

ICC-ES Evaluation Report

ESR-2369

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This report is subject to re-examination in one year.

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DIVISION: 04—MASONRY
Section: 04081—Masonry Anchorage
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EVALUATION SUBJECT:
HUS-H CONCRETE MASONRY SCREW 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)

Property evaluated:

Structural

2.0 USES

The Hilti HUS-H Concrete Masonry Screw Anchor is installed in uncracked, fully grouted concrete masonry unit (CMU) construction as shown in Figure 1 of this report. The screw anchors are alternatives to the cast-in-place anchors described in Section 2107 of the IBC. The screw anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION: MATERIALS
3.1 HUS-H Masonry Screw Anchors:

The HUS-H Masonry Screw Anchor has a hex head, an integral washer, double lead threads, and a chamfered tip (see Figures 2 and 3). The anchor is manufactured from heat-treated carbon steel and has a non-electronically applied zinc flake coating. The HUS-H is available in nominal diameters of $\frac{3}{8}$, $\frac{1}{2}$ and $\frac{5}{8}$ inch (9.5, 12.7 and 15.9 mm). Anchor specifications are summarized in Table 1 of this report.

3.2 Grouted-filled Concrete Masonry:

Concrete masonry unit (CMU) construction must be fully grouted and have, at the time of anchor installation, a

minimum prism strength as specified in the footnotes to Tables 2 and 3 of this report. Fully grouted masonry walls must be constructed from the following materials:

3.2.1 Concrete Masonry Units (CMUs): 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. CMUs must be Grade N, Type 1, in accordance with ASTM C 90 (IBC or IRC).

3.2.2 Grout: Grout must comply with Section 2103.12 of the IBC or Section R609.1.1 of the IRC.

3.2.3 Mortar: Mortar must be Type N (minimum) in accordance with Section 2103.8 if the IBC or Section R607 of the IRC.

4.0 INSTALLATION AND DESIGN
4.1 Installation:

HUS-H screw anchors must be installed after the masonry has reached the minimum designated strength. Holes must be drilled perpendicular to the base material surface, using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. Table 1 specifies the nominal drill bit diameter for each anchor size. Hole depth must be equal to the length of the anchor plus $\frac{3}{8}$ of an inch (9.5 mm). Before anchor installation, dust and other deleterious matter must be removed from the hole using compressed air. The HUS-H anchor must then be installed per the manufacturer's instructions to the specified embedment depth. See Figure 4 for installation instructions.

4.2 Design:

The allowable load values for anchors described in this report are based on allowable stress design under the IBC. Anchors are limited to installation into the face shell or top of grouted CMU construction, as provided in the non-shaded areas in Figure 1 of this report. The allowable tension and shear loads for the HUS-H anchor are shown in Tables 2 and 3 for use in grouted CMU construction. The spacing between anchors and the distance between the anchor and the edge of the concrete masonry wall must be as set forth in Tables 2 and 3.

Allowable loads for anchors installed in grouted CMU construction subjected to combined shear and tension forces are determined by the following equation:

$$(P_s/P_t) + (V_s/V_t) \leq 1$$

where:

P_s = Applied service tension load (lb or N).

P_t = Allowable service tension load (lb or N).

V_s = Applied service shear load (lb or N).

V_t = Allowable service shear load (lb or N).

4.3 Special Inspection:

When specified by Tables 2 and 3, special inspection in accordance with Section 1704 of the IBC must be provided during anchor installation. The code official must receive a report, from an approved special inspector, that includes the following details:

1. Anchor description, including the anchor product name, nominal anchor and bolt diameters, and anchor length.
2. Hole description, including verification of drill bit compliance with ANSI B212.15-1994, hole depth and cleanliness.
3. Installation description, hole location (spacing and edge distance), fastener embedment, and verification of anchor installation in accordance with the manufacturer's published instructions and this report.
4. CMU size and compressive strength, mortar compressive strength and, when required, masonry prism compressive strength.

5.0 CONDITIONS OF USE

The HUS-H Masonry 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 Anchor sizes, dimensions and installation must comply with this report and manufacturer's published installation instructions. In the event of a conflict, this report governs.
- 5.2 Allowable shear and tension loads must comply with this report.
- 5.3 Calculations and details demonstrating compliance with this report must be submitted to the code official, for approval, by a registered design professional.
- 5.4 When using basic load combinations in accordance with IBC Section 1605.3.1.1, the allowable loads presented in Tables 2 and 3 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 presented in Tables 2 and 3 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.
- 5.5 The use of anchors is limited to installation in uncracked masonry. Cracking occurs when $f_t > f_r$ due to service loads or deformations.

