

ICC-ES Evaluation Report

ESR-1678

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This report is subject to re-examination in two years.

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DIVISION: 04—MASONRY
Section: 04081—Masonry Anchorage
REPORT HOLDER:

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EVALUATION SUBJECT:
POWERS WEDGE-BOLT®+ SCREW ANCHORS IN MASONRY
1.0 EVALUATION SCOPE
Compliance with the following codes:

- 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

The Powers Wedge-Bolt+ screw anchors are used for anchoring building components and structural connections in predrilled holes to grout-filled concrete masonry units, to resist dead, live, earthquake and wind loads.

The screw anchors are alternatives to the cast-in-place anchors described in Section 2107.1 of the IBC and Section 2107 of the UBC. The screw anchors may also be used under the IRC where an engineered design is submitted in accordance with Section R301.1.3.

3.0 DESCRIPTION
3.1 Materials:

3.1.1 Powers Wedge-Bolt+ Screw Anchors: The screw anchors are manufactured from case-hardened, low-carbon steel with a minimum ultimate tensile strength of 100 ksi (990 N/mm²). The anchors are formed with a dual lead thread and a chamfered tip, and are zinc-plated in accordance with ASTM B 633, or mechanically galvanized in accordance with ASTM B 695, Class 65. The Wedge-

Bolt+ anchors are available in hex and rod coupling head styles. The anchors are available in nominal diameters ranging from 1/4 to 3/4 inch (6.4 to 19.1 mm), and in various lengths. Figure 1 illustrates Powers Wedge-Bolt+ screw anchors.

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

3.1.2.1 Concrete Masonry Units (CMUs): Grout-filled concrete masonry walls must be constructed from minimum 6-inch-wide (152 mm), Grade N, Type II, concrete masonry units (CMUs) conforming to ASTM C 90 (IBC) or UBC Standard 21-4.

3.1.2.2 Grout: The masonry units must be fully grouted with grout complying with Section 2103.12 of the IBC; Section R609.1.1 of the IRC; or Section 2103.4 of the UBC and UBC Standard 21-15, and having a minimum compressive strength of 2,000 psi (13.8 MPa) at 28 days.

3.1.2.3 Mortar: Mortar must be Types M, S or N prepared in accordance with Section 2103.8 of the IBC, Section R607 of the IRC, or Section 2103.8 of the UBC and UBC Standard 21-15, as applicable.

3.2 Design of Anchors Installed in Grout-filled Concrete Masonry:

The allowable load values for anchors described in this report are based on allowable stress design under the IBC and the UBC. Allowable tension and shear loads for installation in uncracked grout-filled concrete masonry are noted in Table 2.

The allowable loads for anchors installed in grout-filled concrete masonry subjected to combined tension and shear forces must be determined by the following equation:

$$\left(\frac{P_s}{P_t} \right) + \left(\frac{V_s}{V_t} \right) \leq 1$$

where:

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

4.0 INSTALLATION
4.1 General:

Anchors must be installed in accordance with this report and the manufacturer's published installation instructions.

In the event of a conflict between the instructions in this report and the manufacturer's instructions, this report must govern. Anchor locations must comply with the approved plans and specifications. The anchors must not be installed until the base material has reached its minimum designated compressive strength. The drill bit size (Wedge-bit), hole diameter, embedment depth, spacing, edge distance and base material must comply with the requirements of this report.

Installation procedures must be in accordance with Table 2 and Figure 2.

4.2 Special Inspections:

Continuous special inspection must be provided when required by the tables in this evaluation report. Special inspection must be in accordance with Section 1704 of the IBC or Section 1701 of the UBC. For fasteners installed under special inspection, the following items must be inspected: fastener type, fastener dimensions, concrete type, masonry compressive strength, drill bit size, fastener spacing, edge distances and fastener embedment (as applicable). The special inspector must verify that anchor installation was in compliance with this evaluation report and in accordance with the manufacturer's published installation instructions. Installations in grout-filled concrete masonry without special inspection are not permitted under the IBC or the IRC.

5.0 CONDITIONS OF USE

The Powers Wedge-Bolt+ Screw Anchors 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 anchors must be identified and installed in accordance with this report and the manufacturer's instructions. In the event of a conflict between the instructions in this report and the manufacturer's instructions, this report must govern.
- 5.2 Wedge-Bolt+ anchor sizes, dimensions, and allowable loads must be as set forth in this report.
- 5.3 Anchors resisting dead, live, seismic or wind load in grout-filled concrete masonry must be designed in accordance with Section 3.2 of this report.
- 5.4 For installations in grout-filled concrete masonry, anchors are recognized to resist dead, live, wind, and earthquake load applications. When using the basic load combinations in accordance with IBC Section 1605.3.1.1, 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 reduced by a factor of 0.75. When using the basic load combinations in accordance with UBC Section 1612.3.1, allowable loads are not permitted to be increased for wind or earthquake loading. When using the alternative basic load combinations in UBC Section 1612.3.2 that include wind or seismic loads, the allowable shear and tension loads for anchors are permitted to be increased by $33\frac{1}{3}$ percent.
- 5.5 Anchors must be installed in holes predrilled in substrates described in this report, using Wedge-bits complying with Table 1 of this report.
- 5.6 Calculations demonstrating that the applied loads are less than the allowable loads described in this report must be submitted to the code official for approval.

