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Structurlam CrossLam
Structurlam Mass Timber Corporation

PR-L314C
Revised November 19, 2018

Products: Structurlam CrossLam Cross-Laminated Timber
Structurlam Mass Timber Corporation
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1. Basis of the product report:
   - 2015 National Building Code of Canada (NBCC): Clause 1.2.1.1 of Division A and Clauses 4.1, 4.3.1.1, and 9.23 of Division B
   - CAN/CSA O86-14 (reprint 2016) Engineering Design in Wood
   - ANSI/APA PRG 320-2017 Performance Rated Cross-Laminated Timber
   - APA Reports T2014P-08 and T2016P-22, FPInnovations Reports 301006716, 301007702, and 301010876, UBC Team Reports 2015-06 and 2018-05, and other qualification data

2. Product description:
   Structurlam CrossLam cross-laminated timber (CLT) is manufactured with spruce-pine-fir (SPF) lumber in accordance with ANSI/APA PRG 320 or proprietary layup combinations approved by APA through product qualification and/or mathematical models using principles of engineering mechanics. The SPF lumber must have a minimum specific gravity of 0.42 and LSD specified design properties provided in Table 1. The outermost SPF laminations shall be permitted to be replaced by Douglas fir-Larch lumber with design properties that are equal to or greater than the corresponding SPF laminations. Structurlam CrossLam CLT can be used in floor, roof, and wall applications, and is manufactured with nominal widths of 305 to 3050 mm (12 to 120 inches), thicknesses of 76 to 315 mm (3 to 12-3/8 inches), and lengths up to 12.2 m (40 feet).

3. Design properties:
   Structurlam CrossLam CLT shall be designed with the design properties and capacities provided in Tables 2 and 3, or with the maximum load table provided by the manufacturer (www.structurlam.com/wp-content/uploads/2016/10/CrossLam-CLT-CA-Design-Guide-1.pdf) using CSA O86. The lateral resistance of Structurlam CrossLam 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.

4. Product installation:
   Structurlam CrossLam CLT shall be installed in accordance with the recommendations provided by the manufacturer (see link above) 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 Structurlam CrossLam CLT when approved by the authority having jurisdiction.

6. Limitations:
   a) Structurlam CrossLam CLT shall be designed in accordance with principles of mechanics using the design properties specified in this report or provided by the manufacturer.
   b) Structurlam CrossLam products shall be limited to dry service conditions where the average equilibrium moisture content of solid-sawn lumber over a year is 15 percent or less and does not exceed 19 percent.
   c) Design properties for Structurlam CrossLam CLT, when used as beams or lintels with loads applied parallel to the face-bond gluelines, are beyond the scope of this report.
   d) Structurlam CrossLam CLT shall be manufactured in accordance with layup combinations specified in ANSI/APA PRG 320 or proprietary Structurlam CrossLam CLT manufacturing specifications documented in the in-plant manufacturing standard approved by APA.
   e) Structurlam CrossLam CLT is produced at the Structurlam, Penticton, British Columbia facilities under a quality assurance program audited by APA.
   f) This report is subject to re-examination in one year.

7. Identification:
   Structurlam CrossLam CLT described in this report is identified by a label bearing the manufacturer's name (Structurlam) and/or trademark, the APA assigned plant number (1073), the product standard (ANSI/APA PRG 320), the APA logo, the CLT layup (such as V2M1), the report number PR-L314, and a means of identifying the date of manufacture.

Table 1. LSD Specified Strengths and Modulus of Elasticity[a] for Lumber Laminations Used in Structurlam CrossLam CLT (for Use in Canada)

