Essential Code Compliance in Light Wood Frame Construction: Fire Resistance Ratings of Floors and Walls

BCD501

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COURSE DESCRIPTION

Building height, area, and number of stories will often determine the fire resistive construction requirements of building elements in light wood frame construction. This presentation introduces requirements for fire resistance in wood frame buildings of Types III and V construction.

These requirements are summarized in the 2018 Code Conforming Wood Design (CCWD), which will also be discussed. Additionally, one of the methods for determining fire resistance per section 703.3 in the International Building Code is fire-resistant designs documented in approved sources. The American Wood Council's *Design for Code Acceptance No. 3 Fire-Resistance-Rated Wood-Frame Wall and Floor/Ceiling Assemblies* (DCA-3), is commonly used as an approved source to specify rated wood-frame assemblies.

Learning objectives

Building Size Requirements

Examine building size requirements for various building types using CCWD

Types of Fire-Rated Assemblies

Explain the types of fire-rated assemblies described in DCA3 and how the information can be used

Sources of Fire-Resistance Ratings

Recognize the sources of fire-resistance ratings and how they are used in the context of building codes

Code Requirements

Discuss the code requirements that apply to fire-resistance rated floor-wall intersections in Type III construction and examine critical details in these assemblies

Fun/icebreaker Polling Question/Placeholder

According to the rock media, the Greatest Rock and Roll band of all time is?

a) Spinal Tap

b) AC/DC

c) The Rolling Stones

d) Led Zeppelin

e) Motörhead

f) All of the Above

CODE CONFORMING WOOD DESIGN (CCWD) DOCUMENT

The CCWD includes:

- Allowable building size
- Special occupancies
- Fire resistance
- Building features
- Wood in noncombustible construction types
- Structural considerations
- Precautions during construction
- Free download: www.awc.org/codes/ccwdindex.html

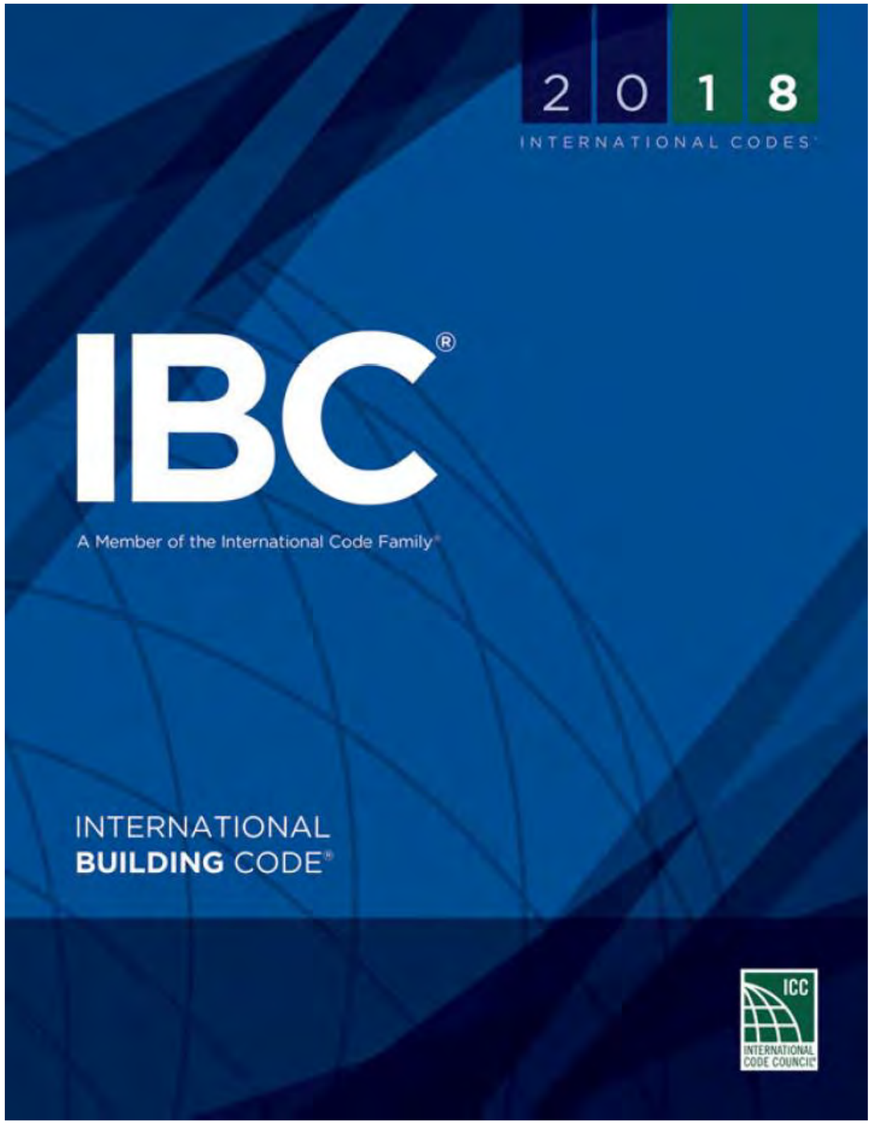
USE AND OCCUPANCY CLASSIFICATION-OVERVIEW

- Building code requirements
  - Appropriate building classification
  - Design purpose and Current occupancy

- Eight occupancy classifications:
  - Group A, Assembly
  - Group B, Business
  - Group E, Educational
  - Group F, Factory/Industrial
  - Group I, Institutional
  - Group M, Mercantile
  - Group R, Residential
  - Group S, Storage

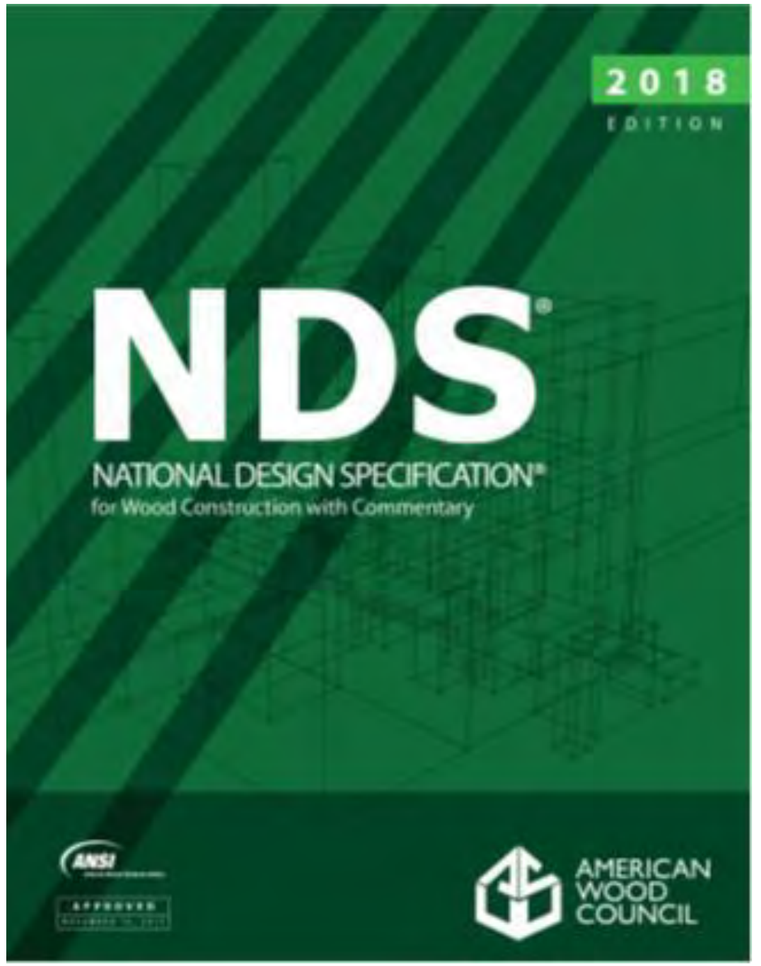
REFERENCED CODES AND STANDARDS

- IBC Chapter 35
- List of referenced standards
  - Agency that writes the standard
  - Identification and title of the standard
  - Referenced edition by year



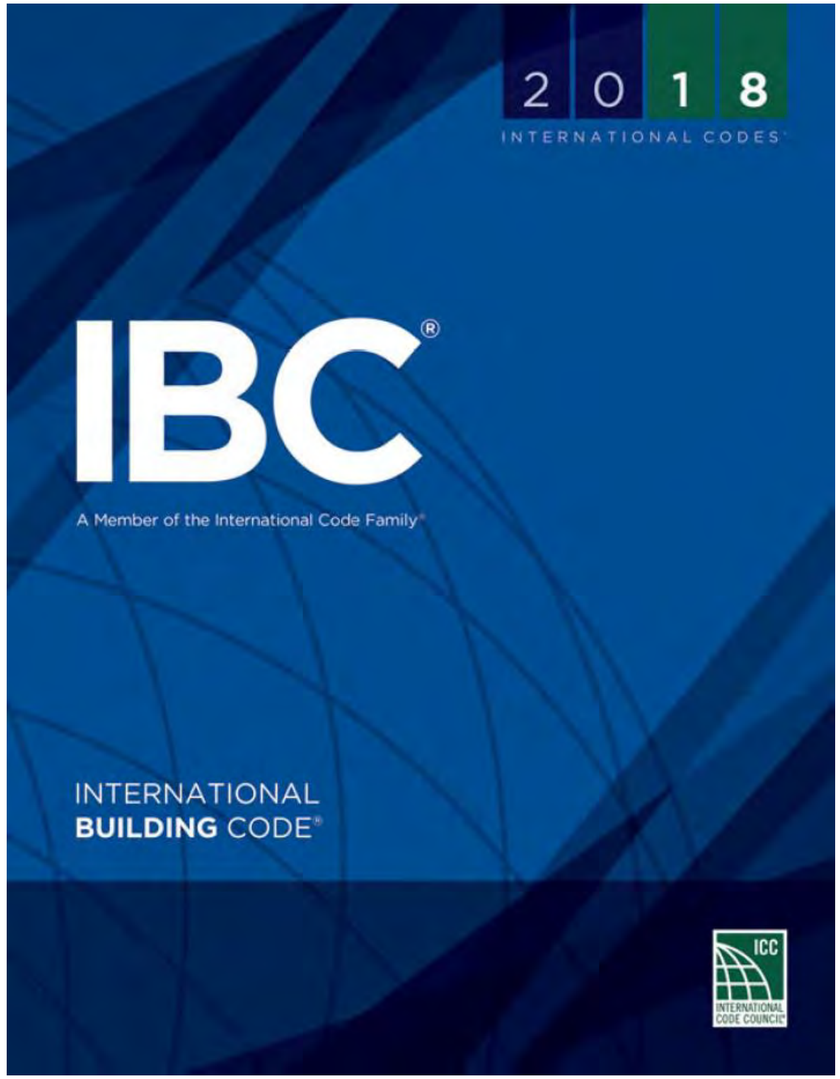
STANDARDS

- American Wood Council (AWC) Standards, referenced in the International Building Code (IBC)
- 2018 National Design Specification® (NDS®-2018) for Wood Construction with 2018 Supplement
- 2018 Special Design Provisions for Wind and Seismic (SDPWS-2018)
- 2018 Wood Frame Construction Manual (WFCM-2018) for One- and Two-Family Dwellings
- 2018 AWC Span Tables for Joists and Rafters (STJR-2018)



INTRODUCTION-TYPES OF CONSTRUCTION

- IBC Chapter 6
- Defines types of construction
- Wood frame construction is typical in Types III, IV, & V
- Specific applications permitting use of wood in Types I and II
- Addressed in Sections of the CCWD



TYPE III CONSTRUCTION

- Requires exterior walls to be noncombustible material or FRTW* and have a minimum 2-hour fire-resistance rating (bearing walls).
- Type IIIA requires 1-hour fire-resistance rating for all building elements other than nonbearing walls.
- Type IIIB does not require any fire-resistance rating other than exterior loadbearing walls.

TYPE V CONSTRUCTION

- Permits the use of wood or other code approved materials for loadbearing and non-loadbearing structural elements.
- Most commonly associated with repetitive, light frame wood, or light gauge, cold-formed steel studs

INTRODUCTION-ALLOWABLE HEIGHTS & AREAS

- IBC Chapter 5
- Size thresholds for wood structures are often determined by structural considerations rather than code limitations.

TABLES 504.3, 504.4 AND 506.2, ALLOWABLE BUILDING HEIGHTS, STORIES, AND AREA

	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
		S	85	75	85	70	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	5	5	5	4	3
	R-2	NS	4	4	4	3	2
		S13R				4	3
		S	5	5	5	4	3

TABLES 504.3, 504.4 AND 506.2, ALLOWABLE BUILDING HEIGHTS, STORIES, AND AREA

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

ALLOWABLE BUILDING AREA – SINGLE OCCUPANCY, ONE-STORY BUILDINGS (506.2.1)

$$A_a = A_t + (NS \times I_f) \quad \text{(Equation 5-1)}$$

Where:
A_a = Allowable building area (square feet).
A_t =Tabular building area factor (NS, S1, or S13R value, as applicable) in accordance with Table 506.2 (square feet).
NS =Tabular allowable area factor in accordance with Table 506.2 for a nonsprinklered building (regardless of whether the building is sprinklered).
I_f = Area factor increase due to frontage (percent) as calculated in accordance with Section 506.3.

ALLOWABLE BUILDING AREA – SINGLE OCCUPANCY, MULTI-STORY BUILDINGS (506.2.3)

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

Where:

A_a = Allowable building area (square feet).

A_t =Tabular building area factor (NS, S13R, or SM value, as applicable)in accordance with Table 506.2 (square feet).

NS =Tabular allowable area factor in accordance with Table 506.2 for a non-sprinklered building (regardless of whether the building is sprinklered).

I_f = Area factor increase due to frontage (percent) as calculated in accordance with Section 506.3.

S_a = Actual number of building stories above grade plane, not to exceed three. For buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2 (NFPA 13R system), use the actual number of building stories above grade plane, not to exceed four.

AREA FACTOR INCREASES FOR FRONTAGE (506.3)

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

Where:

I_f = Area factor increase due to frontage (percent) as calculated in accordance with Section 506.3.

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

P = Perimeter of entire building (feet).

W = Width of public way or open space (feet) in accordance with Section 506.3.2.

WEIGHTED AVERAGE (506.3.2)

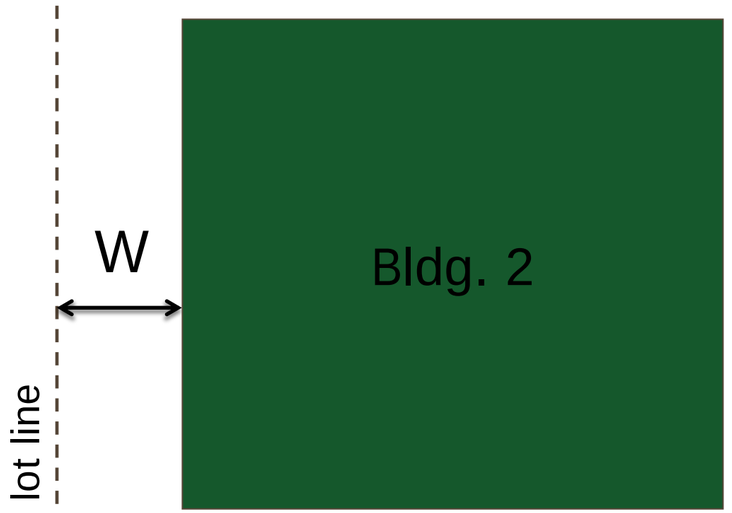
$$W = (L_1 \times w_1 \times L_2 \times w_2 \times L_3 \times w_{3...}) / F \quad \text{(Equation 5-4)}$$

Where:

L_n = Length of a portion of the exterior perimeter wall (feet).

w_n = Width of open space (> 20 ft.) associated with that portion of the exterior perimeter wall (feet).

