



Fire Resistant Design and Detailing

For Light-Frame Wood Construction

EXTERIOR WALL/FLOOR INTERSECTIONS

Mike Romanowski, SE

WoodWorks Regional Director

Exterior Wall/Floor Intersections

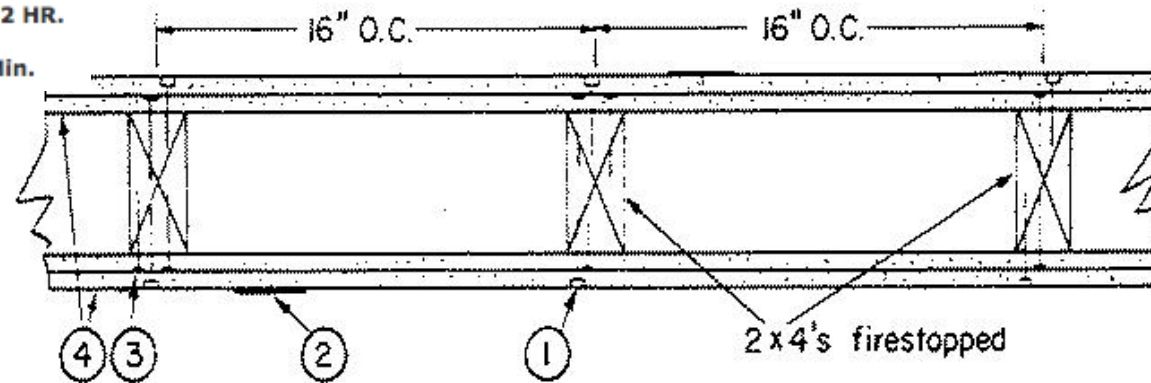
2 Hour Wall

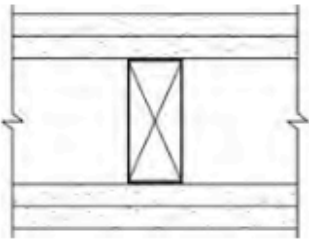
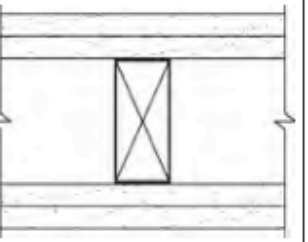
Design No. U301

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	

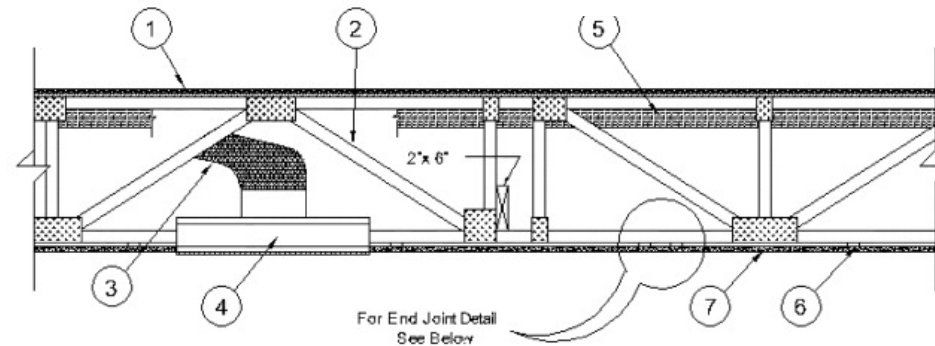
Exterior Wall/Floor Intersections

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

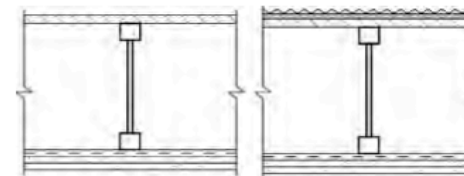
1 HOUR
FIRE

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

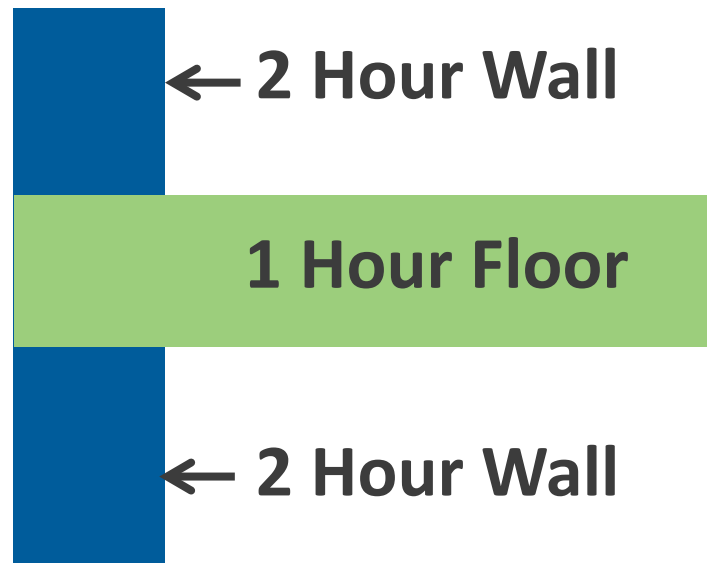
IIC & Test:

(68 C & P)

NRCC B-3150.2, 6-30-00

Intersection of Tested Assemblies

- » Many options are available for fire-resistance tested floor and wall assemblies
- » No tested intersection details exist (no test ovens built for this)
- » We must understand the intent of the code, provide a rationale that meets the code's intent, utilizing available information and testing results



Framing and Fire Rating Requirements

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

IBC Table 601

Note: FRTW = Fire Retardant Treated Wood

Exterior Walls – Structural Stability

IBC 705.6 Structural Stability:

Exterior walls shall extend to the height required by Section 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.

Type III Exterior Walls – FRTW Requirements

Type III Construction - IBC Section 602.3:

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.

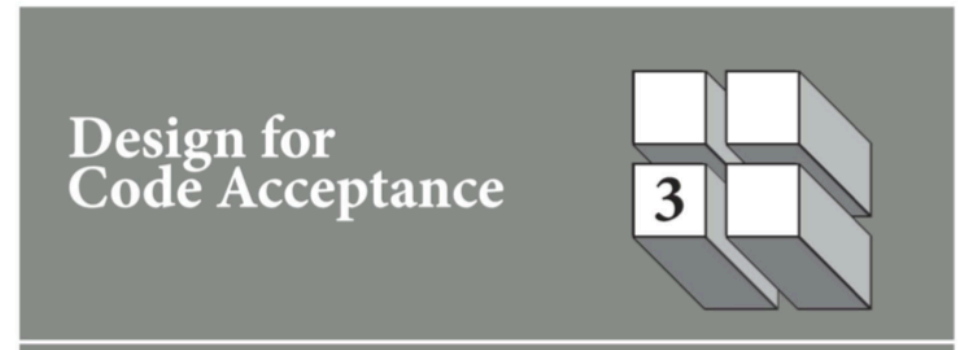
What does this FRTW requirement include?

