

ICC-ES Evaluation Report

ESR-2555

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This report is subject to re-examination in two years.
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DIVISION: 06—WOOD AND PLASTICS
Section: 06090—Wood and Plastic Fastenings

REPORT HOLDER:

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EVALUATION SUBJECT:

**SIMPSON STRONG-TIE CAST-IN-PLACE FOUNDATION
 ANCHOR STRAPS**

1.0 EVALUATION SCOPE
Compliance with the following codes:

- 2009 *International Building Code*® (2009 IBC)
- 2009 *International Residential Code*® (2009 IRC)
- 2006 *International Building Code*® (2006 IBC)
- 2006 *International Residential Code*® (2006 IRC)

Property evaluated:

Structural

2.0 USES

The Simpson Strong-Tie MASA and MASAP foundation anchor straps described in this report are used to connect wood foundation plates (sole plates), having a 2-inch or 3-inch nominal thickness, to concrete foundations or foundation walls. The anchor straps are structural connectors cast-in-place into normal-weight concrete, and resist uplift and sliding forces that result from the application of code-prescribed loads for light-frame construction in accordance with the following IBC Sections (the referenced code sections are applicable to the 2009 and 2006 IBC, unless noted otherwise): IBC Sections 1604.8, 1805.6 (2006 IBC), 2303.5, 2305.3.11 (2006 IBC), 2308.3.3, 2308.6, 2308.11.3.1, 2308.12.8 (2009 IBC), and 2308.12.9 (2009 IBC). These foundation anchor straps may also be used under the IRC in accordance with 2006 and 2009 IRC Sections R301.1.3, R403.1.6, and R602.11.

3.0 DESCRIPTION
3.1 MASA and MASAP Foundation Anchor Straps:

The MASA and MASAP foundation anchor straps are manufactured from No. 16 gage [0.0555-inch base-metal thickness (1.4 mm)], cold-formed, galvanized sheet steel.

Each anchor strap has one end that embeds into a concrete foundation. This end of the anchor strap has two standoff legs that facilitate placement onto the concrete formwork in accordance with the installation instructions prior to placement of concrete. The other end of the foundation anchor straps extends above the concrete foundation or foundation wall and is field-bent over nominally 2-inch or 3-inch wood foundation plates (sole plates) and is nailed to the wood foundation plate, or nailed to both the wood foundation plate and an adjacent wood stud, as shown in Figure 3. The MASA anchor strap is die-formed into a shape that facilitates installation at the top of concrete forms as shown in Figure 1, and the MASAP anchor strap is die-formed into a shape that facilitates installation for panelized formwork as shown in Figure 2.

3.2 Materials:

3.2.1 Steel: The foundation anchor straps described in this report are manufactured from galvanized steel complying with ASTM A 653, SS designation, Grade 33, with minimum yield strength, F_y , of 33,000 psi (227 MPa), a minimum tensile strength, F_u , of 45,000 psi (310 MPa), and a tensile elongation greater than 14 percent. The foundation anchor straps have a minimum G90 zinc coating specification in accordance with ASTM A 653. The anchors are also available with a G185 zinc coating, denoted by model numbers ending with Z. Model numbers in this report do not list the Z ending, but the information shown applies. The lumber treater's recommendations or recommendations of Simpson Strong-Tie Company, Inc., on minimum corrosion resistance and connection capacities of connectors used with the specific proprietary preservative-treated or fire-retardant treated lumber must be followed.

3.2.2 Wood: Wood members with which the connectors are used must be either sawn dimensioned lumber or, when approved by the code official, engineered lumber. The maximum moisture content is 19 percent for sawn dimensional lumber and 16 percent for engineered lumber except as noted in Section 4.1 of this report, and the minimum specified specific gravity is 0.50, such as for Douglas fir–larch. Nominally 2-inch- and 3-inch-thick wood foundation plates (sole plates) must comply with Sections 2304.3.1, 2304.11.2.2, and 2305.3.11 of the 2006 IBC; or Sections 2304.3.1 and 2304.11.2.2 of the 2009 IBC; or Sections R404.3 and R602.3.4 of the 2006 and 2009 IRC.

3.2.3 Fasteners: Nails must comply with ASTM F 1667, as referenced in Section 2303.6 of the IBC. The following table provides the minimum dimensions and bending yield strength (F_{yb}) for the fastener used with foundation anchor straps described in this report:

NAIL TYPE	SHANK DIAMETER (in.)	LENGTH (in.)	F_{yb} (psi)
10d \times 1 $\frac{1}{2}$ common	0.148	1 $\frac{1}{2}$	90,000

For SI: 1 in. = 25.4 mm, 1 psi = 6.89 kPa.

