

Boise Cascade VersaWorks[®] Veneer Laminated Timber PR-L335
Boise Cascade Wood Products, LLC Revised December 28, 2023

Products: Boise Cascade VersaWorks[®] Veneer Laminated Timber
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1. Basis of the product report:
 - 2021, 2018, and 2015 International Building Code (IBC): Section 2303.1.4 Structural glued cross-laminated timber
 - 2012 IBC: Section 104.11 Alternative materials
 - 2021, 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 320-2019 Standard for Performance-Rated Cross-Laminated Timber, recognized in the 2021 IBC and IRC
 - ANSI/APA PRG 320-2017, PRG 320-2012, and PRG 320-2011, recognized in the 2018 IBC and IRC, 2015 IRC, and 2015 IBC, respectively
 - ASTM D5456-18, D5456-14b, D5456-13, and D5456-09 recognized by the 2021 IBC and IRC, 2018 IBC and IRC, 2015 IBC and IRC, and 2012 IBC and IRC, respectively
 - APA Reports T2021P-02, T2021P-32, T2022P-03, T2022M-20, and T2023P-31, and other qualification data
2. Product description:

Boise Cascade VersaWorks[®] Veneer Laminated Timber (VLT) is manufactured with Boise Cascade 1-1/16-inch-thick 1.5E_{true} 1800_{plank} Douglas-fir or 1-inch-thick 1.5E_{true} 1800_{plank} Southern pine laminated veneer lumber (LVL), which is produced only for use as VLT laminations with allowable properties specified in Table 1, in accordance with custom layouts of ANSI/APA PRG 320 through product qualification and mathematical models using principles of engineering mechanics. The LVL layers contain crossband veneers and are parallel-laminated, bonded with qualified structural adhesives, and pressed to form a solid VLT panel. Boise Cascade VLT can be used in floor, roof, and wall applications, and is manufactured in a plank billet with nominal widths of 2 to 48 inches, thicknesses of 2-1/8 to 12-3/4 inches (2 to 12 plies), and lengths up to 66 feet.
3. Design properties:

Boise Cascade VLT shall be designed with the design properties and capacities provided in Tables 2 and 3 or recommendations provided by the manufacturer. The design adjustment factors shall be in accordance with Chapter 10 of the 2018 National Design Specification for Wood Construction (NDS) or based on the recommendations provided by the manufacturer and approved by the engineer of record. The lateral resistance of Boise Cascade VLT, when used as shear walls or diaphragms, depends on the panel-to-panel connection and anchorage designs, and shall be designed in accordance with Sections 4.4 and 4.5 of the 2021 ANSI/AWC Special Design Provisions for Wind and Seismic (SDPWS), or consulted with the manufacturer and approved by the engineer of record.
4. Product installation:

Boise Cascade VLT shall be installed in accordance with the recommendations provided by the manufacturer and engineering drawings approved by the engineer of record. Permissible details shall be in accordance with the recommendations provided by the manufacturer and the engineering drawings.

