EVALUATION REPORT

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DIVISION: 06—WOOD AND PLASTICS
Section: 06090—Wood and Plastics Fastenings

REPORT HOLDER:
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EVALUATION SUBJECT:

SIMPSON STRONG-TIE NAIL HOLD-DOWNS (TENSION TIES)

1.0 EVALUATION SCOPE

1.1 Compliance with the following codes:

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

1.2 Evaluated in accordance with:

- *ICC-ES AC155, Acceptance Criteria for Hold-Downs attached to wood members, editorially revised April 2008*

Property evaluated:

- Structural

2.0 USES

Simpson Strong-Tie structural nail hold-down connectors (tension ties) are used as wood framing anchorage, such as to connect wood posts to concrete foundations or to connect an upper–story wood post to a lower-story supporting wood post, in accordance with IBC Sections 2304.9.3, 2305.1, 2305.3.2, 2305.3.7, 2305.3.8.2.4, and 2308.9.3.1; and are used as anchorage of concrete and masonry walls to structural wood elements to provide lateral support for the walls as required by IBC Section 1604.8.

The hold-down connectors 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, or in alternate braced wall panels per IRC Sections R602.10.6.1 or R602.10.6.2.

3.0 DESCRIPTION

3.1 Product Information:

3.1.1 LTT Nail Hold-downs: LLT Light Tension Ties are nail hold-downs consisting of a steel strap component with 90 degree angle bend at the end, and a base plate component installed in the bend which eliminates the need for a washer to transfer load. The hold-downs have pre-punched holes for installation of fasteners used to connect the hold-down to the wood member. The bodies of the LTT19, LTT20B and LTTI31 are formed from No.16, No.12, and No.18 gage galvanized steel, respectively. The base plate component for LTT's is No. 3 gage galvanized steel. Reference Figure 1 and Table 1 for product dimensions, required fasteners and allowable loads.

3.1.2 HTT Nail Hold-down: HTT Heavy Tension Ties are single-piece formed nail hold-downs consisting of a steel strap with a four-ply formed seat element for an anchor bolt. The straight-strap portion has pre-punched holes for installation of fasteners used to connect the hold-down to the wood member. The HTT is die-formed from No. 11 gage galvanized steel. Bearing plate BP5/8-2 is fabricated from 3/16 inch thickness steel and may be installed with HTT5 and HTT22 as a load transfer washer for additional capacity. Reference Figure 2 and Table 1 for product dimensions, required fasteners and allowable loads.

3.2 Materials:

3.2.1 Steel: The LTT and HTT nail hold-downs described in this report are manufactured from ASTM A 653, SS Grade 33 galvanized steel with a minimum yield strength, Fy, of 33,000 psi (227 MPa) and a minimum ultimate tensile strength, Fu, of 45,000 psi (310 MPa). The load transfer base plates of the LTT series and bearing plate BP5/8-2 are fabricated from ASTM A 1011 SS Grade 33 steel having a minimum yield strength of 33,000 psi (227 MPa) and a minimum ultimate strength of 52,000 psi (359 MPa). Base metal thicknesses for the tension ties in this report are as follows:

GAGE	BASE METAL THICKNESS (in.)
3/16 inch	0.1775
No. 3	0.2285
No. 11	0.1105
No. 12	0.0975
No. 16	0.0555
No. 18	0.0445

For SI: 1 inch = 25.4 mm

The hold-downs have a minimum G90 zinc coating specification per ASTM A653. Some models may also be available with either a G185 zinc coating (denoted by model numbers ending in the letter Z) or with a batch hot-dipped galvanized coating with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (600 g/m^2), total for both sides in accordance with ASTM A123 (denoted by model numbers ending with the letters HDG). Model numbers in this report do not list the Z or HDG ending, but the information shown applies.
The lumber treater or holder of this report (Simpson Strong-Tie Company) should be contacted for recommendations on minimum corrosion resistance of steel connectors in contact with the specific proprietary preservative treated or fire retardant treated lumber.