- Wall Framing (studs & plates) – **Yes**
- Wall Sheathing – **Yes**
- Floor Sheathing – **?**
- Rim Joist – **?**
- Floor Joists/Trusses – **?**

Exterior Wall/Floor Intersections

AWC's DCA3 provides exterior wall to floor intersection detailing options.

Addresses both continuity provisions (structural stability) and FRTW requirements for elements in the plane of the exterior wall.



Fire-Resistance-Rated Wood-Frame Wall and Floor/Ceiling Assemblies

Building Code Requirements

For occupancies such as stores, apartments, offices, and other commercial and industrial uses, building codes commonly require floor/ceiling and wall assemblies to be fire-resistance rated in accordance with standard fire tests. This document is intended to aid in the design of various wood-frame walls and wood-frame floor/ceiling assemblies, where such assemblies are required by code to be fire-resistance-rated.

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

Fire Tested Assemblies

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

Descriptions of successfully tested I-joist floor as-

DCA 3 Detailing Methodology – Membrane Protection for Wood Assemblies

IBC Table 722.6.2(1) provides fire protection times for various membranes

TABLE 722.6.2(1)
TIME ASSIGNED TO WALLBOARD MEMBRANES^{a, b, c, d}

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

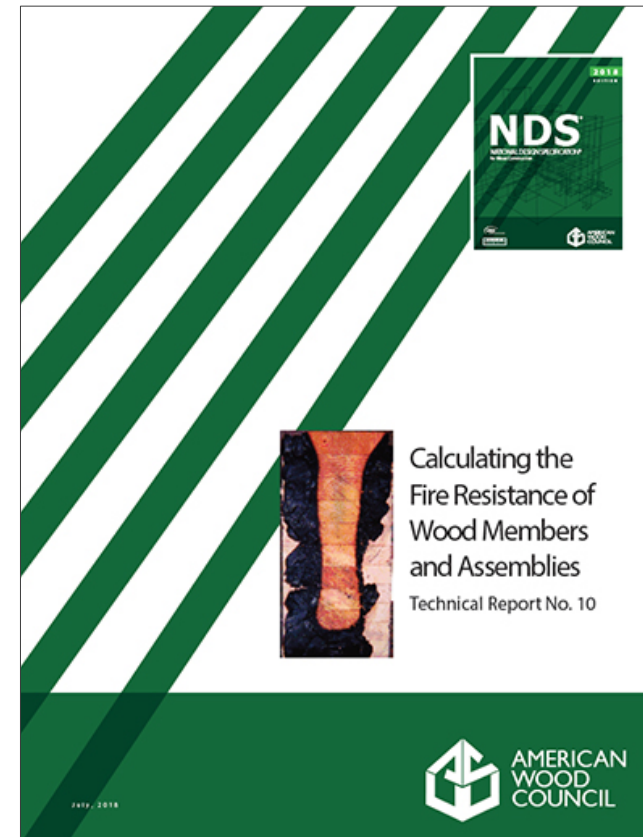
DCA 3 Detailing Methodology – Calculated Fire Resistance of Wood

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)

NATIONAL DESIGN SPECIFICATION FOR WOOD CONSTRUCTION		149
FIRE DESIGN OF WOOD MEMBERS		
16.1	General	150
16.2	Design Procedures for Exposed Wood Members	150
16.3	Wood Connections	151
Table 16.2.1	Effective Char Rates and Char Layer Thicknesses (for $\beta_e = 1.5 \text{ in./hr.}$)	150
Table 16.2.2	Adjustment Factors for Fire Design	151

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AMERICAN WOOD COUNCIL

16



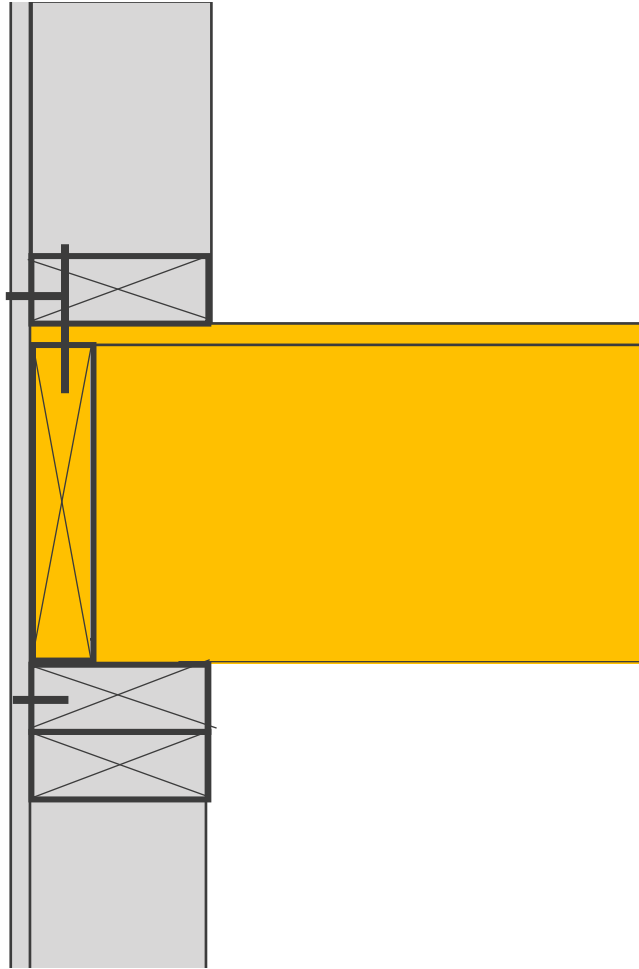
DCA 3 Detailing Methodology – Calculating Fire Endurance of Protective Wood Members

