A New Path Forward for Tall Wood Construction + INTRO Cleveland Tour

October 3, 2023

Presented by
Anthony Harvey, PE
WoodWorks
Tall Timber Building Design: Acoustics, Connections and Fire Protection

Anthony Harvey
Regional Director
13 tall wood projects already under construction or built.

- **Carbon 12**
  - Portland, OR
  - 8 stories mass timber

- **Heartwood**
  - Seattle, WA
  - 8 stories mass timber

- **Minnesota Places**
  - Portland, OR
  - 8 stories – 7 mass timber

- **TimberView**
  - Portland, OR
  - 8 stories mass timber

- **Bakers Place**
  - Madison, WI
  - 15 stories – 12 mass timber

- **INTRO**
  - Cleveland, OH
  - 9 stories – 8 mass timber

- **Ascent**
  - Milwaukee, WI
  - 25 stories – 19 mass timber

- **11 E Lenox**
  - Boston, MA
  - 7 stories mass timber

- **80 M Street**
  - Washington DC
  - 10 stories – 3-story mass timber vertical addition

- **Apex Plaza**
  - Charlottesville, VA
  - 8 stories – 6 mass timber

- **1510 Webster**
  - Oakland, CA
  - 18 stories – 16 mass timber

- **2057 SW Park**
  - Portland, OR
  - 12 stories mass timber

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WoodWorks is supporting 207 tall wood projects in design.
CARBON12, PORTLAND, OR

8 STORIES | 85 FT

Photos: Baumberger Studio/PATH Architecture/Marcus Kauffman | Architect: PATH Architecture
INTRO, CLEVELAND

9 Stories | 115 ft
8 Timber Over 1 Podium

512,000 SF
297 Apartments | Mixed-Use

Photo: Harbor Bay Real Estate Advisors, Image Fiction | Architect: Hartshorne Plunkard Architecture
ASCENT, MILWAUKEE

25 STORIES
19 TIMBER OVER 6 PODIUM, 284 FT

Photo: Korb & Associates Architects | Architect: Korb & Associates Architects
493,000 SF
259 APARTMENTS, MIXED-USE

Photo: Korb & Associates Architects | Architect: Korb & Associates Architects
3 STORY OVER-BUILD
ON EXISTING 7 STORY BUILDING

80 M ST, WASHINGTON, DC

Photo: Hickok Cole | Architect: Hickok Cole
80 M ST, WASHINGTON, DC

100,000 SF
2 NEW LEVELS OF CLASS A OFFICE SPACE
OCCUPIED PENTHOUSE
17'-0" CEILING HEIGHTS
NIR CENTER, PORTLAND, OR

Photo: Hennebery Eddy Architects
Architect: Hennebery Eddy Architects
NIR CENTER, PORTLAND, OR

10 STORIES
Type IV-B Construction
Hybrid Mass Timber + Steel

Photo: Hennebery Eddy Architects | Architect: Hennebery Eddy Architects
NIR CENTER, PORTLAND, OR

~400,000 SF
235,000 SF Laboratory Space
25,000 SF Office Space
Ground Floor Retail
APEX CLEAN ENERGY HQ
CHARLOTTESVILLE, VA
8 STORIES
6 TIMBER OVER 2 PODIUM, 100 FT
PRIMARILY OFFICE SPACE
1510 WEBSTER, OAKLAND

19 STORIES

17 TIMBER OVER 2 PODIUM

Type IV-A  Point Supported Mass Timber Floors
1510 WEBSTER, OAKLAND

19 STORIES

17 TIMBER OVER 2 PODIUM

Type IV-A Point Supported Mass Timber Floors

Photo: WoodWorks & oWOW
Architect/Developer: oWOW
DOES TALL WOOD = HIGH RISE?

Photo: Ema Peter
If this dimension exceeds 75 feet, building is considered a high rise.

