Type III Fire-Resistant Design and Detailing for Exterior Walls, Shafts and Intersections

February 27, 2025

Presented by
Jason Bahr, PE, WoodWorks

Image: 1430 Q / photo Gregory Folkins Photography

Regional Directors: **One-on-One Project Support**

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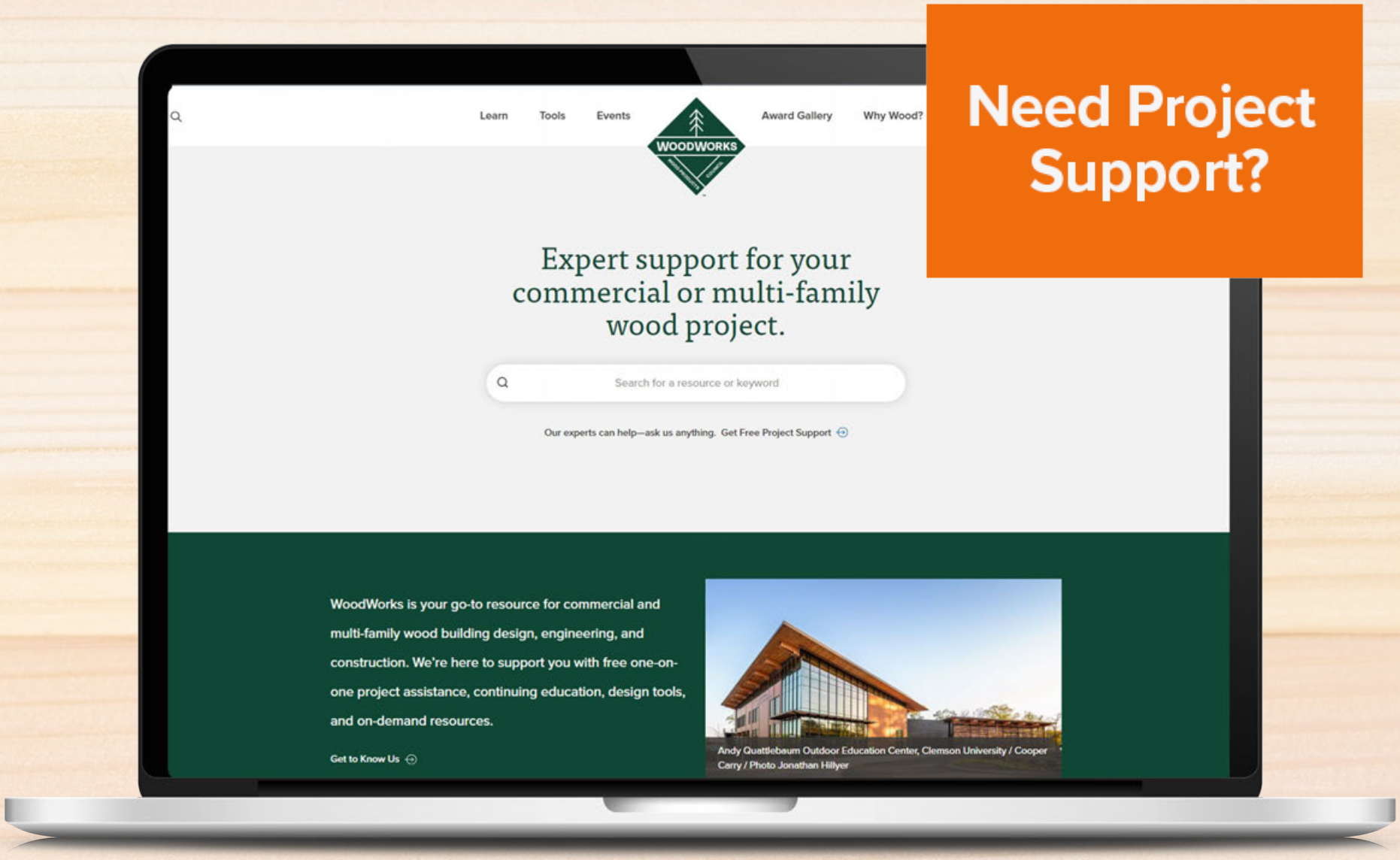

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- Light-Frame
- Mass Timber / CLT
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Building Types

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Building Systems

- Light-Frame 26
- Mass Timber / CLT 20
- Hybrid 10
- Panelized Construction 6

Building Types

- Multi-Family / Mixed-Use 35
- Office 15
- Education 8
- Institutional / Healthcare 8
- Commercial Low-Rise 7
- Civic / Recreational 5
- Industrial 5

Project Roles

- Architect 26
- Structural Engineer 23

podium

Using Podiums in Tall Wood Buildings

Common in light-frame wood construction, podiums are a viable, code-compliant option for tall mass timber buildings under the 2021 IBC.

Expert Tips

5-over-2 Podium Design: Part 1 – Path to Code Acceptance

First published in Structure, Part 1 of this two-part article covers design considerations and traditional approaches to 5-over-2 projects.

Solution Papers

5-over-2 Podium Design: Part 2 – Diaphragm and Shear Wall Flexibility

First published in Structure, Part 2 of this article covers flexibility issues associated with 5-over-2 structures and how they can affect the design process.

Solution Papers

Thomas Logan – Wood-Frame Podium Project Creates Affordable Housing

Developed to help fill a critical need for affordable housing in Boise's downtown core, Thomas Logan is a brick-clad building that fits perfectly within the urban neighborhood.

Case Studies

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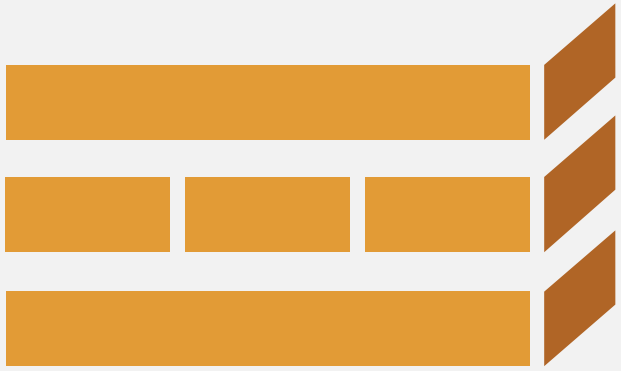

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March 25 – 27,2025

Portland, OR | Oregon Convention Center

Attendee Notes

1. Networking/happy hour immediately following presentation.

2. The PDF of today's presentation can be found on WoodWorks.org under the *Events* tab—then *Presentation Archives*.

3. Certificates will be sent via email, within a week.

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

AIA Approved Continuing Education

Course Description

A trend toward larger mid-rise wood-frame buildings has more designers seeking information on fire resistant detailing. This presentation will focus on common detailing issues and areas of misunderstanding related to exterior walls and their intersection with rated floor assemblies. Mid-rise wood-frame opportunities and code-specified building sizes will also be reviewed, followed by discussion of detailing code requirements, code compliance, and rationale for approval with an emphasis on constructability and practicality.

Learning Objectives

1. Review Type III construction with regard to cost, building size, and fire resistance per the International Building Code.
2. Review code requirements for exterior and shaft walls, emphasizing common questions, including the use of asymmetric assemblies, allowance of wood structural panels, and bearing vs. non-bearing requirements.
3. Examine a variety of floor-to-exterior wall and floor-to-shaft-wall details for use in wood-frame, Type III construction, and discuss code compliance paths and approval rationale for each.
4. Recognize structural design considerations for stair and elevator shafts.

Agenda

Type III Fire-Resistant Design and Detailing for Exterior Walls, Shafts and Intersections	
2:00 – 2:05 pm	Welcome
2:05 – 3:05 pm	***Type III Fire-Resistant Design and Detailing for Exterior Walls, and Intersections***
3:05 – 3:20 pm	Break
3:20 – 4:20 pm	***Shaft Walls***
4:20 – 6:00 pm	Q&A/ Networking/Happy Hour

Outline

- Context for Type III Construction
- Fire Rating Requirements for Exterior Walls
  - Assembly Asymmetry
  - Addition of Wood Structural Panel
  - Bearing vs. Non-bearing
  - Vertical offsets
- Exterior Wall to Floor Intersection
  - Fire Resistant Continuity
  - Fire Retardant Continuity
- Parapets & Balconies

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

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

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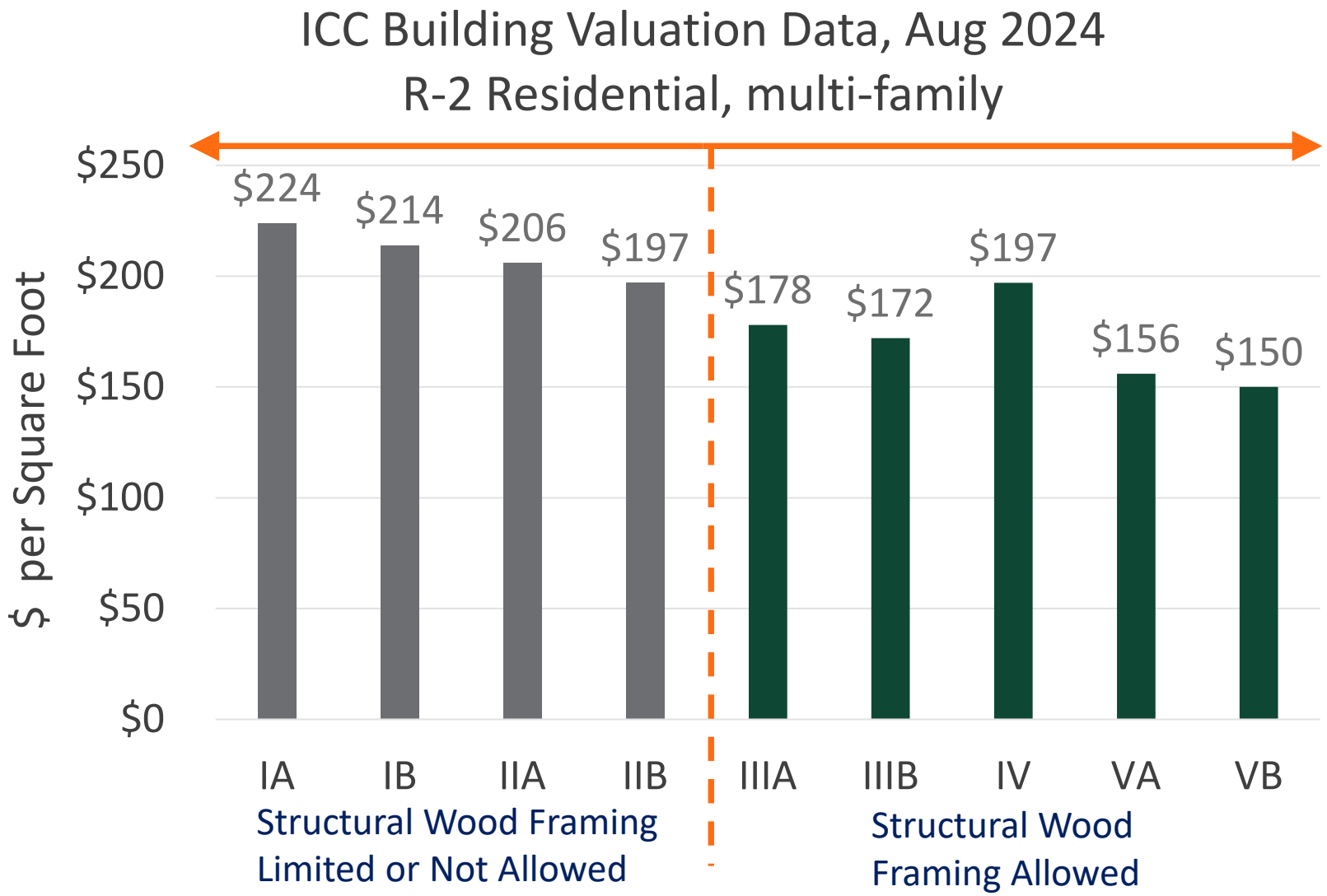
ICC Building Valuation Data (BVD)



Designers accustomed to steel and concrete often design buildings of Type IIA or IIB construction.

However,

nearly identical height and areas can be achieved with wood framing in Type IIIA or IIIB.

Type II (Non-Wood) vs. Type III (Wood Construction) Fire Resistant Requirements

Fire Rating of Structural Elements	IIA	IIB		IIIA	IIIB
IBC Table 601					
Exterior bearing walls (hrs)	1	0		2	2
Interior bearing walls (hrs)	1	0		1	0
All other elements (hrs)	1	0		1	0
IBC Table 602 (705.12 IBC 2021 & 2024) (Exterior Nonbearing Walls)					
X < 10 ft	1	1		1	1
10 ft ≤ X < 30 ft	1	0		1	0
X ≥ 30 ft	0	0		0	0

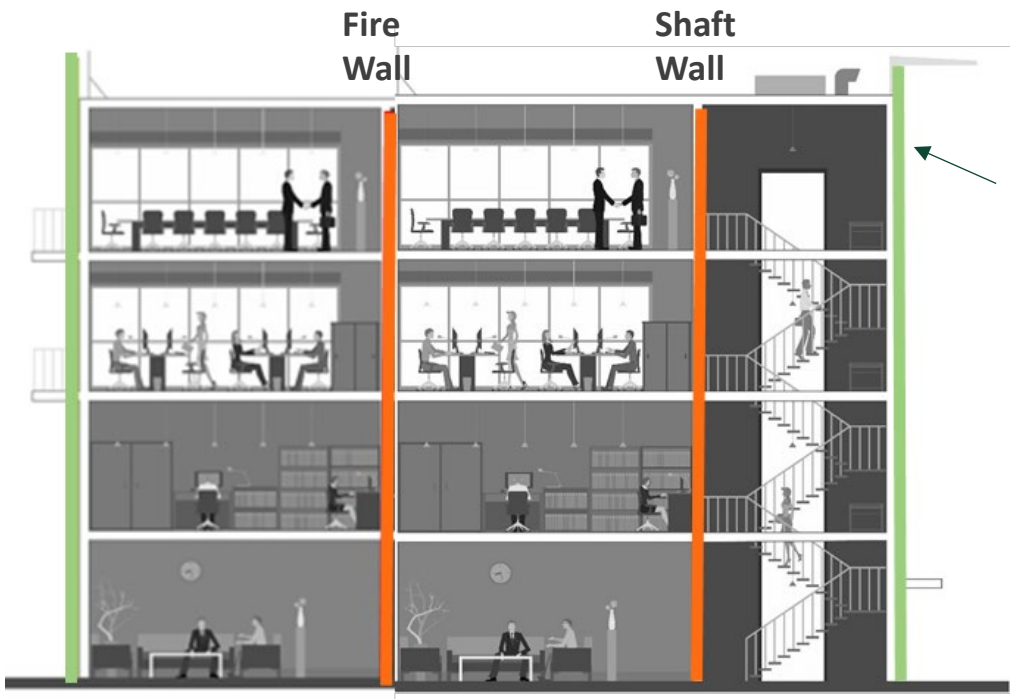
IBC Chapter 7	IIA	IIB		IIIA	IIIB
Shaft Walls (IBC 713.4)[1]	2 max	2 max		2 max	2 max
Fire Walls (706.4) – R Occupancy	2	2		3	3

[1] Shaft Walls are constructed as Fire Barriers (707.3.1). Shaft enclosures require a 2-hr rating when connecting 4 stories or more (1-hr for less than 4 stories).

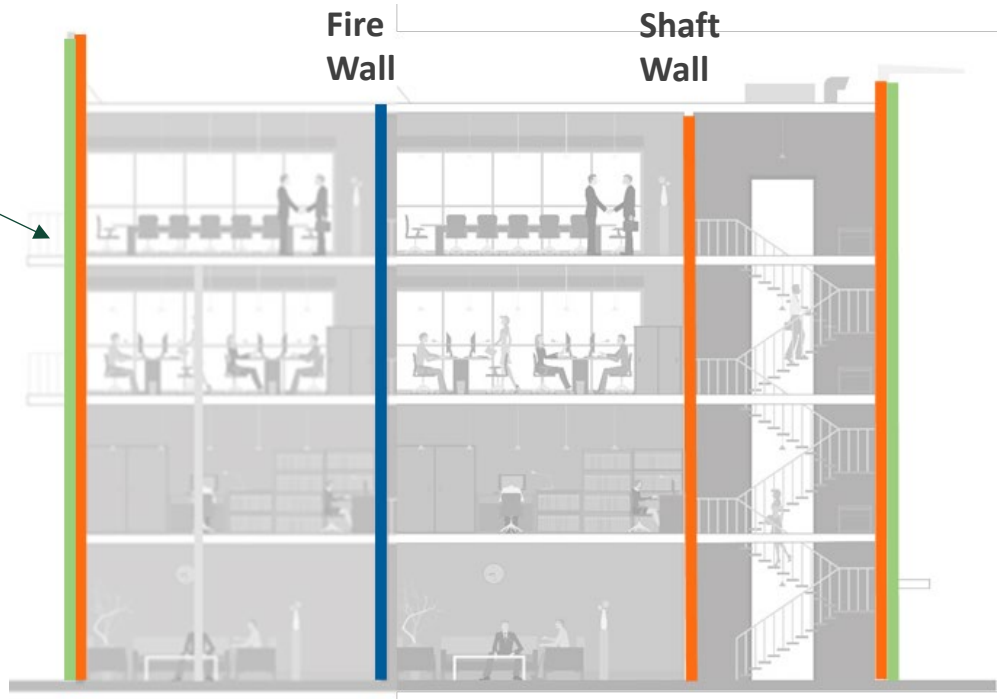
By comparison, Fire-Resistant rating requirements are very similar between Type II and Type III with few exceptions

- Exterior walls on Type III require 2 hour fire-resistance ratings for both IIIA and IIIB
- Fire Walls (R occupancy) require 3 hour fire-resistance rating

Type II vs. Type III Fire Resistant Requirements



Type II (Non-Wood) Construction



Type III Wood Construction

3hr fire-resistance rating
2hr fire-resistance rating
1hr fire-resistance rating

IBC Building Size Limits with Sprinkler

Residential (R1, R2, and R4) Occupancies

Type IIIA Construction Allowable Limit	**NS**	**S13R**	**S1**	**SM**	Max Frontage
Stories	4	4	1	5	5
Height (ft)	65	60	85	85	85
Building Area/Story (ft^2)	24k	24k	96k	72k	90k
Total Building Area* (ft^2)	72k	96k	96k	216k	270k

* Assuming max stories built per IBC 506.4
** Maximum frontage increase possible

903.2.8 Group R
An automatic sprinkler systems installed in accordance with Section 903.3 shall be provided throughout all buildings with a Group R fire area

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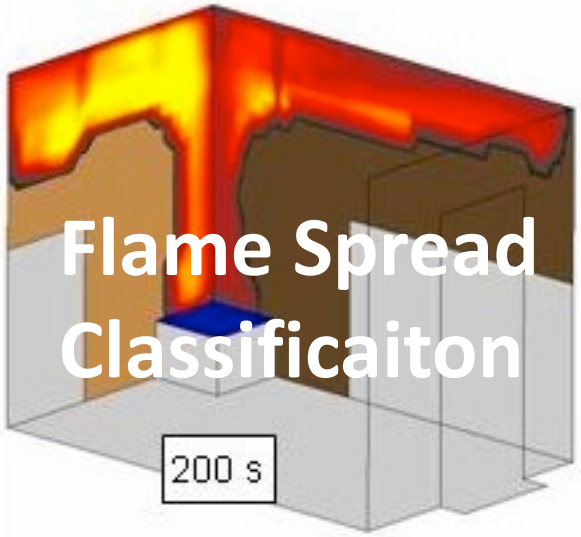
1430 Q, The HR Group Architects, Buehler Engineering, Greg Folkins Photography

Fire Performance



Fire-Resistance Ratings

IBC Tables 601 & 602* (2018 IBC)

***Table 705.5 (2021 & 2024 IBC)**

Note: FRT = Fire Retardant Treated

Key Differences in Fire Ratings for Construction Types				
	IIIA	IIIB	VA	VB
Exterior wall framing	FRT	FRT	non-FRT	Non-FRT
Exterior bearing wall fire rating	2 hr	2 hr	1 hr	0 hr
Interior bearing wall fire rating	1 hr	0 hr	1 hr	0 hr
Interior non-bearing wall fire rating	0 hr	0 hr	0 hr	0 hr
Floor assembly fire rating	1 hr	0 hr	1 hr	0 hr
Fire wall rating	3 hr	3 hr	2 hr	2 hr

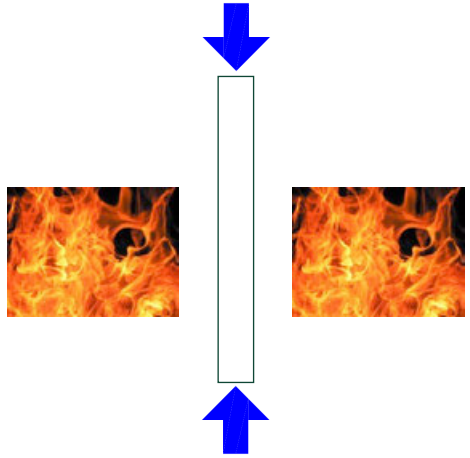
Fire Resistance-Rated Wall Assemblies

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

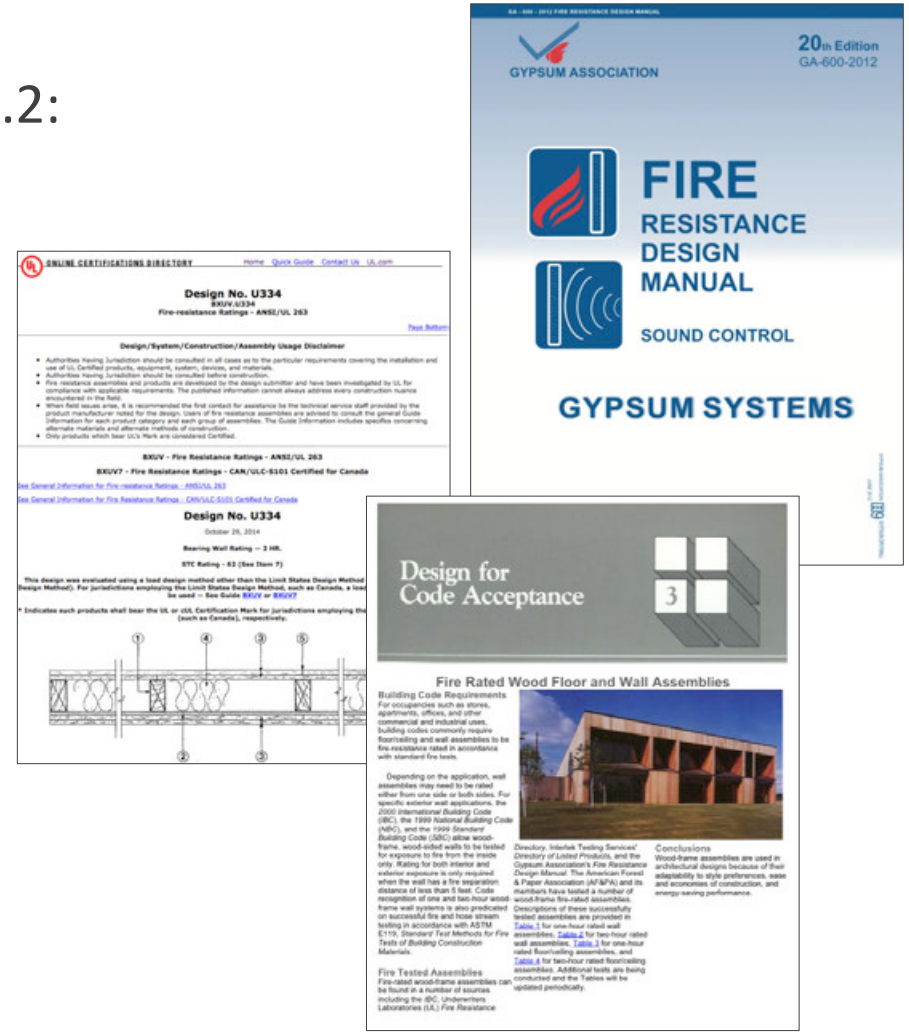
Choosing Fire Rated Assemblies

Common tested assemblies (ASTM E119) per IBC 703.2:

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

Alternate Methods per IBC 703.3

- 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



Fire Resistance-Rated Wall Assemblies

There are four basic types of fire-resistance rated wall assemblies:

- **Exterior Walls (IBC 705)**
- Fire Wall (IBC 706)
- Fire Barrier (IBC 707)
- Fire Partition (IBC 708)

Unique to Exterior Walls

Exterior walls differ from other light frame fire assemblies in three basic ways:

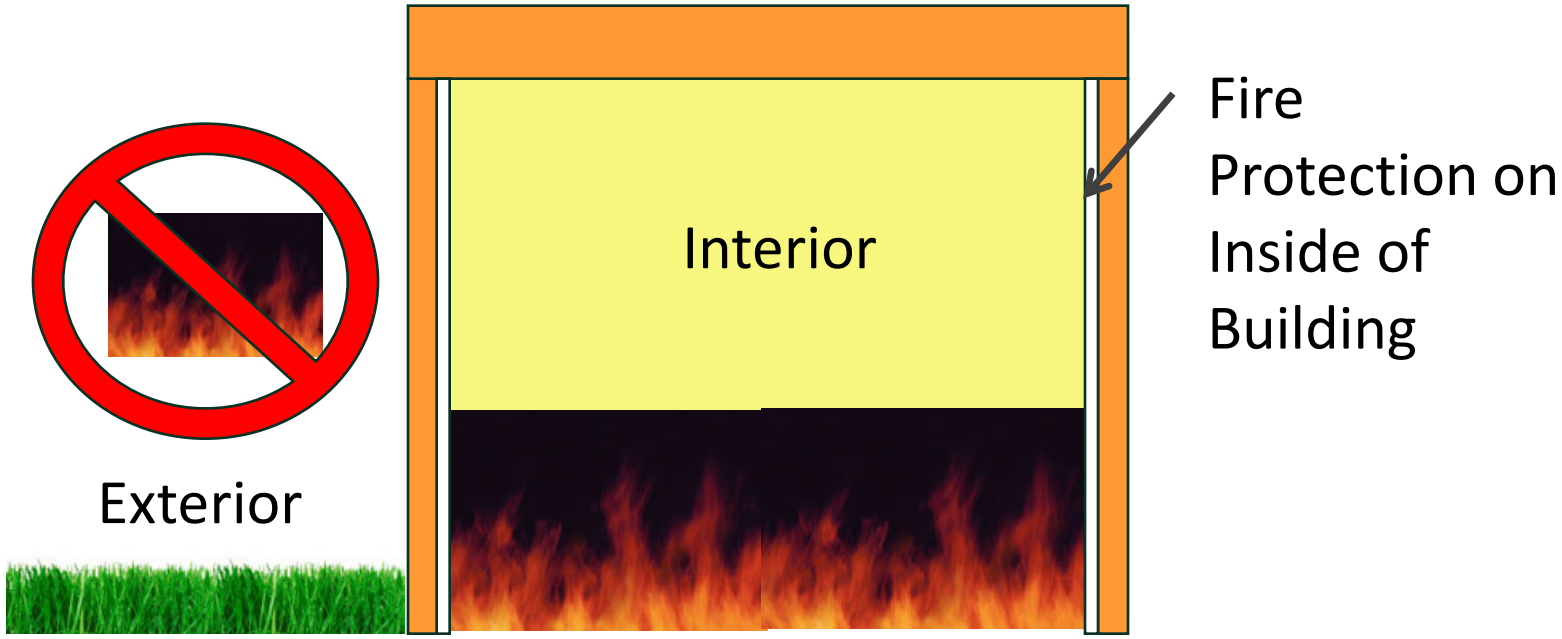
1. Minimum hourly Fire-Resistance rating requirements per 2018 IBC Tables 601 and 602*

   *Table 705.5 (2021 & 2024 IBC)

2. Structural stability requirements
3. Non-combustible exception

Exterior Walls – IBC 705

Basic assumption is that fires begin at the interior and rated wall assemblies are not required *from* the exterior unless close to another structure.



Exterior Walls – Fire Separation Distance

705.5 Fire Resistance Ratings: Exterior walls shall be fire-resistance rated in accordance with Tables 601 and 602 and this section. The required fire-resistance rating of exterior walls with a fire separation distance of greater than 10 feet shall be rated for exposure to fire from the inside. The required fire-resistance rating of exterior walls with a fire separation distance of less than or equal to 10 feet shall be rated for exposure to fire from both sides.

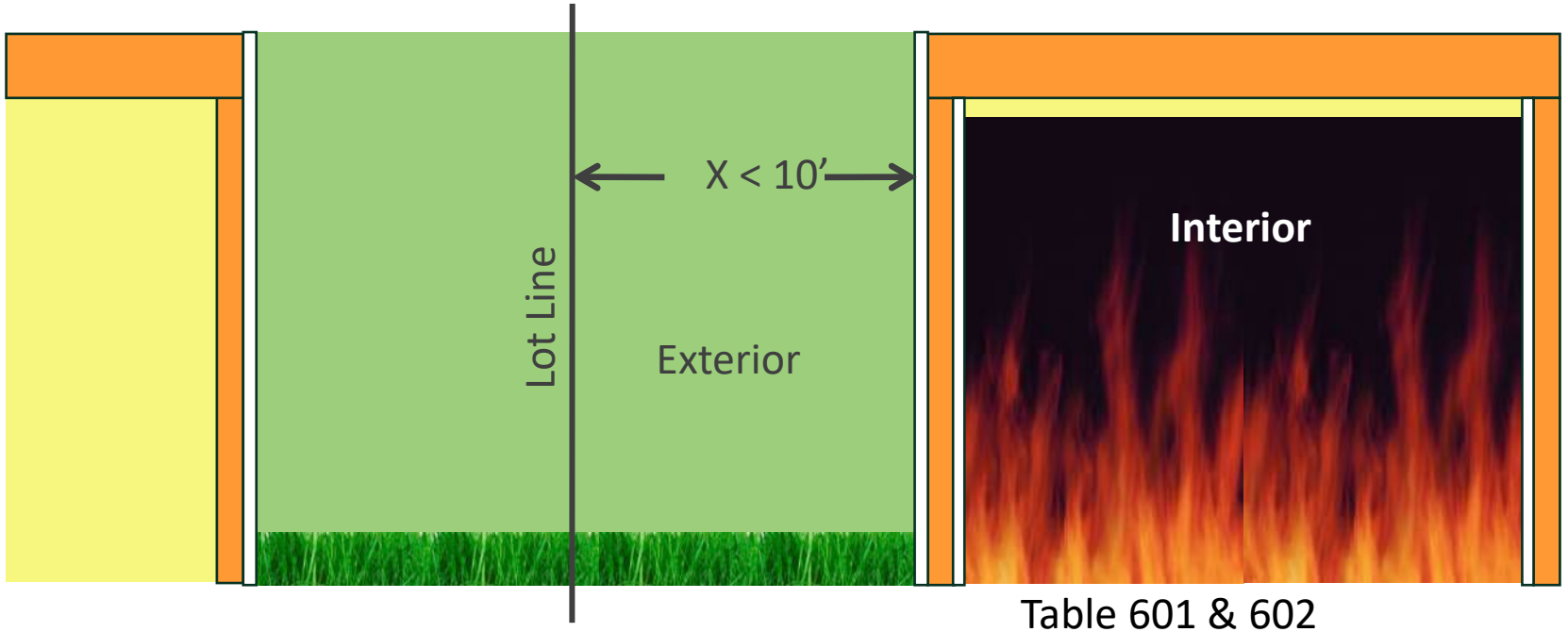


Table 601 & 602

Exterior Wall Fire Resistance

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

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b, c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1[b, c]	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	1 1/2[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	1 1/2	1	1	HT	1[b,c]	0

TABLE 705.5
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R[i], S-2, U[h]
X < 5[b]	All	3	2	1
5 ≤ X < 10	IA, IVA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB, IVA, IVB	2	1	1[c]
	IIB, VB	1	0	0
	Others	1	1	1[c]
X ≥ 30	All	0	0	0

Type III Exterior Walls: Fire Rating Requirements

Fire Rating of Structural Elements	IIIA		IIIB	
For occupancy groups A, B, E, F-2, I, R, S-2, U	Int. face of wall	Ext. face of wall	Int. face of wall	Ext. face of wall
FSD ≥ 30 ft				
Exterior bearing walls (hrs)	2	0	2	0
Exterior Nonbearing walls (hrs)	0	0	0	0
10 ft < FSD < 30 ft				
Exterior bearing walls (hrs)	2	0	2	0
Exterior Nonbearing walls (hrs)	1	0	0	0
FSD ≤ 10 ft				
Exterior bearing walls (hrs)	2	2	2	2
Exterior Nonbearing walls (hrs)	1	1	1	1

Exterior Wall Fire Ratings

- Using the provisions of Fire Separation Distance (705.5), Tables 601 and 705.5 could result in requiring a 1-hour or 2-hour rating on the inside face of exterior walls, while no rating is required on the exterior face of exterior walls.
- How do we specify such an asymmetric assembly?
- This is where prescriptive code methodology begins to break down; procedural data does not align with requirements. Most building jurisdictions understand that this is a deficiency of the system and will recognize one tested assembly for the outside and a second for the inside.

Common Assembly – Type V Construction
Exterior Walls – 1-hr Int; 0-hr Ext

IBC Table 721.1(2)

16. Exterior walls rated for fire resistance from the inside only in accordance with Section 705.5.	16-1.1[q]	2″ × 4″ wood studs at 16″ centers with double top plates, single bottom plate; interior side covered with $^5/_8$″ Type X gypsum wallboard, 4″ wide, applied horizontally unblocked, and fastened with $2^1/_4$″ Type S drywall screws, spaced 12″ on center, wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound. Exterior covered with $^3/_8$″ wood structural panels, applied vertically, horizontal joints blocked and fastened with 6d common nails (bright) — 12″ on center in the field, and 6″ on center panel edges. Cavity to be filled with $3^1/_2$″ mineral wool insulation. Rating established for exposure from interior side only.	—	—	—	$4^1/_2$
	16-1.2[q]	2″ × 6″ wood studs at 16″ centers with double top plates, single bottom plate; interior side covered with $^5/_8$″ Type X gypsum wallboard, 4″ wide, applied horizontally or vertically with vertical joints over studs and fastened with $2^1/_4$″ Type S drywall screws, spaced 12″ on center, wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound, exterior side covered with $^7/_{16}$″ wood structural panels fastened with 6d common nails (bright) spaced 12″ on center in the field and 6″ on center along the panel edges. Cavity to be filled with $5^1/_2$″ mineral wool insulation. Rating established from the gypsum-covered side only.	—	—	—	$6^9/_{16}$
	16-1.3[q]	2″ × 6″ wood studs at 16″ centers with double top plates, single bottom plates; interior side covered with $^5/_8$″ Type X gypsum wallboard, 4″ wide, applied vertically with all joints over framing or blocking and fastened with $2^1/_4$″ Type S drywall screws spaced 7″ on center. Joints to be covered with tape and joint compound. Exterior covered with $^3/_8$″ wood structural panels, applied vertically with edges over framing or blocking and fastened with 6d common nails (bright) at 12″ on center in the field and 6″ on center on panel edges. R-19 mineral fiber insulation installed in stud cavity. Rating established from the gypsum-covered side only.	—	—	—	$6^1/_2$

Common Assembly – Type V Construction
Exterior Walls – 1-hr Int; 0-hr Ext

Design No. U348

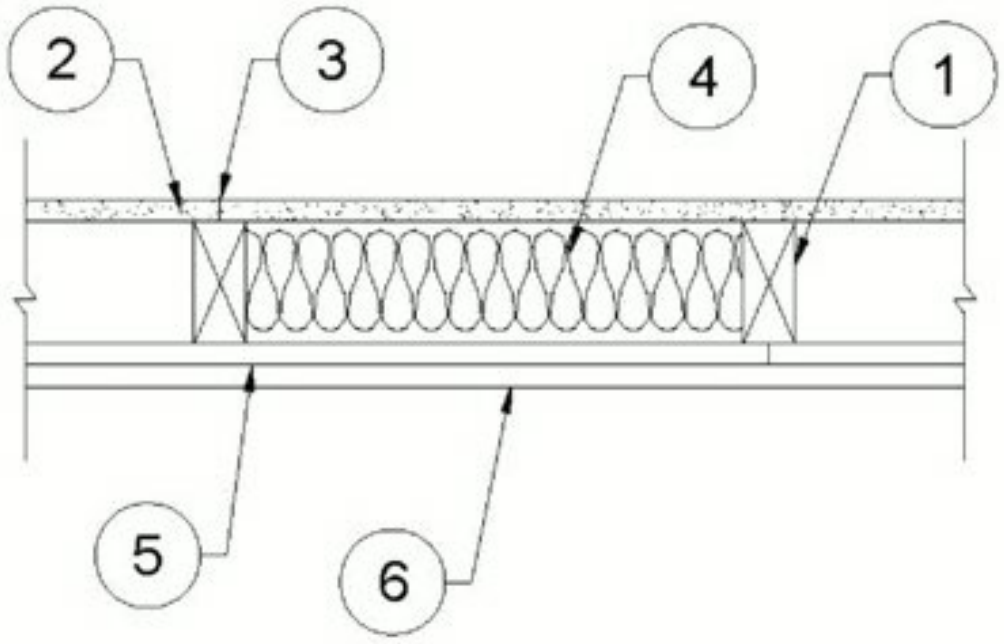
April 01, 2013

Bearing Wall Rating — 1 Hr

(EXPOSED TO FIRE ON INTERIOR FACE ONLY)

Finish Rating — 23 min

1-HOUR
(FIRE FROM INTERIOR ONLY)



1) Wood Studs
2) 5/8” Gypsum Board
3) Joints covered with tape and joint compound
4) Batts and Blankets
5) Proprietary Building Units
6) Exterior Facings

Common Assembly – Type V Construction
Exterior Walls – 1-hr Int; 0-hr Ext

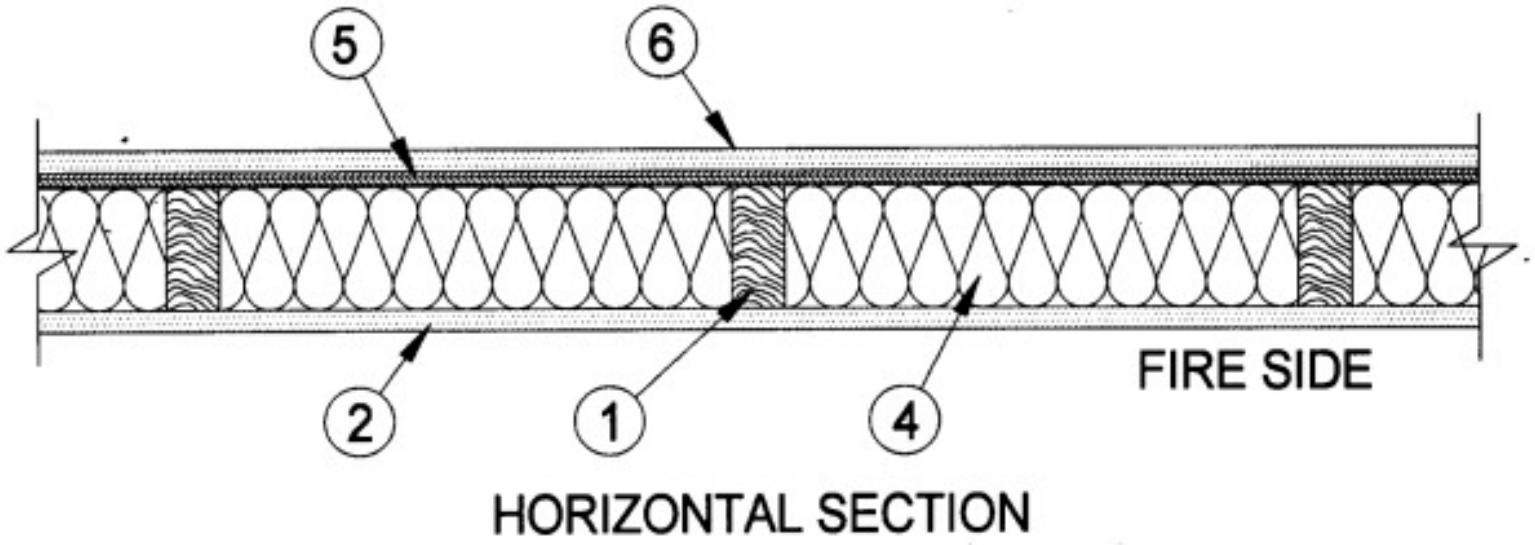
Design No. U356

September 21, 2015

(Exposed to Fire on Interior Face Only)

Bearing Wall Rating — 1 Hr

Finish Rating — 23 Min or 25 Min (See Item 2C)



HORIZONTAL SECTION

1) Wood Studs
2) 5/8” Gypsum Board
3) (not shown) Joints covered with tape and joint compound
4) Batts and Blankets
5) Wood Structural Panel
6) Exterior Facings

Exterior Walls – Asymmetry

Common issues with tested assemblies:

- Assembly asymmetry: separate assemblies for each side

S MAT GYPSUM
SHEATHING AT EXTERIOR CONDITIONS

Common Assembly – Type III Construction
Exterior Walls – 2-hr Int; 0-hr Ext

Design No. **U349**

August 4, 2023

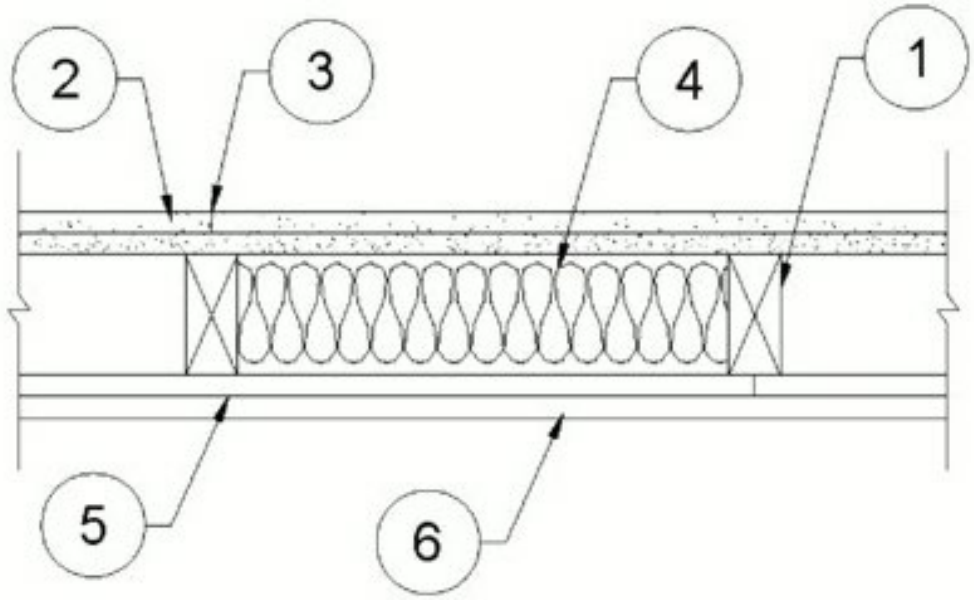
Bearing Wall Rating - 2 Hr Rating Exposed to Fire on Interior Face Only (See Item 6)

Bearing Wall Rating - 1 Hr Rating Exposed to Fire on Exterior Face (See Item 7)

Bearing Wall Rating - 2 Hr Rating Exposed to Fire on Exterior Face (See Item 5C or 8)

For Wood Studs, Finish Rating — 55 min (Exposed to Fire on Interior Face)

2-HOUR
(FIRE FROM INTERIOR ONLY)



1) Wood Studs
2) 5/8” Gypsum Board
3) Joints covered with tape and joint compound
4) Batts and Blankets
5) Proprietary Building Units
6) Exterior Facings

Common Assembly – Type III Construction
Exterior Walls – 2-hr Int; 0-hr Ext

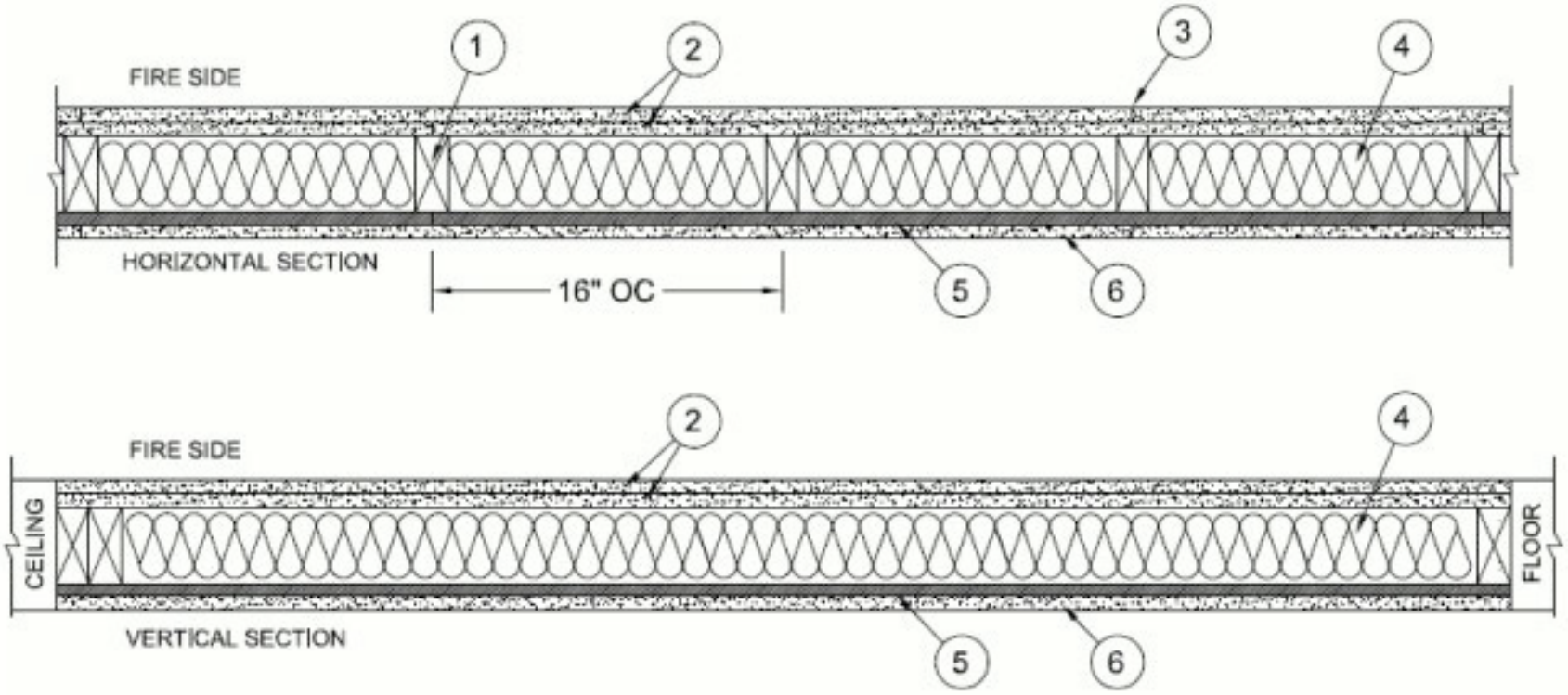
Design No. **V314**

May 25, 2022

Bearing Wall Rating - 1 Hr Rating Exposed to Fire on Exterior Face (See Item 8)

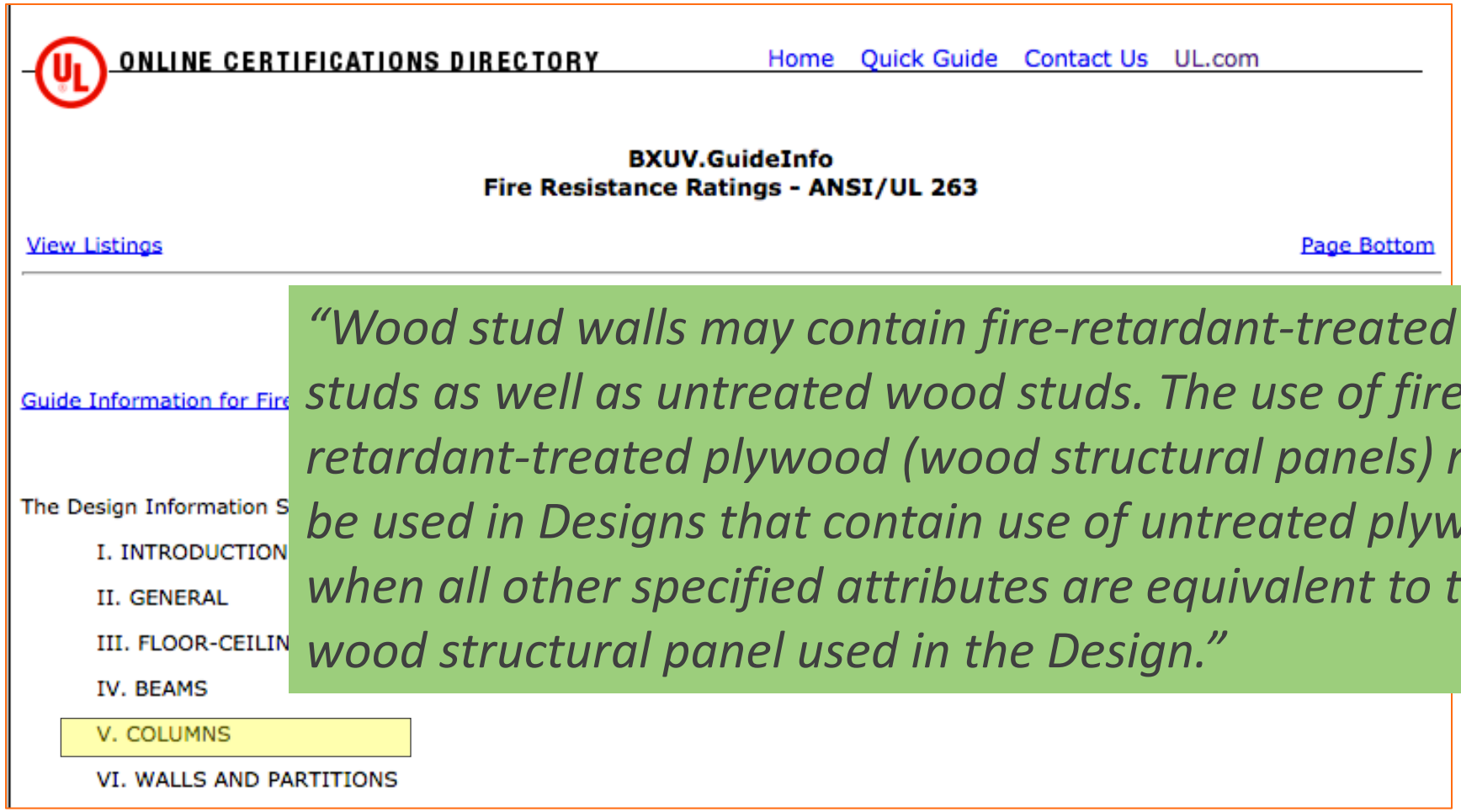
Bearing Wall Rating - 2 Hr Rating Exposed to Fire on Interior Face

Finish Rating — 42 min (Exposed to Fire on Interior Face)



1) Wood Studs
2) Two Layers -5/8” Gypsum Board
3) Joints covered with tape and joint compound
4) Batts and Blankets
5) FRT Plywood
6) Exterior Facings

Exterior Walls – Using FRT Studs



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Guide Information for Fire

The Design Information S

I. INTRODUCTION

II. GENERAL

III. FLOOR-CEILIN

IV. BEAMS

V. COLUMNS

VI. WALLS AND PARTITIONS

"Wood stud walls may contain fire-retardant-treated studs as well as untreated wood studs. The use of fire-retardant-treated plywood (wood structural panels) may be used in Designs that contain use of untreated plywood when all other specified attributes are equivalent to the wood structural panel used in the Design."