5.6 Where not otherwise prohibited by the applicable code, anchors are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support fire-resistance-rated construction or gravity load-bearing structural elements are within a fire-resistance-rated envelope or a fire-resistance-rated membrane, are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support nonstructural elements.

5.7 Anchors are limited to dry, interior locations.

5.8 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of screw anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under these conditions is beyond the scope of this report.

5.9 Use of HUS-H anchors with preservative-treated and fire-retardant-treated wood is beyond the scope this report.

5.10 Special inspection, when required, must be provided in accordance with Section 4.3 of this report.

5.11 HUS-H screw anchors are manufactured by Hilti, Inc., at their manufacturing plant in Schaan, Liechtenstein, with quality inspections by Underwriters Laboratories Inc. (AA-668)

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry (AC106), dated February 2010, including the following optional tests: minimum edge distance on tension and shear (Test Series 5 and 14 of AC106); minimum spacing on tension and shear (Test Series 9 and 18 of AC106); and seismic performance tests (Section 4.6 of AC106).

7.0 IDENTIFICATION

Anchors are identified by a head marking which denotes Hilti, the diameter and the anchor length. Anchor containers bear the Hilti, Inc., name and address, the product name, and the evaluation report number (ESR-2369). The containers for the anchors also include the name of the inspection agency (Underwriters Laboratories Inc.).

TABLE 1—SPECIFICATION TABLE⁴

| PARAMETER | NOMINAL ANCHOR DIAMETER (in.) | | | | | | |
|---|-------------------------------|-------------------------------|------------------------------|---|-------------------------------|---|-------------------------------|
| | ³ / ₈ | | ¹ / ₂ | | ⁵ / ₈ | | |
| d_{bit} : nominal bit diameter ¹ | ⁵ / ₁₆ | | ⁷ / ₁₆ | | ⁹ / ₁₆ | | |
| h_{ef} : minimum embedment depth (in.) ^{2,3} | 2 | 2 ³ / ₄ | 2 | 3 | 2 ³ / ₈ | 4 | 5 ³ / ₈ |
| h_1 : minimum hole depth (in.) | $h_{ef} + \frac{3}{8}$ | | $h_{ef} + \frac{3}{8}$ | | $h_{ef} + \frac{3}{8}$ | | |
| d_h : minimum thread clearance hole in plate (in.) | ⁷ / ₁₆ | | ⁹ / ₁₆ | | ¹¹ / ₁₆ | | |
| Max. tightening torque (ft-lb) | 26 | | 33 | | 48 | | |
| H : minimum base material thickness (in.) | 1.5 h_{ef} | | | | | | |

For **SI**: 1 inch = 25.4 mm, 1 ft-lb. = 1.356 N-m.

¹Carbide-tipped masonry drill bits complying with ANSI B212.15-1994.

²Interpolation allowed between embedment depths.

³Grout-filled concrete masonry unit construction uses standard embedment depths.

⁴See Figure 1 for terminology.

TABLE 2—HUS-H ALLOWABLE TENSION AND SHEAR VALUES (pounds), FACE OF GROUT-FILLED CONCRETE MASONRY CONSTRUCTION^{1,2,3,5,8}

| ANCHOR DIAMETER (in.) | EMBEDMENT DEPTH ⁴ (in.) | MINIMUM DISTANCE FROM EDGE OF WALL ⁷ (in.) | TENSION | SHEAR |
|-----------------------------|------------------------------------|---|---|---|
| | | | IBC/IRC with Special Insp. ⁶ | IBC/IRC with Special Insp. ⁶ |
| ³ / ₈ | 2 ³ / ₄ | 4 | 550 | 810 |
| | | 12 | 725 | |
| ¹ / ₂ | 3 | 4 | 645 | 1375 |
| | | 12 | 725 | |
| ⁵ / ₈ | 4 | 4 | 1090 | 2070 |
| | | 12 | | 2180 |

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

¹The tabulated shear and tension loads are for anchors installed in any masonry construction complying with Section 3.1 of this report.

²Anchors must be installed a minimum of 1 inch from any vertical mortar joint in accordance with Figure 1.

³Anchors are limited to one per masonry cell with a minimum spacing of 8 inches on center.

⁴Embedment depth is measured from the outside face of the concrete masonry construction.

⁵Allowable values may be adjusted in accordance with Section 1605.3 of the IBC, as described in Section 5.3 and Section 5.4, respectively, of this report.

⁶These tension values are only applicable when the anchors are installed with special inspection as set forth in Section 4.3 of this report.

⁷Linear interpolation for edge distances between 4 inches and 12 inches is allowed. Edge distances of less than 4 inches are beyond the scope of this report.

⁸These load values are valid for a masonry prism strength, f'_m of 1,800 psi.