10’ floor to floor

Lowest Level of Fire Dept. Vehicle Access

FIGURE 6-6 Determination of high-rise building
Sprinklers in High Rises

- Two Water Mains Required if:
  - Building Height Exceeds 420 ft, or
  - Type IV-A and IV-B buildings that exceed 120 ft in height
LATERAL SYSTEMS IN TALL WOOD
INTRO, CLEVELAND
Concrete Core Shearwalls
CARBON12, PORTLAND

Buckling-Restrained Braced Frame

Photos: Marcus Kauffmann, ODF
ASCENT, MILWAUKEE
Concrete Core Shearwalls

Photos: Korb + Associates, Thornton Tomasetti
BROCK COMMONS, VANCOUVER
Concrete Core Shearwalls

Photos: Acton Ostry Architects
FUTURE POTENTIAL LATERAL SYSTEM FOR TALL WOOD

Mass Timber
Rocking Shearwalls
CONSIDERATIONS FOR LATERAL SYSTEMS

Prescriptive Code Compliance

Concrete Shearwalls  ✔
Steel Braced Frames  ✔
CLT Shearwalls (65 ft max)  ✔
CLT Rocking Walls  ❌  2021 SDPWS ASCE 7-22
CONSIDERATIONS FOR LATERAL SYSTEMS

Connections to concrete core
- Tolerances & adjustability
- Drag/collector forces
CONSIDERATIONS FOR LATERAL SYSTEMS

Connections to steel frame
- Tolerances & adjustability
- Ease of installation
Shaft Enclosures in Tall Timber...

- When can shaft enclosures be MT?
- What FRR requirements exist?
- If shaft enclosure is MT, is NC req’d?
Tall Wood Shaft Enclosures

Exit & Hoistway Enclosures

E&H Enclosures FRR

<table>
<thead>
<tr>
<th>IV-A</th>
<th>IV-B</th>
<th>IV-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 12 Stories or 180 ft: MT protected with 2 layers 5/8” type X gyp (if 2 HR req’d) OR 3 layers 5/8” type X gyp (if 3 HR req’d) both sides.</td>
<td>NC or MT protected with 2 layers 5/8” type X gyp (IBC 2021 602.4.2.6) both sides.</td>
<td>NC or MT protected with 1 layer 5/8” type X gyp (IBC 602.4.3.6) both sides.</td>
</tr>
<tr>
<td>Above 12 Stories or 180 ft: Noncombustible shafts (IBC 2021 602.4).</td>
<td>2 HR (not less than FRR of floor assembly penetrated, IBC 713.4).</td>
<td></td>
</tr>
</tbody>
</table>
Shaft Wall Requirements in Tall Mass Timber Buildings

Richard McCain, PE, SE • Senior Technical Director • Tall Wood, WoodWorks

The 2021 International Building Code (IBC) introduced three new construction types—Type IV-A, IV-B, and IV-C—which allow tall mass timber buildings. For details on the new types and their requirements, see the WoodWorks paper, Tall Wood Buildings in the 2021 IBC—Up to 18 Stories of Mass Timber™. This paper builds on that document with an in-depth look at the requirements for shaft walls, including when and where wood can be used.

Shaft Enclosure Requirements in the 2021 IBC

A shaft is defined in Section 202 of the 2021 IBC as “an enclosed space extending through one or more stories of a building, connecting vertical openings in successive floors, or floors and roof.” Therefore, shaft enclosure requirements apply to stairs, elevators, and mechanical/electrical/plumbing (MEP) chases in multi-story buildings. While these applications may be similar in their fire design requirements, they tend to differ in terms of their assemblies, detailing, and construction constraints.

Shaft enclosures are specifically addressed in IBC Section 713. However, because shaft enclosure walls must be constructed as fire barriers per Section 713.2, many shaft wall requirements reference provisions for fire barriers found in Section 707.

Allowable Shaft Wall Materials

Provisions addressing materials permitted in shaft wall sections are limited, but shaft wall materials are generally similar to wall sections. A relatively new category of wood products, mass timber can be utilized in shaft wall construction.

Structural elements of Type IV construction primarily of wood, but the new IBC requirements add a new layer of complexity to shaft wall design. Through a thorough understanding of the IBC requirements and the application of suitable materials, architects and engineers can design shaft walls that meet the needs of tall mass timber buildings.
CONNECTIONS IN TALL WOOD
In Construction Types IV-A, IV-B & IV-C, building elements are required to be FRR as specified in IBC Tables 601 and 602. Connections between these building elements must be able to maintain FRR no less than that required of the connected members.

16.3 Wood Connections

Wood connections, including connectors, fasteners, and portions of wood members included in the connection design, shall be protected from fire exposure for the required fire resistance time. Protection shall be provided by wood, fire-rated gypsum board, other approved materials, or a combination thereof.

