Managing Your First Mass Timber Project:

Workflow Mapping

David Kwiatkowski, Project Executive
Chris Johansen, Project Manager

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.
“The Wood Products Council” is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES), Provider #G516.

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.
Mass timber is an innovative building material with many benefits, including construction speed, aesthetics, sustainability, and strength-to-weight ratio. The beauty of the finished product has inspired many owners and designers to pursue mass timber for their projects. However, while design and code aspects receive a great deal of focus, it is the construction aspects that often decide whether a project goes forward. While mass timber draws installation techniques from other construction types, it also has unique attributes—and a complete understanding of the differences is key to efficient estimating, planning and construction. This workshop is designed to address critical gaps in knowledge and skills among contractors and installers, with topics such as cost considerations, site planning, schedule, and risk mitigation. It will also include three brief case studies highlighting design team interaction, challenges, benefits and lessons learned during construction. Intended for construction industry professionals looking to gain a deep understanding of the unique attributes of mass timber, this workshop will leave attendees with information they need to successfully bid and construct a mass timber project.
1. Understand the unique attributes and considerations of mass timber construction.
2. Determine how to manage mass timber building sites and mitigate potential risks to personnel, material and ultimately, schedule.
3. Discuss project workflows to identify potential construction schedule savings and maintaining thorough construction safety practices.
4. Explore best practices for coordination with the mass timber manufacturer, planning and scheduling for cost efficiency, and safety on site.
THE BEGINNING

**FEBRUARY 2019:** C.D. Smith bid on concrete package to Catalyst Construction (Foundations, PT Parking Decks, 7th Floor Transfer Deck, (2) Concrete Shear Walls to Top)

**SEPTEMBER 27, 2019:** Catalyst and New Land bring C.D. Smith on board under a preconstruction agreement. C.D. Smith provides CM services for the core and shell trades including mass timber and MEPs (77% of the contract value).

**AUGUST 21, 2020:** Construction Agreement executed with New Land Enterprises.
C.D. SMITH SELF-PERFORM TRADES ON ASCENT

» General Conditions + Safety
» Virtual Design + Construction (VDC)
» Project Requirements Labor
» Hoisting + Equipment Operation
» Concrete Forming/Placement, including rebar and PT placement
» Masonry
» Structural Steel Erection + Misc. Metals Installation
» Roof Davit Installation
» Cable Vehicle Barrier Installation
» Mass Timber Erection
» Rough Carpentry
» Exterior Cold Formed Framing and Sheathing
» Site Concrete
RESPONSIBILITIES

» Preconstruction, buyout, planning, logistics development, scheduling and budget

» Oversight on the project from a higher level, master schedule and budget management

• Background includes high rises, residential development, corporate, industrial, high institution, labs, plants, healthcare and parking structures.

• Primary construction method experience prior to mass timber includes cast-in-place concrete, precast, structural steel, cold formed high rise, wood framed (stick and panelized).
PARTNERSHIP = KEY TO SUCCESSFUL PRECONSTRUCTION

- New Land Enterprises
- Catalyst Construction
- Korb + Associates
- Thornton Tomasetti
- Swinerton Mass Timber (Now Timberlab)
- Site Visits
LESSONS LEARNED DISCUSSIONS + BID MANUAL

» Review details from a previous mass timber building “framework”

» Thorough preconstruction process with Architect, Engineer and Mass Timber partners
  • Develop details with Architect and Engineer as a team to meet code, constructability, tolerance
  • Follow Architect’s lead on code-required items and permit applications
  • Detail out lessons learned requirements in Project Manual to get requirements to coordinating contractors

PROJECT MANUAL INDEX
1. GENERAL SCOPE
2. SITE LOGISTICS PLAN
3. FOUNDATION SEQUENCE AND CONCRETE POUR BREAK PLANS
4. SCHEDULE
5. SUBMITTAL PROCUREMENT LOG TEMPLATE
6. SITE SAFETY PLAN
7. QUALITY CONTROL PLAN
8. BIM EXECUTION PLAN
9. PAY APPLICATION SCHEDULE
10. SUBCONTRACT TERMS and CONDITIONS
11. CERTIFICATE OF INSURANCE REQUIREMENTS

ATTACHMENTS
• PROJECT SPECIFICATIONS DATED 2020.02.21
• ARCHITECTURAL DRAWINGS DATED 2020.02.21
• STRUCTURAL DRAWINGS DATED 2020.02.21
BID MANUAL BIM EXECUTION

