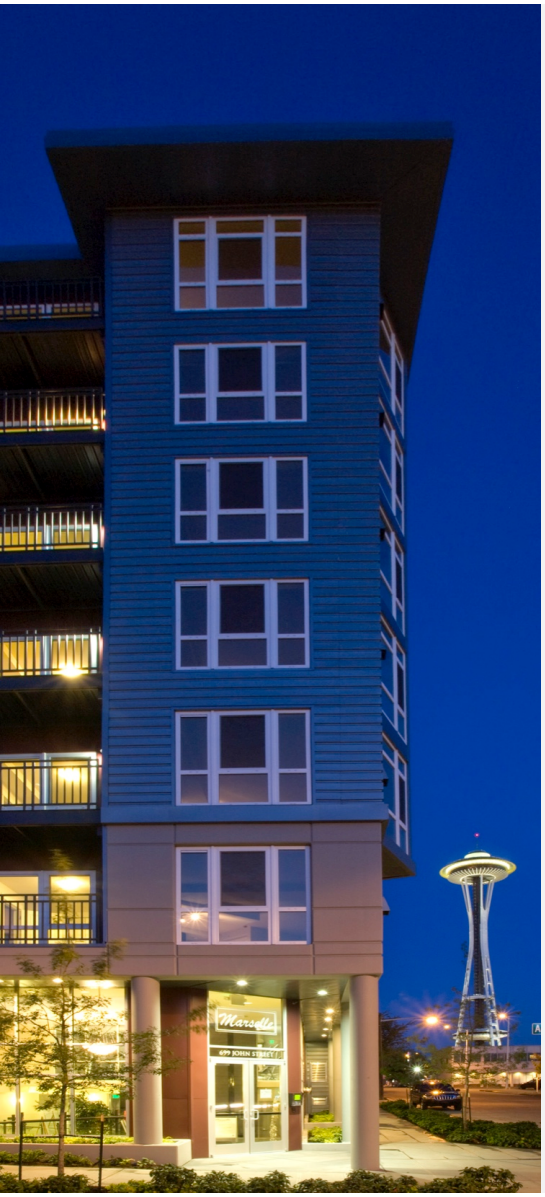

Fire Resistant Design and Detailing

Fire Walls, Fire Barriers & Fire Partitions

Jeff Peters, PE, CGC

March 23, 2022

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Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

With an increase in wood-frame buildings, more designers are seeking information on code-compliant and constructible detailing. Many are unsure of the code's requirements for details, specifically at the intersection of rated assemblies and where structure and fire protection meet. This presentation will focus interior fire rated assemblies such as firewalls, fire barriers and fire partitions. Discussion will include issues of fire-resistance rating continuity, allowable uses of wood framing in rated assemblies, and allowable penetrations.

Learning Objectives

1. Review methods for determining fire-resistance ratings.

2. Discuss detailing aspects of fire resistance for fire walls, fire barriers and fire partitions including material and assembly options, continuity, structural stability, and penetrations.

3. Explore requirements for horizontal assemblies.

4. Understand requirements for individual encasement of beams and columns.

Outline

- Review of Fire Resistance Methods
- Interior Fire Rated Wall Assemblies
  - Fire Walls
  - Fire Barriers
  - Fire Partitions/Corridors
- Horizontal Assemblies

Landing Apartments, Russell Scott Steedle & Capione Architects, photo Gregory Folkins

Outline

- Review of Fire Resistance Methods
  - Interior Fire Rated Wall Assemblies
    - Fire Walls
    - Fire Barriers
    - Fire Partitions/Corridors
  - Horizontal Assemblies

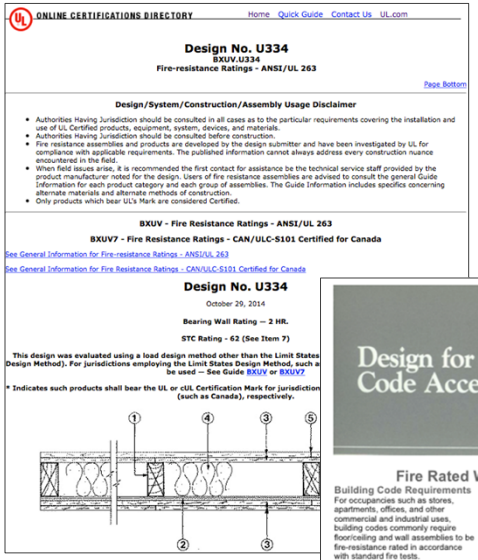
1430 Q, The HR Group Architects, Buehler Engineering, Greg Folkins Photography

Fire Resistance Ratings – IBC 703.2

Fire resistance of elements, components or assemblies shall be based on testing (ASTM E119):

- UL Listings
- Gypsum Catalog
- Proprietary Manufacturer Tests
- Industry Documents: such as AWC's DCA3

OR…



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Design No. U334

BXUV.U334

Fire-resistance Ratings - ANSI/UL 263

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Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

Design No. U334

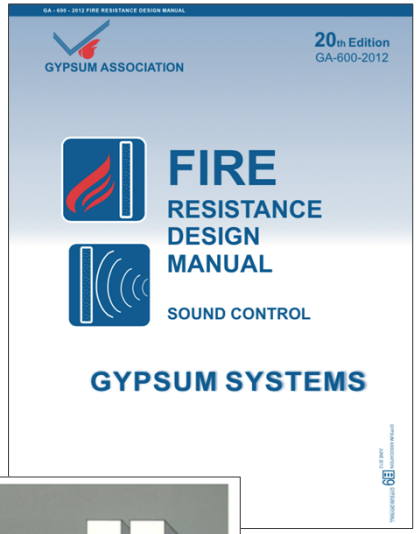
October 29, 2014

Bearing Wall Rating — 2 HR.

STC Rating - 62 (See Item 7)

This design was evaluated using a load design method other than the Limit States Design Method). For jurisdictions employing the Limit States Design Method, such a be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdiction (such as Canada), respectively.**



Fire Resistance Ratings – IBC 703.3

Methods for determining fire resistance:

- Prescriptive designs per IBC 721.1

TABLE 721.1(3)—continued
MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS[a, q]

FLOOR OR ROOF CONSTRUCTION	ITEM NUMBER	CEILING CONSTRUCTION	THICKNESS OF FLOOR OR ROOF SLAB (inches)				MINIMUM THICKNESS OF CEILING (inches)			
			4 hours	3 hours	2 hours	1 hour	4 hours	3 hours	2 hours	1 hour
28. Wood I-joist (minimum I-joist depth $9^{1}/_{4}$" with a minimum flange depth of $1^{1}/_{2}$" and a minimum flange cross-sectional area of 2.25 square inches; minimum web thickness of $^{3}/_{8}$") @ 24" o.c. Unfaced fiberglass insulation or mineral wool insulation is installed between the I-joists supported on the upper surface of the flange by stay wires spaced 12" o.c.	28-1.1	Base layer of $^{5}/_{8}$" Type C gypsum wallboard attached directly to I-joists with $1^{5}/_{8}$" Type S drywall screws spaced 12" o.c. with ends staggered. Minimum 0.0179" thick hat-shaped $^{7}/_{8}$-inch furring channel 16" o.c. (channels doubled at wallboard end joints), placed perpendicular to the joist and attached to each joist by $1^{5}/_{8}$" Type S drywall screws after the base layer of gypsum wallboard has been applied. The middle and face layers of $^{5}/_{8}$" Type C gypsum wallboard applied perpendicular to the channel with end joints staggered. The middle layer is fastened with 1" Type S drywall screws spaced 12" o.c. The face layer is applied parallel to the middle layer but with the edge joints offset 24" from those of the middle layer and fastened with $1^{5}/_{8}$" Type S drywall screws 8" o.c. The joints shall be taped and covered with joint compound.	—	—	—	Varies	—	—	$2^{3}/_{4}$	—

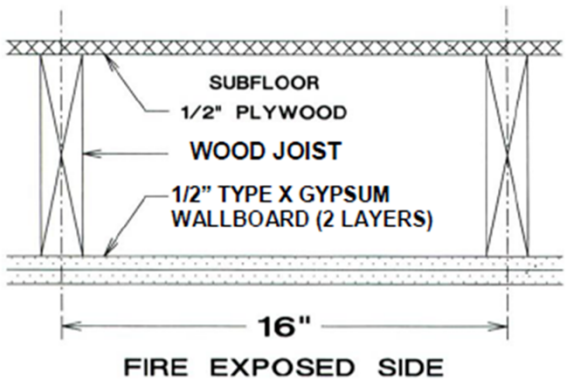
Fire Resistance Ratings – IBC 703.3

Methods for determining fire resistance:

- Prescriptive designs per IBC 721.1
- Calculated Fire Resistance per IBC 722.6

TABLE 722.6.2(1)
TIME ASSIGNED TO WALLBOARD MEMBRANES[a, b, c, d]

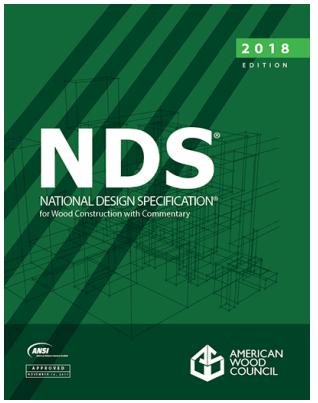
DESCRIPTION OF FINISH	TIME[e](minutes)
3/8-inch wood structural panel bonded with exterior glue	5
15/32-inch wood structural panel bonded with exterior glue	10
19/32-inch wood structural panel bonded with exterior glue	15
3/8-inch gypsum wallboard	10
1/2-inch gypsum wallboard	15
5/8-inch gypsum wallboard	30
1/2-inch Type X gypsum wallboard	25
5/8-inch Type X gypsum wallboard	40
Double 3/8-inch gypsum wallboard	25
1/2-inch + 3/8-inch gypsum wallboard	35
Double 1/2-inch gypsum wallboard	40



1/2 inch Type X Gypsum wallboard	=	25 minutes
1/2 inch Type X Gypsum wallboard	=	25 minutes
Wood joists	=	10 minutes
Combined Assembly Fire Resistance Rating	=	60 minutes

Figure 2 Floor/Ceiling Assembly

Fire Resistance Ratings – IBC 703.3

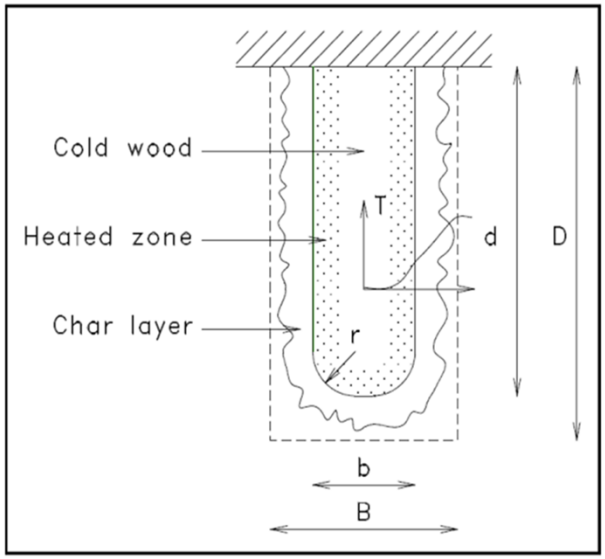


Methods for determining fire resistance:

- Prescriptive designs per IBC 721.1
- Calculated Fire Resistance per IBC 722.6
- Calculated Fire Resistance per IBC 722.1

Table 16.2.1A Char Depth and Effective Char Depth (for β_n = 1.5 in./hr.)

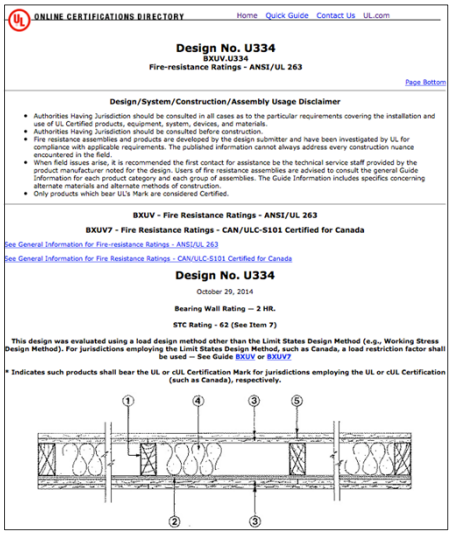
Required Fire Resistance (hr.)	Char Depth, a_{char} (in.)	Effective Char Depth, a_{eff} (in.)
1-Hour	1.5	1.8
1½-Hour	2.1	2.5
2-Hour	2.6	3.2



Fire Resistance Ratings – IBC 703.3

Methods for determining fire resistance:

- Prescriptive designs per IBC 721.1
- Calculated Fire Resistance per IBC 722
- Fire-resistance designs documented in sources
- Engineering analysis based on a comparison
- Fire-resistance designs certified by an approved agency



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Design No. U334
BXUV.U334
Fire-resistance Ratings - ANSI/UL 263

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BXUV - Fire Resistance Ratings - ANSI/UL 263

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

Design No. U334

October 29, 2014

Bearing Wall Rating — 2 HR.

STC Rating - 62 (See Item 7)

This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Design for Code Acceptance

3

Fire Rated Wood Floor and Wall Assemblies

Building Code Requirements

For occupancies such as stores, apartments, offices, and other commercial and industrial uses, building codes commonly require floor/ceiling and wall assemblies to be fire-resistance rated in accordance with standard fire tests.

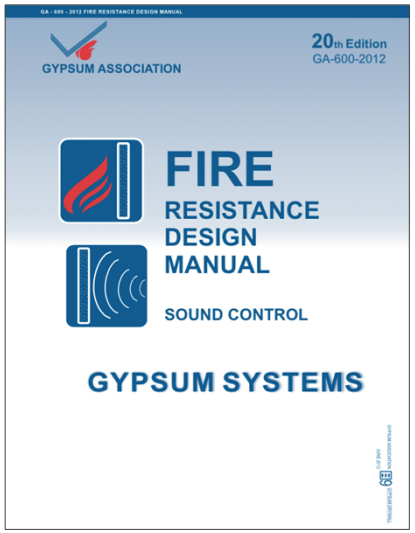
Depending on the application, wall assemblies may need to be rated either from one side or both sides. For specific exterior wall applications, the *2000 International Building Code (IBC)*, the *1999 National Building Code (NBC)*, and the *1999 Standard Building Code (SBC)* allow wood-frame, wood-sided walls to be tested for exposure to fire from the inside only. Rating for both interior and exterior exposure is only required when the wall has a fire separation distance of less than 5 feet. Code recognition of one and two-hour wood-frame wall systems is also predicated on successful fire and hose stream testing in accordance with ASTM E119, *Standard Test Methods for Fire Tests of Building Construction Materials*.

Fire Tested Assemblies

Fire-rated wood-frame assemblies can be found in a number of sources including the *IBC*, Underwriters Laboratories (UL) *Fire Resistance Directory*, Intertek Testing Services' *Directory of Listed Products*, and the Gypsum Association's *Fire Resistance Design Manual*. The American Forest & Paper Association (AF&PA) and its members have tested a number of wood-frame fire-rated assemblies. Descriptions of these successfully tested assemblies are provided in Table 1 for one-hour rated wall assemblies, Table 2 for two-hour rated wall assemblies, Table 3 for one-hour rated floor/ceiling assemblies, and Table 4 for two-hour rated floor/ceiling assemblies. Additional tests are being conducted and the Tables will be updated periodically.

Conclusions

Wood-frame assemblies are used in architectural designs because of their adaptability to style preferences, ease and economies of construction, and energy-saving performance.



GA - 600 - 2012 FIRE RESISTANCE DESIGN MANUAL

GYPSUM ASSOCIATION

20th Edition
GA-600-2012

FIRE
RESISTANCE
DESIGN
MANUAL

SOUND CONTROL

GYPSUM SYSTEMS

Outline

- Review of Fire Resistance Methods
- Interior Fire Rated Wall Assemblies
  - Fire Walls
  - Fire Barriers
  - Fire Partitions/Corridors
- Horizontal Assemblies

1430 Q, The HR Group Architects, Buehler Engineering, Greg Folkins Photography

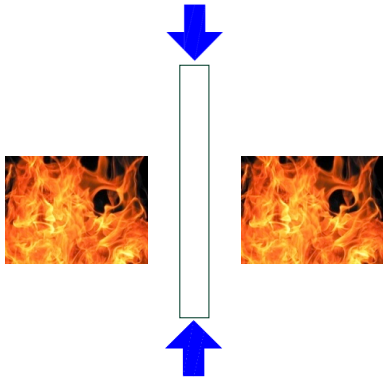
Fire-Resistance Rated Wall Assemblies

Fire-Resistance Rating: The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests, prescribed in Section 703.

