Mid-Rise Design & Detailing: Optimizing Size, Maximizing Value

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WoodWorks
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The Canyons, Kaiser+Path, photo Jeremy Bittermann

Course Description

As cities seek increased density to address urban population growth, many building designers and developers are looking to mid-rise wood construction as a cost-effective, code-compliant and sustainable solution. This presentation will cover some of the design considerations associated with mid-rise wood-frame buildings, including how to maximize height and area through the use of sprinklers, open frontage, sloping sites, podiums and mezzanines. Construction types will be reviewed, with an emphasis on opportunities for wood use in types III and V.

Learning Objectives

1. In the context of a shift toward increased urban density, learn how mid-rise, wood-frame construction meets housing needs while contributing to vibrant and sustainable communities.

2. Discuss allowable construction types, occupancies, and building heights and areas for wood-frame mid-rise construction per the 2018 International Building Code.

3. Identify potential modifications to the IBC's base tabular heights and areas based on code provisions for building frontage, sprinklers, sloping sites, podiums and mezzanines.

4. Highlight constructed buildings that were designed using these code provisions to maximize density.

Outline

- Context for Mid-Rise Construction
- Mid-rise Building Types/Configurations
- Maximizing Height & Area

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

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- Context for Mid-Rise Construction
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1430 Q, The HR Group Architects, Buehler Engineering, Greg Folkins Photography

Global Population Boom

Global Population

7.9 billion now

9.7 billion by 2050

33% increase

Urban Population

6.4 billion by 2050

62% increase

Source: United Nations Department of Economic and Social Affairs

Sustainable Multi-Family & Mixed-Use Structures

Economically Meet
Urban Housing Needs

Increase Environmental
Responsibility

These 2 items don't need to be in opposition—
Wood-framing helps them work together!

Sustainable Multi-Family & Mixed-Use Structures

Mid-rise wood-frame construction provides a common ground for both

How?

Mid-Rise Construction

Where **wood** is a viable option,
it's likely the most appropriate choice.

- Senior Living
- Apartments/Condos
- Mixed Use
- Student Housing
- Affordable Housing
- Hotels

The Gibson, Hummel Architects, KPFF Consulting Engineers, photo Leo A. Geis

Why Wood?

Using wood helps reduce environmental impact
Wood products play significant role in modern economy

- Wood Costs Less
- Wood is Versatile
- Wood Meets Code
- Wood is Durable
- Wood is Renewable

Photo courtesy OFRI

The Gibson, Hummel Architects, KPFF Consulting Engineers, photo Leo A. Geis

Urban Infill Development

Case Study | Wood Buildings Aim High

Architect: Withee Malcolm Architects

Engineer: VanDorpe Chou Associates

Developer/Contractor: AvalonBay Communities

Photo credit: Arden Photography

AvalonBay Stadium

Location: Anaheim, CA

251 Apts., 13K sf retail/restaurant

Type III modified

50% of their projects are podium

Semi-balloon framed with 16" Open web trusses at exterior walls

Carbon Case Study | High Density

AvalonBay Stadium- Anaheim, CA

Climate Change Advantage

Volume of wood used:
5,200 cubic meters / 183,600 cubic feet of lumber and sheathing

U.S. and Canadian forests grow this much wood in:
15 minutes

Carbon stored in the wood:
3,970 metric tons of CO_2

Avoided greenhouse gas emissions:
8,440 metric tons of CO_2

TOTAL POTENTIAL CARBON BENEFIT:
12,410 metric tons of CO_2

EQUIVALENT TO:

2,370 cars off the road for a year

Energy to operate a home for 1,050 years

Source: US EPA

For information on the calculations in this chart, visit woodworks.org
Note: CO_2 on this chart refers to CO_2 equivalent.

Outline

- Context for Mid-Rise Construction
- **Mid-rise Building Types/Configurations**
- Maximizing Height & Area

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

Seattle, WA

Photo: Matt Todd/PB Architects

College Park , MD

Photo: Matt Church

Normal, IL

Image: OKW Architects

Los Angeles, CA

Photo: Lawrence Anderson/Esto

Atlanta, GA

Image: Lord Aeck Sargent

Wood Mid-Rise Construction

How many stories can be wood framed in the IBC?

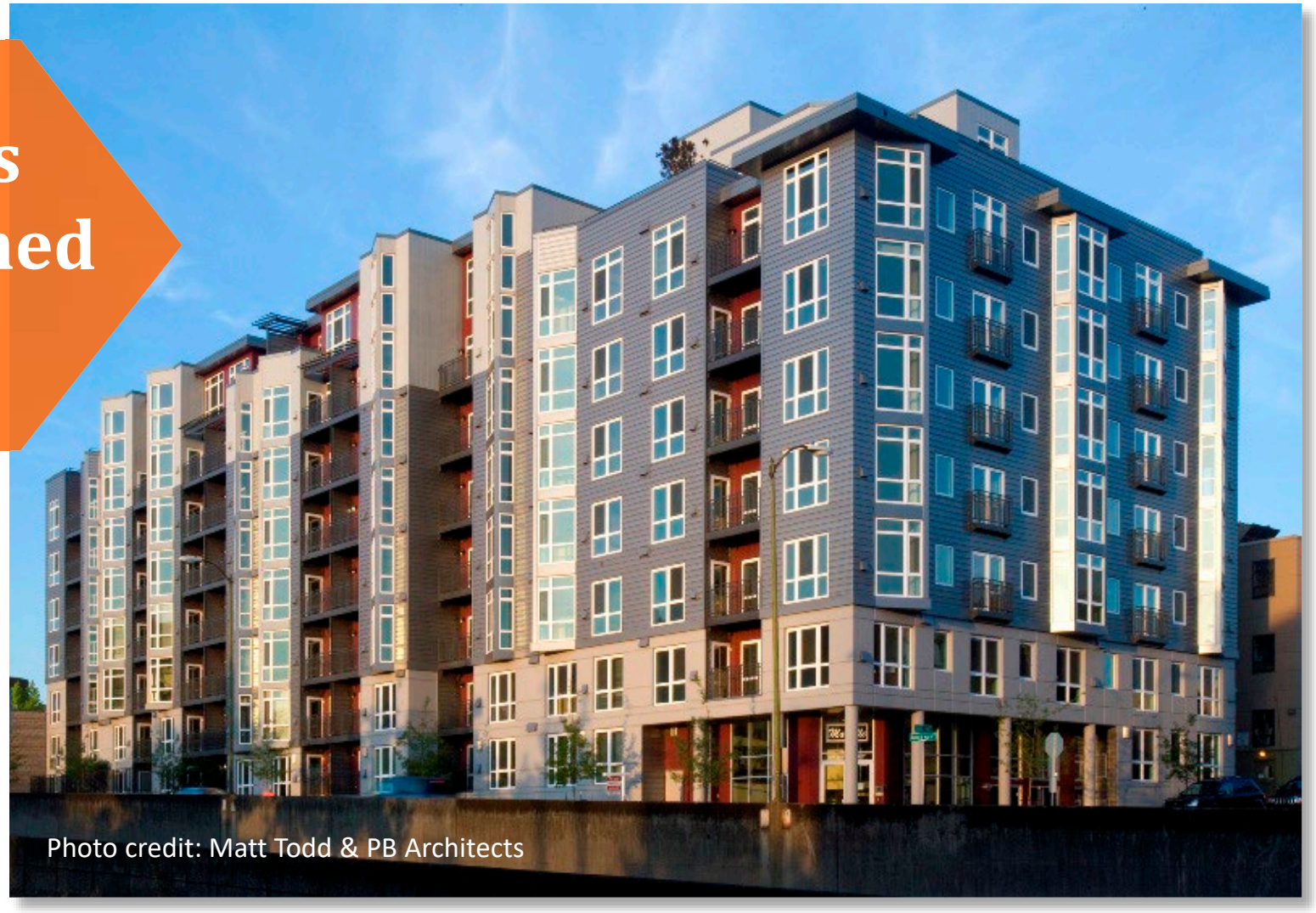


Photo credit: Matt Todd & PB Architects

Wood Mid-Rise Construction

6 stories for Offices,
5 stories for Residential
+ Mezzanine
+ Multi-Story Podium

Photo credit: Matt Todd & PB Architects

Mid-Rise vs. High-Rise Definition – IBC 202

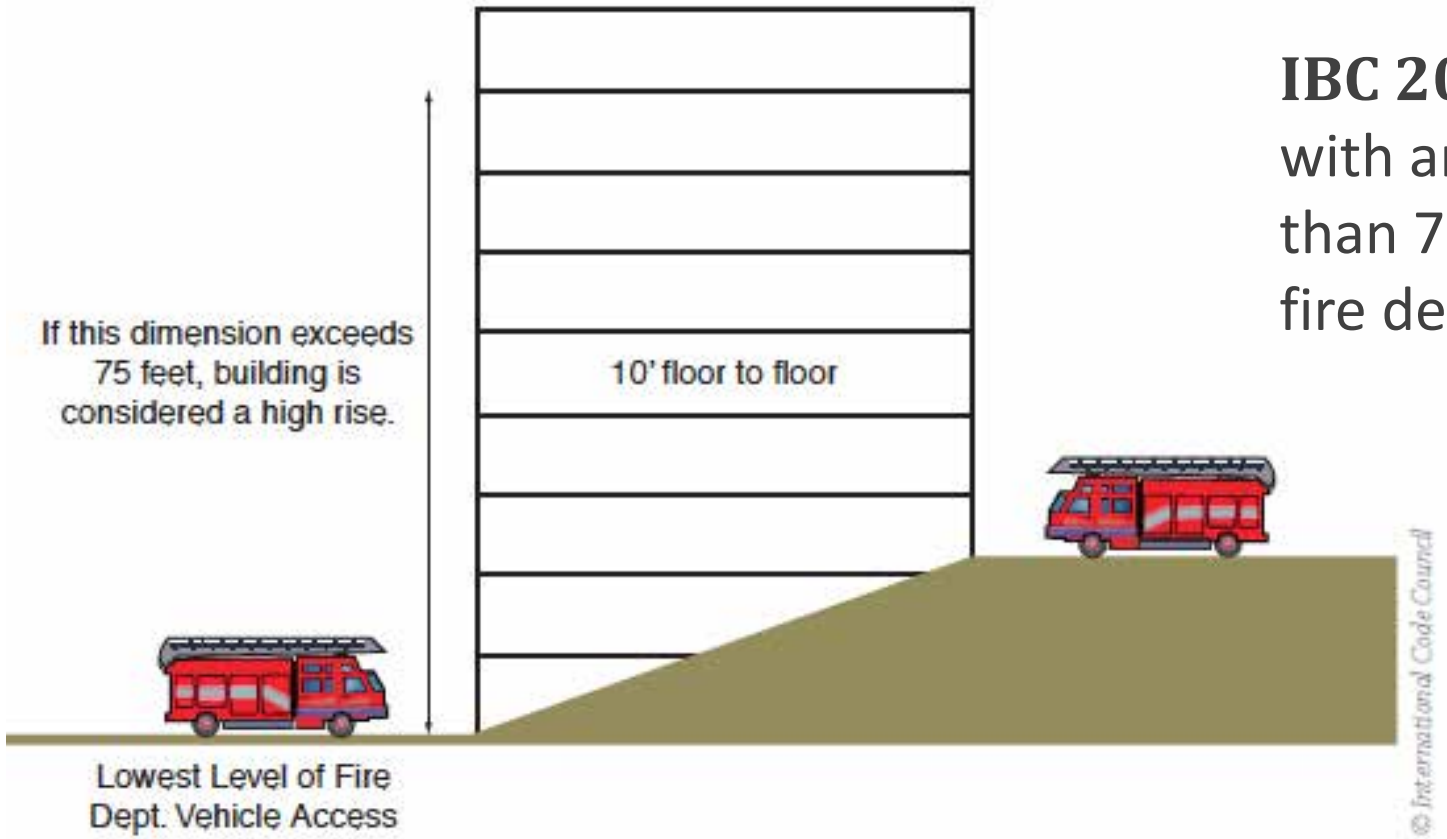


FIGURE 6-6 Determination of high-rise building

IBC 202: High-Rise Building: A building with an occupied floor located more than 75 feet above the lowest level of fire department vehicle access.

Walk-up / Tuck Under

First floor walk up units with private garage

Benefits:

- Eliminates need for S-2 parking garage
- Can be all wood
- Least expensive overall but lowest densification rates (20-30 unites/acre)

Wrap-Around

Walk up units surround parking structure

Benefits:

- Enhanced security
- Centralized access to parking
- Visual appeal from street
- More expensive than walk/up tuck-under
- 5 story yields 60-80 units/acre

Podium

Multiple stories of wood over an elevated concrete deck

Benefits:

- Increased number of stories
- Accommodates Mixed-use occupancies
- Most expensive but can allow increased density

Podium

4 stories of residential over podium (parking or retail)

- 60–80 units/acre

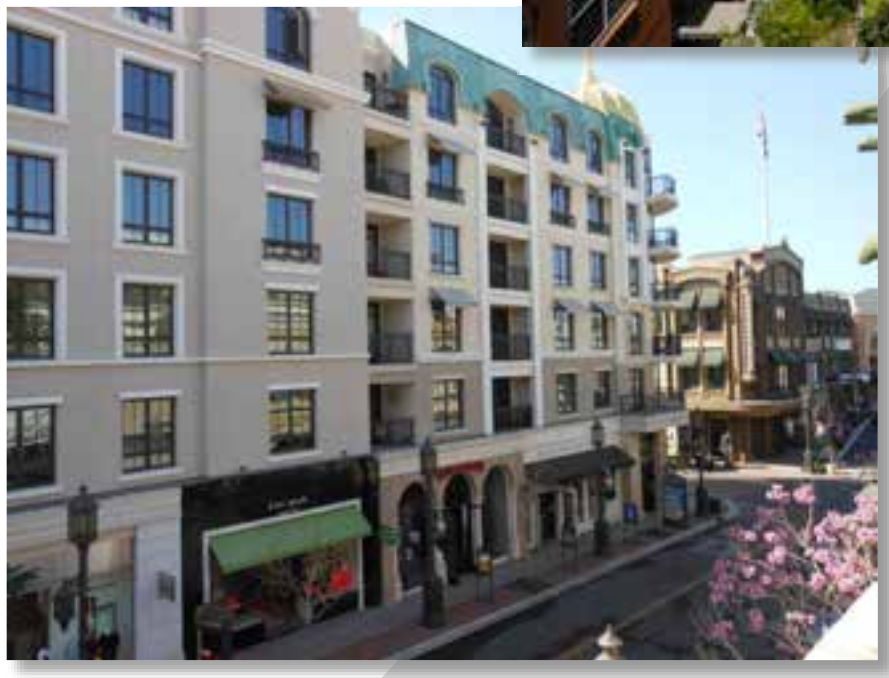
Inman Park Condos, Atlanta, GA
Davis & Church

Podium

5 stories over retail

» 100–120 units/acre

AvalonBay Stadium, Anaheim, CA
VanDorpe Chou Associates



Inman Park Condos, Atlanta, GA
Davis & Church

Podium

5 stories over residential podium

» 120–140 units/acre

16 Powerhouse, Sacramento, CA
D&S Development
LPA Sacramento

Mezzanine & Podium

5 stories with mezzanine + residential podium

» 125–145 units/acre

120 Union, San Diego, CA
Togawa Smith Martin

Outline

- » Context for Mid-Rise Construction
- » Mid-rise Building Types/Configurations
- Maximizing Height & Area
  1. Construction Types
  2. Tabulate Areas & Stories
  3. Allowable increases
  4. Mezzanine & Special Design Provisions

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

Typical Mid-rise Occupancy

Hotels (R-1)

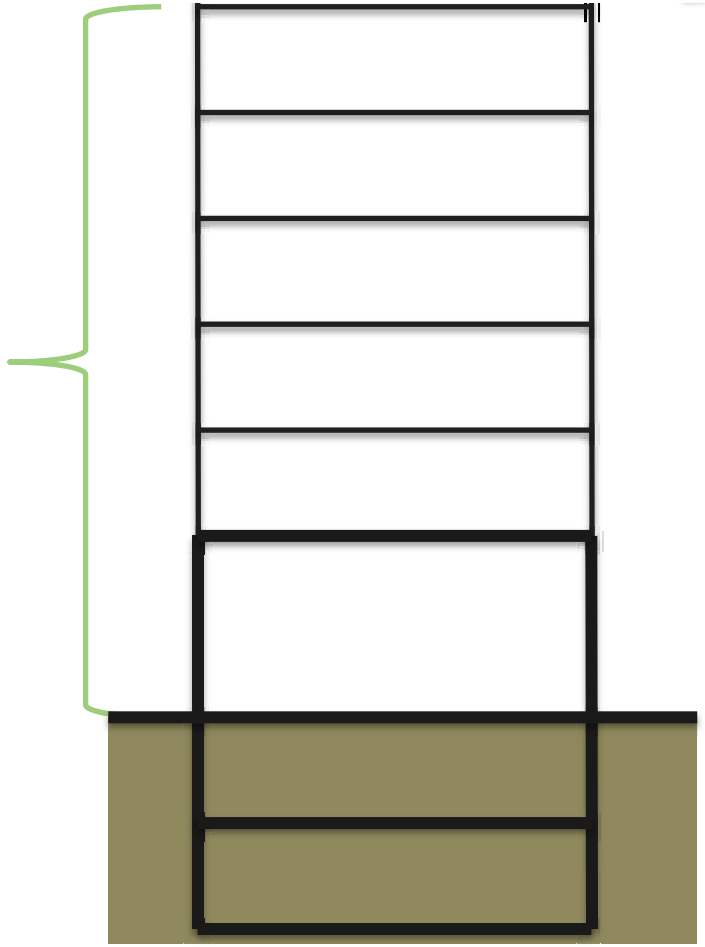
Apartments (R-2)

Condominiums (R-2)

Student housing (R-2)

Live/work units (R-2)

Assisted living (R-4)



(A-2) Restaurants/cafeterias

(A-3) Workout facilities

(A-3) Meeting rooms

(B)Offices

Nursing homes (I-2)

(M) Shops

(S-2/U) Parking

(S-1) Storage

Mid-Rise Construction Types

Type III

- Exterior walls non-combustible (may be FRTW)
- Interior elements any allowed by code

Type V

- All building elements are any allowed by code

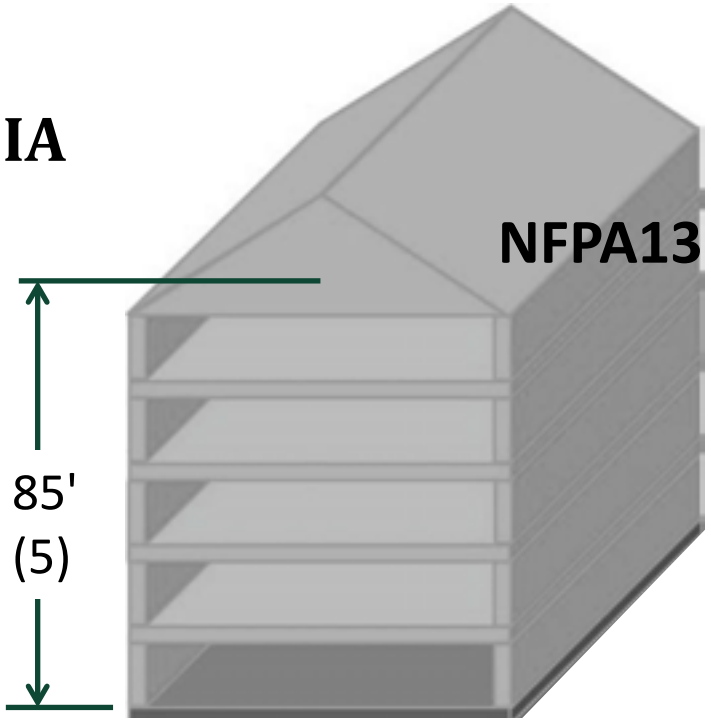
Types III and V can be subdivided to A (protected) or B (unprotected)

Type IV (Heavy Timber)

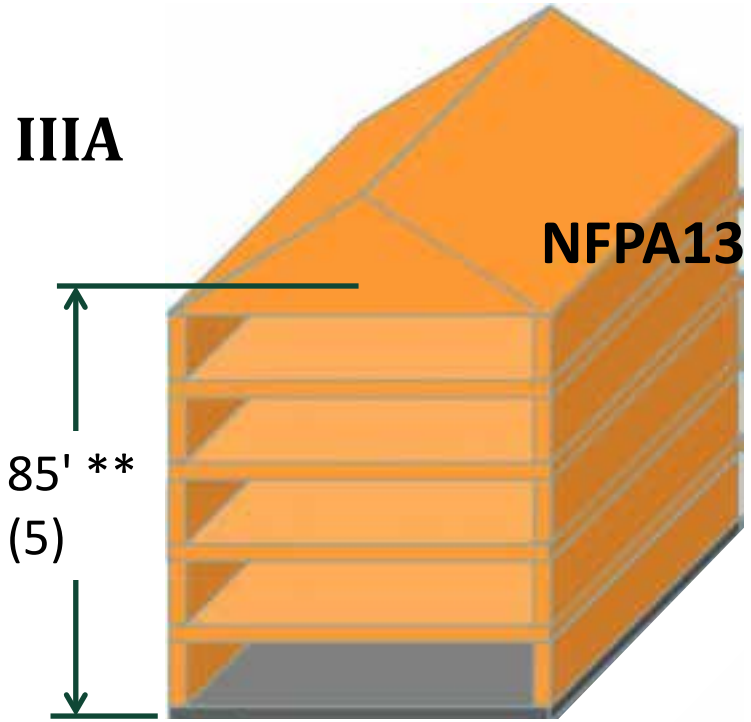
- Exterior walls non-combustible (may be FRTW)
- Interior elements qualify as Heavy Timber

Increased Height & Story Area

Type IIA



Type IIIA



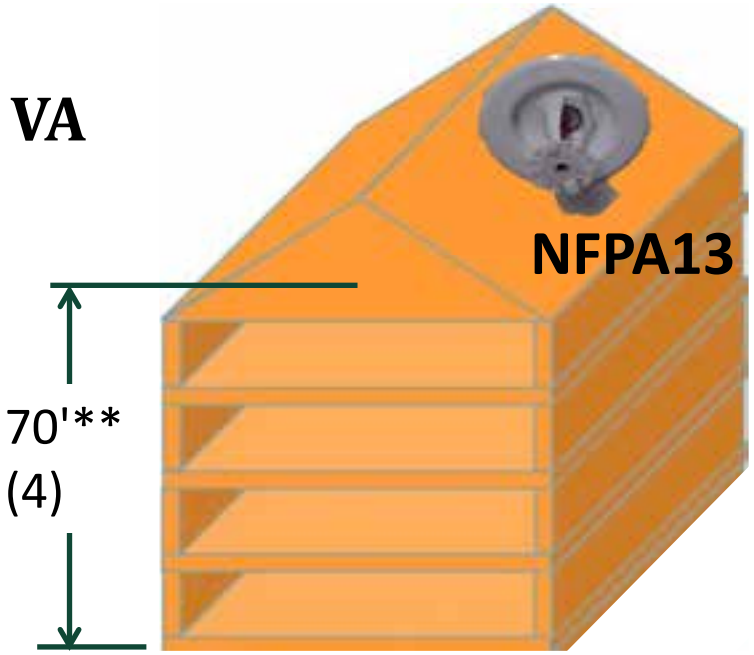
Occupancy	IIA (ft^2)*	IIIA (ft^2)*
R-1	72,000 +18,000 (max frontage)	72,000 +18,000 (max frontage)
R-2	72,000 +18,000 (max frontage)	72,000 +18,000 (max frontage)

* Areas reflect PER STORY max. Total building max may limit area further.

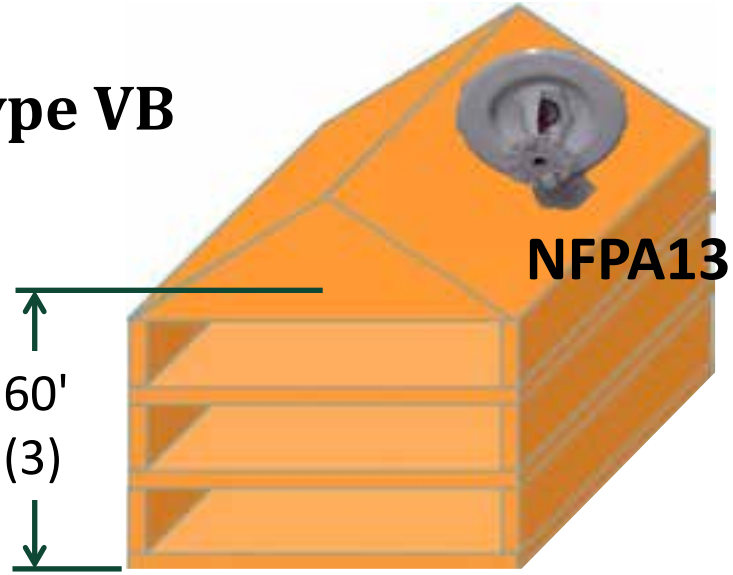
** ASCE7 12.2-1 limits wood shear wall seismic systems to 65' in height in SDC D,E,F

Opportunity for Residential Occupancy (R)

Type VA



Type VB



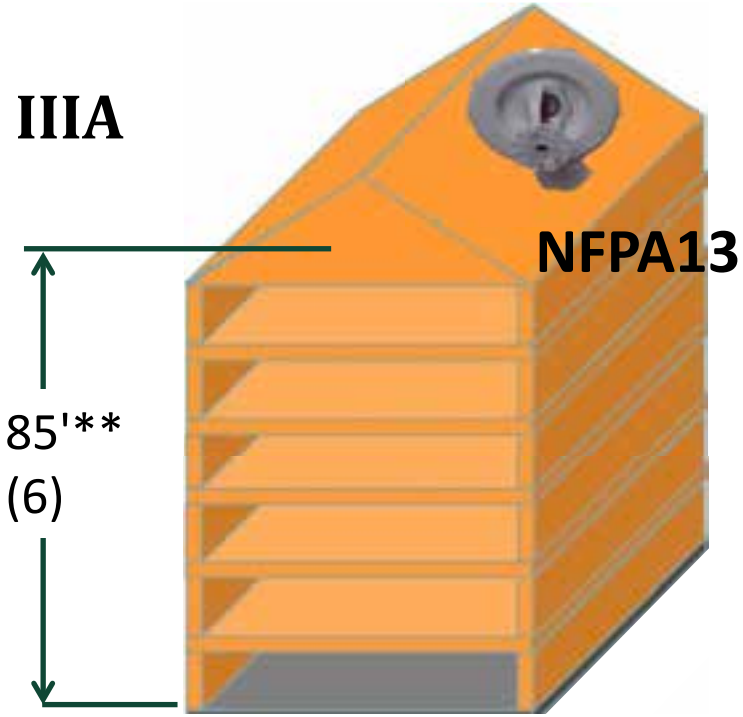
Occupancy	VA (ft^2)*	VB (ft^2)
R-1	36,000 +9,000(max frontage)	21,000 +5,250(max frontage)
R-2	36,000 +9,000(max frontage)	21,000 +5,250(max frontage)

* Areas reflect PER STORY max. Total building max may limit area further.

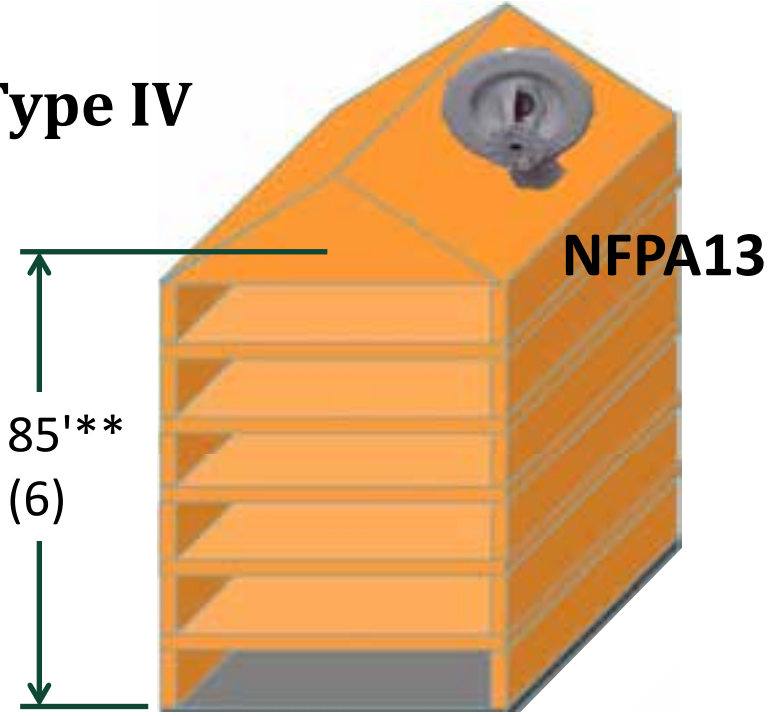
** ASCE7 12.2-1 limits wood shear wall seismic systems to 65' in height in SDC D,E,F

Opportunity for Office Occupancy (B)

Type IIIA



Type IV



Occupancy	IIIA (ft^2)*	IV (ft^2)*
B	85,500 +21,375(max frontage)	108,000 +27,000(max frontage)

* Areas reflect PER STORY max. Total building max may limit area further.

** ASCE7 12.2-1 limits wood shear wall seismic systems to 65' in height in SDC D,E,F

Height – 2018 IBC Table 504.3

- **IBC 2018:** Table 504.3 provides base & increased heights

TABLE 504.3[a]
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A, B, E, F, M, S, U	NS[b]	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
R	NS[d, h]	UL	160	65	55	65	55	65	50	40
	S13R	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	85	70	60

NS = Buildings not equipped throughout with an automatic sprinkler system

S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 (NFPA 13)

S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2 (NFPA 13R)

S13D (not shown) = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3 (NFPA 13D)

Stories – 2018 IBC Table 504.4

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A-2	NS	UL	11	3	2	3	2	3	2	1
	S	UL	12	4	3	4	3	4	3	2
A-3	NS	UL	11	3	2	3	2	3	2	1
	S	UL	12	4	3	4	3	4	3	2
B	NS	UL	11	5	3	5	3	5	3	2
	S	UL	12	6	4	6	4	6	4	3
R-1	NS[d, h]	UL	11	4	4	4	4	4	3	2
	S13R	4	4						4	3
	S	UL	12	5	5	5	5	5	4	3
R-2	NS[d, h]	UL	11	4	4	4	4	4	3	2
	S13R	4	4	4					4	3
	S	UL	12	5	5	5	5	5	4	3
S-1	NS	UL	11	4	2	3	2	4	3	1
	S	UL	12	5	3	4	3	5	4	2

Sloped Sites

Fashion Valley, CA
AvalonBay Communities

Seattle, WA
PB Architects

Sloped Sites – Chapter 2 Definitions

HEIGHT, BUILDING. The vertical distance from *grade plane* to the average height of the highest roof surface.

GRADE PLANE. A reference plane representing the average of finished ground level adjoining the building at *exterior walls*. Where the finished ground level slopes away from the *exterior walls*, the reference plane shall be established by the lowest points within the area between the building and the *lot line* or, where the *lot line* is more than 6 feet (1829 mm) from the building, between the building and a point 6 feet (1829 mm) from the building.

626 Dekalb Avenue, Atlanta, GA
Matt Church - Davis Church Structural Engineers

Basements – 2018 IBC 506.1.3

A basement is not included in the total allowable building area if it doesn't exceed the area permitted for a building with no more than one story above grade plane.

