



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

For Light-Frame Wood Construction

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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

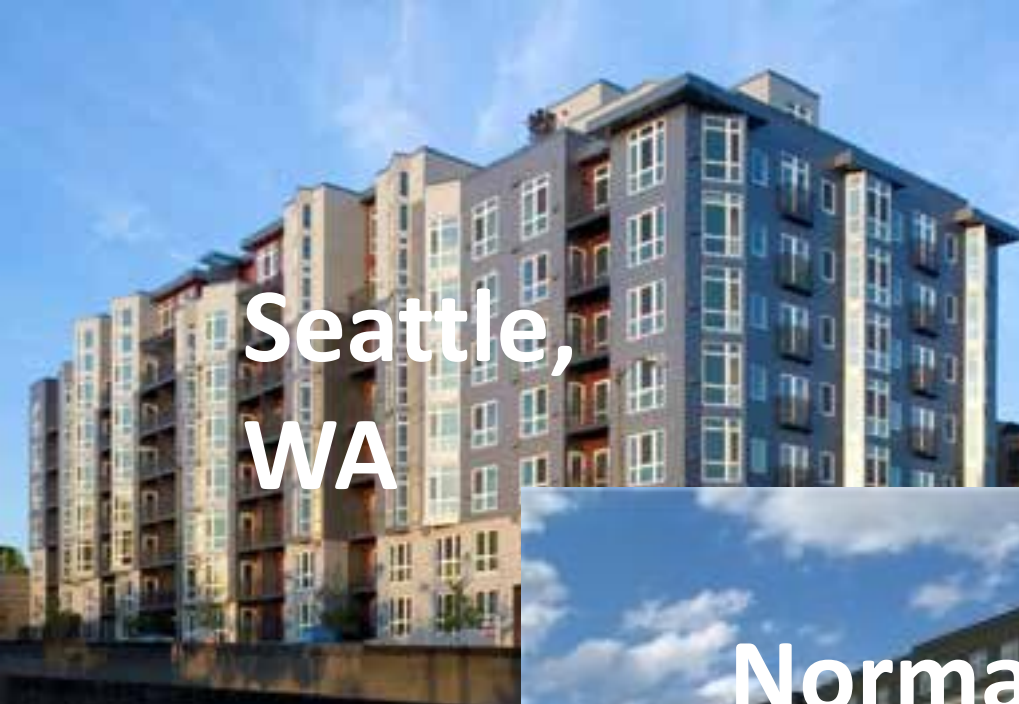
1. Compare Type II to Type III construction with regard to cost, building size and fire resistance per the International Building Code.
2. Review requirements for exterior walls and questions commonly encountered including asymmetric assemblies, the allowance of wood structural panel, and bearing vs. 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

Outline

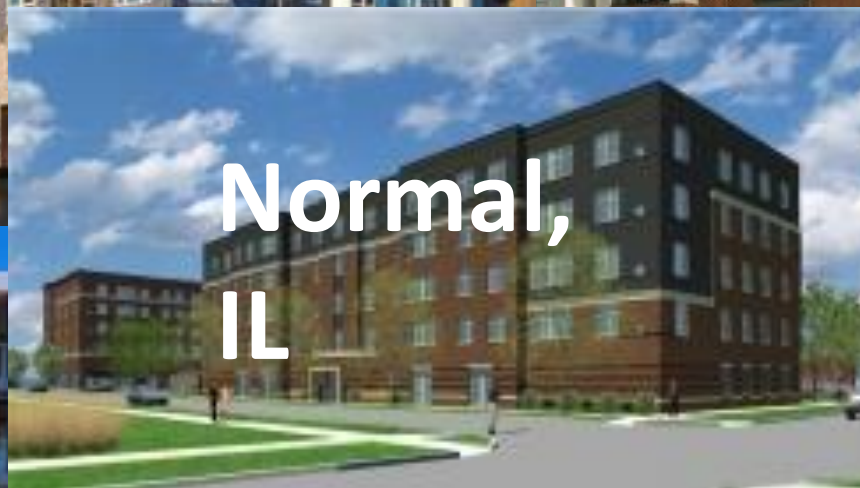
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Seattle,
WA



College Park,
MD



Normal,
IL



Los Angeles,
CA

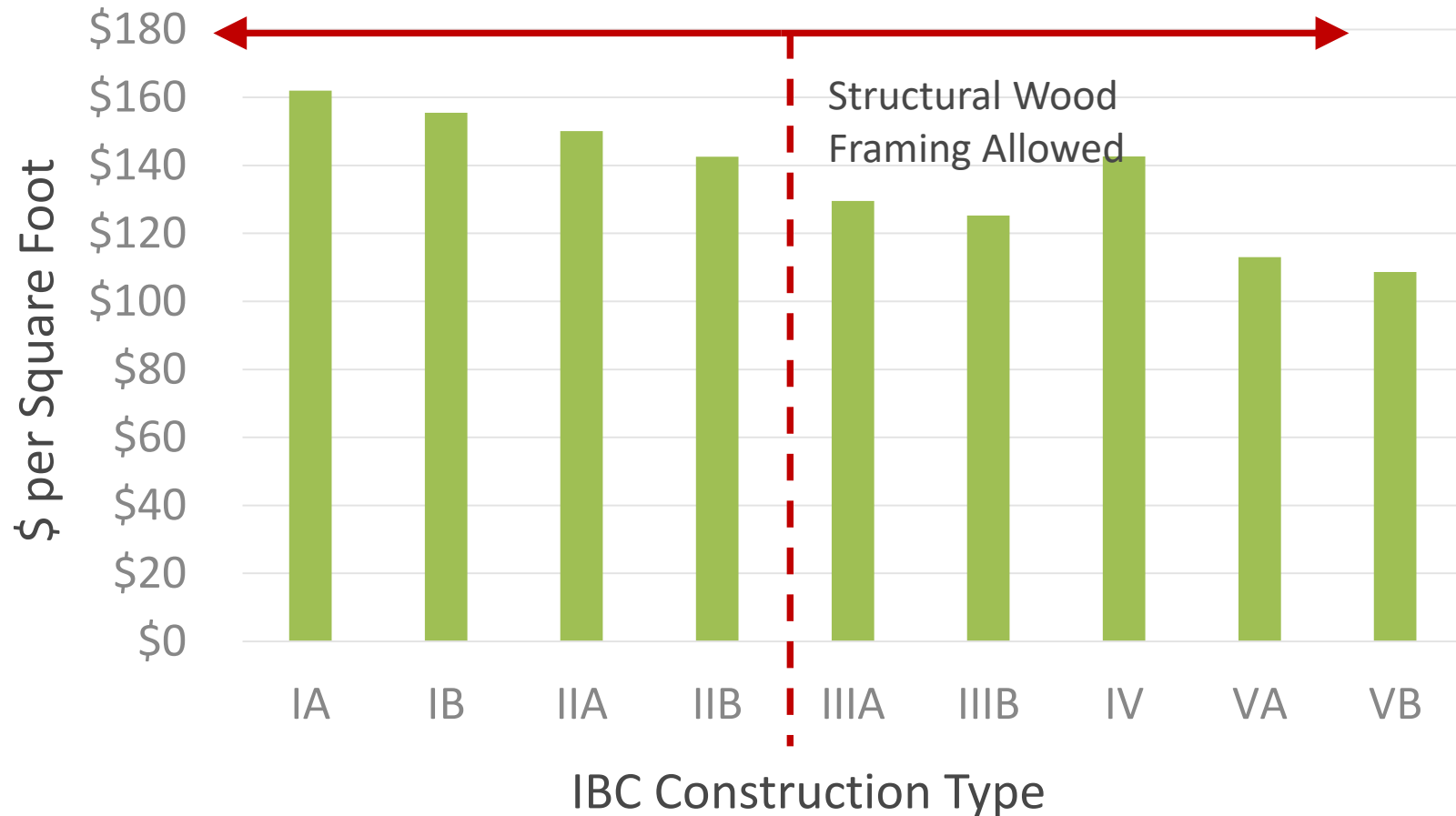


Atlanta,
GA



ICC Building Valuation Data

ICC Building Valuation Data, Feb. 2018
R-2 Residential, multiple family



**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 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
$10 \text{ ft} \leq X < 30$ ft	1	0
$X \geq 30$ 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

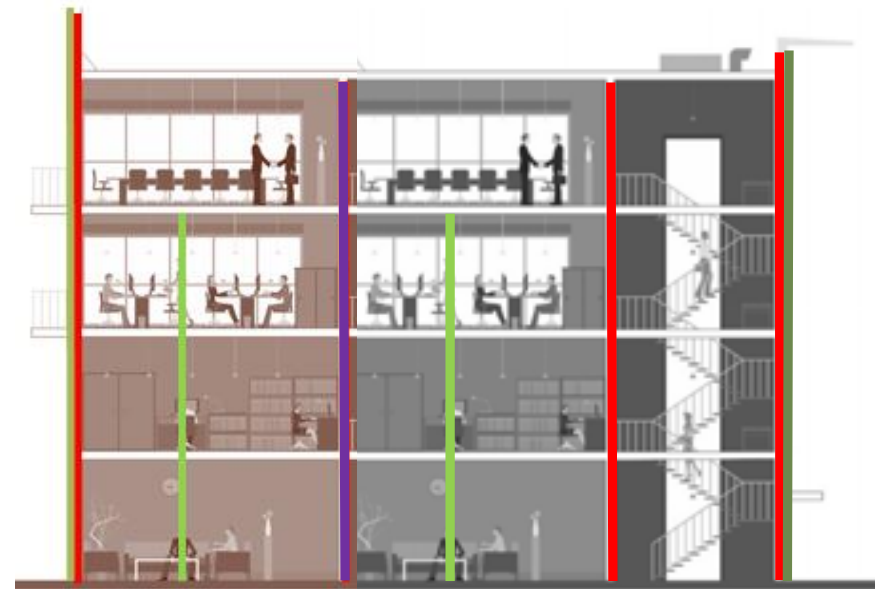


Type III Fire Resistant Requirements

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
$10 \text{ ft} \leq X < 30$ ft	1	0
$X \geq 30$ 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)	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

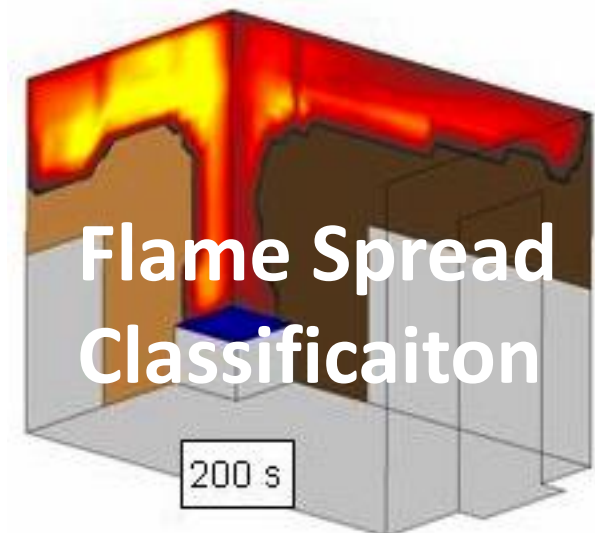
903.2.8 Group R

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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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

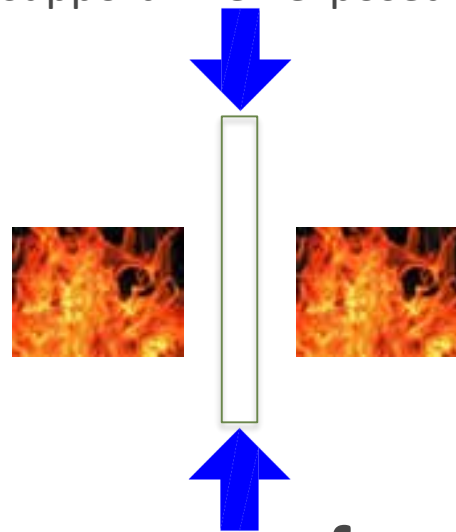
Fire-Resistance Rating: The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests, prescribed in Section 703.

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

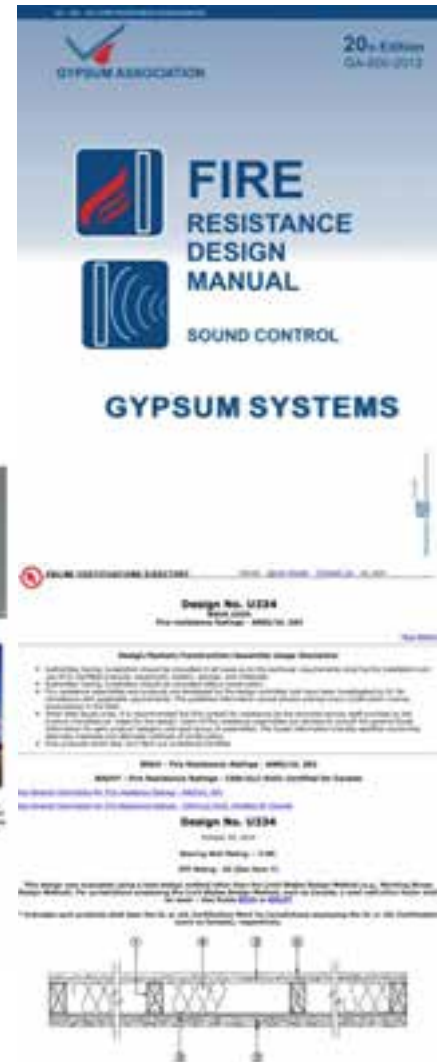
Choosing Fire Rated Assemblies

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

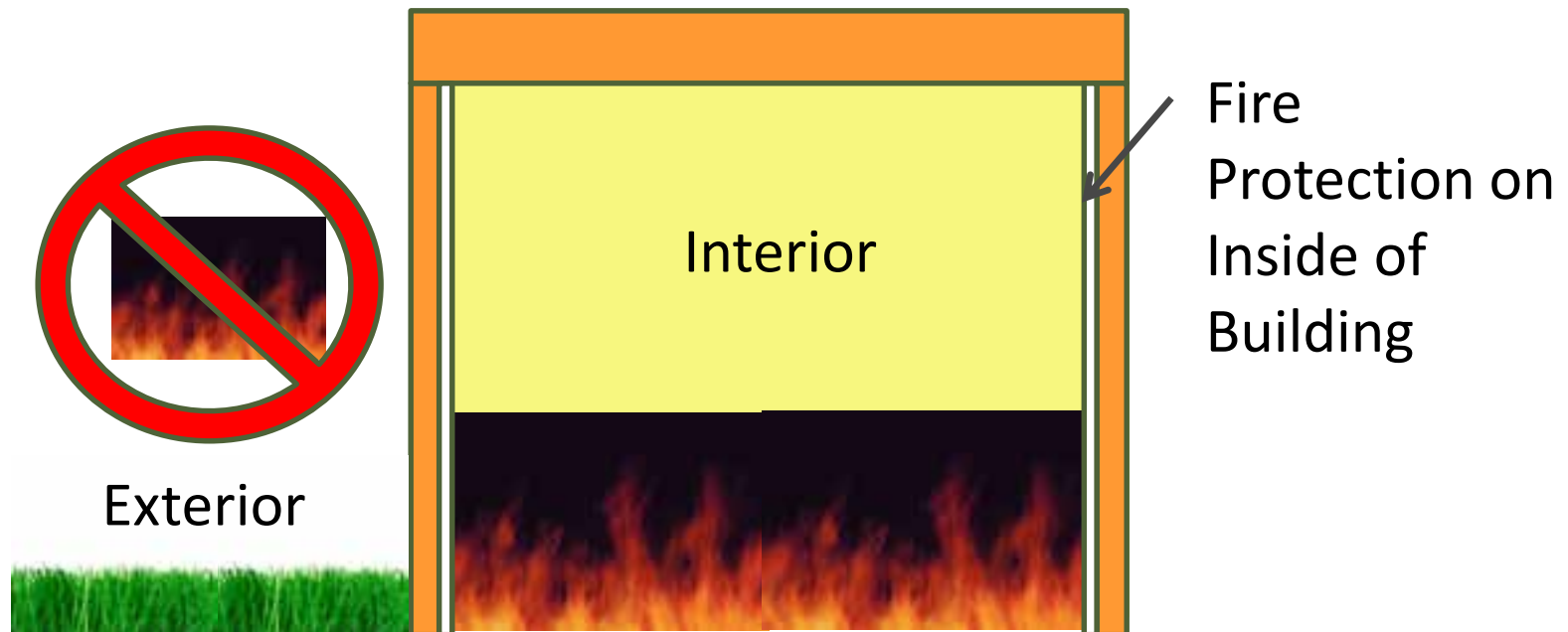
Exterior Wall Fire Resistance

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}	3	2	1	0	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions	See Table 602								
Exterior									
Nonbearing walls and partitions							See		
Interior ^d	0	0	0	0	0	0	Section	0	0
602.4.6									
Floor construction and associated secondary members							HT		
(see Section 202)	2	2	1	0	1	0		1	0
Roof construction and associated secondary members							HT		
(see Section 202)	1½ ^b	1 ^{b, c}	1 ^{b, c}	0 ^c	1 ^{b, c}	0		1 ^{b, c}	0

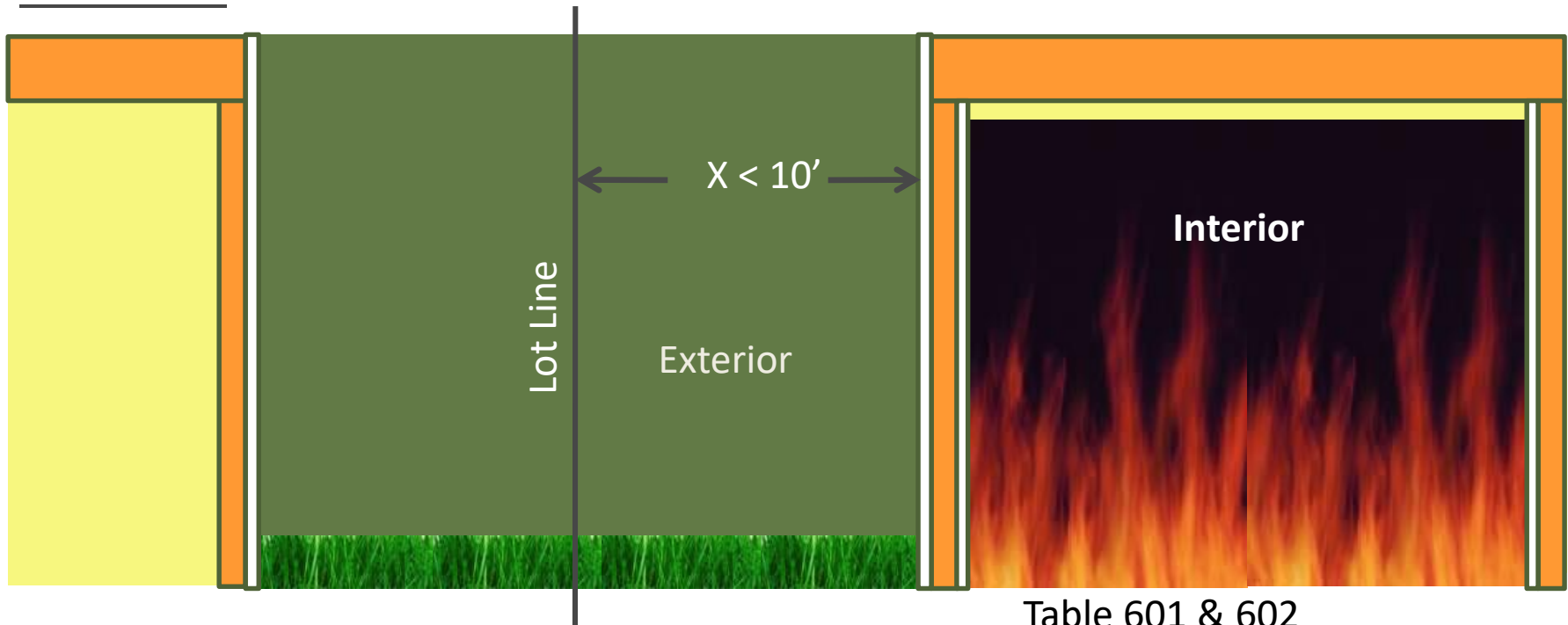
Exterior Walls - FSD

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.



