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

Prepared by:
Dennis Richardson, PE, CBO, CASp
Western Regional Manager, American Wood Council
drichardson@awc.org

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For additional information or assistance contact:

American Wood Council
222 Catoctin Circle SE, Suite 201
Leesburg, VA 20175
http://www.awc.org/
info@awc.org
202-463-2766

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Code assistance – Awc field staff

Jim Smith
Midwest
jsmith@awc.org; 608-635-6635

Dennis Richardson
West
drichardson@awc.org
707-538-2786

Matt Hunter
Northeast
mhunter@awc.org;
484-353-2509

Dave Tyree
South Central
dtyree@awc.org
719-492-3990

Paul Coats
Southeast
pcoats@awc.org
803-980-7304

Sam Francis
National Director - retired
sfrancis@awc.org; 610-869-4774

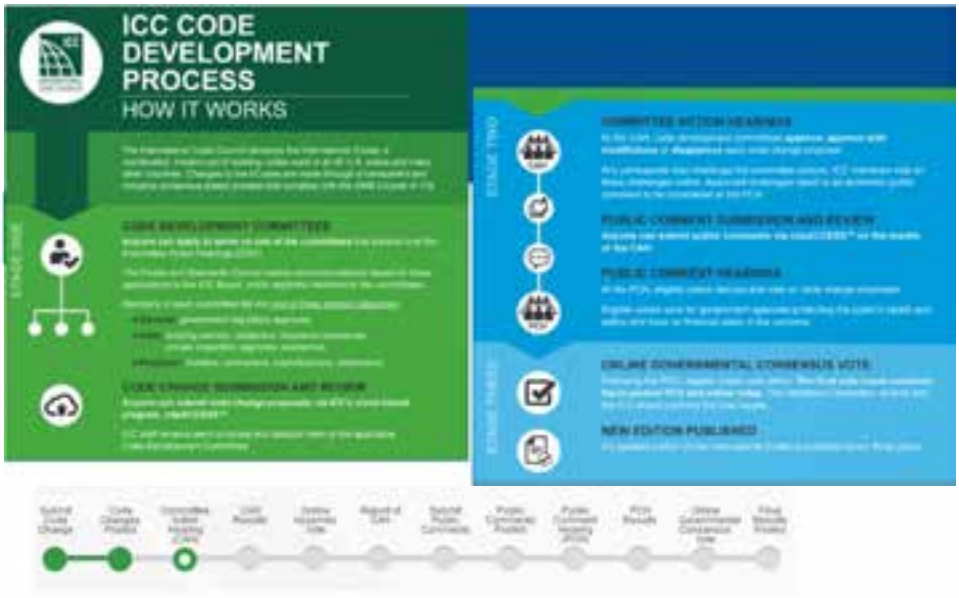
Fire-Resistant Design for Wood Construction

American Wood Council

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

AWC is an ANSI accredited standards developer.

Code Change Process



ICC TALL WOOD AD HOC COMMITTEE

Project Scope

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

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

This scope will require further refinement by the committee.

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ICC TALL WOOD AD HOC COMMITTEE

Membership

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

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

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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:

IBC Section 2304.3.3

Shrinkage must be accounted for in platform construction:

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

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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

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B

Three Main Categories:

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

IBC TABLE 601

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
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	A	B	A	B	A	B	A	B	C	HT	A	B

ICC TALL WOOD AD HOC COMMITTEE

Fire Behavior Depends on:

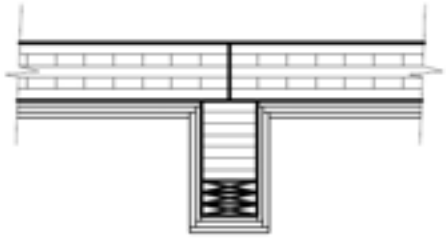
Fire behavior depends in part on:

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

Behavior of Fire and Materials

Protection of mass timber construction:

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)

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.

Testing of NC protection: Western Fire Center

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Photo Courtesy of ROCKWOOL

Other testing of NC protection:

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

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

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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)?