Tested under a standardized test fire exposure for a given duration to:

1. Prevent the passage of flame and temperature rise from one side to the other
2. Continue to provide vertical structural support when exposed to fire and elevated temperatures

Fire Confinement



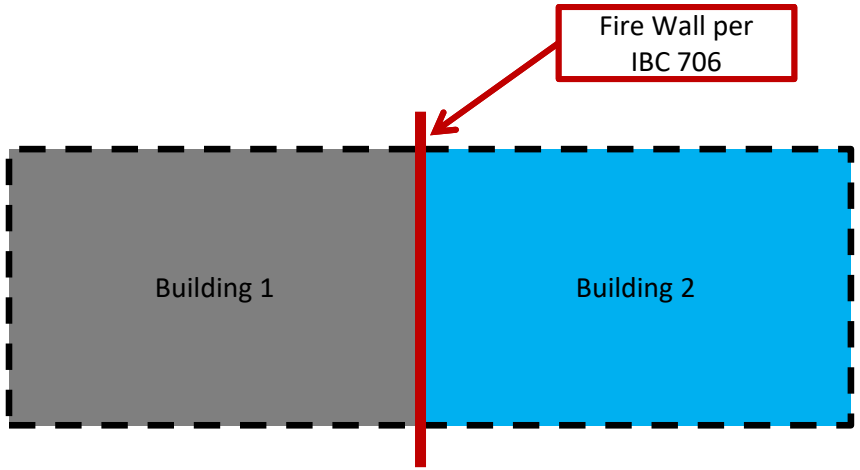
Structural Performance

Interior Fire-Rated Walls: Differences

Fire walls	Fire Barrier	Fire Partition:
• Building Separation • Openings are protected and limited • Continuous from foundation to/through roof and exterior wall to/through exterior wall • Structural stability	• Shafts; Occupancy Separation • Openings are protected and limited • Continuous from floor through concealed space at each level	• Dwelling Unit Separation; Corridors • Openings are protected • May terminate at a fire rated floor/ceiling/roof assembly

Fire Walls – IBC 706

Each portion of a building separated by one or more fire walls shall be considered a separate building.



Fire Walls – Ratings & Materials

TABLE 706.4
FIRE WALL FIRE-RESISTANCE RATINGS

GROUP	FIRE-RESISTANCE RATING (hours)
A, B, E, H-4, I, R-1, R-2, U	3[a]
F-1, H-3[b], H-5, M, S-1	3
H-1, H-2	4[b]
F-2, S-2, R-3, R-4	2

a. In Type II or V construction, walls shall be permitted to have a 2-hour fire-resistance rating.

b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.6 and 415.7.

IBC 706.3 – Fire walls shall be of any approved noncombustible materials.

Exception: Buildings of type V construction

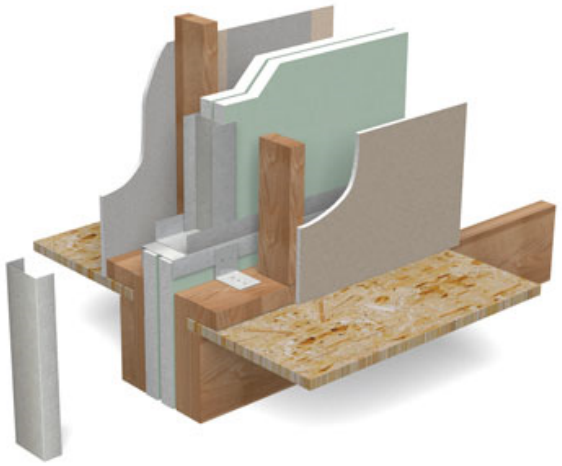
Fire Walls – Ratings & Materials

Opportunity for Wood Framed Fire Walls:

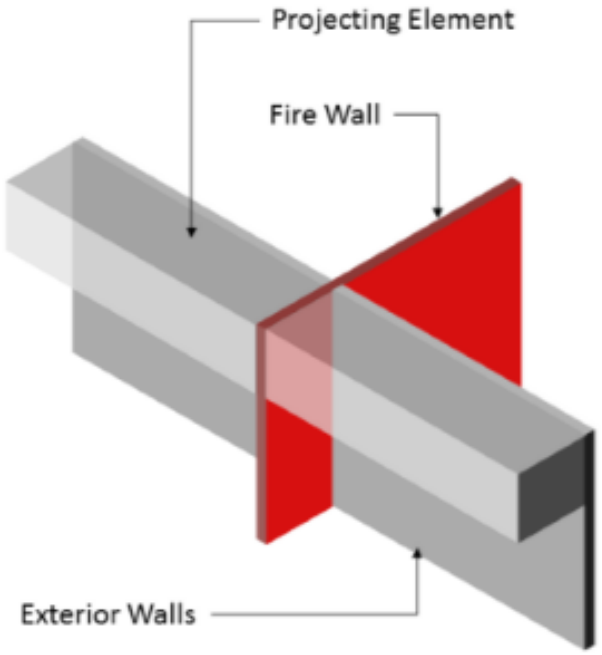
- Permitted in type V construction
- Fire Walls in type V construction of A, B, E, R and several other occupancies may be 2-hr

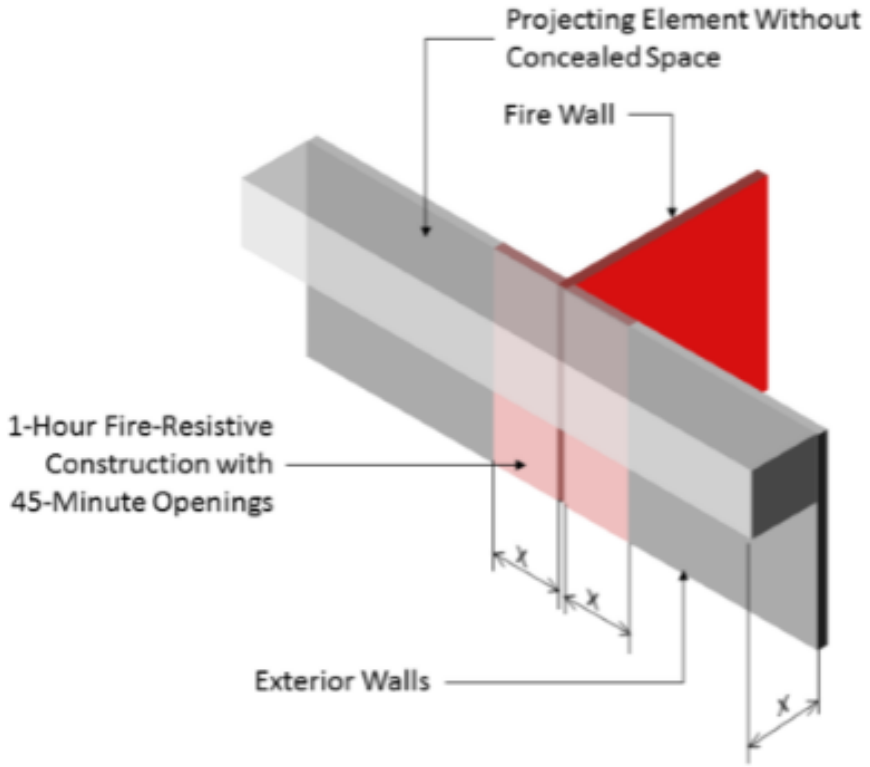
Fire Walls in type III and IV construction are required to be constructed of noncombustible materials

- Opportunity for wood frame bearing walls on each side of fire wall to meet structural stability requirements

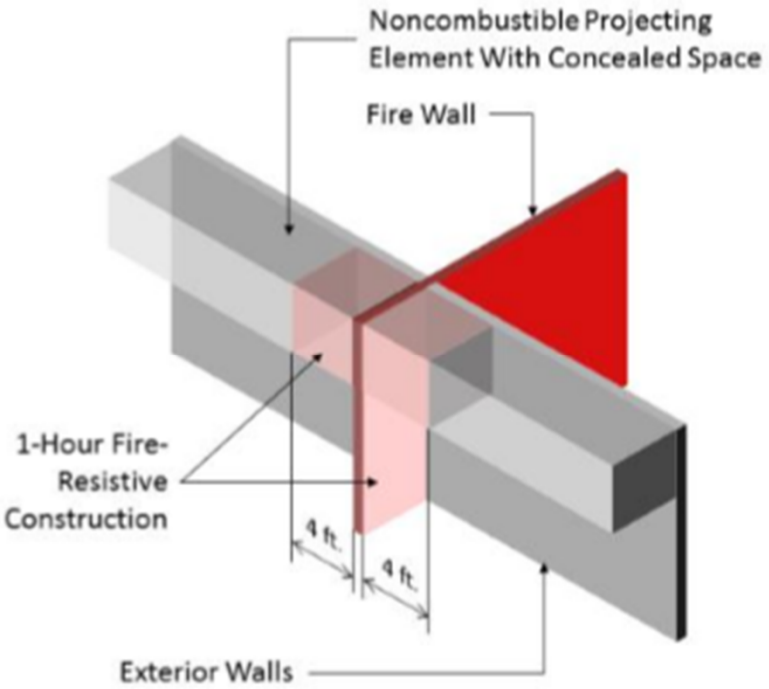


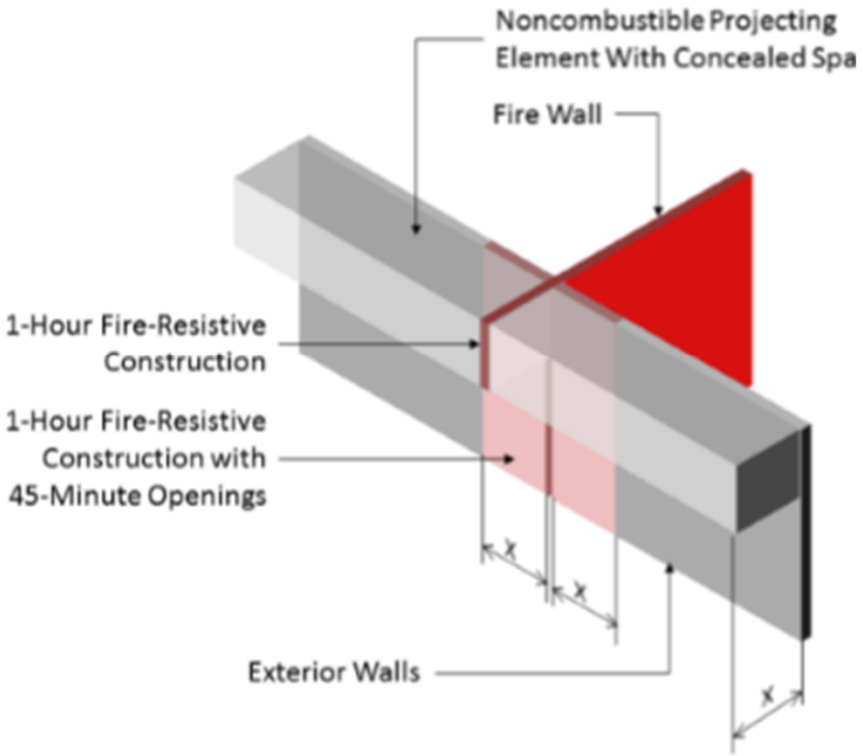
Fire Walls – Horizontal Continuity



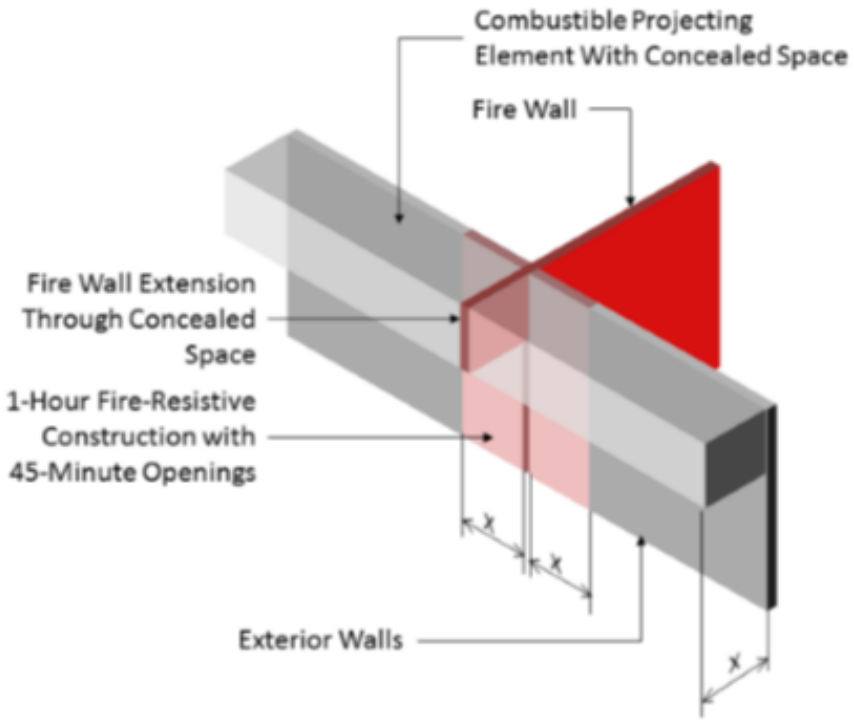


Fire Walls – Horizontal Continuity



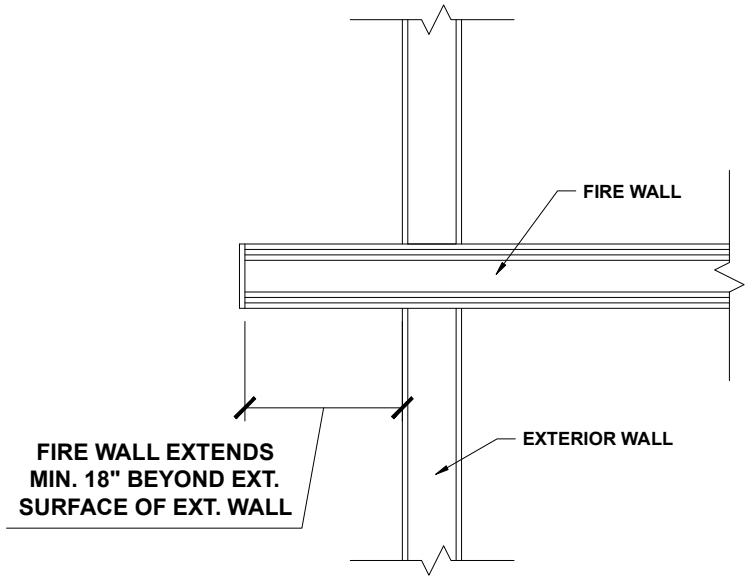


Fire Walls – Horizontal Continuity



Fire Walls - Horizontal Continuity

Fire walls are required to be continuous
from exterior wall to exterior wall

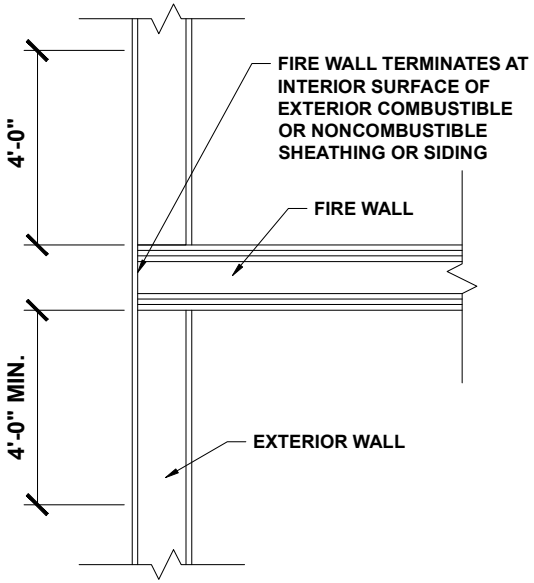


FIRE WALL TO EXTERIOR WALL: OPTION 1

Fire Walls - Horizontal Continuity

ALTERNATIVES:

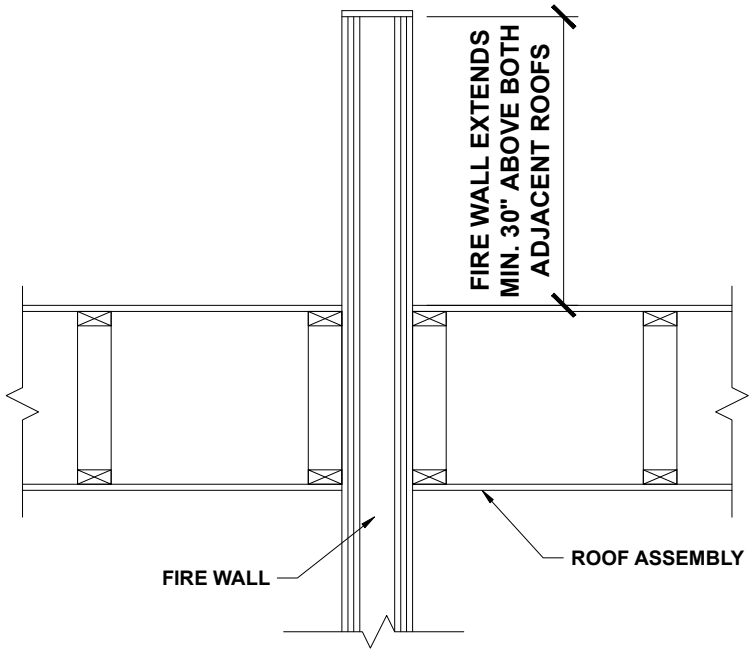
1. **EXTERIOR WALL RATED FOR 1 HR MIN. 4FT EACH SIDE (OPENING PROTECTION REQ'D)**
2. **NONCOMBUSTIBLE SHEATHING/SIDING EXTENDS MIN. 4FT EACH SIDE**
3. **BUILDING ON EACH SIDE OF THE FIRE WALL IS EQUIPPED THROUGHOUT WITH AN NFPA OR NFPA 13 SPRINKLER SYSTEM**