Develop BIM Execution Plan with LOD requirements for timber fabrication

<table>
<thead>
<tr>
<th>LOD</th>
<th>Level of Development</th>
<th>Phase 1 ( Permit Set)</th>
<th>Phase 2 ( Locked-In Pens and Main Runs)</th>
<th>Phase 3 ( Fully Coordinated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Foundations</td>
<td>300 ST</td>
<td>300/500 ST/C/O</td>
<td>300/500 ST/C/O</td>
</tr>
<tr>
<td>2</td>
<td>Walls</td>
<td>300 ST</td>
<td>300/500 ST/C/O</td>
<td>300/500 ST/C/O</td>
</tr>
<tr>
<td>3</td>
<td>Slab</td>
<td>300 ST</td>
<td>300/500 ST/C/O</td>
<td>300/500 ST/C/O</td>
</tr>
<tr>
<td>4</td>
<td>Slab</td>
<td>300 ST</td>
<td>300/500 ST/C/O</td>
<td>300/500 ST/C/O</td>
</tr>
<tr>
<td>5</td>
<td>Slab</td>
<td>300 ST</td>
<td>300/500 ST/C/O</td>
<td>300/500 ST/C/O</td>
</tr>
</tbody>
</table>

**PLANNING SMALL DESIGN TO LOD 350; INCLUDING BUT NOT LIMITED TO THE FOLLOWING:**

- Primary utility lines into building.
- Waste lines.
- Storm lines with proper grade.
- Supports.
- Vent.
- Condensate if applicable.
- Grease traps and lines.
- Water supply/branch.
- Any supports that interact with structural—concrete, CLT, steel, critical framing.
- Floors/penetrations—3D geometry blocks representing net/thorough opening requirement for respective piping.

**MASS TIMBER (GLULAM AND CLT PANELS) WILL DETAIL TO LEVEL 450; INCLUDING BUT NOT LIMITED TO THE FOLLOWING:**

- Accurate perimeter setbacks based on interaction with exterior walls/dore.
- CLT panel seams/splice.
- Glulam brands.
- Blockouts/sleeves.
- Wood-to-wood steel connections.

**SECTION G: BIM MODELING SCOPE / ELEMENTS / LEVEL OF DEVELOPMENT (LOD)**

**THE BASIS FOR LOD DETERMINATION AND MPS COMPLETION**

The LOD as defined in the BIMForum 2015 Level Of Development Specification For Building Information Models (April 30, 2015)

**Fundamental LOD Definitions**

**LOD 100**

The Model Element may be graphically represented in the Model with a symbol or other representation, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e., cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.

**LOD 200**

The Model Element is graphically represented within the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.

**LOD 300**

The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, and orientation. Non-graphic information may also be attached to the Model Element.

**LOD 400**

The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of size, shape, location, orientation, and detail. Non-graphic information may also be attached to the Model Element.

**LOD 500**

The Model Element is a field-verified representation in terms of size, shape, location, quantity, and orientation. Non-graphic information may also be attached to the Model Element.
KEY PRECONSTRUCTION CONTRACTS

» Preconstruction only contracts with alternates to complete work

» October 11, 2019 Bid – November 18, 2019 Award
  • Test Pile Program: Full coordination, installation, reporting
  • Mass Timber Supply: Preconstruction only
  • Tower Crane/Hoist/Concrete Placing: Engineering/shop drawings only
  • Project Requirements Engineering
  • Window Wall: Preconstruction/shop drawings only
  • Elevator: Preconstruction/shop drawings only
  • MEPFP Contractors: Preconstruction, full design and VDC only
KEY PRECONSTRUCTION CONTRACT DELIVERABLES

BID RELEASE #1 | Issued October 11, 2019 | Awarded November 18, 2019

Test Piles
» December 3, 2019: Award | February 21, 2020: Final Report
» Needed for Bid Release #2 Set (Footing and Foundation Set/Permit)

Elevator
» Shaft sizes to determine concrete shear wall size to establish limits of timber
» Issued February 21, 2020 in Bid Release #2

Timber Coordination
» Work through details to get material bid set
» Issued timber materials bid set February 21, 2020 in Bid Release #2
Material Hoist
» Loading for specialty connection to timber structure

Façade
» Connection details, loading and slab edge plan established
» Issued April 3, 2020 in Bid Release #3

MEPFP
» Equipment sizing/location/loading
» Routing to establish shaft sizes – Issued April 3, 2020 in Bid Release #3
» Routing to establish penetrations 4” and larger – Issued April 3, 2020 in Bid Release #3
» Routing to establish all penetrations less than 4” – Issued August 17, 2020 in Bid Release #4
• Determine inclusions/exclusions from drawings and specification requirements with mass timber supplier/fabricator.
• Fill in the blanks on anything missing.
COORDINATION WORKFLOW

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber: Lumber used shall be uniformly manufactured and shall be Austrian Spruce, Grade Combination as noted in the Structural Drawings, graded in accordance with ANSI-117 or Glulam Design Specification Form Y117 or European Equivalent (manufacturer to provide reference) with the following additional requirements: Each piece shall be grade marked or certified prior to selection for laminating. When lumber to be used for laminating is resawn, the new size shall meet the grade requirements. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark; place mark on surfaces that are not exposed in the completed work.

