



Code Compliant Fire-Resistance Design for Wood Construction

(BCD220-2)

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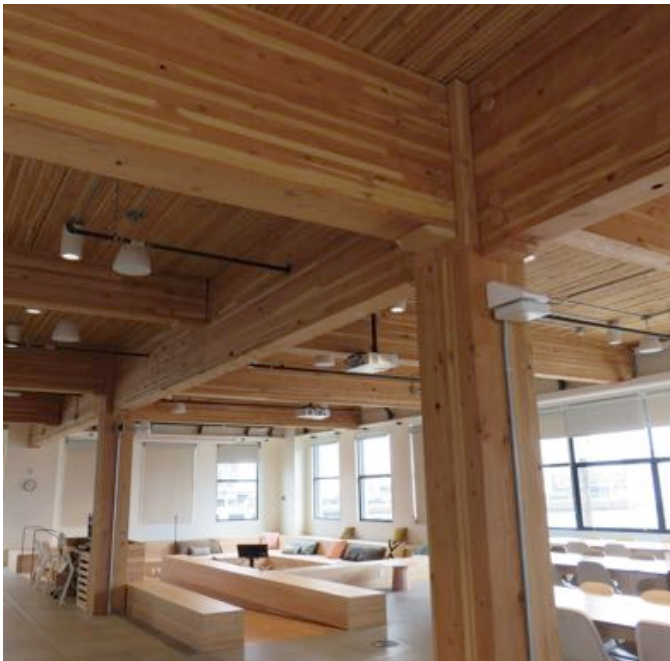
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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

COURSE DESCRIPTION



Determining the proper code application for wood-frame fire assemblies can be challenging and is often further complicated with increases in a project's size and scale. In a building environment where the ability to maximize height and area is key to cost effectiveness, designers must understand the gamut of fire protection considerations applicable to mid- and low-rise wood structures. This presentation will include code requirements, compliance options and nuances related to assembly selection for required fire-resistance-rated floor/ceiling assemblies, exterior walls, fire barriers, fire partitions, and fire walls. Topics will include distinctions between fire-resistive elements for separation vs. class of construction.

LEARNING OBJECTIVES

Upon completion, participants will be better able to:

1

Apply code requirements and intent for wood frame fire-resistance rated assemblies.

3

Understand the paths to achieving code compliant, fire-resistance rated wood frame assemblies as outlined by the 2015 IBC.

2

Discuss the difference in exterior walls, fire walls, fire barriers, and fire partitions, considering performance expectations, code requirements, and appropriate application.

4

Recognize important nuances in the various methods for demonstrating fire-resistance, including: tested assemblies, prescriptive designs, calculations, and engineering analysis.

ABOUT AWC

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Green Building

Manufacturing Environmental Regulation

Advocacy and Public Policy



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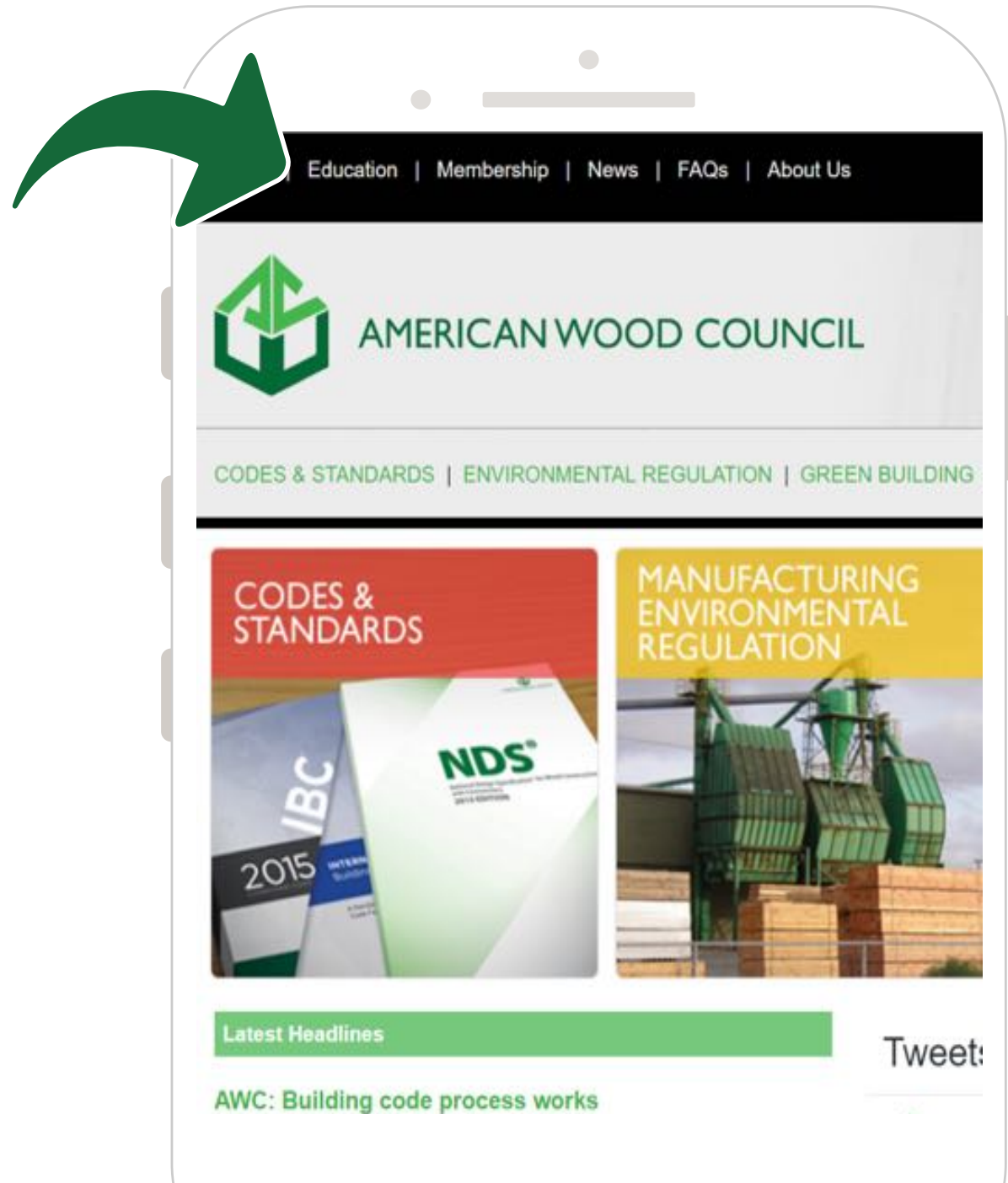


Education Resources

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Education Tab

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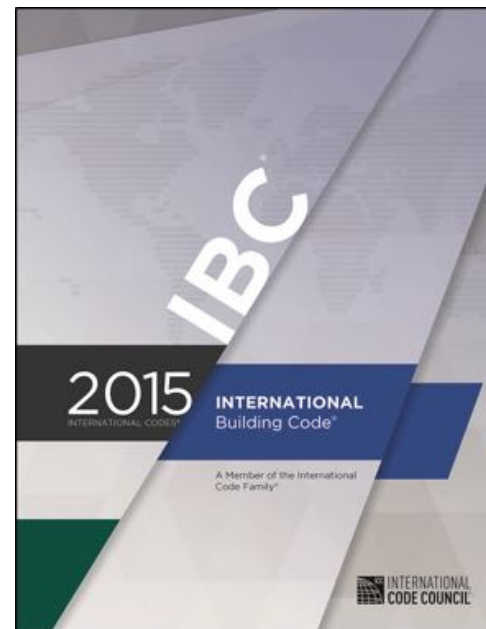
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- **Outline – principles of fire resistance design**
 1. Establish the minimum construction type
 2. Know the reason for the fire resistance
 3. Know the options for establishing fire resistance

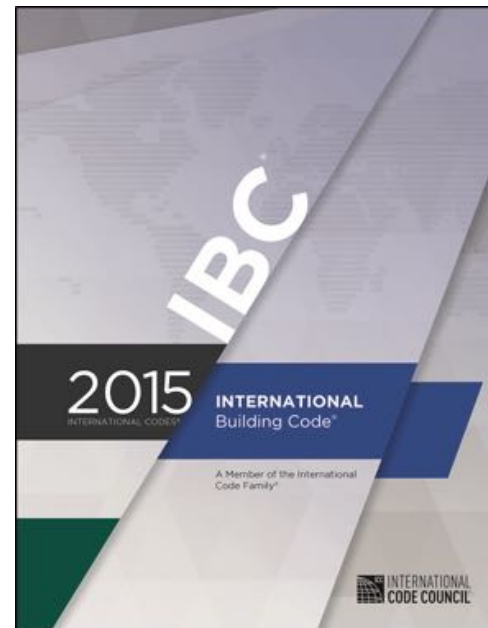
INTRODUCTION

- **The IBC:**
 - Controls building size
 - Regulates types of materials
 - Stipulates fire resistance



INTRODUCTION

- **Building size is determined by:**
 - Tabular values
 - Factors allowing increases
 - Frontage
 - Sprinkler systems
 - **Special Provisions (IBC 510)**