CLT Layup	Laminations Used in Major Strength Direction						Laminations Used in Minor Strength Direction					
	f_b (MPa)	E (MPa)	f_t (MPa)	f_c (MPa)	f_v (MPa)	f_s (MPa)	f_b (MPa)	E (MPa)	f_t (MPa)	f_c (MPa)	f_v (MPa)	f_s (MPa)
E1M3	23.9	10,300	11.4	18.1	1.5	0.50	11.8	9,500	5.5	11.5	1.5	0.50
E1M4 & E1M6	30.4	12,400	17.7	19.9	1.5	0.50	7.0	9,000	3.2	9.0	1.5	0.50
E1M5 & E1M7	30.4	12,400	17.7	19.9	1.5	0.50	11.8	9,500	5.5	11.5	1.5	0.50
V2M1, V2M1.1, V2M2, & V2M2.1	11.8	9,500	5.5	11.5	1.5	0.50	11.8	9,500	5.5	11.5	1.5	0.50
V2.1 & V2.1M1	11.8	9,500	5.5	11.5	1.5	0.50	7.0	9,000	3.2	9.0	1.5	0.50

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 layup used in manufacturing the CLT panel (see Table 2).

Table 2. LSD Stiffness and Unfactored Resistance Values[a] for Structurlam CrossLam CLT Listed in Table 1 (for Use in Canada)

CLT Layup[b]	Layup ID[c]	Thick-ness, t_p (mm)	Lamination Thickness (mm) in CLT Layup									Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	⊥	=	$(F_bS)_{eff,f,0}$ (10^6 N-mm/m)	$(EI)_{eff,f,0}$ (10^9 N-mm²/m)	$(GA)_{eff,f,0}$ (10^6 N/m)	$V_{s,0}$ (kN/m)	$(F_bS)_{eff,f,90}$ (10^6 N-mm/m)	$(EI)_{eff,f,90}$ (10^9 N-mm²/m)	$(GA)_{eff,f,90}$ (10^6 N/m)	$V_{s,90}$ (kN/m)
V2.1[h]	87 V	87	35	17	35							13	518	7.5	29	0.34	3.7	4.4	6
	139 V	139	35	17	35	17	35					29	1,907	15	46	4.9	215	8.7	23
	191 V	191	35	17	35	17	35	17	35			52	4,659	22	64	11	856	13	40
	243 V	243	35	17	35	17	35	17	35	17	35	80	9,230	30	81	19	2,147	17	58
V2M1[g]	99 V	99	32	35	32							16	735	7.0	33	2.4	34	7.5	12
	169 V	169	32	35	35	35	32					37	2,968	15	56	21	884	15	35
	239 V	239	32	35	35	35	35	35	32			67	7,559	22	80	48	3,390	23	58
	309 V	309	32	35	35	35	35	35	35	35	32	105	15,351	30	103	85	8,394	30	82
V2M1.1[i]	105 V	105	35	35	35							18	884	7.6	35	2.4	34	7.6	12
	175 V	175	35	35	35	35	35					41	3,390	15	58	21	884	15	35
	245 V	245	35	35	35	35	35	35	35			72	8,394	23	82	48	3,390	23	58
	315 V	315	35	35	35	35	35	35	35	35	35	112	16,738	30	105	85	8,394	30	82

Table 2. LSD Stiffness and Unfactored Resistance Values[a] for Structurlam CrossLam CLT Listed in Table 1 (for Use in Canada) (continued)

