Evaluation Listing CCMC 13654-L
Nordic X-Lam

Evaluation Issued: 2013-12-24
Revised: 2019-02-27

Preface: Masterformat 06 19 00.02, Cross Laminated Timber (CLT) Panels (Standardized)

Preface Issued: 2012-11-06

Scope

These Evaluation Listings are in accordance with ANSI/APA PRG 320-2012, "Standard for Performance-Rated Cross-Laminated Timber." This standard applies to cross laminated timber (CLT) panels defined as prefabricated solid engineered wood panels made of at least three orthogonally bonded layers of solid-sawn lumber or structural composite lumber (SCL) that are laminated by gluing the longitudinal and transverse layers with structural adhesive to form a solid rectangular-shape, straight and plane timber intended for roof, floor, or wall applications.

CLT panels meeting the requirements of ANSI/APA PRG 320 for use in Canada fall under one of the following five grades:

- **Grade E1**: 1950f-1.7E Spruce-pine-fir MSR lumber in all parallel layers and No. 3 Spruce-pine-fir lumber in all perpendicular layers.
- **Grade E2**: 1650f-1.5E Douglas fir-Larch MSR lumber in all parallel layers and No. 3 Douglas fir-Larch in all perpendicular layers.
- **Grade E3**: 1200f-1.2E Eastern Softwoods, Northern Species, or Western Woods MSR lumber in all parallel layers and No. 3 Eastern Softwoods, Northern Species, or Western Woods lumber in all perpendicular layers.
- **Grade V1**: No. 2 Douglas fir-Larch lumber in all parallel layers and No. 3 Douglas fir-Larch lumber in all perpendicular layers.
- **Grade V2**: No. 1/No. 2 Spruce-pine-fir lumber in all parallel layers and No. 3 Spruce-pine-fir lumber in all perpendicular layers.

These panels are intended for use in dry service conditions only, i.e. conditions where the mean equilibrium moisture content of solid-sawn lumber is less than 16%. The panels are manufactured to meet the standard and are subject to a third-party certification program.

Standard(s)

The prescriptive and performance requirements addressed in the standard are summarized below.

1. panel dimensions and dimensional tolerances;
2. component requirements:
    a. lumber laminations,
    b. structural composite lumber (SCL) laminations,
    c. adhesives, and
    d. lamination joints;
3. CLT performance criteria:
    a. layup requirements, and
    b. structural performance requirements;
4. qualification and product marking;

©National Research Council of Canada, ISSN 1206-1220. CCMC 13654-R All rights reserved

5. quality assurance; and
6. design properties.

Panel Dimensions and Dimensional Tolerances

The standard applies to CLT products that do not exceed a thickness of 508 mm (20 in.).

Table 1. Dimensional Tolerances of the CLT Panel at the Time of Manufacturing

Dimension	Tolerance (mm (in.))[1]
Thickness	Stricter of ± 1.6 (1/16) or 2% of specified thickness
Width	± 3.2 (1/8) of specified width
Length	± 6.4 (1/4) of specified length
Squareness	± 3.2 (1/8) difference in diagonals' length
Straightness	± 1.6 (1/16) deviation of edges from a straight line

Note to Table 1:

1 Textured or other finishes are allowed to alter tolerances specified without affecting the total load-resisting cross-section.

Component Requirements

Table 2. Tabulated Component Requirements of Lumber and SCL Laminations

Property		Requirement
Lumber species or species combination[1]		Any species or species combination recognized by the Canadian Lumber Standards Accreditation Board under CSA O141.[2]
Minimum specific gravity		0.35
Minimum lumber grades[1]	**parallel layers[3]**	1200f-1.2E MSR or Visual grade No. 2
	perpendicular layers[4]	Visual grade No. 3
Lamination sizes	**major strength direction**	Lamination width ≥ 1.75 × lamination thickness for parallel layers
	minor strength direction	Lamination width ≥ 3.5 × lamination thickness for the perpendicular layers[5]
	both directions	51 mm (2 in.) ≥ lamination net thickness[5] ≥ 16 mm (5/8 in.)
Moisture content[6]		12 ± 3%
Face-bonding	**surface preparation**	Planed and cleaned
	dimensional tolerance – variation in thickness	± 0.2 mm (0.008 in.) across the width
		± 0.3 mm (0.012 in.) along the length

©National Research Council of Canada, ISSN 1206-1220. CCMC 13654-R All rights reserved

Table 2. Tabulated Component Requirements of Lumber and SCL Laminations (cont.)

