General Contractor's Guide to Mass Timber Project Estimation

Presented by Jeff Chan, Seagate Mass Timber and Steve Whitcraft, Turner Construction Company

August 12, 2022
Resources

CASE STUDIES

Adidas East Village Expansion
Innovative mass timber designs meet ambitious construction timeline

Nez Perce-Clearwater National Forests Supervisor’s Office
Mass timber project yields low profile exterior, spacious interior.

CAD/Revit tools
Free downloadable details in PDF, DWG, or Revit formats
www.woodworks.org/cad-revit/mass-timber/

Upcoming Events

Common Challenges in Light Wood-Frame Gravity Structural Design | September 15
1.0 AIA/CES HSW LUs, 1.0 PDH credit, 0.10 ICC credit

Visit woodworks.org/learn/
Visit woodworks.org/events
Building the Playbook for the Future of Taller, More Innovative Timber Structures

www.advancing-mass-timber.com
Mass Timber Business Case Studies

Real financial information on real deals

- Prepared by WoodWorks and Conrad Investment Management
- Include qualitative influences + quantitative data to examine investment success

PROPERTY SUB-TYPES:
For-Rent Institutional Housing • Institutional Offices • Industrial Buildings • Redevelopment/Additions • Purpose-Built Owner/Occupied (Student Housing)

« Scan the code to download the current package.»
New for GCs and installers:

Download free at woodworks.org
Nominations Open

Visit woodworks.org/nominate

2023 Wood Design Awards

DEADLINE: OCT. 14, 2022

The Lighthouse | Gensler
Photo Jason O'Rear
Design Professionals: One-on-One Support & Assistance

Senior Director
Field Division West
Janelle Leafblad, PE

Senior Director
Field Division East
Jason Reynolds, MBA, DBIA

Design Professionals:
One-on-One Support & Assistance

PROJECT SUPPORT FIELD DIVISION

Open Position
David Hanley

Open Position
Anthony Harvey, PE

Momo Sun, PE, PEng

Find the Regional Director for your location:

unar
Meet the **Help Desk**

Scott Breneman, PhD, PE, SE
Ashley Cagle, PE, SE
Karen Gesa, PE
Bruce Lindsey
Melissa Kroskey, AIA, SE
Terry Malone, PE, SE
Ricky McLain, PE, SE

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AND

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Current State of Mass Timber Projects

As of June 2022, in the US, **1,502** multi-family, commercial, or institutional projects have been constructed with, or are in design with, mass timber.

* This total includes modern mass timber and post-and-beam structures built since 2013

Source: WoodWorks, June 30, 2022

Scan this code or use the url to find the map and more details online.

https://www.woodworks.org/resources/u-s-mass-timber-projects/
Continuing Education Credits

• Participants will receive a certificate of completion via email
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2. To download the presentation pdf
Ask Questions through the Q&A Box

» Submit questions in the Q&A box at the bottom of your screen as they come up in the presentations. We will get to as many questions as possible.
How can general contractors meet the growing demand for mass timber buildings? While developers across the country are pursuing mass timber projects, knowledge among the general contractor community is not yet widespread. Companies have varying degrees of familiarity with both the products and practicalities of estimating, sourcing, and building a modern mass timber structure, and early adopters continue to play a significant role in educating the rest of the community. This presentation seeks to build on this openness and environment of shared learning, providing an overview of mass timber estimation and bidding processes. We’ll also discuss why some mass timber projects face resistance, and how to overcome value misconceptions to achieve success. With an emphasis on real projects, these discussions will also include preconstruction coordination, BIM and Virtual Design and Construction, and incorporating MEPF subcontractors into a competitive bid.
Learning Objectives

1. Identify the value propositions that can inform a mass timber estimation process and translate into competitive bids.

2. Understand what drives estimating differences between general contractors and specialty installers.

3. Discuss perceived cost saving measures, the efficiencies gained or lost, and lessons identified from built projects.

4. Discuss estimates for project overhead, specifically cost analysis, BIM and VD&C requirements.
Mass Timber: Commercial Considerations

