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)
**OVERVIEW**

**MANUFACTURING**

**STRUCTURAL SOLUTIONS**

**POST, BEAM + PLATE**

Dowel-Laminated Timber (DLT)

Photo: StructureCraft

Mass plywood panels (MPP)

Photo: Freres Lumber

Decking

Photo: Bernard Andre

**OVERVIEW**

**STRUCTURAL SOLUTIONS**

**POST + PLATE**

**OVERVIEW**

**STRUCTURAL SOLUTIONS**

**POST, BEAM + PLATE**

**OVERVIEW**

**STRUCTURAL SOLUTIONS**

**POST + PLATE**
OVERVIEW | CONNECTIONS

Concealed Connectors

Self Tapping Screws

Photos: Rothoblaas

Photos: Structurlam

OVERVIEW | CONNECTIONS

Beam to Column

Photos: StructureCraft

OVERVIEW | CONNECTIONS

Column to Foundation

Photo: Alex Schreyer

OVERVIEW | CONNECTIONS

Panel to Panel & Supports

Photos: Alex Schreyer

Photos: Charles Judd

OVERVIEW | CONNECTIONS

Photos: Alex Schreyer

Photos: Alex Schreyer
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.

http://www.woodworks.org/publications/media/building-trends-mass-timber/

PREVIOUS PROJECTS
UMASS AMHERST DESIGN BUILDING
Photo: Nordic Structures

PREVIOUS PROJECTS
UMASS AMHERST DESIGN BUILDING
Photo: ©Albert Vecerka/Esto

OVERVIEW
PREVIOUS PROJECTS
CARBON 12 | PORTLAND, OR
Photos: Baumberger Studios/PDA Architecture
PREVIOUS PROJECTS | FIRST TECH CREDIT UNION HILLSBORO, OR
Photos: Swinerton | DJC Oregon

PREVIOUS PROJECTS | BROCK COMMONS
Photos: Michael Elkan | Naturally Wood | UBC

PREVIOUS PROJECTS | DALSTON WORKS
Photos: Daniel Shearin | Waugh Thistleton Architects

PREVIOUS PROJECTS | MJOSTARNET NORWAY
Photos: Bygg Mesteren | Voll Arkitekter
Mass Plywood Panels (MPP)

Other Mass Timber Product Options

Photos: Freres Lumber

Photos: StructureCraft

Mass Timber in the Code

Building Code Applications | Construction Type

Mass Timber in Low- to Mid-Rise: 1-6 Stories in Construction Types III, IV or V
Tall Mass Timber: Up to 18 Stories in Construction Types IV-A, IV-B or IV-C

Mass Timber's Fire-Resistive Performance is Well-Tested, Documented and Recognized via Code Acceptance

Source: AWC's TR 10

<table>
<thead>
<tr>
<th>Required Fire Resistance</th>
<th>Char Depth (In)</th>
<th>Effective Char Depth (In)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 hour</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>1 hour</td>
<td>2.0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Mass Timber Fire Design Resource
- Code compliance options for demonstrating FRR
- Updated as new tests are completed
- Free download at woodworks.org

Source: WDO's TR 10
Risk Analysis
Threats to mass timber projects Strategic project delivery

Economics
Holistic project estimating Anatomy of a mass timber package

Logistics
Design Engagement Schedule Site Planning

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: Cost Analysis of Structure Only

$/SF

$/SF

Image: GBD Architects

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: 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)

- Material (Direct Cost): 64%

Labor (Direct Cost)

- Labor (Direct Cost): 15%

Equipment (Direct Cost)

- Equipment (Direct Cost): 14%
Turnkey Mass Timber Package

Value Analysis

\[
\text{Value} = \frac{\text{Function}}{\text{Cost}} + \frac{\text{Aesthetics}}{\text{Cost}}
\]

Value Engineering

\[
\text{Value Engineering} = \frac{\text{Function} + \text{Aesthetics}}{\text{Cost}}
\]

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>IA-B</th>
<th>IB-A</th>
<th>IA-B/C</th>
<th>IB-A/B</th>
<th>IB-C</th>
<th>IA-B/C-D</th>
<th>IA-B/C-D-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Structural Frame</td>
<td>3&quot;</td>
<td>3&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
</tr>
<tr>
<td>Ext. Bearing Walls</td>
<td>3&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>1&quot;</td>
<td>0&quot;</td>
</tr>
<tr>
<td>Int. Bearing Walls</td>
<td>3&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>1&quot;</td>
<td>0&quot;</td>
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<tr>
<td>Floor Construction</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
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<td>2&quot;</td>
<td>2&quot;</td>
<td>1&quot;</td>
<td>0&quot;</td>
</tr>
<tr>
<td>Roof Framing</td>
<td>1.5&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>0&quot;</td>
</tr>
</tbody>
</table>

Cost Source: Swinerton

*Note: These values can be reduced based on certain conditions inIBC 2018, 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
How can I create an efficient structural grid for a mass timber building?

Mass timber products such as cross laminated timber (CLT), solid laminated timber (SLT), and panel laminated timber (PLT) are at the core of modern mass timber construction. These light-weighted, engineered wood products have been used internationally in modern building design to construct sustainable and structurally efficient buildings. The use of mass timber is commonly seen in projects such as offices, schools, and large social and public buildings, which often demand an adaptive structural grid material to cover the needs for large, flexible, and adaptable spaces. Typically, flexible grid systems such as grid trusses are used for mass timber construction because they enable high flexibility and are suitable for design of large, adaptable spaces. An understanding of the mass timber application is crucial for the structural design of mass timber buildings. The following considerations are based on a post-and-beam frame for scenarios such as offices. However, many also apply to the post-and-laminated systems in other occupying spaces.

Tolerances: Interface with Other Structural Materials

Value: Perimeter Glazing

Photos: Swinerton

SCHEDULE

Photos: Swinerton
Procurement Approach Determines Schedule

Example 6 Story Type IIIA Project

Design-Bid-Build Procurement

Procurement Logic for Scheduling

Example 6 Story Type IIIA Project

Procurement Approach Determines Schedule

Design-Build/Design-Assist Procurement

Source: Swinerton

Shop drawings, Planning, Fabrication, Delivery

More

Installation

Source: Swinerton

Example 6 Story Type IIIA Project
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></th>
<th>Mass Timber</th>
<th>PT Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct Cost of Work</strong></td>
<td>86,997,136</td>
<td>85,105,091</td>
</tr>
<tr>
<td><strong>Project Overhead</strong></td>
<td>9,393,750</td>
<td>11,768,750</td>
</tr>
<tr>
<td><strong>Add-Ons</strong></td>
<td>8,387,345</td>
<td>8,429,368</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>104,778,231</td>
<td>105,303,209</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**

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Start Date</th>
<th>Finish Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Select, Demolition, &amp; Pile</td>
<td>1/28/2021</td>
<td>2/11/2021</td>
</tr>
<tr>
<td>Site Survey and Building Permits</td>
<td>1/28/2021</td>
<td>2/11/2021</td>
</tr>
<tr>
<td>Design Phase</td>
<td>2/12/2021</td>
<td>2/25/2021</td>
</tr>
<tr>
<td>Contracting and GMP Contract Phase</td>
<td>2/26/2021</td>
<td>3/12/2021</td>
</tr>
</tbody>
</table>

**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
Overview

Architectural Assemblies

Mass Timber Training the Workforce

Sequencing

Painting steel
Taping joints
Protect end cuts of timber

Material Protection

Credit: Swinerton
Photo: Swinerton
Photo: Alex Schreyer

Mass Timber | Training the Workforce
Questions?

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archie@woodworks.org

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