WoodWorks™
WOOD PRODUCTS COUNCIL

Type III Fire-Resistant Design and Detailing: Exterior walls, Intersections and Balconies

For Light-Frame Wood Construction

Presented by Ethan Martin, PE
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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

With an increase in mid-rise wood-frame buildings, more designers are seeking information on code-compliant and constructible detailing. Many are unsure of the code's requirements for details, specifically at the intersection of rated assemblies and where structure and fire protection meet. This presentation will focus on common detailing issues and areas of misunderstanding of 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

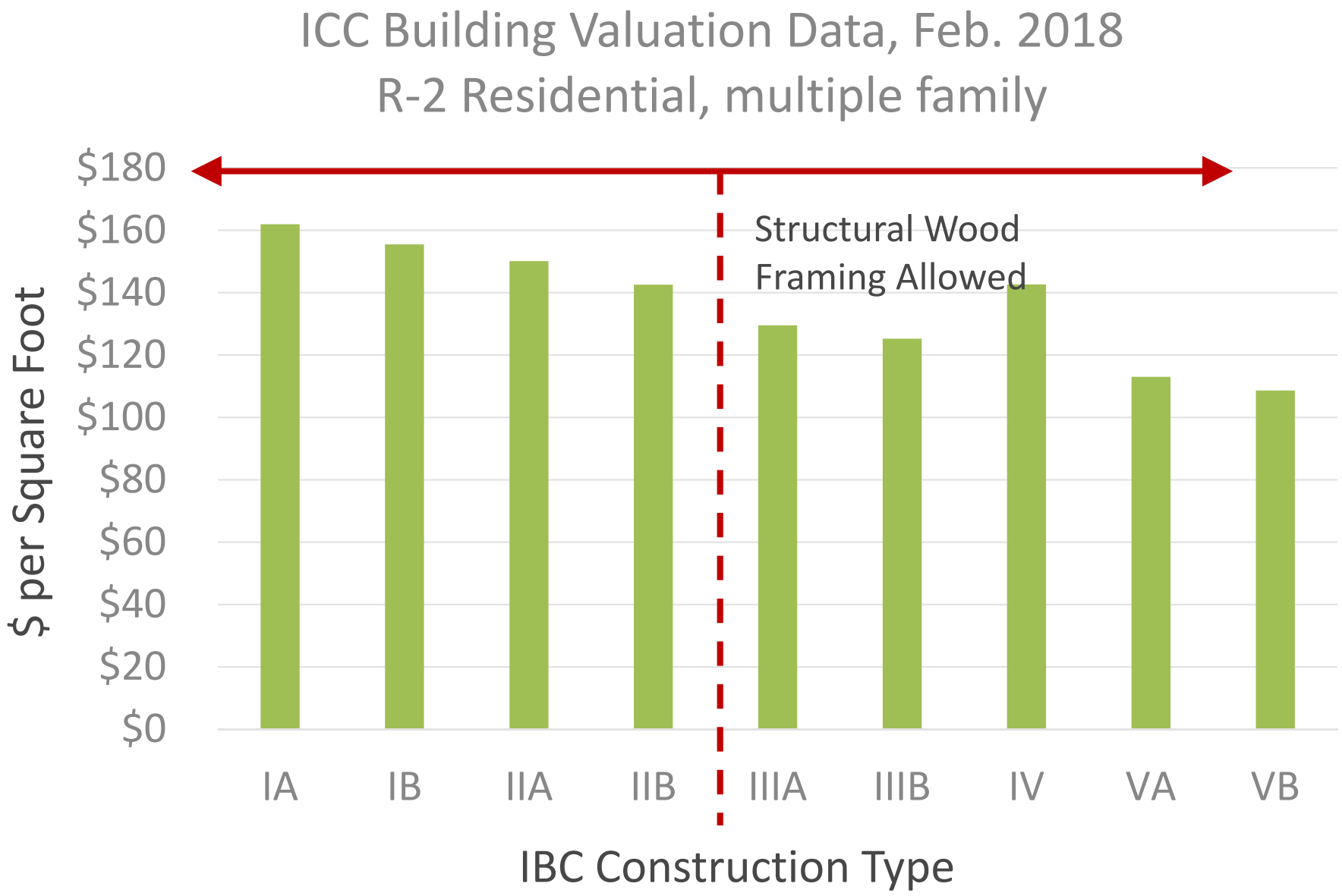
1. Compare Type II to Type III construction with regard to cost, building size and fire resistance per the International Building Code.
2. Review requirements for exterior walls and questions commonly encountered including asymmetric assemblies, the allowance of wood structural panel, and bearing vs. non-bearing requirements.
3. Examine a variety of floor-to-exterior wall details for use in wood-frame, Type III construction and discuss code compliance paths and approval rationale for each.
4. Explore detailing requirements for balconies.

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


Seattle, WA
College Park, MD
CAMDEN
Normal, IL
Los Angeles, CA
STELLA
Atlanta, GA
LORD · AECK · SARGENT

ICC Building Valuation Data

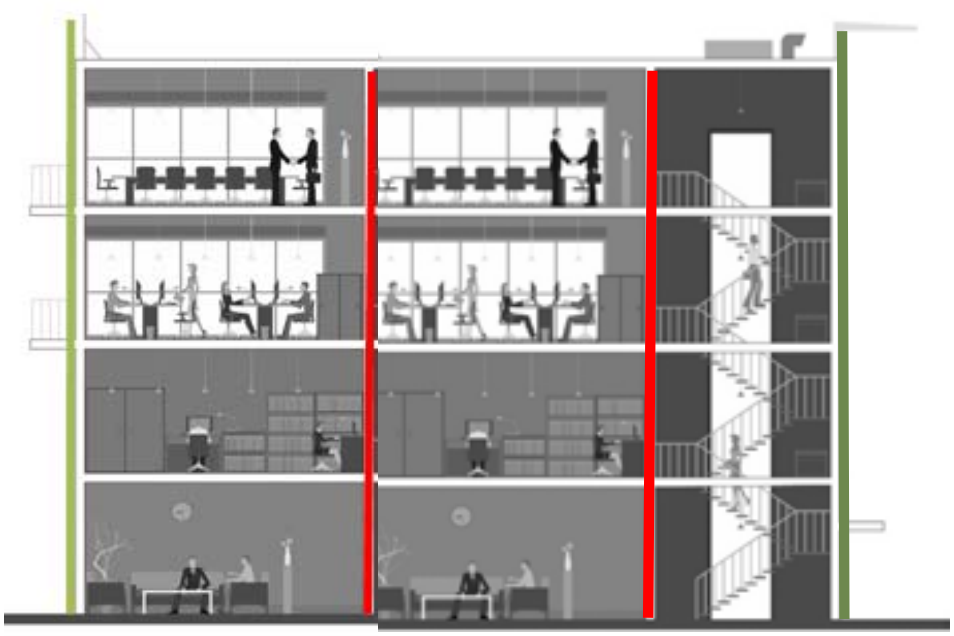


Type II Fire Resistant Requirements

Fire Rating of Structural Elements	IIA	IIB
IBC Table 601		
Exterior bearing walls (hrs)	1	0
Interior bearing walls (hrs)	1	0
All other elements (hrs)	1	0
IBC Table 602		
X < 10 ft	1	1
10 ft ≤ X < 30 ft	1	0
X ≥ 30 ft	0	0
IBC Chapter 7		
Shaft Walls (IBC 713.4)[1]	2 max	2 max
Fire Walls (706.4) – R Occupancy	2	2

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

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



Type III Fire Resistant Requirements

Fire Rating of Structural Elements	IIIA	IIIB
IBC Table 601		
Exterior bearing walls (hrs)	2	2
Interior bearing walls (hrs)	1	0
All other elements (hrs)	1	0
IBC Table 602 (Exterior Non-bearing walls)		
X < 10 ft	1	1
10 ft ≤ X < 30 ft	1	0
X ≥ 30 ft	0	0
IBC Chapter 7		
Shaft Walls (IBC 713.4)[1]	2 max	2max
Fire Walls (706.4) – R Occupancy	3	3

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

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	5	5	5
Height (ft)	55	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

Boise Type VA

Seattle –

- Type VA with NFPA 13 sprinkler adds a story to 5-stories
- building height is 70’ from average grade plane
- occupied floor no more than 75’ from lowest fire department access
- frontage and sprinkler increases still allowed for area, height, and stories
- exterior bearing walls 1-hour rated per IBC Table 601, exterior non-bearing walls rated per IBC Table 602
- one stair tower has to go to roof, exit stairs pressurized, and remote fire department connection
- Seattle’s code allows this to be Type III construction also

Portland

- Type IIIA and IIIB with NFPA 13 sprinkler exterior walls that are typically Fire Retardant Treated Wood (FRTW) for Type III can be of non-FRTW wood
- building height is 85’ and 75’ respectively from average grade plane; however top of roof parapet to lowest required fire apparatus setup point can’t exceed 75’ (this last part is meant to address the increasing amount of occupied roofs in Portland)
- occupied floor no more than 75’ from lowest fire department access
- frontage and sprinkler increases still allowed for area, height, and stories; however base allowable area is 12,000 square feet per floor (comes from Type VA base allowable area non-sprinklered)
- exterior wall has prescriptive assembly approximately 2-hour for bearing, and 1-hour for non-bearing
- all stairs have roof access and only elevator shafts shall be pressurized
- roof sheathing must be FRTW or protected with gypsum
- specific detailing of blocking at floor and wall intersections with exterior rated wall

Boise Type VA

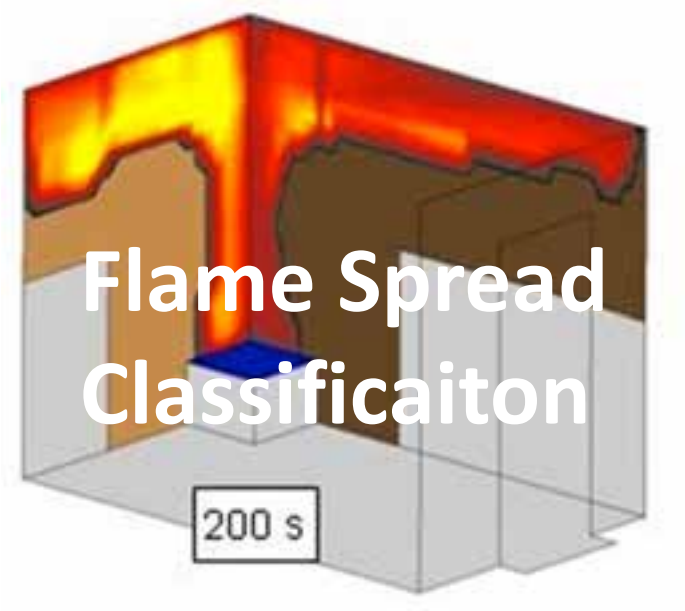
Boise

- Type VA to 5-stories with NFPA 13 sprinkler
- building height is 95’ from lowest fire department access
- occupied floor no more than 75’ from lowest fire department access
- frontage increase still allowed for area but sprinkler increase for area not allowed
- exterior bearing walls 1-hour rated per IBC Table 601, exterior non-bearing walls rated per IBC Table 602, or minimum 1-hour rated per Section 9-3-4, Item B, Sub-item 6, whichever is higher
- all stairs have roof access and all stairs shall be pressurized
- exit travel distance reduced by 40%
- Section 9-3-4, Item B, Sub-item 3 – again mixes some language, but gets the highest occupiable floor to 75’, and then addresses building height of 95’ per fire apparatus access (versus grade plane). That’s a whole 20’ higher than Portland and 25’ higher than Seattle and the 75’ height has always been based on how high a ladder truck can reach which is 75’ (unless Boise has some better ladder trucks which is conceivable). . .

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

Fire Performance



Fire Resistance 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
Interior bearing wall fire rating	1 hr	0 hr	1 hr
Interior non-bearing wall fire rating	0 hr	0 hr	0 hr
Floor assembly fire rating	1 hr	0 hr	1 hr
Fire wall rating	3 hr	3 hr	2 hr

IBC Tables 601 & 706.4

Note: FRT = Fire Retardant Treated

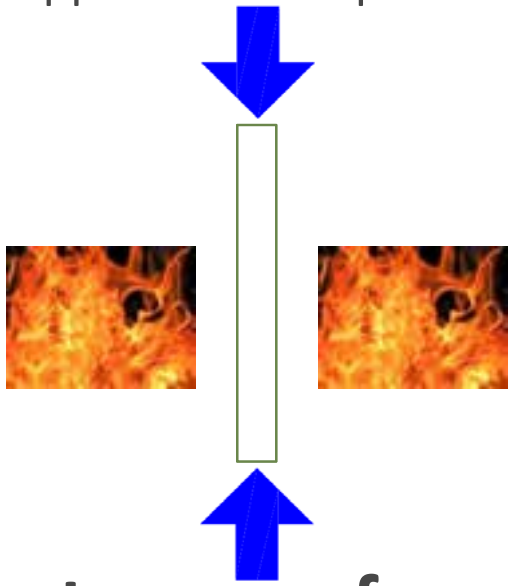
Fire-Resistance Rated Wall Assemblies

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)

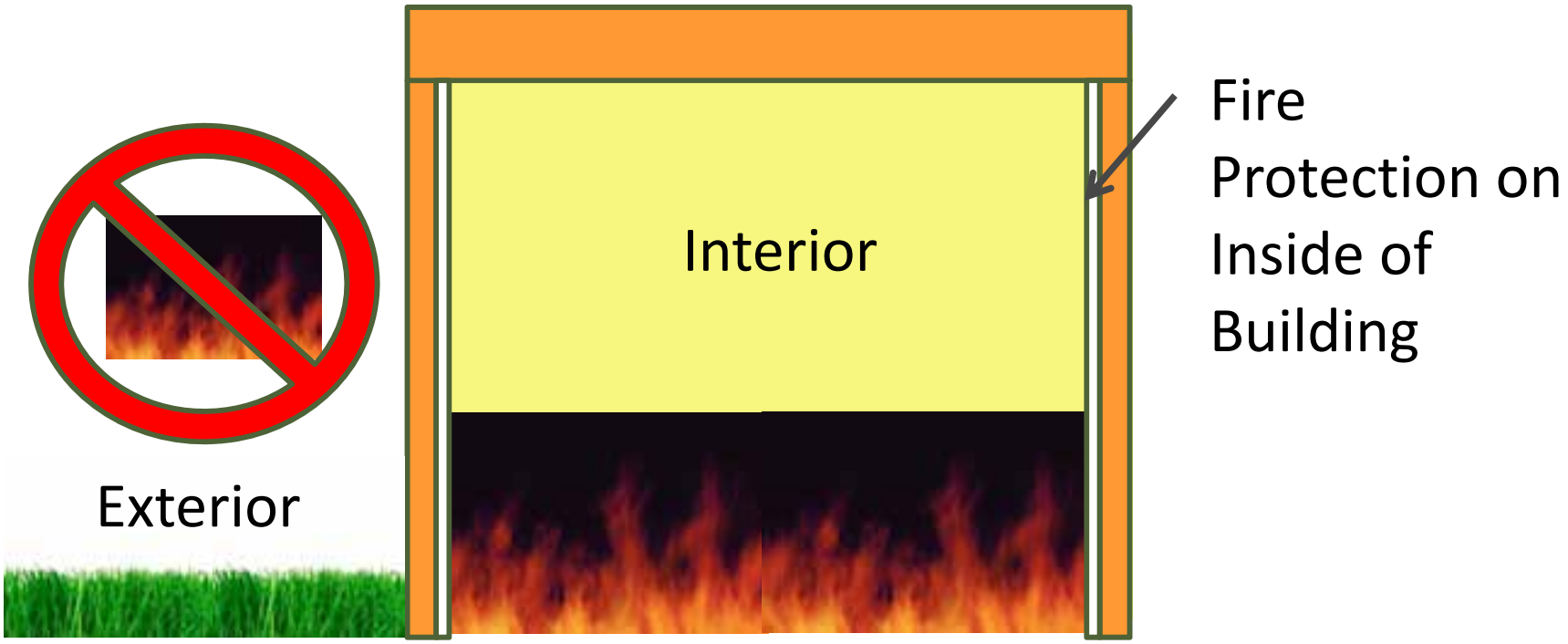
Unique to Exterior Walls

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

- Hourly rating requirements per Tables 601 vs 602
- Structural stability requirements
- Non-combustible exception

Exterior Walls - FSD

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 (IBC 705)

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 (3048 mm) 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 (3048 mm) shall be rated for exposure to fire from both sides.

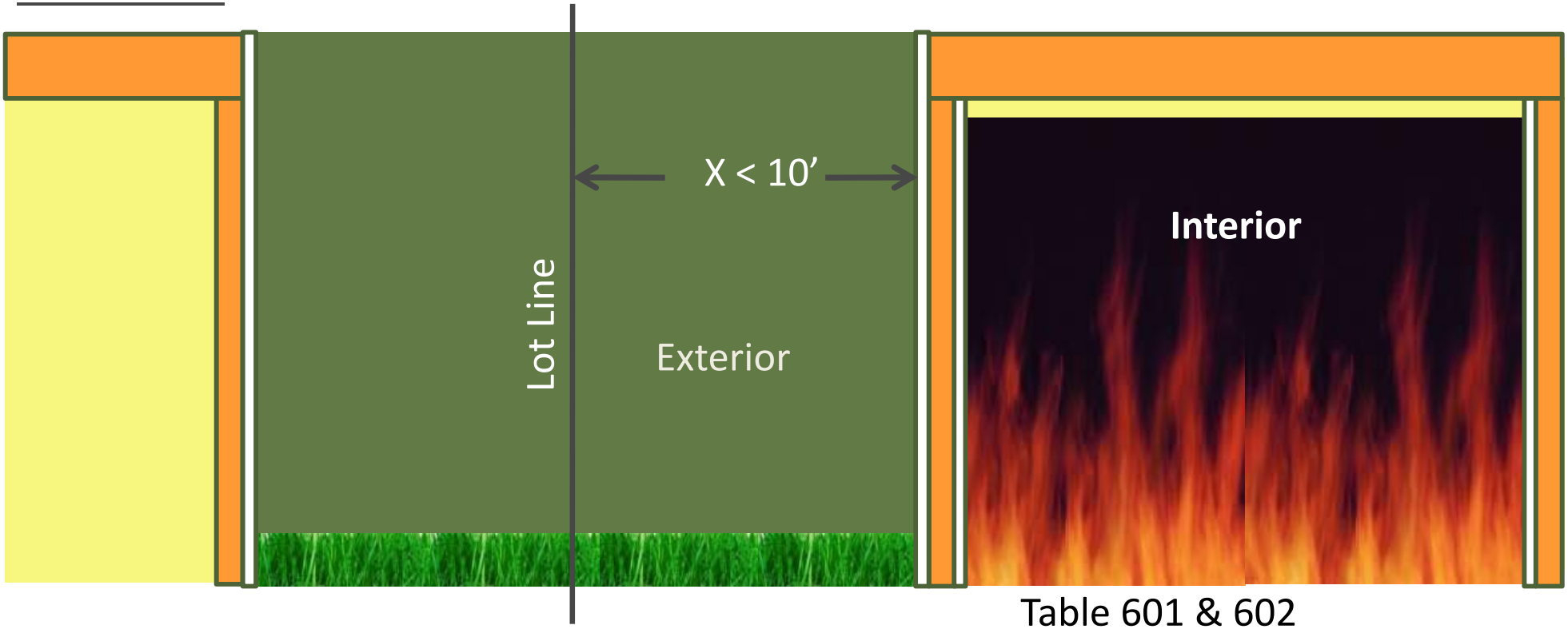


Table 601 & 602

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	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

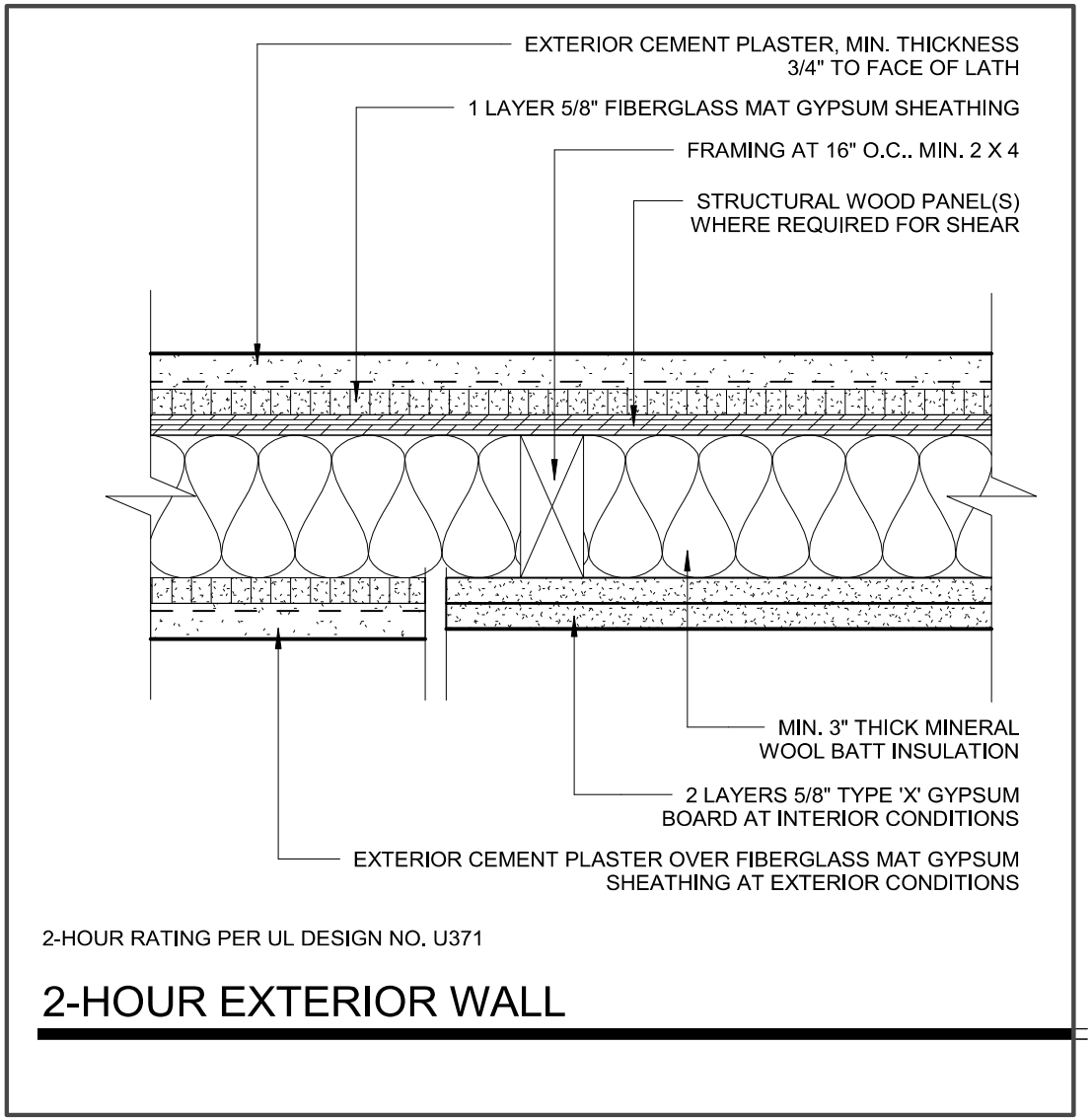
TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

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 ≤ X < 10	IA Others	3 2	2 1	1 1
10 ≤ X < 30	IA, IB IIB, VB Others	2 1 1	1 0 1	1[c] 0 1[c]
X ≥ 30	All	0	0	0

Exterior Wall Fire Ratings

- Using the provisions of section 705.5 and Tables 601 and 602 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.