Exterior Wall Fire Resistance

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 ^a	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
$5 \leq X < 10$	IA	3	2	1
	Others	2	1	1
$10 \leq X < 30$	IA, IB	2	1	1 ^c
	IIB, VB	1	0	0
	Others	1	1	1 ^c
$X \geq 30$	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 Wall Fire Resistance

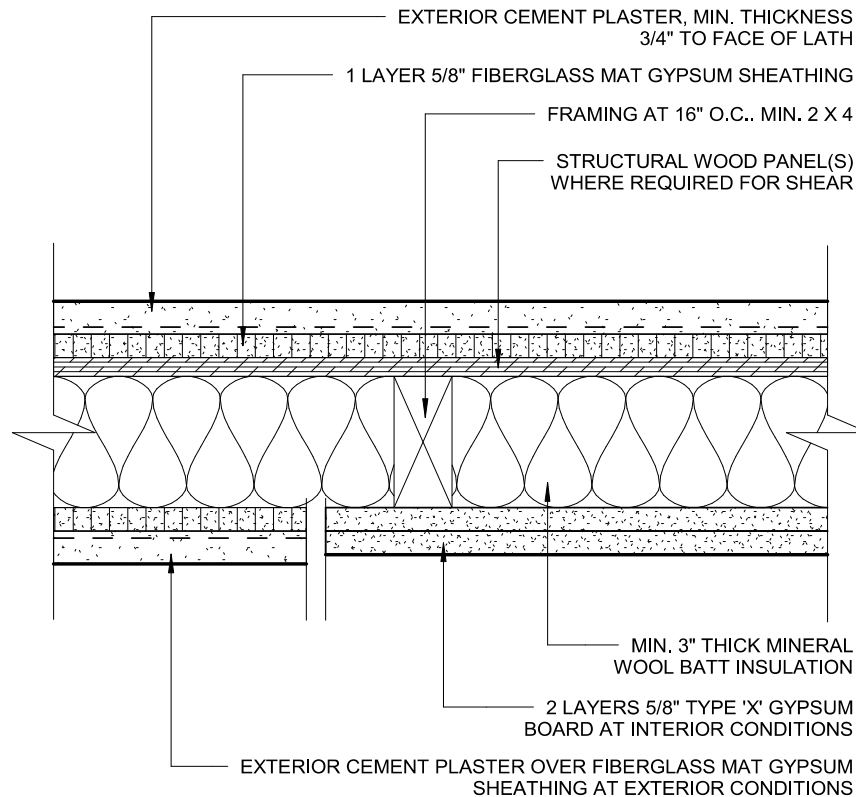
TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

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}	3	2	1	0	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions	See Table 602								
Exterior									
Nonbearing walls and partitions							See		
Interior ^d	0	0	0	0	0	0	Section	0	0
							602.4.6		
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)	1½ ^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 ^a	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	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB	2	1	1 ^c
	IIB, VB	1	0	0
	Others	1	1	1 ^c
X ≥ 30	All	0	0	0

Exterior Walls - Asymmetry



2-HOUR RATING PER UL DESIGN NO. U371

2-HOUR EXTERIOR WALL

Common issues with tested assemblies:

- Assembly Asymmetry- separate assemblies for each side

Exterior Walls – 1 HR Int. 0 HR Ext.

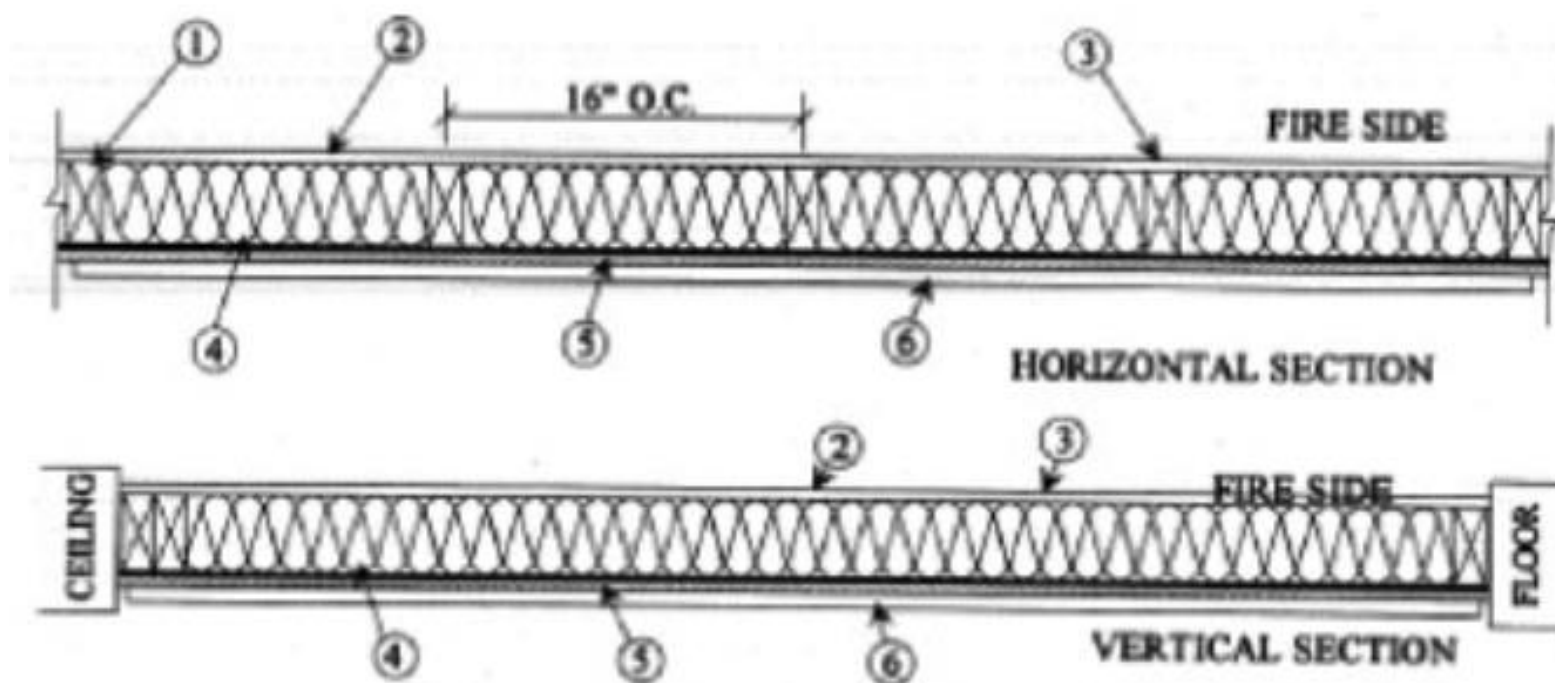
Design No. U348

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.

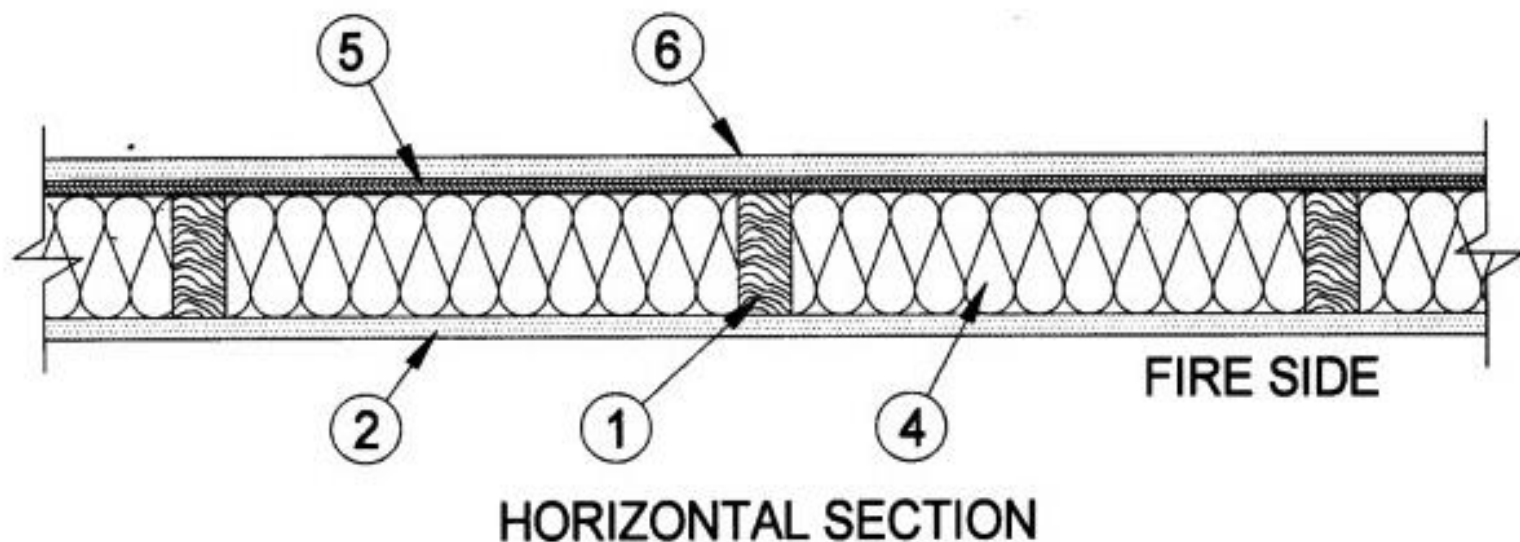
Design No. U356

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)



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 ^a	2" × 4" wood studs at 16" centers with double top plates, single bottom plate; interior side covered with $\frac{5}{8}$ " Type X gypsum wallboard, 4" wide, applied horizontally unblocked, and fastened with $2\frac{1}{4}$ " 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 $\frac{3}{8}$ " 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 $3\frac{1}{2}$ " mineral wool insulation. Rating established for exposure from interior side only.	—	—	—	4 $\frac{1}{2}$
	16-1.2 ^a	2" × 6" wood studs at 16" centers with double top plates, single bottom plate; interior side covered with $\frac{5}{8}$ " Type X gypsum wallboard, 4" wide, applied horizontally or vertically with vertical joints over studs and fastened with $2\frac{1}{4}$ " 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 $\frac{7}{16}$ " 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 $5\frac{1}{2}$ " mineral wool insulation. Rating established from the gypsum-covered side only.	—	—	—	6 $\frac{9}{16}$
	16-1.3 ^a	2" × 6" wood studs at 16" centers with double top plates, single bottom plates; interior side covered with $\frac{5}{8}$ " Type X gypsum wallboard, 4" wide, applied vertically with all joints over framing or blocking and fastened with $2\frac{1}{4}$ " Type S drywall screws spaced 7" on center. Joints to be covered with tape and joint compound. Exterior covered with $\frac{3}{8}$ " 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 $\frac{1}{2}$

Exterior Walls – 2 HR Int. 0 HR Ext.

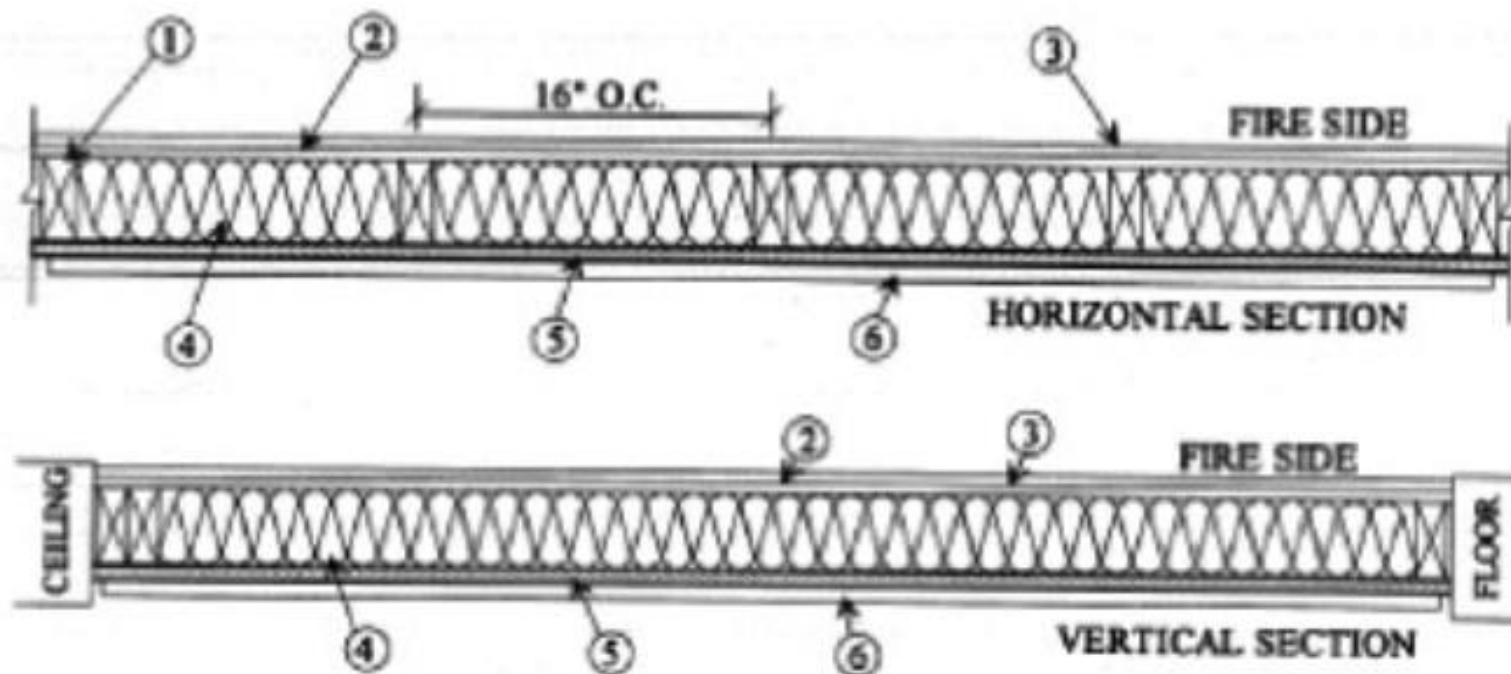
Design No. U349

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

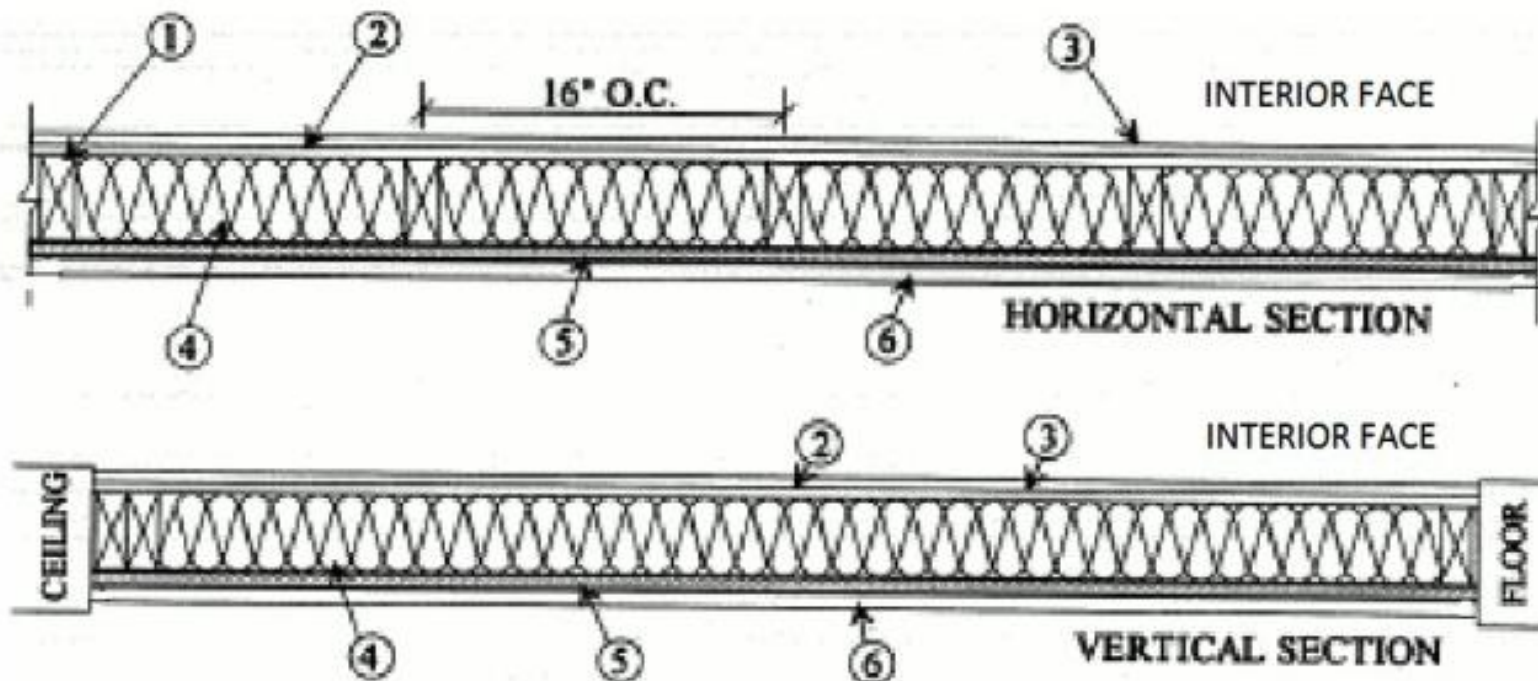
April 01, 2013

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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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

developed 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:

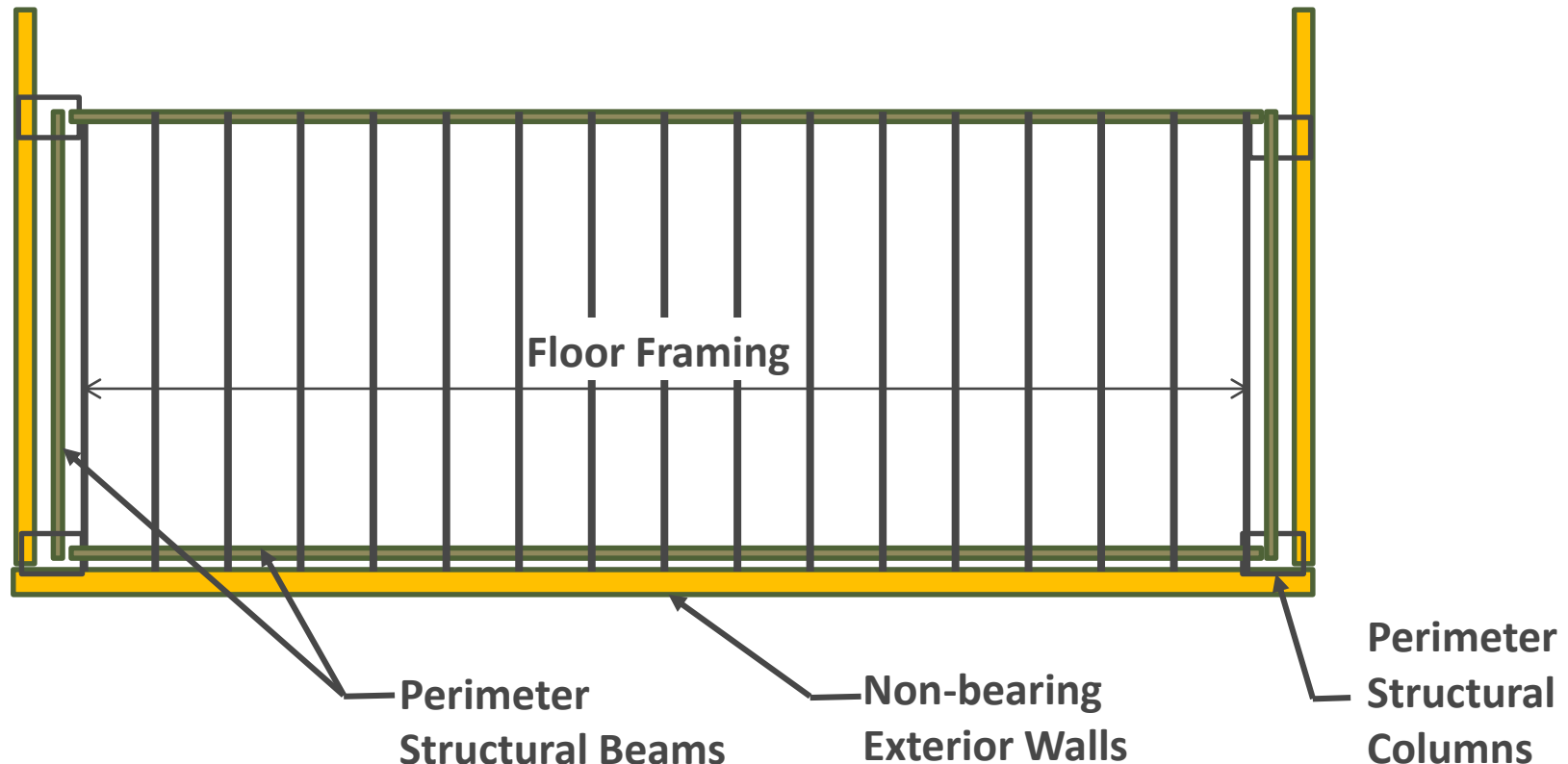
1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.

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

Exterior Walls – Bearing vs. Non-Bearing

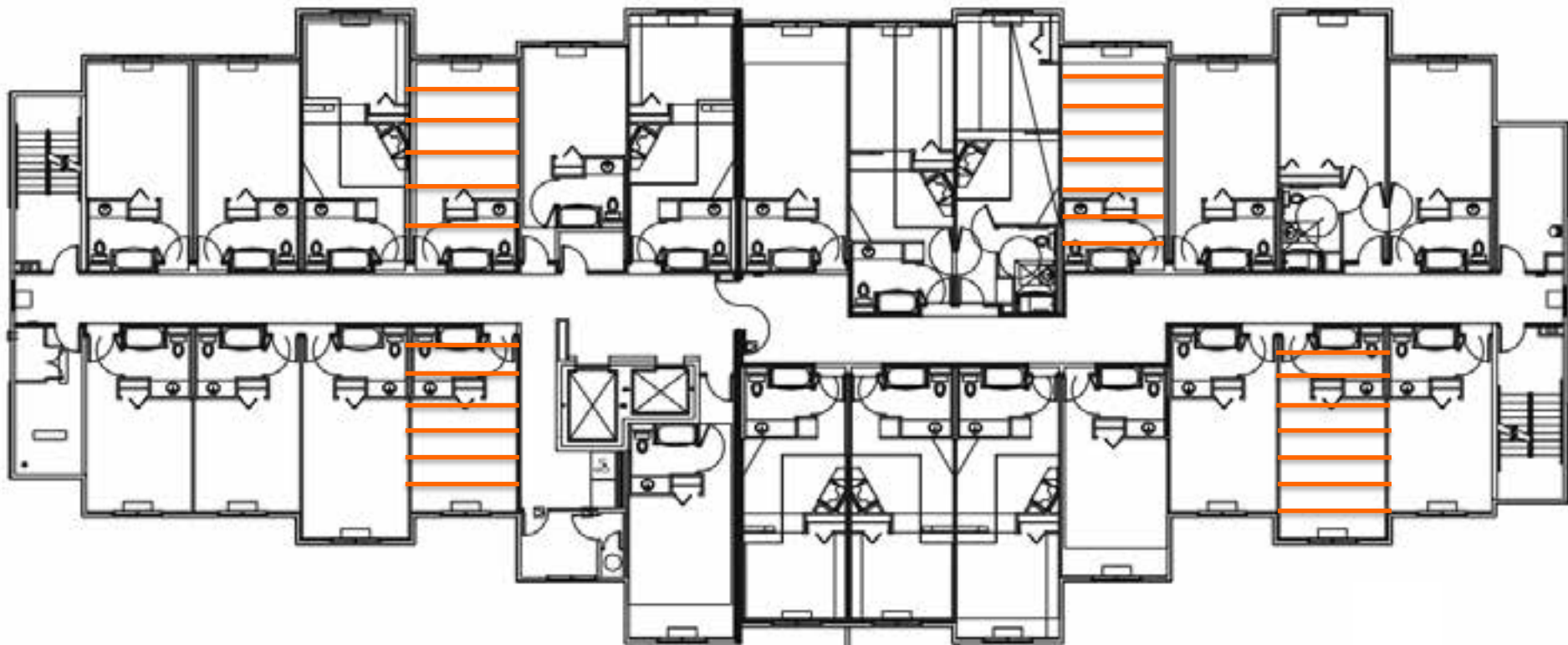
Utilization of structural beams in-board or directly over exterior walls can make walls non-bearing and reduce required fire resistance rating to 1 HR or 0 HR (IBC Table 602)

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 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}	3	2	1	0	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions	See Table 602								
Exterior									
Nonbearing walls and partitions							See		
Interior ^d	0	0	0	0	0	0	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)	1½ ^b	1 ^{b, c}	1 ^{b, c}	0 ^c	1 ^{b, c}	0	HT	1 ^{b, c}	0

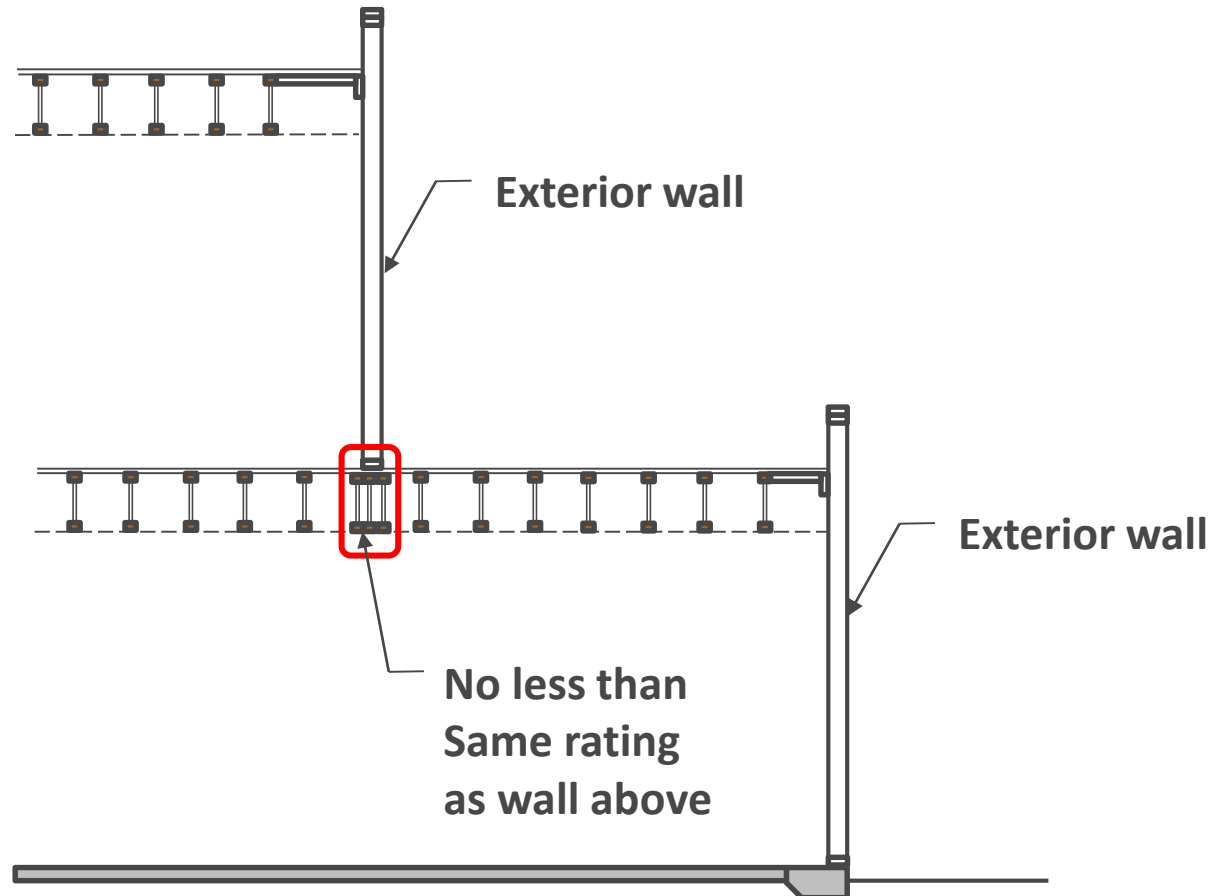
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X < 5 ^b	All	3	2	1
5 ≤ X < 10	IA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB	2	1	1 ^c
	IIB, VB	1	0	0
	Others	1	1	1 ^c
X ≥ 30	All	0	0	0

Exterior Walls – Vertical Offsets

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

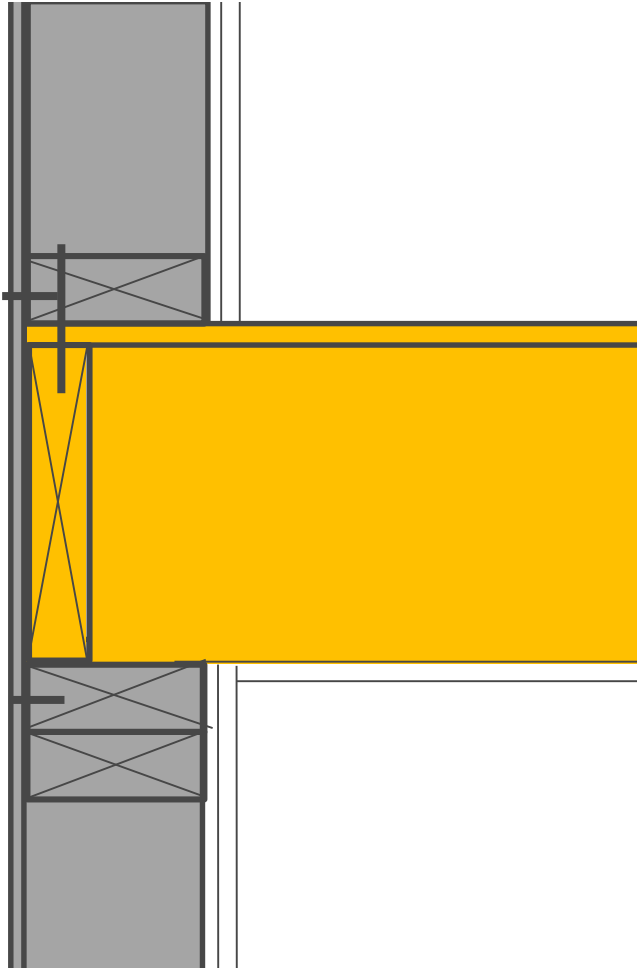
Posts, beams or walls, that support a rated exterior wall must be fire – resistance rated not less than the rating of the supported wall (IBC 704.1)



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Platform Framing



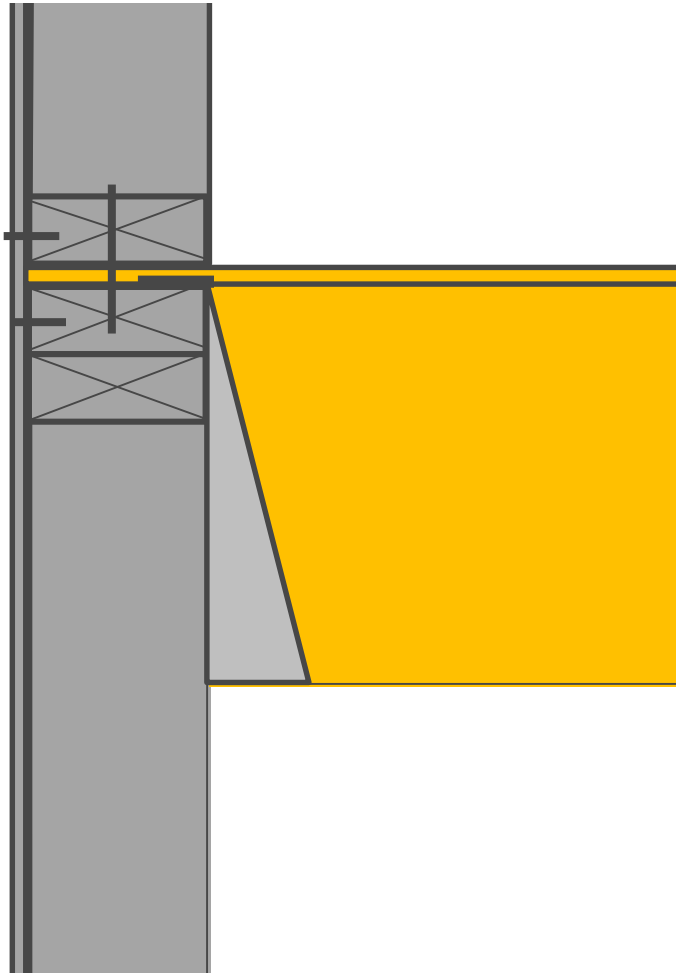
Structural

- 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 Tested Assemblies

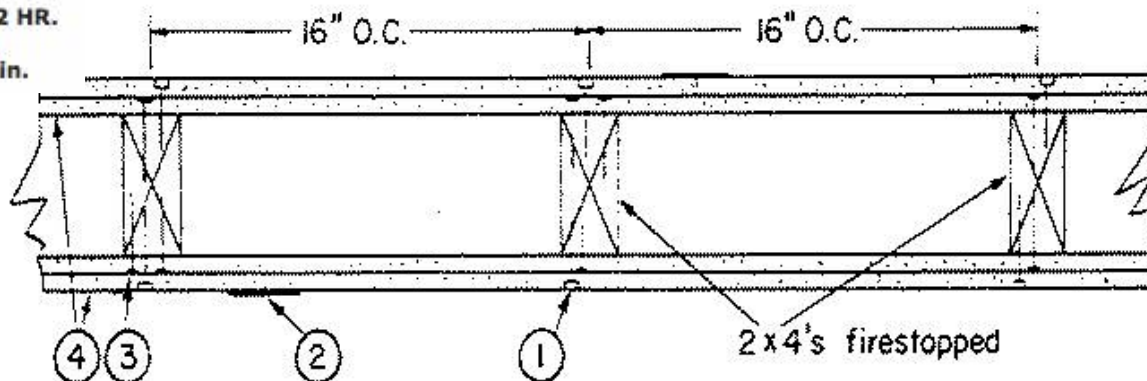
2 Hour Wall

Design No. U301

May 20, 2015

Bearing Wall Rating — 2 HR.