Fasteners used in contact with preservative-treated or fire-retardant-treated lumber must comply with 2006 and 2009 IBC Section 2304.9.5; or 2006 IRC Section R319.3; or 2009 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.

3.2.4 Concrete: Concrete must be normal-weight concrete complying with the provisions of 2006 and 2009 IBC Chapter 19 or 2006 and 2009 IRC Section R402.2, as applicable, and must have a minimum specified concrete compressive strength, f'_c , of 2,500 psi (17.2 MPa) at 28 days, or as required by the applicable code.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 Anchorage to Concrete Strength: Table 1 specifies allowable (ASD) lateral and uplift load values for the portion of the MASA and MASAP foundation anchor straps cast into normal-weight concrete foundations or foundation walls, under the table column identified as "Allowable Loads Based on Anchorage to Concrete Strength."

The allowable loads of MASA and MASAP foundation anchor straps based on anchorage to concrete strength are dependent on the type of loading (wind or seismic). When the governing load combination includes seismic loads, the allowable (ASD) seismic load values shown in Table 1 must be converted to design (LRFD) load values for compliance with 2006 and 2009 IBC Section 1912. Footnote 8 of Table 1 describes a procedure for converting the tabulated allowable (ASD) seismic loads to design (LRFD) load values. Additionally, allowable seismic loads based on anchorage to concrete strength are influenced by the condition of the concrete (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 first exception to 2006 and 2009 IBC Section 1613.1 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, the allowable wind loads assigned to the anchor straps based on anchorage to concrete strength in Table 1 are used.

4.1.2 Wood Connection Strength: Table 1 specifies allowable (ASD) lateral and uplift load values for the portion of the MASA and MASAP foundation anchor straps fastened to the wood foundation plate or fastened to both the wood foundation plate and adjacent wood stud, under the table column identified as "Allowable Loads Based on Wood Connection Strength, $C_D = 1.6$."

Tabulated allowable loads based on connection strength are applicable for the foundation anchor straps connected to wood used under dry conditions and where sustained

temperatures are 100°F (37.8°C) or less. When foundation anchor straps are nailed to sawn lumber having a moisture content greater than 19 percent (16 percent for engineered wood products), or where wet service is expected, the allowable loads based on wood connection strength must be adjusted by the wet service factor, C_M , specified in the NDS. When foundation anchor straps are nailed to wood that will experience sustained exposure to temperatures exceeding 100°F (37.8°C), the allowable loads based on wood connection strength shown in Table 1 must be adjusted by the temperature factor, C_t , specified in the NDS.

4.1.3 Serviceability: Footnotes to Table 1 specify the maximum deflection associated with the allowable lateral and uplift loads resisted by the installed MASA and MASAP foundation anchor straps. This serviceability limit is applicable to both ASD and LRFD.

4.2 Installation:

The foundation anchor straps 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, this report governs. For buildings regulated under the IRC and conventional light-frame construction regulated under IBC Section 2308, the MASA and MASAP foundation anchor straps may be used to attach wood foundation plates (sole/sill plates) to concrete foundations or foundation walls, provided a satisfactory design is submitted to the code official showing that the specified spacing of the anchor straps provides equivalent anchorage as described in IRC Section R403.1.6 or Section R602.11.1, as applicable, or IBC Section 2308.6.

4.3 Special Inspection:

4.3.1 IBC: For installations complying with the 2006 and 2009 IBC, periodic special inspection must be provided for foundation anchor straps that are considered components within the seismic-force-resisting system in Seismic Design Categories C, D, E and F in accordance with IBC Section 1707.3, except for structures that qualify under Section 1704.1.

4.3.2 IRC: For jurisdictions adopting the IRC, special inspection is not required.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie foundation anchor straps 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:

- 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.
- 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.
- 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 with, respectively Sections 3.2.2 and 3.2.3 of this report.
- 5.5 Use of connectors with preservative- or fire-retardant-treated lumber shall be in accordance with Section 3.2.1 of this report. Use of fasteners with preservative- or fire-retardant-treated lumber shall be in accordance with Section 3.2.3 of this report.

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 October 2008.

