Evaluation Report CCMC 12118-R

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Open Joist 2000®/Solive ajourée 2000™

1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "Open Joist 2000®/Solive ajourée 2000™", when used as joists in floor and roof applications 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:
  - Sentence 4.3.1.1.(1) Design Basis for Wood (CAN/CSA-O86-09, reliability-based joist strength qualification and stiffness qualification)
- 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:
  - Sentence 9.23.4.2.(2) Spans for Joists, Rafters and Beams (i.e. alternative floor joist solution)

This opinion is based on CCMC's evaluation of the technical evidence in Section 4.1 provided by the Report Holder.

Ruling No. 07-17-175 (12118-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 2007-07-10 (revised on 2012-05-17) 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 consists of a top and bottom chord connected by a series of diagonal members that are finger-jointed into each chord. Five joist depths have been evaluated: 238 mm (9.4"), 302 mm (11.9"), 330 mm (13"), 355 mm (14") and 406 mm (16"). All joists are composed of the following components:

- top and bottom chords that are either 38 mm x 64 mm or 38 mm x 89 mm and made of S-P-F No.2 and better, MSR 2100F-1.8E, MSR 2400F-2.0E or MSR 1650F-1.5E;
- all S-P-F No. 1/No. 2 diagonals that are 38 mm x 38 mm, 38 mm x 64 mm or 38 mm x 89 mm;
- chords that may have finger joints, but with spacing no closer than 600-mm; and
- a vertical endpost that is either solid-sawn lumber or a glue-laminated lumber element.

All finger joints, including those between the diagonals and the chords, are glued together with phenol-resorcinol adhesive (CCMC 13051-L). Intertek ETL Semko (WHI mark), accredited by the Standards Council of Canada, conducts frequent audits of the manufacturing plant and the quality assurance program.

Figure 1 shows typical installation details of the joist. Figure 2 shows the typical joist end finger joint, which is specific to this product.

These figures are for illustrative purposes only; please refer to the manufacturer's installation guide for more detailed information on the proper installation of the product.

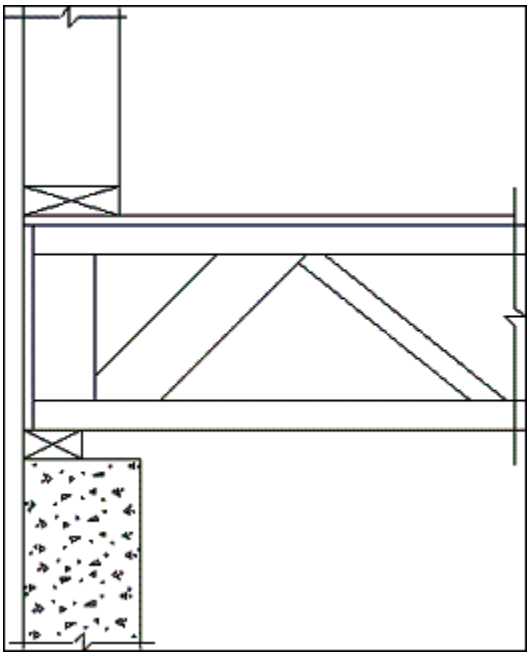

Figure 1. "Open Joist 2000®/Solive ajourée 2000™" – showing proper placement with first web rising from the end bearing (140mm) location

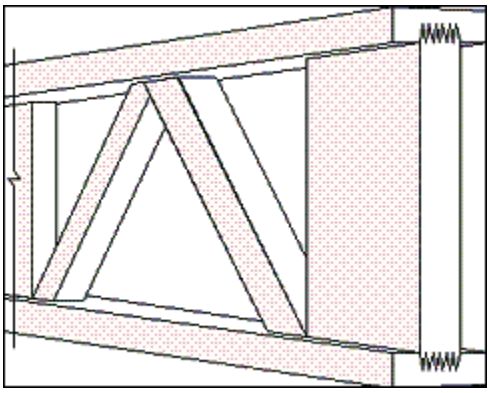

Figure 2. "Open Joist 2000®/Solive ajourée 2000™" – showing end finger joint

3. Conditions and Limitations

CCMC's compliance opinion in Section 1 is bound by the "Open Joist 2000®/Solive ajourée 2000™" being used in accordance with the conditions and limitations set out below.

