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# ICC-ES Evaluation Report

# ESR-2920

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Reissued 02/2017  
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**DIVISION: 03 00 00—CONCRETE**

**SECTION: 03 16 00—CONCRETE ANCHORS**

**DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES**

**SECTION: 06 05 23—WOOD, PLASTIC, AND COMPOSITE FASTENINGS**

**REPORT HOLDER:**

**SIMPSON STRONG-TIE COMPANY INC.**

**5956 WEST LAS POSITAS BOULEVARD  
PLEASANTON, CALIFORNIA 94588**

**EVALUATION SUBJECT:**

**SIMPSON STRONG-TIE® CAST-IN-PLACE STRAP-STYLE HOLD-DOWNS AND  
PURLIN ANCHORS**



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# ICC-ES Evaluation Report

**ESR-2920**

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**DIVISION: 03 00 00—CONCRETE**  
**Section: 03 16 00—Concrete Anchors**

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

**REPORT HOLDER:**

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[www.strongtie.com](http://www.strongtie.com)

**EVALUATION SUBJECT:**

**SIMPSON STRONG-TIE® CAST-IN-PLACE STRAP-STYLE HOLD-DOWNS AND PURLIN ANCHORS**

**1.0 EVALUATION SCOPE**

**Compliance with the following codes:**

- 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2015, 2012 and 2009 *International Residential Code*® (IRC)

**Property evaluated:**

Structural

**2.0 USES**

Simpson Strong-Tie® STHD and LSTHD series cast-in-place strap-style hold-downs are used to connect vertical light-frame construction members (posts or multiple studs of wood and cold-formed steel) to concrete foundations or foundation walls. Simpson Strong-Tie PA51 and PA68 cast-in-place strap-style hold-downs are used to connect light-frame wood members to concrete foundations or foundation walls. Simpson Strong-Tie PA, HPA, and PAI strap-style purlin anchors are used to connect light frame construction members (purlins and wood I-joists) to concrete foundation walls. The STHD, LSTHD, PA51, and PA68 strap-style hold-downs and PA, HPA, and PAI purlin anchors are structural connectors cast-in-place into normal-weight concrete to resist horizontal tension forces. The hold-downs may be used with wood framing in buildings resisting wind and seismic forces assigned to Seismic Design Categories (SDCs) A through F in accordance with IBC Sections [1604.8.1](#) and [1604.9](#). For IRC wall bracing applications, the allowable load capacity

for the hold-down installation condition in [Table 1](#), [Table 2](#), or [Table 3](#) shall be equal to, or exceed, the required load capacity in IRC Sections [R602.10](#) and [R602.12](#). The STHD and LSTHD hold-downs may be used with wood or steel framing in buildings resisting wind and seismic forces assigned to Seismic Design Categories (SDCs) A through F, in accordance with IRC Sections [R603.3.1](#) and [R603.9.4](#). The purlin anchors may be used in buildings resisting wind and seismic forces assigned to Seismic Design Categories (SDC's) A through F, in accordance with IBC Sections 1604.8.1, [1604.8.2](#), and 1604.9. The STHD and LSTHD cast-in-place strap-style hold-downs and PA, HPA, and PAI purlin anchors are alternatives to cast-in-place anchors complying with 2015 IBC Section [1901.3](#), 2012 IBC Sections [1908](#) and [1909](#), or 2009 IBC Sections [1911](#) and [1912](#) for resisting tension forces, when the hold-downs or purlin anchors are used to connect vertical light-frame construction members (posts or multiple studs of wood and cold-formed steel) to concrete foundations or foundation walls, and the purlin anchors are used to connect horizontal light-frame construction members to concrete walls, as applicable. For structures regulated under the IRC, the STHD and LSTHD hold-downs and PA, HPA, and PAI purlin anchors may be used where an engineered design is submitted in accordance with Section [R301.1.3](#), and may be used where approved as required by the building official in accordance with Section [R104.11](#).

**3.0 DESCRIPTION**

**3.1 Series Details:**

**3.1.1 STHD / LSTHD Series Strap-style Hold-downs:**

The STHD and LSTHD series strap-style hold-downs are manufactured from No. 12 gage (STHD) and No. 14 gage (LSTHD) cold-formed, galvanized sheet steel. The portion of the hold-down that attaches to the vertical wood or vertical steel stud member is 3 inches (76 mm) wide, and has a staggered hole fastener pattern suitable for attachment to the narrow edges of a nominally double 2-inch or larger vertical member. The portion of the hold-down that is cast into the concrete is 2<sup>5</sup>/<sub>8</sub> inches (67 mm) wide, and has an 8-, 10-, or 14-inch (203, 254 and 356 mm) concrete embedment depth corresponding to the number in the specific product designation. The strap-style hold-downs are available in rim-joist ("RJ") and non-rim-joist models. [Table 1](#) and [Table 2](#) list model numbers, dimensions, fastener schedules and allowable loads. [Figure 1](#) and [Figure 2](#) depict installation and use with wood and cold-formed steel, respectively.

**3.1.2 PA51 and PA68 Series Strap-style Hold-Downs:**

The PA51 and PA68 series strap-style hold-downs are manufactured from No. 12 gage cold-formed, galvanized

sheet steel. The portion of the hold-down that attaches to the wood member is  $2\frac{1}{16}$  inches (52 mm) wide, and has a staggered hole fastener pattern making the hold-down suitable for attachment to the narrow edge of a vertical wood member. The portion of the hold-down that is cast into the concrete is also  $2\frac{1}{16}$  inches (52 mm) wide, and has a 4-inch (102 mm) concrete embedment depth. [Table 3](#) lists model numbers, dimensions, fastener schedules and allowable loads. [Figure 4](#) depicts product and installation examples.

### 3.1.3 PA / HPA / PAI Series Strap-style Purlin Anchors:

The PA, HPA and PAI series strap-style purlin anchors are manufactured from No. 10 gage (HPA) and No. 12 gage (PA and PAI) cold-formed, galvanized sheet steel. The portion of the strap anchor that attaches to the wood member is  $2\frac{1}{16}$  inches (52 mm) wide, and has a staggered hole fastener pattern making the anchor suitable for attachment to the narrow edges of a purlin member. The portion of the strap anchor that is cast into the concrete is also  $2\frac{1}{16}$  inches (52 mm) wide, and has either a 4-inch, 6-in or  $8\frac{1}{4}$ -inch (101, 152 and 210 mm) concrete embedment depth corresponding to the specific PA/HPA/PAI model number. The strap-style purlin anchors are available in standard and wood I-joist models. [Table 4](#) and [Table 5](#) list model numbers, dimensions, fastener schedules and allowable loads. [Figures 3](#) and [4](#) depict representatives of each model, and installation examples.