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Summary of tests:

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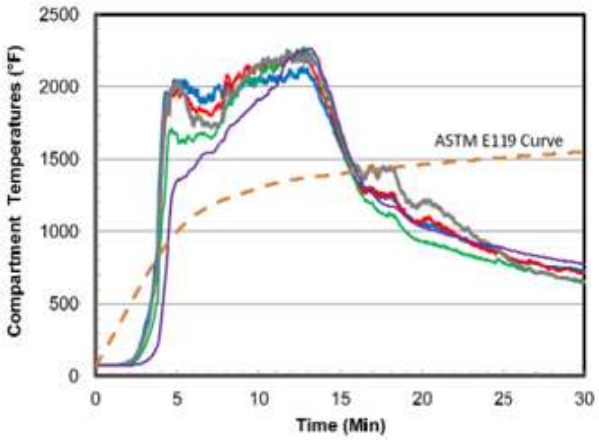
"Non-Standard Fire" not in the code



Compartment Temperature

Typical "non-standard" TT curve

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Mass Timber Fire Testing:

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

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

3.7.1 NRC Protected CLT Floor and Wall Tests

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

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

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

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

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

Table 3.6b Added Contribution of Gypsum Wallboard Protection

Beam Description	Design Stress Ratio	GWB Description		Test Times (minutes)			Estimated Times (minutes)		
		Thickness (inches)	Layers	SCL Beam + GWB	SCL Beam Only	GWB Only	SCL Beam + GWB	SCL Beam Only	GWB Only
3½"-Wide LVL	56%	5/8" Type X	1	71	33	38 [1]	70	30	40
7"-Wide LVL	113%	5/8" Type X	2	139	50	90	130	50	80
3½"-Wide LSL	84%	5/8" Type X	1	74	35	39 [1]	68	26	40
3½"-Wide LSL	84%	5/8" Type X	2	114	35	79	106	26	80

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

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

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

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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

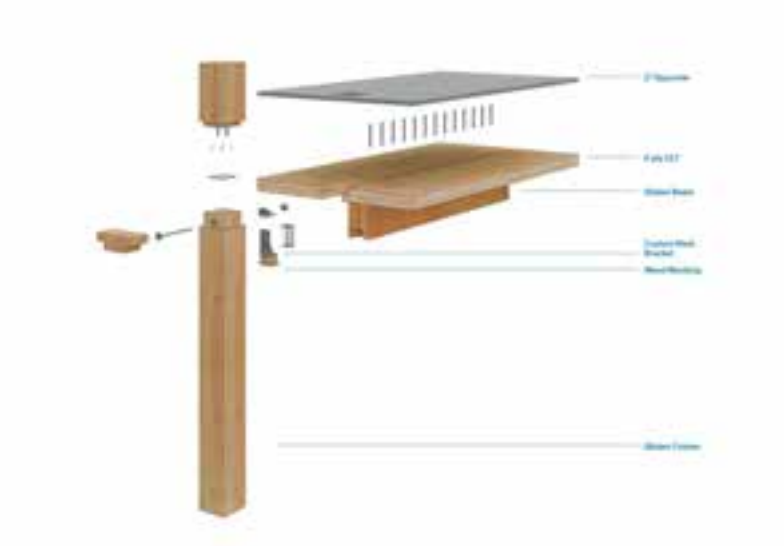
2015	AWC; Southwest Research Institute (SwRI)	Nail Laminated Timber (NLT) and CLT compartments; 2 hour FRR fire stops	Non – Standard; E 814

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

Figure B-4. Sample before the Hose Stream Test.

