

ICC-ES Evaluation Report

ESR-2607

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DIVISION: 06 00 00—WOOD, PLASTICS, AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

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EVALUATION SUBJECT:

SIMPSON STRONG-TIE® CONNECTORS FOR PANELIZED ROOF CONSTRUCTION

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012, 2009 and 2006 *International Building Code*® (IBC)
- * ■ 2012, 2009 and ~~2006~~ *International Residential Code*® (IRC)

Property evaluated:

Structural

2.0 USES

Simpson Strong-Tie® connectors for panelized roof construction are used as wood framing connectors in accordance with Section 2304.9.3 of the IBC. The products may also be used in structures regulated under the IRC when an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 HCA and HCCTA Hinge Connectors:

The HCA hinge connectors support the end of a glued laminated beam to the opposing end of another glued laminated beam of the same width and top elevation. The supporting beam must be at least as deep as the supported beam. An HCCTA hinge connector is identical to an HCA connector, except it has slotted holes along its centerline permitting bolts to be installed in both beams to transfer wind and seismic forces in drag strut applications. The connectors consist of No. 7 gage steel side plates and factory-welded steel top and bottom bearing plates having thicknesses from 3/4 inch to 1 1/2 inches (19 mm to 38 mm). The top and bottom portions of the connector side plates have holes for installing the required rotation bolts, which

resist rotation resulting from the connection offset and resulting load eccentricity between top and bottom bearing plates. See Table 1 hinge connector model numbers, dimensions, required fasteners, and allowable downloads. See Figure 1 for drawings of HCA and HCCTA hinge connectors.

3.2 F Series Hangers:

The F series joist hangers are engineered components for panelized construction only. The hangers are fabricated from No. 18 gage galvanized steel. See Table 2 for hanger model numbers, hanger dimensions, required fasteners, and allowable downloads. See Figure 2 for drawings of the F26P hanger and a typical hanger installation where the joist member is used as a stiffener for the wood-based structural-use panels.

3.3 PCT Purlin Crossies:

PCT purlin crossies connect in-line wood beams to each other where they are separated by a supporting wood beam or girder and transfer axial tension and compression forces induced by wind or seismic loading from one purlin to the other. The crossies are manufactured from cold-formed, square-shaped, seamless, structural carbon-steel tubing. See Table 3 for model numbers, crossie dimensions, required fasteners, and allowable loads. See Figure 3 for a drawing of the PCT purlin cross tie and a typical installation showing the PCT cross ties installed in pairs as necessary to achieve the tabulated allowable loads.

3.4 SA and HSA Strap Anchors:

The SA and HSA strap anchors connect in-line wood beams to each other where they are separated by a supporting wood beam or girder and transfer axial tension and compression forces induced by wind or seismic loading from one purlin to the other. The SA36 strap anchor is formed from No. 12 gage galvanized steel, and the HSA heavy strap anchors are formed from No. 3 gage galvanized steel. See Table 4 for model numbers, strap anchor dimensions, required fasteners, and allowable loads. See Figure 4 for a drawing of typical installations of the SA and HSA purlin strap ties.

3.5 VB Knee Braces:

The knee braces provide lateral support of beams to prevent rotation or lateral displacement, or both, at the point of connection to the beam. The knee braces are not designed for use as a connector to transfer axial tension forces induced by wind or seismic loading. The braces are fabricated from No. 12 gage galvanized steel See Table 5 for model numbers, range of beam depths permitted for

each model, brace strap length, required fasteners, and allowable tension loads. See Figure 5 for a typical installation of a VB knee brace.

3.6 HFN Panelized Roof Hangers:

The HFN series hangers are designed for panelized roof construction. They are die-formed from No. 18 gage galvanized steel. See Table 6 for header nailing schedules, hanger dimensions and allowable loads. See Figure 6 for a typical HFN hanger.

