Description

This presentation examines how fire resistance ratings in the 2015 International Building Code (IBC) apply to mass timber and heavy timber construction. Topics include how the IBC incorporates fire testing and calculation methods to quantify fire resistance as well as how various materials, including wood, behave when exposed to high temperatures in fires. Discussion will include code compliant calculation methods for fire resistance ratings of wood frame assemblies and for wood members exposed to fire per the 2015 National Design Specification® (NDS®) for Wood Construction Chapter 16. Mass timber fire resistance ratings when fully exposed or provided with some degree of noncombustible protection is addressed based on current and proposed future code provisions. Also included is information on fire testing, practical considerations for navigating 2015 IBC Chapter 7 on fire and smoke protection features, and an introduction to cross laminated timber (CLT).

Learning Objectives

Upon completion, participants will:

• Visualize how mass timber and heavy timber building elements behave when subjected to fire.
• Understand basic methods to achieve fire resistance ratings in the 2015 IBC.
• Learn how fire resistance ratings of wood assemblies and mass timber are calculated.
• Utilize an introduction to CLT as incorporated in the 2015 IBC along with future code change concepts to form a basis of understanding about taller and larger timber structures.
Outline

• IBC Fire-resistance rating – Mass Timber and Heavy Timber
• Fire behavior of combustible building materials
• IBC fire-resistance rating methods
• Calculated fire resistance methods
• Mass timber fire tests and details

Polling Question

1. **What is your profession?**
   a) Architect
   b) Engineer
   c) Building Official
   d) Fire Official
   e) Other
Question

What is Mass Timber in Future Building Codes?

Answer

Mass(ive) Timber is proposed to be an umbrella term for wood members meeting the minimum dimensions of Heavy Timber in the current IBC, but will also be tied to specific fire-resistance ratings for wall, floor and roof assemblies.

**Mass Timber:** Construction with vertical and horizontal structural elements primarily of solid, built-up, panelized or engineered wood products that meet minimum cross section dimensions of this code.
Mass Timber is NOT Light-Frame Construction

Richmond Olympic Oval, Richmond, BC

Centre Pompidou Metz, Metz France

Metropol Parasol, Seville, Spain

Cathedral of Christ the Light, Oakland, CA

Stradthaus-Murray Grove, UK
Question

How is Heavy Timber different than Mass Timber?

Answer

Heavy Timber typically relies on the dimensions and detailing to provide an intrinsic but undetermined level of fire resistance....
Heavy Timber “Reorganization”

- Clarifies reqs. Type IV Construction & HT elements
- Moves many HT details to Chapter 23
- 2018 Group A, G179 - G180 IBC 602.4

### Traditional Heavy Timber – Type IV HT
Traditional Heavy Timber – Type IV HT

Heavy Timber Elements

602.4 Type IV. Type IV construction (Heavy Timber, HT) is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid or laminated wood without concealed spaces. The details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.1 or 602.4.2 shall be permitted. Minimum solid sawn nominal dimensions are required for structures built using Type IV construction (HT). For glued-laminated members and structural composite lumber (SCL) members, the equivalent net finished width and depths corresponding to the minimum nominal width and depths of solid sawn lumber are required as specified in Table 603.4-Conn.

SECTION 603
COMBUSTIBLE MATERIAL IN
TYPES I AND II CONSTRUCTION

603.1 Allowable materials. Combustible materials shall be permitted in buildings of Type I or II construction in the following applications and in accordance with Sections 603.1.1 through 603.1.3.

19. Heavy timber as permitted by Note c to Table 601 and Sections 602.4.7 and 1406.3.
### Exterior Walls (IBC 1406)

1406.3 Balconies and similar projections. Balconies and similar projections of combustible construction other than fire-retardant treated wood shall be fire-resistance rated where required by Table 601 for floor construction or shall be of Type IV construction in accordance with Section 602.4. The aggregate length of the projections shall not exceed 50 percent of the building’s perimeter on each floor.

