



EVALUATION SUBJECT: STRONG-BOLT® 2 WEDGE ANCHORS IN MASONRY

REPORT HOLDER:
Simpson Strong-Tie Company Inc.
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CSI Division: 04 00 00—MASONRY
CSI Section: 04 05 19.16 —Masonry Anchors

1.0 SCOPE OF EVALUATION

1.1 Compliance to the following codes & regulations:

- 2015 International Building Code® (2015 IBC)
- 2015 International Residential Code® (2015 IRC)
- 2012 International Building Code® (2012 IBC)
- 2012 International Residential Code® (2012 IRC)
- 2009 International Building Code® (2009 IBC)
- 2009 International Residential Code® (2009 IRC)
- 2006 International Building Code® (2006 IBC)
- 2006 International Residential Code® (2006 IRC)
- 2003 International Building Code® (2003 IBC)
- 2003 International Residential Code® (2003 IRC)

1.2 Evaluated in accordance with:

- ICC-ES AC01, approved November 2015

1.3 Properties assessed:

- Structural

2.0 PRODUCT USE

Simpson Strong-Tie® Strong-Bolt® 2 Wedge Anchors are expansion anchors used to resist static, wind and seismic tension and shear loads in fully grouted uncracked, concrete-masonry unit (CMU) construction.

Strong-Bolt 2 wedge anchors are alternatives to cast-in-place anchors described in Section 2107 of the IBC and Chapters 6 and 8 of 2013 [TMS 402/ACI 530/ASCE 5](#) and Chapters 1 and 2 of 2011, 2008, 2005 and 2002 [TMS 402/ACI 530/ASCE 5](#), as applicable. 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 PRODUCT DESCRIPTION

3.1 Strong-Bolt 2

3.1.1 General: Strong-Bolt 2 wedge anchors are torque-controlled, mechanical expansion anchors consisting of an anchor body, expansion clip, nut, and washer. A typical anchor is shown in [Figure 1](#) of this report. The anchor body has a tapered mandrel formed on the installed end of the anchor and a threaded section at the opposite end. The taper of the mandrel increases in diameter toward the installed end of the anchor. The three-segment expansion clip wraps around the tapered mandrel. Before installation, this expansion clip is free to rotate about the mandrel. The anchor is installed in a predrilled hole. When the anchor is set by applying torque to the hex nut, the mandrel is drawn into the expansion clip, which engages the drilled hole and transfers the load to the base material.

3.1.2 Strong-Bolt 2, Carbon Steel: Anchor bodies are manufactured from carbon steel material with zinc plating conforming to [ASTM B633](#), Service Condition SC1 (Fe/Zn 5), Type III. Expansion clips are fabricated from carbon steel and conform to [ASTM A568](#). Hex nuts conform to [ASTM A563](#), Grade A. Washers conform to [ASTM F844](#). Anchor diameters recognized in this report are ¼ inch, ⅜ inch, ½ inch, ⅝ inch and ¾ inch (6.4 mm, 9.5 mm, 12.7 mm, 15.9 mm and 19.1 mm).

3.2 Materials

3.2.1 Grout-filled Concrete Masonry: When prism tests are required, the compressive strength of masonry, f_m , at 28 days shall be a minimum of 1,500 psi (10.3 MPa). Concrete masonry shall be fully grouted and constructed from the following materials:

3.2.1.1 Concrete Masonry Units (CMUs): CMUs shall be lightweight, medium-weight, or normal-weight conforming to [ASTM C90](#). Minimum allowable nominal size of the CMU shall be 8 inches (203 mm) wide by 8 inches (203 mm) high by 16 inches (406 mm) long (i.e., 8×8×16).

3.2.1.2 Grout: Grout shall comply with IBC Section 2103 or IRC Section R606 (2015 IRC) or R609 (2012, 2009, 2006 and 2003 IRC), as applicable. Alternatively, the grout shall have a minimum compressive strength when tested in accordance with [ASTM C1019](#) equal to its specified strength, f'_g , but not less than 2,000 psi (13.8 MPa).





3.2.1.3 Mortar: Mortar shall be minimum Type N in compliance with IBC Section 2103 or IRC Section R606 (2015 IRC) or R607 (2012, 2009, 2006 and 2003 IRC), as applicable.

4.0 DESIGN AND INSTALLATION

4.1 Design

4.1.1 General: Strong-Bolt® 2 wedge anchor capacities in this report are allowable load values for use in allowable stress design as set forth in Section 2107 of the IBC. For use under the IRC, an engineered design in accordance with IRC Section R301.1.3 shall be submitted to the building official.

