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ESR-1056

Reissued 03/2017
This report is subject to renewal 03/2018.

DIVISION: 04 00 00—MASONRY
SECTION: 04 05 19.16—MASONRY ANCHORS

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY INC.

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

EVALUATION SUBJECT:

SIMPSON STRONG-TIE TITEN HD® SCREW ANCHORS



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REPORT HOLDER:

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EVALUATION SUBJECT:

SIMPSON STRONG-TIE TITEN HD® SCREW ANCHORS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012, 2009 and 2006 *International Building Code*® (IBC)
- 2015, 2012, 2009 and 2006 *International Residential Code*® (IRC)

Property evaluated:

Structural

2.0 USES

The Titen HD® screw anchor is for installation in predrilled holes in fully grouted concrete masonry wall construction.

The Titen HD screw anchors are alternatives to cast-in-place anchors described in Section 8.1.3 (2013 edition), or Section 2.1.4 (2011, 2008 or 2005 edition) of TMS 402/ACI 530/ASCE 5 as referenced in Section 2107.1 of the IBC.

The anchors are permitted to be used in structures regulated by the IRC, provided an engineered design is submitted in accordance with IRC Section [R301.1.3](#).

3.0 DESCRIPTION

3.1 Materials:

3.1.1 Titen HD Screw Anchor: The Titen HD screw anchor is a carbon steel threaded anchor with a hex-washer head. The screw anchor is manufactured from heat-treated steel complying with [SAE J403](#) Grade 10B21, and has either an electrodeposited coating of zinc in accordance with [ASTM B633](#), Service Condition SC1, Type III; or a mechanically deposited coating of zinc in accordance with [ASTM B695](#), Class 55, Type I.

Titen HD screw anchors are available with nominally $\frac{3}{8}$ -, $\frac{1}{2}$ -, $\frac{5}{8}$ -, and $\frac{3}{4}$ -inch (9.5, 12.7, 15.9 and 19.1 mm) shank diameters, and with various lengths for multiple embedments as noted in the tables in this report. Refer to [Figure 1](#) for an illustration of a typical screw anchor.

3.1.2 Grout-filled Concrete Masonry: The specified compressive strength of masonry, f'_m , at 28 days must be a minimum of 1,500 psi (10.3 MPa). Fully grouted masonry walls must be constructed from the following materials:

3.1.2.1 Concrete Masonry Units (CMUs): CMUs must be minimum Grade N, Type II, lightweight, medium-weight, or normal-weight, closed-end, conforming to [ASTM C90](#). The minimum allowable nominal size of the CMU must be 8 inches wide by 8 inches high by 16 inches long.

3.1.2.2 Grout: Grout must comply with IBC Section 2103.3 (2015 IBC), 2013.13 (2012 IBC), Section [2103.12](#) (2009 and 2006 IBC) or IRC Section R606 (2015 IBC), [R609.1.1 \(2012, 2009, 2006\)](#), as applicable. Alternatively, the grout must have a minimum compressive strength when tested in accordance with [ASTM C1019](#) equal to its specified strength, but not less than 2,000 psi (13.8 MPa).

3.1.2.3 Mortar: Mortar must be Type M or S in compliance with IBC Section 2103 or IRC Section R606.2.11 (2015), [R607.1 \(2012, 2009 and 2006\)](#), as applicable.

3.2 Design:

3.2.1 General: Anchors described in this report are assigned allowable tension and shear loads for designs based on allowable stress design (working stress design). Use of the anchors to resist vibratory and moving loads, such as those produced by reciprocating engines, cranes and vehicles, is beyond the scope of this report.

3.2.2 Design of Anchors Installed in Fully Grouted CMU Masonry: Allowable tension and shear loads for anchors installed in the face of fully grouted uncracked CMU masonry are noted in [Table 1](#) for structures complying with the IBC or IRC. The allowable tension and shear loads are for anchors installed in the grouted cells, the center web of CMU units, and horizontal mortared bed joints of fully grouted CMU masonry construction. Allowable loads for anchors installed in the vertical head joint or the end flanges of the CMU units are outside the scope of this report. Edge and end distances, and spacing

requirements for anchors installed in the face of fully grouted CMU masonry, as shown in [Figure 2](#), are noted in [Table 1](#). Allowable load reduction factors for anchors installed at reduced edge distances, and reduced spacing, are noted in [Tables 2](#) and [3](#).