Property		Requirement
Standards on requirements for adhesives		CSA O112.10
		Sections 2.1.3 and 3.3 of AITC 405[7]
		Section 6.1.3.4 of DOC PS1[8]
Lamination Joints	end joints	Section 9.5 of CSA O177
	edge and face joints	Sections 9.2 and 9.3 of CSA O177 except for shear strength

Notes to Table 2:

1 This requirement does not apply to SCL laminations.

2 Within a single layer of the CLT panel, the same species or combination thereof has to be used. However, species can be different between adjacent layers.

3 Parallel layers refer to the layers that will be parallel to the load direction, i.e., parallel to the major strength direction.

4 Perpendicular layers refer to the layers that will be perpendicular to the load direction, i.e., perpendicular to the minor strength direction.

5 This width is only required when the parallel layers are not edge bonded. Furthermore, an alternative is allowed by the standard to forgo this requirement by demonstrating interlaminar shear strength and creep performance through specified testing.

6 This requirement refers to the moisture content at the time of manufacturing.

7 The requirements for heat durability in ASTM D 7247.

8 Evaluation for heat performance.

CLT Performance Criteria

The structural performance of every layup must be evaluated as per the standard (with some exceptions). The minimum required characteristic test values that the CLT products have to meet are shown in Table 3, below, which is reproduced from the standard. The structural performance must be evaluated and approved by a third party certification agency. Custom CLT grades are also permitted by the standard.

Table 3. Required Characteristic Test Values[1 2]

CLT Grades	Major Strength Direction (MPa)						Minor Strength Direction (MPa)					
	$f_{b,0}$	E_0	$f_{t,0}$	$f_{c,0}$	$f_{v,0}$	$f_{s,0}$	$f_{b,90}$	E_{90}	$f_{t,90}$	$f_{c,90}$	$f_{v,90}$	$f_{s,90}$
E1	28.2	11,721	19.9	23.6	2.9	0.97	7.2	8,274	3.6	8.5	2.9	0.97
E2	23.9	10,342	14.8	22.3	3.9	1.31	7.6	9,653	4.7	10.1	3.9	1.31
E3	17.4	8,274	8.7	18.3	2.4	0.79	5.1	6,205	2.2	6.2	2.4	0.79
V1	13.0	11,032	8.3	17.7	3.9	1.31	7.6	9,653	4.7	10.1	3.9	1.31
V2	12.7	9,653	6.5	15.1	2.9	0.97	7.2	8,274	3.6	8.5	2.9	0.97

©National Research Council of Canada, ISSN 1206-1220. CCMC 13654-R All rights reserved

Notes to Table 3:

1 $f_{b,0}$ is the characteristic bending strength parallel to the major strength direction of the CLT.
E_0 is the modulus of elasticity in bending parallel to the major strength direction of the CLT.
$f_{t,0}$ is the characteristic tensile strength parallel to the major strength direction of the CLT.
$f_{c,0}$ is the characteristic compressive strength parallel to the major strength direction of the CLT.
$f_{v,0}$ is the characteristic shear strength parallel to the major strength direction of the CLT.
$f_{s,0}$ is the characteristic interlaminar (rolling) shear strength parallel to the major strength direction of the CLT.
$f_{b,90}$ is the characteristic bending strength perpendicular to the major strength direction of the CLT.
E_{90} is the modulus of elasticity in bending perpendicular to the major strength direction of the CLT.
$f_{t,90}$ is the characteristic tensile strength perpendicular to the major strength direction of the CLT.
$f_{c,90}$ is the characteristic compressive strength perpendicular to the major strength direction of the CLT.
$f_{v,90}$ is the characteristic shear strength perpendicular to the major strength direction of the CLT.
$f_{s,90}$ is the characteristic interlaminar (rolling) shear strength perpendicular to the major strength direction of the CLT.

2 Tabulated values are test values and shall not be used for design.

Qualification

The CLT components are qualified in accordance with the requirements summarized above. The standard includes requirements for plant pre-qualification. The CLT qualification tests include qualification of effective bond area, structural performance, and mechanical properties. The standard also described process change qualification requirements as well as mill specifications.