4.1.2 Design of Strong-Bolt 2 Wedge Anchors Installed in Fully Grouted Concrete Masonry: For installations in fully grouted uncracked concrete masonry, Strong-Bolt 2 wedge anchors are recognized to resist dead, live, wind, and earthquake loads.

Allowable tension and shear capacity values, embedment depths, critical and minimum edge and end distances, and critical and minimum spacing requirements for anchors installed in fully-grouted concrete masonry unit construction are noted in [Table 2](#) of this report. Allowable load reduction factors for anchors installed at distances less than critical edge distance or critical spacing are noted in [Table 3](#) of this report. Allowable loads for anchors installed within 1¼ inches (31.7 mm) of the vertical head joint between CMU of the concrete masonry unit construction are outside the scope of this report. [Figures 2](#) and [3](#) of this report provide additional details.

Allowable loads for the Strong-Bolt 2 wedge anchors installed in fully-grouted concrete masonry subjected to combined tension and shear forces shall be determined by the following equation:

$$\left(\frac{P_s}{P_t}\right)^{5/3} + \left(\frac{V_s}{V_t}\right)^{5/3} \leq 1.0$$

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.

4.2 Installation: Installation parameters are provided in [Table 2](#) of this report and in [Figures 2](#) and [3](#) of this report. Anchor locations shall comply with this report and the plans and specifications approved by the code official. Strong-Bolt 2 wedge anchors shall be installed in

accordance with the manufacturer’s published instructions and this report. Anchors shall be installed in holes drilled into the base material using carbide-tipped drill bits conforming to [ANSI B212.15](#). Nominal drill bit diameters shall be equal to the nominal diameter of the anchors and holes shall be drilled to a depth allowing proper embedment. Drilled holes shall be cleaned, with all dust and debris removed using compressed air. Anchors, nuts, and washers shall be assembled so that the tops of the nuts are flushed with the top of the anchors. Anchors shall be driven into the hole using a hammer until the proper embedment depth is achieved. Nuts and washers shall be tightened against the base material or material to be fastened until the appropriate installation torque value specified in [Table 2](#) of this report is achieved.

4.3 Special Inspection: Periodic special inspection is required in accordance with IBC Sections 1705.4 (2015 IBC), 1705.3 (2012 IBC), 1704.15 (2009 IBC) or 1704.13 (2006 or 2003 IBC), provided the masonry construction is under Level B Quality Assurance in accordance with Section 3.1 of TMS 402-13 (2015 IBC) or Section 1.19 of TMS 402-11(2012 IBC), Level 1 or Level 2 under Section 1704.5 of the 2009 IBC or Section 1704.5 of the 2006 or 2003 IBC, special inspector shall be present as often as required by the “statement of special inspection.” Special inspector shall make periodic inspections during anchor installation to verify anchor type, anchor dimensions, masonry unit type and compliance with ASTM C90; grout and mortar compressive strengths, and (when required) masonry prism compressive strength; drill bit size and compliance with ANSI B212.15; and anchor type, size, embedment depth, spacing, edge distance and end distance. Special inspector shall inspect and verify that anchor installation complies with this evaluation report and the manufacturer’s published installation instructions. Additional requirements as set forth in Sections 1704, 1705, 1706 and 1707 of the IBC shall be observed, where applicable.

5.0 LIMITATIONS

Strong-Bolt 2 wedge anchors described in this report comply with, or are a suitable alternative to what is specified in, those codes listed in Section 1.1 of this report, subject to the following conditions:

5.1 Anchors are identified and installed in accordance with this report, the codes listed in Section 1.1 of this report, and the manufacturer’s published installation instructions. Where conflicts occur, the more restrictive governs.

5.2 Design of Strong-Bolt® 2 wedge anchors installed in fully grouted concrete masonry unit construction to resist



dead, live, wind and earthquake load applications shall be in accordance with Section 4.1 of this report.

5.3 When using the alternative basic load combinations from Section 1605.3.2 of the IBC that include wind or earthquake loads, the allowable tension and shear loads given in Table 2 for Strong-Bolt 2 wedge anchors installed in fully grouted concrete masonry may be adjusted in accordance with Table 1 of this report.

5.4 Anchors shall be installed in accordance with Section 4.2 of this report, and the holes for the anchors shall be predrilled with carbide-tipped masonry drill bits complying with ANSI B212.15, and have the same diameter as the nominal diameter of the anchor.

5.5 Since an acceptance criteria for evaluating data to determine the performance of anchors subjected to fatigue or shock loading are unavailable at this time, the use of these anchors under these conditions is outside the scope of this report.

5.6 **Fire-resistive Construction:** Where not otherwise prohibited in 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.

