

**Nordic X-Lam**  
**Nordic Structures**

**PR-L306**

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Products: Nordic X-Lam

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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
  - FPInnovations Reports 201002775, 201004981, 301010401, 301010956, and 301011903, HPVA Report T-14054R, and other qualification data
2. Product description:

Nordic X-Lam cross-laminated timber (CLT) is manufactured with Spruce-Pine-Fir (mainly Black Spruce) lumber in accordance with the E1 or custom layups of ANSI/APA PRG 320 through product qualification and/or mathematical models using principles of engineering mechanics. Nordic X-Lam panels can be used in floor, roof, and wall applications, and is manufactured in a plank billet with nominal widths of 12 to 106-1/4 inches, thicknesses of 3 to 15 inches, and lengths up to 64 feet.
3. Design properties:

Nordic X-Lam CLT shall be designed with the design properties and capacities provided in Tables 1, 2, and 3, or with the allowable load table provided by the manufacturer ([www.nordic.ca/en/documentation/technical-documents](http://www.nordic.ca/en/documentation/technical-documents)). Note that the unbalanced layup listed in Tables 2 and 3, E1/140-4I, shall be stamped with the word "TOP" on the side that contains a single outermost layer in the major strength direction. The design adjustment factors shall be based on Table 10.3.1 of the 2018 ANSI/AWC National Design Specification for Wood Construction (NDS) and approved by the engineer of record. The lateral resistance of Nordic X-Lam 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 Nordic X-Lam CLT can be derived from the ASD values published in Tables 2 and 3 of this report in accordance with Tables 10.3.1, N1, N2, and N3 of the 2018 NDS.

4. Product installation:  
Nordic X-Lam 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 2018 NDS shall be permitted for use in designing Nordic X-Lam CLT for a fire exposure up to 2 hours.

Nordic X-Lam CLT has been tested in accordance with ASTM E84 and meets the Class A rating for flame spread index (0 – 25) and smoke-developed index (0 – 450) when the thickness is at least 3-1/2 inches (89 mm). The Class B rating for flame spread index (26 – 75) and smoke-developed index (0 – 450) shall be applicable to Nordic X-Lam with a thickness that is less than 3-1/2 inches (89 mm).

6. Limitations:
  - a) Nordic X-Lam CLT shall be designed in accordance with principles of mechanics using the design properties specified in this report or provided by the manufacturer.
  - b) Nordic X-Lam 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 Nordic X-Lam 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. The edgewise shear properties are applicable only to products manufactured at the Nordic Structures, Chibougamau, Quebec facility.
  - d) Nordic X-Lam CLT shall be manufactured in accordance with layup combinations specified in ANSI/APA PRG 320 or custom Nordic X-Lam CLT manufacturing specifications documented in the in-plant manufacturing standard approved by APA.
  - e) Nordic X-Lam CLT is produced at the Nordic Structures, Chibougamau, Quebec facility and 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:  
Nordic X-Lam CLT described in this report is identified by a label bearing the manufacturer's name (Nordic Structures) and/or trademark, the APA assigned plant number (1112 for Nordic Structures, Chibougamau, Quebec and 1145 for Element5 Limited Partnership, St. Thomas, Ontario), the product standard (ANSI/APA PRG 320), the APA logo, the CLT grade, the report number PR-L306, and a means of identifying the date of manufacture.

Table 1. ASD Reference Design Values<sup>(a)</sup> for Lumber Laminations Used in Nordic X-Lam (for Use in the U.S.)

CLT Grade	Laminations Used in Major Strength Direction									Laminations Used in Minor Strength Direction								
	Grade & Species	F <sub>b</sub> (psi)	E (10 <sup>6</sup> psi)	F <sub>t</sub> (psi)	F <sub>c</sub> (psi)	F <sub>v</sub> (psi)	F <sub>s</sub> (psi)	F <sub>c⊥</sub> (psi)	G	Grade & Species	F <sub>b</sub> (psi)	E (10 <sup>6</sup> psi)	F <sub>t</sub> (psi)	F <sub>c</sub> (psi)	F <sub>v</sub> (psi)	F <sub>s</sub> (psi)	F <sub>c⊥</sub> (psi)	G
E1	1950f-1.7E SPF	1,950	1.7	1,375	1,800	135	45	425	0.42	No.3 SPF	500	1.2	250	650	135	45	425	0.42

For SI: 1 psi = 0.006895 MPa

<sup>(a)</sup> 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 layout used in manufacturing the CLT panel (see Table 2).

