ICC 2019 LAS VEGAS NEVADA

Welcome to the

2019 Annual Conference Educational Sessions

AHRI AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE

Outcomes of the ICC Tall Wood Ad Hoc Committee: Mass Timber in the 2021 I Codes

Prepared by:
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NDS

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AMERICAN WOOD COUNCIL

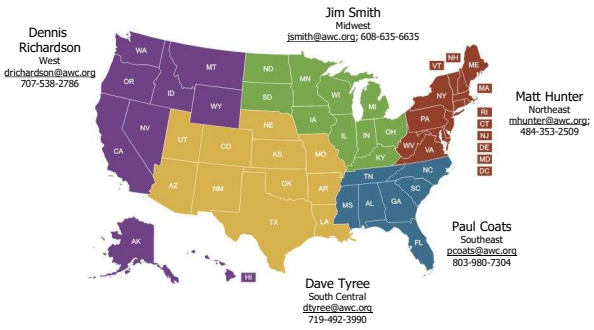
The guidance provided herein is not a formal interpretation of any AF&PA/AWC standard. Interpretations of AF&PA/AWC standards are only available through a formal process outlined in AF&PA's standards development procedures.

American Wood Council

The **American Wood Council (AWC)** provides wood design and construction information to assist building industry professionals, develops structural and fire performance data on a wide range of traditional and engineered wood products, and engages in long-term research.

AWC is an ANSI accredited standards developer.

Code assistance – AWC field staff



Course Description

In early 2016, the ICC Board of Directors approved the creation of an ad hoc committee to explore the building science of tall wood buildings with the scope being to investigate the feasibility of and take action to develop code changes for tall wood buildings. Since that time, the Tall Wood Building (TWB) Ad Hoc Committee has reviewed voluminous materials regarding tall wood buildings, including results of various testing around the world, as well as studies domestically in support of the TWB charge to conduct a thorough review of the science of tall wood..

Course Description (continued)

The TWB developed its own test scenario(s) to substantiate any code change proposals (testing was carried out at ATF labs); and worked to develop a comprehensive set of technically-substantiated code changes for consideration during the 2018 Group A code development process. The intensive research performed by the Committee was submitted under the ICC Code Development Process, along with the resulting proposals developed by Committee consensus. All of the Group A TWB proposals have been approved. The TWB has also developed a set of Group B proposals, submitted in January 2019.

Learning Objectives

Upon completion, participants will be able to:

1. **TWB Ad Hoc Committee**
   Identify the make-up of the TWB Ad Hoc Committee and the process used to reach consensus on proposed code changes.
2. **IBC Construction Types**
   Recognize how the new types of construction compare with existing types of construction in the *International Building Code* and specify the inherent differences and conservative approaches the new types have.
3. **Building Sizes**
   Understand the process by which the allowable heights, areas, and number of stories permitted for the proposed mass timber types of construction were developed and will be able to utilize the information for building design.
4. **Fire Resistance**
   State the fire resistance requirements for mass timber building elements. Further distinguish when and where non-combustible protection can be omitted.

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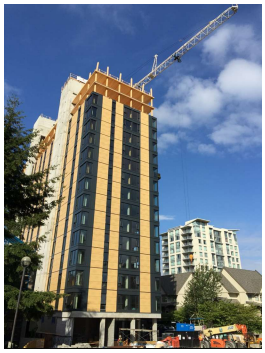
Outline

- History and Overview
- TWB Ad Hoc Committee and Testing
- Code Changes and Definitions
- IBC Construction Types
- Building Sizes



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MASS TIMBER IBC TIMELINE SUMMARY:
(Type IV and Heavy Timber)

- **2000 IBC:** legacy code heavy timber combined to form IBC Type IV HT type of construction and exceptions.
- **2006 IBC:** Table 602.4 added with glulam sizes
- **2015 IBC:**
  - Structural Composite Lumber (SCL) added to Table 602.4
  - Cross Laminated Timber (CLT) and CLT product standard (PRG-320) added to IBC
  - New provisions for CLT Type IV HT exterior walls
- **2018 IBC:** 602.4 and 2304.11 provisions consolidated and moved to 2304.11 along with Table 602.4 (no technical changes)

MASS TIMBER IBC TIMELINE SUMMARY:
(Type IV and Heavy Timber)

- **2021 IBC (group A):**
  - 3 New construction types: IVA, IVB and IVC developed by the ICC ad hoc Committee on Tall Wood Buildings (14 TWB code changes in this class)
  - 6 - 2021 IBC Type IV HT changes (non-TWB):
    - G81-18 corrects S-2 occupancy allowable area
    - G101-18 HT bearing walls 1 hour FRR supporting >2 floors
    - G102-18 Table 601 footnote c applies to roof primary frame
    - G109-18 allows protected concealed spaces in floor or roof
    - G110-18 correlates and clarifies Type IV HT exterior walls
    - G111-18 HT columns, beams & spandrels in exterior walls

Most Asked Questions:

What is Mass Timber ?…

… and

How different than HT?

Answer:

Mass(ive) Timber is an umbrella term in the 2021 IBC for wood elements meeting the minimum dimensions and material types of Type IV-HT:

- sawn or mech laminated timber,
- glulam,
- structural composite lumber (SCL),
- cross laminated timber (CLT)

Question

How is Heavy Timber different than Mass Timber?

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Answer

Heavy Timber typically (but not always) relies on the dimensions and detailing to provide an intrinsic but undetermined level of fire resistance….

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Mass Timber or Heavy Timber FRR

Mass timber or heavy timber fire resistance rating may come from the wood, or noncombustible protection…

…or both

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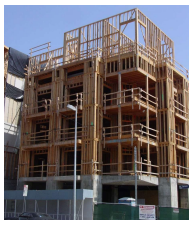
IBC principles for heavy timber and mass timber

Mass Timber ≠ **Conventional Light-Frame**

≠



Traditional Heavy Timber – Type IV HT

- 9 story

Vancouver, BC

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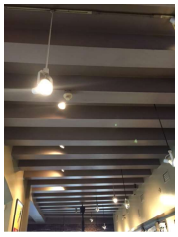
Sawn (Traditional) Heavy Timber:



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Traditional Heavy Timber, Type IV HT:

- Montreal Original Fire Department Building out of Heavy Timber w/ housing above

Mechanically Laminated Decking

Nail Laminated Timber.

Photo courtesy of Structurecraft

Nail-Laminated Timber

- 2304.8.3 Mechanically laminated decking.
- 2304.8.3.1 General.
- 2304.8.3.2 Nailing.
- 2304.8.3.3 Controlled random pattern.

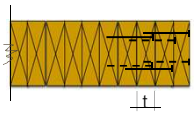
Nail $length_{min}$ = 2.5 x $t_{lamination}$

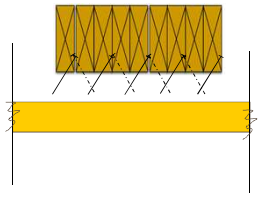
Nail spacing

≤ 30″ o.c.* 48″ span

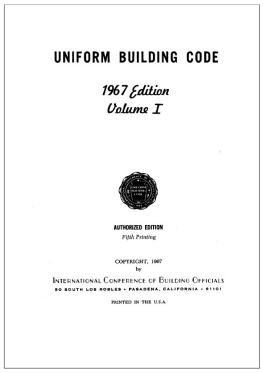
≤ 18″ o.c.* > 48″ span

*nail placement alternates between top and bottom





Nail-Laminated Timber



UNIFORM BUILDING CODE

1967 Edition
Volume I

AUTHORIZED EDITION
Fifth Printing

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(g) **Mechanically Laminated Floors and Decks.** A laminated lumber floor or deck built up of wood members set on edge, when meeting the following requirements, may be designed as a solid floor or roof deck of the same thickness, and continuous spans may be designed on the basis of the full cross section using the simple span moment coefficient.

Laminations shall be driven up and spiked closely together with a row of nails near each edge at spaced intervals and staggered vertically. Nail spacing in each row shall not exceed eighteen inches (18") for two-inch by eight-inch (2" x 8") nominal width and be proportional for other plank widths. Nail length shall be not less than two and one-half times the net thickness of each lamination.

A single span deck shall have all laminations full length.

A continuous deck of two spans shall have not more than every fourth lamination spliced within quarter points adjoining supports.

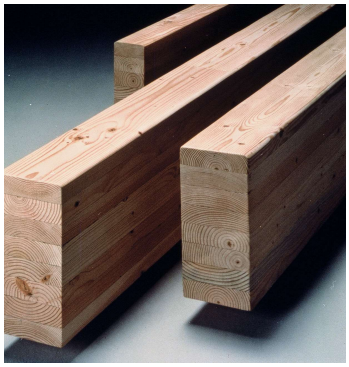
A continuous deck of more than two spans shall have not more than every third lamination spliced within quarter points adjoining supports.

Joints shall be closely butted over supports or staggered across the deck but within the adjoining quarter spans.

No lamination shall be spliced more than twice in any span.

Dowel Laminated Timber

Glulam



Structural Composite Lumber (SCL)


Photo provided by Truss Joist


Photo provided by Weyerhaeuser


Photo provided by Structurecraft


Photo provided by Wood Solutions

- PSL
  - parallel strand lumber
- LSL
  - laminated strand lumber
- LVL
  - laminated veneer lumber
- OSL
  - oriented strand lumber

Structural Composite Lumber

- Parallel Strand Lumber or other SCL

SCL in Type IV Heavy Timber

- **Structural Composite Lumber (SCL) as part of heavy timber in the 2015 IBC:**

TABLE 602.4
WOOD MEMBER SIZE EQUIVALENCIES

MINIMUM NOMINAL SOLID SAWN SIZE		MINIMUM GLUED-LAMINATED NET SIZE		MINIMUM STRUCTURAL COMPOSITE LUMBER NET SIZE	
Width, inch	Depth, inch	Width, inch	Depth, inch	Width, inch	Depth, inch
8	8	6¾	8¼	7	7½
6	10	5	10½	5¼	9½
6	8	5	8¼	5¼	7½
6	6	5	6	5¼	5½
4	6	3	6⅞	3½	5½

- **Minimum dimensions are established for SCL to qualify as Type IV or Heavy Timber in the 2015 IBC**

2018 IBC, G 179 - G 180
602.4 Heavy Timber "reorganization"

- Clarifies requirements for Type IV Construction and heavy timber elements
- Moves many heavy timber details to **IBC Section 2304.11**

		MINIMUM NOMINAL SOLID SAWN SIZE		MINIMUM GLUED-LAMINATED NET SIZE		MINIMUM STRUCTURAL COMPOSITE LUMBER NET SIZE	
SUPPORTING:	HEAVY TIMBER CONSTRUCTION ELEMENT	Width, inch	Depth, inch	Width, inch	Depth, inch	Width, inch	Depth, inch
Floor loads only; combined floor and roof loads	Columns; Framed sawn or glued-laminated timber arches, which spring from the floor line; Framed timber trusses	8	8	6 ¾	8 ¼	7	7 ½
	Wood beams and girders	6	10	5	10 ½	5 ¼	9 ½
Roof loads only	Lower half of: Wood-frame or glued-laminated arches, which spring from the floor line or from grade;	6	8	5	8 ¼	5 ¼	7 ½
	Columns; Upper half of: Wood-frame or glued-laminated arches, which spring from the floor line or from grade;	6	6	5	6	5 ¼	5 ½
	Framed or glued-laminated arches that spring from the top of walls or wall abutments; Framed timber trusses and other roof framing	4	6	5	6 7/8	3 ½	5 ½

AS-OGCV

Cross Laminated Timber (CLT)

Photos provided by FPInnovations

CLT Definition & Product Standard

2015 IBC code change established the definition and product standard for CLT:

> **[BS] CROSS-LAMINATED TIMBER.** A prefabricated engineered wood product consisting of not less than three layers of solid-sawn lumber or *structural composite lumber* where the adjacent layers are cross oriented and bonded with structural adhesive to form a solid wood element.

