A New Path Forward for Tall Wood Construction: Code Provisions and Design Steps

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Photo: Kaiser+Path

New Building Types

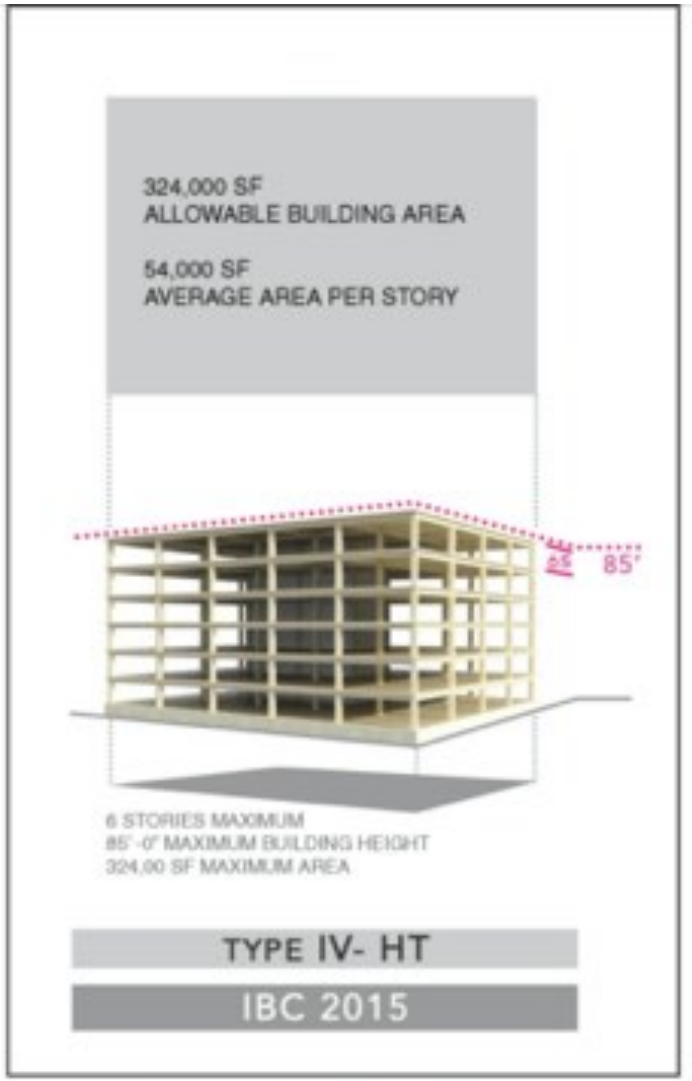
18 STORIES
BUILDING HEIGHT 270'
ALLOWABLE BUILDING AREA 972,000 SF
AVERAGE AREA PER STORY 54,000SF

12 STORIES
BUILDING HEIGHT 180 FT
ALLOWABLE BUILDING AREA 648,000 SF
AVERAGE AREA PER STORY 54,000SF

9 STORIES
BUILDING HEIGHT 85'
ALLOWABLE BUILDING AREA 405,000 SF
AVERAGE AREA PER STORY 45,000 SF

TYPE IV-A | TYPE IV-B | TYPE IV-C

IBC 2021



TYPE IV- HT

IBC 2015

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

Credit: Susan Jones, atelierjones

Photos: Baumberger Studio/PATH Architecture/Marcus Kauffman

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-C Height and Area Limits

IV-C

Occupancy	# of Stories	Height	Area per Story	Building Area
A-2	6	85 ft	56,250 SF	168,750 SF
B	9	85 ft	135,000 SF	405,000 SF
M	6	85 ft	76,875 SF	230,625 SF
R-2	8	85 ft	76,875 SF	230,625 SF

Areas exclude potential frontage increase

In most cases, Type IV-C height allowances = Type IV-HT height allowances, but add'l stories permitted due to enhanced FRR

Type IV-C area = 1.25 * Type IV-HT area

Credit: Susan Jones, atelierjones

Type IV-B

Credit: Susan Jones, atelierjones

Credit: LEVER Architecture

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, see code for requirements

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 Height and Area Limits

Credit: Susan Jones, atelierjones

Occupancy	# of Stories	Height	Area per Story	Building Area
A-2	12	180 ft	90,000 SF	270,000 SF
B	12	180 ft	216,000 SF	648,000 SF
M	8	180 ft	123,000 SF	369,000 SF
R-2	12	180 ft	123,000 SF	369,000 SF

Areas exclude potential frontage increase

In most cases, Type IV-B height & story allowances = Type I-B height & story allowances

Type IV-B area = 2 * Type IV-HT area

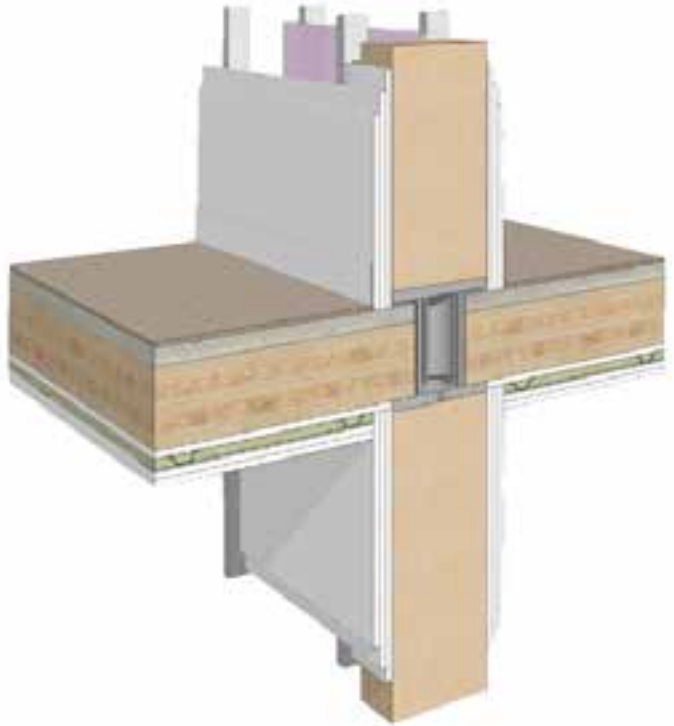
Type IV-A

Credit: Susan Jones, atelierjones

Photos: Structurlam, naturally:wood, Fast + Epp, Urban One

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-A Height and Area Limits

Credit: Susan Jones, atelierjones

Occupancy	# of Stories	Height	Area per Story	Building Area
A-2	18	270 ft	135,000 SF	405,000 SF
B	18	270 ft	324,000 SF	972,000 SF
M	12	270 ft	184,500 SF	553,500 SF
R-2	18	270 ft	184,500 SF	553,500 SF

