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

Prepared by:
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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.
Project Scope

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

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

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

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

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

TWB identified performance objectives to be met:

• No collapse under reasonable scenarios of complete burn-out of fuel without automatic sprinkler protection being considered
• No unusually high radiation exposure from the subject building to adjoining properties to present a risk of ignition under reasonably severe fire scenarios
• No unusual response from typical radiation exposure from adjacent properties to present a risk of ignition of the subject building under reasonably severe fire scenarios
TWB Ad Hoc Objectives (cont’d)

TWB identified performance objectives to be met:

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

The TWB has determined that its comprehensive package of proposals meet these performance objectives
Alternate Means outside of scope TWB:

SOM Timber Research Project

18 Story High-rise inside of scope:

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IBC Section 2304.3.3

Shrinkage must be accounted for in platform construction:

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

Detailing to address shrinkage...
Most Asked Question:

Why are there three....

....new Types of Construction?

Three Main Categories:

1. Noncombustible (Types I & II)
2. Combustible Lt-Frame (Types III & V)
3. Mass Timber (Type IV)

IBC TABLE 601

<table>
<thead>
<tr>
<th>BUILDING ELEMENT</th>
<th>TYPE I</th>
<th>TYPE II</th>
<th>TYPE III</th>
<th>TYPE IV</th>
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</tr>
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ICC TALL WOOD AD HOC COMMITTEE

*Building floor-to-floor heights are shown at 12'-0" for all examples for clarity in comparison between 2015 to 2021 IBC codes.
MASS TIMBER FRR CHECKLIST:

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

Non-combustible protection (for MT)

FRR of mass timber element = time assigned to the wood without protection + time assigned to the added NC protection (usually gypsum)
Fire Behavior Depends on:

Fire behavior depends in part on:

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

Summary of tests:
## Mass Timber Fire Testing:

<table>
<thead>
<tr>
<th>Year</th>
<th>Test Sponsor and Location</th>
<th>Test Description</th>
<th>Fire Test Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>FPInnovations (FPI); National Research Council of Canada (NRC)</td>
<td>Protected Cross-Laminated Timber (CLT) Floor and Wall Tests,</td>
<td>E 119</td>
</tr>
<tr>
<td>2012</td>
<td>American Wood Council (AWC); NGC Testing Services</td>
<td>5 ply CLT wall with 8'000 PLF load protected with 1 layer of 5/8&quot; type X gypsum wall board (GWB) each side</td>
<td>E 119</td>
</tr>
<tr>
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<td>GWB-Protected Beam Tests, Protected Structural Composite Lumber (SCL) Tests</td>
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<td>CLT Compartment Fire Tests (w/ first generation PUR adhesive CLT)</td>
<td>Non-Standard</td>
</tr>
<tr>
<td>2017</td>
<td>US FPL, ICC Tall Wood Ad Hoc (TWB), AWC; ATF Lab</td>
<td>Compartment Fire Tests, Two Story Mass Timber Building</td>
<td>Non-Standard</td>
</tr>
<tr>
<td>2017</td>
<td>AWC; SwRI</td>
<td>Development of a Fire Performance Assessment Methodology for CLT Adhesives</td>
<td>New PRG 120, Annex B standard</td>
</tr>
<tr>
<td>2017</td>
<td>AWC; WFC</td>
<td>CLT Floor/Ceiling Assembly to establish the contribution of GWB to FRR</td>
<td>E 119</td>
</tr>
<tr>
<td>2018</td>
<td>NRCan, CNRC</td>
<td>Fire Testing of Rooms with Exposed Second Generation PUR adhesive CLT</td>
<td>Non-Standard</td>
</tr>
</tbody>
</table>

### “Non-Standard Fire” not in the code

![Typical “non-standard” TT curve](image)

**Compartiment Temperature**

**Typical “non-standard” TT curve**
Behavior of Fire and Materials

Protection of mass timber construction:

Non-combustible protection

FS5-18

IBC: 703.8 (New)

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

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

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

The noncombustible protection time contribution shall be determined by subtracting the fire resistance time, in minutes, of Test Assembly 1 from the fire resistance time, in minutes, of Test Assembly 2.
<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
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<td>AWC; WFC</td>
<td>CLT Floor/Ceiling Assembly to establish the contribution of GWB to FRR</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
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</tbody>
</table>

Figure 5. Test floor assembly during test showing (a) before test, (b) field crack ~ 24 min, (c) flames ~ 33 min, (d) pooling ~ 49 min, (e) falling material ~ 68 min, and (f) glowing at sugarp joint ~ 190 min.
<table>
<thead>
<tr>
<th>Year</th>
<th>Organization</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
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<td>E 119</td>
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**Figure 12:** Test 2 floor assembly during test showing (a) before test, (b) decking – 1 min, (c) flames – 3 min, (d) ember – 35 min, (e) deflection – 138 min, and (f) melted flames – 149 min.