The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is being constructed.

- 5.7 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of screw anchors subjected to fatigue and shock loading is unavailable at this time, the use of these anchors under these conditions is beyond the scope of this report.
- 5.8 Where not otherwise prohibited by the code, anchors are permitted for installation in fire-resistance-rated construction provided 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.
- 5.9 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of screw anchors in cracked masonry is unavailable at this time, the use of screw anchors is limited to installation in uncracked masonry. Cracking occurs when $f_t > f_r$ due to service loads or deformations.
- 5.10 Special inspection, when required, must be provided in accordance with Section 4.2 of this report.
- 5.11 Anchors must be limited to dry, interior locations. Exterior-exposure or damp environments are permitted where zinc-coated anchors are used. Zinc coating must be mechanically deposited in accordance with ASTM B 695, and the coating must be a Class 65 coating having a minimum thickness of 2.6 mils (0.066 mm).
- 5.12 Anchors must not be installed in contact with preservative-treated and fire-retardant-treated wood. The Wedge-Bolt+ screw anchors are manufactured under a quality control program with inspections by CEL Consulting (AA-639).

6.0 EVIDENCE SUBMITTED

- 6.1 Data in accordance with the ICC-ES Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry (AC106), dated June 2006 (editorially revised December 2007), including reports on optional seismic tests on anchors installed in grout-filled concrete masonry.
- 6.2 Quality control manuals.

7.0 IDENTIFICATION

The screw anchors must be identified in the field by labels on the packaging bearing the Powers Fasteners, Inc., name, the product name (Wedge-Bolt+), the anchor diameter and length, the name of the inspection agency (CEL Consulting, AA-639) and the evaluation report number (ESR-1678). In addition, the anchor length (in inches) is stamped on the head of each hex-head screw anchor.

TABLE 1—DRILL BIT SIZES AND MINIMUM FIXTURE CLEARANCE HOLE DIAMETERS

ANCHOR DIAMETER, <i>d</i> (inch)	WEDGE-BOLT+ SCREW ANCHORS	
	Wedge-bit Diameter Range (inch)	Minimum Clearance Hole Diameter ¹ (inch)
1/4	0.255 – 0.259	5/16
3/8	0.385 – 0.389	7/16
1/2	0.490 – 0.495	9/16
5/8	0.600 – 0.605	11/16
3/4	0.720 – 0.725	13/16

For SI: 1 inch = 25.4 mm.

¹Where applicable these dimensions are to be used for anchor installations through a steel or structural member.

TABLE 2—ALLOWABLE TENSION AND SHEAR LOAD CAPACITIES FOR WEDGE-BOLT ANCHORS INSTALLED IN GROUT-FILLED CONCRETE MASONRY^{1,2,3,5,6}

ANCHOR INSTALLED THROUGH FACE SHELL INTO GROUTED CELL									
ANCHOR DIAMETER, <i>d</i> (inch)	MINIMUM EMBED., <i>h_v</i> (inches)	MINIMUM EDGE DISTANCE (inches)	MINIMUM END DISTANCE (inches)	TENSION LOAD (pounds)			SHEAR LOAD (pounds)		
				UBC		IBC/IRC	UBC	IBC/IRC	
				With Special Inspection ⁴	Without Special Inspection	With Special Inspection ⁴	With or Without Special Inspection	With Special Inspection ⁴	
1/4	1	3 3/4	3 3/4	105	50	80	190	150	
	2			425	210	340	385	310	
3/8	1 1/2	3 3/4	12	265	130	210	500	400	
	3 1/2			1,610	805	1,290	1,140	910	
1/2	2	3 3/4	12	420	210	335	905	720	
	4			1,905	950	1,525	1,355	1,085	
5/8	2 1/2	3 3/4	12	570	285	455	1,255	1,005	
	4			1,640	820	1,310	1,355	1,085	
	5			2,425	1,210	1,940	1,595	1,255	
3/4	3	3 3/4	12	765	380	615	940	750	
		12							
	4	12		1,820	910	1,455	1,655	1,320	
	5	12		2,100	1,050	1,680	2,215	1,775	
ANCHOR INSTALLED THROUGH FACE SHELL INTO CELL WEB									
ANCHOR DIAMETER, <i>d</i> (inch)	MINIMUM EMBED., <i>h_v</i> (inches)	MINIMUM EDGE DISTANCE (inches)	MINIMUM END DISTANCE (inches)	TENSION LOAD (pounds)			SHEAR LOAD (pounds)		
				UBC		IBC/IRC	IBC/IRC		
				With Special Inspection ⁴	Without Special Inspection	With Special Inspection ⁴	With Special Inspection ⁴		
3/8	3 1/2	16	16	1,085		540	870		
1/2	4			1,390		695	1,110		
5/8	4			1,505		750	1,205		
3/4	4			1,640		820	1,310		
ANCHOR INSTALLED IN T-JOINT AND BED JOINT ^{7,8}									
ANCHOR DIAMETER, <i>d</i> (inch)	MINIMUM EMBED., <i>h_v</i> (inches)	MINIMUM EDGE DISTANCE (inches)	MINIMUM END DISTANCE (inches)	TENSION LOAD (Pounds)			SHEAR LOAD (Pounds)		
				UBC		IBC/IRC	UBC	IBC/IRC	
				With Special Inspection ⁴	Without Special Inspection	With Special Inspection ⁴	With or Without Special Inspection	With Special Inspection ⁴	
3/8	1 1/2	16	8	—	—	—	635	510	
	3 1/2			1,040	520	830			
1/2	4			1,365	680	1,090	1,535	1,225	
5/8	4			1,050	525	840			
3/4	2 1/2			—	—	—			
	4			1,110	555	890			