Estimating and Procurement

Steve Whitcraft, DBIA, AIA Assoc, CPC
Turner Construction Company

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.
Outline

1. Motivation and Commitment of Owner
2. Basic Mass Timber Components
3. Early Decisions
4. Procurement Strategies
5. Comparison to Other Structural Systems
6. Summary Take-Aways
7. Questions
1. What is Driving Owner to Consider MT?
   - ESG – Doing the Right Thing
   - Improved Employee/Tenant Environment (Amenity)
   - Cost (First vs LCA vs Sale)

2. What Stage of Commitment?
   - All-In Day One
   - Compare at Concept – SD
   - Bid at DD - CD
Components

1. Wall & Floor Panels
   - CLT
   - Glulam Panels
   - NLT/DLT
   - LVL/LSL/MP Panels

2. Columns/Purlins/Beams
   - Glulam
     - Various Sizes/Layups for Required Loads
     - Shapes: Straight, Curved, or Cambered

Wall & Floor Panel Type Examples:
- NLT - Nail Laminated Timber
- GLT - Glued Laminated Timber
- CLT - Cross Laminated Timber
- DLT - Dowel Laminated Timber
- LSL - Laminated Strand Lumber
- LVL - Laminated Veneer Lumber
- TCC - Timber-Concrete Composites

Connections
- Typically Steel
- Various Types
- Often Encased in FRR Layer
Components

3. Connection
Hardware/Fasteners
Early Decisions

1. Lateral System
   - Steel BRB Core
   - Concrete Core
   - Bracing Configuration

2. Floor Assembly \((Cf/Bf + Pcs)\)
   - Diaphragm Connection
   - Lay-Up (Deck/Purlin/Beam config)
   - Grid Spacing
Early Decisions

3. MEP System Routing
   Exposed/Covered/Through Beams
   UFAD/Radiant/Overhead HVAC

4. Façade Attachment
   Edge/Beam HDWE
   Prefab Panels

5. Acoustic Performance
Early Decisions

6. Code Considerations

Type IA/Type III/Type 4A,B,C,HT

Future Tenant Flexibility

Local Changes/Adoption

IBC 602.4 FRR comes from Mass Timber, added non-combustible protection or combination of both. IBC 703.5 and 722.7 give specifics.
Early Decisions

7. Sustainability Considerations

Adhesive/Sealer

Location/Transportation Sourcing Options

Forest Certification
FSC/SFI/PEFC/CSA

Supply Chain Options – Forest to Mill to Fabricator
Schedule Example
Procurement Strategies

1. CM Turn-Key
   - Vendor Design/Fab/Erect
   - Vendor Design-Assist/Fab/Erect

2. GC Parts & Pieces
   - Vendor Fab
   - Vendor Erect

3. GC Self-Erect
   - Vendor Fab
4. Important Considerations

- Staging/Offloading
- Factory vs Field-Installed Hardware
- Factory vs Field-Applied Sealer
- Moisture Mgmt. Factory to Occupancy
- Safety Rails
- BIM Coord/Penetrations – Sign-Offs
- Field Conditions/Touch-Up
Structural System Comparison

1. Concrete/Steel vs Mass Timber
   - Separate Designs
   - Conceptual Deduct/Add
   - Trade Input
   - Fire Code/Building Type/AHJ/Design
   - Owner Priorities (First Cost/Other)
   - Decision Matrix
2. Mass Timber Hybrid Solutions

- Precast Beams/Columns – MT Decks
- Concrete Cores/Shafts – MT Decks
- BRB Shear – MT Decks
- Other Combos (Delta Beam)

Relative Impacts to Other Trades

Tradeoff Pure MT for Cost Savings
3. Additional Comparative Considerations

Foundation (Footing/Wall Sizing) Reduction

UFAD vs Exposed vs Topping vs Structural Diaphragm (Nail/Rebar/HBV)

