MASS TIMBER APPEAL
MASS TIMBER APPEAL

PRIMARY DRIVERS

CARBON REDUCTIONS

CONSTRUCTION SPEED & EFFICIENCY

CONSTRUCTION SITE CONSTRAINTS — URBAN INFILL

INNOVATION/AESTHETIC

STRUCTURAL PERFORMANCE — LIGHT WEIGHT
180,000 SF in 9.5 Weeks
1 Floor = 3 Days

17 Floors Erected in 9.5 Weeks
<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 square feet (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 person hours</td>
<td>14,735</td>
<td>8,203</td>
<td>-44%</td>
</tr>
<tr>
<td>Structural production rate/day</td>
<td>460 sf</td>
<td>803 sf</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

*Source: Lendlease*
MASS TIMBER APPEAL

75% LIGHTER WEIGHT THAN CONCRETE
MASS TIMBER ELEMENTS FABRICATED TO TIGHT TOLERANCES (1/16” IS COMMON)

COMPUTER NUMERICALLY CONTROLLED (CNC) CONNECTIONS

PHOTO CREDIT: NATURALLY WOOD
CLT PREFABRICATION

- Finished panels are planed, sanded, cut to size. Then openings are cut with precise CNC routers.
- Third party inspection at factory
- Custom engineered for material efficiency
- Custom designed for project
- Each panel numbered, delivered & installed in predetermined sequence
MASS TIMBER APPEAL

MINIMAL WASTE
CLT HAS AN R-VALUE OF APPROXIMATELY 1.25 PER INCH OF THICKNESS.
SOURCE: US CLT HANDBOOK
CARBON BENEFITS

**Volume of wood products used:**
2,052 cubic meters (72,467 cubic feet)

**U.S. and Canadian forests grow this much wood in:**
6 minutes

**Carbon stored in the wood:**
1,826 metric tons of CO₂

**Avoided greenhouse gas emissions:**
706 metric tons of CO₂

**TOTAL POTENTIAL CARBON BENEFIT:**
2,532 metric tons of CO₂

**Equivalent to:**

- 535 cars off the road for a year
- Energy to operate 267 homes for a year

Source: US EPA

Frank Rosenstein, courtesy Plum Creek
Volume of wood products used:
818,736 board feet (equivalent)

U.S. and Canadian forests grow this much wood in:
4 minutes

Carbon stored in the wood:
1,014 metric tons of CO₂

Avoided greenhouse gas emissions:
2,155 metric tons of CO₂

TOTAL POTENTIAL CARBON BENEFIT:
3,169 metric tons of CO₂

Equivalent to:
605 cars off the road for a year

Energy to operate a home for 269 years

Source: US EPA

Carbon Stored

The mass of carbon stored in wood products was calculated based upon the assumption that the amount of carbon contained in wood fiber was 50% by dry weight (Sathre O’Connor 2010). After the mass of carbon in the wood products was determined, the carbon was converted to CO$_2$ based on molecular weight ratio. The final value provided in the carbon calculator is an estimate of the mass of carbon dioxide removed from the atmosphere during the growth of the tree and stored as carbon in the chemical structure of the wood building products.

The following is a general equation for the mass of CO$_2$ equivalents contained within wood fiber:

$$m_{CO_2} = \left( \frac{M_{CO_2}}{M_C} \right) \times m_{wood} \times 0.5$$

Where:

- $m_{CO_2}$ = Mass of CO$_2$ equivalents (kg)
- $M_{CO_2}$ = Molecular mass of CO$_2$ (44 g/mol)
- $M_C$ = Molecular mass of carbon (12 g/mol)
- $m_{wood}$ = Mass of oven-dry wood (kg)

Source: WoodWorks Carbon Calculator
The general equation for the mass of GHG emissions avoided is as follows:

\[ GHG = m_{\text{wood}} \times D_f \]

Where:

- \( GHG \) = Greenhouse gas avoided (kg CO\(_2\) equivalents)
- \( m_{\text{wood}} \) = Mass of dry wood (kg)
- \( D_f \) = Displacement factor (kg CO\(_2\) equivalents/kg oven-dry wood)

**Mass Timber Df = 0.71**

Source: WoodWorks Carbon Calculator
UMASS DESIGN BUILDING
AMHERST, MA

4 STORY, 87,500 SF FACILITY WITH: CLASSROOMS, LOUNGES, MEETING ROOMS, MATERIALS-TESTING LAB, GREEN-BUILDING LAB, WOOD SHOP, DIGITAL FABRICATION LAB, CAFE, EXHIBIT SPACE, AND LIBRARY
UMASS DESIGN BUILDING
AMHERST, MA

COMPLETED SPRING 2017

PHOTO CREDIT: ALEX SCHREYER
Volume of wood products used: 2,052 cubic meters (72,467 cubic feet)

U.S. and Canadian forests grow this much wood in: 6 minutes

Carbon stored in the wood: 1,826 metric tons of CO₂

Avoided greenhouse gas emissions: 706 metric tons of CO₂

TOTAL POTENTIAL CARBON BENEFIT: 2,532 metric tons of CO₂

EQUIVALENT TO:

535 cars off the road for a year

Energy to operate 267 homes for a year
Dramatic Potential for Change

Source: Timber Tower Research Project, Skidmore, Owings and Merrill, May 2013
Forest Area in the United States
1630-2007

Western U.S. Wild Fire Epidemic

- Fire readiness and suppression has gone from 20% of the FS budget in 2001 to 52% in 2015.
- It is not uncommon to spend $1 million per hour fighting fires.