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



WEIGHTED AVERAGE (506.3.2)

Length of Walls:

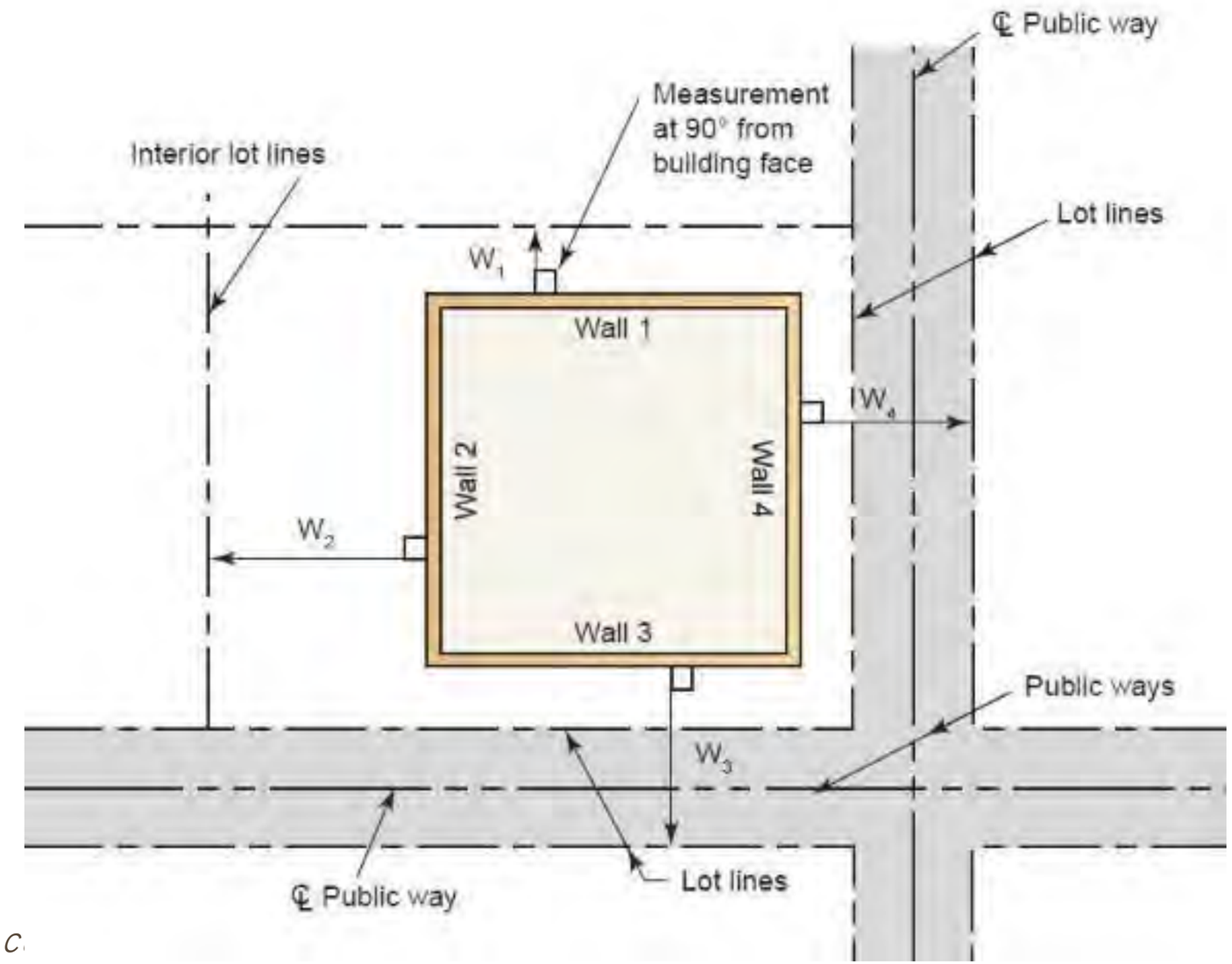
L_1, L_2, L_3 and L4 = 200 ft

Frontage Width:

w_1 = 22 ft w_3 = 55 ft

w_2 = 45 ft w_4 = 50 ft

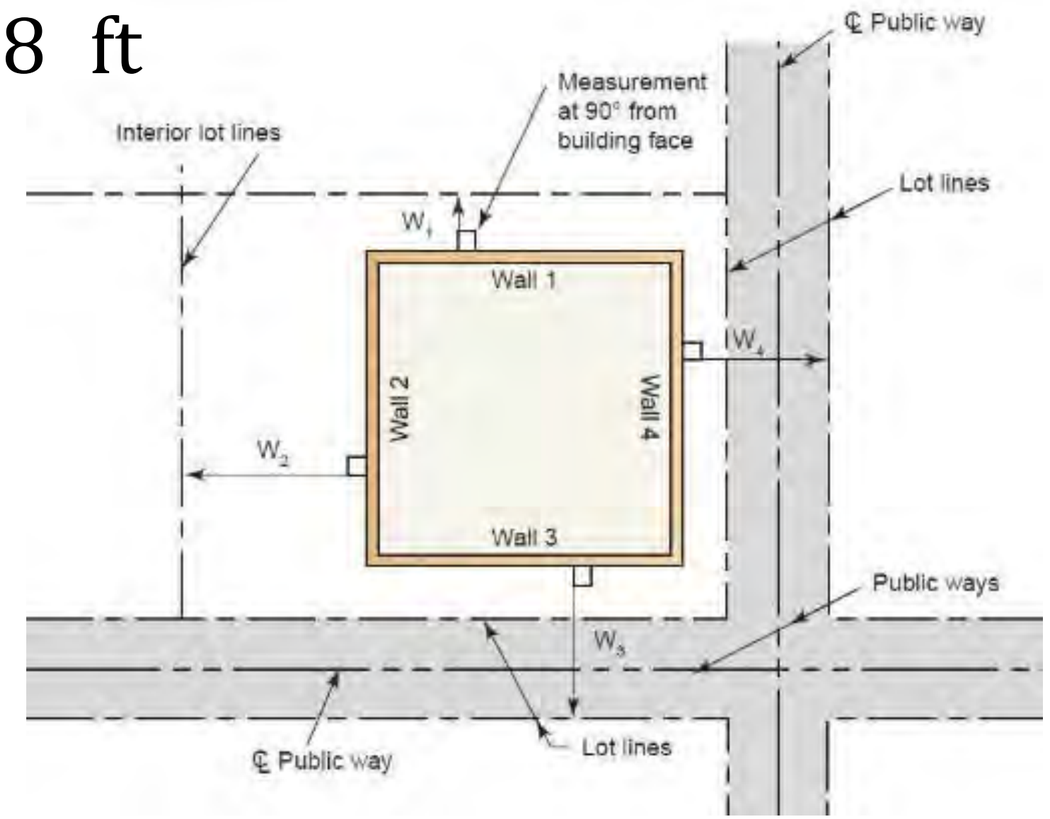
F = 200 x 4 = 800 ft



WEIGHTED AVERAGE (506.3.2)

$$W = \frac{L_1 \times w_1 + L_2 \times w_2 + L_3 \times w_3 + L_4 \times w_4}{F}$$

$$W = \frac{(200x22+200x30+200x30+200x30)}{800} = 28 \text{ ft}$$



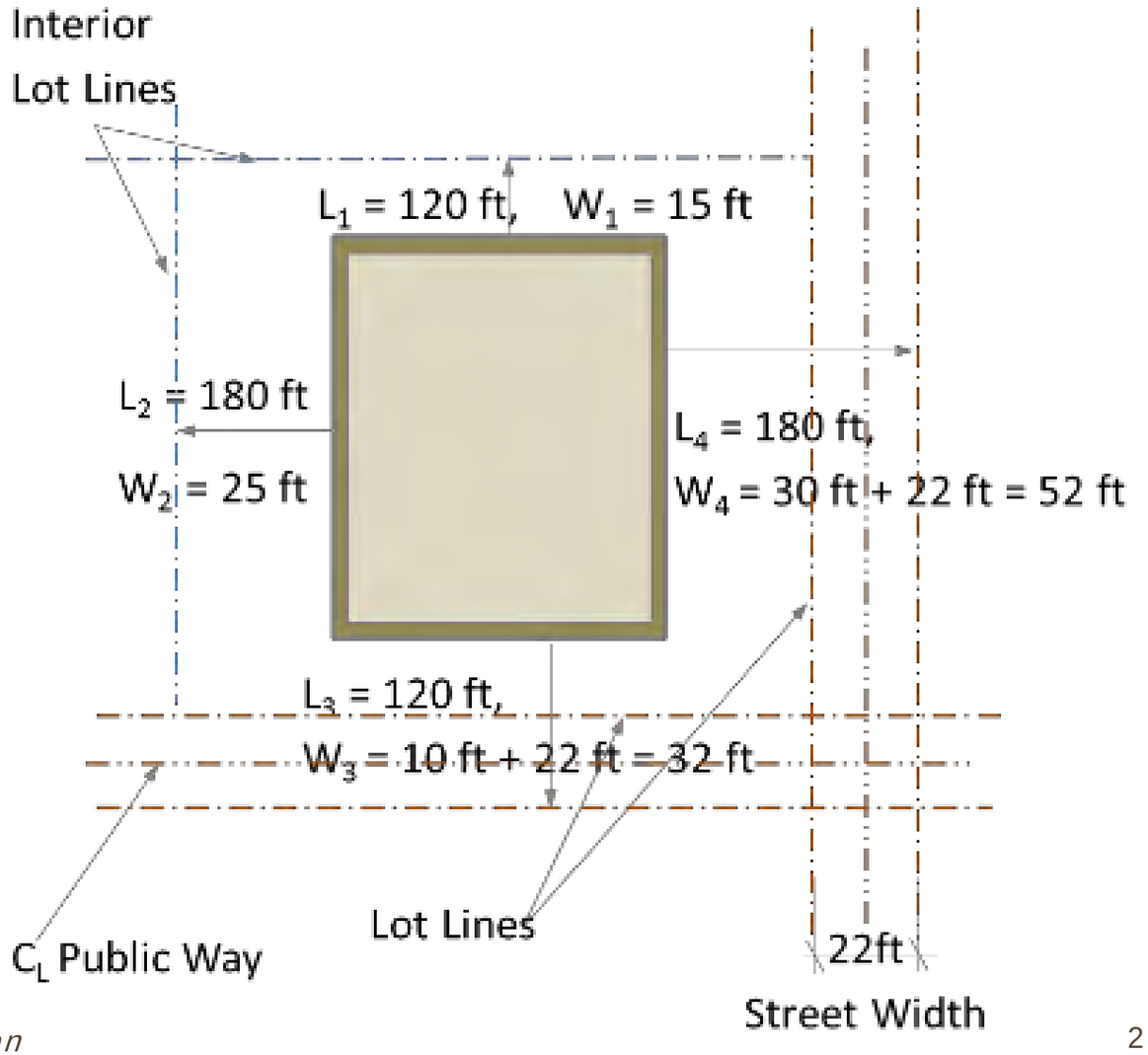
ALLOWABLE AREA EXAMPLE (506.2)

Given:

- 2-story restaurant
- Type IIIA construction
- Street width of 22 feet

Determine:

- Area limitation

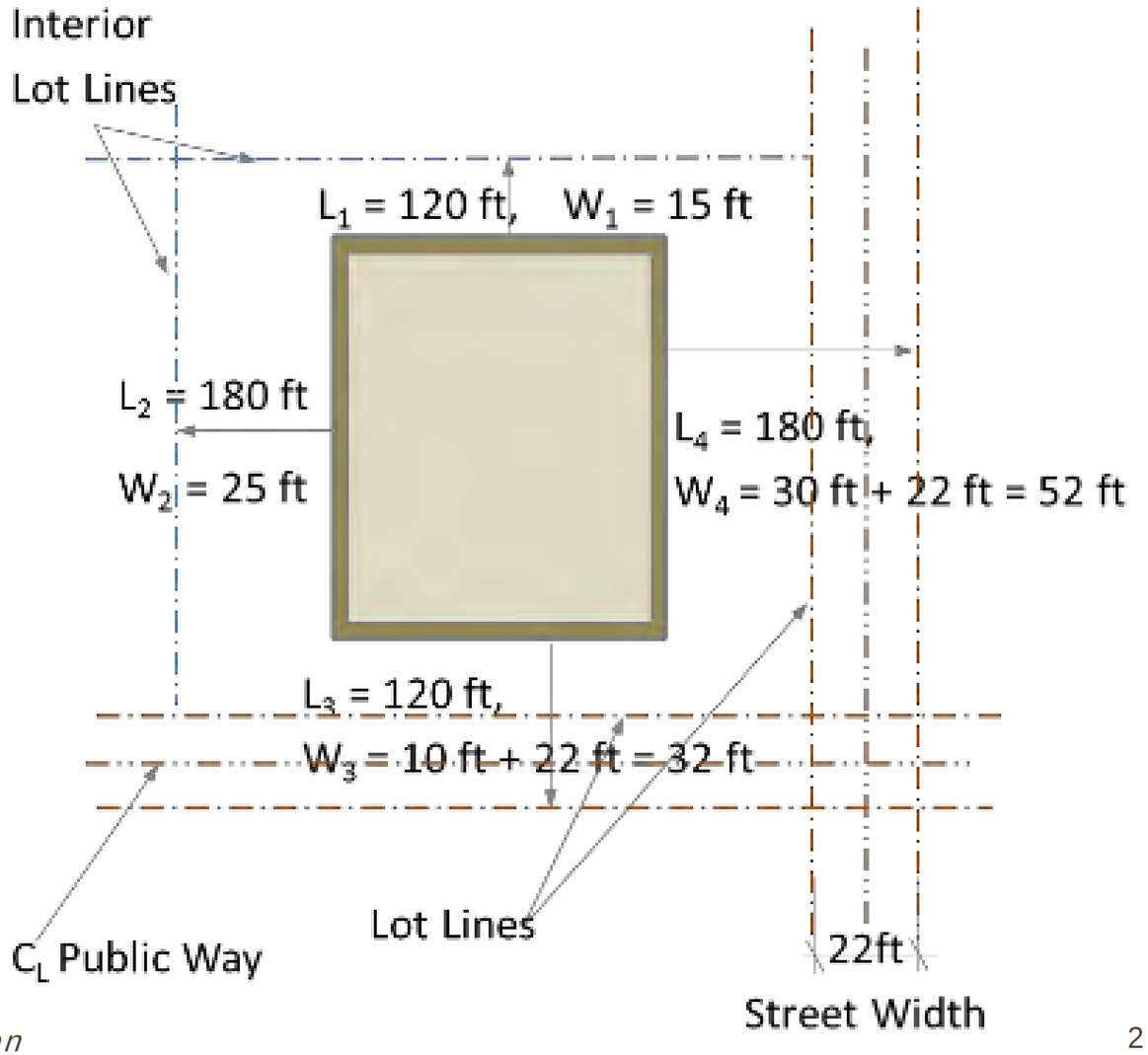


ALLOWABLE AREA EXAMPLE (506.2)

Solution:
Length of Walls:
L_1 = 120 ft L_3 = 120 ft
L_2 = 180 ft L_4 = 180 ft

Frontage Width:
(Note: Public way is 22 ft)

w_1 = 15 ft w_3 = 10 + 22 = 32 ft
w_2 = 25 ft w_4 = 30 + 22 = 52 ft



ALLOWABLE AREA EXAMPLE (506.2)

Weighted Area solution cont.:

$$F = L_2 + L_3 + L_4 = 180 + 120 + 180 = 480 \text{ ft}$$

$$W = \frac{(L_1 \times w_1 + L_2 \times w_2 + L_3 \times w_3 + L_4 \times w_4)}{F}$$

$$W = \frac{(0 + 180 \times 25 + 120 \times 30 + 180 \times 30)}{480} = 28 \text{ ft}$$

Note: W_1 figure is not include (open space width is less than 20').

FRONTAGE INCREASE (506.3.3)

Solution continued:

A_t = NS = 14,000 sq ft
I_f = (F / P - .025) x W / 30

(Equation 5-5)

I_f = [(480 / 600) – 0.25] x 28 / 30 = 0.51
S_a = 2 stories

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

(Equation 5-2)

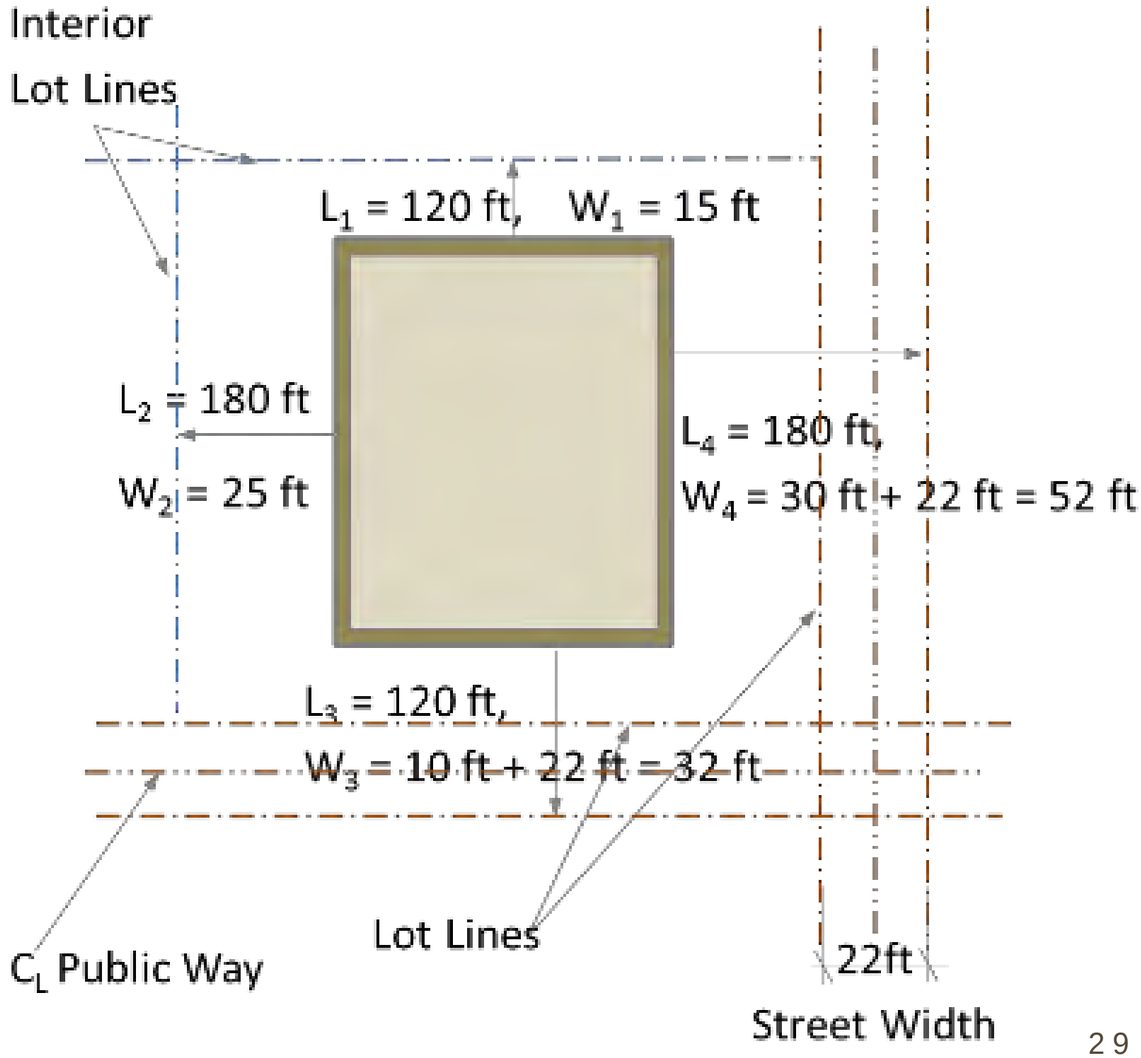
A_a = [14,000 + (14,000 x 0.51)] x 2 = 42,280 sq ft maximum building area

FRONTAGE INCREASE (506.3.3)

Solution continued:

Solution cont.:
42,280 < 43,200 (actual area), so no good

Note: A-2 above the level of exit discharge or > 5,000 sq. ft. require sprinklers per Chapter 9 (this example assumed a nonsprinklered* building).