Quality Assurance

The standard requires an ongoing quality assurance program to be documented in an in-plant manufacturing standard that is approved by a third party certification agency. The standard also describes the requirements for ongoing quality assurance testing for end, face and edge joints in laminations, minimum effective bonding area maintained, lamination grade limits, glue skip in the face bondline, finished product inspections and minor variations.

Design Properties

The limit states design properties are provided in Table 4, below, and the limit states design resistances are shown in Table 5, below. These tables are reproduced from the standard.

Table 4. Specified Strength and Modulus of Elasticity[1 2]

CLT Grades	Major Strength Direction (MPa)						Minor Strength Direction (MPa)					
	$f_{b,0}$	E_0	$f_{t,0}$	$f_{c,0}$	$f_{v,0}$	$f_{s,0}$	$f_{b,90}$	E_{90}	$f_{t,90}$	$f_{c,90}$	$f_{v,90}$	$f_{s,90}$
E1	28.2	11,700	15.4	19.3	1.5	0.50	7.0	9,000	3.2	9.0	1.5	0.50
E2	23.9	10,300	11.4	18.1	1.9	0.63	4.6	10,000	2.1	7.3	1.9	0.63
E3	17.4	8,300	6.7	15.1	1.3	0.43	4.5	6,500	2.0	5.2	1.3	0.43
V1	10.0	11,000	5.8	14.0	1.9	0.63	4.6	10,000	2.1	7.3	1.9	0.63
V2	11.8	9,500	5.5	11.5	1.5	0.50	7.0	9,000	3.2	9.0	1.5	0.50

©National Research Council of Canada, ISSN 1206-1220. CCMC 13654-R All rights reserved

Notes to Table 4:

1 Symbols used in this table are defined as described in Note (1) to Table 3.

2 Tabulated values are limit states design values are not permitted to be increased for the lumber size adjustment factor in accordance with CSA O86. 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.

Table 5. Limit States Design Bending Resistances[1]

CLT Grade	CLT thickness (mm)	Lamination Thickness (mm) in CLT Layup							Major Strength Direction			Minor Strength Direction		
		=	⊥	=	⊥	=	⊥	=	$f_bS_{eff,0}$ (10^6 N-mm/m)	$EI_{eff,0}$ (10^9 N-mm^2/m)	$GA_{eff,0}$ (10^6 N/m)	$f_bS_{eff,90}$ (10^6 N-mm/m)	$EI_{eff,90}$ (10^9 N-mm^2/m)	$GA_{eff,90}$ (10^6 N/m)
E1	105	35	35	35	–	–	–	–	42	1,088	7.3	1.4	32	9.1
	175	35	35	35	35	35	–	–	98	4,166	15	12	836	18
	245	35	35	35	35	35	35	35	172	10,306	22	28	3,183	27
E2	105	35	35	35	–	–	–	–	36	958	8.0	0.94	36	8.2
	175	35	35	35	35	35	–	–	83	3,674	16	8.1	929	16
	245	35	35	35	35	35	35	35	146	9,097	24	19	3,537	25
E3	105	35	35	35	–	–	–	–	26	772	5.3	0.92	23	6.4
	175	35	35	35	35	35	–	–	60	2,956	11	8.0	604	13
	245	35	35	35	35	35	35	35	106	7,313	16	18	2,299	19
V1	105	35	35	35	–	–	–	–	15	1,023	8.0	0.94	36	8.7
	175	35	35	35	35	35	–	–	35	3,922	16	8.1	929	17
	245	35	35	35	35	35	35	35	61	9,708	24	19	3,537	26
V2	105	35	35	35	–	–	–	–	18	884	7.2	1.4	32	7.5
	175	35	35	35	35	35	–	–	41	3,388	14	12	836	15
	245	35	35	35	35	35	35	35	72	8,388	22	28	3,183	23

©National Research Council of Canada, ISSN 1206-1220. CCMC 13654-R All rights reserved

Note to Table 5:

1 The symbols that were previously used in Tables 3 and 4 are as defined in Note (1) to Table 3. Other symbols are defined as follows:

S_{eff} is the effective section modulus (mm^3/m) of the composite CLT section for calculating the moment capacity of CLT.