3.2.2 Wood: Wood members with which the hold-down 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), and having a maximum moisture content of 19 percent (16 percent for engineered lumber). The minimum thickness (depth) of the wood members in the direction of the fastener penetration is 3 inches and the required minimum width of the wood members is 3 ½ inches.

3.2.3 Fasteners:

3.2.3.1 Nails: Common nails used with connectors in this report must comply with ASTM F 1667 and have the following minimum fastener dimensions and bending yield strengths (F_{yb}):

FASTENER	SHANK DIAMETER (inches)	FASTENER LENGTH (inches)	*Fyb* (psi)
10d x 1½	0.148	1½	90,000
10d	0.148	3	90,000
16d × 2½	0.162	2 1/2	90,000
16d	0.162	3 ½	90,000

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

3.2.3.2 Bolts: Machine bolts must comply with ANSI/ASME Standard B18.2.1 and with ASTM A307. The minimum bending yield strength, (F_{yb}), of the bolt must be 45,000 psi (310 MPa).

3.2.3.3 Threaded Anchor Rods: As a minimum, threaded steel anchor rods must comply with ASTM A36 or ASTM F1554, Grade 36.

3.2.3.4 Preservative-treated and fire-retardant-treated wood: Fasteners used in contact with preservative-treated or fire-retardant-treated lumber must comply with IBC Section 2304.9.5 or IRC Section R319.3, as applicable. The lumber treater or report holder should be contacted for recommendations on minimum corrosion resistance and connection capacities of fasteners used with the specific proprietary preservative-treated or fire-retardant treated lumber.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 Hold-Down Assembly: The allowable loads shown in Table 1 of this report are for hold-down assemblies consisting of the following components: (1) hold-down device; (2) an anchor bolt/rod attached to the seat of the device; (3) a wood member, having minimum specified dimensions and properties; (4) quantity and size of fasteners used to attach the hold-down device to the wood member; and, in some cases as noted, (5) bearing plates or washers. The 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 (NDS) for Wood Construction.

Where design load combinations include earthquake loads or effects, story drifts of the structure must be determined in accordance with Section 12.8.6 of ASCE 7-05. The deflection of a shear wall restrained from overturning by hold-downs installed in accordance with this report may be calculated using Equation 23-2 shown in Section 2305.3.2 of the IBC, or Equation 4.3-1 shown in Section 4.3.2 of ANSI/AF&PA SDPWS-2005 (Special Design Provisions for Wind and Seismic). The total deflection values, Δ_{all} and Δ_s, at ASD-level and strength-level forces, respectively, for hold-down assemblies shown in Tables 1 of this report, include all sources of hold-down device extension and rotation, and anchor rod elongation where the length of the anchor rod is a maximum of 4 ½ inches (152 mm). The contribution of the hold-down anchor rod elongation to the total elongation (deflection) of the hold-down assembly needs to be considered when the actual diameter, length or ASTM steel specification of the anchor rod differs from that described in this report.

The symbol Δ_s as used in this report refers to the symbol d_a in section 2305.3.2 of the IBC and to the symbol Δ_a in Section 4.3.2 of ANSI/AF&PA SDPWS-2005.

When hold-downs are fastened to wood having a moisture content greater than 19 percent (16 percent for engineered lumber), or where wet service is expected, the allowable loads shown in Tables 1 of this report must be adjusted by the wet service factor, C_m, specified in the NDS.

Tabulated allowable loads are for hold-downs connected to wood used under continuously dry interior conditions, and where sustained temperatures are 100°F (37.8°C) or less.

When hold-down are fastened to wood that will experience sustained exposure to temperatures, exceeding 100°F (37.8°C), the allowable loads shown in Tables 1 in this report must be adjusted by the temperature factor, C_t, specified in the NDS.

The design of wood members fastened to LTT and HTT hold-down devices must consider combined stresses due to axial tension and flexural bending induced by eccentricity in the connection. Stresses shall be evaluated at the critical net section.