5.7 Since acceptance criteria for evaluating the performance of expansion anchors in cracked masonry are unavailable at this time, the use of anchors is limited to installation in uncracked masonry. Cracking occurs when $f_i > f_r$ due to service loads or deformations.

5.8 Calculations demonstrating that the applied loads are less than the allowable loads described in this report shall be submitted to the code official at the time of permit application. Calculations shall be prepared by a registered design professional where required by the statues of the jurisdiction in which the project is to be constructed.

5.9 Periodic special inspection shall be provided in accordance with Section 4.3 of this report.

5.10 Use of zinc-plated anchors is limited to dry, interior locations.

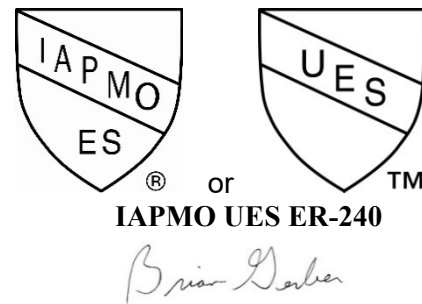
5.11 Strong-Bolt® 2 wedge anchors are manufactured by Simpson Strong-Tie under a quality control program with inspections by CEL Consulting (AA-639).

6.0 EVIDENCE SUBMITTED

Testing and analysis data in accordance with the ICC-ES Acceptance Criteria for Expansion Anchors in Masonry Elements (AC01), approved November 2015. Test results are from laboratories in compliance with ISO/IEC 17025.

7.0 IDENTIFICATION

Simpson Strong-Tie Company Inc., Strong-Bolt® 2 wedge anchors are identified in the field by dimensional characteristics and packaging. The packaging label notes the name and address of Simpson Strong-Tie Company Inc.; the manufacturing location; the anchor type, size, and length; the IAPMO UES evaluation report number (ER-240) and one of the IAPMO UES Marks of Conformity below. The threaded end of each Strong-Bolt 2 wedge anchor is stamped with a length identification code letter as indicated in Table 4 of this report.



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FIGURE 1—STRONG-BOLT® 2 WEDGE ANCHOR

TABLE 1—PERCENT ALLOWABLE LOAD INCREASE FOR WIND AND EARTHQUAKE LOADING CONDITIONS^{1,2}

ANCHOR	SUBSTRATE	PERCENT ALLOWABLE LOAD INCREASE FOR SHORT-TERM LOADING CONDITIONS	
		Tension	Shear
Strong-Bolt® 2 Wedge Anchor	Fully Grouted CMU	33 ¹ / ₃	33 ¹ / ₃

¹When using the basic load combinations for allowable stress design in accordance with IBC Section 1605.3.1, allowable loads shall not be increased for wind or earthquake loading.

²When using the alternative basic load combinations for allowable stress design in IBC Section 1605.3.2 that include wind or earthquake loads, the allowable shear and tension loads for anchors may be increased by the tabulated percentage increases. As an option, the alternative basic load combinations for allowable stress design may be reduced by multiplying them by 0.75 when using IBC Section 1605.3.2, as applicable.



TABLE 2—ALLOWABLE TENSION AND SHEAR LOADS FOR THE STRONG-BOLT® 2 WEDGE ANCHORS INSTALLED IN FULLY GROUTED CMU CONSTRUCTION^{1,2,3}

ANCHORS INSTALLED IN THE FACE OF FULLY GROUTED CMU CONSTRUCTION										
ANCHOR DIAMETER (in.)	EMBEDMENT DEPTH ⁴ (in.)	INSTALLATION TORQUE (ft.-lbf.)	ANCHOR LOCATION ^{5,6} (inches)				ALLOWABLE LOADS FOR ANCHORS INSTALLED AT DISTANCES ≥ CRITICAL EDGE DISTANCE, C_{crit} , AND CRITICAL SPACING, S_{crit} (lbf)			
			Edge / End Distance		Spacing		Tension ^{5,7}	Shear ^{5,7}		
			Critical, C_{crit}	Minimum, C_{min}	Critical, S_{crit}	Minimum, S_{min}				
1/4	1 3/4	4	12	2	8	4	230	300		
3/8	2 5/8	20	12	4	8	4	435	775		
1/2	3 1/2	35	12	4	8	4	530	1,010		
5/8	4 3/8	55	20	4	8	4	890	1,765		
3/4	5 1/4	100	20	4	8	4	1,050	2,490		
ANCHORS INSTALLED IN THE TOP OF FULLY GROUTED CMU CONSTRUCTION										
ANCHOR DIAMETER (in.)	EMBEDMENT DEPTH ⁹ (in.)	INSTALLATION TORQUE (ft.-lbf.)	ANCHOR LOCATION ⁸ (inches)					ALLOWABLE LOADS FOR ANCHORS INSTALLED AT DISTANCES ≥ CRITICAL END DISTANCE, C_{crit} , CRITICAL SPACING, S_{crit} MINIMUM EDGE DISTANCE, C_{edge} (lbf)		
			End Distance		Spacing		Edge Distance	Tension ^{7,8}	Shear Perpendicular to Wall ^{7,8}	Shear Parallel to Wall ^{7,8}
			Critical, C_{crit}	Minimum, C_{min}	Critical, S_{crit}	Minimum, S_{min}	Minimum, C_{edge}			
1/2	3 1/2	35	12	4	8	4	1 3/4	415	235	670
5/8	4 3/8	55	12	4	8	4	1 3/4	640	275	770

