



Tall Timber Buildings

The US Experience

High Rise Fire Safety Conference
October 7, 2020

Present by

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History of CLT

- 1985 First patent for CLT in France
- 1993 First projects in CLT in Switzerland and Germany
- 1995-1996 Development of press technology
- 1998 First multi-story residential building in Styria, Austria
- CLT use (Europe) increased significantly in the early 2000s
 - Driven by the green building movement
 - Due to better efficiencies, product approvals, and improved marketing and distribution channels
 - Over 500 CLT buildings in England
- US and Canadian use of CLT



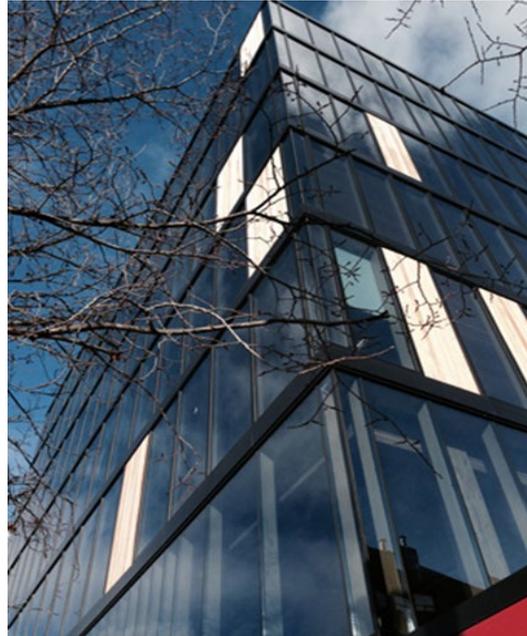
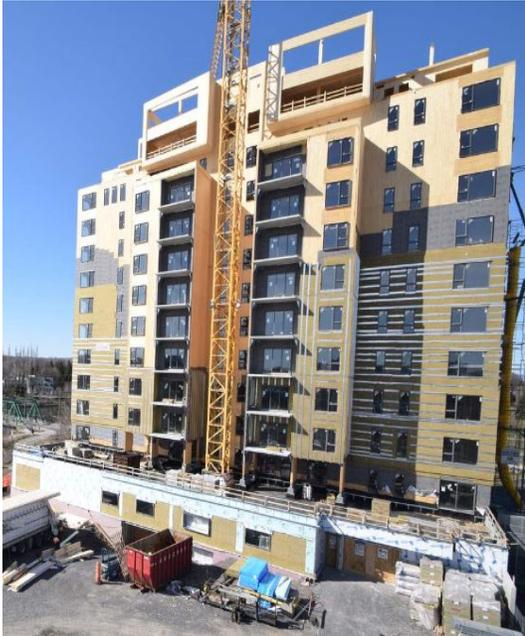
Current Structures



