APA PRODUCT REPORT®

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SmartLam Cross-Laminated Timber — PR-L319
SmartLam, LLC

Revised March 14, 2024

Products: SmartLam Cross-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
   - APA Reports T2016P-34, T2016P-36, T2017P-16A, T2019P-45, T2019P-68, T2020P-13, T2020P-36, T2021P-36, T2022P-30, T2023P-08, and T2024-07, ASCC Report 21-122-1299.2, and other qualification data

2. Product description:
   SmartLam 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. Allowable design properties for lumber laminations used in SmartLam CLT are provided in Table 1. The outermost Spruce-pine-fir (SPF), Spruce-pine-fir South (SPF-S), Hem-fir (HF), Coast Sitka Spruce, or Western Species (WS) lamination may be replaced by Douglas fir-Larch (DF) lumber with design properties that are equal to or greater than the corresponding SPF, SPF-S, HF, Coast Sitka Spruce, or WS lamination. SmartLam CLT can be used in floor, roof, and wall applications, and is manufactured with nominal widths of 12 to 120 inches, thicknesses of 4 1/8 to 12 3/8 inches, and lengths up to 52 feet.

3. Design properties:
   SmartLam CLT shall be designed with the design capacities provided in Tables 2 and 3, or with the allowable load table provided by the CLT manufacturer if approved by the engineer of record (www.smartlam.com/resources/). Note that the unbalanced layups listed in Table 3 can be only used in wall and simple span applications and the compression side, which contains an outermost layer in the minor strength direction, must be stamped with the word “TOP” and shall be installed on the compression (top) side of the simple-span bending member. Other applications shall be reviewed with the manufacturer. The design 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 SmartLam CLT, 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 CLT manufacturer and approved by the engineer of record.

4. Product installation:
SmartLam CLT shall be installed in accordance with the recommendations provided by the manufacturer (www.smartlam.com) and the engineering drawing approved by the engineer of record. Permissible details shall be in accordance with the engineering drawing.

5. Fire-rated assemblies:
Procedures specified in Chapter 16 of the NDS shall be permitted for use in designing SmartLam CLT for a fire exposure up to 2 hours. SmartLam CLT has been tested in accordance ASTM E119 for a fire exposure up to 2 hours. Contact SmartLam for such fire design information (www.smartlam.com).

6. Limitations:
   a) SmartLam CLT shall be designed in accordance with principles of mechanics using the design properties specified in this report or provided by the manufacturer.
   b) SmartLam CLT 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 SmartLam CLT, when used as beams or lintels with loads applied parallel to the face-bond gluelines, are beyond the scope of this report.
   d) Unbalanced SmartLam CLT layups shall be limited to wall and simple span applications and shall be installed with the “TOP” mark on the compression (top) side of the simple-span bending member. Other applications shall be reviewed with the manufacturer.
   e) SmartLam CLT shall be manufactured in accordance with the custom layups specified in this report and documented in the SmartLam in-plant manufacturing standard approved by APA.
   f) SmartLam CLT is produced at the SmartLam, LLC, Columbia Falls, Montana facilities under a quality assurance program audited by APA.
   g) This report is subject to re-examination in one year.

7. Identification:
SmartLam CLT described in this report is identified by a label bearing the manufacturer's name (SmartLam) and/or trademark, the APA assigned plant number (1131), the product standard (ANSI/APA PRG 320), the APA logo, the CLT grade and thickness (or layup ID), the report number PR-L319, and a means of identifying the date of manufacture.

