC: 50 c.f. x 160,000/1,000 (Btu/h)= 8,000 c.f.
6. Actual room volume 7,500 c.f. < 8,000 c.f.
7. Combustion air is needed from outdoor or other rooms.

87

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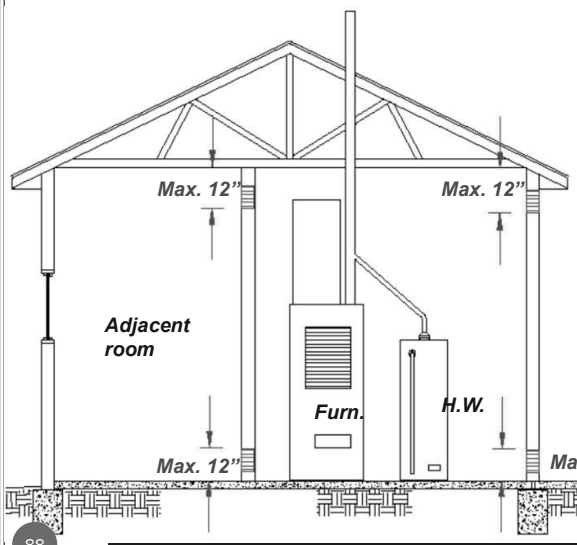
87

➢ 304 IFGC: Combustion air for Gas-fired appliances



Combustion air can be obtained from:

- All outdoor (304.6)
- All indoor (304.5)
- Indoor/outdoor combination (304.7)
- Mechanical (304.9)
- Engineered design

88

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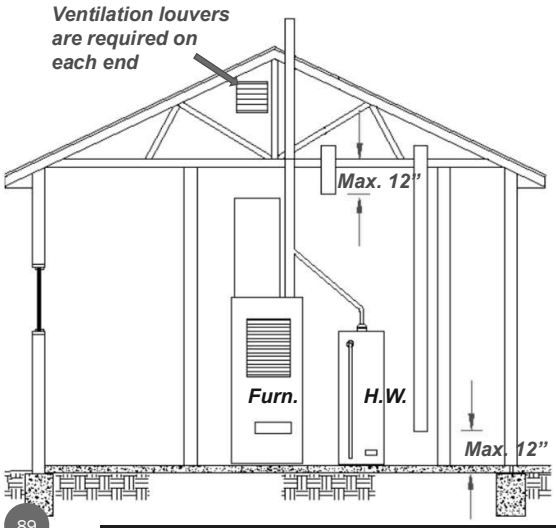
88

➢ 304 IFGC: Combustion air for Gas-fired appliances



- Combustion air can also be obtained from:
  - Attics or crawl space or combination of two with direct ventilation to outdoor. 304.6 IFGC.
- See code sections for provisions of required locations and size of openings,

89

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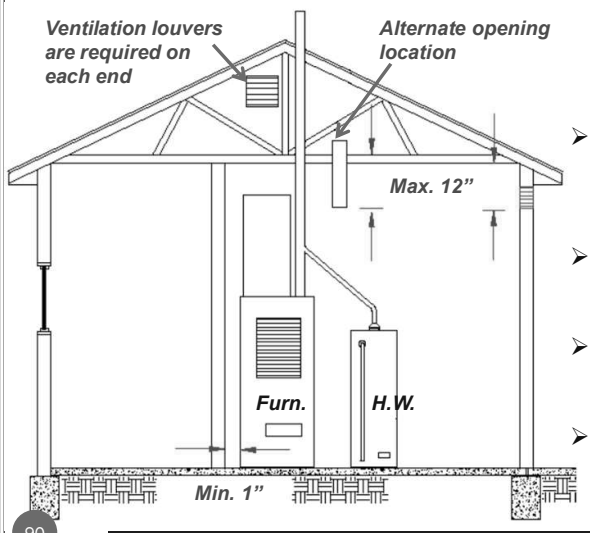
➢ 304 IFGC: Combustion air for Gas-fired appliances



- Combustion air can also be obtained from:
  - One permanent opening. 304.6.2 IFGC.
- Opening directly to outdoor or through a vertical or horizontal duct.
- Opening within 12” from the top of enclosure
- Appliance min. 1” clearance from sides and 6” from front
- Opening size min. 1 sq. inch per 3,000 Btu/h total gas input.

90

90

Chapter 8
Chimneys and Vents

- ***General requirements for chimney and vent systems:***
  - ***Duct size, connectors, cleanouts***
  - ***Chimney vent and terminations***
  - ***Clearance to combustibles***
  - ***Direct venting system***
  - ***Factory-built fireplaces***

- ***801.2 OMC: General***

Every fuel-burning appliance shall discharge the products of combustion to a vent, factory-built chimney or masonry chimney, except for appliances vented in accordance with Section 804 (Direct Vent). The chimney or vent shall be designed for the type of appliance being vented.

Exception:
Commercial cooking appliances vented by a Type I hood installed in accordance with Section 507.

Oil-fired appliances shall be vented in accordance with this code and NFPA 31.

➢ 802 OMC: Vents

802.1 General.
All vent systems shall be listed and labeled. Type L vents and pellet vents shall be tested in accordance with UL 641.

Table 802.2 Vent application

VENT TYPES	APPLIANCE TYPES
Type L oil vents	Oil-burning appliances listed and labeled for venting with Type L vents; Gas appliances listed and labeled for venting with Type B vents.
Pellet vents	Pellet fuel-burning appliances listed and labeled for venting with pellet vents.

PELLET FUEL-BURNING APPLIANCE. A closed-combustion, vented appliance equipped with a fuel-feed mechanism for burning processed pellets of solid fuel of a specified size and composition.

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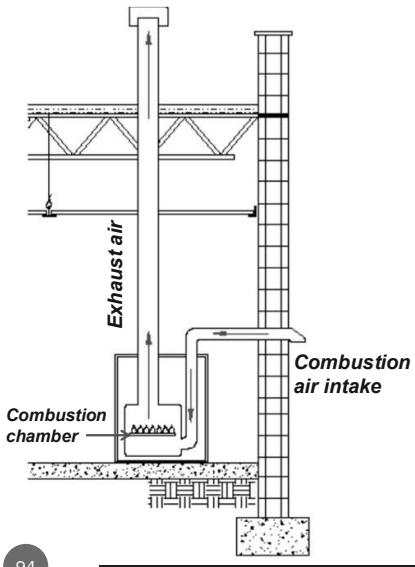
➢ 804 OMC: Direct vent



DIRECT-VENT APPLIANCES. Appliances that are constructed and installed so that all air for combustion is derived from the outdoor atmosphere and all flue gases are discharged to the outdoor atmosphere.

See sections 803 through 806 for provisions of clearance to combustibles, locations of vent termination, and other installation requirements for each type of appliance.

94

94

Chapter 9
Special Appliances, Fireplaces, and Solid Fuel-burning Equipment

- ***General requirements for solid fuel burning appliances:***
  - ***Wall furnaces and floor furnaces***
  - ***Sauna heaters***
  - ***Forced-air warm air furnaces***
  - ***Unit heaters,***
  - ***Other appliances***

95

95

- ***901 OMC: General Requirements***

901.1 Scope.
This chapter shall govern the approval, design, installation, construction, maintenance, alteration and repair of the appliances and equipment specifically identified herein and factory-built fireplaces. The approval, design, installation, construction, maintenance, alteration and repair of gas-fired appliances shall be regulated by the International Fuel Gas Code.

Clarification:
1. ***This code section only applies to solid fuel burning appliances.***
2. ***All gas-fired appliances are governed by the International Fuel Gas Code.***

96

96

Chapter 10
Boilers, Water Heaters, Pressure Vessels

- *General requirements for:*
  - *Water heaters,*
  - *Pressure vessels*
  - *Boilers*
  - *Boiler and pressure vessel testing*

97

97

Chapter 11
Refrigeration

- *General requirements for refrigeration systems:*
  - *Refrigerants*
  - *System classification*
  - *Machinery room*
  - *Refrigerant piping*
  - *Testing*

98

98

Chapter 12
Hydronic Piping

- ***General requirements for hydronic piping systems, such as:***
  - ***High, low, and medium temperature hot water systems,***
  - ***Heating system,***
  - ***Chilled water cooling system,***
  - ***Condenser and cooling tower water system ,***
  - ***Steam and steam condensate piping system,***
  - ***Solar heating system***

99

99

Chapter 13
Fuel Oil Piping and Storage

- ***General requirements for fuel-oil piping and storage:***
  - ***Above-ground and under-ground fuel oil storage tanks,***
  - ***Material standards,***
  - ***Piping systems***
  - ***International Fuel Gas Code will govern items which are not covered under this chapter.***

100

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Chapter 14
Solar Systems

- ***General requirements for solar energy systems:***
  - ***For space heating and cooling,***
  - ***For domestic hot water heating or processing***

101

101

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: Harold L. Plant, Ohio Certificate Renewal

Course Submitter: Harold L. Plant (Contact Name)

Organization: Ohio Certificate Renewal (Organization/Company)

Address: P.O. Box 211102 (Include Room Number, Suite, etc.)

City: Columbus State: OH Zip: 43221

E-Mail: HalPlant2112@outlook.com

Telephone: 614-451-9003 Fax:

Course Sponsor: Ohio Certificate Renewal

COURSE INFORMATION:

Course Title: Overview of the 2017 OMC 4

New Course Submittal: ☐ Update Course: ■ Prior Approval Number: BBS2022-266

Purpose and Objective: As previously approved. Add FPI and FPPE.

Number of Instructional Contact Hours that can be obtained upon completion: 4

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

Program Applicable for the Following Participants:

Building Official	■	Master Plans Examiner	■	Building Inspector	■	Fire Protection Inspector	■
		Building Plans Exam.	✔				
		Plumbing Plans Exam.	☐				
		Electrical Plans Exam.	■				
		Mechanical Plans Exam.	■				
		Fire Protect. Plans Exam.	✔				

Mechanical Inspector	■	Plumbing Inspector	☐	Non-Res IU Inspector	■				
Res Building Official	■	Res Plans Examiner	■	Res Building Inspector	■	Res Mechanical Inspector	☐	Res IU Inspector	■

Electrical Safety Inspectors X

Location of ESI Course: n/a Date(s) of ESI Course(s): tbd

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

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

Overview of the 2017 Ohio Mechanical Code

Presented by:

Robert J. Schutz, P.E., P.S., CBO

BBS approved course No. BBS2019-319 for 4 hours continuing education credit for BO, MPE, BPE, MechPE, BI, MI, NRIUI, RBO, RPE, RBI, RMI, RIUI

Developed by: Yeong T. Jiang, P.E., CBO, BI
Plans Examiner Supervisor
Ohio Department of Commerce

1

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Overview of the 2017 Ohio Mechanical Code

Presented by:

Robert J. Schutz, P.E., P.S., CBO

BBS approved course No. BBS2019-318 for 8 hours continuing education credit for BO, MPE, BPE, MechPE, BI, MI, RBO, RPE, RBI, RMI, NRIUI, RIUI

Developed by: Yeong T. Jiang, P.E., CBO, BI
Plans Examiner Supervisor
Ohio Department of Commerce

2

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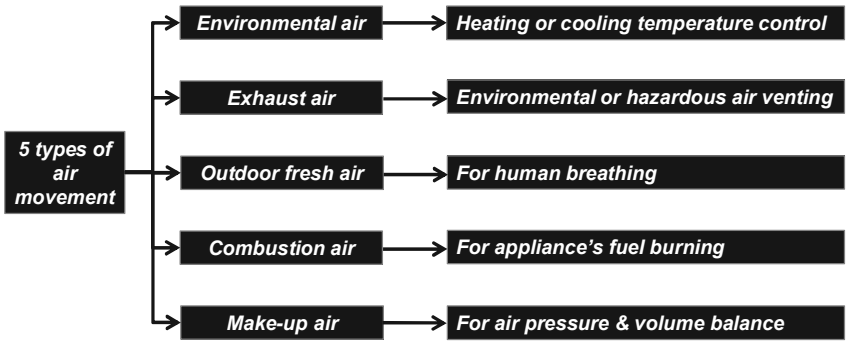
The BIG picture: What is in the Ohio Mechanical Code?



Ohio Mechanical Code (OMC) provides minimum standards for the design and installation of mechanical appliances, equipment and associated piping and ducts to manage, not to prevent, risks produced by these activities to acceptable levels for occupants' safety.

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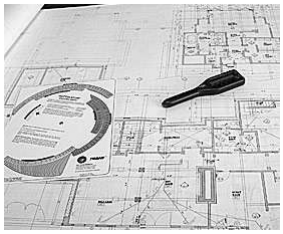

Chapter 1 Scope and Administration

- ***Scope, applicability, jurisdictional authority;***
- ***Certified building department and personnel duties and responsibilities;***
- ***Construction documents, inspections, approvals and certificates of occupancy;***
- ***Violations, notices, and appeals; and***
- ***Materials and products.***

4

4

Section 101.2 Scope
The provisions of this code shall apply to the design, installation, maintenance, alteration, repair, relocation, replacement, addition to, use and inspection of mechanical systems within buildings. This code shall also apply to those systems, system components, equipment and appliances specifically addressed herein.

