

Products: Nordic X-Lam Industrial CLT Matting
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1. Basis of the product report:
 - ANSI/APA PRG 320-2019 Standard for Performance-Rated Cross-Laminated Timber
 - APA Custom Product Specification L-375, Industrial CLT Matting
2. Product description:

Nordic X-Lam industrial cross-laminated timber (CLT) matting is manufactured with Spruce-Pine-Fir (mainly Black Spruce) lumber in accordance with the IND-331 and custom grades of ANSI/APA PRG 320 through product qualification and/or mathematical models using principles of engineering mechanics. Nordic X-Lam industrial CLT matting shall be limited to industrial applications and is not intended for use in timber structures or similar constructions, except for spanning over a short opening (up to 18 times the CLT thickness) recommended by the manufacturer. Nordic X-Lam industrial CLT matting 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 industrial CLT matting shall be designed with the design properties and capacities provided in Tables 1, 2, and 3, when used in different moisture conditions, or with the recommendations provided by the manufacturer (www.nordic.ca). 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 the recommendations provided by the manufacturer.

Design values for the Load and Resistance Factor Design (LRFD) used in the U.S. for Nordic X-Lam industrial CLT matting 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 industrial CLT matting shall be installed in accordance with the recommendations provided by the manufacturer (see link above).
5. Limitations:
 - a) Nordic X-Lam industrial CLT matting 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 industrial CLT matting shall be limited to industrial applications and is not intended for use in timber structures or similar constructions, except for spanning over a short opening (up to 18 times the CLT thickness) recommended by the manufacturer.
 - c) Nordic X-Lam industrial CLT matting shall be manufactured in accordance with custom Nordic X-Lam industrial CLT matting specification IND-331 documented in the in-plant manufacturing standard approved by APA.

- d) The design values recognized in this report are limited to new products. The effect of re-use on the design values is beyond the scope of this report.
- e) Nordic X-Lam industrial CLT matting is produced at the Nordic Structures, Chibougamau, Quebec facilities under a quality assurance program audited by APA.
- f) This report is subject to re-examination in one year.

6. Identification:

Nordic X-Lam industrial CLT matting 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), the APA Custom Product Specification (L-375), the APA logo, the industrial CLT matting grade and thickness (or layup ID), the report number PR-L331, and a means of identifying the date of manufacture.

Table 1. ASD Reference Design Values^(a,b) for Lumber Laminations Used in Nordic X-Lam industrial CLT Matting (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⊥} (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⊥} (psi)	G
IND-331	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
Wet-use factor	NA	0.85	0.90	1.00	0.80	0.97	0.97	0.67	(c)	NA	0.85	0.90	1.00	1.00	0.97	0.97	0.67	(c)

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 industrial CLT matting manufacturer based on the actual layout used in manufacturing the industrial CLT matting panel (see Tables 2 and 3).
- (b) The tabulated allowable design values are for dry conditions of use where the average equilibrium moisture content of solid-sawn lumber is 19% or less. For wet conditions of use where the average equilibrium moisture content of solid-sawn lumber exceeds 19% for an extended period of time, multiply the tabulated values by the wet-use factors shown at the bottom of the table.
- (c) Connection design using the specific gravity (G) in wet-use conditions shall follow Table 11.3.3 of the 2018 NDS.

Table 2. ASD Flatwise Bending Reference Design Values^(a) for Nordic X-Lam Industrial CLT Matting Listed in Table 1 (**Dry Conditions**) (For Use in the U.S.)

CLT Grade ^(b)	Layup ID ^(c)	Thick-ness, t _p (in.)	Lamination Thickness (in.) in CLT Layup						Major Strength Direction				Minor Strength Direction				
			=	⊥	=	⊥	=	⊥	=	(F _b S) _{eff,1.0} (lbf-ft/ft)	(EI) _{eff,1.0} (10 ⁶ lbf-in. ² /ft)	(GA) _{eff,1.0} (10 ⁶ lbf/ft)	V _{s,0} (lbf/ft)	(F _b S) _{eff,1.90} (lbf-ft/ft)	(EI) _{eff,1.90} (10 ⁶ lbf-in. ² /ft)	(GA) _{eff,1.90} (10 ⁶ lbf/ft)	V _{s,90} (lbf/ft)
IND-331	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
	140-4I ^(d)	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
	213-7I	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
	245-7I	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
	267-9I	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
	315-9I	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 = 4.448N

