Cross Laminated Timber

The Market Opportunities in North America

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By: Ben Toosi
Cross Laminated Timber (CLT)

- CLT is a wood alternative to concrete slab
- New flexible building system
- Marriage of Glulam and Plywood
- Can utilize material of various dimensions from 1”x1” to ……
- CLT has been successfully used in Europe
- Potential drivers are:
  - Lack of skilled labor for in-site construction
  - Design flexibility
  - Environmental advantages
Outline

• Manufacturing costs
• Competitiveness
• Market opportunity
• Final remarks
• Detailed Feasibility Analysis
  ▪ large CLT Plant
  ▪ Producing 2 panel types (3-ply 107mm/4.2in thick, 5-ply 178mm/7in thick, 3 x 8 m)
  ▪ Parameters:
    • Capital
    • Labor
    • Energy
    • Material (wood 2x6, adhesive)
    • Delivery
    • Others: yield, residues, packaging
Manufacturing Costs

Variable Cost of CLT (Simulated, September 2010)

- KD W SPF 2&Btr, 2x6: $300/MBF
- Reman+Drying: $100/MBF => $400/MBF
- Glue: PUR: $8.8/kg($19.4/lb)
- Reman factor: 85% (yield)
- Plant Output: 1.4 million cubic feet
- Capital cost $30 million

Total cost: 20 $/ft^3

All dollar values are in US currency
• Manufacturing Costs
• Competitiveness
• Market Opportunity
• Final Remarks
Savings in Construction Time

Minimum assembly time at the building site because of its prefabricated elements
Savings in Construction Time

- Residential, 1st concrete + 8CLT floors
- London, England
- Crew: 4 Carpenters
- Construction of the shell: 3 days per floor
- 22 weeks time saving by choosing CLT over concrete
Tremendous environmental virtues: Preliminary Side by Side CO₂ Comparison: CLT vs. Concrete

- Preliminary side by side comparison:
- 6-storey¹ apartment building: CLT vs. Concrete

Summary Table:

<table>
<thead>
<tr>
<th>Metric tons CO₂ Equivalent to annual emissions of LCA: CLT vs Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings by switching concrete to CLT</td>
</tr>
<tr>
<td>Sequestered in the CLT</td>
</tr>
<tr>
<td>Total GHG benefit</td>
</tr>
</tbody>
</table>

Sequestered: .75 ton/m³
Displacement: .36 ton/m³

¹ 1,300 m³ of CLT

Source: Energy & Environment Program, FPInnovations, September 2009, based on glulam parameters
2. Competitiveness Analysis: Apartments

- Side by side cost appraisal: CLT vs. Non-wood & LWF
  - Same footage by assembly (elevated floors, ext. walls, roof, partitions)
  - Comparison at shell level (superstructure). Finishes assumed constant.
  - CLT configuration based on best practices* (thickness, finishes). Shafts incl.
  - CLT delivered price: Cost+25%+connectors+erection
Competitiveness Analysis: Industrial Structures

- Manufacturing plants
- Big box retail
- Self storage
Outline

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Market Opportunity

- Two market penetration scenarios (5%, 15%)
- Additions: 15% of floor area
- Canada demand was assumed at 7% of US demand
Market Opportunity

**• Up to 2x Lumber (Nonres)**

**• 1+ million metric tons avoided CO₂**

**• At 15% penetration, $4.5 billion CLT sales**

**• 3+ million metric tons stored CO₂ = annual emissions of 800,000+ cars**

**• 20-60 large manufacturing plants**

<table>
<thead>
<tr>
<th>Storey class</th>
<th>Floor area (Million ft²)</th>
<th>CLT (Million m³)</th>
<th>Lumber (BBF)</th>
<th>Shell Value ($ Billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5%</td>
<td>15%</td>
<td>5%</td>
<td>15%</td>
</tr>
<tr>
<td>Low-rise (1 to 4)</td>
<td>52</td>
<td>156</td>
<td>0.9</td>
<td>2.7</td>
</tr>
<tr>
<td>Mid-rise (5 to 10)</td>
<td>16</td>
<td>48</td>
<td>0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Total</td>
<td>68</td>
<td>204</td>
<td>1.2</td>
<td>3.6</td>
</tr>
</tbody>
</table>

*Note: The Canadian market can be estimated at 5 to 10% of the US market on a floor area basis.*
Market Opportunity at 5% Penetration (000 ft³) by Metro Area
Outline

- Manufacturing Costs
- Competitiveness
- Market Opportunity
- Final Remarks
Final Remarks

• Savings in Construction Time
  • Faster capital turnaround

• Other benefits
  • Safe construction
  • Less errors
  • Quiet construction
  • Less waste
  • Carbon economy

• Exciting Wood building system contender for concrete
• Creating new opportunities to use wood systems in areas dominated by other non wood materials
## Summary Scorecard

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Size</td>
<td>0.8 to 2.4 billion bf market (5%-15% market penetration)</td>
</tr>
<tr>
<td>Cost Competitive</td>
<td>+- 5-10% compared to steel/concrete</td>
</tr>
<tr>
<td>Structural Capacity</td>
<td>Examples up to 9 storeys. Need to confirm seismic test results</td>
</tr>
<tr>
<td>Fire Performance</td>
<td>European products rated up to 1.5 hrs. Expect 2hrs possible. Fire testing required</td>
</tr>
<tr>
<td>Thermal Performance</td>
<td>Better than concrete.</td>
</tr>
<tr>
<td>Acoustic Performance</td>
<td>Equivalent to concrete</td>
</tr>
<tr>
<td>Environmental Impact</td>
<td>Better than concrete.</td>
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<tr>
<td>Fits with NLGA lumber</td>
<td></td>
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</tbody>
</table>
CLT Literature

Cross Laminated Timber: a Primer
Edited by: Fabio Crespi and Sylvain Gagnon

FPInnovations
THANK YOU!

Questions?