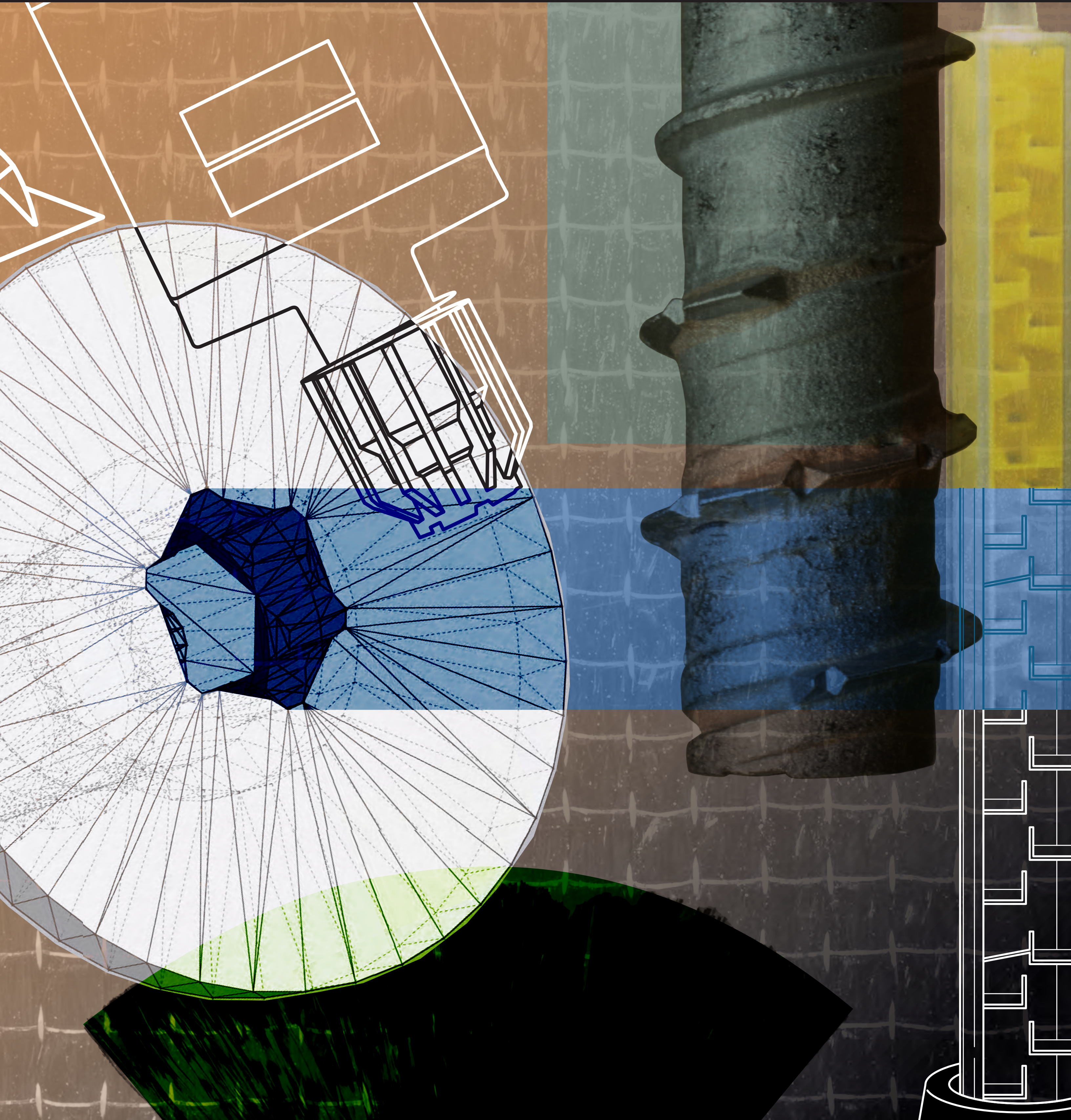
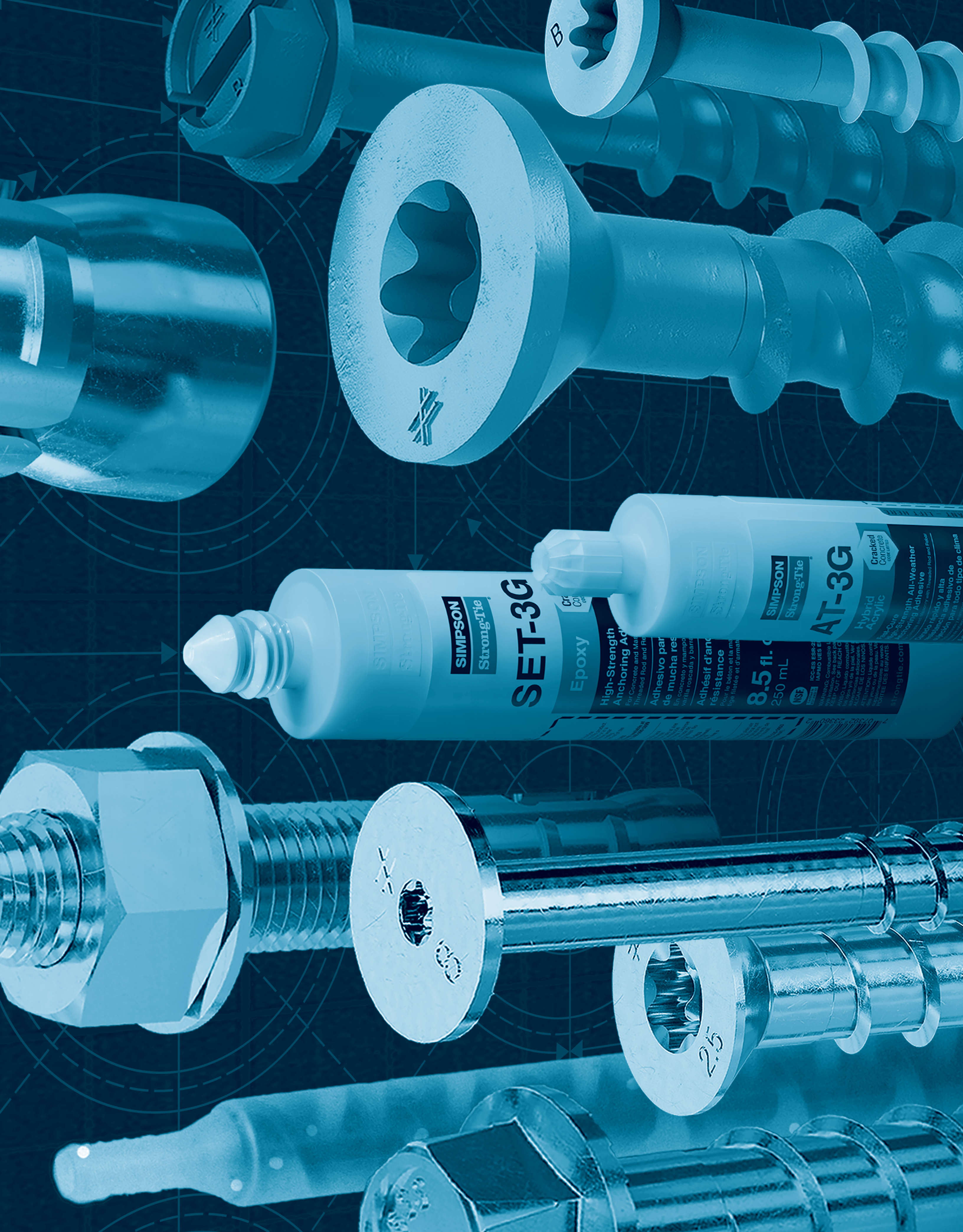
# Anchoring, Fastening, Restoration and Strengthening Systems for Concrete and Masonry

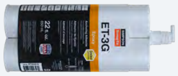
C-A-2023 | (800) 999-5099 | strongtie.com

SIMPSON Strong-Tie®




SIMPSON
Strong-Tie
SET-3G
Epoxy
250 mL
SIMPSON
Strong-Tie
AT-3G
Hybrid
Acrylic
Cracked
Concrete

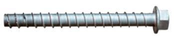
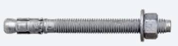
# Product Selection Guide

| Product | | | Page No. | Tested Base Materials and Code Listings | | | | | | Other Listings and Standard Specifications |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Concrete | | Concrete on Metal Deck | CMU | | Unreinforced Clay Brick Masonry | |
| | | | | Cracked | Uncracked | | Grout-Filled | Hollow | | |
| Adhesive Anchors | SET-3G™ |  | 24 | ESR-4057 (COLA and FBC), FL15730 | | — | ICC-ES ESR pending | | — | ASTM C881/ AASHTO M235, DOT, CDPH Std. Method v1.2, NSF/ANSI/CAN Std 61 |
| | NEW ET-3G™ |  | 34 | ICC-ES ESR pending | | — | ICC-ES ESR pending | | — | ASTM C881/ AASHTO M235, DOT, CDPH Std. Method v1.2, NSF/ANSI/CAN Std 61 |
| | NEW AT-3G™ |  | 42 | ESR-5026 (COLA and FBC), FL15730 | | — | — | — | — | ASTM C881/ AASHTO M235, CDPH Std. Method v1.2, NSF/ANSI/CAN Std 61 |
| Restoration Solutions | CI-SLV |  | 192 | — | — | — | — | — | — | ASTM C881/ AASHTO M235 |
| | CI-LV |  | 194 | — | — | — | — | — | — | ASTM C881/ AASHTO M235 NSF/ANSI/CAN Std 61 |
| | CI-LV FS |  | 196 | — | — | — | — | — | — | ASTM C881/ AASHTO M235 |
| | CI-LPL |  | 198 | — | — | — | — | — | — | ASTM C881/ AASHTO M235 |
| | CI-GV |  | 200 | — | — | — | — | — | — | ASTM C881/ AASHTO M235 |
| | NEW CI-PO |  | 206 | — | — | — | — | — | — | ASTM C881/ AASHTO M235 |
| | Heli-Tie™ Wall Tie |  | 216 | — | Non-IBC | — | Non-IBC | Non-IBC | Non-IBC | Wood and Metal Stud |
| | Heli-Tie Stitching Tie |  | 219 | — | — | — | — | — | Non-IBC | — |

Refer to footnotes on p. 6.

# Product Selection Guide

SIMPSON Strong-Tie

| Product | | | Page No. | Tested Base Materials and Code Listings | | | | | | | Other Listings and Standard Specifications |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Concrete | | Concrete on Metal Deck | CMU | | Unreinforced Clay Brick Masonry | Other | |
| | | | | Cracked | Uncracked | | Grout-Filled | Hollow | | | |
| Mechanical Anchors | Titen HD® (THD) |  | 62 | ESR-2713 (COLA), FL15730 | | | ESR-1056 (COLA), FL15730 | | — | — | FM, DOT |
| | Titen HD Mechanically Galvanized (THD-MG) |  | 66 | ESR-2713 (COLA), FL15730 | | | ESR-1056 (COLA), FL15730 | | — | — | FM, DOT |
| | Stainless-Steel Titen HD (THD-SS) |  | 80 | ER-493 (COLA), FL16230 | | | ESR-1056 (COLA), FL15730 | | — | — | DOT |
| | Titen HD Countersunk (THD-CS) |  | 63 | ESR-2713 (COLA), FL15730 | | | ESR-1056 (COLA), FL15730 | | — | — | DOT |
| | Stainless-Steel Titen HD Countersunk (THD-CS-SS) |  | 81 | ER-493 (COLA), FL16230 | | | ESR-1056 (COLA), FL15730 | | — | — | DOT |
| | Titen HD Washer Head (THD-WH) |  | 63 | ESR-2713 (COLA) FL 15730 | | | IBC | | — | — | DOT |
| | Titen HD Rod Coupler (THD-RC) |  | 92 | ESR-2713 (COLA), FL15730 | | | IBC | — | — | — | — |
| | Titen HD Rod Hanger (THD-RH) |  | 136 | ESR-2713 (COLA), FL15730 | | | IBC | — | — | — | FM |
| | Strong-Bolt® 2 (STB2) |  | 96 | ESR-3037 (COLA), FL15730 | | | ER-240 (COLA), FL16230 | — | — | — | UL, FM, DOT |
| | NEW Strong-Bolt 2 Mechanically Galvanized (STB2-MG) |  | 107 | — | Non-IBC | — | Non-IBC | — | — | — | — |
| | Strong-Bolt® 2 Stainless Steel (STB2-SS) |  | 110 | ESR-3037 (COLA), FL15730 | | | — | — | — | — | UL, FM, DOT |
| | Sleeve-All® (SL) |  | 118 | — | Non-IBC | — | Non-IBC | — | — | — | UL, FM, DOT |
| | Easy-Set (EZAC) |  | 123 | — | Non-IBC | — | — | — | — | — | — |
| | Tie-Wire (TW) |  | 124 | — | Non-IBC | Non-IBC | — | — | — | — | — |

Refer to footnotes on p. 6.

# Product Selection Guide

| | Product | | Page No. | Tested Base Materials and Code Listings | | | | | | | Other Listings and Standard Specifications |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Concrete | | Concrete on Metal Deck | CMU | | Unreinforced Clay Brick Masonry | Other | |
| | | | | Cracked | Uncracked | | Grout-Filled | Hollow | | | |
| Mechanical Anchors | Titen Turbo™ (TNT) |  | 126 | — | ER-712 (COLA), FL16230 | — | ER-716 (COLA), FL16230 | | — | — | — |
| | NEW Titen Turbo Trim Head (TNT-TTR) |  | 126 | — | ER-712 (COLA), FL16230 | — | ER-716 (COLA), FL16230 | | — | — | — |
| | Steel Rod Hanger (RSH, RSV) |  | 140 | — | — | — | — | — | — | IBC (Steel) | UL, FM |
| | Wood Rod Hanger (RWH, RWV) |  | 142 | — | — | — | — | — | — | IBC (Wood) | UL, FM |
| | Drop-In (DIAB) |  | 144 | — | Non-IBC | Non-IBC | — | — | — | — | UL, FM |
| | Drop-In Anchor (Stainless Steel: DIA-SS) (Short: DIA-S) |  | 153 149 | — | Non-IBC | Non-IBC | — | — | — | Non-IBC (Hollow-Core Concrete Panel) | UL, FM, DOT |
| | Hollow Drop-In (HDIA) |  | 156 | — | Non-IBC | — | — | IBC | — | Non-IBC (Hollow-Core Concrete Panel) | UL,FM |
| | Zinc Nailon™ (ZN) |  | 160 | — | Non-IBC | — | — | — | — | — | — |
| | Crimp Drive® (CD) |  | 161 | — | Non-IBC | Non-IBC | — | — | — | — | FM |
| | Split Drive (CSD, DSD) |  | 165 | — | Non-IBC | — | — | — | — | — | — |
| | Sure Wall™ (SWN, SWZ) |  | 167 | — | — | — | — | — | — | Drywall | — |
| Direct Fastening | Powder-Actuated Fasteners |  | 171 | — | ESR-2138 (COLA), FL15730 | | | | — | Steel, ESR-2138 (COLA), FL15730 | — |
| | Gas-Actuated Fasteners |  | 174 | — | ESR-2811 (COLA), FL15730 | | | | — | Steel, ESR-2811 (COLA), FL15730 | — |

ESR — ICC-ES code report available at **icc-es.org**.

ER — IAPMO UES code report available at **iapmoes.org**.

COLA — City of Los Angeles Supplement within the ICC-ES or IAPMO UES code report. See supplement for LA Building Code compliance.

FL — Florida building code approval available.

IBC — Load data is available in this catalog intended for use under IBC, but code listings are not available.

Non-IBC — Load data is available in this catalog, but it is outside the scope of the current IBC. May be permitted for non-IBC applications.

UL — Underwriters Laboratories listing available.

FM — Factory Mutual listing available.

DOT — Various departments of transportation listings available. See **strongtie.com/DOT** for details.

Consult the code listings for more detailed information on which models of each product are covered by the listing.

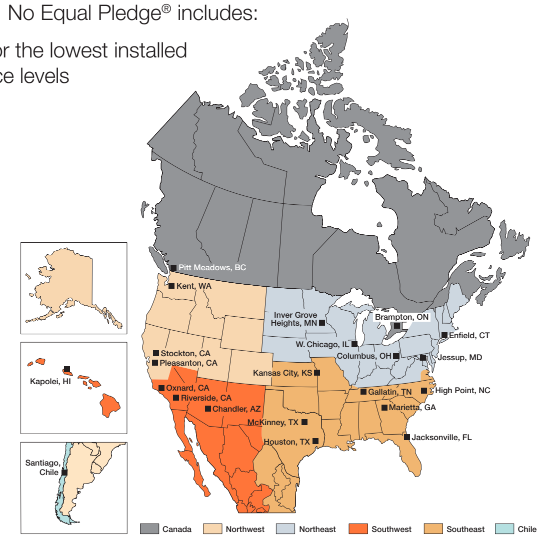
# Simpson Strong-Tie Company Inc.

For more than 65 years, Simpson Strong-Tie has focused on creating structural products that help people build safer and stronger homes and buildings. A leader in structural systems research and technology, Simpson Strong-Tie is one of the largest suppliers of structural building products in the world. The Simpson Strong-Tie commitment to product development, engineering, testing and training is evident in the consistent quality and delivery of its products and services.

For more information, visit the company's website at **strongtie.com**.

The Simpson Strong-Tie Company Inc. No Equal Pledge® includes:

- Quality products value-engineered for the lowest installed cost at the highest-rated performance levels
- The most thoroughly tested and evaluated products in the industry
- Strategically located manufacturing and warehouse facilities
- National code agency listings
- The largest number of patented connectors in the industry
- Global locations with an international sales team
- In-house R&D and tool and die professionals
- In-house product testing and quality control engineers
- Support of industry groups including AISI, AITC, ASTM, ASCE, AWC, AWPA, ACI, AISC, CSI, CFSEI, ICFA, NBMDA, NLBMDA, SDI, SETMA, SFA, SFIA, STAFDA, SREA, NFBA, TPI, WDSC, WIJMA, WTCA and local engineering groups




# The Simpson Strong-Tie Quality Policy

We help people build safer structures economically. We do this by designing, engineering and manufacturing No-Equal® structural connectors and other related products that meet or exceed our customers' needs and expectations. Everyone is responsible for product quality and is committed to ensuring the effectiveness of the Quality Management System.

**Mike Olosky**
Chief Executive Officer

# Getting Fast Technical Support

When you call for engineering technical support, we can help you quickly if you have the following information at hand. This will help us to serve you promptly and efficiently.

- Which Simpson Strong-Tie catalog are you using? *(See the front cover for the form number.)*
- Which Simpson Strong-Tie product are you using?
- What are the design requirements (i.e., loads, anchor diameter, base material, edge/spacing distance, etc.)?

## We Are ISO 9001 Registered

Simpson Strong-Tie is an ISO 9001 registered company. ISO 9001 is an internationally-recognized quality assurance system which lets our domestic and international customers know that they can count on the consistent quality of Simpson Strong-Tie products and services.

**800-999-5099 | strongtie.com**





## Product Identification Key

Products and additional information are divided into eight general categories, identified by tabs along the page's outer edge.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| Direct Fastening Solutions | 168–183 |
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**New products are shown with the NEW symbol.**

SIMPSON Strong-Tie


## AT-3G™ High-Strength Hybrid Acrylic Adhesive

**Fast cure, cold weather performance.**

AT-3G is a hybrid, acrylic-based adhesive for anchoring threaded rod and rebar into cracked and uncracked concrete. Ideal for cold weather and wet concrete applications, AT-3G dispenses easily and offers a fast curing time for same-day bolt up. It can be specified for a wide range of in-service temperatures, and maintains its strong bond strength in extreme environments for ultimate design and jobsite flexibility. Tested and code compliant with the IBC and IRC, AT-3G hybrid adhesive is easy to install with the conventional blow-brush-blow hole cleaning method.

**See pp. 42–47 for more information.**


## ET-3G™ Epoxy Adhesive

**Ideal for general rebar doweling.**

ET-3G is an epoxy-based anchoring adhesive. ET-3G is a 1:1 ratio, two-component anchoring adhesive for anchoring and doweling into concrete (cracked and uncracked) and masonry (cracked and uncracked) applications. The adhesive features jobsite flexibility as it is permitted for sustained load performance at elevated temperature, and it can be specified for dry and damp conditions when in-service temperatures range from –40°F (–40°C) to 150°F (65°C).

**See pp. 34–41 for more information.**

## Titen HD® Heavy-Duty Screw Anchor Mechanically Galvanized

**Now code listed for exterior use**.

The Titen HD heavy-duty screw anchor is a mechanically galvanized high-strength screw anchor for use in cracked and uncracked concrete, as well as uncracked masonry. Its proprietary heat treatment and ASTM B695 Class 65 mechanically galvanized coating make it ideal for both interior and exterior anchoring applications. The Titen HD screw anchor is designed for a wide variety of applications such as sill plates, ledgers, post bases, seating, and other holdown applications. The screw anchor is easy to remove for use in temporary applications such as bracing and formwork, or when a fixture needs to be relocated.

**See pp. 66–67 for more information.**


## Titen Turbo™ Trim-Head Concrete and Masonry Screw Anchor

**Smooth driving with less torque while providing superior holding power.**

The Titen Turbo screw anchor for concrete and masonry delivers what pros want — consistently trouble-free installation and fastening strength they can depend on. This screw anchor features a patented Torque Reduction Channel that displaces dust where it can't obstruct the thread action, reducing the likelihood of binding in the hole. The 6-lobe drive's larger contact area provides better bit grip for more secure driving, lower torque and longer bit life. The new Titen Turbo trim-head screw anchor works with window applications requiring a ¼" screw anchor and a smaller head diameter. It is available in select lengths in white and bronze.

**See pp. 126–128 for more information.**

## Strong-Bolt® 2 Wedge Anchor Mechanically Galvanized

**New mechanically galvanized version of Strong-Bolt 2 expansion anchor (STB2-MG) for exterior-use applications.**

Strong-Bolt 2 wedge-type expansion anchor is now available in mechanically galvanized finish where a high-load-resisting anchor is needed for exterior applications. It has the same dual undercutting embossments on each clip segment as the zinc-electroplated version. Suitable for horizontal, vertical and overhead applications, the STB2-MG is tested in uncracked concrete in accordance with AC193 and also in uncracked masonry in accordance with AC01.

**See pp. 107–109 for more information.**


## RPS-207 Slurry Seal

(Formerly FX-207)

RPS-207 slurry seal is a two-component, polymer-modified cementitious coating designed for fire insulation with FRP materials as well as waterproofing and damp-proofing concrete and masonry substrates. This product is part of the tested assembly in UL Design No. N861, which achieved a four-hour fire rating when subjected to ASTM E119/UL 263 full-scale fire testing.

**See p. 189 for more information.**

# New Products

## RPS-70-9 Epoxy Coating

**(Formerly FX-70-9)**

RPS-70-9 epoxy coating is a high-solids, two-component, moisture-tolerant, high-build protective coating designed to protect steel, concrete and wood.

**See p. 188 for more information.**


## RPS-505 Water-Based Acrylic Coating

**(Formerly FX-505)**

RPS-505 water-based acrylic coating is a single-component, fast-drying, protective architectural coating for concrete, masonry and stucco.

**See p. 189 for more information.**


## RPS-406 Zinc-Rich Primer

**(Formerly FX-406)**

RPS-406 zinc-rich primer is a single-component, fast-drying, zinc-rich coating designed to protect steel from corrosion by combining a barrier coating with the sacrificial galvanic protection of zinc.

**See p. 190 for more information.**


## RPS-752 Epoxy Bonding Agent

**(Formerly FX-752)**

RPS-752 epoxy bonding agent is a 100%-solids, two-component, moisture-tolerant epoxy system designed to increase the bond between freshly placed repair mortars or concrete mixes and existing concrete.

**See p. 190 for more information.**

# New Products


## RPS-792LPL Long Pot Life Epoxy Bonding Agent

**(Formerly FX-792LPL)**

RPS-792LPL long pot life epoxy bonding agent is a two-component, 100%-solids, moisture-tolerant epoxy resin designed to increase the bond between freshly placed repair mortars or concrete mixes and existing concrete.

**See p. 191 for more information.**


## RPS-263 Rapid-Hardening Vertical/Overhead Repair Mortar

**(Formerly FX-263)**

RPS-263 rapid-hardening vertical/overhead repair mortar is a cementitious, single-component, fiber-reinforced, polymer-modified, silica-fume-enhanced, structural repair mortar with integral corrosion inhibitor designed for vertical and overhead applications.

**See p. 191 for more information.**


## CI-PO Paste-Over and Structural Repair Epoxy

CI-PO is a fast-curing, two-component, high-modulus, high-solids, moisture-tolerant, thixotropic epoxy designed for securing injection ports at the concrete surface prior to injection repair. CI-PO is suitable for general concrete repair applications when substrate temperatures are between 40°F (4°C) and 90°F (32°C).

**See pp. 206–207 for more information.**


## G3 Gas-Actuated Fastening Tool

The new G3 gas-actuated fastening tool is designed for attachment of drywall track, lath furring strips and plywood to concrete, lightweight concrete, CMU or steel. The G3 is the only multi-functional gas-actuated tool that offers single shot and magazine functions. The G3's high-power performance is driven by 95 Joules of output and up to 8,000 shots per Li-ion battery charge. The tool is designed for speed, reliability and consistent performance.

**See p. 174 for more information.**

# Using Data Tables and Load Tables

This catalog contains both strength design data tables and allowable load tables. Some allowable load tables for concrete were established under old qualification standards that are no longer valid under the IBC. The following icons indicate whether or not a given table is intended to be used under the IBC (or under other building codes that use the IBC as their basis):

**Valid for International Building Code**

**Not Valid for International Building Code**

Tables that are "not valid for International Building Code" may be used where the designer determines that other building codes or regulations permit it — for example, under AASTHO or temporary construction.

## Strength Design Data Tables

Under the IBC, strength design (see p. 246) must be used for cast-in-place and post-installed mechanical and adhesive anchors that are installed into concrete. The design data from these tables are to be used with the design provisions of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17, ACI 318-11 Appendix D, IBC Chapter 19 and the respective ICC-ES Acceptance Criteria. Given the complexity of strength design calculations, designers may find Simpson Strong-Tie Anchor Designer™ software (**strongtie.com/software**) to be a great time saver for computing anchor design strengths.

SET-3G Tension Strength Design Data for Threaded Rod[1,7]

| Characteristic | Symbol | Units | Nominal Rod Diameter (in.) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 | 1¼ |
| **Steel Strength in Tension** | | | | | | | | | |
| Minimum Tensile Stress Area | $A_{se}$ | in.² | 0.078 | 0.142 | 0.226 | 0.334 | 0.462 | 0.606 | 0.969 |
| Tension Resistance of Steel — ASTM F1554, Grade 36 | $N_{sa}$ | lb. | 4,525 | 8,235 | 13,110 | 19,370 | 26,795 | 35,150 | 56,200 |
| Tension Resistance of Steel — ASTM F1554, Grade 55 | | | 5,850 | 10,650 | 16,950 | 25,050 | 34,650 | 45,450 | 72,675 |
| Tension Resistance of Steel — ASTM A193, Grade B7 | | | 9,750 | 17,750 | 28,250 | 41,750 | 57,750 | 75,750 | 121,125 |
| Tension Resistance of Steel — Stainless Steel ASTM A193, Grade B8 and B8M (Types 304 and 316) | | | 4,445 | 8,095 | 12,880 | 19,040 | 26,335 | 34,540 | 55,235 |
| Tension Resistance of Steel — Stainless Steel ASTM F593 CW (Types 304 and 316) | | | 7,800 | 14,200 | 22,600 | 28,390 | 39,270 | 51,510 | 82,365 |
| Tension Resistance of Steel — Stainless Steel ASTM A193, Grade B6 (Type 410) | | | 8,580 | 15,620 | 24,860 | 36,740 | 50,820 | 66,660 | 106,590 |
| Strength Reduction Factor for Tension — Steel Failure | $\phi$ | — | 0.75[5] | | | | | | |
| **Concrete Breakout Strength in Tension (2,500 psi ≤ f'c ≤ 8,000 psi)** | | | | | | | | | |
| Effectiveness Factor for Cracked Concrete | $k_{c,cr}$ | — | 17 | | | | | | |
| Effectiveness Factor for Uncracked Concrete | $k_{c,uncr}$ | — | 24 | | | | | | |
| Strength Reduction Factor — Concrete Breakout Failure in Tension | $\phi$ | — | 0.65[5] | | | | | | |
| **Bond Strength in Tension (2,500 psi ≤ f'c ≤ 8,000 psi)[6]** | | | | | | | | | |
| Minimum Embedment | $h_{ef,min}$ | in. | 2⅜ | 2¾ | 3⅛ | 3½ | 3¾ | 4 | 5 |
| Maximum Embedment | $h_{ef,max}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| Characteristic Bond Strength in Cracked Concrete[8] | $\tau_{k,cr}$ | psi | 1,448 | 1,402 | 1,356 | 1,310 | 1,265 | 1,219 | 1,128 |

**Example Strength Design Data Table**

## Allowable Load Tables

Under the IBC, allowable stress design (see p. 244) may be used for cast-in-place and post-installed adhesive and mechanical anchors installed into masonry or for gas- and powder-actuated fasteners installed into concrete, masonry or steel.

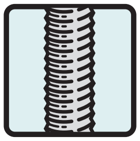
Powder-Actuated and Gas-Actuated Fasteners — Allowable Tension Loads in Normal-Weight Concrete

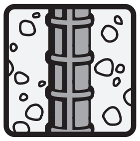
| Direct Fastening Type | Model No. | Shank Diameter in. (mm) | Minimum Embedment in. (mm) | Minimum Edge Distance in. (mm) | Minimum Spacing in. (mm) | Allowable Tension Load — lb. (kN) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | f'c = 2,500 psi (17.2 MPa) | f'c = 3,000 psi (20.7 MPa) | f'c = 4,000 psi (27.6 MPa) | f'c = 5,000 psi (34.5 MPa) | f'c = 6,000 psi (41.3 MPa) |
| Powder Actuated | PDPA PDPAT PDPAWL | **0.157** (4.0) | ¾ (19) | 3½ (89) | 5 (127) | **110** (0.49) | **110** (0.49) | **110** (0.49) | — | **110** (0.49) |
| | | | 1 (25) | 3½ (89) | 5 (127) | **210** (0.93) | **240** (1.07) | **310** (1.38) | — | **160** (0.71) |
| | | | 1¼ (32) | 3½ (89) | 5 (127) | **320** (1.42) | **340** (1.51) | **380** (1.69) | — | **365** (1.62) |
| | | | 1½ (38) | 3½ (89) | 5 (127) | **375** (1.67) | **400** (1.78) | **450** (2.00) | — | **465** (2.07) |
| | PINW PINWP | **0.145** (3.7) | 1 (25) | 3 (76) | 4 (102) | **70** (0.31) | **100** (0.44) | **150** (0.67) | — | **150** (0.67) |
| | | | 1¼ (32) | 3 (76) | 4 (102) | **195** (0.87) | **255** (1.13) | **370** (1.65) | — | **370** (1.65) |
| | PSLV3 | **0.205** (5.2) | 1¼ (32) | 4 (102) | 6 (152) | **260** (1.16) | — | — | — | — |
| Gas | GDP | **0.106** (2.7) | ⅝ (16) | 3 (76) | 4 (102) | **25** (0.11) | **30** (0.13) | **45** (0.20) | **45** (0.20) | — |
| | | | ¾ (19) | 3 (76) | 4 (102) | **30** (0.13) | **30** (0.13) | **30** (0.13) | **30** (0.13) | — |

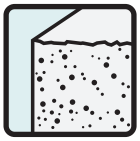
**Example Allowable Load Table**

# Table Icon System

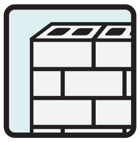
In order to facilitate easier identification of performance data, the following icon system has been incorporated into the sections of the catalog with multiple load tables. These icons will appear in the heading of the table to promote easier visual identification of the type of load, insert type and substrate addressed in the table. Icons are intended for quick identification. All specific information regarding suitability should be read from the table itself.

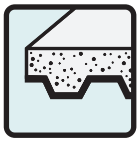

**Threaded Rod**

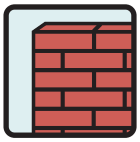

**Rebar**

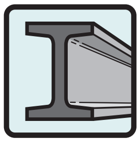

**Normal-Weight Concrete**

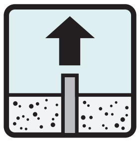
**Lightweight Concrete**

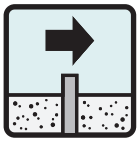

**Concrete Block (CMU)**

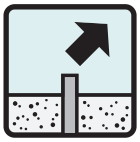

**Lightweight Concrete over Metal Deck**

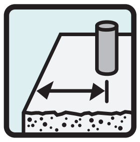

**Unreinforced Brick (URM)**

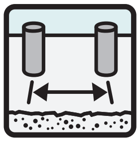

**Steel**


**Tension Load**


**Shear Load**


**Oblique Load**


**Edge Distance**


**Spacing**

**Valid for International Building Code**

**Not Valid for International Building Code**

# General Notes

These general notes are provided to ensure proper installation of Simpson Strong-Tie Company Inc. products and must be followed fully.

a. Simpson Strong-Tie Company Inc. reserves the right to change specifications, designs and models without notice or liability for such changes. Please refer to **strongtie.com** for the latest product updates, availability and load tables.

b. Unless otherwise noted, dimensions are in inches and loads are in pounds.

c. Do not overload, which will jeopardize the anchorage. Service loads shall not exceed published allowable loads. Factored loads shall not exceed design strengths calculated in accordance with published design data.

d. Some hardened fasteners may experience premature failure if exposed to moisture. These fasteners are recommended to be used in dry interior applications.

e. Do not weld products listed in this catalog. Some steel types have poor weldability and a tendency to crack when welded.

# Warning

Simpson Strong-Tie Company Inc. anchors, fasteners and structural connectors are designed and tested to provide specified design loads. To obtain optimal performance from Simpson Strong-Tie products and to achieve maximum design load, the products must be properly installed and used in accordance with the installation instructions and design limits provided by Simpson Strong-Tie. To ensure proper installation and use, designers and installers must carefully read the General Notes, General Instructions to the Installer and General Instructions to the Designer contained in this catalog, as well as consult the applicable catalog pages for specific product installation instructions and notes. Please always consult the Simpson Strong-Tie website at **strongtie.com** for updates regarding all Simpson Strong-Tie products.

Proper product installation requires careful attention to all notes and instructions, including the following basic rules:

1. Be familiar with the application and correct use of the anchor, connector or fastener.
2. Follow all installation instructions provided in the catalog, website, *Product Guide* (S-A-PG) or any other Simpson Strong-Tie publication.
3. Follow all product-related warnings provided in the catalog, website or any other Simpson Strong-Tie publication.
4. Install anchors, structural connectors and fasteners in accordance with their intended use.
5. Install all anchors, structural connectors and fasteners per installation instructions provided by Simpson Strong-Tie.
6. When using power tools to install fasteners: (a) use proper fastener type for direct fastening tool; (b) use proper powder or gas loads; and (c) follow appropriate safety precautions as outlined in this catalog, on the website or in the tool Operator's Manual.

In addition to following the basic rules provided above as well as all notes, warnings and instructions provided in the catalog, installers, designers, engineers and consumers should consult the Simpson Strong-Tie website at **strongtie.com** to obtain additional design and installation information, including:

- Instructional builder/contractor training kits containing an instructional video, an instructor guide and a student guide in both English and Spanish;
- Information on workshops Simpson Strong-Tie conducts at various training centers throughout the United States;
- Product-specific installation videos;
- Specialty catalogs;
- Code reports – Simpson Strong-Tie Code Report Finder;
- Technical fliers, bulletins and engineering letters;
- Master format specifications;
- Safety data sheets;
- Corrosion information;
- Adhesive cartridge estimator;
- Simpson Strong-Tie Software and Web Applications at **strongtie.com/softwareandwebapplications/category**; and
- Answers to frequently asked questions and technical topics.

Failure to fully follow all of the notes and instructions provided by Simpson Strong-Tie may result in improper installation of products. Improperly installed products may not perform to the specifications set forth in this catalog and may reduce a structure's ability to resist the movement, stress and loading that occur from gravity loads as well as impact events such as earthquakes and high-velocity winds.

Simpson Strong-Tie Company Inc. does not guarantee the performance or safety of products that are modified, improperly installed or not used in accordance with the design and load limits set forth in this catalog.

# General Instructions for the Installer

These general instructions for the installer are provided to ensure the proper selection and installation of Simpson Strong-Tie products and must be followed carefully. They are in addition to the specific design and installation instructions and notes provided for each particular product, all of which should be consulted prior to and during the installation of Simpson Strong-Tie products.

a. Do not modify Simpson Strong-Tie products as the performance of modified products may be substantially weakened. Simpson Strong-Tie will not warrant or guarantee the performance of such modified products.

b. Do not alter installation procedures from those set forth in this catalog.

c. Drill holes for post-installed anchors with carbide-tipped drill bits meeting the diameter requirements of ANSI B212.15 (shown in the table to the right). A properly sized hole is critical to the performance of post-installed anchors. Rotary hammers or hammer drills are recommended for drilling holes. When holes are to be drilled in archaic or hollow base materials, the drill should be set to "rotation only" mode.

d. For expansion anchors, failure to apply the required installation torque can result in excessive displacement of the anchor under load or premature failure of the anchor.

e. Expansion anchors set to the required installation torque will lose pre-tension after setting due to pre-load relaxation. See p. 237 for more information.

f. Do not disturb, make attachments, or apply load to adhesive anchors prior to the full cure of the adhesive.

g. Use proper safety equipment.

## Finished Diameters for Rotary and Rotary-Hammer Carbide-Tipped Concrete Drill Bits per ANSI B212.15

| Nominal Drill Bit Diameter (in.) | Tolerance Range Minimum (in.) | Tolerance Range Maximum (in.) |
|---|---|---|
| 1/8 | 0.134 | 0.140 |
| 5/32 | 0.165 | 0.171 |
| 3/16 | 0.198 | 0.206 |
| 7/32 | 0.229 | 0.237 |
| 1/4 | 0.260 | 0.268 |
| 5/16 | 0.327 | 0.335 |
| 3/8 | 0.390 | 0.398 |
| 7/16 | 0.458 | 0.468 |
| 1/2 | 0.520 | 0.530 |
| 9/16 | 0.582 | 0.592 |
| 5/8 | 0.650 | 0.660 |
| 11/16 | 0.713 | 0.723 |
| 3/4 | 0.775 | 0.787 |
| 13/16 | 0.837 | 0.849 |
| 27/32 | 0.869 | 0.881 |
| 7/8 | 0.905 | 0.917 |
| 15/16 | 0.968 | 0.980 |
| 1 | 1.030 | 1.042 |
| 1 1/8 | 1.160 | 1.175 |
| 1 3/16 | 1.223 | 1.238 |
| 1 1/4 | 1.285 | 1.300 |
| 1 5/16 | 1.352 | 1.367 |
| 1 3/8 | 1.410 | 1.425 |
| 1 7/16 | 1.472 | 1.487 |
| 1 1/2 | 1.535 | 1.550 |
| 1 9/16 | 1.588 | 1.608 |
| 1 5/8 | 1.655 | 1.675 |
| 1 3/4 | 1.772 | 1.792 |
| 2 | 2.008 | 2.028 |

# Prior to Tool Use — Recommended Training and Operator's Manual Review

Before operating any Simpson Strong-Tie Powder-Actuated tool (PAT), the user must read and understand the Operator's Manual and become certified by an authorized instructor or pass the online Powder-Actuated Tools Operator Certification test to receive a certified operator card (for online powder-actuated tool test, visit **strongtie.com/products/anchoring-systems/technical-notes/direct-fastening-systems/powder-actuated-operators-exam**). PAT tests and Operator's Manual are included with each tool kit. Manuals for gas-actuated tools are included in each kit. Gas-actuated tools do not require a certified operator card. Simpson Strong-Tie does offer additional online training for the gas tool at **training.strongtie.com**.

To avoid serious injury or death:

a. Always make sure that the operators and bystanders wear safety glasses. Hearing and head protection is also recommended.

b. Always post warning signs within the area when gas- or powder-actuated tools are in use. Signs should state "Tool in Use."

c. Always store gas- and powder-actuated tools unloaded. Store tools and powder loads in a locked container out of reach of children.

d. Never place any part of your body over the front muzzle of the tool, even if no fastener is present. The fastener, pin or tool piston can cause serious injury or death in the event of accidental discharge.

e. Never attempt to bypass or circumvent any of the safety features on a gas- or powder-actuated tool.

f. Always keep the tool pointed in a safe direction.

g. Always keep your finger off the trigger.

h. Always keep the tool unloaded until ready to use.

i. Always hold the tool perpendicular (90°) to the fastening surface to prevent ricocheting fasteners. Use the spall guard whenever possible.

j. Never attempt to fasten into thin, brittle or very hard materials such as glass, tile or cast iron as these materials are inappropriate. Conduct a pre-punch test to determine base material adequacy.

k. Never attempt to fasten into soft material such as drywall or wood. Fastening through soft materials into appropriate base material may be allowed if the application is appropriate.

l. Never attempt to fasten to a spalled, cracked or uneven surface.

m. Redriving of pins is not recommended.

# General Instructions for the Designer

These general instructions for the designer are provided to ensure the proper selection and installation of Simpson Strong-Tie products and must be followed carefully. They are in addition to the specific design and installation instructions and notes provided for each particular product, all of which should be consulted prior to and during the design process.

a. The term "designer" used throughout this catalog is intended to mean a licensed/certified building design professional, a licensed professional engineer or a licensed architect.

b. All connected members and related elements shall be designed by the designer and must have sufficient strength (bending, shear, etc.) to resist the design loads.

c. When the allowable stress design method is used, the design service load shall not exceed the published allowable loads reduced by load-adjustment factors for temperature, spacing and edge distance.

d. When the strength design method is used, the factored loads shall not exceed the design strengths calculated in accordance with the published design data.

e. Simpson Strong-Tie strongly recommends the following addition to construction drawings and specifications: "Simpson Strong-Tie products are specifically required to meet the structural calculations. Before substituting another brand, confirm load capacity based on reliable published testing data or calculations. The designer should evaluate and give written approval for substituton prior to installation."

f. Where used in this catalog, "IBC" refers to the 2021 International Building Code, and "ACI 318" refers to ACI 318-19 Building Code Requirements for Structural Concrete. Local and/or regional building codes may require meeting special conditions. Building codes often require special inspection of post-installed anchors installed in concrete and masonry. For compliance with these requirements, contact the local and/or building authority having jurisdiction. Except where mandated by code, Simpson Strong-Tie products do not require special inspection.

g. Allowable loads and design strengths are determined from test results, calculations and experience. These are guide values for sound base materials with known properties. Due to variation in base materials and site conditions, site-specific testing should be conducted if exact performance in a specific base material at a specific site must be known.

h. Unless stated otherwise, tests conducted to derive performance information were performed in members with thicknesses that comply with the appropriate acceptance criteria during testing and assessment. Anchoring into members thinner than recommended in this catalog requires the evaluation and judgment of a qualified designer.

i. Tests are conducted with anchors installed perpendicular (±6°) from a vertical reference to the surface of the base material. Deviations can result in anchor bending stresses that may reduce the load-carrying capacity of the anchor.

j. Allowable loads and design strengths do not consider bending stresses due to shear loads applied with large eccentricities.

k. Metal anchors and fasteners will corrode and may lose load-carrying capacity when installed in corrosive environments or exposed to corrosive materials. See p. 235.

l. Mechanical anchors should not be installed into concrete that is less than 7 days old. The allowable loads and design strengths of mechanical anchors that are installed into concrete less than 28 days old should be based on the actual compressive strength of the concrete at the time of installation.

m. Nominal embedment depth ("embedment depth") is the distance from the surface of the base material to the installed end of the anchor and is measured prior to application of an installation torque (if applicable). Effective embedment depth is the distance from the surface of the base material to the deepest point at which the load is transferred to the base material.

n. Drill bits shall meet the diameter requirements of ANSI B212.15. For adhesive anchor installations in oversized holes, see p. 238. For adhesive anchor installations into core-drilled holes, see p. 239.

o. Threaded-rod inserts for adhesive anchors shall be oil-free UNC fully threaded steel. Bare steel, zinc plating, mechanical galvanizing or hot-dip galvanizing coatings are acceptable.

p. Allowable loads and design strengths are generally based on testing of adhesive anchors installed into dry holes. For installations into damp, wet and submerged environments, see p. 239.

q. ACI 318 states that adhesive anchors should not be installed into concrete that is less than 21 days old. For information on adhesive anchors installed into concrete less than 21 days old, see p. 238.

r. Adhesive anchors can be affected by elevated base material temperature.

s. Anchors are permitted to support fire-resistant construction provided at least one of the following conditions is fulfilled: (a) anchors are used to resist wind or seismic forces only; (b) anchors that support gravity-load-bearing structural elements are within a fire-resistive envelope or a fire-resistive membrane, are protected by approved fire-resistive materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards; or (c) anchors are used to support non-structural elements.

t. Exposure to some chemicals may degrade the bond strength of adhesive anchors. Refer to the product description for chemical resistance information or refer to see p. 242.

u. Use of rodless pneumatic tools to dispense single-tube, coaxial adhesive cartridges is prohibited.

# Limited Warranty

For the Limited Warranty that applies to Simpson Strong-Tie products, please consult **strongtie.com/limited-warranties**. See p. 250 for the Limited Warranty in effect when this catalog was first published. To obtain a copy of the current Limited Warranty, contact us at **limited_warranty@strongtie.com**, (800) 999-5099 or Simpson Strong-Tie Company Inc., 5956 West Las Positas Boulevard, Pleasanton, CA 94588.

The Limited Warranty contains important disclaimers, limitations and exclusions, and applies only if the products have been properly specified, installed, maintained, and used in accordance with the design limits and the structural, technical, and environmental specifications in the Simpson Strong-Tie Documentation. All future purchases of Simpson Strong-Tie products are subject to the terms of the Limited Warranty in effect as of the purchase date.

Although products are designed for a wide variety of uses, Simpson Strong-Tie assumes no liability for confirming that any product is appropriate for an intended use, and each intended use of a product must be reviewed and approved by qualified professionals. Each product is designed for the load capacities and uses listed in the Simpson Strong-Tie Documentation, subject to the limitations and other information set forth therein. Due to the particular characteristics of potential impact events such as earthquakes and high velocity winds, the specific design and location of the structure, the building materials used, the quality of construction, or the condition of the soils or substrates involved, damage may nonetheless result to a structure and its contents even if the loads resulting from the impact event do not exceed Simpson Strong-Tie's specifications and the products are properly installed in accordance with applicable building codes, laws, rules and regulations.

# Terms and Conditions of Sale

### Product Use

Products in this catalog are designed and manufactured for the specific purposes shown, and should not be used with other connectors not approved by a qualified licensed/certified building design professional, a licensed professional engineer or licensed architect ("designer"). You should review our website and consult a qualified designer familiar with all applicable building codes each time you use a Simpson Strong-Tie product.

### Indemnity

Any designer or other person who modifies any products, changes any installation procedures or designs any non-catalog products for fabrication by Simpson Strong-Tie Company Inc. shall, regardless of specific instructions to the user, indemnify, defend, and hold harmless Simpson Strong-Tie Company Inc. for any and all claimed loss or damage occasioned in whole or in part by such products.

### Non-Catalog and Modified Products

Modifications to products or changes in installation procedures should only be made by a qualified professional designer. The performance of such modified products or altered installation procedures is the sole responsibility of the designer. Any person modifying Simpson Strong-Tie products must provide the installer with specific instructions on the modified products' specifications, installation and use.

Consult Simpson Strong-Tie Company Inc. for applications for which there is no catalog product, or for connectors for use in hostile environments, with excessive wood shrinkage, or with abnormal loading or erection requirements.

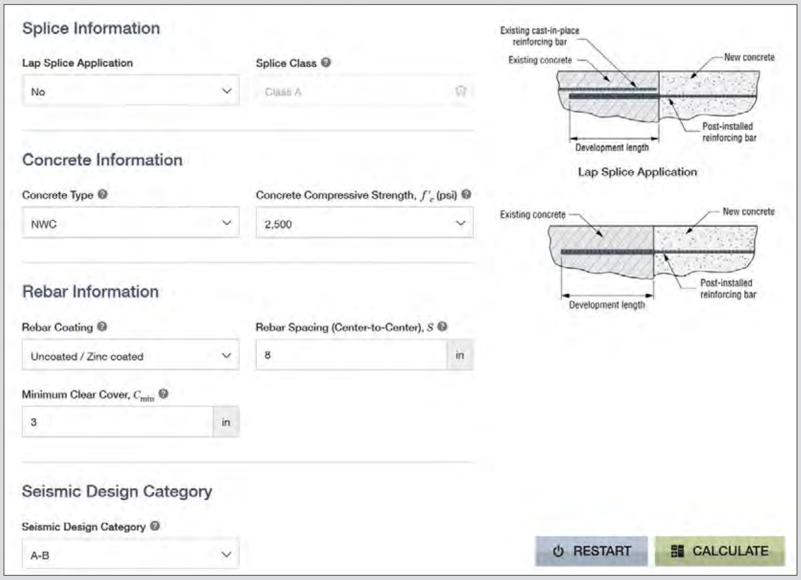
Non-catalog products must be designed by a qualified designer and will be fabricated by Simpson Strong-Tie in accordance with customer specifications.

Any modified, special order or non-catalog products, or any products that are not installed strictly in accordance with Simpson Strong-Tie installation procedures, are provided "AS IS" and without any representation or warranty of any kind.

# Anchor Software and Web Apps

## Rebar Development Length Calculator

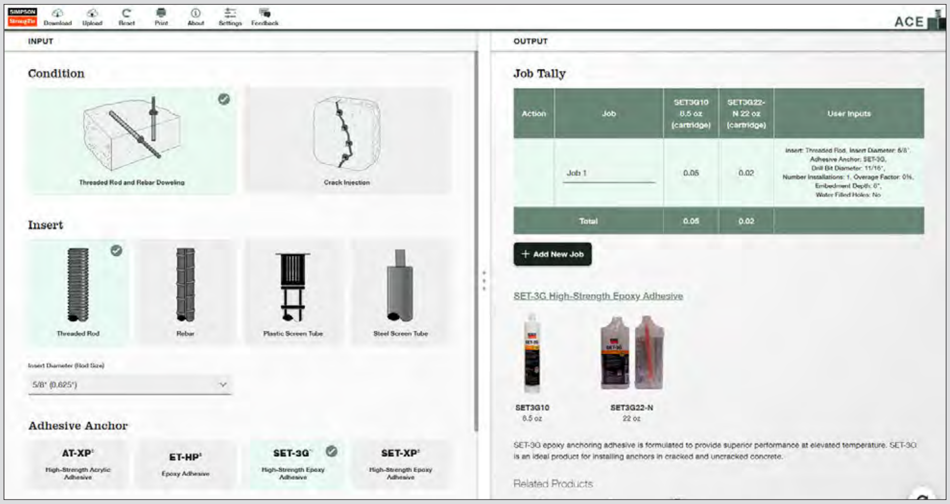
Rebar Development Length Calculator is a web application that supports the design of post-installed rebar in concrete applications by calculating the necessary tension and compression development lengths required in accordance with ACI 318-19 / ACI 318-14.




Visit **strongtie.com/softwareandwebapplications/category**

## Adhesive Cartridge Estimator

With the Adhesive Cartridge Estimator you can easily estimate how much adhesive you will need for your project, including threaded rod and rebar doweling, and crack injection.




Visit **strongtie.com/softwareandwebapplications/category**

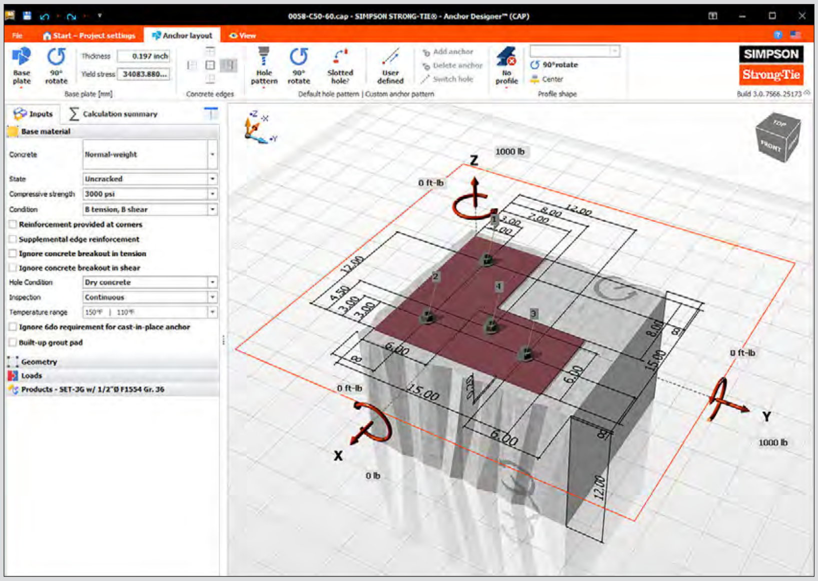
# Anchor Designer™ Software for ACI 318, ETAG and CSA

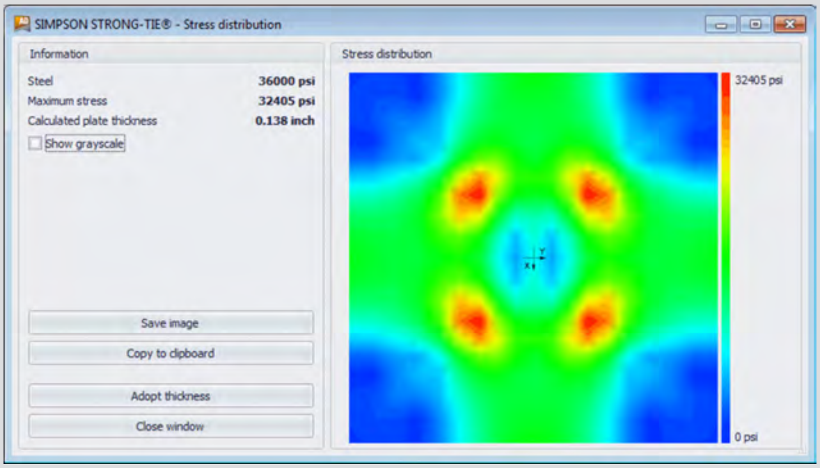
Simpson Strong-Tie® Anchor Designer Software is the latest anchorage design tool for structural engineers to satisfy the strength design provisions and methodologies. Anchor Designer will quickly and accurately analyze an existing design or suggest anchorage solutions based upon user-defined design elements in cracked and uncracked concrete conditions.

The real-time design is visually represented in a fully-interactive 3D graphic user interface, supports imperial and metric-sized Simpson Strong-Tie mechanical and adhesive anchors, and offers cast-in-place anchor solutions. Anchor Designer can calculate single anchor solutions or with multiple anchors in a single plate. Anchor locations are fully customizable to assist engineers in complex design conditions.

**Features include:**

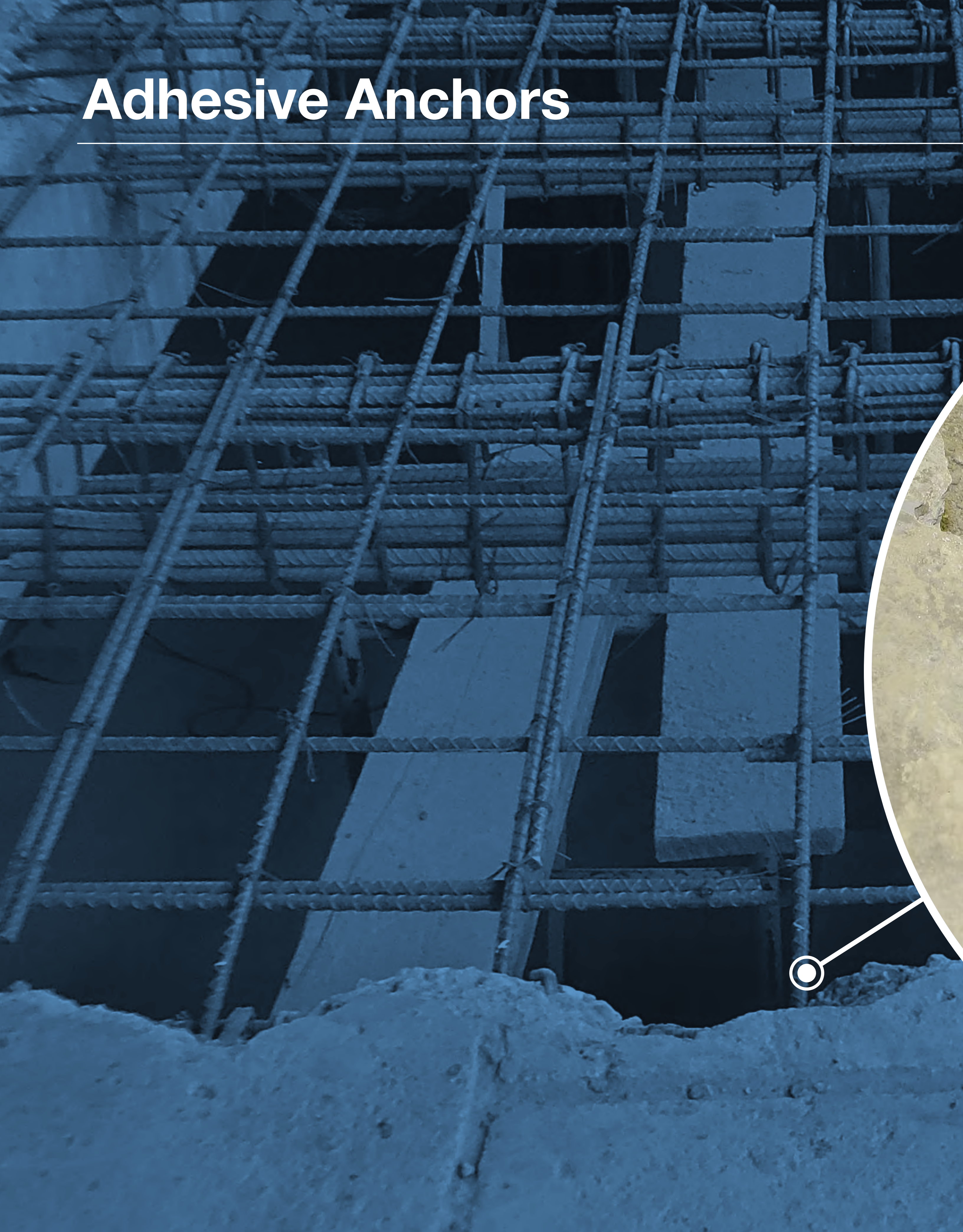
- Design standards: ACI 318-19 and ACI 318-14 Chapter 17 / ACI 318-11 Appendix D, CAN / CSA A23.3 Annex D, ETAG 001 Annex C or EOTA TR029.
- Customizable anchor pattern.
- Easy-to-use menus and updated workflows.
- Ability to calculate single anchor model or to calculate multiple anchor models at once.
- Multi-lingual options include English, German, French, Spanish, Polish and Danish languages.
- Rectangular, circular, L-shape and T-shape base plate geometries with the option to include slotted holes.
- And much more!




Visit **strongtie.com/softwareandwebapplications/category**

# Adhesive Anchors




SIMPSON Strong-Tie
SET-3G
Epoxy
High-Strength Anchoring Adhesive
Cracked Concrete
22 fl oz
650 mL

# SET-3G™ High-Strength Epoxy Adhesive

SET-3G is an epoxy-based anchoring adhesive with high design strength and proven performance. SET-3G is a 1:1 ratio, two-component, anchoring adhesive for concrete (cracked and uncracked). SET-3G installs and performs in a variety of environmental conditions and temperature extremes.

## Features

- Exceptional performance — superior bond strengths permit ductile solutions in high seismic areas
- Design flexibility — improved sustained load performance at elevated temperature
- Jobsite versatility — can be specified for all base material conditions when in-service temperatures range from –40°F (–40°C) to 176°F (80°C)
- Recognized per ICC ES AC308 for post-installed rebar development and splice length design provisions
- Approved for installation with multiple vacuum-drill bit systems without further hole cleaning. See Code Report (ESR-4057) and engineering letter at **strongtie.com** for approved systems.


SET-3G Adhesive

## Product Information

| | |
|---|---|
| Mix Ratio/Type | 1:1 epoxy |
| Mixed Color | Gray |
| Base Materials | Concrete and masonry — cracked and uncracked |
| Base Material Conditions | Dry, water-saturated, water-filled hole, submerged |
| Anchor Type | Threaded rod or rebar |
| Substrate Installation Temperature | 40°F (4°C) to 100°F (38°C) |
| In-Service Temperature Range | –40°F (–40°C) to 176°F (80°C) |
| Storage Temperature | 45°F (7°C) and 90°F (32°C) |
| Shelf Life | 24 months |
| Volatile Organic Compound (VOC) | 2 g/L |
| Chemical Resistance | See pp. 242–243 |
| Manufactured in the US using global materials | |

## Test Criteria

SET-3G has been tested in accordance with ICC-ES AC308, AC58, ACI 355.4 and applicable ASTM test methods.

## Code Reports, Standards and Compliance

Concrete — ICC-ES ESR-4057 (including post-installed rebar connections, City of LA and Florida Building Code), Florida FL15730.
Masonry — ICC-ES ESR pending.
ASTM C881 and AASHTO M235 — Types I/IV and II/V, Grade 3, Class B & C.
UL Certification — CDPH Standard Method v1.2.
NSF/ANSI/CAN 61 (216 in.$^2$ / 1,000 gal.).

## Installation Instructions

Installation instructions are located at the following locations: pp. 48–51; product packaging; or **strongtie.com/set3g**.

- Hole cleaning brushes are located on p. 52.

## SET-3G Adhesive Cartridge System

| Model No. | Capacity (ounces) | Cartridge Type | Carton Quantity | Dispensing Tool(s) | Mixing Nozzle[3] |
|---|---|---|---|---|---|
| SET3G10[4] | 8.5 | Coaxial | 12 | CDT10S | EMN22I |
| SET3G22-N[4] | 22 | Side-by-side | 10 | EDT22S, EDTA22P, EDTA22CKT | |
| SET3G56 | 56 | Side-by-side | 6 | EDTA56P | |

1. Cartridge estimation guidelines are available at **strongtie.com/softwareandwebapplications/category**.
2. Detailed information on dispensing tools, mixing nozzles and other adhesive accessories is available at **strongtie.com**.
3. Use only Simpson Strong-Tie mixing nozzles in accordance with Simpson Strong-Tie instructions. Modification or improper use of mixing nozzle may impair SET-3G adhesive performance.
4. One EMN22I mixing nozzle and one extension are supplied with each cartridge.
5. Use of rodless pneumatic tools to dispense single-tube, coaxial adhesive cartridges is prohibited.

# SET-3G™ High-Strength Epoxy Adhesive

## SET-3G Cure Schedule[1,2]

| Concrete Temperature | | Gel Time (minutes) | Cure Time (hr.) |
|---|---|---|---|
| (°F) | (°C) | | |
| 40 | 4 | 120 | 192 |
| 50 | 10 | 75 | 72 |
| 60 | 16 | 50 | 48 |
| 70 | 21 | 35 | 24 |
| 90 | 32 | 25 | 24 |
| 100 | 38 | 15 | 24 |

For SI: 1°F = (°C x 9⁄5) + 32.

1. For water-saturated concrete, submerged concrete and water-filled holes, the cure times shall be doubled.
2. For installation of anchors in concrete where the temperature is below 70°F (21°C), the adhesive must be conditioned to a minimum temperature of 70°F (21°C).

## SET-3G Typical Properties

| Property | | Class B | Class C | Test Method |
|---|---|---|---|---|
| | | (40°–60°F) | (>60°F) | |
| Consistency | | Non-sag | Non-sag | ASTM C881 |
| Bond Strength, Slant Shear | Hardened to Hardened Concrete, 2-Day Cure[1] | 3,700 psi | 3,300 psi | ASTM C882 |
| | Hardened to Hardened Concrete, 14-Day Cure[1] | 3,850 psi | 3,350 psi | |
| | Fresh to Hardened Concrete, 14-Day Cure[2] | 2,750 psi | 2,750 psi | |
| Compressive Yield Strength, 7-Day Cure[2] | | 13,000 psi | 15,350 psi | ASTM D695 |
| Compressive Modulus, 7-Day Cure[2] | | 650,000 psi | 992,000 psi | ASTM D695 |
| Heat Deflection Temperature, 7-Day Cure[2] | | 147°F (64°C) | | ASTM D648 |
| Glass Transition Temperature, 7-Day Cure[2] | | 149°F (65°C) | | ASTM E1356 |
| Decomposition Temperature, 24-Hour Cure[2] | | 500°F (260°C) | | ASTM E2550 |
| Water Absorption, 24-Hours, 7-Day Cure[2] | | 0.13% | | ASTM D570 |
| Shore D Hardness, 24-Hour Cure[2] | | 84 | | ASTM D2240 |
| Linear Coefficient of Shrinkage, 7-Day Cure[2] | | 0.002 in./in. | | ASTM D2566 |
| Coefficient of Thermal Expansion[2] | | $2.3 \times 10^{-5}$ in./in.°F | | ASTM C531 |

1. Material and curing conditions: Class B at 40° ± 2°F, Class C at 60° ± 2°F.
2. Material and curing conditions: 73° ± 2°F.

## SET-3G Installation Information and Additional Data for Threaded Rod and Rebar[1]

IBC *

| Characteristic | Symbol | Units | Nominal Anchor Diameter $d_a$ (in.) / Rebar Size | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 3⁄8 / #3 | 1⁄2 / #4 | 5⁄8 / #5 | 3⁄4 / #6 | 7⁄8 / #7 | 1 / #8 | 1¼ / #10 |
| **Installation Information** | | | | | | | | | |
| Drill Bit Diameter for Threaded Rod | $d_{hole}$ | in. | 7⁄16 | 9⁄16 | 11⁄16 | 7⁄8 | 1 | 1⅛ | 1⅜ |
| Drill Bit Diameter for Rebar | $d_{hole}$ | in. | ½ | ⅝ | ¾ | ⅞ | 1 | 1⅛ | 1⅜ |
| Maximum Tightening Torque | $T_{inst}$ | ft.-lb. | 15 | 30 | 60 | 100 | 125 | 150 | 200 |
| Minimum Embedment Depth | $h_{ef,\,min}$ | in. | 2⅜ | 2¾ | 3⅛ | 3½ | 3¾ | 4 | 5 |
| Maximum Embedment Depth | $h_{ef,\,max}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| Minimum Concrete Thickness | $h_{min}$ | in. | $h_{ef}$ + 1¼ | | $h_{ef} + 2d_{hole}$ | | | | |
| Critical Edge Distance | $c_{ac}$ | in. | See footnote 2 | | | | | | |
| Minimum Edge Distance | $c_{min}$ | in. | 1¾ | | | | | | 2¾ |
| Minimum Anchor Spacing | $s_{min}$ | in. | 1 | 2½ | 3 | | | | 6 |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. $c_{ac} = h_{ef}(\tau_{k,uncr}/1{,}160)^{0.4} \times [3.1 - 0.7(h/h_{ef})]$, where:
   $[h/h_{ef}] \leq 2.4$
   $\tau_{k,uncr}$ = the characteristic bond strength in uncracked concrete, given in the tables that follow $\leq k_{uncr}((h_{ef} \times f'_c)^{0.5}/(\pi \times d_a))$
   $h$ = the member thickness (inches)
   $h_{ef}$ = the embedment depth (inches)

*See p. 14 for an explanation of the load table icons.

# **SET-3G™** Design Information — Concrete

## SET-3G Tension Strength Design Data for Threaded Rod[1,7]

IBC *

| Characteristic | | | Symbol | Units | Nominal Rod Diameter (in.) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 | 1¼ |
| **Steel Strength in Tension** | | | | | | | | | | | |
| Minimum Tensile Stress Area | | | $A_{se}$ | in.² | 0.078 | 0.142 | 0.226 | 0.334 | 0.462 | 0.606 | 0.969 |
| Tension Resistance of Steel — ASTM F1554, Grade 36 | | | $N_{sa}$ | lb. | 4,525 | 8,235 | 13,110 | 19,370 | 26,795 | 35,150 | 56,200 |
| Tension Resistance of Steel — ASTM F1554, Grade 55 | | | | | 5,850 | 10,650 | 16,950 | 25,050 | 34,650 | 45,450 | 72,675 |
| Tension Resistance of Steel — ASTM A193, Grade B7 | | | | | 9,750 | 17,750 | 28,250 | 41,750 | 57,750 | 75,750 | 121,125 |
| Tension Resistance of Steel — Stainless Steel ASTM A193, Grade B8 and B8M (Types 304 and 316) | | | | | 4,445 | 8,095 | 12,880 | 19,040 | 26,335 | 34,540 | 55,235 |
| Tension Resistance of Steel — Stainless Steel ASTM F593 CW (Types 304 and 316) | | | | | 7,800 | 14,200 | 22,600 | 28,390 | 39,270 | 51,510 | 82,365 |
| Tension Resistance of Steel — Stainless Steel ASTM A193, Grade B6 (Type 410) | | | | | 8,580 | 15,620 | 24,860 | 36,740 | 50,820 | 66,660 | 106,590 |
| Strength Reduction Factor for Tension — Steel Failure | | | $\phi$ | — | 0.75[5] | | | | | | |
| **Concrete Breakout Strength in Tension (2,500 psi ≤ $f'_c$ ≤ 8,000 psi)** | | | | | | | | | | | |
| Effectiveness Factor for Cracked Concrete | | | $k_{c,cr}$ | — | 17 | | | | | | |
| Effectiveness Factor for Uncracked Concrete | | | $k_{c,uncr}$ | — | 24 | | | | | | |
| Strength Reduction Factor — Concrete Breakout Failure in Tension | | | $\phi$ | — | 0.65[5] | | | | | | |
| **Bond Strength in Tension (2,500 psi ≤ $f'_c$ ≤ 8,000 psi)[6]** | | | | | | | | | | | |
| Minimum Embedment | | | $h_{ef,min}$ | in. | 2⅜ | 2¾ | 3⅛ | 3½ | 3¾ | 4 | 5 |
| Maximum Embedment | | | $h_{ef,max}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| Continuous Inspection | Temperature Range A[2,4] | Characteristic Bond Strength in Cracked Concrete[8] | $\tau_{k,cr}$ | psi | 1,448 | 1,402 | 1,356 | 1,310 | 1,265 | 1,219 | 1,128 |
| | | Characteristic Bond Strength in Uncracked Concrete[8] | $\tau_{k,uncr}$ | psi | 2,357 | 2,260 | 2,162 | 2,064 | 1,967 | 1,868 | 1,672 |
| | Temperature Range B[3,4] | Characteristic Bond Strength in Cracked Concrete[8] | $\tau_{k,cr}$ | psi | 1,201 | 1,163 | 1,125 | 1,087 | 1,050 | 1,012 | 936 |
| | | Characteristic Bond Strength in Uncracked Concrete[8] | $\tau_{k,uncr}$ | psi | 1,957 | 1,876 | 1,795 | 1,713 | 1,632 | 1,551 | 1,388 |
| | Anchor Category | Dry Concrete | — | — | 1 | | | | | | |
| | Strength Reduction Factor | Dry Concrete | $\phi_{dry,ci}$ | — | 0.65[5] | | | | | | |
| | Anchor Category | Water-Saturated Concrete, Water-Filled Hole or Submerged Concrete | — | — | 3 | | 2 | | | | |
| | Strength Reduction Factor | Water-Saturated Concrete, Water-Filled Hole or Submerged Concrete | $\phi_{wet,ci}$ | — | 0.45[5] | | 0.55[5] | | | | |
| Periodic Inspection | Temperature Range A[2,4] | Characteristic Bond Strength in Cracked Concrete[8] | $\tau_{k,cr}$ | psi | 1,346 | 1,304 | 1,356 | 1,310 | 1,265 | 1,219 | 1,128 |
| | | Characteristic Bond Strength in Uncracked Concrete[8] | $\tau_{k,uncr}$ | psi | 2,192 | 2,102 | 2,162 | 2,064 | 1,967 | 1,868 | 1,672 |
| | Temperature Range B[3,4] | Characteristic Bond Strength in Cracked Concrete[8] | $\tau_{k,cr}$ | psi | 1,117 | 1,082 | 1,125 | 1087 | 1,050 | 1,012 | 936 |
| | | Characteristic Bond Strength in Uncracked Concrete[8] | $\tau_{k,uncr}$ | psi | 1,820 | 1,744 | 1,795 | 1,713 | 1,632 | 1,551 | 1,388 |
| | Anchor Category | Dry Concrete | | — | 2 | | 1 | | | | |
| | Strength Reduction Factor | Dry Concrete | $\phi_{dry,pi}$ | — | 0.55[5] | | 0.65[5] | | | | |
| | Anchor Category | Water-Saturated Concrete, Water-Filled Hole or Submerged Concrete | — | — | 3 | | | | | | |
| | Strength Reduction Factor | Water-Saturated Concrete, Water-Filled Hole or Submerged Concrete | $\phi_{wet,pi}$ | — | 0.45[5] | | | | | | |
| Reduction Factor for Seismic Tension | | | $\alpha_{N,seis}$[9] | — | 1.0 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. Temperature Range A: Maximum short-term temperature = 160°F, Maximum long-term temperature = 110°F.
3. Temperature Range B: Maximum short-term temperature = 176°F, Maximum long-term temperature = 110°F.
4. Short-term concrete temperatures are those that occur over short intervals (diurnal cycling). Long-term temperatures are roughly constant over significant periods of time.
5. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
6. Bond strength values shown are for normal-weight concrete having a compressive strength of $f'_c$ = 2,500 psi. For higher compressive strengths up to 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of $(f'_c/2{,}500)^{0.35}$ for uncracked concrete and a factor of $(f'_c/2{,}500)^{0.24}$ for cracked concrete.
7. For lightweight concrete, the modification factor for bond strength shall be as given in ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable, where applicable.
8. Characteristic bond strength values are for sustained loads, including dead and live loads.
9. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, the bond strength values must be multiplied by $\alpha_{N,seis}$.

*See p. 14 for an explanation of the load table icons.*

# SET-3G™ Design Information — Concrete



## SET-3G Tension Strength Design Data for Rebar[1,7]

| Characteristic | | | Symbol | Units | Rebar Size #3 | #4 | #5 | #6 | #7 | #8 | #10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel Strength in Tension** | | | | | | | | | | | |
| Minimum Tensile Stress Area | | | $A_{se}$ | in.$^2$ | 0.11 | 0.20 | 0.31 | 0.44 | 0.60 | 0.79 | 1.27 |
| Tension Resistance of Steel — Rebar (ASTM A615 Grade 60) | | | $N_{sa}$ | lb. | 9,900 | 18,000 | 27,900 | 39,600 | 54,000 | 71,100 | 114,300 |
| Tension Resistance of Steel — Rebar (ASTM A706 Grade 60) | | | $N_{sa}$ | lb. | 8,800 | 16,000 | 24,800 | 35,200 | 48,000 | 63,200 | 101,600 |
| Strength Reduction Factor for Tension — Steel Failure | | | $\phi$ | — | 0.75[5] | | | | | | |
| **Concrete Breakout Strength in Tension (2,500 psi ≤ f'$_C$ ≤ 8,000 psi)** | | | | | | | | | | | |
| Effectiveness Factor for Cracked Concrete | | | $k_{c,cr}$ | — | 17 | | | | | | |
| Effectiveness Factor for Uncracked Concrete | | | $k_{c,uncr}$ | — | 24 | | | | | | |
| Strength Reduction Factor — Concrete Breakout Failure in Tension | | | $\phi$ | — | 0.65[5] | | | | | | |
| **Bond Strength in Tension (2,500 psi ≤ f'$_C$ ≤ 8,000 psi)[6]** | | | | | | | | | | | |
| Minimum Embedment | | | $h_{ef,min}$ | in. | 2⅜ | 2¾ | 3⅛ | 3½ | 3¾ | 4 | 5 |
| Maximum Embedment | | | $h_{ef,max}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| Continuous Inspection | Temperature Range A[2,4] | Characteristic Bond Strength in Cracked Concrete[8] | $\tau_{k,cr}$ | psi | 1,448 | 1,402 | 1,356 | 1,310 | 1,265 | 1,219 | 1,128 |
| Continuous Inspection | Temperature Range A[2,4] | Characteristic Bond Strength in Uncracked Concrete[8] | $\tau_{k,uncr}$ | psi | 2,269 | 2,145 | 2,022 | 1,898 | 1,774 | 1,651 | 1,403 |
| Continuous Inspection | Temperature Range B[3,4] | Characteristic Bond Strength in Cracked Concrete[8] | $\tau_{k,cr}$ | psi | 1,201 | 1,163 | 1,125 | 1,087 | 1,050 | 1,012 | 936 |
| Continuous Inspection | Temperature Range B[3,4] | Characteristic Bond Strength in Uncracked Concrete[8] | $\tau_{k,uncr}$ | psi | 1,883 | 1,781 | 1,678 | 1,575 | 1,473 | 1,370 | 1,165 |
| Continuous Inspection | Anchor Category | Dry Concrete | — | — | 1 | | | | | | |
| Continuous Inspection | Strength Reduction Factor | Dry Concrete | $\phi_{dry,ci}$ | — | 0.65[5] | | | | | | |
| Continuous Inspection | Anchor Category | Water-Saturated Concrete, Water-Filled Hole or Submerged Concrete | — | — | 3 | | 2 | | | | |
| Continuous Inspection | Strength Reduction Factor | Water-Saturated Concrete, Water-Filled Hole or Submerged Concrete | $\phi_{wet,ci}$ | — | 0.45[5] | | 0.55[5] | | | | |
| Periodic Inspection | Temperature Range A[2,4] | Characteristic Bond Strength in Cracked Concrete[8] | $\tau_{k,cr}$ | psi | 1,346 | 1,304 | 1,356 | 1,310 | 1,265 | 1,219 | 1,128 |
| Periodic Inspection | Temperature Range A[2,4] | Characteristic Bond Strength in Uncracked Concrete[8] | $\tau_{k,uncr}$ | psi | 2,110 | 1,995 | 2,022 | 1,898 | 1,774 | 1,651 | 1,403 |
| Periodic Inspection | Temperature Range B[3,4] | Characteristic Bond Strength in Cracked Concrete[8] | $\tau_{k,cr}$ | psi | 1,117 | 1,082 | 1,125 | 1,087 | 1,050 | 1,012 | 936 |
| Periodic Inspection | Temperature Range B[3,4] | Characteristic Bond Strength in Uncracked Concrete[8] | $\tau_{k,uncr}$ | psi | 1,751 | 1,656 | 1,678 | 1,575 | 1,473 | 1,370 | 1,165 |
| Periodic Inspection | Anchor Category | Dry Concrete | — | — | 2 | | 1 | | | | |
| Periodic Inspection | Strength Reduction Factor | Dry Concrete | $\phi_{dry,pi}$ | — | 0.55[5] | | 0.65[5] | | | | |
| Periodic Inspection | Anchor Category | Water-Saturated Concrete, Water-Filled Hole or Submerged Concrete | — | — | 3 | | | | | | |
| Periodic Inspection | Strength Reduction Factor | Water-Saturated Concrete, Water-Filled Hole or Submerged Concrete | $\phi_{wet,pi}$ | — | 0.45[5] | | | | | | |
| Reduction Factor for Seismic Tension | | | $\alpha_{N,seis}$[9] | — | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. Temperature Range A: Maximum short-term temperature = 160°F, Maximum long-term temperature = 110°F.
3. Temperature Range B: Maximum short-term temperature = 176°F, Maximum long-term temperature = 110°F.
4. Short-term concrete temperatures are those that occur over short intervals (diurnal cycling). Long-term temperatures are roughly constant over significant periods of time.
5. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
6. Bond strength values shown are for normal-weight concrete having a compressive strength of f'$_C$ = 2,500 psi. For higher compressive strengths up to 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of $(f'_C/2,500)^{0.35}$ for uncracked concrete and a factor of $(f'_C/2,500)^{0.24}$ for cracked concrete.
7. For lightweight concrete, the modification factor for bond strength shall be as given in ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable, where applicable.
8. Characteristic bond strength values are for sustained loads, including dead and live loads.
9. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, the bond strength values must be multiplied by $\alpha_{N,seis}$.