FIRE WALL TO EXTERIOR WALL: OPTION 2

Fire Walls - Vertical Continuity

Fire walls are required to be continuous from foundation to roof

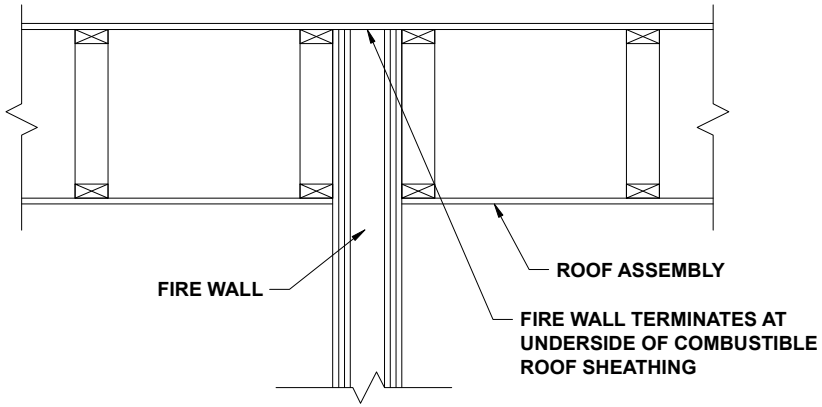


FIRE WALL TO ROOF: OPTION 1

Fire Walls - Vertical Continuity

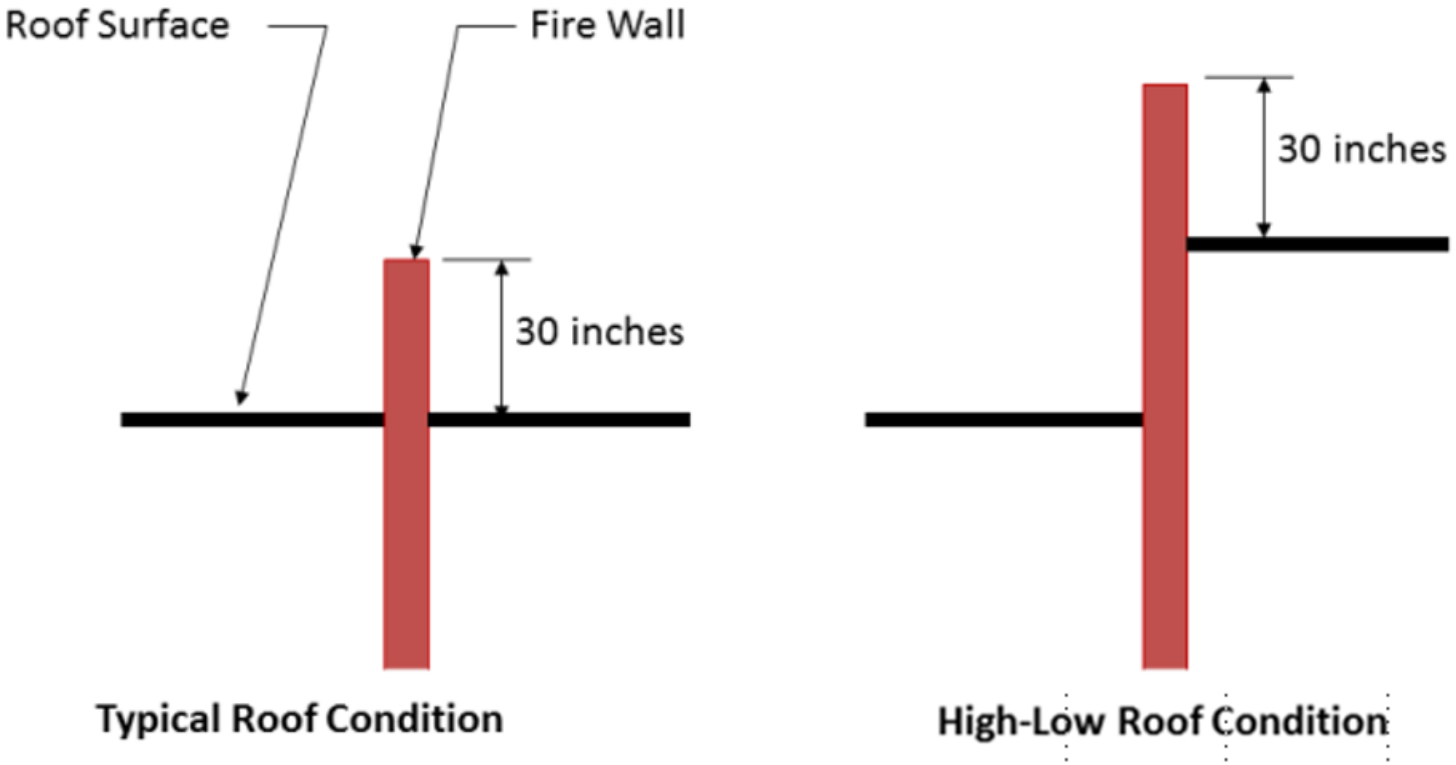
IN CONSTRUCTION TYPES III, IV OR V

- **NO OPENINGS IN ROOF WITHIN 4FT OF FIRE WALL**
- **MIN. CLASS B ROOF COVERING**
- **ROOF SHEATHING/DECK MIN. 4FT EACH SIDE OF WALL IS FRT OR UNDERSIDE OF SHEATHING IS COVERED WITH $\frac{5}{8}$" TYPE X GYPSUM**



FIRE WALL TO ROOF: OPTION 2

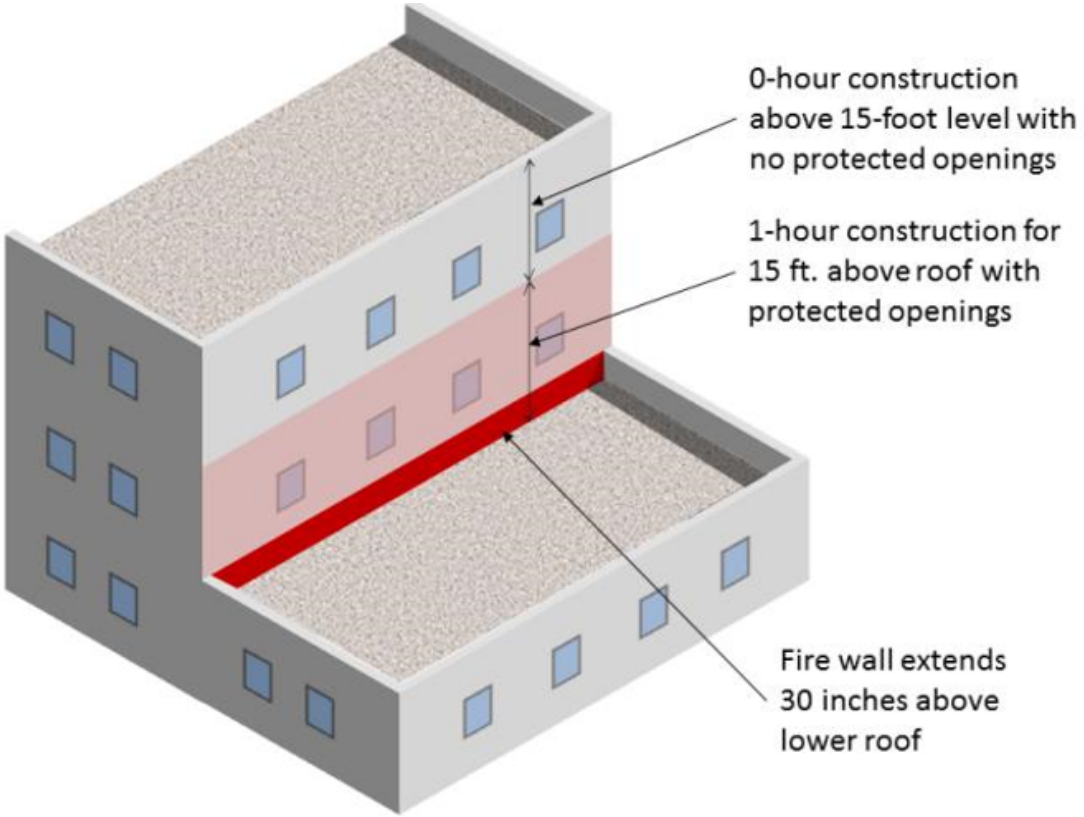
Fire Walls – Vertical Continuity



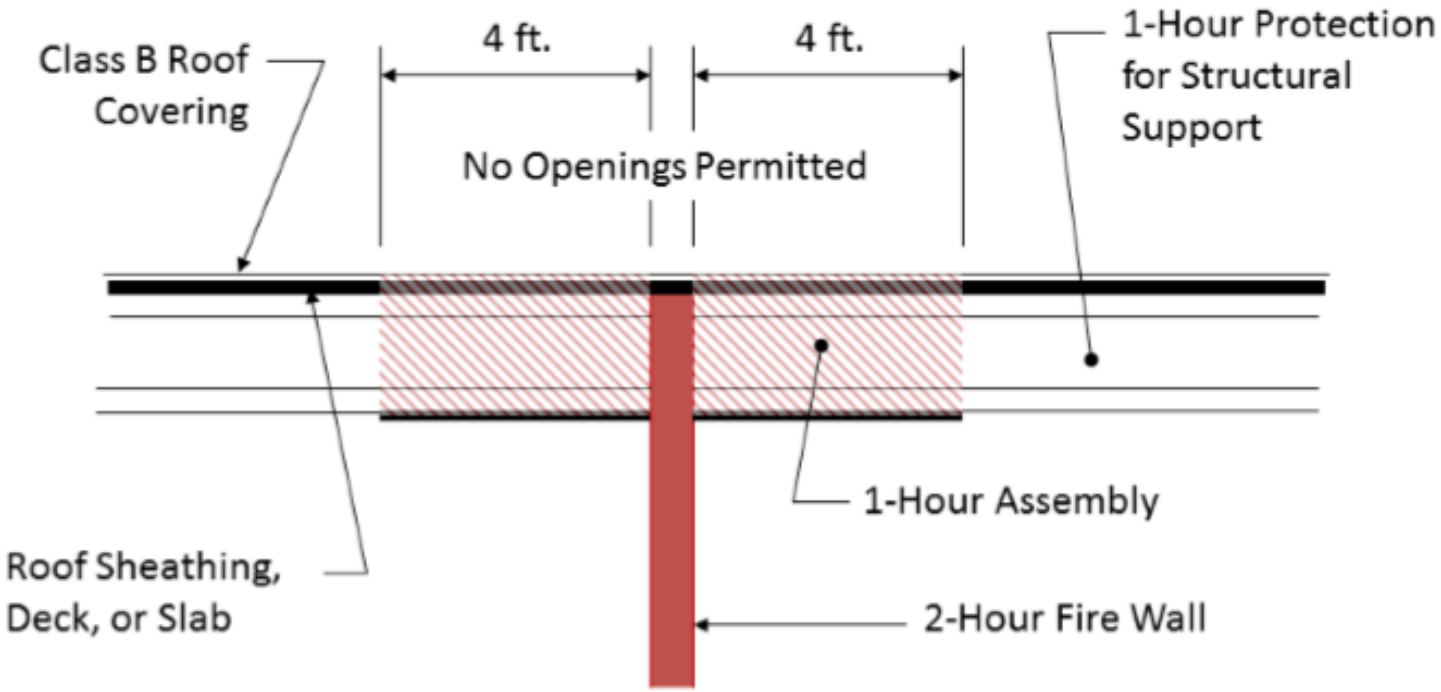
Typical Roof Condition

High-Low Roof Condition

Fire Walls – Vertical Continuity



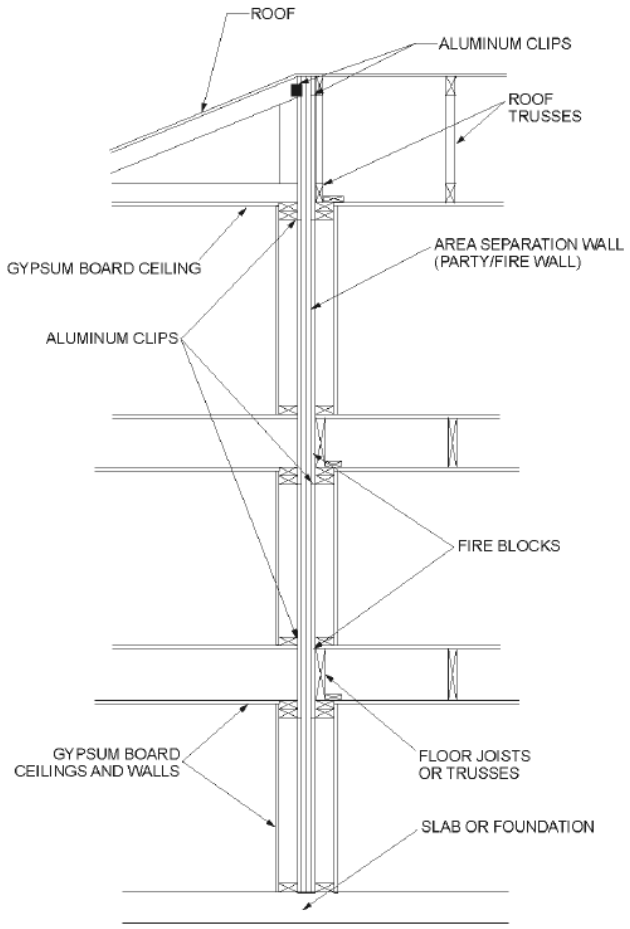
Fire Walls – Vertical Continuity



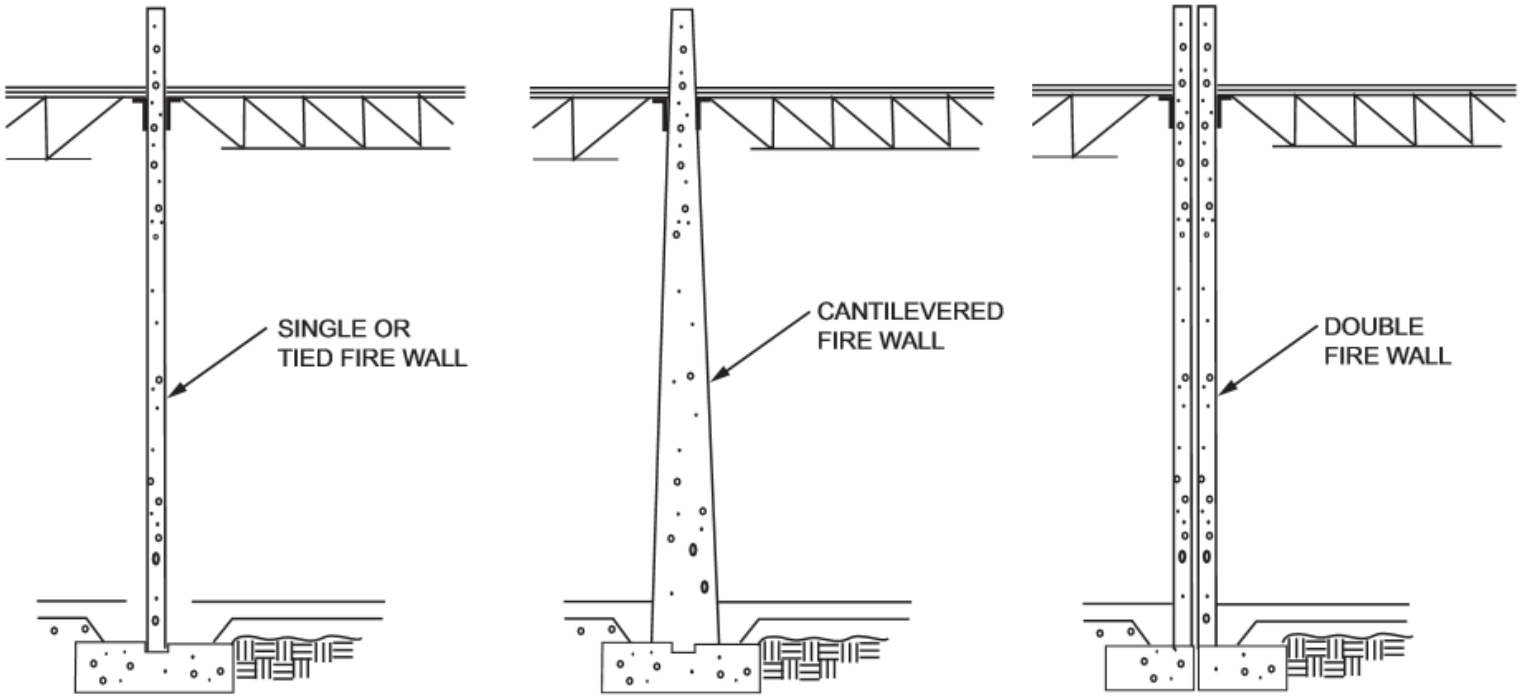
Fire Walls – Structural Stability

706.2 Structural Stability:

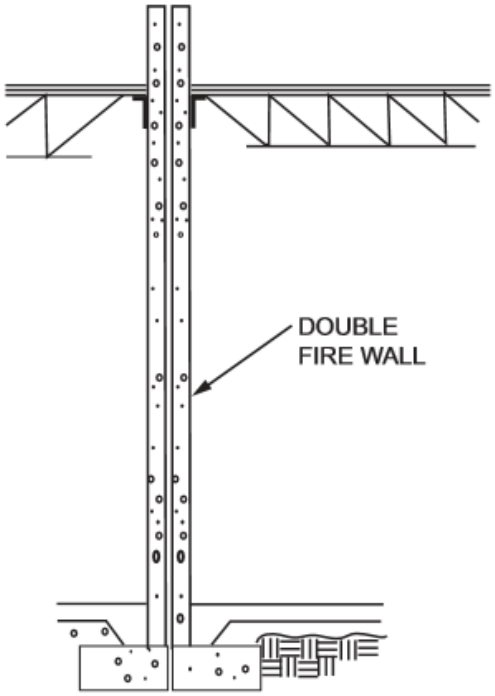
Fire walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall for the duration of time indicated by the required fire-resistance rating or shall be constructed as double fire walls in accordance with NFPA 221.