Exterior Walls – Addition of Wood Structural Panel

Can include WSP in assemblies which were tested without them:

- ESR 2586
- AWC's DCA4
- Gypsum Association Manual

ESR 2586:

4.7 Fire-resistive Construction:

Structural-use panels may be installed between the fire protection and the wood studs on either the interior or exterior side of fire-resistance-rated wood frame wall and partition assemblies described in the applicable code, provided the length of fasteners is adjusted for the added thickness of the panel.

GA Fire Resistance Design Manual

Item 23, Section 1 of the General Explanatory Notes:

"When not specified as a component of a fire- resistance rated wall or partition system, wood structural panels shall be permitted to be added to one or both sides."

Component Additive Method (CAM) for Calculating and Demonstrating Assembly Fire Resistance

Exterior Walls – Bearing vs. Nonbearing

Non loading-bearing exterior walls may have lower fire resistance rating requirements than bearing walls in certain situations. IBC Chapter 2 defines load bearing walls as:

[BS] WALL, LOAD-BEARING. Any wall meeting either of the following classifications:

1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.

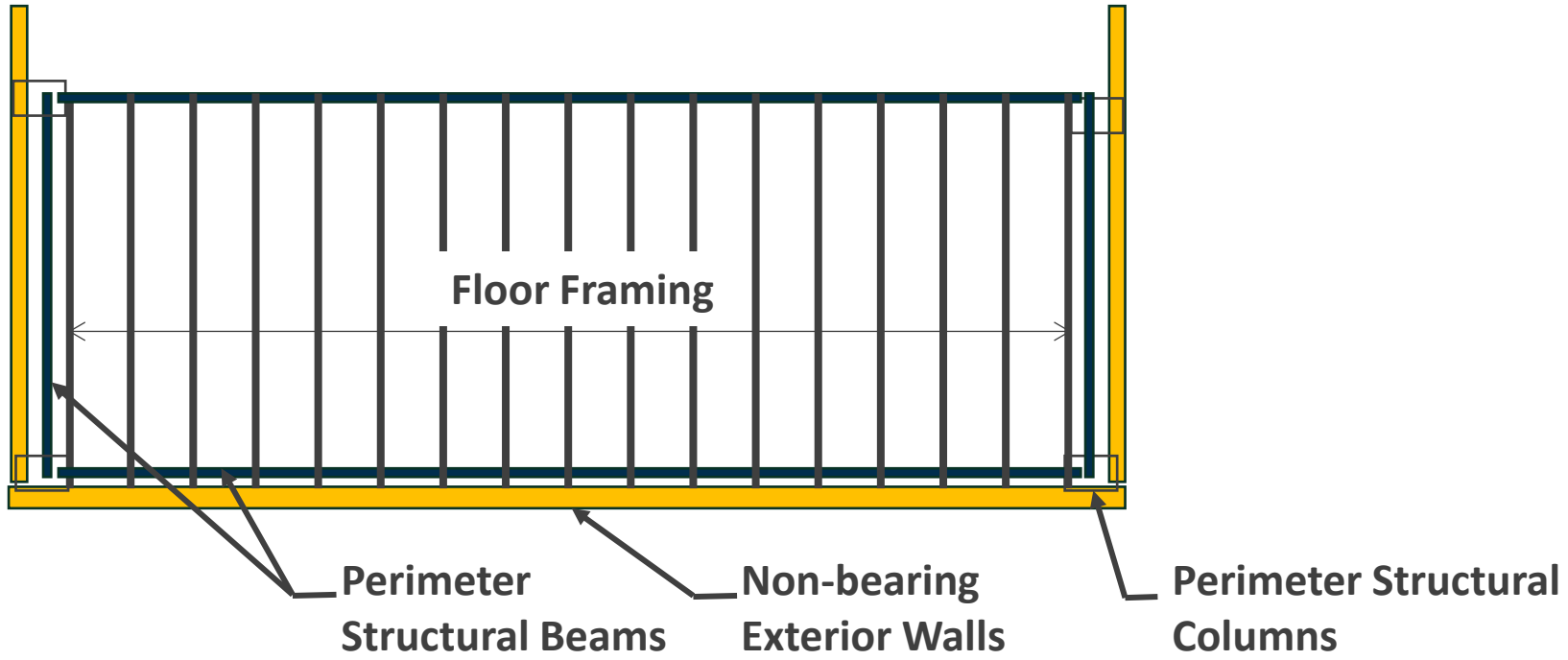
[BS] **WALL, NONLOAD-BEARING.** Any wall that is not a *load-bearing wall*.

Note that 2x6 exterior wall weighs an average of 12 lbs. pers square foot (vertically) based upon ASCE 7, table C-3.1-1A recommendations. At 8' in height, the dead load of the wall will be 96 lbs per lineal foot. Additional height or any floor/roof loading limits the ability to define an exterior wall as *nonload-bearing.*

Exterior Walls – Bearing vs. Non-Bearing

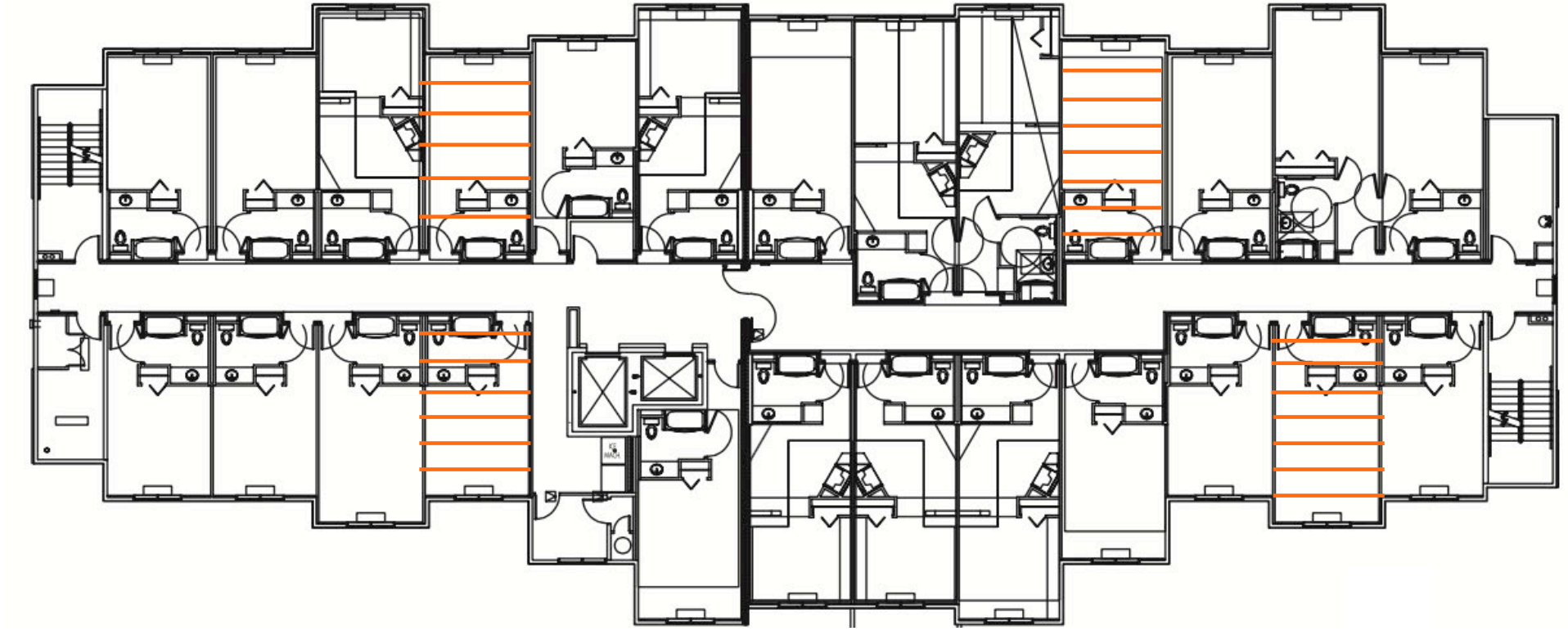
Utilization of structural beams in-board or directly over exterior walls can make walls non-bearing and reduce required fire resistance rating to 1-hr or 0-hr (IBC Table 602)

Note: Beams & Columns will most likely be considered “Primary Structural Frame” & require individual encasement per IBC 704



Exterior Walls – Bearing vs. Non-Bearing

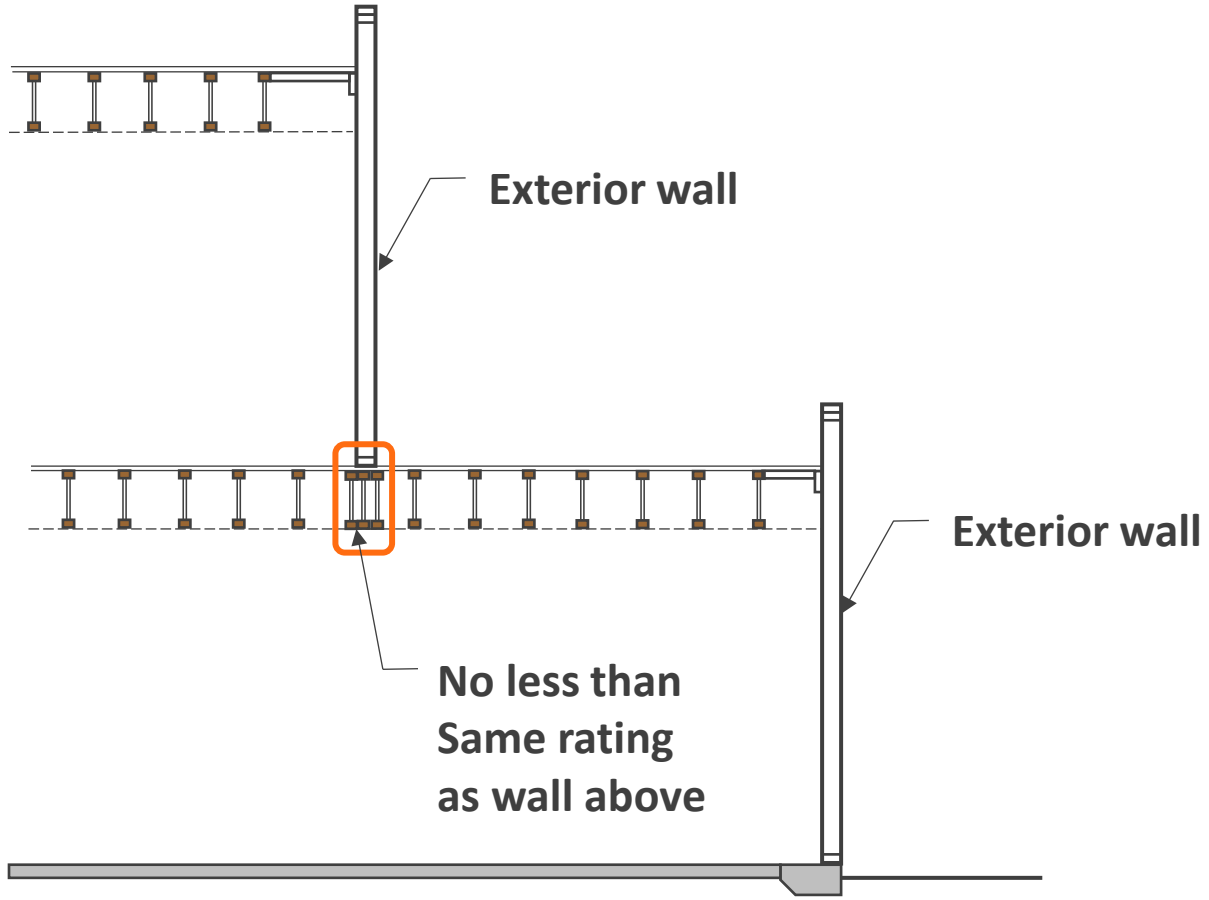
If framing parallel to long exterior walls is possible, minimizes area of load bearing exterior walls



Exterior Walls – Vertical Offsets

There is no requirement for an exterior wall to extend to the foundation in a stepped building.

Posts, beams or walls, that support a rated exterior wall must be fire-resistance rated not less than the rating of the supported wall (IBC 704.1)

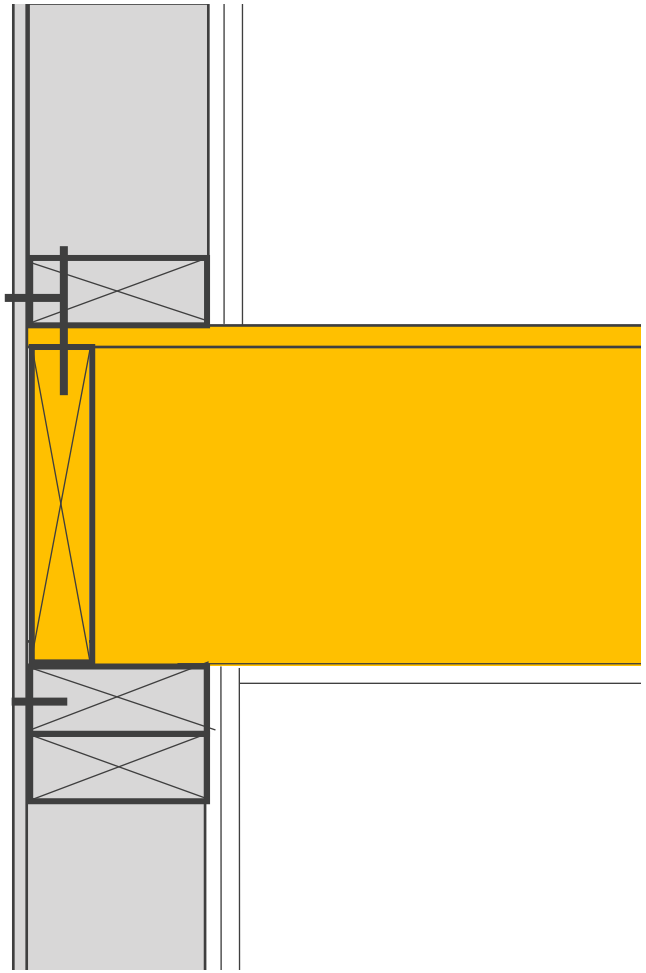


Outline

- Context for Type III Construction
- Fire Rating Requirements for Exterior Walls
  - Assembly Asymmetry
  - Addition of Wood Structural Panel
  - Bearing vs. Non-bearing
  - Vertical offsets
- **Exterior Wall to Floor Intersection**
  - Fire Resistance Continuity
  - Fire Retardant Continuity
- Parapets & Balconies

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

Platform Framing



Structural

» Direct bearing/no add'l hardware

» May require load transfer blocking for concentrated loads from above

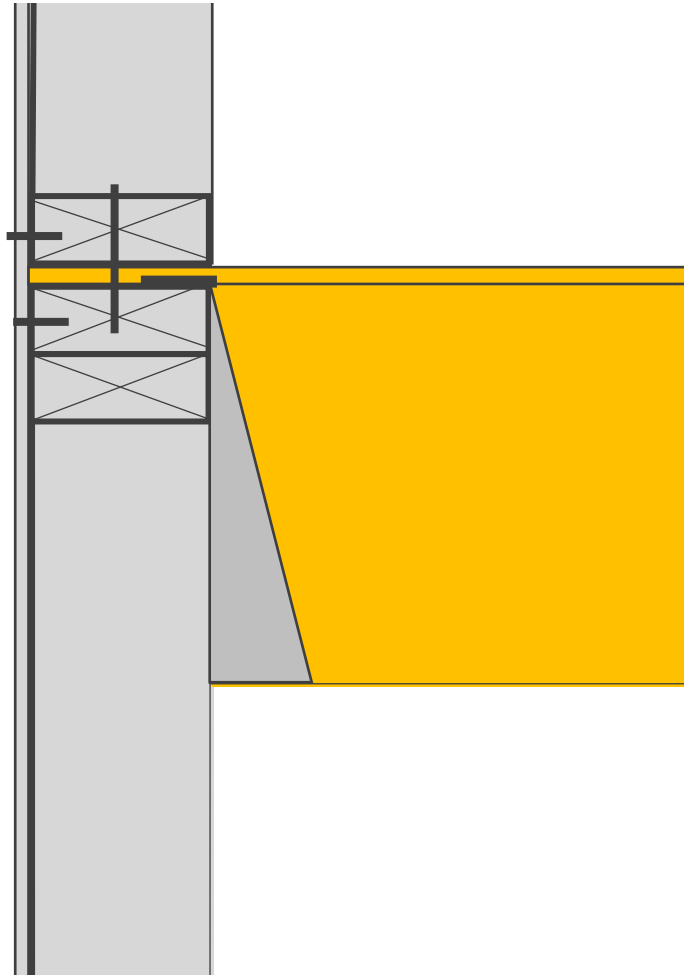
» Wall sole plate and floor sheathing crushing may need to be considered

Constructability

» Framing can be completed before drywall and insulation are installed

» Common length studs

Semi-balloon Framing



Structural

» Additional hardware/no direct bearing

» No load transfer blocking req'd

Rated Assemblies

» May accommodate continuity in exterior walls in type III construction

Constructability

» Framing can be completed before drywall and insulation are installed

» Custom length studs

» Can help minimize building shrinkage

Intersection of Assemblies – Ratings

Key Differences in Fire Ratings for Construction Types			
	IIIA	IIIB	VA
Exterior wall framing	FRT	FRT	non-FRT
Exterior bearing wall fire rating	**2 hr**	**2 hr**	1 hr
Floor assembly fire rating	1 hr	0 hr	1 hr

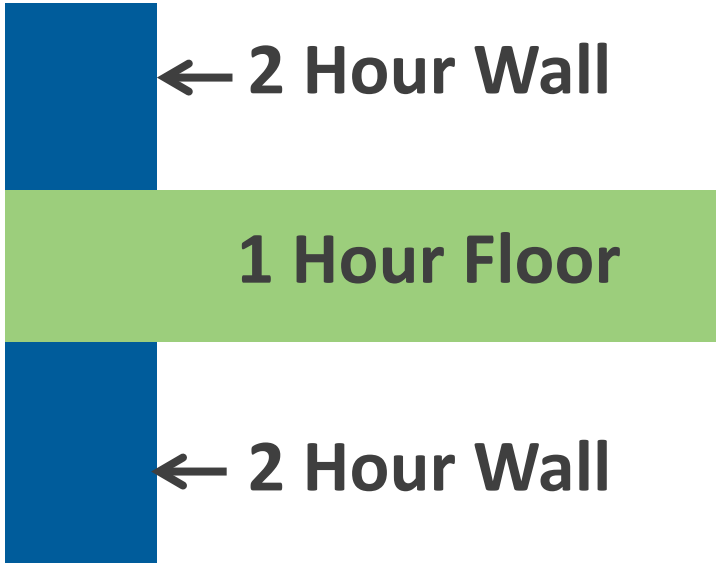
Referencing IBC Tables 601 & 602* (2018 IBC)

***Table 705.5 (2021 & 2024 IBC)**

Note: FRT = Fire Retardant Treated

Intersection of Tested Assemblies

- Many options are available for fire resistance tested floor assemblies and wall assemblies
- No tested intersection details exist
- We must understand the intent of the code, provide a rationale that meets the code's intent, and utilize available information and testing results



Intersection of Tested Assemblies

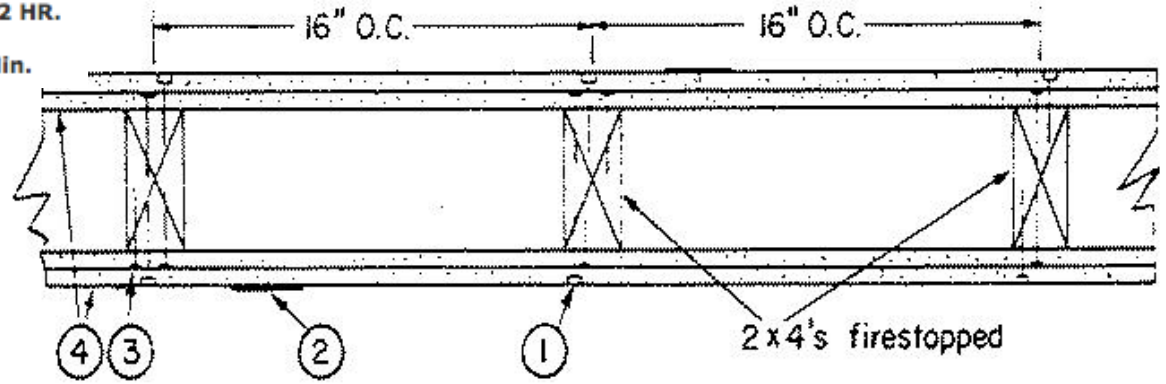
2 Hour Wall

Design No. U301

May 20, 2015

Bearing Wall Rating — 2 HR.

Finish Rating — 66 Min.

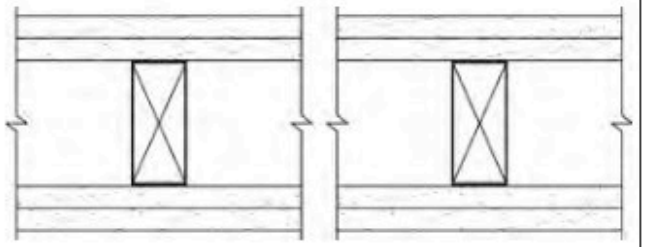


GA FILE NO. WP 4135	GENERIC	2 HOUR FIRE	40 to 44 STC SOUND

GYPSUM WALLBOARD, WOOD STUDS

Base layer 5/8" type X gypsum wallboard or gypsum veneer base applied at right angles to each side of 2 x 4 wood studs 24" o.c. with 6d coated nails, 1 7/8" long, 0.085" shank, 1/4" heads, 24" o.c. **Face** layer 5/8" type X gypsum wallboard or gypsum veneer base applied at right angles to each side with 8d coated nails, 2 3/8" long, 0.100" shank, 1/4" heads, 8" o.c.

Joints staggered 24" each layer and side. Sound tested with studs 16" o.c. and with nails for **base** layer spaced 6" o.c. **(LOAD-BEARING)**



Thickness:	6 1/8"
Approx. Weight:	12 psf
Fire Test:	FM WP 360, 9-27-74
Sound Test:	NGC 2363, 4-1-70

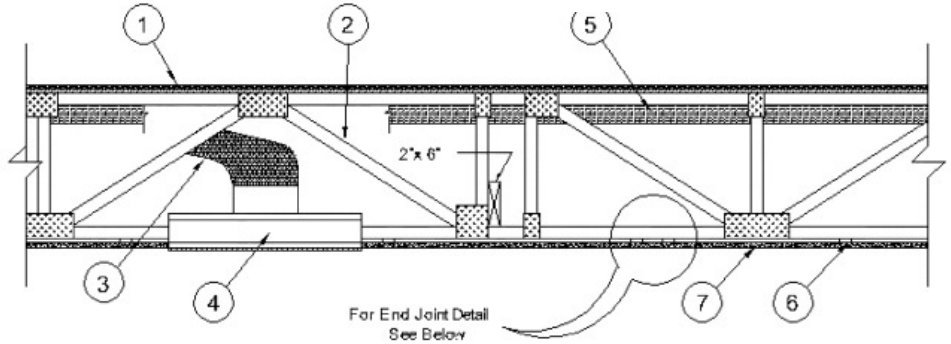
Intersection of Tested Assemblies

1 Hour Floor

Design No. L550

August 27, 2015

Unrestrained Assembly Rating — 1 Hr.



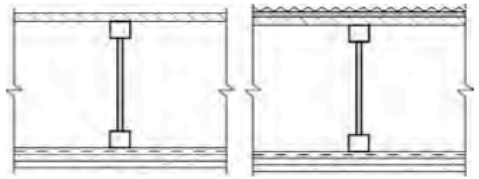
FLOOR-CEILING SYSTEMS, WOOD FRAMED

GA FILE NO. FC 5111	GENERIC	1 HOUR FIRE	50 to 54 STC SOUND

WOOD I-JOISTS, GYPSUM WALLBOARD, RESILIENT CHANNELS

Base layer 1/2" type X gypsum wallboard applied at right angles to resilient channels 16" o.c. with 1 1/4" Type S drywall screws 12" o.c. Resilient channels applied at right angles to minimum 9 1/2" deep wood I-joists, with minimum 1 1/4" deep x 1 1/2" wide flanges and minimum 3/8" webs, 24" o.c. with 1 1/4" Type W drywall screws. **Face** layer 1/2" type X gypsum wallboard applied at right angles to channels with 1 5/8" Type S drywall screws 12" o.c. Face layer end joints located midway between channels and attached to base layer with 1 1/2" Type G screws 12" o.c. Edge joints offset 24" from base layer edge joints. Wood I-joists supporting 5/8" oriented strand board applied at right angles to I-joists with 8d common nails 12" o.c.

STC and IIC tested with 40 oz carpet over 1/4" foam pad.



Approx. Ceiling Weight:	5 psf
Fire Test:	NRCC A-4440.1 (Revised), 6-24-97
Sound Test:	NRCC B-3150.2, 6-30-00
IIC & Test:	(68 C & P) NRCC B-3150.2, 6-30-00

Type III Exterior Walls – Fire Retardant Treated Wood (FRTW)

Type III and IV-HT Construction - IBC Section 602.3 & 602.4:

Fire-retardant-treated wood framing complying with Section 2303.2 shall be permitted within exterior wall assemblies of a 2-hour rating or less

What does this FRTW requirement include?

- Wall Framing (Studs & Plates) – **Yes**
- Wall Sheathing – **Yes**
- Floor sheathing – **No, based upon 2024 (consult AHJ for prior IBC)**
- Rim Joist- **No, based upon 2024 IBC (consult AHJ for prior IBC)**
- Floor Joists- **No, based upon 2024 IBC (consult AHJ for prior IBC)**

Exterior Walls – Intersecting Floors

Some have interpreted the allowance of FRT framing in exterior walls of type III construction as not including FRT wall sheathing. The inclusion of wall sheathing is intended in the allowance of FRT framing.

Changes to the 2018 IBC clarified this and remains in 2021 and 2024 IBC

602.3 Type III.

Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. *Fire-retardant-treated wood* framing and sheathing complying with Section 2303.2 shall be permitted within *exterior wall* assemblies of a 2-hour rating or less.

602.4 Type IV.

Type IV construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated wood, heavy timber (HT) or structural composite lumber (SCL) without concealed spaces. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, structural composite lumber (SCL), and cross-laminated timber and details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.1 or 602.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rating or heavy timber complying with Section 2304.11.2.2 shall be permitted.

Relocated

602.4.1 Fire-retardant-treated wood in exterior walls.

Fire-retardant-treated wood framing and sheathing complying with Section 2303.2 shall be permitted within exterior wall assemblies not less than 6 inches (152 mm) in thickness with a 2-hour rating or less.

Exterior Walls – Structural Stability

IBC 705.6 (2018 & 2021 IBC) / IBC 705.7 (2024 IBC)

Structural Stability:

Exterior walls shall extend to the height required by 705.11. Interior structural elements that brace the exterior wall but that are not located within the plane of the exterior wall shall have the minimum fire resistance rating required in Table 601 for that structural element. Structural elements that brace the exterior wall but are located outside of the exterior wall or within the plane of the exterior wall shall have the minimum fire resistance rating required in Tables 601 or 602 (705.5 in 2021 & 2024 IBC) for the exterior wall.

Code Commentary – Fire Rating

2018 & 2021 IBC 705.6

❖ Structural stability of fire-resistance-rated construction is an important concern. Section 705.6 requires elements providing bracing support to be fi
tance rated for the same duration of time as t
rior wall. In light-frame platform construction,
require that the band joist or beam suppor
floor and the wall above to also be of fire-
construction. Although the floor constructi
may not be required to be of fire-resistan
construction in Type IIB and VB constructio
effort must be made to ensure that the floor
least at the exterior wall, are of fire-resista
construction. Although the floor framing acts
eral support for the exterior wall, this section
require that the entire floor system be of fi
tance-rated construction. To state otherwise would prohibit Type IIB and VB buildings with an FSD of less than 10 feet (3048 mm). Only the structural element within the floor system that supports the vertical load of the wall must be of fire-resistance-rated construction.

"In light-frame platform construction, this will require that the **band joist or beam supporting the floor and the wall above to also be of fire-resistant construction**… Although the floor framing acts as a lateral support for the exterior wall, **this section does not require that the entire floor system be of fire-resistance rated construction**."

This commentary is specific to the fire-resistant construction and should not be implied to indicate that the member should be FRT

IBC 2024 Changes:
Exterior Floor to Wall Intersections

Two key additions to the code language were included in the 2024 IBC to help clarify platform framed floor-to-exterior wall details, particularly Type III construction.

705.6 CONTINUITY:

The addition of code language specifically addressing continuity of the fire-resistance rating of exterior walls was added as section 705.6

705.7.1 FLOOR ASSEMBLIES IN TYPE III CONSTRUCTION:

The addition of code language specifically addressing fire-resistance ratings for portions of floor assemblies intersecting exterior walls in Type III construction and the material allowed for intersecting structure.

IBC 2024 Addition: Continuity

705.6 Continuity. The *fire-resistance rating* of *exterior walls* shall extend from the top of the foundation or floor/ceiling assembly below to one of the following:

1. The underside of the floor sheathing, roof sheathing, deck or slab above.
2. The underside of a floor/ceiling or roof/ceiling assembly having a *fire-resistance rating* equal to or greater than the *exterior wall* and the *fire separation distance* is greater than 10 feet.

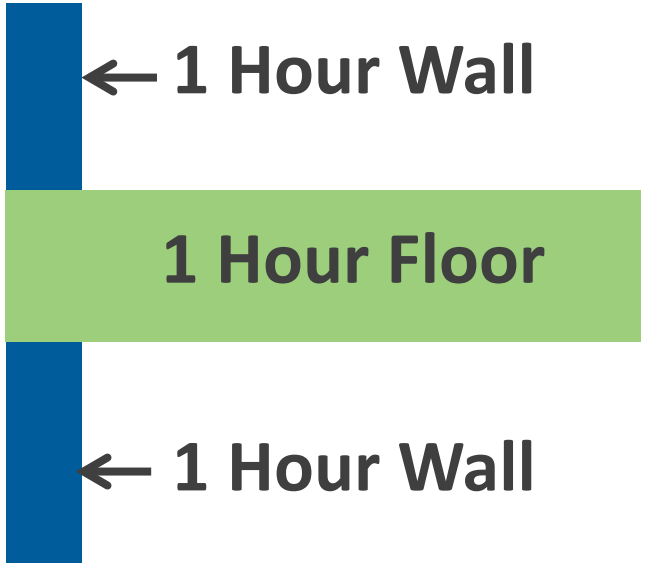
Parapets shall be provided as required by Section 705.12.

Example 1:

Type VA Construction, Group R-2

1 hour FRR exterior wall, supported by 1 hour FRR floor.

If the FRR rating of the floor is equal or greater than the FRR supported exterior wall, then the wall is only required to extend to the underside of the rated floor/ceiling assembly



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1. The underside of the floor sheathing, roof sheathing, deck or slab above.
2. The underside of a floor/ceiling or roof/ceiling assembly having a *fire-resistance rating* equal to or greater than the *exterior wall* and the *fire separation distance* is greater than 10 feet.

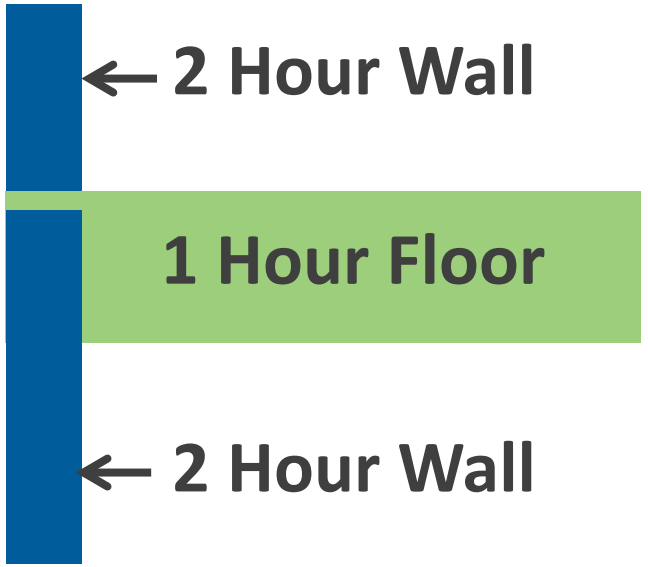
Parapets shall be provided as required by Section 705.12.

Example 2:

Type IIIA Construction, Group R-2

2 hour FRR exterior wall, supported by 1 hour FRR floor

If the FRR of the floor assembly is less than the FRR rating of the exterior wall assembly, then the fire resistance rating of the wall must continue to the underside of the floor/roof sheathing, deck or slab



IBC 2024 Additions: Continuity

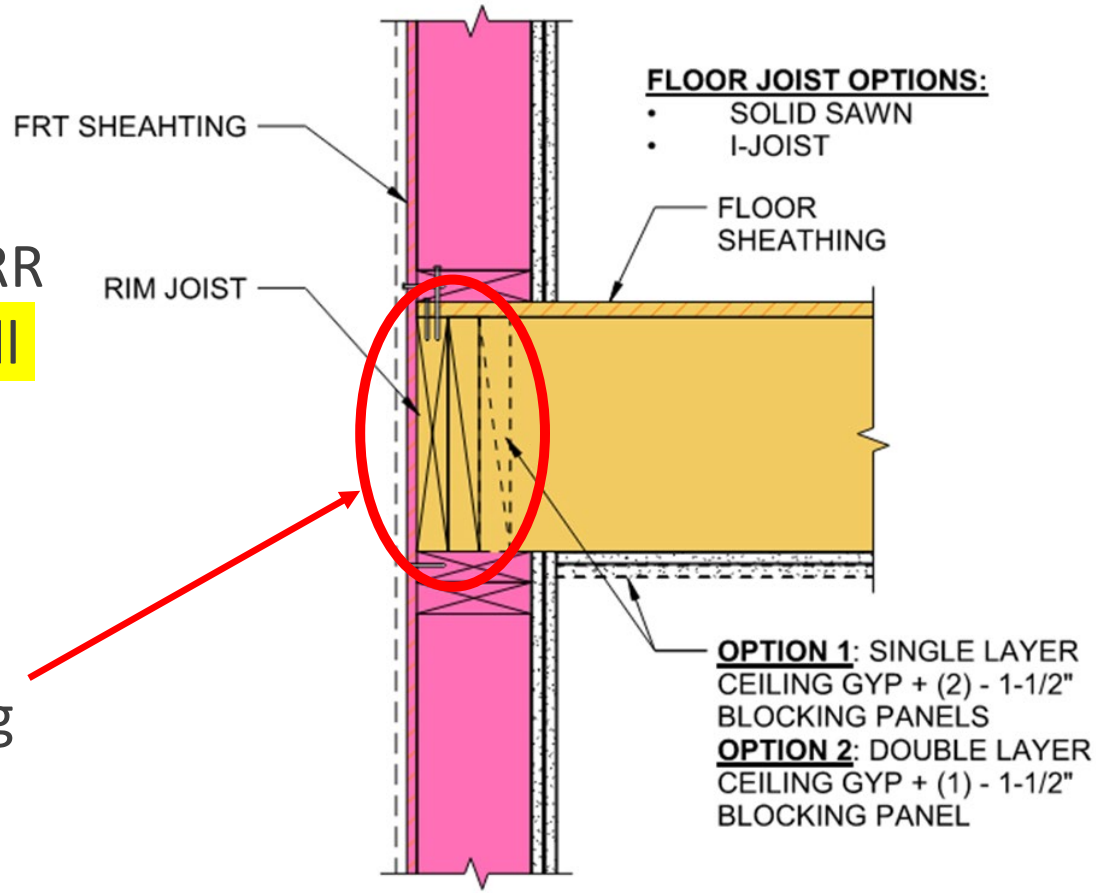
Continuity of Fire Resistance Without Membrane

Type IIIA Construction, Group R-2

2 hour FRR exterior wall, 1 hour FRR floor

Since FRR of the exterior wall is greater than FRR of the floor, the fire resistance rating of the wall must be continuous to the underside of the floor/roof sheathing.

The *membrane* (typically gypsum) need not be continuous to the underside of the floor/ceiling sheathing as long as the FRR of the wall /floor meets or exceeds the FRR of the exterior wall.



IBC 2024 Addition:
Floor Assemblies in Type III Construction

The addition of new code language specifically addressing fire-resistance ratings for portions of floor assemblies intersecting exterior walls in Type III construction.

705.7.1 Floor assemblies in Type III construction. In Type III construction where a floor assembly supports gravity loads from an *exterior wall*, the *fire-resistance rating* of the portion of the floor assembly that supports the *exterior wall* shall be not less than the *fire-resistance rating* required for the *exterior wall* in Table 601. The *fire-resistance rating* provided by the portion of the floor assembly supporting and within the plane of the *exterior wall* shall be permitted to include the contribution of the ceiling membrane when considering exposure to fire from the inside. Where a floor assembly supports gravity loads from an *exterior wall*, the *building elements* of the floor construction within the plane of the *exterior wall*, including but not limited to rim joists, rim boards and blocking, shall be in accordance with the requirements for interior *building elements* of Type III construction.

The highlighted text states that the fire resistance of the floor assembly elements supporting, and within the plane of the exterior wall, shall be permitted to include the contribution of the ceiling membrane (typically gypsum) within the calculated fire resistance.

IBC 2024 Addition:
Floor Assemblies in Type III Construction

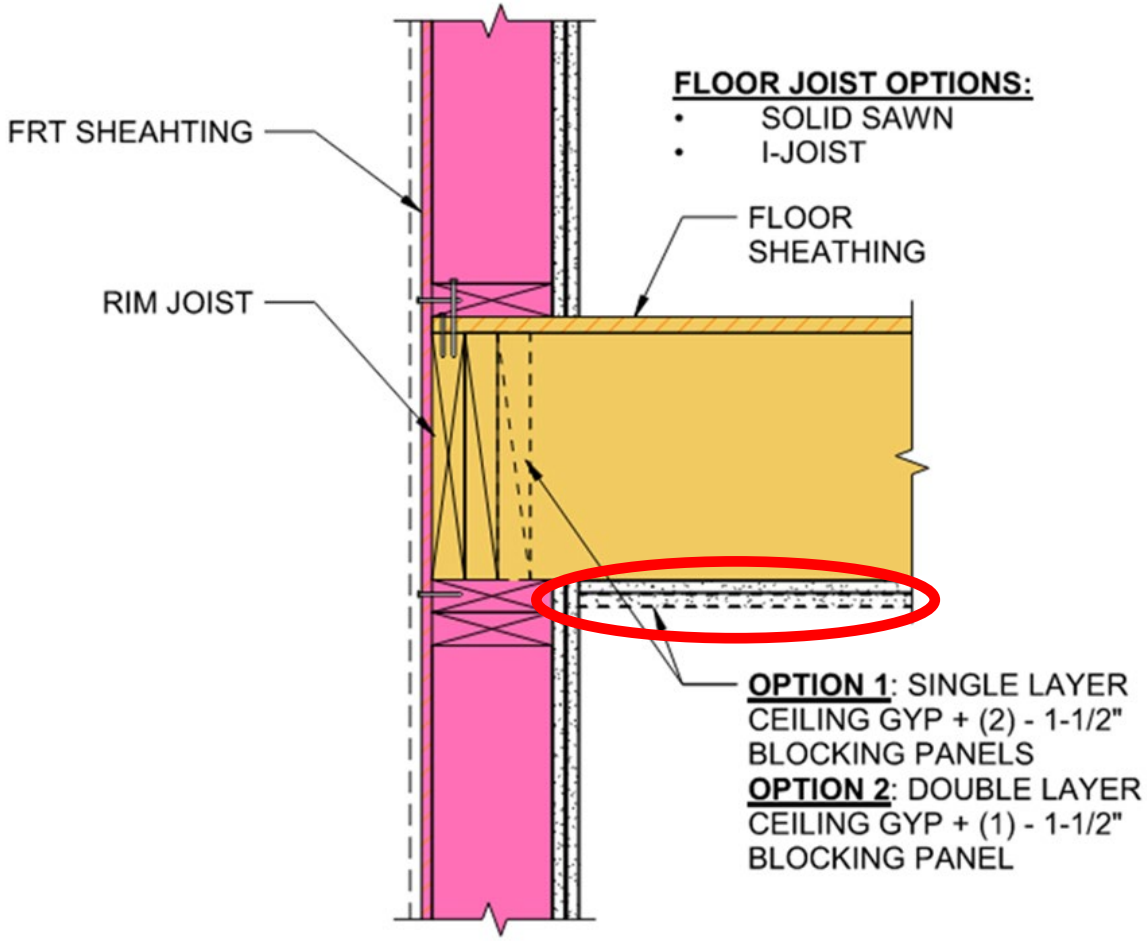


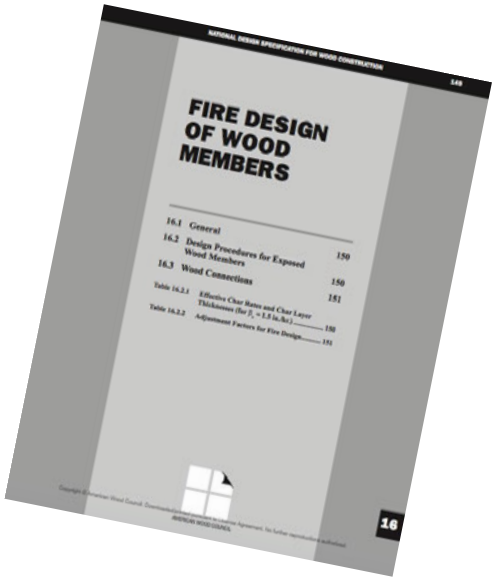
Table 722.6.2(1) [excerpt]

TIME ASSIGNED TO FINISH MATERIALS ON FIRE-EXPOSED SIDE OF WALL

3/8” Gypsum Wallboard	10 min.
1/2” Gypsum Wallboard	15 min.
5/8” Gypsum Wallboard	20 min.
2 layers of 3/8” Wallboard	25 min.
2 layers of ½” Wallboard	40 min.
1/2” Type X Gypsum Wallboard	25 min.
5/8” Type X Gypsum Wallboard	40 min.