**See p. 14 for an explanation of the load table icons.*

# SET-3G™ Design Information — Concrete



## SET-3G Shear Strength Design Data for Threaded Rod[1]

| Characteristic | Symbol | Units | Nominal Rod Diameter (in.) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 | 1¼ |
| **Steel Strength in Shear** | | | | | | | | | |
| Minimum Shear Stress Area | $A_{se}$ | in.$^2$ | 0.078 | 0.142 | 0.226 | 0.334 | 0.462 | 0.606 | 0.969 |
| Shear Resistance of Steel — ASTM F1554, Grade 36 | $V_{sa}$ | lb. | 2,715 | 4,940 | 7,865 | 11,625 | 16,080 | 21,090 | 33,720 |
| Shear Resistance of Steel — ASTM F1554, Grade 55 | | | 3,510 | 6,390 | 10,170 | 15,030 | 20,790 | 27,270 | 43,605 |
| Shear Resistance of Steel — ASTM A193, Grade B7 | | | 5,850 | 10,650 | 16,950 | 25,050 | 34,650 | 45,450 | 72,675 |
| Reduction factor for Seismic Shear — Carbon Streel | $\alpha_{V,seis}$[3] | — | 0.75 | | | | | 1.0 | |
| Shear Resistance of Steel — Stainless Steel ASTM A193, Grade B8 and B8M (Types 304 and 316) | $V_{sa}$ | lb. | 2,665 | 4,855 | 7,730 | 11,425 | 15,800 | 20,725 | 33,140 |
| Shear Resistance of Steel — Stainless Steel ASTM F593 CW (Types 304 and 316) | | | 4,680 | 8,520 | 13,560 | 17,035 | 23,560 | 30,905 | 49,420 |
| Shear Resistance of Steel — Stainless Steel ASTM A193, Grade B6 (Type 410) | | | 5,150 | 9,370 | 14,915 | 22,040 | 30,490 | 40,000 | 63,955 |
| Reduction factor for Seismic Shear — Stainless Steel | $\alpha_{V,seis}$[3] | — | 0.80 | | 0.75 | | | 1.0 | |
| Strength Reduction Factor for Shear — Steel Failure | $\phi$ | — | 0.65[2] | | | | | | |
| **Concrete Breakout Strength in Shear** | | | | | | | | | |
| Outside Diameter of Anchor | $d_a$ | in. | 0.375 | 0.5 | 0.625 | 0.75 | 0.875 | 1 | 1.25 |
| Load-Bearing Length of Anchor in Shear | $l_e$ | in. | Min. of $h_{ef}$ and 8 times anchor diameter | | | | | | |
| Strength Reduction Factor for Shear — Breakout Failure | $\phi$ | — | 0.70[2] | | | | | | |
| **Concrete Pryout Strength in Shear** | | | | | | | | | |
| Coefficient for Pryout Strength | $k_{cp}$ | in. | 1.0 for $h_{ef} < 2.50$"; 2.0 for $h_{ef} \geq 2.50$" | | | | | | |
| Strength Reduction Factor for Shear — Breakout Failure | $\phi$ | — | 0.70[2] | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
3. The values of $V_{sa}$ are applicable for both cracked concrete and uncracked concrete. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, $V_{sa}$ must be multiplied by $\alpha_{Vseis}$ for the corresponding anchor steel type.



*See p. 14 for an explanation of the load table icons.

# SET-3G™ Design Information — Concrete



## SET-3G Shear Strength Design Data for Rebar[1]

IBC *

| Characteristic | Symbol | Units | Rebar Size | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | #3 | #4 | #5 | #6 | #7 | #8 | #10 |
| **Steel Strength in Shear** | | | | | | | | | |
| Minimum Shear Stress Area | $A_{se}$ | in.$^2$ | 0.110 | 0.200 | 0.310 | 0.440 | 0.600 | 0.790 | 1.270 |
| Shear Resistance of Steel — Rebar (ASTM A615 Grade 60) | $V_{sa}$ | lb. | 5,940 | 10,800 | 16,740 | 23,760 | 32,400 | 42,660 | 68,580 |
| Shear Resistance of Steel — Rebar (ASTM A706 Grade 60) | | | 5,280 | 9,600 | 14,880 | 21,120 | 28,800 | 37,920 | 60,960 |
| Reduction Factor for Seismic Shear — Rebar (ASTM A615 Grade 60) | $\alpha_{V,seis}$[3] | — | 0.60 | | | | | 0.8 | |
| Reduction Factor for Seismic Shear — Rebar (ASTM A706 Grade 60) | | | 0.60 | | | | | 0.8 | |
| Strength Reduction Factor for Shear — Steel Failure | $\phi$ | — | 0.65[2] | | | | | | |
| **Concrete Breakout Strength in Shear** | | | | | | | | | |
| Outside Diameter of Anchor | $d_a$ | in. | 0.375 | 0.5 | 0.625 | 0.75 | 0.875 | 1 | 1.25 |
| Load-Bearing Length of Anchor in Shear | $l_e$ | in. | Min. of $h_{ef}$ and 8 times anchor diameter | | | | | | |
| Strength Reduction Factor for Shear — Breakout Failure | $\phi$ | — | 0.70[2] | | | | | | |
| **Concrete Pryout Strength in Shear** | | | | | | | | | |
| Coefficient for Pryout Strength | $k_{cp}$ | in. | 1.0 for $h_{ef}$ < 2.50"; 2.0 for $h_{ef} \geq$ 2.50" | | | | | | |
| Strength Reduction Factor for Shear — Breakout Failure | $\phi$ | — | 0.70[2] | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
3. The values of $V_{sa}$ are applicable for both cracked concrete and uncracked concrete. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, $V_{sa}$ must be multiplied by $\alpha_{Vseis}$ for the corresponding anchor steel type.

For additional load tables, visit **strongtie.com/set3g**.

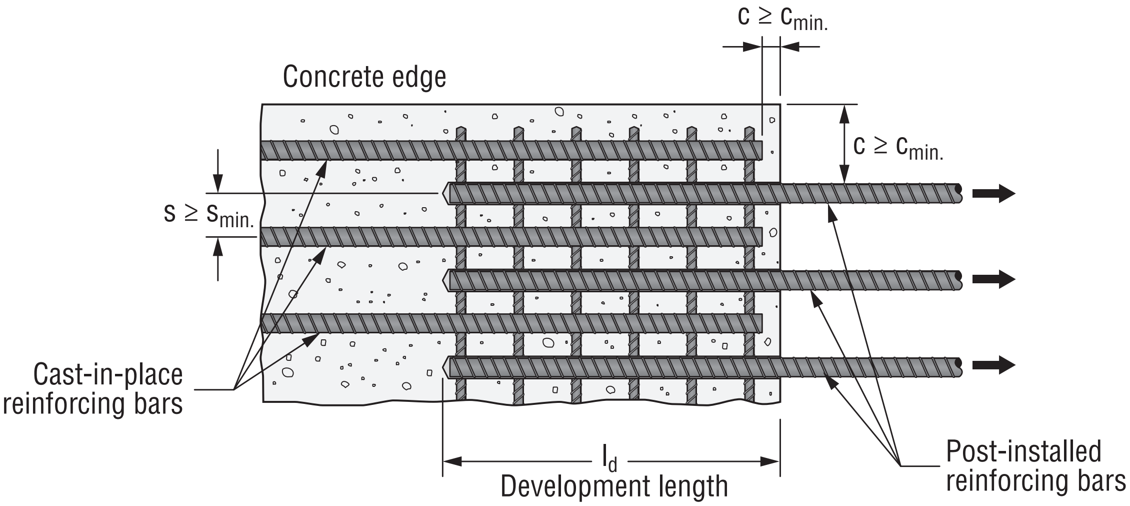




*See p. 14 for an explanation of the load table icons.

# SET-3G™ Design Information — Concrete






## SET-3G Development Length for Rebar Dowel

| Rebar Size | Drill Bit Diameter (in.) | Clear Cover, in. (mm) | Development Length, in. (mm) | | | | |
|---|---|---|---|---|---|---|---|
| | | | $f'_c$ = 2,500 psi (17.2 MPa) Concrete | $f'_c$ = 3,000 psi (20.7 MPa) Concrete | $f'_c$ = 4,000 psi (27.6 MPa) Concrete | $f'_c$ = 6,000 psi (41.4 MPa) Concrete | $f'_c$ = 8,000 psi (55.2 MPa) Concrete |
| #3 | ½ | 1.125 (29) | 12 (305) | 12 (305) | 12 (305) | 12 (305) | 12 (305) |
| #4 | ⅝ | 1.125 (29) | 14.4 (366) | 14 (356) | 12 (305) | 12 (305) | 12 (305) |
| #5 | ¾ | 1.125 (29) | 18 (457) | 17 (432) | 14.2 (361) | 12 (305) | 12 (305) |
| #6 | ⅞ | 1.125 (29) | 21.6 (549) | 20 (508) | 17.1 (434) | 14 (356) | 13 (330) |
| #7 | 1 | 2.30 (58) | 31.5 (800) | 29 (737) | 25 (635) | 21 (533) | 18 (457) |
| #8 | 1⅛ | 2.30 (58) | 36 (914) | 33 (838) | 28.5 (724) | 24 (610) | 21 (533) |
| #9 | 1⅜ | 2.30 (58) | 40.5 (1,029) | 38 (965) | 32 (813) | 27 (686) | 23 (584) |
| #10 | 1⅜ | 2.30 (58) | 45 (1,143) | 42 (1,067) | 35.6 (904) | 30 (762) | 26 (660) |
| #11 | 1¾ | 2.30 (58) | 51 (1,295) | 47 (1,194) | 41 (1,041) | 33 (838) | 29 (737) |

1. Tabulated development lengths are for static, wind and seismic load cases in Seismic Design Category A and B. Development lengths in Seismic Design Category C through F must comply with ACI 318-19 and ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21, as applicable.
2. Rebar is assumed to be ASTM A615 Grade 60 or A706 ($f_y$ = 60,000 psi). For rebar with a higher yield strength, multiply tabulated values by $f_y$/60,000 psi.
3. Concrete is assumed to be normal-weight concrete. For lightweight concrete, multiply tabulated values by 1.33.
4. Tabulated values assume bottom cover less that 12" cast below rebars ($\Psi_1$ = 1.0).
5. Uncoated rebar must be used.
6. The value of $K_{tr}$ is assumed to be 0. Refer to ACI 318-19 Section 25.4.2.4, ACI 319-14 Section 25.4.2.3 or ACI 318-11 Section 12.2.3.

*See p. 14 for an explanation of the load table icons.

# SET-3G™ Design Information — Masonry

## SET-3G Epoxy Anchor Installation Information — Fully Grouted CMU Construction — Face of Wall

IBC *

| Installation Information | Symbol | Units | Nominal Rod Diameter / Rebar Size | | | |
|---|---|---|---|---|---|---|
| | | | 3/8" / #3 | 1/2" / #4 | 5/8" / #5 | 3/4" / #6 |
| Drill Bit Diameter — Threaded Rod | $d_o$ | in. | 7/16 | 9/16 | 11/16 | 7/8 |
| Drill Bit Diameter — Rebar | $d_o$ | in. | 1/2 | 5/8 | 3/4 | 7/8 |
| Minimum Embedment Depth | $h_{ef,min}$ | in. | 3 | 3 | 3 | 3 |

## SET-3G Epoxy Anchor Installation Information — Fully Grouted CMU Construction — Top of Wall

IBC *

| Installation Information | Symbol | Units | Nominal Rod Diameter / Rebar Size | | |
|---|---|---|---|---|---|
| | | | 1/2" / #4 | 5/8" / #5 | 7/8" |
| Drill Bit Diameter — Threaded Rod | $d_o$ | in. | 9/16 | 11/16 | 1 |
| Drill Bit Diameter — Rebar | $d_o$ | in. | 5/8 | 3/4 | — |
| Minimum Embedment Depth | $h_{ef,min}$ | in. | 3 | 3 | 3 |

## SET-3G Epoxy Anchor Installation Information — Ungrouted CMU Construction

IBC *

| Installation Information | Symbol | Units | Nominal Rod Diameter | | |
|---|---|---|---|---|---|
| | | | 3/8" | 1/2" | 5/8" |
| Drill Bit Diameter | $d_o$ | in. | 9/16 | 3/4 | 7/8 |
| Embedment Depth | $h_{ef,min}$ | in. | 3½ | 3½ | 3½ |

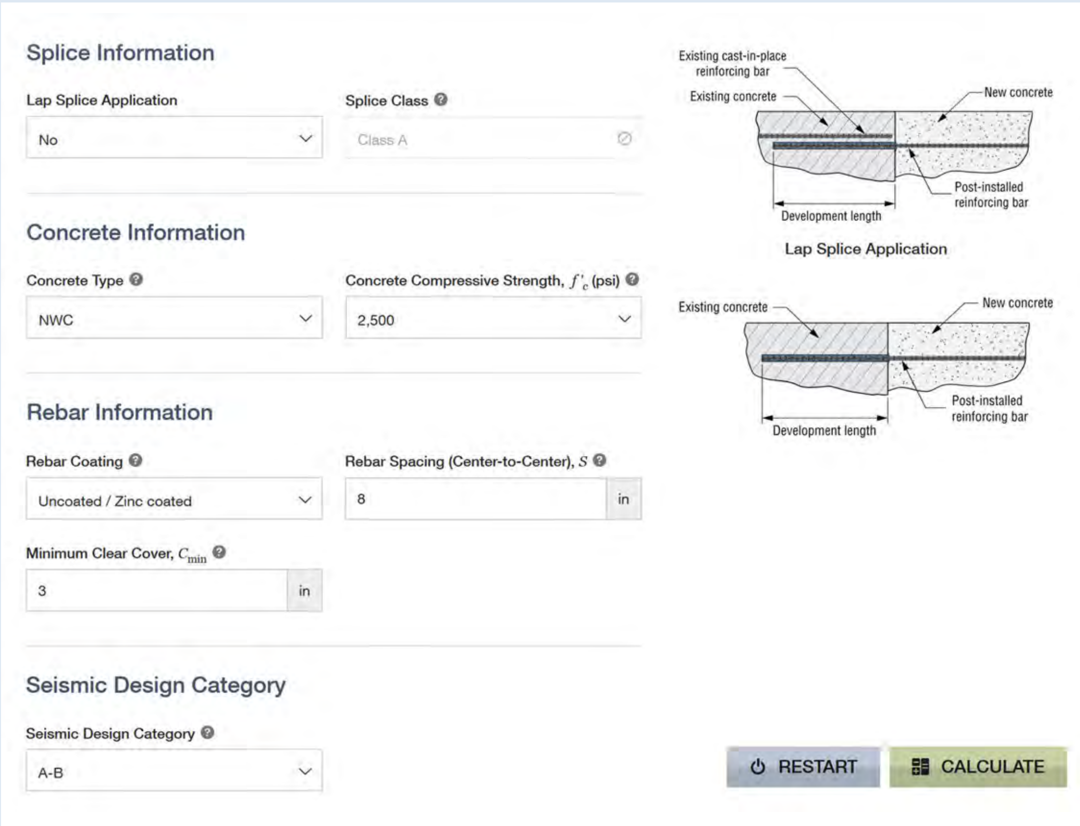
Please see the SET-3G product page at **strongtie.com** and ICC-ES ESR Report for load data.



*See p. 14 for an explanation of the load table icons.

# Rebar Development Length Calculator

Rebar Development Length Calculator is a web application that supports the design of post-installed rebar in concrete applications by calculating the necessary tension and compression development lengths required in accordance with ACI 318-19 / ACI 318-14.




Visit **strongtie.com/softwareandwebapplications/category**

SIMPSON Strong-Tie®

# Notes

# ET-3G™ Epoxy Adhesive

ET-3G is an epoxy-based, 1:1 ratio, two-component system ideal for general anchoring of threaded rod and rebar into concrete (cracked and uncracked) and masonry (cracked and uncracked).

## Features

- Suitable for use under static and seismic loading conditions in cracked and uncracked concrete and masonry
- Ideal for general doweling and threaded rod applications
- Two-year shelf life for unopened cartridges stored between 45°F (7°C) and 90°F (32°C)

## Product Information

| | |
|---|---|
| Mix Ratio/Type | 1:1 epoxy |
| Mixed Color | Teal |
| Base Materials | Concrete and masonry — cracked and uncracked |
| Base Material Conditions | Dry, water-saturated |
| Anchor Type | Threaded rod or rebar |
| Substrate Installation Temperature | 50°F (4°C) to 110°F (43°C) |
| In-Service Temperature Range | –40°F (–40°C) to 150°F (65°C) |
| Storage Temperature | 45°F (7°C) and 90°F (32°C) |
| Shelf Life | 24 months |
| Volatile Organic Compound (VOC) | 3 g/L |
| Chemical Resistance | See pp. 242–243 |
| Manufactured in the US using global materials | |


ET-3G Adhesive

## Test Criteria

ET-3G has been tested in accordance with ICC-ES AC308, AC58, ACI 355.4 and applicable ASTM test methods.

## Code Reports, Standards and Compliance

Concrete — ICC-ES ESR pending (including post-installed rebar connections, City of LA and Florida Building Code); FL15730.
Masonry — ICC-ES ESR pending.
ASTM C881 and AASHTO M235 — Types I/IV and II/V, Grade 3, Class C.
UL Certification — CDPH Standard Method v1.2.
NSF/ANSI/CAN 61 (216 in.$^2$ / 1,000 gal.)

## Installation Instructions

Installation instructions are located at the following locations: pp. 48–51; product packaging; or **strongtie.com/et3g**.

- Hole cleaning brushes are located on p. 52.

## ET-3G Cartridge System

| Model No. | Capacity (ounces) | Cartridge Type | Carton Quantity | Dispensing Tool(s) | Mixing Nozzle[3] |
|---|---|---|---|---|---|
| ET3G10[4] | 8.5 | Single | 12 | CDT10S | EMN22I |
| ET3G22-N[4] | 22 | Side-by-Side | 10 | EDT22S, EDTA22P, EDTA22CKT | |
| ET3G56 | 56 | Side-by-Side | 6 | EDTA56P | |

1. Cartridge estimation guidelines are available at **strongtie.com/softwareandwebapplications/category**.
2. Detailed information on dispensing tools, mixing nozzles and other adhesive accessories is available at **strongtie.com**.
3. Use only Simpson Strong-Tie mixing nozzles in accordance with Simpson Strong-Tie instructions. Modification or improper use of mixing nozzle may impair ET-3G adhesive performance.
4. One EMN22I mixing nozzle and one nozzle extension are supplied with each cartridge.
5. Use of rodless pneumatic tools to dispense single-tube, coaxial adhesive cartridges is prohibited.

# ET-3G™ Epoxy Adhesive



## ET-3G Cure Schedule

| Base Material Temperature | | Gel Time (minutes) | Cure Time (hr.) |
|---|---|---|---|
| °F | °C | | |
| 50 | 10 | 100 | 72 |
| 60 | 16 | 75 | 48 |
| 70 | 21 | 50 | 24 |
| 90 | 32 | 30 | 24 |
| 110 | 43 | 18 | 24 |

For water-saturated concrete, the cure times must be doubled.

## ET-3G Typical Properties

| Property | | Class C (>60°F) | Test Method |
|---|---|---|---|
| Consistency | | Non-sag | ASTM C881 |
| Bond Strength, Slant Shear | Hardened to Hardened Concrete, 2-Day Cure[1] | 2,600 psi | ASTM C882 |
| | Hardened to Hardened Concrete, 14-Day Cure[1] | 2,900 psi | |
| | Fresh to Hardened Concrete, 14-Day Cure[2] | 2,000 psi | |
| Compressive Yield Strength, 7-Day Cure[1] | | 13,000 psi | ASTM D695 |
| Compressive Modulus, 7-Day Cure[1] | | 580,000 psi | ASTM D695 |
| Heat Deflection Temperature, 7-Day Cure[2] | | 132°F (56°C) | ASTM D648 |
| Glass Transition Temperature, 7-Day Cure[2] | | 124°F (51°C) | ASTM E1356 |
| Decomposition Temperature, 24-Hour Cure[2] | | 500°F (260°C) | ASTM E2550 |
| Water Absorption, 24-Hours, 7-Day Cure[2] | | 0.15% | ASTM D570 |
| Shore D Hardness, 24-Hour Cure[2] | | 84 | ASTM D2240 |
| Linear Coefficient of Shrinkage, 7-Day Cure[2] | | 0.002 in./in. | ASTM D2566 |
| Coefficient of Thermal Expansion[2] | | $2.4 \times 10^{-5}$ in./in.°F | ASTM C531 |

1. Material and curing conditions: 60° ± 2°F.
2. Material and curing conditions: 73° ± 2°F.

## ET-3G Installation Information and Additional Data for Threaded Rod and Rebar[1]

IBC *

| Characteristic | | Symbol | Units | Nominal Anchor Diameter (in.) / Rebar Size | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ⅜ / #3 | ½ / #4 | ⅝ / #5 | ¾ / #6 | ⅞ / #7 | 1 / #8 | 1¼ / #10 |
| **Installation Information** | | | | | | | | | | |
| Drill Bit Diameter | | $d_{hole}$ | in. | ½ | ⅝ | ¾ | ⅞ | 1 | 1⅛ | 1⅜ |
| Maximum Tightening Torque | | $T_{inst}$ | ft.-lb. | 10 | 20 | 30 | 45 | 60 | 80 | 125 |
| Permitted Embedment Depth Range | Minimum | $h_{ef}$ | in. | 2⅜ | 2¾ | 3⅛ | 3½ | 3¾ | 4 | 5 |
| | Maximum | $h_{ef}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| Minimum Concrete Thickness | | $h_{min}$ | in. | $h_{ef} + 5d_{hole}$ | | | | | | |
| Critical Edge Distance[2] | | $c_{ac}$ | in. | See footnote 2 | | | | | | |
| Minimum Edge Distance | | $c_{min}$ | in. | 1¾ | | | | | | 2¾ |
| Minimum Anchor Spacing | | $s_{min}$ | in. | 3 | | | | | | 6 |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. $c_{ac} = h_{ef} (\tau_{k,uncr}/1,160)^{0.4} \times [3.1 - 0.7(h/h_{ef})]$, where:
   $[h/h_{ef}] \leq 2.4$
   $\tau_{k,uncr}$ = the characteristic bond strength in uncracked concrete, given in the tables that follow $\leq k_{uncr} ((h_{ef} \times f'_c)^{0.5}/(\pi \times d_{hole}))$
   $h$ = the member thickness (inches)
   $h_{ef}$ = the embedment depth (inches)

*See p. 14 for an explanation of the load table icons.

# ET-3G™ Design Information — Concrete

## ET-3G Tension Strength Design Data for Threaded Rod[1,11]

| Characteristic | Symbol | Units | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 | 1¼ |
|---|---|---|---|---|---|---|---|---|---|
| | | | Nominal Anchor Diameter (in.) | | | | | | |
| **Steel Strength in Tension** | | | | | | | | | |
| Threaded Rod — Minimum Tensile Stress Area | $A_{se}$ | in² | 0.078 | 0.142 | 0.226 | 0.334 | 0.462 | 0.606 | 0.969 |
| Threaded Rod — Tension Resistance of Steel — ASTM F1554, Grade 36 | $N_{sa}$ | lb. | 4,525 | 8,235 | 13,110 | 19,370 | 26,795 | 35,150 | 56,200 |
| Threaded Rod — Tension Resistance of Steel — ASTM A193, Grade B7 | $N_{sa}$ | lb. | 9,750 | 17,750 | 28,250 | 41,750 | 57,750 | 75,750 | 121,125 |
| Threaded Rod — Tension Resistance of Steel — Type 410 Stainless (ASTM A193, Grade B6) | $N_{sa}$ | lb. | 8,580 | 15,620 | 24,860 | 36,740 | 50,820 | 66,660 | 106,590 |
| Threaded Rod — Tension Resistance of Steel — Types 304 and 316 Stainless (ASTM A193, Grade B8 and B8M) | $N_{sa}$ | lb. | 4,445 | 8,095 | 12,880 | 19,040 | 26,335 | 34,540 | 55,235 |
| Threaded Rod — Strength Reduction Factor — Steel Failure | $\phi$ | — | 0.75[7] | | | | | | |
| **Concrete Breakout Strength in Tension (2,500 psi ≤ $f'_c$ ≤ 8,000 psi)[10]** | | | | | | | | | |
| Effectiveness Factor — Uncracked Concrete | $k_{uncr}$ | — | 24 | | | | | | |
| Effectiveness Factor — Cracked Concrete | $k_{cr}$ | — | 17 | | | | | | |
| Strength Reduction Factor — Breakout Failure | $\phi$ | — | 0.65[7] | | | | | | |
| **Bond Strength in Tension (2,500 psi ≤ $f'_c$ ≤ 8,000 psi)[10]** | | | | | | | | | |
| Uncracked Concrete[2,3,4] — Characteristic Bond Strength[5] | $\tau_{k,uncr}$ | psi | See **strongtie.com** for values | | | | | | |
| Uncracked Concrete[2,3,4] — Permitted Embedment Depth Range — Minimum | $h_{ef}$ | in. | 2⅜ | 2¾ | 3⅛ | 3½ | 3¾ | 4 | 5 |
| Uncracked Concrete[2,3,4] — Permitted Embedment Depth Range — Maximum | $h_{ef}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| Cracked Concrete[2,3,4] — Characteristic Bond Strength[5,8,9] | $\tau_{k,cr}$ | psi | See **strongtie.com** for values | | | | | | |
| Cracked Concrete[2,3,4] — Permitted Embedment Depth Range — Minimum | $h_{ef}$ | in. | 3 | 4 | 5 | 6 | 7 | 8 | 10 |
| Cracked Concrete[2,3,4] — Permitted Embedment Depth Range — Maximum | $h_{ef}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| **Bond Strength in Tension — Bond Strength Reduction Factors for Continuous Special Inspection** | | | | | | | | | |
| Strength Reduction Factor — Dry Concrete | $\phi_{dry,ci}$ | — | 0.65[7] | | | | | | |
| Strength Reduction Factor — Water-Saturated Concrete — $h_{ef} \le 12d_a$ | $\phi_{sat,ci}$ | — | 0.55[7] | 0.45[7] | | | | | |
| Additional Factor for Water-Saturated Concrete — $h_{ef} \le 12d_a$ | $K_{sat,ci}$[6] | — | 1 | | | | | 0.84 | |
| Strength Reduction Factor — Water-Saturated Concrete — $h_{ef} > 12d_a$ | $\phi_{sat,ci}$ | — | 0.45[7] | | | | | | |
| Additional Factor for Water-Saturated Concrete — $h_{ef} > 12d_a$ | $K_{sat,ci}$[6] | — | 0.57 | | | | | | |
| **Bond Strength in Tension — Bond Strength Reduction Factors for Periodic Special Inspection** | | | | | | | | | |
| Strength Reduction Factor — Dry Concrete | $\phi_{dry,pi}$ | — | 0.55[7] | | | | | | |
| Strength Reduction Factor — Water-Saturated Concrete — $h_{ef} \le 12d_a$ | $\phi_{sat,pi}$ | — | 0.45[7] | | | | | | |
| Additional Factor for Water-Saturated Concrete — $h_{ef} \le 12d_a$ | $K_{sat,pi}$[6] | — | 1 | 0.93 | | | | 0.71 | |
| Strength Reduction Factor — Water-Saturated Concrete — $h_{ef} > 12d_a$ | $\phi_{sat,pi}$ | — | 0.45[7] | | | | | | |
| Additional Factor for Water-Saturated Concrete — $h_{ef} > 12d_a$ | $K_{sat,pi}$[6] | — | 0.48 | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. Temperature Range: Maximum short-term temperature = 150°F, Maximum long-term temperature = 110°F.
3. Short-term concrete temperatures are those that occur over short intervals (diurnal cycling).
4. Long-term temperatures are roughly constant over significant periods of time.
5. For anchors that only resist wind or seismic loads, bond strengths may be increased by 72%.
6. In water-saturated concrete, multiply $\tau_{k,uncr}$ and $\tau_{k,cr}$ by $K_{sat}$.
7. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
8. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, the bond strength values for ⅞" anchors must be multiplied by $\alpha_{N,seis} = 0.80$.
9. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, the bond strength values for 1" anchors must be multiplied by $\alpha_{N,seis} = 0.92$.
10. The values of $f'_c$ used for calculation purposes must not exceed 8,000 psi (55.1 MPa) for uncracked concrete. The value of $f'_c$ used for calculation purposes must not exceed 2,500 psi (17.2 MPa) for tension resistance in cracked concrete.
11. For lightweight concrete, the modification factor for bond strength shall be as given in ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable, where applicable.

*See p. 14 for an explanation of the load table icons.

# ET-3G™ Design Information — Concrete

## ET-3G Tension Strength Design Data for Rebar[1,9]

IBC *

| Characteristic | | | Symbol | Units | #3 | #4 | #5 | #6 | #7 | #8 | #10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Rebar Size | | | | | | |
| **Steel Strength in Tension** | | | | | | | | | | | |
| Rebar | Minimum Tensile Stress Area | | $A_{se}$ | in² | 0.11 | 0.2 | 0.31 | 0.44 | 0.6 | 0.79 | 1.23 |
| | Tension Resistance of Steel — Rebar (ASTM A615 Grade 60) | | $N_{sa}$ | lb. | 9,900 | 18,000 | 27,900 | 39,600 | 54,000 | 71,100 | 110,700 |
| | Strength Reduction Factor — Steel Failure | | $\phi$ | — | 0.65[7] | | | | | | |
| **Concrete Breakout Strength in Tension (2,500 psi ≤ $f'_c$ ≤ 8,000 psi)[8]** | | | | | | | | | | | |
| Effectiveness Factor — Uncracked Concrete | | | $k_{uncr}$ | — | 24 | | | | | | |
| Effectiveness Factor — Cracked Concrete | | | $k_{cr}$ | — | 17 | | | | | | |
| Strength Reduction Factor — Breakout Failure | | | $\phi$ | — | 0.65[7] | | | | | | |
| **Bond Strength in Tension (2,500 psi ≤ $f'_c$ ≤ 8,000 psi)[8]** | | | | | | | | | | | |
| Uncracked Concrete[2,3,4] | Characteristic Bond Strength[5] | | $\tau_{k,uncr}$ | psi | See **strongtie.com** for values | | | | | | |
| | Permitted Embedment Depth Range | Minimum | $h_{ef}$ | in. | 2⅜ | 2¾ | 3⅛ | 3½ | 3¾ | 4 | 5 |
| | | Maximum | | | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| Cracked Concrete[2,3,4] | Characteristic Bond Strength[5] | | $\tau_{k,cr}$ | psi | See **strongtie.com** for values | | | | | | |
| | Permitted Embedment Depth Range | Minimum | $h_{ef}$ | in. | 3 | 4 | 5 | 6 | 7 | 8 | 10 |
| | | Maximum | | | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| **Bond Strength in Tension — Bond Strength Reduction Factors for Continuous Special Inspection** | | | | | | | | | | | |
| Strength Reduction Factor — Dry Concrete | | | $\phi_{dry,ci}$ | — | 0.65[7] | | | | | | |
| Strength Reduction Factor — Water-Saturated Concrete – $h_{ef} \le 12d_a$ | | | $\phi_{sat,ci}$ | — | 0.55[7] | | 0.45[7] | | | | |
| Additional Factor for Water-Saturated Concrete – $h_{ef} \le 12d_a$ | | | $K_{sat,ci}$[6] | — | 1 | | | | | 0.84 | |
| Strength Reduction Factor — Water-Saturated Concrete – $h_{ef} > 12d_a$ | | | $\phi_{sat,ci}$ | — | 0.45[7] | | | | | | |
| Additional Factor for Water-Saturated Concrete – $h_{ef} > 12d_a$ | | | $K_{sat,ci}$[6] | — | 0.57 | | | | | | |
| **Bond Strength in Tension — Bond Strength Reduction Factors for Periodic Special Inspection** | | | | | | | | | | | |
| Strength Reduction Factor — Dry Concrete | | | $\phi_{dry,pi}$ | — | 0.55[7] | | | | | | |
| Strength Reduction Factor — Water-Saturated Concrete – $h_{ef} \le 12d_a$ | | | $\phi_{sat,pi}$ | — | 0.45[7] | | | | | | |
| Additional Factor for Water-Saturated Concrete – $h_{ef} \le 12d_a$ | | | $K_{sat,pi}$[6] | — | 1 | | 0.93 | | | 0.71 | |
| Strength Reduction Factor — Water-Saturated Concrete – $h_{ef} > 12d_a$ | | | $\phi_{sat,pi}$ | — | 0.45[7] | | | | | | |
| Additional Factor for Water-Saturated Concrete – $h_{ef} > 12d_a$ | | | $K_{sat,pi}$[6] | — | 0.48 | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. Temperature Range: Maximum short-term temperature = 150°F, Maximum long-term temperature = 110°F.
3. Short-term concrete temperatures are those that occur over short intervals (diurnal cycling).
4. Long-term temperatures are roughly constant over significant periods of time.
5. For anchors that only resist wind or seismic loads, bond strengths may be increased by 72%.
6. In water-saturated concrete, multiply $\tau_{k,uncr}$ and $\tau_{k,cr}$ by $K_{sat}$.
7. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
8. The values of $f'_c$ used for calculation purposes must not exceed 8,000 psi (55.1 MPa) for uncracked concrete. The value of $f'_c$ used for calculation purposes must not exceed 2,500 psi (17.2 MPa) for tension resistance in cracked concrete.
9. For lightweight concrete, the modification factor for bond strength shall be as given in ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable, where applicable.



*See p. 14 for an explanation of the load table icons.

# ET-3G™ Design Information — Concrete

## ET-3G Shear Strength Design Data for Threaded Rod[1]

IBC *

| Characteristic | | Symbol | Units | Nominal Anchor Diameter (in.) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1 | 1 1/4 |
| **Steel Strength in Shear** | | | | | | | | | | |
| Threaded Rod | Minimum Shear Stress Area | $A_{se}$ | in.² | 0.078 | 0.142 | 0.226 | 0.334 | 0.462 | 0.606 | 0.969 |
| | Shear Resistance of Steel — ASTM F1554, Grade 36 | $V_{sa}$ | lb. | 2,260 | 4,940 | 7,865 | 11,625 | 16,080 | 21,090 | 33,720 |
| | Shear Resistance of Steel — ASTM A193, Grade B7 | | | 4,875 | 10,650 | 16,950 | 25,050 | 34,650 | 45,450 | 72,675 |
| | Shear Resistance of Steel — Type 410 Stainless (ASTM A193, Grade B6) | | | 4,290 | 9,370 | 14,910 | 22,040 | 30,490 | 40,000 | 63,955 |
| | Shear Resistance of Steel — Types 304 and 316 Stainless (ASTM A193, Grade B8 & B8M) | | | 2,225 | 4,855 | 7,730 | 11,420 | 15,800 | 20,725 | 33,140 |
| | Reduction for Seismic Shear — ASTM F1554, Grade 36 | $\alpha_{V,seis}$[3] | — | 0.87 | 0.78 | 0.68 | | | | 0.65 |
| | Reduction for Seismic Shear — ASTM A193, Grade B7 | | | 0.87 | 0.78 | 0.68 | | | | 0.65 |
| | Reduction for Seismic Shear — Stainless (ASTM A193, Grade B6) | | | 0.69 | 0.82 | 0.75 | | | 0.83 | 0.72 |
| | Reduction for Seismic Shear — Stainless (ASTM A193, Grade B8 & B8M) | | | 0.69 | 0.82 | 0.75 | | | 0.83 | 0.72 |
| | Strength Reduction Factor — Steel Failure | $\phi$ | — | 0.65[2] | | | | | | |
| **Concrete Breakout Strength in Shear** | | | | | | | | | | |
| Outside Diameter of Anchor | | $d_o$ | in. | 0.375 | 0.5 | 0.625 | 0.75 | 0.875 | 1 | 1.25 |
| Load Bearing Length of Anchor in Shear | | $\ell_e$ | in. | Min. of $h_{ef}$ and 8 times anchor diameter | | | | | | |
| Strength Reduction Factor — Breakout Failure | | $\phi$ | — | 0.70[2] | | | | | | |
| **Concrete Pryout Strength in Shear** | | | | | | | | | | |
| Coefficient for Pryout Strength | | $k_{cp}$ | — | 1.0 for $h_{ef} < 2.50$"; 2.0 for $h_{ef} \geq 2.50$" | | | | | | |
| Strength Reduction Factor — Pryout Failure | | $\phi$ | — | 0.70[2] | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
3. The values of $V_{sa}$ are applicable for both cracked concrete and uncracked concrete. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, $V_{sa}$ must be multiplied by $\alpha_{V,seis}$ for the corresponding anchor steel type.



*See p. 14 for an explanation of the load table icons.

# ET-3G™ Design Information — Concrete

## ET-3G Shear Strength Design Data for Rebar[1]

| Characteristic | | Symbol | Units | Rebar Size | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | #3 | #4 | #5 | #6 | #7 | #8 | #10 |
| **Steel Strength in Shear** | | | | | | | | | | |
| Rebar | Minimum Shear Stress Area | $A_{se}$ | in² | 0.11 | 0.2 | 0.31 | 0.44 | 0.6 | 0.79 | 1.23 |
| | Shear Resistance of Steel — Rebar (ASTM A615 Grade 60) | $V_{sa}$ | lb. | 4,950 | 10,800 | 16,740 | 23,760 | 32,400 | 42,660 | 66,420 |
| | Reduction for Seismic Shear — Rebar (ASTM A615 Grade 60) | $\alpha_{V,seis}$[3] | — | 0.85 | 0.88 | 0.84 | | 0.77 | | 0.59 |
| | Strength Reduction Factor — Steel Failure | $\phi$ | — | 0.60[2] | | | | | | |
| **Concrete Breakout Strength in Shear** | | | | | | | | | | |
| Outside Diameter of Anchor | | $d_o$ | in. | 0.375 | 0.5 | 0.625 | 0.75 | 0.875 | 1 | 1.25 |
| Load-Bearing Length of Anchor in Shear | | $\ell_e$ | in. | Min. of $h_{ef}$ and 8 times anchor diameter | | | | | | |
| Strength Reduction Factor — Breakout Failure | | $\phi$ | — | 0.70[2] | | | | | | |
| **Concrete Pryout Strength in Shear** | | | | | | | | | | |
| Coefficient for Pryout Strength | | $k_{cp}$ | — | 1.0 for $h_{ef}$ < 2.50"; 2.0 for $h_{ef}$ ≥ 2.50" | | | | | | |
| Strength Reduction Factor — Pryout Failure | | $\phi$ | — | 0.70[2] | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
3. The values of $V_{sa}$ are applicable for both cracked concrete and uncracked concrete. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, $V_{sa}$ must be multiplied by $\alpha_{V,seis}$.

For additional load tables, visit **strongtie.com/et3g**.



**See p. 14 for an explanation of the load table icons.*

# ET-3G™ Design Information — Concrete

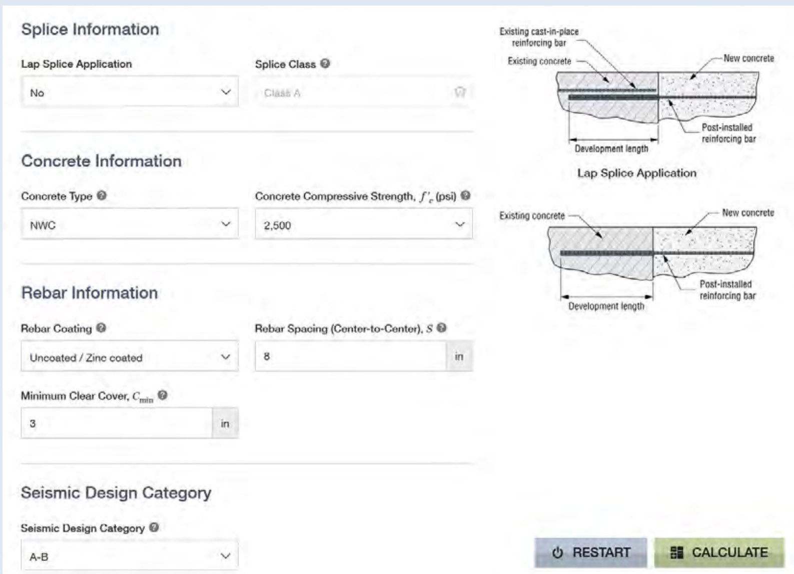
## ET-3G Development Length for Rebar Dowels

| Rebar Size | Drill Bit Diameter (in.) | Clear Cover in. (mm) | Development Length, in. (mm) | | | | |
|---|---|---|---|---|---|---|---|
| | | | $f'_c$ = 2,500 psi (17.2 MPa) Concrete | $f'_c$ = 3,000 psi (20.7 MPa) Concrete | $f'_c$ = 4,000 psi (27.6 MPa) Concrete | $f'_c$ = 6,000 psi (41.4 MPa) Concrete | $f'_c$ = 8,000 psi (55.2 MPa) Concrete |
| #3 (9.5) | ½ | 1½ (38) | 12 (305) | 12 (305) | 12 (305) | 12 (305) | 12 (305) |
| #4 (12.7) | ⅝ | 1½ (38) | 14.4 (366) | 14 (356) | 12 (305) | 12 (305) | 12 (305) |
| #5 (15.9) | ¾ | 1½ (38) | 18 (457) | 17 (432) | 14.2 (361) | 12 (305) | 12 (305) |
| #6 (19.1) | ⅞ | 1½ (38) | 21.6 (549) | 20 (508) | 17.1 (434) | 14 (356) | 13 (330) |
| #7 (22.2) | 1 | 3 (76) | 31.5 (800) | 29 (737) | 25 (635) | 21 (533) | 18 (457) |
| #8 (25.4) | 1⅛ | 3 (76) | 36 (914) | 33 (838) | 28.5 (724) | 24 (610) | 21 (533) |
| #9 (28.7) | 1⅜ | 3 (76) | 40.5 (1,029) | 38 (965) | 32 (813) | 27 (686) | 23 (584) |
| #10 (32.3) | 1⅜ | 3 (76) | 45 (1,143) | 42 (1,067) | 35.6 (904) | 30 (762) | 26 (660) |
| #11 (35.8) | 1¾ | 3 (76) | 51 (1,295) | 47 (1,194) | 41 (1,041) | 33 (838) | 29 (737) |

1. Tabulated development lengths are for static, wind and seismic load cases in Seismic Design Category A and B. Development lengths in SDC C through F must comply with ACI 318-19 and ACI 318-14 Chapter 18 or ACI 318-11 Chapter 12, as applicable. The value of $f'_c$ used to calculate development lengths shall not exceed 2,500 psi in SDC C through F.
2. Rebar is assumed to be ASTM A615 Grade 60 or A706 ($f_y$ = 60,000 psi). For rebar with a higher yield strength, multiply tabulated values by $f_y$ / 60,000 psi.
3. Concrete is assumed to be normal-weight concrete. For lightweight concrete, multiply tabulated values by 1.33.
4. Tabulated values assume bottom cover of less than 12" cast below rebars ($\Psi_t$ = 1.0).
5. Uncoated rebar must be used.
6. The value of $K_{tr}$ is assumed to be 0. Refer to ACI 318-19 Section 25.4.2.4, ACI 318-14 Section 25.4.2.3 or ACI 318-11 Section 12.2.3.

# Rebar Development Length Calculator

Rebar Development Length Calculator is a web application that supports the design of post-installed rebar in concrete applications by calculating the necessary tension and compression development lengths required in accordance with ACI 318-19 / ACI 318-14.




*See p. 14 for an explanation of the load table icons.

# ET-3G™ Design Information — Masonry



## ET-3G Epoxy Anchor Installation Information — Fully Grouted CMU Construction — Face of Wall

| Installation Information | Symbol | Units | Nominal Rod Diameter / Rebar Size | | | |
|---|---|---|---|---|---|---|
| | | | 3/8" / #3 | 1/2" / #4 | 5/8" / #5 | 3/4" / #6 |
| Drill Bit Diameter — Threaded Rod | $d_o$ | in. | 7/16 | 9/16 | 11/16 | 7/8 |
| Drill Bit Diameter — Rebar | $d_o$ | in. | 1/2 | 5/8 | 3/4 | 7/8 |
| Minimum Embedment Depth | $h_{ef,min}$ | in. | 3 | 3 | 3 | 3 |

## ET-3G Epoxy Anchor Installation Information — Fully Grouted CMU Construction — Top of Wall

| Installation Information | Symbol | Units | Nominal Rod Diameter / Rebar Size | | |
|---|---|---|---|---|---|
| | | | 1/2" / #4 | 5/8" / #5 | 7/8" |
| Drill Bit Diameter — Threaded Rod | $d_o$ | in. | 9/16 | 11/16 | 1 |
| Drill Bit Diameter — Rebar | $d_o$ | in. | 5/8 | 3/4 | — |
| Minimum Embedment Depth | $h_{ef,min}$ | in. | 3 | 3 | 3 |

## ET-3G Epoxy Anchor Installation Information — Ungrouted CMU Construction

| Installation Information | Symbol | Units | Nominal Rod Diameter | | |
|---|---|---|---|---|---|
| | | | 3/8" | 1/2" | 5/8" |
| Drill Bit Diameter | $d_o$ | in. | 9/16 | 3/4 | 7/8 |
| Embedment Depth | $h_{ef,min}$ | in. | 3½ | 3½ | 3½ |

Please see the ET-3G product page at **strongtie.com** and ICC-ES ESR Report for load data.



*See p. 14 for an explanation of the load table icons.

# AT-3G™ High-Strength Hybrid Acrylic Adhesive

AT-3G is a hybrid, acrylic-based adhesive for anchoring threaded rod and rebar into cracked and uncracked concrete. Ideal for cold weather and wet concrete applications, AT-3G dispenses easily and offers a fast curing time for same-day bolt up.

NEW

## Features

- Excellent for use in cold weather conditions or applications where fast cure is required
- Recognized per ICC-ES AC308 for threaded rod and rebar anchoring, along with post-installed rebar development and splice length design provisions
- Conventional blow-brush-blow hole cleaning technique using a wire brush — no power brushing required

## Product Information

| | |
|---|---|
| Mix Ratio/Type | 10:1 hybrid acrylic |
| Mixed Color | Gray |
| Base Materials | Concrete — cracked and uncracked |
| Base Material Conditions | Dry, water-saturated, water-filled hole |
| Anchor Type | Threaded rod or rebar |
| Substrate Installation Temperature | 23°F (–5°C) to 104°F (40°C) |
| In-Service Temperature Range | –40°F (–40°C) to 320°F (160°C) |
| Storage Temperature | 41°F (5°C) and 77°F (25°C) |
| Shelf Life | 18 months |
| Volatile Organic Compound (VOC) | 41 g/L |

## Test Criteria

AT-3G has been tested in accordance with ICC-ES AC308, ACI 355.4 and applicable ASTM test methods.

## Code Reports, Standards and Compliance

Concrete — ICC-ES ESR-4057 (including post-installed rebar connections, City of LA and Florida Building Code), Florida FL15730.
ASTM C881 and AASHTO M235 — Types I/IV and II/V, Grade 3, Class B & C.
UL Certification — CDPH Standard Method v1.2.
NSF/ANSI/CAN 61 (216 in.² / 1,000 gal.).

## Installation Instructions

Installation instructions are located at the following locations: pp. 48–51; product packaging; or **strongtie.com/at3g**.

- Hole cleaning brushes are located on p. 52.


**AT-3G Adhesive**

## AT-3G Adhesive Cartridge System

| Model No. | Capacity Ounces (cubic in.) | Cartridge Type | Carton Qty. | Dispensing Tool | Mixing Nozzle |
|---|---|---|---|---|---|
| AT3G10[4] | 9.4 (16.9) | Coaxial | 6 | CDT10S | AMN19Q |
| AT3G30[4] | 28 (50.5) | Side-by-side | 5 | ADT30S, ADTA30P or ADTA30CKT | |

1. Cartridge estimation guidelines are available at **strongtie.com/softwareandwebapplications/category**.
2. Detailed information on dispensing tools, mixing nozzles and other adhesive accessories is available at **strongtie.com**.
3. Use only Simpson Strong-Tie mixing nozzles in accordance with Simpson Strong-Tie instructions. Modification or improper use of mixing nozzle may impair AT-3G adhesive performance.
4. One AMN19Q mixing nozzle and one nozzle extension are supplied with each cartridge.
5. Use of rodless pneumatic tools to dispense single-tube, coaxial adhesive cartridges is prohibited.

# AT-3G™ High-Strength Hybrid Acrylic Adhesive



## AT-3G Cure Schedule

| Base Material Temperature | | Gel Time (minutes) | Cure Time (hr.) |
|---|---|---|---|
| °F | °C | | |
| 23 | –5 | 50 | 5 |
| 32 | 0 | 25 | 3½ |
| 41 | 5 | 15 | 2 |
| 50 | 10 | 10 | 1 |
| 59 | 15 | 6 | 40 min. |
| 68 | 20 | 3 | 30 min. |
| 86 | 30 | 2 | 30 min. |
| 104 | 40 | 2 | 30 min. |

1. For water-saturated concrete, the cure times must be doubled.
2. Cartridge temperature must be between 41°F (5°C) and 104°F (40°C) at the time of installation.
3. For installation in temperatures below 23°F (–5°C), see p. 241 (Supplemental Section) for more information.

## AT-3G Typical Properties

| Property | | Class A (35°–40°F) | Class B (40°–60°F) | Class C (>60°F) | Test Method |
|---|---|---|---|---|---|
| Consistency | | Non-sag | Non-sag | Non-sag | ASTM C881 |
| Bond Strength, Slant Shear | Hardened-to-Hardened Concrete, 2-Day Cure[1] | 2,800 psi | 2,800 psi | 2,820 psi | ASTM C882 |
| | Hardened-to-Hardened Concrete, 14-Day Cure[1] | 3,200 psi | 3,100 psi | 3,250 psi | |
| Compressive Yield Strength, 7-Day Cure[2] | | 10,300 psi | 13,400 psi | 15,000 psi | ASTM D695 |
| Compressive Modulus, 7-Day Cure[2] | | 1,400,000 psi | 1,550,000 psi | 1,650,000 psi | ASTM D695 |
| Heat Deflection Temperature, 7-Day Cure[3] | | 258°F (126°C) | | | ASTM D648 |
| Glass Transition Temperature, 7-Day Cure[3] | | 237°F (114°C) | | | ASTM E1640 |
| Decomposition Temperature, 24-Hour Cure[3] | | 480°F (250°C) | | | ASTM E2550 |
| Water Absorption, 24 Hours, 7-Day Cure[3] | | 0.90% | | | ASTM D570 |
| Shore D Hardness, 24-Hour Cure[3] | | 81 | | | ASTM D2240 |
| Linear Coefficient of Shrinkage, 7-Day Cure[3] | | 0.000 in./in. | | | ASTM D2566 |
| Coefficient of Thermal Expansion[3] | | $2.6 \times 10^{-5}$ in./in.°F | | | ASTM C531 |

1. Material and curing conditions: Class A at 35° ± 2°F, Class B at 40° ± 2°F, Class C at 60° ± 2°F.
2. Material and curing conditions: Class A at 0° ± 2°F, Class B at 40° ± 2°F, Class C at 60° ± 2°F.
3. Material and curing conditions: 73° ± 2°F.

## AT-3G Installation Information and Additional Data for Threaded Rod and Rebar in Normal-Weight Concrete[1]

IBC LW *

| Characteristic | Symbol | Units | Nominal Rod Diameter (in.) / Rebar Size | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | ⅜ / #3 | ½ / #4 | ⅝ / #5 | ¾ / #6 | ⅞ / #7 | 1 / #8 | 1¼ / #9 |
| Drill Bit Diameter for Threaded Rod | $d_{hole}$ | in. | 7/16 | 9/16 | 11/16 | ⅞ | 1 | 1⅛ | 1⅜ |
| Drill Bit Diameter for Rebar | $d_{hole}$ | in. | ½ | ⅝ | ¾ | ⅞ | 1 | 1⅛ | 1⅜ |
| Maximum Tightening Torque for Threaded Rod | $T_{inst}$ | ft.-lb. | 15 | 30 | 44 | 66 | 96 | 147 | 221 |
| Maximum Tightening Torque for Rebar | $T_{inst}$ | ft.-lb. | 15 | 30 | 44 | 66 | 96 | 147 | 185 |
| Minimum Embedment Depth for Threaded Rod or Rebar | $h_{ef,\,min}$ | in. | 2⅜ | 2¾ | 3⅛ | 3½ | 3½ | 4 | 5 |
| Maximum Embedment Depth for Threaded Rod | $h_{ef,\,max}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| Maximum Embedment Depth for Rebar | $h_{ef,\,max}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 22½ |
| Minimum Concrete Thickness | $h_{min}$ | in. | $h_{ef}$ + 1¼ | | $h_{ef} + 2d_{hole}$ | | | | |
| Critical Edge Distance | $c_{ac}$ | in. | See footnote 2 | | | | | | |
| Minimum Edge Distance | $c_{min}$ | in. | 1⅝ | 1¾ | 2 | 2⅜ | 2½ | 2¾ | 3¼ |
| Minimum Anchor Spacing | $s_{min}$ | in. | 1⅞ | 2½ | 3 | 3¾ | 4¼ | 4¾ | 5⅞ |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. $c_{ac} = h_{ef}(\tau_{k,uncr}/1{,}160)^{0.4} \times [3.1 - 0.7(h/h_{ef})]$, where:
   $[h/h_{ef}] \le 2.4$
   $\tau_{k,uncr}$ = the characteristic bond strength in uncracked concrete, given in the tables that follow $\le k_{uncr}((h_{ef} \times f'_c)^{0.5}/(\pi \times d_a))$
   $h$ = the member thickness (inches)
   $h_{ef}$ = the embedment depth (inches)

*See p. 14 for an explanation of the load table icons.*

# AT-3G™ Design Information — Concrete

## AT-3G Tension Strength Design Data for Threaded Rod[1,8]

IBC *

| Characteristic | | Symbol | Units | Nominal Rod Diameter (in.) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 | 1¼ |
| **Steel Strength in Tension** | | | | | | | | | | |
| Minimum Tensile Stress Area | | $A_{se}$ | in.² | 0.078 | 0.142 | 0.226 | 0.334 | 0.462 | 0.606 | 0.969 |
| Tension Resistance of Steel — ASTM F1554, Grade 36 | | $N_{sa}$ | lb. | 4,495 | 8,230 | 13,110 | 19,400 | 26,780 | 35,130 | 56,210 |
| Tension Resistance of Steel — ASTM F1554, Grade 55 | | | | 5,815 | 10,645 | 16,950 | 25,090 | 34,630 | 45,430 | 72,685 |
| Tension Resistance of Steel — ASTM A193, Grade B7 and ASTM F1554, Grade 105 | | | | 9,685 | 17,735 | 28,250 | 41,810 | 57,710 | 75,710 | 121,135 |
| Tension Resistance of Steel — ASTM A449 | | | | 9,300 | 17,030 | 27,120 | 40,140 | 55,405 | 72,685 | 101,755 |
| Tension Resistance of Steel — ASTM F593 CW (Types 304 and 316 Stainless Steel) | | | | 7,750 | 17,190 | 22,600 | 28,430 | 39,245 | 51,485 | 82,370 |
| Tension Resistance of Steel — ASTM A193, Grade B8/B8M, Class 2B (Types 304 and 316 Stainless Steel) | | | | 7,365 | 13,480 | 21,470 | 31,780 | 43,860 | 57,540 | 92,065 |
| Strength Reduction Factor for Tension — Steel Failure | | $\phi$ | — | 0.75[6] | | | | | | |
| **Concrete Breakout Strength in Tension (2,500 psi ≤ $f'_c$ ≤ 8,000 psi)** | | | | | | | | | | |
| Effectiveness Factor for Cracked Concrete | | $k_{c,cr}$ | — | 17 | | | | | | |
| Effectiveness Factor for Uncracked Concrete | | $k_{c,uncr}$ | — | 24 | | | | | | |
| Strength Reduction Factor — Concrete Breakout Failure in Tension | | $\phi$ | — | 0.65[6] | | | | | | |
| **Bond Strength in Tension (2,500 psi ≤ $f'_c$ ≤ 8,000 psi)[7]** | | | | | | | | | | |
| Minimum Embedment | | $h_{ef,min}$ | in. | 2⅜ | 2¾ | 3⅛ | 3½ | 3½ | 4 | 5 |
| Maximum Embedment | | $h_{ef,max}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 25 |
| Temperature Range A[2,5] | Characteristic Bond Strength in Uncracked Concrete[9] | $\tau_{k,uncr}$ | psi | 2,600 | 2,415 | 2,260 | 2,140 | 2,055 | 2,000 | 1,990 |
| | Characteristic Bond Strength in Cracked Concrete[9] | $\tau_{k,cr}$ | psi | 1,040 | 1,040 | 1,110 | 1,220 | 1,210 | 1,205 | 1,145 |
| Temperature Range B[3,5] | Characteristic Bond Strength in Uncracked Concrete[9] | $\tau_{k,uncr}$ | psi | 2,265 | 2,100 | 1,970 | 1,865 | 1,785 | 1,740 | 1,730 |
| | Characteristic Bond Strength in Cracked Concrete[9] | $\tau_{k,cr}$ | psi | 905 | 905 | 965 | 1,060 | 1,055 | 1,050 | 995 |
| Temperature Range C[4,5] | Characteristic Bond Strength in Uncracked Concrete[9] | $\tau_{k,uncr}$ | psi | 1,630 | 1,515 | 1,420 | 1,345 | 1,290 | 1,255 | 1,250 |
| | Characteristic Bond Strength in Cracked Concrete[9] | $\tau_{k,cr}$ | psi | 650 | 655 | 695 | 765 | 760 | 755 | 720 |
| Anchor Category | Dry Concrete | — | — | 1 | | | | | | |
| Strength Reduction Factor | Dry Concrete | $\phi_{dry}$ | — | 0.65[6] | | | | | | |
| Anchor Category | Water-Saturated Concrete | — | — | 2 | | | | | | |
| Strength Reduction Factor | Water-Saturated Concrete | $\phi_{ws}$ | — | 0.55[6] | | | | | | |
| Anchor Category | Water-Filled Hole | — | — | 3 | | | | | | |
| Strength Reduction Factor | Water-Filled Hole | $\phi_{wf}$ | — | 0.45[6] | | | | | | |
| Reduction Factor for Seismic Tension | | $\alpha_{N,seis}$[10] | — | 0.95 | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. Temperature Range A: Maximum short-term temperature = 176°F, Maximum long-term temperature = 122°F.
3. Temperature Range B: Maximum short-term temperature = 248°F, Maximum long-term temperature = 161°F.
4. Temperature Range C: Maximum short-term temperature = 320°F, Maximum long-term temperature = 212°F.
5. Short-term concrete temperatures are those that occur over short intervals (diurnal cycling). Long-term temperatures are roughly constant over significant periods of time.
6. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
7. Bond strength values shown are for normal-weight concrete having a compressive strength of $f'_c$ = 2,500 psi. For higher compressive strengths up to 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of $(f'_c/2{,}500)^{0.10}$.
8. For lightweight concrete, the modification factor for bond strength shall be as given in ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable, where applicable.
9. Characteristic bond strength values are for sustained loads, including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 23% for Temperature Range C.
10. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, the bond strength values must be multiplied by $\alpha_{N,seis}$.

*See p. 14 for an explanation of the load table icons.

## AT-3G Tension Strength Design Data for Rebar[1,8]

| Characteristic | | Symbol | Units | Rebar Size | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | #3 | #4 | #5 | #6 | #7 | #8 | #9 |
| **Steel Strength in Tension** | | | | | | | | | | |
| Minimum Tensile Stress Area | | $A_{se}$ | in.² | 0.11 | 0.20 | 0.31 | 0.44 | 0.60 | 0.79 | 1.00 |
| Tension Resistance of Steel — ASTM A615 Grade 60 | | $N_{sa}$ | lb. | 9,900 | 18,000 | 27,900 | 39,600 | 54,000 | 71,100 | 90,000 |
| Tension Resistance of Steel — ASTM A706 Grade 60 | | $N_{sa}$ | lb. | 8,800 | 16,000 | 24,800 | 35,200 | 48,000 | 63,200 | 80,000 |
| Tension Resistance of Steel — ASTM A615 Grade 40 | | $N_{sa}$ | lb. | 6,600 | 12,000 | 18,600 | 26,400 | Sizes not available | | |
| Strength Reduction Factor for Tension — Steel Failure — ASTM A615 Grades 40 and 60 | | $\phi$ | — | 0.65[6] | | | | | | |
| Strength Reduction Factor for Tension — Steel Failure — ASTM A706 | | $\phi$ | — | 0.75[6] | | | | | | |
| **Concrete Breakout Strength in Tension (2,500 psi ≤ f'c ≤ 8,000 psi)** | | | | | | | | | | |
| Effectiveness Factor for Cracked Concrete | | $k_{c,cr}$ | — | 17 | | | | | | |
| Effectiveness Factor for Uncracked Concrete | | $k_{c,uncr}$ | — | 24 | | | | | | |
| Strength Reduction Factor — Concrete Breakout Failure in Tension | | $\phi$ | — | 0.65[6] | | | | | | |
| **Bond Strength in Tension (2,500 psi ≤ f'c ≤ 8,000 psi)[7]** | | | | | | | | | | |
| Minimum Embedment | | $h_{ef,min}$ | in. | 2⅜ | 2¾ | 3⅛ | 3½ | 3½ | 4 | 4½ |
| Maximum Embedment | | $h_{ef,max}$ | in. | 7½ | 10 | 12½ | 15 | 17½ | 20 | 22½ |
| Temperature Range A[2,5] | Characteristic Bond Strength in Uncracked Concrete[9] | $\tau_{k,uncr}$ | psi | 2,200 | 2,100 | 2,030 | 1,970 | 1,920 | 1,880 | 1,845 |
| Temperature Range A[2,5] | Characteristic Bond Strength in Cracked Concrete[9] | $\tau_{k,cr}$ | psi | 1,090 | 1,055 | 1,130 | 1,170 | 1,175 | 1,155 | 1,140 |
| Temperature Range B[3,5] | Characteristic Bond Strength in Uncracked Concrete[9] | $\tau_{k,uncr}$ | psi | 1,915 | 1,830 | 1,765 | 1,715 | 1,670 | 1,635 | 1,615 |
| Temperature Range B[3,5] | Characteristic Bond Strength in Cracked Concrete[9] | $\tau_{k,cr}$ | psi | 945 | 915 | 980 | 1,015 | 1,020 | 1,005 | 995 |
| Temperature Range C[4,5] | Characteristic Bond Strength in Uncracked Concrete[9] | $\tau_{k,uncr}$ | psi | 1,380 | 1,315 | 1,270 | 1,235 | 1205 | 1,180 | 1,155 |
| Temperature Range C[4,5] | Characteristic Bond Strength in Cracked Concrete[9] | $\tau_{k,cr}$ | psi | 680 | 660 | 705 | 735 | 735 | 725 | 715 |
| Anchor Category | Dry Concrete | — | — | 1 | | | | | | |
| Strength Reduction Factor | Dry Concrete | $\phi_{dry}$ | — | 0.65[6] | | | | | | |
| Anchor Category | Water-Saturated Concrete | — | — | 2 | | | | | | |
| Strength Reduction Factor | Water-Saturated Concrete | $\phi_{ws}$ | — | 0.55[6] | | | | | | |
| Anchor Category | Water-Filled Hole | — | — | 3 | | | | | | |
| Strength Reduction Factor | Water-Filled Hole | $\phi_{wf}$ | — | 0.45[6] | | | | | | |
| Reduction Factor for Seismic Tension | | $\alpha_{N,seis}$[10] | — | 0.95 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. Temperature Range A: Maximum short-term temperature = 176°F, Maximum long-term temperature = 122°F.
3. Temperature Range B: Maximum short-term temperature = 248°F, Maximum long-term temperature = 161°F.
4. Temperature Range C: Maximum short-term temperature = 320°F, Maximum long-term temperature = 212°F.
5. Short-term concrete temperatures are those that occur over short intervals (diurnal cycling). Long-term temperatures are roughly constant over significant periods of time.
6. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
7. Bond strength values shown are for normal-weight concrete having a compressive strength of $f'_c$ = 2,500 psi. For higher compressive strengths up to 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of $(f'_c/2{,}500)^{0.10}$.
8. For lightweight concrete, the modification factor for bond strength shall be as given in ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable, where applicable.
9. Characteristic bond strength values are for sustained loads, including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 23% for Temperature Range C.
10. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, the bond strength values must be multiplied by $\alpha_{N,seis}$.

**See p. 14 for an explanation of the load table icons.*

# AT-3G™ Design Information — Concrete

## AT-3G Shear Strength Design Data for Threaded Rod[1] *

| Characteristic | Symbol | Units | Nominal Rod Diameter (in.) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1 | 1 1/4 |
| **Steel Strength in Shear** | | | | | | | | | |
| Minimum Shear Stress Area | $A_{se}$ | in.[2] | 0.078 | 0.142 | 0.226 | 0.334 | 0.462 | 0.606 | 0.969 |
| Shear Resistance of Steel — ASTM F1554, Grade 36 | $V_{sa}$ | lb. | 2,695 | 4,940 | 7,860 | 11,640 | 16,070 | 21,080 | 33,725 |
| Shear Resistance of Steel — ASTM F1554, Grade 55 | | | 3,490 | 6,385 | 10,170 | 15,055 | 20,780 | 27,260 | 43,610 |
| Shear Resistance of Steel — ASTM A193, Grade B7 and ASTM F1554, Grade 105 | | | 5,810 | 10,640 | 16,950 | 25,085 | 34,625 | 45,425 | 72,680 |
| Shear Resistance of Steel — ASTM A449 | | | 5,580 | 10,220 | 16,270 | 24,085 | 33,240 | 43,610 | 61,055 |
| Shear Resistance of Steel — ASTM F593 CW (Types 304 and 316 Stainless Steel) | | | 4,650 | 8,515 | 13,560 | 17,060 | 23,545 | 30,890 | 49,425 |
| Shear Resistance of Steel — ASTM A193, Grade B8/B8M, Class 2B (Types 304 and 316 Stainless Steel) | | | 4,420 | 8,090 | 12,880 | 19,070 | 26,320 | 34,525 | 55,240 |
| Reduction Factor for Seismic Shear | $\alpha_{V,seis}$[3] | — | 0.65 | | | | | | |
| Strength Reduction Factor for Shear — Steel Failure | $\phi$ | — | 0.65[2] | | | | | | |
| **Concrete Breakout Strength in Shear** | | | | | | | | | |
| Outside Diameter of Anchor | $d_a$ | in. | 0.375 | 0.5 | 0.625 | 0.75 | 0.875 | 1 | 1.25 |
| Load-Bearing Length of Anchor in Shear | $\ell_e$ | in. | Minimum of $h_{ef}$ and 8x anchor diameter | | | | | | |
| Strength Reduction Factor for Shear — Breakout Failure | $\phi$ | — | 0.70[2] | | | | | | |
| **Concrete Pryout Strength in Shear** | | | | | | | | | |
| Load-Bearing Length of Anchor in Shear | $k_{cp}$ | in. | 1.0 for $h_{ef} < 2.50"$; 2.0 for $h_{ef} \geq 2.50"$ | | | | | | |
| Strength Reduction Factor for Shear — Breakout Failure | $\phi$ | — | 0.70[2] | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
3. The values of $V_{sa}$ are applicable for both cracked concrete and uncracked concrete. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, $V_{sa}$ must be multiplied by $\alpha_{V,seis}$ for the corresponding anchor steel type.

For additional load tables, visit **strongtie.com/at3g**.





*See p. 14 for an explanation of the load table icons.

# AT-3G™ Design Information — Concrete



## AT-3G Shear Strength Design Data for Rebar[1]

*

| Characteristic | Symbol | Units | Nominal Rod Diameter (in.) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | #3 | #4 | #5 | #6 | #7 | #8 | #9 |
| **Steel Strength in Shear** | | | | | | | | | |
| Minimum Shear Stress Area | $A_{se}$ | in.² | 0.11 | 0.20 | 0.31 | 0.44 | 0.60 | 0.79 | 1.00 |
| Shear Resistance of Steel — ASTM A615 Grade 60 | | | 5,940 | 10,800 | 16,740 | 23,760 | 32,400 | 42,660 | 54,000 |
| Shear Resistance of Steel — ASTM A706 Grade 60 | $V_{sa}$ | lb. | 5,280 | 9,600 | 14,880 | 21,120 | 28,800 | 37,920 | 48,000 |
| Shear Resistance of Steel — ASTM A615 Grade 40 | | | 3,960 | 7,200 | 11,160 | 15,840 | Sizes not available | | |
| Reduction Factor for Seismic Shear | $\alpha_{V,seis}$[3] | — | 0.65 | | | | | | |
| Strength Reduction Factor for Shear — Steel Failure — ASTM A615 Grades 40 and 60 | $\phi$ | — | 0.60[2] | | | | | | |
| Strength Reduction Factor for Shear — Steel Failure — ASTM A706 | $\phi$ | — | 0.65[2] | | | | | | |
| **Concrete Breakout Strength in Shear** | | | | | | | | | |
| Outside Diameter of Anchor | $d_a$ | in. | 0.375 | 0.5 | 0.625 | 0.75 | 0.875 | 1 | 1.25 |
| Load-Bearing Length of Anchor in Shear | $\ell_e$ | in. | Minimum of $h_{ef}$ and 8x anchor diameter | | | | | | |
| Strength Reduction Factor for Shear — Breakout Failure | $\phi$ | — | 0.70[2] | | | | | | |
| **Concrete Pryout Strength in Shear** | | | | | | | | | |
| Load-Bearing Length of Anchor in Shear | $k_{cp}$ | in. | 1.0 for $h_{ef}$ < 2.50"; 2.0 for $h_{ef} \geq$ 2.50" | | | | | | |
| Strength Reduction Factor for Shear — Breakout Failure | $\phi$ | — | 0.70[2] | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19, ACI 318-14 and ACI 318-11.
2. The tabulated value of $\phi$ applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, refer to ACI 318-11 D.4.4 to determine the appropriate value of $\phi$.
3. The values of $V_{sa}$ are applicable for both cracked concrete and uncracked concrete. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, $V_{sa}$ must be multiplied by $\alpha_{V,seis}$ for the corresponding anchor steel type.

## AT-3G Development Length for Rebar Dowels

*

| Rebar Size | Drill Bit Diameter (in.) | Clear Cover (in.) | Development Length (in.) | | | | |
|---|---|---|---|---|---|---|---|
| | | | $f'_c$ = 2,500 psi Concrete | $f'_c$ = 3,000 psi Concrete | $f'_c$ = 4,000 psi Concrete | $f'_c$ = 6,000 psi Concrete | $f'_c$ = 8,000 psi Concrete |
| #3 | ½ | 1³⁄₁₆ | 12 | 12 | 12 | 12 | 12 |
| #4 | ⅝ | 1³⁄₁₆ | 14.4 | 14 | 12 | 12 | 12 |
| #5 | ¾ | 1³⁄₁₆ | 18 | 17 | 14.2 | 12 | 12 |
| #6 | ⅞ | 1³⁄₁₆ | 21.6 | 20 | 17.1 | 14 | 13 |
| #7 | 1 | 1⁹⁄₁₆ | 31.5 | 29 | 25 | 21 | 18 |
| #8 | 1⅛ | 1⁹⁄₁₆ | 36 | 33 | 28.5 | 24 | 21 |
| #9 | 1⅜ | 1⁹⁄₁₆ | 40.5 | 38 | 32 | 27 | 23 |

1. Tabulated development lengths are for static, wind and seismic load cases in Seismic Design Category A and B. Development lengths in Seismic Design Category C through F must comply with ACI 318-19 and ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21, as applicable.
2. Rebar is assumed to be ASTM A615 Grade 60 or A706 ($f_y$ = 60,000 psi). For rebar with a higher yield strength, multiply tabulated values by $f_y$/60,000 psi.
3. Concrete is assumed to be normal-weight concrete. For lightweight concrete, multiply tabulated values by 1.33. Tabulated values assume bottom cover less that 12" cast below rebars ($\Psi_1$ = 1.0).
4. Uncoated rebar must be used.
5. The value of $K_{tr}$ is assumed to be 0. Refer to ACI 318-19 Section 25.4.2.4, ACI 318-14 Section 25.4.2.3 or ACI 318-11 Section 12.2.3.



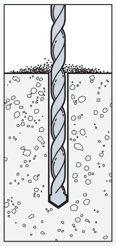
**See p. 14 for an explanation of the load table icons.*

# Adhesive Anchoring Installation Instructions

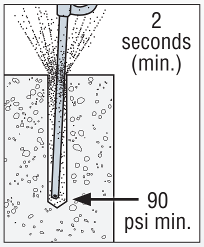
**NOTE:** Always check expiration date on product label. Do not use expired product.
- For best results, adhesive should be conditioned to a temperature between 70°F (21°C) and 80°F (37°C) at the time of installation.
- To warm cold adhesive, store cartridges in a warm, uniformly heated area or storage container. Do not immerse cartridges in water or use microwave to facilitate warming.

**WARNING:** When drilling and cleaning hole, use eye and lung protection. When installing adhesive, use eye and skin protection.

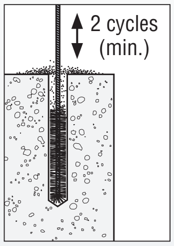
## 1A Hole Preparation — Horizontal, Vertical and Overhead Applications (SET-3G™ and AT-3G™ for anchor installation) and (AT-3G for post-installed rebar connections)



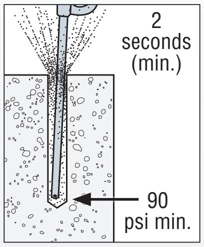
**1. Drill.** Drill hole to specified diameter and depth.




**2. Blow.** Remove dust from hole with oil-free compressed air for a minimum of two seconds. Compressed air nozzle must reach the bottom of the hole.



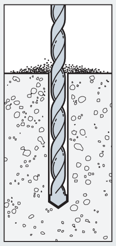

**3. Brush.** Clean with a steel wire brush for a minimum of two cycles. Brush should provide resistance to insertion. If no resistance is felt, the brush is worn and must be replaced.*



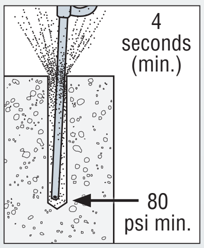

**4. Blow.** Remove dust from hole with oil-free compressed air for a minimum of two seconds. Compressed air nozzle must reach the bottom of the hole.

*__Note:__ Visit **strongtie.com** for proper brush part number.

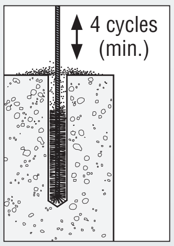
## Hole Preparation — Horizontal, Vertical and Overhead Applications (ET-3G™) and (SET-3G for post-installed rebar connections only)



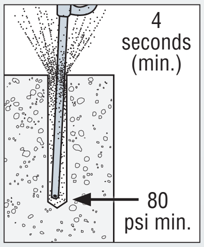
**1. Drill.** Drill hole to specified diameter and depth.




**2. Blow.** Remove dust from hole with oil-free compressed air for a minimum of four seconds. Compressed air nozzle must reach the bottom of the hole.




**3. Brush.** Clean with a nylon brush for a minimum of four cycles. Brush should provide resistance to insertion. If no resistance is felt, the brush is worn and must be replaced.*

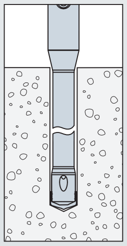



**4. Blow.** Remove dust from hole with oil-free compressed air for a minimum of four seconds. Compressed air nozzle must reach the bottom of the hole.

*__Note:__ Visit **strongtie.com** for proper brush part number.

## 1B Hole Preparation Vacuum Dust Extraction System with the Simpson Strong-Tie DXS Hollow Carbide Drill Bit* — Horizontal, Vertical and Overhead Applications

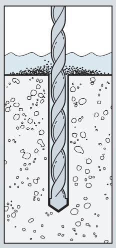
*__Note:__ Visit **strongtie.com** for tested and accepted hollow carbide drill bit and vacuum dust extraction systems.



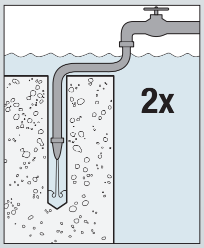
**1. Drill.** Drill hole to specified diameter and depth using the Simpson Strong-Tie DXS hollow carbide drill bit and vacuum dust extraction system.*

**Simpson Strong-Tie DXS drill bit used with the vacuum dust extraction system.***

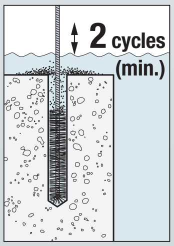
## 1C Hole Preparation — Submerged Applications (SET-3G only)



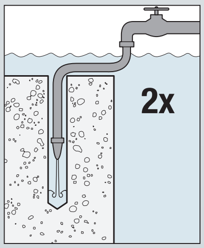
**1. Drill.** Drill hole to specified diameter and depth.




**2. Flush.** Remove slurry from hole by flushing hole twice with water until water runs clear.




**3. Brush.** Clean with a steel wire brush for a minimum of two cycles. Brush should provide resistance to insertion. If no resistance is felt, the brush is worn and must be replaced.*




**4. Flush.** Remove slurry from hole by flushing hole twice with water until water runs clear.

*__Note:__ Visit **strongtie.com** for proper brush part number.

Refer to **strongtie.com** for proper mixing nozzle and dispensing tool part number.

**Installation instructions continued on p. 49.**

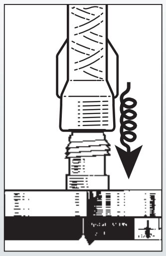
# Adhesive Anchoring Installation Instructions



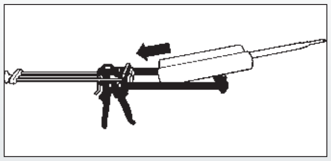
## 2 Cartridge Preparation

**1. Check.**
Check expiration date on product label.
**Do not use expired product.**

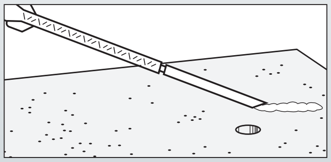
**2. Open.**
Open cartridge per package instructions.



**3. Attach.**
Attach proper Simpson Strong-Tie nozzle and extension to cartridge. Do not modify nozzle.



**4. Insert.**
Insert cartridge into dispensing tool.



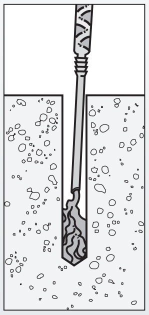
**5. Dispense.**
Dispense adhesive to the side until properly mixed (uniform color).

