

ICC-ES Evaluation Report

ESR-1772

Reissued January 1, 2012

This report is subject to renewal in one year.
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
 (800) 925-5099
www.simpsonanchors.com
jdunagan@strongtie.com

EVALUATION SUBJECT:
SET ADHESIVE ANCHOR SYSTEMS
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

The SET adhesive anchor systems are used for anchoring building components to hollow (ungrouted) and grout-filled concrete masonry, and unreinforced brick walls. Threaded rods or deformed reinforcing bars installed with the SET adhesive resist dead, live, earthquake, and wind loads, as noted in Section 4.0 of this evaluation report. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION
3.1 General:

The SET adhesive anchor systems consist of a two-part epoxy adhesive available in different cartridge systems; threaded rods or deformed reinforcing bars; plastic-mesh screen tubes used for anchor installation in hollow

concrete masonry (ungrouted) wall construction; and plastic-mesh or steel-mesh screen tubes, steel sleeve and steel plate used for anchor installation in unreinforced brick walls.

3.2 SET Adhesive:

The SET adhesive is a two-component, 100 percent solids, low-viscosity, epoxy-based adhesive mixed at a 1-to-1 volume ratio of hardener-to-resin. The SET adhesive is packaged in different cartridge systems, each bearing a different model designation: SET 1.7, SET22, SET56, SET-PAC, and SET-PAC-EZ. Simpson Strong-Tie SET adhesive has a shelf life of two years from date of manufacture in unopened, side-by-side SET 1.7, SET22, and SET56 cartridge systems when stored in a dry environment at storage temperatures between 45°F (7°C) and 90°F (32°C). An unopened SET-PAC cartridge and an unopened SET-PAC-EZ coaxial cartridge have an 18-month shelf life from date of manufacture when stored under the same conditions.

3.2.1 SET 1.7 Cartridge: The SET 1.7 cartridge consists of the SET epoxy adhesive as described in Section 3.2, packaged in dual side-by-side, 1.7-ounce (0.05 liter) cartridges.

3.2.2 SET22 and SET56 Cartridges: The SET22 and SET56 cartridges consist of the SET epoxy adhesive as described in Section 3.2. The SET22 and SET56 are packaged in dual side-by-side, 22-ounce and 56-ounce (0.65 and 1.66 liter) cartridges, respectively.

3.2.3 SET-PAC Cartridge: The SET-PAC cartridge consists of the SET epoxy adhesive as described in Section 3.2, packaged in a single, 10-ounce (0.30 liter) cartridge, having an internal divider that maintains the 1-to-1 volume ratio of hardener to resin.

3.2.4 SET-PAC-EZ Cartridge: The SET-PAC-EZ cartridge consists of the SET epoxy adhesive as described in Section 3.2, packaged in a coaxial, 8.5-ounce (0.25 liter) dual-component cartridge system.

3.3 Screen Tubes:

3.3.1 Simpson Strong-Tie Opti-Mesh™ Plastic Screen Tube: The Opti-Mesh plastic screen tubes are used in hollow (ungrouted) concrete masonry walls and unreinforced brick masonry walls, described in Sections 4.2.2 and 4.2.4, respectively, of this report. In unreinforced brick masonry walls, the Opti-Mesh plastic screen tubes are permitted for use in configurations A and B only (Figure 5). The tubes are plastic and consist of an integral cap, flanges, an open mesh collar, and a black plastic mesh tube.

3.3.2 Steel Screen Tube: The steel screen tubes are for use only in unreinforced brick masonry walls as described in Section 4.2.4 of this report. The tubes, consisting of 60 mesh carbon steel wire screen, are open at one end and closed at the other. The outside diameter of the steel screen tubes used with the threaded rods or rebar specified in Sections 4.2.4.1.1, 4.2.4.1.2, and 4.2.4.1.3 of this report is $3\frac{1}{32}$ inch (24.6 mm).

3.4 Threaded Rods:

Threaded anchor rods, having diameters from $\frac{3}{8}$ inch to $1\frac{1}{4}$ inches (9.5 to 31.8 mm), shall be carbon steel conforming to ASTM A 307, Grade C, or ASTM A 193, Grade B7; or stainless steel conforming to ASTM F 593, Alloy Group 1, Type 304, Condition CW.

3.5 Deformed Reinforcing Bar (Rebar):

Deformed steel rebars, having sizes from No. 4 to No. 11, shall conform to ASTM A 615, A 616, A 617, A 706, or A767.

3.6 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). Fully grouted masonry walls shall be constructed from the following materials:

3.6.1 Concrete Masonry Units (CMU): CMU shall be closed-end minimum Grade N, Type II, lightweight, medium-weight, or normal-weight conforming to ASTM C 90 or UBC Standard 21-4. The allowable nominal size of CMU shall be either 6 or 8 inches (152 mm or 203 mm) wide by 8 inches (203 mm) high by 16 inches (406 mm) long (i.e., 6×8×16 or 8×8×16) for threaded rods installed with the SET Adhesive in the top of the fully grouted masonry wall construction (refer to Table 15). Minimum allowable nominal size of 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) for threaded rods installed with the SET Adhesive in the face of the masonry wall construction (refer to Tables 3, 5 and 6).

3.6.2 Grout: Grout shall comply with IBC Section 2103.12, IRC Section R609.1.1, or UBC Section 2103.4, as applicable. Alternatively, the grout shall have a minimum compressive strength when tested in accordance with ASTM C 1019-98a equal to its specified strength, but not less than 2,000 psi (13.8 MPa).

3.6.3 Mortar: Mortar shall comply with IBC Section 2103.8, IRC Section R607, or UBC Section 2103.3 and UBC Standard 21-15, as applicable. Mortar shall have a minimum compressive strength of 1,500 psi (10.3 MPa).

3.7 Hollow 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). Hollow concrete masonry walls shall be constructed from the following materials:

3.8 Unreinforced Brick Masonry:

Refer to Sections 4.1.4 and 4.2.4 for details concerning design and installation of anchors in unreinforced brick masonry.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 General: The anchor capacities in this report are allowable load values for use in allowable stress design. For use under the IRC, an engineered design in accordance with IRC Section R301.1.3 shall be submitted to the code official.

The allowable tension and shear loads noted in this report shall be adjusted for in-service base-material temperatures in accordance with Figure 1 for anchors installed and cured in base materials having a temperature of 40°F (4.4°C) and above. Anchors installed or cured at temperatures below 40°F (4.4°C) are outside the scope of this report.

Except for the anchor configuration permitted to resist only shear forces as described in Section 4.2.4.1.1 of this report, allowable loads for anchors subjected to combined tension and shear forces shall 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 tension load.
- P_t = Allowable tension load.
- V_s = Applied shear load.
- V_t = Allowable shear load.

4.1.2 Design of Anchors in Hollow Concrete Masonry:

For installations of threaded rods with Opti-Mesh plastic screen tubes through the face shell of hollow concrete masonry walls, the anchors are permitted to resist dead load, live load, and wind load applications. Use of the anchors to resist earthquake loads is outside the scope of this report. Minimum edge and end distances, and allowable tension and shear values are noted in Table 5.

