

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

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New Building Types – IV-A, IV-B, and IV-C







18 STOPIES BUILDING HEIGHT 270 ALLOWARLE BUILDING AREA 972,000 SF AVERAGE AREA PER STORY 54,000SF



12 STORIES



324,000 SF

BUSINESS OCCUPANCY [GROUP B]

9 STORIES

YBUILDING FLOOR/TO FLOOR HEIGHTS ARE SHOWN AT 12:0" FOR ALL EXAMPLES FOR CLARITY IN COMPANISON REYWEEN 2015 TO 2021 (BC CODES-

Credit: Susan Jones, atelierjones

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

Type IV Minimum Timber Sizes - Framing

Fr	aming	Solid Sawn (nominal)	Glulam (actual)	SCL (actual)
or	Columns	8 x 8	6 ³ / ₄ x 8¼	7 x 7½
Flo	Beams	6 x 10	5 x 10½	5¼ x 9½
of	Columns	6 x 8	5 x 8¼	5¼ x 7½
Ro	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



Type IV Minimum Timber Sizes – Floor/Roof Decks

Floor Panels/Decking:

- 4" thick CLT (actual thickness)
- 4" NLT/DLT/GLT (nominal thickness)
- 3" thick (nominal) decking covered with: 1" decking <u>or</u> 15/32" WSP <u>or</u> ½" particleboard

Roof Panels/Decking:

- 3" thick CLT (nominal thickness)
- 3" NLT/DLT/GLT (nominal thickness)
- 2" decking (nominal thickness)
- 1-1/8" WSP





Tall Wood Fire Resistance Ratings (FRR)

	IV-A	IV-B	IV-C	IV-HT
Roof Construction	1.5	1	1	НТ
Primary Frame @ Roof	2	1	1	нт
Floor Construction	2	2	2	нт
Primary Frame	3	2	2	НТ
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)





Credit: LEVER Architecture

Credit: PATH Architecture

Noncombustible Protection (NC)



The definition of "Noncombustible Protection (For Mass Timber)" is to address the passive fire protection of mass timber.

NONCOMBUSTIBLE PROTECTION (FOR MASS TIMBER) Noncombustible material, in accordance with Section 703.5, designed to increase the fire-resistance rating and delay the combustion of mass timber.



TABLE 722.7.1(b)

PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

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

Other Noncombustible materials can qualify by comparative testing per new IBC 703.8

Protection from NC = Tested FRR with NC – Tested FRR without NC

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	
<u>3 or more</u>	120 3 layers 5/8 Type X	



Noncombustible Protection (NC)



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.



Type IV-C Height and Area Limits



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

IV-C

TYPE IV-C

Credit: Susan Jones, atelierjones

Occupancy	# of Stories	Height	Area per Story	Building Area
A-2	6	85 ft	56,250 SF	168,750 SF
В	9	85 ft	135,000 SF	405,000 SF
Μ	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 additional stories permitted due to enhanced FRR Type IV-C area = 1.25 * Type IV-HT area

Type IV-C Protection vs. Exposed



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

IV-C

TYPE IV-C



All Mass Timber surfaces may be exposed

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

Credit: Susan Jones, atelierjones

Type IV-A Height and Area Limits



IV-A

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

TYPE IV-A

Credit: Susan Jones, atelierjones

Occupancy	# of Stories	Height	Area per Story	Building Area
A-2	18	270 ft	135,000 SF	405,000 SF
В	18	270 ft	324,000 SF	972,000 SF
Μ	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



TYPE IV-A

Credit: Susan Jones, atelierjones

Type IV-B Height and Area Limits



IV-B

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

TYPE IV-B

Credit: Susan Jones, atelierjones

Occupancy	# of Stories	Height	Area per Story	Building Area
A-2	12	180 ft	90,000 SF	270,000 SF
В	12	180 ft	216,000 SF	648,000 SF
Μ	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-B Protected vs. Exposed



IV-B

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

TYPE IV-B

Credit: Susan Jones, atelierjones



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 Protected vs. Exposed

Limited Exposed MT allowed in Type IV-B for:

IV-B

- 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, <u>or</u>
- MT walls and columns up to 40% of floor area in dwelling unit or fire area, <u>or</u>
- Combination of ceilings/beams and walls/columns



Credit: Kaiser+Path

Type IV-B Protected vs. Exposed

Horizontal separation of unprotected areas:

IV-B

 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

Advanced CLT Fire Performance

2021 IBC Section 602.4 added:

Cross-laminated timber shall be labeled as conforming to PRG 320 - 18 as referenced in Section 2303.1.4.