Table 1. ASD Reference Design Values[a] for Lumber Laminations Used in SmartLam 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
E4M8	2400f-2.0E SP	2,400	2.0	1,925	1,975	190	60	805	0.57	2400f-2.0E SP	2,400	2.0	1,925	1,975	190	60	805	0.57
E4M9	2400f-2.0E SP	2,400	2.0	1,925	1,975	190	60	805	0.57	No. 2 SP	750	1.4	450	1,250	175	55	565	0.55
E4M10	2400f-2.0E SP	2,400	2.0	1,925	1,975	190	60	805	0.57	No. 3 SP	450	1.3	250	725	175	55	565	0.55
E21	1650f-1.5E SPF-S	1,650	1.5	1,020	1,700	150	50	465	0.42	No. 3 SPF-S	450	1.0	200	575	135	45	335	0.36
E21M1	2100f-1.8E SPF-S	2,100	1.8	1,575	1,875	150	50	555	0.46	No. 3 SPF-S	450	1.0	200	575	135	45	335	0.36
E21M2	2100f-1.8E SPF-S	2,100	1.8	1,575	1,875	150	50	555	0.46	No. 3 SPF	500	1.2	250	650	135	45	425	0.42
V1M2	No. 2 DF	900	1.6	575	1,350	180	60	625	0.50	No. 2 DF	900	1.6	575	1,350	180	60	625	0.50
V1M4	No. 1 & Btr DF[c]	1,200	1.8	800	1,550	180	60	625	0.50	No. 1/No. 2 Coast Sitka Spruce[c]	925	1.5	550	1,100	125	40	455	0.43
V2.7	No. 1/No. 2 SPF	875	1.4	450	1,150	135	45	425	0.42	No. 3 SPF	500	1.2	250	650	135	45	425	0.42
V2M5	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
V3M7	No. 2 SP	750	1.4	450	1,250	175	55	565	0.55	No. 2 SP	750	1.4	450	1,250	175	55	565	0.55
V4M1	No. 2 SPF-S[b]	775	1.1	350	1,000	135	45	335	0.36	No. 2 SPF-S[b]	775	1.1	350	1,000	135	45	335	0.36
V5M1	No. 2 HF	850	1.3	525	1,300	150	50	405	0.43	No. 2 HF	850	1.3	525	1,300	150	50	405	0.43
V5M2	SS HF	1,400	1.6	925	1,500	150	50	405	0.43	SS HF	1,400	1.6	925	1,500	150	50	405	0.43
V21M1	No. 1/No. 2 Coast Sitka Spruce	925	1.5	550	1,100	125	40	455	0.43	No. 1/No. 2 Coast Sitka Spruce	925	1.5	550	1,100	125	40	455	0.43
V23	No. 2 WS[d]	850	1.3	450	1,100	125	40	405	0.42	No. 2 WS[d]	850	1.3	450	1,100	125	40	405	0.42
V23M1.1	No. 2 WS[d]	850	1.3	450	1,100	125	40	405	0.42	No. 3 WS[d]	500	1.2	250	625	125	40	405	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 flat use or size factor in accordance with the NDS. The design values shall be used in conjunction with the section properties analytically derived using the equations outlined in the ANSI/APA PRG 320 based on the actual layup used in manufacturing the CLT panel (see Tables 2 and 3).

(b) No. 2 or higher grade HF is permitted to replace No. 2 SPF-S in this CLT grade.

(c) This grade is limited to 5-alt only. No. 1 & Btr DF lumber laminations are used in the outermost layers and No. 1/No. 2 Coast Sitka Spruce lumber laminations are used in the inner layers.

(d) Western Species (WS) referenced exclusively in this report = Coast Sitka Spruce, HF, HF(N), and SPF. No. 2 WS includes No. 1/No. 2 Coast Sitka Spruce, No. 2 HF, No. 2 HF(N), and No. 1/No. 2 SPF. No. 3 WS includes No. 3 Coast Sitka Spruce, No. 3 HF, No. 3 HF(N), and No. 3 SPF.

Table 2. ASD Reference Design Values[a, b] for SmartLam **Balanced** CLT Listed in Table 1 (for Use in the U.S.)