> **2303.1.4 Structural glued cross-laminated timber.** Cross-laminated timbers shall be manufactured and identified in accordance with ANSI/APA PRG 320.

CLT is now a "material permitted by this code" in the 2015 IBC!

2015 IBC: CLT permitted uses:

- **CLT is now a material permitted by the code:**
- **For Type I and II construction, CLT can be used for balcony and canopy or roof construction**
- **For Type III construction, CLT can be used for the interior building elements including:**
  - **Roof-ceiling assembly,**
  - **Floor-ceiling assembly**
  - **Interior walls**
- **For Type IV or V construction, CLT can be used for anything:**

2012	American Wood Council (AWC); NGC Testing Services	5 ply CLT wall with 8700 PLF load protected with 1 layer of 5/8" type X gypsum wall board (GWB) each side	E 119

Fire Testing Laboratory

ACCREDITED Testing Laboratory TL-216

TEST REPORT

Page 1 of 53

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

2012	American Wood Council (AWC); NGC Testing Services	5 ply CLT wall with 8700 PLF load protected with 1 layer of 5/8" type X gypsum wall board (GWB) each side	E 119

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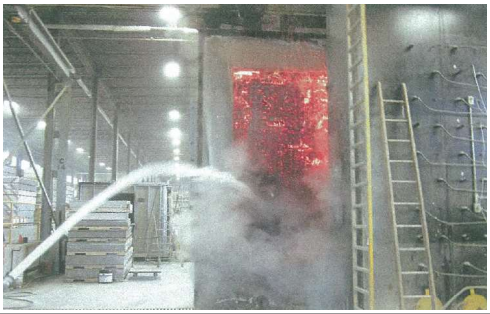
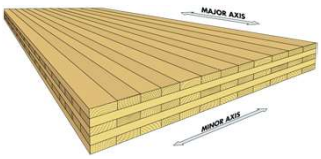


CLT vs. GLT

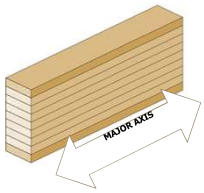
Cross Laminated Timber



Thick Orthotropic Plate

Graphics provided by WoodWorks

Glued Laminated Timber



Beam-like member

Graphics provided by APA

Typical Building Configurations

Mass timber or heavy timber buildings may be of building frame type with: column and beam or slab; or platform with bearing walls

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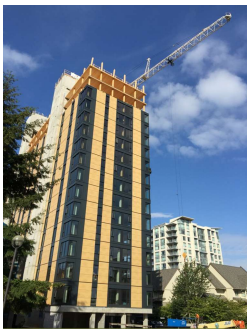
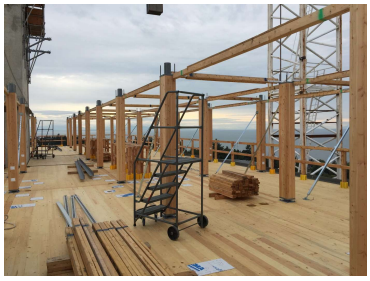
Brock Commons: post and slab



Detailing to address shrinkage…

Brock Commons: post and slab



IBC Section 2304.3.3

Shrinkage must be accounted for in platform construction:

2304.3.3 Shrinkage. Wood walls and bearing partitions shall not support more than two floors and a roof unless an analysis satisfactory to the building official shows that shrinkage of the wood framing will not have adverse effects on the structure or any plumbing, electrical or mechanical systems or other equipment installed therein due to excessive shrinkage or differential movements caused by shrinkage. The analysis shall also show that the roof drainage system and the foregoing systems or equipment will not be adversely affected or, as an alternate, such systems shall be designed to accommodate the differential shrinkage or movements.

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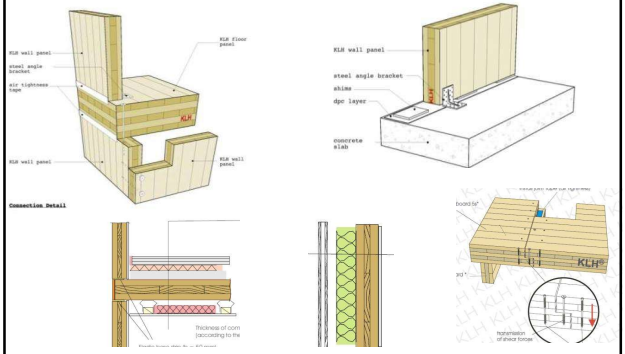
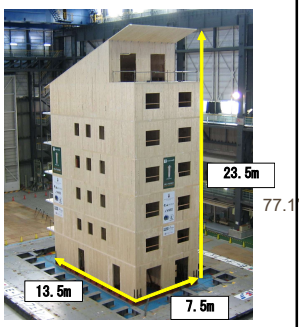
How does CLT work structurally ?



Shake Table Tests on 7-story Building

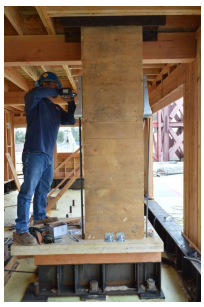
- Conducted at E-Defense
- Building weight 270t
  - Self weight 120t
  - Added weight 150t
- Panel thickness
  - 140 mm (5.5″) floors 1 and 2
  - 125 mm (4.9″) floors 3 and 4
  - 85 mm (3.3″) top 3 floors
- Wall panels length 2.3 m (7.5′)



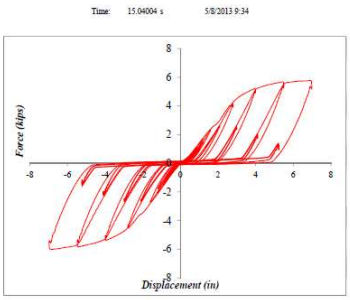
CLT – Soft Story Tests

1. 2′ CLT panels
2. Simpson HD8U
3. 5/8″ A36 rod x 6 foot
4. 8″ displacement
5. 1 inch rod elongation
6. Some angle damage

Google: CLT soft story test



CLT – Soft Story Tests



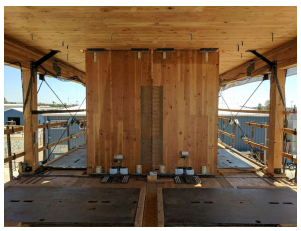
New testing of CLT shear wall system

Shake table testing at UCSD, August and Sept, 2017

Photos Courtesy of Katerra

New testing of CLT shear wall system

Shake table testing at UCSD, August and Sept, 2017



- Steel fuse absorbs energy.

Photos Courtesy of Katerra

New testing of CLT shear wall system

Shake table testing at UCSD, August and Sept, 2017


Photos Courtesy of NHERI Tall Wood Project, Photo by Dr. Shiling Pei at Colorado School of Mines

New testing of CLT shear wall system

Shake table testing at UCSD, August and Sept, 2017


- Bent plate fuse absorbs energy.

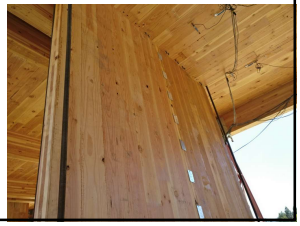
Photos Courtesy of Washington State University

New testing of CLT shear wall system

Shake table testing at UCSD, August and Sept, 2017

- P695 Testing –platform framed wall with light gage clips between segments control drift and absorb energy.



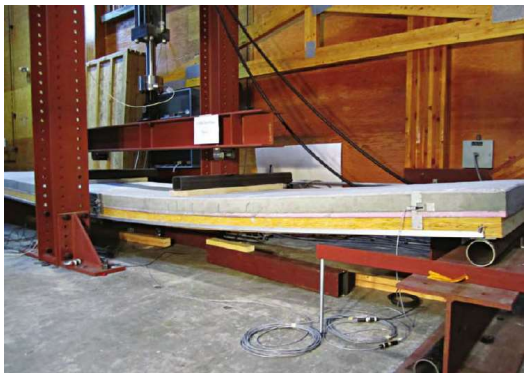


Seismic systems with mass timber

Other lateral systems: buckling restrained brace system

Mass Plywood

Wood-Concrete Composites



Wood-Concrete Composites

Wood (LSL) - Concrete composite panels
(4" conc., 1" insulation, over 3-1/2" LSL)

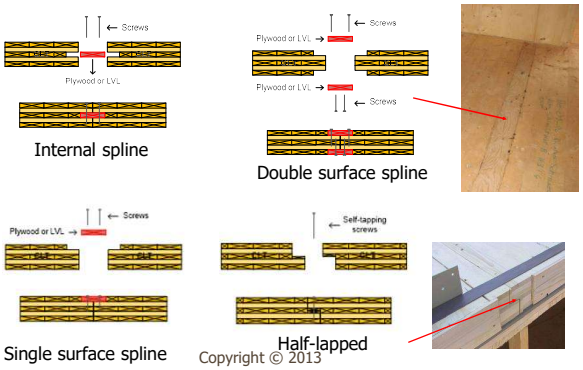
Wood-Concrete Composites

Photos courtesy of StructureCraft

CrossLam Panel tight-fit tool

Slide Courtesy of Structurlam

CLT - Typical Construction Details



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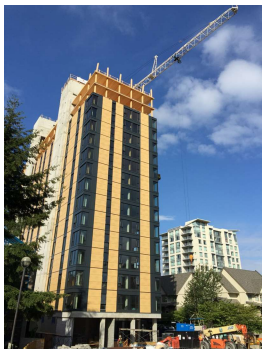

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ICC TALL WOOD AD HOC COMMITTEE

Illustration courtesy Susan Jones

ICC TALL WOOD AD HOC COMMITTEE

Project Scope

In December 2015, the ICC Board established the ICC Ad Hoc Committee on Tall Wood Buildings noting the purpose of the ad hoc committee is to

1. explore the building science of tall wood buildings
2. investigate the feasibility, and
3. take action on developing code changes for tall wood buildings.

This scope will require further refinement by the committee.

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ICC TALL WOOD AD HOC COMMITTEE

Membership

The Board has determined that the effort is to be undertaken by the newly formed Ad Hoc Committee on Tall Wood Buildings (AH-TWB). In making the committee appointments, the Board recognized the need to have a consensus committee comprised of the necessary balance of stakeholders including:

- Representatives from building construction material industries
- Building and Fire Officials
- Architects and engineers
- Fire protection experts
- Other construction related stakeholders

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Photo courtesy Susan Jones

TWB Committee

- 4 Work Groups appointed
  - Definitions and Standards
  - Fire
  - Structural
  - Codes
- 82 major issues identified, assigned to specific work groups, and investigated
- Hundreds of reports reviewed and collected via ICC TWB webpage
- Performance Objectives discussed and listed

TWB Ad Hoc Objectives

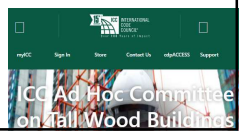
TWB identified performance objectives to be met:

- No collapse under reasonable scenarios of complete burn-out of fuel without automatic sprinkler protection being considered
- No unusually high radiation exposure from the subject building to adjoining properties to present a risk of ignition under reasonably severe fire scenarios
- No unusual response from typical radiation exposure from adjacent properties to present a risk of ignition of the subject building under reasonably severe fire scenarios

TWB Ad Hoc Objectives (cont'd)

TWB identified performance objectives to be met:

- No unusual fire department access issues
- Egress systems designed to protect building occupants during design escape time, plus a factor of safety
- Highly reliable fire suppression systems to reduce risk of failure during reasonably expected fire scenarios. Degree of reliability proportional to evacuation time (height) and risk of collapse.



