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
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

Mass Timber      Structural Steel
Exposed Timber   AESS Steel
CLT Shear Walls  CMU Shear Walls
Exposed CLT Walls Wood Panels

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

**Bowdoin Mills Hall & Center for Arctic Studies**  
Schematic Design Mechanical Pricing Options - HVAC, Plumbing, FP & Electrical Support  
3/6/2019

#### AHUs, Central Steam and Chiller

<table>
<thead>
<tr>
<th></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><strong>Option 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHUs, Central Steam and Chiller</td>
<td>$55 /SF</td>
<td>$1,214,650</td>
<td>$10,000</td>
<td>$105,500</td>
</tr>
<tr>
<td>Per AHU with pressure independent cooling coil valves</td>
<td>$12,000</td>
<td>$120,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Option 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VRF - Air Cooled Option</td>
<td>$45 /SF</td>
<td>$1,028,750</td>
<td>$76,000</td>
<td>$1,061,800</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
| Geothermal AHUs and Central Steam Backup

<table>
<thead>
<tr>
<th></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><strong>Option 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geothermal AHUs and Central Steam Backup</td>
<td>$70.36 /SF</td>
<td>$1,612,620</td>
<td>$125,000</td>
<td>$1,745,150</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Option 4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VRF - Water Cooled Geo Option</td>
<td>$62 /SF</td>
<td>$1,425,500</td>
<td>$12,500</td>
<td>$1,438,000</td>
</tr>
</tbody>
</table>

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*Note: VRF for air-cooled units with reduced temperature and humidity conditions included in option for pricing purposes.*
Planning Mass Timber - Keys to Success – Cost

### Bowdoin College - A

**SF Cost Model - Summit**

2/4/2019 42,520 sf

<table>
<thead>
<tr>
<th>Description</th>
<th>Total (42,520 SF)</th>
<th>$ / SF</th>
<th>% of Total</th>
<th>Notes / Assumptions</th>
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<tbody>
<tr>
<td>3.01 Structural Steel</td>
<td>97,000</td>
<td>2.28</td>
<td>0.43%</td>
<td>Elevator shafts only, based on square footage for 3 elevators</td>
</tr>
<tr>
<td>3.02 Miscellaneous Metals</td>
<td>257,000</td>
<td>4.87</td>
<td>0.92%</td>
<td>Steel at grade, wood framing above</td>
</tr>
<tr>
<td>3.03 Miscellaneous Metals</td>
<td>230,000</td>
<td>6.82</td>
<td>1.29%</td>
<td>Historic gross square footage costs</td>
</tr>
<tr>
<td>6.01 Wood Framing</td>
<td>1,891,000</td>
<td>44.47</td>
<td>8.43%</td>
<td>All above grade wood framed, based on past projects $50/SF on wood areas</td>
</tr>
<tr>
<td>6.02 Architectural Millwork/Casework</td>
<td>206,000</td>
<td>4.84</td>
<td>0.92%</td>
<td>Historic gross square footage costs (carried higher at auditorium &amp; labs)</td>
</tr>
<tr>
<td>6.03 Waterproofing/Caulking</td>
<td>250,000</td>
<td>5.88</td>
<td>1.11%</td>
<td>$5/SF @ solid exterior walls for AVB plus $2/SF on gross SF for waterproofing throughout</td>
</tr>
<tr>
<td>6.04 Exterior Wall Cladding</td>
<td>1,136,000</td>
<td>26.72</td>
<td>5.07%</td>
<td>65% the exterior skin square footage @ $60/SF</td>
</tr>
<tr>
<td>6.05 Roofing &amp; Sheet Metal</td>
<td>280,000</td>
<td>6.59</td>
<td>1.25%</td>
<td>$17/SF across the flat roof square footage since sloping unknown</td>
</tr>
<tr>
<td>6.06 Fireproofing</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>6.05 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>6.06 Doors, Frames, Hardware</td>
<td>137,000</td>
<td>3.22</td>
<td>0.31%</td>
<td>Historic gross square footage costs ($3.22 per gross square footage)</td>
</tr>
<tr>
<td>6.07 Curtain Walls, Windows, Storefront</td>
<td>1,163,000</td>
<td>27.35</td>
<td>5.19%</td>
<td>20% curtainwall @ $120/SF &amp; 15% punched windows @ $65/SF</td>
</tr>
<tr>
<td>6.08 Interior Aluminum, Glass &amp; Glazing</td>
<td>213,000</td>
<td>5.01</td>
<td>0.95%</td>
<td>Historic gross square footage costs ($5 per gross square footage)</td>
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<tr>
<td>6.01 Drywall</td>
<td>597,000</td>
<td>90.74</td>
<td>2.19%</td>
<td>Historic gross square footage costs (carried higher at auditorium)</td>
</tr>
</tbody>
</table>
### 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