Areas exclude potential frontage increase

In most cases, Type IV-A height & story allowances = 1.5 * Type I-B height & story allowances

Type IV-A area = 3 * Type IV-HT area

Building Elements in Type IV Construction

Minimum sizes for existing Type IV (now IV-HT)

apply to the new

Type IV-A, IV-B and IV-C

See

IBC 2018 2304.11

IBC 2015 602.4

Noncombustible Protection (NC)

Noncombustible Protection Required

IV-A

IV-B

IV-C

IV-HT

Credit: LEVER Architecture

Credit: PATH Architecture

Photo: Blaine Brownell

Tall Wood Fire Resistance Ratings (FRR)

	IV-A	IV-B	IV-C	IV-HT
Roof Construction	1.5	1	1	HT
Primary Frame @ Roof	2	1	1	HT
Floor Construction	2	2	2	HT
Primary Frame	3	2	2	HT
Exterior Bearing Walls	3	2	2	2
Interior Bearing Walls	3	2	2	1 or HT

Required Fire Resistance Rating in Hours (per Table 601 only)

Noncombustible Protection (NC)

Noncombustible Protection Required

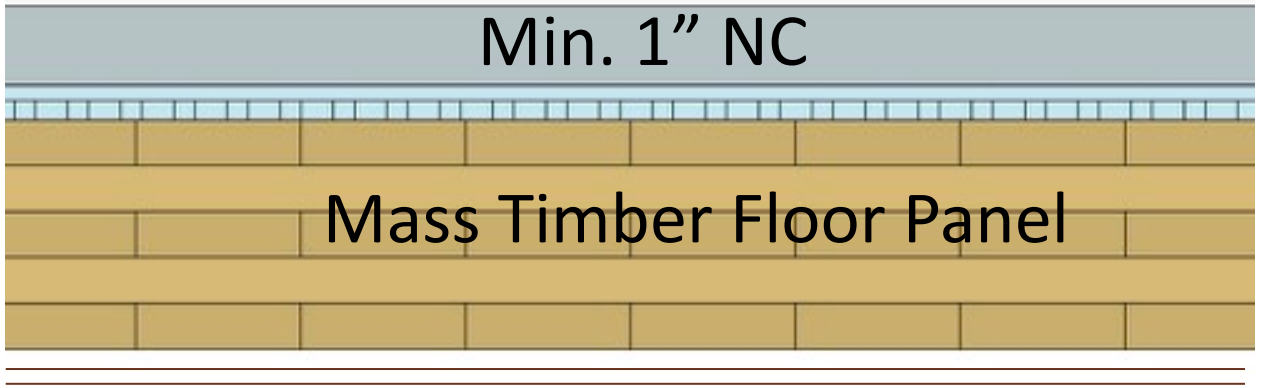
	IV-A	IV-B	IV-C	IV-HT
Roof below Mass Timber	60 min	40 min*	Not Req.	Not Req.
Primary Frame @ Roof	80 min	40 min*	Not Req.	Not Req.
Primary Frame	120 min	80 min*	Not Req.	Not Req.
Below Mass Timber Floor	80 min	80 min*	Not Req.	Not Req.
Above Mass Timber Floor	1” Min NC Material	1” Min NC Material	Not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

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

Type IV-A and IV-B NC Protection over MT Floor

IV-A

IV-B



In Type IV-A and IV-B, the floor assembly shall contain a noncombustible material not less than one inch in thickness above the mass timber.

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

Noncombustible Protection (NC)

TABLE 722.7.1(a)
PROTECTION REQUIRED FROM NONCOMBUSTIBLE COVERING MATERIAL

Required Fire Resistance Rating of Building Element per Tables 601 and 602 (hours)	Minimum Protection Required from Noncombustible Protection (minutes)	
1	40	1 layer 5/8 Type X
2	80	2 layers 5/8 Type X
3 or more	120	3 layers 5/8 Type X

Credit: ICC

TABLE 722.7.1(b)
PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

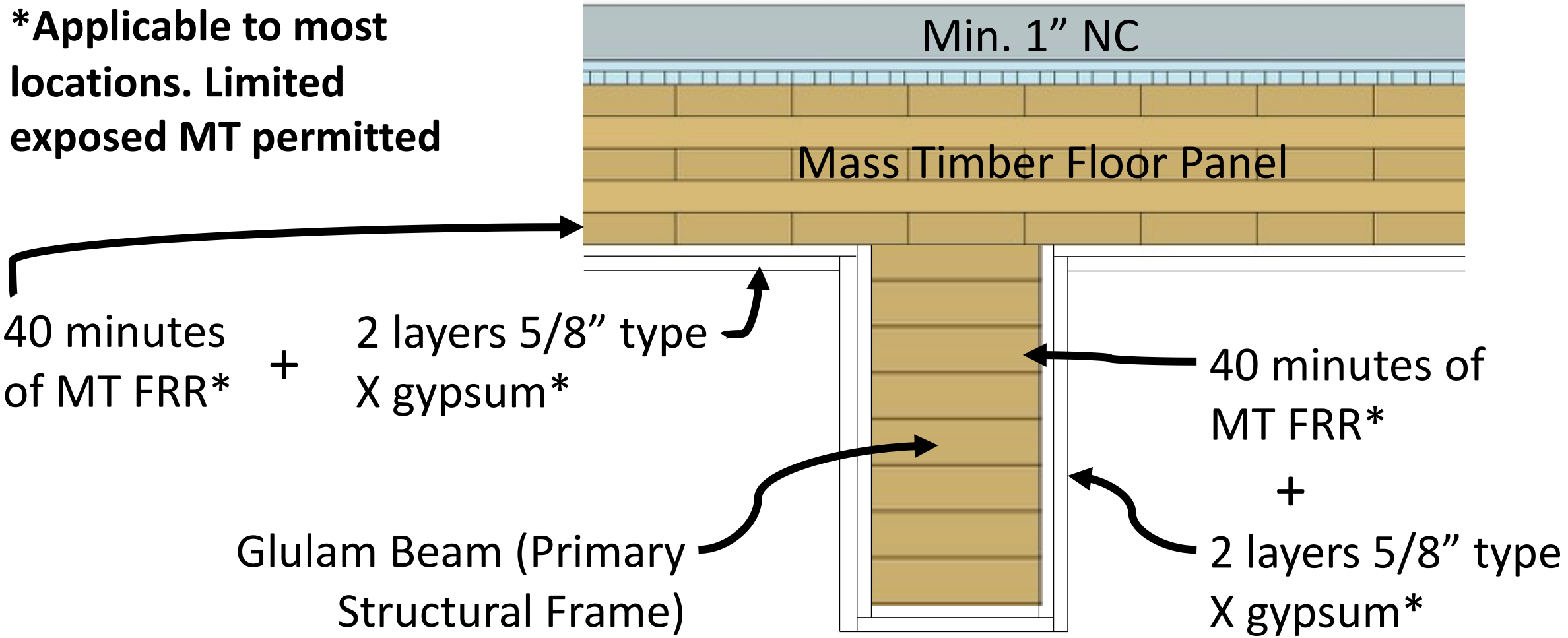
Noncombustible Protection	Protection Contribution (minutes)
1/2 inch Type X Gypsum Board	25
5/8 inch Type X Gypsum Board	40