4.1.2 Anchorage to Concrete or Masonry: Adequate embedment length and anchorage details, including edge and end distances, must be determined by a registered design professional in accordance with Chapters 19 or 21 of the IBC, as applicable, for design of anchorage to concrete and masonry structural members.

Where design load combinations include earthquake loads or effects, the design strength of anchorage to concrete must be determined in accordance with Section 1912 of the IBC, except for detached one-and two-family dwellings assigned to Seismic Design Category A, B or C, or located where the mapped short-period spectral response acceleration, S_s, is less than 0.4g.

4.2 Installation: Installation of the Simpson Strong-Tie hold-down connectors must be 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, this report governs.

4.3 Special Inspection:

4.3.1 IBC: Periodic inspection is required for installation of nail hold-downs (tension ties)

described in this report that are designated as components of the seismic-force-resisting system for a structure in Seismic Design Category C, D, E, or F in accordance with Section 1707.3 or 1707.4, with the exception of those structures qualifying under Section 1704.1.

4.3.2 IRC: Special inspections are not required.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie nail hold-down connectors 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 hold-downs 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 statues 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 3.2.2 and 3.2.3 of this report.

5.5 Use of hold-down 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 3.2.3 of this report.

5.6 Anchorage to concrete or masonry structural members must be designed in accordance with Section 4.1.2 of this report.

6.0 EVIDENCE SUBMITTED

Data in accordance with ICC-ES Acceptance Criteria for Hold-Downs (Tie-Downs) Attached to Wood Members (AC155), inclusive of tests and calculations. Test results are from laboratories in compliance with ISO/IEC 17025.

7.0 IDENTIFICATION

The products 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 the index evaluation report (ER-102) which identifies products recognized in this report.

IAPMO ES ™

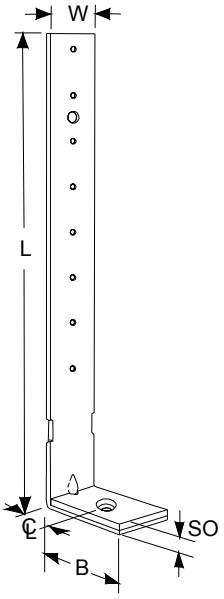
Director of Evaluation Services

TABLE 1: ALLOWABLE LOADS FOR THE LTT AND HTT NAIL HOLD-DOWNS (TENSION TIES)

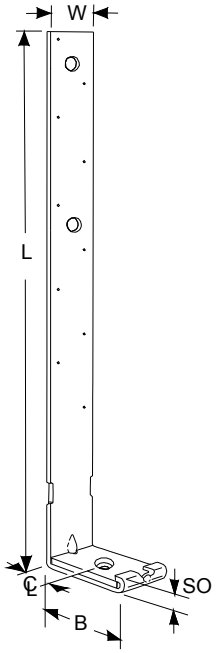
MODEL NO.	DIMENSIONS					FASTENERS		ALLOWABLE TENSION LOADS[5], P_{all} (lbs) C_D = 1.6	DISPLACEMENT Δ AT MAXIMUM LOAD [6,7] (in.)	
	W	L	CL	B	SO	ANCHOR BOLT	FASTENER QUANTITY		Δ_{all}	Δ_s
LTT19	1¾	19⅛	1⅜	2¾	5/16	½, ⅝ or ¾	8-10dx1½	1310	0.180	0.248
							8-10d	1340	0.157	0.233
LTT20B	2	19¾	1½	3⅛	5/16	½, ⅝ or ¾	10-10dx1½	1355	0.195	0.250
							10-10d	1500	0.185	0.250
							2-½" Bolt[9]	1625	0.183	0.250
LTTI31	3¾	31	1⅜	2¾	¼	⅝	18-10dx1½	1350	0.193	0.250
HTT4	2½	12⅜	1⅜	2	7/16	⅝	18-10dx1½	3610	0.086	0.135
							18-16dx2½	4235	0.123	0.201
HTT16	2½	16	1⅜	2	7/16	⅝	18-16dx2½	3955	0.124	0.209
HTT5	2½	16	1⅜	2	7/16	⅝	26-10dx1½	4350	0.120	0.209
							26-10d	4670	0.116	0.234
							26-16dx2½	5090[10]	0.135	0.250
HTT22	2½	22	1⅜	2	7/16	⅝	32-10d	4165[10]	0.152	0.250