Section 101.3 Administrative and enforcement.
For administrative and enforcement provisions of this code, refer to building code Sections 101.2 to 115.4.
Section 101.4 Referenced standards.
When a reference is made within the mechanical code to . . . any . . . technical publication, the specific date and title of the publication and the promulgating agency are listed in Chapter 15 of this code.

5

102.10.2 Minor repairs.
Minor repairs to structures may be made without application or notice to the building official. Such repairs shall not include the cutting away of any wall, …….; nor shall minor repairs include addition to, alteration of, replacement or relocation of any standpipe, water supply, sewer, drainage, drain leader, gas, soil, waste, vent or similar piping, electric wiring or mechanical or other work affecting public health or general safety.

6

OBC Section 102.10: Work exempt from approval.
Approval shall not be required for the following work; however this work shall comply with the applicable provisions of the rules of the board:

Mechanical:

1. ***Portable heating appliances, ventilation equipment, cooling units and evaporative coolers;***
2. ***Replacement of any part which does not alter its approval or make it unsafe;***
3. ***Process equipment and associated piping. For combination . . piping systems . . . piping located downstream of the control valve which separates the process and building services piping is exempt.***
4. ***Distribution piping . . . by public / municipal utilities.***

NOTE: Also see Electrical, Gas and Plumbing

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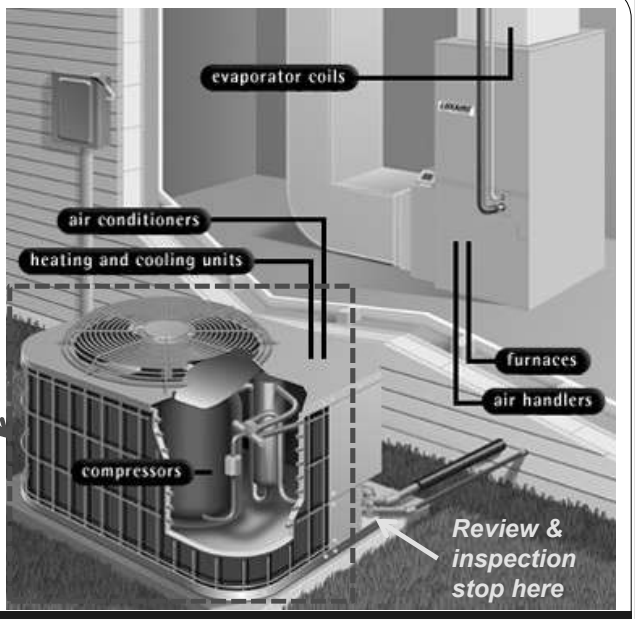
102.10: Work exempt from approval: Mechanical Item #6



Equipment itself & piping/wiring inside are exempt from approval

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Commonly asked question:
We would like to replace our rooftop HVAC units. They are all one-for-one and like-for-like replacements. Do we need a permit for this?

- ***Yes, a building permit is required.***
- ***101.2 OMC states "The provisions of this code shall apply to the . . . replacement . . . of mechanical systems***
- ***102.10 exemption #4 provides an exception to allow replacement of "any part" only; not whole equipment***
- ***This does not meet the "Minor repairs" definition in section 102.10.2 OBC – Mechanical Permit is required and may require a technical analysis by a design professional including structural load, electrical load, sizing, outdoor air analysis, and similar which affect health and safety.***

9

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Section 102.5 Applicability.

- ***When there is conflict between Ohio Mechanical Code (OMC) and other referenced codes, standards, and rules (listed in Chapter 15), the provisions of OMC supersede.***
- ***Exception (102.3) is for rules and orders issued by the fire marshal pursuant to Chapter 3743, ORC (for fireworks facilities).***

10

10

Section 106: Construction Documents

- **What are the requirements for construction documents to be submitted for mechanical plan review?**

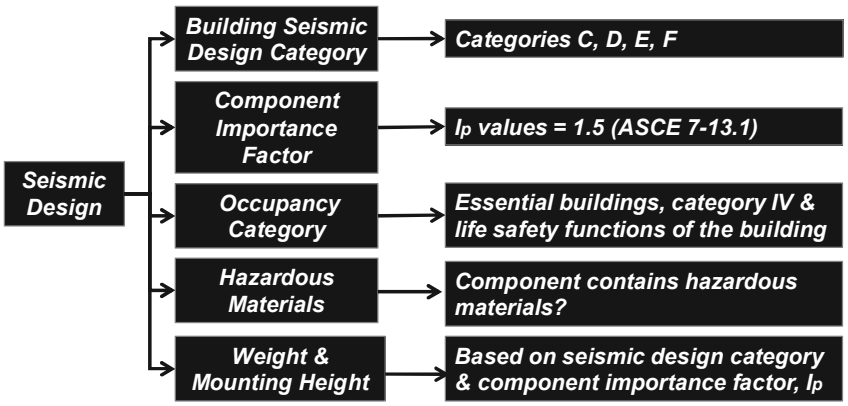
Site Plan and Index	Location of the building & drawing index
Building Information	Use group, construction type, occupant load, height and area, fire protection, DFE
Floor Plans	Building configuration, rooms, work layout in room(s), fire rated assemblies
Proposed Details	System description, layout, new/existing materials & products, dimensions, clearances, sections, connections, dampers, fire stopping, outdoor air, and installation instructions
Evidence of Responsibility	Documents must bear the seal of an Ohio registered design professional per 106.2.1. OBC / 3791.04 ORC

Section 106.1.1 / 2.1: Buildings or structures in flood hazard areas.

Construction documents submitted for buildings or structures located in communities with identified flood hazard areas, pursuant to Section 1612, shall include the current FEMA "Flood Hazard Boundary Map" (FHBM), "Flood Insurance Rate Map" (FIRM) or "Flood Boundary Floodway Map" (FBFM) for the project location. The required site plan shall include building elevations using the same datum as the related flood hazard map. The owner shall be responsible for the compliance with local flood damage prevention regulations for additional critical elevation information for the project site.

Seismic design: 1613.6.8 OBC & 13.6 ASCE 7

Seismic design requirements for the design and installation of mechanical components are important based on the following factors:



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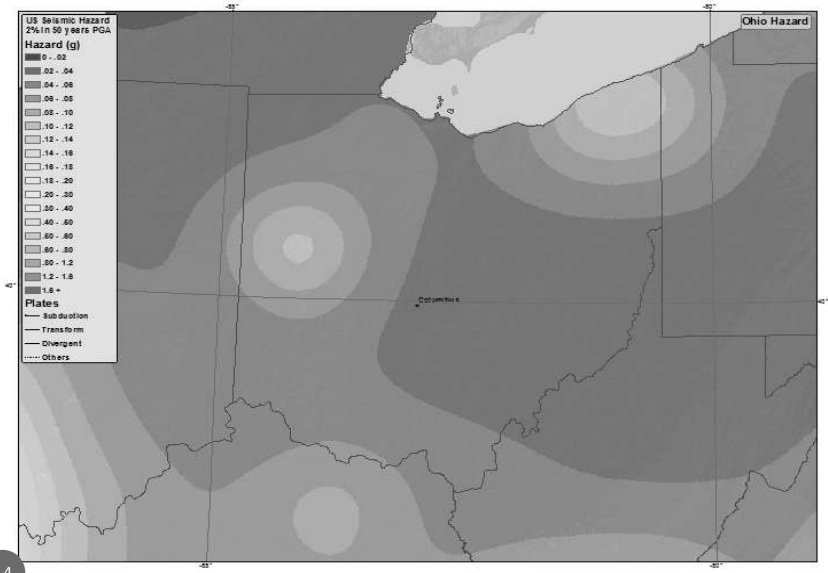
Ohio Seismic Hazard Map



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Section 106.5: Alternative Engineering Design

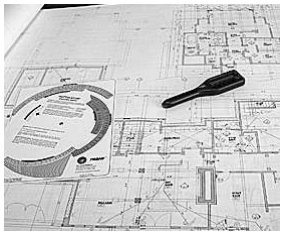
The design, documentation, inspection, testing and approval of an alternative engineered system shall comply with Sections 106.5.1 to 106.5.3 of this rule

Design Criteria	Conform to the intent of code and provide equivalent level of quality, strength, fire resistance, effectiveness, durability, & safety
Submittals	Drawings should indicate that an alternative design has been submitted.
Technical Data	Sufficient technical data should be submitted to prove that the alternative design meets the intent of this code.

Section 114.2: Alternative Products and Materials

- **114.2.1 Research reports.**
  A valid research report from an evaluation service listed in "Appendix P" shall be submitted.

- **114.2.2 Board approval.**
  Any material, product, assembly or method of construction not specifically provided for in this code may be approved by the board of building standards upon application under the procedures prescribed by the board.



Chapter 2
General Definitions

- ***Establishes the meanings of key words and terms used in this code.***
- ***Where terms are not defined through the methods authorized by this section, such terms shall have ordinarily accepted meanings such as the context implies.***

17

17

Section 202: General Definition Example

MEDIUM-DUTY COOKING APPLIANCE.
Medium-duty cooking appliances include electric discrete element ranges (with or without oven), electric and gas hot-top ranges, electric and gas griddles, electric and gas double-sided griddles, electric and gas fryers (including open deep fat fryers, donut fryers, kettle fryers and pressure fryers), electric and gas conveyor pizza ovens, electric and gas tilting skillets (braising pans) and electric and gas rotisseries.

Clarification:

Cooking appliances must be verified per the definition in this section. For example, the required flow rate capacity in section 507.13.3 OMC must be verified for hoods serving these appliances.

18

18

Chapter 3
General Requirements

- ***General requirements for protection of structure, equipment and appliance location, installation, piping support,***
- ***Access and service space, condensate disposal,***
- ***Clearance reduction, temperature control, etc.***

Section 301.4: Listed and Labeled

301.4 Listed and labeled.
Appliances regulated by this code shall be listed and labeled for the application in which they are installed and used, unless otherwise approved in accordance with Section 114 of the building code.

Clarifications:

1. ***Equipment must have a label by the manufacturer listing all criteria and testing information per 301.6 OMC.***
2. ***Examples of common mistakes:***
   - ***Furnace in attic is not listed for attic installation,***
   - ***Appliance installed outdoor not listed for outdoor installation.***

Section 302.2: Penetrations

Penetrations of floor/ceiling assemblies and assemblies required to have a fire-resistance rating shall be protected in accordance with the building code (Section 713.4 OBC)

Clarifications:

1. *All penetrations of floor/ceiling assemblies, fire resistance rated or not, shall be protected per building code.*
2. *All penetrations of a fire-resistance rated wall assemblies shall be protected per building code.*

21

21

Section 303.3: Prohibited appliance locations

Fuel-fired appliances shall not be located in, or obtain combustion air from, any of the following rooms or spaces:

1. *sleeping rooms,*
2. *bathrooms,*
3. *toilet rooms,*
4. *storage closets,*
5. *surgical rooms.*

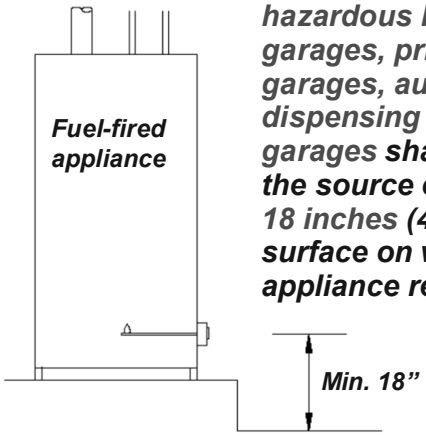
Clarifications:

1. *The intent is prevent the combustion gases from building up and cause harm to the occupants.*
2. *See section 303.3 OMC for exceptions*

22

22

Section 304.3: Elevation of ignition source

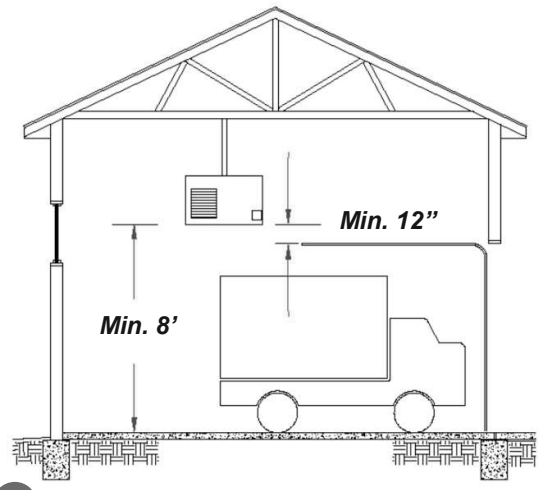


Equipment and appliances having an ignition source and located in hazardous locations and public garages, private garages, repair garages, automotive motor fuel-dispensing facilities and parking garages shall be elevated such that the source of ignition is not less than 18 inches (457 mm) above the floor surface on which the equipment or appliance rests

23

23

Section 304.6: Public Garages



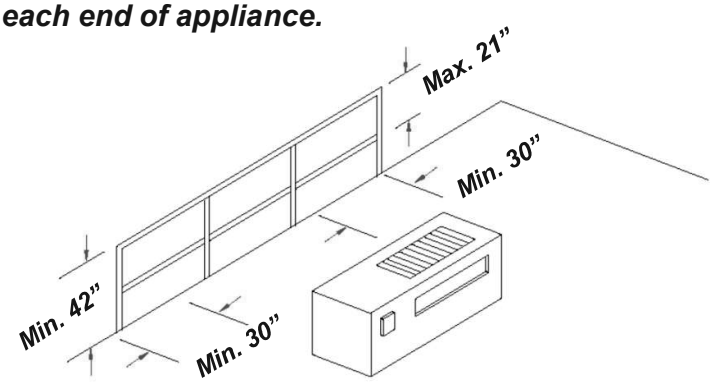
Appliances located in public garages, motor fueling-dispensing facilities, repair garages or other areas frequented by motor vehicles

24

24

Section 304.11: Guards for appliance on roof

- Guard is required for appliance <10' from roof edge, or open side of walking surface > 30" in height,
- Guard shall meet the loading requirements,
- Guard shall be installed at a minimum 30" beyond each end of appliance.