Source: NDS
Connection Fire Protection

Steel hangers/hardware fully concealed within a timber to timber connection is a common method of fire protection.
2304.10.1 Connection fire resistance rating. Fire resistance ratings 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 that demonstrates that the temperature rise at any portion of the connection is limited to an average temperature rise of 250° F (139° C), and a maximum temperature rise of 325° F (181° C), 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.
Many ways to demonstrate connection fire protection: calculations, prescriptive NC, test results, others as approved by AHJ.
Connection Fire Protection

2017 Glulam Beam to Column Connection Fire Tests under standard ASTM E119 time-temperature exposure

Photo: ARUP/SLB
## Fire Test Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Beam</th>
<th>Connector</th>
<th>Applied Load</th>
<th>FRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.75” x 18”</td>
<td>1 x Ricon S VS 290x80</td>
<td>3,905lbs (17.4kN)</td>
<td>1hr</td>
</tr>
<tr>
<td></td>
<td>(222mm x 457mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10.75” x 24”</td>
<td>Staggered double Ricon S VS 200x80</td>
<td>16,620lbs (73.9kN)</td>
<td>1.5hrs</td>
</tr>
<tr>
<td></td>
<td>(273mm x 610mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10.75” x 24”</td>
<td>1 x Megant 430</td>
<td>16,620lbs (73.9kN)</td>
<td>1.5hrs</td>
</tr>
<tr>
<td></td>
<td>(273mm x 610mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Softwood Lumber Board

Glulam Connection Fire Test Summary Report

Issue | June 5, 2017

Full Report Available at:

Wood Connection Coverings for Fire-Resistance

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.

*Inspection of Wood Coverings*
### TABLE 1705.5.3
REQUIRED SPECIAL INSPECTIONS OF MASS TIMBER CONSTRUCTION

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

Source: International Building Code

Table is only required for **Type IV-A, IV-B, and IV-C**
A library of commonly used mass timber connections with designer notes and information on fire resistance, relative cost and load-carrying capacity.
PENETRATIONS IN TALL WOOD

Photo: Alex Schreyer
Penetration Fire Protection

Although not a new code requirement or specific to tall wood, more testing & information is becoming available on firestopping of penetrations through MT assemblies.

Photos: AWC/FPInnovations
Penetration Fire Protection

Most firestopping systems include combination of fire safing (e.g. noncombustible materials such as mineral wool insulation) plus fire caulk.

Photos: AWC/FPInovations/Hilti
Penetration Fire Protection

Firestop systems tests on Mass Timber
Contact WoodWorks for information

FIRE RESISTANCE PERFORMANCE EVALUATION
OF A PENETRATION FIRESTOP SYSTEM TESTED
IN ACCORDANCE WITH ASTM E914-13A,
STANDARD TEST METHOD FOR FIRE TESTS OF
PENETRATION FIRESTOP SYSTEMS

FINAL REPORT
Consisting of 18 Pages

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

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

FIRE PERFORMANCE OF FIRESTOPS, PENETRATIONS, AND FIRE
DOORS IN MASS TIMBER ASSEMBLIES

Lindsay Ranger¹, Christian Dagenais¹, Conroy Lum¹, Tony Thomas¹

ABSTRACT: Integrity and continuity must be maintained for fire separations required to provide fire
prevent passage of hot gases or increased temperature on the unexposed side. Vulnerable locations, where
are introduced into mass timber systems, are susceptible to fire spread. Service and closure penetration
fire separation have been investigated. Many of the fire stop systems were able to achieve 1-5/8
accreditation with CAN/ULC-S115, which would be required for 2-10 fire resistance rated assemblies, such
tall wood buildings. Construction details are outlined which ensure adequate fire performance of these per

KEYWORDS: Firestop, through-penetrations, fire rated door, mass timber, cross-laminated timber
buildings, fire resistance

1 INTRODUCTION

Many tall wood buildings using mass timber are planned or are currently being designed for construction around
the world. A few have been built in Canada, including an 18 storey cross-laminated timber (CLT) and glulam
building in British Columbia. The prescriptive requirements in the National Building Code of Canada
(NBCC) [1] do not (yet) permit the construction of wood buildings taller than six stories, however an alternative
construction, as well as in several alter building designs.

