New Tall Wood Code Provisions: Advanced Fire Design for Exposed Timber

Presented by Ricky McLain, PE, SE, WoodWorks

NIR Center | Photo: Hennebery Eddy Architects | Architect: Hennebery Eddy Architects

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

Course Description

The 2021 International Building Code (IBC) includes a series of changes that significantly expand the opportunities for tall timber structures. Three new construction types—Type IV-A, IV-B and IV-C—will allow the use of mass timber or noncombustible materials in buildings up to 18 stories tall. These new types are based on the previous Heavy Timber construction type (renamed Type IV-HT) but with additional fire-resistance ratings and levels of required noncombustible protection. This presentation will take a detailed look at the new code provisions and methods of addressing requirements for fire resistance and exposed timber. Topics will include tall wood-specific high-rise and sprinkler requirements, methods of demonstrating fire-resistance ratings, fire design for penetrations, connections and abutting panels, allowances for exposed timber, exterior walls, concealed spaces, and more.

Learning Objectives

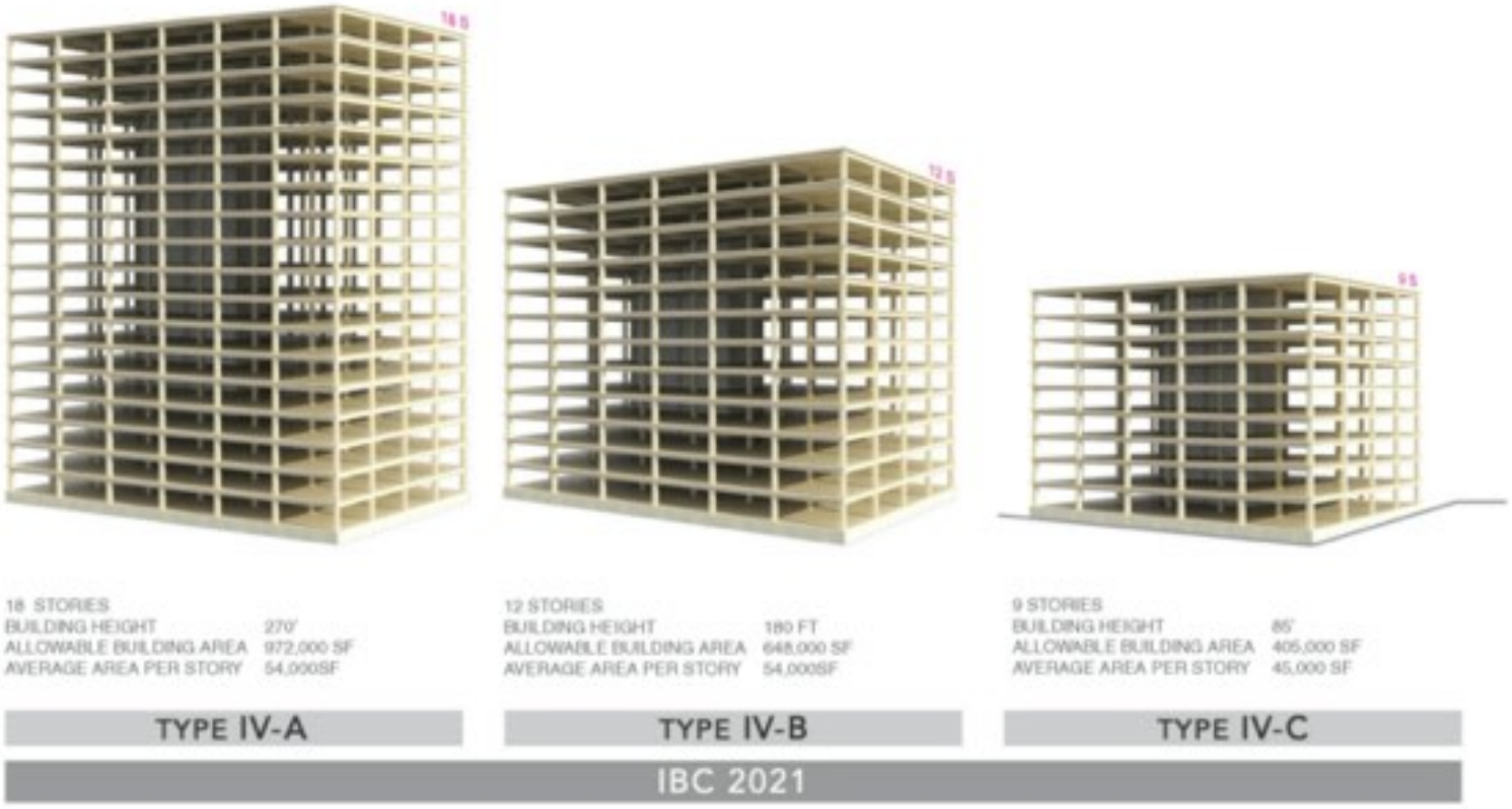
1. Explore the three new tall wood construction types and discuss related code provisions such as allowable heights and fire-resistance ratings.

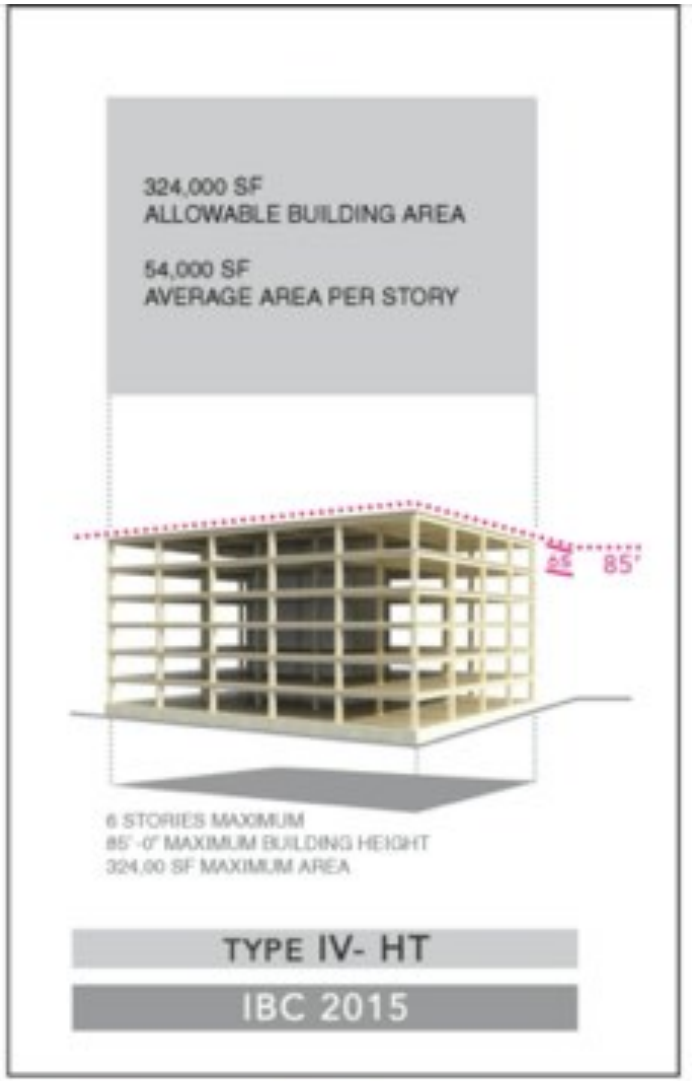
2. Discuss code-compliant options for exposing mass timber, where up to 2-hour fire-resistance ratings are required, and demonstrate design methodologies for achieving these ratings.

3. Review timber exposure strategies for IV-B construction, emphasizing code compliance topics such as horizontal separation and exposure area limits.

4. Highlight resources available to designers for fire-resistance design in tall timber structures, emphasizing tested assemblies, allowances for concealed spaces and contributions of noncombustible protection layers.

Tall Timber Construction Types





BUSINESS OCCUPANCY [GROUP B]

*BUILDING FLOOR-TO-FLOOR HEIGHTS ARE SHOWN AT 12'-0" FOR ALL EXAMPLES FOR CLARITY IN COMPARISON BETWEEN 2015 TO 2021 IBC CODES.

Credit: Susan Jones, atelierjones

Type IV-C Protection vs. Exposed

IV-C

Credit: Susan Jones, atelierjones

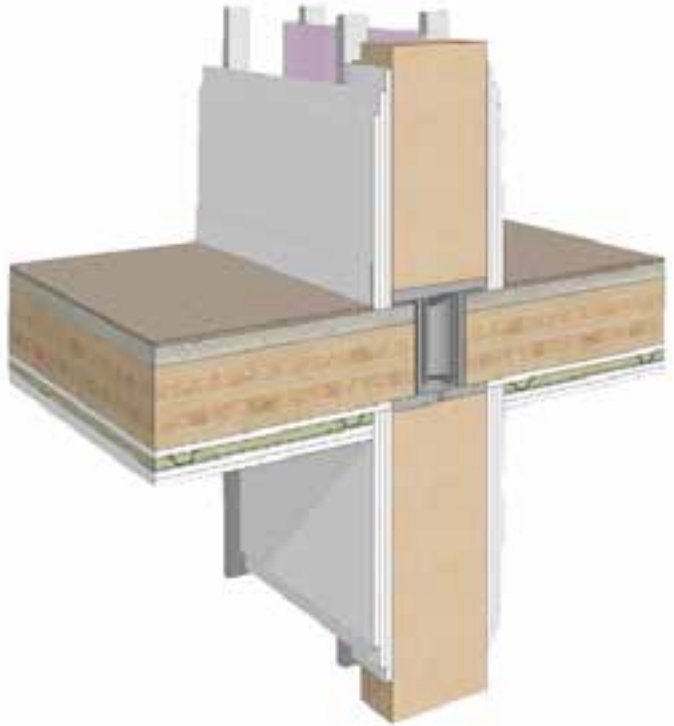
Credit: Kaiser+Path, Ema Peter

All Mass Timber surfaces may be exposed

Exceptions: Shafts, concealed spaces, outside face of exterior walls

Type IV-A Protection vs. Exposed

Credit: Susan Jones, atelierjones



Credit: Acton Ostry Architects, Fast + Epp

100% NC protection on all surfaces of Mass Timber

Type IV-B Protection vs. Exposed

IV-B

Credit: Susan Jones, atelierjones

Credit: Kaiser+Path

NC protection on all surfaces of Mass Timber except limited exposed areas

~20% of Ceiling or ~40% of Wall can be exposed

Type IV-B Protection vs. Exposed

IV-B

Limited Exposed MT allowed in Type IV-B for:

- **MT beams and columns which are not integral part of walls or ceilings, no area limitation applies**
- **MT ceilings and beams up to 20% of floor area in dwelling unit or fire area, or**
- **MT walls and columns up to 40% of floor area in dwelling unit or fire area, or**
- **Combination of ceilings/beams and walls/columns, calculated as follows:**

Credit: Kaiser+Path

Type IV-B Protection vs. Exposed

IV-B

Mixed unprotected areas, exposing both ceilings and walls:

- **In each dwelling unit or fire area, max. unprotected area =**

$$(U_{tc}/U_{ac}) + (U_{tw}/U_{aw}) \leq 1.0$$

- **U_{tc} = Total unprotected MT ceiling areas**
- **U_{ac} = Allowable unprotected MT ceiling areas**
- **U_{tw} = Total unprotected MT wall areas**
- **U_{aw} = Allowable unprotected MT wall areas**

Credit: Kaiser+Path

Type IV-B Protection vs. Exposed

IV-B

Design Example: Mixing unprotected MT walls & ceilings

Credit: AWC

800 SF dwelling unit

- U_{ac} = (800 SF)*(0.20) = 160 SF
- U_{aw} = (800 SF)*(0.40) = 320 SF
- Could expose 160 SF of MT ceiling, OR 320 SF of MT Wall, OR
- If desire to expose 100 SF of MT ceiling in Living Room, determine max. area of MT walls that can be exposed

Type IV-B Protection vs. Exposed

IV-B

Design Example: Mixing unprotected MT walls & ceilings

Credit: AWC

$(U_{tc}/U_{ac}) + (U_{tw}/U_{aw}) \leq 1.0$

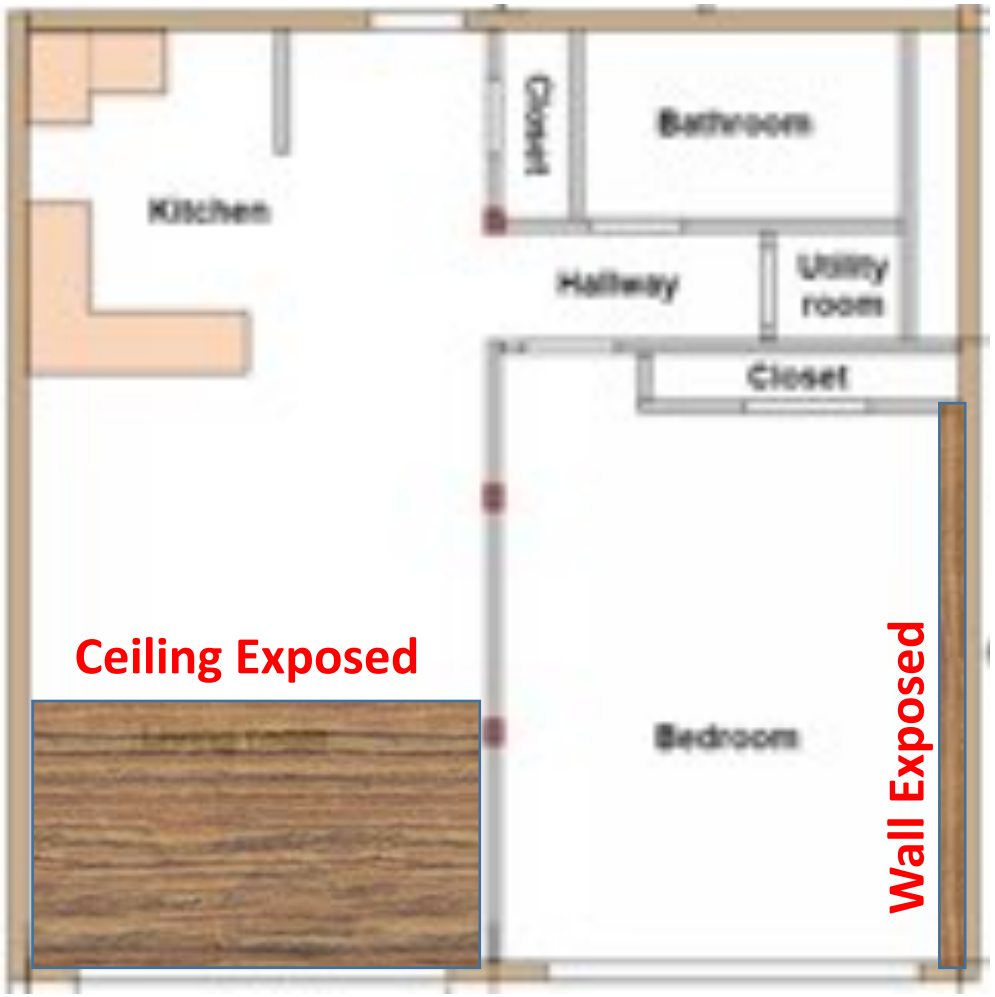
$(100/160) + (U_{tw}/320) \leq 1.0$

$U_{tw} = 120$ SF

- Can expose 120 SF of MT walls in dwelling unit in combination with exposing 100 SF of MT ceiling

Type IV-B Protection vs. Exposed

IV-B



Credit: AWC

Type IV-B Protection vs. Exposed

IV-B

Horizontal separation of unprotected areas:

- Unprotected portions of mass timber walls and ceilings shall be not less than 15 feet from unprotected portions of other walls and ceilings, measured horizontally along the ceiling and from other unprotected portions of walls measured horizontally along the floor.

Credit: Kaiser+Path

Type IV-B Protection vs. Exposed

IV-B

Credit: AWC

Tall Wood Building Size Limits

	Construction Type (All Sprinklered Values)						
	I-A	I-B	**IV-A**	**IV-B**	**IV-C**	IV-HT	III-A
Occupancies	**Allowable Building Height above Grade Plane, Feet (IBC Table 504.3)**						
A, B, R	Unlimited	180	**270**	**180**	**85**	85	85
	Allowable Number of Stories above Grade Plane (IBC Table 505.4)						
A-2, A-3, A-4	Unlimited	12	**18**	**12**	**6**	4	4
B	Unlimited	12	**18**	**12**	**9**	6	6
R-2	Unlimited	12	**18**	**12**	**8**	5	5
	Allowable Area Factor (At) for SM, Feet^2 (IBC Table 506.2)						
A-2, A-3, A-4	Unlimited	Unlimited	**135,000**	**90,000**	**56,250**	45,000	42,000
B	Unlimited	Unlimited	**324,000**	**216,000**	**135,000**	108,000	85,500
R-2	Unlimited	Unlimited	**184,500**	**123,000**	**76,875**	61,500	72,000

Non-Tall Opportunities – Large Area

	Construction Type (All Sprinklered Values)						
	I-A	I-B	**IV-A**	**IV-B**	**IV-C**	IV-HT	III-A
Occupancies	**Allowable Building Height above Grade Plane, Feet (IBC Table 504.3)**						
A, B, R	Unlimited	180	**270**	**180**	**85**	85	85
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R-2	Unlimited	12	**18**	**12**	**8**	5	5
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A-2, A-3, A-4	Unlimited	Unlimited	**135,000**	**90,000**	**56,250**	45,000	42,000
B	Unlimited	Unlimited	**324,000**	**216,000**	**135,000**	108,000	85,500
R-2	Unlimited	Unlimited	**184,500**	**123,000**	**76,875**	61,500	72,000

What's the 'Sweet Spot' for Tall Mass Timber?