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 for cross-laminated timber (CLT) shall be permitted for use in designing Boise Cascade VLT for a fire exposure up to 2 hours.
6. Sound-rated floor/ceiling assemblies:
Boise Cascade VLT is permitted for use as a component of floor/ceiling assemblies required to have acoustical ratings in accordance with the code. Sound ratings are as provided by the manufacturer.
7. Limitations:
 - a) Boise Cascade VLT products shall be designed in accordance with principles of mechanics using the design properties specified in this report or provided by the manufacturer.
 - b) Boise Cascade VLT products shall be limited to dry service conditions where the average equilibrium moisture content of solid-sawn lumber is less than 16%.
 - c) Design properties for Boise Cascade VLT products, when used as beams or lintels with loads applied parallel to the face-bond glue lines, are beyond the scope of this report.
 - d) Boise Cascade VLT products shall be manufactured in accordance with proprietary Boise Cascade VLT manufacturing specifications documented in the in-plant manufacturing standard approved by APA.
 - e) Boise Cascade VLT products are produced at the Boise Cascade facilities in White City, Oregon (Douglas fir VLT only) and Lena, Louisiana (Southern pine VLT only) under a quality assurance program audited by APA.
 - f) Properties shown in this report are limited to VLT products manufactured with Boise Cascade 1-1/16-inch-thick 1.5E_{true} 1800_{plank} Douglas-fir or 1-inch-thick 1.5E_{true} 1800_{plank} Southern pine LVL, which is produced only for use as VLT laminations and documented in the in-plant manufacturing standard approved by APA.
 - g) This report is subject to re-examination in one year.
8. Identification:
Boise Cascade VLT described in this report is identified by a label bearing the manufacturer's name (Boise Cascade) and/or trademark, the APA assigned plant number (1139 for White City, OR and 1106 for Lena, LA), the product standard (ANSI/APA PRG 320), the APA logo, the VLT grade and thickness (or layup ID), the report number PR-L335, and a means of identifying the date of manufacture.

Table 1. ASD Reference Design Values^(a) for LVL Laminations Used in Boise Cascade VLT (for Use in the U.S.)

VLT Grade	Laminations Used in Major Strength Direction								Laminations Used in Minor Strength Direction							
	Grade & Species	F _b (psi)	E _{apparent} (10 ⁶ psi)	F _t (psi)	F _c (psi)	F _{c,l} (psi)	F _v (psi)	F _s (psi)	Grade & Species	F _b (psi)	E _{apparent} (10 ⁶ psi)	F _t (psi)	F _c (psi)	F _{c,l} (psi)	F _v (psi)	F _s (psi)
1.5E	Boise Cascade 1.5E _{true} 1800 _{plank} DF LVL	1,800	1.4	1,200	2,500	450	150	75	Boise Cascade 1.5E _{true} 1800 _{plank} DF LVL	1,800	1.4	1,200	2,500	450	150	37.5
1.5E	Boise Cascade 1.5E _{true} 1800 _{plank} SP LVL	1,800	1.4	1,200	2,500	450	150	75	Boise Cascade 1.5E _{true} 1800 _{plank} SP LVL	1,800	1.4	1,200	2,500	450	150	37.5

For SI: 1 psi = 0.006895 MPa

^(a) Tabulated values are allowable design values and not permitted to be changed for the LVL size adjustment factor. The design values shall be used in conjunction with the section properties provided by the VLT manufacturer based on the actual layout used in manufacturing the VLT panel (see Table 2).

Table 2. ASD Reference Design Values^(a,b,c,d) for Boise Cascade VLT (for Use in the U.S.)

VLT Grade	Species	Thickness, t _p (in.)	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)
1.5E (DF)	DF	2 1/8	1,110	13.5	0.72	1,230	120	0.60	0.14	250
		3 3/16	2,550	47	1.1	1,870	275	2.0	0.14	380
		4 1/4	4,625	115	1.5	2,525	500	5.0	0.14	510
		5 5/16	7,225	224	1.8	3,150	500	5.0	0.14	640
		6 3/8	10,225	380	2.6	3,775	500	5.0	0.14	1,050
		7 7/16	13,625	585	3.0	4,350	500	5.0	0.14	1,050
		8 1/2	17,600	863	3.7	4,975	500	5.0	0.14	1,050
		9 9/16	22,300	1,229	4.2	5,600	500	5.0	0.14	1,050
		10 5/8	25,625	1,602	4.6	6,225	500	5.0	0.14	1,050
		11 11/16	31,000	2,132	5.1	6,850	500	5.0	0.14	1,050
		12 3/4	36,900	2,768	5.6	7,475	500	5.0	0.14	1,050
1.5E (SP)	SP	2	1,070	12.7	0.64	1,200	155	0.75	0.22	257
		3	2,525	43	0.96	1,800	350	2.55	0.22	386
		4	4,500	102	1.3	2,400	625	6.04	0.22	514
		5	7,050	199	1.6	3,000	625	6.04	0.22	643
		6	9,900	335	2.3	3,600	625	6.04	0.22	1,025

