ICC-ES Evaluation Report

DIVISION: 06 00 00—WOOD PLASTICS, AND COMPOSITES
Section: 06 17 33—Wood I-joists

REPORT HOLDER:

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EVALUATION SUBJECT

STARK TRUSS SI-40, SI-60 and SI-80 SERIES PREFABRICATED WOOD I-JOISTS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 *International Building Code*® (IBC)
- 2006 *International Residential Code*® (IRC)

Other Codes (see Section 8.0)

Properties evaluated:

- Structural
- Fire-resistance-rated assemblies

2.0 USES

Stark Truss SI series I-joists are used as roof and floor joists.

3.0 DESCRIPTION

3.1 General:

SI prefabricated wood I-joists consist of solid sawn lumber flanges and oriented strand board (OSB) webs. The top and bottom flanges are grooved to allow the web to be inserted to a depth of 0.5 inch (12.7 mm) in the flanges. The web sections are installed with the face grain perpendicular to the long axis of the I-joist. The I-joists are fabricated in depths of $9^1/_4$, $9^1/_2$, $11^1/_4$, $11^7/_8$, 14, and 16 inches (235, 241, 286, 302, 356, and 406 mm), as shown in Table 1.

3.2 Materials:

3.2.1 Flanges: Flange material for SI series prefabricated wood I-joists is manufactured from spruce-pine-fir MSR lumber conforming to the requirements of the approved quality control manual. The lumber is finger jointed and re-graded to the required specifications documented in the approved quality control manual. Flange dimensions are as shown in Table 1.

3.2.2 Web: Web material is $^3/_8$-inch (9.5 mm) OSB, Exposure 1, meeting the requirements of DOC PS-2 and the approved quality control manual.

3.2.3 Adhesives: Adhesives used in the I-joist manufacturing process are exterior-type, heat durable adhesives complying with ASTM D 2559 and ASTM D 5055, as specified in the approved quality control manual.

4.0 DESIGN AND INSTALLATION

4.1 Design:

Design of the prefabricated wood I-joists described in this report must be in accordance with the applicable code. Reference design moments, reactions, shear, bending stiffness (EI), and shear stiffness coefficients (K) for SI series I-joists are specified in Table 2. The reference design values given in Table 2 must be adjusted by the applicable adjustment factors in accordance with Section 7.3 of the AF&PA National Design Specification for Wood Construction (NDS). Allowable floor spans for SI series I-joists are as indicated in Tables 3 and 4. Web stiffeners are not required when I-joists are used in accordance with the spans, spacing, and other requirements in Tables 3 and 4, except as required by joist hanger manufacturers, where applicable. The bearing lengths at end reactions must be $1^3/_4$ inches (44 mm) or greater. The bearing lengths at intermediate reactions must be $3^1/_2$ inches (89 mm) or greater. Joist webs contain prefabricated $1^1/_2$-inch-diameter (38 mm) knockouts, 16 inches (406 mm) on center, located approximately 2 inches (51 mm) from one flange. Round holes, other than the prefabricated knockouts, are permitted in the webs of the joists in accordance with Table 5. Where required, web stiffeners must be installed in accordance with ESR-1405.

Calculated I-joist deflection must consider both bending and shear deformation. Bending deformation must be calculated using standard engineering formulae. Shear deformation must be calculated using the following equation:

$$\Delta_{shear} = \frac{8M}{K}$$

where:

Δ_{shear} = Deflection caused by shear stress [inches (mm)]

M = Design moment [inch-lbs (mm-N)]

K = Shear stiffness coefficient from Table 2 [in-lbs/in (mm-N/mm)]

For example, the deflection of a uniformly loaded, simply supported I-joist must be determined using the following formula:

$$\Delta_{total} = \Delta_{bending} + \Delta_{shear} = \frac{5wL^4}{384EI} + \frac{wL^2}{K}$$

