



Evaluation Report CCMC 13487-R

MASTERFORMAT: 06 17 33.01
 Issued: 2010-02-23
 Revised: 2010-03-31
 Re-evaluation due: 2013-02-23

Red-I™ Series Joists

1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that “Red-I™ Series Joists” 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 2005:

- 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-O86-01 for I-joist 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

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

Ruling No. 10-03-240 (13487-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 2010-03-31 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

This series consists of prefabricated wood I-joists consisting of two continuous “RedLam™ LVL” flanges glued to either one of two thicknesses of oriented strandboard (OSB) web, manufactured specifically for RedBuilt™. The dimensions of the different products in this series are listed in Table 2.1.

The web-flange connection is made by inserting the profiled OSB web into a machined, tapered groove in the centre of the flange. The web segments are installed into the flanges in 1 220-mm or 1 372-mm lengths. The web segments are serrated and all the joints are bonded with a phenol-resorcinol waterproof adhesive (refer to CCMC Listing 13054-L).

All vented joists are 406 mm deep and are manufactured with 64-mm-diameter holes cut through the web at 305 mm on centre near one flange. The vented joist is used in roof deck or roof joist applications only.

Table 2.1 “Red-I™ Series Joists” product dimensions

Product	Flange Size (width x thickness in mm)	Web Thickness (mm)	Range of Joist Depths (mm)
Red-I45	44.5 x 38	9.5	241 to 406

Table 2.1 “Red-I™ Series Joists” product dimensions

Product	Flange Size (width x thickness in mm)	Web Thickness (mm)	Range of Joist Depths (mm)
Red-I65	63.5 x 38	11.0	241 to 762
Red-I90	89 x 38	11.0	241 to 762
Red-I90H	89 x 44.5	11.0	241 to 762

3. Conditions and Limitations

CCMC's compliance opinion in Section 1 is bound by the “Red-I™ Series Joists” being used in accordance with the conditions and limitations set out below.

- The products are intended for use in structural applications, such as floor, ceiling or roof joists, and are 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 2005.

- i) RedBuilt™ Pre-engineered Tables

There are no pre-engineered tables currently published in the “Red-I™ Series Joists” literature at this time. The spans for the products, when used as floor joists or rafters, must be engineered on a case-by-case basis by a professional engineer skilled in wood design and licensed to practice under the appropriate provincial or territorial legislation.

The products must be installed in accordance with RedBuilt's installation guidelines engineered on a case-by-case basis.

ii) RedBuilt™'s Installation Details

Installation instructions and details must be engineered on a case-by-case basis.

iii) Engineering Required

Since there are no pre-engineered tables currently published for “Red-I™ Series Joists,” 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. The engineer must address the following issues where applicable (list is not all inclusive):

- rim joist and blocking resistance;
- rim board resistance;
- web stiffener requirements;
- floor and roof spans;
- web holes;
- specified hanger resistance;
- 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 2005 pre-engineered floor/roof

- joist tables, and
- o design of supporting foundation footings when the total load exceeds the NBC 2005 pre-engineered lumber floor/roof joist tables.

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

The factored resistance and engineering properties for the products must not exceed the values set forth in Table 4.1.1.1.

The ends of all “Red-I™ Series Joists” members used as joists, rafters and beams must be restrained to prevent rollover. This is normally achieved by attaching a diaphragm sheathing to the top or to the compression edge, and to an end wall or shear transfer panel capable of transferring a minimum unfactored uniform load of 730 N/m or the required shear forces due to wind or seismic conditions. Blocking or cross-bracing with equivalent strength may be used.

The compression edges of all “Red-I™ Series Joists” members used as joists and rafters must be laterally supported at least every 610 mm, except where design is done in accordance with CAN/CSA-O86.

Nailing of the products must be in accordance with RedBuilt™’s engineered details provided on a case-by-case basis.

iv) Engineering Support Provided by Manufacturer

RedBuilt™ may provide engineering services in conjunction with RedBuilt™ product specification and offers the following support contact number for their Canadian operations: 1 866 859 6757.