## 3.2 Materials:

**3.2.1 Connector Steel:** The strap-style hold-downs described in this report are manufactured from galvanized steel complying with [ASTM A653](#), SS designation, Grade 33, with a minimum yield strength,  $F_y$ , of 33,000 psi (227 MPa) and a tensile elongation greater than 14 percent. The STHD8/STHD8RJ, STHD10/STHD10RJ, and LSTHD8/LSTHD8RJ are manufactured from steel with a minimum tensile strength,  $F_u$ , of 45,000 psi (310 MPa). The STHD14 and STHD14RJ are manufactured from steel with a minimum tensile strength,  $F_u$ , of 49,000 psi (338 MPa). The PA18, 23, 51 and 68 are 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 PA28, PA35, HPA28 and HPA35 are Grade 40 with a minimum yield strength,  $F_y$ , of 40,000 psi (276 MPa) and a minimum tensile strength,  $F_u$ , of 55,000 psi (380 MPa). The PAI18 and PAI23 are 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 PAI28 and PAI35 are Grade 40 with a minimum yield strength,  $F_y$ , of 40,000 psi (276 MPa) and a minimum tensile strength,  $F_u$ , of 55,000 psi (380 MPa). The strap-style hold-downs and purlin anchors have a minimum G90 zinc coating designation in accordance with ASTM A653. The lumber treater's recommendations or recommendations of Simpson Strong-Tie Company Inc., regarding minimum corrosion resistance and connection capacities of connectors used with the specific proprietary preservative-treated or fire-retardant treated lumber, must be followed.

The strap-style hold-downs and purlin anchors described in this report have the following minimum base-metal thicknesses:

GAGE NO.	BASE-METAL THICKNESS (in.)
10	0.1342
12	0.1026
14	0.0721

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

**3.2.2 Cold-formed Structural Steel Members:** The allowable loads for the connectors described in this evaluation report that are based on cold-formed structural steel members (see [Table 2](#) and [Figure 2](#)) have been evaluated using No. 20 gage [0.0329-inch (0.84 mm) base-metal thickness] steel complying with ASTM A653, Grade 33,  $F_y = 33$ ksi;  $F_u = 45$ ksi.

**3.2.3 Wood:** Wood members with which the strap-style hold-downs and purlin anchors are used must be either sawn dimensional lumber or engineered lumber complying with an ICC-ES evaluation report. The maximum moisture content is 19 percent for sawn dimensional lumber and 16 percent for engineered lumber except as noted in Section 4.1, and the minimum specified specific gravity, or equivalent specific gravity for engineered lumber, is 0.50, such as for Douglas fir-larch.

**3.2.4 Fasteners:** Nails for wood installation must comply with [ASTM F1667](#), as referenced in Section [2303.6](#) of the IBC. The following table provides the minimum dimensions and bending yield strength ( $F_{yb}$ ) for the fasteners used with the strap-style hold-downs and purlin anchors described in this report.

FASTENER	SHANK DIAMETER (inch)	LENGTH (inches)	$F_{yb}$ (psi)
16d sinker	0.148	$3\frac{1}{4}$	90,000
10d common	0.148	3	90,000
10d x $1\frac{1}{2}$	0.148	$1\frac{1}{2}$	90,000
#10 screw	0.190 nominal diam.	$\frac{3}{4}$	See AISI S200

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

Fasteners used in contact with preservative-treated or fire-retardant-treated lumber must comply with 2015 IBC Section [2304.10.5](#), 2012 and 2009 IBC Section [2304.9.5](#), or IRC Section [R317.3](#), as applicable.

The lumber treater's recommendations or recommendations of Simpson Strong-Tie Company Inc., on minimum corrosion resistance and connection capacities of fasteners used with the specific proprietary preservative-treated or fire-retardant treated lumber, must be followed.

Self-tapping screw fasteners for steel-to-steel connections must comply with [ASTM C1513](#) and must extend through the steel member a minimum of three exposed threads in accordance with AISI S200.

**3.2.5 Concrete:** Concrete must be normal-weight concrete complying with the provisions of IBC [Chapter 19](#) or IRC Section [R402.2](#), as applicable, and must have a minimum specified concrete compressive strength,  $f'_c$  of 2,500 psi (17.2 MPa) for the STHD and LSTHD series and the PA51 and PA68 hold-downs, and 3,000 psi (21 MPa) for the PA, HPA, and PAI series anchors.

**Steel Reinforcing Bars (Rebar):** Steel reinforcement for STHD and LSTHD series hold-down installations must be minimum No. 4 deformed reinforcing bars complying with [ACI 318](#) Section 20.2 (Section 3.5.3 of ACI 318 for the 2012 and 2009 IBC and IRC, and must be located within the foundation in accordance with Section 4.2 and [Figures 1](#) and [2](#) of this report.

## 4.0 DESIGN AND INSTALLATION

### 4.1 Design:

**4.1.1 Design Strength:** The allowable loads shown in the 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* (NDS), where applicable. The allowable tension loads are shown for different hold-down installation conditions, such as location (midwall, corner, or endwall), load type (seismic or wind) and whether the concrete is cracked or uncracked. The allowable anchorage-to-concrete load values based on uncracked concrete are for use where analysis indicates no concrete cracking at service (unfactored) load levels.

The allowable loads listed in [Tables 1, 3, 4, and 5](#) apply to strap-style hold-downs or purlin anchors connected to wood used under dry conditions and where sustained temperatures are 100°F (37.8°C) or less. If installation is in wood that has sustained exposure that exceeds these conditions, the allowable loads in this report must be adjusted by the temperature factor,  $C_t$ , specified in the NDS. When strap-style hold-downs or purlin anchors 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.

The allowable loads in [Table 2](#) apply to installations on No. 20 gage cold-formed steel studs.

IBC Section [1613.1](#) contains an exception that permits detached one- and two- family dwellings assigned to Seismic Design Category (SDC) A, B or C to be exempt from the seismic design provisions of IBC Section [1613](#). When this is the case, as determined by the code official, the allowable wind (or SDCs A and B) loads assigned to the strap-style hold-downs may be used.

**4.1.2 Serviceability:** The strap-style hold-down load ratings also consider a serviceability limit. Footnotes in [Table 1](#) through [Table 5](#) list the deflection of the strap-style hold-downs and anchors at the highest allowable tabulated loads.

#### 4.2 Installation:

The strap-style hold-downs and purlin anchors must be installed in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, the more restrictive requirements govern. Hold-down and purlin anchor locations must comply with this report and the plans and specifications approved by the code official. For buildings regulated under the IRC and conventional light-frame construction regulated under IBC Section [2308](#), the strap-style hold-down may be used to attach light-frame construction vertical wood framing members (posts and studs) and cold-formed steel studs to normal-weight concrete foundations or foundation walls having the minimum thickness shown in the load tables. Predrilling of holes for fasteners installed in the vertical member is not required.