The deflection of a simple-span I-joist with a concentrated load at mid-span must be determined using the following formula:

$$\Delta_{total} = \Delta_{bending} + \Delta_{shear} = \frac{PL^3}{48EI} + \frac{2PL}{K}$$

where:

Δ_{total} = Total I-joist deflection [inches (mm)]

W = Applied uniform load [lbs/inch (N/mm)]

P = Applied concentrated load [lbs (N)]

L = I-joist span [inches (mm)]

EI = I-joist stiffness from Table 2 [in^2-lbs (mm^2-N)]

4.2 Installation:

SI series I-joists must be installed in accordance with this report, the applicable code, the manufacturer's published installation instructions, and the approved engineering drawings for each job. A copy of the manufacturer's published installation instructions and approved engineering drawings must be available at the jobsite during installation. SI series I-joists are limited to uses in covered, dry service conditions, where the in-service moisture content is less than 16 percent.

4.3 One-hour Fire-resistance-rated Assemblies:

The SI series I-joists described in this report may be used in the fire-resistance-rated assemblies described in Section 4.2.2 of ESR-1405, provided they meet the minimum dimensions and other requirements specified for each assembly therein.

5.0 CONDITIONS OF USE

The Stark Truss SI Series I-Joists as described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Design calculations and details for specific applications, demonstrating compliance with this report, must be submitted to the code official. The design calculations and details for specific applications must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.2 SI series I-joists must be installed so that loads are applied parallel with the web and no concentrated loads are applied to the bottom flange.

5.3 Cutting and notching of SI series I-joist flanges is not permitted, except for cutting to proper length for installation. Holes in the webs must conform to the requirements of Section 4.1.

5.4 SI series prefabricated wood I-joists are manufactured in Beach City, Ohio, under a quality control program with inspections by APA—The Engineered Wood Association (AA-649).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Prefabricated Wood I-Joists (AC14), dated October 2007 (editorially revised December 2008).

7.0 IDENTIFICATION

Each SI series prefabricated wood I-joist described in this report is identified by a stamp bearing the manufacturer's name (Stark Truss Company), the I-joist series designation, the name of the inspection agency (APA—The Engineered Wood Association), and the evaluation report number (ESR-2919).

8.0 OTHER CODES

In addition to the codes referenced in Section 1.0, the products described in this report were evaluated for compliance with the requirements of the following codes:

■ BOCA® *National Building Code*/1999 (BNBC)

■ 1999 *Standard Building Code*© (SBC)

■ 1997 *Uniform Building Code*™ (UBC)

The SI series prefabricated wood I-joists described in this report comply with, or are suitable alternatives to what is specified in, the codes listed above, subject to the provisions of Sections 2.0 through 7.0.

TABLE 1—SI SERIES JOIST DIMENSIONS

JOIST SERIES	DEPTH (in.)	FLANGE WIDTH (in.)	FLANGE THICKNESS (in.)	WEB THICKNESS (in.)
SI-40	$9^1/_4$, $9^1/_2$, $11^1/_4$, $11^7/_8$	$2^1/_2$	$1^1/_2$	$^3/_8$
SI-60	$9^1/_4$, $9^1/_2$, $11^1/_4$, $11^7/_8$, 14, 16	$2^1/_2$	$1^1/_2$	$^3/_8$
SI-80	$11^1/_4$, $11^7/_8$, 14, 16	$3^1/_2$	$1^1/_2$	$^3/_8$

For **SI** units: 1 inch = 25.4 mm.

