Kalesnikoff Cross-Laminated Timber

Kalesnikoff Mass Timber Inc.

PR-L332
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Products: Kalesnikoff 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 T2020P-35, T2020P-40, T2020P-48, T2020P-50, T2021P-20, and T2021P-31, and other qualification data

2. Product description:
   Kalesnikoff cross-laminated timber (CLT) is manufactured with laminating 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 laminating lumber shall have allowable reference design properties provided in Table 1. The SPF laminations listed in Table 1 shall be permitted to be substituted by Douglas fir-Larch, Douglas fir-Larch (North), or Hem-fir (North) lumber with design properties that are equal to or greater than the corresponding SPF laminations. When Hem-fir (North) is used to substitute SPF in the outermost layers of the CLT layup, the bearing capacity of the CLT shall be based on the compressive stress perpendicular to grain ($F_{c\perp}$) of 405 psi. Kalesnikoff CLT can be used in floor, roof, and wall applications, and is manufactured with nominal widths up to 138 inches, thicknesses of 3.4 to 13.5 inches, and lengths up to 60 feet.

3. Design properties:
   Kalesnikoff CLT shall be designed with the allowable design properties and capacities provided in Tables 2 and 3. Note that the unbalanced layup listed in Tables 2 and 3, V2/8-ply EL, shall be stamped with the word “TOP” on the side that contains a single outermost layer in the major strength direction. The design value adjustment factors shall be based on Table 10.3.1. of the 2018 ANSI/AWC National Design Specification (NDS) for Wood Construction. The lateral resistance of Kalesnikoff 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.

   Design values for the Load and Resistance Factor Design (LRFD) used in the U.S. for Kalesnikoff CLT can be derived from the ASD values published in Table 2 of this report in accordance with Tables 10.3.1, N1, N2, and N3 of the 2018 NDS.

4. Product installation:
Kalesnikoff CLT shall be installed in accordance with the recommendations provided by the manufacturer (www.kalesnikoff.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:
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 Kalesnikoff CLT for a fire exposure up to 2 hours.

6. Limitations:
   a) Kalesnikoff 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) Kalesnikoff 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 Kalesnikoff CLT, when used as beams or lintels with loads applied parallel to the face-bond gluelines, other than the edgewise shear properties (see Table 3), are beyond the scope of this report.
   d) Kalesnikoff CLT shall be manufactured in compliance with ANSI/APA PRG 320 and documented in the Kalesnikoff Mass Timber Inc.'s in-plant manufacturing standard approved by APA.
   e) Kalesnikoff CLT is produced at the Kalesnikoff, South Slocan, British Columbia facility under a quality assurance program audited by APA.
   f) This report is subject to re-examination in one year.

7. Identification:
Kalesnikoff CLT described in this report is identified by a label bearing the manufacturer's name (Kalesnikoff) and/or trademark, the APA assigned plant number (1133), the product standard (ANSI/APA PRG 320), the APA logo, the CLT grade and thickness (or layup ID), the report number PR-L332, and a means of identifying the date of manufacture.

Table 1. ASD Reference Design Values[(a)] for Lumber Laminations Used in Kalesnikoff 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
E1, E1.1, E1.2, & E1.3	1950f-1.7E SPF[(b)]	1,950	1.7	1,375	1,800	135	45	425	0.42	No. 3 SPF[(b)]	500	1.2	250	650	135	45	425	0.42
E1M8	1950f-1.7E SPF[(b)]	1,950	1.7	1,375	1,800	135	45	425	0.42	1950f-1.7E SPF[(b)]	1,950	1.7	1,375	1,800	135	45	425	0.42
E1M9	1950f-1.7E SPF[(b)]	1,950	1.7	1,375	1,800	135	45	425	0.42	No. 1/No. 2 SPF[(b)]	875	1.4	450	1,150	135	45	425	0.42
E1M11	1650f-1.5E SPF[(b)]	1,650	1.5	1,020	1,700	135	45	425	0.42	No. 3 SPF[(b)]	500	1.2	250	650	135	45	425	0.42
E1M13	1650f-1.5E SPF[(b)]	1,650	1.5	1,020	1,700	135	45	425	0.42	No. 1/No. 2 SPF[(b)]	875	1.4	450	1,150	135	45	425	0.42
V2, V2.2, & V2.4	No. 1/No. 2 SPF[(b)]	875	1.4	450	1,150	135	45	425	0.42	No. 3 SPF[(b)]	500	1.2	250	650	135	45	425	0.42
V2M6	No. 1/No. 2 SPF[(b)]	875	1.4	450	1,150	135	45	425	0.42	No. 1/No. 2 SPF[(b)]	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).