- The product is intended for use in structural applications, such as floor, ceiling or roof joists, and is intended for dry service use(1) applications only.

(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 a MC between 6% and 14% according to 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.

The product follows a manufacturing quality assurance program that is monitored by a third-party certification organization, Intertek Testing Services (ITS). As part of the manufacturing quality control, each joist is proof-tested for a period of 3 to 5 seconds.

This product must be identified with the phrase "CCMC #12118-R" along the side of the joist. This CCMC number is only valid when it appears in conjunction with the WHI Certification Mark of Intertek Testing Services. In addition, there must be an indication that clearly identifies the proper orientation for installing the joist in order to prevent installing it backwards.

- The following pre-engineering has been provided to CCMC by Distribution Toiture Mauricienne to demonstrate compliance to Part 9 buildings for acceptance by the local authority having jurisdiction (AHJ):

  i) Open Joist's Pre-engineered Floor Span Charts

  When the product is used to support uniform loads only, the installation must be in accordance with the span tables (including vibration criteria[(2)]) found in the specifier's guide, in Limit States Design for Canada, entitled:

  - "Open Joist 2000®" dated January 19, 2010, published by Open Joist 2000 Inc. The installed joist span must be the lesser of the spans shown in the tables contained in either: i) the above-mentioned publication for L/360 or ii) the vibration-controlled span charts[(2)] entitled, "Controlled Vibration Maximum Span Tables," dated October 24, 2009.
  - "Open Joist 2000®" Installation Guide, Installation Details, dated June 2009.

  The products must be installed in accordance with product's installation guidelines noted in the above-mentioned documents for those applications falling within the scope of the documents. Applications outside the scope of these installation guidelines shall require engineering on a case-by-case basis.

  [(2)] In cases where concrete topping is applied or bridging/blocking is used and joists are installed at the maximum spans, the current vibration criteria may not address all occupant performance expectations. Distribution Toiture Mauricienne should therefore be consulted for span adjustments, if necessary, in these types of installations.

  ii) Open Joist's Pre-engineered Installation Details

  The pre-engineered details in the documents outlined in 3(i) are limited in scope to building designs where the anticipated loads on the following structural details are not exceeded:

  - floor span tables;
  - minimum end bearing length (140 mm);
  - rim board, joist blocking or sheathing to complete floor diaphragm.

  iii) Engineering Required

  For structural applications beyond the scope/limitations of the documents referenced in 3(i) 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 3(i) and 3(ii) imply, but are not limited to, the following:

- rim board resistance;
- load-bearing cantilever tables;
- higher loads/longer spans than the manufacturer's pre-engineered details;
- concentrated loads;
- offset bearing walls;
- areas of high wind or high seismicity;
- stair openings;
- design of supporting wall studs/beams when the total load/span exceeds the NBC 2010 pre-engineered floor/roof joist tables; and
- design of supporting foundation footings when the total load/span exceeds the NBC 2010 pre-engineered floor/roof joist tables.

The engineer must design in accordance with CAN/CSA-O86, "Engineering Design in Wood," 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

Distribution Toiture Mauricienne may provide engineering services in conjunction with "Open Joist 2000®/Solive ajourée 2000™" product specification and offers the following contact number: (800) 567-8644.

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

The presentation of the reliability-based resistance values for limit states design that were used by the manufacturer are not conventional in their presentation. The resistances have been derived by pooling the quality control test data between 1994 and 2006 and applying reliability-based conversion principles and comparing with the manufacturer's analysis software. The manufacturer's published span charts meet the reliability-based targets set in CAN/CSA-O86.