Table 2. ASD Flatwise Bending Reference Design Values<sup>(a,b)</sup> for Nordic X-Lam Listed in Table 1 (for Use in the U.S.)

CLT Grade <sup>(c)</sup>	Layout ID <sup>(d)</sup>	Thick-ness, t <sub>p</sub> (in.)	Lamination Thickness (in.) in CLT Layout						Major Strength Direction				Minor Strength Direction				
			=	⊥	=	⊥	=	⊥	=	(F <sub>b</sub> S) <sub>eff,f,0</sub> (lbf-ft/ft)	(E <sub>I</sub> ) <sub>eff,f,0</sub> (10 <sup>6</sup> lbf-in. <sup>2</sup> /ft)	(GA) <sub>eff,f,0</sub> (10 <sup>6</sup> lbf/ft)	V <sub>s,0</sub> (lbf/ft)	(F <sub>b</sub> S) <sub>eff,f,90</sub> (lbf-ft/ft)	(E <sub>I</sub> ) <sub>eff,f,90</sub> (10 <sup>6</sup> lbf-in. <sup>2</sup> /ft)	(GA) <sub>eff,f,90</sub> (10 <sup>6</sup> lbf/ft)	V <sub>s,90</sub> (lbf/ft)
E1	78-3s	3 1/8	1 1/64	1 1/16	1 1/64					2,525	48	0.34	1,110	95	1.4	0.47	380
	89-3s	3 1/2	1 3/8	3/4	1 3/8					3,350	72	0.48	1,260	45	0.51	0.39	270
	105-3s	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
	131-5s	5 1/8	1 1/64	1 1/16	1 1/64	1 1/16	1 1/64			5,800	184	0.69	1,860	790	36	0.94	1,130
	140-4s	5 1/2	1 3/8	1 3/8 x2	1 3/8					7,325	248	0.54	1,980	630	25	1.2	990
	140-4 <sup>(e)</sup>	5 1/2	1 3/8 x2	1 3/8	1 3/8					7,150	261	0.70	1,980	160	3.1	0.67	495
	143-5s	5 5/8	1 3/8	3/4	1 3/8	3/4	1 3/8			7,725	267	0.96	2,030	615	26	0.78	1,040
	175-5s	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
	197-7s	7 3/4	1 3/8	3/4	1 3/8	3/4	1 3/8	3/4	1 3/8	13,725	654	1.4	2,800	1,410	101	1.2	1,800
	213-7l	8 3/8	1 3/8 x2	3/4	1 3/8	3/4	1 3/8 x2			18,700	963	1.6	3,025	615	26	0.93	1,040
	220-7s	8 5/8	1 3/8	1 1/16	1 3/8	1 1/16	1 3/8	1 1/16	1 3/8	15,975	853	1.4	3,125	2,190	187	1.5	2,130
	245-7s	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
	245-7l	9 5/8	1 3/8 x2	1 3/8	1 3/8	1 3/8	1 3/8 x2			23,700	1,404	1.4	3,475	1,370	81	1.3	1,490
	267-9l	10 1/2	1 3/8 x2	3/4	1 3/8	3/4	1 3/8	3/4	1 3/8 x2	28,325	1,831	2.0	3,775	1,410	101	1.3	1,800
	315-9l	12 3/8	1 3/8 x2	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8 x2	36,700	2,794	1.8	4,450	3,150	313	1.9	2,480

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

<sup>(a)</sup> Tabulated values are allowable design values and not permitted to be increased for the lumber size adjustment factor in accordance with the NDS.