Although the general fire performance of wood assemblies and their fire separation is well documented, there are still several areas that warrant further investigation to ensure that safety levels are met and a number of options are available for designers to use. Generating a library of generic assemblies will reduce the need for designers to conduct fire testing on individual components.

GHL CONSULTANTS LTD

FIRESTOPPING TEST WITNESS REPORT

NORDIC STRUCTURES
## Inventory of Fire Tested Penetrations in MT Assemblies

<table>
<thead>
<tr>
<th>CLT Panel</th>
<th>Exposed Side Protection</th>
<th>Penetrating Item</th>
<th>Penetrant Centred or Offset in Hole</th>
<th>Firestopping System Description</th>
<th>F Rating</th>
<th>T Rating</th>
<th>Stated Test Protocol</th>
<th>Source</th>
<th>Testing Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-ply (76mm 6.07&quot;)</td>
<td>None</td>
<td>1.5&quot; diameter datacable bunch</td>
<td>Centered</td>
<td>3.5&quot; in diameter hole. Mineral wool was installed in the inner annular space around the data cable to a total depth of approximately 2 – 5/64 in. The remaining inner annular space from the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.</td>
<td>1 hour</td>
<td>0.5 hour</td>
<td>CANULC SI 15</td>
<td>26</td>
<td>Inertak March 30, 2016</td>
</tr>
<tr>
<td>3-ply (76mm 6.07&quot;)</td>
<td>None</td>
<td>2&quot; copper pipe</td>
<td>Centered</td>
<td>4.375 in diameter hole. Pipe wrap was installed around the copper pipe to a total depth of approximately 2 – 5/64 in. The remaining inner annular space starting at the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.</td>
<td>1 hour</td>
<td>NA</td>
<td>CANULC SI 15</td>
<td>26</td>
<td>Inertak March 30, 2016</td>
</tr>
<tr>
<td>3-ply (76mm 6.07&quot;)</td>
<td>None</td>
<td>2.5&quot; schd. 40 pipe</td>
<td>Centered</td>
<td>4.92 in diameter hole. Pipe wrap was installed around the schedule 40 pipe to a total depth of approximately 2 – 5/64 in. The remaining inner annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS-One Max caulking.</td>
<td>1 hour</td>
<td>NA</td>
<td>CANULC SI 15</td>
<td>26</td>
<td>Inertak March 30, 2016</td>
</tr>
<tr>
<td>3-ply (76mm 6.07&quot;)</td>
<td>None</td>
<td>6&quot; cast iron pipe</td>
<td>Centered</td>
<td>8.35 in diameter hole. Mineral wool was installed in the inner annular space around the cast iron pipe to a total depth of approximately 2 – 5/64 in. The remaining inner annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS-One Max caulking.</td>
<td>1 hour</td>
<td>NA</td>
<td>CANULC SI 15</td>
<td>26</td>
<td>Inertak March 30, 2016</td>
</tr>
<tr>
<td>5-ply (76mm 6.07&quot;)</td>
<td>None</td>
<td>H10’ in deep in device system No. F- D-2049</td>
<td>Centered</td>
<td>9.01&quot; diameter hole. Mineral wool was installed in the inner annular space around the drop-in device to a total depth of approximately 1 – 7/64 in and the remaining inner annular space from the top of the mineral wool to the top edge of the 9 – 1/4 in. hole in the CLT was filled with Hilti FS-One Max caulking.</td>
<td>1 hour</td>
<td>0.75 hour</td>
<td>CANULC SI 15</td>
<td>26</td>
<td>Inertak March 30, 2016</td>
</tr>
<tr>
<td>5-ply CLT (131 mm 5.16&quot;)</td>
<td>None</td>
<td>1.5&quot; diameter datacable bunch</td>
<td>Centered</td>