CLT Grade[c]	Layup ID[d]	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)
E4M8	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							5,575	135	0.75	1,980	755	5.2	0.75	660
E4M9	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							5,575	135	0.54	1,820	235	3.6	0.72	660
E4M10	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							5,575	135	0.50	1,820	140	3.4	0.72	660
E21[e]	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							3,825	101	0.39	1,490	140	2.6	0.54	550
	4-maxx	5 1/2	1 3/8	1 3/8 x 2	1 3/8							6,200	219	0.45	1,980	565	21	1.1	1,100
	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					8,800	388	0.77	2,480	1,230	68	1.1	1,650
	5-maxx	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							10,950	484	0.82	2,480	140	2.6	0.65	550
	6-maxx	8 1/4	1 3/8 x 2	1 3/8 x 2	1 3/8 x 2							15,325	812	0.77	2,975	565	21	1.1	1,100
	7-alt	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			15,550	960	1.2	3,475	2,850	261	1.6	2,750
	7-maxx	9 5/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8 x 2					20,050	1,238	1.2	3,475	1,230	68	1.2	1,650

Table 2. ASD Reference Design Values[a, b] for SmartLam **Balanced** CLT Listed in Table 1 (for Use in the U.S.) (continued)

CLT Grade[c]	Layup ID[d]	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)
E21M1[e]	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							4,875	122	0.39	1,490	140	2.6	0.63	550
	4-maxx	5 1/2	1 3/8	1 3/8 x 2	1 3/8							7,900	263	0.45	1,980	565	21	1.2	1,100
	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					11,200	466	0.78	2,480	1,230	68	1.3	1,650
	5-maxx	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							13,950	580	0.84	2,480	140	2.6	0.77	550
	6-maxx	8 1/4	1 3/8 x 2	1 3/8 x 2	1 3/8 x 2							19,525	974	0.78	2,975	565	21	1.3	1,100
	7-alt	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			19,750	1,150	1.2	3,475	2,850	261	1.9	2,750
	7-maxx	9 5/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8 x 2					25,500	1,486	1.2	3,475	1,230	68	1.4	1,650
E21M2[e]	3-alt	3 3/8	1 3/8	5/8	1 3/8							3,375	69	0.50	1,220	35	0.29	0.37	250
	4-maxx	4	1 3/8	5/8 x 2	1 3/8							4,625	112	0.46	1,440	130	2.3	0.60	500
	5-alt	5 3/8	1 3/8	5/8	1 3/8	5/8	1 3/8					7,750	252	1.0	1,940	495	19	0.74	1,050
	6-maxx	6 3/4	1 3/8 x 2	5/8 x 2	1 3/8 x 2							13,475	550	1.0	2,430	130	2.3	0.74	500
	7-alt	7 3/8	1 3/8	5/8	1 3/8	5/8	1 3/8	5/8	1 3/8			13,775	615	1.5	2,650	1,130	75	1.1	1,850
	7-maxx	8 1/8	1 3/8 x 2	5/8	1 3/8	5/8	1 3/8 x 2					19,075	938	1.7	2,925	495	19	0.90	1,050

Table 2. ASD Reference Design Values[a, b] for SmartLam **Balanced** CLT Listed in Table 1 (for Use in the U.S.) (continued)

