CONSTRUCTION

Evaluation Report CCMC 13323-R
RFPI®-Joists

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "RFPI®-Joists," when used as floor and roof joists in accordance with the conditions and limitations stated in Section 3 of this Report, complies 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")
- 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:
  - Article 9.10.8.10., Application to Houses (Fire rating is not required for single-family houses constructed as per Part 9 of the NBC, conventional wood-frame construction)[(1)];
  - Sentence 9.23.4.2.(2), Spans for Joists, Rafters and Beams

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

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(1) Sections 4.2 and 4.3 of this Report provide "fire-protection options" for this proprietary floor joist system as an alternative solution to the acceptable solution in Part 9 for conventional wood-frame floor construction. The proposed joists' fire protection options, referenced in Sections 4.2 and 4.3 and listed in Appendix B, are provided to the authority having jurisdiction (AHJ) for information purposes. The fire-protection options, proposed and explained in Sections 4.2 and 4.3, are provided by the joist manufacturer, and the fire performance has been reviewed by CCMC as performing "as well as" the inherent fire resistance of exposed lumber floors.

Ruling No. 09-13-211 (13323-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 2009-08-05 (revised 2017-03-22) 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 pre-fabricated wood I-joist available in ten series. The I-joists are made with either laminated veneer lumber (LVL) or lumber flanges with an oriented strandboard (OSB) web. The LVL flanges are manufactured by Roseburg Forest Products Co. (the designated LVL flange material falls within the scope of the manufacturing process and quality control system of CCMC 13310-R). The top and bottom flanges range in thicknesses from 35 mm to 38 mm and in widths from 44 mm to 89 mm. The web consists of 9.5-mm- or 11-mm-thick OSB. The web sections are end-jointed to form a continuous web. The flange width, depth and material are listed in Table 2.1.

The web-flange connection is made by inserting the profiled OSB web into a profiled groove in the centre of the wide face of the flange (both top and bottom flanges.) The web-to-web and web-to-flange joints are bonded with phenol resorcinol formaldehyde (PRF) adhesive (see CCMC

13522-L). The LVL is manufactured with a high-temperature cure phenol formaldehyde (PF) adhesive resin (see CCMC 13019-L). The fingerjoint adhesive for the lumber flanges is a melamine formaldehyde adhesive (see CCMC 13252-L).

Table 2.1 "RFPI®-Joists" Series

Joist Series	Flange		Web Material	Joist Depth Range (mm)
	Material	Depth × Width (mm)		
RFPI® 20	Roseburg 1.88E LVL	35 × 44	9.5-mm-thick OSB	241 to 356
RFPI® 40S	1.5E solid sawn lumber	38 × 64	9.5-mm-thick OSB	241 to 406
RFPI® 400	Roseburg 1.88E LVL	35 × 52	9.5-mm-thick OSB	241 to 406
RFPI® 40	Roseburg 1.88E LVL	35 × 59	9.5-mm-thick OSB	241 to 406
RFPI® 60S	1.8E solid sawn lumber	38 × 64	9.5-mm-thick OSB	241 to 406
RFPI® 70	Roseburg 2.21E LVL	38 × 59	9.5-mm-thick OSB	241 to 406
RFPI® 80S	1.8E solid sawn lumber	38 × 89	9.5-mm-thick OSB	302 to 406
RFPI® 90	Roseburg 2.21E LVL	38 × 89	11-mm-thick OSB	302 to 406
RFPI® 700	Roseburg 2.41E LVL	38 × 59	11-mm-thick OSB	457 to 610
RFPI® 900	Roseburg 2.41E LVL	38 × 89	11-mm-thick OSB	457 to 610

3. Conditions and Limitations

CCMC's compliance opinion in Section 1 is bound by the "RFPI®-Joists" being used in accordance with the conditions and limitations set out below.

The product is intended for structural applications such as floor joists, and is intended for dry service applications only.(1)

The following pre-engineering has been provided to CCMC by Roseburg Forest Products Co. to demonstrate compliance with NBC 2015, Part 9, Housing and Small Buildings, for acceptance by the local authority having jurisdiction (AHJ):

i. **Roseburg Forest Products Co.'s Pre-engineered Floor and Roof Span Charts**
When the RFPI® 20, 40S, 400, 40, 60S, 70, 80S or 90 I-joists 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 document entitled, "Roseburg EWP Residential Design and Installation Guide, Limit States Design," November 2018.

When the RFPI® 700 or 900 I-joists 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 document entitled, "Roseburg EWP Commercial Design and Installation Guide, Limit States Design," April 2019.

The joists must be installed in accordance with Roseburg Forest Products Co.'s installation guidelines noted in these documents for those applications falling within the scope of the documents. Applications outside the scope of these installation guidelines require engineering on a case-by-case basis.

ii. **Roseburg Forest Products Co.'s Pre-engineered Installation Details**
Roseburg Forest Products Co.'s pre-engineered installation details within the document entitled, "Roseburg Framing System® – Installation Guide" for Canada, April 2019, includes:

- rim board maximum vertical load;
- squash blocks maximum vertical load;
- blocking panel maximum vertical load;
- web stiffener requirements;
- loadbearing cantilever tables;
- cantilever balcony;
- web hole tables; and
- roof joist details.

iii. Engineering Requirements

For structural applications beyond the scope and limitations of the Roseburg Forest Products Co.'s publication listed 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.