Depends on many factors:

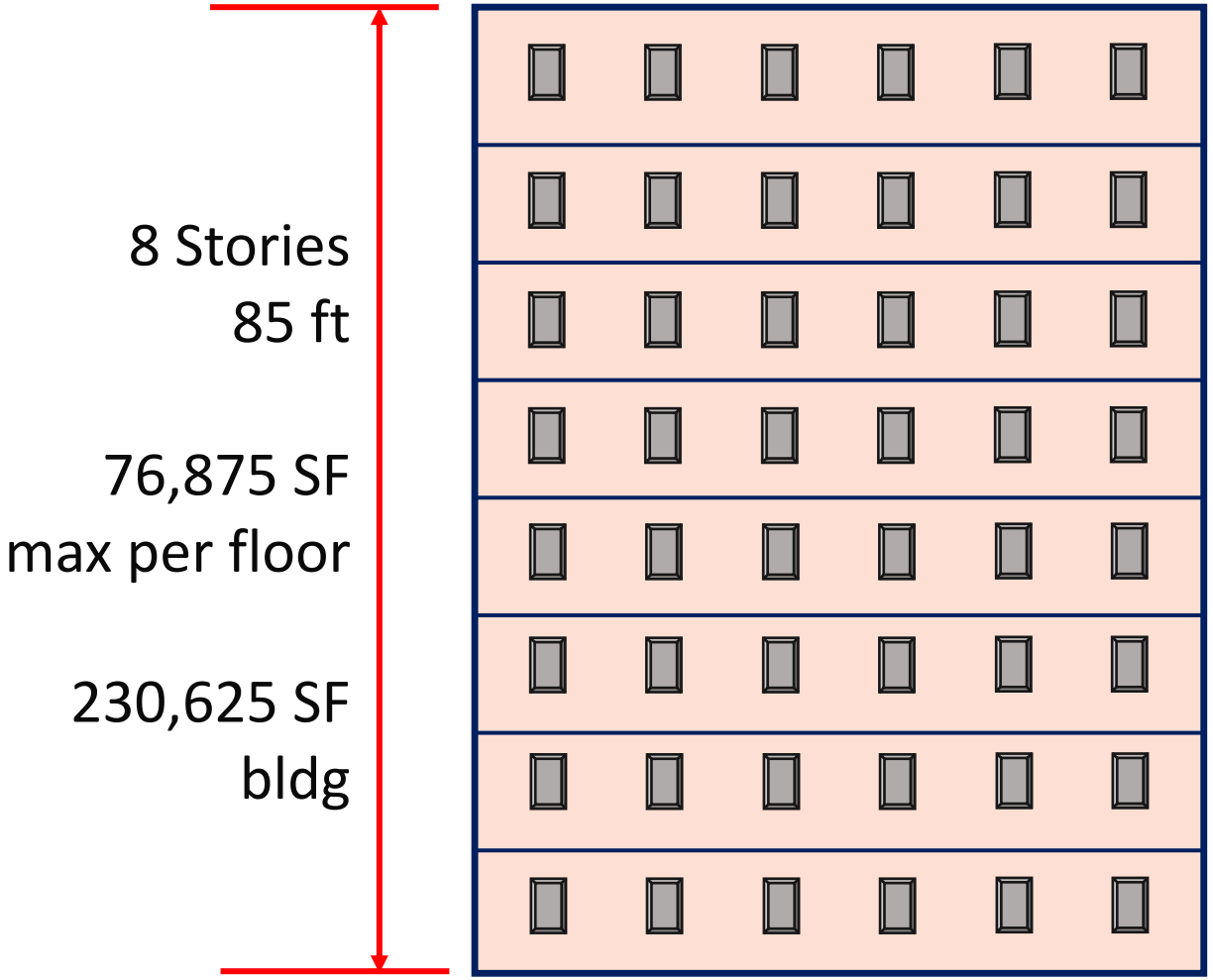
- Project Use
- Site Constraints
- Local Zoning & FAR Limitations
- Budget
- Client Objectives for Sustainability, Exposed Timber
- And More…

But Some General Trends Could Be:

80 M Street, SE, Washington, DC
Photo: Hickok Cole | Architect: Hickok Cole

Type IV-C Tall Mass Timber

Example R-2, Type IV-C Building



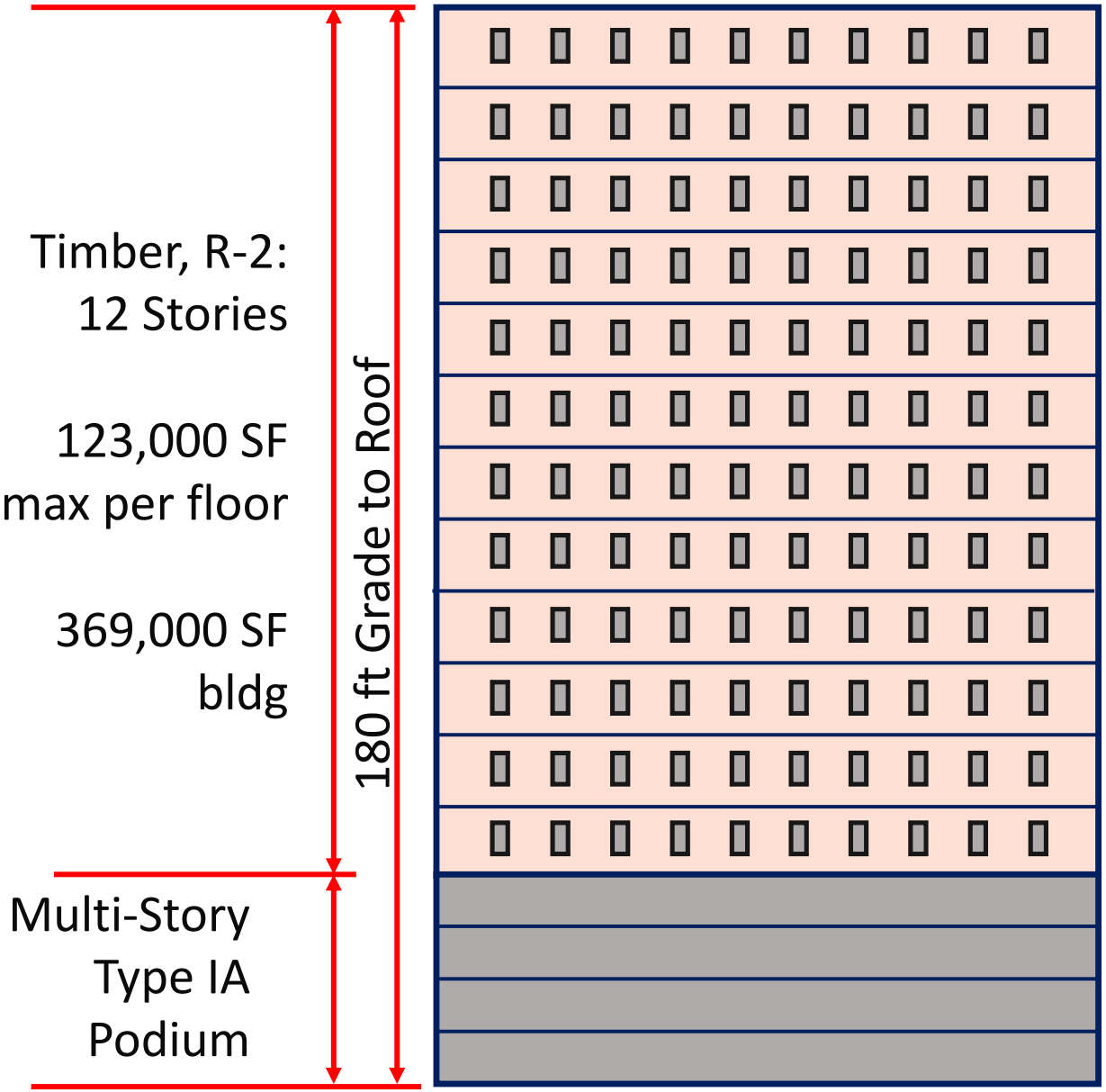
Not Likely to Utilize Podium Due to Overall Building Height Limit (85 ft) Relative to # of Timber Stories (8)

Same Overall Building Height Limit as IV-HT (85 ft) but higher Fire-Resistance Ratings Req'd

3 Additional Stories Permitted Compared to IV-HT

All Timber Exposed

Type IV-B Tall Mass Timber



Example Mixed-Use, Type IV-B Building

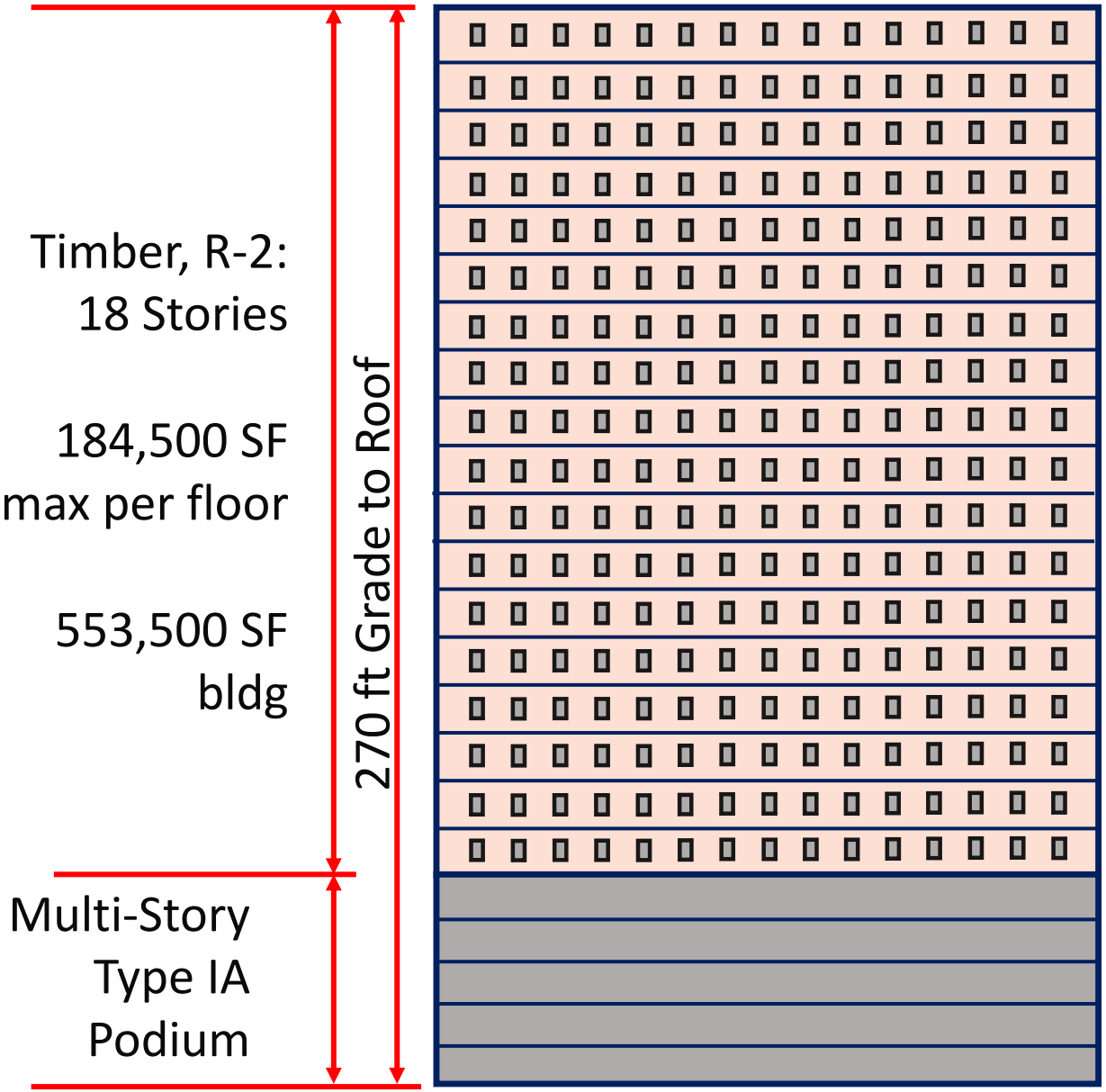
Likely to Utilize Podium Due to Overall Building Height Limit (180 ft) Relative to # of Timber Stories (12)

Same Fire-Resistance Ratings Req'd as IV-C But Limitations on Timber Exposed

4 Additional Stories Permitted Compared to IV-C

Limited Timber Exposed

Type IV-A Tall Mass Timber



Example Mixed-Use, Type IV-A Building

Likely to Utilize Podium Due to Overall Building Height Limit (270 ft) Relative to # of Timber Stories (18)

Higher Fire-Resistance Ratings Req'd than IV-B For Primary Frame

6 Additional Stories Permitted Compared to IV-B

No Exposed Timber Permitted

Materials Permitted

602.4 Type IV. Type IV construction is that type of construction in which the building elements are mass timber or noncombustible materials and have fire resistance ratings in accordance with Table 601. Mass timber elements shall meet the fire resistance rating requirements of this section based on either the fire resistance rating of the noncombustible protection, the mass timber, or a combination of both and shall be determined in accordance with Section 703.2 or 703.3. The minimum dimensions and permitted materials for building elements shall comply with the provisions of this section and Section 2304.11. Mass timber

Exterior load-bearing walls and nonload-bearing walls shall be mass timber construction, or shall be of noncombustible construction.

Exception: Type IV-HT Construction in accordance with Section 602.4.4.

The interior building elements, including nonload-bearing walls and partitions, shall be of mass timber construction or of noncombustible construction.

Exception: Type IV-HT Construction in accordance with Section 602.4.4..

MT Type IV Minimum Sizes

In addition to meeting FRR, all MT elements must also meet minimum sizes

These minimum sizes have been in place for old type IV (current type IV-HT) construction and the same minimums sizes also apply to MT used in new types IV-A, IV-B and IV-C

Contained in IBC 2304.11

Type IV Minimum Sizes - Framing

Framing		Solid Sawn (nominal)	Glulam (actual)	SCL (actual)
Floor	Columns	8 x 8	$6^{3}/_{4}$ x 8¼	7 x 7½
	Beams	6 x 10	5 x 10½	5¼ x 9½
Roof	Columns	6 x 8	5 x 8¼	5¼ x 7½
	Beams*	4 x 6	3 X $6^{7}/_{8}$	3½ X 5½

Minimum Width by Depth in Inches
See IBC 2018 2304.11 or IBC 2015 602.4 for Details

*3” nominal width allowed where sprinklered


Photo: WoodWorks

Interior Wall Construction Recap

	IV-A	IV-B	IV-C	IV-HT
Fire Rating (bearing wall)	3 Hr	2 Hr	2 Hr	1 Hr or HT*
Construction – MT	Laminated construction 4” thick (CLT, NLT, etc) Solid wood construction min. 2 layers of 1” matched boards			
NC Protection	Per Interior Requirements			No
Noncombustible non-bearing wall	0 Hr			1 Hr
Wood Stud Wall	No			1 Hr

*IBC 2021 requires at least 1 Hr FRR for HT walls supporting 2 levels

Exterior Wall Construction Recap

IV-B

IV-A

IV-C

IV-HT

	IV-B	IV-A	IV-C	IBC 2021	IBC 2018
Fire Rating (bearing wall)	3 Hr	2 Hr	2 Hr	2 Hr	2Hr
Mass Timber	Mass Timber/CLT			4” min thick CLT*	6” Wall*
Exterior NC Protection	40 Min NC & No Exterior Combustible Coverings			FRT Sheathing, Gyp or other NC	
Interior NC Protection	Per Interior Requirements			Not Required	
Light Frame FRTW	No			Yes*	6” Wall*

*Changes in IBC 2015, 2018, and 2021 editions

Tall Wood Fire Resistance Ratings (FRR)

FRR Requirements for Tall Mass Timber Structures (hours)

Building Element	IV-A	IV-B	IV-C
Primary Frame	3	2	2
Exterior Bearing Walls	3	2	2
Interior Bearing Walls	3	2	2
Roof Construction	1.5	1	1
Primary Frame at Roof	2	1	1
Floor Construction	2	2	2

Source: 2021 IBC Table 601

Noncombustible Protection (NC)

Where timber is required to be protected, NC must contribute at least 2/3 FRR

Required Noncombustible Contribution to FRR

FRR of Building Element (hours)	Minimum from Noncombustible Protection (minutes)
1	40
2	80
3 or more	120

Source: 2021 IBC Section 722.7

Noncombustible Protection (NC)

Prescriptive Noncombustible Contributions to FRR

Type of Protection	Contribution per Layer (minutes)
1/2" Type X gypsum board	25
5/8" Type X gypsum board	40

Source: 2021 IBC Section 722.7.1

Required Noncombustible Contribution to FRR

FRR of Building Element (hours)	Minimum from Noncombustible Protection (minutes)
1	40
2	80
3 or more	120

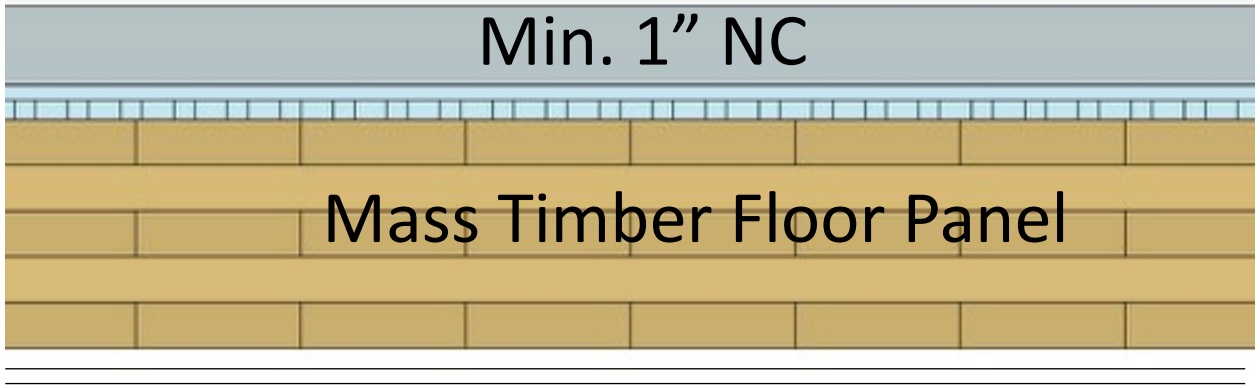
1 layer 5/8 Type X

2 layers 5/8 Type X

3 layers 5/8 Type X

Source: 2021 IBC Section 722.7

Floor Surface Protection



Min. 1” thick NC protection required on mass timber floors in IV-A and IV-B. Not required in IV-C


Credit: Maxxon

Noncombustible Protection

Noncombustible Protection Required

	IV-A	IV-B	IV-C	IV-HT
Roof below Mass Timber	60 min	40 min*	Not Req.	Not Req.
Primary Frame @ Roof	80 min	40 min*	Not Req.	Not Req.
Primary Frame	120 min	80 min*	Not Req.	Not Req.
Below Mass Timber Floor	80 min	80 min*	Not Req.	Not Req.
Above Mass Timber Floor	1” Min NC Material	1” Min NC Material	Not Req.	Not Req.

Requirements Per new 602.4. * Some MT permitted to be exposed.

MT Fire Resistance Ratings (FRR)

IBC 722.7

The fire resistance rating of the mass timber elements shall consist of the fire resistance of the unprotected element (MT) added to the protection time of the noncombustible (NC) protection.

+

= FRR

MT Fire Resistance Ratings (FRR)

However, FRR Doesn't always need to be from a combination of MT + NC. In some cases, just NC can be used, in other cases, just MT can be used:

IBC 602.4
Mass timber elements shall meet the fire resistance rating requirements of this section based on either the fire resistance rating of the noncombustible protection, the mass timber, or a combination of both.

