

Element5 Cross-Laminated Timber
Element5 Limited Partnership

PR-L339(C)
Revised April 25, 2022

Products: Element5 Cross-Laminated Timber
Element5 Limited Partnership, 70 Dennis Road, St. Thomas, Ontario
Canada N5P 0B6
(888) 670-7713
www.elementfive.co

1. Basis of the product report:
 - 2020 National Building Code of Canada (NBC): Clause 1.2.1.1 of Division A and Clauses 4.1, 4.3.1.1, and 9.23 of Division B
 - CAN/CSA O86-19 Engineering Design in Wood
 - ANSI/APA PRG 320-2019 Standard for Performance-Rated Cross-Laminated Timber
 - ANSI/APA PRG 320-2018 recognized in CSA O86-19
 - 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 layouts 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 Limit States design (LSD) specified strength and modulus of elasticity provided in Table 1. Element5 CLT can be used in floor, roof, and wall applications, and is manufactured with nominal widths up to 3,500 mm (137.8 inches), thicknesses of 78 to 315 mm (3.1 to 12.4 inches), and lengths up to 16 m (52.5 feet).
3. Design properties:

Element5 CLT shall be designed with the design properties and capacities provided in Table 2. The design value adjustment factors shall be based on CSA O86. 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 Clause 11.9 of CSA O86, 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 Annex B of CSA O86 shall be permitted for use in the fire design of Element5 CLT when approved by the authority having jurisdiction.
6. Limitations:
 - a) Element5 CLT shall be designed in accordance with principles of mechanics using the 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 over a year is 15% or less and does not exceed 19%.
 - 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 or PR-L339C, and a means of identifying the date of manufacture.

Table 1. LSD Specified Strengths and Modulus of Elasticity^(a) for Lumber Laminations Used in Element5 CLT (for Use in Canada)

CLT Grade	Laminations Used in Major Strength Direction									Laminations Used in Minor Strength Direction								
	Grade & Species	f _b (MPa)	E (MPa)	f _t (MPa)	f _c (MPa)	f _v (MPa)	f _s (MPa)	f _{cp} (MPa)	G	Grade & Species	f _b (MPa)	E (MPa)	f _t (MPa)	f _c (MPa)	f _v (MPa)	f _s (MPa)	f _{cp} (MPa)	G
E1M10 & E1M10.1	2100f-1.8E SPF	30.4	12,400	17.7	19.9	1.5	0.50	6.5	0.47	No. 1/No. 2 SPF	11.8	9,500	5.5	11.5	1.5	0.50	5.3	0.42
E1M12, E1M12.1, & E1M12.2	1650f-1.5E SPF	23.9	10,300	11.4	18.1	1.5	0.50	5.3	0.42	No. 1/No. 2 SPF	11.8	9,500	5.5	11.5	1.5	0.50	5.3	0.42
V2M7, V2M7.1, & V2M7.2	No. 1/No. 2 SPF	11.8	9,500	5.5	11.5	1.5	0.50	5.3	0.42	No. 1/No. 2 SPF	11.8	9,500	5.5	11.5	1.5	0.50	5.3	0.42

For Imperial: 1 MPa = 145.04 psi

^(a) Tabulated values are Limit States design values and not permitted to be increased for the lumber size adjustment factor in accordance with CSA O86. The design values shall be used in conjunction with the section properties provided by the CLT manufacturer based on the actual layout used in manufacturing the CLT panel (see Table 2).

Table 2. LSD Stiffness and Unfactored Resistance Values^(a,b) for Element5 CLT (for Use in Canada)

CLT Grade ^(c)	Layout ID	Thick-ness, t _p (mm)	Lamination Thickness (mm) in CLT Layout									Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	⊥	=	(F _b S) _{eff,f,0} (10 ⁶ N-mm/m)	(EI) _{eff,f,0} (10 ⁹ N-mm ² /m)	(GA) _{eff,f,0} (10 ⁶ N/m)	V _{s,0} (kN/m)	(F _b S) _{eff,f,90} (10 ⁶ N-mm/m)	(EI) _{eff,f,90} (10 ⁹ N-mm ² /m)	(GA) _{eff,f,90} (10 ⁶ N/m)	V _{s,90} (kN/m)
E1M10	3-ply	105	35	35	35							46	1,153	7.7	35	2.4	34	9.6	12
	5-ply	175	35	35	35	35	35					105	4,416	15	58	21	884	19	35
	7-ply	245	35	35	35	35	35	35	35			186	10,922	23	82	48	3,399	29	58
	9-ply	315	35	35	35	35	35	35	35	35	35	288	21,764	31	105	85	8,428	38	82
E1M10.1	3-ply	78	26	26	26							25	473	5.7	26	1.3	14	7.1	9
	5-ply	130	26	26	26	26	26					58	1,810	11	43	12	362	14	26
	7-ply	182	26	26	26	26	26	26	26			103	4,477	17	61	27	1,393	21	43
	9-ply	234	26	26	26	26	26	26	26	26	26	159	8,922	23	78	47	3,455	29	61
E1M12	3-ply	105	35	35	35							36	958	7.6	35	2.4	34	8.1	12
	5-ply	175	35	35	35	35	35					83	3,673	15	58	21	884	16	35
	7-ply	245	35	35	35	35	35	35	35			146	9,091	23	82	48	3,392	24	58
	9-ply	315	35	35	35	35	35	35	35	35	35	227	18,125	30	105	85	8,403	33	82
E1M12.1	3-ply	78	26	26	26							20	393	5.7	26	1.3	14	6.0	9
	5-ply	130	26	26	26	26	26					46	1,506	11	43	12	362	12	26
	7-ply	182	26	26	26	26	26	26	26			81	3,727	17	61	27	1,391	18	43
	9-ply	234	26	26	26	26	26	26	26	26	26	125	7,430	23	78	47	3,445	24	61