Contribution of the Ceiling Membrane

To establish the required minimum fire resistance rating for the building elements supporting or within the plane of the exterior wall, the IBC designates the use of Chapter 16 of the National Design Standard for calculation of fire resistance for wood building elements in section 722.



SECTION 722—CALCULATED FIRE RESISTANCE

722.1 General. The provisions of this section contain procedures by which the *fire resistance* of specific materials or combinations of materials is established by calculations. These procedures apply only to the information contained in this section and shall not be otherwise used. The calculated *fire resistance* of specific materials or combinations of materials shall be established by one of the following:

1. *Concrete,* concrete *masonry* and clay *masonry* assemblies shall be permitted in accordance with ACI 216.1/TMS 0216.
2. Precast and precast, prestressed *concrete* assemblies shall be permitted in accordance with PCI 124.
3. Steel assemblies shall be permitted in accordance with Chapter 5 of ASCE 29.
4. Exposed wood members and wood decking shall be permitted in accordance with Chapter 16 of ANSI/AWC NDS.

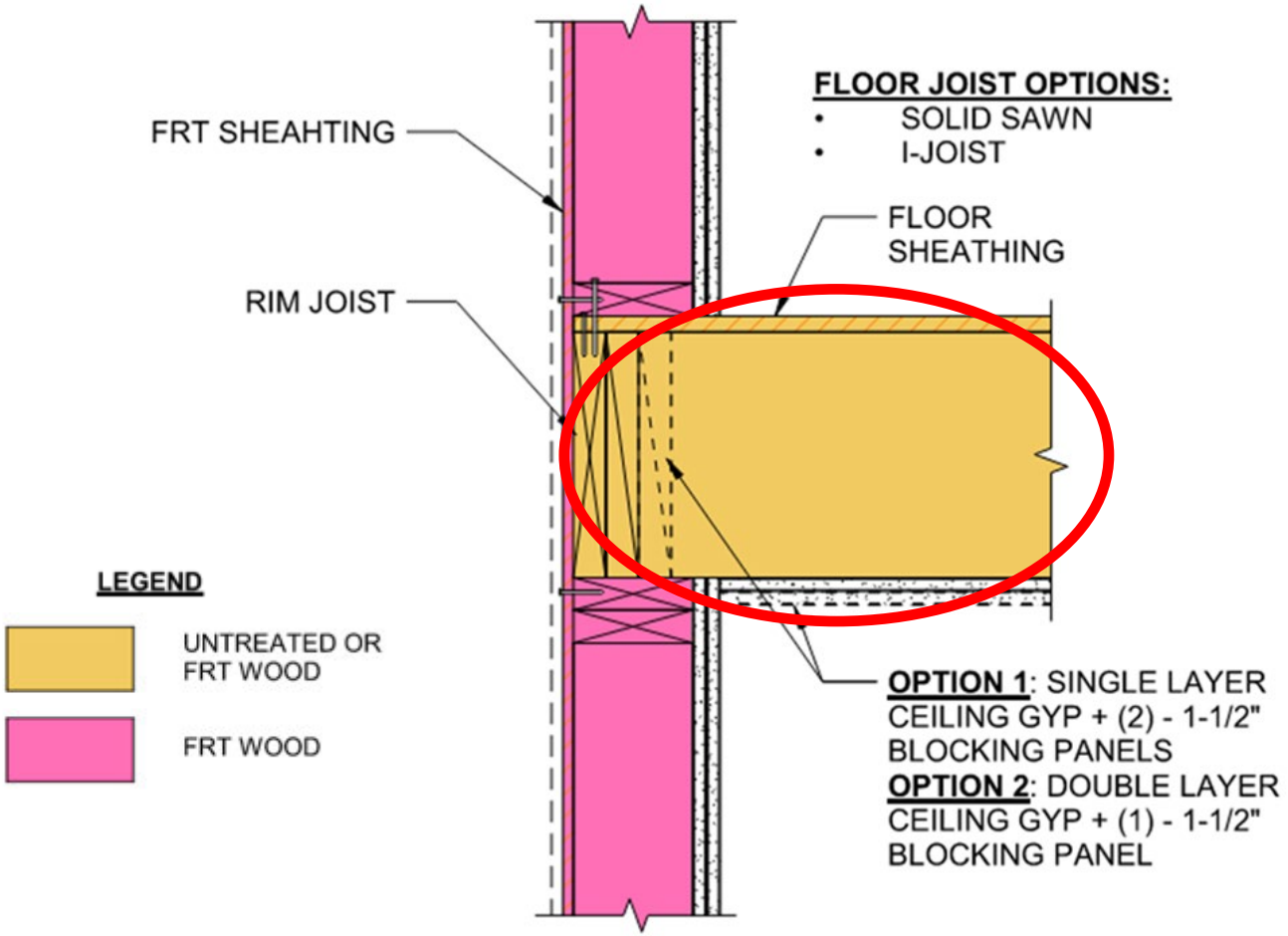
IBC 2024 Addition:
Floor Assemblies in Type III Construction

The addition of new code language specifically addressing fire-resistance ratings for portions of floor assemblies intersecting exterior walls in Type III construction.

705.7.1 Floor assemblies in Type III construction. In Type III construction where a floor assembly supports gravity loads from an *exterior wall*, the *fire-resistance rating* of the portion of the floor assembly that supports the *exterior wall* shall be not less than the *fire-resistance rating* required for the *exterior wall* in Table 601. The *fire-resistance rating* provided by the portion of the floor assembly supporting and within the plane of the *exterior wall* shall be permitted to include the contribution of the ceiling membrane when considering exposure to fire from the inside. Where a floor assembly supports gravity loads from an *exterior wall*, the *building elements* of the floor construction within the plane of the *exterior wall*, including but not limited to rim joists, rim boards and blocking, shall be in accordance with the requirements for interior *building elements* of Type III construction.

The highlighted text states that the building elements of the floor construction within the plane of the exterior wall shall be in accordance with the requirements for interior elements of type III construction. Rim joists, rim boards, and blocking (including, but not limited to) need not be constructed of fire-retardant-treated material.

IBC 2024 Addition:
Where is FRT required?



The 2024 language of 705.7.1 clarifies that the building elements of the floor construction, supporting and within the plane of the exterior wall, shall be in accordance with the requirements for interior building elements. Accordingly, those building elements do not typically require the use of Fire-Retardant Treated materials in Type III Construction.

Structural Wood Panels on the exterior are required to be Fire-Retardant Treated as they are not considered part of the floor assembly.

Exterior Walls – Intersecting Floors – AWC DCA3

AWC's DCA3 provides floor to wall intersection detailing options

Addresses both continuity provisions and requirements for FRT elements in exterior wall plane


Design for
Code Acceptance
3

Fire-Resistance-Rated Wood-Frame Wall and Floor/Ceiling 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. This document is intended to aid in the design of various wood-frame walls and wood-frame floor/ceiling assemblies, where such assemblies are required by code to be fire-resistance-rated.

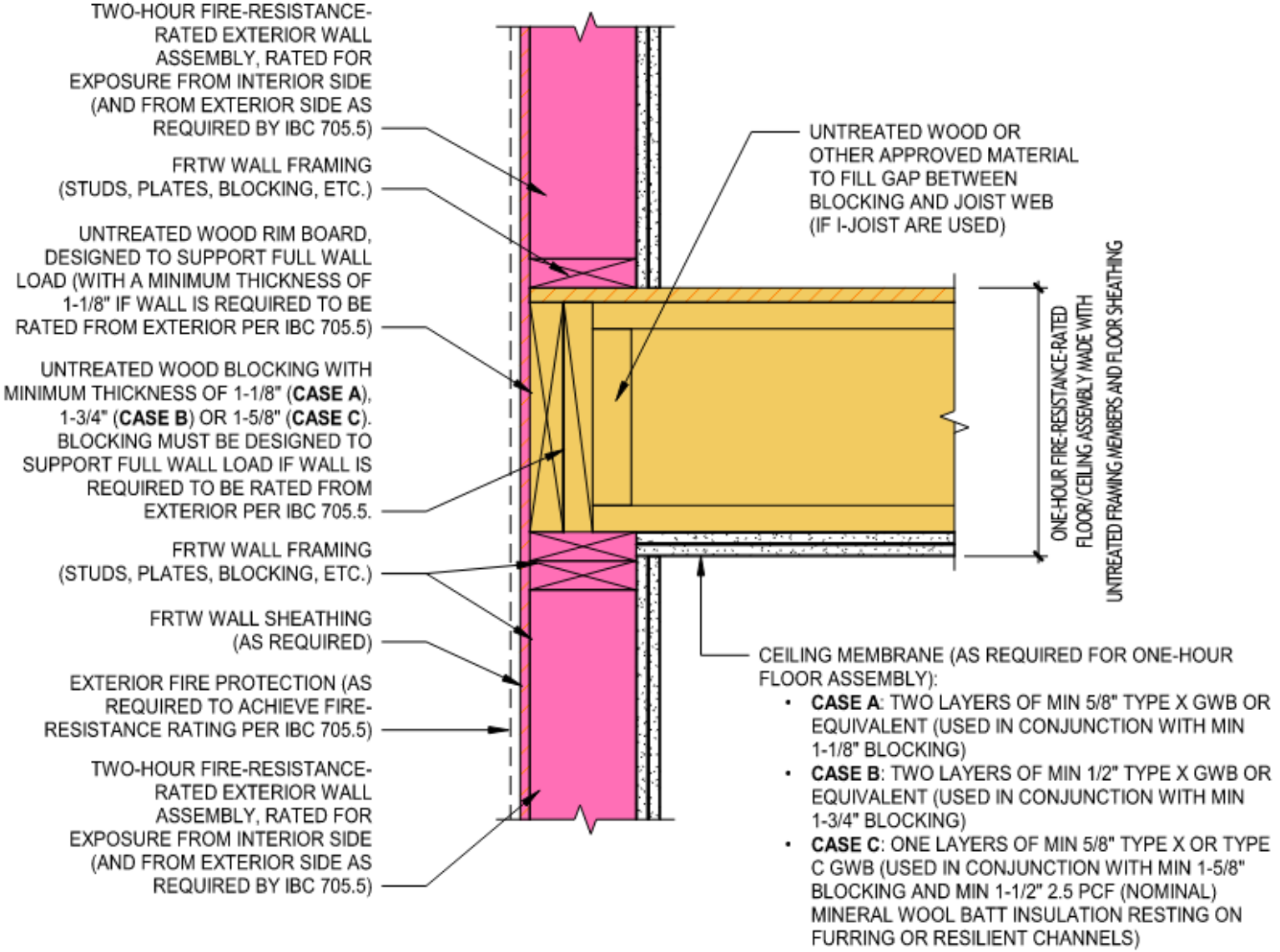
Depending on the application, wall assemblies may need to be fire-resistance-rated for exposure from either one side or both sides. Exterior walls are required to be rated for both interior and exterior fire exposure where the wall has a fire separation distance of 10 feet or less. For exterior walls with a fire separation distance of greater than 10 feet, the required fire-resistance-rating applies only to exposure from the interior. The designer should note that some state and local building code amendments may require fire resistance rating for exposure from both sides of exterior walls, regardless of fire separation distance; however, the solutions and example details provided in this doc-

Fire Tested Assemblies

Fire-resistance-rated wood-frame assemblies can be found in a number of sources including the *International Building Code (IBC)*, Underwriters Laboratories (UL) *Fire Resistance Directory*, Intertek Testing Services' *Directory of Listed Products*, and the Gypsum Association's *Fire Resistance Design Manual* (GA 600). The American Wood Council (AWC) and its members have tested a number of wood-frame fire-resistance-rated assemblies (see photos). Descriptions of successfully tested lumber wall assemblies are provided in Table 1 for one-hour fire-resistance-rated wall assemblies and Table 2 for two-hour fire-resistance-rated wall assemblies. Lumber shall be identified by the grade mark of a lumber grading or inspection agency that has been approved by an accreditation body that complies with the *American Softwood Lumber Standard* (*PS 20*). The fire-resistance-rated assemblies described in this document, as well as those listed in other sources are not species- or grade-specific unless specifically noted as such.

Descriptions of successfully tested I-joist floor as-

Exterior Walls – Intersecting Floors




Design for Code Acceptance

3

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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-resistance-rated wood-frame assemblies can be found in a number of sources including the *International Building Code (IBC)*, Underwriters Laboratories (UL) *Fire Resistance Directory*; Intertek Testing Services' *Directory of Listed Products*, and the Gypsum Association's *Fire Resistance Design Manual* (GA 600). The American Wood Council (AWC) and its members have tested a number of wood-frame fire-resistance-rated assemblies (see photos). Descriptions of successfully tested lumber wall assemblies are provided in Table 1 for one-hour fire-resistance-rated wall assemblies and Table 2 for two-hour fire-resistance-rated wall assemblies.

Lumber shall be identified by the grade mark of a lumber grading or inspection agency that has been approved by an accreditation body that complies with the *American Softwood Lumber Standard (PS 20)*. The fire-resistance-rated assemblies described in this document, as well as those listed in other sources are not species- or grade-specific unless specifically noted as such.

Descriptions of successfully tested I-joist floor assemblies are provided in Table 3 for one-hour fire-resistance-rated floor/ceiling assemblies and Table 4 for two-hour fire-resistance-rated floor/ceiling assemblies. I-joists are required to comply with ASTM D5055, *Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists*. Where resilient channels are specified, single-leg (RC-1) resilient channels shall be used. Alternatively, two-leg

American Wood Council

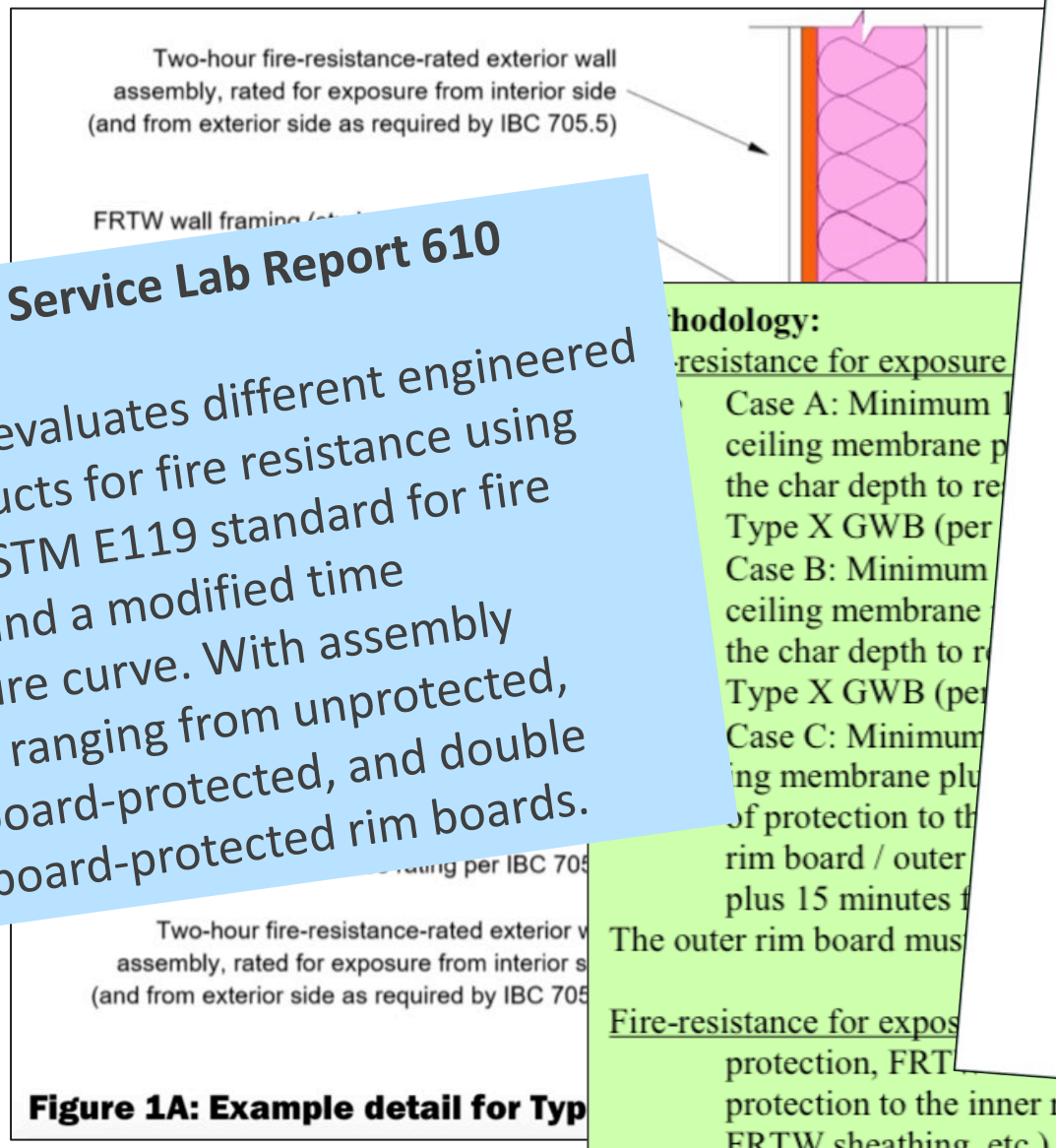
February 2021

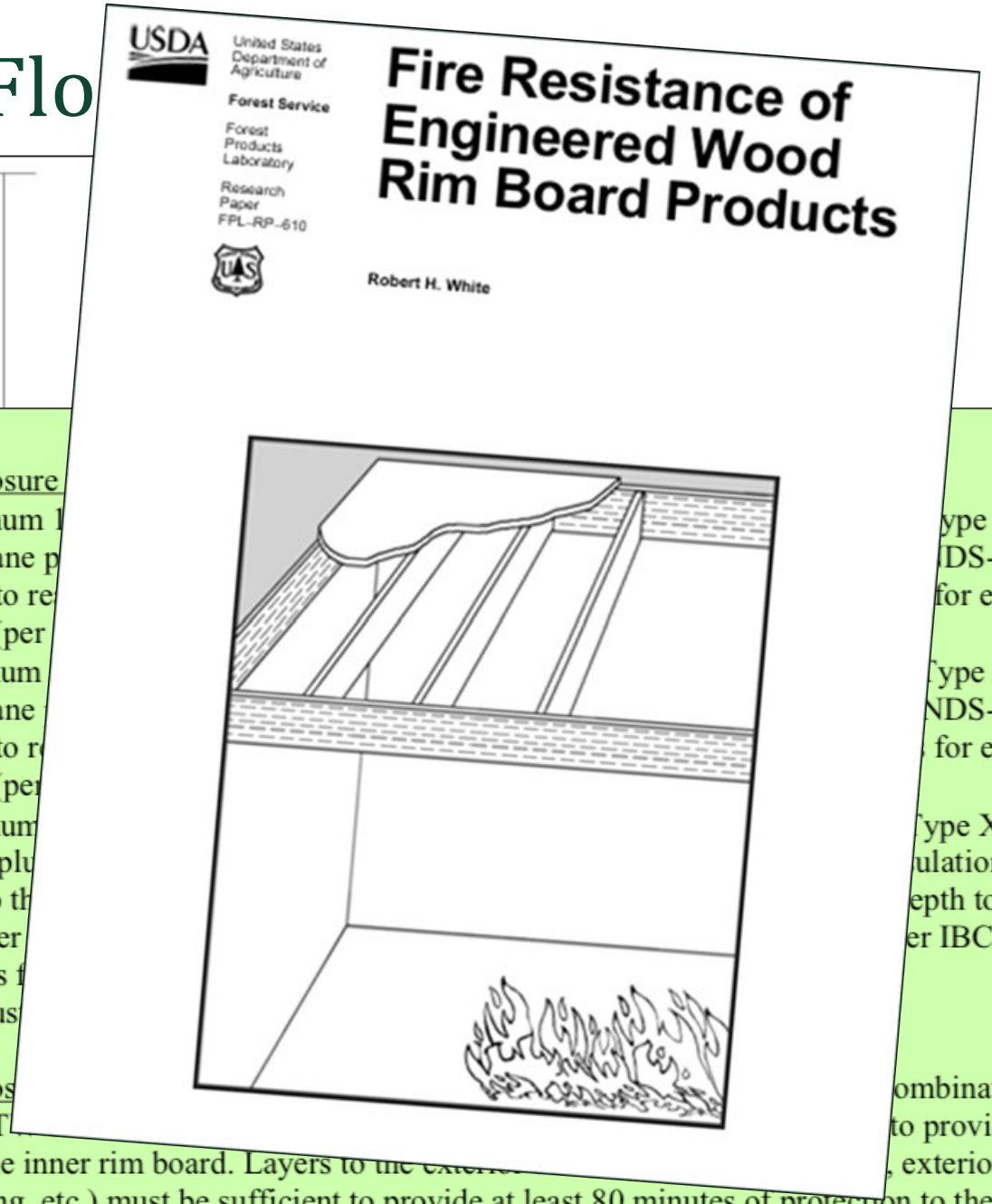
DCA3 Figure 1a: Example Detail for Type IIIA Exterior Wall-Floor Intersection with Rim Board and Blocking

Exterior Walls – Intersecting Flo

USDA Forest Service Lab Report 610

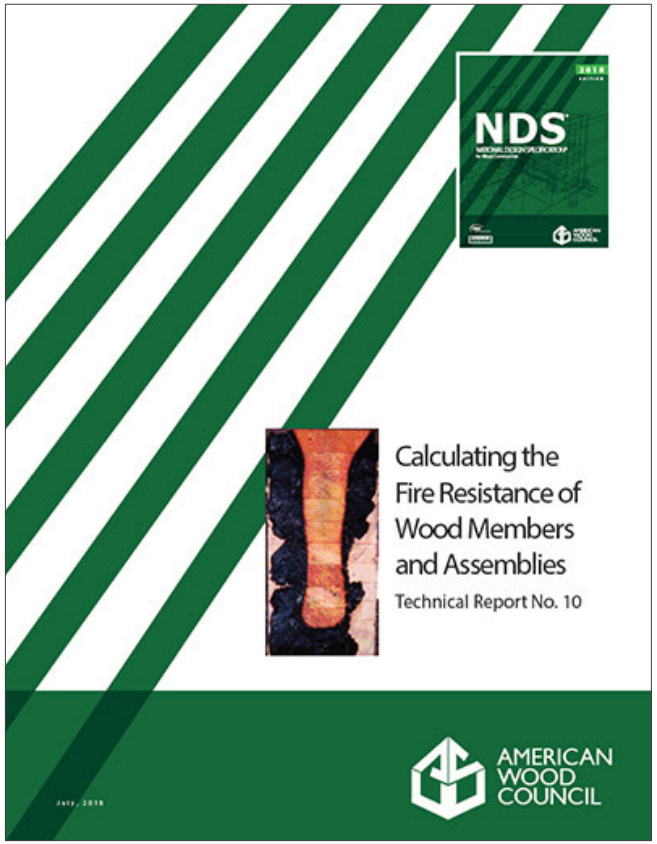
This report evaluates different engineered wood products for fire resistance using both the ASTM E119 standard for fire exposure and a modified time temperature curve. With assembly variations ranging from unprotected, gypsum board-protected, and double gypsum-board-protected rim boards.





Calculated Fire Resistance of Wood

For Exposed Wood Members: IBC 722.1 References AWC's NDS Chapter 16 (AWC's TR 10 is a design aid to NDS Chapter 16)



Equations for Calculating Fire Endurance

Assumptions:

- Nominal assumed char rate = 1.5”/hr.
- Uses ultimate strength for design check

Structurally spanning members: reduced section checked for capacity vs. demand

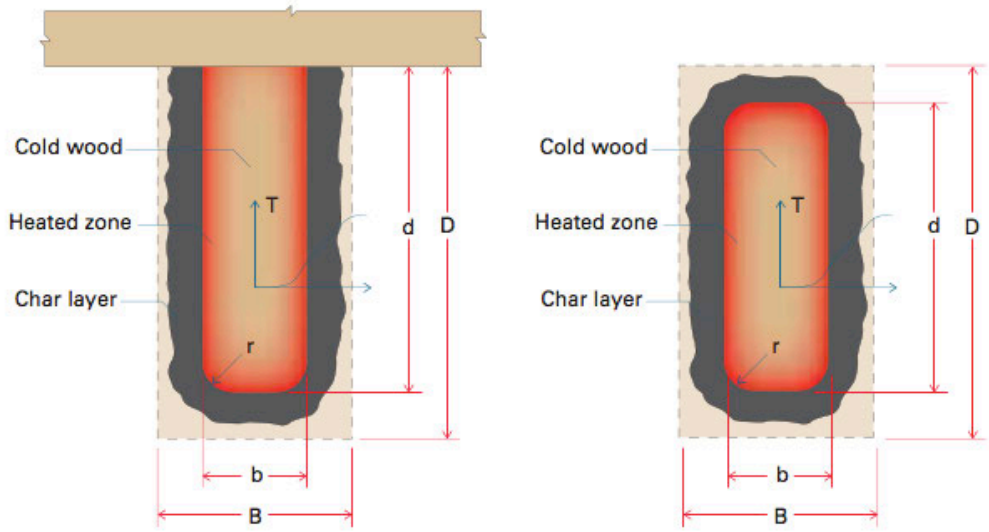


Figure 1-1 Reduction in member breadth and depth over time, t

Source: AWC’s TR 10

Equations for Calculating Fire Endurance

ACCOUNTS FOR NON-CHARRED STRENGTH RED'N

$$\beta_{eff} = \frac{1.2\beta_n}{t^{0.187}}$$

CHAR SLOWS WITH TIME: NONLINEAR

β_{eff} = Effective char rate (in/hr), adjusted for exposure time, t

β_n = Nominal char rate (in/hr), linear char rate based on a 1-hour exposure (1.5"/hr.)

t = Exposure time (hrs)

Exterior Walls – Intersecting Floor Examples

Please note that the following details are examples of what we have seen used on projects and do not necessarily represent details that will be accepted and applicable in all jurisdictions and to all projects.

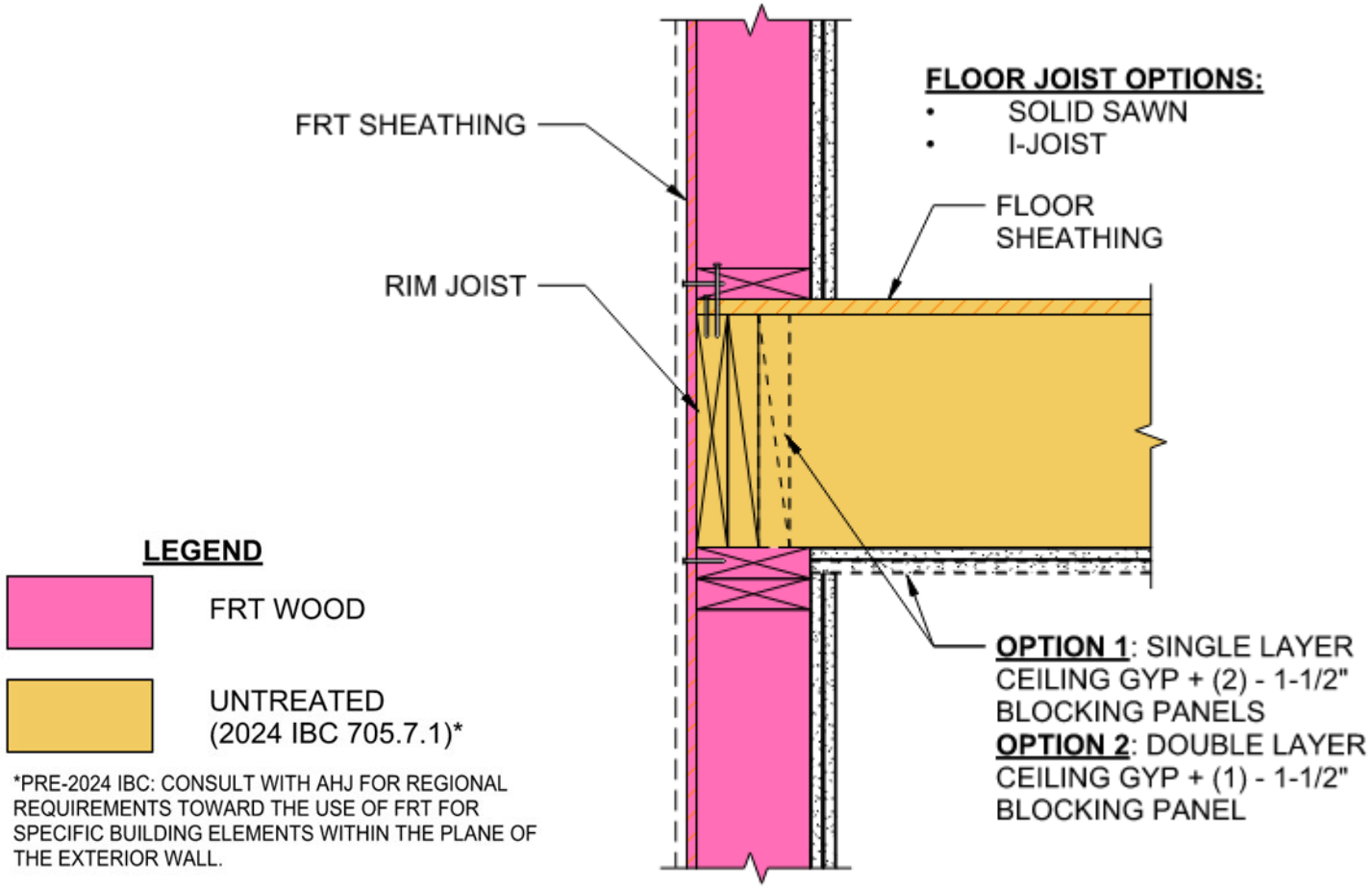
These details are not intended as recommendations for universally accepted details. Local product availability and manufacturer specifications should also be considered for each project.

The Architect of Record and Engineer of Record should verify acceptance of the details used on their project with all provisions of the building code, including local amendments, with the local Authority Having Jurisdiction.

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor

Typical Platform Framing



Considerations:

- Shrinkage of rim, plates, joists

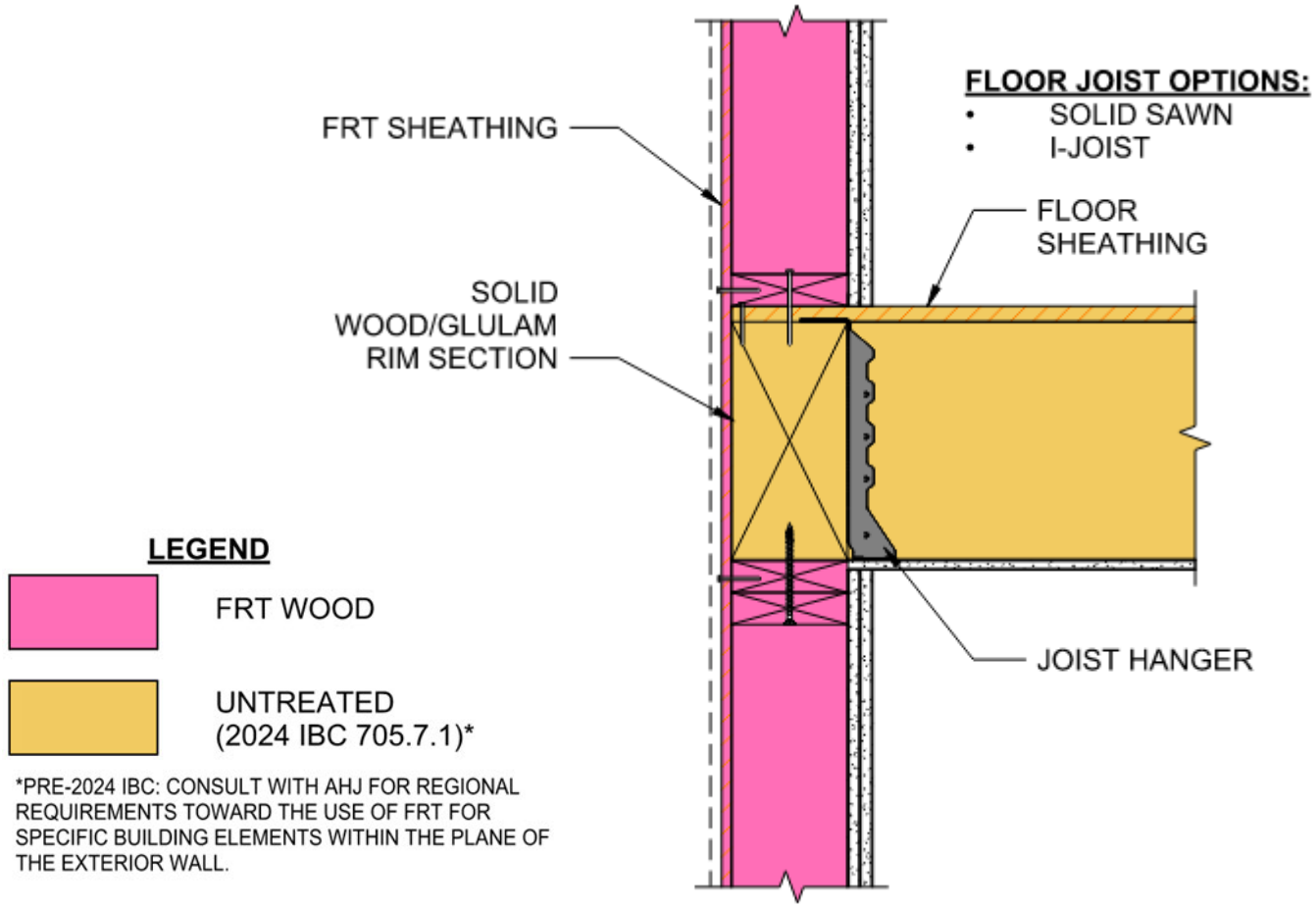
Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor cavity, ceiling provides 1 hour
- 1 layer of blocking provides 2nd hr through char calculations

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor

Modified Platform Framing



Considerations:

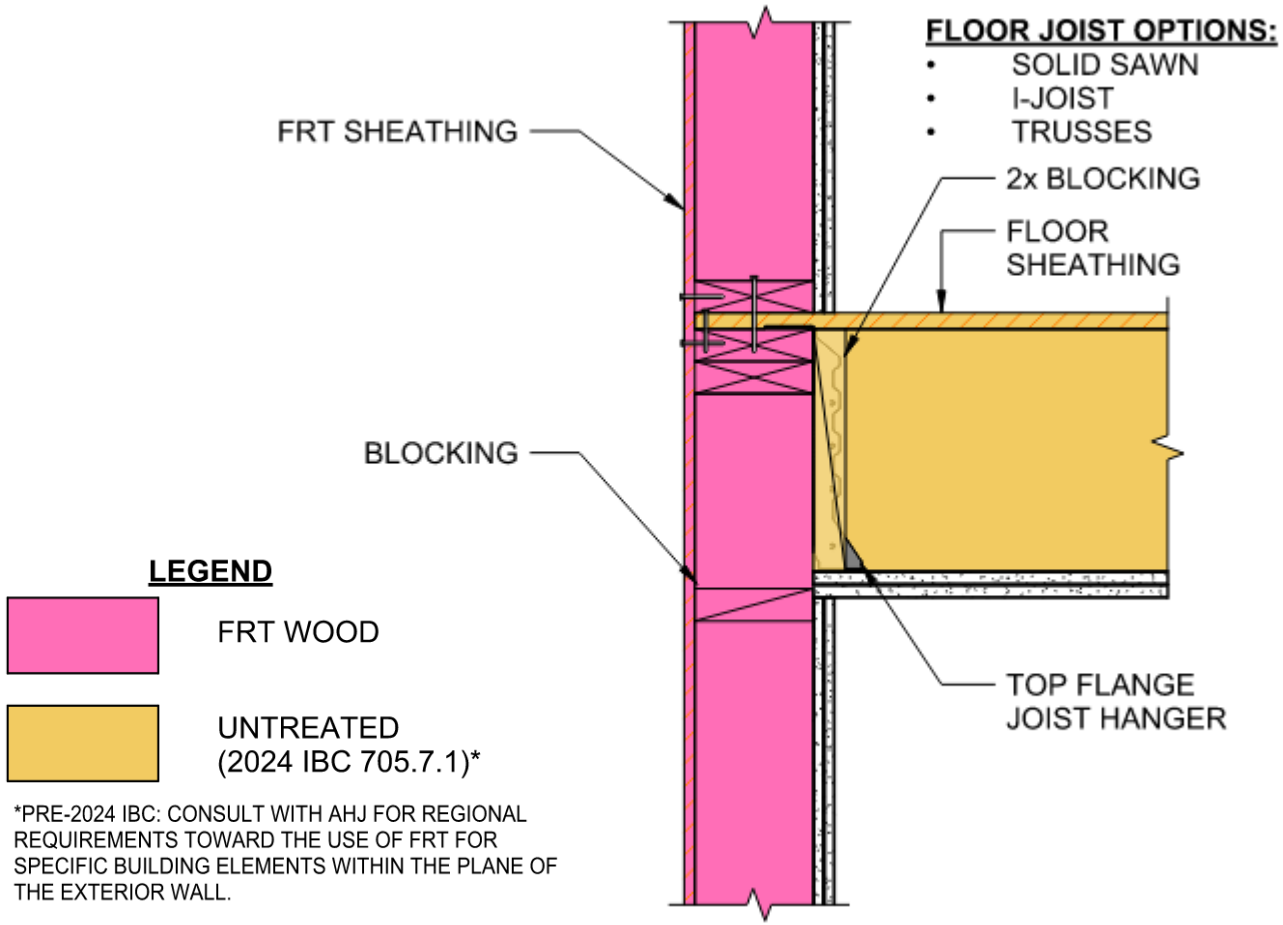
- Shrinkage of rim, plates, joists

Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor cavity, 4x rim provides 2-hr protection through char calculations

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing

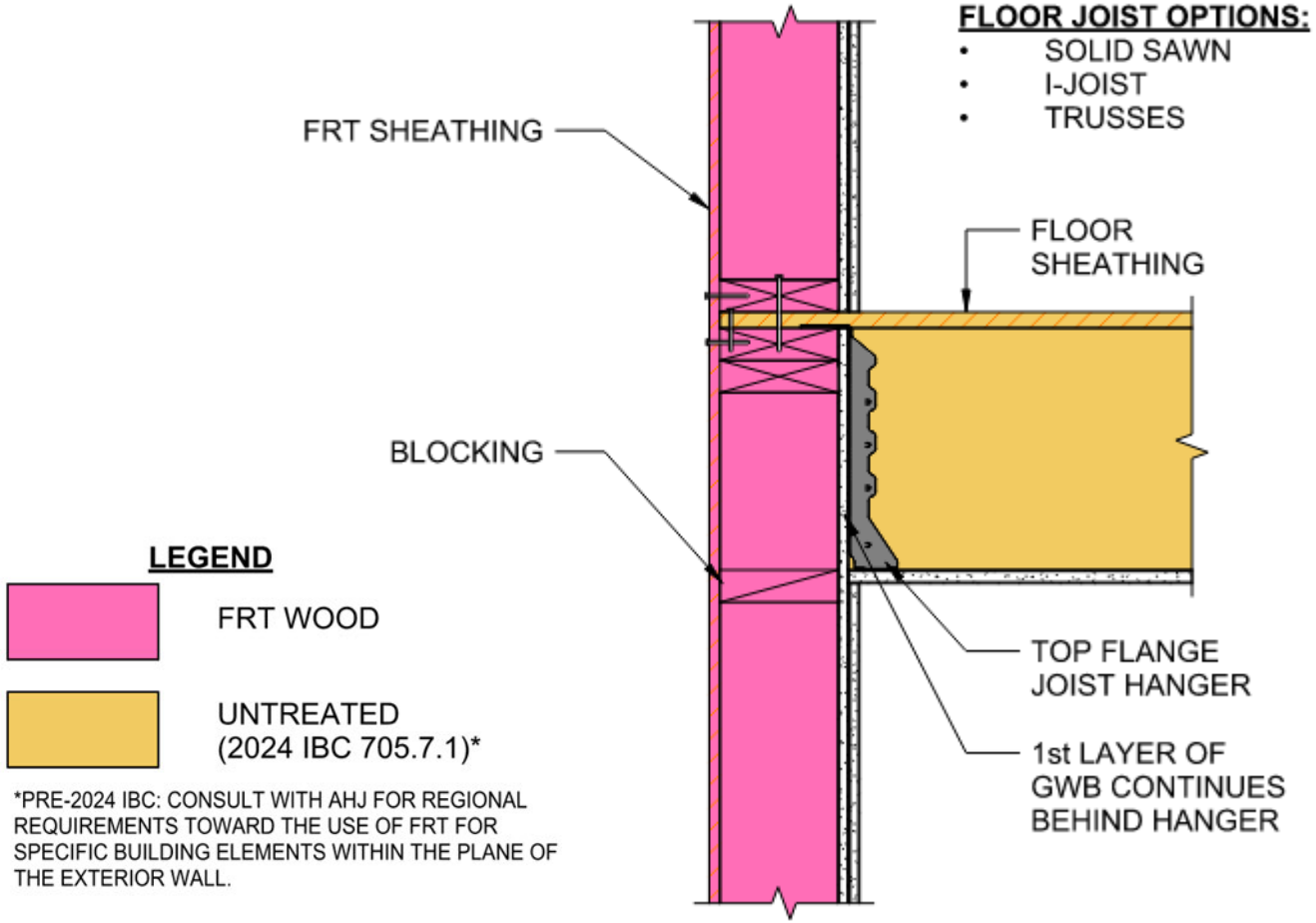


Rationale for detail approval:

- Ceiling membrane provides 1-hr protection
- Blocking between joists provides 2nd hr through char calculations

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing

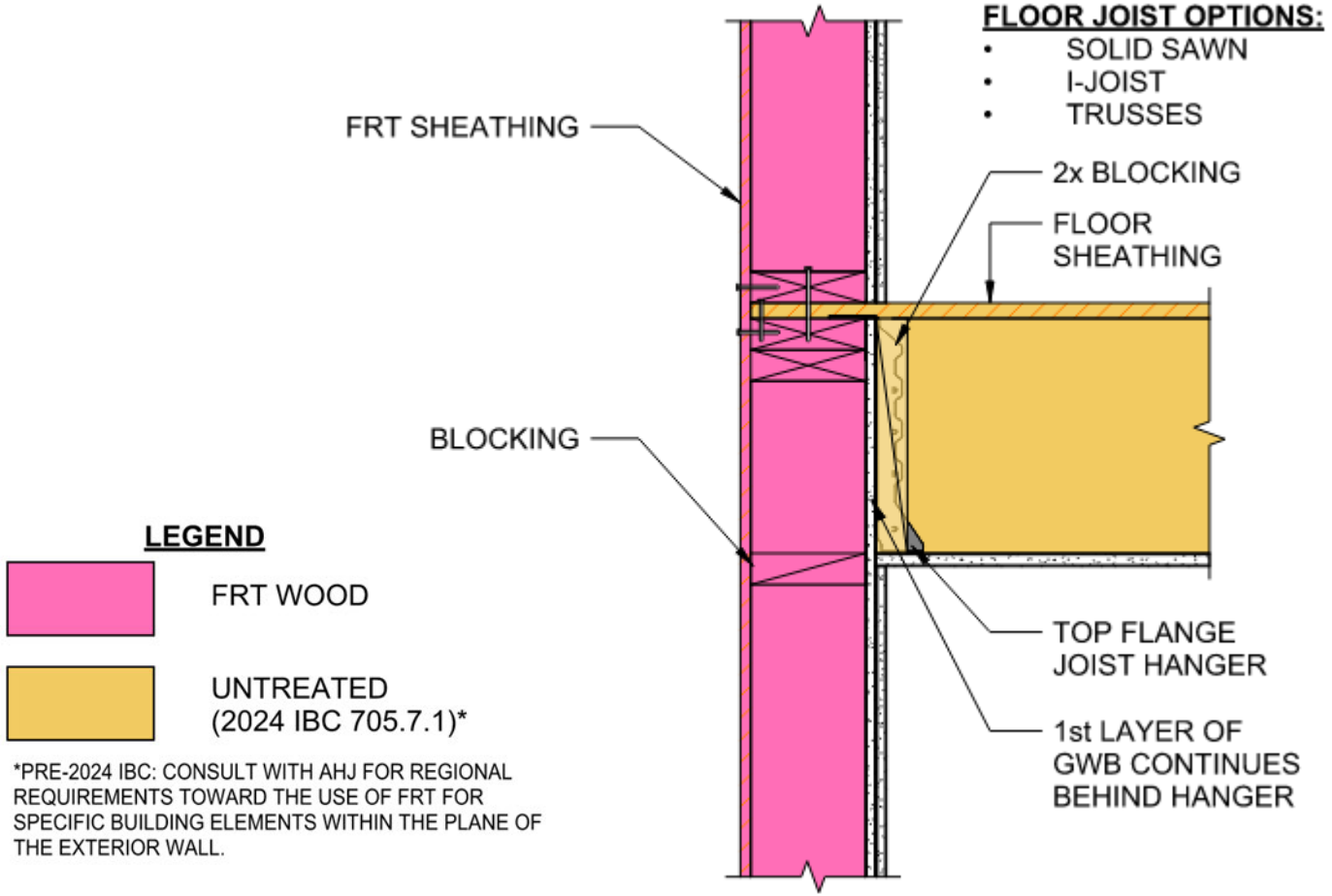


Rationale for detail approval:

- Ceiling membrane provides 1-hr protection
- 1 layer of wall membrane provides 2nd hr

