ICC EVALUATION SERVICE

Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ESR-1396

Reissued March 1, 2012

This report is subject to renewal in two years.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

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
(925) 560-9000
www.simpsonanchors.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE WEDGE-ALL ANCHORS

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)
- 2003 *International Building Code*® (2003 IBC)
- 2003 *International Residential Code*® (2003 IRC)
- 2000 *International Building Code*® (2000 IBC)
- 2000 *International Residential Code*® (2000 IRC)
- 1997 *Uniform Building Code*™ (UBC)

Property evaluated:

Structural

2.0 USES

Wedge-All anchors are expansion anchors post-installed in predrilled holes in the face of fully grouted concrete-masonry (CMU) construction.

The Wedge-All anchors are alternatives to cast-in-place anchors described in Section 2107 of the IBC (TMS 402) and UBC Section 2107.1.5 for concrete-masonry construction. 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 (2009, 2006 and 2003 IRC) or Section R301.1.2 (2000 IRC).

3.0 DESCRIPTION

3.1 Wedge-All Anchors:

Wedge-All Anchors consist of a steel rod threaded at the upper end with standard coarse bolt threads and a machined or cold-formed tapered cone mandrel on the lower end. Attached to the cone mandrel is an expander ring. The diameter of the tapered mandrel increases toward the base of the anchor, permitting the expander ring to expand during anchor installation. The expander ring consists of a split-ring element with two dimples that engage the wall of the hole as it expands. A typical anchor is shown in Figure 1.

3.2 Materials:

3.2.1 Wedge-All Anchors: The Wedge-All anchor is manufactured from carbon steel with a minimum yield strength of 50,000 psi (345 MPa) and a minimum tensile strength of 75,000 psi (517 MPa). The expander ring is formed from carbon steel with a minimum hardness of Rockwell B60. Steel parts are zinc-plated in accordance with ASTM B 633, Service Condition SC1, Type III; or are mechanically galvanized as a minimum in accordance with ASTM B 695, Class 55, Type I.

3.2.2 Grout-filled Concrete Masonry: When prism tests are required, the compressive strength of masonry, f'_m, at 28 days must be a minimum of 1,500 psi (10.3 MPa). The concrete masonry must be fully grouted and constructed from the following materials:

3.2.2.1 Concrete Masonry Units (CMUs): CMUs must be minimum Grade N, Type II, lightweight, medium-weight, or normal-weight conforming to ASTM C 90 or UBC Standard 21-4. The minimum allowable nominal size of the CMU must be 8 inches (203 mm) wide by 8 inches (203 mm) high by 16 inches (406 mm) long (i.e., 8×8×16).

3.2.2.2 Grout: Grout must comply with IBC Section 2103.12 (2009 and 2006 IBC) or 2103.10 (2003 and 2000 IBC), IRC Section R609.1.1, or UBC Section 2103.4, as applicable. Alternatively, the grout must have a minimum compressive strength when tested in accordance with ASTM C 1019 equal to its specified strength, but not less than 2,000 psi (13.8 MPa).

3.2.2.3 Mortar: Mortar must be Type M or S in compliance with IBC Section 2103.8 (2009 and 2006 IBC) or 2103.7 (2003 and 2000 IBC), IRC Section R607, or UBC Section 2103.3 and UBC Standard 21-15, as applicable.

3.3 Design:

3.3.1 General: Wedge-All anchors described in this report must be assigned allowable tension and shear loads for designs based on allowable stress design (working stress design).

3.3.2 Design of Wedge-All (Carbon-steel) Anchors Installed in Fully Grouted Concrete Masonry: For installations in the face of fully grouted uncracked concrete masonry, the Wedge-All (carbon-steel) anchors are recognized to resist dead-, live-, wind-, and earthquake-load applications.