**Exceptions:**

1. On buildings of Type I and II construction, three stories or less above grade plane, fire-retardant treated wood shall be permitted for balconies, porches, decks and exterior stairways not used as required exits.
2. Untreated wood is permitted for pickets and rails or similar guardrail devices that are limited to 42 inches (1067 mm) in height.
3. Balconies and similar projections on buildings of Type III, IV and V construction shall be permitted to be of Type V construction, and shall not be required to have a fire-resistance rating where sprinkler protection is extended to these areas.
4. Where sprinkler protection is extended to the balcony areas, the aggregate length of the balcony on each floor shall not be limited.

### Question

How is the fire-resistance for Mass Timber going to be provided?
Answer

Mass timber fire resistance may come from providing minimum dimensions for the exposed timber, or from noncombustible protection of the wood...

...or both

Fire-resistance Rating in the IBC

**FIRE-RESISTANCE RATING.** The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests, prescribed in Section 703.

- Fire Confinement
- Structural Performance
Fire-resistance Rated Examples

- Two-hour enclosure is required to be two-hour fire resistance rated
  - Structurally
  - As a barrier for passage of fire and heat from the outside in and the inside out of the enclosure

- The supporting members of the two-hour enclosure (that are not part of the enclosure) must have a two-hour structural fire resistance rating

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2015 IBC Ch 6: Types of Construction

<table>
<thead>
<tr>
<th>BUILDING ELEMENT</th>
<th>TYPE I</th>
<th>TYPE II</th>
<th>TYPE III</th>
<th>TYPE IV</th>
<th>TYPE V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>HT</td>
</tr>
<tr>
<td>Primary structural frame (see Section 202)</td>
<td>3”</td>
<td>2”</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bearing walls</td>
<td>3”</td>
<td>2”</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Exterior</td>
<td>3”</td>
<td>2”</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Interior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonbearing walls and partitions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Exterior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonbearing walls and partitions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor construction and associated secondary members</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(see Section 202)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof construction and associated secondary members</td>
<td>1/16”</td>
<td>1/8”</td>
<td>1/4”</td>
<td>0”</td>
<td>1</td>
</tr>
<tr>
<td>(see Section 202)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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For 1 ft = 304.8 mm.

- a. Roof support fire resistance rating of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
- b. Except in Group E-1, H-1, M, and S-1 occupancies, fire protection of structural member shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fine-sand treated wood members shall be allowed to be used for such unprotected members.
- c. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire resistance rating is required.
- d. Not less than the fire resistance rating required by other sections of this code.
- e. Not less than the fire resistance rating based on fire separation distance (see Table 602).
- f. Not less than the fire-resistance rating as referenced in Section 704.10.
Polling Question

2. In the 2015 IBC, which code sections tell users where the use of heavy timber is allowed?
   a) IBC Section 602.4
   b) IBC Section 603
   c) IBC Section 1406.3
   d) All of the above

Outline

• IBC Fire-resistance rating – Mass Timber and Heavy Timber
• Fire behavior of combustible building materials
• IBC fire-resistance rating methods
• Calculated fire resistance methods
• Mass timber fire tests and details
Effect of Fire on Materials

• Desirable Fire Characteristics of Building Materials?
  • Dimensionally stable at high temperatures
  • Little or no loss of strength / stiffness with high temperatures
  • Does not burn or contribute to fire
  • Can be easily repaired after fire exposure

Behavior of Fire and Materials

Wood at high temperature:
• low thermal conductivity
• dimensionally stable
• inner portion remains cool
• does not lose strength
Calculated Fire-Resistance

Fire-resistance up to **two hours**

- Columns
- Beams
- Tension Members
- ASD only

**Products**

- Lumber
- Glulam
- SCL
- Decking
- CLT

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Behavior of Fire and Materials

**Char layer**

- tends to insulate the wood from heat sources

AWC publication TR-10 is available free: [www.awc.org](http://www.awc.org)
Behavior of Fire and Materials

Pyrolysis
- decomposition of wood due to heat without oxygen into:
  - combustible gases
  - wood alcohol
  - tar
  - charcoal
  - carbon
- Starts at 390 – 570 °F
- Result of Pyrolysis = Char

Behavior of Fire and Materials

- Fire needs three things
  - Heat
  - Oxygen
  - Fuel

Source: AWC Staff
Behavior of Fire and Materials

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

Source: AWC Staff

Behavior of Fire and Materials

• Noncombustibility Material Tests (IBC 703.5)
  • 703.5.1 Elementary materials: ASTM E 136
  • 703.5.2 Composite materials
    • surfacing ≤ 0.125” thick
    • flame spread < 50
  • Not subject to increase: age, or moisture
Effect of Fire on Materials

August 2014 Structure Magazine

Reprinted with permission, STRUCTURE magazine, August 2014.