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing

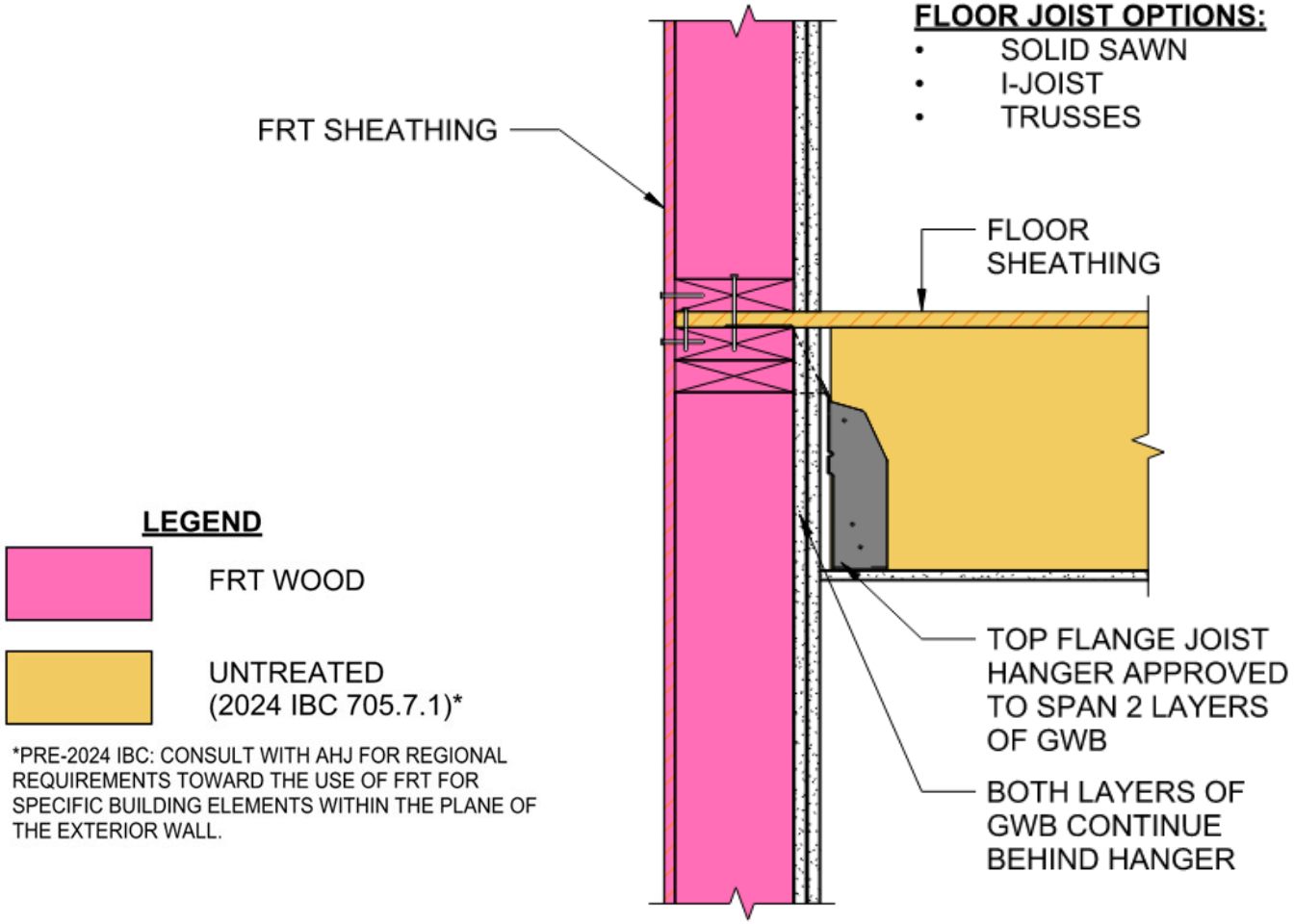


Rationale for detail approval:

- 1 layer of wall membrane provides 1-hr protection
- Blocking between joists provides 2nd hr through char calculations

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing

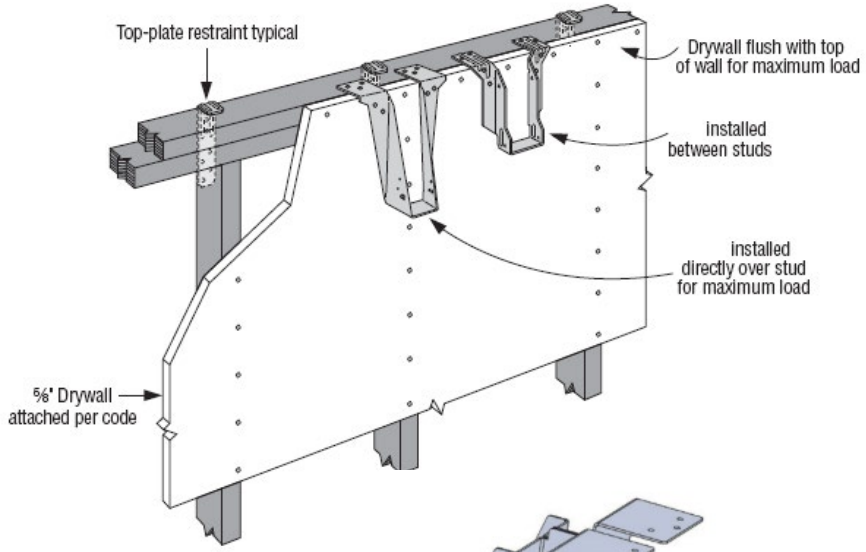


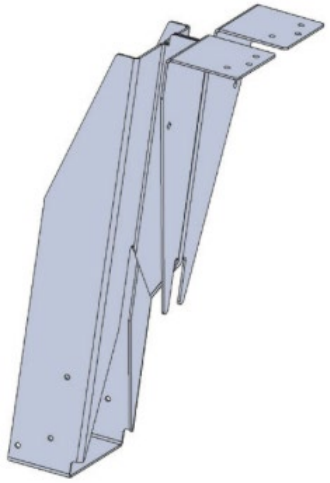
Rationale for detail approval:

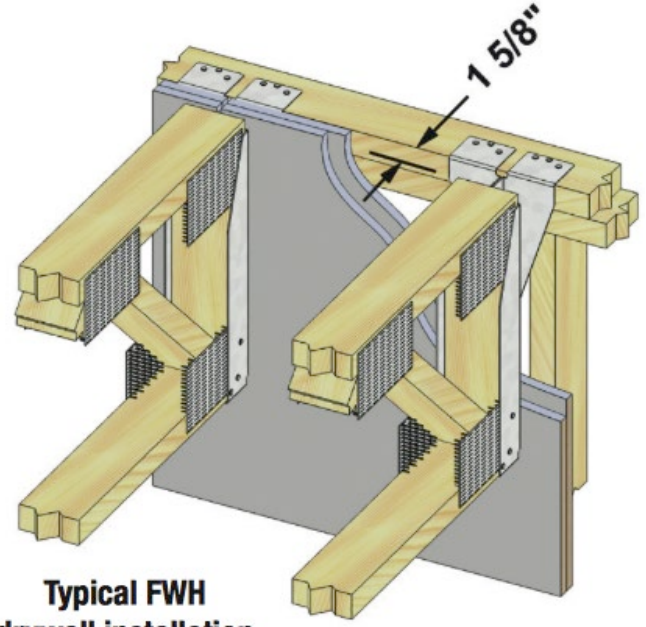
- Membranes on both side of wall provide fire resistance via their approved assembly

Over Gypsum Hangers

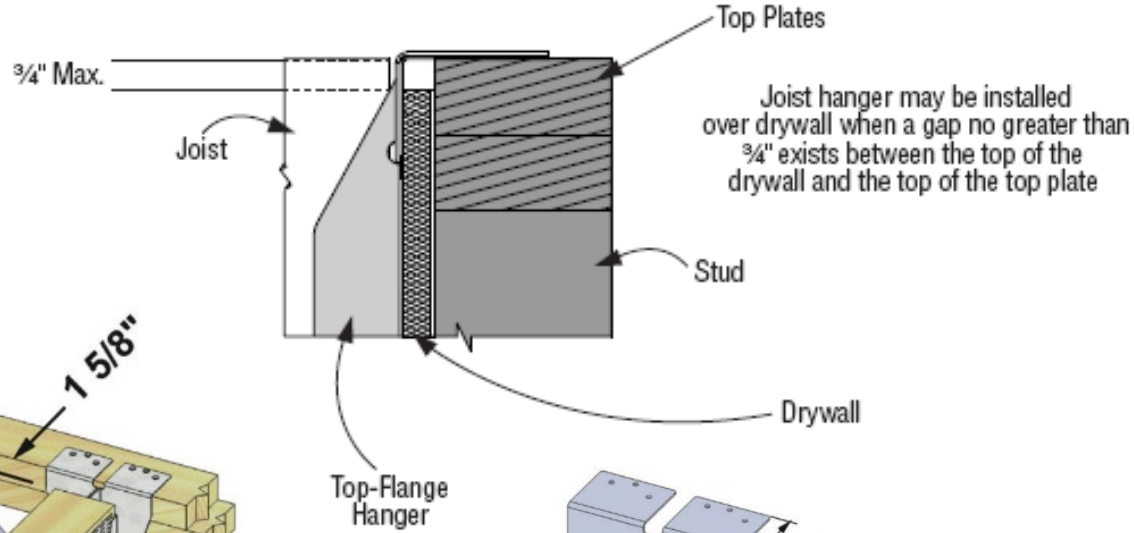
Commonly called Fire Wall or Drywall Hangers

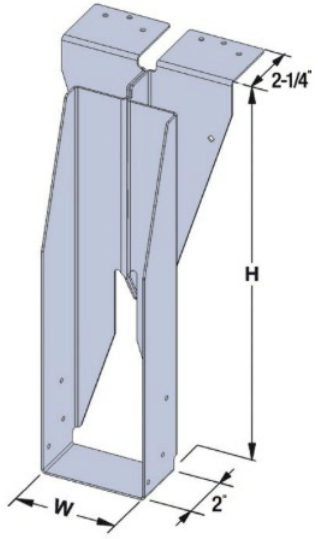






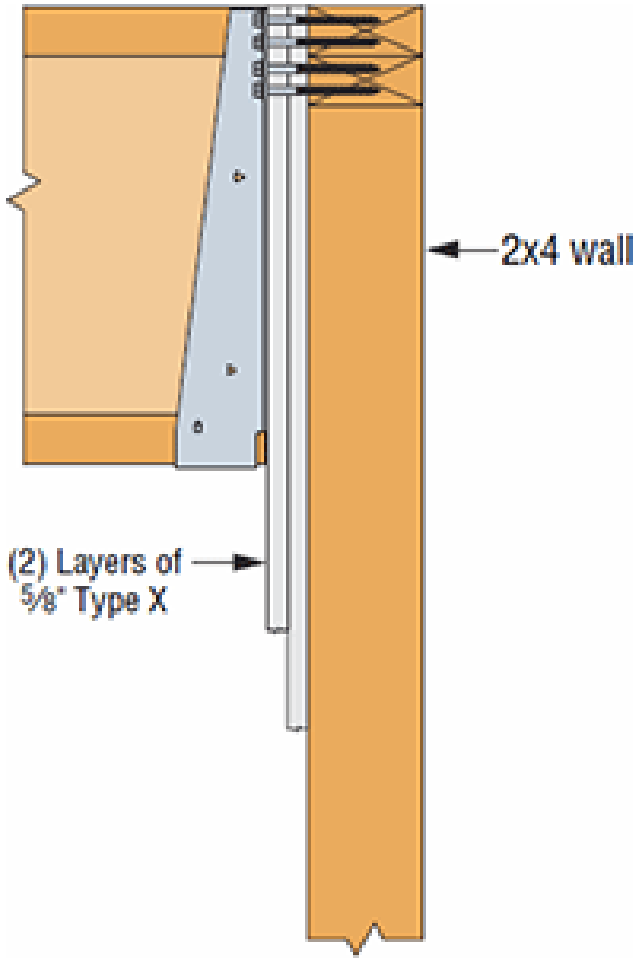
Typical FWH drywall installation using FWH-T Template

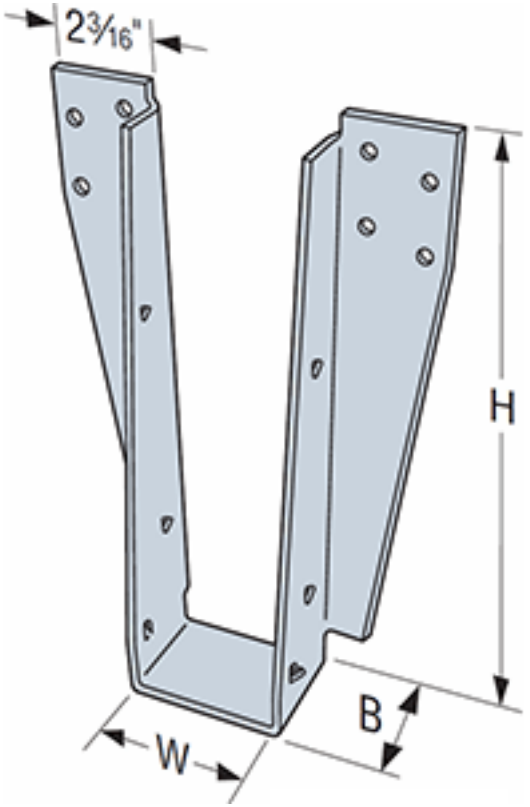




Over Gypsum Hangers

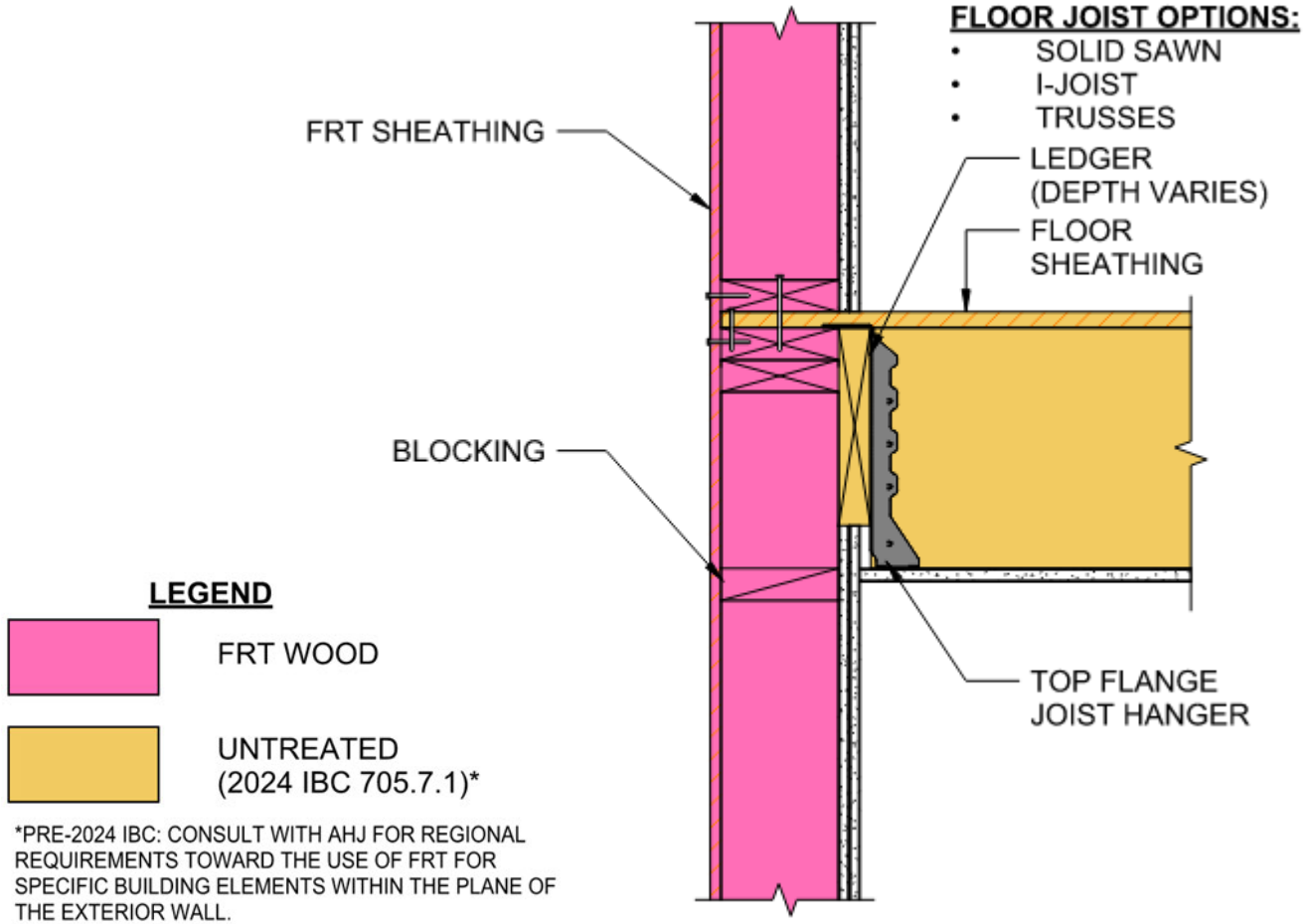
Top Flange Hangers & Face Mount Hangers Available





Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing w/ Ledger



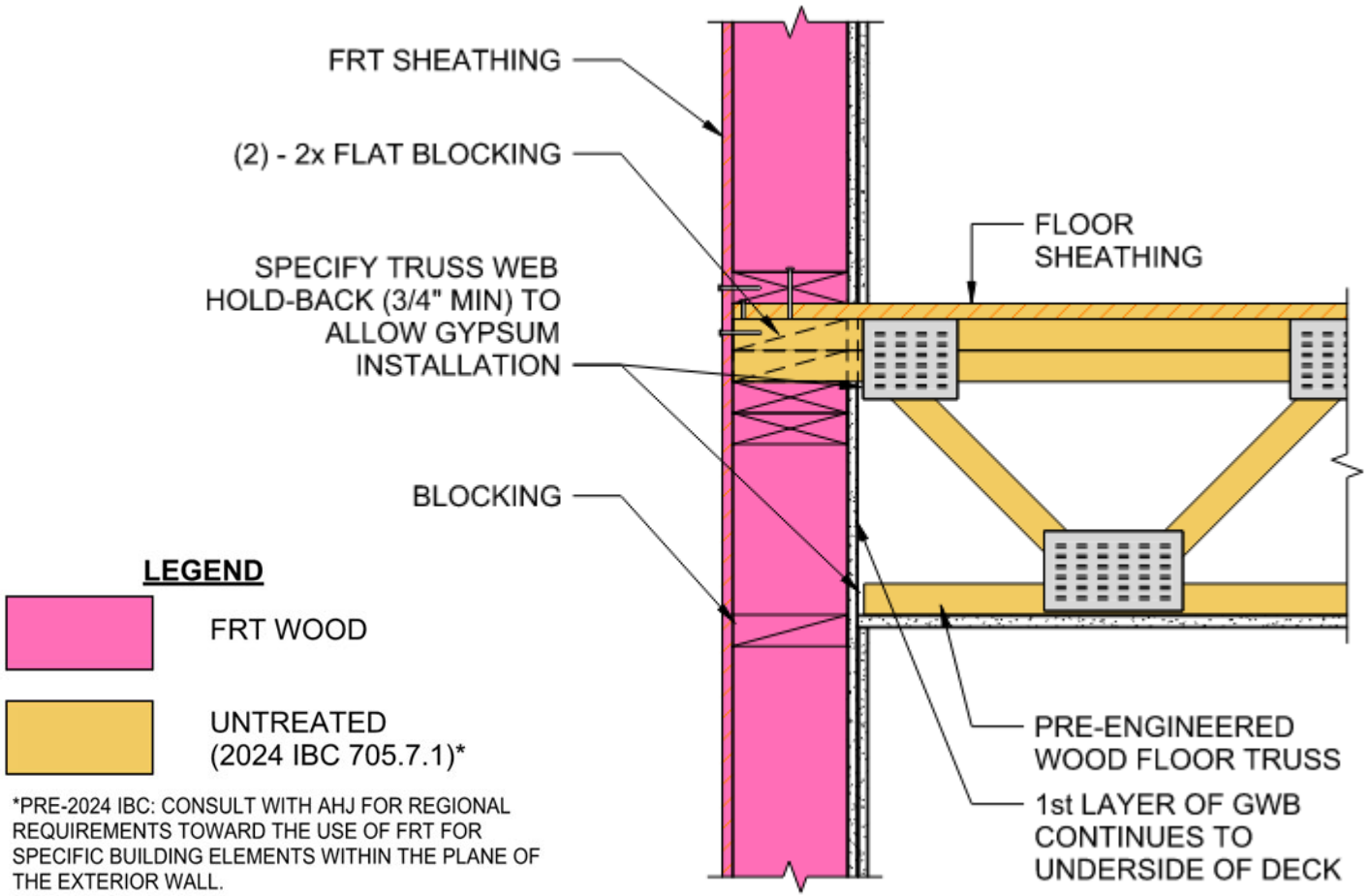
This detail is often used with a balcony; exterior ledger is thru-bolted

Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor, ceiling membrane provides 1 hr
- Blocking provides 2nd hr & maintains FRT continuity

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Top Chord Bearing

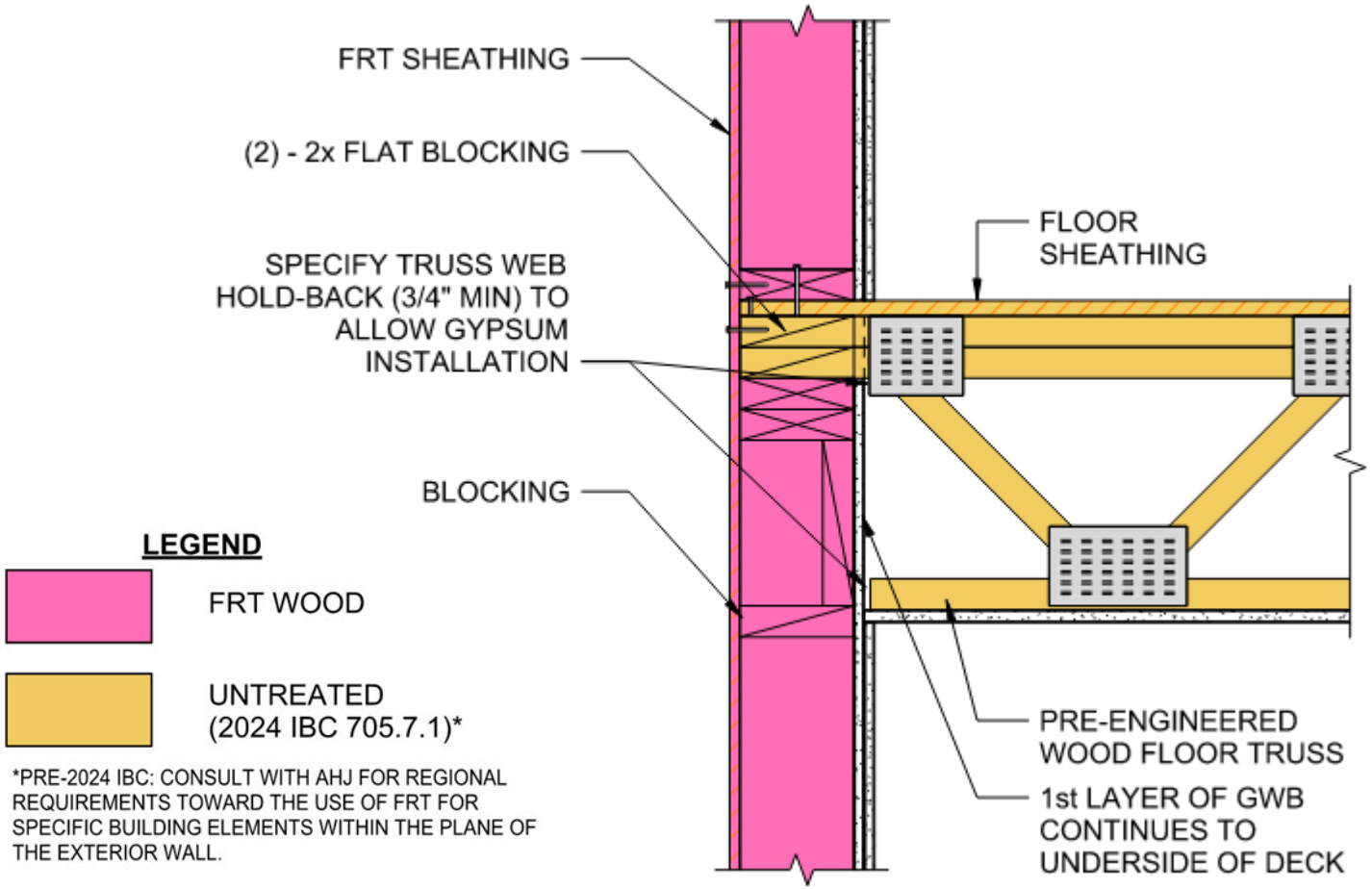


Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor cavity ceiling membrane provides 1st hr
- 1 layer of wall membrane provides 2nd hr

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Top Chord Bearing



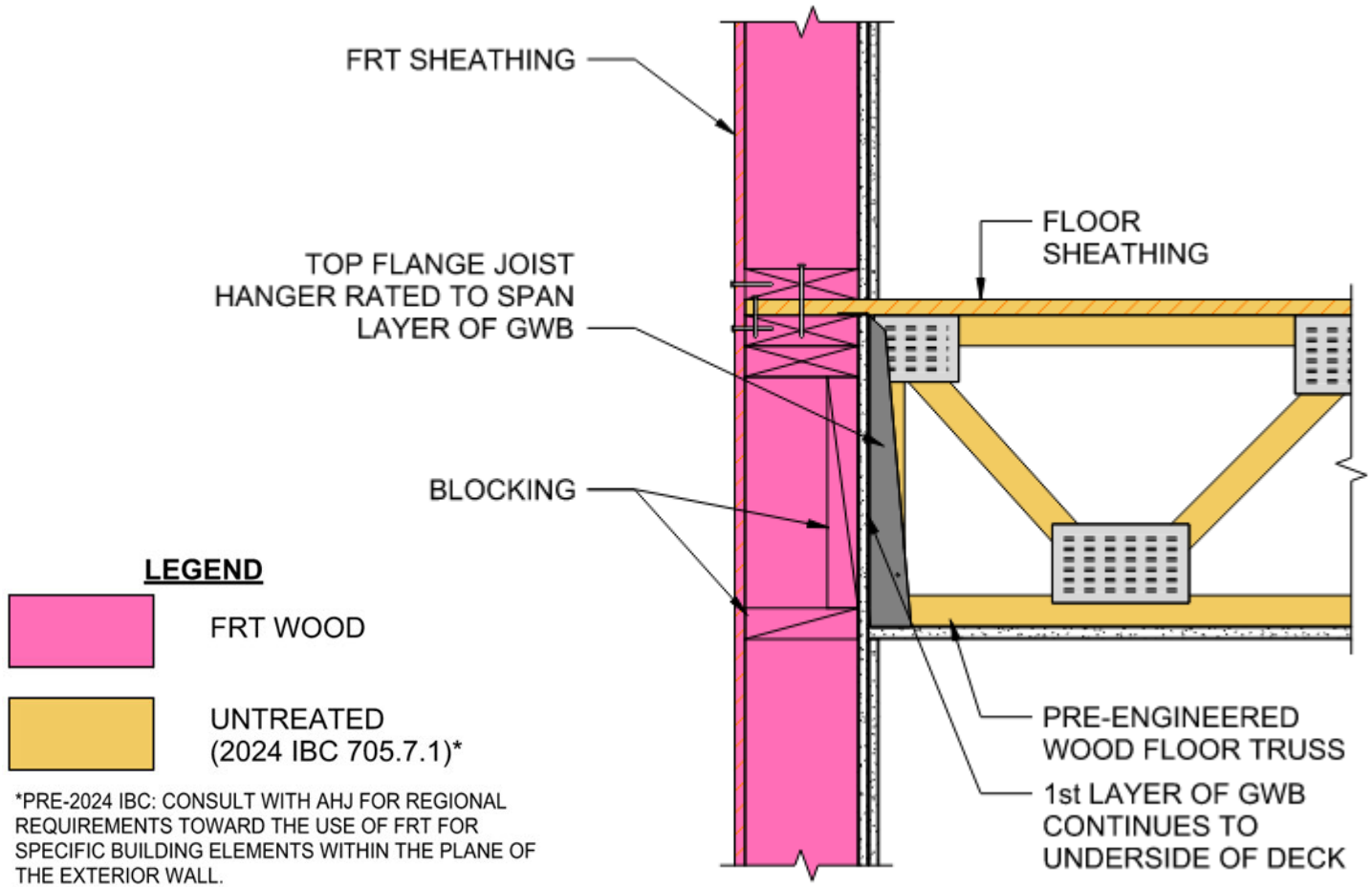
Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor cavity, blocking in wall provides 1st hr
- 1 layer of wall membrane and ceiling membrane provides 2nd hr

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor

Semi-Balloon Framing w/ Hangers

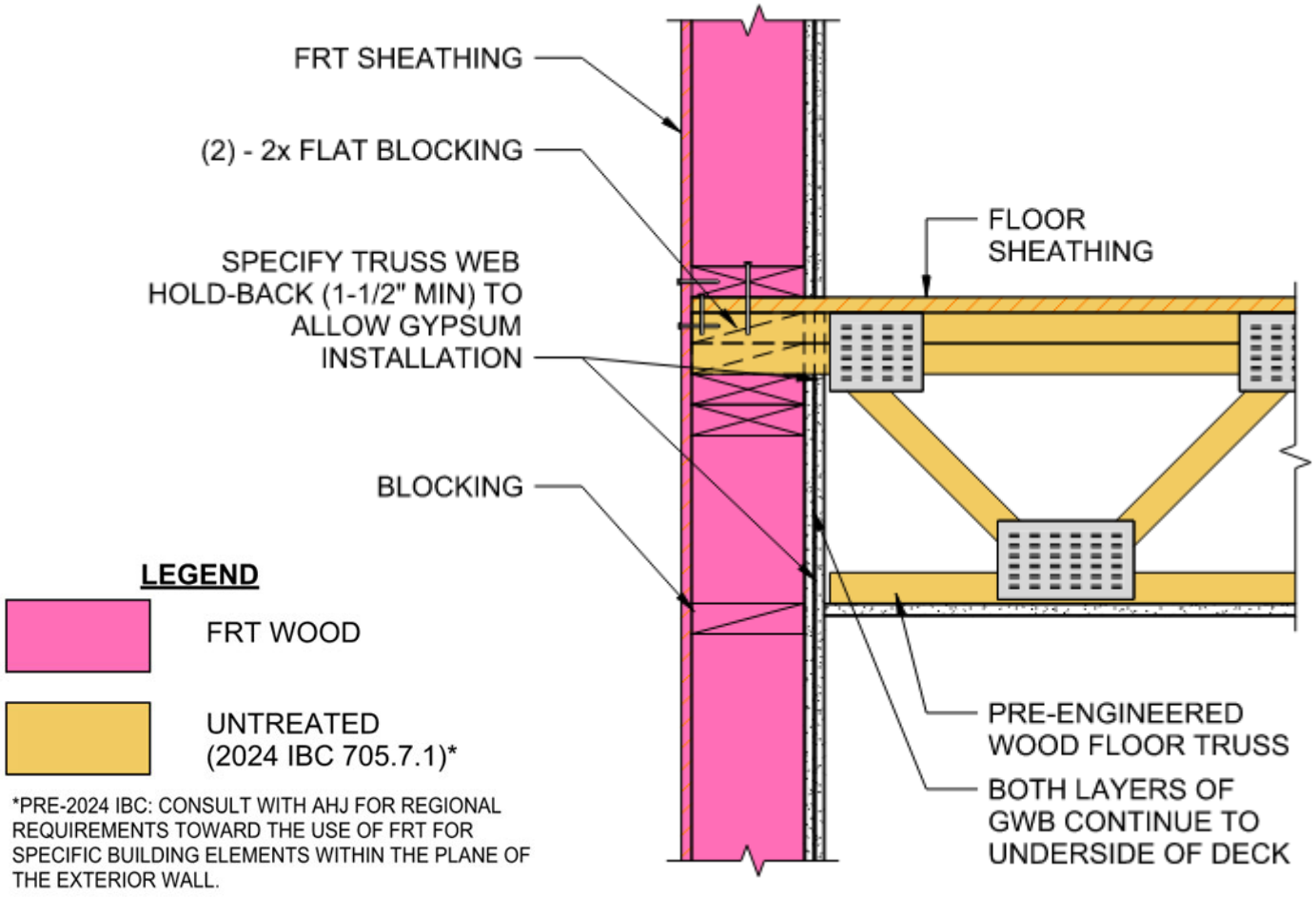


Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor cavity, blocking in wall provides 1st hr
- 1 layer of wall membrane and ceiling membrane provides 2nd hr

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Top Chord Bearing

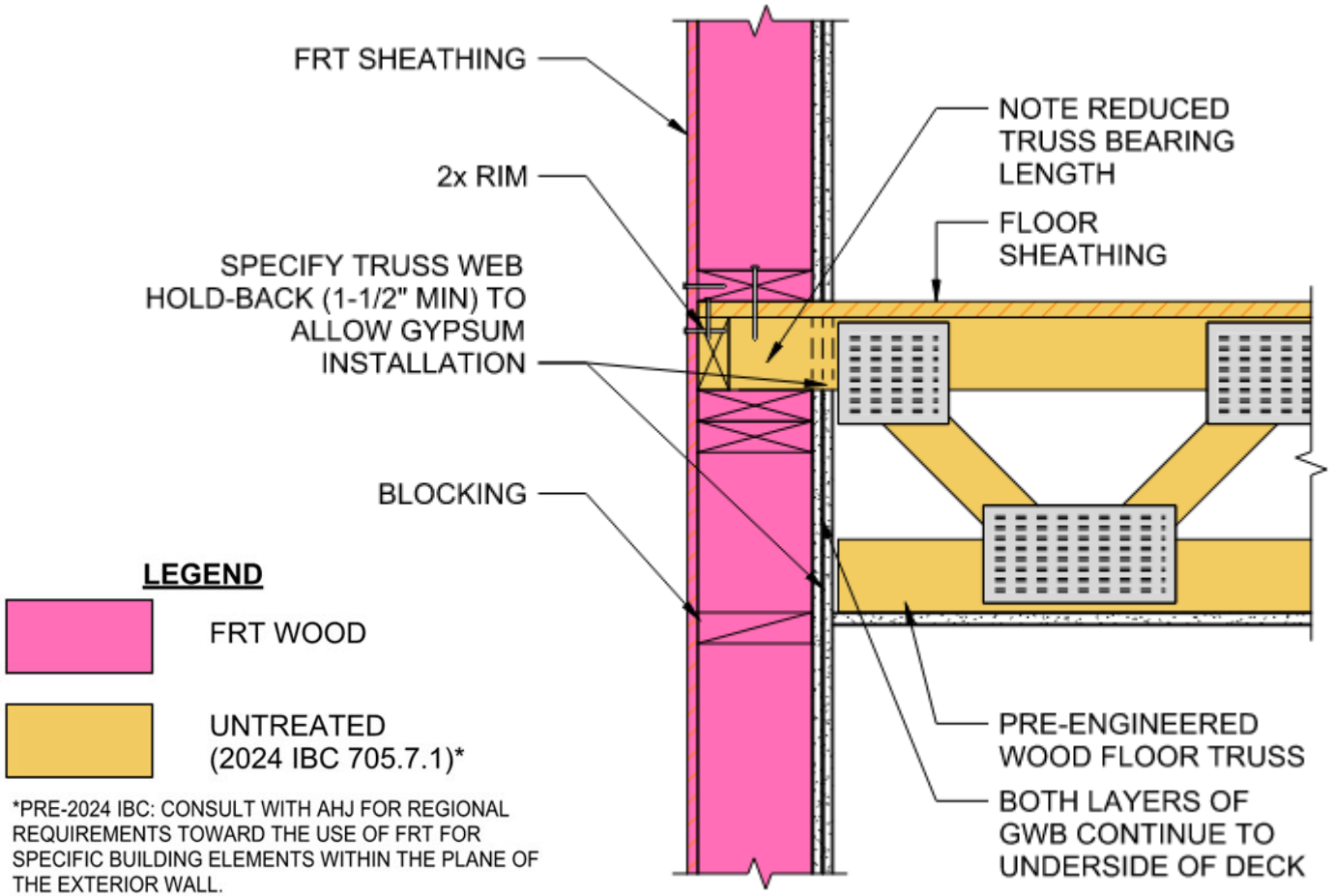


Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Top Chord Bearing



Vertical Orientation of truss chords & web members

Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly

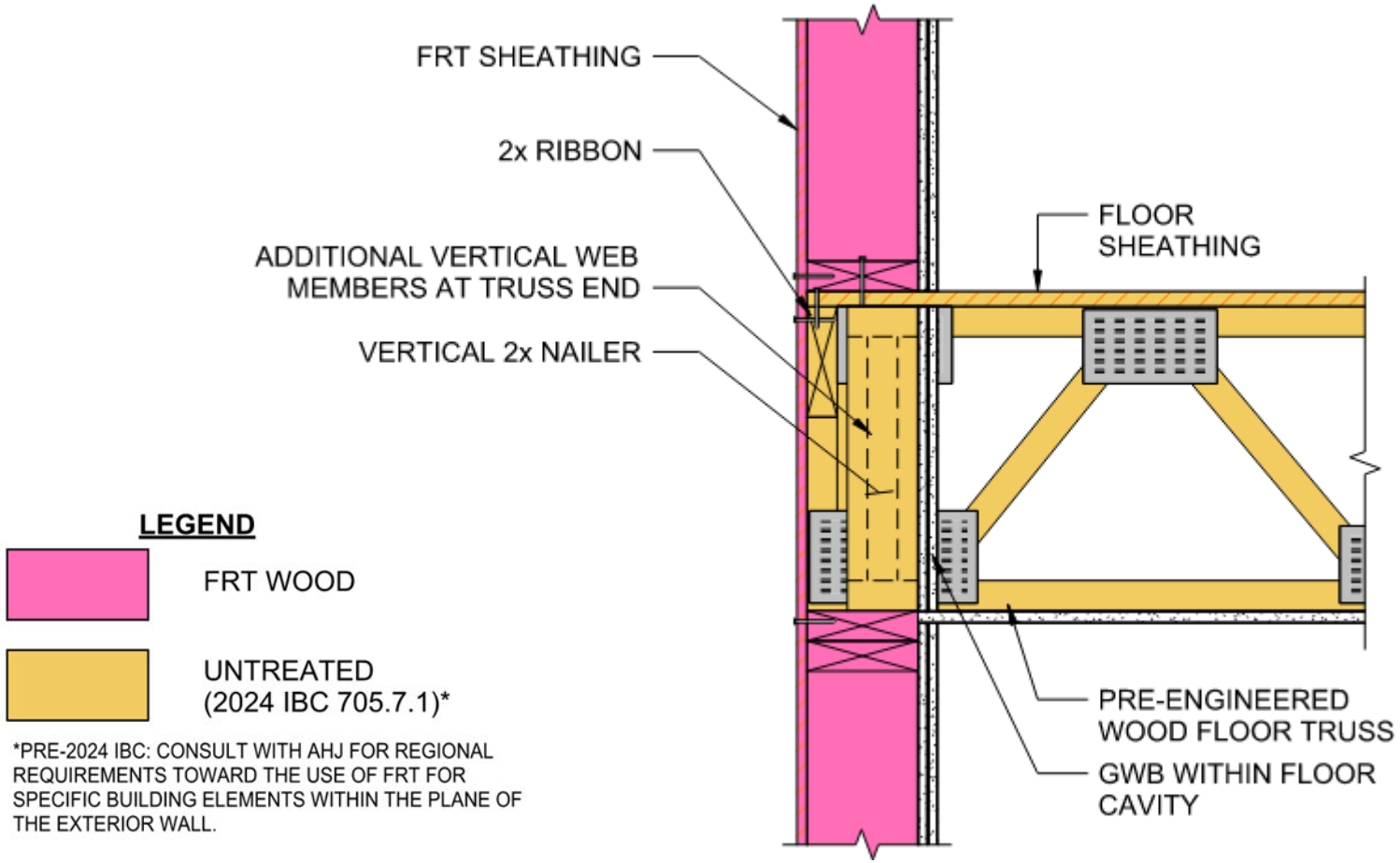
Exterior Walls – Intersecting Floors / Roof

Exter

Gaps between end of truss members and wall framing to allow gypsum install after

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Bottom Chord Bearing



Rationale for detail approval:

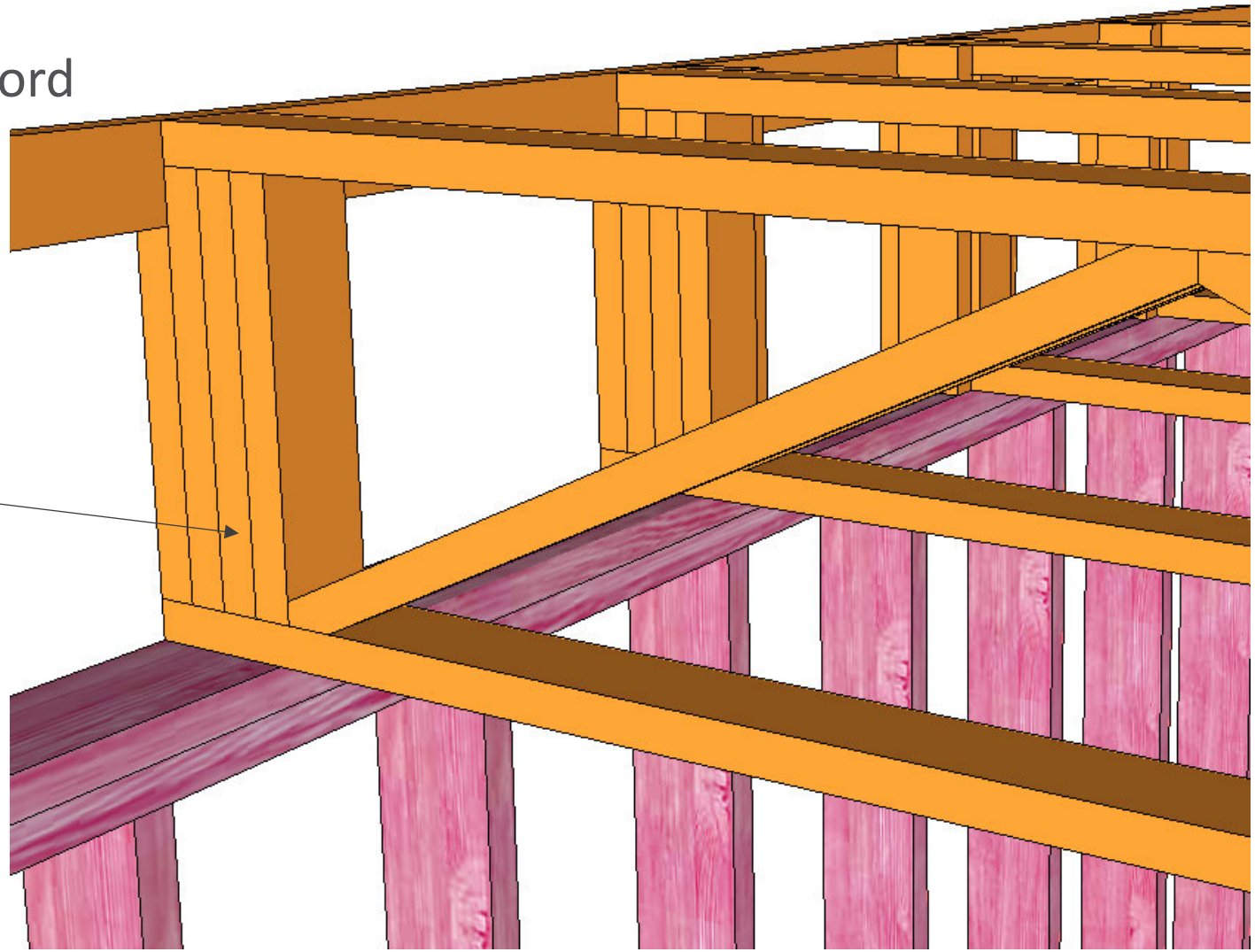
- Membranes on both side of wall provide fire resistance via their approved assembly
- Combined floor assembly, membrane and blocking provide additional fire resistance

Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor

Platform Framing w/ Bottom Chord Bearing Truss

Designed with two or more additional verticals at the exterior wall to provide enhanced FRR based upon charring calculations in NDS Chapter 16 and solid edges for WSP or GWB penetration or transition

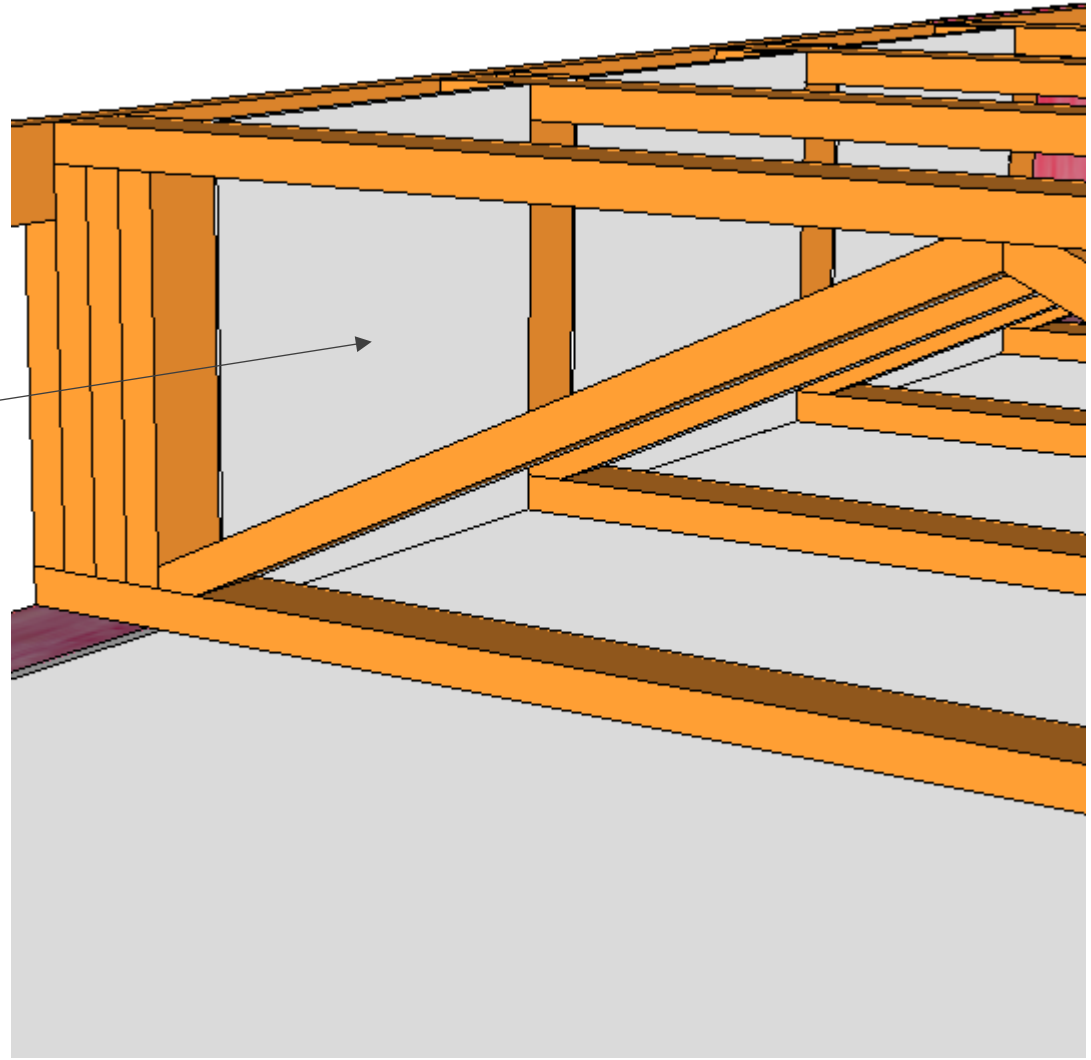


Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor

Platform Framing w/ Bottom Chord Bearing Truss

Gypsum wall panels installed as required between trusses to maintain FRR of building elements supporting or in the plane of the exterior wall (ceiling gypsum omitted in illustration for clarity)

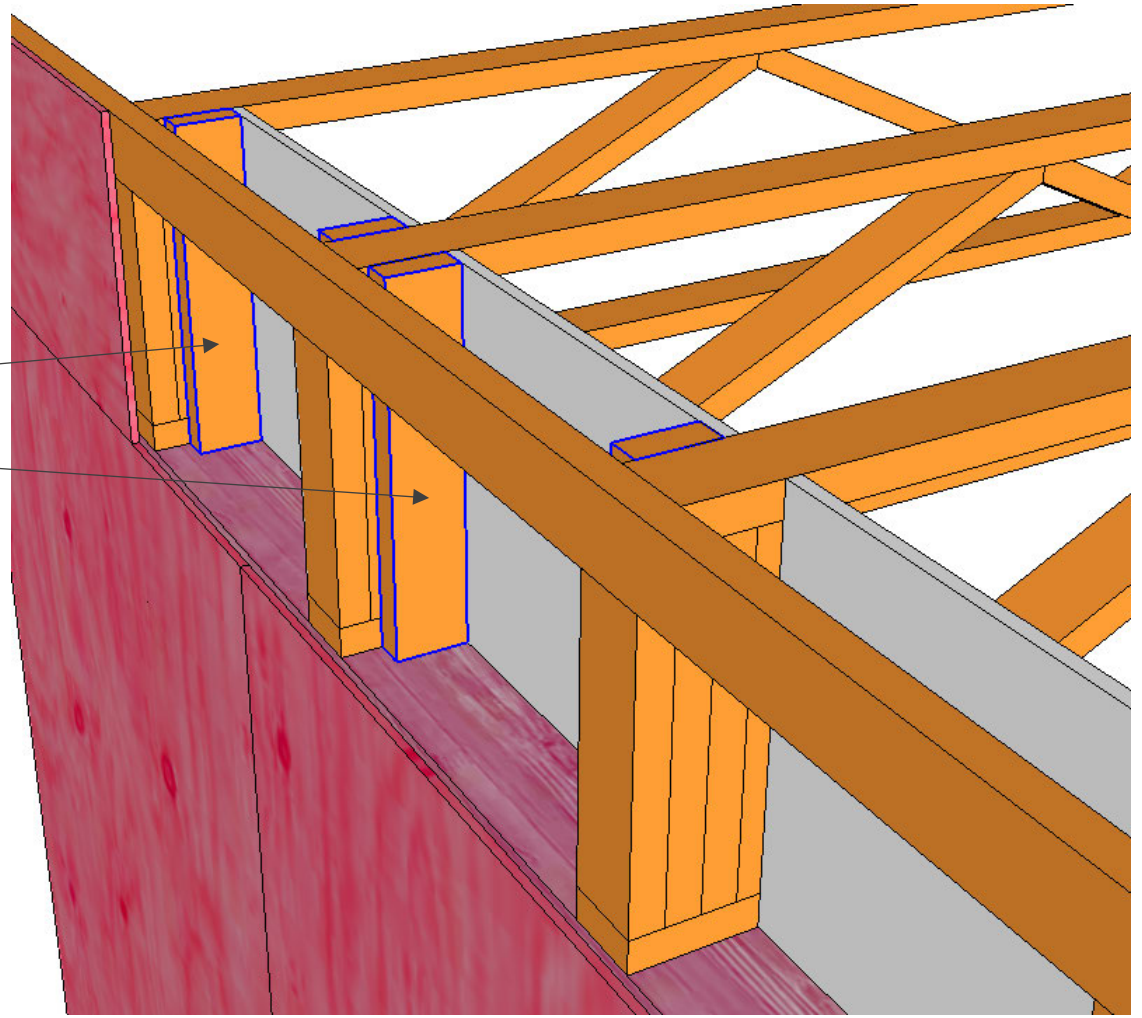


Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor

Platform Framing w/ Bottom Chord Bearing Truss

Add vertical blocking each side of truss (highlighted blue) to provide nailing base for gypsum panels between trusses



The extra vertical truss members, vertical blocking members, and gypsum wallboard panels combine with ceiling membrane to provide req'd fire resistance rating for building members supporting or within the plane of the exterior wall

Outline

- Context for Type III Construction
- Fire Rating Requirements for Exterior Walls
  - Assembly Asymmetry
  - Addition of Wood Structural Panel
  - Bearing vs. Non-bearing
  - Vertical offsets
- Exterior Wall to Floor Intersection
  - Fire Resistant Continuity
  - Fire Retardant Continuity
- Parapets & Balconies

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

Exterior Wall – Roof Intersection

Unlike firewalls, fire barriers and fire partitions, the code does not specify continuity requirements for exterior walls

At the roof – wall interface, how far do fire resistance protection measures need to extend?