Allowable tension and shear loads, critical and minimum edge and end distances, and critical spacing requirements for anchors installed in the face of concrete masonry construction are noted in Table 2 for applications regulated by the IBC or IRC, and Table 3 for applications regulated by the UBC. Allowable load reduction factors for anchors installed at distances less than critical edge distance are noted in Table 4 for IBC, IRC, and UBC applications. Refer to Figure 2 for allowable anchor location and critical and minimum edge distances.

Allowable loads for the Wedge-All (carbon-steel) anchors installed in the face of fully grouted concrete masonry subjected to combined shear and tension forces must 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.

4.0 INSTALLATION

4.1 Wedge-All Anchor:

4.1.1 General: The Wedge-All anchor must be installed in a predrilled hole in the base material (i.e., concrete masonry construction) of the same diameter as the nominal diameter of the anchor. Holes must be drilled with a bit complying with ANSI B212.15 and must be drilled to a depth allowing proper embedment. The anchor must be inserted to a minimum of six threads below the substrate surface, and the nut must be installed on the anchor top and tightened on the washer bearing on the substrate until the torque indicated in Table 2 or 3 is attained. The depth of the drilled holes must exceed the anchor embedment length by a sufficient amount to permit the anchors to be installed to a minimum of six threads below the substrate surface.

4.1.2 Installation in Concrete Masonry: The allowable tension and shear loads are for the Wedge-All (carbon-steel) anchors installed in the grouted cells, the center web of concrete masonry units (CMU), and horizontal mortared bed joints of fully grouted concrete masonry construction. Allowable loads for anchors installed within $1^1/_4$ inches (31.7 mm) of the vertical head joint between CMU of the concrete masonry construction are outside the scope of this report. Refer to Figure 2 for details.

4.2 Special Inspection (When Required):

Continuous special inspection must be provided when required by the tables in this evaluation report. Special inspection under the IBC and IRC must conform to IBC Section 1704; under the UBC, special inspection must be in accordance with UBC Section 1701.

For fasteners installed with special inspection, the following items, as applicable, must be inspected: fastener type and dimensions; masonry unit type and compliance with ASTM C 90; 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 Wedge-All anchor described in this report complies with, or is a suitable alternative to what is specified in, those 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 Design of Wedge-All (carbon-steel) anchors installed in the face of fully grouted concrete masonry construction to resist dead, live, wind and earthquake load applications must be in accordance with Sections 3.3.1 and 3.3.2.

5.3 When using the alternative basic load combinations from Section 1605.3.2 of the IBC or Section 1612.3.2 of the UBC that include wind or earthquake loads, the allowable tension and shear loads shown in Tables 2 and 3 for Wedge-All (carbon-steel) anchors installed in the face of fully grouted concrete masonry may be increased by $33^1/_3$ percent. Alternatively, the load combinations in IBC Section 1605.3.2 may be multiplied by a factor of 0.75. Refer to Table 1 of this report.

5.4 Anchors must be installed in accordance with Section 4.0, and the holes for the anchors must be predrilled with carbide-tipped masonry drill bits complying with ANSI B212.15-1994 into the approved substrate, and have the same diameter as the nominal diameter of the anchor.

5.5 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of anchors subjected to fatigue or shock loading is 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 an ICC-ES acceptance criteria for evaluating the performance of expansion 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.

5.8 Calculations demonstrating that the applied loads are less than the allowable loads described in this report must be submitted to the code official at the time of permit application. 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.

5.9 Special inspection, when required, must be provided in accordance with Section 4.2.

5.10 Use of zinc-plated anchors must be limited to dry, interior locations. Use of mechanically galvanized (according to ASTM B 695), Class 65, Type I anchors is permitted in exterior-exposure or damp environments.

5.11 Wedge-All anchors are manufactured by Simpson Strong-Tie under a quality control program with inspections by CEL Consulting (AA-639).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Expansion Anchors in Masonry Elements (AC01), dated January 2010.

7.0 IDENTIFICATION

The Simpson Strong-Tie Company, Inc., Wedge-All 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 ICC-ES evaluation report number (ESR-1396); and the name of the inspection agency (CEL Consulting). The threaded end of each Wedge-All anchor is stamped with a length identification code letter as indicated in Table 5.