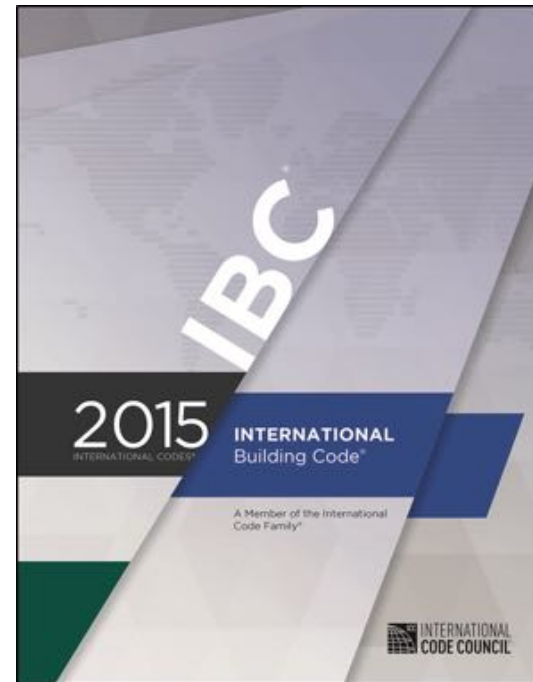
INTRODUCTION

- **Tabular values are based on:**
 - Use of building (occupancy)
 - Type of construction
 - Existence of NFPA 13 sprinkler system

TABLE 506.2: Allowable Area Factor	A-2, A-3	NS	14,000	9,500	15,000	11,500	6,000
		S1	56,000	38,000	60,000	46,000	24,000
		SM	42,000	28,500	45,000	34,500	18,000
	B	NS	28,500	19,000	36,000	18,000	9,000
		S1	114,000	76,000	144,000	72,000	36,000
		SM	85,500	57,000	108,000	54,000	27,000
	E	NS	23,500	14,500	25,500	18,500	9,500
		S1	94,000	58,000	102,000	74,000	38,000
		SM	70,500	43,500	76,500	55,500	28,500
	M	NS	18,500	12,500	20,500	14,000	9,000
		S1	74,000	50,000	82,000	56,000	36,000
		SM	55,500	37,500	61,500	42,000	27,000
	S-2	NS	39,000	26,000	38,500	21,000	13,500
		S1	156,000	104,000	154,000	84,000	54,000
		SM	117,000	78,000	115,500	63,000	40,500
	R-1, R-2	NS	24,000	16,000	20,500	12,000	7,000
		S13R					
		S1	96,000	64,000	82,000	48,000	28,000
		SM	72,000	48,000	61,500	36,000	21,000

INTRODUCTION

- **Occupancy will determine:**
 - Number of occupants
 - Capability of occupants
 - Fuel load



First principle of fire resistance:

Establish the minimum required construction type.



FIRST – MINIMUM CONSTRUCTION TYPE

$$A_a = [A_t + (NS \times I_f)] \times S_a \quad (\text{Equation 5-2})$$

$$I_f = [F / P - 0.25] W / 30 \quad (\text{Equation 5-5})$$

TABLE 506.2: Allowable Area Factor	A-2, A-3	NS	14,000	9,500	15,000	11,500	6,000
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	M	NS	18,500	12,500	20,500	14,000	9,000
		S1	74,000	50,000	82,000	56,000	36,000
		SM	55,500	37,500	61,500	42,000	27,000
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FIRST – MINIMUM CONSTRUCTION TYPE

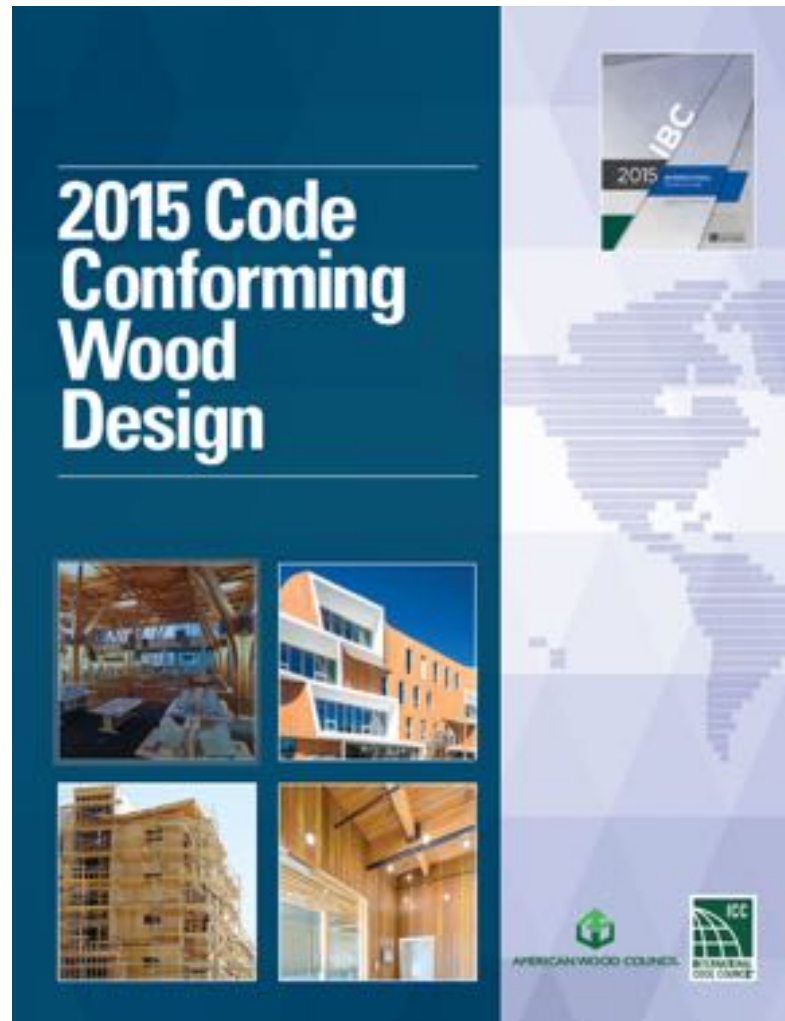
	Occupancy Classification		Type of Construction				
			Type III		Type IV	Type V	
			A	B	HT	A	B
TABLE 504.3: Allowable Building Height (Ft above Grade)	A, B, E, F, M, S, U	NS	65	55	65	50	40
		S	85	75	85	70	60
	I-1 Condition 1, I-3	NS	65	55	65	50	40
		S	85	75	85	70	60
	I-1 Condition 2, I-2	NS	65	55	65	50	40
		S					
	I-4	NS	65	55	65	50	40
		S	85	75	85	70	60
	R	NS	65	55	65	50	40
		S13R	60	60	60	60	60
TABLE 504.4: Allowable Number of Stories above Grade	A-1, A-2, A-3, A-4	NS	3	2	3	2	1
		S	4	3	4	3	2
	B	NS	5	3	5	3	2
		S	6	4	6	4	3
	E	NS	3	2	3	1	1
		S	4	3	4	2	2
	M	NS	4	2	4	3	1
		S	5	3	5	4	2
	S-2	NS	4	3	4	4	2
		S	5	4	5	5	3
	R-1	NS	4	4	4	3	2
		S13R				4	3
		S				4	3
	R-2	NS	4	4	4	3	2
		S13R				4	3
		S				4	3

FIRST – MINIMUM CONSTRUCTION TYPE

Table 601 Fire-Resistance Rating Requirements For Building Elements (hours)

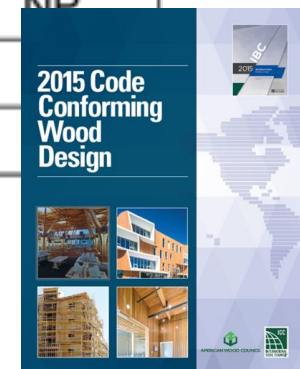
BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A ^d	B	A ^d	B	HT	A ^d	B
Primary structural frame ^g (see Section 202)	3 ^a	2 ^a	1	0	1	0	HT	1	0
Bearing walls, Exterior ^{f, g}	3	2	1	0	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions, Exterior	See Table 602								
Nonbearing walls and partitions, Interior ^e	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	1-1/2 ^b	1 ^{b,c}	1 ^{b,c}	0 ^c	1 ^{b,c}	0	HT	1 ^{b,c}	0

FIRST – MINIMUM CONSTRUCTION TYPE



FIRST – MINIMUM CONSTRUCTION TYPE

Group E Nonsprinklered Buildings ^{a, b, c}						
# of stories	% frontage	Maximum floor area per story (sq. ft.)				
		IIIA	IIIB	IV	VA	VB
1	0-25	23,500	14,500	25,500	12,120	9,500
	50	29,370	25,370	31,870	22,500	11,870
	100	41,120	33,250	44,620	32,370	16,620
2	0-25	23,500	14,500	25,500	NP	NP
	50	29,370	18,120	31,870	NP	NP
	100	41,120	25,370	44,620	NP	NP
3	0-25	23,500	NP	25,500	NP	NP
	50	29,370	NP	31,870	NP	
	100	41,120	NP	44,620	NP	

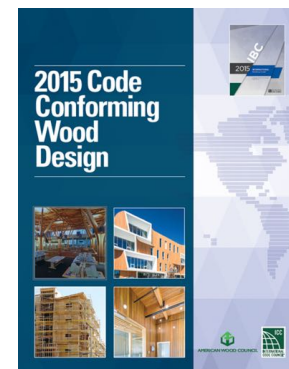


FIRST – MINIMUM CONSTRUCTION TYPE

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		IIIA	IIIB	IV	VA	VB
1	0-25	23,500	14,500	25,500	12,120	9,500
	50	29,370	25,370	31,870	22,500	11,870
	100	41,120	33,250	44,620	32,370	16,620
2	0-25	23,500	14,500	25,500	NP	NP
	50	29,370	18,120	31,870	NP	NP
	100	41,120	25,370	44,620	NP	NP
3	0-25	23,500	NP	25,500	NP	NP
	50	29,370	NP	31,870	NP	NP
	100	41,120	NP	44,620	NP	NP

Footnotes

- Frontage based on open space widths of 30 feet or more.
- Interpolation permitted.
- Sprinklers must be provided for Group E occupancies when the fire area exceeds 12,000 square feet in accordance with Section 903.2.3, or by reason of other specific conditions in that section. In lieu of sprinklers, compartmentalization of the floor area into fire areas not more than 12,000 square feet can be provided with fire-resistance-rated construction in accordance with Chapter 7.