<td>3.5&quot; in diameter hole. Mineral wool was installed in the inner annular space around the data cable to a total depth of approximately 4 – 5/32 in. The remaining inner annular space starting at the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.</td>
<td>2 hours</td>
<td>1.5 hours</td>
<td>CANULC SI 15</td>
<td>26</td>
<td>Inertak March 30, 2016</td>
</tr>
<tr>
<td>5-ply CLT (131 mm 5.16&quot;)</td>
<td>None</td>
<td>2&quot; copper pipe</td>
<td>Centered</td>
<td>4.375 in diameter hole. Pipe wrap was installed around the copper pipe to a total depth of approximately 4 – 5/32 in. The remaining inner annular space starting at the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.</td>
<td>2 hours</td>
<td>NA</td>
<td>CANULC SI 15</td>
<td>26</td>
<td>Inertak March 30, 2016</td>
</tr>
<tr>
<td>5-ply CLT (131 mm 5.16&quot;)</td>
<td>None</td>
<td>2.5&quot; schd. 40 pipe</td>
<td>Centered</td>
<td>4.92 in diameter hole. Pipe wrap was installed around the schedule 40 pipe to a total depth of approximately 4 – 5/32 in. The remaining inner annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS-One Max caulking.</td>
<td>2 hours</td>
<td>0.5 hour</td>
<td>CANULC SI 15</td>
<td>26</td>
<td>Inertak March 30, 2016</td>
</tr>
<tr>
<td>5-ply CLT (131 mm 5.16&quot;)</td>
<td>None</td>
<td>6&quot; cast iron pipe</td>
<td>Centered</td>
<td>8.35 in diameter hole. Mineral wool was installed in the inner annular space around the cast iron pipe to a total depth of approximately 4 – 5/32 in. The remaining inner annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS-One Max caulking.</td>
<td>2 hours</td>
<td>NA</td>
<td>CANULC SI 15</td>
<td>26</td>
<td>Inertak March 30, 2016</td>
</tr>
<tr>
<td>5-ply CLT (131 mm 5.16&quot;)</td>
<td>None</td>
<td>H10’ in deep in device system No. F- D-2049</td>
<td>Centered</td>
<td>9.01&quot; diameter hole. Mineral wool was installed in the inner annular space around the drop-in device to a total depth of approximately 1 – 7/64 in and the remaining inner annular space from the top of the mineral wool to the top edge of the 9 – 1/4 in. hole in the CLT was filled with Hilti FS-One Max caulking.</td>
<td>2 hours</td>
<td>1.5 hours</td>
<td>CANULC SI 15</td>
<td>26</td>
<td>Inertak March 30, 2016</td>
</tr>
<tr>
<td>5-ply (150mmx6.875&quot;)</td>
<td>None</td>
<td>1&quot; nominal PVC pipe</td>
<td>Centered</td>
<td>4.21 in diameter with a 3/4 in plywood reducer flush with the top of the slab reducing the opening to 2.28 in. Two strips of Hilti CP 6480x W45/1-3/4&quot; Fasten-up strip at two locations with a 50 gauge steel sleeve which extended from the top of the slab 1 in below the slab. The first location was with the bottom of the strip strip flush with the bottom of the steel sleeve and the second was with the bottom of the strip strip flush with the bottom of the slab. The void between the steel sleeve and the CLT and between the steel sleeve and pipe top was filled with Roman high insulating mineral wool leaving a 3/4 in deep void at the top of the assembly. Hilti FS-One Max Intumescent (Firestop Sealant) was applied to a depth of 3/4 in on the top of the assembly between the plywood and steel sleeve as well as the steel sleeve and pipe.</td>
<td>2 hours</td>
<td>2 hours</td>
<td>ASTM F 18</td>
<td>24</td>
<td>QAI Laboratories March 3, 2017</td>
</tr>
</tbody>
</table>
SEALANTS AT MT PANEL EDGES