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



Slide Courtesy of LEVER Arch

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

Slide Courtesy of Arup

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
- Report available at FPRF website: https://www.nfpa.org/News-and-Research

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

- 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

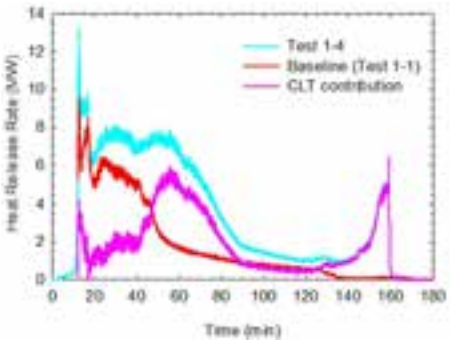
- Fire re-growth observed in multiple FPRF tests
- Fire re-growth caused by failure of bond lines before being reached by char front (i.e., heat-delamination)

Images courtesy of Joseph Su, NRC Canada

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

Test 1-4: Exposed CLT ceiling

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



Graphs courtesy of Joseph Su, NRC Canada

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

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

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

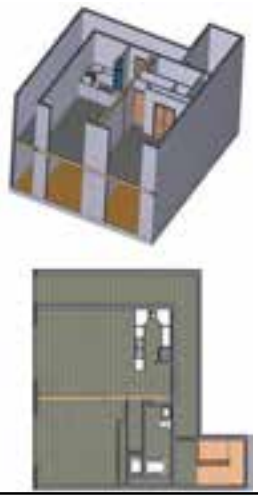
Test	Description	Date	Duration
Test 1	All mass timber surfaces protected with 2 layers of 5/8" Type X GWB	5/23/17	3 hours
Test 2	30% of CLT ceiling area in living room and bedroom exposed	5/31/17	4 hours
Test 3	Two opposing CLT walls exposed – one in bedroom and one in living room (there is a partition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

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

- Partitions used unrated ½" gypsum wallboard
- Kitchen & Living Room: 15 ft x 30 ft
- Bedroom & Bath: 15 ft x 30 ft
- 20-min rated door between compartment and

  corridor
- 90-min rated door between corridor and

  stairwell
- Fuel load ~570 MJ/m^2



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

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

ATF fire Test #2 – 30% CLT Ceilings Exposed

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

Live load applied using water barrels

ATF fire Test #2 – 30% CLT Ceilings Exposed

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

Atf fire Test #2 – 30% CLT Ceilings Exposed

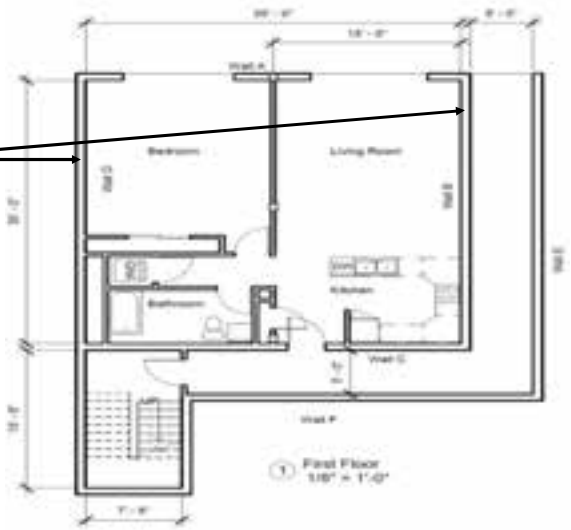
Post-Fire Condition of Glulam After Gypsum Removal

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

Section of exposed ceiling (90º angle)

ATF fire Test #3 – Exposed Walls

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



Atf Fire Test #3 Walls Exposed

ATF Fire Test Results – Event Log

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

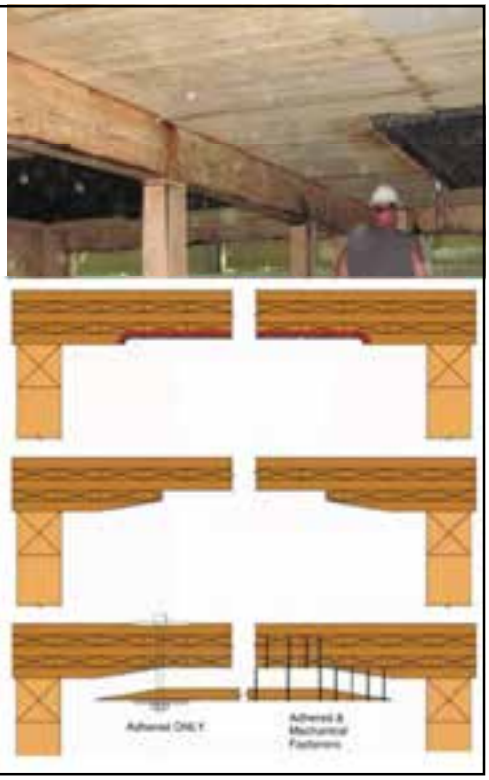
Tests 2 and 3 terminated at 4 hours with no re-growth

ATF Fire tests

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

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

Repair in Place ?