Applications beyond the scope and limitations of 3(i) and 3(ii) imply, but are not limited to, the following:

- higher loads and longer spans than the manufacturer's pre-engineered details;
- concentrated loads;
- offset bearing walls;
- high wind and seismic areas;
- stair openings;
- design of supporting wall studs and beams when the total load exceeds the NBC 2015 pre-engineered floor/roof joist tables; and
- design of supporting foundation footings when the total load exceeds the NBC 2015 pre-engineered floor/roof joist tables.

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

Roseburg Forest Products Co. provides engineering support and may also be consulted in the use of these proprietary pre-fabricated I-joists at the following numbers:

Tel.: 541-679-3311
Fax: 541-679-2543

This product must be identified with the phrase "CCMC 13323-R" along the side of the web or flange of the product. The CCMC number is only valid when it appears in conjunction with the certification mark of APA – The Engineered Wood Association.

Damaged or defective I-joists must not be used unless repaired in accordance with written instructions from the manufacturer.

(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. Therefore, if necessary, Roseburg Forest Products Co. should be consulted for span adjustments in these types of installations.

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 Material Requirements

Table 4.1.1 Engineering Properties(1) of the Product Series for Limit States Design

Joist Series	Joist Depth (mm)	M_r(2) (N·m)	EI ($\times 10^9$ N·mm^2)	K ($\times 10^6$ N)	V_r(3) (N)
RFPI® 20	241	6 360	473	22.0	8 565
	302	8 210	812	27.5	9 970
	356	9 765	1 205	32.4	11 305
RFPI® 40S	241	6 000	554	22.0	7 865
	302	7 710	947	27.5	9 970
	356	9 630	1 383	32.4	12 005
	406	11 160	1 885	37.0	13 830

Table 4.1.1 Engineering Properties[1] of the Product Series for Limit States Design (cont.)

Joist Series	Joist Depth (mm)	M_r [2] (N·m)	EI ($\times 10^9$ N·mm^2)	K ($\times 10^6$ N)	V_r [3] (N)
RFPI® 400	241	7 545	554	22.0	8 565
	302	9 730	947	27.5	10 390
	356	11 590	1 395	32.4	12 005
	406	13 260	1 908	37.0	13 830
RFPI® 40	241	8 480	617	22.0	9 340
	302	10 950	1 050	27.5	10 880
	356	13 045	1 550	32.4	12 425
	406	14 915	2 115	37.0	13 830
RFPI® 60S	241	7 650	663	22.0	7 865
	302	9 910	1 136	27.5	9 970
	356	11 935	1 676	32.4	12 005
	406	13 840	2 293	37.0	13 830
RFPI® 70	241	11 570	763	22.0	9 340
	302	14 985	1 306	27.5	10 880
	356	17 870	1 928	32.4	12 425
	406	20 475	2 634	37.0	13 830
RFPI® 80S	302	15 715	1 570	27.5	11 165
	356	18 920	2 301	32.4	12 885
	406	21 940	3 134	37.0	14 535
RFPI® 90	302	22 875	1 940	27.5	14 395
	356	27 285	2 847	32.4	15 410
	406	31 265	3 874	37.0	16 360
RFPI® 700	457	23 565	3 573	50.4	18 080
	508	26 160	4 531	56.0	19 235
	559	28 730	5 610	61.6	20 605
	610	31 275	6 815	67.3	21 485
RFPI® 900	457	36 260	5 306	50.4	20 255
	508	40 265	6 706	56.0	20 675
	559	44 230	8 282	61.6	21 135
	610	48 155	10 032	67.3	21 485

Notes to Table 4.1.1:

(1) M_r = factored moment resistance; EI = stiffness; K = shear coefficient; and V_r = factored shear resistance.

(2) The M_r must not be increased by any Code-allowed repetitive member factor.

(3) Minimum 102-mm bearing required for shear resistance.

Table 4.1.2 Factored Reaction Resistances[1]

