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Simpson Strong-Tie Co., Inc.  
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Attn: Jason M. Oakley  
(714) 448-9143

RESEARCH REPORT: RR 25741  
(CSI # 03 16 00)

BASED UPON ICC ES EVALUATION  
REPORT NO. ESR-2713

REEVALUATION DUE

DATE: December 1, 2013

Issued Date: November 1, 2011

Code: 2011 LABC

**GENERAL APPROVAL** – Reevaluation/Clerical Modification - Titen HD® Screw Anchor and Titen HD® Rod Hanger for Cracked and Un-cracked Concrete.

**DETAILS**

The above assemblies and/or products are approved when in compliance with the description, use, identification and findings of ICC Evaluation Services Report No.ESR-2713, reissued September 1, 2011, of the ICC Evaluation Service, Incorporated. The report in its entirety is attached and made part of this general approval.

The parts of Report No.ESR-2713 which are excluded on the attached copy have been removed by the Los Angeles Building as not being included in this approval.

**The approval is subject to the following conditions:**

1. The allowable and strength design values listed in the attached report and tables are for the fasteners only. Connected members shall be checked for their capacity (which may govern).
2. The anchors shall be identified by labels on the packaging indicating the manufacturer's name and product designation.
3. The anchors shall be installed as per the attached manufacturer's instructions except as otherwise stated in this report. Copies of the installation instructions shall be available at each job site.

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Simpson Strong-Tie Co., Inc.

Re: Titen HD® Screw Anchor and Titen HD® Rod Hanger for Cracked and Un-cracked Concrete.

4. Design values and minimum embedment requirements shall be per Tables in ICC ES Report No. ESR-2713.
5. Anchor spacing and edge distance, as well as minimum member thickness, must comply with Tables 1 and 4, and Figures 2, 3 and 4, of the attached ESR-2713 and with Table 1911.2 of the 2011 Los Angeles City Building Code.
6. Special inspection in accordance with Section 1704 of the 2011 Los Angeles City Building Code shall be provided for anchor installations.
7. Anchors may be installed at embedment less than minimum depth per Table 1911.2 of the 2011 Los Angeles City Building Code for the following conditions:
  - a. Anchors are limited to the installation of Plumbing/fire sprinkler system, HVAC and electrical conduit.
8. The use of anchors is limited to dry, interior locations.
9. Calculations demonstrating that the applied loads or factored loads are less than the allowable load values or design strength level values respectively, described in this report shall be submitted to the plan check Engineer at the time of permit application. The calculations shall be prepared by a Civil or Structural Engineer registered in the State of California.

**EXCEPTION:** Anchors used for the installation of mechanical, plumbing and electrical equipment may be designed and detailed on a plan prepared by an engineer licensed by the state of California.

## **DISCUSSION:**

The clerical modification is to change the address.

The report is in compliance with the 2011 Los Angeles City Building Code.

The approval is based on tests in accordance with ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated May 2010.

The allowable loads are limited to Table 1911.2 of the 2011 LABC for anchors embedded in concrete. The anchors have been tested in accordance with ACI 355.2-04 and AC193 for static and dynamic loads.

This general approval will remain effective provided the Evaluation Report is maintained valid and unrevised with the issuing organization. Any revisions to this report must be submitted to this Department, with appropriate fee, for review in order to continue the approval of the revised report.

Simpson Strong-Tie Co., Inc.

Re: Titen HD® Screw Anchor and Titen HD® Rod Hanger for Cracked and Un-cracked Concrete.

Addressees to whom this Research Report is issued is responsible for providing copies of it, complete with any attachments indicated, to architects, engineers and builders using items approved herein in design or construction which must be approved by Department of Building and Safety Engineers and Inspectors.

This general approval of an equivalent alternate to the Code is only valid where an engineer and/or inspector of this Department has determined that all conditions of this approval have been met in the project in which it is to be used.

Simpson Strong-Tie offers software to assist in the design of anchorages using Simpson Strong-Tie products. The software "Anchor Designer for ACI-318" includes selectable Strength Design methodology utilizing ICC-ES AC193-compliant data to generate designs in conformance with the 2011 Los Angeles City Building Code.

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Attachment: ICC-ES Evaluation Report No. ESR-2713 (9 pages)

# ICC-ES Evaluation Report

**ESR-2713**

Reissued September 1, 2011

This report is subject to renewal in two years.

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A Subsidiary of the International Code Council®

**DIVISION: 03 00 00—CONCRETE**  
**Section: 03 16 00—Concrete Anchors**
**REPORT HOLDER:**
**SIMPSON STRONG-TIE COMPANY, INC.**  
 5956 WEST LAS POSITAS BOULEVARD  
 PLEASANTON, CALIFORNIA 94588  
 (800) 925-5099  
[www.simpsonanchors.com](http://www.simpsonanchors.com)
**EVALUATION SUBJECT:**
**TITEN HD® SCREW ANCHOR AND TITEN HD® ROD  
 HANGER FOR CRACKED AND UNCRACKED  
 CONCRETE**
**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)~~ \*

**Property evaluated:**

Structural

**2.0 USES**

The Simpson Strong-Tie Titen HD® Screw Anchor is used to resist static, wind and seismic tension and shear loads in cracked and uncracked normal-weight concrete and sand-lightweight concrete members having a specified compressive strength,  $f'_c$ , from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa); and cracked and uncracked sand-lightweight or normal-weight concrete over profile steel deck having a minimum specified compressive strength,  $f'_c$ , of 3,000 psi (20.7 MPa).

The Simpson Strong-Tie Titen HD® Rod Hanger is used to resist static, wind and seismic tension loads in cracked and uncracked normal-weight concrete and sand-lightweight concrete members having a specified compressive strength,  $f'_c$ , from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa); and cracked and uncracked sand-lightweight or normal-weight concrete over profile steel deck having a minimum specified compressive strength,  $f'_c$ , of 3,000 psi (20.7 MPa).