Photos: ARUP
703.9 Sealing of adjacent mass timber elements. In buildings of Type IV-A, IV-B, and IV-C construction, sealant or adhesive shall be provided to resist the passage of air in the following locations:

1. At abutting edges and intersections of mass timber building elements required to be fire resistance-rated
2. At abutting intersections of mass timber building elements and building elements of other materials where both are required to be fire resistance-rated.
Sealants at MT Panel Edges

Sealants shall meet the requirements of ASTM C920 (elastomeric joint sealants). Adhesives shall meet the requirements of ASTM D3498 (gap filling construction adhesives, i.e. not fire caulk).

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

Several MT fire tested assemblies have successfully been completed w/o adhesives/sealants at abutting panel edges

2021 IBC will require periodic special inspections of adhesive/sealant installation (when required to be installed)
FIRE SAFETY DURING CONSTRUCTION
New code provisions in International Fire Code (IFC) address construction fire safety of tall wood buildings

3308.4 Fire safety requirements for buildings of Types IV-A, IV-B, and IV-C construction. Buildings of Types IV-A, IV-B, and IV-C construction designed to be greater than six stories above grade plane shall meet the following requirements during construction unless otherwise approved by the fire code official.

1. Standpipes shall be provided in accordance with Section 3313.
2. A water supply for fire department operations, as approved by the fire chief.
Fire Safety During Construction

IFC 3313 Standpipe Requirements

SECTION 3313
STANDPIPES

3313.1 Where required.
In buildings required to have standpipes by Section 905.3.1, not less than one standpipe shall be provided for use during construction. Such standpipes shall be installed prior to construction exceeding 40 feet (12 192 mm) in height above the lowest level of fire department vehicle access. Such standpipe shall be provided with fire department hose connections at accessible locations adjacent to usable stairways. Such standpipes shall be extended as construction progresses to within one floor of the highest point of construction having secured decking or flooring.

3313.2 Buildings being demolished.
Where a building is being demolished and a standpipe is existing within such a building, such standpipe shall be maintained in an operable condition so as to be available for use by the fire department. Such standpipe shall be demolished with the building but shall not be demolished more than one floor below the floor being demolished.

3313.3 Detailed requirements.
Standpipes shall be installed in accordance with the provisions of Section 905.

**Exception:** Standpipes shall be either temporary or permanent in nature, and with or without a water supply, provided that such standpipes comply with the requirements of Section 905 as to capacity, outlets and materials.
IFC 3308.4 Cont’d

3. Where building construction exceeds six stories above grade plane, at least one layer of noncombustible protection where required by Section 602.4 of the International Building Code shall be installed on all building elements more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor levels.

4. Where building construction exceeds six stories above grade plane required exterior wall coverings shall be installed on all floor levels more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor level.

Exception: Shafts and vertical exit enclosures
Fire Safety During Construction

Prior to placement of mass timber floor panels, all building elements more than 4 floor levels below the level of active mass timber construction shall be protected as required by this section.

Floor level of active mass timber construction.

Noncombustible floor covering required at this level and all lower floor levels.

Heavy bold lines indicate elements one layer of noncombustible protection on building elements of mass timber when required by Section 604.2.

Shading indicates where exterior wall covering is required.

Examples of Protection During Construction
For Mass Timber Buildings Greater Than 6 Stories Above Grade Plane

Figure 1

Figure 2

Credit: ICC
Acoustical Design
Air-Borne Sound:

Sound Transmission Class (STC)

• Measures how effectively an assembly isolates air-borne sound and reduces the level that passes from one side to the other
• Applies to walls and floor/ceiling assemblies
Structure-borne sound:
Impact Insulation Class (IIC)
• Evaluates how effectively an assembly blocks impact sound from passing through it
• Only applies to floor/ceiling assemblies
Acoustical Design

Code requirements only address residential occupancies:

For unit to unit or unit to public or service areas:

**Min. STC of 50 (45 if field tested):**
- Walls, Partitions, and Floor/Ceiling Assemblies

**Min. IIC of 50 (45 if field tested) for:**
- Floor/Ceiling Assemblies
## Acoustical Design

<table>
<thead>
<tr>
<th>STC</th>
<th>What can be heard</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Normal speech can be understood quite easily and distinctly through wall</td>
</tr>
<tr>
<td>30</td>
<td>Loud speech can be understood fairly well, normal speech heard but not understood</td>
</tr>
<tr>
<td>35</td>
<td>Loud speech audible but not intelligible</td>
</tr>
<tr>
<td>40</td>
<td>Onset of &quot;privacy&quot;</td>
</tr>
<tr>
<td>42</td>
<td>Loud speech audible as a murmur</td>
</tr>
<tr>
<td>45</td>
<td>Loud speech not audible; 90% of statistical population not annoyed</td>
</tr>
<tr>
<td>50</td>
<td>Very loud sounds such as musical instruments or a stereo can be faintly heard; 99% of population not annoyed.</td>
</tr>
<tr>
<td>60+</td>
<td>Superior soundproofing; most sounds inaudible</td>
</tr>
</tbody>
</table>
Tall Timber: Structure Often is Finish

Photos: Baumberger Studio/PATH Architecture/Marcus Kauffman | Architect: Kaiser + PATH
But by Itself, Not Adequate for Acoustics
# Mass Timber Acoustics