TABLE 2—REFERENCE DESIGN VALUES FOR SI SERIES I-JOISTS[1]

JOIST DEPTH (inches)	JOIST DESIGNATION	BENDING STIFFNESS[5] EI (in^2-lbs x10^6)	MOMENT[2] M_r (ft-lbs)	SHEAR V_r (lbs)	REACTIONS, R_r End Reaction[3] (lbs)	Intermediate Reaction[4] (lbs)	SHEAR STIFFNESS[5] K (lbs x10^6)
$9^1/_4$	SI-40	182	2,680	1,080	1,030	2,160	4.81
	SI-60	219	3,670	1,080	1,030	2,160	4.81
$9^1/_2$	SI-40	193	2,765	1,120	1,080	2,160	4.94
	SI-60	231	3,790	1,120	1,080	2,160	4.94
$11^1/_4$	SI-40	292	3,370	1,350	1,160	2,500	5.85
	SI-60	350	4,615	1,350	1,160	2,500	5.85
	SI-80	484	6,535	1,350	1,220	2,760	5.85
$11^7/_8$	SI-40	330	3,585	1,420	1,200	2,500	6.18
	SI-60	396	4,910	1,420	1,200	2,500	6.18
	SI-80	547	6,950	1,420	1,280	2,760	6.18
14	SI-60	584	5,910	1,710	1,200	2,500	7.28
	SI-80	802	8,370	1,710	1,280	3,020	7.28
16	SI-60	799	6,855	1,970	1,200	2,500	8.32
	SI-80	1092	9,705	1,970	1,280	3,020	8.32

For **SI** units: 1 inch = 25.4 mm; 1 lb = 4.45 N; 1 ft-lb = 1.36 N-m; 1 in^2-lb = 179 mm^2-N.

[1]Reference design values must be adjusted, as applicable, in accordance with Section 7.3 of the NDS.
[2]The reference design moment, M_r, of the I-joist, must not be increased by any repetitive member factor, C_r.
[3]Reference design reactions, R_r, are given for *end* reactions with a minimum bearing length of $1^3/_4$ inches, without web stiffeners. For bearing lengths of 4 inches or greater, the reference design end reaction may be set equal to the reference design shear value, V_r. Interpolation of the reference design end reaction between $1^3/_4$- and 4-inch bearings is permitted. For end reaction values over 1,550 lbf, web stiffeners are required. Where required, web stiffeners must be installed in accordance with ESR-1405.
[4]Reference design reactions, R_r, are given for *intermediate* reactions with a minimum bearing length of $3^1/_2$ inches, without web stiffeners.
[5]I-joist deflections must be calculated in accordance with Section 4.1.

TABLE 3—ALLOWABLE SPANS FOR SI SERIES JOISTS – SIMPLE SPAN ONLY[1, 2, 3, 4]

JOIST DEPTH (in.)	JOIST SERIES DESIGNATION	ALLOWABLE SIMPLE SPANS (feet - inches) On Center Joist Spacing			
		12"	16"	19.2"	24"
9$\frac{1}{4}$	SI-40	17'-8"	16'-2"	15'-3"	14'-3"
	SI-60	18'-7"	17'-0"	16'-0"	14'-11"
9$\frac{1}{2}$	SI-40	18'-0"	16'-5"	15'-6"	14'-6"
	SI-60	18'-11"	17'-4"	16'-4"	15'-3"
11$\frac{1}{4}$	SI-40	20'-7"	18'-10"	17'-9"	16'-3"
	SI-60	21'-9"	19'-10"	18'-8"	17'-5"
	SI-80	23'-11"	21'-9"	20'-6"	19'-1"
11$\frac{7}{8}$	SI-40	21'-5"	19'-7"	18'-6"	16'-9"
	SI-60	22'-7"	20'-8"	19'-6"	18'-2"
	SI-80	24'-11"	22'-8"	21'-4"	19'-10"
14	SI-60	25'-9"	23'-6"	22'-2"	20'-8"
	SI-80	28'-3"	25'-9"	24'-3"	22'-7"
16	SI-60	28'-6"	26'-0"	24'-7"	22'-10"
	SI-80	31'-4"	28'-6"	26'-10"	25'-0"

For **SI** units: 1 inch = 25.4 mm; 1 foot = 305 mm.