The Simpson Strong-Tie Titen HD® Screw Anchors and Rod Hangers are alternatives to anchors described in Sections 1911 and 1912 of the 2009 and 2006 IBC ~~and Sections 1912 and 1913 of the 2003 IBC~~. The anchors 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 Titen HD® Screw Anchor:**

The Titen HD® Screw Anchor is a carbon steel threaded anchor with a hex-washer head. The screw anchor is manufactured from heat-treated steel complying with SAE J403 Grade 10B21, and has an electrodeposited coating of zinc, minimum thickness 0.0002 inch (5 µm) in accordance with ASTM B 633, SC1, Type III. Titen HD® Screw Anchors are available with nominally 3/8-, 1/2-, and 3/4-inch (9.5, 12.7, and 19.1 mm) shank diameters, and various lengths in each diameter. Figure 1A illustrates a typical Titen HD® Screw Anchor.

**3.2 Titen HD® Rod Hanger:**

The Titen HD® Rod Hanger is a carbon steel threaded anchor with an oversized hex-washer head that is internally threaded. The rod hanger is manufactured from heat-treated steel complying with SAE J403 Grade 10B21, and has an electrodeposited coating of zinc, minimum thickness 0.0002 inch (5 µm), in accordance with ASTM B633, SC1, Type III. The Titen HD® Rod Hanger is available with a nominally 3/8-inch (9.5 mm) shank diameter and either 3/8-inch- or 1/2-inch-diameter (9.5 mm or 12.7 mm) internal threads. Figure 1B illustrates the Titen HD® Rod Hanger.

**3.3 Concrete:**

Normal-weight and sand-lightweight concrete must comply with Sections 1903 and 1905 of the IBC.

**3.4 Profile Steel Deck:**

The profile steel deck must comply with the configuration in Figures 3 and 4 and have a minimum base steel thickness of 0.035 inch (0.889 mm). Steel deck must comply with ASTM A 653/A 653M SS Grade 33, and have a minimum yield strength of 33 ksi (228 MPa).

**4.0 DESIGN AND INSTALLATION**
**4.1 Strength Design:**

- \* **4.1.1 General:** Design strength of anchors complying with the 2009 ~~and 2003~~ IBC, as well as Section R301.1.3 of the 2009 ~~and 2003~~ IRC, must be determined in accordance with ACI 318-08 Appendix D and this report.

Design strength of anchors complying with the 2006 IBC and 2006 IRC must be in accordance with ACI 318-08 Appendix D and this report.

Design parameters provided in Table 1 through 4 and in Figures 2 through 4 of this report are based on the 2009 IBC (ACI 318-08) unless noted otherwise in Section 4.1.1 through 4.1.12 of this report.

The strength design of anchors must comply with ACI 318 D.4.1, except as required in ACI 318 D.3.3. Strength reduction factors,  $\phi$ , as given in ACI 318 D.4.4, and noted in Tables 2 and 3 of this report, must be used for load combinations calculated in accordance with Section 1605.2.1 of the IBC and Section 9.2 of ACI 318. Strength reduction factors,  $\phi$ , as given in ACI 318 D.4.5 must be used for load combinations calculated in accordance with ACI 318 Appendix C. The value of  $f'_c$  used in the calculations must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318 D.3.5.

**4.1.2 Requirements for Static Steel Strength in Tension:** The nominal steel strength of a single screw anchor in tension,  $N_{sa}$ , calculated in accordance with ACI 318 D.5.1.2, is given in Table 2 of this report. The strength reduction factor,  $\phi$ , corresponding to a brittle steel element must be used for all anchors, as given in Table 2.

**4.1.3 Requirements for Static Concrete Breakout Strength in Tension:** The nominal concrete breakout strength of a single screw anchor or a group of screw anchors in tension,  $N_{cb}$  or  $N_{cbg}$ , respectively, must be calculated in accordance with ACI 318 D.5.2, with modifications as described in this section. The basic concrete breakout strength of a single screw anchor in tension in cracked concrete,  $N_b$ , must be calculated in accordance with ACI 318 D.5.2.2 using the values of  $h_{ef}$  and  $k_{cr}$  as given in Table 2 of this report. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318 D.5.2.6 must be calculated with the value of  $k_{uncr}$  as given in Table 2 of this report and with  $\Psi_{c,N} = 1.0$ .

Determination of concrete breakout strength in accordance with ACI 318 D.5.2 is not required for anchors installed in the lower flute or upper flute of the soffit of profile steel deck floor and roof assemblies with sand-lightweight or normal-weight concrete fill as shown in Figure 3 or Figure 4, respectively.

**4.1.4 Requirements for Static Pullout Strength in Tension:** The nominal pullout strength of a single screw anchor or a group of screw anchors in tension in accordance with ACI 318 D.5.3.1 and D.5.3.2 in cracked and uncracked concrete,  $N_{p,cr}$  and  $N_{p,uncr}$ , respectively, is given in Table 2 of this report and must be used in lieu of  $N_p$ . In regions of a concrete member where analysis indicates no cracking at service level loads in accordance with ACI 318 D.5.3.6, the nominal pullout strength in uncracked concrete,  $N_{p,uncr}$ , applies. Where values for  $N_{p,cr}$  or  $N_{p,uncr}$  are not provided in Table 2, the pullout strength does not need to be considered in design.

The nominal pullout strength in cracked concrete for anchors installed in the lower flute or upper flute of the soffit of sand-lightweight or normal-weight concrete filled profile steel deck floor and roof assemblies as shown in Figures 3 and 4,  $N_{p,deck,cr}$  is given in Table 4.  $N_{p,deck,cr}$  must be used in lieu of  $N_{p,cr}$ . In regions of a concrete member where analysis indicates no cracking in accordance with ACI 318 D.5.3.6, the nominal pullout strength in uncracked concrete  $N_{p,deck,uncr}$  applies in lieu of  $N_{p,uncr}$ .