Joist Series	Joist Depth (mm)	Factored End Reaction Resistance (N)				Factored Intermediate Reaction Resistance (N)			
		45-mm Bearing		102-mm Bearing		89-mm Bearing		133-mm Bearing	
		w/o Stiff.	w/ Stiff.	w/o Stiff.	w/ Stiff.	w/o Stiff.	w/ Stiff.	w/o Stiff.	w/ Stiff.
RFPI® 20	241	6 390	8 075	8 565	8 565	12 460	13 165	14 040	16 150
	302	6 670	8 600	9 970	9 970	13 585	14 285	14 990	17 095
	356	6 670	9 055	10 880	11 305	13 585	14 285	14 990	17 095
RFPI® 40S	241	7 580	7 865	7 865	7 865	15 165	15 725	15 725	15 725
	302	8 425	9 410	9 970	9 970	17 550	18 430	18 675	19 940
	356	8 425	10 740	10 880	12 005	17 550	19 235	19 340	21 415
	406	8 425	12 005	10 880	13 830	17 550	20 010	20 010	22 820
RFPI® 400	241	7 195	8 565	8 565	8 565	15 095	15 795	16 150	17 130
	302	7 370	8 880	10 390	10 390	15 795	16 500	16 500	18 605
	356	7 370	9 160	10 880	12 005	15 795	16 500	16 500	18 605
	406	7 370	9 410	10 880	13 830	15 795	16 500	16 500	18 605
RFPI® 40	241	7 580	8 565	9 340	9 340	15 795	17 550	17 905	18 605
	302	8 425	9 830	10 880	10 880	17 475	18 430	18 675	20 150
	356	8 425	10 950	10 880	12 425	17 550	19 235	19 340	21 520
	406	8 425	12 005	10 880	13 830	17 550	20 010	20 010	22 820
RFPI® 60S	241	7 580	7 865	7 865	7 865	15 165	15 725	15 725	15 725
	302	8 425	9 410	9 970	9 970	17 550	18 430	18 675	19 940
	356	8 425	10 740	10 880	12 005	17 550	19 235	19 340	21 415
	406	8 425	12 005	10 880	13 830	17 550	20 010	20 010	22 820
RFPI® 70	241	7 865	9 340	9 340	9 340	16 395	17 550	17 905	18 605
	302	8 425	10 320	10 880	10 880	17 550	18 430	18 675	20 150
	356	8 425	11 165	10 880	12 425	17 550	19 235	19 340	21 520
	406	8 425	12 005	10 880	13 830	17 550	20 010	20 010	22 820
RFPI® 80S	302	8 985	11 165	10 880	11 165	19 730	22 325	21 765	22 325
	356	8 985	12 285	10 880	12 885	21 205	23 590	22 535	25 275
	406	8 985	13 340	10 880	14 535	21 205	24 750	23 240	28 085
RFPI® 90	302	9 830	12 250	13 235	14 395	23 555	24 395	24 395	25 800
	356	9 830	13 235	13 235	15 410	23 555	24 575	24 575	27 030
	406	9 830	14 215	13 235	16 360	23 555	24 750	24 750	28 260
RFPI® 700	457	7 900	15 445	12 635	18 080	19 270	28 435	21,240	31 420
	508	7 655	16 150	12 110	19 235	19 270	28 435	21 240	31 420
	559	N/A	16 850	N/A	20 605	N/A	29 135	N/A	32 330
	610	N/A	17 550	N/A	21 485	N/A	29 135	N/A	32 330
RFPI® 900	457	10 355	18 045	12 990	20 255	21 060	35 875	24 395	40 090
	508	9 480	18 710	12 635	20 675	21 060	35 875	24 395	40 090
	559	N/A	19 340	N/A	21 135	N/A	37 945	N/A	42 265
	610	N/A	20 010	N/A	21 485	N/A	37 945	N/A	42 265

Note to Table 4.1.1:

(1) For the floor or roof span design, the lesser of the reaction resistance or the compressive stress perpendicular to grain of the flange must be used. The Roseburg Design Guide specified in 3(i) above outlines the Table of compressive stress perpendicular to grain not to be exceeded.

This Evaluation Report is applicable only to the products labelled with the certification mark of the APA – The Engineered Wood Association and the phrase "CCMC 13323-R" on each I-joist member.

The manufacturing quality assurance program is evaluated for conformance to ASTM D 5055-13e1, "Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists." The APA – The Engineered Wood Association (APA certification mark) is accredited by the Standards Council of Canada as a product and services certification body.

4.2 Additional Performance Data Submitted by the Report Holder

This section is beyond the scope of CCMC's opinion in Section 1 related to the evaluation of structural performance in Section 4.1. The performance of the fire-protection options has been reviewed by CCMC and is presented as additional information for AHJs.

4.2.1 Background

The following information is intended to be used by the AHJ when the fire performance of the alternative solution is deemed to perform "as well as" that of the Code-specified exposed lumber joists. The engineered joist manufacturer (Report Holder) has submitted to CCMC the fire-protection option for its proprietary joist system when used in single-family houses (unsprinklered). The submission was in response to the decision by the Canadian Commission on Construction Materials Evaluations (CCCME), as outlined in Section 4.3 of this Report.

4.2.2 Proposed Fire-Protection Options

The manufacturer's solutions for proposed fire protection of their proprietary joists are presented in Appendix B. CCMC has reviewed the fire testing and analysis of the fire-protection options in comparison to the fire performance of unprotected exposed 38 mm × 235 mm (2 × 10) floor joist system[(1)]. The fire testing demonstrated that the proposed fire-protection options perform "as well as" exposed 38 mm × 235 mm (2 × 10) lumber joists. It should be noted that the NBC exempts single-family houses constructed using conventional wood-frame construction, in accordance with Part 9, from requiring a fire-resistance rating (see Article 9.10.8.10. of Division B of the NBC 2015). The proposed fire-protection options for proprietary alternative floor joists are not to be considered in sprinklered single-family houses or where fire-resistance-rated assemblies are required.

1. Structural composite lumber, as defined in CSA O86 and evaluated by CCMC, is considered to have equivalent fire performance to lumber for joists of the same size.

4.3 Additional Health and Safety Data Identified by Third Parties

This section is beyond the scope of CCMC's opinion in Section 1 related to the evaluation of structural performance in Section 4.1. The performance of the fire protection options has been reviewed by CCMC and is presented as additional information for AHJs.

4.3.1 Canadian Commission on Construction Materials Evaluations (CCCME) – Fire Safety

The minimum fire performance of innovative structural materials, or alternative solutions, as compared to that of the NBC-specified conventional wood-frame construction, or acceptable solution, has been the subject of analysis and discussion for several years among fire officials, provincial and territorial regulators, and AHJs. The NRC fire tests[(1)] conducted between 2002 and 2008 demonstrated that the innovative structural joist systems tested, and currently in the marketplace (i.e., I-joists, C-channel steel joists, metal-plated wood trusses and metal-web trusses), had a time-to-collapse below the performance of exposed 38 mm × 235 mm (2 × 10) lumber joists (which is considered the benchmark or acceptable solution). At the May 2018 and October 2019 meetings of the CCCME, the Commission directed CCMC to provide floor fire performance information to the local AHJs across Canada to aid their decision-making on whether the fire performance of floors (i.e., the time to evacuate before failure occurs) for alternative joist systems performs "as well as" the inherent fire performance of exposed 38 mm × 235 mm (2 × 10) lumber joists. Testing has been carried out that follows the principles expressed in Appendix D of Division B of the NBC. Following the direction of the CCCME, this CCMC Evaluation Report has been modified to provide this manufacturer's information.