3.7 Materials:

3.7.1 Steel: The galvanized connectors described in this report are fabricated from galvanized sheet steel complying with ASTM A653, SS designation, Grade 33, with a minimum yield strength, F_y , of 33,000 psi (227 MPa) and a minimum tensile strength, F_u , of 45,000 psi (310 MPa). The galvanized coating conforms to ASTM A653 with a G90 designation. The ungalvanized sheet steel connectors are fabricated from ASTM A1011, SS designation, Grade 33, steel with a minimum yield strength of 33,000 psi (227 MPa) and a minimum tensile strength of 52,000 psi (359 MPa). The HCA hinge connector side plates have a minimum yield strength of 36,000 psi, and the top and bottom bearing plates are ASTM A36 steel with a minimum yield strength of 36,000 psi (227 MPa) and a minimum tensile strength of 58,000 psi (310 Mpa). The PCT steel tubing conforms to ASTM A500 and has minimum yield and tensile strengths of 46,000 psi (317 MPa) and 58,000 psi (400 MPa), respectively.

Some models (designated with a model number ending with Z) are available with a G185 zinc coating specification in accordance with ASTM A653. Some models (designated with a model number ending with HDG) are available with a hot-dip galvanization, also known as “batch” galvanization, in accordance with ASTM A123, with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (610 g/m²), total for both sides. Model numbers in this report do not include the Z or HDG ending, but the information shown applies. The PCT crossties are hot-dipped galvanized in accordance with ASTM A123. HCA hinge connectors have either a painted or powder coated finish and may also be available with the HDG finish. The lumber treater and the holder of this report (Simpson Strong-Tie Company) should be contacted for recommendations on the appropriate coating or material to specify for use of the steel connectors in contact with the specific proprietary preservative treated or fire retardant treated lumber.

The base-metal thicknesses for the connectors in this report are as follows:

NOMINAL THICKNESS (Gage)	MINIMUM BASE-METAL THICKNESS (inch)
18	0.0445
12	0.0975
7	0.1705
3	0.2285

For SI: 1 inch = 25.4 mm.

3.7.2 Wood: Wood members with which the connectors are used must be either sawn lumber or engineered lumber having a minimum specific gravity of 0.50 (minimum equivalent specific gravity of 0.50 for engineered lumber), except as noted in Section 4.1. The thickness of the supporting wood member must be equal to or greater than the length of the fasteners specified in the tables in this report, or as required by wood member design,

whichever is greater. For installation in engineered wood members, minimum allowable nail spacing and end and edge distances, as specified in the applicable evaluation report for the engineered wood product, must be met.

3.7.3 Fasteners: Nails used with connectors described in this report must comply with the material requirements, physical properties, tolerances, workmanship, protective coating and finishes, certification, and packaging and package marking requirements specified in ASTM F1667. The nails must have the following minimum fastener dimensions and bending yield strengths (F_{yb}):

FASTENER	SHANK DIAMETER (inch)	LENGTH (inches)	F_{yb} (psi)
10d x 2 ¹ / ₈	0.148	2 ¹ / ₈	90,000
10d	0.148	3	90,000
16d	0.162	3 ¹ / ₂	90,000
N54A	0.250	2 ¹ / ₂	90,000

For SI: 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

At a minimum, bolts must comply with ASTM A36 or A307, and have a bending yield strength (F_{yb}) of 45,000 psi (310 MPa).

Nails and bolts used in contact with preservative treated or fire retardant treated lumber must comply with Section 2304.9.5 of the IBC, Section R317.3 of the 2012 and 2009 IRC or ~~Section R319.3 of the 2006 IRC~~, as applicable. * For use with treated lumber, the lumber treater or this report holder (Simpson Strong-Tie Company), or both, should be contacted for recommendations on the appropriate coating or material to specify for the fasteners as well as the connection capacities of fasteners used with the specific proprietary preservative treated or fire retardant treated lumber.

4.0 DESIGN AND INSTALLATION

4.1 Design:

The tabulated allowable loads shown in the product tables of this report are based on Allowable Stress Design (ASD) and include the load duration factor, C_D , corresponding with the applicable loads in accordance with the National Design Specification for Wood Construction and its supplement (NDS).

Tabulated allowable loads apply to products connected to wood used under dry conditions and where sustained temperatures are 100°F (37.8°C) or less. When products are installed to wood having a moisture content greater than 19 percent (16 percent for engineered wood products), or where wet service is expected, the allowable loads must be adjusted by the wet service factor, C_M , specified in the NDS for dowel-type fasteners. When connectors are installed in wood that will experience sustained exposure to temperatures exceeding 100°F (37.8°C), the allowable loads in this report must be adjusted by the temperature factor, C_t , specified in the NDS. Connected wood members must be analyzed for load-carrying capacity at the connection in accordance with the NDS.

