The Mass Timber Perspective
TALL WOOD, CODE CHANGES AND
FOREST RESOURCE IMPACTS

Jeff Morrow
Mid-Atlantic Wood Design Symposium – Washington DC
October 18, 2018
1. Trump International Hotel & Tower
2. National September 11 Memorial & Museum
3. US Court of Appeals Restoration
4. Statue of Liberty Restoration
5. American Museum of Natural History, Various
6. Military Housing Communities
7. New York-Presbyterian Hospital, Various
8. 432 Park Avenue
9. 56 Leonard
10. Grand Central Terminal Revitalization
11. Jacob K. Javits Convention Center Expansion
12. Time Warner Center
13. Citi Field, NY Mets Stadium
14. Privatized Army Lodging, CLT
15. 1996 Summer Olympic Games
16. Oceanwide Plaza
17. Los Angeles City Hall Restoration
Lendlease CLT Projects
Around the World
Forte’ – Melbourne
Library at the Dock – Melbourne
International House – Sydney
25 King – Brisbane

- 10 Stories (9 office, 1 retail)
- November 2018 Completion
THE TIMBERYARD
UK
(Develop to Rent)
www.homesbylendlease.co.uk/deptford
Google HQ – UK
• 11 Floors Above Ground
• 2 story Basement

- 870,000 sq. ft. Gross Exterior Area (GEA)
- 651,000 sq. ft. Net Interior Area (NIA)
LL in the Americas
Ft. Drum, NY
Future Army CLT Hotels

<table>
<thead>
<tr>
<th>Location</th>
<th># of floors</th>
<th>Room Count</th>
<th>Construction Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ft. Drum, NY</td>
<td>4 Story</td>
<td>99 rooms</td>
<td>Fall 2017 (ongoing)</td>
</tr>
<tr>
<td>Joint Base Lewis-McChord, WA</td>
<td>5 Story</td>
<td>123 rooms</td>
<td>Summer 2018</td>
</tr>
<tr>
<td>Ft. Jackson, SC</td>
<td>2 – 5 Story Buildings</td>
<td>328 rooms</td>
<td>Fall 2018</td>
</tr>
<tr>
<td>Ft. Bragg, NC</td>
<td>2 – 6 Story Buildings</td>
<td>488 rooms</td>
<td>Spring 2019</td>
</tr>
</tbody>
</table>
The Sweet Spot

CLT should be strongly considered when a project experiences 3 of these 5 conditions.
When all development, design and construction costs are aggregated, the schedule savings achieved through CLT with other speed and value added solutions can be cost competitive in 1-5 stories construction.
Benefits
# The Case for CLT / Modular Construction

<table>
<thead>
<tr>
<th>PAL PORTFOLIO</th>
<th>TYPICAL NEW PAL HOTEL (ACTUAL*)</th>
<th>REDSTONE ARSENAL (ACTUAL)</th>
<th>DIFFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross SF</td>
<td>54,891</td>
<td>62,688</td>
<td>+14%</td>
</tr>
<tr>
<td>Average # of Employees</td>
<td>18 (Peak 26)</td>
<td>10 (Peak 11)</td>
<td>-43%</td>
</tr>
<tr>
<td>Structural Duration (Days)</td>
<td>123</td>
<td>78</td>
<td>-37%</td>
</tr>
<tr>
<td>Structural Man Hours</td>
<td>14,735</td>
<td>8,203</td>
<td>-44%</td>
</tr>
<tr>
<td>Structural Production Rate/Day (SF)</td>
<td>460 SF/day</td>
<td>803 SF/day</td>
<td>+75%</td>
</tr>
<tr>
<td>Overall Schedule</td>
<td>15 months</td>
<td>12 months</td>
<td>-20%</td>
</tr>
</tbody>
</table>

* PAL New Build Hotel Historical Average
TRIPLE BOTTOM LINE SUSTAINABILITY HIGHLIGHTS