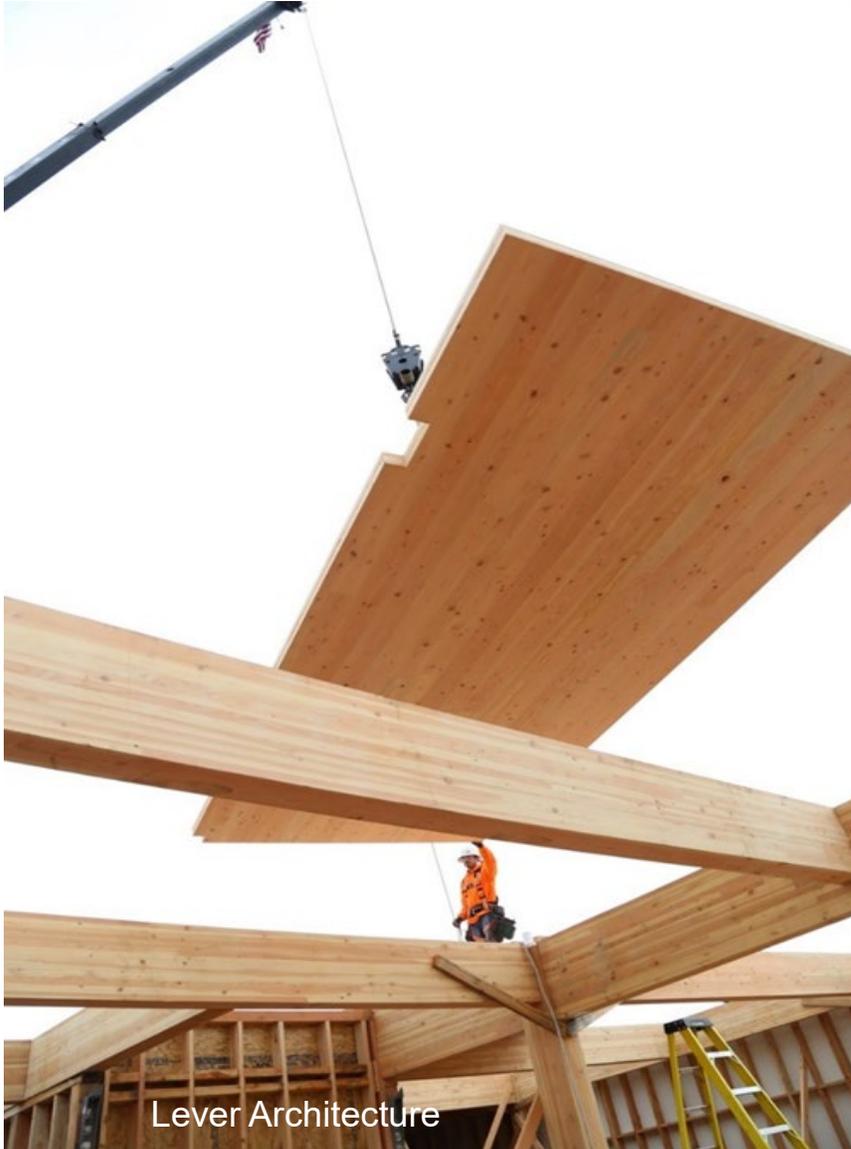
Muhlweg Apartments, Austria



Svartlamoen, Norway



CLT = Jinga



Disconnect



Modern vs Legacy



Heat Release Rate vs Temperature

One candle vs ten candles - same flame temperature but 10 times the energy



HRR:
Approx. 80 W
Temperature Range:
500 C to 1400 C
(930 F to 2500 F)



HRR: Approx. 800 W





Preliminary Results

FPRF's CLT Compartment Fire Tests

Joseph Su, PhD
Principal Research Officer, Fire Safety

CLT Compartment Fire Tests

Opening in W2	Interior dimensions 9.1 m x 4.6 m x 2.7 m					Test
	W1 9.1 m x 2.7 m	W2 4.6 m x 2.7 m	W3 9.1 m x 2.7 m	W4 4.6 m x 2.7 m	Ceiling 9.1 m x 4.6 m	
1.8 m x 2.0 m	3GB	3GB	3GB	3GB	3GB	1-1
	3GB	3GB	3GB	3GB	exposed	1-4
	exposed	3GB	3GB	3GB	3GB	1-5
	exposed	3GB	3GB	3GB	exposed	1-6
3.6 m x 2.0 m	2GB	2GB	2GB	2GB	2GB	1-2
	exposed	2GB	2GB	2GB	3GB	1-3