## Table 1: Examples of Acoustically-Tested Mass Timber Panels

<table>
<thead>
<tr>
<th>Mass Timber Panel</th>
<th>Thickness</th>
<th>STC Rating</th>
<th>IIC Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-ply CLT wall(^a)</td>
<td>3.07&quot;</td>
<td>33</td>
<td>N/A</td>
</tr>
<tr>
<td>5-ply CLT wall(^a)</td>
<td>6.875&quot;</td>
<td>38</td>
<td>N/A</td>
</tr>
<tr>
<td>5-ply CLT floor(^b)</td>
<td>5.1875&quot;</td>
<td>39</td>
<td>22</td>
</tr>
<tr>
<td><strong>5-ply CLT floor(^a)</strong></td>
<td><strong>6.875&quot;</strong></td>
<td><strong>41</strong></td>
<td><strong>25</strong></td>
</tr>
<tr>
<td>7-ply CLT floor(^a)</td>
<td>9.65&quot;</td>
<td>44</td>
<td>30</td>
</tr>
<tr>
<td>2x4 NLT wall(^b)</td>
<td>3-1/2&quot; bare NLT</td>
<td>24</td>
<td>N/A</td>
</tr>
<tr>
<td>4-1/4&quot; with 3/4&quot; plywood</td>
<td>29 with 3/4&quot; plywood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2x6 NLT wall(^b)</td>
<td>5-1/2&quot; bare NLT</td>
<td>22</td>
<td>N/A</td>
</tr>
<tr>
<td>6-1/4&quot; with 3/4&quot; plywood</td>
<td>31 with 3/4&quot; plywood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2x6 NLT floor + 1/2&quot; plywood(^b)</td>
<td>6&quot; with 1/2&quot; plywood</td>
<td>34</td>
<td>33</td>
</tr>
</tbody>
</table>

*Source: Inventory of Acoustically-Tested Mass Timber Assemblies, WoodWorks*
Acoustical Detailing

Regardless of the structural materials used in a wall or floor ceiling assembly, there are 3 effective methods of improving acoustical performance:

1. Add Mass
2. Add noise barriers
3. Add decouplers
Common mass timber floor assembly:

- Finish floor (if applicable)
- Underlayment (if finish floor)
- 1.5” to 4” thick concrete/gypcrete topping
- Acoustical mat
- WSP (if applicable)
- Mass timber floor panels
Mass Timber Acoustics

Mass Timber Assembly Options: Walls

Mass timber panels can also be used for interior and exterior walls, both load-bearing and non-load-bearing. For interior walls, the need to conceal services such as electrical and plumbing is an added consideration. Common approaches include building a chase wall in front of the mass timber wall or installing gypsum wallboard on resilient channels that are attached to the mass timber wall. As with mass timber floor panels, bare mass timber walls don’t typically provide adequate noise control, and mass walls also function as acoustical improvements. For example, a 3-ply CLT wall panel with a thickness of 3 1/2” has an STC rating of 33. In contrast, Figure 3 shows an interior CLT partition wall with chase walls on both sides. This assembly achieves an STC rating of 58, exceeding the BCA’s acoustical requirements for multi-family construction. Other examples are included in the inventory of tested assemblies noted above.

Acoustical Differences between Mass Timber Panel Options

The majority of acoustically tested mass timber assemblies include CLT; however, tests have also been done on other mass timber panel options such as NLT and cross-laminated timber (CLT), as well as traditional heavy timber options such as tongue and groove decking. Most tests have concluded that CLT is acoustically the best performer, followed by CLT, then NLT, and then CLT with glulam. These results are directly related to the mass and the mass of the individual mass timber panels. The heavier the mass, the better the performance.

Improving Performance by Minimizing Flanking

Even when the assemblies in a building are correctly designed and installed for high acoustical performance, consideration of flanking paths—in the case of assembly intersections, beam-to-column, or MEP penetrations—is necessary for a building to meet overall acoustical performance objectives.