CLT Grade[c]	Layup ID[d]	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)
V1M2	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							2,090	108	0.60	1,980	285	4.2	0.60	660
	4-maxx	5 1/2	1 3/8	1 3/8 x 2	1 3/8							3,400	234	0.71	2,650	1,130	33	1.2	1,320
	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					4,825	415	1.2	3,300	2,460	108	1.2	1,980
	5-maxx	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							5,975	516	1.2	3,300	285	4.2	0.71	660
	6-maxx	8 1/4	1 3/8 x 2	1 3/8 x 2	1 3/8 x 2							8,375	866	1.2	3,950	1,130	33	1.2	1,320
	7-alt	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			8,525	1,029	1.8	4,625	5,675	415	1.8	3,300
	7-maxx	9 5/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8 x 2					10,950	1,322	1.8	4,625	2,460	108	1.3	1,980
	8-maxx	11	1 3/8 x 2	1 3/8	1 3/8 x 2	1 3/8	1 3/8 x 2					13,800	1,904	2.5	5,275	4,000	234	1.4	2,650
	9-alt	12 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	13,200	2,051	2.4	5,950	10,025	1,029	2.4	4,625
	9-maxx	12 3/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8 x 2			16,950	2,634	2.4	5,950	5,675	415	1.9	3,300
V1M4	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					6,400	466	1.1	2,200	2,525	102	1.2	1,320
V2.7[e]	3-alt	3 3/8	1 3/8	5/8	1 3/8							1,400	53	0.48	1,220	35	0.29	0.29	225
	4-maxx	4	1 3/8	5/8 x 2	1 3/8							1,920	87	0.45	1,440	130	2.3	0.48	450
	5-alt	5 3/8	1 3/8	5/8	1 3/8	5/8	1 3/8					3,225	196	0.97	1,940	495	19	0.58	945
	6-maxx	6 3/4	1 3/8 x 2	5/8 x 2	1 3/8 x 2							5,625	428	0.97	2,430	130	2.3	0.58	450
	7-alt	7 3/8	1 3/8	5/8	1 3/8	5/8	1 3/8	5/8	1 3/8			5,750	479	1.5	2,650	1,120	75	0.87	1,670
	7-maxx	8 1/8	1 3/8 x 2	5/8	1 3/8	5/8	1 3/8 x 2					7,950	730	1.6	2,925	495	19	0.71	945
	8-maxx	9 1/2	1 3/8 x 2	5/8	1 3/8 x 2	5/8	1 3/8 x 2					10,650	1,142	2.4	3,425	915	53	0.85	1,440
	9-alt	9 3/8	1 3/8	5/8	1 3/8	5/8	1 3/8	5/8	1 3/8	5/8	1 3/8	8,950	948	1.9	3,375	1,970	188	1.2	2,390
	9-maxx	10 1/8	1 3/8 x 2	5/8	1 3/8	5/8	1 3/8	5/8	1 3/8 x 2			11,975	1,371	2.1	3,650	1,120	75	1.0	1,670

Table 2. ASD Reference Design Values[a, b] for SmartLam **Balanced** CLT Listed in Table 1 (for Use in the U.S.) (continued)

CLT Grade[c]	Layup ID[d]	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)
V2M5[e]	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							2,030	95	0.52	1,490	275	3.6	0.52	495
	4-maxx	5 1/2	1 3/8	1 3/8 x 2	1 3/8							3,300	205	0.62	1,980	1,100	29	1.1	990
	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					4,675	363	1.1	2,480	2,390	95	1.1	1,490
	5-maxx	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							5,825	451	1.1	2,480	275	3.6	0.62	495
	6-maxx	8 1/4	1 3/8 x 2	1 3/8 x 2	1 3/8 x 2							8,125	758	1.1	2,975	1,100	29	1.1	990
	7-alt	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			8,275	900	1.6	3,475	5,500	363	1.6	2,480
	7-maxx	9 5/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8 x 2					10,650	1,157	1.6	3,475	2,390	95	1.1	1,490
	8-maxx	11	1 3/8 x 2	1 3/8	1 3/8 x 2	1 3/8	1 3/8 x 2					13,425	1,666	2.2	3,950	3,875	205	1.2	1,980
	9-alt	12 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	12,850	1,795	2.1	4,450	9,750	900	2.1	3,475
	9-maxx	12 3/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8 x 2			16,500	2,305	2.1	4,450	5,500	363	1.6	2,480
V3M7	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							1,740	95	0.52	1,820	235	3.6	0.52	605
V4M1[e]	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							1,800	74	0.41	1,490	245	2.9	0.41	495
	4-maxx	5 1/2	1 3/8	1 3/8 x 2	1 3/8							2,925	161	0.49	1,980	975	23	0.85	990
	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					4,150	286	0.83	2,480	2,120	74	0.83	1,490
	5-maxx	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							5,150	355	0.85	2,480	245	2.9	0.49	495
	6-maxx	8 1/4	1 3/8 x 2	1 3/8 x 2	1 3/8 x 2							7,200	596	0.83	2,975	975	23	0.83	990
	7-alt	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			7,325	707	1.2	3,475	4,875	286	1.2	2,480
	7-maxx	9 5/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8 x 2					9,425	909	1.2	3,475	2,120	74	0.89	1,490
	8-maxx	11	1 3/8 x 2	1 3/8	1 3/8 x 2	1 3/8	1 3/8 x 2					11,875	1,309	1.7	3,950	3,425	161	0.97	1,980
	9-alt	12 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	11,375	1,410	1.7	4,450	8,625	707	1.7	3,475
	9-maxx	12 3/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8 x 2			14,600	1,811	1.6	4,450	4,875	286	1.3	2,480

