



Fire Resistant Design and Detailing: Fire Walls, Fire Barriers, and Fire Partitions

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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 fire walls, 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

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.....



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, b}

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 ³ / 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 ³ / ₈ " Type C gypsum wallboard attached directly to I-joists with 1 ³ / ₈ " Type S drywall screws spaced 12" o.c. with ends staggered. Minimum 0.0179" thick hat-shaped ¹ / ₂ -inch furring channel 16" o.c. (channels doubled at wallboard end joints), placed perpendicular to the joist and attached to each joist by 1 ³ / ₈ " Type S drywall screws after the base layer of gypsum wallboard has been applied. The middle and face layers of ³ / 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 ³ / ₈ " Type S drywall screws 8" o.c. The joints shall be taped and covered with joint compound.	—	—	—	Varies	—	—	2 ³ / ₄	—

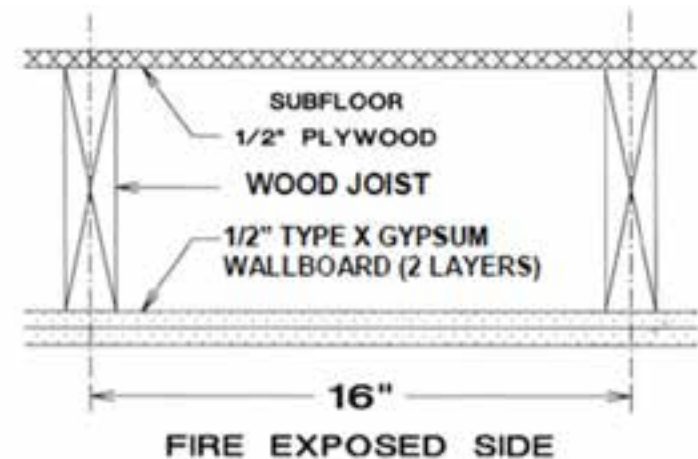
Fire Resistance Ratings – IBC 703.3

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 ^a (minutes)
$\frac{3}{8}$ -inch wood structural panel bonded with exterior glue	5
$\frac{15}{32}$ -inch wood structural panel bonded with exterior glue	10
$\frac{19}{32}$ -inch wood structural panel bonded with exterior glue	15
$\frac{3}{8}$ -inch gypsum wallboard	10
$\frac{1}{2}$ -inch gypsum wallboard	15
$\frac{3}{8}$ -inch gypsum wallboard	30
$\frac{1}{2}$ -inch Type X gypsum wallboard	25
$\frac{3}{8}$ -inch Type X gypsum wallboard	40
Double $\frac{3}{8}$ -inch gypsum wallboard	25
$\frac{1}{2}$ -inch + $\frac{3}{8}$ -inch gypsum wallboard	35
Double $\frac{1}{2}$ -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

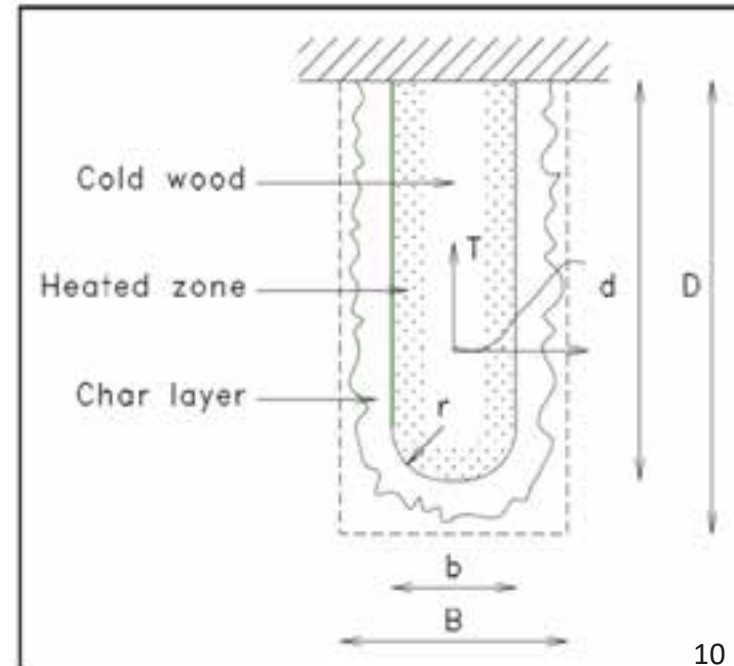
Methods for determining fire resistance:

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



Table 16.2.1A Effective Char Rates and Char Depths (for $\beta_n = 1.5$ in./hr.)

Required Fire Endurance (hr.)	Effective Char Rate, β_{eff} (in./hr.)	Effective Char Depth, a_{char} (in.)
1-Hour	1.8	1.8
1½-Hour	1.67	2.5
2-Hour	1.58	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



Outline

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

Fire-Resistance Rated Wall Assemblies

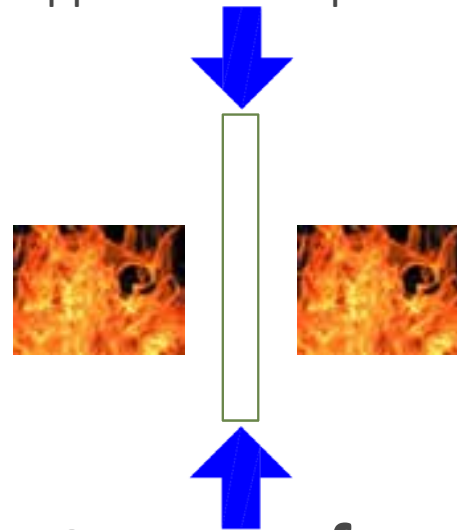
Fire-Resistance Rating: The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests, prescribed in Section 703.

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

- Building Separation
- Openings are protected and limited
- Continuous from foundation to/through roof and exterior wall to/through exterior wall
- Structural stability

Fire Barrier

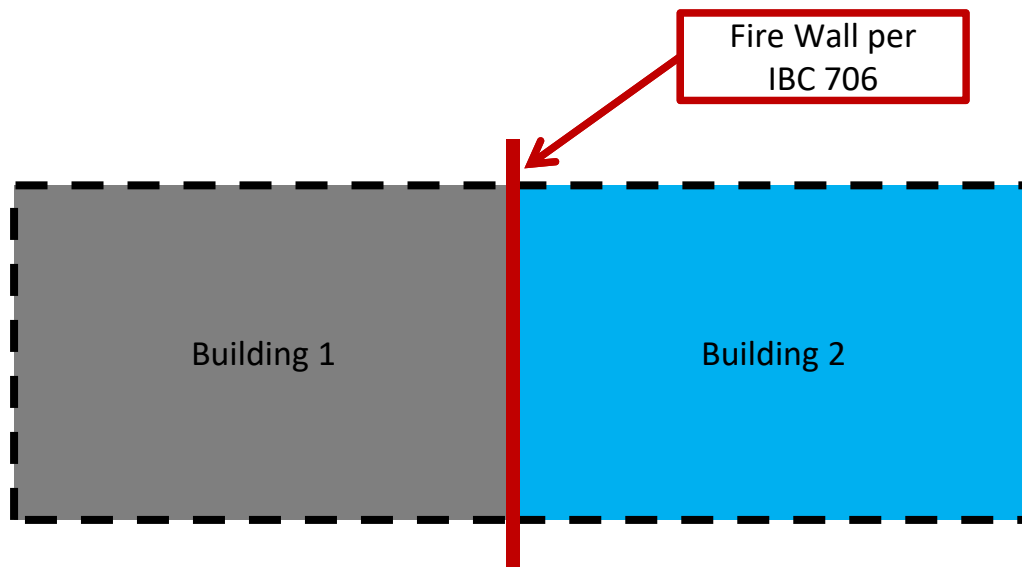
- Shafts, Occupancy Separation
- Openings are protected and limited
- Continuous from floor through concealed space at each level

Fire Partition:

- 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 TO BE 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 non-combustible materials.

Exception: Buildings of Type V construction

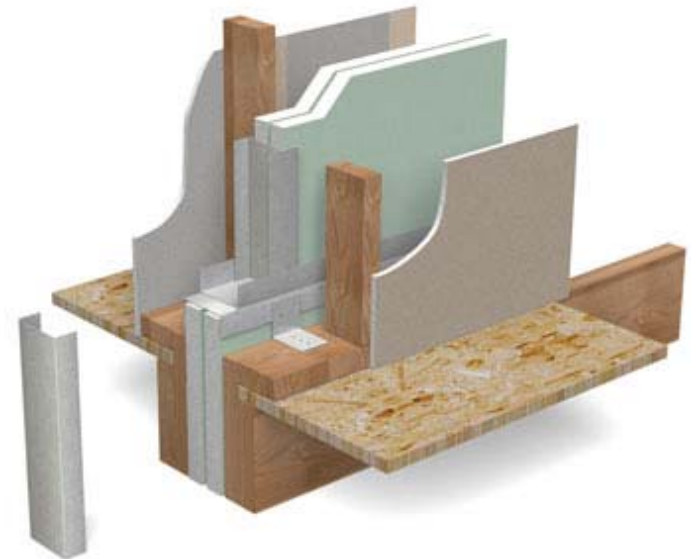
Fire Walls – Ratings & Materials

Opportunity for Wood Framed Fire Walls:

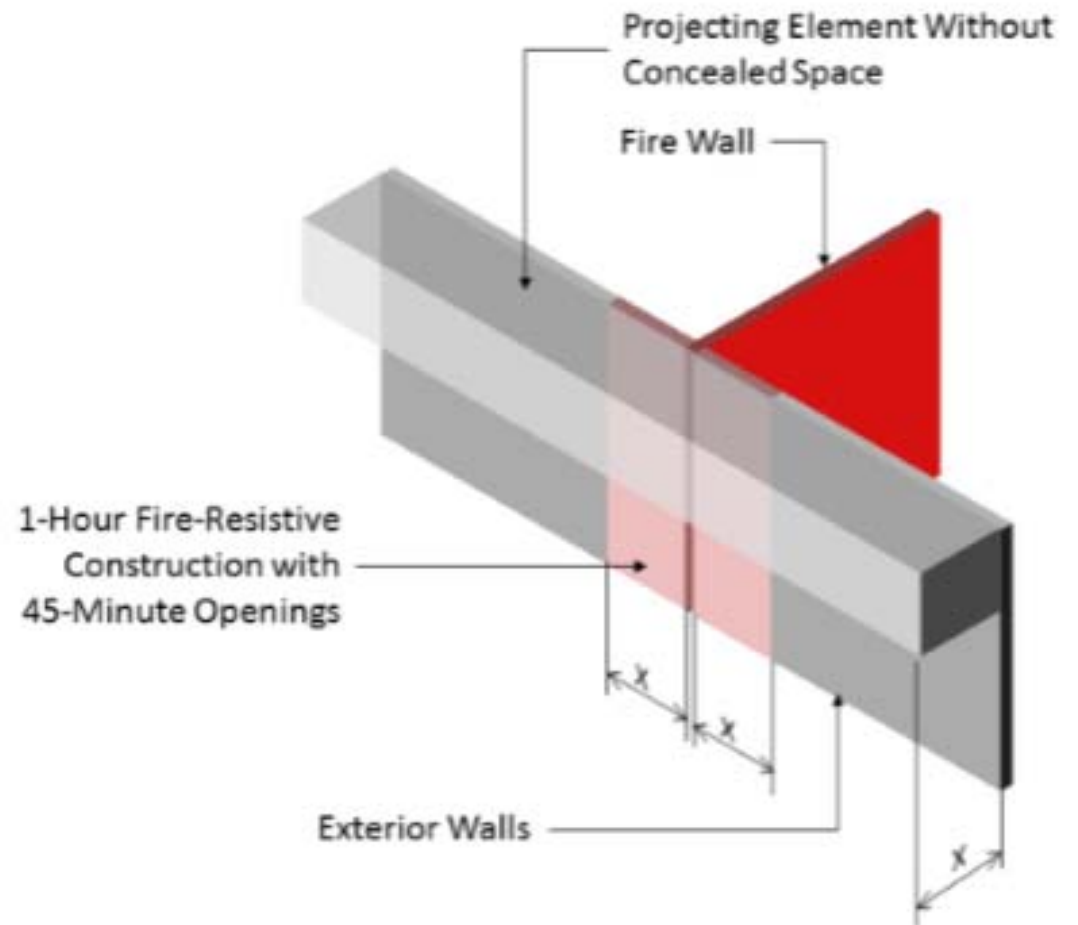
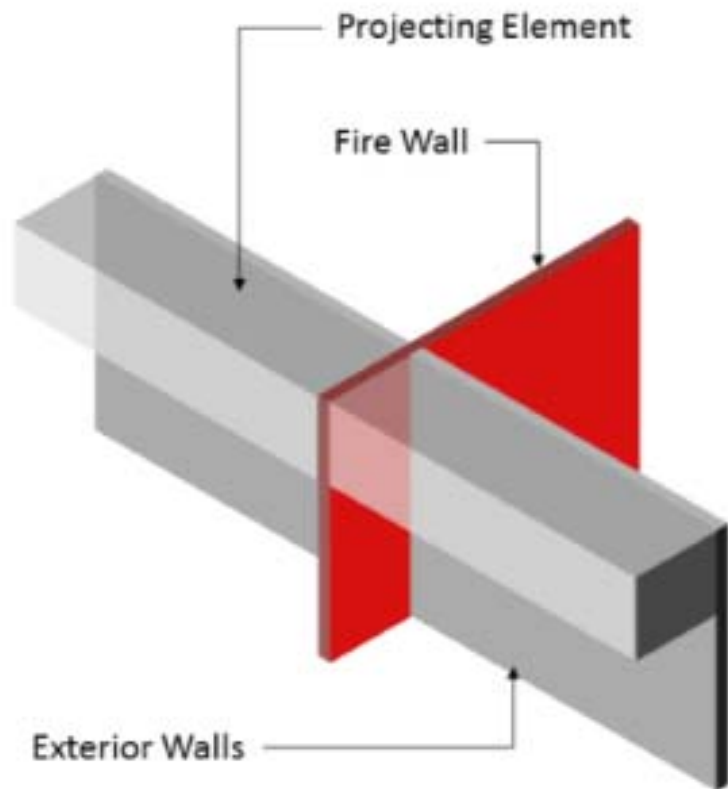
- Permitted in type V Construction
- Fire Walls in type V Construction of A, B, E, R and several other occupancies may be 2 hour

Fire Walls in type III and IV construction are required to be constructed of non-combustible materials

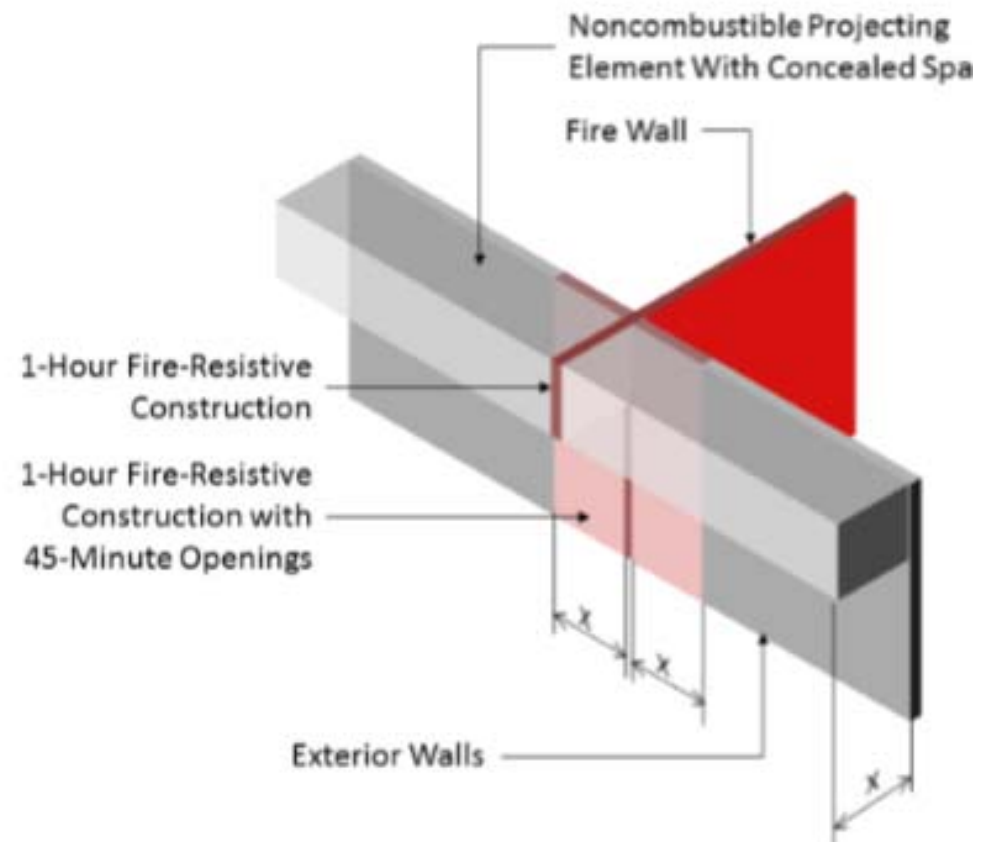
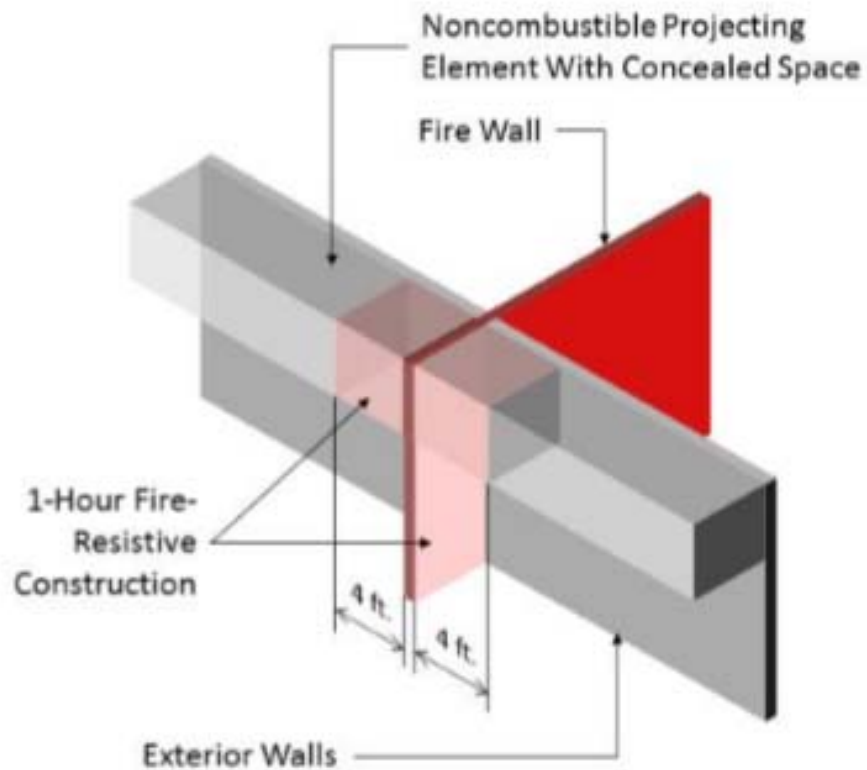
- Opportunity for wood frame bearing walls on each side of fire wall to meet structural stability requirements