Type IV-A Fire Resistance Ratings (FRR)

IV-A

Primary Frame (3-hr) + Floor Panel Example (2-hr):

Minimum 1" noncombustible material

Mass timber floor panel

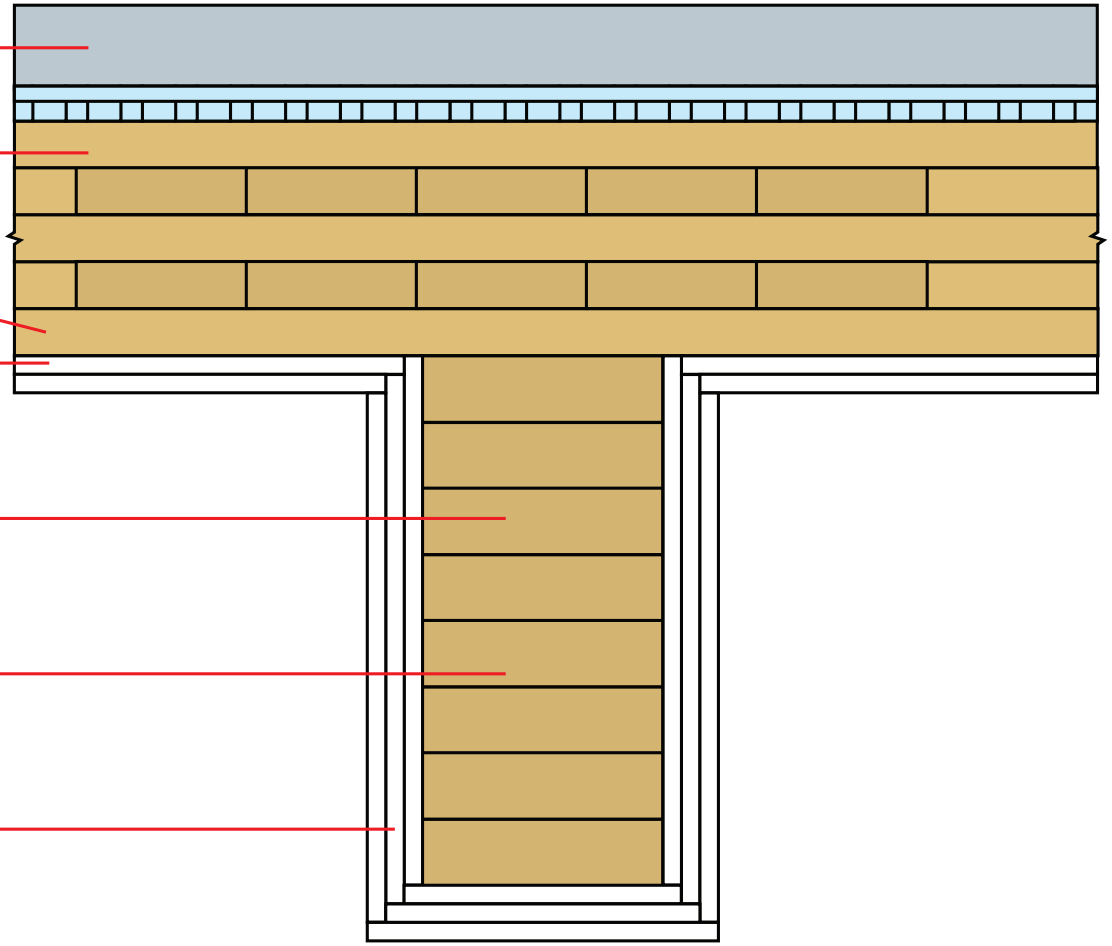
40 minutes of MT FRR

Two layers 5/8" Type X gypsum

Glulam beam (primary structural frame)

60 minutes of MT FRR

Three layers 5/8" Type X gypsum



Type IV-B Fire Resistance Ratings (FRR)

IV-B

Primary Frame (2-hr) + Floor Panel (2-hr)

Minimum 1" noncombustible material

Mass timber floor panel

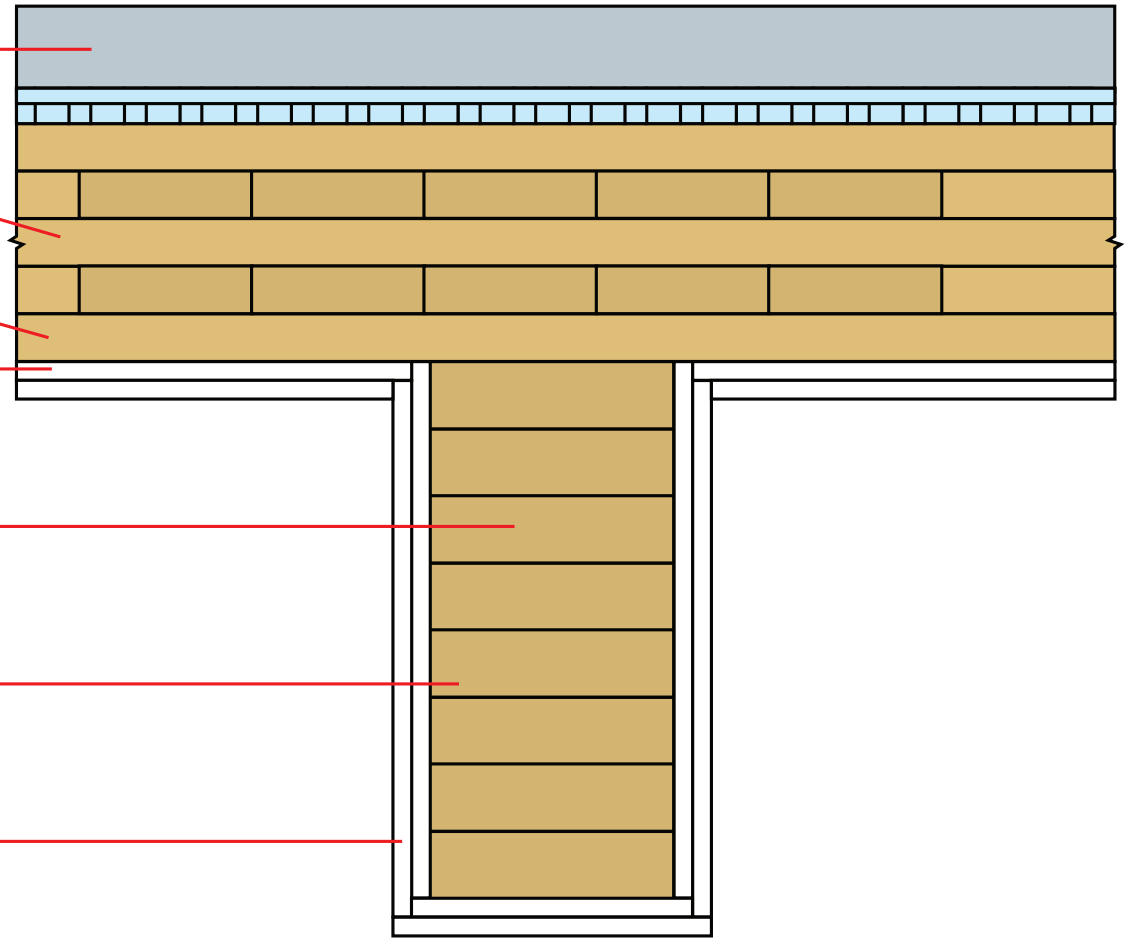
40 minutes of MT FRR

2 layers 5/8" Type X gypsum

Glulam beam (primary structural frame)

40 minutes of MT FRR

Two layers 5/8" Type X gypsum



Type IV-B Fire Resistance Ratings (FRR)

IV-B

Primary Frame (2-hr) + Floor Panel Example (2-hr)

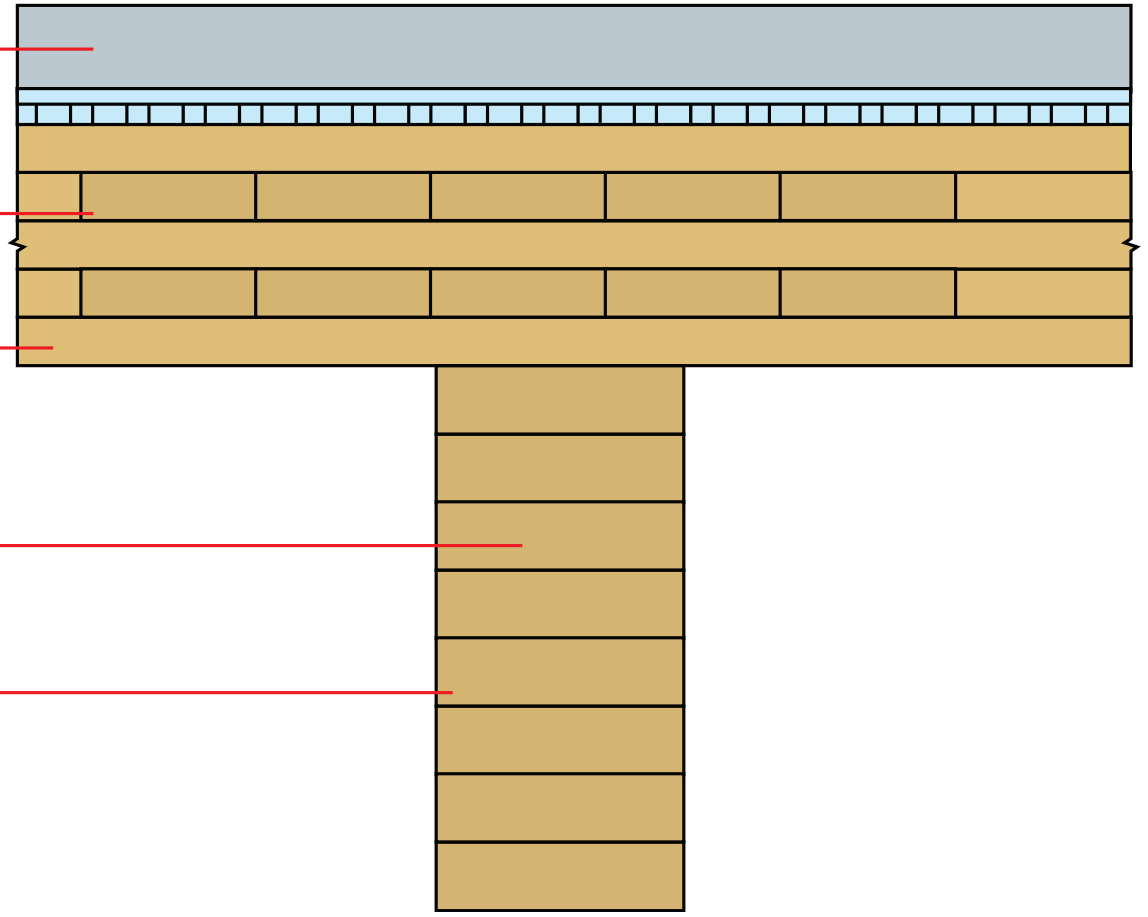
Minimum 1" noncombustible material

Mass timber floor panel

2-hr of MT FRR;
noncombustible material not required

Glulam beam (primary structural frame)

2-hr of MT FRR;
Noncombustible material not required



Type IV-C Fire Resistance Ratings (FRR)

IV-B

Primary Frame (2-hr) + Floor Panel Example (2-hr)

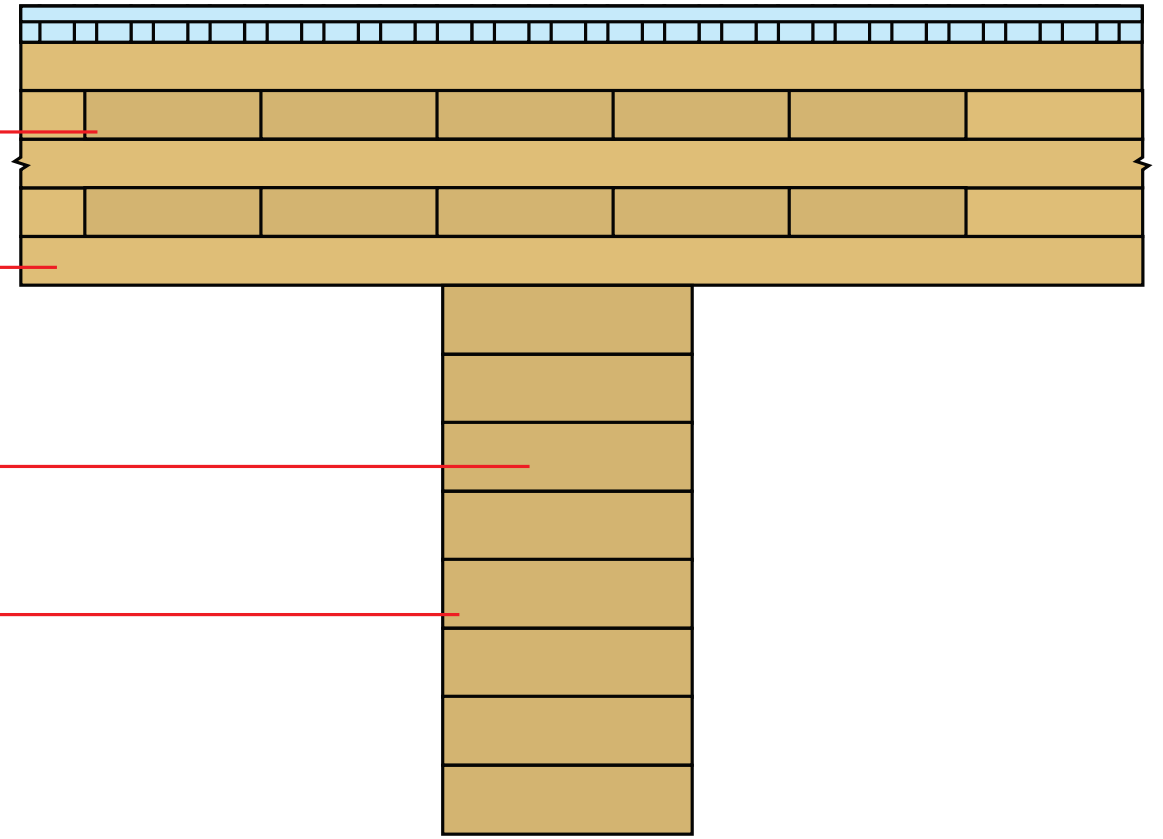
Noncombustible material not required

Mass timber floor panel

2-hr of MT FRR;
noncombustible material not required

Glulam beam (primary structural frame)

2-hr of MT FRR;
Noncombustible material not required

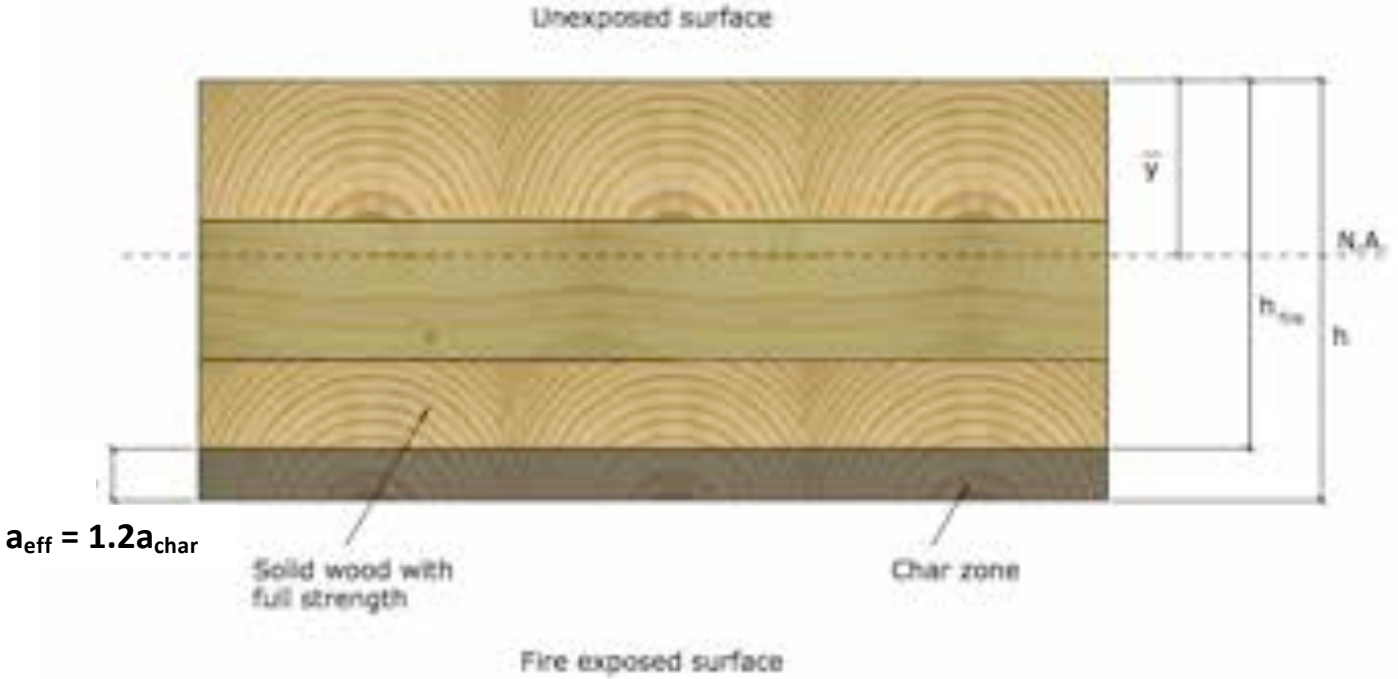


MT Fire Resistance Ratings (FRR)

How do you determine FRR of MT?

2 Options:

1. **Calculations in Accordance with IBC 722 → NDS Chapter 16**
2. **Tests in Accordance with ASTM E119**



MT Fire Resistance Ratings (FRR)

MT FRR Calculations Method:

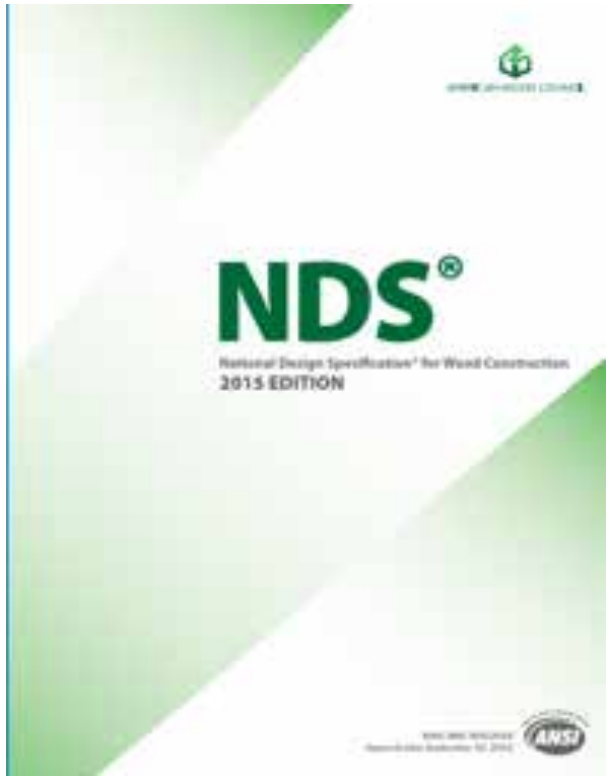
- **IBC 703.3 allows several methods of determining FRR. One is calculations per 722.**
- **722.1 refers to NDS Chpt 16 for exposed wood FRR**

703.3 Methods for determining fire resistance. The application of any of the methods listed in this section shall be based on the fire exposure and acceptance criteria specified in ASTM E119 or UL 263. The required *fire resistance* of a building element, component or assembly shall be permitted to be established by any of the following methods or procedures:

3. Calculations in accordance with Section 722.

722.1 General. The provisions of this section contain procedures by which the *fire resistance* of specific materials or combinations of materials is established by calculations. These procedures apply only to the information contained in this section and shall not be otherwise used. The calculated *fire resistance* of concrete, concrete masonry and clay masonry assemblies shall be permitted in accordance with ACI 216.1/TMS 0216. The calculated *fire resistance* of steel assemblies shall be permitted in accordance with Chapter 5 of ASCE 29. The calculated *fire resistance* of exposed wood members and wood decking shall be permitted in accordance with Chapter 16 of ANSI/AF&PA *National Design Specification for Wood Construction (NDS)*.

MT Fire Resistance Ratings (FRR)



NDS Chapter 16 includes calculation of fire resistance of NLT, CLT, Glulam, Solid Sawn and SCL wood products

Table 16.2.1B Effective Char Depths (for CLT with β_n=1.5in./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

MT Fire Resistance Ratings (FRR)

Nominal char rate of 1.5”/HR is recognized in NDS. Effective char depth calculated to account for duration, structural reduction in heat-affected zone


Credit: ARUP

Table 16.2.1A Char Depth and Effective Char Depth (for β_n = 1.5 in./hr.)

