

Vaagen Cross-Laminated Timber
VAAGEN TIMBERS, LLC

PR-L328

Issued July 30, 2019

Products: Vaagen Cross-Laminated Timber
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1. Basis of the product report:
 - 2018 and 2015 International Building Code (IBC): Section 2303.1.4 Structural Glued Cross-Laminated Timber
 - 2012 IBC: Section 104.11 Alternative materials
 - 2018 and 2015 International Residential Code (IRC): Sections R502.1.6, R602.1.6, and R802.1.6 Cross-Laminated Timber
 - 2012 IRC: Section R104.11 Alternative materials
 - ANSI/APA PRG 320-2018 Performance Rated Cross-Laminated Timber
 - ANSI/APA PRG 320-2017, PRG 320-2012, and PRG 320-2011 Performance Rated Cross-Laminated Timber, recognized in the 2018 IBC and IRC, 2015 IRC, and 2015 IBC, respectively
 - APA Report T2019P-38
2. Product description:

Vaagen cross-laminated timber (CLT) is manufactured in Colville, Washington with Douglas fir-Larch lumber in accordance with custom layups of ANSI/APA PRG 320 through product qualification and/or mathematical models using principles of engineering mechanics. Allowable design properties for lumber laminations used in Vaagen CLT are provided in Table 1. Vaagen CLT is permitted for use in floor, roof, and wall applications, and is manufactured with nominal widths up to 48 inches, thicknesses of 4-1/8 to 9-5/8 inches, and lengths up to 60 feet.
3. Design properties:

Vaagen CLT shall be designed with the allowable design properties and capacities provided in Table 2. The design adjustment factors shall be based on Chapter 10 of the 2018 National Design Specification for Wood Construction (NDS) and approved by the engineer of record. The lateral resistance of Vaagen CLT, when used as shearwalls or diaphragms, depends on the panel-to-panel connection and anchorage designs, and shall be consulted with the CLT manufacturer and approved by the engineer of record.

Design values for the Load and Resistance Factor Design (LRFD) used in the U.S. for Vaagen CLT can be derived from the ASD values published in Table 2 of this report in accordance with Tables 10.3.1, N1, N2, and N3 of the 2018 NDS.
4. Product installation:

Vaagen CLT shall be installed in accordance with the recommendations provided by the manufacturer and the engineering drawing approved by the engineer of record. Permissible details shall be in accordance with the engineering drawing.
5. Fire-rated assemblies:

Fire-rated assemblies shall be constructed in accordance with the recommendations provided by the manufacturer. Procedures specified in Chapter 16 of the 2018 NDS shall be permitted for use in designing Vaagen CLT for a fire exposure up to 2 hours.

6. Limitations:
 - a) Vaagen CLT shall be designed in accordance with principles of mechanics using the design properties specified in this report or provided by the manufacturer.
 - b) Vaagen CLT shall be limited to dry service conditions where the average equilibrium moisture content of solid-sawn lumber is less than 16 percent.
 - c) Design properties for Vaagen CLT, when used as beams or lintels with loads applied parallel to the face-bond gluelines, are beyond the scope of this report.
 - d) Vaagen CLT shall be manufactured in compliance with ANSI/APA PRG 320 and documented in the Vaagen Timbers, LLC's in-plant manufacturing standard approved by APA.
 - e) Vaagen CLT is produced at the Colville, Washington facility under a quality assurance program audited by APA.
 - f) This report is subject to re-examination in one year.

7. Identification:

Vaagen CLT described in this report is identified by a label bearing the manufacturer's name (Vaagen Timbers, LLC) and/or trademark, the APA assigned plant number (1129), the product standard (ANSI/APA PRG 320), the APA logo, the CLT grade, the report number PR-L328, and a means of identifying the date of manufacture.

Table 1. ASD Reference Design Values^(a) for Lumber Laminations Used in Vaagen CLT (for Use in the U.S.)

CLT Grade	Laminations Used in Major Strength Direction						Laminations Used in Minor Strength Direction					
	F _b (psi)	E (10 ⁶ psi)	F _t (psi)	F _c (psi)	F _v (psi)	F _s (psi)	F _b (psi)	E (10 ⁶ psi)	F _t (psi)	F _c (psi)	F _v (psi)	F _s (psi)
V1M3	900	1.35	575	1,350	180	60	900	1.35	575	1,350	180	60

For SI: 1 psi = 0.006895 MPa

^(a) Tabulated values are allowable design values and not permitted to be increased for the lumber flat use or size factor 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 2).

Table 2. ASD Reference Design Values^(a, b) for Vaagen CLT Listed in Table 1 (for Use in the U.S.)

CLT Grade ^(c)	Layup ID ^(d)	CLT Thickness, t _p (in.)	Lamination Thickness (in.) in CLT Layup							Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	(F _b S) _{eff,f,0} (lbf-ft/ft)	(EI) _{eff,f,0} (10 ⁶ lbf-in. ² /ft)	(GA) _{eff,f,0} (10 ⁶ lbf/ft)	V _{s,0} (lbf/ft)	(F _b S) _{eff,f,90} (lbf-ft/ft)	(EI) _{eff,f,90} (10 ⁶ lbf-in. ² /ft)	(GA) _{eff,f,90} (10 ⁶ lbf/ft)	V _{s,90} (lbf/ft)
V1M3 ^(e)	DFL3	4 1/8	1 3/8	1 3/8	1 3/8					2,090	91	0.51	1,980	285	3.5	0.51	660
	DFL5	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			4,825	350	1.0	3,300	2,460	91	1.0	1,980
	DFL7	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	8,525	868	1.5	4,625	5,675	350	1.5	3,300

For SI: 1 in. = 25.4 mm; 1 ft = 304.8 mm; 1 lbf = 4.448N

^(a) Tabulated values are allowable design values and not permitted to be increased for the lumber flat use or size factor in accordance with the NDS.

^(b) Deflection under a specified uniformly distributed load, w, acting perpendicular to the face of a single-span CLT panel shall be permitted to be calculated as a sum of the deflections due to moment and shear effects using the effective bending stiffness, (EI)_{eff}, and the effective in-plane (planar) shear rigidity, (GA)_{eff}, as follows:

$$\delta = \frac{22.5wL^4}{(EI)_{eff}} + \frac{3wL^2}{2(GA)_{eff}} \quad [1]$$

where: δ = Estimated deflection, inches; w = uniform load, plf;
 L = span, feet; (EI)_{eff} = tabulated effective bending stiffness, 10⁶ lbf-in.²/ft; and
 (GA)_{eff} = tabulated effective in-plane (planar) shear rigidity, 10⁶ lbf/ft

For a concentrated line load, P, located in the middle of a single span CLT panel acting perpendicular to the panel, the deflection shall be permitted to be calculated as follows:

$$\delta = \frac{36PL^3}{(EI)_{eff}} + \frac{3PL}{(GA)_{eff}} \quad [2]$$

where: δ = Estimated deflection, inches; P = concentrated line load, lbf;
 L = span, feet; (EI)_{eff} = tabulated effective bending stiffness, 10⁶ lbf-in.²/ft; and
 (GA)_{eff} = tabulated effective in-plane (planar) shear rigidity, 10⁶ lbf/ft

^(c) The CLT grade and layups are developed based on ANSI/APA PRG 320, as permitted by the standard.

^(d) The layup identification (ID) refers to lumber lamination species and number of layers.

^(e) The V1M3 grade and layups use No.2 Douglas fir-Larch lumber in both major and minor strength directions.

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