"Basement" is defined as "not a story above grade plane" and has a finished floor surface:

- Less than 6 feet above grade plane; or
- Less than 12 feet above the finished ground level at any point

Fashion Valley, CA
AvalonBay Communities

Summary of Building Heights

Building Heights and Stories by Building Type With NFPA 13 Sprinklers				
Occupancy	IIIA	IIIB	VA	VB
	85 ft	75 ft	70 ft	60 ft
R-1/R-2/R-4	5	5	4	3
A-2/A-3	4	3	3	2
B	6	4	4	3
M	5	3	4	2
S-2	5	4	5	3
S-1	4	3	4	2

**ASCE7 12.2-1 limits wood shear wall seismic systems to 65’ in height in SDC D,E,F

Area Increases – IBC 2018

TABLE 506.2[a, b]
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, or SM, as applicable) IN SQUARE FEET

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
R-1	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
	S13R									
	S1	UL	UL	96,000	64,000	96,000	64,000	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	61,500	36,000	21,000

**Can still increase these areas by the Frontage Factor of Section 506.3

NS = Buildings not equipped throughout with an automatic sprinkler system

S1 = Buildings a maximum of one story above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 (NFPA 13)

SM = Buildings two or more stories above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 (NFPA 13)

S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2 (NFPA 13R)

Sprinkler Systems: 2018 IBC 903.2

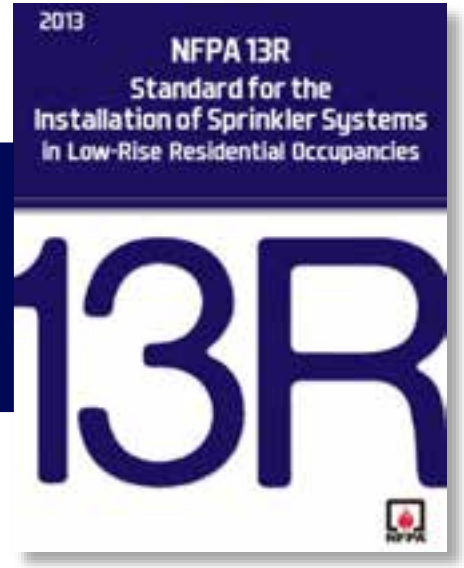
In some cases, sprinklers are required by code depending on occupancy

- Most new Group R fire areas
- Group A, E, M, S-1, I fire areas exceeding 1-12k sf

Stella Apartments, DesignARC, Taylor and Syfan, photo Lawrence Anderson

Commercial Sprinkler Systems – IBC 903.3.1

- NFPA 13
  Standard for Commercial Construction 903.3.1.1
- NFPA 13R
  Residential Occupancies (One- and Two-Family or Low-Rise Multi-Family and Commercial) 903.3.1.2
- NFPA 13D
  Standard for One- and Two-Family Residences (but allowed in a few commercial occupancies) 903.3.1.3



NFPA 13 vs. NFPA 13R

NFPA 13	NFPA 13R
Goal: Provide life safety and property protection	Goal: Provide life safety only
Fully sprinklered system throughout entire building even in unoccupied spaces (closets, attics)	Partially sprinklered system; unoccupied spaces often don't require sprinklers
Can cost more	Lower levels of water discharge, shorter water supply time can result in smaller pipe sizes, reduce need for storage & pumps
Permitted for many occupancies, buildings of many sizes, allows greater building size increases	Limited applications, mainly for multi-family up to 4 stories, 60 feet

Single Occupancy, 1 Story – 506.2.3

$$A_a = A_t + [NS \times I_f]$$

(Equation 5-1)

A_a = Allowable area per story (sq. ft.)

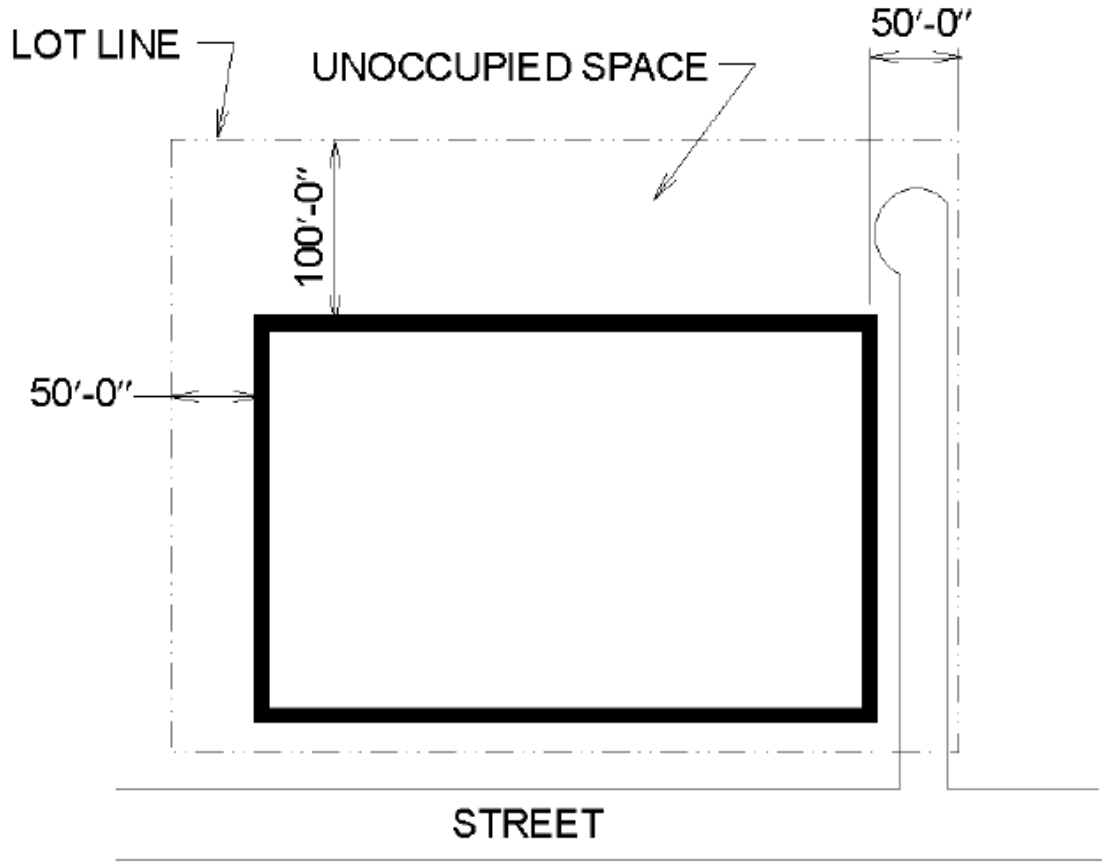
A_t = Tabular allowable area per story per Table 506.2 for NS, S1 or S13R (sq. ft.)

NS = Tabular allowable area per story per Table 506.2 for non-sprinklered building (sprinklered or not)

I_f = Area increase factor due to frontage per 506.3
$I_{f,\ max} = 0.75$

Area Modification – Frontage IBC 506.3

The allowable area of a building is permitted to be increased when it has a certain amount of frontage on streets (public ways) or open spaces, since this provides access to the structure by fire service personnel, a temporary refuge area for occupants as they leave the building in a fire emergency and a reduced exposure to and from adjacent structures.



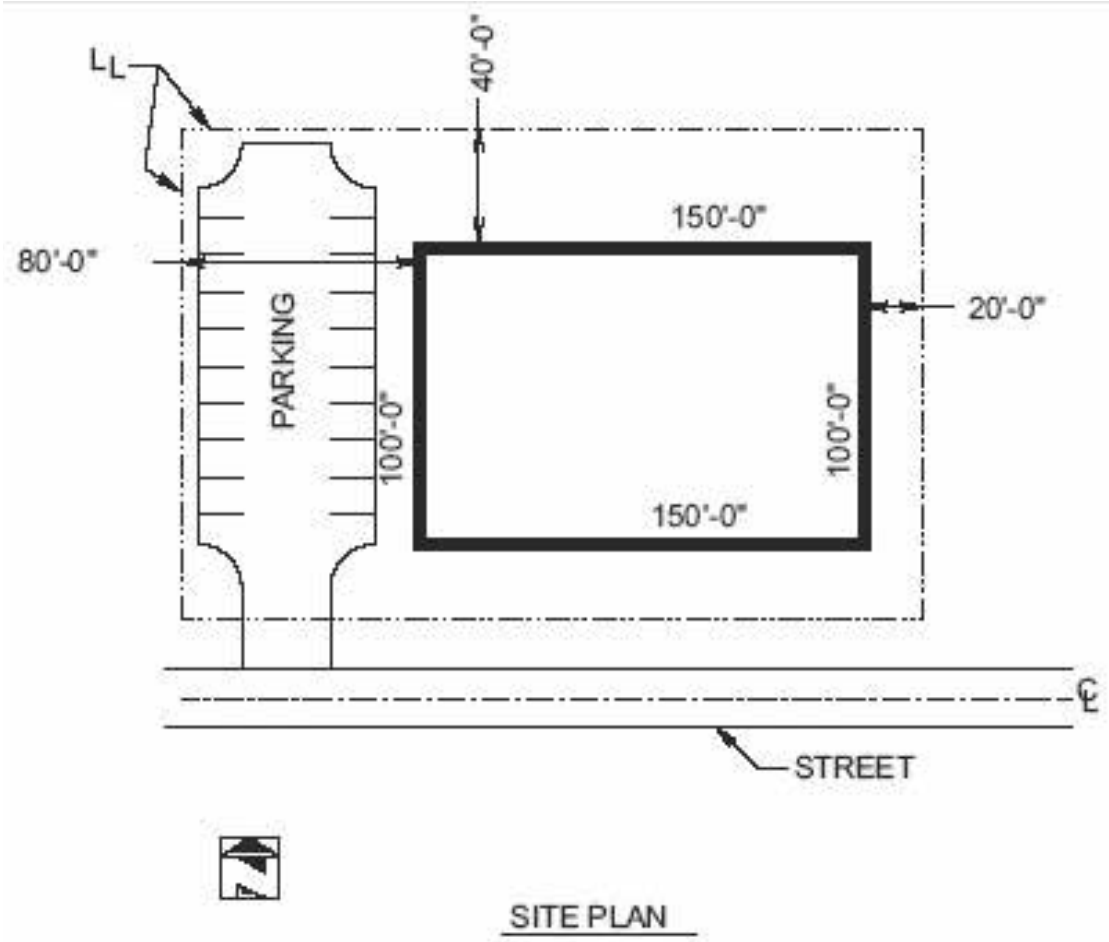
Frontage Increases – IBC 506.3.3

$$I_f = [F/P - 0.25]W/30$$

(IBC Equation 5-5)

WHERE:

- I_f = Area increase due to frontage
- F = Building perimeter that fronts on a public way or open space having 20 feet open minimum width
- P = Perimeter of entire building
- W = Width of public way or open space (feet) in accordance with section 506.3.2



Area Modification – Frontage IBC 506.3

MINIMUM QUALIFICATIONS

25% min of building perimeter is on a public way or open space 20' min distance from building face to:

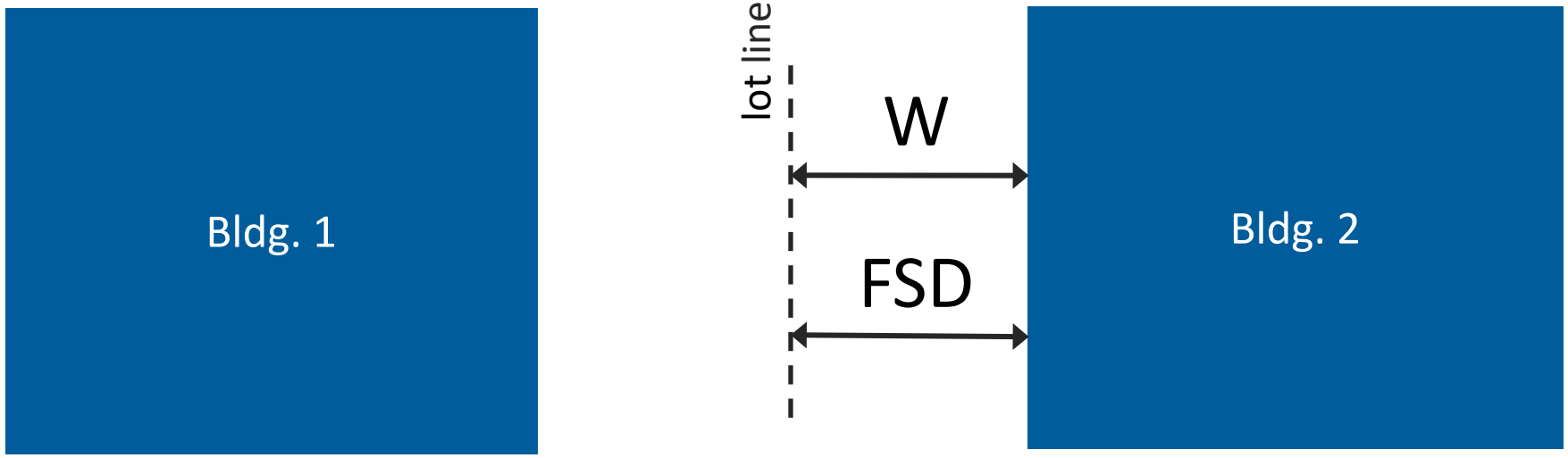
- Closest interior lot line
- Entire width of public way
- Exterior face of adjacent building

Frontage Increases – IBC 506.3.2

"W" for area increases is NOT always the same as Fire Separation Distance for purposes of fire resistance ratings of walls and openings

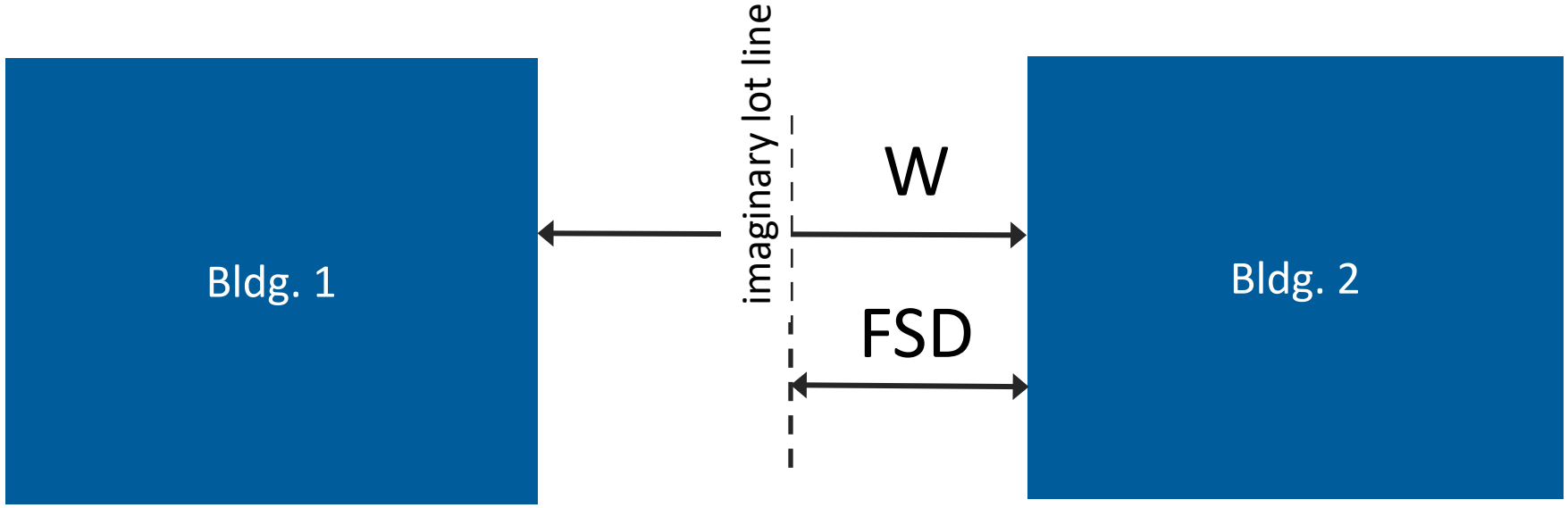
Frontage Increases – IBC 506.3.2

For two buildings on DIFFERENT lots



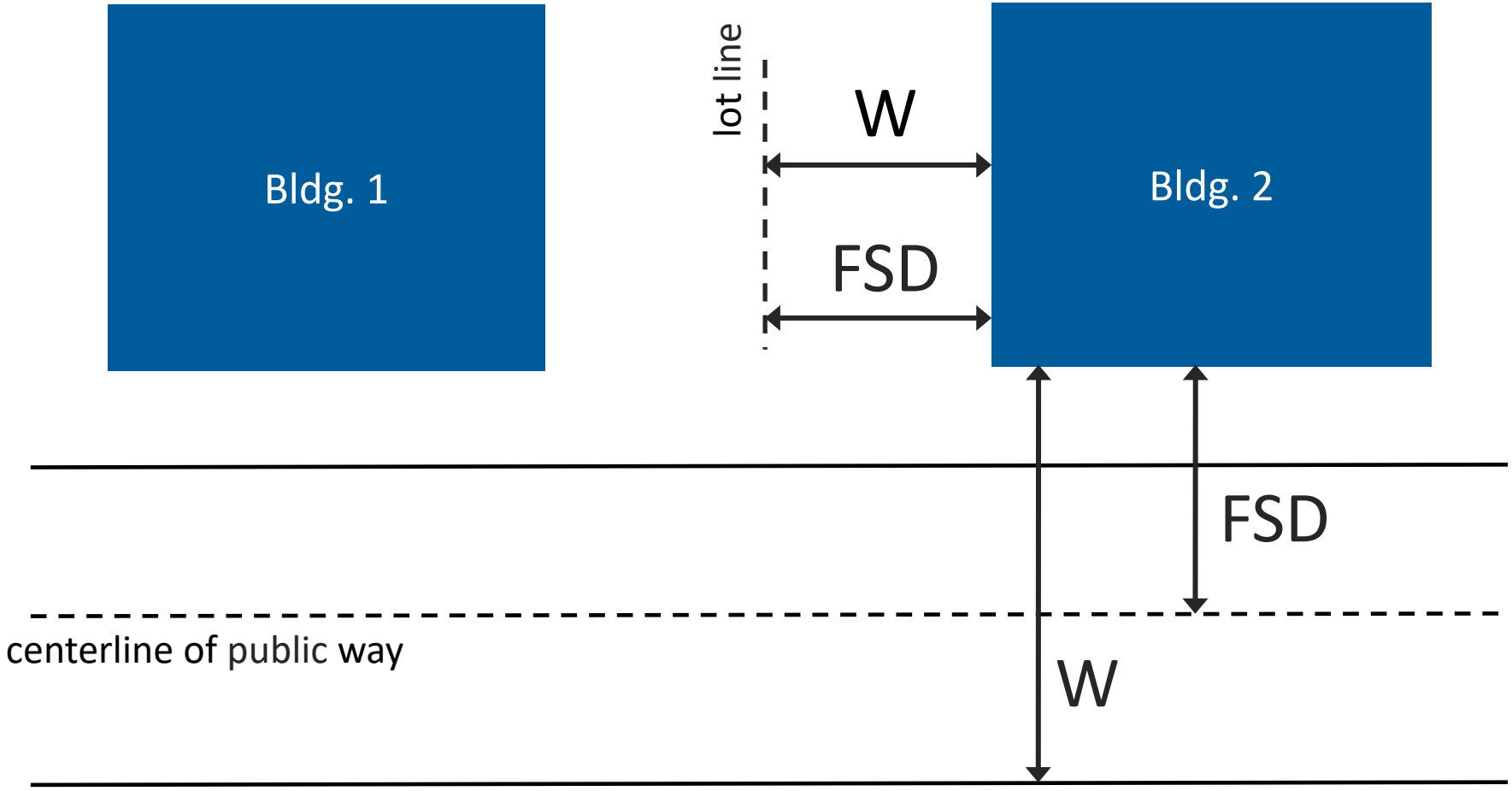
Frontage Increases – IBC 506.3.2

For two buildings on the SAME lots



Frontage Increases – IBC 506.3.2

Buildings near public right of ways:



Frontage Increases – IBC 506.3.3

$$W = [(L_1 \times w_1) + (L_2 \times w_2) + (L_3 \times w_3)....]/F$$

(IBC Equation 5-4)

WHERE:

W = Calculated Width (weighted average) of public way or open space (feet)

$\mathbf{L_n}$ = Length of a portion of the exterior perimeter wall

$\mathbf{w_n}$ = Width (≥ 20 ft) of public way or open space associated with that portion of the exterior perimeter wall

F = Building perimeter that fronts on a public way or open space having 20 feet open minimum width

Total Building Area – 2018 IBC 506.2.3

$$A_a = [A_t + (NS \times I_f)] \times S_a$$

(Equation 5-2)

A_a = Allowable area per story (sq. ft.)

A_t = Tabular allowable area per story per Table 506.2 for NS, S1 or S13R (sq. ft.)

NS = Tabular allowable area per story per Table 506.2 for non-sprinklered building (sprinklered or not)

I_f = Area increase factor due to frontage per 506.3
I_f, max = 0.75

S_a = Actual number of building stories above grade

$S_{a,\ max}$ = 3 for non-sprinklered buildings and those w/ NFPA13

$S_{a,\ max}$ = 4 for buildings w/ NFPA 13R

Total Building Area – 2018 IBC 506.2.3

1 story building

» Total Area is 1x A_a

R-2
S13R

24K

R-2
SM

96K

Total Building Area – 2018 IBC 506.2.3

2 story building

- Total Area is 2x A_a

Total Building Area – 2018 IBC 506.2.3

3 story building

- Total Area is 3x A_a
- Frontage Increase is included in A_a

R-2
S13R + I_f (NS)

24K +	.75(24K)
24K +	.75(24K)
24K +	.75(24K)

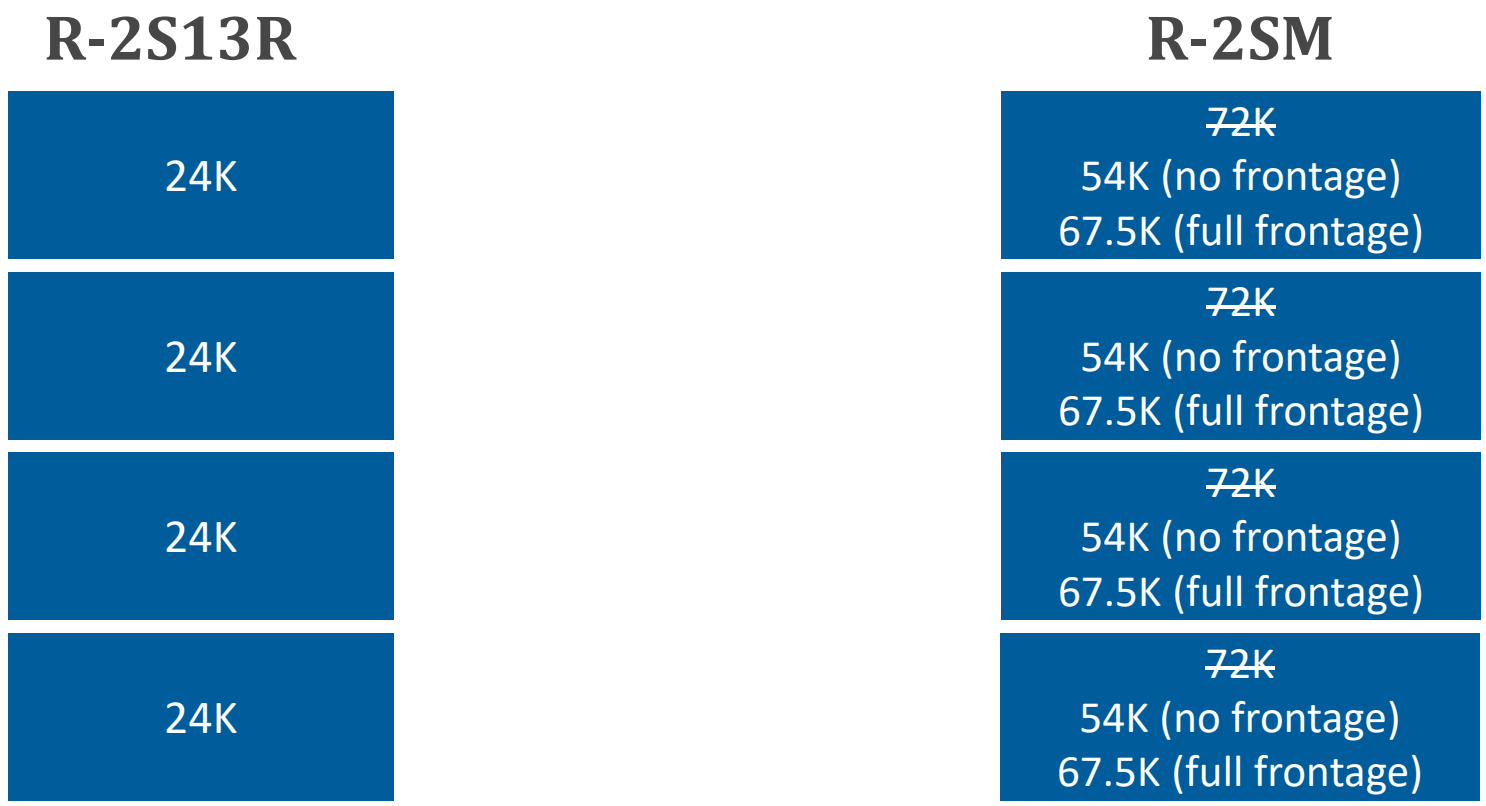
R-2
SM + I_f (NS)

72K +	.75(24K)
72K +	.75(24K)
72K +	.75(24K)

Total Building Area – 2018 IBC 506.2.3

4 story IIIA building

- Total Area is 3x A_a for NFPA 13
- Total area is 4x A_a for NFPA 13R



Mixed Occupancy, Multi-story

Story Area: $\Sigma[A_t + (NS \times I_f)]/A_a \leq 1$

(Described in 508.4.2)

Total Building Area: $\Sigma[A_t + (NS \times I_f)]/A_a \leq S_a$

(Described in 506.2.4)

A_a = Allowable area per story (sq. ft.)

A_t = Tabular allowable area per story per Table 506.2 for NS, S1 or S13R (sq. ft.)

NS = Tabular allowable area per story per Table 506.2 for non-sprinklered building (sprinklered or not)

I_f = Area increase factor due to frontage per 506.3
I_f, max = 0.75

S_a = Actual number of building stories above grade

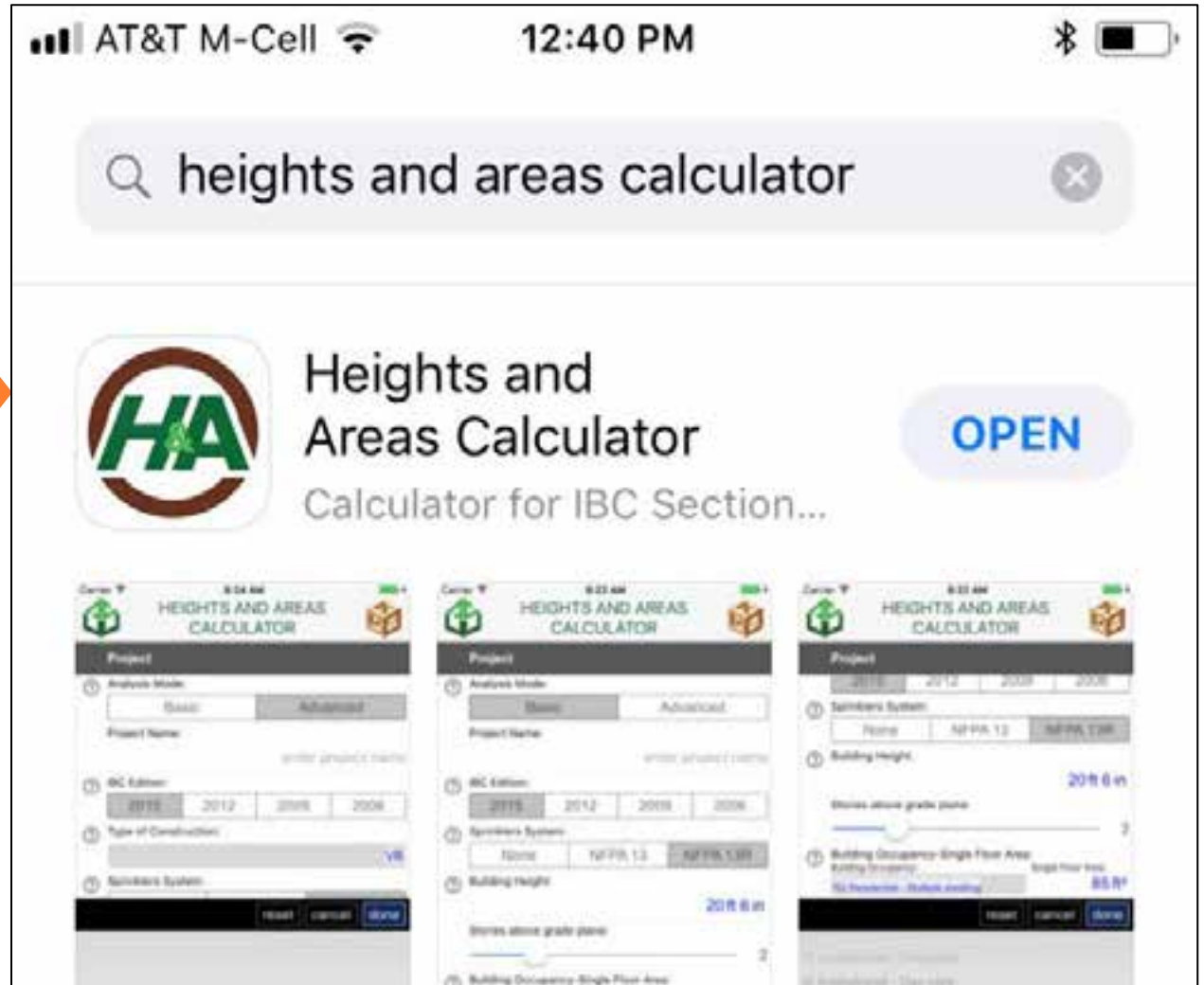
$S_{a,\ max}$ = 3 for non-sprinklered buildings and those w/ NFPA13

$S_{a,\ max}$ = 4 for buildings w/ NFPA 13R

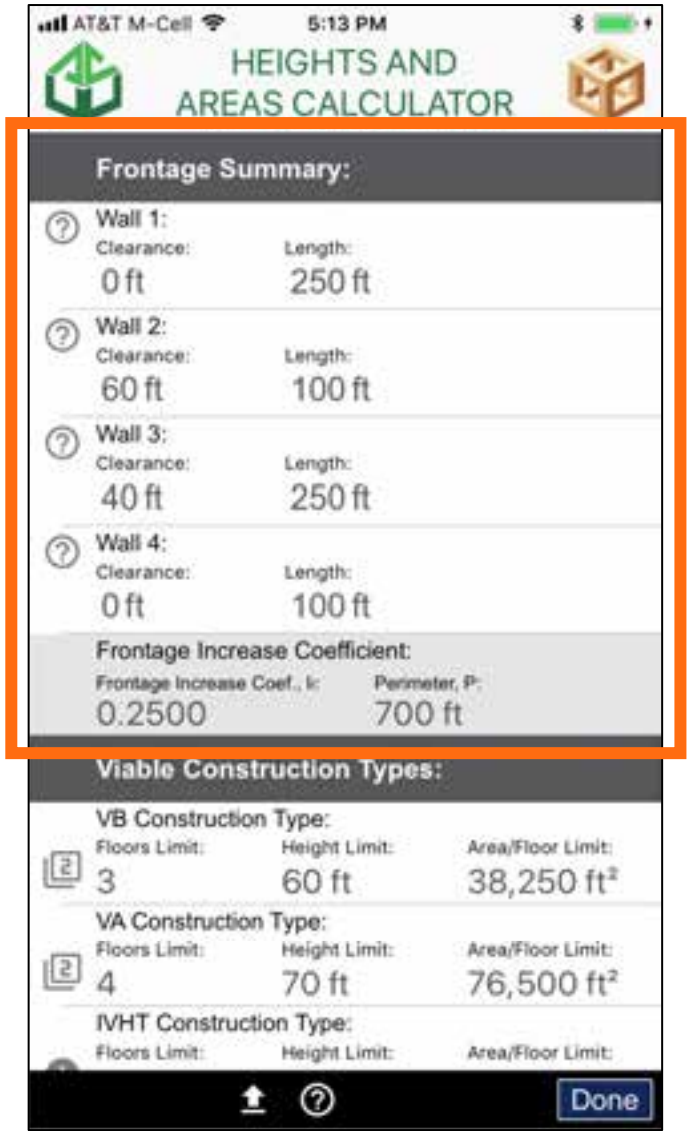
Mixed Use Occupancy – Design Aid

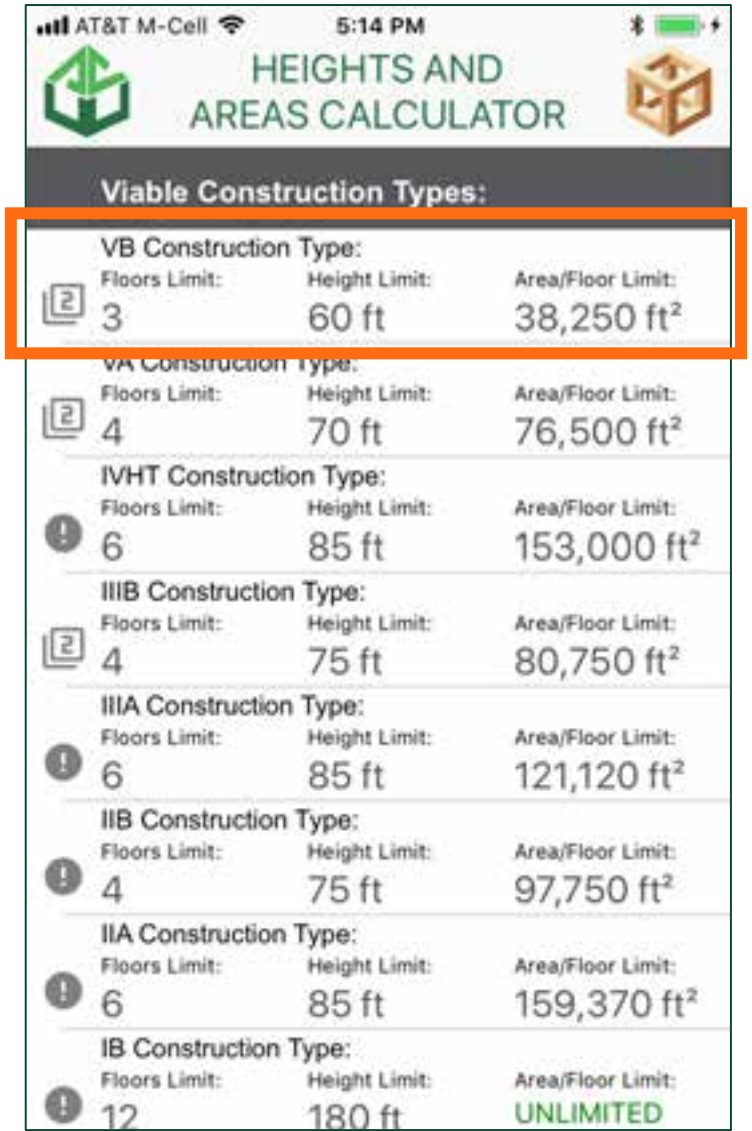
WoodWorks/AWC Heights & Areas Calculator App