(b) The SPF laminations shall be permitted to be substituted by Douglas fir-Larch, Douglas fir-Larch (North), or Hem-fir (North) lumber of equal or greater design properties. When Hem-fir (North) is used to substitute SPF in the outermost layers of the CLT layup, the bearing capacity of the CLT shall be based on the compressive stress perpendicular to grain ($F_{c\perp}$) of 405 psi.

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

CLT Grade[(c)]	Layup ID	Thickness, 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)
E1	3-ply	4 1/8	1 3/8	1 3/8	1 3/8							4,525	115	0.46	1,490	160	3.1	0.61	495
	5-ply	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					10,400	440	0.92	2,480	1,370	81	1.2	1,490
	7-ply	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			18,375	1,089	1.4	3,475	3,150	313	1.8	2,480
	9-ply	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	28,475	2,169	1.8	4,450	5,600	776	2.5	3,475
E1.1	3-ply	3.67	1.50	0.67	1.50							3,700	84	0.55	1,320	40	0.36	0.38	240
	5-ply	5.84	1.50	0.67	1.50	0.67	1.50					8,525	307	1.1	2,100	580	24	0.75	1,020
	7-ply	8.02	1.50	0.67	1.50	0.67	1.50	0.67	1.50			15,150	748	1.6	2,875	1,320	95	1.1	1,810
	9-ply	10.19	1.50	0.67	1.50	0.67	1.50	0.67	1.50	0.67	1.50	23,600	1,480	2.2	3,675	2,320	240	1.5	2,600
E1.2	3-ply	4.50	1.50	1.50	1.50							5,400	149	0.50	1,620	190	4.0	0.67	540
	5-ply	7.50	1.50	1.50	1.50	1.50	1.50					12,375	572	1.0	2,700	1,630	105	1.3	1,620
	7-ply	10.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50			21,875	1,413	1.5	3,775	3,750	406	2.0	2,700
	9-ply	13.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	33,900	2,816	2.0	4,850	6,650	1,007	2.7	3,775

Table 2. ASD Reference Design Values[a, b] for Kalesnikoff 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)
E1.3	3-ply	3.42	1.38	0.67	1.38							3,200	68	0.49	1,230	40	0.36	0.36	240
	5-ply	5.47	1.38	0.67	1.38	0.67	1.38					7,400	249	0.98	1,970	540	21	0.73	980
	7-ply	7.52	1.38	0.67	1.38	0.67	1.38	0.67	1.38			13,150	608	1.5	2,700	1,230	84	1.1	1,720
	9-ply	9.56	1.38	0.67	1.38	0.67	1.38	0.67	1.38	0.67	1.38	20,450	1,204	2.0	3,450	2,170	212	1.5	2,450
E1M8	3-ply	4.13	1.38	1.38	1.38							4,525	115	0.64	1,490	615	4.4	0.64	495
	5-ply	6.88	1.38	1.38	1.38	1.38	1.38					10,425	441	1.3	2,480	5,325	115	1.3	1,490
	7-ply	9.63	1.38	1.38	1.38	1.38	1.38	1.38	1.38			18,450	1,093	1.9	3,475	12,275	441	1.9	2,480
	9-ply	12.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	28,625	2,179	2.6	4,450	21,700	1,093	2.6	3,475
E1M9	3-ply	4.13	1.38	1.38	1.38							4,525	115	0.53	1,490	275	3.6	0.63	495
	5-ply	6.88	1.38	1.38	1.38	1.38	1.38					10,425	441	1.1	2,480	2,390	95	1.3	1,490
	7-ply	9.63	1.38	1.38	1.38	1.38	1.38	1.38	1.38			18,400	1,090	1.6	3,475	5,525	364	1.9	2,480
	9-ply	12.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	28,525	2,173	2.1	4,450	9,775	903	2.5	3,475
E1M11	3-ply	4.13	1.38	1.38	1.38							3,825	101	0.46	1,490	160	3.1	0.55	495
	5-ply	6.88	1.38	1.38	1.38	1.38	1.38					8,800	389	0.92	2,480	1,370	81	1.1	1,490
	7-ply	9.63	1.38	1.38	1.38	1.38	1.38	1.38	1.38			15,575	962	1.4	3,475	3,150	312	1.7	2,480
	9-ply	12.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	24,125	1,917	1.8	4,450	5,575	774	2.2	3,475
E1M13	3-ply	4.13	1.38	1.38	1.38							3,825	102	0.53	1,490	275	3.6	0.56	495
	5-ply	6.88	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	9.63	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	12.38	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
V2	3-ply	4 1/8	1 3/8	1 3/8	1 3/8							2,030	95	0.46	1,490	160	3.1	0.52	495
	5-ply	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8					4,675	363	0.91	2,480	1,370	81	1.0	1,490
	5-ply EL	6 7/8	1 3/8 x 2	1 3/8	1 3/8 x 2							5,825	451	0.95	2,480	160	3.1	0.61	495
	7-ply	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	898	1.4	3,475	3,150	312	1.6	2,480
	7-ply EL	9 5/8	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8 x 2					10,650	1,156	1.4	3,475	1,370	81	1.1	1,490
	8-ply EL[d]	11	1 3/8 x 2	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			11,000	1,463	1.6	3,950	3,150	312	1.6	2,480
	9-ply	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	12,800	1,791	1.8	4,450	5,575	773	2.1	3,475
	9-ply EL	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			16,475	2,303	1.8	4,450	3,150	312	1.6	2,480

