Cross Laminated Timber (CLT) Manufacturing in the Southeast U.S.
Steve Lieberman, Senior Product Engineer

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.
Southern Yellow Pine (SYP) Cross-Laminated Timber (CLT)
### TABLE A1

**ASD REFERENCE DESIGN VALUES**\(^{a,b,c}\) **FOR LAMINATIONS (FOR USE IN THE U.S.)**

<table>
<thead>
<tr>
<th>CLT Layup</th>
<th>(F_b) (psi)</th>
<th>(E^d) (10^6 psi)</th>
<th>(F_t) (psi)</th>
<th>(F_c) (psi)</th>
<th>(F_v) (psi)</th>
<th>(F_x) (psi)</th>
<th>(F_y) (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>1,950</td>
<td>1.7</td>
<td>1,375</td>
<td>1,800</td>
<td>135</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td>1,650</td>
<td>1.5</td>
<td>1,020</td>
<td>1,700</td>
<td>180</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>E3</td>
<td>1,200</td>
<td>1.2</td>
<td>600</td>
<td>1,400</td>
<td>110</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>E4</td>
<td>1,950</td>
<td>1.7</td>
<td>1,375</td>
<td>1,800</td>
<td>175</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>V1</td>
<td>900</td>
<td>1.6</td>
<td>575</td>
<td>1,350</td>
<td>180</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>V2</td>
<td>875</td>
<td>1.4</td>
<td>450</td>
<td>1,150</td>
<td>135</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>V3</td>
<td>750</td>
<td>1.4</td>
<td>450</td>
<td>1,250</td>
<td>175</td>
<td>55</td>
<td></td>
</tr>
</tbody>
</table>

<p>| Laminations Used in Minor Strength Direction |</p>
<table>
<thead>
<tr>
<th>(F_b) (psi)</th>
<th>(E^d) (10^6 psi)</th>
<th>(F_t) (psi)</th>
<th>(F_c) (psi)</th>
<th>(F_v) (psi)</th>
<th>(F_x) (psi)</th>
<th>(F_y) (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V3</td>
<td>450</td>
<td>1.3</td>
<td>250</td>
<td>725</td>
<td>175</td>
<td>55</td>
</tr>
</tbody>
</table>

For SI: 1 psi = 0.006895 MPa

- **a.** See Section 4 for symbols.
- **b.** Tabulated values are ASD reference design values and not permitted to be increased for the lumber size and flat use adjustment factors in accordance with the NDS. The design values shall be used in conjunction with the section properties provided by the CLT manufacturer based on the actual layup used in manufacturing the CLT panel (see Table A2).
- **c.** Custom CLT layups that are not listed in this table shall be permitted in accordance with 7.2.1.
- **d.** The tabulated \(E\) values are published \(E\) for lumber. For calculating the CLT design properties shown in Table A2, the transverse \(E\) of the lamination is assumed to be \(E/30\), the longitudinal \(G\) of the lamination is assumed to be \(E/16\), and the transverse \(G\) of the lamination is assumed to be longitudinal \(G/10\).
Mass Timber Solutions Complex

Economy
$13 Billion Annual Industry

Lumber Supply
22.9 Million Acres of Forest

Transport Access
Railroad
U.S. Highways
Port

Energy costs
Lower 25% Nationally

Workforce
47,000 Employed Skilled Labor Force

Alabama is No. 7 nationally in lumber production and No. 8 in wood panel production.

Forestry is Alabama’s second largest manufacturing industry, ranking No. 1 in the U.S. in pulp production and No. 3 in paper production.

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X-LAM USA will be the first manufacturers of structural Southern Yellow Pine CLT.

**RAW MATERIAL SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood species</td>
<td>Southern Yellow Pine</td>
</tr>
<tr>
<td>Wood moisture</td>
<td>12%</td>
</tr>
<tr>
<td>Width max/min</td>
<td>12/3.35 inch</td>
</tr>
<tr>
<td>Thickness max/min</td>
<td>3/0.8 Inch</td>
</tr>
<tr>
<td>Length max/min</td>
<td>16/8 feet</td>
</tr>
</tbody>
</table>

**CLT SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Width</td>
<td>11 feet</td>
</tr>
<tr>
<td>Max thickness</td>
<td>12 inches</td>
</tr>
<tr>
<td>Max Length</td>
<td>52 feet</td>
</tr>
<tr>
<td>Number of layers</td>
<td>3/5/7/9</td>
</tr>
</tbody>
</table>
CROSS LAMINATED TIMBER

Cross section of panel

- Adhesive
- 3 Layer 4.13”
- 5 Layer 6.88”
- 7 Layer 9.63”
- 9 Layer 12.38”

Width ≤ 11’

Length ≤ 52’
### CLT SPECIFICATIONS

<table>
<thead>
<tr>
<th>Panel Types</th>
<th>TL / TT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finishes</td>
<td></td>
</tr>
<tr>
<td>Domestic Visual (DVQ)</td>
<td></td>
</tr>
<tr>
<td>Industrial Visual (IVQ)</td>
<td></td>
</tr>
<tr>
<td>Non-Visual Quality (NVQ)</td>
<td></td>
</tr>
</tbody>
</table>

Panels for walls: **TT** (Top layers **Transverses**)

Panels for floors/ceilings: **TL** (Top layers **Longitudinal**)

SYP CROSS LAMINATED TIMBER
CLT PROCESS
MANUFACTURING

Digital Fabrication and CLT

CLT Manufacturing is automated through Computer Numerical Controlled (CNC) machines. This enables:

- Mass customization
- Accuracy/Precision
- Fully automated
- Extremely tight tolerances of walls, floors, openings for windows, doors and service channels.

Photos courtesy of KLH
Think CLT at the conception phase

- Requires substantial front end planning and collaboration between architects, engineers and developers to consider the following:
  - CNC precision
  - Mechanical, Electrical and Plumbing
  - Envelope
  - Connections
  - Transportation
  - Assembly

- Preplanning will save time and money during construction
DESIGN PROCESS – 3D Model

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DESIGN PROCESS Export to CNC
MANUFACTURING Layup
MANUFACTURING Gluing
MANUFACTURING Press
MANUFACTURING Press
MANUFACTURING CNC
MANUFACTURING CNC
MANUFACTURING Finishing & Sequencing

Photos courtesy of KLH
FIRST SYP CLT PROJECTS
CLT: 150,000 board feet

First United Bank
Fredericksburg, TX
Glulam: 35,000 board feet

First United Bank
Fredericksburg, TX
First United Bank
Fredericksburg, TX
Outdoor Wellness Center
Clemson, SC

CLT: 324,763 board feet
Glulam: 127,473 board feet
CLT: 290,000 board feet
Glulam: 50,000 board feet

Outdoor Wellness Center
Clemson, SC
50 West
Clermont, FL
CLT: 324,763 board feet
Glulam: 127,473 board feet

50 West
Clermont, FL
KEY ADVANTAGES

CLT is creating a paradigm shift within the building industry, it is much more than a new building material.

- Environmentally sustainable material
- Lightweight construction
- Fast erection time
- Extremely accurate panels and openings
- Maximum architectural freedom
- Reduced site traffic and waste
- Safer construction site
- Simplistic assembly process
- Fire resistant
- Versatility
- Inherent aesthetic quality
QUESTIONS?

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