Realizing the Potential of Tall Wood

Course Number EL503
Thursday, June 21, 2018
Learning Units [As Published]
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Course / Learning Objectives

• Review the historical context for tall timber structures, and consider the construction and sustainability motivators driving modern examples.
• Realize the construction and sustainability motivators for pursuit of tall wood structures and become familiar with available design guidance and research.
• Understand the ICC Ad Hoc Committee's code change proposal for the 2021 International Building Code (IBC) that could allow taller wood buildings.
• Learn where to find information and research that supports the new 2021 IBC Code change.
HOW TALL CAN A WOOD BUILDING BE IN THE IBC?

A. 4 STORIES
B. 5 STORIES
C. 6 STORIES
D. 7 STORIES
HOW TALL CAN A WOOD BUILDING BE IN THE IBC?

A. 4 STORIES
B. 5 STORIES
C. 6 STORIES
D. 7 STORIES

Residential
Office
MARSELLE CONDOS, SEATTLE, WA

Photo credit: Matt Todd & PB Architects
T3 Minneapolis
Minneapolis, MN

Image Credit: Blaine Brownell
What is the tallest wood framed building in the US?

A. 6 Stories
B. 8 Stories
C. 9 Stories
D. 12 Stories
What is the tallest wood framed building in the US?

A. 6 Stories
B. 8 Stories
C. 9 Stories
D. 12 Stories
Modern Tall Wood-Carbon 12
2017, 8 stories, 32,000 sf

Portland, OR

Photos: Baumberger Studio/PATH Architecture/Marcus Kauffman
HISTORIC TALL WOOD
9 STORIES IN 1906

Butler Brothers Building – 500,000 sf – Minneapolis, MN
MODERN TALL WOOD
12 STORIES IN 2018

Framework – 90,000 sf – Portland, OR

Images: Lever Architecture
INCREASING DESIGN INTEREST

Interest in Tall Wood projects has been steadily increasing in the U.S.

Since 2014, of projects far enough along to track, WoodWorks has assisted with more than 44 projects that are over current prescriptive code limits.

25 of these projects are still actively being pursued.

Skidmore, Owings, & Merrill LLP
TALL WOOD = MASS TIMBER

VanDorpe Construction

The Bullitt Center, photo John Staments

El Capitan, DCI Engineers
MARKET DRIVERS FOR MASS TIMBER

**PRIMARY DRIVERS**
- Construction Efficiency & Speed
- Construction site constraints – Urban Infill
- Innovation/Aesthetic

**SECONDARY DRIVERS**
- Carbon Reductions
- Structural Performance – lightweight
POTENTIAL U.S. IMPACT
Dispelling Myths about Wood Products

US Forest Lands

Source: U.S. Forest Service, National Woodland Owner Survey
U.S. Forest Land

Forest Area in the United States 1630-2012

U.S. Forest Land

U.S. Timber *Volume* on Timber Land

<table>
<thead>
<tr>
<th>Year</th>
<th>North</th>
<th>South</th>
<th>West</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>103.7</td>
<td>148.5</td>
<td>363.7</td>
<td>615.9</td>
</tr>
<tr>
<td>1963</td>
<td>128.3</td>
<td>174.1</td>
<td>363.2</td>
<td>665.6</td>
</tr>
<tr>
<td>1977</td>
<td>163</td>
<td>223.4</td>
<td>346.7</td>
<td>713.1</td>
</tr>
<tr>
<td>1987</td>
<td>190</td>
<td>244.6</td>
<td>347</td>
<td>781.2</td>
</tr>
<tr>
<td>1997</td>
<td>214.3</td>
<td>256.4</td>
<td>365.1</td>
<td>835.9</td>
</tr>
<tr>
<td>2007</td>
<td>248</td>
<td>288.5</td>
<td>395.6</td>
<td>932.1</td>
</tr>
<tr>
<td>2012</td>
<td>267.8</td>
<td>306.6</td>
<td>398</td>
<td>972.4</td>
</tr>
</tbody>
</table>

Shift in Forest Service Staffing

Source: US Forest Service –
http://www.fs.fed.us/about-agency/budget-performance/cost-fire-operations
Fire readiness and suppression has gone from 20% of the Forest Service budget in 2001 to 52% in 2015. It is not uncommon to spend $1 million per hour fighting fires.

“Building stronger markets for innovative wood products will support sustainable forestry, reduce green house gas emissions, and put rural America at the forefront of an emerging industry”

Tom Vilsack – US Secretary of Agriculture 2009-2017
Landcape Restoration Impact Potential

Wood Use Paradox

» Increasing the use of products from healthy managed forests helps keep forest land forested

» Finding high value uses for low value wood – mass timber and CLT

» Renewable – sustainable resource
IMPACT ON RURAL ECONOMIES

» Making rural America integral to sustainable urban growth
» Create opportunity for high paying, high tech, innovative jobs in rural America
U.S. BUILDING CODES
AMMR PROCESS

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.
Lendlease CLT Projects
Around the World
Forte’ – Melbourne
Forte’ – Melbourne
Library at the Dock – Melbourne
Library at the Dock – Melbourne
International House – Sydney
International House – Sydney
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
LL in the Americas
## 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 (on going)</td>
</tr>
<tr>
<td>Joint Base Lewis-McChord, WA</td>
<td>4 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>
Why CLT?
“THE TIME IS NOT FAR OFF WHEN COMPANIES WILL HAVE TO JUSTIFY THEIR WORTH TO SOCIETY, WITH GREATER EMPHASIS BEING PLACED ON ENVIRONMENTAL AND SOCIAL IMPACT THAN STRAIGHT ECONOMICS.”

Dick Dusseldorp
Lend Lease Founder, 1973
The Sweet Spot

CLT should be strongly considered when a project experiences 3 of these 5 conditions.
The CLT Optimal Spectrum

*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
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.
Cross Laminated Timber in the US

Positively disrupting traditional construction of mid rise structures
What’s Next
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) propose for the 2021 International Building Code. A series of five tests were conducted. Each test was designed to replicate real world conditions across five scenarios. Identical, furnished, one bedroom apartments were constructed in a multi-story 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 included 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>FPInnovations/ 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>FPInnovations</td>
</tr>
<tr>
<td>Full-scale Mass Timber Shaft Demonstration Fire</td>
<td>NRC- CNRC/ FPInnovations</td>
</tr>
</tbody>
</table>

[https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/](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
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
Step 5: June 1 - July 16 – Public Comments Sought on Committee Action Hearing Results
Step 6: August 31 – Public Comments Posted
Step 7: October 24-31 – Public Comment Hearing and Vote*
Step 8: Fall 2020 – New Edition is Published

For Detailed Information

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

www.builddallbuildsafe.com
Changing the Codes

Engage
Educate
Enroll
Empower
Moving Forward
Questions?

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Thank you!