One way to minimize flanking paths is to use resilient connection isolation and sealant strips. These products are available in various commercial buildings and are effective in preventing sound transmission between structural members and connections while preserving isolation and breaking direct connections between members. In the context of the three methods for improving acoustical performance noted above, these steps are essential. With attention to connections, flanking paths, and penetrations, there is a much greater chance that the acoustic performance of a mass timber building will meet expectations.
Acoustically-Tested Mass Timber Assemblies

Following is a list of mass timber assemblies that have been acoustically tested as of January 23, 2019. Sources are noted at the end of this document. For free technical assistance on any questions related to the acoustical design of mass timber assemblies, or free technical assistance related to any aspect of the design, engineering or construction of a commercial or multi-family wood building in the U.S., email help@woodworks.org or contact the WoodWorks Regional Director nearest you: http://www.woodworks.org/project-assistance

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<table>
<thead>
<tr>
<th>CLT Panel</th>
<th>Concrete/Gypsum Topping</th>
<th>Acoustical Mat Product Between CLT and Topping</th>
<th>Finish Floor</th>
<th>STC</th>
<th>IIC</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2&quot; Gyp-Crete*</td>
<td>Maxxon Acousti-Mat® 3/4</td>
<td>None</td>
<td>LVT</td>
<td>47*</td>
<td>49*</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Carpet + Pad</td>
<td>-</td>
<td>75*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LVT on Acousti-Top®</td>
<td>-</td>
<td>52*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Engineered Wood on Acousti-Top®</td>
<td>-</td>
<td>51*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maxxon Acousti-Mat® % Premium</td>
<td>None</td>
<td>LVT</td>
<td>49*</td>
<td>47*</td>
<td>1</td>
</tr>
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<td></td>
<td></td>
<td>Carpet + Pad</td>
<td>-</td>
<td>75*</td>
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<td></td>
<td></td>
<td></td>
<td>LVT on Acousti-Top®</td>
<td>-</td>
<td>52*</td>
<td></td>
</tr>
<tr>
<td>CLT 5-ply (6.875&quot;)</td>
<td>USG SAM N25 Ultra</td>
<td>None</td>
<td>LVT</td>
<td>45*</td>
<td>39*</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LVT Plus</td>
<td>48*</td>
<td>45*</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Engineered Wood</td>
<td>47*</td>
<td>47*</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Carpet + Pad</td>
<td>45*</td>
<td>67*</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ceramic Tile</td>
<td>50*</td>
<td>46*</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>Supreme® Insonomat</td>
<td>None</td>
<td>LVT</td>
<td>45*</td>
<td>42*</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LVT Plus</td>
<td>48*</td>
<td>44*</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Engineered Wood</td>
<td>47*</td>
<td>45*</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Carpet + Pad</td>
<td>45*</td>
<td>71*</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ceramic Tile</td>
<td>50*</td>
<td>46*</td>
<td>61</td>
</tr>
<tr>
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<td>USG SAM N75 Ultra</td>
<td>None</td>
<td>LVT</td>
<td>45*</td>
<td>38*</td>
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<td></td>
<td></td>
<td></td>
<td>LVT Plus</td>
<td>48*</td>
<td>45*</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Engineered Wood</td>
<td>47*</td>
<td>45*</td>
<td>59</td>
</tr>
</tbody>
</table>
### Table 2: Impact of Direct Applied Ceiling Gypsum and Dropped Ceiling on Mass Timber Floor Panels

<table>
<thead>
<tr>
<th>Base Assembly (top to bottom)</th>
<th>Base assembly plus 2 layers direct applied 5/8” gyp on underside of mass timber</th>
<th>Base assembly plus 2 layers direct applied gyp plus dropped ceiling</th>
</tr>
</thead>
</table>
| 1” poured gypsum, acoustical mat, 5-ply CLT | STC 50  
IIC 40                                                                 | STC 52  
IIC 46                                                                 | STC 63  
IIC 60                                                                 |
| LVT, 1” poured gypsum, acoustical mat, 5-ply CLT | STC 51  
IIC 43                                                                 | STC 52  
IIC 48                                                                 | STC 63  
IIC 63                                                                 |
| 2” concrete, acoustical mat, 5-ply CLT | STC 52  
IIC 46                                                                 | STC 59  
IIC 52                                                                 | Not tested                                             |
| LVT, 2” concrete, acoustical mat, 5-ply CLT | STC 53  
IIC 52                                                                 | STC 58  
IIC 55                                                                 | Not tested                                             |
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https://www.woodworks.org/mass-timber-construction-management-program

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- COMMUNITY COLLEGES
- PARTNER WITH CONSTRUCTION ASSOCIATIONS

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