FRONTAGE INCREASE (506.3.3)

When a building is equipped throughout with an NFPA 13-compliant automatic sprinkler system, the allowable floor area is permitted to be increased:

- Single-story building – 3x (300%)
- Multi-story building – 2x (200%)

SPRINKLER TRADE-OFFS IN ADDITION TO BUILDING SIZE INCREASES

- Reductions in corridor ratings and corridor opening protection
- Flexibility in means of egress (e.g., travel distance to exits, number and separation of exits, common path of travel)
- Reductions in dwelling unit separations
- Alternate to emergency escape openings
- Alternate to certain fire and smoke damper requirements
- Interior finish flexibility
- Several others

CCWD TABLE 10 – GROUP I-1 CONDITION1 NFPA 13R-COMPLIANT SPRINKLERED BUILDINGS – MAXIMUM FLOOR AREA PER STORY

Group I-1 Sprinklered Buildings - NFPA 13R Compliant [a, b, c, d, f]						
# of stories	% frontage	Maximum floor area per story (sq. ft.)				
		IIIA	IIIB	IV	VA	VB
1, 2 &3[e]	0-25	16,500	10,000	18,000	10,500	4,500
	50	20,620	12,500	22,500	13,120	5,620
	100	28,870	17,500	31,500	18,370	7,870
4	0-25	16,500	NP	18,000	NP	NP
	50	20,620	NP	22,500	NP	NP
	100	28,870	NP	31,500	NP	NP

FOOTNOTES – GROUP I-1, NFPA 13R-COMPLIANT BUILDINGS

NP = Not Permitted

a. NFPA 13R-compliant sprinklered buildings do not receive an increase of area for sprinklers. There is an increase in building area for open frontage, if applicable. The maximum floor area for four stories above grade plane was determined in accordance with Section 506.2.3 and using a value of $S_a = 4$ as permitted when using an NFPA 13R sprinkler system.

b. Frontage based on open space widths of 30 feet or more.

c. Interpolation permitted.

d. Section 903.2.6 permits Group I-1 occupancies to be sprinklered with an NFPA 13R-compliant system. The occupancies do not qualify for area increases due to sprinklers.

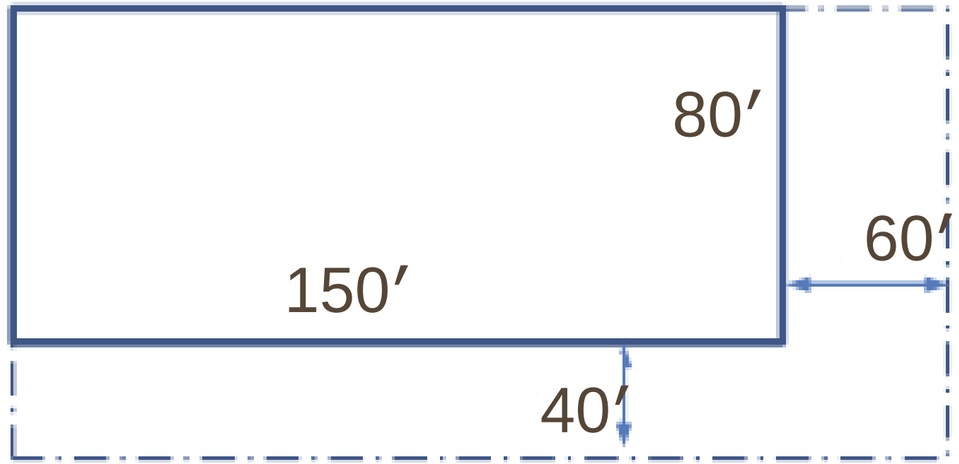
e. Type VB construction does not permit three stories above grade plane.

EXAMPLE – GROUP I-1, CONDITION 1

Given: Two-story Type IIIB NFPA 13-R-compliant sprinklered assisted living facility where residents are capable of evacuating without assistance (Condition 1)

Determine: Maximum allowable area per story

Frontage Increase: 50 percent of the open space qualifies for the frontage increase



EXAMPLE – GROUP I-1, CONDITION 1

Table 10 – Group I-1 NFPA 13R-Compliant Sprinklered Buildings – Maximum Floor Area per Story

Group I-1 Sprinklered Buildings - NFPA 13R Compliant [a, b, c, d, f]						
# of stories	% frontage	Maximum floor area per story (sq. ft.)				
		IIIA	IIIB	IV	VA	VB
1, 2, & 3[e]	0-25	16,500	10,000	18,000	10,500	4,500
	50	20,620	12,500	22,500	13,120	5,620
	100	28,870	17,500	31,500	18,370	7,870
4	0-25	16,500	NP	18,000	NP	NP
	50	20,620	NP	22,500	NP	NP
	100	28,870	NP	31,500	NP	NP

AWC DESIGN FOR CODE ACCEPTANCE SERIES (DCA)

- Resource and design tools providing code compliance for wood construction:

- Flame Spread Performance of Wood Products for Interior Finishes (DCA1)
- Fire Resistance of Exposed Wood Members (DCA2)
- Fire Resistance-Rated Wood-Frame Wall/Ceiling Assemblies (DCA3)
- Component Additive Method (CAM) for Calculating/Demo Fire Resistance (DCA4)
- Post Frame Buildings (DCA5)
- Prescriptive, Residential Wood Deck Construction Guide (DCA6)
- Meeting Residential Energy Requirements w/ Wood-Frame Construction (DCA7)

- Available for free download on the AWC website at:

  https://awc.org/codes-standards/publications

WHAT IS DCA3?

- An AWC publication containing the following information for wood-framed assemblies:

  - ✓ Fire-resistance data for tested wood-frame wall and floor/ceiling assemblies
  - ✓ Sound insulation data for tested wood-frame floor/ceiling assemblies
  - ✓ Example details for exterior wall – floor intersections in platform construction

- Part of a series of AWC documents: Design for Code Acceptance (DCA)

- Available for free download on the AWC website at:

  https://awc.org/codes-standards/publications/dca3

DEFINITIONS

Fire resistance:

The ability of a material, product, or assembly to withstand fire or give protection from it for a period of time (Source: ASTM E176)

- Building codes stipulate minimum fire-resistance ratings for specific building elements or assemblies to slow the spread of a fire from one part of the building to another

FIRE RESISTANCE. That property of materials or their assemblies that prevents or retards the passage of excessive heat, hot gases or flames under conditions of use.

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.

- Minimum code-required fire-resistance ratings are typically in one-hour increments (1-hour, 2-hour or 3-hour)

DEFINITIONS

Wood-frame construction:

Construction in which the primary structural system consists of repetitive wood members and assemblies

- All the assemblies described in DCA3 are light-frame wood assemblies

Fire Retardant Treated Wood (FRTW):

Wood products that, when impregnated with chemicals by a pressure process or other means during manufacture, exhibit reduced surface-burning characteristics and resist propagation of fire.

TYPES OF ASSEMBLIES

The following wood-frame assemblies are addressed in DCA3:

- Floor/ceiling assemblies
  - ✓ Fire resistance test results and sound insulation data (one- and two-hour)
- Wall assemblies
  - ✓ Fire resistance test results (one- and two-hour)
- Exterior wall-floor intersections for Type III construction
  - ✓ Example details provided

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Methods for Establishing Fire Resistance Ratings IBC 703):

- Tested in accordance with ASTM E119 or UL 263
- Fire-resistance rated designs documented in approved sources
- Prescriptive designs of building elements/assemblies in IBC Section 721
- Calculations per IBC Section 722
- Engineering analysis based on comparisons of data from ASTM E119 tests
- Alternative protection methods allowed under IBC Section 104.11
- Fire-resistance designs certified by an approved agency

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Assemblies that may need to be fire-resistance rated:

- Walls, floors & roofs on the basis of building construction type (IBC Table 601)
- Exterior walls (Table 602 and Section 705)
- Fire Walls (Section 706)
- Fire Barriers (Section 707)
- Fire Partitions (Section 708)
- Smoke Barriers (Section 709)
- Horizontal Assemblies (Section 711)
- Shaft Enclosures (Section 713)

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Walls, floors & roofs rated on the basis of construction type:

- Have general protection requirements in IBC Section 704
- Do not require opening/penetration protection
- Have ratings based on IBC Table 601

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

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

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

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Exterior Walls (IBC Section 705):

- Have unique structural and penetration protection requirements
- Have material requirements based on construction type
- The most restrictive rating from Table 601 or Table 602 must be used
- Required to be rated for exposure to both sides of the wall only when FSD $\leq$10′ (otherwise rating is required only from the interior side)

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

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

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

"ORDINARY" CONSTRUCTION

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Exterior Walls - rating requirements based on fire separation distance (IBC Table 602)

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
$5 \le X < 10$	IA Others	3 2	2 1	1 1
$10 \le X < 30$	IA, IB IIB, VB Others	2 1 1	1 0 1	1[c] 0 1[c]
$X \ge 30$	All	0	0	0

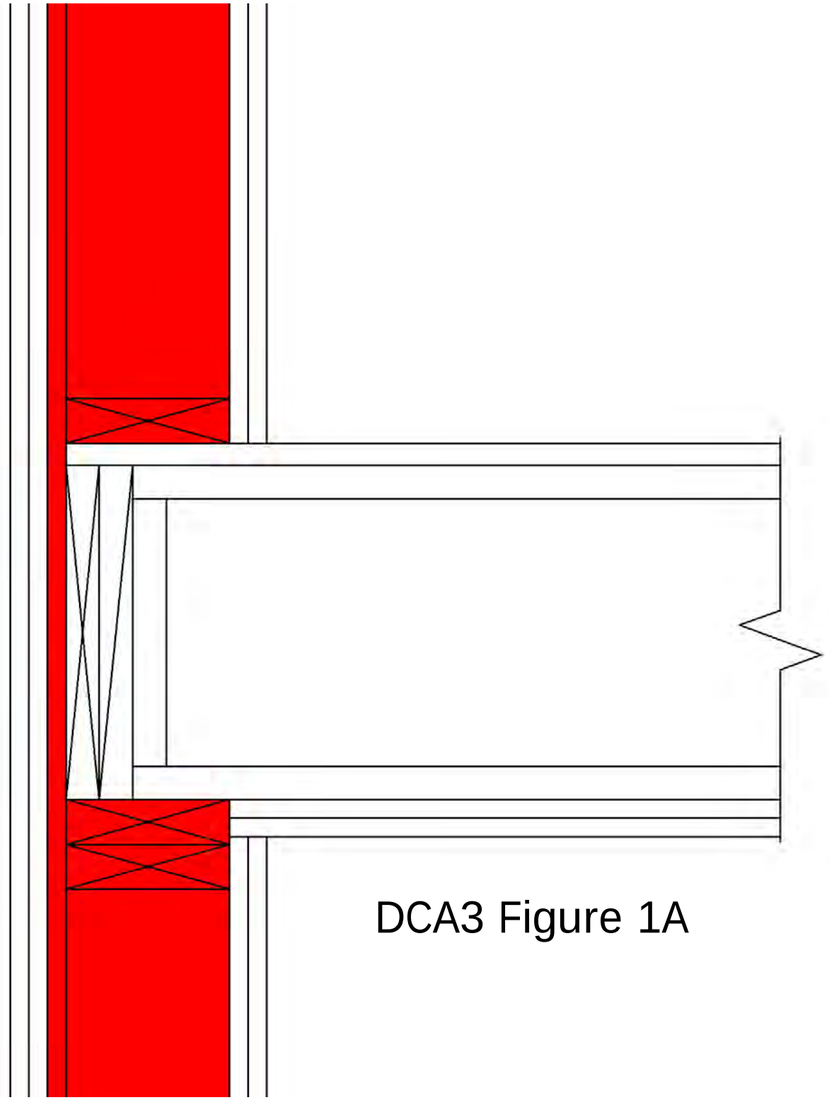
IBC REQUIREMENTS- TYPES OF CONSTRUCTION

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.

IBC 602.3 TYPE III-EXTERIOR WALLS FRTW FRAMING

Example Details of Exterior Wall/Floor Intersections

- Applicable to Type III platform construction
- FIRST, Identify which wall framing members <u>are required to be FRTW</u>
- Understand that graphically, wood required to be FRTW is RED and sacrificial wood blocking is shown in GREEN