Economic

• 37% Faster than Traditional Metal Stud Construction
• Cost Neutral to Metal Stud Framing (On Military Installations)

Environmental

• 31% more energy efficient than previous PAL New Hotels of similar size per current energy model
• 1,276 tons carbon sequestered (1,656 m3 of timber used)

Social

• Unemployed Veterans were upskilled in the construction trades.
• Eliminated exposure to falls for workers from elevated heights.
MASS TIMBER – BEGINNING OF A NEW INDUSTRY
Cross Laminated Timber in the US

Positively disrupting traditional construction of mid rise structures
Performance Based Path:

» Applies to new materials, structural systems, building sizes
» Current Code Path for tall wood buildings
» Requires documentation, data, testing information, etc. to validate that proposed design meets or exceeds code intent for fire and life safety, structural safety, durability, quality, etc.
Mass Timber Fire Testing

ATF Fire Tests

A team of fire experts from the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) working alongside scientists from the U.S. Forest Products Laboratory put identically furnished, multistory, one-bedroom apartments constructed of exposed, partially exposed, and unexposed (protected) five-ply cross-laminated timber (CLT) through a series of rigorously monitored tests. The purpose of the tests is to provide data that will help inform any recommendations the ICC Ad Hoc Committee on Tall Wood Buildings (TWB) will propose for the 2021 International Building Code. A series of five tests were conducted. Each test was designed to replicate real world conditions across a range of living and sleeping scenarios. Identical, furnished, one bedroom apartments were constructed in a multistory building. The door between the living and sleeping areas was left open in both apartments. A three minute video capturing the highlights of each test is in this playlist.

Full-Scale Fire Tests of a Two-Story Cross-Laminated Timber Structure

http://www.awc.org/tallwood
<table>
<thead>
<tr>
<th>Test Types</th>
<th>Testing Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Resistive Component Testing – E119 Fire</td>
<td>FP Innovations / NRC / Southwest Research Institute/ Independent Labs</td>
</tr>
<tr>
<td>Full Tested Assemblies – E119 Fire</td>
<td>Underwriters Laboratory</td>
</tr>
<tr>
<td>Full Scale Encased Compartment Comparison Testing</td>
<td>NRC – CNRC</td>
</tr>
<tr>
<td>System Fire Resistance Testing – US Demonstration Project</td>
<td>ATF &amp; FPL</td>
</tr>
<tr>
<td>Penetration Testing</td>
<td>FP Innovations</td>
</tr>
<tr>
<td>Full-scale Mass Timber Shaft Demonstration Fire</td>
<td>NRC- CNRC / FP Innovations</td>
</tr>
<tr>
<td>Flame Spread Testing – ASTME84</td>
<td>FP Innovations / Independent Labs</td>
</tr>
</tbody>
</table>

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/
<table>
<thead>
<tr>
<th>Type of Construction</th>
<th>Height</th>
<th># of Stories</th>
<th>Exposed Mass Timber</th>
<th>Sprinklers</th>
<th>Primary Frame FRR</th>
<th>Floor FRR</th>
<th>Stair Tower</th>
<th>Concealed Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV-HT (Existing)</td>
<td>85’</td>
<td>4-6</td>
<td>Fully Exposed</td>
<td>Yes</td>
<td>NR</td>
<td>HT</td>
<td>Mass Timber</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>IV–C Proposed</td>
<td>85’</td>
<td>4-9</td>
<td>Fully Exposed</td>
<td>Yes</td>
<td>2 hours</td>
<td>2 hours</td>
<td>Mass Timber</td>
<td>Permitted</td>
</tr>
<tr>
<td>IV-B Proposed</td>
<td>180’</td>
<td>6-12</td>
<td>Partially Exposed</td>
<td>Yes</td>
<td>2 hours</td>
<td>2 hours</td>
<td>Mass Timber</td>
<td>Permitted</td>
</tr>
<tr>
<td>IV-A Proposed</td>
<td>270’</td>
<td>9-18</td>
<td>Fully Protected</td>
<td>Yes</td>
<td>3 hours</td>
<td>2 hours</td>
<td>Noncombustible</td>
<td>Permitted</td>
</tr>
</tbody>
</table>