The TWB has determined that its comprehensive package of proposals meet these performance objectives

Mass Timber Fire Testing:

Year	Test Sponsor and Location	Test Description	Fire Test Std
2011	FPInnovations (FPI); National Research Council of Canada (NRC)	Protected Cross-Laminated Timber (CLT) Floor and Wall Tests,	E 119
2012	American Wood Council (AWC); NGC Testing Services	5 ply CLT wall with 8700 PLF load protected with 1 layer of 5/8" type X gypsum wall board (GWB) each side	E 119
2014	AWC; Western Fire Center (WFC)	GWB-Protected Beam Tests, Protected Structural Composite Lumber (SCL) Tests	E 119
2015	AWC; Southwest Research Institute (SwRI)	Nail Laminated Timber (NLT) and CLT compartments; 2 hour FRR fire stops	Non-Standard; E 814
2016	LEVER Architecture, ARUP; SwRI	2 Hour exposed beam and column test with CLT deck	E 119
2017	FPRF, NRC; NIST National Fire Research Lab	CLT Compartment Fire Tests (w/ first generation PUR adhesive CLT)	Non-Standard
2017	US FPL, ICC Tall Wood Ad Hoc (TWB), AWC; ATF Lab	Compartment Fire Tests, Two Story Mass Timber Building	Non-Standard
2017	AWC; SwRI	Development of a Fire Performance Assessment Methodology for CLT Adhesives	New PRG 320, Annex B standard
2017	AWC; WFC	CLT Floor/Ceiling Assembly to establish the contribution of GWB to FRR	E 119
2018	NRC, CNRC	Fire Testing of Rooms with Exposed Second Generation PUR adhesive CLT	Non-Standard

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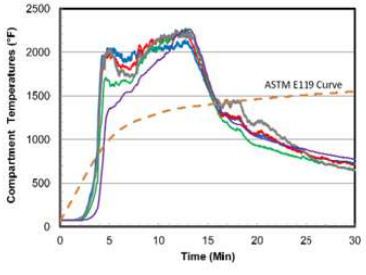
2017	FPRF, NRC; NIST National Fire Research Lab	CLT Compartment Fire Tests (w/ first generation PUR adhesive CLT)	Non-Standard
2017	US FPL, ICC Tall Wood Ad Hoc (TWB), AWC; ATF Lab	Compartment Fire Tests, Two Story Mass Timber Building	Non-Standard
2017	AWC; SwRI	Development of a Fire Performance Assessment Methodology for CLT Adhesives	New PRG 320, Annex B standard
2017	AWC; WFC	CLT Floor/Ceiling Assembly to establish the contribution of GWB to FRR	E 119
2018	NRC, CNRC	Fire Testing of Rooms with Exposed Second Generation PUR adhesive CLT	Non-Standard

"Non-Standard Fire" not in the code



Compartment Temperature

Typical "non-standard" TT curve

72

Behavior of Fire and Materials

- Fire needs three things:
  - Heat
  - Oxygen
  - Fuel

Source: AWC Staff

73

Behavior of Fire and Materials

- Phases of Fire
  - Ignition
  - Growth
  - Fully Developed
  - Decay

Source: AWC Staff

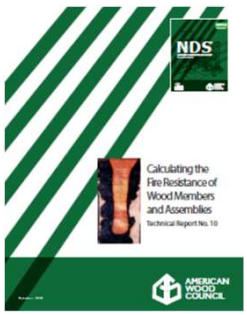
74

Behavior of Fire and Materials

Char layer

- tends to insulate the wood from heat sources

The updated version of AWC publication TR-10 is available free: www.awc.org



75

Mass Timber Fire Testing:

Year	Test Sponsor and Location	Test Description	Fire Test Std
2011	FPInnovations (FPI); National Research Council of Canada (NRC)	Protected Cross-Laminated Timber (CLT) Floor and Wall Tests,	E 119
2012	American Wood Council (AWC); NGC Testing Services	5 ply CLT wall with 8700 PLF load protected with 1 layer of 5/8" type X gypsum wall board (GWB) each side	E 119
2014	AWC; Western Fire Center (WFC)	GWB-Protected Beam Tests, Protected Structural Composite Lumber (SCL) Tests	E 119
2015	AWC; Southwest Research Institute (SwRI)	Nail Laminated Timber (NLT) and CLT compartments; 2 hour FRR fire stops	Non-Standard; E 814
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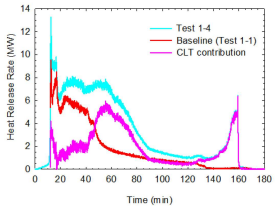
2018	NRC, CNRC	Fire Testing of Rooms with Exposed Second Generation PUR adhesive CLT	Non-Standard

2017	FPRF, NRC; NIST National Fire Research Lab	CLT Compartment Fire Tests (w/ first generation PUR adhesive CLT)	Non-Standard

Test 1-4: Exposed CLT ceiling

- 1st heat-delamination occurred around 50 minutes, extending fully-developed phase
- 2nd heat-delamination occurred around 150 minutes, resulting in fire re-growth



Graphs courtesy of Joseph Su, NRC Canada

Adhesive qualification tests

Direction provided by ICC-TWB Ad-Hoc Committee

- Need test protocol capable of identifying heat-delaminating adhesives
- Code-referenced standards governing CLT should require adhesive qualification using this protocol

2018 ANSI/APA - PRG 320

FLOOR MODIFICATION

G108-18-DIGIOVANNI-1

Cross-laminated timber shall be labeled as conforming to PRG 320 - 18 as referenced in Section 2303.1.4, ~~the heat performance requirements of Section 6.1.3.4 of DOC PS1 and have no delamination in any specimen, except where occurring at a localized characteristic when permitted in the product standard.~~

FIGURE B1
CALIBRATION TIME-TEMPERATURE CURVE

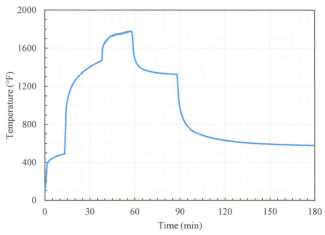
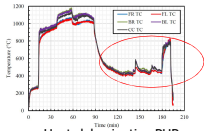


Photo by AWC

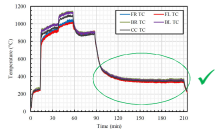
2017	AWC; SwRI	Development of a Fire Performance Assessment Methodology for CLT Adhesives	New PRG 320, Annex B standard

Qualification tests performed on other adhesives

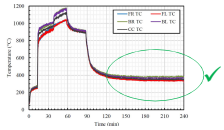
- Fire re-growth observed with PUR
- No fire re-growth observed with
  - Melamine formaldehyde resin
  - Improved PUR
- Test identifies acceptable performance



Heat-delaminating PUR



Melamine formaldehyde resin



Improved PUR

2018	NRC, CNRC	Fire Testing of Rooms with Exposed Second Generation PUR adhesive CLT	Non-Standard

Mass Timber Fire Testing:

Year	Test Sponsor and Location	Test Description	Fire Test Std
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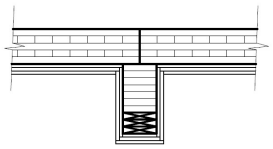
Non-combustible protection



FRR of mass timber element = time assigned to the exposed wood + time assigned to the added protection (usually gypsum)

Ch 7: Fire & Smoke Protection Features

703 Fire-Resistance Ratings and Standardized Fire Tests

Building elements are tested under a standardized test fire exposure for a given duration to:

1. Prevent passage of flame and temperature rise from one side to the other
2. Continue to provide vertical structural support when exposed to fire and elevated temperatures

- **How do calculations work to duplicate structural E119 fire test results?**

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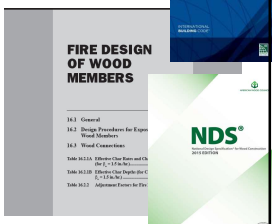
Calculated Fire Resistance, NDS Ch 16

SECTION 722
CALCULATED FIRE RESISTANCE

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).*

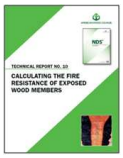


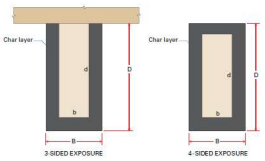
Technical Report 10 includes more details, background and commentary on the methods found in NDS chapter 16.

NDS Ch 16 and TR-10, Beam, Column

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

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





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Calculated Fire Resistance – NDS Ch 16

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[2]	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	-	-	-	-	-

1. See 4.3, 5.3, 8.3, and 10.3 for applicability of adjustment factors for specific products.
2. Factor shall be based on initial cross-section dimensions.
3. Factor shall be based on reduced cross-section dimensions.

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Fire Design of Exposed Wood Members

CLT manufactured with laminations of equal thickness

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

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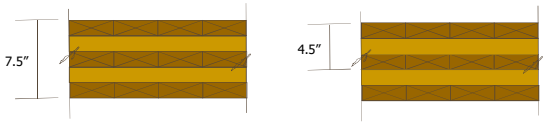
Example Floor Calculation

Determination of effective residual cross-section

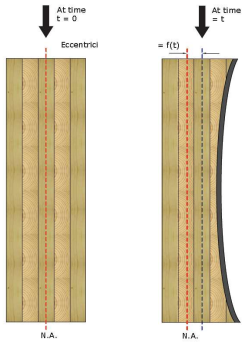
- Assume 5-plies @ 1.5" each ply = 7.5"
- Determine thickness for 1-hour rating
- a_{char} = 1.8" (NDS Table 16.2.1B)
- d = 7.5" – 1.8" = 5.7"
- Could conservatively assume 3-ply panel for design

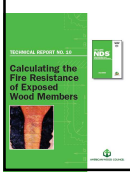


Typical one foot section

89

Calculation on wall:





Non-combustible protection

FS5-18

IBC: 703.8 (New)

Proponent: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB)

703.8 Determination of noncombustible protection time contribution. . The time, in minutes, contributed to the fire resistance rating by the noncombustible protection of mass timber building elements, components, or assemblies, shall be established through a comparison of assemblies tested using procedures set forth in ASTM E 119 or UL 263. The test assemblies shall be identical in construction, loading, and materials, other than the noncombustible protection. The two test assemblies shall be tested to the same criteria of structural failure.

1. Test Assembly 1 shall be without protection.
2. Test Assembly 2 shall include the representative noncombustible protection. The protection shall be fully defined in terms of configuration details, attachment details, joint sealing details, accessories and all other relevant details.

The noncombustible protection time contribution shall be determined by subtracting the fire resistance time, in minutes, of Test Assembly 1 from the fire resistance time, in minutes, of Test Assembly 2.

2011	FPInnovations (FPI); National Research Council of Canada (NRC)	Protected Cross-Laminated Timber (CLT) Floor and Wall Tests,	E 119

3.7.1 NRC Protected CLT Floor and Wall Tests

As discussed in 2.8, in 2011, FPInnovations (FPI), in collaboration with the National Research Council of Canada (NRC), conducted a series of 8 full-scale fire resistance tests of CLT floors and walls [50]. All tests followed the ULC S101 time-temperature curve, a fire exposure comparable to the ASTM E119 time-temperature curve. Three of the CLT floors and one of the CLT walls were protected with GWB.

As reported in Section 2.8 for unprotected CLT floor and wall tests, loading of the floors and walls was based on Canadian standards. For purposes of this analysis, allowable stress design (ASD) values were determined by using relevant grades from the CLT product standard, PRG-320 [51]. Structural fire resistance was then calculated using NDS design provisions and appropriate ASD design values from PRG-320.

NRC Test #1 - Protected Floor:
NRC Test #2 - Protected Wall:
NRC Test #5 - Protected Floor:
NRC Test #6 - Protected Floor:

2014	AWC; Western Fire Center (WFC)	GWB-Protected Beam Tests, Protected Structural Composite Lumber (SCL) Tests	E 119

Table 3.6b Added Contribution of Gypsum Wallboard Protection

Beam Description	Design Stress Ratio	GWB Description: Thickness (inches)	GWB Description: Layers	Test Times (minutes): SCL Beam + GWB	Test Times (minutes): SCL Beam Only	Test Times (minutes): GWB Only	Estimated Times (minutes): SCL Beam + GWB	Estimated Times (minutes): SCL Beam Only	Estimated Times (minutes): GWB Only
3½"-Wide LVL	56%	5/8" Type X	1	71	33	38 [1]	70	30	40
7"-Wide LVL	113%	5/8" Type X	2	139	50	90	130	50	80
3½"-Wide LSL	84%	5/8" Type X	1	74	35	39 [1]	66	26	40
3½"-Wide LSL	84%	5/8" Type X	2	114	35	79	106	26	80

[1]Gypsum wallboard corners were not finished, resulting in early penetration of fire.

