AMERICAN WOOD COUNCIL

Mass Timber Buildings and the 2021 IBC

WM1

James B. Smith, P.E..
Intuitive Codes & Consulting

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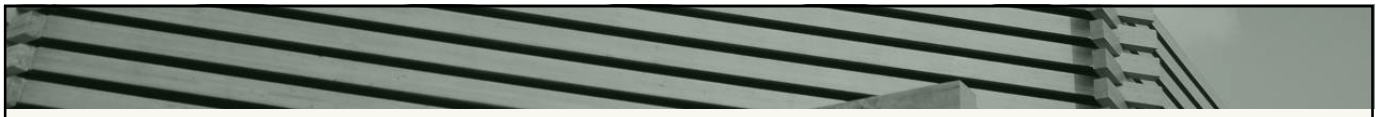

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ICC INTERNATIONAL CODE COUNCIL®

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Slide 1

WM1 Suggest new title since this one belongs to an existing program (DES607)
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Required by our lawyers

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Funding provided in part by the Softwood Lumber Board.

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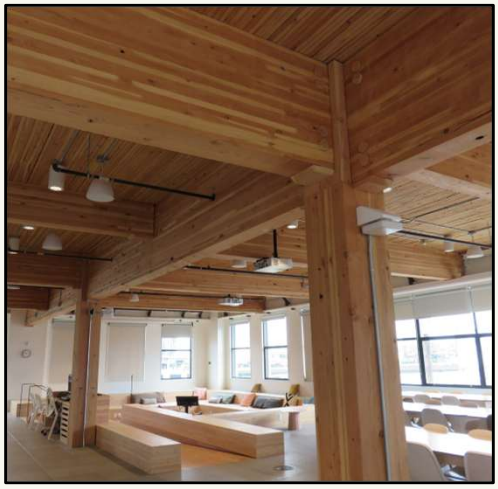
Course Description

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. 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 and the three remaining Group B changes were also approved. These proposals are now part of the 2021 IBC.



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Objectives

1. Identify the make-up of the TWB Ad Hoc Committee and the process used to reach consensus on proposed code changes.
2. 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. List 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. State the fire resistance requirements for mass timber building elements. Further, they will be able to distinguish when and where non-combustible protection can be omitted.

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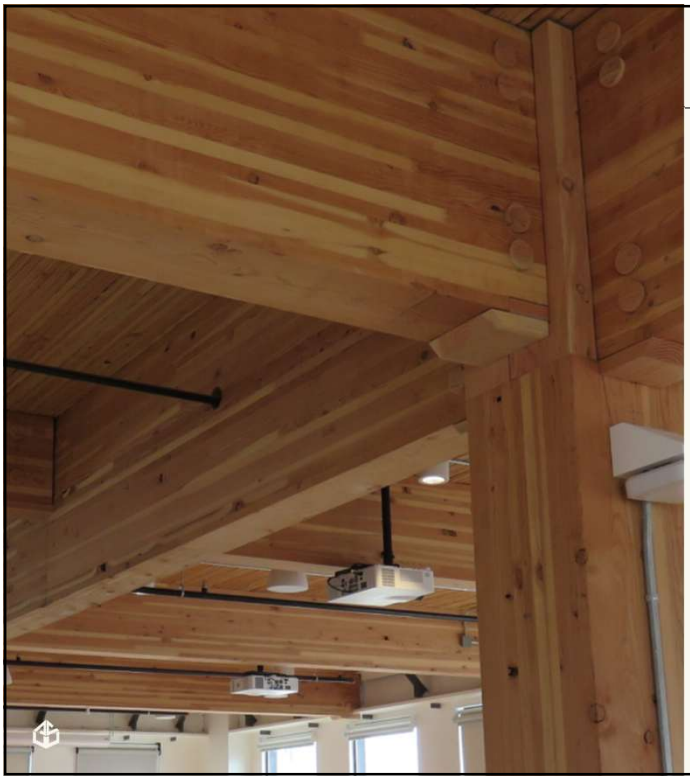

Outline

- **History and Overview**
- TWB Ad-Hoc Committee
- IBC Construction Types
- Building Sizes
- Design of Fire Protection for Mass Timber Connections
- Special Inspection

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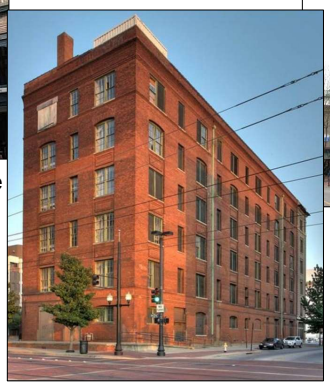
Historical Tall Wood: Heavy Timber

(Type IV-HT)

Kelly, Douglas and Co. Warehouse
Vancouver , BC (c. 1905)



The Purse Building, Dallas, TX, (c. 1905)

Leckie Building
Vancouver, BC (c. 1908)

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Introduction to Mass Timber Products (New definition)

What are all these acronyms?

- Sawn Lumber
  - Heavy Timber – HT
- Glued Laminated Timber
  - Beam or column – Glulam
  - Floor or roof slab – GLT
- Mechanically Laminated Decking
  - Nail-Laminated Timber – NLT
  - Dowel-Laminated Timber – DLT
- Structural Composite Lumber – SCL
  - Laminated Veneer Lumber – LVL
  - Parallel Strand Lumber – PSL
  - Laminated Strand Lumber – LSL
  - Oriented Strand Lumber – OSL
- Cross-Laminated Timber – CLT
- Mass Plywood Panels – MPP

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Glued-laminated Timber (GLT)

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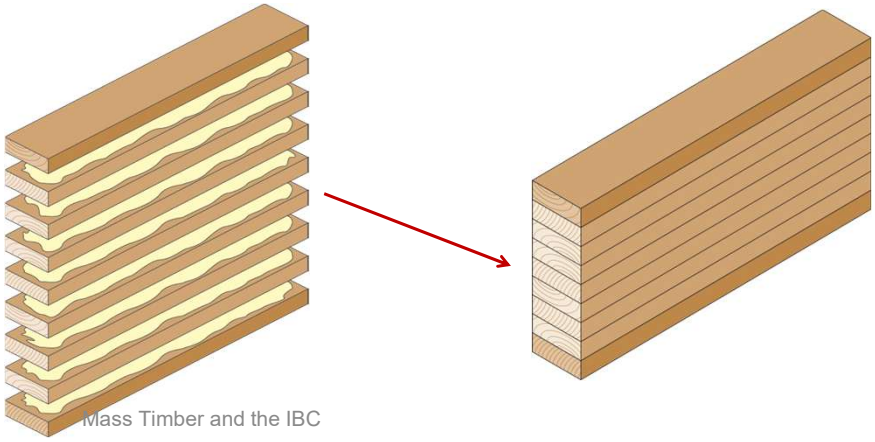
Glued Laminated Timber

- STRUCTURAL GLUED LAMINATED TIMBER = Glued laminated timber = Glulam
  - composite of lumber laminations bonded with adhesives



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Nail Laminated Timber (NLT)

Photo courtesy of Structurecraft

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UNIFORM BUILDING CODE

1967 Edition
Volume I

AUTHORIZED EDITION
Fifth Printing

PRINTED IN THE U.S.A.

(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.

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Structural Composite Lumber (SCL) - defined as heavy timber

Photo provided by Truss Joist

Photo provided by Weyerhaeuser

- **PSL**
  - parallel strand lumber
- **LSL**
  - laminated strand lumber

Photo provided by Structurecraft

Photo provided by Wood Solutions

- **LVL**
  - laminated veneer lumber
- **OSL**
  - oriented strand lumber

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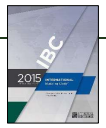
2015 IBC: SCL in Type IV



Structural Composite Lumber (SCL) defined as heavy timber

Minimum Nominal Solid Sawn Size		Minimum Glued Laminated Timber 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	$6^{7}/_{8}$	3½	5½

2021, Table is Table 2304.11

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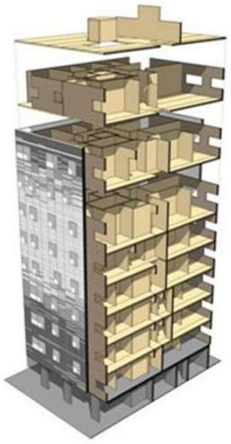
Recently-Developed Forms of Mass Timber



Cross-Laminated Timber (CLT)

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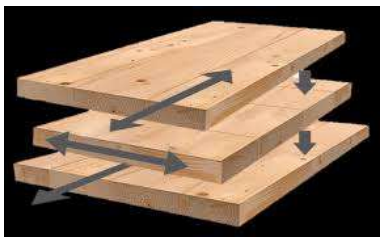
Recently-Developed Forms of Mass Timber

Cross-Laminated Timber (CLT)



- 1985 1st CLT patent - France
- 1993 1st CLT projects - Switzerland and Germany
- 1995-1996 Improved press technology
- 1998 1st multi-story res building - Austria
- Early 2000's
  - CLT use (Europe) increased significantly
  - Green building movement driven
  - Better efficiencies, product approvals, improved marketing and distribution channels
  - Over 500 CLT buildings in England
- Recent - US and Canadian use of CLT

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CLT – WV Elementary School




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CLT and Glulam – Vancouver, BC

Brock Commons

- 18 Stories
- Mixed use student housing
- Glulam columns
- CLT floors


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ASCENT

Construction Progress

Start of Timber Construction
(June 2021)

Thornton Tomasetti

Level 17 Complete
(September 2021)

Level 26 (Roof) Topped Out
(December 2021)

284 feet high
25 stories
Podium 19 over 6

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Mass Timber Buildings From Around The World

Source: ThinkWood

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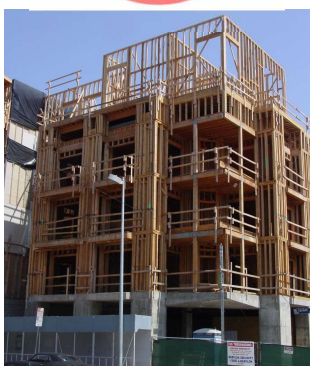
IBC Principles For Heavy Timber And Mass Timber

Mass Timber ≠ **Conventional Light-Frame**

≠



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IBC Principles For Heavy Timber And Mass Timber 2021 IBC

LIGHT WOOD-FRAME **POST + BEAM** **MASS TIMBER**

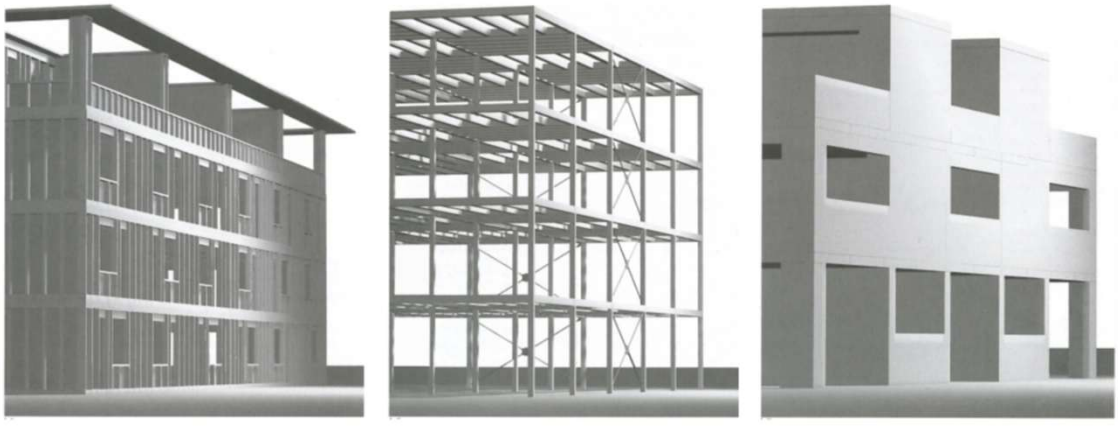

Image courtesy of Fast + Epp

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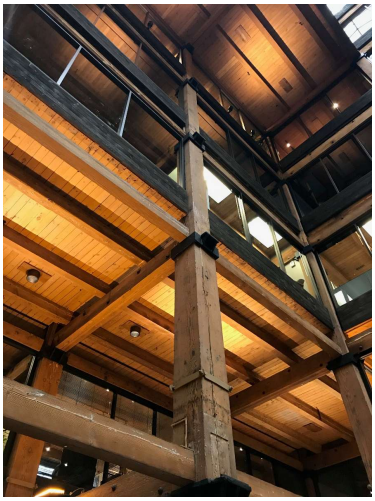
Mass Timber vs. Traditional