Strap-style hold-downs and purlin anchors must be installed with the minimum embedment depth,  $l_e$ , noted in [Table 1](#) through [Table 5](#) of this report. The strap may be bent one full cycle (bent horizontally 90 degrees then bent vertically) to aid wall placement. Bending of the installed strap may cause concrete spalling behind the strap. If the spall is 1 inch (25 mm) or less, measured from the embedment line to the bottom of the spall, full loads apply. Any portion of the strap left exposed must be protected against corrosion by providing weather protection complying with IBC Section [1403.2](#) or IRC Section [R703](#).

The tabulated allowable tension loads for STHD and LSTHD strap-style hold-downs are based on installation into concrete reinforced with one No. 4 deformed steel reinforcing bar located within the potential concrete failure region installed from 3 to 5 inches (76 to 127 mm) from the top of foundation. The No. 4 bar is not required to be tied or in contact with the strap-style hold-down.

Where required by the code, one No. 4 deformed steel reinforcing bar shall be placed in the scoop of the anchor for purlin anchor installations.

#### 4.3 Special Inspection:

**4.3.1** For the purpose of determining special inspection requirements, connectors may be considered to be special cases in accordance with Section [1705.1.1](#) of the IBC (Section [1704.15](#) of the 2009 IBC). Periodic special inspection shall be provided except where otherwise required or excepted by specific provisions of the IBC.

**4.3.2** For installations under the IRC, special inspection shall not be required.

#### 5.0 CONDITIONS OF USE

The Simpson Strong-Tie cast-in-place strap-style hold-down connectors and purlin anchors 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 strap-style hold-downs and purlin anchors 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. In the event of conflict between this report and the manufacturers published installation instructions, the more restrictive requirements govern.
- 5.2** Calculations and details 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 3.2.3 and 3.2.4 of this report. Connected cold-formed steel members and screws must comply, respectively, with Sections 3.2.2 and 3.2.4.
- 5.5** Use of connectors with preservative- or fire-retardant-treated lumber must be in accordance with Section 3.2.1 of this report. Use of fasteners with preservative- or fire-retardant-treated lumber must be in accordance with Section 3.2.4 of this report.
- 5.6** Strap-style hold-downs and purlin anchors may be installed in cracked or uncracked concrete. Cracking occurs in regions of concrete where analysis indicates cracking may occur ( $f_t > f_r$ ) subject to the conditions of this report.
- 5.7** Special Inspection must be provided in accordance with Section 4.3 of this report.
- 5.8** Strap-style hold-downs and purlin anchors are limited to resisting tension loads resulting from wind or earthquake loads only.

**6.0 EVIDENCE SUBMITTED**

Data in accordance with the ICC-ES Acceptance Criteria for Cast-in-place Cold-formed Steel Connectors in Concrete for Light-frame Construction (AC398), dated June 2017.

**7.0 IDENTIFICATION**

The Simpson Strong-Tie cast-in-place strap-style hold-downs and purlin anchors described in this report are

identified with a die-stamped 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—ALLOWABLE STRESS DESIGN (ASD) LOADS FOR STHD/STHDRJ STRAP-STYLE HOLD-DOWNS  
INSTALLED ON WOOD VERTICAL MEMBERS – 2,500 psi CONCRETE<sup>1,3,4,7,9</sup>**

Wind and SDC A & B - Allowable Tension Loads (lbf.) <sup>5,6</sup>													
Min. Stem Thickness Wall (in)	Model No.		Strap Length (L)		l <sub>e</sub> (in)	Uncracked Concrete				Cracked Concrete			
	Standard	Rim Joist	Standard (in)	Rim Joist (in)		Req'd Nails <sup>2,8</sup>				Req'd Nails <sup>2,8</sup>			
						midwall	corner	endwall	Req'd Nails <sup>2,8</sup>	midwall	corner	endwall	
6	LSTHD8	LSTHD8RJ	18 <sup>5</sup> / <sub>8</sub>	32 <sup>1</sup> / <sub>8</sub>	8	20 -16d Sinkers	2,985	2,590	1,620	18 -16d Sinkers	2,565	2,225	1,395
	STHD8	STHD8RJ	21 <sup>5</sup> / <sub>8</sub>	35 <sup>1</sup> / <sub>8</sub>	8	20 -16d Sinkers	3,230	2,740	1,710	18 -16d Sinkers	2,655	2,255	1,405
	STHD10	STHD10RJ	24 <sup>5</sup> / <sub>8</sub>	38 <sup>1</sup> / <sub>8</sub>	10	24 -16d Sinkers	3,535	3,535	1,960	22 -16d Sinkers	2,910	2,910	1,635
	STHD14	STHD14RJ	26 <sup>1</sup> / <sub>8</sub>	39 <sup>5</sup> / <sub>8</sub>	14	30 -16d Sinkers	4,935	4,935	3,065	30 -16d Sinkers	4,935	4,935	3,065
8	LSTHD8	LSTHD8RJ	18 <sup>5</sup> / <sub>8</sub>	32 <sup>1</sup> / <sub>8</sub>	8	20 -16d Sinkers	2,985	2,590	2135	18 -16d Sinkers	2,565	2,225	1,835
	STHD8	STHD8RJ	21 <sup>5</sup> / <sub>8</sub>	35 <sup>1</sup> / <sub>8</sub>	8	20 -16d Sinkers	3,230	2,740	2265	18 -16d Sinkers	2,655	2,255	1,860
	STHD10	STHD10RJ	24 <sup>5</sup> / <sub>8</sub>	38 <sup>1</sup> / <sub>8</sub>	10	28 -16d Sinkers	4,755	4,075	3015	26 -16d Sinkers	4,020	3,350	2,480
	STHD14	STHD14RJ	26 <sup>1</sup> / <sub>8</sub>	39 <sup>5</sup> / <sub>8</sub>	14	30 -16d Sinkers	5,285	5,285	4410	30 -16d Sinkers	5,285	5,285	4,410
SDC C-F - Allowable Tension Loads (lbf.) <sup>5,6</sup>													
Min. Stem Thickness Wall (in)	Model No.		Strap Length (L)		l <sub>e</sub> (in)	Uncracked Concrete				Cracked Concrete			
	Standard	Rim Joist	Standard (in)	Rim Joist (in)		Req'd Nails <sup>2,8</sup>				Req'd Nails <sup>2,8</sup>			
						midwall	corner	endwall	Req'd Nails <sup>2,8</sup>	midwall	corner	endwall	
6	LSTHD8	LSTHD8RJ	18 <sup>5</sup> / <sub>8</sub>	32 <sup>1</sup> / <sub>8</sub>	8	16 -16d Sinkers	2,270	2,090	1,220	16 -16d Sinkers	2,250	1,950	1,220
	STHD8	STHD8RJ	21 <sup>5</sup> / <sub>8</sub>	35 <sup>1</sup> / <sub>8</sub>	8	16 -16d Sinkers	2,555	2,185	1,370	16 -16d Sinkers	2,330	1,975	1,235
	STHD10	STHD10RJ	24 <sup>5</sup> / <sub>8</sub>	38 <sup>1</sup> / <sub>8</sub>	10	18 -16d Sinkers	2,750	2,750	1,615	18 -16d Sinkers	2,640	2,640	1,435
	STHD14	STHD14RJ	26 <sup>1</sup> / <sub>8</sub>	39 <sup>5</sup> / <sub>8</sub>	14	22 -16d Sinkers	3,695	3,695	2,685	22 -16d Sinkers	3,695	3,695	2,685
8	LSTHD8	LSTHD8RJ	18 <sup>5</sup> / <sub>8</sub>	32 <sup>1</sup> / <sub>8</sub>	8	16 -16d Sinkers	2,615	2,125	1,635	16 -16d Sinkers	2,250	1,950	1,610
	STHD8	STHD8RJ	21 <sup>5</sup> / <sub>8</sub>	35 <sup>1</sup> / <sub>8</sub>	8	16 -16d Sinkers	2,790	2,185	1,660	16 -16d Sinkers	2,330	1,975	1,635
	STHD10	STHD10RJ	24 <sup>5</sup> / <sub>8</sub>	38 <sup>1</sup> / <sub>8</sub>	10	20 -16d Sinkers	3,400	2,940	2,295	20 -16d Sinkers	3,400	2,940	2,175
	STHD14	STHD14RJ	26 <sup>1</sup> / <sub>8</sub>	39 <sup>5</sup> / <sub>8</sub>	14	24 -16d Sinkers	3,815	3,815	3,500	24 -16d Sinkers	3,815	3,815	3,500