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

¹Tabulated loads are for anchors installed in fully grouted CMU wall construction consisting of materials in compliance with Section 3.2 of this report. The specified compressive strength of masonry, f'_m , at 28 days shall be a minimum of 1,500 psi.

²Allowable loads are based on periodic special inspection being provided during anchor installation. Special inspection requirements shall comply with Section 4.3 of this report.

³Allowable loads may be increased in accordance with Section 5.3 and [Table 1](#) of this report, where permitted by the IBC or its referenced standards.

⁴Embedment depth is measured from the outside face of the masonry to the end of the mandrel.

⁵Critical and minimum edge distances and critical and minimum spacing shall comply with this table. [Figure 2 of this report](#) illustrates permitted and prohibited [anchor positions](#). Critical edge distance and critical spacing are valid for anchors resisting the tabulated allowable tension or shear loads. [Table 3 of this report](#) tabulates allowable tension and shear load reduction factors for anchors installed between critical and minimum edge distances and spacing.

⁶Anchors shall be installed a minimum of 1 1/4 inches from vertical head joints and T-joints. [Figure 2 of this report](#) illustrates permitted and prohibited anchor installation positions. Section 4.2 of this report provides additional installation details.

⁷Tabulated allowable loads are based on a factor of safety of five (5).

⁸Critical and minimum end distances, critical and minimum spacing, and minimum edge distance shall comply with this table and [Figure 3 of this report](#). Critical end distance and critical spacing are valid for anchors resisting the tabulated allowable tension or shear loads. [Table 3 of this report](#) contains allowable tension and shear load reduction factors for anchors installed between critical and minimum end distances and spacing.

⁹Embedment depth is measured from the top of the masonry wall to the end of the mandrel.



TABLE 3—LOAD REDUCTION FACTORS FOR STRONG-BOLT® 2 WEDGE ANCHORS INSTALLED IN FULLY GROUTED CMU CONSTRUCTION^{1,2,3}

ANCHORS INSTALLED IN THE FACE OF FULLY GROUTED CMU CONSTRUCTION							
ANCHOR DIAMETER (in.)	EMBED-MENT DEPTH ⁴ (in.)	Edge Distance			Spacing		
		Critical Edge Distance, C_{crit}	Minimum Edge/End Distance, c_{min}		Critical Spacing Distance, s_{crit}	Minimum Spacing, s_{min}	
			Tension or Shear	Tension		Shear	Tension or Shear
1/4	3 3/4	1.0	1.0	0.88	1.0	1.0	1.0
3/8	2 5/8	1.0	1.0	0.71	1.0	1.0	1.0
1/2	3 1/2	1.0	1.0	0.60	1.0	0.93	1.0
5/8	4 3/8	1.0	1.0	0.36	1.0	0.86	1.0
3/4	5 1/4	1.0	0.97	0.28	1.0	0.80	1.0

ANCHORS INSTALLED IN THE TOP OF FULLY GROUTED CMU CONSTRUCTION									
ANCHOR DIAMETER (in.)	EMBED-MENT DEPTH ⁵ (in.)	End Distance				Spacing			Minimum Edge Distance, C_{edge}
		Critical End Distance, C_{crit}	Minimum End Distance, c_{min}			Critical Spacing Distance, s_{crit}	Minimum Spacing, s_{min}		
			Tension or Shear	Tension	Shear Perp. To Wall		Shear Parallel to Wall	Tension or Shear	
1/2	3 1/2	1.0	1.0	0.90	0.53	1.0	0.93	1.0	1.0
5/8	4 3/8	1.0	1.0	0.83	0.50	1.0	0.86	1.0	1.0

For SI: 1 inch = 25.4 mm.

¹The load reduction factors in this table are applicable to the allowable loads shown in Table 2 of this report.

