Mass Timber’s Growing Foothold in the Northeast

Bowdoin College Mills Hall and Center for Arctic Studies

Presented by Matthew Tonello, P.E.

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

1. Planning / Modeling Costs for Mass Timber Projects
2. Lessons Learned – Procurement, Planning and Construction Phase
3. A Perspective on Environmental Impact of a Structural System
Bowdoin College Center for Arctic Studies & Mills Hall

Arctic Museum (CAS)  Mills Hall Classroom & Events
Center for Arctic Studies
Mills Hall
Center for Arctic Studies - Entry
Center for Arctic Studies Gallery Space
Mills Hall – Conference / Event Space
Planning Mass Timber - Keys to Success – Cost
Planning Mass Timber – Early CM Involvement

1. Construction Manager engaged simultaneously with Designer
   Designer & CM Involved in Project Goal Setting
Keys to Success – Cost
Planning Mass Timber – Compare to Comparable Design

<table>
<thead>
<tr>
<th>Mass Timber</th>
<th>Structural Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed Timber</td>
<td>AESS Steel</td>
</tr>
<tr>
<td>CLT Shear Walls</td>
<td>CMU Shear Walls</td>
</tr>
<tr>
<td>Exposed CLT Walls</td>
<td>Wood Panels</td>
</tr>
</tbody>
</table>

*Schedule Factors (the tough one):*

- Trades on Mass Timber earlier
- Earlier Exterior Framing on Mass Timber
- General Conditions Savings

**INCLUDE SCHEDULE IMPACT**
### Planning Mass Timber - Keys to Success – Cost

#### Schematic Design Mechanical Pricing Options - HVAC, Plumbing, FP & Electrical Support

**Option 1: AHUs, Central Steam and Chiller**

<table>
<thead>
<tr>
<th>Description</th>
<th>Mills Hall - 23,000 sqft</th>
<th>Center for Arctic Study - 14,000 sqft</th>
<th>Mills $5</th>
<th>CAS $5</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) 20,000 CFM Semi-Custom Indoor Air Handling Unit. Hot Water Preheat Piping and Chilled Water Coils, Piping and Sound Attenuation. Per unit with pressure independent cooling coil valves.</td>
<td>$149,000</td>
<td>$202,000</td>
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<tr>
<td>(ii) 3,000 CFM Dedicated Outdoor Air Handling Unit. Instantaneous Hot Water Piping and Chilled Water Coils, Piping and Sound Attenuation. Per unit with pressure independent cooling coil valves.</td>
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**Option 2: VRF - Air Cooled Option**

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**Option 3: Geothermal AHUs and Central Steam Backup**

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</tbody>
</table>

**Option 4: VRF - Water Cooled Geo Option**

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<thead>
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</tr>
</tbody>
</table>

### Notes:
- VRF for measure costs suitable with related weather temperature/conditions. Included in option for pricing purposes.
Planning Mass Timber - Keys to Success – Cost

### Bowdoin College - Art & Academic Building

#### SF Cost Model - Summer 2020

<table>
<thead>
<tr>
<th>Item</th>
<th>Total</th>
<th>$ / SF</th>
<th>% of Total</th>
<th>Notes / Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>06.01 Wood Framing</td>
<td>$1,891,000</td>
<td>44.47</td>
<td>0.44%</td>
<td>All above grade wood framed, based on past projects $30/SF on wood areas</td>
</tr>
<tr>
<td>06.02 Architectural Millwork/Casework</td>
<td>$206,000</td>
<td>4.84</td>
<td>0.02%</td>
<td>Historic gross square footage costs (carried higher at auditorium &amp; labs)</td>
</tr>
<tr>
<td>07.01 Waterproofing/Caulking</td>
<td>$250,000</td>
<td>5.88</td>
<td>0.11%</td>
<td>$8/SF @ solid exterior walls for AVB plus $2/SF on gross SF for waterproofing throughout</td>
</tr>
<tr>
<td>07.02 Exterior Wall Cladding</td>
<td>$1,136,000</td>
<td>26.72</td>
<td>0.07%</td>
<td>65% the exterior skin square footage @ $6/SF</td>
</tr>
<tr>
<td>07.03 Roofing &amp; Sheet Metal</td>
<td>$280,000</td>
<td>6.58</td>
<td>0.23%</td>
<td>$17/SF across the flat roof square footage since sloping unknown</td>
</tr>
<tr>
<td>07.05 Firestopping</td>
<td>$43,000</td>
<td>1.01</td>
<td>0.19%</td>
<td>Historic gross square footage costs ($1 per gross square footage)</td>
</tr>
<tr>
<td>08.01 Doors, Frames, Hardware</td>
<td>$137,000</td>
<td>3.22</td>
<td>0.09%</td>
<td>Historic gross square footage costs ($3.22 per gross square footage)</td>
</tr>
<tr>
<td>08.02 Curtain Wall, Windows, Storefront</td>
<td>$1,163,000</td>
<td>27.35</td>
<td>0.19%</td>
<td>20% curtainwall @ $120/SF &amp; 15% punched windows @ $65/SF</td>
</tr>
<tr>
<td>08.03 Interior (Non-Mass)</td>
<td>$213,000</td>
<td>5.01</td>
<td>0.05%</td>
<td>Historic gross square footage costs ($5 per gross square footage)</td>
</tr>
</tbody>
</table>