4.1.3 Design of Anchors in Grout-filled CMU Walls:

4.1.3.1 Threaded Rods Installed in the Top of Fully Grouted CMU Walls (Resisting Dead, Live, and Wind Load Applications Only): Table 4A specifies allowable tension and shear values for $\frac{5}{8}$ -inch-diameter (15.9 mm) threaded rods installed in the top of fully grouted concrete masonry walls (CMU core openings), for anchors designed to resist dead, live, and wind load applications only. Minimum edge and end distances, and spacing requirements, are noted in Table 4A. Minimum edge and end distances are shown in Figure 3.

4.1.3.2 Threaded Rods Installed in the Top of Fully Grouted CMU Walls (Resisting Dead, Live, Wind, and Earthquake Load Applications): Table 4B specifies allowable tension and shear values for $\frac{5}{8}$ -inch-diameter (15.9 mm) threaded rods installed in the top of fully grouted concrete masonry walls (CMU core openings), for anchors designed to resist dead, live, wind, and earthquake load applications. Minimum edge and end distances and spacing requirements are noted in Table 4B, and minimum edge and end distances shown in Figure 3.

4.1.3.3 Threaded Rods Installed in the Vertical Face of Fully Grouted CMU Walls (Resisting Dead, Live, Wind, and Earthquake Load Applications): Table 6 specifies allowable tension and shear values for $\frac{1}{2}$ -, $\frac{5}{8}$ -, and $\frac{3}{4}$ -inch-diameter (12.7, 15.9 and 19.1 mm) threaded rods installed at any location in the face of the fully grouted CMU masonry wall construction (cell, web, head joint, bed joint, etc.), for anchors designed to resist dead, live, wind, and earthquake load applications. Edge and end distances, and spacing requirements, and allowable load reduction factors are noted in Table 5.

4.1.4 Design of Anchors in Unreinforced Brick Masonry: Anchors installed in existing unreinforced brick walls are permitted to resist short-term forces due to earthquake and wind loads only. Allowable loads are noted in Section 4.2.4.3 of this report.

4.2 Installation:

4.2.1 General: Anchors shall be installed in accordance with the manufacturer's published installation instructions and the requirements of this report. The anchors shall not be installed until the base material has reached its minimum specified compressive strength. The hole diameter, embedment depth, spacing, edge distance, and base material shall comply with the requirements in this report.

Anchors installed or cured in masonry or brick at temperatures below 40°F (4.4°C) are outside the scope of this report. The manufacturer's recommended gel and cure times are shown in Table 1. After installation of an anchor, it shall be undisturbed during the gel time, and shall be allowed to reach initial cure before building components are attached.

4.2.2 Installation in Hollow Concrete Masonry: Anchor holes shall be drilled into and through the face shell of hollow concrete masonry walls using a rotary hammer drill, set on rotation-only mode, with a carbide-tipped drill bit complying with ANSI B212.15-1994. Allowable anchor location relative to edge and end of the masonry wall and to mortared joints shall comply with Table 3 and Figure 2.

The SET adhesive shall be injected into a Simpson Strong-Tie Opti-Mesh plastic screen tube, as described in Section 3.3.1 of this report, starting at the bottom, until the tube is completely full. Steel mesh screen tubes for use with anchors installed in hollow masonry are outside the scope of this report. The Opti-Mesh plastic screen tube, completely filled with adhesive, shall be inserted into the predrilled hole until it is fully seated at the required embedment. A threaded rod, which is free of dirt, grease, oil, or other foreign material, shall be pushed into the screen, while being turned slightly, to the bottom of the epoxy-filled screen tube to ensure complete coating of the rod.

4.2.3 Installation in Grout-filled Concrete Masonry: Anchor holes shall be drilled into the concrete to a predetermined depth, using a handheld, electro-pneumatic rotary hammer drill, in either a rotation-and-hammering or rotation-only mode, having a carbide-tipped drill bit conforming to ANSI B212.15-1994. Anchor holes shall be cleaned of dust and debris using oil-free compressed air and a nylon brush.

Holes may be dry, damp, or water-filled. If the hole is filled with water and contains sludge and/or debris, the hole shall be cleaned with pressurized water and a nylon brush. A clean, static-mixing nozzle shall be attached to the SET adhesive cartridge. Prior to injection of the adhesive into the anchor hole, an initial amount of adhesive shall be dispensed through the nozzle until the two adhesive components are uniformly blended. The initial amount of adhesive shall be discarded. The adhesive shall be injected into the hole, starting at the bottom, until the hole is approximately one-half full. Anchors, which are free of oil, scale, and rust, shall be inserted into the hole with a slow twisting motion to the required embedment depth. As a minimum, the adhesive shall be level with the concrete masonry surface after insertion of the anchor.

For installations of $\frac{5}{8}$ -inch-diameter (15.9 mm) threaded rods in the top of fully grouted concrete masonry walls (CMU core openings), anchor location shall comply with the minimum edge and end distances noted in Tables 4A and 4B and shown in Figure 3.

For installations of anchors in the face of the fully grouted masonry wall construction (cell, web, flange, head joint, bed joint, etc.), anchor location shall comply with the

critical and minimum edge and end distances noted in Table 5 and shown in Figure 4, and the critical and minimum spacing's noted in Table 5.

4.2.4 Installation in Unreinforced Brick Masonry Walls:

4.2.4.1 General: The unreinforced brick walls shall have a minimum thickness of 13 inches (330 mm), and three wythes of brick. The anchor shall be installed in one of the three configurations shown in Figure 5, which are described in Sections 4.2.4.1.1 through 4.2.4.1.3. The anchors shall be approved by the registered design professional, and installed under special inspection in accordance with IBC Section 1704 or UBC Section 1701, as applicable. Minimum edge distance and vertical and horizontal spacing is 16 inches (406 mm) for all anchor configurations described in Sections 4.2.4.1.1, 4.2.4.1.2, and 4.2.4.1.3 of this report.

4.2.4.1.1 Configuration A: Configuration A consists of a $\frac{3}{4}$ -inch-diameter (19.1 mm), ASTM A 307, straight threaded rod or a No. 5 or No. 6, straight deformed steel reinforcing dowel bar, and a $\frac{31}{32}$ -inch-outer-diameter-by-8-inch-long (26.4 mm by 203 mm) steel wire or plastic mesh screen tube. This anchor shall be embedded a minimum of 8 inches (203 mm) into the wall and is used when the outside wall is inaccessible. This anchor configuration resists shear loads only.

4.2.4.1.2 Configuration B: Configuration B consists of a $\frac{3}{4}$ -inch-diameter (19.1 mm), ASTM A 307, threaded rod bent at a 22.5-degree angle and installed a minimum of 13 inches (330 mm) into the wall, to within a maximum of 1 inch (25.4 mm) of the exterior wall surface. The pre-bent threaded rod is used with a $\frac{31}{32}$ -inch-outer-diameter-by-13-inch-long (26.4 mm by 330 mm) steel wire or plastic mesh screen tube. This anchor configuration resists tension and shear loads, and is used where the outside of the wall is inaccessible.