For **SI**: 1 in = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 6.895 kPa.

<sup>1</sup>See [Figure 1](#) for installation requirements.

<sup>2</sup>10d Common (3" long x 0.148" diameter) nails may be used with no load reduction.

<sup>3</sup>Deflection at highest allowable loads for install over wood double studs are as follows: LSTHD8 = 0.0891", STHD8 = 0.085", STHD10 = 0.117" and STHD14 = 0.118".

<sup>4</sup>Deflection at highest allowable loads for install over 1/2" Sheathing is as follows: LSTHD8 = 0.114", STHD8 = 0.123", STHD10 = 0.146" and STHD14 = 0.164".

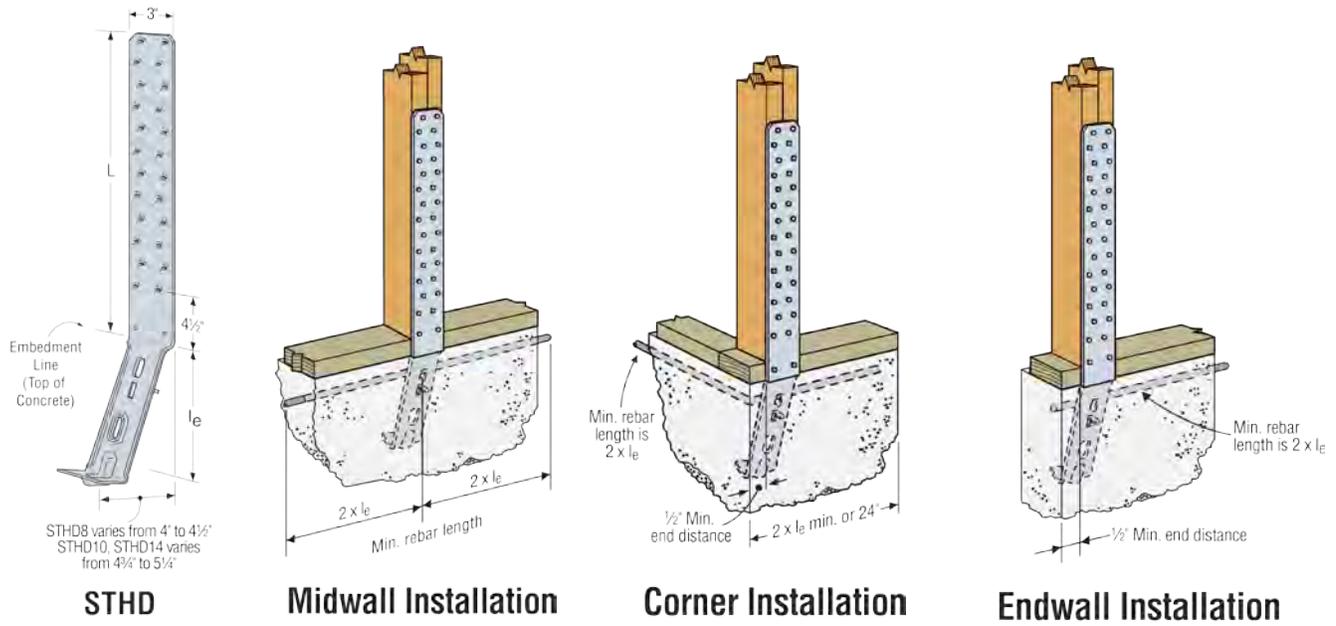
<sup>5</sup>Multiply Seismic and Wind ASD load values by 1.43 or 1.67 respectively to obtain LRFD capacities.

<sup>6</sup>In accordance with IBC Section [1613.1](#), detached one- and two- family dwellings in Seismic Design Category (SDC) C may use "Wind and SDC A&B" allowable loads.

<sup>7</sup>Minimum center-to-center spacing is 3 times the required embedment (S<sub>min</sub>=3 x l<sub>e</sub>) for STHD's acting in tension simultaneously. Midwall location is based on 1.5 x l<sub>e</sub> end distance.

<sup>8</sup>Nail quantities are based on 2015 NDS nail calculations using the lesser SG of Spruce Pine-Fir (SPF) with SG = 0.42, Hem Fir (HF) with SG = 0.43, Southern Pine (SP) with SG = 0.55, and Douglas Fir (DF) with SG = 0.50 as the wood species. Engineered wood must comply with Section 3.2.3.

<sup>9</sup>See Sections 3.2.1 and 3.2.4 of this report for installations with treated wood. Reduction in connection strength due to chemical treatment shall be applied to the allowable tension loads based on data from lumber treaters.