Based on 2015 IBC
Available for FREE at
woodworks.org



Frontage Calculation – Design Aid





Case Study Innovations in Wood

Emory Point Atlanta, GA

- 3 buildings complete – Luxury Apt., retail, restaurants
- (1) 5 story Type III wood frame over slab on grade
- (2) 4 stories of wood over 1 story concrete podium

35% Structure Savings

- $14/sf (wood concept)
- $22/sf (PT conc. Slab and frame)

Architect: Cooper Carry, The Preston Partnership

Engineer: Ellinwood + Machado, Pruitt Eberly Stone

Contractor: Fortune-John

Photo credit: Gables Residential

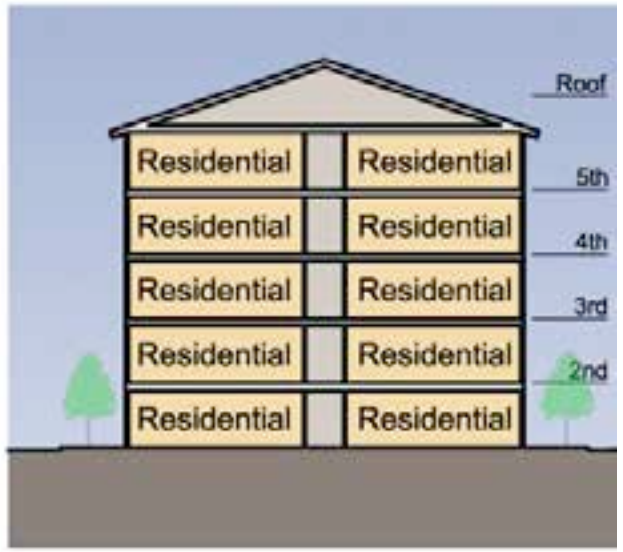
Mezzanines – 2018 IBC 505

Not counted toward building area* or number of stories if:

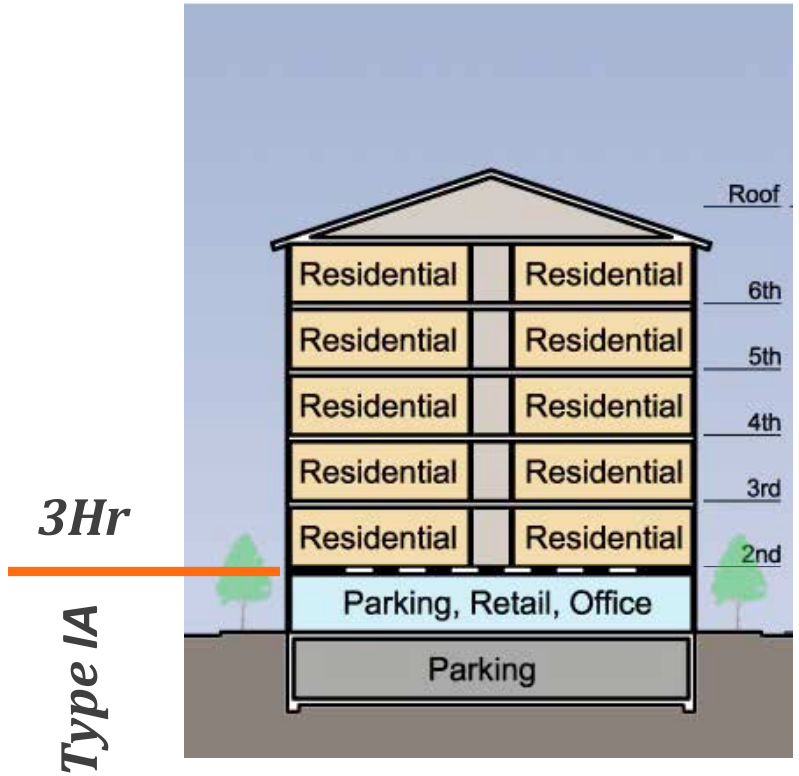
- Maximum 1/3 floor area of *room* or *space* where located
- Special egress provisions apply
- Must be open and unobstructed to room in which it's located (walls ≤ 42" allowed)
  - Several exceptions
- Slightly different for equipment platforms

*Does count toward fire area with regard to fire protection in Chapter 9

IBC Podium Provisions



5 story Type III Building



5 story Type III Building
On Top of a Type IA Podium

Special Provisions for Podiums in IBC 510.2
Increases allowable stories… not allowable building height

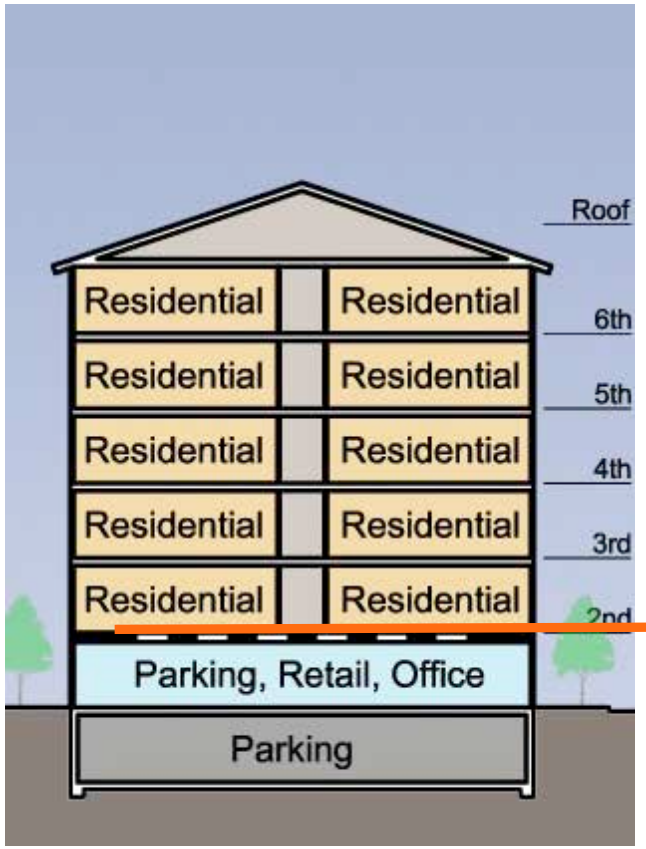
Horizontal Building Separation – 510.2

Considered separate buildings above and below for purposes of area calculations if:

- Overall height is still limited to min of either building
- 3hr rated horizontal assembly
- Building below is Type 1A with sprinklers
- Enclosures penetrating horizontal assembly are 2hr rated
- Occupancy above is A (occupant load <300), B, M, R or S
- Occupancy below is any except H

The Flats at ISU, Normal, IL
OKW Architects
Precision Builders & Associates

Evolution of IBC Mixed-Use Podium



3Hr

Type IA

IBC	2006	2009	2012	2015	2018
Section	509.2	509.2	510.2	510.2	510.2
Upper Occupancy	A, B, M, R or S				
Lower Occupancy	S-2 Parking	A, B, M, R or S-2 Parking		Any Except H	
Podium Height	1 Story			No Restriction	

IBC Provisions for mixed-use podiums have been evolving.

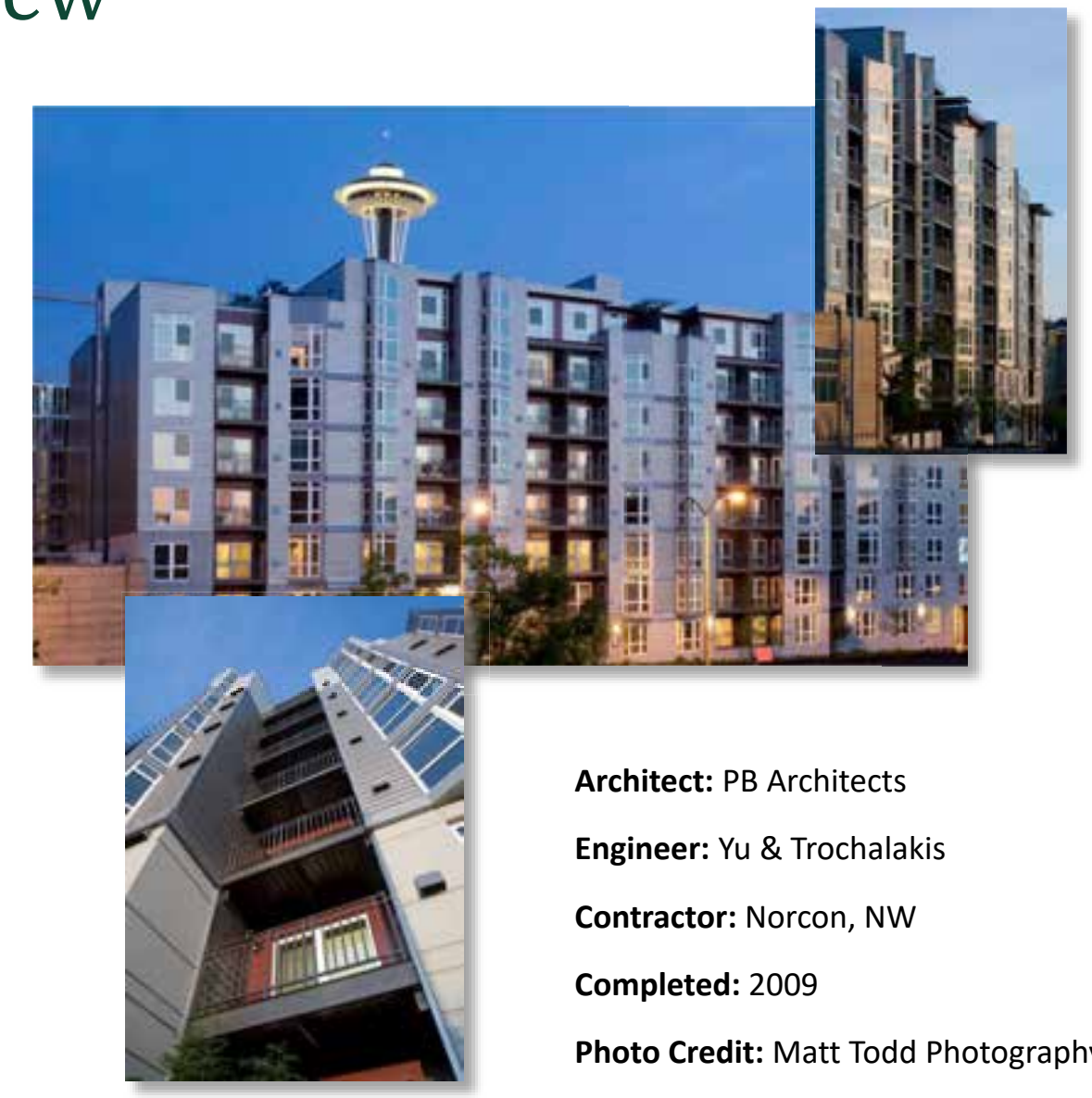
Starting in 2015, IBC allows multiple podium stories above grade.

Case Study Maximizing View and Value With Wood

Marselle Condominiums

Seattle, WA

- Type IIIA condo complex
- 5 -1/2 stories of wood over 2 stories of concrete
- Mezzanine added $250K cost but $1M in value
- 30% cost saving over concrete
- Time savings over steel



Architect: PB Architects

Engineer: Yu & Trochalakis

Contractor: Norcon, NW

Completed: 2009

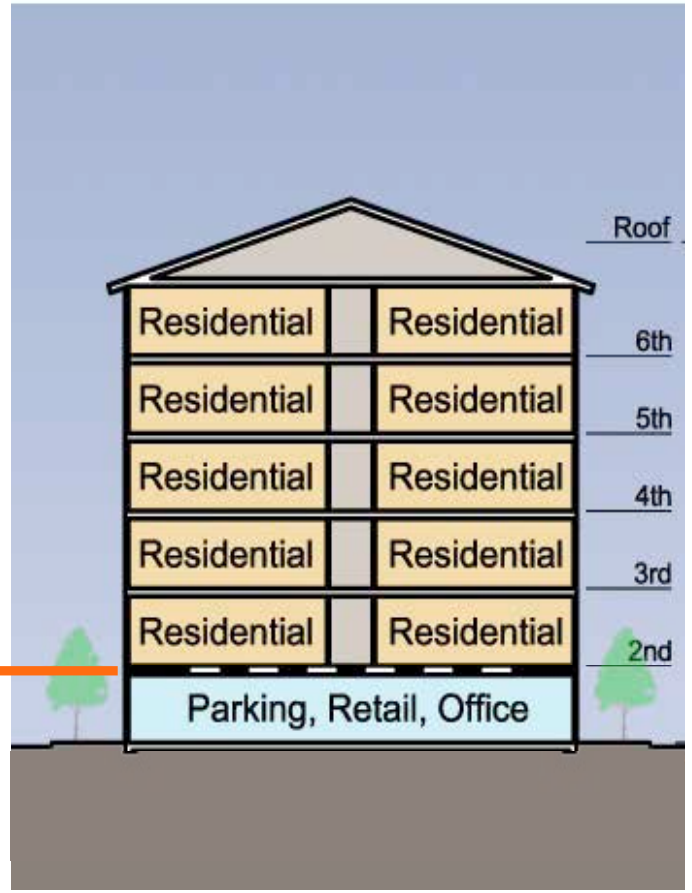
Photo Credit: Matt Todd Photography

Parking Beneath Group R – IBC 510.4

Possibility of a Type IV podium where number of stories starts above parking when:

- Occupancy above is R and below is S-2
- Lower floor is open Type IV parking with grade entrance
- Horizontal assembly between 1st and 2nd floor shall be:
  - Type IV
  - Have 1 hr fire resistance rating when sprinklered
  - Have 2 hr fire resistance rating when not sprinklered
- Overall height is still limited to occupancy

http://www.woodworks.org/experttip/can-parking-incorporated-mixed-use-wood-frame-buildings-construction-type-perspective/



5 story Type III Building On Top of a Type IV

Horizontal Separation

SEAOC 2012 CONVENTION PROCEEDINGS

All-wood Podiums in Mid-rise Construction

Michelle Kam-Biron, S.E.
WoodWorks
Newbury Park, CA

Karyn Beebe, P.E., LEED AP
APA
San Diego, CA

Abstract

Concern for the environment and climate change as well as the economic downturn of the past few years have created a demand for sustainable multi-family housing. According to the Washington, D.C.-based National Association of Home Builders Multifamily Production Index (MPI), a leading indicator for the multi-family market, the apartment and condominium housing market has shown steady improvement for six consecutive quarters. However, today's economic and environmental realities have led the building industry to re-evaluate the way we design and build multi-story buildings.

Mid-rise podium construction, consisting of two to four stories of wood framing above a concrete first story (the "podium") and often incorporating additional subterranean concrete levels, is common throughout North America and in levels of residential units built on top of one or two levels of parking or other non-residential occupancies below. In this paper, we are defining wood podium as the level (or transfer level) between the two or more stories of wood-framed residential occupancy and the lower non-residential occupancy which is traditionally constructed of concrete. In an article titled, "What to Build Now," by Michael Russo, Dan Withee, AIA, LEED AP, and partner with Withee Malcolm Architects LLP in Torrance, CA states, "Wood podium is basically tuck-under apartments on steroids."

The projects described in this paper have parking, retail, and restaurant space on their first level. The podium is composed of gypcrete (or light weight concrete) topping over wood structural panels supported by I-joists and glued laminated (glulam) beams. Both design teams made a conscientious effort to not utilize concrete or steel framing.

ALL-WOOD PODIUMS

Although a podium structure typically refers to wood-frame construction over concrete, a handful of designers have lowered their costs even further by designing the podium in wood.

"When determining the cost of a structure, there are a lot variables, including most notably time, materials and labor," said Karyn Beebe, P.E., of APA. "Using wood instead of concrete lowers the mass of the building, which results in more economical podium shear walls and foundations. Using the same material for the entire structure may also mean lower design costs, and the construction team experiences savings in the form of fewer trades on site, which means less mobilization time, greater efficiency because framing is repeated on all of the levels, easier field modifications, and a faster schedule."

Architect Dan Withee, AIA, LEED AP, of Withee Malcolm Architects designed an 85-unit wood podium project in San Diego. He estimated that a concrete podium can cost $15,000 per parking space compared to $9,500 for wood podium.[4]

Horizontal Wood Assemblies are effectively used to transition from Residential units above to Retail/Parking below

CONTINUING EDUCATION

Multi-Story Wood Construction

A cost-effective and sustainable solution for today's changing housing market

Sponsored by reThink Wood and WoodWorks

CONTINUING EDUCATION

Learning Objectives

Case Study: Horizontal Separation

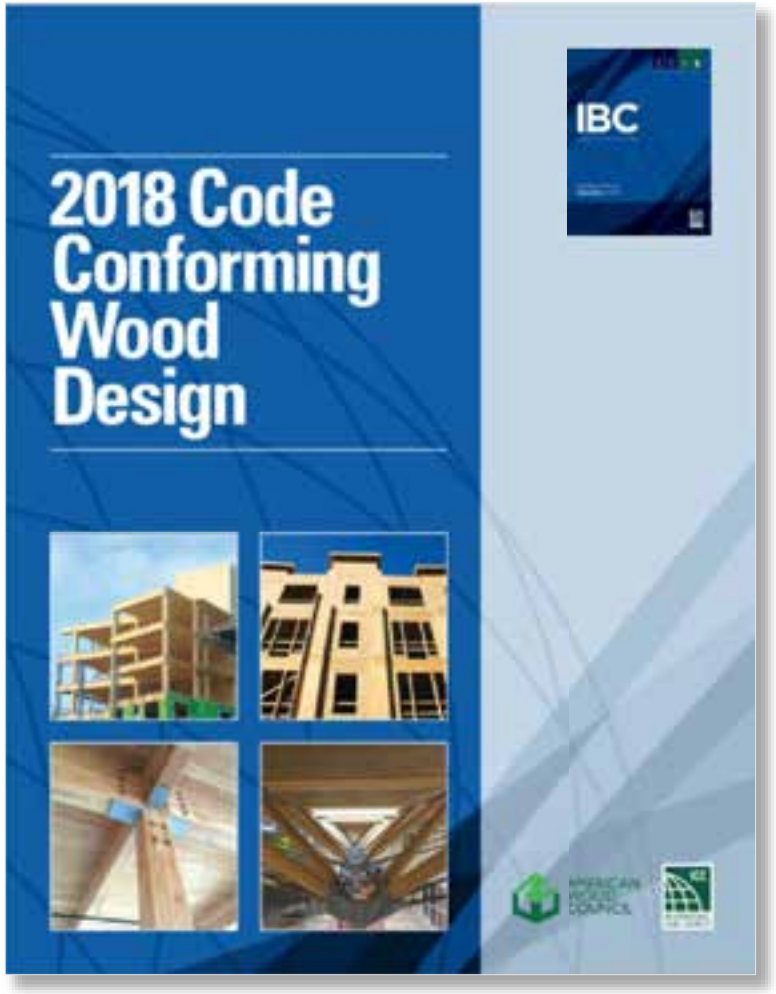
Galt Place Apartments

Location: Galt, CA

Mixed Use Residential over Retail and Parking

Architect: Applied Architecture

2018 Code Conforming Wood



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1. General Information
2. Type of Construction
3. Allowable Heights and Areas for Type V, IV and III Construction
4. Establishing Fire Resistance
5. Wood Use in "Noncombustible" Construction
6. Wood Features
7. Structural Considerations
8. Precautions during Construction
9. Resources
10. Building Area Tables

Available for Free Download: www.awc.org

Outline

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

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

Outline

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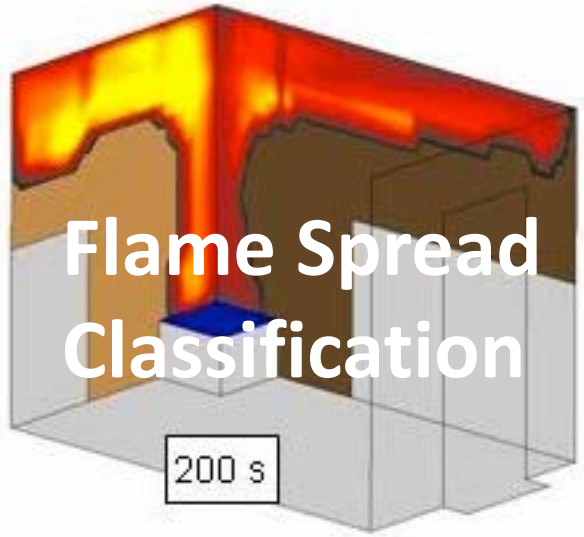
1430 Q, The HR Group Architects, Buehler Engineering, Greg Folkins Photography

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

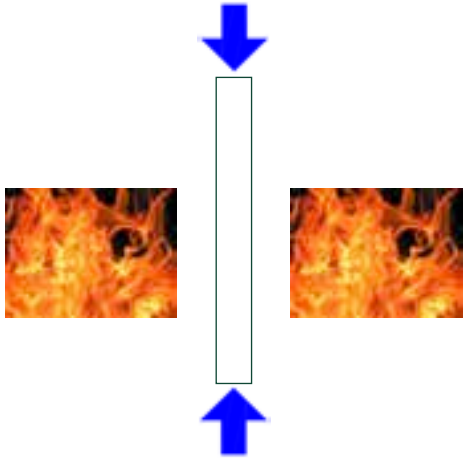
Fire-Resistance Rated Wall Assemblies

- **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

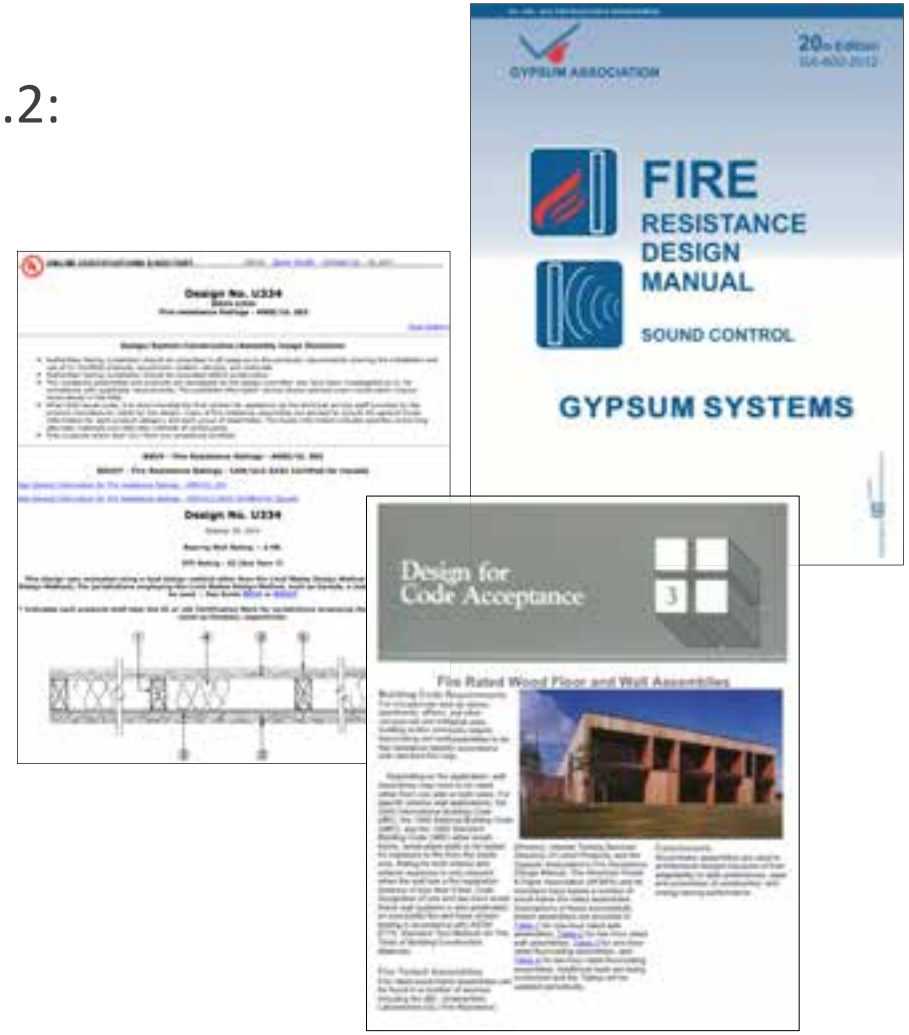
Choosing Fire Rated Assemblies

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:

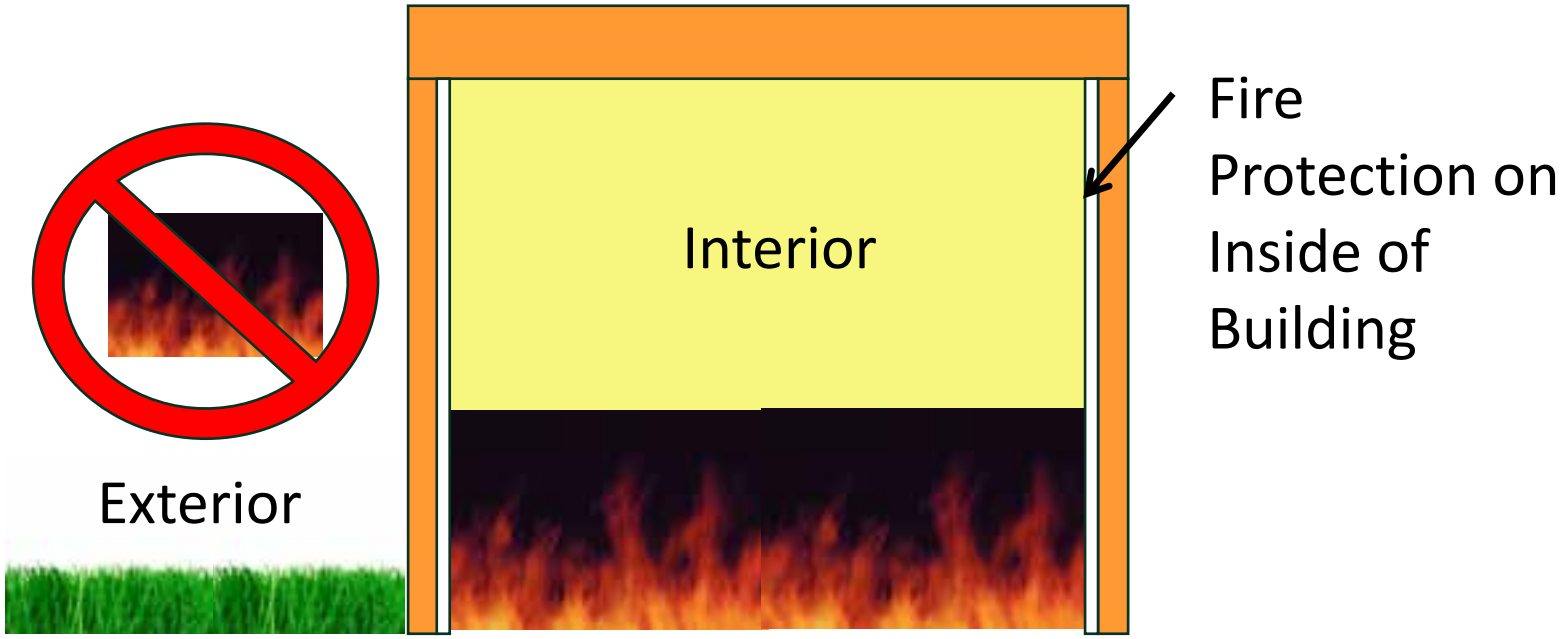
» Hourly rating requirements per Tables 601 vs 602

» Structural stability requirements

» Non-combustible exception

Exterior Walls – IBC 705

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



Exterior Walls – Fire Separation Distance

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

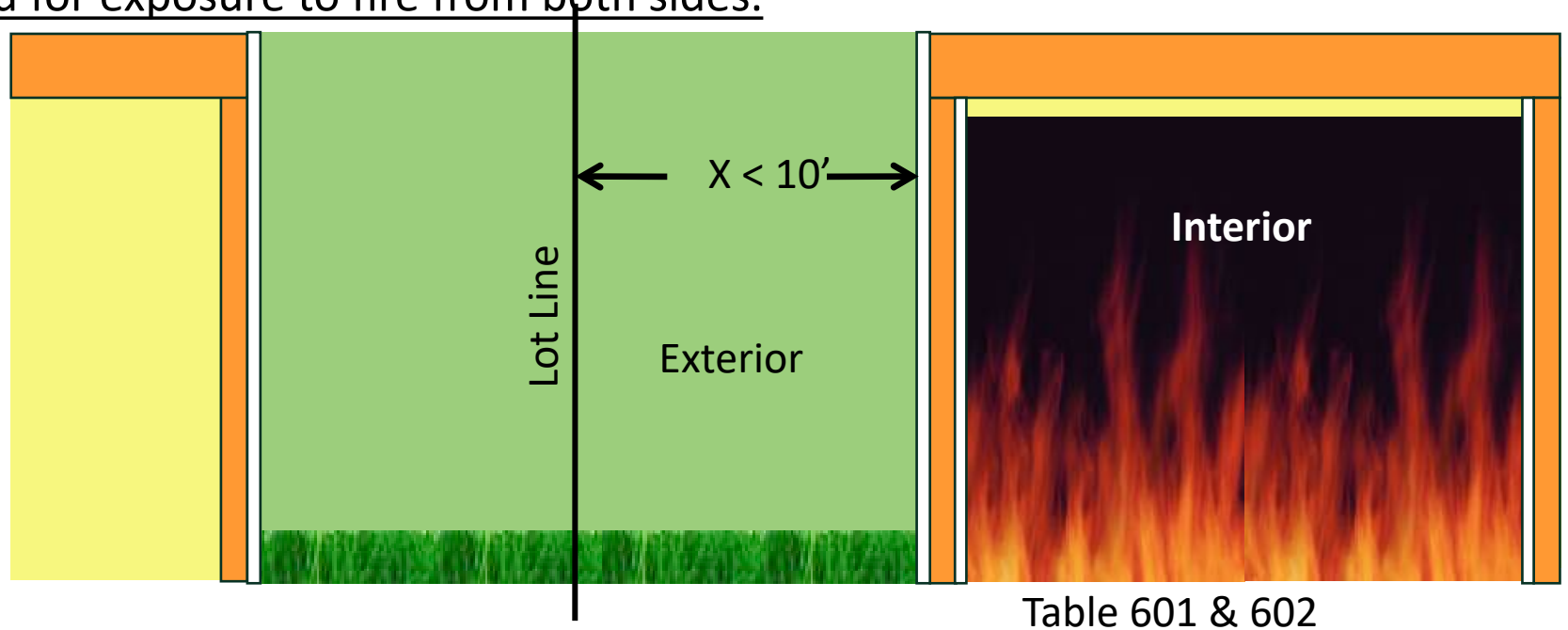


Table 601 & 602

Exterior Wall Fire Resistance

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

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b]	1[b]	0	1[b]	0	HT	1[b]	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 2304.11.2	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