<sup>(b)</sup> 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, (E<sub>I</sub>)<sub>eff</sub>, and the effective in-plane (planar) shear rigidity, (GA)<sub>eff</sub>, as follows:

$$\delta = \frac{22.5wL^4}{(EI)_{eff}} + \frac{9wL^2}{5(GA)_{eff}} \quad [1]$$

where:  $\delta$  = estimated deflection, inches;  $w$  = uniform load, lbf/ft<sup>2</sup>;  
L = span, feet;  $(EI)_{eff}$  = tabulated effective bending stiffness, lbf-in.<sup>2</sup>/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:  $\delta$  = estimated deflection, inches; P = concentrated load, lbf/ft of width;  
L = span, feet;  $(EI)_{eff}$  = tabulated effective bending stiffness, lbf-in.<sup>2</sup>/ft; and  
 $(GA)_{eff}$  = tabulated effective in-plane (planar) shear rigidity, lbf/ft.

- (c) The CLT layups are developed based on ANSI/APA PRG 320, as permitted by the standard.
- (d) The layup designation refers to the panel thickness (expressed in mm), the number of layers, and the layup combination ("s" for standard perpendicular layers, and "l" for doubled outermost parallel layers).
- (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."

Table 3. ASD Edgewise Bending Reference Design Values<sup>(e)</sup> for Nordic X-Lam Listed in Table 1 (for Use in the U.S.)

CLT Grade	Layup ID	Thickness, $t_p$ (in.)	Major Strength Direction		Minor Strength Direction	
			$F_{v,e,0}$ <sup>(a)</sup> (psi)	$G_{e,0} t_p$ <sup>(d)</sup> (10 <sup>6</sup> lbf/ft)	$F_{v,e,90}$ <sup>(a)</sup> (psi)	$G_{e,90} t_p$ <sup>(d)</sup> (10 <sup>6</sup> lbf/ft)
E1	78-3s	3 1/8	155 <sup>(b)</sup>	1.36	190 <sup>(b)</sup>	1.36
	89-3s	3 1/2	155	1.52	190 <sup>(b)</sup>	1.52
	105-3s	4 1/8	155	1.79	190	1.79
	131-5s	5 1/8	185 <sup>(c)</sup>	2.23	215 <sup>(c)</sup>	2.23
	140-4s	5 1/2	145	2.39	190 <sup>(b)</sup>	2.39
	140-4I	5 1/2	155 <sup>(b)</sup>	2.39	190 <sup>(b)</sup>	2.39
	143-5s	5 5/8	185 <sup>(c)</sup>	2.44	215 <sup>(c)</sup>	2.44
	175-5s	6 7/8	185	2.99	215	2.99
	197-7s	7 3/4	155 <sup>(b)</sup>	3.37	215 <sup>(c)</sup>	3.37
	213-7I	8 3/8	185 <sup>(c)</sup>	3.64	215 <sup>(c)</sup>	3.64
	220-7s	8 5/8	185 <sup>(c)</sup>	3.75	215 <sup>(c)</sup>	3.75
	245-7s	9 5/8	185 <sup>(c)</sup>	4.18	215 <sup>(c)</sup>	4.18
	245-7I	9 5/8	185 <sup>(c)</sup>	4.18	215 <sup>(c)</sup>	4.18
	267-9I	10 1/2	155 <sup>(b)</sup>	4.56	215 <sup>(c)</sup>	4.56
	315-9I	12 3/8	185 <sup>(c)</sup>	5.38	215 <sup>(c)</sup>	5.38

For SI: 1 psi = 0.006895 MPa

- <sup>(a)</sup> Allowable edgewise in-plane shear stress, which 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.
- <sup>(b)</sup> Based on test results from 105-3s.
- <sup>(c)</sup> Based on test results from 175-5s.
- <sup>(d)</sup> Edgewise shear rigidity is based on  $G_{e,0}$  and  $G_{e,90} = 36,200$  psi and the CLT thickness,  $t_p$ , in accordance with product performance testing.
- <sup>(e)</sup> Tabulated edgewise shear properties are applicable only to products manufactured at the Nordic Structures, Chibougamau, Quebec facility.

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