CLT Layup[b]	Layup ID[c]	Thick-ness, t_p (mm)	Lamination Thickness (mm) in CLT Layup									Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	⊥	=	$(F_bS)_{eff,f,0}$ (10^6 N-mm/m)	$(EI)_{eff,f,0}$ (10^9 N-mm²/m)	$(GA)_{eff,f,0}$ (10^6 N/m)	$V_{s,0}$ (kN/m)	$(F_bS)_{eff,f,90}$ (10^6 N-mm/m)	$(EI)_{eff,f,90}$ (10^9 N-mm²/m)	$(GA)_{eff,f,90}$ (10^6 N/m)	$V_{s,90}$ (kN/m)
V2M2[g]	169 V XL	169	32 + 35	35	35 + 32							47	3,788	15	56	2.4	34	8.8	12
	239 V XL	239	32 + 35	35	35	35	35 + 32					88	9,955	22	80	21	884	16	35
	309 V XL	309	32 + 35	35	35	35	35	35	35 + 32			137	20,109	29	103	48	3,390	24	58
V2M2.1[j]	175 V XL	175	35 x 2	35	35 x 2							51	4,210	16	58	2.4	34	8.9	12
	245 V XL	245	35 x 2	35	35	35	35 x 2					93	10,789	23	82	21	884	16	35
	315 V XL	315	35 x 2	35	35	35	35	35	35 x 2			144	21,496	30	105	48	3,390	24	58
V2.1M1[k]	157 V XL	157	35 x 2	17	35 x 2							41	3,060	18	52	0.34	3.7	6.3	6
	209 V XL	209	35 x 2	17	35	17	35 x 2					71	7,008	25	70	4.9	215	11	23
	261 V XL	261	35 x 2	17	35	17	35	17	35 x 2			107	13,218	32	87	11	856	15	40
E1M3[d]	SLT5	169	32	35	35	35	32					75	3,216	15	56	21	884	16	35
E1M4[e]	87 E	87	35	17	35							32	675	7.8	29	0.34	3.7	5.6	6
	139 E	139	35	17	35	17	35					75	2,487	16	46	4.9	216	11	23
	191 E	191	35	17	35	17	35	17	35			133	6,073	23	64	11	861	17	40
	243 E	243	35	17	35	17	35	17	35	17	35	206	12,026	31	81	19	2,166	22	58
E1M5[f]	105 E	105	35	35	35							46	1,153	7.7	35	2.4	34	9.6	12
	175 E	175	35	35	35	35	35					105	4,416	15	58	21	884	19	35
	245 E	245	35	35	35	35	35	35	35			186	10,922	23	82	48	3,399	29	58
	315 E	315	35	35	35	35	35	35	35	35	35	288	21,764	31	105	85	8,428	38	82
E1M6[e]	157 E XL	157	35 x 2	17	35 x 2							106	3,994	19	52	0.34	3.7	8.1	6
	209 E XL	209	35 x 2	17	35	17	35 x 2					182	9,146	26	70	4.9	216	14	23
	261 E XL	261	35 x 2	17	35	17	35	17	35 x 2			275	17,245	34	87	11	861	19	40

Table 2. LSD Stiffness and Unfactored Resistance Values[a] for Structurlam CrossLam CLT Listed in Table 1 (for Use in Canada) (continued)

CLT Layup[b]	Layup ID[c]	Thick-ness, t_p (mm)	Lamination Thickness (mm) in CLT Layup									Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	⊥	=	$(F_bS)_{eff,f,0}$ (10^6 N-mm/m)	$(EI)_{eff,f,0}$ (10^9 N-mm²/m)	$(GA)_{eff,f,0}$ (10^6 N/m)	$V_{s,0}$ (kN/m)	$(F_bS)_{eff,f,90}$ (10^6 N-mm/m)	$(EI)_{eff,f,90}$ (10^9 N-mm²/m)	$(GA)_{eff,f,90}$ (10^6 N/m)	$V_{s,90}$ (kN/m)
E1M7[f]	175 E XL	175	35 x 2	35	35 x 2							131	5,495	16	58	2.4	34	11	12
	245 E XL	245	35 x 2	35	35	35	35 x 2					239	14,074	23	82	21	884	21	35
	315 E XL	315	35 x 2	35	35	35	35	35	35 x 2			371	28,024	31	105	48	3,399	30	58

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] The CLT layups are developed based on ANSI/APA PRG 320, as permitted by the standard.
[c] The layup identification (ID) refers to the layup thickness (mm), lamination grade (visual graded or MSR) and series name (e.g. XL).
[d] The E1M3 grade uses 1650f-1.5E SPF MSR lumber for the outermost (top and bottom) layers in the major strength direction and visually graded No. 2 SPF lumber in the minor strength direction and the remainder layer in the major strength direction.
[e] The E1M4 and E1M6 grades use 2100f-1.8E SPF MSR in the major strength direction and visually graded No. 3 SPF lumber in the minor strength direction.
[f] The E1M5 and E1M7 grades use 2100f-1.8E SPF MSR in the major strength direction and visually graded No. 2 SPF lumber in the minor strength direction.
[g] The V2M1 and V2M2 grades use all visually graded No. 2 SPF lumber in both major and minor strength directions.
[h] The V2.1 grade uses the same layup as V2 except for lamination thicknesses (i.e., visually graded No. 2 SPF lumber in the major strength direction and visually graded No. 3 SPF lumber in the minor strength direction).
[i] The V2M1.1 grade uses the same layup as V2M1 except for lamination thicknesses.
[j] The V2M2.1 grade uses the same layup as V2M2 except for lamination thicknesses.
[k] The V2.1M1 grade uses the same layup as V2.1 except for the double exterior layers in the major strength direction.