Finish Rating — 66 Min.



GA FILE NO. WP 4135

GENERIC

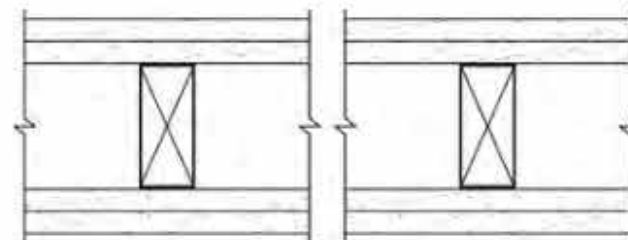
GYPSUM WALLBOARD, WOOD STUDS

Base layer $\frac{5}{8}$ " 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, $1\frac{7}{8}$ " long, 0.085" shank, $\frac{1}{4}$ " heads, 24" o.c. **Face** layer $\frac{5}{8}$ " type X gypsum wallboard or gypsum veneer base applied at right angles to each side with 8d coated nails, $2\frac{3}{8}$ " long, 0.100" shank, $\frac{1}{4}$ " 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**)

2 HOUR
FIRE

40 to 44 STC
SOUND



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

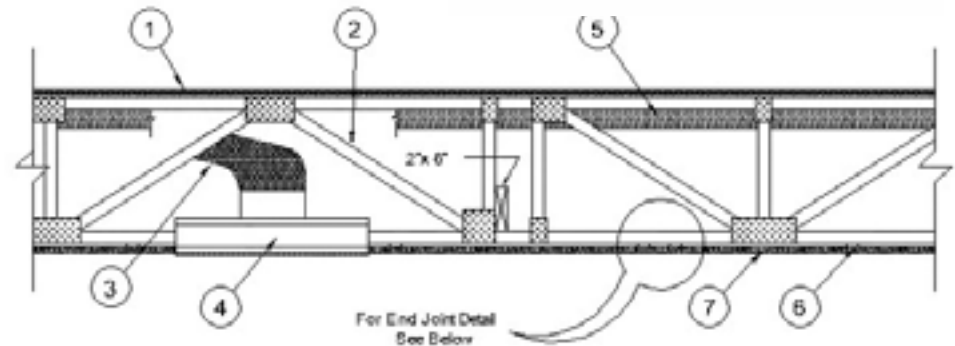
Intersection of Tested Assemblies

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

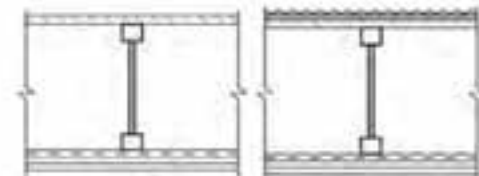
1 HOUR
FIRE

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 1/8" 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 support to be fire-resistance-rated for the same duration as the exterior wall. In light-frame platform construction, this requires that the band joist or beam supporting the floor and the wall above to be of fire-resistance-rated construction. Although the floor joists may not be required to be fire-resistance-rated construction in Type IIB and VB buildings, an effort must be made to ensure lateral support for the exterior wall, at least at the exterior wall, and the floor system must be of fire-resistance-rated construction. Although the floor joists may not be required to be fire-resistance-rated construction, the floor system must be of fire-resistance-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-resistance-rated 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

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.

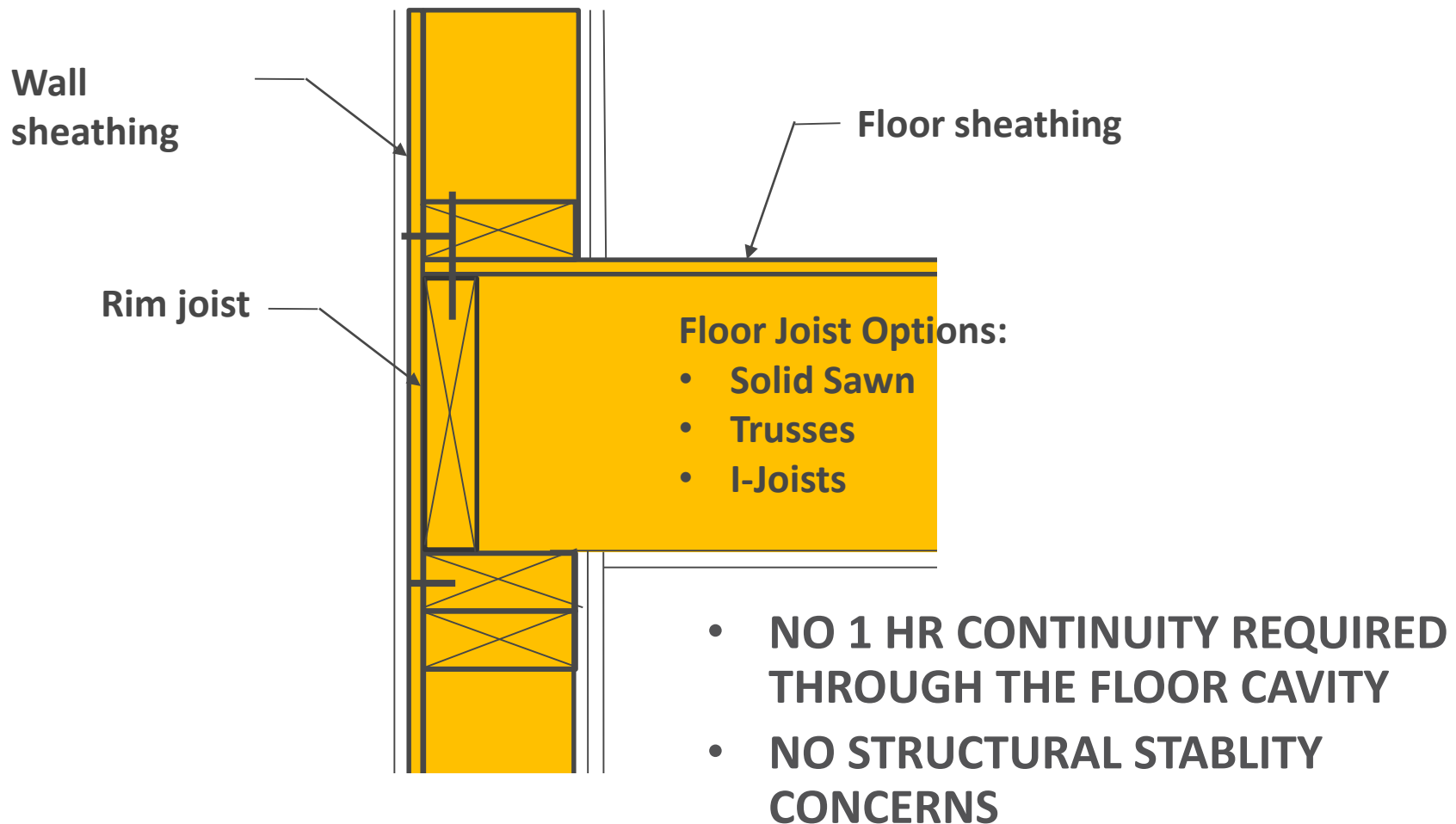
These details are not intended as recommendations for universally accepted details. Local product availability and manufacturer specifications should also be considered for each project.

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

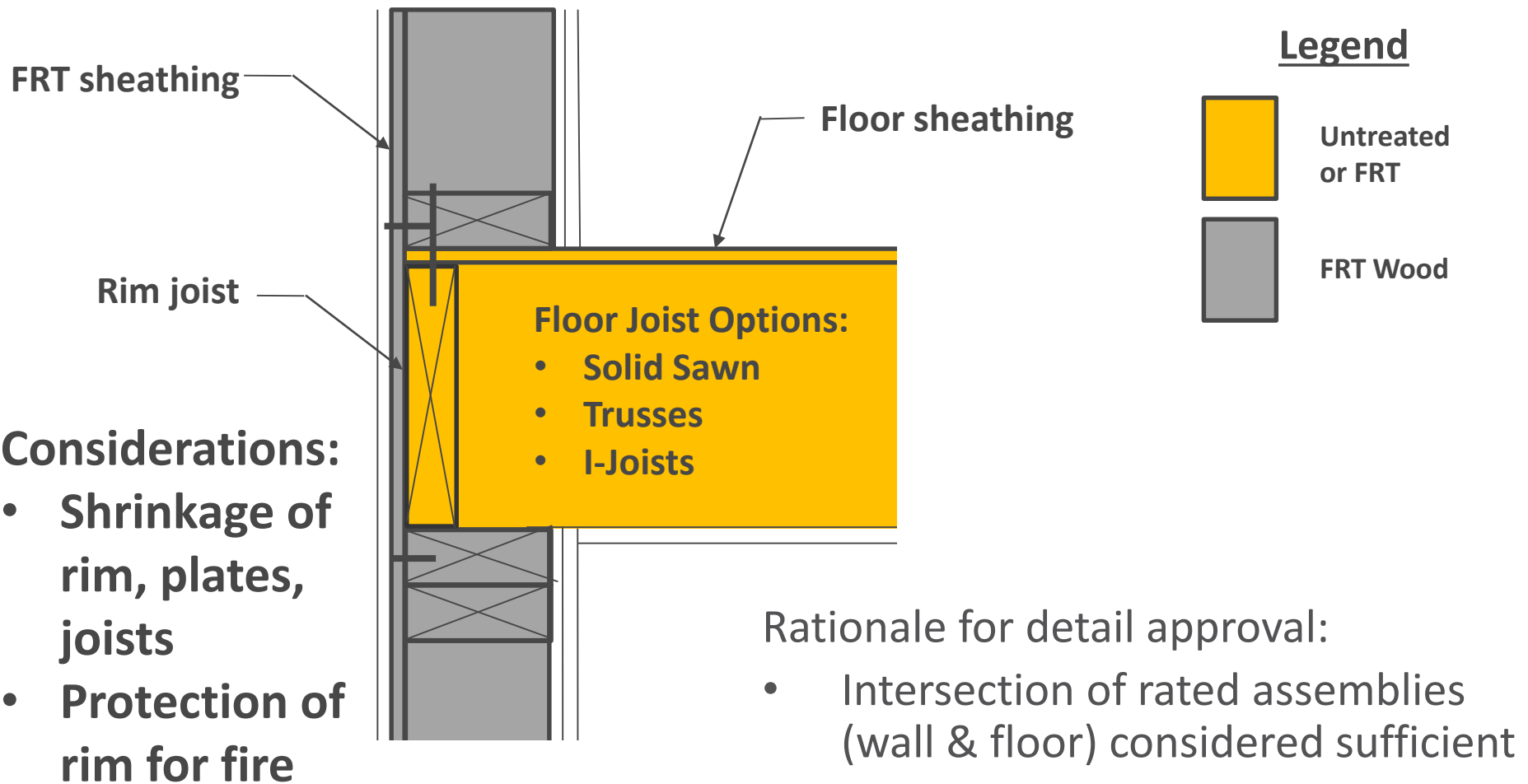
Type V Construction – 1 HR Wall, 1 HR Floor

