Evaluation Report CCMC 13216-R
Nordic Lam™

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "Nordic Lam™", when used as glue-laminated timber beams and columns in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code 2010:

- Clause 1.2.1.1.(1)(a), Division A, using the following acceptable solutions from Division B:
  - Article 4.3.1.1., Design Basis for Wood (CSA O86-09, "Engineering Design in Wood")

- Clause 1.2.1.1.(1)(b), Division A, as an alternative solution that achieves at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the following applicable acceptable solutions:
  - Article 4.3.1.2., Glued-Laminated Members
  - Article 9.23.4.2., Spans for Joists, Rafters and Beams
  - Subsection 9.23.10., Wall Studs

This opinion is based on CCMC's evaluation of the technical evidence in Section 4 provided by the Report Holder.

Ruling No. 07-02-160 (13216-R) authorizing the use of this product in Ontario, subject to the terms and conditions contained in the Ruling, was made by the Minister of Municipal Affairs and Housing on 2007-02-05 pursuant to s.29 of the Building Code Act, 1992 (see Ruling for terms and conditions). This Ruling is subject to periodic revisions and updates.

2. Description

The product is a glue-laminated timber construction made of black spruce in the tension and compression zones and/or Spruce-Pine-Fir (SPF) species in the core. All laminating boards (lamina) are surfaced to a thickness of 50 mm or less prior to lamination. The lamina is made of short-length pieces, typically 900 mm with an occasional piece of not less than 685 mm, and is end-jointed by means of a structural finger joint. Laminations of one or two grades are arranged within the depth of the member according to the desired layup pattern having one or three zones. Tables 4.1.3 and 4.1.4 outline the minimum layup requirements.

The lamina may also be made with multiple pieces of 38 mm × 38 mm lumber graded in accordance with standard grading rules and face-bonded. The face bonding and end joints are bonded with a polyurethane adhesive (for end-joints: Ashland UX-100/WD3-A22, CCMC 13512-L; for edge and face laminations: Ashland WD3-A322/CX-47, CCMC 13591-L).

APA conducts regular audits of the manufacturing plant and the quality assurance program to CSA O177-06, "Qualification Code for Manufacturers of Structural Glued-Laminated Timber." The engineering properties of the product are listed in Tables 4.1.1 and 4.1.2. The specified strengths for Limit States Design were based on the format conversion used in CSA O86 for conventional glulam. Additional engineering data is available from the manufacturer.