4.2.4.1.3 Configuration C: Configuration C consists of a $\frac{5}{8}$ -inch-diameter (15.9 mm), ASTM A 307 threaded rod; an 8-inch-long (203 mm) sleeve, formed from AISI 1010 steel, having outside and inside diameters of $\frac{13}{16}$ inch (20.6 mm) and $\frac{11}{16}$ inch (17.5 mm), respectively; and a $\frac{31}{32}$ -inch-outer-diameter-by-8-inch-long (26.4 mm by 203 mm) steel screen tube. A 6-inch-by-6-inch-by- $\frac{3}{8}$ -inch-thick (152 mm by 152 mm by 9.5 mm) ASTM A 36 steel plate shall be located on the back face of the wall at the end of the threaded rod of the through-bolted connection. This anchor configuration resists tension and shear loads, and is used when the outside surface of the wall is accessible.

4.2.4.2 Installation: The anchors shall be installed in 1-inch-diameter (25.4 mm) holes drilled with a rotary drill or rotary hammer drill used in the rotation-only mode using standard rotary drill bits designed for use in concrete or masonry. The hole shall be drilled perpendicular to the wall face, to a depth of 8 inches (203 mm) for Configurations A and C. The hole for the Configuration B anchor shall be drilled at the angle as described in Section 4.2.4.1.2, and is achieved by using a guide that is hand-held or attached to the drill. The holes shall be cleaned with oil-free compressed air and a nylon brush.

The mixed SET adhesive shall be injected into the screen tube until the tube is completely full, and then placed immediately into the drilled hole. The threaded rod of Configurations A and B, or the steel sleeve of Configuration C, shall be slowly pushed into the screen tube, forcing the adhesive through the screen and into the hole. The adhesive shall be installed and cured at temperatures above 40°F (4.4°C), and for the time period

noted in Table 1 before load application is permitted for Configuration A or B anchors, and before continuing installation of the Configuration C anchor. After the adhesive of the Configuration C anchor has cured, standard rotary drill bits are used to drill a $\frac{5}{8}$ -inch-diameter (15.9 mm) hole through the plastic plug in the end of the steel sleeve and completely through the wall. The $\frac{5}{8}$ -inch (15.9 mm) threaded rod is inserted through the hole and attached to a steel plate and a nut on the other side of the wall.

4.2.4.3 Conditions of Acceptance: Conditions of acceptance for threaded rods and reinforcing dowel bars in unreinforced brick masonry shall be in accordance with Sections 4.2.4.3.1 and 4.2.4.3.2, as applicable.

4.2.4.3.1 Allowable Tension and Shear Loads for Anchor Configurations B and C:

1. Maximum 1,200 pounds (5338 N) allowable tension load for Configuration B (22.5-degree bent threaded rod) and Configuration C [$\frac{5}{8}$ -inch-diameter (15.9 mm) through-bolt], with no adjustment for wind or earthquake loading.
2. Maximum 1,000 pounds (4448 N) allowable shear load for Configuration B (22.5-degree bent threaded rod), with no adjustment for wind or earthquake loading.
3. Maximum 750 pounds (3336 N) allowable shear load for Configuration C [$\frac{5}{8}$ -inch-diameter (15.9 mm) through-bolt], with no adjustment for wind or earthquake loading.
4. Maximum allowable load for Configuration B and C anchors subjected to a combined tension and shear load shall be determined by assuming a straight-line relationship between allowable tension and shear using the equation in Section 4.1.1.
5. The allowable load is applicable only where in-place shear tests indicate a minimum net mortar strength of 50 psi (345 kPa) in accordance with Section A106.3.3.5 of the 2009 *International Existing Building Code*[®] or Section A106.3.3.5 of the 1997 *Uniform Code for Building Conservation*.
6. Five percent of the anchors resisting tension loads shall be tested, with a minimum of two tests required. Where the wall thickness varies, at least one test shall be performed on an anchor that has the least embedment. Tests shall indicate that bolts can sustain a tensile load of 3,000 pounds (13 345 N) (10 percent deviation) for a continuous five-minute period. At a minimum, the test report shall include:
 - a. Test location(s).
 - b. Brick/mortar condition.
 - c. Bolt movement/elongation measurements.
 - d. Embedment depth.
 - e. Applied load and duration.
7. One-fourth (25 percent) of the anchors shall be tested by a special inspector using a calibrated torque wrench set at a minimum torque of 60 foot-pounds (81 N-m). At a minimum, the test report shall include:
 - a. Test location(s).
 - b. Brick/mortar condition.
 - c. Embedment depth.

4.2.4.3.2 Allowable Shear Load for Anchor Configuration A:

1. Maximum 1,000 pounds (4448 N) allowable shear load for the $\frac{3}{4}$ -inch-diameter (19.1 mm) threaded rod, with no adjustment for wind or earthquake loading.
2. Maximum 750 pounds (3336 N) and 1,000 pounds (4448 N) allowable shear loads for the No. 5 and No. 6 reinforcing dowel bars, respectively, with no adjustment for wind or earthquake loading.
3. The allowable load is applicable only where in-place shear tests in accordance with Section A106.3.3.5 of the 2009 *International Existing Building Code*[®] or Section A106.3.3.5 of the 1997 *Uniform Code for Building Conservation* indicate a minimum net mortar strength of 50 psi (345 kPa).
4. One-fourth (25 percent) of the anchors shall be tested by a special inspector using a calibrated torque wrench. The torque for the $\frac{3}{4}$ -inch-diameter (19.1 mm) threaded rod and the No. 6 reinforcing dowel bar shall be 60 foot-pounds (81 N-m); the torque for the No. 5 reinforcing dowel bar shall be 50 foot-pounds (68 N-m).

4.3 Compliance with NSF/ANSI Standard 61:

SET Adhesive Anchor Systems comply with the requirements of NSF/ANSI Standard 61, as referenced in Section 605 of the 2009 *International Plumbing Code*[®] (IPC) for products used in water distribution systems. SET Adhesive Anchor Systems may have a maximum exposed surface area to volume ratio of 216 square inches per 1,000 gallons (139,500 square millimeters per 3,785 liters) of potable water and/or drinking water treatment chemicals. The focus of NSF/ANSI Standard 61 as it pertains to adhesive anchors is to ensure that the contaminants or impurities imparted from the adhesive product to the potable water do not exceed acceptable levels.