Fire Walls – Horizontal Continuity



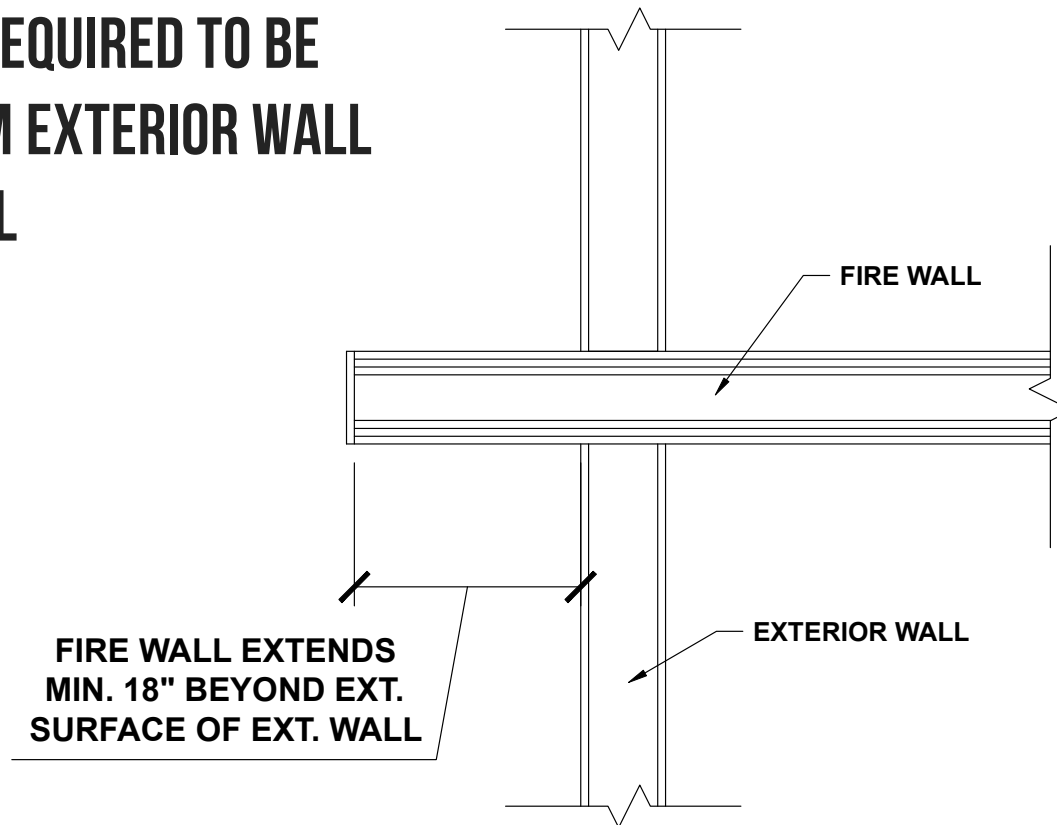
Fire Walls – Horizontal Continuity





Fire Walls - Horizontal Continuity

**FIRE WALLS ARE REQUIRED TO BE
CONTINUOUS FROM EXTERIOR WALL
TO EXTERIOR WALL**

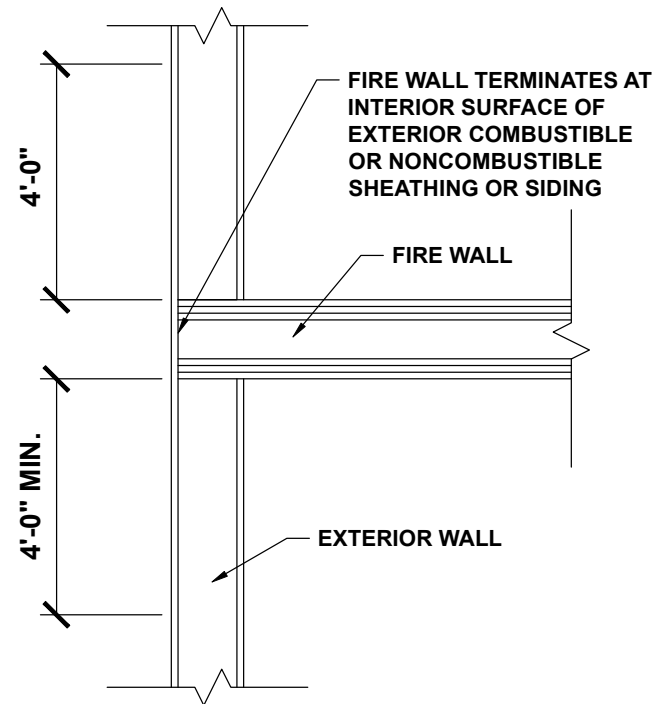


FIRE WALL TO EXTERIOR WALL: OPTION 1

Fire Walls - Horizontal Continuity

ALTERNATIVES:

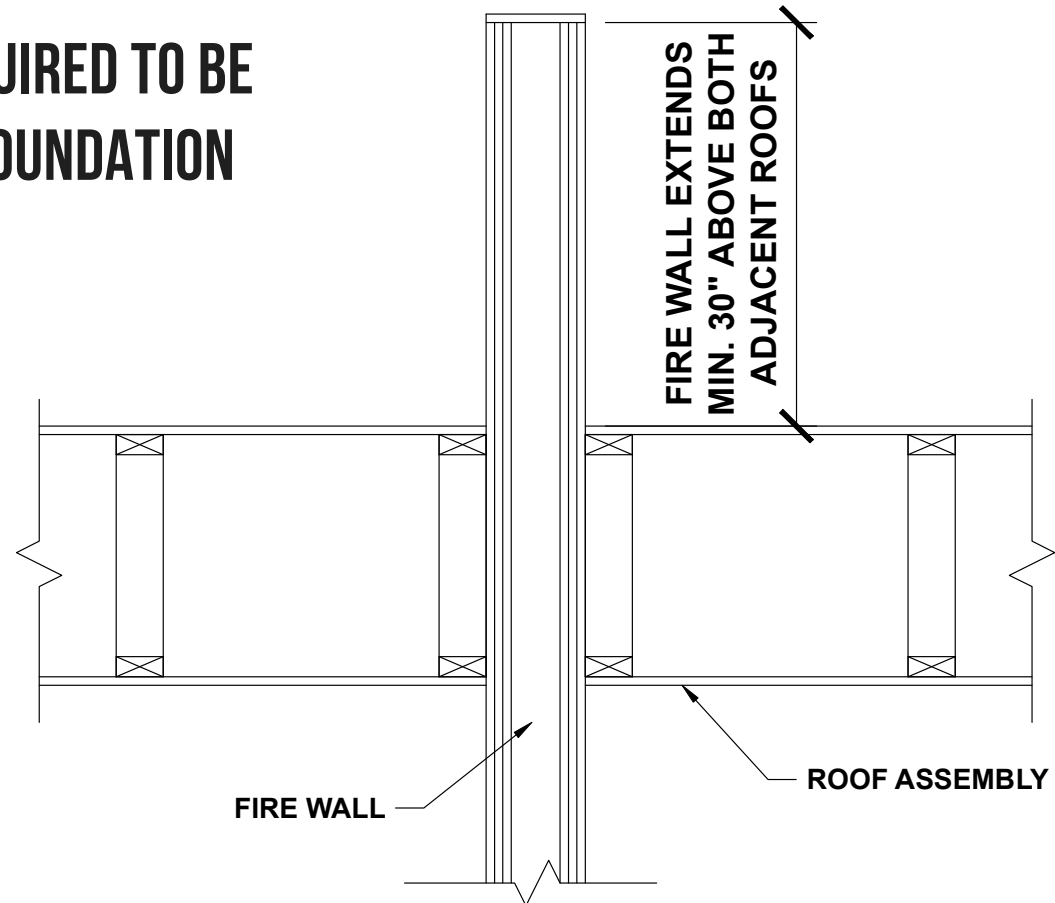
1. EXTERIOR WALL RATED FOR 1 HR MIN. 4FT EACH SIDE (OPENING PROTECTION REQ'D)
2. NONCOMBUSTIBLE SHEATHING/SIDING EXTENDS MIN. 4FT EACH SIDE
3. BUILDING ON EACH SIDE OF THE FIRE WALL IS EQUIPPED THROUGHOUT WITH AN NFPA OR NFPA 13 SPRINKLER SYSTEM