Table 2. ASD Reference Design Values[a, b] for Kalesnikoff 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)
V2.2	3-ply	3.42	1.38	0.67	1.38							1,440	56	0.48	1,230	40	0.36	0.30	240
	5-ply	5.47	1.38	0.67	1.38	0.67	1.38					3,325	205	0.95	1,970	540	21	0.61	980
	5-ply EL	6.17	1.38 x 2	0.67	1.38 x 2							4,725	329	1.2	2,220	40	0.36	0.43	240
	7-ply	7.52	1.38	0.67	1.38	0.67	1.38	0.67	1.38			5,900	501	1.4	2,700	1,220	84	0.91	1,720
	7-ply EL	8.22	1.38 x 2	0.67	1.38	0.67	1.38 x 2					8,125	753	1.6	2,950	540	21	0.73	980
	9-ply	9.56	1.38	0.67	1.38	0.67	1.38	0.67	1.38	0.67	1.38	9,200	993	1.9	3,450	2,150	211	1.2	2,450
	9-ply EL	10.27	1.38 x 2	0.67	1.38	0.67	1.38	0.67	1.38 x 2			12,250	1,421	2.0	3,700	1,220	84	1.0	1,720
V2.4	3-ply	4.50	1.50	1.50	1.50							2,420	123	0.50	1,620	190	4.0	0.56	540
	5-ply	7.50	1.50	1.50	1.50	1.50	1.50					5,575	471	0.99	2,700	1,630	105	1.1	1,620
	7-ply	10.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50			9,825	1,166	1.5	3,775	3,750	405	1.7	2,700
	9-ply	13.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	15,250	2,325	2.0	4,850	6,650	1,004	2.3	3,775
V2M6	3-ply	4.14	1.38	1.38	1.38							2,050	96	0.53	1,490	280	3.7	0.53	495
	5-ply	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
	7-ply	9.66	1.38	1.38	1.38	1.38	1.38	1.38	1.38			8,350	910	1.6	3,475	5,500	367	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	12,925	1,814	2.1	4,475	9,800	910	2.1	3,475

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

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;
L = span, feet;
$(GA)_{eff}$ = tabulated effective in-plane (planar) shear rigidity, lbf/ft.
P = concentrated load, lbf/ft of width;
$(EI)_{eff}$ = tabulated effective bending stiffness, lbf-in.^{2}/ft; and

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

(d) This layup is not balanced (the top and bottom layers are different in the layer thickness). The side that contains a single outermost layer in the major strength direction must be stamped with the word “TOP.”