## FOR SOLID BASE MATERIALS

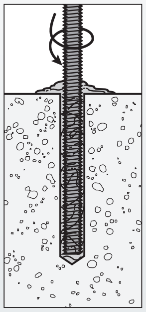
### 3A Filling the Hole — Vertical Anchorage

Prepare the hole per "Hole Preparation" instructions on product label.

**Dry and Damp Holes:**

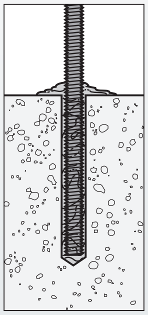


**1. Fill.**
Fill hole ½ to ⅔ full, starting from bottom of hole to prevent air pockets. Withdraw nozzle as hole fills up.



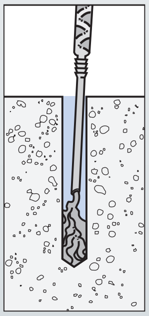
**2. Insert.**
Insert clean, oil-free anchor, turning slowly until the anchor contacts the bottom of the hole.

*Threaded rod or rebar*

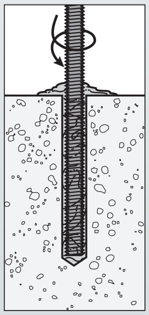


**3. Do not disturb.**
Do not disturb anchor until fully cured.(See cure schedule for specific adhesive.)

**Water-Filled Holes:**

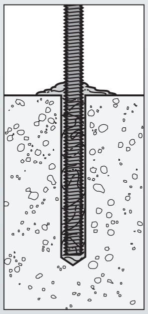


**1. Fill.**
Fill hole completely full, starting from bottom of hole to prevent water pockets. Withdraw nozzle as hole fills up.



**2. Insert.**
Insert clean, oil-free anchor, turning slowly until the anchor contacts the bottom of the hole.

*Threaded rod or rebar*



**3. Do not disturb.**
Do not disturb anchor until fully cured. (See cure schedule.)

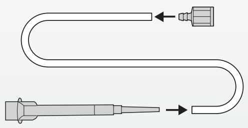
**Note:** Nozzle extensions may be needed for deep holes.

**Installation instructions continued on p. 50.**

# Adhesive Anchoring Installation Instructions

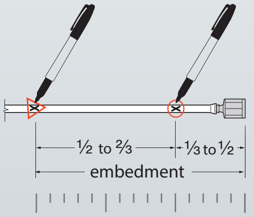
## 3B Filling the Hole — Horizontal and Overhead Anchorage

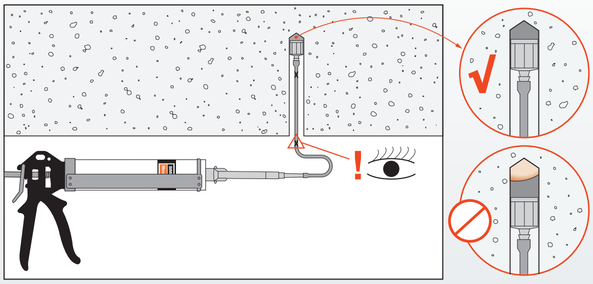
Prepare the hole per "Hole Preparation" instructions on product label.



**Step 1:**

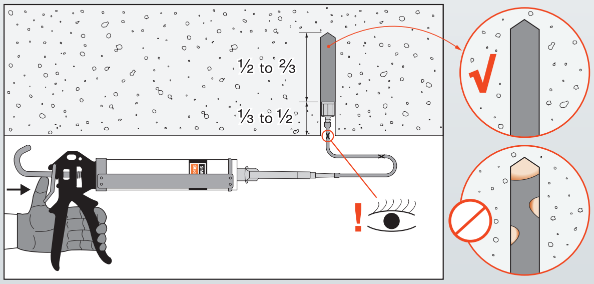
- Attach the piston plug to one end of the flexible tubing (PPFT25).
- Cut tubing to the length needed for the application, mark tubing as noted below and attach other end of tubing to the mixing nozzle.
- If using a pneumatic dispensing tool, regulate air pressure to 80–100 psi.



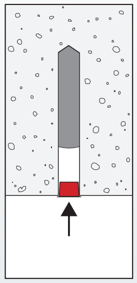
**Step 2:**

- Insert the piston plug to the back of the drilled hole and dispense adhesive.



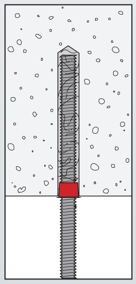

**Step 3:**

- Fill the hole ½ to ⅔ full.
- **Note:** As adhesive is dispensed into the drilled hole, the piston plug will slowly displace out of the hole due to back pressure, preventing air gaps.



**Step 4:**

- Install the appropriate Simpson Strong-Tie adhesive retaining cap.

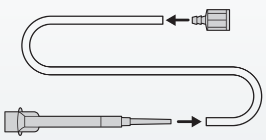


**Step 5:**

- Place either threaded rod or rebar through the adhesive retaining cap and into adhesive-filled hole.
- Turn rod/rebar slowly until the insert bottoms out.
- Do not disturb until fully cured.

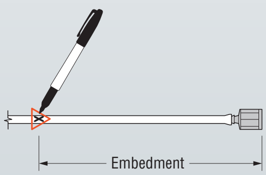
## 3C Filling the Hole — Submerged Anchorage (SET-3G™ only)

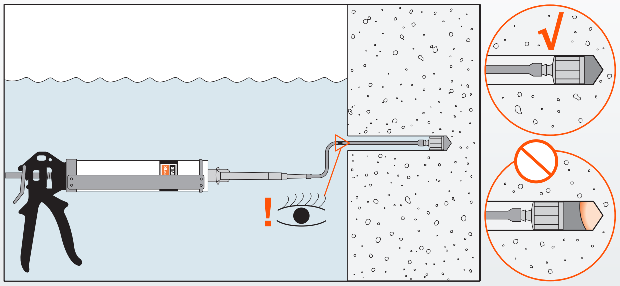
Prepare the hole per "Hole Preparation" instructions on product label.



**Step 1**

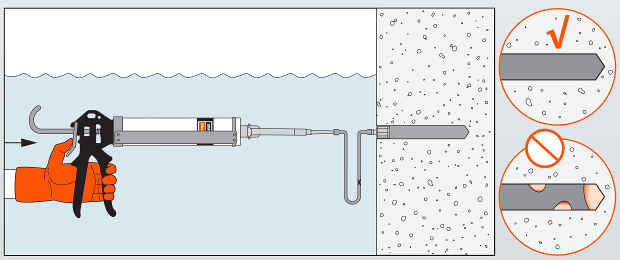
- Attach the piston plug to one end of the flexible tubing (PPFT25).
- Cut tubing to the length needed for the application, mark tubing as noted below and attach other end of tubing to the mixing nozzle.
- If using a pneumatic dispensing tool, regulate air pressure to 80–100 psi.



**Step 2**

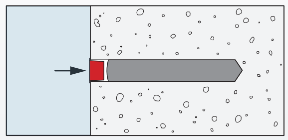
- Insert the piston plug to the back of the drilled hole and dispense adhesive.



**Step 3**

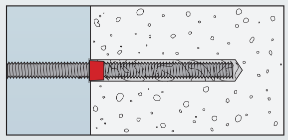
- Fill the hole completely full.

**Note:** As adhesive is dispensed into the drilled hole, the piston plug will slowly displace out of the hole due to back pressure, preventing air gaps.



**Step 4**

- Install the appropriate Simpson Strong-Tie adhesive retaining cap.



**Step 5**

- Place either threaded rod or rebar through the adhesive retaining cap and into adhesive filled hole.
- Turn rod/rebar (marked with the required embedment depth) slowly until the insert bottoms out.
- Do not disturb load or torque anchor until fully cured.

**Installation instructions continued on p. 51.**

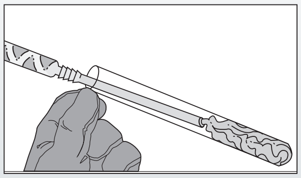
# Adhesive Anchoring Installation Instructions



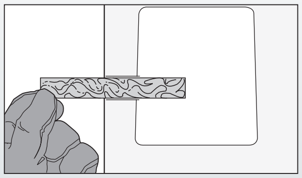
## FOR HOLLOW BASE MATERIALS

### 3D Filling the Hole — For Hollow Base Material Installations.

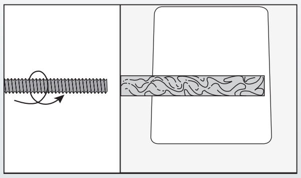
Prepare the hole per instructions on “Hole Preparation.”



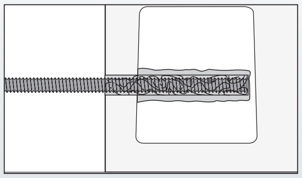
**1. Fill.**
Fill screen completely. Fill from the bottom of the screen and withdraw the nozzle as the screen fills to prevent air pockets. (Close integral cap after filling.)



**2. Insert.**
Insert adhesive-filled screen into hole.



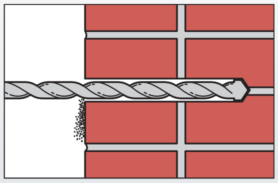
**3. Insert.**
Insert clean, oil-free anchor, turning slowly until the anchor contacts the bottom of the screen.



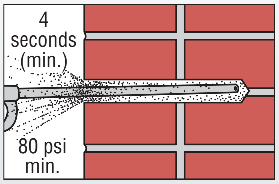
**4. Do not disturb.**
Do not disturb anchor until fully cured. (See cure schedule for specific adhesive.)

## FOR UNREINFORCED BRICK MASONRY

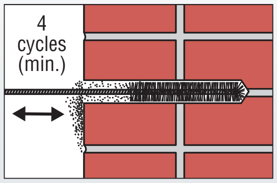
### 1 Hole Preparation — For Configurations A (Horizontal) and B (22½° Downward) Installations with a Carbide-Tipped Drill Bit.



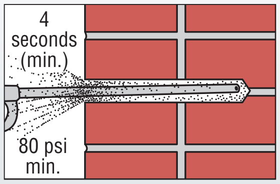
**1. Drill.**
Drill 1"-diameter hole to specified depth with a carbide-tipped drill bit, using rotation only mode. For Configurations A, drill 8" deep. For Configuration B, drill to within 1" of the opposite side of wall (minimum 13" deep).




**2. Blow.**
Remove dust from hole with oil-free compressed air for a minimum of four seconds. Compressed air nozzle MUST reach the bottom of the hole.




**3. Brush.**
Clean with a nylon brush for a minimum of four cycles. Brush MUST reach the bottom of the hole. Brush should provide resistance to insertion. If no resistance is felt, the brush is worn and must be replaced.

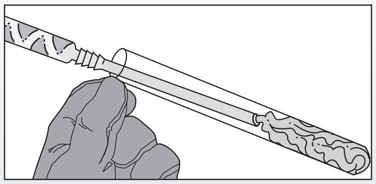



**4. Blow.**
Remove dust from hole with oil-free compressed air for a minimum of four seconds. Compressed air nozzle MUST reach the bottom of the hole.

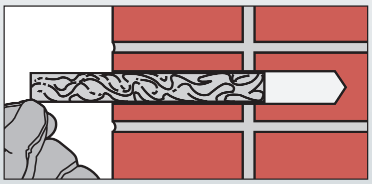
### 2 Cartridge Preparation

Reference p. 49 for cartridge preparation.

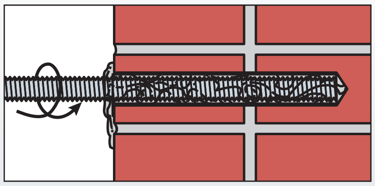
### 3 Filling the Hole — For Configurations A (Horizontal) and B (22½-Degree Downward) Installations.



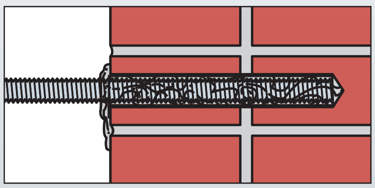
**1. Fill.**
Fill screen completely. Fill from the bottom of the screen and withdraw the nozzle as the screen fills to prevent air pockets.



**2. Insert.**
Insert adhesive filled screen into hole.



**3. Insert.**
Insert clean, oil-free anchor, turning slowly until the anchor contacts the bottom of the screen.



**4. Do not disturb.**
Do not disturb anchor until fully cured. (See cure schedule for specific adhesive.)

**Note:** Steel wire mesh screens may be used for Configurations A and B.

# Hole-Cleaning Brushes

Brushes are used for cleaning drilled holes prior to adhesive installation.

**Note:** The standard hole-cleaning method (blow-brush-blow) can be avoided by using the vacuum dust extraction system (DXS Hollow Carbide Drill Bit) with SET-3G™ and ET-3G™.

## Wire Brush — Standard
(For use with SET-3G and AT-3G™)

| Model No. | Hole Diameter (in.) | Anchor Diameter (in.) | Rebar Size | Usable Length (in.) | Carton Quantity |
|---|---|---|---|---|---|
| ETB43S | 7⁄16 | 3⁄8 | — | 5 | 25 |
| ETB50S | 1⁄2 | — | #3 | 5 | 25 |
| ETB56S | 9⁄16 | 1⁄2 | — | 5 | 25 |
| ETB62S | 5⁄8 | — | #4 | 5 | 25 |
| ETB68S | 11⁄16 | 5⁄8 | — | 5 | 25 |
| ETB75S | 3⁄4 | — | #5 | 5 | 25 |
| ETB87S | 7⁄8 | 3⁄4 | #6 | 5 | 25 |
| ETB100S | 1 | 7⁄8 | #7 | 5 | 25 |
| ETB112S | 1 1⁄8 | 1 | #8 | 5 | 25 |
| ETB137S | 1 3⁄8 | 1 1⁄4 | #10 | 5 | 25 |
| ETBS-TH | T-handle | | | 8 1⁄2 | 25 |
| ETBS-EXT | Extension | | | 11 1⁄2 | 25 |

1. T-handle is required for use with all sizes of standard wire brush.
2. To obtain total usable length, add the usable length for each part used.

## Nylon Brush — Standard
(For use with ET-3G)

| Model No. | Hole Diameter (in.) | Anchor Diameter (in.) | Rebar Size | Usable Length (in.) | Carton Quantity |
|---|---|---|---|---|---|
| ETB4 | 3⁄8–7⁄16 | 1⁄4–5⁄16 | — | 7 | 24 |
| ETB6 | 1⁄2–3⁄4 | 3⁄8–5⁄8 | #3 – #5 | 15 | 24 |
| ETB8 | 13⁄16–7⁄8 | 3⁄4 | #6 | 15 | 24 |
| ETB8L | 13⁄16–7⁄8 | 3⁄4 | #6 | 23 | 24 |
| ETB10 | 1–1 1⁄8 | 7⁄8–1 | #7 – #8 | 28 | 24 |
| ETB12 | 1 3⁄16–1 3⁄8 | 1 1⁄4 | #10 | 33 | 24 |

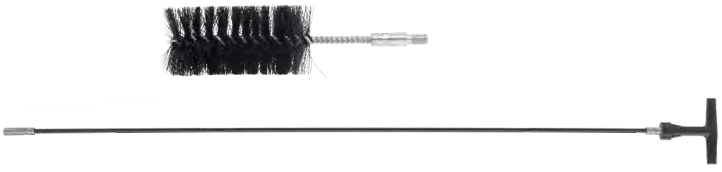
1. All standard nylon brushes are one-piece which includes a twisted wire handle.

## Nylon Brush — Rebar
(For use with ET-3G and SET-3G)

*(**Note:** Brushes are only applicable for SET-3G when used for post-installed rebar connections.)*

| Model No. | Hole Diameter (in.) | Rebar Size | Usable Length (in.) | Carton Quantity |
|---|---|---|---|---|
| ETB6R | 1⁄2–3⁄4 | #3 – #5 | 6 | 25 |
| ETB8R | 7⁄8 | #6 | 6 | 25 |
| ETB10R | 1–1 1⁄8 | #7 – #8 | 8 | 25 |
| ETB12R | 1 3⁄8 | #10 | 8 | 25 |
| ETB14R | 1 3⁄4 | #11 | 7 | 25 |
| ETBR-EXT | T-handle and extension | | 35 1⁄4 | 25 |

1. ETBR-EXT is required for use with all sizes of rebar nylon brushes.
2. To obtain total usable length, add the usable length for each part used.
3. Brushes are used when rebar is installed to replace cast-in-place bar for lap splices and development length.



# Piston Plug Delivery System

The Simpson Strong-Tie Piston Plug Delivery System for adhesives offers you an easy-to-use, reliable and less time-consuming means to dispense adhesive into drilled holes for threaded rod and rebar dowel installations in overhead, upwardly inclined and horizontal orientations. The matched tolerance design between the piston plug and drilled hole virtually eliminates the formation of voids and air pockets during adhesive dispensing.

The Piston Plug Delivery System consists of three components: piston plug, flexible extension tubing, and adhesive retaining cap.

## Features

- Designed for dispensing adhesive into drilled holes in overhead, upwardly inclined and horizontal orientations, as well as deep embedments
- Suitable for use with all Simpson Strong-Tie anchoring adhesives
- Adhesive piston plugs are sized to fit each drilled hole diameter
- Model number is embossed on each adhesive piston plug for identification
- A barbed end provides a reliable connection to the flexible extension tubing
- Flexible extension tubing is available in 25-foot-long rolls to be cut to required lengths


**Use the piston plug delivery system with all Simpson Strong-Tie adhesive products:**


SET-3G™


ET-3G™


AT-3G™

# Piston Plug Delivery System (cont.)

### Piston Plugs

| Model No. | Hole Size (in.) | Package Quantity | Carton Quantity* |
|---|---|---|---|
| PP56-RP10 | 9⁄16 | 10 | 10 packs of 10 |
| PP62-RP10 | 5⁄8 | 10 | 10 packs of 10 |
| PP68-RP10 | 11⁄16 | 10 | 10 packs of 10 |
| PP75-RP10 | 3⁄4 | 10 | 10 packs of 10 |
| PP87-RP10 | 7⁄8 | 10 | 10 packs of 10 |
| PP100-RP10 | 1 | 10 | 10 packs of 10 |
| PP112-RP10 | 1 1⁄8 | 10 | 10 packs of 10 |
| PP137-RP10 | 1 3⁄8 | 10 | 10 packs of 10 |
| PP175-RP10 | 1 3⁄4 | 10 | 10 packs of 10 |

*Product is sold by package.

**Piston Plugs**

### Tubing

| Model No. | Description | Package Quantity |
|---|---|---|
| PPFT25 | Piston Plug Flexible Extension Tubing — 25 ft. roll | 1 |

1. Tubing dimensions: inner diameter 3⁄8", outer diameter 1⁄2".

**Piston Plug Flexible Extension Tubing**

# Adhesive Retaining Caps

Adhesive retaining caps make overhead and horizontal installation easier by preventing the adhesive from running out of the hole. They also center the rod in the hole, making them ideal for applications where precise anchor placement is required. It may be necessary to provide support for the anchor during cure time. Adhesive retaining caps are not designed to support the weight of the anchor in overhead installations. Adhesive retaining caps should be used for horizontal and overhead adhesive installations. ARCs may be used in conjunction with the Piston Plug Delivery system.

**Adhesive Retaining Caps**

### Retaining Caps

| Model No. | Hole Size (in.) | Anchor Diameter (in.) | Rebar Size | Cap Depth (in.) | Package Quantity | Carton Quantity* (ea.) |
|---|---|---|---|---|---|---|
| ARC37A-RP25 | 7⁄16 | 3⁄8 | #3 | 7⁄16 | 25 | 8 packs of 25 |
| ARC37-RP25 | 1⁄2 | 3⁄8 | | 7⁄16 | 25 | 8 packs of 25 |
| ARC50A-RP25 | 9⁄16 | 1⁄2 | #4 | 1⁄2 | 25 | 8 packs of 25 |
| ARC50-RP25 | 5⁄8 | 1⁄2 | | 1⁄2 | 25 | 8 packs of 25 |
| ARC62A-RP25 | 11⁄16 | 5⁄8 | #5 | 9⁄16 | 25 | 8 packs of 25 |
| ARC62-RP25 | 3⁄4 | 5⁄8 | | 9⁄16 | 25 | 8 packs of 25 |
| ARC75-RP25 | 7⁄8 | 3⁄4 | | 9⁄16 | 25 | 8 packs of 25 |
| ARC87-RP25 | 1 | 7⁄8 | #7 | 11⁄16 | 25 | 8 packs of 25 |
| ARC100-RP25 | 1 1⁄8 | 1 | | 11⁄16 | 25 | 8 packs of 25 |
| ARC125-RP25 | 1 3⁄8 | 1 1⁄4 | #10 | 7⁄8 | 25 | 8 packs of 25 |
| ARC137-RP25 | 1 3⁄4 | — | #11 | 11⁄16 | 25 | 8 packs of 25 |

*Product is sold by package.

# Opti-Mesh Adhesive-Anchoring Screen Tubes

Screen tubes are vital to the performance of adhesive anchors in base materials that are hollow or contain voids, such as hollow block and brick. The Simpson Strong-Tie Opti-Mesh screen tube with woven mesh insert provides the advantages of a plastic screen tube while providing superior performance to steel screen tubes and competitive plastic screen tubes.

**Material:** Plastic

**Caution:** Screen tubes are designed for a specific adhesive type.

- **Integral Cap:** Serves to center and secure the rod in the screen tube, while displaying important information such as rod diameter, drill bit diameter and the Simpson Strong-Tie "≠" symbol for easy inspection after installation. The cap also prevents adhesive from running out the front of the screen tube.
- **Flanges:** Prevents the screen tube from slipping into over-drilled holes. Allows screen tube to function in holes that are drilled too deep.
- **Open-Mesh Collar:** This section of larger mesh allows extra adhesive to flow out the screen tube behind the face shell of hollow block applications. The extra "collar" of adhesive increases bearing area and results in higher load capacities in hollow concrete block.
- **Color-Coded, Formula-Specific Mesh:** The openings between the woven mesh screen tube strands are sized to allow only the right amount of adhesive to flow through the screen tube to bond with the base material while the balance remains in the screen to bond the rod.

**EWSP Epoxy Adhesive Screen Tube**
*(mesh is black)*
**For use with ET-3G™**
US Patent 6,837,018

**3GWSP Adhesive Screen Tube**
*(gray frame with gray mesh)*
**For use with SET-3G™**


The integral cap centers the rod and displays drill bit and rod diameter.

# Opti-Mesh Adhesive-Anchoring Screen Tubes

Screen Tubes — Plastic

| For Rod Diameter (in.) | Hole Size (in.) | Length (in.) | EWSP Model No. for ET-3G™ | 3GWSP Model No. for SET-3G™ | Carton Quantity |
|---|---|---|---|---|---|
| ⅜ | 9⁄16 | 3½ | EWS373P | 3GWS373P | 150 |
| | | 6 | EWS376P | 3GWS376P | 150 |
| | | 10 | EWS3710P | 3GWS3710P | 100 |
| ½ | ¾ | 3½ | EWS503P | 3GWS503P | 100 |
| | | 6 | EWS506P | 3GWS506P | 100 |
| | | 10 | EWS5010P | 3GWS5010P | 50 |
| ⅝ | ⅞ | 3½ | EWS623P | 3GWS623P | 50 |
| | | 6 | EWS626P | 3GWS626P | 50 |
| | | 10 | EWS6210P | 3GWS6210P | 25 |
| ¾ | 1 | 8 | EWS758P | 3GWS758P | 25 |
| | | 13 | EWS7513P | 3GWS7513P | 25 |

Specially sized holes in Opti-Mesh screens allow for adhesive to seep out at the appropriate location at the hollow portion of the CMU to create a better bond to the face shell.

# Steel Adhesive-Anchoring Screen Tubes

Screen tubes are used in unreinforced brick masonry applications to contain adhesive around the anchor and prevent it from running into voids. Simpson Strong-Tie screen tubes are specifically designed to work with ET-3G™ adhesive in order to precisely control the amount of adhesive that passes through the mesh. This results in thorough coating and bonding of the rod to the screen tube and base material. Order screen tubes based upon rod diameter and adhesive type. The actual outside diameter of the screen tube is larger than the rod diameter.

**Material:** 60 mesh carbon steel

**Caution:** Screen tubes are designed specifically for unreinforced brick masonry applications.

**Screen Tube**

Screen tubes are for use in unreinforced brick masonry applications.

## Screen Tubes

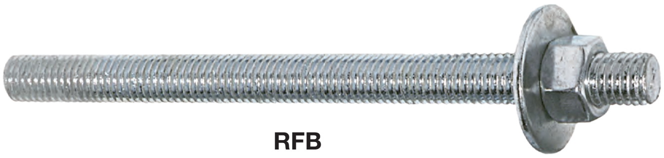
| For Rod Diameter (in.) | Hole Size (in.) | ETS Carbon Steel Screen Tubes for ET-3G | | Carton Quantity |
|---|---|---|---|---|
| | | Actual Screen Size O.D./Length (in.) | Model No. | |
| ¾ | 1 | 31⁄32 x 8 | ETS758 | 25 |
| | | 31⁄32 x 13 | ETS7513 | 25 |
| | | 31⁄32 x 17 | ETS7517 | 25 |
| | | 31⁄32 x 21 | ETS7521 | 25 |

# Retrofit Bolts

RFBs are pre-cut threaded rod, supplied with nut and washer. Each end of the threaded rod is stamped with the rod length in inches and our No-Equal® symbol for easy identification after installation.

**Material:** ASTM F1554 Grade 36

**Coating:** Zinc-plated, hot-dip galvanized



**RFB**
**Retrofit Bolts**

| Size. (in.) | Zinc-Plated Model No. | Hot-Dip Galvanized Model No. | Carton Quantity | Hot-Dip Galvanized Retail Model No.* | Package Quantity | Carton Quantity |
|---|---|---|---|---|---|---|
| ⅜ x 4 | RFB#3x4 | RFB#3x4HDG | 50 | — | — | — |
| ⅜ x 6 | RFB#3x6 | — | 50 | — | — | — |
| ⅜ x 8 | RFB#3x8 | — | 50 | — | — | — |
| ½ x 4 | RFB#4x4 | — | 50 | — | — | — |
| ½ x 5 | RFB#4x5 | RFB#4x5HDG | 50 | RFB#4x5HDGP2 | 2 | 5 packs of 2 |
| ½ x 6 | RFB#4x6 | RFB#4x6HDG | 50 | — | — | — |
| ½ x 7 | RFB#4x7 | RFB#4x7HDG | 50 | — | — | — |
| ½ x 8 | RFB#4x8 | RFB#4x8HDG | 50 | RFB#4x8HDGP2 | 2 | 5 packs of 2 |
| ½ x 10 | RFB#4x10 | RFB#4x10HDG | 25 | — | — | — |
| ⅝ x 5 | RFB#5x5 | RFB#5x5HDG | 50 | RFB#5x5HDGP2 | 2 | 5 packs of 2 |
| ⅝ x 8 | RFB#5x8 | RFB#5x8HDG | 50 | RFB#5x8HDGP2 | 2 | 5 packs of 2 |
| ⅝ x 10 | RFB#5x10 | RFB#5x10HDG | 50 | — | — | — |
| ⅝ x 12 | — | RFB#5x12HDG | 25 | RFB#5x12HDGP2 | 2 | 5 packs of 2 |
| ⅝ x 16 | RFB#5x16 | RFB#5x16HDG | 25 | RFB#5x16HDGP2 | 2 | 5 packs of 2 |
| ¾ x 6 | RFB#6x6 | — | 50 | — | — | — |
| ¾ x 8 | RFB#6x8 | RFB#6x8HDG | 50 | — | — | — |
| ¾ x 10½ | RFB#6x10.5 | RFB#6x10.5HDG | 25 | — | — | — |

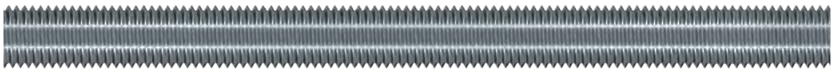
*Retail products ("P2") packaged in a polybag.

# All Thread Rod

ATRs are pre-cut threaded rod for use with Simpson Strong-Tie adhesives.

**Material:** ASTM F1554 Grade 36, A36 or A307
min $f_y$ = 36 ksi, min $F_u$ = 58 ksi and not to exceed 80 ksi

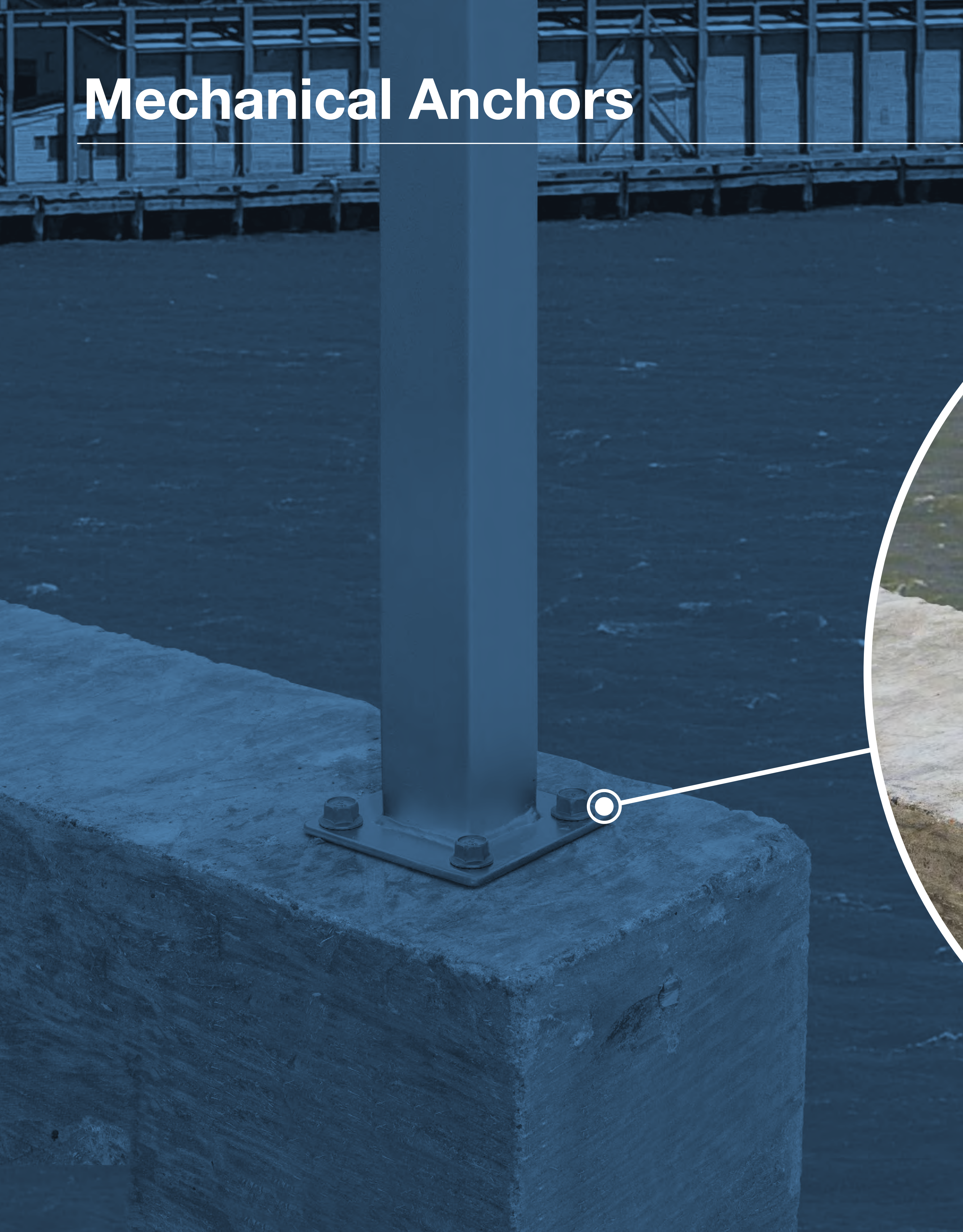
**Coating:** Uncoated, zinc-plated; hot-dip galvanized



**ATR**
**All Thread Rod**

| Description Dia. x Length (in.) | Uncoated Model No. | Zinc-Plated Model No. | Hot-Dip Galvanized Model No. | Carton Quantity |
|---|---|---|---|---|
| ⅜ x 12 | ATR3/8x12 | — | — | 1 |
| ⅜ x 24 | ATR3/8x24 | — | — | 1 |
| ⅜ x 36 | ATR3/8x36 | — | ATR3/8x36HDG | 1 |
| ½ x 12 | ATR1/2x12 | ATR1/2x12ZP | ATR1/2x12HDG | 1 |
| ½ x 18 | ATR1/2x18 | — | ATR1/2x18HDG | 1 |
| ½ x 24 | ATR1/2x24 | ATR1/2x24ZP | ATR1/2x24HDG | 1 |
| ½ x 36 | ATR1/2x36 | ATR1/2x36ZP | ATR1/2x36HDG | 1 |
| ⅝ x 12 | ATR5/8x12 | ATR5/8x12ZP | ATR5/8x12HDG | 1 |
| ⅝ x 18 | ATR5/8x18 | ATR5/8x18ZP | ATR5/8x18HDG | 1 |
| ⅝ x 24 | ATR5/8x24 | ATR5/8x24ZP | ATR5/8x24HDG | 1 |
| ⅝ x 30 | ATR5/8x30 | — | — | 1 |
| ⅝ x 36 | ATR5/8x36 | ATR5/8x36ZP | ATR5/8x36HDG | 1 |
| ¾ x 12 | ATR3/4x12 | ATR3/4x12ZP | ATR3/4x12HDG | 1 |
| ¾ x 18 | ATR3/4x18 | ATR3/4x18ZP | ATR3/4x18HDG | 1 |
| ¾ x 24 | ATR3/4x24 | ATR3/4x24ZP | ATR3/4x24HDG | 1 |
| ¾ x 36 | ATR3/4x36 | ATR3/4x36ZP | ATR3/4x36HDG | 1 |
| ⅞ x 12 | ATR7/8x12 | ATR7/8x12ZP | ATR7/8x12HDG | 1 |
| ⅞ x 18 | ATR7/8x18 | ATR7/8x18ZP | ATR7/8x18HDG | 1 |
| ⅞ x 20 | ATR7/8x20 | — | — | 1 |
| ⅞ x 24 | ATR7/8x24 | ATR7/8x24ZP | ATR7/8x24HDG | 1 |
| ⅞ x 26 | ATR7/8x26 | — | — | 1 |
| ⅞ x 36 | ATR7/8x36 | ATR7/8x36ZP | ATR7/8x36HDG | 1 |
| 1 x 12 | ATR1x12 | ATR1x12ZP | ATR1x12HDG | 1 |
| 1 x 18 | ATR1x18 | ATR1x18ZP | ATR1x18HDG | 1 |
| 1 x 24 | ATR1x24 | ATR1x24ZP | ATR1x24HDG | 1 |
| 1 x 36 | ATR1x36 | ATR1x36ZP | ATR1x36HDG | 1 |

# Mechanical Anchors



# Titen HD® Heavy-Duty Screw Anchor



A high-strength screw anchor for use in cracked and uncracked concrete, as well as uncracked masonry. The Titen HD offers low installation torque and outstanding performance. The Titen HD screw anchor is designed for a wide variety of applications such as sill plates, ledgers, post bases, seating, and other holdown applications. The screw anchor is easy to remove when used in temporary applications such as bracing and formwork, or when a fixture needs to be relocated.

## Features

- Tested in accordance with ACI 355.2, AC193 and AC106
- Qualified for static, wind and seismic loading conditions
- Thread design undercuts to efficiently transfer the load to the base material
- Standard fractional sizes
- Specialized heat-treating process creates tip hardness for better cutting without compromising the ductility
- No special drill bit required — designed to install using standard-sized ANSI tolerance drill bits
- Hex-washer head requires no separate washer, unless required by code, and provides a clean installed appearance
- Removable — ideal for temporary anchoring (e.g. formwork, bracing) or applications where fixtures may need to be moved
- Use in dry interior environments only

**Codes:** ICC-ES ESR-2713 (concrete);
ICC-ES ESR-1056 (masonry);
City of LA Supplement within ESR-2713 (concrete);
City of LA Supplement within ESR-1056 (masonry);
Florida FL15730 (concrete and masonry);
FM 3017082, 3035761 and 3043442;
Multiple DOT listings

**Material:** Carbon steel

**Coating:** Zinc plated

**Titen HD Screw Anchor**

Cracked Concrete CODE LISTED

Serrated teeth on the tip of the Titen HD screw anchor facilitate cutting and reduce installation torque.

## Installation

Holes in steel fixtures to be mounted should match the diameter specified in the table below.

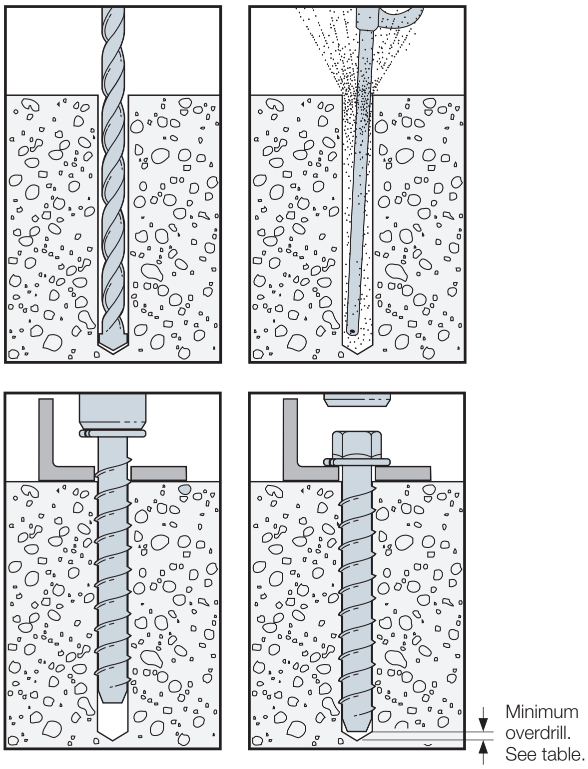
Use a Titen HD screw anchor one time only — installing the anchor multiple times may result in excessive thread wear and reduce load capacity.

Do not use impact wrenches to install into hollow CMU.

**Caution:** Oversized holes in base material will reduce or eliminate the mechanical interlock of the threads with the base material and reduce the anchor's load capacity.

1. Drill a hole in the base material using a carbide drill bit the same diameter as the nominal diameter of the anchor to be installed. Drill the hole to the specified embedment depth plus minimum hole depth overdrill (see table below) to allow the thread tapping dust to settle, and blow it clean using compressed air. (Overhead installations need not be blown clean.) Alternatively, drill the hole deep enough to accommodate embedment depth and the dust from drilling and tapping.
2. Insert the anchor through the fixture and into the hole.
3. Tighten the anchor into the base material until the hex-washer head contacts the fixture.

## Installation Sequence




## Additional Installation Information

| Titen HD Diameter (in.) | Wrench Size (in.) | Recommended Steel Fixture Hole Size (in.) | Minimum Hole Depth Overdrill (in.) |
|---|---|---|---|
| ¼ | ⅜ | ⅜ to 7/16 | ⅛ |
| ⅜ | 9/16 | ½ to 9/16 | ¼ |
| ½ | ¾ | ⅝ to 11/16 | ½ |
| ⅝ | 15/16 | ¾ to 13/16 | ½ |
| ¾ | 1⅛ | ⅞ to 15/16 | ½ |

Suggested fixture hole sizes are for structural steel thicker than 12 gauge only. Larger holes are not required for wood or thinner cold-formed steel members.

# **Countersunk** Head Style

The countersunk head style is for applications that require a flush-mount profile. Countersinking also leaves a cleaner surface appearance for exposed through-set applications. The anchor head's 6-lobe drive eases installation and is less prone to stripping than traditional recessed anchor heads.

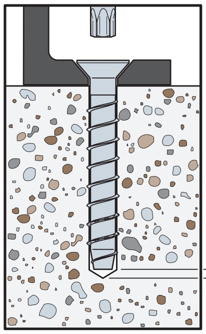
### Features

- Available in many standard lengths in ¼" and ⅜" diameters
- Driver bit included in each box

**Codes:** ICC-ES ESR-2713 (concrete);
ICC-ES ESR-1056 (masonry);
City of LA Supplement within ESR-2713 (concrete);
City of LA Supplement within ESR-1056 (masonry);
Florida FL15730 (concrete and masonry)

**Material:** Carbon steel

**Coating:** Zinc plated



Minimum overdrill.
See table.

### Additional Installation Information

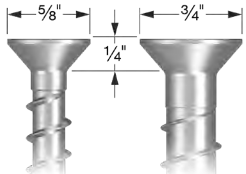
| Titen HD Diameter (in.) | Bit Size | Recommended Steel Fixture Hole Size (in.) | Minimum Hole Depth Overdrill (in.) |
|---|---|---|---|
| ¼ | T30 | ⅜ to 7⁄16 | ⅛ |
| ⅜ | T50 | ½ to 9⁄16 | ¼ |

Suggested fixture hole sizes are for structural steel thicker than 12 gauge only. Larger holes are not required for wood or thinner cold-formed steel members.

**Titen HD Countersunk Head Style**

Cracked Concrete CODE LISTED

**6-lobe drive**




**1⁄4"** **3⁄8"**

# **Washer-Head** Head Style

The washer-head design is commonly used where a minimal head profile is necessary. The model is offered in sizes suitable for use in sill plate applications, and the washer head's low installed profile means modular wall and floor systems can be installed on top with no need for notching the wall framing to accommodate the anchor. The anchor's 6-lobe drive eases driving and seating without stripping.

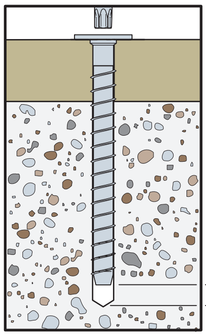
### Features

- Available in many standard lengths in ½" and ⅝" diameters
- Driver bit included in each box

**Codes:** ICC-ES ESR-2713 (concrete);
City of LA Supplement within ESR-2713 (concrete)
Florida FL15730 (concrete)

**Material:** Carbon steel

**Coating:** Zinc plated



Minimum overdrill.
See table.

### Additional Installation Information

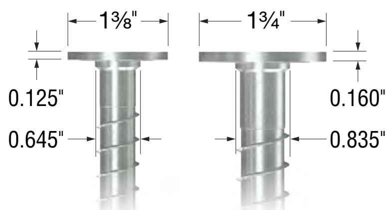
| Titen HD Diameter (in.) | Bit Size | Recommended Steel Fixture Hole Size (in.) | Minimum Hole Depth Overdrill (in.) |
|---|---|---|---|
| ½ | T50 | ¾ to 11⁄16 | ½ |
| ⅝ | T60 | 15⁄16 to 13⁄16 | ½ |

Suggested fixture hole sizes are for structural steel thicker than 12 gauge only. Larger holes are not required for wood or thinner cold-formed steel members.

**Titen HD Washer-Head Head Style**

Cracked Concrete CODE LISTED

**6-lobe drive**




**½"** **⅝"**

# Titen HD® Heavy-Duty Screw Anchor





## Titen HD Anchor Product Data — Hex Washer Head — Zinc Plated[1]

| Size (in.) | Model No. | Thread Length (in.) | Drill Bit Diameter (in.) | Wrench Size (in.) | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| ¼ x 1⅞ | THDB25178H | 1½ | ¼ | ⅜ | 100 | 500 |
| ¼ x 2¾ | THDB25234H | 2⅜ | ¼ | ⅜ | 50 | 250 |
| ¼ x 3 | THDB25300H | 2⅝ | ¼ | ⅜ | 50 | 250 |
| ¼ x 3½ | THDB25312H | 3⅛ | ¼ | ⅜ | 50 | 250 |
| ¼ x 4 | THDB25400H | 3⅝ | ¼ | ⅜ | 50 | 250 |
| ⅜ x 1¾ | THD37134H[2,3] | 1¼ | ⅜ | 9⁄16 | 50 | 250 |
| ⅜ x 2½ | THD37212H[2,3] | 2 | ⅜ | 9⁄16 | 50 | 200 |
| ⅜ x 3 | THD37300H | 2½ | ⅜ | 9⁄16 | 50 | 200 |
| ⅜ x 4 | THD37400H | 3½ | ⅜ | 9⁄16 | 50 | 200 |
| ⅜ x 5 | THD37500H | 4½ | ⅜ | 9⁄16 | 50 | 100 |
| ⅜ x 6 | THD37600H | 5½ | ⅜ | 9⁄16 | 50 | 100 |
| ½ x 3 | THD50300H[2,4] | 2½ | ½ | ¾ | 25 | 100 |
| ½ x 4 | THD50400H | 3½ | ½ | ¾ | 20 | 80 |
| ½ x 5 | THD50500H | 4½ | ½ | ¾ | 20 | 80 |
| ½ x 6 | THD50600H | 5½ | ½ | ¾ | 20 | 80 |
| ½ x 6½ | THD50612H | 5½ | ½ | ¾ | 20 | 40 |
| ½ x 8 | THD50800H | 5½ | ½ | ¾ | 20 | 40 |
| ½ x 12 | THD501200H | 5½ | ½ | ¾ | 5 | 20 |
| ½ x 13 | THD501300H | 5½ | ½ | ¾ | 5 | 20 |
| ½ x 14 | THD501400H | 5½ | ½ | ¾ | 5 | 20 |
| ½ x 15 | THD501500H | 5½ | ½ | ¾ | 5 | 20 |
| ⅝ x 4 | THDB62400H[2,4] | 3½ | ⅝ | 15⁄16 | 10 | 40 |
| ⅝ x 5 | THDB62500H | 4½ | ⅝ | 15⁄16 | 10 | 40 |
| ⅝ x 6 | THDB62600H | 5½ | ⅝ | 15⁄16 | 10 | 40 |
| ⅝ x 6½ | THDB62612H | 5½ | ⅝ | 15⁄16 | 10 | 40 |
| ⅝ x 8 | THDB62800H | 5½ | ⅝ | 15⁄16 | 10 | 20 |
| ⅝ x 10 | THDB62100H | 5½ | ⅝ | 15⁄16 | 10 | 20 |
| ¾ x 4 | THD75400H[2,5] | 3½ | ¾ | 1⅛ | 10 | 40 |
| ¾ x 5 | THD75500H | 4½ | ¾ | 1⅛ | 5 | 20 |
| ¾ x 6 | THDT75600H | 4½ | ¾ | 1⅛ | 5 | 20 |
| ¾ x 7 | THD75700H | 5½ | ¾ | 1⅛ | 5 | 10 |
| ¾ x 8½ | THD75812H | 5½ | ¾ | 1⅛ | 5 | 10 |
| ¾ x 10 | THD75100H | 5½ | ¾ | 1⅛ | 5 | 10 |

1. Length of anchor is measured from underside of head to end of anchor.
2. These models do not meet minimum embedment depth requirements for strength design.
3. Installation torque shall not exceed 25 ft.-lb. using a manual torque wrench or maximum torque rating of 100 ft.-lb. when installed with impact wrench.
4. Installation torque shall not exceed 50 ft.-lb. using a manual torque wrench or maximum torque rating of 100 ft.-lb. when installed with impact wrench.
5. Installation torque shall not exceed 50 ft.-lb. using a manual torque wrench or maximum torque rating of 135 ft.-lb. when installed with impact wrench.

# Titen HD® Heavy-Duty Screw Anchor

SIMPSON Strong-Tie



## Titen HD Anchor Product Data — Countersunk — Zinc Plated

| Size (in.) | Model No. | Thread Length (in.) | Drill Bit Diameter (in.) | Bit Size | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| ¼ x 1⅞ | THDB25178CS | 1½ | ¼ | T30 | 100 | 500 |
| ¼ x 2¾ | THDB25234CS | 2⅜ | ¼ | T30 | 50 | 250 |
| ¼ x 3½ | THDB25312CS | 3⅛ | ¼ | T30 | 50 | 250 |
| ¼ x 4½ | THDB25412CS | 4⅛ | ¼ | T30 | 50 | 250 |
| ⅜ x 2½ | THD37212CS† | 2 | ⅜ | T50 | 50 | 200 |
| ⅜ x 3 | THD37300CS | 2½ | ⅜ | T50 | 50 | 200 |
| ⅜ x 4 | THD37400CS | 3½ | ⅜ | T50 | 50 | 200 |
| ⅜ x 5 | THD37500CS | 4½ | ⅜ | T50 | 50 | 100 |

† This model does not meet minimum embedment depth requirements for strength design and require maximum installation torque of 25 ft.-lb. using a torque wrench, driver drill or cordless ¼" impact driver with a maximum permitted torque rating of 100 ft.-lb.

1. Length of anchor is measured from top of head to bottom of anchor.

## Titen HD Anchor Product Data — Washer Head — Zinc Plated

| Size (in.) | Model No. | Thread Length (in.) | Drill Bit Diameter (in.) | Bit Size | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| ½ x 6 | THD50600WH | 5½ | ½ | T50 | 15 | 60 |
| ½ x 8 | THD50800WH | 5½ | ½ | T50 | 15 | 30 |
| ⅝ x 6 | THDB62600WH | 5½ | ⅝ | T60 | 10 | 40 |
| ⅝ x 8 | THDB62800WH | 5½ | ⅝ | T60 | 10 | 20 |
| ⅝ x 10 | THDB62100WH | 5½ | ⅝ | T60 | 10 | 20 |

1. Length of anchor is measured from underside of head to bottom of anchor.

# **Hex Head** Mechanically Galvanized

The Titen HD heavy-duty screw anchor is a mechanically galvanized high-strength screw anchor for use in cracked and uncracked concrete, as well as uncracked masonry. Its proprietary heat treatment and ASTM B695 Class 65 mechanically galvanized coating make it ideal for both interior and exterior anchoring applications.

The Titen HD screw anchor is designed for a wide variety of applications such as sill plates, ledgers, post bases, seating, and other holdown applications. The screw anchor is easy to remove for use in temporary applications such as bracing and formwork, or when a fixture needs to be relocated.

### Features

- Thread design undercuts to efficiently transfer the load to the base material
- Standard fractional sizes, hole size equals anchor size
- Specialized heat-treating process creates tip hardness for better cutting without compromising ductility
- Hex washer head requires no separate washer, unless required by code
- Fully and easily removable
- Code listed for exterior applications

**Codes:** ICC-ES ESR-2713 (concrete);
ICC-ES ESR-1056 (masonry);
City of LA Supplement within ESR-2713 (concrete);
City of LA Supplement within ESR-1056 (masonry);
Florida FL15730 (concrete and masonry);
FM 3017082, 3035761 and 3043442;
Multiple DOT listings

**Material:** Carbon steel

**Coating:** Mechanically galvanized

Cracked Concrete CODE LISTED

Titen HD Screw Anchor Mechanically Galvanized

Head-stamped for easy identification

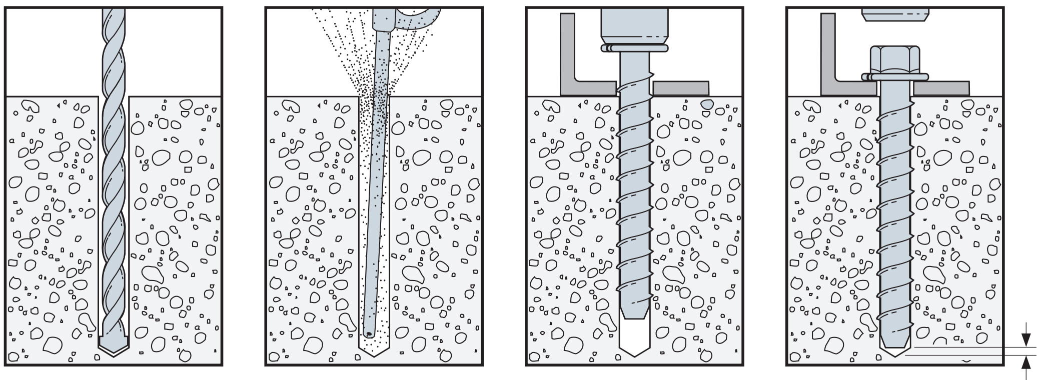
Serrated teeth on the tip of the Titen HD screw anchor facilitates cutting and reduces installation torque.

## Additional Installation Information

| Titen HD Diameter (in.) | Wrench Size (in.) | Recommended Steel Fixture Hole Size (in.) | Minimum Hole Depth Overdrill (in.) |
|---|---|---|---|
| 3/8 | 9/16 | 1/2 to 9/16 | 1/4 |
| 1/2 | 3/4 | 5/8 to 11/16 | 1/2 |
| 5/8 | 15/16 | 3/4 to 13/16 | 1/2 |
| 3/4 | 1 1/8 | 7/8 to 15/16 | 1/2 |

Suggested fixture hole sizes are for structural steel thicker than 12 gauge only. Larger holes are not required for wood or cold-formed steel members.

### Installation Sequence



# Titen HD® Heavy-Duty Screw Anchor — Mechanically Galvanized



Titen HD Anchor Product Data — Mechanically Galvanized

| Size (in.) | Model No. | Thread Length (in.) | Drill Bit Diameter (in.) | Wrench Size (in.) | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| ⅜ x 3 | THD37300HMG | 2½ | ⅜ | 9⁄16 | 50 | 200 |
| ⅜ x 4 | THD37400HMG | 3½ | | | 50 | 200 |
| ⅜ x 5 | THD37500HMG | 4½ | | | 50 | 100 |
| ⅜ x 6 | THD37600HMG | 5½ | | | 50 | 100 |
| ½ x 4 | THD50400HMG | 3½ | ½ | ¾ | 20 | 80 |
| ½ x 5 | THD50500HMG | 4½ | | | 20 | 80 |
| ½ x 6 | THD50600HMG | 5½ | | | 20 | 80 |
| ½ x 6½ | THD50612HMG | 5½ | | | 20 | 40 |
| ½ x 8 | THD50800HMG | 5½ | | | 20 | 40 |
| ½ x 12 | THD501200HMG | 5½ | | | 5 | 20 |
| ⅝ x 5 | THDB62500HMG | 4½ | ⅝ | 15⁄16 | 10 | 40 |
| ⅝ x 6 | THDB62600HMG | 5½ | | | 10 | 40 |
| ⅝ x 6½ | THDB62612HMG | 5½ | | | 10 | 40 |
| ⅝ x 8 | THDB62800HMG | 5½ | | | 10 | 20 |
| ⅝ x 10 | THDB62100HMG | 5½ | | | 10 | 20 |
| ¾ x 5 | THD75500HMG | 4½ | ¾ | 1⅛ | 5 | 20 |
| ¾ x 6 | THDT75600HMG | 4½ | | | 5 | 20 |
| ¾ x 8½ | THD75812HMG | 5½ | | | 5 | 10 |
| ¾ x 10 | THD75100HMG | 5½ | | | 5 | 10 |

Mechanical galvanizing meets ASTM B695, Class 65, Type 1.
Visit **strongtie.com/info** for corrosion information.

## Titen HD Installation Information and Additional Data[1]

IBC *

| Characteristic | Symbol | Units | Nominal Anchor Diameter, $d_a$ (in.) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼ | | ⅜ | | ½ | | ⅝ | | ¾ | | |
| **Installation Information** | | | | | | | | | | | | | |
| Drill Bit Diameter | $d_{bit}$ | in. | ¼ | | ⅜ | | ½ | | ⅝ | | ¾ | | |
| Baseplate Clearance Hole Diameter | $d_c$ | in. | ⅜ | | ½ | | ⅝ | | ¾ | | ⅞ | | |
| Maximum Installation Torque | $T_{inst,max}$ | ft.-lbf | 24[2] | | 50[2] | | 65[2] | | 100[2] | | 150[2] | | |
| Maximum Impact Wrench Torque Rating | $T_{impact,max}$ | ft.-lbf | 125[3] | | 150[3] | | 340[3] | | 340[3] | | 385[3] | | |
| Minimum Hole Depth | $h_{hole}$ | in. | 1¾ | 2⅝ | 2¾ | 3½ | 3¾ | 4½ | 4½ | 6 | 4½ | 6 | 6¾ |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1⅝ | 2½ | 2½ | 3¼ | 3¼ | 4 | 4 | 5½ | 4 | 5½ | 6¼ |
| Critical Edge Distance | $c_{ac}$ | in. | 3 | 6 | 2¹¹⁄₁₆ | 3⅝ | 3⁹⁄₁₆ | 4½ | 4½ | 6⅜ | 6 | 6⅜ | 7⁵⁄₁₆ |
| Minimum Edge Distance | $c_{min}$ | in. | 1½ | | 1¾ | | | | | | | | |
| Minimum Spacing | $s_{min}$ | in. | 1½ | | 3 | | | | | | 2¾ | 3 | |
| Minimum Concrete Thickness | $h_{min}$ | in. | 3¼ | 3½ | 4 | 5 | 5 | 6¼ | 6 | 8½ | 6 | 8¾ | 10 |
| **Additional Data** | | | | | | | | | | | | | |
| Anchor Category | Category | — | 1 | | | | | | | | | | |
| Yield Strength | $f_{ya}$ | psi | 100,000 | | 97,000 | | | | | | | | |
| Tensile Strength | $f_{uta}$ | psi | 125,000 | | 110,000 | | | | | | | | |
| Minimum Tensile and Shear Stress Area | $A_{se}$ | in² | 0.042 | | 0.099 | | 0.183 | | 0.276 | | 0.414 | | |
| Axial Stiffness in Service Load Range — Uncracked Concrete | $\beta_{uncr}$ | lb./in. | 202,000 | | 672,000 | | | | | | | | |
| Axial Stiffness in Service Load Range — Cracked Concrete | $\beta_{cr}$ | lb./in. | 173,000 | | 345,000 | | | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 and ACI 318-11 Appendix D.
2. $T_{inst,max}$ is the maximum permitted installation torque for the embedment depth range covered by this table using a torque wrench.
3. $T_{impact,max}$ is the maximum permitted torque rating for impact wrenches for the embedment depth range covered by this table.



*See p. 14 for an explanation of the load table icons.

# Titen HD® Design Information — Concrete



## Titen HD Tension Strength Design Data[1]

| Characteristic | Symbol | Units | Nominal Anchor Diameter, $d_a$ (in.) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼ | | ⅜ | | ½ | | ⅝ | | ¾ | | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1⅝ | 2½ | 2½ | 3¼ | 3¼ | 4 | 4 | 5½ | 4 | 5½ | 6¼ |
| **Steel Strength in Tension — ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1** | | | | | | | | | | | | | |
| Tension Resistance of Steel | $N_{sa}$ | lb. | 5,195 | | 10,890 | | 20,130 | | 30,360 | | 45,540 | | |
| Strength Reduction Factor — Steel Failure[2] | $\phi_{sa}$ | — | 0.65 | | | | | | | | | | |
| **Concrete Breakout Strength in Tension[6] — ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 Section D.5.2** | | | | | | | | | | | | | |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.19 | 1.94 | 1.77 | 2.40 | 2.35 | 2.99 | 2.97 | 4.24 | 2.94 | 4.22 | 4.86 |
| Critical Edge Distance | $c_{ac}$ | in. | 3 | 6 | 2 11/16 | 3⅝ | 3 9/16 | 4½ | 4½ | 6⅜ | 6 | 6⅜ | 7 5/16 |
| Effectiveness Factor — Uncracked Concrete | $k_{uncr}$ | — | 30 | 24 | | | | | | | 27 | 24 | |
| Effectiveness Factor — Cracked Concrete | $k_{cr}$ | — | 17 | | | | | | | | | | |
| Modification Factor | $\psi_{c,N}$ | — | 1.0 | | | | | | | | | | |
| Strength Reduction Factor — Concrete Breakout Failure[2] | $\phi_{cb}$ | — | 0.65 | | | | | | | | | | |
| **Pullout Strength in Tension — ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 Section D.5.3** | | | | | | | | | | | | | |
| Pullout Resistance, Uncracked Concrete ($f'_c$ = 2,500 psi) | $N_{p,uncr}$ | lb. | —[3] | —[3] | 2,700[4] | —[3] | —[3] | —[3] | —[3] | 9,810[4] | —[3] | —[3] | —[3] |
| Pullout Resistance, Cracked Concrete ($f'_c$ = 2,500 psi) | $N_{p,cr}$ | lb. | —[3] | 1,905[4] | 1,235[4] | 2,700[4] | —[3] | —[3] | 3,040[4] | 5,570[4] | —[3] | 6,070[4] | 7,195[4] |
| Strength Reduction Factor — Pullout Failure[2] | $\phi_p$ | — | 0.65 | | | | | | | | | | |
| **Tension Strength for Seismic Applications — ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 Section D.3.3.3** | | | | | | | | | | | | | |
| Nominal Pullout Strength for Seismic Loads ($f'_c$ = 2,500 psi) | $N_{p,eq}$ | lb. | —[3] | 1,905[4] | 1,235[4] | 2,700[4] | —[3] | —[3] | 3,040[4] | 5,570[4] | 3,840[4] | 6,070[4] | 7,195[4] |
| Strength Reduction Factor — Pullout Failure[2] | $\phi_{eq}$ | — | 0.65 | | | | | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, except as modified below.
2. The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
3. Pullout strength is not reported since concrete breakout controls.
4. Adjust the characteristic pullout resistance for other concrete compressive strengths by multiplying the tabular value by $(f'_{c,specified} / 2,500)^{0.5}$.



*See p. 14 for an explanation of the load table icons.

# Titen HD® Design Information — Concrete

## Titen HD Shear Strength Design Data[1]

| Characteristic | Symbol | Unit | Nominal Anchor Diameter, $d_a$ (in.) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼ | | ⅜ | | ½ | | ⅝ | | ¾ | | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1⅝ | 2½ | 2½ | 3¼ | 3¼ | 4 | 4 | 5½ | 4 | 5½ | 6¼ |
| **Steel Strength in Shear (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 Section D.6.1)** | | | | | | | | | | | | | |
| Shear Resistance of Steel | $V_{sa}$ | lb. | 2,020 | | 4,460 | | 7,455 | | 10,000 | | 14,950 | 16,840 | |
| Strength Reduction Factor — Steel Failure[2] | $\phi_{sa}$ | — | 0.60 | | | | | | | | | | |
| **Concrete Breakout Strength in Shear (ACI 318-19 17.7.2 ACI 318-14 17.5.2 or ACI 318-11 Section D.6.2)** | | | | | | | | | | | | | |
| Outside Diameter | $d_a$ | in. | 0.25 | | 0.375 | | 0.500 | | 0.625 | | 0.750 | | |
| Load Bearing Length of Anchor in Shear | $\ell_e$ | in. | 1.19 | 1.94 | 1.77 | 2.40 | 2.35 | 2.99 | 2.97 | 4.24 | 2.94 | 4.22 | 4.86 |
| Strength Reduction Factor — Concrete Breakout Failure[2] | $\phi_{cb}$ | — | 0.70 | | | | | | | | | | |
| **Concrete Pryout Strength in Shear (ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 Section D.6.3)** | | | | | | | | | | | | | |
| Coefficient for Pryout Strength | $k_{cp}$ | lb. | 1.0 | | | | | 2.0 | | | | | |
| Strength Reduction Factor — Concrete Pryout Failure[2] | $\phi_{cp}$ | — | 0.70 | | | | | | | | | | |
| **Steel Strength in Shear for Seismic Applications (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 Section D.3.3.3)** | | | | | | | | | | | | | |
| Shear Resistance for Seismic Loads | $V_{eq}$ | lb. | 1,695 | | 2,855 | | 4,790 | | 8,000 | | 9,350 | | |
| Strength Reduction Factor — Steel Failure[2] | $\phi_{eq}$ | — | 0.60 | | | | | | | | | | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 and ACI 318-11 Appendix D, except as modified below.
2. The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.

## Titen HD Tension and Shear Strength Design Data for the Soffit of Normal-Weight or Sand-Lightweight Concrete over Steel Deck[1,6,7]

| Characteristic | Symbol | Units | Nominal Anchor Diameter, $d_a$ (in.) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lower Flute | | | | | | Upper Flute | | | |
| | | | Figure 2 | | Figure 1 | | | | Figure 2 | | Figure 1 | |
| | | | ¼ | | ⅜ | | ½ | | ¼ | | ⅜ | ½ |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1⅝ | 2½ | 1⅞ | 2½ | 2 | 3½ | 1⅝ | 2½ | 1⅞ | 2 |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.19 | 1.94 | 1.23 | 1.77 | 1.29 | 2.56 | 1.19 | 1.94 | 1.23 | 1.29 |
| Pullout Resistance, concrete on steel deck (cracked)[2,3,4] | $N_{p,deck,cr}$ | lb. | 420 | 535 | 375 | 870 | 905 | 2,040 | 655 | 1,195 | 500 | 1,700 |
| Pullout Resistance, concrete on steel deck (uncracked)[2,3,4] | $N_{p,deck,uncr}$ | lb. | 995 | 1,275 | 825 | 1,905 | 1,295 | 2,910 | 1,555 | 2,850 | 1,095 | 2,430 |
| Steel Strength in Shear, concrete on steel deck[5] | $V_{sa,\ deck}$ | lb. | 1,335 | 1,745 | 2,240 | 2,395 | 2,435 | 4,430 | 2,010 | 2,420 | 4,180 | 7,145 |
| Steel Strength in Shear, Seismic | $V_{sa,\ deck,eq}$ | lb. | 870 | 1,135 | 1,434 | 1,533 | 1,565 | 2,846 | 1,305 | 1,575 | 2,676 | 4,591 |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 and ACI 318-11 Appendix D, except as modified below.
2. Concrete compressive strength shall be 3,000 psi minimum. The characteristic pullout resistance for greater compressive strengths shall be increased by multiplying the tabular value by $(f'_{c,specified}/3{,}000)^{0.5}$.
3. For anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies, as shown in Figure 1 and Figure 2, calculation of the concrete breakout strength may be omitted.
4. In accordance with ACI 318-19 Section 17.6.3.2.1, ACI 318-14 Section 17.4.3.2 or ACI 318-11 Section D.5.3.2, the nominal pullout strength in cracked concrete for anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies $N_{p,deck,cr}$ shall be substituted for $N_{p,cr}$. Where analysis indicates no cracking at service loads, the normal pullout strength in uncracked concrete $N_{p,deck,uncr}$ shall be substituted for $N_{p,uncr}$.
5. In accordance with ACI 318-19 Section 17.7.1.2(c), ACI 318-14 Section 17.5.1.2(c) or ACI 318-11 Section D.6.1.2(c), the shear strength for anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies $V_{sa,deck}$ and $V_{sa,deck,eq}$ shall be substituted for $V_{sa}$.
6. Minimum edge distance to edge of panel is $2h_{ef}$.
7. The minimum anchor spacing along the flute must be the greater of $3h_{ef}$, or 1.5 times the flute width.

*See p. 14 for an explanation of the load table icons.

# Titen HD® Design Information — Concrete

## Titen HD Anchor Tension and Shear Strength Design Data in the Topside of Normal-Weight Concrete or Sand-Lightweight Concrete over Steel Deck[1,2,3,4]

*

| Design Information | Symbol | Units | Nominal Anchor Diameter, $d_a$ (in.) | | | |
|---|---|---|---|---|---|---|
| | | | Figure 3 | | | |
| | | | ¼ | ⅜ | ½ | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1⅝ | 2½ | 3¼ | 4 |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.19 | 1.77 | 2.35 | 2.99 |
| Minimum Concrete Thickness[5] | $h_{min,deck}$ | in. | 2½ | 3¼ | 4½ | 4½ |
| Critical Edge Distance | $c_{ac,deck,top}$ | in. | 3¾ | 7¼ | 9 | 9 |
| Minimum Edge Distance | $c_{min,deck,top}$ | in. | 3½ | 3 | 2½ | 2½ |
| Minimum Spacing | $s_{min,deck,top}$ | in. | 3½ | 3 | 3 | 3 |

1. For anchors installed in the topside of concrete-filled deck assemblies, as shown in Figure 3, the nominal concrete breakout strength of a single anchor or group of anchors in shear, $V_{cb}$ or $V_{cbg}$, respectively, must be calculated in accordance with ACI 318-19 Section 17.7.2, ACI 318-14 Section 17.5.2 or ACI 318-11 Section D.6.2, using the actual member thickness, $h_{min,deck}$, in the determination of $A_{vc}$.
2. Design capacity shall be based on calculations according to values in the tables featured on pp. 69 and 70.
3. Minimum flute depth (distance from top of flute to bottom of flute) is 1½" (see Figure 3).
4. Steel deck thickness shall be minimum 20 gauge.
5. Minimum concrete thickness ($h_{min,deck}$) refers to concrete thickness above upper flute (see Figure 3).

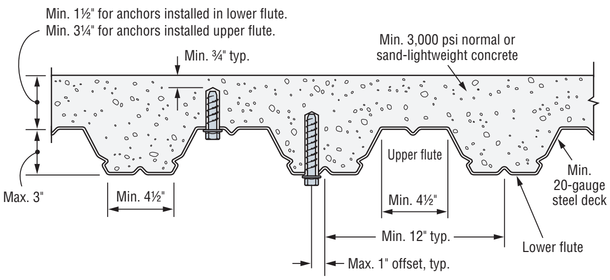



**Figure 1.** Installation of ⅜"- and ½"-Diameter Anchors in the Soffit of Concrete over Steel Deck

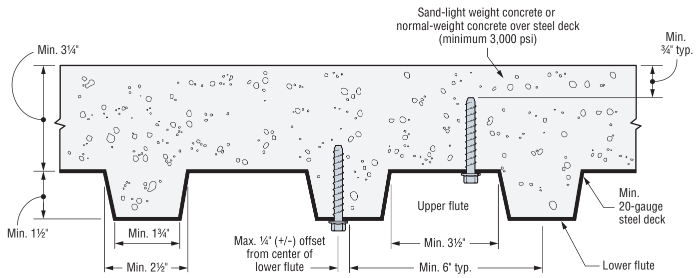



**Figure 2.** Installation of ¼"-Diameter Anchors in the Soffit of Concrete over Steel Deck

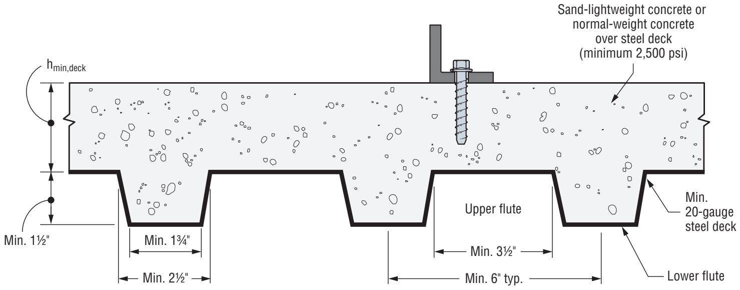



**Figure 3.** Installation of ¼"- and ⅜"-Diameter Anchors in the Topside of Concrete over Steel Deck



*See p. 14 for an explanation of the load table icons.

# Titen HD® Design Information — Masonry



## Titen HD Allowable Tension and Shear Loads in 8" Lightweight, Medium-Weight and Normal-Weight Grout-Filled CMU

IBC *

| Size in. (mm) | Drill Bit Diameter in. | Minimum Embedment Depth in. (mm) | Critical Edge Distance $C_{crit}$ in. (mm) | Minimum Edge Distance $C_{min}$ in. (mm) | Critical Spacing Distance in. (mm) | Values for 8" Lightweight, Medium-Weight or Normal-Weight Grout-Filled CMU | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tension Load | | Shear Load | |
| | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| **Anchor Installed in the Face of the CMU Wall (See Figure 4)** | | | | | | | | | |
| ¼ (6.4) | ¼ | 2½ (64) | 4 (102) | 1¼ (32) | 4 (102) | 2,050 (9.1) | 410 (1.8) | 2,500 (11.1) | 500 (2.2) |
| ⅜ (9.5) | ⅜ | 2¾ (70) | 12 (305) | 4 (102) | 6 (152) | 2,390 (10.6) | 480 (2.1) | 4,340 (19.3) | 870 (3.9) |
| ½ (12.7) | ½ | 3½ (89) | 12 (305) | 4 (102) | 8 (203) | 3,440 (15.3) | 690 (3.1) | 6,920 (30.8) | 1,385 (6.2) |
| ⅝ (15.9) | ⅝ | 4½ (114) | 12 (305) | 4 (102) | 10 (254) | 5,300 (23.6) | 1,060 (4.7) | 10,420 (46.4) | 2,085 (9.3) |
| ¾ (19.1) | ¾ | 5½ (140) | 12 (305) | 4 (102) | 12 (305) | 7,990 (35.5) | 1,600 (7.1) | 15,000 (66.7) | 3,000 (13.3) |

1. The tabulated allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.
2. Values for 8"-wide, lightweight, medium-weight and normal-weight concrete masonry units.
3. The masonry units must be fully grouted.
4. The minimum specified compressive strength of masonry, $f'_m$, at 28 days is 1,500 psi.
5. Embedment depth is measured from the outside face of the concrete masonry unit.
6. Grout-filled CMU wall design must satisfy applicable design standards and be capable of withstanding applied loads.
7. Refer to allowable load-adjustment factors for spacing and edge distance on pp. 78–79.

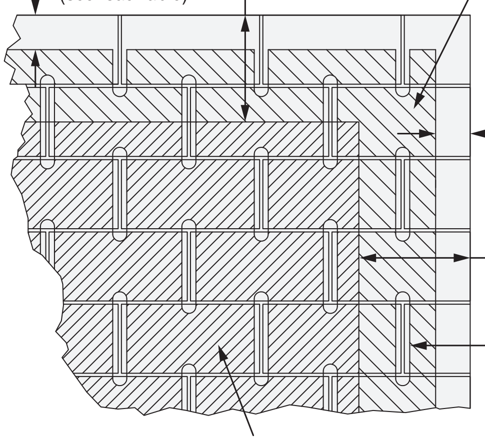



**Figure 4.** Shaded Area = Placement for Full and Reduced Allowable Load Capacity in Grout-Filled CMU

*See p. 14 for an explanation of the load table icons.

# Titen HD® Design Information — Masonry



## Titen HD Allowable Tension and Shear Loads in 8" Lightweight, Medium-Weight and Normal-Weight Hollow CMU

*

| Size in. (mm) | Drill Bit Diameter in. | Embedment Depth[4] in. (mm) | Minimum Edge Distance in. (mm) | 8" Hollow CMU Loads Based on CMU Strength | | | |
|---|---|---|---|---|---|---|---|
| | | | | Tension Load | | Shear Load | |
| | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| **Anchor Installed in Face Shell (See Figure 5)** | | | | | | | |
| ⅜ (9.5) | ⅜ | 1¾ (45) | 4 (102) | 720 (3.2) | 145 (0.6) | 1,240 (5.5) | 250 (1.1) |
| ½ (12.7) | ½ | 1¾ (45) | 4 (102) | 760 (3.4) | 150 (0.7) | 1,240 (5.5) | 250 (1.1) |
| ⅝ (15.9) | ⅝ | 1¾ (45) | 4 (102) | 800 (3.6) | 160 (0.7) | 1,240 (5.5) | 250 (1.1) |
| ¾ (19.1) | ¾ | 1¾ (45) | 4 (102) | 880 (3.9) | 175 (0.8) | 1,240 (5.5) | 250 (1.1) |

1. The tabulated allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC. **Note:** No installation within 4⅝" of bed joint of hollow masonry block wall.
2. Values for 8"-wide, lightweight, medium-weight and normal-weight concrete masonry units.
3. The minimum specified compressive strength of masonry, $f'_m$, at 28 days is 1,500 psi.
4. Embedment depth is measured from the outside face of the concrete masonry unit and is based on the anchor being embedded an additional ½"- through 1¼"-thick face shell.
5. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
6. CMU wall design must satisfy applicable design standards and be capable of withstanding applied loads.
7. Do not use impact wrenches to install in hollow CMU.
8. Set drill to rotation-only mode when drilling into hollow CMU.
9. The tabulated allowable loads are based on one anchor installed in a single cell.
10. Distance from centerline of anchor to head joint shall be a minimum of 4⅝".

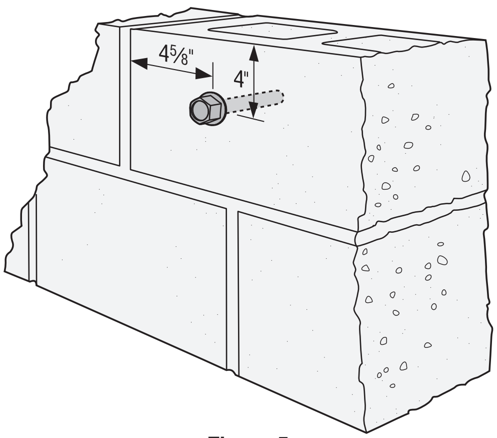



**Figure 5**

*See p. 14 for an explanation of the load table icons.

# Titen HD® Design Information — Masonry

## Titen HD Allowable Tension and Shear Loads in 8" Lightweight, Medium-Weight and Normal-Weight Grout-Filled CMU Stemwall

IBC *

| Size in. (mm) | Drill Bit Diameter in. | Embed. Depth in. (mm) | Minimum Edge Distance in. (mm) | Minimum End Distance in. (mm) | Critical Spacing Distance in. (mm) | 8" Grout-Filled CMU Allowable Loads Based on CMU Strength, f'$_m$ = 1,500 psi | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tension | | Shear Perpendicular to Edge | | Shear Parallel to Edge | |
| | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| Anchor Installed in Cell Opening or Web (Top of Wall) (See Figure 6) | | | | | | | | | | | |
| ½ (12.7) | ½ | 4½ (114) | 1¾ (45) | 8 (203) | 8 (203) | 2,860 (12.7) | 570 (2.5) | 800 (3.6) | 160 (0.7) | 2,920 (13.0) | 585 (2.6) |
| ⅝ (15.9) | ⅝ | 4½ (114) | 1¾ (45) | 10 (254) | 10 (254) | 2,860 (12.7) | 570 (2.5) | 800 (3.6) | 160 (0.7) | 3,380 (15.0) | 675 (3.0) |

1. The tabulated allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.
2. Values are for 8"-wide, lightweight, medium-weight and normal-weight concrete masonry units.
3. The masonry units must be fully grouted.
4. The minimum specified compressive strength of masonry, f'$_m$, at 28 days is 1,500 psi.
5. Grout-filled CMU wall design must satisfy applicable design standards and be capable of withstanding applied design loads.
6. Loads are based on anchor installed in either the web or grout-filled cell opening in the top of wall.

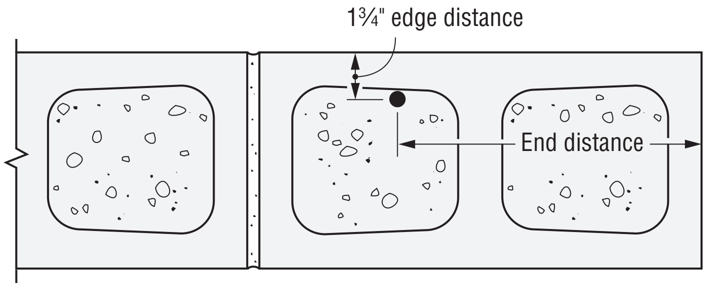



**Figure 6.** Anchor Installed in Top of Wall at 1¾" Edge Distance

## Titen HD Allowable Tension and Shear Loads in 8" Medium-Weight and Normal-Weight Grout-Filled CMU Stemwall

IBC *

| Size in. (mm) | Drill Bit Diameter in. | Embed. Depth in. (mm) | Minimum Edge Distance in. (mm) | Minimum End Distance in. (mm) | Critical Spacing Distance in. (mm) | 8" Grout-Filled CMU Allowable Loads Based on CMU Strength, f'$_m$ = 2,000 psi | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tension | | Shear Perpendicular to Edge | | Shear Parallel to Edge | |
| | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| Anchor Installed in Cell Opening (Top of Wall) (See Figure 7) | | | | | | | | | | | |
| ½ (12.7) | ½ | 4½ (114) | 3 (76) | 12 (305) | 12 (305) | 5,800 (25.8) | 1,160 (5.2) | 2,750 (12.2) | 550 (2.5) | 7,500 (33.4) | 1,500 (6.7) |
| ⅝ (15.9) | ⅝ | | | | | | | | | | |

1. The tabulated allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.
2. Values are for 8"-wide, medium-weight and normal-weight concrete masonry units.
3. The masonry units must be fully grouted.
4. The minimum specified compressive strength of masonry, f'$_m$, at 28 days is 2,000 psi.
5. Allowable loads are not permitted to be increased for short-term loading due to wind or seismic forces.
6. Grout-filled CMU wall design must satisfy applicable design standards and be capable of withstanding applied design loads.
7. Loads are based on anchor installed in grout-filled cell opening in the top of wall.