4.2 Installation:

Installation of the connectors must be in accordance with this evaluation report and the manufacturer’s published installation instructions. Bolts and nails must be installed in accordance with the applicable provisions in the NDS. In the event of a conflict between this report and the manufacturer’s published installation instructions, this report governs.

4.3 Special Inspection:

4.3.1 Main Wind-force-resisting Systems under the IBC: Where required and not exempted by the IBC, periodic special inspection must be conducted for components within the main wind-force-resisting system in accordance with Sections 1704.2 and 1705.10 of the 2012 IBC, Sections 1704 and 1706 of the 2009 IBC, and Section 1704 of the 2006 IBC.

4.3.2 Seismic-Force-resisting Systems under the IBC: Where required and not exempted by the IBC, periodic special inspection must be conducted for components within the seismic-force-resisting system in accordance with Sections 1704.2 and 1705.11 of the 2012 IBC, and Sections 1704 and 1707 of the 2009 and 2006 IBC.

4.3.3 Installations under the IRC: Special inspections are normally not required for connectors used in structures regulated under the IRC. However, for components and systems requiring an engineered design in accordance with IRC Section R301, periodic special inspection must be in accordance with Sections 4.3.1 and 4.3.2 of this report.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie products 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 The connectors must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. A copy of the instructions must be available at the jobsite at all times during installation.
- 5.2 Calculations showing compliance with this report must be submitted to the code official. The calculations must be prepared by a registered design professional

where required by the statutes of the jurisdiction in which the project is to be constructed.

- 5.3 Adjustment factors noted in Section 4.1 and the applicable codes must be considered, where applicable.
- 5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.6.2 and 3.6.3 of this report.
- 5.5 Use of connectors with preservative treated or fire retardant treated lumber must be in accordance with Section 3.6.1 of this report. Use of fasteners with preservative treated or fire retardant treated lumber must be in accordance with Section 3.6.3 of this report.
- 5.6 Welded connectors are manufactured under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Joist Hangers and Similar Devices (AC13), dated October 2010 (editorially revised December 2011).

7.0 IDENTIFICATION

The products described in this report are identified with a die-stamped label or an adhesive label, indicating the name of the manufacturer (Simpson Strong-Tie), the model number, and the number of an index evaluation report ([ESR-2523](#)) that is used as an identifier for the products recognized in this report.

TABLE 1—HCA AND HCCTA SERIES HINGE CONNECTORS^{1,2}

MODEL NO.	DIMENSIONS (inches)			BOLT DIA. (in.)	TWO ROTATION BOLTS ³ PER BEAM		THREE ROTATION BOLTS ³ PER BEAM	
	Width for Beams (W)	Bearing Plate ⁴			Minimum Connector Height, H ^{5,6} (in.)	Allowable Downloads ^{7,8,9} C _D = 1.25 (lbs)	Minimum Connector Height, H ^{5,6} (in.)	Allowable Downloads ^{7,8,9} C _D = 1.25 (lbs)
		Thickness (PT)	Length (PD)					
HCA5-5	5 ¹ / ₄	3/4	5	3/4	16	14,350	13	14,350
HCA5-6			6	3/4	20	17,220	16	17,220
HCA5-7			7	3/4	25	20,090	19	20,090
HCA5-9			9	3/4	37	25,830	27	25,830
HCA7-5	6 ⁷ / ₈	1	5	3/4	19	18,900	16	18,900
HCA7-6			6	3/4	24	22,680	19	22,680
HCA7-7			7	3/4	31	26,460	23	16,460
HCA7-9			9	3/4	40	28,865	33	34,020
HCA9-5	8 ⁷ / ₈	1 ¹ / ₄	5	3/4	23	24,500	17	24,500
HCA9-6			6	3/4	30	29,400	22	29,400
HCA9-7			7	3/4	38	34,300	28	34,300
HCA9-9			9	3/4	40	28,865	40	42,865
HCA11-5	10 ⁷ / ₈	1 ¹ / ₂	5	3/4	26	30,100	20	30,100
HCA11-6			6	3/4	35	36,120	16	26,120
HCA11-7			7	3/4	40	36,970	33	42,140
HCA11-9			9	3/4	40	28,865	40	42,865

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbs = 4.45 N.