U.S. Patent 5,813,182

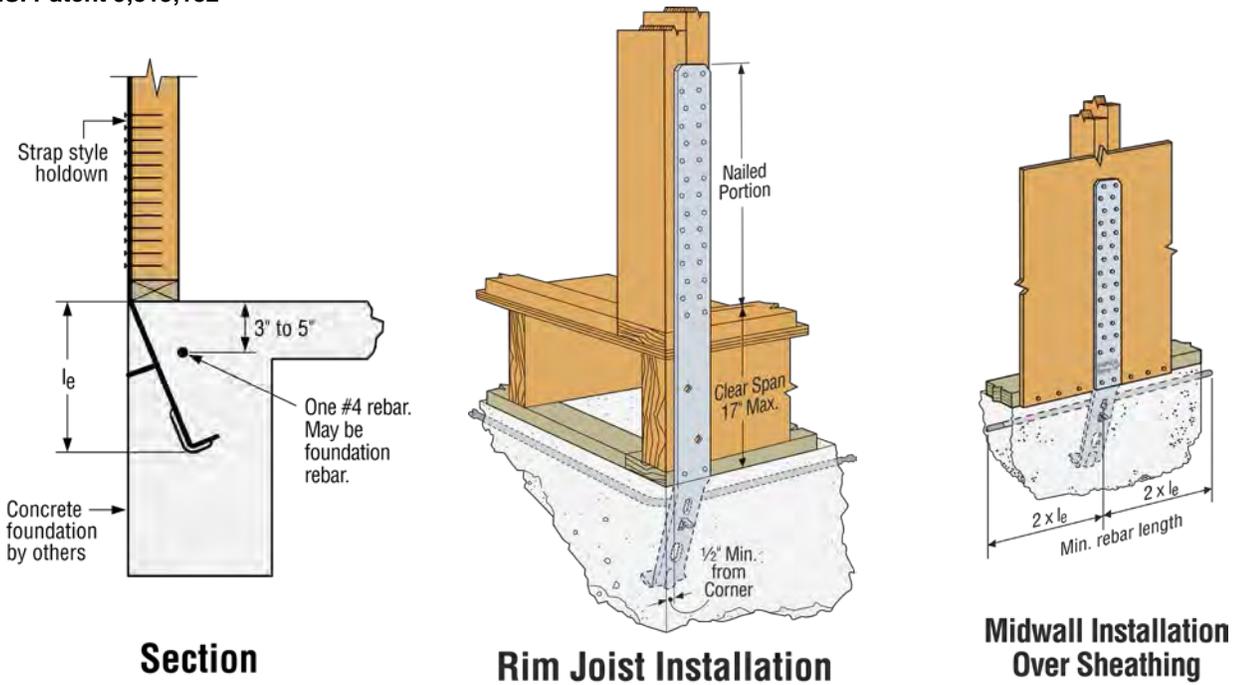


FIGURE 1

**TABLE 2—ALLOWABLE STRESS DESIGN (ASD) LOADS FOR STHD / STHDRJ ON COLD-FORMED STEEL (CFS) – 2,500 psi CONCRETE<sup>1,2,5</sup>**

Wind and SDC A & B - Allowable Tension Loads (lbf.) - 33 mil (No. 20 ga) Studs <sup>3,4</sup>													
Min. Stem Wall (in)	Model No.		Strap Length (L)		l <sub>e</sub> (in)	Uncracked Concrete				Cracked Concrete			
	Standard	Rim Joist	Standard (in)	Rim Joist (in)		Req'd Screws	midwall	corner	endwall	Req'd Screws	midwall	corner	endwall
6	LSTHD8	LSTHD8RJ	18 <sup>5</sup> / <sub>8</sub>	32 <sup>1</sup> / <sub>8</sub>	8	20 #10	2,565	2,225	1,395	16 #10	2,830	2,590	1,620
	STHD8	STHD8RJ	21 <sup>5</sup> / <sub>8</sub>	35 <sup>1</sup> / <sub>8</sub>	8	20 #10	2,655	2,255	1,405	16 #10	2,830	2,740	1,710
	STHD10	STHD10RJ	24 <sup>5</sup> / <sub>8</sub>	38 <sup>1</sup> / <sub>8</sub>	10	24 #10	2,910	2,910	1,635	22 #10	3,535	3,535	1,960
	STHD14	STHD14RJ	26 <sup>1</sup> / <sub>8</sub>	39 <sup>5</sup> / <sub>8</sub>	14	30 #10	4,935	4,935	3,065	30 #10	4,935	4,935	3,065
8	LSTHD8	LSTHD8RJ	18 <sup>5</sup> / <sub>8</sub>	32 <sup>1</sup> / <sub>8</sub>	8	20 #10	2,565	2,225	1,835	16 #10	2,830	2,590	2,135
	STHD8	STHD8RJ	21 <sup>5</sup> / <sub>8</sub>	35 <sup>1</sup> / <sub>8</sub>	8	20 #10	2,655	2,255	1,860	16 #10	2,830	2,740	2,265
	STHD10	STHD10RJ	24 <sup>5</sup> / <sub>8</sub>	38 <sup>1</sup> / <sub>8</sub>	10	28 #10	4,020	3,350	2,480	26 #10	4,595	4,075	3,015
	STHD14	STHD14RJ	26 <sup>1</sup> / <sub>8</sub>	39 <sup>5</sup> / <sub>8</sub>	14	30 #10	5,285	5,285	4,410	30 #10	5,285	5,285	4,410
SDC C-F - Allowable Tension Loads (lbf.) - 33 mil (No. 20 ga) Studs <sup>3,4</sup>													
Min. Stem Wall (in)	Model No.		Strap Length (L)		l <sub>e</sub> (in)	Uncracked Concrete				Cracked Concrete			
	Standard	Rim Joist	Standard (in)	Rim Joist (in)		Req'd Screws	midwall	corner	endwall	Req'd Screws	midwall	corner	endwall
6	LSTHD8	LSTHD8RJ	18 <sup>5</sup> / <sub>8</sub>	32 <sup>1</sup> / <sub>8</sub>	8	16 #10	2,270	2,090	1,220	14 #10	2,250	1,950	1,220
	STHD8	STHD8RJ	21 <sup>5</sup> / <sub>8</sub>	35 <sup>1</sup> / <sub>8</sub>	8	16 #10	2,555	2,185	1,370	14 #10	2,330	1,975	1,235
	STHD10	STHD10RJ	24 <sup>5</sup> / <sub>8</sub>	38 <sup>1</sup> / <sub>8</sub>	10	18 #10	2,750	2,750	1,615	18 #10	2,640	2,640	1,435
	STHD14	STHD14RJ	26 <sup>1</sup> / <sub>8</sub>	39 <sup>5</sup> / <sub>8</sub>	14	22 #10	3,695	3,695	2,685	22 #10	3,695	3,695	2,685
8	LSTHD8	LSTHD8RJ	18 <sup>5</sup> / <sub>8</sub>	32 <sup>1</sup> / <sub>8</sub>	8	16 #10	2,615	2,125	1,635	14 #10	2,250	1,950	1,610
	STHD8	STHD8RJ	21 <sup>5</sup> / <sub>8</sub>	35 <sup>1</sup> / <sub>8</sub>	8	16 #10	2,790	2,185	1,660	14 #10	2,330	1,975	1,635
	STHD10	STHD10RJ	24 <sup>5</sup> / <sub>8</sub>	38 <sup>1</sup> / <sub>8</sub>	10	20 #10	3,400	2,940	2,295	20 #10	3,400	2,940	2,175
	STHD14	STHD14RJ	26 <sup>1</sup> / <sub>8</sub>	39 <sup>5</sup> / <sub>8</sub>	14	24 #10	3,815	3,815	3,500	24 #10	3,815	3,815	3,500

For **SI**: 1 in = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 6.895 kPa.