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

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

Test protocol developed by Southwest Research Institute (SwRI)

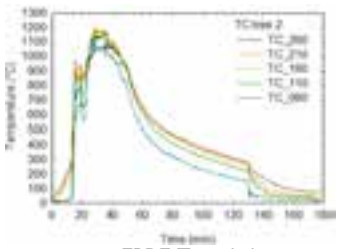
- Large-scale compartment test (9' x 19' compartment)
- Exposed CLT ceiling (as was tested in FPRF Test 1-4)
  - Same CLT span as in FPRF tests (~15')
  - Same loading as in FPRF tests (20 psf)
  - Same ventilation ratio as in FPRF tests (~0.03 $m^{0.5}$)

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

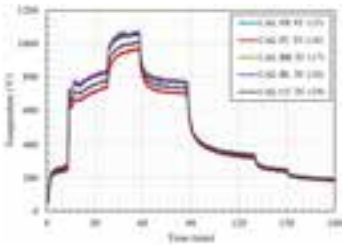
1. Validate test setup for FPRF T/T curve
2. Recreate char drop off or “delamination” of original PUR
3. Melamine adhesive testing
4. 2nd generation PUR adhesive testing

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)



FPRF Test 1-1



Adhesive qualification calibration test

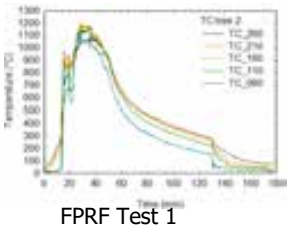
2017	AWC; SwRI	Development of a Fire Performance Assessment Methodology for CLT Adhesives	New PRG 320, Annex B standard

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

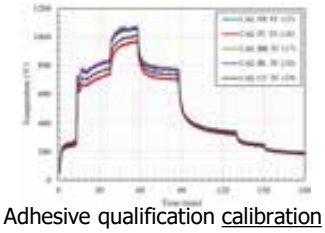
Just prior to fire re-growth (2:59)

2nd Flashover caused by fire re-growth (3:10)

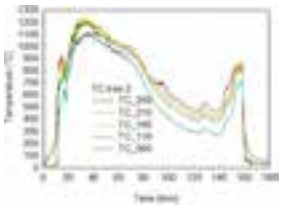
2017	AWC; SwRI	Development of a Fire Performance Assessment Methodology for CLT Adhesives	New PRG 320, Annex B standard



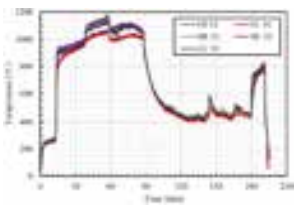
FPRF Test 1 -1



Adhesive qualification calibration test



FPRF Test 1-4

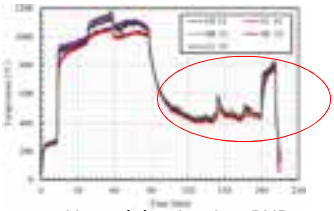


Adhesive qualification validation test

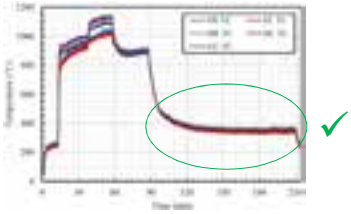
2017	AWC; SwRI	Development of a Fire Performance Assessment Methodology for CLT Adhesives	New PRG 320, Annex B standard