FIGURE 1—WEDGE-ALL ANCHOR

TABLE 1—PERCENT INCREASE FOR WIND AND EARTHQUAKE LOADING CONDITIONS

ANCHOR (Material Type)	SUBSTRATE	PERCENT INCREASE FOR SHORT-TERM LOADING CONDITIONS	
		Tension	Shear
Wedge-All (carbon steel)	Fully Grouted CMU Masonry[1,2]	$33^1/_3$	$33^1/_3$

[1]When using the basic load combinations in accordance with IBC Section 1605.3.1 or UBC Section 1612.3.1, allowable loads must not be increased for wind or earthquake loading.
[2]When using the alternative basic load combinations in IBC Section 1605.3.2 or UBC Section 1612.3.2 that include wind or earthquake loads, the allowable shear and tension loads for anchors may be increased by the tabulated percentage increases. Alternatively, the alternate basic load combinations may be reduced by multiplying them by 0.75 when using IBC Section 1605.3.2, as applicable.

TABLE 2—IBC AND IRC ALLOWABLE TENSION AND SHEAR LOADS FOR THE WEDGE-ALL ANCHORS INSTALLED IN THE FACE OF FULLY GROUTED CMU MASONRY CONSTRUCTION[1,2,3]

ANCHOR DIAMETER (in.)	EMBEDMENT DEPTH[4] (in.)	INSTALLATION TORQUE (ft.–lbs.)	ANCHOR LOCATION[5,6] (inches)			ALLOWABLE LOADS FOR ANCHORS INSTALLED AT DISTANCES ≥ CRITICAL EDGE DISTANCE, c_{crit}, AND CRITICAL SPACING, s_{crit} (lbf)	
			Edge Distance		Critical Spacing, s_{crit}	Tension[7]	Shear[7]
			Critical, c_{crit}	Minimum, c_{min}			
3/8	2 5/8	30	10 1/2	4	10 1/2	340	670
1/2	3 1/2	35	14	4	14	425	1,070
5/8	4 3/8	55	17 1/2	4	17 1/2	625	1,635
3/4	5 1/4	120	21	4	21	865	2,035

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

[1]Tabulated loads are for anchors installed in fully grouted masonry wall construction, consisting of Grade N, Type II, lightweight, medium-weight, or normal-weight, closed-end, concrete masonry units (CMUs) conforming to ASTM C 90. Masonry must be fully grouted with coarse grout having a minimum compressive strength of 2,000 psi, and complying with IBC Section 2103.12 (2009 and 2006) or 2103.10 (2003 and 2000) or IRC Section R609.1.1 as applicable. Mortar must be Type M or S in compliance with IBC Section 2103.8 (2009 and 2006 IBC) or Section 2103.7 (2003 and 2000 IBC) or IRC Section R607, as applicable. The specified compressive strength of masonry, f'_m, at 28 days must be a minimum of 1,500 psi.

[2]Allowable loads are based on special inspection being provided during anchor installation. Special inspection requirements must comply with Section 4.2 of this report.

[3]Allowable loads may be increased by 33 1/3 percent when using the alternate basic load combinations in accordance with Section 1605.3.2 of the IBC for wind or earthquake loading conditions. Alternatively, the load combinations in IBC Section 1605.3.2 may be multiplied by a factor of 0.75.

[4]Embedment depth is measured from the outside face of the masonry.

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

[6]Anchors must be installed a minimum of 1 1/4 inches from vertical head joints and T-joints. Refer to Figure 2 for permitted and prohibited anchor installation locations. Refer to Section 4.1 of this report for installation details.

[7]Tabulated allowable loads are based on a factor of safety of 5.