Ignition with 50 kW gas burner
Time = 0 min

Baseline Test 1-1 (Narrow Opening) Post Test



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Sealing The Joints





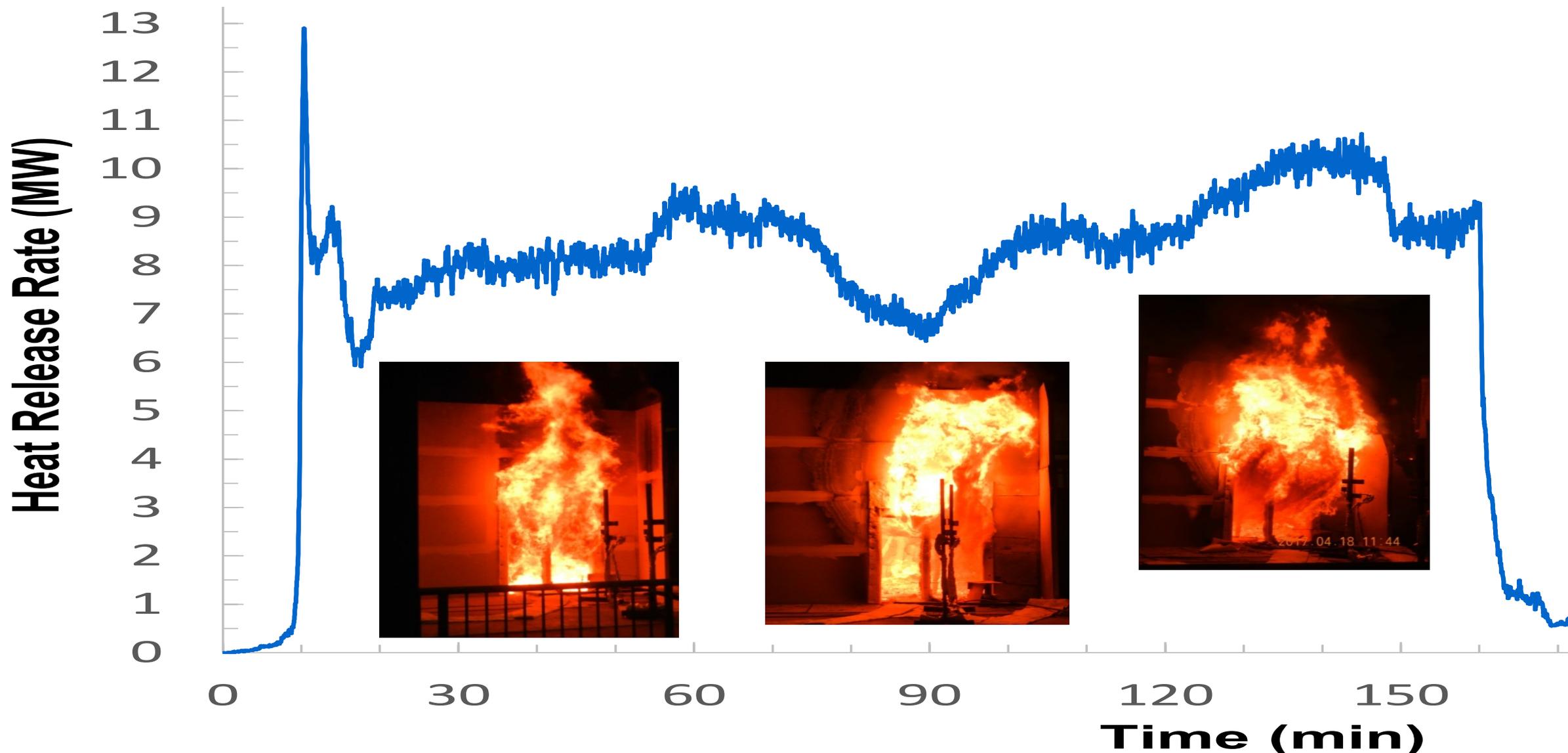
Test 1-4 (Exposed Ceiling, Narrow Opening) Post Test



Ceiling Delamination



Test 1-6 (One Wall & Ceiling Exposed, Narrow Opening) Heat Release Rate (HRR)



Test 1-6 (One Wall & Ceiling Exposed, Narrow Opening) Post Test



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ICC TWB Ad Hoc Committee Meeting

- Includes stakeholders, code officials and other interested parties
- Developed to study tall wood construction
- May develop code changes for the 2021 International Building Code
- Four workgroups
 - Fire
 - Structural
 - Standards/Definitions
 - Code: Height and Area

No.	Test Floor / Construction Type	Wall A	Wall B	Wall C	Wall D	Floor/Ceiling	Interior Partition	Active Protection
1	1 st / IV-A Completed	60% openings with 2 layers Type X GWB elsewhere	2 Layers Type X GWB	2 Layers Type X GWB	2 Layers Type X GWB	Floor: 2 layers cement board Ceiling: 2 layers GWB	Non-fire rated ½" GWB on each side	None
2	2 nd / IV-B Completed		2 Layers Type X GWB	2 Layers Type X GWB	2 Layers Type X GWB	Floor: 2 layers cement board Ceiling: 2 layers GWB with 30% exposed CLT		
3	2 nd / IV-B Week of June 19		Livingroom: Exposed CLT Kitchen: 2 Layers GWB	2 Layers Type X GWB	Bedroom: Exposed CLT Bathroom: 2 Layers Type X GWB	Floor: 2 layers cement board Ceiling: 2 layers GWB		
4	1 st / IV-C Week of June 26	60% openings with glazing with 2 layers Type X GWB	Exposed CLT			Floor: 2 layers cement board Ceiling: Exposed CLT		NFPA 13, Ordinary Hazard
5	1 st / IV-C Week of June 26		Exposed CLT			Floor: 2 layers cement board Ceiling: Exposed		NFPA 13, Ordinary Hazard with 20-minute