FIRST – MINIMUM CONSTRUCTION TYPE

- **The minimum construction type:**
 - Can be independent of materials chosen
 - Allows greatest flexibility for materials use



FIRST – MINIMUM CONSTRUCTION TYPE

- **The minimum construction type:**
 - Should take into account the final size of building with all future expansions in mind



Second principle of fire resistance:

Know the reason for the
fire resistance.



SECOND – REASON FOR THE FIRE RESISTANCE

- **Building elements (walls, floors, roofs) rated per construction type (704):**
 - Have general protection requirements in 704
 - Do not require opening/penetration protection
 - Have ratings based on Table 601

SECOND – REASON FOR THE FIRE RESISTANCE

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.



SECOND – REASON FOR THE FIRE RESISTANCE

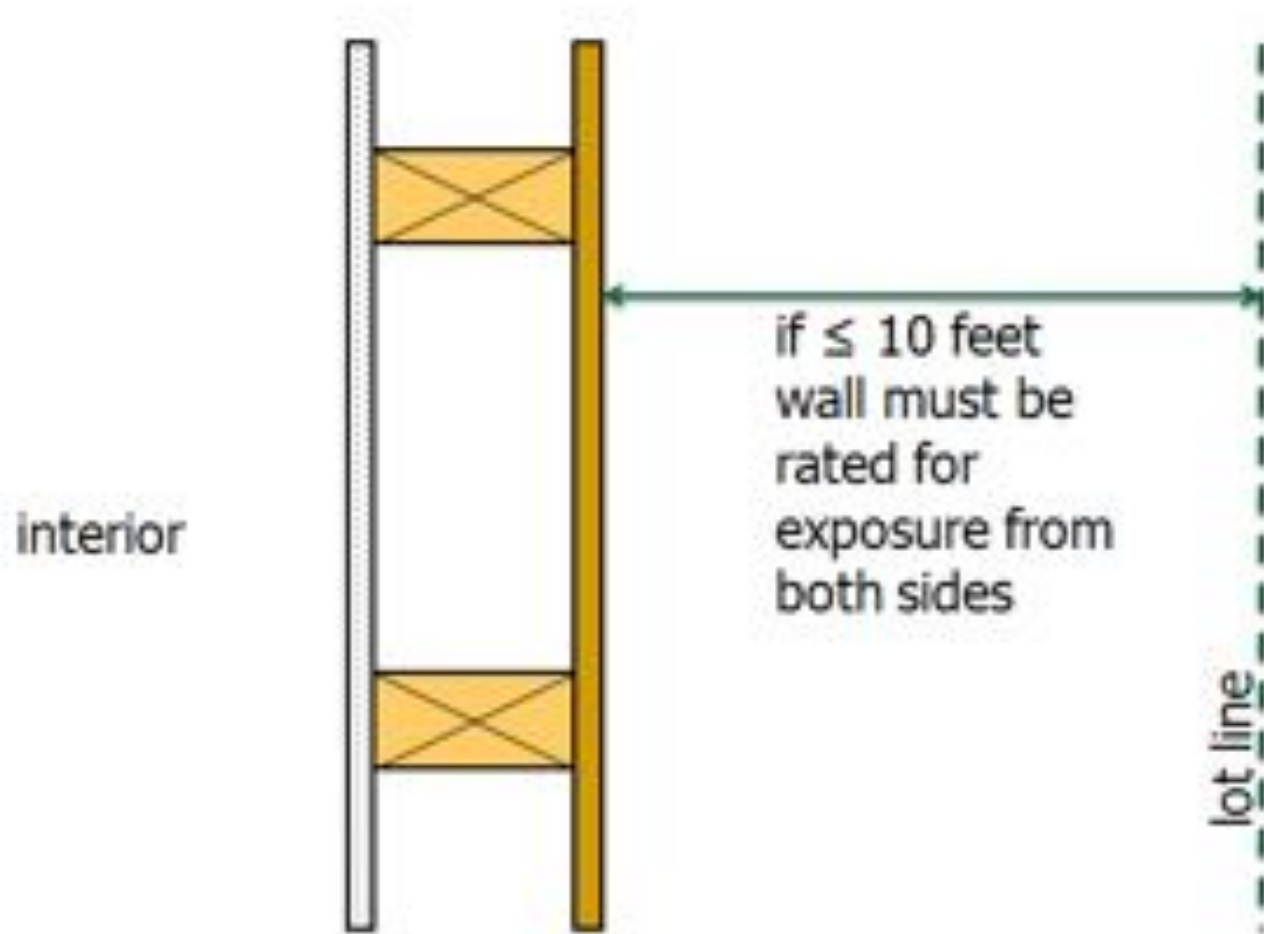
Table 601 Fire-Resistance Rating Requirements For Building Elements (hours)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A ^d	B	A ^d	B	HT	A ^d	B
Primary structural frame ^g (see Section 202)	3 ^a	2 ^a	1	0	1	0	HT	1	0
Bearing walls, Exterior ^{f, g}	3	2	1	0	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions, Exterior	See Table 602								
Nonbearing walls and partitions, Interior ^e	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	1-1/2 ^b	1 ^{b,c}	1 ^{b,c}	0 ^c	1 ^{b,c}	0	HT	1 ^{b,c}	0

SECOND – REASON FOR THE FIRE RESISTANCE

- **Exterior walls (705):**
 - Have unique structural, continuity, and opening/penetration protection requirements
 - Have material requirements based on construction type
 - Have ratings based on proximity to lot lines
 - Required to be rated for exposure to both sides of the wall only when $FSD \leq 10$ ft. (otherwise interior side of wall is the exposed side for testing)

SECOND – REASON FOR THE FIRE RESISTANCE



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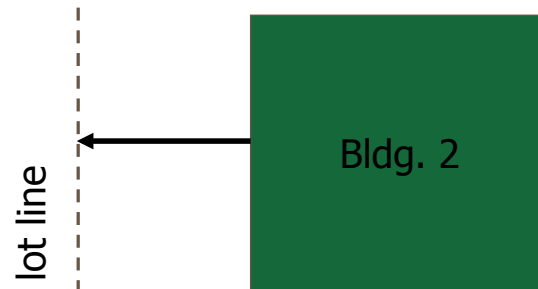
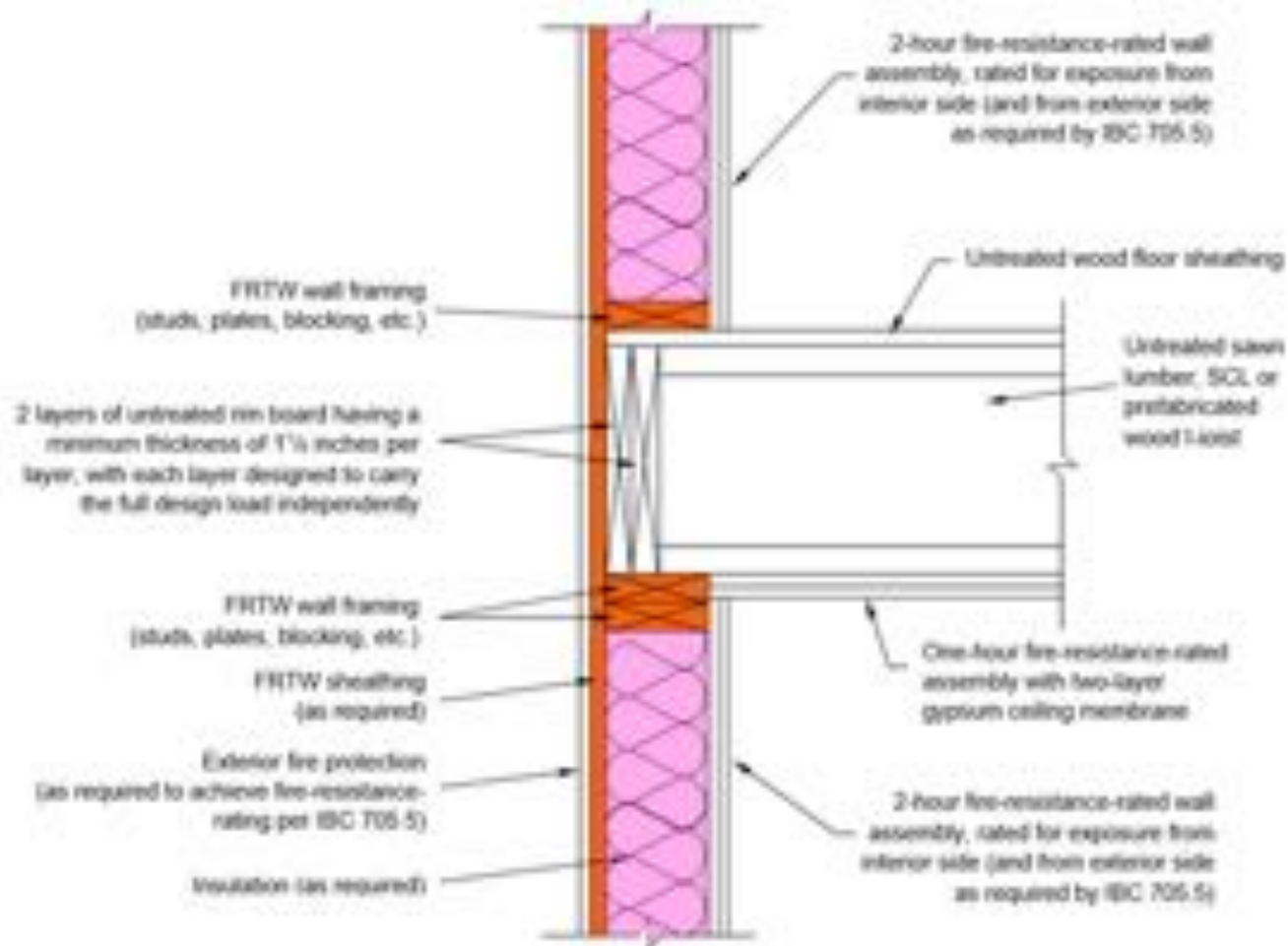


TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE^{a, b}

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

SECOND – REASON FOR THE FIRE RESISTANCE



SECOND – REASON FOR THE FIRE RESISTANCE

- **Fire walls (706):**
 - Define separate buildings
 - Have unique structural, continuity, and opening/penetration protection requirements
 - Have materials requirements based on type of construction (Type V may be wood)
 - Have ratings based on occupancy

SECOND – REASON FOR THE FIRE RESISTANCE

- **Fire barriers (707):**
 - Create fire resistant separations
 - Have unique continuity and opening/penetration protection requirements
 - May have any materials permitted by the construction type
 - Have ratings based on function
 - shaft enclosures, exit enclosures, occupancy separations, hazardous material control areas, fire areas, atrium protection, and others

SECOND – REASON FOR THE FIRE RESISTANCE

TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)

OCCUPANCY	A, E		I-1 ^a , I-3, I-4		I-2		R ^a		F-2, S-2 ^b , U		B ^c , F-1, M, S-1		H-1		H-2		H-3, H-4		H-5	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A, E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP	3	4	2	3	2	NP
I-1 ^a , I-3, I-4	—	—	N	N	2	NP	1	NP	1	2	1	2	NP	NP	3	NP	2	NP	2	NP
I-2	—	—	—	—	N	N	2	NP	2	NP	2	NP	NP	NP	3	NP	2	NP	2	NP
R ^a	—	—	—	—	—	—	N	N	1 ^c	2 ^c	1	2	NP	NP	3	NP	2	NP	2	NP
F-2, S-2 ^b , U	—	—	—	—	—	—	—	—	N	N	1	2	NP	NP	3	4	2	3	2	NP
B ^c , F-1, M, S-1	—	—	—	—	—	—	—	—	—	—	N	N	NP	NP	2	3	1	2	1	NP
H-1	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	NP	NP	NP	NP	NP	NP
H-2	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	1	NP	1	NP	NP
H-3, H-4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1 ^e	NP	1	NP	NP
H-5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

NS = Buildings not equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

N = No separation requirement.

NP = Not permitted.

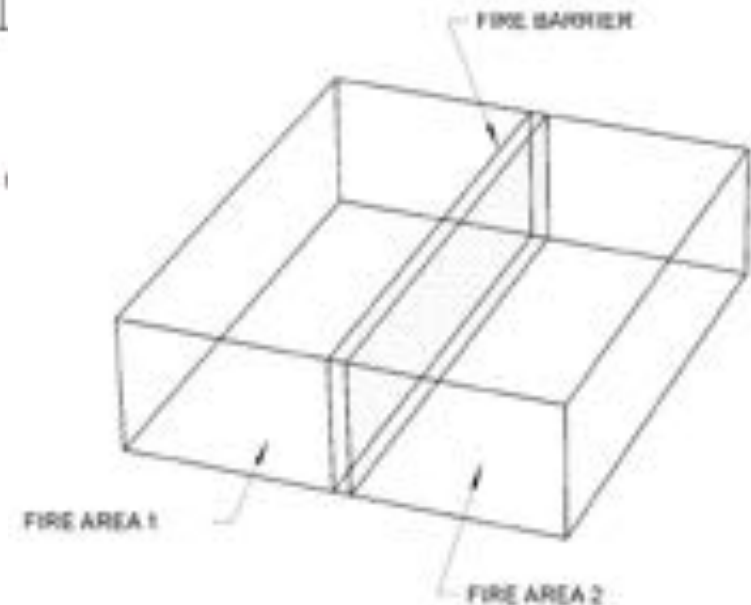
a. See Section 420.

b. The required separation from areas used only for private or pleasure vehicles shall be reduced by 1 hour but not to less than 1 hour.

c. See Section 406.3.4.

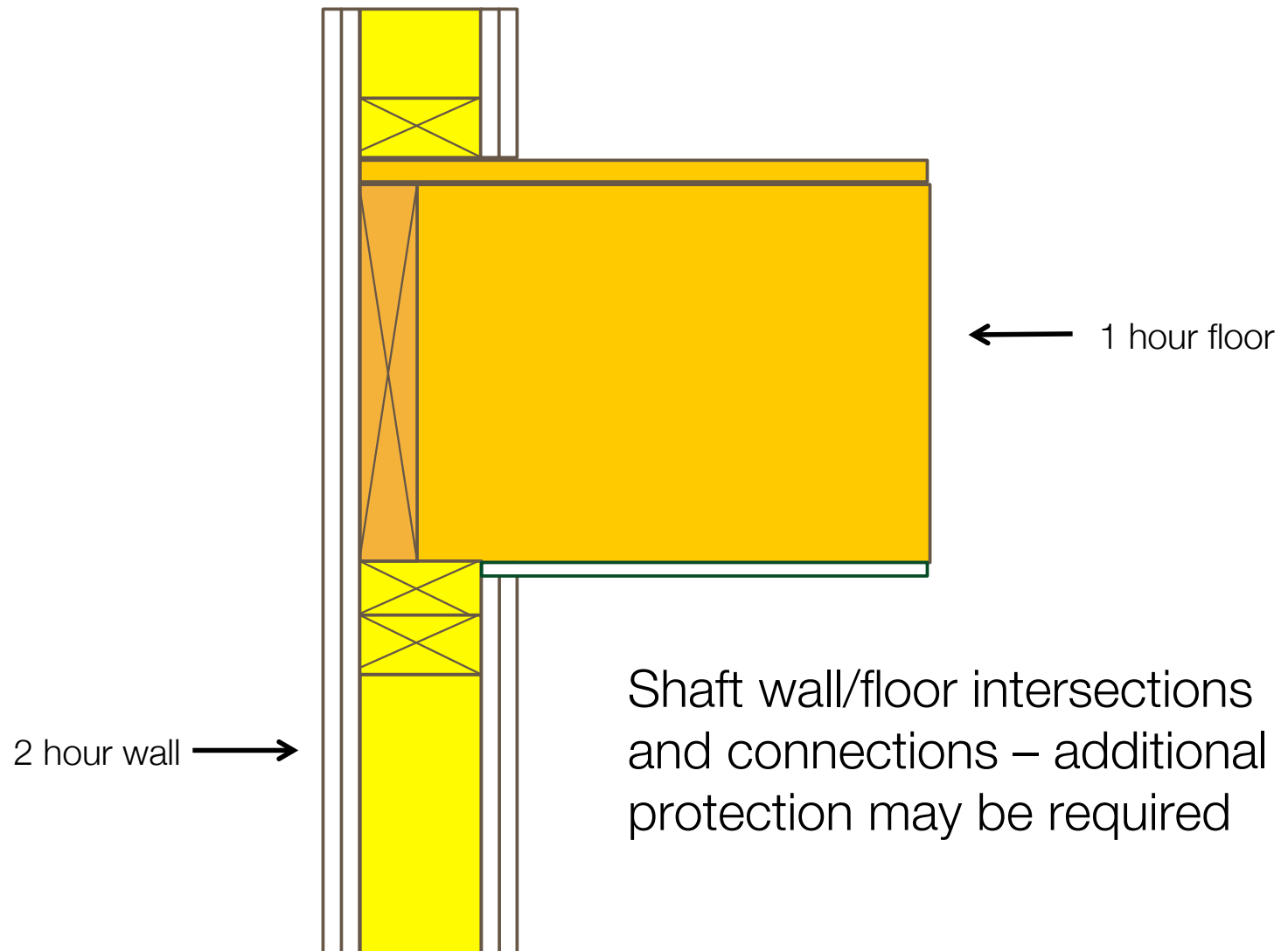
d. Separation is not required between occupancies of the same classification.

e. See Section 422.2 for ambulatory care facilities.



$$\text{BUILDING AREA} = \text{FIRE AREA 1} + \text{FIRE AREA 2}$$

SECOND – REASON FOR THE FIRE RESISTANCE



SECOND – REASON FOR THE FIRE RESISTANCE

- **Fire partitions (708):**
 - Create fire resistant separations
 - Have unique continuity and opening/penetration protection requirements
 - May have any materials permitted by the construction type
 - Have ratings based on function and sprinkler protection
 - Dwelling unit separation, tenant space separation, corridor walls, elevator lobby separation

SECOND – REASON FOR THE FIRE RESISTANCE

- **Horizontal assemblies (711):**
 - Have unique continuity and opening/penetration protection requirements
 - Have requirements for supporting construction
 - Have ratings based on function

SECOND – REASON FOR THE FIRE RESISTANCE

- **Penetrations protection (714)**
- **Openings protection (716)**
- **Fire resistant joint systems (715)**
 - “Joint: The opening in or between adjacent assemblies that is created due to building tolerances, or is designed to allow independent movement of the building in any plane caused by thermal, seismic, wind or any other loading.”