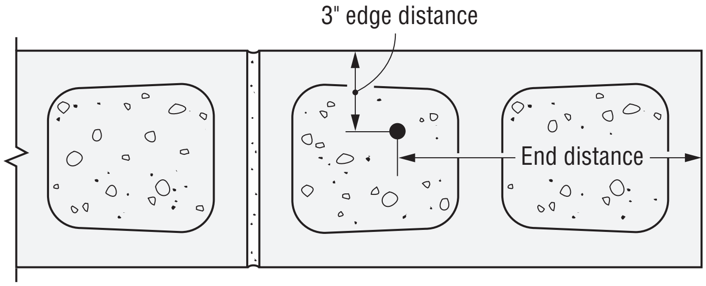



**Figure 7.** Anchor Installed in Top of Wall at 3" Edge Distance



*See p. 14 for an explanation of the load table icons.

# Titen HD® Design Information — Masonry



## Titen HD Allowable Tension and Shear Loads in End of 8" Lightweight, Medium-Weight and Normal-Weight Grout-Filled CMU Wall

IBC *

| Size (in.) | Drill Bit Diameter (in.) | Embedment Depth (in.) | Minimum Edge Distance (in.) | Minimum End Distance (in.) | Minimum Spacing (in.) | Allowable Loads | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Tension (lbf) | Shear Vertical (lbf) | Shear Horizontal (lbf) |
| ¼ | ¼ | 2⅜ | 3¹³⁄₁₆ | 1¾ | 4 | 310 | 215 | 375 |
| ⅜ | ⅜ | 2⅜ | 3¹³⁄₁₆ | 1¾ | 6 | 335 | 215 | 375 |

1. The tabulated allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.
2. Values are for 8"-wide, lightweight, medium-weight and normal-weight concrete masonry units.
3. The masonry units must be fully grouted.
4. The minimum specified compressive strength of masonry, $f'_m$, at 28 days is 2,000 psi.
5. Grout-filled CMU wall design must satisfy applicable design standards and be capable of withstanding applied design loads.
6. Minimum edge and end distances are measured from anchor centerline to the edge and end of the CMU masonry wall, respectively. Refer to Figure 8 below.

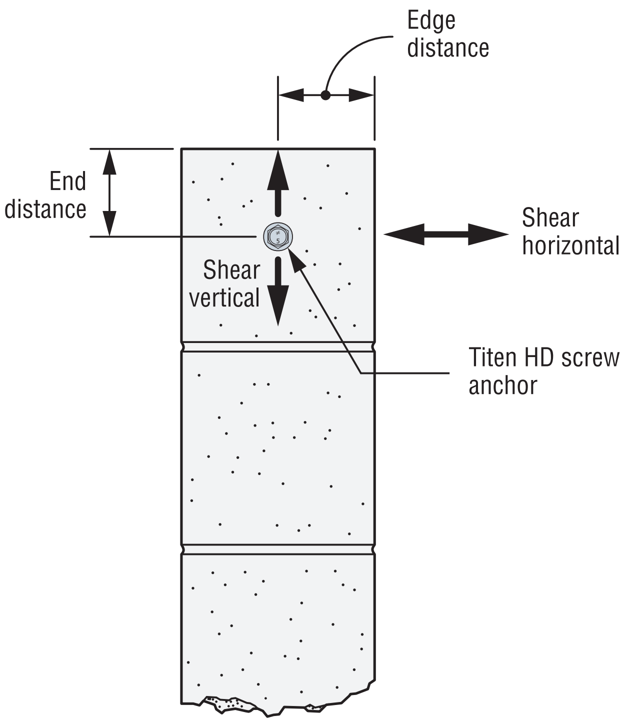



**Figure 8.**
Anchor Installed in
End of Grout-Filled CMU Wall



*See p. 14 for an explanation of the load table icons.

# Titen HD® Design Information — Masonry

## Titen HD Allowable Tension and Shear Loads in End of 8" Lightweight, Medium-Weight and Normal-Weight Hollow CMU Wall

IBC *

| Size (in.) | Drill Bit Diameter (in.) | Embedment Depth (in.) | Minimum Edge Distance (in.) | Minimum End Distance (in.) | Minimum Spacing (in.) | Allowable Loads | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Tension (lbf) | Shear Vertical (lbf) | Shear Horizontal (lbf) |
| ¼ | ¼ | 2⅜ | 3¹³⁄₁₆ | 1¾ | 4 | 130 | 105 | 120 |
| ⅜ | ⅜ | 2⅜ | 3¹³⁄₁₆ | 1¾ | 6 | 130 | 115 | 125 |

1. The tabulated allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.
2. Values for 8"-wide, lightweight, medium-weight and normal-weight concrete masonry units.
3. The minimum specified compressive strength of masonry, $f'_m$, at 28 days is 2,000 psi.
4. Embedment depth is measured from the outside face of the concrete masonry unit and is based on the anchor being embedded an additional 1⅛"- through 1¼"-thick face shell.
5. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
6. CMU wall design must satisfy applicable design standards and be capable of withstanding applied loads.
7. Do not use impact wrenches to install in hollow CMU.
8. Set drill to rotation-only mode when drilling into hollow CMU.
9. Minimum edge and end distances are measured from anchor centerline to the edge and end of the CMU masonry wall, respectively. Refer to Figure 9 below.
10. Anchors must be installed a minimum of 1½" from centerlie of bed joints. See Figure 9 for prohibited anchor installation locations.

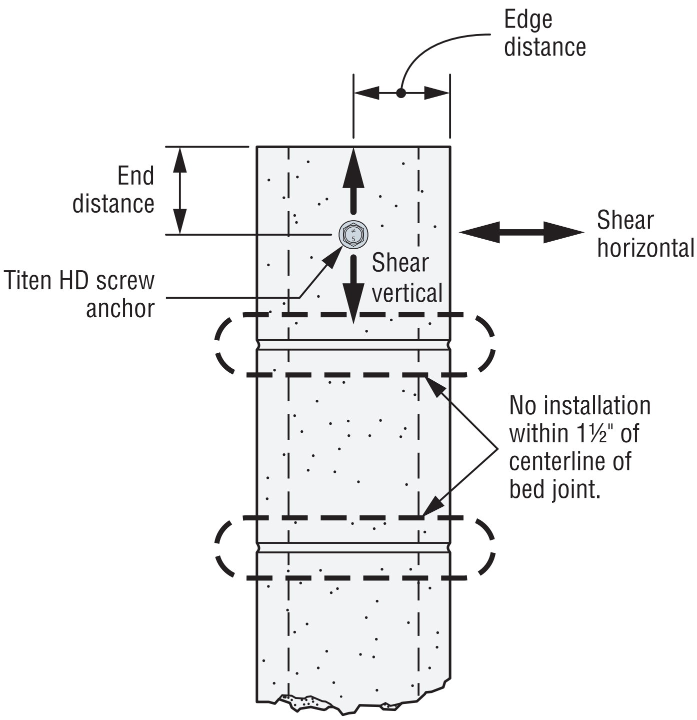



**Figure 9.**
Anchor Installed in End of Hollow CMU Wall



*See p. 14 for an explanation of the load table icons.*

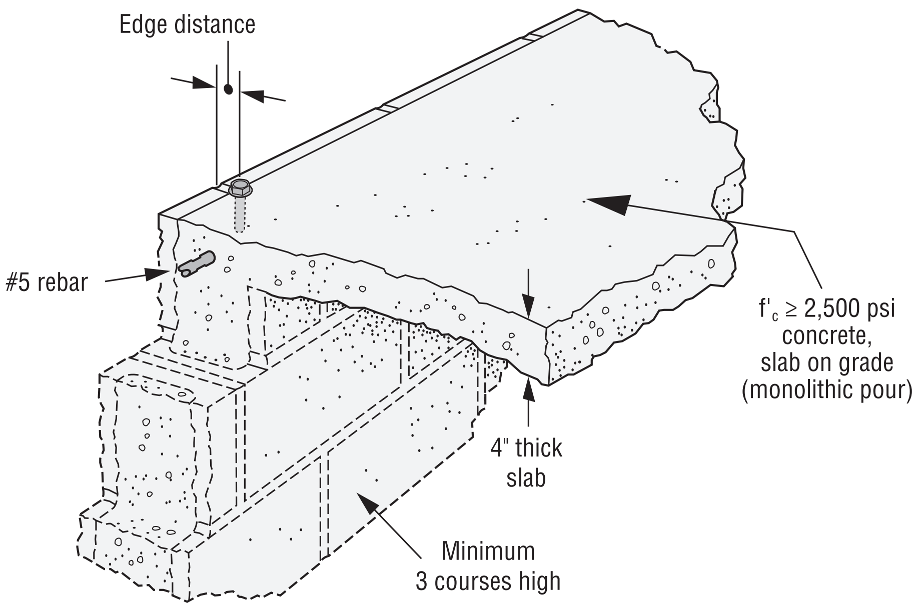
# Titen HD® Design Information — Masonry



## Titen HD Allowable Tension Loads for 8" Lightweight, Medium-Weight and Normal-Weight CMU Chair Blocks Filled with Normal-Weight Concrete

| Size in. (mm) | Drill Bit Diameter (in.) | Minimum Embedment Depth in. (mm) | Minimum Edge Distance in. (mm) | Critical Spacing in. (mm) | 8" Concrete-Filled CMU Chair Block Allowable Tension Loads Based on CMU Strength | |
|---|---|---|---|---|---|---|
| | | | | | Ultimate lb. (kN) | Allowable lb. (kN) |
| 3/8 (9.5) | 3/8 | 2 3/8 (60) | 1 3/4 (44) | 9 1/2 (241) | 3,175 (14.1) | 635 (2.8) |
| | | 3 3/8 (86) | 1 3/4 (44) | 13 1/2 (343) | 5,175 (23.0) | 1,035 (4.6) |
| | | 5 (127) | 2 1/4 (57) | 20 (508) | 10,584 (47.1) | 2,115 (9.4) |
| 1/2 (12.7) | 1/2 | 8 (203) | 2 1/4 (57) | 32 (813) | 13,722 (61.0) | 2,754 (12.2) |
| | | 10 (254) | 2 1/4 (57) | 40 (1016) | 16,630 (74.0) | 3,325 (14.8) |
| 5/8 (15.9) | 5/8 | 5 1/2 (140) | 1 3/4 (44) | 22 (559) | 9,025 (40.1) | 1,805 (8.1) |

1. The tabulated allowable loads are based on a safety factor of 5.0.
2. Values are for 8"-wide concrete masonry units (CMU) filled with concrete, with minimum compressive strength of 2,500 psi and poured monolithically with the floor slab.
3. Center #5 rebar in CMU cell and concrete slab as shown in the illustration below.




*See p. 14 for an explanation of the load table icons.

## Load-Adjustment Factors for Titen HD Anchors in Face-of-Wall Installation in 8" Grout-Filled CMU: Edge Distance and Spacing, Tension and Shear Loads

**How to use these charts:**

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
5. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load adjustment factor.
7. Reduction factors for multiple edges or spacings are multiplied together.

### Edge Distance Tension ($f_c$)

IBC *

| $c_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | E | 2½ | 2¾ | 3½ | 4½ | 5½ |
| | $c_{cr}$ | 4 | 12 | 12 | 12 | 12 |
| | $c_{min}$ | 1.25 | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | 0.77 | 1.00 | 1.00 | 0.83 | 0.66 |
| 1.25 | | 0.77 | | | | |
| 2 | | 0.83 | | | | |
| 3 | | 0.92 | | | | |
| 4 | | 1.00 | 1.00 | 1.00 | 0.83 | 0.66 |
| 6 | | 1.00 | 1.00 | 1.00 | 0.87 | 0.75 |
| 8 | | 1.00 | 1.00 | 1.00 | 0.92 | 0.83 |
| 10 | | 1.00 | 1.00 | 1.00 | 0.96 | 0.92 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

See footnotes below.

### Edge Distance Shear ($f_c$)
### Shear Load Parallel to Edge or End

IBC *

| $c_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | E | 2½ | 2¾ | 3½ | 4½ | 5½ |
| | $c_{cr}$ | 4 | 12 | 12 | 12 | 12 |
| | $c_{min}$ | 1.25 | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | 0.58 | 0.77 | 0.48 | 0.46 | 0.44 |
| 1.25 | | 0.58 | | | | |
| 2 | | 0.69 | | | | |
| 3 | | 0.85 | | | | |
| 4 | | 1.00 | 0.77 | 0.48 | 0.46 | 0.44 |
| 6 | | 1.00 | 0.83 | 0.61 | 0.60 | 0.58 |
| 8 | | 1.00 | 0.89 | 0.74 | 0.73 | 0.72 |
| 10 | | 1.00 | 0.94 | 0.87 | 0.87 | 0.86 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

See footnotes below.

### Edge Distance Shear ($f_c$)
### Shear Load Perpendicular to Edge or End
### (Directed Towards Edge or End)

IBC *

| $c_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | E | 2½ | 2¾ | 3½ | 4½ | 5½ |
| | $c_{cr}$ | 4 | 12 | 12 | 12 | 12 |
| | $c_{min}$ | 1.25 | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | 0.71 | 0.58 | 0.38 | 0.30 | 0.21 |
| 1.25 | | 0.71 | | | | |
| 2 | | 0.79 | | | | |
| 3 | | 0.89 | | | | |
| 4 | | 1.00 | 0.58 | 0.38 | 0.30 | 0.21 |
| 6 | | 1.00 | 0.69 | 0.54 | 0.48 | 0.41 |
| 8 | | 1.00 | 0.79 | 0.69 | 0.65 | 0.61 |
| 10 | | 1.00 | 0.90 | 0.85 | 0.83 | 0.80 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

1. E = embedment depth (inches).
2. $c_{act}$ = actual end or edge distance at which anchor is installed (inches).
3. $c_{cr}$ = critical end or edge distance for 100% load (inches).
4. $c_{min}$ = minimum end or edge distance for reduced load (inches).
5. $f_c$ = adjustment factor for allowable load at actual end or edge distance.
6. $f_{ccr}$ = adjustment factor for allowable load at critical end or edge distance. $f_{ccr}$ is always = 1.00.
7. $f_{cmin}$ = adjustment factor for allowable load at minimum end or edge distance.
8. $f_c = f_{cmin} + [(1 - f_{cmin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

*See p. 14 for an explanation of the load table icons.

# Load-Adjustment Factors for Titen HD Anchors in Face-of-Wall Installation in 8" Grout-Filled CMU: Edge Distance and Spacing, Tension and Shear Loads (cont.)

**How to use these charts:**

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
5. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load adjustment factor.
7. Reduction factors for multiple edges or spacings are multiplied together.

## Edge Distance Shear ($f_c$)
Shear Load Perpendicular to Edge or End (Directed Away from Edge or End)

| $c_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | E | 2½ | 2¾ | 3½ | 4½ | 5½ |
| | $c_{cr}$ | 4 | 12 | 12 | 12 | 12 |
| | $c_{min}$ | 1.25 | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | 0.71 | 0.89 | 0.79 | 0.58 | 0.38 |
| 1.25 | | 0.71 | | | | |
| 2 | | 0.79 | | | | |
| 3 | | 0.89 | | | | |
| 4 | | 1.00 | 0.89 | 0.79 | 0.58 | 0.38 |
| 6 | | 1.00 | 0.92 | 0.84 | 0.69 | 0.54 |
| 8 | | 1.00 | 0.95 | 0.90 | 0.79 | 0.69 |
| 10 | | 1.00 | 0.97 | 0.95 | 0.90 | 0.85 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

## Spacing Tension ($f_s$)

| $s_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | E | 2½ | 2¾ | 3½ | 4½ | 5½ |
| | $s_{cr}$ | 4 | 6 | 8 | 10 | 12 |
| | $s_{min}$ | 2 | 3 | 4 | 5 | 6 |
| | $f_{smin}$ | 0.66 | 0.87 | 0.69 | 0.59 | 0.50 |
| 2 | | 0.66 | | | | |
| 3 | | 0.83 | 0.87 | | | |
| 4 | | 1.00 | 0.91 | 0.69 | | |
| 5 | | | 0.96 | 0.77 | 0.59 | |
| 6 | | | 1.00 | 0.85 | 0.67 | 0.50 |
| 8 | | | | 1.00 | 0.84 | 0.67 |
| 10 | | | | | 1.00 | 0.83 |
| 12 | | | | | | 1.00 |

## Spacing Shear ($f_s$)

| $s_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | E | 2½ | 2¾ | 3½ | 4½ | 5½ |
| | $s_{cr}$ | 4 | 6 | 8 | 10 | 12 |
| | $s_{min}$ | 2 | 3 | 4 | 5 | 6 |
| | $f_{smin}$ | 0.87 | 0.62 | 0.62 | 0.62 | 0.62 |
| 2 | | 0.87 | | | | |
| 3 | | 0.93 | 0.62 | | | |
| 4 | | 1.00 | 0.75 | 0.62 | | |
| 5 | | | 0.87 | 0.72 | 0.62 | |
| 6 | | | 1.00 | 0.81 | 0.70 | 0.62 |
| 8 | | | | 1.00 | 0.85 | 0.75 |
| 10 | | | | | 1.00 | 0.87 |
| 12 | | | | | | 1.00 |

1. E = embedment depth (inches).
2. $s_{act}$ = actual spacing distance at which anchors are installed (inches).
3. $s_{cr}$ = critical spacing distance for 100% load (inches).
4. $s_{min}$ = minimum spacing distance for reduced load (inches).
5. $f_s$ = adjustment factor for allowable load at actual spacing distance.
6. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
7. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
8. $f_s = f_{smin} + [(1 - f_{smin}) (s_{act} - s_{min}) / (s_{cr} - s_{min})]$.

*See p. 14 for an explanation of the load table icons.

# Stainless-Steel Titen HD® Heavy-Duty Screw Anchor



The Titen HD stainless-steel screw anchor for concrete and masonry is ideal for when the job calls for fast and efficient installation in multiple types of environments. The Titen HD stainless steel is a state-of-the-art anchor solution that combines the long-lasting corrosion resistance of Type 300 Series stainless steel with the undercutting ability of heat-treated carbon-steel cutting threads.

Cracked Concrete CODE LISTED

**Innovative** — The serrated carbon-steel threads on the tip of the stainless-steel Titen HD are vital because they undercut the concrete as the anchor is driven into the hole, making way for the rest of the threads to interlock with the concrete. In order for these threads to be durable enough to cut into the concrete, they are formed from carbon steel that is then hardened and brazed onto the tip of the anchor.

**Corrosion Resistant** — For dry, interior applications, carbon-steel corrosion is not a risk, but in any kind of exterior, coastal or chemical environment stainless steel provides the best solution for corrosion protection.

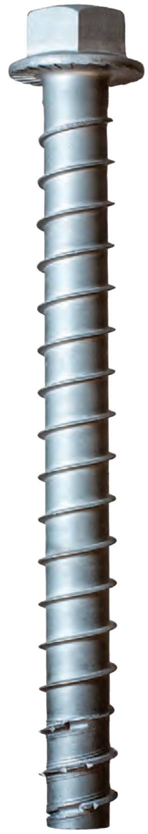
### Features:

- Ideal for exterior or corrosive environments
- Installs with an impact wrench or with a hand tool
- Tested per ACI355.2, AC193 and AC106

**Codes:** IAPMO UES ER-493 (concrete);
ICC-ES ESR-1056 (masonry);
City of LA Supplement within ER-493 (concrete);
City of LA Supplement within ESR-1056 (masonry);
Florida FL15730 (masonry); FL16230 (concrete)

**Material:** Type 316 and Type 304 stainless steel.
See pp. 235–236 or visit **strongtie.com/info** for more corrosion information.

**Innovative Carbon-Steel Lead Threads**



**Stainless-Steel Titen HD Hex-Washer Head Style Screw Anchor**

US Patents 8,747,042 B2 and 9,517,519

### Installation

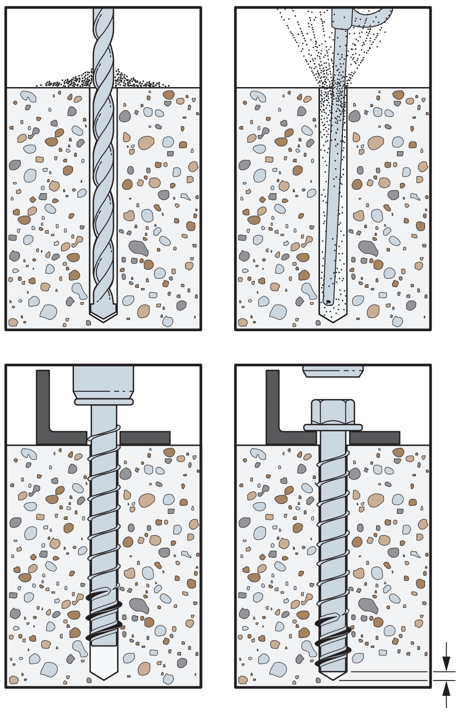
**Caution:** Holes in steel fixtures to be mounted should match the diameter specified in the table below if steel is thicker than 12 gauge.

**Caution:** Use a Titen HD screw anchor one time only — installing the anchor multiple times may result in excessive thread wear and reduce load capacity. Do not use impact wrenches to install into hollow CMU.

**Caution:** Oversized holes in base material will reduce or eliminate the mechanical interlock of the threads with the base material and reduce the anchor's load capacity.

1. Drill a hole in the base material using a carbide drill bit (complying with ANSI B212.15) with the same diameter as the nominal diameter of the anchor to be installed. Drill the hole to the specified minimum hole depth overdrill (see table below) to allow the thread tapping dust to settle, and blow it clean using compressed air. (Overhead installations need not be blown clean.) Alternatively, drill the hole deep enough to accommodate embedment depth and the dust from drilling and tapping.
2. Insert the anchor through the fixture and into the hole.
3. Tighten the anchor into the base material until the hex-washer head or the countersunk head contacts the fixture.

### Installation Sequence




### Additional Installation Information

| Titen HD Diameter (in.) | Wrench Size (in.) | Recommended Steel Fixture Hole Size (in.) | Minimum Hole Depth Overdrill (in.) |
|---|---|---|---|
| 1/4 | 3/8 | 3/8 to 7/16 | 1/8 |
| 3/8 | 9/16 | 1/2 to 9/16 | 1/4 |
| 1/2 | 3/4 | 5/8 to 11/16 | 1/2 |
| 5/8 | 15/16 | 3/4 to 13/16 | 1/2 |
| 3/4 | 1 1/8 | 7/8 to 15/16 | 1/2 |

Suggested fixture hole sizes are for structural steel thicker than 12 gauge only. Larger holes are not required for wood or thinner cold-formed steel members.

# Stainless-Steel **Countersunk** Head Style

The countersunk head style is for applications that require a flush-mount profile. Countersinking also leaves a cleaner surface appearance for exposed through-set applications. The anchor head's 6-lobe drive eases installation and is less prone to stripping than traditional recessed anchor heads.

### Features

- Available in many standard lengths in ¼" and ⅜" diameters
- Countersunk head allows screw anchor applications incompatible with a hex head
- Countersunk version includes (1) driver bit in each box

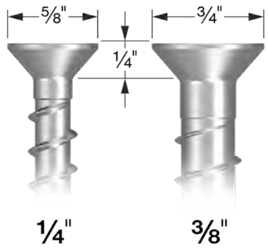
**Codes:** IAPMO UES ER-493 (concrete);
ICC-ES ESR-1056 (masonry);
City of LA Supplement within ER-493 (concrete);
City of LA Supplement within ESR-1056 (masonry);
Florida FL15730 (masonry); FL16230 (concrete)

**Material:** Type 316 stainless steel with carbon-steel lead threads

**Stainless-Steel Titen HD Countersunk Head Style Screw Anchor**

Cracked Concrete CODE LISTED

**6-lobe drive**

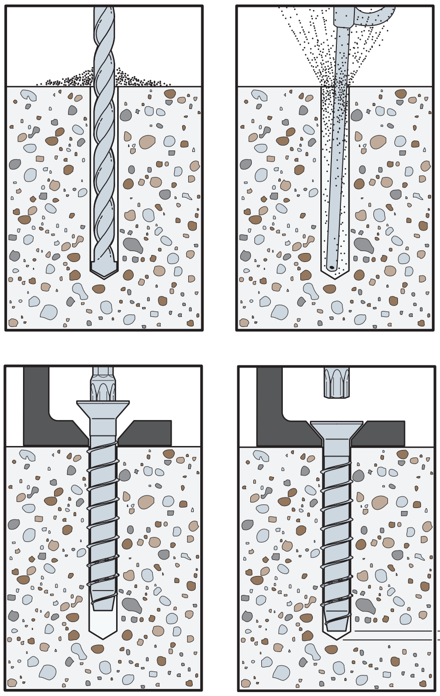



## Additional Installation Information

| Titen HD Diameter (in.) | Bit Size | Recommended Steel Fixture Hole Size (in.) | Minimum Hole Depth Overdrill (in.) |
|---|---|---|---|
| ¼ | T30 | ⅜ to 7/16 | ⅛ |
| ⅜ | T50 | ½ to 9/16 | ¼ |

Suggested fixture hole sizes are for structural steel thicker than 12 gauge only. Larger holes are not required for wood or thinner cold-formed steel members.

### Installation Sequence



Minimum overdrill. See table.

**Titen HD Countersunk Installation**

# Stainless-Steel Titen HD® Heavy-Duty Screw Anchor



## Stainless-Steel Titen HD Anchor Product Data — Hex Washer Head

| Size (in.) | Model No. (Type 316) | Model No. (Type 304) | Thread Length (in.) | Drill Bit Diameter (in.) | Wrench Size (in.) | Quantity | |
|---|---|---|---|---|---|---|---|
| | | | | | | Box | Carton |
| ¼ x 2 | THDC25200H6SS† | — | 1⅞ | ¼ | ⅜ | 50 | 250 |
| ¼ x 2⅜ | THDC25238H6SS | — | 2¼ | ¼ | ⅜ | 50 | 250 |
| ¼ x 3 | THDC25300H6SS | — | 2⅞ | ¼ | ⅜ | 50 | 250 |
| ¼ x 4 | THDC25400H6SS | — | 3⅞ | ¼ | ⅜ | 50 | 250 |
| ⅜ x 3 | THD37300H6SS | THD37300H4SS | 2½ | ⅜ | 9/16 | 50 | 200 |
| ⅜ x 4 | THD37400H6SS | THD37400H4SS | 3½ | ⅜ | 9/16 | 50 | 200 |
| ⅜ x 5 | THD37500H6SS | THD37500H4SS | 4½ | ⅜ | 9/16 | 50 | 100 |
| ⅜ x 6 | THD37600H6SS | THD37600H4SS | 5½ | ⅜ | 9/16 | 50 | 100 |
| ½ x 3 | THD50300H6SS† | THD50300H4SS† | 2½ | ½ | ¾ | 25 | 100 |
| ½ x 4 | THD50400H6SS | THD50400H4SS | 3½ | ½ | ¾ | 20 | 80 |
| ½ x 5 | THD50500H6SS | THD50500H4SS | 4½ | ½ | ¾ | 20 | 80 |
| ½ x 6 | THD50600H6SS | THD50600H4SS | 5½ | ½ | ¾ | 20 | 80 |
| ½ x 6½ | THD50612H6SS | THD50612H4SS | 6 | ½ | ¾ | 20 | 40 |
| ½ x 8 | THD50800H6SS | THD50800H4SS | 6⅞ | ½ | ¾ | 20 | 40 |
| ⅝ x 4 | THDB62400H6SS† | THDB62400H4SS† | 3½ | ⅝ | 15/16 | 10 | 40 |
| ⅝ x 5 | THDB62500H6SS | THDB62500H4SS | 4½ | ⅝ | 15/16 | 10 | 40 |
| ⅝ x 6 | THDB62600H6SS | THDB62600H4SS | 5½ | ⅝ | 15/16 | 10 | 40 |
| ⅝ x 6½ | THDB62612H6SS | THDB62612H4SS | 6 | ⅝ | 15/16 | 10 | 40 |
| ⅝ x 8 | THDB62800H6SS | THDB62800H4SS | 7 1/16 | ⅝ | 15/16 | 10 | 20 |
| ¾ x 4 | THD75400H6SS† | THD75400H4SS† | 3½ | ¾ | 1⅛ | 10 | 40 |
| ¾ x 5 | THD75500H6SS† | THD75500H4SS† | 4½ | ¾ | 1⅛ | 5 | 20 |
| ¾ x 6 | THD75600H6SS | THD75600H4SS | 5½ | ¾ | 1⅛ | 5 | 20 |
| ¾ x 7 | THD75700H6SS | THD75700H4SS | 6½ | ¾ | 1⅛ | 5 | 10 |
| ¾ x 8½ | THD75812H6SS | THD75812H4SS | 7 3/16 | ¾ | 1⅛ | 5 | 10 |

† Does not meet minimum embedment in code report.

1. Anchor length is measured from under head to bottom of anchor.

## Stainless-Steel Titen HD Anchor Product Data — Countersunk

| Size (in.) | Model No. (Type 316) | Thread Length (in.) | Drill Bit Diameter (in.) | Bit Size | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| ¼ x 2⅜ | THDC25238CS6SS† | 2 | ¼ | T30 | 25 | 250 |
| ¼ x 3 | THDC25300CS6SS | 2⅝ | ¼ | T30 | 25 | 250 |
| ¼ x 4 | THDC25400CS6SS | 3⅝ | ¼ | T30 | 25 | 250 |
| ⅜ x 2½ | THD37212CS6SS† | 2 | ⅜ | T50 | 25 | 125 |
| ⅜ x 3 | THD37300CS6SS | 2½ | ⅜ | T50 | 25 | 125 |
| ⅜ x 4 | THD37400CS6SS | 3½ | ⅜ | T50 | 25 | 125 |

† These models do not meet minimum embedment depth requirements for strength design and require maximum installation torque of 25 ft.-lb. using a torque wrench, driver drill or cordless ¼" impact driver with a maximum permitted torque rating of 100 ft.-lb.

1. Anchor length is measured from top of head to bottom of anchor.

# Stainless-Steel Titen HD® Design Information — Concrete

SIMPSON Strong-Tie



## Stainless-Steel Titen HD Installation Information[1]

IBC *

| Characteristic | Symbol | Units | Nominal Anchor Diameter (in.) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼ | | ⅜ | | ½ | | | ⅝ | | ¾ | |
| **Installation Information** | | | | | | | | | | | | | |
| Nominal Diameter | $d_a$ | in. | ¼ | | ⅜ | | ½ | | | ⅝ | | ¾ | |
| Drill Bit Diameter | $d_{bit}$ | in. | ¼ | | ⅜ | | ½ | | | ⅝ | | ¾ | |
| Minimum Baseplate Clearance Hole Diameter[2] | $d_c$ | in. | ⅜ | | ½ | | ⅝ | | | ¾ | | ⅞ | |
| Maximum Installation Torque[3] | $T_{inst,max}$ | ft.-lbf | N/A | | 40 | | 70 | | | 85 | | 150 | |
| Maximum Impact Wrench Torque Rating | $T_{impact,max}$ | ft.-lbf | 125 | | 150 | | 345 | | | 345 | | 380 | |
| Minimum Hole Depth | $h_{hole}$ | in. | 2¼ | 3⅛ | 2¾ | 3½ | 3¾ | | 4½ | 4½ | 6 | 6 | 6¾ |
| Nominal Embedment Depth | $h_{nom}$ | in. | 2⅛ | 3 | 2½ | 3¼ | 3¼ | | 4 | 4 | 5½ | 5½ | 6¼ |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.27 | 2.01 | 1.40 | 2.04 | 1.86 | | 2.50 | 2.31 | 3.59 | 3.49 | 4.13 |
| Critical Edge Distance | $c_{ac}$ | in. | 3 | 3 | 4½ | 5½ | 6 | | 5¾ | 6 | 6⅜ | 6¾ | 7⅜ |
| Minimum Edge Distance | $c_{min}$ | in. | 1½ | 1½ | 1¾ | 1¾ | 1¾ | 2¼ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ |
| Minimum Spacing | $s_{min}$ | in. | 1½ | 1½ | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 |
| Minimum Concrete Thickness | $h_{min}$ | in. | 3½ | 4⅜ | 4 | 5 | 5 | | 6¼ | 6 | 8½ | 8¾ | 10 |
| **Anchor Data** | | | | | | | | | | | | | |
| Yield Strength | $f_{ya}$ | psi | 88,000 | | 98,400 | | 91,200 | | | 83,200 | | 92,000 | |
| Tensile Strength | $f_{uta}$ | psi | 110,000 | | 123,000 | | 114,000 | | | 104,000 | | 115,000 | |
| Minimum Tensile and Shear Stress Area | $A_{se}$ | in.$^2$ | 0.0430 | | 0.099 | | 0.1832 | | | 0.276 | | 0.414 | |
| Axial Stiffness in Service Load Range — Uncracked Concrete | $\beta_{uncr}$ | lb./in. | 139,300 | | 807,700 | | 269,085 | | | 111,040 | | 102,035 | |
| Axial Stiffness in Service Load Range — Cracked Concrete | $\beta_{cr}$ | lb./in. | 103,500 | | 113,540 | | 93,675 | | | 94,400 | | 70,910 | |

For **SI**: 1 in. = 25.4 mm, 1 ft.-lbf = 1.356 N-m, 1 psi = 6.89 kPa, 1 in.$^2$ = 645 mm$^2$, 1 lb./in. = 0.175 N/mm.

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The minimum hole size must comply with applicable code requirements for the connected element.
3. $T_{inst,max}$ applies to installations using a calibrated torque wrench.



*See p. 14 for an explanation of the load table icons.

SIMPSON Strong-Tie



## Stainless-Steel Titen HD Tension Strength Design Data[1,5]

*

| Characteristic | Symbol | Units | Nominal Anchor Diameter (in.) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼ | | ⅜ | | ½ | | ⅝ | | ¾ | |
| Anchor Category | 1, 2 or 3 | — | 3 | | 1 | | | | | | | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 2⅛ | 3 | 2½ | 3¼ | 3¼ | 4 | 4 | 5½ | 5½ | 6¼ |
| **Steel Strength in Tension (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1)** | | | | | | | | | | | | |
| Tension Resistance of Steel | $N_{sa}$ | lbf | 4,730 | | 12,177 | | 20,885 | | 28,723 | | 47,606 | |
| Strength Reduction Factor — Steel Failure[2] | $\phi_{sa}$ | — | 0.75 | | | | | | | | | |
| **Concrete Breakout Strength in Tension (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318 Section D.5.2)** | | | | | | | | | | | | |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.27 | 2.01 | 1.40 | 2.04 | 1.86 | 2.50 | 2.31 | 3.59 | 3.49 | 4.13 |
| Critical Edge Distance | $c_{ac}$ | in. | 3 | 3 | 4½ | 5½ | 6 | 5¾ | 6 | 6⅜ | 6¾ | 7⅜ |
| Effectiveness Factor — Uncracked Concrete | $k_{uncr}$ | — | 24 | 24 | 27 | 24 | 27 | 24 | 24 | 24 | 27 | 27 |
| Effectiveness Factor — Cracked Concrete | $k_{cr}$ | — | 17 | 17 | 21 | 17 | 17 | 17 | 17 | 17 | 17 | 21 |
| Modification Factor | $\Psi_{c,N}$ | — | 1 | | | | | | | | | |
| Strength Reduction Factor — Concrete Breakout Failure[3] | $\phi_{cb}$ | — | 0.45 | | 0.65 | | | | | | | |
| **Pullout Strength in Tension (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 Section D.5.3)** | | | | | | | | | | | | |
| Pullout Resistance Uncracked Concrete ($f'_c$ = 2,500 psi) | $N_{p,uncr}$ | lbf | 1,725[5] | 3,550[8] | N/A[4] | N/A[4] | N/A[4] | N/A[4] | 3,820[5] | 9,080[7] | N/A[4] | N/A[4] |
| Pullout Resistance Cracked Concrete ($f'_c$ = 2,500 psi) | $N_{p,cr}$ | lbf | 695[5] | 1,225[5] | 1,675[5] | 2,415[5] | 1,995[5] | N/A[4] | N/A[4] | N/A[4] | N/A[4] | N/A[4] |
| Strength Reduction Factor — Pullout Failure[6] | $\phi_p$ | — | 0.45 | | 0.65 | | | | | | | |
| **Tension Strength for Seismic Applications (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 Section D.3.3.3)** | | | | | | | | | | | | |
| Nominal Pullout Strength for Seismic Loads ($f'_c$ = 2,500 psi) | $N_{p,eq}$ | lbf | 695[5] | 1,225[5] | 1,675[5] | 2,415[5] | 1,995[5] | N/A[4] | N/A[4] | N/A[4] | N/A[4] | N/A[4] |
| Strength Reduction Factor for Pullout Failure[6] | $\phi_{eq}$ | — | 0.45 | | 0.65 | | | | | | | |

For **SI**: 1 in. = 25.4 mm, 1 ft.-lbf = 1.356 N-m, 1 psi = 6.89 kPa, 1 in.$^2$ = 645 mm$^2$, 1 lb./in. = 0.175 N/mm.

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The tabulated value of $\phi_{sa}$ applies when the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, 2012, and 2009 IBC, ACI 318-19 and ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2 are used, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $\phi$ must be determined in accordance with ACI 318 D.4.4(b), as applicable.
3. The tabulated values of $\phi_{cb}$ applies when both the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, 2012, and 2009 IBC, ACI 318-19 and ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2 are used, as applicable, are used and the requirements of ACI 318-19 Section 17.5.3 and Table 17.5.3(b), ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c) for Condition B are met. Condition B applies where supplementary reinforcement is not provided in concrete. For installations where complying reinforcement can be verified, the $\phi_{cb}$ factors described in ACI 318-19 Table 17.5.3(b), ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, may be used for Condition A. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $\phi$ must be determined in accordance with ACI 318-11 D.4.4(c) for Condition B.
4. N/A denotes that pullout resistance does not govern and does not need to be considered.
5. The characteristic pullout resistance for greater compressive strengths may be increased by multiplying the tabular value by $(f'_c/2{,}500)^{0.5}$.
6. The tabulated values of $\phi_p$ or $\phi_{eq}$ applies when both the load combinations of ACI 318-19 Section 5.3, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-19 Section 17.5.3 and Table 17.5.3(b), ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c) for Condition B are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $\phi$ must be determined in accordance with ACI 318-11 D.4.4(c) for Condition B.
7. The characteristic pullout resistance for greater compressive strengths may be increased by multiplying the tabular value by $(f'_c/2{,}500)^{0.4}$.
8. The characteristic pullout resistance for greater compressive strengths may be increased by multiplying the tabular value by $(f'_c/2{,}500)^{0.3}$.

*See p. 14 for an explanation of the load table icons.

# **Stainless-Steel Titen HD®** Design Information — Concrete

## Stainless-Steel Titen HD Shear Strength Design Data[1]

| Characteristic | Symbol | Units | Nominal Anchor Diameter (in.) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼ | | ⅜ | | ½ | | ⅝ | | ¾ | |
| Anchor Category | 1, 2 or 3 | — | 3 | | 1 | | | | | | | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 2⅛ | 3 | 2½ | 3¼ | 3¼ | 4 | 4 | 5½ | 5½ | 6¼ |
| **Steel Strength in Shear (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 Section D.6.1)** | | | | | | | | | | | | |
| Shear Resistance of Steel | $V_{sa}$ | lbf | 2,285 | | 3,790 | 4,780 | 6,024 | 7,633 | 10,422 | 10,649 | 13,710 | 19,161 |
| Strength Reduction Factor — Steel Failure[2] | $\phi_{sa}$ | — | 0.65 | | | | | | | | | |
| **Concrete Breakout Strength in Shear (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 Section D.6.2)** | | | | | | | | | | | | |
| Nominal Diameter | $d_a$ | in. | 0.250 | | 0.375 | | 0.500 | | 0.625 | | 0.750 | |
| Load Bearing Length of Anchor in Shear | $l_e$ | in. | 1.27 | 2.01 | 1.40 | 2.04 | 1.86 | 2.50 | 2.31 | 3.59 | 3.49 | 4.13 |
| Strength Reduction Factor — Concrete Breakout Failure[3] | $\phi_{cb}$ | — | 0.70 | | | | | | | | | |
| **Concrete Pryout Strength in Shear (ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 Section D.6.3)** | | | | | | | | | | | | |
| Coefficient for Pryout Strength | $k_{cp}$ | — | 1.0 | | | | | 2.0 | 1.0 | 2.0 | | |
| Strength Reduction Factor — Concrete Pryout Failure[3] | $\phi_{cp}$ | — | 0.70 | | | | | | | | | |
| **Shear Strength for Seismic Applications (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 Section D.3.3.3)** | | | | | | | | | | | | |
| Shear Resistance — Single Anchor for Seismic Loads ($f'_C$ = 2,500 psi) | $V_{sa,eq}$ | lbf | 1,370 | 1,600 | 3,790 | 4,780 | 5,345 | 6,773 | 9,367 | 9,367 | 10,969 | 10,969 |
| Strength Reduction Factor — Steel Failure[2] | $\phi_{eq}$ | — | 0.65 | | | | | | | | | |

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

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The tabulated value of $\phi_{sa}$ and $\phi_{eq}$ applies when the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, 2012, and 2009 IBC, ACI 318-19 or ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $\phi_{sa}$ and $\phi_{eq}$ must be determined in accordance with ACI 318-11 D.4.4(b).
3. The tabulated values of $\phi_{cb}$ and $\phi_{cp}$ apply when both the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, 2012, and 2009 IBC, ACI 318-19 or ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used and the requirements of ACI 318-19 Section 17.5.3 and Table 17.5.3(b), ACI 318-14 Section 1703.3, or ACI 318-11 D.4.3(c) for Supplementary reinforcement are not present (Condition B) are met. Condition B applies where supplementary reinforcement is not provided in concrete. For installations where complying reinforcement is verified, the $\phi_{cb}$ and $\phi_{cp}$ factors described in ACI 318-19 Table 17.5.3(b), ACI 318-14 17.3.3(c), or ACI 318-11 D.4.3(c), as applicable, may be used for Condition A. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $\phi_{cb}$ shall be determined in accordance with ACI 318-11 D.4.5(c) for Condition B.



**See p. 14 for an explanation of the load table icons.*

# Stainless-Steel Titen HD® Design Information — Concrete





## Stainless-Steel Titen HD Screw Anchor Setting Information for Installation on the Top of Concrete-Filled Profile Steel Deck Floor and Roof Assemblies[1,2,3,4]

IBC *

| Design Information | Symbol | Units | Nominal Anchor Diameter (in.) | | |
|---|---|---|---|---|---|
| | | | ¼ | ⅜ | ½ |
| Nominal Embedment Depth | $h_{nom}$ | in. | 2⅛ | 2½ | 3¼ |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.27 | 1.40 | 1.86 |
| Minimum Concrete Thickness[5] | $h_{min,deck}$ | in. | 2½ | 3¼ | 3¾ |
| Critical Edge Distance | $c_{ac,deck,top}$ | in. | 3 | 4½ | 7½ |
| Minimum Edge Distance | $c_{min,deck,top}$ | in. | 1½ | 1¾ | 1¾ |
| Minimum Spacing | $s_{min,deck,top}$ | in. | 1½ | 3 | 3 |

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

1. For anchors installed in the topside of concrete-filled deck assemblies, as shown in Figure 1, the nominal concrete breakout strength of a single anchor or group of anchors in shear, $V_{cb}$ or $V_{cbg}$, respectively, must be calculated in accordance with ACI 318-19 Section 17.7.2, ACI 318-14 Section 17.5.2 or ACI 318-11 Section D.6.2, using the actual member thickness, $h_{min,deck}$, in the determination of $A_{vc}$.
2. Design capacity shall be based on calculations according to values in the tables featured on pp. 84–85.
3. Minimum flute depth (distance from top of flute to bottom of flute) is 1½" (see Figure 1).
4. Steel deck thickness shall be minimum 20 gauge.
5. Minimum concrete thickness ($h_{min,deck}$) refers to concrete thickness above upper flute (see Figure 1).

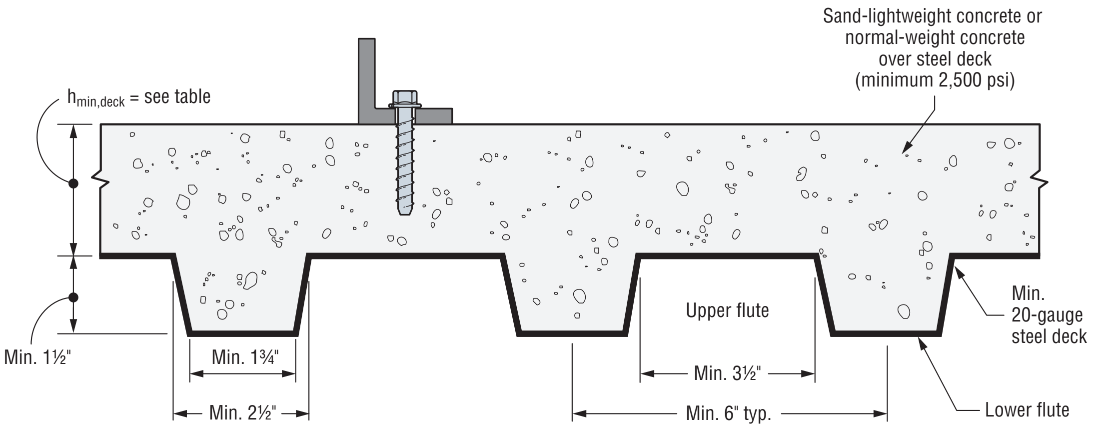



**Figure 1.** Installation of ¼"-, ⅜"- and ½"-Diameter Anchors in the Topside of Concrete over Steel Deck



*See p. 14 for an explanation of the load table icons.

# Stainless-Steel Titen HD® Design Information — Masonry



## Stainless-Steel Titen HD Allowable Tension and Shear Loads in 8" Medium-Weight and Normal-Weight Grout-Filled CMU

IBC *

| Size in. (mm) | Drill Bit Diameter in. | Minimum Embedment Depth in. (mm) | Critical Edge Distance $c_{crit}$ in. (mm) | Minimum Edge Distance $c_{min}$ in. (mm) | Critical Spacing Distance in. (mm) | Values for 8" Medium-Weight or Normal-Weight Grout-Filled CMU | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tension Load | | Shear Load | |
| | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| **Anchor Installed in the Face of the CMU Wall (See Figure 1)** | | | | | | | | | |
| ¼ (6.4) | ¼ | 2½ (64) | 4 (102) | 1¼ (32) | 4 (102) | 1,325 (5.9) | 265 (1.2) | 1,400 (6.2) | 280 (1.3) |
| ⅜ (9.5) | ⅜ | 2¾ (70) | 12 (305) | 4 (102) | 8 (203) | 2,125 (9.5) | 425 (1.9) | 2,850 (12.7) | 570 (2.5) |
| ½ (12.7) | ½ | 3½ (89) | 12 (305) | 4 (102) | 8 (203) | 3,325 (14.8) | 665 (3.0) | 4,950 (22.0) | 990 (4.4) |
| ⅝ (15.9) | ⅝ | 4½ (114) | 12 (305) | 4 (102) | 8 (203) | 3,850 (17.1) | 770 (3.4) | 4,925 (21.9) | 985 (4.4) |
| ¾ (19.1) | ¾ | 5½ (140) | 12 (305) | 4 (102) | 8 (203) | 5,200 (23.1) | 1,040 (4.6) | 4,450 (19.8) | 890 (4.0) |

1. The tabulated allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.
2. Values for 8"-wide, medium-weight and normal-weight concrete masonry units. For ⅜"- to ¾"-diameter anchors, anchors may be installed in lightweight masonry units.
3. The masonry units must be fully grouted.
4. The minimum specified compressive strength of masonry, $f'_m$, at 28 days is 2,000 psi.
5. Embedment depth is measured from the outside face of the concrete masonry unit.
6. Grout-filled CMU wall design must satisfy applicable design standards and be capable of withstanding applied loads.
7. Refer to allowable load-adjustment factors for spacing and edge distance on pp. 89–90.
8. Although the ¼" stainless steel Titen HD is not part of the evaluation report, we still tested the ¼" screw per the appropriate AC.

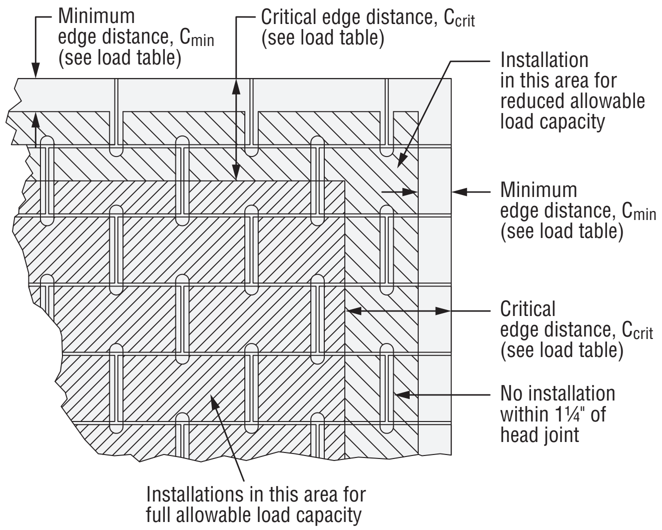



**Figure 1.** Shaded Area = Placement for Full and Reduced Allowable Load Capacity in Grout-Filled CMU



*See p. 14 for an explanation of the load table icons.

# Stainless-Steel Titen HD® Design Information — Masonry



## Stainless-Steel Titen HD Allowable Tension and Shear Loads in 8" Lightweight, Medium-Weight and Normal-Weight Hollow CMU

IBC *

| Size in. (mm) | Drill Bit Diameter in. | Minimum Embedment Depth[4] in. (mm) | Critial Edge Distance in. (mm) | Critical Spacing Distance in. (mm) | 8" Hollow CMU Loads Based on CMU Strength | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Tension Load | | Shear Load | |
| | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| Anchor Installed in Face Shell (See Figure 2) | | | | | | | | |
| 3/8 (9.5) | 3/8 | 2½ (64) | 12 (305) | 8 (203) | 925 (4.1) | 185 (0.8) | 2,250 (10.0) | 450 (2.0) |
| ½ (12.7) | ½ | 2½ (64) | 12 (305) | 8 (203) | 1,025 (4.6) | 205 (0.9) | 2,325 (10.3) | 465 (2.1) |
| 5/8 (15.9) | 5/8 | 2½ (64) | 12 (305) | 8 (203) | 550 (2.4) | 110 (0.5) | 2,025 (9.0) | 405 (1.8) |
| ¾ (19.1) | ¾ | 2½ (64) | 12 (305) | 8 (203) | 775 (3.4) | 155 (0.7) | 1,975 (8.8) | 395 (1.8) |

1. The tabulated allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.
2. Values for 8"-wide, lightweight, medium-weight and normal-weight concrete masonry units.
3. The minimum specified compressive strength of masonry, $f'_m$, at 28 days is 2,000 psi.
4. Embedment depth is measured from the outside face of the concrete masonry unit and is based on the anchor being embedded an additional 1¼" through 1¼"-thick face shell.
5. Allowable loads may not be increased for short-term loading due to wind or seismic forces. CMU wall design must satisfy applicable design standards and be capable of withstanding applied loads.
6. Do not use impact wrenches to install in hollow CMU.
7. Set drill to rotation-only mode when drilling into hollow CMU.
8. Refer to allowable load-adjustment factors for spacing and edge distance on p. 91.
9. Anchors must be installed a minimum of 1½" from vertical head joints and T-joints. Refer to Figure 2 for permitted and prohibited anchor installation locations.

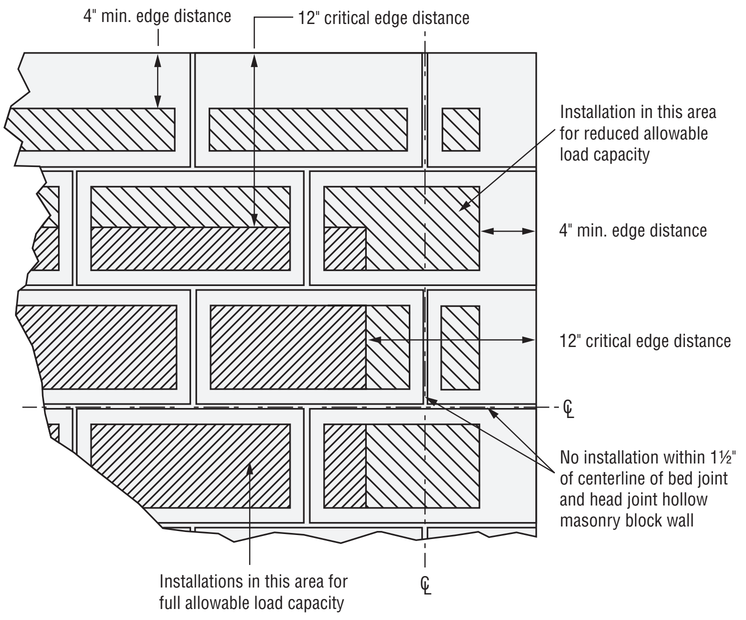



**Figure 2.** Stainless-Steel Titen HD Screw Anchor Installed in the Face of Hollow CMU Wall Construction

*See p. 14 for an explanation of the load table icons.

# Load-Adjustment Factors for Stainless-Steel Titen HD Anchors in Face-of-Wall Installation in 8" Grout-Filled CMU: Edge Distance and Spacing, Tension and Shear Loads

**How to use these charts:**

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
5. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load adjustment factor.
7. Reduction factors for multiple edges or spacings are multiplied together.

## Edge Distance Tension ($f_c$)

IBC *

| $c_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | **E** | **2½** | **2¾** | **3½** | **4½** | **5½** |
| | $c_{cr}$ | **4** | **12** | **12** | **12** | **12** |
| | $c_{min}$ | **1.25** | **4** | **4** | **4** | **4** |
| | $f_{cmin}$ | **0.84** | **0.80** | **0.81** | **1.00** | **1.00** |
| 1.25 | | 0.84 | | | | |
| 2 | | 0.88 | | | | |
| 3 | | 0.94 | | | | |
| 4 | | 1.00 | 0.80 | 0.81 | 1.00 | 1.00 |
| 6 | | 1.00 | 0.85 | 0.86 | 1.00 | 1.00 |
| 8 | | 1.00 | 0.90 | 0.91 | 1.00 | 1.00 |
| 10 | | 1.00 | 0.95 | 0.95 | 1.00 | 1.00 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

See footnotes below.

## Edge Distance Shear ($f_c$)
## Shear Load Parallel to Edge or End

IBC *

| $c_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | **E** | **2½** | **2¾** | **3½** | **4½** | **5½** |
| | $c_{cr}$ | **4** | **12** | **12** | **12** | **12** |
| | $c_{min}$ | **1.25** | **4** | **4** | **4** | **4** |
| | $f_{cmin}$ | **0.89** | **0.88** | **0.56** | **0.65** | **0.84** |
| 1.25 | | 0.89 | | | | |
| 2 | | 0.92 | | | | |
| 3 | | 0.96 | | | | |
| 4 | | 1.00 | 0.88 | 0.56 | 0.65 | 0.84 |
| 6 | | 1.00 | 0.91 | 0.67 | 0.74 | 0.88 |
| 8 | | 1.00 | 0.94 | 0.78 | 0.83 | 0.92 |
| 10 | | 1.00 | 0.97 | 0.89 | 0.91 | 0.96 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

See footnotes below.

## Edge Distance Shear ($f_c$)
## Shear Load Perpendicular to Edge or End (Directed Towards Edge or End)

IBC *

| $c_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | **E** | **2½** | **2¾** | **3½** | **4½** | **5½** |
| | $c_{cr}$ | **4** | **12** | **12** | **12** | **12** |
| | $c_{min}$ | **1.25** | **4** | **4** | **4** | **4** |
| | $f_{cmin}$ | **0.33** | **0.93** | **0.48** | **0.66** | **0.69** |
| 1.25 | | 0.33 | | | | |
| 2 | | 0.51 | | | | |
| 3 | | 0.76 | | | | |
| 4 | | 1.00 | 0.93 | 0.48 | 0.66 | 0.69 |
| 6 | | 1.00 | 0.95 | 0.61 | 0.75 | 0.77 |
| 8 | | 1.00 | 0.97 | 0.74 | 0.83 | 0.85 |
| 10 | | 1.00 | 0.98 | 0.87 | 0.92 | 0.92 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

1. E = embedment depth (inches).
2. $c_{act}$ = actual end or edge distance at which anchor is installed (inches).
3. $c_{cr}$ = critical end or edge distance for 100% load (inches).
4. $c_{min}$ = minimum end or edge distance for reduced load (inches).
5. $f_c$ = adjustment factor for allowable load at actual end or edge distance.
6. $f_{ccr}$ = adjustment factor for allowable load at critical end or edge distance. $f_{ccr}$ is always = 1.00.
7. $f_{cmin}$ = adjustment factor for allowable load at minimum end or edge distance.
8. $f_c = f_{cmin} + [(1 - f_{cmin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

**See p. 14 for an explanation of the load table icons.*

# Stainless-Steel Titen HD® Design Information — Masonry

## Load-Adjustment Factors for Stainless-Steel Titen HD Anchors in Face-of-Wall Installation in 8" Grout-Filled CMU: Edge Distance and Spacing, Tension and Shear Loads (cont.)

**How to use these charts:**

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
5. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load adjustment factor.
7. Reduction factors for multiple edges or spacings are multiplied together.

### Edge Distance Shear ($f_c$)
Shear Load Perpendicular to Edge or End (Directed Away from Edge or End)

IBC *

| $c_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | E | 2½ | 2¾ | 3½ | 4½ | 5½ |
| | $c_{cr}$ | 4 | 12 | 12 | 12 | 12 |
| | $c_{min}$ | 1.25 | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | 0.33 | 0.93 | 0.48 | 0.66 | 0.69 |
| 1.25 | | 0.33 | | | | |
| 2 | | 0.51 | | | | |
| 3 | | 0.76 | | | | |
| 4 | | 1.00 | 0.93 | 0.48 | 0.66 | 0.69 |
| 6 | | 1.00 | 0.95 | 0.61 | 0.75 | 0.77 |
| 8 | | 1.00 | 0.97 | 0.74 | 0.83 | 0.85 |
| 10 | | 1.00 | 0.98 | 0.87 | 0.92 | 0.92 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

### Spacing Tension ($f_s$)

IBC *

| $s_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | E | 2½ | 2¾ | 3½ | 4½ | 5½ |
| | $s_{cr}$ | 4 | 8 | 8 | 8 | 8 |
| | $s_{min}$ | 2 | 4 | 4 | 4 | 4 |
| | $f_{smin}$ | 0.79 | 0.81 | 0.79 | 0.87 | 0.78 |
| 2 | | 0.79 | | | | |
| 3 | | 0.90 | | | | |
| 4 | | 1.00 | 0.81 | 0.79 | 0.87 | 0.78 |
| 6 | | | 0.91 | 0.90 | 0.94 | 0.89 |
| 8 | | | 1.00 | 1.00 | 1.00 | 1.00 |

### Spacing Shear ($f_s$)

IBC *

| $s_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | E | 2½ | 2¾ | 3½ | 4½ | 5½ |
| | $s_{cr}$ | 4 | 6 | 8 | 10 | 12 |
| | $s_{min}$ | 2 | 3 | 4 | 5 | 6 |
| | $f_{smin}$ | 0.78 | 1.00 | 0.86 | 0.90 | 0.94 |
| 2 | | 0.78 | | | | |
| 3 | | 0.89 | | | | |
| 4 | | 1.00 | 1.00 | 0.86 | 0.90 | 0.94 |
| 6 | | | 1.00 | 0.93 | 0.95 | 0.97 |
| 8 | | | 1.00 | 1.00 | 1.00 | 1.00 |

1. E = embedment depth (inches).
2. $s_{act}$ = actual spacing distance at which anchors are installed (inches).
3. $s_{cr}$ = critical spacing distance for 100% load (inches).
4. $s_{min}$ = minimum spacing distance for reduced load (inches).
5. $f_s$ = adjustment factor for allowable load at actual spacing distance.
6. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
7. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
8. $f_s = f_{smin} + [(1 - f_{smin}) (s_{act} - s_{min}) / (s_{cr} - s_{min})]$.

*See p. 14 for an explanation of the load table icons.

# Stainless-Steel Titen HD® Design Information — Masonry

SIMPSON Strong-Tie



## Load-Adjustment Factors for Stainless-Steel Titen HD Anchors in Face-of-Wall Installation in 8" Hollow CMU: Edge Distance and Spacing, Tension and Shear Loads

### How to use these charts:

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
5. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load adjustment factor.
7. Reduction factors for multiple edges or spacings are multiplied together.

### Edge Distance Tension ($f_c$)

| $c_{act}$ (in.) | Dia. | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|
| | E | 2½ | 2½ | 2½ | 2½ |
| | $c_{cr}$ | 12 | 12 | 12 | 12 |
| | $c_{min}$ | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | **1.00** | **1.00** | **1.00** | **1.00** |
| 4 | | 1.00 | 1.00 | 1.00 | 1.00 |
| 6 | | 1.00 | 1.00 | 1.00 | 1.00 |
| 8 | | 1.00 | 1.00 | 1.00 | 1.00 |
| 10 | | 1.00 | 1.00 | 1.00 | 1.00 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 |

IBC *

### Edge Distance Shear ($f_c$)

| $c_{act}$ (in.) | Dia. | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|
| | E | 2½ | 2½ | 2½ | 2½ |
| | $c_{cr}$ | 12 | 12 | 12 | 12 |
| | $c_{min}$ | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | **0.78** | **0.63** | **0.55** | **0.51** |
| 4 | | 0.78 | 0.63 | 0.55 | 0.51 |
| 6 | | 0.84 | 0.72 | 0.66 | 0.63 |
| 8 | | 0.89 | 0.82 | 0.78 | 0.76 |
| 10 | | 0.95 | 0.91 | 0.89 | 0.88 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 |

IBC *

1. E = embedment depth (inches).
2. $c_{act}$ = actual end or edge distance at which anchor is installed (inches).
3. $c_{cr}$ = critical end or edge distance for 100% load (inches).
4. $c_{min}$ = minimum end or edge distance for reduced load (inches).
5. $f_c$ = adjustment factor for allowable load at actual end or edge distance.
6. $f_{ccr}$ = adjustment factor for allowable load at critical end or edge distance. $f_{ccr}$ is always = 1.00.
7. $f_{cmin}$ = adjustment factor for allowable load at minimum end or edge distance.
8. $f_c = f_{cmin} + [(1 - f_{cmin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

### Spacing Tension ($f_s$) One Anchor per Cell

| $c_{act}$ (in.) | Dia. | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|
| | E | 2½ | 2½ | 2½ | 2½ |
| | $c_{cr}$ | 8 | 8 | 8 | 8 |
| | $c_{min}$ | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | **0.72** | **0.87** | **0.89** | **0.70** |
| 4 | | 0.72 | 0.87 | 0.89 | 0.70 |
| 6 | | 0.86 | 0.94 | 0.95 | 0.85 |
| 8 | | 1.00 | 1.00 | 1.00 | 1.00 |

IBC *

See notes below.

### Spacing Tension ($f_s$) Two Anchors per Cell

| $c_{act}$ (in.) | Dia. | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|
| | E | 2½ | 2½ | 2½ | 2½ |
| | $c_{cr}$ | 8 | 8 | 8 | 8 |
| | $c_{min}$ | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | **1.00** | **1.00** | **1.00** | **0.78** |
| 4 | | 1.00 | 1.00 | 1.00 | 0.78 |
| 6 | | 1.00 | 1.00 | 1.00 | 0.89 |
| 8 | | 1.00 | 1.00 | 1.00 | 1.00 |

IBC *

See notes below.

### Spacing Shear ($f_s$) One Anchor per Cell

| $s_{act}$ (in.) | Dia. | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|
| | E | 2½ | 2½ | 2½ | 2½ |
| | $s_{cr}$ | 8 | 8 | 8 | 8 |
| | $s_{min}$ | 4 | 4 | 4 | 4 |
| | $f_{smin}$ | **0.81** | **1.00** | **0.71** | **0.74** |
| 4 | | 0.81 | 1.00 | 0.71 | 0.74 |
| 6 | | 0.91 | 1.00 | 0.86 | 0.87 |
| 8 | | 1.00 | 1.00 | 1.00 | 1.00 |

IBC *

### Spacing Shear ($f_s$) Two Anchors per Cell

| $s_{act}$ (in.) | Dia. | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|
| | E | 2½ | 2½ | 2½ | 2½ |
| | $s_{cr}$ | 8 | 8 | 8 | 8 |
| | $s_{min}$ | 4 | 4 | 4 | 4 |
| | $f_{smin}$ | **0.76** | **1.00** | **0.75** | **0.75** |
| 4 | | 0.76 | 1.00 | 0.75 | 0.75 |
| 6 | | 0.88 | 1.00 | 0.88 | 0.88 |
| 8 | | 1.00 | 1.00 | 1.00 | 1.00 |

IBC *

1. E = embedment depth (inches).
2. $s_{act}$ = actual spacing distance at which anchors are installed (inches).
3. $s_{cr}$ = critical spacing distance for 100% load (inches).
4. $s_{min}$ = minimum spacing distance for reduced load (inches).
5. $f_s$ = adjustment factor for allowable load at actual spacing distance.
6. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
7. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
8. $f_s = f_{smin} + [(1 - f_{smin}) (s_{act} - s_{min}) / (s_{cr} - s_{min})]$.

*See p. 14 for an explanation of the load table icons.

# Titen HD® Rod Coupler

The Titen HD rod coupler is designed to be used in conjunction with a single or multi-story rod tiedown system. This anchor provides a fast and simple way to attach threaded rod to a concrete stem wall or thickened slab footing. Unlike adhesive anchors, the installation requires no special tools, cure time or secondary setting process; just drill a hole and drive the anchor.

## Features

- Now included in ESR-2713 for wind and seismic loading.
- The serrated cutting teeth and patented thread design enable the Titen HD rod coupler to be installed quickly and easily. Less installation time translates to lower installed cost.
- The specialized heat treating process creates tip hardness to facilitate cutting while the body remains ductile.
- No special setting tools are required. The Titen HD rod coupler installs with regular or hammer drill, ANSI size bits and standard sockets.
- Compatible with threaded rods in ⅜" and ½" diameters.
- Use in dry interior environments only.

**Codes:** ICC-ES ESR-2713 (concrete);
City of LA Supplement within ESR-2713 (concrete);
FL15730 (concrete)

**Material:** Carbon steel

**Coating:** Zinc plated

## Installation

**Caution:** Oversized holes in the base material will reduce or eliminate the mechanical interlock of the threads with base material and will reduce the anchor's load capacity. Use a Titen HD Rod Coupler one time only. Installing the anchor multiple times may result in excessive thread wear and reduce load capacity.

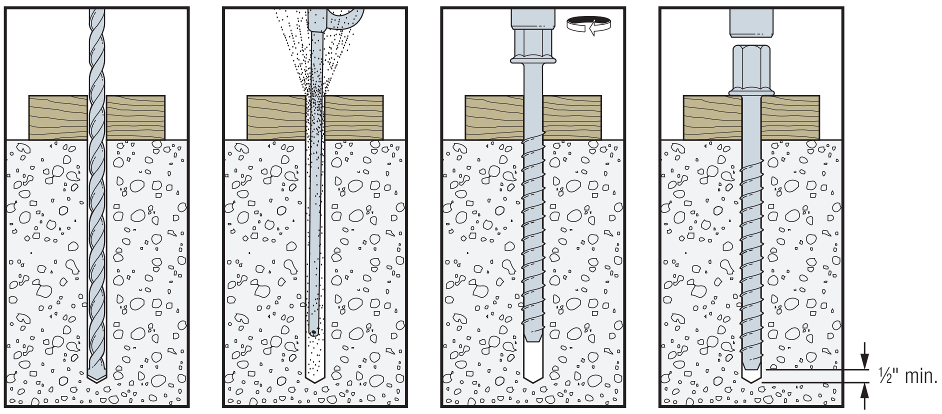
1. Drill a hole using the specified diameter carbide bit into the base material to a depth of at least ½" deeper than the required embedment.
2. Blow the hole clean of dust and debris using compressed air. Overhead application need not be blown clean.
3. Tighten the anchor with appropriate size socket until the head sits flush against base material.

Titen HD Rod Coupler

### Titen HD Rod Coupler Product Data

| Size (in.) | Model No. | Accepts Rod Diameter (in.) | Drill Bit Diameter (in.) | Wrench Size (in.) | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| ⅜ x 6¾ | THD37634RC | ⅜ | ⅜ | 9⁄16 | 25 | 50 |
| ½ x 9¾ | THD50934RC | ½ | ½ | ¾ | 20 | 40 |

## Installation Sequence



# Titen HD® Rod Coupler





## Titen HD Rod Coupler Installation Information and Additional Data[1]

IBC *

| Characteristic | Symbol | Units | Model No. | |
|---|---|---|---|---|
| | | | THD37634RC | THD50934RC |
| **Installation Information** | | | | |
| Nominal Diameter | $d_a$ | in. | ⅜ | ½ |
| Drill Bit Diameter | $d_{bit}$ | in. | ⅜ | ½ |
| Internal Thread Diameter | $d_{rh}$ | — | ⅜ | ½ |
| Maximum Installation Torque[2] | $T_{inst,max}$ | ft.-lbf | 50 | 65 |
| Maximum Impact Wrench Torque Rating | $T_{impact,max}$ | ft.-lbf | 150 | 340 |
| Minimum Hole Depth | $h_{hole}$ | in. | 3½ | 4½ |
| Nominal Embedment Depth | $h_{nom}$ | in. | 3¼ | 4 |
| Effective Embedment Depth | $h_{ef}$ | in. | 2.40 | 2.99 |
| Critical Edge Distance | $c_{ac}$ | in. | 3⅝ | 4½ |
| Minimum Edge Distance | $c_{min}$ | in. | 1¾ | |
| Minimum Spacing | $s_{min}$ | in. | 3 | |
| Minimum Concrete Thickness | $h_{min}$ | in. | 5 | 6¼ |
| **Anchor Data** | | | | |
| Yield Strength | $f_{ya}$ | psi | 97,000 | |
| Tensile Strength | $f_{uta}$ | psi | 110,000 | |
| Minimum Tensile Stress Area | $A_{se}$ | in.$^2$ | 0.099 | 0.183 |
| Axial Stiffness in Service Load Range — Uncracked Concrete | $\beta_{uncr}$ | lb./in. | 672,000 | |
| Axial Stiffness in Service Load Range — Cracked Concrete | $\beta_{cr}$ | lb./in. | 345,000 | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. $T_{inst,max}$ applies to installations using a calibrated torque wrench.

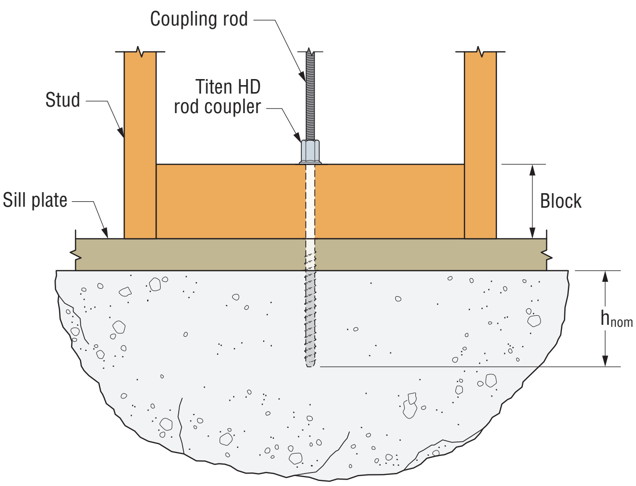



**Figure 1.**
**Typical Titen HD Rod Coupler Installation Through Blocking and Sill Plate**

## Titen HD Rod Coupler Block Height Requirement

| Model No. | Shank Length (in.) | Nominal Embedment Depth (in.) | Sill Plate Thickness | Block Height (in.) |
|---|---|---|---|---|
| THD37634RC | 6¾ | 3¼ | 2x | 2 |
| | | | 3x | 1 |
| THD50934RC | 9¾ | 4 | 2x | 4¼ |
| | | | 3x | 3¼ |

*See p. 14 for an explanation of the load table icons.

## Titen HD Rod Coupler Tension Strength Design Data[1]

| Characteristic | Symbol | Units | Model No. | |
|---|---|---|---|---|
| | | | THD37634RC | THD50934RC |
| Anchor Category | 1, 2 or 3 | — | 1 | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 3¼ | 4 |
| **Steel Strength in Tension (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1)** | | | | |
| Tension Resistance of Steel | $N_{sa}$ | lbf | 10,890 | 20,130 |
| Strength Reduction Factor — Steel Failure[2] | $\phi_{sa}$ | — | 0.65 | |
| **Concrete Breakout Strength in Tension (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318 Section D.5.2)** | | | | |
| Effective Embedment Depth | $h_{ef}$ | in. | 2.4 | 2.99 |
| Critical Edge Distance | $c_{ac}$ | in. | 3⅝ | 4½ |
| Effectiveness Factor — Uncracked Concrete | $k_{uncr}$ | — | 24 | |
| Effectiveness Factor — Cracked Concrete | $k_{cr}$ | — | 17 | |
| Modification factor | $\Psi_{c,N}$ | — | 1 | |
| Strength Reduction Factor — Concrete Breakout Failure[2] | $\phi_{cb}$ | — | 0.65 | |
| **Pullout Strength in Tension (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 Section D.5.3)** | | | | |
| Pullout Resistance Uncracked Concrete ($f'_c$ = 2,500 psi) | $N_{p,uncr}$ | lbf | N/A[3] | N/A[3] |
| Pullout Resistance Cracked Concrete ($f'_c$ = 2,500 psi) | $N_{p,cr}$ | lbf | 2,700[4] | N/A[3] |
| Strength Reduction Factor — Pullout Failure[2] | $\phi_p$ | — | 0.65 | |
| **Tension Strength for Seismic Applications (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 Section D.3.3.3)** | | | | |
| Nominal Pullout Strength for Seismic Loads ($f'_c$ = 2,500 psi) | $N_{p,eq}$ | lbf | 2,700[4] | N/A[3] |
| Strength Reduction Factor for Pullout Failure[2] | $\phi_{eq}$ | — | 0.65 | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
3. N/A denotes that pullout resistance does not govern and does not need to be considered.
4. The characteristic pullout resistance for greater compressive strengths may be increased by multiplying the tabular value by $(f'_c/2{,}500)^{0.5}$.

*See p. 14 for an explanation of the load table icons.

# Notes

# **Strong-Bolt® 2** Wedge Anchor — Zinc-Plated Carbon Steel



Code listed for cracked and uncracked concrete, and masonry applications, the Strong-Bolt 2 wedge-type expansion anchor is an optimal choice for high-performance even in seismic and high-wind conditions. Dual undercutting embossments on each clip segment enable secondary expansion should a crack form and intersect the anchor location; this feature significantly increases the ability of Strong-Bolt 2 to carry load if the hole expands.

## Features

- Chamfered top designed to prevent mushrooming during installation
- Qualified for static and seismic loading conditions (seismic design categories A through F)
- Suitable for horizontal, vertical and overhead applications
- Qualified for minimum concrete thickness of 3¼", and lightweight concrete-over-steel deck
- Standard (ANSI) fractional sizes: fits standard fixtures and installs with common drill bit and tool sizes
- Tested per ACI355.2 and AC193

**Material:** Carbon steel

**Coating:** Zinc plated

**Codes:** ICC-ES ESR-3037 (concrete);
IAPMO UES ER-240 (carbon steel in CMU);
City of LA Supplement within ESR-3037 (concrete);
City of LA Supplement within ER-240 (carbon steel in CMU);
Florida FL15730 (concrete); FL16230 (masonry);
UL File Ex3605;
FM 3043342 and 3047639;
Mulitiple DOT listings; meets the requirements of
Federal Specifications A-A-1923A, Type 4

Cracked Concrete CODE LISTED

**Strong-Bolt 2 Wedge Anchor**

**Head Stamp**
The head is stamped with the length identification letter, bracketed top and bottom by horizontal lines.

## Installation

Do not use an impact wrench to set or tighten the Strong-Bolt 2 anchor.

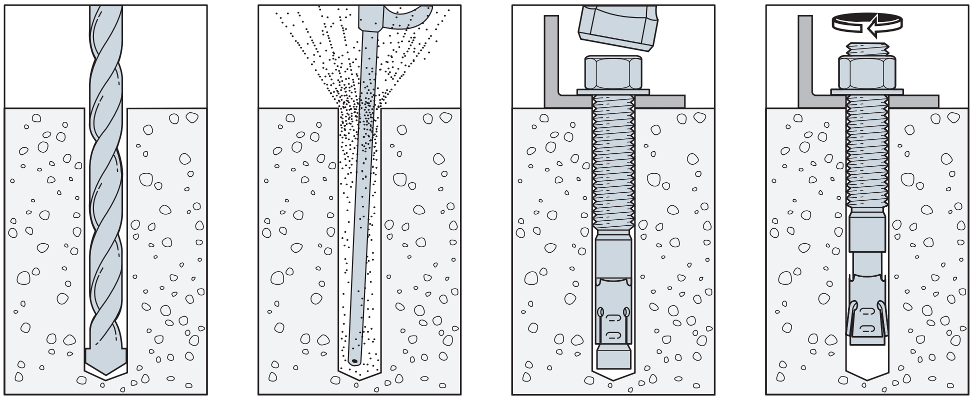
**Caution:** Oversized holes in the base material will make it difficult to set the anchor and will reduce the anchor's load capacity.

1. Drill a hole in the base material using a carbide drill bit the same diameter as the nominal diameter of the anchor to be installed. Drill the hole to the specified minimum hole depth, and blow it clean using compressed air. (Overhead installations need not be blown clean.) Alternatively, drill the hole deep enough to accommodate embedment depth and dust from drilling.
2. Assemble the anchor with nut and washer so the top of the nut is flush with the top of the anchor. Place the anchor in the fixture, and drive it into the hole until the washer and nut are tight against the fixture.
3. Tighten to the required installation torque.