- ^(a) Tabulated values are allowable design values and not permitted to be increased for the lumber size adjustment factor in accordance with the NDS. The tabulated allowable design values are for dry conditions of use where the average equilibrium moisture content of solid-sawn lumber is less than 16%.
- ^(b) The CLT layouts are developed based on ANSI/APA PRG 320, as permitted by the standard.
- ^(c) 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 "I" for doubled outermost parallel layers).
- ^(d) This layup is not balanced (the top and bottom layers are different in the layer thickness), which shall be considered in design and installation based on the manufacturer's recommendations.

Table 3. ASD Flatwise Bending Reference Design Values^(a) for Nordic X-Lam Industrial CLT Matting Listed in Table 1 (**Wet Conditions**) (For Use in the U.S.)

CLT Grade ^(b)	Layup ID ^(c)	Thick-ness, t_p (in.)	Lamination Thickness (in.) in CLT Layup						Major Strength Direction				Minor Strength Direction				
			=	⊥	=	⊥	=	⊥	=	($F_b S$) _{eff,1.0} (lbf-ft/ft)	(EI) _{eff,1.0} (10^6 lbf-in. ² /ft)	(GA) _{eff,1.0} (10^6 lbf/ft)	$V_{s,0}$ (lbf/ft)	($F_b S$) _{eff,1.90} (lbf-ft/ft)	(EI) _{eff,1.90} (10^6 lbf-in. ² /ft)	(GA) _{eff,1.90} (10^6 lbf/ft)	$V_{s,90}$ (lbf/ft)
IND-331	78-3s	3 1/8	1 1/64	1 1/16	1 1/64					2,150	43	0.31	990	80	1.3	0.42	340
	89-3s	3 1/2	1 3/8	3/4	1 3/8					2,850	65	0.43	1,120	40	0.46	0.35	240
	105-3s	4 1/8	1 3/8	1 3/8	1 3/8					3,850	104	0.42	1,320	135	2.8	0.55	440
	131-5s	5 1/8	1 1/64	1 1/16	1 1/64	1 1/16	1 1/64			4,950	166	0.62	1,650	670	32	0.85	1,000
	140-4s	5 1/2	1 3/8	1 3/8 x2	1 3/8					6,225	223	0.48	1,760	535	22	1.1	880
	140-4I ^(d)	5 1/2	1 3/8 x2	1 3/8	1 3/8					6,075	235	0.63	1,760	135	2.8	0.60	440
	143-5s	5 5/8	1 3/8	3/4	1 3/8	3/4	1 3/8			6,575	241	0.86	1,800	525	23	0.70	920
	175-5s	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			8,850	396	0.83	2,200	1,160	73	1.1	1,320
	197-7s	7 3/4	1 3/8	3/4	1 3/8	3/4	1 3/8	3/4	1 3/8	11,650	589	1.3	2,480	1,200	91	1.0	1,600
	213-7I	8 3/8	1 3/8 x2	3/4	1 3/8	3/4	1 3/8 x2			15,900	867	1.4	2,675	525	23	0.84	920
	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	13,575	767	1.2	2,775	1,870	168	1.3	1,890
	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	15,625	980	1.2	3,075	2,675	281	1.7	2,200
	245-7I	9 5/8	1 3/8 x2	1 3/8	1 3/8	1 3/8	1 3/8 x2			20,150	1,263	1.3	3,075	1,160	73	1.2	1,320
	267-9I	10 1/2	1 3/8 x2	3/4	1 3/8	3/4	1 3/8	3/4	1 3/8 x2	24,075	1,648	1.8	3,350	1,200	91	1.2	1,600
	315-9I	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	31,200	2,515	1.7	3,950	2,675	281	1.7	2,200

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. The tabulated allowable design values are for wet conditions of use where the average equilibrium moisture content of solid-sawn lumber is 16% or greater.
- ^(b) The CLT layouts are developed based on ANSI/APA PRG 320, as permitted by the standard.
- ^(c) 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 "I" for doubled outermost parallel layers).
- ^(d) This layup is not balanced (the top and bottom layers are different in the layer thickness), which shall be considered in design and installation based on the manufacturer's recommendations.

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