MEP Exposed vs Traditional Ceilings (Owner Aesthetic)

Building Type Impacts/Restrictions (Type 1A vs III vs 4B/C vs 5)

Finishes Reduction (C/S and TI)
Benchmark Interiors Costs

OFFICE TENANT IMPROVEMENT COST GUIDE
PROJECT & DEVELOPMENT SERVICES
NORTH AMERICA 2021

TENANT IMPROVEMENT COSTS
Source: Cushman & Wakefield Project & Development Services

- 1st Generation
- 2nd Generation

USD/SQ FT

New York
San Francisco
San Jose
Seattle
Boston
Los Angeles
Chicago
Portland
San Diego
Denver
Austin
Salt Lake City
Kansas City
St. Louis
Cincinnati
Cleveland
Indianapolis
Minneapolis
Denver
Washington, D.C.
Miami/S. Florida
Atlanta
Orlando
Dallas
Baltimore

CUSHMAN & WAKEFIELD
### Benchmark Interiors Costs

#### OFFICE TENANT IMPROVEMENT COST GUIDE

**PROJECT & DEVELOPMENT SERVICES NORTH AMERICA 2021**

Dallas “First Generation” Space Cost (p. 18)

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<td>Total with Tax and Contingency</td>
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*1st Generation Tenant Space Cost Reduced by $6.17*

Lessons/Good Practices

1. Exchange Rates and Material Pricing (*tie to Index/Allowance*)

2. Moisture Management Plan – *Wrap/Seal/Touch-Up*
   Splines/Tape for Spline Joints

3. Transportation/Unload-Staging - *JIT Efficiency*

4. Hardware/Fasteners/Plates/Bracing (*Weight/Who Designs*)

5. Lay-up Combinations (*Fabricator Standards & Erector Efficiency*)

6. Target Fiber Density (*BF/SF or CF/SF*) - Potential Cost/Design Optimization

7. Erection Production Goals (*% of Material or Pieces/Day*) - Potential Cost/Design Optimization
Summary Take-Aways

1. Choose a Reliable, Experienced GC/CM
2. Establish Priorities/Goals with Owner & Design Team
3. Determine Appropriate Procurement Strategy
4. Confirm Comparison/Determine MT Early
5. Bring In MT Team As Soon As Reasonable
6. Coordinate MT Details with Overall Design
7. Watch for Key Considerations
8. Learn from Trade Partners
DATA TIMBER
PROJECT ESTIMATION

Presented by: Jeff Chan
Pre-Construction Manager

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.
LEARNING OBJECTIVES

• Identify Unique Factors of Mass Timber Projects
• Account for the Complete Scope, Comparing Apples to Apples
• Mitigating Risk
MAIN PRICING COMPONENTS OF A SCOPE

- Supply
- Install
- Other Cost Considerations
- Design Assist & Value Engineering

*Important to consider how you want to structure the contract for the mass timber scope*
SUPPLY

• Understanding and Defining the Supply Scope
• Options for Supply Packages
• Understanding your suppliers / options
• Fabrication
• Logistics and Timelines
• Understanding Risks
DEFINING THE SUPPLY SCOPE

• Type of Mass Timber Build
  o Post & Panel
  o Post Beam & Panel
  o Hybrid

• Related Scope Items
  o Drag Struts, L-angle, Embeds

• Coatings and/or Membranes

• Components
  o Glulam
  o CLT
  o GLT
  o DLT
  o Steel Columns
  o Connections
  o Hardware
OPTIONS FOR SUPPLY PACKAGE

• Single Source Supply

• Multiple Timber Suppliers
  o Procure Glulam and CLT separately

• Separate Steel Supplier for connections
  o Would require offsite or onsite pre-assembly by installer

* Ultimately depends on comfort level of GC to manage scope
SUPPLIER CONSIDERATIONS

• North American & European

• Capabilities & Availability
  o Products & Sizes
  o Wood Species
  o Capacity
  o Certification

