APA PRODUCT REPORT®

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Element5 Cross-Laminated Timber
Element5 Limited Partnership

PR-L339
Revised April 25, 2022

Products: Element5 Cross-Laminated Timber
Element5 Limited Partnership, 70 Dennis Road, St. Thomas, Ontario, Canada N5P 0B6
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www.elementfive.co

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
   - PFS TECO Reports No. 20-202, 20-211, 21-031, 21-044, 21-052, 21-053, 21-113, 21-132, 21-504, 21-609, 21-610, 21-689, and 21-690, and other qualification data

2. Product description:
   Element5 cross-laminated timber (CLT) is manufactured with laminating lumber in accordance with custom layups approved by APA through product qualification and/or mathematical models using principles of engineering mechanics in accordance with ANSI/APA PRG 320. The laminating lumber shall have allowable reference design properties provided in Table 1. Element5 CLT can be used in floor, roof, and wall applications, and is manufactured with nominal widths of up to 137.8 inches, thicknesses of 3.1 to 12.4 inches, and lengths up to 52.5 feet.

3. Design properties:
   Element5 CLT shall be designed with the allowable design properties and capacities provided in Table 2. The design value adjustment factors shall be based on Table 10.3.1. of the 2018 ANSI/AWC National Design Specification for Wood Construction (NDS). The lateral resistance of Element5 CLT, when used as shearwalls 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 CLT manufacturer and approved by the engineer of record.

4. Product installation:
   Element5 CLT shall be installed in accordance with the recommendations provided by the manufacturer (www.elementfive.co) 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 (see link above). Procedures specified in Chapter 16 of the 2018 NDS shall be permitted for use in designing Element5 CLT for a fire exposure up to 2 hours.

6. Limitations:
   a) Element5 CLT shall be designed in accordance with principles of mechanics using the allowable design properties specified in this report or provided by the manufacturer.
   b) Element5 CLT 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 Element5 CLT, when used as beams or lintels with loads applied parallel to the face-bond gluelines, are beyond the scope of this report.
   d) Element5 CLT shall be manufactured in compliance with ANSI/APA PRG 320 and documented in the Element5's in-plant manufacturing standard approved by APA.
   e) Element5 CLT is produced at the Element5 Limited Partnership, St. Thomas, Ontario facility under a quality assurance program audited by APA.
   f) This report is subject to re-examination in one year.

7. Identification:
   Element5 CLT described in this report is identified by a label bearing the manufacturer's name (Element5) and/or trademark, the APA assigned plant number (1145), the product standard (ANSI/APA PRG 320), the APA logo, the CLT grade and thickness (or layup ID), the report number PR-L339, and a means of identifying the date of manufacture.

Table 1. ASD Reference Design Values[(a)] for Lumber Laminations Used in Element5 CLT (for Use in the U.S.)

CLT Grade	Laminations Used in Major Strength Direction									Laminations Used in Minor Strength Direction								
	Grade & Species	F_b (psi)	E (10^6 psi)	F_t (psi)	F_c (psi)	F_v (psi)	F_s (psi)	$F_{c\perp}$ (psi)	G	Grade & Species	F_b (psi)	E (10^6 psi)	F_t (psi)	F_c (psi)	F_v (psi)	F_s (psi)	$F_{c\perp}$ (psi)	G
E1M10 & E1M10.1	2100f-1.8E SPF	2,100	1.8	1,575	1,875	160	50	525	0.46	No. 1/No. 2 SPF	875	1.4	450	1,150	135	45	425	0.42
E1M12, E1M12.1, & E1M12.2	1650f-1.5E SPF	1,650	1.5	1,020	1,700	135	45	425	0.42	No. 1/No. 2 SPF	875	1.4	450	1,150	135	45	425	0.42
V2M7, V2M7.1, & V2M7.2	No. 1/No. 2 SPF	875	1.4	450	1,150	135	45	425	0.42	No. 1/No. 2 SPF	875	1.4	450	1,150	135	45	425	0.42

For SI: 1 psi = 0.006895 MPa

(a) Tabulated values are allowable design values and not permitted to be increased for the lumber size adjustment 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 Element5 CLT (for Use in the U.S.)