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

Photo Courtesy of ROCKWOOL
### Other testing of NC protection:

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

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

---

**2014 AWC; Western Fire Center (WFC) **

**GWB-Protected Beam Tests, Protected Structural Composite Lumber (SCL) Tests**

<table>
<thead>
<tr>
<th>Beam Description</th>
<th>Design Stress Ratio</th>
<th>Thickness (inches)</th>
<th>Layers</th>
<th>SCL Beam</th>
<th>SCL Beam Only</th>
<th>SCL Beam + GWB</th>
<th>GWB Only</th>
<th>Test Times (minutes)</th>
<th>Estimated Times (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3⅝”-Wide LVL</td>
<td>50%</td>
<td>5/8” Type X</td>
<td>1</td>
<td>71</td>
<td>33</td>
<td>38”</td>
<td>70</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>7”-Wide LVL</td>
<td>113%</td>
<td>5/8” Type X</td>
<td>2</td>
<td>139</td>
<td>50</td>
<td>90</td>
<td>120</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>3⅝”-Wide LVL</td>
<td>84%</td>
<td>5/8” Type X</td>
<td>1</td>
<td>71</td>
<td>33</td>
<td>38”</td>
<td>70</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>3⅝”-Wide LS</td>
<td>113%</td>
<td>5/8” Type X</td>
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<td>79</td>
<td>106</td>
<td>28</td>
<td>80</td>
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1Gypsum wallboard corners were not finished, resulting in early penetration of fire.

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

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

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

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

---

### 2012 American Wood Council (AWC); NGC Testing Services

5 ply CLT wall with 8700 PLF load protected with 1 layer of 5/8” type X gypsum wall board (GWB) each side

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Copyright © 2015 American Wood Council
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Slide Courtesy of LEVER Arch

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Slide Courtesy of Arup

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![Image of Nail Laminated Timber (NLT) and CLT compartments with 2 hour FRR fire stops.](image1)

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![Image of an interior space with Nail Laminated Timber (NLT) and CLT compartments.](image2)
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![Image of fire test]

![Image of fire test]

![Image of fire test]

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<tr>
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<th>Description</th>
<th>Fire Rating</th>
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**FIRE RESISTANCE PERFORMANCE EVALUATION OF A PENETRATION FIRESTOP SYSTEM TESTED IN ACCORDANCE WITH ASTM E814-13A, STANDARD TEST METHOD FOR FIRE TESTS OF PENETRATION FIRESTOP SYSTEMS**

**FINAL REPORT**
Consisting of 18 Pages

SwRI® Project No. 01.21428.01.001a
Test Date: September 30, 2015
Report Date: October 22, 2015

Prepared for:
American Wood Council
222 Catoctin Circle SE
Leesburg, VA 20175

---

**Figure B-3. Sample after 2-h Exposure.**
### 2015

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

**Image:** Sample before the Hose Stream Test.

### 2017

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

**NFPA Fire Protection Research Foundation (FPRF)**

- Tests done for NFPA’s Property Insurance Research Group (PIRG)
- Purpose: Evaluate the contribution of CLT elements to compartment fires to collect data for insurance modeling
- Tests performed by NRC Canada
- Tests performed at NIST facilities
- 6 Compartment tests:
  - 2 with all CLT protected
  - 4 with various surfaces exposed

**Image:** Nonstandard fire compartment with CLT and PUR adhesive.
2017  FPRF, NRC; NIST National Fire Research Lab  CLT Compartment Fire Tests (w/ first generation PUR adhesive CLT)  Non-Standard

• No significant contribution of CLT when all surfaces were protected with Type X gypsum wallboard

• Where surfaces were exposed, CLT contribution increased with increasing exposed CLT surface area

• Modeling performed by Research Institute of Sweden (RISE) was close to measured results

Images courtesy of Joseph Su, NRC Canada

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

• Fire re-growth observed in multiple FPRF tests
• Fire re-growth caused by failure of bond lines before being reached by char front (i.e., heat-delamination)

Images courtesy of Joseph Su, NRC Canada
Test 1-4: Exposed CLT ceiling

• 1st heat-delamination occurred around 50 minutes, extending fully-developed phase

• 2nd heat-delamination occurred around 150 minutes, resulting in fire re-growth

Graphs courtesy of Joseph Su, NRC Canada

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

- 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/m²
<table>
<thead>
<tr>
<th>2017</th>
<th>US FPL, ICC Tall Wood Ad Hoc (TWB), AWC; ATF Lab</th>
<th>Compartment Fire Tests, Two Story Mass Timber Building</th>
<th>Non-Standard</th>
</tr>
</thead>
</table>

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

Photos provided by U.S. Forest Products Laboratory, USDA
ATF fire Test #2 – 30% CLT Ceilings Exposed

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

Exposed mass timber surfaces self-extinguished in the decay phase.