TR 10 Section 3.8.1

For a nominal char rate of 1.5 inches per hour, which has been demonstrated applicable to lumber, glulam, SCL and CLT, the equation to calculate the added fire resistance time “ t_p ” associated with a protective wood membrane of a thickness “ d ” is as follows:

$$t_p = 60 \left(\frac{d}{1.5} \right)^{1.23} \text{ minutes}$$

Platform Framing



Structural

- Direct bearing/no add'l hardware
- May require load transfer blocking for concentrated loads from above

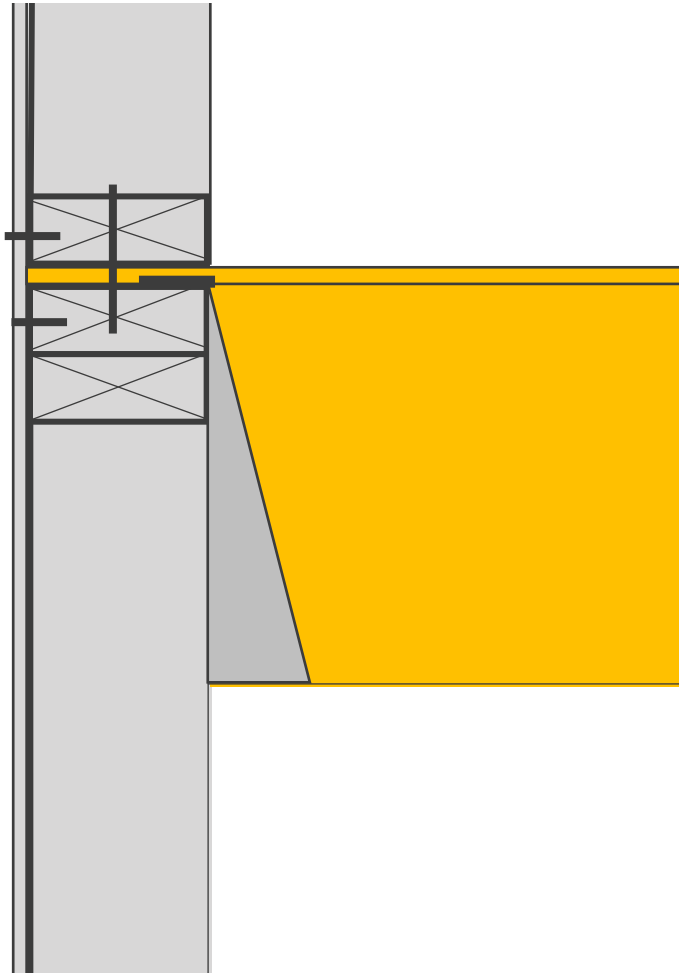
Rated Assemblies

- Fire rating continuity of exterior walls in Type III construction questionable

Constructability

- Framing can be completed before drywall and insulation are installed
- Common length studs
- Overall building shrinkage may need to be considered

Semi-Balloon Framing



Structural

- Additional hardware/no direct bearing
- No load transfer blocking req.'d

Rated Assemblies

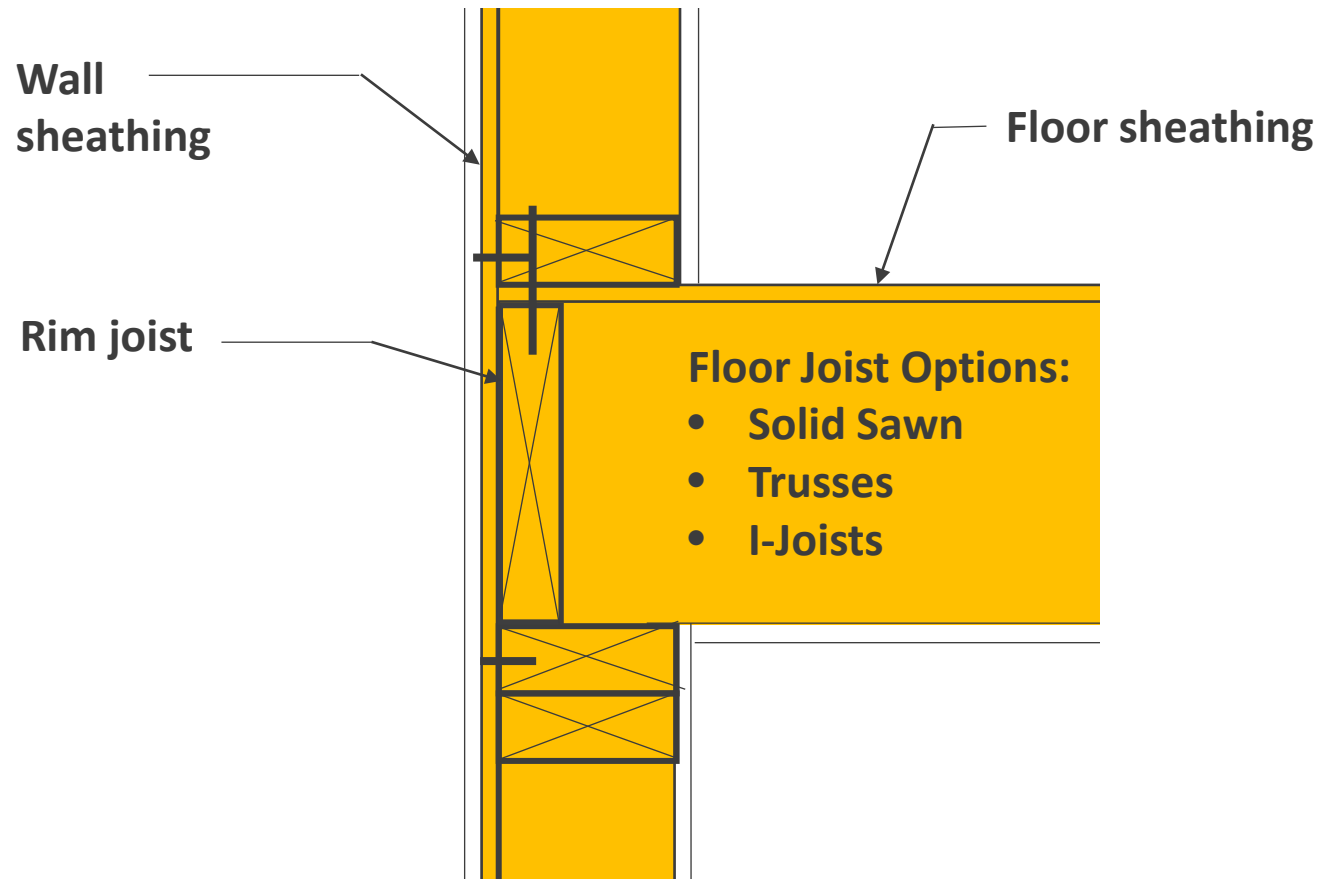
- May better accommodate fire rating continuity of exterior walls in Type III construction