Type III Exterior Walls: Fire Rating Requirements

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

Exterior Wall Fire Ratings

- Using the provisions of 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

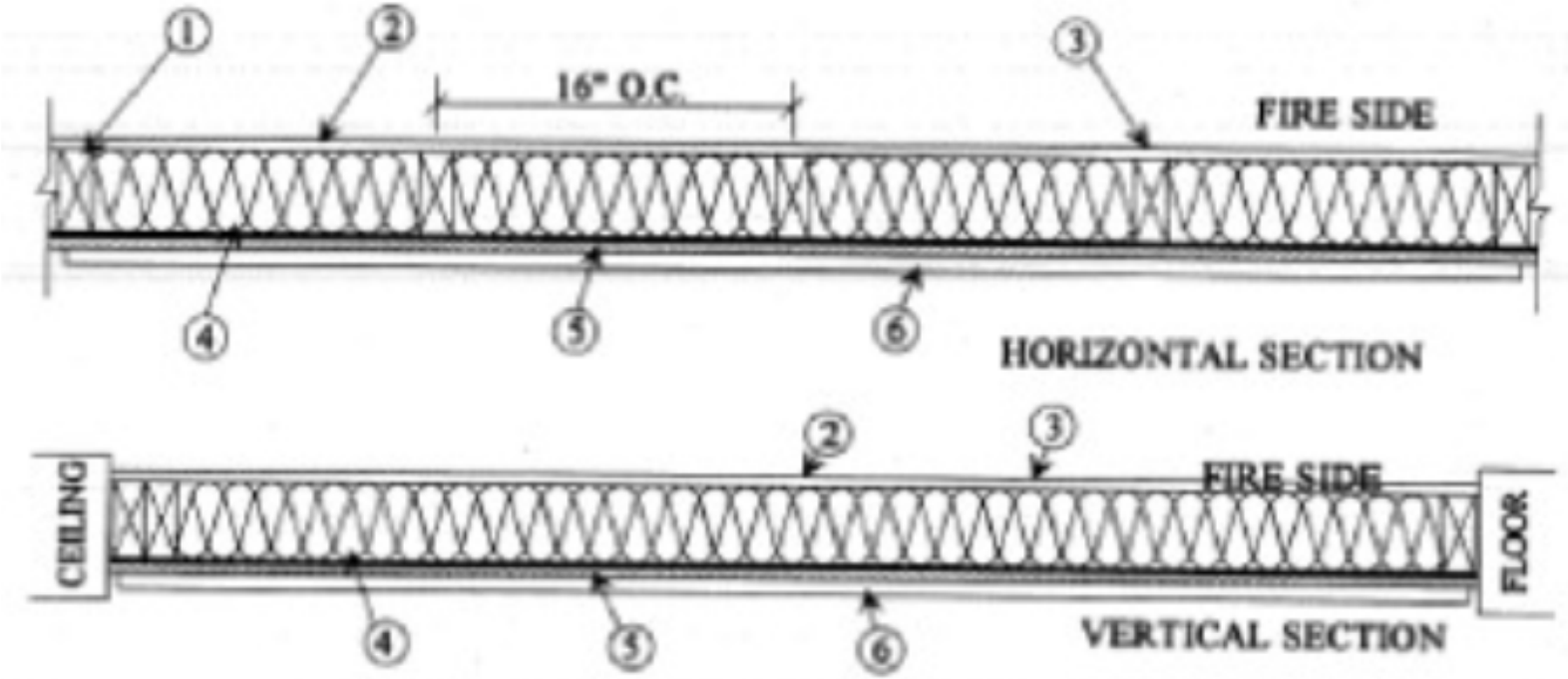
Design No. U348

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

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

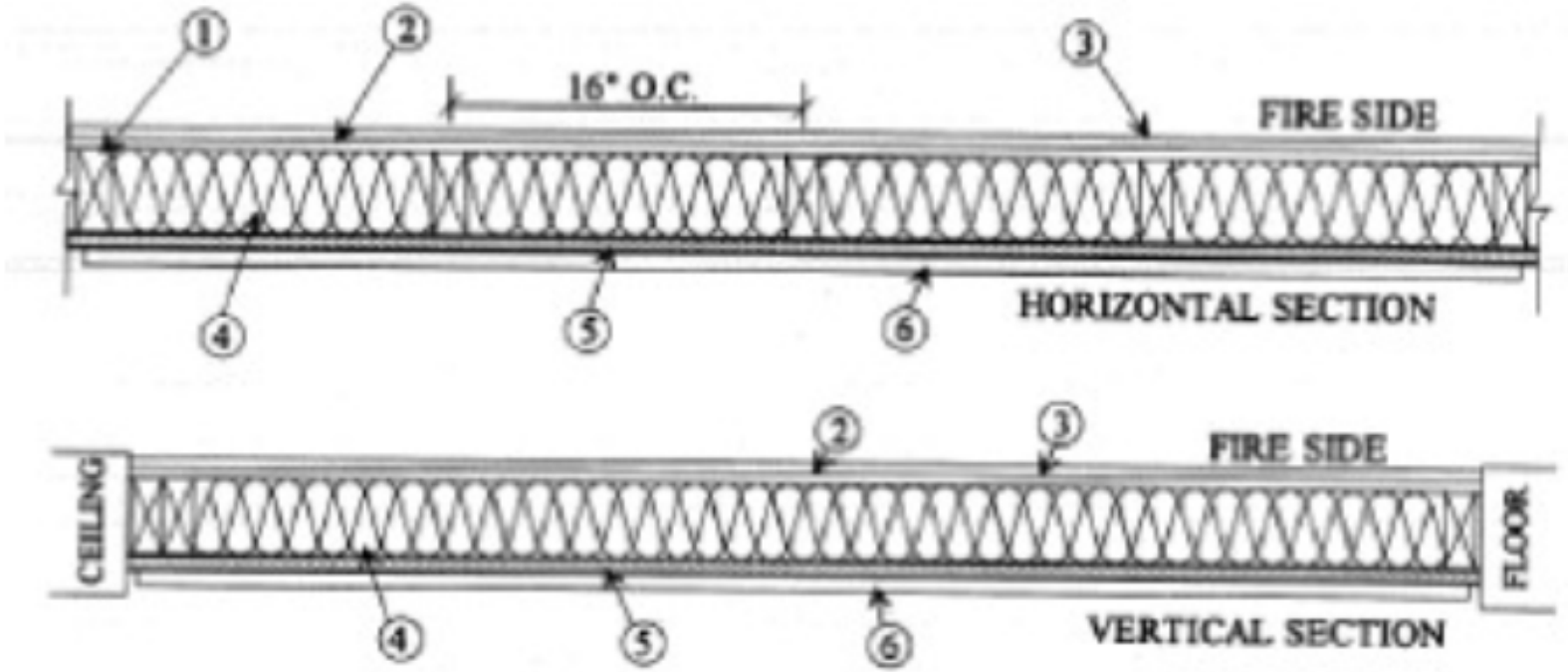
Design No. U349

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; 0-hr Ext

Design No. W408

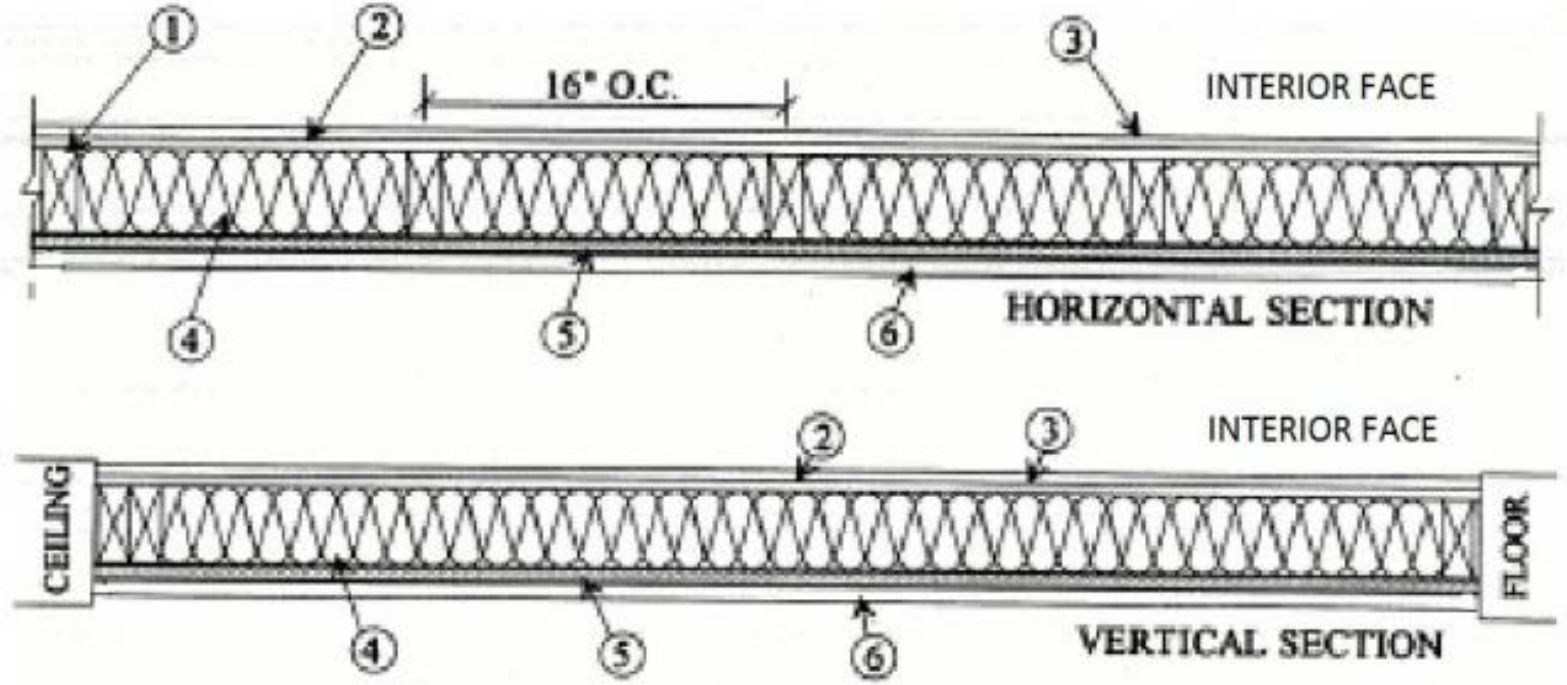
April 01, 2013

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

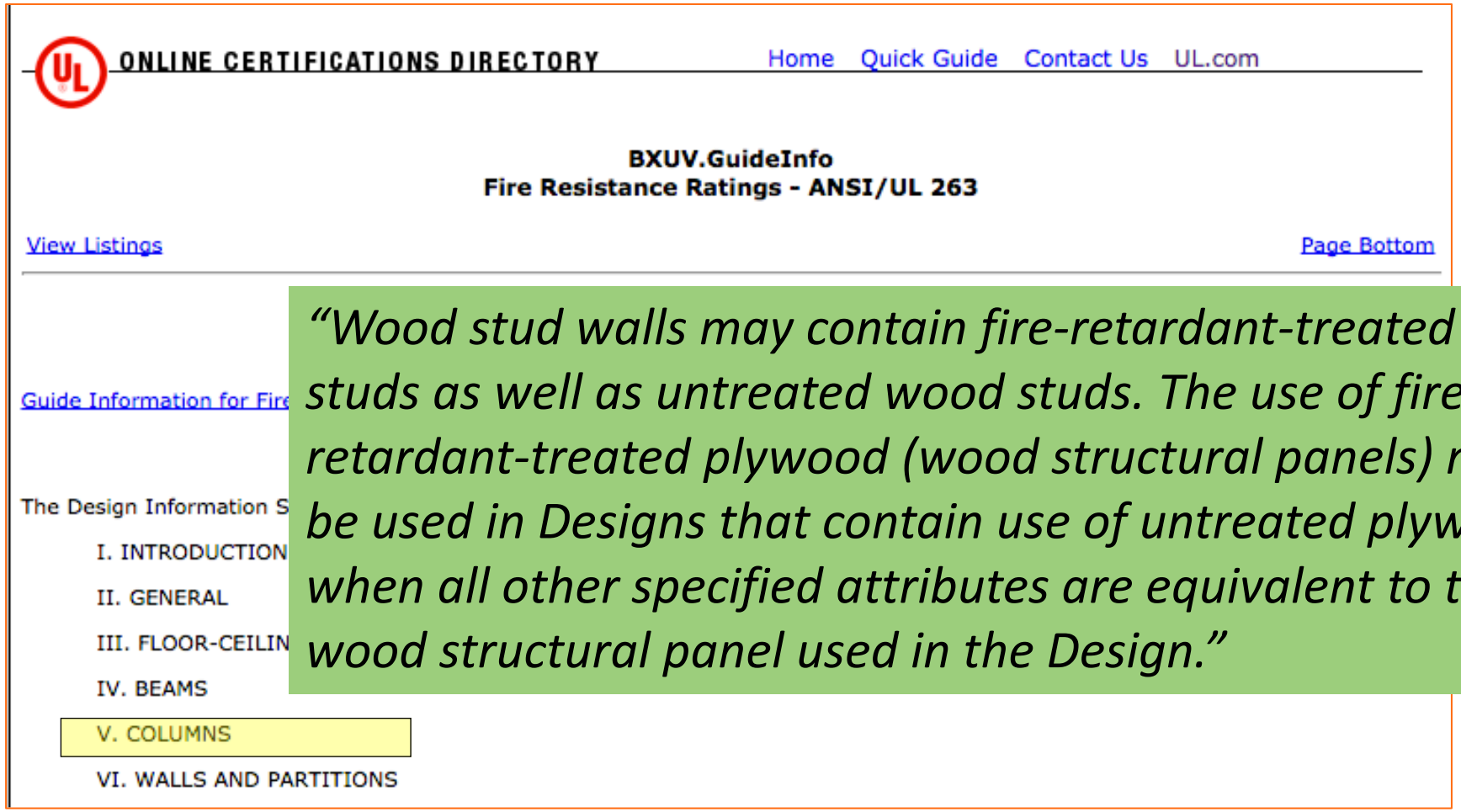
Bearing Wall Rating — 1 Hr when EXPOSED TO FIRE ON EXTERIOR FACE ONLY, see Item 4 and 6

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



ONLINE CERTIFICATIONS DIRECTORY

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BXUV.GuideInfo
Fire Resistance Ratings - ANSI/UL 263

View Listings Page Bottom

Guide Information for Fire

The Design Information S

I. INTRODUCTION

II. GENERAL

III. FLOOR-CEILIN

IV. BEAMS

V. COLUMNS

VI. WALLS AND PARTITIONS

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

Exterior Walls – Addition of Wood Structural Panel

- Can include WSP in assemblies which were tested without them:

» ESR 2586

» AWC's DCA4

» Gypsum Association Manual

ESR 2586:

4.7 Fire-resistive Construction:

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

GA Fire Resistance Design Manual

Item 23, Section 1 of the General Explanatory Notes:

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

Exterior Wall – Bearing vs. Nonbearing

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

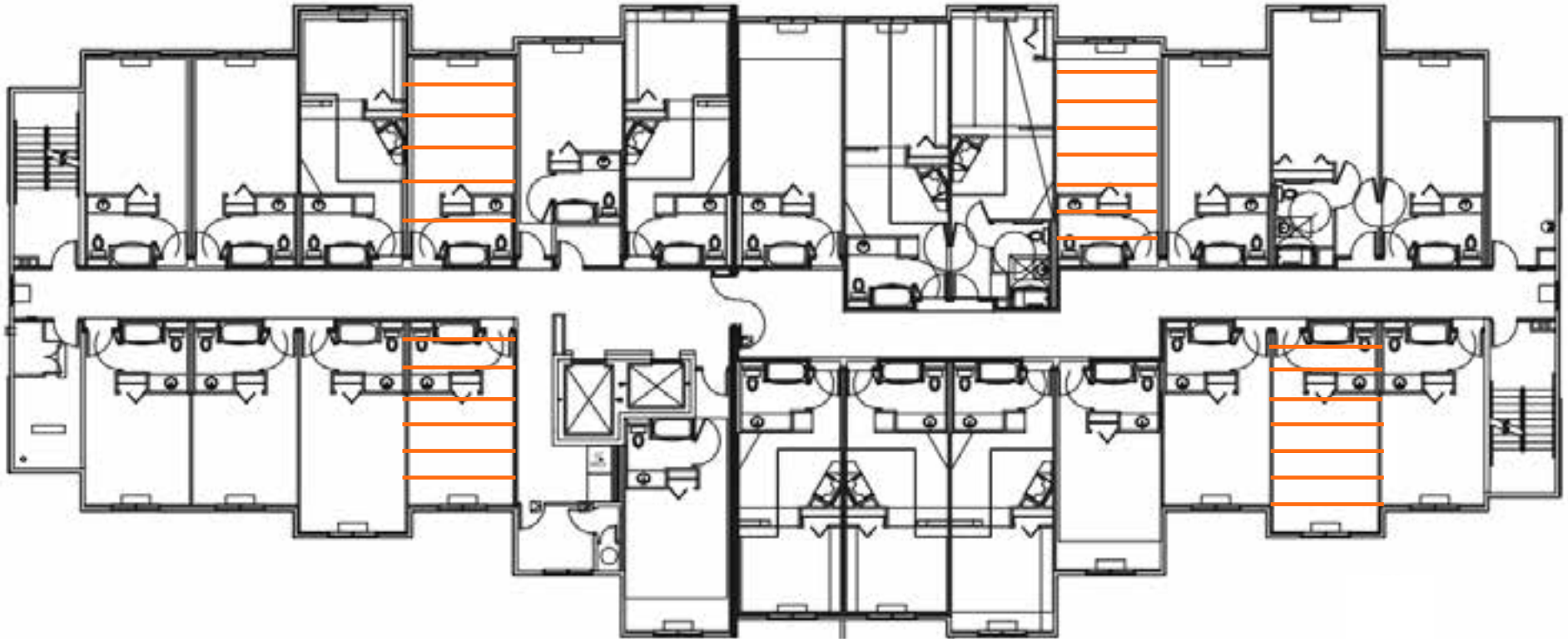
[BS] WALL, LOAD-BEARING. Any wall meeting either of the following classifications:

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

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

Exterior Walls – Bearing vs. Non-Bearing

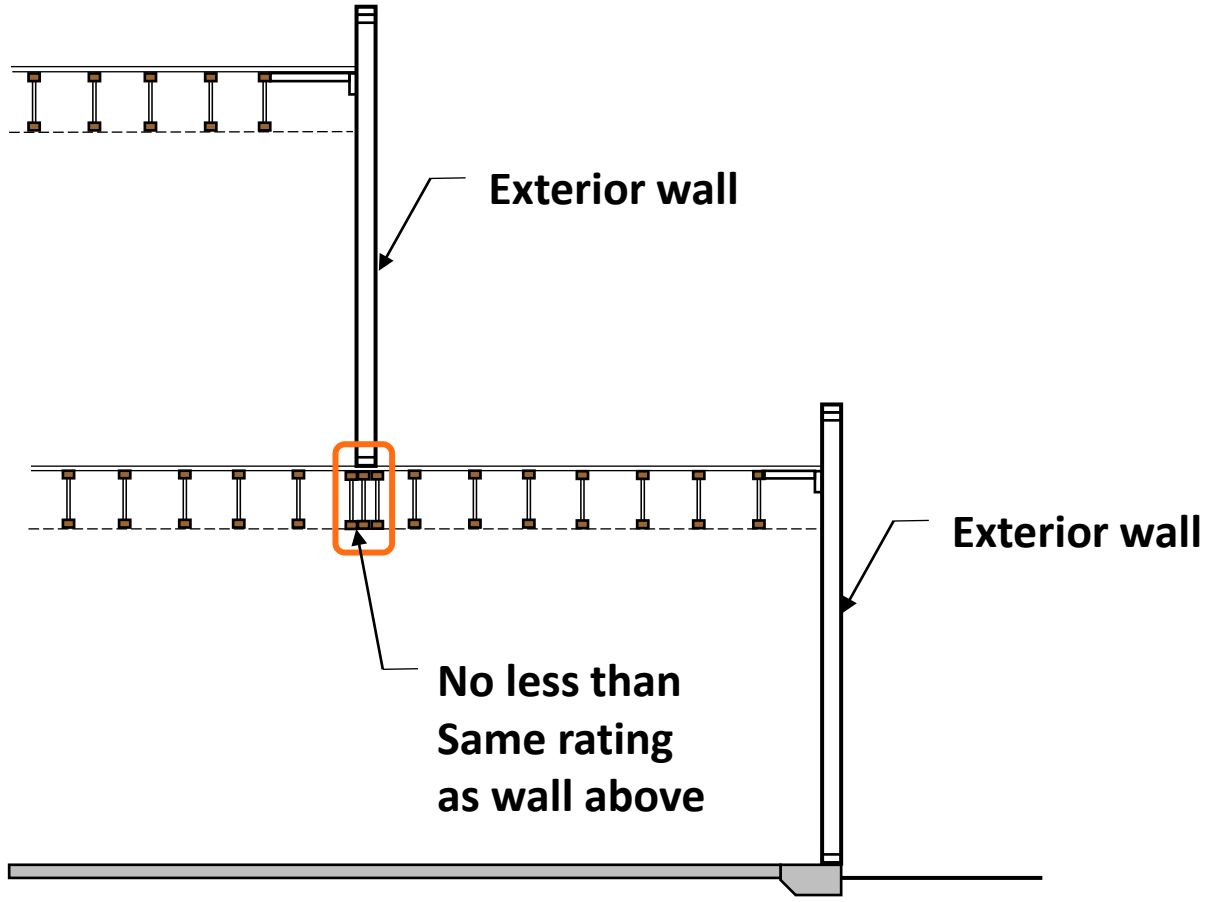
- If framing parallel to long exterior walls is possible, minimizes area of load bearing exterior walls



Exterior Walls – Vertical Offsets

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

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

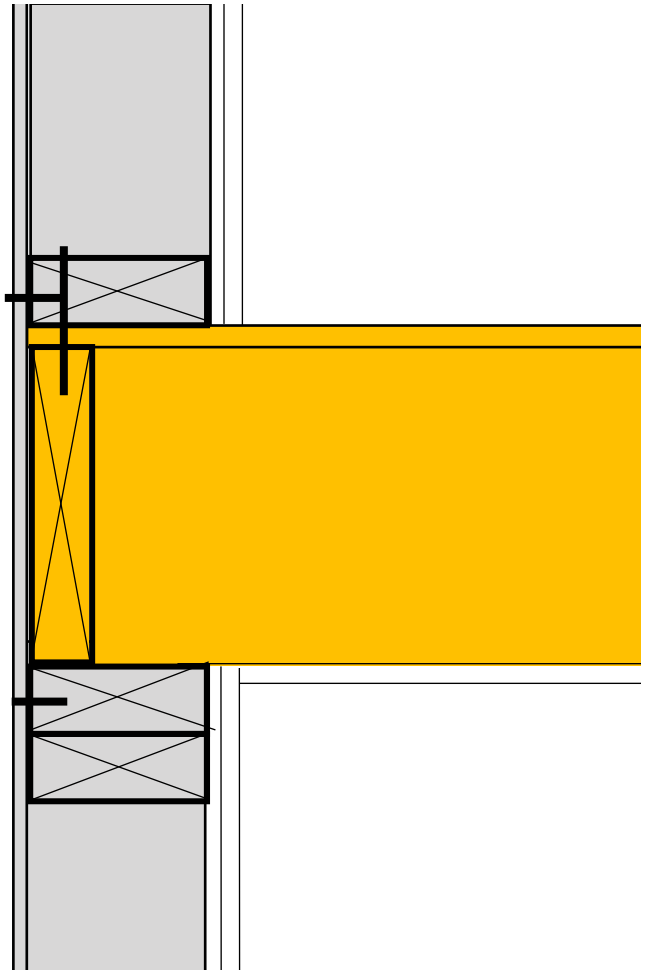


Outline

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

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

Platform Framing



- **Structural**

» Direct bearing/no add'l hardware

» May require load transfer blocking for concentrated loads from above

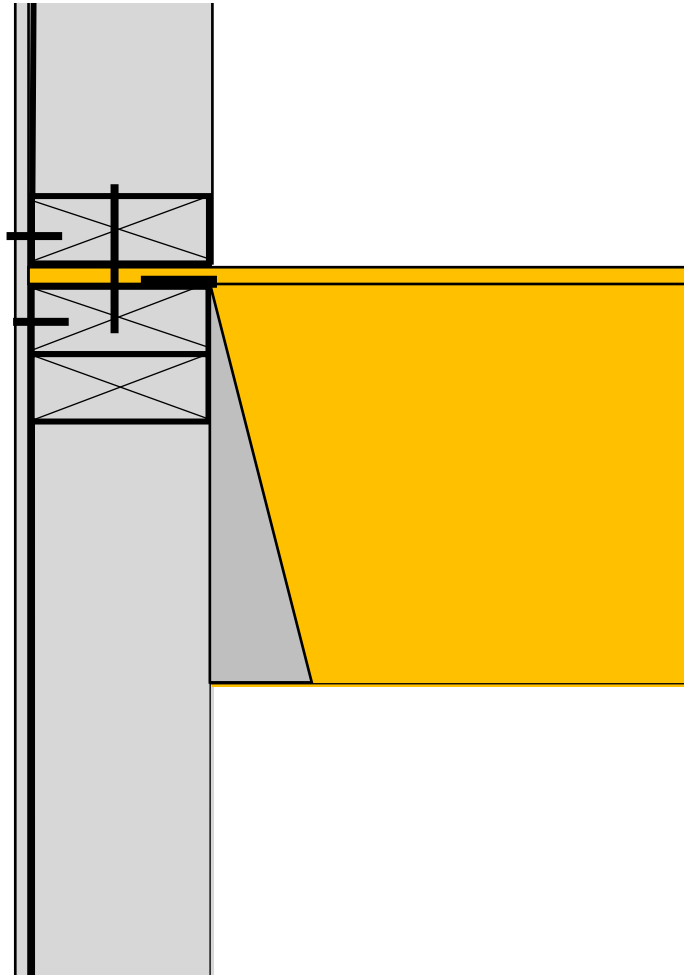
» Wall sole plate and floor sheathing crushing may need to be considered

- **Constructability**

» Framing can be completed before drywall and insulation are installed

» Common length studs

Semi-balloon Framing



Structural

» Additional hardware/no direct bearing

» No load transfer blocking req'd

Rated Assemblies

» May accommodate continuity in exterior walls in type III construction

Constructability

» Framing can be completed before drywall and insulation are installed

» Custom length studs

» Can help minimize building shrinkage

Intersection of Assemblies - Ratings

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

IBC Tables 601 & 706.4

Note: FRT = Fire Retardant Treated

Intersection of Tested Assemblies

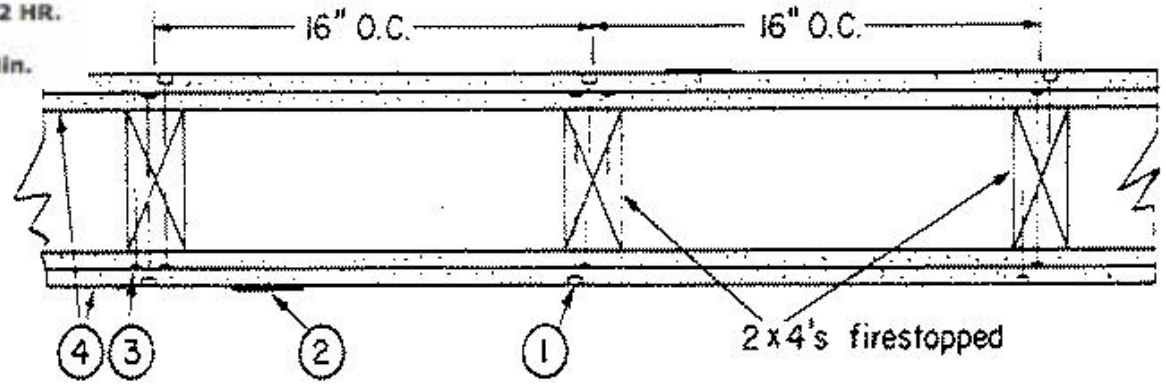
2 Hour Wall

Design No. U301

May 20, 2015

Bearing Wall Rating — 2 HR.

Finish Rating — 66 Min.

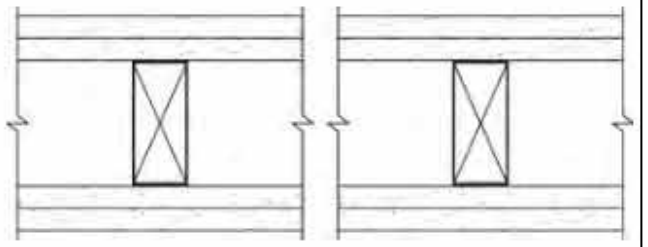


GA FILE NO. WP 4135	GENERIC	2 HOUR FIRE	40 to 44 STC SOUND

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

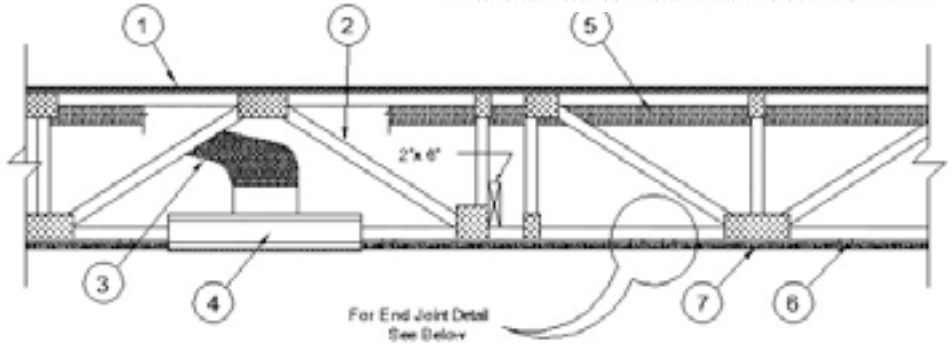
Intersection of Tested Assemblies

1 Hour Floor

Design No. L550

August 27, 2015

Unrestrained Assembly Rating — 1 Hr.



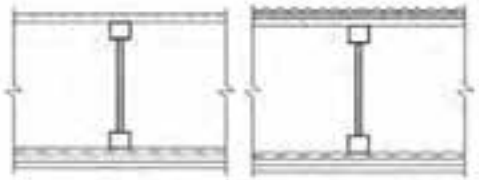
FLOOR-CEILING SYSTEMS, WOOD FRAMED

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

WOOD I-JOISTS, GYPSUM WALLBOARD, RESILIENT CHANNELS

Base layer ½" type X gypsum wallboard applied at right angles to resilient channels 16" o.c. with 1¼" Type S drywall screws 12" o.c. Resilient channels applied at right angles to minimum 9½" deep wood I-joists, with minimum 1¼" deep x 1½" wide flanges and minimum ⅜" webs, 24" o.c. with 1¼" Type W drywall screws. **Face** layer ½" type X gypsum wallboard applied at right angles to channels with 1⅝" Type S drywall screws 12" o.c. Face layer end joints located midway between channels and attached to base layer with 1½" Type G screws 12" o.c. Edge joints offset 24" from base layer edge joints. Wood I-joists supporting ⅝" oriented strand board applied at right angles to I-joists with 8d common nails 12" o.c.

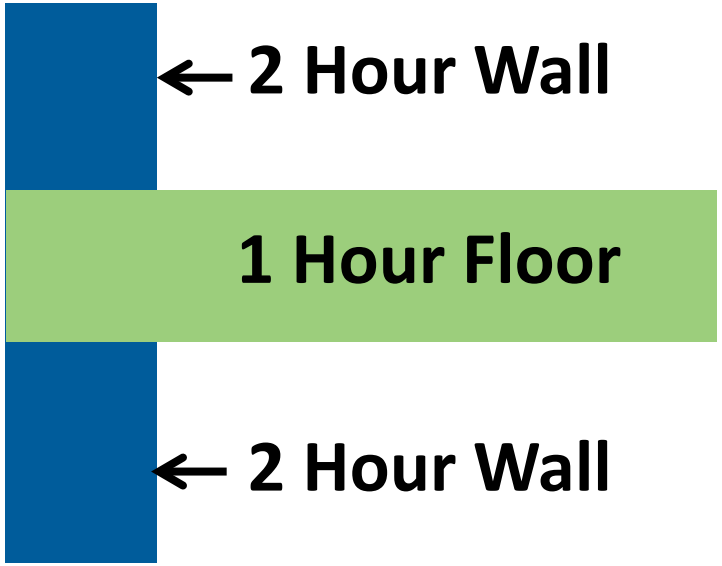
STC and IIC tested with 40 oz carpet over ¼" foam pad.



