

ICC-ES Report

ESR-1671

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Reissued 09/2015
This report is subject to renewal 09/2016.

DIVISION: 04 00 00—MASONRY
SECTION: 04 05 19.16—MASONRY ANCHORS

REPORT HOLDER:

ILLINOIS TOOLS WORKS, INC., REDHEAD DIVISION

**2171 EXECUTIVE DRIVE, SUITE 100
ADDISON, ILLINOIS 60101**

EVALUATION SUBJECT:

TAPCON® ANCHORS WITH ADVANCED THREADFORM TECHNOLOGY



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DIVISION: 04 00 00—MASONRY
Section: 04 05 19.16—Masonry Anchors

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EVALUATION SUBJECT:

TAPCON® ANCHORS WITH ADVANCED THREADFORM TECHNOLOGY

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1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2009 and 2006 *International Building Code*® (IBC)
- 2009 and 2006 *International Residential Code*® (IRC)
- 1997 *Uniform Building Code*™ (UBC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)[†]

[†]The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

Property evaluated:

Structural

2.0 USES

The Tapcon Anchors with Advanced Threadform Technology are used to resist static, tension and shear loads in uncracked, grouted or ungrouted concrete masonry construction, unless otherwise noted in this report. The Tapcon anchors are alternatives to cast-in-place anchors described in IBC Section 2107.1 and UBC Section 2107. The anchors are permitted to be used in structures regulated by the IRC, provided an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 Tapcon Anchors with Advanced Threadform Technology:

The Tapcon anchors with Advanced Threadform Technology are carbon steel screw anchors available with manufactured from UNS G 10220 heat-treated steel. They have an alternating high-low thread form and are available in ³/₁₆- and ¹/₄-inch (4.8 and 6.4 mm) diameters with various lengths. Tapcon carbon steel anchors are available with a slotted hex washer head, Phillips flat head, maxi-set head and Scots® stainless steel head, and have a white, silver or blue coating. Different head styles and types of coatings for Tapcon Anchors with Advanced Threadform Technology are noted in Table 5, Figure 1 and Figure 2.

3.2 Grout-filled Concrete Masonry:

3.2.1 Concrete Masonry Units (CMUs): Concrete masonry units are closed-end units, 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 a CMU is 8 inches (203 mm) wide by 8 inches (203 mm) high by 16 inches (406 mm) long.

3.2.2 Grout: When walls are fully grouted, the grout must comply with IBC Section 2103.12, 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 2000 psi (13.8 MPa).

3.2.3 Mortar: Mortar must comply with IBC Section 2103.8, IRC Section R607, UBC Section 2103.4 or UBC Standard 21-15, as applicable. The mortar must have a minimum compressive strength of 1,500 psi (10.3 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Allowable Stress Design (ASD):

4.1.1 General: Anchors described in this report are assigned allowable tension and shear loads for design based on allowable stress design (working stress design).

4.1.2 Design of Anchors in Concrete Masonry: Anchors are limited to installation into the face shell of grouted or ungrouted, uncracked concrete masonry units at locations indicated by the non-shaded areas in Figure 3. Masonry wall construction must be fully mortared. Allowable tension and shear loads for installation in concrete masonry under the IBC, IRC and UBC are noted in Tables 1 and 2.

Allowable load reduction factors noted in Table 3 are applicable to the allowable loads shown in Tables 1 and 2. Allowable loads for anchors installed in concrete masonry subjected to combined shear and tension forces must be determined by the following equation:

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

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.

4.1.3 Minimum Spacing and Minimum Edge Requirements: The minimum spacing between anchors and the minimum edge distance between the anchor and the edge of the concrete masonry wall must be as set forth in Table 3. For anchors installed between the critical edge distance, c_{cr} , and minimum edge distance, c_{min} , load reduction factors must be used in accordance with Table 3. For anchors installed between the critical spacing distance, s_{cr} , and minimum spacing distance, s_{min} , load reduction factors must be used in accordance with Table 3. Edge distances less than the critical edge distance, c_{cr} , are not permitted for anchors installed in medium- or normal-weight CMUs.

4.2 Installation:

Anchors must not be installed until the masonry has fully cured. Anchors are installed by drilling a hole into the substrate using a rotary hammer drill with a carbide-tipped drill bit supplied by ITW Buildex as noted in Table 1. The hole is drilled to the specified embedment depth plus a minimum of $\frac{1}{4}$ inch (6.35 mm). Dust and other deleterious matter is removed using compressed air, before anchor installation. The anchors are then be installed into the hole in accordance with ITW Buildex's instructions to the specified embedment depth using a hammer drill in a rotary-only mode with an ITW Buildex Condrive Tool and drive socket.