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

- (a) Tabulated values are allowable design values.
- (b) Tabulated values are limited to VLT products manufactured with Boise Cascade 1-1/16-inch-thick 1.5E_{true} 1800_{plank} Douglas-fir or 1-inch-thick 1.5E_{true} 1800_{plank} Southern pine LVL documented in the in-plant manufacturing standard approved by APA.
- (c) Equivalent Specific Gravity (ESG) = 0.50 for nails and bolts installed into the wide or narrow face under lateral or withdrawal loading.
- (d) Deflection under a specified uniformly distributed load, w, acting perpendicular to the face of a single-span panel may 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 shear rigidity, (GA)_{eff}, as follows:

$$\delta = \frac{22.5wL^4}{(EI)_{eff}} + \frac{9wL^2}{5(GA)_{eff}} \quad [1]$$

where: δ = estimated deflection, inches; w = uniform load, lbf/ft²;
 L = span, feet; (EI)_{eff} = tabulated effective bending stiffness, 10⁶ lbf-in.²/ft; and
 (GA)_{eff} = tabulated effective in-plane shear rigidity, 10⁶ lbf/ft.

For a concentrated load, P, located in the middle of a single span VLT panel acting perpendicular to the panel, the deflection may be calculated as follows:

$$\delta = \frac{36PL^3}{(EI)_{eff}} + \frac{18PL}{5(GA)_{eff}} \quad [2]$$

where: δ = estimated deflection, inches; P = concentrated load, lbf/ft of width;
 L = span, feet; $(EI)_{eff}$ = tabulated effective bending stiffness, 10^6 lbf-in.²/ft; and
 $(GA)_{eff}$ = tabulated effective in-plane shear rigidity, 10^6 lbf/ft.

Table 3. ASD In-Plane Reference Design Values^(a,b,c) for Boise Cascade VLT (for Use in the U.S.)

VLT Grade	Species	Thickness, t_p (in.)	In-Plane Shear Capacity		In-Plane Shear Stiffness			
			Both Directions		Major Strength Direction		Minor Strength Direction	
			(psi)	(lbf/ft of width)	G (ksi)	GA (kip/ft of width)	G (ksi)	GA (kip/ft of width)
1.5E (DF)	DF	2 1/8	225	5,550	155	3,837	53	1,312
		3 3/16	225	8,425	155	5,812	53	1,987
		4 1/4	225	11,350	155	7,826	53	2,676
		5 5/16	225	14,200	155	9,783	53	3,345
		6 3/8	225	17,025	155	11,740	53	4,014
		7 7/16	225	19,675	155	13,557	53	4,635
		8 1/2	225	22,475	155	15,493	53	5,297
		9 9/16	225	25,300	155	17,430	53	5,959
		10 5/8	225	28,100	155	19,368	53	6,622
		11 11/16	225	30,925	155	21,304	53	7,284
1.5E (SP)	SP	2	225	5,400	125	3,000	125	3,000
		3	225	8,100	125	4,500	125	4,500
		4	225	10,800	125	6,000	125	6,000
		5	225	13,500	125	7,500	125	7,500
		6	225	16,200	125	9,000	125	9,000

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

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- (b) Tabulated values are limited to VLT products manufactured with Boise Cascade 1-1/16-inch-thick 1.5E_{true} 1800_{plank} Douglas-fir or 1-inch-thick 1.5E_{true} 1800_{plank} Southern pine LVL documented in the in-plant manufacturing standard approved by APA.
- (c) Equivalent Specific Gravity (ESG) = 0.50 for nails and bolts installed into the wide or narrow face under lateral or withdrawal loading.

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