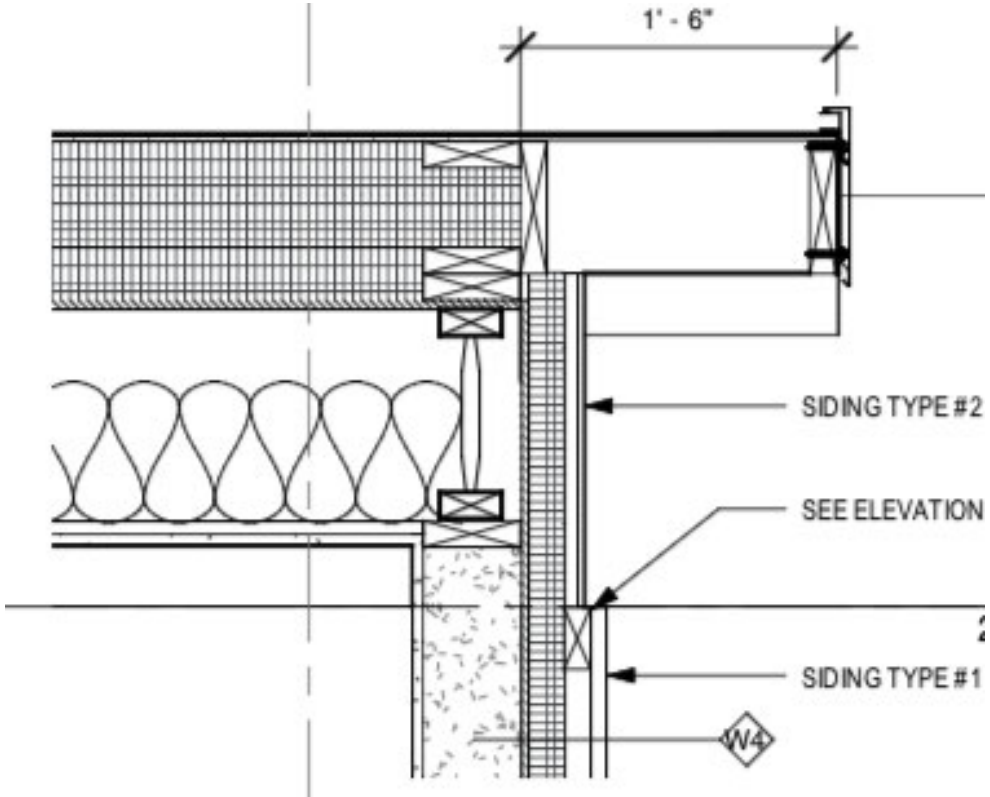
- To the underside/ceiling of a rated roof assembly?
- To the underside of the roof sheathing regardless of whether or nor the roof assembly is rated?
- Beyond the top of the roof (i.e. parapet)?

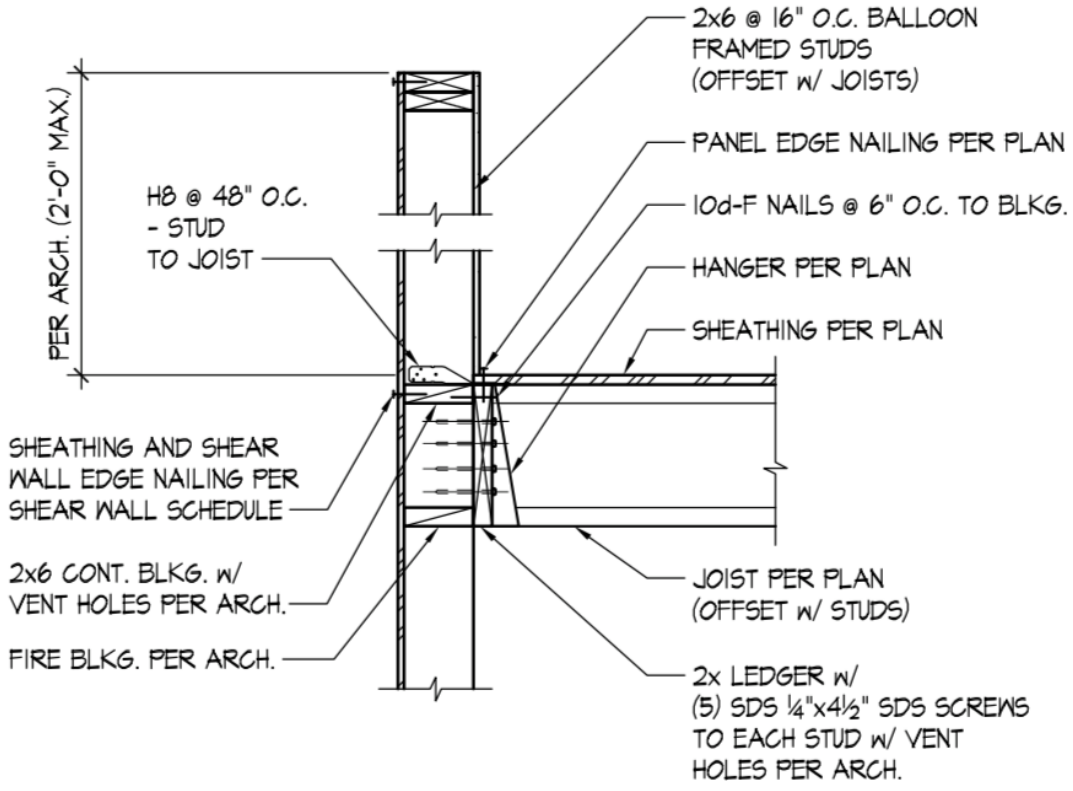
Similarly, in type III construction, do roof framing elements in the plane of the exterior wall need to be FRT?

Exterior Wall – Roof Intersection

The floor-wall intersection principles discussed previously apply here too - DCA 3 details could be applied to this condition

Discussion with Building Official to determine their interpretation and requirements is often warranted





Parapets – IBC 705.11

Parapets shall be provided on exterior walls of buildings.

Exceptions:

1. The wall is not required to be fire rated per Table 602
2. Floor area is ≤ 1000 sf on each floor
3. Walls terminate at a roof that is rated for 2-hr or more OR

   Where roof and supporting construction are non-combustible

Parapets – IBC 705.11 (IBC 705.12 – 2024 IBC)

Parapets shall be provided on exterior walls of buildings.

Exceptions:

4. 1hr rated exterior walls that terminate at the underside of the roof sheathing where:
   - Framing parallel to wall is not less than 1-hr rated for 4’ for Group R/U and 10’ for other occupancies
   - Framing perpendicular to wall is 1-hr rated for entire span
   - Openings are not located within 5’ of the exterior wall for Group R/U and 10’ for other occupancies.
   - Entire building has class B roofing
5. Groups R-2 and R-3 where roofing is Class C, 1-hr rated exterior walls that terminate at the underside of the roof sheathing where:
   - Sheathing is FRT for 4’ OR
   - 5/8” Type X gyp on underside of deck for 4’
6. Exterior wall is permitted to have >25% unprotected openings

Parapets – IBC 705.11.1

Parapets, where required, shall have:

- the same fire resistance as the supporting wall
- minimum height of 30” above roof surface

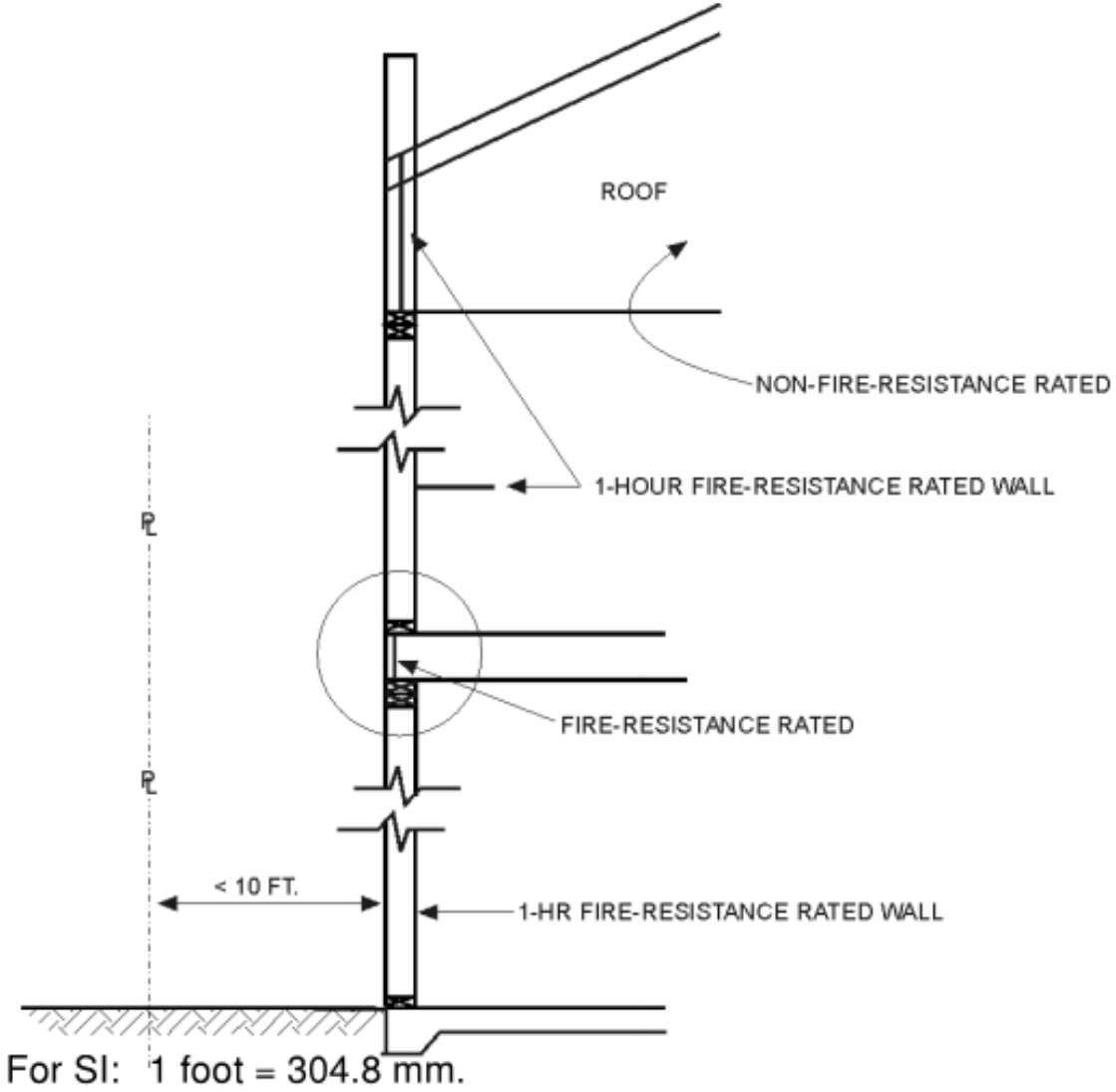
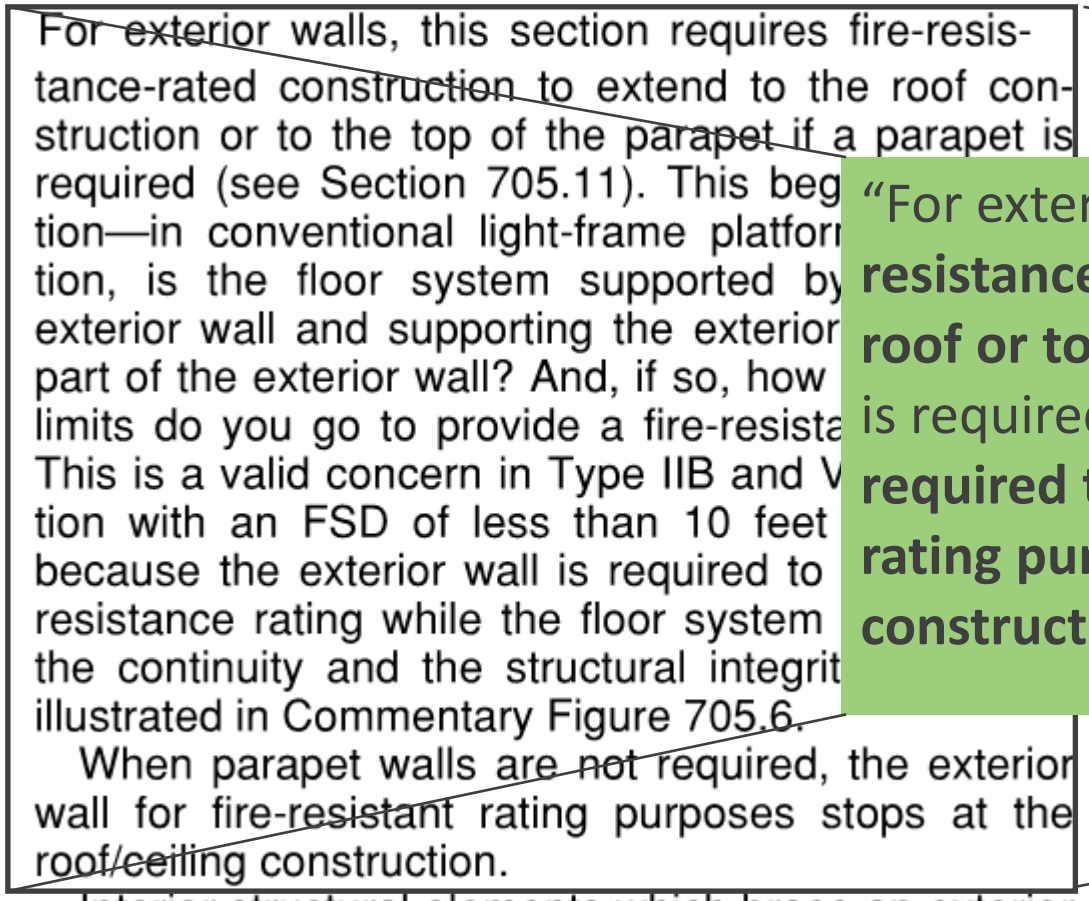


Figure 705.6
TYPE IIB AND VB EXTERIOR FIRE-RESISTANCE-RATED WALL CONTINUITY AND STRUCTURAL STABILITY

Code Commentary - IBC 705.6

What is the requirement for continuity with regard to parapets?



For exterior walls, this section requires fire-resistance-rated construction to extend to the roof construction or to the top of the parapet if a parapet is required (see Section 705.11). This beg
tion—in conventional light-frame platfor
tion, is the floor system supported by
exterior wall and supporting the exterior
part of the exterior wall? And, if so, how
limits do you go to provide a fire-resista
This is a valid concern in Type IIB and V
tion with an FSD of less than 10 feet
because the exterior wall is required to
resistance rating while the floor system
the continuity and the structural integrit
illustrated in Commentary Figure 705.6.

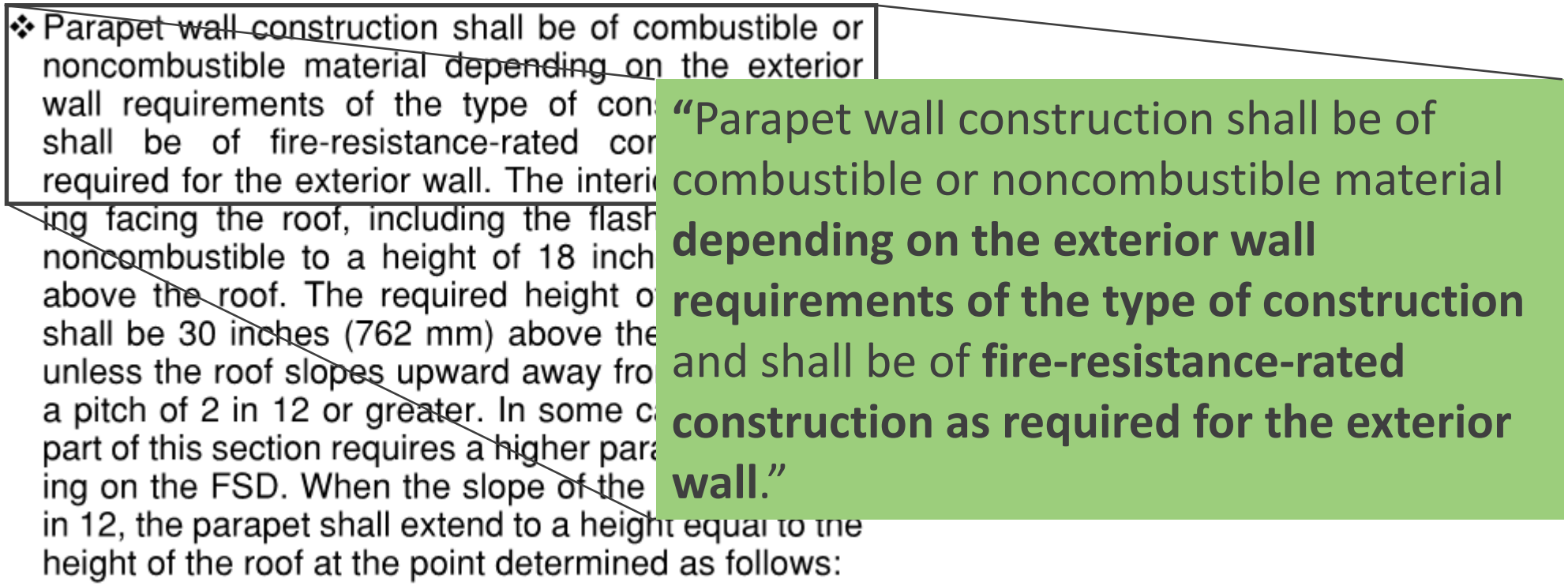
When parapet walls are not required, the exterior wall for fire-resistant rating purposes stops at the roof/ceiling construction.

Interior structural elements which brace an exterior

"For exterior walls, this section requires **fire-resistance rated construction to extend to the roof or to the top of the parapet** if a parapet is required. …**When parapet walls are not required the exterior wall for fire-resistance-rating purposes stops at the roof/ceiling construction.**"

Code Commentary – IBC 705.11.1

If a building is type III construction and the exterior walls are framed with fire-retardant treated wood, do the parapets need to be framed with FRTW?


❖ Parapet wall construction shall be of combustible or noncombustible material depending on the exterior wall requirements of the type of cons shall be of fire-resistance-rated cor required for the exterior wall. The interi ing facing the roof, including the flash noncombustible to a height of 18 inch above the roof. The required height o shall be 30 inches (762 mm) above the unless the roof slopes upward away fro a pitch of 2 in 12 or greater. In some c part of this section requires a higher para ing on the FSD. When the slope of the in 12, the parapet shall extend to a height equal to the height of the roof at the point determined as follows:

"Parapet wall construction shall be of combustible or noncombustible material **depending on the exterior wall requirements of the type of construction** and shall be of **fire-resistance-rated construction as required for the exterior wall**."

Balconies – IBC 705.2.3.1

Balconies of combustible construction and non-FRT shall be:

- Rated in accordance w/ Table 601 for floors
- Or be of Type IV
- And shall not exceed 50% of bldg perimeter

Exceptions

- Balconies in Type III, IV and V can be of type V construction and shall not have fire resistance rating if sprinkler protection provided
- Non-FRT wood is permitted for rails and guardrails

Balconies – IBC 705.2.3.1

So….

For Type III or V balcony options are:

1. **Non-combustible**: no sprinklers, no fire rating
2. **FRT**: no fire sprinklers, no fire rating
3. **Type IV**: no fire sprinklers, no fire rating
4. Non-FRT: **with fire sprinkler**, no fire rating
5. Non-FRT: no sprinkler, **fire rated per 601 & 602**

Disclaimer: These options are allowed by code for meeting construction type and fire-resistance rating requirements. They do not address durability considerations. Other code requirements may apply.

2018 IBC Balcony Code Changes

Broadstone Apartments on 5th, Fort Worth, TX

2018 IBC Balcony Code Changes

As a result of the Berkeley balcony collapse in 2015, several code changes were implemented in the 2018 IBC relative to balcony durability, inspections, ventilation and moisture protection

Changes Included:

Impervious moisture barrier system changes:

- Thorough documentation on construction documents
- Inspections
- Positive drainage

Ventilation requirements

Broadstone Apartments on 5th, Fort Worth, TX

2018 IBC Balcony Code Changes

Documentation of impervious moisture barrier system on the construction documents, IBC 107.2.5 (new section)

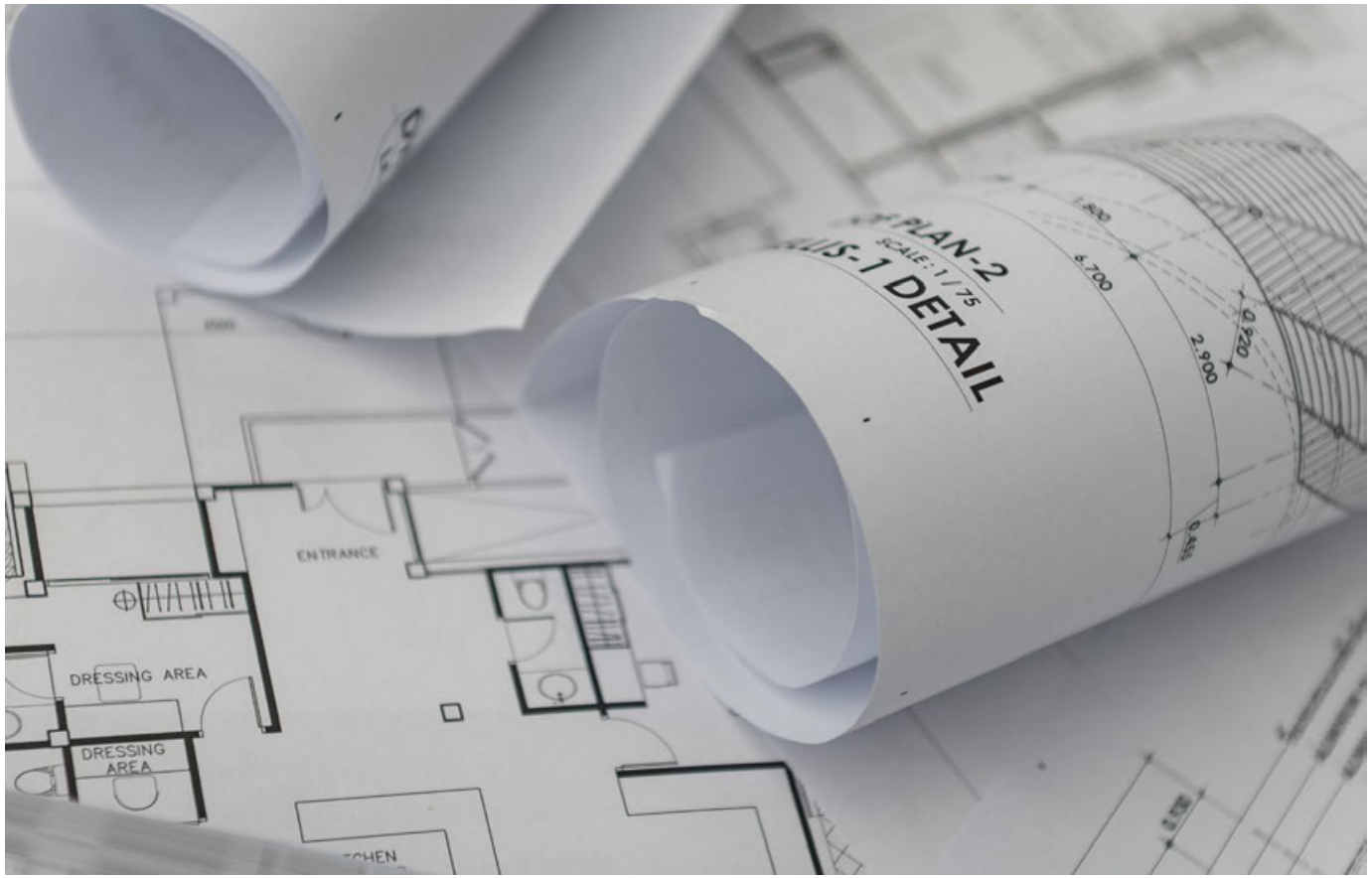
IBC 107.2.5 Exterior balcony and elevated walking surfaces. Where balcony or other elevated walking surfaces are exposed to water from direct or blowing rain, snow, or irrigation, and the structural framing is protected by an impervious moisture barrier, the construction documents shall include details for all elements of the impervious moisture barrier system. The construction documents shall include manufacturer's installation instructions.

Credit: Larry Harwell

2018 IBC Balcony Code Changes

Documentation of impervious moisture barrier system on the construction documents, IBC 107.2.5 (new section)

Purpose: ensure that all installation details and system components are fully documented to enable proper installation techniques and material use



2018 IBC Balcony Code Changes

Required inspection of impervious moisture barrier system, IBC 110.3.6 (new section)

IBC 110.3.6 Weather exposed balcony and walking surface waterproofing. Where balcony or other elevated walking surfaces are exposed to water from direct or blowing rain, snow, or irrigation, and the structural framing is protected by an impervious moisture barrier, all elements of the impervious moisture barrier system shall be not be concealed until inspected and approved.

Exception: Where special inspections are provided in accordance with Section 1705.1.1, Item 3.

2018 IBC Balcony Code Changes

Required inspection of impervious moisture barrier system, IBC 110.3.6 (new section)

Purpose: ensure that an inspection of the impervious moisture barrier system takes place prior to enclosing the space.

A further step toward ensuring that systems are installed in the intended manner with the ability to function as designed

2018 IBC Balcony Code Changes

Positive drainage for impervious moisture barrier systems, IBC 2304.12.2.5 (added language underlined)

IBC 2304.12.2.5 Supporting members for permeable floors and roofs.

Wood structural members that support moisture-permeable floors or roofs that are exposed to the weather, such as concrete or masonry slabs, shall be of naturally durable or preservative treated wood unless separated from such floors or roofs by an impervious moisture barrier. <u>The impervious moisture barrier system protecting the structure supporting floors shall provide positive drainage of water that infiltrates the moisture-permeable floor topping</u>.

2018 IBC Balcony Code Changes

So what are the options?

When wood balcony framing is covered with a moisture permeable topping such as a concrete slab, the wood framing must meet one of the following criteria:

- Be preservative-treated or naturally decay resistant wood

or

- Be covered with an impervious moisture barrier system **with positive drainage**

2018 IBC Balcony Code Changes

If the impervious moisture barrier system does not have positive drainage, water that infiltrates the topping can remain stagnant over the impervious moisture barrier system, creating hydrostatic pressure

Positive drainage components commonly include a drainage mat above a waterproof membrane

Some feel that using both preservative treated wood and an impervious moisture barrier system with positive drainage is the best approach, even though it exceeds 'code minimums'

Walter Huntington Apartments

2018 IBC Balcony Code Changes

Enclosed balconies must be ventilated, IBC 2304.12.2.6 (new section)

IBC 2304.12.2.6 Ventilation required beneath balcony or elevated walking surfaces. Enclosed framing in exterior balconies and elevated walking surfaces that are exposed to rain, snow, or drainage from irrigation, shall be provided with openings that provide a net free cross ventilation area not less than 1 /150 of the area of each separate space.

2018 IBC Balcony Code Changes

What's the purpose of ventilating enclosed balcony framing spaces?

No matter how well detailed and installed the balcony moisture protection system is, moisture may still find its way into enclosed spaces. There needs to be a way for this moisture to exit – the ventilation strategy aims to solve that.

Note that the inclusion of ventilation openings will create membrane voids within the balcony floor assembly. The use of sprinklers may be req'd.

Credit: Balcony Inspection Vents

Type III Construction Detail Examples

What is being enforced in jurisdictions you are working in?


BREAK
TIME!

Shaft Wall Resource

Code provisions, detailing options, project examples and more for light-frame wood and mass timber shaft walls

Free resource at **woodworks.org**

Richard McLain, PE, SE
Senior Technical Director – Tall Wood
WoodWorks – Wood Products Council

Shaft Wall Solutions for Light-Frame and Mass Timber Buildings

An overview of design considerations, detailing options and code requirements

It is fairly common for mid-rise wood buildings to include shaft walls made from other materials. However, wood shaft walls are a code-compliant option for both light-frame and mass timber projects—and they typically have the added benefits of lower cost and faster installation.

A shaft is defined in Section 202 of the 2018 International Building Code[1] (IBC) as *"an enclosed space extending through one or more stories of a building, connecting vertical openings in successive floors, or floors and roof."* Therefore, shaft enclosure requirements apply to stairs, elevators, and mechanical-engineering-plumbing (MEP) chases in multi-story buildings. While these applications might be similar in their fire design requirements, they often have different construction constraints and scenarios where assemblies and detailing may also differ.

This paper provides an overview of design considerations, requirements, and options for light wood-frame and mass timber shaft walls under the 2018 and 2021 IBC, and considerations related to non-wood shaft walls in wood buildings.

CONTENTS

Fire Resistance

Fire Barrier Construction

Shaft enclosures are specifically addressed in IBC Section 713. However, because shaft enclosure walls need to be constructed as fire barriers per Section 713.2, many shaft wall requirements directly reference provisions of fire barriers found in Section 707.

Provisions addressing materials permitted in shaft wall construction are given in both the shaft enclosures section (713.3) and fire barriers section (707.2). These

Hotel Magdelena in Austin, TX

https://www.woodworks.org/resources/shaft-wall-solutions-for-wood-frame-buildings/

Shaft Walls

Mass Timber

Photo: Quality Contractors

Steel Studs, Wood Studs

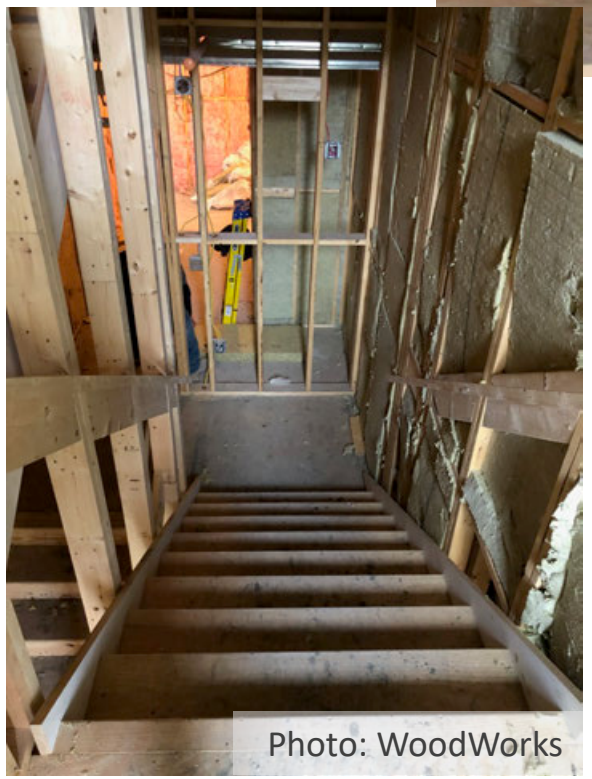


Photo: WoodWorks

Shaftliner Panels

Photo: Georgia Pacific

Masonry

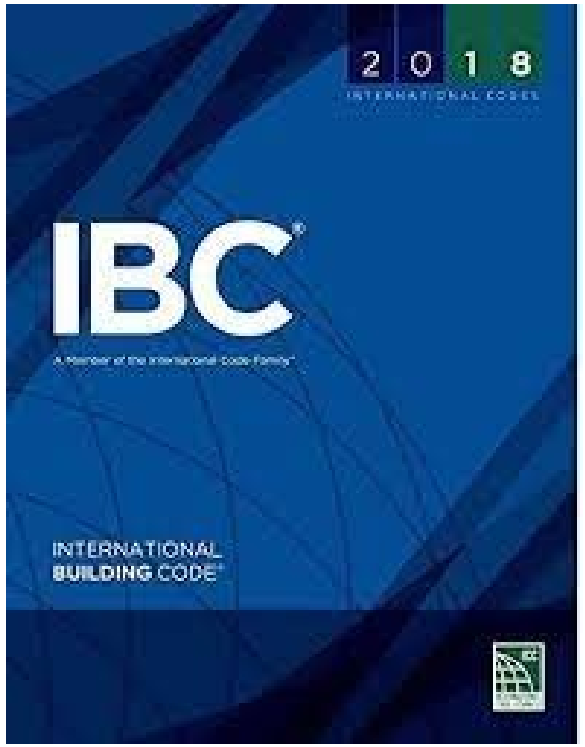
Photo: WoodWorks

Shaft Walls

Shaft Walls Form Shaft Enclosures

"The purpose of shafts is to confine a fire to the floor of origin and to prevent the fire or the products of the fire (smoke, heat and hot gases) from spreading to other levels."

Source: IBC Commentary to Section 713.1



Types of Shaft Walls

Types of Shafts:

- Elevator
- Stair
- Mechanical

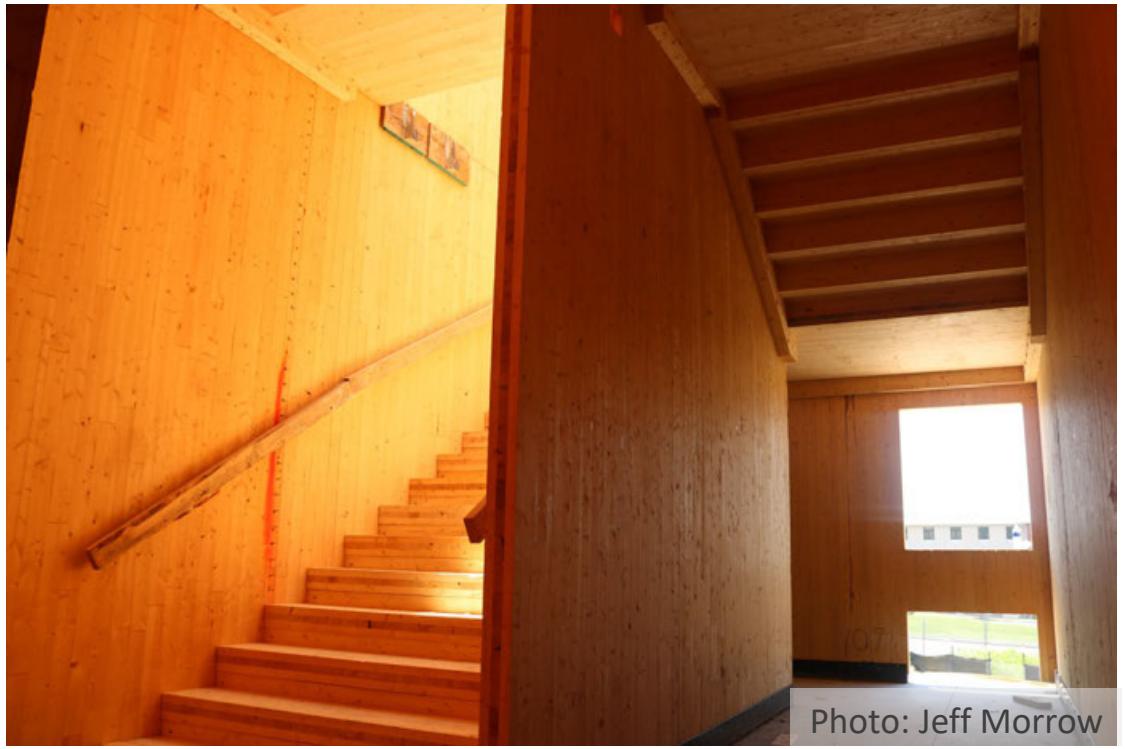


Photo: Jeff Morrow

Code requirements apply to any/all shaft enclosures. Some points of shaft wall construction and detailing apply to all types of shafts. Some are unique to each type of shaft.

More on the differences later…

Shaft Wall Design Topics - Agenda

- Wall Definition
- Materials
- Continuity
- Supporting Construction
- Joints & Penetrations
- Exterior Walls
- Assemblies
- Floor to Shaft Wall Intersections
- Stair, Elevator & Mechanical Shafts – Differences
- Non-Wood Shaft Walls

Defining Shaft Wall Requirements

IBC defines 4 different types of fire-resistance rated walls:

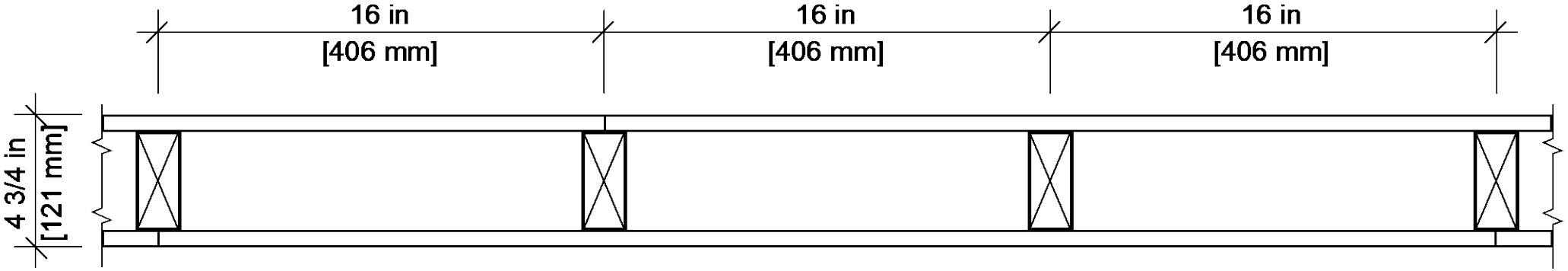
- Exterior Walls (IBC 705)
- Fire Walls (IBC 706)
- Fire Barriers (IBC 707)
- Fire Partitions (IBC 708)

Shaft Wall Hourly Rating

Section 713: Shaft Enclosures

713.4: Fire-Resistance Rating

- 2 hours when connecting 4 stories or more
- 1 hour when connecting less than 4 stories
- Number of connected stories includes basement but not mezzanine
- Fire rating of shaft walls shall not be less than floor assembly penetrated, but need not exceed 2 hours



Shaft Wall Materials

707.2 Materials.

Fire barriers shall be of materials permitted by the building type of construction.