Table 2. ASD Reference Design Values[a, b] for SmartLam **Balanced** CLT Listed in Table 1 (for Use in the U.S.) (continued)

CLT Grade[c]	Layup ID[d]	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)
V5M1[e]	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							1,980	88	0.49	1,650	270	3.4	0.49	550
	4-maxx	5 1/2	1 3/8	1 3/8 x 2	1 3/8							3,200	190	0.57	2,200	1,070	27	1.0	1,100
	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					4,550	337	0.98	2,750	2,320	88	0.98	1,650
	5-maxx	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							5,650	419	1.0	2,750	270	3.4	0.57	550
	6-maxx	8 1/4	1 3/8 x 2	1 3/8 x 2	1 3/8 x 2							7,900	704	0.98	3,300	1,070	27	0.98	1,100
	7-alt	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			8,050	836	1.5	3,850	5,350	337	1.5	2,750
	7-maxx	9 5/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8 x 2					10,350	1,074	1.5	3,850	2,320	88	1.0	1,650
V5M2[e]	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							3,250	108	0.60	1,650	440	4.2	0.60	550
	4-maxx	5 1/2	1 3/8	1 3/8 x 2	1 3/8							5,275	234	0.71	2,200	1,760	33	1.2	1,100
	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					7,500	415	1.2	2,750	3,825	108	1.2	1,650
	5-maxx	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							9,300	516	1.2	2,750	440	4.2	0.71	550
	6-maxx	8 1/4	1 3/8 x 2	1 3/8 x 2	1 3/8 x 2							13,025	866	1.2	3,300	1,760	33	1.2	1,100
	7-alt	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			13,250	1,029	1.8	3,850	8,800	415	1.8	2,750
	7-maxx	9 5/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8 x 2					17,025	1,322	1.8	3,850	3,825	108	1.3	1,650

Table 2. ASD Reference Design Values[a, b] for SmartLam **Balanced** CLT Listed in Table 1 (for Use in the U.S.) (continued)