Typical Platform Framing



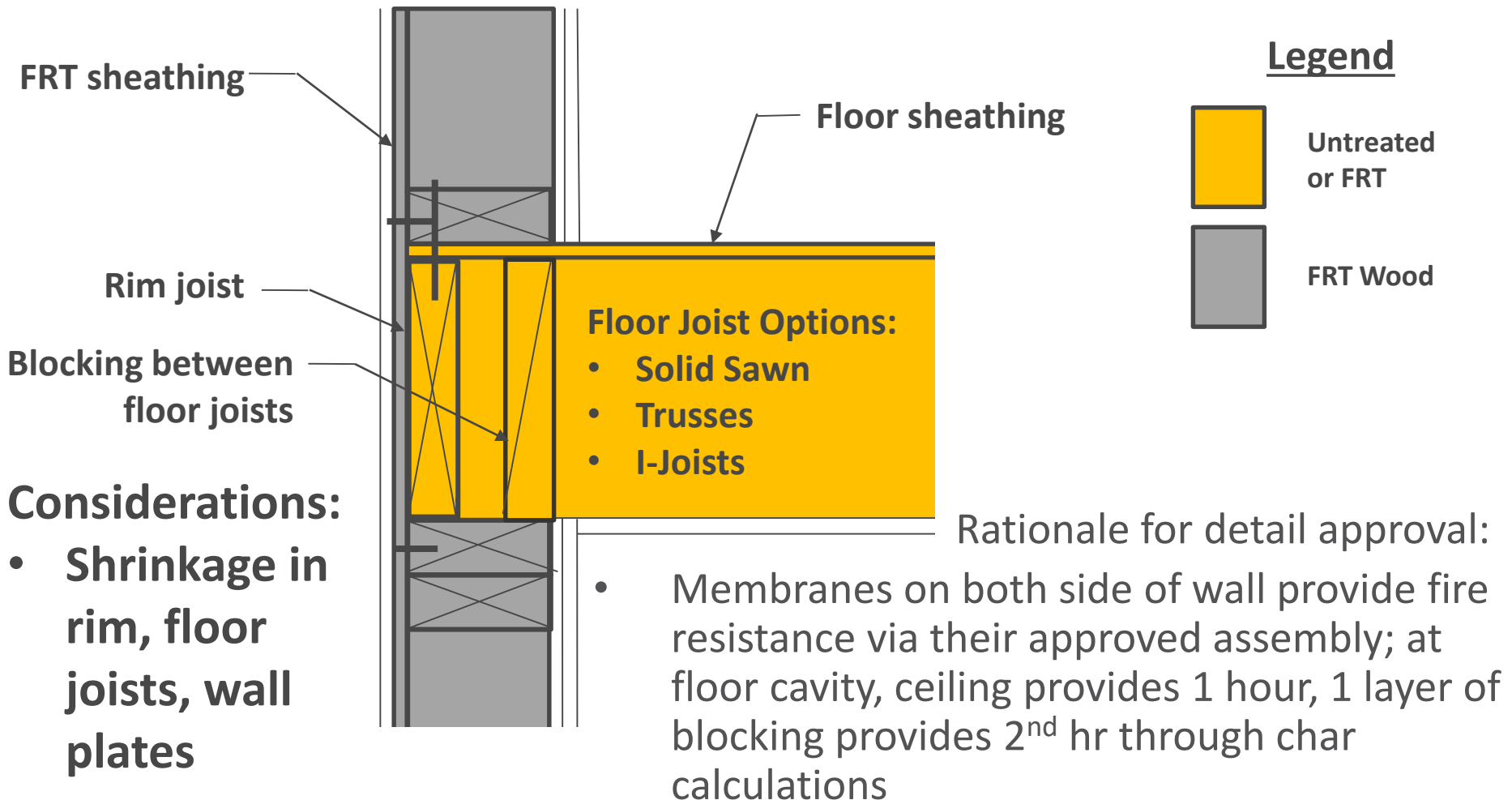
Exterior Walls – Intersecting Floors

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



Exterior Walls – Intersecting Floors

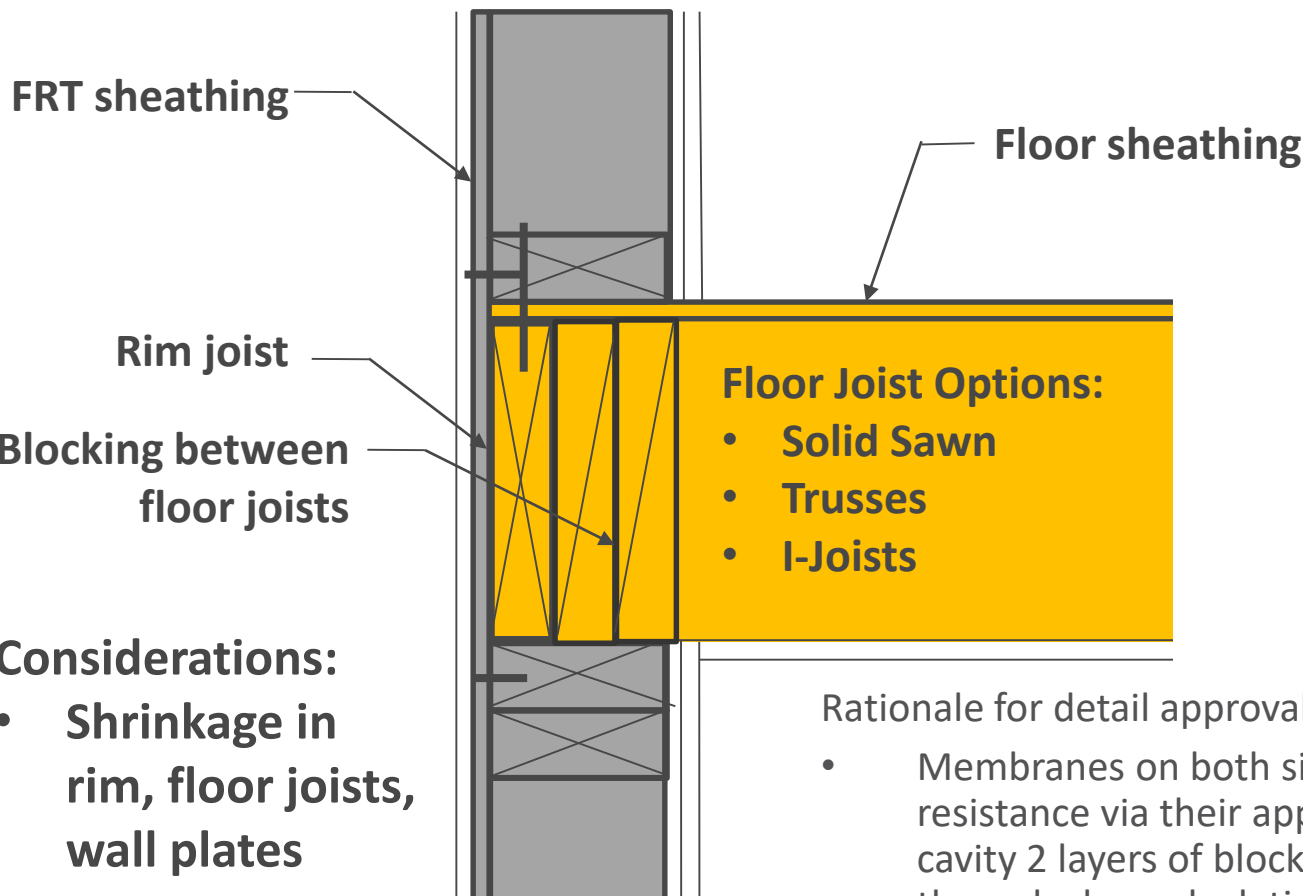
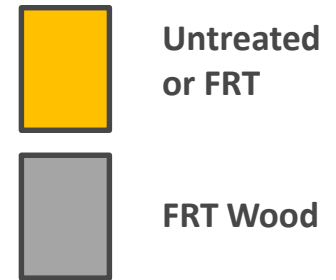
Type III Construction – 2 HR Wall, 1 HR Floor
Typical Platform Framing



Exterior Walls – Intersecting Floors

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

Legend



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

AWC's DCA3 provides floor to wall intersection detailing options

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



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

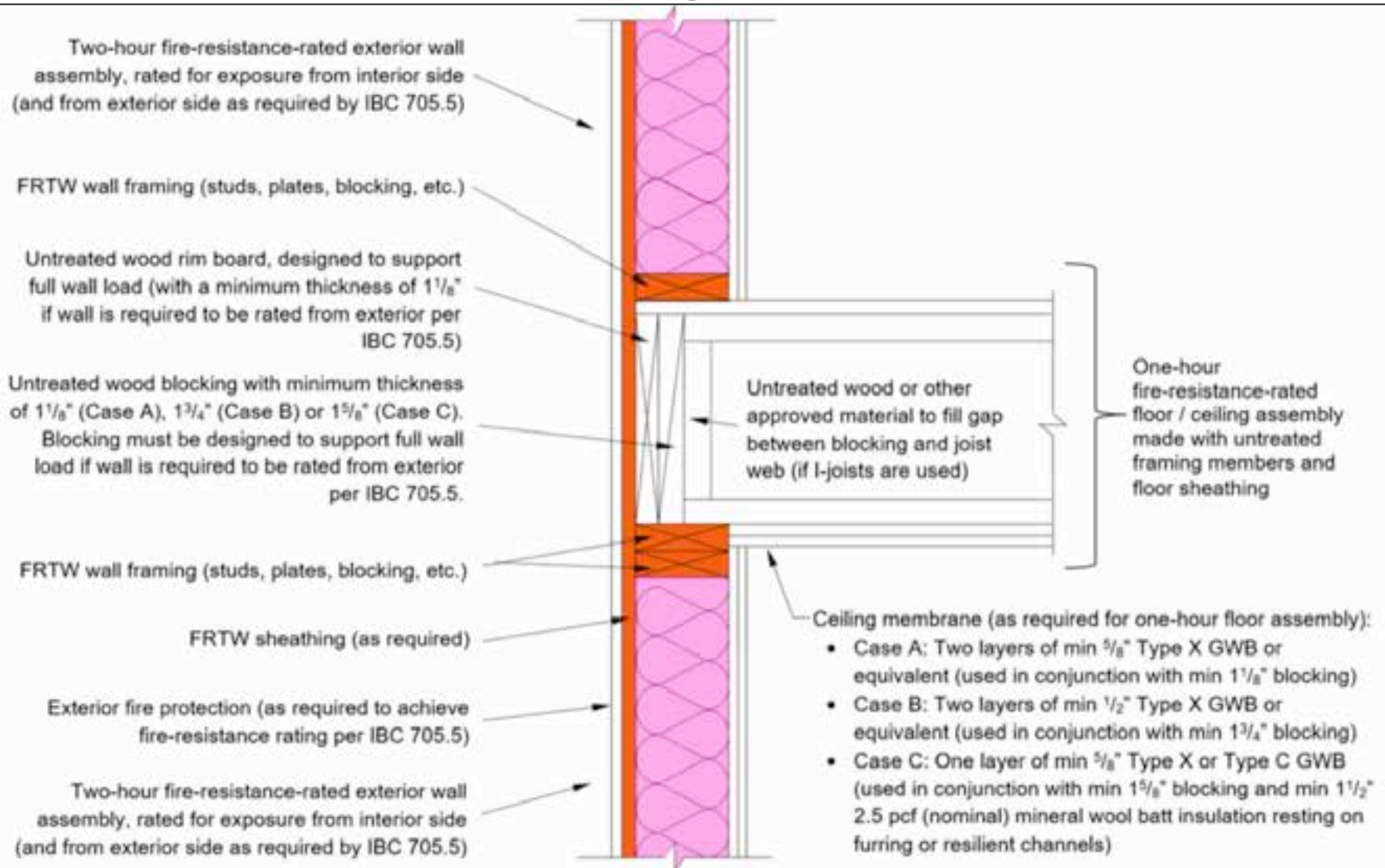


Figure 1A: Example detail for Type III-A exterior wall-floor intersection with rim board and blocking

Exterior Walls – Intersecting Floors

Two-hour fire-resistance-rated exterior wall assembly, rated for exposure from interior side



Methodology:

Fire-resistance for exposure from interior side:

- Case A: Minimum $1\frac{1}{8}$ -inch-thick inner rim board plus two layers of minimum $\frac{5}{8}$ 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 $\frac{5}{8}$ in. Type X GWB (per IBC Table 722.6.2(1)).
- Case B: Minimum $1\frac{3}{4}$ -inch-thick inner rim board plus two layers of minimum $\frac{1}{2}$ 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 $\frac{1}{2}$ in. Type X GWB (per IBC Table 722.6.2(1)).
- Case C: Minimum $1\frac{5}{8}$ -inch-thick inner rim board plus one layer of minimum $\frac{5}{8}$ in. Type X GWB in the ceiling membrane plus minimum $1\frac{1}{2}$ -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 $\frac{5}{8}$ 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 $1\frac{1}{8}$ -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.

(and from exterior side as required by IBC 705.5)

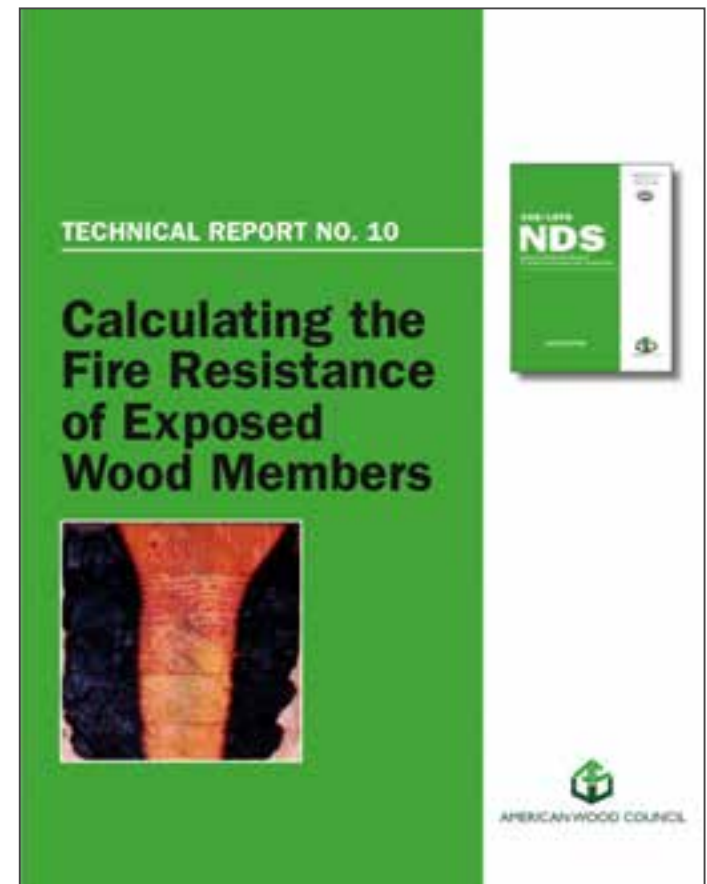


Turning of Resilient Channels)

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

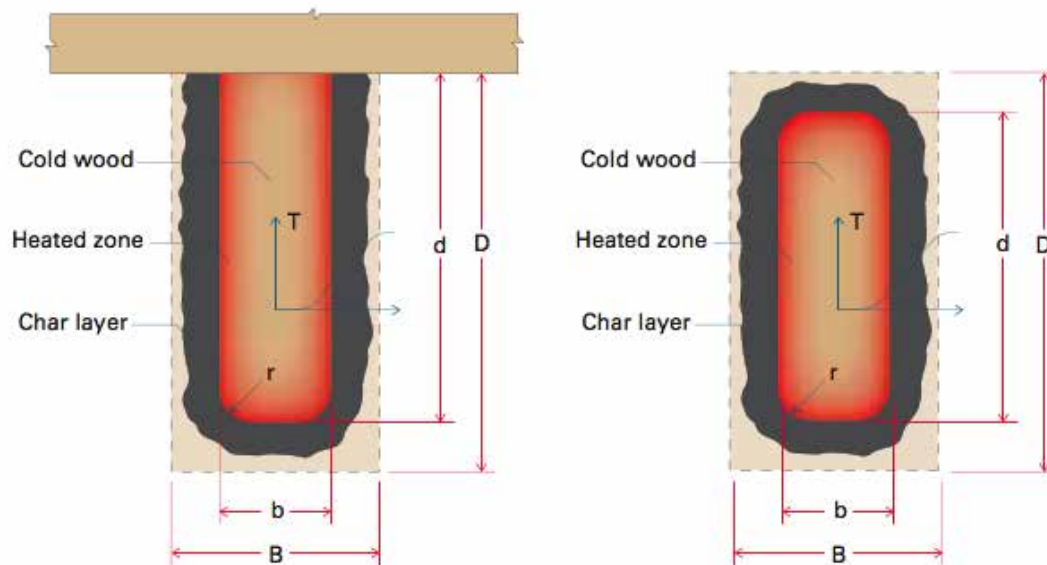


Figure 1-1 Reduction in member breadth and depth over time, t

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

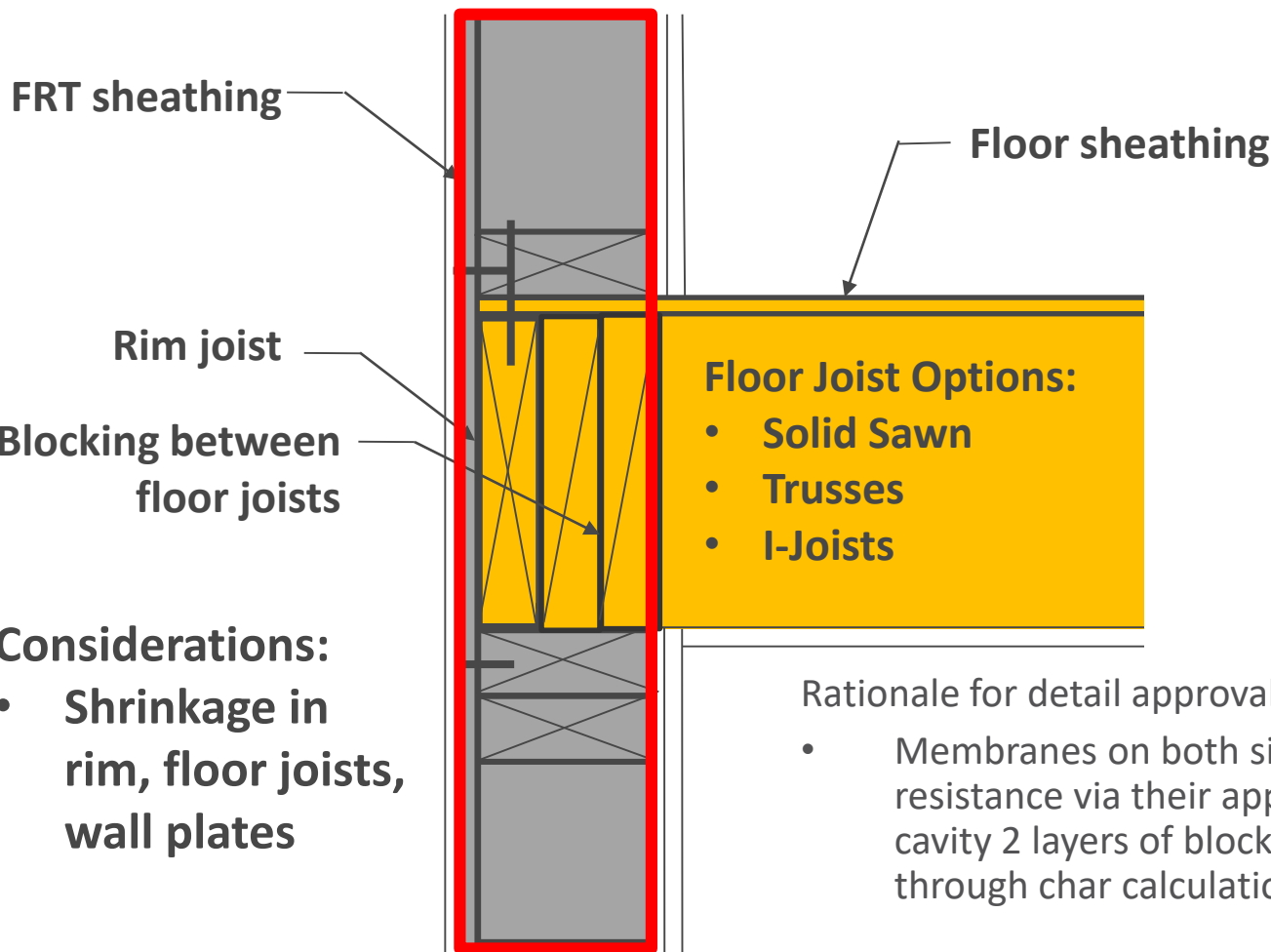
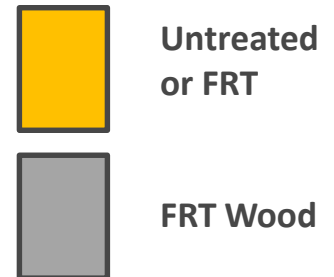
β_n = Nominal char rate (in/hr), linear
char rate based on a 1-hour exposure (1.5"/hr.)

t = Exposure time (hrs)

Exterior Walls – Intersecting Floors

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

Legend



Considerations:

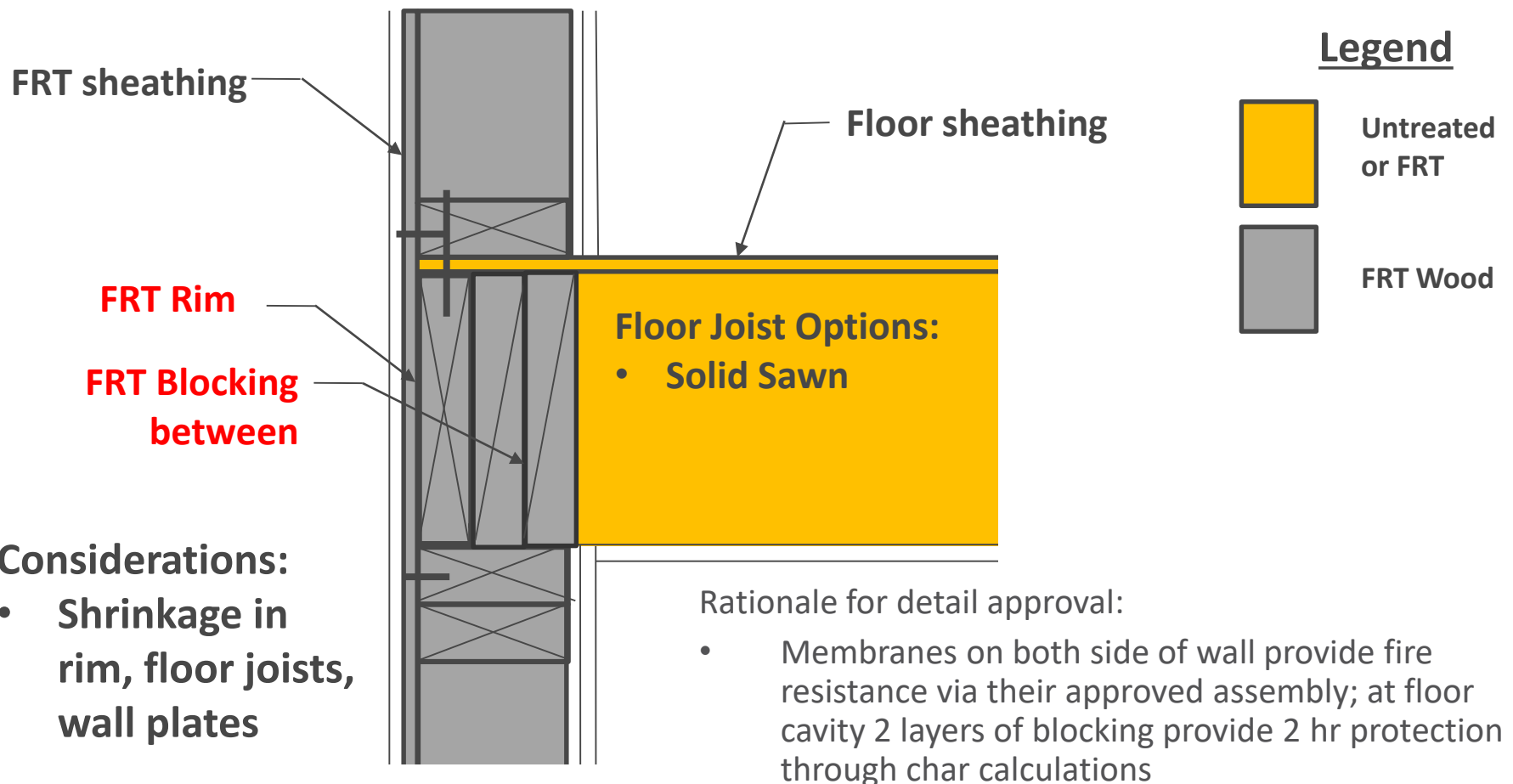
- Shrinkage in rim, floor joists, wall plates

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

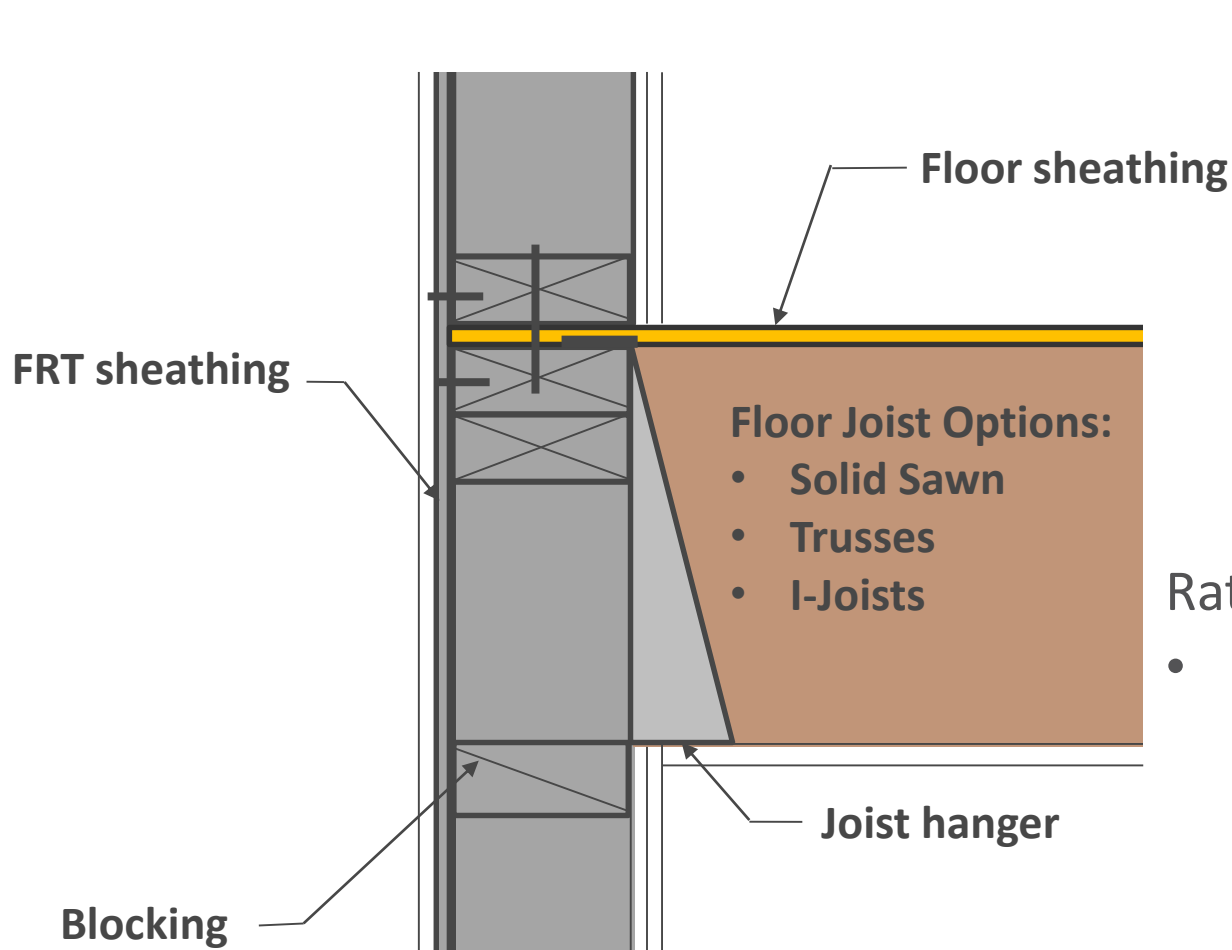
Exterior Walls – Intersecting Floors

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



Exterior Walls – Intersecting Floors

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



Legend



Untreated
or FRT



FRT Wood



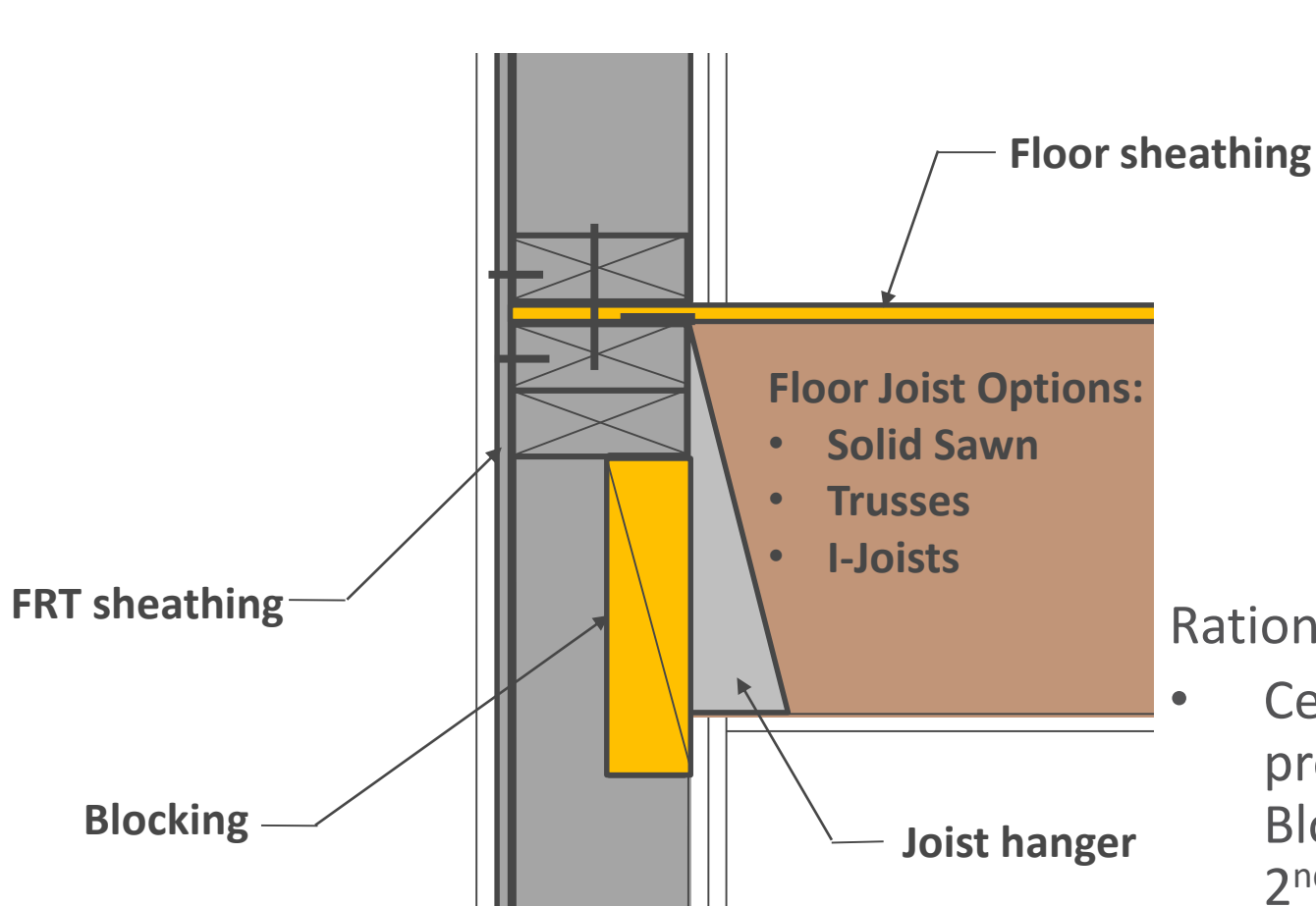
Untreated

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
Semi-Balloon Framing w/Add'l Fire Protection



Legend



Untreated
or FRT



FRT Wood



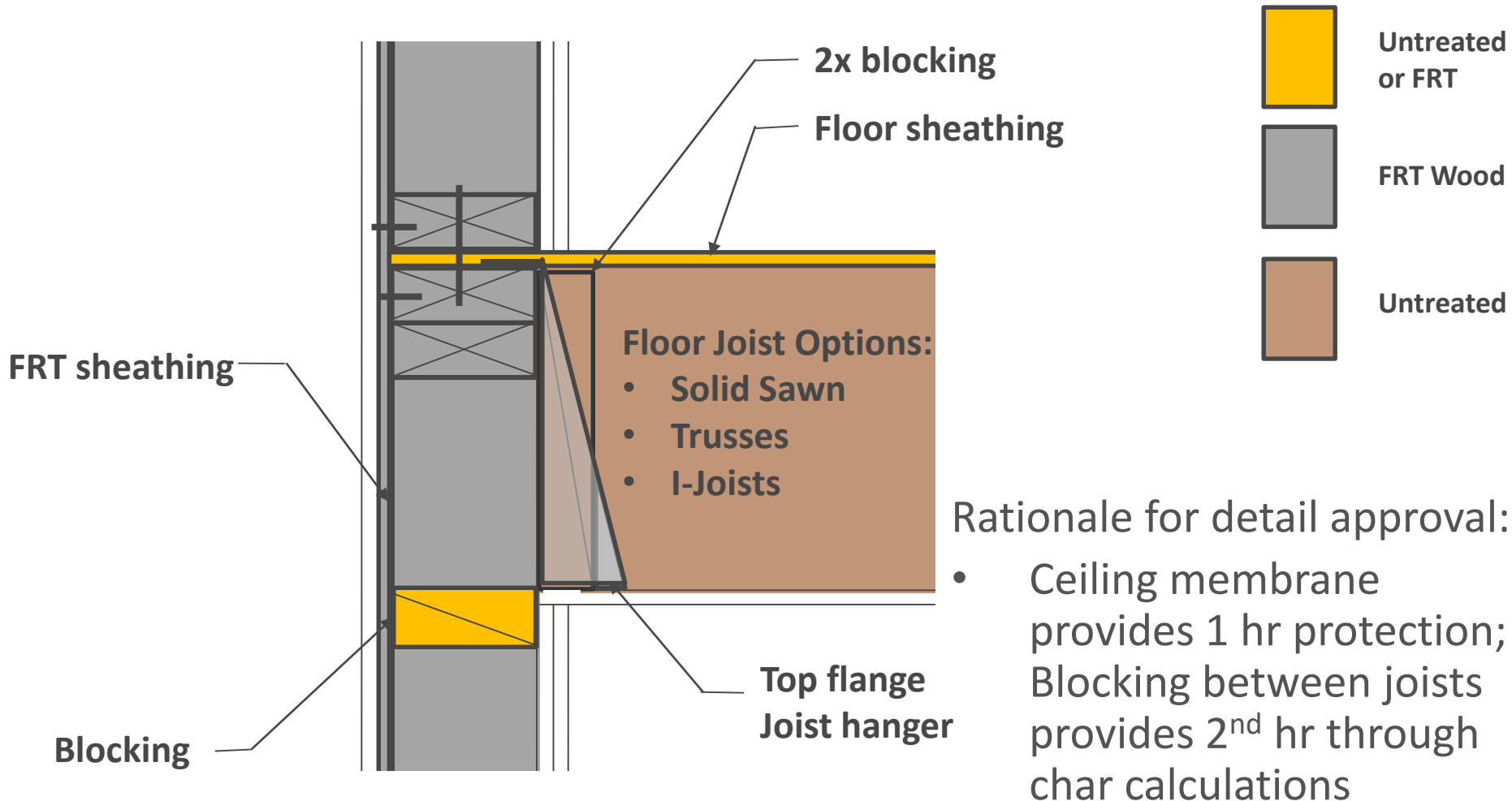
Untreated

Rationale for detail approval:

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

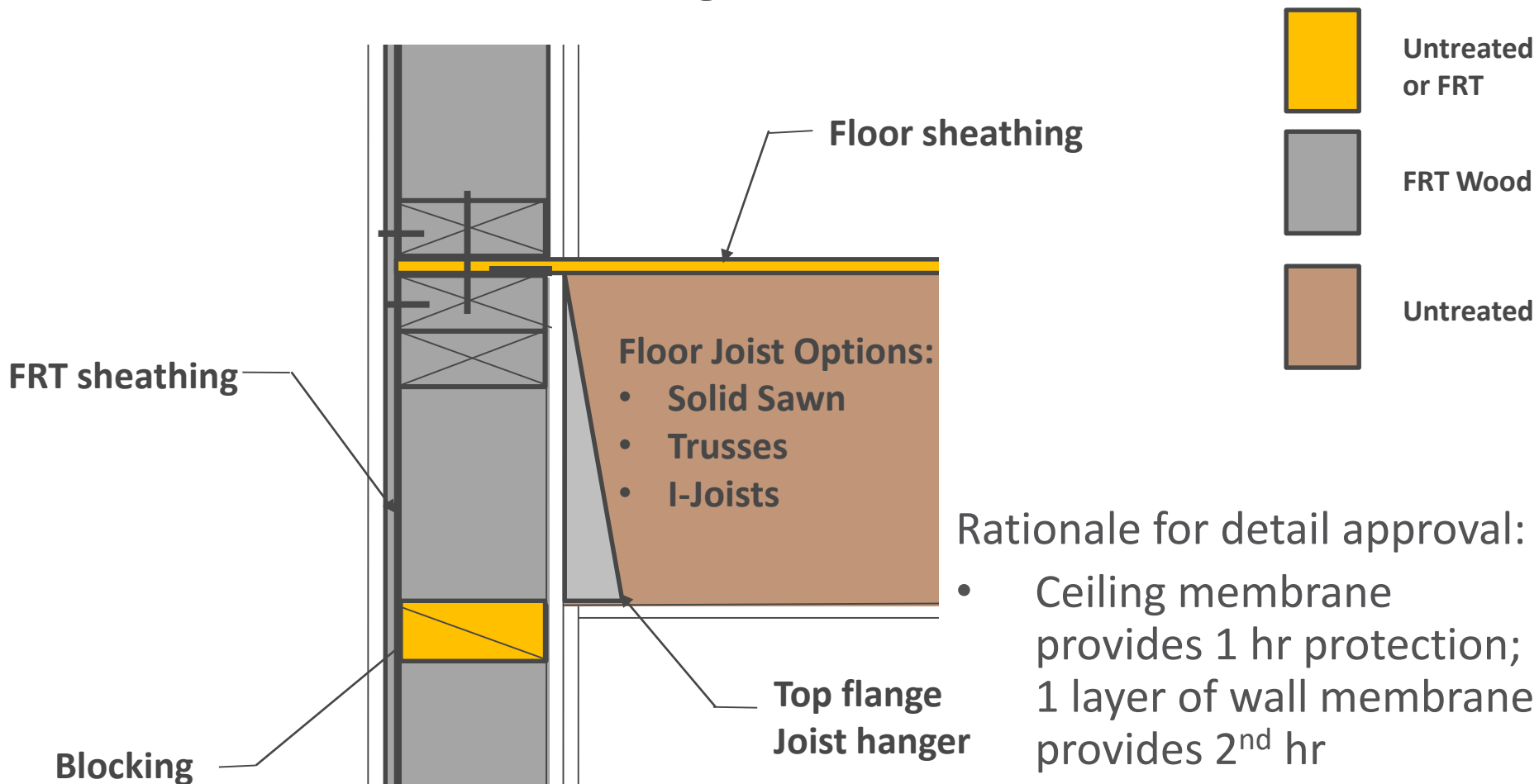
Exterior Walls – Intersecting Floors

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



Exterior Walls – Intersecting Floors

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



Exterior Walls – Intersecting Floors

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

Legend



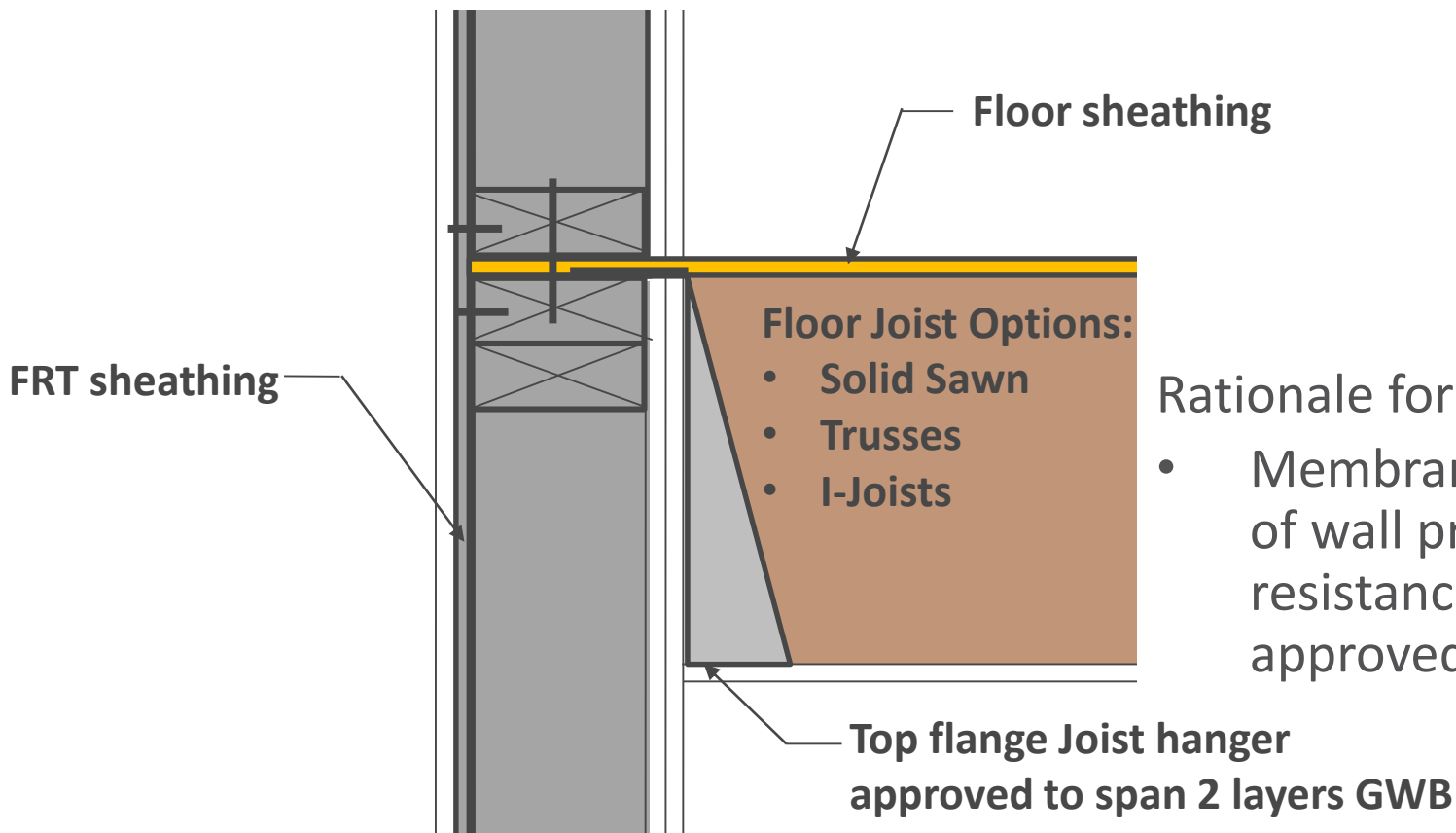
Untreated
or FRT



FRT Wood



Untreated

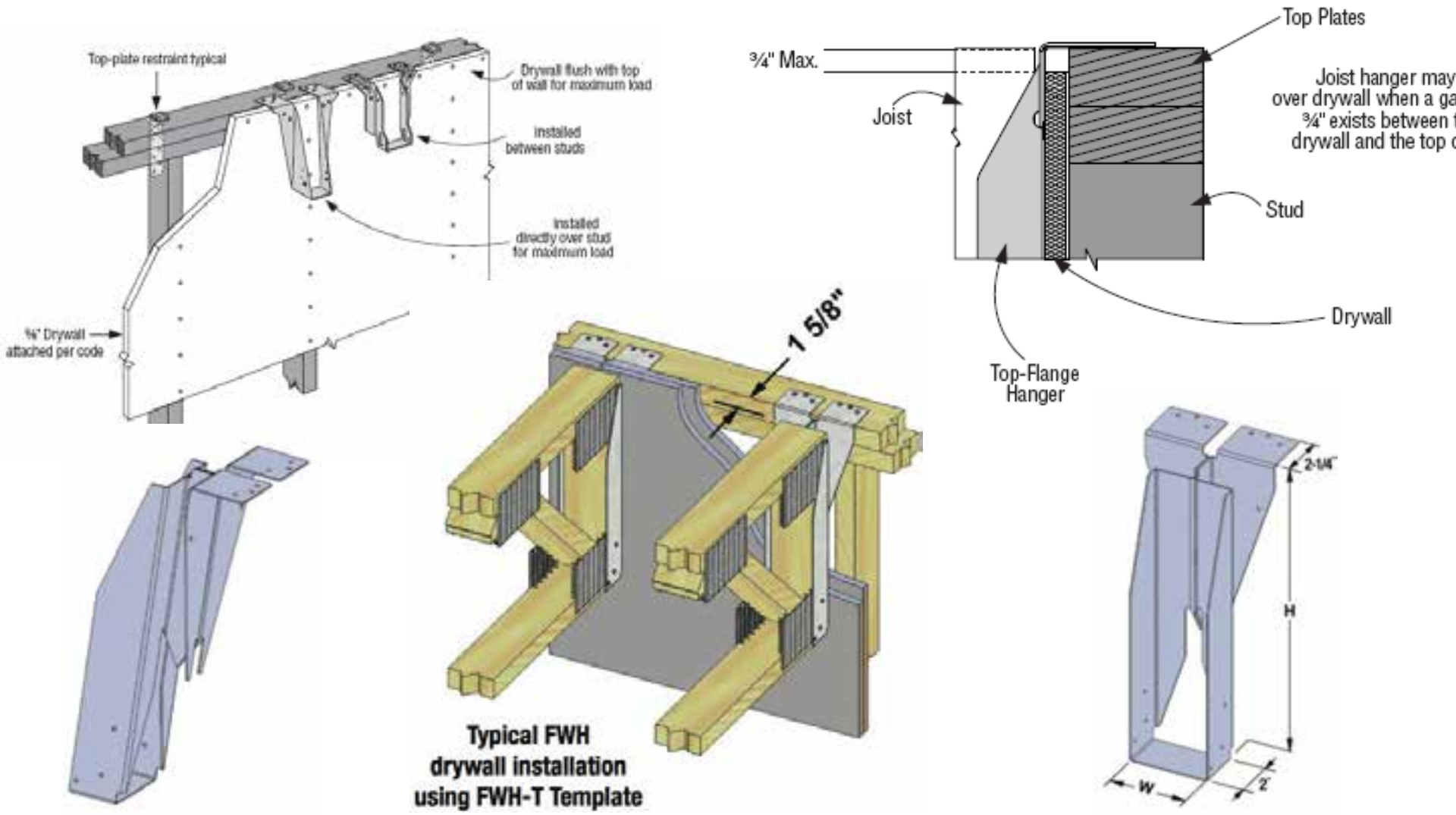


Rationale for detail approval:

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

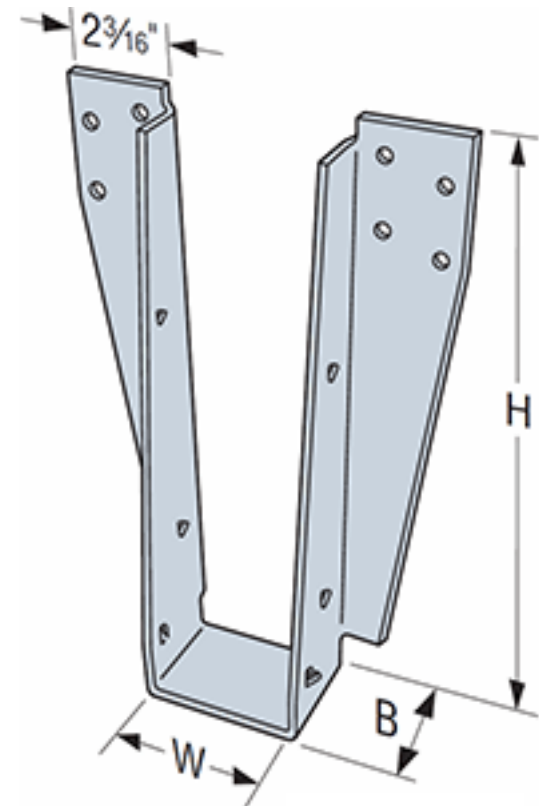
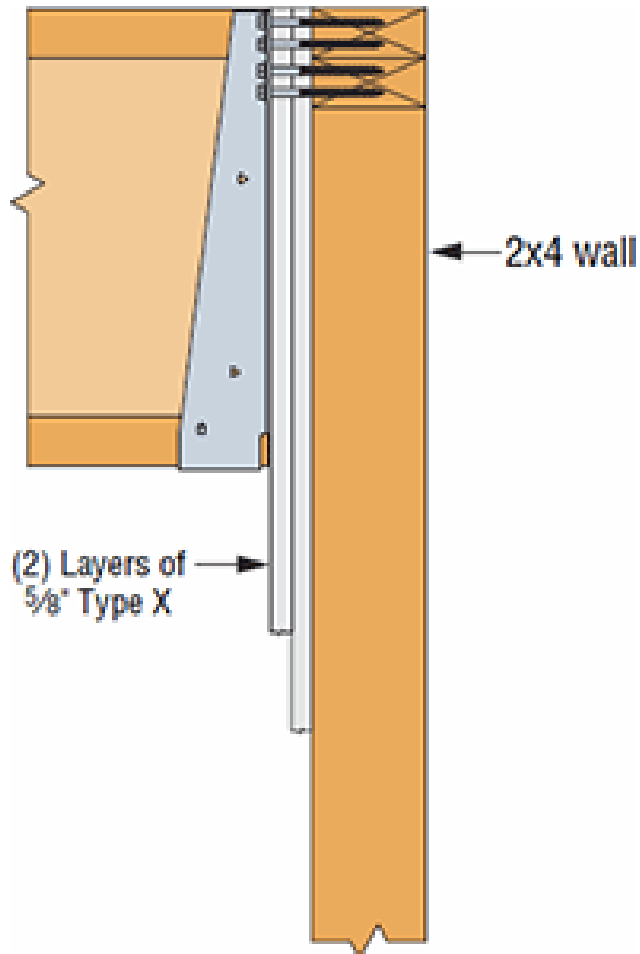
Over Gypsum Hangers

Commonly called Fire Wall or Drywall Hangers



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

Legend



Untreated
or FRT



FRT Wood



Untreated

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

FRT sheathing

Ledger (depth
varies)

Blocking

Floor sheathing

Floor Joist
Options:

- Solid Sawn
- Trusses
- I-Joists

Top flange
Joist hanger

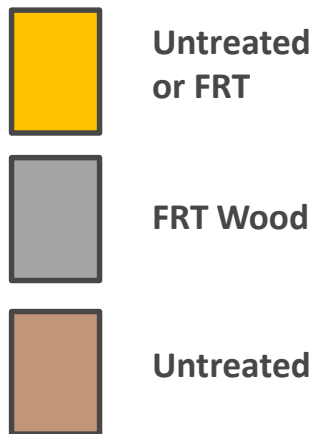
Rationale for detail approval:

- 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

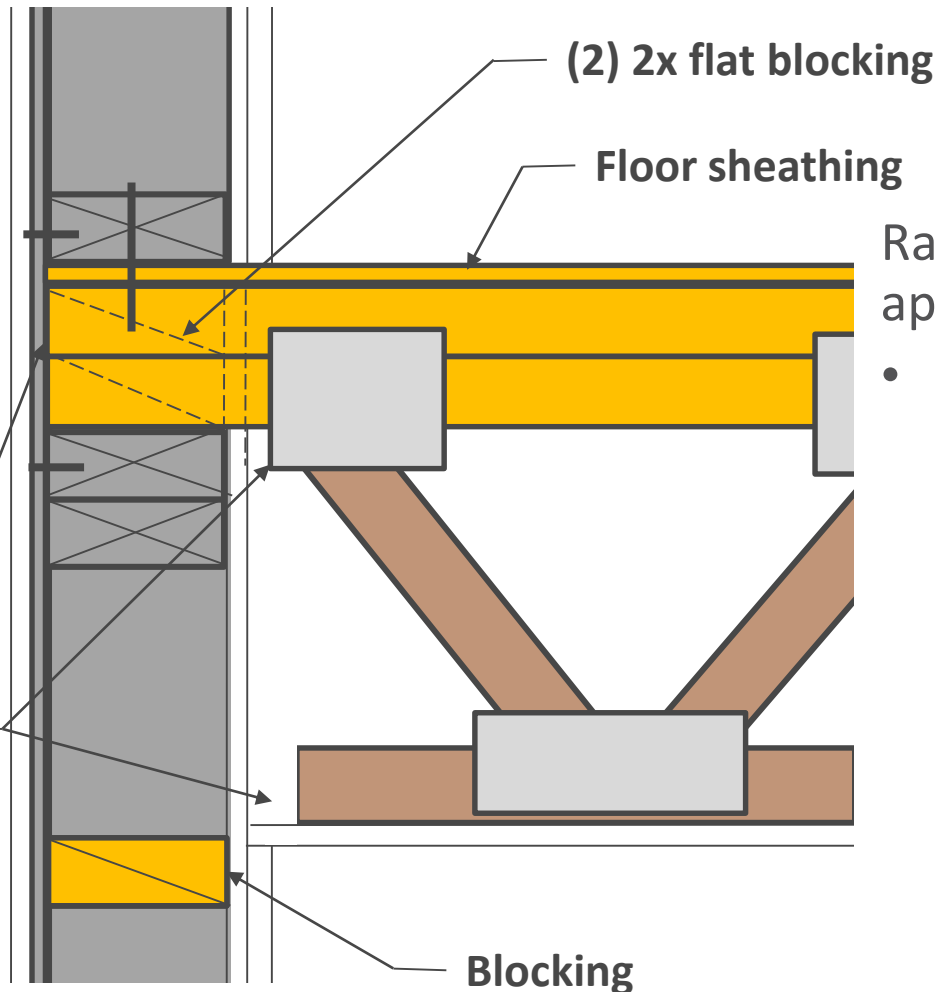
Type III Construction – 2 HR Wall, 1 HR Floor
Platform Framing w/Top Chord Bearing

Legend



FRT sheathing

Should specify truss web holdback (3/4" min.) to allow gypsum installation



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 Semi-Balloon Framing w/Hangers

Legend



Untreated
or FRT

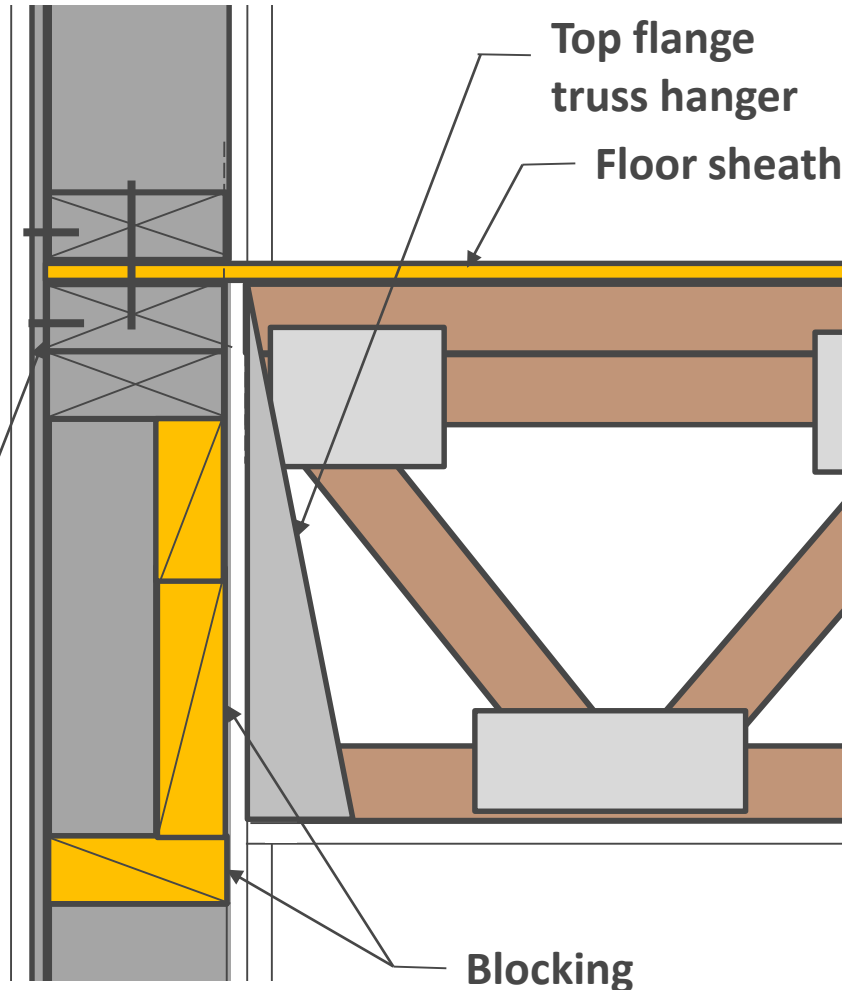


FRT Wood



Untreated

FRT sheathing



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; 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