The CCCME asked CCMC to review and validate the fire-test data from manufacturer and publish the fire performance to assist the AHJ's decision regarding fire protection for alternative solutions to exposed lumber floor joists of conventional wood-frame construction. CCMC has agreed to review the proposed fire-protection alternatives and provide the AHJ with valid fire-protection options. It is confirmed that the I-joist fire-protection solutions submitted by this manufacturer have been reviewed by CCMC and are outlined in Appendix B. These joist fire-

protection options, tested by following the principles of the CAN/ULC-S101 floor test[2], are considered by CCMC as having performed as well as exposed 38 mm × 235 mm (2 × 10) lumber joists.

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1. Fire Performance of Houses. Phase I. Study of Unprotected Floor Assemblies in Basement Fire Scenarios, RR-252, 2008-12-15
2. Essentially following the ULC S101 time-temperature curve, the floor joists loaded to in-service loads and structural joist failure as the criterion.

Report Holder

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Date modified:
2020-04-10

Appendix A

The design values obtained from testing to ASTM D 5055-08a as specified in CSA O86-09 are summarized below. The manufacturer's published pre-engineered joist spans were then designed in accordance with CSA O86-14.

Table A1. Additional Test Information(1)

Property	Test Information
Shear capacity	The shear capacity of the "RFPI®-Joists" series was established by test as per ASTM D 5055-08a. Qualification and quality control tests were used to establish the applicable coefficient of variation, CV_w, and the reliability normalization factor from Table 14.2.3.2 of 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 5055-08a. Quality control tests and qualification tests were used to establish the applicable coefficient of variation, CV_w, and the reliability normalization factor from Table 14.2.3.2 of 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 should be used to predict mid-span deflection: $$\frac{5wL^4}{384EI \times 10^3} + \frac{wL^2}{K}$$ where EI = from Table 4.1.1 w = uniform load (kN/m) L = span (mm) K = shear deflection factor from Table 4.1.1.
Creep	The product specimens were tested for creep performance as per ASTM D 5055-08a, whereby two specimens in each I-joist series group are loaded to 1.5 times the design resistive moment capacity and the average deflection recovery must exceed 90% of the deflection between 1.5 times the total load and the basic dead load deflection (20% design).
Bearing length	Tests were conducted to qualify a minimum end bearing of 45 mm and 89 mm. Qualification tests were used to establish the applicable coefficient of variation, CV_w, and the reliability normalization factor from Table 14.2.3.2 of CSA O86-09 was used to determine the specified strength.
Adhesive qualification	The web-to-web and web-to-flange joints are bonded with PRF adhesive conforming to CSA O112.9-10, "Evaluation of Adhesives for Structural Wood Products (Exterior Exposure)" (see CCMC 13522-L). The LVL flanges are bonded with PF adhesive conforming to CSA O112.6-M1977, "Phenol and Phenol-Resorcinol Resins for Wood (High-Temperature Curing)" (see CCMC 13019-L). The lumber flange end joints are glued with a melamine formaldehyde adhesive conforming to CSA O112.9-04 (see CCMC 13252-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.

Appendix B

B-1 CCMC Important Note from the CCMC Registry of Product Evaluations

Fire Performance of Innovative Structural Products in Houses

This Registry contains opinions on the suitability-for-use of products intended as structural elements in houses. Although historically there has been no need to regulate the structural fire performance of houses, an inherent intent of the National Building Code of Canada (NBC) is that occupants have sufficient time to escape from a building in the event of a fire.

There are many factors that may determine whether that intent is achieved. The fire endurance of structural elements may be one. However, its importance may be minimized by other factors such as combustible content load, early warning devices, smoke movement and toxicity, and fire department response time; all contributing to the overall system performance. Research is underway within the NRC Construction Research Centre to determine the critical factors that affect occupant escape from houses.

Some innovative structural products have been used in the marketplace for several years and have gained the confidence of design professionals, code authorities and users with respect to their performance under typical fire scenarios in today's house system. Some newer products have not been in service long enough to have gained that confidence and may present a more obvious concern.

Unless otherwise stated, innovative structural products for houses have not been evaluated in the context of the NBC intent noted above. As is the case for all innovative products, designers and authorities need to exercise judgment in considering the use of innovative structural products for houses.

B-2 "RFPI®-Joists" – Fire-Protection Options

The following seven (7) options of I-joist floor fire-protection alternative solutions are provided by the manufacturer[(1)]. These floor assemblies have demonstrated fire performance as good as conventional wood-frame 38 mm × 235 mm (2 × 10) exposed-floor construction.

The details of the following fire protection floor assemblies are outlined in the Figures 1 to 7, below.

