Mass Timber Construction Management:

Economics, Logistics & Risk Analysis

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WoodWorks

Course Description

How do contractors answer the ever-growing demand from architects and ownership groups for mass timber buildings? The growth of this budding 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.

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)

MASS TIMBER OVERVIEW

OVERVIEW | TIMBER METHODOLOGIES

Heavy Timber
Photo: Benjamin Benschneider

Mass Timber
Photo: John Stamets

Glue Laminated Timber (GLT)

Cross-Laminated Timber (CLT)

Nail-Laminated Timber (NLT)

Photo: Think Wood

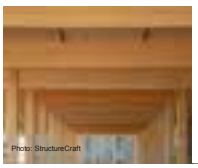


Photo: StructureCraft

Photo: LendLease

Photo: Erna Peter

Dowel-Laminated Timber (DLT)

Photo: StructureCraft

Mass plywood panels (MPP)

Photo: Freres Lumber

Decking

Photo: StructureCraft

Photo: LEVER Architecture

Photo: Bernard André Photography

OVERVIEW | MANUFACTURING

Photo: Ema Peter

STRUCTURAL SOLUTIONS | POST, BEAM + PLATE

Photo: Seagate Structures

STRUCTURAL SOLUTIONS | POST + PLATE

STRUCTURAL SOLUTIONS | HONEYCOMB

STRUCTURAL SOLUTIONS | HYBRID LIGHT-FRAME + MASS TIMBER

STRUCTURAL SOLUTIONS | HYBRID STEEL + MASS TIMBER

STRUCTURAL SOLUTIONS | HYBRID CONCRETE + MASS TIMBER

OVERVIEW | CONNECTIONS

Concealed Connectors

Self Tapping Screws

Photos: Rothoblaas

OVERVIEW | CONNECTIONS

Beam to Column

Photo: StructureCraft

Photo: Structurlam

OVERVIEW | CONNECTIONS

Column to Foundation

Photo: Alex Schreyer

OVERVIEW | CONNECTIONS

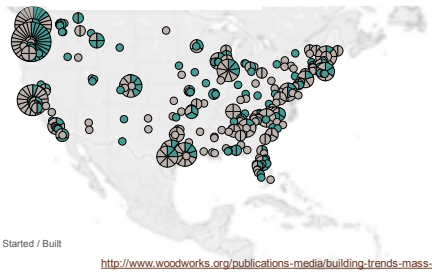
Panel to Panel & Supports

Photo: Charles Judd

Photo: 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/

Photo: Nordic Structures

PRECEDENT PROJECTS | UMASS AMHERST DESIGN BUILDING

Photo: ©Albert Vecerka/Esto

PRECEDENT PROJECTS | UMASS AMHERST DESIGN BUILDING

Photos: Baumberger Studio/PATH Architecture

PRECEDENT PROJECTS | CARBON 12 | PORTLAND, OR

Photo: Hines

PRECEDENT PROJECTS | T3 MINNEAPOLIS

Photo: Corey Gaffer courtesy Perkins + W

PRECEDENT PROJECTS | T3 MINNEAPOLIS

Photos: StructureCraft

Photo: Hartshorne Plunkard Architecture

PRECEDENT PROJECTS | T3 ATLANTA

Photos: Flank

PRECEDENT PROJECTS | 360 WYTHE BROOKYLN, NY


Photos: Swinerton | DJC Orego

PRECEDENT PROJECTS | FIRST TECH CREDIT UNION HILLSBORO, OR


Photos: Michael Elkan | Naturally Wood | UB

PRECEDENT PROJECTS | BROCK COMMONS



Photos: Daniel Shearin | Waugh Thistleton Architec

PRECEDENT PROJECTS | DALSTON WORKS


Photos: Bygg Mesteren | Voll Arkitekter

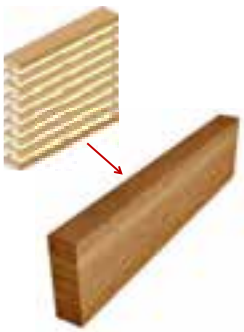
PRECEDENT PROJECTS | MJOSTARNET NORWAY

MASS TIMBER PRODUCTS

Glue Laminated Timber (GLT)