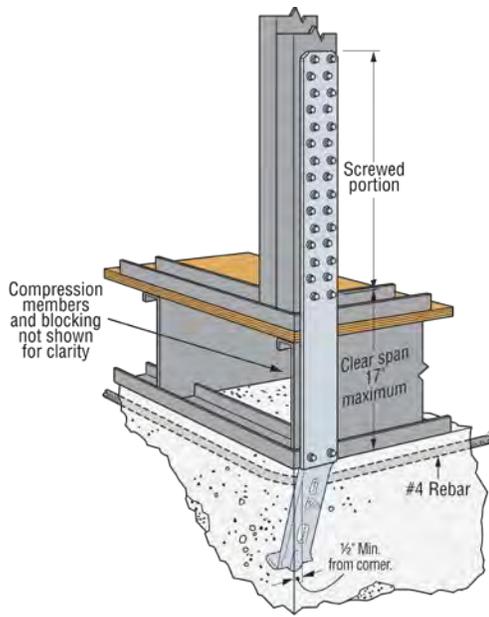
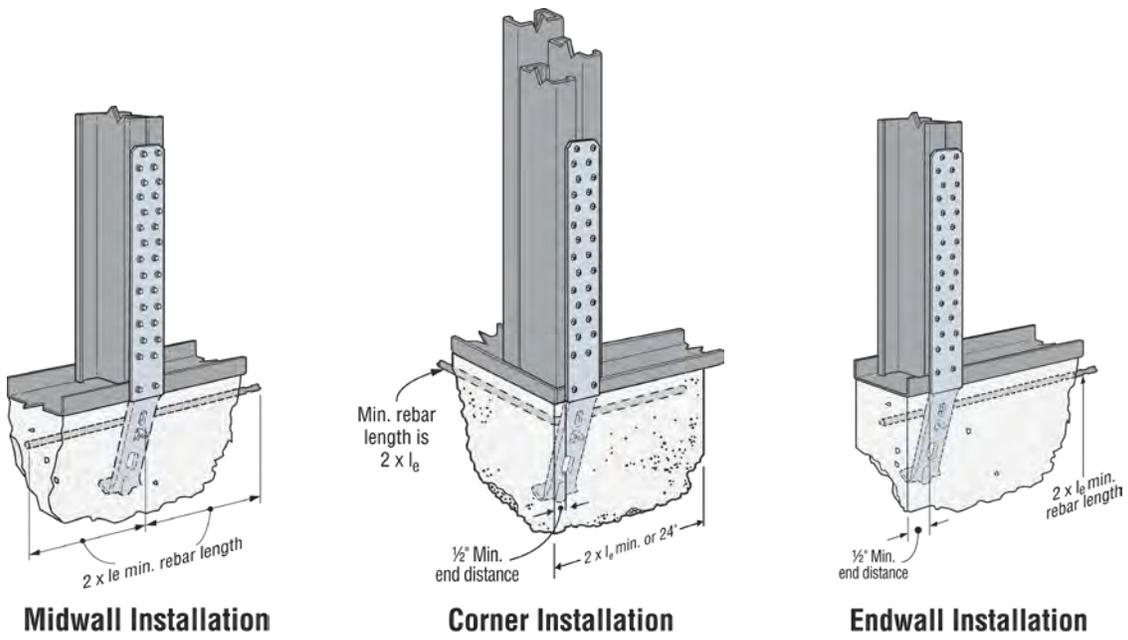
<sup>1</sup>See [Figure 2](#) for installation requirements.

<sup>2</sup>Deflection at highest allowable loads for install over CFS double studs are as follows: LSTHD8 = 0.065", STHD8 = 0.071", STHD10 = 0.096" and STHD14 = 0.115".

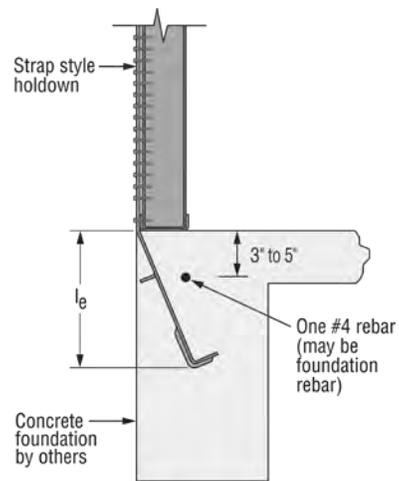
<sup>3</sup>Multiply Seismic and Wind ASD load values by 1.43 or 1.67 respectively to obtain LRFD capacities.

<sup>4</sup>In accordance with IBC Section 1613.1, detached one- and two- family dwellings in Seismic Design Category (SDC) C may use "Wind and SDC A&B" allowable loads.

<sup>5</sup>Minimum center-to-center spacing is 3 times the required embedment (S<sub>min</sub>=3 x l<sub>e</sub>) for STHD's acting in tension simultaneously. Midwall location is based on 1.5 x l<sub>e</sub> end distance.



**Rim Joist Installation**



**Section**

**FIGURE 2**

**TABLE 3—ALLOWABLE STRESS DESIGN (ASD) LOADS FOR PA51 & PA68 STRAP-STYLE HOLD-DOWNS  
INSTALLED ON WOOD MEMBERS – 2,500 psi CONCRETE<sup>1,3,4,5,6,10</sup>**

Wind and SDC A & B - Allowable Tension Loads (lbf.)						
Model No.	Strap Length, L (in)	l <sub>e</sub> (in)	Uncracked		Cracked	
			Req'd Nails <sup>2,8,9</sup>	Wall	Req'd Nails <sup>2,8,9</sup>	Wall
PA51	51	4	10 – 10d Common	2,025	10 – 10d Common	2,025
PA68	70	4	10 – 10d Common	2,025	10 – 10d Common	2,025
SDC C-F - Allowable Tension Loads (lbf.)						
Model No.	Strap Length, L (in)	l <sub>e</sub> (in)	Uncracked		Cracked	
			Req'd Nails <sup>2,8,9</sup>	Wall	Req'd Nails <sup>2,8,9</sup>	Wall
PA51	51	4	10 – 10d Common	2,025	10 – 10d Common	1,840
PA68	70	4	10 – 10d Common	2,025	10 – 10d Common	1,840

For **SI**: 1 in = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 6.895 kPa.