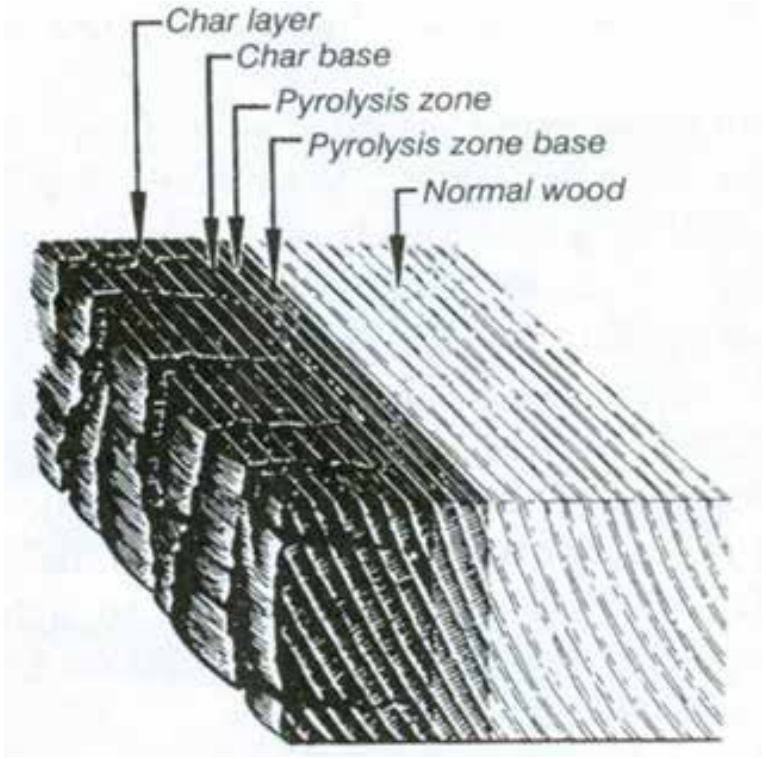
Required Fire Resistance (hr.)	Char Depth, a_{char} (in.)	Effective Char Depth, a_{eff} (in.)
1-Hour	1.5	1.8
1½-Hour	2.1	2.5
2-Hour	2.6	3.2

Table 16.2.1B Effective Char Depths (for CLT with β_n=1.5in./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

MT Fire Resistance Ratings (FRR)

Structural capacity check performed on remaining section, with stress increases



Credit: Forest Products Laboratory

Table 16.2.2 Adjustment Factors for Fire Design[1]

			ASD					
			Design Stress to Member Strength Factor	Size Factor [2]	Volume Factor [2]	Flat Use Factor [3]	Beam Stability Factor [3]	Column Stability Factor [3]
Bending Strength	F_b	x	2.85	C_F	C_V	C_{fu}	C_L	-
Beam Buckling Strength	F_{bE}	x	2.03	-	-	-	-	-
Tensile Strength	F_t	x	2.85	C_F	-	-	-	-
Compressive Strength	F_c	x	2.58	C_F	-	-	-	C_P
Column Buckling Strength	F_{cE}	x	2.03	-	-	-	-	-

$$a_{char} = \beta_t t^{0.813}$$ **Solid Sawn, Glulam, SCL**

$$a_{char} = n_{lam} h_{lam} + \beta_t \left(t - \left(n_{lam} t_{gi}\right)\right)^{0.813}$$ **CLT**

$$a_{eff} = 1.2 a_{char}$$ **Effective Char Depth**

MT Fire Resistance Ratings (FRR)

Tested Assemblies Method:

- **Many successful Mass Timber ASTM E119 fire tests have been completed by industry & manufacturers**


NGC Testing Services

Fire Testing Laboratory

ACCREDITED Testing Laboratory TL-216

TEST REPORT

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for

American Wood Council

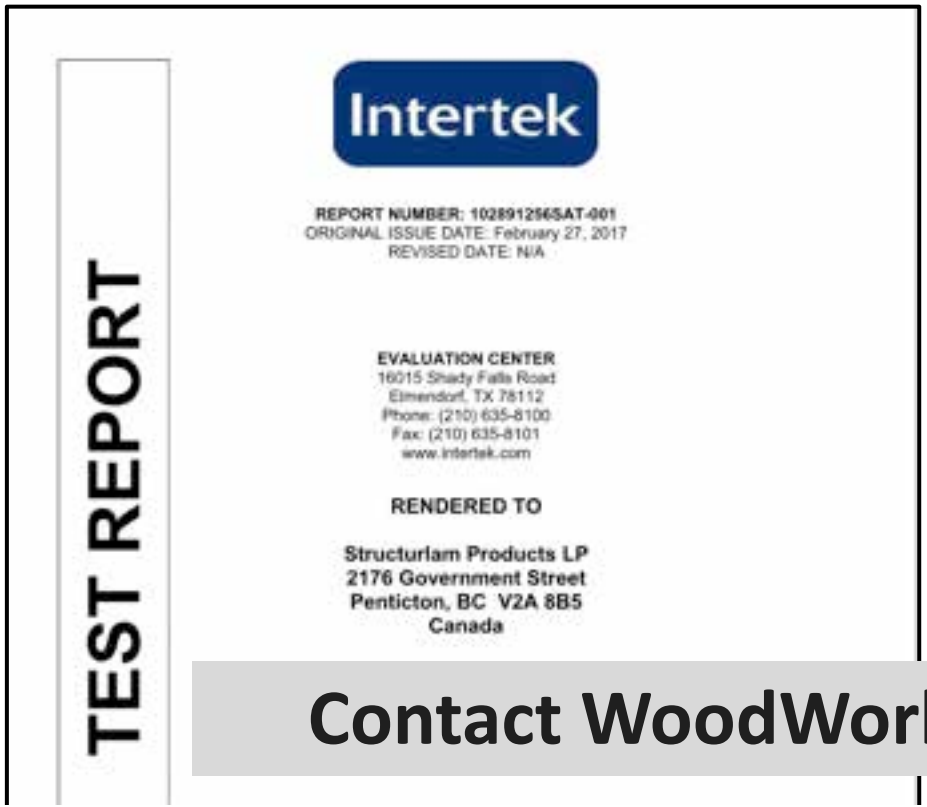
222 Catoctin Circle SE, Suite 201
Leesburg, VA 20175

Standard Methods of
Fire Tests of Building Construction and Materials
ASTM E 119 – 11a

Test Report No: WP-1950
Assignment No: K-1089
Subject Material: Cross-Laminated Timber and Gypsum Board Wall Assembly (Load-Bearing)
Test Date: October 4, 2012
Report Date: October 15, 2012

Prepared by:
Michael J. Ritter
Test Engineer

Reviewed by:
Robert J. Merchett
Director, Laboratory Facilities and Testing Services


TEST REPORT

Intertek

REPORT NUMBER: 102891256SAT-001
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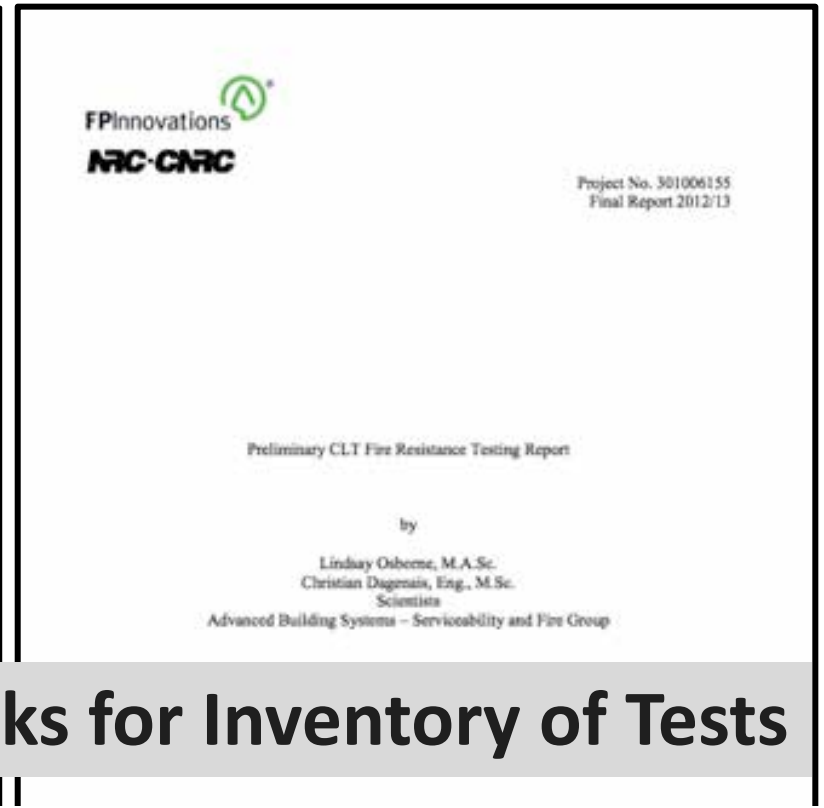
Structurlam Products LP
2176 Government Street
Penticton, BC V2A 8B5
Canada


FPInnovations
NRC·CNRC

Project No. 301006155
Final Report 2012/13

Preliminary CLT Fire Resistance Testing Report

by

Lindsay Osborne, M.A.Sc.
Christian Dagenais, Eng., M.Sc.
Scientists
Advanced Building Systems – Serviceability and Fire Group

Contact WoodWorks for Inventory of Tests

MT Fire Resistance Ratings (FRR)

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Fire-Resistive Design of Mass Timber Members

Code Applications, Construction Types and Fire Ratings

For many years, exposed heavy timber framing elements have been permitted in U.S. buildings due to their inherent fire-resistance properties. The predictability of wood's char rate has been well-established for decades and has long been recognized in building codes and standards.

Today, one of the exciting trends in building design is the growing use of mass timber—i.e., large solid wood panel products such as cross-laminated timber (CLT) and nail-laminated timber (NLT)—for floor, wall and roof construction. Like heavy timber, mass timber products have inherent fire resistance that allows them to be left exposed and still achieve a fire-resistance rating. Because of their strength and dimensional stability, these products also offer a low-carbon alternative to steel, concrete, and masonry for many applications. It is this combination of exposed structure and strength that developers and designers across the country are leveraging to create innovative designs with a warm yet modern aesthetic, often for projects that go beyond traditional norms of wood design.

This paper has been written to support architects and engineers exploring the use of mass timber for commercial and multi-family construction. It focuses on how to meet fire-resistance requirements in the International Building Code (IBC), including calculation and testing-based methods. Unless otherwise noted, references refer to the 2018 IBC.

Mass Timber & Construction Type

Before demonstrating fire-resistance ratings of exposed mass timber elements, it's important to understand under what circumstances the code currently allows the use of mass timber in commercial and multi-family construction.

A building's assigned construction type is the main indicator of where and when all wood systems can be used. IBC Section 602 defines five main options (Type I through V) with all but Type IV having subcategories A and B. Types III and V permit the use of wood framing throughout much of the structure and both are used extensively for modern mass timber buildings.

Type III (IBC 602.3) – Timber elements can be used in floors, roofs and interior walls. Fire-retardant-treated wood (FRTW) framing is permitted in exterior walls with a fire-resistance rating of 2 hours or less.

Type V (IBC 602.5) – Timber elements can be used throughout the structure, including floors, roofs and both interior and exterior walls.

Type IV (IBC 602.4) – Commonly referred to as 'Heavy Timber' construction, this option

Cadence | Portland, Oregon
Kaiser Group | Rath Architecture
Magnus Structural Engineering

Mass Timber Fire Design Resource

- **Code compliance options for demonstrating FRR**
- **Updated as new tests are completed**
- **Free download at woodworks.org**

MT Fire Resistance Ratings (FRR)

Inventory of Fire Tested MT Assemblies

Table 1: North American Fire Resistance Tests of Mass Timber Floor / Roof Assemblies

WoodWorks
WOOD PRODUCTS COUNCIL

CLT Panel	Manufacturer	CLT Grade or Major x Minor Grade	Ceiling Protection	Panel Connection in Test	Floor Topping	Load Rating	Fire Resistance Achieved (Hours)	Source	Testing Lab
3-ply CLT (154mm 6.063 in.)	Nordic	SPF 1650 Fb 1.3 E MSR x SPF #3	2 layers 1/2" Type X gypsum	Half-Lap	None	Reduced 54% Moment Capacity	1	1 (Test 1)	NRC Fire Laboratory
3-ply CLT (105mm 4.134 in.)	Structurlam	SPF #1/#2 x SPF #1/#2	1 layer 5/8" Type X gypsum	Half-Lap	None	Reduced 73% Moment Capacity	1	1 (Test 3)	NRC Fire Laboratory
5-ply CLT (175mm 6.875")	Nordic	E1	None	Topside Splines	2 staggered layers of 1/2" cement boards	Loaded, See Manufacturer	2	2	NRC Fire Laboratory March 2016
5-ply CLT (175mm 6.875")	Nordic	E1	1 layer of 5/8" Type X gypsum under Z-channels and furring strips with 1 1/4" [illegible]	Topside Splines	2 staggered layers of 1/2" cement boards	Loaded, See Manufacturer	2	5	NRC Fire Laboratory Nov 2014
5-ply CLT (175mm 6.875")	Nordic	E1	None	Topside Splines	3/4 in. proprietary gypcrete over Maxxon acoustical mat	Reduced 30% Moment Capacity	1.5	3	UL
5-ply CLT (175mm 6.875")	Nordic	E1	1 layer 5/8" normal gypsum	Topside Splines	3/4 in. proprietary gypcrete over Maxxon acoustical mat or proprietary sound board	Reduced 30% Moment Capacity	2	4	UL
5-ply CLT (175mm 6.875")	Nordic	E1	1 layer 5/8" Type X Gyp under Resilient Channel under 1 7/8" I-Joists with 1 1/2" Mineral Wool between Joists	Half-Lap	None	Loaded, See Manufacturer	2	21	Intertek 8/24/2012
5-ply CLT (175mm 6.875")	Structurlam	E1 M5 MSR 2100 x SPF #2	None	Topside Splines	1-1/2" Maxxon CypGrete 2800 over Maxxon Reinforcing Mesh	Loaded, See Manufacturer	2.5	6	Intertek, 2/22/2016
5-ply CLT (175mm 6.875")	DR Johnson	V1	None	Half-Lap & Topside Splines	2" gypcrete topping	Loaded, See Manufacturer	2	7	SwRI (May 2016)
5-ply CLT (175mm 6.875")	Nordic	SPF 1/#2 Fb MSR x SPF #3	None	Half-Lap	None	Reduced 19% Moment Capacity	1.5	1 (Test 3)	NRC Fire Laboratory
5-ply CLT (175mm 6.875")	Structurlam	SPF #1/#2 x SPF #1/#2	1 layer 5/8" Type X gypsum	Half-Lap	None	Unreduced 100% Moment Capacity	2	1 (Test 4)	NRC Fire Laboratory
7-ply CLT (245mm 9.65")	Structurlam	SPF #1/#2 x SPF #1/#2	None	Half-Lap	None	Unreduced 100% Moment Capacity	2.5	1 (Test 7)	NRC Fire Laboratory
5-ply CLT (175mm 6.875")	SmartLam	SL-V4	None	Half-Lap	nominal 1/2" plywood with 8d nails	Loaded, See Manufacturer	2	12 (Test 4)	Western Fire Center 10/26/2016
5-ply CLT (175mm 6.875")	SmartLam	V1	None	Half-Lap	nominal 1/2" plywood with 8d nails	Loaded, See Manufacturer	2	12 (Test 5)	Western Fire Center 10/28/2016
5-ply CLT (175mm 6.875")	DR Johnson	V1	None	Half-Lap	nominal 1/2" plywood with 8d nails	Loaded, See Manufacturer	2	12 (Test 6)	Western Fire Center 11/01/2016
5-ply CLT (190mm 6.5")	KLH	CV SM1	None	Half-Lap & Topside Splines	None	Loaded, See Manufacturer	1	14	SwRI

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TECHNICAL BRIEF

Demonstrating Fire-Resistance Ratings for Mass Timber Elements in Tall Wood Structures

Richard McLain, PE, SE • Senior Technical Director – Tall Wood, WoodWorks

Changes to the 2021 International Building Code (IBC) have created opportunities for wood buildings that are much larger and taller than prescriptively allowed in past versions of the code. Occupant safety, and the need to ensure fire performance in particular, was a fundamental consideration as the changes were developed and approved. The result is three new construction types—Type IV-A, IV-B and IV-C—which are based on the previous Heavy Timber construction type (renamed Type IV-HT), but with additional fire protection requirements.

One of the main ways to demonstrate that a building will meet the required level of passive fire protection, regardless of structural materials, is through hourly fire-resistance ratings (FRRs) of its elements and assemblies. The IBC defines an FRR as *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.*

FRRs for the new construction types are similar to those required for Type I construction, which is primarily steel and concrete.[1] (See Table 1.) They are found in IBC Table 601, which includes FRR requirements for all construction types and building elements; however, other code sections should be checked for overriding provisions (e.g., occupancy separation, shaft enclosures, etc.) that may alter the requirement.

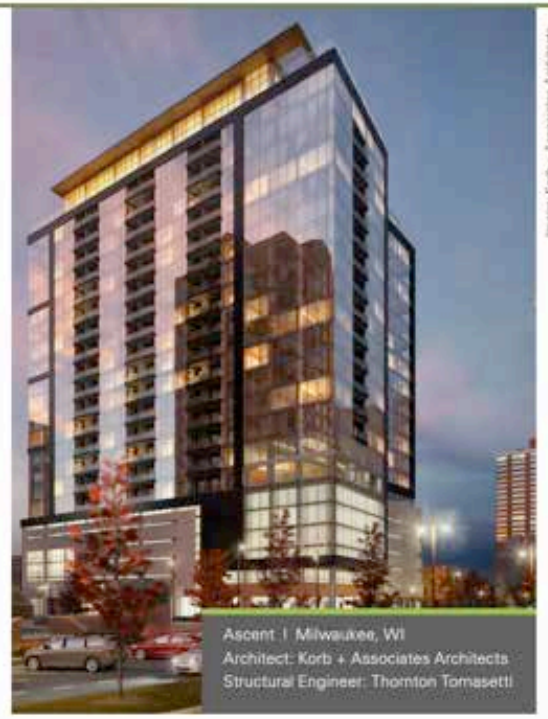


Image: Korb + Associates Architects

Ascent | Milwaukee, WI
Architect: Korb + Associates Architects
Structural Engineer: Thornton Tomasetti

TABLE 1:
FRR Requirements (Hours) for Tall Mass Timber Construction Types and Existing Type I