Photo Courtesy of Sandberg LLP

Effect of Fire on Materials

• Primary Materials
  • Reinforced Concrete / Masonry
  • Steel
  • Wood
Performance of Wood vs. Steel

Comparative Strength Loss of Wood versus Steel

Percentage of Material Strength

Concrete and Steel Protection

Protection of Type I construction

722.2.1.4 Walls with gypsum wallboard or plaster finishes. The fire-resistance rating of cast-in-place or precast concrete walls with finishes of gypsum wallboard or plaster applied to one or both sides shall be permitted to be calculated in accordance with the provisions of this section.
Wood Can Self-Protect

Effect of Fire on Materials

What happens if wood is further protected with other fire resistive material?

This is not a new concept!
Polling Question

3. What AWC Publication provides commentary and examples on how to calculate fire-resistance-rating of exposed wood elements?
   a) DCA-6
   b) TR-10
   c) TR-12
   d) TR-14
Outline

- IBC Fire-resistance rating – Mass Timber and Heavy Timber
- Fire behavior of combustible building materials
- IBC fire-resistance rating methods
- Calculated fire resistance methods
- Mass timber fire tests and details

Fire-resistance Rated Wall Assemblies

**FIRE-RESISTANCE RATING.** The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests, prescribed in Section 703.
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

703.2 Fire-resistance ratings. The fire-resistance rating of building elements, components or assemblies shall be determined in accordance with the test procedures set forth in ASTM E 119 or UL 263 or in accordance with Section 703.3. Where materials, systems or devices that have not been tested as part of a fire-resistance-rated assembly are incorporated into the building element, component or assembly, sufficient data shall be made available to the building official to show that the required fire-resistance rating is not reduced. Materials and methods of construction used to protect joints and penetrations in fire-resistance-rated building elements, components or assemblies shall not reduce the required fire-resistance rating.
Nature of Fire in Buildings – 101

• Standard Time & Temperature Curve
• Most fires are not “Standard”
• Time – Temperature affected by many factors

Ch 7: Fire & Smoke Protection Features

The IBC provides seven methods for establishing the fire-resistance rating of building elements.
703.4 **Automatic sprinklers.** Under the prescriptive fire-resistance requirements of the *International Building Code*, the fire-resistance rating of a building element, component or assembly shall be established without the use of *automatic sprinklers* or any other fire suppression system being incorporated as part of the assembly tested in accordance with the fire exposure, procedures, and acceptance criteria specified in ASTM E 119 or UL 263. However, this section shall not prohibit or limit the duties and powers of the *building official* allowed by Sections 104.10 and 104.11.

**Outline**

- IBC Fire- resistance rating – Mass Timber and Heavy Timber
- Fire behavior of combustible building materials
- IBC fire-resistance rating methods
- **Calculated fire resistance methods**
- Mass timber fire tests and details
Calculated Fire Resistance

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 Specifications for Wood Construction (NDS).

Technical Report 10 includes more details, background and commentary on the methods found in NDS chapter 16. Chapter 16 of NDS provides for design up to 2 hours.

Effect of Fire on Wood

[Diagram showing fire effects on wood with labels for cold wood, heated zone, char layer, and dimension notations for b, B, d, D, r, t.]
NDS Ch 16 and TR-10

Table 16.2.1A Effective Char Rates and Char Depths (for $\beta_a = 1.5 \text{ in./hr.}$)

<table>
<thead>
<tr>
<th>Required Fire Endurance (hr.)</th>
<th>Effective Char Rate, $\beta_a$ (in./hr.)</th>
<th>Effective Char Depth, $a_{d,c}$ (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Hour</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>1½-Hour</td>
<td>1.67</td>
<td>2.5</td>
</tr>
<tr>
<td>2-Hour</td>
<td>1.58</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Calculated Fire Resistance – NDS Ch 16