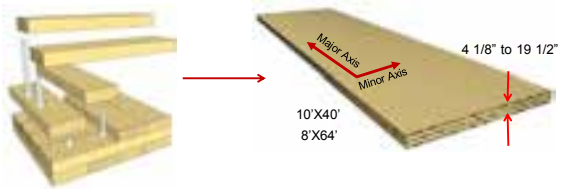
Glue Laminated Timber (GLT)

Photo: Manasc Isaac Architects/Fast + Epp



Cross-Laminated Timber (CLT)

Cross-Laminated Timber (CLT)



Nail-Laminated Timber (NLT)

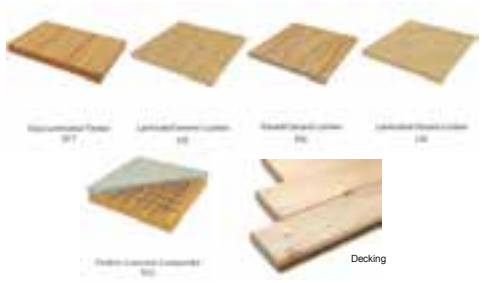
Nail-Laminated Timber (NLT)

Dowel-Laminated Timber (NLT)

Mass Plywood Panels (MPP)

Photos: Freres Lumber

Other Mass Timber Product Options



Decking

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

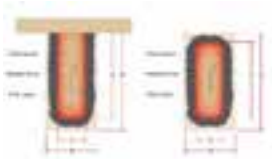
BUILDING CODE APPLICATIONS | CONSTRUCTION TYPE

Tall Mass Timber: Up to 18 Stories in Construction Types IV-A, IV-B or IV-C

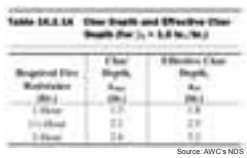
Credit: Susan Jones, atelierjones

BUILDING CODE APPLICATIONS | FIRE RESISTANCE

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



Source: AWC's TR 10



Source: AWC's NDS

Credit: David Barber, ARUP

BUILDING CODE APPLICATIONS | FIRE RESISTANCE

Mass Timber Fire Design Resource

- Code compliance options for demonstrating FRR
- Updated as new tests are completed
- Free download at woodworks.org

MASS TIMBER CONSTRUCTION MANAGEMENT

MASS TIMBER CONSTRUCTION MANAGEMENT

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

Mass Timber Construction Management

RISK ANALYSIS

ECONOMICS

LOGISTICS

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

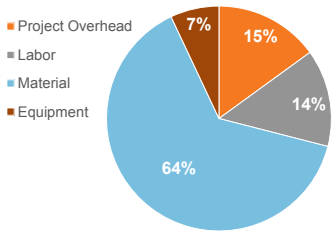
Risk Mitigation: Embrace the Prefab Advantage

Risk: Lack of Supply Chain Understanding

Risk Mitigation: Complementary Procurement

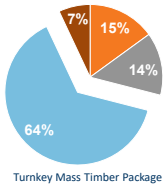
Schedule Savings for Rough-In Trades

Anatomy of a Turnkey Mass Timber Package



Source: Swinerton

Material (Direct Cost)



or

Source: Swinerton

Labor (Direct Cost)

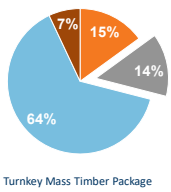


Photo: Swinerton

Source: Swinerton

Equipment (Direct Cost)

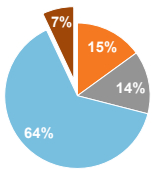
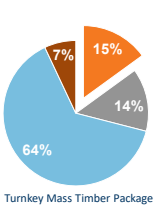