Allowable tension and shear loads for $1/2$ -inch and $5/8$ -inch (12.7 mm and 15.9 mm) anchors installed in the top of fully grouted concrete masonry (CMU grouted cores and CMU webs), are noted in [Table 4](#) for anchors installed in structures complying with the IBC or IRC.

Allowable loads for anchors installed in the face of fully grouted CMU masonry walls subjected to combined shear and tension forces must be determined by the following equation:

$$\left(\frac{P_s}{P_t}\right) + \left(\frac{V_s}{V_t}\right) \leq 1.0$$

where:

- P_s = Applied service tension load.
- P_t = Allowable service tension load.
- V_s = Applied service shear load.
- V_t = Allowable service shear load.

4.0 INSTALLATION

Titen HD screw anchors must be installed by drilling a pilot hole into the substrate using a handheld electro-pneumatic rotary hammer drill with a carbide-tipped drill bit conforming to [ANSI B212.15-1994](#). The pilot hole must have the same diameter as the nominal diameter of the anchor. The hole is drilled to the specified embedment depth plus $1/2$ inch (12.7 mm). Dust and debris in the hole must be removed by using oil-free compressed air. The Titen HD screw anchor must be installed into the hole to the required embedment using a socket wrench or powered impact wrench.

4.1 Installation in Fully Grouted CMU Masonry: Anchors installed in the face of fully grouted CMU construction must be limited to the face shell of the CMU unit (center web and grouted cores) and the horizontal mortared bed joints, as indicated by the shaded areas in [Figure 2](#). Anchors installed in a T-joint, the mortared head joint, or the end webs of a CMU unit, as indicated in the non-shaded areas in [Figure 2](#), are outside the scope of this report.

For anchors installed in the top of fully grouted concrete masonry (CMU grouted cores and CMU webs), anchor location must comply with the minimum edge and end distances noted in [Table 4](#) and shown in [Figure 3](#). Anchors installed in the mortared head joint are outside the scope of this report.

4.2 Installation with Special Inspection (When Required):

Anchors must be installed with special inspection. For the IBC and IRC, special inspection must conform to Sections [1704](#) and [1705](#) of the IBC

For fasteners installed with special inspection, the following items, as applicable, must be inspected: fastener type and dimensions; masonry unit type and compliance with ASMT C90; grout and mortar compressive strengths, and (when required) masonry prism compressive strength; drill bit size and compliance with ANSI B212.15-1994; and fastener embedment, spacing, and edge (and end) distances. The special inspector must inspect and verify that anchor installation complies with this evaluation report

and Simpson Strong-Tie Company's published installation instructions.