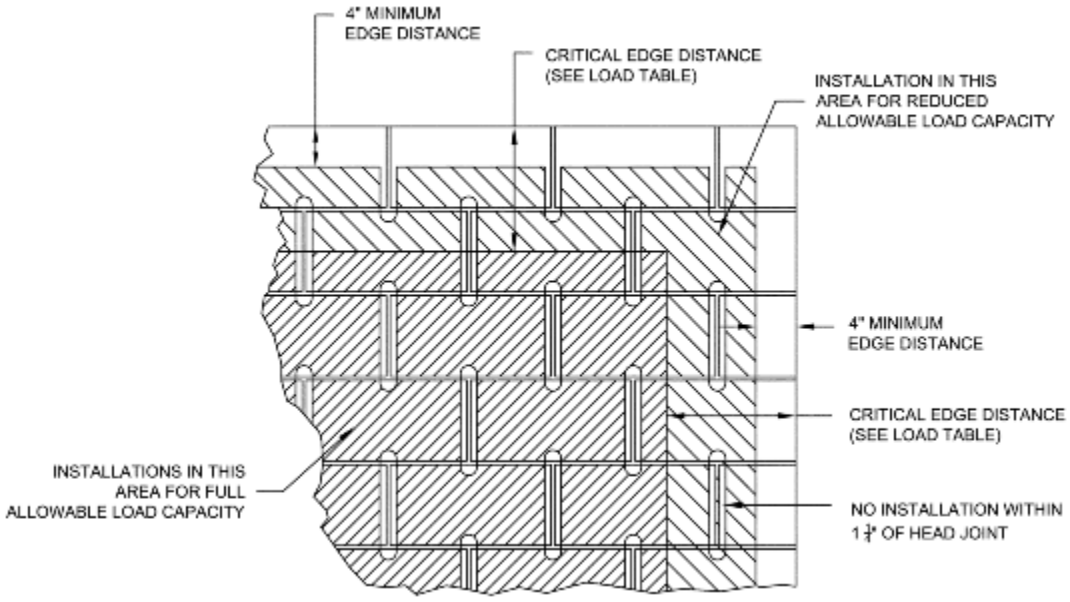

FIGURE 2—WEDGE-ALL ANCHOR INSTALLED IN THE FACE OF GROUT-FILLED CMU (CONCRETE MASONRY UNIT) CONSTRUCTION
(Refer to Tables 2, 3, and 4)

TABLE 3—UBC ALLOWABLE TENSION AND SHEAR LOADS FOR THE WEDGE-ALL ANCHORS INSTALLED IN THE FACE OF FULLY GROUTED CMU MASONRY CONSTRUCTION[1,2]

ANCHOR DIAMETER (in.)	EMBED-MENT DEPTH[3] (in.)	INSTALL-ATION TORQUE (ft.–lbs.)	ANCHOR LOCATION[4,5] (inches)			ALLOWABLE LOADS FOR ANCHORS INSTALLED AT DISTANCES ≥ CRITICAL EDGE DISTANCE, c_{crit}, AND CRITICAL SPACING, s_{crit} (lbf)		
			Edge Distance		Critical Spacing, s_{crit}	Tension		Shear[8]
			CRITICAL, c_{crit}	MINIMUM, c_{min}		Installed with Special Inspection[6]	Installed without Special Inspection[7]	
3/8	2 5/8	30	10 1/2	4	10 1/2	425	215	840
1/2	3 1/2	35	14	4	14	530	265	1,340
5/8	4 3/8	55	17 1/2	4	17 1/2	785	395	2,045
3/4	5 1/4	120	21	4	21	1,080	540	2,540