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

Type IV-HT



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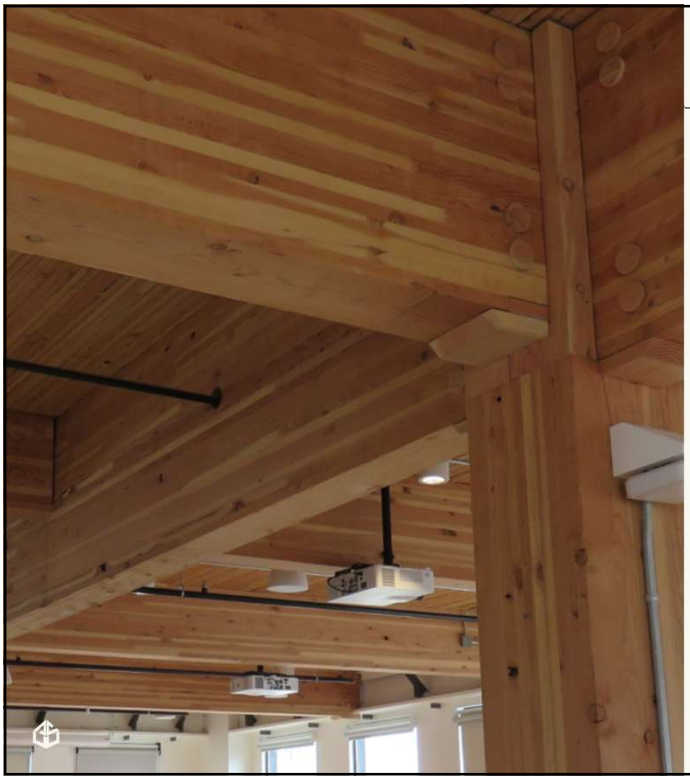

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Supporting Data: CLT Fire Test

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

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Supporting Data: CLT Fire Test

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ICC Ad-Hoc Committee on Tall Wood Buildings (TWB)

PROJECT SCOPE

To explore the building science of tall wood buildings and, if shown to warrant it, investigate the feasibility of and take action on developing code changes for tall wood buildings.

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ICC Tall Wood Ad Hoc Committee

- Consensus committee with necessary balance of stakeholders
- Building and Fire Officials
- Architects and engineers
- Fire protection experts
- Representatives from building construction material industries
- Other construction-related professionals

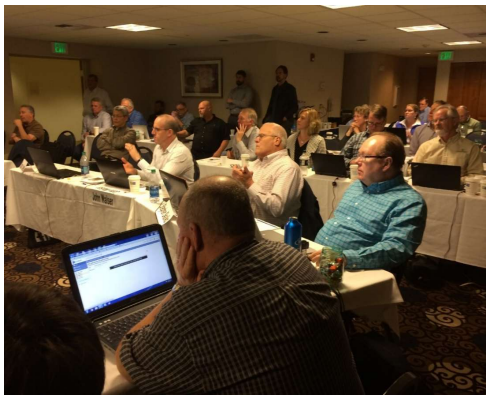

Photo courtesy of Susan Jones, atelierjones

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ICC Tall Wood Ad Hoc Committee

- Four Work Groups appointed
  - Definitions and Standards
  - Fire
  - Structural
  - Codes
- 82 major issues investigated
- Hundreds of reports reviewed
- Performance Objectives discussed

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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

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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.

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The TWB determined…

its comprehensive package of proposals meet these performance objectives.

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Multi-Story Fire Test Structure

- **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

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TWB Committee

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 → 550 MJ/m^2 as tested, 570 MJ/m2
  - fuel load was approximately 85th percentile of Group R fuel loads from survey of Group R's

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TWB Committee

Type Of Construction

- Each Type of Construction based on test conditions in at least 1 of the 5 ATF fire tests
- Fire Test Plan developed by TWB Fire Work Group
- Test Plan included testing of various “generic” connections as recommended by the Structural Work Group
- Both panel mass timber (CLT) and other mass timber (glulam beams and columns) were tested

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ATF Fire Test Scenarios

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 (20% of the total floor area as permitted)	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

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ATF Fire Test Plan

- **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

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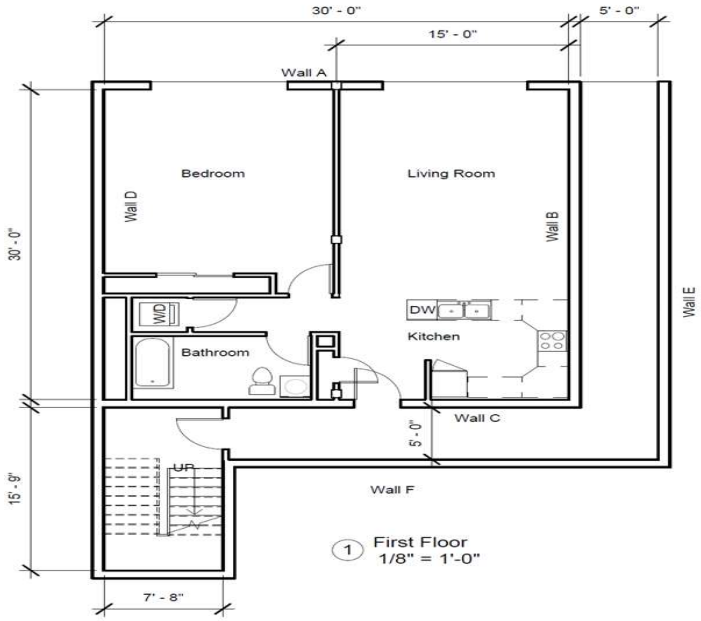

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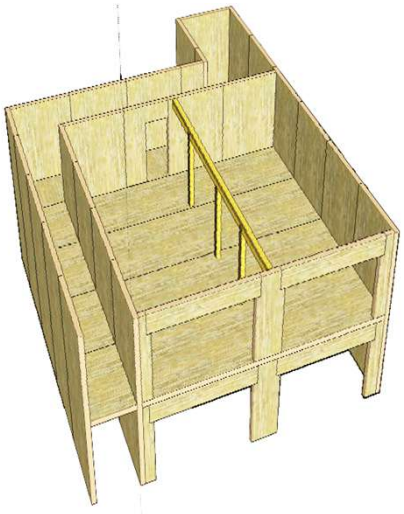
Two-Story Structure

- 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 stairwell



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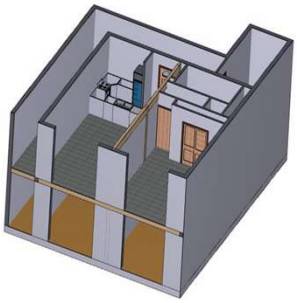
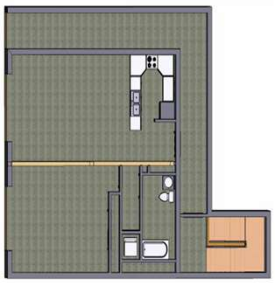
Apartment Layout

- 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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Apartment Furnishings – Bedroom & Bath

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

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Apartment Furnishings – Kitchen & Living Rm

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

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ATF Fire Test #1 - All Mass Timber Protected

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

Any guesses as to what these are??

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ATF Fire Test #1 - All Mass Timber Protected to Burnout

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

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ATF Fire Test #1 – All Mass Timber Protected to Burnout

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ATF Fire Test #1 - All Mass Timber Protected to Burnout

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

1	All mass timber surfaces protected with 2-layers of 5/8" Type X GWB – establishes baseline	5/23/17	3 hours

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ATF Fire Test #2 – 30% CLT Ceilings Exposed

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

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ATF Fire Test #2 – 30% CLT Ceilings Exposed

- 30% of CLT ceiling area in living room and bedroom exposed
- Live load applied using water barrels

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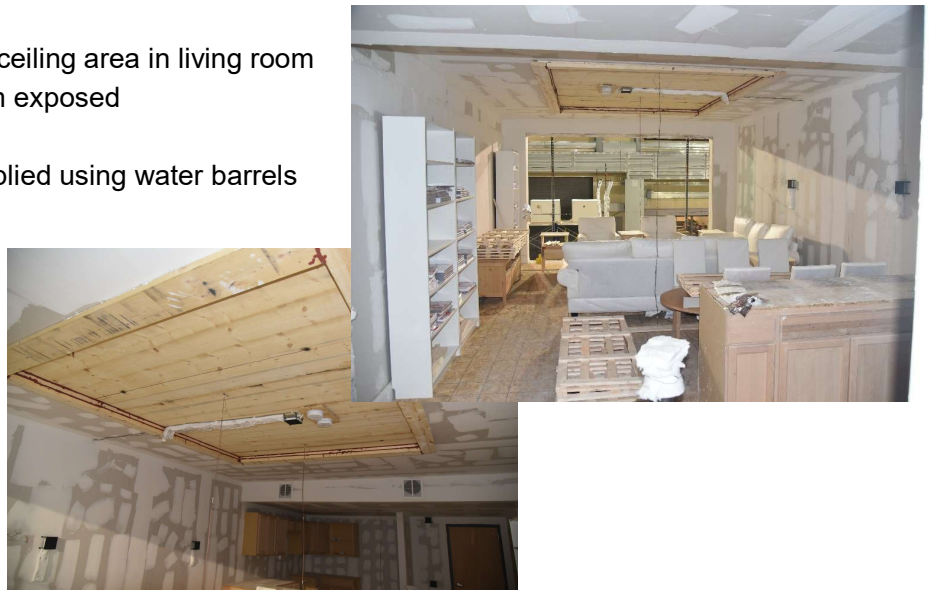
ATF Fire Test #2 – 30% CLT Ceilings Exposed

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

Live load applied using water barrels



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ATF Fire Test #2 - 30% CLT Ceilings Exposed to Burnout


Ignition


Living Room / Kitchen Flashover


Bedroom Flashover


Decay Phase


Living Room Ceiling


Bedroom Ceiling

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

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ATF Fire Test #2 - 30% 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

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Section of Exposed (Obtuse Angle)

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Section of Exposed Ceiling (90º angle)

Protected CLT

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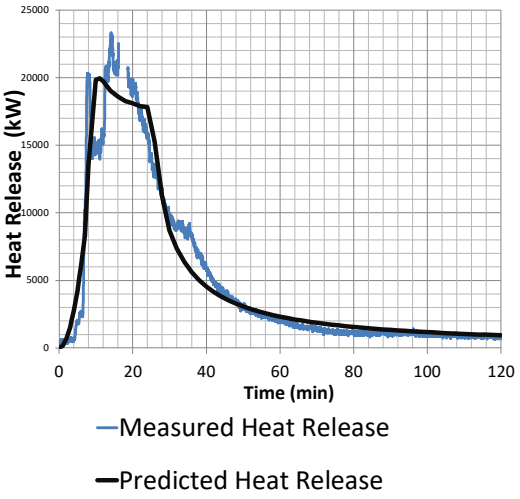
Comparison of Modeling & Measured Data

Comparison of
Heat Release Data

- Modeling conducted by Research Institutes of Sweden (RISE)
- Measured data from ATF #2 with 30% Ceiling exposed



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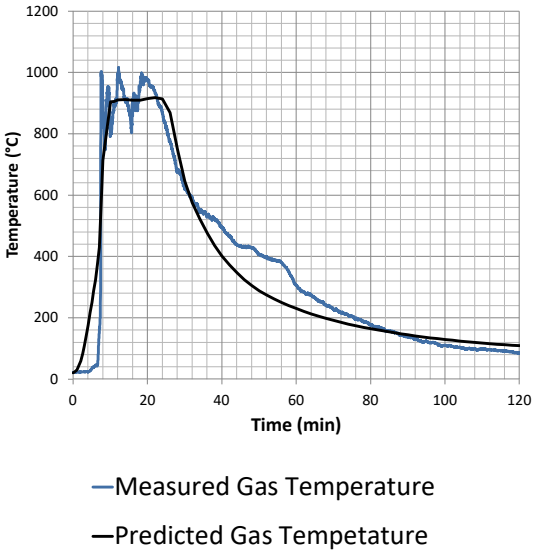
Comparison of Modeling & Measured Data

Comparison of
Ceiling Gas Temperature

- Modeling conducted by Research Institutes of Sweden (RISE)
- Measured data from ATF #2 with 30% Ceiling exposed