The value of  $\Psi_{c,p}$  equals 1.0 for all design cases.

**4.1.5 Requirements for Static Steel Strength in Shear:**

The nominal steel strength in shear,  $V_{sa}$ , of a single screw anchor in accordance with ACI 318 D.6.1.2, is given in Table 3 of this report and may not be derived by calculation from ACI 318 Eq. D-20. The strength reduction factor,  $\phi$ , corresponding to a brittle steel element must be used for all anchors, as described in Table 3.

The nominal shear strength,  $V_{sa,deck}$ , of a single screw anchor installed in the lower flute or upper flute of the soffit of sand-lightweight or normal-weight concrete filled profile steel deck floor and roof assemblies, as shown in Figures 3 and 4, is given in Table 4.

**4.1.6 Requirements for Static Concrete Breakout Strength in Shear:**

The nominal concrete breakout strength in shear of a single screw anchor or group of screw anchors,  $V_{cb}$  or  $V_{cbg}$ , respectively, must be calculated in accordance with ACI 318 D.6.2, with modifications as described in this section. The basic concrete breakout strength in shear of a single screw anchor in cracked concrete,  $V_b$ , must be calculated in accordance with ACI 318 D.6.2.2 using the values of  $l_e$  and  $d_a$  as given in Table 3 of this report. The modification factors in ACI 318 D.6.2.4, D.6.2.5, D.6.2.6 and D.6.2.7 must be applied to the basic breakout strength in shear,  $V_b$ , as applicable.

Calculation of the concrete breakout strength in accordance with ACI 318 D.6.2 is not required for screw anchors installed in the lower flute or upper flute of the soffit of sand-lightweight or normal-weight concrete filled profile steel deck floor and roof assemblies, as shown in Figures 3 and 4.

**4.1.7 Requirements for Static Concrete Pryout Strength in Shear:**

The nominal concrete pryout strength for a single screw anchor or group of screw anchors,  $V_{cp}$  or  $V_{cpg}$ , respectively, must be calculated in accordance with ACI 318 D.6.3, using the coefficient for pryout strength,  $K_{cp}$ , provided in Table 3 of this report and the value of nominal breakout strength in tension of a single screw anchor or group screw anchors,  $N_{cb}$  or  $N_{cbg}$ , as calculated in Section 4.1.3 of this report.

For anchors installed in the lower flute or upper flute of the soffit of sand-lightweight or normal-weight concrete filled profile steel deck floor and roof assemblies, as shown in Figure 3 or Figure 4, respectively, calculation of the concrete pryout strength in accordance with ACI 318 D.6.3 is not required.

**4.1.8 Requirements for Seismic Design:**

**4.1.8.1 General:** When the screw anchor design includes seismic loads, the additional requirements of ACI 318 D.3.3 must apply, as modified by Section 1908.1.9 of the 2009 IBC, Section 1908.1.16 of the 2006 IBC, or the following:

CODE	ACI 318 D.3.3 SEISMIC REGION	CODE EQUIVALENT DESIGNATION
2003 IBC & 2003 IRC	Moderate or high seismic risk	Seismic Design Categories C, D, E and F

Except for use in Seismic Design Category A or B of the IBC, design strengths must be determined presuming the concrete is cracked unless it can be demonstrated that the concrete remains uncracked.

The nominal steel strength and nominal concrete breakout strength of anchors in tension, and the nominal concrete breakout strength and pryout strength of anchors in shear, must be calculated according to ACI 318 Sections D.5 and D.6, respectively, taking into account the corresponding values in Tables 1 through 4.

\* Deleted by the City of Los Angeles

The screw anchors comply with ACI 318 D.1 as brittle steel elements and must be designed in accordance with ACI 318-08 D.3.3.5 or D.3.3.6 or ACI 318-05 D.3.3.5, as applicable.

**4.1.8.2 Seismic Tension:** The nominal steel strength and concrete breakout strength in tension must be determined in accordance with ACI 318 D.5.1 and D.5.2, as described in Sections 4.1.2 and 4.1.3 of this report. In accordance with ACI 318 D.5.3.2, the appropriate value for nominal pullout strength in tension for seismic loads,  $N_{p,eq}$  or  $N_{p,deck,cr}$ , described in Tables 2 and 4 of this report, must be used in lieu of  $N_p$ .

**4.1.8.3 Seismic Shear:** The nominal concrete breakout and concrete pryout strength in shear must be determined in accordance with ACI 318 D.6.2 and D.6.3, as described in Sections 4.1.6 and 4.1.7 of this report. In accordance with ACI 318 D.6.1.2, the appropriate value for nominal steel strength in shear for seismic loads,  $V_{eq}$ , or  $V_{sa,deck,eq}$  described in Tables 3 and 4 of this report, must be used in lieu of  $V_{sa}$ .

**4.1.9 Interaction of Tensile and Shear Forces:** Screw anchors or groups of screw anchors that are subjected to combined axial (tensile) and shear loadings must be designed in accordance with ACI 318 D.7.

**4.1.10 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance:** In lieu of ACI 318 D.8.1 and D.8.3, values of  $c_{min}$  and  $s_{min}$  provided in Table 1 of this report must be used. In lieu of ACI 318 D.8.5, minimum member thickness,  $h_{min}$ , must comply with Table 1 of this report.

For anchors installed in the lower flute or upper flute of the soffit of sand-lightweight or normal-weight concrete filled profile steel deck floor and roof assemblies, details in Figures 3 and 4 must be observed. The minimum anchor spacing along the flute must be the greater of  $3h_{ef}$  or 1.5 times the flute width.

