Monotonic and Cyclic Testing of Large-Scale CLT Diaphragms

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Phase I: Self Tapping Screw Connections in CLT Diaphragms

Objectives
1) Determine strengths/stiffnesses of common self-tapping screw connections with fastener spacings that will be used in practice.
2) Find the ductility/energy dissipation of the connections so as to better understand the structural performance characteristics for use in seismic design.

Test Description
- 2 CLT panels (one panel shown in circle 1 in Fig. 2) were held restrained to test connectivity to the middle CLT panel
- The middle panel was connected to an actuator that applied all loading protocols (circle 2)
- (2) monotonic and (2) cyclic tests per construction (#4, which did not have a cyclic series)
- CUREE load protocol run up to 1.5Δref as final cycle
- Lateral restraint isolates shear
- SWG ASSY Eco & VG CSK self-tapping screws

Results

Monotonic
- 20% higher load capacities per screw for the 12” spacing compared to the 6” spacing
- A 25% increase in cross-sectional area of the screw provided an average of 35% increased capacity

Cyclic
- Equal capacity per screw for the cyclic tests.
- 60% increased capacity per screw per 25% area increase

Connection Type
- Splines generally showed lower stiffness and strength compared to the Half-Lap specimens

Phase II: Monotonic and Cyclic Testing of Large-Scale CLT Diaphragms with Surface Splines

Objectives
1) Find the ductility/energy dissipation of a large scale CLT diaphragm
2) Compare the performance and ductility of a diaphragm system with surface splines to connection tests
3) Compute design force reduction factors for use in seismic design of CLT diaphragm systems.

Test Description
- Proposed 15’x15’ CLT diaphragms
- ASTM E 455 for monotonic testing and CUREE protocol for cyclic testing
- Cantilever style diaphragms will be tested as shown in Figure 6
- Plywood surface spline connections with steel plate chord connectors

Table 1: Testing Matrix

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Test Style</th>
<th>Species</th>
<th>Fastener Type</th>
<th>Thread Type</th>
<th>Spacing in (mm)</th>
<th>Screw Dia. in (mm)</th>
<th>Loading</th>
<th>Δref in (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cantilever</td>
<td>DF L</td>
<td>STS SK</td>
<td>Partial</td>
<td>12 (305)</td>
<td>5/16 (8)</td>
<td>Mono.</td>
<td>–</td>
</tr>
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<td>Cantilever</td>
<td>DF L</td>
<td>STS SK</td>
<td>Partial</td>
<td>12 (305)</td>
<td>5/16 (8)</td>
<td>Cyc.</td>
<td>TBD</td>
</tr>
<tr>
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<td>Cantilever</td>
<td>DF L</td>
<td>STS SK</td>
<td>Partial</td>
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<td>5/16 (8)</td>
<td>Cyc.</td>
<td>TBD</td>
</tr>
<tr>
<td>4</td>
<td>Cantilever</td>
<td>DF L</td>
<td>STS SK</td>
<td>Partial</td>
<td>12 (305)</td>
<td>5/16 (8)</td>
<td>Cyc.</td>
<td>TBD</td>
</tr>
<tr>
<td>5</td>
<td>Cantilever</td>
<td>SPF</td>
<td>STS SK</td>
<td>Partial</td>
<td>12 (305)</td>
<td>5/16 (8)</td>
<td>Mono.</td>
<td>–</td>
</tr>
<tr>
<td>6</td>
<td>Cantilever</td>
<td>SPF</td>
<td>STS SK</td>
<td>Partial</td>
<td>12 (305)</td>
<td>5/16 (8)</td>
<td>Cyc.</td>
<td>TBD</td>
</tr>
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<td>7</td>
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<td>STS SK</td>
<td>Partial</td>
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<td>5/16 (8)</td>
<td>Cyc.</td>
<td>TBD</td>
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<td>8</td>
<td>Cantilever</td>
<td>SPF</td>
<td>STS SK</td>
<td>Partial</td>
<td>12 (305)</td>
<td>5/16 (8)</td>
<td>Cyc.</td>
<td>TBD</td>
</tr>
</tbody>
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Acknowledgments
Oregon State University College of Engineering
Oregon State University College of Forestry
TallWood Design Institute
MyTiCon for Self Tapping Screws
Sierra Pacific Industries