4.4 Special Inspection:

Adhesive anchor installations require special inspection in accordance with IBC Section 1704 or UBC Section 1701. Special inspection in accordance with Section 1704 of the IBC shall be provided for installations under the IRC. The approved special inspector shall record the following:

1. Adhesive product description, including the adhesive product name and expiration date, adhesive mixing procedure for the SET-PAC cartridge (if used), and use of proper nozzles for all cartridges described in this report.
2. Anchor bolt or rebar material, grade, diameter, length and cleanliness.
3. Required drill bit diameter, including verification of carbide-tipped drill bit compliance with ANSI B212.15-1994.
4. Hole depth and cleanliness.
5. Installation description, including verification of concrete compressive strength by ASTM C 42 methods, when required; verification of physical properties of the concrete masonry wall construction components; substrate temperature at time of anchor installation, actual gel time when installed anchors are not disturbed; and verification of anchor installation and location (spacing and edge distance) in accordance with the manufacturer's published installation instructions and this report.

5.0 CONDITIONS OF USE

The SET Adhesive Anchor Systems 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 adhesive shall be identified and installed in accordance with this report and the manufacturer's published instructions. In the event of a conflict between this report and the manufacturer's instructions, this report shall govern.
- 5.2 Anchors installed in hollow concrete masonry walls to resist dead, live, and wind load applications shall be in accordance with Sections 4.1.1, 4.1.2, 5.7, 5.9 and 5.11 of this report. Use of the anchors to resist earthquake loads is outside the scope of this report.
- 5.3 Anchors installed in the top of fully grouted concrete masonry walls (CMU core openings) to resist dead, live, and wind load applications (with a zero percent allowable load increase for wind loads) shall be in accordance with Sections 4.1.1, 4.1.3.1, 5.7, 5.9 and 5.11 of this report.
- 5.4 Anchors installed in the top of fully grouted concrete masonry walls (CMU core openings) to resist dead, live, wind and earthquake load applications (with a $33\frac{1}{3}$ percent allowable load increase for wind and earthquake loads) shall be in accordance with Sections 4.1.1, 4.1.3.2, 5.6, 5.8 and 5.10 of this report.
- 5.5 Anchors installed in the face of the fully grouted masonry wall construction (cell, web, flange, head joint, bed joint, etc.) to resist dead, live, wind, and earthquake load applications shall be in accordance with Section 4.1.3.3, 5.6, 5.8 and 5.10 of this report.
- 5.6 **Grouted Masonry (Table 4-B and Table 6) under the 2009, 2006 and 2003 IBC or the 2009, 2006 and 2003 IRC:** The adhesive anchors described in the evaluation report are capable of resisting seismic and wind loads. When using the basic load combinations in accordance with 2009, 2006 or 2003 IBC Section 1605.3.1, as modified in Table 2, allowable loads are not permitted to be increased for seismic or wind loading. When using the alternative basic load combinations in 2009, 2006 or 2003 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.
- 5.7 **Grouted Masonry (Table 4-A) and Hollow Masonry under the 2009, 2006 and 2003 IBC and the 2009, 2006 and 2003 IRC:** Use of the anchors to resist seismic loads is beyond the scope of this report. The allowable loads or load combinations for the adhesive anchors shall not be adjusted for anchors subjected to wind loads.
- 5.8 **Grouted Masonry (Table 4-B and Table 6) under the 2000 IBC and the 2000 IRC:** When using the basic load combinations in accordance with IBC Section 1605.3.1, as modified by Table 2, 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, as modified by Table 2.
- 5.9 **Grouted Masonry (Table 4-A) and Hollow Masonry under the 2000 IBC and the 2000 IRC:** Use of the anchors to resist seismic loads is beyond the scope of this report. The allowable loads or load combinations for the adhesive anchors shall not be adjusted for anchors subjected to wind loads.
- 5.10 **Grouted Masonry (Table 4-B and Table 6) under the UBC:** When using the basic load combinations in accordance with UBC Section 1612.3.1, as modified by Table 2, allowable loads are not permitted to be increased for wind or seismic 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, as modified in Table 2.
- 5.11 **Grouted Masonry (Table 4-A) and Hollow Masonry under the UBC:** Use of the anchors to resist seismic loads is beyond the scope of this report. The allowable loads or load combinations for the adhesive anchors shall not be adjusted for anchors subjected to wind loads.
- 5.12 Use of anchors installed in unreinforced brick masonry walls is limited to resisting earthquake and wind loads only, as addressed in Section 4.1.4 and described in Section 4.2.4.
- 5.13 Anchors shall be installed in holes predrilled with carbide-tipped masonry drill bits complying with ANSI B212.15-1994. For installation of anchors in normal-weight concrete only, a diamond core bit having the same tolerance limits specified in ANSI B212.15-1994 is an alternative to the carbide-tipped masonry drill bits.
- 5.14 Special inspection in accordance with Section 4.4 of this report shall be provided for all anchor installations.
- 5.15 Calculations and details demonstrating compliance with this report shall be submitted to the code official for approval. The calculations shall be prepared by a registered design professional where required by statutes of the jurisdiction in which the project is to be constructed.
- 5.16 **Fatigue and Shock Loading:** Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive 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.
- 5.17 **Wall Installations:** The adhesive anchors may be used to resist tension and shear forces in wall installations only if consideration is given to the effects of elevated temperature conditions on anchor performance. Figure 1 describes load reduction factors for elevated temperatures.
- 5.18 **Fire-resistance-rated Construction:** Anchors are not permitted to support fire-resistance-rated construction. Where not otherwise prohibited by the applicable code, anchors are permitted for installation in 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 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.

5.19 Cracked Masonry: Since an ICC-ES acceptance criteria for evaluating the performance of adhesive anchors in cracked masonry is unavailable at this time, the use of the anchors is limited to installation in uncracked masonry. Cracking occurs when $f_t > f_r$ due to service loads or deformations.

5.20 SET adhesive used in conjunction with steel rebars and carbon steel threaded rods shall be limited to interior exposure. Installations exposed to severe, moderate, or negligible exterior weathering conditions, as defined in Figure 1 of ASTM C 62 (IBC or IRC) or Figure 21-1-1 of UBC Standard 21-1, shall be permitted where stainless steel threaded rods or hot-dipped anchors with a zinc coating complying with ASTM A 153, Class C or D, are used.

5.21 Anchors installed in masonry may be installed in dry, damp, or water-filled holes.

5.22 The SET adhesive shall be installed in base materials (concrete masonry) having interior temperatures (i.e., substrate temperature measured within anchor hole) between 40°F (4.4°C) and 110°F (43°C) at time of anchor installation. Installation of anchors in base materials having interior temperatures outside this range is outside the scope of this report.

5.23 When anchors are located where the interior base-material temperature may exceed 110°F (43°C) in service, allowable loads in this report shall be adjusted for in-service temperatures in accordance with Figure 1. Use of the SET adhesive anchors in base materials having interior temperatures exceeding 180°F (82°C) is outside the scope of this report.

5.24 For anchors installed in unreinforced brick masonry, the registered design professional or contractor must submit a report to the building official verifying that requirements in this report have been met.