- Wood-framed shaft walls permitted for any shaft walls in construction types III, IV-HT and V
- FRT wood-framed shaft walls may be used for non-bearing shaft walls in construction types I and II (pending AHJ interpretation)

Shaft Wall Materials

Type III Construction:

- Any material permitted by code for all interior elements
- Fire-retardant treated wood for exterior walls

Type IV-HT Construction:

- Heavy/mass timber members for all interior elements
- Any wall with 1-hr min for all interior walls/partitions
- Fire retardant treated wood or CLT for exterior walls

Type V Construction:

- Any material permitted by code for all interior and exterior elements

Shaft Wall Materials

	Type III	Type IV-HT	Type V
Interior Shaft Walls	Any code-permitted wood framing	Heavy timber or any code-permitted, 1-hr wood framing	Any code-permitted wood framing
Exterior Shaft Walls	Fire-retardant treated wood	Fire-retardant treated wood or CLT	Any code-permitted wood framing

Info on unique fire rating requirements of exterior shaft walls to come in a bit…

Shaft Wall Materials

Light Frame Wood Shaft Walls:

- Cost
- Construction Schedule
- Material Compatibility
  (movement & lateral load resistance)

Credit: WoodWorks

Shaft Wall Savings – Case Study

Switch to Wood Framed Shaft Walls Saves Project $176,000

- Gala at Oakcrest, Euless, TX
- 4 Story, 135,000 sf multi-family building
- 2 Elevator Shafts, 3 Stair Shafts, all originally designed in masonry – project was otherwise all wood framed
- Initial estimates were total of $266,000 for all 5 shafts
- Team switched to wood shafts, cut $176,000 from cost and at least 3 weeks from schedule

Source: Gardner Capital Construction, project General Contractor & Developer

Shaft Wall Materials


Photo: StructureCraft


Photo: Jeff Morrow

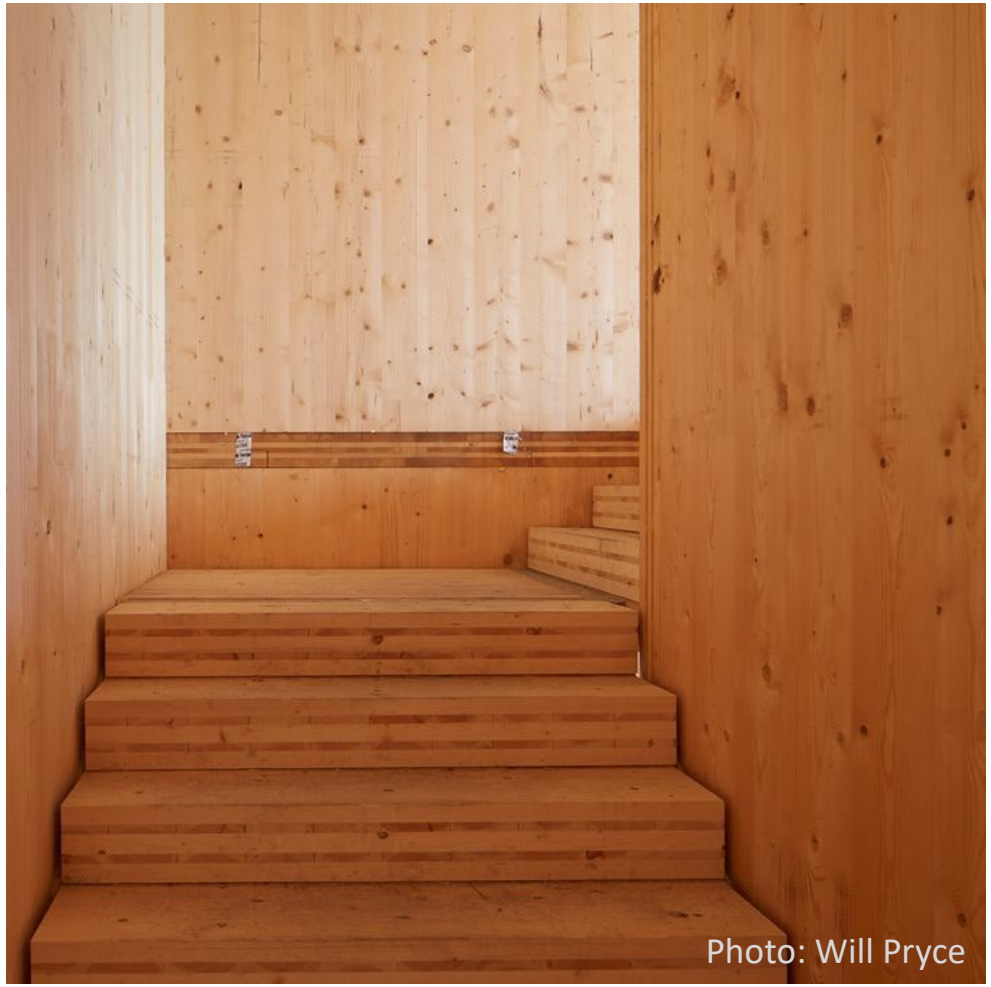


Photo: Will Pryce

There is no restriction on combustible material within shaft walls or fire barriers in Types III, IV-HT or V construction.

Continuity Provisions

Section 713: Shaft Enclosures

713.5 Continuity.

Shaft enclosures shall have continuity in accordance with 707.5 for fire barriers.

Section 707: Fire Barriers

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 though concealed space such as the space above a suspended ceiling. Joints and voids at intersections shall comply with Sections 707.8 and 707.9.

Continuity Provisions

What do these continuity provisions look like?

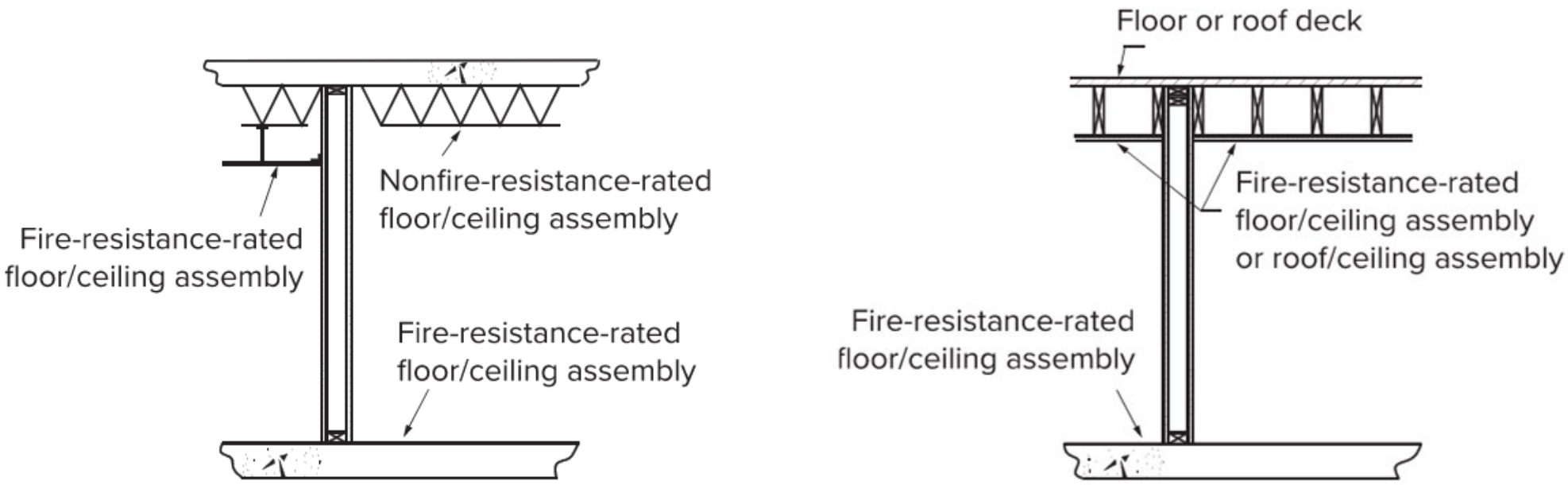


FIGURE 1: IBC Commentary Figure 707.5 – Continuity of fire barriers

Continuity Provisions

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

Fire barriers, including shaft walls, must extend from top of sheathing to underside of sheathing. Sheathing does not obstruct continuity.

Continuity Provisions

How do we achieve these requirements?

Continuity: The general requirements in 707.5 were not written with platform construction in mind. They were attempting to preclude large open concealed spaces to provide a continuous barrier between one portion of the building and another

Many jurisdictions have recognized that continuity of the fire barrier's fire protection can be maintained even if the wall framing does not extend to the underside of the decking above

We'll cover some detailing options later…

Continuity Provisions

The continuity of the fire barrier's fire protection can be maintained even if the wall framing does not extend to the underside of the decking above

Photo: WoodWorks

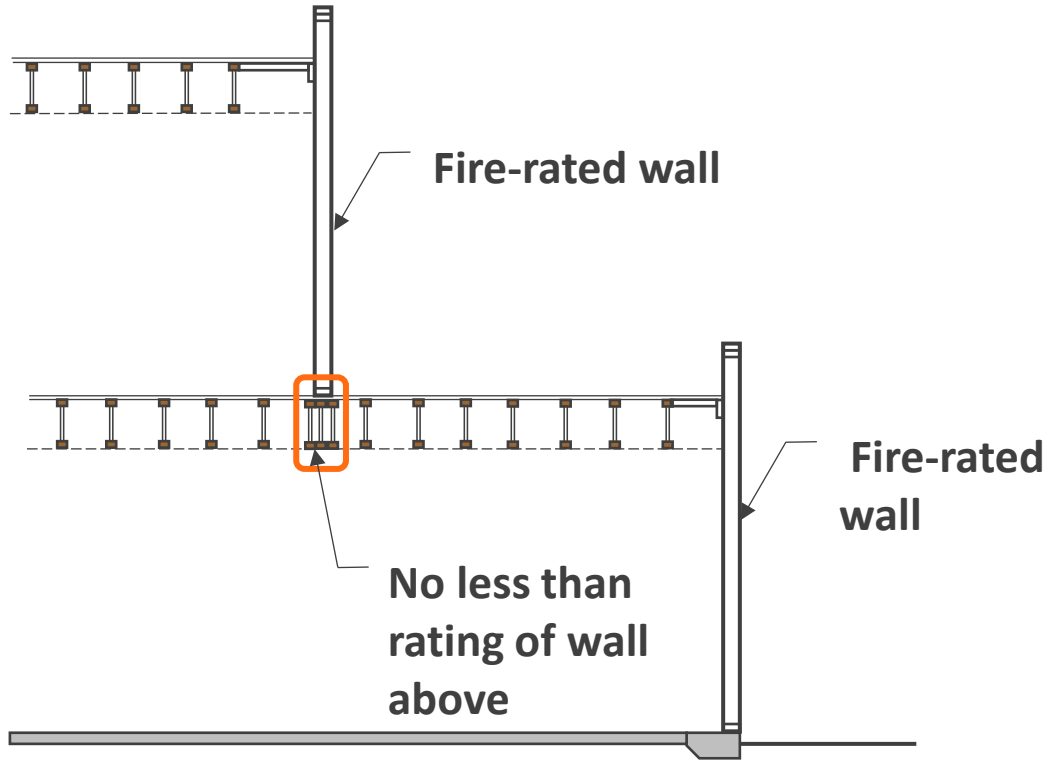
Supporting Construction Provisions

Section 707: Fire Barriers

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.

Ex., shaft walls that are not continuous to lowest level



The intent of a fire barrier is to provide fire confinement. If a fire barrier wall is supported directly by a wall below, the intersecting floor should not be considered a supporting element.

Joints in Shaft Walls

Section 707: Fire Barriers

707.5 Continuity.

Joints and voids at intersections shall comply with Sections 707.8 and 707.9.

707.8 Joints.

Joints made in or between fire barriers, and joints made at the intersection of fire barriers with underside of a fire resistance-rated floor or roof sheathing, slab or deck above, and the exterior vertical wall intersection shall comply with Section 715.

Does floor sheathing or a floor assembly intersecting a shaft wall constitute a joint?
In wood-frame construction, typically, no.

Joints in Shaft Walls

Section 202: Definitions

Joint. The opening in or between adjacent assemblies that is created due to building tolerances, or is designed to allow independent movement of the building in any plane caused by thermal, seismic, wind or any other loading.

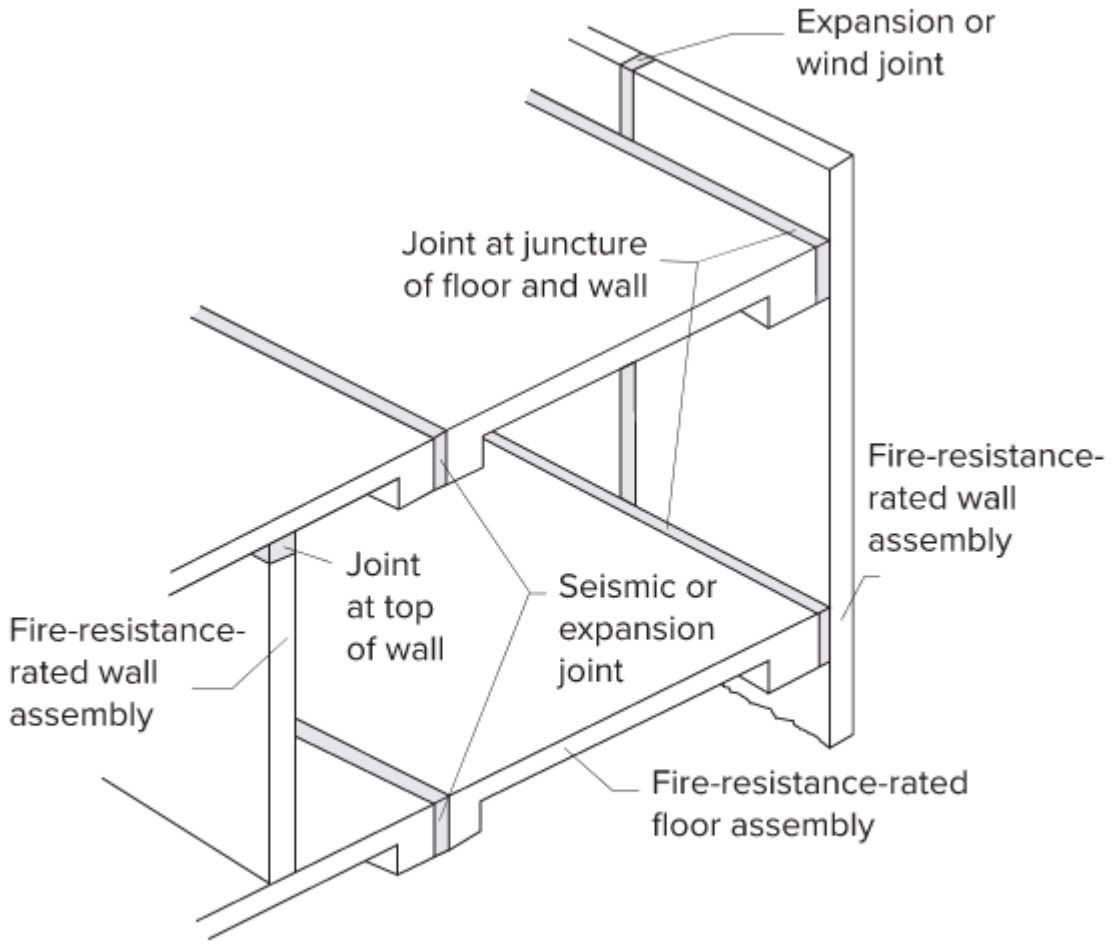


FIGURE 2: IBC Commentary Figure 715.1 – Examples of joint locations

Assembly intersections that are in direct contact and securely attached are not considered joints.

Penetrations in Shaft Walls

Section 713: Shaft Enclosures

713.8 Penetrations.

Penetrations in shaft enclosure shall be protected in accordance with Section 714 as required for fire barriers. Structural elements such as beams or joists, where protected in accordance with Section 714 shall be permitted to penetrate a shaft enclosure.

Section 707: Fire Barriers

707.7 Penetrations.

Penetrations of fire barriers shall comply with Section 714.

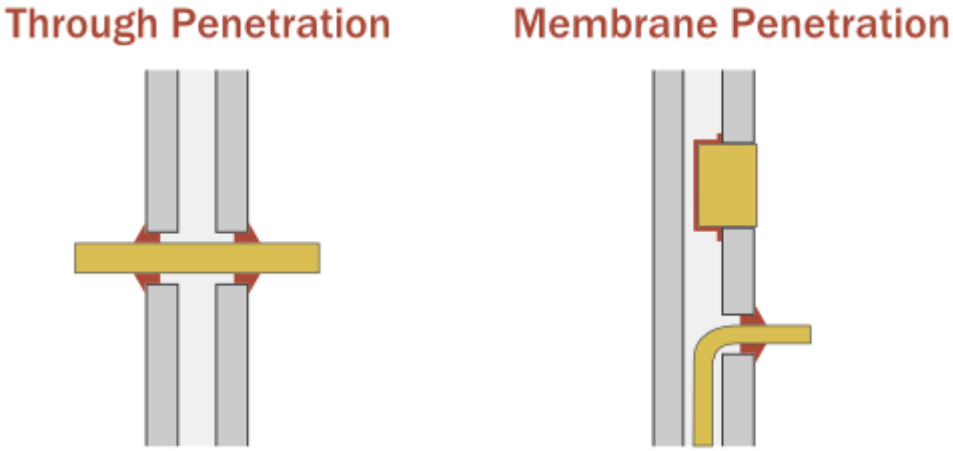
Penetrations in Shaft Walls

Where are structural penetrations in shaft walls common?

- Main Floor Joists to Shaft Wall Connection
- Stair framing to Shaft Wall Connection

Credit: WoodWorks

Penetrations in Shaft Walls



Section 714: Penetrations

714.3.1.1 Fire-resistance-rated assemblies.

Penetrations shall be installed as tested in an approved fire resistance rated assembly.

or

714.3.1.2 Through-penetration firestop system.

Through penetrations shall be protected by an approved penetration firestop system installed as tested in accordance with ASTM E814 or UL 1479, with a minimum positive pressure differential of .01 inch of water and shall have an F rating of not less than the required fire-resistance rating of the wall penetrated.

Penetrations in Shaft Walls

Stair landing beam shaft wall structural penetration prior to firestop system installation

Credit: WoodWorks

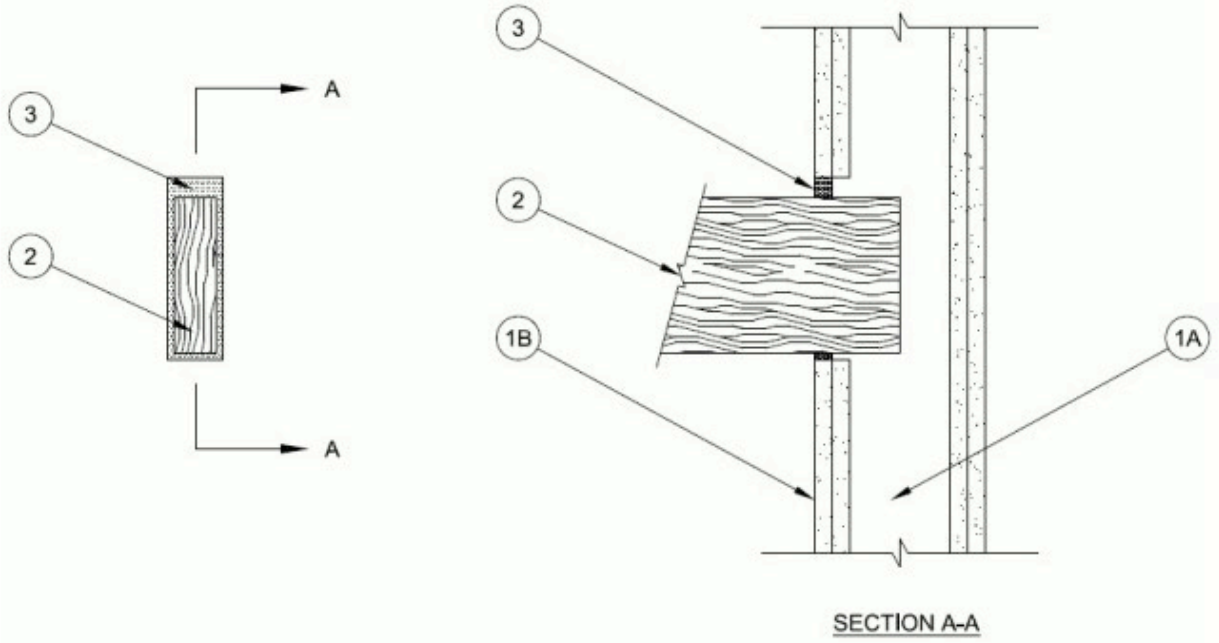
- Some firestopping systems available as tested configurations for wood conditions
- Most manufacturers can provide engineering judgement details, certification statements for this condition

Penetrations in Shaft Walls

System No. W-L-7244

August 24, 2016

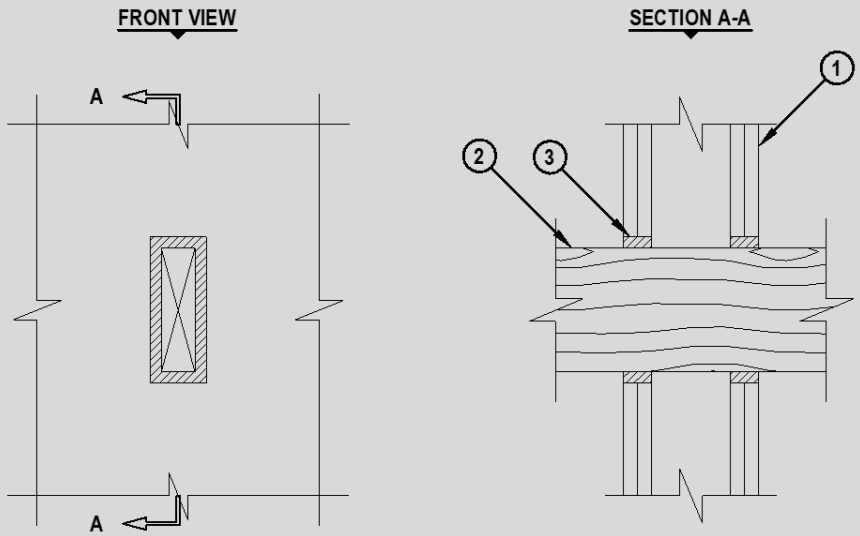
ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Ratings — 1 and 2 Hr (See Item 1)	F Ratings — 1 and 2 Hr (See Item 1)
T Ratings — 1 and 2 Hr (See Item 1)	FT Ratings — 1 and 2 Hr (See Item 1)
	FH Ratings — 1 and 2 Hr (See Item 1)
	FTH Ratings — 1 and 2 Hr (See Item 1)



DH

ENGINEERING JUDGMENT FIRESTOP DETAIL

F-RATING = 2-HR.



1. GYPSUM WALL ASSEMBLY (UL/cUL CLASSIFIED) WITH MINIMUM 2" x 6" WOOD STUDS (2-HR. FIRE-RATING).
2. NOMINAL 3-1/2" x 9-1/2" WOOD MEMBER (NON FIRE-RATED).
3. MINIMUM 1-1/4" DEPTH HILTI FS-ONE MAX INTUMESCENT FIRESTOP SEALANT.

NOTES : 1. MAXIMUM SIZE OF OPENING = 4-1/2" x 10-1/2".
2. ANNULAR SPACE = MINIMUM 1/4", MAXIMUM 1".
3. FIRE-RATING AND STRUCTURAL INTEGRITY OF ASSEMBLY IS DEPENDENT UPON THE PERFORMANCE OF WOOD MEMBER UNDER FIRE CONDITIONS.

THIS ENGINEERING JUDGMENT REPRESENTS A FIRESTOP SYSTEM THAT WOULD BE EXPECTED TO PASS THE STATED RATINGS IF TESTED.
(REFERENCE : UL/cUL SYSTEM NO. W-L-1054 & W-L-7130; INTERNAL TESTING)

	Designed by	Sheet 1 of 1	Drawing No.
		Scale 11/64" = 1"	251723a
		Date Jan. 30, 2017	

Saving Lives through Innovation and Education

Structural members are specifically called out as allowable penetrants in shaft enclosures.

Shaft Walls that are also Exterior Walls

Stair and elevator shaft enclosures are commonly placed along the exterior of the building

When a shaft wall also serves as the exterior wall of a building, unique provisions exist

Shaft Walls that are also Exterior Walls

Section 713: Shaft Enclosures

713.6 Exterior walls.

Where exterior walls serve as a part of a required shaft enclosure, such walls shall comply with the requirements of Section 705 for exterior walls and the fire resistance-rated enclosure requirements shall not apply.

Exception: Exterior walls required to be fire-resistance rated in accordance with Section 1021.2 for exterior egress balconies, Section 1023.7 for interior exit stairways and ramps and Section 1027.6 for exterior exit stairways and ramps.

Shaft Walls that are also Exterior Walls

Exterior bearing wall fire resistance rating per Table 601

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]	2[a]	1	0	1	0	HT	1	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 602.4.6	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

Shaft Walls that are also Exterior Walls

Exterior non-bearing wall fire resistance rating per Table 602

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U[h]
$X < 5^b$	All	3	2	1
$5 \le X < 10$	IA Others	3 2	2 1	1 1
$10 \le X < 30$	IA, IB IIB, VB Others	2 1 1	1 0 1	1[c] 0 1[c]
$X \ge 30$	All	0	0	0

Shaft Walls that are also Exterior Walls

Exterior Walls (IBC 705):

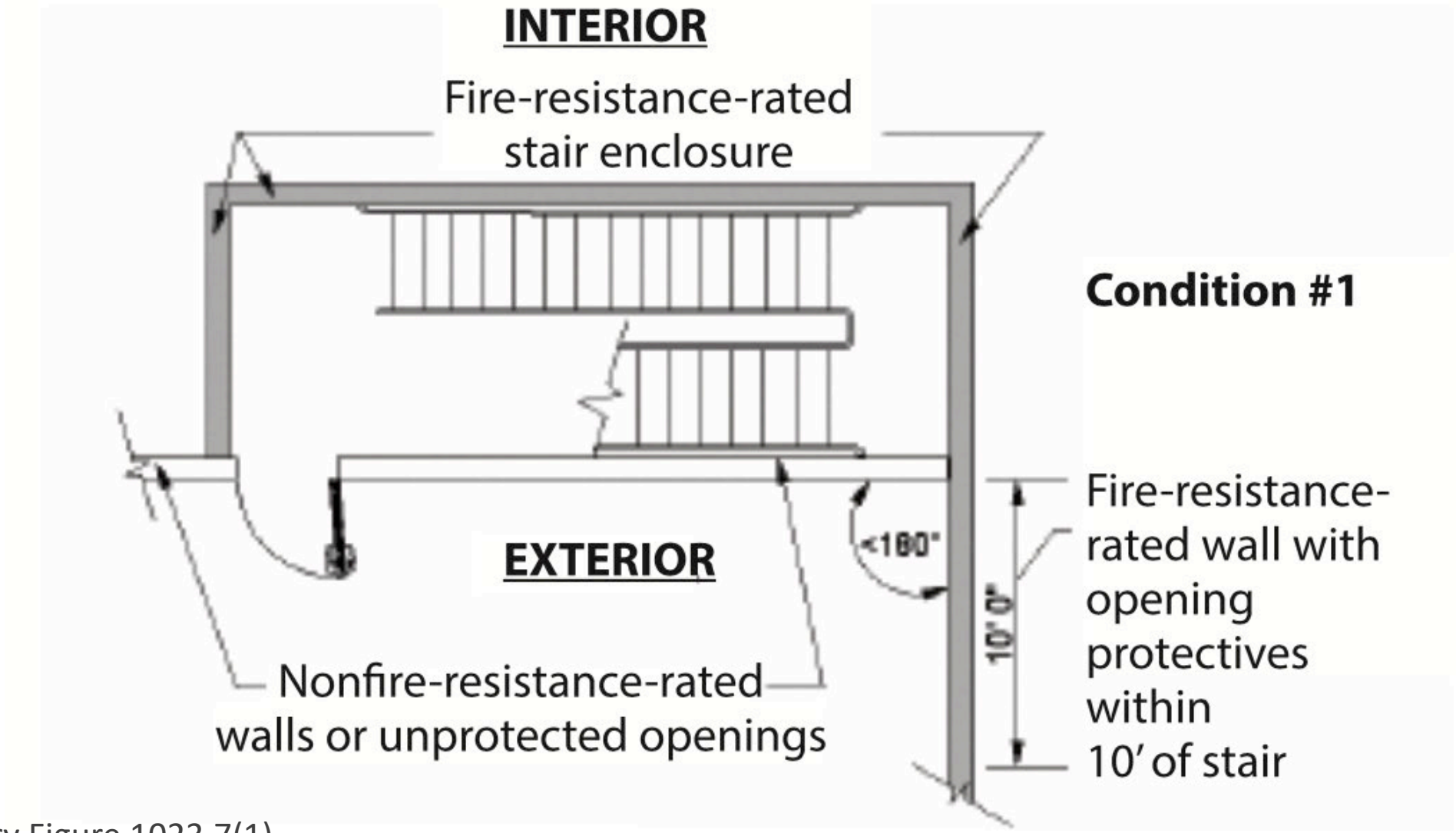
- Materials as permitted for type of construction (same as fire barrier) – 705.4
- Fire resistance only required from inside if fire separation distance is > 10 ft – 705.5
- Possible to have exterior shaft wall that does not require a fire resistance rating

Shaft Walls that are also Exterior Walls

1023.7 Interior exit stairway and ramp exterior walls.

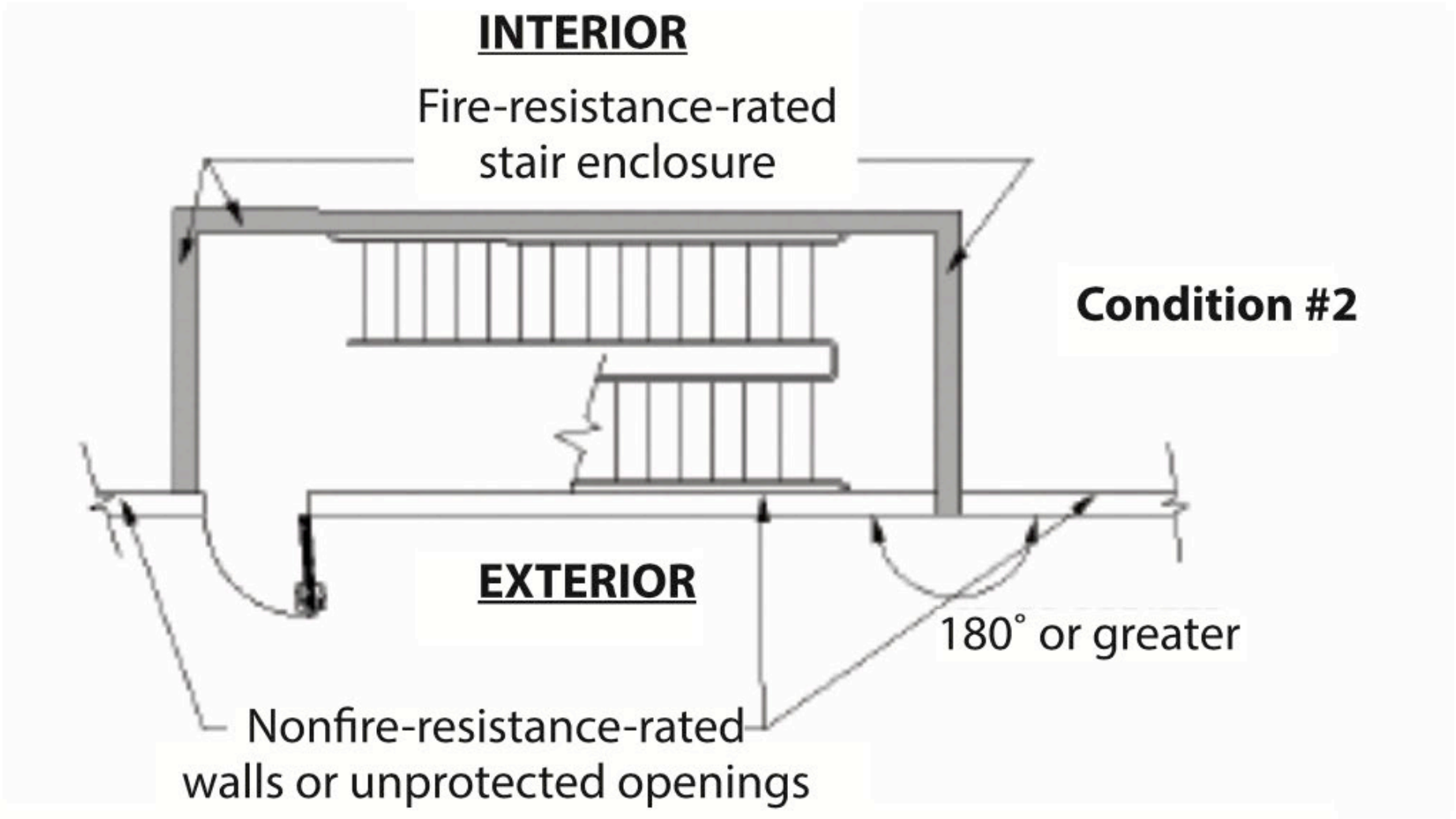
Exterior walls of the interior exit stairway or ramp shall comply with the requirements of Section 705 for exterior walls. Where nonrated walls or unprotected openings enclose the exterior of the stairway or ramps and the walls or openings are exposed by other parts of the building at an angle of less than 180 degrees (3.14 rad), the building exterior walls within 10 feet (3048 mm) horizontally of a nonrated wall or unprotected opening shall have a fire-resistance rating of not less than 1 hour. Openings within such exterior walls shall be protected by opening protectives having a fire protection rating of not less than 3/4 hour. This construction shall extend vertically from the ground to a point 10 feet (3048 mm) above the topmost landing of the stairway or ramp, or to the roof line, whichever is lower.

Shaft Walls that are also Exterior Walls



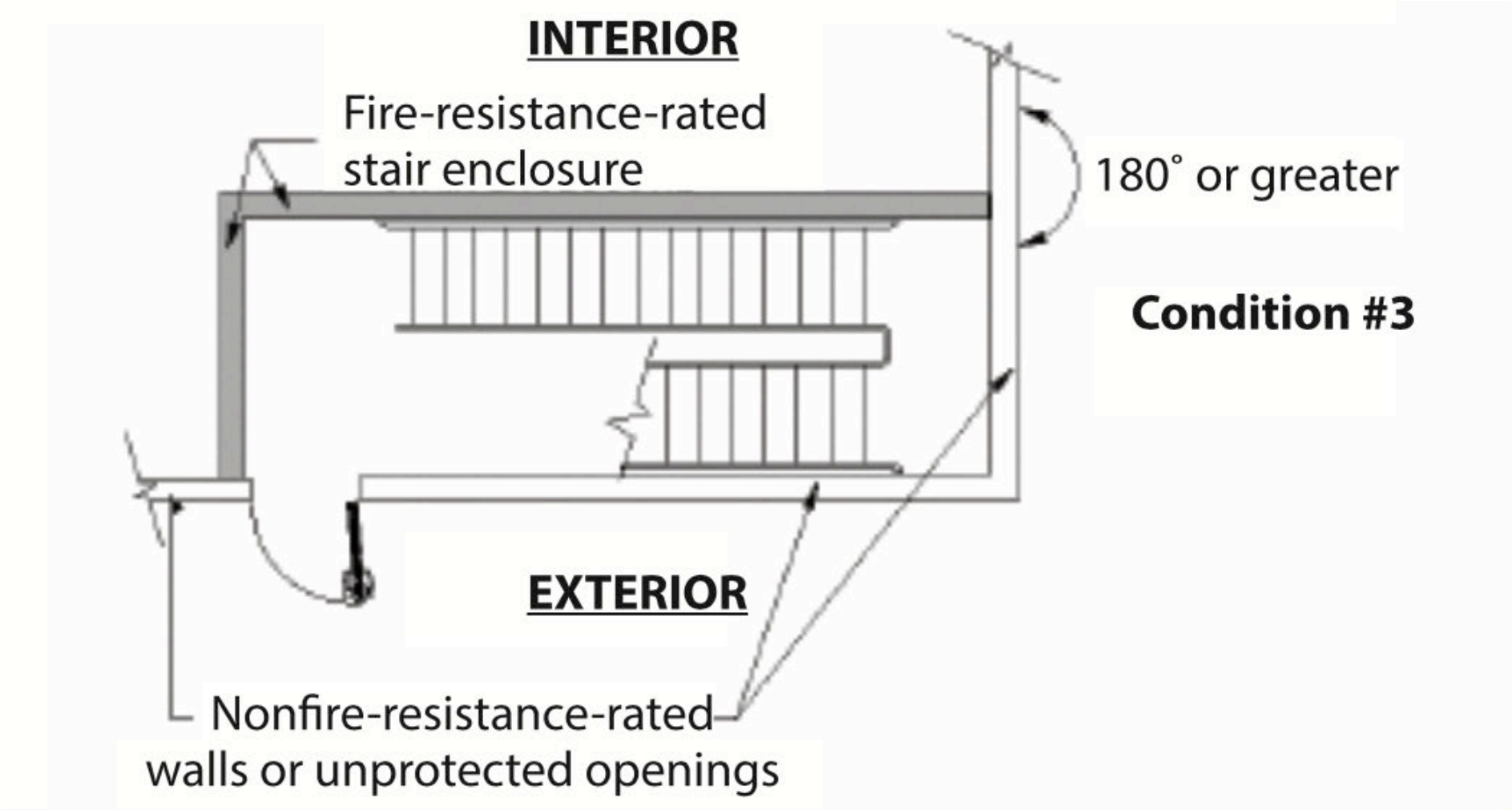
Source: IBC Commentary Figure 1023.7(1)

Shaft Walls that are also Exterior Walls



Source: IBC Commentary Figure 1023.7(1)

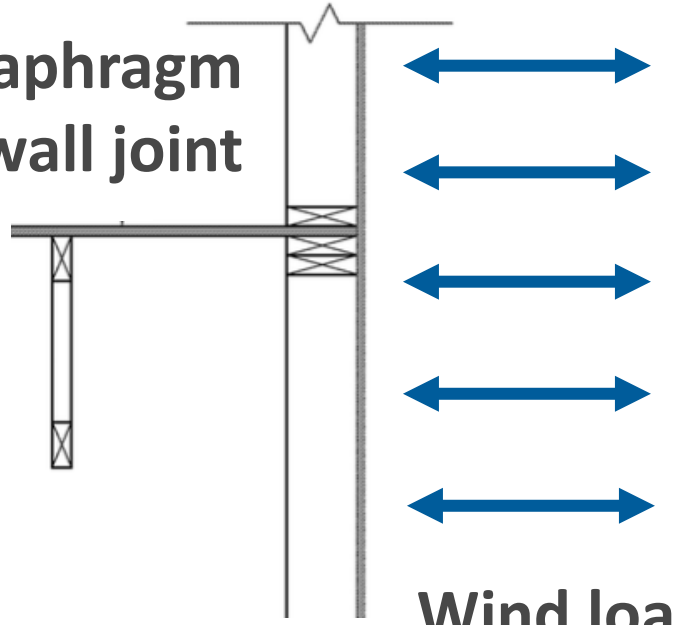
Shaft Walls that are also Exterior Walls



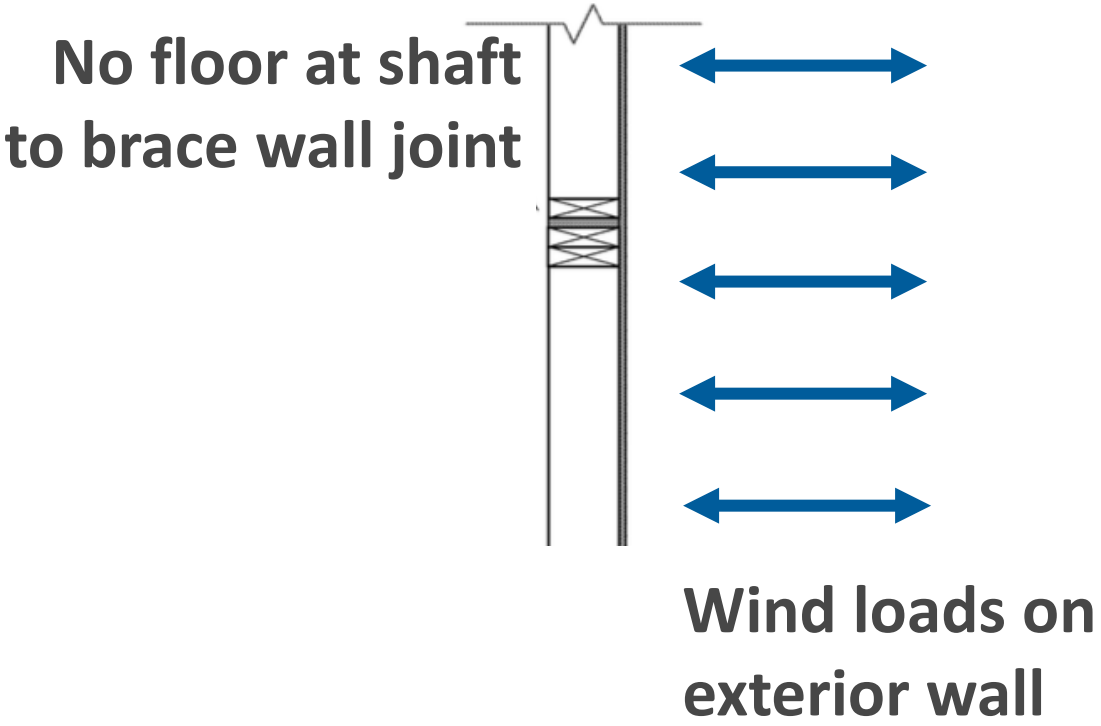
Source: IBC Commentary Figure 1023.7(1)

Shaft Walls that are also Exterior Walls

Shaft Walls that are also Exterior Walls

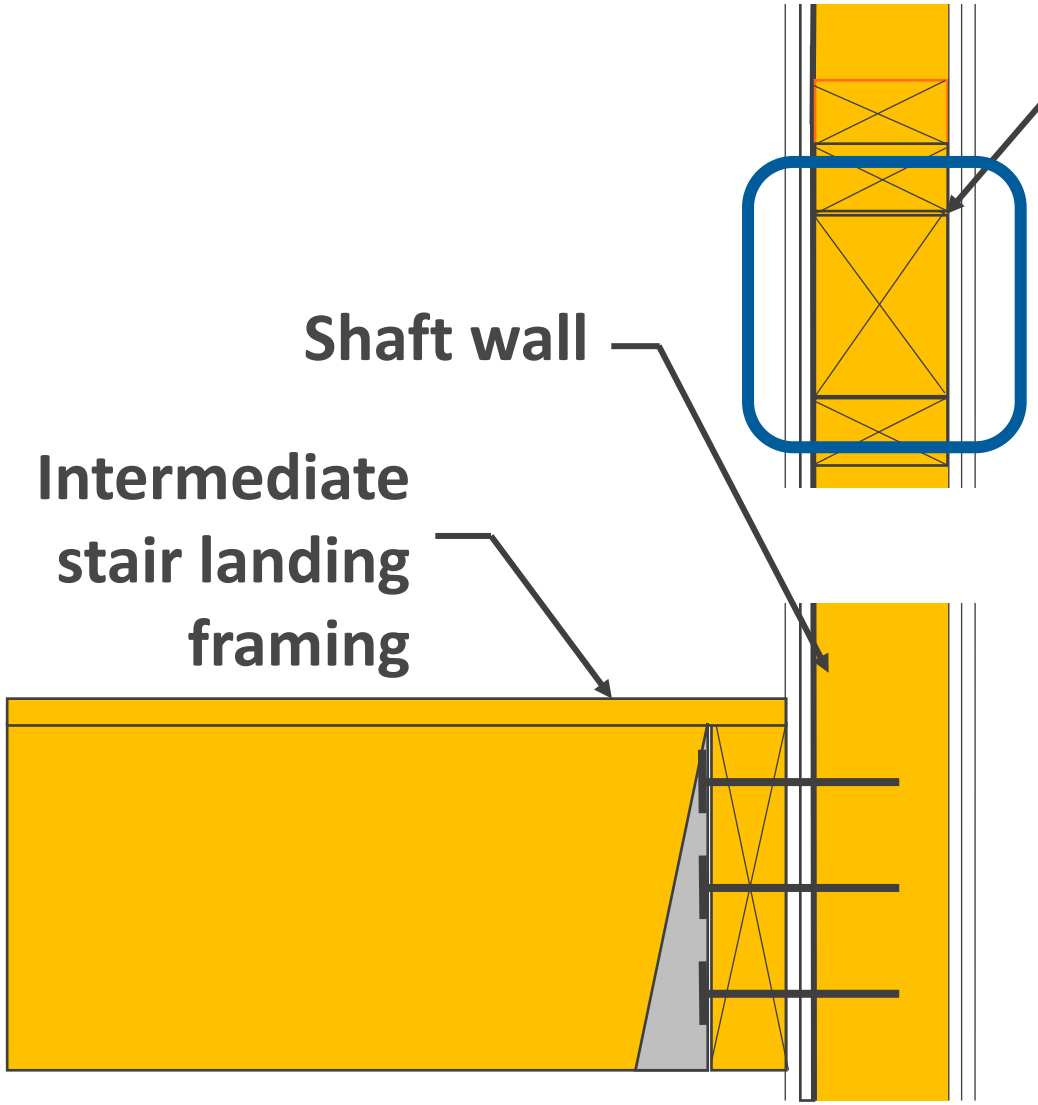


Typical Exterior Wall



Exterior Wall that is Shaft Wall

Shaft Walls that are also Exterior Walls

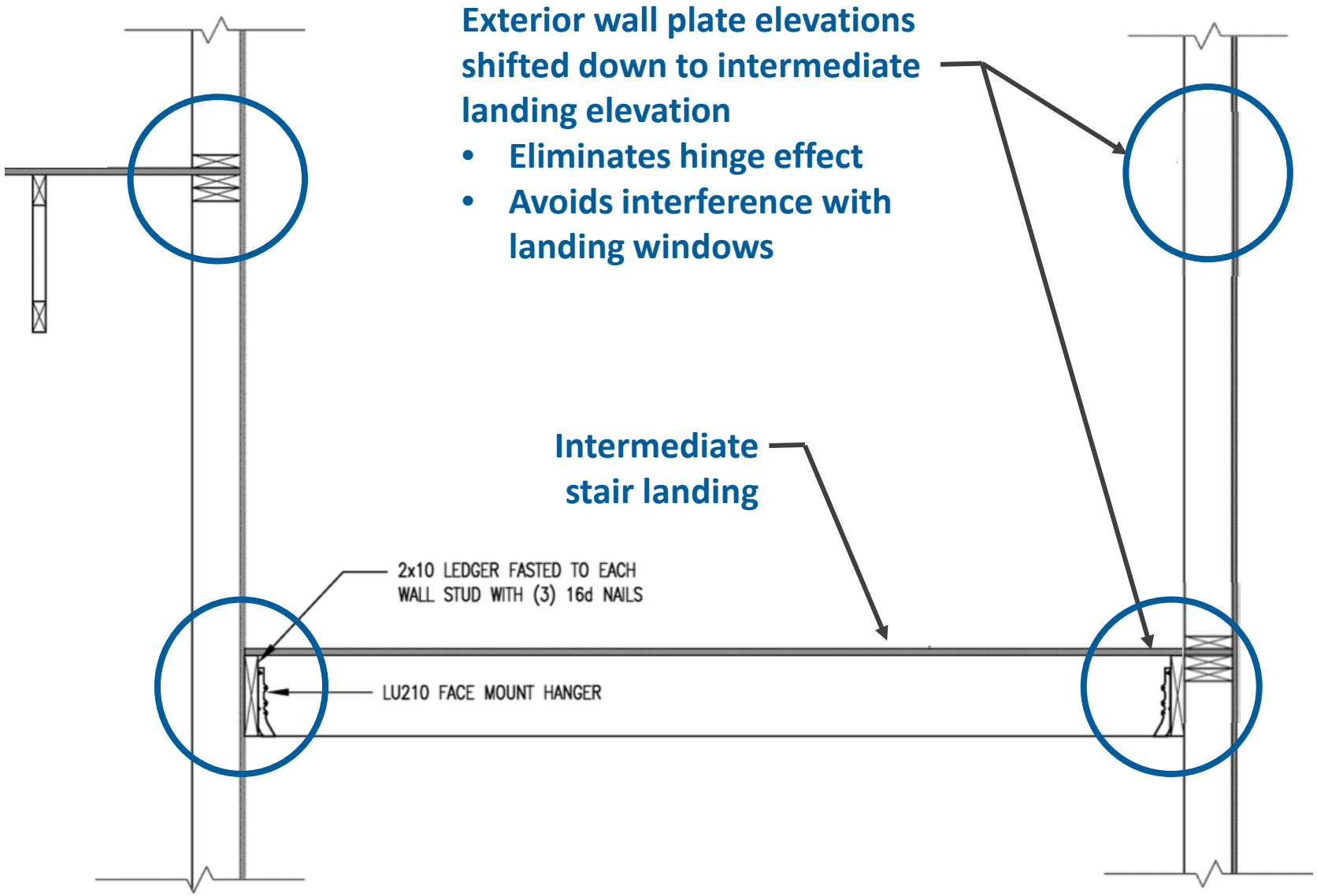


Consider “hinge” at wall plates for out-of-plane wind & seismic loads due to lack of adjacent floor:

- Install additional member (rim) to span horizontally

Credit: WoodWorks

When Stair Shaft Wall is Exterior Wall

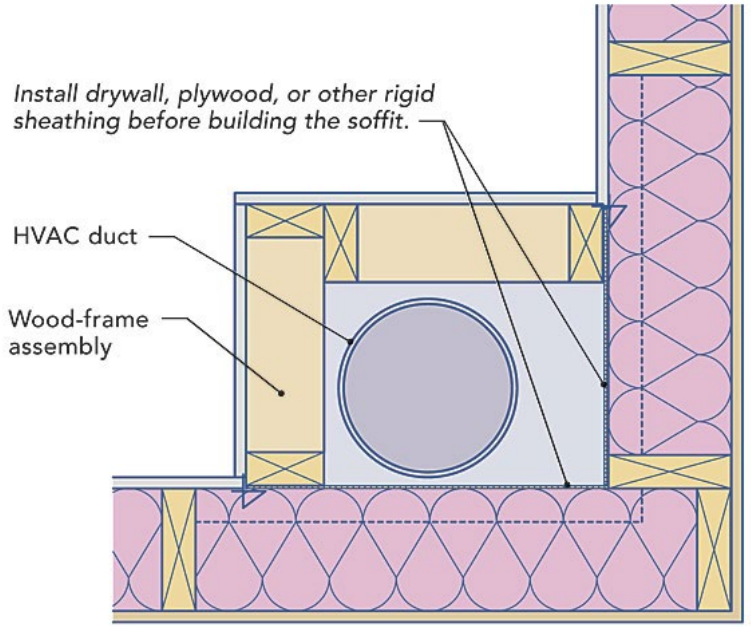


Stair, Elevator & MEP Shafts

Main Differences & Unique Design Constraints:

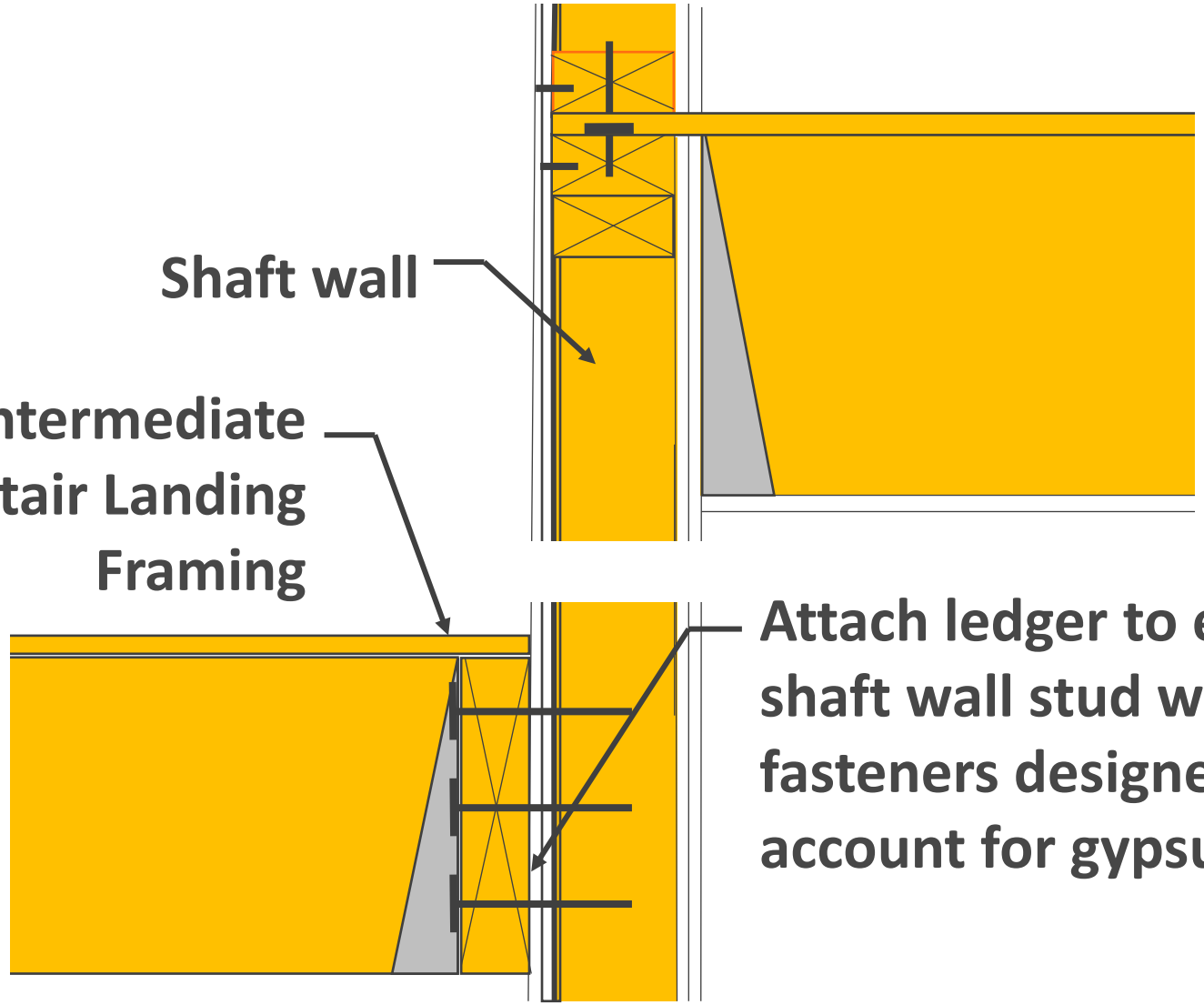
- Stair Shafts – Stair Framing
- Elevator Shafts – Rail supports
- MEP Shafts – Small Size


Credit: WoodWorks




Credit: WoodWorks

Stair Shafts



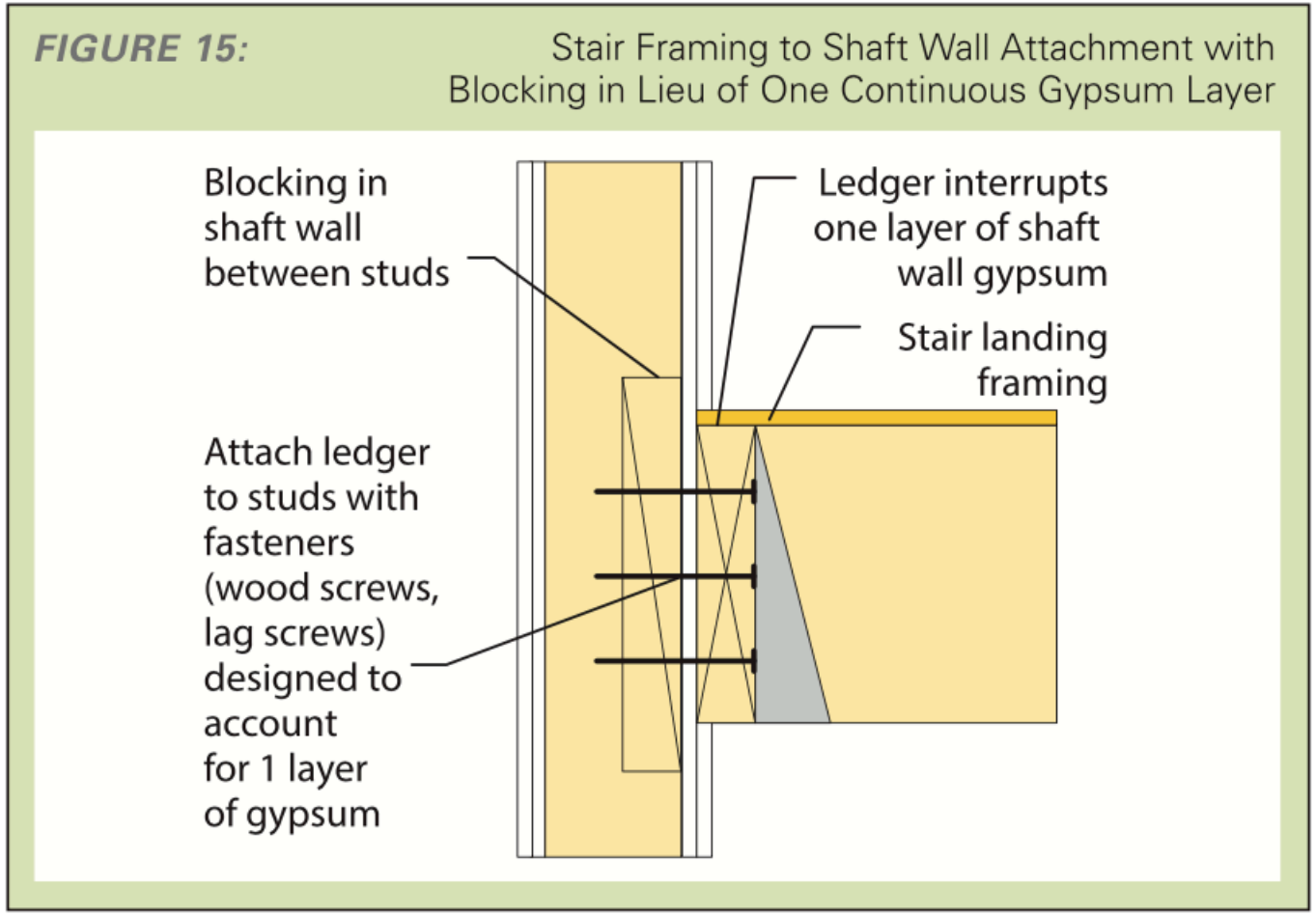

Credit: WoodWorks

Stairway Shaft Enclosures & Framing

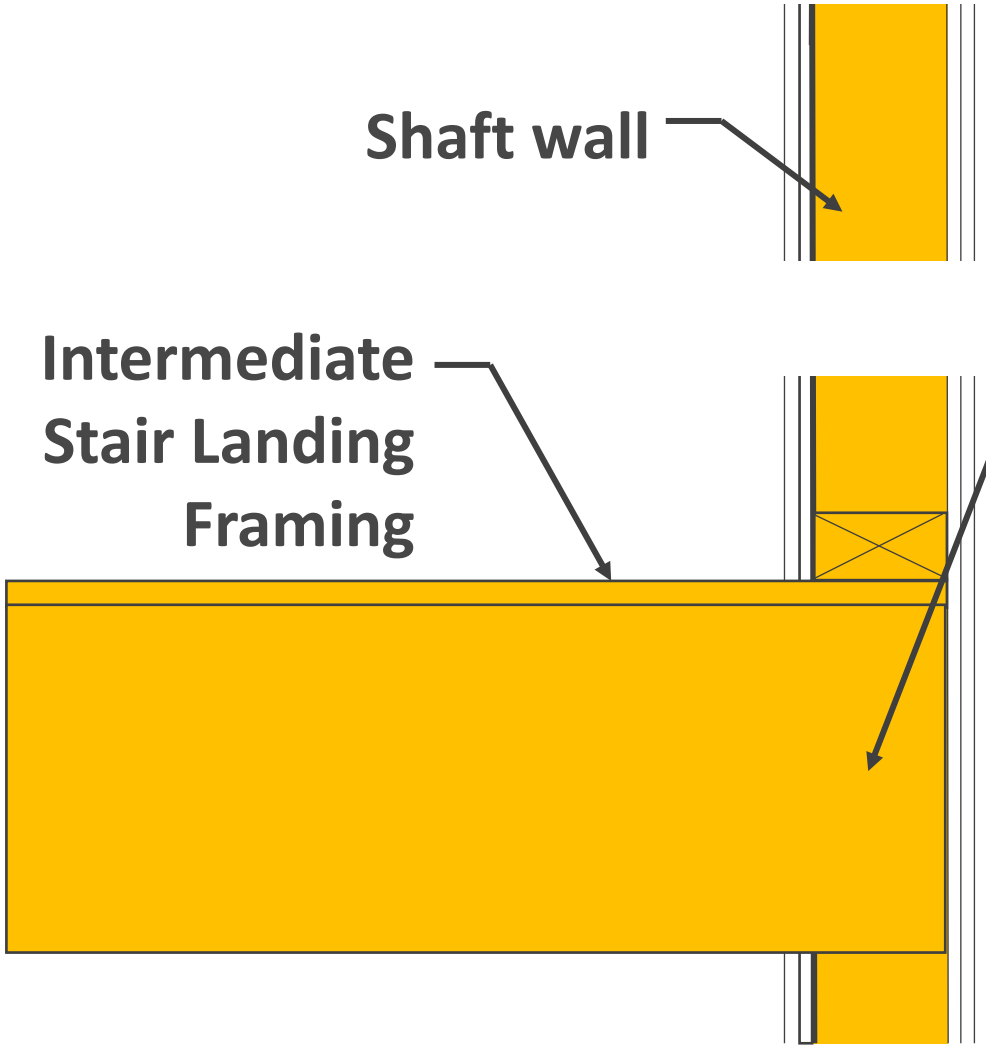
Credit: WoodWorks

Stair Shafts

- Wood blocking in wall used to achieve 1-hr of continuity
- Alternatively – interrupt both gypsum layers and use 2 layers of blocking in wall
- Key to attach ledger to studs, not blocking



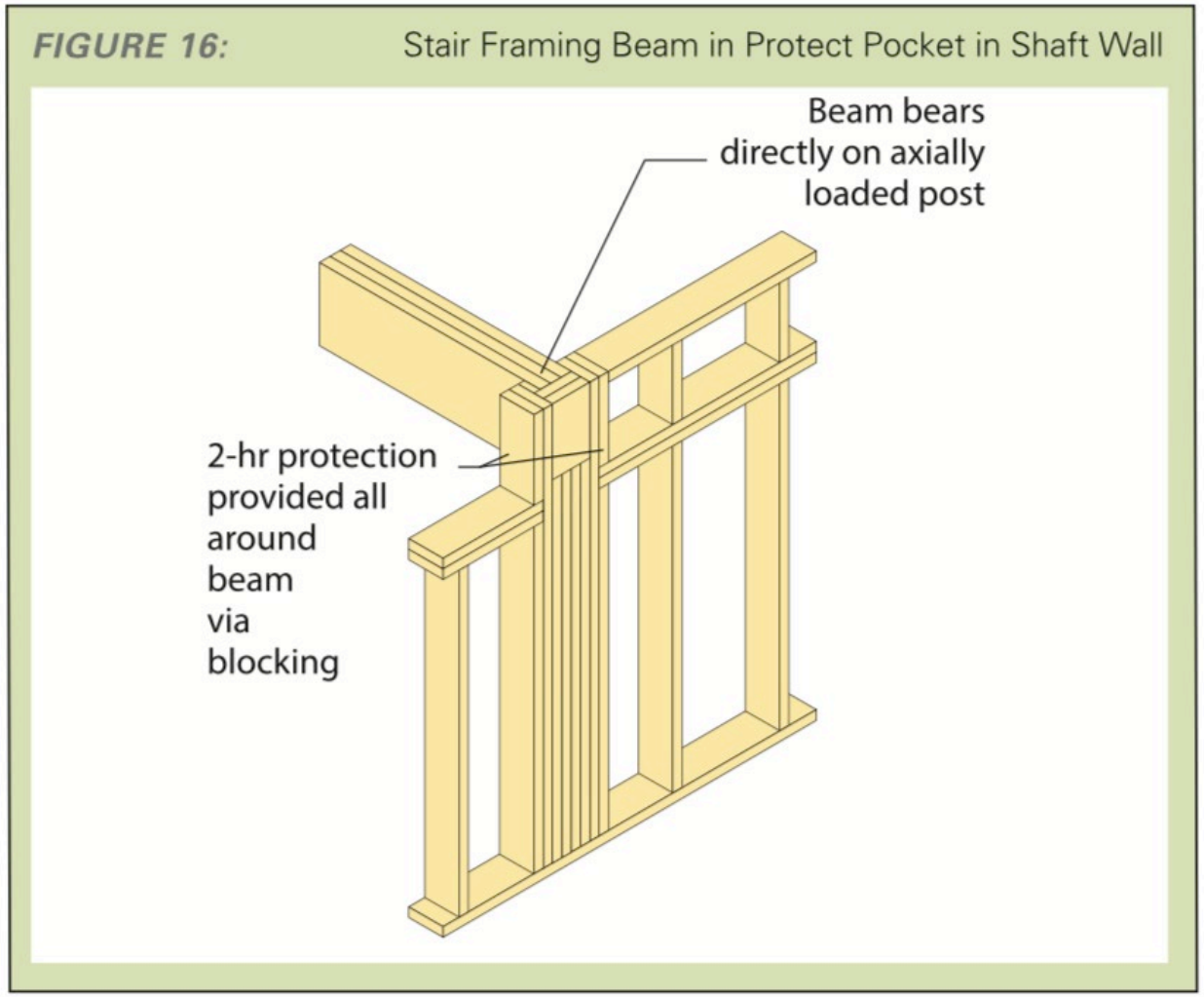
Stair Shafts



Intermediate Landing Beam Extends into Shaft Wall – Oversize to Provide 2 Hour Fire Protection Using Calculated Char Rates

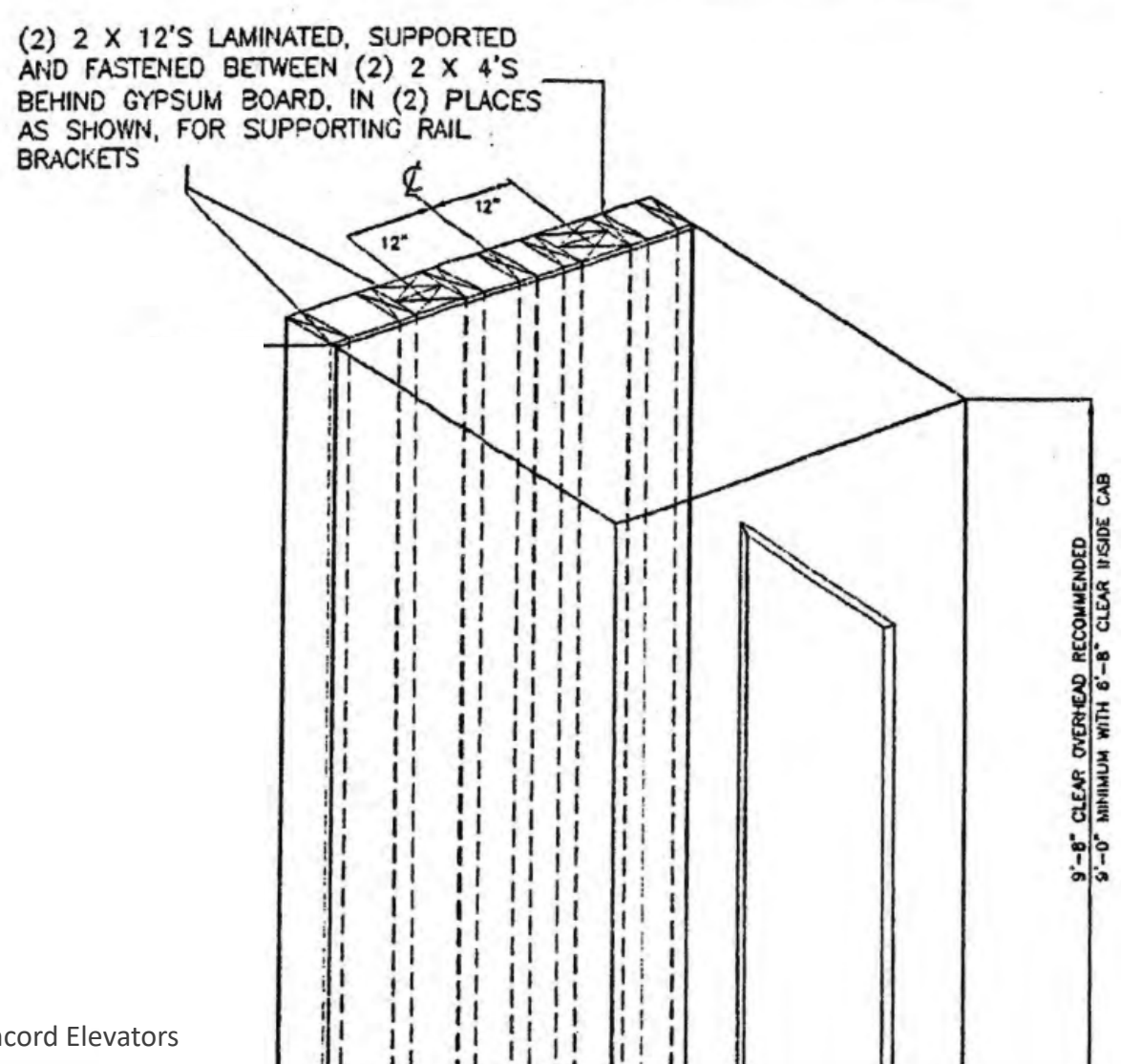
- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor cavity beam oversized to provide 2-hr char protection

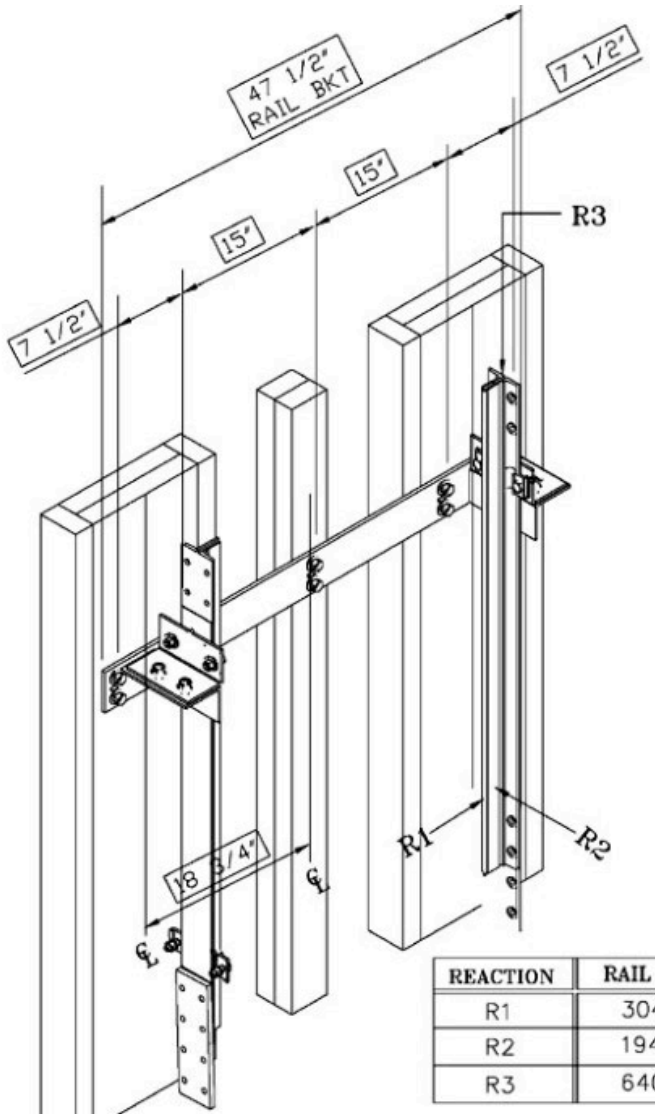
Stair Shafts



Elevator Shafts

Elevator Shafts

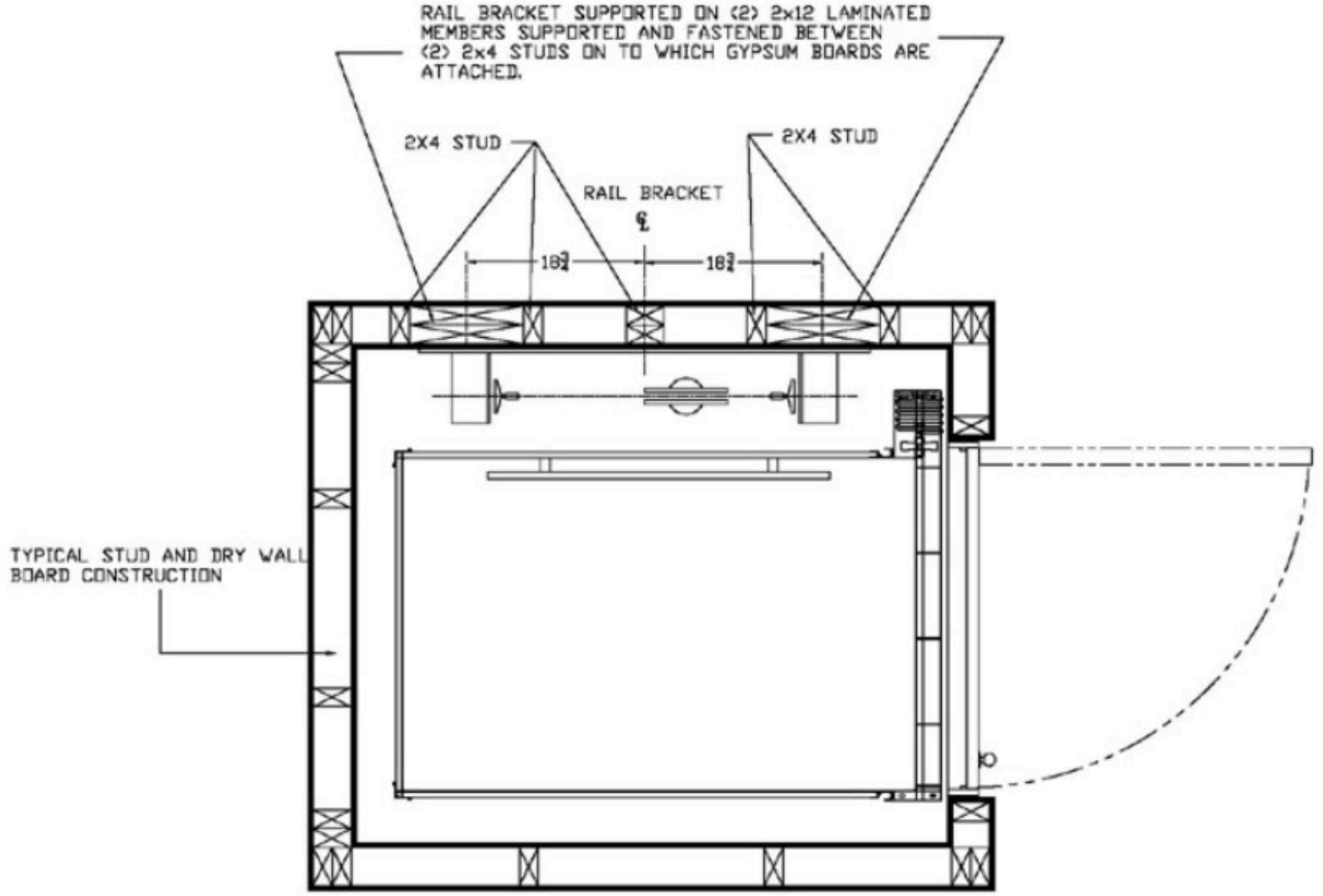




REACTION	RAIL FORCES
R1	304 LBS
R2	194 LBS
R3	6400 LBS

Credit: Concord Elevators

Elevator Shafts



Credit: Concord Elevators

Elevator Shafts


Credit: WoodWorks

- Elevator hoist beam can be wood
- Material compatibility
- Construction schedule & sequencing
- Consult elevator manufacturer for details, forces, location information

MEP Shafts

Credit: WoodWorks

- Size of MEP shaft may require a solution with one or more sides being shaftliner panels
- Ability to get inside shaft to finish gypsum panels often the controlling factor in wall assembly selection

Shaft Wall Assemblies

Assembly selection considerations:

- Fire resistance rating requirement (1-hr or 2-hr)
- Size and height of shaft
- Structural needs (gravity & lateral loads)
- Acoustics
- Space available for wall (allowed thickness)

Photo: WoodWorks

Shaft Wall Assemblies

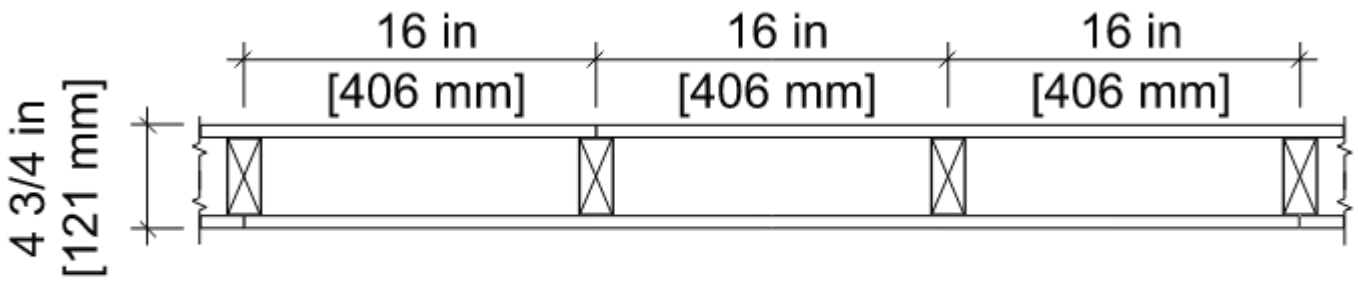


FIGURE 4: UL U305

1-Hour Single Wall

- UL U305
- GA WP 3510
- UL U311
- IBC 2012 Table 721.1(2), Item 14-1.3
- UL U332

1-Hour Double Wall

- UL U341

1-Hour Wall with Shaftliner

- UL V455
- UL V433

Shaft Wall Assemblies

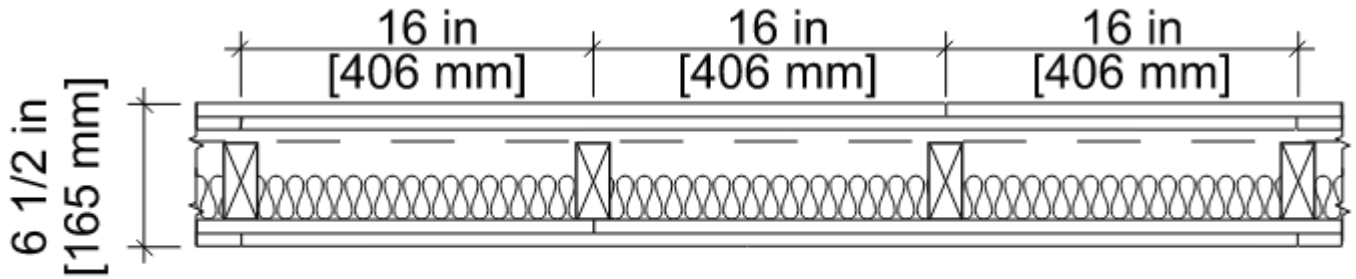


FIGURE 5: UL U334

2-Hour Single wall

- UL U301
- UL U334
- IBC 2012 Table 721.1(2) Item Number 14-1.5
- IBC 2012 Table 721.1(2) Item Number 15-1.16

2-Hour Double Wall

- UL U342
- UL U370
- GA WP 3820

2-Hour Wall with Shaftliner

- UL U336
- UL U373
- UL U375
- UL V455
- UL V433
- GA ASW 1000

Shaftliner Systems - Benefits & Limitations

Benefits

- Allows installation from one side only – useful in small MEP shafts where finishing from inside isn't possible

Limitations

- Some have height limitations, both per story and overall system
- Not structural, requires back-up wood wall

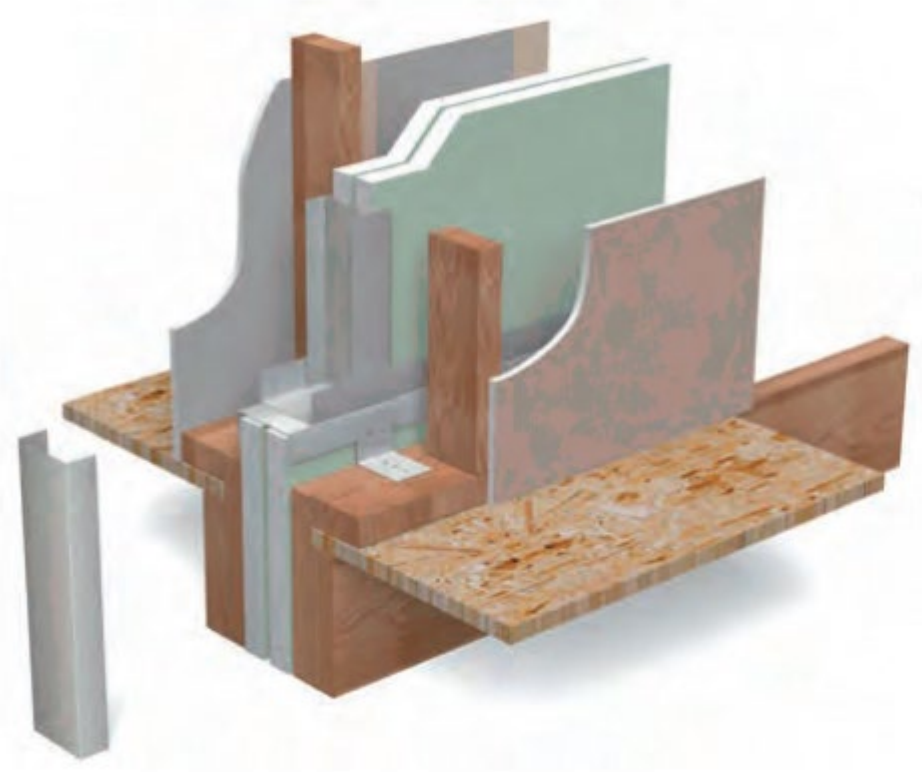


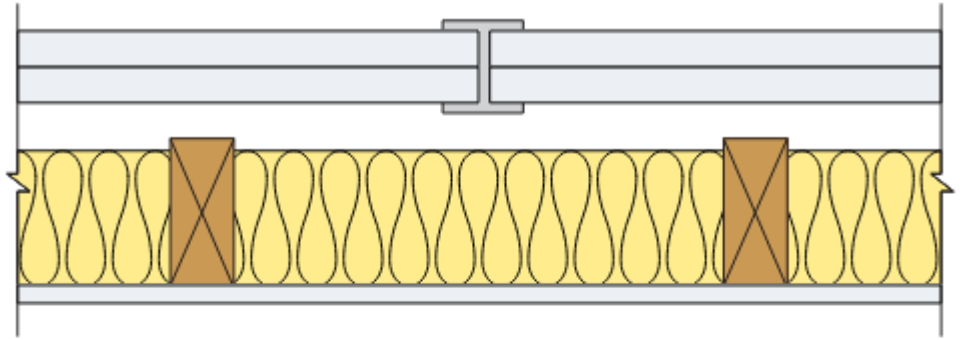
FIGURE 6: Shaftliner wall assembly with wood wall on each side

Credit: ClarkDietrich

Shaftliner Systems – Configuration Options

H-Stud Option

Source: Clark Dietrich

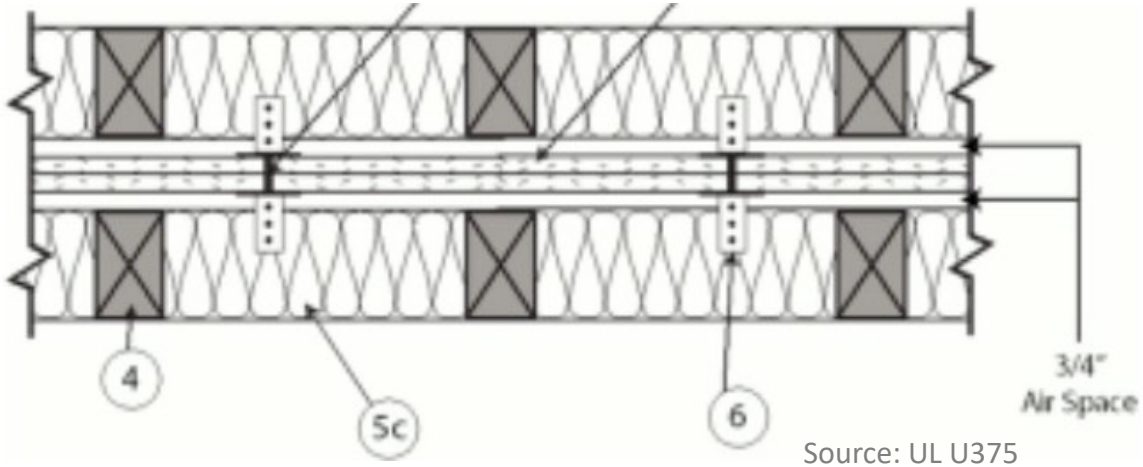


59 STC Sound Transmission

Test Reference: RAL TL 10-290

Two layers 1" (25.4 mm) shaftliner inserted in H-studs 24" (610 mm) o.c., min. 3/4" (19 mm) air spacing between liner panels and adjacent or wood metal framing

Sound tested with 2"x4" stud wall with 1/2" (12.7 mm) wallboard or interior panels and 3-1/2" (89 mm) fiberglass insulation in stud space



Source: UL U375

FIGURE 8: UL U373

Credit: Georgia Pacific

Shaftliner Systems – Height Limits

Example Shaftliner Clip Attachment Schedule per UL U375		
System No.	System Height Limitation	Attachment Clip Schedule
1	23 ft	10 ft o.c.
2	44 ft	Base to 20 ft: 5 ft o.c. 20 ft to 44 ft: 10 ft o.c.
3	66 ft	Base to 22 ft: 3’-4” o.c. 22 ft to 42 ft: 5 ft o.c. 42 ft to 66 ft: 10 ft o.c.

H-Stud

Source: Clark Dietrich

Attachment Clips: Aluminum or steel angles, usually 14 – 16 gauge, 2” wide with 2” to 2-1/2” long legs. Attaches to wall framing and H-studs

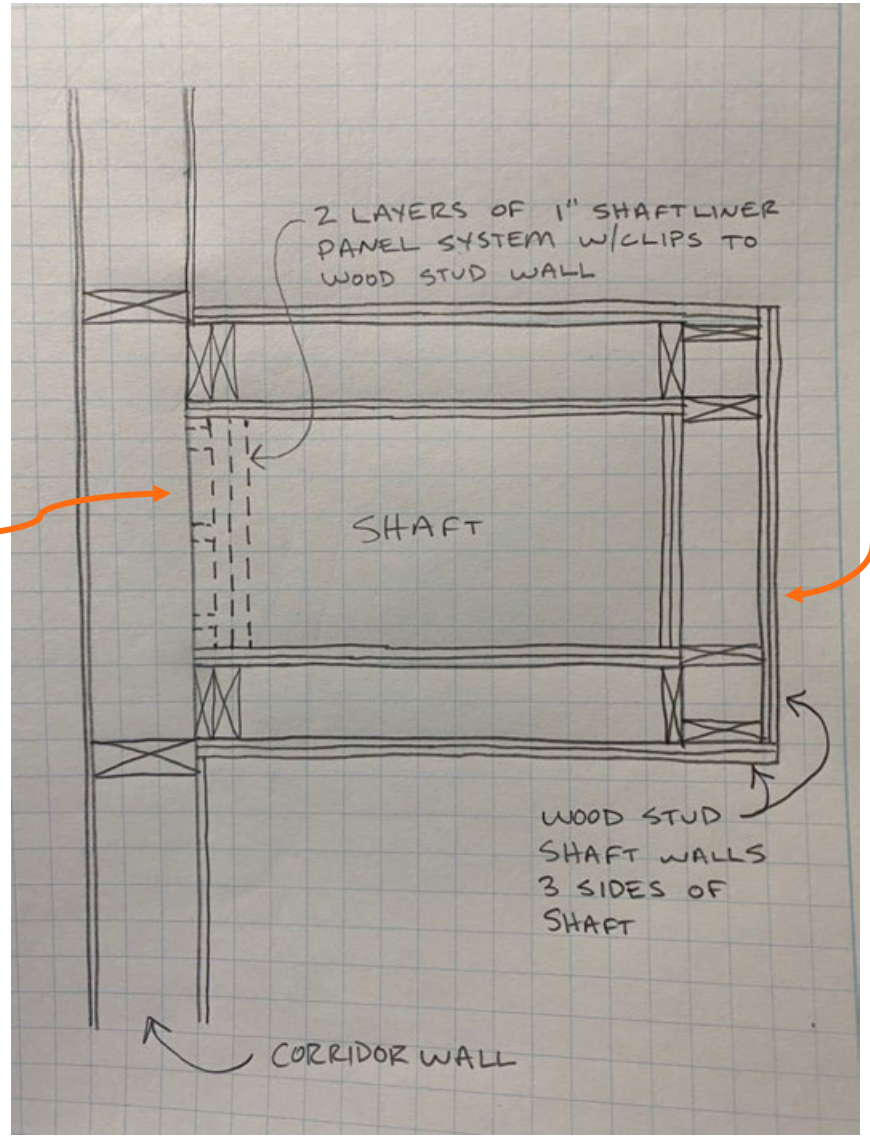
Shaftliner Systems – Configuration Options


Credit: WoodWorks

Can also utilize wood framed shaft walls on 3 sides and CH studs with shaftliner on 4th side

Shaftliner Systems – Configuration Options

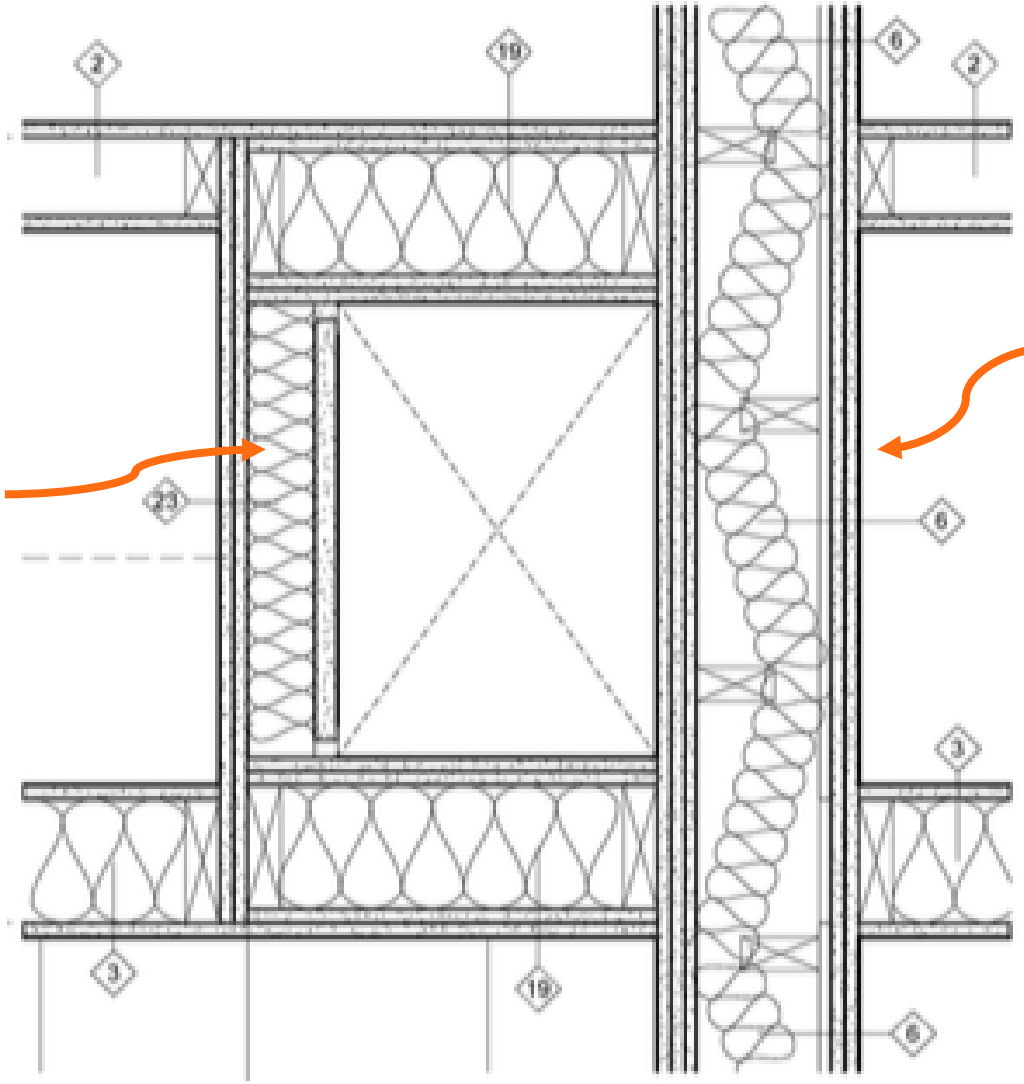
H-stud shaftliner with wood stud wall backup



3 sides of wood shaft walls installed first. If shaft is small enough, might suggest shaftliner system on more than one side

Shaftliner Systems – Configuration Options

CH-stud shaftliner



3 sides of wood shaft walls installed first. If shaft is small enough, might suggest shaftliner system on more than one side