B. Appearance Grade: Architectural or Industrial as indicated in drawings, complying with AITC 110. For Architectural appearance grade, fill voids as required by AITC 110.

C. Glue: Use exterior type adhesive conforming to ASTM D2559, resin adhesive of phenol, or melamine base applied in accordance with manufacturer's recommendations. Approved adhesives shall be those which have been acceptably certified as performing satisfactorily for mixing, spreading, storage, life, pot life, working life and assembly life recommendations.

D. Laminating Combinations must meet laminating requirements as specified in drawings, including cantilevered beam requirements (tension lambs and bottom).

E. Laminating Combinations for European Spruce shall meet:

1. GL28h. Allowable stresses shall meet at least the following minimum values:

<table>
<thead>
<tr>
<th>Description</th>
<th>Framing Appearance Grade</th>
<th>Industrial Appearance Grade</th>
<th>Architectural Appearance Grade</th>
<th>Premium Appearance Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bending</td>
<td>2.42</td>
<td>2.42</td>
<td>2.42</td>
<td>2.42</td>
</tr>
<tr>
<td>Compression Perp. to Grain</td>
<td>2.15</td>
<td>2.15</td>
<td>2.15</td>
<td>2.15</td>
</tr>
<tr>
<td>Horizontal Shear</td>
<td>2.07</td>
<td>2.07</td>
<td>2.07</td>
<td>2.07</td>
</tr>
<tr>
<td>Modules of Elasticity</td>
<td>9.05</td>
<td>9.05</td>
<td>9.05</td>
<td>9.05</td>
</tr>
</tbody>
</table>

Determine the species, grade, appearance, sizes, fiber content, sizing and connections to get mass timber material bid set.
Early Procurement Schedule

- Bid Release #2 Material Bidding and Award **February 21, 2020** Bid Set
- Notice to Proceed to timber supplier – **May 26, 2020**
- Down payment to procure materials – **July 2020** Pay App
- Shop drawings with cross-laminated timber (CLT)/glulam beam penetrations and slab edge established **July 17, 2020** – **October 2, 2020**
- Shop drawing review and approvals **October 2, 2020** – **November 16, 2020**
- Production drawings **November 17, 2020** – **February 5, 2021**
- CLT manufacturing started **February 8, 2021**
- Glulam manufacturing started **February 9, 2021**
- Base plats for column at L7 arrived **June 1, 2021**
- Glulam columns L7-L8 started **June 2, 2021**
Build the Master Schedule

» Procurement and coordination
» Coordination sign off schedule to fabrication drawings
» Fabrication of 12 weeks
» Shipping time 7 weeks *(Pre COVID / Suez Canal Impacts)*

Complete a Coordination Sign Off Schedule by Phases/
Releases Working Up the Building

» **Phase 1:** Levels 7-10
» **Phase 2A:** Levels 10-18
» **Phase 2B:** Levels 18-23
» **Phase 3:** Levels 23 – Roof (26)
COORDINATION WORKFLOW

Procure a Mockup and Erect It

Ensure Permitting Is On Track for Work to Start
» Glulam Fire Testing: Complete December 17, 2020
» Building structure variance approvals: Submitted February 13, 2020 – Obtained July 22, 2020
» Footing and Foundation Permit: Submitted February 21, 2020 – Obtained July 27, 2020
» Full Building Permit: Submitted August 17, 2020 – Obtained October 30, 2020

Date ready onsite (concrete complete with anchor bolts) = Date timber will be arriving.
**COORDINATION WORKFLOW**

**SCHEDULE**

**Concurrent Work On Site**

- NTP to procure pip pile material: **July 2020**
- Executed prime contract: **August 24, 2020**
- Pile driving started: **September 1, 2020**
- Concrete shear walls ahead of decks
- Executed fGMP amendment: **November 20, 2020**
- Concrete SOG/elevated parking structure/L7 transfer slab: Complete **May 20, 2021**
- L9 transfer slab above pool at Southwest corner: Complete **June 19, 2021**
- Concrete shear walls complete **September 17, 2021** North, **October 1, 2021** South
- **Currently** installing L19 CLT with anticipated erection completion in December
COORDINATION WORKFLOW