Constructability

- Framing can sometimes be completed before drywall and insulation are installed
- Custom length studs
- Can help minimize building shrinkage

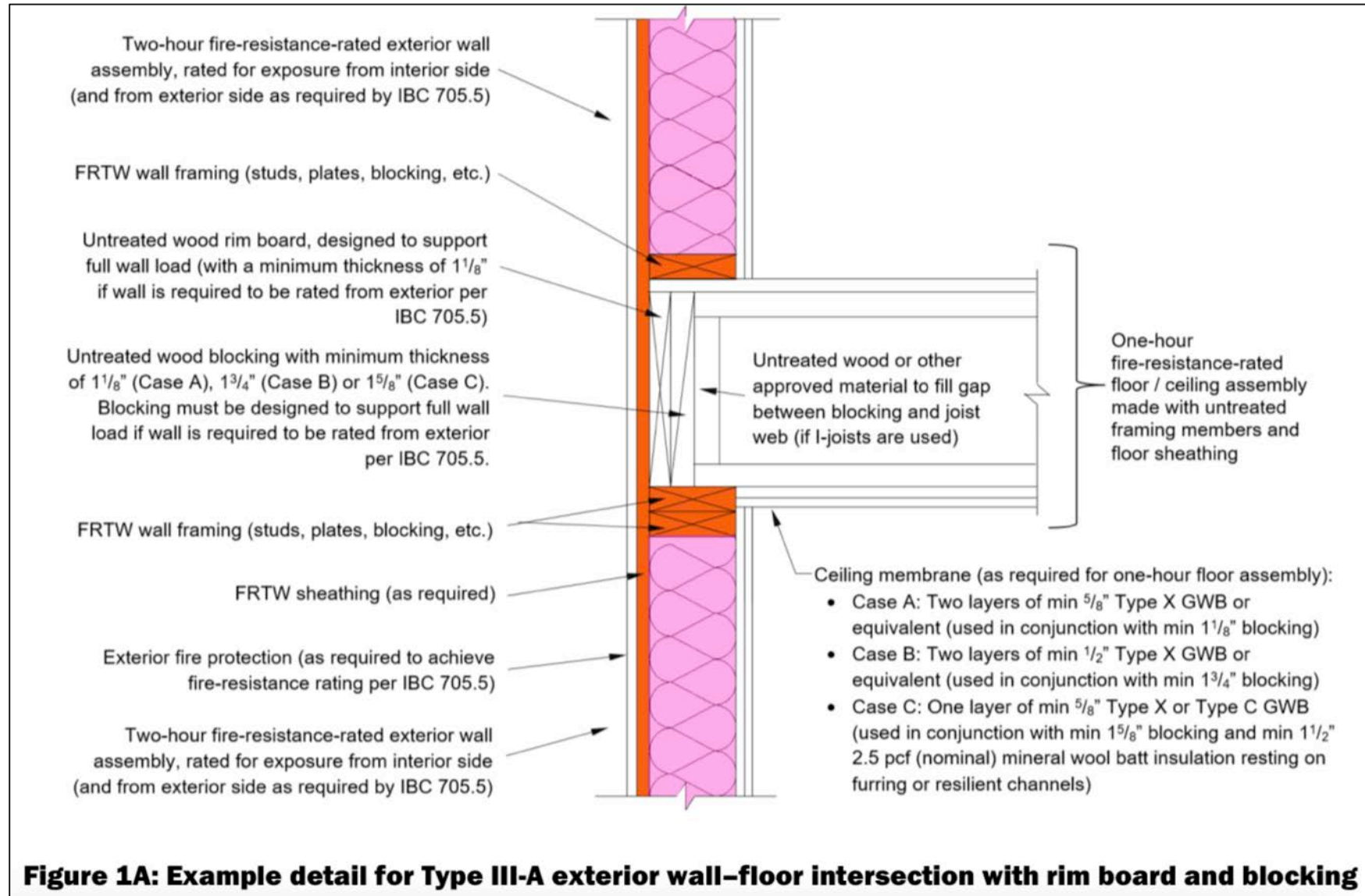
Exterior Wall/Floor Intersections

Type VA Construction: 1-hr Wall, 1-hr Floor
Typical Platform Framing



- Wall assembly has same rating as floor assembly; no continuity (structural stability) concerns

DCA 3 Detailing



DCA 3 Detailing

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.

Exterior Wall/Floor Intersections

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 based on the DCA 3 detailing approach and 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 Wall/Floor Intersections