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#### Bowdoin C. Unified Science Hall & Center for Arctic Studies

**1/30/2020 DR BP-1 Early Rel**

<table>
<thead>
<tr>
<th>Task Description</th>
<th>DD w/ VE, Distributed DC + Escalation</th>
<th>BP-1 GMP Value 1/30/2020</th>
<th>BP-1 Variance</th>
<th>MEPFP Budget</th>
<th>GMP Budget</th>
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<tr>
<td>03-30</td>
<td></td>
<td>1,671,397</td>
<td>1,812,366</td>
<td>140,969</td>
<td>1,812,366</td>
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<td>04-20</td>
<td></td>
<td>1,396,994</td>
<td>1,396,994</td>
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<tr>
<td>05-12</td>
<td></td>
<td>242,552</td>
<td>216,900</td>
<td>(25,652)</td>
<td>216,900</td>
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<tr>
<td>05-50</td>
<td></td>
<td>433,111</td>
<td></td>
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<tr>
<td>06-10</td>
<td></td>
<td>80,206</td>
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<tr>
<td>06-13</td>
<td></td>
<td>2,160,070</td>
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<tr>
<td>06-25</td>
<td></td>
<td>482,928</td>
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<tr>
<td>07-10</td>
<td></td>
<td>176,665</td>
<td>183,300</td>
<td>6,635</td>
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<tr>
<td>07-41</td>
<td></td>
<td>1,274,445</td>
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</table>

**Total:** $2,160,070
# 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>2/1/2019</td>
<td>8/1/2020</td>
</tr>
<tr>
<td>Schematic Design</td>
<td></td>
<td>2/1/19</td>
<td>4/30/19</td>
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<tr>
<td>SD Pricing</td>
<td></td>
<td>5/1/19</td>
<td>5/31/19</td>
</tr>
<tr>
<td>Design Development</td>
<td></td>
<td>6/3/19</td>
<td>9/27/19</td>
</tr>
<tr>
<td>Site Test Films and Suitability</td>
<td></td>
<td>7/1/18</td>
<td>7/12/19</td>
</tr>
<tr>
<td>DD Pricing</td>
<td></td>
<td>10/1/19</td>
<td>10/31/19</td>
</tr>
<tr>
<td>Value Management (TBD)</td>
<td></td>
<td>10/12/19</td>
<td>2/14/20</td>
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<tr>
<td>CD’s</td>
<td></td>
<td>11/1/19</td>
<td>3/13/20</td>
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<tr>
<td>Bid Package - Early Date</td>
<td></td>
<td>1/10/20</td>
<td>1/17/20</td>
</tr>
<tr>
<td>Subcontractor Bidding (Ideal)</td>
<td></td>
<td>1/20/20</td>
<td>2/14/20</td>
</tr>
<tr>
<td>Set GMP (Assumed needed for March Mobilization)</td>
<td></td>
<td>3/1/2020</td>
<td>3/1/2020</td>
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<tr>
<td>Bid Package - Late Date</td>
<td></td>
<td>4/1/20</td>
<td>4/10/20</td>
</tr>
<tr>
<td>Subcontractor Bidding (Late)</td>
<td></td>
<td>4/13/20</td>
<td>5/15/20</td>
</tr>
<tr>
<td>Set GMP (Assumed needed for March Mobilization)</td>
<td></td>
<td>5/1/2020</td>
<td>5/1/2020</td>
</tr>
<tr>
<td>Procurement</td>
<td></td>
<td>1/17/2020</td>
<td>8/3/2020</td>
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<tr>
<td>Potential Early Release - Stainwork and Structure</td>
<td></td>
<td>1/17/20</td>
<td>2/14/20</td>
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<tr>
<td>MEP’s (Bid and Award from 10% CD’s)</td>
<td></td>
<td>2/3/20</td>
<td>3/13/20</td>
</tr>
<tr>
<td>Envelope (Bid and Award from 90% CD’s)</td>
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<td>2/3/20</td>
<td>3/13/20</td>
</tr>
<tr>
<td>Elevators (Bid and Award from 90% CD’s)</td>
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<td>3/2/20</td>
<td>4/10/20</td>
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<tr>
<td>Fixtures and Specialties</td>
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<td>5/4/20</td>
<td>6/12/20</td>
</tr>
<tr>
<td>Finishes</td>
<td></td>
<td>6/15/20</td>
<td>7/31/20</td>
</tr>
<tr>
<td>Buyout Complete</td>
<td></td>
<td>8/3/20</td>
<td>8/3/20</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td>2/24/2020</td>
<td>7/30/2021</td>
</tr>
<tr>
<td>Start of Construction / Mobilize</td>
<td></td>
<td>1</td>
<td>2/24/20</td>
</tr>
<tr>
<td>Install Site Fencing</td>
<td></td>
<td>2</td>
<td>2/25/20</td>
</tr>
<tr>
<td>MEP Coordination</td>
<td></td>
<td>3</td>
<td>2/27/20</td>
</tr>
</tbody>
</table>