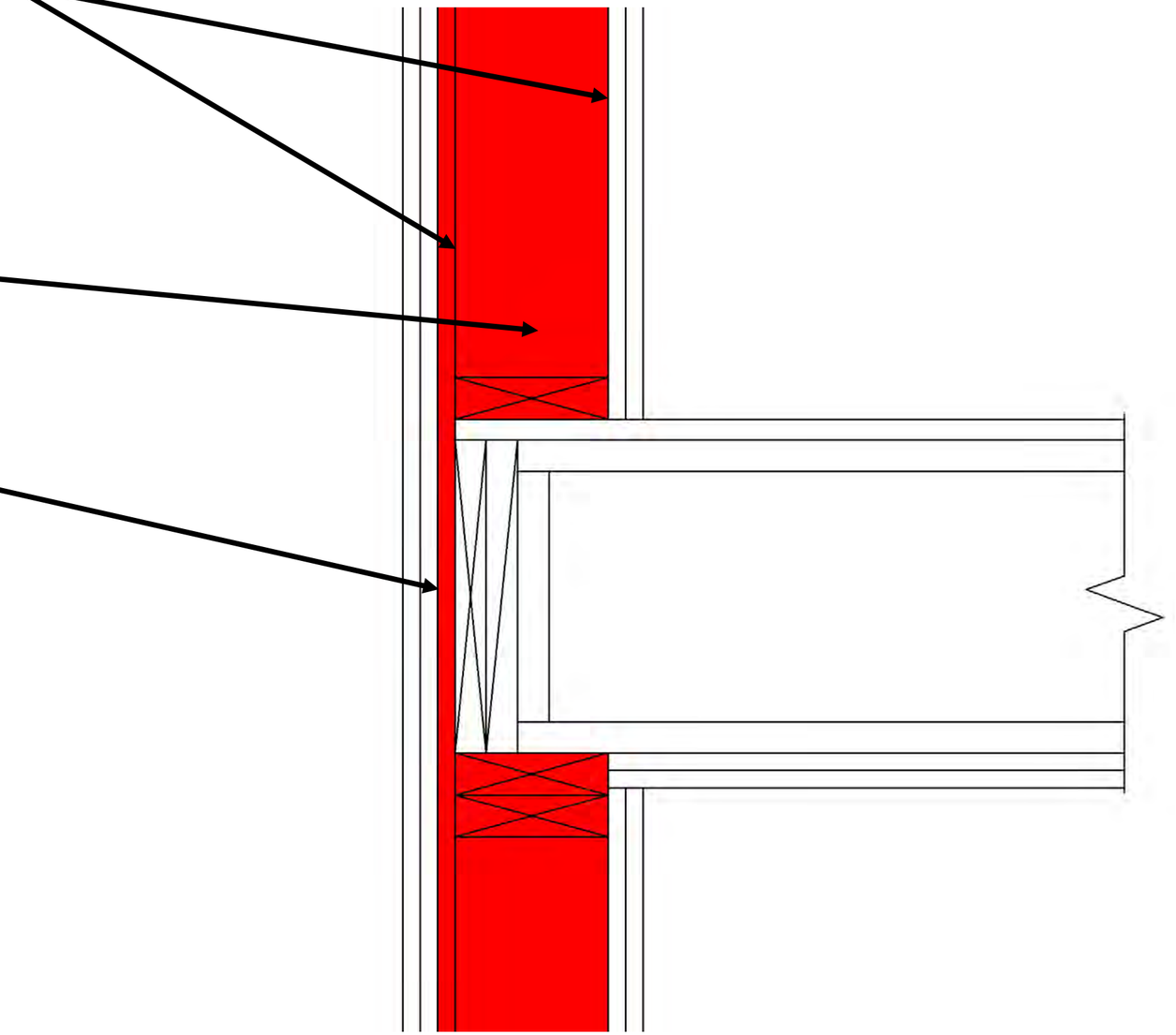
DCA3 Figure 1A

IBC 602.3 TYPE III-EXTERIOR WALLS FRTW FRAMING

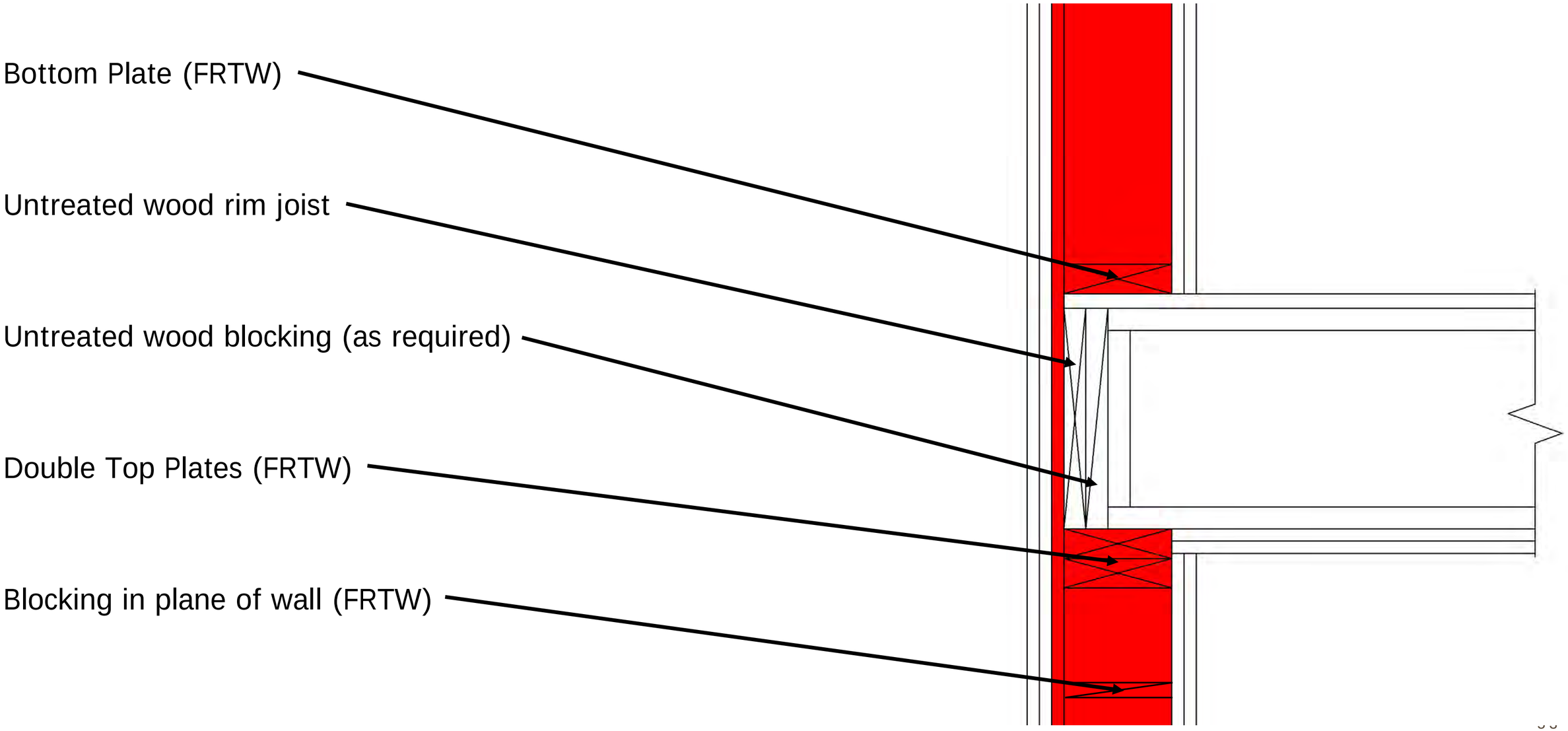
Fire Retardant Treated Wood (FRTW) exterior wall framing

Framing Studs (FRTW)

FRTW Sheathing (as required)



IBC 602.3 TYPE III-EXTERIOR WALLS FRTW FRAMING



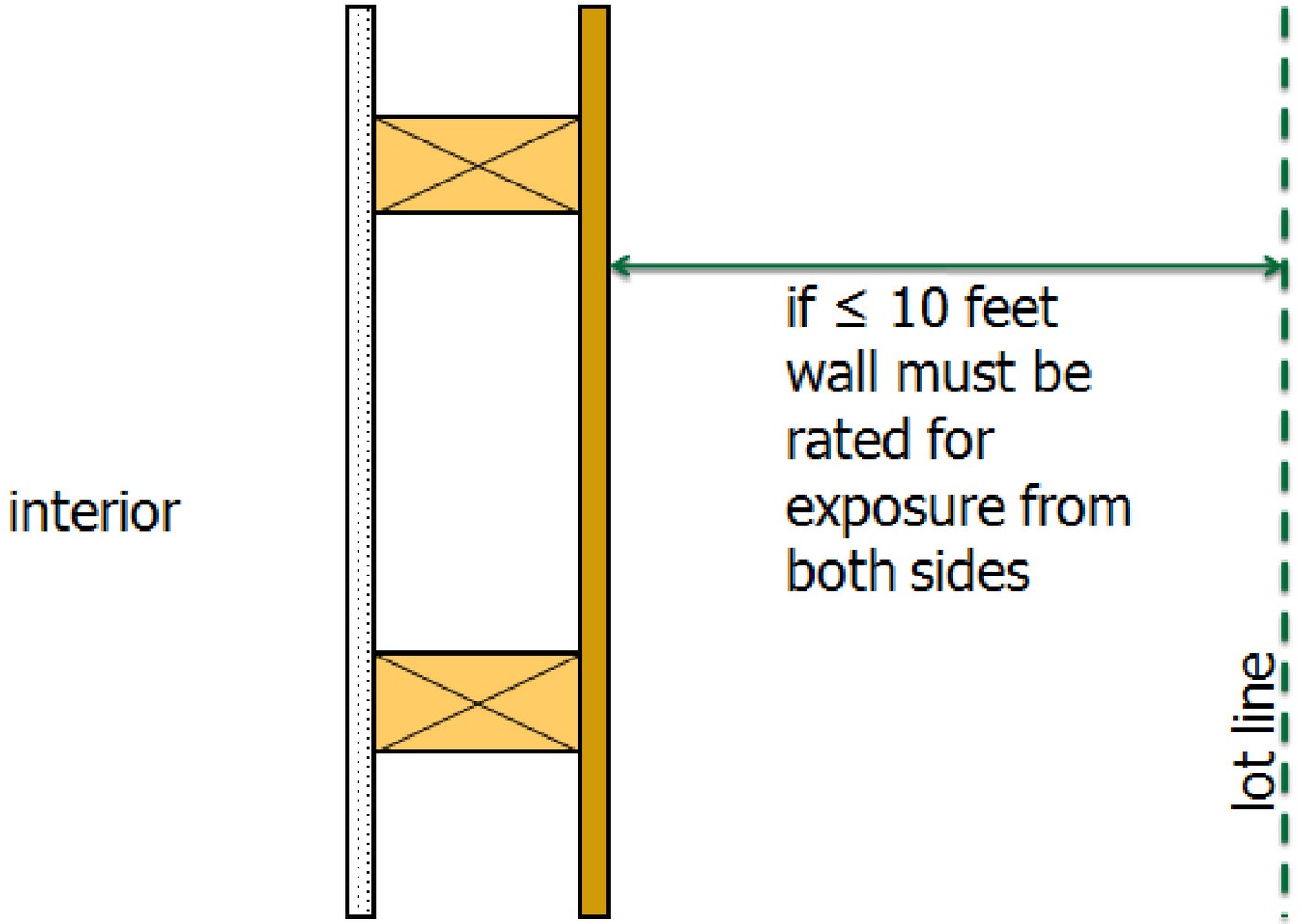
BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Fire-Resistance ratings-Exterior Walls (IBC Section 705):

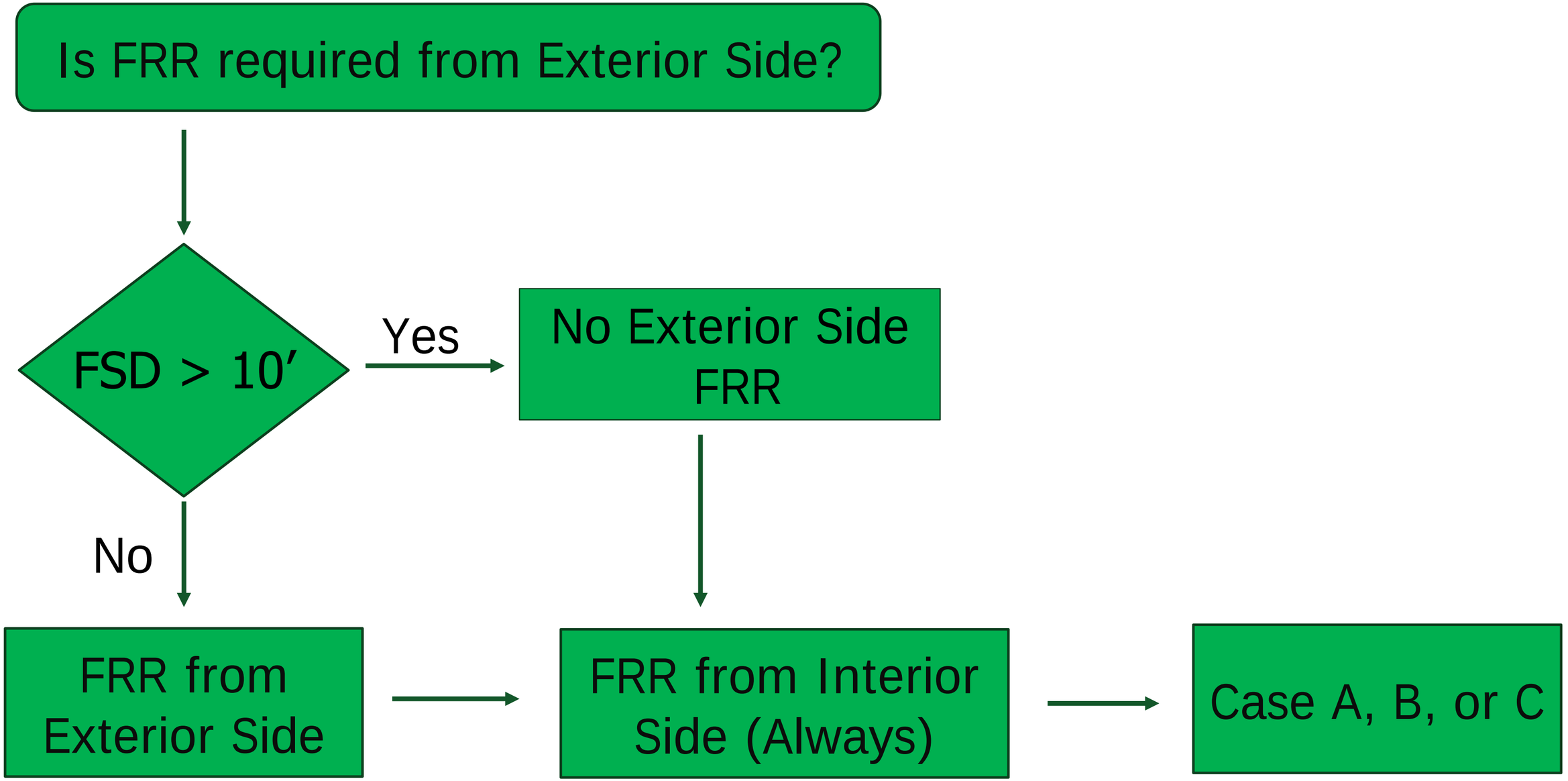
- Have unique structural and penetration protection requirements
- Have material requirements based on construction type
- The most restrictive rating from Table 601 or Table 602 must be used
- Required to be rated for exposure to both sides of the wall only when FSD ≤**10' (otherwise rating is required only from the interior side)**

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Fire Separation Distance:

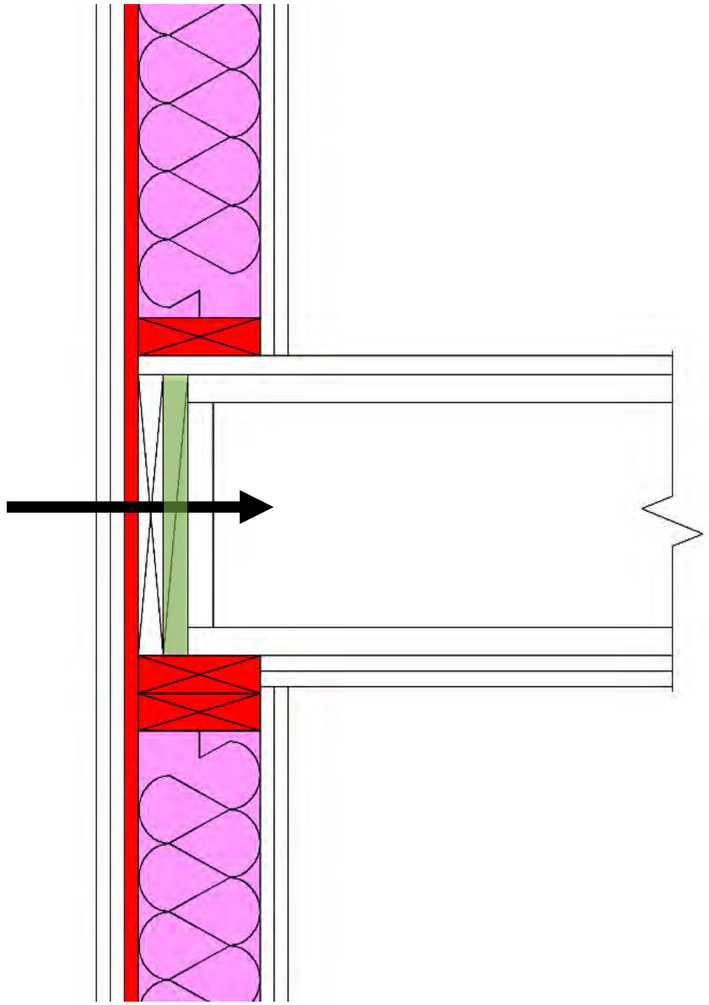


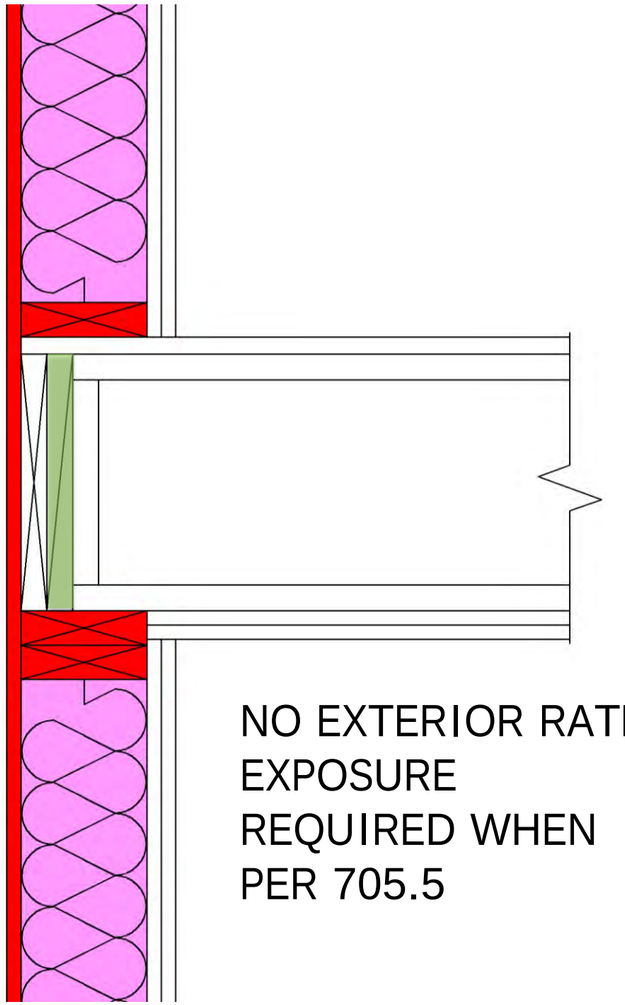
DCA3 – TYPE III-A EXTERIOR BEARING WALL



DCA3 – TYPE III-A EXTERIOR WALL CONFIGURATIONS

2-HOUR FIRE RATING
FROM EXTERIOR SIDE
IF ≤ 10′ FSD PER IBC
705.5





NO EXTERIOR RATED FIRE
EXPOSURE
REQUIRED WHEN FSD > 10′
PER 705.5

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Exterior Walls - rating requirements based on fire separation distance (IBC Table 602)

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
$5 \le X < 10$	IA Others	3 2	2 1	1 1
$10 \le X < 30$	IA, IB IIB, VB Others	2 1 1	1 0 1	1[c] 0 1[c]
$X \ge 30$	All	0	0	0

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Fire Walls (IBC Section 706):

- Act as a divide between separate buildings
- Have unique structural, continuity and penetration protection requirements
- Material requirements based on type of construction (wood allowed in Type V)
- Rating requirements based on occupancy

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Fire Barriers (IBC Section 707):

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

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Fire Partitions (IBC Section 708):

- Create fire resistant separations
- Have unique continuity and opening/penetration protection requirements
- May have any materials permitted by the construction type
- Rating requirements based on function and sprinkler protection:
  - dwelling unit separation, tenant space separation, corridor walls, elevator lobby separation

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Horizontal Assemblies (IBC Section 711):

- Have unique continuity and opening/penetration protection requirements
- Have requirements for supporting construction
- Rating requirements based on function

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Integrity and Continuity of Fire Resistance Rated Assemblies:

- Penetration protection (IBC Section 714)
- Opening protection (IBC Section 716)
- Fire resistant joint systems (IBC Section 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... (Source: IBC)

BUILDING CODE REQUIREMENTS – EXTERIOR WALL/FLOOR INTERSECTIONS

Exterior bearing walls in Type III construction:

- Must have a 2-hour fire-resistance rating (IBC Table 601)
- If wood is used, the framing members of the exterior wall must be FRTW (IBC Section 602.3)
- Note: the IBC says nothing about the floors requiring FRTW or having a 2-hour rating.

BUILDING CODE REQUIREMENTS – EXTERIOR WALL/FLOOR INTERSECTIONS

- In platform construction, the floor assembly bears on the wall below; and the wall above bears on the floor
  - ✓ This intersecting part of the floor assembly should follow the requirements for floors or ceilings.
  - ✓ However, the portion of the floor that transfers load from the wall above to the wall below must be designed to provide continuity of fire resistance from the wall above to the wall below

NEW! GROUP A CDPACCESS RESULTS-2024 IBC

Code change FS18:

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 .

NOW THE 2024 IBC IS ALIGNED WITH DCA3!