When tested in accordance with ASTM E119, all ten SCL beams lasted longer in the fire tests than the calculated fire resistance corresponding to the actual applied load level. Accordingly, test results support the use of the calculation procedure in NDS Chapter 16 and TR10 for SCL.

2017	AWC; WFC	CLT Floor/Ceiling Assembly to establish the contribution of GWB to FRR	E 119

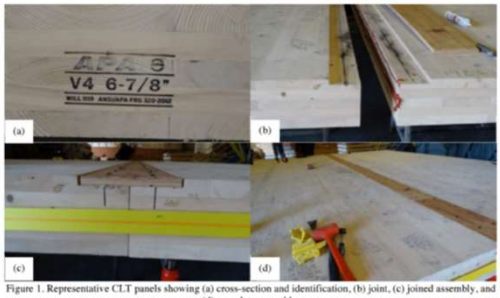


Figure 1. Representative CLT panels showing (a) cross-section and identification, (b) joint, (c) joined assembly, and (d) complete assembly.

2017	AWC; WFC	CLT Floor/Ceiling Assembly to establish the contribution of GWB to FRR	E 119

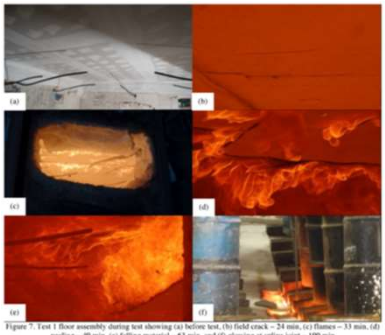


Figure 7. Test 1 floor assembly during test showing (a) before test, (b) field crack – 24 min, (c) flames – 33 min, (d) peeling – 49 min, (e) falling material – 63 min, and (f) glowing at spline joint – 190 min

2017	AWC; WFC	CLT Floor/Ceiling Assembly to establish the contribution of GWB to FRR	E 119

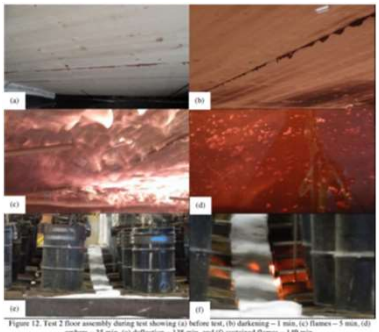


Figure 12. Test 2 floor assembly during test showing (a) before test, (b) darkening – 1 min, (c) flames – 5 min, (d) embers – 35 min, (e) deflection – 138 min, and (f) sustained flames – 149 min.

2017	AWC; WFC	CLT Floor/Ceiling Assembly to establish the contribution of GWB to FRR	E 119

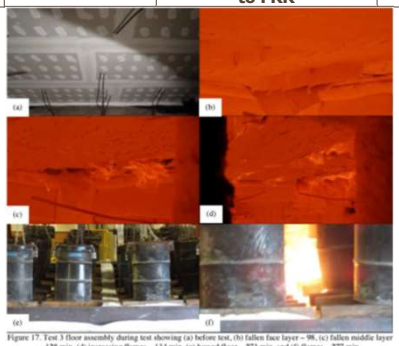


Figure 17. Test 3 floor assembly during test showing (a) before test, (b) fallen face layer – 98, (c) fallen middle layer – 128 min, (d) increasing flames – 134 min, (e) bowed floor – 273 min, and (f) flames – 277 min.

2017	AWC; WFC	CLT Floor/Ceiling Assembly to establish the contribution of GWB to FRR	E 119

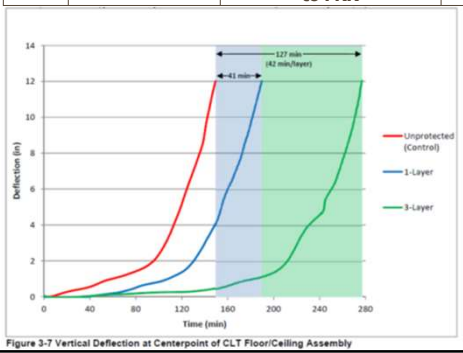


Figure 3-7 Vertical Deflection at Centerpoint of CLT Floor/Ceiling Assembly

Non-combustible protection

FS81-18

IBC: 722.7 (New), 722.7.1 (New), TABLE 722.7.1(1) (New), TABLE 722.7.1(2) (New), 722.7.2 (New), 722.7.2.1 (New), 722.7.2.2 (New)

Proponent: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB) (TWB@iccsafe.org)

TABLE 722.7.1(1)

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

- 2/3 of Table 601 required FRR from NC protection
- Installation requirements of deemed to comply NC protection

TABLE 722.7.1(2)
PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

Noncombustible Protection	Protection Contribution (minutes)
1/2 inch Type X Gypsum Board	~~30~~ 25
5/8 inch Type X Gypsum Board	40

FLOOR MODIFICATION
FS81-18-DIGIOVANNI-1

Noncombustible protection

Table 722.7.1(a) Protection Required From Noncombustible Covering Material

Fire Resistance Rating of Building Elements (Per Tables 601 and 602) (hours)	Minimum Protection Required from Noncombustible Protection (minutes)
1	40
2	80
3 or more	120

Table 722.7.1(b) Protection Provided by Noncombustible Covering Material

Noncombustible Protection	Protection Contribution (minutes)
1/2 inch Type X Gypsum Board	~~30~~ 25
5/8 Type X Gypsum Board	40

Noncombustible protection

Attachment of Type X Gypsum Board Used as Noncombustible Protection:

- Screws shall penetrate ≥1″ into mass timber
- Screws shall be spaced no more than 12″ o.c. in each direction
- Screws at panel edges shall be between 1″ and 2″ from the edge
- Panel edges shall be offset 18″ from those of adjacent layers
- Stair-step profile required at wall-to-wall & wall-to-ceiling intersections
- Screw heads and panel joints shall be covered with joint compound

Other testing of NC protection:

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Photo Courtesy of ROCKWOOL

Other testing of NC protection:

Objective: Quantify contribution of other non-combustible protection in in addition to gypsum on Mass Timber

	Unprotected CLT (control test)	Single-Layer Protection	Triple-Layer Protection	Mineral Wool Protection
CLT type/grade	5-Layer V4 (Smartlam)			
CLT panel size	Two 7'x18' panels per test, joined together for an overall size of 14'x18'			
Loading	24 sand-filled barrels, uniformly-distributed for an applied load of 60 psf			
Span	17'-10"			
Load Ratio	75% of ASD moment (including self-weight)			
Noncombustible protection	None	1 layer of 5/8" Type X gypsum wallboard	3 layers of 5/8" Type X gypsum wallboard	2" thick; 8 pcf mineral wool
GWB attachment	None	Type S screws @ 12" o.c. both directions. 1" penetration into CLT. 1.5" edge distance.	Type S screws @ 12" o.c. both directions, staggered 4"each layer. 1" penetration into CLT. 1.5" edge distance.	Type S screws and 1.5" fender washers at
Deflection at End of Test	12.5"	12.5"	12.0"	12.0"
Test duration	149.4 minutes	189.7 minutes	276.8 minutes	261.3 minutes
Noncombustible protection contribution	--	40.3 minutes	127.4 minutes	113 minutes
Time attributed to each layer	--	40.3 min/layer	42.5 min/layer	113 minutes

103

Behavior of Fire and Materials

- **Wood exposed to high temperature:**
  - low thermal conductivity
  - dimensionally stable
  - inner portion remains cool
  - does not lose strength
  - **Contributes to the Fire !**

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Fire Behavior Depends on:

Fire behavior depends in part on:

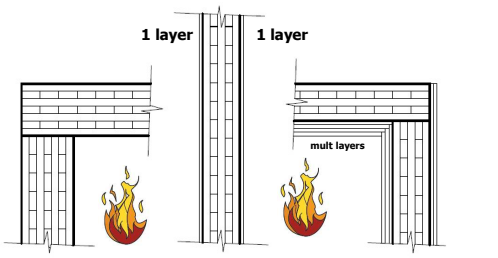
- Amount of exposed wood
- Arrangement of exposed wood
- Thermal performance of adhesive

MASS TIMBER: FRR & NC PROTECTION CHECKLIST:

- ❑ Mass timber material meets heavy timber minimum dimension requirements found in IBC 2304.11?
- ❑ Exposed MT meets limits for area and separation between exposed locations?
- ❑ NC Protection meets 2/3 FRR of Table 601 and other specific requirements?
- ❑ Overall FRR of building elements (either exposed or protected) meet the minimum FRR requirements of Table 601 (calculated or tested)?

Additional NC Protection of CLT:

All have 3 hour or more fire resistance rating:



exposed CLT | limited protection | complete protection

Is the behavior the same?

Behavior of Fire and Materials

Protection of mass timber construction:

ICC TALL WOOD AD HOC COMMITTEE

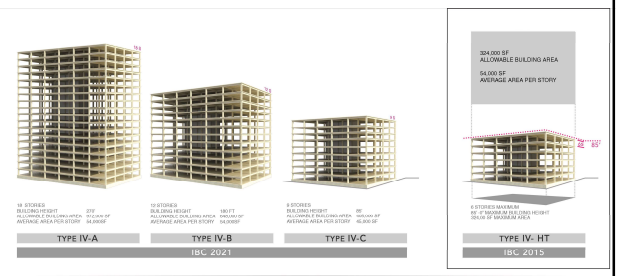


Illustration courtesy Susan Jones

Mass Timber Fire Testing:

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2017	US FPL, ICC Tall Wood Ad Hoc (TWB), AWC; ATF Lab	Compartment Fire Tests, Two Story Mass Timber Building	Non-Standard

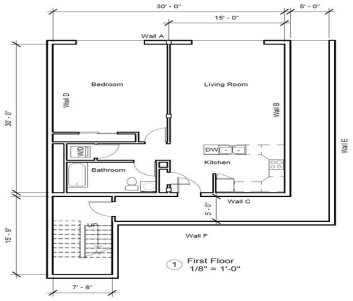
- Purpose: Perform tests of realistic fire scenarios applicable to tall wood construction in order to evaluate occupant and firefighter tenability for egress and suppression efforts, and to provide data necessary to guide further development of relevant code and standard provisions
- Conducted at U.S. government facilities (ATF)
- Supervised by U.S. Forest Product Laboratory staff

2017	US FPL, ICC Tall Wood Ad Hoc (TWB), AWC; ATF Lab	Compartment Fire Tests, Two Story Mass Timber Building	Non-Standard

Test	Description	Date	Duration
Test 1	All mass timber surfaces protected with 2 layers of 5/8" Type X GWB	5/23/17	3 hours
Test 2	30% of CLT ceiling area in living room and bedroom exposed	5/31/17	4 hours
Test 3	Two opposing CLT walls exposed – one in bedroom and one in living room (there is a partition wall)	6/20/17	4 hours
Test 4	All mass timber surfaces fully exposed in bedroom and living room. Sprinklered – normal activation	6/27/17	6 minutes
Test 5	All mass timber surfaces fully exposed in bedroom and living room (except bathroom). Sprinklered – 23 min delayed activation	6/29/17	30 minutes

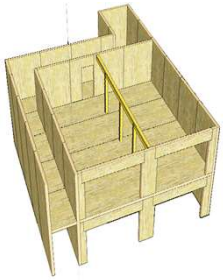
2017	US FPL, ICC Tall Wood Ad Hoc (TWB), AWC; ATF Lab	Compartment Fire Tests, Two Story Mass Timber Building	Non-Standard