5.0 CONDITIONS OF USE

The Titen HD Screw Anchors described in this report comply with, or are suitable alternatives to what is specified in, the codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1** Anchors are identified and installed in accordance with this report and the manufacturer's published installation instructions.
- 5.2** Anchors installed in the face or the top of fully grouted CMU masonry to resist dead, live, wind, and earthquake load applications must be in accordance with Sections 3.2.1 and 3.2.2.
- 5.3 Grouted Masonry under IBC or IRC:** The anchors described in the evaluation report are capable of resisting seismic and wind loads. When using the basic load combinations in accordance with IBC Section [1605.3.1](#), allowable loads are not permitted to be increased for seismic or wind loading. When using the alternative basic load combinations in IBC Section [1605.3.2](#) that include seismic or wind loads, the allowable shear and tension loads for anchors are permitted to be increased by $33\frac{1}{3}$ percent, or the alternative basic load combinations may be multiplied by a factor of 0.75. The allowable stress increase or load reduction is not permitted under 2015 and 2012 codes.
- 5.4 Fatigue and Shock Loading:** Since an ICC-ES acceptance criteria is evaluating data to determine the performance of screw anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under these conditions is beyond the scope of this report.
- 5.5 Fire-resistive Construction:** Where not otherwise prohibited by the applicable code, anchors are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled.
 - Anchors are used to resist wind or seismic forces only.
 - Anchors that support fire-resistance-rated construction or gravity load-bearing structural elements are within a fire-resistance-rated envelope or a fire-resistance-rated membrane, are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
 - Anchors are used to support nonstructural elements.
- 5.6 Cracked Masonry:** Since an ICC-ES acceptance criteria for evaluating the performance of screw anchors in cracked masonry is unavailable at this time, the use of anchors is limited to installation in uncracked masonry. Cracking occurs when $f_t > f_r$ due to service loads or deformations.
- 5.7** Anchors are installed in substrates in holes predrilled with carbide-tipped masonry drill bits complying with ANSI B212.15-1994, and having the same diameter as the nominal diameter of the anchor.
- 5.8** Calculations demonstrating that the applied loads are less than the allowable loads described in this report,

must be submitted to the building 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.

- 5.9 Special inspection, when required, must be provided in accordance with Section 4.2.
- 5.10 Anchors are limited to dry, interior use.
- 5.11 The Titen HD screw anchors are manufactured by Simpson Strong-Tie Company under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry (AC106), dated November 2015, including the following optional tests:

- 6.1 Anchors installed in the face of fully grouted CMU masonry wall construction: Effects of edge distance

on tension and shear performance (Test Series 4, 5, 13, and 14 of AC106), and seismic performance tests (Section 4.6 of AC106).

- 6.2 Anchors installed in the top of fully grouted CMU masonry wall construction with a minimum 1³/₄-inch (44 mm) edge distance: Effects on tension and shear performance (Test Series 4 and 13 of AC106), and seismic performance tests (Section 4.6 of AC106).

7.0 IDENTIFICATION

Titen HD screw anchor packaging is marked with the Simpson Strong-Tie Company name; product name (Titen HD); anchor diameter and length; and the evaluation report number (ESR-1056). In addition, the ≠ symbol and anchor length (in inches) is stamped on the head of each screw anchor.



FIGURE 1—TYPICAL HD SCREW ANCHOR

TABLE 1—IBC AND IRC ALLOWABLE TENSION AND SHEAR LOADS FOR TITEN HD SCREW ANCHORS INSTALLED IN THE FACE OF FULLY GROUTED CMU MASONRY CONSTRUCTION¹

ANCHOR DIA. ² (in.)	DRILL BIT DIA. (in.)	MIN. EMBED. ³ (in.)	ANCHOR LOCATION ⁴ (in.)				ALLOWABLE LOADS BASED ON ANCHORS INSTALLED AT DISTANCES ≥ CRITICAL EDGE DISTANCE, <i>c_{crit}</i> AND SPACING, <i>s_{crit}</i> ^{5,6} (lbf)	
			Edge Distance		Spacing		Tension	Shear
			Critical, <i>c_{crit}</i>	Minimum, <i>c_{min}</i>	Critical, <i>s_{crit}</i>	Minimum, <i>s_{min}</i>		
3/8	3/8	2 ³ / ₄	12	4	6	3	480	870
1/2	1/2	3 ¹ / ₂	12	4	8	4	690	1,385
5/8	5/8	4 ¹ / ₂	12	4	10	5	1,060	2,085
3/4	3/4	5 ¹ / ₂	12	4	12	6	1,600	3,000

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.48 N.

¹Anchors must be installed a minimum of 1¹/₄ inches from vertical head joints and T-joints. Refer to Figure 2 for permitted and prohibited anchor installation locations.

²The drill bit diameter must be equal to the nominal diameter of the anchor. Anchor installation –must comply with Section 4.0 of this report.

³Embedment depth is measured from the outside face of the masonry.