GROUP A CDP ACCESS RESULTS-2024 IBC

2024 IBC

- Group A Code change proposal, FS19
- Approved by stakeholders via OGCV process on 11/24/21
- New 2024 IBC Section 705.6.1 Supporting construction
- Codifies the methodology espoused in DCA3 document and aligns itself with existing ICC Commentary
- Rim joist/band joist DOES NOT require Fire Retardant Treatment (FTRW)
- Ceiling membrane can contribute to the required FRR of the exterior wall

NEW! GROUP A CDPACCESS RESULTS-2024 IBC

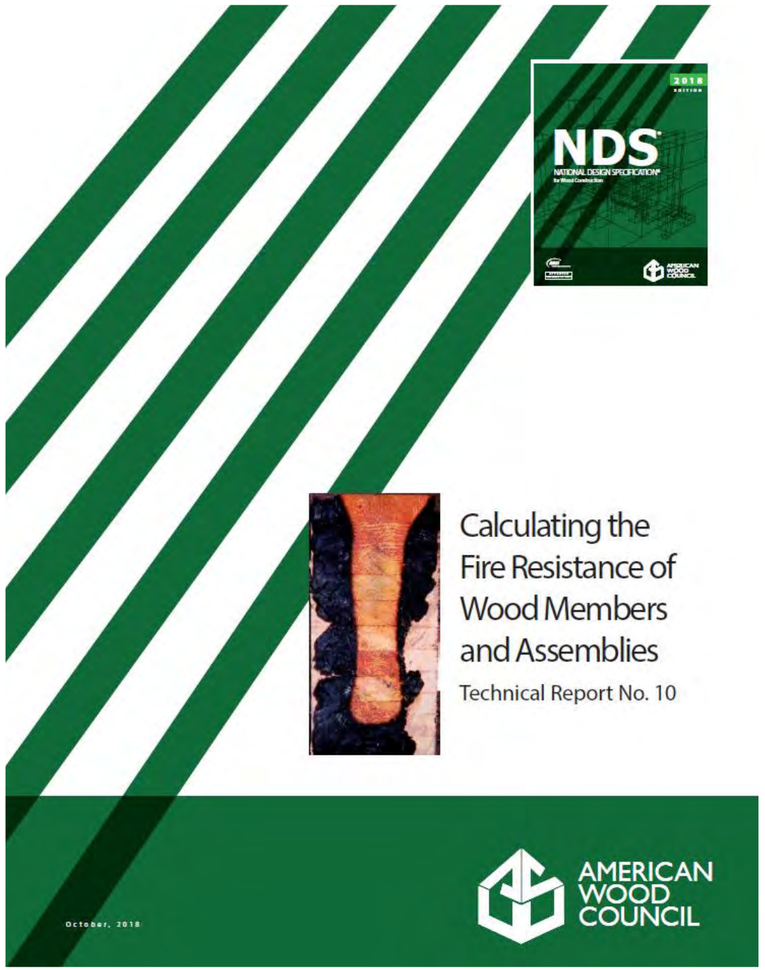
Code change FS19:

705.6.1 Floor Assemblies in Type III Construction. In Type III construction where a floor assembly supports gravity loads from 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.

NOW THE 2024 IBC IS ALIGNED WITH DCA3!

CALCULATING FIRE RESISTANCE OF WOOD ASSEMBLIES

- Technical Report 10 (TR10) provides supplemental design information beyond NDS Chapter 16 on determining fire resistance rating of exposed wood members and assemblies.



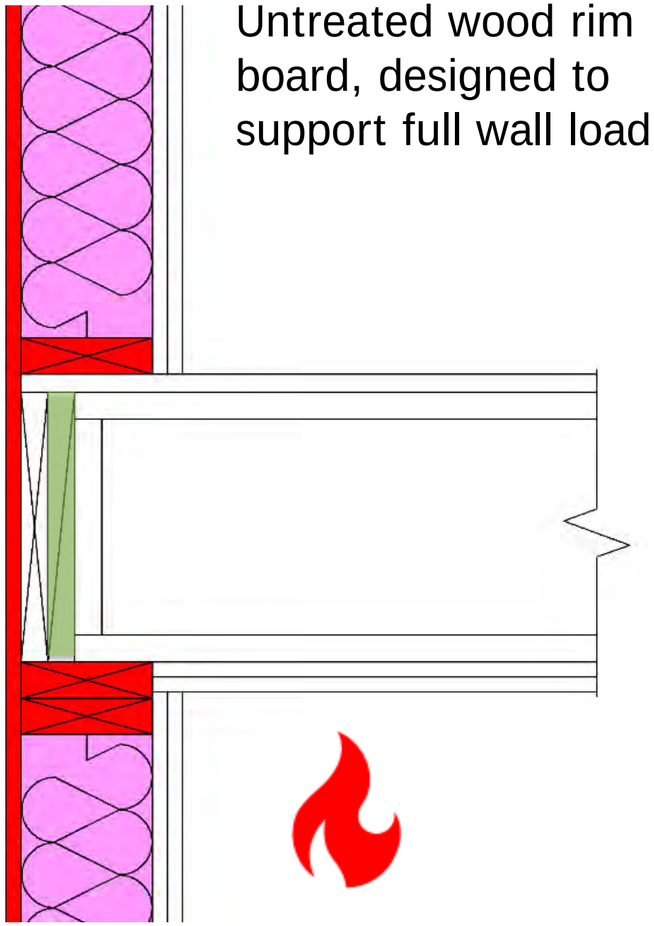
SACRIFICIAL CHAR OF EXPOSED WOOD MEMBERS

Sample of CLT taken from the ceiling of a panel burned in support of the Tall Wood Building Ad-Hoc Committee Tall Mass Timber code change proposals

SACRIFICIAL CHAR OF EXPOSED WOOD MEMBERS

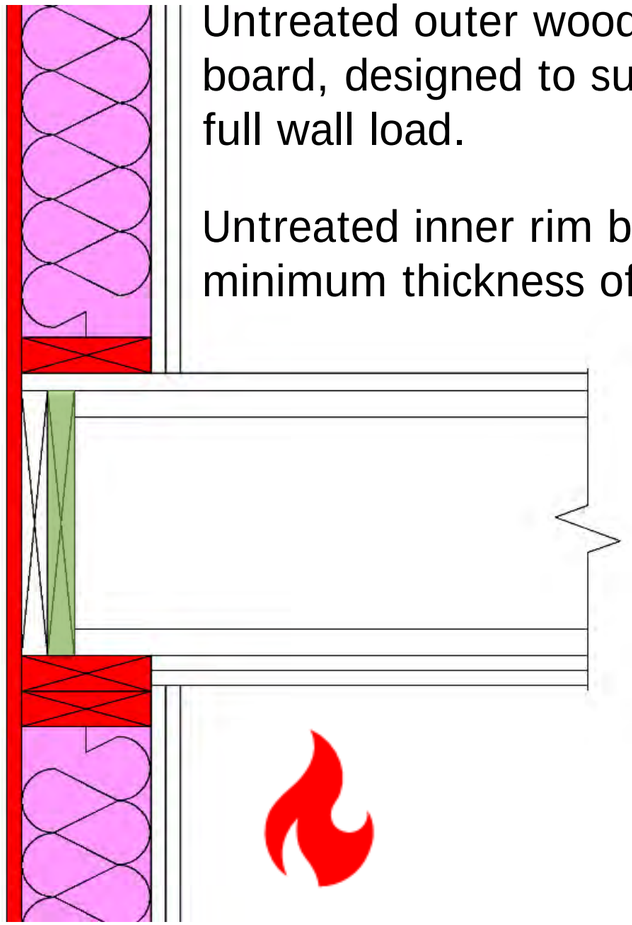
Same CLT sample removed-note that the bottom layer protected the next layer from heat and delayed ignition of the next layer

DCA3 – TYPE III-A EXTERIOR WALL (CASE A)



Untreated wood rim board, designed to support full wall load.

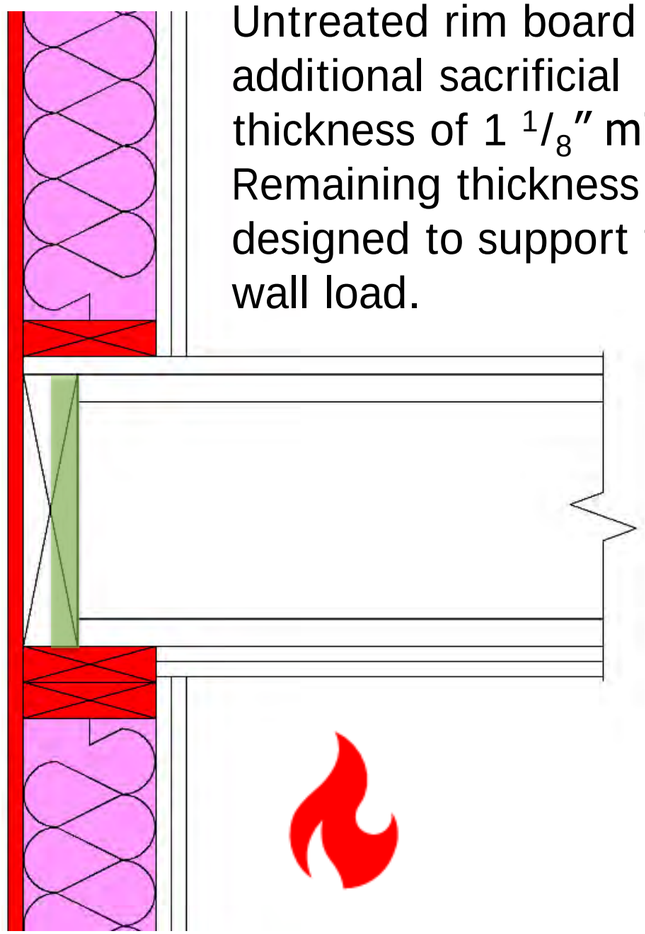
FIGURE 1A
RIM CONFIGURATION



Untreated outer wood rim board, designed to support full wall load.

Untreated inner rim board minimum thickness of 1 $^{1}/_{8}$″

FIGURE 1B
RIM CONFIGURATION

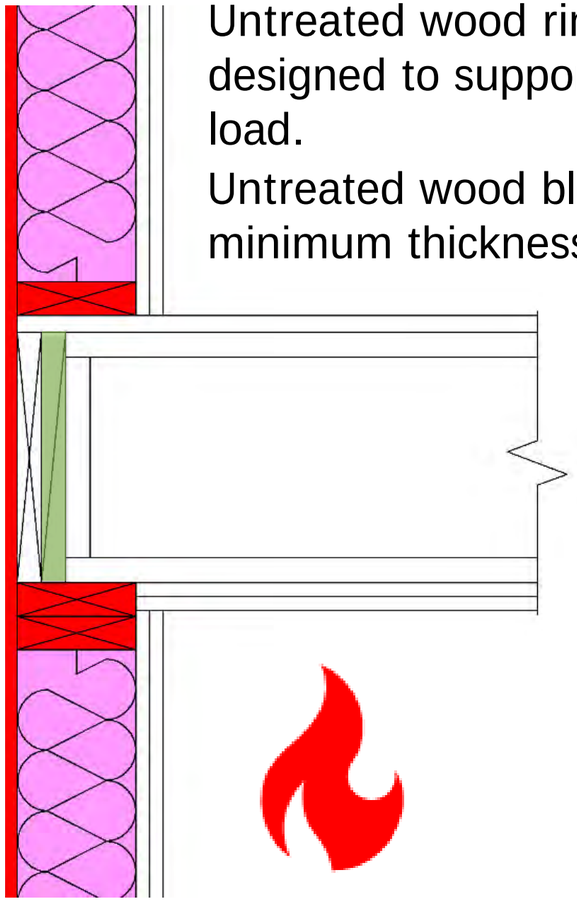


Untreated rim board with additional sacrificial thickness of 1 $^{1}/_{8}$″ min. Remaining thickness designed to support full wall load.

FIGURE 1C
RIM CONFIGURATION

Ceiling membrane 2-layers of min. 5/8″ Type X GWB or equivalent in all figures.

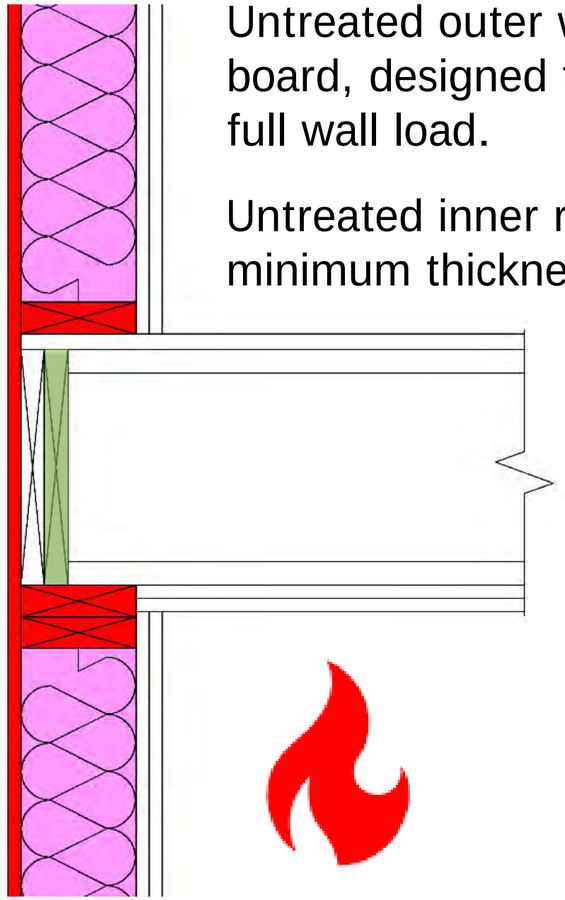
DCA3 – TYPE III-A EXTERIOR WALL (CASE B)



Untreated wood rim board, designed to support full wall load.

Untreated wood blocking with minimum thickness of 1 $^{3}/_{4}$″

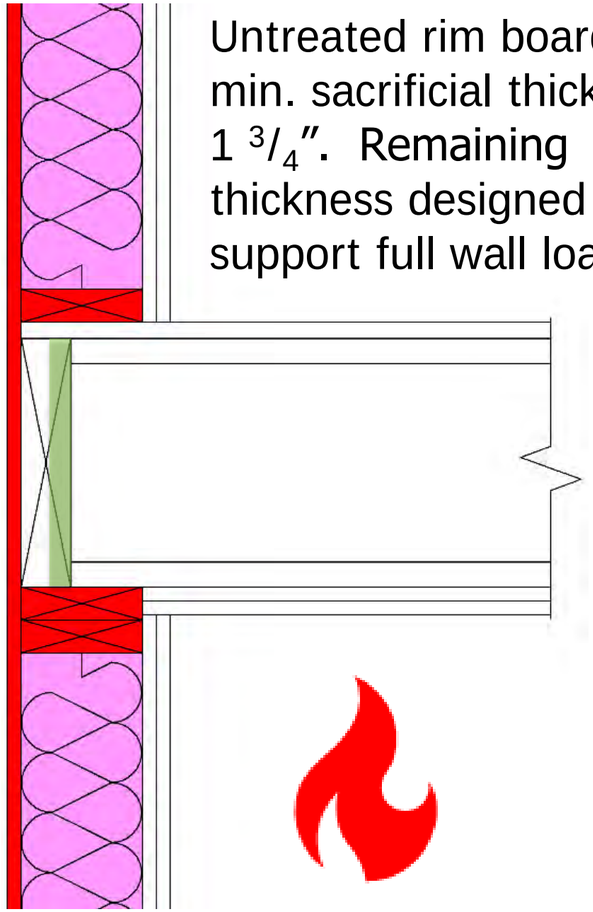
FIGURE 1A



Untreated outer wood rim board, designed to support full wall load.

Untreated inner rim board minimum thickness of 1 $^{3}/_{4}$″

FIGURE 1B

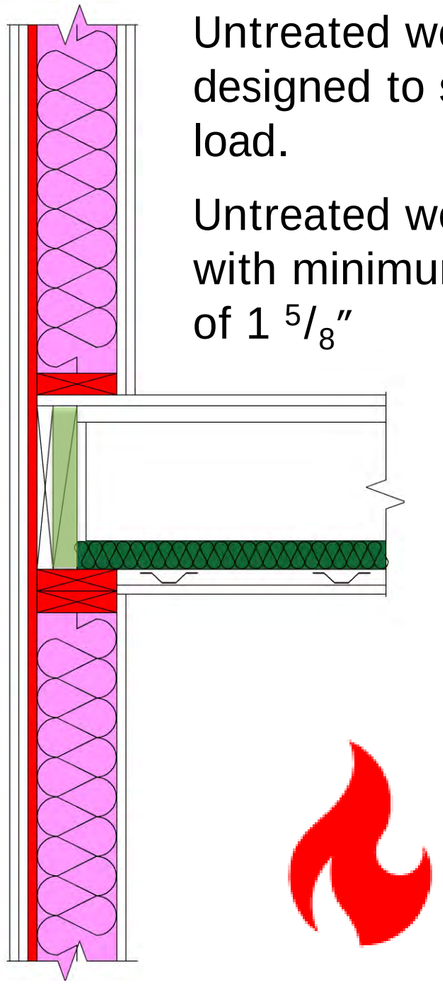


Untreated rim board with min. sacrificial thickness of 1 $^{3}/_{4}$″. Remaining thickness designed to support full wall load.

FIGURE 1C

Ceiling membrane 2-layers of min. 1/2″ Type X GWB or equivalent.