Table 16.2.2 Adjustment Factors for Fire Design

<table>
<thead>
<tr>
<th></th>
<th>ASD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Design Stress to Member Strength Factor</td>
</tr>
<tr>
<td>Bending Strength</td>
<td>$F_b$ x 2.85 $C_F$ $C_V$ $C_{fn}$ $C_L$ -</td>
</tr>
<tr>
<td>Beam Buckling Strength</td>
<td>$F_{bc}$ x 2.03 - - - -</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>$F_t$ x 2.85 $C_F$ - - - -</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>$F_c$ x 2.58 $C_F$ - - - $C_P$</td>
</tr>
<tr>
<td>Column Buckling Strength</td>
<td>$F_{cb}$ x 2.03 - - - -</td>
</tr>
</tbody>
</table>

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.
16.2.4 Special Provisions for Structural Glued Laminated Timber Beams

For structural glued laminated timber bending members given in Table 5A and rated for 1-hour fire endurance, an outer tension lamination shall be substituted for a core lamination on the tension side for unbalanced beams and on both sides for balanced beams. For structural glued laminated timber bending members given in Table 5A and rated for 1½- or 2-hour fire endurance, 2 outer tension laminations shall be substituted for 2 core laminations on the tension side for unbalanced beams and on both sides for balanced beams.

Special Provisions NDS 16.2.4

Glued-laminated Timber Tension Lam Provisions – unbalanced layup

Figure 3-1 Typical glued unbalanced beam layups
Glued-laminated Timber
Tension Lam Provisions – balanced layup

Calculated Fire Resistance

- Chapter 16 NDS
  - Charring Rate and Char Depth
  - Modified char depth model
  - Step-wise approach
Fire Design of Exposed Wood Members

CLT manufactured with laminations of equal thickness

**Table 16.2.1B Effective Char Depths (for CLT with $\beta_n=1.5$ in./hr.)**

<table>
<thead>
<tr>
<th>Required Fire Endurance (hr.)</th>
<th>Effective Char Depths, $a_{char}$ (in.)</th>
<th>Elevation thicknesses, $b_{elev}$ (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8</td>
<td>2.2</td>
<td>1.8</td>
</tr>
<tr>
<td>3/4</td>
<td>2.2</td>
<td>1.8</td>
</tr>
<tr>
<td>7/8</td>
<td>2.1</td>
<td>1.8</td>
</tr>
<tr>
<td>1</td>
<td>2.0</td>
<td>1.9</td>
</tr>
<tr>
<td>1-1/4</td>
<td>2.0</td>
<td>1.8</td>
</tr>
<tr>
<td>1-3/8</td>
<td>1.9</td>
<td>1.8</td>
</tr>
<tr>
<td>1-1/2</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>1-3/4</td>
<td>1.8</td>
<td>1.8</td>
</tr>
</tbody>
</table>

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
Calculated Fire Resistance

Component Additive Method (IBC 722.6)

- Additional time added for framing and insulation
- Method allowed for floors, walls and roofs
- Up to one hour rating

<table>
<thead>
<tr>
<th>DESCRIPTION OF FINISH</th>
<th>TIME (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8-inch wood structural panel bonded with exterior glue</td>
<td>5</td>
</tr>
<tr>
<td>11/32-inch wood structural panel bonded with exterior glue</td>
<td>10</td>
</tr>
<tr>
<td>13/32-inch wood structural panel bonded with exterior glue</td>
<td>15</td>
</tr>
<tr>
<td>1/4-inch gypsum wallboard</td>
<td>10</td>
</tr>
<tr>
<td>5/8-inch gypsum wallboard</td>
<td>15</td>
</tr>
<tr>
<td>3/8-inch gypsum wallboard</td>
<td>30</td>
</tr>
<tr>
<td>1/2-inch Type X gypsum wallboard</td>
<td>25</td>
</tr>
<tr>
<td>3/8-inch Type X gypsum wallboard</td>
<td>40</td>
</tr>
<tr>
<td>Double 5/8-inch gypsum wallboard</td>
<td>25</td>
</tr>
<tr>
<td>1/2-inch + 5/8-inch gypsum wallboard</td>
<td>35</td>
</tr>
<tr>
<td>Double 3/8-inch gypsum wallboard</td>
<td>40</td>
</tr>
</tbody>
</table>