Type IIIA Construction: 2-hr Wall, 1-hr Floor
Typical Platform Framing

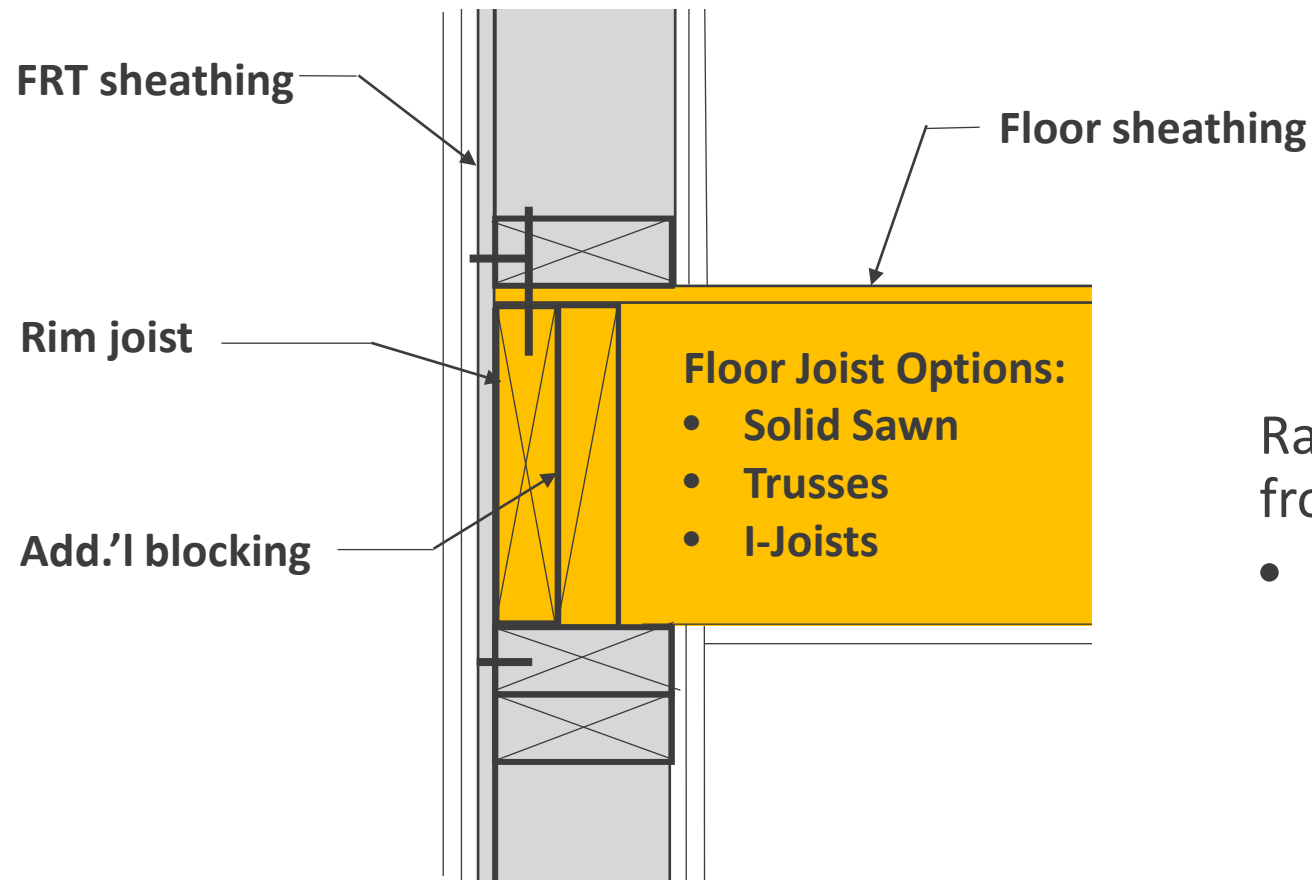
Legend



Untreated
Wood



FRT Wood



Rationale for detail approval (fire exposure from inside):

- Ceiling membrane(s) provide initial fire protection, add'l blocking provides remaining protection of structural rim joist through char calculations

Exterior Wall/Floor Intersections

Type IIIA Construction: 2-hr Wall, 1-hr Floor
Typical Platform Framing

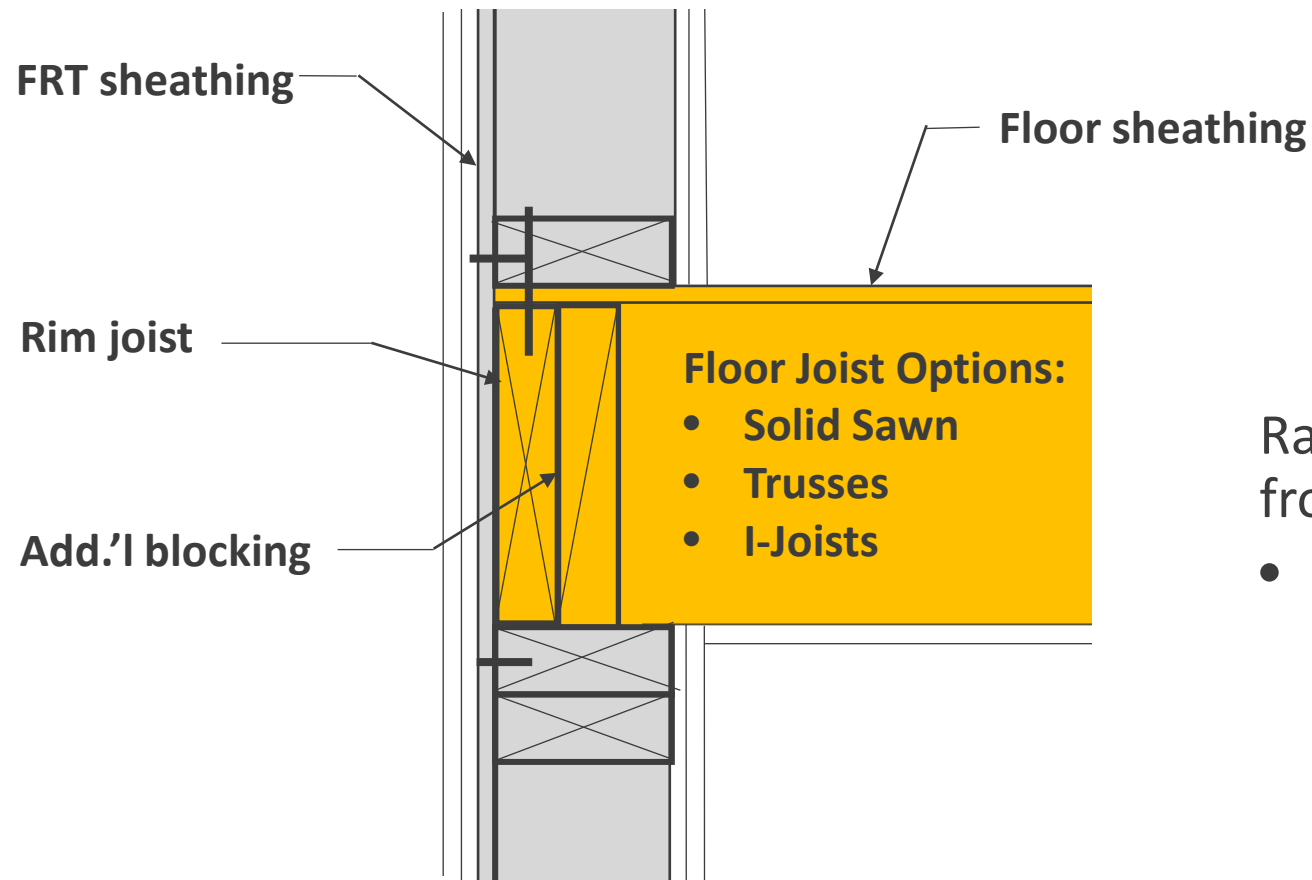
Legend



Untreated
Wood



FRT Wood



Rationale for detail approval (fire exposure from outside):

- Wall membrane(s) provide initial fire protection, rim joist provides remaining protection of structural blocking through char calculations