NFPA 221


SINGLE OR
TIED FIRE WALL
CANTILEVERED
FIRE WALL
DOUBLE
FIRE WALL

NFPA 221 – Double Walls



4.5* Double Wall Assemblies. Where either wall of a double wall is laterally supported by a building frame with a fire resistance rating less than that required for the wall, double wall assemblies shall be considered to have a combined assembly fire resistance rating as specified in Table 4.5.

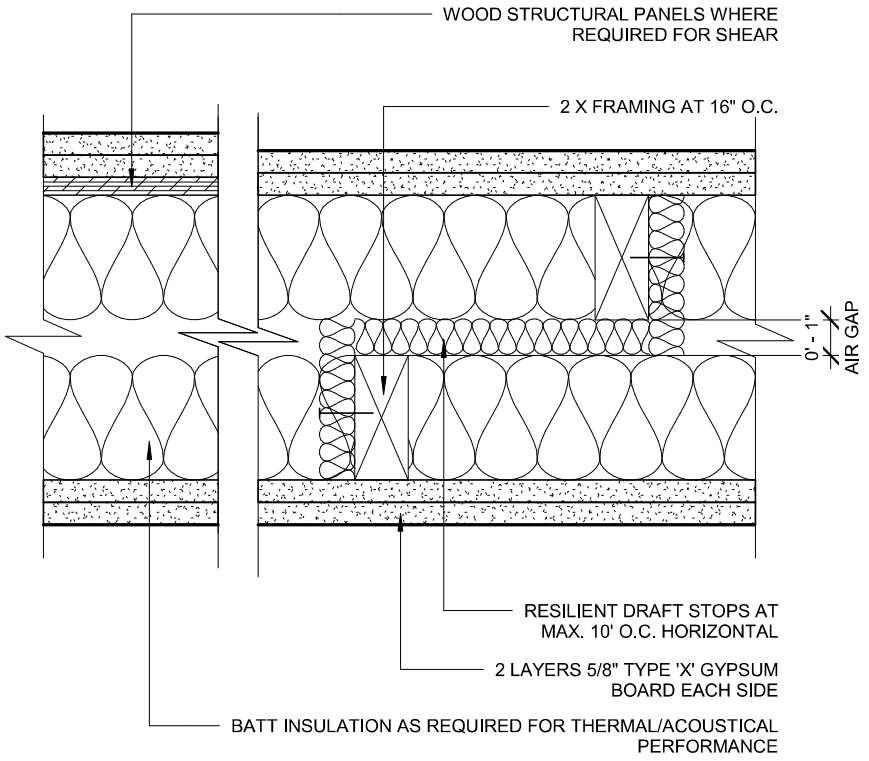
Table 4.5 Fire Resistance Ratings for Double Wall Assemblies

Fire Resistance Rating of Each Wall (hr)	Equivalent to Single Wall (hr)
3	4
2	3
1	2

2-Hour Fire W

Constructic

- V



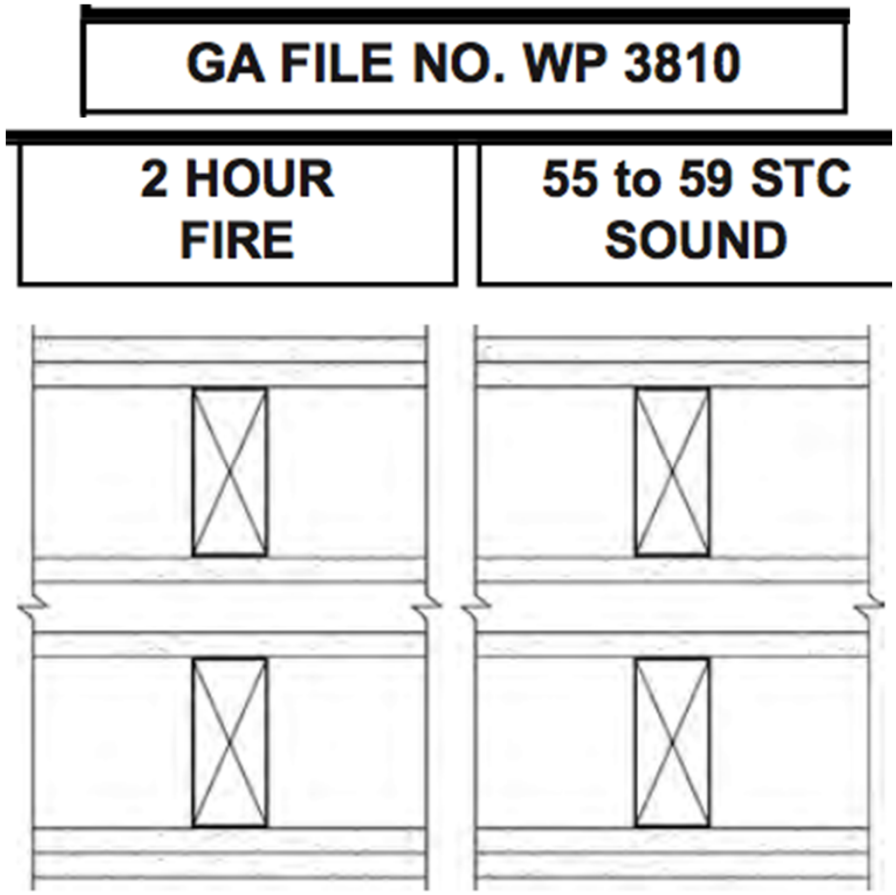
2-HOUR RATING PER GA FILE NO. WP 3820

2-HOUR DOUBLE STUD WALL

2-Hour Fire Wall Assembly

Construction Type:

- V

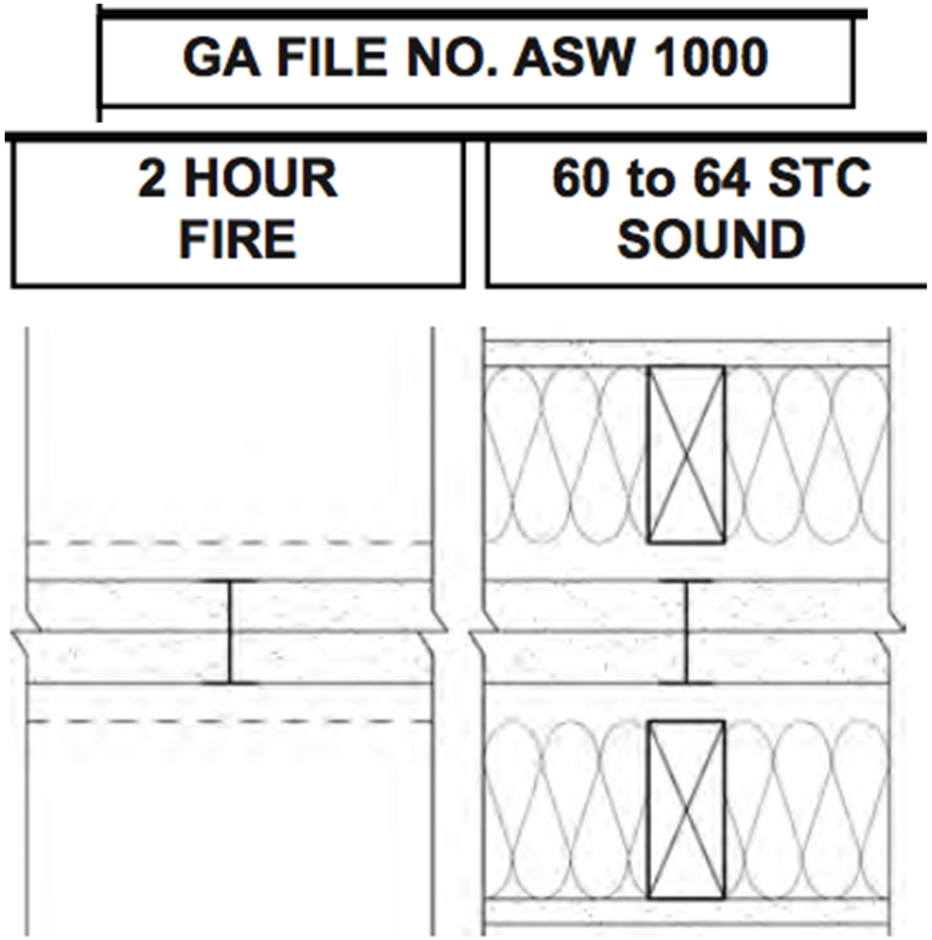


2-Hour Fire Wall Assembly

Construction Types:

- III
- IV
- V

Also see UL 336



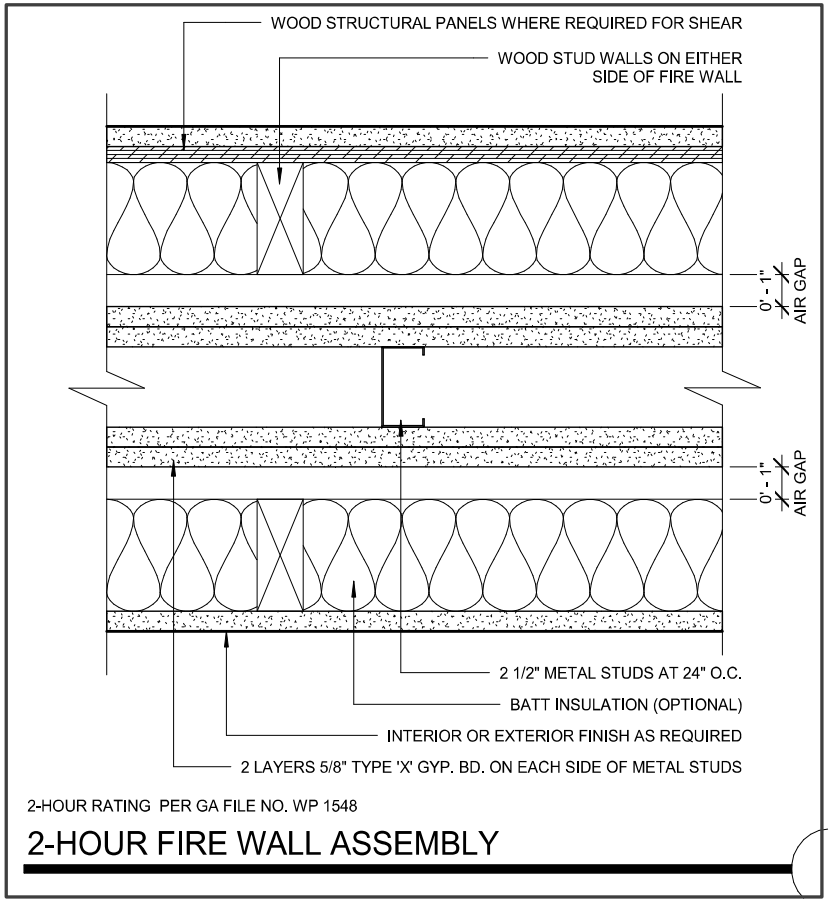
2-Hour Fire Wall As

Construction Types:

- III
- IV
- V

GA WP 1548

UL U411



CAD & Revit Details: www.woodworks.org

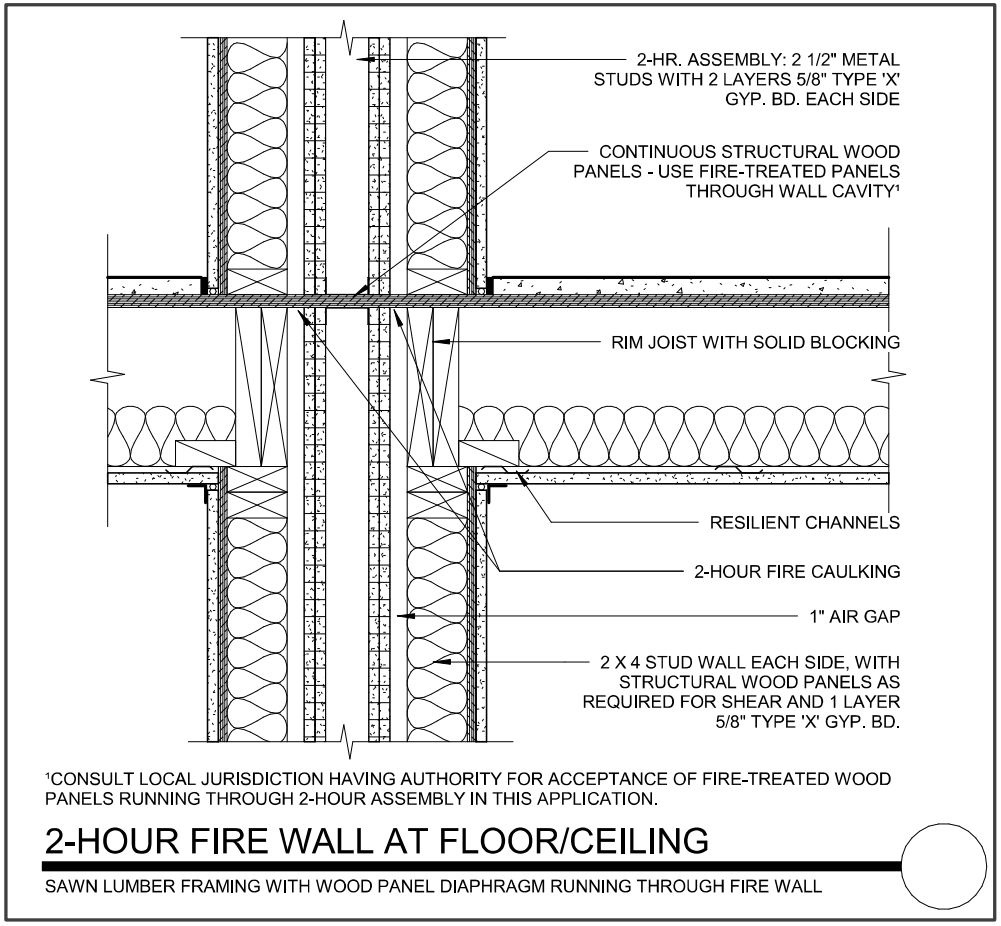
2-Hour Fire Wall As

Construction Types:

- III
- IV
- V

GA WP 1548

UL U411

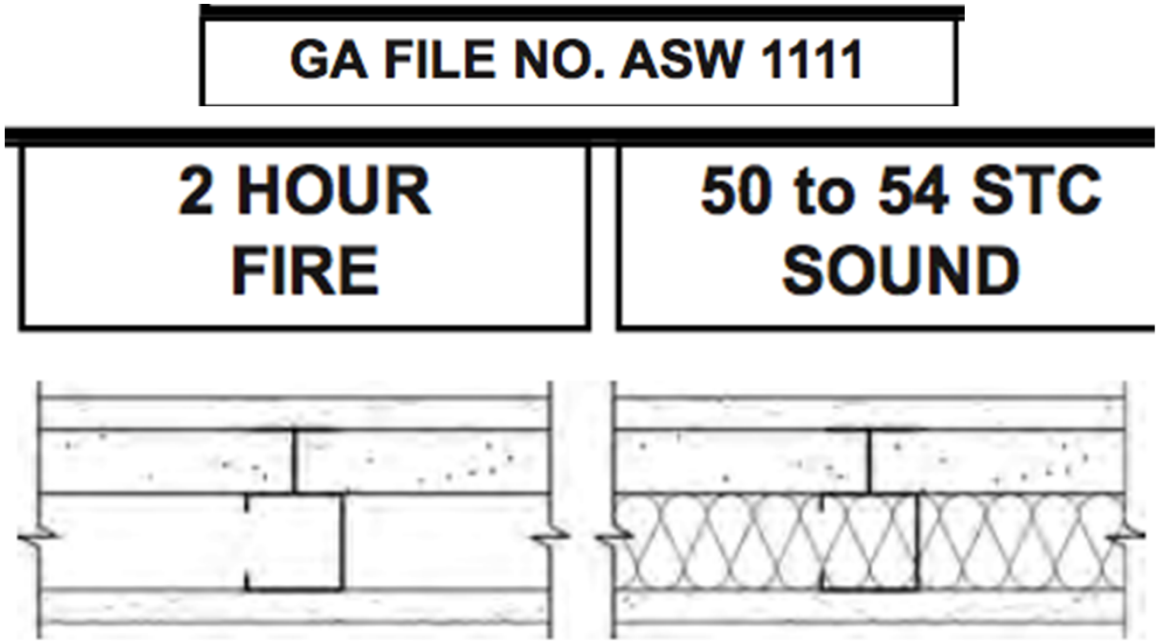


CAD & Revit Details: www.woodworks.org

2-Hour Fire Wall Assembly

Construction Types:

- III
- IV
- V

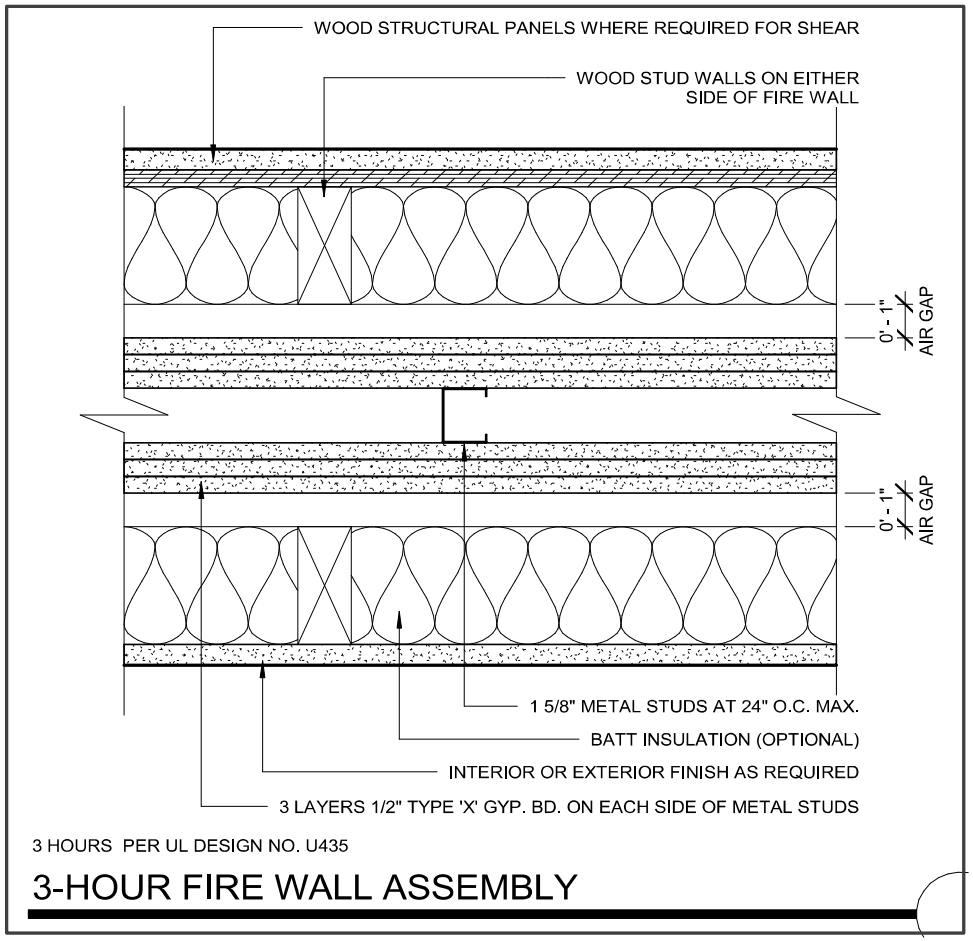


Can install wood bearing wall on each side of 2-hour wall

3-Hour Fire Wall A

Construction Types:

- III
- IV
- V



3 Hour Fire Wall Assembly

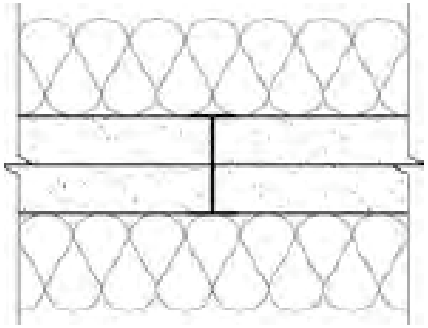
Construction Types:

- III
- IV
- V

Can install wood bearing wall on each side of 3-hour wall

GA FILE NO. ASW 2600

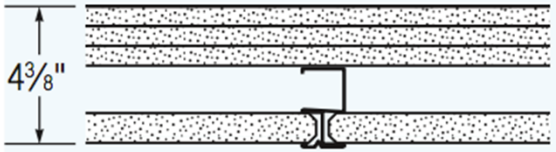
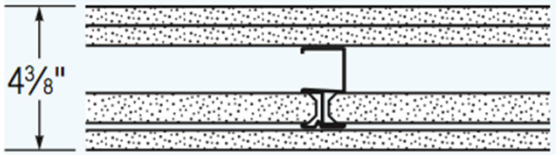
3 HOUR FIRE



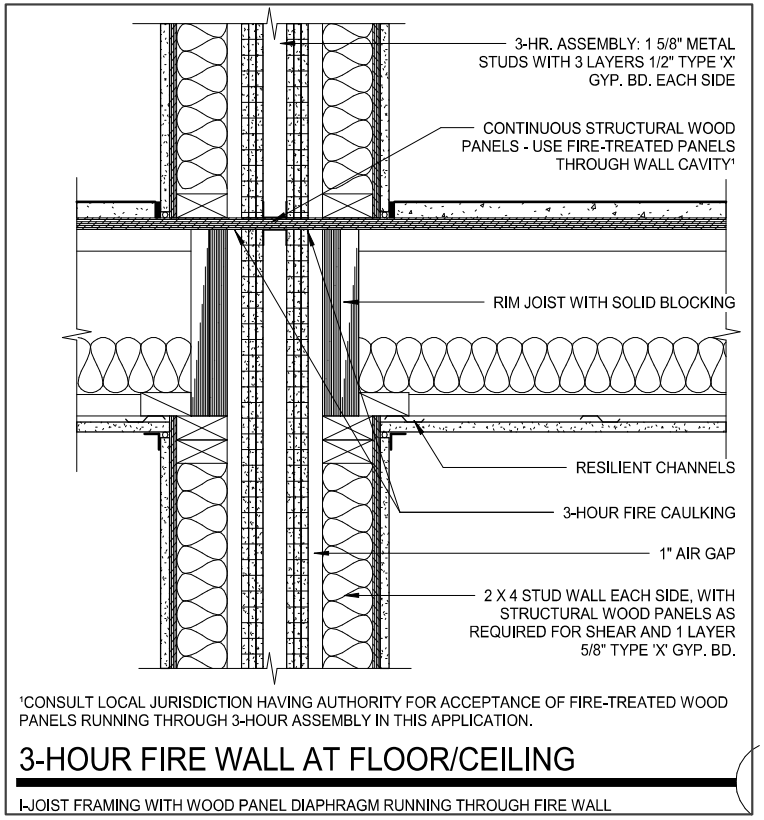
- (2) 1” Type X Gypsum
- 2” H Studs
- 2” mineral fiber insulation each side

Thickness:	6"
Approx. Weight:	9.6 psf
Fire Test:	WHI-495-0393, 1-14-82

3-Hour Fire Wall Assembly

3 Hour Fire-Rated Construction		
wt. 13  	• 5/8" SHEETROCK FIRECODE C Core gypsum panels, face layer joints finished • 2-1/2" USG C-H Studs 25 gauge 24" o.c. • 1" SHEETROCK gypsum liner panels	**UL Des U415, System G**
wt. 13  	• 5/8" SHEETROCK FIRECODE C Core gypsum panels, face layer joints finished • 2-1/2" USG C-H Studs 25 gauge 24" o.c. • 1" SHEETROCK gypsum liner panels • 5/8" SHEETROCK FIRECODE C Core gypsum panels, joints finished	**UL Des U415, System H**

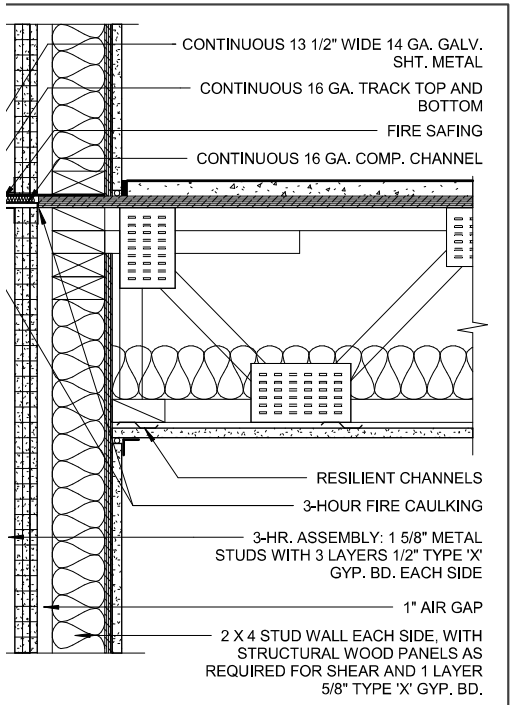
Can install wood bearing wall on each side of 3-hour wall



[1]CONSULT LOCAL JURISDICTION HAVING AUTHORITY FOR ACCEPTANCE OF FIRE-TREATED WOOD PANELS RUNNING THROUGH 3-HOUR ASSEMBLY IN THIS APPLICATION.

3-HOUR FIRE WALL AT FLOOR/CEILING

I-JOIST FRAMING WITH WOOD PANEL DIAPHRAGM RUNNING THROUGH FIRE WALL



L AT FLOOR/CEILING

/OOD PANEL DIAPHRAGM RUNNING THROUGH FIRE WALL

CAD & Revit Details: www.woodworks.org

Fire Walls – Seismic Diaphragm Continuity

SEAoSC LIGHT-FRAMING CONSTRUCTION COMMITTEE
STRUCTURAL ENGINEERS ASSOCIATION OF SOUTHERN CALIFORNIA
SEISMOLOGY OPINION

SEAOSC

DATE: **March 21, 2008**

Continuity of Plywood Diaphragm Sheathing in 2 hr and 3hr Fire Walls:

Opinion: The continuity of plywood diaphragm sheathing should be maintained across the air gap commonly encountered in double stud Firewalls of 2 or 3 hour construction. The intent is to ensure that structural continuity is not significantly reduced in the roof and floor diaphragms.

Commentary:

This opinion is prepared to address the issue of diaphragm continuity as it relates to recent changes in 2007 CBC and 2006 IBC model code. Specifically the outgoing UBC provisions for Area-Separation walls have more or less been replaced by the Fire wall provisions of the IBC. Such walls are encountered in light-frame multifamily or mixed-use construction and are often constructed as a double studwall when occurring at partywall locations. The double stud walls are typically separated by an airspace of a one to four inches.

The IBC has introduced language [IBC 705.4] that states fire walls must have "sufficient structural stability" under fire conditions to allow collapse of either side. Previous commentary to the UBC topic of Area Separation

Fire Walls – Seismic Diaphragm Continuity

2018 IBC Provisions Allow Floor Sheathing Through Firewall under Certain Conditions

706.2 Structural stability.

Fire walls shall be designed and constructed to allow collapse of the structure on either side without collapse of the wall under fire conditions. *Fire walls* designed and constructed in accordance with NFPA 221 shall be deemed to comply with this section.

Exception: In Seismic Design Categories D through F, where double *fire walls* are used in accordance with NFPA 221, floor and roof sheathing not exceeding $^{3}/_{4}$ inch (19.05 mm) thickness shall be permitted to be continuous through the wall assemblies of light frame construction.

Fire Walls - Openings

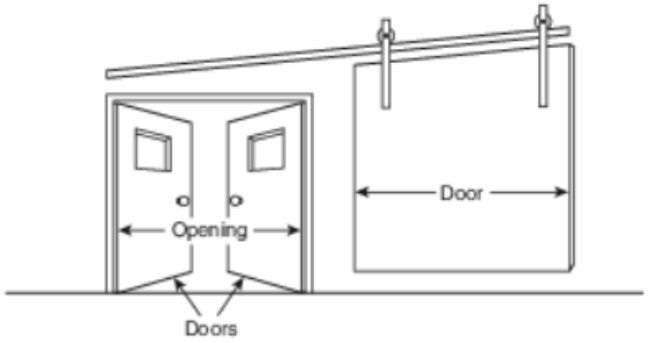


FIGURE A.5.8.3(a) Swinging Door and Sliding Door Configuration for Egress Purposes in an HC Fire Wall.

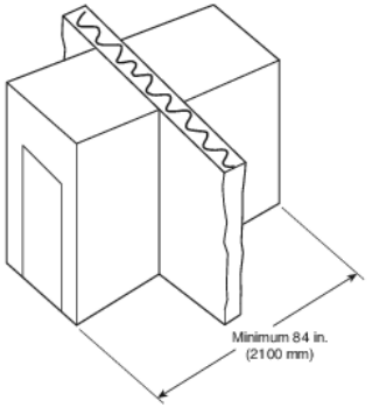


FIGURE A.5.8.3(b) Vestibule Arrangement for Egress Purposes in an HC Fire Wall.

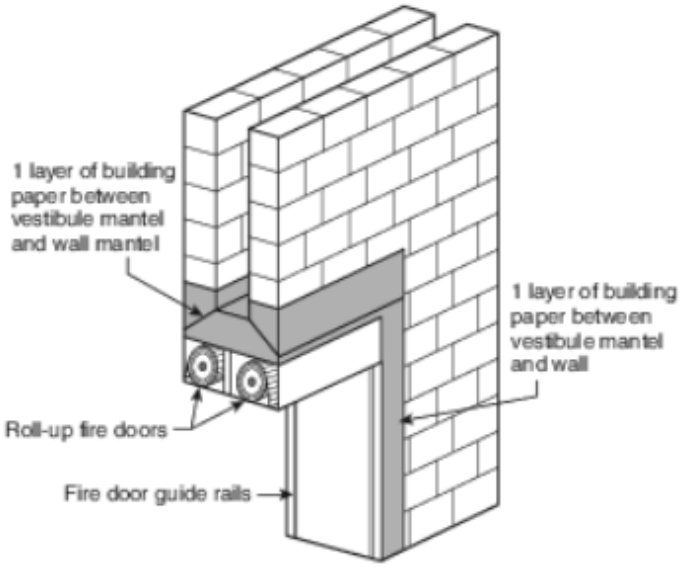
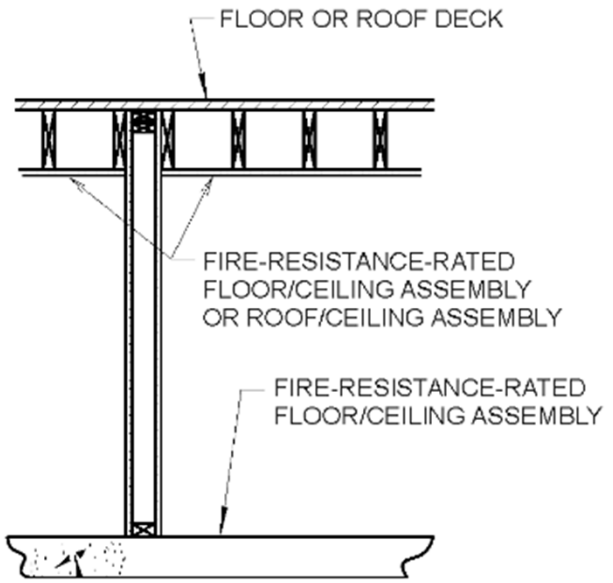


FIGURE A.5.8.4 Double Doors on a Freestanding Vestibule.

Fire Barriers – IBC 707

Commonly used for:

- Shaft enclosures
- Interior exit stairway
- Exit stairway enclosures
- Exit passageways
- Incidental uses
- Separated occupancies
- Fire Areas



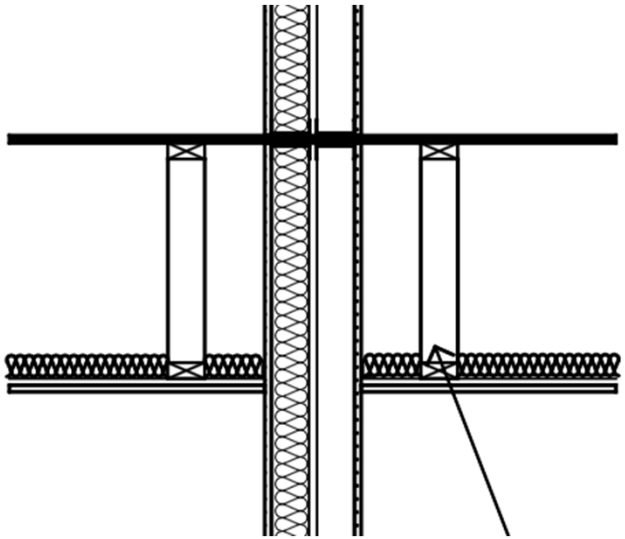
Fire Barrier Example

2018 IBC Code & Commentary

Fire Barriers – IBC 707

May be constructed with any materials permitted by the construction type

- Fire Resistance Ratings:
  - Shaft Enclosures: IBC 713.4
    - 2-hr when connecting 4 stories or more,
    - 1-hr when connecting less than 4 stories
  - Separated Occupancies: IBC Table 508.4
  - Fire Areas: IBC Table 707.3.10



Fire Barriers – IBC 707

707.5: Continuity. Fire barriers shall extend from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, slab or deck above and shall be securely attached thereto. Such fire barriers shall be continuous through concealed space, such as the space above a suspended ceiling

707.5.1 Supporting Construction. The supporting construction for a fire barrier shall be protected to afford the required fire-resistance rating of the fire barrier supported. Hollow vertical spaces within a fire barrier shall be fireblocked in accordance with Section 718.2 at every floor level.