4.3 Special Inspection:

Continuous special inspection under the IBC and IRC, in accordance with Section 1704 of the IBC and Section 1701 of the UBC, must be provided when design loads are based on special inspection being provided during anchor installation as set forth in Tables 1 or 2 of this report. 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 diameter, and anchor length.
2. Hole description, including verification of drill bit compliance with ITW Buildex's instructions, hole depth, concrete masonry wall thickness and hole cleanliness.
3. Installation description, including hole location (spacing and edge distance), anchor embedment, and verification of anchor installation in accordance with the manufacturer's published installation instructions and this report.
4. Concrete masonry unit size and compressive strength, mortar compressive strength and, when required, masonry prism compressive strength.

5.0 CONDITIONS OF USE

The Tapcon Anchors with Advanced Threadform Technology, as described in this report, 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 the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.
- 5.2 Under the IBC, IRC or UBC, use of the anchors to resist wind or seismic loads is beyond the scope of this report. The allowable loads or load combinations for the anchors must not be adjusted for anchors subjected to wind or seismic loads.
- 5.3 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 beyond the scope of this report.
- 5.4 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 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.
- 5.5 Since an ICC-ES acceptance criteria for evaluating the performance of screw 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.
- 5.6 Calculations demonstrating that the applied loads are less than the allowable loads described in this report, must be submitted to the code official. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.
- 5.7 Special inspection must be provided in accordance with Section 4.3 of this report.
- 5.8 Anchors are limited to dry, interior use.
- 5.9 Use of anchors in contact with preservative-treated and fire-retardant-treated wood is beyond the scope of this report.
- 5.10 Anchors are manufactured by ITW Buildex at facilities in Itasca, Illinois, and Roselle, Illinois, under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry (AC106), dated February 2010.

7.0 IDENTIFICATION

The packaging of Tapcon Anchors with Advanced Threadform Technology is marked with the ITW Buildex company name, or the name of one of the additional listees noted in this report; the product name (Tapcon with

Advanced Threadform Technology); anchor diameter and length; and the evaluation report number (ESR-1671). A length identification code letter is stamped on the head of each anchor. See the length identification system noted in Table 4 of this report.

TABLE 1—ALLOWABLE TENSION VALUES FOR TAPCON ANCHORS WITH ADVANCED THREADFORM TECHNOLOGY INSTALLED IN CONCRETE MASONRY UNITS^{1,2}

| ANCHOR DIAMETER (inch) | DRILL BIT DIAMETER (inch) | MINIMUM EMBEDMENT DEPTH (inch) ³ | UBC - WITH SPECIAL INSPECTION ⁴ | | UBC - WITHOUT SPECIAL INSPECTION | | IBC/IRC ⁴ | |
|------------------------------|---------------------------|---|--|--------------------|----------------------------------|--------------------|----------------------|--------------------|
| | | | UBC 21-4 CMU Type | | UBC 21-4 CMU Type | | ASTM C 90 CMU Type | |
| | | | Lightweight (lb) | Medium/Normal (lb) | Lightweight (lb) | Medium/Normal (lb) | Lightweight (lb) | Medium/Normal (lb) |
| ³ / ₁₆ | 0.173 | 1 | 50 | 75 | 25 | 35 | 40 | 60 |
| ¹ / ₄ | 0.204 | 1 | 55 | 130 | 25 | 65 | 45 | 105 |

For SI: 1 inch = 25.4 mm; 1 lb = 4.45 N.

¹The tabulated tension loads are for anchors installed in the face shell of lightweight, medium-weight and normal-weight concrete masonry units in compliance with ASTM C 90 or UBC Standard 21-4, as shown in Figure 3 of this report.

²The tabulated tension values are for anchors installed at the specified critical spacing, s_{cr} , and critical edge distance, c_{cr} , as noted in Table 3.

³The embedment depth is the distance from the concrete masonry unit surface to the bottom of the fastener.

⁴Special inspection shall be provided in accordance with Section 4.3 of this report.

TABLE 2—ALLOWABLE SHEAR VALUES FOR TAPCON ANCHORS WITH ADVANCED THREADFORM TECHNOLOGY INSTALLED IN CONCRETE MASONRY UNITS^{1,2,3}

| ANCHOR DIAMETER (inch) | DRILL BIT DIAMETER (inch) | MINIMUM EMBEDMENT DEPTH (inch) | UBC—WITH OR WITHOUT SPECIAL INSPECTION ⁵ | | IBC/IRC ⁴ | |
|------------------------------|---------------------------|--------------------------------|---|--------------------|----------------------|--------------------|
| | | | UBC 21-4 CMU Type | | ASTM C 90 CMU Type | |
| | | | Lightweight (lb) | Medium/Normal (lb) | Lightweight (lb) | Medium/Normal (lb) |
| ³ / ₁₆ | 0.173 | 1 | 110 | 160 | 85 | 130 |
| ¹ / ₄ | 0.204 | 1 | 135 | 220 | 110 | 180 |

For SI: 1 inch = 25.4 mm; 1 lb = 4.45 N.