Test 2 (4 hour Test)

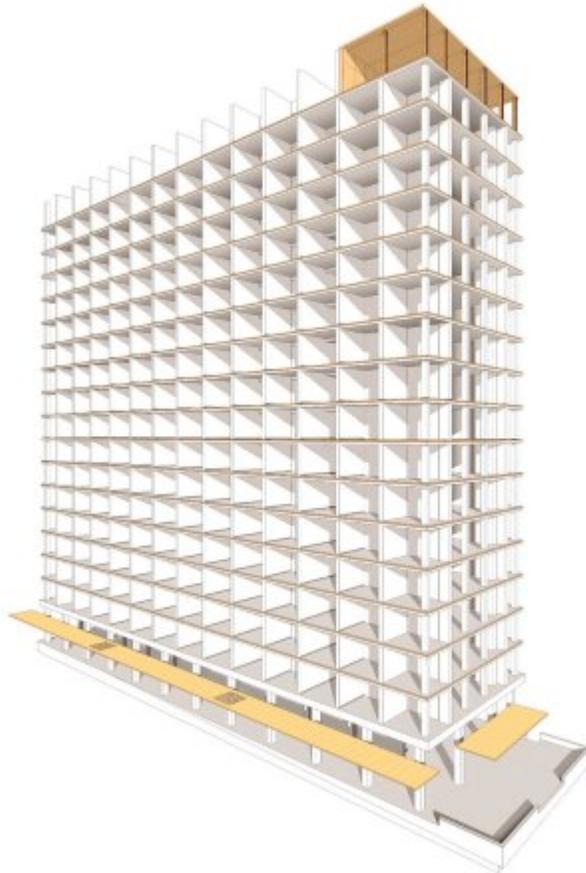
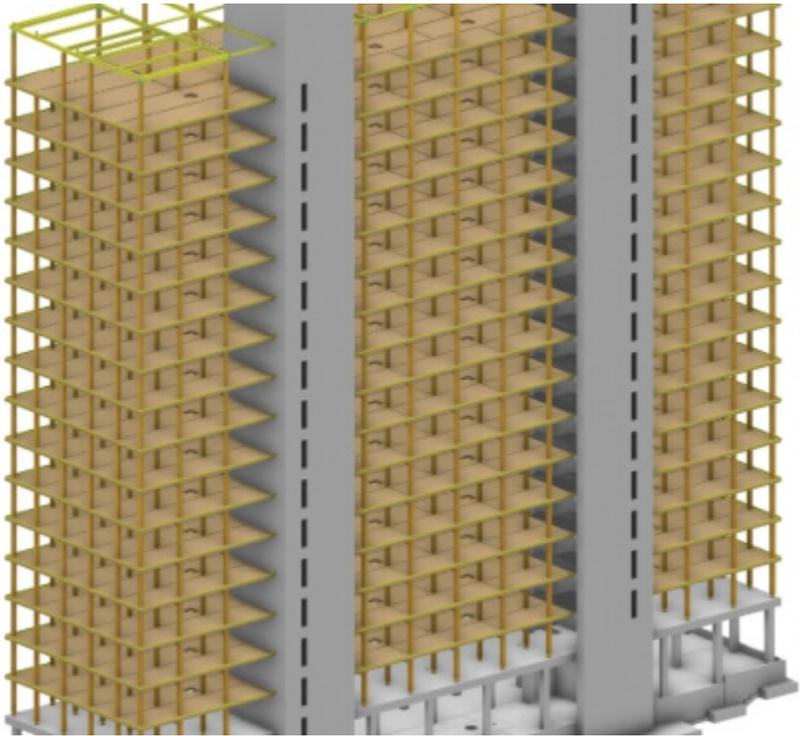
Photos courtesy of USDA FS Forest Products Laboratory



