CLT & Mass Timber Opportunities

Glulam & CLT

Cross Laminated Timber

Nail Laminated Timber
Who am I

• UMaine Civil Grad., Umass, B.U.

• Practiced Structural Engineering ‘95-’02

• Construction from ‘02 – today
  – Consigli Construction Co., Inc. – Northern N.E.
    • Academic, Healthcare, Laboratory, Institutional, Government
Other Wood Based Components

- Lockdeck
- Structural Insulated Panels (SIPS)
- Laminated Strand Lumber (LSL)
Motivation

Construction Managers always looking for:

1. Environmentally responsible
2. Safe to work with
3. Fast / Efficient to erect
   a) (low on-site labor cost)
4. Positive thermal, acoustic performance, durable
5. Aesthetically pleasing (or easy to cover up)
6. Uniform and or known capacity / strength
7. Available subcontractor market able to construct
8. Readily available from multiple vendors/fabricators
9. Cost competitive material to build structures
10. Unlimited restrictions or a predictable code path
Wood – What it has going for it

Opinion – Equal/better than Steel & Concrete

1. Environmentally responsible
2. Safe to work with
3. Fast / Efficient to erect
   a) (low on-site labor cost)
4. Positive thermal, acoustic performance, durable
5. Aesthetically pleasing (or easy to cover up)
6. Uniform and or known capacity / strength
Mass Timber – Limitations

1. Available Field Installers / Erectors
2. Available from local fabricators
3. Perceived Fire Durability
4. Limited Design knowledge
5. Flexibility / Not Economical long spans
6. Not cost competitive in light commercial / low rise
7. Lobbying from Steel and Concrete Industry?
8. Building Code Constraints specifically on height
Mass Timber – Easy Hurdles

1. Available Field Installers / Erectors
2. Available from local fabricators
3. Perceived Fire Durability
4. Limited Design knowledge
5. Flexibility / Not economical long spans
Mass Timber – Harder Hurdles

1. Not cost Competitive in light commercial / low rise
   Easy – don’t compete against stick frame

2. Lobbying from Steel and Concrete Industry?
   Not my Expertise

3. Building Code Constraints specifically on height?
   Need your Energy
Mass Timber Opportunities in Maine

1. European Market has figured it out
2. Plentiful SPF #2 or better stock
3. Existing Value Chain – Logging, Processing, lumber
4. Location - LEED

500 miles New York
500 miles Boston
Cost Case Study

• Higher Education Classroom and light laboratory building in Southern Maine

• Compared Structural Systems

• Compared Solid Exterior Wall Backup Framing Systems
Superstructure Comparison

Compared Costs and Environmental Impact across three Superstructure Schemes

• Base Case: Steel Beams, Steel Columns, Concrete floors on metal deck, metal roofdeck

• Glu-laminated Timber Beams, Columns with solid plank wood floor and plank roof plates

• Glu-laminated Timber Beams, Columns with Cross Laminated Timber floor and roof plates
Exterior wall comparison

• Base Case: Light Gauge metal framed exterior walls with glass fiber gypsum sheathing

• Cross Laminated Timber (CLT)

• Structural Insulated Panels (SIPs)

• Laminated Strand Lumber (LSL)
Terminology – Base Case

- Structural Steel / Metal Deck and Concrete slab
Terminology – Alternate Schemes

- Glu-Laminated Timber
- Cross Laminated Timber (CLT)
- Laminated Strand Lumber (LSL)
Terminology – Base Case

- Light Gauge Metal Framed Exterior Walls
  - With glass fiber reinforced gypsum sheathing
Evaluation of Costs

• Structural Engineer provided (3) Designs

• Developed Control Baseline for Steel & Concrete option
  – Quantified and costed on historical costs
  – Subcontractor pricing - (2) Steel Fab/Erectors

• Developed Matrix of Costs for Timber
  – Varied Supply only options from various vendors with installer pricing
  – Developed Self Perform Estimates for scopes proposed as Supply only
  – Evaluated Best Option / Combination (cost)
## Responses Mass Timber