7.0 IDENTIFICATION

The Simpson Strong-Tie foundation anchor straps 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 STRENGTH DESIGN (ASD) LOADS FOR MASA AND MASAP FOUNDATION ANCHOR STRAPS

MASA/MASAP ANCHOR INSTALLATION ^{1,2,3}						LOAD DIRECTION ⁴ (See Fig. 3)	ALLOWABLE LOADS ⁵				
Application (See Fig. 3)	Wood Plate Nominal Size	Quantity of 10d×1 ¹ / ₂ Nails into:			Minimum Concrete Stem-wall Thickness (in.)		Based on Anchorage to Concrete Strength ^{6,7}				Based on Wood Connection Strength ¹¹ C _D = 1.6
		Wood Plate		Wood Stud			Seismic ⁸ (lbs.)			Wind (lbs.)	
		Side	Top				Concrete Condition ⁹	Seismic Design Categories			
						A, B ⁽¹⁰⁾		C ⁽¹⁰⁾ , D, E, F			
Both Legs Bent over Foundation Plate	2×4 or 2×6	3	6	—	6	F1	Uncracked	1,535	1,235	1,535	1,515 ⁽¹²⁾
							Cracked	1,535	1,235		
						F2	Uncracked	1,245	1,045	1,245	1,095 ⁽¹³⁾
	Cracked	910	765								
	Uplift	Uncracked	1,045	745	1,045	920 ⁽¹²⁾					
		Cracked	785	660							
One Leg Bent over Foundation Plate and One Leg Vertical Directly Against Stud	3×4 or 3×6	5	4	—	6	F1	Uncracked	1,215	1,020	1,215	1,395 ⁽¹²⁾
							Cracked	1,215	1,020		
						F2	Uncracked	1,045	870	1,045	725 ⁽¹³⁾
	Cracked	760	640								
	Uplift	Uncracked	650	550	650	855 ⁽¹²⁾					
		Cracked	495	415							
One Leg Bent over Foundation Plate and One Leg Vertical Directly Against Stud	2×4 or 2×6	3	3	3	6	F1	Uncracked	1,005	845	1,005	1,070 ⁽¹²⁾
							Cracked	1,005	845		
						F2	Uncracked	1,320	1,110	1,320	995 ⁽¹³⁾
	Cracked	965	810								
	Uplift	Uncracked	785	660	785	935 ⁽¹²⁾					
		Cracked	595	500							

For **SI**: 1 in. = 25.4 mm, 1 lbs. = 4.45 N, 1 psi. = 6.895 kPa, 1 plf. = 14.59 N/m.

¹Refer to Figure 3 for illustrations of anchor straps installed to wood plates and wood plate/stud. Allowable loads are applicable to anchors nailed directly to the wood plate, stud, or both having a S.G. ≥ 0.50 (S.G. = Specific Gravity; refer to Table 11.3.2A of the NDS-2005).

²According to Section 2305.3.11 of the IBC, when the seismic design shear load (F1) in SDC D, E, or F exceeds 350 plf, a 3-inch nominal wood foundation plate must be used. When the seismic design shear load (F1) in SDC D, E, or F is greater than 350 plf but less than 600 plf (using ASD), the wood foundation plate may be a 2-inch nominal member provided the sill plate is anchored by 2 times the number of MASA or MASAP anchor straps required by design.

³Nails must comply with Section 3.2.3 of this report.

⁴Load direction F1 is parallel to the foundation plate wood member, and load direction F2 is perpendicular to the foundation plate wood member.

⁵The lesser of the allowable load based on anchorage to concrete strength or wood connection strength must be selected. For simultaneous loads in more than one direction, the connector must be evaluated using the straight line interaction equation.

⁶Minimum specified concrete compressive strength, *f_c* is 2,500 psi.

⁷For full allowable loads based on anchorage to concrete strength, the minimum anchor end distance is 4 inches and the minimum anchor spacing is 8 inches.

⁸For compliance with Section 1912 of the IBC, the allowable (ASD) seismic loads based on anchorage to concrete strength must be converted to design (LRFD) load values by multiplying the tabulated ASD load values by 1.4, which is the load factor assigned to service-level seismic forces. The tabulated allowable (ASD) seismic loads are adjusted nominal strength values and include a strength reduction factor: Φ = 0.65 for F1 and F2 lateral loads, and Φ = 0.70 for uplift loads. Consequently, when using the load combinations of IBC Section 1605.2.1, it is not necessary to apply a strength reduction factor, Φ, because it is already incorporated into the derived design (LRFD) load values.

⁹The allowable anchorage-to-concrete load values based on uncracked concrete are for use where analysis indicates no concrete cracking at service (unfactored) load levels.

¹⁰According to the first exception to Section 1613.1 of the IBC, detached one- and two-family dwellings assigned to Seismic Design Category (SDC) A, B, or C are exempt from the seismic design provisions of IBC Section 1613. When this is the case, the allowable wind loads assigned to the anchor straps based on anchorage to concrete strength should be used.