¹The depth of the hinge connector varies as the depth of the supported beam. Supporting and supported beams must be the same width. Supporting beam needs to be at least as deep as the supported beam.

²Tabulated allowable downloads shown for the HCA hinge connectors are also applicable to the HCCTA hinge connectors, which have additional bolt holes about the centerline to resist horizontal loads if the beams are part of the continuous lateral load path.

³Rotation bolts must be used to resist rotation resulting from the connection offset and resulting load eccentricity between top and bottom bearing plates.

⁴When hinge connectors are installed, the bearing plates will protrude beyond the top of the beams, which may interfere with the installation of wood-based structural panels and other finish material. The connector may be made flush with the beams by dapping (notching) a recess into the beams to accommodate the bearing plates, which reduces the effective height of the beam by the thickness of the bearing plate (PT).

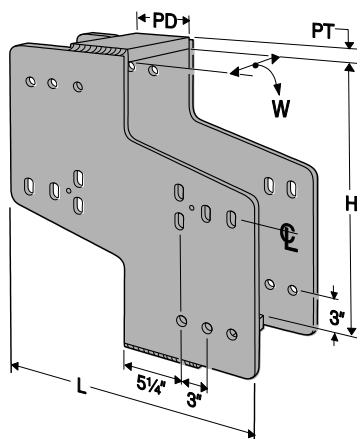
⁵Where minimum depth of glulam being carried exceeds the dimension shown, allowable loads are not subject to an increase in value. For minimum depth of glued laminated beams smaller than the tabulated depths, allowable loads must be decreased in direct proportion to the two depths. Minimum supported beam depth is 8 inches.

⁶Allowable loads are increased for seven-day duration roof loads, and no further increase is permitted.

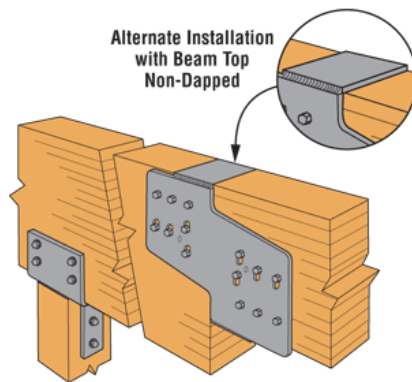
⁷No uplift loads are permitted on the connectors.

⁸Loads must be reduced where member shear capacity results in lower values.

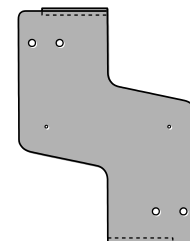
⁹Allowable loads are based on an allowable compression perpendicular-to-grain, F_{C⊥}, value of 560 psi.



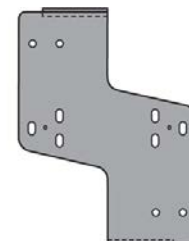
HC4C3TA



Typical HC4C3TA Installation with Beam Top Dapped



HCA



HCCTA

FIGURE 1—HCA AND HCCTA HINGE CONNECTORS

TABLE 2—F SERIES HANGERS¹

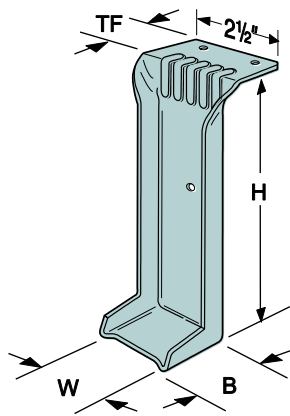
MODEL NO.	HANGER DIMENSIONS (inches)				FASTENERS (Quantity-Size) Into Header	ALLOWABLE DOWNLOADS ² (lbs) C _D = 1.0 C _D = 1.15 C _D = 1.25
	Hanger Seat Width for Joist (W)	Hanger Height (H)	Hanger Seat Depth for Joist (B)	Top Flange Width (TF)		
F26P	1 ²¹ / ₃₂	5 ³ / ₈	1 ³ / ₈	1 ³ / ₁₆	2-10d	585
F24-2	3 ¹ / ₄	3 ¹⁵ / ₃₂	1 ³ / ₈	1 ³ / ₈	2-10d	735
F26-2	3 ¹ / ₄	5 ³ / ₈	1 ¹ / ₄	1 ³ / ₁₆	2-10d	800
F44 ³	3 ⁹ / ₁₆	3 ⁷ / ₁₆	1 ¹ / ₄	1 ¹ / ₂	2-10d	880
F46 ³	3 ⁹ / ₁₆	5 ³ / ₈	1 ¹ / ₈	1 ⁷ / ₁₆	2-10d	785

For SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

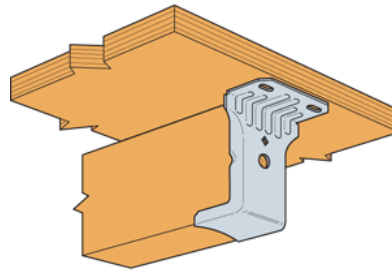
¹ F hangers are only for panelized roof construction where the joist member is used as a panel stiffener for the structural wood-based panel.

² Tabulated allowable downloads must be selected based on duration of load as permitted by the applicable building code.

³ The F44 and F46 models have one or two dimples on each flange to aid in fabrication of panelized construction.



F26P Hanger (others similar)



Typical Installation of a hanger used only for panelized roof construction.

FIGURE 2—F HANGERS

TABLE 3—PCT PURLIN CROSS TIES

MODEL NO.	DIMENSIONS (inches)				MACHINE BOLTS (Quantity-Diameter)	ALLOWABLE TENSION AND COMPRESSION LOADS FOR A PAIR OF PCT CROSS TIES ¹ (lbs)								
						Based on Steel Capacity		Based on Double Shear Bolt Capacity ^{2,3,4,5} and Load Duration Factor (C _D)						
	Tube Wall Thickness	L	L ₁	L ₂		Tension	Comp.	C _D	Length of Bolts through Purlin (inches)					
									3 ¹ / ₈	3 ¹ / ₂	5 ¹ / ₈	5 ¹ / ₂	6 ³ / ₄	
PCT18	1/8	44 ³ / ₄	14	17 ³ / ₄	8 - 5/8	24,665	19,165	1.6	17,235	19,110	19,110	19,090	19,050	
PCT23	1/8	52 ³ / ₄	14	17 ³ / ₄	10 - 5/8	24,665	19,165	1.6	21,390	23,645	23,645	23,620	23,525	
PCT27	3/16	66 ⁵ / ₈	19 ¹ / ₂	23 ¹ / ₂	12 - 5/8	39,665	28,665	1.6	24,855	27,705	28,400	28,430	28,255	
PCT38	3/16	71 ⁵ / ₈	19 ¹ / ₂	23 ¹ / ₂	12 - 3/4	39,365	26,030	1.6	29,105	33,020	40,485	40,570	40,190	

For SI: 1 inch = 25.4 mm, 1 lbs = 4.45N.

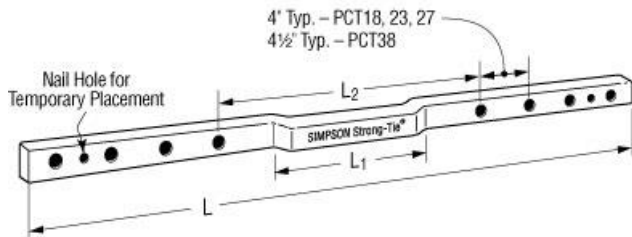
¹The allowable load for a pair of PCT cross tie connectors must be the lower of the steel capacity or the bolt capacity.

²Tabulated allowable loads are based on double shear capacity of the bolts installed through the purlin, which requires the ties to be installed in pairs, as shown in Figure 3.

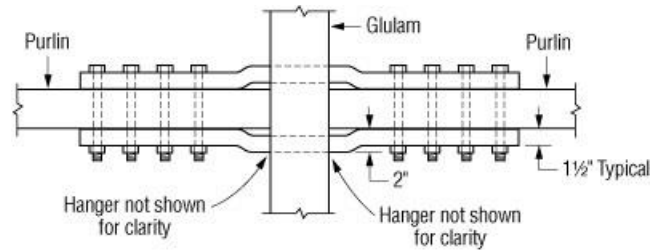
³Allowable loads must be selected based on duration of load as permitted by the applicable building code.