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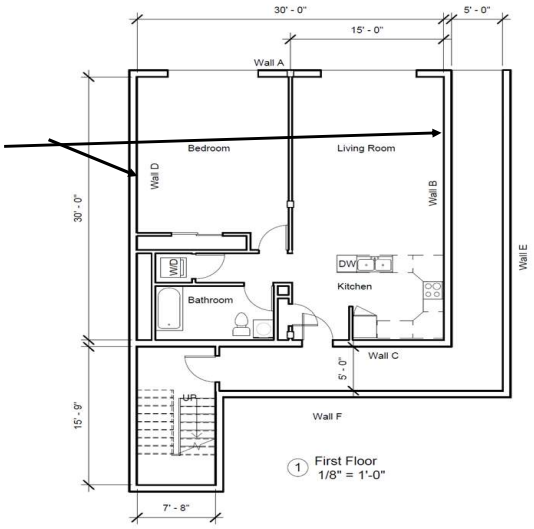
ATF Fire Test #3 – Exposed Walls

Two opposing CLT walls exposed one in bedroom and one in living room (approx. 40% of wall area) – center demising wall is steel stud w/ ½" gypsum



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ATF Fire Test #3 - Walls Exposed to Burnout

Mass Timber Contribution Declining

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ATF Fire Test #4 – Sprinklers, Exposed

All mass timber surfaces fully exposed in bedroom and living room
Sprinkler – normal activation




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ATF Fire Test #4 – Sprinklers, Exposed

All mass timber surfaces fully exposed in bedroom and living room
Sprinkler – normal activation

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ATF 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

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ATF Fire Test Results – Event Log

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

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

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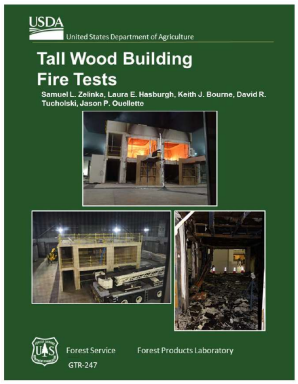
ATF Fire Tests

Full Report on FPL Website:

https://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr247.pdf

Fire Test Videos on AWC Website:

https://awc.org/resource hub/?gsearch=ATF+FIRE



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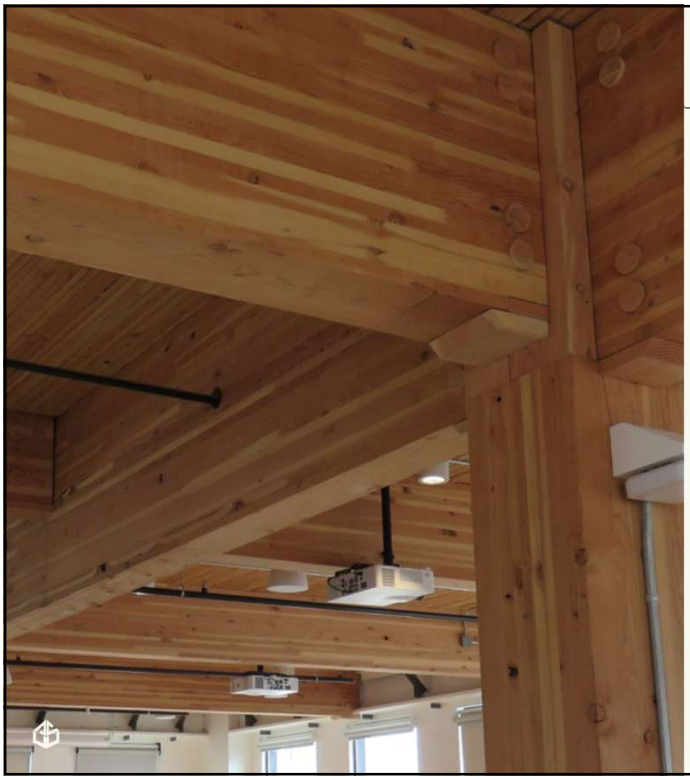

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TWB Committee Proposals

TWB Product

- 14 code change proposals to-date; hundreds of code sections reviewed
- 3 new types of construction proposed
- 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)

ALL 14 PROPOSALS WERE APPROVED AS RECOMMENDED

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TWB Committee

TWB Product

- Revise IBC Section 602.4 to reflect 3 new types of construction: IV-A, IV-B, and IV-C
- "Do no harm" to existing heavy timber (formerly known at Type IV)
- Rename heavy timber to IV-HT (throughout code when referring to heavy timber as a type of construction)
- Be sure to say heavy timber in sections where building elements are permitted to be "heavy timber" such as roof structure in Types I & II

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TWB Committee

Definitions

- *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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Minimum Sizes for Mass Timber

DESIGNATED IN Sections 602.4 and 2304.11

CLT minimum thicknesses

- Floors – 4" actual
- Roofs – 3" nominal
- Exterior Walls in Type IV – 6" with limitations (see 602.4.2)

Table 2304.11 MINIMUM DIMENSIONS OF HEAVY TIMBER STRUCTURAL MEMBERS

Supporting	Min. Nom. Solid Sawn Size		Min. Glulam Net Size		Min. SCL Net Size	
	Width (in.)	Depth (in.)	Width (in.)	Depth (in.)	Width (in.)	Depth (in.)
Floor or Floor/Roof	8	8	6¾	8¼	7	7½
	6	10	5	10½	5¼	9½
Roof Only	6	8	5	8¼	5¼	7½
	6	6	5	6	5¼	5½
	4	6	3	6 7/8	3½	5½

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TWB Committee

Definitions

- *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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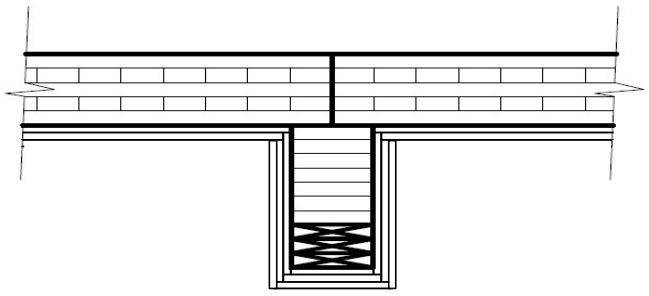
Noncombustible Time Contribution

722.7 Fire-resistance rating of mass timber. The required fire resistance of mass timber elements in Section 602.4 shall be determined in accordance with Section 703.2. The fire resistance rating of building elements shall be as required in Tables 601 and 705.5 and as specified elsewhere in this code. The fire-resistance rating of the mass timber elements shall consist of the fire resistance of the unprotected element added to the protection time of the noncombustible protection.



IV-A

IV-B

IV-C

2/3 fire protection rating must come from non-combustible material

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Noncombustible Protection as It Relates to Mass Timber

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	25
5/8 inch Type X Gypsum Board	40

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Types of Construction

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

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame [f] (see Section 202)	3[a,b]	2[a,b,c]	1[b,c]	0[c]	1[b,c]	0	3[a]	2[a]	2[a]	HT	1[b,c]	0
Bearing walls Exterior [e, f] Interior	3 3[a]	2 2[a]	1 1	0 0	2 1	2 0	3 3	2 2	2 2	2 1/HT[g]	1 1	0 0
Nonbearing walls and partitions – Exterior	See Table 705.5											
Nonbearing walls and partitions – Interior [d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	1 ½[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	1 ½	1	1	HT	1[b,c]	0

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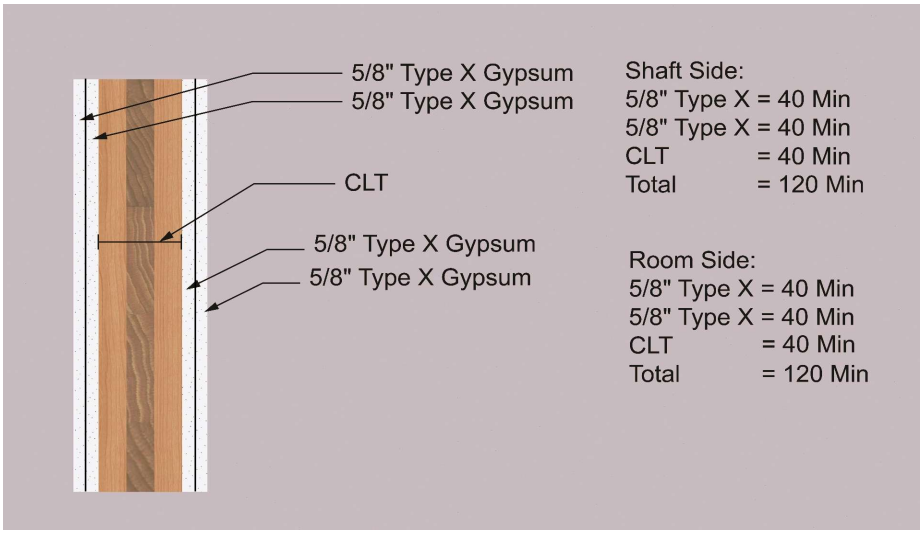
Section 722.6 – Additive Method



IBC 2021

IV-A

IV-B

Noncombustible protection shall provide 2/3 of the required Fire Resistance Rating for Building Elements (Table 601, 602)

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TWB Committee

Definitions

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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WM1

TWB Committee

Definitions

PRIMARY STRUCTURAL FRAME. The primary structural frame shall include all of the following structural members:

1. The columns.
2. Structural members having direct connections to the columns, including girders, beams, trusses and spandrels.
3. Members of the floor construction and roof construction having direct connections to the columns.
4. ~~Bracing~~ Members that are essential to the vertical stability of the primary structural frame under gravity loading ~~shall be considered part of the primary structural frame whether or not the bracing member carries gravity *loads.*~~

SECONDARY MEMBERS. The following structural members shall be considered secondary members and not part of the *primary structural frame*:

1. Structural members not having direct connections to the columns.
2. Members of the floor construction and roof construction not having direct connections to the columns.
3. Bracing members ~~other than those that are part of the *primary structural frame*.~~ that are not designated as part of a primary structural frame or bearing wall.

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TWB Committee

Definitions

PRIMARY STRUCTURAL FRAME. The primary structural frame shall include all the following structural members:

1. The columns.
2. Structural members having direct connections to the columns, including girders, beams, trusses and spandrels.
3. Members of the floor construction and roof construction having direct connections to the columns.
4. ~~Bracing~~ Members that are essential to the vertical stability of the primary structural frame under gravity loading ~~shall be considered part of the primary structural frame whether or not the bracing member carries gravity *loads.*~~

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Slide 73

WM1 Too much text on this slide. I suggest breaking it into two slides as provided in following hidden slides.
Weeber, Marcie, 2023-03-24T13:40:48.224

TWB Committee

Definitions

SECONDARY MEMBERS. The following structural members shall be considered secondary members and not part of the *primary structural frame*:

1. Structural members not having direct connections to the columns.
2. Members of the floor construction and roof construction not having direct connections to the columns.
3. Bracing members ~~other than those that are part of the *primary structural frame*.~~ that are not designated as part of a primary structural frame or bearing wall.