25

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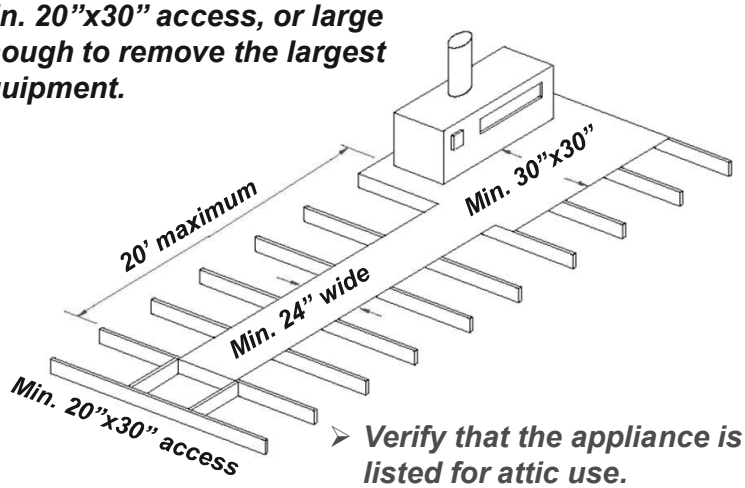
25

Section 306.3: Appliance in attics

- Min. 30" clearance in height,
- Min. 20"x30" access, or large enough to remove the largest equipment.



- Verify that the appliance is listed for attic use.

26

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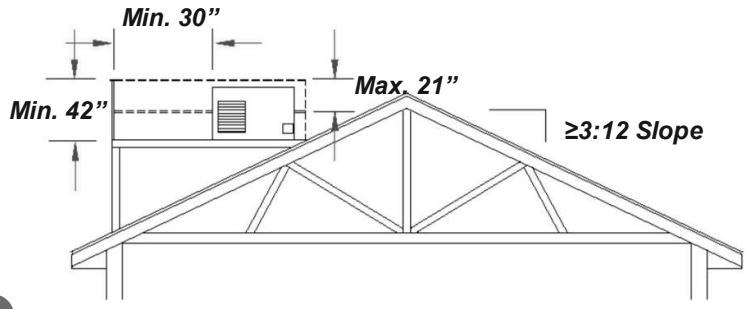
26

Section 306.5.1: Appliance on sloped roof

- A level platform must be provided,
- Guards shall meet the loading requirements,
- Access to platform shall not require walking on sloped roofs > 4:12 in pitch,
- Shall not require to climb over obstructions higher than 30", otherwise, a ladder or stair shall be provided.



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Section 306.5.1: Appliance on sloped roof

- Something like one of these?

28

Section 307: Condensate disposal

- ***The minimum condensate pipe slope 1/8" per foot, i.e., is 1%.***
- ***The minimum size for a condensate pipe is ¾" internal diameter; shall not decrease in size down flow.***

TABLE 307.2.2 CONDENSATE DRAIN SIZING

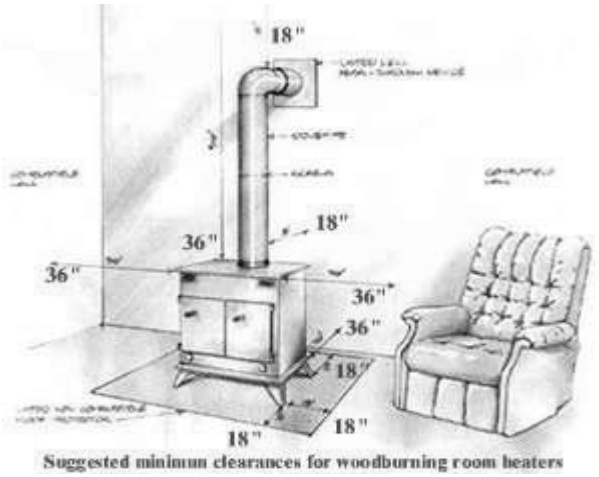
EQUIPMENT CAPACITY	MINIMUM CONDENSATE PIPE DIAMETER
Up to 20 tons of refrigeration	$^3/_4$ inch
Over 20 tons to 40 tons of refrigeration	1 inch
Over 40 tons to 90 tons of refrigeration	$1^1/_4$ inch
Over 90 tons to 125 tons of refrigeration	$1^1/_2$ inch
Over 125 tons to 250 tons of refrigeration	2 inch

29

29

Section 308: Clearance Reduction

- ***Clearance to combustible surfaces shall be based on the manufacturer's instructions in listing label.***



Suggested minimum clearances for woodburning room heaters

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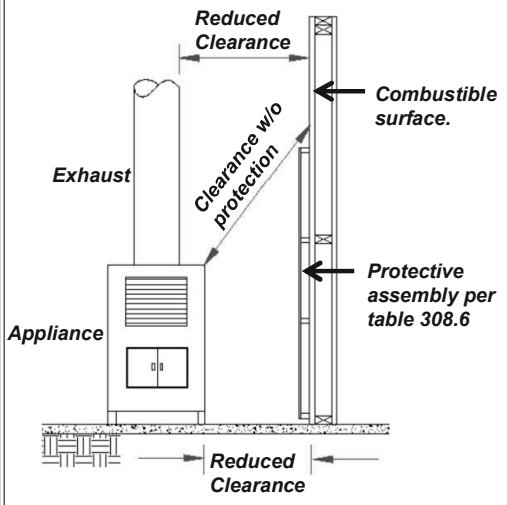
Section 308.2.1: Clearance Reduction



- **Clearance distance is measured from the heat source to the combustible surface** even if that combustible surface is not visible.
- **The listed clearance to combustible surfaces can be reduced based on the types of protective assembly listed in table 308.6 OMC.**
- **Clearance reduction in table 308.6 OMC** can not be used **if the manufacturer's listing or label** prohibits **the** reduction. (308.2 OMC)

31

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31

Section 309: Temperature Control

- **What is the minimum indoor temperature for space or room designed for human occupancy? Can portable space heaters be used to accomplish this?**

Section 309.1 OMC:
Interior spaces intended for human occupancy shall be provided with active or passive space-heating systems capable of maintaining a minimum indoor temperature of 68°F (20°C) at a point 3 feet (914 mm) above floor **on the design heating day. The installation of portable space heaters** shall not **be used to achieve compliance with this section.**

32

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32

Chapter 4
Ventilation

- ***General requirements for the ventilation of spaces within a building intended to be occupied.***

Section 401: General Requirements

- ***Ventilation shall be provided during the periods that the room or space is occupied.***
- ***Every occupied space shall be ventilated by:***
  - ***Natural means (Section 402) or,***
  - ***Mechanical means (Section 403).***

Question:

- ***Can a designer use a combination of natural and mechanical ventilations in the same building?***
- ***The requirement is to use either natural ventilation or mechanical ventilation for each occupied space. So, use combination of two methods in the same building is not prohibited. However, spaces using natural ventilation still need to meet the requirement of minimum temperature. Also, temperature and pressure balance for the whole building will need to be verified.***

Section 401: General Requirements

- **Section 401.4: Intake opening locations**
  - Min. 10' from lot lines or building on same lot,
  - Min. 10' horizontally from any hazardous or noxious contaminant source such as vents, streets, alleys, parking lots, loading docks,
  - If within 10', intake opening must be minimum 3' below contaminant source
  - Intake opening must be at or above the design flood level

35

35

Section 402: Natural ventilation

- Natural ventilation shall be through windows, doors, louvers, vents, skylights, or other openings to the outdoors.
- The minimum openable area to the outdoors shall be 4% of the floor area being ventilated.

Clarification:

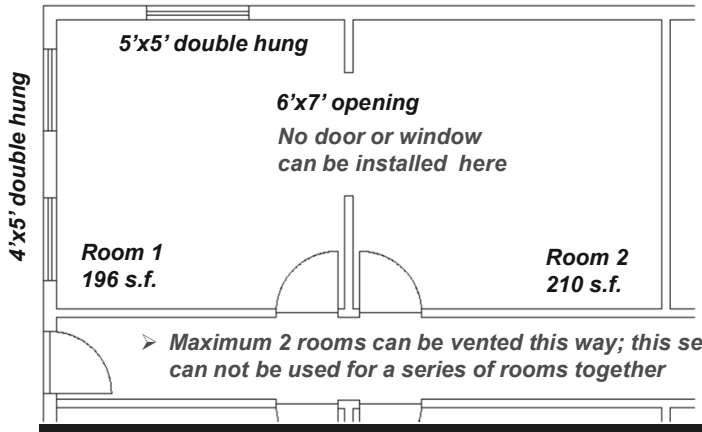
1. Only openable portion of a window, door, or other opening can be calculated into the ventilation area. Fixed window or storefront, etc., can not be used.
2. For example, a 4'x3' double hung window can be calculated as 6 square feet openable area because only ½ of the window leafs can be open at one time.
3. If any window or door is used for natural ventilation purpose, the location must be in compliance with 401.4 OMC.

36

36

Section 402.3: Natural ventilation thru adjoining space

- 6'x7' opening = 42 s.f. > (210 s.f. x 8% = 16.8 s.f.) and min. 25 s.f. …… O.K.
- Total openable area: 5'x5'/2 + 4'x5'/2 + 4'x5'/2 = 32.5 s.f.
- Openable area 32.5 s.f. > (196 s.f. + 210 s.f.) x 4% = 16.24 s.f. …….. O.K.
- Natural ventilation for room 2 through room 1 is acceptable.



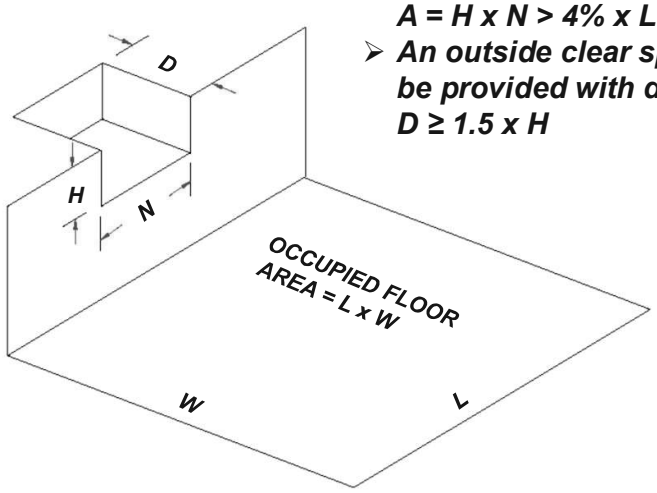
- Maximum 2 rooms can be vented this way; this section can not be used for a series of rooms together

37

37

Section 402.4: Natural ventilation opening below grade

- Openable area (A)
  A = H x N > 4% x L x W
- An outside clear space must be provided with depth
  D ≥ 1.5 x H



38

38

Section 403: Mechanical ventilation

403.2 Outdoor air required.
The minimum outdoor airflow rate shall be determined in accordance with Section 403.3. Ventilation supply systems shall be designed to deliver the required rate of outdoor airflow to the breathing zone within each occupiable space.

Exception: The registered design professional may use ASHRAE 62.1 or ASHRAE 62.2, as applicable, as an alternative engineered ventilation system design provided that the registered design professional demonstrates compliance with all applicable sections of the ASHRAE standard.

39

39

Section 403: Mechanical ventilation

What are some of differences between ASHRAE 62.1 or ASHRAE 62.2 and provisions in OMC?