Table 3. LSD Specified In-Plane Shear Strength for Structurlam CrossLam CLT[(a)] (For Use in Canada)

CLT Layup	Layup ID	Thickness, t_p (mm)	Specified In-Plane Shear Strength	
			$f_{v,e,0}$ (MPa)	$f_{v,e,90}$ (MPa)
V2.1	87 V	87	2.2	3.0
	139 V	139	2.2[(e)]	3.0[(e)]
	191 V	191	2.2[(e)]	3.0[(e)]
	243 V	243	2.2[(e)]	3.0[(e)]
V2M1	99 V	99	2.2[(e)]	3.0[(e)]
	169 V	169	2.2[(e)]	3.0[(e)]
	239 V	239	2.2[(e)]	3.0[(e)]
	309 V	309	2.2[(e)]	3.0[(e)]
V2M1.1	105 V	105	2.5	3.7
	175 V	175	3.4	3.7[(c)]
	245 V	245	3.4[(b)]	3.7[(c)]
	315 V	315	3.4[(b)]	3.7[(c)]
V2M2	169 V XL	169	2.2[(e)]	3.0[(e)]
	239 V XL	239	2.2[(e)]	3.0[(e)]
	309 V XL	309	2.2[(e)]	3.0[(e)]
V2M2.1	175 V XL	175	2.2[(e)]	3.0[(e)]
	245 V XL	245	2.2[(e)]	3.0[(e)]
	315 V XL	315	2.2[(e)]	3.0[(e)]
V2.1M1	157 V XL	157	2.2[(e)]	3.0[(e)]
	209 V XL	209	2.2[(e)]	3.0[(e)]
	261 V XL	261	2.2[(e)]	3.0[(e)]
E1M3	SLT5	169	2.2[(e)]	3.0[(e)]
E1M4	87 E	87	2.2[(e)]	3.0[(e)]
	139 E	139	2.2[(e)]	3.0[(e)]
	191 E	191	2.2[(e)]	3.0[(e)]
	243 E	243	2.2[(e)]	3.0[(e)]
E1M5	105 E	105	2.5[(d)]	3.7[(d)]
	175 E	175	3.4[(d)]	3.7[(d)]
	245 E	245	3.4[(d)]	3.7[(d)]
	315 E	315	3.4[(d)]	3.7[(d)]
E1M6	157 E XL	157	2.2[(e)]	3.0[(e)]
	209 E XL	209	2.2[(e)]	3.0[(e)]
	261 E XL	261	2.2[(e)]	3.0[(e)]
E1M7	175 E XL	175	2.2[(e)]	3.0[(e)]
	245 E XL	245	2.2[(e)]	3.0[(e)]
	315 E XL	315	2.2[(e)]	3.0[(e)]

For Imperial: 1 MPa = 145.04 psi

[(a)] The tabulated values are for Limit States Design (LSD) for use in Canada based on the full CLT thickness in the major strength direction ($f_{v,e,0}$) and minor strength direction ($f_{v,e,90}$). The values shall be used in conjunction with the CLT thickness, t_p, to determine the in-plane shear capacities. If the net CLT thickness is less than the full CLT thickness, the in-plane shear capacities shall be calculated based on the net CLT thickness.

[(b)] Based on test results from 175V of V2M1.1.

[(c)] Based on test results from 105V of V2M1.1.

[(d)] Based on test results from V2M1.1.

[(e)] Based on test results from 87V of V2.1.

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