APA PRODUCT REPORT®

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Structurlam CrossLam
Structurlam Mass Timber Corporation

PR-L314

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Products: Structurlam CrossLam 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 320-2017, 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
   - 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 much have a minimum specific gravity of 0.42 and allowable reference 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 12 to 120 inches, thicknesses of 3 to 12-3/8 inches, and lengths up to 40 feet.

3. Design properties:
   Structurlam CrossLam CLT shall be designed with the allowable design capacities provided in Tables 2 and 3 or with the allowable load table provided by the manufacturer (www.structurlam.com/wp-content/uploads/2017/04/CLT-US-Design-Guide-Sept-2015.pdf). The design value adjustment factors, such as load duration, creep, moisture, temperature, volume factors, etc., shall be based on the recommendations provided by the manufacturer or the U.S. CLT Handbook (www.rethinkwood.com/mass-timber-webform/cross-laminated-timber-clt-handbook), and approved by the engineer of record. 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 Chapter 16 of the 2015 National Design Specification for Wood Construction (NDS) shall be permitted for use in designing Structurlam CrossLam CLT for a fire exposure up to 2 hours.

6. Limitations:
   a) Structurlam CrossLam 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) Structurlam CrossLam products 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 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 grade (such as V2M1), the report number PR-L314, and a means of identifying the date of manufacture.

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

CLT Layup	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)
E1M4 & E1M6	2,100	1.8	1,575	1,875	160	50	500	1.2	250	650	135	45
E1M5 & E1M7	2,100	1.8	1,575	1,875	160	50	875	1.4	450	1,150	135	45
V2M1, V2M1.1, V2M2, & V2M2.1	875	1.4	450	1,150	135	45	875	1.4	450	1,150	135	45
V2.1 & V2.1M1	875	1.4	450	1,150	135	45	500	1.2	250	650	135	45

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] for Structurlam CrossLam CLT Listed in Table 1 (for Use in the U.S.)

CLT Layup[b]	Layup ID[c]	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)
V2.1[g]	87 V	3.43	1.38	0.67	1.38							1,440	56	0.48	1,230	35	0.36	0.30	240
	139 V	5.47	1.38	0.67	1.38	0.67	1.38					3,325	206	0.96	1,970	540	21	0.60	980
	191 V	7.52	1.38	0.67	1.38	0.67	1.38	0.67	1.38			5,925	503	1.4	2,700	1,220	84	0.91	1,710
	243 V	9.57	1.38	0.67	1.38	0.67	1.38	0.67	1.38	0.67	1.38	9,200	995	1.9	3,450	2,140	210	1.2	2,450
V2M1[f]	99 V	3.90	1.26	1.38	1.26							1,800	79	0.49	1,400	280	3.7	0.52	495
	169 V	6.66	1.26	1.38	1.38	1.38	1.26					4,275	321	1.0	2,400	2,410	96	1.0	1,490
	239 V	9.42	1.26	1.38	1.38	1.38	1.38	1.38	1.26			7,700	818	1.5	3,400	5,550	367	1.6	2,480
	309 V	12.18	1.26	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.26	12,075	1,662	2.1	4,375	9,800	910	2.1	3,475
V2M1.1[h]	105 V	4.14	1.38	1.38	1.38							2,050	96	0.53	1,490	280	3.7	0.53	495
	175 V	6.90	1.38	1.38	1.38	1.38	1.38					4,725	367	1.1	2,480	2,410	96	1.1	1,490
	245 V	9.66	1.38	1.38	1.38	1.38	1.38	1.38	1.38			8,350	910	1.6	3,475	5,550	367	1.6	2,480
	315 V	12.42	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	12,925	1,814	2.1	4,475	9,800	910	2.1	3,475

Table 2. ASD Reference Design Values[a] for Structurlam CrossLam CLT Listed in Table 1 (for Use in the U.S.) (continued)

