Versa-Lam® LVL
Boise Cascade Company

Product: 1.8E 2650/1650, 1.9E 2750/1825, and 2.1E 3100/2150 Versa-Lam® LVL

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1. Basis of the product report:
   - 2015 National Building Code of Canada: Clause 1.2.1.1 of Division A and Clauses 4.1, 4.3.1.1, and 9.23 of Division B
   - CSA O86-14 (Reprint 2016) Engineering Design in Wood
   - ASTM D5456-14b recognized by CAN/CSA O86-14 (Reprint 2016)

2. Product description:
   Versa-Lam® LVL is made with veneer sheets of various species and grades in accordance with the in-plant manufacturing standards approved by APA. Versa-Lam LVL is available in thicknesses from 19 mm (3/4 inch) to 89 mm (3-1/2 inches), widths of 89 mm (3-1/2 inches) to 1,219 mm (48 inches) and lengths up to 24 m (80 feet).

3. Design properties:
   Table 1 lists the Limit States Design properties; Table 2 lists the equivalent relative densities for connection design; Table 3 lists the minimum fastener spacing for Versa-Lam LVL. The factored resistances for Versa-Lam LVL shall be in accordance with the recommendations provided by the manufacturer (www.bc.com/manufacturing/gp-lvl/ and www.bcewp.com).

4. Product installation:
   Versa-Lam LVL shall be installed in accordance with the recommendations provided by the manufacturer. Permissible details and maximum hole sizes shall be in accordance with the recommendations provided by the manufacturer.

5. Fire-rated assemblies:
   Fire-rated assemblies shall be constructed in accordance with the recommendations provided by the manufacturer and approved by the authority having jurisdiction.

6. Limitations:
   a) Versa-Lam LVL shall be designed in accordance with the code using the design properties specified in this report.
   b) Versa-Lam LVL are limited to dry service conditions, as defined in CSA O86, at which the average equilibrium moisture content of solid-sawn lumber over a year is 15 percent or less and does not exceed 19 percent.
   c) The Versa-Lam LVL are produced at Boise Cascade’s facility in Thorsby, Alabama under a quality assurance program audited by APA.
   d) This report is subject to re-examination in one year.
7. Identification: Versa-Lam LVL described in this report is identified by a label bearing the manufacturer’s name and/or trademark, the APA assigned plant number (1086 for the Thorsby plant), the LVL grade, the APA logo, the report number PR-L266 (or PR-L266C), and a means of identifying the date of manufacture.

Identification may include one or more of the following: Versa-Lam®, Boise Cascade or Boise Cascade Company
Table 1. Specified Strengths and MOE (Limit States Design for Use in Canada) for Versa-Lam LVL \(^{(a,b)}\)

<table>
<thead>
<tr>
<th>Product Grade</th>
<th>True E (\text{MPa (psi)})</th>
<th>Apparent E (\text{MPa (psi)})</th>
<th>Flexural Stress, (F_b) MPa ((c,d))</th>
<th>Tension Parallel to Grain, (F_t) MPa (psi) (^{(e)})</th>
<th>Compression Perpendicular to Grain, (F_c) MPa (psi)</th>
<th>Horizontal Shear, (F_v) MPa (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8E 2650/1650</td>
<td>12.411 (1.8x10^6)</td>
<td>1.7 2650</td>
<td>11.721 (1.7x10^6)</td>
<td>33.8 (4,900)</td>
<td>30.6 (4,435)</td>
<td>17.2 (2,494)</td>
</tr>
<tr>
<td>1.8E 2750/1825</td>
<td>13.101 (1.9x10^6)</td>
<td>1.8 2750</td>
<td>12.411 (1.8x10^6)</td>
<td>35.0 (5,080)</td>
<td>31.9 (4,620)</td>
<td>19.0 (2,759)</td>
</tr>
<tr>
<td>2.1E 3100/2150</td>
<td>14.480 (2.1x10^6)</td>
<td>2.0 3100</td>
<td>13.789 (2.0x10^6)</td>
<td>39.5 (5,730)</td>
<td>35.7 (5,175)</td>
<td>22.4 (3,250)</td>
</tr>
</tbody>
</table>

\(^{(a)}\) The tabulated values are specified strengths and modulus of elasticity for standard-term load duration. All values, except for E, are permitted to be adjusted for other load durations as permitted by the code. The tabulated values are limited to dry service conditions.