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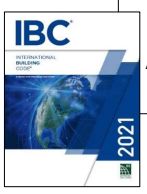
2021 IBC Construction Types

Type of Construction -- Comparison			
Feature	**Type IV-A**	**Type IV-B**	**Type IV-C**
Description of New Construction Types	100% Noncombustible (NC) protection on all surfaces of Mass Timber (MT)	100% NC protection on all surfaces of mass timber (MT) except for limited exposed mass timber (MT) elements	100% 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
Non-loadbearing Exterior Walls	MT or NC	MT or NC	MT or NC
Non-loadbearing Interior Walls	MT or NC	MT or NC	MT or NC
Shaft and Exit Enclosures			
Highrise* to 12 stories or 180 ft: *see IBC definition of highrise Above 12 stories or 180 feet:	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



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Types of Construction

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

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame [f] (see Section 202)	3[a,b]	2[a,b,c]	1[b,c]	0[c]	1[b,c]	0	3[a]	2[a]	2[a]	HT	1[b,c]	0
Bearing walls Exterior [e, f] Interior	 3 3[a]	 2 2[a]	 1 1	 0 0	 2 1	 2 0	 3 3	 2 2	 2 2	 2 1/HT[g]	 1 1	 0 0
Nonbearing walls and partitions – Exterior	See Table 705.5											
Nonbearing walls and partitions – Interior [d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	1 ½[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	1 ½	1	1	HT	1[b,c]	0

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TWB Committee Proposals

Type of Construction

TYPE IV-A Mass Timber with noncombustible protection

- Noncombustible protection shall provide 2/3 of the required Fire Resistance Rating for Building Elements (Table 601, 602)
- Taller buildings therefore not permitted to have exposed mass timber

TYPE IV-B Mass Timber with limited portions of noncombustible protection omitted

- limits on how much mass timber can be exposed
- limits on how close exposed areas can be to one another

TYPE IV-C Mass Timber with no requirement for noncombustible protection, except certain features

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TWB Committee Proposals

Type of Construction

TYPE IV-A Mass Timber with noncombustible protection

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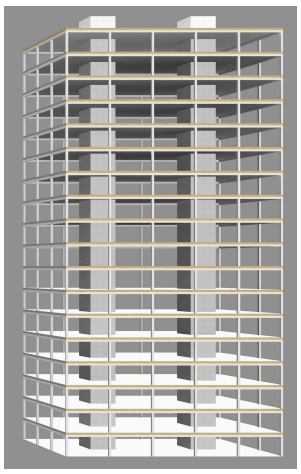
- limits on how much mass timber can be exposed
- limits on how close exposed areas can be to one another

TYPE IV-C Mass Timber with no requirement for noncombustible protection, except certain features

79

Type of Construction IV-A



IV-A

IBC 2021

Building Elements	
Maximum Height	270’
Number of Stories (except H’s)	9 - 18
Exposed Mass Timber	Fully Protected
Sprinklers	Yes
Primary Frame FRR	3 hours
Floor FRR	2 hours
FRR from Noncom Protection	120 minutes
Stairs Tower	Non-combustible
Concealed Spaces	OK if protected
Floor Topping	Noncombustible

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80

TWB Committee Proposals

Type of Construction

TYPE IV-A Mass Timber with noncombustible protection

- Noncombustible protection shall provide 2/3 of the required Fire Resistance Rating for Building Elements (Table 601, 602)
- Taller buildings therefore not permitted to have exposed mass timber

TYPE IV-B Mass Timber with limited portions of noncombustible protection omitted

- limits on how much mass timber can be exposed
- limits on how close exposed areas can be to one another

TYPE IV-C Mass Timber with no requirement for noncombustible protection, except certain features

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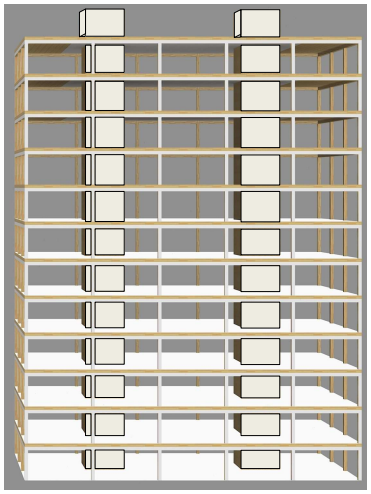
Type of Construction IV-B



IV-B

IBC 2021

Building Elements	
Maximum Height	180’
Number of Stories (except H’s)	6 - 12
Exposed Mass Timber	Partially
Sprinklers	Yes
Primary Frame FRR	2 hours
Floor FRR	2 hours
FRR from Noncom Protection	80 minutes
Stairs Tower	Protected mass timber
Concealed Spaces	OK if protected
Floor Topping	Noncombustible

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2021 IBC 602.4.2 Type IV-B

602.4.2.2.2 Protected Area. Interior faces of 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 and walls complying with one of the following:

   1.1 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.

   1.2 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.

   1.3 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.

Noncombustible Protection in 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

   Increased to 100% in the 2024 IBC

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.

TWB Committee Proposals

Type of Construction

TYPE IV-A Mass Timber with noncombustible protection

- Noncombustible protection shall provide 2/3 of the required Fire Resistance Rating for Building Elements (Table 601, 602)
- Taller buildings therefore not permitted to have exposed mass timber

TYPE IV-B Mass Timber with limited portions of noncombustible protection omitted

- limits on how much mass timber can be exposed
- limits on how close exposed areas can be to one another

TYPE IV-C Mass Timber with no requirement for noncombustible protection, except certain features

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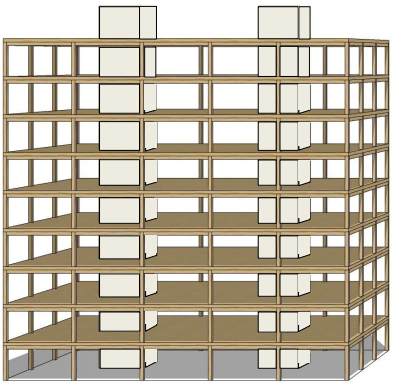
Type of Construction IV-C



IV-C

IBC 2021

Building Element	
Maximum Height	85’
Number of Stories	4 - 9
Exposed Mass Timber	Fully Exposed
Sprinklers	Yes
Primary Frame FRR	2 hours
Floor FRR	2 hours
Stairs Tower	Protected mass timber
FRR from Non-com Protection	0 hours
Concealed Spaces	OK if Protected
Floor Topping	No requirement

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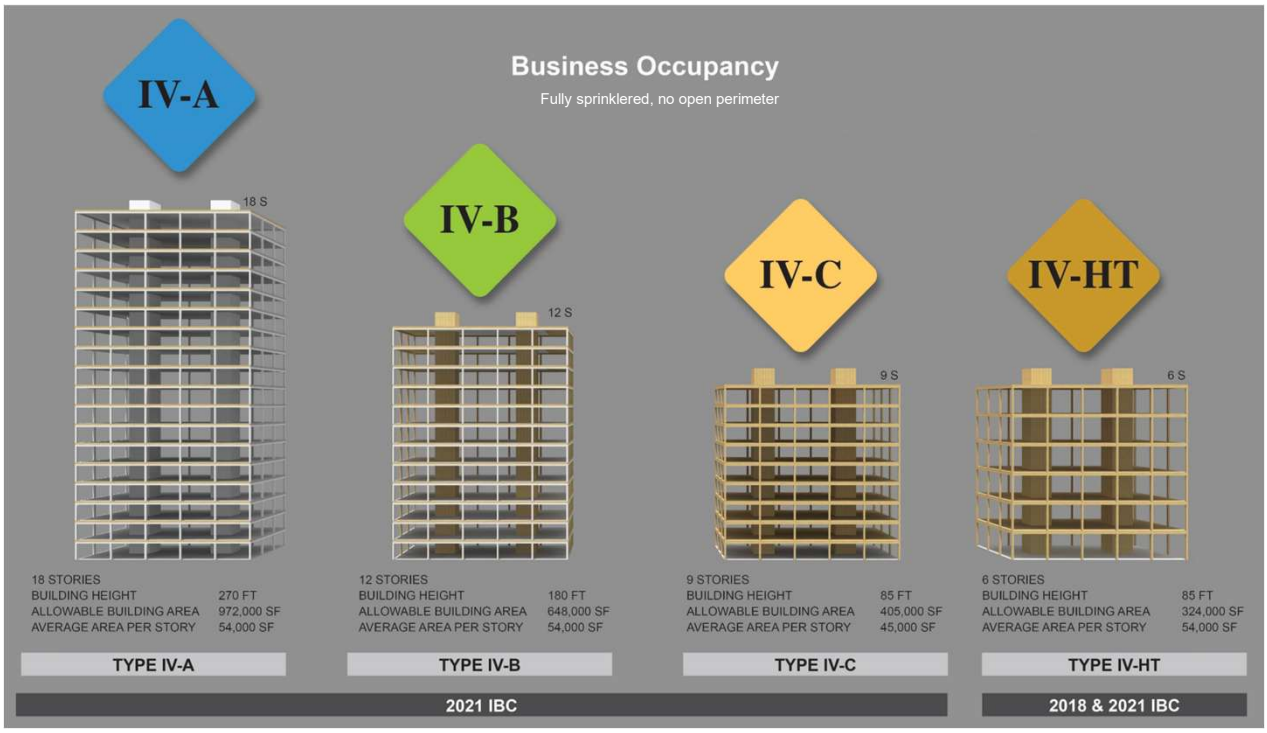

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IBC Section 602.4 Requirements

- Mass Timber elements shall have noncombustible protection as specified in 602.4.
- Mass Timber elements shall have a fire resistance rating shown in Tables 601 & 602
- Mass Timber CLT elements shall be tested and labeled for Heat Performing Adhesives
- All building elements including load-bearing and nonload-bearing walls and partitions must be mass timber or noncombustible construction (no combustible light frame)
- No combustibles allowed in concealed spaces except those currently allowed in plenums (e.g., insulated wires, etc.)
- In Types IV-A and IV-B, floors must have minimum 1-inch noncombustible material above the mass timber

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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
Required on outside
of exterior walls for
Type IV-A, B and C

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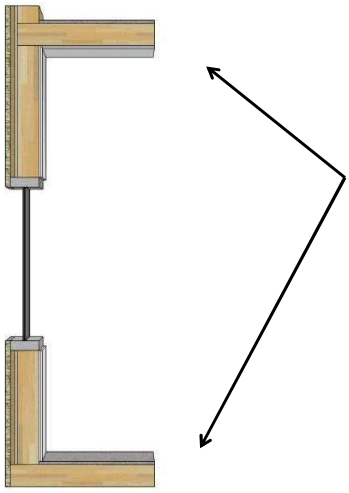
IBC Type IV-A Exterior Wall Covering



- 3 Hr. Fire Resistance Rating (Table 601)
- 2/3 must be from noncombustible protection
- 2 Hr. Fire Resistance rating from noncombustible protection
- 2 Hr. FRR = 3 layers 5/8 in. Type X GWB
- 40 min. X 3 layers = 120 min or 2 hrs.

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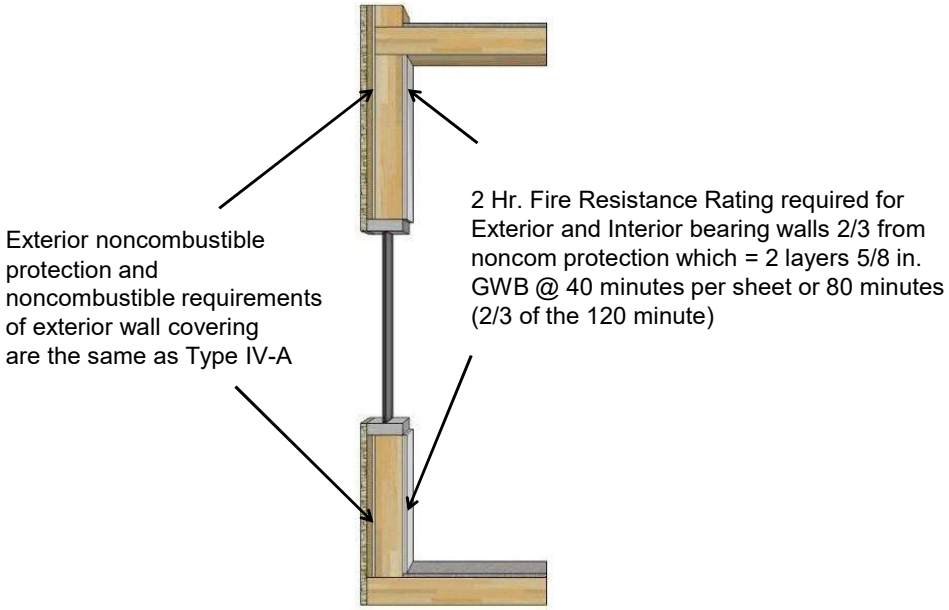
IBC Type IV-B Exterior Wall Section



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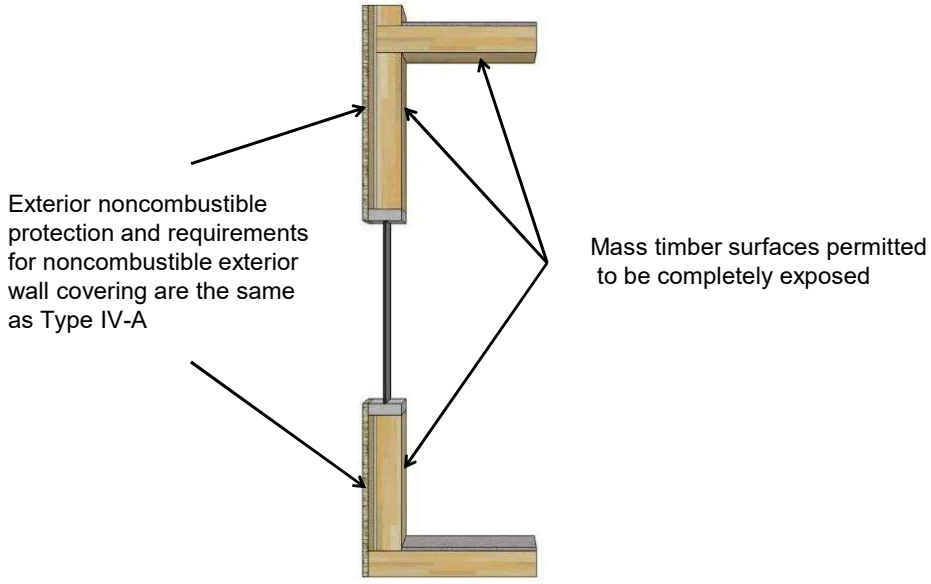
IBC Type IV-C Exterior Wall Section