**4.1.11 Requirements for Critical Edge Distance:** In applications where  $c < c_{ac}$  and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318 D.5.2, must be further multiplied by the factor  $\psi_{cp,N}$  given by Eq-1:

$$\psi_{cp,N} = \frac{c}{c_{ac}} \quad (\text{Eq-1})$$

whereby the factor  $\psi_{cp,N}$  need not be taken less than  $\frac{1.5h_{ef}}{c_{ac}}$ .

For all other cases,  $\psi_{cp,N} = 1.0$ . In lieu of using ACI 318 D.8.6, values of  $c_{ac}$  provided in Table 1 of this report must be used.

**4.1.12 Requirements for Sand-lightweight Concrete:** For ACI 318-08, when anchors are used in sand-lightweight concrete, the modification factor  $\lambda$  for concrete breakout strength must be taken as 0.6. In addition, the pullout strength  $N_{p,uncr}$ ,  $N_{p,cr}$ , and  $N_{p,eq}$  must be multiplied by 0.6, as applicable.

For ACI 318-05, the values  $N_b$ ,  $N_{p,eq}$ ,  $N_{p,uncr}$ ,  $N_{p,cr}$ , and  $V_b$  determined in accordance with this report must be multiplied by 0.60, in lieu of ACI 318 D.3.4.

For anchors installed in the lower flute or upper flute of the soffit of sand-lightweight concrete filled profile steel deck floor and roof assemblies, this reduction is not required.

## 4.2 Allowable Stress Design (ASD):

**4.2.1 General:** Design values for use with allowable stress design load combinations calculated in accordance with Sections 1605.3 of the IBC must be established using the following equations:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \quad (\text{Eq-2})$$

and

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha} \quad (\text{Eq-3})$$

where:

$T_{allowable,ASD}$  = Allowable tension load, (lbf, N)

$V_{allowable,ASD}$  = Allowable shear load, (lbf, N)

$\phi N_n$  = The lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 Appendix D, Section 4.1 of this report, and either 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16, as applicable (lbf or N).

$\phi V_n$  = The lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 Appendix D, Section 4.1 of this report, and either 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16, as applicable (lbf or N).

$\alpha$  = A conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition,  $\alpha$  must include all applicable factors to account for nonductile failure modes and required over-strength.

An example calculation for the derivation of allowable stress design tension values is presented in Table 5.

The requirements for member thickness, edge distance and spacing, described in Table 1 of this report, must apply.

**4.2.2 Interaction of Tensile and Shear Forces:** The interaction of tension and shear loads must be consistent with ACI 318 D.7, as follows:

If  $T_{applied} \leq 0.2T_{allowable,ASD}$ , then the full allowable strength in shear,  $V_{allowable,ASD}$ , shall be permitted.

If  $V_{applied} \leq 0.2V_{allowable,ASD}$ , then the full allowable strength in tension,  $T_{allowable,ASD}$ , shall be permitted.

For all other cases:

$$\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2 \quad (\text{Eq-4})$$

## 4.3 Installation:

Installation parameters are provided in Table 1 and Figures 2, 3, and 4. Anchor locations must comply with this report and the plans and specifications approved by the code official. The Titen HD<sup>®</sup> Screw Anchors and Rod Hangers must be installed in accordance with the manufacturer's published instructions and this report. Anchors must be installed by drilling a pilot hole into the concrete using a handheld electro-pneumatic rotary hammer drill with a carbide-tipped drill bit conforming to ANSI B212.15-1994. The pilot hole must have the same nominal diameter as the nominal diameter of the anchor. The hole is drilled to the specified nominal embedment depth plus  $\frac{1}{2}$  inch (12.7 mm). Dust and debris in the hole must be removed by using oil-free compressed air. The Titen HD<sup>®</sup> Screw Anchors and Rod Hangers must be installed into the hole to the specified embedment depth using a socket wrench

or powered impact wrench. The maximum installation torque and maximum impact wrench torque rating requirements for the Titen HD® Screw Anchor and Rod Hangers are detailed in Table 1. Titen HD® Screw Anchors and Rod Hangers may be loosened by a maximum one turn and reinstalled with a socket wrench or powered impact wrench to facilitate fixture attachment or realignment.

For anchors installed in the lower flute or upper flute of the soffit of sand-lightweight or normal-weight concrete over profile steel deck floor and roof assemblies, the hole diameter in the steel deck must not exceed the diameter of the hole in the concrete by more than  $\frac{1}{8}$  inch (3.2 mm).

#### 4.4 Special Inspection:

Periodic special inspection is required in accordance with Section 1704.15 of the 2009 IBC or Section 1704.13 of the 2006 ~~or 2003~~ IBC. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, hole cleaning procedure, embedment depth, concrete type, concrete compressive strength, concrete member thickness, hole dimensions, anchor spacing, edge distance, installation torque, maximum impact wrench torque rating, and adherence to the manufacturer's published installation instructions. The special inspector must be present as often as required in accordance with the "statement of special inspection."

Under the IBC, additional requirements as set forth in Section 1705 or 1706 must be observed.

#### 5.0 CONDITIONS OF USE

The Simpson Strong-Tie Titen HD® Screw Anchors and Rod Hangers 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 installed in accordance with the manufacturer's published installation instructions and this report. In case of conflict, this report governs.
- 5.2 Anchor sizes, dimensions and minimum embedment depths are set forth in the tables of this report.
- 5.3 The anchor must be installed in accordance with Section 4.3 of this report in cracked and uncracked normal-weight and sand-lightweight concrete having a compressive strength,  $f'_c$ , of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa); and cracked and uncracked sand-lightweight or normal-weight concrete over profile steel deck having a minimum specified compressive strength,  $f'_c$ , of 3,000 psi (20.7 MPa).
- 5.4 The value of  $f'_c$  used for calculation purposes must not exceed 8,000 psi (55.2 MPa).
- 5.5 Strength design values must be established in accordance with Section 4.1 of this report.
- 5.6 Allowable stress design values must be established in accordance with Section 4.2 of this report.
- 5.7 Anchor spacing(s) and edge distance(s), as well as minimum member thickness, must comply with Tables 1 and 4, and Figures 3 and 4 of this report.
- 5.8 Reported values for the Titen HD® Rod Hanger do not consider the steel insert element which must be verified by the design professional.