Exterior Walls - Asymmetry



Common issues with tested assemblies:

- Assembly Asymmetry- separate assemblies for each side

Exterior Walls – 1 HR Int. 0 HR Ext.

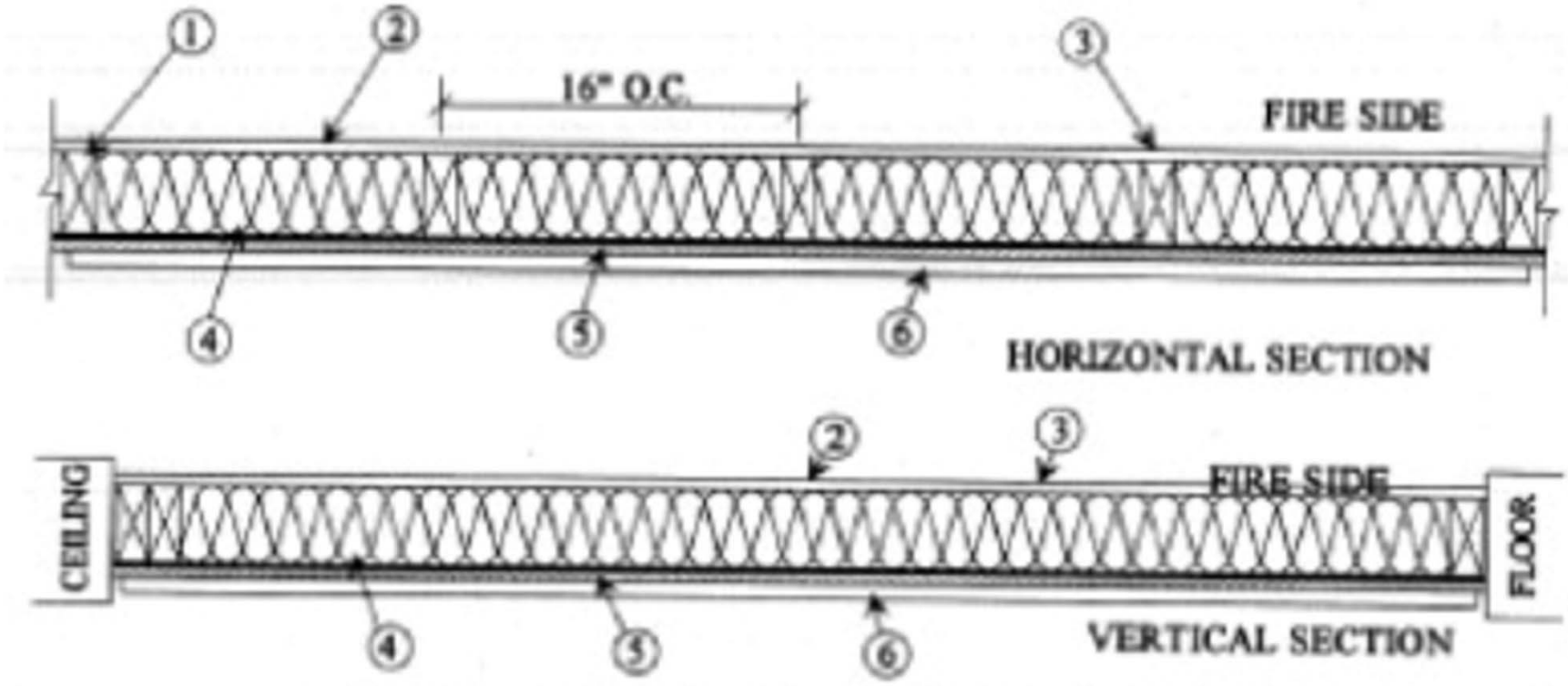
Design No. U348

April 01, 2013

Bearing Wall Rating — 1 Hr

(EXPOSED TO FIRE ON INTERIOR FACE ONLY)

Finish Rating — 23 min



Exterior Walls – 1 HR Int. 0 HR Ext.

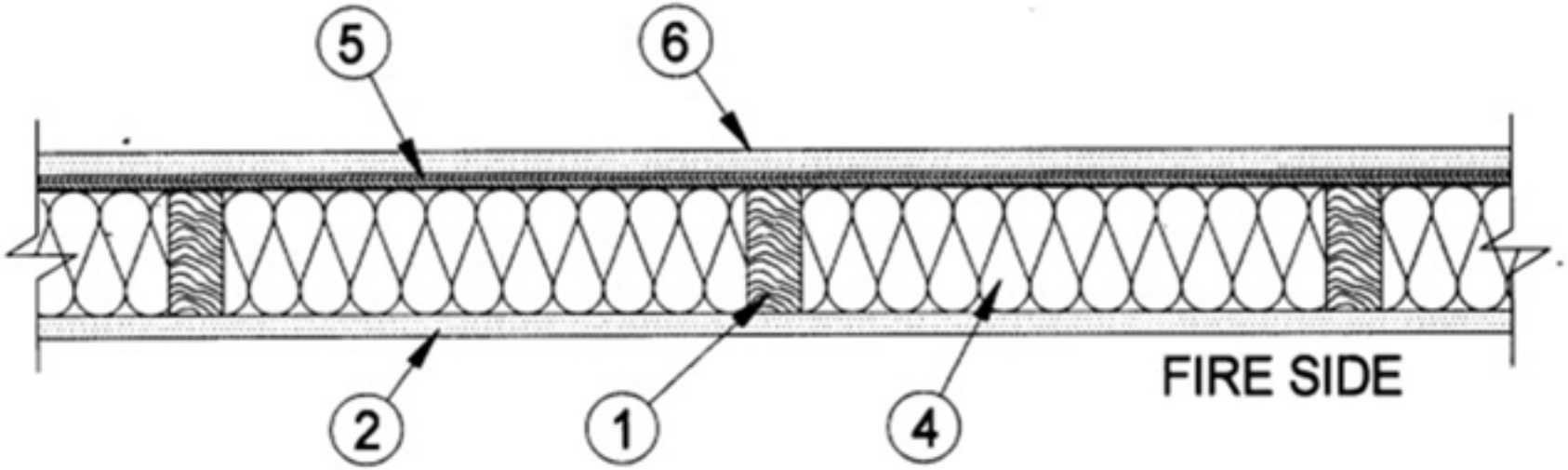
Design No. U356

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

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.	—	—	—	$6^1/_2$

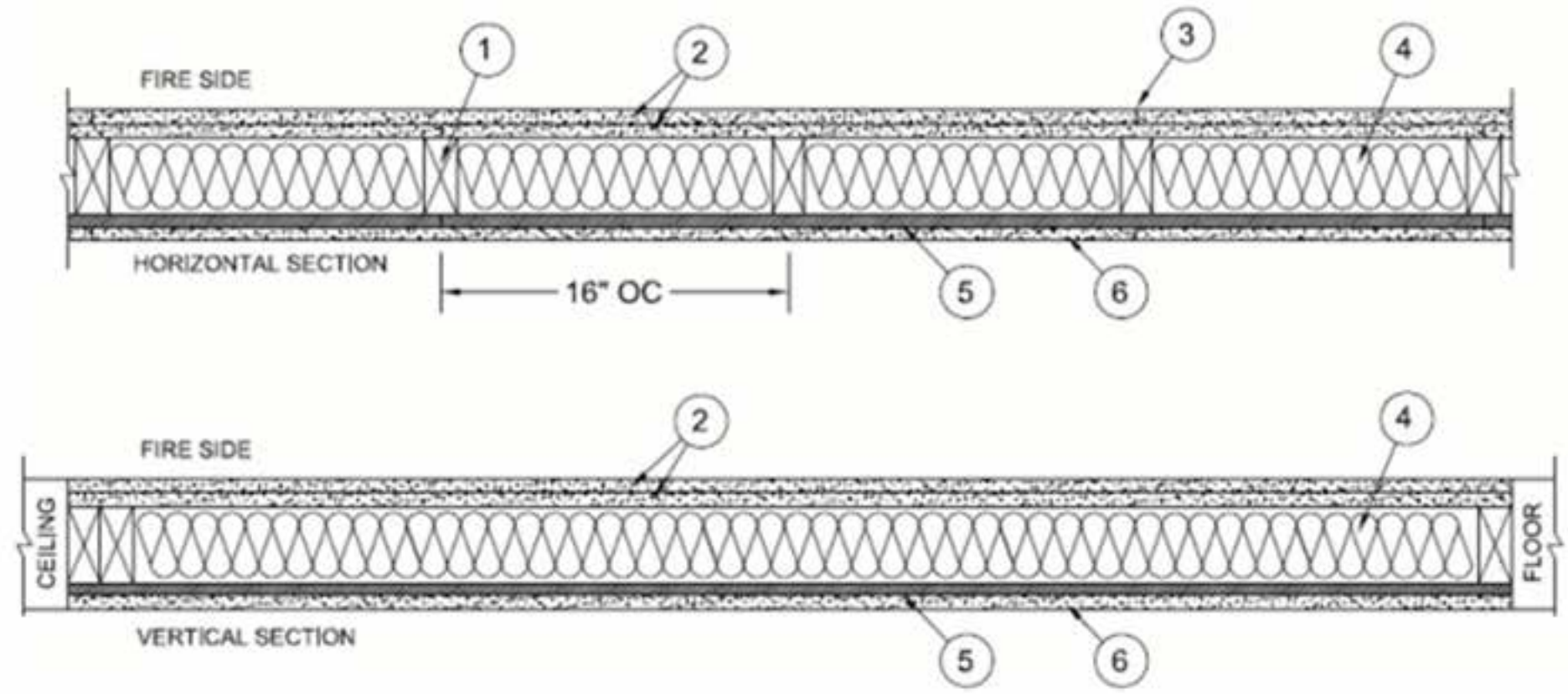
Exterior Walls – 2 HR Int. 0 HR Ext.

Design No. V314

September 03, 2015

Bearing Wall Rating — 2 Hr

(EXPOSED TO FIRE ON INTERIOR FACE ONLY)



Exterior Walls – 2 HR Int. 0 HR Ext.

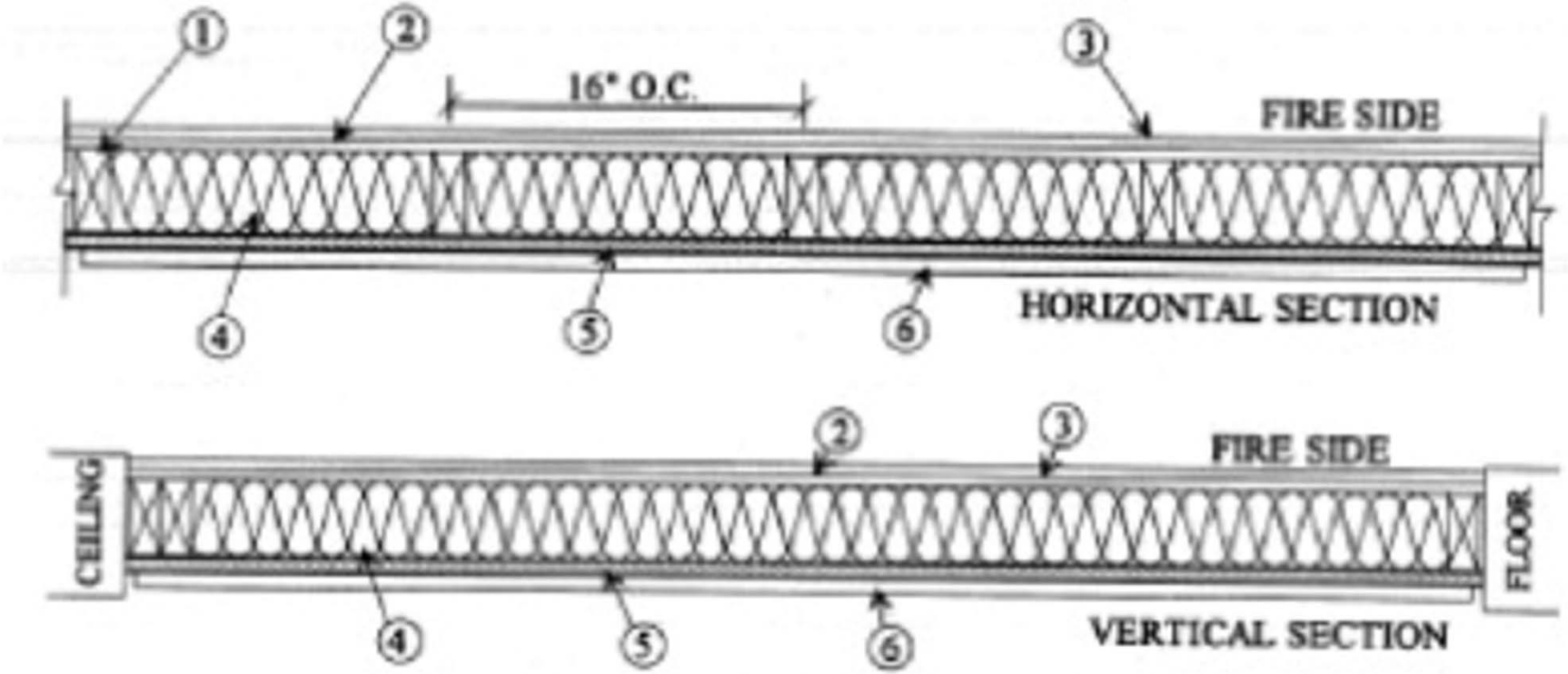
Design No. U349

August 21, 2013

Bearing Wall Rating — 2 Hr

(EXPOSED TO FIRE ON INTERIOR FACE ONLY)

For Wood Studs, Finish Rating — 55 min



Exterior Walls – 2 HR Int. 1 HR Ext.

Design No. W408

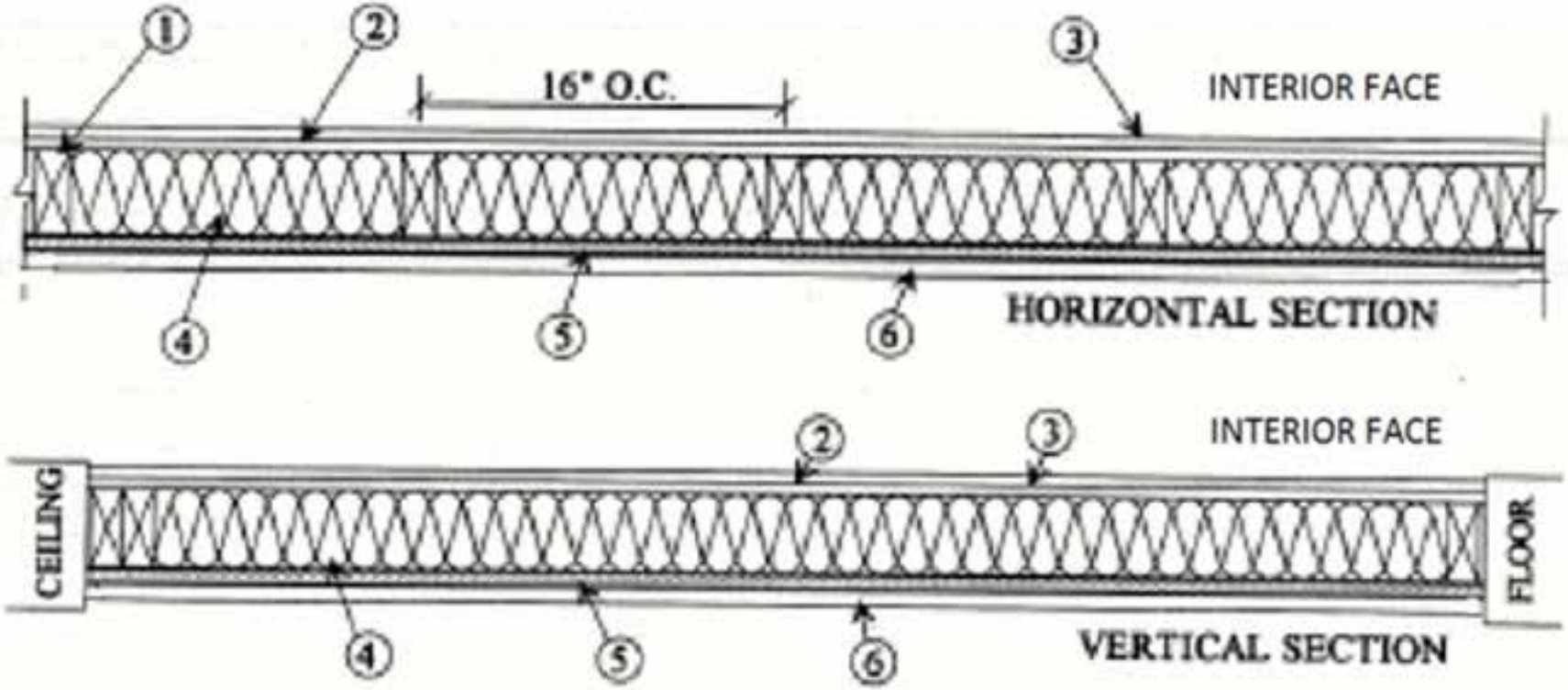
April 01, 2013

Bearing Wall Rating — 2 Hr when EXPOSED TO FIRE ON INTERIOR FACE ONLY

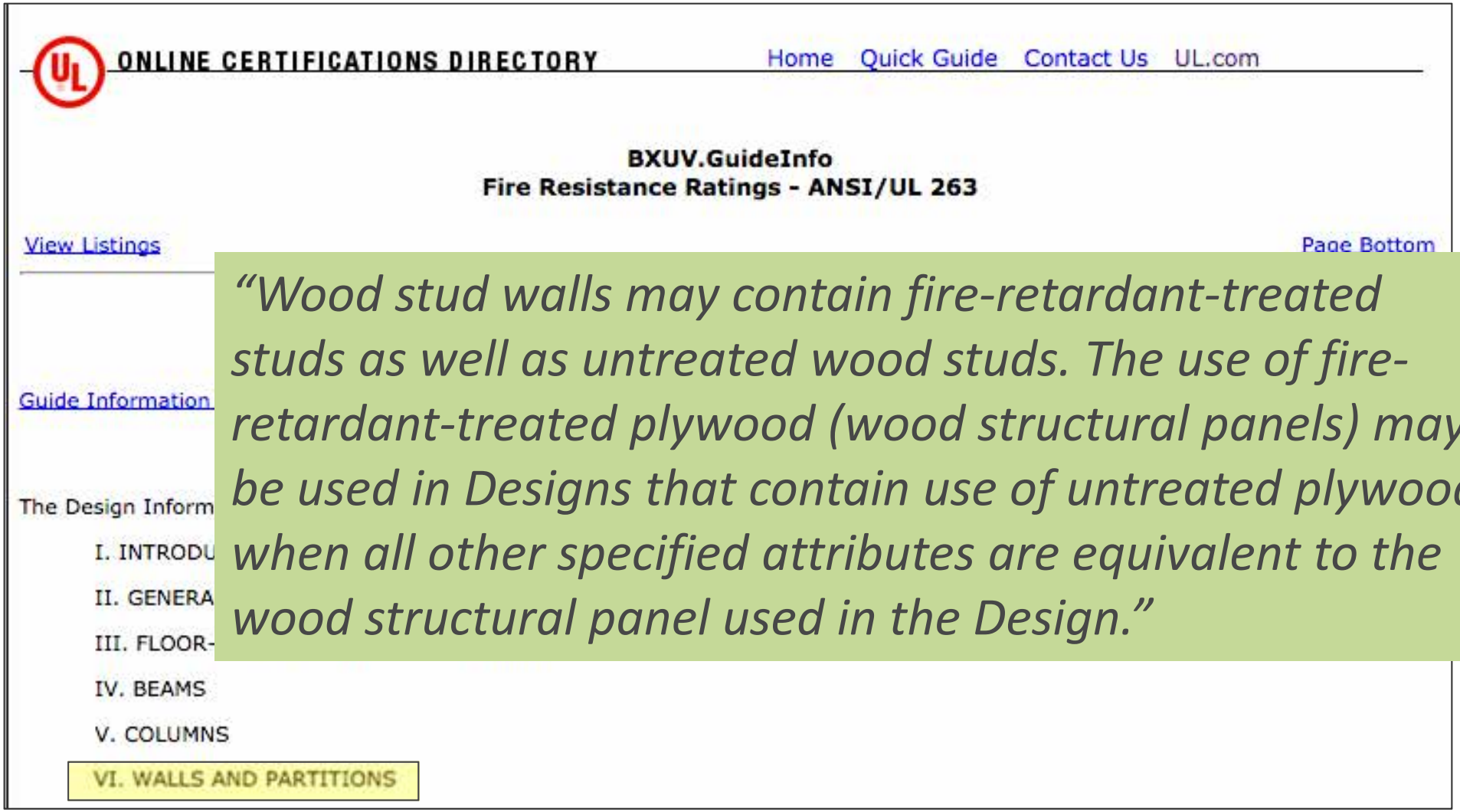
Bearing Wall Rating — 1 Hr when EXPOSED TO FIRE ON EXTERIOR FACE ONLY, see Item 4 and 6

For Wood Studs, Finish Rating — 50 min when EXPOSED TO FIRE ON INTERIOR FACE.

For Wood Studs, Finish Rating — 17 min when EXPOSED TO FIRE ON EXTERIOR FACE.



Exterior Walls – Using FRT Studs



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Fire Resistance Ratings - ANSI/UL 263

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Guide Information

The Design Inform

I. INTRODU

II. GENERA

III. FLOOR-

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 WSP

Can include WSP in assemblies which were tested without them:

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

GA Fire Resistance Design Manual item 23 in 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.*"

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.