Qualification tests performed on other adhesives

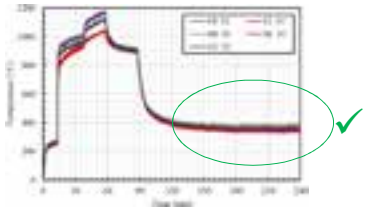
- Fire re-growth observed with PUR
- No fire re-growth observed with
  - Melamine formaldehyde resin
  - Improved PUR
- Test identifies acceptable performance



Heat-delaminating PUR



Melamine formaldehyde resin



Improved PUR

2018 ANSI/APA - PRG 320

FLOOR MODIFICATION

G108-18-DIGIOVANNI-1

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

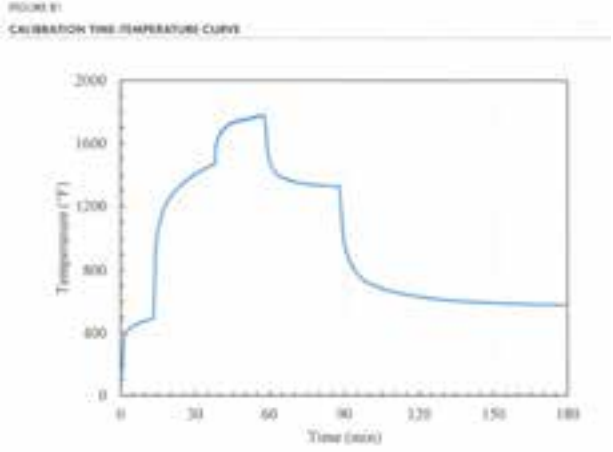


Photo by AWC

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

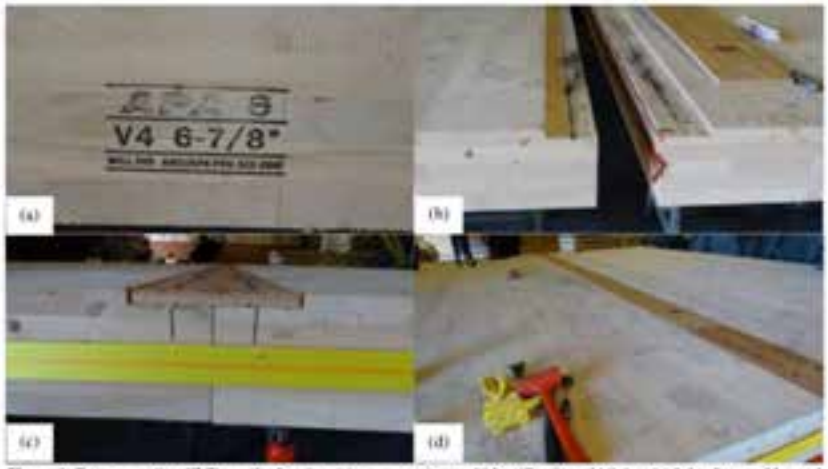
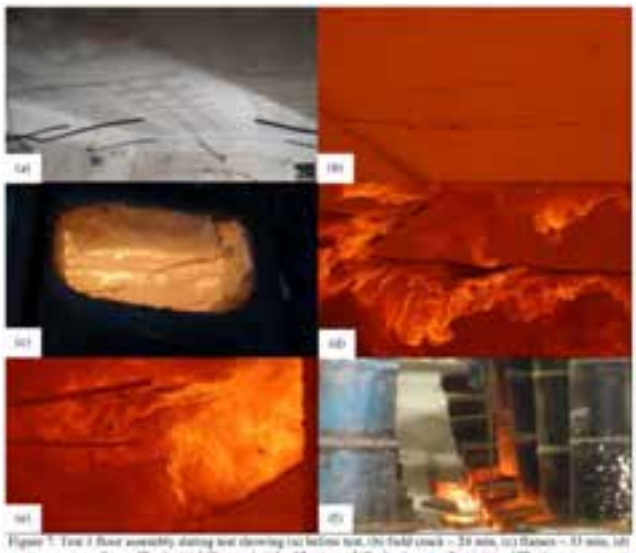
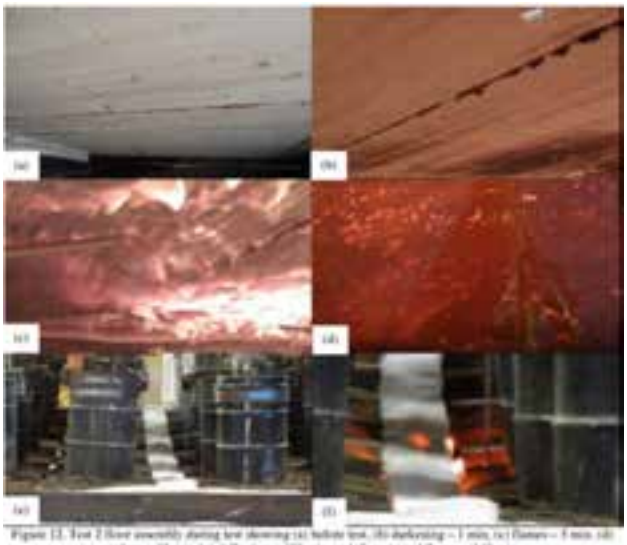