⁴The bolt loads have been increased for wind or earthquake loading with no further increase allowed. Allowable loads must be reduced when other load durations govern.

⁵Allowable loads for bolts assume a purlin with a minimum depth of 10¹/₂ inches.



PCT Purlin Cross Tie



PCT Installed in Pairs

FIGURE 3—PCT PURLIN CROSS TIES

TABLE 4—SA AND HSA PURLIN STRAP TIES

MODEL NO.	STRAP DIMENSIONS (inches)		NAILS (Total Quantity – Size)	BOLTS (Total Quantity – Dia.)	ALLOWABLE TENSION (F1) LOADS ^{1,2,3,4} (lbs)	
	Width	Length			C _D = 1.6	
					Nails	Bolts
SA36	2 ¹ / ₁₆	36	22 –16d	4 – ¹ / ₂	1,900 ⁽⁵⁾	1,605 ⁽⁵⁾
HSA32	3	32	--	2 – ³ / ₄	--	1,910
HSA41	3	41	--	4 – ³ / ₄	--	3,770
HSA50	3	50	--	6 – ³ / ₄	--	5,470
HSA59	3	59	--	8 – ³ / ₄	--	6,940
HSA68	3 ¹ / ₂	68	--	10 – ³ / ₄	--	8,350

For SI: 1 inch = 25.4 mm, 1 lbs = 4.45N.

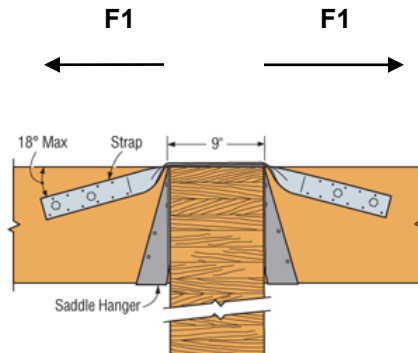
¹Tabulated allowable tension load (F1) must be selected based on duration of load as permitted by the applicable building code.

²The F1 tension loads have been increased for wind or earthquake loading with no further increase allowed. Allowable loads must be reduced when other load durations govern.

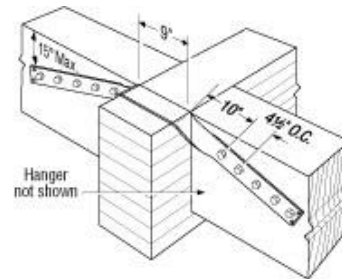
³Straps should be installed in pairs at opposite sides of the connected purlins to reduce eccentricity. When only one strap is installed, the design of the purlins needs to consider bending moment about their weak axis induced by an unsymmetrical arrangement of the connection (see Section 3.1.3 of the NDS).

⁴Allowable loads assume a restrained purlin member having a minimum 3¹/₂-inch thickness with bolts loaded in single shear.

⁵Bolt and nail values may not be combined.



Typical SA Purlin Strap Tie Installation



Typical HSA Purlin Strap Tie Installation

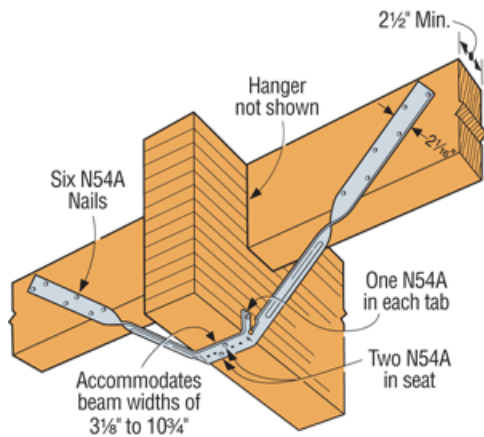
FIGURE 4—SA/HAS PURLIN STRAP TIES

TABLE 5—VB KNEE BRACES

MODEL NO.	BEAM DEPTH (inches)		LENGTH (feet)	FASTENERS (Total Quantity – Size)	ALLOWABLE TENSION LOADS ^{1,2,3,4,5} (lbs)	
	Minimum	Maximum			C _D = 1.0	C _D = 1.6
VB-5	10	15	5	16 – N54A	990	1,240
VB-7	15	22 ¹ / ₂	7	16 – N54A	990	1,240
VB-8	22 ¹ / ₂	28 ¹ / ₂	8	16 – N54A	990	1,240
VB-10	28 ¹ / ₂	36	10	16 – N54A	990	1,240
VB-12	36	42	12	16 – N54A	990	1,240

