How do contractors answer the ever-growing demand from architects and ownership groups for mass timber buildings? The growth of this building industry can be slowed by a lack of will and lack of know-how among seasoned construction professionals who know how to build, understand the onus of “architectural intent,” and must ultimately take on financial responsibility to deliver the dream of a new building system. This presentation will introduce mass timber products and building systems and then consider why some mass timber projects die at concept, what leads to the resistance, and how the development, architectural, engineering, and construction community can overcome assumptions to achieve success with mass timber projects of various scales and typologies. Particular emphasis will be given to preconstruction coordination, holistic approaches to costing and scheduling studies, project delivery methods, and how to achieve the highest level of cost efficiency.

Course Description

Learning Objectives

1. Understand the preconstruction manager’s role in material procurement and MEP coordination of code-compliant mass timber projects.
2. Highlight effective methods of early design-phase cost estimation that keeps mass timber options on the table.
3. Discuss potential construction schedule savings realized through the use of prefabricated mass timber elements.
4. Explore best practices for interaction between manufacturer, design team and preconstruction manager that can lead to cost efficiency and safety on site.
PRESENTATION OUTLINE

1. MASS TIMBER OVERVIEW
   • Structural Solutions
   • Connections
   • Projects
   • Products

2. CONSTRUCTION MANAGEMENT
   • Risk Analysis (Risks & Solutions)
   • Economics (What does it cost?)
   • Logistics (Schedule & Coordination)
12/6/2019

STRUCTURAL SOLUTIONS | HONEYCOMB

PHOTO: Lendlease

STRUCTURAL SOLUTIONS | HYBRID LIGHT-FRAME + MASS TIMBER

PHOTO: John Klein

STRUCTURAL SOLUTIONS | HYBRID STEEL + MASS TIMBER

PHOTO: SOM

STRUCTURAL SOLUTIONS | HYBRID CONCRETE + MASS TIMBER

PHOTO: Structurlam
OVERVIEW | CONNECTIONS

Concealed Connectors

Self Tapping Screws

Photo: Rothoblaas

Photo: Structurlam

OVERVIEW | CONNECTIONS

Beam to Column

Photo: StructureCraft

OVERVIEW | CONNECTIONS

Column to Foundation

Photo: Alex Schreyer

OVERVIEW | CONNECTIONS

Panel to Panel & Supports

Photo: Alex Schreyer

Photo: Charles Judd
CURRENT STATE OF MASS TIMBER PROJECTS

As of July 2019, 599 multi-family, commercial, or institutional projects have been constructed out of mass timber across the U.S., or they’re currently in design.


PRECEDENT PROJECTS

<table>
<thead>
<tr>
<th>UMASS AMHERST DESIGN BUILDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo: Nordic Structures</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CARBON 12</th>
<th>PORTLAND, OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photos: Baumberger Studio/PATH Architecture</td>
<td></td>
</tr>
</tbody>
</table>
PRECEDENT PROJECTS | FIRST TECH CREDIT UNION HILLSBORD, OR
Photos: Swinerton | DJC Oregon

PRECEDENT PROJECTS | BROCK COMMONS

PRECEDENT PROJECTS | DALSTON WORKS
Photos: Daniel Broun | Rough Masonry London

PRECEDENT PROJECTS | MJOSTARNE NORWAY
Photos: Yipp Studio | Volk Architekten
MASS TIMBER PRODUCTS

Glue Laminated Timber (GLT)

Photo: Alex Schreyer

Cross-Laminated Timber (CLT)

Photo: Manasc Isaac Architects/Fast + Epp

Glue Laminated Timber (GLT)

Photo: Manasc Isaac Architects/Fast + Epp
Cross-Laminated Timber (CLT)

Nail-Laminated Timber (NLT)

Dowel-Laminated Timber (NLT)
Mass Plywood Panels (MPP)

Photos: Freres Lumber

Other Mass Timber Product Options

Decking

Mass Timber in Low- to Mid-Rise: 1-6 Stories in Construction Types III, IV or V
Mass Timber Fire Design Resource

- Code compliance options for demonstrating FRR
- Updated as new tests are completed
- Free download at woodworks.org
Three Key Points:
1. Mass timber is a custom building system, not a commodity.
2. Select the right partners for your project.
3. Assess projects holistically when estimating costs.

Risk Mitigation: Total Project Cost Analysis

Considerations:
- Ceiling treatment
- Floor topping
- HVAC system & route
- Foundation size
- Soil improvements
- Exterior skin coordination
- Value of time

Risk: Cost Analysis of Structure Only

$/SF  $/SF

Image: GBD Architects
Risk: Design-Bid-Build Procurement

Risk Mitigation: Trade Partner/Master Builder Approach

Procurement Strategy is Key to Success

Risk: Perception of a Commoditized Material
Risk Mitigation: Embrace the Prefab Advantage

Risk: Lack of Supply Chain Understanding

I don’t have any historic cost data for this structural system.
Who makes this stuff? How do you procure it?