I_{eff} is the effective moment of inertia (mm^4/m) of the composite CLT section for calculating the bending stiffness of the CLT.

G_0 is the modulus of rigidity in parallel to the major strength direction of the CLT (MPa). In the standard, $G_0 = E_0/16$ for lumber.

G_{90} is the modulus of rigidity in perpendicular to the major strength direction of the CLT (MPa). In the standard, $G_{90} = G_0/10$ for lumber.

A_{eff} is the effective cross sectional area (mm^2/m) of the composite CLT for calculating the interlaminar shear capacity of the CLT.

Labelling

The standard requires the CLT products to bear the stamp of a third party certification agency that either inspects the manufacturer or has performed sampling and testing of the finished product in the shipment being certified for conformance with the standard.

In addition the product has to be identified with the following marks and information:

1. CLT grade;
2. CLT thickness or identification;
3. mill name or identification number;
4. the name of third party certification agency or logo;
5. the symbol of ANSI/APA PRG 320;
6. any manufacturer designation which has to be separated from the grade-marks or trademarks of the certification agency by not less than 152 mm (6 in.); and
7. “Top” stamp on the top face of custom CLT panels used for roof or floor if manufactured with an unbalanced layup.

The standard also specifies that the spacing of markings shall be no more than 2.4 m (8 ft.).

National Building Code of Canada (NBC)

NBC References

ANSI/APA PRG 320-2012, is not referenced in the NBC 2010.

©National Research Council of Canada, ISSN 1206-1220. CCMC 13654-R All rights reserved

Evaluation Listing CCMC 13654-L: Nordic X-Lam

Evaluation Issued: 2013-12-24
Revised: 2019-02-27

1. Evaluation

The CLT panels conform to Grade E1 of ANSI/APA PRG-320-2012, "Standard for Performance-Rated Cross-Laminated Timber." This evaluation is based on the APA certification to ANSI/APA PRG-320.

2. Description

The product consists of cross-laminated timber (CLT) panels complying with the definition of CLT presented in ANSI/APA PRG 320-2012. The product is manufactured with black spruce in accordance with Grade E1 of the Standard. The product is intended for use as panels in floor, roof and wall applications. The product is available in widths ranging from 305 mm to 2 440 mm (12 in. to 96 in.), in thicknesses of 76 mm to 381 mm (3 in. to 15 in.), and lengths up to 19.5 m (64 ft.).

The adhesive used in the finger-joints is Ashland UX-160/WD3-A322 (CCMC 13513-L), and laminations are face-glued using the Purbond HB E202 adhesive (CCMC 13586-L); the boards are not edge-glued.

3. Standard and Regulatory Information

See the Preface and the standard for explanation.

Listing Holder

Nordic Structures
100-1100, avenue des Canadiens-de-Montréal
Montréal, QC H3B 2S2

Telephone: 514 871 8526
Fax: 514 871 9789

Plant(s)

Chibougamau, QC

Disclaimer

This Listing is issued by the Canadian Construction Materials Centre, a program of NRC Construction at the National Research Council of Canada. The Listing must be read in the context of the entire CCMC Registry of Product Evaluations.

Readers must confirm that the Listing is current and has not been withdrawn or superseded by a later issue. Please refer to http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/ccmc_index.html, or contact the Canadian Construction Materials Centre, NRC Construction, National Research Council of Canada, 1200 Montreal Road, Ottawa, Ontario, K1A 0R6. Telephone (613) 993-6189. Fax (613) 952-0268.

NRC has evaluated the material, product, system or service described herein only for those characteristics stated herein. The information and opinions in this Listing are directed to those who have the appropriate degree of experience to use and apply its contents. This Listing is provided without representation, warranty, or guarantee of any kind, expressed, or implied, and the National Research Council of Canada (NRC) provides no endorsement for any evaluated material, product, system or service described herein. NRC accepts no responsibility whatsoever arising in any way from any and all use and reliance on the information contained in this Listing. NRC is not undertaking to render professional or other services on behalf of any person or entity nor to perform any duty owed by any person or entity to another person or entity.

Date modified:
2019-02-27

©National Research Council of Canada, ISSN 1206-1220. CCMC 13654-R All rights reserved