# **Strong-Bolt® 2** Wedge Anchor — Zinc-Plated Carbon Steel



### Installation Sequence



### Material Specifications

| Anchor Body | Nut | Washer | Clip |
|---|---|---|---|
| Carbon Steel | Carbon Steel, ASTM A 563, Grade A | Carbon Steel ASTM F844 | Carbon Steel, ASTM A 568 |

### Strong-Bolt 2 Anchor Installation Data

| Strong-Bolt 2 Diameter (in.) | ¼ | ⅜ | ½ | ⅝ | ¾ | 1 |
|---|---|---|---|---|---|---|
| Drill Bit Size (in.) | ¼ | ⅜ | ½ | ⅝ | ¾ | 1 |
| Min. Fixture Hole (in.) | 5/16 | 7/16 | 9/16 | 11/16 | ⅞ | 1⅛ |
| Wrench Size (in.) | 7/16 | 9/16 | ¾ | 15/16 | 1⅛ | 1½ |
| Concrete Installation Torque (ft.-lbf) Carbon Steel | 4 | 30 | 60 | 90 | 150 | 230 |

### Length Identification Head Marks on Strong-Bolt 2 Wedge Anchors (corresponds to length of anchor — inches)

| Mark | Units | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From | in. | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Up To But Not Including | in. | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |

## Strong-Bolt 2 Anchor Product Data — Zinc-Plated Carbon Steel

| Size (in.) | Zinc-Plated Carbon Steel Model No. | Drill Bit Diameter (in.) | Thread Length (in.) | Quantity | |
|---|---|---|---|---|---|
| | | | | Box | Carton |
| ¼ x 1¾ | STB2-25134† | ¼ | 1⁵⁄₁₆ | 100 | 500 |
| ¼ x 2¼ | STB2-25214 | ¼ | 1⁷⁄₁₆ | 100 | 500 |
| ¼ x 3¼ | STB2-25314 | ¼ | 2⁷⁄₁₆ | 100 | 500 |
| ⅜ x 2¼ | STB2-37214R50 | ⅜ | 1 | 50 | 250 |
| ⅜ x 2¾ | STB2-37234 | ⅜ | 1⁵⁄₁₆ | 50 | 250 |
| ⅜ x 3 | STB2-37300 | ⅜ | 1⁹⁄₁₆ | 50 | 250 |
| ⅜ x 3½ | STB2-37312 | ⅜ | 2¹⁄₁₆ | 50 | 250 |
| ⅜ x 3¾ | STB2-37334 | ⅜ | 2⁵⁄₁₆ | 50 | 250 |
| ⅜ x 5 | STB2-37500 | ⅜ | 3⁹⁄₁₆ | 50 | 200 |
| ⅜ x 7 | STB2-37700 | ⅜ | 5⁹⁄₁₆ | 50 | 200 |
| ½ x 2¾ | STB2-50234R25† | ½ | 1¼ | 25 | 125 |
| ½ x 3¾ | STB2-50334 | ½ | 2¹⁄₁₆ | 25 | 100 |
| ½ x 4¼ | STB2-50414 | ½ | 2⁹⁄₁₆ | 25 | 100 |
| ½ x 4¾ | STB2-50434 | ½ | 3¹⁄₁₆ | 25 | 100 |
| ½ x 5½ | STB2-50512 | ½ | 3¹³⁄₁₆ | 25 | 100 |
| ½ x 7 | STB2-50700 | ½ | 5⁵⁄₁₆ | 25 | 100 |
| ½ x 8½ | STB2-50812 | ½ | 6 | 25 | 100 |
| ½ x 10 | STB2-50100 | ½ | 6 | 25 | 100 |
| ½ x 12 | STB2-501200R10 | ½ | 6 | 10 | 20 |
| ⅝ x 3½ | STB2-62312R20† | ⅝ | 1⅝ | 20 | 80 |
| ⅝ x 4½ | STB2-62412 | ⅝ | 2⁷⁄₁₆ | 20 | 80 |
| ⅝ x 5 | STB2-62500 | ⅝ | 2¹⁵⁄₁₆ | 20 | 80 |
| ⅝ x 6 | STB2-62600 | ⅝ | 3¹⁵⁄₁₆ | 20 | 80 |
| ⅝ x 7 | STB2-62700 | ⅝ | 4¹⁵⁄₁₆ | 20 | 80 |
| ⅝ x 8½ | STB2-62812 | ⅝ | 4¹⁵⁄₁₆ | 20 | 80 |
| ⅝ x 10 | STB2-62100 | ⅝ | 6 | 20 | 40 |
| ⅝ x 12 | STB2-621200R10 | ⅝ | 6 | 10 | 20 |
| ¾ x 4¾ | STB2-75434R10† | ¾ | 2⅝ | 10 | 40 |
| ¾ x 5½ | STB2-75512 | ¾ | 3³⁄₁₆ | 10 | 40 |
| ¾ x 6¼ | STB2-75614 | ¾ | 3¹⁵⁄₁₆ | 10 | 40 |
| ¾ x 7 | STB2-75700 | ¾ | 4¹¹⁄₁₆ | 10 | 40 |
| ¾ x 8½ | STB2-75812 | ¾ | 6 | 10 | 20 |
| ¾ x 10 | STB2-75100 | ¾ | 6 | 10 | 20 |
| ¾ x 12 | STB2-751200R5 | ¾ | 6 | 10 | 20 |
| 1 x 7 | STB2-100700 | 1 | 3½ | 5 | 20 |
| 1 x 10 | STB2-1001000 | 1 | 3½ | 5 | 10 |
| 1 x 13 | STB2-1001300 | 1 | 3½ | 5 | 10 |

† Does not meet minimum embedment in code report.

# Strong-Bolt® 2 Design Information — Concrete



IBC LW*

## Zinc-Plated Carbon-Steel Strong-Bolt 2 Installation Information and Additional Data[1]

| Characteristic | Symbol | Units | Nominal Anchor Diameter, $d_a$ (in.) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼[4] | ⅜[5] | | ½[5] | | | | ⅝[5] | | | | ¾[5] | | | 1[5] | |
| **Installation Information** | | | | | | | | | | | | | | | | | | |
| Nominal Diameter | $d_a$ | in. | ¼ | ⅜ | | ½ | | | | ⅝ | | | | ¾ | | | 1 | |
| Drill Bit Diameter | $d$ | in. | ¼ | ⅜ | | ½ | | | | ⅝ | | | | ¾ | | | 1 | |
| Baseplate Clearance Hole Diameter[2] | $d_c$ | in. | 5⁄16 | 7⁄16 | | 9⁄16 | | | | 11⁄16 | | | | ⅞ | | | 1⅛ | |
| Installation Torque | $T_{inst}$ | ft-lbf | 4 | 30 | | 60 | | | | 90 | | | | 150 | | | 230 | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1¾ | 1⅞ | 2⅞ | 2¼[6] | 2¾ | | 3⅞ | 2¾[6] | 3⅜ | | 5⅛ | 3⅜[6] | 4⅛ | 5¾ | 5¼ | 9¾ |
| Effective Embedment Depth | $h_{ef}$ | in. | 1½ | 1½ | 2½ | 1¾ | 2¼ | | 3⅜ | 2⅛ | 2¾ | | 4½ | 2⅝ | 3⅜ | 5 | 4½ | 9 |
| Minimum Hole Depth | $h_{hole}$ | in. | 1⅞ | 2 | 3 | 2½ | 3 | | 4⅛ | 3 | 3⅝ | | 5⅝ | 3⅝ | 4⅜ | 6 | 5½ | 10 |
| Minimum Overall Anchor Length | $\ell_{anch}$ | in. | 2¼ | 2¾ | 3½ | 2¾ | 3¾ | | 5½ | 3½ | 4½ | | 6 | 4¾ | 5½ | 7 | 7 | 13 |
| Critical Edge Distance | $c_{ac}$ | in. | 2½ | 6½ | 6 | 6 | 6 | 6 | 7½ | 7½ | 7½ | | 9 | 6 | 6 | 8 | 18 | 13½ |
| Minimum Edge Distance | $c_{min}$ | in. | 1¾ | 6 | | 6 | 6 | 4 | 4 | 6½ | 6½ | 6½ | 6½ | 4¼ | 4¼ | 4¼ | 8 | |
| | for $s \geq$ | in. | — | — | | 6 | 6 | 4 | 4 | — | — | 5 | 5 | 10 | 10 | 10 | — | |
| Minimum Spacing | $s_{min}$ | in. | 2¼ | 3 | | 2¾ | 2¾ | 2¾ | 2¾ | 5 | 5 | 2¾ | 2¾ | 3½ | 3½ | 3½ | 8 | |
| | for $c \geq$ | in. | — | — | | 12 | 12 | 12 | 12 | — | — | 8 | 8 | 6 | 6 | 6 | — | |
| Minimum Concrete Thickness | $h_{min}$ | in | 3¼ | 3¼ | 4½ | 4 | 4 | 5½ | 6 | 5½ | 5½ | 6 | 7⅞ | 6 | 6 | 8¾ | 9 | 13½ |
| **Additional Data** | | | | | | | | | | | | | | | | | | |
| Yield Strength | $f_{ya}$ | psi | 56,000 | 92,000 | | 85,000 | | | | | | | | 70,000 | | | 60,000 | |
| Tensile Strength | $f_{uta}$ | psi | 70,000 | 115,000 | | | | | | | | | | 110,000 | | | 78,000 | |
| Minimum Tensile and Shear Stress Area | $A_{se}$ | in.² | 0.0318 | 0.0514 | | 0.105 | | | | 0.166 | | | | 0.270 | | | 0.472 | |
| Axial Stiffness in Service Load Range — Cracked and Uncracked Concrete | $\beta$ | lb./in. | 73,700[3] | 34,820 | | 63,570[3] | 63,570 | | | 91,370[3] | 91,370 | | | 118,840[3] | 118,840 | | 299,600 | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.
2. The clearance must comply with applicable code requirements for the connected element.
3. The tabulated value of $\beta$ is for installations in uncracked concrete only.
4. The ¼"-diameter (6.4 mm) anchor may be installed in top of uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in this table.
5. The ⅜"- through 1"-diameter (9.5 mm through 25.4 mm) anchors may be installed in top of cracked and uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in this table for ⅝"- through 1"-diameter anchors and in the table on p. 102 for ⅜"- and ½"- diameter anchors.
6. Tabulated values for this embedment depth are based on internal testing and they are not listed in ICC-ES ESR-3037.

*See p. 14 for an explanation of the load table icons.

# **Strong-Bolt® 2** Design Information — Concrete



## Zinc-Plated Carbon-Steel Strong-Bolt 2 Tension Strength Design Data[1]

IBC *

| Characteristic | Symbol | Units | Nominal Anchor Diameter, $d_a$ (in.) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼[7] | ⅜[8] | | ½[8] | | | ⅝[8] | | | ¾[8] | | | 1[8] | |
| Anchor Category | 1, 2 or 3 | — | 1 | | | | | | | | | | | | 2 | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1¾ | 1⅞ | 2⅞ | 2¼[9] | 2¾ | 3⅞ | 2¾[9] | 3⅜ | 5⅛ | 3⅜[9] | 4⅛ | 5¾ | 5¼ | 9¾ |
| **Steel Strength in Tension (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1)** | | | | | | | | | | | | | | | | |
| Steel Strength in Tension | $N_{sa}$ | lb. | 2,225 | 5,600 | | 12,100 | | | 19,070 | | | 29,700 | | | 36,815 | |
| Strength Reduction Factor — Steel Failure[2,3] | $\phi_{sa}$ | — | 0.75 | | | | | | | | | | | | 0.65 | |
| **Concrete Breakout Strength in Tension (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 Section D.5.2)** | | | | | | | | | | | | | | | | |
| Effective Embedment Depth | $h_{ef}$ | in. | 1½ | 1½ | 2½ | 1¾ | 2¼ | 3⅜ | 2⅛ | 2¾ | 4½ | 2⅝ | 3⅜ | 5 | 4½ | 9 |
| Critical Edge Distance | $c_{ac}$ | in. | 2½ | 6½ | 6 | 6 | 6 | 7½ | 7½ | 7½ | 9 | 6 | 6 | 8 | 18 | 13½ |
| Effectiveness Factor — Uncracked Concrete | $k_{uncr}$ | — | 24 | | | | | | 27 | 24 | | 27 | 24 | | | |
| Effectiveness Factor — Cracked Concrete | $k_{cr}$ | — | —[6] | 17 | | —[10] | 17 | | —[10] | 17 | | —[10] | 17 | | | |
| Modification Factor | $\psi_{c,N}$ | — | —[6] | 1.00 | | —[10] | 1.00 | | —[10] | 1.00 | | —[10] | 1.00 | | | |
| Strength Reduction Factor — Concrete Breakout Failure[3] | $\phi_{cb}$ | — | 0.65 | | | | | | | | | | | | 0.55 | |
| **Pullout Strength in Tension (ACI 318-19 17.6.3, ACI 318-14 17.4.3.1 or ACI 318-11 Section D.5.3)** | | | | | | | | | | | | | | | | |
| Pullout Strength, Cracked Concrete (f'$_c$ = 2,500 psi) | $N_{p,cr}$ | lb. | —[6] | 1,300[5] | 2,775[5] | —[10] | N/A[4] | 4,985[5] | —[10] | N/A[4] | 6,895[5] | —[10] | N/A[4] | 8,500[5] | 7,700[5] | 11,185[5] |
| Pullout Strength, Uncracked Concrete (f'$_c$ = 2,500 psi) | $N_{p,uncr}$ | lb. | N/A[4] | N/A[4] | 3,340[5] | N/A[4] | 3,615[5] | 5,255[5] | N/A[4] | N/A[4] | 9,025[5] | N/A[4] | 7,115[5] | 8,870[5] | 8,360[5] | 9,690[5] |
| Strength Reduction Factor — Pullout Failure[3] | $\phi_p$ | — | 0.65 | | | | | | | | | | | | 0.55 | |
| **Tensile Strength for Seismic Applications (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 Section D3.3.3)** | | | | | | | | | | | | | | | | |
| Nominal Pullout Strength for Seismic Loads (f'$_c$ = 2,500 psi) | $N_{p.eq}$ | lb. | —[6] | 1,300[5] | 2,775[5] | —[10] | N/A[4] | 4,985[5] | —[10] | N/A[4] | 6,895[5] | —[10] | N/A[4] | 8,500[5] | 7,700[5] | 11,185[5] |
| Strength Reduction Factor — Pullout Failure[3] | $\phi_{eq}$ | — | 0.65 | | | | | | | | | | | | 0.55 | |

SD

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, except as modified below.
2. The ¼"-, ⅜"-,½"-, ⅝"- and ¾"-diameter carbon steel Strong-Bolt 2 anchors are ductile steel elements as defined in ACI 318-19 2.3, ACI 318-14 2.3 or ACI 318-11 D.1, as applicable. The 1"-diameter carbon steel Strong-Bolt 2 anchor is a brittle steel element as defined in ACI 318-19 2.3, ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
3. The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
4. N/A (not applicable) denotes that pullout resistance does not need to be considered.
5. The characteristic pullout strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c/2{,}500\text{ psi})^{0.5}$.
6. The ¼"-diameter carbon steel Strong-Bolt 2 anchor installation in cracked concrete is beyond the scope of this table.
7. The ¼"-diameter (6.4 mm) anchor may be installed in top of uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in the table on p. 99.
8. The ⅜"- through 1"-diameter (9.5 mm through 25.4 mm) anchors may be installed in top of cracked and uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in the table on p. 99 and in the table on p. 102 for the ⅜"- and ½"-diameter anchors.
9. Tabulated values for this embedment depth are based on internal testing and they are not listed in ICC-ES ESR-3037.
10. Anchor installation in cracked concrete is beyond the scope of this table for this embedment depth.

**See p. 14 for an explanation of the load table icons.*

# **Strong-Bolt® 2** Design Information — Concrete



## Zinc-Plated Carbon-Steel Strong-Bolt 2 Shear Strength Design Data[1]

IBC *

| Characteristic | Symbol | Units | Nominal Anchor Diameter, $d_a$ (in.) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼[5] | ⅜[6] | | ½[6] | | | ⅝[6] | | | ¾[6] | | | 1[6] | |
| Anchor Category | 1, 2 or 3 | — | 1 | | | | | | | | | | | | 2 | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1¾ | 1⅞ | 2⅞ | 2¼[7] | 2¾ | 3⅞ | 2¾[7] | 3⅜ | 5⅛ | 3⅜[7] | 4⅛ | 5¾ | 5¼ | 9¾ |
| **Steel Strength in Shear (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 Section D.6.1)** | | | | | | | | | | | | | | | | |
| Steel Strength in Shear | $V_{sa}$ | lb. | 965 | 1,800 | | 5,285 | 7,235 | | 2,980 | 11,035 | | 10,220 | 14,480 | | 15,020 | |
| Strength Reduction Factor — Steel Failure[2,3] | $\phi_{sa}$ | — | 0.65 | | | | | | | | | | | | 0.60 | |
| **Concrete Breakout Strength in Shear (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 Section D.6.2)** | | | | | | | | | | | | | | | | |
| Outside Diameter | $d_a$ | in. | 0.25 | 0.375 | | 0.500 | | | 0.625 | | | 0.750 | | | 1.00 | |
| Load-Bearing Length of Anchor in Shear | $\ell_e$ | in. | 1.500 | 1.500 | 2.500 | 1.750 | 2.250 | 3.375 | 2.125 | 2.750 | 4.500 | 2.625 | 3.375 | 5.000 | 4.500 | 8.000 |
| Strength Reduction Factor — Concrete Breakout Failure[3] | $\phi_{cb}$ | — | 0.70 | | | | | | | | | | | | | |
| **Concrete Pryout Strength in Shear (ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 Section D.6.3)** | | | | | | | | | | | | | | | | |
| Coefficient for Pryout Strength | $k_{cp}$ | — | 1.0 | | 2.0 | 1.0 | 1.0 | 2.0 | 1.0 | 2.0 | | | | | | |
| Effective Embedment Depth | $h_{ef}$ | in. | 1½ | 1½ | 2½ | 1¾ | 2¼ | 3⅜ | 2⅛ | 2¾ | 4½ | 2⅝ | 3⅜ | 5 | 4½ | 9 |
| Strength Reduction Factor — Concrete Pryout Failure[3] | $\phi_{cp}$ | — | 0.70 | | | | | | | | | | | | | |
| **Steel Strength in Shear for Seismic Applications (ACI 318-19 17.10.3, ACI 315-14 17.2.3.3 or ACI 318-11 Section D.3.3.3)** | | | | | | | | | | | | | | | | |
| Shear Strength of Single Anchor for Seismic Loads ($f'_c$ = 2,500 psi) | $V_{sa.eq}$ | lb. | —[4] | 1,800 | | —[8] | 6,510 | | —[8] | 9,930 | | —[8] | 11,775 | | 15,020 | |
| Strength Reduction Factor — Steel Failure[2,3] | $\phi_{eq}$ | — | 0.65 | | | | | | | | | | | | 0.60 | |

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, except as modified below.
2. The ¼"-, ⅜"-, ½"-, ⅝"- and ¾"-diameter carbon steel Strong-Bolt 2 anchors are ductile steel elements as defined in ACI 318-19 2.3, ACI 318-14 2.3 or ACI 318-11 D.1, as applicable. The 1"-diameter carbon steel Strong-Bolt 2 anchor is a brittle steel element as defined in ACI 318-19 2.3, ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
3. The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
4. The ¼"-diameter carbon steel Strong-Bolt 2 anchor installation in cracked concrete is beyond the scope of this table.
5. The ¼"-diameter (6.4 mm) anchor may be installed in top of uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in the table on p. 99.
6. The ⅜"- through 1"-diameter (9.5 mm through 25.4 mm) anchors may be installed in top of cracked and uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in the table on p. 102.
7. Tabulated values for this embedment depth are based on internal testing and they are not listed in ICC-ES ESR-3037.
8. Anchor installation in cracked concrete is beyond the scope of this table for this embedment depth.



*See p. 14 for an explanation of the load table icons.*

SIMPSON Strong-Tie

# Strong-Bolt® 2 Design Information — Concrete



## Zinc-Plated Carbon-Steel Strong-Bolt 2 Information for Installation in the Topside of Concrete-Filled Profile Steel Deck Floor and Roof Assemblies[1,2,3,4]

IBC *

| Design Information | Symbol | Units | Nominal Anchor Diameter (in.) | | | |
|---|---|---|---|---|---|---|
| | | | 3/8 | | 1/2 | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1 7/8 | | 2 3/4 | 3 7/8 |
| Effective Embedment Depth | $h_{ef}$ | in. | 1 1/2 | | 2 1/4 | 3 3/8 |
| Minimum Concrete Thickness[5] | $h_{min,deck}$ | in. | 2 1/2 | 3 1/4 | 3 1/4 | 4 3/16 |
| Critical Edge Distance | $c_{ac,deck,top}$ | in. | 4 3/4 | 4 | 4 | 6 |
| Minimum Edge Distance | $c_{min,deck,top}$ | in. | 4 3/4 | 4 1/2 | 4 3/4 | 12 |
| Minimum Spacing | $s_{min,deck,top}$ | in. | 7 | 6 1/2 | 8 | 3 1/2 |

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

1. Installation must comply with the table on p. 99 and Figure 1 below.
2. Design capacity shall be based on calculations according to values in the tables on pp. 100 and 101.
3. Minimum flute depth (distance from top of flute to bottom of flute) is 1 1/2".
4. Steel deck thickness shall be a minimum 20 gauge.
5. Minimum concrete thickness ($h_{min,deck}$) refers to concrete thickness above upper flute.

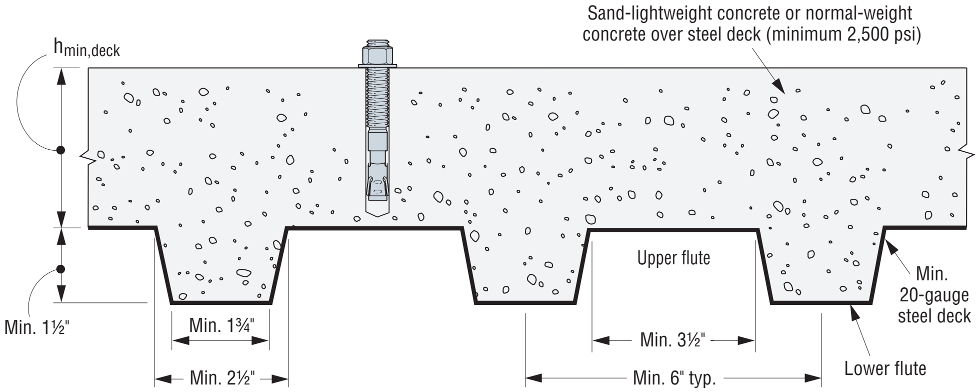



**Figure 1**

*See p. 14 for an explanation of the load table icons.

# Strong-Bolt® 2 Design Information — Concrete

## Zinc-Plated Carbon-Steel Strong-Bolt 2 Tension and Shear Strength Design Data for the Soffit of Concrete over Steel Deck Floor and Roof Assemblies[1,2,6,8,9]

IBC *

| Characteristic | Symbol | Units | Nominal Anchor Diameter (in.) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Carbon Steel | | | | | | | | |
| | | | Lower Flute | | | | | | | Upper Flute | |
| | | | 3/8 | | 1/2 | | 5/8 | | 3/4 | 3/8 | 1/2 |
| Nominal Embedment Depth | $h_{nom}$ | in. | 2 | 3 3/8 | 2 3/4 | 4 1/2 | 3 3/8 | 5 5/8 | 4 1/8 | 2 | 2 3/4 |
| Effective Embedment Depth | $h_{ef}$ | in. | 1 5/8 | 3 | 2 1/4 | 4 | 2 3/4 | 5 | 3 3/8 | 1 5/8 | 2 1/4 |
| Installation Torque | $T_{inst}$ | ft.-lbf | 30 | | 60 | | 90 | | 150 | 30 | 60 |
| Pullout Strength, concrete on steel deck (cracked)[3,4] | $N_{p,deck,cr}$ | lb. | 1,040[7] | 2,615[7] | 2,040[7] | 3,645[7] | 2,615[7] | 4,990[7] | 2,815[7] | 1,340[7] | 3,785[7] |
| Pullout Strength, concrete on steel deck (uncracked)[3,4] | $N_{p,deck,uncr}$ | lb. | 1,765[7] | 3,150[7] | 2,580[7] | 3,840[7] | 3,685[7] | 6,565[7] | 3,800[7] | 2,275[7] | 4,795[7] |
| Pullout Strength, concrete on steel deck (seismic)[3,4] | $N_{p,deck,eq}$ | lb. | 1,040[7] | 2,615[7] | 2,040[7] | 3,645[7] | 2,615[7] | 4,990[7] | 2,815[7] | 1,340[7] | 3,785[7] |
| Steel Strength in Shear, concrete on steel deck[5] | $V_{sa,deck}$ | lb. | 1,595 | 3,490 | 2,135 | 4,580 | 2,640 | 7,000 | 4,535 | 3,545 | 5,920 |
| Steel Strength in Shear, concrete on steel deck (seismic)[5] | $V_{sa,deck,eq}$ | lb. | 1,595 | 3,490 | 1,920 | 4,120 | 2,375 | 6,300 | 3,690 | 3,545 | 5,330 |

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318-19 Chapter 19, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, except as modified below.
2. The steel deck profile must comply with the configuration in Figure 2 below, and have a minimum base-steel thickness of 0.035 inch (20 gauge). Steel must comply with ASTM A 653/A 653M SS Grade 33 with minimum yield strength of 33,000 psi. Concrete compressive strength shall be 3,000 psi minimum.
3. For anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies, calculation of the concrete breakout strength may be omitted.
4. In accordance with ACI 318-19 Section 17.6.3.2.1, ACI 318-14 Section 17.4.3.2 or ACI 318-11 Section D.5.3.2, the nominal pullout strength in cracked concrete for anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies $N_{p,deck,cr}$ shall be substituted for $N_{p,cr}$. Where analysis indicates no cracking at service loads, the normal pullout strength in uncracked concrete $N_{p,deck,uncr}$ shall be substituted for $N_{p,uncr}$. For seismic loads, $N_{p,deck,eq}$ shall be substituted for $N_p$.
5. In accordance with ACI 318-19 Section 17.7.1.2(c), ACI 318-14 Section 17.5.1.2(c) or ACI 318-11 Section D.6.1.2(c), the shear strength for anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies $V_{sa,deck}$ shall be substituted for $V_{sa}$. For seismic loads, $V_{sa,deck,eq}$ shall be substituted for $V_{sa}$.
6. The minimum anchor spacing along the flute must be the greater of $3.0h_{ef}$ or 1.5 times the flute width.
7. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 3{,}000 \text{ psi})^{0.5}$.
8. Concrete shall be normal-weight or structural sand-lightweight concrete having a minimum specified compressive strength, $f'_c$, of 3,000 psi.
9. Minimum distance to edge of panel is $2h_{ef}$.

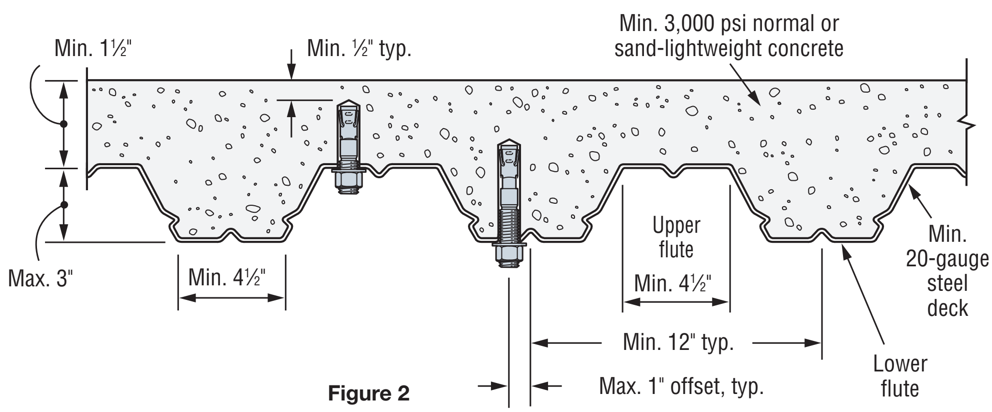



**Figure 2**



*See p. 14 for an explanation of the load table icons.

# Strong-Bolt® 2 Design Information — Concrete



## Zinc-Plated Carbon-Steel Strong-Bolt 2 Anchor Tension and Shear Strength Design Data for the Soffit of Concrete over Steel Deck, Floor and Roof Assemblies[1,2,6,8,9]

IBC *

| Characteristic | Symbol | Units | Carbon Steel Nominal Anchor Diameter (in.) Installed in Lower Flute | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | ⅜ | | ½ | | ⅝ | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 2 | 3⅜ | 2¾ | 4½ | 3⅜ | 5⅝ |
| Effective Embedment Depth | $h_{ef}$ | in. | 1⅝ | 3 | 2¼ | 4 | 2¾ | 5 |
| Minimum Hole Depth | $h_{hole}$ | in. | 2⅛ | 3½ | 3 | 4¾ | 3⅝ | 5⅝ |
| Minimum Concrete Thickness | $h_{min,deck}$ | in. | 2 | 2 | 2 | 3¼ | 2 | 3¼ |
| Installation Torque | $T_{inst}$ | ft.-lbf | 30 | | 60 | | 90 | |
| Pullout Strength, concrete on steel deck (cracked)[3,4,7] | $N_{p,deck,cr}$ | lb. | 1,295 | 2,705 | 2,585 | 5,850 | 3,015 | 5,120 |
| Pullout Strength, concrete on steel deck (uncracked)[3,4,7] | $N_{p,deck,uncr}$ | lb. | 2,195 | 3,260 | 3,270 | 6,165 | 4,250 | 6,735 |
| Pullout Strength, concrete on steel deck (seismic)[3,4,7] | $N_{p,deck,eq}$ | lb. | 1,295 | 2,705 | 2,585 | 5,850 | 3,015 | 5,120 |
| Steel Strength in Shear, concrete on steel deck[5] | $V_{sa,deck}$ | lb. | 1,535 | 3,420 | 2,785 | 5,950 | 3,395 | 6,745 |
| Steel Strength in Shear, concrete on steel deck (seismic)[5] | $V_{sa,deck,eq}$ | lb. | 1,535 | 3,420 | 2,505 | 5,350 | 3,055 | 6,070 |

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, except as modified below.
2. The steel deck profile must comply with the configuration in Figure 3 below, and have a minimum base-steel thickness of 0.035 inch (20 gauge). Steel must comply with ASTM A 653/A 653M SS Grade 50 with minimum yield strength of 50,000 psi. Concrete compressive strength shall be 3,000 psi minimum.
3. For anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies, calculation of the concrete breakout strength may be omitted.
4. In accordance with ACI 318-19 Section 17.6.3.2.1, ACI 318-14 Section 17.4.3.2 or ACI 318-11 Section D.5.3.2, the nominal pullout strength in cracked concrete for anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies $N_{p,deck,cr}$ shall be substituted for $N_{p,cr}$. Where analysis indicates no cracking at service loads, the normal pullout strength in uncracked concrete $N_{p,deck,uncr}$ shall be substituted for $N_{p,uncr}$. For seismic loads, $N_{p,deck,eq}$ shall be substituted for $N_p$.
5. In accordance with ACI 318-19 Section 17.7.1.2(c), ACI 318-14 Section 17.5.1.2(c) or ACI 318-11 Section D.6.1.2(c), the shear strength for anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies $V_{sa,deck}$ shall be substituted for $V_{sa}$. For seismic loads, $V_{sa,deck,eq}$ shall be substituted for $V_{sa}$.
6. The minimum anchor spacing along the flute must be the greater of $3.0h_{ef}$ or 1.5 times the flute width.
7. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 3{,}000 \text{ psi})^{0.5}$.
8. Concrete shall be normal-weight or structural sand-lightweight concrete having a minimum specified compressive strength, $f'_c$, of 3,000 psi.
9. Minimum distance to edge of panel is $2h_{ef}$.

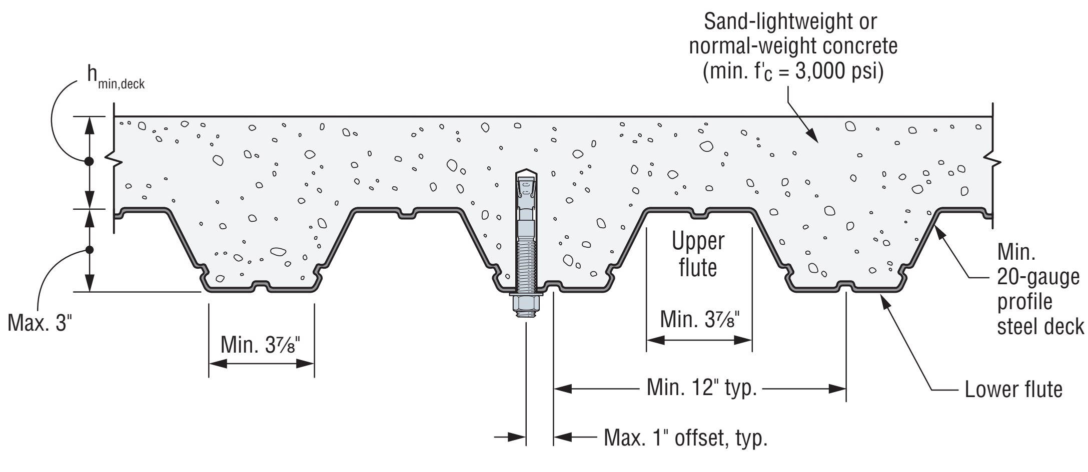



**Figure 3**

*See p. 14 for an explanation of the load table icons.

# Strong-Bolt® 2 Design Information — Masonry

## Zinc-Plated Carbon-Steel Strong-Bolt 2 Tension and Shear Loads in 8" Lightweight, Medium-Weight and Normal-Weight Grout-Filled CMU

IBC *

| Size in. (mm) | Drill Bit Diameter (in.) | Min. Embed. Depth in. (mm) | Install. Torque ft.-lb. (N-m) | Critical Edge Dist. in. (mm) | Critical End Dist. in. (mm) | Critical Spacing in. (mm) | Tension Load | | Shear Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| **Anchor Installed in the Face of the CMU Wall (See Figure 1)** | | | | | | | | | | |
| ¼ (6.4) | ¼ | 1¾ (45) | 4 (5.4) | 12 (305) | 12 (305) | 8 (203) | 1,150 (5.1) | 230 (1.0) | 1,500 (6.7) | 300 (1.3) |
| ⅜ (9.5) | ⅜ | 2⅝ (67) | 20 (27.1) | 12 (305) | 12 (305) | 8 (203) | 2,185 (9.7) | 435 (1.9) | 3,875 (17.2) | 775 (3.4) |
| ½ (12.7) | ½ | 3½ (89) | 35 (47.5) | 12 (305) | 12 (305) | 8 (203) | 2,645 (11.8) | 530 (2.4) | 5,055 (22.5) | 1,010 (4.5) |
| ⅝ (15.9) | ⅝ | 4⅜ (111) | 55 (74.6) | 20 (508) | 20 (508) | 8 (203) | 4,460 (19.8) | 890 (4.0) | 8,815 (39.2) | 1,765 (7.9) |
| ¾ (19.1) | ¾ | 5¼ (133) | 100 (135.6) | 20 (508) | 20 (508) | 8 (203) | 5,240 (23.3) | 1,050 (4.7) | 12,450 (55.4) | 2,490 (11.1) |

1. The tabulated allowable loads are based on a safety factor of 5.0 for installation under the IBC and IRC.
2. Listed loads may be applied to installations on the face of the CMU wall at least 1¼" away from head joints.
3. Values for 8"-wide concrete masonry units (CMU) with a minimum specified compressive strength of masonry, $f'_m$, at 28 days is 1,500 psi.
4. Embedment depth is measured from the outside face of the concrete masonry unit.
5. Tension and shear loads may be combined using the parabolic interaction equation (n = ⅗).
6. Refer to allowable load adjustment factors for edge distance and spacing on p. 106.

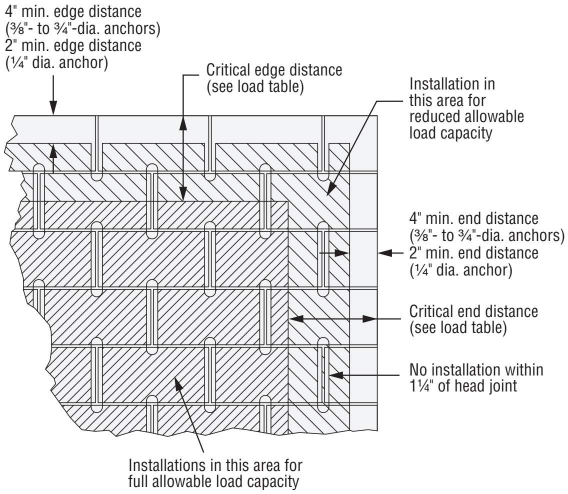



**Figure 1**

## Zinc-Plated Carbon-Steel Strong-Bolt 2 Tension and Shear Loads in 8" Lightweight, Medium-Weight and Normal-Weight Grout-Filled CMU

IBC *

| Size in. (mm) | Drill Bit Diameter in. | Min. Embed. Depth. in. (mm) | Install. Torque ft.-lb. (N-m) | Min. Edge Dist. in. (mm) | Critical End Dist. in. (mm) | Critical Spacing in. (mm) | Tension Load | | Shear Load Perpendicular to Edge | | Shear Load Parallel to Edge | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| **Anchor Installed in Cell Opening or Web (Top of Wall) (See Figure 2)** | | | | | | | | | | | | |
| ½ (12.7) | ½ | 3½ (89) | 35 (47.5) | 1¾ (45) | 12 (305) | 8 (203) | 2,080 (9.3) | 415 (1.8) | 1,165 (5.2) | 235 (1.0) | 3,360 (14.9) | 670 (3.0) |
| ⅝ (15.9) | ⅝ | 4⅜ (111) | 55 (74.6) | 1¾ (45) | 12 (305) | 8 (203) | 3,200 (14.2) | 640 (2.8) | 1,370 (6.1) | 275 (1.2) | 3,845 (17.1) | 770 (3.4) |

1. The tabulated allowable loads are based on a safety factor of 5.0 for installation under the IBC and IRC.
2. Values for 8"-wide concrete masonry units (CMU) with a minimum specified compressive strength of masonry, $f'_m$, at 28 days is 1,500 psi.
3. Tension and shear loads may be combined using the parabolic interaction equation (n = ⅗).
4. Refer to allowable load adjustment factors for edge distance and spacing on p. 106.

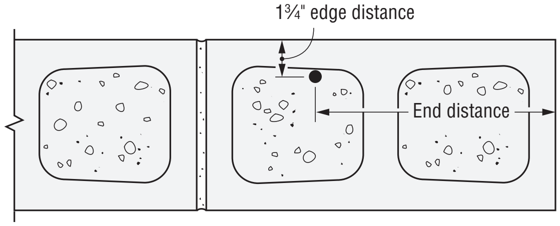



**Figure 2**

*See p. 14 for an explanation of the load table icons.

# Strong-Bolt® 2 Design Information — Masonry

## Zinc-Plated Carbon-Steel Strong-Bolt 2 Allowable Load Adjustment Factors for Face-of-Wall Installation in 8" Grout-Filled CMU: Edge Distance and Spacing, Tension and Shear Loads

**How to use these charts:**

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
5. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load adjustment factor.
7. Reduction factors for multiple edges or spacings are multiplied together.

### Edge or End Distance Tension ($f_c$) IBC*

| $c_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | *E* | 1¾ | 2⅝ | 3½ | 4⅜ | 5¼ |
| | $c_{cr}$ | 12 | 12 | 12 | 20 | 20 |
| | $c_{min}$ | 2 | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 |
| 2 | | 1.00 | | | | |
| 4 | | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 |
| 6 | | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 |
| 8 | | 1.00 | 1.00 | 1.00 | 1.00 | 0.98 |
| 10 | | 1.00 | 1.00 | 1.00 | 1.00 | 0.98 |
| 12 | | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 |
| 14 | | | | | 1.00 | 0.99 |
| 16 | | | | | 1.00 | 0.99 |
| 18 | | | | | 1.00 | 1.00 |
| 20 | | | | | 1.00 | 1.00 |

### Edge or End Distance Shear ($f_c$) IBC*

| $c_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | *E* | 1¾ | 2⅝ | 3½ | 4⅜ | 5¼ |
| | $c_{cr}$ | 12 | 12 | 12 | 20 | 20 |
| | $c_{min}$ | 2 | 4 | 4 | 4 | 4 |
| | $f_{cmin}$ | 0.88 | 0.71 | 0.60 | 0.36 | 0.28 |
| 2 | | 0.88 | | | | |
| 4 | | 0.90 | 0.71 | 0.60 | 0.36 | 0.28 |
| 6 | | 0.93 | 0.78 | 0.70 | 0.44 | 0.37 |
| 8 | | 0.95 | 0.86 | 0.80 | 0.52 | 0.46 |
| 10 | | 0.98 | 0.93 | 0.90 | 0.60 | 0.55 |
| 12 | | 1.00 | 1.00 | 1.00 | 0.68 | 0.64 |
| 14 | | | | | 0.76 | 0.73 |
| 16 | | | | | 0.84 | 0.82 |
| 18 | | | | | 0.92 | 0.91 |
| 20 | | | | | 1.00 | 1.00 |

### Spacing Tension ($f_s$) IBC*

| $s_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | *E* | 1¾ | 2⅝ | 3½ | 4⅜ | 5¼ |
| | $s_{cr}$ | 8 | 8 | 8 | 8 | 8 |
| | $s_{min}$ | 4 | 4 | 4 | 4 | 4 |
| | $f_{smin}$ | 1.00 | 1.00 | 0.93 | 0.86 | 0.80 |
| 4 | | 1.00 | 1.00 | 0.93 | 0.86 | 0.80 |
| 6 | | 1.00 | 1.00 | 0.97 | 0.93 | 0.90 |
| 8 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

### Spacing Shear ($f_s$) IBC*

| $s_{act}$ (in.) | Dia. | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | *E* | 1¾ | 2⅝ | 3½ | 4⅜ | 5¼ |
| | $s_{cr}$ | 8 | 8 | 8 | 8 | 8 |
| | $s_{min}$ | 4 | 4 | 4 | 4 | 4 |
| | $f_{smin}$ | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 4 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 6 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 8 | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

## Load Adjustment Factors for Carbon-Steel Strong-Bolt 2 Wedge Anchors in Top-of-Wall Installation in 8" Grout-Filled CMU: Edge Distance and Spacing, Tension and Shear Loads

### End Distance Tension ($f_c$) IBC*

| $s_{act}$ (in.) | Dia. | ½ | ⅝ |
|---|---|---|---|
| | *E* | 3½ | 4⅜ |
| | $c_{cr}$ | 12 | 12 |
| | $c_{min}$ | 4 | 4 |
| | $f_{cmin}$ | 1.00 | 1.00 |
| 4 | | 1.00 | 1.00 |
| 6 | | 1.00 | 1.00 |
| 8 | | 1.00 | 1.00 |
| 10 | | 1.00 | 1.00 |
| 12 | | 1.00 | 1.00 |

### End Distance Shear Perpendicular to Edge ($f_c$) IBC*

| $c_{act}$ (in.) | Dia. | ½ | ⅝ |
|---|---|---|---|
| | *E* | 3½ | 4⅜ |
| | $c_{cr}$ | 12 | 12 |
| | $c_{min}$ | 4 | 4 |
| | $f_{cmin}$ | 0.90 | 0.83 |
| 4 | | 0.90 | 0.83 |
| 6 | | 0.93 | 0.87 |
| 8 | | 0.95 | 0.92 |
| 10 | | 0.98 | 0.96 |
| 12 | | 1.00 | 1.00 |

### End Distance Shear Parallel to Edge ($f_c$) IBC*

| $c_{act}$ (in.) | Dia. | ½ | ⅝ |
|---|---|---|---|
| | *E* | 3½ | 4⅜ |
| | $c_{cr}$ | 12 | 12 |
| | $c_{min}$ | 4 | 4 |
| | $f_{cmin}$ | 0.53 | 0.50 |
| 4 | | 0.53 | 0.50 |
| 6 | | 0.65 | 0.63 |
| 8 | | 0.77 | 0.75 |
| 10 | | 0.88 | 0.88 |
| 12 | | 1.00 | 1.00 |

### Spacing Tension ($f_s$) IBC*

| $s_{act}$ (in.) | Dia. | ½ | ⅝ |
|---|---|---|---|
| | *E* | 3½ | 4⅜ |
| | $s_{cr}$ | 8 | 8 |
| | $s_{min}$ | 4 | 4 |
| | $f_{cmin}$ | 0.93 | 0.86 |
| 4 | | 0.93 | 0.86 |
| 6 | | 0.97 | 0.93 |
| 8 | | 1.00 | 1.00 |

### Spacing Shear Perpendicular or Parallel to Edge ($f_s$) IBC*

| $s_{act}$ (in.) | Dia. | ½ | ⅝ |
|---|---|---|---|
| | *E* | 3½ | 4⅜ |
| | $s_{cr}$ | 8 | 8 |
| | $s_{min}$ | 4 | 4 |
| | $f_{cmin}$ | 1.00 | 1.00 |
| 4 | | 1.00 | 1.00 |
| 6 | | 1.00 | 1.00 |
| 8 | | 1.00 | 1.00 |

For footnotes, please see p. 105.

*See p. 14 for an explanation of the load table icons.

# **Strong-Bolt® 2** Wedge Anchor — Mechanically Galvanized



Strong-Bolt 2 wedge-type expansion anchor in a mechanically galvanized finish can be used where a high-load-resisting anchor is needed for exterior applications. It has the same dual undercutting embossments on each clip segment as the zinc-electroplated version. Suitable for horizontal, vertical and overhead applications, the STB2-MG anchor is tested in uncracked concrete in accordance with AC193 and also in uncracked masonry in accordance with AC01.

**Available Fall 2023**
**Please refer to strongtie.com for updated engineering/ load value tables.**

## Features

- Chamfered top designed to prevent mushrooming during installation
- Suitable for horizontal, vertical and overhead applications
- Tested for minimum concrete thickness of 3¼"
- Standard (ANSI) fractional sizes: fits standard fixtures and installs with common drill bit and tool sizes
- Tested per ACI355.2 and AC193

**Material:** Carbon steel

**Coating:** Mechanically galvanized

## Installation

⚠ Do not use an impact wrench to set or tighten the Strong-Bolt 2 anchor.

⚠ **Caution:** Oversized holes in the base material will make it difficult to set the anchor and will reduce the anchor's load capacity.

1. Drill a hole in the base material using a carbide drill bit the same diameter as the nominal diameter of the anchor to be installed. Drill the hole to the specified minimum hole depth, and blow it clean using compressed air. (Overhead installations need not be blown clean.) Alternatively, drill the hole deep enough to accommodate embedment depth and dust from drilling.
2. Assemble the anchor with nut and washer so the top of the nut is flush with the top of the anchor. Place the anchor in the fixture, and drive it into the hole until the washer and nut are tight against the fixture.
3. Tighten to the required installation torque.

NEW

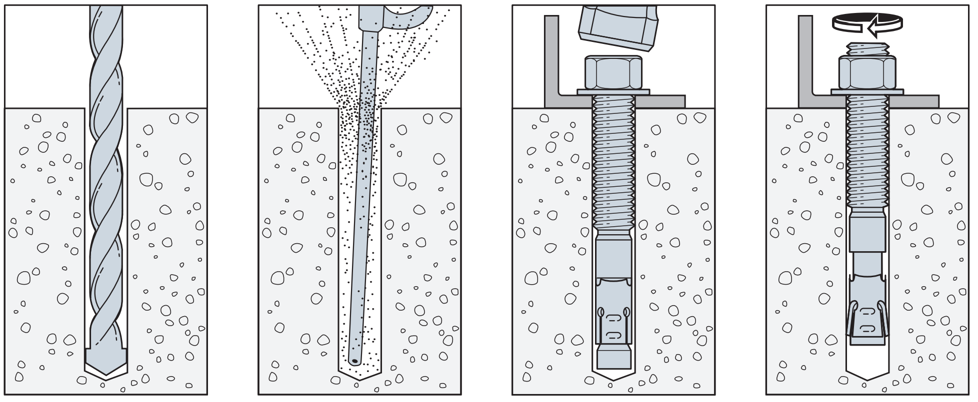
**Strong-Bolt 2 Wedge Anchor — Mechanically Galvanized**

**Head Stamp**
The head is stamped with the length identification letter, bracketed top and bottom by horizontal lines.

# Strong-Bolt® 2 Wedge Anchor — Mechanically Galvanized



## Installation Sequence



## Material Specifications

| Anchor Body | Nut | Washer | Clip |
|---|---|---|---|
| Mechanically Galvanized | Carbon Steel, ASTM A 563, Grade A | Carbon Steel ASTM F844 | Carbon Steel, ASTM A 568 |

## Strong-Bolt 2 Anchor Installation Data

| Strong-Bolt 2 Diameter (in.) | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|
| Drill Bit Size (in.) | ¼ | ⅜ | ½ | ⅝ | ¾ |
| Min. Fixture Hole (in.) | 5⁄16 | 7⁄16 | 9⁄16 | 11⁄16 | ⅞ |
| Wrench Size (in.) | 7⁄16 | 9⁄16 | ¾ | 15⁄16 | 1⅛ |

## Length Identification Head Marks on Strong-Bolt 2 Wedge Anchors (corresponds to length of anchor — inches)

| Mark | Units | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From | in. | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Up To But Not Including | in. | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |

# **Strong-Bolt® 2** Wedge Anchor — Mechanically Galvanized



Strong-Bolt 2 Anchor Product Data — Mechanically Galvanized

| Size (in.) | Mechanically Galvanized Model No. | Drill Bit Diameter (in.) | Thread Length (in.) | Quantity | |
|---|---|---|---|---|---|
| | | | | Box | Carton |
| ¼ x 3¼ | STB2-25314MG | ¼ | 2⁷⁄₁₆ | 100 | 500 |
| ⅜ x 3 | STB2-37300MG | ⅜ | 1⁹⁄₁₆ | 50 | 250 |
| ⅜ x 3¾ | STB2-37334MG | ⅜ | 2⁵⁄₁₆ | 50 | 250 |
| ⅜ x 5 | STB2-37500MG | ⅜ | 3⁹⁄₁₆ | 50 | 200 |
| ⅜ x 7 | STB2-37700MG | ⅜ | 5⁹⁄₁₆ | 50 | 200 |
| ½ x 2¾ | STB2-50234MG | ½ | 1¼ | 25 | 125 |
| ½ x 3¾ | STB2-50334MG | ½ | 2¹⁄₁₆ | 25 | 100 |
| ½ x 4¼ | STB2-50414MG | ½ | 2⁹⁄₁₆ | 25 | 100 |
| ½ x 5½ | STB2-50512MG | ½ | 3¹³⁄₁₆ | 25 | 100 |
| ½ x 7 | STB2-50700MG | ½ | 5⁵⁄₁₆ | 25 | 100 |
| ½ x 8½ | STB2-50812MG | ½ | 6 | 25 | 100 |
| ½ x 10 | STB2-50100MG | ½ | 6 | 25 | 100 |
| ⅝ x 3½ | STB2-62312MG | ⅝ | 1⅝ | 20 | 80 |
| ⅝ x 4½ | STB2-62412MG | ⅝ | 2⁷⁄₁₆ | 20 | 80 |
| ⅝ x 5 | STB2-62500MG | ⅝ | 2¹⁵⁄₁₆ | 20 | 80 |
| ⅝ x 6 | STB2-62600MG | ⅝ | 3¹⁵⁄₁₆ | 20 | 80 |
| ⅝ x 7 | STB2-62700MG | ⅝ | 4¹⁵⁄₁₆ | 20 | 80 |
| ⅝ x 8½ | STB2-62812MG | ⅝ | 4¹⁵⁄₁₆ | 20 | 80 |
| ⅝ x 10 | STB2-62100MG | ⅝ | 6 | 10 | 20 |
| ⅝ x 12 | STB2-62120MG | ⅝ | 6 | 10 | 20 |
| ¾ x 4¾ | STB2-75434MG | ¾ | 2⅝ | 10 | 40 |
| ¾ x 5½ | STB2-75512MG | ¾ | 3³⁄₁₆ | 10 | 40 |
| ¾ x 6¼ | STB2-75614MG | ¾ | 3¹⁵⁄₁₆ | 10 | 40 |
| ¾ x 7 | STB2-75700MG | ¾ | 4¹¹⁄₁₆ | 10 | 40 |
| ¾ x 8½ | STB2-75812MG | ¾ | 6 | 10 | 20 |
| ¾ x 10 | STB2-75100MG | ¾ | 6 | 10 | 20 |
| ¾ x 12 | STB2-751200MG | ¾ | 6 | 5 | 10 |

# Strong-Bolt® 2 Wedge Anchor — Stainless Steel



Code listed for cracked and uncracked concrete, and masonry applications, the Strong-Bolt 2 wedge-type expansion anchor is an optimal choice for high-performance even in seismic and high-wind conditions. Dual undercutting embossments on each clip segment enable secondary expansion should a crack form and intersect the anchor location; this feature significantly increases the ability of Strong-Bolt 2 to carry load if the hole expands.

## Features

- Chamfered top designed to prevent mushrooming during installation
- Qualified for static and seismic loading conditions (seismic design categories A through F)
- Suitable for horizontal, vertical and overhead applications
- Qualified for minimum concrete thickness of 3¼", and lightweight concrete-over-steel deck
- Standard (ANSI) fractional sizes: fits standard fixtures and installs with common drill bit and tool sizes
- Tested per ACI355.2 and AC193

**Material:** Stainless steel (Type 304; Type 316). See pp. 235–236 or visit **strongtie.com/info** for more corrosion information.

**Codes:** ICC-ES ESR-3037 (concrete);
City of LA Supplement within ESR-3037 (concrete);
Florida FL15730 (concrete);
UL File Ex3605;
FM 3043342 and 3047639;
Mulitiple DOT listings

## Installation

⚠ Do not use an impact wrench to set or tighten the Strong-Bolt 2 anchor.

⚠ **Caution:** Oversized holes in the base material will make it difficult to set the anchor and will reduce the anchor's load capacity.

1. Drill a hole in the base material using a carbide drill bit the same diameter as the nominal diameter of the anchor to be installed. Drill the hole to the specified minimum hole depth, and blow it clean using compressed air. (Overhead installations need not be blown clean.) Alternatively, drill the hole deep enough to accommodate embedment depth and dust from drilling.
2. Assemble the anchor with nut and washer so the top of the nut is flush with the top of the anchor. Place the anchor in the fixture, and drive it into the hole until the washer and nut are tight against the fixture.
3. Tighten to the required installation torque.

**Strong-Bolt 2 Wedge Anchor — Stainless Steel**

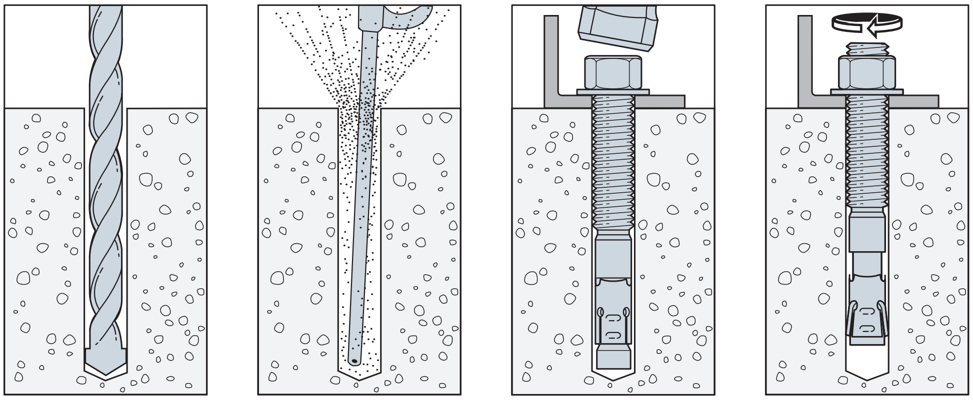
Cracked Concrete CODE LISTED

**Head Stamp**
The head is stamped with the length identification letter, bracketed top and bottom by horizontal lines.

# Strong-Bolt® 2 Wedge Anchor — Stainless Steel



### Installation Sequence



## Material Specifications

| Anchor Body | Nut | Washer | Clip |
|---|---|---|---|
| Type 304 Stainless Steel | Type 304 Stainless Steel | Type 304 Stainless Steel | Type 304 or 316 Stainless Steel |
| Type 316 Stainless Steel | Type 316 Stainless Steel | Type 316 Stainless Steel | Type 316 Stainless Steel |

## Strong-Bolt 2 Anchor Installation Data

| Strong-Bolt 2 Diameter (in.) | 1/4 | 3/8 | 1/2 | 5/8 | 3/4 |
|---|---|---|---|---|---|
| Drill Bit Size (in.) | 1/4 | 3/8 | 1/2 | 5/8 | 3/4 |
| Min. Fixture Hole (in.) | 5/16 | 7/16 | 9/16 | 11/16 | 7/8 |
| Wrench Size (in.) | 7/16 | 9/16 | 3/4 | 15/16 | 1 1/8 |
| Concrete Installation Torque (ft.-lbf) Stainless Steel | 4 | 30 | 65 | 80 | 150 |

## Length Identification Head Marks on Strong-Bolt 2 Wedge Anchors (corresponds to length of anchor — inches)

| Mark | Units | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From | in. | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Up To But Not Including | in. | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |

# Strong-Bolt® 2 Wedge Anchor — Stainless Steel

SIMPSON Strong-Tie



## Strong-Bolt 2 Anchor Product Data — Stainless Steel

| Size (in.) | Type 304 Stainless Steel Model No. | Type 316 Stainless Steel Model No. | Drill Bit Diameter (in.) | Thread Length (in.) | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| ¼ x 1¾ | STB2-251344SS† | STB2-251346SS† | ¼ | 1 5/16 | 100 | 500 |
| ¼ x 2¼ | STB2-252144SS | STB2-252146SS | ¼ | 1 7/16 | 100 | 500 |
| ¼ x 3¼ | STB2-253144SS | STB2-253146SS | ¼ | 2 7/16 | 100 | 500 |
| ⅜ x 2¼ | STB2-372144SSR50 | STB2-372146SSR50 | ⅜ | 1 | 50 | 250 |
| ⅜ x 2¾ | STB2-372344SS | STB2-372346SS | ⅜ | 1 5/16 | 50 | 250 |
| ⅜ x 3 | STB2-373004SS | STB2-373006SS | ⅜ | 1 9/16 | 50 | 250 |
| ⅜ x 3½ | STB2-373124SS | STB2-373126SS | ⅜ | 2 1/16 | 50 | 250 |
| ⅜ x 3¾ | STB2-373344SS | STB2-373346SS | ⅜ | 2 5/16 | 50 | 250 |
| ⅜ x 5 | STB2-375004SS | STB2-375006SS | ⅜ | 3 9/16 | 50 | 200 |
| ⅜ x 7 | STB2-377004SS | STB2-377006SS | ⅜ | 5 9/16 | 50 | 200 |
| ½ x 2¾ | STB2-502344SSR25† | STB2-502346SSR25† | ½ | 1¼ | 25 | 125 |
| ½ x 3¾ | STB2-503344SS | STB2-503346SS | ½ | 2 1/16 | 25 | 125 |
| ½ x 4¼ | STB2-504144SS | STB2-504146SS | ½ | 2 9/16 | 25 | 100 |
| ½ x 4¾ | STB2-504344SS | STB2-504346SS | ½ | 3 1/16 | 25 | 100 |
| ½ x 5½ | STB2-505124SS | STB2-505126SS | ½ | 3 13/16 | 25 | 100 |
| ½ x 7 | STB2-507004SS | STB2-507006SS | ½ | 5 5/16 | 25 | 100 |
| ½ x 8½ | STB2-508124SS | STB2-508126SS | ½ | 6 | 25 | 50 |
| ½ x 10 | STB2-501004SS | STB2-501006SS | ½ | 6 | 25 | 50 |
| ⅝ x 3½ | STB2-623124SSR20† | STB2-623126SSR20† | ⅝ | 1⅝ | 20 | 80 |
| ⅝ x 4½ | STB2-624124SS | STB2-624126SS | ⅝ | 2 7/16 | 20 | 80 |
| ⅝ x 5 | STB2-625004SS | STB2-625006SS | ⅝ | 2 15/16 | 20 | 80 |
| ⅝ x 6 | STB2-626004SS | STB2-626006SS | ⅝ | 3 15/16 | 20 | 80 |
| ⅝ x 7 | STB2-627004SS | STB2-627006SS | ⅝ | 4 15/16 | 20 | 80 |
| ⅝ x 8½ | STB2-628124SS | STB2-628126SS | ⅝ | 6 | 20 | 40 |
| ⅝ x 10 | STB2-621004SS | STB2-621006SS | ⅝ | 6 | 10 | 20 |
| ¾ x 4¾ | STB2-754344SSR10† | STB2-754346SSR10† | ¾ | 2½ | 10 | 40 |
| ¾ x 5½ | STB2-755124SS | STB2-755126SS | ¾ | 3 3/16 | 10 | 40 |
| ¾ x 6¼ | STB2-756144SS | STB2-756146SS | ¾ | 3 15/16 | 10 | 40 |
| ¾ x 7 | STB2-757004SS | STB2-757006SS | ¾ | 4 11/16 | 10 | 40 |
| ¾ x 8½ | STB2-758124SS | STB2-758126SS | ¾ | 6 | 10 | 20 |

† Does not meet minimum embedment in code report.

# **Strong-Bolt® 2** Design Information — Concrete



## Stainless-Steel Strong-Bolt 2 Installation Information and Additional Data[1]

IBC *

| Characteristic | Symbol | Units | Nominal Anchor Diameter, $d_a$ (in.) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼[4] | ⅜[5] | | ½[5] | | | | ⅝[5] | | | ¾[5] | | |
| **Installation Information** | | | | | | | | | | | | | | | |
| Nominal Diameter | $d_a$ | in. | ¼ | ⅜ | | ½ | | | | ⅝ | | | ¾ | | |
| Drill Bit Diameter | $d$ | in. | ¼ | ⅜ | | ½ | | | | ⅝ | | | ¾ | | |
| Baseplate Clearance Hole Diameter[2] | $d_c$ | in. | 5⁄16 | 7⁄16 | | 9⁄16 | | | | 11⁄16 | | | ⅞ | | |
| Installation Torque | $T_{inst}$ | ft-lbf | 4 | 30 | | 65 | | | | 80 | | | 150 | | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1¾ | 1⅞ | 2⅞ | 2¼[6] | 2¾ | 3⅞ | | 2¾[6] | 3⅜ | 5⅛ | 3⅜[6] | 4⅛ | 5¾ |
| Effective Embedment Depth | $h_{ef}$ | in. | 1½ | 1½ | 2½ | 1¾ | 2¼ | 3⅜ | | 2⅛ | 2¾ | 4½ | 2⅝ | 3⅜ | 5 |
| Minimum Hole Depth | $h_{hole}$ | in. | 1⅞ | 2 | 3 | 2½ | 3 | 4⅛ | | 3 | 3⅝ | 5⅜ | 3⅝ | 4⅜ | 6 |
| Minimum Overall Anchor Length | $\ell_{anch}$ | in. | 2¼ | 2¾ | 3½ | 2¾ | 3¾ | 5½ | | 3½ | 4½ | 6 | 4¾ | 5½ | 7 |
| Critical Edge Distance | $c_{ac}$ | in. | 2½ | 6½ | 8½ | 4½ | 4½ | 7 | | 7½ | 7½ | 9 | 8 | 8 | 8 |
| Minimum Edge Distance | $c_{min}$ | in. | 1¾ | 6 | | 6½ | 6½ | 5 | 4 | 4 | 4 | | 6 | 6 | |
| | for $s \geq$ | in. | — | 10 | | — | — | — | 8 | 8 | 8 | | — | — | |
| Minimum Spacing | $s_{min}$ | in. | 2¼ | 3 | | 8 | 8 | 5½ | 4 | 6¼ | 6¼ | | 6½ | 6½ | |
| | for $c \geq$ | in. | — | 10 | | — | — | — | 8 | 5½ | 5½ | | — | — | |
| Minimum Concrete Thickness | $h_{min}$ | in. | 3¼ | 3¼ | 4½ | 4½ | 4½ | 6 | | 5½ | 5½ | 7⅞ | 6¾ | 6¾ | 8¾ |
| **Additional Data** | | | | | | | | | | | | | | | |
| Yield Strength | $f_{ya}$ | psi | 96,000 | 80,000 | | 92,000 | | | | 82,000 | | | 68,000 | | |
| Tensile Strength | $f_{uta}$ | psi | 120,000 | 100,000 | | 115,000 | | | | 108,000 | | | 95,000 | | |
| Minimum Tensile and Shear Stress Area | $A_{se}$ | in.² | 0.0255 | 0.0514 | | 0.105 | | | | 0.166 | | | 0.270 | | |
| Axial Stiffness in Service Load Range — Cracked and Uncracked Concrete | $\beta$ | lb./in. | 54,430[3] | 29,150 | | 54,900[3] | 54,900 | | | 61,270[3] | 61,270 | | 154,290[3] | 154,290 | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.
2. The clearance must comply with applicable code requirements for the connected element.
3. The tabulated value of β is for installtions in uncracked concrete only.
4. The ¼"-diameter (6.4 mm) anchor may be installed in top of uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in this table.
5. The ⅜"- through ¾"-diameter (9.5 mm through 19.1 mm) anchors may be installed in top of cracked and uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in this table and in the table on p. 116 for the ⅜"- and ½"-diameter anchors.
6. Tabulated values for this embedment depth are based on internal testing and they are not listed in ICC-ES ESR-3037.

*See p. 14 for an explanation of the load table icons.

# Strong-Bolt® 2 Design Information — Concrete



## Stainless-Steel Strong-Bolt 2 Tension Strength Design Data[1]

| Characteristic | Symbol | Units | Nominal Anchor Diameter, $d_a$ (in.) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼[9] | ⅜[10] | | ½[10] | | | ⅝[10] | | | ¾[10] | | |
| Anchor Category | 1, 2 or 3 | — | 1 | | | | | | | | | | | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1¾ | 1⅞ | 2⅞ | 2¼[11] | 2¾ | 3⅞ | 2¾[11] | 3⅜ | 5⅛ | 3⅜[11] | 4⅛ | 5¾ |
| **Steel Strength in Tension (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 Section D5.1)** | | | | | | | | | | | | | | |
| Steel Strength in Tension | $N_{sa}$ | lb. | 3,060 | 5,140 | | 12,075 | | | 17,930 | | | 25,650 | | |
| Strength Reduction Factor — Steel Failure[2,3] | $\phi_{sa}$ | — | 0.75 | | | | | | | | | | | |
| **Concrete Breakout Strength in Tension (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 Section D5.2)** | | | | | | | | | | | | | | |
| Effective Embedment Depth | $h_{ef}$ | in. | 1½ | 1½ | 2½ | 1¾ | 2¼ | 3⅜ | 2⅛ | 2¾ | 4½ | 2⅝ | 3⅜ | 5 |
| Critical Edge Distance | $c_{ac}$ | in. | 2½ | 6½ | 8½ | 4½ | 4½ | 7 | 7½ | 7½ | 9 | 8 | 8 | 8 |
| Effectiveness Factor — Uncracked Concrete | $k_{uncr}$ | — | 24 | | | | | | | | | | | |
| Effectiveness Factor — Cracked Concrete | $k_{cr}$ | — | —[8] | 17 | | —[12] | 17 | | —[12] | 17 | | —[12] | 17 | |
| Modification Factor | $\psi_{c,N}$ | — | —[8] | 1.00 | | —[12] | 1.00 | | —[12] | 1.00 | | —[12] | 1.00 | |
| Strength Reduction Factor — Concrete Breakout Failure[3] | $\phi_{cb}$ | — | 0.65 | | | | | | | | | | | |
| **Pullout Strength in Tension (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 Section D5.3)** | | | | | | | | | | | | | | |
| Pullout Strength, Cracked Concrete (f'$_c$ = 2,500 psi) | $N_{p,cr}$ | lb. | —[8] | 1,720[6] | 3,145[6] | —[12] | 2,560[5] | 4,305[5] | —[12] | N/A[4] | 6,545[7] | —[12] | N/A[4] | 8,230[5] |
| Pullout Strength, Uncracked Concrete (f'$_c$ = 2,500 psi) | $N_{p,uncr}$ | lb. | 1,925[7] | N/A[4] | 4,770[6] | 2,180[5] | 3,230[5] | 4,495[5] | 2,380[5] | N/A[4] | 7,615[5] | 6,770[13] | 7,725[7] | 9,625[7] |
| Strength Reduction Factor — Pullout Failure[3] | $\phi_p$ | — | 0.65 | | | | | | | | | | | |
| **Tensile Strength for Seismic Applications (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 Section D.3.3.3)** | | | | | | | | | | | | | | |
| Nominal Pullout Strength for Seismic Loads (f'$_c$ = 2,500 psi) | $N_{p.eq}$ | lb. | —[8] | 1,720[6] | 2,830[6] | —[12] | 2,560[5] | 4,305[5] | —[12] | N/A[4] | 6,545[7] | —[12] | N/A[4] | 8,230[5] |
| Strength Reduction Factor — Pullout Failure[3] | $\phi_{eq}$ | — | 0.65 | | | | | | | | | | | |

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, except as modified below.
2. The stainless-steel Strong-Bolt 2 anchors are ductile steel elements as defined in ACI 318-19 2.3, ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
3. The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
4. N/A (not applicable) denotes that pullout resistance does not need to be considered.
5. The characteristic pullout strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c/2{,}500\ \text{psi})^{0.5}$.
6. The characteristic pullout strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c/2{,}500\ \text{psi})^{0.3}$ .
7. The characteristic pullout strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c/2{,}500\ \text{psi})^{0.4}$ .
8. The ¼"-diameter stainless-steel Strong-Bolt 2 anchor installation in cracked concrete is beyond the scope of this table.
9. The ¼"-diameter (6.4 mm) anchor may be installed in top of uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in the table on p. 113.
10. The ⅜"- through ¾"-diameter (9.5 mm through 19.1 mm) anchors may be installed in top of cracked and uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in the table on p. 113 and in the table on p. 116 for the ⅜"- and ½"-diameter anchors.
11. Tabulated values for this embedment depth are based on internal testing and they are not listed in ICC-ES ESR-3037.
12. Anchor installation in cracked concrete is beyond the scope of this table for this embedment depth.
13. The characteristic pullout strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c/2{,}500\ \text{psi})^{0.15}$.



*See p. 14 for an explanation of the load table icons.

# Strong-Bolt® 2 Design Information — Concrete



## Stainless-Steel Strong-Bolt 2 Shear Strength Design Data[1]

*

| Characteristic | Symbol | Units | Nominal Anchor Diameter, $d_a$ (in.) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ¼[5] | ⅜[6] | | ½[6] | | | ⅝[6] | | | ¾[6] | | |
| Anchor Category | 1, 2 or 3 | — | 1 | | | | | | | | | | | |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1¾ | 1⅞ | 2⅞ | 2¼[7] | 2¾ | 3⅞ | 2¾[7] | 3⅜ | 5⅛ | 3⅜[7] | 4⅛ | 5¾ |
| **Steel Strength in Shear (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 Section D.6.1)** | | | | | | | | | | | | | | |
| Steel Strength in Shear | $V_{sa}$ | lb. | 1,605 | 3,085 | | 3,665 | 7,245 | | 6,745 | | 10,760 | 12,765 | 15,045 | |
| Strength Reduction Factor — Steel Failure[2,3] | $\phi_{sa}$ | — | 0.65 | | | | | | | | | | | |
| **Concrete Breakout Strength in Shear (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 Section D.6.2)** | | | | | | | | | | | | | | |
| Outside Diameter | $d_a$ | in. | 0.250 | 0.375 | | 0.500 | | | 0.625 | | | 0.750 | | |
| Load Bearing Length of Anchor in Shear | $\ell_e$ | in. | 1.500 | 1.500 | 2.500 | 1.75 | 2.250 | 3.375 | 2.125 | 2.750 | 4.500 | 2.625 | 3.375 | 5.000 |
| Strength Reduction Factor — Concrete Breakout Failure[3] | $\phi_{cb}$ | — | 0.70 | | | | | | | | | | | |
| **Concrete Pryout Strength in Shear (ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 Section D.6.3)** | | | | | | | | | | | | | | |
| Coefficient for Pryout Strength | $k_{cp}$ | — | 1.0 | | 2.0 | 1.0 | | 2.0 | 1.0 | 2.0 | | | | |
| Effective Embedment Depth | $h_{ef}$ | in. | 1½ | 1½ | 2½ | 1¾ | 2¼ | 3⅜ | 2⅛ | 2¾ | 4½ | 2⅝ | 3⅜ | 5 |
| Strength Reduction Factor — Concrete Pryout Failure[3] | $\phi_{cp}$ | — | 0.70 | | | | | | | | | | | |
| **Steel Strength in Shear for Seismic Applications (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 Section D.3.3.3)** | | | | | | | | | | | | | | |
| Shear Strength of Single Anchor for Seismic Loads ($f'_c$ = 2,500 psi) | $V_{sa,eq}$ | lb. | —[4] | 3,085 | | —[8] | 6,100 | | —[8] | 6,745 | 10,760 | —[8] | 13,620 | |
| Strength Reduction Factor — Steel Failure[2,3] | $\phi_{sa}$ | — | 0.65 | | | | | | | | | | | |

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, except as modified below.
2. The stainless steel Strong-Bolt 2 anchors are ductile steel elements as defined in ACI 318-19 2.3, ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
3. The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
4. The ¼"-diameter stainless-steel Strong-Bolt 2 anchor installation in cracked concrete is beyond the scope of this table.
5. The ¼"-diameter (6.4 mm) anchor may be installed in top of uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in the table on p. 113.
6. The ⅜"- through ¾"-diameter (9.5 mm through 19.1 mm) anchors may be installed in top of cracked and uncracked normal-weight and sand-lightweight concrete over profile steel deck, where concrete thickness above upper flute meets the minimum thickness specified in the table on p. 116.
7. Tabulated values for this embedment depth are based on internal testing and they are not listed in ICC-ES ESR-3037.
8. Anchor installation in cracked concrete is beyond the scope of this table for this embedment depth.

*See p. 14 for an explanation of the load table icons.

# Strong-Bolt® 2 Design Information — Concrete



## Stainless-Steel Strong-Bolt 2 Information for Installation in the Topside of Concrete-Filled Profile Steel Deck Floor and Roof Assemblies[1,2,3,4]

IBC *

| Design Information | Symbol | Units | Nominal Anchor Diameter (in.) | | |
|---|---|---|---|---|---|
| | | | ⅜ | | ½ |
| Nominal Embedment Depth | $h_{nom}$ | in. | 1⅞ | | 2¾ |
| Effective Embedment Depth | $h_{ef}$ | in. | 1½ | | 2¼ |
| Minimum Concrete Thickness[5] | $h_{min,deck}$ | in. | 2½ | 3¼ | 3¼ |
| Critical Edge Distance | $c_{ac,deck,top}$ | in. | 4¾ | 4 | 4 |
| Minimum Edge Distance | $c_{min,deck,top}$ | in. | 4¾ | | 6 |
| Minimum Spacing | $s_{min,deck,top}$ | in. | 6½ | | 8 |

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

1. Installation must comply with the table on p. 113 and Figure 1 below.
2. Design capacity shall be based on calculations according to values in the tables on pp. 114 and 115.
3. Minimum flute depth (distance from top of flute to bottom of flute) is 1½".
4. Steel deck thickness shall be a minimum 20 gauge.
5. Minimum concrete thickness ($h_{min,deck}$) refers to concrete thickness above upper flute.

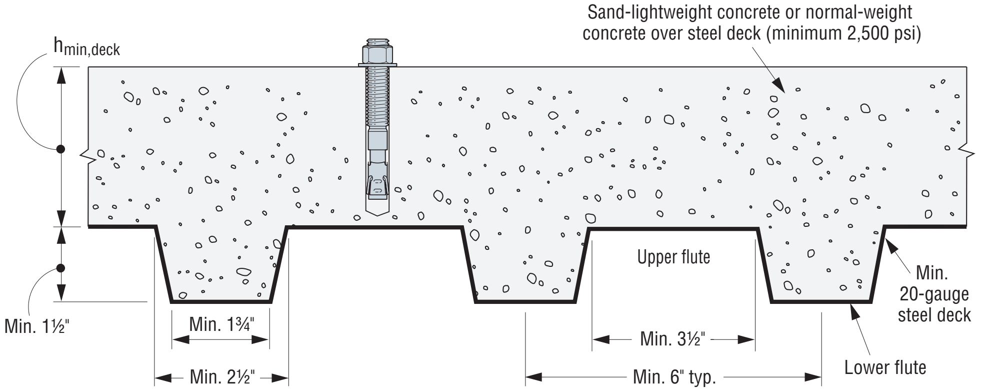



**Figure 1**



*See p. 14 for an explanation of the load table icons.

# **Strong-Bolt® 2** Design Information — Concrete



## Stainless-Steel Strong-Bolt 2 Tension and Shear Strength Design Data for the Soffit of Concrete over Steel Deck Floor and Roof Assemblies[1,2,6,10,11]

IBC *

| Characteristic | Symbol | Units | Stainless Steel | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lower Flute | | | | | | | Upper Flute | |
| | | | ⅜ | | ½ | | ⅝ | | ¾ | ⅜ | ½ |
| Nominal Embedment Depth | $h_{nom}$ | in. | 2 | 3⅜ | 2¾ | 4½ | 3⅜ | 5⅝ | 4⅛ | 2 | 2¾ |
| Effective Embedment Depth | $h_{ef}$ | in. | 1⅝ | 3 | 2¼ | 4 | 2¾ | 5 | 3⅜ | 1⅝ | 2¼ |
| Installation Torque | $T_{inst}$ | ft.-lbf | 30 | | 65 | | 80 | | 150 | 30 | 65 |
| Pullout Strength, concrete on steel deck (cracked)[3] | $N_{p,deck,cr}$ | lb. | 1,230[8] | 2,605[8] | 1,990[7] | 2,550[7] | 1,750[9] | 4,020[9] | 3,030[7] | 1,550[8] | 2,055[7] |
| Pullout Strength, concrete on steel deck (uncracked)[3] | $N_{p,deck,uncr}$ | lb. | 1,580[8] | 3,950[8] | 2,475[7] | 2,660[7] | 2,470[7] | 5,000[7] | 4,275[9] | 1,990[8] | 2,560[7] |
| Pullout Strength, concrete on steel deck (seismic)[5] | $N_{p,deck,eq}$ | lb. | 1,230[8] | 2,345[8] | 1,990[7] | 2,550[7] | 1,750[9] | 4,020[9] | 3,030[7] | 1,550[8] | 2,055[7] |
| Steel Strength in Shear, concrete on steel deck[4] | $V_{sa,deck}$ | lb. | 2,285 | 3,085 | 3,430 | 4,680 | 3,235 | 5,430 | 6,135 | 3,085 | 5,955 |
| Steel Strength in Shear, concrete on steel deck (seismic)[5] | $V_{sa,deck,eq}$ | lb. | 2,285 | 3,085 | 2,400 | 3,275 | 3,235 | 5,430 | 5,520 | 3,085 | 4,170 |

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, except as modified below.
2. The steel deck profile must comply with the configuration in Figure 2 below, and have a minimum base-steel thickness of 0.035 inch (20 gauge). Steel must comply with ASTM A 653/A 653M SS Grade 33 with minimum yield strength of 33,000 psi. Concrete compressive strength shall be 3,000 psi minimum.
3. For anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies, calculation of the concrete breakout strength may be omitted.
4. In accordance with ACI 318-19 Section 17.6.3.2.1, ACI 318-14 Section 17.4.3.2 or ACI 318-11 Section D.5.3.2, the nominal pullout strength in cracked concrete for anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies $N_{p,deck,cr}$ shall be substituted for $N_{p,cr}$. Where analysis indicates no cracking at service loads, the normal pullout strength in uncracked concrete $N_{p,deck,uncr}$ shall be substituted for $N_{p,uncr}$. For seismic loads, $N_{p,deck,eq}$ shall be substituted for $N_p$.
5. In accordance with ACI 318-19 Section 17.7.1.2(c), ACI 318-14 Section 17.5.1.2(c) or ACI 318-11 Section D.6.1.2(c), the shear strength for anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies $V_{sa}$,deck shall be substituted for $V_{sa}$. For seismic loads, $V_{sa,\,deck,eq}$ shall be substituted for $V_{sa}$.
6. The minimum anchor spacing along the flute must be the greater of $3.0h_{ef}$ or 1.5 times the flute width.
7. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 3{,}000 \text{ psi})^{0.5}$.
8. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 3{,}000 \text{ psi})^{0.3}$.
9. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 3{,}000 \text{ psi})^{0.4}$.
10. Concrete shall be normal-weight or structural sand-lightweight concrete having a minimum specified compressive strength, $f'_c$, of 3,000 psi.
11. Minimum distance to edge of panel is $2h_{ef}$.