Exterior Wall/Floor Intersections

Type IIIB Construction: 2-hr Wall, 0-hr Floor
Typical Platform Framing

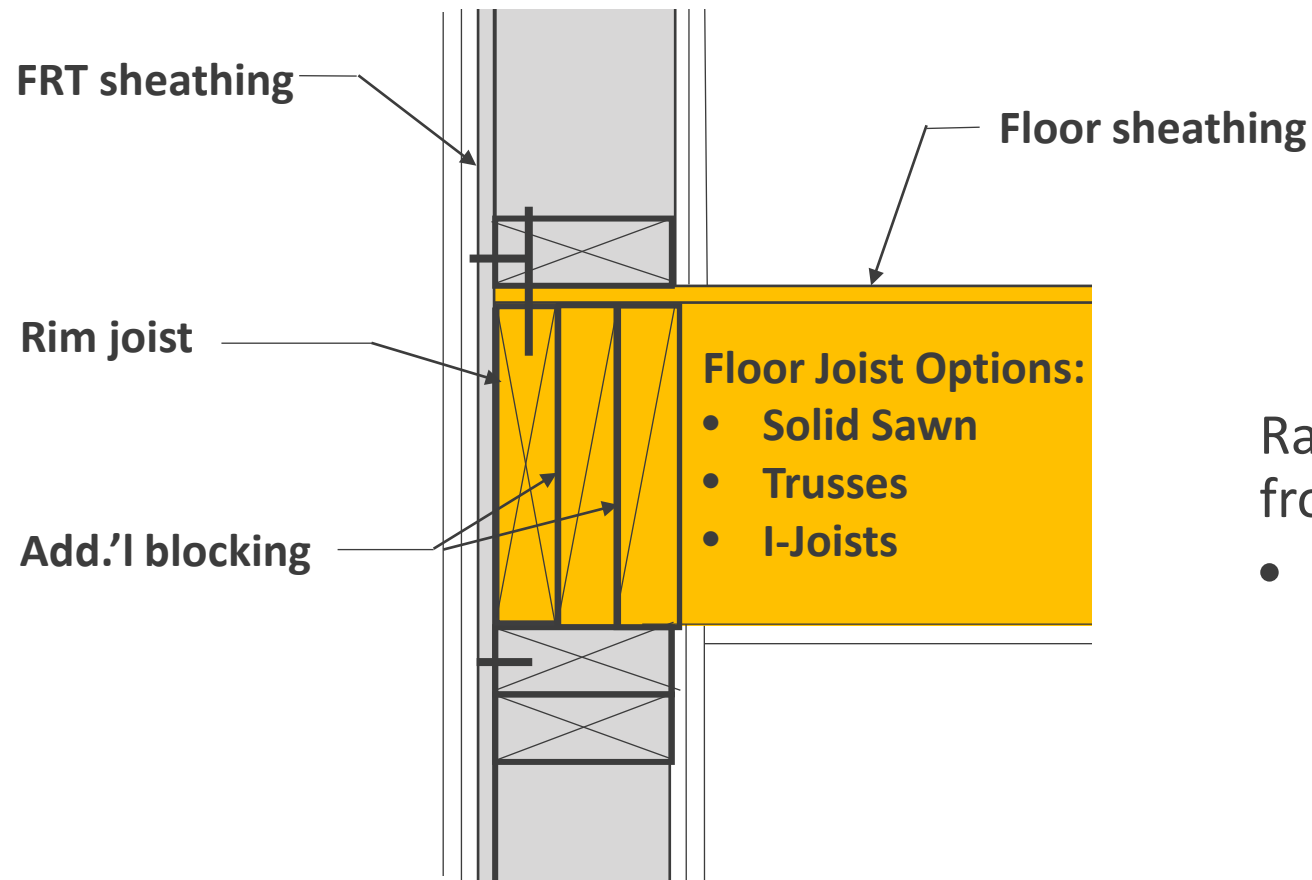
Legend



Untreated
Wood



FRT Wood



Rationale for detail approval (fire exposure from inside):

- Ceiling membrane(s) provide initial fire protection, add.'l blocking provides remaining protection of structural rim joist through char calculations