Floor to Shaft Wall Detailing

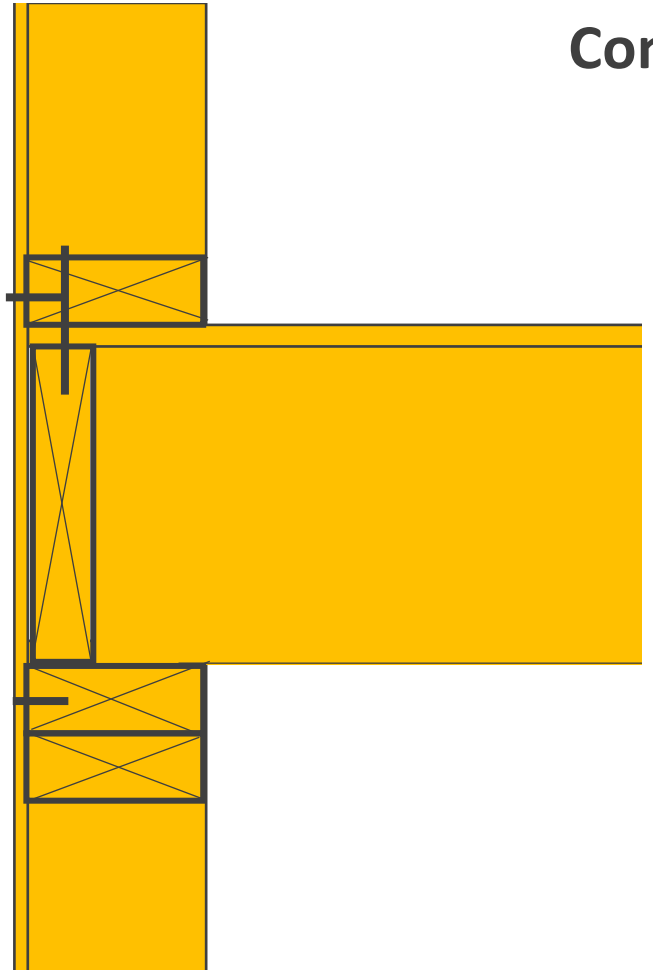
After shaft wall assembly is selected, need to consider how it will interface with floors and roof it intersects

Some key considerations are:

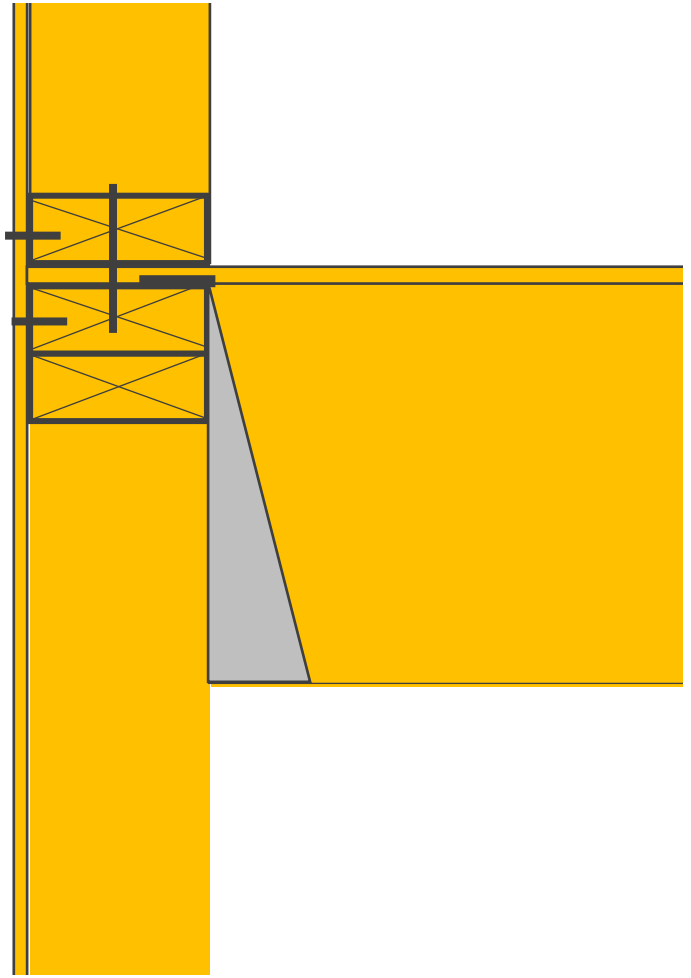
- Supporting Construction
- Continuity and Hourly Ratings
- Joints and Penetrations
- Depends on floor joist/truss type used, bearing condition
- No tested intersections exist; discuss desired detail and rationale with building official
- The following are just a few options - Contact local WoodWorks Regional Director for regional preferences, rationale, insight

Floor to Shaft Wall Detailing

Common Details



Platform Framing

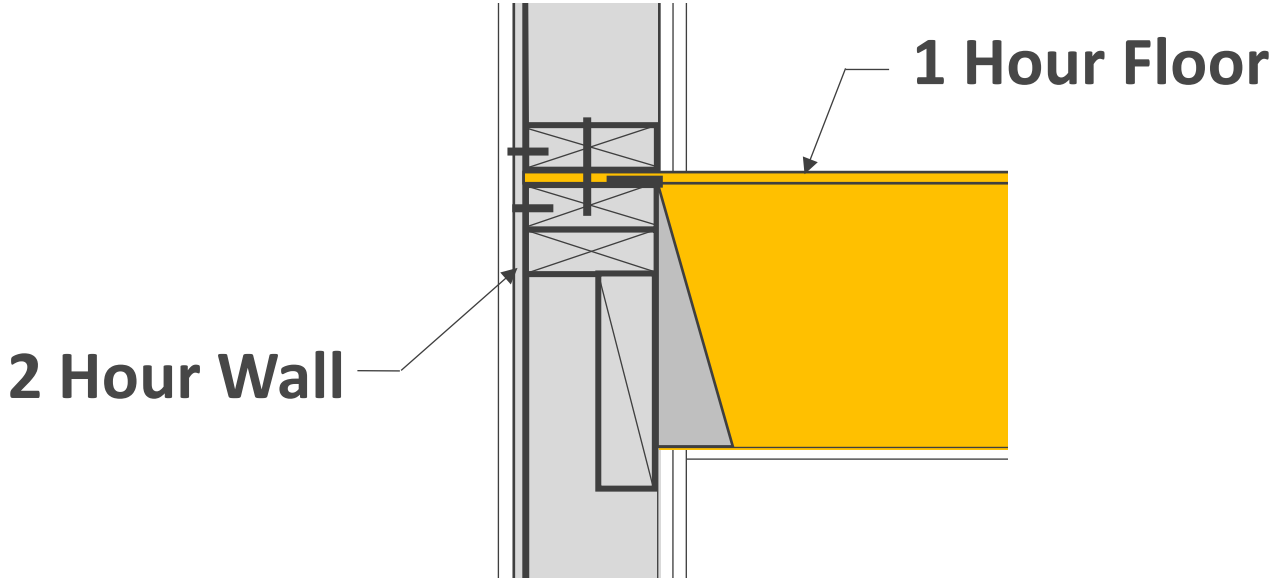


Semi-Balloon Framing

Floor to Shaft Wall Detailing

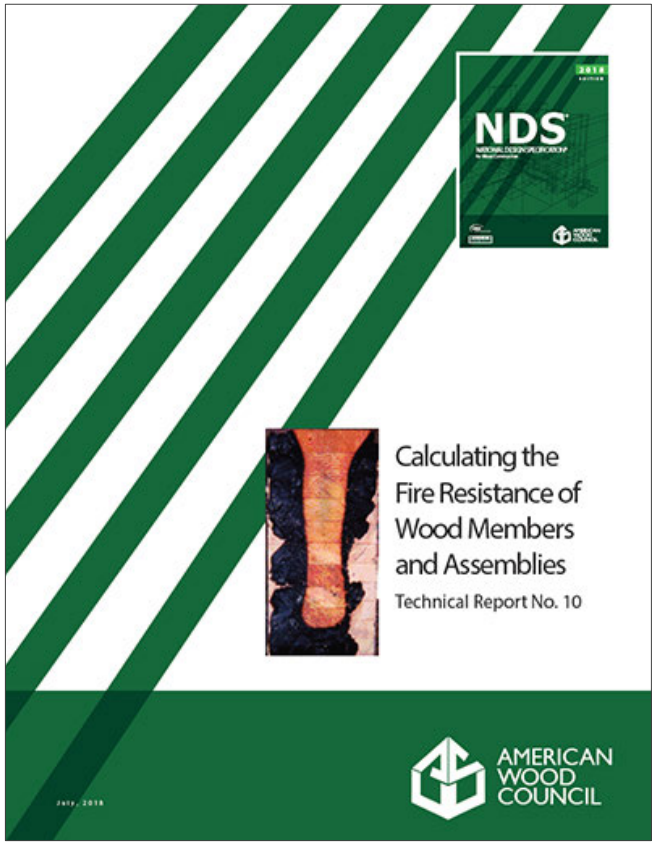
Supporting Construction: In platform and semi-balloon frame construction, if we have a 2-hour shaft wall and a 1-hour floor, how do we achieve this?

If we are able to demonstrate the wall's 2-hour continuity through the floor depth, should not need to consider the floor "supporting construction"



Calculated Fire Resistance of Wood

For Exposed Wood Members: IBC 722.1 References AWC's NDS Chapter 16 (AWC's TR 10 is a design aid to NDS Chapter 16)



Calculated Fire Resistance of Wood

Assumptions:

- Nominal assumed char rate = 1.5”/hr.
- Uses ultimate strength for design check

Structurally spanning members: reduced section checked for capacity vs. demand

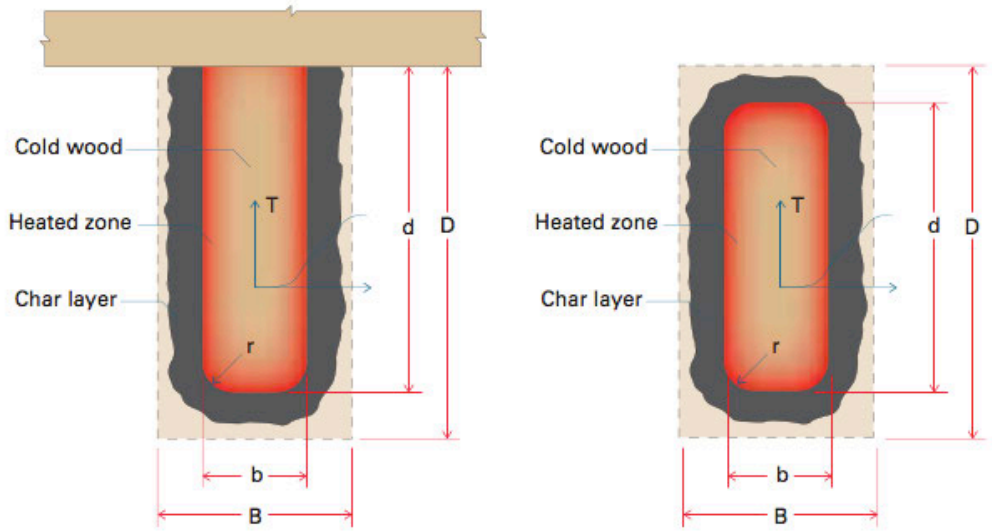


Figure 1-1 Reduction in member breadth and depth over time, t

Source: AWC’s TR 10

Light Wood-Frame Shaft Walls in Light Wood-Frame Buildings

Floor to Shaft Wall Detailing

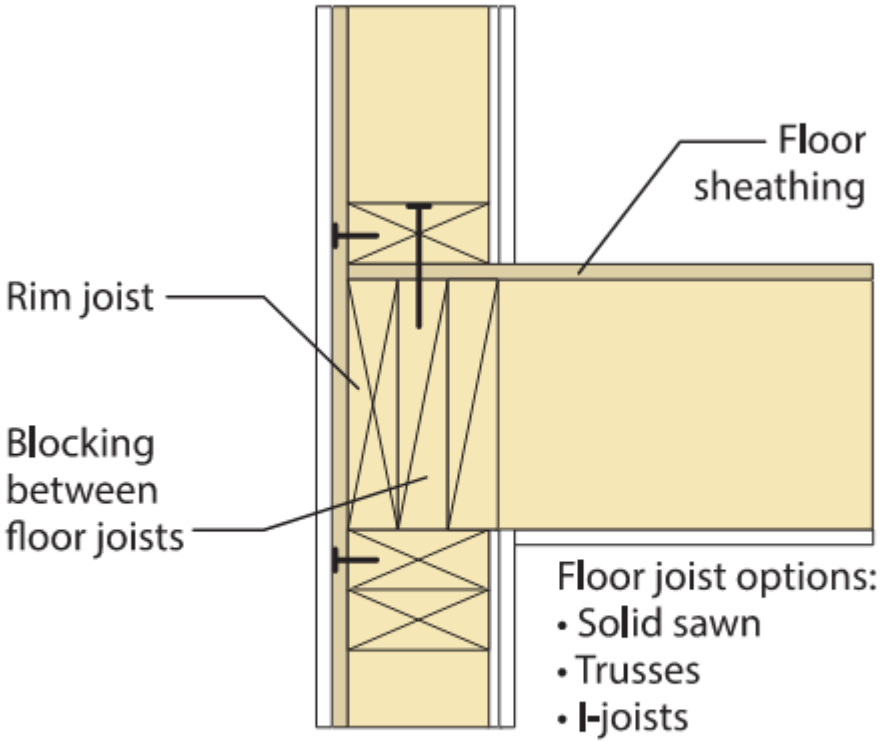


FIGURE 11: Floor-to-shaft wall intersection with blocking between floor joists

- Fire-resistance rating continues to the underside of the deck
- Assumes a tested assembly to the top of wall plate
- Above wall top plate, uses 703.3 allowance for fire-resistance calculations per 722
- 722 allows NDS Chapter 16 methods for fire resistance calculations for exposed wood
- Combustibility of the material is not an issue; must meet the fire rating requirement

Floor to Shaft Wall Detailing

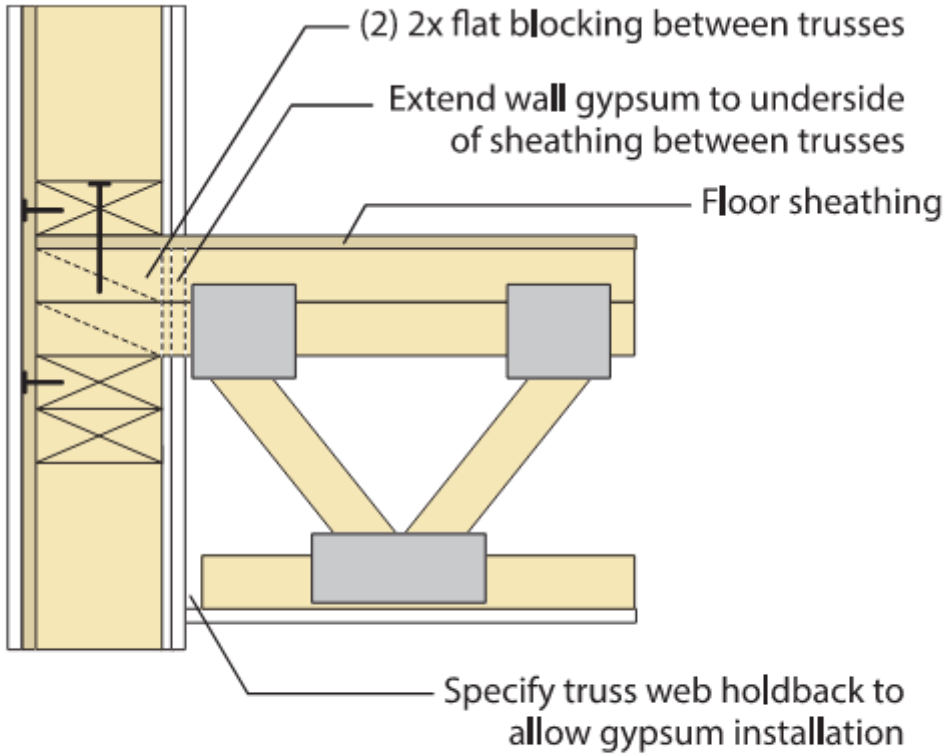


FIGURE 12: Floor-to-shaft wall intersection with gypsum extending to underside of sheathing between trusses

Credit: WoodWorks

Floor to Shaft Wall Detailing

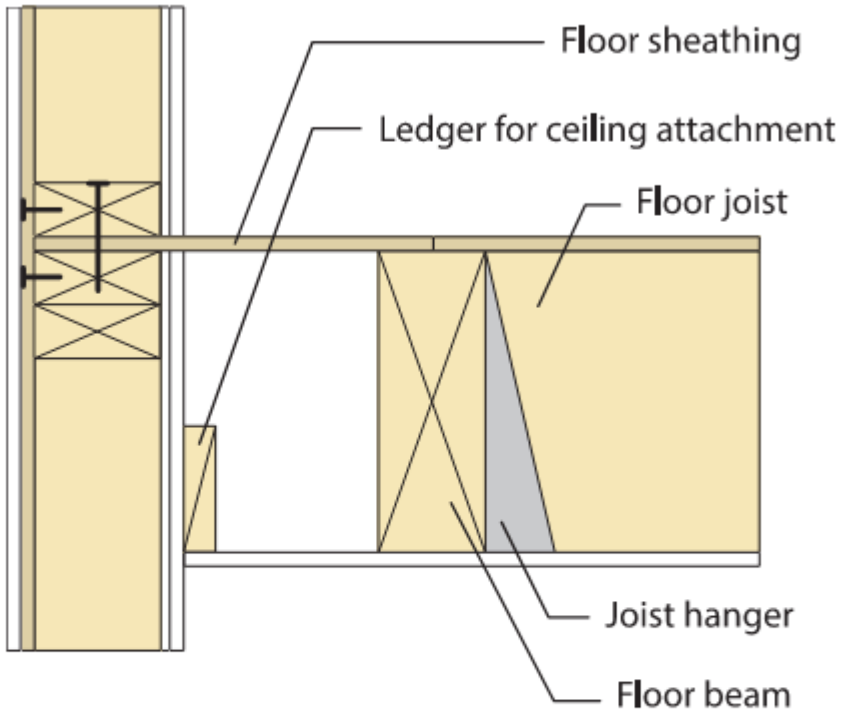


FIGURE 13: Floor-to-shaft wall intersection with supporting beam just inboard of wall

Credit: WoodWorks

Floor to Shaft Wall Detailing

- Perhaps most conservative solution
- Cost and schedule are considerations
- Some require that wall gypsum be installed prior to hanger, some allow post-install
- Not uncommon in type III floor to exterior wall details – easy extension to shaft walls
- Several options on the market

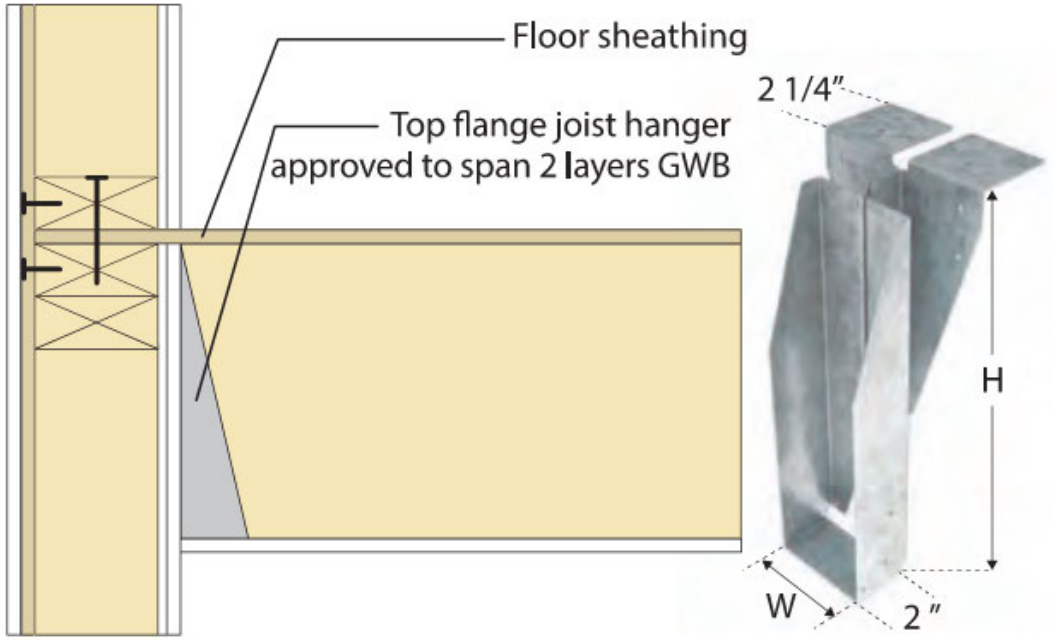


FIGURE 14: Floor-to-shaft wall intersection with hangers designed to span over gypsum

Credit (image on the right): MiTek Builder Products

Floor to Shaft Wall Detailing

- Can be a challenge structurally to make fasteners work
- Scheduling and sequencing considerations
- Allows use of standard face mount hangers
- A common situation at stair shaft intermediate framing

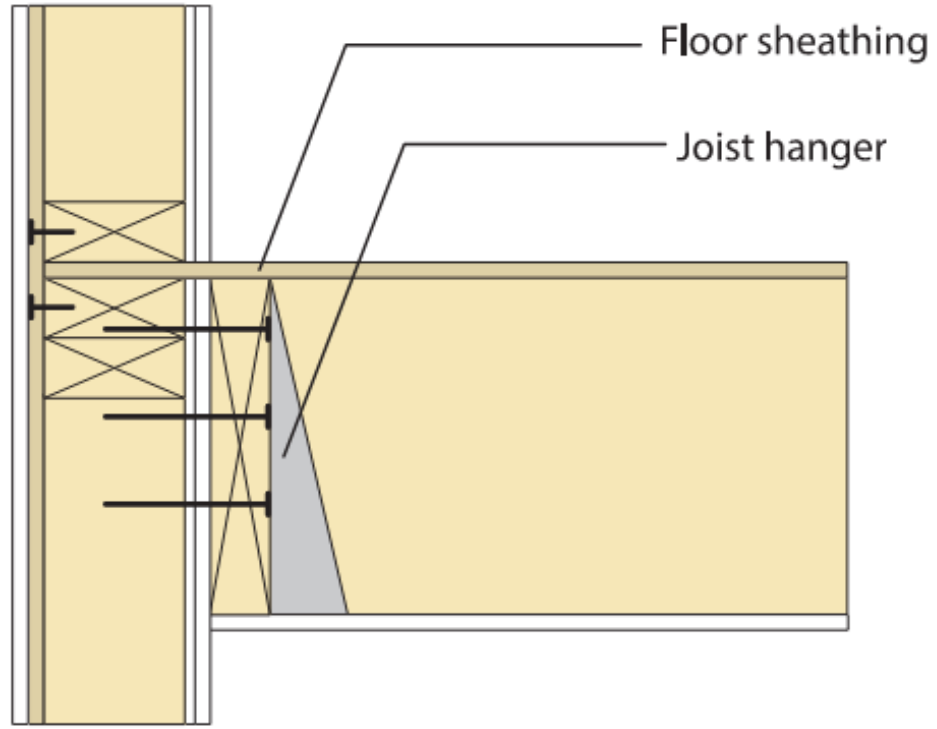
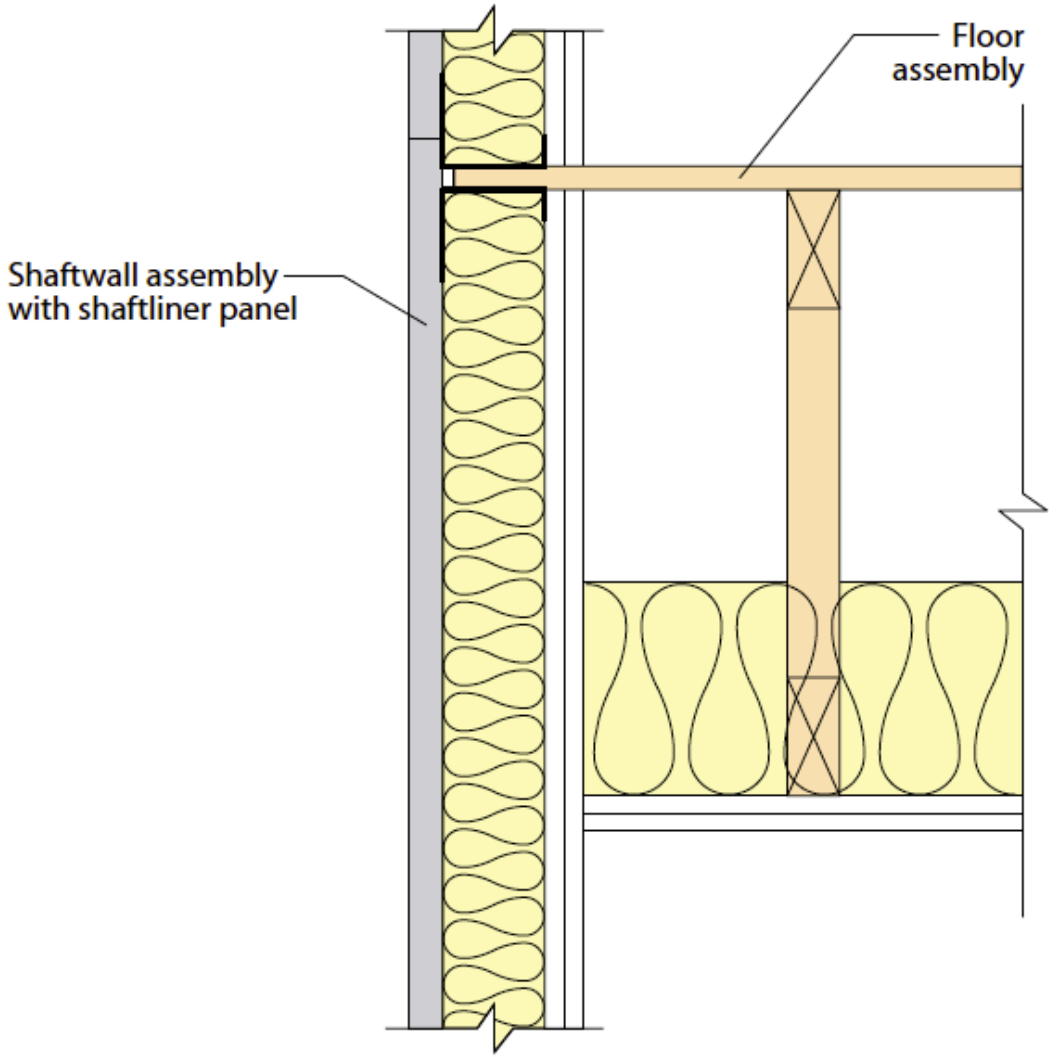
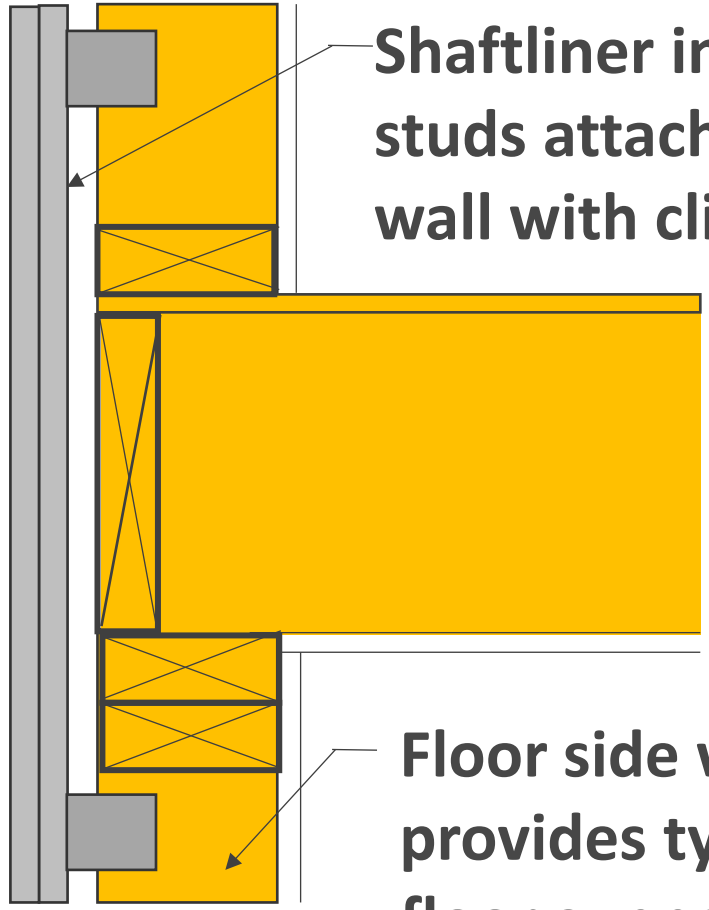


FIGURE 15: Floor framing ledger attached to shaft wall through two layers of gypsum

Shaftliner Systems in Light Wood-Frame Buildings

Floor to Shaft Wall Detailing



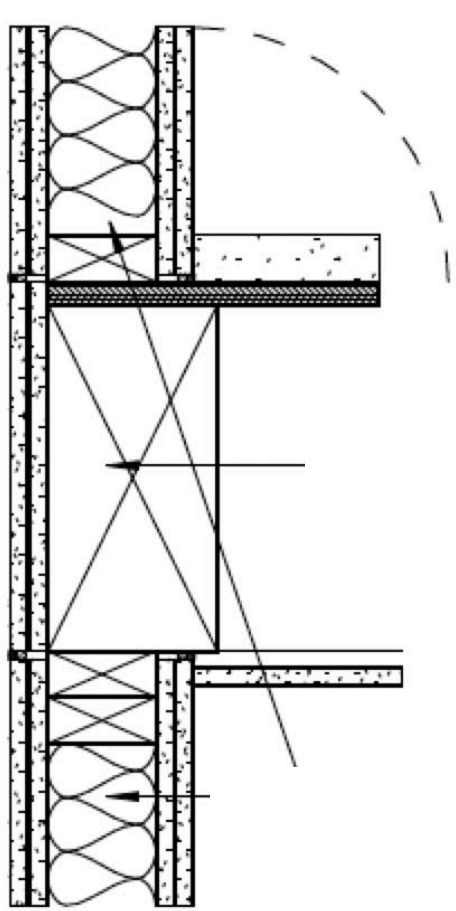


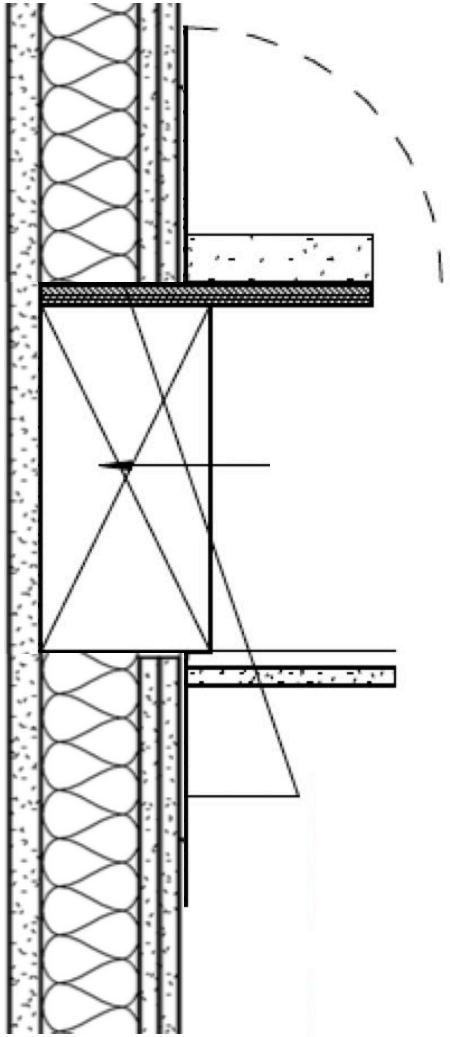
Shaftliner in H-studs attached to wall with clips

Floor side wall provides typical floor support

Shaftliner Systems – Support Details

Shaftliner system self-weight supported on wood floor in platform framed condition





Other Shaft Wall Materials in Light Wood-Frame Buildings

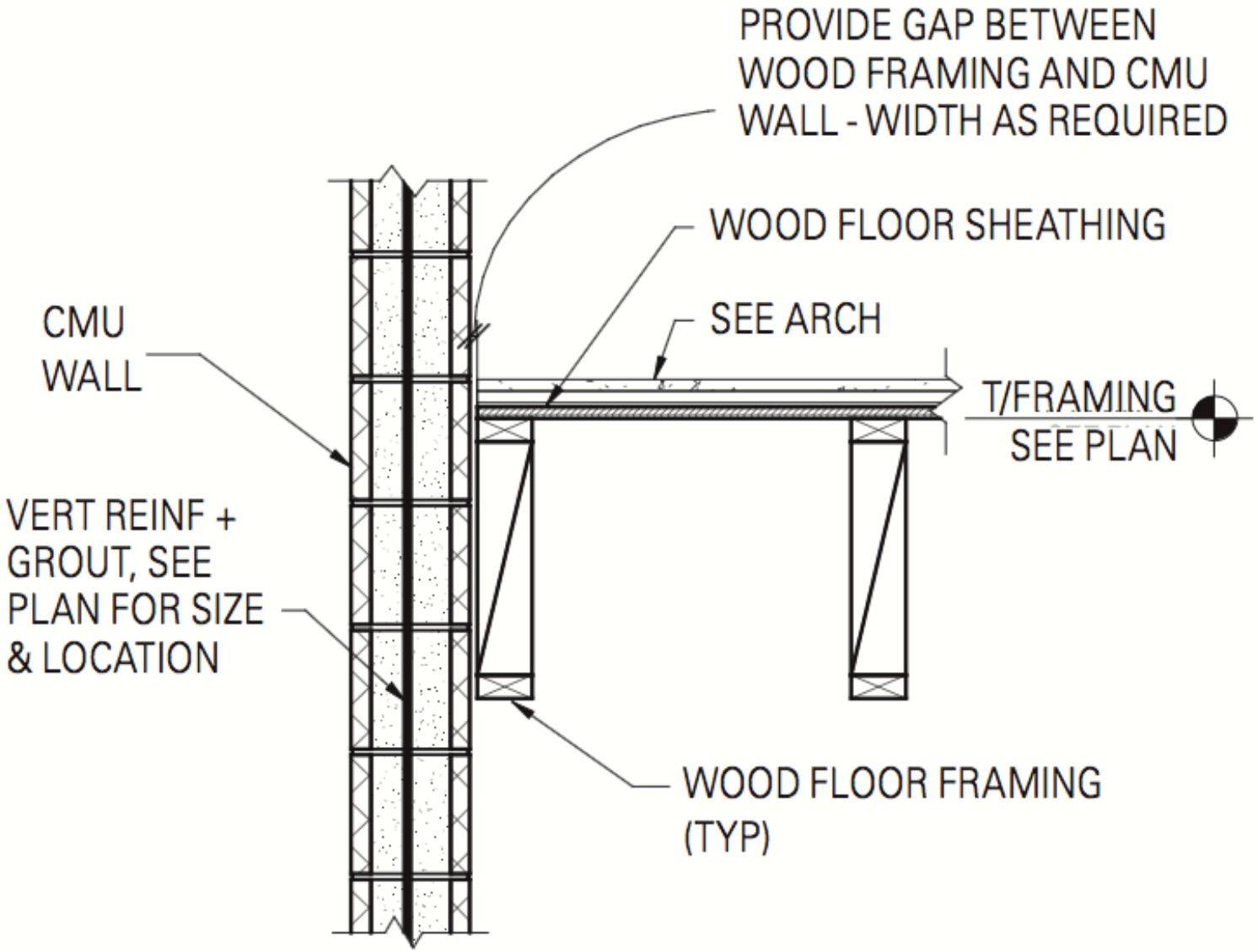
Non-Wood Shaft Walls

Masonry Shaft Walls

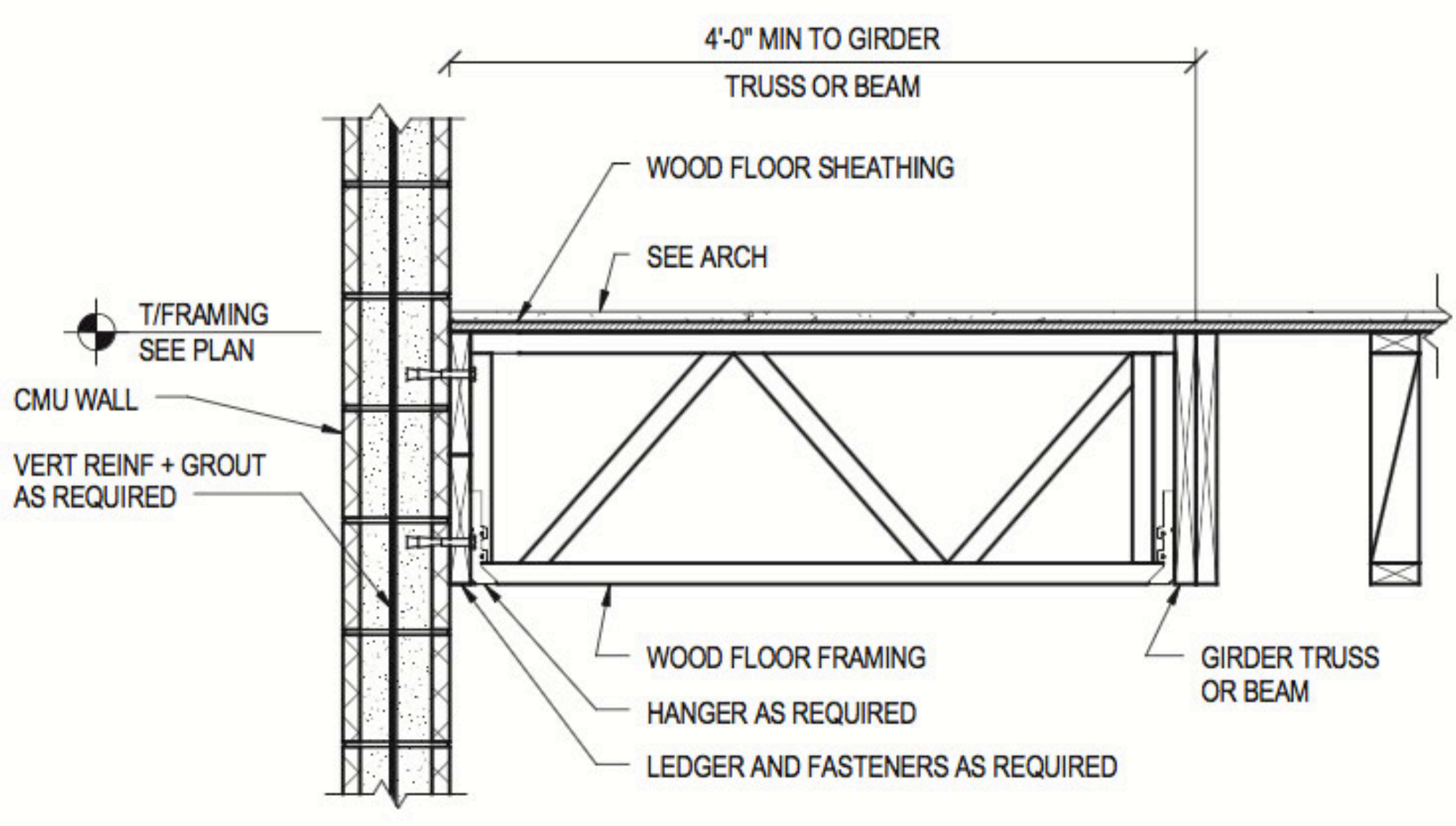
Mixing masonry shaft walls with wood floor framing can create several issues:

- Masonry shaft walls often become part of building's lateral force resisting system
- This increases seismic forces and adds mass
- Difference in stiffness between wood & masonry shear walls may need to be considered
- Differential shrinkage between wood and masonry needs to be considered
- Best practices include seismically isolating masonry shaft walls, only tie wood floor to masonry shaft if/where required (i.e., at door threshold)

Masonry Shaft Walls



Masonry Shaft Walls



Shrinkage & Movement Resource

Code provisions, detailing options, calculations and more for accommodating differential material movement in wood structures

Free resource at **woodworks.org**

WoodWorks™
WOOD PRODUCTS COUNCIL

Accommodating Shrinkage in Multi-Story Wood-Frame Structures

Richard McLain, MS, PE, SE, Technical Director, WoodWorks • Doug Steinle, PE, Principal, Schaefer

In wood-frame buildings of three or more stories, cumulative shrinkage can be significant and have an impact on the function and performance of finishes, openings, mechanical/electrical/plumbing (MEP) systems, and structural connections. However, as more designers look to wood-frame construction to improve the cost and sustainability of their mid-rise projects, many have learned that accommodating wood shrinkage is actually very straightforward.

Wood is hygroscopic, meaning it has the ability to absorb and release moisture. As this occurs, it also has the potential to change dimensionally. Knowing how and where wood shrinks and swells helps designers detail their buildings to minimize related effects.

Wood shrinkage occurs perpendicular to grain, meaning that a solid sawn wood stud or floor joist will shrink in its cross-section dimensions (width and depth). Longitudinal shrinkage is negligible, meaning the length of a stud or floor joist will essentially remain unchanged. In multi-story buildings, wood shrinkage is therefore concentrated at the wall plates, floor and roof joists, and rim boards. Depending on the materials and details used at floor-to-wall and roof-to-wall intersections, shrinkage in light-frame wood construction can range from 0.05 inches to 0.5 inches per level.

This publication will describe procedures for estimating wood shrinkage and provide detailing options that minimize its effects on building performance.

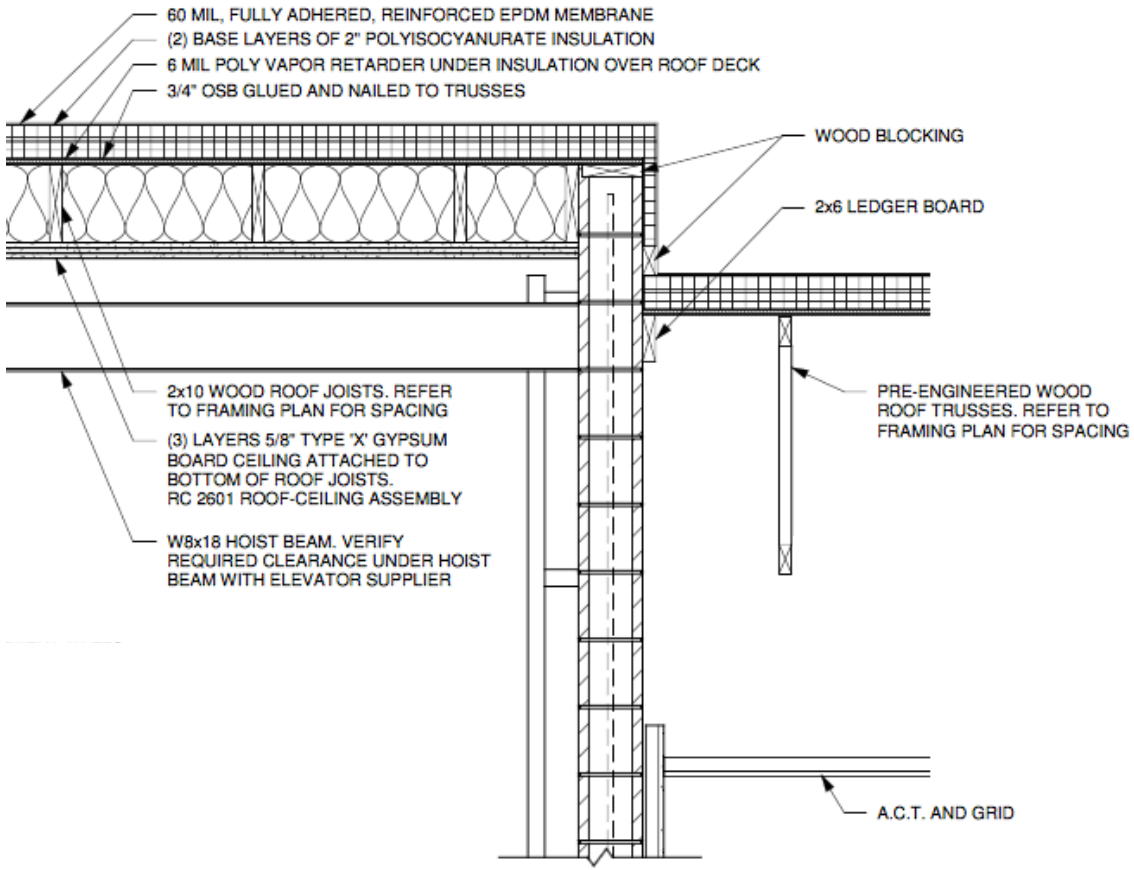
The Brooklyn Riverside
Jacksonville, Florida
Architect: Dwell Design Studio
Structural Engineer: M2 Structural Engineering

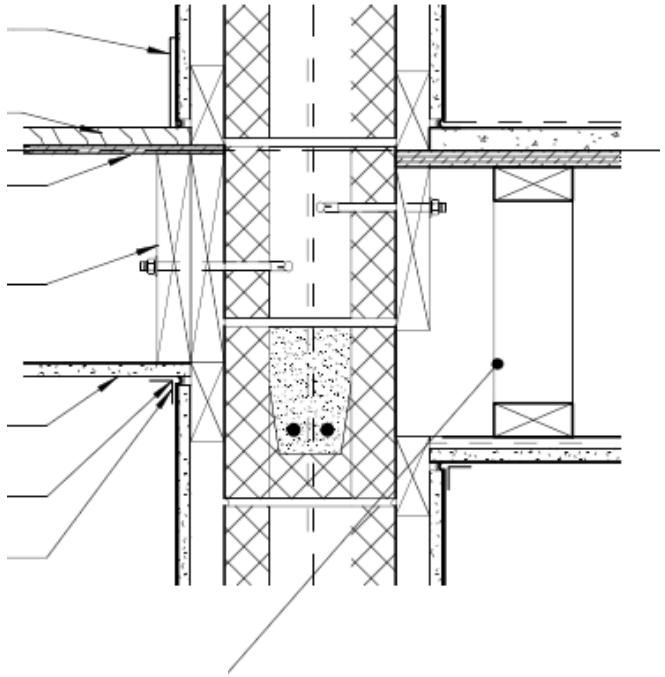
Photo: Pollack Shores, Matrix Residential

a longitudinal cell in the wood. Water can be free water stored in the straw cavity or bound water absorbed by the straw walls. At high moisture contents, water exists in both locations. As the wood dries, the free water is released from the cell cavities before the bound water is released from the cell walls. When wood has no free water and yet the cell wall is still saturated, it is said to be at its fiber saturation

https://www.woodworks.org/resources/accommodating-shrinkage-in-multi-story-wood-frame-structures/

Shaft Wall Material Choice





Why do we introduce new materials for our shaft walls?

They can be framed with wood!

Questions? Ask us anything.

Survey QR code

Jason Bahr, PE
Regional Director | KS, AR, MO, OK

(913) 732-0075
jason.bahr@woodworks.org

901 East Sixth, Thoughtbarn-Delineate Studio, Leap!Structures, photo Casey Dunn

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