FIRE WALL TO EXTERIOR WALL: OPTION 2

Fire Walls - Vertical Continuity

**FIRE WALLS ARE REQUIRED TO BE
CONTINUOUS FROM FOUNDATION
TO ROOF**

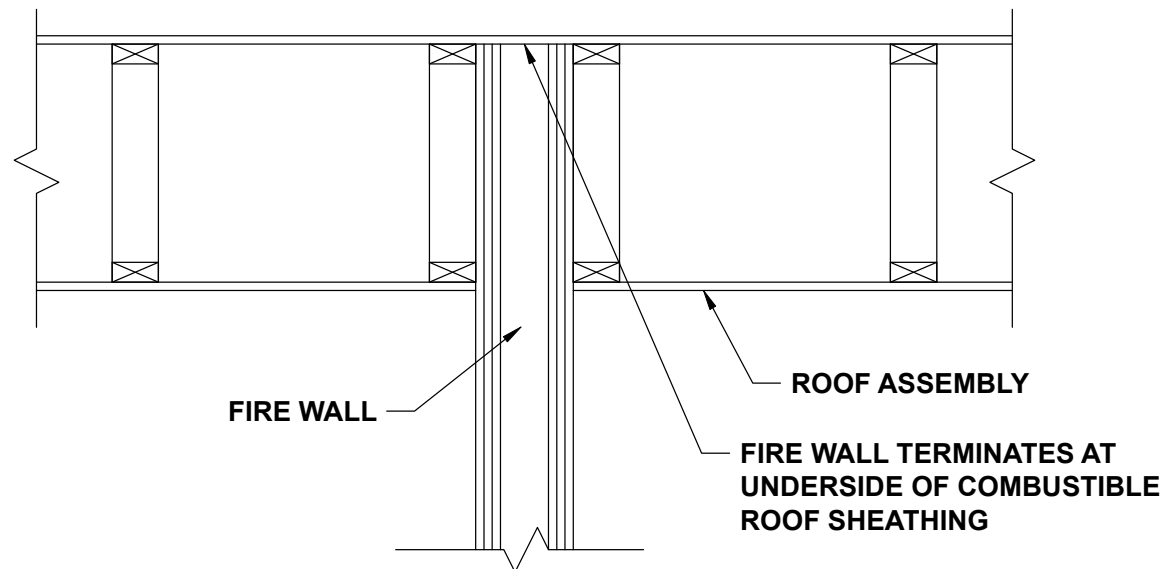


FIRE WALL TO ROOF: OPTION 1

Fire Walls - Vertical Continuity

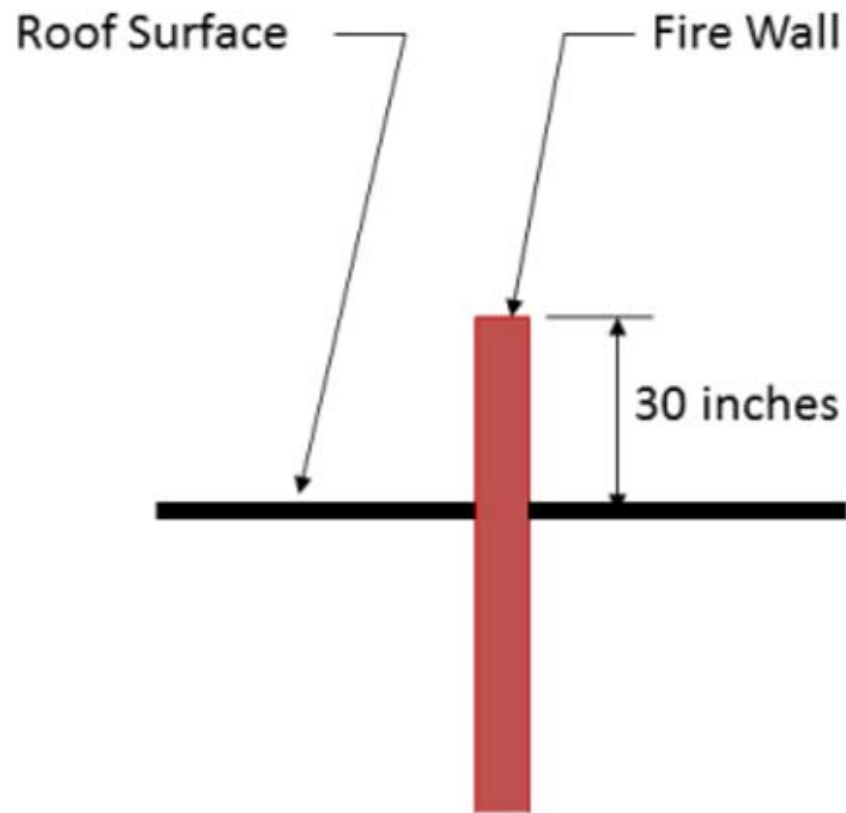
IN CONSTRUCTION TYPES III, IV OR V

- **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**

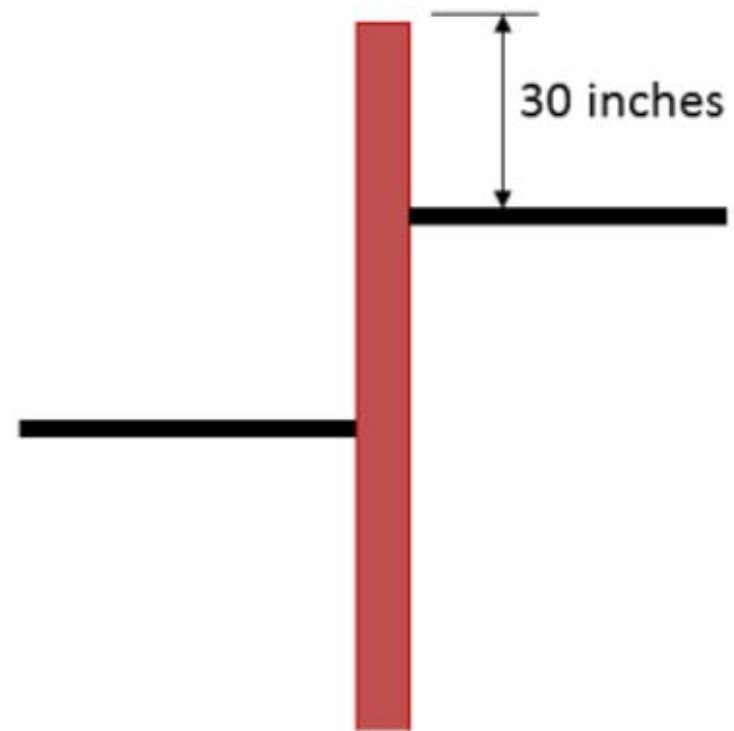


FIRE WALL TO ROOF: OPTION 2

Fire Walls – Vertical Continuity

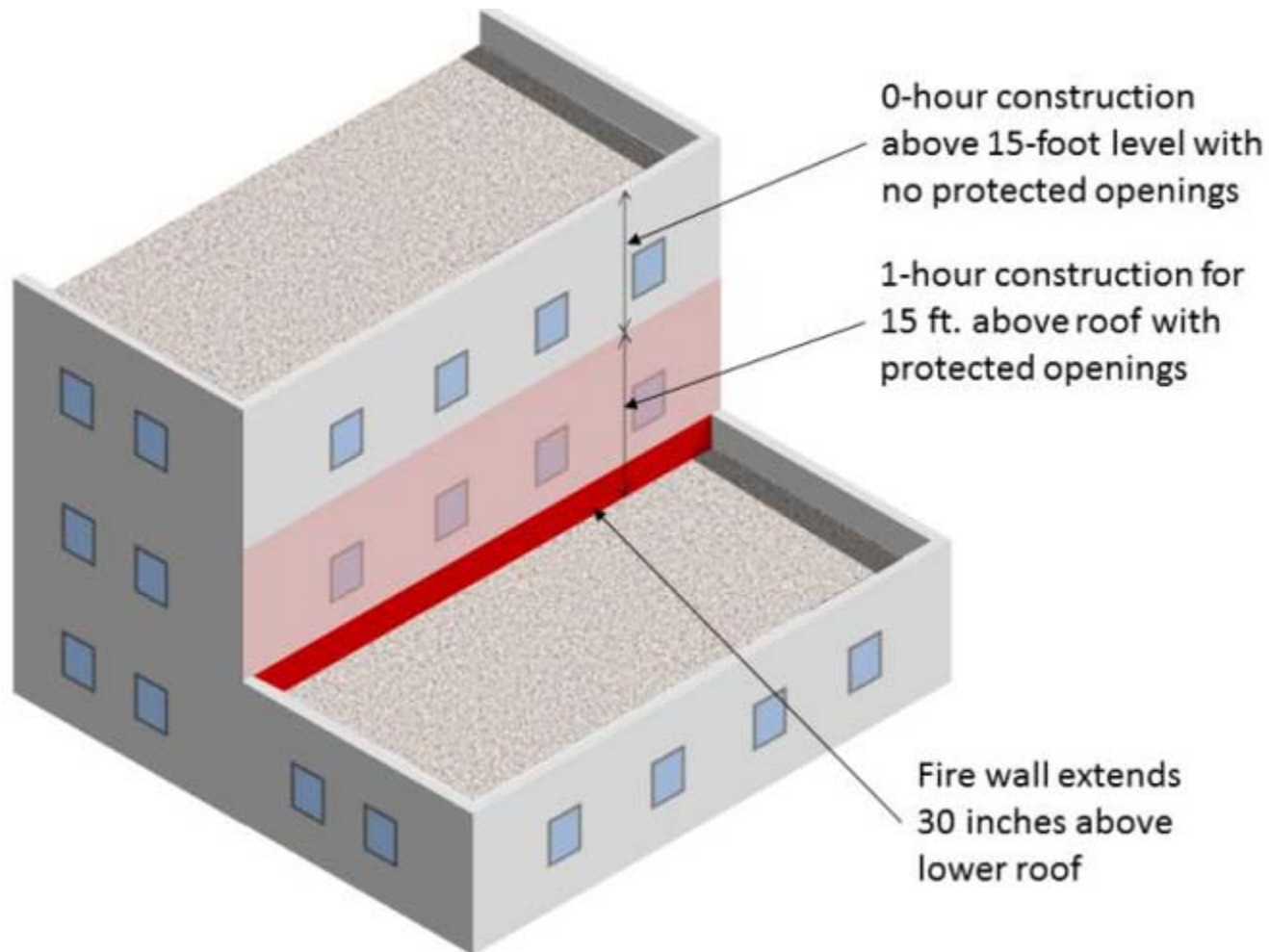


Typical Roof Condition