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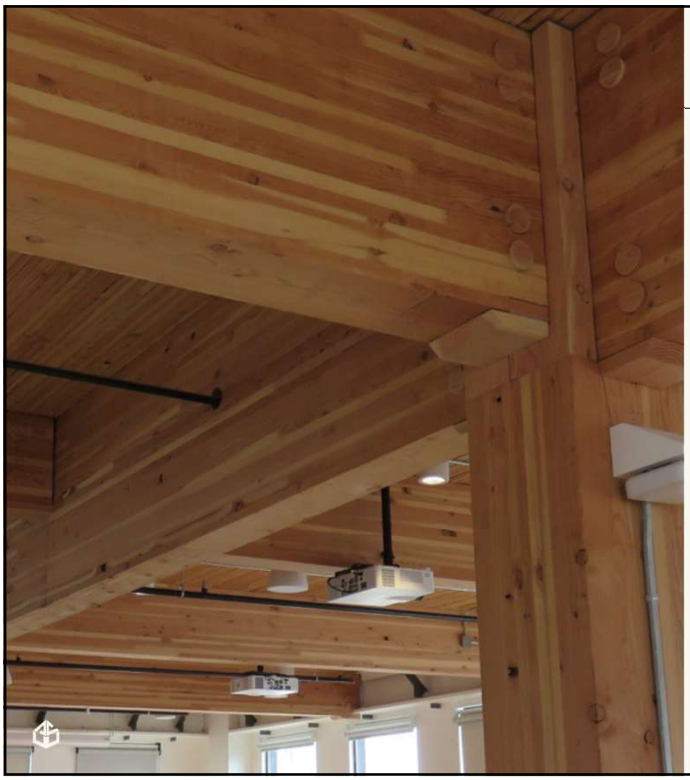

Outline

- **History and Overview**
- TWB Ad-Hoc Committee
- IBC Construction Types
- **Building Sizes**
- Design of Fire Protection for Mass Timber Connections
- Special Inspection

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Mass Timber Fire-Resistance Design

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

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame [f] (see Section 202)	3[a,b]	2[a,b,c]	1[b,c]	0[c]	1[b,c]	0	3[a]	2[a]	2[a]	HT	1[b,c]	0
Bearing walls Exterior [e, f] Interior	3 3[a]	2 2[a]	1 1	0 0	2 1	2 0	3 3	2 2	2 2	2 1/HT[g]	1 1	0 0
Nonbearing walls and partitions – Exterior	See Table 705.5											
Nonbearing walls and partitions – Interior [d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	1 ½[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	1 ½	1	1	HT	1[b,c]	0

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TD1

Allowable Heights – Table 504.3

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE [a]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	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, 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

No changes to footnotes.

IV-A

IV-B

IV-C

Allowable Stories – Table 504.4

ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE[a] [b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	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-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	6	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	4	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

WM2

V-A

V-B

V-C

Slide 95

TD1 Please explain the wording at the end of the table. Not sure I understand. Lines not in line with column.
Tyree, David, 2023-03-25T02:53:56.731

WM1 0 [@Tyree, David] I have no idea what the wording at the end of the table means. welp. I didn't change any content. That was what was already there. Tried to line up the lines better.
Weeber, Marcie, 2023-03-27T13:59:53.010

Slide 96

WM1 Random callout here.
Weeber, Marcie, 2023-03-24T13:54:21.917

WM2 Random call out here
Weeber, Marcie, 2023-03-24T13:54:41.125

Allowable Stories – Table 504.4 (cont'd)

ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE[a, b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	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
H-1	NS[c,d]	1	1	1	1	1	1	NP	NP	NP	1	1	NP
	S							1	1	1			
H-2	NS[c,d]	UL	3	2	1	2	1	1	1	1	2	1	1
	S							2	2	2			
H-3	NS[c,d]	UL	6	4	2	4	2	3	3	3	4	2	1
	S							4	4	4			
H-4	NS[c,d]	UL	7	5	3	5	3	5	5	5	5	3	2
	S	UL	8	6	4	6	4	8	7	6	6	4	3
H-5	NS[c,d]	4	4	3	3	3	3	2	2	2	3	3	2
	S							3	3	3			
I-1 Condition 1	NS[d,e]	UL	9	4	3	4	3	4	4	4	4	3	2
	S	UL	10	5	4	5	4	10	7	5	5	4	3
I-1 Condition 2	NS[d,e]	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NS[d,f]	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
I-3	NS[d,e]	UL	4	2	1	2	1	2	2	2	2	2	1
	S	UL	5	3	2	3	2	7	5	3	3	3	2
I-4	NS[d,g]	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

IV-A

IV-B

IV-C

IV-C = IV-HT with exceptions

Allowable Stories – Table 504.4 (cont'd)

ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE[a, b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	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
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	34	4	34	10	7	5	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	4	4-5	4	2
	S	UL	12	6	4	5	4	12	8	5	5-6	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

IV-A

IV-B

IV-C

Allowable Areas – Table 506.2

ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D OR SM, as applicable) IN SQUARE FEET[a,b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		A	B	A	B	A	B	A 3xHT	B 2xHT	C 1.25xHT	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1												
	SM												
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	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
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500

IV-A

IV-B

IV-C

General approach with exceptions.

99

99

Allowable Areas – Table 506.2 (cont'd)

ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D OR SM, as applicable) IN SQUARE FEET[a,b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		A	B	A	B	A	B	A 3xHT	B 2xHT	C 1.25xHT	HT	A	B
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500	14,000	8,500
	S1	UL	UL	100,000	62,000	76,000	48,000	402,000	268,000	167,500	134,000	56,000	34,000
	SM	UL	UL	75,000	46,500	57,000	36,000	301,500	201,000	125,625	100,500	42,000	25,500
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	151,500	101,000	63,125	50,500	21,000	13,000
	S1	UL	UL	150,000	92,000	114,000	72,000	606,000	404,000	252,500	202,000	84,000	52,000
	SM	UL	UL	112,500	69,000	85,500	54,000	454,500	303,000	189,375	151,500	63,000	39,000
H-1	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	NP
	S1												
H-2	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	3,000
	S1												
	SM												
H-3	NS[c]	UL	60,000	26,500	14,000	17,500	13,000	25,500	25,500	25,500	25,500	10,000	5,000
	S1												
	SM												
H-4	NS[c,d]	UL	UL	37,500	17,500	28,500	17,500	72,000	54,000	40,500	36,000	18,000	6,500
	S1	UL	UL	150,000	70,000	114,000	70,000	288,000	216,000	162,000	144,000	72,000	26,000
	SM	UL	UL	112,500	52,500	85,500	52,500	216,000	162,000	121,500	108,000	54,000	19,500
H-5	NS[c,d]	UL	UL	37,500	23,000	28,500	19,000	72,000	54,000	40,500	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	288,000	216,000	162,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	216,000	162,000	121,500	108,000	54,000	27,000

IV-A

IV-B

IV-C

100

100

Allowable Areas – Table 506.2 (cont'd)

ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D OR SM, as applicable) IN SQUARE FEET[a,b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		A	B	A	B	A	B	A 3xHT	B 2xHT	C 1.25xHT	HT	A	B
I-1	NS[d,e]	UL	55,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	18,000	10,500	4,500
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000	42,000	18,000
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000	31,500	13,500
I-2	NS[d,f]	UL	UL	15,000	11,000	12,000	NP	36,000	24,000	12,000	12,000	9,500	NP
	S1	UL	UL	60,000	44,000	48,000	NP	144,000	96,000	48,000	48,000	38,000	NP
	SM	UL	UL	45,000	33,000	36,000	NP	108,000	72,000	36,000	36,000	28,500	NP
I-3	NS[d,e]	UL	UL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000	7,500	5,000
	S1	UL	UL	60,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000	30,000	20,000
	SM	UL	UL	45,000	30,000	31,500	22,500	108,000	72,000	36,000	36,000	22,500	15,000
I-4	NS[d,g]	UL	60,500	26,500	13,000	23,500	13,000	76,500	51,000	25,500	25,500	18,500	9,000
	S1	UL	121,000	106,000	52,000	94,000	52,000	306,000	204,000	102,000	102,000	74,000	36,000
	SM	UL	181,500	79,500	39,000	70,500	39,000	229,500	153,000	76,500	76,500	55,500	27,000
M	NS	UL	UL	21,500	12,500	18,500	12,500	61,500	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

IV-A

IV-B

IV-C

Allowable Areas – Table 506.2 (cont'd)

ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D OR SM, as applicable) IN SQUARE FEET[a,b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		A	B	A	B	A	B	A 3xHT	B 2xHT	C 1.25xHT	HT	A	B
R-1[h]	NS[d]	UL	UL	24,000	16,000	24,000	16,000	61,500	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[h]	NS[d]	UL	UL	24,000	16,000	24,000	16,000	61,500	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-3[h]	NS[d]	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S13D												
	S13R												
	S1												
	SM												
R-4[h]	NS[d]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13D												
	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

IV-A

IV-B

IV-C

General approach with exceptions.

Allowable Areas – Table 506.2 (cont'd)

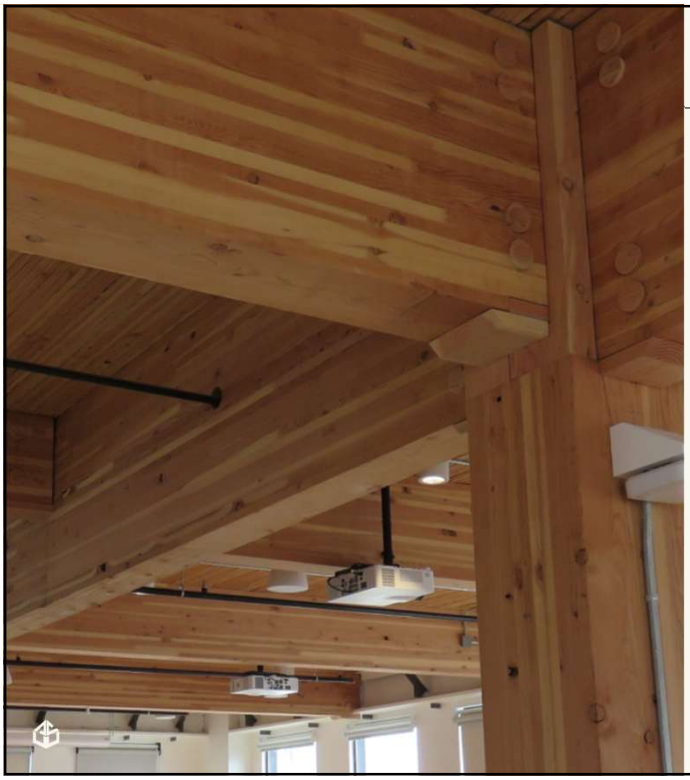
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D OR SM, as applicable) IN SQUARE FEET[a,b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		A	B	A	B	A	B	A 3xHT	B 2xHT	C 1.25xHT	HT	A	B
S-1	NS	UL	48,000	26,000	17,500	26,000	17,500	76,500	51,000	31,875	25,500	14,000	9,000
	S1	UL	192,000	104,000	70,000	104,000	70,000	306,000	204,000	127,500	102,000	56,000	36,000
	SM	UL	144,000	78,000	52,500	78,000	52,500	229,500	153,000	95,625	76,500	42,000	27,000
S-2	NS	UL	79,000	39,000	26,000	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500
	S1	UL	316,000	156,000	104,000	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
	SM	UL	237,000	117,000	78,000	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500
U	NS[j]	UL	35,500	19,000	8,500	14,000	8,500	54,000	36,000	22,500	18,000	9,000	5,500
	S1	UL	142,000	76,000	34,000	56,000	34,000	216,000	144,000	90,000	72,000	36,000	22,000
	SM	UL	106,500	57,000	25,500	42,000	25,500	162,000	108,000	67,500	54,000	27,000	16,500