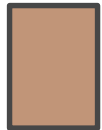
Legend



Untreated
or FRT



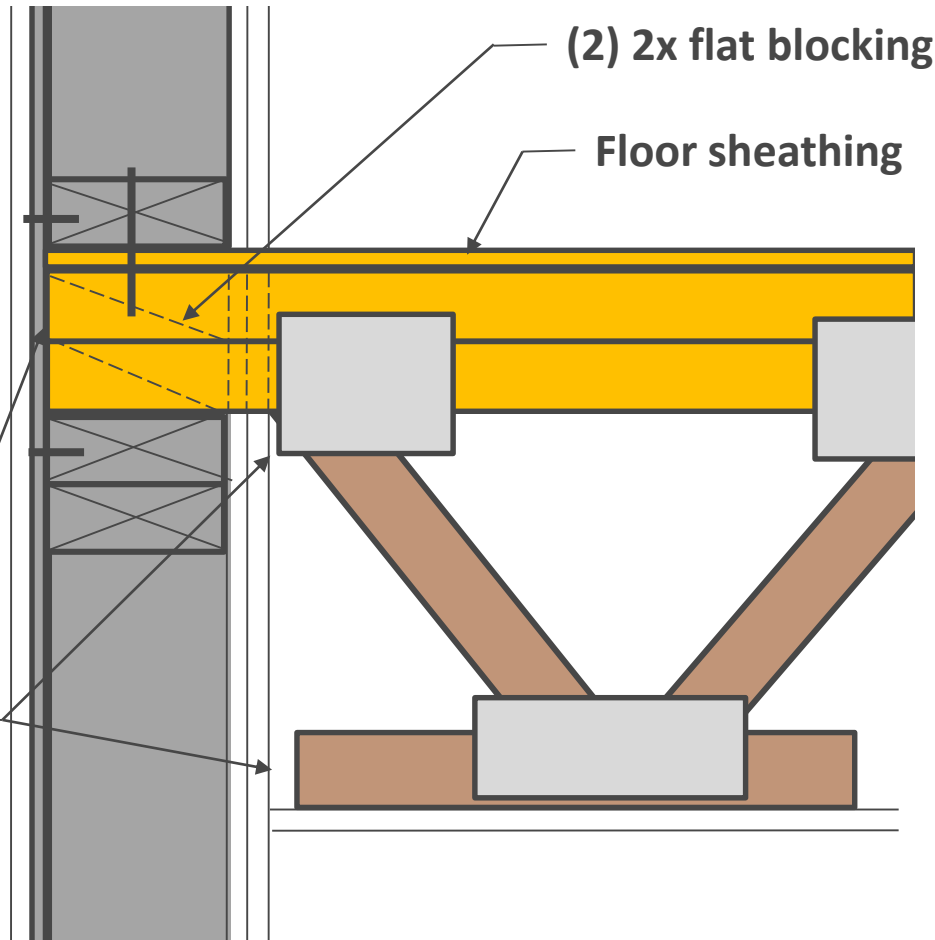
FRT Wood



Untreated

FRT sheathing

Should specify truss
web holdback (1-1/2"
min.) to allow gypsum
installation



Rationale for detail approval:

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

Exterior Walls – Intersecting Floors



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

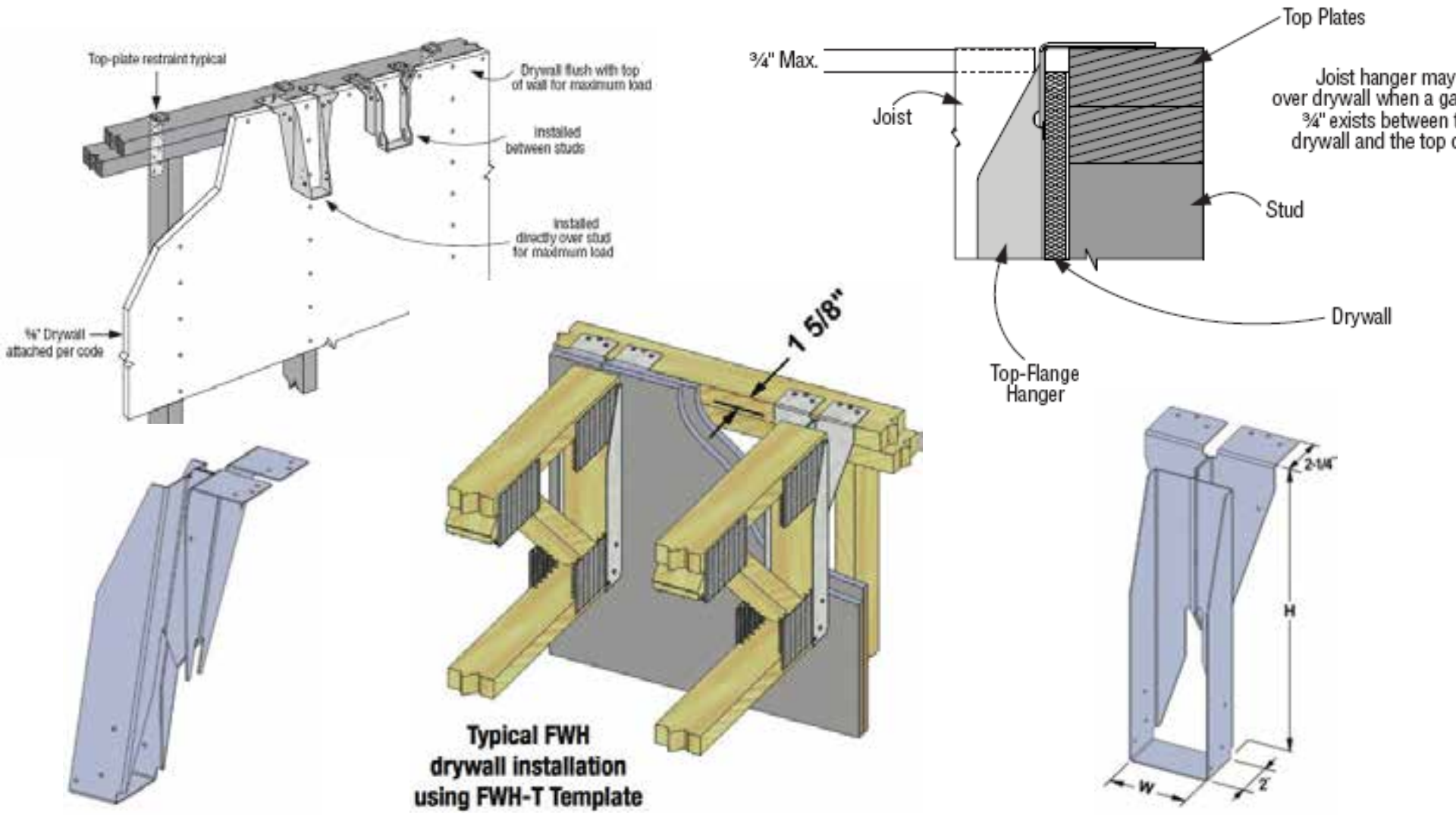
Exterior Walls – Intersecting Floors





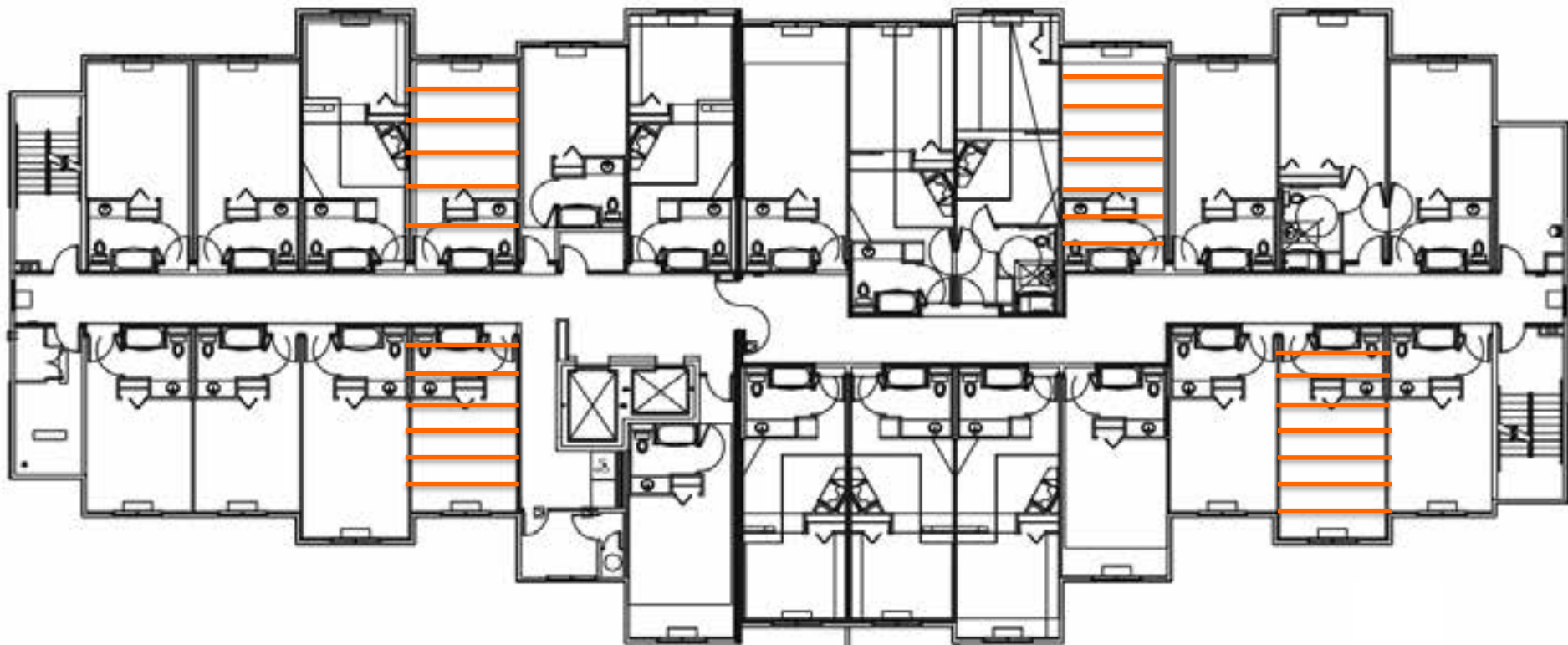
Over Gypsum Hangers

Commonly called Fire Wall or Drywall Hangers



Framing Direction

Running the floor members parallel to the outside walls minimizes the amount of hangers required



**Parallel Floor Truss
Located minimum
of 12" from wall**

Type III Construction Detail Examples

What is being enforced in jurisdictions you are working in?



Outline

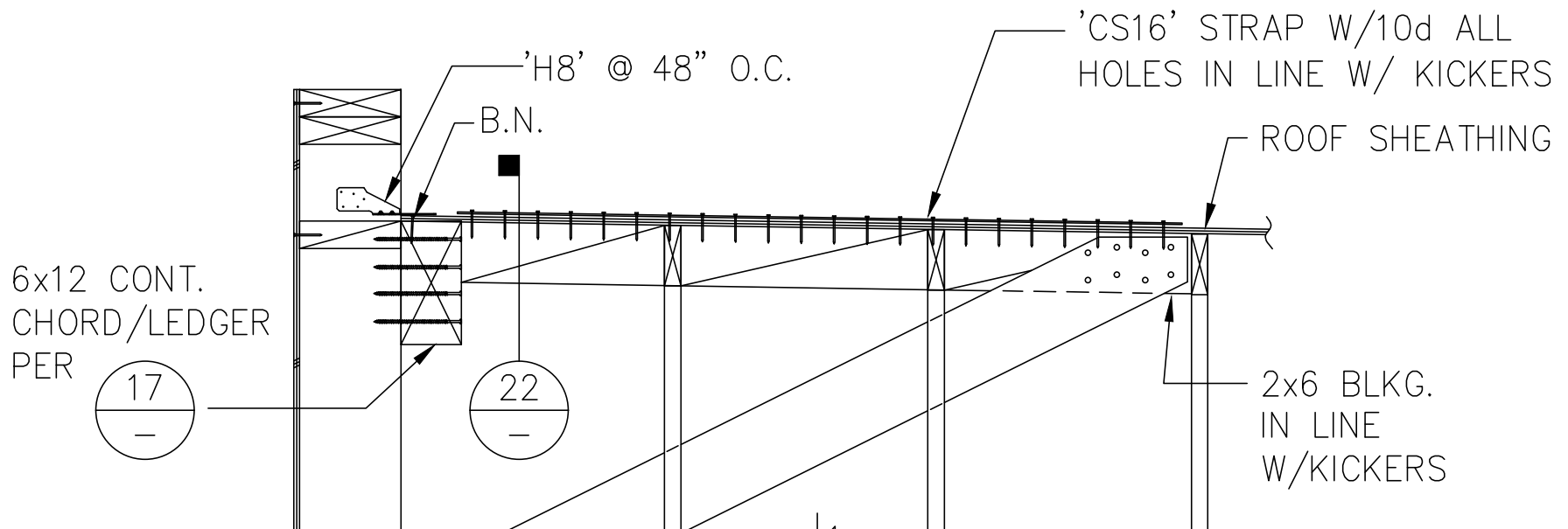
- Context for Type III Construction
- Fire Rating Requirements for Exterior Walls
 - Assembly Asymmetry
 - Addition of Wood Structural Panel
 - Bearing vs. Non-bearing
 - Vertical offsets
- Exterior Wall to Floor Intersection
 - Fire Resistant Continuity
 - Fire Retardant Continuity
- Parapets & Balconies

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

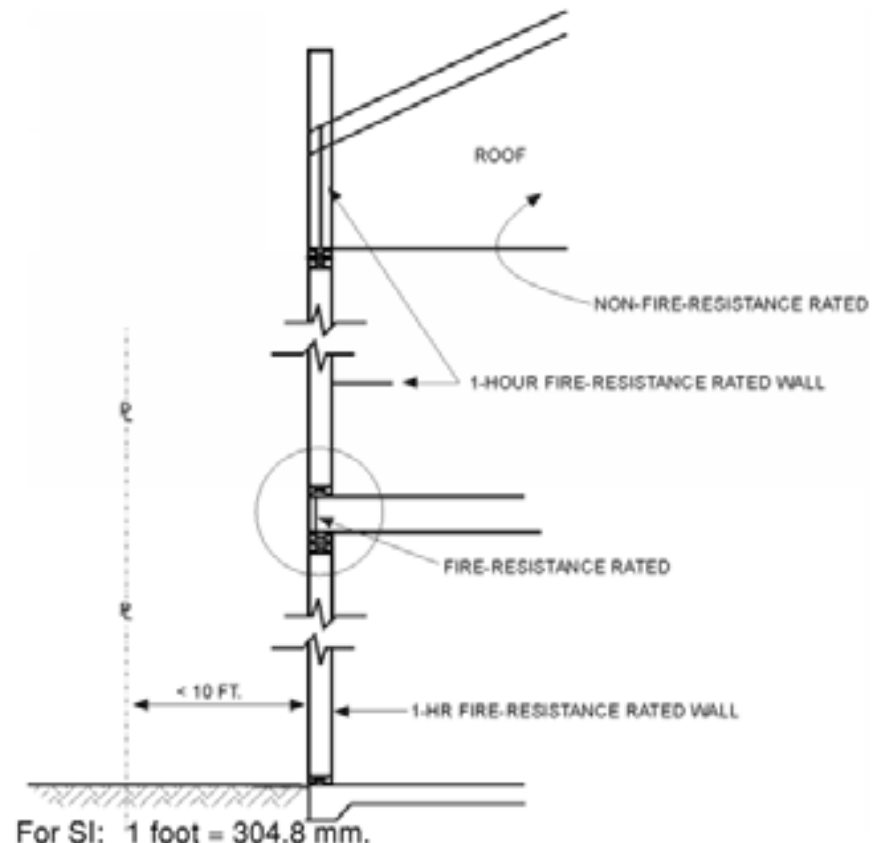


Figure 705.6
TYPE IIB AND VB EXTERIOR
FIRE-RESISTANCE-RATED WALL
CONTINUITY AND STRUCTURAL STABILITY

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 material. Parapet wall requirements shall be of fire-resistance-rated construction as required for the exterior wall.

ing facing the roof, noncombustible to a height above the roof. The parapet shall be 30 inches (762 mm) unless the roof slope is a pitch of 2 in 12 or greater. Part of this section relating to the FSD. When the pitch is 2 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?

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 poses the question—

in conventional construction, is the floor system, exterior wall and supporting part of the exterior wall limits do you go to provide continuity? This is a valid concern with an FSD of 2 hours because the exterior wall fire-resistance rating which provides the continuity and the floor system is illustrated in Commercial Code.

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 wall do not require a fire-resistance rating equal to

“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.”

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



Balconies





Questions?

This concludes The
American Institute of
Architects Continuing
Education Systems
Course

Bruce Lindsey

Regional Director

NC, SC, GA, TN

(704) 877-6255

bruce@woodworks.org

THANK YOU FOR JOINING US – WE HOPE YOU ENJOY TODAY’S SEMINAR!

Keep your **regional staff member** in mind for questions and support:



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