Ceiling Damage - Replacement



Brock Common Tower British Columbia



Portland, Oregon

12 Stories



Tall Wood CLT Winning Building Planned for New York City



A 10-story building in New York will be the first high rise there constructed with cross laminated timber.
475 W 18th Street



ICC Code Development Process

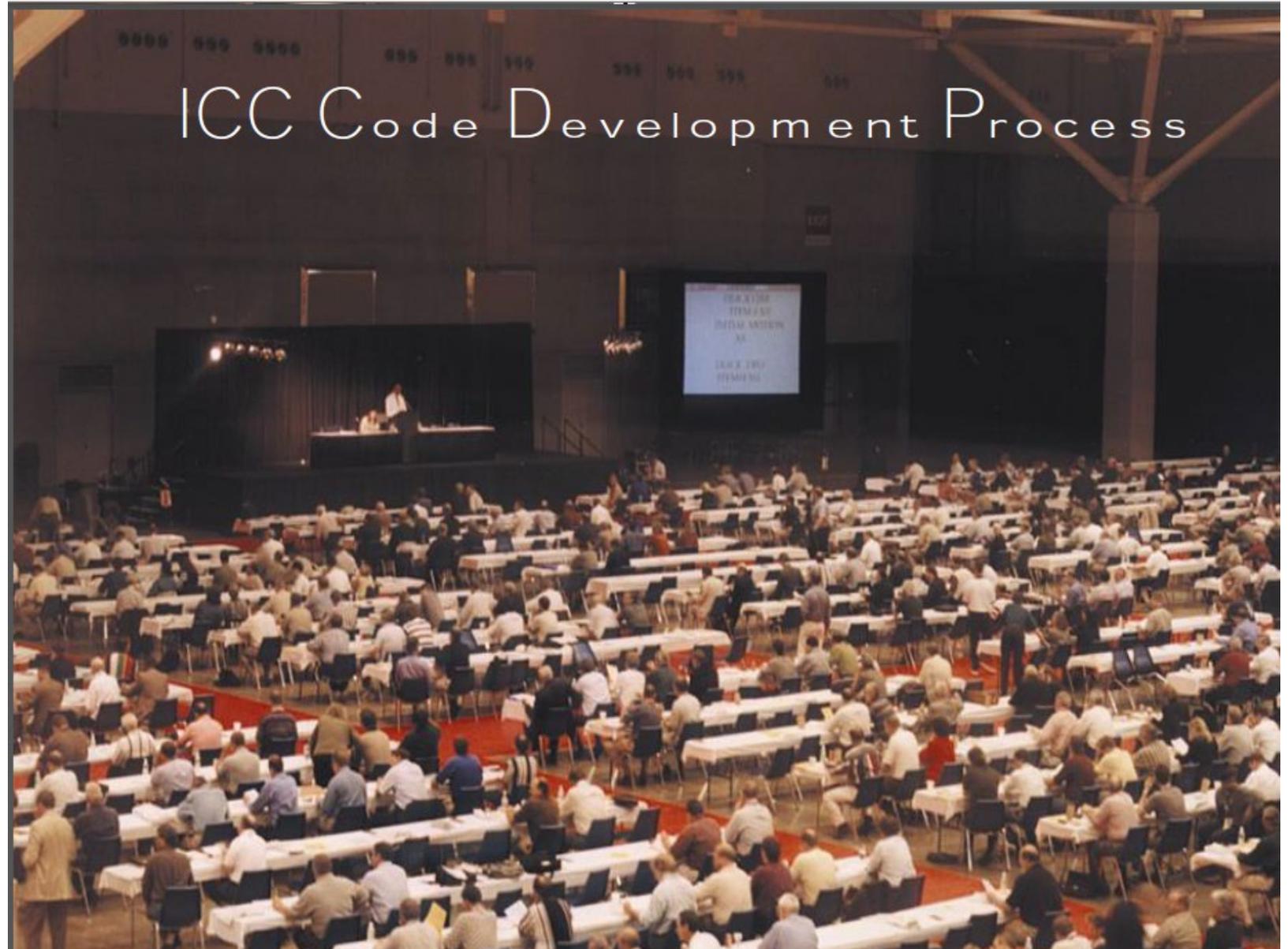


Photo courtesy of
www.iccsafe.org

2021 International Code Council Edition Committee Actions - Stories

	NS=Nonsprinklerd S= Sprinklered	<u>Type IV-A</u>	<u>Type IV-B</u>	<u>Type IV-C</u>	Type IV-HT
R-1	S	<u>18</u>	<u>12</u>	<u>9</u>	5
	NS	<u>4</u>	<u>4</u>	<u>4</u>	4
R-2	S	<u>18</u>	<u>12</u>	<u>9</u>	5
	NS	<u>4</u>	<u>4</u>	<u>4</u>	4
R-3	S	<u>18</u>	<u>12</u>	<u>5</u>	5
	NS	<u>4</u>	<u>4</u>	<u>4</u>	4
R-4	S	<u>18</u>	<u>12</u>	<u>5</u>	5
	NS	<u>4</u>	<u>4</u>	<u>4</u>	4



2021 International Code Council Edition Committee Actions - Area

Use Group	NS - non sprklrd S1 -1 story sprklrd SM - >1 story sprklrd	Type I-A	Type I-B	Type II-A	Type II-B	<u>Type IV-A</u>	<u>Type IV-B</u>	<u>Type IV-C</u>	Type IV-HT	Type V-A	Type V-B
A-1	NS	UL	UL	15,500	8,500	<u>45,000</u>	<u>30,000</u>	<u>18,750</u>	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	<u>180,000</u>	<u>120,000</u>	<u>75,000</u>	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	<u>135,000</u>	<u>90,000</u>	<u>56,250</u>	45,000	34,500	16,500
B	NS	UL	UL	37,500	23,000	<u>108,000</u>	<u>72,000</u>	<u>45,000</u>	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	<u>432,000</u>	<u>288,000</u>	<u>180,000</u>	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	<u>324,000</u>	<u>216,000</u>	<u>135,000</u>	108,000	54,000	27,000



Exterior Walls

Permits exterior walls of mass timber

Exterior walls are required to have 40 minutes of protection

No combustible materials are permitted outside of mass timber

- Except water barrier that meets the requirements of Exception 2 for Section 1402



2021 International Code Council Edition Committee Actions – Special Inspections

<u>Type</u>	<u>Continuous Special Inspection</u>	<u>Periodic Special Inspection</u>