This product must be identified with the phrase “CCMC 13487-R” along the side of the product. This CCMC number is only valid when it appears in conjunction with the WHI certification mark of Intertek Testing Services and/or the mark of PFS Corporation.

4. Technical Evidence

CCMC’s Technical Guide for “Red-I™ Series Joists” sets out the nature of the technical evidence required by CCMC to enable it to evaluate a product as an acceptable or alternative solution in compliance with the NBC 2005. The Report Holder has submitted documentation for CCMC’s evaluation. Testing was conducted at independent laboratories recognized by CCMC. The corresponding test results for “Red-I™ Series Joists” are summarized below.

4.1 NBC 2005 Compliance Data for “Red-I™ Series Joists” on which CCMC Based its Opinion in Section 1

4.1.1 Design Requirements

Table 4.1.1.1 Engineering properties of “Red-I™ Series Joists”

Basic Properties – Limit States Design						
Product	Joist Depth (mm)	Weight (N/m)	Factored Resistance		EI x 10⁶ (kN·mm²)	K x 10⁴ (kN/m)
			Moment⁽¹⁾ (N·m)	Vertical Shear (N)		
Red-I45	241	33	8 155	7 875	532	7.9
	302	37	10 560	9 965	916	7.9
	356	40	12 555	12 010	1 361	7.9
	406	44	14 405	13 835	1 874	7.9
	406V	44	14 405	11 945	1 874	7.9

Table 4.1.1.1 Engineering properties of “Red-I™ Series Joists” (cont’d)

Basic Properties – Limit States Design						
Product	Joist Depth (mm)	Weight (N/m)	Factored Resistance		EI x 10⁶ (kN·mm²)	K x 10⁴ (kN/m)
			Moment⁽¹⁾ (N·m)	Vertical Shear (N)		
Red-I65	241	44	11 755	11 765	755	9.2
	302	49	15 225	13 525	1 291	9.2
	356	53	18 105	14 925	1 911	9.2
	406	57	20 770	16 370	2 620	9.2
	457	61	23 410	17 795	3 458	9.2
	508	65	26 025	19 240	4 434	9.2
	559	69	28 615	20 615	5 550	9.2
	610	73	31 185	21 485	6 813	9.2
	660	77	33 740	20 350	8 231	9.2
	711	81	36 275	20 350	9 806	9.2
	762	85	38 795	20 350	11 551	9.2
Red-I90	241	56	16 725	11 765	1 047	9.2
	302	61	21 665	13 525	1 782	9.2
	356	65	25 775	14 925	2 620	9.2
	406	69	29 575	16 370	3 576	9.2
	457	73	33 330	17 795	4 693	9.2
	508	77	37 060	19 240	5 984	9.2
	559	81	40 755	20 615	7 452	9.2
	610	85	44 425	21 485	9 104	9.2
	660	89	48 065	20 350	10 946	9.2
	711	93	51 675	20 350	12 985	9.2
	762	97	55 275	20 350	15 227	9.2
Red-I90H	302	67	24 715	13 525	1 972	9.2
	356	71	29 525	14 925	2 914	9.2
	406	75	33 970	16 370	3 985	9.2
	457	79	38 360	17 795	5 242	9.2
	508	83	42 715	19 240	6 690	9.2
	559	87	47 035	20 615	8 335	9.2
	610	91	51 315	21 485	10 184	9.2
	660	95	55 575	20 350	12 244	9.2
	711	99	59 800	20 350	14 519	9.2
	762	103	64 000	20 350	17 018	9.2

Table 4.1.1.1 Engineering properties of “Red-I™ Series Joists” (cont’d)