IV-A

IV-B

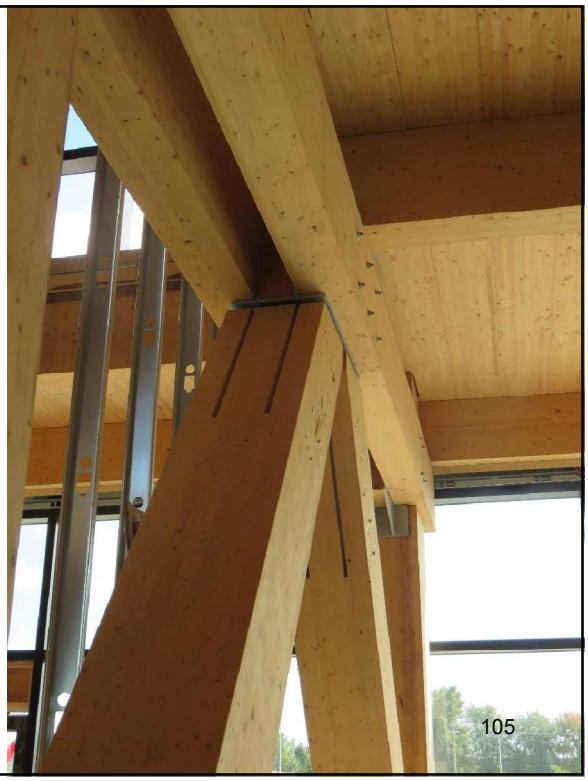
IV-C



Outline

- History and Overview
- TWB Ad-Hoc Committee
- IBC Construction Types
- Building Sizes
- **Design of Fire Protection for Mass Timber Connections**
- Special Inspection

Design of Fire Protection for Mass Timber Connections



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Fire-Resistive Connection Protection

704.2 Column protection. Where columns are required to have protection to achieve a *fire-resistance rating*, the entire column shall be provided individual encasement protection by protecting it on all sides for the full column height, including connections to other structural members, with materials having the required *fire-resistance rating*. Where the column extends through a ceiling, the encasement protection shall be continuous from the top of the foundation or floor/ceiling assembly below through the ceiling space to the top of the column.

704.3 Protection of the primary structural frame other than columns. Members of the primary structural frame other than columns that are required to have protection to achieve a *fire-resistance rating* and support more than two floors or one floor and roof, or support a load-bearing wall or a nonload-bearing wall more than two stories high, shall be provided individual encasement protection by protecting them on all sides for the full length, including connections to other structural members, with materials having the required *fire-resistance rating*.

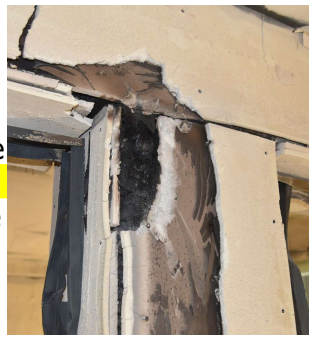
106

Fire-Resistive Connection Protection

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

IV-A IV-B IV-C

1. Testing in accordance with Section 703.2 where the connection is a part of the fire-resistance test.
2. Engineering analysis that demonstrates that the temperature rise at any portion of the connection is limited to an average temperature rise of 250°F, and a maximum temperature rise of 325°F, for a time corresponding to the required fire-resistance rating of the structural element being connected. For the purposes of this analysis, the connection includes connectors, fasteners, and portions of wood members included in the structural design of the connection.



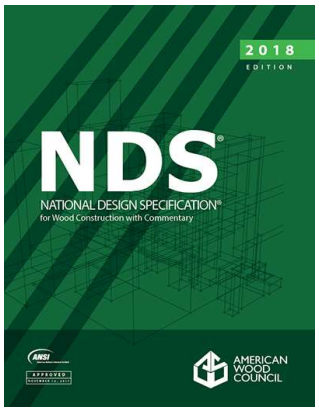
Beam-to-column connection tested at ATF Fire Research Lab.

But we can't test every connection!

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

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

2. Engineering analysis that demonstrates . . .



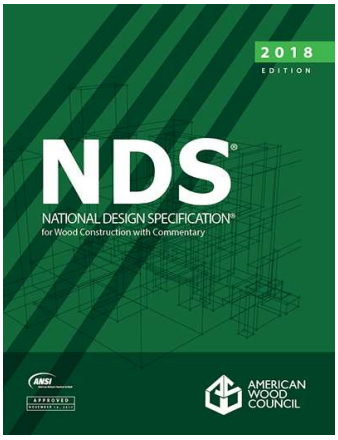
IV-A IV-B IV-C

Fire-Resistive Connection Protection

NDS 16.3 Wood Connections

Where fire resistance is required, connectors and fasteners shall be protected from fire exposure

- Additional wood cover
- Fire-rated gypsum board
- Other approved materials like coatings or insulation (approved for required endurance time)
- OR a combination thereof



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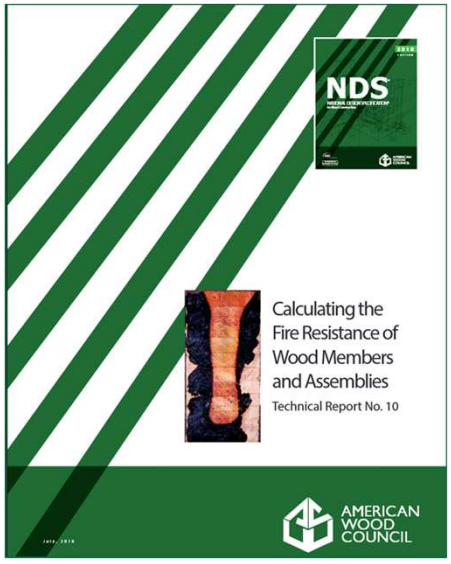
Fire-Resistive Connection Protection

AWC *Technical Report 10*

- NDS Chapter 16 basis
  - Protecting connections
    - Background
    - Commentary
    - Examples



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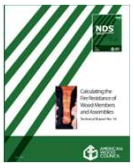
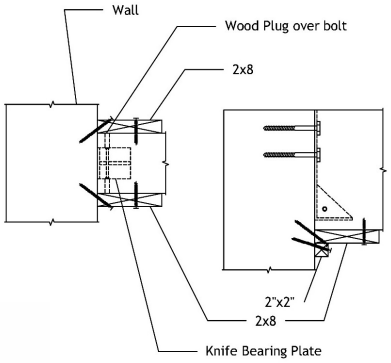
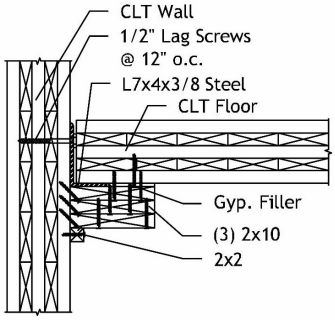
Fire-Resistive Connection Protection

AWC *Technical Report 10*

- Thermal protection (separation)
- Example details
- Common fasteners and connectors







AWC TR10 Figures

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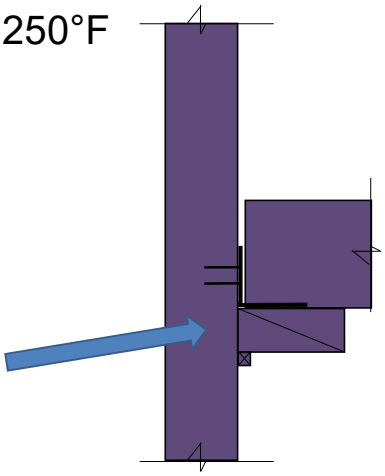
Fire-Resistive Connection Protection

- Thermal Separation – limit avg temp rise ≤ 250°F
- 2-hr Example
  - 3 inches of wood protection
  - $t_p = 60\left(\frac{3.0}{1.5}\right)^{1.23} = 141\ minutes$
  - Wood protecting a connection
  - 0.85 x (calculated protection time)
  - $0.85\ t_p = (0.85)\ 141\ minutes = 120\ minutes$



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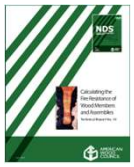
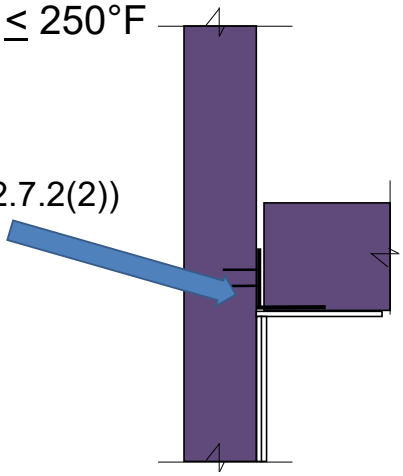
Fire-Resistive Connection Protection

- Thermal Separation – limit avg temp rise ≤ 250°F
- 1-hr Example
  - Gypsum Board
  - 0.5 x (NC Protection Time)
  - 5/8" Type X GB = 40 minutes (IBC Table 722.7.2(2))
  - 0.5 $t_p = (0.5)\ 40\ minutes = 20\ minutes$ NG

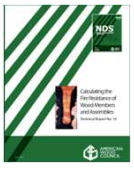


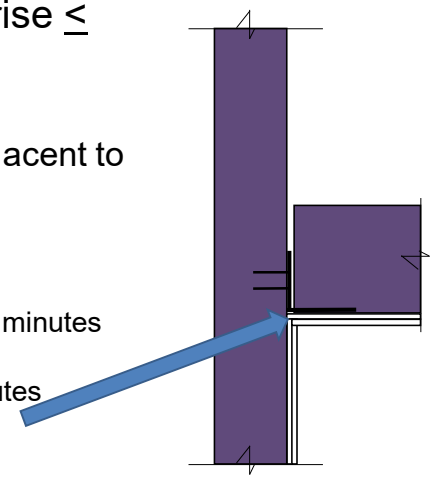


113

Fire-Resistive Connection Protection

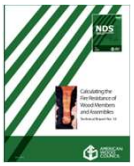
- Thermal Separation – limit avg temp rise ≤ 250°F
- Multiple layers of protection
  - Reduction factor only applies to layer adjacent to connection
- 1-hr Example
  - 2 layers of 5/8" Type X GB
    - Layer adjacent to connection = 40 (0.5) = 20 minutes
    - Second layer = 40 minutes
    - Total thermal separation = 40 + 20 = 60 minutes



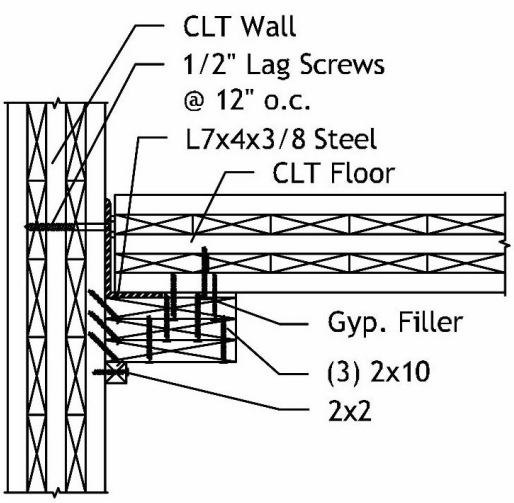


114

Fire-Resistive Connection Protection



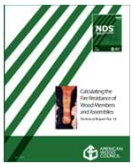
- Char contraction
  - Abutting edges
  - Char layer < char depth
  - Wedge-shaped gap
  - Additional wood cover protects abutting edges
  - Fasteners attaching cover do not require protection



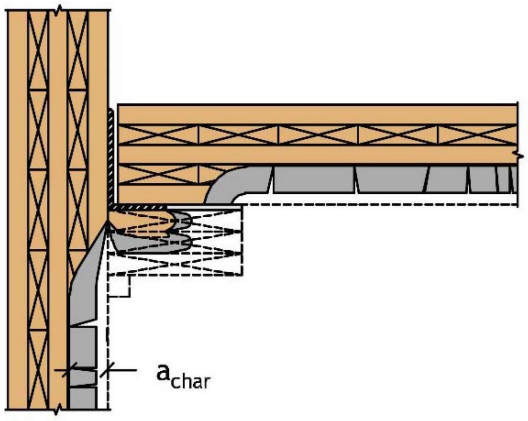
AWC TR10 Figure 8-4. Example connection protection