Risk Mitigation: Complementary Procurement

Schedule Savings for Rough-In Trades
Anatomy of a Turnkey Mass Timber Package

- Project Overhead: 7%
- Labor: 15%
- Material: 14%
- Equipment: 64%

Material (Direct Cost)

- Project Overhead: 7%
- Labor: 15%
- Material: 14%
- Equipment: 64%

Turnkey Mass Timber Package

Labor (Direct Cost)

- Project Overhead: 7%
- Labor: 15%
- Material: 14%
- Equipment: 64%

Turnkey Mass Timber Package

Equipment (Direct Cost)

- Project Overhead: 7%
- Labor: 15%
- Material: 14%
- Equipment: 64%

Turnkey Mass Timber Package
Value Engineering = \frac{Function + Aesthetics}{Cost}

Value Analysis

Value = \frac{Function + Aesthetics}{Cost}

Value: Program

Turnkey Mass Timber Package

Project Overhead

Value: Program

Cost Analysis
Design Refinement
VD&C
Detail Optimization
System Integration
Logistics Planning

Source: Swinerton

Photo: Swinerton

Value: Program

Value Analysis

Photo: RMW Architecture & Interiors

Value: Program

Level 1

Level 2

Photo: RMW Architecture & Interiors

Concept Plan

Source: Swinerton

Value Analysis

Value: Program
### Cost: Construction Type

**TABLE 601**  
Fire Resistance Rating Requirements for Building Elements (Hours)

<table>
<thead>
<tr>
<th>Building Element</th>
<th>IA</th>
<th>IB</th>
<th>IIA</th>
<th>IIB</th>
<th>IIIA</th>
<th>IIIB</th>
<th>IV-A</th>
<th>IV-B</th>
<th>V-A</th>
<th>V-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Structural Frame</td>
<td>3&quot;</td>
<td>2&quot;</td>
<td>0</td>
<td></td>
<td>3*</td>
<td></td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Ext. Bearing Walls</td>
<td>3&quot;</td>
<td>2&quot;</td>
<td>0</td>
<td></td>
<td>3*</td>
<td></td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Int. Bearing Walls</td>
<td>3&quot;</td>
<td>2&quot;</td>
<td>0</td>
<td></td>
<td>3*</td>
<td></td>
<td>2</td>
<td>1/HT</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Floor Construction</td>
<td>3&quot;</td>
<td>2&quot;</td>
<td>0</td>
<td></td>
<td>3*</td>
<td></td>
<td>2</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

- **Exposed Mass Timber Elements**: None, 20-40%, Most, All

*These values can be reduced based on certain conditions in IBC 403.2.1, which do not apply to Type IV buildings.

### Value: Open Floor Plan

### Cost: Structural System & Grid

**Baseline**  
- 12'-6" Glulam Spacing  
- 5.5" CLT

**+$5%**  
- 15' Glulam Spacing  
- 7" CLT

*Source: Seattle Mass Timber Tower Book*
Procurement Approach Determines Schedule

When do we need to engage a trade partner for the mass timber work?

Photo: Alex Schreyer

Design-Bid-Build Procurement

Example 6 Story Type IIIA Project

Source: Swinerton

Design-Build/Design-Assist Procurement

Procurement Logic for Scheduling

Example 6 Story Type IIIA Project

Source: Swinerton
What are the schedule drivers on a mass timber project?

Schedule Impacts: Translating 2D to 3D

Schedule Impacts: Hybrid Structures

Is there a schedule savings with a mass timber structure compared to other structural systems?
Overall Project Cost Analysis: 12 Story Type IV-B

<table>
<thead>
<tr>
<th>Component</th>
<th>Mass Timber</th>
<th>PT Concrete</th>
<th>Savings</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Cost of Work</td>
<td>98,997,736</td>
<td>95,105,091</td>
<td>3,892,645</td>
<td>2.2%</td>
</tr>
<tr>
<td>Project Overhead</td>
<td>6,350,760</td>
<td>11,704,760</td>
<td>5,353,990</td>
<td>-20.2%</td>
</tr>
<tr>
<td>Add-ons</td>
<td>8,387,345</td>
<td>8,429,368</td>
<td>42,023</td>
<td>-0.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>104,778,231</td>
<td>105,303,209</td>
<td>-538,978</td>
<td>-0.5%</td>
</tr>
</tbody>
</table>

*Includes 2 layers of gyp on 80% of interior surfaces.*

Overall Project Schedule Analysis: 12 Story Type IV-B

5 Months

Schedule Impact on Cost | Value of Time

A large scale MT project can be up to 2% higher in direct costs, but a minimum of 20% lower in project overhead costs. The net result is cost-neutrality and higher value.

Early Move-In for Rough-In Trades.
Embracing BIM for Fabrication

Holistic Schedule Analysis

Shorter Schedule = Lower General Conditions Costs

SITE PLANNING

QA/QC
Sequencing

Material Protection
- Painting steel
- Taping joints
- Protect end cuts of timber
Questions?

This concludes The American Institute of Architects Continuing Education Systems Course.

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