¹The tabulated shear loads are for anchors installed in lightweight, medium-weight and normal-weight concrete masonry units complying with ASTM C 90 or UBC 21-4.

²The tabulated tension values are for anchors installed at the specified critical spacing, s_{cr} , and critical edge distance, c_{cr} , as noted in Table 3.

³The embedment depth is the distance from the concrete masonry unit surface to the bottom of the fastener.

⁴Special inspection shall be provided in accordance with Section 4.3 of this report.

⁵Special inspection under UBC is optional. When required, special inspection shall be provided in accordance with Section 4.3 of this report.

TABLE 3—ALLOWABLE SPACING AND EDGE DISTANCES FOR TAPCON ANCHORS WITH ADVANCED THREADFORM TECHNOLOGY INSTALLED IN CONCRETE MASONRY UNITS (inches)^{1,2,3,4,5,6}

| CHARACTERISTIC | SYMBOL | UNITS | NOMINAL ANCHOR DIAMETER (inches) | |
|---|-----------|--------|----------------------------------|-----------------------------|
| | | | ³ / ₁₆ | ¹ / ₄ |
| Minimum spacing distance | s_{min} | inches | 1 ¹ / ₂ | 2 |
| Critical spacing distance | s_{cr} | inches | 3 | 4 |
| Spacing load reduction factor - Tension | - | - | 1.00 | 0.84 |
| Spacing load reduction factor - Shear | - | - | 1.00 | 0.81 |
| Minimum edge distance ⁶ | c_{min} | inches | 2 | 2 |
| Critical edge distance | c_{cr} | inches | 4 | 4 |
| Edge load reduction factor - Tension | - | - | 0.91 ⁷ | 0.88 ⁷ |
| Edge load reduction factor - Shear | - | - | 0.93 | 0.80 |

For SI: 1 inch = 25.4 mm.

¹The critical edge and spacing distances are for full anchor capacity, and the minimum edge and spacing distances are for reduced anchor capacity.

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

⁴Reduction factors are cumulative. Multiple reduction factors for more than one spacing or edge distance are calculated separately and multiplied.

⁵Load reduction factors for anchors loaded in tension or shear with spacing between critical and minimum are obtained by linear interpolation.

⁶Load reduction factors for anchors loaded in tension or shear with edge distances between critical and minimum are obtained by linear interpolation.

⁷Reduction applies to anchors installed in lightweight CMU only.

TABLE 4—LENGTH IDENTIFICATION SYSTEM

| LENGTH OF ANCHOR (inch) | | STAMP ON HEAD OF ANCHOR |
|-------------------------|-------------------------|-------------------------|
| From | Up to But Not Including | |
| 1 | 1½ | ■ |
| 1½ | 2 | A |
| 2 | 2½ | B |
| 2½ | 3 | C |
| 3 | 3½ | D |
| 3½ | 4 | E |
| 4 | 4½ | F |
| 5 | 5½ | H |
| 6 | 6½ | J |

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

TABLE 5—TAPCON ANCHORS WITH ADVANCED THREADFORM TECHNOLOGY HEAD TYPES AND COATINGS

| HEAD TYPE | FASTENER COATING | | | |
|-------------------------|-----------------------------|-------------------------------|----------------------------|--------------------------------|
| | Blue Climaseal ¹ | Silver Climaseal ² | Ultrashield ^{TM3} | White Ultrashield ⁴ |
| Slotted hex washer head | X | | | |
| Phillips flat head | X | | | |
| Maxi-set head | | | X | X |
| Scots head | | X | | |

¹Blue Climaseal is a water-based polymer type coating (blue in color) that has been cured at elevated temperature.
²Silver Climaseal is a water-based polymer type coating (silver in color) that has been cured at elevated temperature.
³Ultrashield is a water-based polymer type coating (silver in color) that consists generally of multiple coats which are cured at elevated temperature.
⁴White Ultrashield is a water-based polymer type coating (white in color) that consists generally of multiple coats which are cured at elevated temperature.