115

Fire-Resistive Connection Protection



- Char contraction
  - Abutting edges
  - Char layer < char depth
  - Wedge-shaped gap
  - Additional wood cover or blocking to protect abutting edges
  - Fasteners attaching cover do not require protection



AWC TR10 Figure 8-3. Char pattern with wood strip added

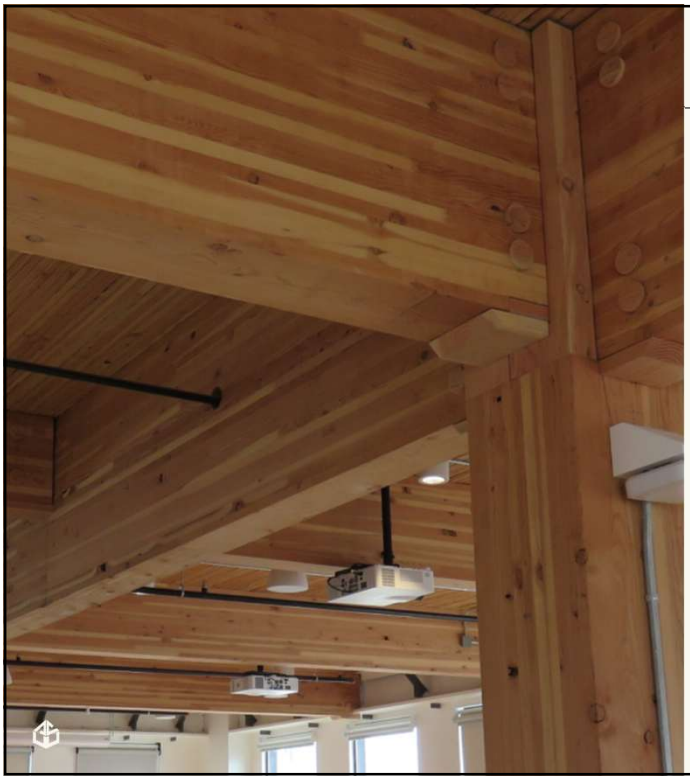
116

Fire-Resistive Connection Protection

Code Official Inspection

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

117

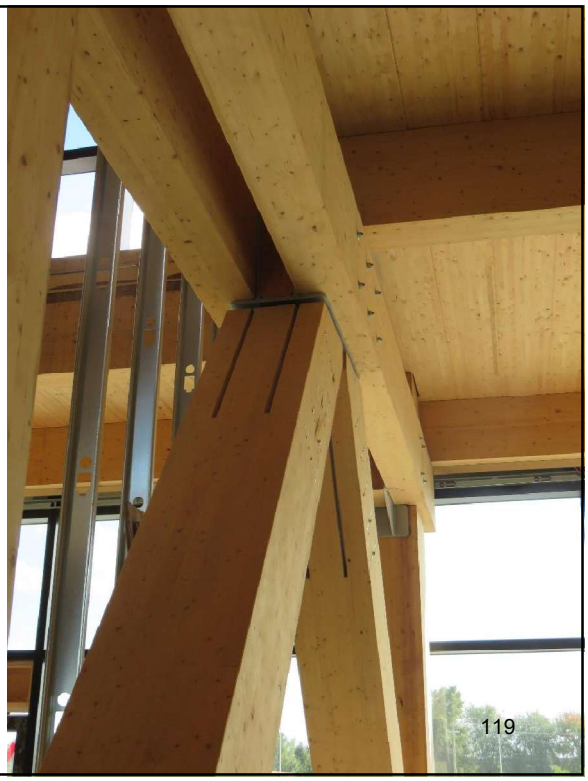


Outline

- History and Overview
- TWB Ad-Hoc Committee
- IBC Construction Types
- Building Sizes
- Design of Fire Protection for Mass Timber Connections
- **Special Inspection**

118

Special Inspection of Tall Mass Timber Structures



119

Special Inspection

- New Section 1705.5.3 on Tall Mass Timber Construction
- New Table 1705.5.3
  - Required special inspections for <u>new</u> mass timber construction types
    - IV-A, IV-B & IV-C
- NOT Type IV-HT

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TABLE 1705.5.3
REQUIRED SPECIAL INSPECTIONS OF MASS TIMBER CONSTRUCTION

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

IV-A

IV-B

IV-C

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Special Inspection

- Connections for TMT can be designed with common connectors
  - Screws, bolts, etc.
  - Thus, periodic
- Continuous inspection
  - Adhesive anchors under sustained tension
  - Similar to precast

IV-A IV-B IV-C

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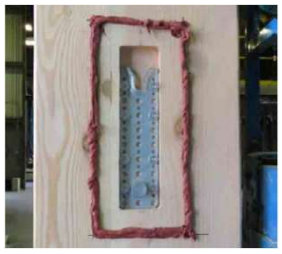
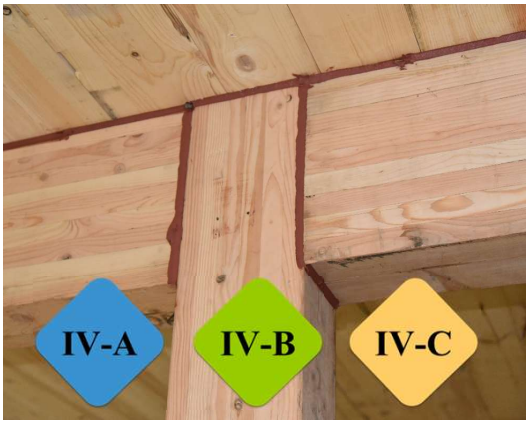
1705.19 Sealing of mass timber

Periodic special inspections of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.9 is applied to *mass timber* building elements as designated in the *approved* construction documents.

Photo Courtesy of ARUP





Sealants shown. Adhesives used likely not visible.

INSIDE …. (not outside)

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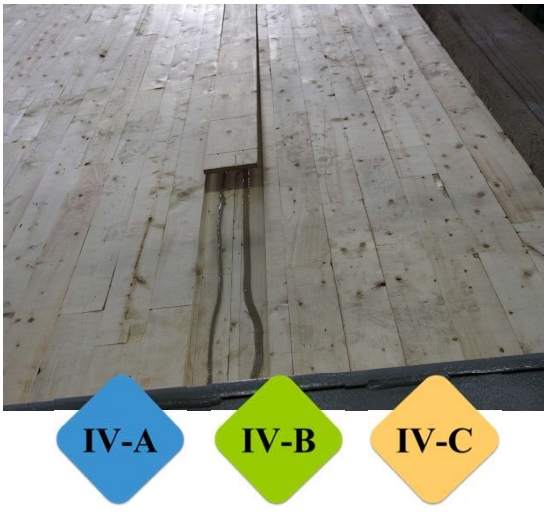
703.9 Sealing of adjacent mass timber elements…

- Sealants per ASTM C920

or

- Adhesives per ASTM D3498

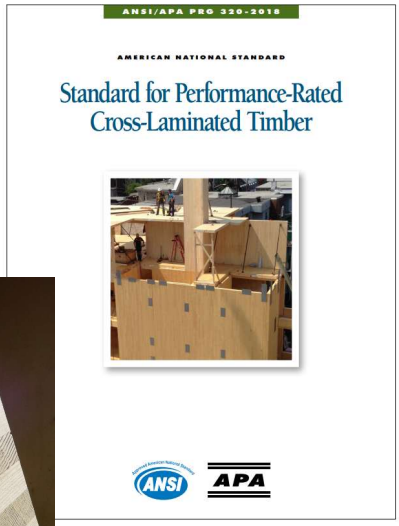
Exception: Sealants or adhesives need not be provided where they are not a required component of a tested fire-resistance-rated assembly.



124

Fabricated items exempt from on-site special inspection

- IBC 1704.2.5 – fabricator approved via QC/QA and third-party audit
  - CLT
  - SCL
  - Glulam
  - Sawn Timber

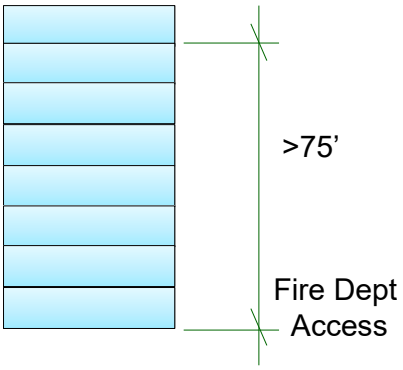


125

1704.6.1 Structural observations for structures. Structural observations shall be provided for those structures where one or more of the following conditions exist:

1. The structure is classified as Risk Category III or IV.
2. The structure is a high-rise building.
3. The structure is assigned to Seismic Design Category E and is greater than two stories above the grade plane.
4. Such observation is required by the registered design professional responsible for the structural design.
5. Such observation is specifically required by the building official.

Not Specific to Tall Mass Timber



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AMERICAN WOOD COUNCIL

ICC INTERNATIONAL CODE COUNCIL®

IBC 2021 Code Conforming Wood Design

Based on the 2021 *International Building Code*® (IBC®)

James B. Smith, P.E.
Intuitive Codes & Consulting

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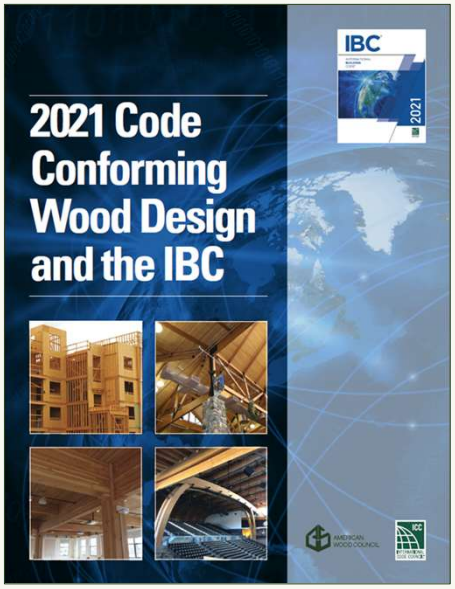
2021 Code Conforming Wood Design

CCWD includes

- Use and occupancy classifications
- Construction Types
- Heights and areas
- Fire resistance
- Building features
- Wood in noncombustible construction types
- Structural considerations
- Precautions during construction
- Energy and acoustical considerations

https://web-media.awc.org/wp-content/uploads/2023/11/17210144/CCWD2021_20231129_AWCWebsite.pdf



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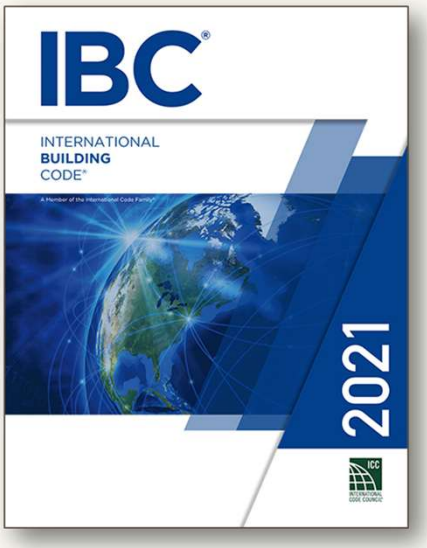
Introduction

Noncombustible
(703.3)
≠
Fire-resistant
(703.2)



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Allowable Heights and Areas

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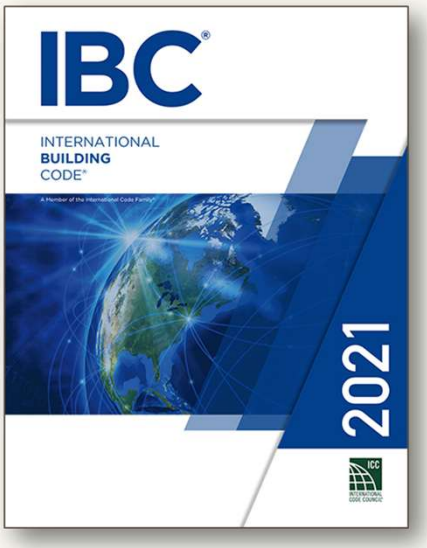
Introduction

IBC Chapter 5

- Size thresholds for wood frame structures often determined by structural rather than code limitations
- CLT and developments in mass timber technology have changed structural limitations for wood



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Allowable Building Heights and Areas

Table 504.3: Allowable Building Height (ft above grade)

OCCUPANCY CLASSIFICATION	See Footnotes	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, B, E, F, M, S, U	NS	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	86	75	270	180	85	85	70	60
R	NS	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

[Ref. Table 504.3]

Note: UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with a NFPA 13 automatic sprinkler system; S13R = Buildings equipped throughout with a NFPA 13R automatic sprinkler system; S13D = Buildings equipped with an automatic sprinkler system installed in accordance with NFPA 13D.

