Local Mass Timber: A Paradox

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Northeast Sustainable Energy Association (NESEA)
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PRESENTERS

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AGENDA

What is Mass Timber?

Case Study: Bowdoin College Mills Hall & Center for Arctic Studies

Timber: Sourcing, Benefits & Constraints

Results at Bowdoin

Questions
LEARNING OBJECTIVES

Measure the benefits of mass timber structures in relation to embodied carbon in new building design, compared to other structural systems.

Describe the alignment of a college’s core educational and research mission on climate, environment, and human activities for specific building projects.

Define the current constraints to local sourcing and fabrication of mass timber structural components.

Evaluate possibilities for establishing future localized industry with renewable forestry resources.
WHAT IS MASS TIMBER?

Mass timber consists of structural members formed by combining laminations of multiple layers of dimensional lumber into panels, which achieves greater strength than traditional dimensional lumber.

History

- 1985 – 1st CLT patent (France)
- 1993 – 1st CLT projects (Switzerland and Germany)
- 1998 – 1st multi-story project (Austria)
- Early 2000s – widespread use in Europe
BENEFITS

Environmental Impact
• Reduced embodied energy
• Reduced carbon emissions
• Positive impacts on forest health

Construction Flexibility
• Reduced construction time
• Reduced building weight
• Proven fire resistance

Occupant Wellbeing
• Improved interior air quality
• Good response to humidity control
• Acoustic properties
• Aesthetics
• Reduced stress levels in building occupants
Wood can be burned for clean energy

Forests absorb CO₂ from the atmosphere via photosynthesis

Trees are a renewable resource and store carbon

Wood products can be reused or recycled to create new products

Manufacturing processes typically use all parts of the log, producing no waste and little pollution

Timber buildings store carbon in their structures for the period of their maintained life
CONSTRUCTION FLEXIBILITY | PROVEN FIRE RESISTANCE

**Figure 1-1** Reduction in member breadth and depth over time, $t$
OCCUPANT WELLBEING | AESTHETICS+
BOWDOIN COLLEGE

- **Project Name:** Barry Mills Hall | John & Lile Gibbons Center for Arctic Studies
- **Location:** Brunswick, ME
- **Size:** 2 Buildings | 50,000 SF
- **Program:** Museum, Event Space, Classroom, Offices
- **Construction Type:** V-A
In June 2007, Bowdoin joined 270 colleges and universities in signing the American College and University Presidents’ Climate Commitment, pledging to achieve carbon neutrality by 2020.

In April of 2018, carbon neutrality was achieved two years ahead of schedule, making Bowdoin only the third college in the country to have fulfilled its commitment.
Arctic Studies

- 4 million people, living in 8 nations
- Sensitive marine and terrestrial ecosystems
- Rich in natural resources
- Feeling the effects of global warming, pollution, colonization, and globalization
INSPIRED BY THE ARCTIC

THE ROOSEVELT

HUBBARD SLEDGE
NET CARBON EMISSIONS

PROCESS EMISSIONS LESS CARBON STORED

-2 -1 0 1 2 3

kg CO₂e/kg

FRAMING LUMBER
CLT
MASONRY
STEEL (RECYCLED)
PORTLAND CEMENT
STEEL (VIRGIN)
LIFE CYCLE ANALYSIS | THE CARBON CYCLE

Steel

- Steel Beams and Trusses: 28,470 kgCO2eq
- Steel Columns: 4,750 kgCO2eq
- Concrete Footings: 9,820 kgCO2eq
- Laminated Timber Decking: 560 kgCO2eq
- Composite Floor Slab w/ Concrete Topping: 30,525 kgCO2eq
- Concrete Slab on Grade: 9,820 kgCO2eq
- Concrete Foundation Walls: 9,630 kgCO2eq

Comprehensive Structure: 92,455 kgCO2eq
Superstructure: 63,185 kgCO2eq

Mass Timber

- Cross-laminated Timber Roof Panel: 4,925 kgCO2eq
- Cross-Laminated Timber Floor Panel w/ Concrete Topping: 2,660 kgCO2eq
- Concrete Slab on Grade: 9,820 kgCO2eq
- Concrete Footings: 9,820 kgCO2eq
- Glulam Timber Beams and Trusses: -7,320 kgCO2eq
- Glulam Timber Columns: -1,455 kgCO2eq
- Concrete Foundation Walls: 9,630 kgCO2eq