[1]Allowable clear spans are applicable to simple-span residential floor construction with a design dead load of 10 psf and live load of 40 psf. The live load deflection is limited to span/480.
[2]Spans are based on a composite floor with glued-nailed sheathing meeting the requirements for APA Rated Sheathing or APA Rated STURD-I-FLOOR conforming to PS 1 or PS 2 with a minimum thickness of 19/32 inch (40/20 or 20 oc) for a joist spacing of 19.2 inches or less, or 23/32 inch (48/24 or 24 oc) for a joist spacing of 24 inches. Adhesive must meet APA Specification AFG-01 or ASTM D 3498-03. Spans must be reduced by 12 inches when the floor sheathing is nailed only.
[3]Bearing lengths must be 1$\frac{3}{4}$ inches or greater for the end bearings.
[4]Web stiffeners are not required when I-joists are used with the spans and spacings given in this table, except as required by joist hanger manufacturers.

TABLE 4—ALLOWABLE SPANS FOR SI SERIES JOISTS – MULTIPLE SPANS ONLY[1, 2, 3, 4]

JOIST DEPTH (in.)	JOIST SERIES DESIGNATION	ALLOWABLE MULTIPLE SPANS (feet - inches) On Center Joist Spacing			
		12"	16"	19.2"	24"
9$\frac{1}{4}$	SI-40	19'-3"	17'-7"	16'-2"	14'-5"
	SI-60	20'-3"	18'-6"	17'-5"	16'-3"
9$\frac{1}{2}$	SI-40	19'-7"	17'-11"	16'-5"	14'-8"
	SI-60	20'-8"	18'-10"	17'-9"	16'-6"
11$\frac{1}{4}$	SI-40	22'-5"	19'-11"	18'-2"	16'-2"
	SI-60	23'-8"	21'-7"	20'-4"	18'-11"
	SI-80	26'-0"	23'-8"	22'-3"	20'-9"
11$\frac{7}{8}$	SI-40	23'-5"	20'-6"	18'-9"	16'-9"
	SI-60	24'-8"	22'-6"	21'-2"	19'-7"
	SI-80	27'-1"	24'-8"	23'-3"	21'-7"
14	SI-60	28'-0"	25'-7"	24'-1"	19'-9"
	SI-80	30'-10"	28'-0"	26'-5"	23'-11"
16	SI-60	31'-1"	28'-4"	24'-9"	19'-9"
	SI-80	34'-2"	31'-1"	29'-3"	23'-11"

For **SI** units: 1 inch = 25.4 mm; 1 foot = 305 mm.

[1]Allowable clear spans are applicable to multiple-span residential floor construction with a design dead load of 10 psf and live load of 40 psf. The end spans must have a length of 40% or more of the adjacent span. The live load deflection is limited to span/480.
[2]Spans are based on a composite floor with glued-nailed sheathing meeting the requirements for APA Rated Sheathing or APA Rated STURD-I-FLOOR conforming to PS 1 or PS 2 with a minimum thickness of 19/32 inch (40/20 or 20 oc) for a joist spacing of 19.2 inches or less, or 23/32 inch (48/24 or 24 oc) for a joist spacing of 24 inches. Adhesive must meet APA Specification AFG-01 or ASTM D 3498-03. Spans must be reduced by 12 inches when the floor sheathing is nailed only.
[3]Bearing lengths must be 1$\frac{3}{4}$ inches or greater for the end bearings, and 3$\frac{1}{2}$ inches or greater for the intermediate bearings.
[4]Web stiffeners are not required when I-joists are used with the spans and spacings given in this table, except as required by joist hanger manufacturers.

TABLE 5—MINIMUM DISTANCES FROM JOIST SUPPORTS TO THE CENTER OF A ROUND HOLE[1, 2, 3, 4, 5]