- ***The minimum ventilation rate table and notes in ASHRAE are slightly different from OMC,***
  - ***Occupancy classifications are slightly different,***
  - ***Re-circulation allowance based on zone air class in ASHRAE,***
  - ***ASHRAE table has "combined outdoor air rates".***
- ***The tables for zone air distribution effectiveness (Ez) and ventilation efficiency (Ev) are slightly different,***
- ***ASHRAE has provisions for reduced outdoor air rates based on varying operating conditions such as variable occupant load conditions short term occupancy conditions (intermittent use).***

40

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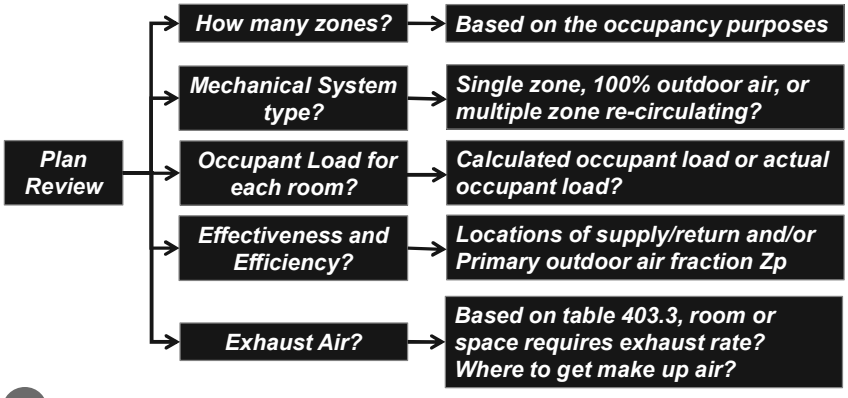
Section 403: Mechanical ventilation

The following factors of building mechanical ventilation system must be verified to review the total required outdoor air rates for a building:



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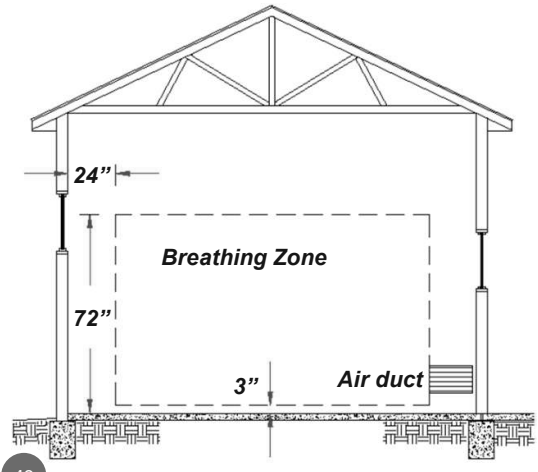
Section 202: Breathing zone definition

The region within an occupied space between planes 3 and 72 inches above the floor and more than 2 feet from the walls of the space or from fixed air-conditioning equipment.



Section 202 OMC:
Definition of ZONE
One occupiable space or several occupiable spaces with similar occupancy classification (see Table 403.3), occupant density, zone air distribution effectiveness and zone primary airflow rate per unit area.

42

42

Section 403.3.1: Zone outdoor airflow

The minimum outdoor airflow required to be supplied to each zone shall be determined as a function of occupancy classification and space air distribution effectiveness in accordance with Sections 403.3.1.1 through 403.3.1.3.

- **Section 403.3.1.1: Breathing zone outdoor air rate (V_{bz})**

  $V_{bz} = R_p P_z + R_a A_z$

  P_z = Zone population A_z = Zone floor area
  R_p = From table 403.3 R_a = From table 403.3

- **Section 403.3.1.2: Zone air distribution effectiveness (E_z)**
  - **E_z values taken from table 403.3.1.2**
  - **If cooling mode and heating mode effectiveness values are different, use the most restrictive value (smaller value)**

- **Section 403.3.1.3: Zone outdoor air rate (V_{oz})**
  $V_{oz} = V_{bz} / E_z$

43

43

TABLE 403.3 MINIMUM VENTILATION RATES (Partial table shown)

OCCUPANCY CLASSIFICATION	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_a CFM/FT² [a]	DEFAULT OCCUPANT DENSITY #/1000 FT² [a, i]	EXHAUST AIRFLOW RATE CFM/FT² [a]
Correctional facilities				
Cells				
without plumbing fixtures	5	0.12	25	—
with plumbing fixtures[g]	5	0.12	25	1.0
Dining halls (see food and beverage service)	—	—	—	—
Guard stations	5	0.06	15	—
Day room	5	0.06	30	—
Booking/waiting	7.5	0.06	50	—
Dry cleaners, laundries				

- **Mechanical exhaust is required where indicated in the table,**
- **Re-circulated air is prohibited in areas listed & in section 403.2.1,**
- **The total occupant load calculated by "Default Occupant Density" shall be less than that determined by section 1004 of the Ohio Building Code.**

44

44

Section 403.3.2: System outdoor airflow

The total system outdoor airflow rate (V_{ot}) for a building shall be summarized in accordance with section 403.3.2.

- **Section 403.3.2.1: Single zone system**
  - $V_{ot} = V_{oz}$
- **Section 403.3.2.2: 100% outdoor air system**
  - $V_{ot} = \Sigma_{\text{all zones}} V_{oz}$
- **Section 403.3.2.3: Multiple zone recirculating systems**
  - System with outdoor air and re-circulated return air
  - $V_{ot} = V_{ou} / E_z$ where E_z is taken from table 403.3.2.3.2
  - $V_{ou} = D \Sigma_{\text{all zones}} R_p P_z + \Sigma_{\text{all zones}} R_a A_z$
  - $D = P_s / \Sigma_{\text{all zones}} P_z$ where P_s is total occupant load expected to be concurently in all zones.

45

45

Section 403.2: Recirculation of air

- The outdoor air required by Section 403.3 shall not be re-circulated.
- Air in excess of that required by Section 403.3 shall not be prohibited from being re-circulated as a component of supply air to building spaces, except:
  - Re-circulation from one dwelling to another or dissimilar occupancies,
  - Swimming pool, must be dehumidified to ≤ 60% and ≤ 10% re-circulated air.
  - Re-circulation is prohibited by notes b and g in table 403.3 where mechanical exhaust is required.

Clarification:

- Only the required outdoor air rates are not allowed to be re-circulated.

46

46

403.4 Exhaust ventilation.
Exhaust airflow rate shall be provided in accordance with the requirements in Table 403.3. Exhaust makeup air shall be permitted to be any combination of outdoor air, re-circulated air and transfer air, except as limited in accordance with Section 403.2.

Clarification:

1. ***Where the exhaust rate is required in the room or space listed in table 403.3 OMC, the makeup air must be evaluated.***
2. ***Makeup air for the required mechanical exhaust may be included in the required outdoor ventilation rate calculation or from other means.***

47

47

403.5 System operation.
The minimum flow rate of outdoor air that the ventilation system must be capable of supplying during its operation shall be permitted to be based on the rate per person indicated in Table 403.3 and the actual number of occupants present.

Clarification:

1. ***Designer may use the actual number of occupants for the required outdoor ventilation air calculation in those rooms that has "default occupant density" in table 403.3 OMC.***
2. ***This rule does not apply to the room or space that is required to have exhaust rate only.***

48

48

Chapter 5
Exhaust Systems

- ***General requirements for the mechanical exhaust systems serving:***
  - ***Clothes dryers,***
  - ***Cooking appliances,***
  - ***Hazardous exhaust system,***
  - ***Dust, stock, and refuse conveyor,***
  - ***Sub-slab soil exhaust system,***
  - ***Smoke control system,***
  - ***Other exhaust systems.***

49

49

Section 501.2: Exhaust discharge

- ***The air removed by every mechanical exhaust system shall be discharged outdoors at a point where it will not cause a nuisance and not less than the distances specified in Section 501.2.1.***
- ***The air shall be discharged to a location from which it cannot again be readily drawn in by a ventilating system.***
- ***Air shall not be exhausted into an attic or crawl space.***

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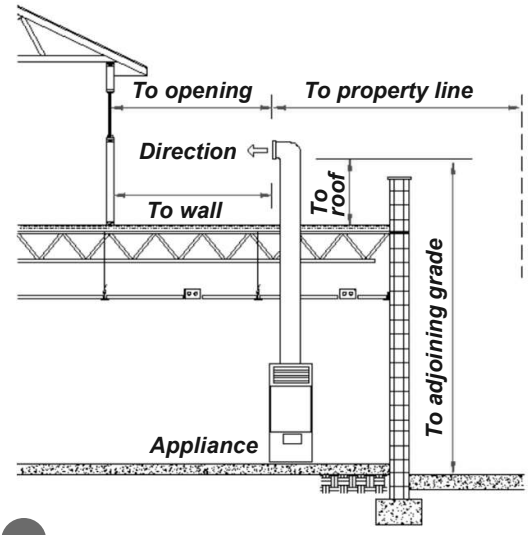
Section 501.2.1: Locations of exhaust outlets



Factors that determine the proper locations of exhaust air termination:

- *Type of exhaust air*
  - *Explosive*
  - *Flammable*
  - *Product conveying*
  - *Environmental air*
- *Flow direction*
- *Distance to:*
  - *Building openings*
  - *Exterior walls / roof*
  - *Combustible walls*
  - *Property line*
  - *Adjoining grade*
  - *Mechanical intakes*

51

An Overview of the Ohio Mechanical Code 2017

51

Section 501.3: Pressure equalization

Where exhaust air rate is required

- *Other than R-3 or dwelling unit in R-2* → *All rooms must be maintained with a natural or negative pressure*
- *Supply rate > Exhaust rate* → *Excessive air must be removed by an adequate mean.*
- *Exhaust rate > Supply rate* → *Adequate make up air rate must be provided to neutralize pressure by the possible means of:*
  - *Supply air*
  - *Transfer air*
  - *outdoor air*
- *Calculated building infiltration air rate can not be used to neutralize the pressure balance requirements.*

52

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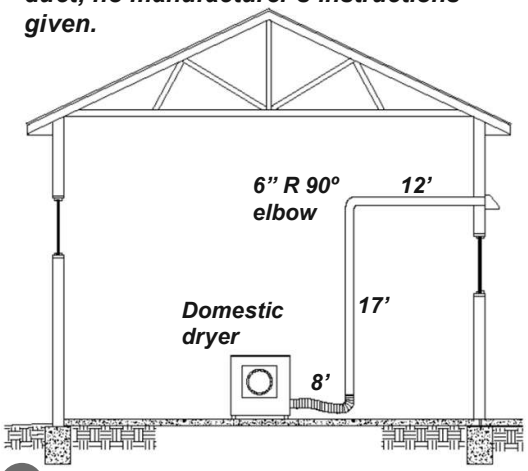
52

Section 504: Clothes Dryer Exhaust

- Exhaust ducts shall not penetrate or located within any fire-blocking, draft-stopping, or any wall, floor ceiling assembly required to be fire resistance rated unless such duct is constructed of galvanized steel or aluminum of the thickness specified in section 603.4.
- Fire dampers, combination fire/smoke dampers, and any similar devices that will obstruct the exhaust flow shall be prohibited in dryer exhaust ducts.
- Make up air shall be provided for clothes dryer exhausting more than 200 cfm.
- Domestic clothes dryer ducts requirements are in section 504.6.

Section 504.6.4: Domestic Clothes Dryer Exhaust

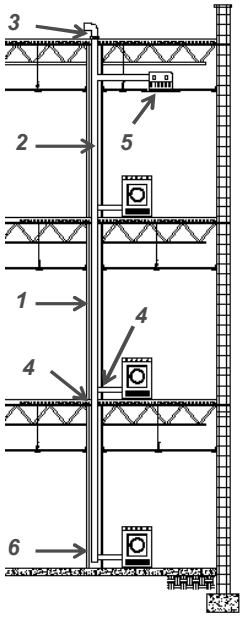
Domestic clothes dryer uses 4" Ø smooth metal ducts with 8' transition duct; no manufacturer's instructions given.



- The maximum exhaust duct length shall be per manufacturer's instructions.
- When not available, the maximum exhaust duct length should be 35'
- One 6" radius, 90º elbows reduces 1.75' per table 504.6.4.1
- Maximum length allowed = 35' – 1.75' = 33.25'
- Total length of exhaust ducts = 17'+12' = 29'
- 29' < 33.25' ….. O.K.
- The length of transition duct should not be included in calculation.

504.8: Common dryer exhaust in multi-story buildings

1. Protected by a fire rated shaft enclosure construction per OBC.
2. Min. 26 GA. Rigid metal duct without any offsets. Min. 6" clearance to combustible materials. No sheet metal screws shall be used (504.4 OMC).
3. Exhaust fan motor shall be designed per section 503.2 and located outside of air stream. It shall be interlocked with dryer operation and have standby power and be monitored.
4. No damper is allowed in exhaust duct,
5. Other exhaust system shall be prohibited from connecting to the dryer exhaust duct. (504.1 OMC)
6. A clean out & 12"x12" access shall be provided at the base of shaft.



Section 505.2: Domestic Kitchen Exhaust Equipment

New code provisions:

Exhaust hood systems capable of exhausting in excess of 400 cfm (0.19 m^3/s) shall be provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with a means of closure and shall be automatically controlled to start and operate simultaneously with the exhaust system.

Clarification:
This provision applies to all residential buildings. We can no longer make the assumption that residential units do not require make up air for kitchen hoods.

