Evaluation Report CCMC 13053-R
P3 Joist® PJI-40, PJI-60, PJI-80 I-Joists

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "P3 Joist® PJI-40, PJI-60, PJI-80 I-Joists," when used as joists in accordance with the conditions and limitations stated in Section 3 of this Report, comply with the National Building Code (NBC) of Canada 2015:

- Clause 1.2.1.1.(1)(a) of Division A, using the following acceptable solutions from Division B:
  - Sentence 4.3.1.1.(1), Design Basis for Wood (CSA O86-14, "Engineering Design in Wood," for I-joist qualification)
- Clause 1.2.1.1.(1)(b) of 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

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

Ruling No. 07-16-174 (13053-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 2007-05-29 (revised on 2017-03-31) 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 products are families of prefabricated, wood I-joists consisting of two continuous proprietary grade Spruce-Pine-Fir (S-P-F) flanges glued to a 9.5-mm-thick oriented strand board (OSB) web. The flange sizes and grades are listed in Table 2.1.

The web-flange connection is made by inserting the profiled OSB web into a tapered groove in the centre of the wide face of the flange at various depths. The OSB web material is manufactured in 2 743-mm lengths and end-jointed by gluing a full thickness V-joint. The flange finger joints are bonded with a polyurethane adhesive (see CCMC 13512-L). The web-to-web and web-to-flange joints are bonded with a phenol-resorcinol waterproof adhesive (see CCMC 13054-L).

APA − The Engineered Wood Association (APA EWS trademark) conducts regular audits of the manufacturing plant and the quality assurance program.

The engineering properties of the products are listed in Tables 4.1.1 and 4.1.2.

Table 2.1 Flange Sizes and Grades of the Products

Product	Width (mm)	Thickness (mm)	Grade
PJI-40	63.5	38.0	Enhanced 1650f-1.5E
PJI-60	63.5	38.0	2100f-1.8E
PJI-80	89.0	38.0	2100f-1.8E

3. Conditions and Limitations

The CCMC compliance opinion in Section 1 is bound by the "P3 Joist® PJI-40, PJI-60, PJI-80 I-Joists" being used in accordance with the conditions and limitations set out below:

- The products are intended for structural applications such as floor joists, and are intended for dry service use(1) applications only.
- The following pre-engineering information has been provided to CCMC by the manufacturer to demonstrate compliance with Part 9, Housing and Small Buildings, of the NBC 2015, for acceptance by the local authority having jurisdiction (AHJ):

i. **EACOM Pre-engineered Floor Span Charts**

When the products are used as floor joists in simple (single) span or continuous (multiple) span applications supporting uniform loads only, the installation must be in accordance with the span tables (including vibration criteria(2)) found in the "P3 Joist User Guide Canada 2018," January 2019.

The products must be installed in accordance with EACOM's "P3 Joist Installation Guide Canada 2018," January 2018 installation guidelines for those applications falling within the scope of the document. Applications outside the scope of these installation guidelines require engineering on a case-by-case basis.

ii. **EACOM Pre-engineered Installation Details**

The product is to be installed in accordance with the manufacturer's pre-engineered details outlined in the user guide specified in i. above, where the following requirements are met and limits are not exceeded:

- blocking panel and rim board, maximum factored uniform vertical load (page 8);
- squash blocks, maximum factored vertical load per pair (page 9);
- stair opening header (page 11);
- web stiffener requirements (page 12);
- cantilever balcony (page 13);
- loadbearing cantilever load table (page 15);
- web hole rules and specifications, and table (pages 16 and 17);
- joist roof framing and construction details (pages 18 to 23);
- roof span and uniform load tables (pages 24 to 29); and
- connectors (pages 31 and 32).

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 i. and ii. imply, but are not limited to, the following:

- 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 exceeds the NBC 2010 2015 pre-engineered lumber floor/roof joist tables; and
- design of supporting foundation footings when the total load exceeds the NBC 2010 2015 pre-engineered lumber floor/roof joist tables.

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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 average 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 2015.

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

The engineer must design in accordance with CSA O86-14 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**

APA EWS provides engineering support in conjunction with EACOM product support. EACOM and APA EWS offer the following support contact numbers: APA EWS help desk: 253-620-7400 and APA EWS email: help@apawood.org.

- Damaged or defective joists must not be used, unless repaired in accordance with written instructions from the manufacturer.
- This product must be identified with the phrase "CCMC 13053-R" along the side of the flange. This CCMC number is only valid when it appears in conjunction with the APA EWS certification mark.

4. Technical Evidence

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

4.1 Design Requirements

Table 4.1.1 Factored Resistances for the Products(1)

Basic Properties – Limit States Design					
Product	**Joist Depth (mm)**	**Factored Resistance**		**EI × 10^6 (kN·mm^2)**	**K × 10^6 (N)**
		Moment(2) (N·m)	**Vertical Shear (N)**		
PJI-40	241	6 167	7 860	554	21.97
	302	7 994	9 970	947	27.49
	356	9 629	12 010	1 383	32.38
	406	11 162	13 830	1 885	37.01
PJI-60	241	8 524	7 860	663	21.97
	302	11 049	9 970	1 136	27.49
	356	13 293	12 010	1 676	32.38
	406	15 413	13 830	2 293	37.01
PJI-80	302	15 650	9 970	1 570	27.49
	356	18 852	12 006	2 301	32.38
	406	21 851	13 830	3 134	37.01
	457	24 805	17 200	4 055	41.63
	508	27 466	17 760	5 137	46.26
	559	30 082	18 360	6 353	50.89
	610	32 675	18 920	7 711	55.51

Notes to Table 4.1.1:

(1) Design values were developed in accordance with CSA O86 for a standard term load duration (K_D = 1). All values, except EI and K, are permitted to be adjusted for other load durations as permitted by CSA O86.