Total 42,520 SF

Cost Breakdown:
- Structural Steel: $796,000
- Miscellaneous Metals: $267,000
- Miscellaneous: $290,000
- Stairs: $97,000
- Elevator Shafts: $2,280
- Steel at grade, wood framing above: $4,870
- Historic gross square footage costs: $1,290

**42,520 sf**
Planning Mass Timber - Keys to Success – Cost

SD to DD >> Square Footage Increase of: 8%
Trade Cost Locked in at ~ $47/sqft
Escalation / Procurement Risk removed
Planning Mass Timber - Keys to Success - Schedule

Bowdoin Arctic Museum and Event Space
Consigli / HGA

<table>
<thead>
<tr>
<th>TASK DESCRIPTION</th>
<th>Duration</th>
<th>PLAN START</th>
<th>PLAN END</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design / Preconstruction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schematic Design</td>
<td>2/1/19</td>
<td>4/30/19</td>
<td></td>
</tr>
<tr>
<td>SD Pricing</td>
<td>5/1/19</td>
<td>5/31/19</td>
<td></td>
</tr>
<tr>
<td>Design Development</td>
<td>6/3/19</td>
<td>9/27/19</td>
<td></td>
</tr>
<tr>
<td>Site Test Pits and Suitability</td>
<td>7/1/19</td>
<td>7/12/19</td>
<td></td>
</tr>
<tr>
<td>DO Pricing</td>
<td>10/1/19</td>
<td>10/31/19</td>
<td></td>
</tr>
<tr>
<td>Value Management (TBD)</td>
<td>10/12/19</td>
<td>2/14/20</td>
<td></td>
</tr>
<tr>
<td>CD's</td>
<td>11/1/19</td>
<td>3/13/20</td>
<td></td>
</tr>
<tr>
<td>Bid Package - Early Date</td>
<td>1/10/20</td>
<td>1/17/20</td>
<td></td>
</tr>
<tr>
<td>Subcontractor Bidding (Ideal)</td>
<td>1/20/20</td>
<td>2/14/20</td>
<td></td>
</tr>
<tr>
<td>Set GMP (Assumed needed for March Mobilization)</td>
<td>3/1/2020</td>
<td>3/1/2020</td>
<td></td>
</tr>
<tr>
<td>Bid Package - Late Date</td>
<td>4/1/20</td>
<td>4/10/20</td>
<td></td>
</tr>
<tr>
<td>Subcontractor Bidding (Late)</td>
<td>4/13/20</td>
<td>5/16/20</td>
<td></td>
</tr>
<tr>
<td>Set GMP (Assumed needed for March Mobilization)</td>
<td>6/1/2020</td>
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Procurement

- Potential Early Release - Sitework and Structure: 1/17/20 - 8/3/2020
- MEP's (Bid and Award from %90 CD's): 2/3/20 - 3/13/20
- Envelope (Bid and Award from %90 CD's): 2/3/20 - 3/13/20
- Elevators (Bid and Award from %90 CD's): 3/2/20 - 4/10/20
- Fixtures and Specialties: 5/4/20 - 6/12/20
- Finishes: 6/15/20 - 7/31/20
- Buyout Complete: 8/3/20 - 6/3/20

Construction

- Start of Construction / Mobilize: 2/24/20 - 7/30/2021
- Install Site Fencing: 2/25/20 - 2/27/20
- MEP (Piping): 2/12/20 - 3/12/20

3 Month Delay in setting GMP will likely push construction through end of Fall 2021 Semester.
Procurement – Lessons Learned

1. European Glulam – Design Parameters
2. Building Type – Nuances – NFPA / IBC – Building Type Ratings
3. Connection Hardware Clarifications
4. Shipping – Delivery – Where’s it Coming From?
6. Connections to Concrete & Where is handoff?
Planning Mass Timber - Procurement

Bowdoin College Center for Arctic Studies and Mills Hall
RFP for Mass Timber Design Assist Manufacture, Fabrication and Delivery
Procurement – Clearly Define Delegated Design

Delegated Design services shall be included for all connections and timber elements that will be supplied by the Timber Vendor. Submission of calculations to the engineer of record for review and approval and will be consistent with requirements of original RFP.

