Workshop B: Cross-Laminated Timber and Tall Wood Buildings: Essential Issues for Building Officials to Consider

Gaps in Regulations and Issues/Resources to Consider during Alternate Methods Reviews

Ali Fattah, P.E. City of San Diego

CALBO Annual Meeting, San Diego 2019
Presentation Objectives

• Cross Laminated Timber & Tall Wood – my perspective
• Highlight Gaps in Approved Regulations
• 2019 CBC Interim Cycle Consideration of Tall Wood
• Review Of Alternate Methods and Materials
What does CLT Actually Look Like
Cross Laminated Timber & Tall Wood – my perspective

• CLT does not lose all structural capacity under fire.
• Type IV A and IV B construction requires protecting CLT from ignition so has more fire resistance than other construction.
• Full scale testing of 2 story building with different configurations (gyp covered or partially covered or sprinklers delayed or not delayed).
• Repair scheme developed in case of fire or wood damage.
• Will be used in sprinkler protected buildings.
• Due to cost is a niche product.
• Due to reduced stiffness compared concrete slabs will have more slab support so more redundant.
• Fully vetted in 2021 IBC through consensus but differences in opinion still exist.
Where Are We Now in Code Development

- Gaps in regulations when not adopted in a code or not complete.
- Gaps in regulations will exist if structural testing results not adopted in SDPWS and seismic coefficients not codified. ASCE 7-16 seismic force resisting system?
- BO will have to rely on academic research papers for diaphragm designs.
- Will require alternate methods approvals and possibly 3rd party reviews.

<table>
<thead>
<tr>
<th></th>
<th>2021 ICC Group A</th>
<th>2021 ICC Group B</th>
<th>2019 CBC Supplement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall Wood Approved</td>
<td>Structural Ch 17</td>
<td>Cycle starts 2019</td>
<td></td>
</tr>
<tr>
<td>Non-structural</td>
<td>SDPWS?</td>
<td>Non-structural</td>
<td></td>
</tr>
</tbody>
</table>
| Adopted in Cal 2023    | Adopted in Cal 2023        | Effective in California July 1, 2021?
• A two story CLT building tested on shake table.

• CLT shearwalls were used for bracing.

• Side lap joint for floor panels.
Gaps in Regulations

• Diaphragm testing still under way so connections between multiple CLT panels not codified.

• Diaphragm deflection equations between multiple CLT panels not codified.

• Seismic coefficients not codified so need to rely on conventional wall or frame systems like steel and concrete for seismic resistance.

• Fire resistance of connections not codified will have to rely on test reports if proprietary connections used.

• Creating floor openings and boring holes not codified. Unlike glulam beams where core is filler in CLT lams in direction of span required.

• Penetration of fasteners at laps into through full lam of just remaining wood.
Gaps in Regulations

- Partially protected CLT in Type IV B construction hard to enforce in fire area and unit. Fire area could be whole building so complete floors can be exposed.
- Fire safety during construction requires protecting CLT however Type IV C allows unprotected wood.
- Proprietary or limited floor/ceiling assemblies for fire and sound transmission.
- Presently no special inspection requirements (similar to precast) but proposed in Group B.
- Flexible vs rigid diaphragm cannot be determined without deflection equations.
- Some question fire safety after earthquake event since CLT not fire tested after shake table test.
- Some question long term durability of adhesives and CLT assembly.
- CLT supporting heavy concentrated loads and CLT reinforcement.
Ongoing Research

- Various research papers from Canada and US by PHD candidates.
- Not full scale connection testing.
- ICC Evaluation Developing criteria to list CLT panels however excluding diaphragm values when multiple CLT panels joined to create larger panel.
- Woodworks taking the lead and provides a clearing house of ongoing testing [http://www.woodworks.org/](http://www.woodworks.org/)
- SEAOC working to develop a tool box to help fill in the gaps as well as AWC in collaboration with CalBO.
Ongoing Code Development

• **2021 SDPWS (for reference in 2021 IBC )** has been in balloting phase for a little over a year now.
  
  • The inclusion of CLT shear walls & CLT diaphragms has been balloted but comments must be addressed. If successfully added, these new criteria intended to be contained in 2021 SDPWS.

  • The CLT shear wall system for high seismic that was balloted for inclusion in 2021 SDPWS is based on a yet to be finalized P695 Report of the system. Conclusion of P695 Report for determination of R, Cd, and Omega is expected soon. The P695 Report project has been ongoing for years and is funded by USDA Forest Products Laboratory.

• **ASCE 7-22 (for reference in 2021 IBC )**

  • Following completion of the P695 Report for CLT shear walls, a separate effort will be made to get the CLT shear wall system and associated R, Cd, and Omega recognized in ASCE 7-22.

  • In theory, SDPWS 2021 will be near completion on resolving comments on the strength/stiffness and detailing of CLT shear walls so that the ASCE 7 Seismic Subcommittee need only focus on review of the proposed seismic coefficients, SDC limits, and height limits.
CLT Is Being Used in US Construction

- CLT used in many states with seismic
- CLT addressed in NDS
- CLT addressed in CBC
- Several projects in California.
- Certified fab plants by APA & ICC-ES
- How are projects being approved!
Currently Permitted Type IV Applications

- CLT considered a form of mass timber like gluelams.
- Can be up to 85 ft tall (high-rise) and 6 stories plus mezzanines.
- Special provisions allow for parking garage on 1st story above grade plane.
- Can be used where Ch 6 allows substitution of heavy timber in non-combustible construction.
- The wood folks are right you can use CLT right now.
Alternate Methods Review Process

1. Project Specific AMMR App
2. Review code deviation and justification
3. Review research to gain background
4. Determine whether third party review needed
Issues to consider

• Will proposal comply with 2021 IBC or modifications for inclusion in intervening cycle to 2019 Code?

• Has a draft proposal codifying CLT been submitted through AWC for inclusion into SDPWS?

• Will the lateral force resisting system be using CLT or a conventional structural system?

• How will fire safety during construction be addressed?

• Special inspection during installation (periodic like precast concrete).

• Special inspection for fire resistance rated connections in tall wood.

• Support/anchorage of equipment and boring of holes in lap joint.
City of San Diego AMMR Approval

- Three story steel office IIB building.
- CLT used for roof diaphragm of half of R&D building.
- CLT supported on exposed glue-lams and steel columns.
- Code deviation was diaphragm design, method of diaphragm lap and diaphragm deflection.
- Process took 6 months and required a review of Canadian and US research papers and interacting with Woodworks.
- Similar projects approved up north near silicon valley.
- Continuous special inspection and structural observation.
- Prohibited anchorage/support in lap joint and equipment suspension.
- Performed site visit.
1" x 6" Plywood Spline, Typ.

Stagger 5/8" where required by schedule

Edge fasteners per S2.25A

EQ

4"

LAP

CLT Panel Side Joint