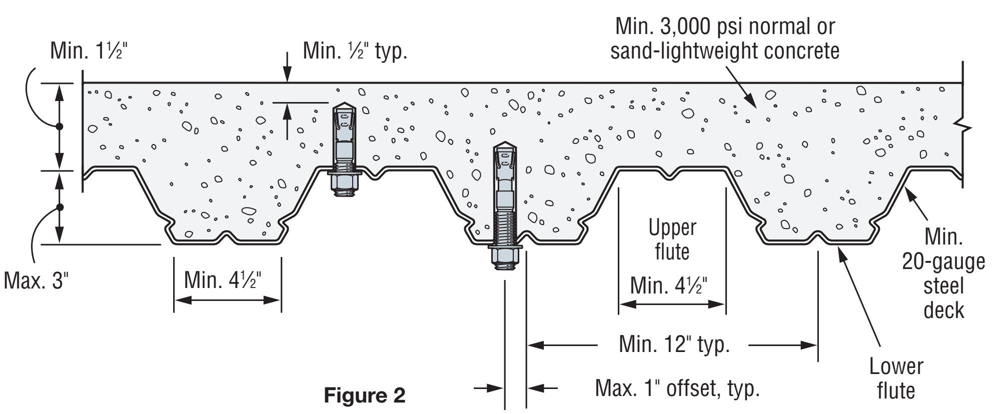



**Figure 2**

**See p. 14 for an explanation of the load table icons.*

SIMPSON Strong-Tie

# Sleeve-All® Sleeve Anchor



Sleeve-All expanding anchors are pre-assembled, expanding sleeve anchors for use in all types of solid base materials. This anchor is available in acorn, hex, rod coupler or flat head style for a wide range of applications.

**Codes:** FM 3017082, 3026805 and 3029959 (carbon steel ⅜" – ½" diameter); Underwriters Laboratories File Ex3605 (⅜" – ¾" diameter); Mulitiple DOT listings; meets the requirements of Federal Specification A-A-1922A

**Material:** Carbon steel or Type 304 stainless steel

**Coating:** Carbon steel anchors are zinc plated


Hex


Acorn


Rod Coupler

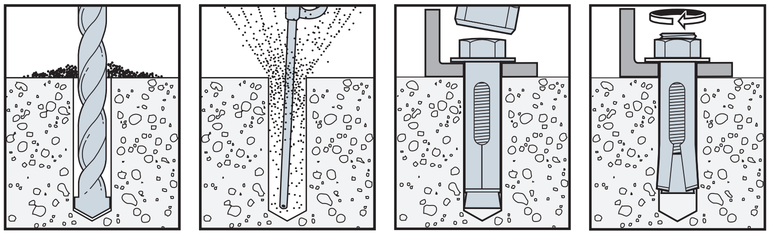

Flat Head *(Phillips drive)*

### Installation

1. Drill a hole in the base material using a carbide drill bit the same diameter as the nominal diameter of the anchor to be installed.
2. Drill the hole to the specified embedment depth, and blow it clean using compressed air. (Overhead installations need not be blown clean.) Alternatively, drill the hole deep enough to accommodate embedment depth and the dust from drilling.
3. Place the anchor in the fixture, and drive it into the hole until the washer and nut are tight against the fixture.
4. Tighten to required installation torque.

**Caution:** Oversized holes will make it difficult to set the anchor and will reduce the anchor's load capacity.

### Installation Sequence



### Material Specifications

| Anchor Component | Zinc-Plated Carbon Steel | Stainless Steel |
|---|---|---|
| Anchor Body | Material meets minimum 50,000 psi tensile | Type 304 |
| Sleeve | SAE J403, Grade 1008 cold-rolled steel | Type 304 |
| Nut | Commercial Grade, meets requirements of ASTM A563 Grade A | Type 304 |
| Washer | SAE J403, Grade 1008/1010 cold-rolled steel | Type 304 |

### Sleeve-All Anchor Installation Data

| Sleeve-All Diameter (in.) | ¼ | 5/16 | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| Installation Torque (ft.-lb.) | 5 | 8 | 15 | 25 | 50 | 90 |
| Drill Bit Size (in.) | ¼ | 5/16 | ⅜ | ½ | ⅝ | ¾ |
| Wrench Size[1] (in.) | ⅜ | 7/16 | ½ | 9/16 | ¾ | 15/16 |
| Wrench Size for Coupler Nut (in.) | | | ½ | ⅝ | ¾ | — |

1. Applies to acorn- and hex-head configurations only.

SIMPSON Strong-Tie®

# Sleeve-All® Sleeve Anchor



## Sleeve-All Anchor Product Data — Zinc-Plated Carbon Steel

| Size (in.) | Model No. | Head Style | Bolt Diameter – Threads per Inch | Max. Fixture Thickness (in.) | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| ¼ x 1⅜ | SL25138A | Acorn Head | 3⁄16–24 | ¼ | 100 | 500 |
| ¼ x 2¼ | SL25214A | | | 1⅛ | 100 | 500 |
| 5⁄16 x 1½ | SL31112H | Hex Head | ¼–20 | ⅜ | 100 | 500 |
| 5⁄16 x 2½ | SL31212H | | | 1 1⁄16 | 50 | 250 |
| ⅜ x 1⅞ | SL37178H | | 5⁄16–18 | ⅜ | 50 | 250 |
| ⅜ x 3 | SL37300H | | | 1½ | 50 | 200 |
| ⅜ x 4 | SL37400H | | | 2¼ | 50 | 200 |
| ½ x 2¼ | SL50214H | | ⅜–16 | ½ | 50 | 200 |
| ½ x 3 | SL50300H | | | ¾ | 25 | 100 |
| ½ x 4 | SL50400H | | | 1¾ | 25 | 100 |
| ½ x 6 | SL50600H | | | 3⅜ | 20 | 80 |
| ⅝ x 2¼ | SL62214H | | ½–13 | ½ | 25 | 100 |
| ⅝ x 3 | SL62300H | | | ¾ | 20 | 80 |
| ⅝ x 4¼ | SL62414H | | | 1½ | 10 | 40 |
| ⅝ x 6 | SL62600H | | | 3¼ | 10 | 40 |
| ¾ x 2½ | SL75212H | | ⅝–11 | ½ | 10 | 40 |
| ¾ x 4¼ | SL75414H | | | ⅞ | 10 | 40 |
| ¾ x 6¼ | SL75614H | | | 2⅞ | 5 | 20 |
| ¼ x 2 | SL25200PF | Phillips Flat Head | 3⁄16–24 | ⅞ | 100 | 500 |
| ¼ x 3 | SL25300PF | | | 1⅞ | 50 | 250 |
| 5⁄16 x 2½ | SL31212PF | | ¼–20 | 1 1⁄16 | 50 | 250 |
| 5⁄16 x 3½ | SL31312PF | | | 2 1⁄16 | 50 | 250 |
| ⅜ x 2¾ | SL37234PF | | 5⁄16–18 | 1¼ | 50 | 200 |
| ⅜ x 4 | SL37400PF | | | 2½ | 50 | 200 |
| ⅜ x 5 | SL37500PF | | | 3½ | 50 | 200 |
| ⅜ x 6 | SL37600PF | | | 4½ | 50 | 200 |

## Sleeve-All Anchor Product Data — Stainless Steel

| Size (in.) | Model No. | Head Style | Bolt Diameter – Threads per Inch | Max. Fixture Thickness (in.) | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| ⅜ x 1⅞ | SL37178HSS | Hex Head | 5⁄16–18 | ⅜ | 50 | 250 |
| ⅜ x 3 | SL37300HSS | | | 1½ | 50 | 200 |
| ½ x 3 | SL50300HSS | | ⅜–16 | ¾ | 25 | 100 |
| ½ x 4 | SL50400HSS | | | 1¾ | 25 | 100 |

## Sleeve-All Anchor (with rod coupler) Product Data — Zinc-Plated Carbon Steel

| Size (in.) | Model No. | Accepts Rod Diameter (in.) | Wrench Size | Quantity | |
|---|---|---|---|---|---|
| | | | | Box | Carton |
| ⅜ x 1⅞ | SL37178C | ⅜ | ½ | 50 | 200 |
| ½ x 2¼ | SL50214C | ½ | ⅝ | 25 | 100 |
| ⅝ x 2¼ | SL62214C | ⅝ | ¾ | 20 | 80 |

## Length Identification Head Marks on Sleeve-All Anchors (corresponds to length of anchor — inches)

| Mark | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Up To But Not Including | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |

# Sleeve-All® Design Information — Concrete and Masonry

SIMPSON Strong-Tie®

Mechanical Anchors

## Allowable Tension and Shear Loads for Sleeve-All in Normal-Weight Concrete

| Size in. (mm) | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing Dist. in. (mm) | Tension Load | | | | | | Shear Load | | | Install. Torque ft.-lb. (N-m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | f'c ≥ 2,000 psi (13.8 MPa) Concrete | | | f'c ≥ 4,000 psi (27.6 MPa) Concrete | | | f'c ≥ 2,000 psi (13.8 MPa) Concrete | | | |
| | | | | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allow. lb. (kN) | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allow. lb. (kN) | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allow. lb. (kN) | |
| ¼ (6.4) | 1⅛ (29) | 2½ (64) | 4½ (114) | 880 (3.9) | 94 (0.4) | 220 (1.0) | 1,320 (5.9) | 189 (0.8) | 330 (1.5) | 1,440 (6.4) | 90 (0.4) | 360 (1.6) | 5 (7) |
| 5/16 (7.9) | 1 (25) | 3⅛ (79) | 5¾ (146) | 930 (4.1) | 201 (0.9) | 230 (1.0) | 1,095 (4.9) | 118 (0.5) | 275 (1.2) | 1,480 (6.6) | 264 (1.2) | 370 (1.6) | 8 (11) |
| | 1 7/16 (37) | 3⅛ (79) | 5¾ (146) | 1,120 (5.0) | 113 (0.5) | 280 (1.2) | 1,320 (5.9) | 350 (1.6) | 330 (1.5) | 2,160 (9.6) | 113 (0.5) | 540 (2.4) | 8 (11) |
| ⅜ (9.5) | 1½ (38) | 3¾ (95) | 6 (152) | 1,600 (7.1) | 294 (1.3) | 400 (1.8) | 2,680 (11.9) | 450 (2.0) | 670 (3.0) | 3,080 (13.7) | 223 (1.0) | 770 (3.4) | 15 (20) |
| ½ (12.7) | 1¾ (45) | 5 (127) | 9 (229) | 2,900 (12.9) | 369 (1.6) | 725 (3.2) | 3,480 (15.5) | 529 (2.4) | 870 (3.9) | 4,250 (18.9) | 659 (2.9) | 1,060 (4.7) | 25 (34) |
| | 2¼ (57) | 5 (127) | 9 (229) | 3,160 (14.1) | 254 (1.1) | 790 (3.5) | 4,760 (21.2) | 485 (2.2) | 1,190 (5.3) | 5,000 (22.2) | 473 (2.1) | 1,250 (5.6) | 25 (34) |
| ⅝ (15.9) | 1¾ (45) | 6¼ (159) | 11 (279) | 3,200 (14.2) | 588 (2.6) | 800 (3.6) | 3,825 (17.0) | 243 (1.1) | 955 (4.2) | 4,625 (20.6) | 747 (3.3) | 1,155 (5.1) | 50 (68) |
| | 2¾ (70) | 6¼ (159) | 11 (279) | 4,200 (18.7) | 681 (3.0) | 1,050 (4.7) | 6,160 (27.4) | 1,772 (7.9) | 1,540 (6.9) | 8,520 (37.9) | 713 (3.2) | 2,130 (9.5) | 50 (68) |
| ¾ (19.1) | 2 (51) | 7½ (191) | 13½ (343) | 3,200 (14.2) | 588 (2.6) | 800 (3.6) | 4,465 (19.9) | 1,017 (4.5) | 1,115 (5.0) | 5,080 (22.6) | 771 (3.4) | 1,270 (5.6) | 90 (122) |
| | 3⅜ (86) | 7½ (191) | 13½ (343) | 6,400 (28.5) | 665 (3.0) | 1,600 (7.1) | 9,520 (42.3) | 674 (3.0) | 2,380 (10.6) | 10,040 (44.7) | 955 (4.2) | 2,510 (11.2) | 90 (122) |

1. The tabulated allowable loads are based on a safety factor of 4.0.
2. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
3. Refer to allowable load-adjustment factors for spacing and edge distance on p. 122.
4. Drill bit diameter used in base material corresponds to nominal anchor diameter.
5. Allowable tension loads may be linearly interpolated between concrete strengths listed.
6. The minimum concrete thickness is 1½ times the embedment depth.

## Allowable Tension and Shear Loads for ⅜" Sleeve-All in Grout-Filled CMU (Anchor Installed in Horizontal Mortar Joint or Face Shell)

| Size in. (mm) | Embed. Depth in. (mm) | Min. Edge Dist. in. (mm) | Min. End Dist. in. (mm) | Min. Spacing in. (mm) | Tension Load | | Shear Load | | Install. Torque ft.-lb. (N-m) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ultimate lb. (kN) | Allow. lb. (kN) | Ultimate lb. (kN) | Allow. lb. (kN) | |
| ⅜ (9.5) | 1½ (38) | 16 (406) | 16 (406) | 24 (610) | 2,000 (8.9) | 400 (1.8) | 2,300 (10.2) | 460 (2.0) | 15 (20) |

See footnotes on p. 121.

*See p. 14 for an explanation of the load table icons.

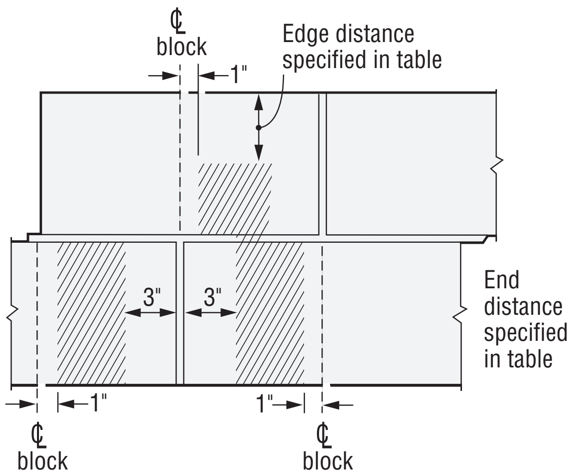
# Sleeve-All® Design Information — Concrete and Masonry



## Allowable Tension and Shear Loads for Sleeve-All in Grout-Filled CMU

| Size in. (mm) | Embed. Depth in. (mm) | Min. Edge Dist. in. (mm) | Min. End Dist. in. (mm) | Min. Spacing in. (mm) | Tension Load | | Shear Load | | Install. Torque ft.-lb. (N-m) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ultimate lb. (kN) | Allow. lb. (kN) | Ultimate lb. (kN) | Allow. lb. (kN) | |
| **Anchor Installed in a Single Face Shell** | | | | | | | | | |
| 3/8 (9.5) | 1 1/2 (38) | 12 (305) | 12 (305) | 24 (610) | 1,746 (7.8) | 350 (1.6) | 2,871 (12.8) | 575 (2.6) | 15 (20) |
| 1/2 (12.7) | 2 1/4 (57) | 12 (305) | 12 (305) | 24 (610) | 3,384 (15.1) | 675 (3.0) | 5,670 (25.2) | 1,135 (5.0) | 25 (34) |
| 5/8 (15.9) | 2 3/4 (70) | 12 (305) | 12 (305) | 24 (610) | 3,970 (17.7) | 795 (3.5) | 8,171 (36.3) | 1,635 (7.3) | 50 (68) |
| 3/4 (19.1) | 3 3/8 (86) | 12 (305) | 12 (305) | 24 (610) | 6,395 (28.4) | 1,280 (5.7) | 12,386 (55.1) | 2,475 (11.0) | 90 (122) |
| **Anchor Installed in Mortar "T" Joint** | | | | | | | | | |
| 3/8 (9.5) | 1 1/2 (38) | 8 (203) | 8 (203) | 24 (610) | 1,927 (8.6) | 385 (1.7) | 3,436 (15.3) | 685 (3.0) | 15 (20) |
| 1/2 (12.7) | 2 1/4 (57) | 8 (203) | 8 (203) | 24 (610) | 3,849 (17.1) | 770 (3.4) | 5,856 (26.0) | 1,170 (5.2) | 25 (34) |
| 5/8 (15.9) | 2 3/4 (70) | 8 (203) | 8 (203) | 24 (610) | 4,625 (20.6) | 925 (4.1) | 7,040 (31.3) | 1,410 (6.3) | 50 (68) |
| 3/4 (19.1) | 3 3/8 (86) | 8 (203) | 8 (203) | 24 (610) | 5,483 (24.4) | 1,095 (4.9) | 7,869 (35.0) | 1,575 (7.0) | 90 (122) |

1. The tabulated allowable loads are based on a safety factor of 5.0.
2. Listed loads may be applied to installations through a face shell with the following placement guidelines:
   a. Minimum 3" from vertical mortar joint.
   b. Minimum 1" from vertical cell centerline.
3. Values for 6"- and 8"-wide concrete masonry units (CMU) with a minimum specified compressive strength of masonry, $f'_m$, at 28 days is 1,500 psi.
4. Embedment depth is measured from the outside face of the concrete masonry unit.
5. Drill bit diameter used in base material corresponds to nominal anchor diameter.




**Face Shell Installation**
Allowable anchor placement in grout-filled CMU shown by shaded areas.



*See p. 14 for an explanation of the load table icons.

# Sleeve-All® Design Information — Concrete



## Allowable Load-Adjustment Factors for Sleeve-All Anchors in Normal-Weight Concrete: Edge Distance and Spacing, Tension and Shear Loads

**How to use these charts:**

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
4. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
5. Multiply the allowable load by the applicable load adjustment factor.
6. Reduction factors for multiple edges or spacing are multiplied together.

### Edge Distance Tension ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Size | ¼ | 5/16 | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|---|
| | $c_{cr}$ | 2½ | 3⅛ | 3¾ | 5 | 6¼ | 7½ |
| | $c_{min}$ | 1¼ | 1 9/16 | 1⅞ | 2½ | 3⅛ | 3¾ |
| | $f_{cmin}$ | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| 1¼ | | 0.60 | | | | | |
| 1½ | | 0.68 | | | | | |
| 1 9/16 | | 0.70 | 0.60 | | | | |
| 1⅞ | | 0.80 | 0.68 | 0.60 | | | |
| 2 | | 0.84 | 0.71 | 0.63 | | | |
| 2½ | | 1.00 | 0.84 | 0.73 | 0.60 | | |
| 3 | | | 0.97 | 0.84 | 0.68 | | |
| 3⅛ | | | 1.00 | 0.87 | 0.70 | 0.60 | |
| 3½ | | | | 0.95 | 0.76 | 0.65 | |
| 3¾ | | | | 1.00 | 0.80 | 0.68 | 0.60 |
| 4 | | | | | 0.84 | 0.71 | 0.63 |
| 4½ | | | | | 0.92 | 0.78 | 0.68 |
| 5 | | | | | 1.00 | 0.84 | 0.73 |
| 5½ | | | | | | 0.90 | 0.79 |
| 6 | | | | | | 0.97 | 0.84 |
| 6¼ | | | | | | 1.00 | 0.87 |
| 6½ | | | | | | | 0.89 |
| 7 | | | | | | | 0.95 |
| 7½ | | | | | | | 1.00 |

See footnotes below.

### Edge Distance Shear ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Size | ¼ | 5/16 | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|---|
| | $c_{cr}$ | 2½ | 3⅛ | 3¾ | 5 | 6¼ | 7½ |
| | $c_{min}$ | 1¼ | 1 9/16 | 1⅞ | 2½ | 3⅛ | 3¾ |
| | $f_{cmin}$ | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| 1¼ | | 0.30 | | | | | |
| 1½ | | 0.44 | | | | | |
| 1 9/16 | | 0.48 | 0.30 | | | | |
| 1⅞ | | 0.65 | 0.44 | 0.30 | | | |
| 2 | | 0.72 | 0.50 | 0.35 | | | |
| 2½ | | 1.00 | 0.72 | 0.53 | 0.30 | | |
| 3 | | | 0.94 | 0.72 | 0.44 | | |
| 3⅛ | | | 1.00 | 0.77 | 0.48 | 0.30 | |
| 3½ | | | | 0.91 | 0.58 | 0.38 | |
| 3¾ | | | | 1.00 | 0.65 | 0.44 | 0.30 |
| 4 | | | | | 0.72 | 0.50 | 0.35 |
| 4½ | | | | | 0.86 | 0.61 | 0.44 |
| 5 | | | | | 1.00 | 0.72 | 0.53 |
| 5½ | | | | | | 0.83 | 0.63 |
| 6 | | | | | | 0.94 | 0.72 |
| 6¼ | | | | | | 1.00 | 0.77 |
| 6½ | | | | | | | 0.81 |
| 7 | | | | | | | 0.91 |
| 7½ | | | | | | | 1.00 |

1. $c_{act}$ = actual edge distance at which anchor is installed (inches).
2. $c_{cr}$ = critical edge distance for 100% load (inches).
3. $c_{min}$ = minimum edge distance for reduced load (inches).
4. $f_c$ = adjustment factor for allowable load at actual edge distance.
5. $f_{cccr}$ = adjustment factor for allowable load at critical edge distance. $f_{cccr}$ is always = 1.00.
6. $f_{cmin}$ = adjustment factor for allowable load at minimum edge distance.
7. $f_c = f_{cmin} + [(1 - f_{smin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

### Spacing Tension and Shear ($f_s$)

| $s_{act}$ (in.) | Size | ¼ | 5/16 | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|---|
| | $s_{cr}$ | 4½ | 5¾ | 6 | 9 | 11 | 13½ |
| | $s_{min}$ | 2¼ | 2⅞ | 3 | 4½ | 5½ | 6¾ |
| | $f_{smin}$ | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| 2¼ | | 0.50 | | | | | |
| 2½ | | 0.56 | | | | | |
| 2⅞ | | 0.64 | 0.50 | | | | |
| 3 | | 0.67 | 0.52 | 0.50 | | | |
| 3½ | | 0.78 | 0.61 | 0.58 | | | |
| 4 | | 0.89 | 0.70 | 0.67 | | | |
| 4½ | | 1.00 | 0.78 | 0.75 | 0.50 | | |
| 5 | | | 0.87 | 0.83 | 0.56 | | |
| 5½ | | | 0.96 | 0.92 | 0.61 | 0.50 | |
| 5¾ | | | 1.00 | 0.96 | 0.64 | 0.52 | |
| 6 | | | | 1.00 | 0.67 | 0.55 | |
| 6½ | | | | | 0.72 | 0.59 | |
| 6¾ | | | | | 0.75 | 0.61 | 0.50 |
| 7 | | | | | 0.78 | 0.64 | 0.52 |
| 8 | | | | | 0.89 | 0.73 | 0.59 |
| 9 | | | | | 1.00 | 0.82 | 0.67 |
| 10 | | | | | | 0.91 | 0.74 |
| 11 | | | | | | 1.00 | 0.81 |
| 12 | | | | | | | 0.89 |
| 13 | | | | | | | 0.96 |
| 13½ | | | | | | | 1.00 |

1. E = Embedment depth (inches).
2. $s_{act}$ = actual spacing distance at which anchors are installed (inches).
3. $s_{cr}$ = critical spacing distance for 100% load (inches).
4. $s_{min}$ = minimum spacing distance for reduced load (inches).
5. $f_s$ = adjustment factor for allowable load at actual spacing distance.
6. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
7. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
8. $f_s = f_{smin} + [(1 - f_{smin}) (s_{act} - s_{min}) / (s_{cr} - s_{min})]$.

*See p. 14 for an explanation of the load table icons.

# **Easy-Set** Pin-Drive Expansion Anchor

The Easy-Set is a pin-drive expansion anchor for medium- and heavy-duty fastening applications into concrete. Integrated nut and washer help keep track of parts.

**Material:** Carbon steel

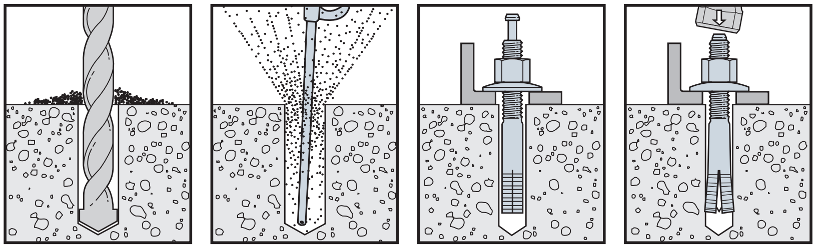
**Coating:** Yellow zinc plated

## Installation

**Caution:** Oversized holes in the base material will make it difficult to set the anchor and will reduce the anchor's load capacity.

1. Drill a hole in the base material using a carbide drill bit the same diameter as the nominal diameter of the anchor to be installed. Drill the hole to the specified embedment depth plus ¼" to allow for pin extension and blow it clean using compressed air. (Overhead installations need not be blown clean.) Alternatively, drill the hole deep enough to accommodate embedment depth and the dust from drilling.
2. Adjust the nut for required embedment. Place the anchor through the fixture and into the hole.
3. Hammer the center pin until the bottom of the head is flush with top of anchor.

## Installation Sequence



**Easy-Set (EZAC)**

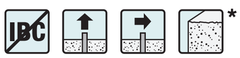
## EZAC Product Data

| Size (in.) | Model No. | Thread Length (in.) | Quantity | |
|---|---|---|---|---|
| | | | Box | Carton |
| ⅜ x 2⅜ | EZAC37238 | 1 | 50 | 250 |
| ⅜ x 3½ | EZAC37312 | 1⅛ | 50 | 250 |
| ⅜ x 4¾ | EZAC37434 | 1½ | 50 | 200 |
| ½ x 2¾ | EZAC50234 | 1 | 25 | 125 |
| ½ x 3½ | EZAC50312 | 1⅛ | 25 | 125 |
| ½ x 4¾ | EZAC50434 | 1½ | 25 | 100 |
| ½ x 6 | EZAC50600 | 2 | 25 | 100 |
| ⅝ x 4 | EZAC62400 | 1⅝ | 15 | 60 |
| ⅝ x 4¾ | EZAC62434 | 1⅝ | 15 | 60 |
| ⅝ x 6 | EZAC62600 | 2 | 15 | 60 |

## Easy-Set Anchor Installation Data

| Easy-Set Diameter (in.) | ⅜ | ½ | ⅝ |
|---|---|---|---|
| Drill Bit Size (in.) | ⅜ | ½ | ⅝ |
| Min. Fixture Hole Size (in.) | 7/16 | 9/16 | 11/16 |
| Wrench Size (in.) | 9/16 | ¾ | 15/16 |

## EZAC Allowable Tension and Shear Loads in Normal-Weight Concrete



| Size in. | Embed. Depth in. (mm) | Drill Bit Dia. in. | Critical Edge Dist. in. (mm) | Critical Spacing Dist. in. (mm) | Tension Load | Shear Load |
|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq$ 2,000 psi (13.8 MPa) Concrete | |
| | | | | | Allowable lb. (kN) | |
| ⅜ | **1¾** (44) | ⅜ | **2¾** (70) | **5¼** (133) | **630** (2.8) | **645** (2.9) |
| ½ | **2½** (64) | ½ | **3⅜** (86) | **6¾** (171) | **1,005** (4.5) | **1,230** (5.5) |
| ⅝ | **3** (76) | ⅝ | **4¼** (108) | **9** (229) | **1,515** (6.7) | **1,325** (5.9) |

1. The allowable loads listed are based on a safety factor of 4.0.
2. 100% of the allowable load is permitted at critical spacing and critical edge distance. Allowable loads at lesser spacings and edge distance have not been determined.
3. The minimum concrete thickness is 1½ times the embedment depth.
4. Tension and shear loads for the EZAC anchor may be combined using the straight-line interaction equation (n = 1).

*See p. 14 for an explanation of the load table icons.*

# **Tie-Wire** Wedge Anchor



The Simpson Strong-Tie tie-wire anchor is a wedge-style expansion anchor for use in normal-weight concrete or in concrete over steel deck. With a tri-segmented, dual-embossed clip, the tie-wire anchor is ideal for the installation of acoustic ceiling grid and is easily set with the claw of a hammer.

## Features

- ¼" eyelet for easy threading of wire
- Sets with claw of hammer
- Tri-segmented clip — each segment adjusts independently to hole irregularities
- Dual embossments on each clip segment enable the clip to undercut into the concrete, increasing follow-up expansion
- Wedge-style expansion anchor for use in normal weight concrete or concrete over steel deck

**Material:** Carbon steel

**Coating:** Zinc plated

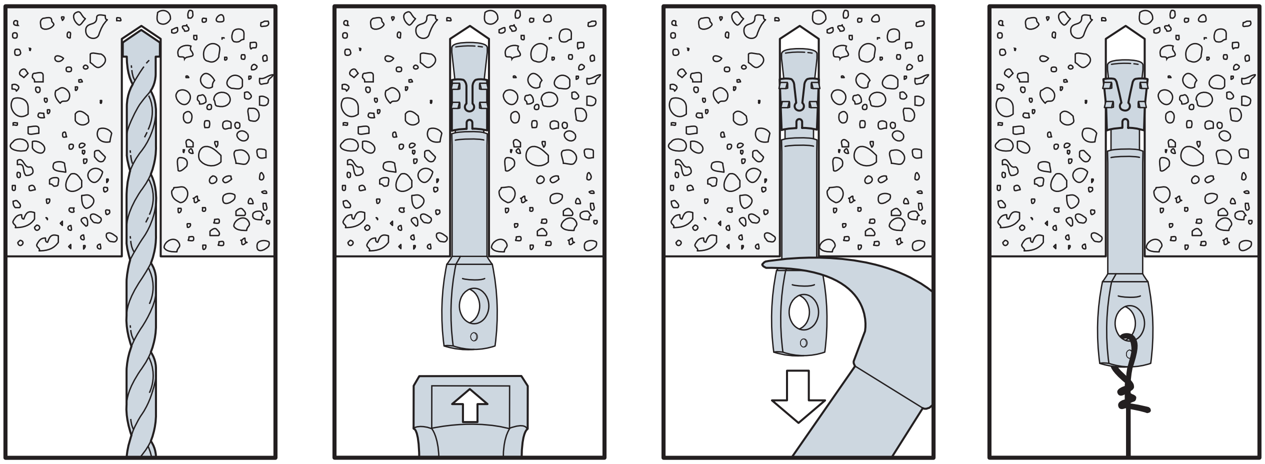
## Installation

1. Drill a hole at least 1¼" deep using a ¼"-diameter carbide tipped bit.
2. Drive the anchor into the hole until the bottom of the head is flush with the base material.
3. Set the anchor by prying/pulling the head with the claw end of the hammer.

| Size (in.) | Model No. | Drill Bit Diameter (in.) | Eyelet Hole Size (in.) | Quantity | |
|---|---|---|---|---|---|
| | | | | Box | Carton |
| ¼ x 1¼ | TW25114 | ¼ | ¼ | 100 | 500 |

Tie-Wire

## Installation Sequence



# **Tie-Wire** Wedge Anchor

## Allowable Tension and Shear Loads for Tie-Wire Anchor in Normal-Weight Concrete

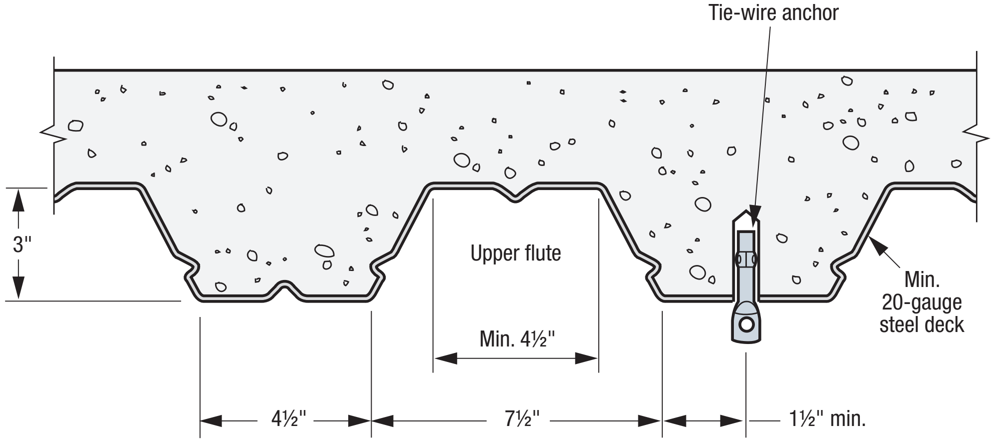
| Size in. (mm) | Drill Bit Diameter in. | Embed Depth in. (mm) | Critical End Dist. in. (mm) | Critical Spacing in. (mm) | Tension Load | | Shear Load | |
|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq$ 2,500 psi (17.2 MPa) | | $f'_c \geq$ 2,500 psi (17.2 MPa) | |
| | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| ¼ (6.4) | ¼ | 1¼ (32) | 2½ (64) | 5 (127) | 1,155 (5.1) | 290 (1.3) | 380 (1.7) | 95 (0.4) |

1. The allowable loads listed are based on a safety factor of 4.0.
2. The minimum concrete thickness is 1½ times the embedment depth.

## Allowable Tension and Shear Loads for Tie-Wire Anchor in the Soffit of Normal-Weight Concrete or Sand-Lightweight Concrete over Steel Deck

| Size in. (mm) | Drill Bit Diameter in. | Embed Depth in. (mm) | Critical End Dist.[5] in. (mm) | Critical Spacing in. (mm) | Tension Load | | Shear Load | |
|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq$ 3,000 psi (20.7 MPa) | | $f'_c \geq$ 3,000 psi (20.7 MPa) | |
| | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| ¼ (6.4) | ¼ | 1¼ (32) | 2½ (64) | 5 (127) | 1,155 (5.1) | 290 (1.3) | 460 (2.0) | 115 (0.5) |

1. The allowable loads listed are based on a safety factor of 4.0.
2. The minimum concrete thickness is 1½ times the embedment depth.
3. Steel deck must be minimum 20-gauge thick with minimum yield strength of 33 ksi.
4. Anchors installed in the bottom flute of the steel deck must have a minimum edge distance of 1½" away from inclined edge of the bottom flute. See the figure below.
5. Critical end distance is defined as the distance from the end of the slab in the direction of the flute.




**Installation in the Soffit of Concrete over Steel Deck**

Mechanical Anchors



*See p. 14 for an explanation of the load table icons.

# Titen Turbo™ Concrete and Masonry Screw Anchor



The Titen Turbo screw anchor features an innovative Torque Reduction Channel to trap drilling dust where it can't obstruct thread action, significantly reducing binding, stripping, and snapping without compromising strength. The patented reverse thread design enables smooth driving with less torque while providing superior holding power. The Torque Reduction Channel also allows more space for dust to help prevent anchors from bottoming out in smaller-diameter screw holes. The Titen Turbo screw anchors feature a serrated leading edge to cut into concrete or masonry, and a pointed tip for fast, easy installation in wood-to-concrete and wood-to-wood anchoring applications.

## Features

- Patented Torque Reduction Channel that displaces dust where it can't obstruct the thread action, reducing the likelihood of binding in the hole
- Available with either a hex head or, for a flush profile, a 6-lobe-drive countersunk flat head or trim head
- 6-lobe drive provides positive bit engagement resulting in easy installations and long bit life
- 6-lobe bit included in packaging for countersunk flat head and trim-head version
- Superior tension load performance
- Matched-tolerance bit not required; use a standard ANSI drill bit for installation
- Serrated screw point for fast starts when fastening wood
- Designed for installation with an impact driver or cordless drill. Installation using the Titen Turbo Installation Tool is recommended.
- Use in dry interior environments only
- Code listed in accordance with ICC-ES AC193 for uncracked concrete and ICC-ES AC106 for masonry applications without cleaning dust from predrilled holes

**Codes:** IAPMO UES ER-712 (uncracked concrete) (City of LA Supplement within ER-712);
IAPMO UES ER-716 (masonry) (City of LA Supplement within ER-716);
FL16230 (concrete and masonry)

**Material:** Carbon steel

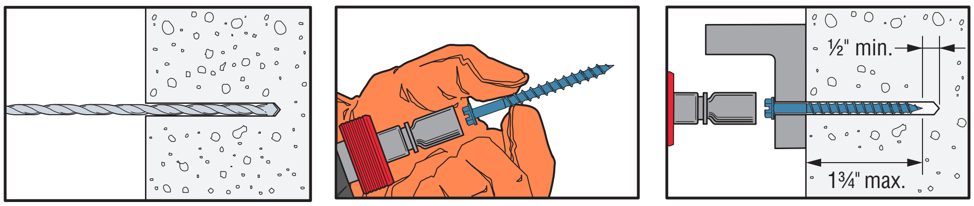
**Coating:** Zinc plating with baked-on ceramic coating

**Caution:** Industry studies show that hardened fasteners can experience performance problems in wet or corrosive environments. Steps must be taken to prevent inadvertent sustained loads above the listed allowable loads. Overtightening and bending moments can initiate cracks detrimental to the hardened screw's performance. Use the Simpson Strong-Tie Titen installation tool kit as it has a bit that is designed to reduce the potential for overtightening the screw.

**Caution:** Oversized holes in the base material will reduce or eliminate the mechanical interlock of the threads with the base material and will reduce the anchor's load capacity.

| Titen Turbo Flat Head Screw | Titen Turbo Hex-Head Screw | Titen Turbo Trim-Head Screw |
|---|---|---|
| US Patent 11,002,305 | US Patent 11,002,305 | US Patent 11,002,305 |

## Installation Sequence




6-lobe drive

## Versatile Applications

Sliding door track installation

Window frames

Furring strips

## Blue Titen Turbo Product Data (3/16" diameter)

| Size (in.) | Head Style | Model No. | Drill Bit Diameter (in.) | Quantity | |
|---|---|---|---|---|---|
| | | | | Pack | Carton |
| 3/16 x 1¼ | ¼" hex | TNT18114H | 5/32 | 100 | 1,600 |
| 3/16 x 1¾ | | TNT18134H | | 100 | 500 |
| 3/16 x 2¼ | | TNT18214H | | 100 | 500 |
| 3/16 x 2¾ | | TNT18234H | | 100 | 500 |
| 3/16 x 3¼ | | TNT18314H | | 100 | 400 |
| 3/16 x 3¾ | | TNT18334H | | 100 | 400 |
| 3/16 x 1¼ | T25 6-lobe flat | TNT18114TF | 5/32 | 100 | 1,600 |
| 3/16 x 1¾ | | TNT18134TF | | 100 | 500 |
| 3/16 x 2¼ | | TNT18214TF | | 100 | 500 |
| 3/16 x 2¾ | | TNT18234TF | | 100 | 500 |
| 3/16 x 3¼ | | TNT18314TF | | 100 | 400 |
| 3/16 x 3¾ | | TNT18334TF | | 100 | 400 |

## Blue Titen Turbo Product Data (¼" diameter)

| Size (in.) | Head Style | Model No. | Drill Bit Diameter (in.) | Quantity | |
|---|---|---|---|---|---|
| | | | | Pack | Carton |
| ¼ x 1¼ | 5/16" hex | TNT25114H | 3/16 | 100 | 1,600 |
| ¼ x 1¾ | | TNT25134H | | 100 | 500 |
| ¼ x 2¼ | | TNT25214H | | 100 | 500 |
| ¼ x 2¾ | | TNT25234H | | 100 | 500 |
| ¼ x 3¼ | | TNT25314H | | 100 | 400 |
| ¼ x 3¾ | | TNT25334H | | 100 | 400 |
| ¼ x 4 | | TNT25400H | | 100 | 400 |
| ¼ x 5 | | TNT25500H | | 100 | 400 |
| ¼ x 6 | | TNT25600H | | 100 | 400 |
| ¼ x 1¼ | T30 6-lobe flat | TNT25114TF | 3/16 | 100 | 1,600 |
| ¼ x 1¾ | | TNT25134TF | | 100 | 500 |
| ¼ x 2¼ | | TNT25214TF | | 100 | 500 |
| ¼ x 2¾ | | TNT25234TF | | 100 | 500 |
| ¼ x 3¼ | | TNT25314TF | | 100 | 400 |
| ¼ x 3¾ | | TNT25334TF | | 100 | 400 |
| ¼ x 4 | | TNT25400TF | | 100 | 400 |

# Titen Turbo™ Concrete and Masonry Screw Anchor



## White Titen Turbo Product Data (6-Lobe Flat Head)

| Size (in.) | Head Style | Model No. | Drill Bit Diameter (in.) | Quantity | |
|---|---|---|---|---|---|
| | | | | Pack | Carton |
| 3/16 x 1¼ | T25 6-lobe flat | TNTW18114TF | 5/32 | 100 | 1,600 |
| 3/16 x 1¾ | | TNTW18134TF | | 100 | 500 |
| 3/16 x 2¼ | | TNTW18214TF | | 100 | 500 |
| 3/16 x 2¾ | | TNTW18234TF | | 100 | 500 |
| 3/16 x 3¼ | | TNTW18314TF | | 100 | 400 |
| 3/16 x 3¾ | | TNTW18334TF | | 100 | 400 |
| ¼ x 1¼ | T30 6-lobe flat | TNTW25114TF | 3/16 | 100 | 1,600 |
| ¼ x 1¾ | | TNTW25134TF | | 100 | 500 |
| ¼ x 2¼ | | TNTW25214TF | | 100 | 500 |
| ¼ x 2¾ | | TNTW25234TF | | 100 | 500 |
| ¼ x 3¼ | | TNTW25314TF | | 100 | 400 |
| ¼ x 3¾ | | TNTW25334TF | | 100 | 400 |

## Silver Titen Turbo Product Data (6-Lobe Flat Head)

| Size (in.) | Head Style | Model No. | Drill Bit Diameter (in.) | Quantity |
|---|---|---|---|---|
| 3/16 x 1¾ | T25 6-lobe flat | TNTS18134TFB | 5/32 | 1,000 |
| 3/16 x 2¾ | | TNTS18234TFB | | 1,000 |
| 3/16 x 3¾ | | TNTS18334TFB | | 1,000 |
| ¼ x 2¾ | T30 6-lobe flat | TNTS25234TFB | 3/16 | 1,000 |
| ¼ x 3¼ | | TNTS25314TFB | | 1,000 |

## White Titen Turbo Trim Head Product Data (6-Lobe)

| | Size (in.) | Model No. | Drill Bit Diameter (in.) | Bit Size | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| NEW | ¼ x 2¾ | TNTW25234TTR | 3/16 | T25 | 100 | 500 |
| NEW | ¼ x 3¼ | TNTW25314TTR | | | 100 | 400 |
| NEW | ¼ x 2¾ | TNTW25234TTRB | | | 1,000 | — |
| NEW | ¼ x 3¼ | TNTW25314TTRB | | | 1,000 | — |

## Bronze Titen Turbo Trim Head Product Data (6-Lobe)

| | Size (in.) | Model No. | Drill Bit Diameter (in.) | Bit Size | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| NEW | ¼ x 2¾ | TNTB25234TTR | 3/16 | T25 | 100 | 500 |
| NEW | ¼ x 3¼ | TNTB25314TTR | | | 100 | 400 |
| NEW | ¼ x 2¾ | TNTB25234TTRB | | | 1,000 | — |
| NEW | ¼ x 3¼ | TNTB25314TTRB | | | 1,000 | — |

## Titen Turbo Screw Anchor — Installation Tool

Six-piece kit includes:

- 6-lobe bit socket
- T25 and T30 bits
- 1/4" and 5/16" hex sockets
- Canvas storage bag

Titen Turbo Screw Anchor Installation Kit

### Titen Turbo Installation Tool

| Model No. | Quantity | |
|---|---|---|
| | Clamshell | Carton |
| TNTINSTALLKIT | 1 | 4 |

### Titen Turbo Screw Anchor — Drill Bits

| Size (in.) | Model No. | Use With | | Quantity | |
|---|---|---|---|---|---|
| | | Screw | Length | Box | Carton |
| 5/32 x 3 1/2 | MDB15312 | 3/16" diameter | To 1 3/4 | 12 | 48 |
| 5/32 x 4 1/2 | MDB15412 | | To 3 1/4 | | |
| 5/32 x 5 1/2 | MDB15512 | | To 4 | | |
| 3/16 x 3 1/2 | MDB18312 | 1/4" diameter | To 1 3/4 | 12 | 48 |
| 3/16 x 4 1/2 | MDB18412 | | To 3 1/4 | | |
| 3/16 x 5 1/2 | MDB18512 | | To 4 | | |

### Titen Turbo Screw Anchor — SDS-plus® Drill Bits

| Size (in.) | Model No. | For Screw Diameter (in.) | Drilling Depth (in.) | Overall Length (in.) |
|---|---|---|---|---|
| 5/32 x 6 | MDPL01506H | 3/16 | 3 1/8 | 6 |
| 5/32 x 7 | MDPL01507H | | 4 1/8 | 7 |
| 3/16 x 5 | MDPL01805H | 1/4 | 2 3/8 | 5 |
| 3/16 x 6 | MDPL01806H | | 3 1/8 | 6 |
| 3/16 x 7 | MDPL01807H | | 4 1/8 | 7 |

Titen drivers are sold individually.

### Titen Turbo Screw Drill Bit/Driver — Bulk Packs*

| Diameter (in.) | Drilling Depth (in.) | Overall Length (in.) | For Screw Diameter (in.) | Model No. |
|---|---|---|---|---|
| 5/32 | 4 1/8 | 7 | 3/16 | MDPL01507H-R25 |
| 3/16 | 4 1/8 | 7 | 1/4 | MDPL01807H-R25 |

*SDS-plus shank.


SDS-plus Drill Bit


Straight Shank Drill Bit

Titen Turbo Installation Information and Additional Data[1]

IBC *

| Characteristic | Symbol | Units | Nominal Anchor Diameter (in.) | |
|---|---|---|---|---|
| | | | 3⁄16 | 1⁄4 |
| **Installation Information** | | | | |
| Drill Bit Diameter | $d$ | in. | 5⁄32 | 3⁄16 |
| Minimum Baseplate Clearance Hole Diameter | $d_c$ | in. | 1⁄4 | 5⁄16 |
| Minimum Hole Depth | $h_{hole}$ | in. | 2 1⁄4 | 2 1⁄4 |
| Embedment Depth | $h_{nom}$ | in. | 1 3⁄4 | 1 3⁄4 |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.25 | 1.20 |
| Critical Edge Distance | $c_{ac}$ | in. | 3 | 3 |
| Minimum Edge Distance | $c_{min}$ | in. | 1 3⁄4 | 1 3⁄4 |
| Minimum Spacing | $s_{min}$ | in. | 1 | 2 |
| Minimum Concrete Thickness | $h_{min}$ | in. | 3 1⁄4 | 3 1⁄4 |
| **Additional Data** | | | | |
| Yield Strength | $f_{ya}$ | psi | 100,000 | |
| Tensile Strength | $f_{uta}$ | psi | 125,000 | |
| Minimum Tensile and Shear Stress Area | $A_{se}$ | in.² | 0.0131 | 0.0211 |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.



*See p. 14 for an explanation of the load table icons.

## Titen Turbo Tension Strength Design Data[1]

| Characteristic | Symbol | Units | Nominal Anchor Diameter (in.) | |
|---|---|---|---|---|
| | | | 3⁄16 | 1⁄4 |
| Anchor Category | 1, 2 or 3 | — | 1 | |
| Embedment Depth | $h_{nom}$ | in. | 1¾ | 1¾ |
| **Steel Strength in Tension** | | | | |
| Tension Resistance of Steel | $N_{sa}$ | lb. | 1,640 | 2,640 |
| Strength Reduction Factor — Steel Failure[2] | $\phi_{sa}$ | — | 0.65 | |
| **Concrete Breakout Strength in Tension** | | | | |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.25 | 1.20 |
| Critical Edge Distance | $c_{ac}$ | in. | 3 | 3 |
| Effectiveness Factor — Uncracked Concrete | $k_{uncr}$ | — | 24 | |
| Modification Factor | $\Psi_{c,N}$ | — | 1.0 | |
| Strength Reduction Factor — Concrete Breakout Failure[3] | $\phi_{cb}$ | — | 0.65 | |
| **Pullout Strength in Tension** | | | | |
| Pullout Resistance Uncracked Concrete ($f'_c$ = 2,500 psi)[5] | $N_{p,uncr}$ | lb. | 1,515 | 1,515 |
| Strength Reduction Factor — Pullout Failure[4] | $\phi_p$ | — | 0.65 | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.
2. The tabulated value of $\phi_{sa}$ applies when the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, 2012, and 2009 IBC, ACI 318-19, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $\phi$ must be determined in accordance with ACI 318-11 Section D.4.4.
3. The tabulated value of $\phi_{cb}$ applies when both the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, 2012, and 2009 IBC, ACI 318-19, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used and the requirements of ACI 318-19 Section 17.5.3, ACI 318-14 Section 17.3.3 (c) or ACI 318-11 Section D.4.3, as applicable, for Condition B are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $\phi$ must be determined in accordance with ACI 318-11 Section D.4.4 for Condition B.
4. The tabulated value of $\phi_p$ applies when both the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, 2012, and 2009 IBC, ACI 318-19, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used and the requirements of ACI 318-19 Section 17.5.3, ACI 318-14 Section 17.3.3 (c) or ACI 318-11 Section D.4.3 (c) for Condition B are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $\phi$ must be determined in accordance with ACI 318-11 Section D.4.4 for Condition B.
5. The characteristic pullout resistance for greater compressive strengths may be increased by multiplying the tabular value by $(f'_c/2500)^{0.23}$ for ¼" screw anchors. No increase in the characteristic pullout resistance for greater compressive strengths is permitted for 3⁄16" screw anchors.

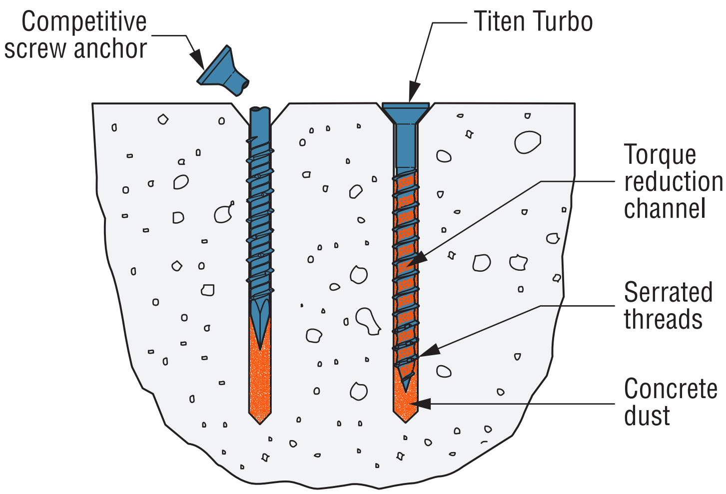
*See p. 14 for an explanation of the load table icons.

## Titen Turbo Shear Strength Design Data Into Concrete[1]

| Characteristic | Symbol | Units | Nominal Anchor Diameter (in.) | |
|---|---|---|---|---|
| | | | 3/16 | 1/4 |
| Anchor Category | 1, 2 or 3 | — | 1 | |
| Embedment Depth | $h_{nom}$ | in. | 1¾ | 1¾ |
| **Steel Strength in Shear** | | | | |
| Shear Resistance of Steel | $V_{sa}$ | lb. | 475 | 720 |
| Strength Reduction Factor — Steel Failure | $\phi_{sa}$ | — | 0.60[2] | |
| **Concrete Breakout Strength in Shear** | | | | |
| Outside Diameter | $d_a$ | in. | 0.129 | 0.164 |
| Load Bearing Length of Anchor in Shear | $l_e$ | in. | 1.25 | 1.20 |
| Strength Reduction Factor — Concrete Breakout Failure | $\phi_{cb}$ | — | 0.70[3] | |
| **Concrete Pryout Strength in Shear** | | | | |
| Coefficient for Pryout Strength | $k_{cp}$ | — | 1.0 | |
| Strength Reduction Factor — Concrete Pryout Failure | $\phi_{cp}$ | — | 0.70[3] | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.
2. The tabulated value of $\phi_{sa}$ applies when the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, 2012, and 2009 IBC, ACI 318-19 and ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2 are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $\phi$ must be determined in accordance with ACI 318-11 Section D.4.4.
3. The tabulated values of $\phi_{cb}$ and $\phi_{cp}$ apply when both the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, 2012 and 2009 IBC, ACI 318-19, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used and the requirements of ACI 318-19 Section 17.5.3, ACI 318-14 Section 17.3.3 (c) or ACI 318-11 Section D.4.3, as applicable, for Condition B are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of $\phi$ must be determined in accordance with ACI 318-11 Section D.4.4 for Condition B.

**Torque Reduction Channel to trap drilling dust where it can't obstruct thread action.**




**Patented Torque Reduction Channel Displaces Dust for Trouble-Free Installation**



*See p. 14 for an explanation of the load table icons.

# Titen Turbo™ Concrete and Masonry Screw Anchor



## Allowable Tension Load for Titen Turbo Screw Anchor Installed in Face of Grouted CMU[1,2,3]

| Anchor Diameter (in.) | Embedment Depth (in.) | Minimum Dimensions (in.) | | | Allowable Load (lb.)[4] |
|---|---|---|---|---|---|
| | | Spacing | Edge | End | |
| 3⁄16 | 2 | 3 | 3⅞ | 3⅞ | 267 |
| 3⁄16 | 2 | 3 | 1½ | 3⅞ | 267 |
| ¼ | 2 | 4 | 3⅞ | 3⅞ | 393 |
| ¼ | 2 | 4 | 1½ | 3⅞ | 343 |

1. The tabulates values are for screw anchors installed in minimum 8"-wide grouted concrete masonry walls having reached a minimum f'm of 1,500 psi at time of installation.
2. Embedment is measured from the masonry surface to the embedded end of the screw anchor.
3. Screw anchors must be installed in grouted cell. The minimum edge and end distances must be maintained.
4. Allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.

## Allowable Shear Load for Titen Turbo Screw Anchor Installed in Face of Grouted CMU[1,2,3]

| Anchor Diameter (in.) | Embedment Depth (in.) | Minimum Dimensions (in.) | | | Direction of Loading | Allowable Load (lb.)[4] |
|---|---|---|---|---|---|---|
| | | Spacing | Edge | End | | |
| 3⁄16 | 2 | 3 | 3⅞ | 3⅞ | Toward edge, parallel to wall end | 218 |
| 3⁄16 | 2 | 3 | 1½ | 3⅞ | Toward wall end, parallel to wall edge | 218 |
| ¼ | 2 | 4 | 3⅞ | 3⅞ | Toward edge, parallel to wall end | 342 |
| ¼ | 2 | 4 | 1½ | 3⅞ | Toward wall end, parallel to wall edge | 283 |

1. The tabulates values are for screw anchors installed in minimum 8"-wide grouted concrete masonry walls having reached a minimum f'm of 1,500 psi at time of installation.
2. Embedment is measured from the masonry surface to the embedded end of the screw anchor.
3. Screw anchors must be installed in grouted cell. The minimum edge and end distances must be maintained.
4. Allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.

## Allowable Tension Load for Titen Turbo Screw Anchor Installed in Hollow CMU Wall Faces[1,2,3]

| Anchor Diameter (in.) | Embedment Depth (in.) | Minimum Dimensions (in.) | | | Allowable Load (lb.)[4] |
|---|---|---|---|---|---|
| | | Spacing | Edge | End | |
| 3⁄16 | 1¼ | 3 | 3⅞ | 3⅞ | 117 |
| ¼ | 1¼ | 4 | 3⅞ | 3⅞ | 117 |

1. The tabulates values are for screw anchors installed in minimum 8"-wide hollow masonry walls having reached a minimum f'm of 1,500 psi at time of installation.
2. Embedment is the thickness of the face shell.
3. Screw anchors may be installed at any location in the wall face provided the minimum edge and end distances are maintained.
4. Allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.

## Allowable Shear Load for Titen Turbo Screw Anchor Installed in Hollow CMU Wall Faces[1,2,3]

| Anchor Diameter (in.) | Embedment Depth (in.) | Minimum Dimensions (in.) | | | Direction of Loading | Allowable Load (lb.)[4] |
|---|---|---|---|---|---|---|
| | | Spacing | Edge | End | | |
| 3⁄16 | 1¼ | 3 | 3⅞ | 3⅞ | Toward edge, parallel to wall end | 164 |
| ¼ | 1¼ | 4 | 3⅞ | 3⅞ | Toward edge, parallel to wall end | 190 |

1. The tabulates values are for screw anchors installed in minimum 8"-wide hollow masonry walls having reached a minimum f'm of 1,500 psi at time of installation.
2. Embedment is the thickness of the face shell.
3. Screw anchors may be installed at any location in the wall face provided the minimum edge and end distances are maintained.
4. Allowable loads are based on a safety factor of 5.0 for installations under the IBC and IRC.

*See p. 14 for an explanation of the load table icons.

# Titen® Stainless-Steel Concrete and Masonry Screw



Stainless-steel Titen screws are ideal for attaching various types of components to concrete and masonry, such as fastening electrical boxes or light fixtures. They offer the versatility of our standard Titen screws with enhanced corrosion protection. Available in hex and Phillips flat head.

## Features

- Suitable for concrete, brick, grout-filled CMU and hollow-block applications
- Suitable for some preservative-treated wood applications
- Titen drill bits included in each box
- Available in lengths from 1¼"–4"

**Codes:** Florida FL2355 (concrete and masonry)

**Material:** Type 410 stainless steel

**Coating:** Zinc plated with a protective overcoat

## Installation

**Caution:** Industry studies show that hardened fasteners can experience performance problems in wet or corrosive environments. Steps must be taken to prevent inadvertent sustained loads above the listed allowable loads. Overtightening and bending moments can initiate cracks detrimental to the hardened screw's performance.

**Caution:** Oversized holes in the base material will reduce or eliminate the mechanical interlock of the threads with the base material and will reduce the anchor's load capacity.

1. Drill a hole in the base material using the appropriate diameter carbide drill bit as specified in the table. Drill the hole to the specified embedment depth plus ½" to allow the thread tapping dust to settle and blow it clean using compressed air. Overhead installations need not be blown clean. Alternatively, drill the hole deep enough to accommodate embedment depth and dust from drilling and tapping.
2. Position fixture, insert screw and tighten using drill fitted with a hex socket or Phillips bit.

The 410 stainless-steel Titen screw with top coat provides "medium" corrosion protection. Refer to p. 236 for more information. Recommendations are based on testing and experience at the time of publication and may change. Simpson Strong-Tie cannot provide estimated on-service life of screws.

**Titen**
**Stainless-Steel**
**Phillips Flat Head Screw**
**(PFSS)**

**Titen**
**Stainless-Steel**
**Hex-Head Screw**
**(HSS)**

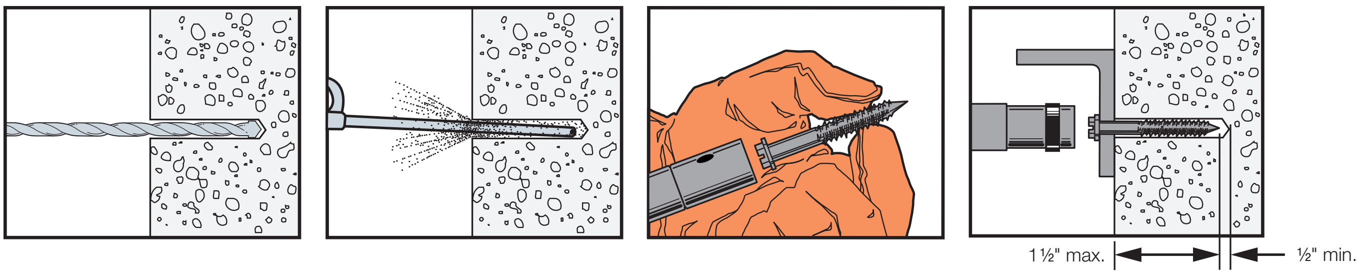
### Stainless-Steel Titen Product Data

| Size (in.) | Head Style | Model No. | Drill Bit Diameter (in.) | Quantity | |
|---|---|---|---|---|---|
| | | | | Box | Carton |
| ¼ x 1¼ | Hex Head | TTN25114HSS | 3/16 | 100 | 1600 |
| ¼ x 1¾ | | TTN25134HSS | | 100 | 500 |
| ¼ x 2¼ | | TTN25214HSS | | 100 | 500 |
| ¼ x 2¾ | | TTN25234HSS | | 100 | 500 |
| ¼ x 3¼ | | TTN25314HSS | | 100 | 400 |
| ¼ x 3¾ | | TTN25334HSS | | 100 | 400 |
| ¼ x 4 | | TTN25400HSS | | 100 | 400 |
| ¼ x 1¼ | Phillips Flat Head | TTN25114PFSS | 3/16 | 100 | 1600 |
| ¼ x 1¾ | | TTN25134PFSS | | 100 | 500 |
| ¼ x 2¼ | | TTN25214PFSS | | 100 | 500 |
| ¼ x 2¾ | | TTN25234PFSS | | 100 | 500 |
| ¼ x 3¼ | | TTN25314PFSS | | 100 | 400 |
| ¼ x 3¾ | | TTN25334PFSS | | 100 | 400 |
| ¼ x 4 | | TTN25400PFSS | | 100 | 400 |

One drill bit is included in each box.



## Installation Sequence



# Titen® Stainless-Steel Concrete and Masonry Screw



## Stainless-Steel Titen Allowable Tension and Shear Loads in Normal-Weight Concrete

IBC *

| Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Critical Spacing in. (mm) | Critical Edge Dist. in. (mm) | Tension Load | | | | Shear Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | f'c ≥ 2,000 psi (13.8 MPa) Concrete | | f'c ≥ 4,000 psi (27.6 MPa) Concrete | | f'c ≥ 2,000 psi (13.8 MPa) Concrete | |
| | | | | | Ultimate lb. (kN) | Allow. lb. (kN) | Ultimate lb. (kN) | Allow. lb. (kN) | Ultimate lb. (kN) | Allow. lb. (kN) |
| ¼ (6.4) | 3⁄16 | 1 (25.4) | 3 (76.2) | 1 ½ (38.1) | 600 (2.7) | 150 (0.7) | 935 (4.2) | 235 (1.0) | 760 (3.4) | 190 (0.8) |
| ¼ (6.4) | 3⁄16 | 1 ½ (38.1) | 3 (76.2) | 1 ½ (38.1) | 1,040 (4.6) | 260 (1.2) | 1,760 (7.8) | 440 (2.0) | 810 (3.6) | 200 (0.9) |

1. Maximum anchor embedment is 1 ½" (38.1 mm).
2. Minimum concrete thickness is 1.5 x embedment.

## Stainless-Steel Titen Allowable Tensionand Shear Loads in Face Shell of Hollow and Grout-Filled CMU

IBC *

| Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Critical Spacing in. (mm) | Critical Edge Dist. in. (mm) | Values for 6" or 8" Lightweight, Medium-Weight or Normal-Weight CMU | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Tension Load | | Shear Load | |
| | | | | | Ultimate lb. (kN) | Allow. lb. (kN) | Ultimate lb. (kN) | Allow. lb. (kN) |
| ¼ (6.4) | 3⁄16 | 1 (25.4) | 4 (101.6) | 1 ½ (38.1) | 550 (2.4) | 110 (0.5) | 495 (2.2) | 100 (0.4) |

1. The tabulated allowable loads are based on a safety factor of 5.0.
2. Maximum anchor embedment is 1 ½" (38.1 mm).

## Length Identification Head Marks on Stainless-Steel Titen Screw Anchors (corresponds to anchor length in inches)

| Length ID Marking on Head | | — | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length of Anchor (in.) | From | 1 | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 |
| | Up To But Not Including | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ |

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



*See p. 14 for an explanation of the load table icons.

# **Titen HD®** Threaded Rod Hanger



The Titen HD threaded rod hanger is a high-strength screw anchor designed to suspend threaded rod from concrete slabs, beams or concrete over steel in order to hang pipes, cable trays and other HVAC equipment. The anchor offers low installation torque with no secondary setting, and has been tested to offer industry-leading performance in cracked and uncracked concrete — even in seismic loading conditions.

### Features

- Thread design undercuts to efficiently transfer the load to the base material
- Serrated cutting teeth and patented thread design enable quick and easy installation
- Specialized heat-treating process creates tip hardness to facilitate cutting while the anchor body remains ductile
- Designed to install using a rotary hammer or hammer drill with standard ANSI drill bits — no special tools required
- Installs with standard-sized sockets
- Use in dry interior environments only
- Code listed for cracked and uncracked concrete applications under the 2015, 2012 and 2009 IBC/IRC, per ICC-ES ESR-2713
- FM listed


**THD50234RH** (⅜"-dia. shank)
**THDB37158RH** (¼"-dia. shank)
**THDB25158RH** (¼"-dia. shank)

**Codes:** ICC-ES ESR-2713;
City of LA Supplement within ESR-2713;
Florida FL15730 (concrete and masonry);
Factory Mutual 3031136 (THD50234RH)
and 3061897 (THDB37158RH)

**Material:** Carbon steel

**Coating:** Zinc plated

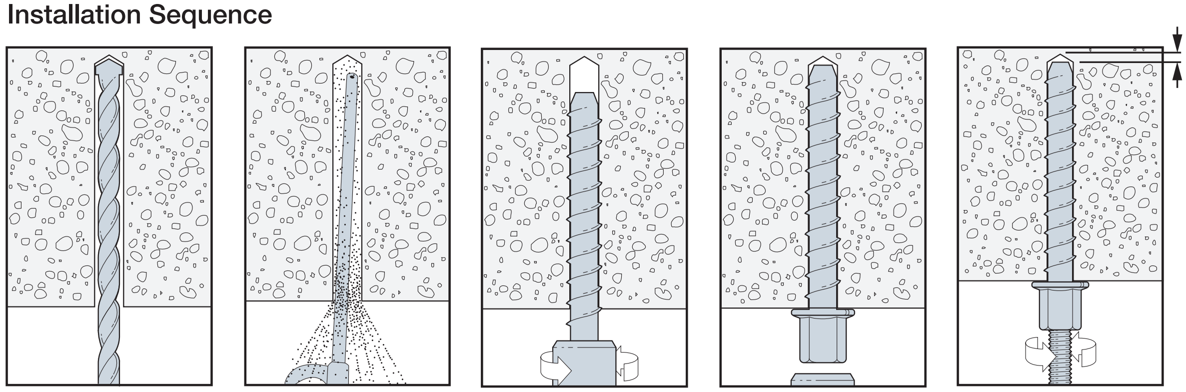
### Installation

**Caution:** Oversized holes in the base material will reduce or eliminate the mechanical interlock of the threads with base material and will reduce the anchor's load capacity.

**Caution:** Use a Titen HD rod hanger one time only. Installing the anchor multiple times may result in excessive thread wear and reduce load capacity.

1. Drill a hole using the specified diameter carbide bit into the base material to the specified embedment depth plus minimum hole depth overdrill (see the product data table on the next page).
2. Blow the hole clean of dust and debris using compressed air.
3. Install with a torque wrench, driver drill, hammer drill or cordless impact wrench.
4. Fully insert threaded rod.

### Installation Sequence



# Titen HD® Rod Hanger Design Information — Concrete





## Titen HD Threaded Rod Hanger Product Data

| Size (in.) | Model No. | Accepts Rod Size (in.) | Drill Bit Dia. (in.) | Wrench Size (in.) | Min. Embed. (in.) | Hole Depth Overdrill (in.) | Quantity | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Box | Carton |
| ¼ x 1⅝ | THDB25158RH | ¼-20 | ¼ | ⅜ | 1⅝ | ⅛ | 100 | 500 |
| ⅜ x 1⅝ | THDB37158RH | ⅜-16 | ¼ | ½ | 1⅝ | ⅛ | 50 | 200 |
| ½ x 2¾ | THD50234RH | ½-13 | ⅜ | 11⁄16 | 2½ | ¼ | 50 | 100 |

## Titen HD Threaded Rod Hanger Installation Information and Additional Data[1]

| Characteristic | Symbol | Units | Model No. | |
|---|---|---|---|---|
| | | | THDB25158RH THDB37158RH | THD50234RH |
| **Installation Information** | | | | |
| Rod Hanger Diameter | $d_o$ | in. | ¼ or ⅜ | ½ |
| Drill Bit Diameter | $d_{bit}$ | in. | ¼ | ⅜ |
| Maximum Installation Torque[2] | $T_{inst,max}$ | ft.-lb. | 24 | 50 |
| Maximum Impact Wrench Torque Rating[3] | $T_{impact,max}$ | ft.-lb. | 125 | 150 |
| Minimum Hole Depth | $h_{hole}$ | in. | 1¾ | 3 |
| Embedment Depth | $h_{nom}$ | in. | 1⅝ | 2¾ |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.19 | 1.77 |
| Critical Edge Distance | $c_{ac}$ | in. | 3 | 2 11⁄16 |
| Minimum Edge Distance | $c_{min}$ | in. | 1½ | 1¾ |
| Minimum Spacing | $s_{min}$ | in. | 1½ | 3 |
| Minimum Concrete Thickness | $h_{min}$ | in. | 3¼ | 4¼ |
| **Anchor Data** | | | | |
| Yield Strength | $f_{ya}$ | psi | 100,000 | 97,000 |
| Tensile Strength | $f_{uta}$ | psi | 125,000 | 110,000 |
| Minimum Tensile and Shear Stress Area | $A_{se}$ | in.$^2$ | 0.042 | 0.099 |
| Axial Stiffness in Service Load Range — Uncracked Concrete | $\beta_{uncr}$ | lb./in. | 202,000 | 672,000 |
| Axial Stiffness in Service Load Range — Cracked Concrete | $\beta_{cr}$ | lb./in. | 173,000 | 345,000 |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.
2. $T_{inst,max}$ is the maximum permitted installation torque for installations using a torque wrench.
3. $T_{impact,max}$ is the maximum permitted torque rating for impact wrenches.

# Titen HD® Rod Hanger Design Information — Concrete



## Titen HD Threaded Rod Hanger Tension Strength Design Data for Installations in Concrete[1]

| Characteristic | Symbol | Units | Model No. | |
|---|---|---|---|---|
| | | | THDB25158RH THDB37158RH | THD50234RH |
| Anchor Category | 1, 2 or 3 | — | 1 | |
| Embedment Depth | $h_{nom}$ | in. | 1⅝ | 2½ |
| **Steel Strength in Tension (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1)** | | | | |
| Tension Resistance of Steel | $N_{sa}$ | lb. | 5,195 | 10,890 |
| Strength Reduction Factor — Steel Failure[2] | $\phi_{sa}$ | — | 0.65 | |
| **Concrete Breakout Strength in Tension (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 Section D.5.2)** | | | | |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.19 | 1.77 |
| Critical Edge Distance | $c_{ac}$ | in. | 3 | 2¹¹⁄₁₆ |
| Effectiveness Factor — Uncracked Concrete | $k_{uncr}$ | — | 30 | 24 |
| Effectiveness Factor — Cracked Concrete | $k_{cr}$ | — | 17 | |
| Modification Factor | $\psi_{c,N}$ | — | 1.0 | |
| Strength Reduction Factor — Concrete Breakout Failure[2] | $\phi_{cb}$ | — | 0.65 | |
| **Pullout Strength in Tension (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 Section D.5.3)** | | | | |
| Pullout Resistance — Uncracked Concrete ($f'_c$ = 2,500 psi) | $N_{p,uncr}$ | lb. | N/A[4] | 2,025[4] |
| Pullout Resistance — Cracked Concrete ($f'_c$ = 2,500 psi) | $N_{p,cr}$ | lb. | N/A[4] | 1,235[4] |
| Strength Reduction Factor — Pullout Failure[2] | $\phi_p$ | — | 0.65 | |
| **Tension Strength for Seismic Applications (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 Section D.3.3.3)** | | | | |
| Nominal Pullout Strength for Seismic Loads ($f'_c$ = 2,500 psi) | $N_{p,eq}$ | lb. | N/A[3] | 1,235[4] |
| Strength Reduction Factor — Pullout Failure[2] | $\phi_{eq}$ | — | 0.65 | |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
3. As described in this report, N/A denotes that pullout resistance does not govern and does not need to be considered.
4. The characteristic pullout resistance for greater compressive strengths may be increased by multiplying the tabular value by $(f'_c/2{,}500)^{0.5}$.

*See p. 14 for an explanation of the load table icons.

# Titen HD® Rod Hanger Design Information — Concrete



## Titen HD Threaded Rod Hanger Tension Strength Design Data for Installations in the Lower and Upper Flute of Normal-Weight or Sand-Lightweight Concrete Through Steel Deck[1,2,5,6]

IBC *

| Characteristic | Symbol | Units | Model No. | | |
|---|---|---|---|---|---|
| | | | Lower Flute | | Upper Flute |
| | | | Figure 2 | Figure 1 | Figure 2 |
| | | | THDB25158RH THDB37158RH | THD50234RH | THDB25158RH THDB37158RH |
| Minimum Hole Depth | $h_{hole}$ | in. | 1¾ | 3 | 1¾ |
| Embedment Depth | $h_{nom}$ | in. | 1⅝ | 2½ | 1⅝ |
| Effective Embedment Depth | $h_{ef}$ | in. | 1.19 | 1.77 | 1.19 |
| Pullout Resistance – Cracked Concrete[2,3,4] | $N_{p,deck,cr}$ | lbf | 420 | 870 | 655 |
| Pullout Resistance – Uncracked Concrete[2,3,4] | $N_{p,deck,uncr}$ | lbf | 995 | 1,430 | 1,555 |

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17, ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. Concrete compressive strength shall be 3,000 psi minimum. The characteristic pullout resistance for greater compressive strengths shall be increased by multiplying the tabular value by $(f'_{c,specified}/3{,}000\ psi)^{0.5}$.
3. For anchors installed in the soffit of sand-lightweight or normal-weight concrete over steel deck floor and roof assemblies, as shown in Figure 1 or Figure 2, calculation of the concrete breakout strength may be omitted.
4. In accordance with ACI 318-19 Section 17.6.3.2.1, ACI 318-14 Section 17.4.3.2 or ACI 318-11 Section D.5.3.2, the nominal pullout strength in cracked concrete for anchors installed in the soffit of sand-lightweight or normal-weight-concrete-over-steel-deck floor and roof assemblies $N_{p,deck,cr}$ shall be substituted for $N_{p,cr}$. Where analysis indicates no cracking at service loads, the normal pullout strength in uncracked concrete $N_{p,deck,uncr}$ shall be substituted for $N_{p,uncr}$.
5. Minimum distance to edge of panel is $2h_{ef}$.
6. The minimum anchor spacing along the flute must be the greater of $3h_{ef}$ or 1.5 times the flute width.

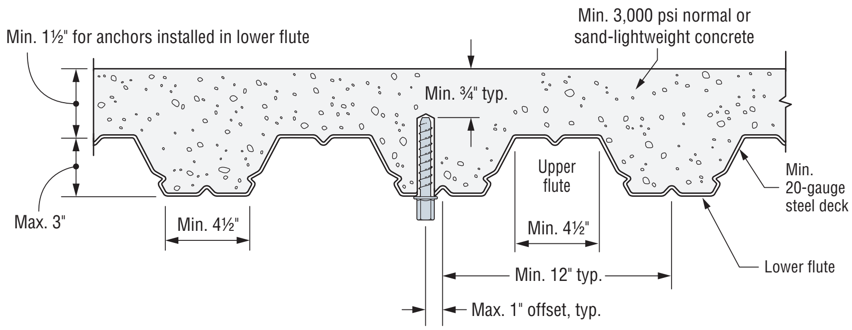



**Figure 1.** THD50234RH Installation in Concrete over Steel Deck

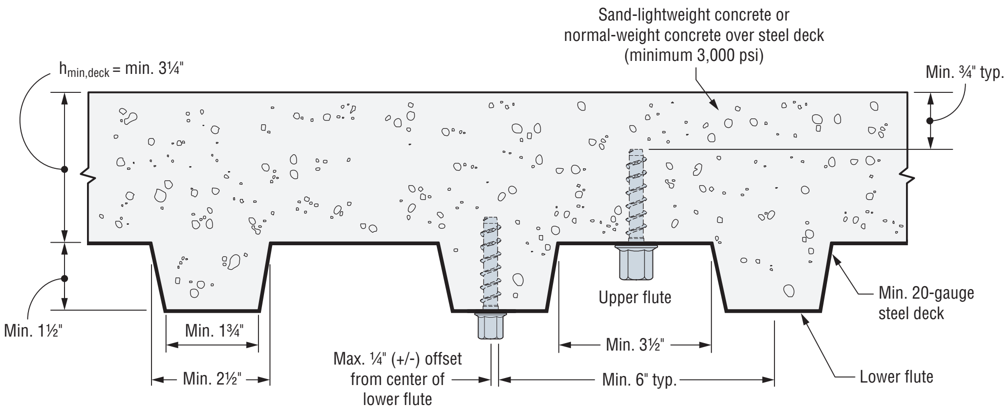



**Figure 2.** THDB25158RH and THDB37158RH Installation in Concrete over Steel Deck

*See p. 14 for an explanation of the load table icons.

# **Steel Rod Hanger** Threaded Rod Anchor System



The Simpson Strong-Tie steel rod hanger is a one-piece fastening system for suspending ¼" and ⅜" threaded rod. Vertical rod hangers are designed to suspend threaded rod in overhead applications from steel joists and beams. Horizontal rod hangers are available for applications requiring installation into the side of joists, columns and overhead members. Both rod hangers provide attachment points for use in pipe hanging, fire protection, electrical conduit and cable-tray applications. Recommended for use in dry, interior, non-corrosive environments only.