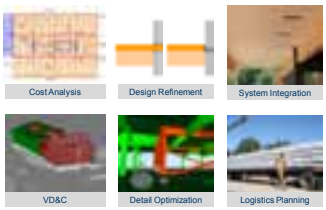
Photo: Swinerton

Photo: Alex Schreyer

Source: Swinerton

Project Overhead





Photos: Swinerton

Source: Swinerton

Value Analysis

$$Value = \frac{\uparrow Function \; + \uparrow Aesthetics}{\downarrow Cost}$$

Value Analysis

$$Value\ Engineering = \frac{\downarrow Function \; + \downarrow Aesthetics}{\downarrow Cost}$$

Value: Program

Cost: Construction Type

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

Building Element	I-A	I-B	III-A	III-B	IV-A	IV-B	IV-C	IV-HT	V-A	V-B
Primary Structural Frame	3*	2*	1	0	3*	2	2	HT	1	0
Ext. Bearing Walls	3*	2*	2	2	3*	2	2	2	1	0
Int. Bearing Walls	3*	2*	1	0	3*	2	2	1/HT	1	0
Floor Construction	2	2*	1	0	2	2	2	HT	1	0
Roof Construction	1.5*	1*	1	0	1.5	1	1	HT	1	0
Exposed Mass Timber Elements					None	20-40%	Most	All		

Baseline
0hr & HT

+$10/SF
1hr & maybe 2hr

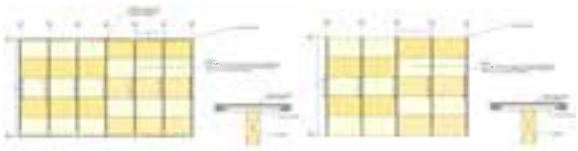
+$12-15/SF
2hr FRR

Cost Source: Swinerton

*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

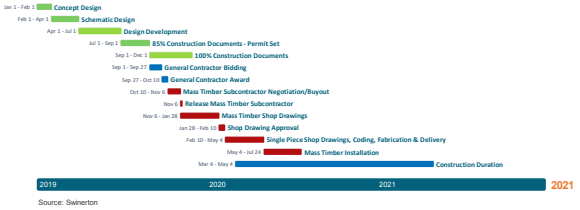
Value: Perimeter Glazing

Tolerances: Interface with Other Structural Materials

Procurement Approach Determines Schedule

Procurement Approach Determines Schedule

Example 6 Story Type IIIA Project

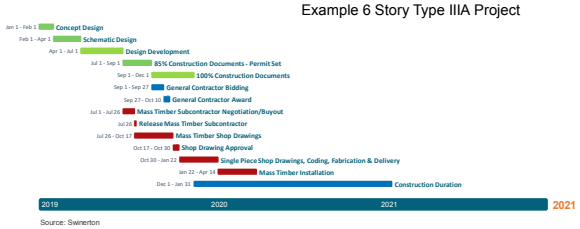


Source: Swinerton

Design-Bid-Build Procurement

Procurement Approach Determines Schedule

Example 6 Story Type IIIA Project



Source: Swinerton

Design-Build/Design-Assist Procurement

Procurement Logic for Scheduling

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

	MASS TIMBER	PT CONCRETE	MASS TIMBER SAVINGS VS. PT CONCRETE (%) *
DIRECT COST OF WORK	86,997,136	85,105,091	2.2%
PROJECT OVERHEAD	9,393,750	11,768,750	-20.2%
ADD-ONS	8,387,345	8,429,368	-0.5%
Total	*104,778,231*	*105,303,209*	*-0.5%*

Source: Swinerton

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

Overall Project Schedule Analysis: 12 Story Type IV-B

Source: Swinerton

Schedule Impact on Cost | Value of Time

Early Move-In for Rough-In Trades.

Embracing BIM for Fabrication

Photos: Swinerton

Holistic Schedule Analysis

Shorter Schedule = Lower General Conditions Costs

Photo: Swinerton

Photo: Swinerton

Photo: Swinerton


PICK PLAN
Photo: Swinerton


SITE ORGANIZATION & STAGING
Photo: Swinerton


LOGISTICS PLANNING
Photo: Swinerton


MATERIAL DELIVERY
Photo: Swinerton

Sequencing

Material Protection

Painting steel
Taping joints
Protect end cuts of timber

Copyright Materials