MASS TIMBER: CONSTRUCTION CONSIDERATIONS

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

• Procurement
• Design Coordination
• Construction Considerations
• Cost Analysis
Procurement
Supply Chain
Manufacturer Selection

- Domestic vs. International Sourcing
- Varying Panel Fabrication Size Limits
- Engineering Support to Optimize Column Grid
- Panel Width Shipping Constraints – Land vs. Sea
- Proximity to Jobsite / Shipping Costs
- Supplier Only vs. Turn-Key
- Sustainability – FSC vs. SFI Certification
- Aesthetic Considerations
- Wood Species & Stains
CLT Layup Combinations

NORDIC X-LAM CROSS-LAMINATED TIMBER

Nordic X-Lam cross-laminated timber is made of at least three orthogonal layers of graded sawn lumber that are laminated by gluing with structural adhesives.

SLABS AND PANELS

Layup combinations:
- 89-3s
- 105-3s
- 143-5s
- 175-5s
- 197-7s
- 213-7s
- 244-7s
- 267-7s
- 287-8s

Maximum sizes:
- 2.44 x 19.5 m (8 x 64 ft)

Stress grade:
- 81 (E15SGB and T=No. 3/S6D)

Diagram showing various layup combinations for 3, 5, and 7 layers.
Procurement Best Practices

- Early Go/No-Go Decision on Mass Timber
- CM/GC design-assist
- Early Supplier Selection vs. Competitive Bid
- Layout column grid with supplier input
- Maximize time for design coordination
  - Shop drawing release
  - Connection details
  - MEP coordination
- Transfer of Revit model to contractor
Procurement Best Practices

Mass Timber is not a Commodity Material!
Design Coordination
MEP Coordination

- MEP systems are primarily exposed
- Heightened focus on MEP routing
- Prefabrication coordination
- Coordinated ceiling/soffit locations
MEP Coordination
MEP Coordination
MEP Coordination Best Practices

- Identify aesthetic MEP routing goals early
- Determine extent of future flexibility required
- Optimize REVIT model criteria & timing of handoff
- Prioritize MEP penetration coordination
- Consolidate MEP systems in soffits/dropped ceilings
- Maximize shop penetrations made with CNC machine
- Minimize field penetrations
Acoustic Assemblies

- STC 39, IIC 27
- STC 55, IIC 51
- STC 64, IIC 59
- STC 66, IIC 60
Construction Considerations
Faster Construction Schedule

Up to 40% Faster than Concrete

- Concurrent CLT core wall erection
- Eliminate re-shores
- Accelerated start of MEP rough-in
- No field welding
- Reduced manpower & crew size
- Prefabrication / precision-fit
- Minimal weather protection
- No temp heat required
Reduced Construction Waste

- Prefabricated components
- Precision-fit
- No scrap material or field cuts
- Less deliveries / construction traffic
- Smaller onsite workforce
- Less impact on water quality
Construction Tolerances

Dissimilar structural material tolerances
• Allowable tolerances – ACI, AISC
• Steel: +/- 1/2”
• Concrete: 1/4” in 10 ft., up to 1’
• Mass Timber: 1/16”

Quality Control
• Build tolerance into the interface detail
• Base plate layout & verification
• Overlay field scan with 3D model
Hybrid Structures
Erection Sequence

• Shear wall bracing plan
• Early establishment of diaphragm – lock the building in
• Coordination w/ Just-in-Time material delivery
• Ensure erection sequence aligns with details
Site Logistics

- Alignment with supplier fabrication sequence
- Optimize lay down area & crane placement
- Onsite vs. Offsite Marshalling Yard

Goals:
- Pick CLT panels directly off the trailer
- Eliminate double-handling
- Eliminate onsite storage of material
Protection of Finishes

- Working around finished material earlier than typical
- Communicate expectations with craft workers
- Padded rigging & dunnage
- Protection in high traffic areas
- Column protection
- Manage UV light exposure
Moisture Management

- Stain mitigation – rust bleed, water, oil, grease
- Prime all steel connections
- Eliminate standing water
- Eliminate trapped moisture
- Seal joints in CLT panels
- Temp roofing membrane
Cost Analysis
Pavilion at Laurel Village

Construction Type
2-stories, 11,500 SF
Type V-B – unprotected wood frame

Hybrid Structure
Floor Panels – 5-ply CLT
Roof Panels – 7-ply CLT
Frame – Glulam beams & HSS Columns
Lateral System – CMU Walls

Cost Drivers
Unique geometry
Asymmetrical column grid
Limited full size CLT panels
Long roof spans – thicker CLT panels

Superstructure Cost
$82/SF (2020 dollars)
Burwell Center for Career Achievement

**Construction Type**
3-stories – 23,300 SF  
Type III-B – Unprotected Combustible

**Mass Timber Structure**
Floor Panels – 3-ply CLT w/ 3” concrete topping  
Roof Panels – 3-ply CLT  
Frame – Glulam beams & columns  
Lateral System – 5-ply CLT wall panels

**Cost Drivers**
Unique geometry – radiused perimeter edge  
Optimized column grid & beam sizes  
Exposed connections  
Small footprint w/ limited repetition

**Superstructure Cost**
$53/SF (2020 dollars)
## Impact of Construction Type

<table>
<thead>
<tr>
<th>Location of Event Space</th>
<th>Rooftop</th>
<th>1st Floor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Type</td>
<td>III-A</td>
<td>III-B</td>
</tr>
<tr>
<td>Assembly Group</td>
<td>A-3</td>
<td>A-3</td>
</tr>
<tr>
<td>Fire Resistive Rating</td>
<td>1-Hr</td>
<td>Not required</td>
</tr>
<tr>
<td>Connections</td>
<td>Concealed</td>
<td>Exposed</td>
</tr>
<tr>
<td>CLT Panel Thickness</td>
<td>5-Ply</td>
<td>3-Ply</td>
</tr>
<tr>
<td>Superstructure Cost/SF</td>
<td>$65/SF</td>
<td>$53/SF</td>
</tr>
</tbody>
</table>
TMBR Condominiums

Construction Type
10-stories – 120’ tall
217,000 SF
Type IV-B

Mass Timber Structure
Floor Panels – 5-ply CLT w/ 2 ¼” concrete topping
Roof Panels – 7-ply CLT
Frame – Glulam beams & columns
Lateral System – Concrete core walls

Cost Drivers
7-ply CLT band-beams at column lines
Efficient geometry & column grid
Limited exposure of CLT ceilings

Mass Timber Superstructure Cost
$46/SF (2020 dollars)
Cost Drivers

### Superstructure Cost Drivers
- Construction type & fire rating
- Size & geometry of building
- Structural column grid
- CLT panel spans & thickness
- Panel size & shapes
- Depth of glulam beams
- Connection details
- Acoustic floor assembly

### Superstructure Costs

<table>
<thead>
<tr>
<th>Superstructure Costs</th>
<th>Mass Timber</th>
<th>Concrete</th>
<th>Structural Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Range</td>
<td>$40/SF</td>
<td>$38/SF</td>
<td>$36/SF</td>
</tr>
<tr>
<td>High Range</td>
<td>$70/SF</td>
<td>$52/SF</td>
<td>$45/SF</td>
</tr>
</tbody>
</table>

### Offsetting Factors – Beyond Superstructure
- Schedule reduction – up to 40% faster on superstructure work
- Enhanced trade flow – no re-shores
- Smaller foundations
- Reduced floor to floor height
- Reduction in ceiling finishes
- Smaller crane size
- Reduce temp heating costs