5.9 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.10 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 such conditions is beyond the scope of this report.

5.11 Anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ( $f_t > f_r$ ), subject to the conditions of this report.

5.12 Anchors may be used to resist short-term loading due to wind or seismic forces, subject to the conditions of this report.

5.13 Anchors are not permitted to support fire-resistance-rated construction. Where not otherwise prohibited by the code, Titen HD® Screw Anchors and Rod Hangers 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.

5.14 Anchors have been evaluated for reliability against brittle failure and found to be not significantly sensitive to stress-induced hydrogen embrittlement.

5.15 Use of anchors is limited to dry, interior locations.

5.16 Special inspection must be provided in accordance with Section 4.4.

5.17 The anchors are manufactured by Simpson Strong-Tie Company, Inc., under a quality control program with inspections by CEL Consulting (AA-639.)

#### 6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated February 2010, including an optional suitability test for seismic tension and shear; profile steel deck soffit tests; mechanical properties tests; calculations; and quality control documentation.

#### 7.0 IDENTIFICATION

The Titen HD® Screw Anchor and Rod Hanger packaging is marked with the Simpson Strong-Tie Company name; product name (Titen HD®); anchor diameter and length; catalog number corresponding to Table 6 of this report; the name or logo of the inspection agency (CEL Consulting); and the evaluation report number (ESR-2713). In addition, the ≠ symbol and the anchor length (in inches) are stamped on the head of each screw anchor.

TABLE 1—TITEN HD® SCREW ANCHORS AND ROD HANGERS INSTALLATION INFORMATION<sup>1</sup>

Characteristic	Symbol	Units	Nominal Anchor Diameter / Threaded Coupler Diameter (inch)							
			<sup>3</sup> / <sub>8</sub>		<sup>1</sup> / <sub>2</sub>		<sup>3</sup> / <sub>4</sub>		3 <sup>3</sup> / <sub>8</sub> Rod Hanger	<sup>1</sup> / <sub>2</sub> Rod Hanger
<b>Installation Information</b>										
Nominal Diameter	$d_a$ ( $d_o$ ) <sup>5</sup>	in.	<sup>3</sup> / <sub>8</sub>		<sup>1</sup> / <sub>2</sub>		<sup>3</sup> / <sub>4</sub>		<sup>3</sup> / <sub>8</sub>	<sup>3</sup> / <sub>8</sub>
Drill Bit Diameter	$d_{bit}$	in.	<sup>3</sup> / <sub>8</sub>		<sup>1</sup> / <sub>2</sub>		<sup>3</sup> / <sub>4</sub>		<sup>3</sup> / <sub>8</sub>	<sup>3</sup> / <sub>8</sub>
Minimum Baseplate Clearance Hole Diameter <sup>2</sup>	$d_c$	in.	<sup>1</sup> / <sub>2</sub>		<sup>5</sup> / <sub>8</sub>		<sup>7</sup> / <sub>8</sub>		N/A <sup>3</sup>	N/A <sup>3</sup>
Maximum Installation Torque <sup>4</sup>	$T_{inst,max}$	ft-lbf	50		65		150		50	50
Maximum Impact Wrench Torque Rating	$T_{impact,max}$	ft-lbf	150		385		385		150	150
Minimum Hole Depth	$h_{hole}$	in.	3	3 <sup>3</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>2</sub>	6	6 <sup>3</sup> / <sub>4</sub>	3	3 <sup>1</sup> / <sub>4</sub>
Nominal Embedment Depth	$h_{nom}$	in.	2 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>4</sub>	4	5 <sup>1</sup> / <sub>2</sub>	6 <sup>1</sup> / <sub>4</sub>	2 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>2</sub>
Effective Embedment Depth	$h_{ef}$	in.	1.77	2.40	2.35	2.99	4.22	4.86	1.77	1.77
Critical Edge Distance	$c_{ac}$	in.	2 <sup>11</sup> / <sub>16</sub>	3 <sup>5</sup> / <sub>8</sub>	3 <sup>9</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>2</sub>	6 <sup>3</sup> / <sub>8</sub>	7 <sup>5</sup> / <sub>16</sub>	2 <sup>11</sup> / <sub>16</sub>	2 <sup>11</sup> / <sub>16</sub>
Minimum Edge Distance	$c_{min}$	in.	1 <sup>3</sup> / <sub>4</sub>							
Minimum Spacing	$s_{min}$	in.	3							
Minimum Concrete Thickness	$h_{min}$	in.	4 <sup>1</sup> / <sub>4</sub>	5	5	6 <sup>1</sup> / <sub>4</sub>	8 <sup>3</sup> / <sub>4</sub>	10	4 <sup>1</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>4</sub>
<b>Anchor Data</b>										
Yield Strength	$f_{ya}$	psi	97,000							
Tensile Strength	$f_{uta}$ <sup>6</sup>	psi	110,000							
Minimum Tensile & Shear Stress Area	$A_{se}$ <sup>7</sup>	in <sup>2</sup>	0.099		0.183		0.414		0.099	0.099
Axial Stiffness in Service Load Range - Uncracked Concrete	$\beta_{uncr}$	lb/in.	715,000							
Axial Stiffness in Service Load Range - Cracked Concrete	$\beta_{cr}$	lb/in.	345,000							

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 Pa, 1 in<sup>2</sup> = 645 mm<sup>2</sup>, 1 lb/in = 0.175 N/mm.