Reaction Properties											
Product	Joist Depth (mm)	Factored End Reaction (N)					Factored Intermediate Reaction (N)				
		45-mm Brg. Length		89-mm Brg. Length		Web Stiff. Nails (2)	89-mm Brg. Length		133-mm Brg. Length		Web Stiff. Nails (2)
		Web Stiffeners		Web Stiffeners			133-mm Brg. Length⁽⁴⁾		178-mm Brg. Length⁽⁴⁾		
		No	Yes	No	Yes		Web Stiffeners		Web Stiffeners		
		No	Yes	No	Yes	No	Yes	No	Yes		
Red-I45	241	7 115	N/A ⁽³⁾	7 875	N/A	N/A	14 255	N/A	18 080	N/A	N/A
	302	7 115	7 650	9 965	9 965	3-A	14 255	16 235	18 080	20 060	3-A
	356	7 115	7 650	10 475	12 010	3-A	14 255	16 235	18 080	20 060	3-A
	406	7 115	7 650	10 475	12 455	3-A	14 255	16 235	18 080	20 060	3-A
	406V	7 115	7650	10 475	11 945	3-A	14 255	16 235	18 080	20 060	3-A
Red-I65	241	9 075	N/A	11 765	N/A	N/A	19 350	N/A	23 685	N/A	N/A
	302	9 075	11 385	12 235	13 525	3-A	19 350	21 640	23 685	26 000	3-A
	356	9 075	11 965	12 235	14 925	5-A	19 350	23 175	23 685	27 535	5-A
	406	9 075	11 965	12 235	16 370	6-A	19 350	23 955	23 685	28 290	6-A
	457	9 075	11 965	12 235	17 595	7-A	19 350	24 710	23 685	29 070	7-A
	508	N/A	11 965	N/A	18 370	8-A	N/A	25 490	N/A	29 825	8-A
	559	N/A	11 965	N/A	19 125	9-A	N/A	26 245	N/A	30 605	9-A
	610	N/A	11 965	N/A	19 905	10-A	N/A	26 510	N/A	31 360	10-A
	660	N/A	11 965	N/A	20 350	11-A	N/A	32 140	N/A	36 475	11-A
	711	N/A	11 965	N/A	20 350	12-A	N/A	32 895	N/A	37 255	12-A
	762	N/A	11 965	N/A	20 350	13-A	N/A	33 675	N/A	38 030	13-A
Red-I90	241	9 075	N/A	11 765	N/A	N/A	22 710	N/A	26 645	N/A	N/A
	302	9 075	11 120	12 235	13 525	2-B	22 710	24 755	26 645	28 670	2-B
	356	9 075	12 145	12 235	14 925	3-B	22 710	25 755	26 645	29 690	3-B
	406	9 075	13 165	12 235	16 305	4-B	22 710	26 780	26 645	30 715	4-B
	457	9 075	13 165	12 235	16 305	4-B	22 710	26 780	26 645	30 715	4-B
	508	N/A	14 170	N/A	17 325	5-B	N/A	27 800	N/A	31 740	5-B
	559	N/A	15 190	N/A	18 350	6-B	N/A	33 920	N/A	37 885	11-B
	610	N/A	15 190	N/A	18 350	6-B	N/A	35 940	N/A	39 880	13-B
	660	N/A	16 215	N/A	19 350	7-B	N/A	40 700	N/A	40 700	14-B
	711	N/A	16 745	N/A	20 350	8-B	N/A	40 700	N/A	40 700	15-B
	762	N/A	16 745	N/A	20 350	8-B	N/A	40 700	N/A	40 700	17-B

Table 4.1.1.1 Engineering properties of “Red-I™ Series Joists” (cont’d)