- Tests 1 through 3: unlikely scenario in which automatic sprinklers fail to activate and fire service unable to respond
- Test 4: normal sprinkler activation
- Test 5: automatic sprinklers fail to activate, but are later manually charged by fire service



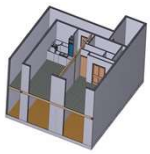
2017	US FPL, ICC Tall Wood Ad Hoc (TWB), AWC; ATF Lab	Compartment Fire Tests, Two Story Mass Timber Building	Non-Standard

- Two stories, one apartment per level
- Each apartment: 30 ft x 30 ft
- Ceiling height: 9 ft
- 5-ply CLT
  - Douglas fir-Larch species group
  - Lamination Thickness: 1.375 inches
  - CLT Thickness: 6.875 inches
  - Polyurethane Adhesive
- Corridor around each apartment and a 2 hour stair enclosure



2017	US FPL, ICC Tall Wood Ad Hoc (TWB), AWC; ATF Lab	Compartment Fire Tests, Two Story Mass Timber Building	Non-Standard

- Partitions used unrated ½" gypsum wallboard
- Kitchen & Living Room: 15 ft x 30 ft
- Bedroom & Bath: 15 ft x 30 ft
- 20-min rated door between compartment and corridor
- 90-min rated door between corridor and stairwell
- Fuel load ~570 MJ/m^2



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Photos provided by U.S. Forest Products Laboratory, USDA

2017	US FPL, ICC Tall Wood Ad Hoc (TWB), AWC; ATF Lab	Compartment Fire Tests, Two Story Mass Timber Building	Non-Standard

Photos provided by U.S. Forest Products Laboratory, USDA

ATF fire Test #1 - All Mass Timber Protected

All mass timber surfaces protected with 2 layers of 5/8" Type X GWB

Photos provided by U.S. Forest Products Laboratory, USDA

ATF fire Test #1 - All Mass Timber Protected

Photos provided by U.S. Forest Products Laboratory, USDA

Atf fire Test #2 – 20% of Dwelling Unit CLT Ceilings Exposed

30% of CLT ceiling area in living room and bedroom exposed

Live load applied using water barrels

Atf fire Test #2 – 20% of Dwelling Unit CLT Ceilings Exposed

Photos provided by U.S. Forest Products Laboratory, USDA

Atf fire Test #2 – 20% of Dwelling Unit CLT Ceilings Exposed

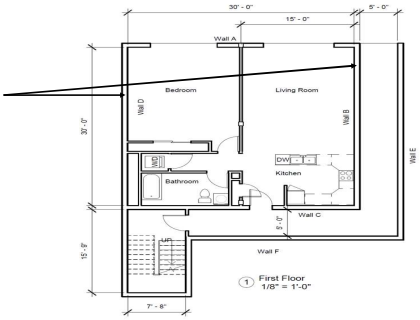
Post-Fire Condition of Glulam After Gypsum Removal

- Fire intensity decreased subsequent to consumption of furnishings and contents (known as *decay phase*)
- Exposed mass timber surfaces self-extinguished in the decay phase
- Mass timber surfaces protected with 2 layers of 5/8" Type X GWB remained mostly uncharred

Section of exposed ceiling (90º angle)

ATF fire Test #3 – Exposed Walls

Two opposing CLT walls exposed one in bedroom and one in living room



Atf Fire Test #3 40% of Dwelling Unit Floor Area Walls Exposed




ATF fire Test #4 – Sprinklers, Exposed

All mass timber surfaces fully exposed in bedroom and living room

Sprinkler – normal activation




Test #5 – delayed Sprinklers

All mass timber surfaces fully exposed in bedroom and living room.

Sprinkler – water delayed for 20 minutes after sprinkler activation within the test compartment…approximately 23 minutes from ignition

- Flashover conditions were reached in the kitchen, and the bedroom was very near reaching flashover
- The sprinkler system effectively suppressed the fire

TWB Committee Fire Testing Summary:

Fire Work Group created fire test scenarios to study and validate the TWB code change proposals

- Test structure represented multi-story condo
- 30 ft x 30 ft interior dimensions
- Corridor and stair included in the structure
- UL "modern furnishings" fuel load imposed → 570 MJ/m^2
  - fuel load was approximately 85th percentile of Group R fuel loads from survey of Group R's

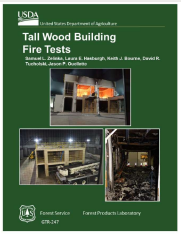
ATF Fire Test Results – Event Log

Test No.	Time After Ignition (mm:ss)				
	Flashover (600°C) Living Room	Flashover (600°C) Bedroom	Flames in Hallway	Compartment door Fails	Sprinkler Activation
1 1st floor	13:27	17:20	26:51	57:46	N/A
2 2nd floor	11:42	17:20	30:38	63:59	N/A
3 2nd floor	12:37	17:00	13:06 (door frame installation error)	29:42 (door frame installation error)	N/A
4 1st floor	-	-	-	-	2:37
5 1st floor	-	-	-	-	23:00

Tests 2 and 3 terminated at 4 hours with no re-growth

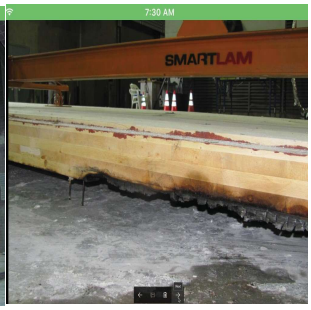
ATF Fire tests

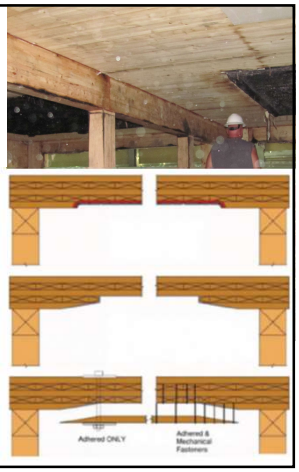
Full Report on FPL Website:
https://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr247.pdf



Fire Test Videos on AWC Website:
www.awc.org/tallmasstimber
Link to you tube videos available on this page

Repair in Place ?





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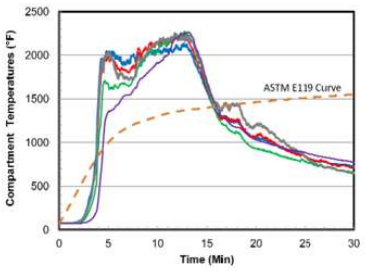
"Non-Standard Fire" not in the code



Compartment Temperature

Typical "non-standard" TT curve

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2015	AWC; Southwest Research Institute (SwRI)	Nail Laminated Timber (NLT) and CLT compartments; 2 hour FRR fire stops	Non – Standard; E 814

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Figure B-3. Sample after 2-h Exposure.

2016	LEVER Architecture, ARUP; SwRI	2 Hour exposed beam and column test with CLT deck	E 119


Slide Courtesy of Arup

ICC TALL WOOD AD HOC COMMITTEE

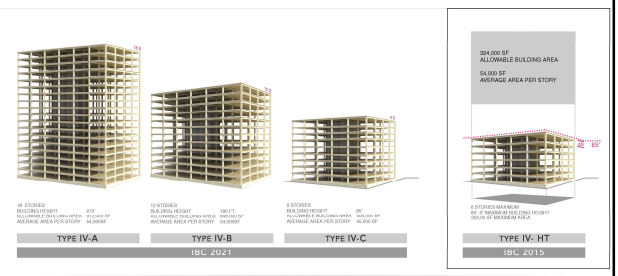
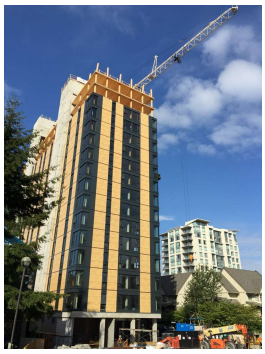


Illustration courtesy Susan Jones

Outline

- History and Overview
- TWB Ad Hoc Committee and Testing
- Code Changes and Definitions
- IBC Construction Types
- Building Sizes



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TWB Committee Proposals

TWB Group A Work Product:

- 14 code change proposals to-date; hundreds of code sections reviewed
- 3 new types of construction
- New entries in Height (feet), Height (stories) and Area for the IBC
- Multiple new requirements for safety while under construction
- Existing exterior wall test standard still required (currently NFPA 285 per IBC)

TWB Committee Group A Proposals –
ALL APPROVED as submitted OR as modified.

- **G108 New types of construction and definitions**
- **G75 Height in feet**
- **G80 Height in stories**
- **G84 Allowable area per floor**
- **G89 Fire barriers**
- **G146 Membrane structures with mass timber**
- **G152 Appendix**
- **G28 Redundant water supply**

- **FS5 Performance based noncombustible protection**
- **FS6 Sealing of Splices and intersections**
- **FS73 mass timber as fire blocking**
- **FS81 Prescriptive noncombustible protection**

- **IFC F88 Owners responsibility**
- **IFC F266 Fire safety during construction**

SO LET'S LOOK AT SOME OF THOSE NEW CODE SECTIONS…

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SO LET'S LOOK AT SOME OF THOSE NEW CODE SECTIONS…

Definitions: G108-18

Mass Timber: Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross section dimensions of Type IV construction.

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.

[BS] *Wall, Load Bearing*. Any wall meeting either of the following classifications:

1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.
2. Any masonry, ~~or~~ concrete, or *mass timber* wall that supports more than 200 pounds per linear foot (2919 N/m) of vertical load in addition to its own weight.

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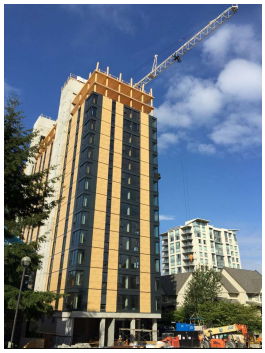

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G108-18

G108-18
IBC: 202, 602.4, 602.4.1, 602.4.1.1 (New), 604.2.4.1.2(New), 602.4.1.2.1 (New), 602.4.1.3 (New), 602.4.1.4 (New), 602.4.1.5 (New), 602.4.1.6 (New), 602.4.2, 602.4.2.1 (New), 602.4.2.2 (New), 602.4.2.2.1 (New), 602.4.2.2.2 (New), 602.4.2.2.3 (New), 602.4.2.2.4 (New), 602.4.2.3 (New), 602.4.2.4 (New), 602.4.2.5 (New), 602.4.2.6 (New), 602.4.3, 602.4.3.1 (New), 602.4.3.2 (New), 602.4.3.3 (New), 602.4.3.4 (New), 602.4.3.5 (New), 602.4.3.6 (New), 602.4.4(New), , TABLE 601, TABLE 602

Proponent: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB) (TWB@iccsafe.org)

Key considerations in Chapter 6:

- Allowed Materials
- Structural FRR (Table 601)
- Amount and location of non-combustible protection
- NC protection of concealed spaces
- NC protection of other features

G108-18

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G108-18 Text

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 elements of Types IV A, IV B and IV C construction shall be protected with noncombustible protection applied directly to the mass timber in accordance with Sections 602.4.1 through 602.4.3. The time assigned to the noncombustible protection shall be determined in accordance with Section 703.8 and comply with 722.7.

TWB proposed Text

602.4 Type IV (cont'd)

All cross-laminated timber shall be labeled as conforming to ~~the heat performance requirements of Section 6.1.3.4 of DOC PS1~~ PRG 320-18 as referenced in Section 2303.1.4 ~~and have no delamination in any specimen, except when occurring at a localized characteristic when permitted in the product standard~~.

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.

Combustible concealed spaces are not permitted except as otherwise indicated in Sections 602.4.1 through 602.4.4. Combustible stud spaces within light frame walls of Type IV-HT construction shall not be considered concealed spaces, but shall comply with Section 718.