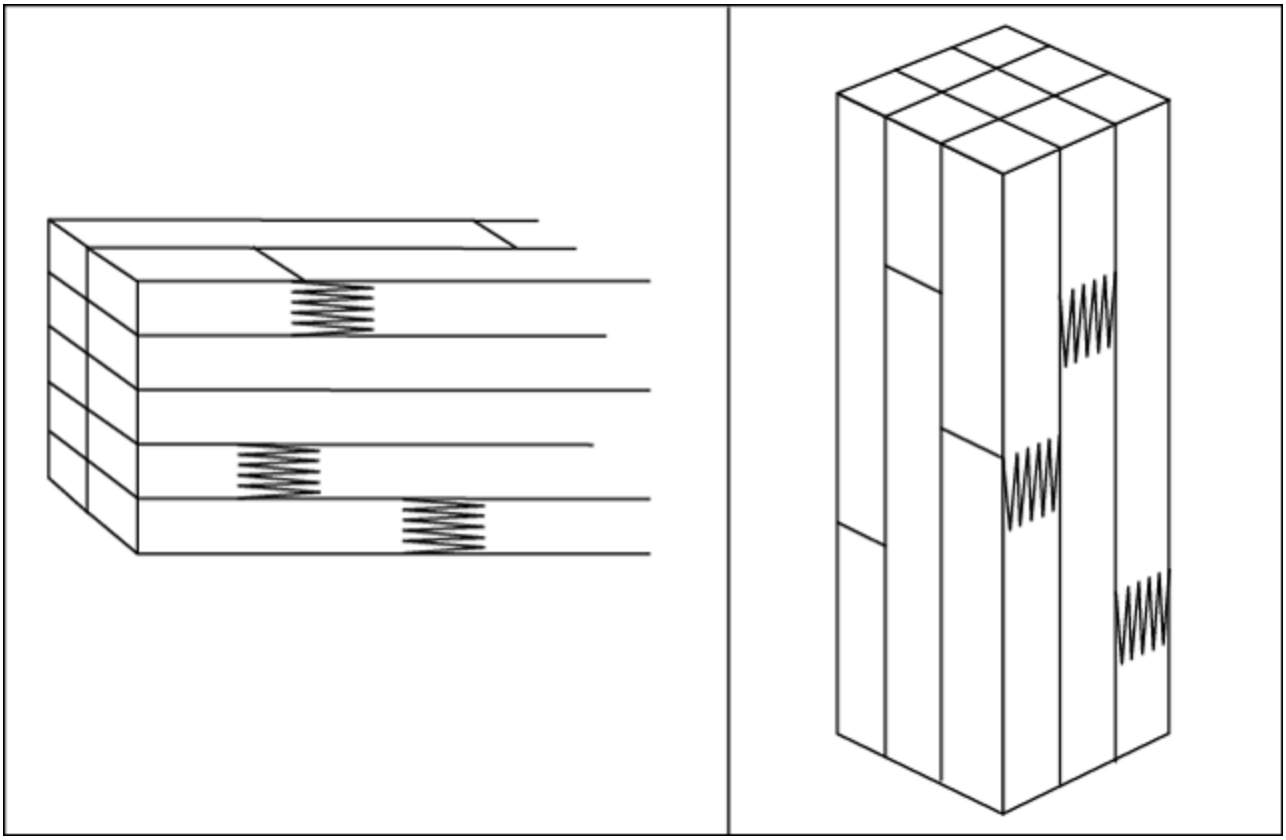

Figure 1. Examples of the product – finger-jointed, short-length, face-bonded laminations in a beam and a column

3. Conditions and Limitations

CCMC's compliance opinion in Section 1 is bound by the "Nordic Lam™" being used in accordance with the conditions and limitations set out below.

- The product is intended for use where conventional glulam beams and columns are permitted for structural use by the NBC 2010.
- The product is intended for use in dry service conditions only.[1]
- The glulam beams covered within the scope of this Evaluation Report must not exceed 2.0 m^3 in volume and 600 mm in depth based on empirical data provided.
- The product has met the adhesive testing requirements for Annex A, "Bond line fire performance equivalency tests" of CSA O177. The authority having jurisdiction should determine whether NBCC Annex D formulas or product-specific derivations apply to glulam columns/beams with an adhesive qualified under CSA O112.9.
- The pre-engineering details outlined below have been provided to CCMC by the manufacturer to demonstrate compliance to Part 9 buildings for acceptance by the local authority having jurisdiction (AHJ):

    i. Nordic Engineered Wood Pre-engineered Tables[2]

    When the product is used as beams, headers columns or wall studs, the installation must be in accordance with the spans and details found in the following documents, in limit states design for Canada:

    - Nordic Lam™, "Beams and Headers," dated June 2013,
    - Nordic Lam™, "Beams and Headers, commercial depths," dated June 2013;
    - Nordic Lam™, "Columns," dated June 2013,
    - Nordic Lam™, "Wall Studs," dated December 2013,
    - Nordic Lam™, "Residential Design/Construction Guide," dated December 2013, and
    - Nordic Lam™, "Construction Details for Residential Applications," dated December 2013.

    Applications outside the scope of these installation guidelines and this CCMC Evaluation Report require engineering on a case-by-case basis.

ii. Nordic Engineered Wood Installation Details

The manufacturer's pre-engineered details within the documents outlined in (i) above are limited in scope to building designs where the anticipated loads on the following structural details are not exceeded:

- floor loads,
- roof loads,
- garage door headers,
- bearing length requirements,
- connections for multiple-piece members,
- columns,
- floor framing details,
- garage door header framing details,
- holes in beams and headers, and
- tapered cut.

iii. Engineering Required

For structural applications beyond the scope/limitations of the above-referenced publications or when required by the AHJ, the drawings or related documents must bear the authorized seal of a professional engineer skilled in wood design and licensed to practice under the appropriate provincial or territorial legislation.

Installations beyond the scope/limitations of Sections (i) and (ii) imply, but are not limited to, the following:

- higher loads/longer spans than the manufacturer's pre-engineered details,
- concentrated loads,
- areas of high wind or high seismicity,
- nonbearing-type fastener designs,
- design of supporting foundation footings when the total load exceeds the NBC 2010 pre-engineered floor/roof joist spans and beam spans, and
- fire-resistance ratings.

The engineer must design in accordance with CSA O86, and may use as a guide the "Engineering Guide for Wood Frame Construction" published by the Canadian Wood Council.

iv. Engineering Support Provided by Manufacturer

The manufacturer provides engineering support and offers the following customer support contact number: 1-514-871-8526 or toll free 1-866-817-3418.