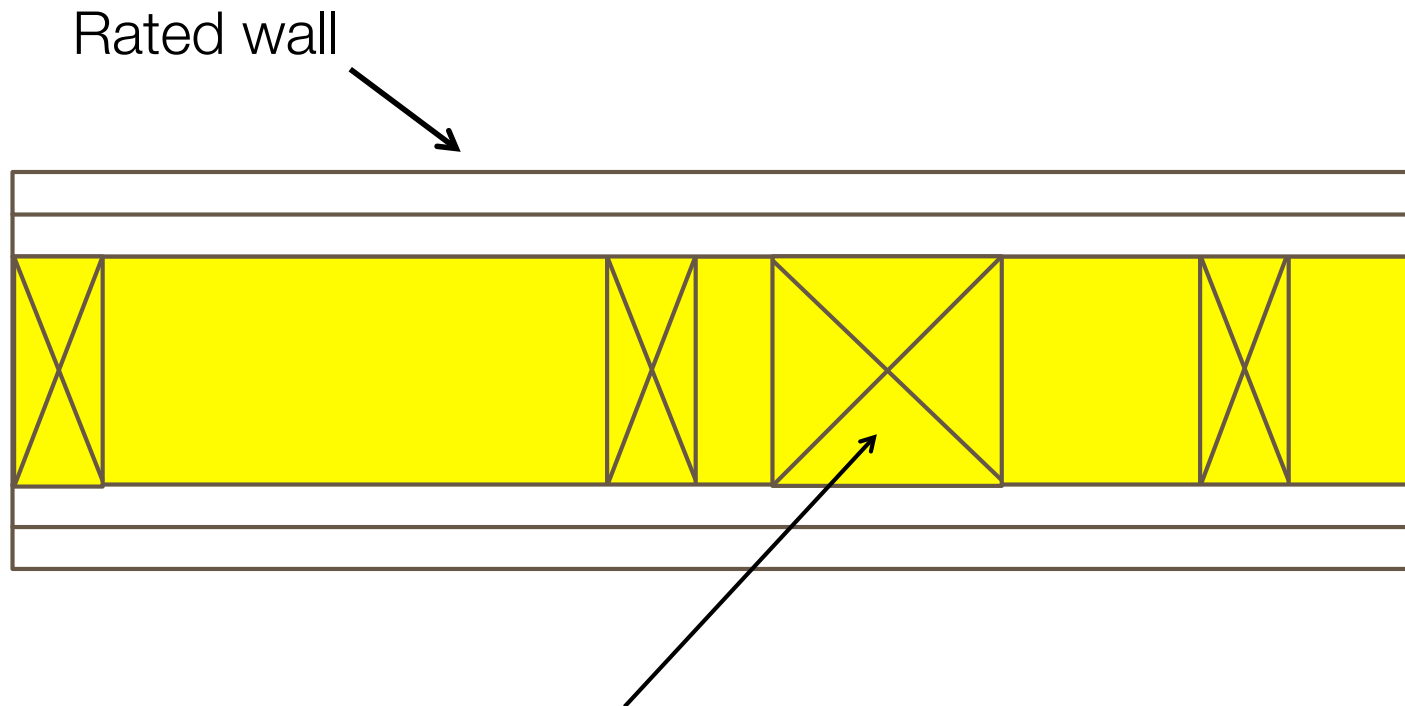
SECOND – REASON FOR THE FIRE RESISTANCE

- **Structural connections and building element intersections not always regulated by the code**
- **Supporting construction fire resistance requirements may apply**

SECOND – REASON FOR THE FIRE RESISTANCE

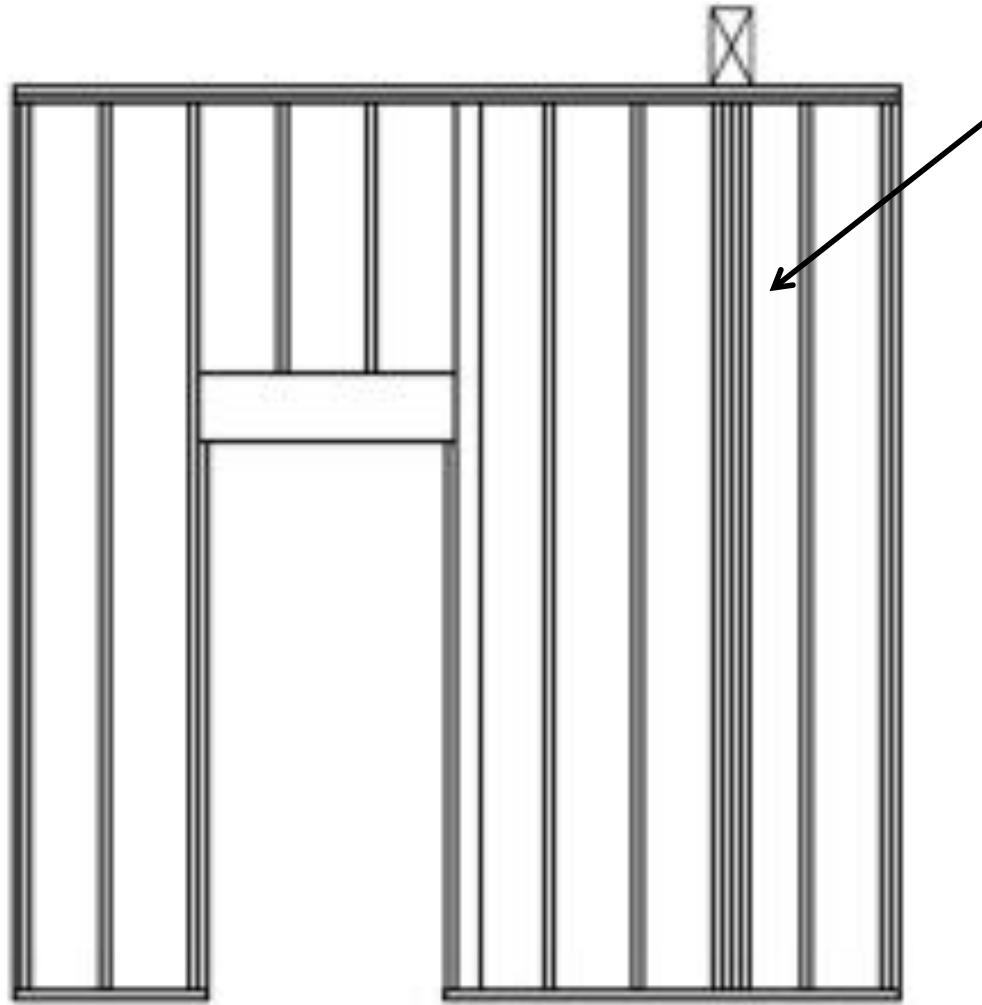
- **704.2 Column protection (IBC 2018 text)**
 - “Exception: Columns that meet the limitations of Section 704.4.1”
- **704.4.1 Light-frame construction (IBC 2018 text)**
 - “Studs, columns, and boundary elements that are integral elements in walls of light-frame construction, and are located entirely between the top and bottom plates or tracks shall be permitted to have required fire-resistance ratings provided by the membrane protection provided for the wall.”