Section 506: Commercial Kitchen Exhaust Equipment

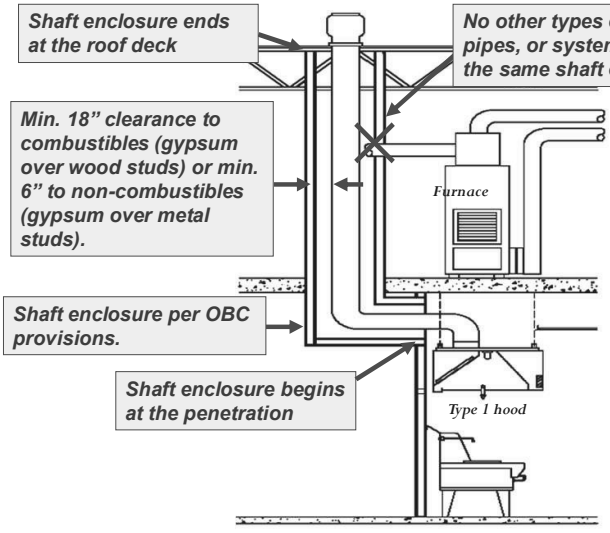
Type I hood grease duct requirements:

- Minimum thickness of 0.0575" (No. 16 gage) or stainless steel not less than 0.0450" (No. 18 gage).
- Continuous liquid-tight weld or braze made on the external surface of the duct system.
- Air velocity not less than 500 feet per minute (2.5 m/s)
- Duct bracing/supports shall be of non-combustible materials designed to carry the load
- Vibration isolation connectors are required
- Cleanouts are required with tight-fitting access doors; horizontal cleanouts shall not be more than 20' apart and the opening at minimum 12" on each side.

57

57

❖ Grease duct enclosure requirements: 506.3.10 OMC



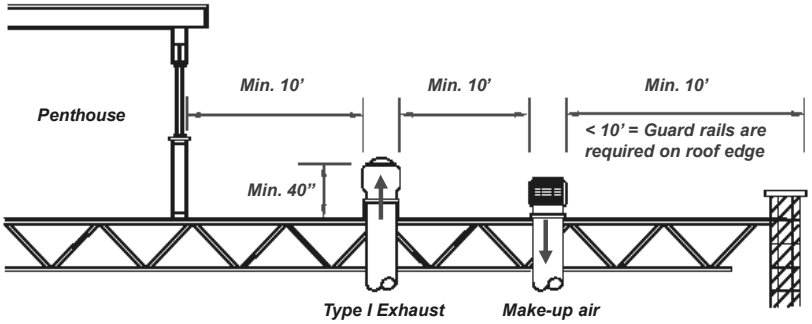
Grease duct enclosures:

1. Shaft enclosures per Ohio Building Code.
2. Penetration protected by approved fire stop system, (duct wrap per ASTM E2336)
3. Prefabricated grease duct enclosure system per UL 2221.
4. Penetrated only one non-fire rated roof /ceiling assembly.

58

506.3.12 OMC: Grease duct termination on roof

- Discharge at minimum 40" above roof surface
- Minimum 10' from parts of the same building, contiguous buildings, adjacent building, adjacent property lines, and air intakes to any building
  - Exception: Required clearance reduced to 5' if exhaust outlet discharged away from the above locations.
- Minimum 3' above air intake openings into any building

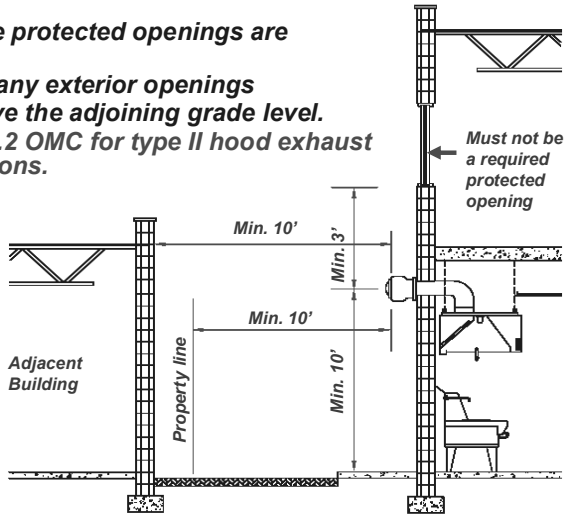


59

506.3.12 OMC: Grease duct termination on wall

- Shall not create a public nuisance or a fire hazard
- Not located where protected openings are required
- Minimum 3' from any exterior openings
- Minimum 10' above the adjoining grade level.
- See section 506.4.2 OMC for type II hood exhaust termination locations.

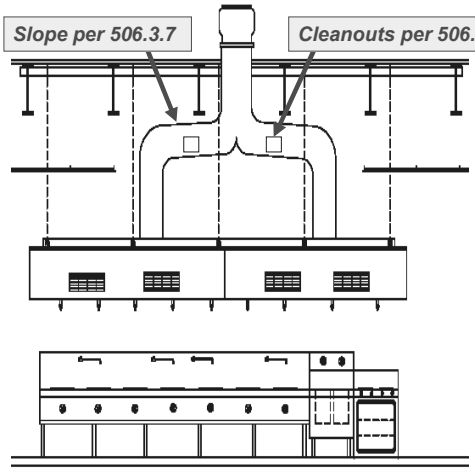
Grease duct shall not discharge over a walkway, an occupied space, or below a building soffit.



60

➢ 506.3.5 OMC: Separation of grease duct system

A separate grease duct system shall be provided for each type I hood.



Exceptions:

1. ***All interconnected hoods are on the same story***
2. ***All interconnected hoods are in the same room or adjoining rooms***
3. ***Ducts do not penetrate fire rated assemblies***
4. ***No solid fuel cooking appliances served by the hoods.***

61

➢ 507 OMC: Commercial Kitchen Hoods

- ***Section 507.2.1:*** ***Type I hoods shall be installed where cooking appliances produce grease or smoke, such as occurs with griddles, fryers, broilers, ovens, ranges, wok ranges, salamanders, tilting skillets, and rotisseries.***
- ***Section 507.2.2:*** ***Type II hoods shall be installed where cooking or dishwashing appliances produce heat, steam, or products of combustion and do not produce grease or smoke, such as steamers, kettles, pasta cookers, cheese-melters, ovens, and dishwashing machines.***
- ***Section 507.2.3:*** ***Domestic cooking appliances utilized for commercial purposes shall be provided with Type I or Type II hoods as required for the type of appliances and processes in accordance with Sections 507.2, 507.2.1 and 507.2.2.***
- ***Misconception:*** ***Domestic cooking appliances utilized in commercial buildings shall automatically require a type I hood. NO. It depends on the cooking appliance and process.***

62

62

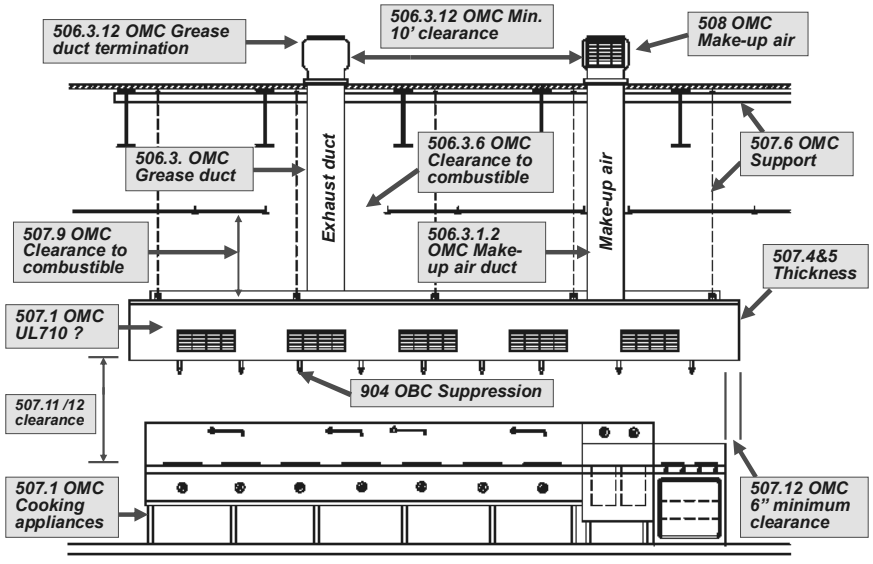
507 OMC: Commercial Kitchen Hoods

- Sections 507.4 through 507.15 have general requirements for type I and II hoods regarding the materials and installation.
- Misconception: A factory built UL 710 type I or II hood is exempt from all these requirements.
  - NO, only exemptions applicable are 507.4, 507.7, 507.11, 507.12, 507.13, 507.14, and 507.15. (Section 507.1 Exception 1)
- Misconception: A factory built UL 710B type I or II recirculating hood is exempt from all these requirements.
  - NO, only exemptions applicable are 507.4, 507.5, 507.7, 507.12, 507.13, 507.14, and 507.15. (Section 507.1 Exception 2)

63

63

507 OMC: Type I hood



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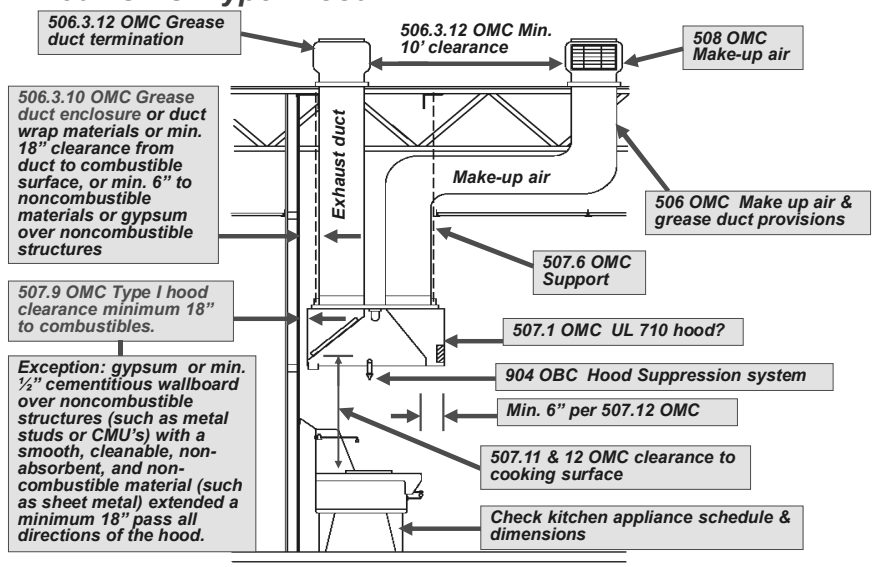
➢ 507 OMC: Type I hood



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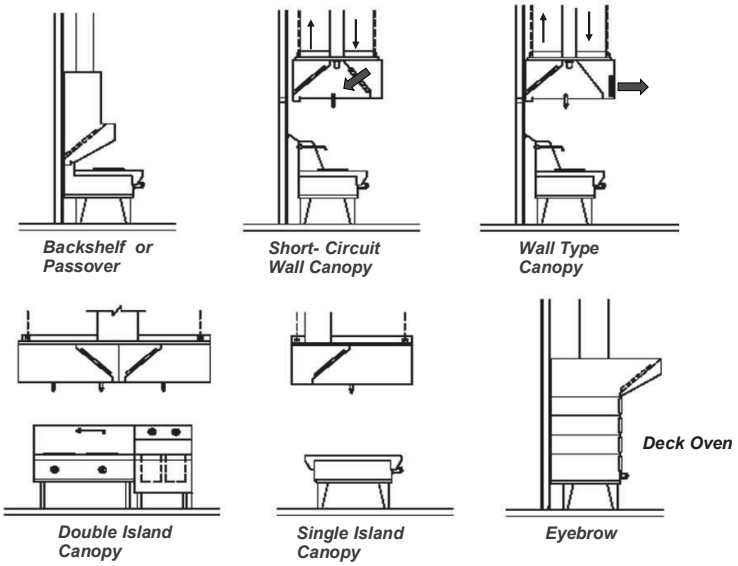
❖ Type I hoods in section 507.13 of Ohio Mechanical Code:



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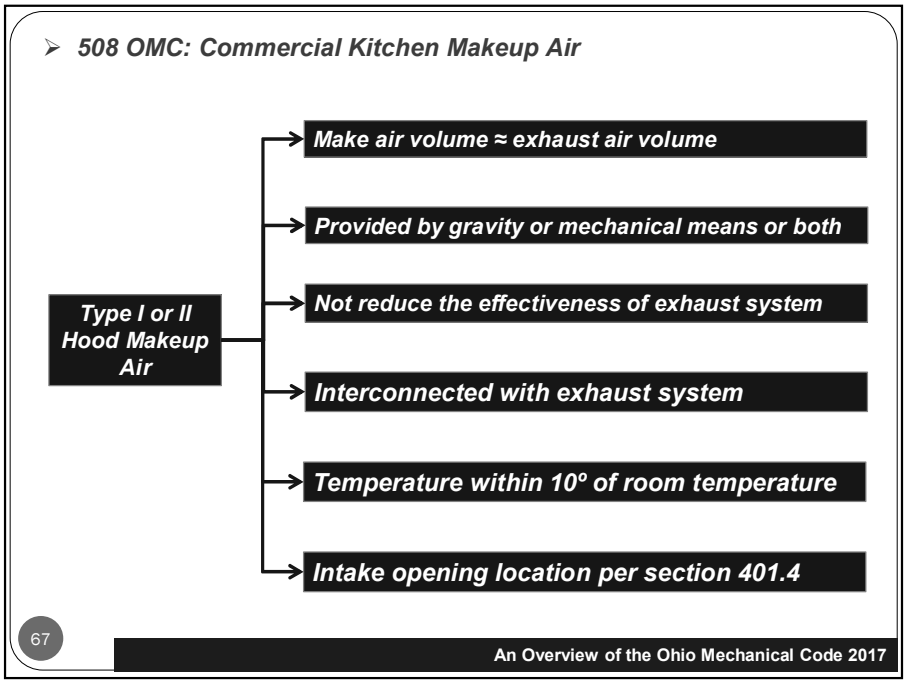
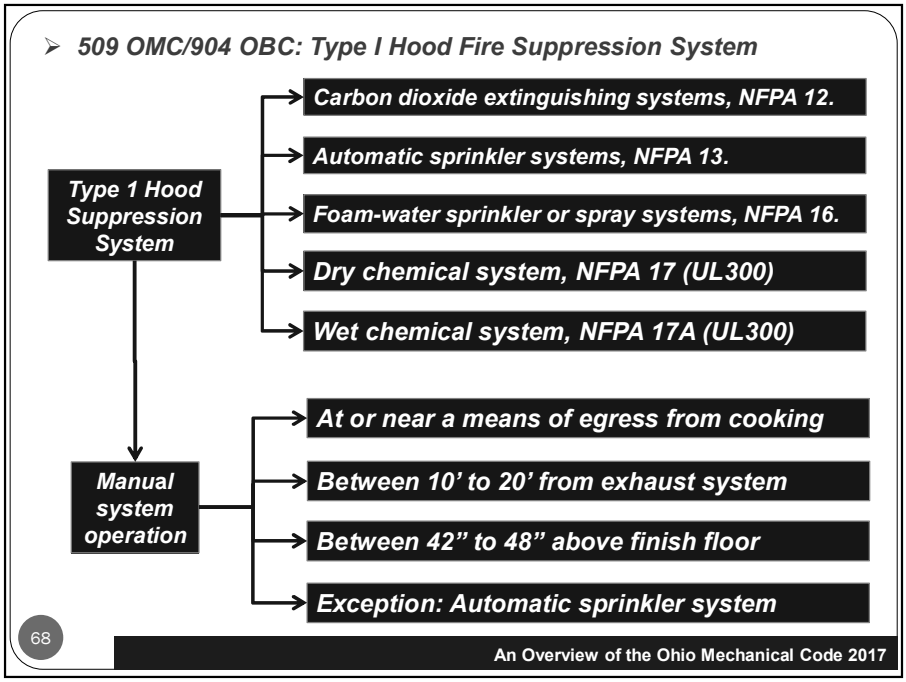

508 OMC: Commercial Kitchen Makeup Air
Type I or II Hood Makeup Air
Make air volume ≈ exhaust air volume
Provided by gravity or mechanical means or both
Not reduce the effectiveness of exhaust system
Interconnected with exhaust system
Temperature within 10º of room temperature
Intake opening location per section 401.4
67
An Overview of the Ohio Mechanical Code 2017

67


509 OMC/904 OBC: Type I Hood Fire Suppression System
Type 1 Hood Suppression System
Carbon dioxide extinguishing systems, NFPA 12.
Automatic sprinkler systems, NFPA 13.
Foam-water sprinkler or spray systems, NFPA 16.
Dry chemical system, NFPA 17 (UL300)
Wet chemical system, NFPA 17A (UL300)
Manual system operation
At or near a means of egress from cooking
Between 10' to 20' from exhaust system
Between 42" to 48" above finish floor
Exception: Automatic sprinkler system
68
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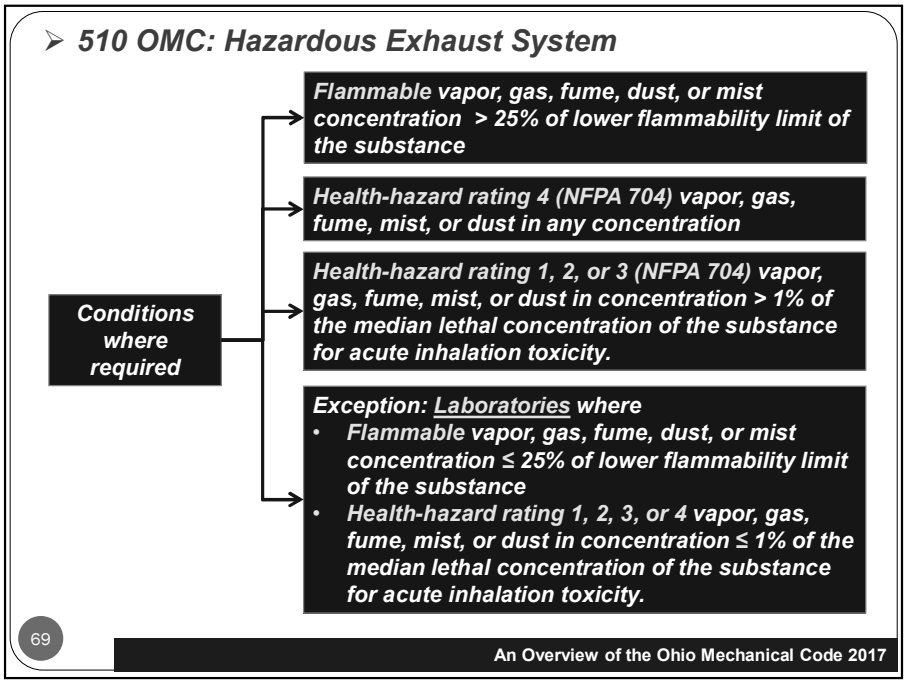
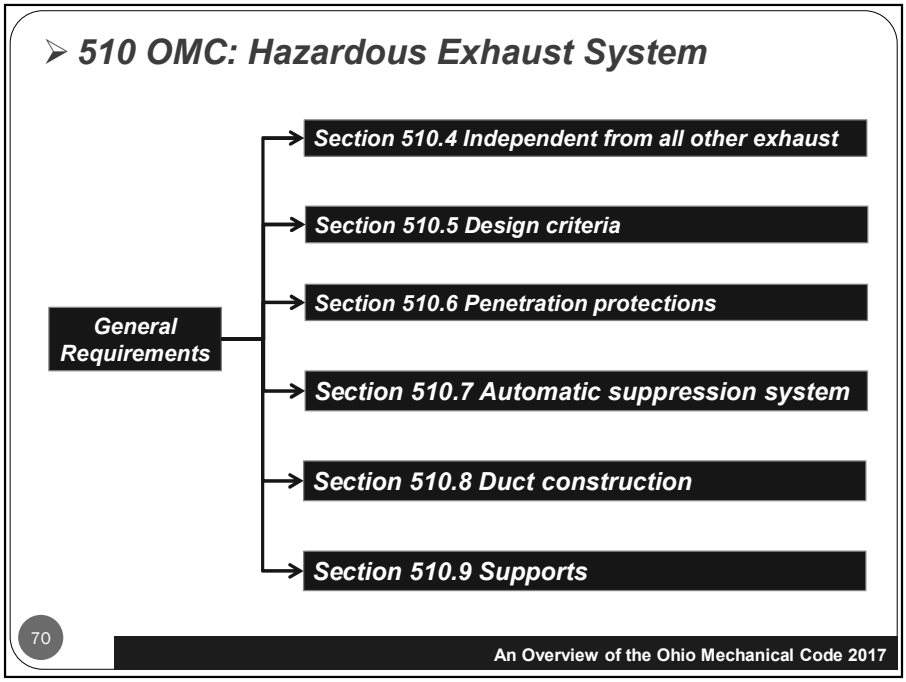
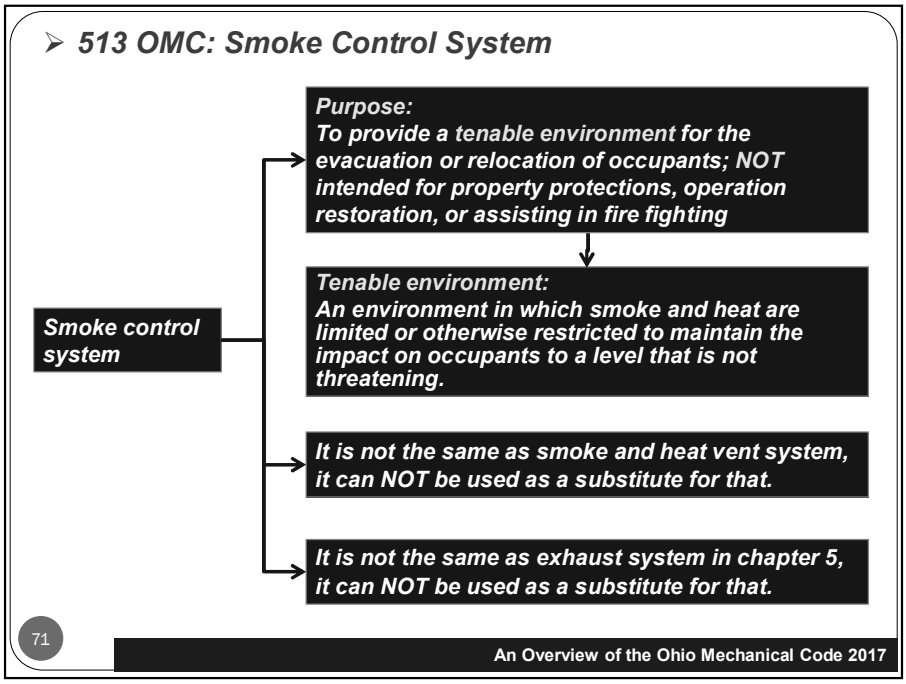
68


➢ 510 OMC: Hazardous Exhaust System
Conditions where required
Flammable vapor, gas, fume, dust, or mist concentration > 25% of lower flammability limit of the substance
Health-hazard rating 4 (NFPA 704) vapor, gas, fume, mist, or dust in any concentration
Health-hazard rating 1, 2, or 3 (NFPA 704) vapor, gas, fume, mist, or dust in concentration > 1% of the median lethal concentration of the substance for acute inhalation toxicity.
Exception: Laboratories where
• Flammable vapor, gas, fume, dust, or mist concentration ≤ 25% of lower flammability limit of the substance
• Health-hazard rating 1, 2, 3, or 4 vapor, gas, fume, mist, or dust in concentration ≤ 1% of the median lethal concentration of the substance for acute inhalation toxicity.
69
An Overview of the Ohio Mechanical Code 2017

69


➢ 510 OMC: Hazardous Exhaust System
General Requirements
Section 510.4 Independent from all other exhaust
Section 510.5 Design criteria
Section 510.6 Penetration protections
Section 510.7 Automatic suppression system
Section 510.8 Duct construction
Section 510.9 Supports
70
An Overview of the Ohio Mechanical Code 2017

70


513 OMC: Smoke Control System
Smoke control system
Purpose:
To provide a tenable environment for the evacuation or relocation of occupants; NOT intended for property protections, operation restoration, or assisting in fire fighting
Tenable environment:
An environment in which smoke and heat are limited or otherwise restricted to maintain the impact on occupants to a level that is not threatening.
It is not the same as smoke and heat vent system, it can NOT be used as a substitute for that.
It is not the same as exhaust system in chapter 5, it can NOT be used as a substitute for that.
71
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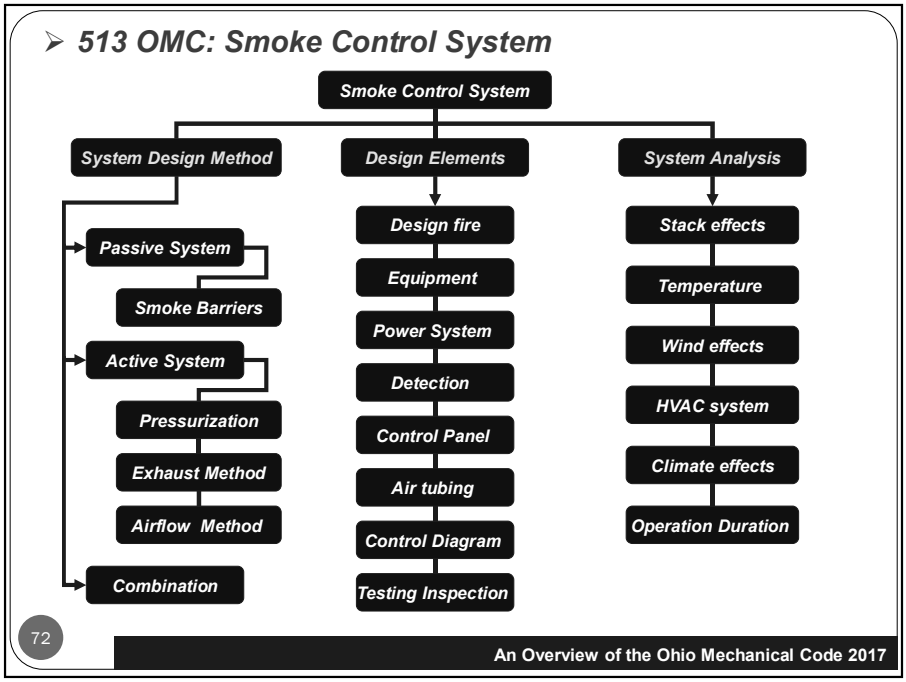
71