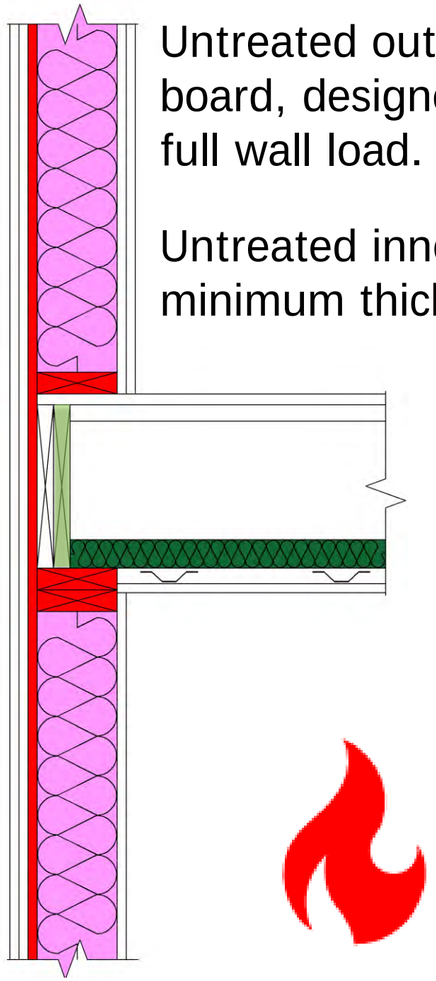
DCA3 – TYPE III-A EXTERIOR WALL (CASE C)



Untreated wood rim board, designed to support full wall load.

Untreated wood blocking with minimum thickness of 1 $^{5}/_{8}$″

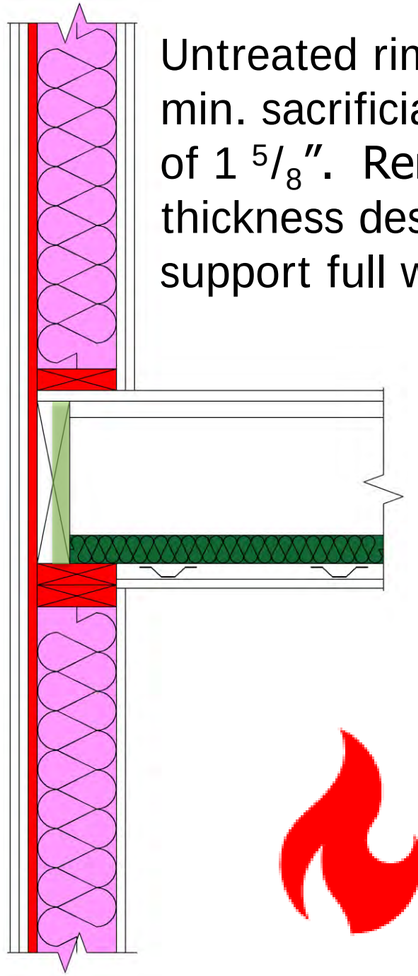
FIGURE 1A



Untreated outer wood rim board, designed to support full wall load.

Untreated inner rim board minimum thickness of 1 $^{5}/_{8}$″

FIGURE 1B



Untreated rim board with min. sacrificial thickness of 1 $^{5}/_{8}$″. Remaining thickness designed to support full wall load.

FIGURE 1C

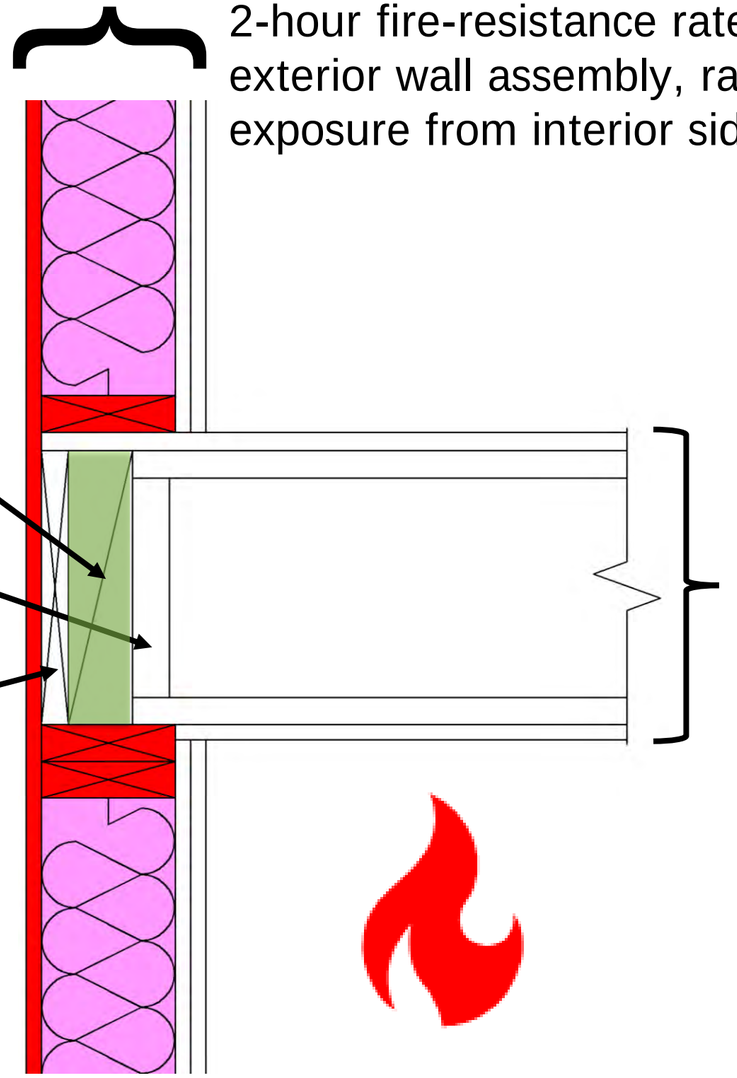
Ceiling membrane 1-layer of 5/8″ Type X GWB or equivalent. 1.5″ thick (2.5 pcf) mineral wool batt insulation resting on resilient channels.

DCA3 – TYPE III-B EXTERIOR WALL FIGURE 2

Untreated sacrificial wood blocking (single layer with min. 2 5/8″ thickness or multiple two layers with a total thickness of 3″

Untreated wood or other approved material to fill gap between blocking and joist web (if I-joists are used)

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



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

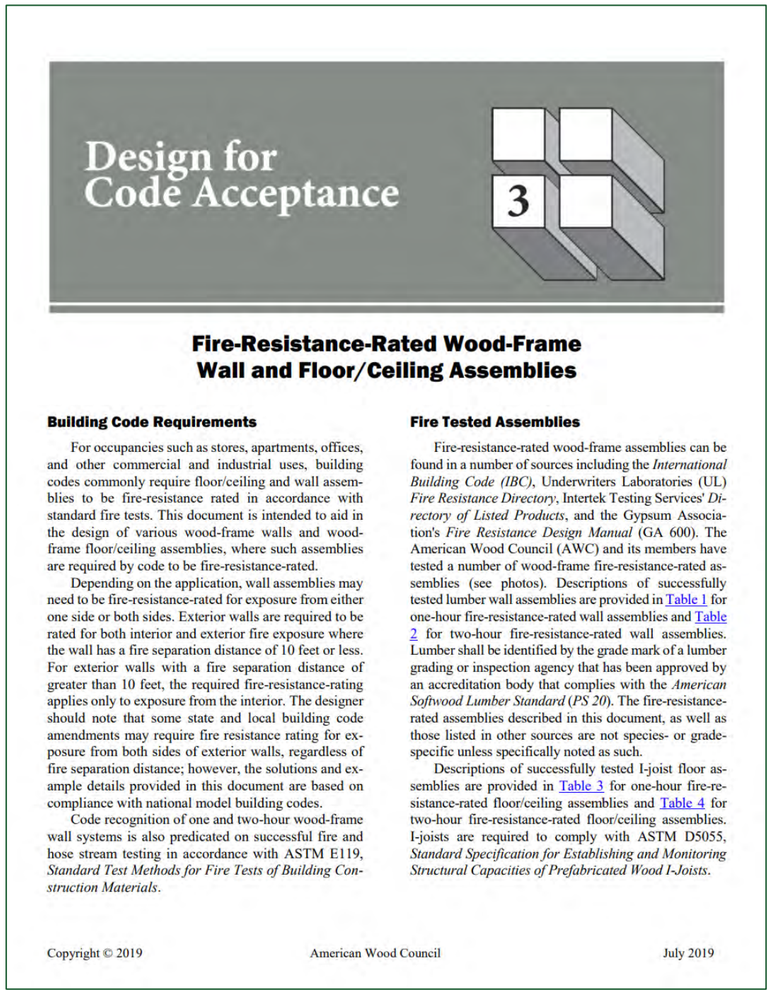
Untreated floor/ceiling assembly made with untreated framing members and floor sheathing (rated floor/ceiling assemblies are also acceptable)

DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Fire resistance ratings in DCA3 are established by:

- ✓ All assemblies were tested per ASTM E119
- ✓ DCA3 is typically considered an approved source
- ✓ Duplicate assemblies are prescribed in IBC Section 721

- ➢ Thus, the FRR of the assemblies are established through multiple methods allowed by IBC 703



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 document are based on compliance with national model building codes.

Code recognition of one and two-hour wood-frame wall systems is also predicated on successful fire and hose stream testing in accordance with ASTM E119, *Standard Test Methods for Fire Tests of Building Construction Materials*.

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 assemblies are provided in Table 3 for one-hour fire-resistance-rated floor/ceiling assemblies and Table 4 for two-hour fire-resistance-rated floor/ceiling assemblies. I-joists are required to comply with ASTM D5055, *Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists*.

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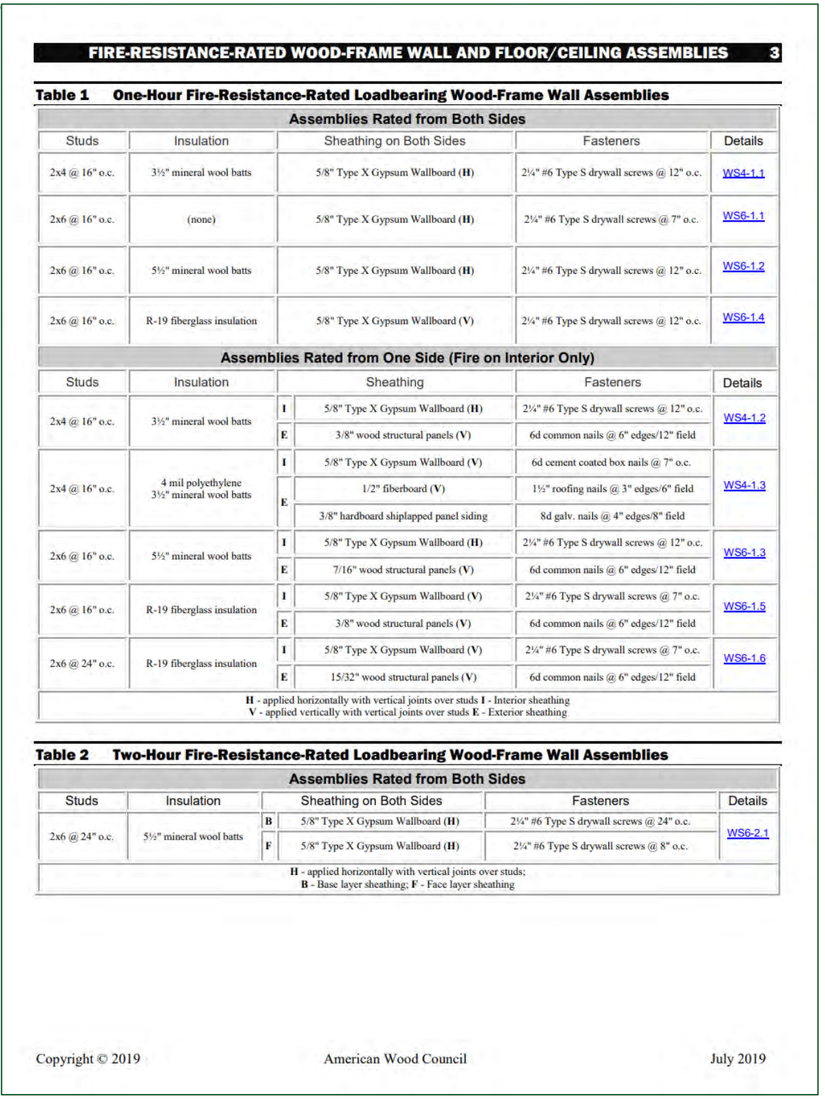
DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Wall Assemblies:

- Table 1 provides descriptions of one-hour assemblies
  - ✓ Symmetrical assemblies rated from both sides
  - ✓ Asymmetrical assemblies rated from interior side
- Table 2 describes a two-hour wall assembly
  - ✓ Rated from both sides
- Embedded links take reader to detailed descriptions



FIRE-RESISTANCE-RATED WOOD-FRAME WALL AND FLOOR/CEILING ASSEMBLIES 3

Table 1 One-Hour Fire-Resistance-Rated Loadbearing Wood-Frame Wall Assemblies

Assemblies Rated from Both Sides

Studs	Insulation	Sheathing on Both Sides	Fasteners	Details
2x4 @ 16" o.c.	3½" mineral wool batts	5/8" Type X Gypsum Wallboard (**H**)	2¼" #6 Type S drywall screws @ 12" o.c.	WS4-1.1
2x6 @ 16" o.c.	(none)	5/8" Type X Gypsum Wallboard (**H**)	2¼" #6 Type S drywall screws @ 7" o.c.	WS6-1.1
2x6 @ 16" o.c.	5½" mineral wool batts	5/8" Type X Gypsum Wallboard (**H**)	2¼" #6 Type S drywall screws @ 12" o.c.	WS6-1.2
2x6 @ 16" o.c.	R-19 fiberglass insulation	5/8" Type X Gypsum Wallboard (**V**)	2¼" #6 Type S drywall screws @ 12" o.c.	WS6-1.4

Assemblies Rated from One Side (Fire on Interior Only)

Studs	Insulation		Sheathing	Fasteners	Details
2x4 @ 16" o.c.	3½" mineral wool batts	**I**	5/8" Type X Gypsum Wallboard (**H**)	2¼" #6 Type S drywall screws @ 12" o.c.	WS4-1.2
		E	3/8" wood structural panels (**V**)	6d common nails @ 6" edges/12" field	
2x4 @ 16" o.c.	4 mil polyethylene 3½" mineral wool batts	**I**	5/8" Type X Gypsum Wallboard (**V**)	6d cement coated box nails @ 7" o.c.	WS4-1.3
		E	1/2" fiberboard (**V**)	1½" roofing nails @ 3" edges/6" field	
			3/8" hardboard shiplapped panel siding	8d galv. nails @ 4" edges/8" field	
2x6 @ 16" o.c.	5½" mineral wool batts	**I**	5/8" Type X Gypsum Wallboard (**H**)	2¼" #6 Type S drywall screws @ 12" o.c.	WS6-1.3
		E	7/16" wood structural panels (**V**)	6d common nails @ 6" edges/12" field	
2x6 @ 16" o.c.	R-19 fiberglass insulation	**I**	5/8" Type X Gypsum Wallboard (**V**)	2¼" #6 Type S drywall screws @ 7" o.c.	WS6-1.5
		E	3/8" wood structural panels (**V**)	6d common nails @ 6" edges/12" field	
2x6 @ 24" o.c.	R-19 fiberglass insulation	**I**	5/8" Type X Gypsum Wallboard (**V**)	2¼" #6 Type S drywall screws @ 7" o.c.	WS6-1.6
		E	15/32" wood structural panels (**V**)	6d common nails @ 6" edges/12" field	

H - applied horizontally with vertical joints over studs **I** - Interior sheathing
V - applied vertically with vertical joints over studs **E** - Exterior sheathing

Table 2 Two-Hour Fire-Resistance-Rated Loadbearing Wood-Frame Wall Assemblies

Assemblies Rated from Both Sides

Studs	Insulation		Sheathing on Both Sides	Fasteners	Details
2x6 @ 24" o.c.	5½" mineral wool batts	**B**	5/8" Type X Gypsum Wallboard (**H**)	2¼" #6 Type S drywall screws @ 24" o.c.	WS6-2.1
		F	5/8" Type X Gypsum Wallboard (**H**)	2¼" #6 Type S drywall screws @ 8" o.c.	