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

Wood-frame walls and floors offer designers a unique opportunity to provide structures with economy as well as proven energy performance. Where these assemblies are required by the building codes to

eloped from conducting a series of fire resistance tests. The Component Additive Method (CAM) provides for calculating the fire resistance of load bearing and non-load bearing floor, wall, ceiling and roof

Exterior Wall – Bearing vs. Non Bearing

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:

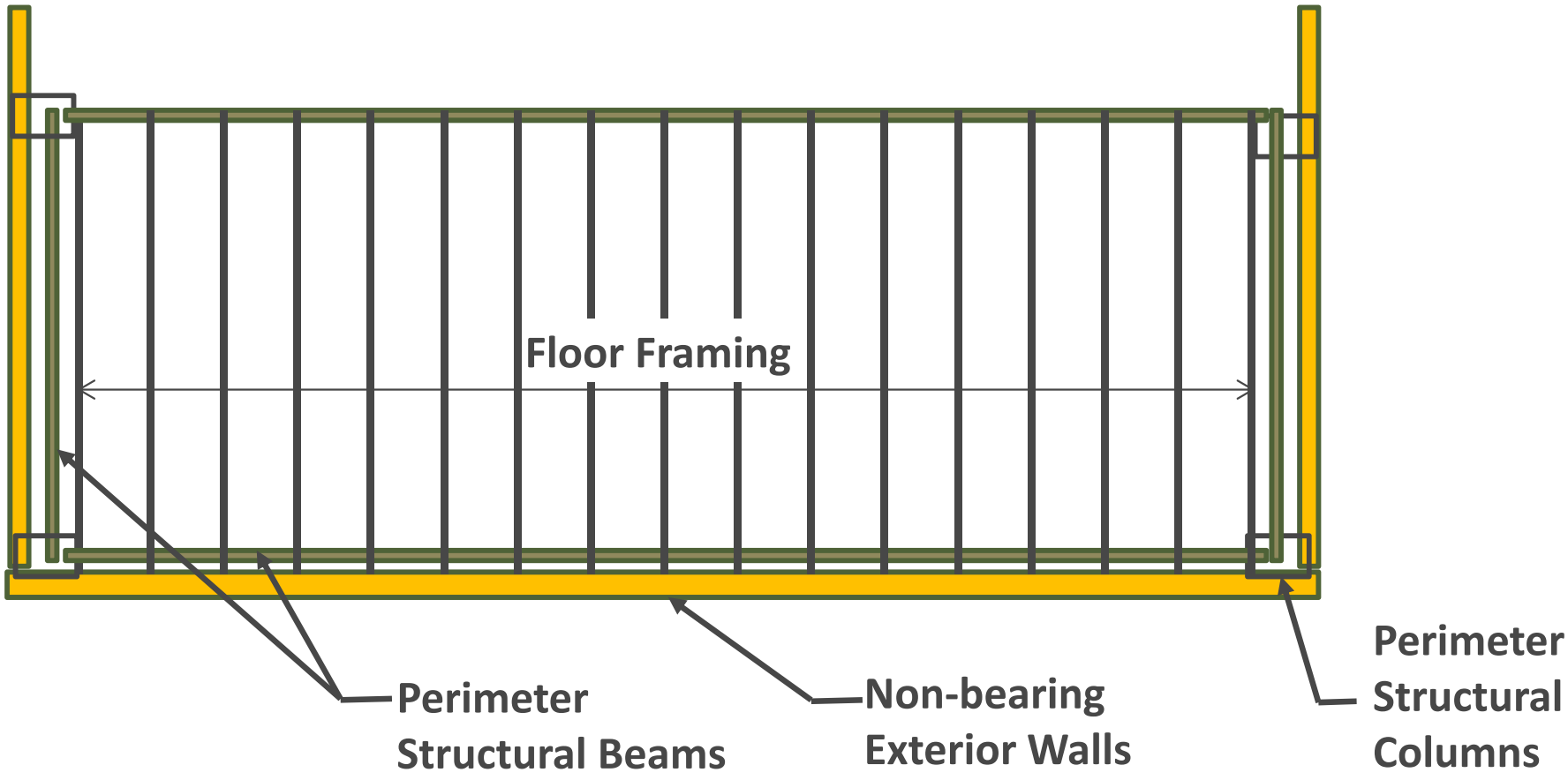
1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.

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

Exterior Walls – Bearing vs. Non-Bearing

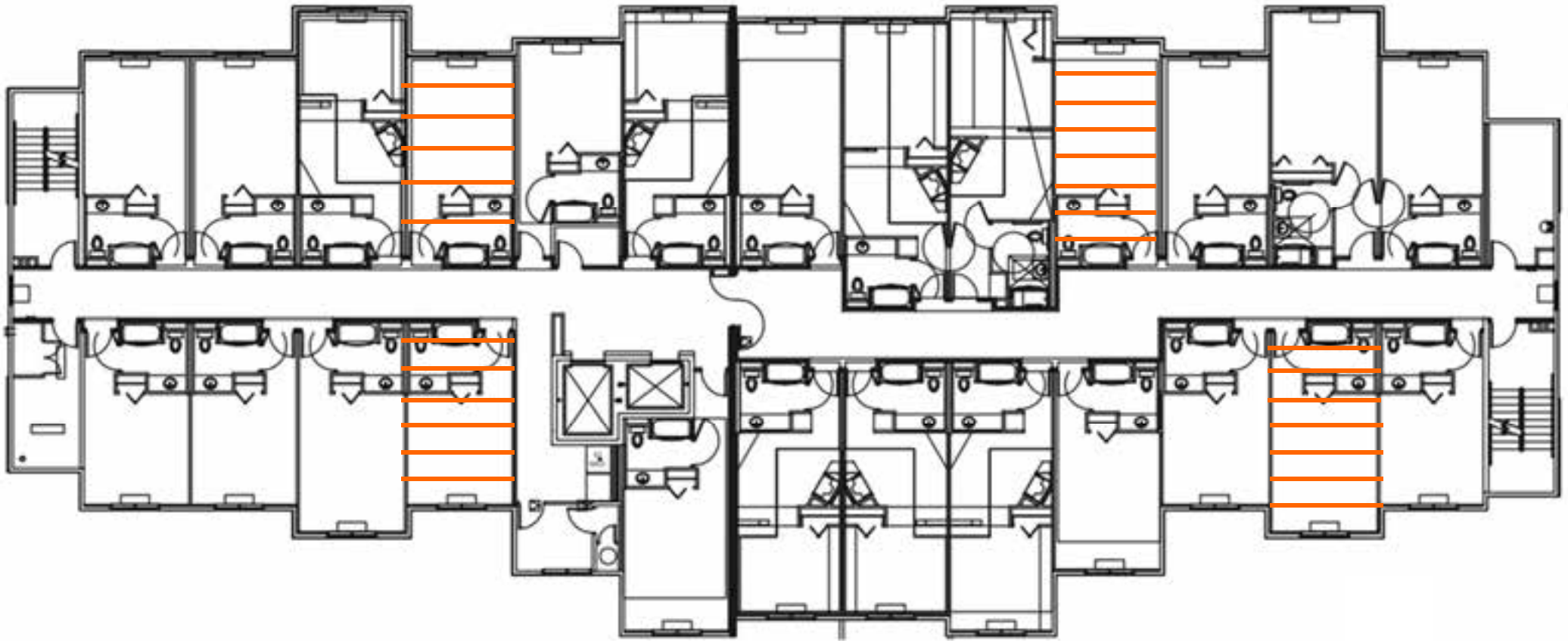
Utilization of structural beams in-board or directly over exterior walls can make walls non-bearing and reduce required fire resistance rating to 1 HR or 0 HR (IBC Table 602)

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



Exterior Walls – Bearing vs. Non-Bearing

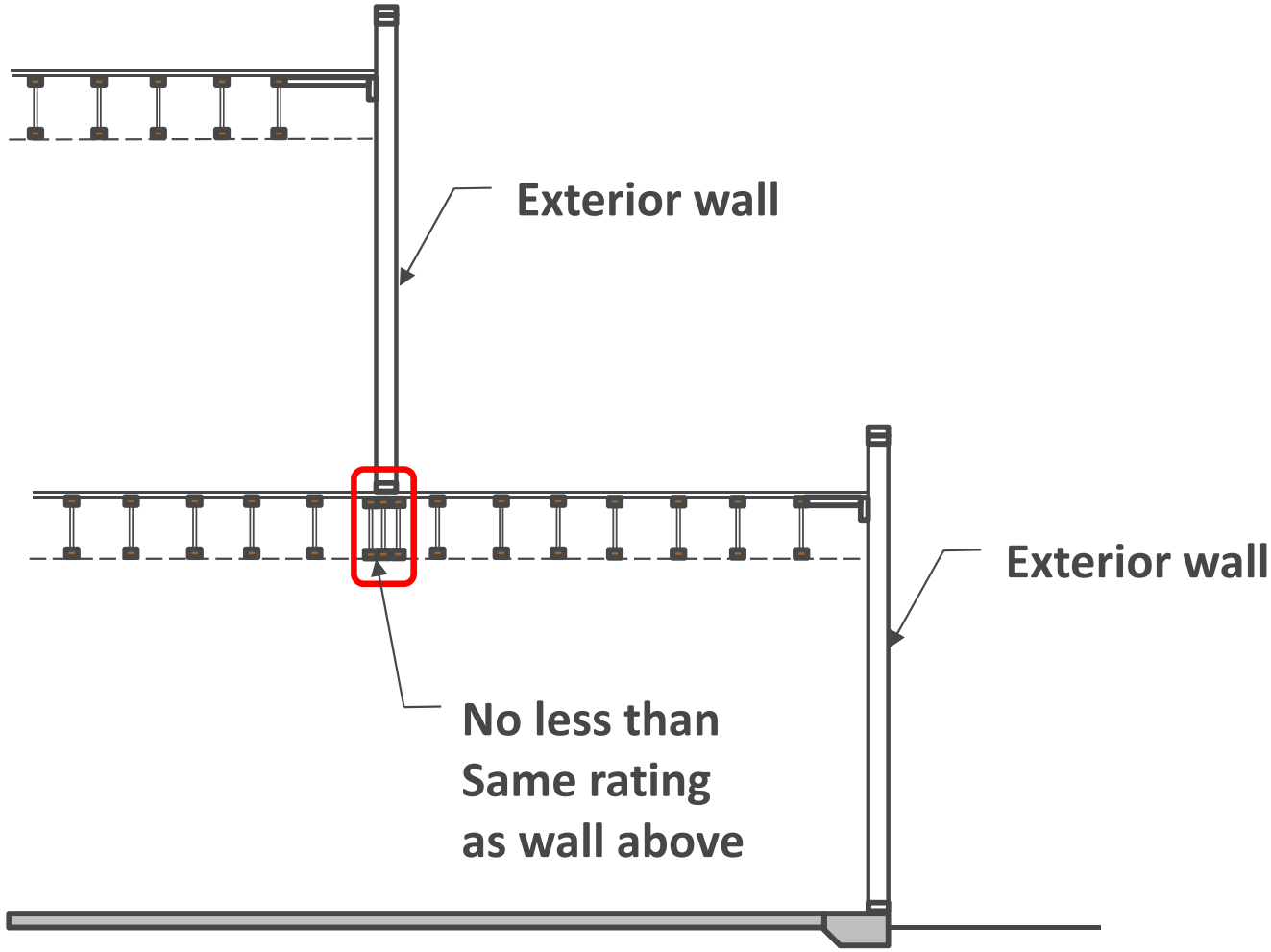
If framing parallel to long exterior walls is possible, minimizes area of load bearing exterior walls



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
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  - Vertical offsets
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  - Fire Resistant Continuity
  - Fire Retardant Continuity
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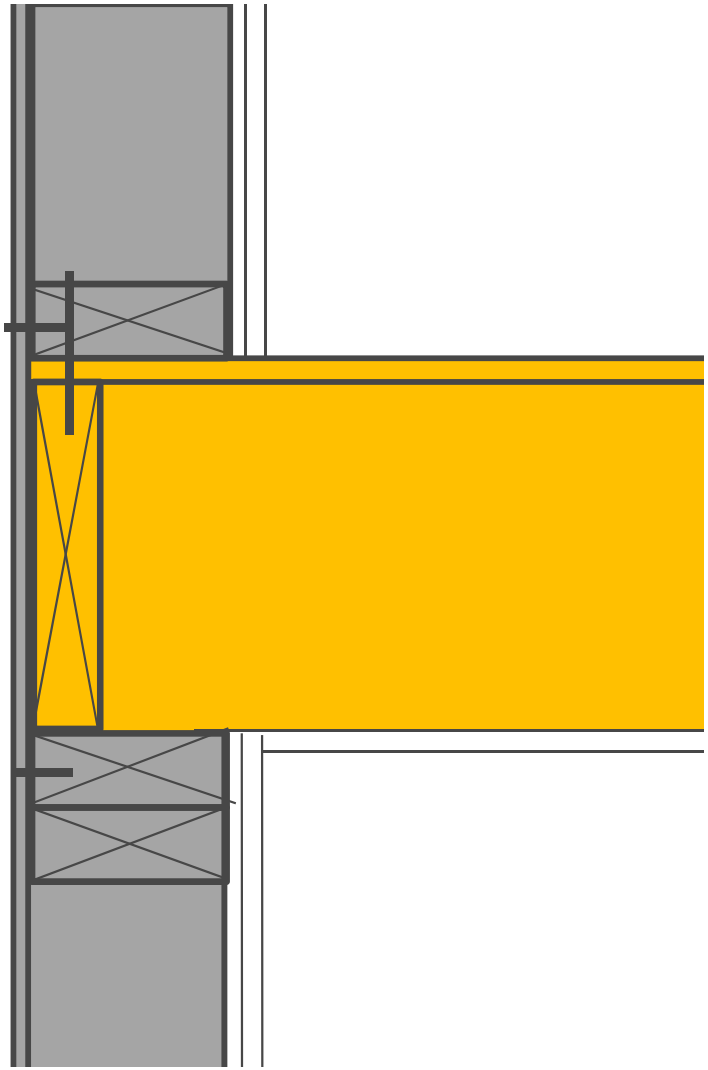
Platform Framing



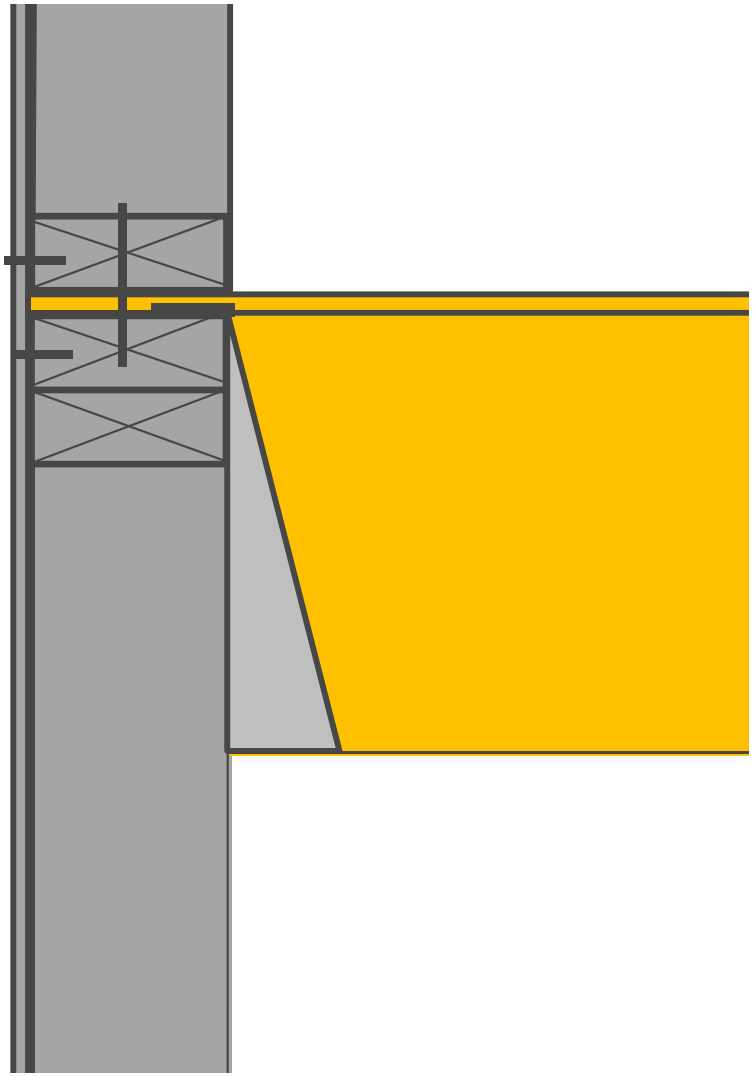
Structural

- 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 (bearing) 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

IBC Tables 601 & 706.4

Note: FRT = Fire Retardant Treated

Intersection of Tested Assemblies

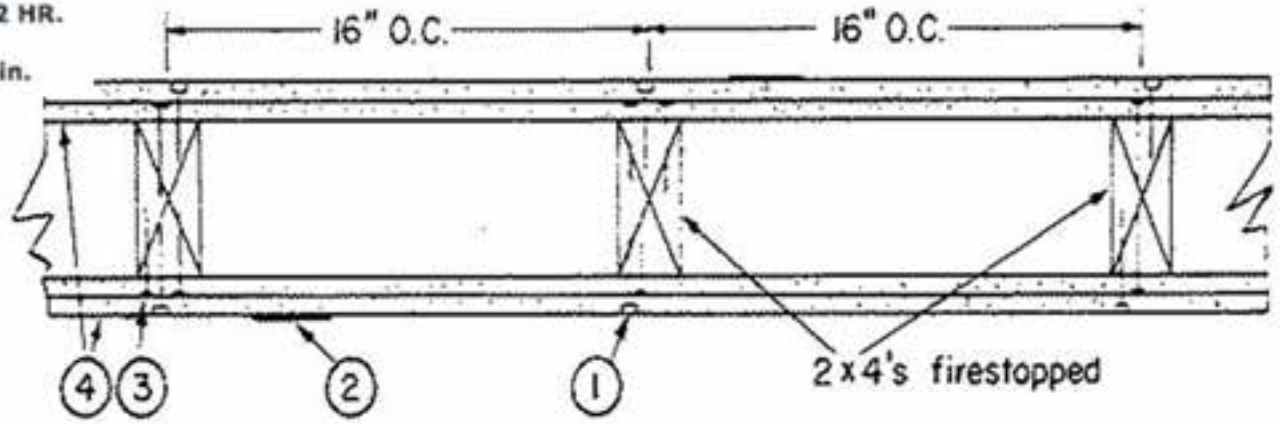
2 Hour Wall

Design No. U301

May 20, 2015

Bearing Wall Rating — 2 HR.

Finish Rating — 66 Min.

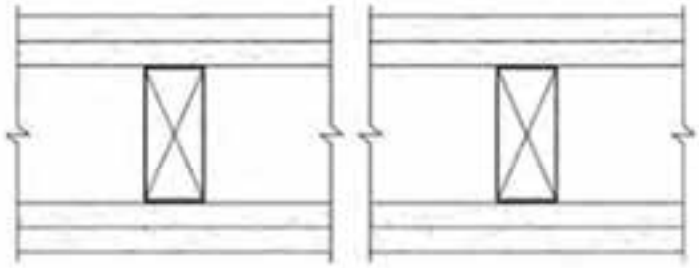


GA FILE NO. WP 4135	GENERIC	2 HOUR FIRE	40 to 44 STC SOUND

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

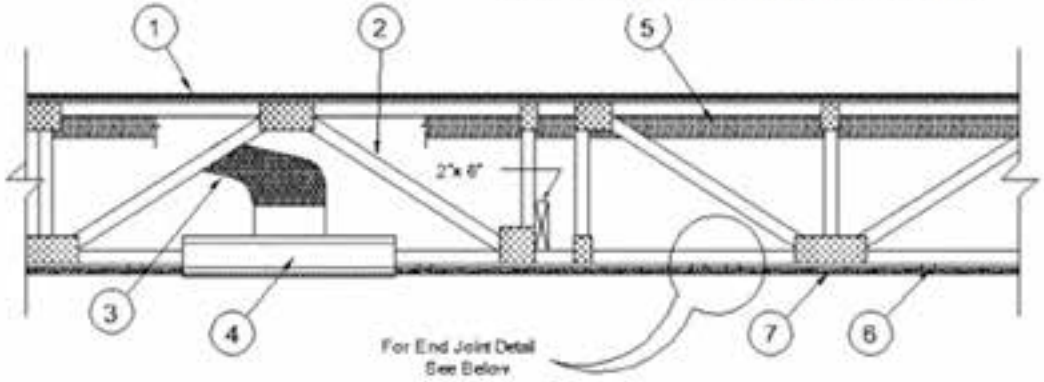
Intersection of Tested Assemblies

1 Hour Floor

Design No. L550

August 27, 2015

Unrestrained Assembly Rating — 1 Hr.



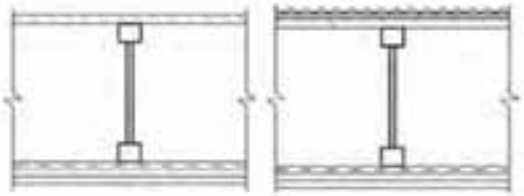
FLOOR-CEILING SYSTEMS, WOOD FRAMED

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.

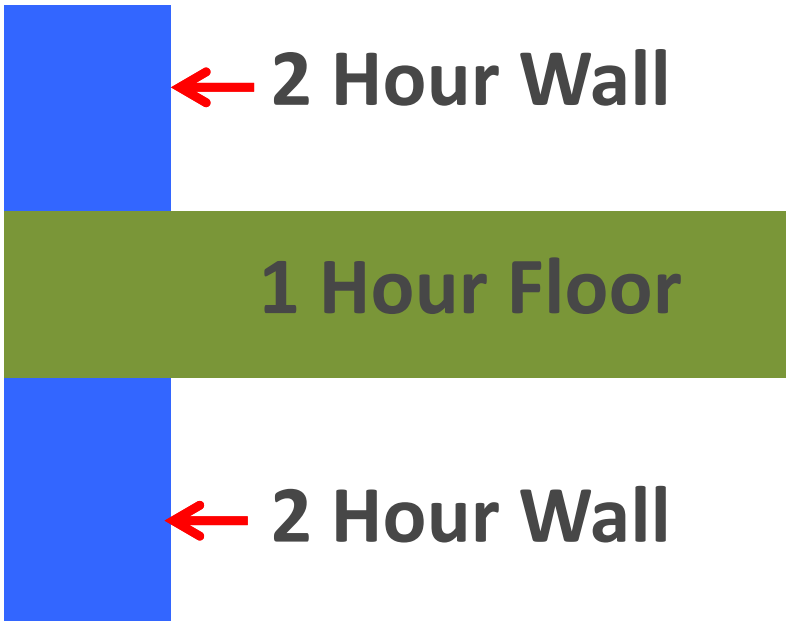
STC and IIC tested with 40 oz carpet over 1/4" foam pad.



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

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



Type III Exterior Walls – FRT

Type III and IV Construction - IBC Section 602.3:
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 - ?
- Rim Joist- ?
- Floor Joists- ?