1) Fire Protection of Floors FP-01 – 12.5 mm (1/2 in.) Gypsum Board Attached to Bottom of Flange;
2) Fire Protection of Floors FP-02 – 12.5 mm (1/2 in.) Gypsum Board Attached Directly to Web;
3) Fire Protection of Floors FP-03 – 12.5 mm (1/2 in.) Gypsum Board Attached Directly to Sides of Flange;
4) Fire Protection of Floors FP-04 – Mineral Wool Insulation[(2)];
5) Fire Protection of Floors FP-06 – 12.5 mm (1/2 in.) Gypsum Board Installed on Top of the Bottom Flange;
6) Fire Protection of Floors FP-07 – 15.8 mm (5/8 in.) Gypsum Board Installed on Top of the Bottom Flange;
7) Fire Protection of Floors FP-09 – Rockwool SAFE'n'Sound® Mineral Wool Insulation.[(2)]

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1. Note. These floor assemblies and supporting fire test data have been provided to CCMC by the I-joist industry in collaboration with the APA-Engineered Wood Association. The floor assemblies contained herein reviewed by the CCMC provide equivalent fire performance to exposed 38 mm × 235 mm (2 × 10) lumber joists, and are a subset of those published in APA System Report SR-405G, dated April 2019.

2. Note. For assemblies where mineral-fibre insulation is installed to provide joist protection in a fire, as per NBC 2015, Sentence 9.25.2.3.(7), any insulation that may be subjected to mechanical damage is to be protected by a covering such as gypsum board, plywood, particleboard, oriented strandboard (OSB) or hardboard.

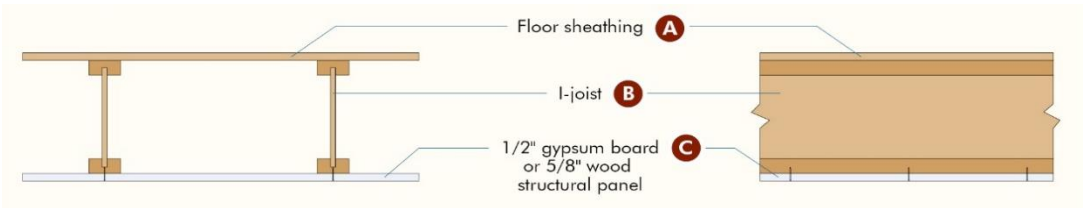
Table B2. Applicable "RFPI®-Joists" for Fire-Protection Assemblies based on Flange Size

Product	Flange Size (thickness x width) (mm)	Fire Protection Assembly
RFPI® 20	35 × 44	FP-01, FP-03, FP-04
RFPI® 40S	38 × 64	FP-01, FP-02, FP-03, FP-04, FP-06, FP-07, FP-09
RFPI® 400	35 × 52	FP-01, FP-03, FP-04, FP-06, FP-07, FP-09
RFPI® 40	35 × 59	FP-01, FP-03, FP-04, FP-06, FP-07, FP-09
RFPI® 60S	38 × 64	FP-01, FP-02, FP-03, FP-04, FP-06, FP-07, FP-09
RFPI® 70	38 × 59	FP-01, FP-02, FP-03, FP-04, FP-06, FP-07, FP-09
RFPI® 80S	38 × 89	FP-01, FP-02, FP-03, FP-04, FP-06, FP-07, FP-09
RFPI® 90	38 × 89	FP-01, FP-02, FP-03, FP-04, FP-06, FP-07, FP-09
RFPI® 700	38 × 59	FP-01, FP-02, FP-03, FP-04, FP-06, FP-07, FP-09
RFPI® 900	38 × 89	FP-01, FP-02, FP-03, FP-04, FP-06, FP-07, FP-09

Figures 1 to 7 of Fire Protection Assemblies

The following floor assembly design (Figure 1) is the default alternative solution for all cases and where the manufacturer has not undertaken any specific testing to show equivalency to exposed 38 mm × 235 mm (2 × 10) lumber with proprietary joist fire protection options.

1/2 IN. GYPSUM BOARD ATTACHED TO BOTTOM OF FLANGE



A. Floor sheathing: materials and installation in accordance with the NBC 2015.

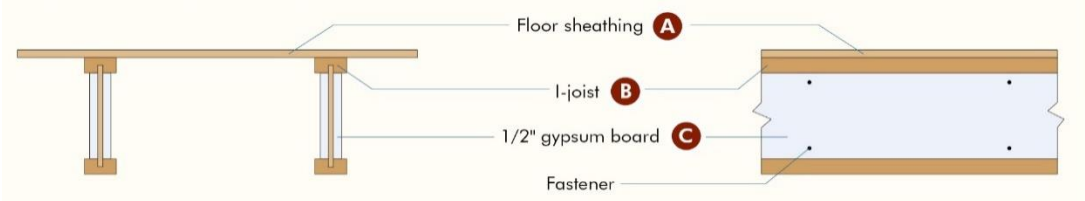
B. I-joist: installation in accordance with Section 3 of this Report. Maximum 24 in. on centre spacing. Applicable to all flange sizes. Minimum web thickness of 9.5 mm (3/8 in.).

C. 12.5 mm (1/2 in.) gypsum board: materials and installation in accordance with the NBC 2015. 1 × 3 (nominal) wood furring strips are permitted to be installed perpendicular to the bottom flange of the I-joists at 400 mm (16 in.) on centre provided that the gypsum boards are directly attached to the furring strips using 32 mm (1-1/4 in.) Type W drywall screws at 300 mm (12 in.) on centre. Gypsum board not required to be finished with tape and joint compound.