<sup>1</sup>The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D.

<sup>2</sup>The clearance must comply with applicable code requirements for the connected element.

<sup>3</sup>The Titen HD® Rod Hanger version is driven directly to the supporting member surface.

<sup>4</sup> $T_{inst,max}$  applies to installations using a calibrated torque wrench.

<sup>5</sup>For the 2006 IBC  $d_o$  replaces  $d_a$

<sup>6</sup>For the 2003 IBC  $f_{ut}$  replaces  $f_{uta}$

<sup>7</sup> $A_{se,N} = A_{se,V} = A_{se}$

\*

TABLE 2—TITEN HD® SCREW ANCHOR AND ROD HANGER CHARACTERISTIC TENSION STRENGTH DESIGN VALUES<sup>1</sup>

Characteristic	Symbol	Units	Nominal Anchor Diameter / Threaded Coupler Diameter (inch)							
			<sup>3</sup> / <sub>8</sub>	<sup>1</sup> / <sub>2</sub>	<sup>3</sup> / <sub>4</sub>	<sup>3</sup> / <sub>8</sub> Rod Hanger	<sup>1</sup> / <sub>2</sub> Rod Hanger			
Anchor Category	1, 2 or 3	-	1							
Nominal Embedment Depth	$h_{nom}$	in.	2 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>4</sub>	4	5 <sup>1</sup> / <sub>2</sub>	6 <sup>1</sup> / <sub>4</sub>	2 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>2</sub>
<b>Steel Strength in Tension (ACI 318 Section D.5.1)</b>										
Tension Resistance of Steel	$N_{sa}$ <sup>8</sup>	lbf	10,890	20,130	45,540			10,890	10,890	
Strength Reduction Factor - Steel Failure <sup>2</sup>	$\phi_{sa}$	-	0.65							
<b>Concrete Breakout Strength in Tension (ACI 318 Section D.5.2)</b>										
Effective Embedment Depth	$h_{ef}$	in.	1.77	2.40	2.35	2.99	4.22	4.86	1.77	1.77
Critical Edge Distance	$c_{ac}$	in.	2 <sup>11</sup> / <sub>16</sub>	3 <sup>5</sup> / <sub>8</sub>	3 <sup>9</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>2</sub>	6 <sup>3</sup> / <sub>8</sub>	7 <sup>5</sup> / <sub>16</sub>	2 <sup>11</sup> / <sub>16</sub>	2 <sup>11</sup> / <sub>16</sub>
Effectiveness Factor - Uncracked Concrete	$k_{uncr}$	-	24							
Effectiveness Factor - Cracked Concrete	$k_{cr}$	-	17							
Modification factor	$\psi_{c,N}$ <sup>7</sup>	-	1.0							
Strength Reduction Factor - Concrete Breakout Failure <sup>3</sup>	$\phi_{cb}$	-	0.65							
<b>Pullout Strength in Tension (ACI 318 Section D.5.3)</b>										
Pullout Resistance Uncracked Concrete ( $f'_c=2,500$ psi)	$N_{p,uncr}$	lbf	2,700 <sup>5</sup>	N/A <sup>4</sup>	N/A <sup>4</sup>	N/A <sup>4</sup>	N/A <sup>4</sup>	N/A <sup>4</sup>	2,025 <sup>5</sup>	2,025 <sup>5</sup>
Pullout Resistance Cracked Concrete ( $f'_c=2,500$ psi)	$N_{p,cr}$	lbf	1,235 <sup>5</sup>	2,700 <sup>5</sup>	N/A <sup>4</sup>	N/A <sup>4</sup>	6,070 <sup>5</sup>	7,195 <sup>5</sup>	1,235 <sup>5</sup>	1,235 <sup>5</sup>
Strength Reduction Factor - Pullout Failure <sup>6</sup>	$\phi_p$	-	0.65							
<b>Tension Strength for Seismic Applications (ACI 318 Section D.3.3.3)</b>										
Nominal Pullout Strength for Seismic Loads ( $f'_c=2,500$ psi)	$N_{p,eq}$	lbf	1,235 <sup>5</sup>	2,700 <sup>5</sup>	N/A <sup>4</sup>	N/A <sup>4</sup>	6,070 <sup>5</sup>	7,195 <sup>5</sup>	1,235 <sup>5</sup>	1,235 <sup>5</sup>
Strength Reduction Factor for Pullout Failure <sup>6</sup>	$\phi_{eq}$	-	0.65							

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 Pa, 1 in<sup>2</sup> = 645 mm<sup>2</sup>, 1 lb/in = 0.175 N/mm.

<sup>1</sup>The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D.

<sup>2</sup>The tabulated value of  $\phi_{sa}$  applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5(b).

<sup>3</sup>The tabulated values of  $\phi_{cb}$  applies when both the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5(c) for Condition B.

<sup>4</sup>As described in this report, N/A denotes that pullout resistance does not govern and does not need to be considered.

<sup>5</sup>The characteristic pullout resistance for greater compressive strengths may be increased by multiplying the tabular value by  $(f'_c/2,500)^{0.5}$ .

<sup>6</sup>The tabulated values of  $\phi_p$  or  $\phi_{eq}$  applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5(c) for Condition B.