JOIST DEPTH (in.)	JOIST SERIES DESIGNATION	SAF[5]	MINIMUM DISTANCE FROM INSIDE FACE OF ANY SUPPORT TO CENTER OF ROUND HOLE, D (feet - inches) Round Hole Diameter (in.)														
			2	3	4	5	6	6¼	7	8	8⅝	9	10	10¾	11	12	12¼
9¼	SI-40	14'-3"	0'-9"	2'-0"	3'-3"	4'-7"	6'-2"										
	SI-60	14'-11"	1'-11"	3'-2"	4'-6"	5'-11"	7'-6"										
9½	SI-40	14'-6"	0'-7"	1'-9"	3'-0"	4'-5"	5'-10"	6'-4"									
	SI-60	15'-3"	1'-8"	3'-0"	4'-4"	5'-8"	7'-3"	7'-8"									
11¼	SI-40	16'-2"	0'-7"	0'-8"	1'-8"	2'-11"	4'-3"	4'-7"	5'-9"	7'-6"							
	SI-60	17'-5"	0'-11"	2'-2"	3'-6"	4'-10"	6'-3"	6'-7"	7'-9"	9'-5"							
	SI-80	19'-1"	2'-1"	3'-5"	4'-9"	6'-1"	7'-7"	8'-0"	9'-2"	10'-11"							
11⅞	SI-40	16'-9"	0'-7"	0'-8"	1'-3"	2'-6"	3'-10"	4'-2"	5'-3"	6'-9"	8'-0"						
	SI-60	18'-2"	0'-8"	1'-10"	3'-2"	4'-5"	5'-10"	6'-2"	7'-4"	8'-11"	10'-0"						
	SI-80	19'-10"	1'-11"	3'-2"	4'-6"	5'-10"	7'-3"	7'-8"	8'-10"	10'-6"	11'-7"						
14	SI-60	19'-9"	0'-7"	0'-8"	0'-8"	1'-7"	3'-2"	3'-6"	4'-9"	6'-6"	7'-8"	8'-4"	10'-4"	11'-11"			
	SI-80	22'-7"	0'-7"	1'-9"	3'-0"	4'-4"	5'-8"	6'-1"	7'-1"	8'-7"	9'-7"	10'-3"	12'-2"	13'-10"			
16	SI-60	19'-9"	0'-7"	0'-8"	0'-8"	0'-9"	0'-9"	0'-10"	1'-10"	3'-6"	4'-6"	5'-2"	7'-3"	8'-11"	9'-6"	11'-10"	13'-9"
	SI-80	23'-11"	0'-7"	0'-8"	0'-8"	1'-7"	3'-2"	3'-7"	4'-10"	6'-6"	7'-7"	8'-3"	10'-2"	11'-8"	12'-2"	14'-3"	16'-0"

For **SI** units: 1 inch = 25.4 mm; 1 foot = 305 mm.

[1]Tabulated values may be used for simple or multiple spans with a 10 psf dead load, 40 psf live load, and an I-joist spacing of 24 inches on center or less.
[2]Hole location distance is measured from inside face of supports to center of hole.
[3]Distances in this chart are based on uniformly loaded joists.
[4]Joists with web hole locations and/or sizes that fall outside the scope of this table must be analyzed based on the actual hole size, joist spacing, span and loading conditions. The I-joist shear capacity at the location of a circular web hole is calculated using the following equation: V_{rh} = Published Shear Value x [(Joist Depth – Hole Diameter) / Joist Depth].
[5]SAF = Span adjustment factor, used as defined below.

This table is based on I-joists being used at their maximum span. If the I-joists are used in applications at less than their full allowable span, as given in Tables 3 and 4, the minimum distance from the centerline of the hole to the face of any support (D), as given above may be reduced as follows:

Optional:

$$D_{reduced} = \frac{L_{actual}}{SAF} \times D$$

where:

$D_{reduced}$	=	Minimum distance from the inside face of any support to center of hole, reduced for less-than-maximum span applications (ft). The reduced distance must not be less than 6 inches from the face of the support to the edge of the hole.
L_{actual}	=	The actual measured span distance between the inside faces of supports (ft).
SAF	=	Span Adjustment Factor given in the table above.
D	=	The minimum distance from the inside face of any support to the center of the hole, as given in the table above.

If L_{actual}/SAF is greater than 1, use 1 in the above calculation for L_{actual}/SAF.