5.25 Treated Wood: Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood must be of stainless steel.

5.26 Mortar Shear Strength of Existing Buildings: For unreinforced brick masonry, in-place mortar shear strength tests shall be conducted in accordance with IEBC and Section A 106.3.3.1. A minimum of five tests are required. Test locations shall observe general requirements in Section A 106.3.3.3 of the IEBC and Section A 106.3.3.2 of the UCBC. The in-place mortar shear strength or the building comply with requirements in Section A 106.3.3.5 of the IEBC or Section A 106.3.3.5 of the UCBC.

5.27 The SET adhesive is manufactured and packaged into the cartridges described in this report by Simpson Strong-Tie Company, Inc., 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 Adhesive Anchors in Masonry Elements (AC58), dated December 2006, including the following optional test series: effects of edge distance on tension performance (Test Series 4 and 5); effects of spacing on tension performance (Test Series 8 and 9); effects of edge distance on shear performance (Test Series 13 and 14); creep (Test Series 17); in-service temperature testing of anchors installed and cured at 40°F (Test Series 18); damp and water-filled hole (Test Series 19); freeze/thaw (Test Series 20); and earthquake investigations in fully-grouted concrete masonry construction (Test Series 21).

6.2 Data in accordance with the ICC-ES Acceptance Criteria Anchors in Unreinforced Masonry Elements (AC60), dated April 2005 (editorially revised May 2007).

6.3 Data in accordance with NSF/ANSI Standard 61, Drinking Water System Components—Health Effects, for the SET adhesive.

6.4 A quality control manual.

7.0 IDENTIFICATION

Simpson Strong-Tie SET adhesive anchoring systems are identified in the field by labels on the cartridges or packaging, bearing the company name (Simpson Strong-Tie Company, Inc.), the product name (SET 1.7, SET22, SET56, SET-PAC, or SET-PAC-EZ), the batch number, the expiration date, the name of the inspection agency (CEL Consulting), and the evaluation report number (ESR-1772). Screen tubes are identified by a label on the packaging, bearing the Simpson Strong-Tie name, type (plastic or metal), and size.

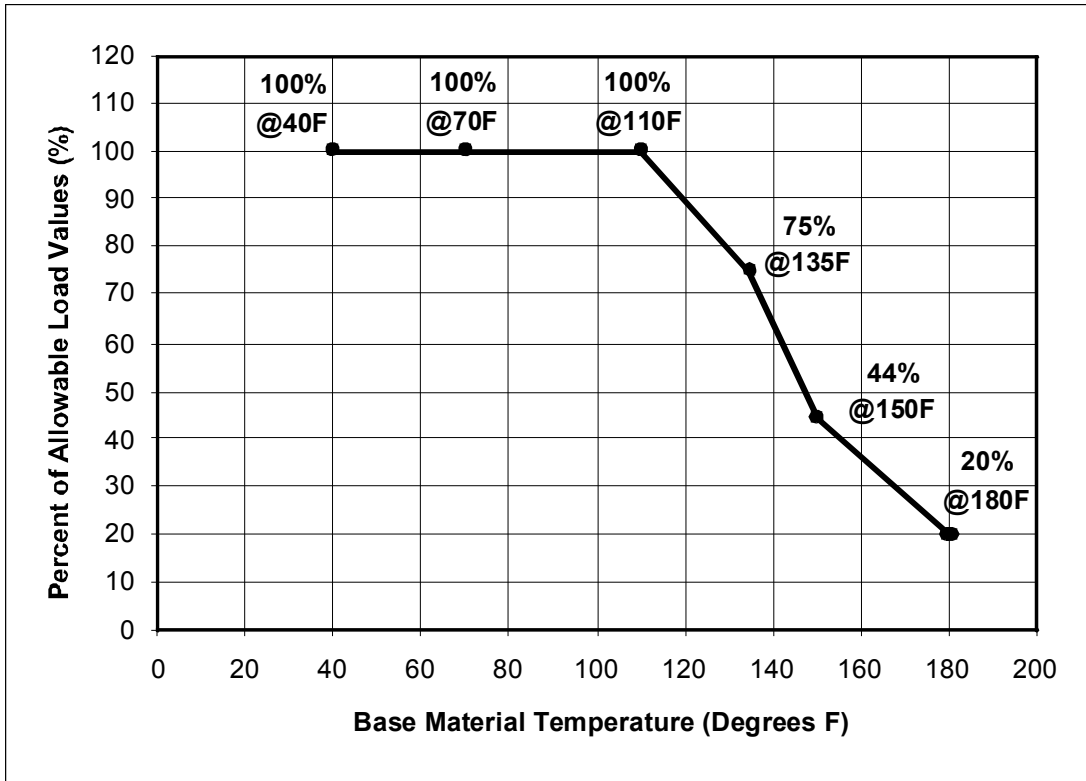
TABLE 1—MANUFACTURER’S RECOMMENDED CURING TIMES FOR SET ADHESIVES¹

TEMPERATURE (°F)	GEL TIME ² (hours)	INITIAL CURE ² (hours)
40	2	72
65	1 ¹ / ₄	24
85	1	20
90	1	16

For SI: 1°C = 5/9 (°F-32).

¹Anchors installed or cured, or both, at temperatures below 40°F (4.4°C) are outside the scope of this report.

²Anchors shall be undisturbed during the gel time, and shall be allowed to reach initial cure before attaching building components.



For SI: 1°C = 5/9 (°F-32).

FIGURE 1—LOAD CAPACITY BASED ON IN-SERVICE TEMPERATURE

TABLE 2—PERCENT INCREASE FOR WIND OR EARTHQUAKE LOADING CONDITIONS USING ALTERNATIVE BASIC LOAD COMBINATIONS

SUBSTRATE	ALLOWABLE LOAD TABLE NUMBER IN THIS EVALUATION REPORT	ANCHOR TYPE	PERCENT INCREASE FOR SHORT-TERM LOADING CONDITIONS			
			Earthquake		Wind	
			Tension	Shear	Tension	Shear
Hollow concrete masonry	3	Threaded rods ⁴	N/R ¹	N/R ¹	zero	zero
Grout-filled concrete masonry	4A	Threaded rods ⁴	N/R ¹	N/R ¹	zero	zero
	4B	Threaded rods	33 ¹ / ₃	33 ¹ / ₃	33 ¹ / ₃	33 ¹ / ₃
	6	Threaded rods	33 ¹ / ₃	33 ¹ / ₃	33 ¹ / ₃	33 ¹ / ₃

¹N/R = Not recognized (for use to resist earthquake loads)

TABLE 3—ALLOWABLE TENSION AND SHEAR VALUES
 (For Threaded Rods Installed with the SET Adhesive and Plastic Screen Tubes in the Face Shell of Hollow Concrete Masonry)

THREADED ROD DIAMETER (inch)	DRILL BIT DIA. (inch)	MIN. EMBED. ¹ (inches)	ANCHOR LOCATION ² (Distance of Anchor to Edge or End of Masonry Wall)		ALLOWABLE LOADS BASED ON ANCHOR LOCATION ^{3,4,5,6,7,8,9} (pounds)					
					Tension				Shear	
			Crit., C_{cr} (inches)	Min., C_{min} (inches)	UBC		IBC & IRC		UBC	IBC & IRC
					Crit., C_{cr}	Min., C_{min}	Crit., C_{cr}	Min., C_{min}	Crit., C_{cr} and Min., C_{min}	
3/8	9/16	3	12	4	375	255	300	205	320	255
1/2	3/4	3	12	4	375	255	300	205	320	255
5/8	7/8	3	12	4	375	255	300	205	345	275

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

¹The tabulated minimum embedment is the minimum length of the plastic screen tube.