See Table 4 for Footnotes.

**TABLE 4—ALLOWABLE STRESS DESIGN (ASD) LOADS FOR  
PA/HPA STRAP-STYLE PURLIN ANCHORS – 3,000 psi CONCRETE<sup>1,3,4,5,6,10</sup>**

Wind and SDC A & B - Allowable Tension Loads (lbf.)								
Max Ledger Size	Model No.	Strap Length (L)	l <sub>e</sub> (in)	Uncracked Concrete		Cracked Concrete		Max. Allowable Strap Tensile Capacity <sup>7</sup>
				Req'd Nails <sup>8,9</sup>	Tension	Req'd Nails <sup>8,9</sup>	Tension	
4x Ledger	PA18	18 1/2	4	12 -10d Common	2,430	12 -10d Common	2,260	N/A
	PA23	23 3/4	4	16 -10d Common	3,220	12 -10d Common	2,260	N/A
	PA28	29	4	16 -10d Common	3,230	12 -10d Common	2,260	N/A
	PA35	35	4	16 -10d Common	3,230	12 -10d Common	2,260	N/A
	HPA28	32 1/2	6	22 -10d Common	5,145	20 -10d Common	4,675	N/A
	HPA35	38 1/2	8.25	22 -10d Common	5,145	22 -10d Common	5,145	N/A
SDC C-F - Allowable Tension Loads (lbf.)								
Max Ledger Size	Model No.	Strap Length (L)	l <sub>e</sub> (in)	Uncracked Concrete		Cracked Concrete		Max. Allowable Strap Tensile Capacity <sup>7</sup>
				Req'd Nails <sup>8,9</sup>	Tension	Req'd Nails <sup>8,9</sup>	Tension	
4x Ledger	PA18	18 1/2	4	12 -10d Common	2,430	10 -10d Common	1,980	3,220
	PA23	23 3/4	4	14 -10d Common	2,830	10 -10d Common	1,980	3,220
	PA28	29	4	14 -10d Common	2,830	10 -10d Common	1,980	3,935
	PA35	35	4	14 -10d Common	2,830	10 -10d Common	1,980	3,935
	HPA28	32 1/2	6	22 -10d Common	5,145	18 -10d Common	4,090	5,145
	HPA35	38 1/2	8.25	22 -10d Common	5,145	22 -10d Common	5,145	5,145

For **SI**: 1 in = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 6.895 kPa.

<sup>1</sup>Footnotes under Table 4 apply to Table 3 and Table 4.

<sup>2</sup>Where installed nail quantities are greater than those shown in Table 3, the allowable tension loads and required nail quantities for the PA18 and PA23 in Table 4 may be used.

<sup>3</sup>See [Figure 4](#) for installation requirements.

<sup>4</sup>Deflection at highest allowable loads are as follows: PA18 = 0.087", PA23 = 0.118", PA28 = 0.085", PA35 = 0.085", PA51 & 68 = 0.10", HPA28 = 0.133" and HPA35 = 0.132".

<sup>5</sup>Multiply Seismic and Wind ASD load values by 1.43 or 1.67 respectively to obtain LRFD capacities.

<sup>6</sup>Minimum center-to-center spacing is 3 times the required embedment. Standard installation is based on minimum 1.5 x l<sub>e</sub> end distance.

<sup>7</sup>For wall anchorage systems in structures assigned to SDC C-F, the maximum allowable strap steel tensile capacity shall not be less than 1.4 times the ASD anchor design load.

<sup>8</sup>Nail quantities are based on Douglas Fir (DF) and Southern Pine (SP). For use on Spruce Pine-Fir (SPF) or Hem Fir (HF) nail quantities must be increased by 1.15 to achieve allowable loads. Engineered wood must comply with Section 3.2.3.

<sup>9</sup>10d x 1.5 nails may be substituted for the required 10d Commons with no load reduction but with a 15% increase in deflection. This shorter nail substitution is not applicable when installing over sheathing. 16d Sinkers may be substituted with no load reduction and no increase in deflection.

<sup>10</sup>See Sections 3.2.1 and 3.2.4 of this report for installations with treated wood.

**TABLE 5—ALLOWABLE STRESS DESIGN (ASD) LOADS FOR PAI STRAP-STYLE PURLIN ANCHORS – 3000 psi CONCRETE<sup>1,2,3,4</sup>**

Wind and SDC A & B - Allowable Tension Loads (lbf.)								
Max Ledger Size	Model No.	Strap Length, L (in)	l <sub>e</sub> (in)	Uncracked Concrete		Cracked Concrete		Max. Allowable Strap Tensile Capacity <sup>5</sup>
				Req'd Nails <sup>6</sup>	Tension	Req'd Nails <sup>6</sup>	Tension	
4x Ledger	PAI18	18 <sup>1</sup> / <sub>2</sub>	4	9 -10d x 1.5	1,820	12 -10d x 1.5	2,260	N/A
	PAI23	23 <sup>3</sup> / <sub>4</sub>	4	14 -10d x 1.5	2,835	12 -10d x 1.5	2,260	N/A
	PAI28	29	4	16 -10d x 1.5	3,330	12 -10d x 1.5	2,260	N/A
	PAI35	35	4	18 -10d x 1.5	3,330	12 -10d x 1.5	2,260	N/A
SDC C-F - Allowable Tension Loads (lbf.)								
Max Ledger Size	Model No.	Strap Length, L (in)	l <sub>e</sub> (in)	Uncracked Concrete		Cracked Concrete		Max. Allowable Strap Tensile Capacity <sup>5</sup>
				Req'd Nails <sup>6</sup>	Tension	Req'd Nails <sup>6</sup>	Tension	
4x Ledger	PAI18	18 <sup>1</sup> / <sub>2</sub>	4	9 -10d x 1.5	1,820	9 -10d x 1.5	1,820	4,180
	PAI23	23 <sup>3</sup> / <sub>4</sub>	4	14 -10d x 1.5	2,830	10 -10d x 1.5	1,980	4,180
	PAI28	29	4	20 -10d x 1.5	2,830	10 -10d x 1.5	1,980	5,070
	PAI35	35	4	26 -10d x 1.5	2,830	10 -10d x 1.5	1,980	5,070

For **SI**: 1 in = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 6.895 kPa.

<sup>1</sup>See Figure 3 for installation requirements.