Type IV-B Fire Resistance Ratings (FRR)

IV-B

Primary Frame (2 HR) + Floor Panel Example (2 HR):

***Applicable to most locations. Limited exposed MT permitted**



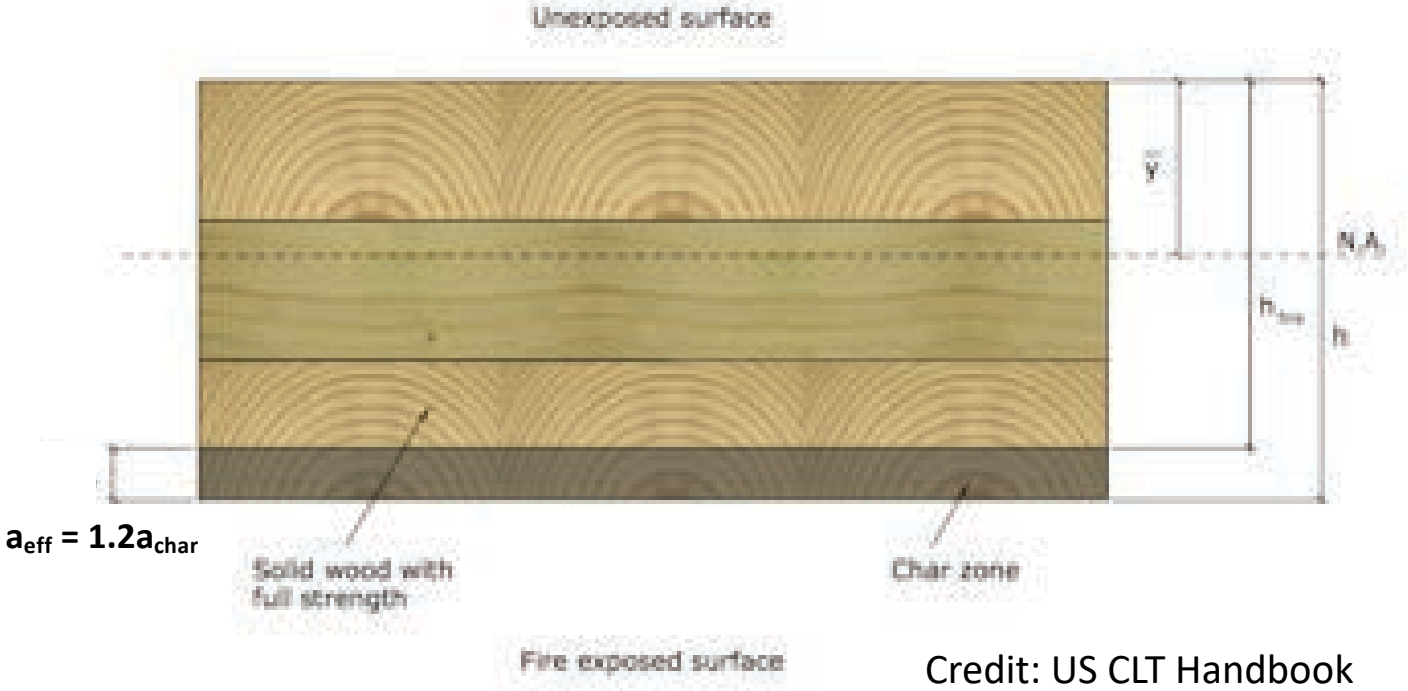
MT Fire Resistance Ratings (FRR)

How do you determine FRR of MT?

2 Options:

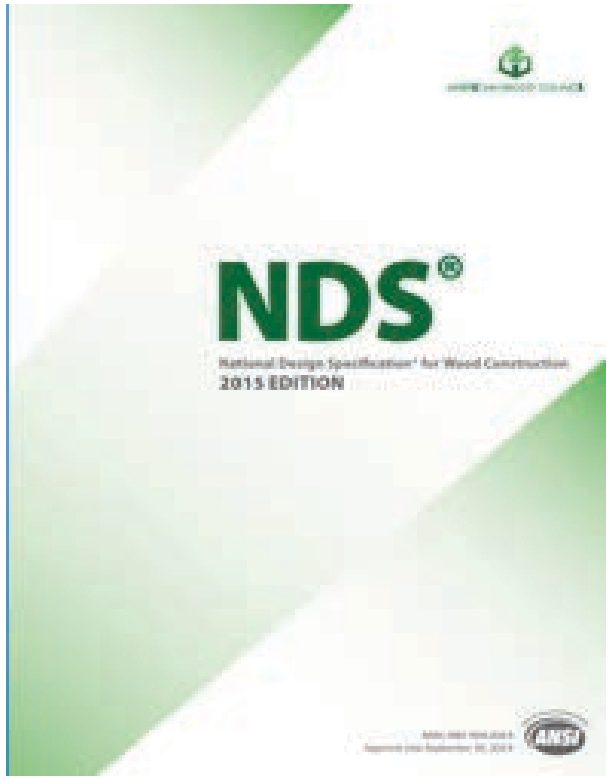
1. **Calculations in Accordance with IBC 722 → NDS Chapter 16**
2. **Tests in Accordance with ASTM E119**

Credit: Urban One



Credit: US CLT Handbook

MT Fire Resistance Ratings (FRR)




Credit: FPInnovations

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)