**TABLE 3—HUS-H ALLOWABLE TENSION AND SHEAR VALUES (pounds),
TOP OF GROUT-FILLED CONCRETE MASONRY CONSTRUCTION^{1,2,3,5,7}**

| ANCHOR DIAMETER (in.) | EMBEDMENT DEPTH ⁴ (in.) | MINIMUM EDGE DISTANCE (in.) | TENSION | | | SHEAR | | | |
|-----------------------|------------------------------------|-----------------------------|-------------------------------------|--|---|-----------------------------------|---|-----------------------------------|---|
| | | | UBC with Special Insp. ⁶ | UBC without Special Insp. ⁷ | IBC/IRC with Special Insp. ⁶ | Perpendicular to Wall | | Parallel to Wall | |
| | | | | | | UBC With or without Special Insp. | IBC/IRC with Special Insp. ⁶ | UBC with or without Special Insp. | IBC/IRC with Special Insp. ⁶ |
| 3/8 | 2 3/4 | 1 3/4 | 650 | 325 | 525 | 270 | 215 | 710 | 570 |
| | | 2 3/4 | 805 | 400 | 645 | 460 | 370 | 825 | 660 |
| 1/2 | 3 | 1 3/4 | 650 | 325 | 525 | 300 | 240 | 960 | 770 |
| | | 2 3/4 | 830 | 415 | 660 | 525 | 420 | 1140 | 910 |
| 5/8 | 4 | 1 3/4 | 1000 | 500 | 800 | 300 | 240 | 1125 | 900 |
| | | 2 3/4 | 1305 | 650 | 1045 | 590 | 475 | 1505 | 1205 |

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

¹The tabulated shear and tension loads are for anchors installed in any masonry construction complying with Section 3.1 of this report.

²Allowable values may be adjusted in accordance with Section 1605.3 of the IBC and Section 1612.3 of the UBC, as described in Section 5.3 and Section 5.4, respectively, of this report.

³Anchor locations are limited to one per masonry cell with minimum spacing of 8 inches on center.

⁴Embedment depth is measured from the top edge of the concrete masonry construction.

⁵Loads in this table are for HUS-H anchors installed in the masonry at the edge distance listed in this table. No reductions for edge distance are required when anchors are installed with the minimum edge distance specified in this table. Capacity of attached sill plate or other material to resist loads in this table must comply with the applicable code.

⁶These tension values are only applicable when the anchors are installed with special inspection as set forth in Section 4.2 of this report.

⁷These load values are valid for a masonry prism strength, f'_m of 1,800 psi.