1. <u>Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.</u>		<u>X</u>
1. <u>Inspect erection and sequence of mass timber construction</u>		<u>X</u>
1. <u>Inspection of connections where installation methods are required to meet design loads</u>		
a. <u>Threaded fasteners</u>		
1. <u>Verify use of proper installation equipment.</u>		<u>X</u>
1. <u>Verify use of pre-drilled holes where required.</u>		<u>X</u>
1. <u>Inspect screws, including diameter, length, head type, spacing, installation angle, and depth.</u>		<u>X</u>
a. <u>Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads</u>	<u>X</u>	
c. <u>Bolted connections</u>		<u>X</u>
d. <u>Concealed connections</u>		<u>X</u>



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Committee Actions – Water Supply

403.3.2 Water supply to required fire pumps. In all buildings that are more than 420 feet (128 m) in building *height*, and buildings of Type IVA and IVB that are more than 120' in building height, required fire pumps shall be supplied by connections to not fewer than two water mains located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.

Exception: Two connections to the same main shall be permitted provided that the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through not fewer than one of the connections.



2021 International Code Council Edition Committee Actions – Annual Inspections

701.6 Owner's responsibility. The owner shall maintain an inventory of all required fire-resistance-rated construction, construction installed to resist the passage of smoke and the construction included in Sections 602.4.1, 602.4.2 and Sections 703 through 707. Such construction shall be visually inspected by the owner annually and properly repaired, restored or replaced where damaged, altered, breached or penetrated. Records of inspections and repairs shall be maintained. Where concealed, such elements shall not be required to be visually inspected by the owner unless the concealed space is accessible by the removal or movement of a panel, access door, ceiling tile or similar movable entry to the space.