4.1.1 Design Values

Table 4.1.1.1 Engineering Properties of the Product - Bending Strength[1]

	Bending Strength – Maximum Factored Total Load kN/m (plf)							
Depth	**238 mm (9.4")**	**302 mm (11.9")**	**330 mm (13")/ 355 mm (14")**		**400 mm (16")**			
Flange Grade, Size	**#2 or better, 2x3**	**#2 or better, 2x3** / **MSR2100, 2x4[2]**	**#2 or better, 2x3** / **#2 or better, 2x4[2]**	**MSR2100, 2x4**	**#2 or better, 2x3**	**MSR1650, 2x3** / **MSR1650, 2x4[2]**	**MSR2100 1.8E, 2x4**	**MSR2400 2.0E, 2x4**
Span, m (ft)	**Bending Strength kN/m (plf)**							
3.04 (10)	4.8 (329)	5.54 (380)	6.18 (424)	–	6.18 (424)	–	–	–
3.35 (11)	4.21 (289)	4.91 (337)	5.35 (367)	–	5.35 (367)	–	–	–
3.65 (12)	3.48 (239)	4.39 (301)	4.74 (325)	–	4.74 (325)	–	–	–
3.96 (13)	2.78 (191)	3.86 (265)	4.23 (290)	–	4.24 (290)	–	–	–
4.26 (14)	2.30 (158)	3.44 (236)	3.83 (263)	–	3.95 (271)	–	–	–
4.57 (15)	1.95 (134)	2.90 (199)	3.51 (241)	–	3.71 (254)	–	–	–
4.87 (16)	1.67 (115)	2.50 (172)	3.07 (211)	–	3.45 (236)	–	–	–
5.18 (17)	–	2.20 (151)	2.59 (178)	–	–	3.23 (221)	–	–
5.48 (18)	–	2.24 (158)	2.26 (155)	–	–	3.56 (244)	–	–
5.79 (19)	–	1.98 (136)	2.61 (179)	–	–	3.36 (230)	–	–
6.09 (20)	–	1.73 (119)	2.26 (155)	–	–	3.14 (215)	–	–
6.4 (21)	–	1.56 (107)	2.02 (139)	–	–	2.90 (199)	–	–
6.7 (22)	–	–	–	2.08 (143)	–	2.64 (181)	–	–
7.01 (23)	–	–	–	1.89 (130)	–	–	2.77 (190)	–
7.3 (24)	–	–	–	1.67 (115)	–	–	2.48 (170)	–
7.6 (25)	–	–	–	1.51 (104)	–	–	2.24 (154)	–
7.92 (26)	–	–	–	–	–	–	2.02 (139)	–
8.23 (27)	–	–	–	–	–	–	–	2.02 (139)
8.53 (28)	–	–	–	–	–	–	–	1.85 (127)
8.84 (29)	–	–	–	–	–	–	–	1.67 (115)
9.14 (30)	–	–	–	–	–	–	–	1.48 (101)

Notes to Table 4.1.1.1:

(1) These maximum specified (factored) total load has been qualified at a minimum end bearing of 140 mm.

(2) Shaded cells below apply to corresponding shaded flange grade, size.

Table 4.1.1.2 Engineering Properties of the Product - Shear Strength[1]

	Shear Strength – Maximum Factored Total Load kN/m (plf)							
Depth	**238 mm (9.4")**	**302 mm (11.9")**	**330 mm (13")/ 355 mm (14")**		**400 mm (16")**			
Flange Grade, Size	**#2 or better, 2x3**	**#2 or better, 2x3** / **MSR2100, 2x4[2]**	**#2 or better, 2x3**	**#2 or better, 2x4** / **MSR2100, 2x4[2]**	**#2 or better, 2x3**	**MSR1650, 2x3** / **MSR1650, 2x4[2]**	**MSR2100 1.8E, 2x4**	**MSR2400 2.0E, 2x4**
Span, m (ft)	**Shear Strength kN/m (plf)**							
3.04 (10)	4.81 (329)	5.54 (380)	6.18 (424)	–	6.18 (424)	–	–	–
3.35 (11)	4.21 (289)	4.91 (337)	5.35 (367)	–	–	4.74 (325)	–	–
3.66 (12)	3.49 (239)	4.39 (301)	4.74 (325)	–	–	4.74 (325)	–	–
3.96 (13)	2.79 (191)	3.86 (265)	4.24 (290)	–	–	4.24 (290)	–	–
4.27 (14)	2.31 (158)	3.44 (236)	3.84 (263)	–	–	3.95 (271)	–	–
4.57 (15)	1.96 (134)	2.90 (199)	3.51 (241)	–	–	3.71 (254)	–	–
4.88 (16)	1.67 (115)	2.50 (172)	3.08 (211)	–	–	3.45 (236)	–	–
5.18 (17)	–	2.20 (151)	2.59 (178)	–	–	3.23 (221)	–	–
5.49 (18)	–	2.24 (158)	2.27 (155)	–	–	3.56 (244)	–	–
5.79 (19)	–	1.98 (136)	–	2.62 (179)	–	3.36 (230)	–	–
6.10 (20)	–	1.73 (119)	–	2.27 (155)	–	3.14 (215)	–	–
6.40 (21)	–	1.56 (107)	–	2.02 (139)	–	2.90 (199)	–	–
6.71 (22)	–	–	–	2.09 (143)	–	2.64 (181)	–	–
7.01 (23)	–	–	–	1.89 (130)	–	–	2.77 (190)	–
7.32 (24)	–	–	–	1.67 (115)	–	–	2.48 (170)	–
7.62 (25)	–	–	–	1.52 (104)	–	–	2.24 (154)	–
7.92 (26)	–	–	–	–	–	–	2.02 (139)	–
8.23 (27)	–	–	–	–	–	–	–	2.02 (139)
8.53 (28)	–	–	–	–	–	–	–	1.85 (127)
8.84 (29)	–	–	–	–	–	–	–	1.67 (115)
9.14 (30)	–	–	–	–	–	–	–	1.48 (101)