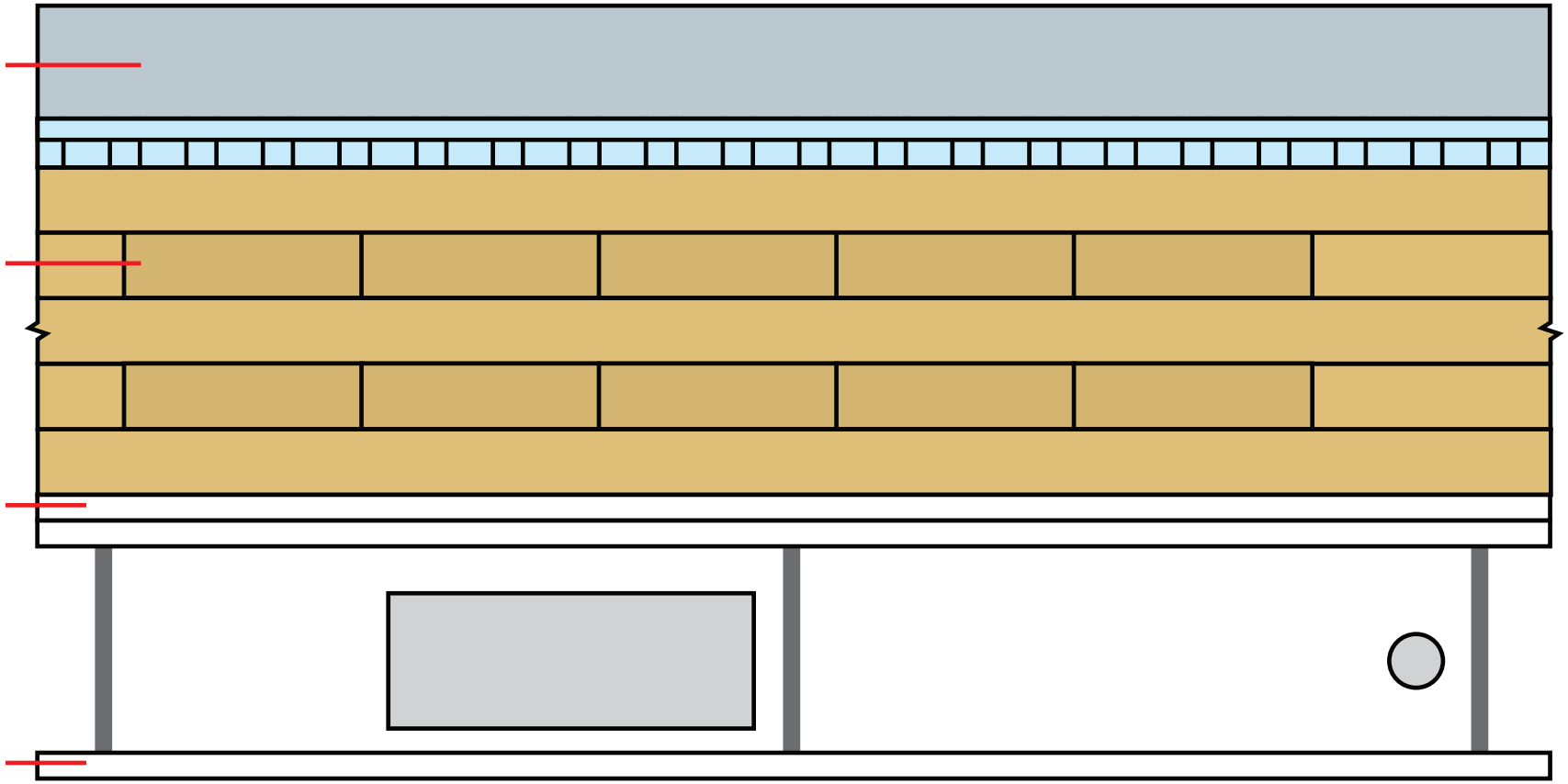
Building Element	I-A *Unlimited stories,*	IV-A *Max. 18 stories,*	I-B *Max. 12 stories,*	IV-B *Max. 12 stories,*	IV-C *Max. 9 stories,*
Interior Bearing Walls	3	3	2	2	2

Tall Timber Fire-Resistance Design

Concealed Spaces in Type IV

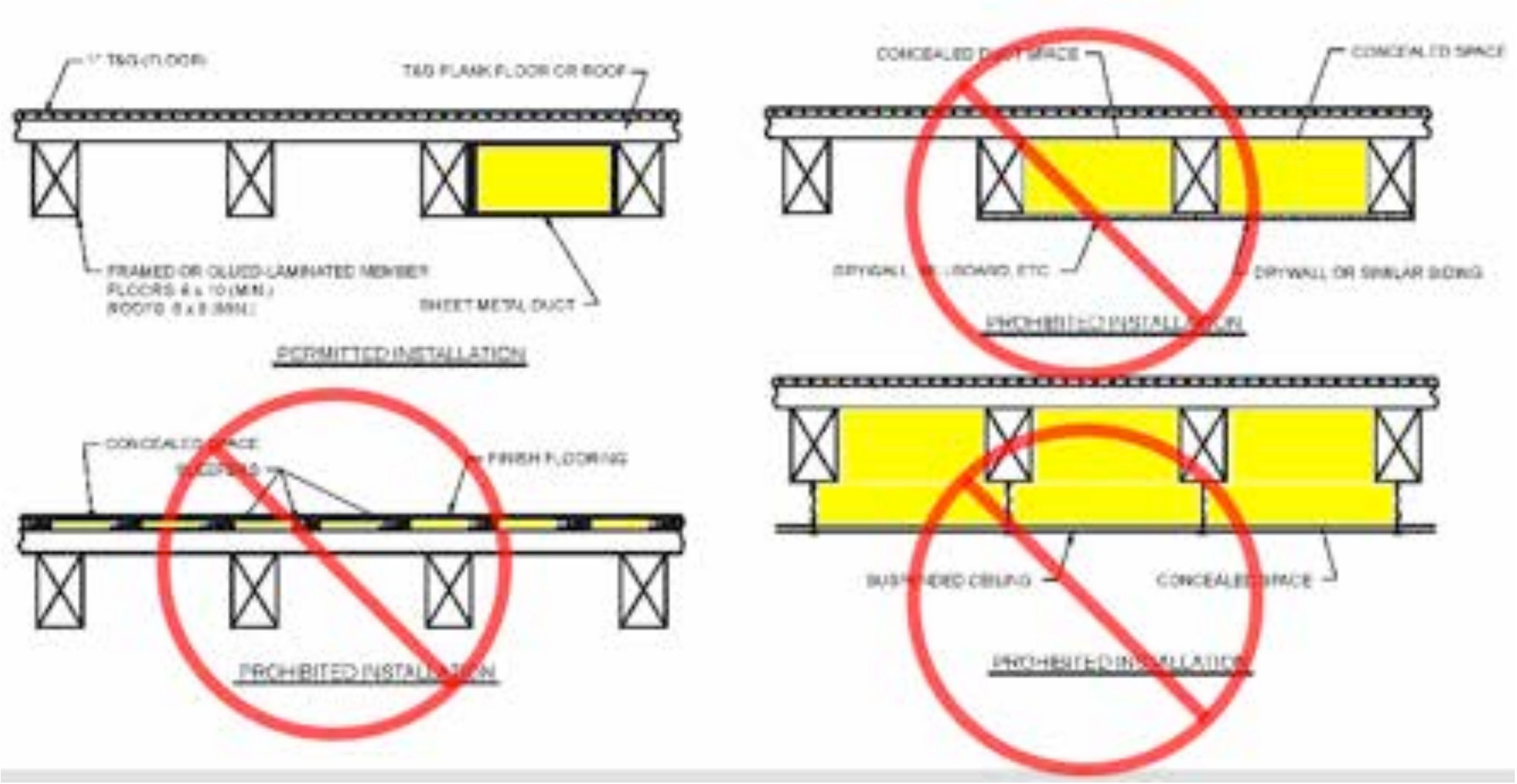
What if I have a dropped ceiling? Can I have a dropped ceiling?

- **Impact on FRR, NC placement, sprinkler requirements**



Concealed Spaces in Type IV

Previous Type IV (now IV-HT) provisions prohibited concealed spaces

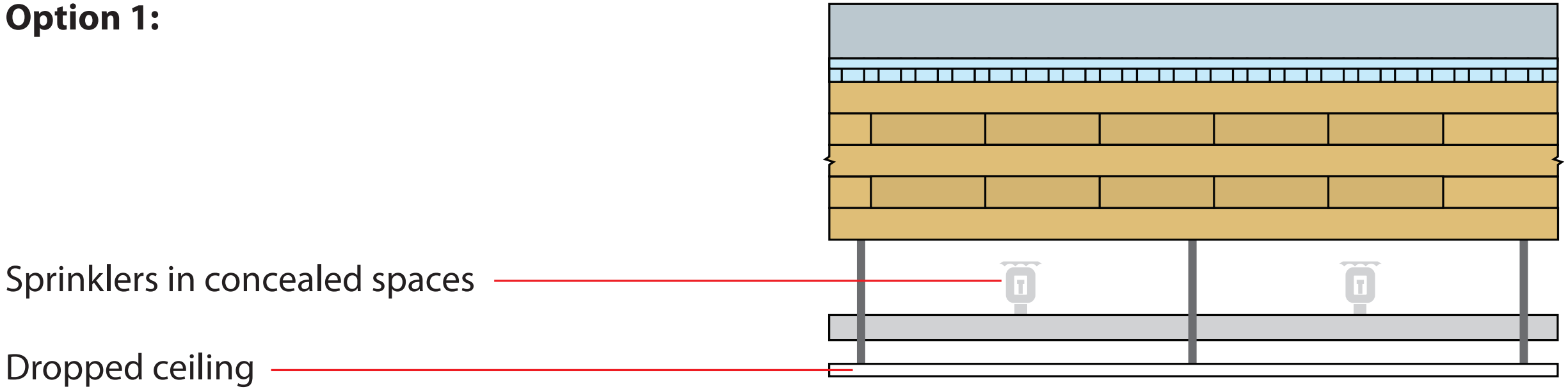


Credit: IBC

Concealed Spaces in Type IV-HT – 2021 IBC

CONCEALED SPACES: TYPE IV-HT

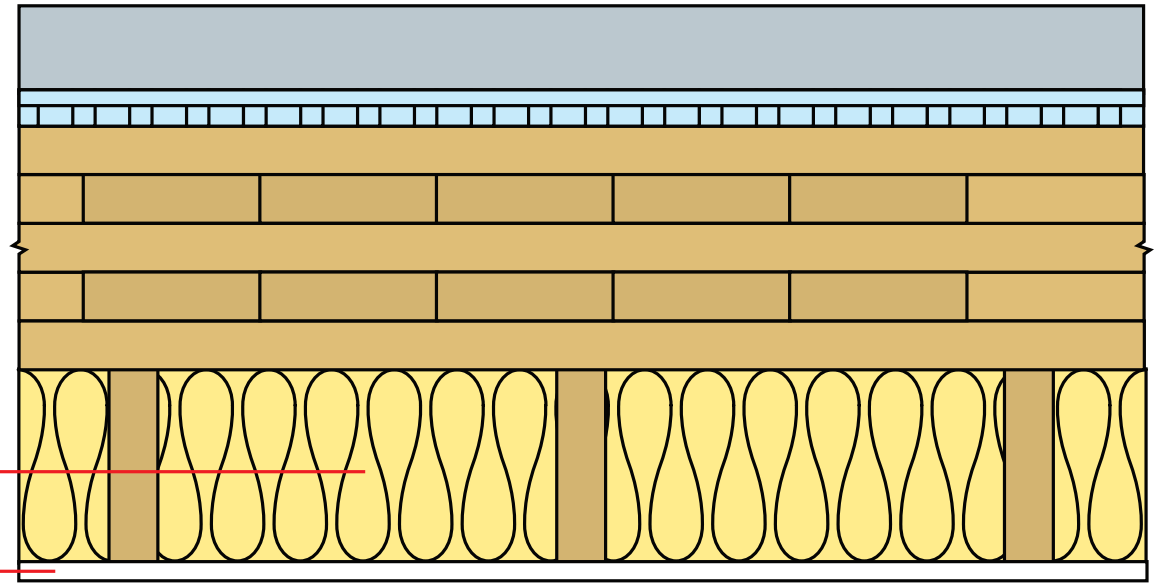
Option 1:



Concealed Spaces in Type IV-HT – 2021 IBC

CONCEALED SPACES: TYPE IV-HT

Option 2:



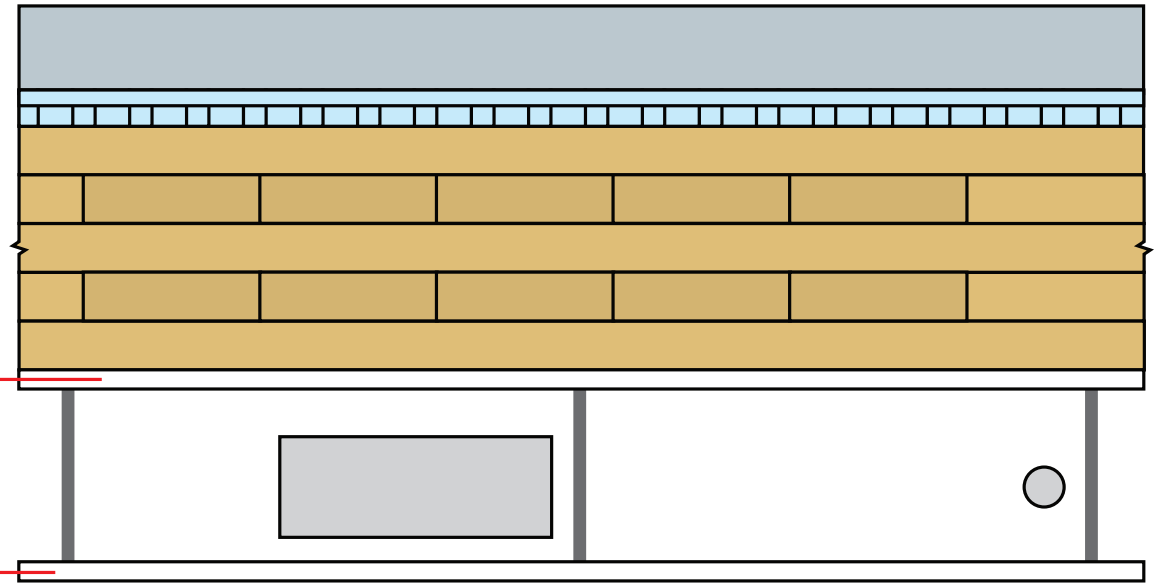
Concealed Spaces in Type IV-HT – 2021 IBC

CONCEALED SPACES: TYPE IV-HT

Option 3:

5/8" Type X gypsum on all mass timber surfaces within concealed space

Dropped ceiling



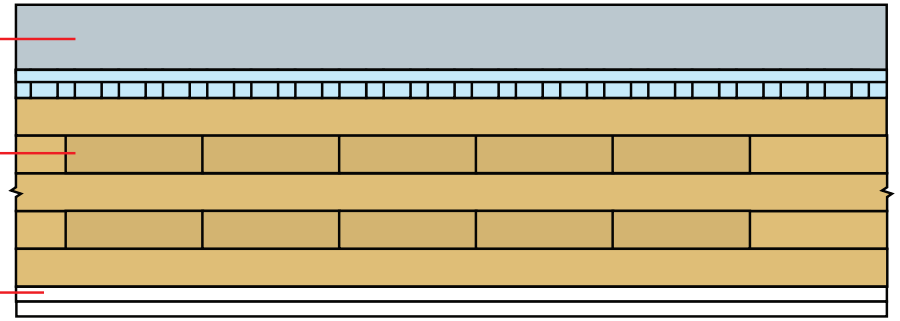
Concealed Spaces in Type IV-A, IV-B

Without Dropped Ceiling

Minimum 1" noncombustible material

Mass timber floor panel

Two layers 5/8" Type X gypsum*



**Applicable to most locations; limited exposed mass timber permitted in IV-B*

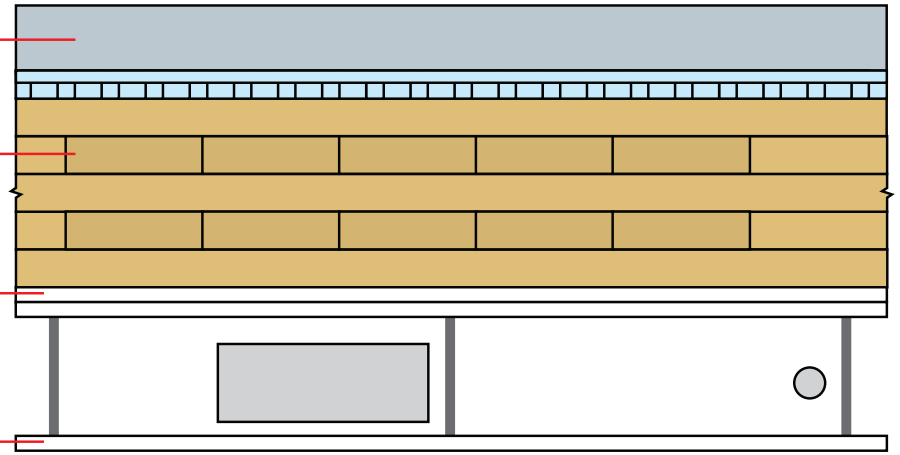
With Dropped Ceiling

Minimum 1" noncombustible material

Mass timber floor panel

Two layers 5/8" Type X gypsum

Dropped ceiling



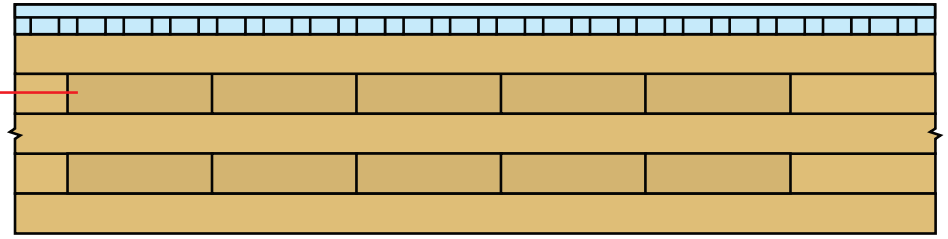
Concealed Spaces in Type IV-C

Without Dropped Ceiling

Noncombustible material not required

Mass timber floor panel

Noncombustible material not required



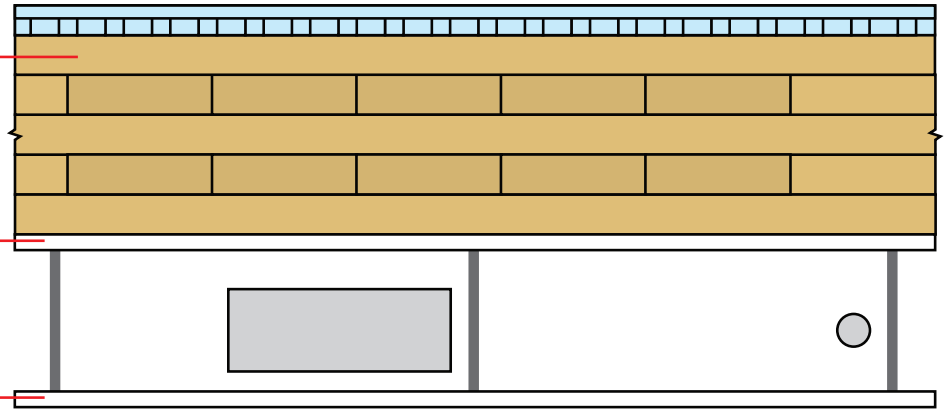
With Dropped Ceiling

Noncombustible material not required

Mass timber floor panel

One layer 5/8" Type X gypsum covering all mass timber surfaces within concealed space