SECOND – REASON FOR THE FIRE RESISTANCE



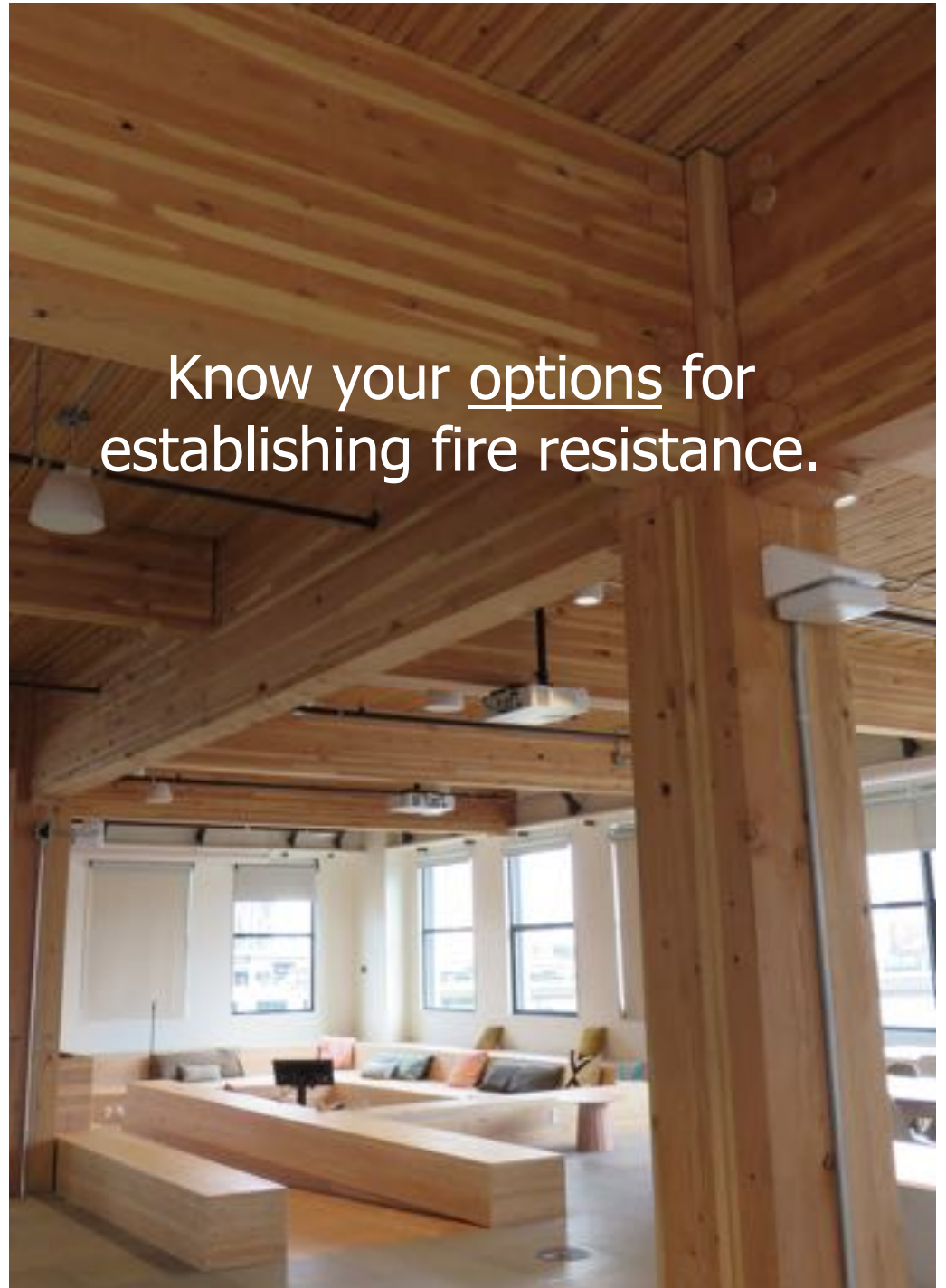
Column needs no separate protection

SECOND – REASON FOR THE FIRE RESISTANCE



Third principle of fire resistance:

Know your options for
establishing fire resistance.



THIRD – OPTIONS FOR FIRE RESISTANCE

- **Methods for establishing fire resistance (703):**
 - 1. Tested fire assembly (ASTM E119 or UL 263)**
 - 2. Fire-resistance designs documented in approved sources**
 - 3. Prescriptive assemblies using fire-resistance rated designs in Section 721**
 - 4. Calculation of fire-resistance per Section 722**
 - 5. Engineering analysis based on a comparison of building element, component or assembly designs that have been tested**
 - 6. Alternative protection methods per Section 104.11**
 - 7. Fire-resistance designs certified by an approved agency**

THIRD – OPTIONS FOR FIRE RESISTANCE

- **Tested assembly:**
 - ASTM E119/UL 263 test
 - May be listed in fire resistance directories
 - Approval may be based on listing or the test report



THIRD – OPTIONS FOR FIRE RESISTANCE

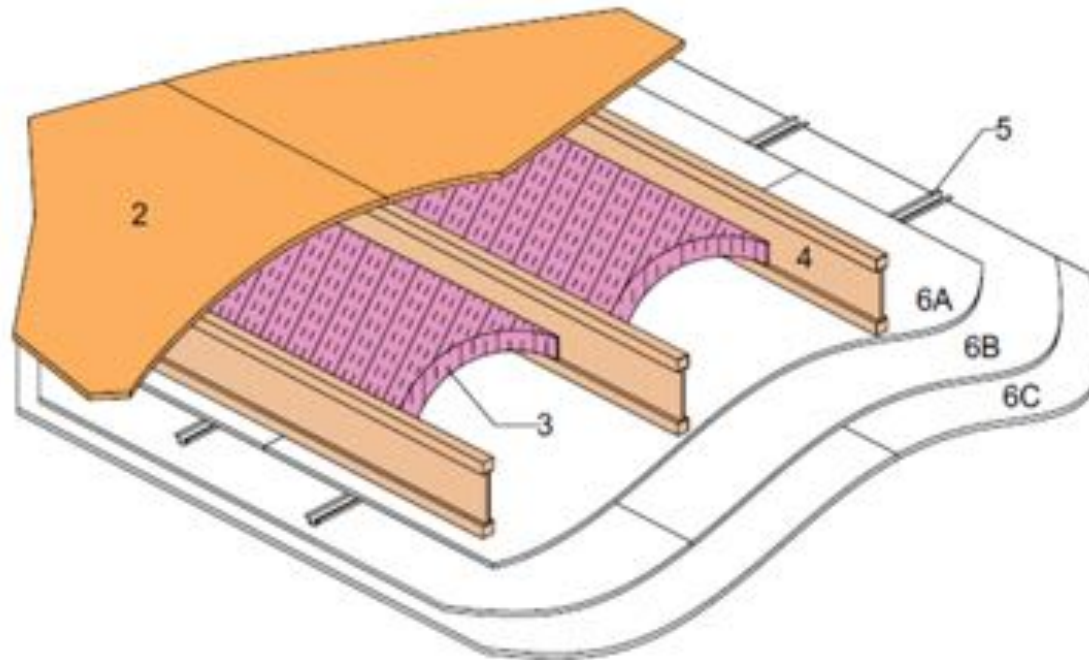
- **Documentation in approved source:**
 - AWC DCA 3 is one example
 - Fire-Resistive Wood Wall and Floor/Ceiling Assemblies
 - ASTM E119 or UL 263
 - NFPA 251



THIRD – OPTIONS FOR FIRE RESISTANCE

WIJ-2.1 Two-Hour Fire-Resistive Ceiling Assembly

Floor^a/Ceiling - 100% Design Load - 2 Hour Rating - ASTM E 119 / NFPA 251



THIRD – OPTIONS FOR FIRE RESISTANCE

- **Prescriptive assemblies from the code (721):**
 - Based on ASTM E119 or UL 263 testing

TABLE 721.1(3)—continued
MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS^{a, 1}

FLOOR OR ROOF CONSTRUCTION	ITEM NUMBER	CEILING CONSTRUCTION	THICKNESS OF FLOOR OR ROOF SLAB (inches)				MINIMUM THICKNESS OF CEILING (inches)			
			4 hours	3 hours	2 hours	1 hour	4 hours	3 hours	2 hours	1 hour
28. Wood I-joist (minimum I-joist depth 9 1/2" with a minimum flange depth of 1 1/2" and a minimum flange cross-sectional area of 2.25 square inches; minimum web thickness of 1/4" @ 24" o.c. Unfaced fiberglass insulation or mineral wool insulation is installed between the I-joists supported on the upper surface of the flange by stay wires spaced 12" o.c.	28-1.1	Base layer of 1/2" Type C gypsum wallboard attached directly to I-joists with 1 1/2" Type S drywall screws spaced 12" o.c. with ends staggered. Minimum 0.0179" thick hat-shaped 7/8-inch furring channel 16" o.c. (channels doubled at wallboard end joints), placed perpendicular to the joist and attached to each joist by 1 1/4" Type S drywall screws after the base layer of gypsum wallboard has been applied. The middle and face layers of 1/2" Type C gypsum wallboard applied perpendicular to the channel with end joints staggered. The middle layer is fastened with 1" Type S drywall screws spaced 12" o.c. The face layer is applied parallel to the middle layer but with the edge joints offset 24" from those of the middle layer and fastened with 1 1/4" Type S drywall screws 8" o.c. The joints shall be taped and covered with joint compound.	—	—	—	Varies	—	—	2 3/4	—

THIRD – OPTIONS FOR FIRE RESISTANCE

- **Calculated fire resistance (722.6):**
- **Component Additive Method (CAM)**
- **Calculated fire resistance of exposed wood members per Chapter 16 of the NDS**