513 OMC: Smoke Control System
Smoke Control System
System Design Method
Design Elements
System Analysis
Passive System
Smoke Barriers
Active System
Pressurization
Exhaust Method
Airflow Method
Combination
Design fire
Equipment
Power System
Detection
Control Panel
Air tubing
Control Diagram
Testing Inspection
Stack effects
Temperature
Wind effects
HVAC system
Climate effects
Operation Duration
72
An Overview of the Ohio Mechanical Code 2017

72

Chapter 6
Duct Systems

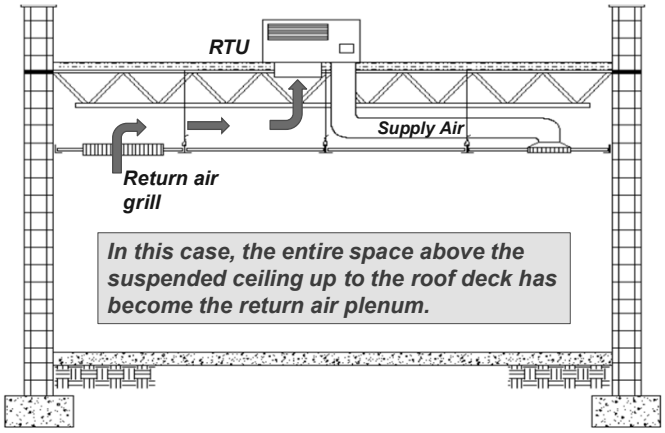
- ***General requirements for the mechanical duct systems:***
  - ***Plenums,***
  - ***Duct materials and installation,***
  - ***Duct insulation,***
  - ***Air filters,***
  - ***Duct smoke detection system,***
  - ***Duct and transfer openings***

73

73

- ***602 OMC: Plenums***

Section 202: Definition
An enclosed portion of the building structure, other than an occupiable space being conditioned, that is designed to allow air movement, and thereby serve as part of an air distribution system.



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74

➢ *602 OMC: Plenums*

General Requirements

- *Plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces and mechanical equipment rooms*
- *Plenums shall be limited to one fire area*
- *Fuel-fired appliances shall not be installed within a plenum*
- *Use of gypsum boards to form plenums shall be limited to systems where the air temperatures ≤ 125°F and above air stream dew-point temperature*
- *Materials within plenums shall be noncombustible or shall have a flame spread index of ≤ 25 and a smoke-developed index of ≤ 50 when tested in accordance with ASTM E 84 or UL 723.*
- *Wiring within plenum must be plenum rated.*

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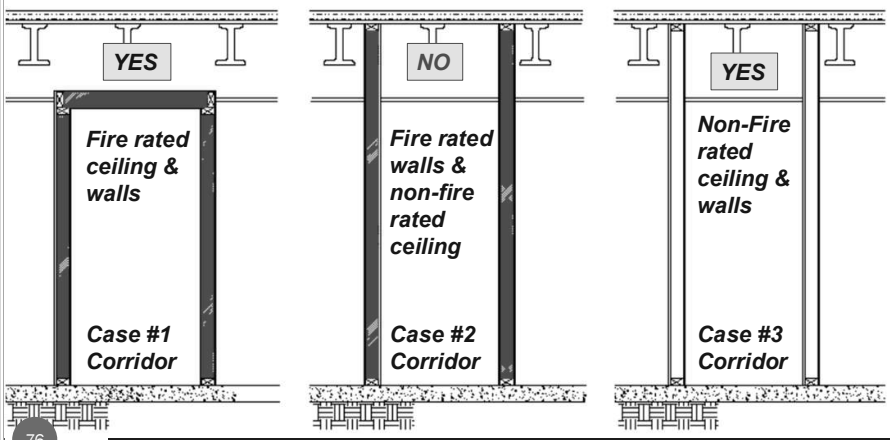
75

➢ *Section 601.2.1: Corridor ceiling space*

Can the ceiling space above the corridor be used as a part of return air plenum?

See also Section 602 for other requirements for air plenums.



76

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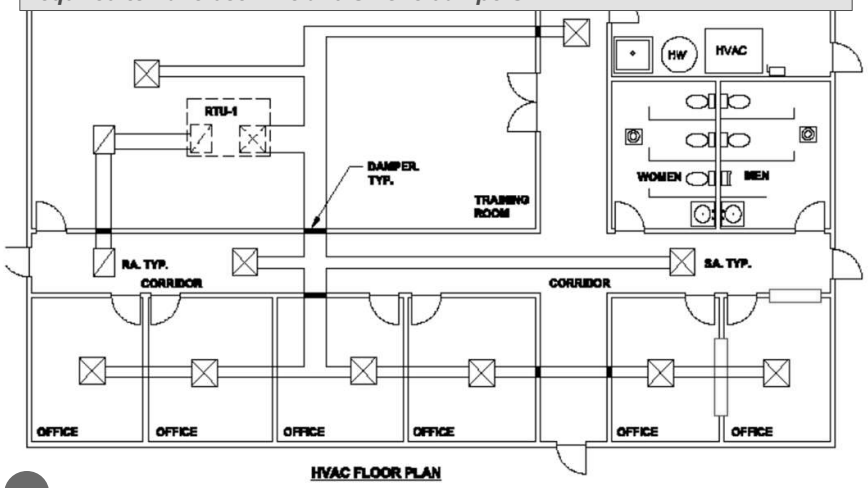
➢ Section 601.2: Air movement in corridor

Corridors shall not serve as supply, return, exhaust, relief or ventilation air ducts. Ducts are allowed to penetrate the rated corridor walls but are required to have both fire and smoke dampers.



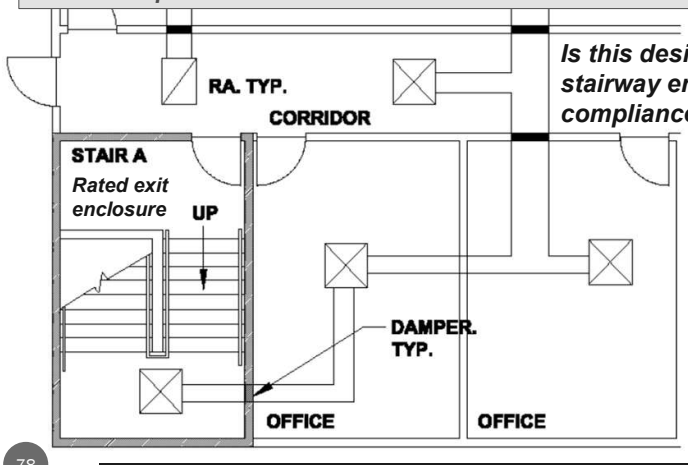
HVAC FLOOR PLAN

77

77

➢ Section 601.3: Ventilation in Exits

Equipment and ductworks serving the exit stairway enclosure shall be independent from the remainder of building ventilation systems to prevent smoke or fire spreading into the exit enclosure. See also Section 1022 OBC for other requirements.



Is this design for exit stairway enclosure code compliance?

78

78

- ***603.6 OMC: Flexible air ducts & flexible air connectors***

603.6.1 OMC: Flexible air ducts.
Flexible air ducts, both metallic and nonmetallic, shall be tested in accordance with UL 181. Such ducts shall be listed and labeled as Class 0 or Class 1 flexible air ducts and shall be installed in accordance with Section 304.1.

603.6.2 OMC: Flexible air connectors.
Flexible air connectors, both metallic and nonmetallic, shall be tested in accordance with UL 181. Such connectors shall be listed and labeled as Class 0 or Class 1 flexible air connectors and shall be installed in accordance with Section 304.1.

- ***What are the differences?***

79

79

- ***603.6 OMC: Flexible air ducts & flexible air connectors***
- ***The differences are in the UL 181 test items:***

Test items	*Flexible duct*	*Flexible connector*
Surface burning characteristics	*Yes*	*Yes*
Flame penetration	*Yes*	*No*
Burning	*Yes*	*Yes*
Corrosion	*Yes*	*Yes*
Mold growth and humidity	*Yes*	*Yes*
Temperature	*Yes*	*Yes*
Puncture	*Yes*	*No*
Impact	*Yes*	*No*
Erosion	*Yes*	*Yes*
Pressure	*Yes*	*Yes*
Collapse	*Yes*	*Yes*
Tension	*Yes*	*Yes*
.....	*Yes*	*Yes*

We must pay attention to marking or labeling of materials.

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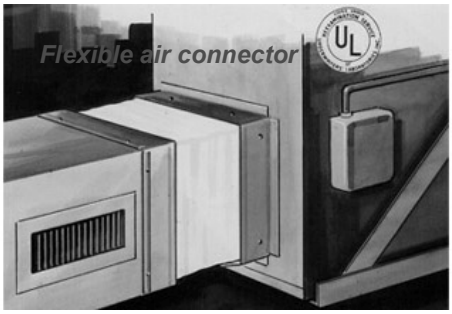
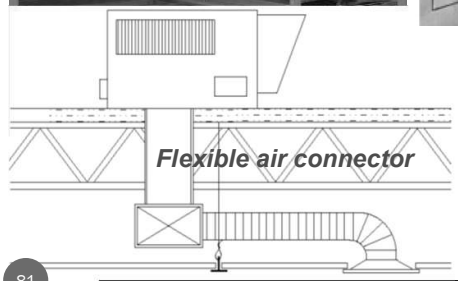
- 603.6 OMC: Flexible air ducts & flexible air connectors



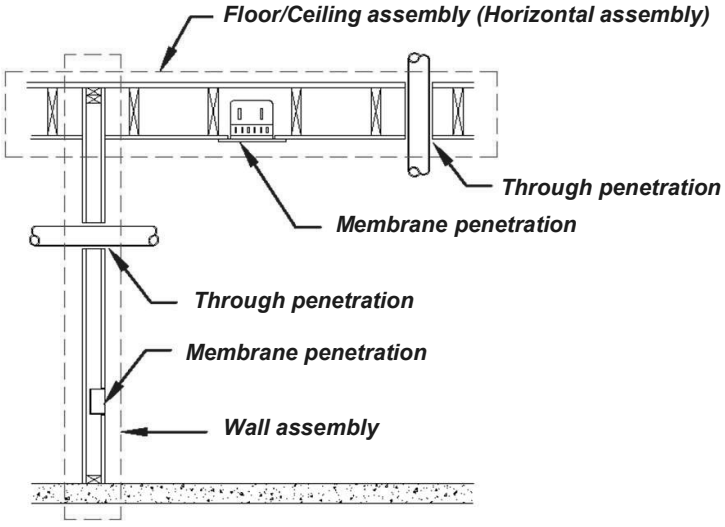


- Are these considered flexible air ducts or flexible air connectors?
- Flexible air connector has 14 feet length limitation (603.6.2 OMC), flexible air duct does not.

81

81

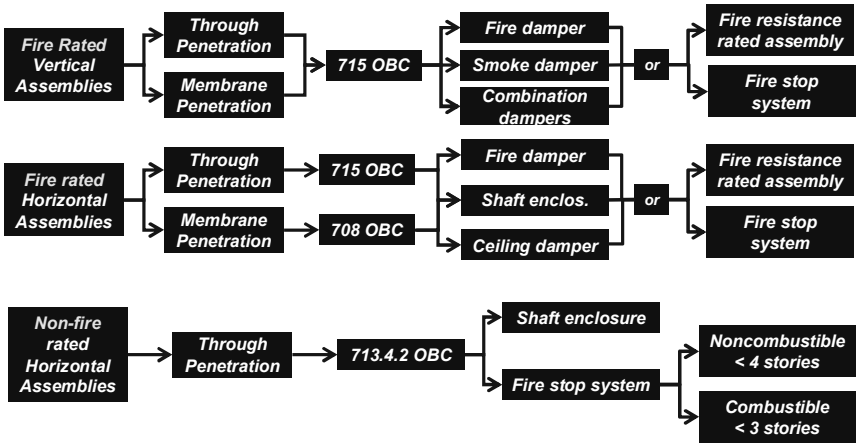
- 607 OMC: Ducts penetrations and transfer openings



82

82

- 607 OMC: Ducts penetrations and transfer openings



- No protection is required for penetrations in non-fire rated vertical assemblies except smoke partitions per 710 OBC.