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

- **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 - 2018 IBC 705.6

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

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

Exterior Walls – Intersecting Floors

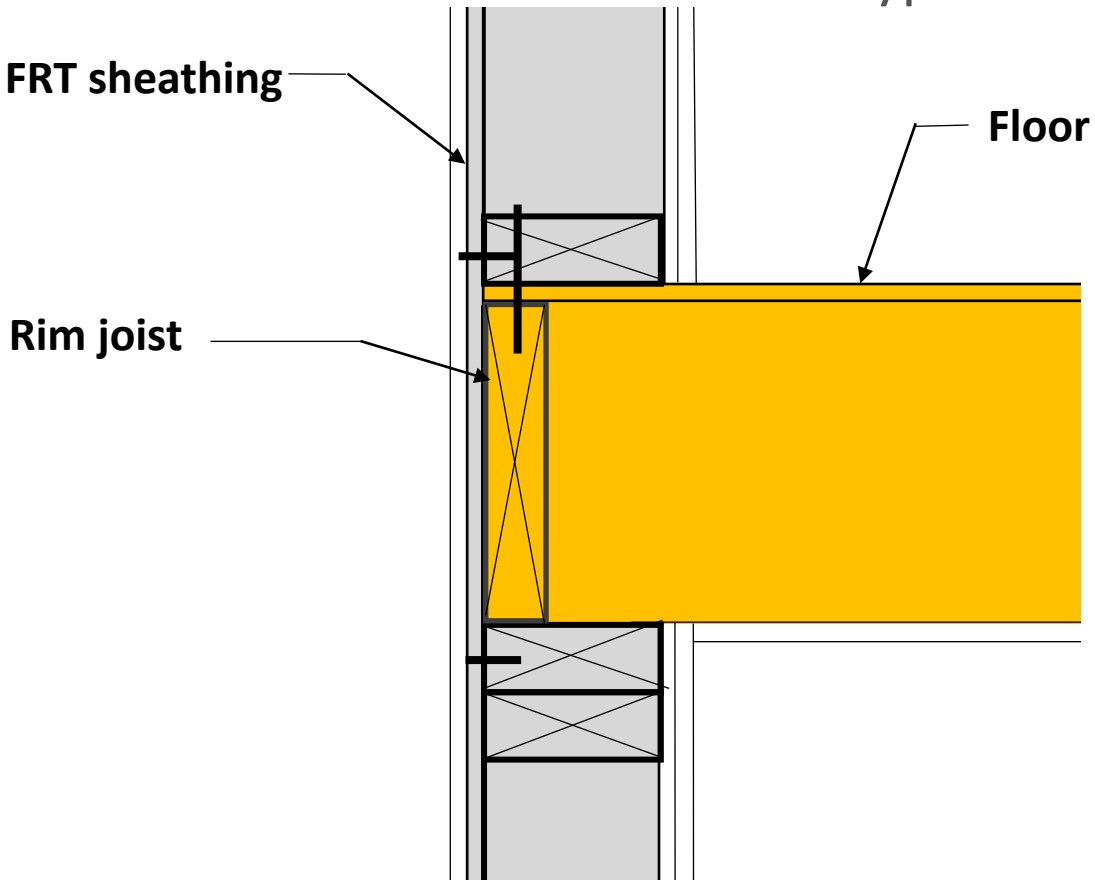
- Please note that the following details are examples of what we have seen used on projects and do not necessarily represent details that will be accepted and applicable in all jurisdictions and to all projects.

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



Floor Joist Options:

- **Solid Sawn**
- **Trusses**
- **I-Joists**

Legend

Untreated or FRT

FRT Wood

Considerations:

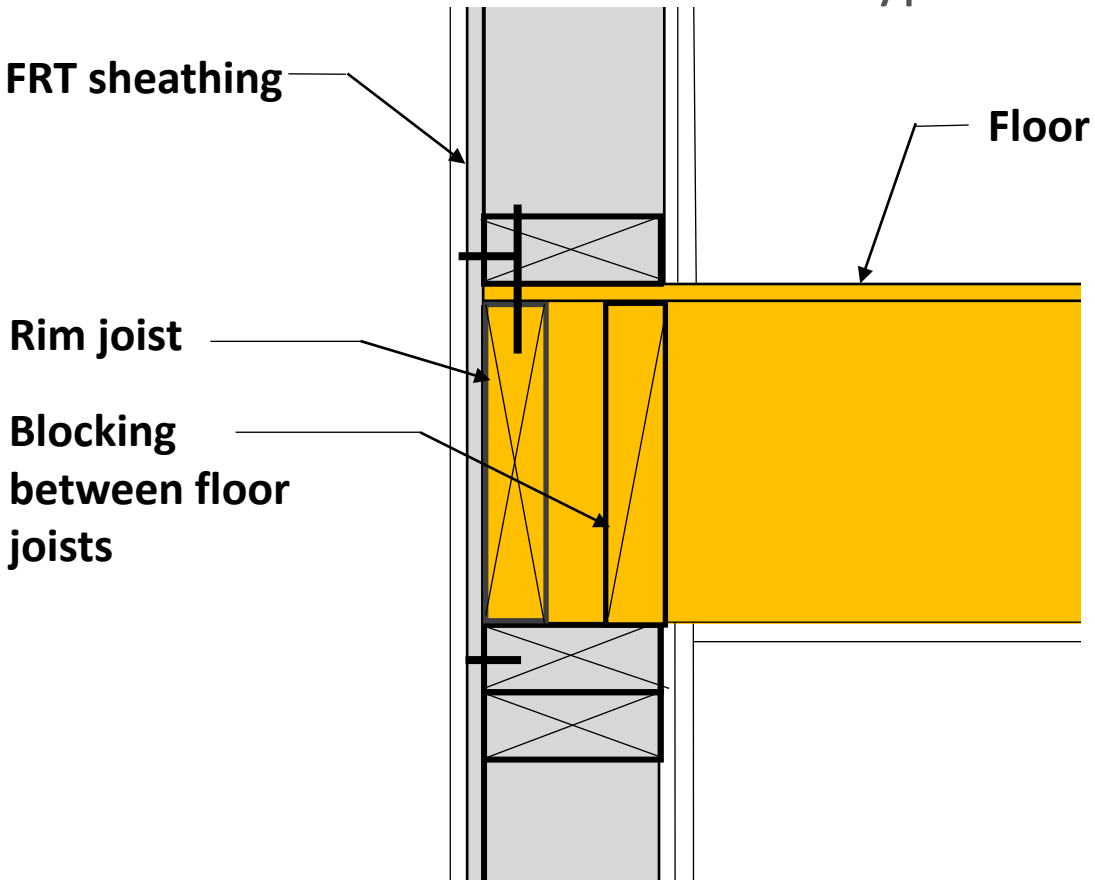
- Shrinkage of rim, plates, joists
- Protection of rim for fire

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



Floor Joist Options:

- **Solid Sawn**
- **Trusses**
- **I-Joists**

Legend

Untreated or FRT

FRT Wood

Considerations:

» Shrinkage of rim, plates, joists

Rationale for detail approval:

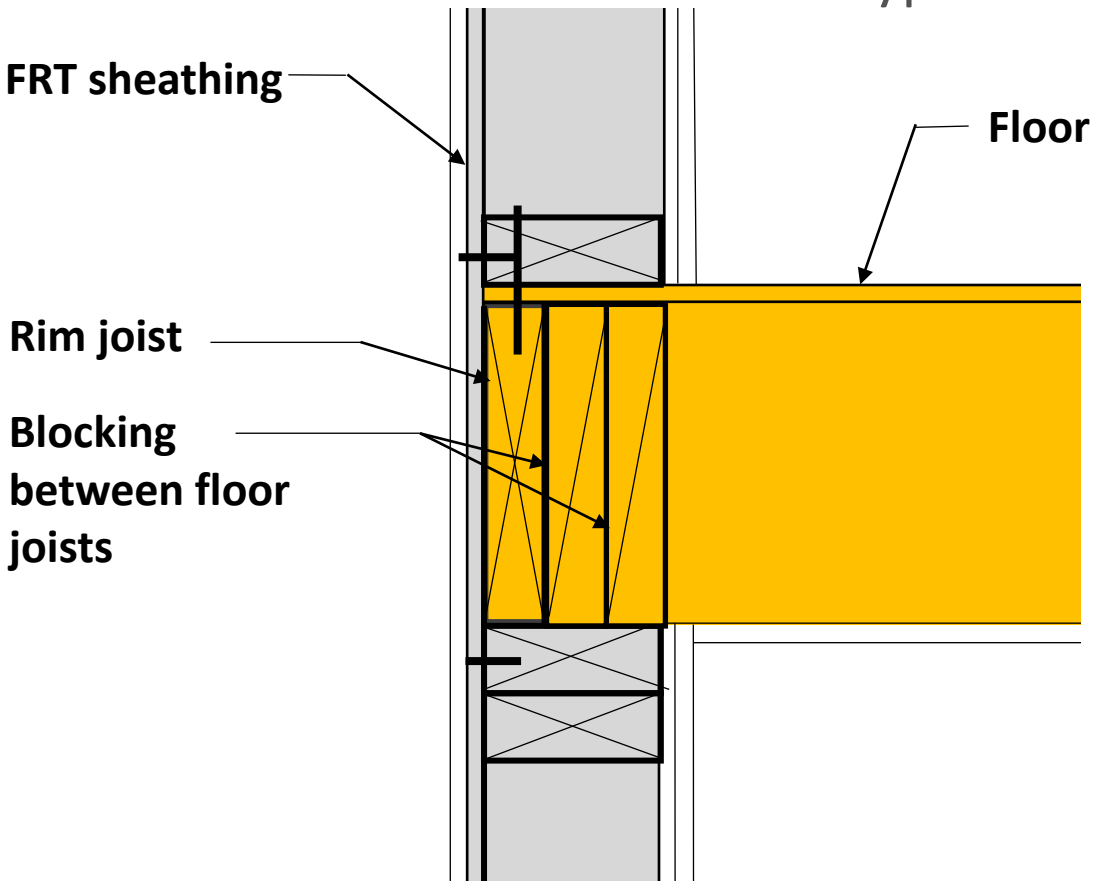
» Membranes on both side of wall provide fire resistance via their approved assembly

» At floor cavity, ceiling provides 1 hour

» 1 layer of blocking provides 2nd hr through char calculations

Exterior Walls – Intersecting Floors

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



Floor Joist Options:

- **Solid Sawn**
- **Trusses**
- **I-Joists**

Legend

Untreated or FRT

FRT Wood

Considerations:

» Shrinkage of rim, plates, joists

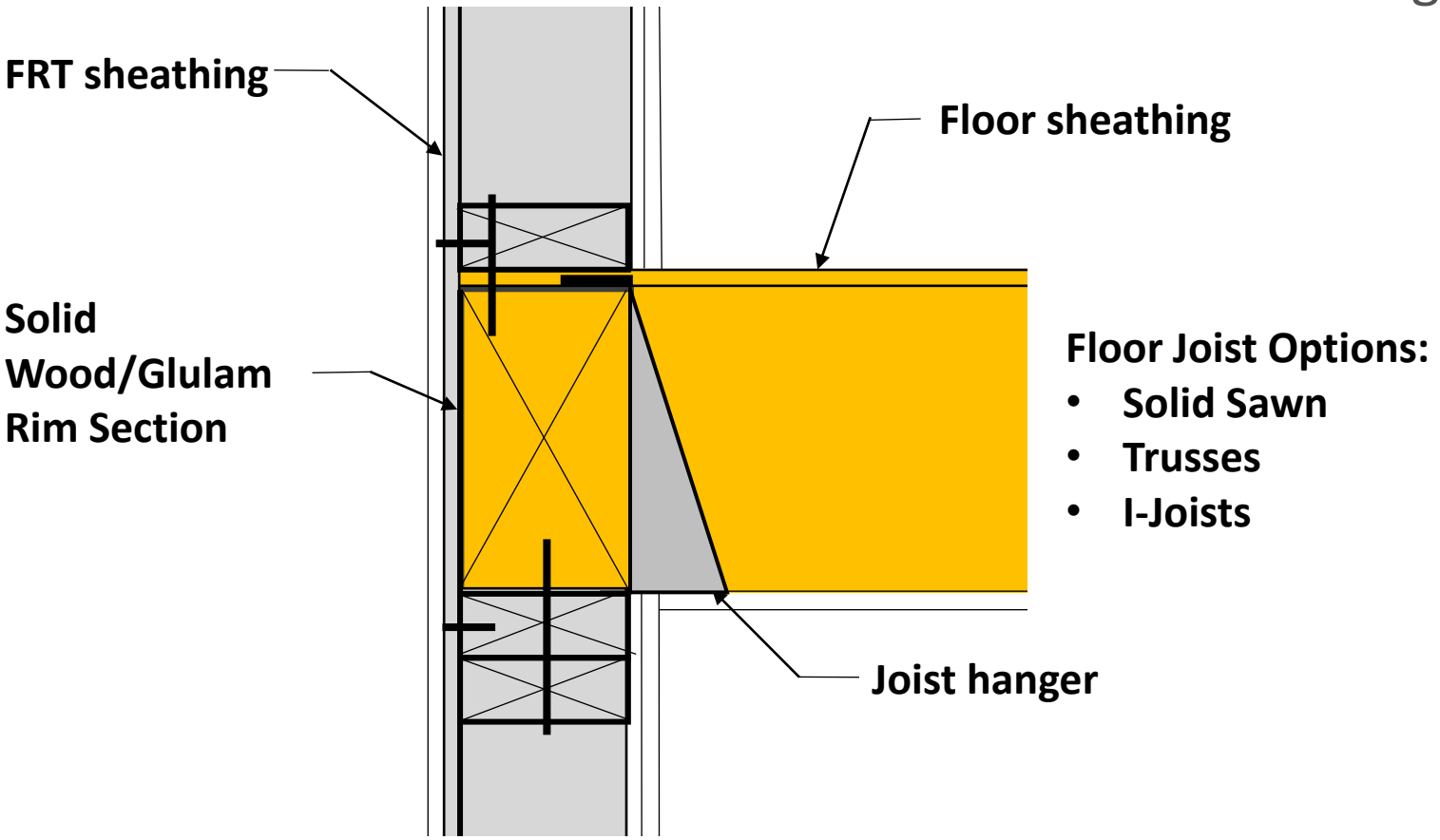
Rationale for detail approval:

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

» At floor cavity, 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



Legend

Untreated or FRT

FRT Wood

Considerations:

» Shrinkage of rim, plates, joists

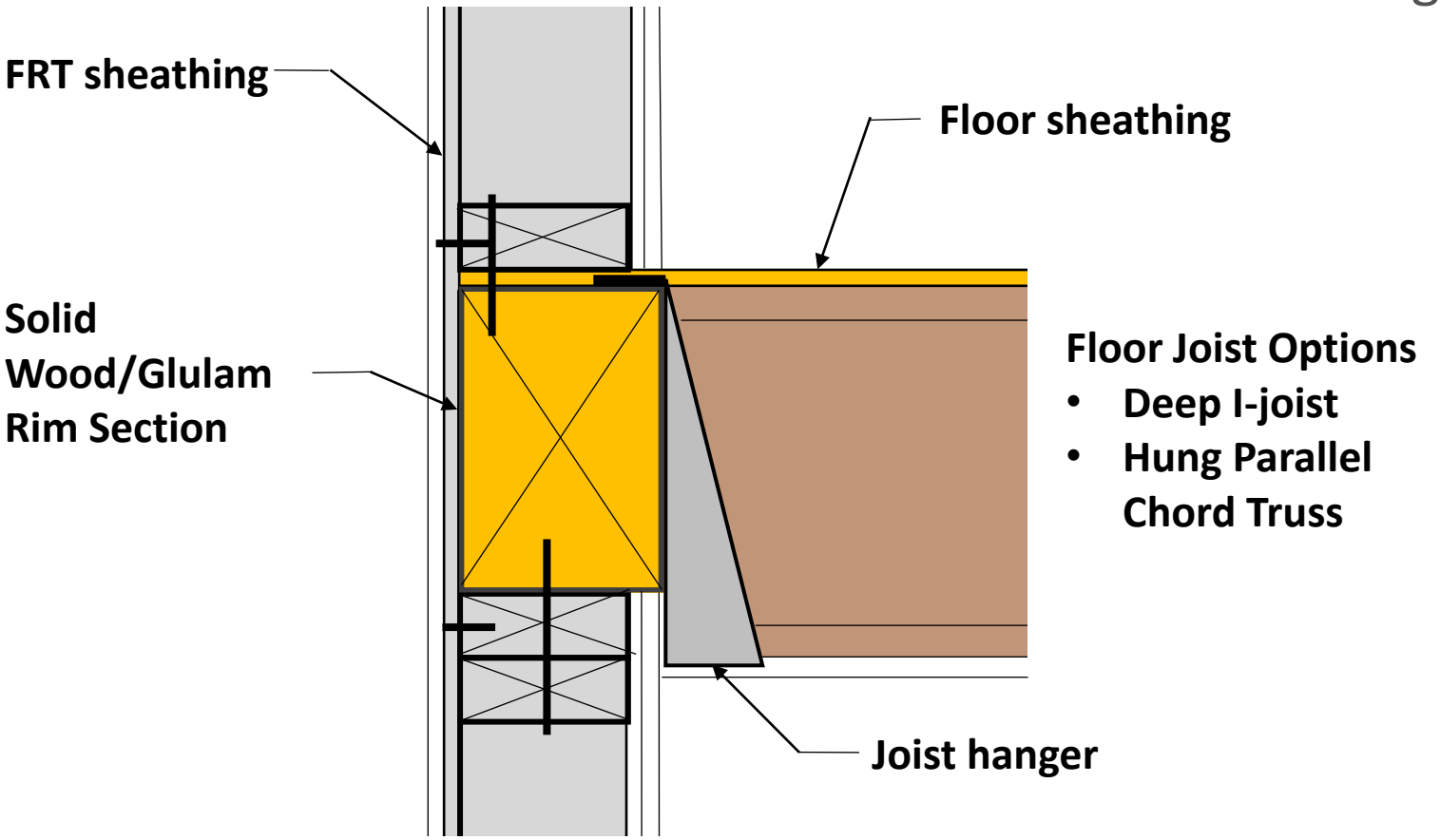
Rationale for detail approval:

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

» At floor cavity, 4x rim provides 2-hr protection through char calculations

Exterior Walls – Intersecting Floors

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



Legend

- Untreated or FRT
- FRT Wood
- Untreated

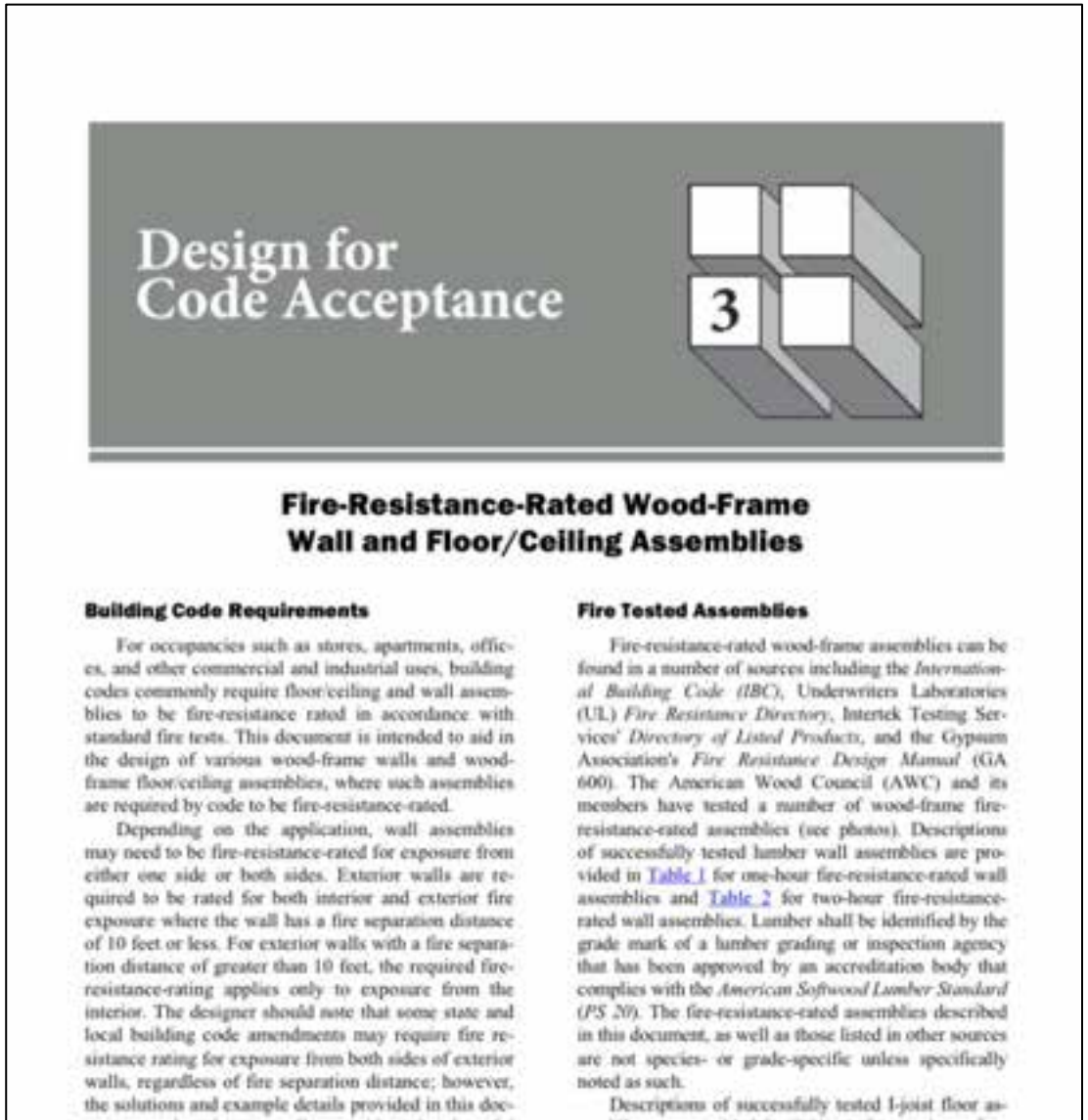
Rationale for detail approval:

- 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, the solutions and example details provided in this doc-

Fire Tested Assemblies

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

Descriptions of successfully tested I-joist floor as-

Exterior Walls – Intersecting Floors

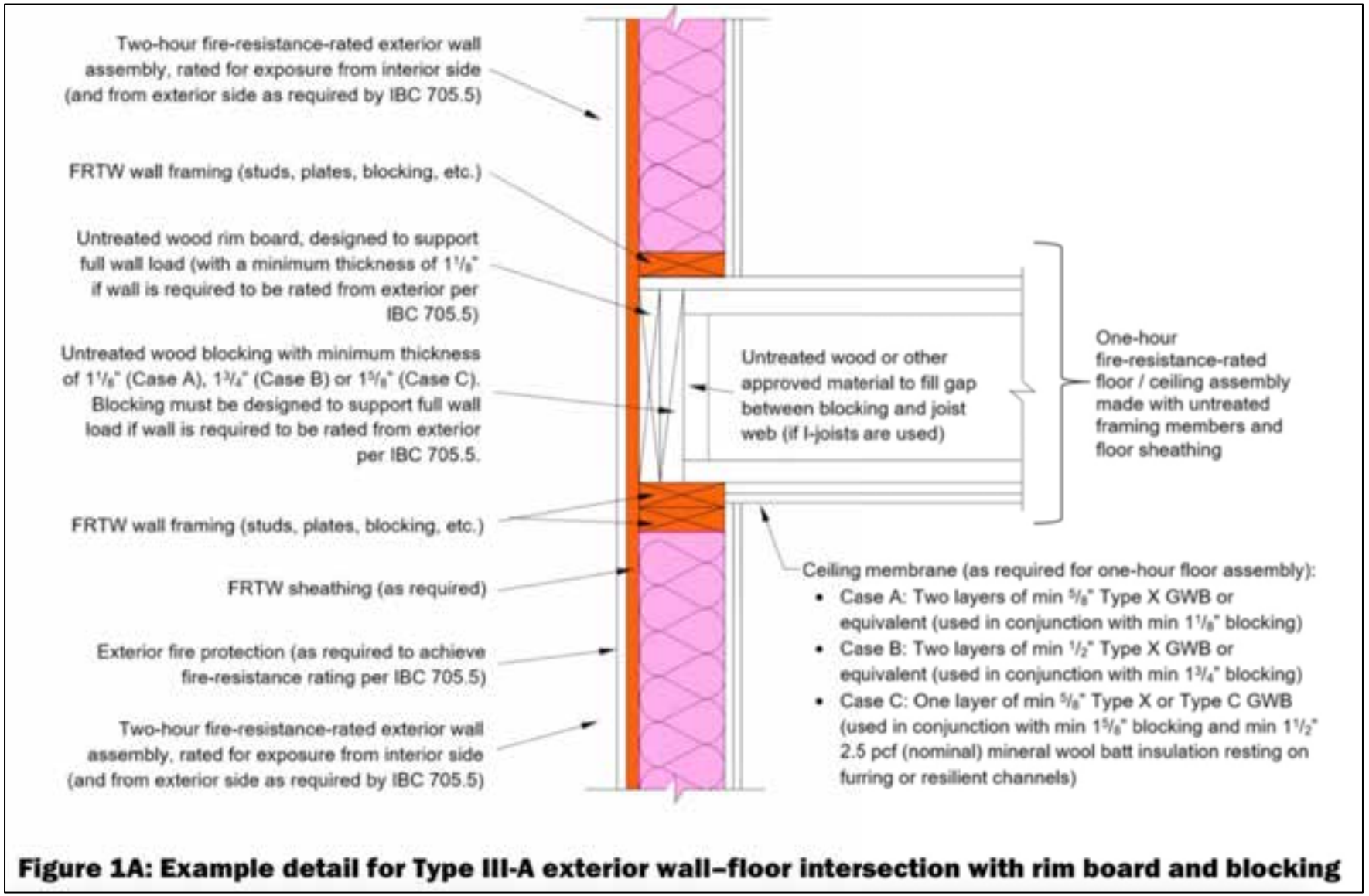
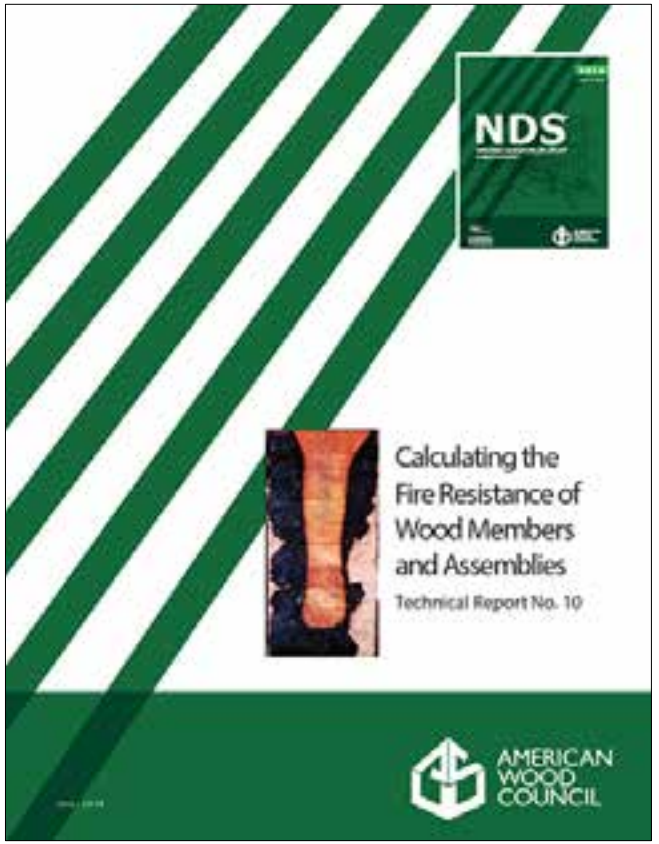


Figure 1A: Example detail for Type III-A exterior wall–floor intersection with rim board and blocking

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

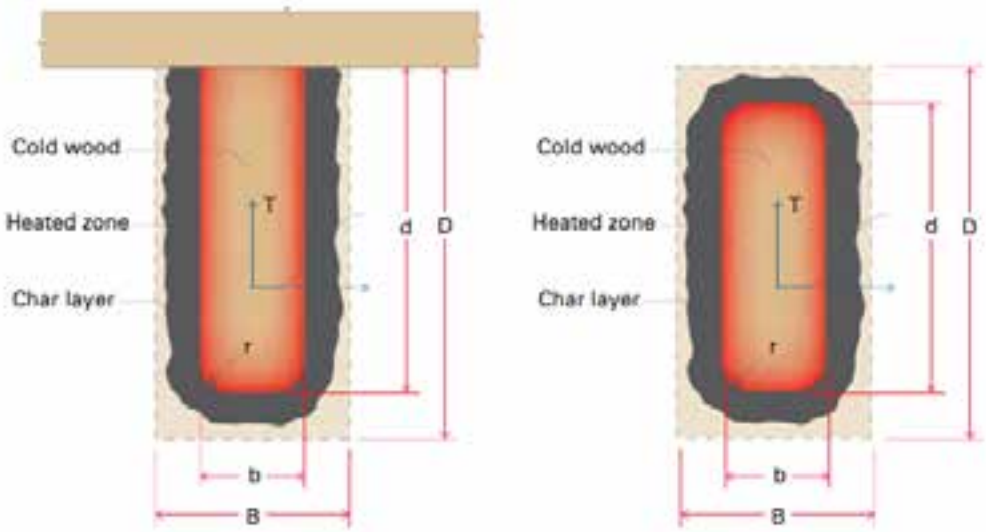
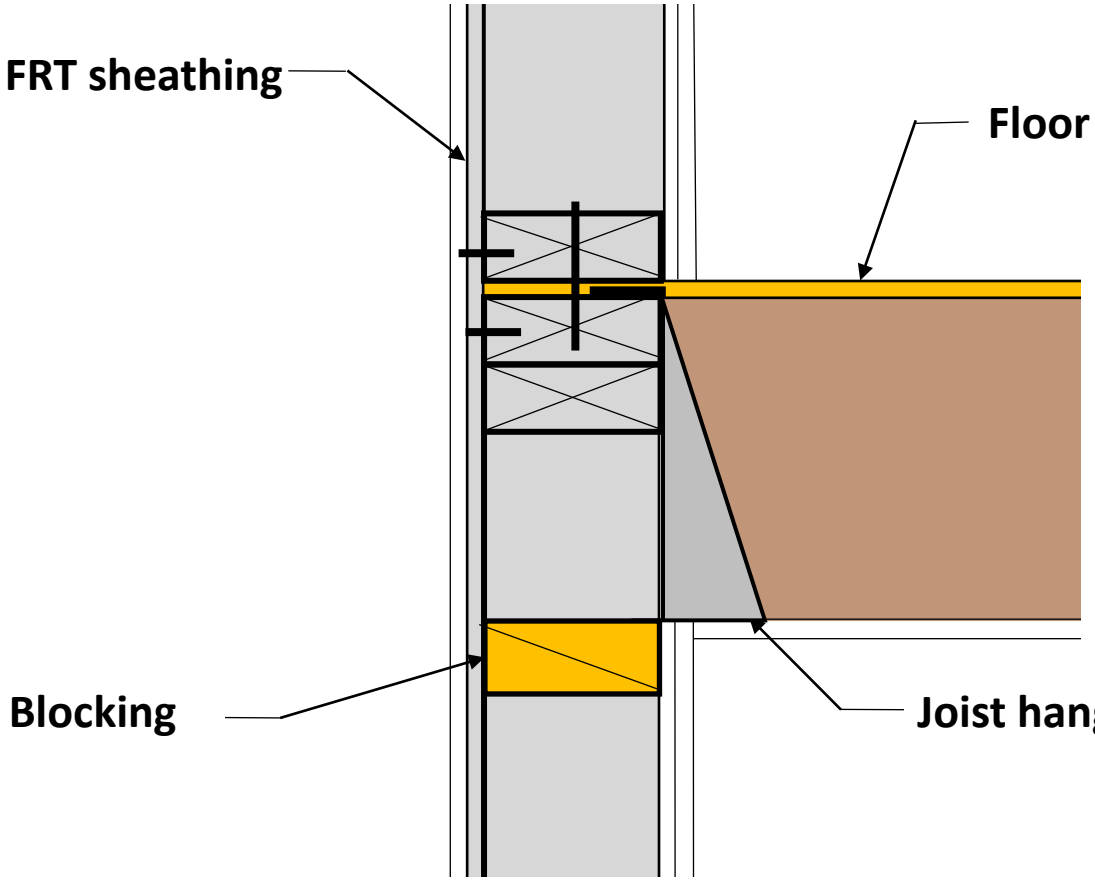


Figure 1-1 Reduction in member breadth and depth over time, t

Source: AWC’s TR 10

Exterior Walls – Intersecting Floors

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



Floor Joist Options:

- **Solid Sawn**
- **Trusses**
- **I-Joists**

Legend

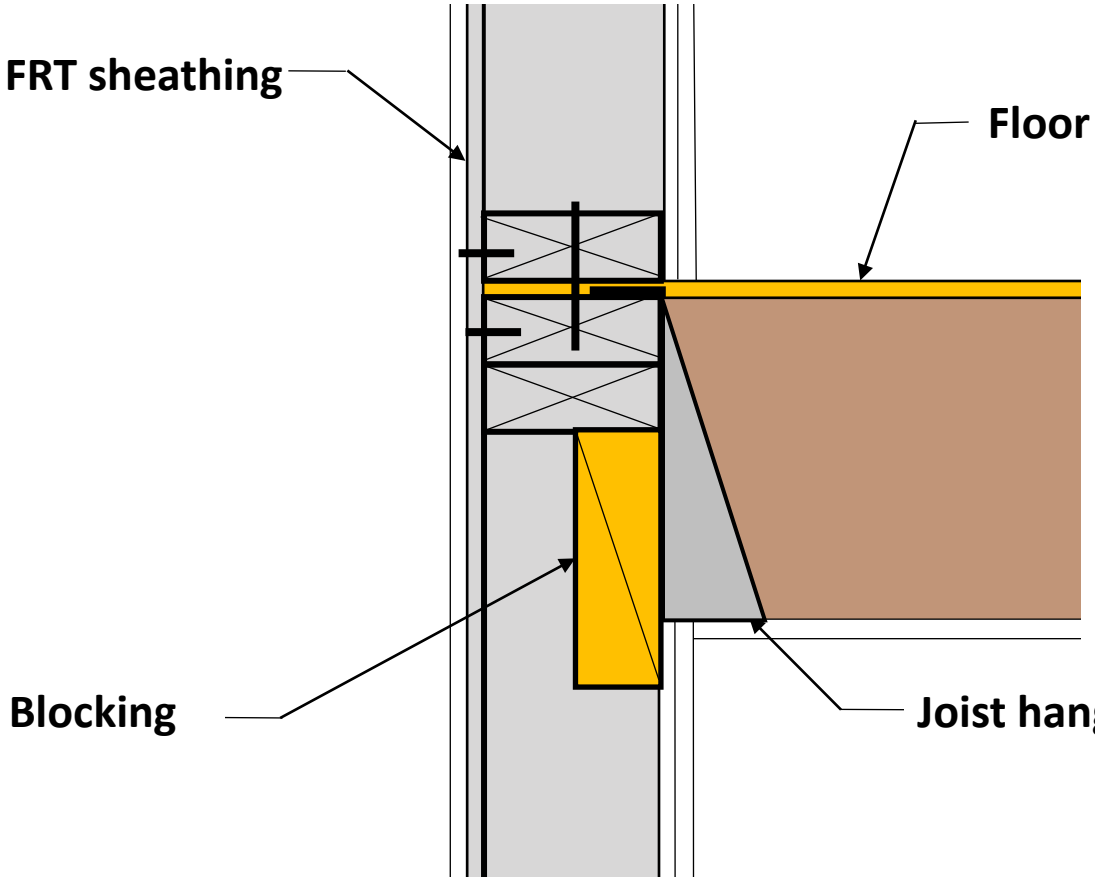
- **Untreated or FRT**
- **FRT Wood**
- **Untreated**