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

¹Tabulated load values are for anchors installed in minimum 6-inch-wide (152 mm) grout-filled concrete masonry units described in Section 3.2 of this report. See Figure 2 for permitted anchor locations.

²Refer to Section 5.0 of this report for modifying allowable loads of anchors to resist short-term loads.

³The tabulated values are applicable for screw anchors installed at a minimum spacing between screw anchors of 16 times the screw anchor diameter.

⁴These tension and shear load values are applicable only when the anchors are installed with special inspection as set forth in Section 4.2.

⁵Embedment depth is measured from the outside surface of the concrete masonry unit.

⁶Allowable shear loads for 1/4-inch- and 3/8-inch-diameter anchor installations into the face shell of a masonry wall may be applied in any direction.

Allowable shear loads for anchors with diameters of 1/2 inch and greater installed into the face shell may be applied in any direction provided the location is a minimum of 12 inches from the edge and end of the wall. For anchors with diameters of 1/2 inch and greater installed with an edge distance less than 12 inches, the allowable shear loads may be applied in any direction except upward vertically.

⁷Allowable shear loads for anchor installations into the mortar bed joint may be applied in any direction provided the anchor location is a minimum of 16 inches from the edge of the wall. For anchor installations with an edge distance of less than 16 inches, the allowable shear loads may be applied in any direction except upward vertically.

⁸Allowable tension load values apply to installations in T-joints. For anchors installed into a horizontal mortar joint (bed joint), allowable tension loads may be increased by 35 percent.

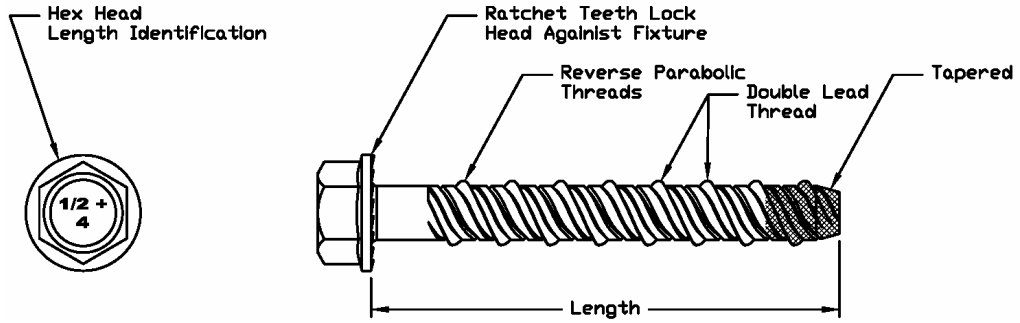


FIGURE 1—WEDGE-BOLT+ SCREW ANCHOR DESCRIPTION

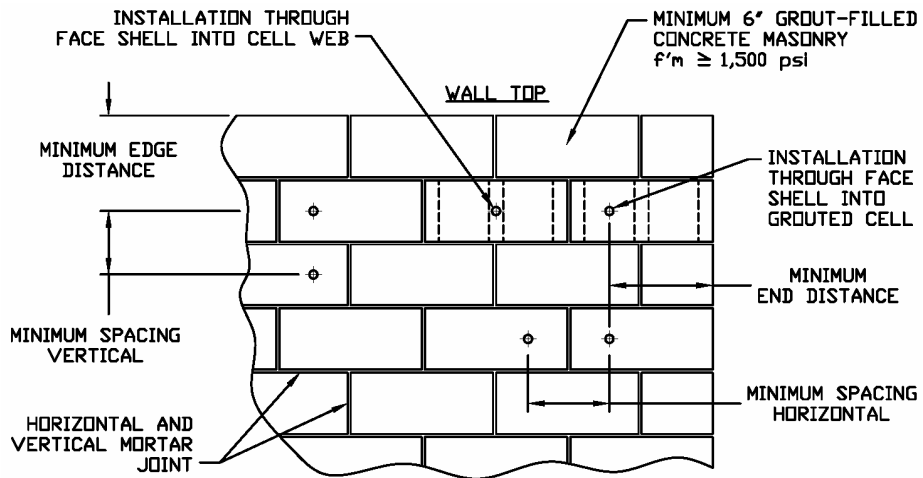


FIGURE 2—WEDGE-BOLT+ SCREW ANCHORS INSTALLED INTO GROUT-FILLED CONCRETE MASONRY