Table 2. LSD Stiffness and Unfactored Resistance Values^(a,b) for Element5 CLT (for Use in Canada) (Continued)

CLT Grade ^(c)	Layup ID	Thickness, t _p (mm)	Lamination Thickness (mm) in CLT Layup									Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	⊥	=	(F _b S) _{eff,f,0} (10 ⁶ N-mm/m)	(EI) _{eff,f,0} (10 ⁹ N-mm ² /m)	(GA) _{eff,f,0} (10 ⁶ N/m)	V _{s,0} (kN/m)	(F _b S) _{eff,f,90} (10 ⁶ N-mm/m)	(EI) _{eff,f,90} (10 ⁹ N-mm ² /m)	(GA) _{eff,f,90} (10 ⁶ N/m)	V _{s,90} (kN/m)
E1M12.2	3-ply	89	35	19	35							27	599	7.8	30	0.71	5.4	5.1	6
	5-ply	143	35	19	35	19	35					61	2,222	16	48	9.4	275	10	24
	7-ply	197	35	19	35	19	35	19	35			109	5,439	23	66	21	1,089	15	42
	9-ply	251	35	19	35	19	35	19	35	19	35	169	10,785	31	84	37	2,727	20	60
V2M7	3-ply	105	35	35	35							18	884	7.6	35	2.4	34	7.6	12
	5-ply	175	35	35	35	35	35					41	3,390	15	58	21	884	15	35
	7-ply	245	35	35	35	35	35	35	35			72	8,394	23	82	48	3,390	23	58
	9-ply	315	35	35	35	35	35	35	35	35	35	112	16,738	30	105	85	8,394	30	82
V2M7.1	3-ply	78	26	26	26							9.8	362	5.6	26	1.3	14	5.6	9
	5-ply	130	26	26	26	26	26					23	1,390	11	43	12	362	11	26
	7-ply	182	26	26	26	26	26	26	26			40	3,441	17	61	27	1,390	17	43
	9-ply	234	26	26	26	26	26	26	26	26	26	62	6,862	22	78	47	3,441	22	61
V2M7.2	3-ply	89	35	19	35							13	553	7.7	30	0.71	5.4	4.7	6
	5-ply	143	35	19	35	19	35					30	2,050	15	48	9.4	275	9.4	24
	7-ply	197	35	19	35	19	35	19	35			54	5,019	23	66	21	1,087	14	42
	9-ply	251	35	19	35	19	35	19	35	19	35	84	9,954	31	84	37	2,721	19	60

For Imperial: 1 mm = 0.0394 in.; 1 m = 3.28 ft; 1 N = 0.2248 lbf

^(a) Tabulated values are unfactored Limit States design values and not permitted to be increased for the lumber size adjustment factor in accordance with CSA O86.

^(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:

$$\delta = \frac{5wL^4}{384(EI)_{eff}} + \frac{wL^2}{8000(GA)_{eff}} \quad [1]$$

where: δ = estimated deflection, mm; w = uniform load, N/m²;
 L = span, m; (EI)_{eff} = tabulated effective bending stiffness, 10⁹ N-mm²/m; and
 (GA)_{eff} = tabulated effective in-plane (planar) shear rigidity, 10⁶ N/m.

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:

$$\delta = \frac{PL^3}{48(EI)_{eff}} + \frac{PL}{4000(GA)_{eff}} \quad [2]$$

where: δ = estimated deflection, mm; P = concentrated load, N/m of width;
 L = span, m; (EI)_{eff} = tabulated effective bending stiffness, 10⁹ N-mm²/m; and
 (GA)_{eff} = tabulated effective in-plane (planar) shear rigidity, 10⁶ N/m.

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

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**APA – THE ENGINEERED WOOD ASSOCIATION
HEADQUARTERS**

7011 So. 19th St. ▪ Tacoma, Washington 98466
Phone: (253) 565-6600 ▪ Fax: (253) 565-7265 ▪ Internet Address: www.apawood.org

PRODUCT SUPPORT HELP DESK
(253) 620-7400 ▪ *E-mail Address:* help@apawood.org

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