Comprehensive Structure: 18,230 kgCO2eq
Superstructure: -11,040 kgCO2eq
NET CARBON EMISSIONS

Steel: 92,455 kg CO₂eq
Wood: 18,230 kg CO₂eq

Steel: 5 X CO₂eq
Wood: 1 X CO₂eq

Legend
- Net value (impacts + credits)

Design Options
- Option 1 - STEEL
- Option 2 - WOOD (primary)

Divisions
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites

Tally LCA App for Revit
“Cambridge in England has its willows, Oxford its osiers and we have our pines.”

-Bowdoin College Peucinian Society
KEYS TO SUCCESS

• Early Goal Setting Involving Owner/Designer/Contractor

• Structural System Aligned with Project Goals

• Early Procurement – Timber Vendor selection

• Early Coordination Completed prior to CDs
EARLY CM INVOLVEMENT

• Construction Manager engaged simultaneously with Designer

• Designer & CM Involved in Project Goal Setting
# KEYS TO SUCCESS

## Task Description

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Duration</th>
<th>Plan Start</th>
<th>Plan End</th>
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</thead>
<tbody>
<tr>
<td><strong>Design / Preconstruction</strong></td>
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<td>2/1/2019</td>
<td>6/1/2020</td>
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<td>Schematic Design</td>
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<td>4/30/19</td>
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<td>2/14/20</td>
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## Procurement

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## Construction

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*3 Month Delay in setting GMP will likely push construction through end of Fall 2021 Semester*
EVALUATION OF SCHEDULE & SYSTEMS

Mass Timber
- Exposed Timber
- CLT Shear Walls
- CLT Walls – Finished surfaces
- Single Trade Sequencing

VIMEO Link

Structural Steel
- AESS Steel or Column Wraps
- CMU Shear Walls
- Millwork Wall Panels
- Six Trades in Sequence

Local Link
LARGER COST FACTORS IN DESIGN

TRADE COST TOTAL 24,909,550

- Site / Landscaping: 2,550,839 (10%)
- Electrical: 2,570,733 (10%)
- HVAC & Plumbing: 4,458,352 (18%)
- Fire Protection/Proofing: 512,325 (2%)
- Elevators: 453,750 (2%)
- Concrete & Steel: 2,735,830 (11%)
- Glulam & CLT: 2,489,569 (10%)
- Envelope: 4,892,329 (20%)
- Interiors & Finishes: 4,245,819 (17%)
LOCAL SOURCING CONSTRAINTS

- Closest Manufacturer of CLT: Nordic – Chibougamau, Quebec (560 miles)
- Closest Manufacturer of Glulam: Unalam – (388 miles)
- Closest Fabricator of Glulam: South County Post & Beam (230 miles)
  Limitations: Less than 4’ wide fabrication

RFP for Design Assist to (5) manufacturers
(2) independent Fabricators / Integrators
INTERNATIONAL PROCUREMENT

• European Glulam – Conversion
  • Engineering Responsibility
• Connection Hardware Clarifications / Ownership
• Escalation Risk Management
• Supply Chain Understanding – Who is doing what
  • Manufacturing / Fabrication / Logistics Planning

New Lessons Learned: Containers/Port Selection
## GLOBAL SHIPPING CONTAINER SHORTAGE

### CONTAINERS - "RORO" / BREAK BULK

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<th>SCPB Load Reference</th>
<th>SCPB Delivery Sequence</th>
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<th>DBS No.</th>
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<td>GLULAM 1</td>
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Random Lengths Weekly Report

Combined Random Lengths graphs (7/30/21 & 1/7/22)

WEEK OF 2/22/2022: $1,325 / THOUSAND BF
RESULTS AT BOWDOIN

• How did it go? Expectations / Reality

• No, really, how did it go? Side by side

Local Side by side
RESULTS
HOW TO TRULY LOCALIZE
HOW TO TRULY LOCALIZE

• Less Costly Capital Cost Equipment

• Stabilization of Lumber Cost

• Supply Chain Maturity

• Market – Sufficient Demand
  • Additional Manufacturing Choices
  • Additional Fabricator Options
  • More Experienced CMs