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
5-ply CLT (154mm 6.063 in)	Nordic	SPF 1650 Fb 1.5E MSR x SPF #3	2 layers 1/2" Type X gypsum	Half-Lap	None	Reduced 64% Maximum Capacity	1	1 (Test 1)	NRC Fire Laboratory
5-ply CLT (169mm 6.213 in)	Structurlam	SPF #1/#2 x SPF #1/#2	1 layer 5/8" Type X gypsum	Half-Lap	None	Reduced 73% Maximum Capacity	1	1 (Test 5)	NRC Fire Laboratory
5-ply CLT (175mm 6.875")	Nordic	E1	None	Topside Spline	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 3.5-9" [illegible]	Topside Spline	2 staggered layers of 1/2" cement boards	Loaded, See Manufacturer	2	3	NRC Fire Laboratory Nov 2014
5-ply CLT (175mm 6.875")	Nordic	E1	None	Topside Spline	3/4 in. proprietary gypcrete over Maxxon acoustical mat	Reduced 10% Maximum Capacity	1.5	3	UL
5-ply CLT (175mm 6.875")	Nordic	E1	1 layer 5/8" normal gypsum	Topside Spline	3/4 in. proprietary gypcrete over Maxxon acoustical mat on proprietary sound board	Reduced 10% Maximum Capacity	2	4	UL
5-ply CLT (175mm 6.875")	Nordic	E1	1 layer 5/8" Type X Gyp under Resilient Channel under 5 7/8" I-Joists with 1 1/2" Mineral Wool between Joists	Half-Lap	None	Loaded, See Manufacturer	2	2.1	Intertek 6/24/2015
5-ply CLT (175mm 6.875")	Structurlam	E1/M3 MSR 2100 x SPF #2	None	Topside Spline	1-1/2" Maxxon Cyp-Crete 2000 over Maxxon Reinforcing Mesh	Loaded, See Manufacturer	2.5	4	Intertek, 2/22/2016
5-ply CLT (175mm 6.875")	DR Johnson	V1	None	Half-Lap & Topside Spline	2" gypsum topping	Loaded, See Manufacturer	2	7	SwRI (May 2016)
5-ply CLT (175mm 6.875")	Nordic	SPF 1/0 E70 MSR x SPF #3	None	Half-Lap	None	Reduced 10% Maximum 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% Maximum Capacity	1	1 (Test 6)	NRC Fire Laboratory
7-ply CLT (245mm 9.65")	Structurlam	SPF #1/#2 x SPF #1/#2	None	Half-Lap	None	Unreduced 100% Maximum 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 6-d 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 6-d nails	Loaded, See Manufacturer	2	12 (Test 3)	Western Fire Center 10/28/2016
5-ply CLT (175mm 6.875")	DR Johnson	V1	None	Half-Lap	nominal 1/2" plywood with 6-d nails	Loaded, See Manufacturer	2	12 (Test 6)	Western Fire Center 11/01/2016
5-ply CLT (175mm 6.875")	KLH	V1M1	None	Half-Lap & [illegible]	None	Loaded, See Manufacturer	1	1.6	SwRI

Credit: WoodWorks

MT Fire Resistance Ratings (FRR)

WoodWorks
WOOD PRODUCTS COUNCIL

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 IA IBC 602.1B – Timber elements can be used in floors, roofs and exterior 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 602.5I – Timber elements can be used throughout the structure, including floors, roofs and both interior and exterior walls.

Type IV IBC 602.4I – Commonly referred to as "Heavy Timber" construction, this option

Mass Timber Fire Design Resource

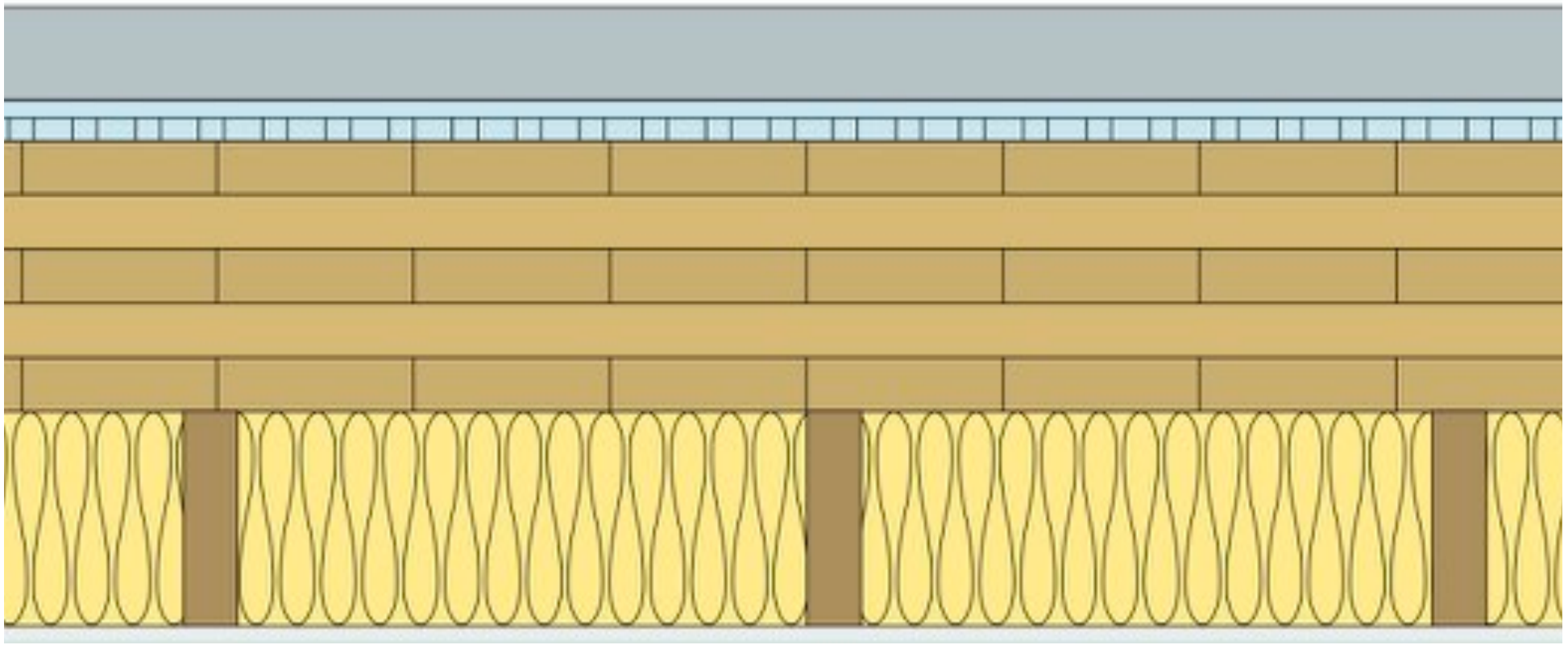
- Code compliance options for demonstrating FRR
- Updated as new tests are completed
- Free download at woodworks.org