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



Floor Joist Options:

- **Solid Sawn**
- **Trusses**
- **I-Joists**

Legend

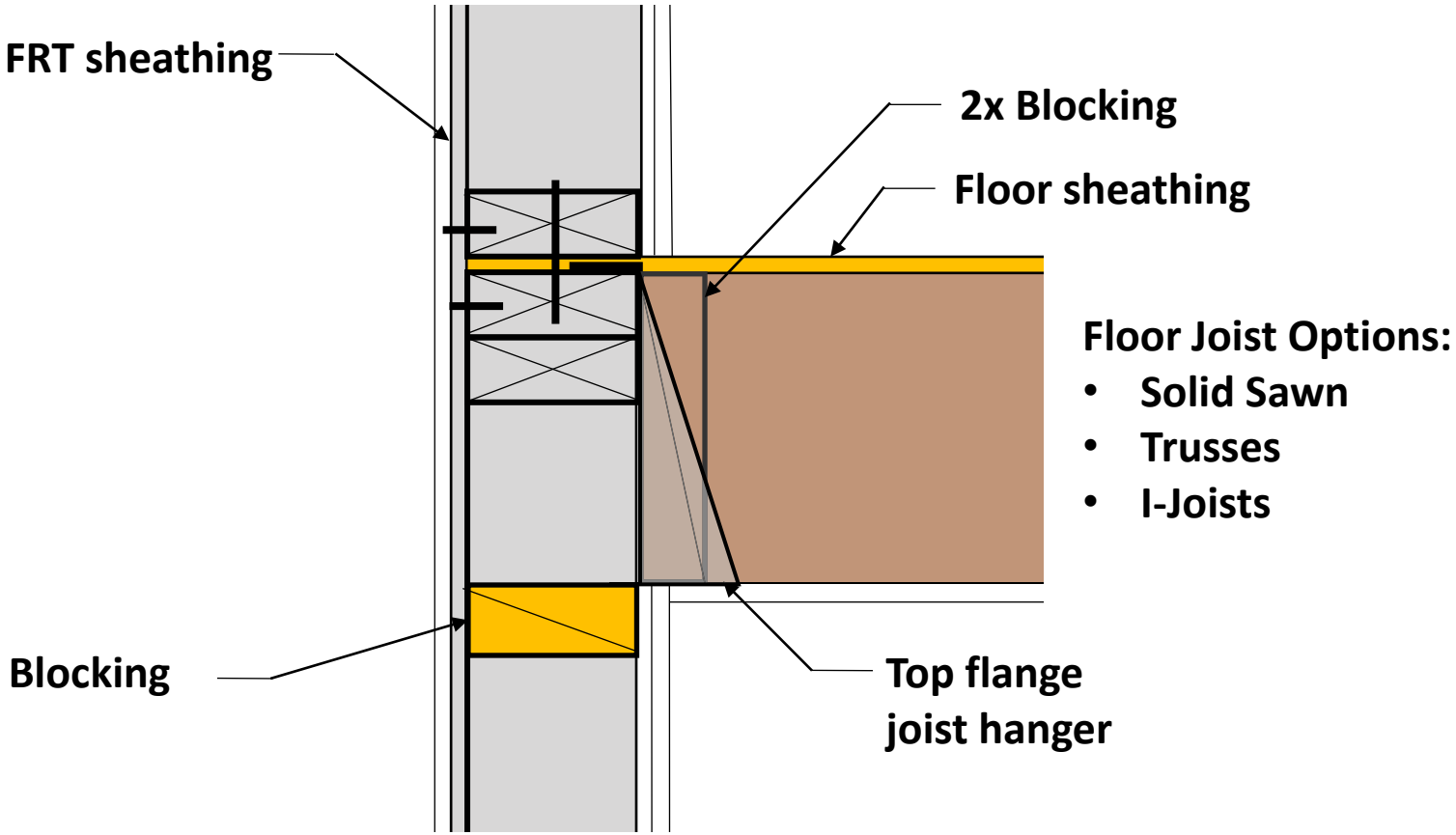
- **Untreated or FRT**
- **FRT Wood**
- **Untreated**

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



Floor Joist Options:

- **Solid Sawn**
- **Trusses**
- **I-Joists**

Legend

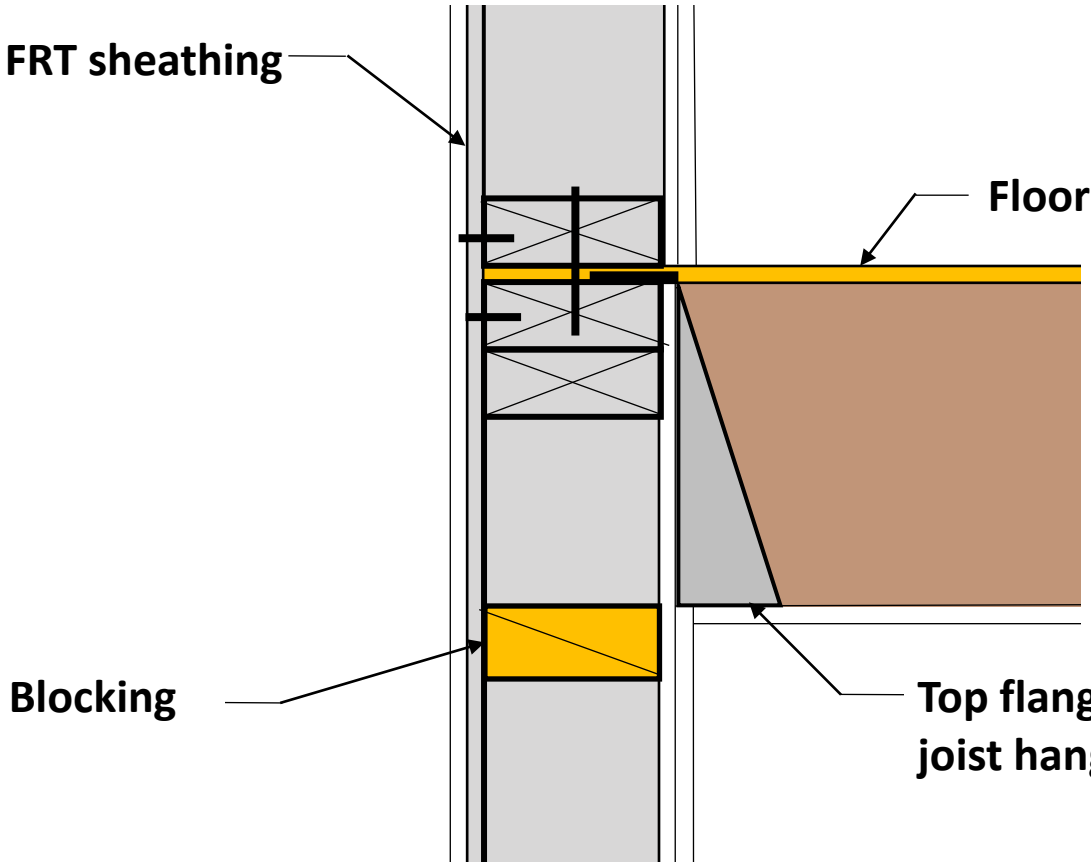
- **Untreated or FRT**
- **FRT Wood**
- **Untreated**

Rationale for detail approval:

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

Exterior Walls – Intersecting Floors

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



Floor Joist Options:

- **Solid Sawn**
- **Trusses**
- **I-Joists**

Legend

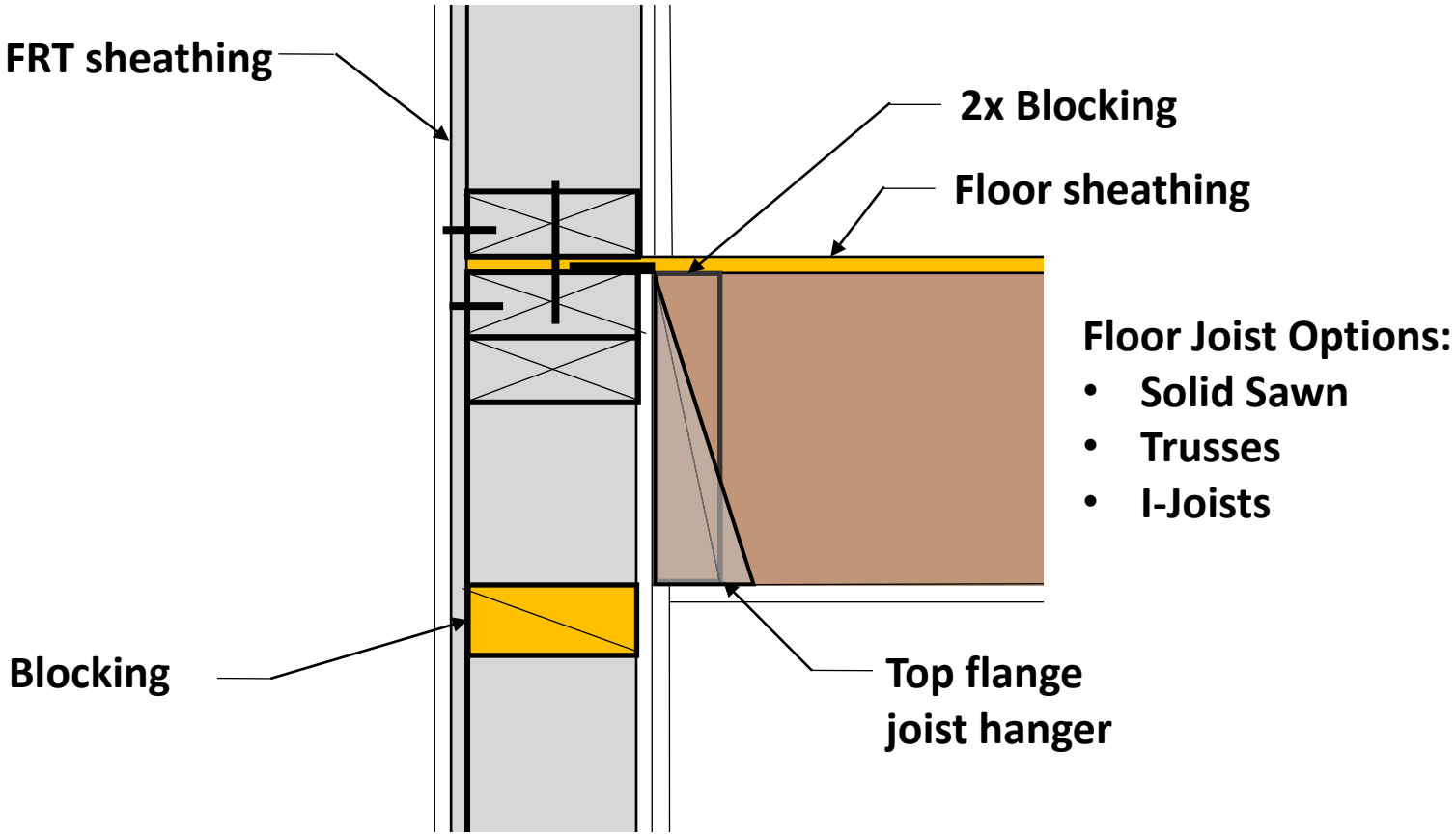
- **Untreated or FRT**
- **FRT Wood**
- **Untreated**

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



Legend

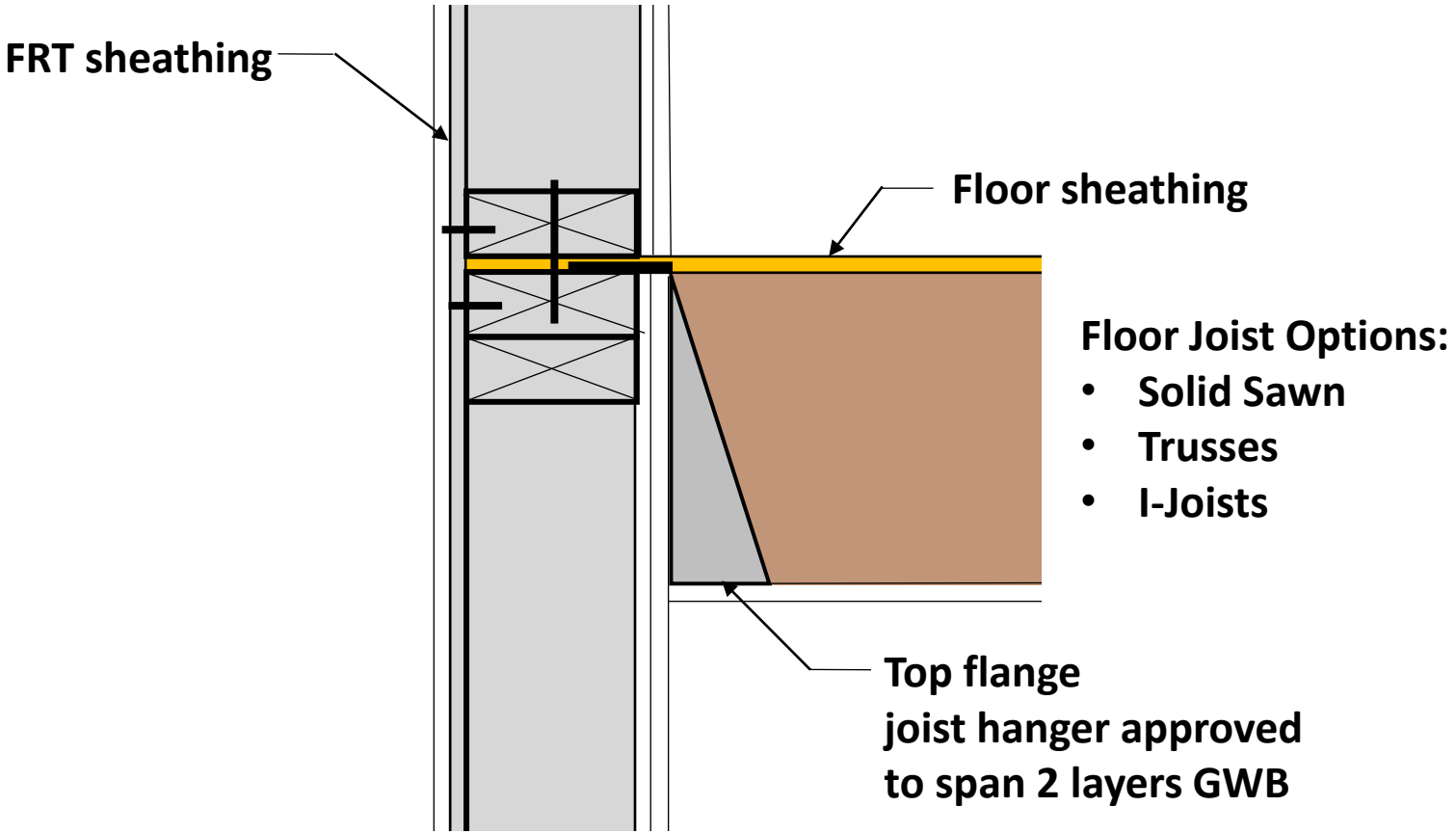
- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:

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

Exterior Walls – Intersecting Floors

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



Legend

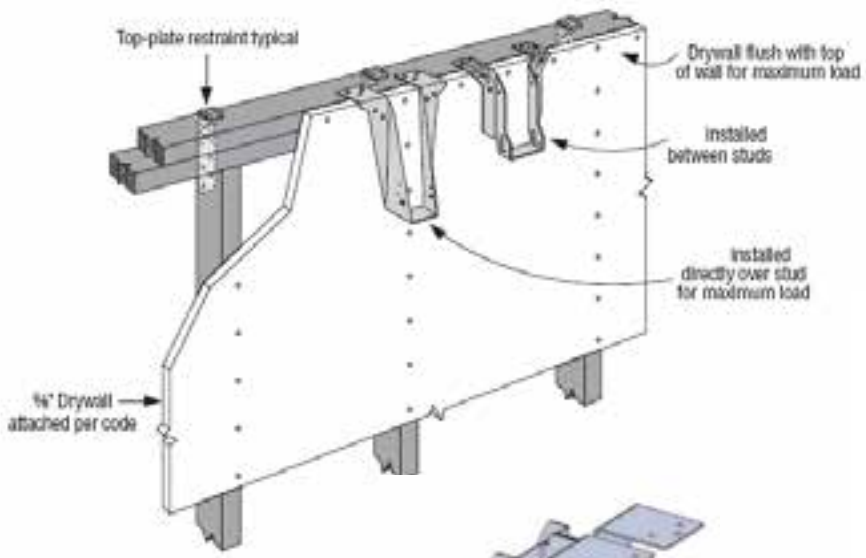
- Untreated or FRT
- FRT Wood
- Untreated

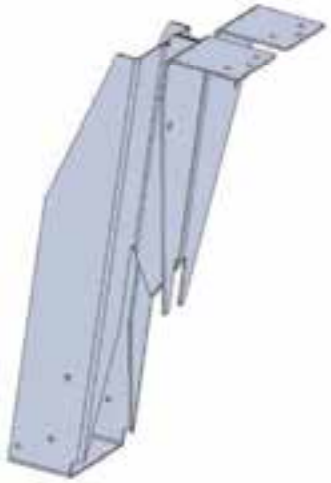
Rationale for detail approval:

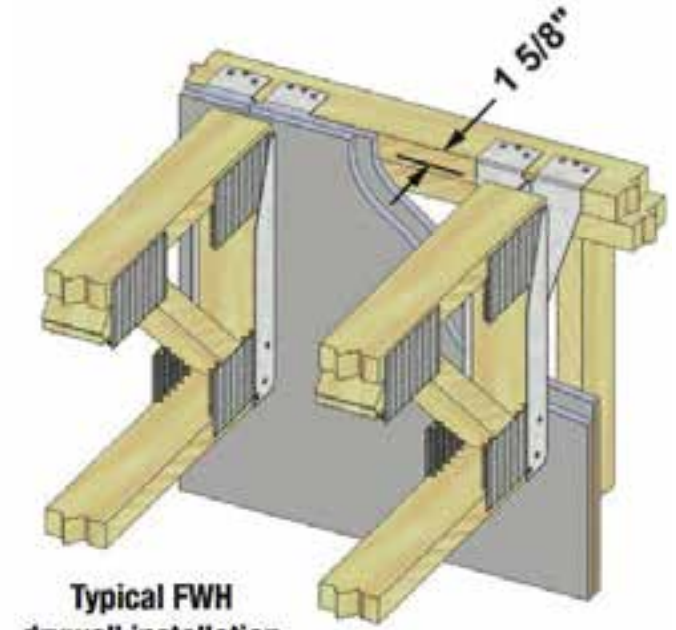
» Membranes on both side of wall provide fire resistance via their approved assembly

Over Gypsum Hangers

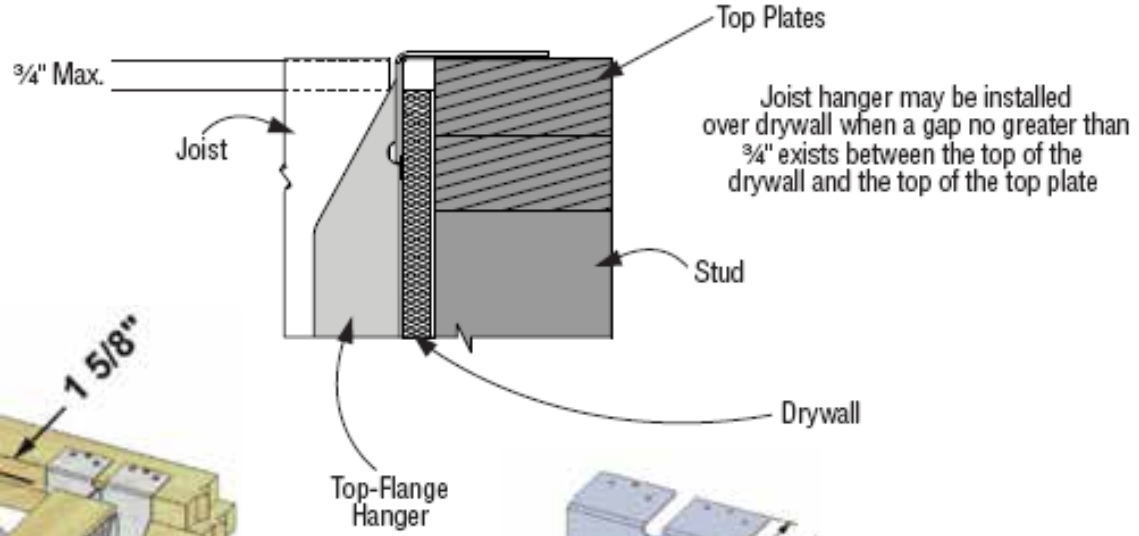
- Commonly called Fire Wall or Drywall Hangers

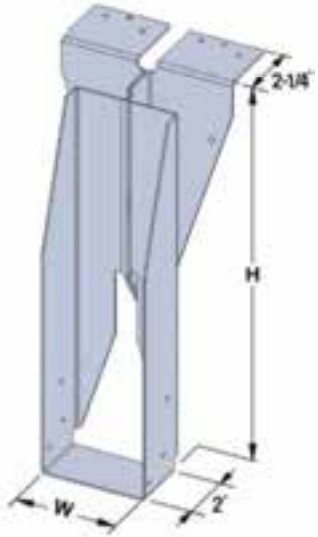






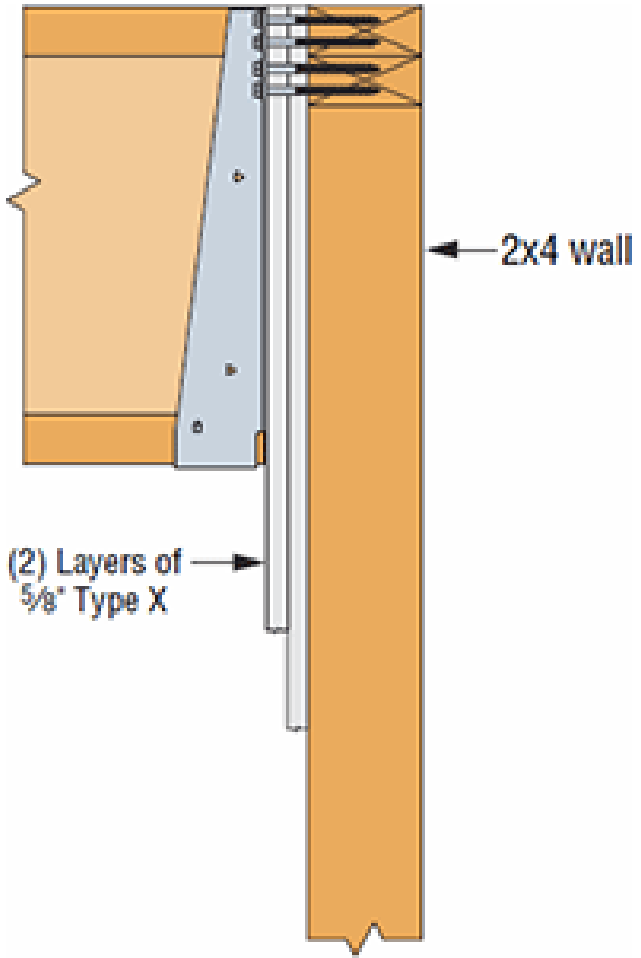
Typical FWH drywall installation using FWH-T Template

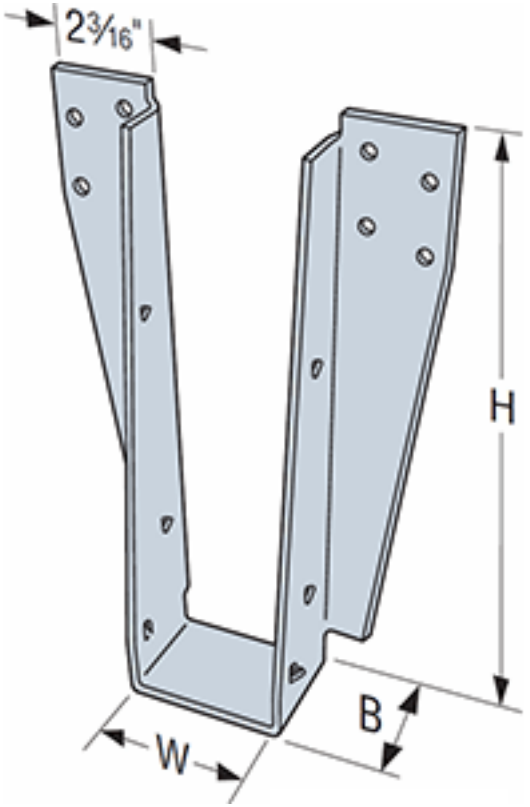




Over Gypsum Hangers

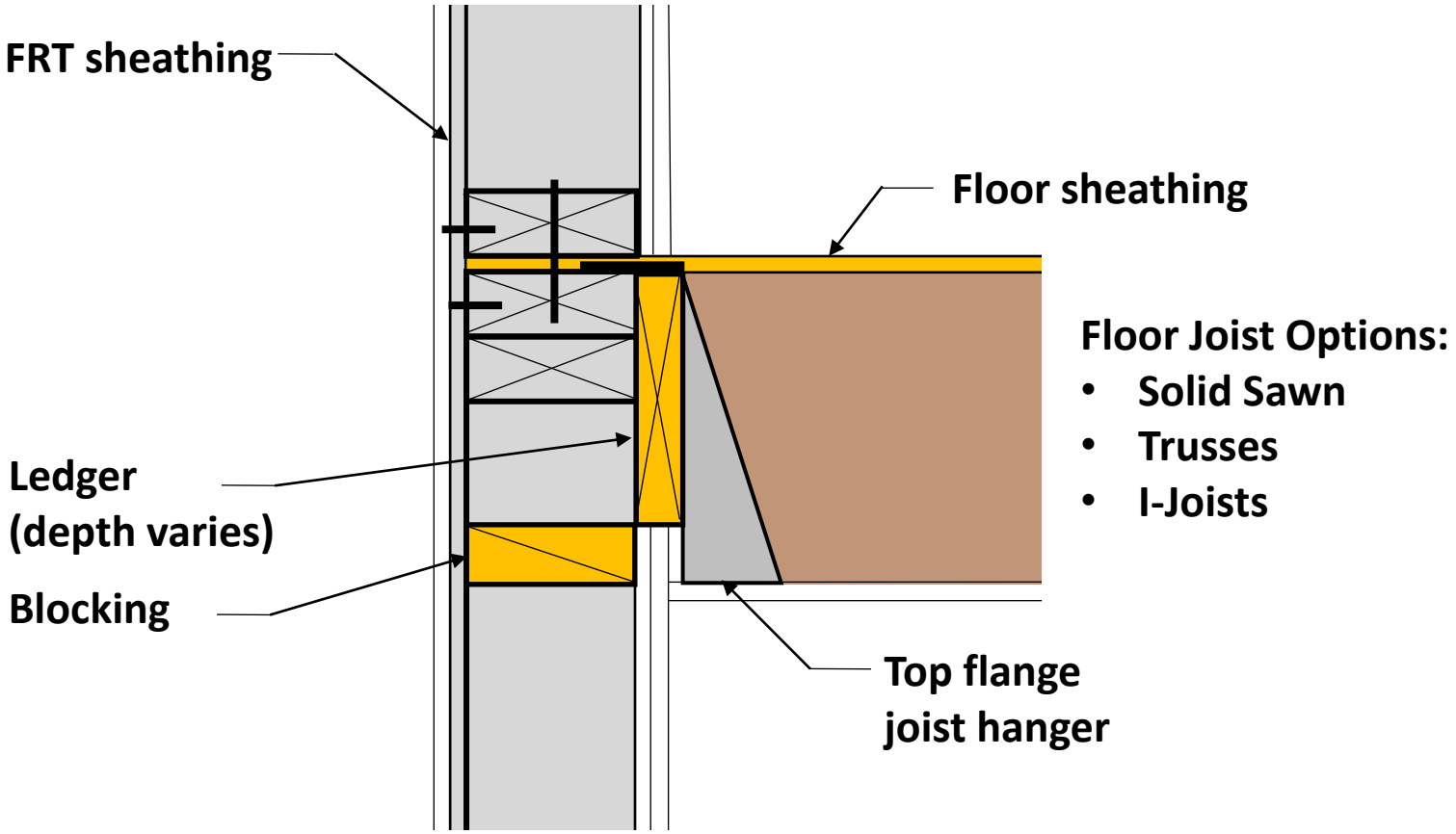
- Top Flange Hangers & Face Mount Hangers Available





Exterior Walls – Intersecting Floors

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



Floor Joist Options:

- **Solid Sawn**
- **Trusses**
- **I-Joists**

Legend

- **Untreated or FRT**
- **FRT Wood**
- **Untreated**

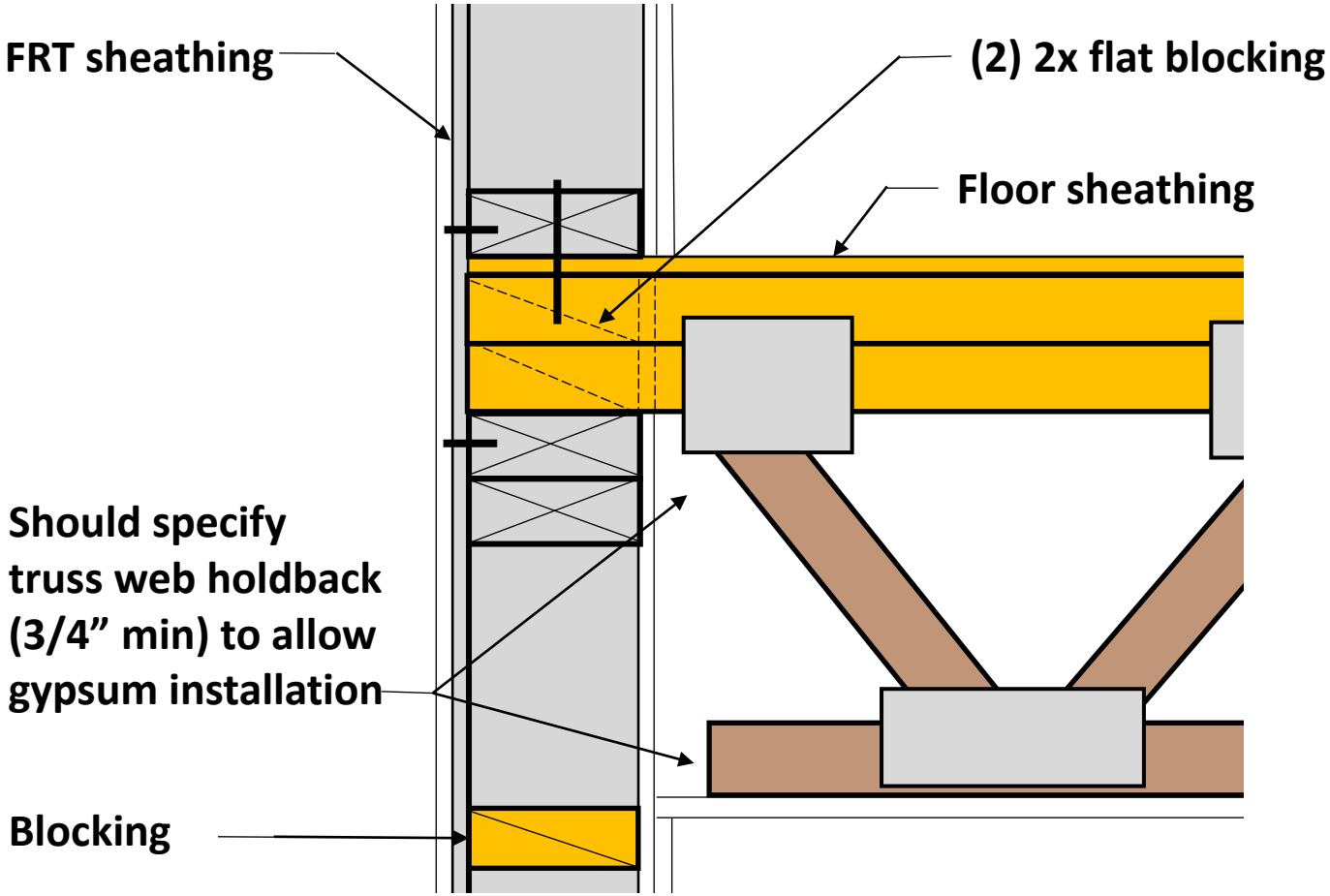
This detail is often used with a balcony; ledger is thru-bolted