Standard for Performance-Rated Cross-Laminated Timber

CAN MATIOMAL STANDARS

ANSI/APA PRG 310-1018





Advanced CLT Fire Performance

PRG 320 is manufacturing & performance standard for CLT. 2018 edition (referenced in 2021 IBC) added new elevated temp adhesive performance requirements



ANNEX B. PRACTICE FOR EVALUATING ELEVATED TEMPERATURE PERFORMANCE OF ADHESIVES USED IN CROSS-LAMINATED TIMBER (MANDATORY)

Note 7. The intent of the elevated temperature performance evaluation is to identify and exclude use of adhesives that permit CLT char layer fall-off resulting in fire regrowth during the cooling phase of a fully developed fire.

Noncombustible Protection (NC)



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



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.





Exterior Wall Construction



Fire Rating (bearing v

	IV-A	IV-B	V-C	IV-	HT
				IBC 2021	IBC 2018
e Rating (bearing wall)	3 Hr	2 Hr	2 Hr	2 Hr	2Hr
Mass Timber	Ma	ass Timber/(CLT	4" min thick <u>CLT</u> * 6" <u>Wall</u> *	
Exterior NC Protection	40 Min NC & FRT Sheathing, G		Gyp or other NC		
Interior NC Protection	Per Inte	Per Interior Requirements		Not R	equired
Light Frame FRTW		No		Yes*	6" Wall*

*Changes in IBC 2015, 2018, and 2021 editions

Interior Wall Construction



Fire Rating (bearing wall)

Construction – MT

NC Protection

Noncombustible non-bearing wall

Wood Stud Wall



3 Hr	2 Hr	2 Hr	1 Hr or HT*		
Laminated construction 4" thick (CLT, NLT, etc) Solid wood construction min. 2 layers of 1" matched boards					
Per Interior Requirements No					
	1 Hr				
No			1 Hr		

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

Tall Wood Exit and Hoistway Shaft Enclosures



Fire Resistance

Mass Timber Option



2 Hr	2 Hr	2 Hr	1 or 2 Hr FRR per IBC 713.4
80 Min NC Protection, inside & outside	80 Min NC Protection, inside & outside	40 Min NC Protection, inside & outside	No NC Protection





Tall Wood Exit and Hoistway Shaft Enclosures

	<pre>>12 Stories or > 180 ft</pre>	Z-A	IV-B	IV-C	IV-HT
Fire Resistance	2 Hr	2 Hr	2 Hr	2 Hr	1 or 2 Hr FRR per IBC 713.4
Mass Timber Option	Not Allowed Noncombustible only	80 Min NC Protection, inside & outside	80 Min NC Protection, inside & outside	40 Min NC Protection, inside & outside	No NC Protection







What is one code requirement of Type IV today that project teams really do not like?

Restrictions on Concealed Spaces





Concealed Spaces in Type IV-A, IV-B



Concealed Spaces in Type IV-C



Concealed Spaces in Type IV-HT



Many More Items not Covered

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







Tall Wood Buildings in the 2021 IBC Up to 18 Stories of Mass Timber

Scott Danaman, PhD, SE, WandAloka - Wood Products Council • Matt Tenmers, SE, John A. Mactin & Associates • Demis Richerburn, PE, CBD, CASp, American Wood Council

In January 2019, the International Code Council IICCI approved a set of proposals to allow tail wood buildings as part of the 2021 International Building Code (IBC). Based on these proposals, the 2021 IBC will include three new construction types—Type IV-A, IV-B and IV-C—allowing the use of mass timber or noncombustible materials. 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. The code will include provisions for up to 18 stories of Type IV-A construction for Business and Residential Occupancies.

Based on information first published in the Structural Engineers Association of California (SEAOC) 2018 Conference Proceedings, this paper summarizes the background to these proposals, technical research that supported their adoption, and resulting changes to the IBC and product-specific standards.

Background: ICC Tall Wood Building Ad Hoc Committee

Over the past 10 years, there has been a growing interest in tail buildings constructed from mass timber materials (Breneman 2013, Timmers 2015). Around the world there



WoodWorks Tall Wood Design Resource

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

-	And American Street Street	Paratriana -	 500 CT 11177
	Via Cenni	Milan, Italy	 2013



QUESTIONS?



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This concludes The American Institute of Architects Continuing Education Systems Course