Credit: WoodWorks

Concealed Spaces in Type IV

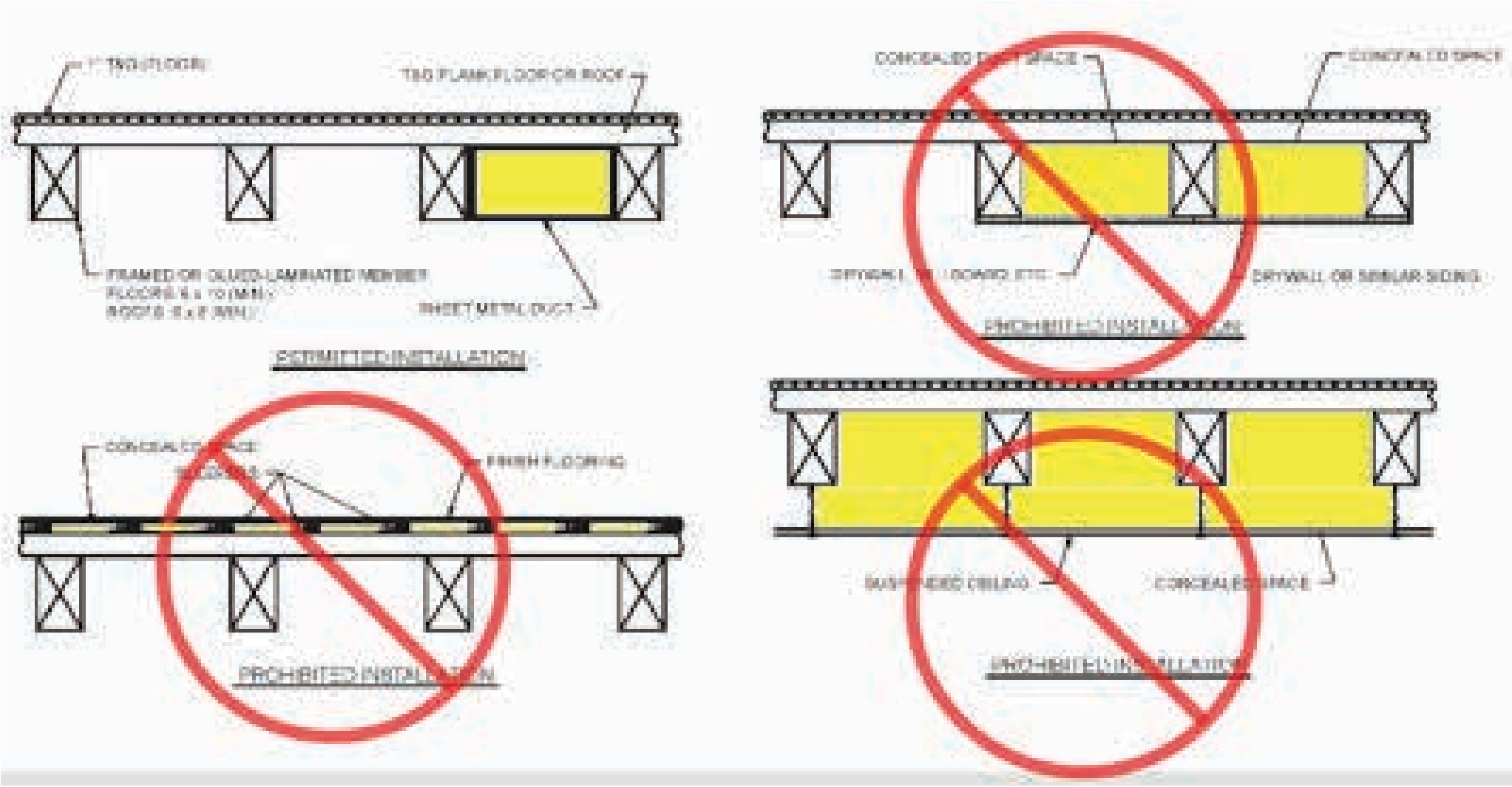
What if I have a dropped ceiling? Can I have a dropped ceiling?