Reaction Properties											
Product	Joist Depth (mm)	Factored End Reaction (N)					Factored Intermediate Reaction (N)				
		45-mm Brg. Length		89-mm Brg. Length		Web Stiff. Nails (2)	89-mm Brg. Length		133-mm Brg. Length		Web Stiff. Nails(2)
		Web Stiffeners		Web Stiffeners			133-mm Brg. Length ⁽⁴⁾		178-mm Brg. Length ⁽⁴⁾		
		No	Yes	No	Yes		Web Stiffeners		Web Stiffeners		
No	Yes	No	Yes	No	Yes	No	Yes				
Red-I90H	302	9 075	11 120	12 235	13 525	2-B	22 710	24 755	26 645	28 670	2-B
	356	9 075	12 145	12 235	14 925	3-B	22 710	25 755	26 645	29 690	3-B
	406	9 075	13 165	12 235	16 305	4-B	22 710	26 780	26 645	30 715	4-B
	457	9 075	13 165	12 235	16 305	4-B	22 710	26 780	26 645	30 715	4-B
	508	N/A	14 170	N/A	17 325	5-B	N/A	27 800	N/A	31 740	5-B
	559	N/A	15 190	N/A	18 350	6-B	N/A	33 920	N/A	37 855	11-B
	610	N/A	15 190	N/A	18 350	6-B	N/A	35 940	N/A	39 880	13-B
	660	N/A	16 215	N/A	19 350	7-B	N/A	40 700	N/A	40 700	14-B
	711	N/A	16 745	N/A	20 350	8-B	N/A	40 700	N/A	40 700	15-B
	762	N/A	16 745	N/A	20 350	8-B	N/A	40 700	N/A	40 700	17-B

Notes to Table 4.1.1.1:

- (1) The factored moment resistances listed in Table 4.1.1.1 shall not be increased by any Code-allowed repetitive member system factor.
- (2) All nails are box nails, A = 63.5 mm, B = 89 mm.
- (3) “N/A” means not applicable.
- (4) Shaded cells indicate those results which were determined using either 133-mm or 178-mm bearing lengths.

Additional engineering data and load/span tables are available from the manufacturer.

Note: Red-I™, RedLam™, and RedBuilt™ are trademarks of RedBuilt LLC, Boise, ID.

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Appendix A

The design values obtained from testing to ASTM D 5055-04, “Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists,” as specified in CAN/CSA-O86-01, “Engineering Design in Wood,” are summarized below. The manufacturer’s published pre-engineered joist spans were designed in accordance with CAN/CSA-O86-01.

Table A1. Additional test information for “Red-I™ Series Joists”

Property	Test Information
Shear capacity	The shear capacity of the specimens was established by combining data in accordance with ASTM D 5055-04. Data from quality control (QC) tests have been used to establish the applicable coefficient of variation, CV_w , and the reliability normalization factor from Table 13.2.3.2 of CAN/CSA-O86-01 was used to determine the specified strength.
Moment capacity	The moment capacity qualification was carried out using the analytical method based on the characteristics of the flange material, with confirmatory testing in accordance with ASTM D 5055-04. Data from quality control (QC) tests have been used to establish the applicable coefficient of variation, CV_w , and the reliability normalization factor from Table 13.2.3.2 of CAN/CSA-O86-01 was used to determine the specified strength.
Stiffness	<p>An appropriate test program was used to confirm the stiffness capacity. The following formula was used to predict mid-span deflection:</p> $\text{deflection} = \frac{5wL^4}{384EI \times 10^3} + \frac{wL^2}{Kd}$ <p>where: w = load (kN/m), L = span (mm), EI and K from Table 4.1.1.1 and d = joist depth (mm).</p>
End joints	The flanges for the products do not include any end joints.
Creep	Specimens were tested for creep performance in accordance with ASTM D 5055-04. The specimens recovered more than 90% of the basic dead load deflection.
Bearing length	The product reaction properties listed in Table 4.1.1.1 are specific to bearing lengths shown and are based on a rational bearing analysis methodology applicable to “Red-I™ Series Joists.” Data submitted confirm satisfactory performance to the rational methodology. Reaction properties for end or intermediate bearing lengths within ranges shown in Table 4.1.1.1 may be determined by linear interpolation. Extrapolation of reaction properties in Table 4.1.1.1 is not allowed.
Adhesive qualification	The adhesive used complies with CSA O112.7-M1977, “Phenol and Phenol Resorcinol, Resin Adhesives for Wood (Room and Intermediate Temperature Curing).” See CCMC Listing 13054-L.
Web stock	The web stock complies with CAN/CSA-O325.0-92, “Construction Sheathing.”