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

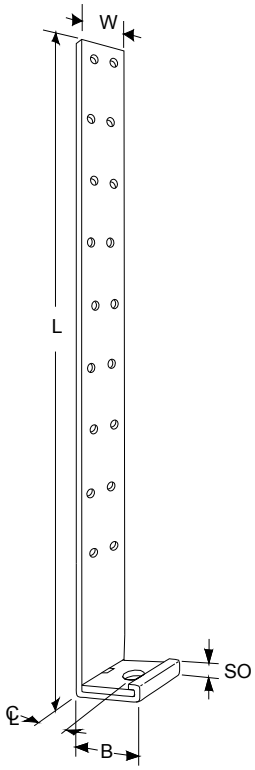
1. Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a minimum of a 3-inch thick wood structural member, or multiple members attached together to be 3-inches or greater in thickness, with the fasteners as specified in Table 1.
2. The allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D = 1.6, corresponding with wind/earthquake loading in accordance with the NDS. No further increase is allowed. Reduce where other load durations govern.
3. When using the basic load combinations in accordance with IBC Section 1605.3.1 the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternate basic load combinations in IBC Section 1605.3.2 that includes wind or earthquake loads, the tabulated allowable loads for the hold-down assembly must not be increased by 33⅓ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
4. Anchorage to concrete or masonry must be determined in accordance with Section 4.1.2 of this report.
5. The tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_s deformations.
6. Tabulated displacement values, Δ_{all} and Δ_s, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation, at ASD-level and strength level forces respectively.
7. Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report or actual unbraced length is greater than 4 ½ inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 4 ½" to 18" above the concrete, it is permitted to add an additional anchor rod elongation of 0.01 to the tabulated hold-down deflection.
8. If a ½" or ⅝" anchor bolt is used for the LTT19 or LTT20B, add a standard cut washer to the seat. No additional washer is required for a ¾" anchor bolt. See table for specified anchor bolt sizes.
9. Wood member bolts shall be in accordance with Section 3.2.3.2 of this report.
10. Allowable tension load for HTT5 and HTT22 with bearing washer BP5/8-2 is 5295 lbs. (Δ_{all} = 0.126, Δ_s = 0.179) and 4265 lbs. (Δ_{all} = 0.124, Δ_s = 0.166) respectively.
11. 16d common nails are permitted to substitute for 16d×2½" nails.