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Location</th>
<th>Status</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>South County Post &amp; Beam</td>
<td>Rhode Island</td>
<td>Submitted</td>
<td>Fab &amp; Install – Glulam Install only – CLT</td>
</tr>
<tr>
<td>Libby Timber Frame</td>
<td>Freeport, ME</td>
<td>Declined</td>
<td>N/A</td>
</tr>
<tr>
<td>Nordic</td>
<td>Quebec</td>
<td>Submitted</td>
<td>Fab &amp; Install Glulam and CLT</td>
</tr>
<tr>
<td>Smartlam</td>
<td>Montana</td>
<td>Submitted</td>
<td>Fab &amp; Deliver CLT</td>
</tr>
<tr>
<td>Structurlam</td>
<td>Ontario</td>
<td>Submitted</td>
<td>Fab &amp; Deliver Glulam &amp; CLT</td>
</tr>
<tr>
<td>DR Johnson</td>
<td>Oregon</td>
<td>Submitted</td>
<td>Fab &amp; Deliver Glulam &amp; CLT</td>
</tr>
<tr>
<td>Louisiana Pacific</td>
<td>Houlton, ME</td>
<td>Submitted</td>
<td>Fabricate LSL Billets</td>
</tr>
<tr>
<td>Guardian Structures</td>
<td>Ontario</td>
<td>Pending</td>
<td>waiting</td>
</tr>
<tr>
<td>Mayr Melnhof Holz</td>
<td>Germany</td>
<td>Submitted</td>
<td>Fab &amp; Deliver Glulam &amp; CLT</td>
</tr>
<tr>
<td>KLH</td>
<td>Austria</td>
<td>Submitted</td>
<td>Fab &amp; Deliver Glulam &amp; CLT</td>
</tr>
<tr>
<td>Binderholz</td>
<td>Germany</td>
<td>Submitted</td>
<td>Fab &amp; Deliver Glulam &amp; CLT</td>
</tr>
<tr>
<td>Stora Enso</td>
<td>Germany</td>
<td>Declined</td>
<td>N/A</td>
</tr>
</tbody>
</table>
## Cost Summary / Combination

### Structural and Concrete

<table>
<thead>
<tr>
<th>Vendor Combination</th>
<th>Baseline Structural Steel Option A</th>
<th>STEEL</th>
<th>MASS TIMBER</th>
<th>MASS TIMBER</th>
<th>MASS TIMBER</th>
<th>COPY OF PREV. COIL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steel Marketplace</td>
<td>$70,643</td>
<td>$70,643</td>
<td>$70,643</td>
<td>$70,643</td>
<td>$70,643</td>
</tr>
<tr>
<td></td>
<td>2nd Floor Framing and Deck</td>
<td>$311,291</td>
<td>$311,291</td>
<td>$311,291</td>
<td>$311,291</td>
<td>$311,291</td>
</tr>
<tr>
<td></td>
<td>3rd Floor / Low Roof Framing and Deck</td>
<td>$236,957</td>
<td>$236,957</td>
<td>$236,957</td>
<td>$236,957</td>
<td>$236,957</td>
</tr>
<tr>
<td></td>
<td>Glulamized Timber Supply</td>
<td>$380,000 incl. above</td>
<td>$380,000 incl. above</td>
<td>$440,000 incl. above</td>
<td>$480,000 incl. above</td>
<td>$480,000 incl. above</td>
</tr>
<tr>
<td></td>
<td>Glulamized Timber Install</td>
<td>$250,000 incl. above</td>
<td>$250,000 incl. above</td>
<td>$330,000 incl. above</td>
<td>$330,000 incl. above</td>
<td>$330,000 incl. above</td>
</tr>
<tr>
<td></td>
<td>Floor Deck / Roof Deck Product Supply (industrial finish/fused)</td>
<td>$183,276 incl. above</td>
<td>$183,276 incl. above</td>
<td>$183,276 incl. above</td>
<td>$183,276 incl. above</td>
<td>$183,276 incl. above</td>
</tr>
<tr>
<td></td>
<td>Floor Deck / Roof Deck Product Inst</td>
<td>$183,276 incl. above</td>
<td>$183,276 incl. above</td>
<td>$183,276 incl. above</td>
<td>$183,276 incl. above</td>
<td>$183,276 incl. above</td>
</tr>
<tr>
<td></td>
<td>Steel Wall Supply and Install at Stair Towers (industrial finish / non-fused)</td>
<td>$8,000 incl. above</td>
<td>$8,000 incl. above</td>
<td>$8,000 incl. above</td>
<td>$8,000 incl. above</td>
<td>$8,000 incl. above</td>
</tr>
<tr>
<td></td>
<td>Safety Rails at perimeter of floors</td>
<td>$40,694 incl. above</td>
<td>$40,694 incl. above</td>
<td>$40,694 incl. above</td>
<td>$40,694 incl. above</td>
<td>$40,694 incl. above</td>
</tr>
<tr>
<td></td>
<td>Temporary protection for concrete and construction on exposed wood</td>
<td>$7,586 incl. above</td>
<td>$7,586 incl. above</td>
<td>$7,586 incl. above</td>
<td>$7,586 incl. above</td>
<td>$7,586 incl. above</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>$754,816</td>
<td>$754,816</td>
<td>$997,358</td>
<td>$997,358</td>
<td>$997,358</td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
<td>$22,663</td>
<td>$22,663</td>
<td>$22,663</td>
<td>$22,663</td>
<td>$22,663</td>
</tr>
<tr>
<td></td>
<td>Total Anticipated Cost of Superstructure System</td>
<td>$777,480</td>
<td>$777,480</td>
<td>$997,358</td>
<td>$997,358</td>
<td>$997,358</td>
</tr>
</tbody>
</table>