⁴Critical and minimum edge distances, *c_{crit}* and *c_{min}*, respectively, must comply with this table. Refer to Figure 2. Critical and minimum spacing, *s_{crit}* and *s_{min}*, respectively, must comply with this table. Critical and minimum edge and spacing distances are valid for anchors resisting tension or shear loads. Refer to Table 2 for allowable tension and shear load reduction factors for anchors installed between critical and minimum edge distances, and to Table 3 for anchors installed between critical and minimum spacing.

⁵Tabulated allowable loads are based on a safety factor of 5.0

⁶For wind or earthquake loading conditions under 2009 and 2006 codes, allowable loads may be adjusted in accordance with Section 5.3.

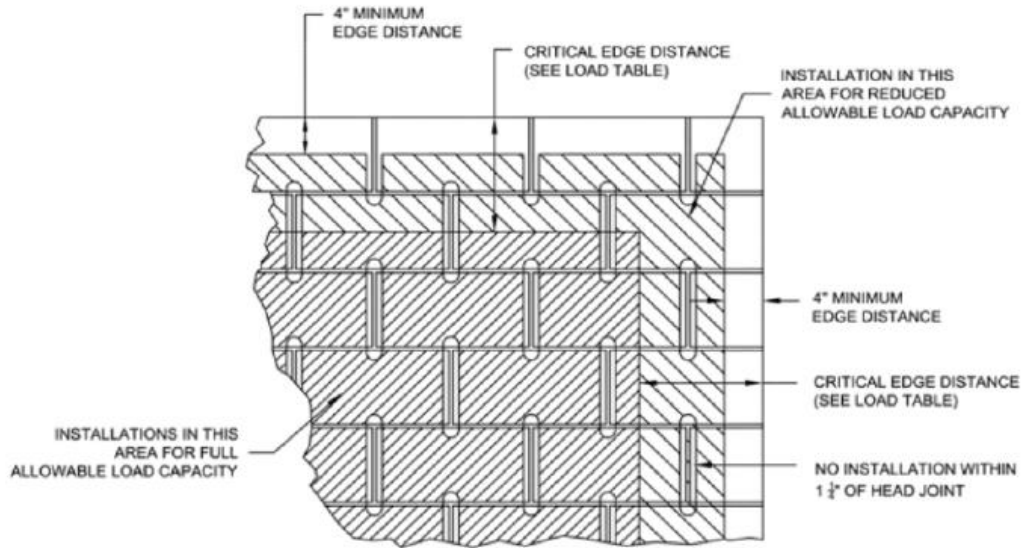


FIGURE 2—TITEN HD SCREW ANCHOR INSTALLED IN THE FACE OF GROUT-FILLED CMU (CONCRETE MANSORY UNIT) WALL CONSTRUCTION (Refer to Table 1, 2, and 3)

TABLE 2—LOAD REDUCTION FACTORS FOR TITEN HD SCREW ANCHORS INSTALLED BETWEEN CRITICAL AND MINIMUM EDGE DISTANCES (Anchors Installed in the Face of Grout-filled CMU Masonry)^{1,2,3}

ANCHOR DIAMETER (in)	MINIMUM EMBEDMENT DEPTH (in)	LOAD REDUCTION FACTORS FOR ANCHORS INSTALLED AT:				
		Critical Edge Distance, c_{crit}	Tension or Shear Load	Minimum Edge Distance, c_{min}		
				Tension Load	Shear Load Acting:	
					Towards an Edge	Away from an Edge
$\frac{3}{8}$	$2\frac{3}{4}$	1.0	1.0	0.58	0.89	0.77
$\frac{1}{2}$	$3\frac{1}{2}$	1.0	1.0	0.38	0.79	0.48
$\frac{5}{8}$	$4\frac{1}{2}$	1.0	0.83	0.30	0.58	0.46
$\frac{3}{4}$	$5\frac{1}{2}$	1.0	0.66	0.21	0.38	0.44

For SI: 1 inch = 25.4 mm.

¹The load reduction factors in this table are applicable to the allowable loads shown in Table 1.

²Reduction factors are cumulative. Multiple reduction factors for more than one spacing or edge distance are calculated separately and multiplied.