Exceptions: for... walls separating incidental uses in buildings of Type IIB, IIIB and VB construction.

Other requirements for openings, penetrations, joints

Fire Barriers – IBC 707

Common Detailing Method: Fire Barrier & membrane extend to underside of floor deck above

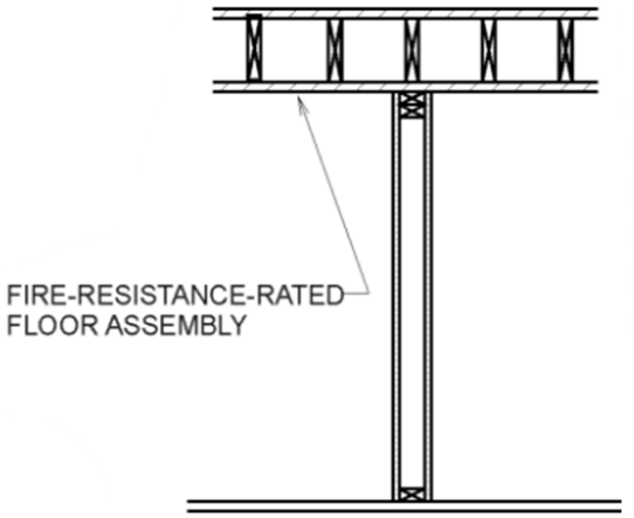
Fire Partitions – IBC 708

Commonly used to separate:

- Dwelling or sleeping units in same bldg.
- Tenant spaces in malls
- Corridor walls

Minimum 1-hr rating except:

- Some corridors
- Separate dwelling units in VB and IIB



Fire Partition Example

2018 IBC Code & Commentary

Fire Partitions – IBC 708

708.4 Continuity.

Fire partitions shall extend from the top of the foundation or floor/ceiling assembly below and be securely attached to one of the following:

1. The underside of the floor or roof sheathing, deck or slab above.
2. The underside of a floor/ceiling or roof/ceiling assembly having a fire-resistance rating that is not less than the fire-resistance rating of the fire partition.

Exceptions: for certain crawlspace conditions, corridor conditions (See Section 708.4).

708.4.1 Supporting construction.

The supporting construction for a fire partition shall have a fire-resistance rating that is equal to or greater than the required fire-resistance rating of the support fire partition.

Exceptions: for... walls separating dwelling units, walls separating sleeping units, and corridor walls, in buildings of Type IIB, IIIB and VB construction.

Fire Partitions – IBC 708

Common Detailing Method: Fire Partition & membrane stop at underside of rated floor/ceiling with fireblocking/draftstopping if required

Fire Barriers & Partitions – Horizontal Continuity

- Code language exists to clarify vertical & horizontal continuity requirements of **fire walls**.
- However, for **fire barriers** & **fire partitions**, only vertical continuity requirements exist.
- How are partition wall to partition wall (or partition wall to exterior wall) intersections handled?

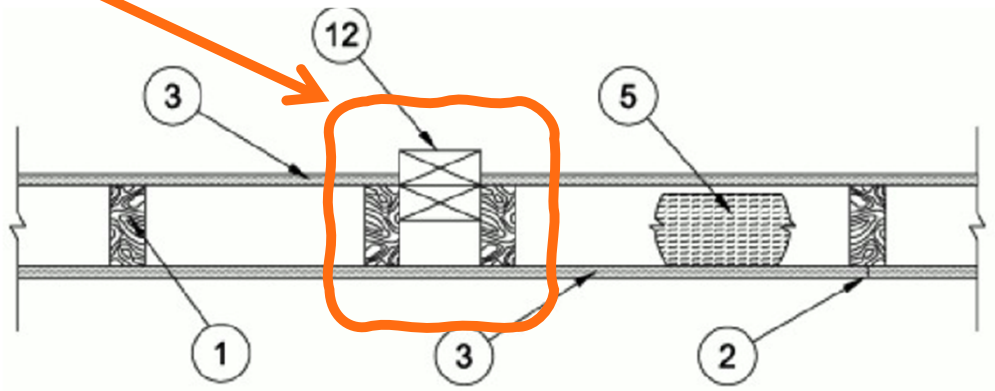
Fire Barriers & Partitions – Horizontal Continuity

Permitted as noted in tested wall assembly

Design No. U305

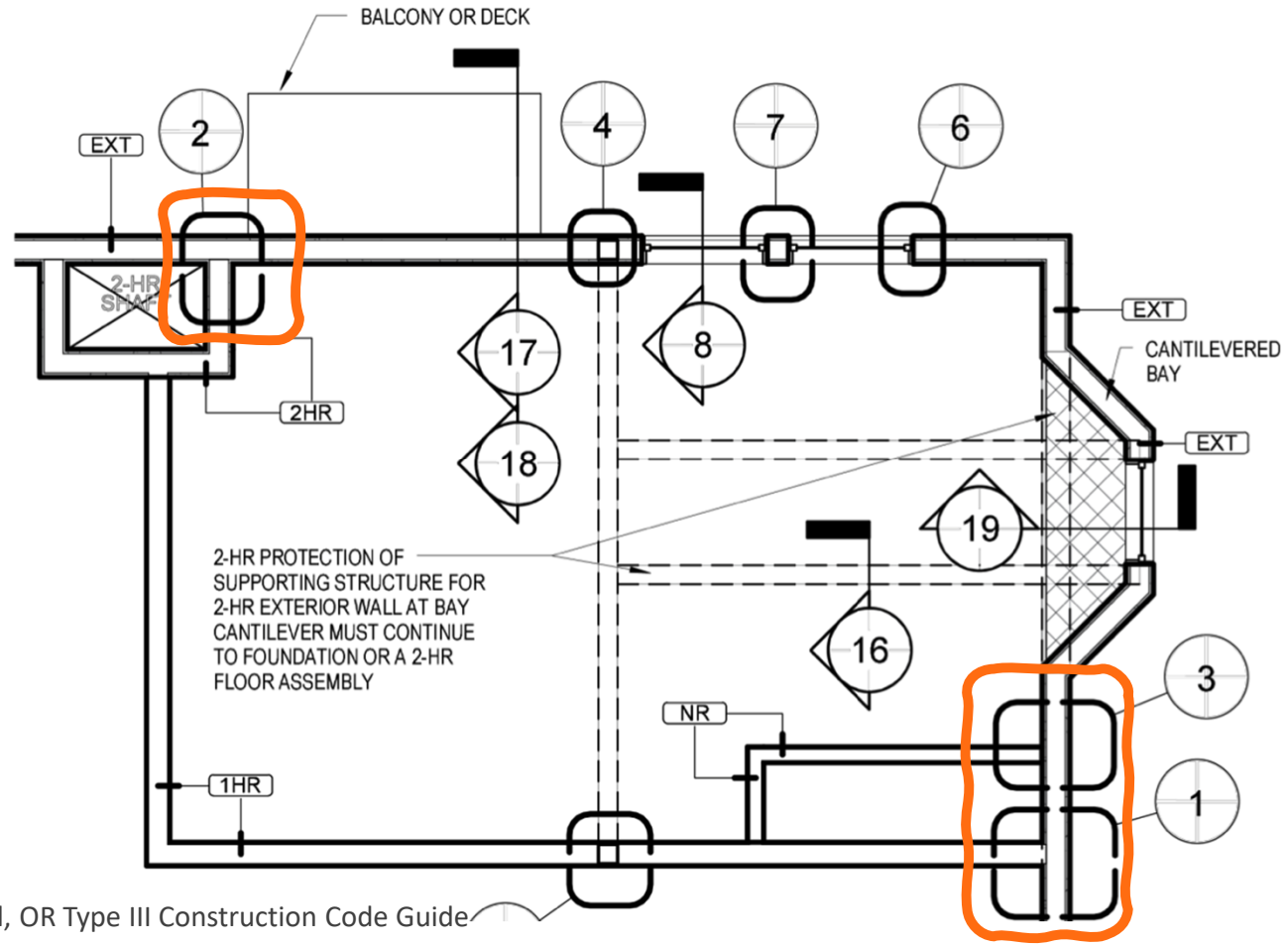
March 10, 2020

Bearing Wall Rating — 1 Hr



12. **Non-Bearing Wall Partition Intersection —** (Optional) —Two nominal 2 by 4 in. studs or nominal 2 by 6 in. studs nailed together with two 3 in. long 10d nails spaced a max. 16 in. OC. vertically and fastened to one side of the minimum 2 by 4 in. stud with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Intersection between partition wood studs to be flush with the 2 by 4 in. studs. The wall partition wood studs are to be framed by with a second 2 by 4 in. wood stud fastened with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Maximum one non-bearing wall partition intersection per stud cavity. Non-bearing wall partition stud depth shall be at a minimum equal to the depth of the bearing wall.

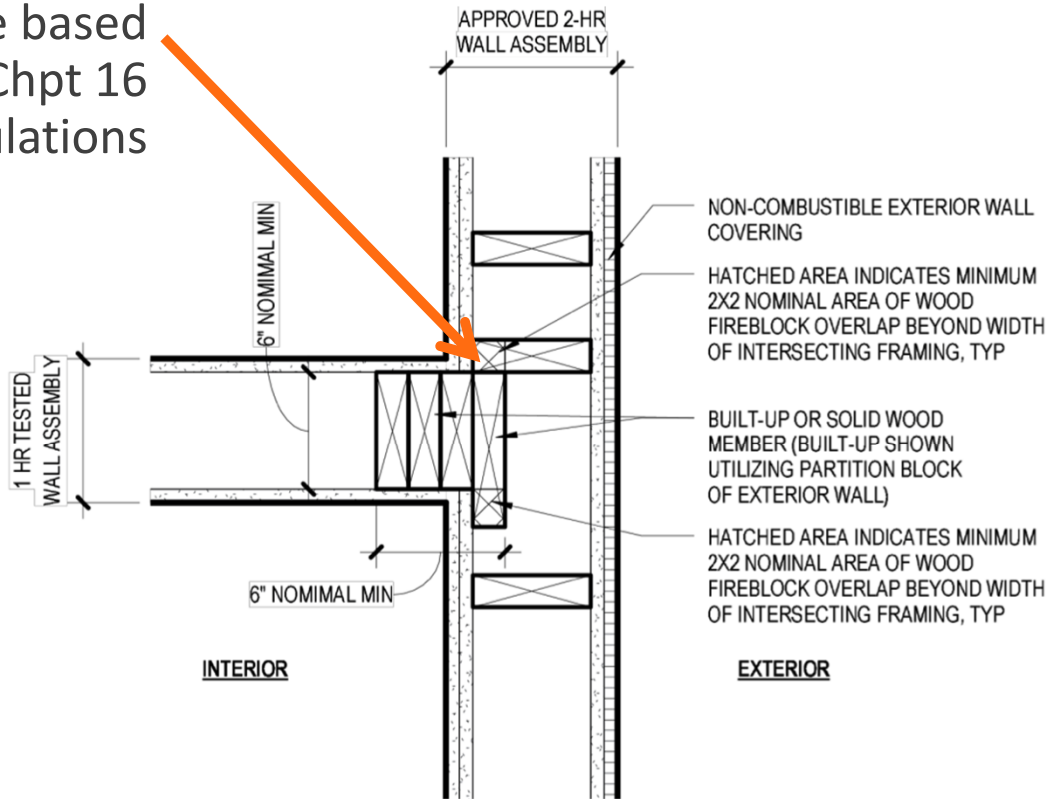
Fire Barriers & Partitions – Horizontal Continuity



Source: City of Portland, OR Type III Construction Code Guide

Fire Barriers & Partitions – Horizontal Continuity

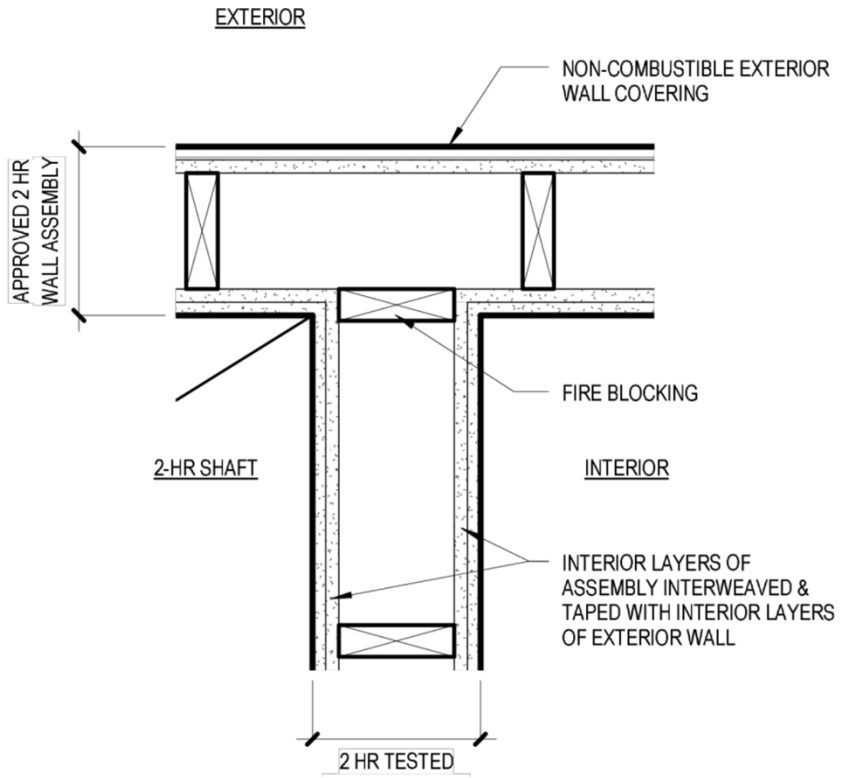
Rationale based on NDS Chpt 16 char calculations



1-HR INTERIOR WALL AT 2-HR EXTERIOR WALL

Source: City of Portland, OR Type III Construction Code Guide

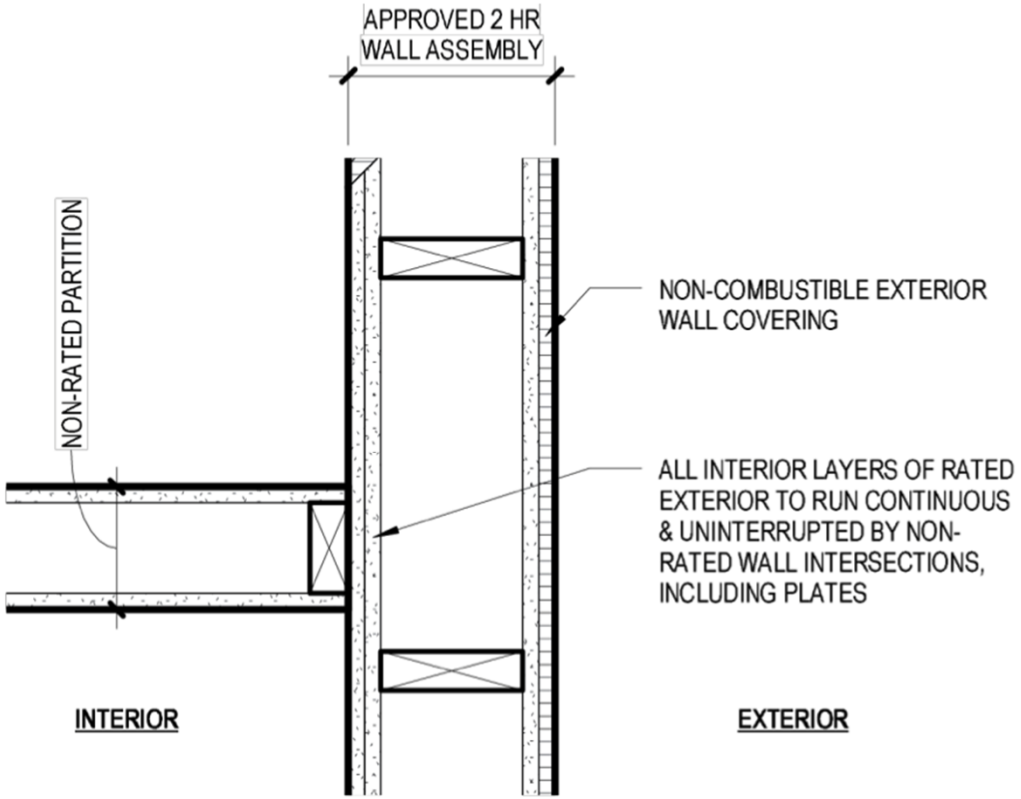
Fire Barriers & Partitions – Horizontal Continuity



2-HR INTERIOR WALL AT 2-HR EXTERIOR WALL

Source: City of Portland, OR Type III Construction Code Guide

Fire Barriers & Partitions – Horizontal Continuity



NON-RATED INTERIOR WALL AT EXTERIOR WALL

Source: City of Portland, OR Type III Construction Code Guide

Tell a Friend

What are the fire-resistance rating requirements when an interior partition wall intersects a membrane-protected wall, floor or roof assembly? Can the membrane on the intersected assembly be interrupted by the partition framing?