- **2019**
- **2020**

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?
Bowdoin College Center for Arctic Studies and Mills Hall
RFP for Mass Timber Design Assist Manufacture, Fabrication and Delivery

**Planning Mass Timber - Procurement**

The scope of your proposal shall not and premise be completed the following information.

**Objective:**

To develop a design and construction project for the Center for Arctic Studies and Mills Hall at Bowdoin College. The project will involve the design and construction of a new facility that will serve as a center for Arctic studies and a residence hall for students. The facility will be designed to be energy-efficient and sustainable, with a focus on mass timber construction. The purpose of the project is to create a world-class facility that will serve as a hub for Arctic research and education.

**Proposed Site:**

The project will be located on the campus of Bowdoin College, in Brunswick, Maine. The site is adjacent to the center's existing buildings and provides a suitable location for the construction of a new facility.

**Project Description:**

The project will involve the design and construction of a new facility that will serve as a center for Arctic studies and a residence hall for students. The facility will be designed to be energy-efficient and sustainable, with a focus on mass timber construction. The purpose of the project is to create a world-class facility that will serve as a hub for Arctic research and education.

**Proposed Scope:**

The project will include the following components:

- Design and construction of a new facility
- Site preparation
- Construction of a new facility
- Site restoration

**Proposed Timeline:**

The project is expected to be completed within 18 months from the date of award. The project will be managed in accordance with the project schedule outlined in the proposal.

**Budget:**

The budget for the project is anticipated to be $10 million. The budget will include all costs associated with the design, construction, and delivery of the facility.

**Proposal Requirements:**

Proposals must be submitted in accordance with the RFP requirements. The proposal should include the following components:

- Project overview
- Design approach
- Construction approach
- Cost proposal
- Schedule proposal
- Quality assurance plan
- Safety plan
- Environmental impact statement
- Social impact statement

Proposals must be submitted by 5:00 PM on October 1, 2023. All proposals must be submitted electronically to the project team at the email address provided in the RFP.

**Contact Information:**

Bowdoin College
155 North Street
Brunswick, ME 04011

Email: ProjectTeam@Bowdoin.edu

Phone: 207-725-3000

**Notes:**

- The project is expected to be completed within 18 months from the date of award.
- The project will be managed in accordance with the project schedule outlined in the proposal.
- All proposals must be submitted electronically to the project team at the email address provided in the RFP.

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**Concerns and Questions:**

Any concerns or questions regarding the RFP should be directed to the Project Team at 207-725-3000 or ProjectTeam@Bowdoin.edu.

**Closing Date:**

October 1, 2023

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**Proposals must be submitted in accordance with the RFP requirements.**

---

**Proposals must be submitted by 5:00 PM on October 1, 2023.**

---

**All proposals must be submitted electronically to the project team at the email address provided in the RFP.**
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 *(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
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

Legend
- Net value (impacts + credits)
- Floors
  - 6F (6th Floor)
  - 5F (5th Floor)
  - 4F (4th Floor)
  - 3F (3rd Floor)
  - 2F (2nd Floor)
  - 1F (1st Floor)
  - CFT (Cold-Formed Steel)
- Structure
  - Steel Joists
  - Steel Beams
  - Concrete Beams
  - Concrete Slabs
- Wals
  - Metal Studs
  - Steel Studs
  - Concrete Slabs

Graph showing environmental impacts and credits for various building materials.
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
3. Premium for FSC certified wood – ($40K on a $1.5MM Supply)

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