Notes to Table 4.1.1.2:

(1) These maximum specified (factored) total load has been qualified at a minimum end bearing of 140 mm.

(2) Shaded cells below apply to corresponding shaded flange grade, size.

Manufacturing plants are listed at the end of this Report and include the orginal OJ2000 manufacturing plant and one licensed manufacturing facility, namely:

Universal Forest Products
3778 Oneida Valley Road
Emlenton, Pennsylvania
16373

Report Holder: Open Joist, Solive Ajourée 2000 Inc. (Solamco Inc)
Division de Dist. Toiture Mauricienne Inc.
1970, rue des Toitures
Trois-Rivières, QC G8V 1V9
Tel: 819-374-8784
Fax: 819-384-4527

Plant(s): Ste-Marthe-du-Cap, QC
Emlenton, PA, U.S.A.

APPENDIX A

The reliability-based limit states design values were derived by pooling the results from quality control testing performed on joists between 1994-2006. The test data was used to determine the characteristic value and 2-P Weibull CVw for applying the reliability normalization factors as per CAN/CSA-O86-09. Previous testing to CCMC's Technical Guide for "Open-Web Wood Floor Trusses," MasterFormat 06174, verified the adequacy of the manufacturer's proprietary floor truss design methodology by creep testing.

Table A1. Additional Test Information for the Product

Property	Test Information
Shear capacity	Quality control test data of 1,424 joists, representing shear failures, was used to determine the characteristic values and 2-P Weibull coefficient of variation, CV_W. The reliability normalization factor was determined following the CSA Standard Procedure to determine the reliability-based moment resistance for limit states design.
Moment capacity	Quality control test data of 1,264 joists, representing bending failures, was used to determine the characteristic values and 2-P Weibull coefficient of variation, CV_W. The reliability normalization factor was determined following the CSA Standard Procedure to determine the reliability-based moment resistance for limit states design.
Stiffness/ deflection	The stiffness capacity and deflection prediction is determined by calculation utilizing the principles of truss design. The proprietary method has been validated empirically through tests.
End joints	End joints were qualified as part of the flange tension qualification by the finger-jointed lumber supplier certified by a certification organization (C.O.) The manufacturer conducts periodic tension tests to confirm the chord tension specified strength.
Creep	Specimens of spans controlled by: bending, shear and deflection were tested for creep performance in accordance with the 24-hr CCMC creep and recovery test. All specimens passed the CCMC creep and recovery criteria.
Bearing length	The specified bearing length is 140-mm. Bearing capacity does not affect the design of spans at their bearing length.
Adhesive qualification	The chord finger joints and the web-to-chord finger joints are attached using a phenol-resorcinol adhesive complying with CSA O112.7-M1977, "Resorcinol and Phenol-Resorcinol, Resin Adhesives for Wood (Room- and Intermediate-Temperature Curing)." (CCMC 12917-L)
Proof loading	A detailed study has been conducted to establish a proof load that is appropriate based on the variability of the joist. The proof load has been set at 71% of the 5^{th} load without any further adjustment for load duration.