CLT Layup[b]	Layup ID[c]	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)
V2M2[f]	169 V XL	6.66	1.26 + 1.38	1.38	1.38 + 1.26							5,450	409	1.0	2,400	275	3.7	0.61	495
	239 V XL	9.42	1.26 + 1.38	1.38	1.38	1.38	1.38 + 1.26					10,100	1,074	1.5	3,375	2,400	95	1.1	1,490
	309 V XL	12.18	1.26 + 1.38	1.38	1.38	1.38	1.38	1.38	1.38 + 1.26			15,800	2,170	2.0	4,375	5,525	366	1.6	2,480
V2M2.1[i]	175 V XL	6.90	1.38 x 2	1.38	1.38 x 2							5,850	454	1.1	2,480	275	3.7	0.62	495
	245 V XL	9.66	1.38 x 2	1.38	1.38	1.38	1.38 x 2					10,700	1,164	1.6	3,475	2,400	95	1.1	1,490
	315 V XL	12.42	1.38 x 2	1.38	1.38	1.38	1.38	1.38	1.38 x 2			16,550	2,320	2.1	4,475	5,525	366	1.6	2,480
V2.1M1[j]	157 V XL	6.19	1.38 x 2	0.67	1.38 x 2							4,725	330	1.2	2,230	35	0.36	0.43	240
	209 V XL	8.24	1.38 x 2	0.67	1.38	0.67	1.38 x 2					8,150	756	1.6	2,950	540	21	0.73	980
	261 V XL	10.29	1.38 x 2	0.67	1.38	0.67	1.38	0.67	1.38 x 2			12,300	1,426	2.1	3,700	1,220	84	1.0	1,710
E1M4[d]	87 E	3.43	1.38	0.67	1.38							3,475	72	0.50	1,230	35	0.36	0.38	270
	139 E	5.47	1.38	0.67	1.38	0.67	1.38					7,975	264	0.99	1,970	540	21	0.77	1,090
	191 E	7.52	1.38	0.67	1.38	0.67	1.38	0.67	1.38			14,175	645	1.5	2,700	1,230	84	1.1	1,910
	243 E	9.57	1.38	0.67	1.38	0.67	1.38	0.67	1.38	0.67	1.38	22,075	1,278	2.0	3,450	2,160	212	1.5	2,725
E1M5[e]	105 E	4.14	1.38	1.38	1.38							4,900	123	0.54	1,490	275	3.7	0.66	550
	175 E	6.90	1.38	1.38	1.38	1.38	1.38					11,250	469	1.1	2,480	2,400	95	1.3	1,650
	245 E	9.66	1.38	1.38	1.38	1.38	1.38	1.38	1.38			19,900	1,161	1.6	3,475	5,550	367	2.0	2,750
	315 E	12.42	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	30,850	2,314	2.1	4,475	9,825	909	2.6	3,850
E1M6[d]	157 E XL	6.19	1.38 x 2	0.67	1.38 x 2							11,350	425	1.2	2,230	35	0.36	0.55	270
	209 E XL	8.24	1.38 x 2	0.67	1.38	0.67	1.38 x 2					19,525	972	1.7	2,950	540	21	0.93	1,090
	261 E XL	10.29	1.38 x 2	0.67	1.38	0.67	1.38	0.67	1.38 x 2			29,475	1,833	2.1	3,700	1,230	84	1.3	1,910

Table 2. ASD Reference Design Values[a] for Structurlam CrossLam CLT Listed in Table 1 (for Use in the U.S.) (continued)

CLT Layup[b]	Layup ID[c]	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)
E1M7[e]	175 E XL	6.90	1.38 x 2	1.38	1.38 x 2							14,000	584	1.1	2,480	275	3.7	0.79	550
	245 E XL	9.66	1.38 x 2	1.38	1.38	1.38	1.38 x 2					25,625	1,496	1.6	3,475	2,400	95	1.4	1,650
	315 E XL	12.42	1.38 x 2	1.38	1.38	1.38	1.38	1.38	1.38 x 2			39,700	2,979	2.1	4,475	5,550	367	2.1	2,750

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] 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 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.
[e] 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.
[f] The V2M1 and V2M2 grades use all visually graded No. 2 SPF lumber in both major and minor strength directions.
[g] 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).
[h] The V2M1.1 grade uses the same layup as V2M1 except for lamination thicknesses.
[i] The V2M2.1 grade uses the same layup as V2M2 except for lamination thicknesses.
[j] The V2.1M1 grade uses the same layup as V2.1 except for the double exterior layers in the major strength direction.

Table 3. ASD Reference Design Values[a] for In-Plane Shear of Structurlam CrossLam CLT (for Use in the U.S.)