Dropped ceiling



WoodWorks
WOOD PRODUCTS COUNCIL

Concealed Spaces in Mass Timber and Heavy Timber Structures

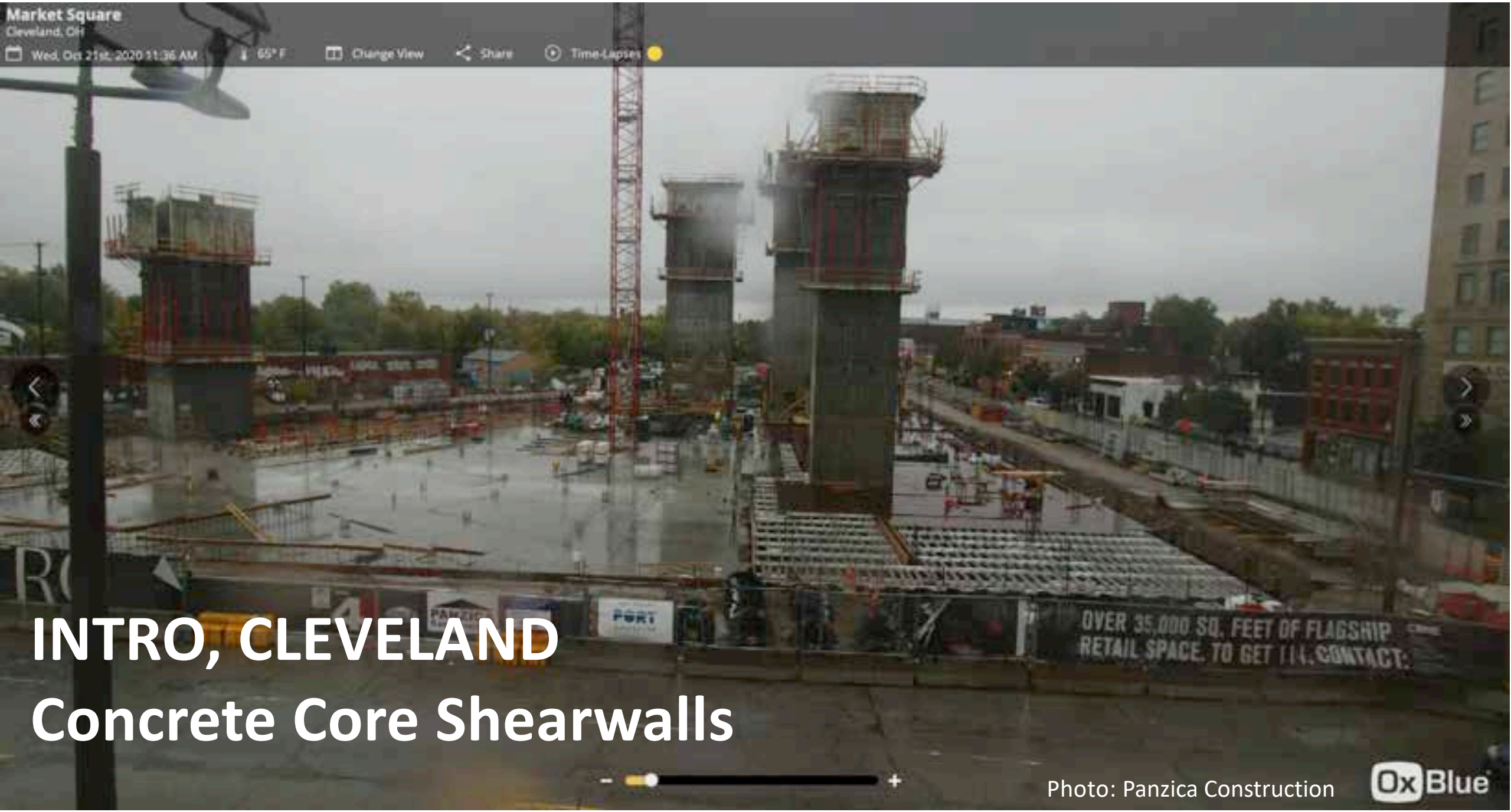
Concealed spaces, such as those created by a dropped ceiling in a floor/ceiling assembly or by a stud wall assembly, have unique requirements in the International Building Code (IBC) to address the potential of fire spread in non-visible areas of a building. Section 718 of the 2018 IBC includes prescriptive requirements for protection and/or compartmentalization of concealed spaces through the use of draft stopping, fire blocking, sprinklers, and other means. For information on these requirements, see the WoodWorks Q&A, *Are sprinklers required in concealed spaces such as floor and roof cavities in multi-family wood-frame buildings?*

For mass timber building elements, the choice of construction type can have a significant impact on concealed space requirements. Because mass timber products such as cross-laminated timber (CLT) are prescriptively recognized for Type IV construction, there is a common misperception that exposed mass timber building elements cannot be used or exposed in other construction types. This is not the case. In addition to Type IV buildings, structural mass timber elements—including CLT, glued-laminated timber (glulam), nail-laminated timber (NLT), structural composite lumber (SCL), and tongue-and-groove (T&G) decking—can be utilized and exposed in the following construction types, whether or not a fire resistance rating is required:

- **Type III** – Floors, roofs and interior walls may be any material permitted by code, including mass timber; exterior walls are required to be noncombustible or fire-retardant-treated wood.
- **Type V** – Floors, roofs, interior walls, and exterior walls (i.e., the entire structure) may be constructed of mass timber.
- **Types I and II** – Mass timber may be used in select circumstances such as roof construction—including the primary frame in the 2021 IBC—in Types I-B, II-A or II-B; exterior columns and arches when 20 feet or more of horizontal separation is provided; and balconies, canopies and similar projections.

Concealed Space Protection in Mass Timber

LATERAL SYSTEMS IN TALL WOOD

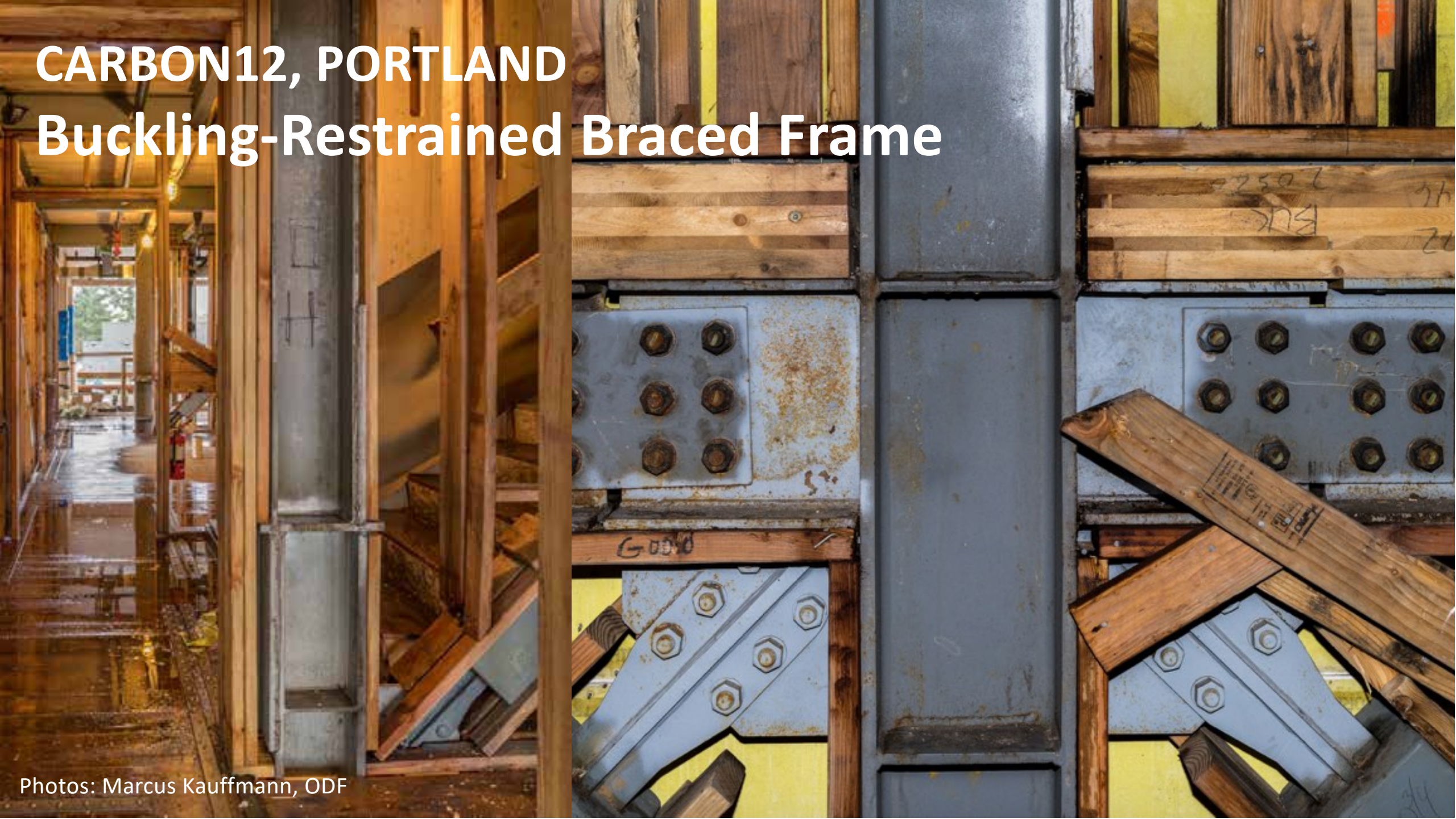


INTRO, CLEVELAND
Concrete Core Shearwalls

Photo: Panzica Construction

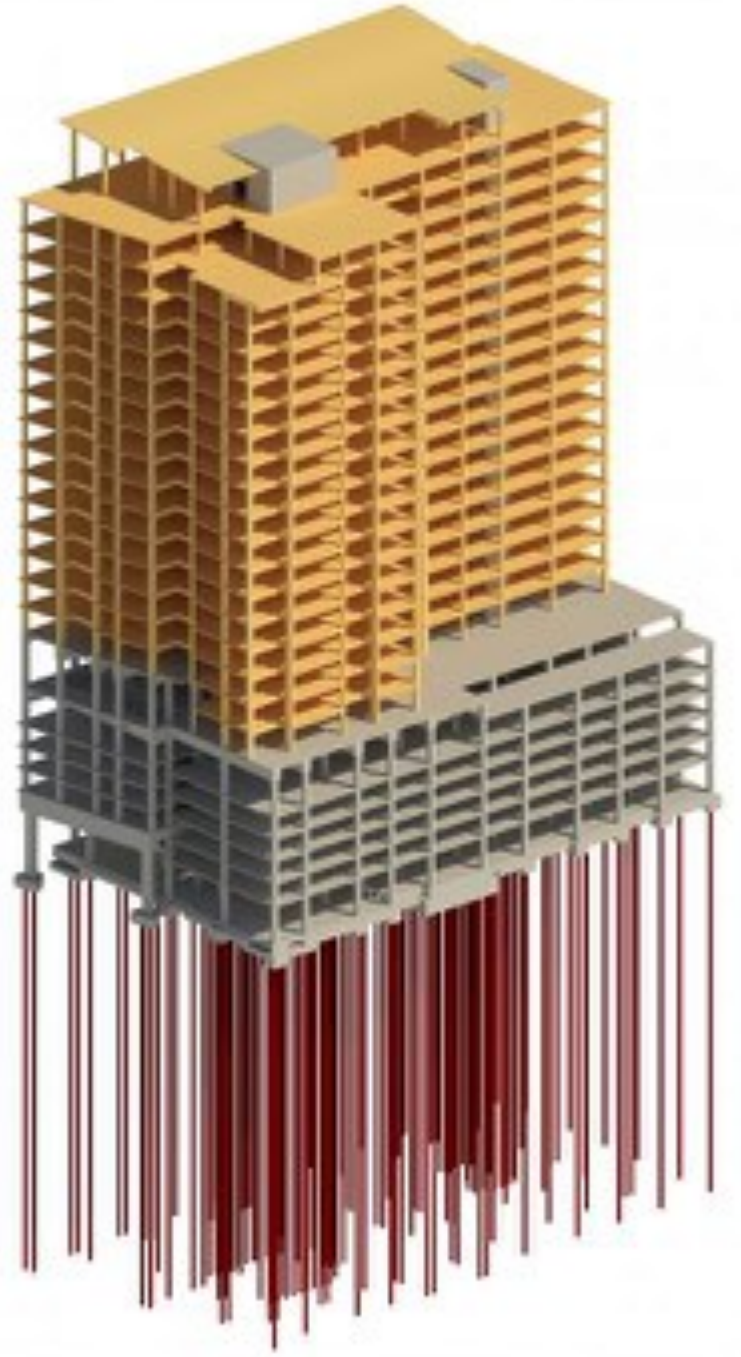
OxBlue

CARBON12, PORTLAND
Buckling-Restrained Braced Frame



Photos: Marcus Kauffmann, ODF

ASCENT, MILWAUKEE
Concrete Core Shearwalls



Photos: Korb + Associates, Thornton Tomasetti

BROCK COMMONS, VANCOUVER
Concrete Core Shearwalls

Photos: Acton Ostry Architects

FUTURE POTENTIAL LATERAL SYSTEM FOR TALL WOOD

Photo: WoodWorks

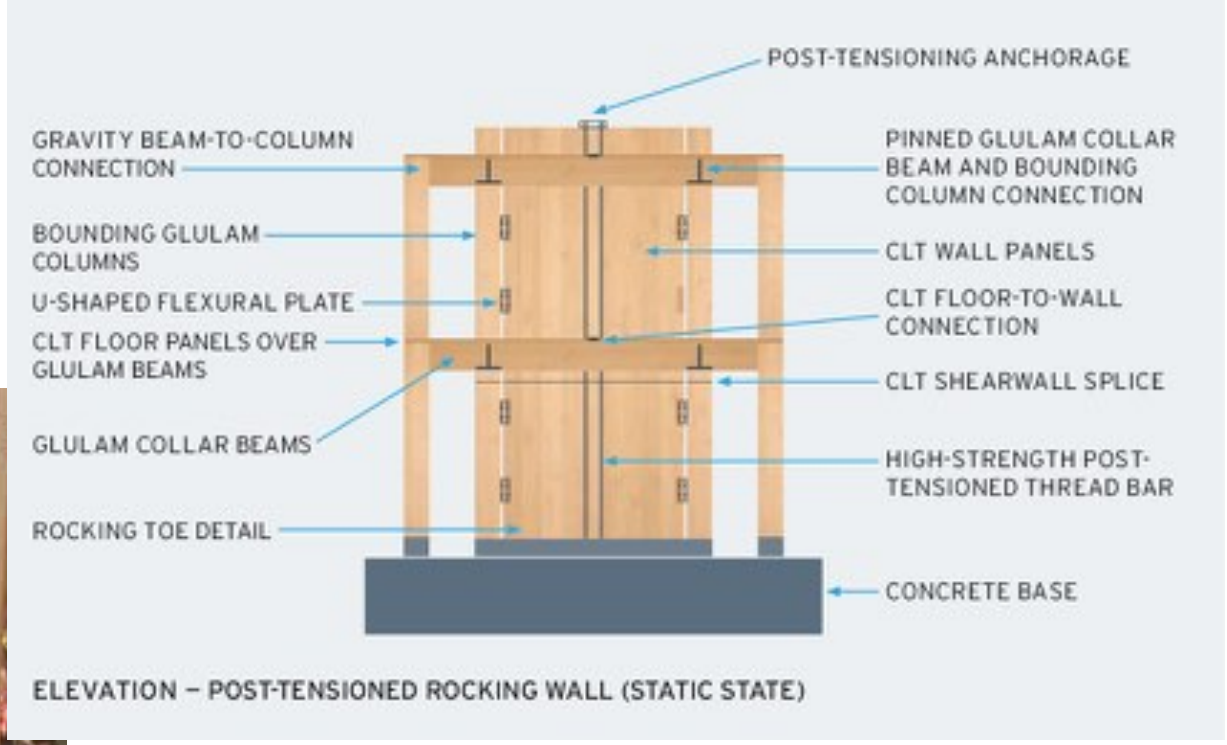


Image: KPFF

Mass Timber Rocking Shearwalls

CONNECTIONS IN TALL WOOD

Photo: Structurlam

Connection Fire Protection

In Construction Types IV-A, IV-B & IV-C, building elements are required to be FRR as specified in IBC Tables 601 and 602. Connections between these building elements must be able to maintain FRR no less than that required of the connected members.

Photo: MyTiCon

16.3 Wood Connections

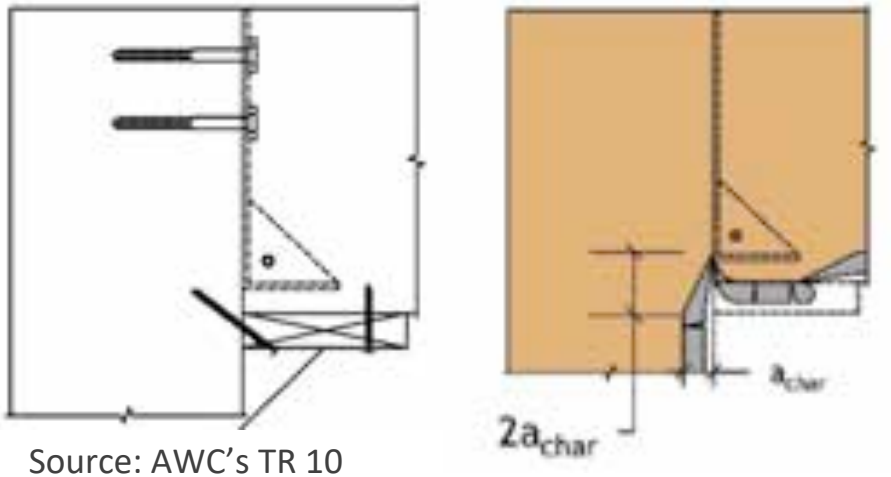
Wood connections, including connectors, fasteners, and portions of wood members included in the connection design, shall be protected from fire exposure for the required fire resistance time. Protection shall be provided by wood, fire-rated gypsum board, other approved materials, or a combination thereof.

Source: NDS

Fire Resistance of Connections

2304.10.1 Connection fire resistance rating. Fire resistance ratings in Type IV-A, IV-B, or IV-C construction shall be determined by one of the following:

1. Testing in accordance with Section 703.2 where the connection is part of the fire resistance test.



Source: AWC's TR 10

2. Engineering analysis that demonstrates that the temperature rise at any portion of the connection is limited to an average temperature rise of 250° F (139° C), and a maximum temperature rise of 325° F (181° C), for a time corresponding to the required fire resistance rating of the structural element being connected. For the purposes of this analysis, the connection includes connectors, fasteners, and portions of wood members included in the structural design of the connection.