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Allowable Building Heights and Areas

Table 504.4: Allowable Number of Stories Above Grade

OCCUPANCY CLASSIFICATION	See Footnotes	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-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
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
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-2	NS	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

[Ref. Table 504.4]

Note: UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with a NFPA 13 automatic sprinkler system; S13R = Buildings equipped throughout with a NFPA 13R automatic sprinkler system.

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Allowable Building Heights and Areas

Table 506.2: Allowable Area Factor, A_t

OCCUPANCY CLASSIFICATION	See Foot-notes	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-2	NS	UL	UL	15500	9500	14000	9500	45000	30000	18750	15000	11500	6000
	S1	UL	UL	62000	38000	56000	38000	180000	120000	75000	60000	46000	24000
	SM	UL	UL	46500	28500	42000	28500	135000	90000	56250	45000	34500	18000
B	NS	UL	UL	37500	23000	28500	19000	108000	72000	45000	36000	18000	9000
	S1	UL	UL	150000	92000	114000	76000	432000	288000	180000	144000	72000	36000
	SM	UL	UL	112500	69000	85500	57000	324000	216000	135000	108000	54000	27000
M	NS	UL	UL	21500	12500	18500	12500	61500	41000	26625	20500	14000	9000
	S1	UL	UL	86000	50000	74000	50000	246000	164000	102500	82000	56000	36000
	SM	UL	UL	64500	37500	55500	37500	184500	123000	76875	61500	42000	27000
R-2	NS	UL	UL	24000	16000	24000	16000	61500	41000	25625	20500	12000	7000
	S13R												
	S1	UL	UL	96000	64000	96000	64000	246000	164000	102500	82000	48000	28000
	SM	UL	UL	72000	48000	72000	48000	184500	123000	76875	61500	36000	21000

[Ref. Table 506.2]

Note: UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with a NFPA 13 automatic sprinkler system; S13R = Buildings equipped throughout with a NFPA 13R automatic sprinkler system.

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CCWD Building Area Tables

AMERICAN WOOD COUNCIL

ICC INTERNATIONAL CODE COUNCIL®

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Table 3 – Group B Nonsprinklered Buildings

No. of Stories	% Frontage	Maximum floor area per story [a, b, c, d] (sq. ft.)							
		III-A	III-B	IV-A	IV-B	IV-C	IV-HT	V-A	V-B
1, 2, 3 [e]	0 to <25	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	25 to <50	35,625	23,750	135,000	90,000	56,250	45,000	22,500	11,250
	50 to <75	42,750	28,500	162,000	108,000	67,500	54,000	27,000	13,500
	75 to 100	49,875	33,250	189,000	126,000	78,750	63,000	31,500	15,750
4	0 to <25	21,375	NP	81,000	54,000	33,750	27,000	NP	NP
	25 to <50	26,719	NP	101,250	67,500	42,188	33,750	NP	NP
	50 to <75	32,063	NP	121,500	81,000	50,625	40,500	NP	NP
	75 to 100	37,406	NP	141,750	94,500	59,063	47,250	NP	NP
5	0 to <25	17,100	NP	64,800	43,200	27,000	21,600	NP	NP
	25 to <50	21,375	NP	81,000	54,000	33,750	27,000	NP	NP
	50 to <75	25,650	NP	97,200	64,800	40,500	32,400	NP	NP
	75 to 100	29,925	NP	113,400	75,600	47,250	37,800	NP	NP

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Table 3 – Group B Nonsprinklered Buildings

Footnotes

NP = Not Permitted

a. The maximum floor area for four or more stories above grade plane was determined by dividing the maximum total allowable building area determined in accordance with Section 506.2.1 by the number of stories. The floor area of the stories is assumed to be equal.
b. Frontage based on open space widths of 30 feet or more.
c. Interpolation permitted.
d. Sprinklers must be provided for ambulatory care facilities in accordance with Section 903.2.2.
e. Type V-B construction does not permit three stories above grade plane.

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Table 4 – Group B Sprinklered Buildings

No. of Stories	% Frontage	Maximum floor area per story [a, b, c] (sq. ft.)							
		III-A	III-B	IV-A	IV-B	IV-C	IV-HT	V-A	V-B
1	0 to <25	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	25 to <50	121,125	80,750	459,000	306,000	191,250	153,000	76,500	38,250
	50 to <75	128,250	85,500	486,000	324,000	202,500	162,000	81,000	40,500
	75 to 100 [d]	135,375	90,250	513,000	342,000	213,750	171,000	85,500	42,750
2, 3	0 to <25	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
	25 to <50	92,625	61,750	351,000	234,000	146,250	117,000	58,500	29,250
	50 to <75	99,750	66,500	378,000	252,000	157,500	126,000	63,000	31,500
	75 to 100 [d]	106,875	71,250	405,000	270,000	168,750	135,000	67,500	33,750
4	0 to <25	64,125	42,750	243,000	162,000	101,250	81,000	40,500	NP
	25 to <50	69,469	46,313	263,250	175,500	109,688	87,750	43,875	NP
	50 to <75	74,813	49,875	283,500	189,000	118,125	94,500	47,250	NP
	75 to 100	80,156	53,438	303,750	202,500	126,563	101,250	50,625	NP
5	0 to <25	51,300	NP	194,400	129,600	81,000	64,800	NP	NP
	25 to <50	55,575	NP	210,600	140,400	87,750	70,200	NP	NP
	50 to <75	59,850	NP	226,800	151,200	94,500	75,600	NP	NP
	75 to 100	64,125	NP	243,000	162,000	101,250	81,000	NP	NP
6	0 to <25	42,750	NP	162,000	108,000	67,500	54,000	NP	NP
	25 to <50	46,313	NP	175,500	117,000	73,125	58,500	NP	NP
	50 to <75	49,875	NP	189,000	126,000	78,750	63,000	NP	NP
	75 to 100	53,438	NP	202,500	135,000	84,375	67,500	NP	NP

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Table 4 – Group B Sprinklered Buildings

(Continued)

No. of Stories	% Frontage	Maximum floor area per story [a, b, c] (sq. ft.)							
		III-A	III-B	IV-A	IV-B	IV-C	IV-HT	V-A	V-B
9	0 to <25	NP	NP	108,000	72,000	45,000	NP	NP	NP
	25 to <50	NP	NP	117,000	78,000	48,750	NP	NP	NP
	50 to <75	NP	NP	126,000	84,000	52,500	NP	NP	NP
	75 to 100	NP	NP	135,000	90,000	56,250	NP	NP	NP
12	0 to <25	NP	NP	81,000	54,000	NP	NP	NP	NP
	25 to <50	NP	NP	87,750	58,500	NP	NP	NP	NP
	50 to <75	NP	NP	94,500	63,000	NP	NP	NP	NP
	75 to 100	NP	NP	101,250	67,500	NP	NP	NP	NP
18	0 to <25	NP	NP	54,000	NP	NP	NP	NP	NP
	25 to <50	NP	NP	58,500	NP	NP	NP	NP	NP
	50 to <75	NP	NP	63,000	NP	NP	NP	NP	NP
	75 to 100	NP	NP	67,500	NP	NP	NP	NP	NP

New to 2021 IBC

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Table 4 – Group B Sprinklered Buildings

Footnotes

NP = Not Permitted

a. The maximum floor area for four or more stories above grade plane was determined by dividing the maximum total allowable building area determined in accordance with Section 506.2.1 by the number of stories. The floor area of the stories is assumed to be equal.
b. Frontage based on open space widths of 30 feet or more.
c. Interpolation permitted.
d. Sprinklered Group B buildings of one or two stories may be unlimited in area if 100 percent of the frontage width is at least 60 feet in accordance with Sections 507.4 and 507.5.

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Questions?

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AMERICAN WOOD COUNCIL

Conclusion

This concludes *Mass Timber Buildings & the IBC.* You should now be able to:

- Identify the make-up of the TWB Ad Hoc Committee and the process used to reach consensus on proposed code changes.
- Recognize how the new types of construction compare with existing types of construction in the *International Building Code*
- List the process by which the allowable heights, areas, and number of stories permitted for the proposed mass timber types of construction were developed
- State the fire resistance requirements for mass timber building elements.

142

Slide 142

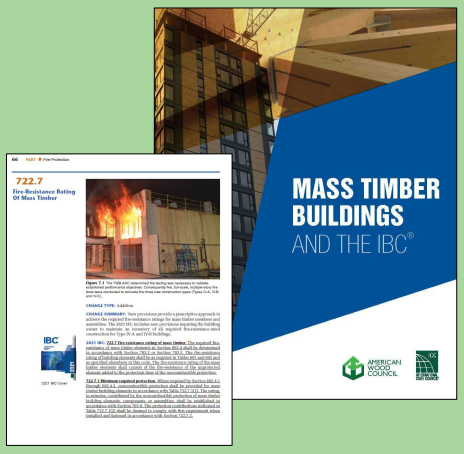
WM1 What is the title of this presentation?
Weeber, Marcie, 2023-03-24T14:27:23.612

WM2 What are the objectives of this course? These should match the objectives at the beginning of the presentation (I have changed them to match, but not sure they are what you want as final objectives.)
Weeber, Marcie, 2023-03-24T14:27:44.681

Resources

Mass Timber Buildings & the IBC

- AWC & ICC publication WM1
- Available PDF and Print



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Resources

Tall Mass Timber Special Inspector

- Exam now available
- PRONTO

WM1

144

Slide 143

WM1 How do they access these? I would put an URL or some way for them to access on the slide.
Weeber, Marcie, 2023-03-24T14:30:56.268

Slide 144

WM1 Again, how do they access? I would iinclude an URL or some way for them to access on the slide so they can write it down.
Weeber, Marcie, 2023-03-24T14:33:03.187

2021 I-Codes

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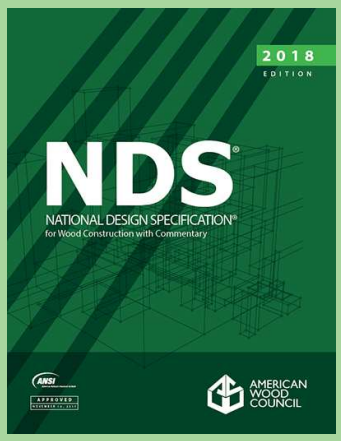
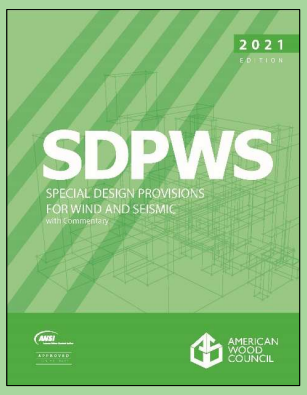
AWC Standards





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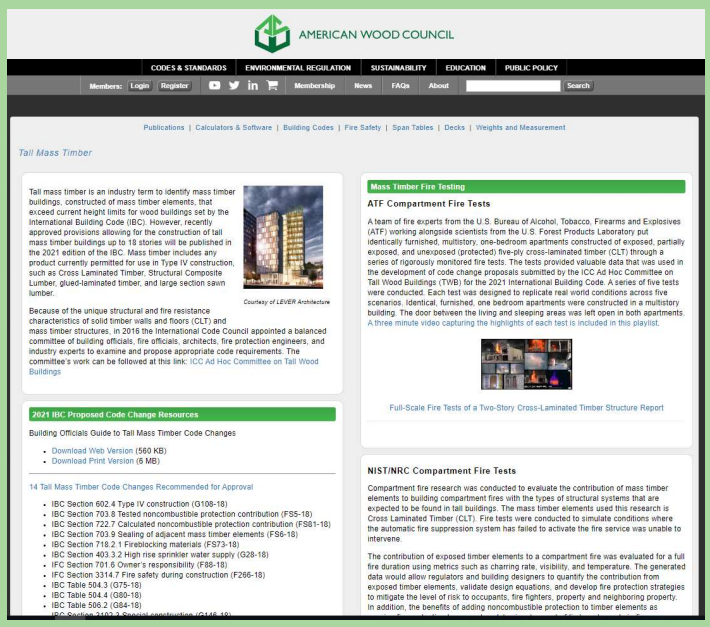
AWC Tall Mass Timber Webpage



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Thank You for Participating

Mass Timber Buildings and the IBC

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