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



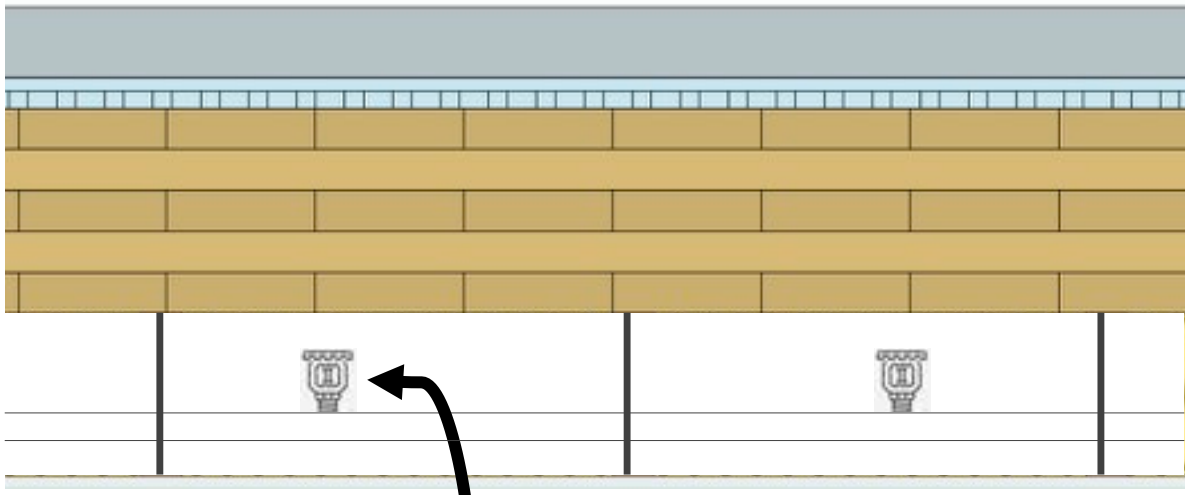
Concealed Spaces in Type IV

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



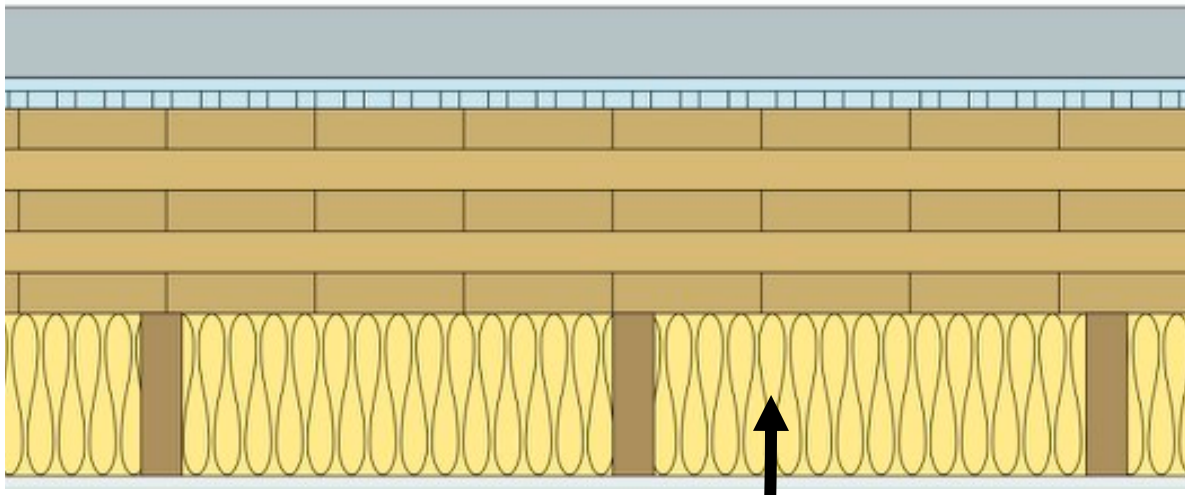
Credit: IBC

Concealed Spaces in Type IV-HT – 2021 IBC



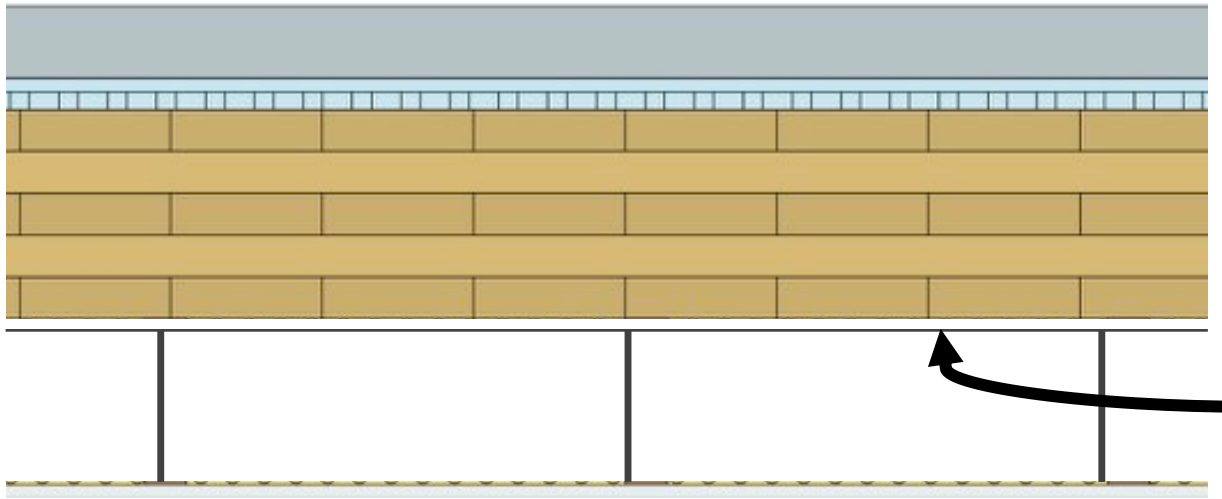
Option 1

Sprinklers in concealed spaces



Option 2

Noncombustible insulation



Option 3

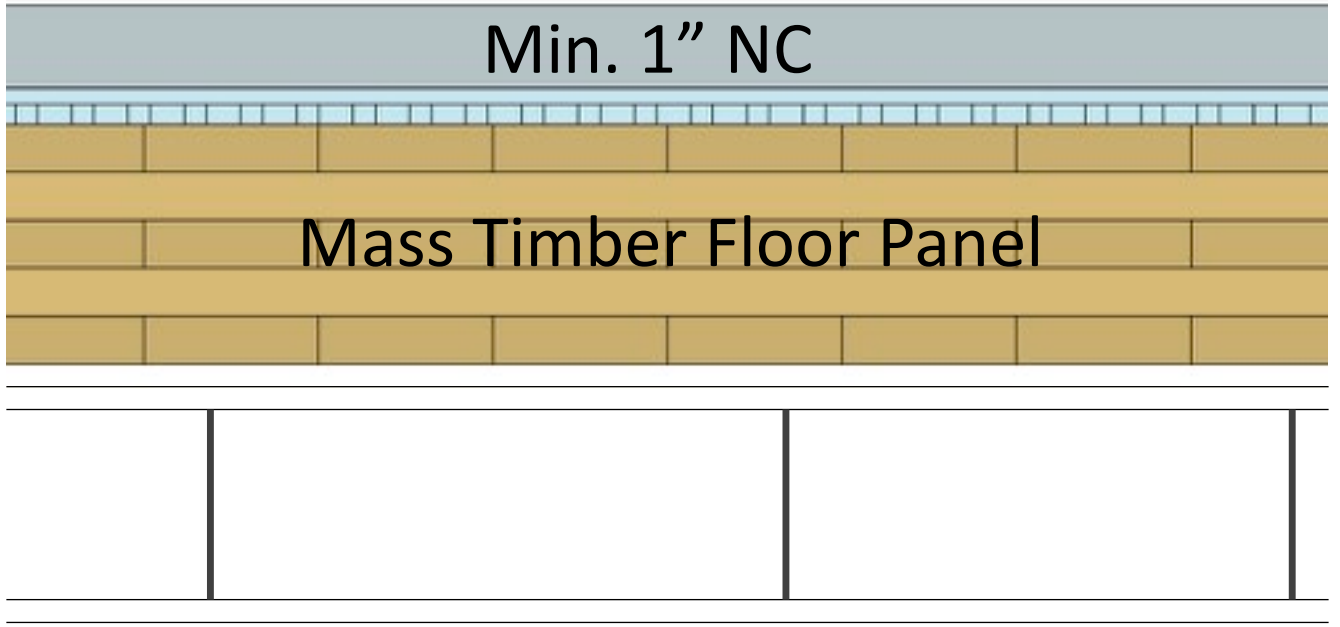
5/8” Type X gypsum on all MT surfaces

Concealed Spaces in Type IV-A, IV-B

*Applicable to most locations. Limited exposed MT permitted in IV-B

2 layers 5/8” type X gypsum*

w/o dropped ceiling

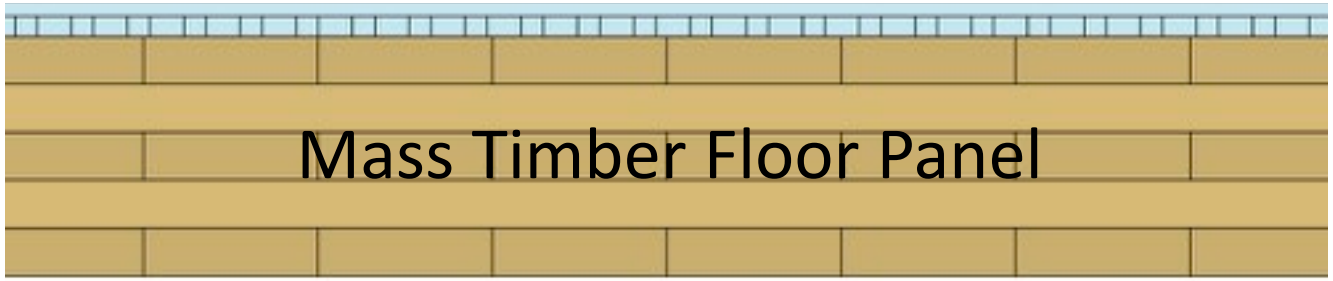


2 layers 5/8” type X gypsum

w/ dropped ceiling

Concealed Spaces in Type IV-C