Courtesy of American Wood Council
14 Tall Mass Timber Code Changes by Section Number

1. IBC Section 602.4  Type IV construction (G108-18)
2. IBC Section 703.8  Tested noncombustible protection contribution (FS5-18)
3. IBC Section 722.7  Calculated noncombustible protection contribution (FS81-18)
4. IBC Section 703.9  Sealing of adjacent mass timber elements (FS6-18)
5. IBC Section 718.2.1 Fireblocking materials (FS73-18)
6. IBC Section 403.3.2 High rise sprinkler water supply (G28-18)
7. IFC Section 701.6  Owner’s responsibility (F88-18)
8. IFC Section 3314.7  Fire safety during construction (F266-18)

https://awc.org/tallmasstimber
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<th>14 Tall Mass Timber Code Changes by Section Number</th>
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<tbody>
<tr>
<td>9.</td>
<td>IBC Table 504.3 (G75-18)</td>
</tr>
<tr>
<td></td>
<td>Allowable Building Height</td>
</tr>
<tr>
<td>10.</td>
<td>IBC Table 504.4 (G80-18)</td>
</tr>
<tr>
<td></td>
<td>Allowable Number of Stories</td>
</tr>
<tr>
<td>11.</td>
<td>IBC Table 506.2 (G84-18)</td>
</tr>
<tr>
<td></td>
<td>Allowable Area Factor</td>
</tr>
<tr>
<td>12.</td>
<td>IBC Section 3102.3</td>
</tr>
<tr>
<td></td>
<td>Special construction (G146-18)</td>
</tr>
<tr>
<td>13.</td>
<td>IBC Appendix D</td>
</tr>
<tr>
<td></td>
<td>Fire Districts (G152-18)</td>
</tr>
<tr>
<td>14.</td>
<td>IBC Sections 508.4.4.1 and 509.4.1.1</td>
</tr>
<tr>
<td></td>
<td>Fire barriers at separated occupancies and</td>
</tr>
<tr>
<td></td>
<td>incidental uses (G89-18)</td>
</tr>
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[https://awc.org/tallmasstimber](https://awc.org/tallmasstimber)
The 8-Step I-Code Development Cycle

Step 1: January 8 – Final Proposed Language submitted to ICC – COMPLETED

Step 2: February 28 – Changes are posted for Public Viewing – COMPLETED

Step 3: April 15-25 – Committee Action Public Hearing – Columbus, OH
   • Floor Discussion – The code change proposals are considered and discussed at the floor discussion – COMPLETED
   • Committee Action – The code development committee makes a recommendation on the code change proposal disposition – PASSED
   • Assembly Action – ICC members in attendance can challenge committee actions
     – Online assembly floor motion voting period is 2 weeks and begins approximately 2 weeks after the hearings close. – NOT CHALLENGED

The 8-Step I-Code Development Cycle

Step 4: May 30 – Committee Action Hearing results posted – COMPLETED

Step 5: June 1 - July 16 – Public Comments Sought on Committee Action Hearing Results – COMPLETED

Step 6: August 31 – Public Comments Posted – COMPLETED

Step 7: October 24-31 – Public Comment Hearing and Vote*

Step 8: Fall 2020 – New Edition is Published

For Detailed Information

[Website Link]

www.icc-safe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/

[Website Link]

www.buildtallbuildsafe.com
Changing the Codes

Engage
Educate
Enroll
Empower
Moving Forward
MASS TIMBER – BEGINNING OF A NEW INDUSTRY
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Questions?

This concludes The American Institute of Architects Continuing Education Systems Course

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