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 clarify this.

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

2015 IBC 705.6 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 for the exterior wall.

Code Commentary - 2015 IBC 705.6

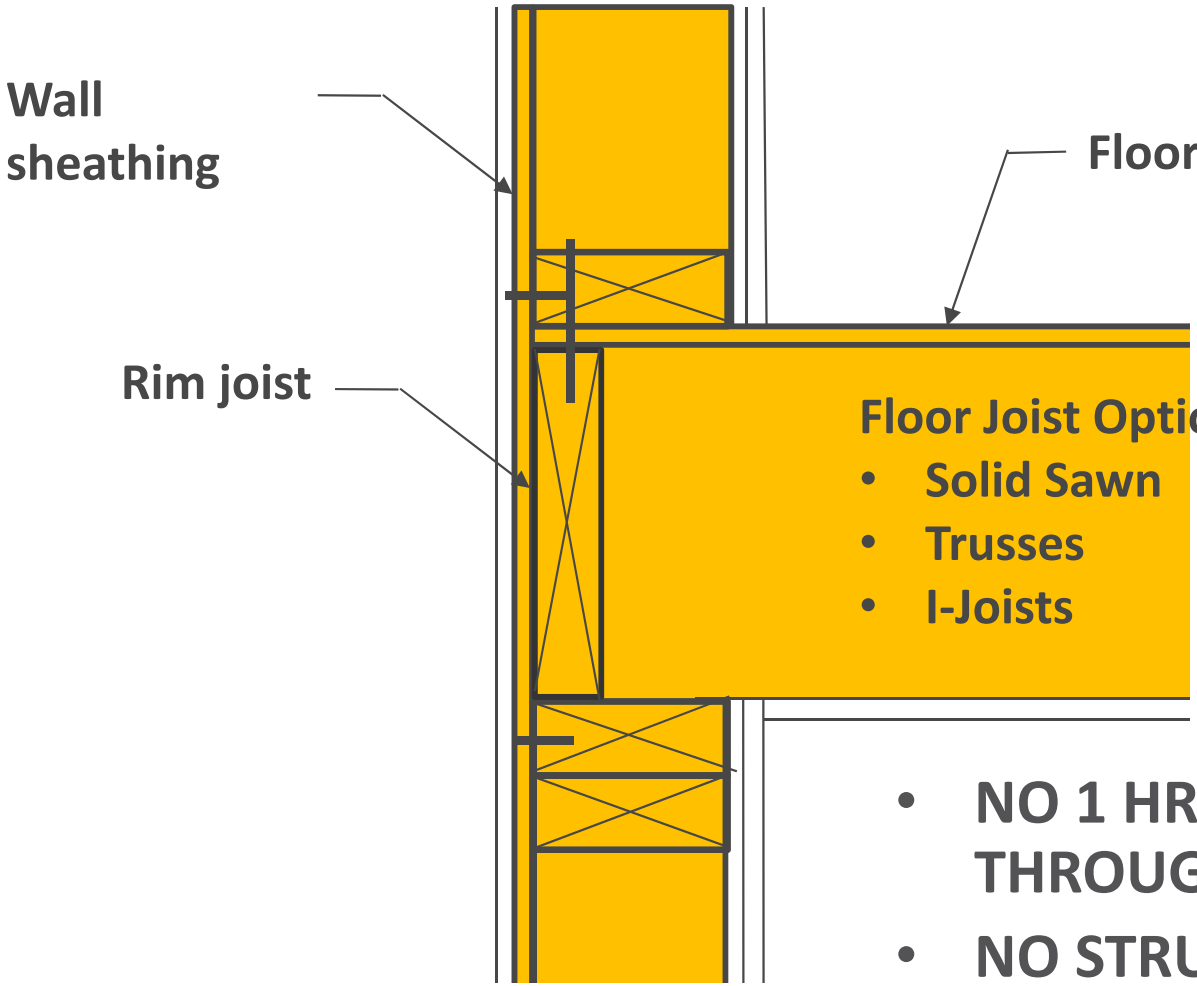
❖ Structural stability of fire-resistance-rated construction is an important concern. Section 705.6 requires elements providing bracing s
tance rated for the same dura
rior wall. In light-frame platfor
require that the band joist o
floor and the wall above to a
construction. Although the f
may not be required to be
construction in Type IIB and
effort must be made to ensure
least at the exterior wall, ar
construction. Although the floo
eral support for the exterior wa
require that the entire floor s
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."

Exterior Walls – Intersecting Floors

Type V Construction – 1 HR Wall, 1 HR Floor

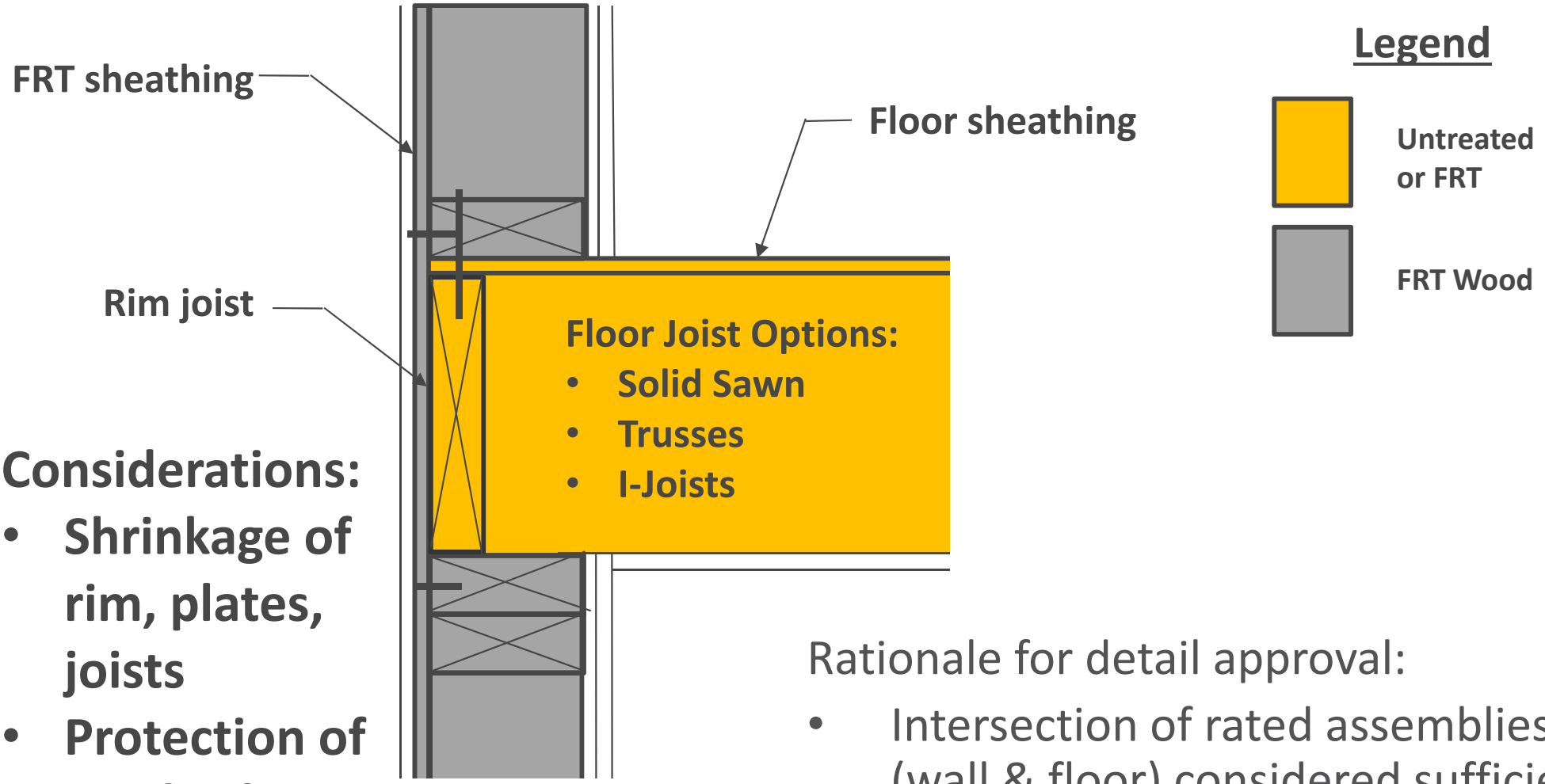
Typical Platform Framing



- **NO 1 HR CONTINUITY REQUIRED THROUGH THE FLOOR CAVITY**
- **NO STRUCTURAL STABLITY CONCERNS**

Exterior Walls – Intersecting Floors

Type III Construction – 2 HR Wall, 1 HR Floor
Typical Platform Framing



Considerations:

- **Shrinkage of rim, plates, joists**
- **Protection of rim for fire**

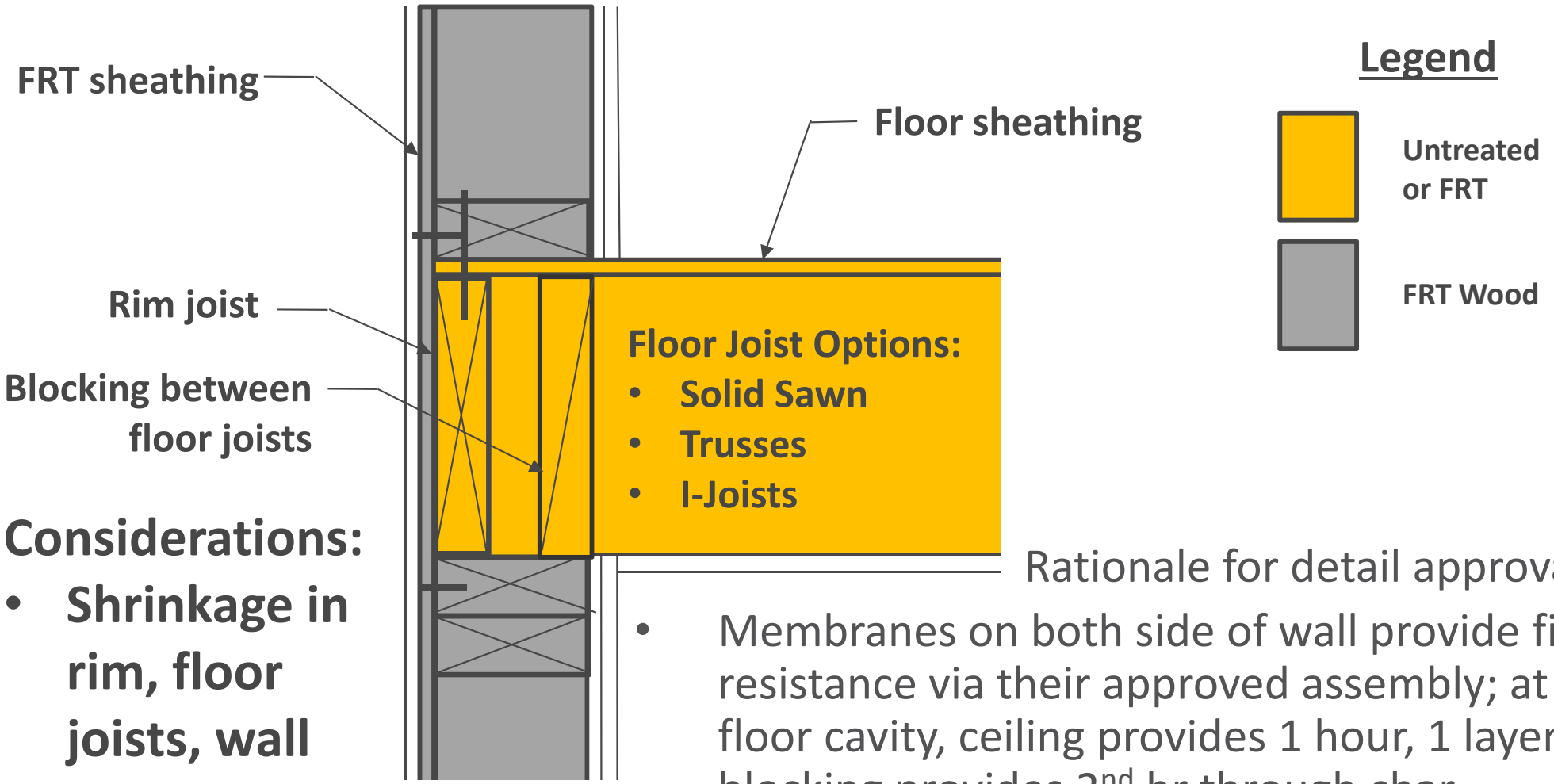
Rationale for detail approval:

- Intersection of rated assemblies (wall & floor) considered sufficient

Exterior Walls – Intersecting Floors

Type III Construction – 2 HR Wall, 1 HR Floor

Typical Platform Framing



Considerations:

- **Shrinkage in rim, floor joists, wall plates**

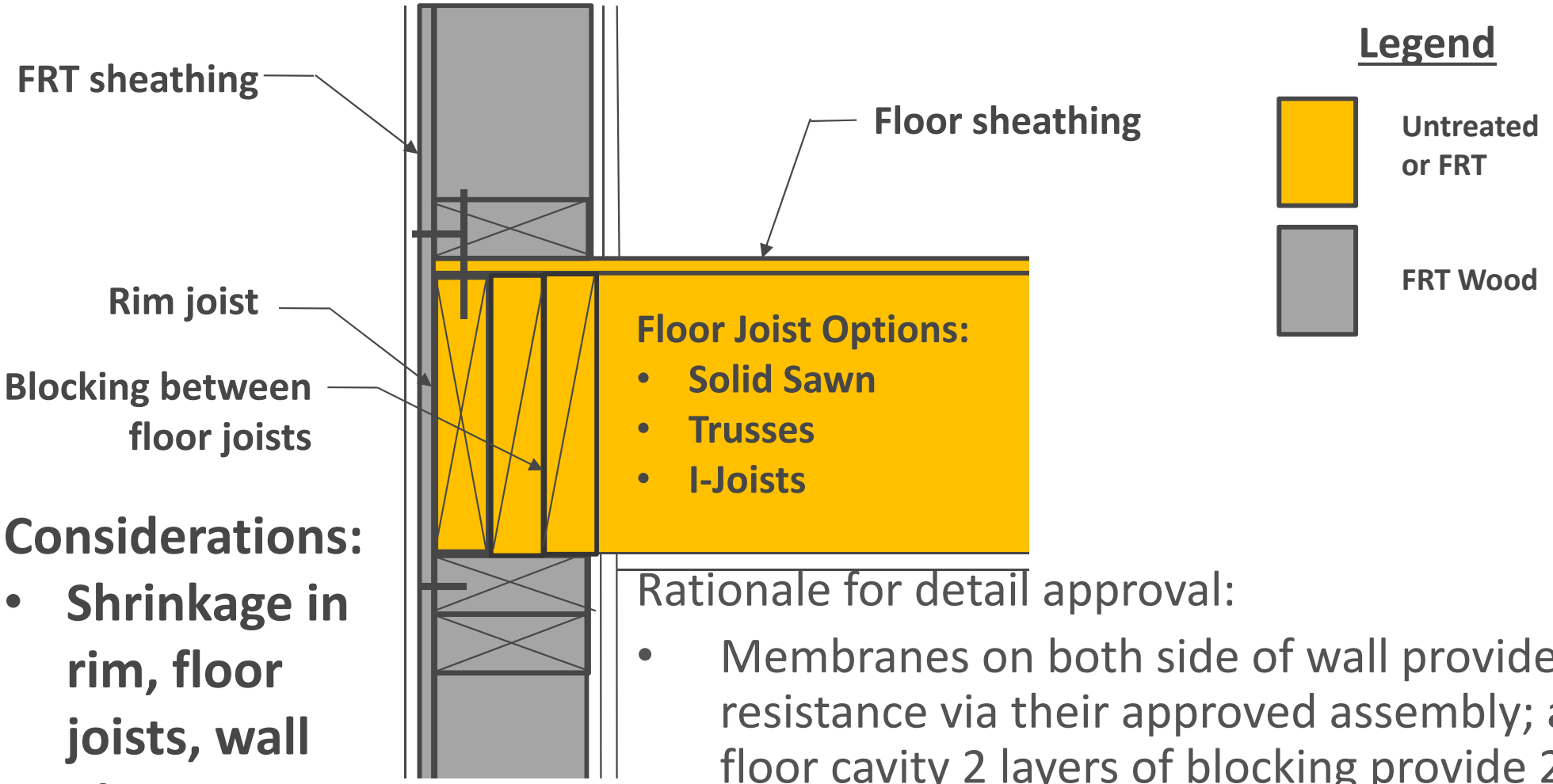
Rationale for detail approval:

- 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

Typical Platform Framing



Considerations:

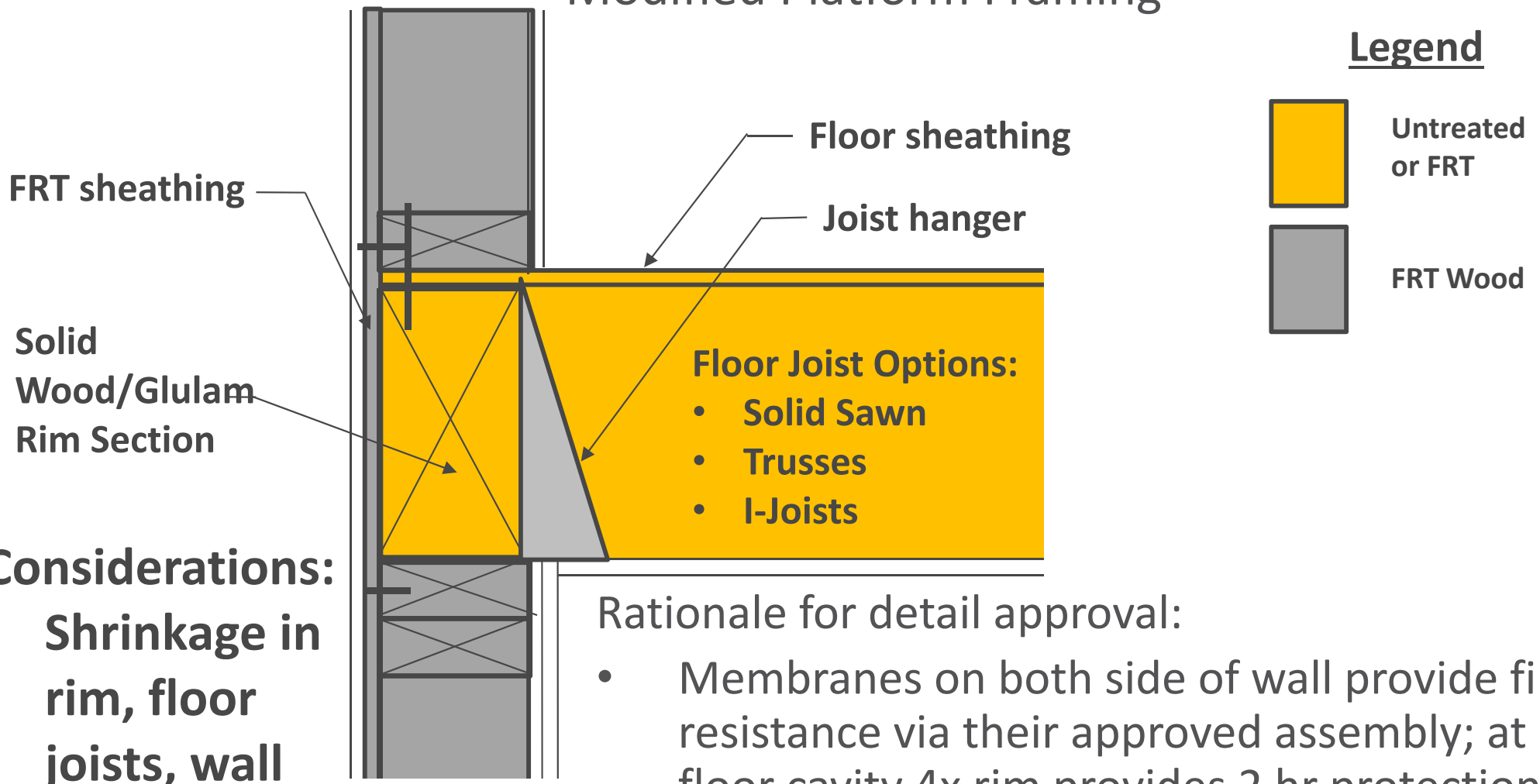
- **Shrinkage in rim, floor joists, wall plates**

Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly; at floor cavity 2 layers of blocking provide 2 hr protection through char calculations

Exterior Walls – Intersecting Floors

Type III Construction – 2 HR Wall, 1 HR Floor
Modified Platform Framing



Considerations:

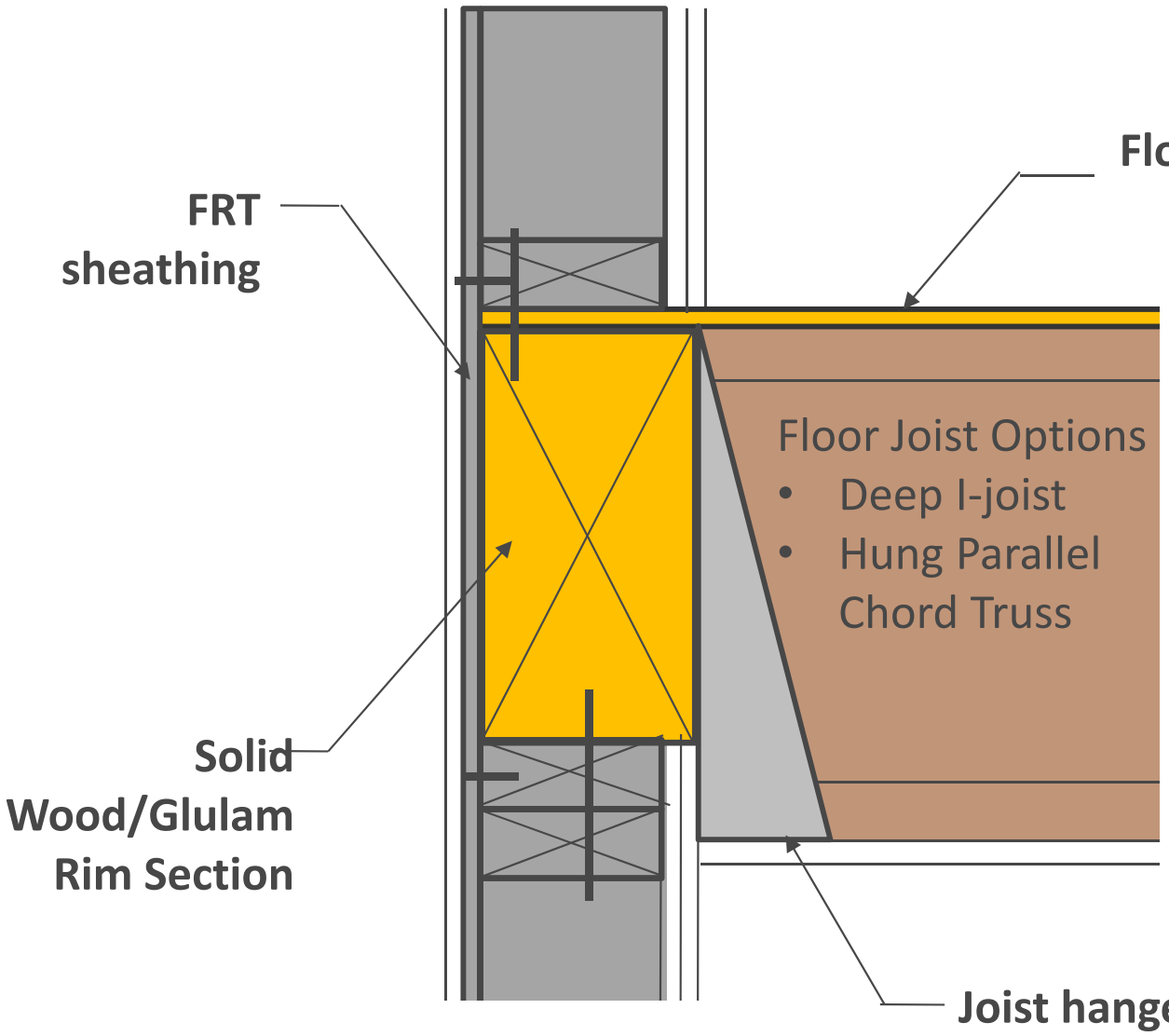
- **Shrinkage in rim, floor joists, wall plates**