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

CLT Grade	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)
E1	3-ply	4 1/8	105[c]	105[c]	5,200[c]	5,200[c]
	5-ply	6 7/8	165[d]	165[d]	13,600[d]	13,600[d]
	7-ply	9 5/8	165[d]	165[d]	19,100[d]	19,100[d]
	9-ply	12 3/8	165[d]	165[d]	24,500[d]	24,500[d]
E1.1	3-ply	3.67	105[c]	105[c]	4,600[c]	4,600[c]
	5-ply	5.84	165[d]	165[d]	11,600[d]	11,600[d]
	7-ply	8.02	165[d]	165[d]	15,900[d]	15,900[d]
	9-ply	10.19	165[d]	165[d]	20,200[d]	20,200[d]
E1.2	3-ply	4.50	105[c]	105[c]	5,700[c]	5,700[c]
	5-ply	7.50	165[d]	165[d]	14,900[d]	14,900[d]
	7-ply	10.50	165[d]	165[d]	20,800[d]	20,800[d]
	9-ply	13.50	165[d]	165[d]	26,700[d]	26,700[d]
E1.3	3-ply	3.42	105[c]	105[c]	4,300[c]	4,300[c]
	5-ply	5.47	165[d]	165[d]	10,800[d]	10,800[d]
	7-ply	7.52	165[d]	165[d]	14,900[d]	14,900[d]
	9-ply	9.56	165[d]	165[d]	18,900[d]	18,900[d]
E1M8	3-ply	4.13	105[c]	105[c]	5,200[c]	5,200[c]
	5-ply	6.88	165[d]	165[d]	13,600[d]	13,600[d]
	7-ply	9.63	165[d]	165[d]	19,100[d]	19,100[d]
	9-ply	12.38	165[d]	165[d]	24,500[d]	24,500[d]
E1M9	3-ply	4.13	105[c]	105[c]	5,200[c]	5,200[c]
	5-ply	6.88	165[d]	165[d]	13,600[d]	13,600[d]
	7-ply	9.63	165[d]	165[d]	19,100[d]	19,100[d]
	9-ply	12.38	165[d]	165[d]	24,500[d]	24,500[d]
E1M11	3-ply	4.13	105[c]	105[c]	5,200[c]	5,200[c]
	5-ply	6.88	165[d]	165[d]	13,600[d]	13,600[d]
	7-ply	9.63	165[d]	165[d]	19,100[d]	19,100[d]
	9-ply	12.38	165[d]	165[d]	24,500[d]	24,500[d]
E1M13	3-ply	4.13	105[c]	105[c]	5,200[c]	5,200[c]
	5-ply	6.88	165[d]	165[d]	13,600[d]	13,600[d]
	7-ply	9.63	165[d]	165[d]	19,100[d]	19,100[d]
	9-ply	12.38	165[d]	165[d]	24,500[d]	24,500[d]
V2	3-ply	4 1/8	105[c]	105[c]	5,200[c]	5,200[c]
	5-ply	6 7/8	165[d]	165[d]	13,600[d]	13,600[d]
	5-ply EL	6 7/8	165[d]	165[d]	13,600[d]	13,600[d]
	7-ply	9 5/8	165[d]	165[d]	19,100[d]	19,100[d]
	7-ply EL	9 5/8	165[d]	165[d]	19,100[d]	19,100[d]
	8-ply EL[e]	11	165[d]	165[d]	21,800[d]	21,800[d]
	9-ply	12 3/8	165[d]	165[d]	24,500[d]	24,500[d]
	9-ply EL	12 3/8	165[d]	165[d]	24,500[d]	24,500[d]
V2.2	3-ply	3.42	105	105[c]	4,300	4,300[c]
	5-ply	5.47	165	165[d]	10,800	10,800[d]
	5-ply EL	6.17	165[d]	165[d]	12,200[d]	12,200[d]
	7-ply	7.52	165[d]	165[d]	14,900[d]	14,900[d]
	7-ply EL	8.22	165[d]	165[d]	16,300[d]	16,300[d]
	9-ply	9.56	165[d]	165[d]	18,900[d]	18,900[d]
	9-ply EL	10.27	165[d]	165[d]	20,300[d]	20,300[d]
V2.4	3-ply	4.50	105[c]	105[c]	5,700[c]	5,700[c]
	5-ply	7.50	165[d]	165[d]	14,900[d]	14,900[d]
	7-ply	10.50	165[d]	165[d]	20,800[d]	20,800[d]
	9-ply	13.50	165[d]	165[d]	26,700[d]	26,700[d]

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

CLT Grade	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)
V2M6	3-ply	4.14	105[c]	105[c]	5,200[c]	5,200[c]
	5-ply	6.90	165[d]	165[d]	13,600[d]	13,600[d]
	7-ply	9.66	165[d]	165[d]	19,100[d]	19,100[d]
	9-ply	12.42	165[d]	165[d]	24,500[d]	24,500[d]

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 3-ply of V2.2.
[d] Based on test results from 5-ply of V2.2.
[e] This layup is not balanced (the top and bottom layers are different in the layer thickness). The side that contains a single outermost layer in the major strength direction must be stamped with the word “TOP.”

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