LANDSCAPE 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

ECONOMIC IMPACT RESULTS OF THE U.S. LUMBER INDUSTRY
from Bureau of Labor Statistics

215,000+ Direct jobs in harvesting & manufacturing related to softwood lumber
700,000+ Direct & Indirect jobs in harvesting & manufacturing related to softwood lumber

465 communities supported by

510 softwood lumber mills in 31 states

COMPARITIVE INDUSTRIES:
181,430 jobs in oil & gas extraction
140,200 jobs in primary steel manufacturing
207,000 jobs in motor vehicle manufacturing

LUMBER INDUSTRY PAYROLL
$8 BILLION USD Direct Lumber Jobs (sawmills and wood preservation)

Credit: U.S. Softwood Lumber Board, infographic, Changing how America Builds, 2017
WOOD ENVIRONMENTS MAKE PEOPLE HAPPY

DESIGN BUILDING

When the Design Building for the ArchiTech campus of the University of Maine opens in 2017, it will feature the greenest and most sustainable architectural design. The building will exemplify the principles of “biophilic design,” which aims to reconnect people with nature.

Studies have shown that being around natural elements contributes to psychological and physical well-being—lowering blood pressure, improving mental focus, and facilitating learning and productivity. In an age where the average American spends 90% of their time indoors, bringing nature into interior environments can improve health and well-being in real and meaningful ways.
MASS TIMBER APPEAL

DISASTER RESILIENT

USFPL WOOD TORNADO SHELTER
MASS TIMBER APPEAL
DISASTER RESILIENT

LIVE BLAST PERFORMANCE OF MASS TIMBER
MASS TIMBER CONSTRUCTION

THE FUTURE’S LOOKING UP

PHOTO CREDIT: ALEX SCHREYER
TALL WOOD IN NORTH AMERICA CIRCA 1906
9 STORIES

THE LANDING, VANCOUVER

BUTLER SQUARE, MINNEAPOLIS
GLOBAL TALL WOOD CIRCA 2015
7-14 STORIES
GLOBAL TALL WOOD CIRCA 2019
18-24 STORIES
TALL WOOD IN THE US CIRCA 2019

8 STORIES

Photos: Baumberger Studio/PATH Architecture/Marcus Kauffman | Architect: PATH Architecture
» Current Prescriptive Code Limit - 6 stories (B occupancy) or 85 feet

» Over 6 Stories - Alternate Means and Methods Request (AMMR) through performance based design

» Based on the 1910 Heights and Areas Act
TYPE III CONSTRUCTION, RESIDENTIAL OCCUPANCY: 5 STORIES

LIGHT-FRAME WOOD
MASS TIMBER

Photo: Leers Weinzapfel Associates
U.S. BUILDING CODE STATUS
In December 2015, the ICC Board established the ICC Ad Hoc Committee on Tall Wood Buildings. Objectives:
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.
TALL WOOD APPROVED!

Unofficial results posted Dec 19, 2018
Final votes ratified Jan 31, 2019

AWC: Tall Mass Timber code changes get final approval
Dec 19, 2018

LEESBURG, VA. – The International Code Council (ICC) has released the unofficial voting results on code change proposals considered in 2018, including passage of the entire package of 14 tall mass timber code change proposals. The proposals create three new types of construction (Types IV-A, IV-B and IV-C), which set fire safety requirements, and allowable heights, areas and number of stories for tall mass timber buildings. Official results are expected to be announced during the first quarter of 2019. The new provisions will be included in the 2021 International Building Code (IBC).

“Mass timber has been capturing the imagination of architects and developers, and the ICC result means they can now turn sketches into reality. ICC’s rigorous study, testing and voting process now recognizes a proven innovation alternative to traditional tall building materials used in the building.
2021 IBC Introduces 3 new tall wood construction types: IV-A, IV-B, IV-C
Previous type IV renamed type IV-HT
New Building Types

TYPE IV-A

IBC 2021

TYPE IV-B

TYPE IV-C

IBC 2015

BUSINESS OCCUPANCY [GROUP B]

*BUILDING FLOOR-TO-FLOOR HEIGHTS ARE SHOWN AT 12'-0" FOR ALL EXAMPLES FOR CLARITY IN COMPARISON BETWEEN 2015 TO 2021 IBC CODES.

Credit: Susan Jones, atelierjones
Questions?

This concludes The American Institute of Architects Continuing Education Systems Course

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