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
Modified Platform Framing



Legend

- Untreated or FRT
- FRT Wood
- Untreated

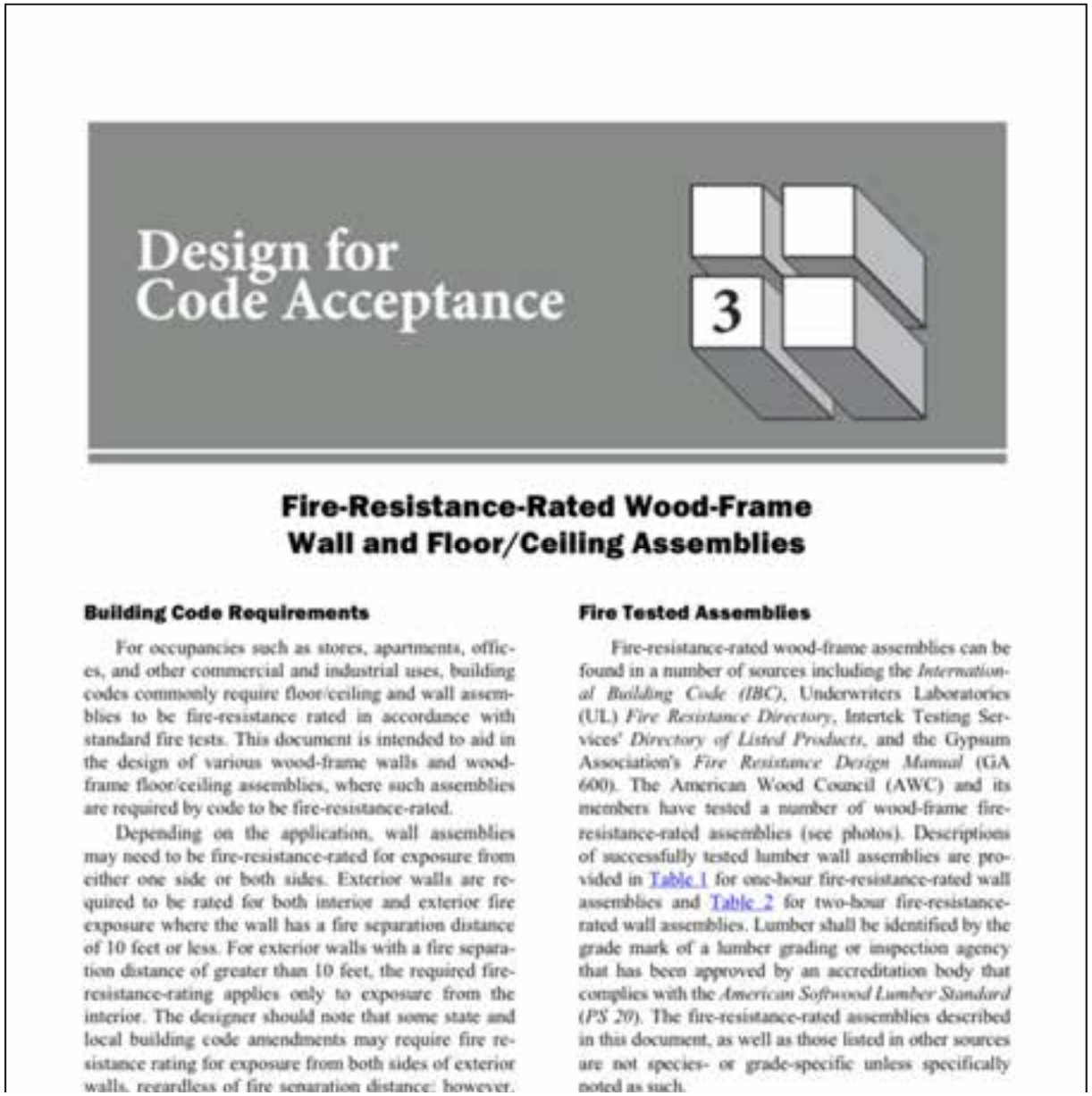
Rationale for detail approval:

- 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

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,

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.

Exterior Walls – Intersecting Floors

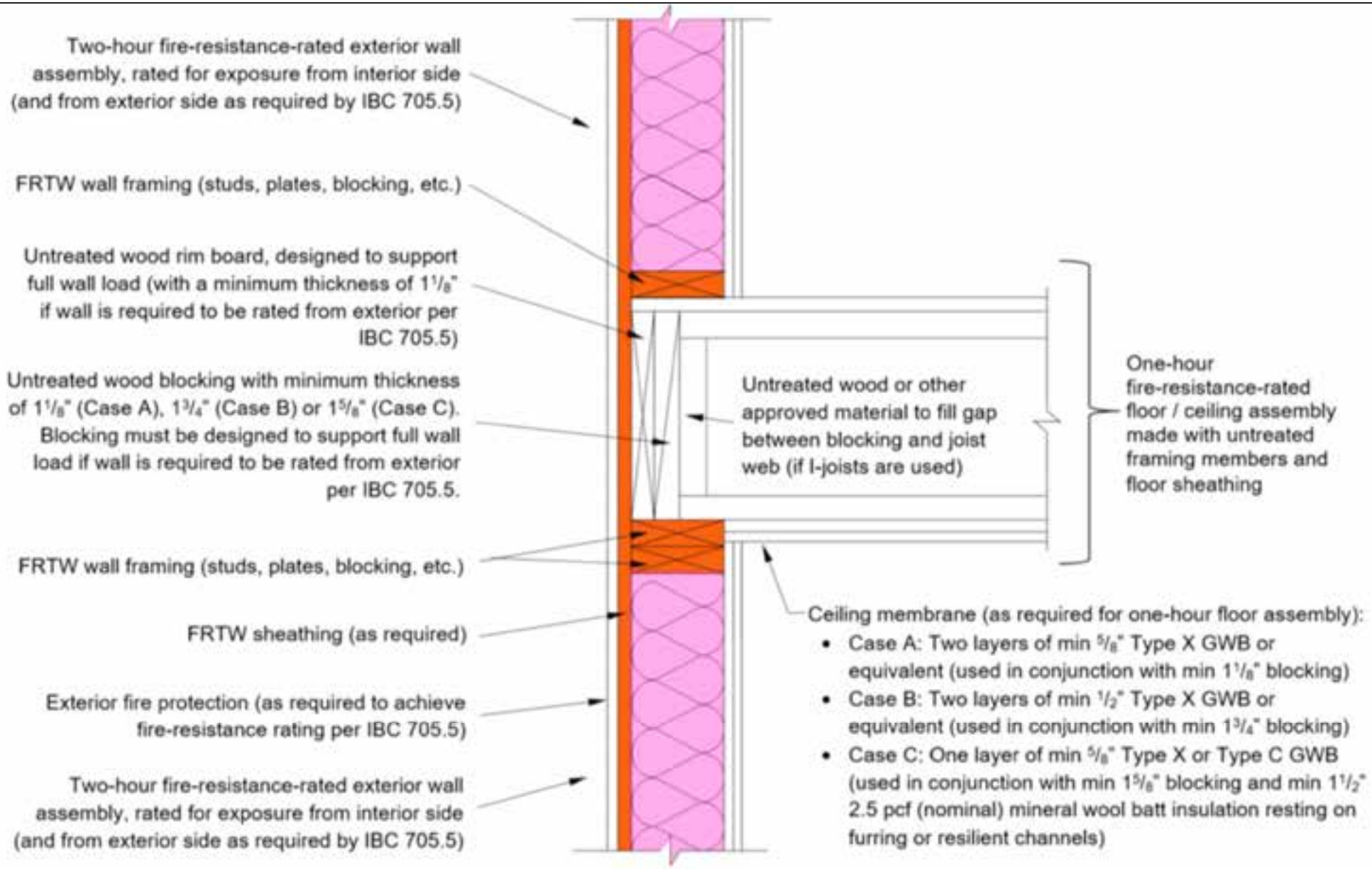
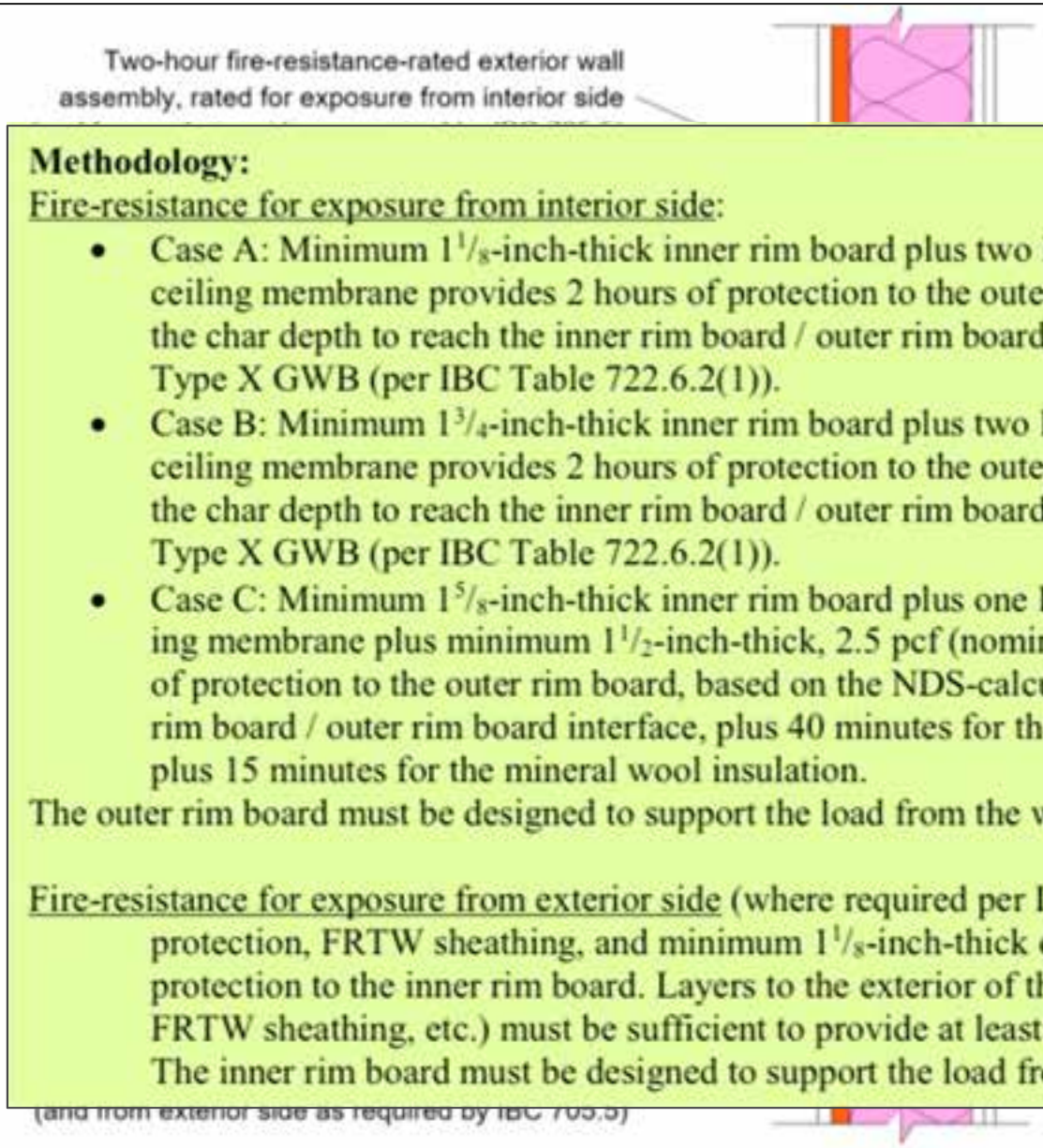


Figure 1A: Example detail for Type III-A exterior wall–floor intersection with rim board and blocking

Exterior Walls – Intersecting Floors



Methodology:

Fire-resistance for exposure from interior side:

- Case A: Minimum $1^{1}/_{8}$-inch-thick inner rim board plus two layers of minimum $^{5}/_{8}$ in. Type X GWB in the ceiling membrane provides 2 hours of protection to the outer rim board, based on the NDS-calculated time for the char depth to reach the inner rim board / outer rim board interface plus 40 minutes for each layer of $^{5}/_{8}$ in. Type X GWB (per IBC Table 722.6.2(1)).
- Case B: Minimum $1^{3}/_{4}$-inch-thick inner rim board plus two layers of minimum $^{1}/_{2}$ in. Type X GWB in the ceiling membrane provides 2 hours of protection to the outer rim board, based on the NDS-calculated time for the char depth to reach the inner rim board / outer rim board interface plus 25 minutes for each layer of $^{1}/_{2}$ in. Type X GWB (per IBC Table 722.6.2(1)).
- Case C: Minimum $1^{5}/_{8}$-inch-thick inner rim board plus one layer of minimum $^{5}/_{8}$ in. Type X GWB in the ceiling membrane plus minimum $1^{1}/_{2}$-inch-thick, 2.5 pcf (nominal) mineral wool batt insulation provides 2 hours of protection to the outer rim board, based on the NDS-calculated time for the char depth to reach the inner rim board / outer rim board interface, plus 40 minutes for the $^{5}/_{8}$ in. Type X GWB (per IBC Table 722.6.2(1)), plus 15 minutes for the mineral wool insulation.

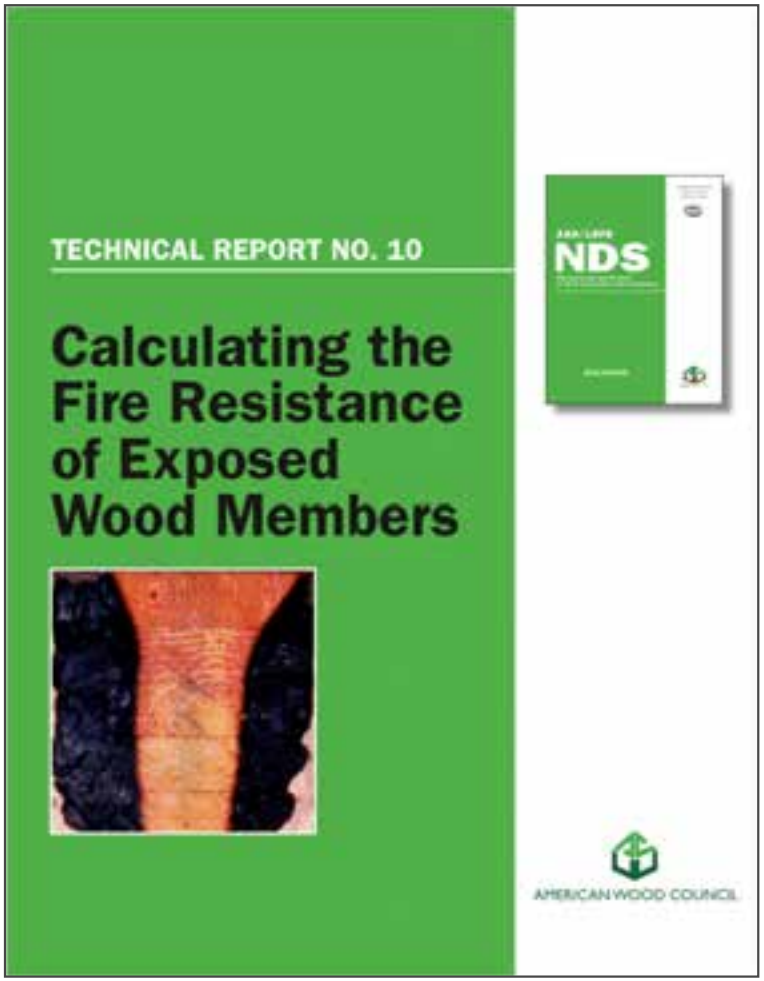
The outer rim board must be designed to support the load from the wall above.

Fire-resistance for exposure from exterior side (where required per IBC Section 705.5): A combination of exterior fire protection, FRTW sheathing, and minimum $1^{1}/_{8}$-inch-thick outer rim board is used to provide two hours of protection to the inner rim board. Layers to the exterior of the outer rim board (e.g., exterior fire protection, FRTW sheathing, etc.) must be sufficient to provide at least 80 minutes of protection to the outer rim board. The inner rim board must be designed to support the load from the wall above.

Figure 1A: Example detail for Type III-A exterior wall–floor intersection with rim board and blocking

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

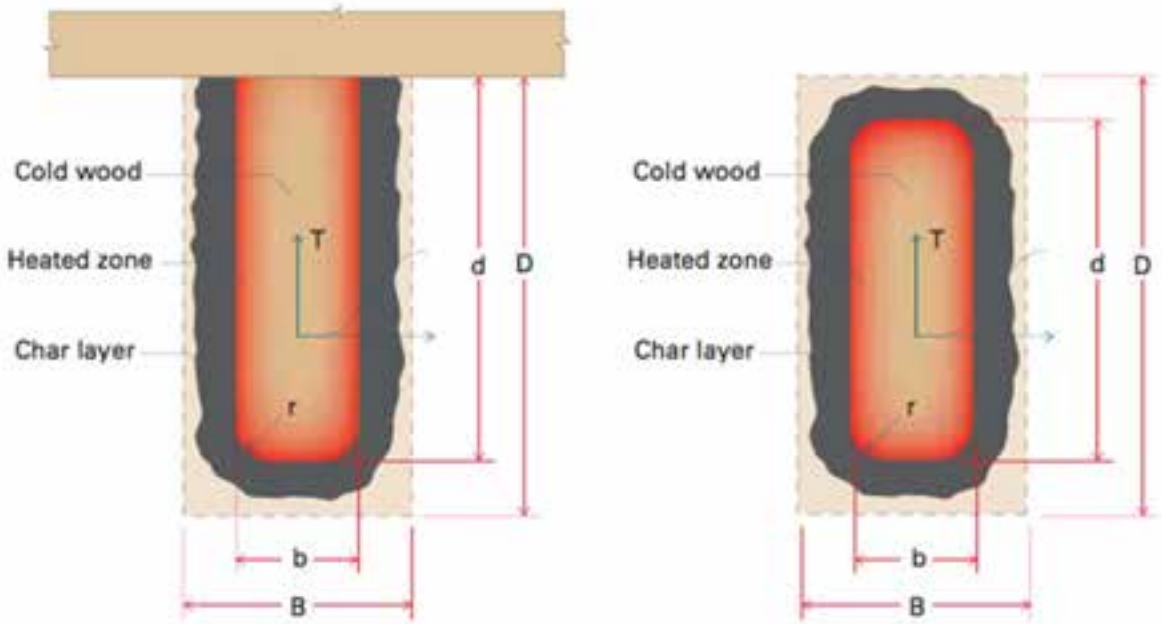


Figure 1-1 Reduction in member breadth and depth over time, t

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-NON LINEAR

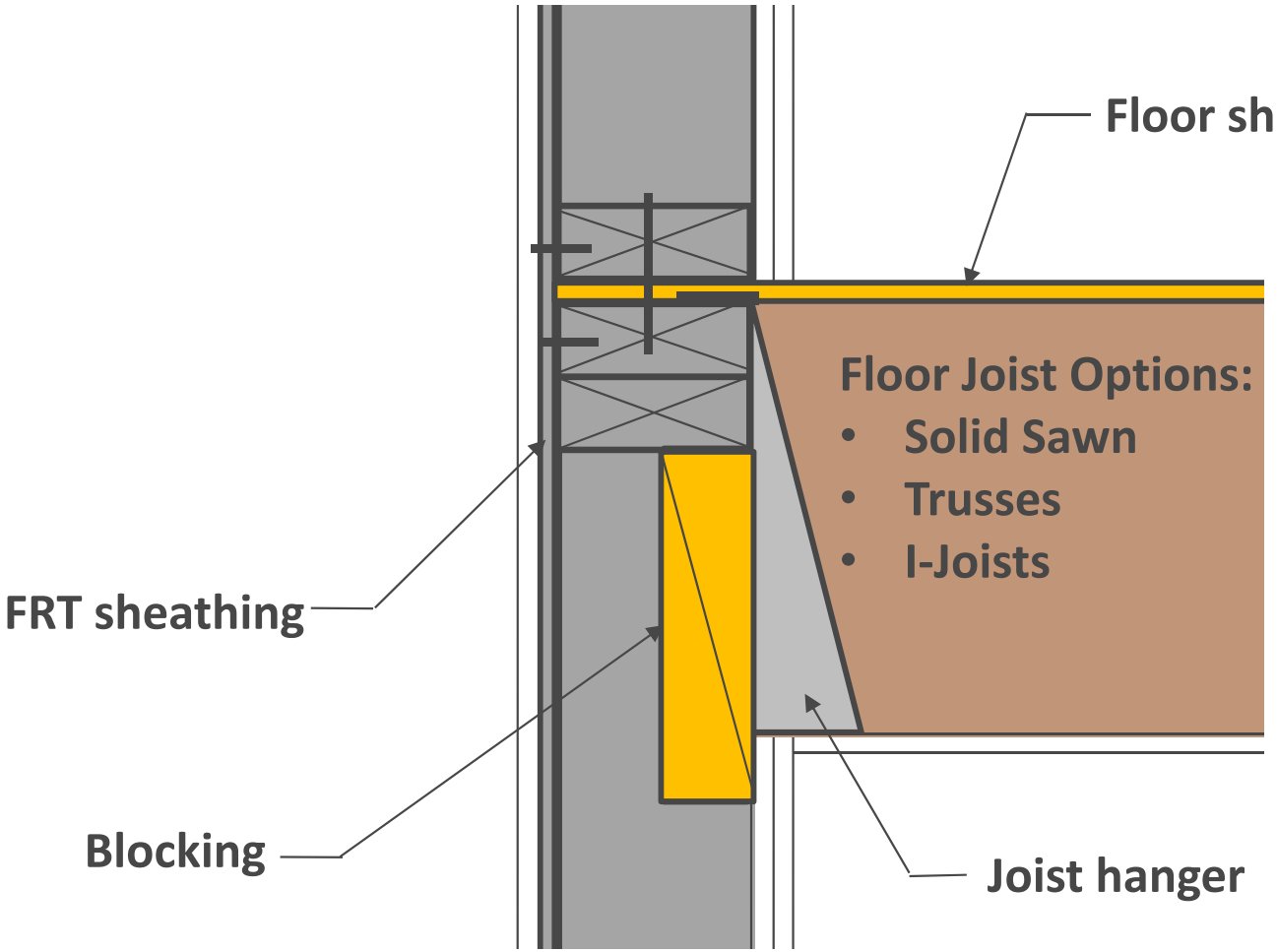
β_{eff} = Effective char rate (in/hr), adjusted for exposure time, t