Exterior Wall/Floor Intersections

Type IIIA Construction: 2-hr Wall, 1-hr Floor
Modified Platform Framing

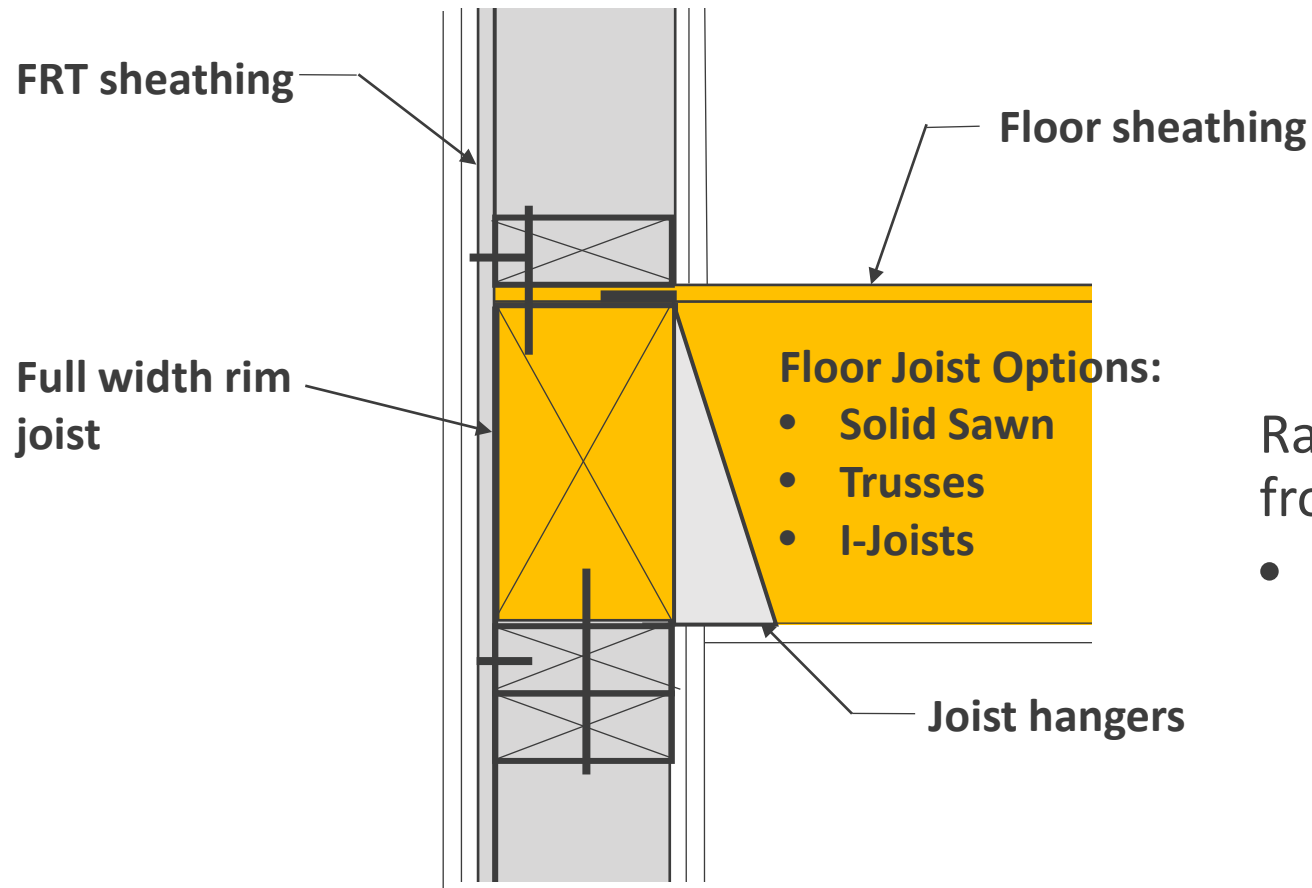
Legend



Untreated
wood



FRT Wood



Rationale for detail approval (fire exposure from inside):

- Ceiling membrane(s) provide initial fire protection, inner side of rim joist provides remaining protection through char calculations (un-charred portion adequate for vertical load)