Calculated Resistance

- AWC’s DCA-4 Component Additive Method (CAM)
- Code provisions with background
- Ten Rules of Fire Resistance Rating (Harmathy’s Rules)
722 - Harmathy’s Ten Rules


Harmathy’s “Ten Rules of Fire Endurance Ratings”

1. The "thermal" fire endurance of a construction consisting of a number of parallel layers is greater than the sum of the "thermal" fire endurance's characteristic of the individual layers when exposed separately to fire.
2. The fire endurance of a construction does not decrease with the addition of further layers.
3. The fire endurance of constructions containing continuous air gaps or cavities is greater than the fire endurance of similar constructions of the same weight, but containing no air gaps or cavities.
4. The farther an air gap or cavity is located from the exposed surface, the more beneficial is its effect on the fire endurance.

722 - Harmathy’s Ten Rules (cont’d)

5. Increasing the thickness of a completely enclosed air layer cannot increase the fire endurance of a construction.
6. Layers of materials of low thermal conductivity are better utilized on that side of the construction on which fire is more likely to happen.
7. The fire endurance of asymmetrical constructions depends on the direction of heat flow.
8. The presence of moisture, if it does not result in explosive spalling, increases the fire endurance.
9. Load-supporting elements, such as beams, girders and joists, yield higher fire endurance’s when subjected to fire endurance tests as parts of floor, roof, or ceiling assemblies than they would when tested separately.
10. The load-supporting elements (beams, girders, joists, etc.) of a floor, roof, or ceiling assembly can be replaced by such other load-supporting elements which, when tested separately, yielded fire endurance’s not less than that of the assembly.
2021 Draft IBC Mass Timber CAM

- Proposed CAM method in the 2021 IBC

\[ \text{FRR of Element} = \text{FRR of Wood} + \text{FRR of Added Gypsum} \]

Outline

- IBC Fire-resistance rating – Mass Timber and Heavy Timber
- Fire behavior of combustible building materials
- IBC fire-resistance rating methods
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- Mass timber fire tests and details
Polling Question

4. What Section of the IBC references to Ch. 16 of the NDS for calculating the fire-resistance rating of exposed wood members?
   a) IBC Section 703.3
   b) IBC Section 721
   c) IBC Section 722.1

Connections

Figure 9
CLT panel-to-panel half lapped joint detail
Source: US CLT Handbook
Connections

Figure 14
Concealed metal plates

Source: US CLT Handbook

Connections

Figure 12
Examples of connections seen in CLT platform construction

Source: US CLT Handbook
Connections

**Figure 13**
Examples of connections seen in CLT balloon construction

Source: US CLT Handbook

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Connections – NDS Ch 16 and TR-10

### 16.3 Wood Connections

Where fire endurance is required, connectors and fasteners shall be protected from fire exposure by wood, fire-rated gypsum board, or any coating approved for the required endurance time.

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**Figure 3-1** Beam to column connection, connection not exposed to fire

**Figure 3-2** Beam to column connection, connection exposed to fire where appearance is a factor
Connections – NDS Ch 16 and TR-10

2-hour Exposed Glulam Beam/Column

Photos Courtesy of Arup
Residential Fire Load Demonstration

Nail Laminated Timber: September 3, 2015

Residential Fire Load Demonstration

Nail Laminated Timber: September 3, 2015
Residential Fire Load Demonstration

Nail Laminated Timber: September 3, 2015

Residential Fire Load Demonstration

Nail Laminated Timber: September 3, 2015
Residential Fire Load Demonstration

Nail Laminated Timber: September 3, 2015

Residential Fire Load Demonstration

September 15, 2015
Residential Fire Load Demonstration

September 15, 2015

Residential Fire Load Demonstration

Compartment Temperature

CLT: September 15, 2015
Residential Fire Load Demonstration

Heat Release Rate

CLT : September 15, 2015

ICC Tall Wood Ad Hoc

- October - December 2015
  - ICC Board approves formation of the TWAH
- January 2016
  - ICC advertises call for committee
  - Over 60 applications received
- April 2016
  - ICC appoints committee

ICC NEWS RELEASE

For Immediate Release
January 7, 2016
www.icc-sae.org

ICC Accepting Applications for Ad Hoc Committee on Tall Wood Buildings

The International Code Council (ICC) Board of Directors has established an ad hoc committee to explore the building science of tall wood buildings. Tall wood is a term used in the industry to identify wood construction which utilizes Cross Laminated Timber (CLT) in buildings of heights greater than six stories. CLT buildings with heights varying from seven to 12 stories are in the planning stages in Minneapolis, Portland, and New York City.