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 Floors

Type III Construction – 2 HR Wall, 1 HR Floor
Semi-Balloon Framing w/Add'l Fire Protection



Legend

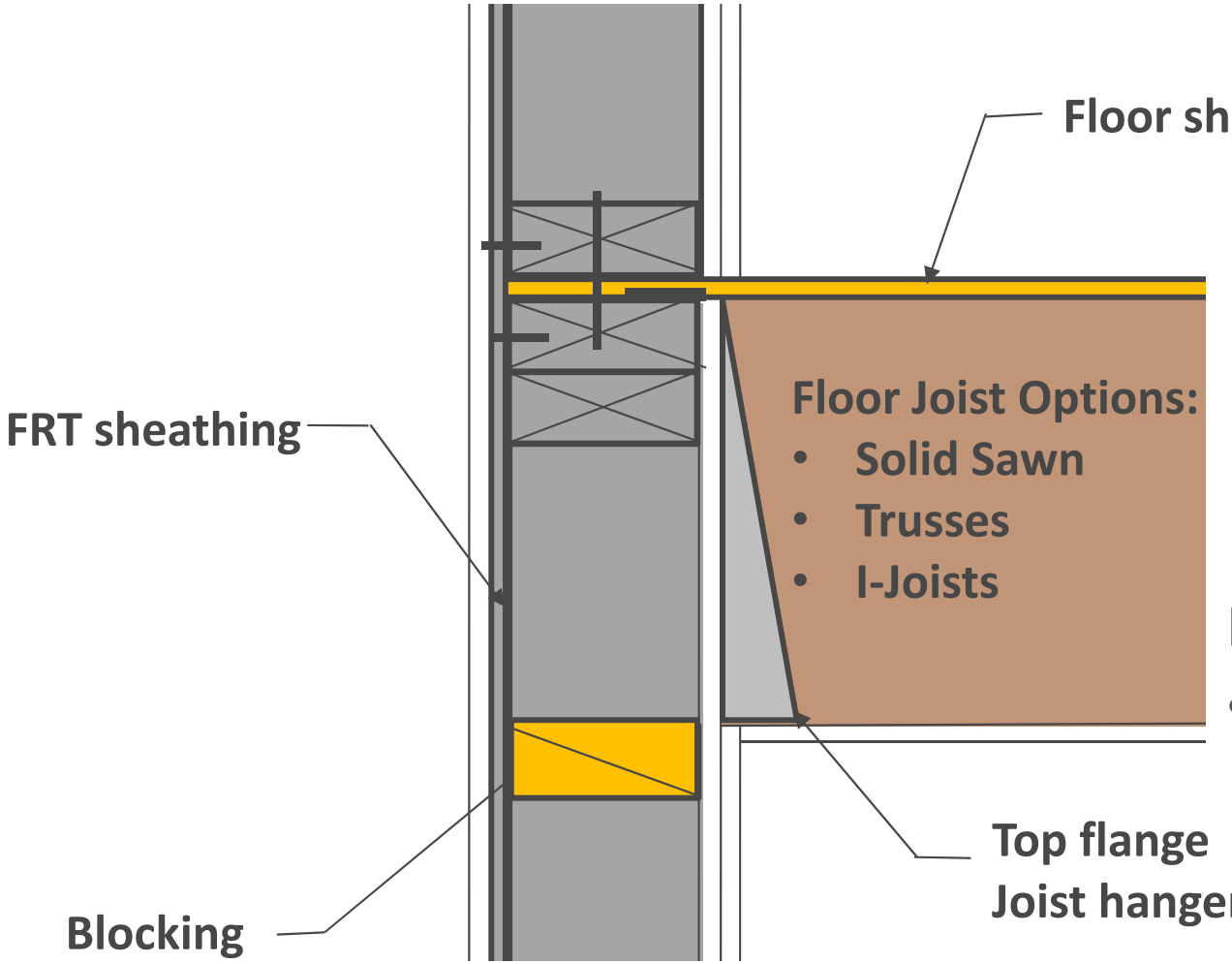
- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:

- Ceiling membrane provides 1 hr protection; Blocking in wall provides 2nd hr through char calculations

Exterior Walls – Intersecting Floors

Type III Construction – 2 HR Wall, 1 HR Floor
Semi-Balloon Framing w/Add'l Fire Protection



Legend

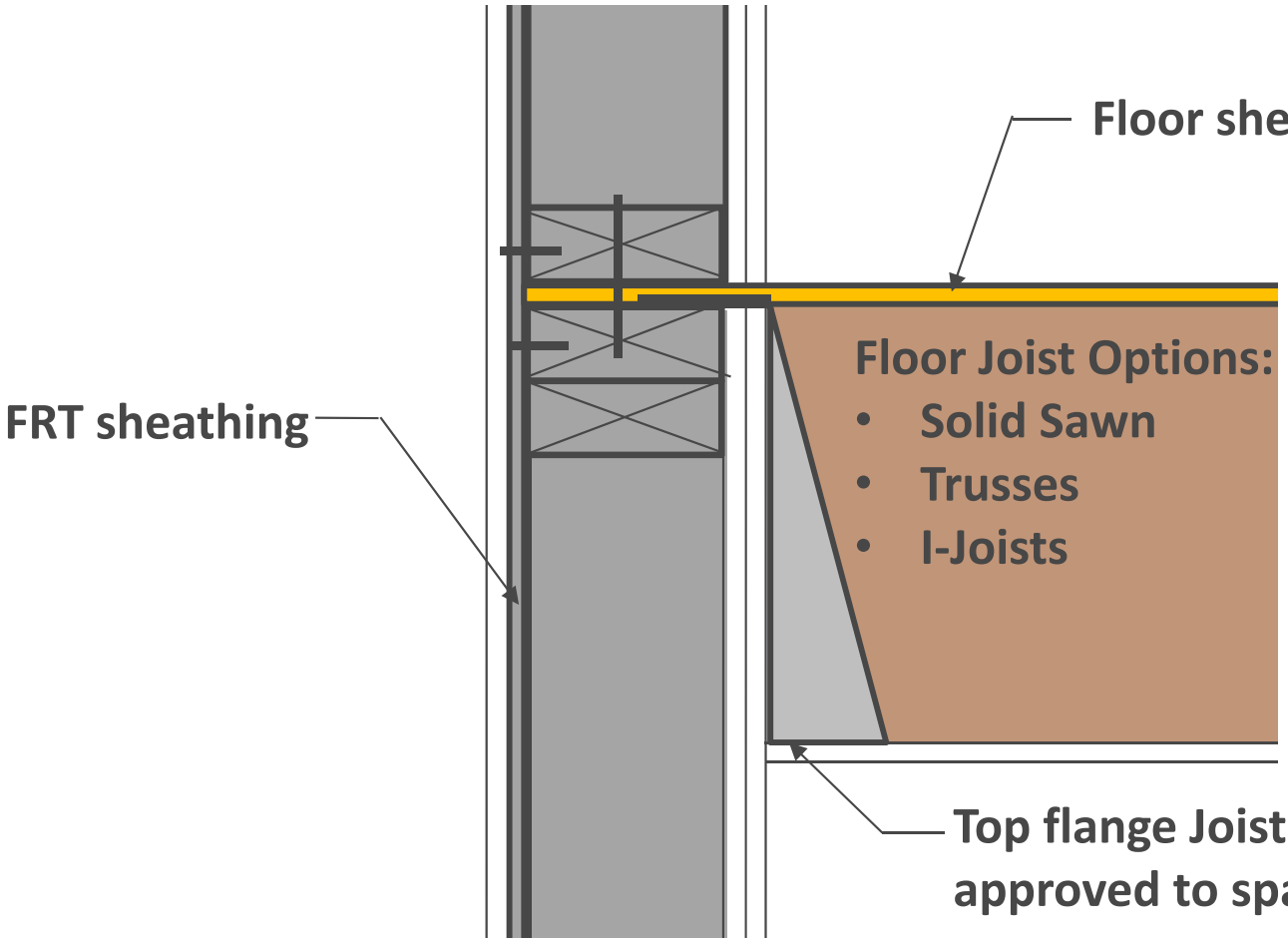
- Untreated or FRT
- FRT Wood
- Untreated

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 w/Add'l Fire Protection



Legend

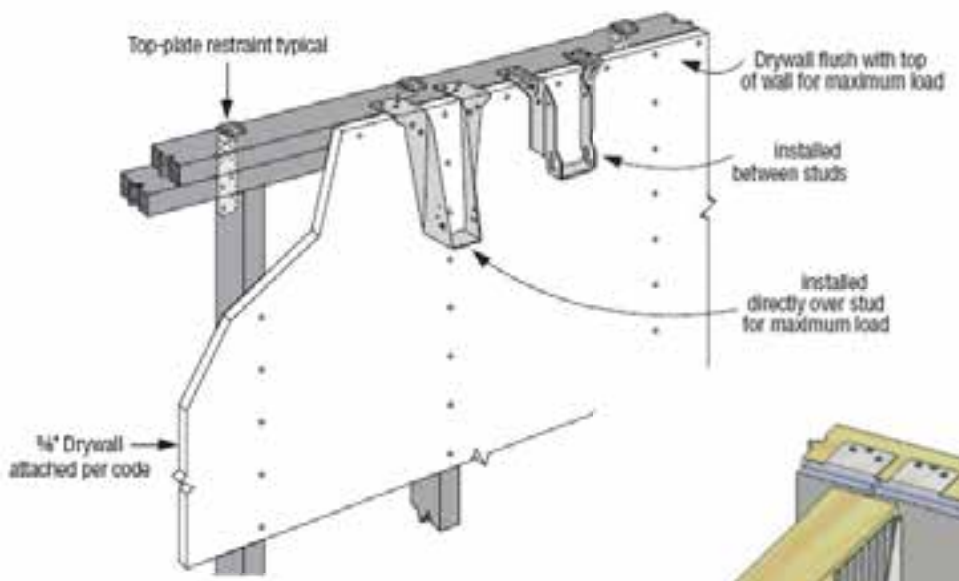
- Untreated or FRT
- FRT Wood
- Untreated

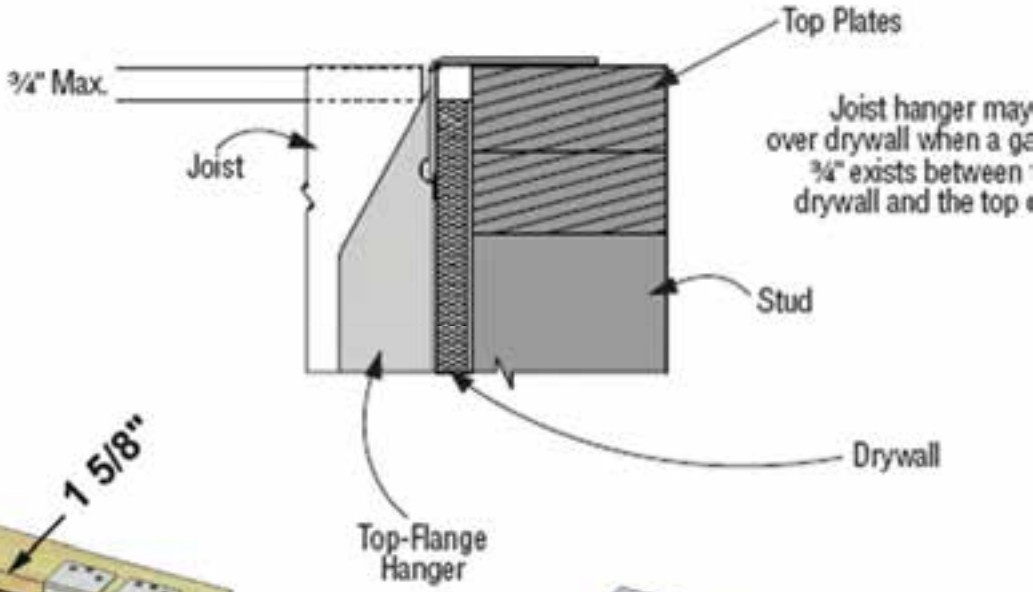
Rationale for detail approval:

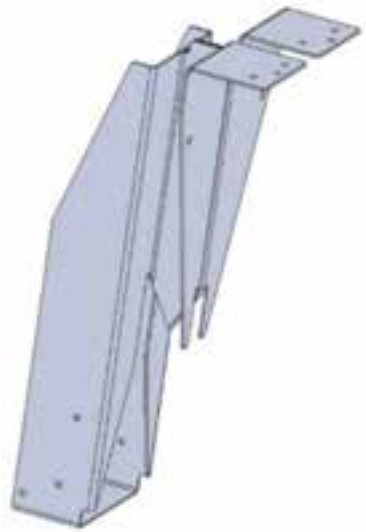
- Membranes on both side of wall provide fire resistance via their approved assembly

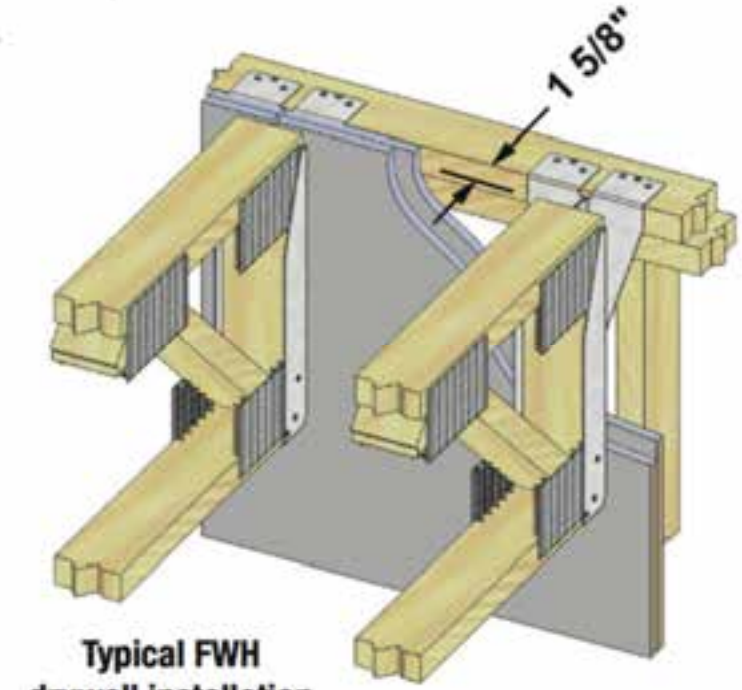
Over Gypsum Hangers

Commonly called Fire Wall or Drywall Hangers

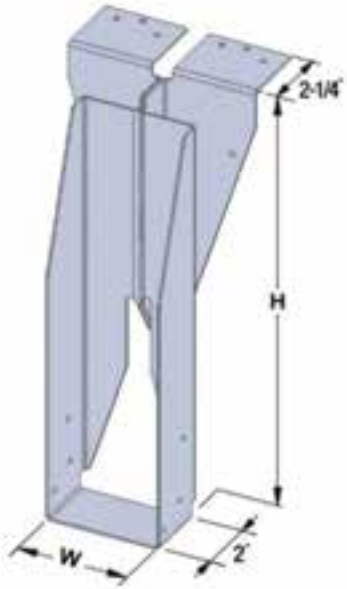






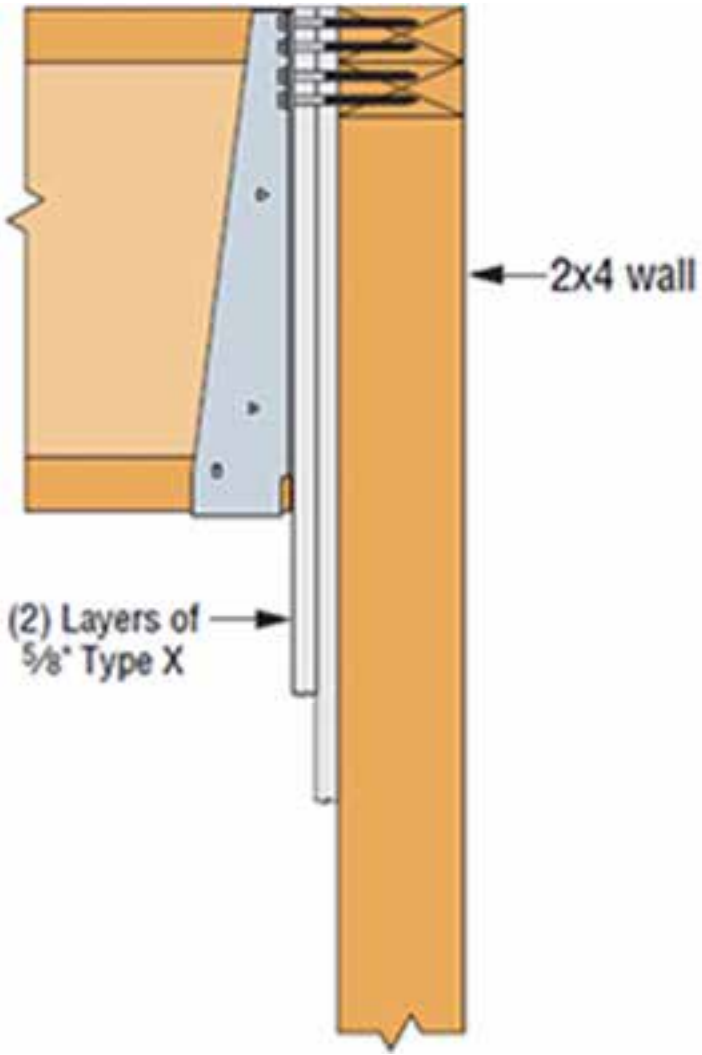


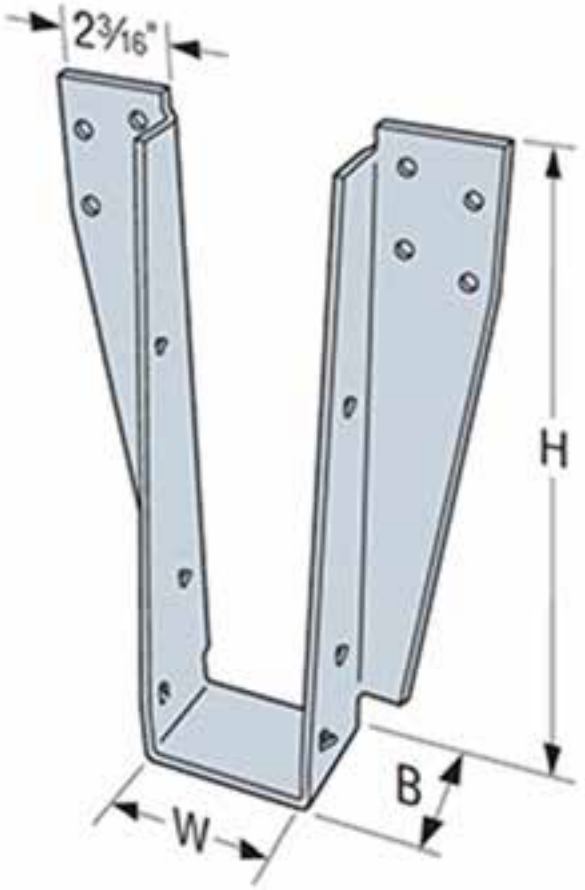
Typical FWH drywall installation using FWH-T Template