1. All loads from Engineer of Record will be provided to Timber engineer for incorporation in calculations for connections and final size verification.

2. Loads will be provided for relieving angle connections indicated on S701 once the exterior veneer system is selected. Horizontal and vertical loads will be provided by the Engineer of Record.

3. Other loads required to complete the design of the Delegated Design Services will be available from the Engineer of Record at the request of the timber supplier.
3. All Roof Framing (beams and truss members) will be required to have a one hour rating. *(The currently drawn double members and trusses do NOT meet this requirement, see below for changes anticipated that are requested to be priced / budgeted to establish a baseline GMP value).*

   a. Roof framing members indicated as (2) 5.125x30 & (2) 5.125x16.5 at the roof of The Center for Arctic Studies will convert to a single solid Glulam as indicated in Sketch attached.

   b. The Ridge Beam indicated as “Wood / Steel Flitch Beam (2) 5.5”x36” Glulam with 1” x 34.5” [steel plate] will either be converted to one of the following options based on the loads indicated on Sketch “2019-11-20 – Ridge Beam Loading…pdf”

      i. Solid glulam element and upsized to accommodate loads.

      ii. Remain as a built-up steel and wood member, but will require embedding the steel plate with a wood layer protecting the steel (shop fabricated and delivered as a solid built up member).

      iii. All beam connections attaching to the ridge beam will be changed to concealed connectors with (1) hour fire protection.
Procurement – Fire Ratings

4. All CLT floor panels are required to carry a 1 hour rating \(\text{(Note that the current sizing shown in the October 18, 2019 DD documents meet this requirement)}\)

5. For baseline proposal purposes, the current 3-ply roof decks will remain as drawn on the October 18, 2019 drawings. If changes occur under this assumption, revisions to pricing and scope will occur during the Design Assist Process.

6. All column splices will be required to maintain a 1 hour rating. Steel splice connections will be eliminated / minimized to the extent possible with recommendations made by Design Assist Timber Vendor. Specifically, connections shown for detail 3 on S800 will be eliminated and columns will be changed to continuous columns.

7. All Beam to Beam, Beam to Column and Column to column connections shall be shop installed and delivered to the job site pre-installed and will be required to maintain a 1 hour rating.
   a. All Connections shall be supplied with any required fire caulking to achieve the rating
Coordination – Mass Timber & MEPs

1.
Coordination – Shear Wall Penetrations
Coordination – CLT Floor Plate Invisible
Summary of Mass Timber Choice at Bowdoin

1. Client has Sustainability Goals for the Project
   - Carbon is a factor in material choices
   - Forest Sustainability is of Importance

2. Timber is a design feature (Exposed Structure is of Importance)

3. Timber Structure can do more than one job
   - Gravity Force Resisting
   - Lateral Force Resisting
   - Finished interior surface
   - Envelope Panel

And COST... Schedule Benefits Are Considered **INCLUDE SCHEDULE IMPACT**
Environmental Perspective
Environmental – Global Warming Potential
Environmental Perspective

1. North America – All Vendors Solicited have SFI Certified
2. German & Austrian Vendor – All offered PEFC Certified
3. Premium for FSC certified wood – ($40K on a $1.5MM Supply)
Environmental Perspective

1. North America – All Vendors Solicited have SFI Certified
2. German & Austrian Vendor – All offered PEFC Certified
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Opinion:
We have the ability to keeping working forests as working forests by sustainably harvesting wood.
Environmental Forests vs. U.S. Population

Environmental Forests vs. U.S. Population

**How Maine’s trees are used**

In 2011, 459 million cubic feet of wood was harvested from Maine forests. Here's how it was used:

- **Pulpwood** (for paper) - 56.5%
- **Sawlogs** (for lumber) - 23.5%
- **Biomass** (for electricity) - 18%
- **Firewood/pellets** (to heat homes) - 2%

*Source: Maine Forest Products Council, 2013 report*
Environmental Perspective