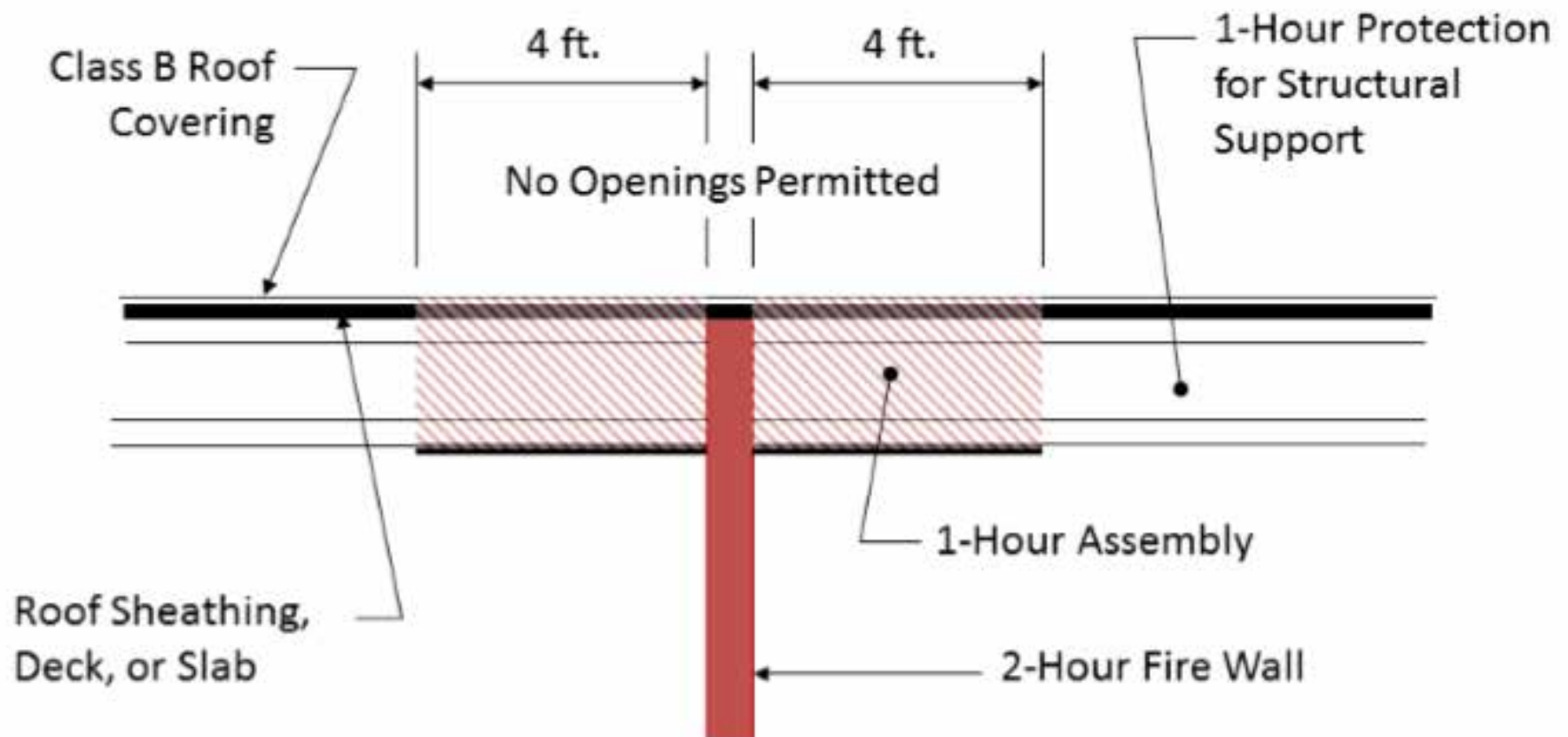


High-Low Roof Condition

Fire Walls – Vertical Continuity



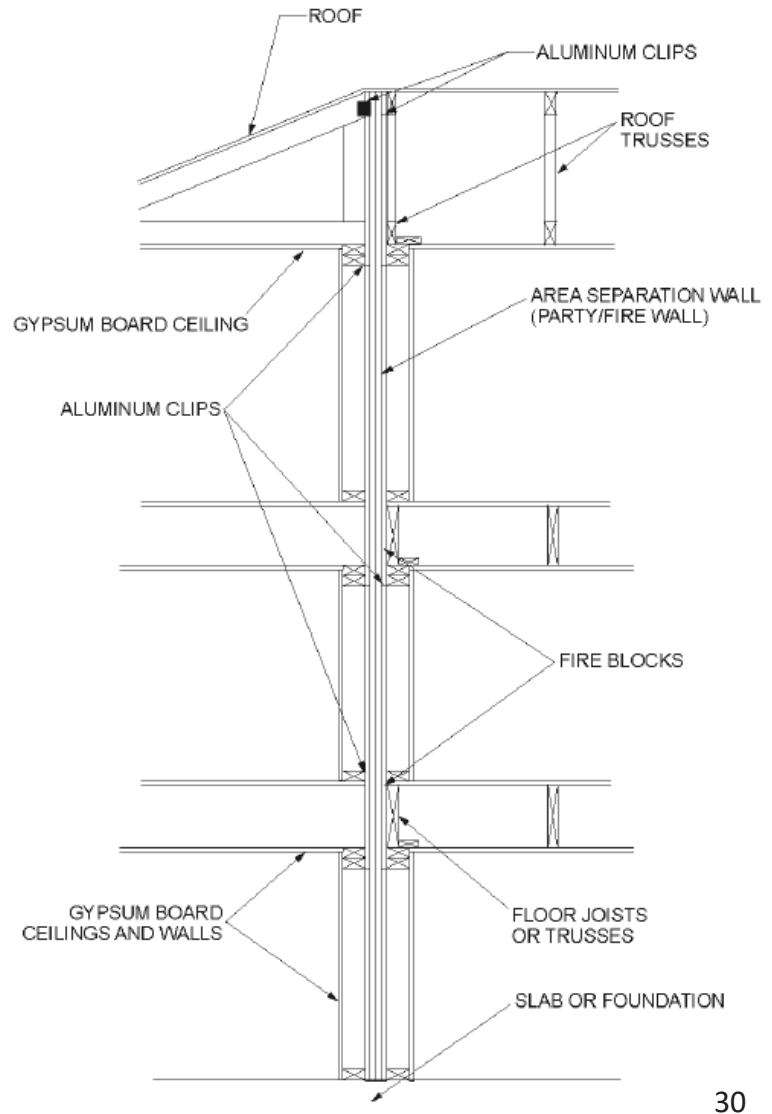
Fire Walls – Vertical Continuity



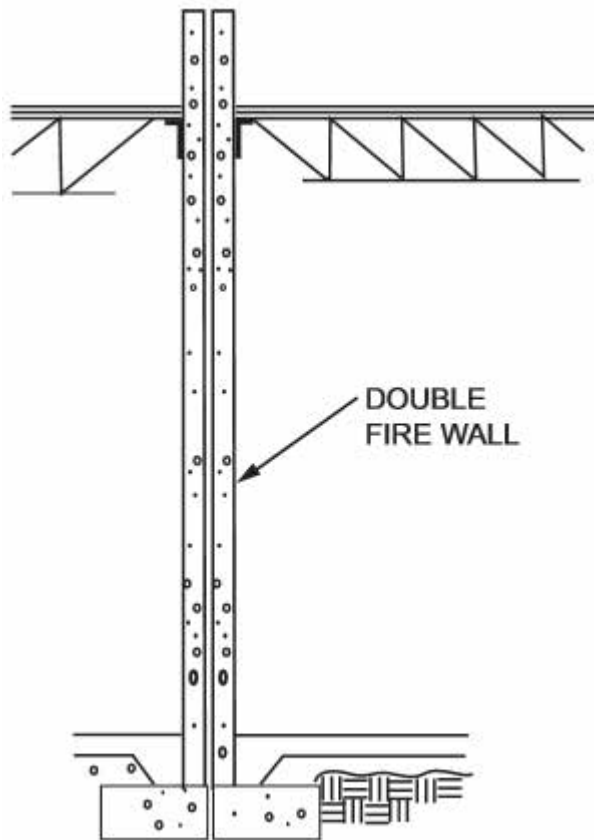
Fire Walls – Structural Stability

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 – 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.

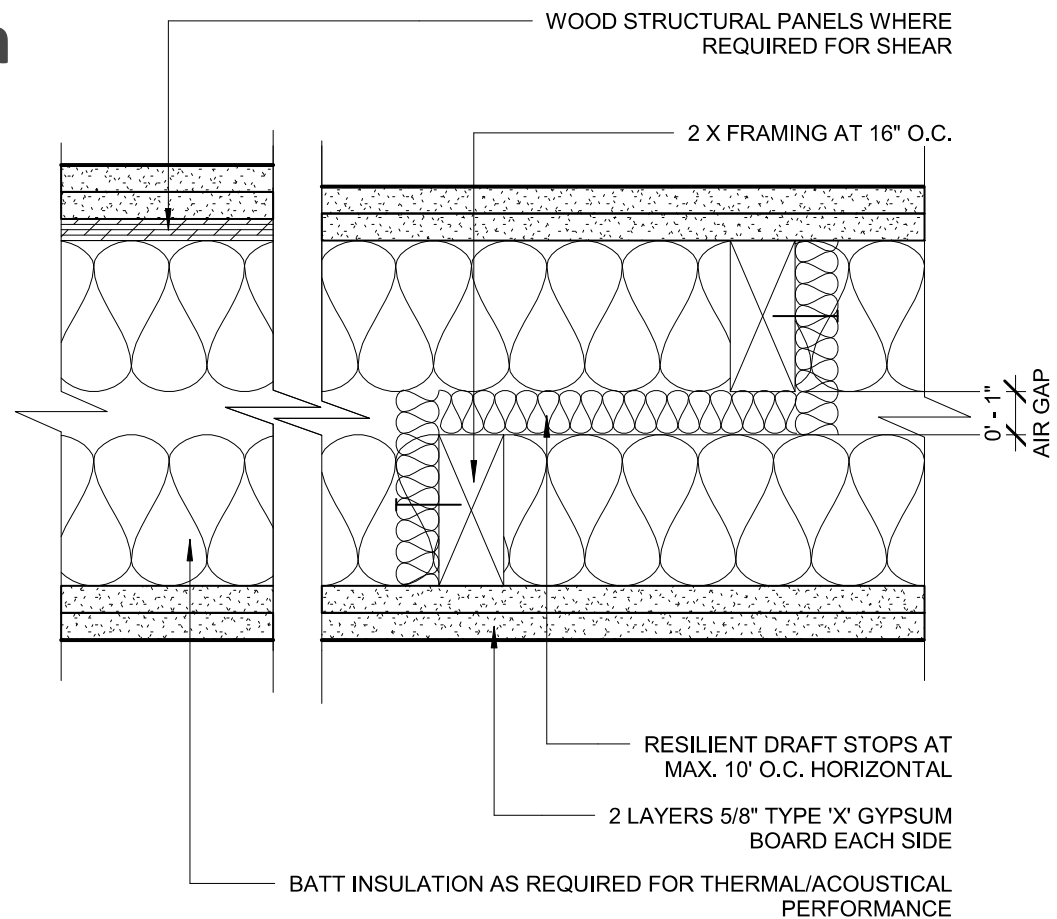
Table 4.5 Fire Resistance Ratings for Double Wall Assemblies

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

Construction

Type:

- V



2-HOUR RATING PER GA FILE NO. WP 3820

2-HOUR DOUBLE STUD WALL

2 Hour Fire Wall Assembly

Construction

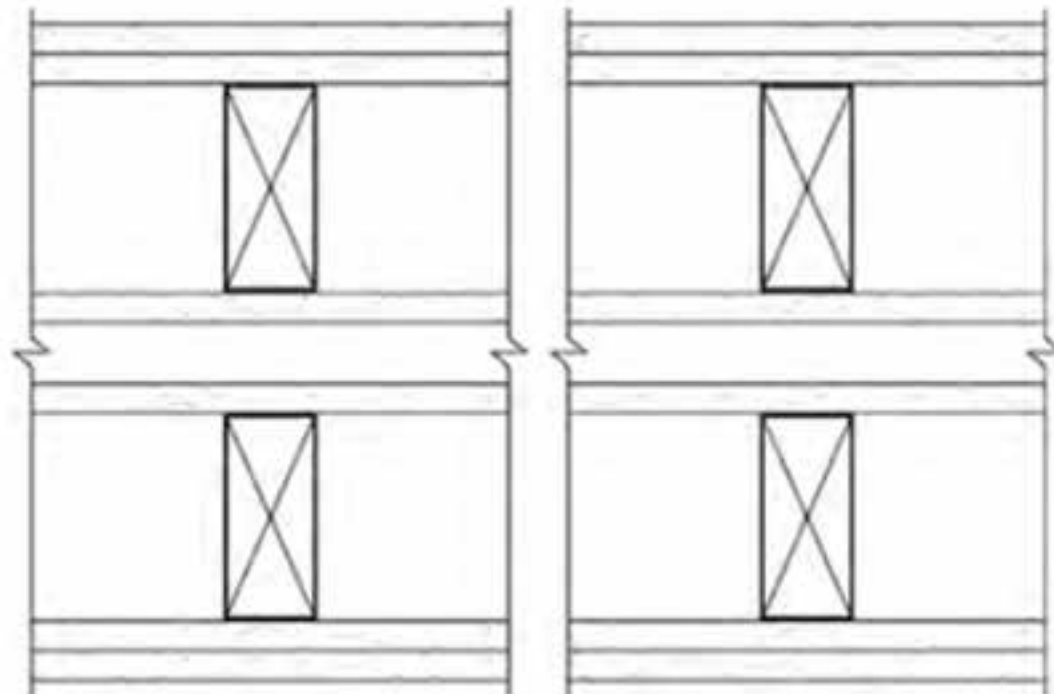
Type:

- V

GA FILE NO. WP 3810

**2 HOUR
FIRE**

**55 to 59 STC
SOUND**



2 Hour Fire Wall Assembly

Construction

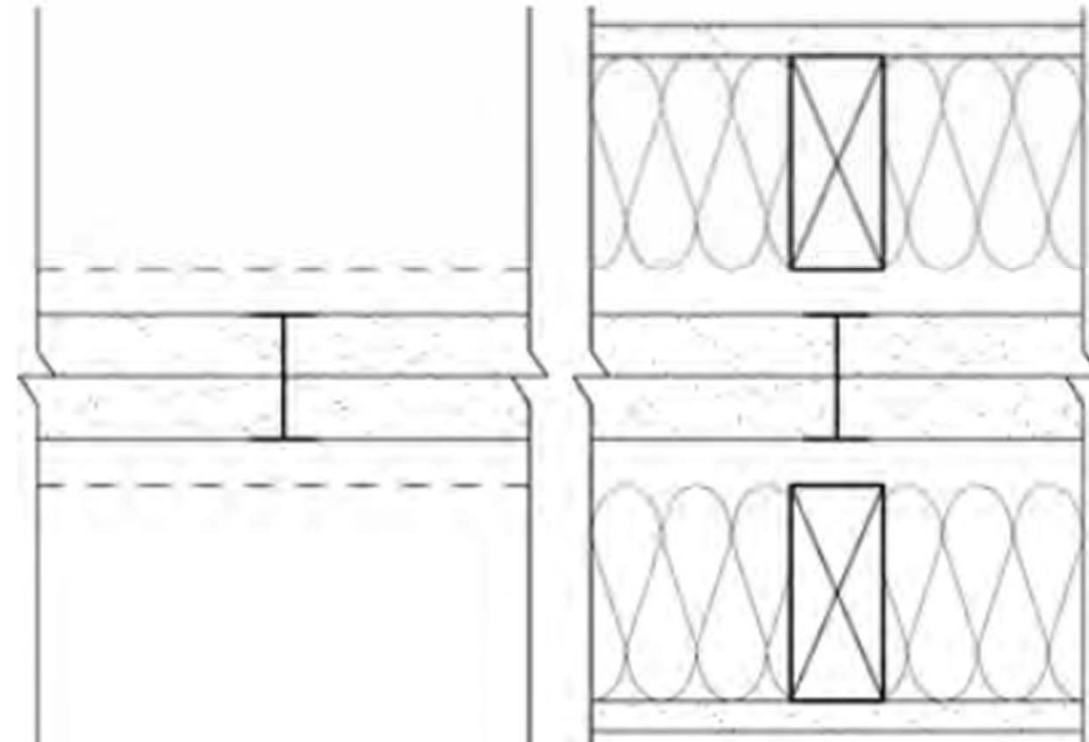
GA FILE NO. ASW 1000

Types:

- III
- IV
- V

2 HOUR
FIRE

60 to 64 STC
SOUND



Also see UL
U336

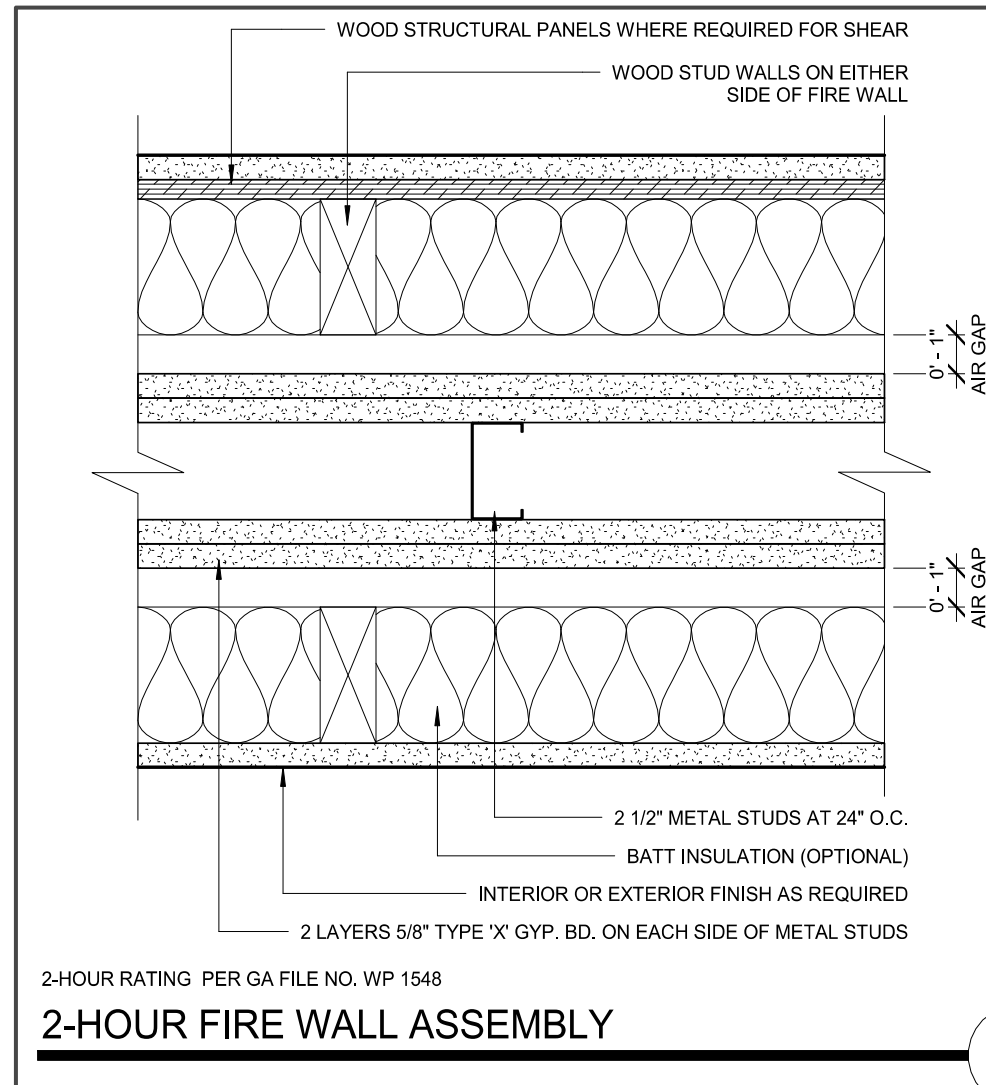
2 Hour Fire Wall Assembly

Construction

Types:

- III
- IV
- V

GA WP 1548
UL U411

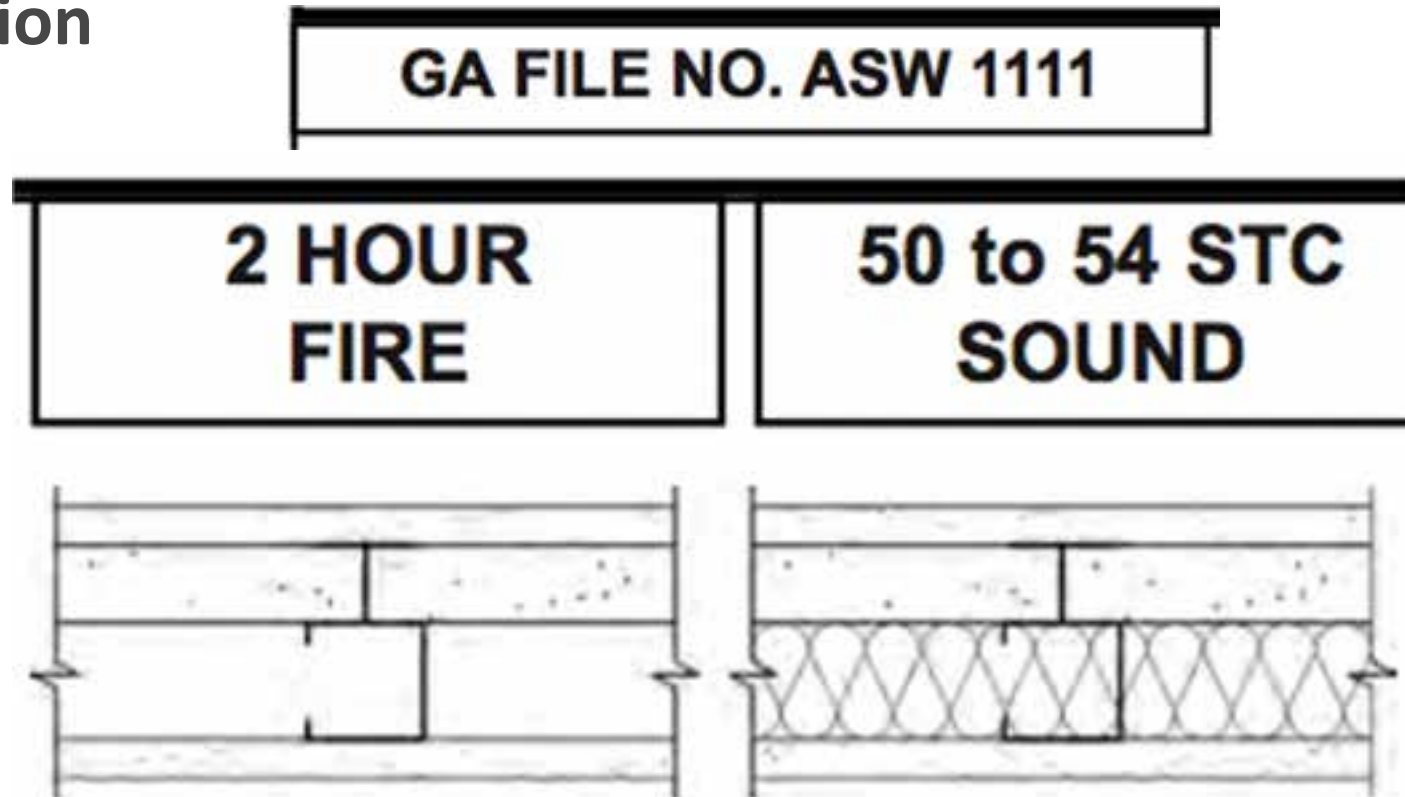


2 Hour Fire Wall Assembly

Construction

Types:

- III
- IV
- V



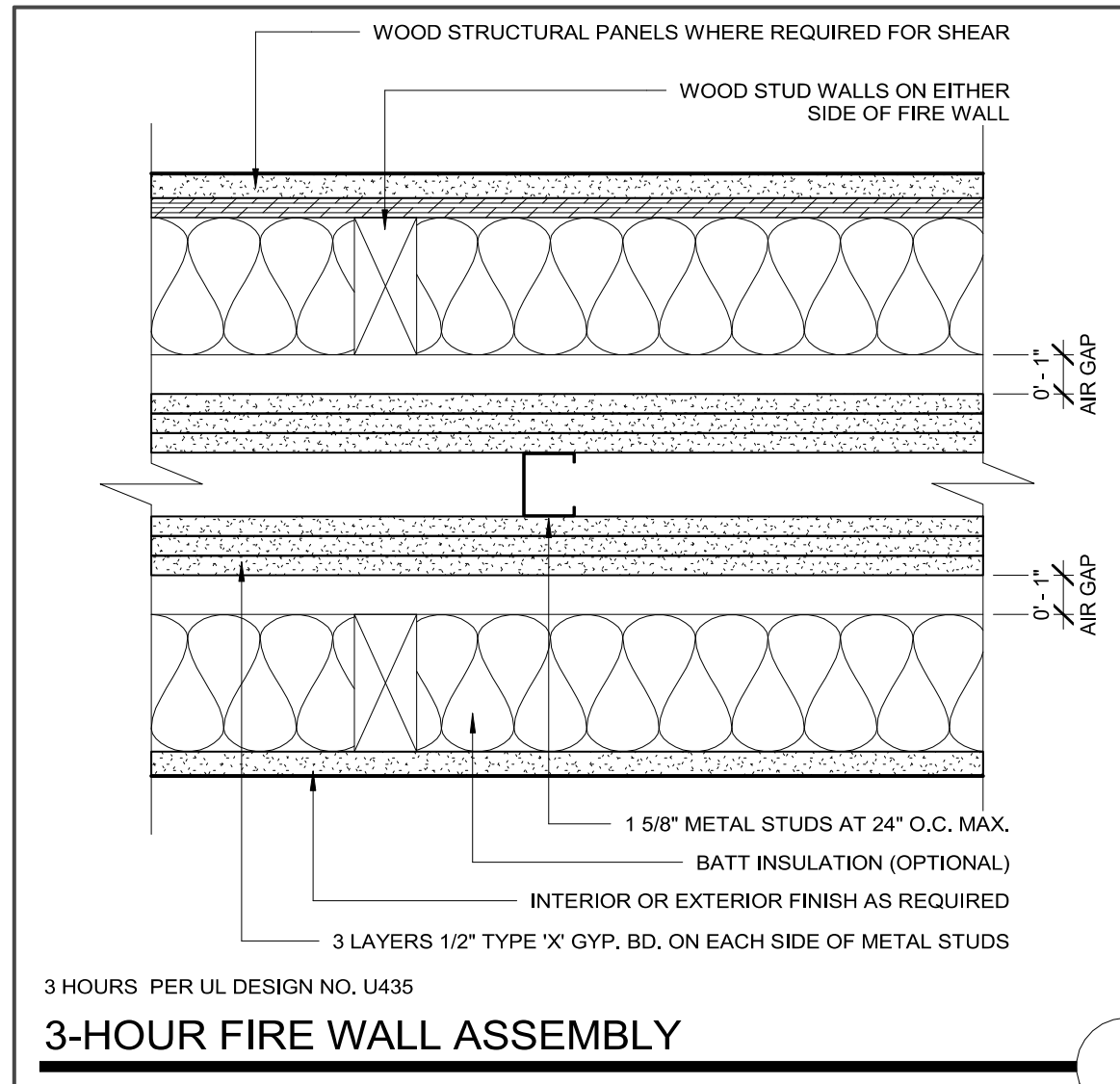
Can install wood bearing wall on
each side of 2 hour wall

3 Hour Fire Wall Assembly

Construction

Types:

- III
- IV
- V



3 Hour Fire Wall Assembly

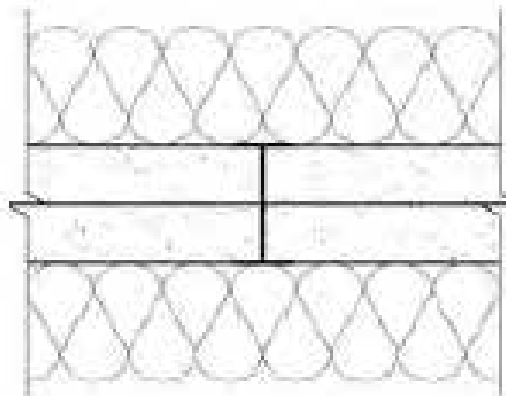
Construction

Types:

- III
- IV
- V

GA FILE NO. ASW 2600

**3 HOUR
FIRE**



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

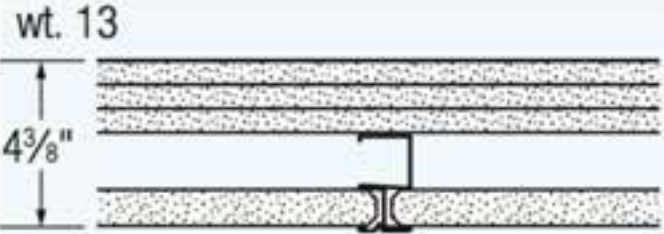
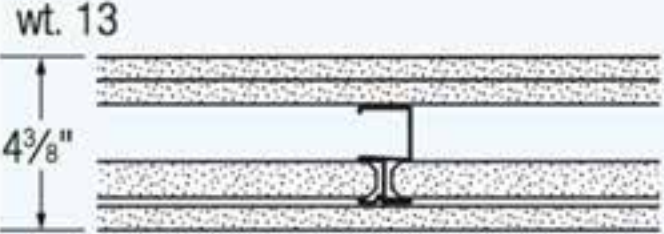
Thickness: 6"

Approx. Weight: 9.6 psf

Fire Test: WHI-495-0393, 1-14-82

**Could install wood bearing wall on
each side of 3 hour wall**

3 Hour Fire Wall Assembly

3 Hour Fire-Rated Construction		
 <p>wt. 13</p> <p>4³/₈"</p>	<ul style="list-style-type: none"> • 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
 <p>wt. 13</p> <p>4³/₈"</p>	<ul style="list-style-type: none"> • 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

Could install wood bearing wall on
each side of 3 hour wall

Fire Walls - Openings

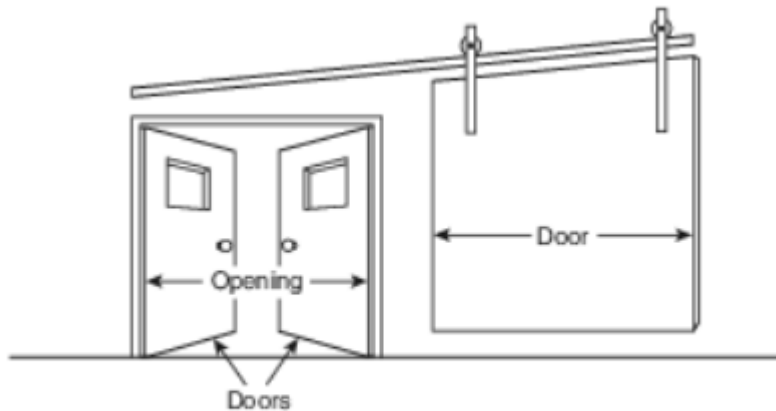


FIGURE A.5.8.3(a) Swinging Door and Sliding Door Configuration for Egress Purposes in an HC Fire Wall.

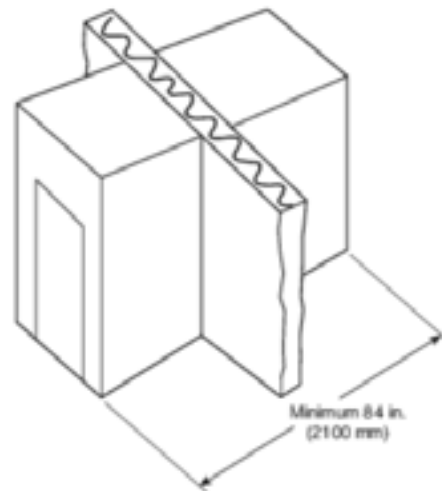


FIGURE A.5.8.3(b) Vestibule Arrangement for Egress Purposes in an HC Fire Wall.