ANCHOR INSTALLATION IS RESTRICTED TO NON-SHADED AREAS

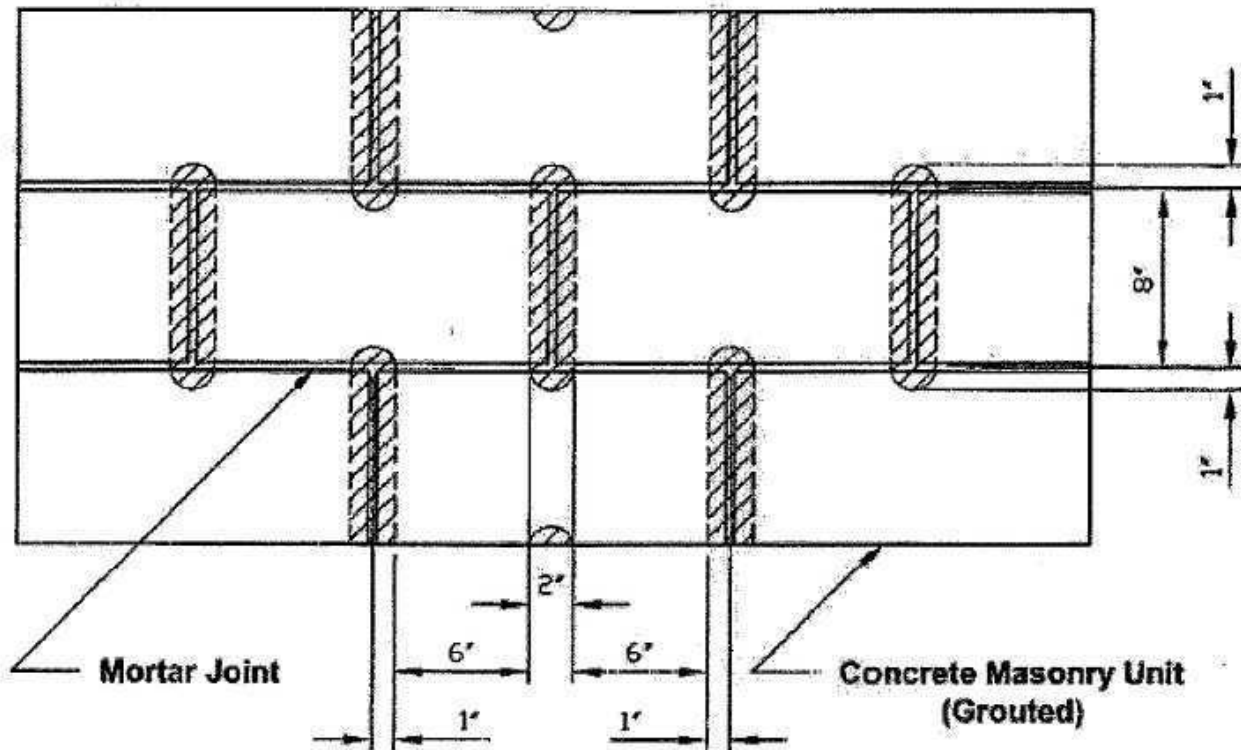


FIGURE 1—ACCEPTABLE LOCATIONS FOR HUS-H ANCHOR IN FACE OF GROUT-FILLED CONCRETE MASONRY

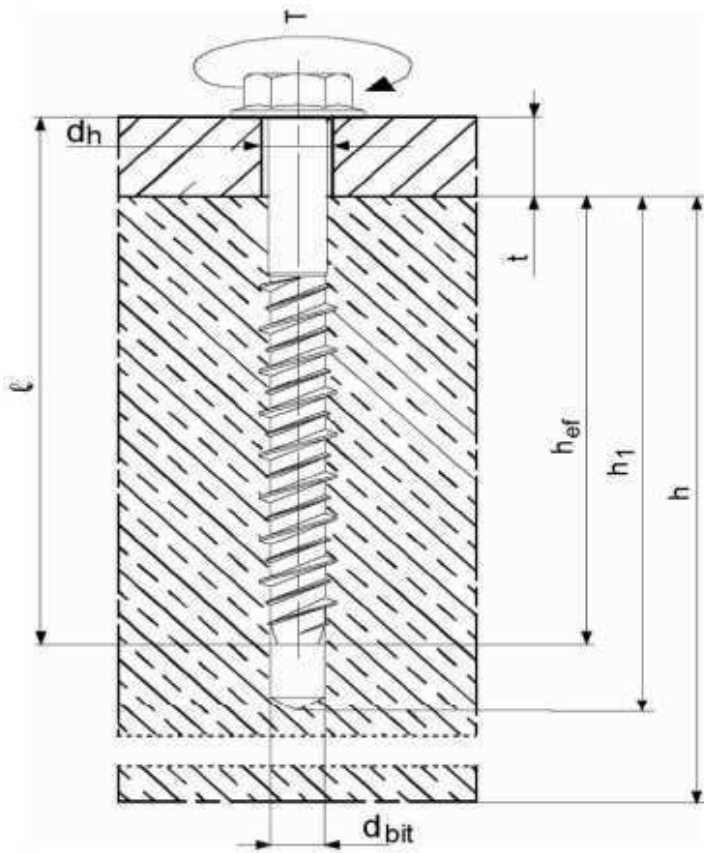


FIGURE 2—HUS-H SCREW ANCHOR



FIGURE 3—HUS-H SCREW ANCHOR

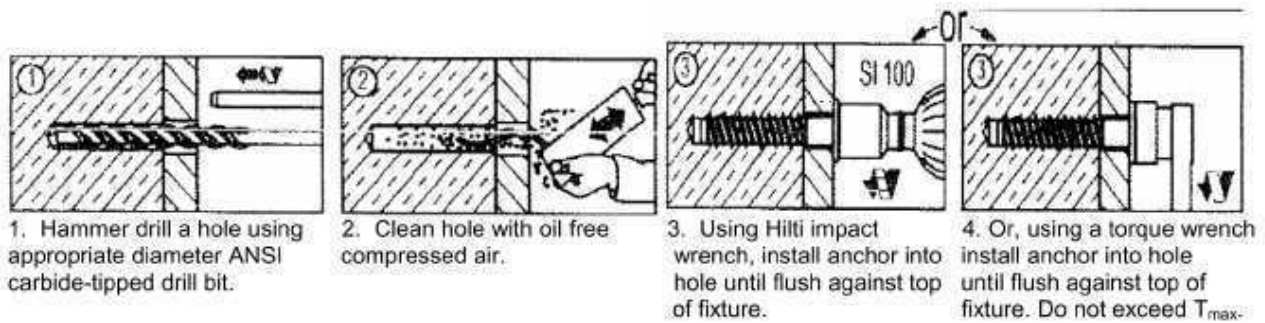


FIGURE 4—ILLUSTRATIVE INSTALLATION INSTRUCTIONS