Develop the Work Breakdown Structure » Input Activities » Coordinate and Link
COORDINATION WORKFLOW

SCHEDULE

Preconstruction Schedule
COORDINATION WORKFLOW

SCHEDULE

Preconstruction Schedule
COORDINATION WORKFLOW

» Equipment
» Management
» Mockup Erection
» Safety
» Protection
» Snow/Water Removal
» Ladders/Stairs/Access
» Cleanup
» Firestopping
» Get Baseplates Early
» Baseplate Grouting
» Connection Review
» Piece Counts of Glulam Columns and Beams
» Piece Counts of CLT Panels

PLAN + ESTIMATE ERECTION

» CLT Connection Details
» CLT Spline Details
» Specialty Connections of Timber to Concrete
» Specialty Connections of Succeeding Trades to CLT – Balconies – Window Wall
» Unloading of Trucks
» Breakdown of Dunnage, Protection
» Labor Makeup of Crew – Ironworkers, Carpenters, Laborers
EXECUTE IN THE FIELD

» Delivery Tracking
» Quality Assurance/Quality Control (QA/QC)
» Logistics of Delivery Unloading
» Piece-by-piece Erection Sequences
TRACKING IN THE FIELD

What is going to be completed in the factory?
» Beam columns cut to size?
» Notches/brackets?
» Recessed pockets/plugs?
» Screws/nails?

Identify what needs to be ordered for field installation:
» Identify who will be tracking and try to keep it to one person.
» Lots of information!
SCREWS

» Ascent has over 600,000 fasteners.
» What can be installed in the factory?
» How do we track what is installed in the field (~5,500 field-installed screws per floor)?
QUALITY CONTROL

» Field Measuring
» 3rd Party Inspections
  • Who is contracting – owner or GC/CM?
  • Identify the specific scope.
  • Review install sequence to confirm duration inspectors are needed onsite.
LOGISTICS

» How is material arriving on jobsite?
  • Do you need a large forklift to pull material from connex boxes? If so, source a facility that has these capabilities.

» Location of:
  • Conventional Crane or Tower Crane
    o Heaviest pick vs. radius of crane
    o Dedicated to timber from 7:00 AM – 3:00 PM
  • Hoist: Get design included in Structural Drawings
  • Concrete Placing: Get design included in Structural Drawings
TIMBER DELIVERIES

» Dedicated access into jobsite

» How to trucks access the jobsite?
TIMBER + BRACKETS ARRIVING ON JOBSITE
TIMBER “SLEDS”

Sleds are used to pull the material out of the connex box via industrial forklift.
Each column has its own identification.
FASTENER STORAGE OVER 100,000 FIELD-INSTALLED!
MOBILE CHARGING STATION FOR CORDLESS DRILLS
ERECITION SEQUENCE
BRACING
Level 8 Fasteners Above - Bearing Fasteners

Maintain Minimum 3" Edge Distance at End of Beam, Typ.

RED: Ecofast 5/16" x 11-7/8" Screws @ 12" O.C.

BLUE: Two Rows Ecofast 5/16" x 11-7/8" Screws @ 12" O.C.

PINK: Two Rows Ecofast 3/8" x 11-7/8" Screws @ 2" O.C.

GREEN: Two Rows Ecofast 5/16" x 11-7/8" Screws @ 6" O.C.

YELLOW: 14ea CSK 3/8" x 11-7/8" Uniformly Distributed Each Panel

ORANGE: 24ea CSK 5/16" x 11-7/8" Uniformly Distributed in Two Rows
Level 8 Fasteners Below

- BLUE: Ecofast 3/8" x 4" Screws
- PINK: Kombi 1/2" x 5-1/2" Screws
- GREEN: Kombi 1/2" x 7-1/2" Screws

**Typical CLT Support at Reinforced Concrete Face**

**Fastener Through Concrete:**
1/2" x 8" Lag Screw (with Washer) @ 8" O.C.

**CLT Reinforcing Screws:**
CSK 5/16" x 6-1/4" Screws @ 8" O.C. with Pre-drilled holes
COLOR-CODED BOXES

Simplify install and eliminate confusion.
FRIDAY, SEPTEMBER 17, 2021

CORE FINAL POUR
280 FEET
QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

Dave Kwiatkowski
Chris Johansen
C.D. Smith Construction