For designers working on light wood-frame multi-family and commercial structures, there are many publicly available fire resistance-rated assemblies. However, each assembly must intersect other assemblies at its ends and often multiple points along its length, and the requirements for detailing the intersection of one assembly to another are seldom addressed. Specifically, interior partition walls often intersect fire resistance-rated interior and exterior walls, as well as the underside of fire resistance-rated floor and roof assemblies. While no interruption of the membrane on each fire resistance-rated assembly would seem to provide the most direct route of compliance, this approach can create issues with construction sequencing since it is often preferable to install all of the wood framing prior to any gypsum wall/ceiling membrane.

View All Expert Tips

http://www.woodworks.org/ask-an-expert/

Corridors – Fire Resistance Ratings

Check requirements of IBC Tables 601 and 1020.1 for Corridor Wall and Floor/Ceiling Fire-Resistance Ratings

TABLE 1020.1
CORRIDOR FIRE-RESISTANCE RATING

OCCUPANCY	OCCUPANT LOAD SERVED BY CORRIDOR	REQUIRED FIRE-RESISTANCE RATING (hours)	
		Without sprinkler system	With sprinkler system
H-1, H-2, H-3	All	Not Permitted	1[c]
H-4, H-5	Greater than 30	Not Permitted	1[c]
A, B, E, F, M, S, U	Greater than 30	1	0
R	Greater than 10	Not Permitted	0.5[c]/1[d]
I-2[a]	All	Not Permitted	0
I-1, I-3	All	Not Permitted	1[b, c]
I-4	All	1	0

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b]	1[b]	0	1[b]	0	HT	1[b]	0
Bearing walls Exterior[e, f] Interior	3 3[a]	2 2[a]	1 1	0 0	2 1	2 0	2 1/HT	1 1	0 0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	1 1/2[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

Corridors – Fire Resistance Ratings

Corridor Walls

IBC 1020.1: Corridor walls required to be fire-resistance rated shall comply with Section 708 for fire partitions.

708.3 Fire-resistance rating.

Fire partitions shall have a fire-resistance rating of not less than 1 hour.

Exception: Corridor walls permitted to have a ½-hour fire-resistance rating by Table 1020.1 (applies to R occupancies with NFPA 13 or NFPA 13R sprinkler systems)

Fire Partitions – IBC 708

708.4 Continuity.

Fire partitions shall extend from the top of the foundation or floor/ceiling assembly below and be securely attached to one of the following:

1. The underside of the floor or roof sheathing, deck or slab above.
2. The underside of a floor/ceiling or roof/ceiling assembly having a fire-resistance rating that is not less than the fire-resistance rating of the fire partition.

Exceptions: for certain crawlspace conditions, corridor conditions (See Section 708.4).

708.4.1 Supporting construction.

The supporting construction for a fire partition shall have a fire-resistance rating that is equal to or greater than the required fire-resistance rating of the support fire partition.

Exceptions: for... walls separating dwelling units, walls separating sleeping units, and corridor walls, in buildings of Type IIB, IIIB and VB construction.

Corridor Walls

Exceptions:

2. Fire partitions serving as a corridor wall shall not be required to extend above the lower membrane of a corridor ceiling provided that the corridor ceiling membrane is equivalent to corridor wall membrane, and either of the following conditions is met:
   - 2.1 The room-side membrane of the corridor wall extends to the underside of the floor or roof sheathing of a fire-resistance-rated floor or roof above.
   - 2.2 The building is equipped with an NFPA 13 or NFPA 13R sprinkler system installed throughout, including in the space between the top of the fire partition and underside of the floor or roof sheathing, deck or slab above.
3. Fire partitions serving as a corridor wall shall be permitted to terminate at the upper membrane of the corridor ceiling assembly where the corridor ceiling is constructed as required for the corridor wall.

Corridor Walls – 708.4 Exception 2

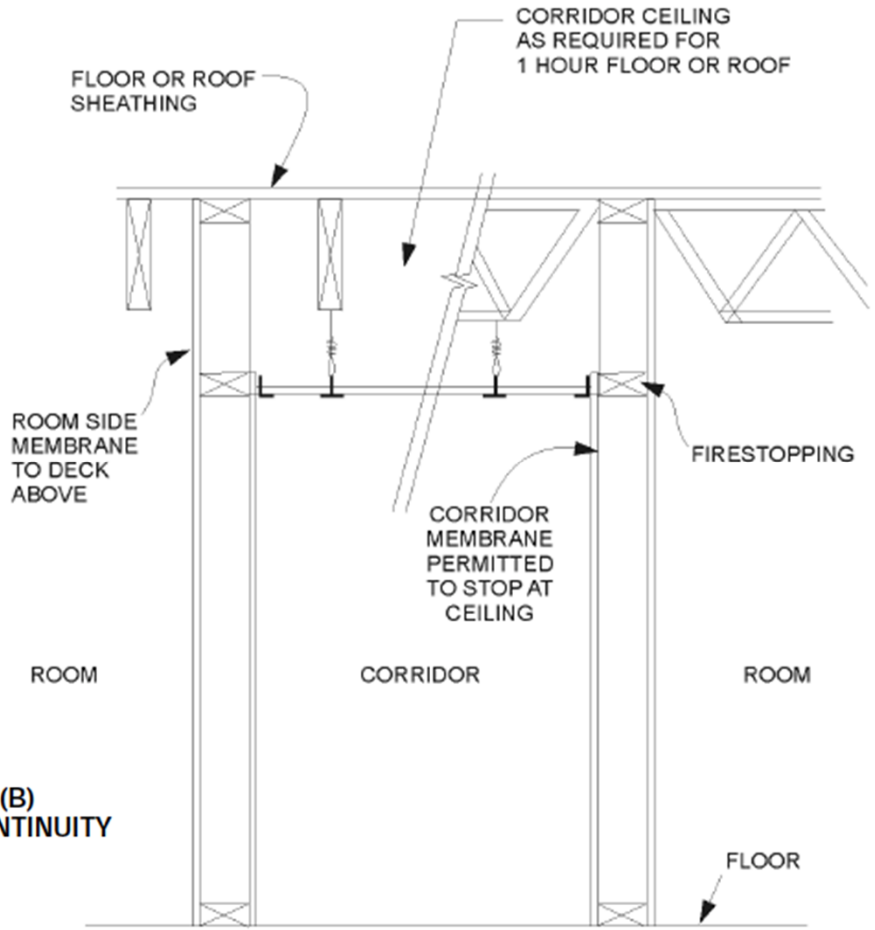
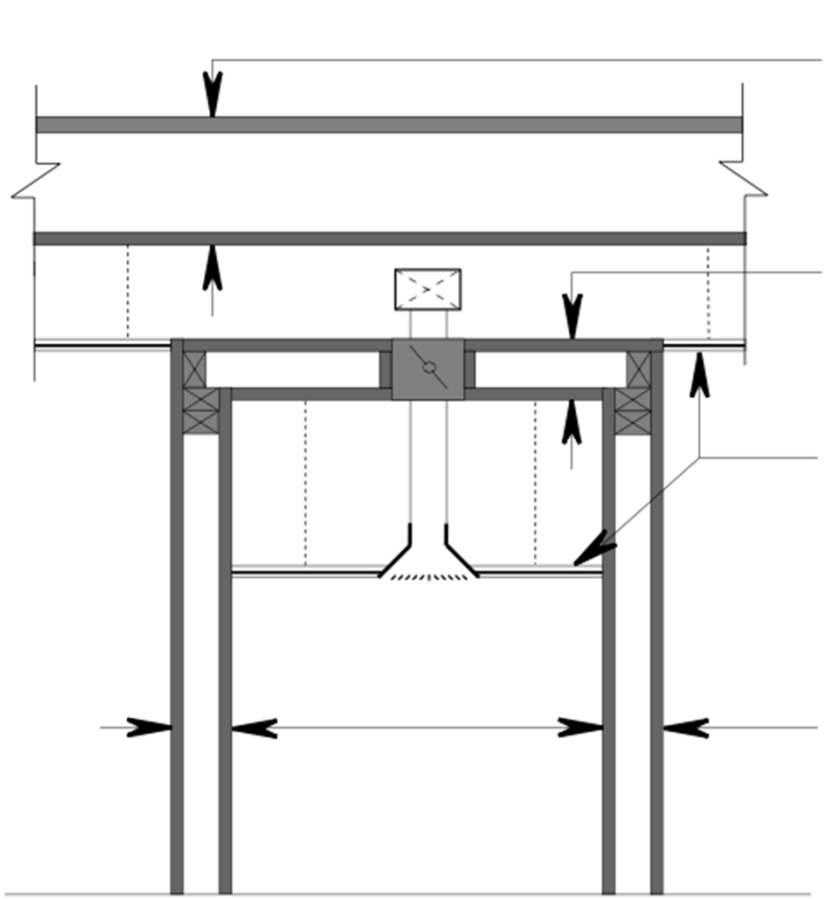


Figure 708.4(2)(B)
FIRE PARTITION CONTINUITY

Corridor Walls – 708.4 Exception 3



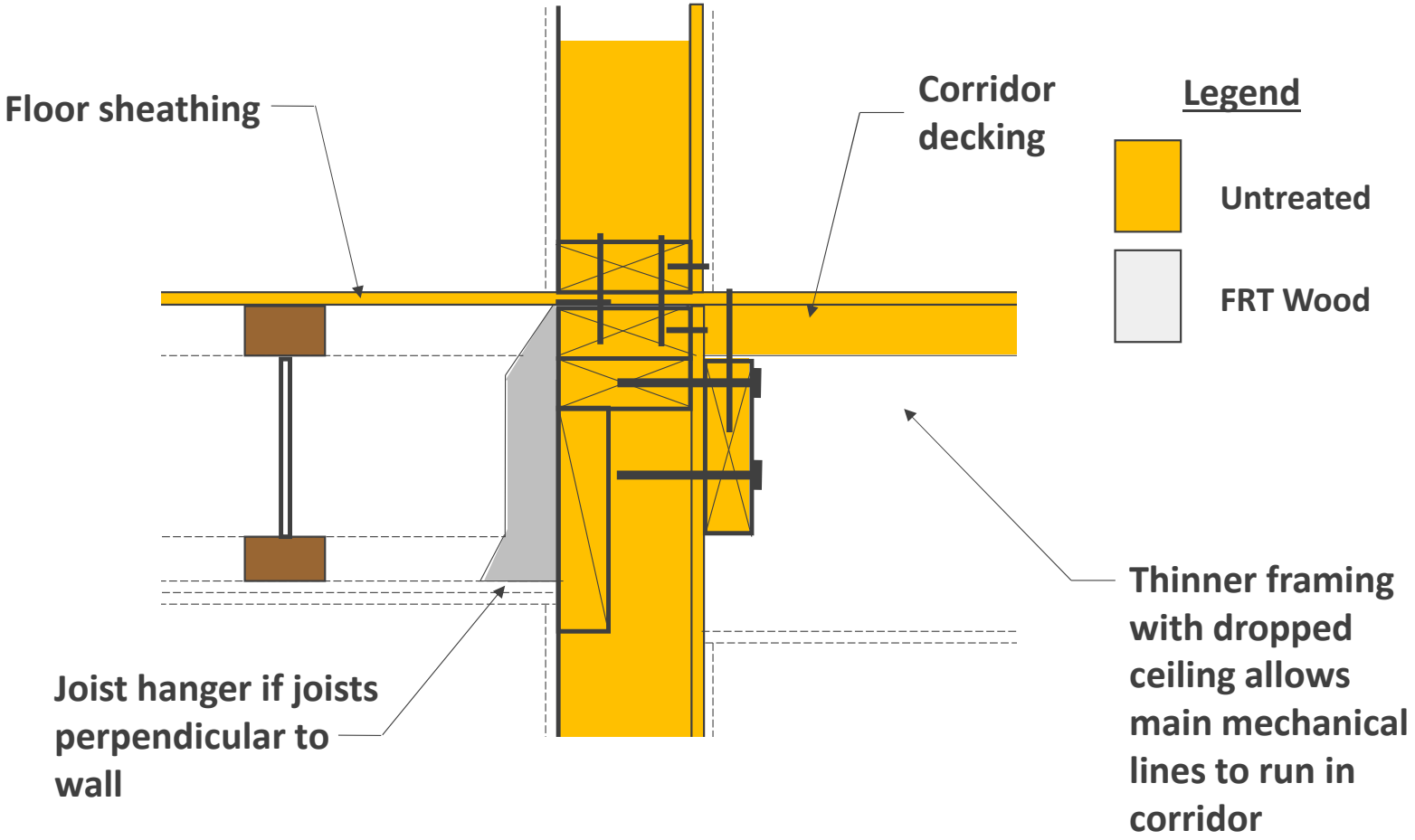
Floor or roof sheathing, framing and ceiling membrane as required for a one-hour fire-resistive floor or roof system throughout entire story.

Corridor ceiling constructed the same as corridor walls.

Optional nonrated suspended ceiling.

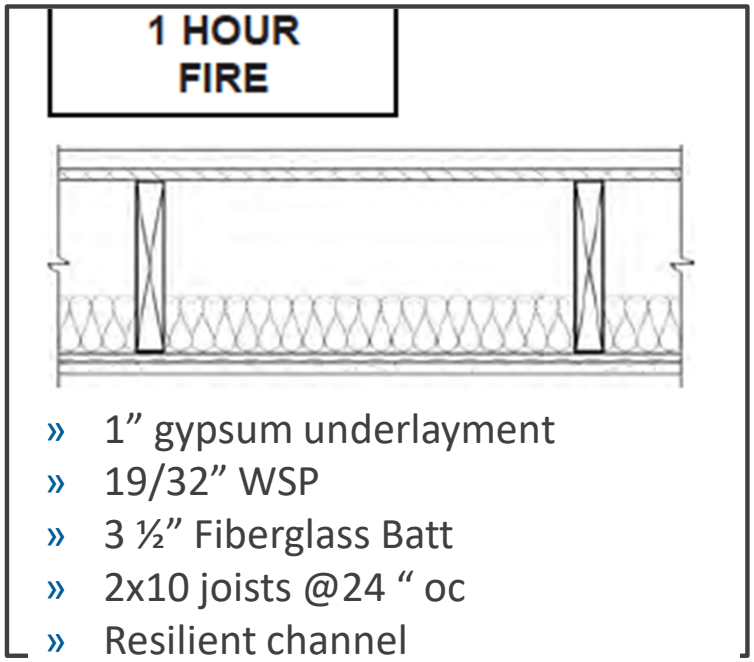
Corridor wall framing and membrane each side as required for one-hour fire-resistive wall construction.