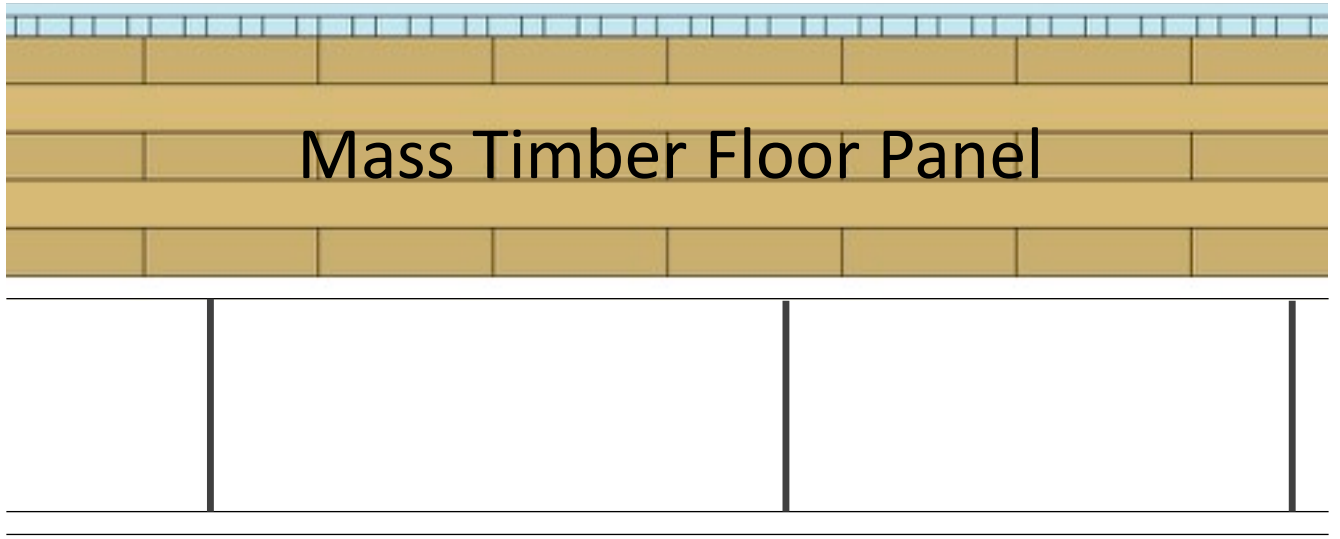
No NC req'd



No NC req'd

w/o dropped ceiling

No NC req'd



1 layer 5/8" type X gypsum

w/ dropped ceiling

Tall Wood Shaft Enclosures

- When can shaft enclosures be MT?
- What FRR requirements exist?
- If shaft enclosure is MT, is NC req'd?

Tall Wood Shaft Enclosures

	IV-A	IV-B	IV-C
Exit & Hoistway Enclosures	Up to 12 Stories or 180 ft: MT protected with 2 layers 5/8” type X gyp (if 2 HR req’d) or 3 layers 5/8” type X gyp (if 3 HR req’d) both sides Above 12 Stories or 180 ft: Noncombustible shafts (IBC 2021 602.4)	NC or MT protected with 2 layers 5/8” type X gyp (IBC 2021 602.4.2.6) both sides	NC or MT protected with 1 layer 5/8” type X gyp (IBC 602.4.3.6) both sides
E&H Enclosures FRR	2 HR (not less than FRR of floor assembly penetrated, IBC 713.4)		