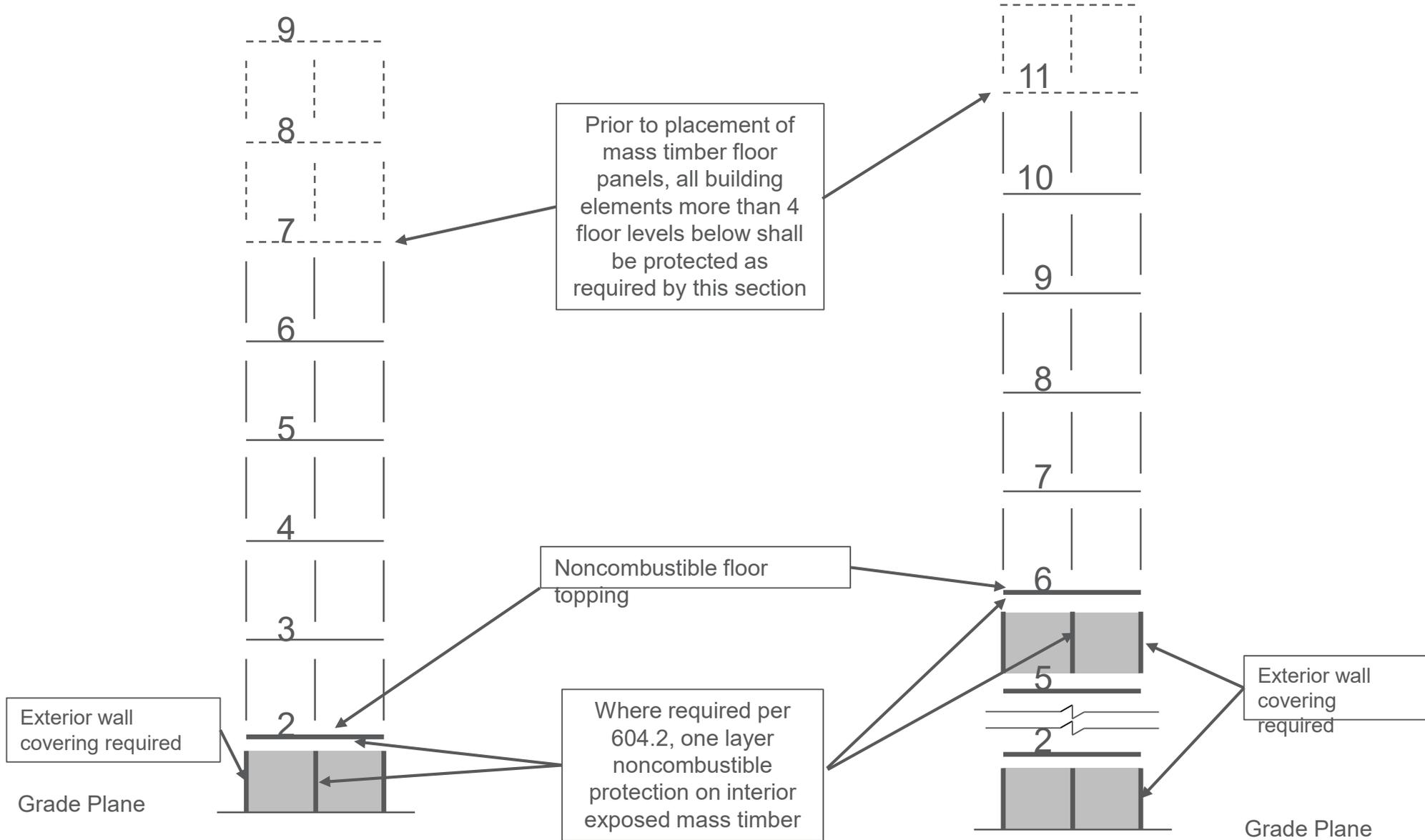
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Committee Actions – Under Construction

3314.7 Fire safety requirements for buildings of Types IVA, IVB, and IVC construction. Buildings of Types IVA, IVB, and IVC 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 during construction in accordance with Section 3311 .
2. A water supply for fire department operations, as approved by the fire chief.
3. Where building construction exceeds six stories ABOVE GRADE PLANE, at least one layer of the noncombustible protection where required by Section 602.4 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.





Examples of Protection During Construction for Types IV-A, IV-B, and IV-C Mass Timber Buildings

Adhesive Qualification Tests

Large-scale Compartment Test Protocol

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



Prior to flashover (11 minutes)



Flashover (~14 minutes)

Milwaukee – Proposed Project



River Beech – Proposed Chicago, IL



The Goal No More Names