²Anchors shall be installed in the face shell of the hollow CMU unit. A maximum of one anchor for each 8"×8"×16" CMU block is allowed. The minimum distance from the anchor centerline to a mortar head (vertical) joint is 4 5/8 inches. Refer to Figure 2 for an illustration of an anchor located at minimum edge distance, C_{min} , and minimum head joint distance.

³Tabulated load values are for anchors installed in hollow masonry construction wall construction, consisting of closed-end, Type II, Grade N, lightweight, medium-weight, or normal-weight concrete masonry units (CMU) conforming to ASTM C 90 or UBC Standard 21-4 (where the minimum face shell thickness of the masonry units shall be 1 1/4 inches). The allowable minimum nominal CMU dimensions shall be 8 inches wide by 8 inches high by 16 inches long. The mortar type shall conform to ASTM C 270 or UBC Standard 21-15, as applicable, and shall have a minimum 1,500 psi compressive strength.

⁴Tabulated allowable loads are based on the bond capacity for the SET adhesive installed with the Simpson Strong-Tie Opti-Mesh™ screen tube described in Section 3.3.1 of this report. Installation of anchors with steel screen tubes described in Section 3.3.2 of this report is outside the scope of this report.

⁵Tabulated allowable loads are based on a safety factor of 4.0 for installations under the UBC, and a safety factor of 5.0 for installations under the IBC and the IRC.

⁶Anchors are not recognized for resisting earthquake forces. For short-term loading due to wind forces, the allowable loads shall not be increased. Refer to Section 4.1.4, Section 5.0 and Table 2 of this report for details.

⁷Special inspection shall be provided for installations in accordance with Section 4.4.

⁸Allowable load values shall be adjusted for increased base material temperatures in accordance with Figure 1.

⁹Linear interpolation for allowable loads may be used for edge distances between critical, C_{cr} , and minimum, C_{min} . Reduction factors are cumulative when two or more are applicable.

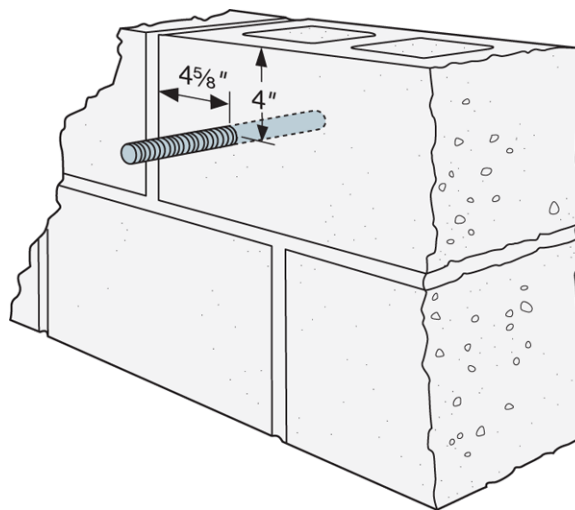


FIGURE 2—ANCHOR INSTALLATION IN HOLLOW CMU MASONRY WALL CONSTRUCTION
 [Minimum 4-inch (102 mm) Distance to Edge or End of Masonry Wall Construction and Minimum 4 5/8-inch (117 mm) Distance to a Head Joint]

TABLE 4A—ALLOWABLE TENSION AND SHEAR VALUES EXCLUDING EARTHQUAKE LOADS¹
 (For Threaded Rods Installed with the SET Adhesive in Grout-filled Core of CMU Masonry—Top of Masonry Wall,
 for Sill Plates and Other Attachments)

THREADED ROD DIAMETER (inch)	DRILL BIT DIAMETER (inch)	MINIMUM EMBEDMENT (inches)	ANCHOR LOCATION ³ (inches)			ALLOWABLE LOADS ^{4,5,6,7} (pounds)			
			Minimum Edge Distance	Minimum End Distance	Minimum Spacing	Tension		Shear (Parallel or Perpendicular to Edge of Masonry Wall)	
						UBC	IBC & IRC	UBC	IBC & IRC
5/8	3/4	5	3	3 1/2	20	3,140	2,510	2,380	1,905

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

¹The allowable loads in Table 4A are for a 5/8-inch-diameter threaded rod resisting dead, live, and wind load applications only. For short-term loading due to wind forces, the allowable loads shall not be increased as indicated in Section 4.1.3.1, Section 5.0 and Table 2 of this report.

³⁻⁷Footnotes 3 through 7 are located under Table 4B.

TABLE 4B—ALLOWABLE TENSION AND SHEAR VALUES INCLUDING EARTHQUAKE LOADS²
 (For Threaded Rods Installed with the SET Adhesive in Grout-filled Core of CMU Masonry—Top of Masonry Wall,
 for Sill Plates and Other Attachments)

THREADED ROD DIAMETER (inch)	DRILL BIT DIAMETER (inch)	MINIMUM EMBEDMENT (inches)	ANCHOR LOCATION ³ (inches)			ALLOWABLE LOADS ^{4,5,6,7} (pounds)			
			Minimum Edge Distance	Minimum End Distance	Minimum Spacing	Tension		Shear (Parallel or Perpendicular to Edge of Masonry Wall)	
						UBC	IBC & IRC	UBC	IBC & IRC
5/8	3/4	5	3	3 1/2	20	1,625	1,300	1,695	1,355

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

²The allowable loads in Table 4B are for a 5/8-inch diameter threaded rod resisting dead, live, wind, and earthquake load applications. For short-term loading due to wind and earthquake forces, the allowable loads may be increased as indicated in Section 4.1.3.2, Section 5.0 and Table 2 of this report.

(The following footnotes apply to both Tables 4A and 4B):

³One anchor shall be permitted to be installed in each CMU block. The tabulated minimum 3-inch edge and 3 1/2-inch end distance are measured from the anchor centerline to the edge and end of the CMU block, respectively. Anchors are not permitted to be installed in a head (vertical) joint, CMU flange, or CMU center web. Refer to Figure 3 for an illustration of the anchor location for which the tabulated loads are applicable.

⁴Values for Grade N, Type II, lightweight, medium-weight, or normal-weight concrete masonry units (CMU) conforming to ASTM C 90 or UBC Standard 21-4, as applicable. Allowable minimum nominal dimensions of the CMU shall be either 6 or 8 inches wide by 8 inches high by 16 inches long. Masonry wall construction shall be fully grouted with coarse grout having a minimum compressive strength of 2,000 psi, and complying with IBC Section 2103.12 or UBC Section 2103.4, as applicable. Mortar shall comply with IBC Section 2103.8, or UBC Section 2103.3 and UBC Standard 21-15, as applicable; and have a minimum compressive strength of 1,500 psi. The specified compressive strength of masonry, *f'm*, at 28 days shall be a minimum of 1,500 psi.