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

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

⁴Embedment depth is measured from the outside face of the masonry to the end of the mandrel.

⁵Embedment depth is measured from the top of the masonry wall to the end of the mandrel.

TABLE 4—LENGTH IDENTIFICATION HEAD MARKS ON STRONG-BOLT® 2 WEDGE ANCHORS (CORRESPONDS TO LENGTH OF ANCHOR – INCHES)

Mark	Units	A	B	C	D	E	F	G	H	I	J	K	L	M
From	in	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2
Up to But Not Including	in	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8

Mark	Units	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
From	in	8	8 1/2	9	9 1/2	10	11	12	13	14	15	16	17	18
Up to But Not Including	in	8 1/2	9	9 1/2	10	11	12	13	14	15	16	17	18	19

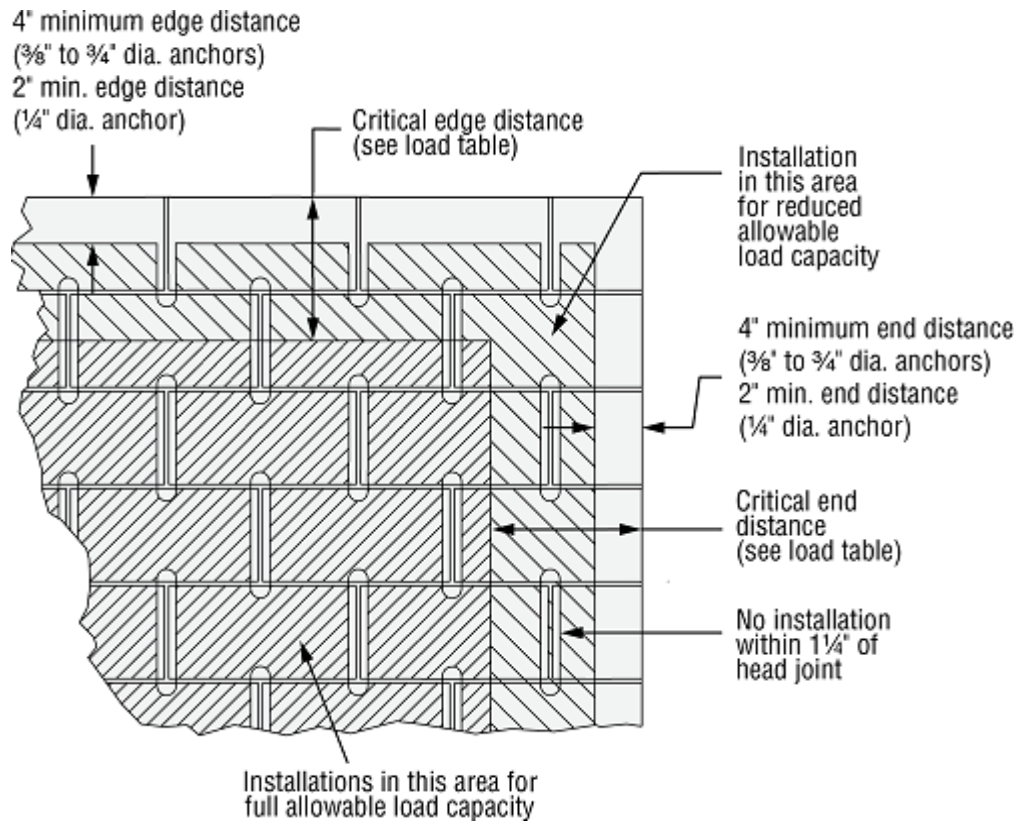


FIGURE 2—STRONG-BOLT® 2 WEDGE ANCHOR INSTALLED IN THE FACE OF FULLY GROUTED CMU CONSTRUCTION

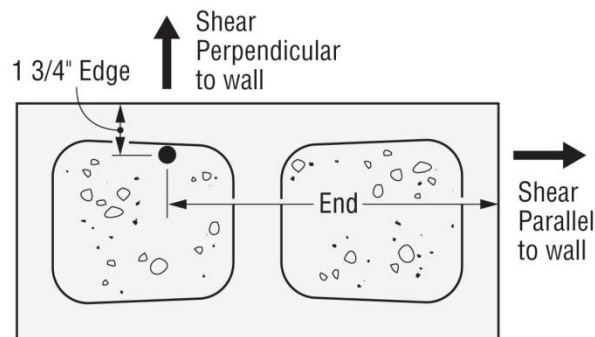


FIGURE 3—STRONG-BOLT® 2 WEDGE ANCHOR INSTALLED IN THE TOP OF FULLY GROUTED CMU CONSTRUCTION