Corridors – 1-hr Floor



Shallow Floor Depths

UL L502
GA FC5104



- 1” gypsum underlayment
- 19/32” WSP
- 3 ½” Fiberglass Batt
- 2x10 joists @24 “ oc
- Resilient channel
- 5/8” Type-X Gyp

Common issues with UL approved assemblies:

- Shallow Floor depth
  - Use prescriptive assemblies: IBC 721.1(3) assembly 21-1.1
  - Or use the CAM method in IBC 722
- Use of Structural Composite Lumber
  - Manufacturer’s ESR shows equivalent fire performance to solid sawn

Outline

- Review of Fire Resistance Methods
- Interior Fire Rated Wall Assemblies
  - Fire Walls
  - Fire Barriers
  - Fire Partitions/Corridors
- **Horizontal Assemblies**

1430 Q, The HR Group Architects, Buehler Engineering, Greg Folkins Photography

Horizontal Assemblies

- A floor or roof assembly required to have a fire resistance rating such as for occupancy separations and fire area separations
- May be constructed with any materials permitted by the construction type
- Occupancy separation: Fire resistance ratings per IBC Table 508.4
- Required to be continuous without vertical openings except as permitted in IBC 712
- Supporting construction required to have same fire-resistance rating as the fire barrier being supported (with exceptions per 711.4)
- Other requirements for openings, penetrations, joints

Fire Resistance Ratings – 711.2.4

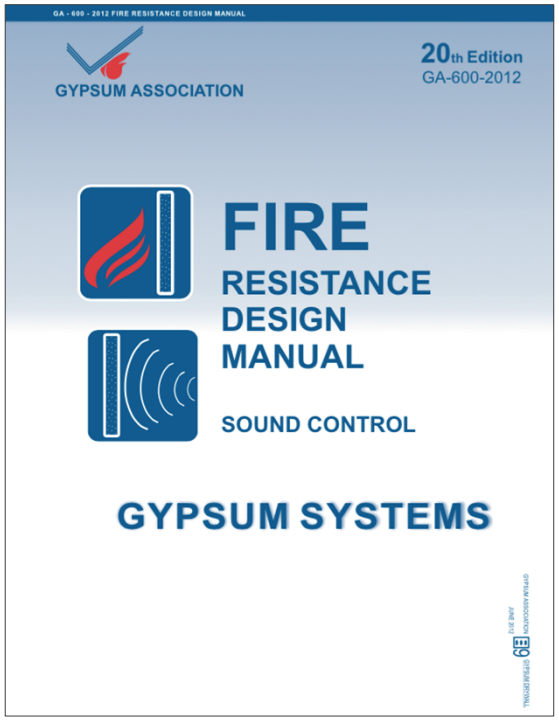
Fire resistance shall not be less than that required for:

- Separating mixed occupancies – 508.4
  - Up to 1-hr for sprinklered for other than I and H occupancy
  - Up to 2-hr for non-sprinklered for other than I and H occupancy
- Separating fire areas – 707.3.10
  - 2-hr for most occupancies for other than H and F-1
  - 3-hr for S1/ 1-hr for U
- Dwelling units – not less than 1hr
  - Except for IIB, IIIB, VB with NFPA 13 sprinklers is ½-hr
- Separating smoke compartments – 709
- Separating incidental uses – 509

Fire Resistance – Insulation Effects

"The addition of up to 16-3/4 inches of 0.5 pcf glass fiber insulation (R-40), either batt or loose-fill, to any 1- or 2-hour fire resistance rated floor-ceiling or roof-ceiling system having a cavity deep enough to accept the insulation is permitted provided that one additional layer of either 1/2 inch or 5/8 inch type X gypsum board is applied to the ceiling. The additional layer of gypsum board shall be applied as described for the face layer of the tested system except that the fastener length shall be increased by not less than the thickness of the additional layer of gypsum board."

Section 1.12 Gypsum Association
Fire Resistance Design Manual



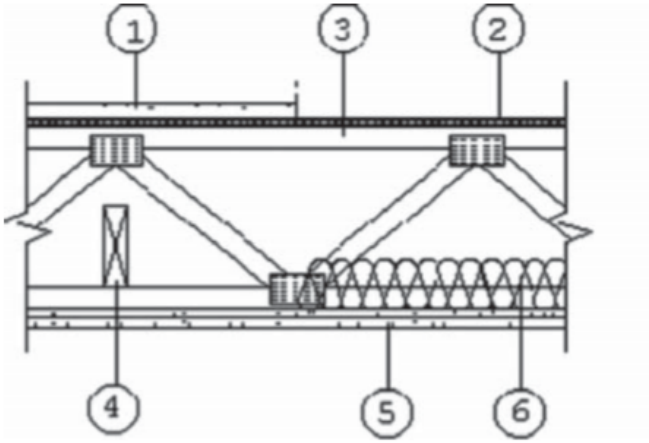
Trusses

"Specified floor-ceiling and roof-ceiling framing sizes or truss dimensions are minimums. Greater joist or truss sizes (depths) shall be permitted to be used in metal- or wood-framed systems.“

Section 1.17 Gypsum Association’s
Fire Resistance Design Manual

"Thus, larger and deeper trusses can be used under the auspices of the same design number. This approach has often been applied to roof truss applications since roof trusses are usually much deeper than the tested assemblies".

WTCA's Metal Plate Connected
Wood Truss Handbook



TSC/FCA 60-10

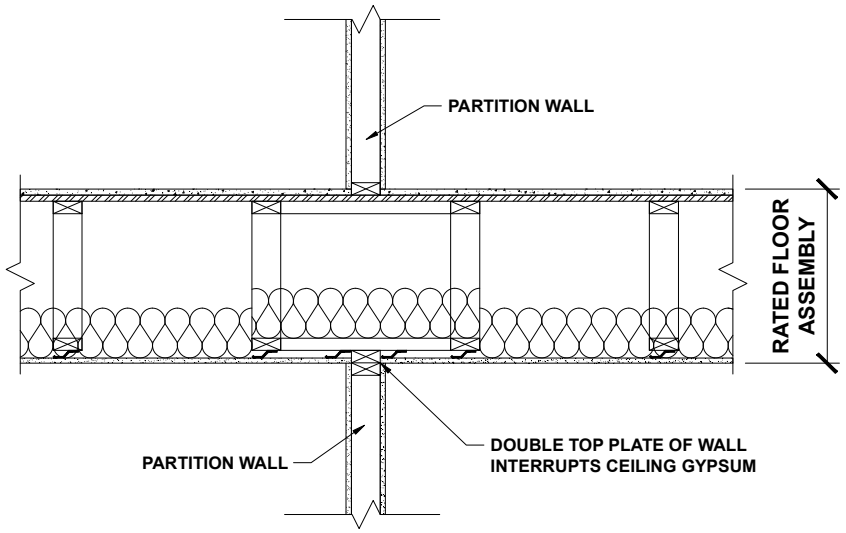
1. Topping (optional)
2. Flooring - min ¾” plywood
3. Truss – min depth 10”, spaced at 24”oc
4. Bridging/Strongback
5. 2 layers ½” Type X Gyp
6. Insulation (optional) – supported by metal furring or 1x3 wood furring strips at 16” oc. “Equivalent methods that retain insulation above joist bottom flange are acceptable”

Assembly Intersection

Can a wall interrupt the ceiling gypsum of a rated horizontal assembly?

Yes!

- IBC 2012 714.4.1.2, Except. 7: Permitted if wall is rated to match horizontal assembly
- IBC 2015 714.4.2, Except. 7 or IBC 2018 714.5.2, Except. 7 Permitted if wall is covered with type X gypsum each side



INTERIOR WALL TO FLOOR INTERSECTION

Tell a Friend

Do light-frame wood columns located entirely within fire resistance-rated walls also require individual fire protection or encasement?

It is not uncommon for light-frame wood columns, whether solid or built-up, to be embedded in light-frame walls (bearing or non-bearing). In many instances, these walls must be rated for fire resistance per IBC Table 601 or because they serve as fire barriers, fire partitions or fire walls. However, guidance on whether they are considered primary structural elements that require individual fire protection has evolved over the last several building code cycles.

Under the 2012 IBC, Section 704.2 was sometimes interpreted to mean that light-frame wood columns would need individual fire protection (demonstrated via their own gypsum wrap or charred wood calculations):

2012 IBC: 704.2 Column protection.

Where columns are required to have protection to be fire-resistance rated, the entire column shall be provided individual encasement protection by protecting it on all sides for the full column length, including connections to other structural members with materials having the required fire-resistance rating. Where the column extends through a ceiling, the encasement shall be continuous from the top of the foundation or floor/ceiling assembly below through the ceiling space to the top

View All Expert Tips

http://www.woodworks.org/ask-an-expert/

Individual Encasement - Columns

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b]	1[b]	0	1[b]	0	HT	1[b]	0
Bearing walls									
Exterior[e, f]	3	2	1	0	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	$1\frac{1}{2}$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

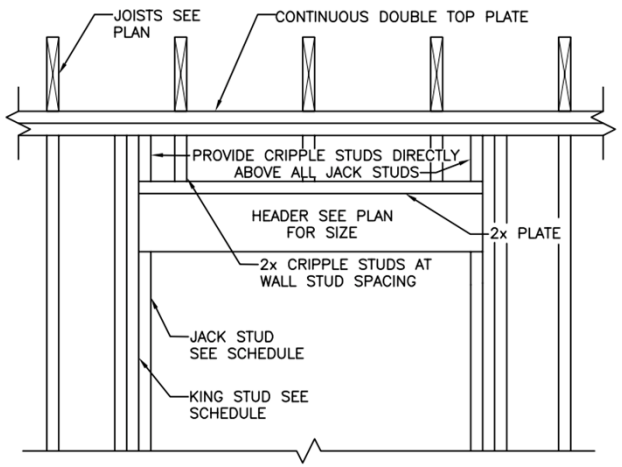
BEARING WALL STRUCTURE. *A building or other structure in which vertical loads from floors and roofs are primarily supported by walls.*

FRAME STRUCTURE. *A building or other structure in which vertical loads from floors and roofs are primarily supported by columns.*

Light Frame Bearing Walls -IBC 704.4.1

704.4 Protection of secondary members.
Secondary members that are required to have a fire resistance rating shall be protected by individual encasement protection, by the membrane or ceiling of a horizontal assembly in accordance with 711, or by a combination of both.

704.4.1 Light Frame Construction.
King Studs and boundary elements that are integral elements in load-bearing walls of light-frame construction shall be permitted to have required fire-resistance ratings provided by the membrane protection provided for the load-bearing wall.



Typ. Bearing Wall Opening Framing

Light Frame Bearing Walls – 2018 IBC

2018 IBC: 704.2 Column protection.
Where columns are required to have protection to achieve a fire-resistance rating, the entire column shall be provided individual encasement protection by protecting it on all sides for the full column height, including connections to other structural members, with materials having the required fire-resistance rating. Where the column extends through a ceiling, the encasement protection shall be continuous from the top of the foundation or floor/ceiling assembly below through the ceiling space to the top of the column.
Exception: Columns that meet the limitations of Section 704.4.1

2018 IBC: 704.4.1 Light-frame construction.
Studs, columns and boundary elements *that are integral elements in walls of light-frame construction and are located entirely between the top and bottom plates or tracks shall be permitted to have required fire-resistance ratings provided by the membrane protection provided for the wall.*

Not in the 2020 FBC

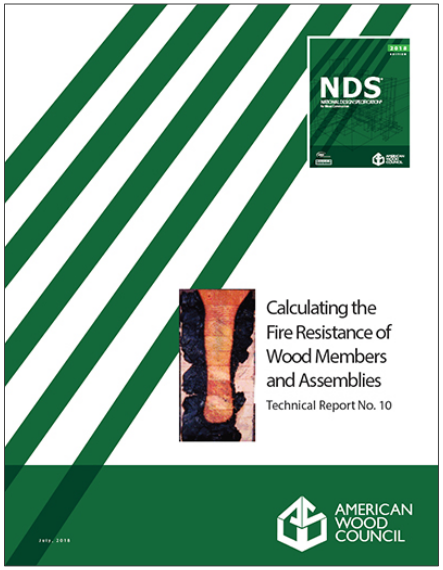
Column Fire Resistance

"Fire-resistance ratings for exposed structural wood elements are typically calculated using either the T.T. Lie method or the National Design Specifications (NDS) Method. There is no widely accepted method for calculating the fire-resistance rating of an individual structural wood column or beam protected with gypsum board applied to exposed surfaces. In general, fire resistance of the unprotected column or beam is calculated using one of the above methods and the rating of the protected column or beam is estimated by adding 30 min. for a single layer of 5/8 inch Type X gypsum board or 60 min. for a double layer of 5/8 inch Type X gypsum board."

Gypsum Association Fire Resistance Design Manual

IBC Commentary on 704.2

"Columns that provide inherent fire resistance, without encasement, such as heavy timber, are considered as not requiring protection and do not need to comply with this section."



Column vs. Boundary Elements

- If posts/stud packs in a wall lie between plates:
  - Considered “secondary members” by not having direct connection to the columns and covered by exceptions
  - Fire rating can be provided by membrane
  - Per Table 601, need to be 2-hr rated for IIIA and 1-hr for VA
- If posts/stud packs break the top and/or bottom plate:
  - May be considered primary frame and be considered a “column” member
  - Need to be individually encased
  - Per Table 601, need to be rated to 1-hr for IIIA and VA construction
  - Protection can be provided by charring effects
  - Protection of connections needs to be considered

Beam Encasement

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b]	1[b]	0	1[b]	0	HT	1[b]	0
Bearing walls									
Exterior[e, f]	3	2	1	0	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	$1\frac{1}{2}$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

BEARING WALL STRUCTURE. *A building or other structure in which vertical loads from floors and roofs are primarily supported by walls.*

FRAME STRUCTURE. *A building or other structure in which vertical loads from floors and roofs are primarily supported by columns.*

Beam Encasement

704.3 Protection of the primary structural frame other than columns.

Members of the primary structural frame other than columns that are required to have protection to achieve a fire-resistance rating and support more than two floors or one floor and roof, or support a load-bearing wall or a non load-bearing wall more than two stories high, shall be provided individual encasement protection by protecting them on all sides for the full length including connections to other structural members, with materials having the required fire-resistance rating.

Exception: *Individual encasement protection on all sides shall be permitted on all exposed sides provided the extent of protection is in accordance with the required fire resistance rating as determined in Section 703.*

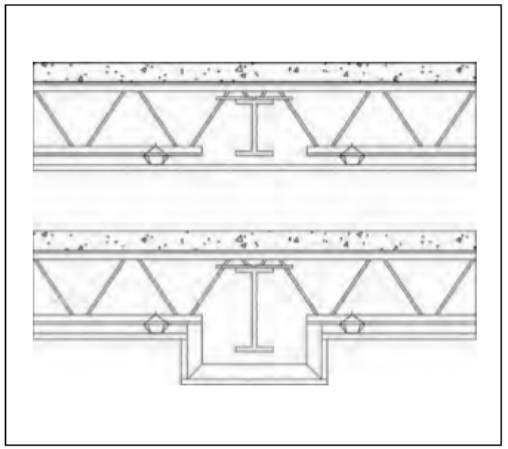


Figure 4
Membrane Protected Steel Beam- Continuous

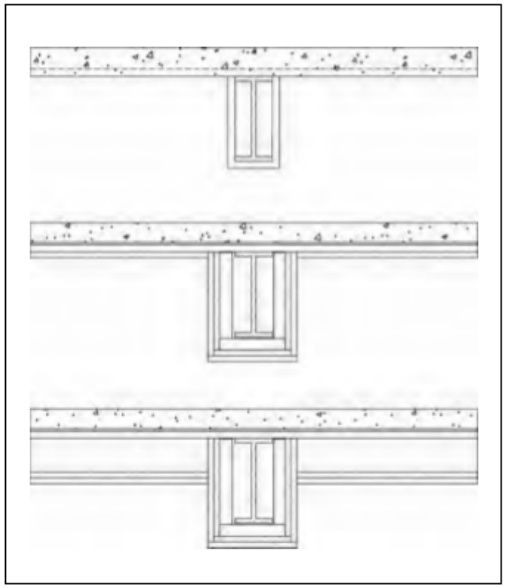


Figure 5
Steel Beam - Individual Encasement Protection

Exposed Framing Fire Resistance

IBC 703.3 Alternate Methods for determining fire resistance

Prescriptive designs per IBC 721.1

- **Calculations in accordance with IBC 722**
- Fire-resistance designs documented in sources
- Engineering analysis based on a comparison
- Alternate protection methods as allowed by 104.11

IBC 722 Calculated Fire Resistance

"…The calculated *fire resistance* of exposed wood members and wood decking shall be permitted in accordance with **Chapter 16** of ANSI/AF&PA *National Design Specification for Wood Construction (**NDS**.)*"

NDS Chapter 16 Fire Design of Wood Members

Limited to calculating fire resistance up to 2 hours.

Char rate varies based on endurance required, product type and lamination thickness. Equations and tables provided.

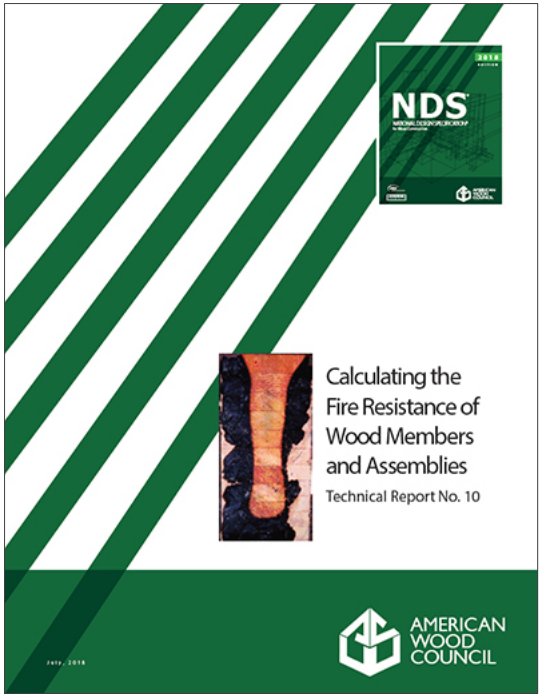
TR10 and NDS commentary are helpful in implementing permitted calculations.

Exposed Framing Fire Resistance

Table 16.2.1A Char Depth and Effective Char Depth (for β_n = 1.5 in./hr.)

Required Fire Resistance (hr.)	Char Depth, a_{char} (in.)	Effective Char Depth, a_{eff} (in.)
1-Hour	1.5	1.8
1½-Hour	2.1	2.5
2-Hour	2.6	3.2

Source: 2018 NDS Chapter 16



https://awc.org/codes-standards/publications/tr10

Questions? Ask me anything.

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