³Load reduction factors for anchors loaded in tension or shear with edge distances between critical and minimum are obtained by linear interpolation.

TABLE 3—LOAD REDUCTION FACTORS FOR TITEN HD SCREW ANCHORS INSTALLED BETWEEN CRITICAL AND MINIMUM SPACING (Anchors Installed in the Face of Grout-filled CMU Masonry)^{1,2,3}

ANCHOR DIAMETER (in)	MINIMUM EMBEDMENT DEPTH (in)	LOAD REDUCTION FACTORS FOR ANCHORS INSTALLED AT:		
		Critical Spacing, s_{crit}	Minimum Spacing, s_{min}	
			Tension or Shear Load	Tension Load
$\frac{3}{8}$	$2\frac{3}{4}$	1.0	0.87	0.62
$\frac{1}{2}$	$3\frac{1}{2}$	1.0	0.69	0.62
$\frac{5}{8}$	$4\frac{1}{2}$	1.0	0.59	0.62
$\frac{3}{4}$	$5\frac{1}{2}$	1.0	0.50	0.62

For SI: 1 inch = 25.4 mm.

¹The load reduction factors in this table are applicable to the allowable loads shown in Table 1.

²Reduction factors are cumulative. Multiple reduction factors for more than one spacing or edge distance are calculated separately and multiplied.

³Load reduction factors for anchors loaded in tension or shear with spacing between critical and minimum are obtained by linear interpolation.

TABLE 4—IBC AND IRC ALLOWABLE TENSION AND SHEAR LOADS FOR TITEN HD SCREW ANCHORS INSTALLED IN TOP OF GROUT-FILLED CMU MASONRY¹

ANCHOR DIA. (in)	DRILL BIT DIA. (in)	MINIMUM EMBEDMENT DEPTH (in)	ANCHOR LOCATION ² (in)			IBC AND IRC ALLOWABLE LOADS ^{3,4} (lbf)		
			Minimum Edge Distance	Minimum End Distance	Minimum Spacing	Tension	Shear	
							Parallel to Edge of Masonry Wall	Perpendicular to Edge of Masonry Wall
1/2	1/2	4 1/2	1 3/4	8	8	570	585	160
5/8	5/8	4 1/2	1 3/4	10	10	570	675	160

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

¹The allowable tension and shear loads in Table 4 are applicable when anchors are installed in structures regulated by the IRC or IBC.

²Minimum edge and end distances are measured from the anchor centerline to the edge and end of the CMU masonry wall, respectively. Refer to Figure 3 Minimum spacing is measured from center-to-center of two anchors. Anchors installed in the mortared head joint are outside the scope of this report.

³The allowable loads in Table 4 are for anchors resisting dead, live, wind, and earthquake load applications. For short-term loading due to wind and earthquake forces under 2006 and 2009 codes, the allowable loads may be adjusted in accordance with Section 5.3.

⁴Allowable tension and shear loads are based on a safety factor of 5.0.

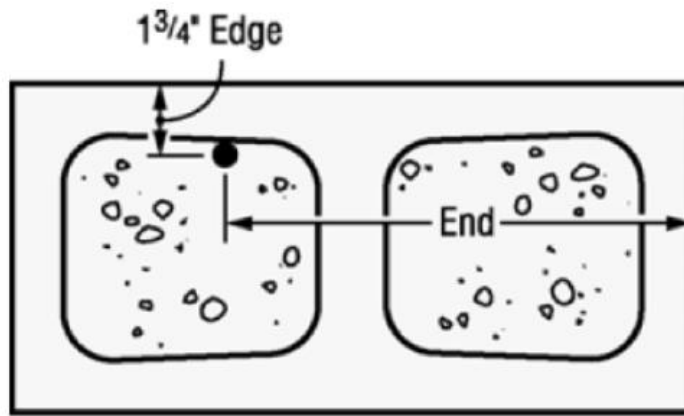


FIGURE 3—EDGE AND END DISTANCES FOR THE TITEN HD ANCHOR INSTALLED IN THE TOP OF CMU MANSORY WALL CONSTRUCTION