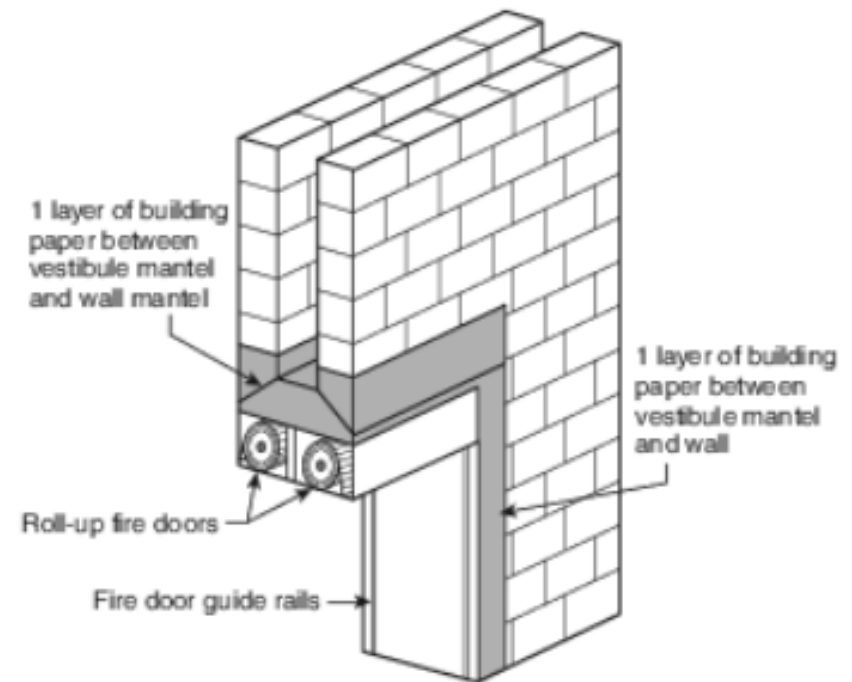
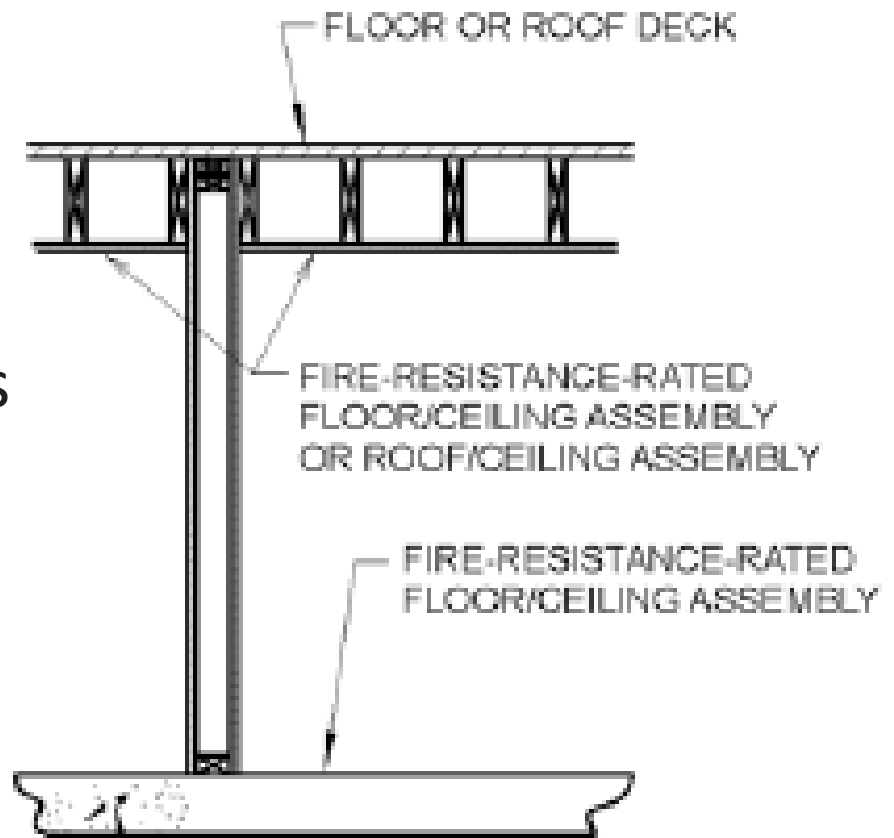


FIGURE A.5.8.4 Double Doors on a Freestanding Vestibule.

Fire Barriers – IBC 707

Commonly used in:

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

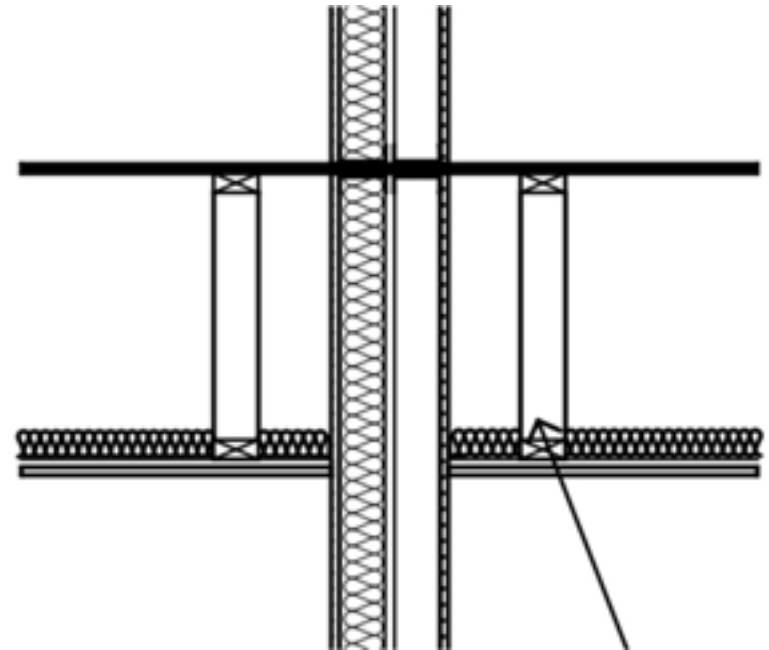


Fire Barrier Example

Fire Barriers – IBC 707

Fire Barriers:

- 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 if less
 - 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.

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

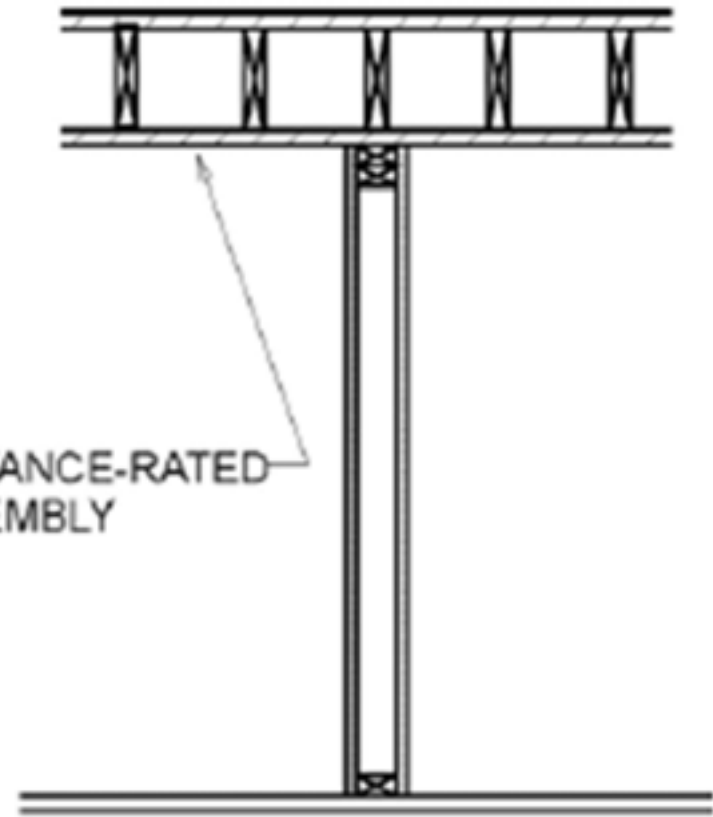
Commonly used to separate:

- 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 IIIB

FIRE-RESISTANCE-RATED
FLOOR ASSEMBLY



Fire Partition Example

Fire Partitions – IBC 708

Fire Partitions:

- May be constructed with any materials permitted by the construction type
- 708.3 Fire Resistance Ratings:
 - Fire partitions shall have a *fire-resistance rating* of not less than 1 hour.

Exceptions:

1. Corridor walls permitted to have a $1/2$ hour fire-resistance rating by Table 1020.1
2. Dwelling unit and sleeping unit separations in buildings of Type IIB, IIIB and VB construction shall have fire-resistance ratings of not less than $1/2$ hour in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

Fire Partitions – IBC 708

708.4 Continuity.

Fire partitions 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 or to the fire-resistance-rated floor/ceiling or roof/ceiling assembly above, and shall be securely attached thereto. In combustible construction where the *fire partitions* are not required to be continuous to the sheathing, deck or slab, the space between the ceiling and the sheathing, deck or slab above shall be fireblocked or draftstopped in accordance with Section 718.2 and 718.3 at the partition line.

The supporting construction shall be supported to afford the required fire-resistance rating of the wall supported, except 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

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 $\frac{1}{2}$ hour fire-resistance rating by Table 1020.1 (applies to R occupancies with sprinkler systems)

Outline

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

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 1hr for sprinklered for other than I and H occupancy
 - Up to 2hr for non-sprinklered for other than I and H occupancy
- Separating fire areas – 707.3.10
 - 2hr for most occupancies for other than H and F-1
 - 3hr for S1/ 1hr 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

> Questions?

This concludes The
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