- Damaged or defective products must not be used unless repaired in accordance with written instructions from the manufacturer.
- This product must be identified with the phrase "CCMC 13216-R" along the side or top of the glulam member. This CCMC number is only valid when it appears in conjunction with the APA-EWS certification mark.

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1. All lumber, wood-based panels and proprietary engineered wood products are intended for dry service conditions. "Dry service" is defined as the in-service environment under which the equilibrium moisture content (MC) of lumber is 15% or less over a year and does not exceed 19% at any time. Wood contained within the interior of dry, heated or unheated buildings has generally been found to have an MC between 6% and 14% depending on season and location. During construction, all wood-based products should be protected from the weather to ensure that the 19% MC is not exceeded in accordance with Article 9.3.2.5., Moisture Content, of Division B of the NBC 2010.

2. The pre-engineered tables present the pre-engineered factored resistance of the product. The AHJ may require further engineering to determine the factored load in accordance with Part 4 of Division B of the NBC 2010.

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4. Technical Evidence

The Report Holder has submitted technical documentation for CCMC's evaluation. Testing was conducted at laboratories recognized by CCMC. The corresponding technical evidence for this product is summarized below.

4.1 General

Table 4.1.1 Beam Specified Strengths (MPa)[1] [2] [3]

Property		Type of Beam	
Engineering properties	Appearance grade	Industrial	
	Stress grade	20F-1.6E	24F-1.9E
	Layup combination	20F-E8M1	24F-ES1M1
Bending about X-X axis (loaded perpendicular to wide face of laminations)	Bending moment (F_{bx})[4] [5]	25.6	30.7
	Longitudinal shear (F_{vx})[6]	2.2	2.2
	Compression perpendicular to grain (F_{cp})[4]	5.8	7.5
	True modulus of elasticity (E)	11 000	13 100
	Apparent modulus of elasticity (E)	10 300	12 400
Bending about Y-Y axis (loaded parallel to wide face of laminations)	Bending moment (F_{bx})[4] [5]	13.4	14.1
	Longitudinal shear (F_{vx})[6]	1.5	1.5
	Compression perpendicular to grain (F_{cp})[4]	3.9	3.8
	True modulus of elasticity (E)	10 300	11 000
	Apparent modulus of elasticity (E)	9 700	10 300
Axially loaded	Compression parallel to grain (F_c)	14.4	16.5
	Tension parallel to grain (F_t)	10.2	13.4
	Modulus of elasticity (E)	9 700	11 000

Notes to Table 4.1.1:

1 Design of glulam members must be in accordance with CSA O86.

2 The tabulated design values are for dry service conditions and for standard term duration of load.

3 The 20F-1.6E and 24F-1.9E stress grades are primarily used for headers and beams, respectively. Designers should check the availability of a grade before specifying.

4 Bending members of the product are symmetrical throughout the depth of the member.

5 Specified strengths in bending have been adjusted for volume (adjusted to CSA O86 standard beam of 130 mm × 610 mm × 9 100 mm). In calculating the size factor for bending, K_{Zbg}, the beam width, b, must be taken as the full member width.

6 Specified shear strengths have been adjusted to a 2.0 m^3 of beam volume.

Table 4.1.2 Column Specified Strengths (MPa)[1] [2] [3]

Property		Type of column	
Engineering properties	Appearance grade	Industrial	
	Stress grade	ES11[4]	ES12[4]
	Layup combination(s)	ES11	ES12
Bending about X-X axis (loaded perpendicular to wide face of laminations)	Bending moment (F_{bx})[5] [6]	17.2	24.9
	Longitudinal shear (F_{vx})	2.2	2.2
	Compression perpendicular to grain (F_{cp})[5]	5.8	7.5
	True modulus of elasticity (E)	11 000	13 100
	Apparent modulus of elasticity (E)	10 300	12 400
Bending about Y-Y axis (loaded parallel to wide face of laminations)	Bending moment (F_{bx})[5] [6]	22.4	30.7
	Longitudinal shear (F_{vx})	1.5	1.5
	Compression perpendicular to grain (F_{cp})[5]	5.8	7.0
	True modulus of elasticity (E)	11 000	13 100
	Apparent modulus of elasticity (E)	10 300	12 400
Axially loaded	Compression parallel to grain (F_c)	22.3	33.0
	Tension parallel to grain (F_t)	12.5	20.4
	Modulus of elasticity (E)	10 300	12 400

Notes to Table 4.1.2:

1 Design of glulam members must be in accordance with CSA O86.

2 The tabulated design values are for dry service conditions and for standard term duration of load.

3 The design values are based on four or more laminations. For ES11 made of three laminations, F_{bx} must be taken as 20.4 MPa and $F_c$as 19.4 MPa. For ES12 made of three laminations, F_c must be taken as 24.4 MPa.