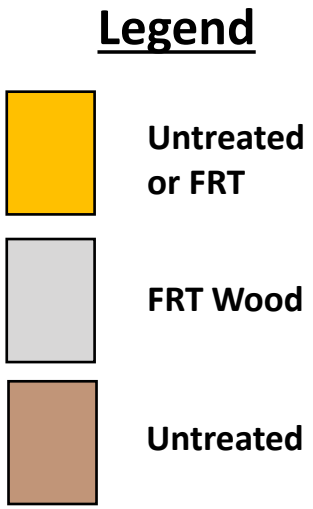
Rationale for detail approval:

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

Exterior Walls – Intersecting Floors

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



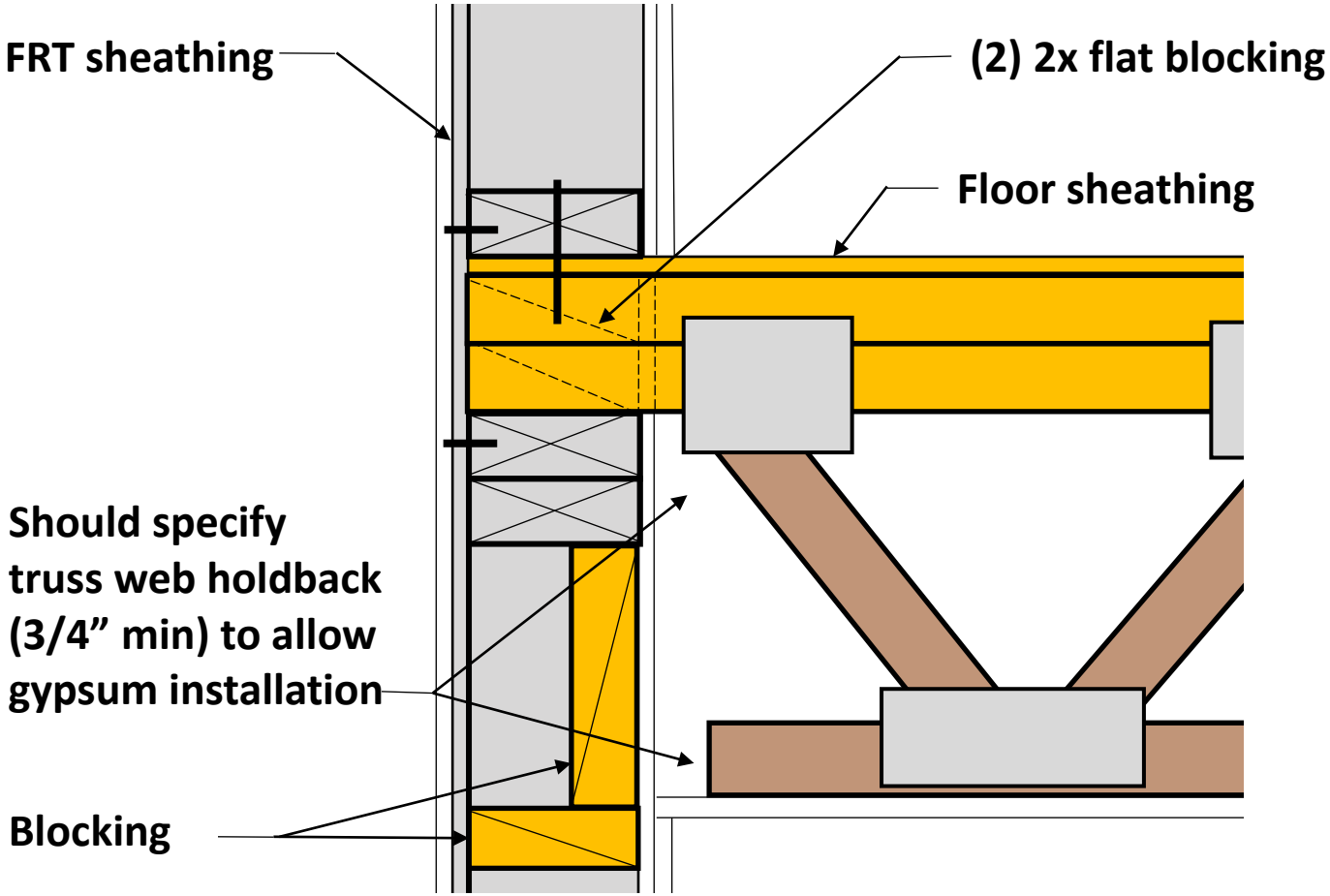


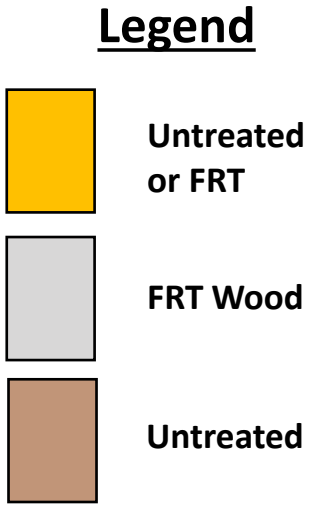
Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor cavity ceiling membrane provides 1 hr
- 1 layer of wall membrane provides 2^{n}d hr

Exterior Walls – Intersecting Floors

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



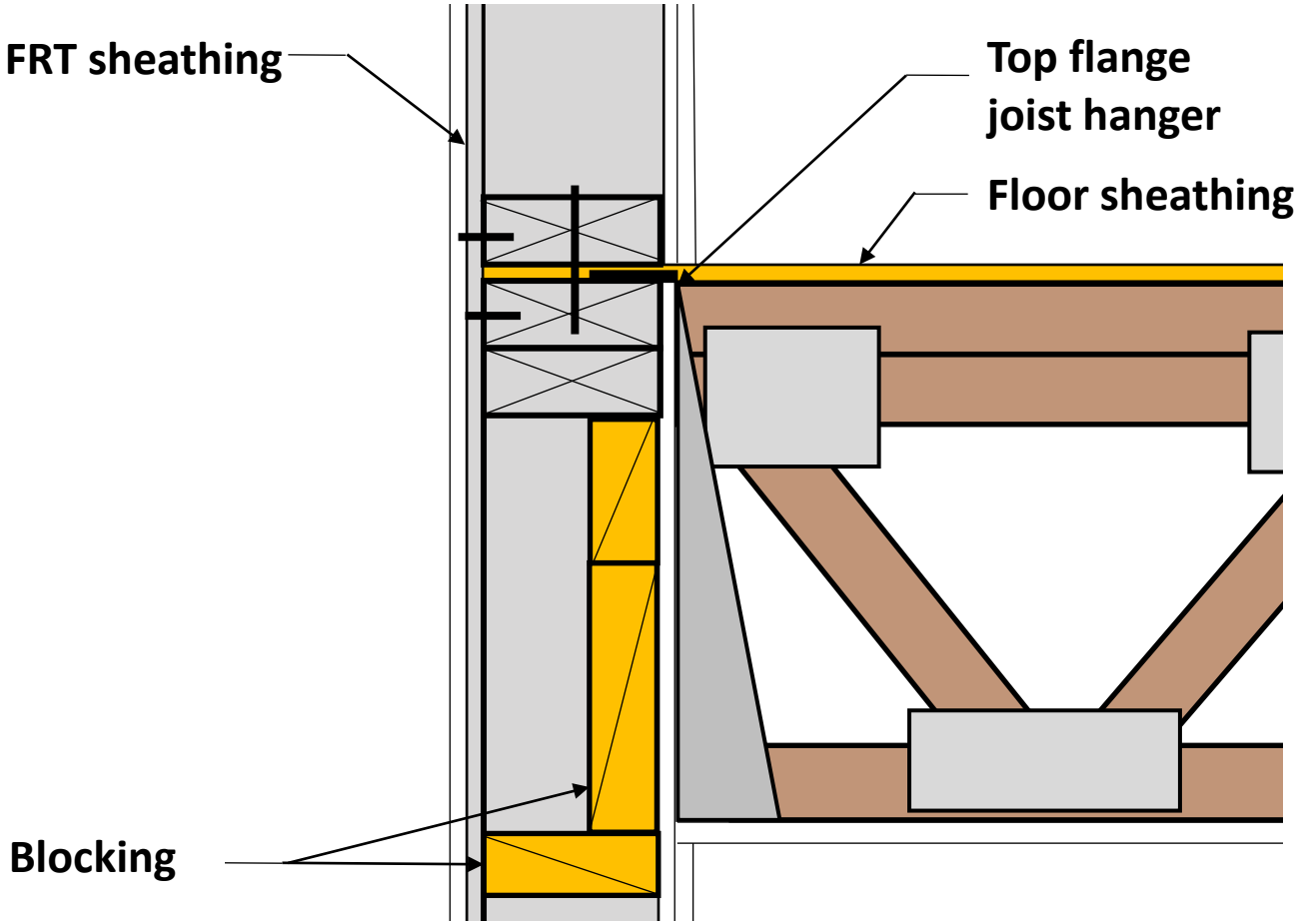


Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor cavity, blocking in wall provides 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

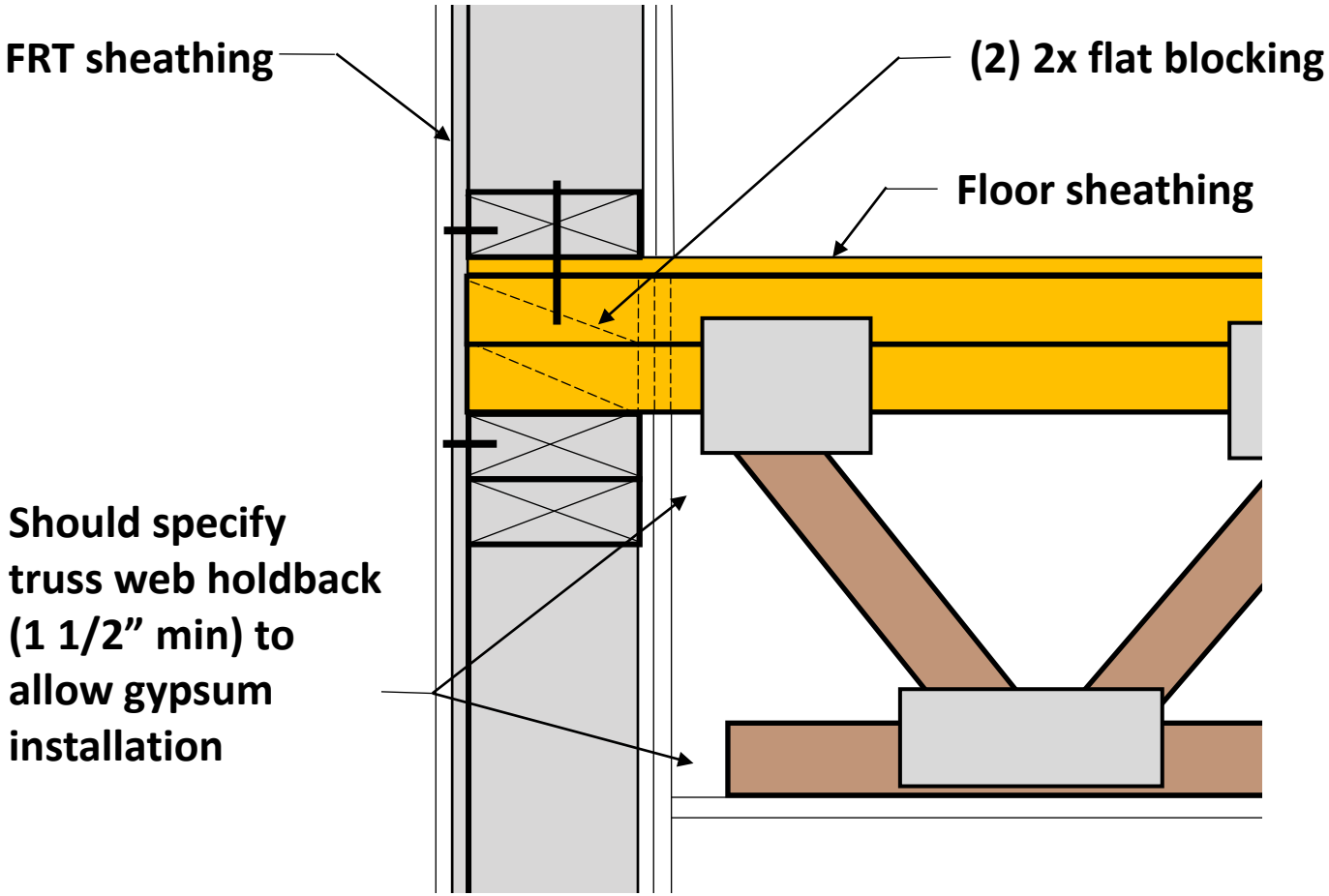
- Untreated or FRT
- FRT Wood
- Untreated

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

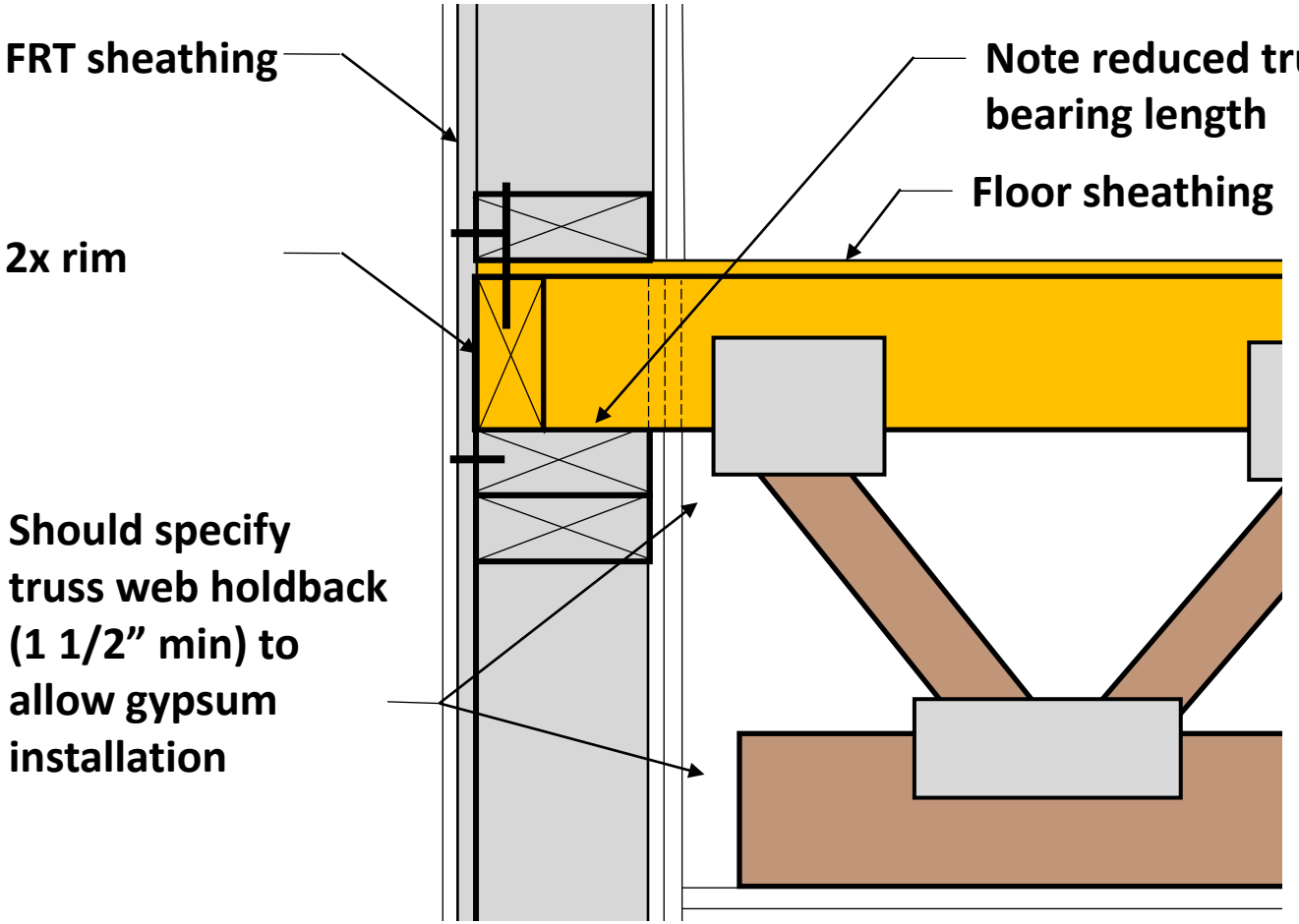
- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:

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

Exterior Walls – Intersecting Floors

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



Legend

- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:

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

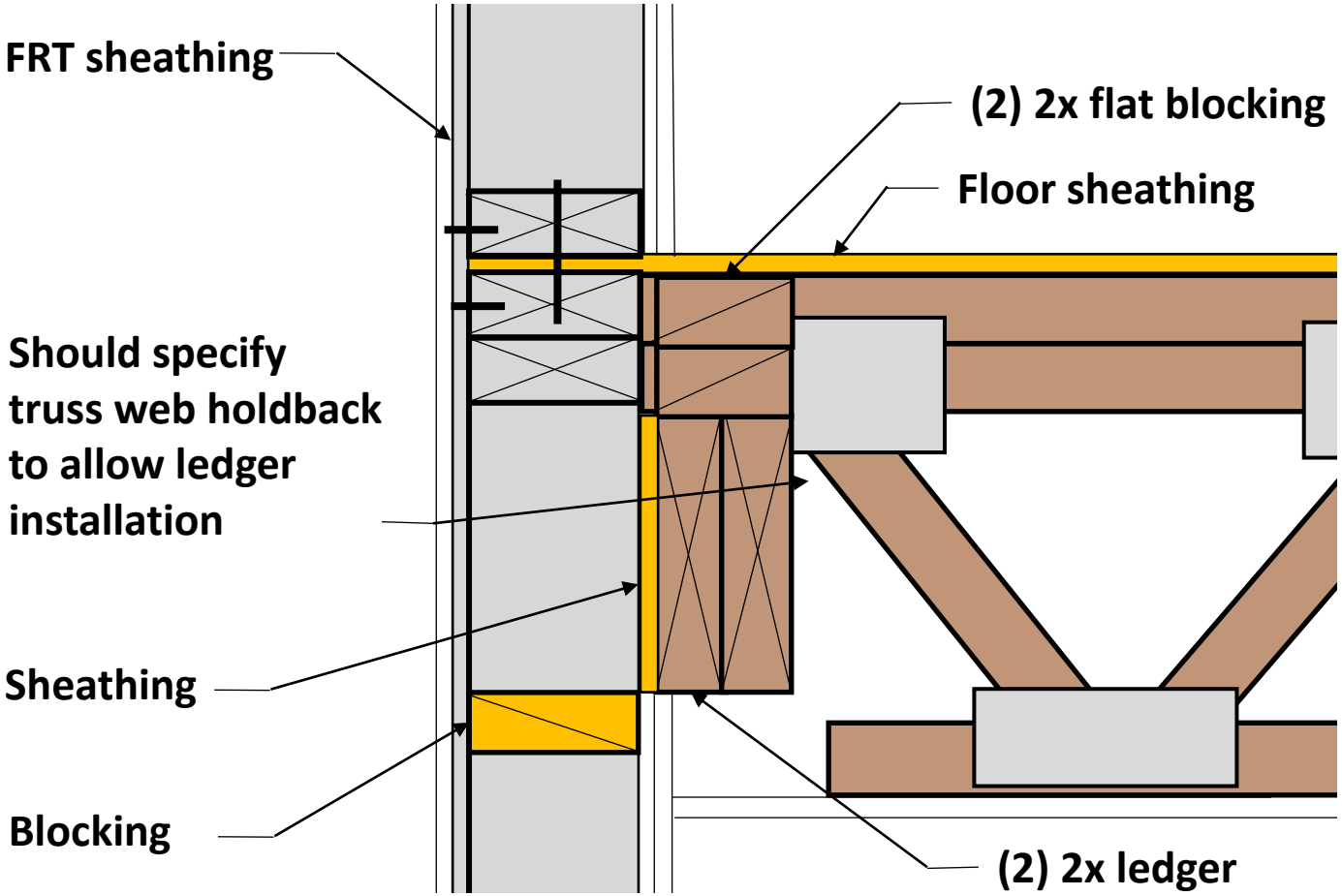
Exterior Walls – Intersecting Floors

Exterior Walls – Intersecting Floors

Gaps betweem 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 & Ledger



Legend

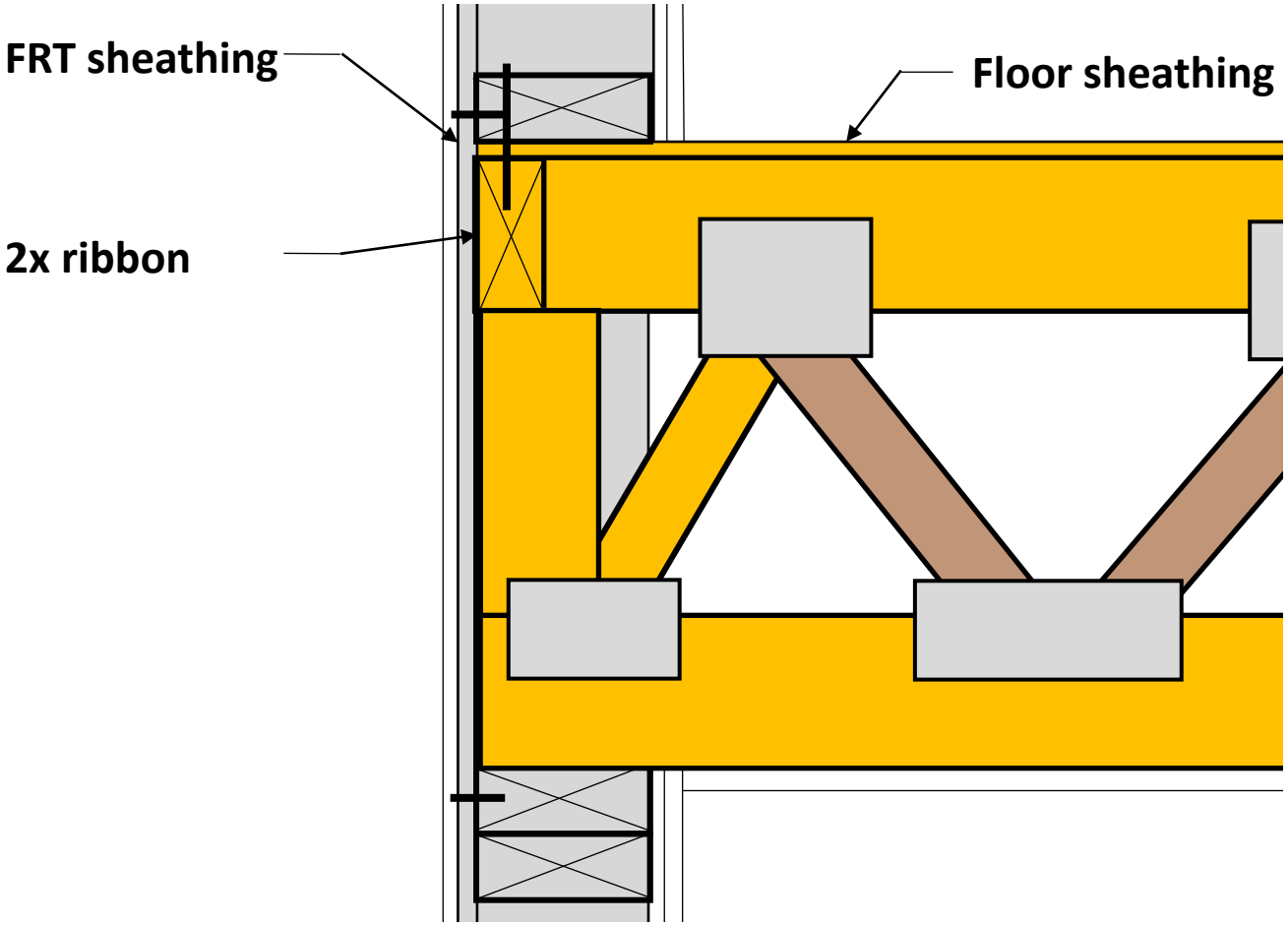
- Untreated or FRT
- FRT Wood
- Untreated

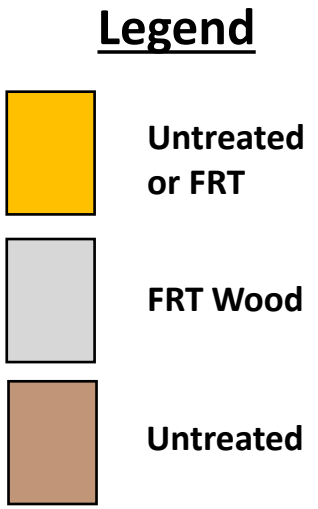
Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly
- At top chords, ledger & sheathing provide continuity

Exterior Walls – Intersecting Floors

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



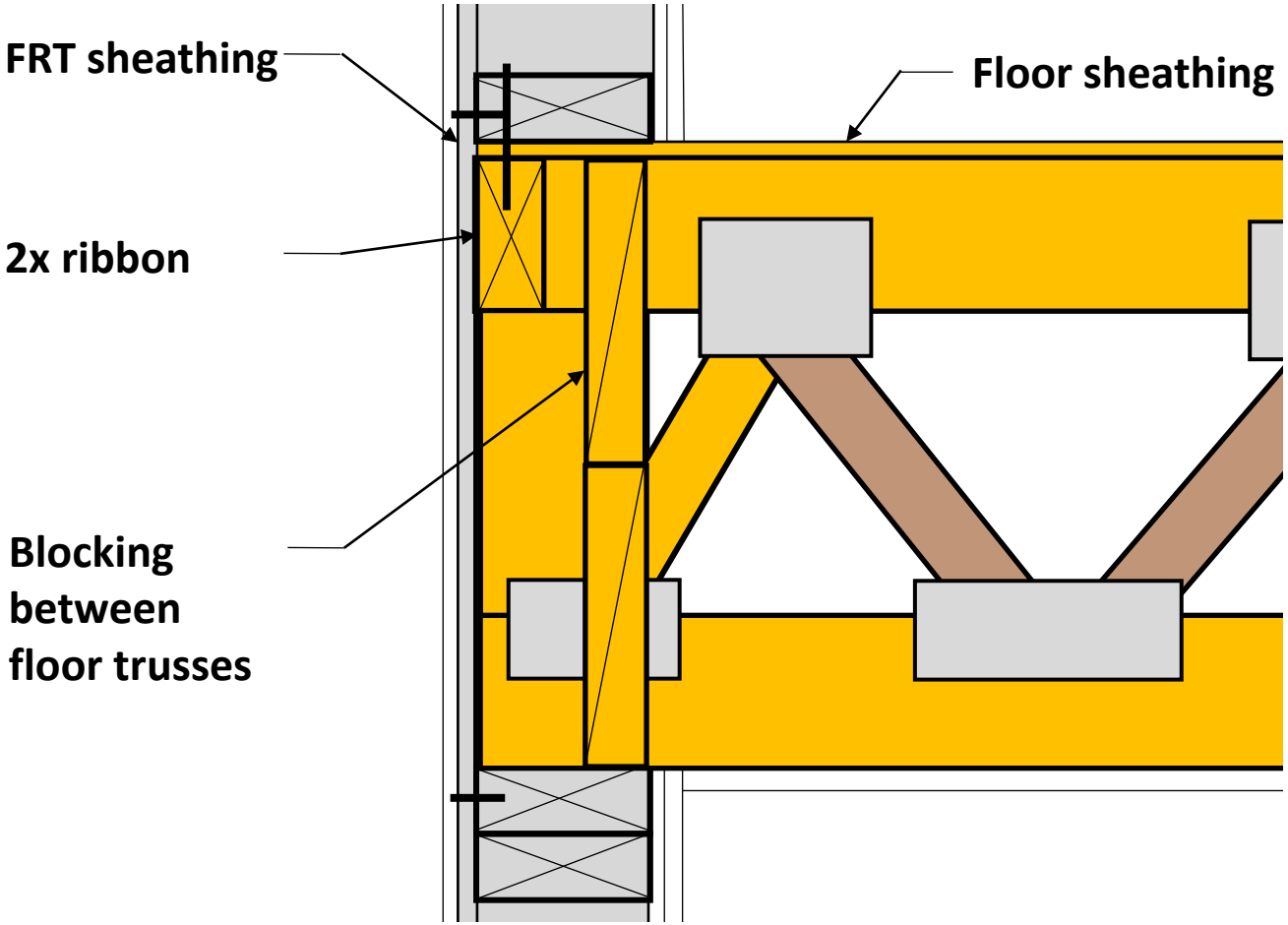


Rationale for detail approval:

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

Exterior Walls – Intersecting Floors

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



Legend

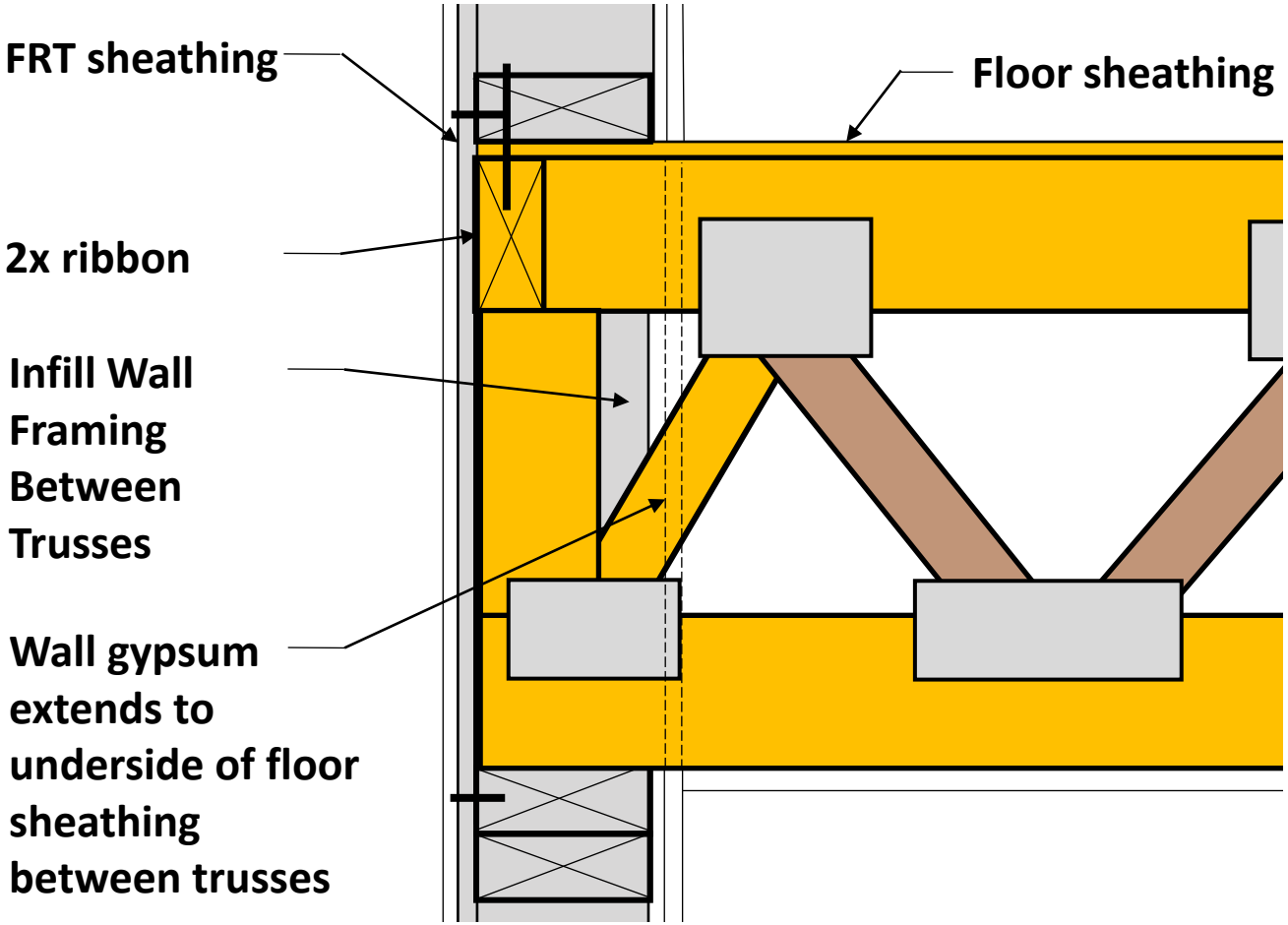
- Untreated or FRT
- FRT Wood
- Untreated