⁵Allowable load values shall be adjusted for increased base material temperatures in accordance with Figure 1, as applicable.

⁶Tabulated allowable loads are based on a safety factor of 4.0 for installations under the UBC, and a safety factor of 5.0 for installations under the IBC and the IRC.

⁷Special inspection shall be provided for installations in accordance with Section 4.4.

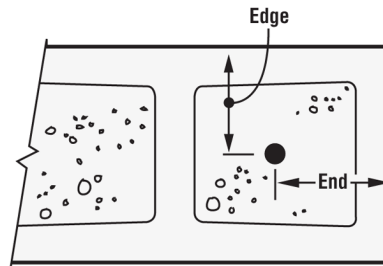


FIGURE 3—EDGE AND END DISTANCES FOR THE 5/8-INCH-DIAMETER ANCHOR INSTALLED IN THE TOP OF CMU MASONRY WALL CONSTRUCTION

TABLE 5—EDGE DISTANCE AND SPACING REQUIREMENTS AND ALLOWABLE LOAD REDUCTION FACTORS¹
(For Threaded Rods Installed with the SET Adhesive in the Face of Fully Grouted CMU Masonry Wall Construction)

ROD DIA. (in.)	MIN. EMBED. DEPTH, h_v (inches)	EDGE OR END DISTANCE ²						SPACING ³				
		Critical ⁴ (Full Anchor Capacity)		Minimum ⁵ (Reduced Anchor Capacity)				Critical ⁶ (Full Anchor Capacity)		Minimum ^{7,8} (Reduced Anchor Capacity)		
		Critical Edge or End Distance, C_{cr} (inches)	Allowable Load Reduction Factor	Minimum Edge or End Distance, C_{min} (inches)	Allowable Load Reduction Factor ^{9,10}		Critical Spacing, S_{cr} (inches)	Allowable Load Reduction Factor	Minimum Spacing, S_{min} (inches)	Allowable Load Reduction Factor ^{9,11}		
					Tension	Shear ¹²				Ten.	Shear	
		Load Direction		Load Direction				Load Direction		Load Direction		
Tension or Shear	Tension or Shear	Tension or Shear	Tension	Shear ¹²		Tension or Shear	Tension or Shear	Tension or Shear	Ten.	Shear		
					Perp.	Para.						
$1/2$	$4 1/4$	17	1.0	4	1.0	0.43	0.95	17	1.0	8	0.89	1.0
$5/8$	5	20	1.0	4	0.84	0.25	0.51	20	1.0	8	0.81	1.0
$3/4$	$6 3/4$	27	1.0	4	0.54 ⁽¹³⁾	0.25	0.45	27	1.0	8	0.59	1.0

For SI: 1 inch = 25.4 mm.

¹Special inspection shall be provided for installations in accordance with Section 4.4.

²Edge distance, c , is the distance measured from the anchor centerline to the edge or end of the CMU masonry wall. Refer to Figure 4 for an illustration showing critical and minimum edge and end distances.

³Anchor spacing, s , is the distance measured from centerline to centerline of two anchors.

⁴Critical edge distance, c_{cr} , is the least edge distance at which the tabulated allowable load of an anchor is achieved where a load reduction factor equals 1.0 (no load reduction).

⁵Minimum edge distance, c_{min} , is the least edge distance where an anchor has an allowable load capacity, which shall be determined by multiplying the allowable loads assigned to anchors installed at critical edge distance, c_{cr} , in Table 6 by the load reduction factors shown above.

⁶Critical spacing, s_{cr} , is the least anchor spacing at which the tabulated allowable load of an anchor is achieved such that the anchor performance is not influenced by adjacent anchors.

⁷Minimum spacing, s_{min} , is the least spacing where an anchor has an allowable load capacity, which shall be determined by multiplying the allowable loads assigned to anchors installed at critical edge distance, c_{cr} , in Table 6 by the load reduction factors shown above.

⁸The shear load reduction is equal to 1.0 for anchors installed at minimum spacing of 8 inches, i.e., anchors have full shear load capacity from Table 6 when spaced at minimum spacing of 8 inches.

⁹Reduction factors are cumulative. Multiple reduction factors for more than one spacing or edge or end distance shall be calculated separately and multiplied.

¹⁰The load reduction factor for anchors loaded in tension or shear with edge distances between critical and minimum shall be obtained by linear interpolation.

¹¹The load reduction factor for anchors loaded in tension with spacing between critical and minimum shall be obtained by linear interpolation.

¹²Perpendicular shear loads act towards the edge or end. Parallel shear loads act parallel to the edge or end. Perpendicular and parallel shear load reduction factors are cumulative when the anchor is located between the critical and minimum edge and end distance.

¹³The allowable tension load reduction factor is permitted to equal 1.0 provided both of the following conditions are met: (a) The anchor is installed with a minimum end distance, c_{min} , between 4 inches and 8 inches; and (b) a masonry return wall of identical construction is on the opposite side (such as two masonry walls intersecting at a building corner).

TABLE 6—ALLOWABLE TENSION AND SHEAR VALUES
(For Threaded Rods Installed with the SET Adhesive in the Face of Fully Grouted CMU Masonry Wall Construction)

THREADED ROD DIAMETER (inch)	DRILL BIT DIAMETER (inch)	MINIMUM EMBEDMENT ¹ (inches)	ALLOWABLE LOADS BASED ON ANCHORS INSTALLED AT CRITICAL EDGE/END DISTANCE, C_{cr} ^{2,3,4,5,6,7,8,9} (pounds)			
			Tension		Shear	
			UBC	IBC & IRC	UBC	IBC & IRC
$1/2$	$5/8$	$4 1/4$	1,625	1,300	1,695	1,355
$5/8$	$3/4$	5	2,060	1,645	3,420	2,735
$3/4$	$7/8$	$6 3/4$	3,915	3,130	4,395	3,515

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

¹Embedment depth is measured from the outside face of the masonry.

²Critical, c_{cr} , and minimum, c_{min} , edge distance and critical, s_{cr} , and minimum, s_{min} , spacing shall comply with Table 5. Refer to Figure 4 for an illustration showing critical and minimum edge and end distances.

³Anchors are limited to one per masonry cell.

⁴Anchors are permitted to be installed at any location in the face of the fully grouted masonry wall construction (cell, web, head joint, bed joint, etc.).

⁵Tabulated load values are for anchors installed in fully grouted masonry construction wall construction, consisting of Grade N, Type II, lightweight, medium-weight, or normal-weight, closed-end, concrete masonry units (CMU) conforming to ASTM C 90 or UBC Standard 21-4. Masonry shall be fully grouted with coarse grout having a minimum compressive strength of 2,000 psi, and complying with IBC Section 2103.10 or UBC Section 2103.4. Mortar shall comply with IBC Section 2103.7, or UBC Section 2103.3 and UBC Standard 21-15; and have a minimum compressive strength of 1,500 psi. The specified compressive strength of masonry, f'_m , at 28 days shall be a minimum of 1,500 psi.