Exterior Wall/Floor Intersections

Type IIIB Construction: 2-hr Wall, 0-hr Floor
Semi-Balloon Framing

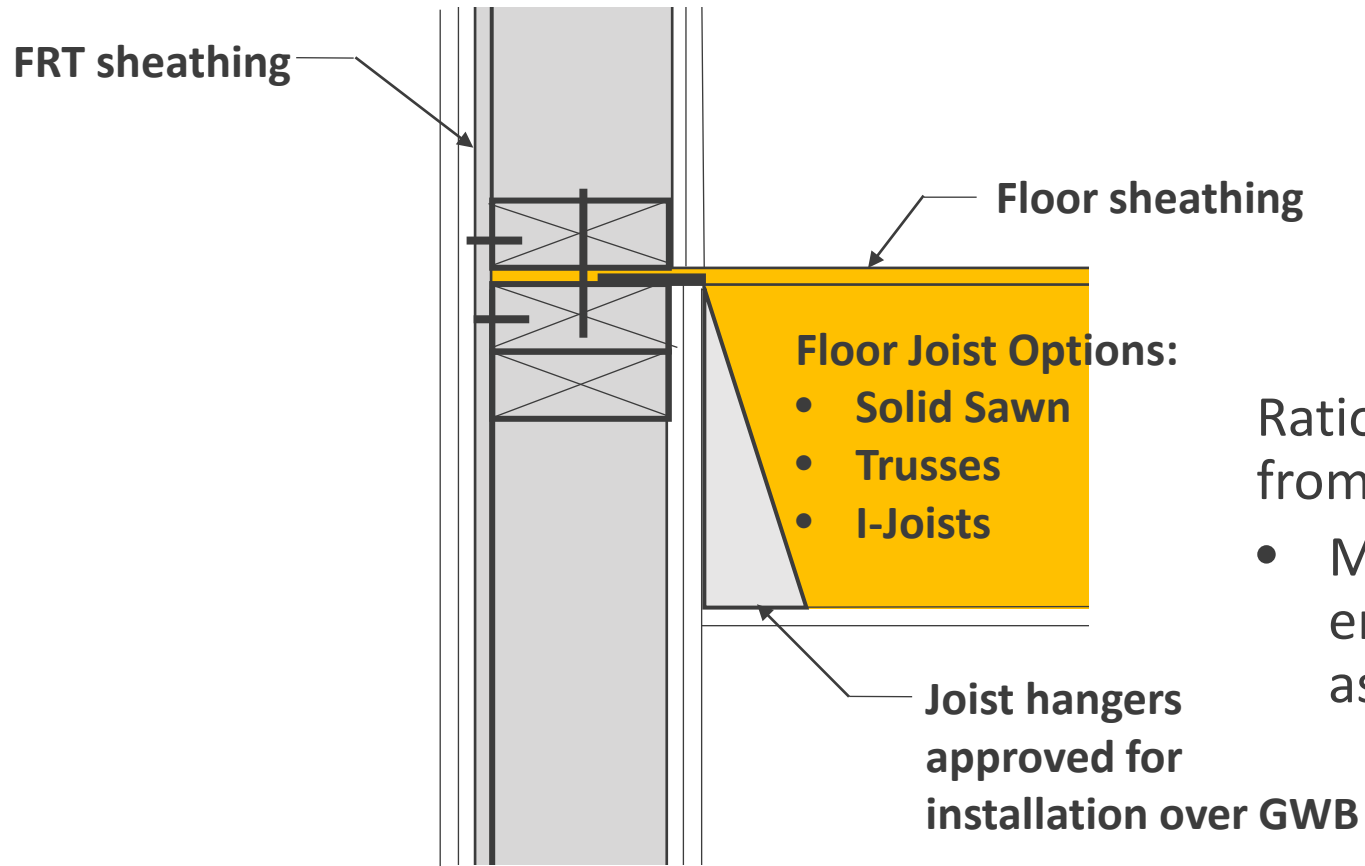
Legend



Untreated
wood



FRT Wood

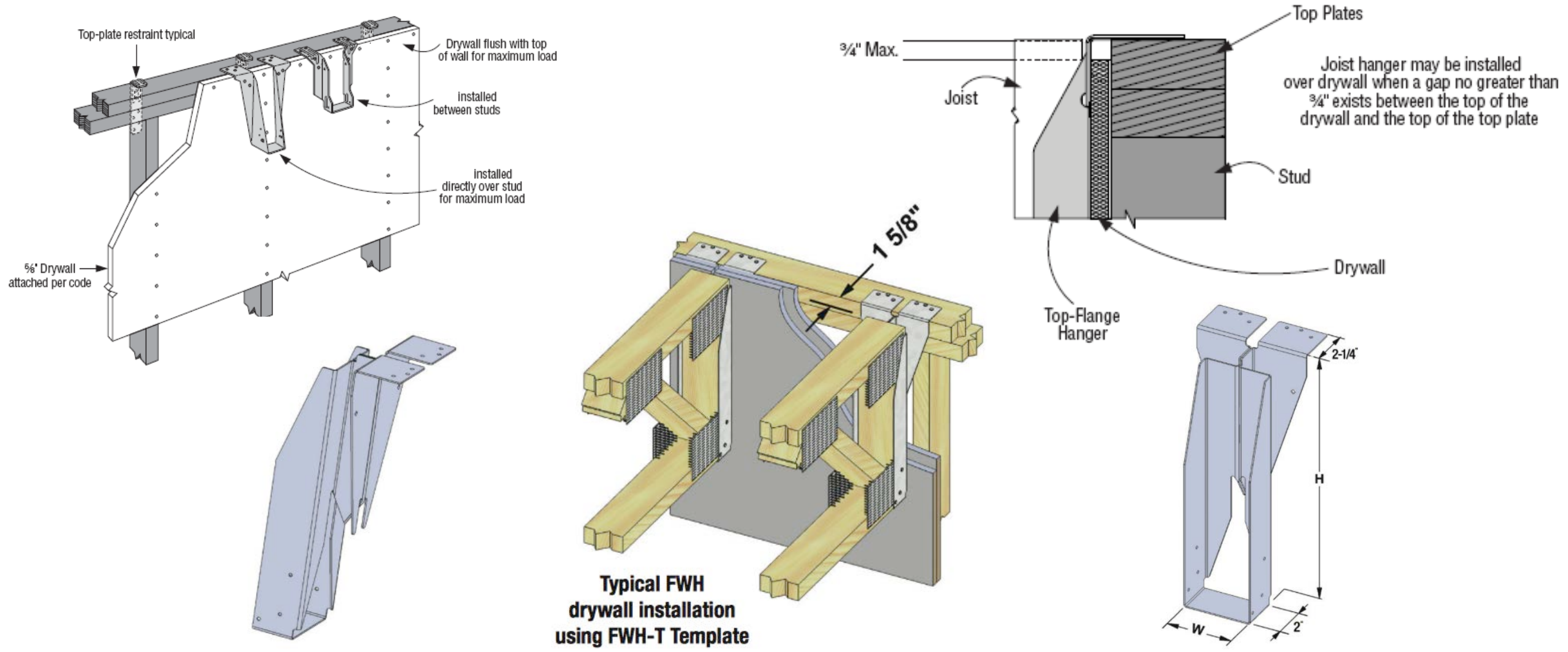


Rationale for detail approval (fire exposure from either side):

- Membrane fire protection neglected, entire protection provided by rated wall assembly

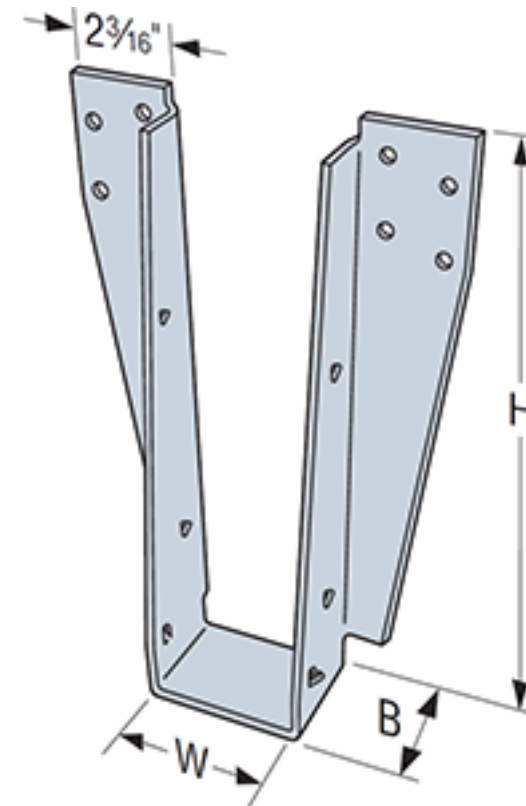
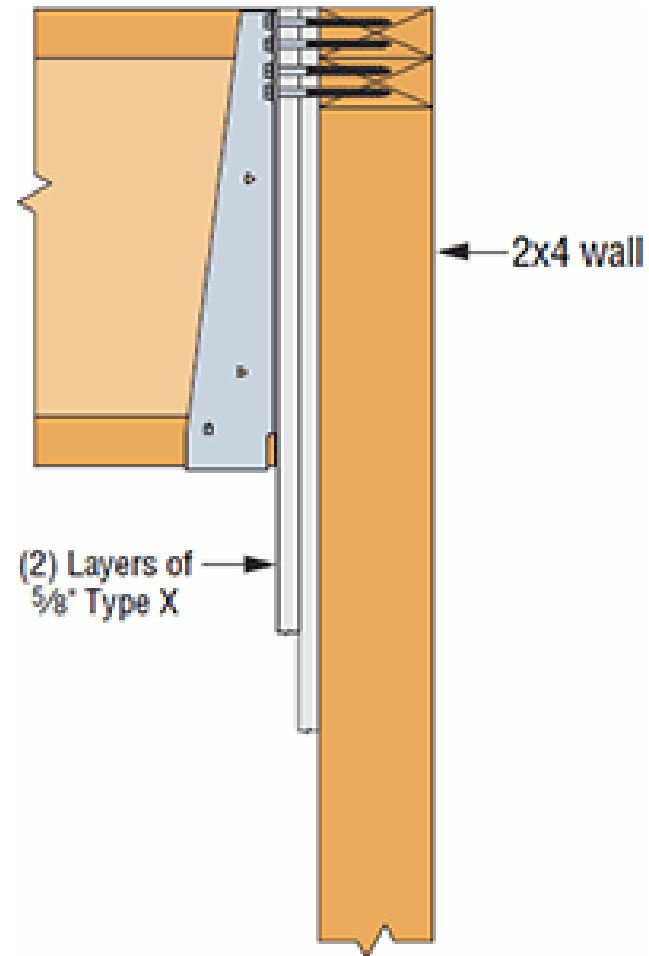
Hangers Installed Over GWB

Commonly called Fire Wall or Drywall Hangers



Hangers Installed Over GWB

Top Flange Hangers & Face Mount Hangers Available



➤ QUESTIONS?

This concludes The American
Institute of Architects Continuing
Education Systems Course

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