For SI: 1 inch = 25.4 mm, 1 lbs = 4.45N.

- ¹Tabulated allowable tension loads must be selected based on duration of load as permitted by the applicable building code.
- ²The allowable tension loads have been increased for wind or earthquake loading with no further increase allowed. Allowable loads must be reduced when other load durations govern.
- ³Use of the VB Knee Brace to resist compression loads is outside the scope of this report.
- ⁴The tabulated allowable tension loads are based on braces installed at an approximate 45-degree angle, with a minimum 1³/₈-inch (35 mm) edge distance for nails.
- ⁵Allowable loads apply to tensile loads along the length of the knee brace strap.



Typical Installation of a VB Knee Brace: All nail holes at each end of the strap must be filled with the required nails, and four nails must be installed into the bottom of the beam to provide a positive connection.

FIGURE 5—VB KNEE BRACE

TABLE 6—HFN SERIES ROOF HANGERS^{1,2,3}

MODEL	HANGER DIMENSIONS (inches)			FASTENER SCHEDULE (quantity-size)	DFL/SP ALLOWABLE LOADS (lbs)		
	W	H	TF		C _D =1.0	C _D =1.15	C _D =1.25
HF24N	1 ¹⁷ / ₃₂	3 ³ / ₈	1 ¹ / ₄	2 -10d x 2 ¹ / ₈	580	580	580
HF26N	1 ¹⁷ / ₃₂	5 ³ / ₈	1 ¹ / ₄	2 -10d x 2 ¹ / ₈	635	635	635
HF34N	2 ⁹ / ₁₆	3 ³ / ₈	1 ¹ / ₄	2 -10d x 2 ¹ / ₈	690	690	690
HF36N	2 ⁹ / ₁₆	5 ³ / ₈	1 ¹ / ₄	2 -10d x 2 ¹ / ₈	725	725	725

For SI: 1 inch = 25.4 mm, 1 pound = 4.45 N.

¹Tabulated allowable load capacities shall be selected based on duration of load as permitted by the applicable building code.

²The uplift loads have been increased for wind or earthquake loads. No further increase is allowed.

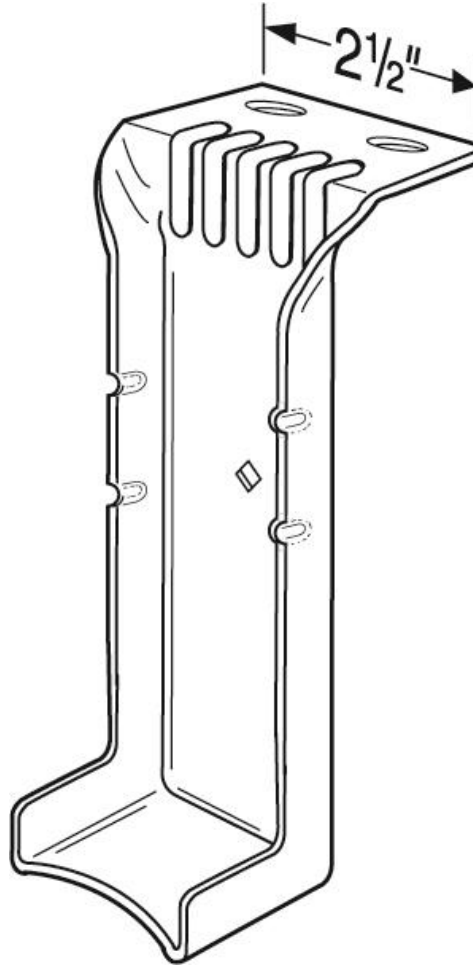


FIGURE 6—HFN HANGER