• 3D Modeling & Value Engineering

• Pricing Factors
  o Lumber Procurement & Availability
  o Pricing Stability
FABRICATION

- 3D Modeling & MEP Coordination
- Shop Drawings
- Manufacturing
- Machining
- Pre-Assembly requirement
- Coatings & Membranes
SUPPLY DELIVERY & SCHEDULE

• **Freight & Shipping**  
  o Offsite Storage / Staging  
  o Duty & Taxes  
  o Logistics

• **Schedule & Timelines**  
  o Shop Drawings  
  o Fabrication  
  o Shipping
UNDERSTANDING RISKS

• Pricing Stability

• Capacity and availability of Supplier

• Lead times (from design assist phase if required through to delivery to site)

• Logistics & Shipping
  o Shipping from Europe

• Missing Cost Factors

• Trade Coordination
  o MEP Penetrations
INSTALL

- Defining your Scope
- Site Logistics
- Pre-Assembly Requirements
- Crane & Equipment
- Scheduling & Manpower
- Additional Cost Considerations
- Additional Miscellaneous Items
- Understanding Risks
IDENTIFYING & DEFINING THE INSTALL SCOPE

- Installation of Mass Timber Components
- Connection between Timber & Other Structural Components
- Related Scope Items
  - Embeds
  - Perimeter Angles
  - Drag Struts
  - Ledgers
  - Brace Frames
- Guardrails (# of Floors)
- Temporary Bracing
SITE LOGISTICS

• Sequencing & Conditions
  o Truck Routes
  o Pick points & Strategy
  o Laydown & Storage Area
  o Site Conditions
  o Crane Location
PRE-ASSEMBLY REQUIREMENTS

- **Pre-Assembly Offsite**
  - Facility & Storage Requirements
  - Trucking & Shipping Logistics

- **Pre-Assembly Onsite**
  - Designated Onsite Location or Active Deck

- **Additional Time Requirements & Schedule Impact**

- **Equipment & Staging Requirements**
CRANE & EQUIPMENT

- **Hoisting /Crane**
  - Time allocation / Accessibility
  - Other hoisting methods
  - Crane Location, Reach & Capacity

- **Other Equipment**
  - Aerial equipment
  - Telehandlers
SCHEDULING & MANPOWER REQUIREMENTS

• Schedule & Sequencing

• Strategic planning
  o Mobilization
  o Itemize Scope
  o Establish Sequencing & Productivity
    • Driven by Crane and Pick Times
  o Allocate Manpower & Durations
SCHEDULING & MANPOWER REQUIREMENTS

- Number of Mobilizations
- Travel Costs & Live Out Allowance
- Labor Requirements
ADDITIONAL COST CONSIDERATIONS

• Moisture Management Plan
  o Mitigating Damage during Storage & Handling
  o What is the Final Finish
  o Weather & Building Conditions

• Material Protection, Damage & Repairs
  o Defining Scope & Responsibilities
  o Allocating Time
  o Cost
ADDITIONAL MISCELLANEOUS ITEMS

- Lifting & Bracing Engineering Plan
- Fall Protection Plan
- Layout & Surveying
- Welding
- Regulatory Requirements
  - City/County/State/Country Requirements
UNDERSTANDING RISKS

- Crane Schedule and Allocation
- Scope Gaps
- Connection Details & Interaction with Trades
- Tolerances and Mitigating Re-Work
- Coordination between Supplier and Installer (if separated)
CASE STUDY SCENARIO

- 5 Storey Mass Timber Office with Concrete Core
  - 91,000 SF GFA (approx. 16,000 SF per Floor)
  - Post, Beam & Panel
  - Half Lap CLT Joints

- Invited to Provide Turnkey Supply and Install Proposal and Install Only
  - Hard bid to multiple GCs
  - Different GCs had their own approach
CASE STUDY SCENARIO