<sup>7</sup>For the 2003 IBC,  $\psi_3$  replaces  $\psi_{c,N}$

<sup>8</sup>For the 2003 IBC,  $N_s$  replaces  $N_{sa}$

\*

TABLE 3—TITEN HD® SCREW ANCHOR CHARACTERISTIC SHEAR STRENGTH DESIGN VALUES<sup>1</sup>

Characteristic	Symbol	Units	Nominal Anchor Diameter (inch)					
			<sup>3</sup> / <sub>8</sub>	<sup>1</sup> / <sub>2</sub>	<sup>3</sup> / <sub>4</sub>	4	5 <sup>1</sup> / <sub>2</sub>	6 <sup>1</sup> / <sub>4</sub>
Anchor Category	1, 2 or 3	-	1					
Nominal Embedment Depth	$h_{nom}$	in.	2 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>4</sub>	4	5 <sup>1</sup> / <sub>2</sub>	6 <sup>1</sup> / <sub>4</sub>
<b>Steel Strength in Shear (ACI Section D.6.1)</b>								
Shear Resistance of Steel	$V_{sa}$ <sup>5</sup>	lbf	4,460		7,455		16,840	
Strength Reduction Factor - Steel Failure <sup>2</sup>	$\phi_{sa}$	-	0.60					
<b>Concrete Breakout Strength in Shear (ACI 318 Section D.6.2)</b>								
Nominal Diameter	$d_a (d_o)$ <sup>4</sup>	in.	0.375		0.500		0.750	
Load Bearing Length of Anchor in Shear	$l_e$ <sup>6</sup>	in.	1.77	2.40	2.35	2.99	4.22	4.86
Strength Reduction Factor - Concrete Breakout Failure <sup>3</sup>	$\phi_{cb}$	-	0.70					
<b>Concrete Pryout Strength in Shear (ACI 318 Section D.6.3)</b>								
Coefficient for Pryout Strength	$k_{cp}$	-	1.0			2.0		
Strength Reduction Factor - Concrete Pryout Failure <sup>3</sup>	$\phi_{cp}$	-	0.70					
<b>Shear Strength for Seismic Applications (ACI 318 Section D.3.3.3)</b>								
Shear Resistance of Single Anchor for Seismic Loads ( $f'_c=2,500$ psi)	$V_{eq}$	lbf	2,855		4,790		9,350	
Strength Reduction Factor - Steel Failure <sup>2</sup>	$\phi_{eq}$	-	0.60					

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

<sup>1</sup>The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D.

<sup>2</sup>The tabulated value of  $\phi_{sa}$  and  $\phi_{eq}$  applies when the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5(b).

<sup>3</sup>The tabulated values of  $\phi_{cb}$  and  $\phi_{cp}$  applies when both the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\phi$  must be determined in accordance with ACI 318 D.4.5(c) for Condition B.

<sup>4</sup>The notation in parenthesis is for the 2006 IBC.

<sup>5</sup>For the 2003 IBC,  $V_s$  replaces  $V_{sr}$ .

<sup>6</sup>For the 2003 IBC,  $l$  replaces  $l_e$ .

\*

**TABLE 4—TITEN HD® SCREW ANCHOR AND ROD HANGER CHARACTERISTIC TENSION AND SHEAR DESIGN VALUES FOR THE SOFFIT OF CONCRETE-FILLED PROFILE STEEL DECK ASSEMBLIES<sup>1,5,6</sup>**

Characteristic	Symbol	Units	Nominal Anchor Diameter / Threaded Coupler Diameter (inch)							
			Lower Flute				Upper Flute			
			3/8		1/2		3/8 Rod Hanger	1/2 Rod Hanger	3/8	1/2
Minimum Hole Depth	$h_{hole}$	in.	2	3	2 1/2	4	3	3 1/4	2	2 1/2
Nominal Embedment Depth	$h_{nom}$	in.	1 7/8	2 1/2	2	3 1/2	2 1/2	2 1/2	1 7/8	2
Effective Embedment Depth	$h_{ef}$	in.	1.23	1.77	1.29	2.56	1.77	1.77	1.23	1.29
Pullout Resistance, Cracked Concrete <sup>2,7</sup>	$N_{p,deck,cr}$	lbf	375	870	905	2040	870	870	500	1700
Pullout Resistance, Uncracked Concrete <sup>3,7</sup>	$N_{p,deck,uncr}$	lbf	825	1905	1295	2910	1430	1430	1095	2430
Steel Strength in Shear <sup>4</sup>	$V_{sa,deck}$	lbf	2240	2395	2435	4430	N/A	N/A	4180	7145
Steel Strength in Shear, Seismic <sup>4</sup>	$V_{sa,deck,eq}$	lbf	1434	1533	1565	2846	N/A	N/A	2676	4591

For **SI**: 1 inch = 25.4mm, 1 lbf = 4.45N.

<sup>1</sup>Installation must comply with Sections 3.4, 4.1.10 and 4.3 and Figures 3 and 4 of this report.

<sup>2</sup>The values listed must be used in accordance with Section 4.1.4 and 4.1.8.2 of this report.

<sup>3</sup>The values listed must be used in accordance with Section 4.1.4 of this report.

<sup>4</sup>The values listed must be used in accordance with Section 4.1.5 and 4.1.8.3 of this report.

<sup>5</sup>The values for  $\phi_p$  (reduction factor for pullout strength) can be found in Table 2 and the value for  $\phi_{sa}$  (reduction factor for steel strength in shear) can be found in Table 3.

<sup>6</sup>The minimum anchor spacing along the flute must be the greater of  $3h_{ef}$  or 1.5 times the flute width in accordance with Section 4.1.10 of this report.

<sup>7</sup>The characteristic pull-out resistance for greater concrete compressive strengths shall be increased by multiplying the tabular value by  $(f'_c / 3,000 \text{ psi})^{0.5}$ .