83

83

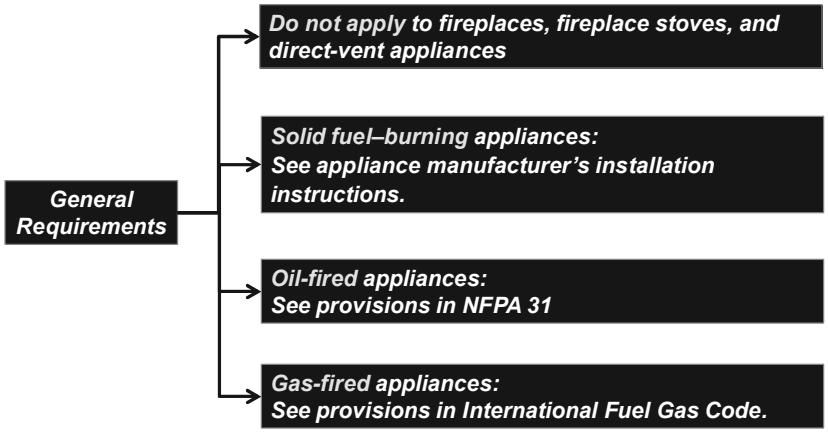
Chapter 7
Combustion Air

- General requirements for combustion air:
  - Solid fuel-burning appliances
  - Oil-fired appliances
  - Gas-fired appliances
- Combustion air is not the same as outdoor air required in chapter 4 of OMC or makeup air required for any exhaust systems.

84

84

- *701.1 Scope for Combustion air requirements:*



- *Insufficient combustion air supply will cause incomplete combustion result in appliance malfunction and excessive carbon monoxide.*

85

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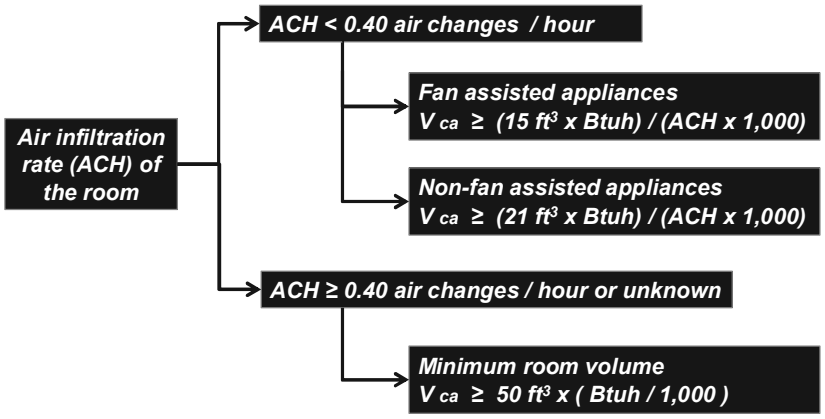
85

- *304.5 IFGC: Combustion air for Gas-fired appliances*
- *Verify if the required combustion air can be taken from the room volume where the appliances are located.*



86

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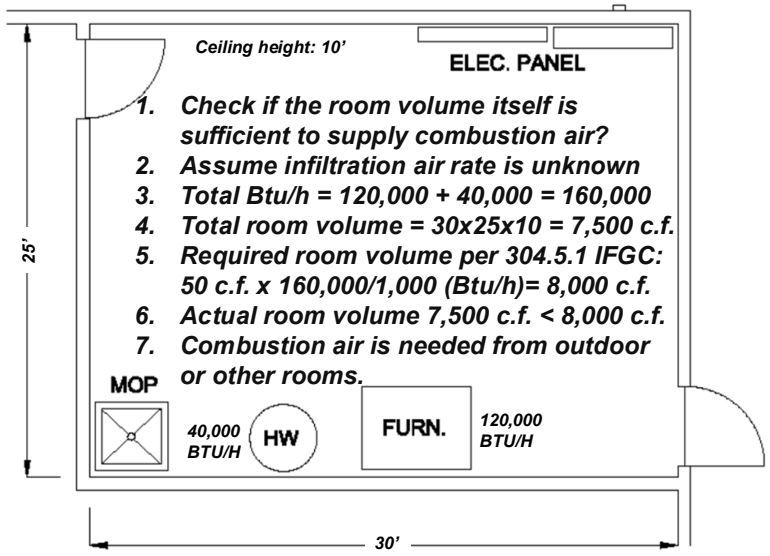
86

➢ 304.5 IFGC: Combustion air for Gas-fired appliances



1. Check if the room volume itself is sufficient to supply combustion air?
2. Assume infiltration air rate is unknown
3. Total Btu/h = 120,000 + 40,000 = 160,000
4. Total room volume = 30x25x10 = 7,500 c.f.
5. Required room volume per 304.5.1 IFGC: 50 c.f. x 160,000/1,000 (Btu/h)= 8,000 c.f.
6. Actual room volume 7,500 c.f. < 8,000 c.f.
7. Combustion air is needed from outdoor or other rooms.

87

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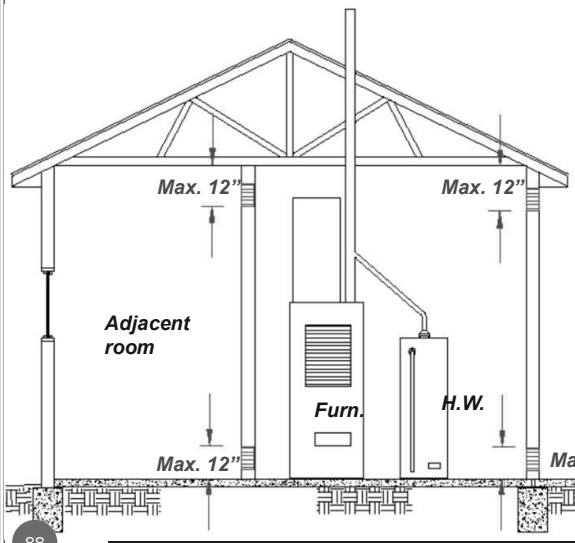
87

➢ 304 IFGC: Combustion air for Gas-fired appliances



Combustion air can be obtained from:

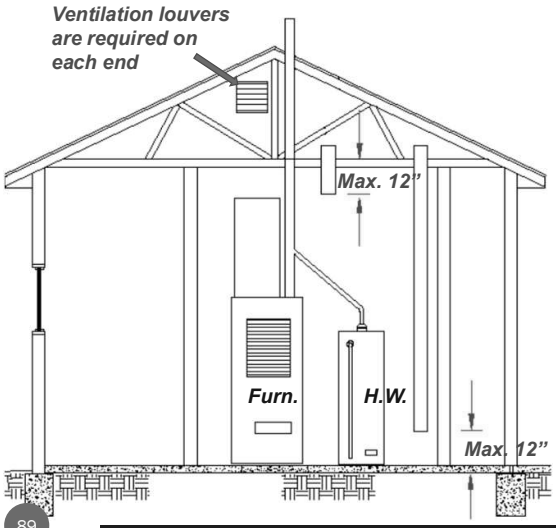
- All outdoor (304.6)
- All indoor (304.5)
- Indoor/outdoor combination (304.7)
- Mechanical (304.9)
- Engineered design

88

An Overview of the Ohio Mechanical Code 2017

88

➢ 304 IFGC: Combustion air for Gas-fired appliances



- Combustion air can also be obtained from:
  - Attics or crawl space or combination of two with direct ventilation to outdoor. 304.6 IFGC.
- See code sections for provisions of required locations and size of openings,

89

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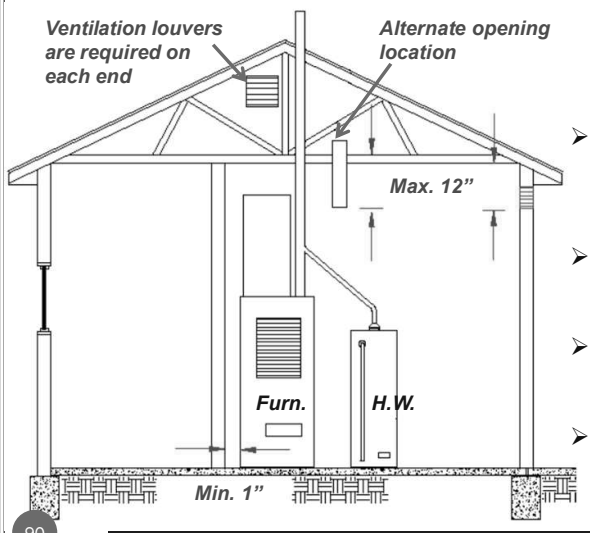
89

➢ 304 IFGC: Combustion air for Gas-fired appliances



- Combustion air can also be obtained from:
  - One permanent opening. 304.6.2 IFGC.
- Opening directly to outdoor or through a vertical or horizontal duct.
- Opening within 12” from the top of enclosure
- Appliance min. 1” clearance from sides and 6” from front
- Opening size min. 1 sq. inch per 3,000 Btu/h total gas input.

90

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90

Chapter 8
Chimneys and Vents

- ***General requirements for chimney and vent systems:***
  - ***Duct size, connectors, cleanouts***
  - ***Chimney vent and terminations***
  - ***Clearance to combustibles***
  - ***Direct venting system***
  - ***Factory-built fireplaces***

- ***801.2 OMC: General***

Every fuel-burning appliance shall discharge the products of combustion to a vent, factory-built chimney or masonry chimney, except for appliances vented in accordance with Section 804 (Direct Vent). The chimney or vent shall be designed for the type of appliance being vented.

Exception:
Commercial cooking appliances vented by a Type I hood installed in accordance with Section 507.

Oil-fired appliances shall be vented in accordance with this code and NFPA 31.

➢ 802 OMC: Vents

802.1 General.
All vent systems shall be listed and labeled. Type L vents and pellet vents shall be tested in accordance with UL 641.

Table 802.2 Vent application

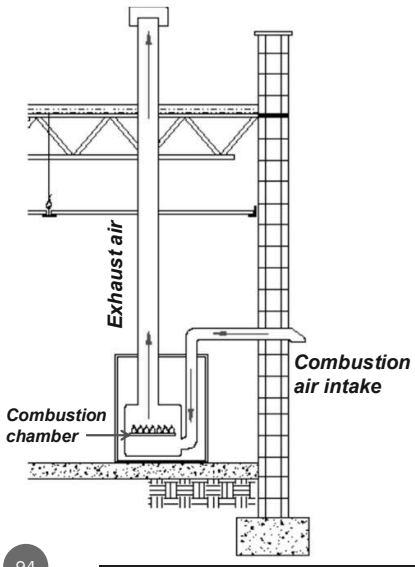
VENT TYPES	APPLIANCE TYPES
Type L oil vents	Oil-burning appliances listed and labeled for venting with Type L vents; Gas appliances listed and labeled for venting with Type B vents.
Pellet vents	Pellet fuel-burning appliances listed and labeled for venting with pellet vents.

PELLET FUEL-BURNING APPLIANCE. A closed-combustion, vented appliance equipped with a fuel-feed mechanism for burning processed pellets of solid fuel of a specified size and composition.

93

93

➢ 804 OMC: Direct vent



DIRECT-VENT APPLIANCES. Appliances that are constructed and installed so that all air for combustion is derived from the outdoor atmosphere and all flue gases are discharged to the outdoor atmosphere.

See sections 803 through 806 for provisions of clearance to combustibles, locations of vent termination, and other installation requirements for each type of appliance.

94

94

Chapter 9 Special Appliances, Fireplaces, and Solid Fuel-burning Equipment

- ***General requirements for solid fuel burning appliances:***
  - ***Wall furnaces and floor furnaces***
  - ***Sauna heaters***
  - ***Forced-air warm air furnaces***
  - ***Unit heaters,***
  - ***Other appliances***

95

95

- ***901 OMC: General Requirements***

901.1 Scope.
This chapter shall govern the approval, design, installation, construction, maintenance, alteration and repair of the appliances and equipment specifically identified herein and factory-built fireplaces. The approval, design, installation, construction, maintenance, alteration and repair of gas-fired appliances shall be regulated by the International Fuel Gas Code.

Clarification:
1. ***This code section only applies to solid fuel burning appliances.***
2. ***All gas-fired appliances are governed by the International Fuel Gas Code.***

96

96

Chapter 10
Boilers, Water Heaters, Pressure Vessels

- ***General requirements for:***
  - ***Water heaters,***
  - ***Pressure vessels***
  - ***Boilers***
  - ***Boiler and pressure vessel testing***

97

97

Chapter 11
Refrigeration

- ***General requirements for refrigeration systems:***
  - ***Refrigerants***
  - ***System classification***
  - ***Machinery room***
  - ***Refrigerant piping***
  - ***Testing***

98

98

Chapter 12
Hydronic Piping

- ***General requirements for hydronic piping systems, such as:***
  - ***High, low, and medium temperature hot water systems,***
  - ***Heating system,***
  - ***Chilled water cooling system,***
  - ***Condenser and cooling tower water system ,***
  - ***Steam and steam condensate piping system,***
  - ***Solar heating system***

99

99

Chapter 13
Fuel Oil Piping and Storage

- ***General requirements for fuel-oil piping and storage:***
  - ***Above-ground and under-ground fuel oil storage tanks,***
  - ***Material standards,***
  - ***Piping systems***
  - ***International Fuel Gas Code will govern items which are not covered under this chapter.***

100

100

Chapter 14
Solar Systems

- ***General requirements for solar energy systems:***
  - ***For space heating and cooling,***
  - ***For domestic hot water heating or processing***

101

101