TWB Committee proposals

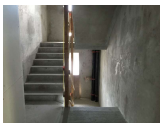
602.4 Type IV (cont'd)

In buildings of Type IV-A, B, and C, construction with an occupied floor located more than 75 feet above the lowest level of fire department access, up to and including 12 stories or 180 feet above grade plane, mass timber interior exit and elevator hoistway enclosures shall be protected in accordance with Section 602.4.1.2. In buildings greater than 12 stories or 180 feet above grade plane, interior exit and elevator hoistway enclosures shall be constructed of non-combustible materials.

.....

602.4.1.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and Section 718. Both the shaft side and room side of mass timber elements shall be protected in accordance with Section 602.4.1.2.

Exit and Hoistway Enclosures:



G108-18

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Type of construction G108-18

Table 601 (comparison)

	Non-combustible				Mass Timber			
BUILDING ELEMENT	TYPE I		TYPE II		TYPE IV			
	A	B	A	B	A	B	C	HT
Columns	3	2 (1**)	1	1	3	2	2	HT
Primary Frame	3 (2*)	2 (1**)	1	0	3	2	2	HT
Interior Bearing Walls	3 (2*)	2 (1**)	1	0	3	2	2	HT
Floor Assembly	2	2 (1**)	1	0	2	2	2	HT
IBC 403.2.1 reductions: * reduce 1 hour ** reduce 1 hour (except for F-1, H-2, H-3, H-5, M and S-1 occupancy)					no reduction (all fire resistance rating greater or equal than non-combustible)			

G108-18

G108-18

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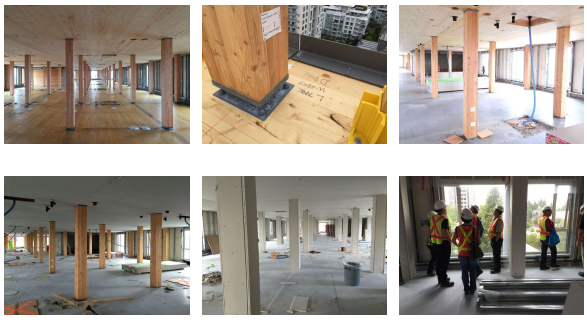
- Amount and location of non-combustible protection
- NC protection of concealed spaces
- NC protection of other features

TWB proposed Text

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 elements of Types IV A, IV B and IV C construction shall be protected with noncombustible protection applied directly to the mass timber in accordance with Sections 602.4.1 through 602.4.3. The time assigned to the noncombustible protection shall be determined in accordance with Section 703.8 and comply with 722.7.

Brock Commons: IVA NC Protection:



Noncombustible protection in Type IV-B

Type IV-B

602.4.2.2.2 Protected Area. All interior faces of all mass timber elements shall be protected in accordance with Section 602.4.2.2.1, including the inside faces of exterior mass timber walls and mass timber roofs.

Exceptions: Unprotected portions of mass timber ceilings and walls complying with Section 602.4.2.2.4 and the following:

1. Unprotected portions of mass timber ceilings, including attached beams, shall be permitted and shall be limited to an area equal to 20% of the floor area in any *dwelling unit* or *fire area*; or
2. Unprotected portions of mass timber walls, including attached columns, shall be permitted and shall be limited to an area equal to 40% of the floor area in any *dwelling unit* or *fire area*; or
3. Unprotected portions of both walls and ceilings of mass timber, including attached columns and beams, in any *dwelling unit* or *fire area* shall be permitted in accordance with section 602.4.2.2.3.

ATF Test: IVB NC Protection:

TWB Committee proposals

602.4.2.2.3 Mixed Unprotected Areas. In each *dwelling unit* or *fire area*, where both portions of ceilings and portions of walls are unprotected, the total allowable unprotected area shall be determined in accordance with Equation 6-1.

$(U_{tc}/U_{ac}) + (U_{tw}/U_{aw}) \leq 1$ (Equation 6-1) where:

U_{tc} = Total unprotected mass timber ceiling areas

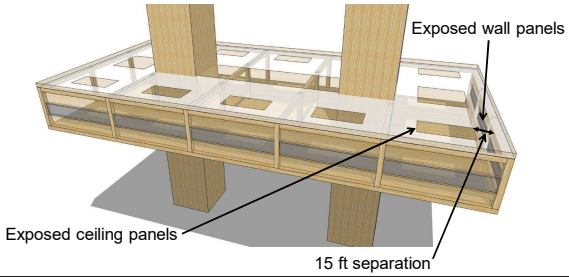
U_{ac} = Allowable unprotected mass timber ceiling area conforming to Section 602.4.2.2.2, exception item 1

U_{tw} = Total unprotected mass timber wall areas

U_{aw} = Allowable unprotected mass timber wall area conforming to Section 602.4.2.2.2, exception item 2

TWB Committee proposals

602.4.2.2.4 Separation Distance Between Unprotected Mass Timber Elements. In each *dwelling unit* or *fire area*, 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.



G108-18

G108-18

IBC: 202, 602.4, 602.4.1, 602.4.1.1 (New), 604.2.4.1.2(New), 602.4.1.2.1 (New), 602.4.1.3 (New), 602.4.1.4 (New), 602.4.1.5 (New), 602.4.1.6 (New), 602.4.2, 602.4.2.1 (New), 602.4.2.2 (New), 602.4.2.2.1 (New), 602.4.2.2.2 (New), 602.4.2.2.3 (New), 602.4.2.2.4 (New), 602.4.2.3 (New), 602.4.2.4 (New), 602.4.2.5 (New), 602.4.2.6 (New), 602.4.3, 602.4.3.1 (New), 602.4.3.2 (New), 602.4.3.3 (New), 602.4.3.4 (New), 602.4.3.5 (New), 602.4.3.6 (New), 602.4.4(New), , TABLE 601, TABLE 602

Proponent: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB) (TWB@iccsafe.org)

Key considerations in Chapter 6:

- Allowed Materials
- Structural FRR (Table 601)
- Amount and location of non-combustible protection
- NC protection of concealed spaces
- NC protection of other features

TWB proposed Text

602.4 Type IV (cont'd)

All cross-laminated timber shall be labeled as conforming to ~~the heat performance requirements of Section 6.1.3.4 of DOC PS1~~ PRG 320-18 as referenced in Section 2303.1.4 ~~and have no delamination in any specimen, except when occurring at a localized characteristic when permitted in the product standard~~.

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.

Combustible concealed spaces are not permitted except as otherwise indicated in Sections 602.4.1 through 602.4.4. Combustible stud spaces within light frame walls of Type IV-HT construction shall not be considered concealed spaces, but shall comply with Section 718.

Concealed Spaces

No exposed combustibles other than plenum exception permitted in concealed space

G108-18

G108-18

IBC: 202, 602.4, 602.4.1, 602.4.1.1 (New), 604.2.4.1.2(New), 602.4.1.2.1 (New), 602.4.1.3 (New), 602.4.1.4 (New), 602.4.1.5 (New), 602.4.1.6 (New), 602.4.2, 602.4.2.1 (New), 602.4.2.2 (New), 602.4.2.2.1 (New), 602.4.2.2.2 (New), 602.4.2.2.3 (New), 602.4.2.2.4 (New), 602.4.2.3 (New), 602.4.2.4 (New), 602.4.2.5 (New), 602.4.2.6 (New), 602.4.3, 602.4.3.1 (New), 602.4.3.2 (New), 602.4.3.3 (New), 602.4.3.4 (New), 602.4.3.5 (New), 602.4.3.6 (New), 602.4.4(New), , TABLE 601, TABLE 602

Proponent: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB) (TWB@iccsafe.org)

Key considerations in Chapter 6:

- Allowed Materials
- Structural FRR (Table 601)
- Amount and location of non-combustible protection
- NC protection of concealed spaces
- NC protection of other features

TWB Committee proposals

602.4 Type IV (cont'd)

In buildings of Type IV-A, B, and C, construction with an occupied floor located more than 75 feet above the lowest level of fire department access, up to and including 12 stories or 180 feet above grade plane, mass timber interior exit and elevator hoistway enclosures shall be protected in accordance with Section 602.4.1.2. In buildings greater than 12 stories or 180 feet above grade plane, interior exit and elevator hoistway enclosures shall be constructed of non-combustible materials.

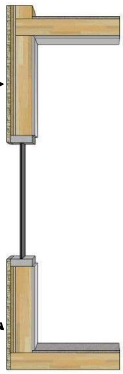
.....

602.4.1.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and Section 718. Both the shaft side and room side of mass timber elements shall be protected in accordance with Section 602.4.1.2.

Exterior Wall Section

All material outboard of the Mass Timber
MUST BE NONCOMBUSTIBLE
Except: water resistive barrier

1 layer
5/8 in. Type X GWB
(or equivalent)
Required on outside
Of exterior walls for
Type IV-A, B and C



Exterior Wall Section

In Summary: Type of Construction IV-A

Building Element	
Maximum Height	270'
Number of Stories	18 maximum
Exposed Mass Timber?	No exposed MT, full NC protection including floors
Sprinklers	Yes
Primary Frame FRR	3 hours
Floor FRR	2 hours
Primary Frame FRR coming from NC protection	120 minutes
Stair Towers (if over 120 feet)	Non-combustible
Concealed Spaces	Permitted but protected

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In Summary: Type of Construction IV-B

Building Element	
Maximum Height	180'
Number of Stories	12 maximum
Exposed Mass Timber?	Up to 20% Ceiling or 40% of floor area for walls; floors protected
Sprinklers	Yes
Primary Frame FRR	2 hours
Floor FRR	2 hours
Fire Resistance from Non-com	80 minutes
Stair Towers	Mass Timber or NC
Concealed Spaces	Permitted but protected

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In Summary: Type of Construction IV-C

Building Element	
Maximum Height	85'
Number of Stories	9 maximum
Exposed Mass Timber?	Fully exposed (except both sides of stair and shaft enclosures, outside of exterior walls protected)
Sprinklers	Yes
Primary Frame FRR	2 hours
Floor FRR	2 hours
Stair Tower	Mass Timber or NC
Concealed Spaces	Permitted but protected

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Review Guide - Type of Const Comparison

2021 IBC, 2018 Group A, Tall Mass Timber Proposals

Code Action Hearing (CAH) Unofficial Results:

The ICC Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board of Directors to explore the science of tall wood buildings and take action to develop and submit code change proposals in the ICC process. 14 proposals were submitted into cdpACCESS for the Group A Committee Action Hearing (CAH). All proposals were approved as submitted (AS) or approved as modified (AM) at the Committee Action Hearing in Columbus Ohio. The next step in the ICC process will be a web posting on May 30 of a report of the committee action hearing. Until that time, this list of committee action hearing proposals and actions including modifications is based on information on the ICC live hearing website: www.cdpaccess.com/live. The 2018/2019 ICC Code Development Schedule is attached for reference.

This document is intended to assist individual code official groups to navigate the proposals in order to become familiar and understand the proposed changes with the least amount of time and effort and also provide a clean copy from the hearings for those governmental agencies who want to consider early adoption of the proposals and modifications that were approved at the CAH.