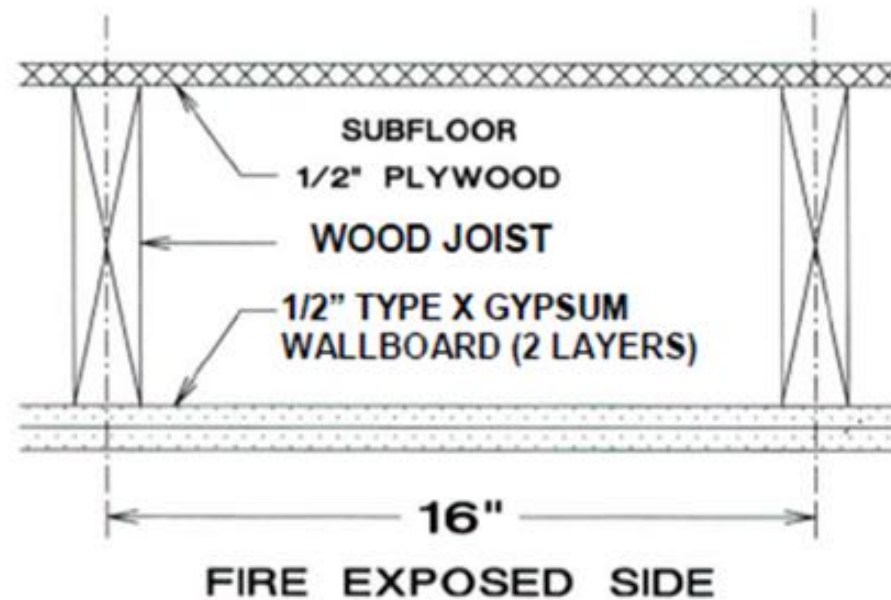


THIRD – OPTIONS FOR FIRE RESISTANCE

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

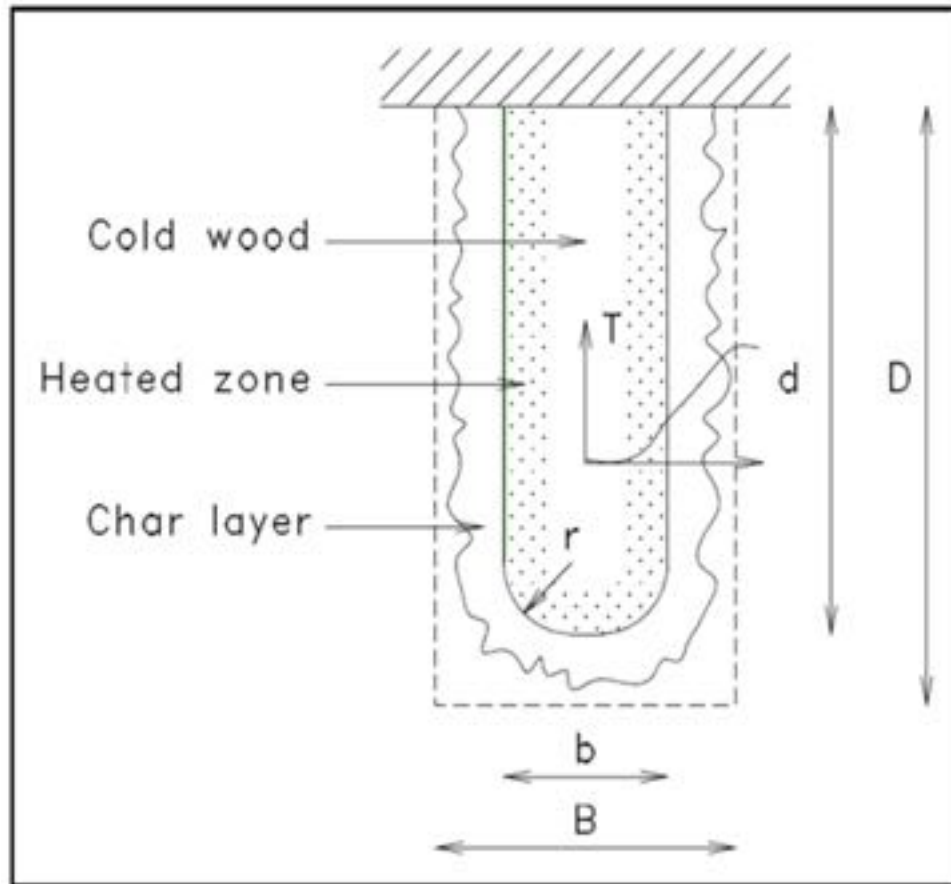
THIRD – OPTIONS FOR FIRE RESISTANCE



1/2 inch Type X Gypsum wallboard	= 25 minutes
1/2 inch Type X Gypsum wallboard	= 25 minutes
Wood joists	= 10 minutes
<hr/>	
Combined Assembly Fire Resistance Rating	= 60 minutes

Figure 2 Floor/Ceiling Assembly

THIRD – OPTIONS FOR FIRE RESISTANCE



THIRD – OPTIONS FOR FIRE RESISTANCE

Table 16.2.1A Effective Char Rates and Char Depths (for $\beta_n = 1.5$ in./hr.)

Required Fire Endurance (hr.)	Effective Char Rate, β_{eff} (in./hr.)	Effective Char Depth, a_{char} (in.)
1-Hour	1.8	1.8
1½-Hour	1.67	2.5
2-Hour	1.58	3.2



THIRD – OPTIONS FOR FIRE RESISTANCE

$$\beta_{\text{eff}} = \frac{1.2\beta_n}{t^{0.187}} \quad (16.2-1)$$

where:

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

β_n = nominal char rate (in./hr.), linear char rate based on 1-hour exposure

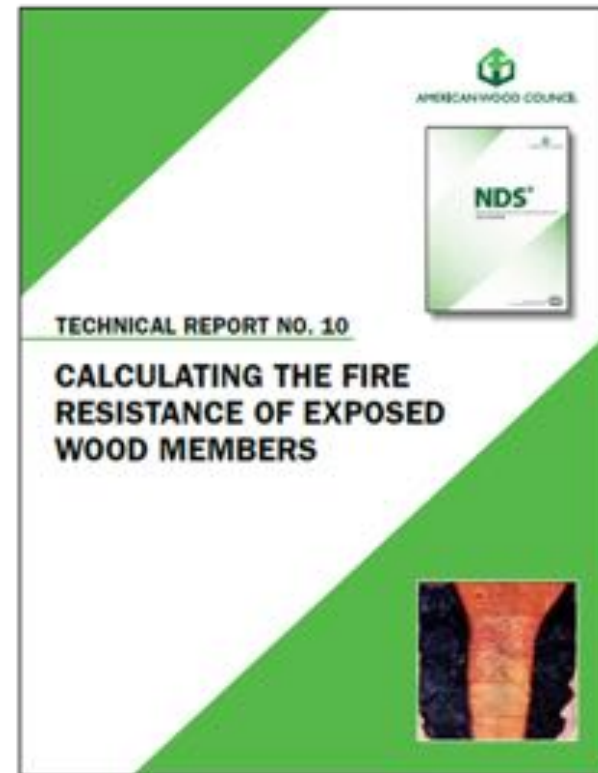
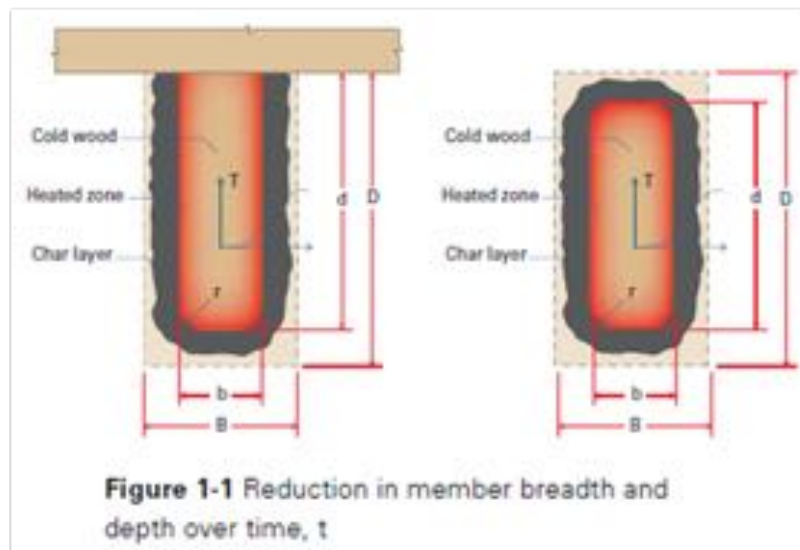
t = exposure time (hr.)



THIRD – OPTIONS FOR FIRE RESISTANCE

Technical Report No. 10 (TR10)