**TABLE 5—EXAMPLE TITEN HD® SCREW ANCHOR AND ROD HANGER ALLOWABLE STRESS DESIGN TENSION VALUES FOR ILLUSTRATIVE PURPOSES<sup>1,2,3,4,5,6,7,8,9,10</sup>**

Nominal Anchor Diameter, $d_a$ (inches)	Nominal Embedment Depth, $h_{nom}$ (inches)	Effective Embedment Depth, $h_{ef}$ (inches)	Allowable Tension Load, $\phi N_n/\alpha$ (lbs)
3/8	2 1/2	1.77	1185**
	3 1/4	2.40	1960
1/2	3 1/4	2.35	1900
	4	2.99	2725
3/4	5 1/2	4.22	4570
	6 1/4	4.86	5645

Design Assumptions:

- Single Anchor.
- Tension load only.
- Concrete determined to remain uncracked for the life of the anchorage.
- Load combinations from ACI 318 Section 9.2 (no seismic loading).
- 30% Dead Load (D) and 70% Live Load (L); Controlling load combination is 1.2 D + 1.6L
- Calculation of  $\alpha$  based on weighted average:  $\alpha = 1.2D + 1.6L = 1.2(0.3) + 1.6(0.7) = 1.48$
- Normal weight concrete:  $f'_c = 2500 \text{ psi}$
- $C_{a1} = C_{a2} \geq C_{ac}$
- $h \geq h_{min}$
- Values are for Condition B (Supplementary reinforcement in accordance with ACI 318 D.4.4 is not provided).

**\*\* Illustrative Procedure (reference Table 2 of this report):**

<sup>3</sup>/<sub>8</sub>" Titen HD with an Effective Embedment,  $h_{ef} = 1.77"$

Step 1: Calculate Static Steel Strength in Tension per ACI 318-05 Section D.5.1;  $\phi_{sa}N_{sa} = 0.65 \times 10,890 = 7,078 \text{ lbs.}$

Step 2: Calculate Static Concrete Breakout Strength in Tension per ACI 318-05 Section D.5.2;  $\phi_{cb}N_{cb} = 0.65 \times 2,826 = 1,837 \text{ lbs.}$

Step 3: Calculate Static Pullout Strength in Tension per ACI 318-05 Section D.5.3;  $\phi_p N_{p,unscr} = 0.65 \times 2,700 = 1,755 \text{ lbs.}$

Step 4: The controlling value (from Steps 1, 2 and 3 above) per ACI 318-05 Section D.4.1.2;  $\phi N_n = 1,755 \text{ lbs.}$

Step 5: Divide the controlling value by the conversion factor  $\alpha$  per section 4.2.1 of this report:

$T_{allowable,ASD} = \phi N_n / \alpha = 1,755 / 1.48 = 1,185 \text{ lbs.}$

TABLE 6—TITEN HD® SCREW ANCHOR AND ROD HANGER IDENTIFICATION INFORMATION

Anchor Size	Catalog Number
3/8"	THD37xxxxH
1/2"	THD50xxxxH
3/4"	THD75xxxxH
3/8" Rod Hanger	THD37212RH
1/2" Rod Hanger	THD50234RH



FIGURE 1A—TITEN HD® SCREW ANCHOR



FIGURE 1B—TITEN HD® ROD HANGER

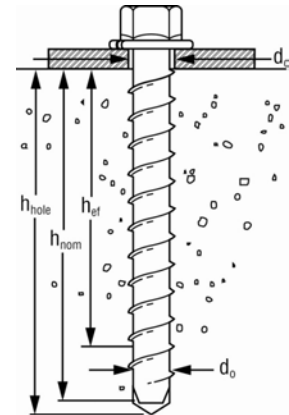


FIGURE 2—TITEN HD® SCREW ANCHOR INSTALLATION

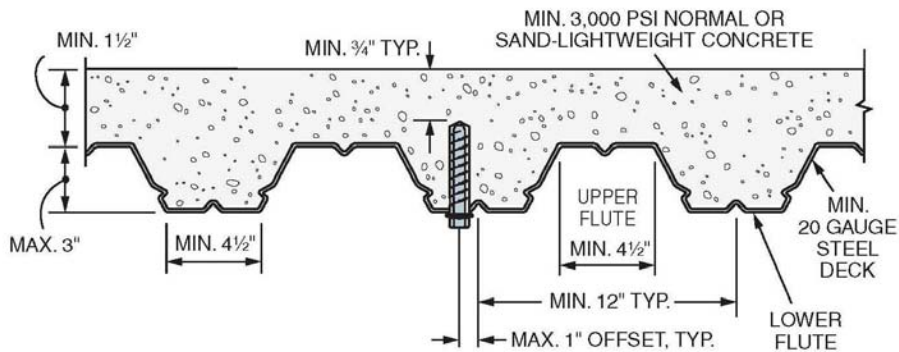


FIGURE 3 - INSTALLATION IN THE SOFFIT OF CONCRETE OVER PROFILE STEEL DECK FLOOR AND ROOF ASSEMBLIES (LOWER FLUTE)

(1 in = 25.4 mm)

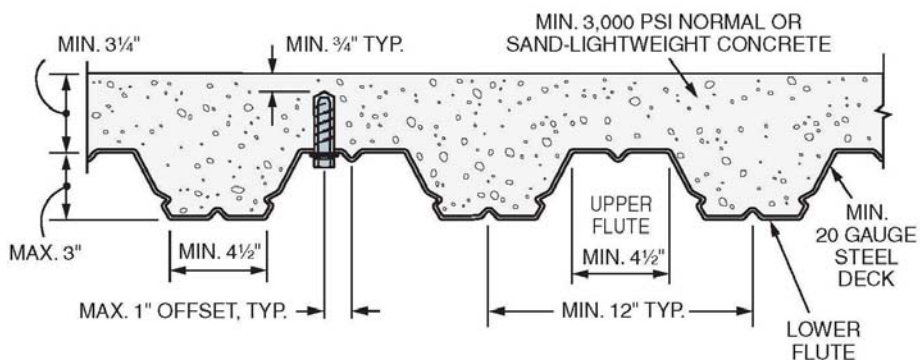


FIGURE 4 - INSTALLATION IN THE SOFFIT OF CONCRETE OVER PROFILE STEEL DECK FLOOR AND ROOF ASSEMBLIES (UPPER FLUTE)

(1 in = 25.4 mm)