The CAH approved proposals, when finalized, will create three new types of construction: IVA, IVB and IVC. Heavy timber (Type IV HT) remains technically unchanged by these proposals as in the current 2018 ibc, in is important to note none of the new types or construction permit the unlimited or combustible light frame construction in any manner. As a start Mass Timber, used in the new types of construction, must meet the minimum dimensions assigned the 2018 IBC for heavy timber construction. For those becoming familiar with the package, it is recommended the code change proposals are reviewed in the following order starting with the basic requirements for the new types of construction:

- **G108-18**: Section 602.4 - Type of Construction; Approved As Modified (AM) by DiGiovanni 1 & 2
- **FS5-18**: Section 703.8 - Performance Method; Approved As Submitted (AS)
- **FS81-18**: Section 722.7 – Ratings Installation; Approved AM by DiGiovanni 1
- **FS6-18**: Section 703.9 – Sealants at Edges; Approved AS (note: DiGiovanni 1 ruled out of order due to format but recommended for future approval by the ad hoc committee).
- **FS73-18**: Chapter 7 – Section 718.2.1 – Fireblocking Material; Approved AS
- **G28-18**: Section 403.3.2 – High Rise Sprinkler Water Supply; Approved AS
- **F88-18**: Section 701.4 – Owners Responsibility; Approved AS
- **F266-18**: Section 3309.4 of the IFC - Fire Safety During Const; Approved AM DiGiovanni 2
- **G75-18**: Table 504.3; Approved AM by DiGiovanni 1
- **G 80-18**: Table 504.4; Approved AS
- **G84-18**: Table 506; Approved AS
- **G146-18**: Chapter 31 – Section 3102 – Special Construction; Approved AS
- **G152-18**: IBC Appendix D – Fire Districts; Approved AS
- **G89-18**: Sections 508.4 and 509.4 Fire Barriers; Approved AM DiGiovanni 1

Tall Wood Type of Construction Comparison

Feature	Type IVA	Type IVB	Type IVC
Description of new Type IV types:	100 % Noncombustible (NC) protection on all surfaces of Mass Timber (MT).	NC protection on all surfaces of mass timber (MT) except for limited exposed areas.	Exposed mass timber (MT) except: shafts, concealed spaces, and outside of exterior walls.
Permitted Materials			
Structural Building elements	MT or NC	MT or NC	MT or NC
Nonloadbearing Ext Walls	MT or NC	MT or NC	MT or NC
Nonloadbearing Int Walls	MT or NC	MT or NC	MT or NC
Shaft and Exit Enclosures			
Highrise* to 12 stories or 180 feet Above 12 stories or 180 ft *see IBC definition of highrise	NC or MT protected with 2 (or 3 when 3 hr FRR) layers of 5/8" type X; NC	NC or MT protected with 2 layers of 5/8" type X gypsum or equiv each side of enclosure; Not Permitted	NC or MT protected with one layer of 5/8" type X gypsum each side of shaft or enclosure. Not Permitted
Interior Protection			
Req'd 3 hr FRR Req'd 2 hr or less FRR	3 layers of 5/8" type X gypsum 2 layers of 5/8" type X gypsum	SAME AS TYPE IV-A FOR PROTECTED MT. Limited exposed MT elements must have same FRR but may be calculated	All MT is allowed to be exposed except for 1 layer of 5/8" type x on outside surfaces of exterior walls, inside and outside of shafts and exit enclosures, and in concealed spaces.
Exterior Protection	Minimum of 1 layer of 5/8" type X gypsum.	Minimum of 1 layer of 5/8" type X gypsum.	Minimum of 1 layer of 5/8" type X gypsum.
Floor Surface	1 inch of NC protection	1 inch of NC protection	No protection required
Roof	No NC protection on exterior roof surface. 2 layers of 5/8" type X gypsum on inside of roof deck.	No NC protection on exterior roof surface. 2 layers of 5/8" type X gypsum on inside of roof deck.	No protection on roof surface or inside of roof deck is required (unless concealed space).
Concealed Spaces	No exposed MT in concealed spaces. NC protection in concealed spaces.	No exposed MT in concealed spaces. NC protection in concealed spaces.	No exposed MT in concealed spaces. One layer of 5/8" type x gypsum NC protection in concealed spaces.
Table 601, FRR			
Primary frame or bearing Wall: Floor: Roof:	3 hr FRR (2 hr at roof); 2 hr FRR; 1.1 hr FRR;	2 hr FRR (1 hr at roof); 2 hr FRR; 1 hr FRR;	2 hr FRR (1 hr at roof); 2 hr FRR; 1 hr FRR;
Fire Resistance Rating trade off:	No FRR reduction for sprinkler in 4.3.2.1.	No FRR reduction for sprinkler in 4.3.2.1.	No FRR reduction for sprinkler in 4.3.2.1.

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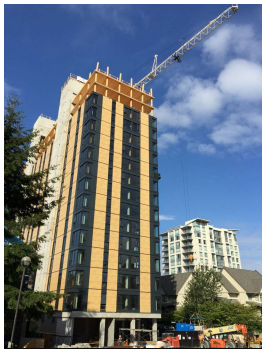
TWB Committee Group A Proposals –
ALL APPROVED as submitted OR as modified.

- ✓ **G108 New types of construction**
- **G75 Height in feet**
- **G80 Height in stories**
- **G84 Allowable area per floor**
- **G89 Fire barriers**
- **G146 Membrane structures with mass timber**
- **G152 Appendix**
- **G28 Redundant water supply**
- ✓ **FS5 Performance based noncombustible protection**
- **FS6 Sealing of Splices and intersections**
- **FS73 mass timber as fire blocking**
- ✓ **FS81 Prescriptive noncombustible protection**
- **IFC F88 Owners responsibility**
- **IFC F266 Fire safety during construction**

SO LET'S LOOK AT SOME OF THOSE NEW CODE SECTIONS…

Outline

- History and Overview
- TWB Ad Hoc Committee and Testing
- Code Changes and Definitions
- IBC Construction Types
- Building Sizes



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Height and area

Table 504.3, Allowable Height (G75-18):

- Type IV B set based on equivalence with Type I B: 180 feet for occupancy groups A, B, E, F, M, S, U and R
- Reduced ½ to 1/3 for other occ groups
- Type IV A = IV B x 1.5 instead of UL
- Type IV C = IV HT with no increase

ALLOWABLE HEIGHTS – feet

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION											TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS[b]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1, H-2, H-3, H-5	NS[c, d]	UL	160	65	55	65	55	120	90	65	65	50	40
	S												
H-4	NS[c, d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1 Condition 1, I-3	NS[d, e]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1 Condition 2, I-2	NS[d, e, f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
I-4	NS[d, g]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
R[h]	NS[d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S13D	60	60	60	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

Height and area

Table 504.4, Allowable Stories (G80-18):

- Type IV B set based on equivalence with Type I B: 12 stories for occupancy groups A-2, A-3, A-4, B, and R; 6 stories for A-1, E and U
- Reduced for F, I, M, H-4 and S occ groups; and other H occ groups = IV HT
- Type IV A = IVB x 1.5 (not UL); H=IV HT
- Type IV C = IV HT x 1.5 for A 2-4, B, R

ALLOWABLE HEIGHTS – stories

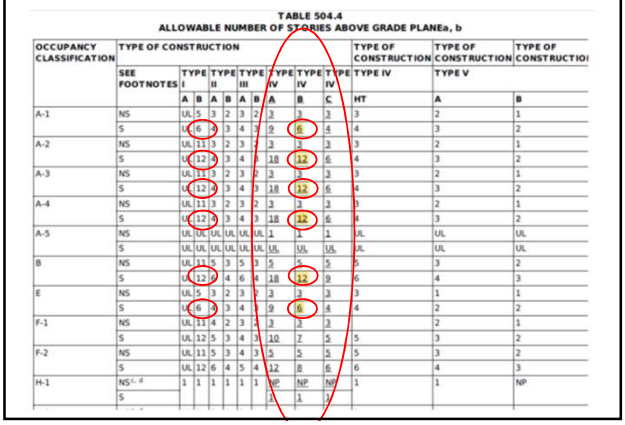
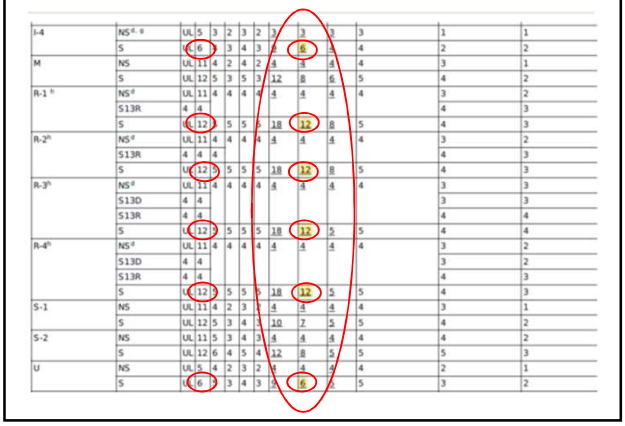


TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANEa, b

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTIO
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE IV	TYPE IV	TYPE V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	9	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
F-1	NS	UL	11	4	2	3	2	3	3	3		2	1
	S	UL	12	5	3	4	3	10	7	5	5	3	2
F-2	NS	UL	11	5	3	4	3	5	5	5	5	3	2
	S	UL	12	6	4	5	4	12	8	6	6	4	3
H-1	NS[c, d]	1	1	1	1	1	1	NP	NP	NP	1	1	NP
	S							1	1	1			

ALLOWABLE HEIGHTS – stories



I-4	NS[d, e]	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
M	NS	UL	11	4	2	4	2	4	4	4	4	3	1
	S	UL	12	5	3	5	3	12	8	6	5	4	2
R-1[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-2[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4								4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-3[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	3
	S13D	4	4									3	3
	S13R	4	4									4	4
	S	UL	12	5	5	5	5	18	12	5	5	4	4
R-4[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13D	4	4									3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	5	5	4	3
S-1	NS	UL	11	4	2	3	2	4	4	4	4	3	1
	S	UL	12	5	3	4	3	10	7	5	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	4	4	4	2
	S	UL	12	6	4	5	4	12	8	5	5	5	3
U	NS	UL	5	4	2	3	2	4	4	4	4	2	1
	S	UL	6	5	3	4	3	9	6	5	5	3	2

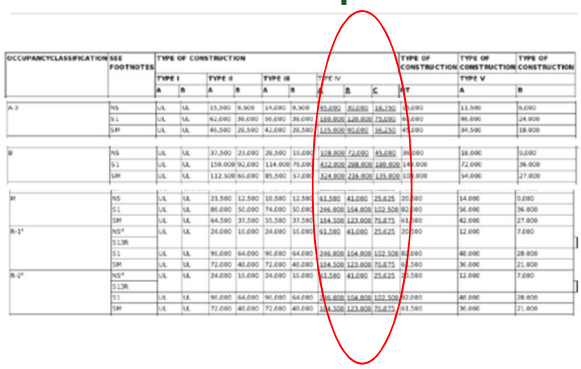
Height and area

Table 506.2, Allowable Area (G84-18):

- Type IV C based on IV HT x 1.25 (with some exceptions)
- Type IV B based on IV HT x 2.0 (with some exceptions)
- Type IV A based on IV HT x 3.0 (with some exceptions)

IVA and IVB much more conservative than UL (taller = smaller fire area, floor)

ALLOWABLE areas – square feet



OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION									TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION
		TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-3	NS	UL	UL	15,500	9,900	14,000	9,900	45,000	30,000	18,750	15,000	11,500	9,000
	S1	UL	UL	62,000	39,000	56,000	39,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	29,500	42,000	29,500	135,000	90,000	56,250	45,000	34,500	18,000
B	NS	UL	UL	37,500	23,000	36,500	15,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	144,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
M	NS	UL	UL	21,500	12,500	10,500	12,500	63,500	41,000	25,625	20,500	14,000	9,000
	S1	UL	UL	86,000	50,000	74,000	50,000	246,000	164,000	102,500	82,000	56,000	36,000
	SM	UL	UL	64,500	37,500	55,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000
R-1*	NS*	UL	UL	24,000	16,000	24,000	16,000	63,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-2*	NS*	UL	UL	24,000	16,000	24,000	16,000	63,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000

Comparison of Fire Area:

	Non-combustible				Mass Timber			
BUILDING	TYPE I		TYPE II		TYPE IV			
ELEMENT	A	B	A	B	A	B	C	HT
Columns	3	2 (1**)	1	1	3	2	2	HT
Primary Frame	3 (2*)	2 (1**)	1	0	3	2	2	HT
Interior Bearing Walls	3 (2*)	2 (1**)	1	0	3	2	2	HT
Floor Assembly	2	2 (1**)	1	0	2	2	2	HT
IBC 403.2.1 reductions: * reduce 1 hour ** reduce 1 hour (except for F-1, H-2, H-3, H-5, M and S-1 occupancy)					no reduction (all fire resistance rating greater or equal than non-combustible)			

EACH Type IV A, B or C FLOOR IS A SEPARATE FIRE AREA FOR:

- A,B,E,F-2,H-4,H-5,I, M,R, & S-2 occ groups

TABLE 707.3.10
FIRE-RESISTANCE RATING REQUIREMENTS FOR FIRE BARRIERS, FIRE WALLS OR HORIZONTAL ASSEMBLIES BETWEEN FIRE AREAS

OCCUPANCY GROUP	FIRE-RESISTANCE RATING (hours)
H-1, H-2	4
F-1, H-3, S-1	3
A, B, E, F-2, H-4, H-5, I, M, R, S-2	2
U	1

Comparison of Fire Area (5 story - R)

Maximum Fire Area Comparison for A-2,3,4,B,R Occupancy Groups (no frontage increase)						
	Type IB (2016 CBC)			Type IVB (proposed 2021 IBC)		
Building # of Stories	Assembly Occupancy	Office Occupancy	Residential Occupancy	Assembly Occupancy	Office Occupancy	Residential Occupancy
1	UL	UL	UL	120,000	288,000	164,000
2	UL	UL	UL	90,000	216,000	123,000
3	UL	UL	UL	90,000	216,000	123,000
4	UL	UL	UL	67,500	162,000	92,250
5	UL	UL	UL	54,000	129,600	73,800
6	UL	UL	UL	45,000	108,000	61,500
7	UL	UL	UL	38,571	92,571	52,714
8	UL	UL	UL	33,750	81,000	46,125
9	UL	UL	UL	30,000	72,000	41,000
10	UL	UL	UL	27,000	64,800	36,900
11	UL	UL	UL	24,545	58,909	33,545
12	UL	UL	UL	22,500	54,000	30,750

Fire Area Comparison of IB (unlimited) vs. IVB vs. IIIA:
Fire Area is each floor for Type IVB: 73,800 sf one floor (147,600 sf if 2 floors open)
Fire Area is entire building for Type IIIA: 3 x 72,000 = 216,000 sf for total building

Comparison of Fire Area (5 story - R)

Maximum Fire Area Comparison for A-2,3,4,B,R Occupancy Groups (no frontage increase)						
	Type IB (2016 CBC)			Type IVB (proposed 2021 IBC)		
Building # of Stories	Assembly Occupancy	Office Occupancy	Residential Occupancy	Assembly Occupancy	Office Occupancy	Residential Occupancy
1	UL	UL	UL	120,000	288,000	164,000
2	UL	UL	UL	90,000	216,000	123,000
3	UL	UL	UL	90,000	216,000	123,000
4	UL	UL	UL	67,500	162,000	92,250
5	UL	UL	UL	54,000	129,600	73,800
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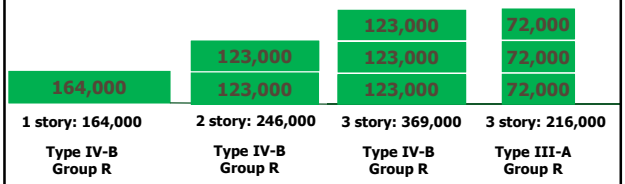
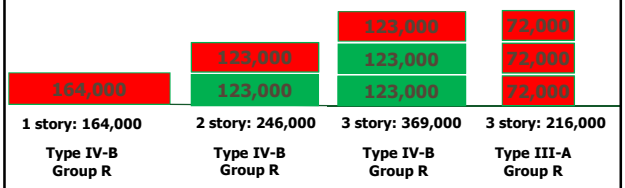
IV B vs IIIA: group R Fire Area Comparison:



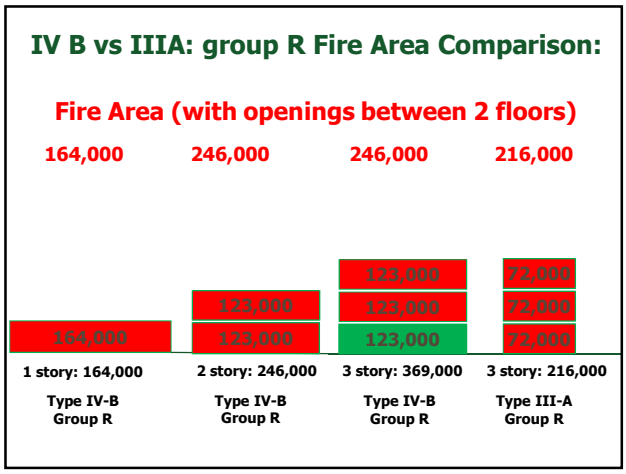
IV B vs IIIA: group R Fire Area Comparison:

Fire Area (with no openings between floors)

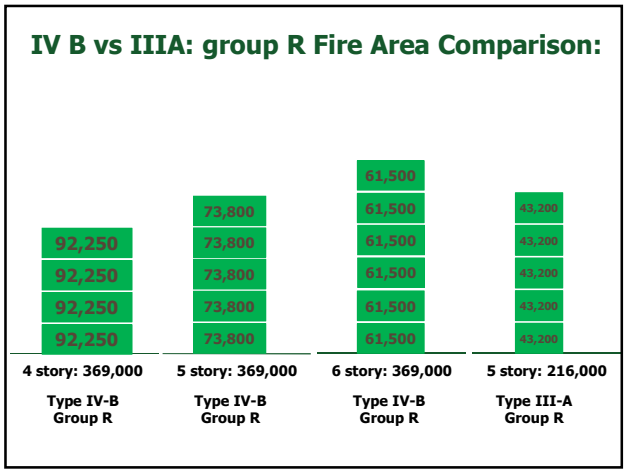
164,000 123,000 123,000 216,000



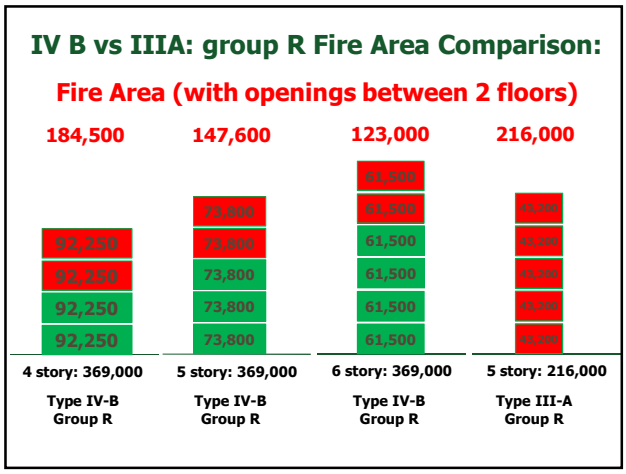
IV B vs IIIA: group R Fire Area Comparison:

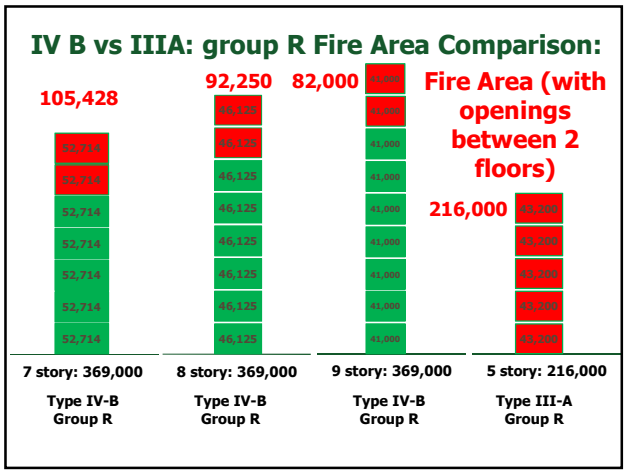


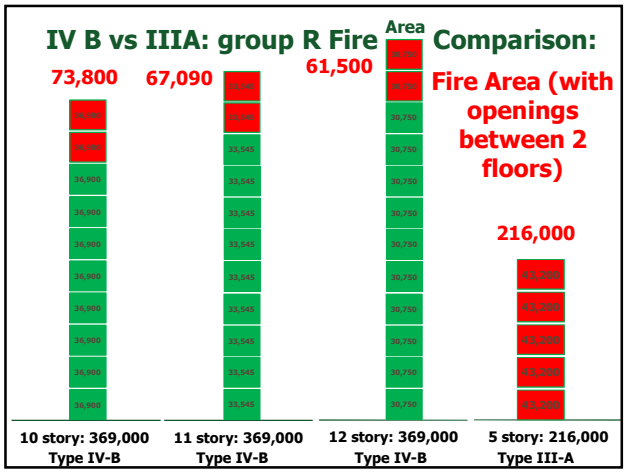
IV B vs IIIA: group R Fire Area Comparison:

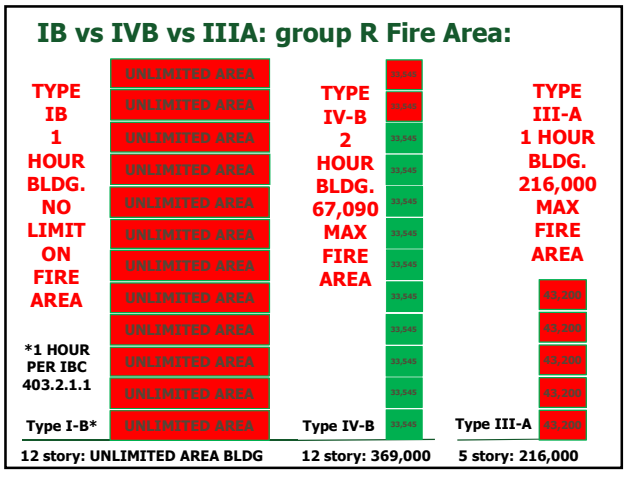


IV B vs IIIA: group R Fire Area Comparison:









TWB Committee Group A Proposals –
ALL APPROVED as submitted OR as modified.

- ✓ G108 New types of construction
- ✓ G75 Height in feet
- ✓ G80 Height in stories
- ✓ G84 Allowable area per floor
- G89 Fire barriers
- G146 Membrane structures with mass timber
- G152 Appendix
- G28 Redundant water supply
- ✓ FS5 Performance based noncombustible protection
- FS6 Sealing of Splices and intersections
- FS73 mass timber as fire blocking
- ✓ FS81 Prescriptive noncombustible protection
- IFC F88 Owners responsibility
- IFC F266 Fire safety during construction

SO LET'S LOOK AT SOME OF THOSE NEW CODE SECTIONS…

Tall Wood Code Changes are Conservative

IV A , IV B proposals more conservative than Type I A , I B:

- All material outboard of the CLT exterior wall must be non-combustible (except weather resistive barrier)
- No one hour reduction allowed in required FRR for supervised sprinkler valves as in IBC 403.2.1
- No combustible light frame walls, floors, shafts or roofs
- In addition to the NC protection (FRR of 2/3 of table 601 FRR), MT has it's own redundant FRR based on size
- Limitations on height, area and number of stories (can not be unlimited area like Type I A and B)
- Minimum of 80 minutes of noncombustible protection also provided for roof construction
- Owner responsibilities for maintenance
- Limits on exposed combustible materials during construction

Questions?

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- info@awc.org
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- Dennis Richardson
- (707) 538-2786
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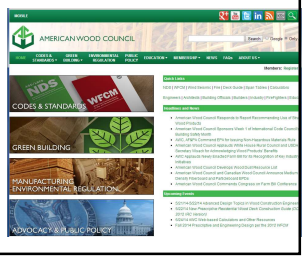
Check out the AWC website:



Thankyou!

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Thank You For Attending

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