Mass timber surfaces protected with 2 layers of 5/8” Type X GWB remained mostly uncharred.
Section of exposed ceiling (90° angle)

ATF fire Test #3 – Exposed Walls

Two opposing CLT walls exposed one in bedroom and one in living room
Atf Fire Test #3  Walls Exposed

ATF Fire Test Results – Event Log

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Time After Ignition (mm:ss)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flashover (600°C)</td>
</tr>
<tr>
<td>1 1st floor</td>
<td>13:27</td>
</tr>
<tr>
<td>2 2nd floor</td>
<td>11:42</td>
</tr>
<tr>
<td>3 2nd floor</td>
<td>12:37</td>
</tr>
<tr>
<td>4 1st floor</td>
<td>-</td>
</tr>
<tr>
<td>5 1st floor</td>
<td>-</td>
</tr>
</tbody>
</table>

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


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

Repair in Place?

7:30 AM

7:30 AM
Adhesive qualification tests

Direction provided by ICC-TWB Ad-Hoc Committee

- Need test protocol capable of identifying heat-delaminating adhesives
- Code-referenced standards governing CLT should require adhesive qualification using this protocol
Test protocol developed by Southwest Research Institute (SwRI)

- Large-scale compartment test (9’ x 19’ compartment)
- Exposed CLT ceiling (as was tested in FPRF Test 1-4)
  - Same CLT span as in FPRF tests (~15”)
  - Same loading as in FPRF tests (20 psf)
  - Same ventilation ratio as in FPRF tests (~0.03 m$^{0.5}$)

---

1. Validate test setup for FPRF T/T curve
2. Recreate char drop off or “delamination” of original PUR
3. Melamine adhesive testing
4. 2$^{nd}$ generation PUR adhesive testing
2017 AWC; SwRI Development of a Fire Performance Assessment Methodology for CLT Adhesives New PRG 320, Annex B standard

- Calibration of adhesive qualification test protocol:
  - Exposure replicates conditions of FPRF baseline test (Test 1-1)
  - Exposure based on heat flux to the ceiling to replicate fire curve of FPRF Test 1-1 (no exposed CLT)

- Validation of adhesive qualification test protocol
  - Validation test performed on same CLT used in FPRF tests to verify similar performance

Just prior to fire re-growth (2:59) 2nd Flashover caused by fire re-growth (3:10)
### Qualification tests performed on other adhesives

- Fire re-growth observed with PUR
- No fire re-growth observed with
  - Melamine formaldehyde resin
  - Improved PUR
- Test identifies acceptable performance
2018 ANSI/APA - PRG 320

FLOOR MODIFICATION
G108-18-DIGIOVANNI-1

Cross-laminated timber shall be labeled as conforming to PRG 320 as referenced in Section 2303.14, the heat performance requirements of Section 613.4 of IRC PSI and have no delamination in any specimen, except where occurring at a localized characteristic when permitted in the product standard.

Photo by AWC

<table>
<thead>
<tr>
<th>2018</th>
<th>NRC, CNRC</th>
<th>Fire Testing of Rooms with Exposed Second Generation PUR adhesive CLT</th>
<th>Non-Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FIRE TESTING OF ROOMS WITH EXPOSED WOOD SURFACES IN  ENCAPSULATED MASS TIMBER CONSTRUCTION</td>
<td></td>
</tr>
</tbody>
</table>

Joseph Su, Patrice Leroux, Pier-Simon Lafrance, Rob Berzins, Karl Gratton, Eric Gibbs, Mark Weinfurter

8 August 2018

Copyright © 2015 American Wood Council
<table>
<thead>
<tr>
<th>Year</th>
<th>Institution</th>
<th>Description</th>
<th>Non-Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>NRC, CNRC</td>
<td>Fire Testing of Rooms with Exposed Second Generation PUR adhesive CLT</td>
<td>Non-Standard</td>
</tr>
</tbody>
</table>

Figure 4. Room schematic for Test 4 – fully exposed ceiling, column (4 sides) and beam (3 sides).

Figure 4F. Photograph of test Ibeam elements after Test 4.