- **Supply Scope**
  - Mass Timber Components (Glulam & CLT)
  - Timber Connections
  - Steel (Diaphragm Straps, Drag Plates, Perimeter Channel and CLT Bearing Ledgers @ Concrete Core)
  - Timber Fasteners
  - Shop Applied Membrane for Moisture Protection
  - Shop Applied Sealers for CLT & Glulam
  - Delegated Connection Design
CASE STUDY SCENARIO

Project Considerations

• **Supplier**
  o Looked at Options for Separating Scopes
  o Pre-assembly & Fabrication
  o Sourcing Locally
  o Certification & FSC

• **Design Assist & Value Engineering**

• **Modeling Capabilities**

• **Half Lap Instead of Splines** (Lots of Diaphragm Steel)

• **Use detailed "Supplier Bid Breakdown" to Align Scopes for all Bidders**
Develop a "Supplier Bid Breakdown" at an early stage:

- Lay out all Project Requirements
- Eliminates any Scope Gaps
- Speak with Suppliers early
## CASE STUDY - SUPPLY

### Bid Evaluation & Comparison

- Compare all Suppliers Once Each Supplier has been Assessed
- Add in any Risks or Contingencies

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<th>ITEM OF WORK</th>
<th>Supplier 1</th>
<th>Supplier 2</th>
<th>Supplier 3</th>
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*Note: The table continues with similar entries.*
CASE STUDY - INSTALL

- **Install Scope**
  - Install Glulam Columns, Beams and CLT Floor/Roof Panels (Connections Pre-installed by Supplier)
  - Install Steel (Diaphragm Straps, Drag Plates, Perimeter Channel and CLT Bearing Ledgers @ Concrete Core, Perimeter HSS for Header and Sill Support)
  - Guardrails

- **Site Logistics**
  - Met with all bidding GCs to discuss their logistics
    - Site Conditions
    - # of Cranes & Placement (Tower Crane)
    - Schedule (Plan for Concrete Cores)
    - Review Scope
    - Truck Route
    - Possible Truck Staging Area
CASE STUDY - INSTALL

Project Considerations

• Larger crew to keep pace as there was a lot of steel to install

• Crane and site logistic for each GC

• Limited Onsite Storage Area

• Picks per day

• Material unloading strategy

• No allowances for onsite moisture management, material repairs or finishing
### Scope Method

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<td>Mass Timber Installation</td>
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<tr>
<td>- Glulam Beams</td>
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<td>- CLT Floor Panels</td>
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<td>- Drag Strap</td>
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- **Scope Method is good for pricing as it covers all scopes**
- **Unit rates per item based on historical data**
- **Baseline of hours to complete the project and compare to sequence we develop**
- **Also incorporates project setup, mobilization and demobilization**
CASE STUDY - INSTALL

Sequencing Method

- Sequencing Method is great for developing a schedule and optimizing the crane
- Develop a cycle based on the crane crew and staff up to complete non-critical tasks
CASE STUDY - REVIEW

Key Take Aways from Case Study

- GC's logistics plan and schedule can impact how we execute the mass timber scope
- Need to have very clear methodology to compare all bids received and allow contingencies for possible scope gaps
- Suppliers and installers may provide different bid packages based on their capabilities and willingness to take on scope items
- Understand if and how you want present cost savings measures if possible
ITEMS TO CONSIDER

• Allow for additional preconstruction and planning time compared to other construction methods

• Understand nuances between different mass timber players (suppliers, contractors, installers) and how they can affect pricing and risk

• Know your options and manage expectation

• Sequencing and trade coordination is key to driving schedule

• Strong communication between GC and mass timber proponents
LEARNING OBJECTIVES

• Identify Unique Factors of Mass Timber Projects

• Account for the Complete Scope, Comparing Apples to Apples

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

Steve Whitcraft, DBIA, AIA Assoc, CPC
Turner Construction Company
swhitcraft@tcco.com

Jeff Chan
Seagate Structures (USA), Inc.
jchan@seagatemasstimber.com