CLT Grade[(c)]	Layup ID	Thick-ness, t_p (in.)	Lamination Thickness (in.) in CLT Layup									Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	⊥	=	$(F_bS)_{eff,f,0}$ (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)	$(F_bS)_{eff,f,90}$ (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)
E1M10	3-ply	4.14	1.38	1.38	1.38							4,875	122	0.54	1,490	275	3.6	0.66	550
	5-ply	6.90	1.38	1.38	1.38	1.38	1.38					11,225	466	1.1	2,480	2,390	95	1.3	1,650
	7-ply	9.66	1.38	1.38	1.38	1.38	1.38	1.38	1.38			19,800	1,154	1.6	3,475	5,525	364	2.0	2,750
	9-ply	12.42	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	30,700	2,299	2.1	4,450	9,775	903	2.6	3,850
E1M10.1	3-ply	3.09	1.03	1.03	1.03							2,750	51	0.40	1,110	155	1.5	0.49	415
	5-ply	5.15	1.03	1.03	1.03	1.03	1.03					6,300	197	0.80	1,860	1,350	40	0.99	1,240
	7-ply	7.21	1.03	1.03	1.03	1.03	1.03	1.03	1.03			11,150	487	1.2	2,600	3,100	154	1.5	2,060
	9-ply	9.27	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	17,275	970	1.6	3,350	5,500	381	2.0	2,900
E1M12	3-ply	4.14	1.38	1.38	1.38							3,825	102	0.53	1,490	275	3.6	0.56	495
	5-ply	6.90	1.38	1.38	1.38	1.38	1.38					8,825	389	1.1	2,480	2,390	95	1.1	1,490
	7-ply	9.66	1.38	1.38	1.38	1.38	1.38	1.38	1.38			15,600	963	1.6	3,475	5,500	364	1.7	2,480
	9-ply	12.42	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	24,200	1,921	2.1	4,450	9,750	901	2.2	3,475
E1M12.1	3-ply	3.09	1.03	1.03	1.03							2,160	43	0.40	1,110	155	1.5	0.42	370
	5-ply	5.15	1.03	1.03	1.03	1.03	1.03					4,950	164	0.79	1,860	1,350	40	0.84	1,110
	7-ply	7.21	1.03	1.03	1.03	1.03	1.03	1.03	1.03			8,775	406	1.2	2,600	3,100	153	1.3	1,860
	9-ply	9.27	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	13,600	810	1.6	3,350	5,475	380	1.7	2,600

Table 2. ASD Reference Design Values[a, b] for Element5 CLT (for Use in the U.S.) (Continued)

CLT Grade[c]	Layup ID	Thick-ness, t_p (in.)	Lamination Thickness (in.) in CLT Layup									Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	⊥	=	$(F_bS)_{eff,f,0}$ (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)	$(F_bS)_{eff,f,90}$ (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)
E1M12.2	3-ply	3.50	1.38	0.75	1.38							2,825	64	0.54	1,260	80	0.59	0.35	270
	5-ply	5.63	1.38	0.75	1.38	0.75	1.38					6,550	236	1.1	2,030	1,080	30	0.70	1,040
	7-ply	7.75	1.38	0.75	1.38	0.75	1.38	0.75	1.38			11,625	578	1.6	2,800	2,450	118	1.0	1,800
	9-ply	9.88	1.38	0.75	1.38	0.75	1.38	0.75	1.38	0.75	1.38	18,100	1,147	2.2	3,550	4,300	295	1.4	2,575
V2M7	3-ply	4.14	1.38	1.38	1.38							2,030	95	0.52	1,490	275	3.6	0.52	495
	5-ply	6.90	1.38	1.38	1.38	1.38	1.38					4,675	363	1.1	2,480	2,390	95	1.1	1,490
	7-ply	9.66	1.38	1.38	1.38	1.38	1.38	1.38	1.38			8,275	900	1.6	3,475	5,500	363	1.6	2,480
	9-ply	12.42	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	12,850	1,795	2.1	4,450	9,750	900	2.1	3,475
V2M7.1	3-ply	3.09	1.03	1.03	1.03							1,140	40	0.39	1,110	155	1.5	0.39	370
	5-ply	5.15	1.03	1.03	1.03	1.03	1.03					2,625	153	0.79	1,860	1,350	40	0.79	1,110
	7-ply	7.21	1.03	1.03	1.03	1.03	1.03	1.03	1.03			4,650	380	1.2	2,600	3,100	153	1.2	1,860
	9-ply	9.27	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	7,225	757	1.6	3,350	5,475	380	1.6	2,600
V2M7.2	3-ply	3.50	1.38	0.75	1.38							1,500	59	0.53	1,260	80	0.59	0.33	270
	5-ply	5.63	1.38	0.75	1.38	0.75	1.38					3,475	221	1.1	2,030	1,080	30	0.65	1,040
	7-ply	7.75	1.38	0.75	1.38	0.75	1.38	0.75	1.38			6,175	540	1.6	2,800	2,450	118	0.98	1,800
	9-ply	9.88	1.38	0.75	1.38	0.75	1.38	0.75	1.38	0.75	1.38	9,600	1,071	2.1	3,550	4,300	294	1.3	2,575

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 size adjustment 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:

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

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

For a concentrated 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:

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

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 (planar) shear rigidity, 10^6 lbf/ft.

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

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