Over Gypsum Hangers

Top Flange Hangers & Face Mount Hangers Available

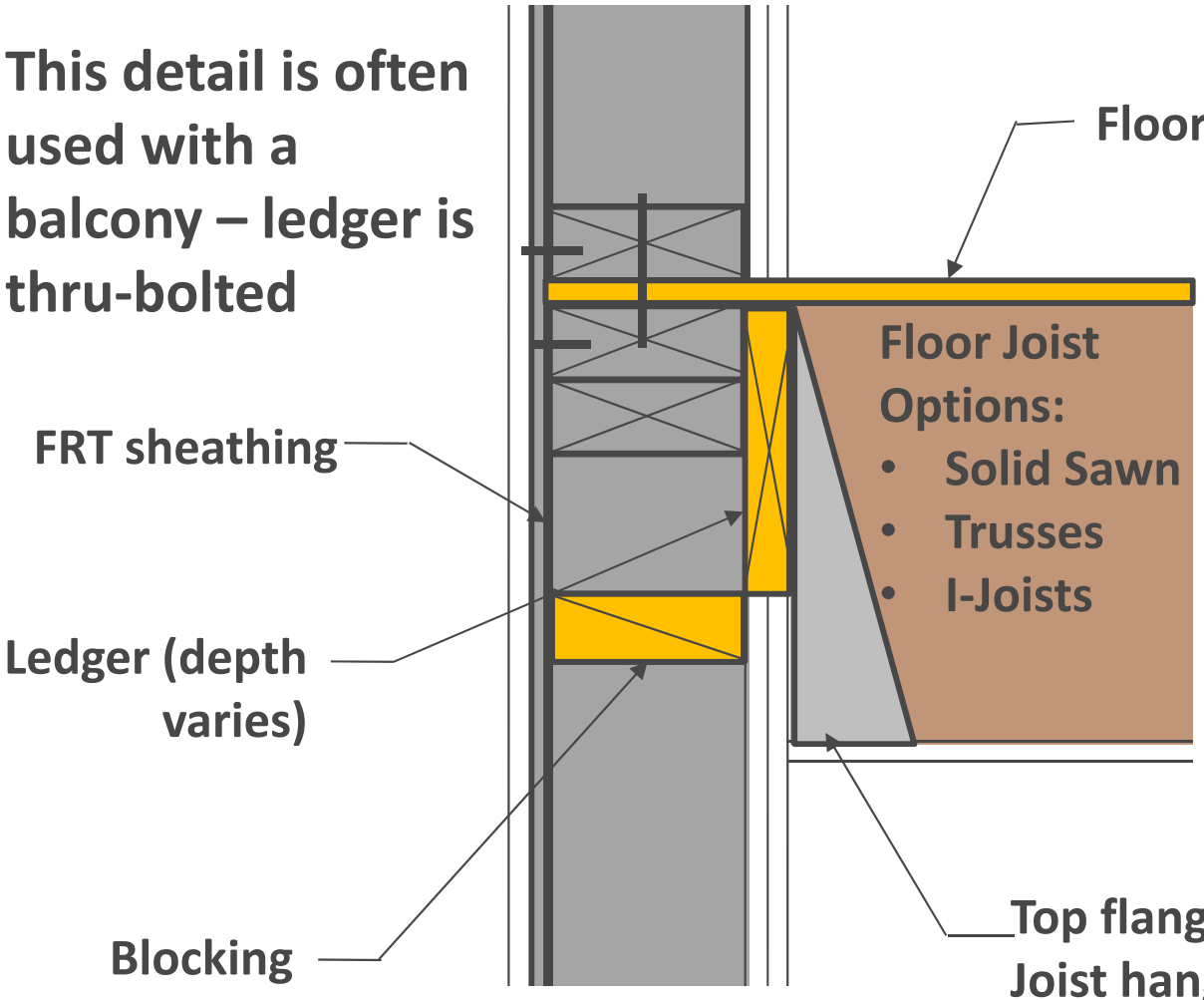




Exterior Walls – Intersecting Floors

Type III Construction – 2 HR Wall, 1 HR Floor
Semi-Balloon Framing w/Ledger

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



Legend

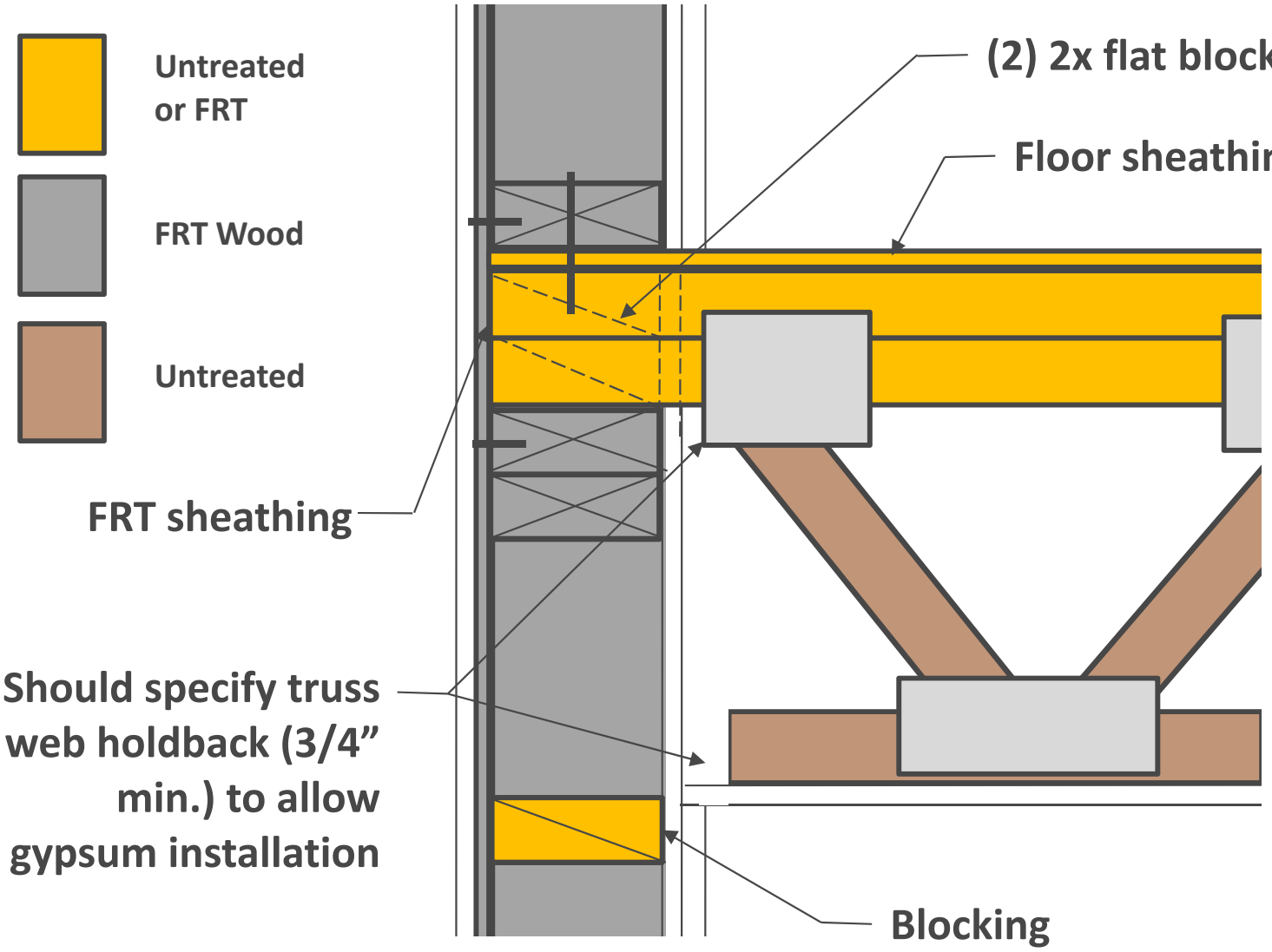
- Untreated or FRT
- FRT Wood
- Untreated

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

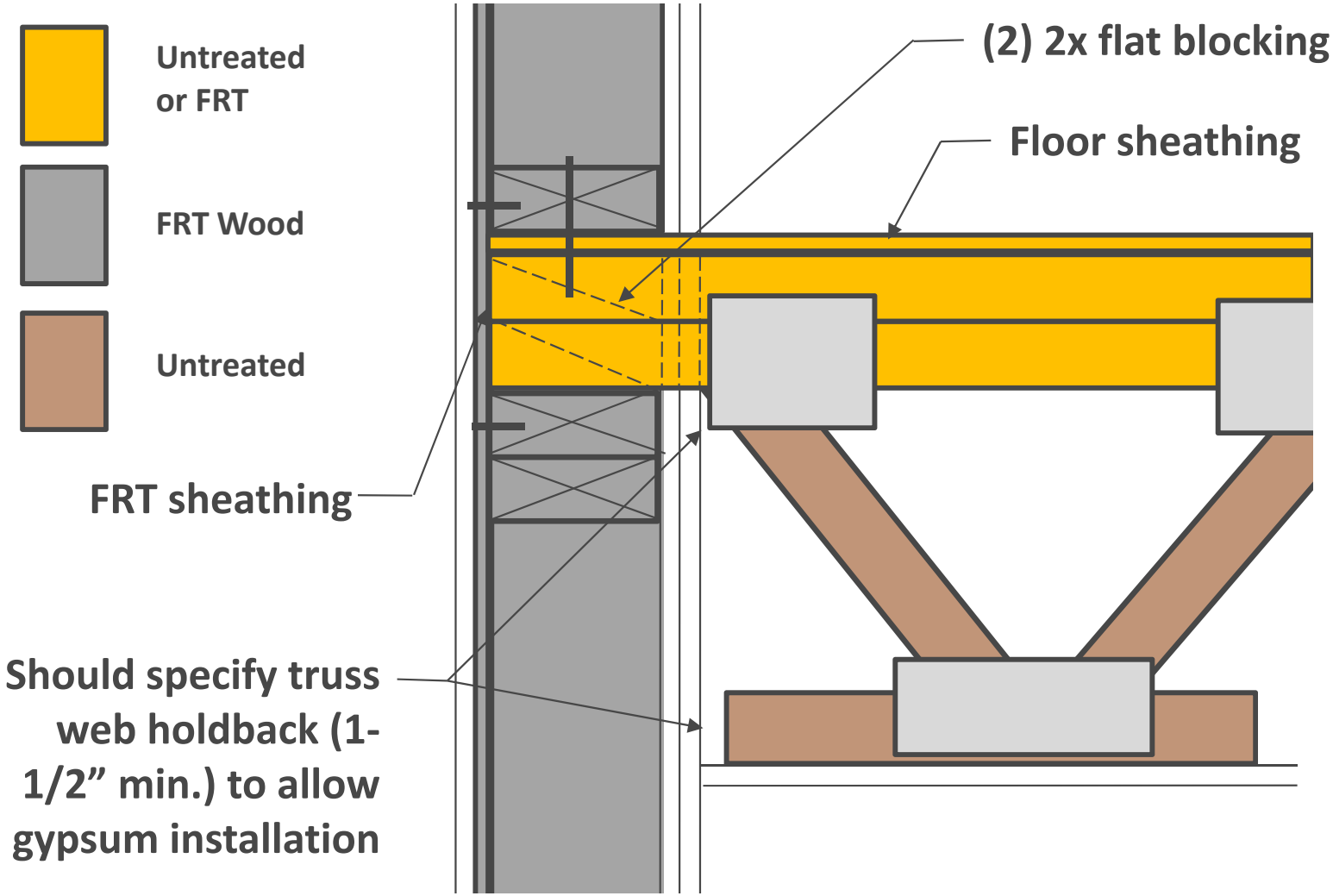


Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly; at floor cavity ceiling membrane provides 1 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

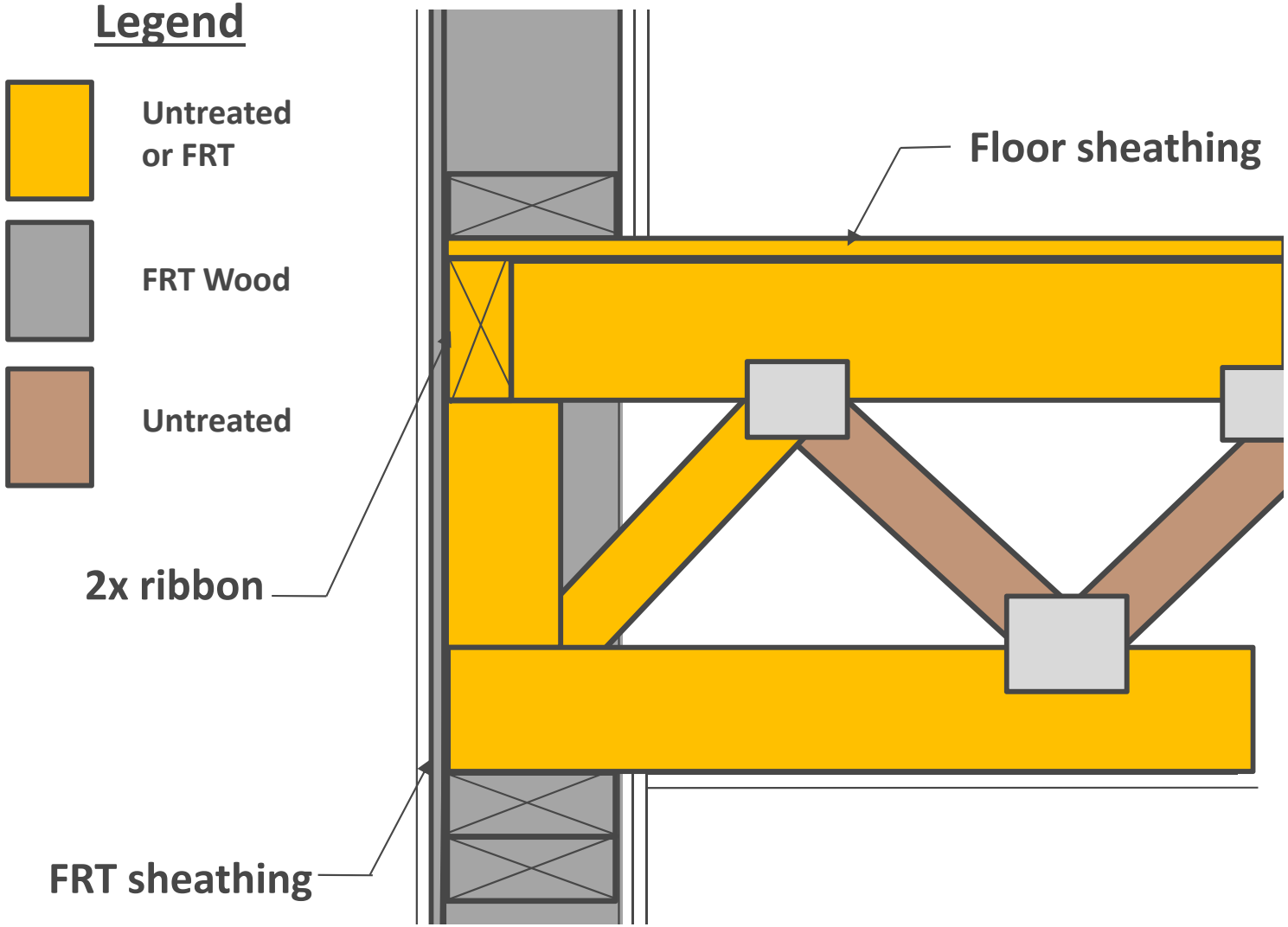
Exterior Walls – Intersecting Floors

Exterior Walls – Intersecting Floors

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

Exterior Walls – Intersecting Floors

Type III Construction – 2 HR Wall, 1 HR Floor
Platform Framing w/Top Chord Bearing

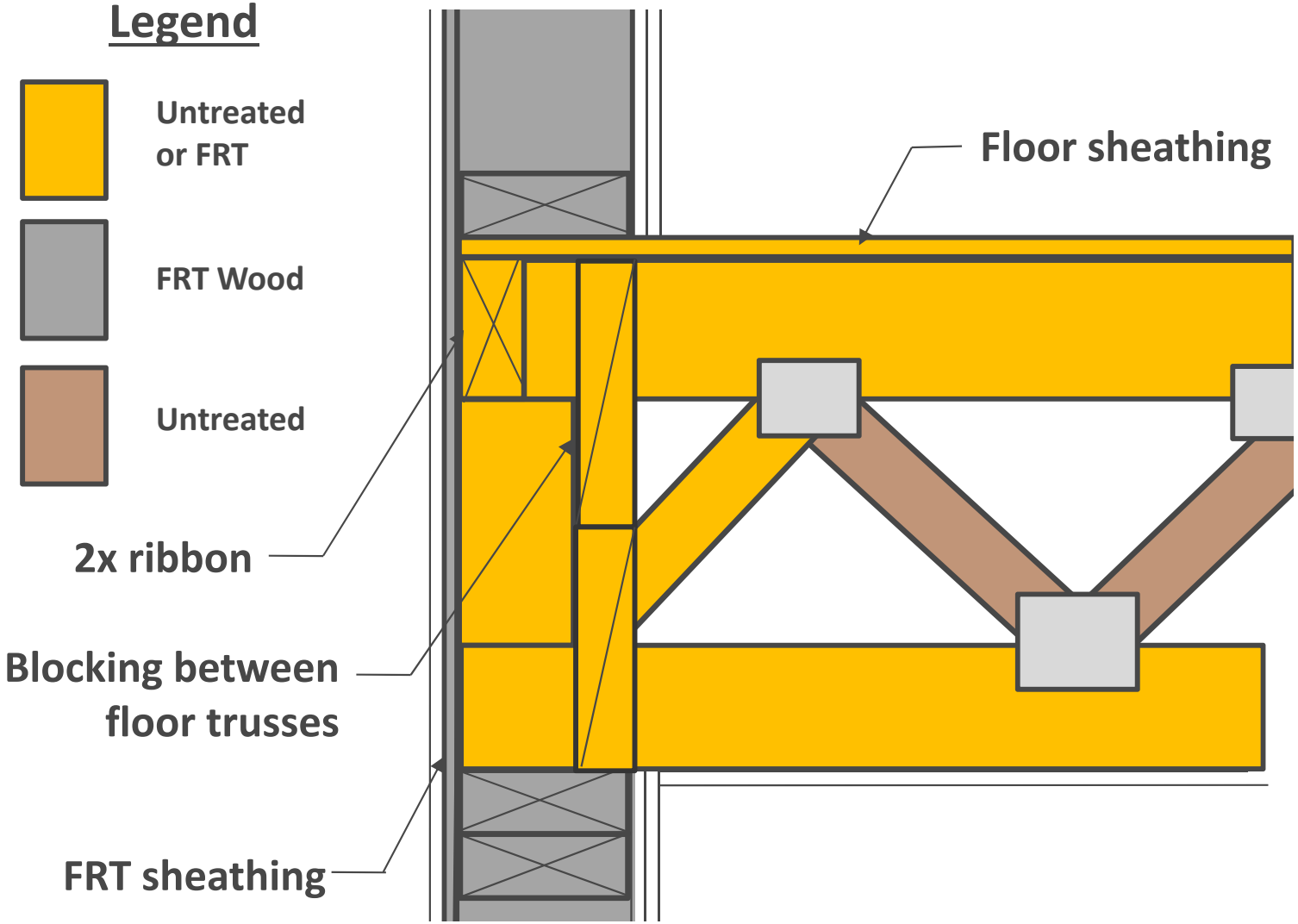


Rationale for detail approval:

- Intersection of rated assemblies (wall & floor) considered sufficient

Exterior Walls – Intersecting Floors

Type III Construction – 2 HR Wall, 1 HR Floor
Platform Framing w/Top Chord Bearing

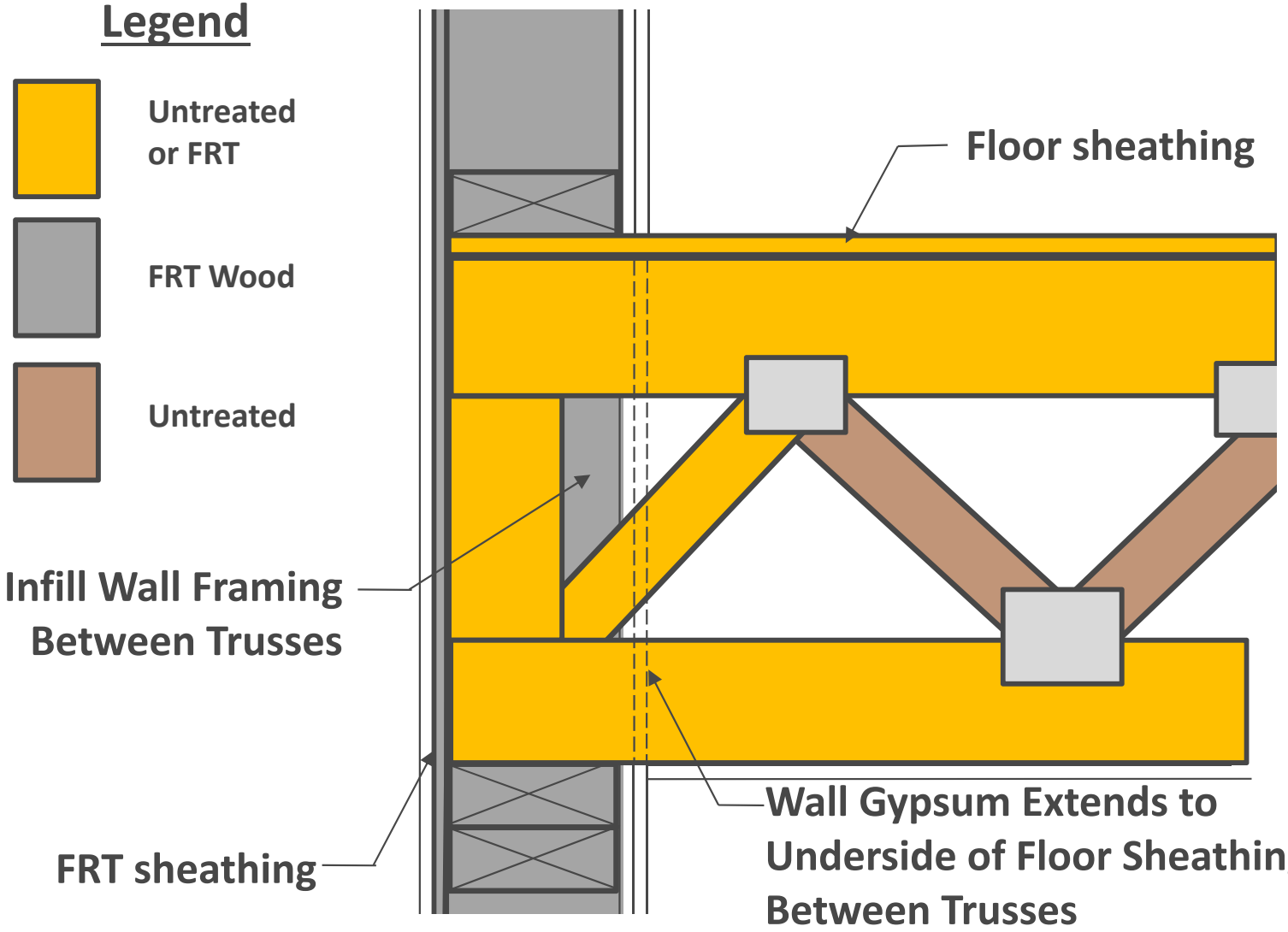


Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly; at floor cavity blocking in wall provides 1 hr; ceiling provides 2nd hr

Exterior Walls – Intersecting Floors

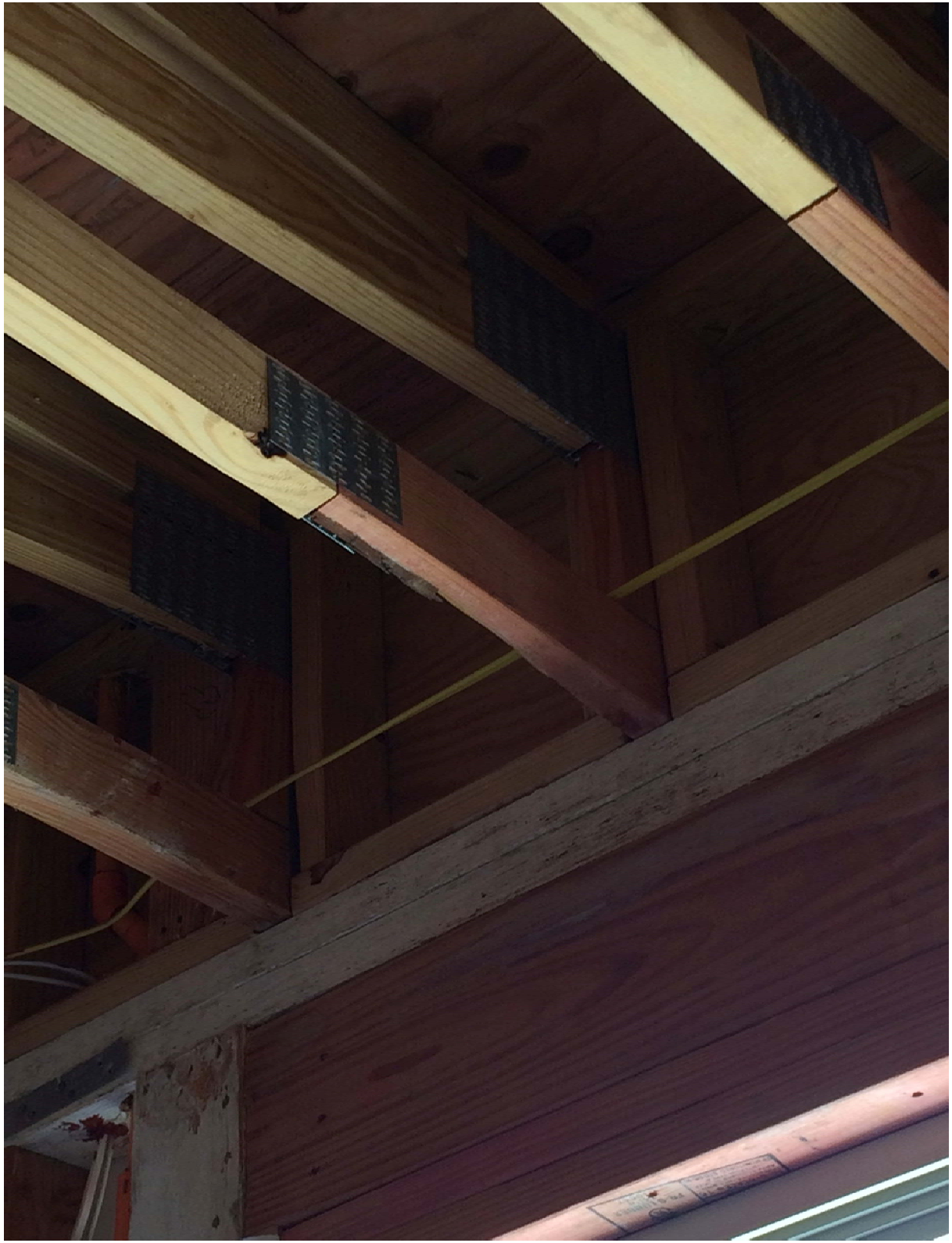
Type III Construction – 2 HR Wall, 1 HR Floor
Platform Framing w/Top Chord Bearing



Rationale for detail approval:

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

Exterior Walls – Intersecting Floors



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

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?