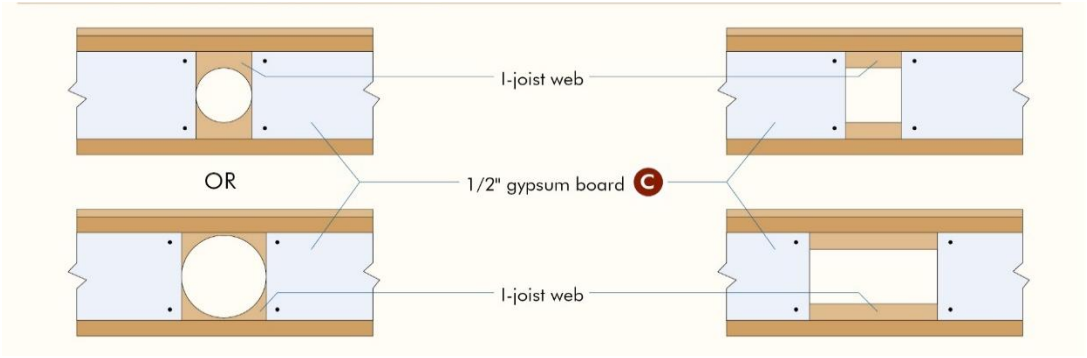
Figure 1. Fire Protection of Floors FP-01 – Fire Protection: 12.5 mm (1/2 in.) Gypsum Board Attached to Bottom of Flange

The following fire resistance designs, Figures 2 to 7, provided by the manufacturer provide fire performance as good as to 2 × 10 dimensional lumber exposed floor joists.

12.5 MM (1/2 IN.) GYPSUM BOARD ATTACHED TO WEB



INSTALLATION REQUIREMENTS AT WEB HOLES



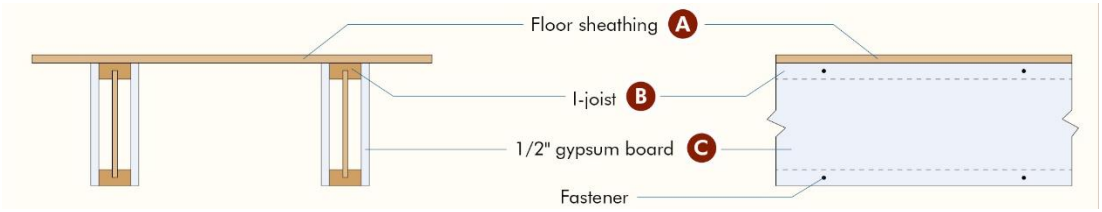
A. Floor sheathing: materials and installation in accordance with the NBC 2015.

B. I-joist: installation in accordance with Section 3 of this Report. Maximum 24 in. on centre spacing. Minimum flange size of 38 mm (1-1/2 in.) thick × 50 mm (2 in.) wide. Minimum web thickness of 9.5 mm (3/8 in.). At hole location, fasteners shall be installed 25 mm (1 in.) from the edge and end of the gypsum board.

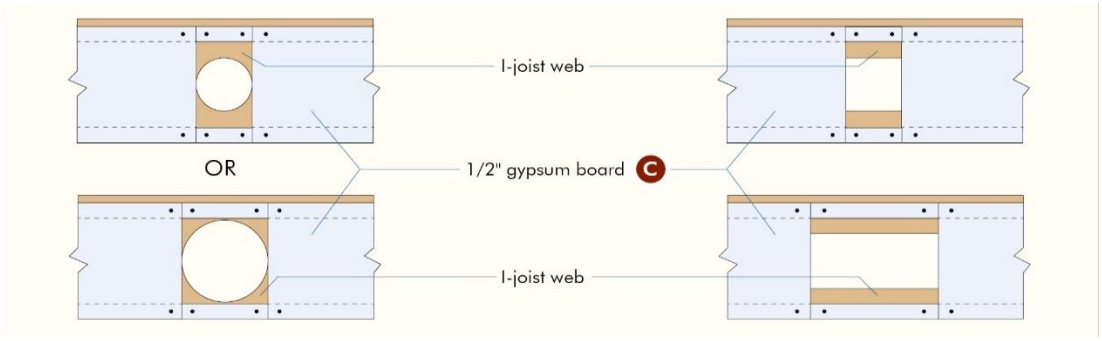
C. 12.5 mm (1/2 in.) gypsum board: materials (over entire length of I-joist) not required to be finished with tape and joint compound. Fasteners: minimum 25 mm (1 in.) screws (Type W or Type S) or nails installed 25 mm (1 in.) from edges and ends and 400 mm (16 in.) on center, top and bottom. Fasteners may be staggered from top to bottom.

Figure 2. Fire Protection of Floors FP-02 – Fire Protection: 12.5 mm (1/2 in.) Gypsum Board Attached Directly to Web

12.5 MM (1/2 IN.) GYPSUM BOARD ATTACHED TO SIDES OF FLANGE



INSTALLATION REQUIREMENTS AT WEB HOLES



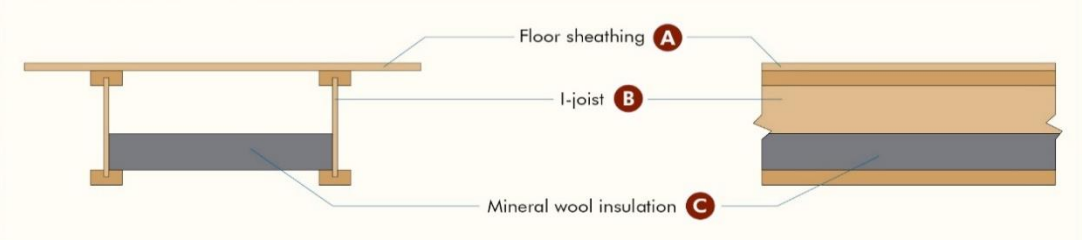
A. Floor sheathing: materials and installation in accordance with the NBC 2015.