### Features

- Threaded anchors for rod-hanging applications in steel members
- Suitable to be installed horizontally or vertically in overhead applications
- Self-drilling tip, no predrilling required
- Custom-matched nut driver sets anchor to optimal depth (sold separately)

**Codes:** FM 3058980;
UL File Ex3605

**Material:** Carbon steel

**Coating:** Zinc plated

**RSH**
**Horizontal Steel Rod Hangers**

Steel Rod Hangers

| Rod Size (in.) | Size | Model No. | Drill Point | Application | Steel Thickness Range | Quantity | |
|---|---|---|---|---|---|---|---|
| | | | | | | Box | Carton |
| ¼–20 | ¼"–20 x 1" with nut | RSH25100N | #3 | Horizontal | 20 ga. – 12 ga. | 25 | 250 |
| ¼–20 | #12–20 x 1½" | RSH25112-5 | #5 | | 20 ga. – ¼" | | |
| ⅜–16 | ¼"–20 x 1" with nut | RSH37100N | #3 | | 20 ga. – 12 ga. | | |
| ⅜–16 | #12–20 x 1½" with nut | RSH37112N-5 | #5 | | 20 ga. – ¼" | | |
| ¼–20 | ¼"–20 x 1" | RSV25100 | #3 | Vertical | 20 ga. – 12 ga. | 25 | 250 |
| ⅜–16 | ¼"–20 x 1" with nut | RSV37100N | #3 | | 20 ga. – 12 ga. | | |
| ⅜–16 | ¼"–20 x 1½" | RSV37112 | #3 | | 20 ga. – 14 ga. | | |
| ⅜–16 | ¼"–20 x 1½" with nut | RSV37112N | #3 | | 20 ga. – 14 ga. | | |
| ⅜–16 | #12–20 x 1½" with nut | RSV37112N-5 | #5 | | 20 ga. – ¼" | | |
| ⅜–16 | ¼"–20 x 2" | RSV37200 | #3 | | 20 ga. – 14 ga. | | |

**RSV**
**Vertical Steel Rod Hangers**

# Nut Driver

Custom-matched nut driver sets the rod hangers to optimal depth every time.

| Model No. | Description | Quantity | |
|---|---|---|---|
| | | Box | Carton |
| RND62 | Nut driver | 10 | 60 |

**RND62**

# **Steel Rod Hanger** Threaded Rod Anchor System



## Ultimate and Allowable Loads for Vertical Steel Rod Hangers

*

| Model No. | Rod Size (in.) | Size (in.) | Loads in Various Steel Thicknesses | | | | | | | | | | | | | | UL Listed Steel Thickness Range | FM Listed Steel Thickness Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 33 mil (20 ga.) | | 43 mil (18 ga.) | | 54 mil (16 ga.) | | 68 mil (14 ga.) | | 97 mil (12 ga.) | | 3⁄16" | | ¼" | | | |
| | | | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | | |
| RSV25100 | ¼–20 | ¼ x 1 | 355 | 130 | 575 | 190 | 880 | 325 | 1,110 | 410 | 2,050 | 760 | — | — | — | — | — | — |
| RSV37100N[3] | ⅜–16 | ¼ x 1 | 1,370 | 505 | 1,980 | 730 | 3,405 | 1,260 | 3,890 | 1,440 | 3,900 | 1,440 | — | — | — | — | 20 ga. – 12 ga. | 16 ga. – 12 ga. |
| RSV37112 | ⅜–16 | ¼ x 1½ | 355 | 130 | 575 | 190 | 880 | 325 | 1,110 | 410 | — | — | — | — | — | — | — | — |
| RSV37112N[3] | ⅜–16 | ¼ x 1½ | 1,370 | 505 | 1,980 | 730 | 3,405 | 1,260 | 3,890 | 1,440 | — | — | — | — | — | — | 20 ga. – 14 ga. | 16 ga. – 14 ga. |
| RSV37200 | ⅜–16 | ¼ x 2 | 355 | 130 | 575 | 190 | 880 | 325 | 1,110 | 410 | — | — | — | — | — | — | — | — |
| RSV37112N-5[3] | ⅜–16 | #12–20 x 1½ | 1,370 | 505 | 1,980 | 730 | 2,185 | 730 | 2,185 | 730 | 2,560 | 940 | 3,290 | 1,095 | 3,290 | 1,095 | 20 ga. – ¼" | 16 ga. – ¼" |

Footnotes below apply to both tables.

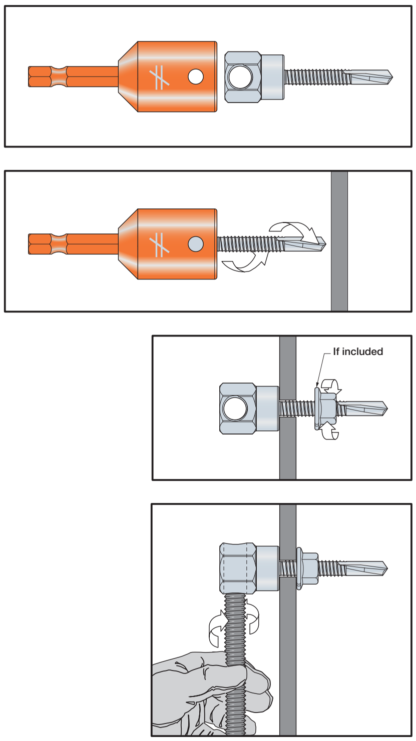
## Ultimate and Allowable Loads for Horizontal Steel Rod Hangers

*

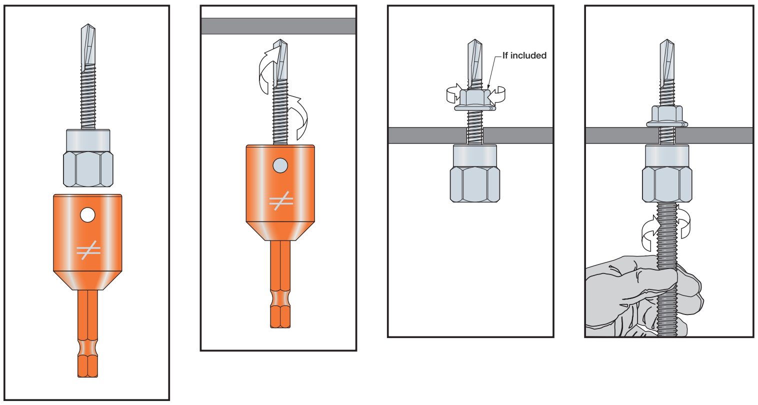
| Model No. | Rod Size (in.) | Size ( in.) | Loads in Various Steel Thicknesses | | | | | | | | | | | | | | UL Listed Steel Thickness Range | FM Listed Steel Thickness Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 33 mil (20 ga.) | | 43 mil (18 ga.) | | 54 mil (16 ga.) | | 68 mil (14 ga.) | | 97 mil (12 ga.) | | 3⁄16" | | ¼" | | | |
| | | | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | Ult. (lb.) | Allow. (lb.) | | |
| RSH25112-5 | ¼–20 | #12–20 x 1½ | 420 | 155 | 685 | 255 | 835 | 310 | 930 | 310 | 1,240 | 425 | 1,270 | 425 | 1,350 | 500 | — | — |
| RSH25100N[3] | ¼–20 | ¼ x 1 | 1,150 | 385 | 1,235 | 455 | 1,235 | 455 | 1,235 | 455 | 1,480 | 545 | — | — | — | — | — | — |
| RSH37100N[3] | ⅜–16 | ¼ x 1 | 1,575 | 525 | 1,865 | 665 | 1,865 | 665 | 1,865 | 665 | 1,865 | 665 | — | — | — | — | 18 ga. – 12 ga. | 16 ga. – 12 ga. |
| RSH37112N-5[3] | ⅜–16 | #12–20 x 1½ | 1,490 | 550 | 1,490 | 550 | 1,490 | 550 | 1,490 | 550 | 1,490 | 550 | 1,490 | 550 | 1,490 | 550 | 18 ga. – ¼" | 16 ga. – ¼" |

1. Allowable loads are based on a factor of safety calculated in accordance with AISI S100 Section F1.
2. Mechanical and plumbing design codes may prescribe lower allowable loads. Verify with local codes.
3. Model requires installation with supplied retaining nut.
4. Values are based on steel members with the following minimum yield and tensile strengths:
   - 43 mil (18 ga.) and 33 mil (20 ga.): $F_y$ = 33 ksi and $F_u$ = 45 ksi
   - 54 mil (16 ga.) to 97 mil (12 ga.): $F_y$ = 50 ksi and $F_u$ = 65 ksi
   - 3⁄16" and ¼": $F_y$ = 36 ksi and $F_u$ = 58 ksi.
5. Minimum edge distance must be 1" and minimum spacing must be 2".
6. Acceptability of base material deflection due to imposed loads must be investigated separately.

### Horizontal Installation




### Vertical Installation






*See p. 14 for an explanation of the load table icons.

# **Wood Rod Hanger** Threaded Rod Anchor System





The wood rod hanger from Simpson Strong-Tie is a one-piece fastening system for suspending ¼" or ⅜" threaded rod. Vertical rod hangers are designed to suspend threaded rod in overhead applications from wood members. Horizontal rod hangers are available for applications requiring installation into the side of joists, columns and overhead members. Both rod hangers provide attachment points for use in pipe hanging, fire protection, electrical conduit and cable-tray applications. Recommended for use in dry, interior, non-corrosive environments only.

## Features

- Threaded anchors for rod-hanging applications in wood
- Suitable for installation horizontally or vertically in overhead applications
- No predrilling required
- Type-17 point provides for fast starts

**Codes:** FM 3058980;
UL File Ex3605

**Material:** Carbon steel

**Coating:** Zinc plated

**RWH**
**Horizontal Wood Rod Hanger**

**RWV**
**Vertical Wood Rod Hanger**

### Wood Rod Hangers

| Rod Size (in.) | Size (in.) | Model No. | Application | Point Style | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Box | Carton |
| ¼–20 | ¼ x 2 | RWV25200 | Vertical | Type 17 | 25 | 250 |
| ⅜–16 | ¼ x 1 | RWV37100 | | | | |
| ⅜–16 | ¼ x 2 | RWV37200 | | | | |
| ⅜–16 | ⁵⁄₁₆ x 2½ | RWV37212 | | | | |
| ¼–20 | ¼ x 1 | RWH25100 | Horizontal | Type 17 | 25 | 250 |
| ⅜–16 | ¼ x 2 | RWH37200 | | | | |
| ⅜–16 | ⁵⁄₁₆ x 2½ | RWH37212 | | | | |

**Type-17 point for use in wood**

# **Wood Rod Hanger** Design Information — Wood

## Tension Wood Rod Hanger Allowable Loads

| Model No. | Rod Size (in.) | Size (in.) | Minimum Edge Distance (in.) | Minimum End Distance (in.) | Minimum Spacing (in.) | Allowable Tension Loads (lb.) | | | Pipe Size (in.) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | DF | SP | SPF | UL Approval | FM Approval |
| RWV25200 | ¼–20 | ¼ x 2 | ¾ | 2¾ | 2¾ | 375 | 435 | 310 | — | — |
| RWV37100 | ⅜–16 | ¼ x 1 | | | | 155 | 190 | 105 | — | — |
| RWV37200 | ⅜–16 | ¼ x 2 | | | | 375 | 435 | 310 | 3 | — |
| RWV37212 | ⅜–16 | 5⁄16 x 2½ | | 3¼ | 3¼ | 605 | 590 | 495 | 4 | 4 |

1. Load values are based on full shank penetration into the wood member.
2. Allowable loads may be increased by CD = 1.6 for wind or earthquake.
3. Allowable loads are based on a factor of safety of 5.0.
4. Mechanical and plumbing design codes may prescribe lower allowable loads. Verify with local codes.
5. Allowable loads are based on Douglas Fir–Larch (DF), Southern Pine (SP) and Spruce-Pine-Fir (SPF) wood members having a minimum specific gravity of 0.50, 0.55 and 0.42, respectively.

## Shear Wood Rod Hanger Allowable Loads

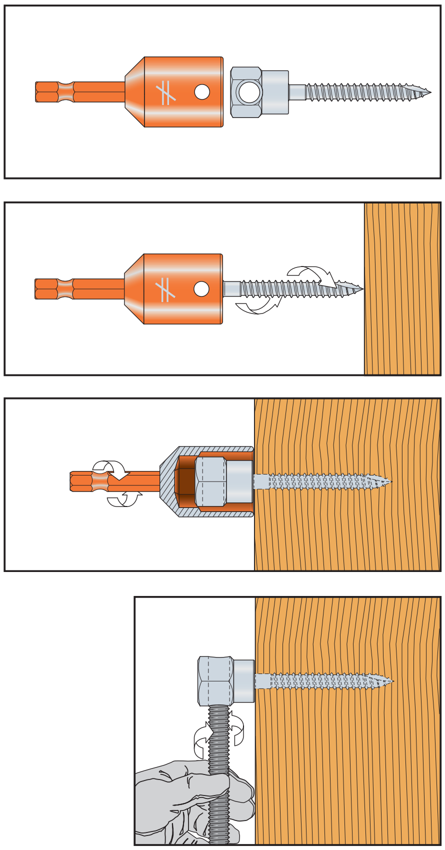
| Model No. | Rod Size (in.) | Size (in.) | Minimum Edge Distance (in.) | Minimum End Distance (in.) | Minimum Spacing (in.) | Allowable Shear Loads (lb.) | | | Pipe Size (in.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | DF | SP | SPF | UL Approval |
| RWH25100 | ¼–20 | ¼ x 1 | 1 | 2¾ | 2¾ | 110 | 135 | 85 | — |
| RWH37200 | ⅜–16 | ¼ x 2 | 2½ | | | 240 | 225 | 330 | 3 |
| RWH37212 | ⅜–16 | 5⁄16 x 2½ | | 3¼ | 3¼ | 230 | 265 | 240 | 3 |

1. Load values are based on full shank penetration into the wood member.
2. Allowable loads may not be increased for short-term loading.
3. Allowable loads are based on a factor of safety of 5.0.
4. Mechanical and plumbing design codes may prescribe lower allowable loads. Verify with local codes.
5. Allowable loads are based on Douglas Fir–Larch (DF), Southern Pine (SP) and Spruce-Pine-Fir (SPF) wood members having a minimum specific gravity of 0.50, 0.55 and 0.42, respectively.

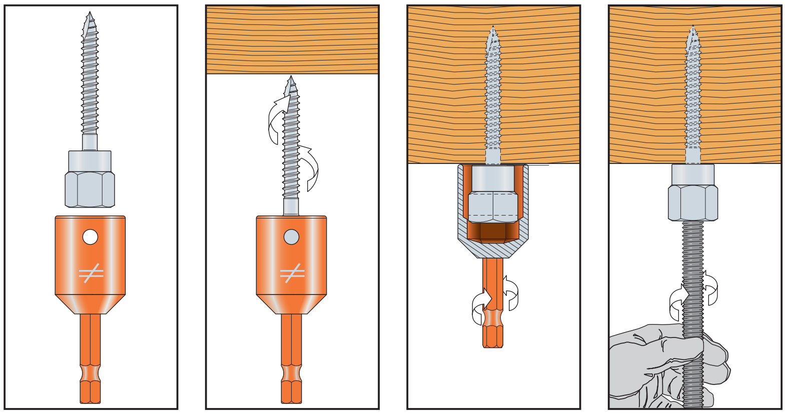
### Installation Sequence

1. Attach RND62 nut driver to a drill.
2. Insert rod hanger into the RND62 nut driver.
3. Using rotation-only mode, drive rod hanger until it contacts the surface. Do not over-tighten. RND62 nut driver will disengage the rod hanger at the appropriate depth to prevent over-driving.
4. Insert threaded rod. Minimum thread engagement should be equal to the nominal diameter of the threaded insert.

### Horizontal Wood Rod Hanger



### Vertical Wood Rod Hanger



**See p. 14 for an explanation of the load table icons.*

# **Drop-In** Internally Threaded Anchor (DIAB)



## Expansion shell anchors for use in solid base materials

Simpson Strong-Tie introduces a redesigned Drop-In Anchor (DIAB) that provides easier installation into base materials. Improved geometry in the preassembled expansion plug improves setting capability so the anchor installs with 40% fewer hammer strikes than previous versions. These displacement-controlled expansion anchors are easily set by driving the plug toward the bottom of the anchor using either the hand- or power-setting tools. DIAB anchors feature a positive-set marking indicator at the top of the anchor — helping you see more clearly when proper installation has taken place.

Use a Simpson Strong-Tie fixed-depth stop bit to take the guesswork out of drilling to the correct depth. The fluted design of the tip draws debris away from the hole during drilling, allowing for a cleaner installation.

### Key features

- Positive set marking system indicates when anchor is properly set
- Lipped drop-in version available for flush installation
- Hand- and power-setting tools available for fast, easy and economical installation
- Fixed-depth stop bit helps you drill to the correct depth every time
- Available in coil-thread version for ½" and ¾" coil-thread rod

**Codes:** FM 3053987; UL File Ex3605; Multiple DOT listings; Meets the requirements of Federal Specification A-A-55614, Type 1

**Material:** Carbon steel

**Coating:** Zinc plated

Drop-In

Lipped Drop-In

Coil-Thread Drop-In

Fixed-Depth Drill Bits for DIAB

| Model No. | Drill Bit Diameter (in.) | Drill Depth (in.) | Drop-In Anchor (in.) |
|---|---|---|---|
| MDPL037DIA | ⅜ | 1 1/16 | ¼ |
| MDPL050DIA | ½ | 1 11/16 | ⅜ |
| MDPL062DIA | ⅝ | 2 1/16 | ½ |

Fixed-Depth Drill Bit

Anchor being set with hand setting tool.

Anchor being set with SDS setting tool.

Positive set indicator.

# Drop-In Internally Threaded Anchor (DIAB)

## Drop-In Anchor

| Rod Size (in.) | Model No. | Drill Bit Dia. (in.) | Bolt Threads (per in.) | Body Length (in.) | Thread Length (in.) | Quantity | |
|---|---|---|---|---|---|---|---|
| | | | | | | Box | Carton |
| ¼ | DIAB25 | ⅜ | 20 | 1 | ⅜ | 100 | 500 |
| ⅜ | DIAB37 | ½ | 16 | 1 9⁄16 | ⅝ | 50 | 250 |
| ½ | DIAB50 | ⅝ | 13 | 2 | ¾ | 50 | 200 |
| ⅝ | DIAB62 | ⅞ | 11 | 2½ | 1 | 25 | 100 |
| ¾ | DIAB75 | 1 | 10 | 3⅛ | 1¼ | 20 | 80 |

Drop-In

## Lipped Drop-In Anchor

| Rod Size (in.) | Model No. | Drill Bit Dia. (in.) | Bolt Threads (per in.) | Body Length (in.) | Thread Length (in.) | Quantity | |
|---|---|---|---|---|---|---|---|
| | | | | | | Box | Carton |
| ¼ | DIABL25 | ⅜ | 20 | 1 | ⅜ | 100 | 500 |
| ⅜ | DIABL37 | ½ | 16 | 1 9⁄16 | ⅝ | 50 | 250 |
| ½ | DIABL50 | ⅝ | 13 | 2 | ¾ | 50 | 200 |

Lipped Drop-In

## Coil-Thread Drop-In Anchor

| Rod Size (in.) | Model No. | Drill Bit Dia. (in.) | Bolt Threads (per in.) | Body Length (in.) | Thread Length (in.) | Quantity | |
|---|---|---|---|---|---|---|---|
| | | | | | | Box | Carton |
| ½ | DIAB50C[1] | ⅝ | 6 | 2 | ¾ | 50 | 200 |
| ¾ | DIAB75C[1] | 1 | 4½ | 3⅛ | 1¼ | 20 | 80 |

1. DIAB50C and DIAB75C accept ½" and ¾" coil-thread rod, respectively.

Coil-Thread Drop-In

## Drop-In Anchor Hand-Setting Tool

| Model No. | Description | Box Quantity | Carton Qty. |
|---|---|---|---|
| DIABST25 | Setting tool for use with Drop-In models DIAB25, DIABL25 | 10 | 50 |
| DIABST37 | Setting tool for use with Drop-In models DIAB37, DIABL37 | 10 | 50 |
| DIABST50 | Setting tool for use with Drop-In models DIAB50, DIABL50, DIAB50C | 10 | 50 |
| DIABST62 | Setting tool for use with Drop-In model DIAB62 | 5 | 25 |
| DIABST75 | Setting tool for use with Drop-In models DIAB75, DIAB75C | 5 | 20 |

1. Setting tools sold separately. Tools may be ordered by the piece.

Hand-Setting Tool

## Drop-In Anchor Power-Setting Tool (SDS-plus®)

| Model No. | Description | Box Quantity | Carton Qty. |
|---|---|---|---|
| DIABST25-SDS | Power-setting tool for use with Drop-In models DIAB25, DIABL25 | 10 | 50 |
| DIABST37-SDS | Power-setting tool for use with Drop-In models DIAB37, DIABL37 | 10 | 50 |
| DIABST50-SDS | Power-setting tool for use with Drop-In models DIAB50, DIABL50, DIAB50C | 10 | 50 |

1. Setting tools sold separately. Tools may be ordered by the piece.

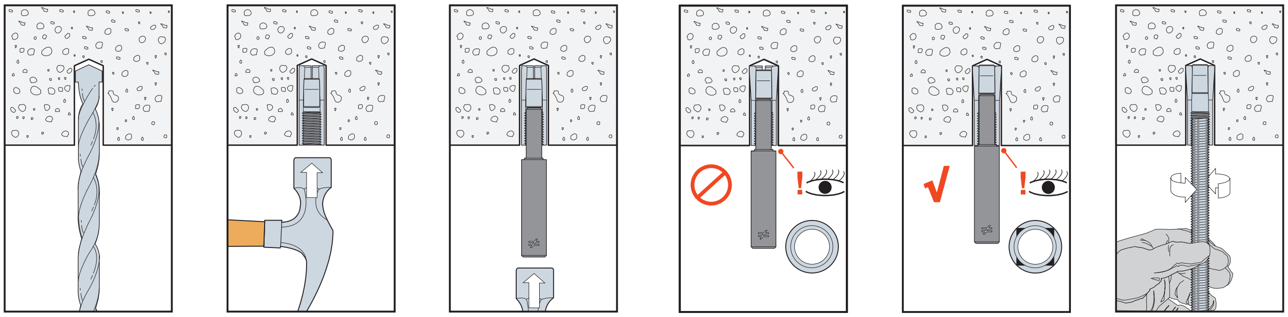
Power-Setting Tool

# **Drop-In** Internally Threaded Anchor (DIAB)

## DIAB Manual Installation

**Caution:** Oversized holes will reduce the anchors load capacity

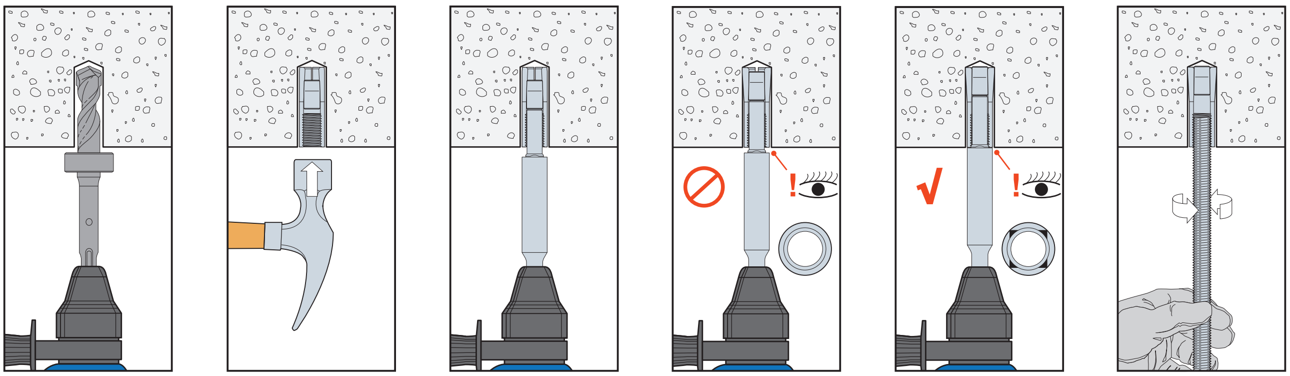
1. Drill a hole in the base material using the appropriate diameter carbide drill bit or fixed-depth bit as specified in the table. Drill the hole to the specified embedment. For fixed-depth bits, drill the hole until the shoulder of the bit contacts the surface of the base material. Then blow the hole clean of dust and debris using compressed air. Overhead installations need not be blown clean.
2. Insert the anchor into the hole. Tap with hammer until flush against the surface.
3. Using the designated Drop-In setting tool, drive expander plug towards the bottom of the anchor until the shoulder of the setting tool makes contact with the top of the anchor. When properly set, four indentations will be visible on the top of the anchor indicating full expansion.
4. Insert bolt or threaded rod. Minimum thread engagement should be equal to the nominal diameter of the threaded insert.



## DIAB SDS Installation

**Caution:** Oversized holes will reduce the anchors load capacity

1. Drill a hole in the base material using the appropriate diameter carbide drill bit or fixed-depth drill bit as specified in the table. Drill the hole to the specified embedment. For fixed-depth bits, drill the hole until the shoulder of the bit contacts the surface of the base material. Then blow the hole clean of dust and debris using compressed air. Overhead installations need not be blown clean.
2. Insert the anchor into the hole. Tap with hammer until flush against the surface.
3. Attach SDS Drop-In setting tool to a drill. Drive expander plug towards the bottom of the anchor using only hammer mode until the shoulder of the setting tool makes contact with the top of the anchor. When properly set, four indentations will be visible on the top of the anchor indicating full expansion.
4. Insert bolt or threaded rod. Minimum thread engagement should be equal to the nominal diameter of the threaded insert.



SIMPSON Strong-Tie

# Drop-In (DIAB) Design Information — Concrete

## DIAB Allowable Tension and Shear Loads in Normal-Weight Concrete

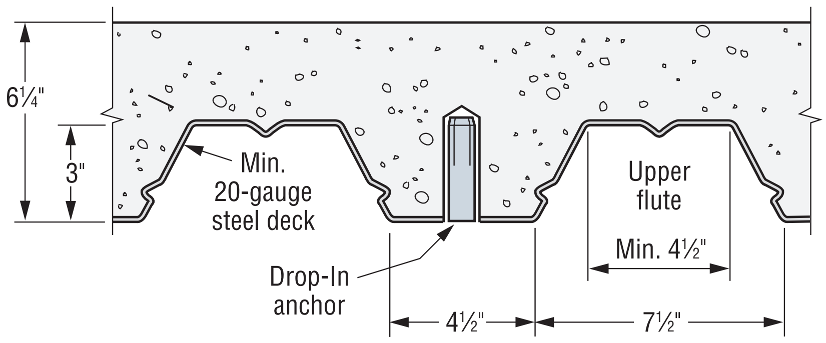
| Model No. | Rod Size in. (mm) | Drill Bit Dia. in. | Embed Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing in. (mm) | $f'_c \geq$ 2,500 psi (17.2 MPa) | | | | $f'_c \geq$ 4,000 psi (27.6 MPa) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tension Load | | Shear Load | | Tension Load | | Shear Load | |
| | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| DIAB25<br>DIABL25 | ¼<br>(6.4) | ⅜ | 1<br>(25) | 3<br>(76) | 4<br>(102) | 1,565<br>(7.0) | 390<br>(1.7) | 1,840<br>(8.2) | 460<br>(2.0) | 1,965<br>(8.7) | 490<br>(2.2) | 1,840<br>(8.2) | 460<br>(2.0) |
| DIAB37<br>DIABL37 | ⅜<br>(9.5) | ½ | 1 9/16<br>(40) | 4½<br>(114) | 6<br>(152) | 2,950<br>(13.1) | 740<br>(3.3) | 4,775<br>(21.2) | 1,195<br>(5.3) | 3,910<br>(17.4) | 980<br>(4.4) | 4,775<br>(21.2) | 1,195<br>(5.3) |
| DIAB50<br>DIABL50<br>DIAB50C | ½<br>(12.7) | ⅝ | 2<br>(51) | 6<br>(152) | 8<br>(203) | 5,190<br>(23.1) | 1,300<br>(5.8) | 6,760<br>(30.1) | 1,690<br>(7.5) | 6,515<br>(29.0) | 1,630<br>(7.3) | 6,760<br>(30.1) | 1,690<br>(7.5) |
| DIAB62 | ⅝<br>(15.9) | ⅞ | 2½<br>(64) | 7½<br>(191) | 10<br>(254) | 7,010<br>(31.2) | 1,755<br>(7.8) | 12,190<br>(54.2) | 3,050<br>(13.6) | 9,060<br>(40.3) | 2,265<br>(10.1) | 12,190<br>(54.2) | 3,050<br>(13.6) |
| DIAB75<br>DIAB75C | ¾<br>(19.1) | 1 | 3⅛<br>(79) | 9<br>(229) | 12½<br>(318) | 9,485<br>(42.2) | 2,370<br>(10.5) | 15,960<br>(71.0) | 3,990<br>(17.7) | 11,660<br>(51.9) | 2,915<br>(13.0) | 15,960<br>(71.0) | 3,990<br>(17.7) |

1. The allowable loads listed are based on a safety factor of 4.0.
2. Refer to allowable load-adjustment factors for edge distance and spacing on p. 148.
3. Allowable loads may be linearly interpolated between concrete strength listed.
4. The minimum concrete thickness is 1½ times the embedment depth.
5. Allowable loads may not be increased for short-term loading due to wind or seismic forces.

## DIAB Allowable Tension and Shear Loads in Soffit of Sand-Lightweight Concrete over Steel Deck

| Model No. | Rod Size in. (mm) | Drill Bit Dia. in. | Embed Depth in. (mm) | Critical End Dist.[6] in. (mm) | Critical Spacing in. (mm) | $f'_c \geq$ 3,000. psi (20.7 MPa) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tension Load | | Shear Load | |
| | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| DIAB37<br>DIABL37 | ⅜<br>(9.5) | ½ | 1 9/16<br>(40) | 4½<br>(114) | 6<br>(152) | 2,895<br>(12.9) | 725<br>(3.2) | 3,530<br>(15.7) | 885<br>(3.9) |
| DIAB50<br>DIABL50<br>DIAB50C | ½<br>(12.7) | ⅝ | 2<br>(51) | 6<br>(152) | 8<br>(203) | 4,100<br>(18.2) | 1,025<br>(4.6) | 4,685<br>(20.8) | 1,170<br>(5.2) |

1. The allowable loads listed are based on a safety factor of 4.0.
2. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
3. Refer to allowable load-adjustment factors for edge distance and spacing on p. 148.
4. Anchors were installed in the center of the bottom flute of the steel deck.
5. Steel deck must be minimum 20-gauge thick with minimum yield strength of 33 ksi.
6. Critical end distance is defined as the distance from end of the slab in the direction of the flute.




**Lightweight Concrete over Steel Deck**

*See p. 14 for an explanation of the load table icons.

Mechanical Anchors

# **Drop-In** (DIAB) Design Information — Concrete

## Allowable Load-Adjustment Factors for Drop-In Anchor (DIAB) in Normal-Weight Concrete and Sand-Lightweight Concrete over Steel Deck: Edge Distance and Spacing, Tension and Shear Loads

### How to use these charts:

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or a shear load application.
3. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
4. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
5. Multiply the allowable load by the applicable load adjustment factor.
6. Reduction factors for multiple edges or spacing are multiplied together.

### Edge Distance Tension ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Size | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | $c_{cr}$ | 3 | 4½ | 6 | 7½ | 9 |
| | $c_{min}$ | 1¾ | 2⅝ | 3½ | 4⅜ | 5¼ |
| | $f_{cmin}$ | **0.77** | **0.77** | **0.77** | **0.77** | **0.77** |
| 1¾ | | 0.77 | | | | |
| 2 | | 0.82 | | | | |
| 2½ | | 0.91 | | | | |
| 2⅝ | | 0.93 | 0.77 | | | |
| 3 | | 1.00 | 0.82 | | | |
| 3½ | | | 0.88 | 0.77 | | |
| 4 | | | 0.94 | 0.82 | | |
| 4⅜ | | | 0.98 | 0.85 | 0.77 | |
| 4½ | | | 1.00 | 0.86 | 0.78 | |
| 5 | | | | 0.91 | 0.82 | |
| 5¼ | | | | 0.93 | 0.83 | 0.77 |
| 5½ | | | | 0.95 | 0.85 | 0.79 |
| 6 | | | | 1.00 | 0.89 | 0.82 |
| 6½ | | | | | 0.93 | 0.85 |
| 7 | | | | | 0.96 | 0.88 |
| 7½ | | | | | 1.00 | 0.91 |
| 8 | | | | | | 0.94 |
| 8½ | | | | | | 0.97 |
| 9 | | | | | | 1.00 |

1. $c_{act}$ = actual edge distance at which anchor is installed (inches).
2. $c_{cr}$ = critical edge distance for 100% load (inches).
3. $c_{min}$ = minimum edge distance for reduced load (inches).
4. $f_c$ = adjustment factor for allowable load at actual edge distance.
5. $f_{ccr}$ = adjustment factor for allowable load at critical edge distance. $f_{ccr}$ is always = 1.00.
6. $f_{cmin}$ = adjustment factor for allowable load at minimum edge distance.
7. $f_c = f_{cmin} + [(1 - f_{cmin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

### Edge Distance Shear ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Size | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | $c_{cr}$ | 3 | 4½ | 6 | 7½ | 9 |
| | $c_{min}$ | 1¾ | 2⅝ | 3½ | 4⅜ | 5¼ |
| | $f_{cmin}$ | **0.54** | **0.54** | **0.64** | **0.64** | **0.64** |
| 1¾ | | 0.54 | | | | |
| 2 | | 0.63 | | | | |
| 2½ | | 0.82 | | | | |
| 2⅝ | | 0.86 | 0.54 | | | |
| 3 | | 1.00 | 0.63 | | | |
| 3½ | | | 0.75 | 0.64 | | |
| 4 | | | 0.88 | 0.71 | | |
| 4⅜ | | | 0.97 | 0.77 | 0.64 | |
| 4½ | | | 1.00 | 0.78 | 0.65 | |
| 5 | | | | 0.86 | 0.71 | |
| 5¼ | | | | 0.89 | 0.74 | 0.64 |
| 5½ | | | | 0.93 | 0.77 | 0.66 |
| 6 | | | | 1.00 | 0.83 | 0.71 |
| 6½ | | | | | 0.88 | 0.76 |
| 7 | | | | | 0.94 | 0.81 |
| 7½ | | | | | 1.00 | 0.86 |
| 8 | | | | | | 0.90 |
| 8½ | | | | | | 0.95 |
| 9 | | | | | | 1.00 |

1. $c_{act}$ = actual edge distance at which anchor is installed (inches).
2. $c_{cr}$ = critical edge distance for 100% load (inches).
3. $c_{min}$ = minimum edge distance for reduced load (inches).
4. $f_c$ = adjustment factor for allowable load at actual edge distance.
5. $f_{ccr}$ = adjustment factor for allowable load at critical edge distance. $f_{ccr}$ is always = 1.00.
6. $f_{cmin}$ = adjustment factor for allowable load at minimum edge distance.
7. $f_c = f_{cmin} + [(1 - f_{cmin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

### Spacing Tension ($f_s$)

| Spacing $s_{act}$ (in.) | Size | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | $s_{cr}$ | 4 | 6 | 8 | 10 | 12½ |
| | $s_{min}$ | 1½ | 2¼ | 3 | 3¾ | 4¾ |
| | $f_{smin}$ | **0.72** | **0.72** | **0.80** | **0.80** | **0.80** |
| 1½ | | 0.72 | | | | |
| 2 | | 0.78 | | | | |
| 2¼ | | 0.80 | 0.72 | | | |
| 2½ | | 0.83 | 0.74 | | | |
| 3 | | 0.89 | 0.78 | 0.80 | | |
| 3½ | | 0.94 | 0.81 | 0.82 | | |
| 3¾ | | 0.97 | 0.83 | 0.83 | 0.80 | |
| 4 | | 1.00 | 0.85 | 0.84 | 0.81 | |
| 4½ | | | 0.89 | 0.86 | 0.82 | |
| 4¾ | | | 0.91 | 0.87 | 0.83 | 0.80 |
| 5 | | | 0.93 | 0.88 | 0.84 | 0.81 |
| 5½ | | | 0.96 | 0.90 | 0.86 | 0.82 |
| 6 | | | 1.00 | 0.92 | 0.87 | 0.83 |
| 6½ | | | | 0.94 | 0.89 | 0.85 |
| 7 | | | | 0.96 | 0.90 | 0.86 |
| 7½ | | | | 0.98 | 0.92 | 0.87 |
| 8 | | | | 1.00 | 0.94 | 0.88 |
| 8½ | | | | | 0.95 | 0.90 |
| 9 | | | | | 0.97 | 0.91 |
| 9½ | | | | | 0.98 | 0.92 |
| 10 | | | | | 1.00 | 0.94 |
| 10½ | | | | | | 0.95 |
| 11 | | | | | | 0.96 |
| 11½ | | | | | | 0.97 |
| 12 | | | | | | 0.99 |
| 12½ | | | | | | 1.00 |

1. $s_{act}$ = actual spacing distance at which anchor is installed (inches).
2. $s_{cr}$ = critical spacing distance for 100% load (inches).
3. $s_{min}$ = minimum spacing distance for reduced load (inches).
4. $f_s$ = adjustment factor for allowable load at actual spacing distance.
5. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
6. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
7. $f_s = f_{smin} + [(1 - f_{smin}) (s_{act} - s_{min}) / (s_{cr} - s_{min})]$.

### Spacing Shear ($f_s$)

| Spacing $s_{act}$ (in.) | Size | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | $s_{cr}$ | 4 | 6 | 8 | 10 | 12½ |
| | $s_{min}$ | 1½ | 2¼ | 3 | 3¾ | 4¾ |
| | $f_{smin}$ | **1.00** | **1.00** | **1.00** | **1.00** | **1.00** |
| 1½ | | 1.00 | | | | |
| 2 | | 1.00 | | | | |
| 2¼ | | 1.00 | 1.00 | | | |
| 2½ | | 1.00 | 1.00 | | | |
| 3 | | 1.00 | 1.00 | 1.00 | | |
| 3½ | | 1.00 | 1.00 | 1.00 | | |
| 3¾ | | 1.00 | 1.00 | 1.00 | 1.00 | |
| 4 | | 1.00 | 1.00 | 1.00 | 1.00 | |
| 4½ | | | 1.00 | 1.00 | 1.00 | |
| 4¾ | | | 1.00 | 1.00 | 1.00 | 1.00 |
| 5 | | | 1.00 | 1.00 | 1.00 | 1.00 |
| 5½ | | | 1.00 | 1.00 | 1.00 | 1.00 |
| 6 | | | 1.00 | 1.00 | 1.00 | 1.00 |
| 6½ | | | | 1.00 | 1.00 | 1.00 |
| 7 | | | | 1.00 | 1.00 | 1.00 |
| 7½ | | | | 1.00 | 1.00 | 1.00 |
| 8 | | | | 1.00 | 1.00 | 1.00 |
| 8½ | | | | | 1.00 | 1.00 |
| 9 | | | | | 1.00 | 1.00 |
| 9½ | | | | | 1.00 | 1.00 |
| 10 | | | | | 1.00 | 1.00 |
| 10½ | | | | | | 1.00 |
| 11 | | | | | | 1.00 |
| 11½ | | | | | | 1.00 |
| 12 | | | | | | 1.00 |
| 12½ | | | | | | 1.00 |

1. $s_{act}$ = actual spacing distance at which anchor is installed (inches).
2. $s_{cr}$ = critical spacing distance for 100% load (inches).
3. $s_{min}$ = minimum spacing distance for reduced load (inches).
4. $f_s$ = adjustment factor for allowable load at actual spacing distance.
5. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
6. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
7. $f_s = f_{smin} + [(1 - f_{smin}) (s_{act} - s_{min}) / (s_{cr} - s_{min})]$.





*See p. 14 for an explanation of the load table icons.

# **Drop-In** Short Internally Threaded Anchor (DIAS)



Drop-in anchors are internally threaded drop-in expansion anchors for use in flush-mount applications in solid base materials. Minimum thread engagement should be equal to the nominal diameter of the threaded insert.

**DIAS**
**Short Drop-In**

## Features

- Lipped edge eliminates need for precisely drilled hole depth
- Hand- and power-setting tools available for fast, easy and economical installation
- Fixed-depth stop bit helps you drill to the correct depth every time
- Short length enables shallow embedment to help avoid drilling into rebar or pre-stressed/post-tensioned cables
- Short drop-in anchors include a setting tool compatible with the anchor to ensure consistent installation

**Material:** Carbon steel

**Coating:** Zinc plated

**Codes:** DOT; Factory Mutual 3017082; Underwriters Laboratories File Ex3605

## Installation

1. Drill a hole in the base material using the appropriate diameter carbide drill bit as specified in the table. Drill the hole to the specified embedment depth plus ⅛" for flush mounting. Blow the hole clean using compressed air. Overhead installations need not be blown clean.
2. Insert designated anchor into hole. Tap with hammer until flush against surface.
3. Using the designated drop-in setting tool, drive expander plug toward the bottom of the anchor until shoulder of setting tool makes contact with the top of the anchor.
4. Minimum thread engagement should be equal to the nominal diameter of the threaded insert.

**Caution:** Oversized holes will make it difficult to set the anchor and will reduce the anchor's load capacity.

### Material Specifications

| Anchor Component | Component Material |
|---|---|
| | Zinc-Plated Carbon Steel |
| Anchor Body | Meets minimum 70,000 psi tensile |
| Expander Plug | Meets minimum 50,000 psi tensile |
| Thread | UNC/Coil-thread |

### Fixed-Depth Drill Bits for DIAS

| Model No. | Drill Bit Diameter (in.) | Drill Depth (in.) | Drop-In Anchor (in.) |
|---|---|---|---|
| MDPL050DIAS | ½ | 13/16 | ⅜ |
| MDPL062DIAS | ⅝ | 1 1/16 | ½ |

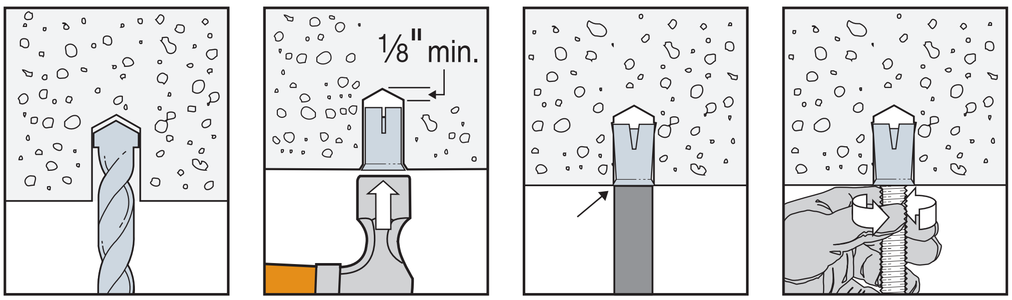
**Fixed-Depth Drill Bit**

### Short Drop-In Anchor Product Data

| Rod Size (in.) | Model No. | Drill Bit Diameter (in.) | Bolt Threads (per in.) | Body Length (in.) | Thread Length (in.) | Quantity | |
|---|---|---|---|---|---|---|---|
| | | | | | | Box | Carton |
| ⅜ | DIA37S [1] | ½ | 16 | ¾ | ¼ | 100 | 500 |
| ½ | DIA50S [1] | ⅝ | 13 | 1 | 5/16 | 50 | 200 |

1. A dedicated setting tool is included with each box of DIA37S and DIA50S.

## Installation Sequence



# **Drop-In** Short (DIAS) Design Information — Concrete

SIMPSON Strong-Tie



## Allowable Tension and Shear Loads for ⅜" and ½" Short Drop-In Anchor in Sand-Lightweight Concrete Fill over Steel Deck

| Model No. | Rod Size (in.) | Drill Bit Dia. (in.) | Emb. Depth (in.) | Tension Critical End Distance (in.) | Shear Critical End Distance (in.) | Critical Spacing (in.) | Install Through the Lower Flute or Upper Flute of Steel Deck, $f'_c \geq$ 3,000 psi Concrete (20.7 MPa) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Tension Load | | Shear Load | |
| | | | | | | | Ultimate (lb.) | Allowable (lb.) | Ultimate (lb.) | Allowable (lb.) |
| DIA37S | ⅜ | ½ | ¾ | 6 | 7 | 8 | 1,345 | 335 | 1,650 | 410 |
| DIA50S | ½ | ⅝ | 1 | 8 | 9⅜ | 10⅝ | 1,710 | 430 | 2,070 | 515 |

1. The allowable loads listed are based on a safety factor of 4.0.
2. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
3. Refer to allowable load-adjustment factors for edge distances and spacing on p. 152.
4. Anchors were installed with a 1" offset from the centerline of the flute.

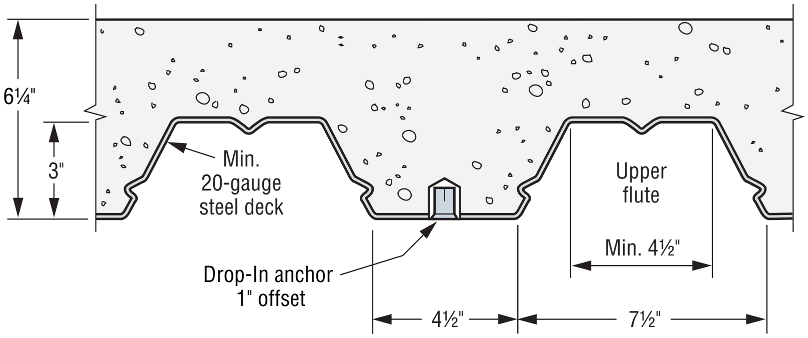



**Figure 1.** Lightweight Concrete over Steel Deck

## Allowable Tension and Shear Loads for ⅜" and ½" Short Drop-In Anchor in Normal-Weight Concrete

| Model No. | Rod Size (in.) | Drill Bit Dia. (in.) | Emb. Depth (in.) | Tension Critical Edge Distance (in.) | Shear Critical Edge Distance (in.) | Critical Spacing (in.) | Normal-Weight Concrete, $f'_c \geq$ 2500 psi | | | | Normal-Weight Concrete, $f'_c \geq$ 4,000 psi | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Tension Load | | Shear Load | | Tension Load | | Shear Load | |
| | | | | | | | Ultimate (lb.) | Allowable (lb.) | Ultimate (lb.) | Allowable (lb.) | Ultimate (lb.) | Allowable (lb.) | Ultimate (lb.) | Allowable (lb.) |
| DIA37S | ⅜ | ½ | ¾ | 4½ | 5¼ | 3 | 1,500 | 375 | 2,275 | 570 | 2,170 | 540 | 3,480 | 870 |
| DIA50S | ½ | ⅝ | 1 | 6 | 7 | 4 | 2,040 | 510 | 3,225 | 805 | 3,420 | 855 | 5,175 | 1,295 |

1. The allowable loads listed are based on a safety factor of 4.0.
2. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
3. Refer to allowable load-adjustment factors for edge distances and spacing on p. 151.
4. Allowable loads may be linearly interpolated between concrete strengths.
5. The minimum concrete thickness is 1½ times the embedment depth.

## Allowable Tension and Shear Loads for ⅜" and ½" Short Drop-In Anchor in Hollow-Core Concrete Panel

| Model No. | Rod Size (in.) | Drill Bit Dia. (in.) | Emb. Depth (in.) | Tension Critical Edge Distance (in.) | Shear Critical Edge Distance (in.) | Critical Spacing (in.) | Hollow Core Concrete Panel, $f'_c \geq$ 4,000 psi | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Tension Load | | Shear Load | |
| | | | | | | | Ultimate (lb.) | Allowable (lb.) | Ultimate (lb.) | Allowable (lb.) |
| DIA37S | ⅜ | ½ | ¾ | 4½ | 5¼ | 3 | 1,860 | 465 | 3,310 | 825 |
| DIA50S | ½ | ⅝ | 1 | 6 | 7 | 4 | 2,650 | 660 | 4,950 | 1,235 |

1. The allowable loads listed are based on a safety factor of 4.0.
2. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
3. Refer to allowable load-adjustment factors for edge distances and spacing on p. 151.
4. Allowable loads may be linearly interpolated between concrete strengths.

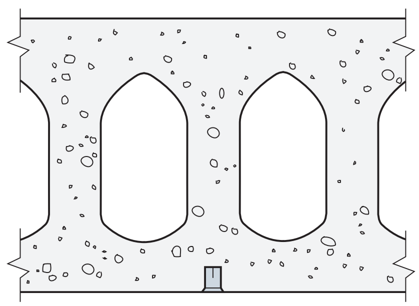


**Figure 2.** Hollow-Core Concrete Panel
*(anchor can be installed below web or hollow core)*

*See p. 14 for an explanation of the load table icons.

# **Drop-In** Short (DIAS) Design Information — Concrete



## Allowable Load-Adjustment Factors for Short Drop-In Anchors in Normal-Weight Concrete: Edge Distance and Spacing, Tension and Shear Loads

**How to use these charts:**

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
4. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
5. Multiply the allowable load by the applicable load adjustment factor.
6. Reduction factors for multiple edges or spacing are multiplied together.

### Edge Distance Tension ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Size | ⅜ | ½ |
|---|---|---|---|
| | $c_{cr}$ | **4½** | **6** |
| | $c_{min}$ | **2⅝** | **3½** |
| | $f_{cmin}$ | **0.65** | **0.65** |
| 2⅝ | | 0.65 | |
| 3 | | 0.72 | |
| 3½ | | 0.81 | 0.65 |
| 4 | | 0.91 | 0.72 |
| 4⅜ | | 0.98 | 0.77 |
| 4½ | | 1.00 | 0.79 |
| 5 | | | 0.86 |
| 5¼ | | | 0.90 |
| 5½ | | | 0.93 |
| 6 | | | 1.00 |

See notes below.

### Edge Distance Shear ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Size | ⅜ | ½ |
|---|---|---|---|
| | $c_{cr}$ | **5¼** | **7** |
| | $c_{min}$ | **2⅝** | **3½** |
| | $f_{cmin}$ | **0.45** | **0.45** |
| 2⅝ | | 0.45 | |
| 3 | | 0.53 | |
| 3½ | | 0.63 | 0.45 |
| 4 | | 0.74 | 0.53 |
| 4⅜ | | 0.82 | 0.59 |
| 4½ | | 0.84 | 0.61 |
| 5 | | 0.95 | 0.69 |
| 5¼ | | 1.00 | 0.73 |
| 5½ | | | 0.76 |
| 6 | | | 0.84 |
| 6½ | | | 0.92 |
| 7 | | | 1.00 |

1. $c_{act}$ = actual edge distance at which anchor is installed (inches).
2. $c_{cr}$ = critical edge distance for 100% load (inches).
3. $c_{min}$ = minimum edge distance for reduced load (inches).
4. $f_c$ = adjustment factor for allowable load at actual edge distance.
5. $f_{ccr}$= adjustment factor for allowable load at critical edge distance. $f_{ccr}$ is always = 1.00.
6. $f_{cmin}$ = adjustment factor for allowable load at minimum edge distance.
7. $f_c = f_{cmin} + [(1 - f_{cmin})(c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

### Spacing Tension and Shear ($f_s$)

| $s_{act}$ (in.) | Size | ⅜ | ½ |
|---|---|---|---|
| | $s_{cr}$ | **3** | **4** |
| | $s_{min}$ | **1½** | **2** |
| | $f_{smin}$ | **0.50** | **0.50** |
| 1½ | | 0.50 | |
| 2 | | 0.67 | 0.50 |
| 2½ | | 0.83 | 0.63 |
| 3 | | 1.00 | 0.75 |
| 3½ | | | 0.88 |
| 4 | | | 1.00 |

1. $s_{act}$ = actual spacing distance at which anchors are installed (inches).
2. $s_{cr}$ = critical spacing distance for 100% load (inches).
3. $s_{min}$ = minimum spacing distance for reduced load (inches).
4. $f_s$ = adjustment factor for allowable load at actual spacing distance.
5. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
6. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
7. $f_s = f_{smin} + [(1 - f_{smin})(s_{act} - s_{min}) / (s_{cr} - s_{min})]$.

**See p. 14 for an explanation of the load table icons.*

## Allowable Load-Adjustment Factors for Short Drop-in Anchors in Sand-Lightweight Concrete over Steel Deck: Edge Distance and Spacing, Tension and Shear Loads

**How to use these charts:**

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
4. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
5. Multiply the allowable load by the applicable load adjustment factor.
6. Reduction factors for multiple edges or spacing are multiplied together.

### Edge Distance Tension ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Size | ⅜ | ½ |
|---|---|---|---|
| | $c_{cr}$ | 6 | 8 |
| | $c_{min}$ | 3½ | 4¾ |
| | $f_{cmin}$ | 0.65 | 0.65 |
| 3½ | | 0.65 | |
| 4 | | 0.72 | |
| 4½ | | 0.79 | |
| 4¾ | | 0.83 | 0.65 |
| 5 | | 0.86 | 0.68 |
| 5½ | | 0.93 | 0.73 |
| 6 | | 1.00 | 0.78 |
| 6½ | | | 0.84 |
| 7 | | | 0.89 |
| 7½ | | | 0.95 |
| 8 | | | 1.00 |

See notes below.

### Edge Distance Shear ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Size | ⅜ | ½ |
|---|---|---|---|
| | $c_{cr}$ | 7 | 9⅜ |
| | $c_{min}$ | 3½ | 4¾ |
| | $f_{cmin}$ | 0.45 | 0.45 |
| 3½ | | 0.45 | |
| 4 | | 0.53 | |
| 4½ | | 0.61 | |
| 4¾ | | 0.65 | 0.45 |
| 5 | | 0.69 | 0.48 |
| 5½ | | 0.76 | 0.54 |
| 6 | | 0.84 | 0.60 |
| 6½ | | 0.92 | 0.66 |
| 7 | | 1.00 | 0.72 |
| 7½ | | | 0.78 |
| 8 | | | 0.84 |
| 8½ | | | 0.90 |
| 9 | | | 0.96 |
| 9⅜ | | | 1.00 |

1. $c_{act}$ = actual edge distance at which anchor is installed (inches).
2. $c_{cr}$ = critical edge distance for 100% load (inches).
3. $c_{min}$ = minimum edge distance for reduced load (inches).
4. $f_c$ = adjustment factor for allowable load at actual edge distance.
5. $f_{ccr}$ = adjustment factor for allowable load at critical edge distance. $f_{ccr}$ is always = 1.00.
6. $f_{cmin}$ = adjustment factor for allowable load at minimum edge distance.
7. $f_c = f_{cmin} + [(1 - f_{cmin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

### Spacing Tension and Shear ($f_s$)

| $s_{act}$ (in.) | Size | ⅜ | ½ |
|---|---|---|---|
| | $s_{cr}$ | 8 | 10⅝ |
| | $s_{min}$ | 4 | 5¼ |
| | $f_{smin}$ | 0.50 | 0.50 |
| 4 | | 0.50 | |
| 4½ | | 0.56 | |
| 5 | | 0.63 | |
| 5¼ | | 0.66 | 0.50 |
| 6 | | 0.75 | 0.57 |
| 6½ | | 0.81 | 0.62 |
| 7 | | 0.88 | 0.66 |
| 7½ | | 0.94 | 0.71 |
| 8 | | 1.00 | 0.76 |
| 8½ | | | 0.80 |
| 9 | | | 0.85 |
| 9½ | | | 0.90 |
| 10 | | | 0.94 |
| 10⅝ | | | 1.00 |

1. $s_{act}$ = actual spacing distance at which anchors are installed (inches).
2. $s_{cr}$ = critical spacing distance for 100% load (inches).
3. $s_{min}$ = minimum spacing distance for reduced load (inches).
4. $f_s$ = adjustment factor for allowable load at actual spacing distance.
5. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
6. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
7. $f_s = f_{smin} + [(1 - f_{smin}) (s_{act} - s_{min}) / (s_{cr} - s_{min})]$.

*See p. 14 for an explanation of the load table icons.

# **Drop-In** Stainless-Steel Internally Threaded Anchor (DIASS)



Drop-in anchors are internally threaded drop-in expansion anchors for use in flush-mount applications in solid base materials. Minimum thread engagement should be equal to the nominal diameter of the threaded insert.

### Features

- Hand- and power-setting tools available for fast, easy and economical installation
- Fixed-depth stop bit helps you drill to the correct depth every time

**Material:** Stainless steel

**Codes:** DOT; Factory Mutual 3017082; Underwriters Laboratories File Ex3605. Meets requirements of Federal Specifications A-A-55614, Type I.

### Installation

1. Drill a hole in the base material using the appropriate diameter carbide drill bit as specified in the table. Drill the hole to the specified embedment depth plus ⅛" for flush mounting. Blow the hole clean using compressed air. Overhead installations need not be blown clean.
2. Insert designated anchor into hole. Tap with hammer until flush against surface.
3. Using the designated drop-in setting tool, drive expander plug toward the bottom of the anchor until shoulder of setting tool makes contact with the top of the anchor.
4. Minimum thread engagement should be equal to the nominal diameter of the threaded insert.

**Caution:** Oversized holes will make it difficult to set the anchor and will reduce the anchor's load capacity.

**DIASS**
**Stainless-Steel Drop-In**

**Fixed-Depth Drill Bit**

## Material Specifications

| Anchor Component | Component Material | |
|---|---|---|
| | Type 303 or 304 Stainless Steel | Type 316 Stainless Steel |
| Anchor Body | AISI 303. Meets chemical requirements of ASTM A582 | Type 316 |
| Expander Plug | AISI 303 | Type 316 |
| Thread | UNC | UNC |

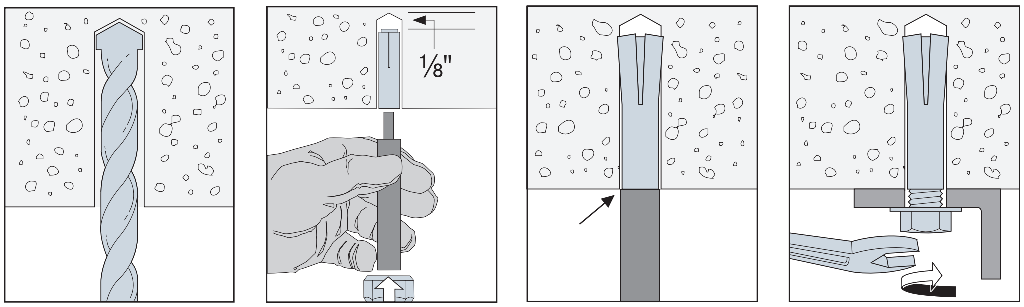
## Fixed-Depth Drill Bits for DIASS

| Model No. | Drill Bit Diameter (in.) | Drill Depth (in.) | Drop-In Anchor (in.) |
|---|---|---|---|
| MDPL037DIA | ⅜ | 1 1/16 | ¼ |
| MDPL050DIA | ½ | 1 11/16 | ⅜ |
| MDPL062DIA | ⅝ | 2 1/16 | ½ |

## Stainless-Steel Drop-In Anchor Product Data

| Rod Size (in.) | Type 303 or 304 Stainless Model No. | Type 316 Stainless Model No. | Drill Bit Diameter (in.) | Bolt Threads (per in.) | Body Length (in.) | Thread Length (in.) | Quantity | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Box | Carton |
| ¼ | DIA25SS | DIA256SS | ⅜ | 20 | 1 | ⅜ | 100 | 500 |
| ⅜ | DIA37SS | DIA376SS | ½ | 16 | 1 9/16 | ⅝ | 50 | 250 |
| ½ | DIA50SS | DIA506SS | ⅝ | 13 | 2 | ¾ | 50 | 200 |
| ⅝ | DIA62SS | — | ⅞ | 11 | 2½ | 1 | 25 | 100 |
| ¾ | DIA75SS | — | 1 | 10 | 3⅛ | 1¼ | 20 | 80 |

### Installation Sequence



# **Drop-In** Stainless-Steel Internally Threaded Anchor (DIASS)



## Allowable Tension Loads for Stainless-Steel Drop-In Anchor in Normal-Weight Concrete

*

| Rod Size in. (mm) | Drill Bit Dia. (in.) | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing in. (mm) | Tension Load | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq$ 2,000 psi (13.8 MPa) Concrete | | | $f'_c \geq$ 3,000 psi (20.7 MPa) Concrete | $f'_c \geq$ 4,000 psi (27.6 MPa) Concrete | | |
| | | | | | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allowable lb. (kN) |
| ¼ (6.4) | ⅜ | 1 (25) | 3 (76) | 4 (102) | 1,400 (6.2) | 201 (0.9) | 350 (1.6) | 405 (1.8) | 1,840 (8.2) | 451 (2.0) | 460 (2.0) |
| ⅜ (9.5) | ½ | 1 9/16 (40) | 4½ (114) | 6 (152) | 2,400 (10.7) | 251 (1.1) | 600 (2.7) | 795 (3.5) | 3,960 (17.6) | 367 (1.6) | 990 (4.4) |
| ½ (12.7) | ⅝ | 2 (51) | 6 (152) | 8 (203) | 3,320 (14.8) | 372 (1.7) | 830 (3.7) | 1,178 (5.2) | 6,100 (27.1) | 422 (1.9) | 1,525 (6.8) |
| ⅝ (15.9) | ⅞ | 2½ (64) | 7½ (191) | 10 (254) | 5,040 (22.4) | 689 (3.1) | 1,260 (5.6) | 1,715 (7.6) | 8,680 (38.6) | 971 (4.3) | 2,170 (9.7) |
| ¾ (19.1) | 1 | 3⅛ (79) | 9 (229) | 12½ (318) | 8,160 (36.3) | 961 (4.3) | 2,040 (9.1) | 2,365 (10.5) | 10,760 (47.9) | 1,696 (7.5) | 2,690 (12.0) |

See foonotes below.

## Allowable Shear Loads for Stainless-Steel Drop-In Anchor in Normal-Weight Concrete

*

| Rod Size in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing in. (mm) | Shear Load | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq$ 2,000 psi (13.8 MPa) Concrete | | | $f'_c \geq$ 3,000 psi (20.7 MPa) Concrete | $f'_c \geq$ 4,000 psi (27.6 MPa) Concrete |
| | | | | | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) |
| ¼ (6.4) | ⅜ | 1 (25) | 3½ (89) | 4 (102) | 1,960 (8.7) | 178 (0.8) | 490 (2.2) | 490 (2.2) | 490 (2.2) |
| ⅜ (9.5) | ½ | 1 9/16 (40) | 5¼ (133) | 6 (152) | 3,240 (14.4) | 351 (1.6) | 810 (3.6) | 925 (4.1) | 1,040 (4.6) |
| ½ (12.7) | ⅝ | 2 (51) | 7 (178) | 8 (203) | 7,000 (31.1) | 562 (2.5) | 1,750 (7.8) | 1,750 (7.8) | 1,750 (7.8) |
| ⅝ (15.9) | ⅞ | 2½ (64) | 8¾ (222) | 10 (254) | 11,080 (49.3) | 923 (4.1) | 2,770 (12.3) | 2,770 (12.3) | 2,770 (12.3) |
| ¾ (19.1) | 1 | 3⅛ (79) | 10½ (267) | 12½ (318) | 13,800 (61.4) | 1,781 (7.9) | 3,450 (15.3) | 3,725 (16.6) | 4,000 (17.8) |

1. The allowable loads listed are based on a safety factor of 4.0.
2. Refer to allowable load-adjustment factors for edge distance and spacing on p. 155.
3. Allowable loads may be linearly interpolated between concrete strengths listed.
4. The minimum concrete thickness is 1½ times the embedment depth.



*See p. 14 for an explanation of the load table icons.

## Allowable Load-Adjustment Factors for Stainless-Steel Drop-In Anchors in Normal-Weight Concrete: Edge Distance and Spacing, Tension and Shear Loads

**How to use these charts:**

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the edge distance ($c_{act}$) or spacing ($s_{act}$) at which the anchor is to be installed.
4. The load adjustment factor ($f_c$ or $f_s$) is the intersection of the row and column.
5. Multiply the allowable load by the applicable load adjustment factor.
6. Reduction factors for multiple edges or spacing are multiplied together.

### Edge Distance Tension ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Size | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | $c_{cr}$ | 3 | 4½ | 6 | 7½ | 9 |
| | $c_{min}$ | 1¾ | 2⅝ | 3½ | 4⅜ | 5¼ |
| | $f_{cmin}$ | 0.65 | 0.65 | 0.65 | 0.65 | 0.65 |
| 1¾ | | 0.65 | | | | |
| 2 | | 0.72 | | | | |
| 2½ | | 0.86 | | | | |
| 2⅝ | | 0.90 | 0.65 | | | |
| 3 | | 1.00 | 0.72 | | | |
| 3½ | | | 0.81 | 0.65 | | |
| 4 | | | 0.91 | 0.72 | | |
| 4⅜ | | | 0.98 | 0.77 | 0.65 | |
| 4½ | | | 1.00 | 0.79 | 0.66 | |
| 5 | | | | 0.86 | 0.72 | |
| 5¼ | | | | 0.90 | 0.75 | 0.65 |
| 5½ | | | | 0.93 | 0.78 | 0.67 |
| 6 | | | | 1.00 | 0.83 | 0.72 |
| 6½ | | | | | 0.89 | 0.77 |
| 7 | | | | | 0.94 | 0.81 |
| 7½ | | | | | 1.00 | 0.86 |
| 8 | | | | | | 0.91 |
| 8½ | | | | | | 0.95 |
| 9 | | | | | | 1.00 |

See notes below.

### Edge Distance Shear ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Size | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | $c_{cr}$ | 3½ | 5¼ | 7 | 8¾ | 10½ |
| | $c_{min}$ | 1¾ | 2⅝ | 3½ | 4⅜ | 5¼ |
| | $f_{cmin}$ | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |
| 1¾ | | 0.45 | | | | |
| 2 | | 0.53 | | | | |
| 2½ | | 0.69 | | | | |
| 2⅝ | | 0.73 | 0.45 | | | |
| 3 | | 0.84 | 0.53 | | | |
| 3½ | | 1.00 | 0.63 | 0.45 | | |
| 4 | | | 0.74 | 0.53 | | |
| 4⅜ | | | 0.82 | 0.59 | 0.45 | |
| 4½ | | | 0.84 | 0.61 | 0.47 | |
| 5 | | | 0.95 | 0.69 | 0.53 | |
| 5¼ | | | 1.00 | 0.73 | 0.56 | 0.45 |
| 5½ | | | | 0.76 | 0.59 | 0.48 |
| 6 | | | | 0.84 | 0.65 | 0.53 |
| 6½ | | | | 0.92 | 0.72 | 0.58 |
| 7 | | | | 1.00 | 0.78 | 0.63 |
| 7½ | | | | | 0.84 | 0.69 |
| 8 | | | | | 0.91 | 0.74 |
| 8½ | | | | | 0.97 | 0.79 |
| 8¾ | | | | | 1.00 | 0.82 |
| 9 | | | | | | 0.84 |
| 9½ | | | | | | 0.90 |
| 10 | | | | | | 0.95 |
| 10½ | | | | | | 1.00 |

1. $c_{act}$ = actual edge distance at which anchor is installed (inches).
2. $c_{cr}$ = critical edge distance for 100% load (inches).
3. $c_{min}$ = minimum edge distance for reduced load (inches).
4. $f_c$ = adjustment factor for allowable load at actual edge distance.
5. $f_{ccr}$= adjustment factor for allowable load at critical edge distance. $f_{ccr}$ is always = 1.00.
6. $f_{cmin}$ = adjustment factor for allowable load at minimum edge distance.
7. $f_c = f_{cmin} + [(1 - f_{cmin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

### Spacing Tension and Shear ($f_s$)

| $s_{act}$ (in.) | Size | ¼ | ⅜ | ½ | ⅝ | ¾ |
|---|---|---|---|---|---|---|
| | $s_{cr}$ | 4 | 6 | 8 | 10 | 12½ |
| | $s_{min}$ | 2 | 3 | 4 | 5 | 6¼ |
| | $f_{smin}$ | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| 1½ | | | | | | |
| 2 | | 0.50 | | | | |
| 2½ | | 0.63 | | | | |
| 3 | | 0.75 | 0.50 | | | |
| 3½ | | 0.88 | 0.58 | | | |
| 4 | | 1.00 | 0.67 | 0.50 | | |
| 4½ | | | 0.75 | 0.56 | | |
| 5 | | | 0.83 | 0.63 | 0.50 | |
| 5½ | | | 0.92 | 0.69 | 0.55 | |
| 6 | | | 1.00 | 0.75 | 0.60 | |
| 6¼ | | | | 0.78 | 0.63 | 0.50 |
| 7 | | | | 0.88 | 0.70 | 0.56 |
| 8 | | | | 1.00 | 0.80 | 0.64 |
| 9 | | | | | 0.90 | 0.72 |
| 10 | | | | | 1.00 | 0.80 |
| 11 | | | | | | 0.88 |
| 12 | | | | | | 0.96 |
| 12½ | | | | | | 1.00 |

1. $s_{act}$ = actual spacing distance at which anchors are installed (inches).
2. $s_{cr}$ = critical spacing distance for 100% load (inches).
3. $s_{min}$ = minimum spacing distance for reduced load (inches).
4. $f_s$ = adjustment factor for allowable load at actual spacing distance.
5. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
6. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
7. $f_s = f_{smin} + [(1 - f_{smin}) (s_{act} - s_{min}) / (s_{cr} - s_{min})]$.

*See p. 14 for an explanation of the load table icons.

# **Hollow Drop-In** Internally Threaded Anchor





The Simpson Strong-Tie Hollow Drop-In Anchor (HDIA) is an internally threaded, flush-mount expansion anchor for use in hollow materials such as CMU and hollow-core plank, as well as in solid base materials such as brick, normal-weight and lightweight concrete.

**Features:**

- Suitable for suspending conduit, cable trays, pipe supports, fire sprinklers and suspended lighting into concrete
- Expansion design allows HDIA to anchor into CMU, hollow-core plank, brick, normal-weight concrete and lightweight concrete
- Internally threaded anchor allows for easy bolt removal

**Material:** Die-cast Zamac 3 alloy shell with carbon-steel cone or Type 304 stainless-steel cone

**Codes:** Factory Mutual 3053987 (⅜"–½" diameter)
Underwriters Laboratories EX3605 (⅜"–½" diameter)

**Hollow Drop-In**

## Hollow Drop-In Anchor

| Size (in.) | Model No. | Drill Bit Diameter (in.) | Threads (per in.) | Overall Anchor Length (in.) | Quantity | |
|---|---|---|---|---|---|---|
| | | | | | Package Qty. | Carton Qty. |
| ¼ | HDIA25 | ⅜ | 20 | ¾ | 100 | 1,600 |
| ¼ | HDIA25SS | ⅜ | 20 | ¾ | 100 | 1,600 |
| 5⁄16 | HDIA31 | ⅝ | 18 | 1¼ | 50 | 200 |
| ⅜ | HDIA37 | ⅝ | 16 | 1¼ | 50 | 200 |
| ⅜ | HDIA37SS | ⅝ | 16 | 1¼ | 50 | 200 |
| ½ | HDIA50 | ¾ | 13 | 1¾ | 50 | 250 |
| ⅝ | HDIA62 | 1 | 11 | 2 | 25 | 125 |

## HDIASTH Setting Tool for Hollow Materials

Setting tool designed to set the Hollow Drop-In internally threaded anchor in hollow materials such as CMU and hollow-core plank.

| Model No. | Description | Size (in.) | Carton Qty. |
|---|---|---|---|
| HDIASTH25 | Setting tool for use with Hollow Drop-In models HDIA25, HDIA25SS | ¼ | 25 |
| HDIASTH31 | Setting tool for use with Hollow Drop-In model HDIA31 | 5⁄16 | 25 |
| HDIASTH37 | Setting tool for use with Hollow Drop-In models HDIA37, HDIA37SS | ⅜ | 25 |
| HDIASTH50 | Setting tool for use with Hollow Drop-In model HDIA50 | ½ | 25 |
| HDIASTH62 | Setting tool for use with Hollow Drop-In model HDIA62 | ⅝ | 10 |

1. Tools sold separately. Tools may be ordered by the piece.

**HDIASTH Setting Tool**

## HDIASTS Setting Tool for Solid Materials

Setting tool designed to set the Hollow Drop-In internally threaded anchor in solid materials such as brick, normal-weight and lightweight concrete.

| Model No. | Description | Size (in.) | Box Qty. | Carton Qty. |
|---|---|---|---|---|
| HDIASTS25 | Setting tool for use with Hollow Drop-In models HDIA25, HDIA25SS | ¼ | 25 | 125 |
| HDIASTS31-37 | Setting tool for use with Hollow Drop-In models HDIA31, HDIA37, HDIA37SS | 5⁄16 – ⅜ | 10 | 50 |
| HDIASTS50 | Setting tool for use with Hollow Drop-In model HDIA50 | ½ | 10 | 50 |
| HDIASTS62 | Setting tool for use with Hollow Drop-In model HDIA62 | ⅝ | 5 | 20 |

1. Tools sold separately. Tools may be ordered by the piece.

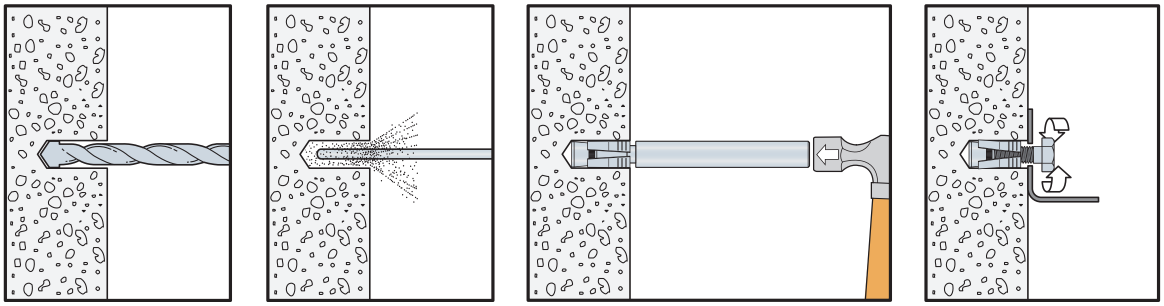
**HDIASTS Setting Tool**

# **Hollow Drop-In** Internally Threaded Anchor



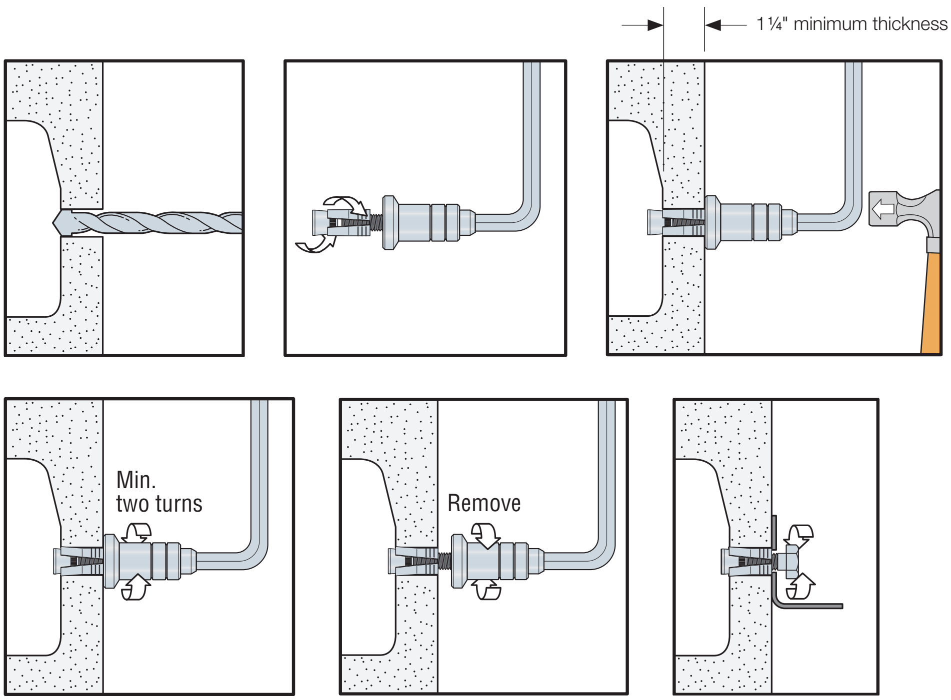
### Installation Instructions — Solid Base (using solid setting tool)

- Drill a hole in the base material using the appropriate diameter carbide drill bit as specified in the table. Drill the hole to the specified embedment depth.
- Blow the hole clean using compressed air. Overhead installations need not be blown clean.
- Insert the HDIA into hole. Tap with hammer until flush against surface.
- Using the designated setting tool, drive the anchor to the bottom of the drilled hole. After the anchor reaches the bottom of the drilled hole, perform an additional 3 hammer blows against the setting tool to drive the anchor body over the cone.
- Position fixture; insert fastener and tighten.



### Installation Instructions — Hollow Base (using hollow setting tool)

- Drill a hole in the base material using the appropriate diameter carbide drill bit as specified in the table.
- Thread the HDIA onto the designated setting tool for hollow base materials.
- Insert the HDIA into the hole. Tap the setting tool until the face of the tool contacts the surface.
- Rotate the setting tool a minimum of two turns to set the anchor.
- Remove the setting tool.
- Position fixture; insert fastener and tighten.



# **Hollow Drop-In** Design Information — Concrete and Masonry



## Allowable Tension Loads for Hollow Drop-In Anchor in Normal-Weight Concrete

*

| Model No. | Size in. (mm) | Drill Bit Dia. in. (mm) | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing in. (mm) | Tension Load | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $f'_c \geq$ 2,500 psi (17.2 MPa) | | $f'_c \geq$ 4,000 psi (27.6 MPa) | |
| | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| HDIA25, HDIA25SS | ¼ (6.4) | ⅜ (9.5) | ⅞ (22) | 2⅝ (67) | 3½ (89) | 1,180 (5.2) | 295 (1.3) | 1,220 (5.4) | 305 (1.4) |
| HDIA31 | 5⁄16 (7.9) | ⅝ (15.9) | 1½ (38) | 4½ (114) | 6 (152) | 3,000 (13.3) | 750 (3.3) | 3,420 (15.2) | 855 (3.8) |
| HDIA37, HDIA37SS | ⅜ (9.5) | ⅝ (15.9) | 1½ (38) | 4½ (114) | 6 (152) | 3,000 (13.3) | 750 (3.3) | 3,420 (15.2) | 855 (3.8) |
| HDIA50 | ½ (12.7) | ¾ (19.1) | 2 (51) | 6 (152) | 8 (203) | 4,260 (18.9) | 1,065 (4.7) | 5,500 (24.5) | 1,375 (6.1) |
| HDIA62 | ⅝ (15.9) | 1 (25.4) | 2¼ (57) | 6¾ (171) | 9 (229) | 6,100 (27.1) | 1,525 (6.8) | 6,300 (28.0) | 1,575 (7.0) |

1. The allowable loads listed are based on a safety factor of 4.0.
2. The minimum concrete thickness is 1½ times the embedment depth.
3. Allowable loads may be linearly interpolated between concrete strengths listed.

## Allowable Shear Loads for Hollow Drop-In Anchor in Normal-Weight Concrete

*

| Model No. | Size in. (mm) | Drill Bit Dia. in. (mm) | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing in. (mm) | Shear Load Based on Anchor Strength | | Shear Load Based on Steel Strength | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $f'_c \geq$ 2,500 psi (17.2 MPa) | | F1554 Grade 36 | A193 Grade B7 |
| | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) |
| HDIA25, HDIA25SS | ¼ (6.4) | ⅜ (9.5) | ⅞ (22) | 2⅝ (67) | 3½ (89) | 1,840 (8.2) | 460 (2.0) | 485 (2.2) | 1,045 (4.6) |
| HDIA31 | 5⁄16 (7.9) | ⅝ (15.9) | 1½ (38) | 4½ (114) | 6 (152) | 2,660 (11.8) | 665 (3.0) | 755 (3.4) | 1,630 (7.3) |
| HDIA37, HDIA37SS | ⅜ (9.5) | ⅝ (15.9) | 1½ (38) | 4½ (114) | 6 (152) | 3,580 (15.9) | 895 (4.0) | 1,085 (4.8) | 2,340 (10.4) |
| HDIA50 | ½ (12.7) | ¾ (19.1) | 2 (51) | 6 (152) | 8 (203) | 8,220 (36.6) | 2,055 (9.1) | 1,930 (8.6) | 4,160 (18.5) |
| HDIA62 | ⅝ (15.9) | 1 (25.4) | 2¼ (57) | 6¾ (171) | 9 (229) | 10,180 (45.3) | 2,545 (11.3) | 3,025 (13.5) | 6,520 (29.0) |

1. The allowable loads listed are based on a safety factor of 4.0.
2. The minimum concrete thickness is 1½ times the embedment depth.
3. Allowable load must be the lesser of the load based on anchor strength or steel strength.