Connection Fire Protection

Many ways to demonstrate connection fire protection: calculations, prescriptive NC, test results, others as approved by AHJ


Photo: John Stamets


Photo: Josh Partee

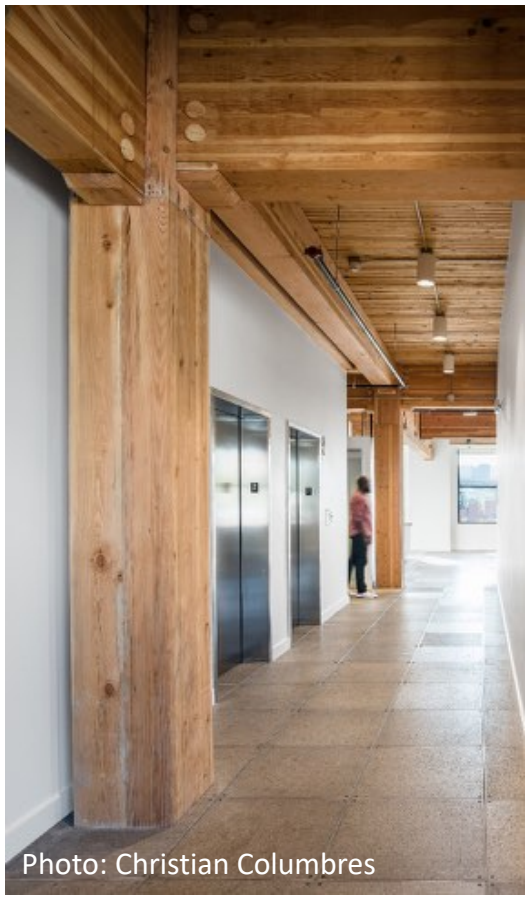


Photo: Christian Columbres


Photo: Blaine Brownell

Connection Fire Protection

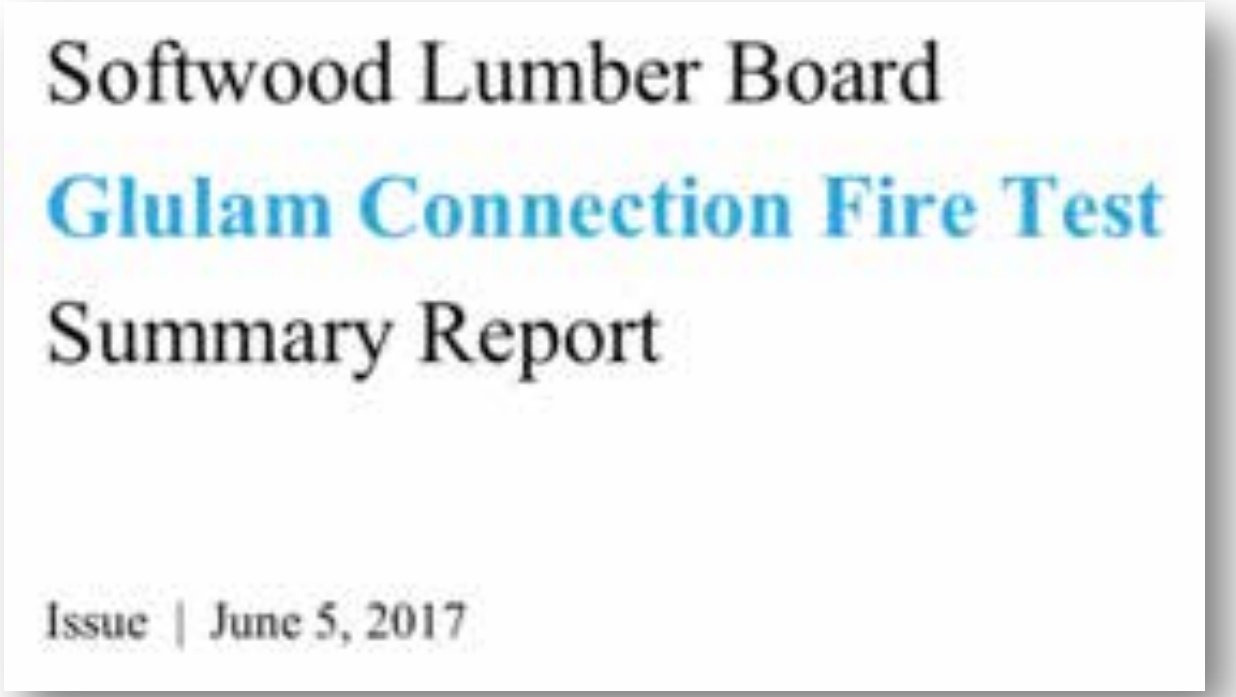
2017 Glulam Beam to Column Connection Fire Tests under standard ASTM E119 time-temperature exposure

Connection Fire Protection

Fire Test Results

Test	Beam	Connector	Applied Load	FRR
1	8.75" x 18" (222mm x 457mm)	1 x Ricon S VS 290x80	3,905lbs (17.4kN)	1hr
2	10.75" x 24" (273mm x 610mm)	Staggered double Ricon S VS 200x80	16,620lbs (73.9kN)	1.5hrs
3	10.75" x 24" (273mm x 610mm)	1 x Megant 430	16,620lbs (73.9kN)	1.5hrs

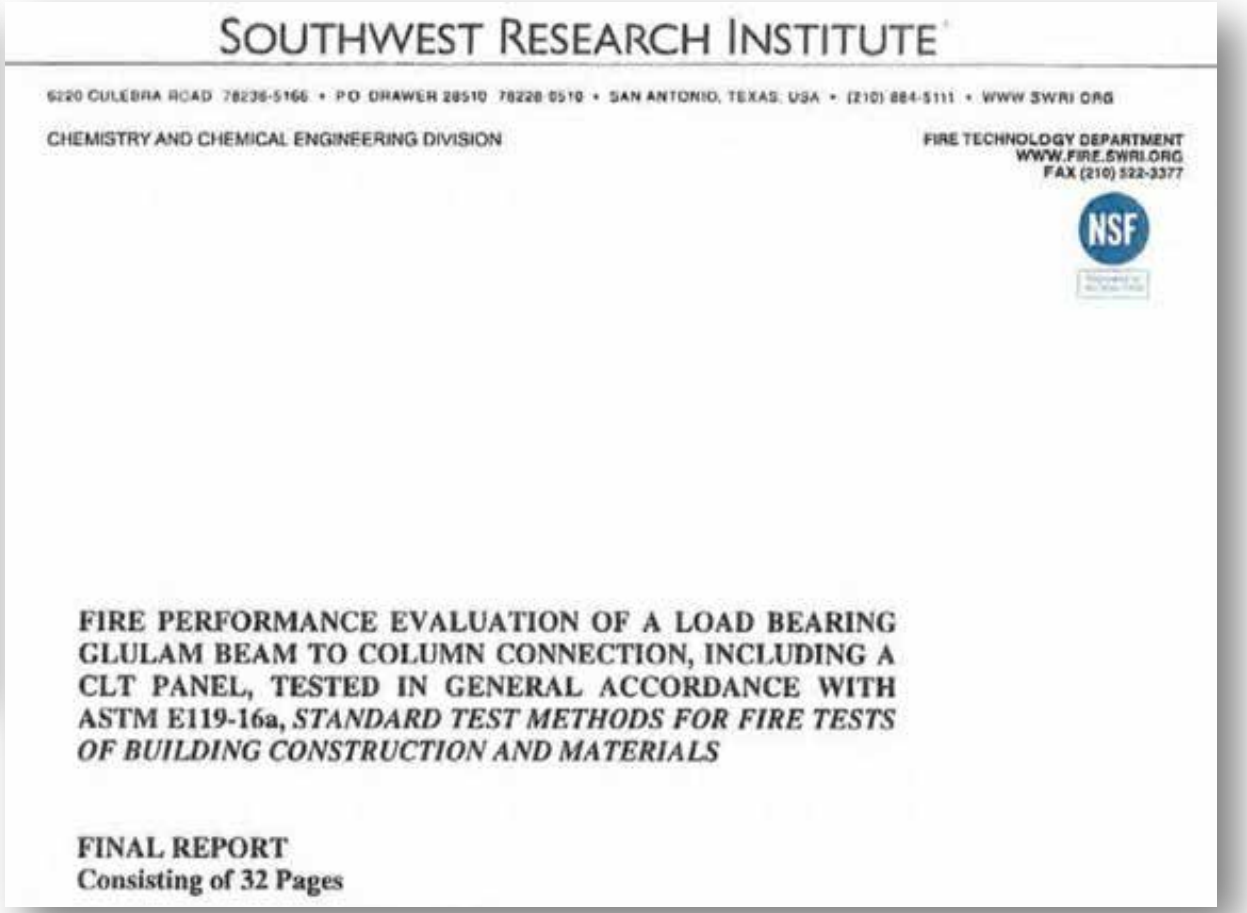
Connection Fire Protection


Softwood Lumber Board

Glulam Connection Fire Test

Summary Report

Issue | June 5, 2017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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION

FIRE TECHNOLOGY DEPARTMENT
WWW.FIRE.SWRI.ORG
FAX (210) 522-3377

NSF

FIRE PERFORMANCE EVALUATION OF A LOAD BEARING GLULAM BEAM TO COLUMN CONNECTION, INCLUDING A CLT PANEL, TESTED IN GENERAL ACCORDANCE WITH ASTM E119-16a, *STANDARD TEST METHODS FOR FIRE TESTS OF BUILDING CONSTRUCTION AND MATERIALS*

FINAL REPORT
Consisting of 32 Pages

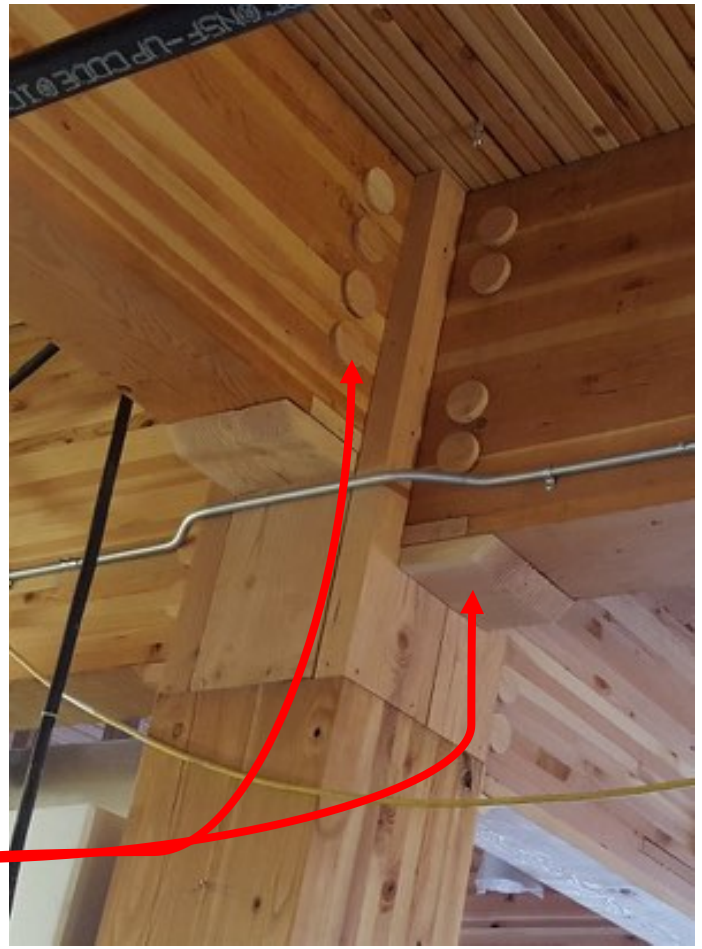
Full Report Available at:

https://www.thinkwood.com/wp-content/uploads/2018/01/reThink-Wood-Arup-SLB-Connection-Fire-Testing-Summary-web.pdf

Tall Mass Timber Inspections

Wood Connection Coverings for Fire-Resistance

110.3.5 Type IV-A, IV-B, and IV-C connection protection inspection. In buildings of Type IV-A, IV-B, and IV-C Construction, where connection fire resistance ratings are provided by wood cover calculated to meet the requirements of Section 2304.10.1, inspection of the wood cover shall be made after the cover is installed, but before any other coverings or finishes are installed.



Inspection of Wood Coverings

Tall Mass Timber Special Inspections

TABLE 1705.5.3
REQUIRED SPECIAL INSPECTIONS OF MASS TIMBER CONSTRUCTION

Type	Continuous Special Inspection	Periodic Special Inspection
1. Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.		X
2. Inspect erection of mass timber construction		X
3. Inspection of connections where installation methods are required to meet design loads		
3.1. Threaded fasteners		
3.1.1. Verify use of proper installation equipment.		X
3.1.2. Verify use of pre-drilled holes where required.		X
3.1.3. Inspect screws, including diameter, length, head type, spacing, installation angle, and depth.		X
3.2. Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads	X	
3.3. Adhesive anchors not defined in 3.2.		X
3.4. Bolted connections		X
3.5. Concealed connections		X

Source: International Building Code

PENETRATIONS IN TALL WOOD

Photo: Alex Schreyer

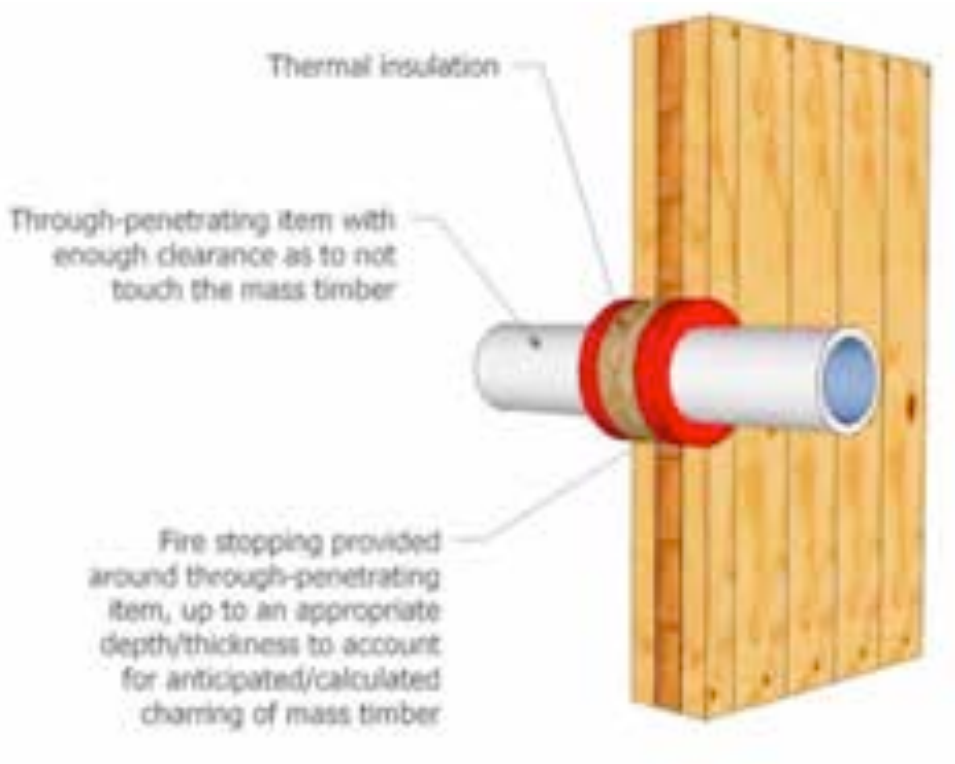
Penetration Fire Protection

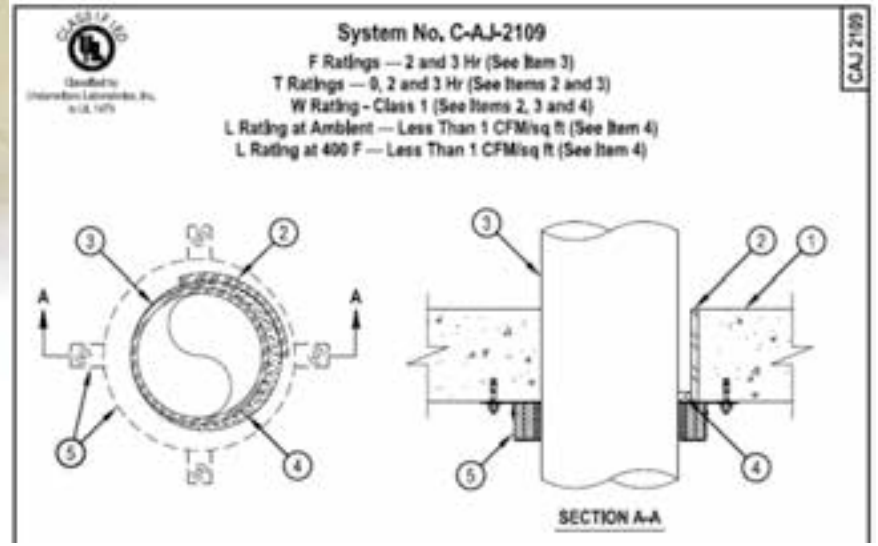
Although not a new code requirement or specific to tall wood, more testing & information is becoming available on firestopping of penetrations through MT assemblies

Photos: AWC/FPInnovations

Penetration Fire Protection

Most firestopping systems include combination of fire safing (eg. noncombustible materials such as mineral wool insulation) plus fire caulk





Photos: AWC/FPInnovations/Hilti

Penetration Fire Protection

Firestop systems tests on Mass Timber
Contact WoodWorks for information

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION

FIRE TECHNOLOGY DEPARTMENT

FIRE RESISTANCE PERFORMANCE EVALUATION OF A PENETRATION FIRESTOP SYSTEM TESTED IN ACCORDANCE WITH ASTM E814-13A, *STANDARD TEST METHOD FOR FIRE TESTS OF PENETRATION FIRESTOP SYSTEMS*

FINAL REPORT
Consisting of 18 Pages

SwRI® Project No. 01.21428.01.001a
Test Date: September 30, 2015
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Leesburg, VA 20175

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FIRE PERFORMANCE OF FIRESTOPS, PENETRATIONS, AND FIRE DOORS IN MASS TIMBER ASSEMBLIES

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ABSTRACT: Integrity and continuity must be maintained for fire separations required to provide fi
prevent passage of hot gases or increased temperature on the unexposed side. Vulnerable locations, whe
are introduced into mass timber systems, are susceptible to fire spread. Service and closure penetrat
timber fire separation have been investigated. Many of the fire stop systems were able to achieve 1-½
accordance with CAN/ULC-S115, which would be required for 2-hr fire resistance rated assemblies, su
tall wood buildings. Construction details are outlined which ensure adequate fire performance of these p

KEYWORDS: Firestop, through-penetrations, fire rated door, mass timber, cross-laminated tim
buildings, fire resistance

1 INTRODUCTION

Many tall wood buildings using mass timber are planned or are currently being designed for construction around the world. A few have been built in Canada, including an 18 storey cross-laminated timber (CLT) and glulam building in British Columbia. The prescriptive requirements in the National Building Code of Canada (NBCC) [1] do not (yet) permit the construction of wood buildings taller than six stories, however an alternative

construction, as well as in several alter
building designs.

Although the general fire performance
well documented, there are still sever
warrant further investigation to ensure
safety levels are met and a number
available for designers to use. Generating
generic assemblies will reduce the need
completed on an individual construction

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FIRESTOPPING TEST WITNESS REPORT

for

NORDIC STRUCTURES

Penetration Fire Protection

Inventory of Fire Tested Penetrations in MT Assemblies

WoodWorks
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Table 3: North American Fire Tests of Penetrations and Fire Stops in CLT Assemblies

CLT Panel	Exposed Side Protection	Penetrating Item	Penetrant Centered or Offset in Hole	Firestopping System Description	F Rating	T Rating	Stated Test Protocol	Source	Testing Lab
3-ply (78mm/3.07")	None	1.5" diameter data cable bunch	Centered	3.5 in diameter hole. Mineral wool was installed in the 1in. annular space around the data cables to a total depth of approximately 2 – 3/4in. The remaining 1in. annular space from the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.	1 hour	0.3 hour	CAN/ULC S115	24	Intertek March 30, 2016
3-ply (78mm/3.07")	None	2" copper pipe	Centered	4.375 in diameter hole. Pipe wrap was installed around the copper pipe to a total depth of approximately 2 – 3/4in. The remaining 1in. annular space starting at the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.	1 hour	N.A.	CAN/ULC S115	24	Intertek March 30, 2016
3-ply (78mm/3.07")	None	2.5" sched. 40 pipe	Centered	4.92 in diameter hole. Pipe wrap was installed around the schedule 40 pipe to a total depth of approximately 2 – 3/4in. The remaining 1in. annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS-One Max caulking.	1 hour	N.A.	CAN/ULC S115	24	Intertek March 30, 2016
3-ply (78mm/3.07")	None	4" cast iron pipe	Centered	8.35 in diameter hole. Mineral wool was installed in the 1in. annular space around the cast iron pipe to a total depth of approximately 2 – 3/4in. The remaining 1in. annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS- One Max caulking.	1 hour	N.A.	CAN/ULC S115	24	Intertek March 30, 2016
3-ply (78mm/3.07")	None	Hilti 4 in drop in device System No.: F- B-2049	Centered	9.03" diameter hole. Mineral wool was installed in the 1 – 1/4in. annular space around the drop-in device to a total depth of approximately 1 – 7/8in and the remaining 1in. annular space from the top of the mineral wool to the top edge of the 9 – 1/4in. hole in the CLT was filled with Hilti FS-One Max caulking.	1 hour	0.75 hour	CAN/ULC S115	24	Intertek March 30, 2016
5-ply CLT (131mm/5.16")	None	1.5" diameter data cable bunch	Centered	3.5" diameter hole. Mineral wool was installed in the 1in. annular space around the data cables to a total depth of approximately 4 – 5/32 in. The remaining 1in. annular space from the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.	2 hours	1.5 hours	CAN/ULC S115	24	Intertek March 30, 2016
5-ply CLT (131mm/5.16")	None	2" copper pipe	Centered	4.375 in diameter hole. Pipe wrap was installed around the copper pipe to a total depth of approximately 4 – 5/32 in. The remaining 1in. annular space starting at the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.	2 hours	N.A.	CAN/ULC S115	24	Intertek March 30, 2016
5-ply CLT (131mm/5.16")	None	2.5" sched. 40 pipe	Centered	4.92 in diameter hole. Pipe wrap was installed around the schedule 40 pipe to a total depth of approximately 4 – 5/32 in. The remaining 1in. annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS-One Max caulking.	2 hours	0.3 hour	CAN/ULC S115	24	Intertek March 30, 2016
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3-ply (175mm/6.87")	None	1" nominal PVC pipe	Centered	8.25 in diameter with a 5/8 in plywood subset flush with the top of the slab reducing the opening to 2.26 in. Two rings of Hilti CP 643E WF(3/4-3/4" Firestop wrap strip at two locations with a 50 gauge steel sleeve which extended from the top of the slab to 1 in below the slab. The first location was with the bottom of the wrap strip flush with the bottom of the steel sleeve and the second was with the bottom of the wrap strip 2 in. from the bottom of the slab. The void between the steel sleeve and the CLT and between the steel sleeve and pipe at the top was filled with Rockwool fire-resistant wool leaving a 5/8 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 5/8 in on the top of the assembly between the plywood and steel sleeve on wall as the steel sleeve and pipe.	2 hours	2 hours	ASTM E814	24	QAI Laboratories March 3, 2017