B. I-joist: installation in accordance with Section 3 of this Report. Maximum 600 mm (24 in.) on centre spacing. Minimum flange size of 28.5 mm (1-1/8 in.) thick × 44.5 mm (1-3/4 in.) wide. Minimum web thickness of 9.5 mm (3/8 in.). At hole location, fasteners shall be installed 12.5 mm (1/2 in.) from the edge and 1 in. from the end of the gypsum board. Maximum fastener spacing shall be no more than 8 in. on gypsum board above and below the hole.

C. 12.5 mm (1/2 in.) gypsum board: materials (over entire length of I-joist) not required to be finished with tape and joint compound. Fasteners: minimum 25 mm (1 in.) screws (Type W or Type S) or nails installed 12.5 mm (1/2 in.) from edges and 1 in. from ends, and 400 mm (16 in.) on centre, top and bottom. Fasteners may be staggered from top to bottom.

Figure 3. Fire Protection of Floors FP-03 – Fire Protection: 12.5 mm (1/2 in.) Gypsum Board Attached Directly to Sides of Flange

MINERAL WOOL INSULATION



A. Floor sheathing: materials and installation in accordance with the NBC 2015.

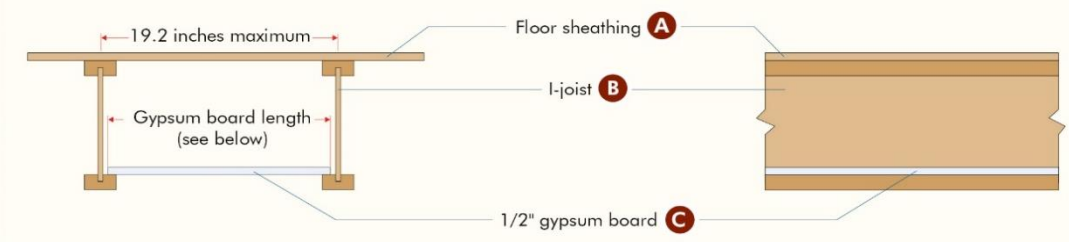
B. I-joist: installation in accordance with Section 3 of this Report. Maximum 487 mm (19.2 in.) on centre spacing. Minimum flange size of 28.5 mm (1-1/8 in.) thick × 44.5 mm (1-3/4 in.) wide. Minimum web thickness of 9.5 mm (3/8 in.).

C. Mineral wool insulation: minimum 46.5 kg/m^3 (2.9 lb/ft^3) (nominal) and 50 mm (2 in.) thick mineral wool insulation made of rock slag, complying with ULC S702 with CCMC Listing, installed without gaps between individual batts as shown with stay wire insulation supports, spaced no more than 600 mm (24 in.) apart and no more than 100 mm (4 in.) from ends of batts. Minimum 40 kg/m^3 (2.5 lb/ft^3) (nominal) and 50 mm (2 in.) thick mineral wool insulation shall be permitted if the I-joists are spaced no more than 400 mm (16 in.) on centre. Use minimum 387 mm (15.25 in.) and 470 mm (18.5 in.) wide batts when I-joist spacing is 400 mm (16 in.) and 487 mm (19.2 in.) on centre, respectively.

Note. *As per NBC 2015, Sentence 9.25.2.3.(7), any insulation that may be subjected to mechanical damage is to be protected by a covering such as gypsum board, plywood, particleboard, OSB or hardboard.*

Figure 4. Fire Protection of Floors FP-04 – Fire Protection: Mineral Wool Insulation

12.5 MM (1/2 IN.) GYPSUM BOARD



Joist spacing	Required length for gypsum boards
300 mm (12 in.)	282.5 mm (11-1/8 in.) ± 3.2 mm (1/8 in.)
400 mm (16 in.)	384.2 mm (15-1/8 in.) ± 3.2 mm (1/8 in.)
487 mm (19.2 in.)	467 mm (18-3/8 in.) ± 3.2 mm (1/8 in.)

Note:
Gypsum board lengths shown above provide at least a 6 mm (1/4 in.) bearing on the top of the bottom flange in each I-joist as installed. For other joist spacings, the required gypsum board lengths shall be adjusted so that the required gypsum board lengths are determined based on a full bearing on the flange at one end of the joist spacing, while maintaining at least a 6 mm (1/4 in.) bearing at the other end. If double joists are used, the required gypsum board lengths shall be reduced from the table above by a length equal to the flange width.

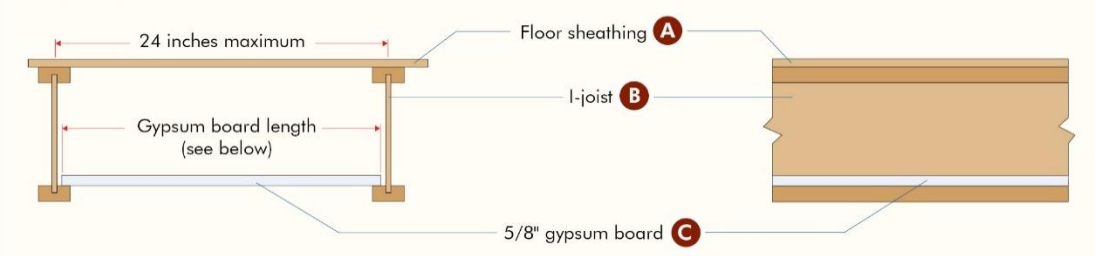
A. Floor sheathing: materials and installation in accordance with NBC 2015.