Copyright © 2015 American Wood Council
Summary of code changes:

2018 ANSI/APA - PRG 320

FLOOR MODIFICATION
G108-18-DIGIOVANNI-1

Cross-laminated timber shall be labeled as conforming to PRG 320 - 18 as referenced in Section 2303.14, the heat performance requirements of Section 6.3.3.4 of DOC PS1 and have no delamination in any specimen, except where occurring at a localized characteristic when permitted in the product standard.

Photo by AWC
Groups of code changes:

14 approved change fall into 6 basic subjects:

• Non-combustible protection
• New construction types (materials and amount of protection)
• Height and area
• Other building requirements
• Construction and maintenance
• Correlation with existing code

Type of construction – G 108-18

Key considerations in Chapter 6:

• Allowed Materials (mass timber or noncombustible, no light frame combustible)
• Structural FRR (Table 601)
• Amount and location of non-combustible protection
• Protection of concealed spaces
Other building requirements

Other Building Requirements:
- Sealant at edges (FS6-18)
- High-rise sprinkler redundant water supply for Type IVA and IV B greater than 120 height above grade (G 28-18)
- Separated occupancy and incidental use separations additional requirements (G89-18)

Correlation with existing code

Other Building Requirements:
- Fireblocking (FS73-18)
- Special construction (G 146-18)
- Fire Districts (G152-18)
Construction and maintenance

Fire Code Requirements:
• Construction Fire Safety (F266-18)
• Owners Responsibilities (F 88-18)

Additional Fire Protection During Construction Requirements
• Requirements for fire protection during construction:
  • Standpipes in accordance with IFC 3313
  • Water supply for fire department operations
  • One layer of noncom protection, if required, on all mass timber more than 4 stories below uppermost floor under construction
  • Exterior wall coverings on all floor levels more than 4 levels below floor under construction – includes mezzanines
Fire safety during construction
Fire safety during construction

Structural Connections and Special Inspections
Group B changes:

S100-19
IBC: 1705.5.3 (New), TABLE 1705.5.3 (New)
Proponent: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB) (TWB@iccsafe.org)

2018 International Building Code
Add new text as follows:

1705.5.3 Mass timber construction. Special inspections of Mass Timber elements in Types IV-A, IV-B, and IV-C construction shall be in accordance with Table 1705.5.3.

<table>
<thead>
<tr>
<th>TABLE 1705.5.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>REQUIRED SPECIAL INSPECTIONS OF MASS TIMBER CONSTRUCTION</td>
</tr>
</tbody>
</table>

ADM35-19
IBC: 1103.3 (New)
Proponent: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB) (TWB@iccsafe.org)

2018 International Building Code
Add new text as follows:

1103.3 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 2304.1(1), inspection of the wood cover shall be made after the cover is installed, but before any other coverings or finishes are installed.
Group B: Connection code proposal

GROUP B DRAFT LANGUAGE 2021 IBC  S170-19

IBC: 2304.10.1 (Now)

2304.10.1 Connection fire resistance rating. Fire resistance ratings for connections in Type IV-A, IV-B, or IV-C construction shall be determined by one of the following:
1. Testing in accordance with Section 703.2 where the connection is part of the fire resistance test.
2. Engineering analysis which 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.

![Diagram of CLT wall and floor connection](image)

Figure 8-4: Final wood protection design

State adoptions:
Oregon CLT and MT Alt Means

Statewide Alternate Method
January 2015
No. 15-01
Cross-Laminated Timber Provisions
(Ref. ORS 690.646)

Abstract
August 2018
Statewide Alternate Method
No. 18-01 Tall Wood Buildings – Background

Statewide Alternate Methods are approved by the Division administrator in consultation with the appropriate advisory board. The advisory board’s review of proposed alternate methods includes:
- Building officials shall approve the use of any alternate method.
- The document in use shall include alternate methods.
- Current alternate methods do not limit the use of other proposed alternate methods encompassed.

Code Section: OCSIC Section 062.4 Type IV, Note
Date: January 15, 2015
Initiated by: Building Codes Division
Subject: Cross-Laminated Timber

Washington State: MT changes

State-Wide Code Change Proposal

CLT Coalition
Language from ICC TWB
Educational Outreach to SBCC members
TAG and Code Council Process
Public Hearings

ESB 5450 was vital
2015 vs. 2018
SBCC process...
WACO: In step with National Process
Could be enacted as early as July 2019

Slide Courtesy of Joe Mayo
**CA Accelerated MT Process:**

**Governor Brown Executive Order B 52-18:**

In effect July 2021:

Questions? ...Thank You!

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- info@awc.org
- (202) 463-4713

- Dennis Richardson
- (707) 538-2786
- drichardson@awc.org