Figure 1. Representative CLT panels showing (a) cross-section and identification, (b) joint, (c) joined assembly, and (d) complete assembly.

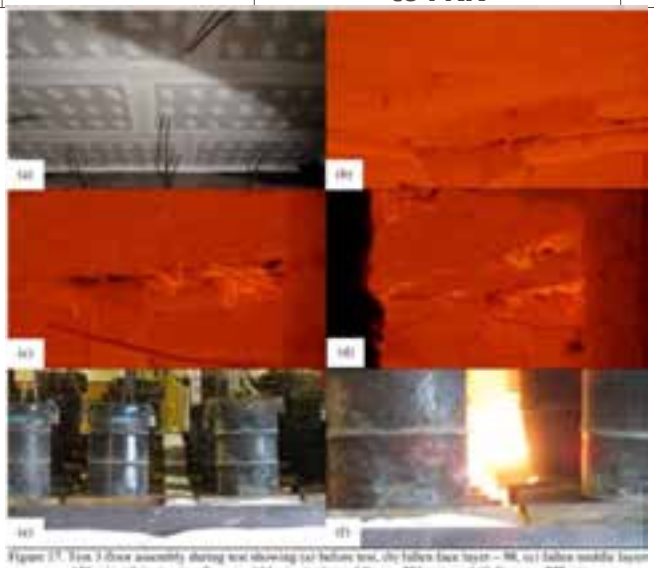
2017	AWC; WFC	CLT Floor/Ceiling Assembly to establish the contribution of GWB to FRR	E 119



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



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



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

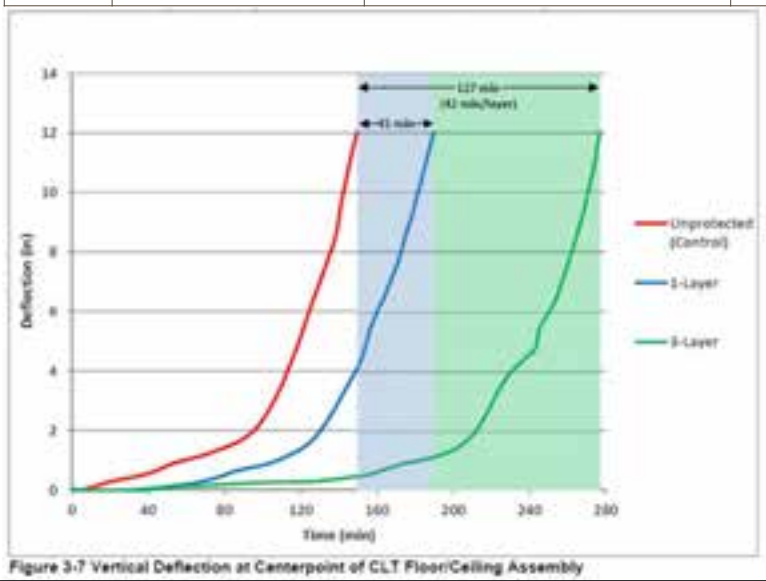


Figure 3-7 Vertical Deflection at Centerpoint of CLT Floor/Ceiling Assembly

Other testing of NC protection:

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Photo Courtesy of ROCKWOOL

Other testing of NC protection:

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

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

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

FIRE TESTING OF ROOMS WITH EXPOSED WOOD SURFACES IN ENCAPSULATED MASS TIMBER CONSTRUCTION

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

8 August 2018

National Research Council Canada | Conseil national de recherches Canada

Canada

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

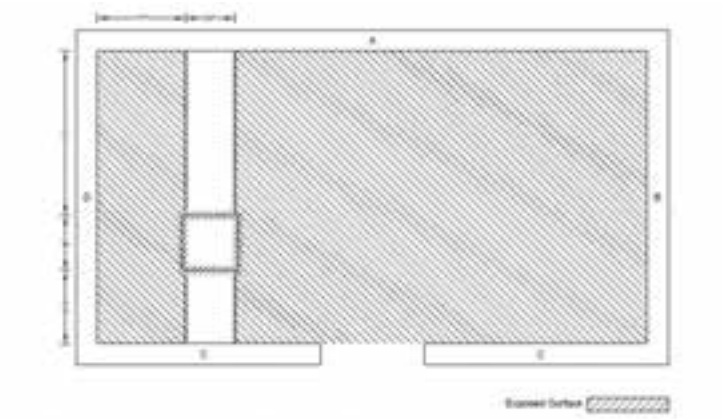

Figure 4. Room schematic for Test 4 – fully exposed ceiling, column (4 sides) and beam (3 sides).

A1-012710.1 4 NRC·CNRC

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

Summary of code changes:

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2018 ANSI/APA - PRG 320

FLOOR MODIFICATION

G108-18-DIGIOVANNI-1

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

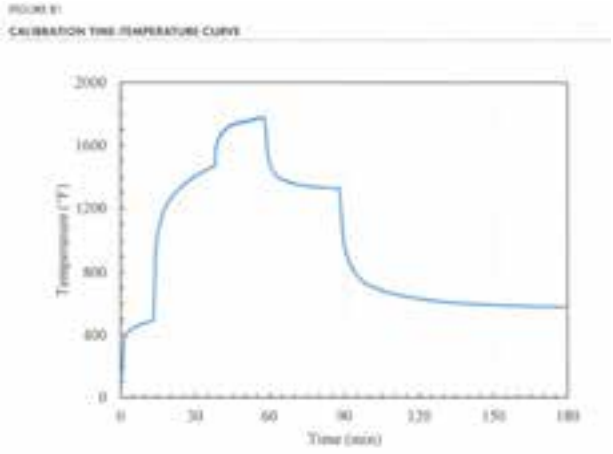


Photo by AWC

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

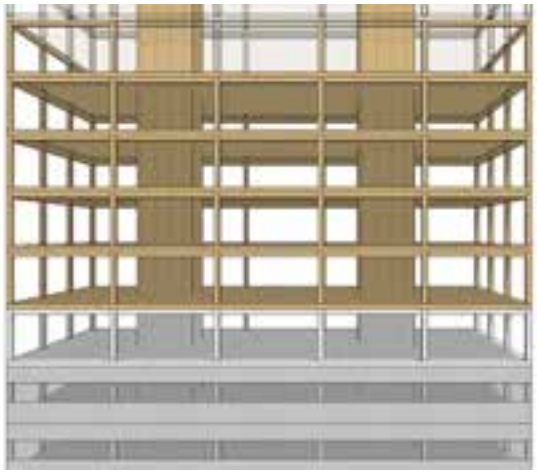
Fire Code Requirements:

- Construction Fire Safety (F266-18)
- Owners Responsibilities (F 88-18)