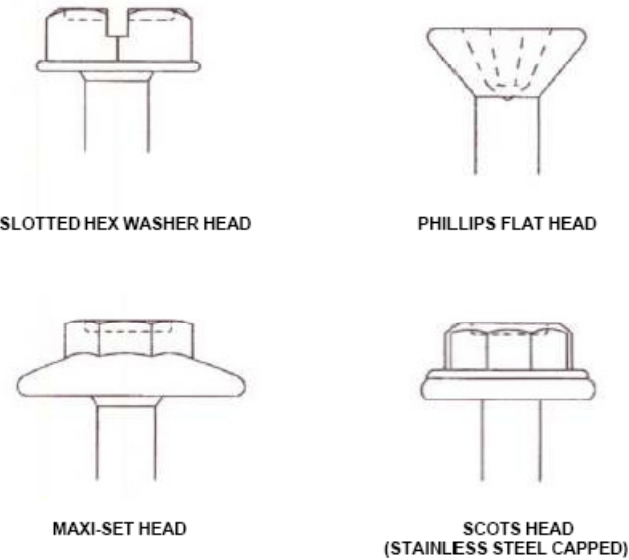


FIGURE 1—TAPCON ANCHORS WITH ADVANCED THREADFORM TECHNOLOGY HEAD STYLES

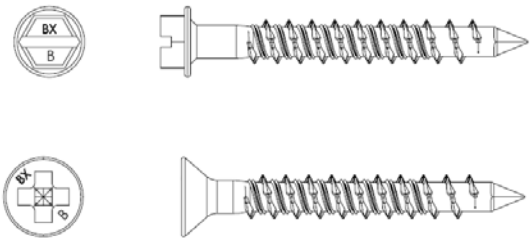


FIGURE 2—TAPCON ANCHORS WITH ADVANCED THREADFORM TECHNOLOGY ANCHORS

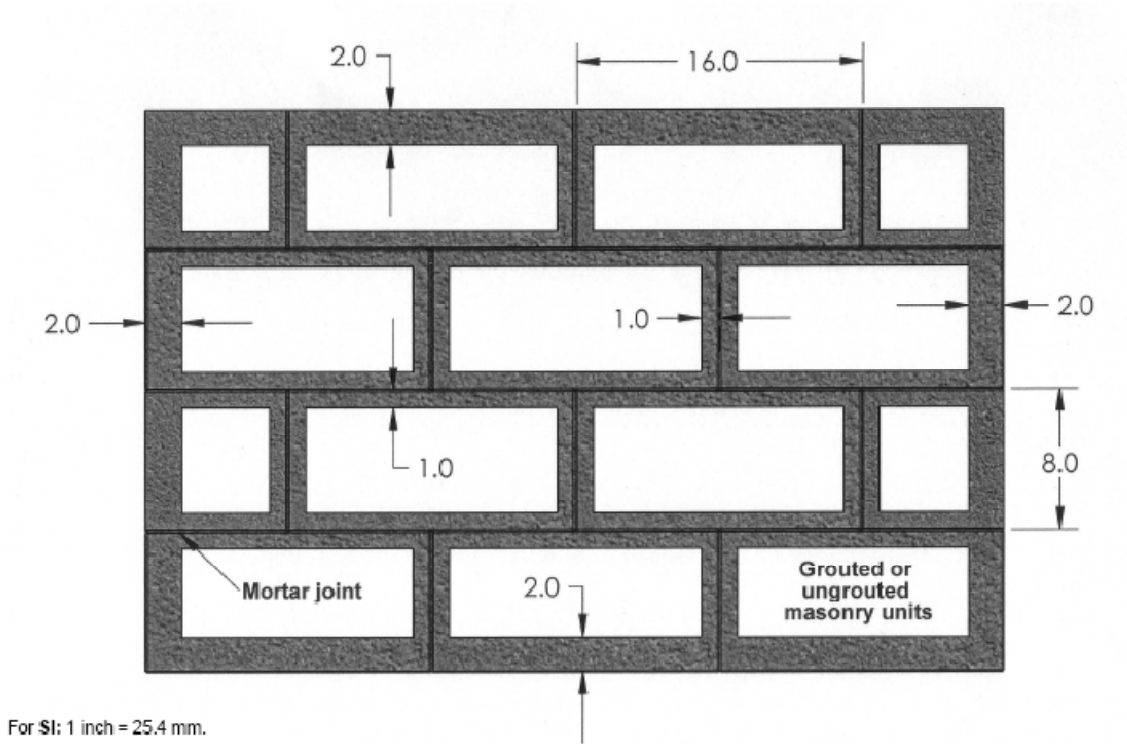


FIGURE 3—ANCHOR LOCATIONS (LIGHT COLOR AREAS) FOR INSTALLATION IN MASONRY UNITS (ALL DIMENSIONS IN INCHES)