- contains background and examples for the method



THIRD – OPTIONS FOR FIRE RESISTANCE

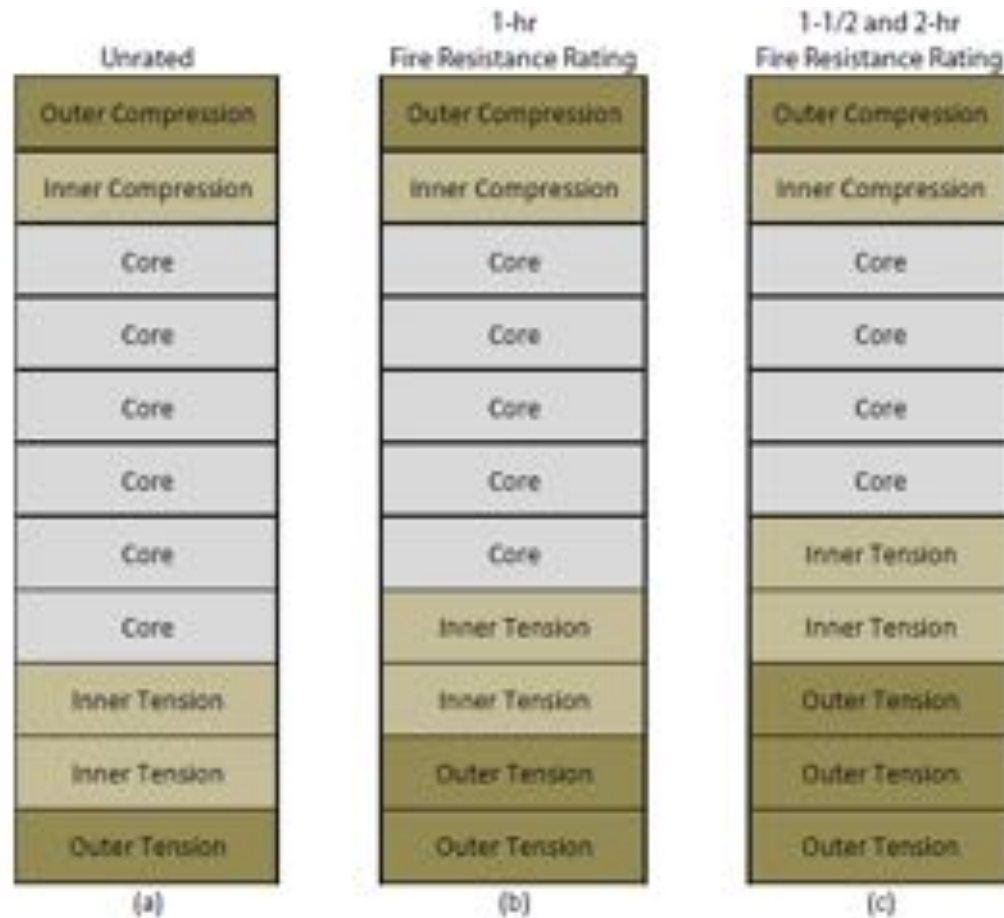


Figure 3-1 Typical glulam unbalanced beam layouts

THIRD – OPTIONS FOR FIRE RESISTANCE

**Table 16.2.1B Effective Char Depths (for CLT
with $\beta_n=1.5\text{in./hr.}$)**

Required Fire Endurance (hr.)	Effective Char Depths, a_{char} (in.)								
	lamination thicknesses, h_{lam} (in.)								
	5/8	3/4	7/8	1	1-1/4	1-3/8	1-1/2	1-3/4	2
1-Hour	2.2	2.2	2.1	2.0	2.0	1.9	1.8	1.8	1.8
1½-Hour	3.4	3.2	3.1	3.0	2.9	2.8	2.8	2.8	2.6
2-Hour	4.4	4.3	4.1	4.0	3.9	3.8	3.6	3.6	3.6

THIRD – OPTIONS FOR FIRE RESISTANCE



THIRD – OPTIONS FOR FIRE RESISTANCE

- **ASTM E119 test:**
 - 5-ply CLT (6-7/8")
 - Single layer 5/8" Type X wallboard each side
 - Achieved 3 hrs. 6 min.



THIRD – OPTIONS FOR FIRE RESISTANCE



THIRD – OPTIONS FOR FIRE RESISTANCE

- **Methods for establishing fire resistance (703):**
 1. Tested fire assembly (ASTM E119 or UL 263)
 2. Fire-resistance designs documented in approved sources
 3. Prescriptive assemblies using fire-resistance rated designs in Section 721
 4. Calculation of fire-resistance per Section 722
 5. **Engineering analysis based on a comparison of building element, component or assembly designs that have been tested**
 6. Alternative protection methods per Section 104.11
 7. Fire-resistance designs certified by an approved agency

THIRD – OPTIONS FOR FIRE RESISTANCE

Harmathy's "Ten Rules of Fire Endurance Ratings"

1. The "*thermal*" fire endurance of a construction consisting of a number of parallel layers is greater than the sum of the "*thermal*" fire endurance's characteristic of the individual layers when exposed separately to fire.
2. The fire endurance of a construction does not decrease with the addition of further layers.
3. The fire endurance of constructions containing continuous air gaps or cavities is greater than the fire endurance of similar constructions of the same weight, but containing no air gaps or cavities.
4. The farther an air gap or cavity is located from the exposed surface, the more beneficial is its effect on the fire endurance.
5. Increasing the thickness of a completely enclosed air layer cannot increase the fire endurance of a construction.

THIRD – OPTIONS FOR FIRE RESISTANCE

6. Layers of materials of low thermal conductivity are better utilized on that side of the construction on which fire is more likely to happen.
7. The fire endurance of asymmetrical constructions depends on the direction of heat flow.
8. The presence of moisture, if it does not result in explosive spalling, increases the fire endurance.
9. Load-supporting elements, such as beams, girders and joists, yield higher fire endurance's when subjected to fire endurance tests as parts of floor, roof, or ceiling assemblies than they would when tested separately.
10. The load-supporting elements (beams, girders, joists, etc.) of a floor, roof, or ceiling assembly can be replaced by such other load-supporting elements which, when tested separately, yielded fire endurance's not less than that of the assembly.



THIRD – OPTIONS FOR FIRE RESISTANCE

- **Methods for establishing fire resistance (703):**
 1. Tested fire assembly (ASTM E119 or UL 263)
 2. Fire-resistance designs documented in approved sources
 3. Prescriptive assemblies using fire-resistance rated designs in Section 721
 4. Calculation of fire-resistance per Section 722
 5. Engineering analysis based on a comparison of building element, component or assembly designs that have been tested
 6. **Alternative protection methods per Section 104.11**
 7. Fire-resistance designs certified by an approved agency

THIRD – OPTIONS FOR FIRE RESISTANCE

- **Methods for establishing fire resistance (703):**
 1. Tested fire assembly (ASTM E119 or UL 263)
 2. Fire-resistance designs documented in approved sources
 3. Prescriptive assemblies using fire-resistance rated designs in Section 721
 4. Calculation of fire-resistance per Section 722
 5. Engineering analysis based on a comparison of building element, component or assembly designs that have been tested
 6. Alternative protection methods per Section 104.11
 7. **Fire-resistance designs certified by an approved agency**

THIRD – OPTIONS FOR FIRE RESISTANCE

- **Protections of connections in the NDS:**
 - Section 16.3
 - Protection can be provided by wood or fire-rated gypsum board



THIRD – OPTIONS FOR FIRE RESISTANCE

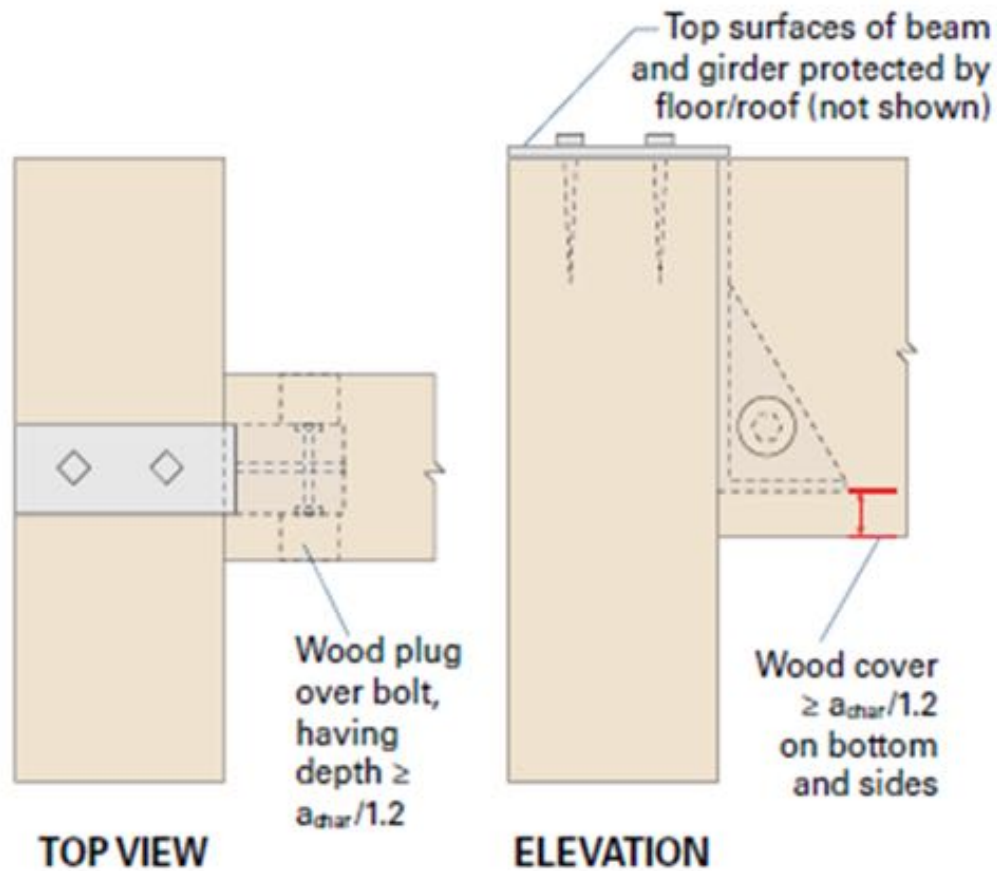


Figure 3-8 Beam to girder – concealed connection

PRECAUTIONS DURING CONSTRUCTION



PRECAUTIONS DURING CONSTRUCTION

- **IBC/IFC Chapters 33:**
 - Fire-fighting vehicle access and water supply (3310 and 3312)
 - Requirements for a fire watch, a fire protection superintendent, and prevention program (3304 and 3308)
 - Extensive hot work and roofing requirements (3304, Chapter 35, and 3317)
 - Fire extinguishers (3309)
 - Standpipes (3311)
 - Temporary heating equipment (3303)
 - Emergency phones (3309)



PRECAUTIONS DURING CONSTRUCTION

www.constructionfiresafety.org



My contact info: pcoats@awc.org | 803-984-7304



AMERICAN WOOD COUNCIL

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