¹¹The allowable loads for anchors fastened to wood members are based on allowable stress design (ASD) and include the load duration factor (C_D) corresponding with wind and earthquake loading in accordance with the NDS (C_D = 1.6). No further increase is allowed.

¹²Deflection at allowable load based on wood connection strength is less than or equal to 1/16 inch.

¹³Deflection at allowable load based on wood connection strength is less than or equal to 1/8 inch.

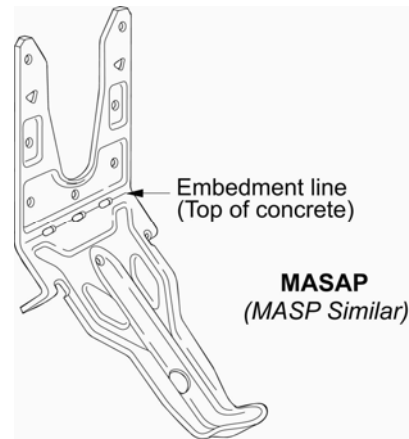
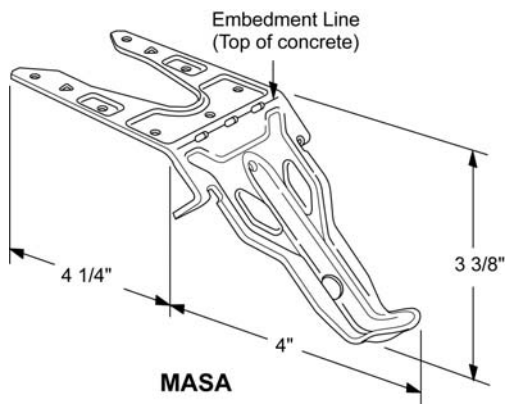
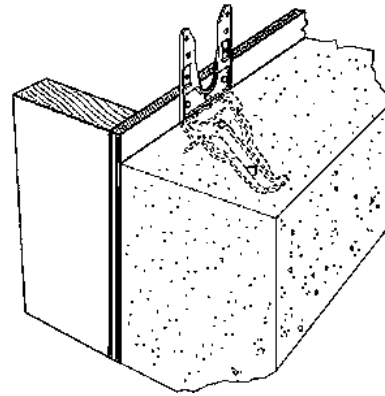
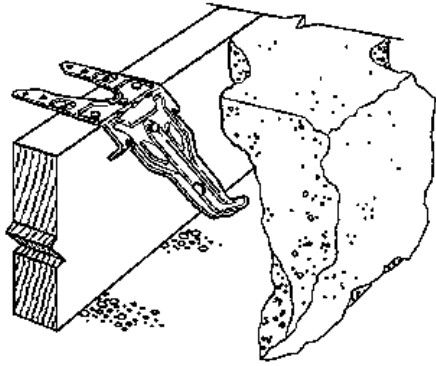


FIGURE 1—MASA FOUNDATION ANCHOR STRAP

FIGURE 2—MASAP FOUNDATION ANCHOR STRAP

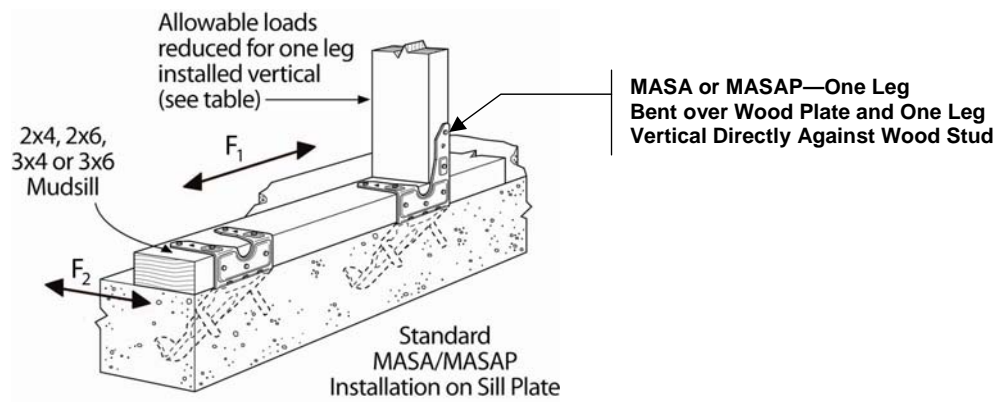


FIGURE 3—TYPICAL INSTALLATION OF MASA AND MASAP FOUNDATION ANCHOR STRAPS ON SILL PLATE