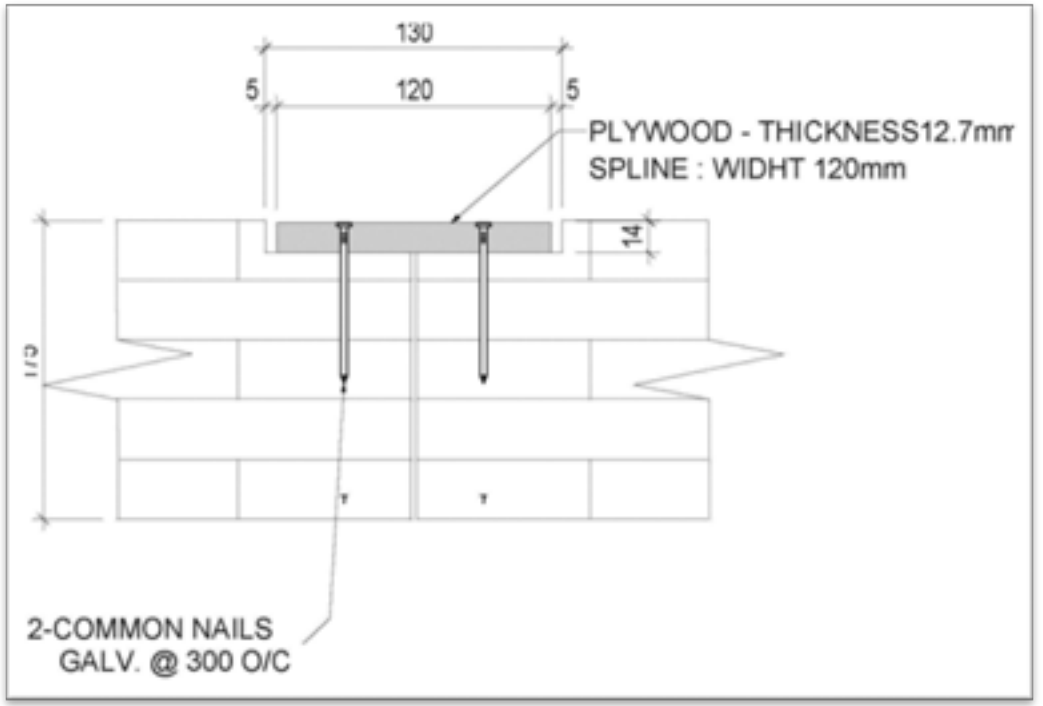
SEALANTS AT MT PANEL EDGES

Photos: ARUP

Sealants at MT Panel Edges

703.9 Sealing of adjacent mass timber elements. In buildings of Type IVA, IVB, and IVC construction, sealant or adhesive shall be provided to resist the passage of air in the following locations:

1. At abutting edges and intersections of mass timber building elements required to be fire resistance-rated
2. At abutting intersections of mass timber building elements and building elements of other materials where both are required to be fire resistance-rated.



Sealants at MT Panel Edges

Sealants shall meet the requirements of ASTM C920 (elastomeric joint sealants). Adhesives shall meet the requirements of ASTM D3498 (gap filling construction adhesives, i.e. not fire caulk).

Exception: Sealants or adhesives need not be provided where they are not a required component of a fire resistance- rated assembly.


Photo: NRCAN


Photo: Charles Judd


Photo: ARUP

Sealants at MT Panel Edges

Several MT fire tested assemblies have successfully been completed w/o adhesives/sealants at abutting panel edges

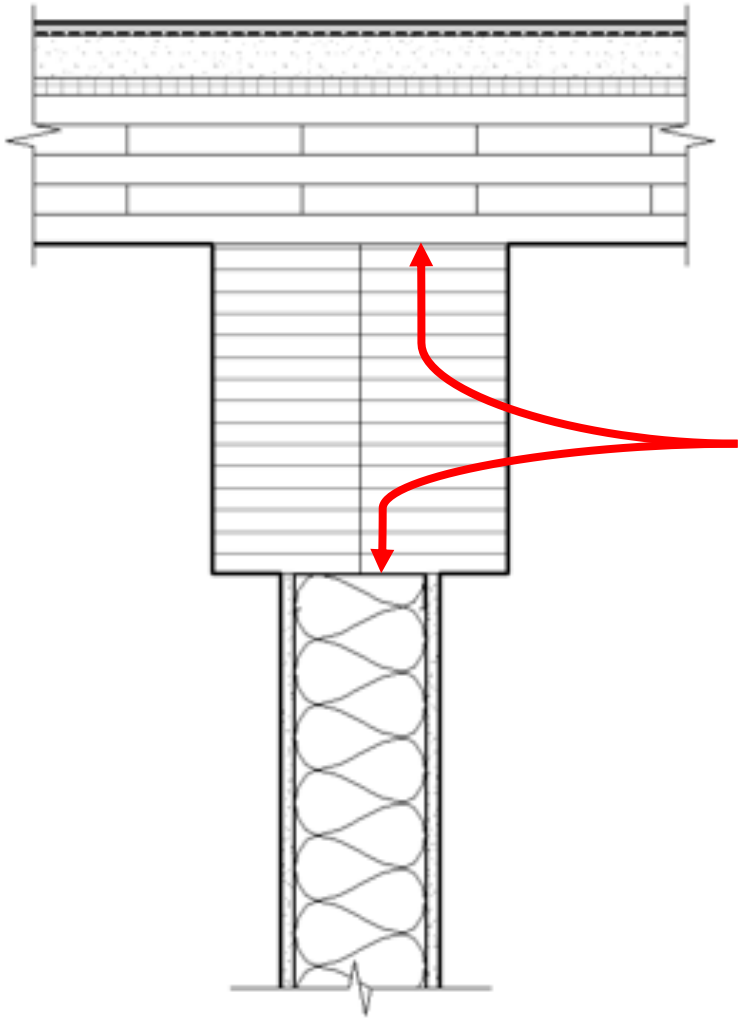
2021 IBC will require periodic special inspections of adhesive/sealant installation (when required to be installed)


Photo: NRCAN


Photo: Fast + Epp


Photo: ARUP

Joints & Intersecting Elements

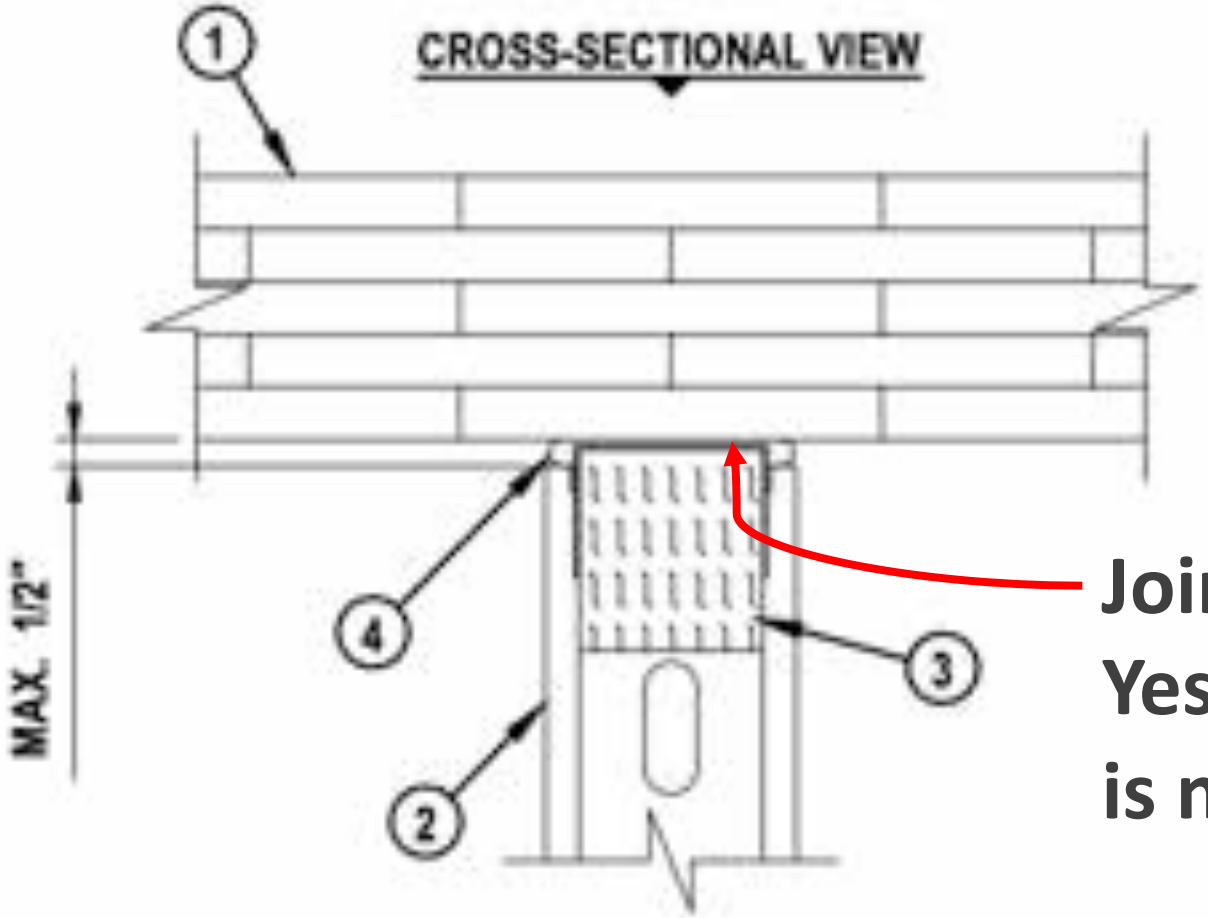


Joint?
No (if wall is bearing)

SECTION 202
DEFINITIONS

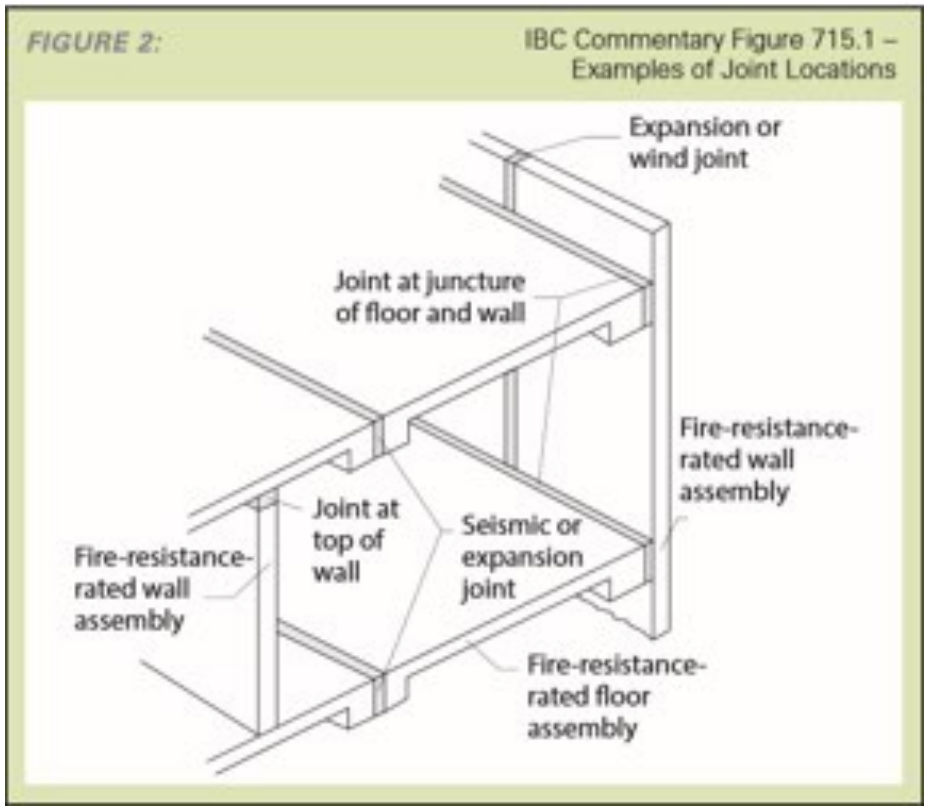
Joint. *The opening in or between adjacent assemblies that is created due to building tolerances, or is designed to allow independent movement of the building in any plane caused by thermal, seismic, wind or any other loading.*

Joints & Intersecting Elements



Source: Hilti

Joint?
Yes (if wall is non-brng)



Source: International Building Code

Fire Safety During Construction

New code provisions in International Fire Code (IFC) address construction fire safety of tall wood buildings

3308.4 Fire safety requirements for buildings of Types IV-A, IV-B, and IV-C construction. Buildings of Types IV-A, IV-B, and IV-C construction designed to be greater than six stories above grade plane shall meet the following requirements during construction unless otherwise approved by the fire code official.

1. Standpipes shall be provided in accordance with Section 3313.
2. A water supply for fire department operations, as approved by the fire chief.

Photo: Structurlam

Fire Safety During Construction

IFC 3313 Standpipe Requirements

SECTION 3313
STANDPIPES

3313.1 Where required.

In buildings required to have standpipes by Section 905.3.1, not less than one standpipe shall be provided for use during construction. Such standpipes shall be installed prior to construction exceeding 40 feet (12 192 mm) in height above the lowest level of fire department vehicle access. Such standpipe shall be provided with fire department hose connections at accessible locations adjacent to usable stairways. Such standpipes shall be extended as construction progresses to within one floor of the highest point of construction having secured decking or flooring.

3313.2 Buildings being demolished.

Where a building is being demolished and a standpipe is existing within such a building, such standpipe shall be maintained in an operable condition so as to be available for use by the fire department. Such standpipe shall be demolished with the building but shall not be demolished more than one floor below the floor being demolished.

3313.3 Detailed requirements.

Standpipes shall be installed in accordance with the provisions of Section 905.

Exception: Standpipes shall be either temporary or permanent in nature, and with or without a water supply, provided that such standpipes comply with the requirements of Section 905 as to capacity, outlets and materials.

Credit: IFC

Fire Safety During Construction

IFC 3308.4 Cont'd

3. Where building construction exceeds six stories above grade plane, at least one layer of noncombustible protection where required by Section 602.4 of the International Building Code shall be installed on all building elements more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor levels.
4. Where building construction exceeds six stories above grade plane required exterior wall coverings shall be installed on all floor levels more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor level.


Photo: Urban One

Exception: Shafts and vertical exit enclosures

Fire Safety During Construction

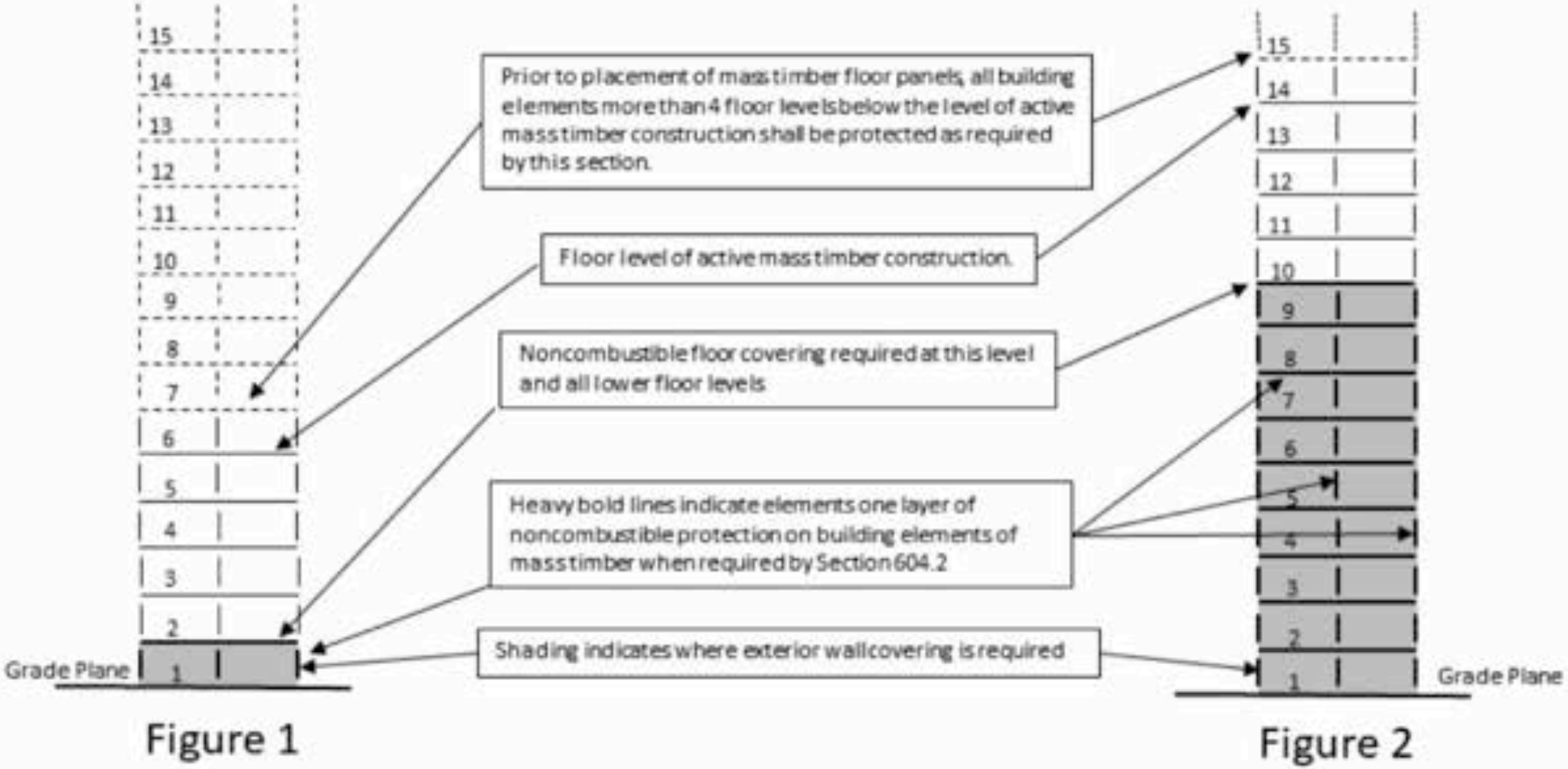


Figure 1

Figure 2

Examples of Protection During Construction For Mass Timber Buildings Greater Than 6 Stories Above Grade Plane

Credit: ICC

QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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