⁶Tabulated allowable loads are based on a safety factor of 4.0 for installations under the UBC, and a safety factor of 5.0 for installations under the IBC and the IRC.

⁷Tabulated allowable load values shall be adjusted for increased base material temperatures in accordance with Figure 1, as applicable.

⁸Threaded rods installed in fully grouted masonry walls with the SET adhesive are permitted to resist earthquake and wind loads. Refer to Section 4.1.3.3, Section 5.0 and Table 2 of this report for design requirement details.

⁹Special inspection shall be provided for installations in accordance with Section 4.4.

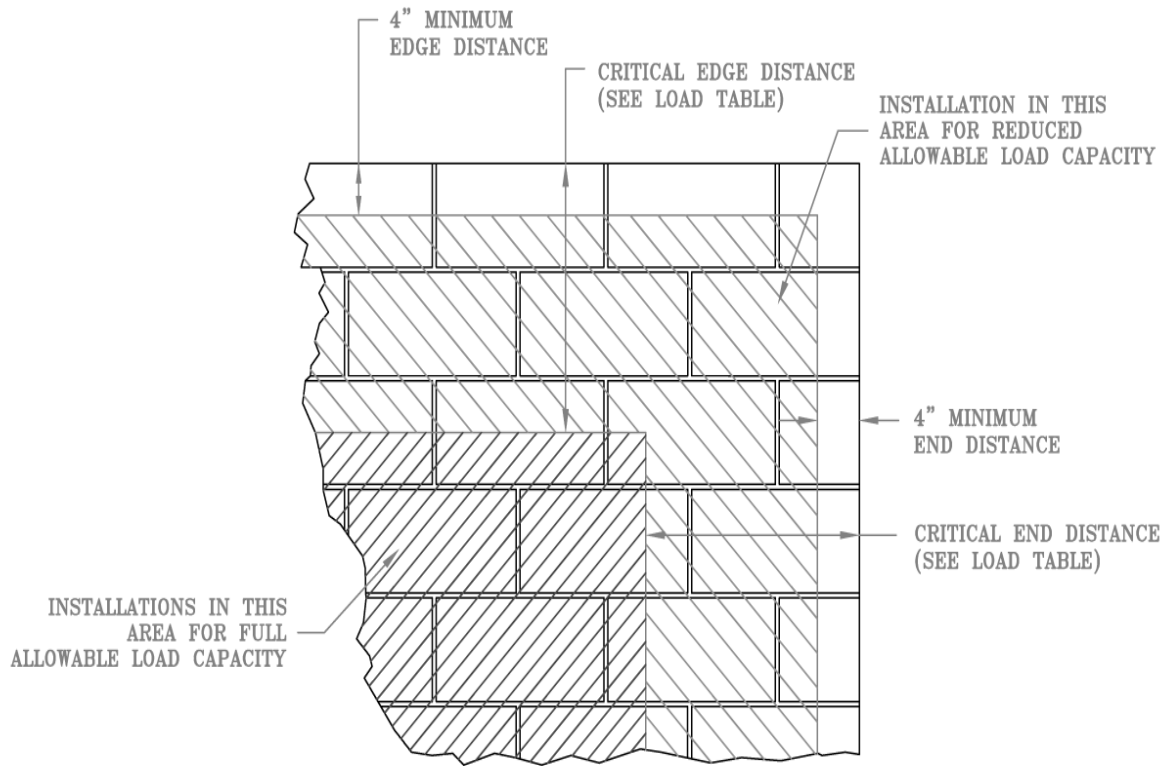


FIGURE 4—ALLOWABLE ANCHOR LOCATIONS FOR FULL AND REDUCED LOAD CAPACITY WHEN INSTALLATION IS IN THE FACE OF FULLY GROUTED CMU MASONRY WALL CONSTRUCTION

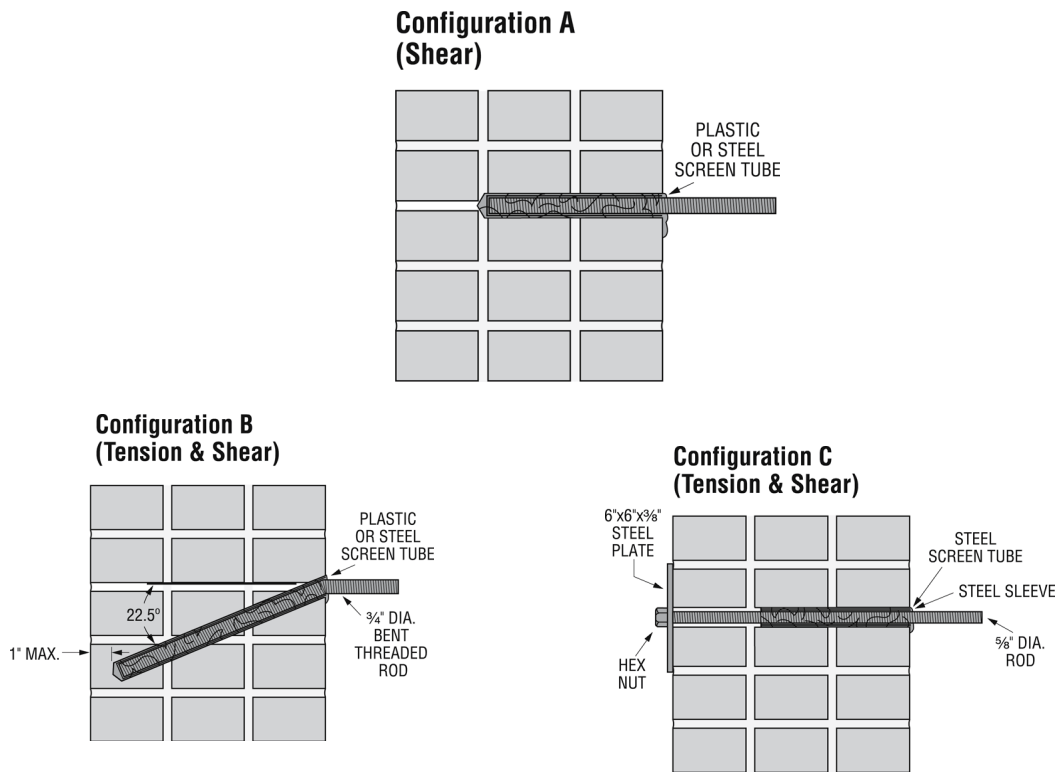


FIGURE 5—ANCHOR INSTALLATIONS FOR UNREINFORCED BRICK MASONRY (Refer to sections 4.1.4 and 4.2.4 for Details Concerning design and Installation of Anchors in Unreinforced Brick Masonry)