H - applied horizontally with vertical joints over studs;
B - Base layer sheathing; **F** - Face layer sheathing

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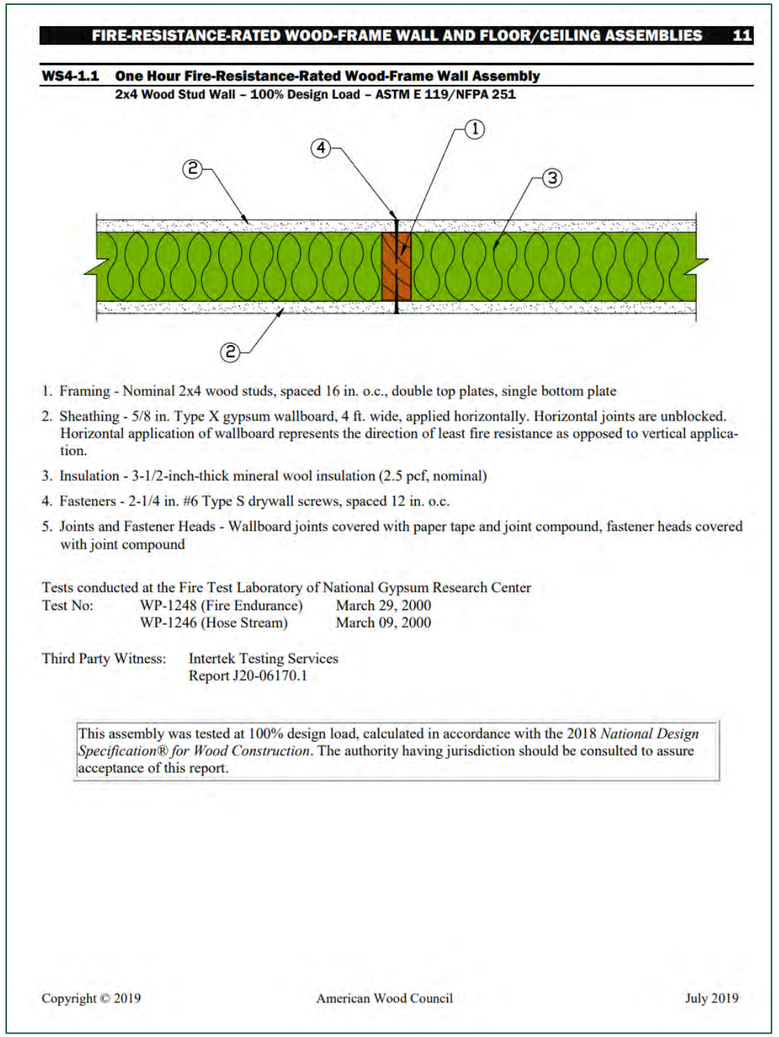
DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Symmetrical One-hour Wall Assemblies:

- Rated from <u>both sides</u>
  - ✓ 5/8″ Type X gypsum wallboard on each side
- Four symmetrical one-hour wall assemblies in all
  - ✓ One with 2x4 studs 16″o.c., three with 2x6 studs 16″o.c.
  - ✓ One with fiberglass, two with mineral wool, one without insulation
- <u>All four rated under 100% design load</u>



FIRE-RESISTANCE-RATED WOOD-FRAME WALL AND FLOOR/CEILING ASSEMBLIES 11

WS4-1.1 One Hour Fire-Resistance-Rated Wood-Frame Wall Assembly
2x4 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251

1. Framing - Nominal 2x4 wood studs, spaced 16 in. o.c., double top plates, single bottom plate
2. Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally. Horizontal joints are unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Insulation - 3-1/2-inch-thick mineral wool insulation (2.5 pcf, nominal)
4. Fasteners - 2-1/4 in. #6 Type S drywall screws, spaced 12 in. o.c.
5. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

Tests conducted at the Fire Test Laboratory of National Gypsum Research Center
Test No: WP-1248 (Fire Endurance) March 29, 2000
WP-1246 (Hose Stream) March 09, 2000

Third Party Witness: Intertek Testing Services
Report J20-06170.1

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

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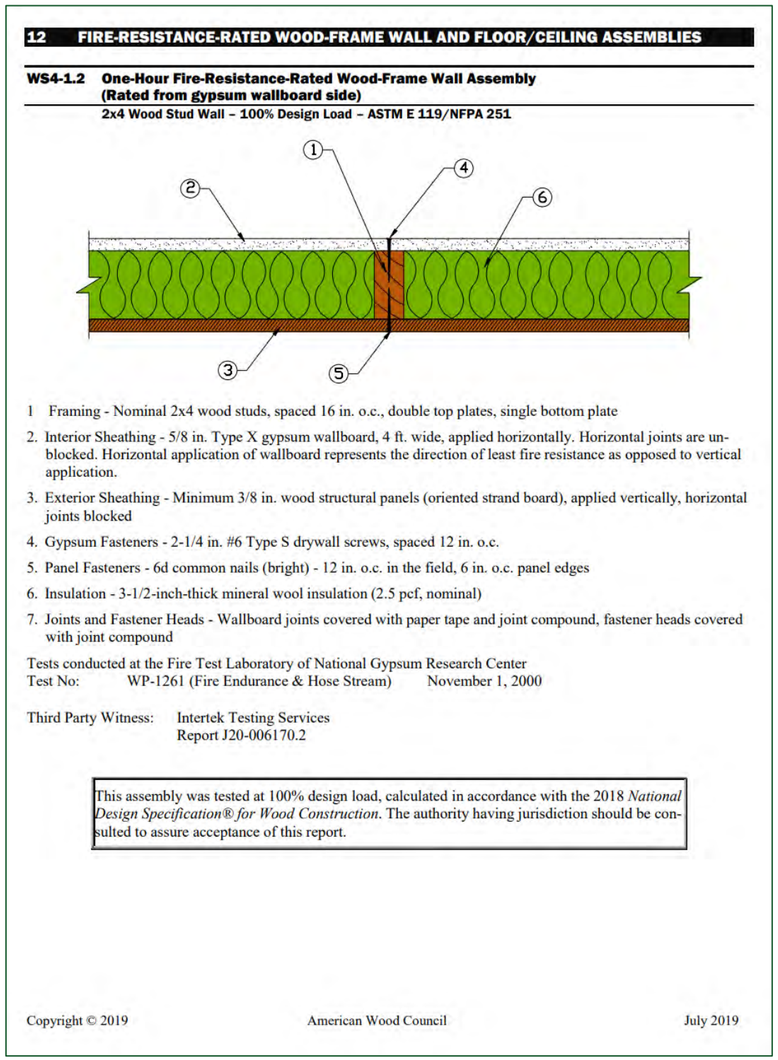
DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Asymmetrical One-hour Wall Assemblies:

- Rated from gypsum wallboard side (interior side)
- Five asymmetrical one-hour wall assemblies in all
  - ✓ Two with 2x4 studs 16”o.c., two with 2x6 studs 16”o.c., one with 2x6 studs 24”o.c.
  - ✓ Two with fiberglass, three with mineral wool insulation
- Four rated under 100% design load; one rated under 78% design load



12 FIRE-RESISTANCE-RATED WOOD-FRAME WALL AND FLOOR/CEILING ASSEMBLIES

WS4-1.2 One-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly
(Rated from gypsum wallboard side)
2x4 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251

1 Framing - Nominal 2x4 wood studs, spaced 16 in. o.c., double top plates, single bottom plate

2. Interior Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally. Horizontal joints are unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Exterior Sheathing - Minimum 3/8 in. wood structural panels (oriented strand board), applied vertically, horizontal joints blocked
4. Gypsum Fasteners - 2-1/4 in. #6 Type S drywall screws, spaced 12 in. o.c.
5. Panel Fasteners - 6d common nails (bright) - 12 in. o.c. in the field, 6 in. o.c. panel edges
6. Insulation - 3-1/2-inch-thick mineral wool insulation (2.5 pcf, nominal)
7. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

Tests conducted at the Fire Test Laboratory of National Gypsum Research Center
Test No: WP-1261 (Fire Endurance & Hose Stream) November 1, 2000

Third Party Witness: Intertek Testing Services
Report J20-006170.2

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

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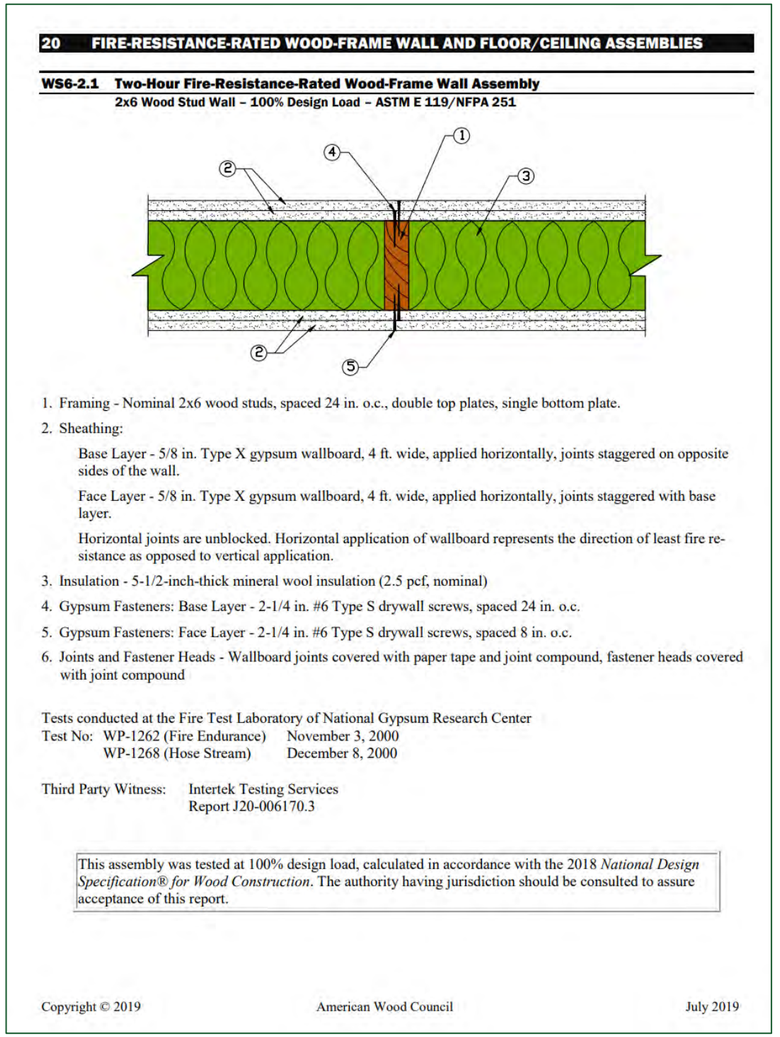
DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Symmetrical Two-hour Wall Assembly:

- Rated from <u>both sides</u>
  - ✓ Two layers of 5/8″ Type X gypsum wallboard on each side
- One symmetrical two-hour wall assembly
  - ✓ 2x6 studs at 24″o.c.
  - ✓ Mineral wool insulation
- <u>Rated under 100% design load</u>



20 FIRE-RESISTANCE-RATED WOOD-FRAME WALL AND FLOOR/CEILING ASSEMBLIES

WS6-2.1 Two-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly
2x6 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251

1. Framing - Nominal 2x6 wood studs, spaced 24 in. o.c., double top plates, single bottom plate.
2. Sheathing:

   Base Layer - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally, joints staggered on opposite sides of the wall.

   Face Layer - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally, joints staggered with base layer.

   Horizontal joints are unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Insulation - 5-1/2-inch-thick mineral wool insulation (2.5 pcf, nominal)
4. Gypsum Fasteners: Base Layer - 2-1/4 in. #6 Type S drywall screws, spaced 24 in. o.c.
5. Gypsum Fasteners: Face Layer - 2-1/4 in. #6 Type S drywall screws, spaced 8 in. o.c.
6. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

Tests conducted at the Fire Test Laboratory of National Gypsum Research Center
Test No: WP-1262 (Fire Endurance) November 3, 2000
WP-1268 (Hose Stream) December 8, 2000

Third Party Witness: Intertek Testing Services
Report J20-006170.3

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

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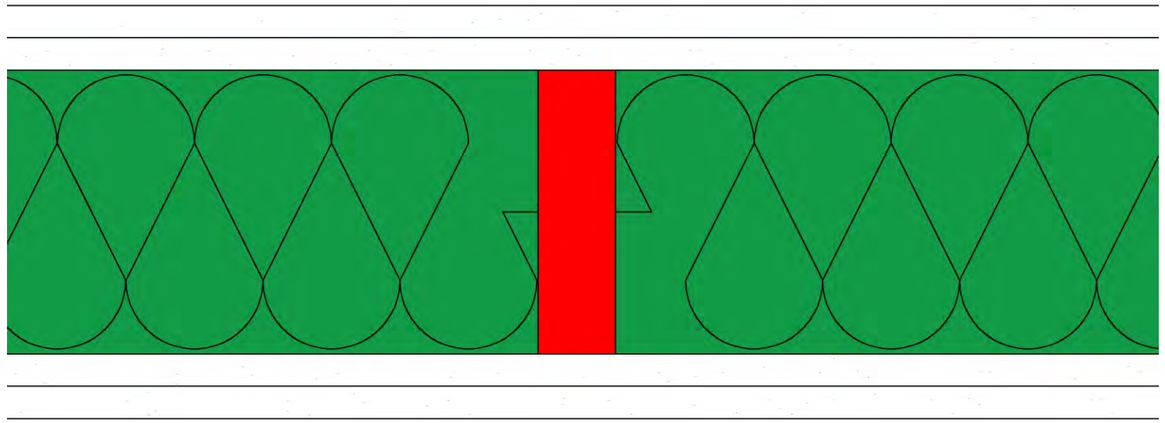
DCA3 – DETAIL WS6-2.1



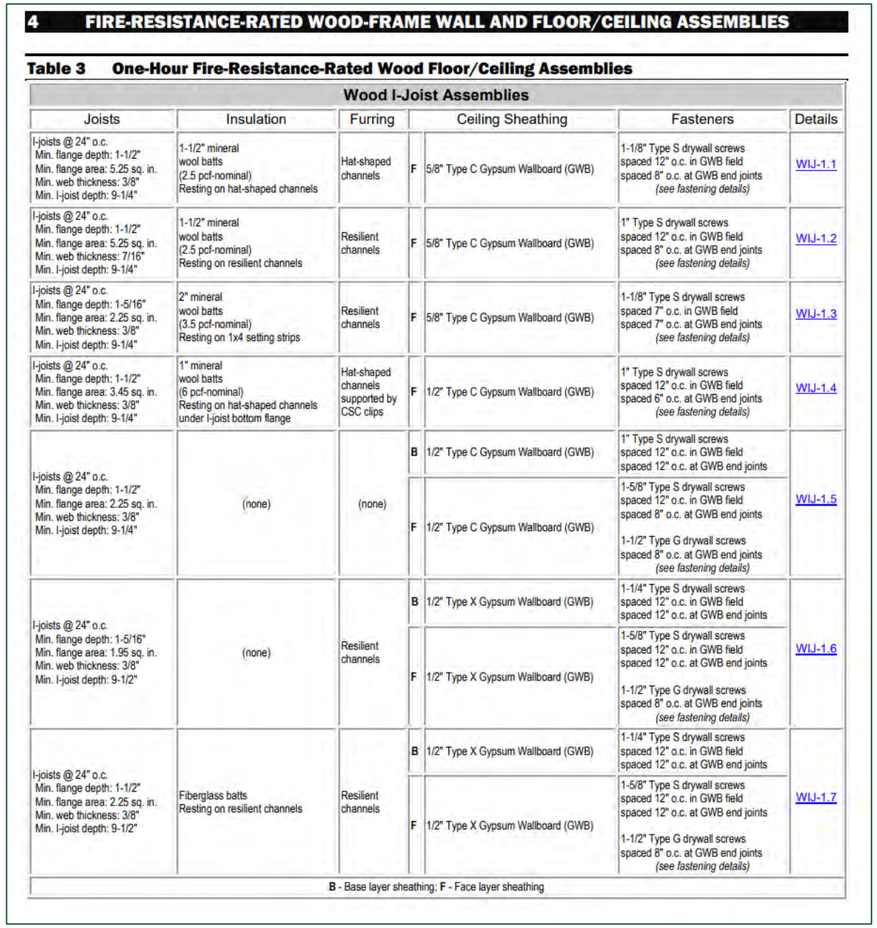
Symmetrical Two-hour Wall Assembly:

- Rated from both sides
  - ✓ Two layers of 5/8” Type X gypsum wallboard on each side
- One symmetrical two-hour wall assembly
  - ✓ 2x6 studs at 24”o.c.
  - ✓ Rock mineral wool insulation
- Rated under 100% design load

DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Floor/Ceiling Assemblies:

- Table 3 provides descriptions of one-hour assemblies
- Seven one-hour floor/ceiling assemblies in all
  - ✓ Variety of single-layer and double-layer assemblies
  - ✓ One direct-attached assembly, the rest with steel furring
- Embedded links take reader to detailed descriptions



4 FIRE-RESISTANCE-RATED WOOD-FRAME WALL AND FLOOR/CEILING ASSEMBLIES

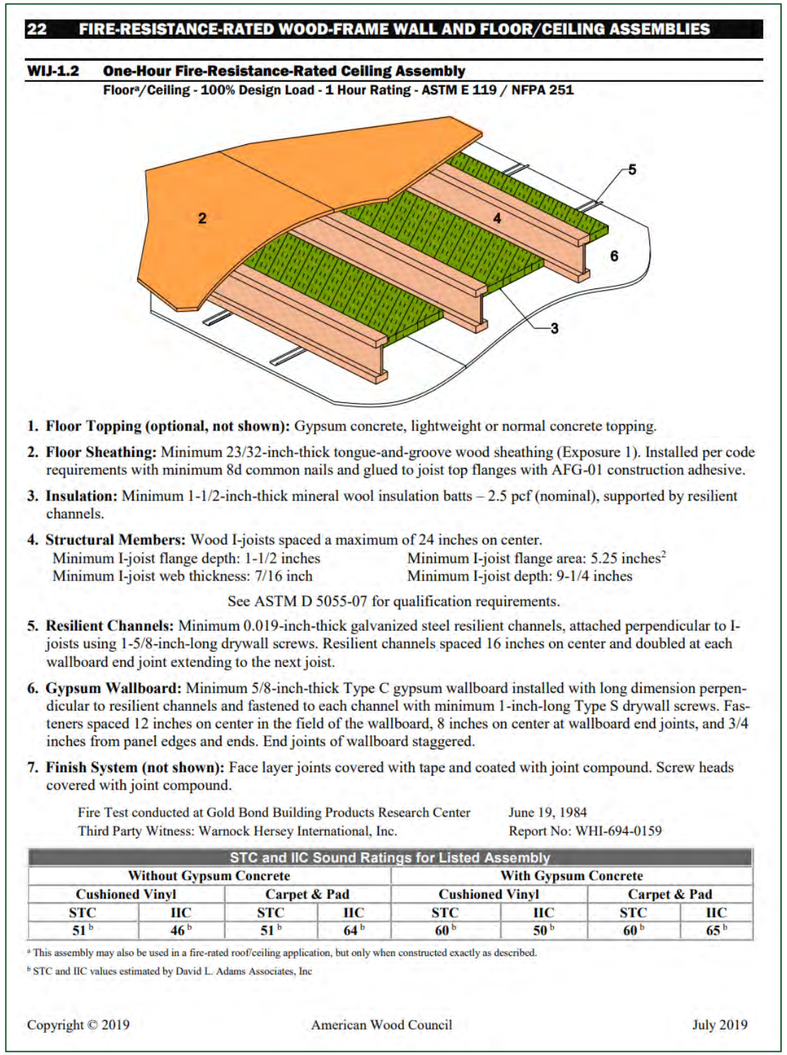
Table 3 One-Hour Fire-Resistance-Rated Wood Floor/Ceiling Assemblies