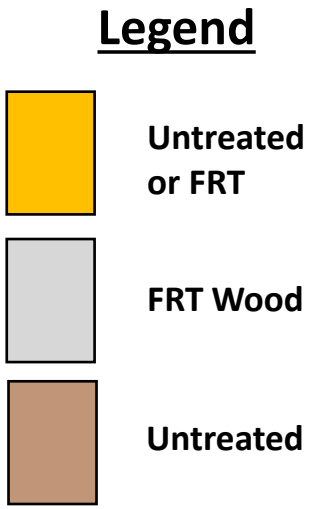
Rationale for detail approval:

- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor cavity, 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/ Bottom Chord Bearing

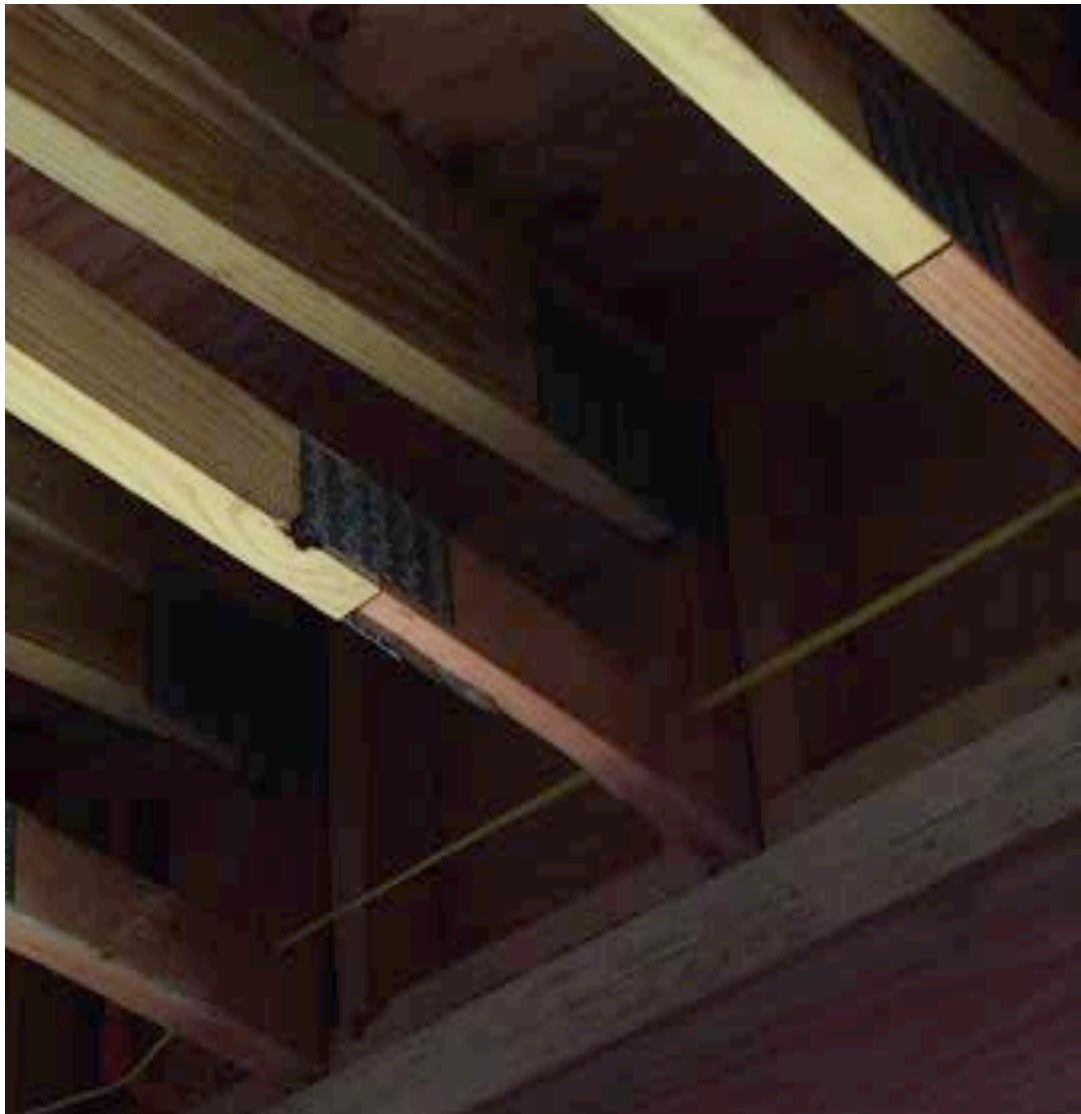




Rationale for detail approval:

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

Exterior Walls – Intersecting Floors



IBC 2024 Changes: Floor to Wall Intersections

- Two key changes that have been approved for inclusion in the 2024 IBC clarify platform framed floor to wall details

- Code change 1: clarifies fire-resistance continuity requirements for exterior walls:

2021 International Building Code

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

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

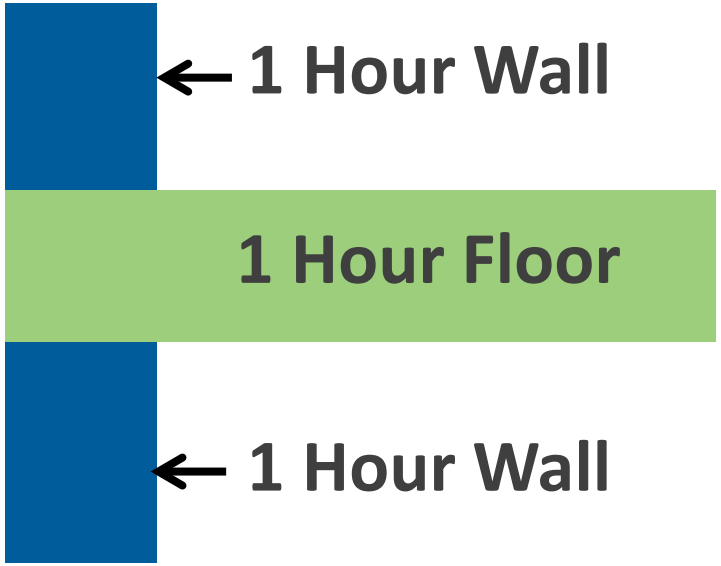
IBC 2024 Changes: Floor to Wall Intersections

2021 International Building Code

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

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

- **Example 1:** Type VA Construction, Group R-2
- 1 hour exterior wall, 1 hour floor
- Fire-resistance rating extends from the top of the floor/ceiling assembly below to the underside of an assembly having a fire-resistance rating equal to the exterior wall



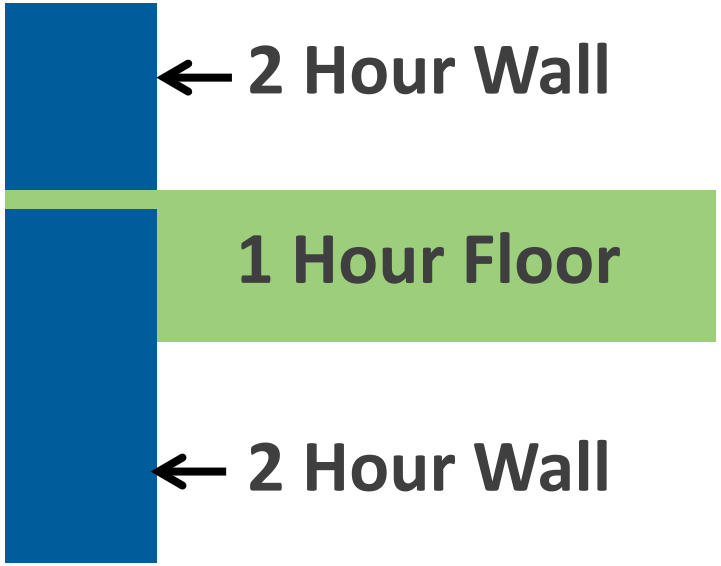
IBC 2024 Changes: Floor to Wall Intersections

2021 International Building Code

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

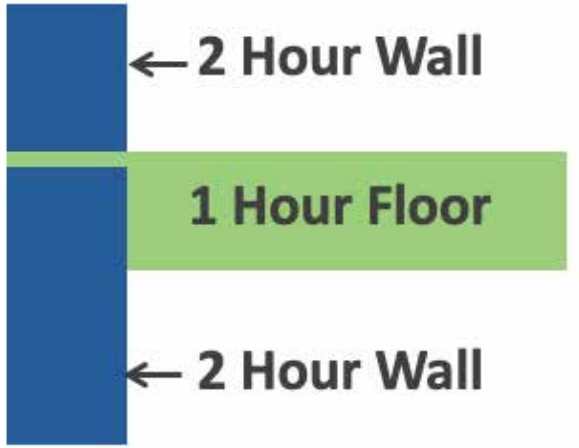
1. The underside of the floor or roof sheathing, deck or slab above.
2. The underside of a ~~one-hour fire-resistance rated~~ floor/ceiling or roof/ceiling ~~assembly.~~ assembly having a fire-resistance rating equal to or greater than the exterior wall and the fire separation distance is greater than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

- **Example 2:** Type IIIA Construction, Group R-2
- 2 hour exterior wall, 1 hour floor
- Fire-resistance rating extends from the top of the floor/ceiling assembly below to the underside of the floor sheathing above

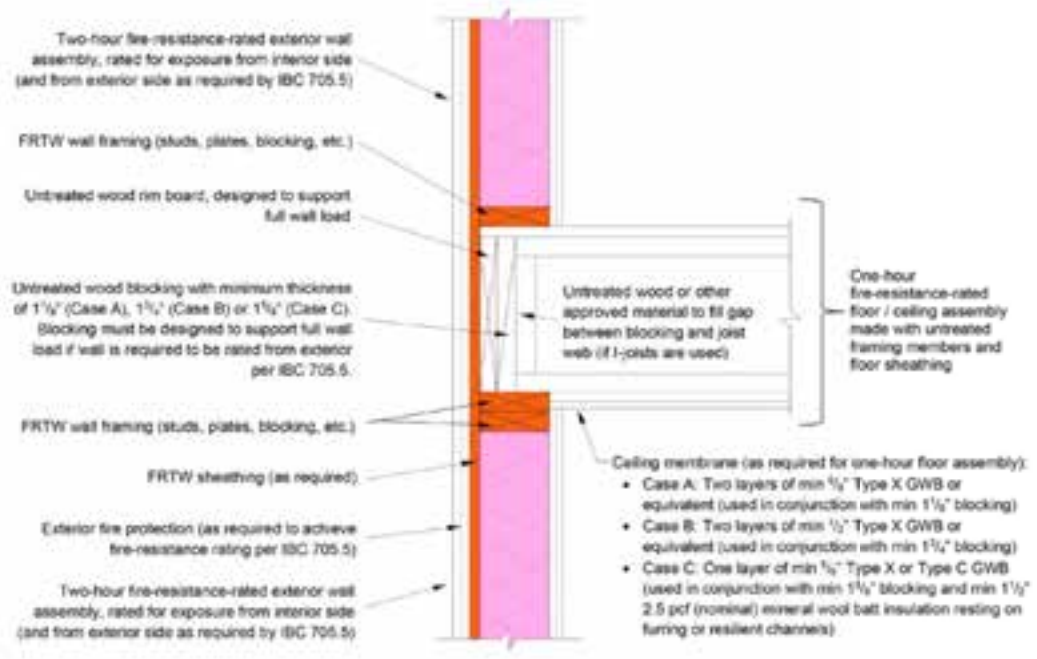


IBC 2024 Changes: Floor to Wall Intersections

- **Example 2:** Type IIIA Construction, Group R-2
- 2 hour exterior wall, 1 hour floor



- Since FRR of exterior wall is greater than FRR of floor, the exterior wall's FRR must extend to the underside of the floor sheathing. As noted previously, this doesn't mean that the wall needs to fully bypass the floor, but we do need to demonstrate the wall's 2 hour FRR through the depth of the floor.



IBC 2024 Changes: Floor to Wall Intersections

- Two key changes that have been approved for inclusion in the 2024 IBC clarify platform framed floor to wall details.

- Code change 2: clarifies material requirements for floor construction at exterior walls intersections (i.e. does floor sheathing, joists, rim board at exterior walls in Type III Construction need to be FRTW?):

705.6.1 ~~Supporting construction~~ Floor Assemblies in Type III Construction . ~~Construction that~~ In Type III construction where a floor assembly supports gravity loads from ~~fire-resistance-rated exterior walls shall have a fire-resistance rating that is equal to or greater than the required fire resistance rating of the supported wall. For achieving the required fire resistance rating for exposure from the interior of the building, ceiling materials shall be permitted to contribute to the required fire-resistance of the supporting construction.~~ an exterior wall, the fire-resistance rating of the portion of the floor assembly that supports the exterior wall shall not be less than the fire-resistance rating required for the exterior wall in Table 601. The fire-resistance rating provided by the portion of the floor assembly supporting and within the plane of the exterior wall shall be permitted to include the contribution of the ceiling membrane when considering exposure to fire from the inside. Where a floor assembly supports gravity loads from an exterior wall, the building elements of the floor construction within the plane of the exterior wall, including but not limited to, rim joists, rim boards, and blocking, shall be in accordance with the requirements for interior building elements of Type III Construction.

IBC 2024 Changes: Floor to Wall Intersections

705.6.1 ~~Supporting construction~~ Floor Assemblies in Type III Construction . ~~Construction that~~ In Type III construction where a floor assembly supports gravity loads from ~~fire-resistance-rated exterior walls shall have a fire-resistance rating that is equal to or greater than the required fire resistance rating of the supported wall. For achieving the required fire resistance rating for exposure from the interior of the building, ceiling materials shall be permitted to contribute to the required fire-resistance of the supporting construction.~~ an exterior wall, the fire-resistance rating of the portion of the floor assembly that supports the exterior wall shall not be less than the fire-resistance rating required for the exterior wall in Table 601. The fire-resistance rating provided by the portion of the floor assembly supporting and within the plane of the exterior wall shall be permitted to include the contribution of the ceiling membrane when considering exposure to fire from the inside. Where a floor assembly supports gravity loads from an exterior wall, the building elements of the floor construction within the plane of the exterior wall, including but not limited to, rim joists, rim boards, and blocking, shall be in accordance with the requirements for interior building elements of Type III Construction.

- Where a floor assembly supports gravity loads from an exterior wall, the building elements of the floor construction within the plane of the exterior wall, including but not limited to rim joists, rim boards, and blocking shall be in accordance with the requirements for interior building elements of Type III Construction.

- Interior building elements (floor construction) in Type III is not required to be FRTW

Outline

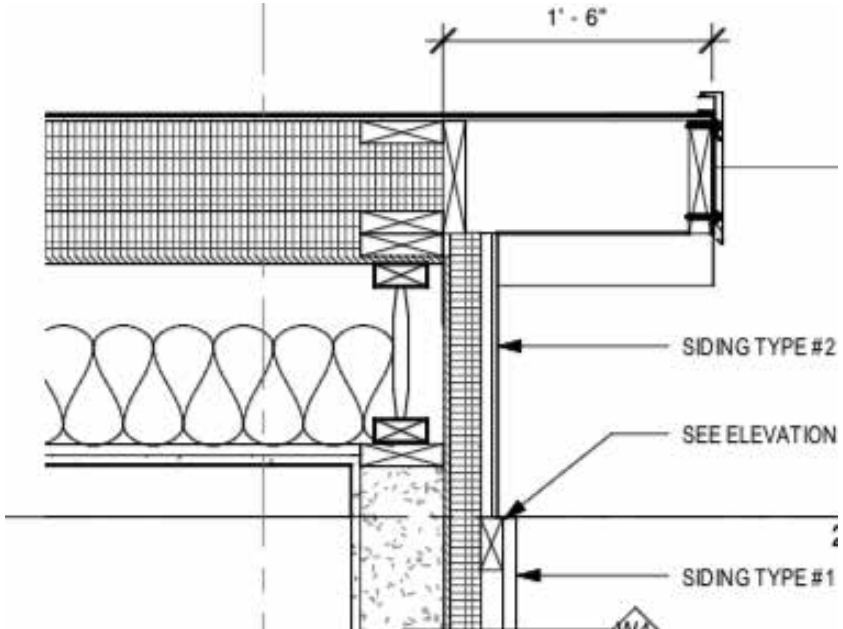
- Context for Type III Construction
- Fire Rating Requirements for Exterior Walls
  - Assembly Asymmetry
  - Addition of Wood Structural Panel
  - Bearing vs. Non-bearing
  - Vertical offsets
- Exterior Wall to Floor Intersection
  - Fire Resistant Continuity
  - Fire Retardant Continuity
- **Parapets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

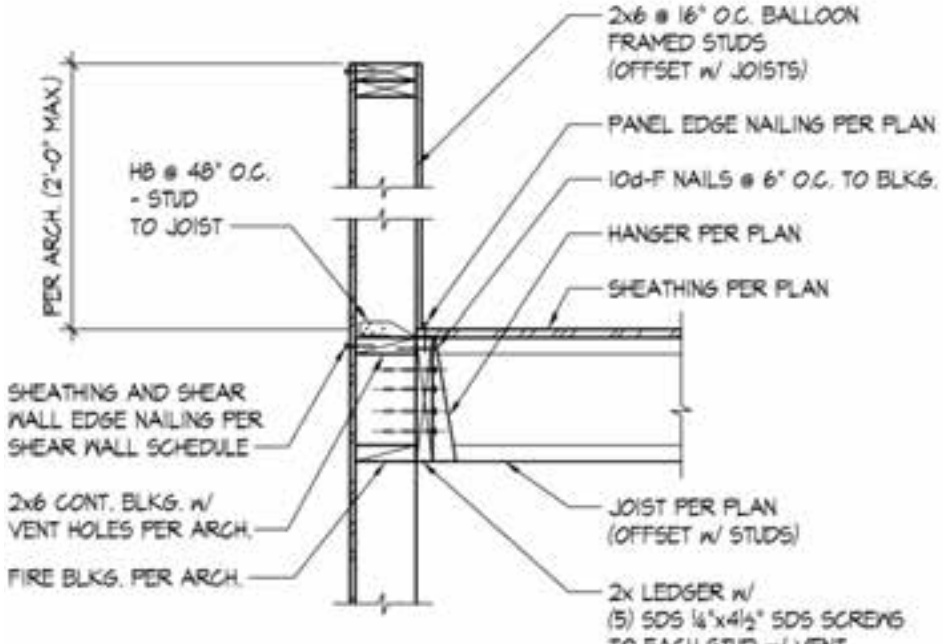
1430 Q, The HR Group Architects, Buehler Engineering, Greg Folkins Photography

Exterior Wall – Roof Intersection

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

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



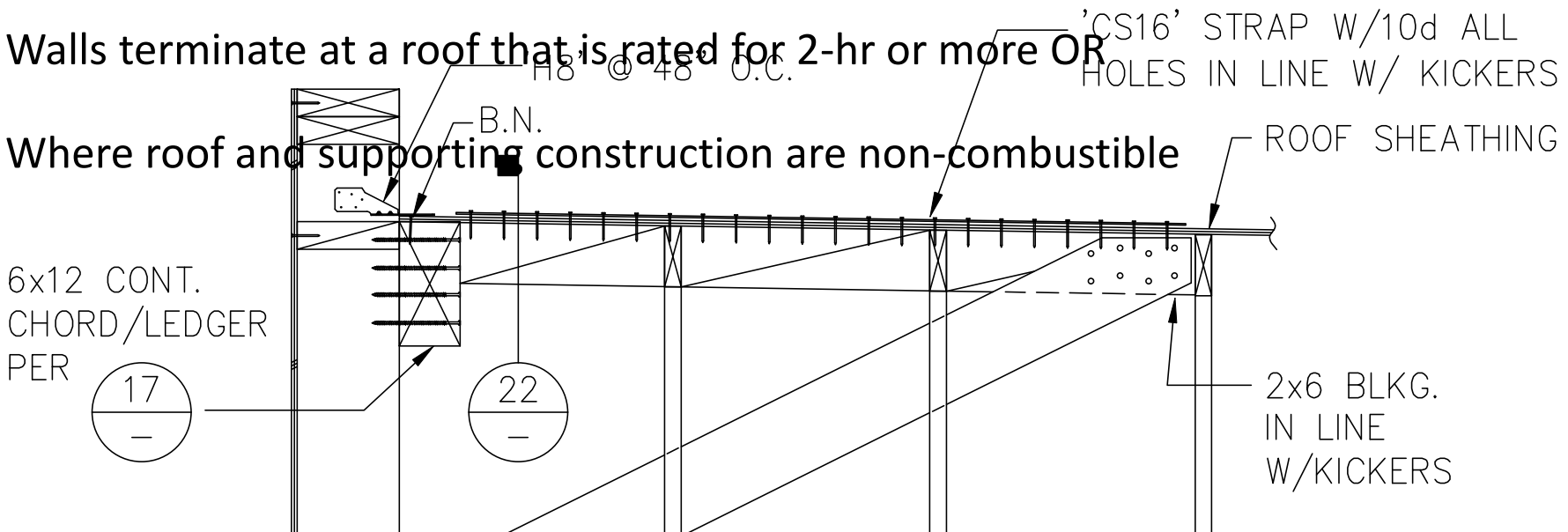


Parapets – IBC 705.11

- Parapets shall be provided on exterior walls of buildings.
- **Exceptions:**

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

   Where roof and supporting construction are non-combustible



Parapets – IBC 705.11

- Parapets shall be provided on exterior walls of buildings.

- **Exceptions:**

4. 1hr rated exterior walls that terminate at the underside of the roof sheathing where:

    - Framing parallel to wall is not less than 1-hr rated for 4’ for Group R/U and 10’ for other occupancies
    - Framing perpendicular to wall is 1-hr rated for entire span
    - Openings are not located within 5’ of the exterior wall for Group R/U and 10’ for other occupancies.
    - Entire building has class B roofing

5. Groups R-2 and R-3 where roofing is Class C, 1-hr rated exterior walls that terminate at the underside of the roof sheathing where:

    - Sheathing is FRT for 4’ OR 5/8 Type X Gyp to underside of sheathing

Parapets – IBC 705.11.1

- Parapets, where required, shall have:
  - » the same fire resistance as the supporting wall
  - » minimum height of 30” above roof surface

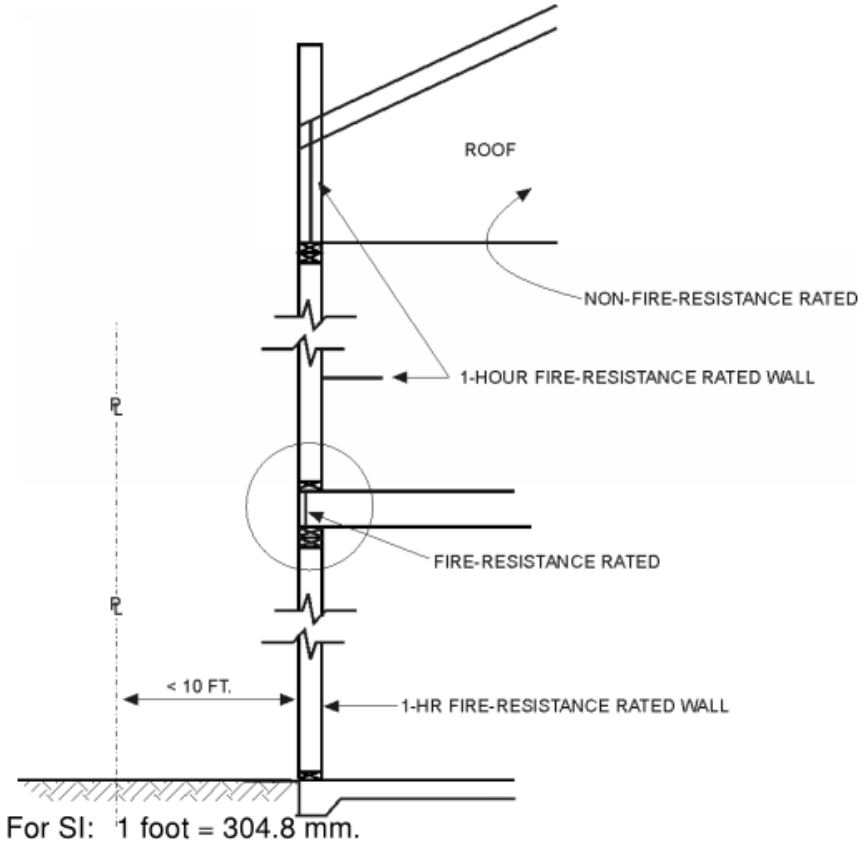


Figure 705.6
TYPE IIB AND VB EXTERIOR FIRE-RESISTANCE-RATED WALL CONTINUITY AND STRUCTURAL STABILITY

Code Commentary - IBC 705.11.1

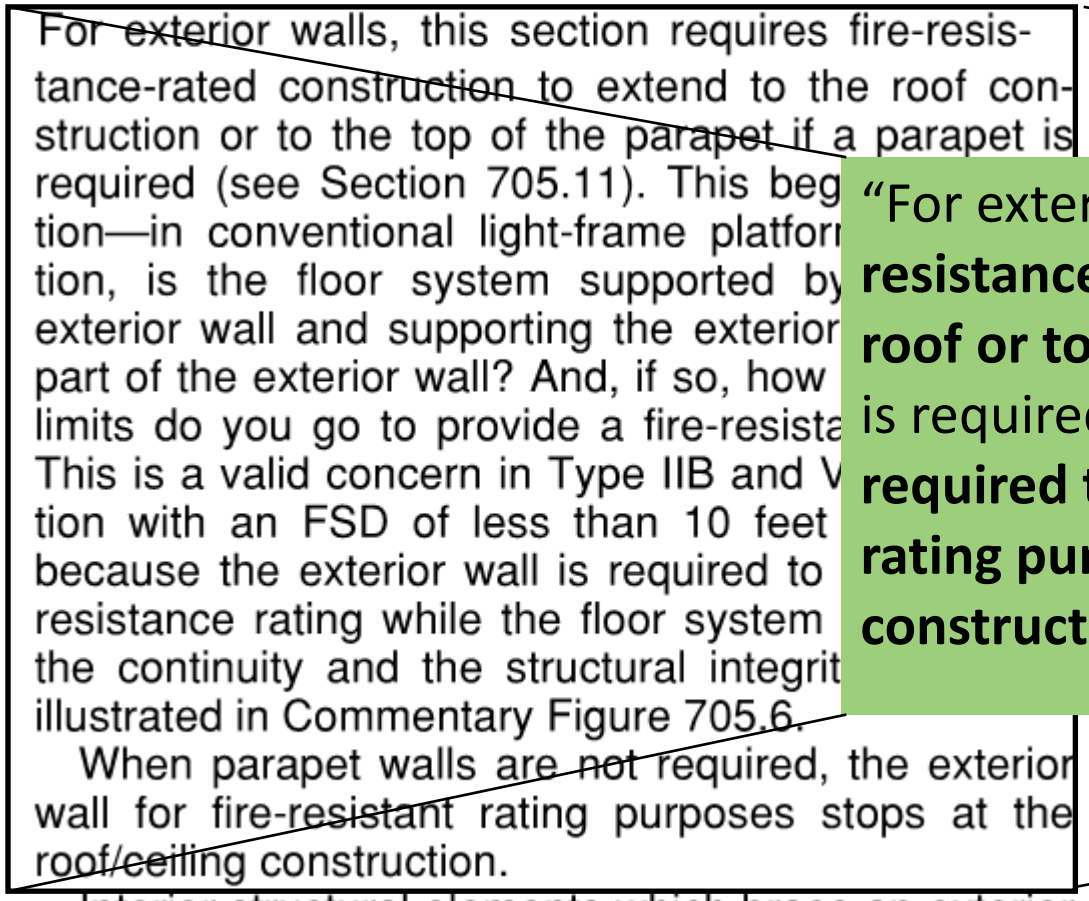
- If a building is type III construction and the exterior walls are framed with fire-retardant treated wood, do the parapets need to be framed with FRTW?

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

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

Code Commentary - 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 beg
tion—in conventional light-frame platfor
tion, is the floor system supported by
exterior wall and supporting the exterior
part of the exterior wall? And, if so, how
limits do you go to provide a fire-resista
This is a valid concern in Type IIB and V
tion with an FSD of less than 10 feet
because the exterior wall is required to
resistance rating while the floor system
the continuity and the structural integrit
illustrated in Commentary Figure 705.6.

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

Interior structural elements which brace an exterior

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

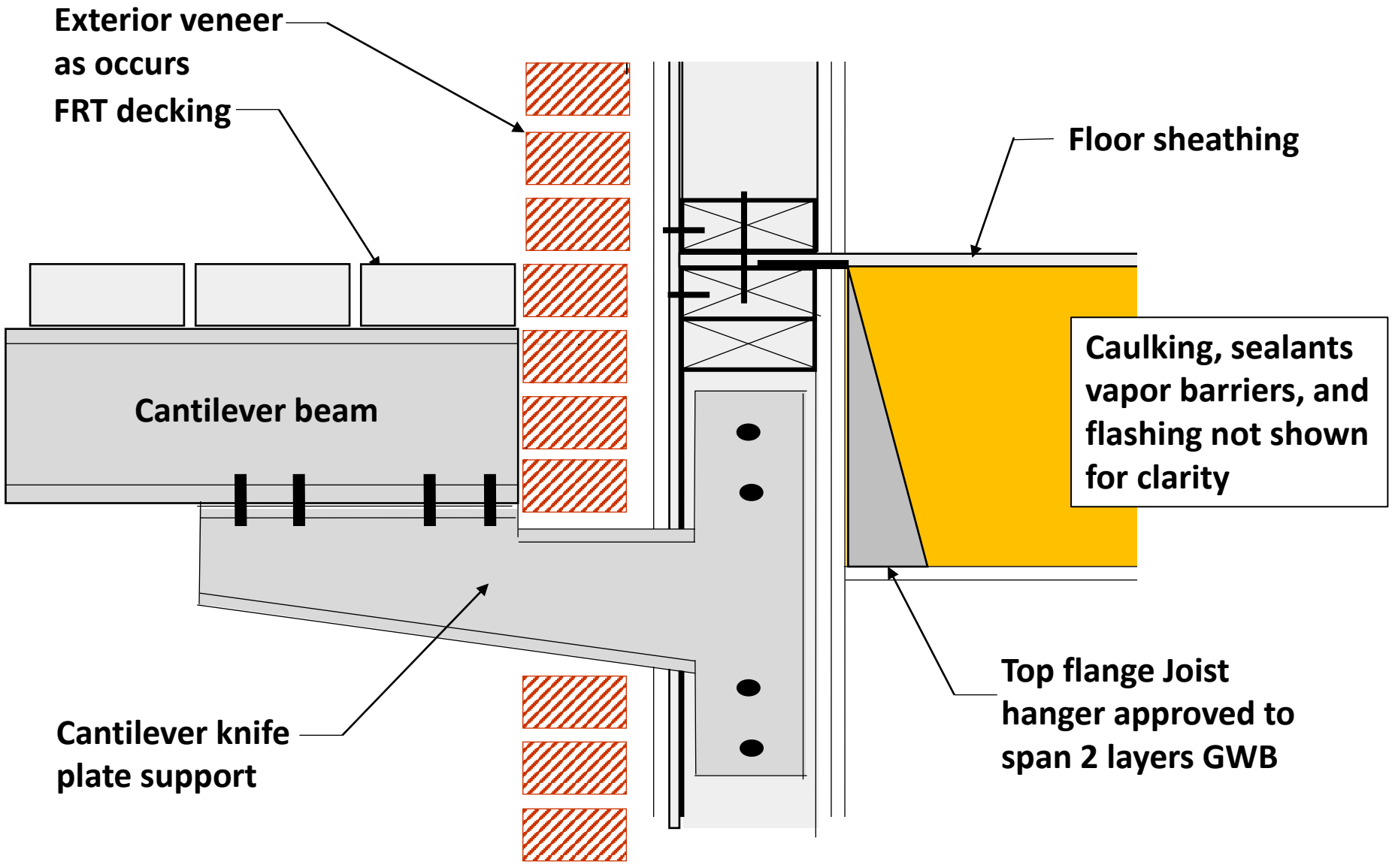
Balconies – IBC 705.2.3.1

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

Balconies – IBC 705.2.3.1

- So….
- For Type III or V balcony options are:
  1. **Non-combustible**: no sprinklers, no fire rating
  2. **FRT**: no fire sprinklers, no fire rating
  3. **Type IV**: no fire sprinklers, no fire rating
  4. Non-treated: **with fire sprinkler**, no fire rating
  5. Non-treated: no sprinkler, **fire rated per 601 & 602**

Balconies – Exterior Wall Penetration



Questions? Ask me anything.

John O'Donald II, PE

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

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