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

[1]Tabulated loads are for anchors installed in fully grouted masonry wall construction, consisting of Grade N, Type II, lightweight, medium-weight, or normal-weight, closed-end, concrete masonry units (CMUs) conforming to UBC Standard 21-4. Masonry must be fully grouted with coarse grout having a minimum compressive strength of 2,000 psi, and complying with UBC Section 2103.4. Mortar must be Type M or S in compliance with UBC Section 2103.3 and UBC Standard 21-15. The specified compressive strength of masonry, f'_m, at 28 days must be a minimum of 1,500 psi.
[2]Allowable loads may be increased by 33 1/3 percent when using the alternate basic load combinations in accordance with Section 1612.3.2 of the UBC for wind or earthquake loading conditions. Refer to Table 1.
[3]Embedment depth is measured from the outside face of the masonry.
[4]Critical and minimum edge distances, c_{crit} and c_{min}, respectively, and critical spacing, s_{crit}, must comply with this table. Refer to Figure 2. Critical edge and spacing distances are valid for anchors resisting the tabulated allowable tension or shear loads. Refer to Table 4 for allowable tension and shear load reduction factors for anchors installed between critical and minimum edge distances.
[5]Anchors must be installed a minimum of 1 1/4 inches from vertical head joints and T-joints. Refer to Figure 2 for permitted and prohibited anchor installation locations. Refer to Section 4.1 of this report for installation details.
[6]These allowable tension loads are based on special inspection being provided during anchor installation. Special inspection requirements must comply with Section 4.2 of this report.
[7]These reduced allowable tension loads are applicable for anchors installed without special inspection.
[8]These allowable shear loads are based on a factor of safety of 4.0 and anchor installation with or without special inspection.

TABLE 4—LOAD REDUCTION FACTORS FOR WEDGE-ALL ANCHORS INSTALLED BETWEEN CRITICAL AND MINIMUM EDGE DISTANCES (ANCHORS INSTALLED IN THE FACE OF GROUT-FILLED CMU MASONRY)[1,2,3]

ANCHOR DIAMETER (inch)	MINIMUM EMBEDMENT DEPTH, h_v (inches)	LOAD REDUCTION FACTORS FOR ANCHORS INSTALLED AT:		
		Critical Edge Distance, c_{crit}	Minimum Edge Distance, c_{min}	
		Tension or Shear Load	Tension Load	Shear Load
3/8	2 5/8	1.0	1.0	0.79
1/2	3 1/2	1.0	1.0	0.52
5/8	4 3/8	1.0	0.8	0.32
3/4	5 1/4	1.0	0.8	0.32

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

[1]The load reduction factors in this table are applicable to the allowable loads shown in Tables 2 and 3.
[2]Reduction factors are cumulative. Multiple reduction factors for more than one spacing or edge distance are calculated separately and multiplied.
[3]Load reduction factors for anchors loaded in tension or shear with edge distances between critical and minimum are obtained by linear interpolation.

TABLE 5—ANCHOR LENGTH IDENTIFICATION CODE

CODE[1]		LENGTH OF ANCHOR	
		inches	**mm**
A	Black	$1^1/_2 < 2$	38 < 51
B	White	$2 < 2^1/_2$	51 < 63
C	Red	$2^1/_2 < 3$	63 < 76
D	Green	$3 < 3^1/_2$	76 < 89
E	Yellow	$3^1/_2 < 4$	89 < 102
F	Blue	$4 < 4^1/_2$	102 < 114
G	Purple	$4^1/_2 < 5$	114 < 127
H	Brown	$5 < 5^1/_2$	127 < 140
I	Orange	$5^1/_2 < 6$	140 < 152
J	N/A	$6 < 6^1/_2$	152 < 165
K	N/A	$6^1/_2 < 7$	165 < 178
L	N/A	$7 < 7^1/_2$	178 < 191
M	N/A	$7^1/_2 < 8$	191 < 203
N	N/A	$8 < 8^1/_2$	203 < 216
O	N/A	$8^1/_2 < 9$	216 < 229
P	N/A	$9 < 9^1/_2$	229 < 241
Q	N/A	$9^1/_2 < 10$	241 < 254
R	N/A	10 < 11	254 < 267
S	N/A	11 < 12	267 < 305
T	N/A	12 < 13	305 < 330
U	N/A	13 < 14	330 < 366
V	N/A	14 < 15	366 < 381
W	N/A	15 < 16	381 < 406
X	N/A	16 < 17	406 < 432
Y	N/A	17 < 18	432 < 457
Z	N/A	18 < 19	457 < 483

[1]N/A = Not applicable