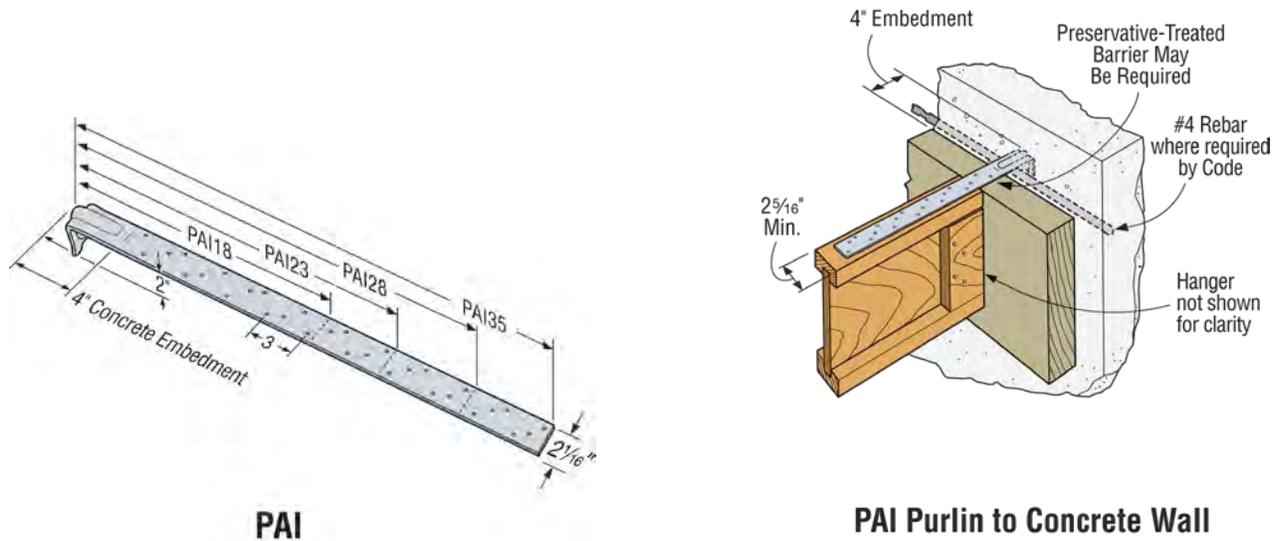
<sup>2</sup>Deflection at highest allowable loads are as follows: PAI18 = 0.10", PAI23 = 0.158", PAI28 = 0.167" and PAI35 = 0.141".

<sup>3</sup>Multiply Seismic and Wind ASD load values by 1.43 or 1.67 respectively to obtain LRFD capacities.

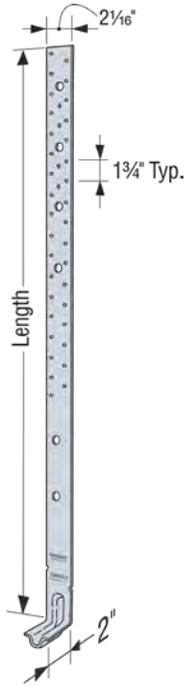
<sup>4</sup>Minimum center-to-center spacing is 3 times the required embedment. Standard installation is based on minimum 1.5 x l<sub>e</sub> end distance.

<sup>5</sup>For wall anchorage systems in SDC C-F, the maximum allowable strap tensile capacity shall not be less than 1.4 times the ASD anchor design load.

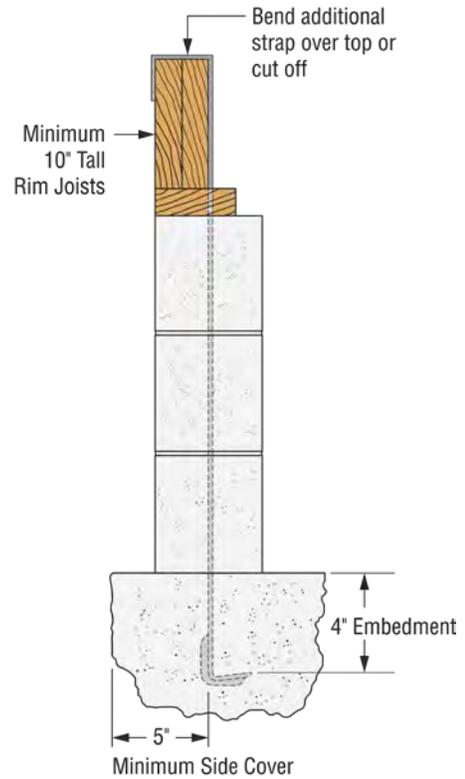
<sup>6</sup>Nail quantities are based on Douglas Fir (DF) and Southern Pine (SP) top chord members. For use on Spruce Pine-Fir (SPF) or Hem Fir (HF) nail quantities must be increased by 1.15 to achieve allowable loads. Engineered wood must comply with Section 3.2.3.



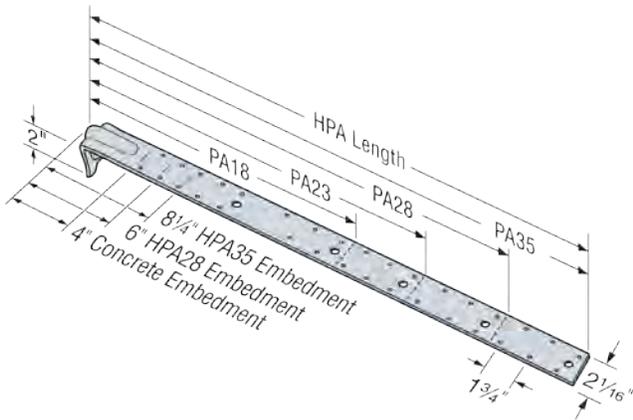
**FIGURE 3**



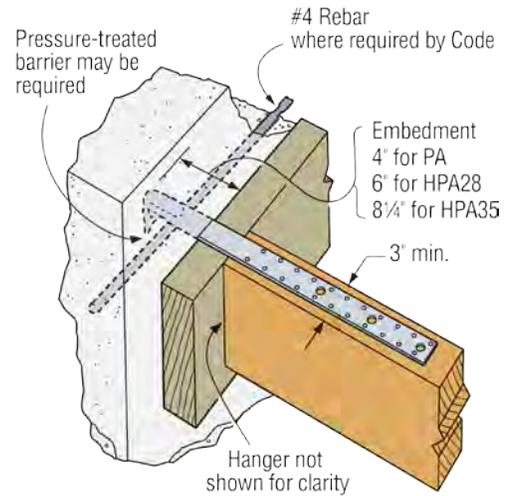
**PA51 / PA68**



**Typical PA51 / PA68 Installation**



**PA / HPA**



**PA / HPA Purlin to Concrete Wall**

**FIGURE 4**