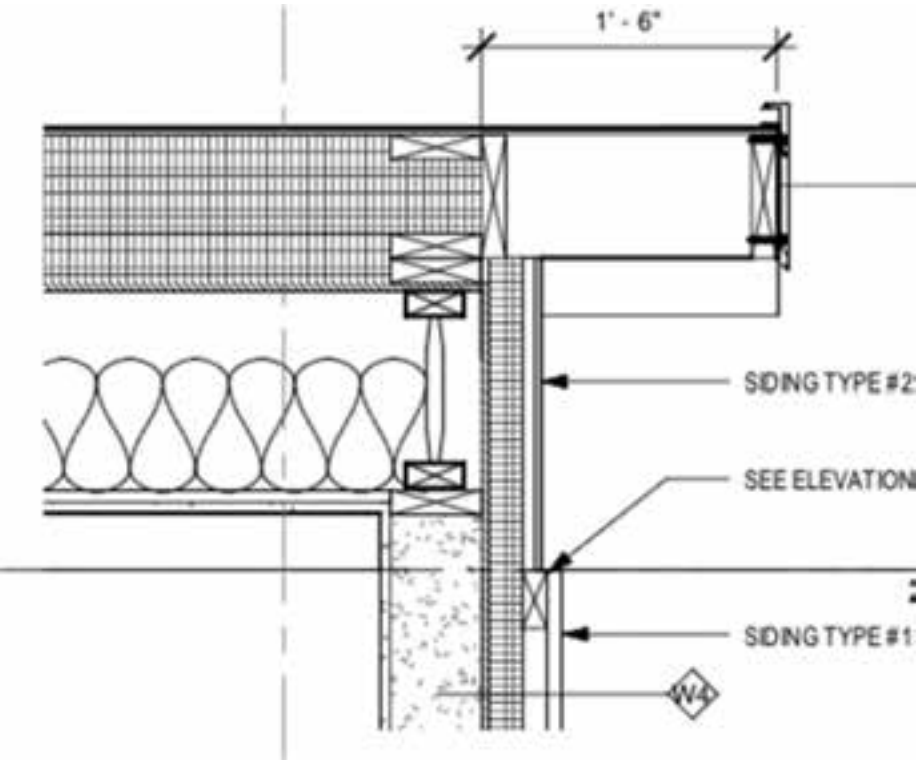
- To the underside/ceiling of a rated roof assembly?
- To the underside of the roof sheathing regardless of whether or nor the roof assembly is rated?
- Beyond the top of the roof (i.e. parapet)?

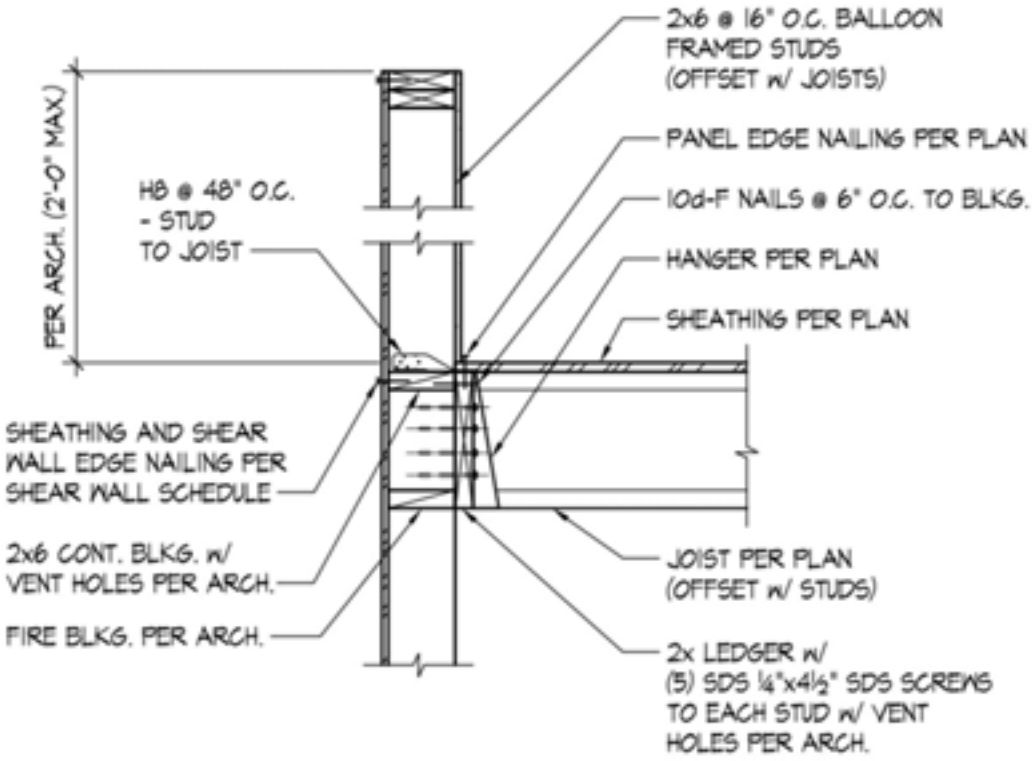
Similarly, in type III construction, do roof framing elements in the plane of the exterior wall need to be FRT?

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



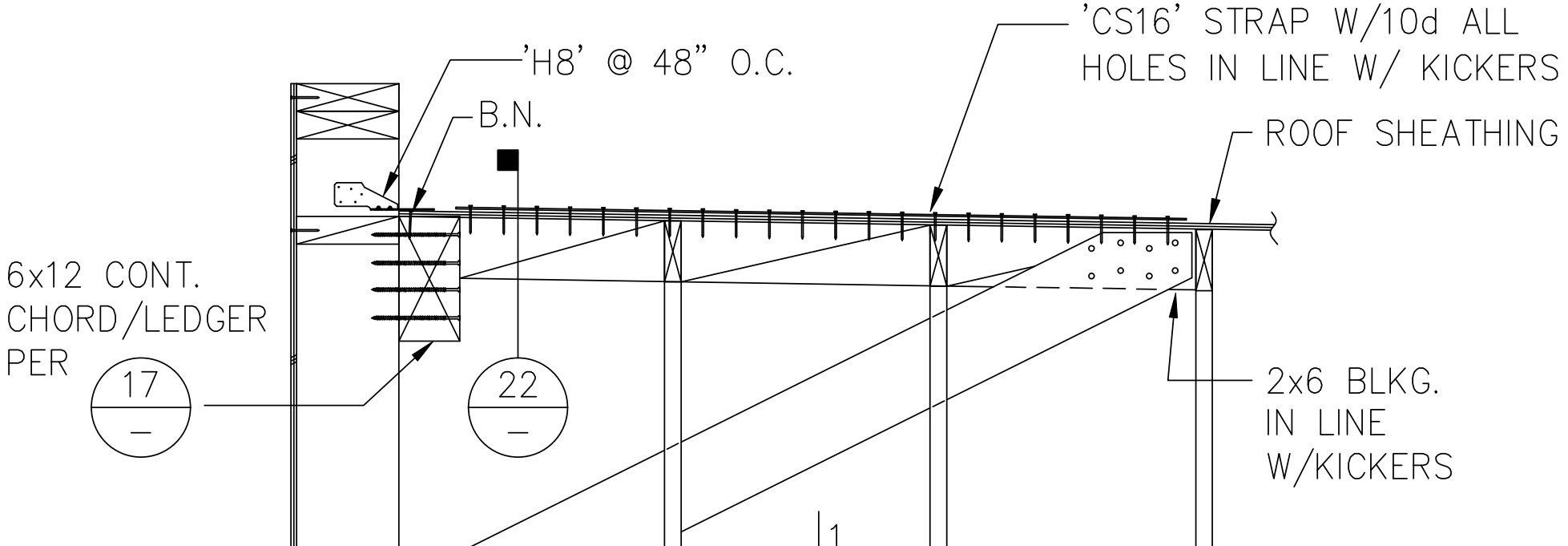


Parapets – IBC 705.11

Parapets shall be provided on exterior walls of buildings.

Exceptions:

- The wall is not required to be fire rated per table 602
- Floor area is ≤ 1000 sf on each floor
- Walls terminate at a roof that is rated for 2 hrs or more
- Where roof and supporting construction are non-combustible



Parapets – IBC 705.11

Parapets shall be provided on exterior walls of buildings.

Exceptions:

- 1hr rated exterior walls that terminate at the underside of the roof sheathing where:
  - Framing parallel to wall is not less than 1hr rated for 4’ for Group R/U and 10’ for other occupancies
  - Framing perpendicular to wall is 1hr 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
- Groups R-2 and R-3 where roofing is Class C, 1hr 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’
- Exterior wall is permitted to have >25% unprotected openings

Parapets – IBC 705.11.11

Parapets, where required, shall have:

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

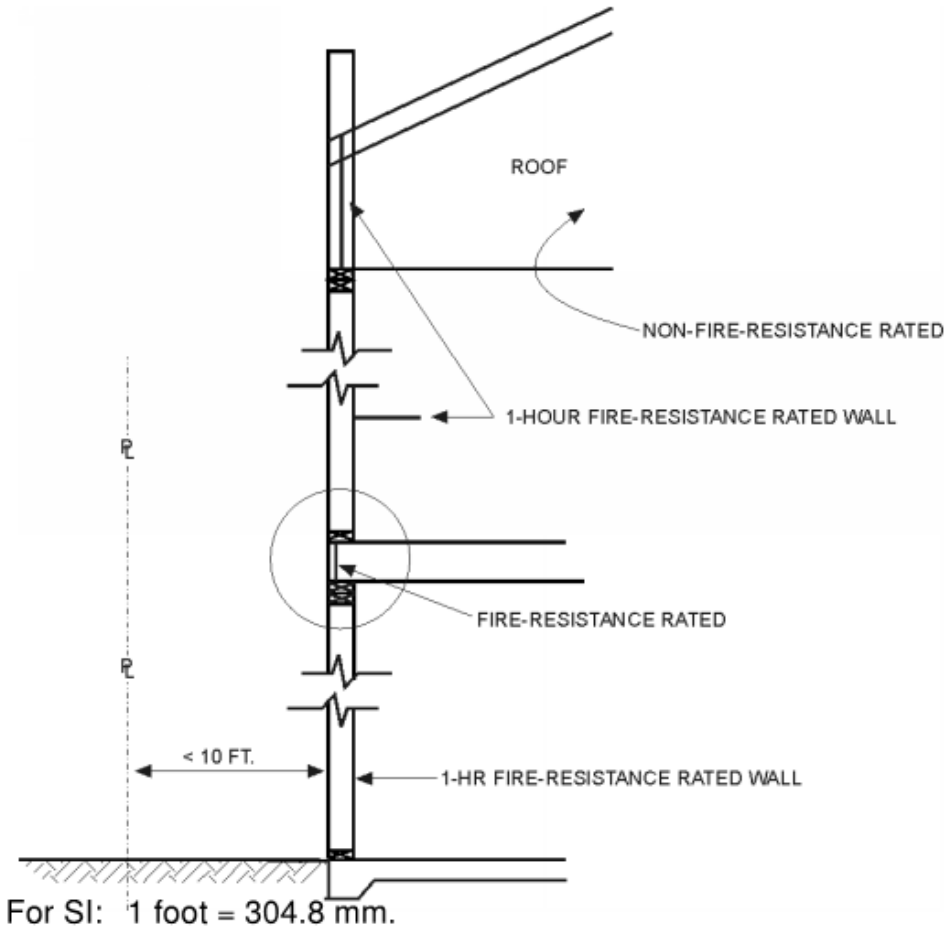


Figure 705.6
TYPE IIB AND VB EXTERIOR FIRE-RESISTANCE-RATED WALL CONTINUITY AND STRUCTURAL STABILITY

Code Commentary - 2015 IBC 705.11.1

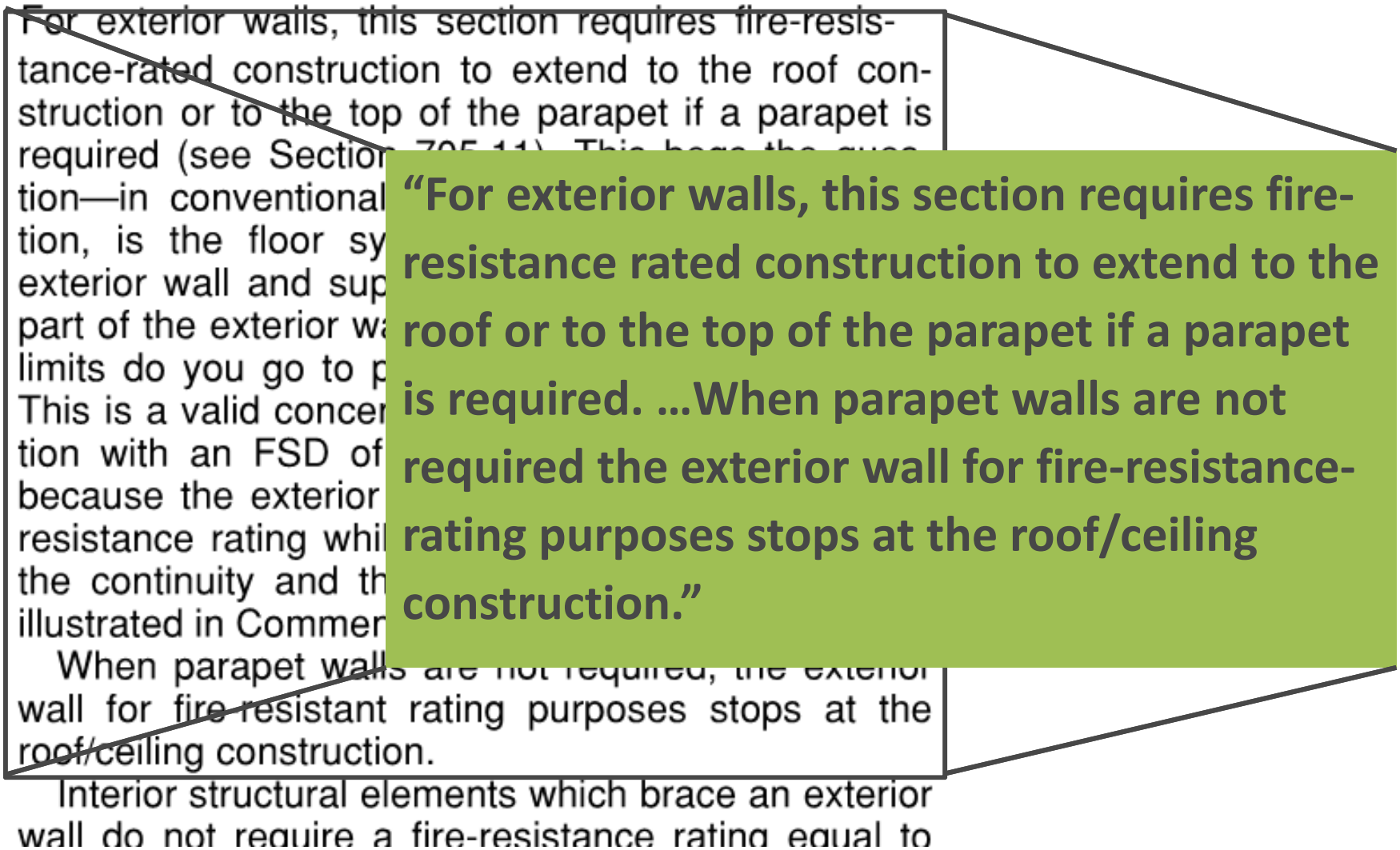
If a building is type III construction and the exterior walls are framed with fire-retardant treated wood, do the parapets need to be framed with FRTW?

❖ Parapet wall construction shall be of combustible or noncombustible ma
wall requirements
shall be of fire-re
required for the exte
ing facing the roof,
noncombustible to
above the roof. The
shall be 30 inches (
unless the roof slope
a pitch of 2 in 12 or
part of this section re
ing on the FSD. Wh
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."

Code Commentary - 2015 IBC 705.6

What is the requirement for continuity?



Balconies – IBC 1406.3

Balconies of combustible construction and not 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 const and shall not have fire resistance rating if sprinkler protection provided
- Untreated wood is permitted for rails and guardrails

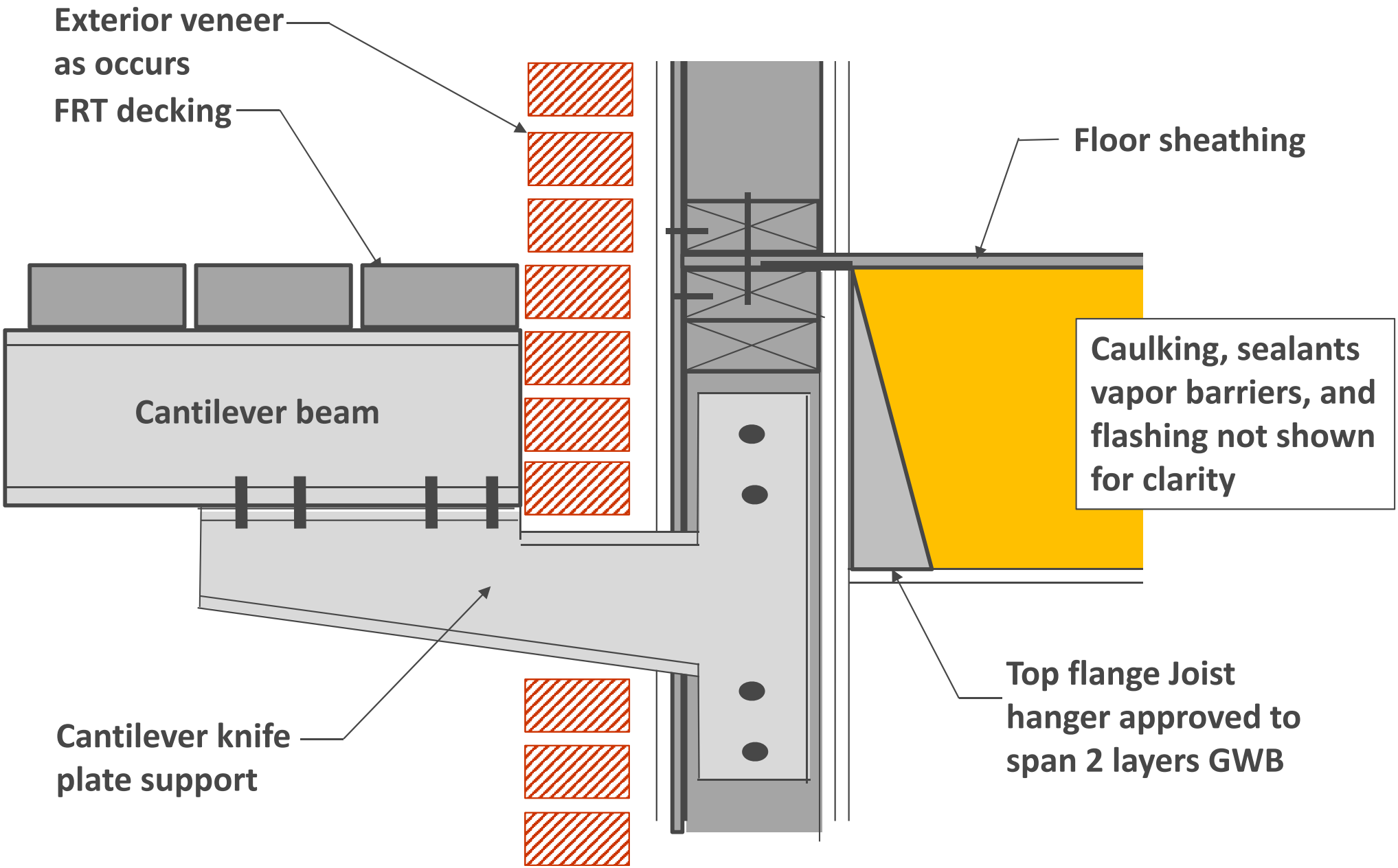
Balconies – IBC 1406.3

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 treated – fire sprinkler/no fire rating
5. Non treated – fire rated per 601 & 602/ no sprinkler

Balconies – Exterior Wall Penetration



Questions?

This concludes The American Institute of Architects Continuing Education Systems Course

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