Wood I-Joist Assemblies						
Joists	Insulation	Furring		Ceiling Sheathing	Fasteners	Details
I-joists @ 24" o.c. Min. flange depth: 1-1/2" Min. flange area: 5.25 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/4"	1-1/2" mineral wool batts (2.5 pcf-nominal) Resting on hat-shaped channels	Hat-shaped channels	F	5/8" Type C Gypsum Wallboard (GWB)	1-1/8" Type S drywall screws spaced 12" o.c. in GWB field spaced 8" o.c. at GWB end joints *(see fastening details)*	WIJ-1.1
I-joists @ 24" o.c. Min. flange depth: 1-1/2" Min. flange area: 5.25 sq. in. Min. web thickness: 7/16" Min. I-joist depth: 9-1/4"	1-1/2" mineral wool batts (2.5 pcf-nominal) Resting on resilient channels	Resilient channels	F	5/8" Type C Gypsum Wallboard (GWB)	1" Type S drywall screws spaced 12" o.c. in GWB field spaced 8" o.c. at GWB end joints *(see fastening details)*	WIJ-1.2
I-joists @ 24" o.c. Min. flange depth: 1-5/16" Min. flange area: 2.25 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/4"	2" mineral wool batts (3.5 pcf-nominal) Resting on 1x4 setting strips	Resilient channels	F	5/8" Type C Gypsum Wallboard (GWB)	1-1/8" Type S drywall screws spaced 7" o.c. in GWB field spaced 7" o.c. at GWB end joints *(see fastening details)*	WIJ-1.3
I-joists @ 24" o.c. Min. flange depth: 1-1/2" Min. flange area: 3.45 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/4"	1" mineral wool batts (6 pcf-nominal) Resting on hat-shaped channels under I-joist bottom flange	Hat-shaped channels supported by CSC clips	F	1/2" Type C Gypsum Wallboard (GWB)	1" Type S drywall screws spaced 12" o.c. in GWB field spaced 6" o.c. at GWB end joints *(see fastening details)*	WIJ-1.4
I-joists @ 24" o.c. Min. flange depth: 1-1/2" Min. flange area: 2.25 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/4"	(none)	(none)	B	1/2" Type C Gypsum Wallboard (GWB)	1" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints	WIJ-1.5
			F	1/2" Type C Gypsum Wallboard (GWB)	1-5/8" Type S drywall screws spaced 12" o.c. in GWB field spaced 8" o.c. at GWB end joints 1-1/2" Type G drywall screws spaced 8" o.c. at GWB end joints *(see fastening details)*	
I-joists @ 24" o.c. Min. flange depth: 1-5/16" Min. flange area: 1.95 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/2"	(none)	Resilient channels	B	1/2" Type X Gypsum Wallboard (GWB)	1-1/4" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints	WIJ-1.6
			F	1/2" Type X Gypsum Wallboard (GWB)	1-5/8" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints 1-1/2" Type G drywall screws spaced 8" o.c. at GWB end joints *(see fastening details)*	
I-joists @ 24" o.c. Min. flange depth: 1-1/2" Min. flange area: 2.25 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/2"	Fiberglass batts Resting on resilient channels	Resilient channels	B	1/2" Type X Gypsum Wallboard (GWB)	1-1/4" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints	WIJ-1.7
			F	1/2" Type X Gypsum Wallboard (GWB)	1-5/8" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints 1-1/2" Type G drywall screws spaced 8" o.c. at GWB end joints *(see fastening details)*	
B - Base layer sheathing; **F** - Face layer sheathing						

DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Single-Layer One-Hour Floor/Ceiling Assemblies:

- Four single-layer assemblies in all
  - ✓ Three have $^{5}/_{8}$″ Type C GWB, one with $^{1}/_{2}$″ Type C GWB
  - ✓ I-joist framing at 24″o.c. or less
  - ✓ Utilize steel furring (resilient channels or hat channels)
  - ✓ Include mineral wool insulation
- All four assemblies rated under 100% design load



22 FIRE-RESISTANCE-RATED WOOD-FRAME WALL AND FLOOR/CEILING ASSEMBLIES

WIJ-1.2 One-Hour Fire-Resistance-Rated Ceiling Assembly

Floor[a]/Ceiling - 100% Design Load - 1 Hour Rating - ASTM E 119 / NFPA 251

1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails and glued to joist top flanges with AFG-01 construction adhesive.
3. **Insulation:** Minimum 1-1/2-inch-thick mineral wool insulation batts – 2.5 pcf (nominal), supported by resilient channels.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center.
   Minimum I-joist flange depth: 1-1/2 inches — Minimum I-joist flange area: 5.25 inches^2
   Minimum I-joist web thickness: 7/16 inch — Minimum I-joist depth: 9-1/4 inches
   See ASTM D 5055-07 for qualification requirements.
5. **Resilient Channels:** Minimum 0.019-inch-thick galvanized steel resilient channels, attached perpendicular to I-joists using 1-5/8-inch-long drywall screws. Resilient channels spaced 16 inches on center and doubled at each wallboard end joint extending to the next joist.
6. **Gypsum Wallboard:** Minimum 5/8-inch-thick Type C gypsum wallboard installed with long dimension perpendicular to resilient channels and fastened to each channel with minimum 1-inch-long Type S drywall screws. Fasteners spaced 12 inches on center in the field of the wallboard, 8 inches on center at wallboard end joints, and 3/4 inches from panel edges and ends. End joints of wallboard staggered.
7. **Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at Gold Bond Building Products Research Center — June 19, 1984
Third Party Witness: Warnock Hersey International, Inc. — Report No: WHI-694-0159

STC and IIC Sound Ratings for Listed Assembly

Without Gypsum Concrete				With Gypsum Concrete			
Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
STC	IIC	STC	IIC	STC	IIC	STC	IIC
51[b]	46[b]	51[b]	64[b]	60[b]	50[b]	60[b]	65[b]

[a] This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.
[b] STC and IIC values estimated by David L. Adams Associates, Inc

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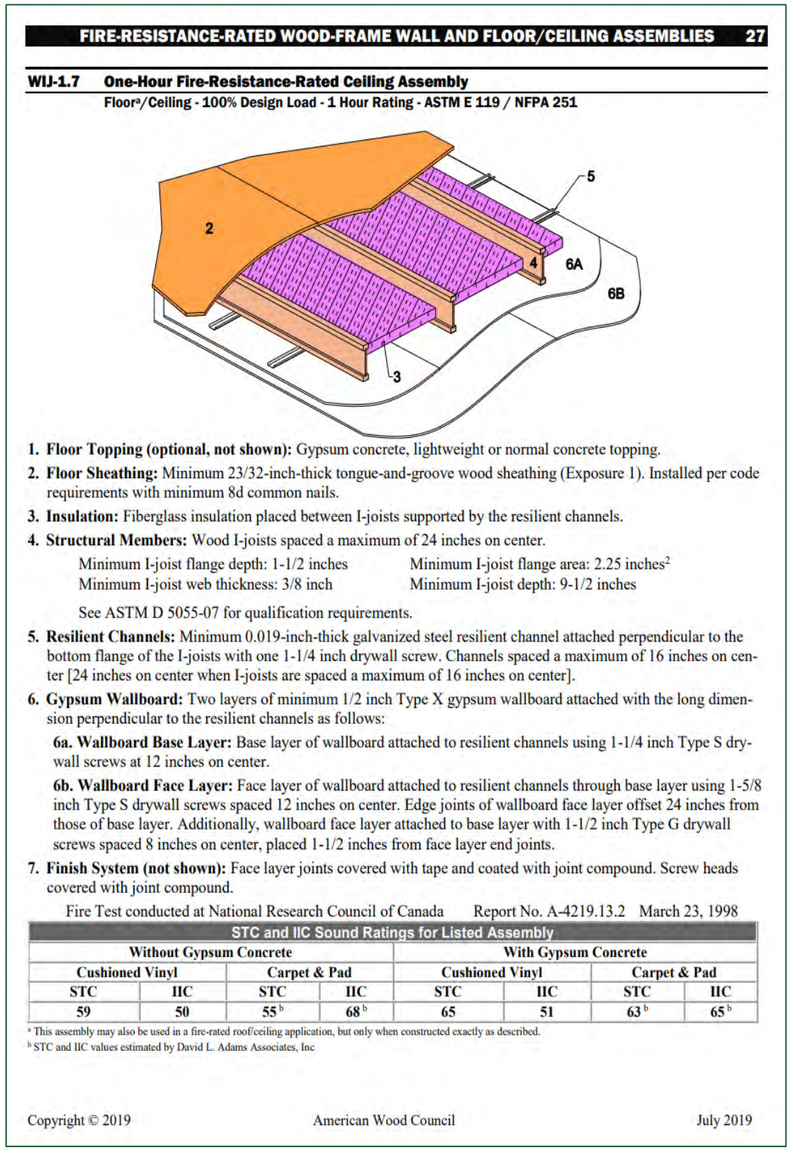
DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Double-Layer One-Hour Floor/Ceiling Assemblies:

- Three double-layer assemblies in all
  - ✓ All three have two layers of $^1/_2$" GWB (Type X or C)
  - ✓ I-joist framing at 24"o.c. or less
  - ✓ Two utilize steel furring, the other has direct-attached GWB
  - ✓ One assembly has fiberglass, the others have no insulation
- All three assemblies rated under 100% design load



FIRE-RESISTANCE-RATED WOOD-FRAME WALL AND FLOOR/CEILING ASSEMBLIES 27

WIJ-1.7 One-Hour Fire-Resistance-Rated Ceiling Assembly

Floor[a]/Ceiling - 100% Design Load - 1 Hour Rating - ASTM E 119 / NFPA 251

1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails.
3. **Insulation:** Fiberglass insulation placed between I-joists supported by the resilient channels.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center.
   Minimum I-joist flange depth: 1-1/2 inches — Minimum I-joist flange area: 2.25 inches^2
   Minimum I-joist web thickness: 3/8 inch — Minimum I-joist depth: 9-1/2 inches
   See ASTM D 5055-07 for qualification requirements.
5. **Resilient Channels:** Minimum 0.019-inch-thick galvanized steel resilient channel attached perpendicular to the bottom flange of the I-joists with one 1-1/4 inch drywall screw. Channels spaced a maximum of 16 inches on center [24 inches on center when I-joists are spaced a maximum of 16 inches on center].
6. **Gypsum Wallboard:** Two layers of minimum 1/2 inch Type X gypsum wallboard attached with the long dimension perpendicular to the resilient channels as follows:
   6a. Wallboard Base Layer: Base layer of wallboard attached to resilient channels using 1-1/4 inch Type S drywall screws at 12 inches on center.
   6b. Wallboard Face Layer: Face layer of wallboard attached to resilient channels through base layer using 1-5/8 inch Type S drywall screws spaced 12 inches on center. Edge joints of wallboard face layer offset 24 inches from those of base layer. Additionally, wallboard face layer attached to base layer with 1-1/2 inch Type G drywall screws spaced 8 inches on center, placed 1-1/2 inches from face layer end joints.
7. **Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at National Research Council of Canada Report No. A-4219.13.2 March 23, 1998

STC and IIC Sound Ratings for Listed Assembly

Without Gypsum Concrete				With Gypsum Concrete			
Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
STC	IIC	STC	IIC	STC	IIC	STC	IIC
59	50	55[b]	68[b]	65	51	63[b]	65[b]

[a] This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.
[b] STC and IIC values estimated by David L. Adams Associates, Inc

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DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

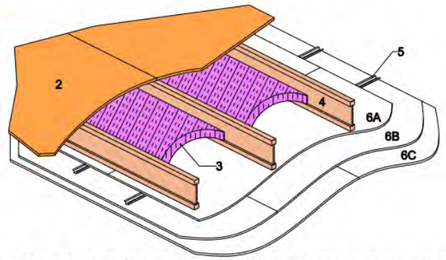
Two-Hour Floor/Ceiling Assembly:

- Table 4 describes the assembly;
  - ✓ Three layers of $^{5}/_{8}$″ Type C GWB
  - ✓ Steel hat channels between base and middle layer of GWB
  - ✓ I-joist framing at 24″o.c. or less
  - ✓ Minimum $3^{1}/_{2}$″-thick fiberglass insulation
- Assembly rated under 100% design load

28 FIRE-RESISTANCE-RATED WOOD-FRAME WALL AND FLOOR/CEILING ASSEMBLIES

WIJ-2.1 Two-Hour Fire-Resistance-Rated Ceiling Assembly

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



1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements.
3. **Insulation:** Minimum 3-1/2-inch-thick unfaced fiberglass insulation fitted between I-joists supported by stay wires spaced 12 inches on center.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center.
   Minimum I-joist flange depth: 1-1/2 inches — Minimum I-joist flange area: 2.25 inches^2
   Minimum I-joist web thickness: 3/8 inch — Minimum I-joist depth: 9-1/4 inches
   See ASTM D 5055-07 for qualification requirements.
5. **Furring Channels:** Minimum 0.0179-inch-thick galvanized steel hat-shaped furring channels, attached perpendicular to I-joists using 1-5/8 inch long drywall screws. Furring channels spaced 16 inches on center (furring channels used to support the second and third layers of gypsum wallboard).
6. **Gypsum Wallboard:** Three layers of minimum 5/8 inch Type C gypsum wallboard as follows:
   6a. Wallboard Base Layer: Base layer of wallboard attached to bottom flange of I-joists using 1-5/8 inch Type S drywall screws at 12 inches on center with the long dimension of wallboard perpendicular to I-joist. End joints of wallboard centered on bottom flange of the I-joist and staggered from end joints in adjacent sheets.
   6b. Wallboard Middle Layer: Middle layer of wallboard attached to furring channels using 1 inch Type S drywall screws spaced 12 inches on center with the long dimension of wallboard perpendicular to furring channels. End joints staggered from end joints in adjacent sheets.
   6c. Wallboard Face Layer: Face layer of wallboard attached to furring channels through middle layer using 1-5/8 inch Type S drywall screws spaced 8 inches on center. Edge joints of face layer of wallboard offset 24 inches from those of middle layer. End joints of face layer of wallboard staggered with respect to the middle layer.
7. **Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at Gold Bond Building Products Research Center — December 16, 1992
Third Party Witness: PFS Corporation — Report No: #92-56

STC and IIC Sound Ratings for Listed Assembly

Without Gypsum Concrete				With Gypsum Concrete			
Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
STC	IIC	STC	IIC	STC	IIC	STC	IIC
-	-	49[b]	54[b]	58	45	58	64

[a] This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.
[b] STC and IIC values estimated by David L. Adams Associates, Inc

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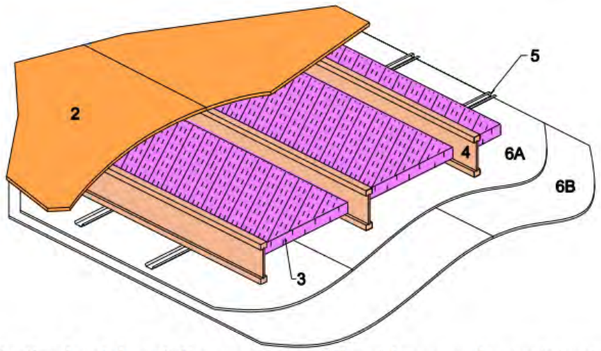
DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Optional Variations to Floor/Ceiling Assemblies:

- Floor topping options
  - ✓ Concrete (normal or light weight), any thickness
  - ✓ Gypsum concrete, any thickness
- I-joist framing options
  - ✓ Any spacing less than or equal to 24″o.c.
  - ✓ Any joist depth, flange size and web thickness greater than or equal to the minimums specified in DCA3



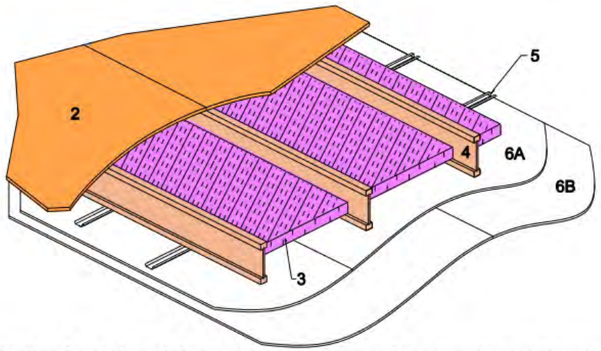
1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails.
3. **Insulation:** Fiberglass insulation placed between I-joists supported by the resilient channels.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center.

   Minimum I-joist flange depth: 1-1/2 inches — Minimum I-joist flange area: 2.25 inches^2
   Minimum I-joist web thickness: 3/8 inch — Minimum I-joist depth: 9-1/2 inches

DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Optional Variations (continued):

- Any code-permitted floor covering
- Any insulation thickness greater than or equal to the specified minimums
- These options apply to all DCA3 floor/ceiling assemblies
  - ✓ Fire-resistance ratings still apply with these variations



1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails.
3. **Insulation:** Fiberglass insulation placed between I-joists supported by the resilient channels.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center.

Minimum I-joist flange depth: 1-1/2 inches	Minimum I-joist flange area: 2.25 inches^2
Minimum I-joist web thickness: 3/8 inch	Minimum I-joist depth: 9-1/2 inches

This concludes our presentation.
Questions? mhunter@awc.org

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