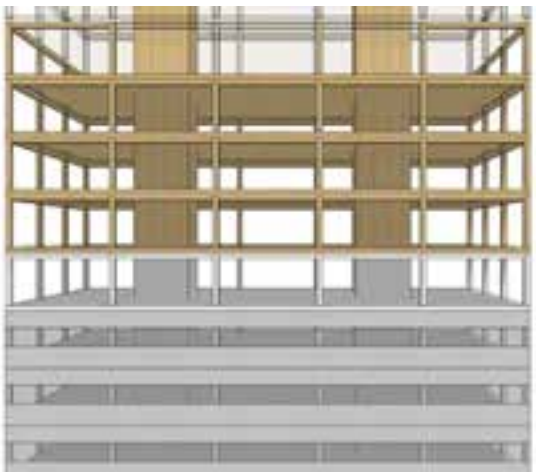
Additional Fire Protection During Construction Requirements

- 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

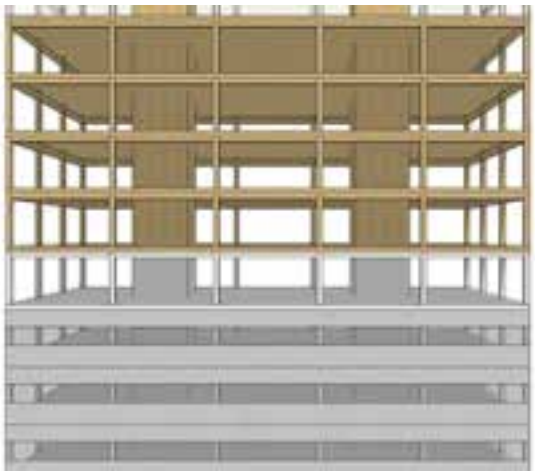
Fire safety during construction



Fire safety during construction



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 1705.5.3
REQUIRED SPECIAL INSPECTIONS OF MASS TIMBER CONSTRUCTION

ADM35-19

IBC®: 110.3.5 (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:

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.*

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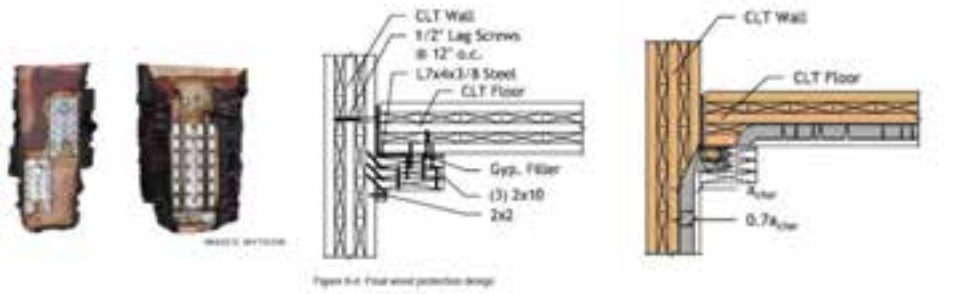
Group B: Connection code proposal

GROUP B DRAFT LANGUAGE 2021 IBC **S170-19**

IBC: 2304.10.1 (New)

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.



State adoptions:

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Oregon CLT and MT Alt Means

Statewide Alternate Method
January 2015

No. 15-01
Cross-Laminated Timber Provisions

Abstract
August 2018

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

Code Edition:
Code Section:
Date:
Initiated by:
Subject:
Cross-Laminated Timber

Statewide Alternate Method (SAM) Number 18-01 provides prescriptive path elements for Tall Wood Buildings of mass timber construction. This alternate path includes scientific conclusions established by the International Code Council's Ad Hoc Committee on Tall Wood Buildings that were incorporated into fourteen national proposals and utilizes concrete, steel or masonry for the vertical elements of the seismic force-resisting system.

The provisions detailed in the SAM are crafted to coincide with the 2014 Oregon Structural Specialty Code (OSSC) when adopted for use.

There are types of construction are introduced under this method, all three of which are organized under Type IV construction, typically referred to as heavy timber.

The new types of construction are:

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

Washington State: MT changes

Slide Courtesy of Joe Mayo

CA Accelerated MT Process:

Governor Brown Executive Order B 52-18:

CA Accelerated MT Process (+18 months):

In effect July 2021:

Questions? …Thank You!

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

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