CLT Grade[c]	Layup ID[d]	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)
V21M1[e]	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							2,150	102	0.56	1,320	290	3.9	0.56	440
	4-maxx	5 1/2	1 3/8	1 3/8 x 2	1 3/8							3,475	219	0.66	1,760	1,170	31	1.2	880
	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					4,950	389	1.1	2,200	2,525	102	1.1	1,320
	5-maxx	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							6,150	484	1.2	2,200	290	3.9	0.66	440
	6-maxx	8 1/4	1 3/8 x 2	1 3/8 x 2	1 3/8 x 2							8,600	812	1.1	2,650	1,170	31	1.1	880
	7-alt	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			8,750	964	1.7	3,075	5,825	389	1.7	2,200
	7-maxx	9 5/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8 x 2					11,250	1,239	1.7	3,075	2,525	102	1.2	1,320
	8-maxx	11	1 3/8 x 2	1 3/8	1 3/8 x 2	1 3/8	1 3/8 x 2					14,175	1,785	2.3	3,525	4,100	219	1.3	1,760
	9-alt	12 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	13,575	1,923	2.3	3,950	10,300	964	2.3	3,075
	9-maxx	12 3/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8 x 2			17,425	2,469	2.2	3,950	5,825	389	1.8	2,200
V23[e]	3-alt	4 1/8	1 3/8	1 3/8	1 3/8							1,980	88	0.49	1,320	270	3.4	0.49	440
	4-maxx	5 1/2	1 3/8	1 3/8 x 2	1 3/8							3,200	190	0.57	1,760	1,070	27	1.0	880
	5-alt	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					4,550	337	0.98	2,200	2,320	88	0.98	1,320
	5-maxx	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							5,650	419	1.0	2,200	270	3.4	0.57	440
	6-maxx	8 1/4	1 3/8 x 2	1 3/8 x 2	1 3/8 x 2							7,900	704	0.98	2,650	1,070	27	0.98	880
	7-alt	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			8,050	836	1.5	3,075	5,350	337	1.5	2,200
	7-maxx	9 5/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8 x 2					10,350	1,074	1.5	3,075	2,320	88	1.0	1,320
	8-maxx	11	1 3/8 x 2	1 3/8	1 3/8 x 2	1 3/8	1 3/8 x 2					13,025	1,547	2.0	3,525	3,775	190	1.1	1,760
	9-alt	12 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	12,475	1,667	2.0	3,950	9,450	836	2.0	3,075
	9-maxx	12 3/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8 x 2			16,025	2,140	1.9	3,950	5,350	337	1.5	2,200

Table 2. ASD Reference Design Values[a, b] for SmartLam **Balanced** CLT Listed in Table 1 (for Use in the U.S.) (continued)

CLT Grade[c]	Layup ID[d]	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)
V23M1.1[e]	3-alt	3 3/8	1 3/8	5/8	1 3/8							1,360	50	0.48	1,080	35	0.29	0.27	200
	4-maxx	4	1 3/8	5/8 x 2	1 3/8							1,870	81	0.45	1,280	130	2.3	0.44	400
	5-alt	5 3/8	1 3/8	5/8	1 3/8	5/8	1 3/8					3,150	182	0.96	1,720	495	19	0.54	840
	6-maxx	6 3/4	1 3/8 x 2	5/8 x 2	1 3/8 x 2							5,450	397	0.96	2,160	130	2.3	0.54	400
	7-alt	7 3/8	1 3/8	5/8	1 3/8	5/8	1 3/8	5/8	1 3/8			5,600	445	1.4	2,360	1,120	75	0.81	1,480
	7-maxx	8 1/8	1 3/8 x 2	5/8	1 3/8	5/8	1 3/8 x 2					7,725	678	1.6	2,600	495	19	0.66	840
	8-maxx	9 1/2	1 3/8 x 2	5/8	1 3/8 x 2	5/8	1 3/8 x 2					10,325	1,060	2.3	3,050	915	53	0.79	1,280
	9-alt	9 3/8	1 3/8	5/8	1 3/8	5/8	1 3/8	5/8	1 3/8	5/8	1 3/8	8,700	881	1.9	3,000	1,960	187	1.1	2,120
	9-maxx	10 1/8	1 3/8 x 2	5/8	1 3/8	5/8	1 3/8	5/8	1 3/8 x 2			11,650	1,273	2.1	3,250	1,120	75	0.93	1,480

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

[a] Tabulated values are allowable design values and not permitted to be increased for the lumber flat use or size 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, lbf-in.^{2}/ft; and
$(GA)_{eff}$ = tabulated effective in-plane (planar) shear rigidity, 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, lbf-in.^{2}/ft; and
$(GA)_{eff}$ = tabulated effective in-plane (planar) shear rigidity, lbf/ft.

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

[d] The layup designation refers to the number of layers and the layup series (alt or maxx).