PENETRATIONS IN RATED ASSEMBLIES

Photo: Alex Schreyer

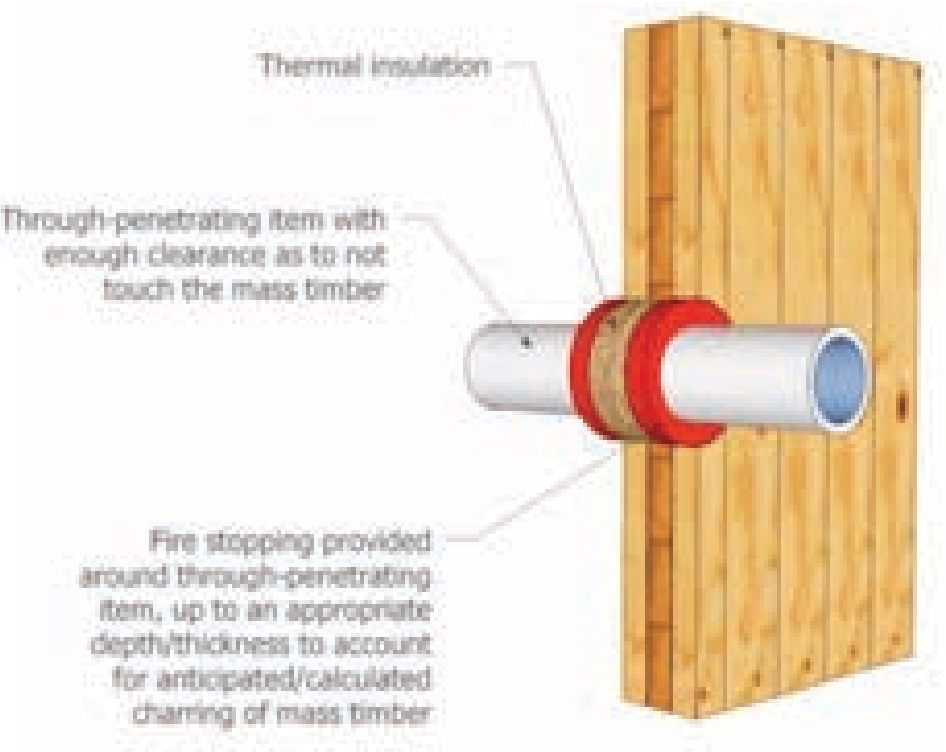
Penetration Fire Protection

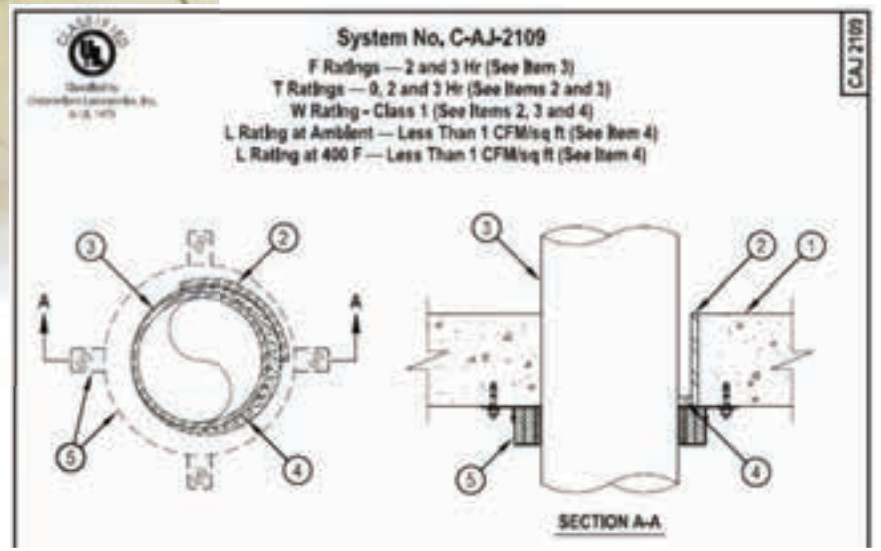
Although not a new code requirement or specific to tall wood, more testing & information is becoming available on firestopping of penetrations through MT assemblies

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

Inventory of Fire Tested Penetrations in MT Assemblies

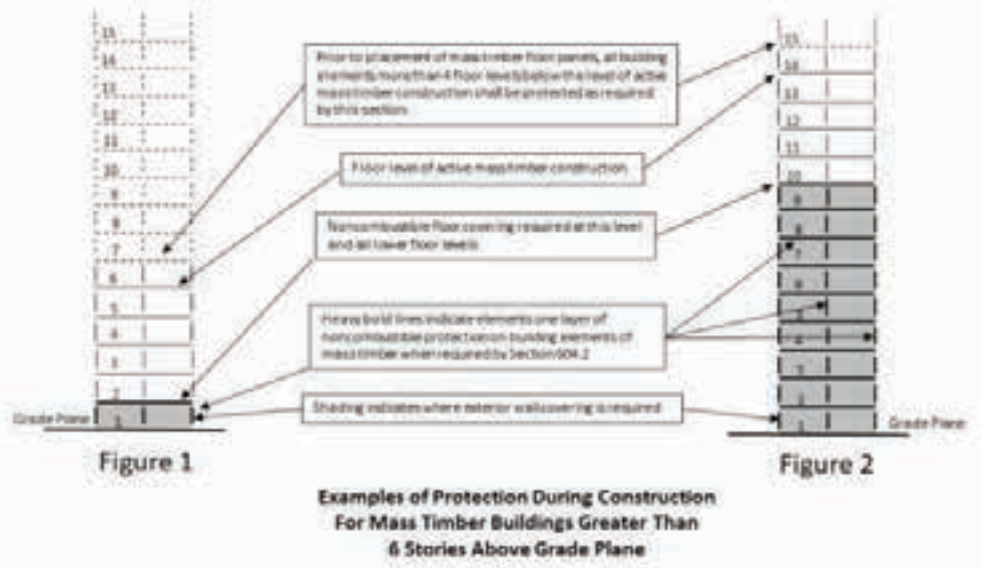
WoodWorks
WOOD PRODUCTS COUNCIL

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	5.5 in. diameter hole. Mineral wool was installed in the 1in. annular space around the data cables to a total depth of approximately 2 – 5/64 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.	1 hour	0.5 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 – 5/64 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.	1 hour	NA	CAN/ULC S115	24	Intertek March 30, 2016
3-ply (78mm/3.07")	None	2.5" schedd. 40 pipe	Centered	4.92 in diameter hole. Pipe wrap was installed around the schedule 40 pipe to a total depth of approximately 2 – 5/64 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.	1 hour	NA	CAN/ULC S115	24	Intertek March 30, 2016
3-ply (78mm/3.07")	None	6" 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 – 5/64 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.	1 hour	NA	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	9.017" 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 – 7/64in and the remaining 1in. annular space from the top of the mineral wool to the top edge of the 9 – 1/4-in. 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	5.5" 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	NA	CAN/ULC S115	24	Intertek March 30, 2016
5-ply CLT (131mm/5.16")	None	2.5" schedd. 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	0.5 hour	CAN/ULC S115	24	Intertek March 30, 2016
5-ply CLT (131mm/5.16")	None	6" 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 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	NA	CAN/ULC S115	24	Intertek March 30, 2016
5-ply CLT (131mm/5.16")	None	Hilti 4 in drop in device System No.: F-B-2049	Centered	9.017" 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 – 7/64in and the remaining 1in. annular space from the top of the mineral wool to the top edge of the 9 – 1/4-in. hole in the CLT was filled with Hilti FS-One Max caulking.	2 hours	1.5 hours	CAN/ULC S115	24	Intertek March 30, 2016
3-ply (78mm/3.07")	None	1" nominal PVC pipe	Centered	8.25 in diameter with a 1/4 in plywood mineral fiber thick with the top of the slab reducing the opening to 2.25 in. Two wraps of Hilti CP 644-E Web 1-1/4" Pyrotop wrap strip at two locations with a 30 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 1 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 Safe mineral wool leaving a 1/4 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 1/4 in on the top of the assembly between the plywood and steel sleeve as well as the steel sleeve and pipe.	2 hours	2 hours	ASTM E814	24	QAI Laboratories March 3, 2017

Many More Items not Covered

- Sealants at panel edges
- Fire safety during construction
- NC protection at occupancy separations
- Reliability of water supply for sprinklers



WoodWorks Tall Wood Design Resource

http://www.woodworks.org/wp-content/uploads/wood_solution_paper-TALL-WOOD.pdf

QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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