4 The ES11 and ES12 stress grades are primarily used for wall studs and columns, respectively. Designers should check the availability of a grade before specifying.

5 Compression members of the product are symmetrical throughout the depth of the member.

6 Specified strengths in bending have been adjusted for volume (adjusted to CSA O86 standard column of 130 mm × 610 mm × 9 100 mm). In calculating the size factor for bending, K_{Zbg}, the beam width, b, must be taken as the full member width.

Table 4.1.3 Beam Layup Combinations Grade Requirements

Property	Type of beam	
Appearance grade	**Industrial**	
Stress grade	**20F-1.6E**	**24F-1.9E**
Layup combination	**20F-E8M1**	**24F-ES1M1**
Outer compression zone	4 lams to 343 mm, 10%, 2250f	4 lams to 600 mm, 25% 2250f
	> 343 to 457 mm 20% 2250f	
Inner	1650f	1650f
Outer tension zone	4 lams to 343 mm, 10% 2250f	4 lams to 600 mm, 25% 2250f
	> 343 to 457 mm 20% 2250f	

Table 4.1.4 Column Layup Combinations Grade Requirements

Property	Type of beam	
Appearance grade	**Industrial**	
Stress grade	**ES11**	**ES12**
Layup combination(s)	**ES11**	**ES12**
Uniform grade	2 lams to 381 mm, 1650f	2 lams to 381 mm, 2250f

Grade designations are as follows:

- E-rated 2250f has a minimum long-span, E, of 11 790 MPa (1.71×10^6 psi) and a mean long-span, E, of 13 100 MPa (1.90×10^6 psi).
- E-rated 1650f has a minimum long-span, E, of 9 650 MPa (1.40×10^6 psi) and a mean long-span, E, of 10 300 MPa (1.50×10^6 psi).

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Appendix A

The product with built-up lamina that is made of short-length end-jointed and edge-bonded lumber laminations (i.e. less than 1830 mm long) is not covered in commodity-type glulam by CAN/CSA-O122-06, "Structural Glued-Laminated Timber." In this case, the proprietary laminations are manufactured differently than described in CAN/CSA-O122, but are produced to match the same 20f and 24f conventional glulam stress grades to allow for direct substitution of the conventional laminations.

The equivalency being sought is with respect to producing conventional 20f and 24f stress grades. This was accomplished by establishing bending strength and stiffness that are equivalent to or better than conventional glulam lamination grades. The quality of manufacturing of new built-up short-length lamina in proprietary layup designs will be equivalent to glulam manufactured in accordance with CAN/CSA-O122. In addition, beams covered within the scope of this Report are limited to a maximum of 2.0 m^3 in volume and 600 mm depth of beams.

Property	Test Information
Short-length elements	The short-length lumber elements are typically 900 mm with an occasional piece of not less than 685 mm. The laminating effect of joining 38 mm × 38 mm short lengths and face-bonding was demonstrated by testing a statistical sample of short-length end-joints, jointed short-length elements, and 38 mm × 140 mm lamina made of short-length elements. In production, the jointed elements are proof-loaded at the full-length.
Tension	Tension testing of 102 samples of various lamina grades was conducted to confirm the design tension values.
Modulus of elasticity	Long span E was confirmed on statistical samples of all grades of lamina.
Moment capacity	The moment capacity predictions were confirmed through testing of sixty (60) beams of 20f and 24f grades at 300-mm and 400-mm depths. Fifteen (15) beams of 600-mm depth were also tested.
Shear capacity	Thirty (30) short beams of 450-mm depth were tested to confirm the characteristic value.
Compression parallel to grain	Thirty (30) short column tests were conducted for 89 mm × 89 mm and 140 mm × 140 mm columns to confirm the characteristic value.
Fasteners	Fastener tests were not conducted to establish an "equivalent" species for fastener design. SPF species are recommended for fastener design as a conservative approach.
Manufacturing quality assurance	The manufacturing quality assurance program follows the principles of CSA O177 and ANSI 190.1, which is verified by APA-EWS as part of the plant qualification.
Adhesives	The face and edge bonding and end joints are bonded with either a phenol-resorcinol adhesive or a polyurethane adhesive. The products are currently qualified with the following adhesives: • for end-joints: Ashland UX-100/WD3A22, CCMC 13512-L, and • for edge and face laminations: Ashland WD3-A322/CX-47, CCMC 13591-L.