[e] The outermost laminations shall be permitted to be replaced by Douglas fir-Larch lumber with design properties equal to or greater than that of the laminations specified for the layup.

Table 3. ASD Reference Design Values[a] for SmartLam **Unbalanced** CLT[b] Listed in Table 1 (for Use in the U.S.)

CLT Grade[c]	Layup ID[d]	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)
E21[e]	4-alt	5 1/2	1 3/8	1 3/8	1 3/8	1 3/8						3,825	101	0.39	1,490	140	2.6	0.54	550
	6-alt	8 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8				8,800	388	0.77	2,480	1,230	68	1.1	1,650
	8-alt	11	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8		15,550	960	1.2	3,475	2,850	261	1.6	2,750
E21M1[e]	4-alt	5 1/2	1 3/8	1 3/8	1 3/8	1 3/8						4,875	122	0.39	1,490	140	2.6	0.63	550
	6-alt	8 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8				11,200	466	0.78	2,480	1,230	68	1.3	1,650
	8-alt	11	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8		19,750	1,150	1.2	3,475	2,850	261	1.9	2,750
V1M2	4-alt	5 1/2	1 3/8	1 3/8	1 3/8	1 3/8						2,090	108	0.60	1,980	285	4.2	0.60	660
	6-alt	8 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8				4,825	415	1.2	3,300	2,460	108	1.2	1,980
	8-alt	11	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8		8,525	1,029	1.8	4,625	5,675	415	1.8	3,300
V2M5[e]	4-alt	5 1/2	1 3/8	1 3/8	1 3/8	1 3/8						2,030	95	0.52	1,490	275	3.6	0.52	495
	6-alt	8 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8				4,675	363	1.1	2,480	2,390	95	1.1	1,490
	8-alt	11	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8		8,275	900	1.6	3,475	5,500	363	1.6	2,480
V4M1[e]	4-alt	5 1/2	1 3/8	1 3/8	1 3/8	1 3/8						1,800	74	0.41	1,490	245	2.9	0.41	495
	6-alt	8 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8				4,150	286	0.83	2,480	2,120	74	0.83	1,490
	8-alt	11	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8		7,325	707	1.2	3,475	4,875	286	1.2	2,480
V5M1[e]	4-alt	5 1/2	1 3/8	1 3/8	1 3/8	1 3/8						1,980	88	0.49	1,650	270	3.4	0.49	550
	6-alt	8 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8				4,550	337	0.98	2,750	2,320	88	0.98	1,650
	8-alt	11	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8		8,050	836	1.5	3,850	5,350	337	1.5	2,750
V5M2[e]	4-alt	5 1/2	1 3/8	1 3/8	1 3/8	1 3/8						3,250	108	0.60	1,650	440	4.2	0.60	550
	6-alt	8 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8				7,500	415	1.2	2,750	3,825	108	1.2	1,650
	8-alt	11	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8		13,250	1,029	1.8	3,850	8,800	415	1.8	2,750
V21M1[e]	4-alt	5 1/2	1 3/8	1 3/8	1 3/8	1 3/8						2,150	102	0.56	1,320	290	3.9	0.56	440
	6-alt	8 1/4	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8				4,950	389	1.1	2,200	2,525	102	1.1	1,320
	8-alt	11	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8		8,750	964	1.7	3,075	5,825	389	1.7	2,200

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

[a] Tabulated values are allowable design values and not permitted to be increased for the lumber flat use or size factor in accordance with the NDS. Tabulated values ignore the contribution of the outermost compression layer.

[b] Unbalanced CLT layups can be only used in wall and simple span applications. The compression side, which contains an outermost layer in the minor strength direction, must be stamped with the word "TOP" and shall be installed on the compression (top) side of the simple-span bending member.

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

[d] The layup designation refers to the number of layers and the layup series (alt).

[e] The outermost laminations shall be permitted to be replaced by Douglas fir-Larch lumber with design properties equal to or greater than that of the laminations specified for the layup.

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