B. I-joist: installation in accordance with Section 3 of this Report. Maximum 487 mm (19.2 in.) on centre spacing. Minimum flange size of 28.5 mm (1-1/8 in.) thick × 50 mm (2 in.) wide. Minimum web thickness of 9.5 mm (3/8 in.).

C. One layer of 12.5 mm (1/2 in.) lightweight or normal weight (nominal 7.3 kg/m^2 (1.5 psf) minimum) gypsum wall board meeting ASTM C 1396, installed on the top of the bottom flange. Mechanical fastener or adhesive attachment to the top of the bottom flange is not required.

Figure 5. Fire Protection of Floors FP-06 – Fire Protection: 12.5mm (1/2-in.) Gypsum Board Installed on Top of the Bottom Flange

15.8 MM (5/8 IN.) GYPSUM BOARD



Joist spacing	Required length for gypsum boards
300 mm (12 in.)	282.5 mm (11-1/8 in.) ± 3.2 mm (1/8 in.)
400 mm (16 in.)	384.2 mm (15-1/8 in.) ± 3.2 mm (1/8 in.)
487 mm (19.2 in.)	467 mm (18-3/8 in.) ± 3.2 mm (1/8 in.)
600 mm (24 in.)	587 mm (23-1/8 in.) ± 3.2 mm (1/8 in.)

Note:
Gypsum board lengths shown above provide at least a 6 mm (1/4 in.) bearing on the top of the bottom flange in each I-joist as installed. For other joist spacings, the required gypsum board lengths shall be adjusted so that the required gypsum board lengths are determined based on a full bearing on the flange at one end of the joist spacing, while maintaining at least a 6 mm (1/4 in.) bearing at the other end. If double joists are used, the required gypsum board lengths shall be reduced from the table above by a length equal to the flange width.

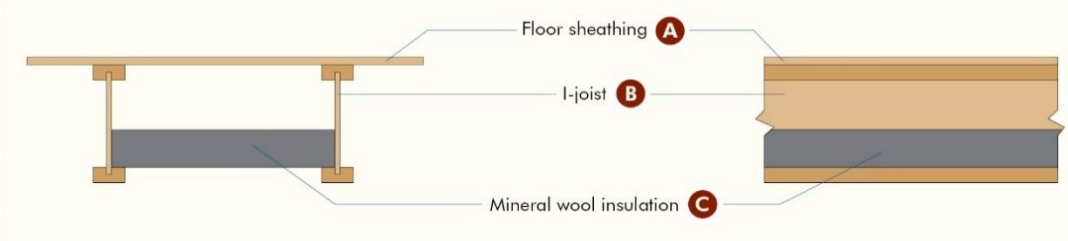
A. Floor sheathing: materials and installation in accordance with the NBC 2015.

B. I-joist: installation in accordance with Section 3 of this Report. Maximum 600 mm (24 in.) on centre spacing. Minimum flange size of 28.5 mm (1-1/8 in.) thick × 50 mm (2 in.) wide. Minimum web thickness of 9.5 mm (3/8 in.).

C. One layer of 15.8 mm (5/8 in.) lightweight or normal weight (nominal 9.3 kg/m^2 (1.9 psf) minimum) gypsum wall board meeting ASTM C 1396, installed on the top of the bottom flange. Mechanical fastener or adhesive attachment to the top of the bottom flange is not required.

Figure 6. Fire Protection of Floors FP-07 – Fire Protection: 15.8mm (5/8 in.) Gypsum Board Installed on Top of the Bottom Flange

ROCKWOOL SAFE'n'SOUND® MINERAL WOOL INSULATION



A. Floor sheathing: materials and installation in accordance with the NBC 2015.

B. I-joist: installation in accordance with Section 3 of this Report. Maximum 600 mm (24 in.) on centre spacing. Minimum flange size of 28.5 mm (1-1/8 in.) thick × 50 mm (2 in.) wide. Minimum web thickness of 9.5 mm (3/8 in.).

C. Mineral wool insulation: Rockwool SAFE'n'SOUND® minimum 40 kg/m^3 (2.5 lb/ft^3) (nominal) and 75 mm (3 in.) thick mineral wool batt insulation made of rock or furnace slag (ASTM C 665 Type 1-compliant) installed as shown with insulation stay wire supports, spaced no more than 600 mm (24 in.) apart and no more than 100 mm (4 in.) from ends of batts. Use minimum 387 mm (15.25 in.), 470 mm (18.5 in.) and 584 mm (23 in.) wide batts when I-joist spacing is 400 mm (16 in.), 487 mm (19.2 in.) and 600 mm (24 in.) on center, respectively.

Note. *As per NBC 2015, Sentence 9.25.2.3.(7), any insulation that may be subjected to mechanical damage is to be protected by a covering such as gypsum board, plywood, particleboard, OSB or hardboard.*

Figure 7. Fire Protection of Floors FP-09 – Fire Protection: Rockwool SAFE'n'Sound® Mineral Wool Insulation