\(^{(b)}\) Joist = load parallel to glueline. Plank = load perpendicular to glueline.

\(^{(c)}\) Tabulated flexural stress \(F_b\) may be increase by 4 percent when members are used in a load-sharing system as defined in the CSA O86 15.3.2.4.

\(^{(d)}\) The tabulated plank values require no depth modification. The tabulated joist values are based on a reference depth of 305 mm (12 inches). For other depths, when loaded edgewise, the specified bending strength \(F_b\) shall be modified by \((305/d)^{1/2}\), where \(d = \) depth in mm. For depths less than 89 mm (3-1/2 inches), the factor for the 89 mm (3-1/2 inches) depth shall be used.

\(^{(e)}\) The tabulated values are based on a reference length of 6,096 mm (20 feet). For other lengths, the specified tensile strength shall be modified by \((6,096/L)^{1/8}\) for all grades of Versa-Lam LVL, where \(L = \) length in mm. For lengths less than 1,219 mm (4 feet), the factor for the length of 1,219 mm (4 feet) shall be used.

\(^{(f)}\) The MOE values given are the apparent modulus of elasticity and include the effects of shear deformations. When calculating deflection, only the bending deformations need be included and the second term of the equation in footnote \((g)\) may be ignored.

\(^{(g)}\) The MOE values given are the shear-free modulus of elasticity. When calculating deflection, both bending and shear deformations must be included.

The deflection equation for a simply-supported beam under uniform load is:

\[
\delta = \frac{156.3wL^4}{Eb^5} \times 10^6 + \frac{2400wL^2}{Ebd}
\]

Where: \(\delta = \) estimated deflection, mm \(w = \) uniform load, N/m \(L = \) span, m \(E = \) modulus of elasticity, MPa \(b = \) beam width, mm \(d = \) beam depth, mm

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### Table 2. Fastener Details for Versa-Lam (a)

<table>
<thead>
<tr>
<th>LVL Grade</th>
<th>Equivalent Relative Density (G)</th>
<th>Nails</th>
<th>Bolts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Withdrawal Load</td>
<td>Lateral Load</td>
<td>Installed in Face</td>
</tr>
<tr>
<td>LVL Grade</td>
<td>Installed in Edge</td>
<td>Installed in Face</td>
<td>Installed in Edge</td>
</tr>
<tr>
<td>1.8E, 1.9E and 2.1E VERSA-LAM</td>
<td>Spruce-pine-fir (SPF) (0.42)</td>
<td>Douglas-fir/larch (0.50)</td>
<td>Spruce-pine-fir (SPF) (0.42)</td>
</tr>
</tbody>
</table>

(a) Fastener values determined using the equivalent relative densities in this table are for standard-term load duration and are permitted to be adjusted for other load durations as permitted by the code.

### Table 3. Minimum Fastener Spacing for Installation Parallel to the Glue Line in Versa-Lam (a,b,c)

<table>
<thead>
<tr>
<th>Minimum Member Size, mm (in.)</th>
<th>Connector: Length, mm (in.)</th>
<th>Nails Installed in the Narrow Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 x 89 (1 x 3-1/2)</td>
<td>8d box or common, 10d box or common, 12d box or common, 16d sinker, 16d common</td>
<td>Minimum On-Center Spacing, mm (in.)</td>
</tr>
<tr>
<td>38 x 89 (1-1/2 x 3-1/2)</td>
<td>8d box or common, 10d box or common, 12d box or common, 16d sinker, 16d common</td>
<td>152 (6)</td>
</tr>
<tr>
<td>44 x 140 (1-3/4 x 5-1/2)</td>
<td>8d box or common, 10d box or common, 12d box or common, 16d sinker, 16d common</td>
<td>102 (4)</td>
</tr>
<tr>
<td>89 x 140 (3-1/2 x 5-1/2)</td>
<td>8d box or common, 10d box or common, 12d box or common, 16d sinker, 16d common</td>
<td>203 (8)</td>
</tr>
</tbody>
</table>

(a) The minimum on-center spacing permitted for nails installed in the wide face of VERSA-LAM, i.e., perpendicular to the glue line, is the same as that permitted by the applicable code for solid-sawn lumber.

(b) Edge distance is similar to Minimum On-Center Spacing.

(c) Fastener sizes and minimum on-center spacing not specifically described above are beyond the scope of this report.
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