### Carbon Comparison

<table>
<thead>
<tr>
<th>Wall Panel Material Vendor</th>
<th>IN Progress</th>
<th>IN Progress</th>
<th>IN Progress</th>
<th>IN Progress</th>
<th>IN Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior wall LCM Wall system</td>
<td>$188,315 incl. above</td>
<td>$213,500 incl. above</td>
<td>$117,604 incl. above</td>
<td>$117,604 incl. above</td>
<td>$117,604 incl. above</td>
</tr>
<tr>
<td>Wall Panel Material Source</td>
<td>$249,000 incl. above</td>
<td>$249,000 incl. above</td>
<td>$240,000 incl. above</td>
<td>$372,613 incl. above</td>
<td>$372,613 incl. above</td>
</tr>
<tr>
<td>Exterior Wall System (solid walls)</td>
<td>$1,205,794</td>
<td>$1,520,939</td>
<td>$1,424,118</td>
<td>$1,387,470</td>
<td>$1,369,970</td>
</tr>
<tr>
<td>Total of Structural System and Exterior Solid Walls (No finishes)</td>
<td>$751,174</td>
<td>$718,187</td>
<td>$181,685</td>
<td>$144,186</td>
<td>$164,186</td>
</tr>
<tr>
<td>Baseline from Baseline Structure and Envelope option</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Environmental Analysis

• Woodworks Environmental Calculator
• Athena Software

• Results: Carbon Sequestration – show of hands….
• GHG significantly lower ~ (45%) less
Cost Comparison Process

• Exterior Solid Walls – LGM
  – Quantified and costed on historical costs
  – Labor and Material priced based on performing

• Exterior Solid Walls – Wood (or composite)
  – Quantified and costed on self perform install
  – Analyzed LSL, SIPS, CLT
Best Current Combination

Superstructure – Glulam Timbers
  Douglas Fir from Oregon
  or Spruce from Austria
Floor Plates – Cross Laminated Timbers
  Spruce from Montana
  or Spruce from Austria
Exterior Solid Walls – Options Pending Technical Quest.
  SIPs from New Hampshire
  Laminated Strand Lumber from Maine
Results

- Sourcing of wood combinations – HARDER
- Cost of wood combination – More
  - By 24% on structure alone compared to steel, concrete structure
  - By 6% on structure if Lateral system is combined with exterior solid wall design
  - By 0.7% on total cost on $11MM project

- Environmental Impact of wood - Better
Superstructure Alone Cost Result

Baseline Combination
Steel, Concrete, metal deck: $777,500

Best Mass Timber Combination
Glulam and CLT: $997,400
(Oregon Glulam, Montana or Austria CLT)

2nd Best Mass Timber Combination
Glulam & LSL Floors: $1,050,000
(Oregon Glulam, Maine LSL)
## Environmental Result

### Baseline Combination
- **Steel, Concrete, metal deck:** XXX Tons C

### Best Mass Timber Combination
- **Glulam and CLT:** XXX Tons C
  - (Oregon Glulam, Montana CLT) xxxxx cuft miles

### 2nd Best Mass Timber Combination
- **Glulam & LSL Floors:** XXX Tons C+
  - (Oregon Glulam, Maine LSL) xxxxx cuft miles
Sacrifices using Mass Timber

• Could have cost premium to steel & conc. (on this cost study)
• Space planning flexibility column density
• Does not maintain cost neutral position if
  – Space planning controls layout
  – High mechanical / ductwork complexity (laboratory facilities)
  – Stick frame becomes an option

• Smaller market from which to buy
• Lack of knowledge of detailing in design community
• Lack of confidence across Construction Management and GC market – (its easier to buy steel)
Conclusions

- Wood can be competitive – with the right design, construction building type and client.
- Limited slice of construction market where it can work against stick framing and steel.
- Shipping cost premium is smaller driver than anticipated.
- Without a local vendor or larger market from which to buy – more risk than established products.
- Play environmental card after finding cost neutrality.
- Code Limitations are one of largest hurdles.
IBC 2012 – Height Limitations

IBC Table 503: Base Height

IBC Section 504: NFPA 13-Compliant Sprinkler System
Can go higher with IBC’s Alternative Materials, Designs, and Methods of Construction (IBC Section 104.11).
Next Steps

- Work on Building Code Lobby
- Focus on competing against Structural Steel and Concrete buildings
- Educate the design community – Woodworks!
- Drive costs down for fabrication and shipping
- Generate confidence in Construction Managers
- Fabricator of CLT (and Glulam?) in Maine