CLT Layup	Layup ID	Thickness, t_p (in.)	In-Plane Shear Stress		In-Plane Shear Capacity[b]	
			$F_{v,e,0}$ (psi)	$F_{v,e,90}$ (psi)	$F_{v,e,0}$ t_p (lbf/ft of width)	$F_{v,e,90}$ t_p (lbf/ft of width)
V2.1	87 V	3.43	175	235	7,200	9,700
	139 V	5.47	175[f]	235[f]	11,500[f]	15,400[f]
	191 V	7.52	175[f]	235[f]	15,800[f]	21,200[f]
	243 V	9.57	175[f]	235[f]	20,100[f]	27,000[f]
V2M1	99 V	3.90	175[f]	235[f]	8,200[f]	11,000[f]
	169 V	6.66	175[f]	235[f]	14,000[f]	18,800[f]
	239 V	9.42	175[f]	235[f]	19,800[f]	26,600[f]
	309 V	12.18	175[f]	235[f]	25,600[f]	34,300[f]
V2M1.1	105 V	4.14	195	290	9,700	14,400
	175 V	6.90	270	290[d]	22,400	24,000[d]
	245 V	9.66	270[c]	290[d]	31,300[c]	33,600[d]
	315 V	12.42	270[c]	290[d]	40,200[c]	43,200[d]
V2M2	169 V XL	6.66	175[f]	235[f]	14,000[f]	18,800[f]
	239 V XL	9.42	175[f]	235[f]	19,800[f]	26,600[f]
	309 V XL	12.18	175[f]	235[f]	25,600[f]	34,300[f]
V2M2.1	175 V XL	6.90	175[f]	235[f]	14,500[f]	19,500[f]
	245 V XL	9.66	175[f]	235[f]	20,300[f]	27,200[f]
	315 V XL	12.42	175[f]	235[f]	26,100[f]	35,000[f]
V2.1M1	157 V XL	6.19	175[f]	235[f]	13,000[f]	17,500[f]
	209 V XL	8.24	175[f]	235[f]	17,300[f]	23,200[f]
	261 V XL	10.29	175[f]	235[f]	21,600[f]	29,000[f]
E1M4	87 E	3.43	175[f]	235[f]	7,200[f]	9,700[f]
	139 E	5.47	175[f]	235[f]	11,500[f]	15,400[f]
	191 E	7.52	175[f]	235[f]	15,800[f]	21,200[f]
	243 E	9.57	175[f]	235[f]	20,100[f]	27,000[f]
E1M5	105 E	4.14	195[e]	290[e]	9,700[e]	14,400[e]
	175 E	6.90	270[e]	290[e]	22,400[e]	24,000[e]
	245 E	9.66	270[e]	290[e]	31,300[e]	33,600[e]
	315 E	12.42	270[e]	290[e]	40,200[e]	43,200[e]
E1M6	157 E XL	6.19	175[f]	235[f]	13,000[f]	17,500[f]
	209 E XL	8.24	175[f]	235[f]	17,300[f]	23,200[f]
	261 E XL	10.29	175[f]	235[f]	21,600[f]	29,000[f]
E1M7	175 E XL	6.90	175[f]	235[f]	14,500[f]	19,500[f]
	245 E XL	9.66	175[f]	235[f]	20,300[f]	27,200[f]
	315 E XL	12.42	175[f]	235[f]	26,100[f]	35,000[f]

For SI: 1 psi = 0.006895 MPa

[a] The tabulated values are allowable design values.
[b] The tabulated values are for the full thickness (t_p) of the CLT. The values shall be reduced when the CLT panel thickness is less than the full thickness.
[c] Based on test results from 175V of V2M1.1.
[d] Based on test results from 105V of V2M1.1.
[e] Based on test results from V2M1.1.
[f] Based on test results from 87V of V2.1.

APA – The Engineered Wood Association is an approved national standards developer accredited by American National Standards Institute (ANSI). APA publishes ANSI standards and Voluntary Product Standards for wood structural panels and engineered wood products. APA is an accredited certification body under ISO/IEC 17065 by Standards Council of Canada (SCC), an accredited inspection agency under ISO/IEC 17020 by International Code Council (ICC) International Accreditation Service (IAS), and an accredited testing organization under ISO/IEC 17025 by IAS. APA is also an approved Product Certification Agency, Testing Laboratory, Quality Assurance Entity, and Validation Entity by the State of Florida, and an approved testing laboratory by City of Los Angeles.

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