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

KLH, Binderholz, Stora Enso, Kaufmann, Egoin, Hasslacher, Diemme Legno, Derix, Metsa Wood, Novatop
+MORE
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

<table>
<thead>
<tr>
<th>Layup combinations</th>
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<tr>
<td>89-3s, 105-3s, 143-5s, 175-5s, 197-7s, 213-7s, 244-7s, 244-7f and 267-9f</td>
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<table>
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<tr>
<th>Maximum sizes</th>
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<td>2.44 x 1.95 m (8 x 64 ft)</td>
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<th>Stress grade</th>
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<td>E1 (L-950N/m and T-No. 3/Stud)</td>
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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
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

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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>
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<td>CLT Panel Thickness</td>
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<td>Superstructure Cost/SF</td>
<td>$65/SF</td>
<td>$53/SF</td>
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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

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

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
Thank you!

Ankit Sanghvi
Preconstruction Manager
PCL Construction Services
asanghvi@pcl.com