(2) The factored moment resistances listed in this table must not be increased by any Code-allowed repetitive member system factor.

Table 4.1.2 Product Engineering Properties[1]

Reaction Properties – Limit States Design									
Product	Joist Depth (mm)	Factored End Reaction (N)				Factored Intermediate Reaction (N)			
		44-mm Bearing Length		102-mm Bearing Length		89-mm Bearing Length		140-mm Bearing Length	
		Web Stiffeners		Web Stiffeners		Web Stiffeners		Web Stiffeners	
		No	Yes	No	Yes	No	Yes	No	Yes
PJI-40	241	7 582	7 863	7 863	7 863	19 342	20 360	22 783	22 783
	302	8 425	9 197	9 970	9 970	19 342	21 378	22 783	23 695
	356	8 425	10 391	10 882	12 006	19 342	22 291	22 783	24 468
	406	8 425	11 514	10 882	13 831	19 342	23 169	22 783	25 240
PJI-60	241	7 582	7 863	7 863	7 863	19 342	20 360	22 783	22 783
	302	8 425	9 197	9 970	9 970	19 342	21 378	22 783	23 695
	356	8 425	10 391	10 882	12 006	19 342	22 291	22 783	24 468
	406	8 425	11 514	10 882	13 831	19 342	23 169	22 783	25 240
PJI-80	302	8 987	9 970	9 970	9 970	19 377	23 169	22 853	25 170
	356	8 987	12 006	10 882	12 006	21 203	24 257	24 116	26 293
	406	8 987	12 953	10 882	13 831	22 923	25 275	25 275	27 381
	457	8 776	14 393	11 584	17 201	22 467	27 732	25 626	30 541
	508	8 776	14 393	11 584	17 763	22 467	27 732	25 626	30 541
	559	8 776	14 393	11 584	18 359	22 467	27 732	25 626	30 541
	610	8 776	14 393	11 584	18 921	22 467	27 732	25 626	30 541

Note to Table 4.1.2:

(1) Design values were developed in accordance with CSA O86 for a standard term load duration ($K_D = 1$). The reaction resistances are permitted to be adjusted for other load durations as permitted by CSA O86.

Report Holder

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Appendix A

The methods used to determine the design values, except for bearing length capacities, were obtained from testing in accordance with ASTM D 5055-04, "Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists," as specified in CSA O86-09, and are summarized below. The methods used to determine the bearing length capacities were obtained from testing to ASTM D 5055-08, as specified in CSA O86-09, and are also summarized below. The manufacturer's published pre-engineered joist spans were designed in accordance with CSA O86-14.

Table A1 Additional Product Test Information[(1)]

Property	Test Information
Shear capacity	The shear capacity of the product was established by computing the shear capacity for each depth separately as per ASTM D 5055-04. Qualification tests were used to establish the applicable coefficient of variation, CV_w, and the reliability normalization factor from CSA O86-09 was used to determine the specified strength.
Moment capacity	The moment capacity qualification was carried out using the analytical method in accordance with ASTM D 5055-04. At least 10 specimens of each joist depth were tested to verify the actual capacity versus the design capacity. Qualification tests were used to establish the applicable coefficient of variation, CV_w, and the reliability normalization factor from CSA O86-09 was used to determine the specified strength.
Stiffness	A bending test program of varying depths was used to confirm the stiffness capacity. The following formula was used to predict mid-span deflection: $$deflection = \frac{5wL^4}{384EI \times 10^3} + \frac{wL^2}{K}$$ where EI = shear-free EI from Table 4.1.1, w = uniform load (kN/m), L = span (mm), K = shear deflection factor from Table 4.1.1.
End joints	End joints were qualified as part of the flange tension qualification. The flanges are finger-jointed in plant, and regular tension testing is conducted.
Creep	Product specimens were tested for creep performance as per ASTM D 5055-04, whereby two specimens from each I-joist series group are loaded to 1.5 times the design resistive moment capacity where the average deflection recovery must exceed 90%.
Bearing length	The design values on end bearing and intermediate reaction were analyzed using the procedure in ASTM D 5055-08 whereby linear interpolation was used to establish reaction capacities within the tested bounds of depth and bearing length. A minimum of 10 specimens were tested for four bearing lengths at I-joist extreme depths. Qualification tests were used to establish the applicable coefficient of variation, CV_w, and the reliability normalization factor from CSA O86 was used to determine the specified strength.
Adhesive qualification	The flange-to-flange finger joint is adhered with a polyurethane adhesive (see CCMC 13512-L); web-to-web and web-to-flange joints are bonded with a phenol-resorcinol formaldehyde adhesive complying with CSA O112.7-M1977, "Resorcinol and Phenol-Resorcinol Resin Adhesives for Wood (Room- and Intermediate-Temperature Curing)" (see CCMC 13054-L).

Note to Table A1:

(1) Design values were developed in accordance with the referenced standards found herein. The requirements met have not changed in the current editions of the standards.