Hughes@icc-sae.org
ICC Tall Wood Ad Hoc

- First meeting July 2016 in Chicago
- 83 Issues identified
- Work Groups established
  - Allowable height and area, Fire, Structural, Definitions
- Second meeting November 2016 in Seattle
  - UBC – Brock Commons presentations
  - Committee Reports
- Third meeting August 2017 in Chicago
  - Reviewed all of the proposal brought forward from the four Work Groups
  - Finalized the proposals for posting on the ICC Tall Wood Building Adhoc Committee Website

ICC TWB Ad Hoc – Fire Tests

- The Fire Subcommittee of the TWB Ad Hoc Committee requested a series of five FULL SCALE multi-story fire tests to help determine the necessary fire safety measures for the new types of construction being considered.
- One bedroom unit (LR, Kitchen, Bath, BR) layout per story, 900 SF +/-, a corridor and a stairway enclosure. Modern furnishings.
  1. All surfaces protected with two layers 5/8-inch GWB
  2. 30% of ceiling exposed in each main room
  3. Two opposite facing CLT walls left fully exposed.
  4. All wood surfaces above the floor were exposed and the entire space protected by a sprinkler system using sidewall sprinklers.
  5. Same as test 4 except fronts filled with fixed tempered glass in metal frames with one panel (3’x7’ +/-) broken open at 17 minutes to simulate an open patio door. Protected by sprinkler system that was delayed 20 minutes from time of sprinkler fusing.
Fire tests – ATF Lab Maryland

- All tests conducted at the Federal Bureau of Alcohol, Tobacco, Firearms & Explosives Testing Laboratory in Maryland.
- 400 channels of data collection resulting in millions of data points.

ICC TWB Ad Hoc – Fire Tests
Fire Test #2 Video

http://www.awc.org/tallwood

ICC TWB Ad Hoc – Fire Test 3
ICC TWB Ad Hoc – Fire Test 3

• Notice in the picture on the right that only a small portion of the contents remained on fire. The structure self extinguished.
Test 4 - As noted earlier, all wood surfaces above the floor were exposed and the entire space protected by a sprinkler system using sidewall sprinklers. The fire caused the sprinkler system to activate at approximately 3 minutes and the system extinguished the fire.

Test 5 – The same as Test 4 except the fronts were filled with fixed tempered glass in metal frames to replicate patio doors. At 17 minutes into the fire, one panel (3’x7’ +/-) was broken open to simulate an open patio door. The sprinkler system was delayed 20 minutes from the time of sprinkler fusing (approx. 23 minutes from start of fire) to replicate a system that was inoperative until being charged by the arrival of the Fire Department. The sprinkler system extinguished the fire.
Polling Question

5. Which of the following statement about the ICC TWB Ad Hoc fire tests is correct?
   a) Five fire tests were performed
   b) Exposed CLT stopped burning after char formed
   c) CLT remained structurally sound at the end of each test
   d) Where provided, sprinklers put out the fire on the exposed CLT
   e) All of the above

ICC TWAH Next Steps

• TWAH to remain through 2021 Code Development process
  • Code provisions for all items (except structural) submitted Fall of 2017
  • Remaining provisions by Fall 2018
• ICC Tall Wood Ad Hoc Information
Questions?

- This concludes The American Institute of Architects Continuing Education Systems Course

American Wood Council
info@awc.org
www.awc.org

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
2015 Code Conforming Wood Design

• Special occupancies
• Fire-resistance
• Building features
• Wood in noncombustible construction types
• Structural considerations
• Precautions during construction
• Also available for 2009 and 2012 IBC
  • [http://awc.org/codes-standards/buildingcodes/ccwd](http://awc.org/codes-standards/buildingcodes/ccwd)

Construction Fire Safety

[Construction Fire Safety Practices](http://awc.org/codes-standards/buildingcodes/ccwd)

[www.constructionfiresafety.org](http://www.constructionfiresafety.org)