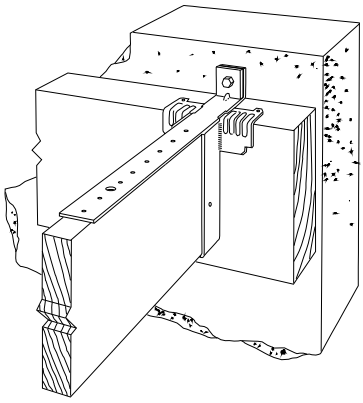
LTT19



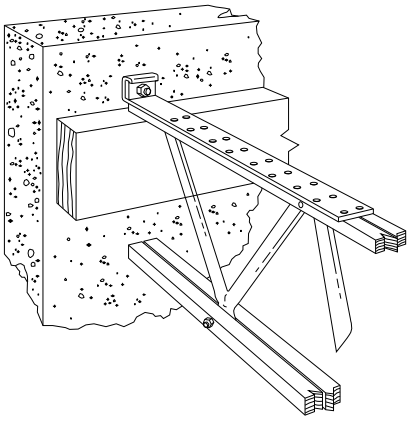
LTT20B



LTTI31

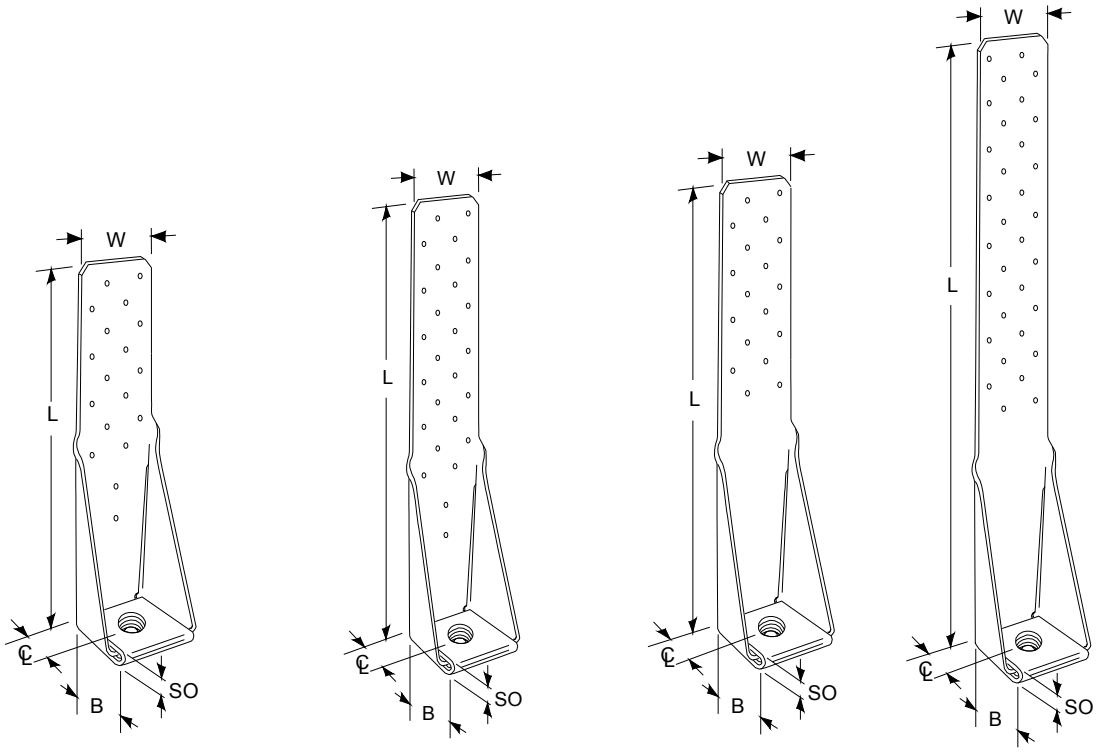


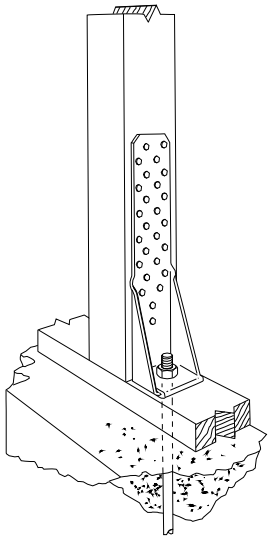
LTT19 Horizontal Installation
(LTT20B Similar)



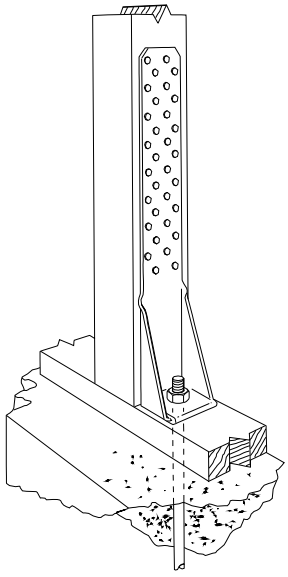
LTTI31 Horizontal Installation

Figure 1 – LTT Nail Hold-Downs





HTT5 Vertical Typical Installation
(HTT4 Similar)



HTT22 Vertical Typical Installation
(HTT16 Similar)

Figure 2 – HTT Nail Hold-Downs