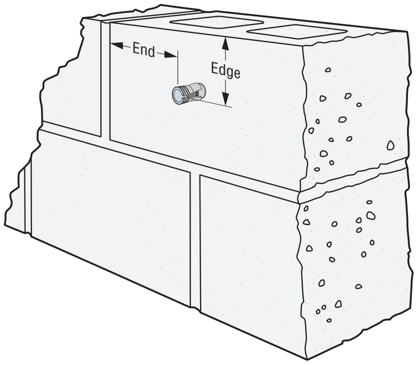
**See p. 14 for an explanation of the load table icons.*

## Allowable Tension and Shear Loads for Hollow Drop-In Anchor in 8" Lightweight, Medium-Weight and Normal-Weight Hollow CMU

*

| Model No. | Size in. (mm) | Drill Bit Dia. in. (mm) | Embed. Depth[4] in. (mm) | Minimum Edge Dist. in. (mm) | Minimum End Dist. in. (mm) | Minimum Spacing in. (mm) | Tension Load | | Shear Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| HDIA25, HDIA25SS | ¼ (6.4) | ⅜ (9.5) | ¾ (19) | 4 (102) | 4⅝ (117) | 8 (203) | 500 (2.2) | 100 (0.4) | 975 (4.3) | 195 (0.9) |
| HDIA31 | 5⁄16 (7.9) | ⅝ (15.9) | 1¼ (32) | 4 (102) | 4⅝ (117) | 8 (203) | 500 (2.2) | 100 (0.4) | 1,450 (6.4) | 290 (1.3) |
| HDIA37, HDIA37SS | ⅜ (9.5) | ⅝ (15.9) | 1¼ (32) | 4 (102) | 4⅝ (117) | 8 (203) | 500 (2.2) | 100 (0.4) | 1,450 (6.4) | 290 (1.3) |
| HDIA50 | ½ (12.7) | ¾ (19.1) | 1¾ (44) | 4 (102) | 4⅝ (117) | 8 (203) | 1,525 (6.8) | 305 (1.4) | 2,300 (10.2) | 460 (2.0) |
| HDIA62 | ⅝ (15.9) | 1 (25.4) | 2 (51) | 4 (102) | 4⅝ (117) | 8 (203) | 1,525 (6.8) | 305 (1.4) | 2,325 (10.3) | 465 (2.1) |

1. The allowable loads listed are based on a safety factor of 5.0.
2. Values for 8-inch wide lightweight, medium-weight, and normal-weight CMU.
3. The minimum specified compressive strength of masonry, $f'_m$, at 28 days with a minimum face shell thickness of 1¼" is 1,500 psi.
4. The installed end of the anchor may extend into the CMU cavity depending upon face shell thickness.




## Tension and Shear Loads for Hollow Drop-In Anchor in Hollow-Core Concrete Panel

*

| Model No. | Size in. (mm) | Drill Bit Dia. in. (mm) | Embed. Depth[4] in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing in. (mm) | Tension Load | | Shear Load Based on Anchor Strength | | Shear Load Based on Steel Strength of Threaded Rod | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $f'_c \geq$ 5,000 psi (34.5 Mpa) | | $f'_c \geq$ 5,000 psi (34.5 MPa) | | F1554 Grade 36 | A193 Grade B7 |
| | | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) |
| HDIA25, HDIA25SS | ¼ (6.4) | ⅜ (9.5) | ¾ (19) | 3 (76) | 4½ (114) | 1,340 (6.0) | 335 (1.5) | 2,040 (9.1) | 510 (2.3) | 485 (2.2) | 1,045 (4.6) |
| HDIA31 | 5⁄16 (7.9) | ⅝ (15.9) | 1¼ (32) | 5 (127) | 7½ (191) | 1,820 (8.1) | 455 (2.0) | 3,240 (14.4) | 810 (3.6) | 755 (3.4) | 1,630 (7.3) |
| HDIA37, HDIA37SS | ⅜ (9.5) | ⅝ (15.9) | 1¼ (32) | 5 (127) | 7½ (191) | 1,820 (8.1) | 455 (2.0) | 4,560 (20.3) | 1,140 (5.1) | 1,085 (4.8) | 2,340 (10.4) |
| HDIA50 | ½ (12.7) | ¾ (19.1) | 1¾ (44) | 7 (178) | 10½ (267) | 2,840 (12.6) | 710 (3.2) | 5,820 (25.9) | 1,455 (6.5) | 1,930 (8.6) | 4,160 (18.5) |
| HDIA62 | ⅝ (15.9) | 1 (25.4) | 2 (51) | 8 (203) | 12 (305) | 2,980 (13.3) | 745 (3.3) | 8,700 (38.7) | 2,175 (9.7) | 3,025 (13.5) | 6,520 (29.0) |

1. The allowable loads listed are based on a safety factor of 4.0.
2. The minimum concrete thickness over the open cores is 1¼".
3. The minimum specified compressive strength of the concrete used in the hollow-core panel, $f'_c$, is 5,000 psi (34.5 MPa).
4. The installed end of the anchor may extend into the panel cavity depending upon face shell thickness.

**See p. 14 for an explanation of the load table icons.*

# Zinc Nailon™ Pin Drive Anchors



Zinc Nailon anchors are low-cost, easy-to-install anchors for applications under static loads.

### Features

- Available with carbon and stainless-steel pins
- Pin and head configuration designed to make anchor tamper-resistant

### Materials

- Body — Die-cast Zamac 3 alloy
- Pin — Carbon steel; Type 304 stainless steel

**Code:** Meets Federal Specification A-A-1925A, Type 1

### Installation

**Caution:** Not for use in overhead applications.

**Caution:** Nailon anchors are not recommended for eccentric tension (prying) loads — capacity will be greatly reduced in such applications

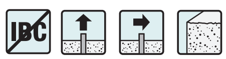
1. Drill a hole in base material using a carbide drill bit the same diameter as the nominal diameter of the anchor to be installed. Drill the hole to specified embedment depth, plus ¼" for pin extension, and blow hole clean using compressed air. Alternatively, drill the hole deep enough to accommodate embedment depth and dust from drilling.
2. Position fixture and insert Nailon anchor.
3. Tap with hammer until flush with fixture, then drive pin until flush with top of head.

**Zinc Nailon Anchor**
(Mushroom Head)

### Zinc Nailon Product Data

| Size (in.) | Carbon Steel Pin Model No. | Stainless Steel Pin Model No. | Quantity | | |
|---|---|---|---|---|---|
| | | | Box | Carton | Bulk |
| 3⁄16 x 7⁄8 | ZN18078 | — | 100 | 1,600 | 3,000 |
| ¼ x ¾ | ZN25034 | ZN25034SS | 100 | 500 | 2,000 |
| ¼ x 1 | ZN25100 | ZN25100SS | 100 | 500 | 1,500 |
| ¼ x 1¼ | ZN25114 | ZN25114SS | 100 | 500 | 1,500 |
| ¼ x 1½ | ZN25112 | ZN25112SS | 100 | 500 | 1,000 |
| ¼ x 2 | ZN25200 | ZN25200SS | 100 | 400 | 1,000 |
| ¼ x 2½ | ZN25212 | ZN25212SS | 100 | 400 | — |
| ¼ x 3 | ZN25300 | ZN25300SS | 100 | 400 | 1,000 |

### Allowable Tension and Shear Loads for Zinc Nailon in Normal-Weight Concrete

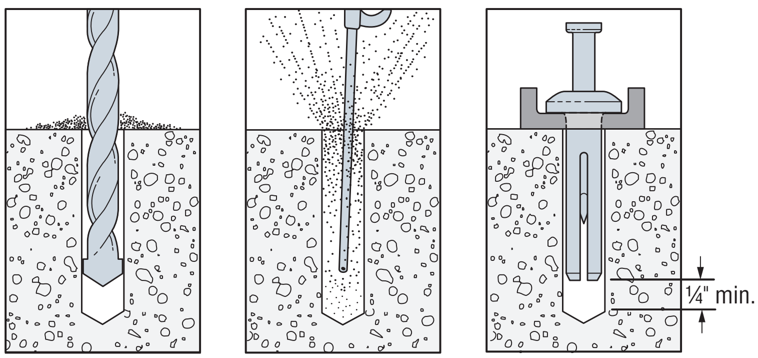



*

| Size (in.) | Drill Bit Dia. (in.) | Embed. Depth (in.) | Ultimate Loads (lb.) | | Allowable Loads (lb.)[1] | |
|---|---|---|---|---|---|---|
| | | | f'c ≥ 3,000 psi | | f'c ≥ 3,000 psi | |
| | | | Tension | Shear | Tension | Shear |
| 3⁄16 | 3⁄16 | 5⁄8 | 460 | 465 | 115 | 115 |
| ¼ | ¼ | 5⁄8 | 590 | 635 | 150 | 160 |
| | | ¾ | 780 | 765 | 195 | 190 |
| | | 1½ | 1,050 | 1,050 | 265 | 265 |

1. The allowable loads are based on a safety factor of 4.0.

### Installation Sequence




*See p. 14 for an explanation of the load table icons.

# Crimp Drive® Anchor



The Crimp Drive anchor is an easy-to-install expansion anchor for use in concrete and grout-filled block. The pre-formed curvature along the shaft creates an expansion mechanism that secures the anchor in place and eliminates the need for a secondary tightening procedure. This speeds up anchor installation and reduces the overall cost.

Five crimp anchor head styles are available to handle different applications that include fastening wood or light-gauge steel, attaching concrete formwork and hanging overhead support for sprinkler pipes or suspended ceiling panels.

**Material:** Carbon steel, stainless steel

**Coating:** Zinc plated and mechanically galvanized

**Codes:** Factory Mutual 3031136 for the ⅜" rod coupler.

**Head Styles:** Mushroom, rod coupler, countersunk, tie-wire and duplex

## Installation

**Warning:** Industry studies show that hardened fasteners can experience performance problems in wet or corrosive environments. Accordingly, with the exception of the duplex anchor, use these products in dry, interior and non-corrosive environments only.

1. Drill a hole using the specified diameter carbide bit into the base material to a depth of at least ½" deeper than the required embedment.
2. Blow the hole clean of dust and debris using compressed air. Overhead application need not be blown clean. Where a fixture is used, drive the anchor through the fixture into the hole until the head sits flush against the fixture.
3. Be sure the anchor is driven to the required embedment depth. The rod coupler and tie-wire models should be driven in until the head is seated against the surface of the base material.

Mushroom Head

Rod Coupler

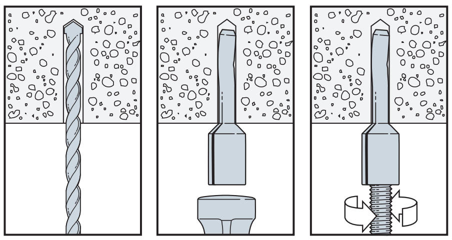
Countersunk Head

Tie-Wire

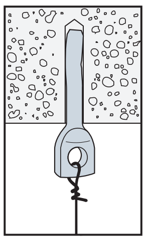
Duplex Head

## Installation Sequence

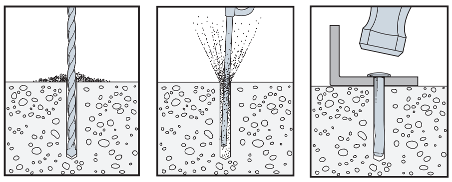
### Rod Coupler



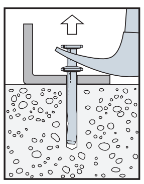
### Tie-Wire



### Mushroom Head

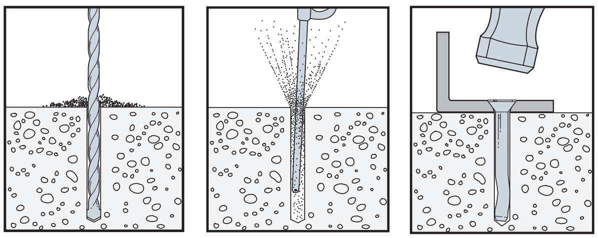


### Duplex



Duplex-head anchor may be removed with a claw hammer

### Countersunk Head Installation Sequence



# Crimp Drive® Anchor



## Crimp Drive Anchor Product Data

| Size (in.) | Model No. | Head Style/ Finish | Drill Bit Dia. (in.) | Min. Fixture Hole Size | Min. Embed. (in.) | Quantity | |
|---|---|---|---|---|---|---|---|
| | | | | | | Pkg. Qty. | Carton Qty. |
| 3⁄16 x 1¼ | CD18114M | Mushroom Head / Zinc Plated | 3⁄16 | ¼ | ⅞ | 100 | 1,600 |
| 3⁄16 x 2 | CD18200M | | | | 1¼ | 100 | 500 |
| 3⁄16 x 2½ | CD18212M | | | | 1¼ | 100 | 500 |
| 3⁄16 x 3 | CD18300M | | | | 1¼ | 100 | 500 |
| 3⁄16 x 3½ | CD18312M | | | | 1¼ | 100 | 500 |
| 3⁄16 x 4 | CD18400M | | | | 1¼ | 100 | 500 |
| ¼ x 1 | CD25100M | | ¼ | 5⁄16 | ⅞ | 100 | 1,600 |
| ¼ x 1¼ | CD25114M | | | | ⅞ | 100 | 1,600 |
| ¼ x 1½ | CD25112M | | | | 1¼ | 100 | 1,600 |
| ¼ x 2 | CD25200M | | | | 1¼ | 100 | 500 |
| ¼ x 2½ | CD25212M | | | | 1¼ | 100 | 500 |
| ¼ x 3 | CD25300M | | | | 1¼ | 100 | 500 |
| ¼ x 3½ | CD25312M | | | | 1¼ | 100 | 500 |
| ¼ x 4 | CD25400M | | | | 1¼ | 100 | 500 |
| ⅜ x 2 | CD37200M | | ⅜ | 7⁄16 | 1¾ | 25 | 125 |
| ⅜ x 3 | CD37300M | | | | 1¾ | 25 | 125 |
| ¼ x 3 | CD25300MG | Mushroom Head / Mechanically Galvanized | ¼ | 5⁄16 | 1¼ | 100 | 500 |
| ¼" rod coupler | CD25114RC | Rod Coupler / Zinc Plated | 3⁄16 | N/A | 1¼ | 100 | 500 |
| ⅜" rod coupler | CD37112RC | | ¼ | N/A | 1½ | 50 | 250 |
| 3⁄16 x 2½ | CD18212C | Countersunk Head / Zinc Plated | 3⁄16 | ¼ | 1¼ | 100 | 500 |
| 3⁄16 x 3 | CD18300C | | | | 1¼ | 100 | 500 |
| 3⁄16 x 4 | CD18400C | | | | 1¼ | 100 | 500 |
| ¼ x 1½ | CD25112C | | ¼ | 5⁄16 | 1¼ | 100 | 500 |
| ¼ x 2 | CD25200C | | | | 1¼ | 100 | 500 |
| ¼ x 2½ | CD25212C | | | | 1¼ | 100 | 500 |
| ¼ x 3 | CD25300C | | | | 1¼ | 100 | 500 |
| ¼ x 3½ | CD25312C | | | | 1¼ | 100 | 400 |
| ¼ x 4 | CD25400C | | | | 1¼ | 100 | 400 |
| ¼ x 3 | CD25300CMG | Countersunk Head / Mechanically Galvanized[1] | ¼ | 5⁄16 | 1¼ | 100 | 500 |
| ¼ x 4 | CD25400CMG | | | | 1¼ | 100 | 400 |
| ¼" Tie Wire | CD25118T | Tie-Wire/Zinc Plated | ¼ | N/A | 1⅛ | 100 | 500 |
| ¼" duplex | CD25234D | Duplex Head/Zinc Plated | ¼ | 5⁄16 | 1¼ | 100 | 500 |

1. Mechanical galvanizing meets ASTM B695, Class 55, Type 1. Intended for some pressure-treated wood sill plate applications. Not for use in other corrosive or outdoor environments. See p. 235 for details.

## Length Identification Head Marks on Mushroom, Countersunk and Duplex-Head Crimp Drive Anchors (corresponds to length of anchor — inches)

| Mark | ☐ | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| From | 1 | 1½ | 2 | 2½ | 3 | 3½ | 4 |
| Up To But Not Including | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4½ |

# Crimp Drive® Design Information — Concrete



## Carbon-Steel Crimp Drive Allowable Tension and Shear Loads in Normal-Weight Concrete

| Size (in.) | Drill Bit Diameter (in.) | Embed. Depth (in.) | Minimum Spacing (in.) | Minimum Edge Distance (in.) | Tension Load | | Shear Load | |
|---|---|---|---|---|---|---|---|---|
| | | | | | f'c ≥ 2,000 psi Concrete | f'c ≥ 4,000 psi Concrete | f'c ≥ 2,000 psi Concrete | f'c ≥ 4,000 psi Concrete |
| | | | | | Allowable Load (lb.) | Allowable Load (lb.) | Allowable Load (lb.) | Allowable Load (lb.) |
| **Mushroom/Countersunk Head** | | | | | | | | |
| 3/16 | 3/16 | 1 1/4 | 3 | 3 | 145 | 250 | 340 | 450 |
| 1/4 | 1/4 | 1 1/4 | 3 | 3 | 175 | 275 | 395 | 610 |
| 3/8 | 3/8 | 1 3/4 | 4 | 4 | 365 | 780 | 755 | 1,305 |
| **Duplex Head** | | | | | | | | |
| 1/4 | 1/4 | 1 1/4 | 3 | 3 | 175 | 275 | 395 | 610 |
| **Tie Wire** | | | | | | | | |
| 1/4 | 1/4 | 1 1/8 | 3 | 3 | 155 | 215 | 265 | 325 |
| **Rod Coupler[4]** | | | | | | | | |
| 1/4 | 3/16 | 1 1/4 | 3 | 3 | 145 | 250 | — | — |
| 3/8 | 1/4 | 1 1/2 | 4 | 4 | 265 | 600 | — | — |

1. The allowable loads listed are based on a safety factor of 4.0.
2. The minimum concrete thickness is 1 1/2 times the embedment depth.
3. Allowable loads may be linearly interpolated between concrete strengths listed.
4. For rod coupler, mechanical and plumbing design codes may prescribe lower allowable loads; verify with local codes.



*See p. 14 for an explanation of the load table icons.

# Crimp Drive® Design Information — Concrete





## Carbon-Steel Crimp Drive Allowable Tension and Shear Loads in Sand-Lightweight Concrete over Steel Deck

*

| Size (in.) | Drill Bit Diameter (in.) | Embed. Depth (in.) | Minimum Spacing (in.) | Minimum Edge Distance (in.) | Tension Load (Install in Concrete) | Tension Load (Install Through Steel Deck) | Shear Load (Install in Concrete) | Shear Load (Install Through Steel Deck) |
|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq$ 3,000 psi Concrete | $f'_c \geq$ 3,000 psi Concrete | $f'_c \geq$ 3,000 psi Concrete | $f'_c \geq$ 3,000 psi Concrete |
| | | | | | Allowable Load (lb.) | Allowable Load (lb.) | Allowable Load (lb.) | Allowable Load (lb.) |
| **Mushroom/Countersunk Head** | | | | | | | | |
| 3/16 | 3/16 | 1¼ | 4 | 4 | 115 | 85 | 345 | 600 |
| ¼ | ¼ | 1¼ | 4 | 4 | 145 | 130 | 375 | 890 |
| ⅜ | ⅜ | 1¾ | 5½ | 5½ | 315 | 330 | 1,030 | 1,085 |
| **Duplex Head** | | | | | | | | |
| ¼ | ¼ | 1¼ | 4 | 4 | 145 | 130 | 375 | 890 |
| **Tie Wire** | | | | | | | | |
| ¼ | ¼ | 1⅛ | 3 | 3 | 130 | 90 | 275 | 210 |
| **Rod Coupler[4]** | | | | | | | | |
| ¼ | 3/16 | 1¼ | 4 | 4 | 115 | 85 | — | — |
| ⅜ | ¼ | 1½ | 5 | 5 | 300 | 280 | — | — |

1. The allowable loads listed are based on a safety factor of 4.0.
2. The minimum concrete thickness is 1½ times the embedment depth.
3. Anchors may be installed off-center in the flute, up to 1" from the center of flute.
4. Anchor may be installed in either upper or lower flute.
5. Deck profile shall be 3" deep, 20-gauge minimum.
6. For rod coupler, mechanical and plumbing design codes may prescribe lower allowable loads; verify with local codes.

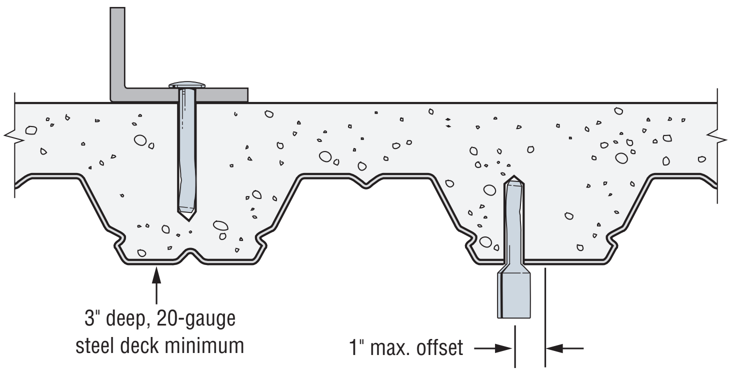



**Figure 1.** Sand-Lightweight Concrete on Steel Deck



*See p. 14 for an explanation of the load table icons.

# **CSD/DSD** Split-Drive Anchors

The Split-Drive anchor is a one-piece expansion anchor that can be installed in concrete, grout-filled block and stone. As the anchor is driven in, the split-type expansion mechanism on the working end compresses and exerts force against the walls of the hole.

## Features

- Available in countersunk (CSD) and duplex-head (DSD) styles
- DSD anchor can be removed with a claw hammer for temporary applications

**Material:** Carbon steel

**Coating:** Zinc plated; mechanically galvanized

## Installation

**Warning:** Industry studies show that hardened fasteners can experience performance problems in wet or corrosive environments. Accordingly, use these products in dry, interior and non-corrosive environments only.

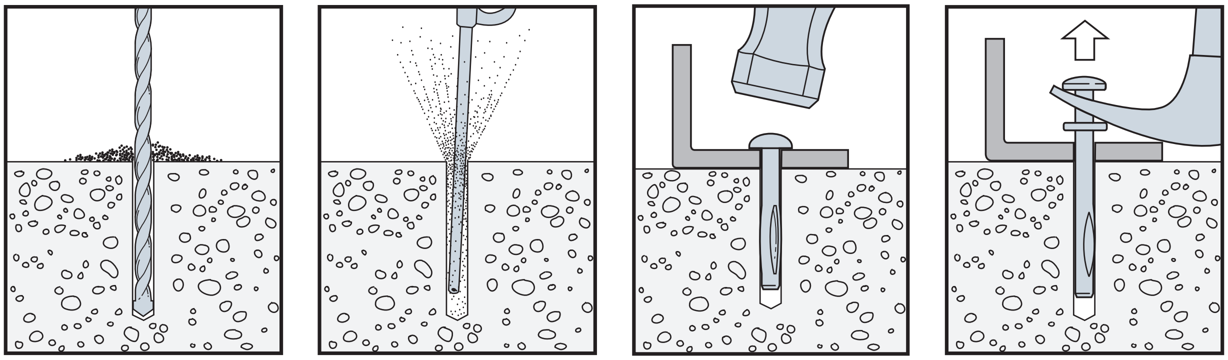
**Caution:** Oversized holes in the base material will greatly reduce the anchor's load capacity. For CSD, embedment depths greater than 1½" may cause bending during installation.

1. Drill a hole in base material using a ¼"-diameter carbide-tipped drill. Drill hole to specified embedment depth and blow clean using compressed air. Overhead installation need not be blown clean. Alternatively, drill hole deep enough to accommodate embedment depth and dust from drilling. Position fixture and insert split-drive anchor through fixture hole.
2. For CSD, ⅜"-diameter fixture hole is recommended for hard fixtures such as steel. For DSD, 5⁄16"-diameter fixture hole is recommended.
3. Drive anchor until head is flush against fixture.

**DSD**
*(duplex)*

**CSD**
*(countersunk)*

## Installation Sequence



DSD anchor may be removed with a claw hammer.

SIMPSON Strong-Tie®

# CSD/DSD Design Information — Concrete



## CSD/DSD Product Data

| Size (in.) | Model No. | Head Style/Finish | Drill Bit Diameter (in.) | Quantity | |
|---|---|---|---|---|---|
| | | | | Box | Carton |
| ¼ x 1½ | CSD25112 | Countersunk head – Zinc plated | ¼ | 100 | 500 |
| ¼ x 2 | CSD25200 | | | 100 | 500 |
| ¼ x 2½ | CSD25212 | | | 100 | 500 |
| ¼ x 3 | CSD25300 | | | 100 | 400 |
| ¼ x 3½ | CSD25312 | | | 100 | 400 |
| ¼ x 4 | CSD25400 | | | 100 | 400 |
| ¼ x 3 | CSD25300MG | Countersunk head – Mechanically galvanized[1] | ¼ | 100 | 400 |
| ¼ x 4 | CSD25400MG | | | 100 | 400 |
| ¼ x 3 | DSD25300 | Duplex head – Zinc plated | ¼ | 100 | 400 |

1. Mechanical galvanizing meets ASTM B695, Class 55, Type 1. Intended for some preservative-treated wood sill plate applications. Not for use in other corrosive or outdoor environments. See p. 235 for details.

## CSD Allowable Tension and Shear Loads in Normal-Weight Concrete

*

| Size (in.) | Drill Bit Diameter (in.) | Embed. Depth (in.) | Minimum Spacing (in.) | Minimum Edge Distance (in.) | Tension Load (lb.) | | Shear Load (lb.) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq$ 2,000 psi | | $f'_c \geq$ 2,000 psi | |
| | | | | | Ultimate Load | Allowable Load | Ultimate Load | Allowable Load |
| ¼ | ¼ | 1¼ | 2½ | 3 | 655 | 165 | 970 | 240 |

## DSD Allowable Tension and Shear Loads in Normal-Weight Concrete

*

| Size (in.) | Drill Bit Diameter (in.) | Embed. Depth (in.) | Minimum Spacing (in.) | Minimum Edge Distance (in.) | Concrete Compressive Strength (psi) | Tension Load (lb.) | | Shear Load (lb.) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Ultimate Load | Allowable Load | Ultimate Load | Allowable Load |
| ¼ | ¼ | 1¼ | 2½ | 3 | 2,500 | 800 | 200 | 2,480 | 620 |
| ¼ | ¼ | 1¼ | 2½ | 3 | 4,000 | 1,060 | 265 | 2,740 | 685 |

*See p. 14 for an explanation of the load table icons.

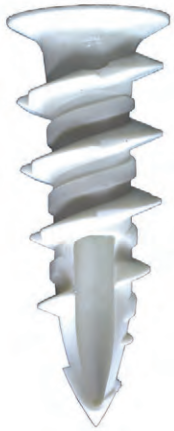
# **Sure Wall™** Drywall Anchor

Sure Wall anchors are self-drilling drywall anchors and provide excellent holding value and greater capacity than screws alone. This anchor cuts threads into drywall, greatly increasing the bearing surface and strength of the fastening.

### Features

- Self-drilling — may be installed in gypsum board drywall with only a screwdriver
- Easy to remove

**Material:** Die-cast zinc or reinforced nylon



**Sure Wall Nylon**

**Sure Wall Zinc**



### Sure Wall Product Data

| Screw Size | Model No. | | Style | Quantity | | Applications |
|---|---|---|---|---|---|---|
| | Packaged with Screws | Packaged Without Screws | | Box | Carton | |
| #8 x 1¼" | SWN08LS-R100 | SWN08L-R100 | Nylon | 100 | 500 | ⅜", ½" drywall, ceiling tile |
| #8 x 1¼" | SWZ08LS-R100 | SWZ08L-R100 | Zinc | 100 | 500 | ⅜", ½", ⅝" drywall, plaster |

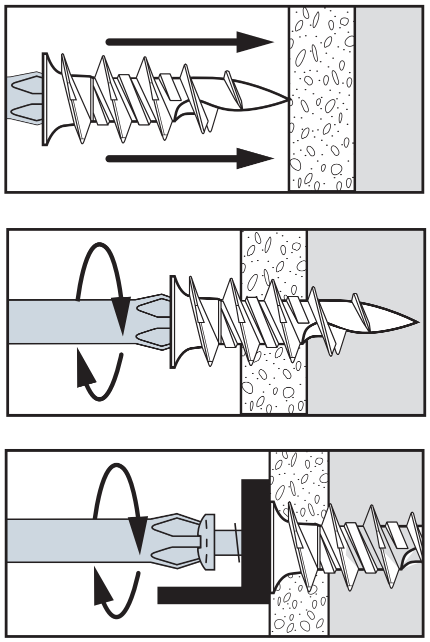
### Sure Wall Tension and Shear Loads in ½" Drywall

IBC *

| Model No. | Screw Size | Allowable Loads | |
|---|---|---|---|
| | | Tension (lb.) | Shear (lb.) |
| SWN08LS | #8 | 10 | 50 |
| SWZ08LS | #8 | 10 | 50 |

1. The allowable loads are baswed on a safety factor of 4.0.
2. The allowable loads listed are based on single anchor tests.
3. The performance of multiple anchors spaced closely together has not been investigated.

### Installation Sequence





**See p. 14 for an explanation of the load table icons.*

# Direct Fastening Solutions


PT-27
27 Caliber • Semi-Automatic
SIMPSON
Strong-Tie

# Powder-Actuated Tool / Fastener Suitability



This matrix matches Simpson Strong-Tie powder-actuated tools with the fasteners typically used with each tool.

✓ = Suitable
— = Not suitable

| Fasteners | | General-Purpose Tools | | | |
|---|---|---|---|---|---|
| | | PTP-27L  | PT-27  | PT-22A  | PT-22HA  |
| **0.300"-Headed Fasteners with 0.157" Shank Diameter** | | | | | |
| PDPA-XXX |  | ✓ | ✓ Max. 2½" | ✓ | ✓ |
| PDPAWL-XXX |  | ✓ | ✓ | ✓ | ✓ |
| PDPAS-XXX |  | — | — | — | — |
| PDPAT-XXX |  | ✓ | ✓ | ✓ | ✓ |
| PCLDPA-XXX |  | ✓ | ✓ | ✓ | ✓ |
| PECLDPA-XXX |  | ✓ | ✓ | ✓ | ✓ |
| PTRHA3-XXX |  | ✓ | ✓ | ✓ | ✓ |
| **0.300"-Headed Fasteners with 0.145" Shank Diameter** | | | | | |
| PINW-XXX |  | ✓ | ✓ | ✓ | ✓ |
| PINWP-XXX |  | ✓ | ✓ | ✓ | ✓ |
| PHBC-XXX |  | ✓ | ✓ | ✓ | ✓ |
| PCC-XXX |  | ✓ | ✓ | ✓ | ✓ |
| PBXDP-100 |  | ✓ | ✓ | ✓ | ✓ |
| **8 mm-Headed Fasteners** | | | | | |
| PKP-250 |  | ✓ | ✓ | ✓ | ✓ |
| **⅜"-Headed Fasteners / Threaded Studs** | | | | | |
| PSLV3-XXX |  | — | — | — | — |

See **strongtie.com** for more tool and fastener product information.

# Powder-Actuated Tools, Fasteners and Loads



| | Simpson Strong-Tie Powder-Actuated Tools | | | |
|---|---|---|---|---|
| |  |  |  |  |
| | **PTP-27L** | **PT-27** | **PT-22A** | **PT-22HA** |
| **Load Caliber** | 0.27 cal strip loads | 0.27 cal strip loads | 0.22 cal “A” crimp | 0.22 cal “A” crimp |
| **Load Power Level** | Brown (2) – Purple (6) | Brown (2) – Red (5) | Brown (2) – Yellow (4) | Brown (2) – Yellow (4) |
| **Firing Action** | Automatic | Semi-automatic | Single shot | Single shot |
| **Features** | Adjustable Power | Professional Grade | Economical | DIY |

## PDPA Drive Pins

- Manufactured with tight tolerances for superior performance
- Code listed per ICC-ES ESR-2138; City of L.A. RR25469; Florida FL15730

All pins/loads available in 100 count boxes. See **strongtie.com** or product guide (S-A-PG) for additional information.

### Drive Pin
0.157" Shank Diameter
0.300" Head Diameter

| Model No. | Pin Length (in.) |
|---|---|
| PDPA-50 | ½ |
| PDPA-50K | ½ knurled |
| PDPA-62K | ⅝ knurled |
| PDPA-75 | ¾ |
| PDPA-100 | 1 |
| PDPA-106 | 1 1⁄16 |
| PDPA-125 | 1¼ |
| PDPA-131 | 1 5⁄16 |
| PDPA-150 | 1½ |
| PDPA-187 | 1⅞ |
| ► PDPA-200 | 2 |
| ► PDPA-250 | 2½ |
| ► PDPA-287 | 2⅞ |

► These models available in mechanically galvanized Class 65 finish (PDPA-200MG, PDPA-250MG and PDPA-287MG).

**PDPA**

### Drive Pin with Washer
0.157" Shank Diameter
0.300" Head Diameter
1" Washer Diameter

| Model No. | Pin Length (in.) |
|---|---|
| PDPAWL-50K | ½ knurled |
| PDPAWL-75 | ¾ |
| PDPAWL-100 | 1 |
| PDPAWL-125 | 1¼ |
| PDPAWL-150 | 1½ |
| PDPAWL-187 | 1⅞ |
| ► PDPAWL-200 | 2 |
| PDPAWL-225 | 2¼ |
| ► PDPAWL-250 | 2½ |
| ► PDPAWL-287 | 2⅞ |

► These models available in mechanically galvanized Class 65 finish (PDPAWL-200MG, PDPAWL-250MG and PDPAWL-287MG).

**PDPAWL**

### Collated Drive Pin
0.157" Shank Diameter
0.300" Head Diameter
(10-Pin Collation)

| Model No. | Pin Length (in.) |
|---|---|
| PDPAS-50K | ½ knurled |
| PDPAS-62K | ⅝ knurled |
| PDPAS-75 | ¾ |
| PDPAS-100 | 1 |
| PDPAS-125 | 1¼ |
| PDPAS-150 | 1½ |
| PDPAS-187 | 1⅞ |
| PDPAS-200 | 2 |
| PDPAS-250 | 2½ |
| PDPAS-287 | 2⅞ |

**PDPAS**

### Drive Pin with Tophat
0.157" Shank Diameter
0.300" Head Diameter

| Model No. | Pin Length (in.) |
|---|---|
| PDPAT-50K | ½ knurled |
| PDPAT-62KP | ⅝ knurled |
| PDPAT-75 | ¾ |
| PDPAT-100 | 1 |

K — Knurled

KP — Knurled, point protrusion to aid in hole location

**PDPAT**

### Pre-Assembled Ceiling Clips
0.157" Shank Diameter
0.300" Head Diameter

| Model No. | Pin Length (in.) |
|---|---|
| PCL | — |
| PCLDPA-87 | ⅞ |
| PCLDPA-106 | 1 1⁄16 |
| PCLDPA-131 | 1 5⁄16 |
| PECLDPA-106 | 1 1⁄16 |
| PECLDPA-131 | 1 5⁄16 |

**PCL**

**PCLDPA**

**PECLDPA**

# Powder-Actuated Tools, Fasteners and Loads



### Threaded Rod Hanger
0.145" Shank Diameter
0.300" Head Diameter

| Model No. | Pin Length (in.) |
|---|---|
| PTRHA4-131 | 1 5/16, ¼ – 20 threaded rod hanger |
| PTRHA3-131 | 1 5/16, ⅜ – 16 threaded rod hanger |

PTRHA

### Insulation Metal Washer
0.145" Shank Diameter
0.300" Head Diameter
1 7/16" Washer Diameter

| Model No. | Pin Length (in.) |
|---|---|
| PINW-150 | 1½ |
| PINW-200 | 2 |
| PINW-250 | 2½ |
| PINW-300 | 3 |

PINW

### Insulation Plastic Washer
0.145" Shank Diameter
0.300" Head Diameter
1⅜" Washer Diameter

| Model No. | Pin Length (in.) |
|---|---|
| PINWP-150W | 1½ |
| PINWP-175W | 1¾ |
| PINWP-200W | 2 |
| PINWP-250W | 2½ |
| PINWP-300W | 3 |

PINWP

### Highway Basket Clip
0.145" Shank Diameter
0.300" Head Diameter

| Model No. | Pin Length (in.) |
|---|---|
| PHBC-150 | 1½ |
| PHBC-200 | 2 |
| PHBC-250 | 2½ |

PHBC

### Pre-Assembled BX Cable Straps and Conduit Clips
0.145" Shank Diameter
0.300" Head Diameter

| Model No. | Description |
|---|---|
| PBXDP-100 | BX cable strap with 1" pin |
| PCC50-DP100 | Conduit clip ½" EMT with 1" pin |
| PCC75-DP100 | Conduit clip ¾" EMT with 1" pin |
| PCC100-DP100 | Conduit clip 1" EMT with 1" pin |

PBXDP

PCC

### ⅜"-16 Threaded Studs
0.205" Shank Diameter

| Model No. | Pin Length (in.) |
|---|---|
| PSLV3-12575K | Thread: 1¼ Shank: ¾ (knurled) |
| PSLV3-125100 | Thread: 1¼ Shank: 1 |
| PSLV3-125125 | Thread: 1¼ Shank: 1¼ |

PSLV3

### Concrete Forming Pin
0.145" Shank Diameter
0.187" Head Diameter

| Model No. | Pin Length (in.) |
|---|---|
| PKP-250 | 2½ |

PKP

### Hammer Drive Fastener
0.140" Shank Diameter
0.250" Head Diameter
⅜" Metal Washer

| Model No. | Pin Length (in.) |
|---|---|
| PHD-75 | ¾ |
| PHD-100 | 1 |
| PHD-125 | 1¼ |

PHD

PHT-38
Manual Hammer Tool

1. Designed for use with PHD fastener.
2. **Warning:** Do not use powder loads with this tool. This is a hammer drive tool only. Use of powder loads with this tool may result in injury or death.

# Powder-Actuated Tools, Fasteners and Loads



## 0.22-Caliber "A" Crimp Loads — Single Shot

| Model No. | Caliber | Load | |
|---|---|---|---|
| | | Color | Level |
| P22AC2 | 0.22 | Brown | 2 |
| P22AC2A | | | |
| P22AC3 | | Green | 3 |
| P22AC3A | | | |
| P22AC4 | | Yellow | 4 |
| P22AC4A | | | |

**Note:** An "A" in a part number denotes imported load.
No "A" indicates a domestic load.

**P22AC**

## 0.27-Caliber Single-Shot Loads — Long

| Model No. | Caliber | Load | |
|---|---|---|---|
| | | Color | Level |
| P27LVL4 | 0.27 | Yellow | 4 |
| P27LVL5 | | Red | 5 |
| P27LVL6 | | Purple | 6 |

**P27LVL**

## 0.27-Caliber Plastic, 10-Shot Strip Loads

| Model No. | Caliber | Load | |
|---|---|---|---|
| | | Color | Level |
| P27SL2 | 0.27 | Brown | 2 |
| P27SL2A | | | |
| P27SL3 | | Green | 3 |
| P27SL3A | | | |
| P27SL4 | | Yellow | 4 |
| P27SL4A | | | |
| P27SL5 | | Red | 5 |
| P27SL5A | | | |
| P27SL6 | | Purple | 6 |

**Note:** An "A" in a part number denotes imported load.
No "A" indicates a domestic load.

**P27SL**

## 0.25-Caliber Plastic, 10-Shot Strip Loads

| Model No. | Caliber | Load | |
|---|---|---|---|
| | | Color | Level |
| P25SL3 | 0.25 | Green | 3 |
| P25SL4 | | Yellow | 4 |
| P25SL5 | | Red | 5 |

**P25SL**

# Gas Tool / Fastener Suitability



**Gas Tool**
**G3**


**Fuel Cell**
**GFC34**


**0.106"-Diameter Shank Pins**
**GDP**
US Patent 605,016

| Model No. | Pin Length (in.) |
|---|---|
| GDP-50KT | ½ |
| GDP-62KT | ⅝ |
| GDP-75KT | ¾ |
| GDP-100KT | 1 |
| GDP-125KT | 1¼ |
| GDP-150KT | 1½ |

**0.118"- / 0.102"-Diameter Stepped-Shank Pins**
**GDPS**

| Model No. | Pin Length (in.) |
|---|---|
| GDPS-50KT | ½ |
| GDPS-62KT | ⅝ |
| GDPS-75KT | ¾ |

**Spiral Knurl Pins**
**GDPSK**

| Model No. | Pin Length (in.) |
|---|---|
| GDPSK-138KT | 1⅜ |

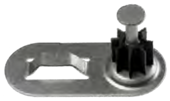
**Mechanical, Electrical, Plumbing and Ceiling Pins**

| Model No. | Pin Diameter (in.) | Pin Length (in.) | Description |
|---|---|---|---|
| GCC50-R100 | 0.126 | 1 | ½" conduit clip (0.047" thick) with pin |
| GCC75-R100 | 0.126 | 1 | ¾" conduit clip (0.059" thick) with pin |
| GCC100-R100 | 0.126 | 1 | 1" conduit clip (0.059" thick) with pin |
| GCC125-R50 | 0.126 | 1 | 1¼" conduit clip (0.071" thick) with pin |
| GCL50-R50 | 0.126 | 1 | ½" conduit clamp (0.047" thick) with pin |
| GCL75-R25 | 0.126 | 1 | ¾" conduit clamp (0.047" thick) with pin |
| GAC-R100 | 0.126 | 1 | 90° ceiling angle clip (0.071" thick) with pin |
| GCT-R50 | 0.126 | 1 | Tie-strap holder (0.0315" thick) with pin |
| GW50-R200 | 0.128/ 0.110 | ½ | ½" dome washer stepped-shank pin |
| GW75-R200 | 0.126 | ¾ | ½" dome washer pin |
| GW100-R100 | 0.126 | 1 | ½" dome washer pin |
| GTS4-5075-R200 | 0.128 | 1¼ | ¼" – 20 threaded stud (¾" shank and ½" thread) |
| GTH-R200 | 0.126 | 1 | Top-Hat pin |


GCL


GCC


GAC


GCT


GW


GTS


GTH

See product guide (S-A-PG) and **strongtie.com** for additional information.

## Powder-Actuated and Gas-Actuated Fasteners — Allowable Tension Loads in Normal-Weight Concrete

IBC *

| Direct Fastening Type | Model No. | Shank Diameter in. (mm) | Minimum Embedment in. (mm) | Minimum Edge Distance in. (mm) | Minimum Spacing in. (mm) | Allowable Tension Load — lb. (kN) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | f'c = 2,500 psi (17.2 MPa) | f'c = 3,000 psi (20.7 MPa) | f'c = 4,000 psi (27.6 MPa) | f'c = 5,000 psi (34.5 MPa) | f'c = 6,000 psi (41.3 MPa) |
| Powder Actuated | PDPA PDPAT PDPAWL | **0.157** (4.0) | ¾ (19) | 3½ (89) | 5 (127) | 110 (0.49) | 110 (0.49) | 110 (0.49) | — | 110 (0.49) |
| | | | 1 (25) | 3½ (89) | 5 (127) | 210 (0.93) | 240 (1.07) | 310 (1.38) | — | 160 (0.71) |
| | | | 1¼ (32) | 3½ (89) | 5 (127) | 320 (1.42) | 340 (1.51) | 380 (1.69) | — | 365 (1.62) |
| | | | 1½ (38) | 3½ (89) | 5 (127) | 375 (1.67) | 400 (1.78) | 450 (2.00) | — | 465 (2.07) |
| | PINW PINWP | **0.145** (3.7) | 1 (25) | 3 (76) | 4 (102) | 70 (0.31) | 100 (0.44) | 150 (0.67) | — | 150 (0.67) |
| | | | 1¼ (32) | 3 (76) | 4 (102) | 195 (0.87) | 255 (1.13) | 370 (1.65) | — | 370 (1.65) |
| | PSLV3 | **0.205** (5.2) | 1¼ (32) | 4 (102) | 6 (152) | 260 (1.16) | — | — | — | — |
| Gas Actuated | GDP | **0.106** (2.7) | ⅝ (16) | 3 (76) | 4 (102) | 25 (0.11) | 30 (0.13) | 45 (0.20) | 45 (0.20) | — |
| | | | ¾ (19) | 3 (76) | 4 (102) | 30 (0.13) | 30 (0.13) | 30 (0.13) | 30 (0.13) | — |
| | GW-75 GW-100 GTH | **0.126** (3.2) | ⅝ (16) | 3 (76) | 4 (102) | 65 (0.29) | 70 (0.31) | 95 (0.42) | — | — |
| | | | ¾ (19) | 3 (76) | 4 (102) | 95 (0.42) | 105 (0.47) | 190 (0.85) | — | — |

1. The fasteners must not be driven until the concrete has reached the designated minimum compressive strength.
2. Minimum concrete thickness must be three times the fastener embedment into the concrete.
3. The allowable tension values are only for the fastener in the concrete. Members connected to the concrete must be investigated in accordance with accepted design criteria.
4. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.
5. For fastener installation in concrete with compressive strength outside of the listed range, published allowable loads shall not be extrapolated.

## Powder-Actuated and Gas-Actuated Fasteners — Allowable Shear Loads in Normal-Weight Concrete

IBC *

| Direct Fastening Type | Model No. | Shank Diameter in. (mm) | Minimum Embedment in. (mm) | Minimum Edge Distance in. (mm) | Minimum Spacing in. (mm) | Allowable Shear Load — lb. (kN) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | f'c = 2,500 psi (17.2 MPa) | f'c = 3,000 psi (20.7 MPa) | f'c = 4,000 psi (27.6 MPa) | f'c = 5,000 psi (34.5 MPa) | f'c = 6,000 psi (41.3 MPa) |
| Powder Actuated | PDPA PDPAT PDPAWL | **0.157** (4.0) | ¾ (19) | 3½ (89) | 5 (127) | 120 (0.53) | 125 (0.56) | 135 (0.60) | — | 130 (0.58) |
| | | | 1 (25) | 3½ (89) | 5 (127) | 285 (1.27) | 290 (1.29) | 310 (1.38) | — | 350 (1.56) |
| | | | 1¼ (32) | 3½ (89) | 5 (127) | 360 (1.60) | 380 (1.69) | 420 (1.87) | — | 390 (1.73) |
| | | | 1½ (38) | 3½ (89) | 5 (127) | 405 (1.80) | 430 (1.91) | 485 (2.16) | — | 495 (2.20) |
| | PINW PINWP | **0.145** (3.7) | 1 (25) | 3 (76) | 4 (102) | 140 (0.62) | 165 (0.73) | 205 (0.91) | — | 205 (0.91) |
| | | | 1¼ (32) | 3 (76) | 4 (102) | 265 (1.18) | 265 (1.18) | 265 (1.18) | — | 265 (1.18) |
| Gas Actuated | GDP | **0.106** (2.7) | ⅝ (16) | 3 (76) | 4 (102) | 25 (0.11) | 25 (0.11) | 25 (0.11) | 25 (0.11) | — |
| | | | ¾ (19) | 3 (76) | 4 (102) | 50 (0.22) | 55 (0.24) | 75 (0.33) | 75 (0.33) | — |
| | GW-75 GW-100 GTH | **0.126** (3.2) | ⅝ (16) | 3 (76) | 4 (102) | 60 (0.27) | 65 (0.29) | 95 (0.42) | — | — |
| | | | ¾ (19) | 3 (76) | 4 (102) | 135 (0.60) | 145 (0.64) | 215 (0.96) | — | — |

1. The fasteners must not be driven until the concrete has reached the designated minimum compressive strength.
2. Minimum concrete thickness must be three times the fastener embedment into the concrete.
3. The allowable shear values are only for the fastener in the concrete. Members connected to the concrete must be investigated in accordance with accepted design criteria.
4. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.
5. For fastener installation in concrete with compressive strength outside of the listed range, published allowable loads shall not be extrapolated.

**See p. 14 for an explanation of the load table icons.*

## Powder-Actuated and Gas-Actuated Assemblies — Allowable Tension Loads in Normal-Weight Concrete

| Direct Fastening Type | Model No. | Shank Diameter in. (mm) | Minimum Embedment in. (mm) | Minimum Edge Distance in. (mm) | Minimum Spacing in. (mm) | Allowable Tension Load — lb. (kN) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | f'$_c$ = 2,500 psi (17.2 MPa) | f'$_c$ = 3,000 psi (20.7 MPa) | f'$_c$ = 4,000 psi (27.6 MPa) | f'$_c$ = 5,000 psi (34.5 MPa) | f'$_c$ = 6,000 psi (41.3 MPa) |
| Powder Actuated | PCLDPA | 0.157 (4.0) | ¾ (19) | 3½ (89) | 5 (102) | 70 (0.31) | — | 120 (0.53) | — | 130 (0.58) |
| | | | 1 (25) | 3½ (89) | 5 (102) | 175 (0.78) | — | 180 (0.80) | — | 190 (0.85) |
| | | | 1¼ (32) | 3½ (89) | 5 (102) | 210 (0.93) | — | 210 (0.93) | — | 190 (0.85) |
| | PECLDPA | 0.157 (4.0) | ⅞ (22) | 3½ (89) | 5 (102) | 90 (0.40) | — | 110 (0.49) | — | 85 (0.38) |
| | | | 1 (25) | 3½ (89) | 5 (102) | 180 (0.80) | — | 155 (0.69) | — | 180 (0.80) |
| | PTRHA3 PTRHA4 | 0.157 (4.0) | 1¼ (32) | 3½ (89) | 5 (102) | 185 (0.82) | — | 220 (0.98) | — | 190 (0.85) |
| Gas Actuated | GAC | 0.126 (3.2) | ¾ (19) | 3 (76) | 4 (102) | 105 (0.47) | 120 (0.53) | 150 (0.67) | 170 (0.76) | 195 (0.87) |

1. The fasteners must not be driven until the concrete has reached the designated minimum compressive strength.
2. Minimum concrete thickness must be three times the fastener embedment into the concrete.
3. The allowable tension values are only for the fastener in the concrete. Members connected to the concrete must be investigated in accordance with accepted design criteria.
4. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.
5. For fastener installation in concrete with compressive strength outside of the listed range, published allowable loads shall not be extrapolated.

## Powder-Actuated and Gas-Actuated Assemblies — Allowable Oblique Loads in Normal-Weight Concrete

| Direct Fastening Type | Model No. | Shank Diameter in. (mm) | Minimum Embedment in. (mm) | Minimum Edge Distance in. (mm) | Minimum Spacing in. (mm) | Allowable Oblique Load — lb. (kN) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | f'$_c$ = 2,500 psi (17.2 MPa) | f'$_c$ = 3,000 psi (20.7 MPa) | f'$_c$ = 4,000 psi (27.6 MPa) | f'$_c$ = 5,000 psi (34.5 MPa) | f'$_c$ = 6,000 psi (41.3 MPa) |
| Powder Actuated | PCLDPA | 0.157 (4.0) | ¾ (19) | 3½ (89) | 5 (102) | 115 (0.51) | — | 105 (0.47) | — | 140 (0.62) |
| | | | 1 (25) | 3½ (89) | 5 (102) | 255 (1.13) | — | 240 (1.07) | — | 245 (1.09) |
| | | | 1¼ (32) | 3½ (89) | 5 (102) | 250 (1.11) | — | 265 (1.18) | — | 265 (1.18) |
| | PECLDPA | 0.157 (4.0) | ⅞ (22) | 3½ (89) | 5 (102) | 135 (0.60) | — | 130 (0.58) | — | 115 (0.51) |
| | | | 1 (25) | 3½ (89) | 5 (102) | 225 (1.00) | — | 230 (1.02) | — | 255 (1.13) |
| Gas Actuated | GAC | 0.126 (3.2) | ¾ (19) | 3 (76) | 4 (102) | 130 (0.58) | 135 (0.60) | 145 (0.64) | 155 (0.69) | 175 (0.78) |

1. The fasteners must not be driven until the concrete has reached the designated minimum compressive strength.
2. Minimum concrete thickness must be three times the fastener embedment into the concrete.
3. The allowable oblique values are only for the fastener in the concrete. Members connected to the concrete must be investigated in accordance with accepted design criteria.
4. Oblique load direction is 45° from the concrete member surface.
5. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.
6. For fastener installation in concrete with compressive strength outside of the listed range, published allowable loads shall not be extrapolated.



*See p. 14 for an explanation of the load table icons.

## Powder-Actuated Fasteners — Allowable Tension and Shear Loads for Attachment of Wood Sill Plates to Normal-Weight Concrete

IBC *

| Direct Fastening Type | Model No. | Shank Length in. (mm) | Nominal Head Diameter in. (mm) | Shank Diameter in. (mm) | Washer Thickness in. (mm) | Washer Bearing Area in.$^2$ (mm$^2$) | $f'_c$ = 2,500 psi (17.2 MPa) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Allowable Tension Load lb. (kN) | Allowable Shear Load lb. (kN) |
| Powder Actuated | PDPAWL-287<br>PDPAWL-287MG | **2⅞**<br>(73) | **0.300**<br>(7.6) | **0.157**<br>(4.0) | **0.070**<br>(1.8) | **0.767**<br>(495) | **200**<br>(0.89) | **205**<br>(0.91) |

1. The fasteners must not be driven until the concrete has reached the designated minimum compressive strength.
2. Minimum concrete thickness must be three times the fastener embedment into the concrete.
3. The allowable tension and shear values are only for the fastener in the concrete. Members connected to the concrete must be investigated in accordance with accepted design criteria.
4. Minimum concrete edge distance is 1¾" (44.5 mm).
5. Only mechanically galvanized fasteners (with 'MG' in the designation) may be used to attach preservative-treated wood to concrete.
6. Minimum spacing shall be 4" (101.6 mm) on center.
7. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 code report for seismic load conditions.

## Pin Spacing Requirements of Powder-Actuated Fasteners for Attachment of Wood Sill Plates for Interior Non-Structural Walls to Normal-Weight Concrete

IBC *

| Direct Fastening Type | Model No. | Shank Length in. (mm) | Shank Diameter in. (mm) | Concrete Edge Distance in. (mm) | Maximum Spacing in. (mm) |
|---|---|---|---|---|---|
| Powder Actuated | PDPAWL-287[3]<br>PDPAWL-287MG[3] | **2⅞**<br>(73) | **0.157**<br>(4.0) | **1¾**<br>(44.5) | **48**<br>(1,219) |

1. Spacings are based upon the attachment of 2" (nominal thickness) wood sill plates, with specific gravity of 0.50 or greater, to concrete floor slabs or footings.
2. All walls shall have fasteners placed at 6" (152.4 mm) from ends of sill plates, with maximum spacing as shown in the table.
3. Fasteners shall not be driven until the concrete has reached a compressive strength of 2,500 psi.
4. The maximum horizontal transverse load on the wall shall be 5 psf (0.239 kPa).
5. The maximum wall height shall be 14 feet (4.3 m).
6. For exterior walls and interior structural walls, this table is not applicable and allowable loads must be used.
7. Walls shall be laterally supported at the top and the bottom.
8. Minimum fastener spacing shall be 4" (101.6 mm) on center.
9. Only mechanically galvanized fasteners (with 'MG' in the designation) may be used to attach preservative-treated wood to concrete.

*See p. 14 for an explanation of the load table icons.

## Powder-Actuated and Gas-Actuated Fasteners — Allowable Tension Loads in Sand-Lightweight Concrete over Steel Deck

IBC *

| Direct Fastening Type | Model No. | Shank Diameter in. (mm) | Minimum Embedment in. (mm) | Allowable Tension Load — lb. (kN) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | $f'_c$ = 3,000 psi (20.7 MPa) Sand-Light Weight Concrete | | | | |
| | | | | Installed in Top Side of Concrete[4] | Installed Through 3" "W" Deck with | | Installed Through 1.5" "B" Deck with | |
| | | | | | 3¼" Concrete Fill[5] | 2¼" Concrete Fill[6] | 2¼" Concrete Fill[7] | 2" Concrete Fill[8] |
| | | | | Figure 1, 2 and 3 | Figure 1 | Figure 1 | Figure 2 and 3 | Figure 2 |
| Powder Actuated | PDPA PDPAT PDPAWL | 0.157 (4.0) | ¾ (19) | 85 (0.38) | 105 (0.47) | — | — | 160 (0.71) |
| | | | 1 (25) | 150 (0.67) | 145 (0.64) | — | — | 210 (0.93) |
| | | | 1¼ (32) | 320 (1.42) | 170 (0.76) | — | — | 265 (1.18) |
| | | | 1½ (38) | 385 (1.71) | 325 (1.45) | — | — | — |
| | PINW PINWP | 0.145 (3.7) | ⅞ (22) | 85 (0.38) | 40 (0.18) | — | — | — |
| | PSLV3 | 0.205 (5.2) | 1¼ (32) | — | 225 (1.00) | — | — | — |
| Gas Actuated | GDP | 0.106 (2.7) | ⅝ (16) | 75 (0.33) | — | 60 (0.27) | 65 (0.29) | — |
| | | | ¾ (19) | 105 (0.47) | — | 60 (0.27) | 130 (0.58) | — |
| | GW-75 GW-100 GTH | 0.126 (3.2) | ⅝ (16) | 60 (0.27) | — | 35 (0.16) | — | — |
| | | | ¾ (19) | 115 (0.51) | — | 55 (0.24) | — | — |

1. The fastener shall not be driven until the concrete has reached the designated compressive strength.
2. The allowable tension values are for the fastener only. Members connected to the concrete must be invesigated separately in accordance with accepted design criteria.
3. Steel deck must be minimum 20 gauge and have a minimum yield strength of 38,000 psi.
4. The minimum fastener spacing is 4". The minimum edge distances are 3½" and 3" for powder-actuated fasteners and gas-actuated fasteners, respectively.
5. The fastener shall be installed minimum 1½" from the edge of flute and 4" from the end of the deck. The minimum fastener spacing is 4".
6. The fastener shall be installed minimum 1" from the edge of flute and 3" from the end of the deck. The minimum fastener spacing is 4". For GW and GTH fasteners, the fastener must be a minimum of 1⅛" from the edge of flute.
7. The fastener shall be installed minimum ⅞" from the edge of flute. For inverted 1.5" "B" deck configuration, the fastener must be a minimum of 1" from the edge of flute. Fastener must be installed miminim 3" from the end of the deck. The minimum fastener spacing is 4".
8. The fastener shall be installed minimum ⅞" from the edge of flute and 4" from the end of the deck. The minimum fastener spacing is 4".
9. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.
10. See figures on the right for nominal deck dimensions and fastener locations.

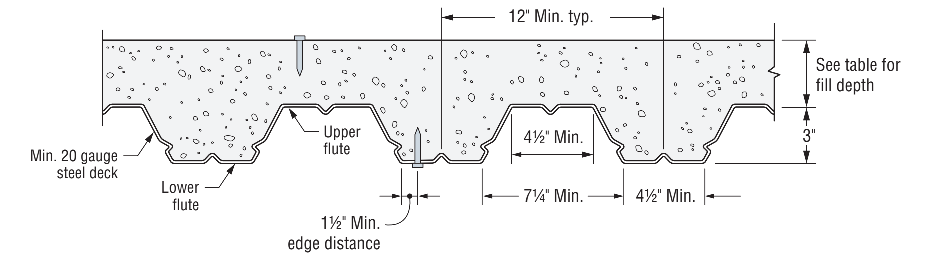



**Figure 1.** 3" "W" Deck with Concrete Infill

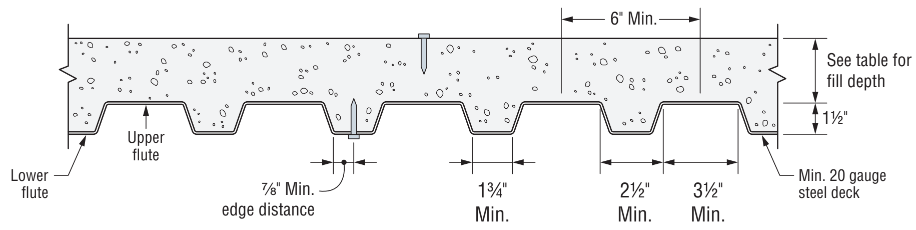



**Figure 2.** 1½" "B" Deck with Concrete Infill

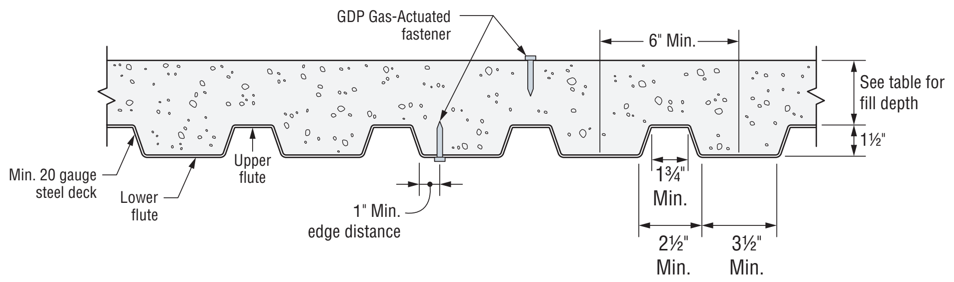



**Figure 3.** 1½" Inverted "B" Deck with 2¼" Concrete Infill

*See p. 14 for an explanation of the load table icons.

# Gas- and Powder-Actuated Fasteners Design Information – Concrete

## Powder-Actuated and Gas-Actuated Fasteners — Allowable Shear Loads in Sand-Lightweight Concrete over Steel Deck

| Direct Fastening Type | Model No. | Shank Diameter in. (mm) | Minimum Embedment in. (mm) | Allowable Shear Load — lb. (kN) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | $f'_c$ = 3,000 psi (20.7 MPa) Sand-Light Weight Concrete | | | | |
| | | | | Installed in Top Side of Concrete[9] | Installed Through 3" "W" Deck with | | Installed Through 1.5" "B" Deck with | |
| | | | | | 3¼" Concrete Fill[5] | 2¼" Concrete Fill[6] | 2¼" Concrete Fill[7] | 2" Concrete Fill[8] |
| | | | | Figure 1, 2 and 3[11] | Figure 1[11] | Figure 1[11] | Figure 2 and 3[11] | Figure 2[11] |
| Powder Actuated | PDPA PDPAT PDPAWL | **0.157** (4.0) | ¾ (19) | **105** (0.47) | **280** (1.25) | — | — | **275** (1.22) |
| | | | 1 (25) | **225** (1.00) | **280** (1.25) | — | — | **370** (1.65) |
| | | | 1¼ (32) | **420** (1.87) | **320** (1.42) | — | — | **460** (2.05) |
| | | | 1½ (38) | **455** (2.02) | **520** (2.31) | — | — | — |
| | PINW PINWP | **0.145** (3.7) | ⅞ (22) | **250** (1.11) | **275** (1.22) | — | — | — |
| Gas Actuated | GDP | **0.106** (2.7) | ⅝ (16) | **35** (0.16) | — | **180** (0.80) | **195** (0.87) | — |
| | | | ¾ (19) | **140** (0.62) | — | **180** (0.80) | **270** (1.20) | — |
| | GW-75 GW-100 GTH | **0.126** (3.2) | ⅝ (16) | **110** (0.49) | — | **215** (0.96) | — | — |
| | | | ¾ (19) | **130** (0.58) | — | **235** (1.05) | — | — |

1. The fastener shall not be driven until the concrete has reached the designated compressive strength.
2. The allowable shear values are for the fastener only. Members connected to the concrete must be invesigated separately in accordance with accepted design criteria.
3. Steel deck must be minimum 20 gauge and have a minimum yield strength of 38,000 psi.
4. Shear values are for loads applied toward edge of flute.
5. The fastener shall be installed minimum 1½" from the edge of flute and 4" from the end of the deck. The minimum fastener spacing is 4".
6. The fastener shall be installed minimum 1" from the edge of flute and 3" from the end of the deck. The minimum fastener spacing is 4". For GW and GTH fasteners, the fastener must be a minimum of 1⅛" from the edge of flute.
7. The fastener shall be installed minimum ⅞" from the edge of flute. For inverted 1.5" "B" deck configuration, the fastener must be a minimum of 1" from the edge of flute. Fastener must be installed miminim 3" from the end of the deck. The minimum fastener spacing is 4".
8. The fastener shall be installed minimum ⅞" from the edge of flute and 4" from the end of the deck. The minimum fastener spacing is 4".
9. The minimum fastener spacing is 4". The minimum edge distances are 3½" and 3" for powder-actuated fasteners and gas-actuated fasteners, respectively.
10. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.
11. See figures on p. 178 for nominal deck dimensions and fastener locations.





*See p. 14 for an explanation of the load table icons.

## Powder-Actuated and Gas-Actuated Assemblies — Allowable Tension Loads in Sand-Lightweight Concrete over Steel Deck

IBC *

| Direct Fastening Type | Model No. | Shank Diameter in. (mm) | Minimum Embedment in. (mm) | Allowable Tension Load — lb. (kN) | | | |
|---|---|---|---|---|---|---|---|
| | | | | f'c = 3,000 psi (20.7 MPa) Sand-Lightweight Concrete | | | |
| | | | | Installed Through 3" "W" Deck with | | Installed Through 1.5" "B" Deck with | |
| | | | | 2½" Concrete Fill[4] | 2¼" Concrete Fill[5] | 2¼" Concrete Fill[6] | 2" Concrete Fill[7] |
| | | | | Figure 1[9] | Figure 1[9] | Figure 2 and 3[9] | Figure 2[9] |
| Powder Actuated | PTRHA3 PTRHA4 | **0.157** (4.0) | 1¼ (32) | **160** (0.71) | — | — | **175** (0.78) |
| | PCLDPA | **0.157** (4.0) | ¾ (19) | **115** (0.51) | — | — | **60** (0.27) |
| | | | 1 (25) | **140** (0.62) | — | — | **160** (0.71) |
| | | | 1¼ (32) | **160** (0.71) | — | — | **180** (0.80) |
| | PECDLPA | **0.157** (4.0) | ⅞ (22) | **80** (0.36) | — | — | **95** (0.40) |
| | | | 1 (25) | **120** (0.53) | — | — | **135** (0.60) |
| Gas Actuated | GAC | **0.126** (3.2) | ¾ (19) | — | **105** (0.47) | **90** (0.40) | — |

1. The fastener shall not be driven until the concrete has reached the designated compressive strength.
2. The allowable tension values are for the fastener only. Members connected to the concrete must be invesigated separately in accordance with accepted design criteria.
3. Steel deck must be minimum 20 gauge and have a minimum yield strength of 38,000 psi.
4. The fastener shall be installed minimum 1½" from the edge of flute and 4" from the end of the deck. The minimum fastener spacing is 4".
5. The fastener shall be installed minimum 1" from the edge of flute and 3" from the end of the deck. The minimum fastener spacing is 4".
6. The fastener shall be installed minimum ⅞" from the edge of flute and 3" from the end of the deck. The minimum fastener spacing is 4".
7. The fastener shall be installed minimum ⅞" from the edge of flute and 4" from the end of the deck. The minimum fastener spacing is 4".
8. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.
9. See figures on p. 178 for nominal deck dimensions and fastener locations.

## Powder-Actuated and Gas-Actuated Assemblies — Allowable Oblique Loads in Sand-Lightweight Concrete over Steel Deck

IBC *

| Direct Fastening Type | Model No. | Shank Diameter in. (mm) | Minimum Embedment in. (mm) | Allowable Oblique Load — lb. (kN) | | | |
|---|---|---|---|---|---|---|---|
| | | | | f'c = 3,000 psi (20.7 MPa) Sand-Lightweight Concrete | | | |
| | | | | Installed Through 3" "W" Deck with | | Installed Through 1.5" "B" Deck with | |
| | | | | 2½" Concrete Fill[4] | 2¼" Concrete Fill[5] | 2¼" Concrete Fill[6] | 2" Concrete Fill[7] |
| | | | | Figure 1[10] | Figure 1[10] | Figure 2 and 3[10] | Figure 2[10] |
| Powder Actuated | PCLDPA | **0.157** (4.0) | ¾ (19) | **155** (0.69) | — | — | **175** (0.78) |
| | | | 1 (25) | **175** (0.78) | — | — | **240** (1.07) |
| | | | 1¼ (32) | **185** (0.82) | — | — | **280** (1.25) |
| | PECDLPA | **0.157** (4.0) | ⅞ (22) | **110** (0.49) | — | — | **110** (0.49) |
| | | | 1 (25) | **145** (0.64) | — | — | **175** (0.78) |
| Gas Actuated | GAC | **0.126** (3.2) | ¾ (19) | — | **120** (0.53) | **90** (0.40) | — |

1. The fastener shall not be driven until the concrete has reached the designated compressive strength.
2. The allowable oblique values are for the fastener only. Members connected to the concrete must be invesigated separately in accordance with accepted design criteria.
3. Steel deck must be minimum 20 gauge and have a minimum yield strength of 38,000 psi.
4. The fastener shall be installed minimum 1½" from the edge of flute and 4" from the end of the deck. The minimum fastener spacing is 4".
5. The fastener shall be installed minimum 1" from the edge of flute and 3" from the end of the deck. The minimum fastener spacing is 4".
6. The fastener shall be installed minimum ⅞" from the edge of flute and 3" from the end of the deck. The minimum fastener spacing is 4".
7. The fastener shall be installed minimum ⅞" from the edge of flute and 4" from the end of the deck. The minimum fastener spacing is 4".
8. Oblique load direction is 45° from the concrete member surface.
9. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.
10. See figures on p. 178 for nominal deck dimensions and fastener locations.

**See p. 14 for an explanation of the load table icons.*

# **Gas- and Powder-Actuated Fasteners** Design Information – CMU

## Powder-Actuated and Gas-Actuated Fasteners — Allowable Tension and Shear Loads in Hollow and Grout-Filled CMU[4,5,8]

IBC *

| Direct Fastening Type | Model No. | Shank Diameter in. (mm) | Minimum Embedment in. (mm) | Minimum Edge Distance in. (mm) | 8-inch Hollow CMU | | 8-inch Grout-Filled CMU | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Allowable Tension Load lb. (kN) | Allowable Shear Load lb. (kN) | Allowable Tension Load lb. (kN) | Allowable Shear Load lb. (kN) |
| Powder Actuated | PDPA<br>PDPAT<br>PDPAWL | **0.157**<br>(4.0) | **1¾**<br>(44) | **3½**<br>(89) | **125**[1]<br>(0.56) | **210**[1]<br>(0.93) | **190**[3]<br>(0.85) | **245**[3]<br>(1.09) |
| | PINW<br>PINWP | **0.145**<br>(3.7) | **1¾**<br>(44) | **3½**<br>(89) | **110**[1]<br>(0.49) | **200**[1]<br>(0.89) | — | — |
| Gas Actuated | GDP | **0.106**<br>(2.7) | **⅝**<br>(16) | **3**<br>(76) | **35**[1]<br>(0.16) | **60**[1]<br>(0.27) | — | — |
| | GW-75<br>GW-100<br>GTH | **0.126**<br>(3.2) | **⅝**<br>(16) | **3**<br>(76) | **75**[2]<br>(0.33) | **90**[2]<br>(0.40) | — | — |

1. Allowable values for fasteners in hollow lightweight concrete masonry units conforming to ASTM C90.
2. Allowable values for fasteners in hollow medium-weight concrete masonry units conforming to ASTM C90.
3. Allowable values for fasteners in grout-filled lightweight concrete masonry units conforming to ASTM C90 with coarse grout conforming to ASTM C746.
4. The minimum allowable nominal size of the CMU must be 8" high by 8" wider by 16" long, with a minimum 1¼"-thick face shell thickness.
5. Allowable values are for fasteners installed in the center of a CMU face shell. See Figure 1 for the applicable placement zone. Only one fastener may be installed at each cell.
6. Minimum embedment is measured from the outside face of the CMU.
7. Allowable values are for the fastener only. Members connected to the CMU must be investigated separately in accordance with accepted design criteria.
8. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.

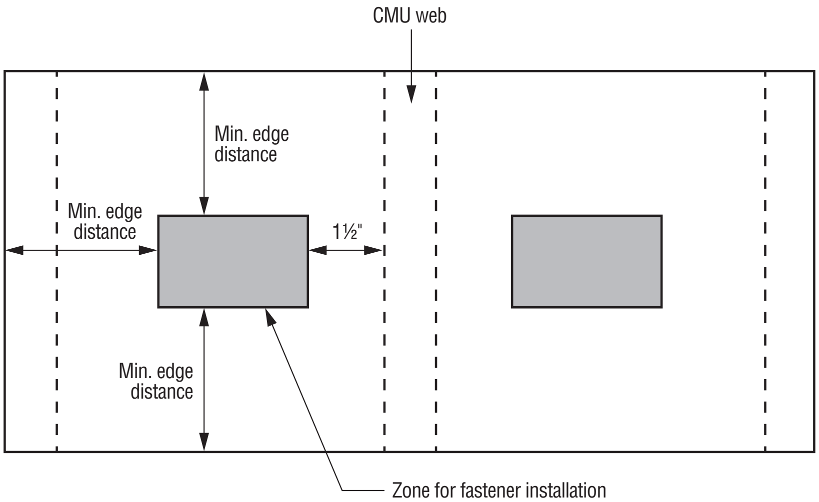



**Figure 1.** Zone for Fastener Installation in Face Shell of CMU

**See p. 14 for an explanation of the load table icons.*

Direct Fastening Solutions

SIMPSON Strong-Tie®



## Powder-Actuated and Gas-Actuated Fasteners — Allowable Tension Loads in Steel[1]

IBC *

| Direct Fastening Type | Model No. | Shank Diameter[10] in. (mm) | Minimum Edge Distance in. (mm) | Minimum Spacing in. (mm) | Minimum Steel Strength[3] ASTM | Allowable Tension Load — lb. (kN) Steel Thickness 1/8" | 3/16" | 1/4" | 3/8" | 1/2" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Powder Actuated | PDPA PDPAT PDPAWL | **0.157** (4.0) | ½ (13) | 1 (25) | A36 | — | **260** (1.16) | **370** (1.65) | **380**[7] (1.69) | **530**[7] (2.36) | **195**[4] (0.87) |
| | | | ½ (13) | 1 (25) | A572 Gr. 50 or A992 | — | **305** (1.36) | **335** (1.49) | **355**[7] (1.58) | **485**[5] (2.16) | **170**[6] (0.76) |
| | PINW PINWP | **0.145** (3.7) | ½ (13) | 1 (25) | A36 | — | **155** (0.69) | — | — | — | — |
| | PSLV3 Smooth shank | **0.205** (5.2) | 1 (25) | 1½ (38) | A36 | — | **270** (1.20) | **680** (3.02) | — | — | — |
| | PSLV3-12575K Knurled shank | **0.205** (5.2) | 1 (25) | 1½ (38) | A36 | — | **270** (1.20) | **870** (3.87) | — | — | — |
| Gas Actuated | GDP | **0.106** (2.7) | ½ (13) | 1 (25) | A36 | **125** (0.56) | **210** (0.93) | **220** (0.98) | — | — | — |
| | | | ½ (13) | 1 (25) | A572 Gr. 50 or A992 | — | **225** (1.00) | **185** (0.82) | — | — | — |
| | GDPS | **0.118/0.102** (3.0/2.6) | ½ (13) | 1 (25) | A36 | — | **95** (0.42) | **170** (0.76) | **165**[8] (0.73) | **145**[8] (0.64) | — |
| | | | ½ (13) | 1 (25) | A572 Gr. 50 or A992 | — | **110** (0.49) | **170** (0.76) | **155**[8] (0.69) | — | — |
| | GW-50 | **0.128/0.110** (3.3/2.8) | ½ (13) | 1 (25) | A36 | — | **225** (1.00) | **275** (1.22) | **245**[9] (1.09) | — | — |
| | | | ½ (13) | 1 (25) | A572 Gr. 50 or A992 | — | **240** (1.07) | **215**[9] (0.96) | **280**[9] (1.25) | — | — |

1. The entire pointed portion of the fastener must penetrate through the steel to obtain the tabulated values, unless otherwise indicated.
2. The allowable tension values are for the fastener only. Members connected to the steel must be investigated separately in accordance with accepted design criteria.
3. Steel strength must comply with the minimum requirements of ASTM A 36 ($F_y$ = 36 ksi, $F_u$ = 58 ksi), ASTM A 572, Grade 50 ($F_y$ = 50 ksi, $F_u$ = 65 ksi), or ASTM A992 ($F_y$ = 50 ksi, $F_u$ = 65 ksi).
4. Based upon minimum penetration depth of 0.46" (11.7 mm).
5. Based upon minimum penetration depth of 0.58" (14.7 mm).
6. Based upon minimum penetration depth of 0.36" (9.1 mm).
7. The fastener must be driven to where the point of the fastener penetrates through the steel.
8. Based upon minimum penetration depth of 0.35" (8.9 mm).
9. Based upon minimum penetration depth of 0.25" (6.4 mm).
10. For stepped shank fasteners: (Diameter of shank above the step)/(Diameter of shank below the step)
11. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.



*See p. 14 for an explanation of the load table icons.

# **Gas- and Powder-Actuated Fasteners** Design Information – Steel

## Powder-Actuated and Gas-Actuated Fasteners — Allowable Shear Loads in Steel[1]

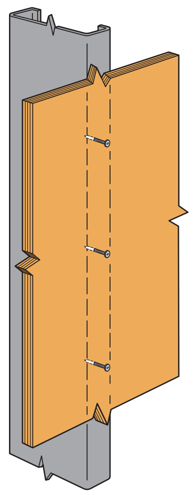
| Direct Fastening Type | Model No. | Shank Diameter[10] in. (mm) | Minimum Edge Distance in. (mm) | Minimum Spacing in. (mm) | Minimum Steel Strength[3] ASTM | Allowable Shear Load — lb. (kN) Steel Thickness 1/8" | 3/16" | 1/4" | 3/8" | 1/2" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Powder Actuated | PDPA, PDPAT, PDPAWL | **0.157**<br>(4.0) | ½<br>(13) | **1**<br>(25) | A36 | — | **410**<br>(1.82) | **365**<br>(1.62) | **385[7]**<br>(1.71) | **385[7]**<br>(1.71) | **325[4]**<br>(1.45) |
| | | | | | A572 Gr. 50 or A992 | — | **420**<br>(1.87) | **365**<br>(1.62) | **290[7]**<br>(1.29) | **275[7]**<br>(1.22) | **275[7]**<br>(1.22) |
| | PINW<br>PINWP | **0.145**<br>(3.7) | ½<br>(13) | **1**<br>(25) | A36 | — | **395**<br>(1.76) | — | — | — | — |
| | PSLV3<br>Smooth shank | **0.205**<br>(5.2) | **1**<br>(25) | **1½**<br>(38) | A36 | — | **770**<br>(3.43) | **1,120**<br>(4.98) | — | — | — |
| | PSLV3-12575K<br>Knurled shank | **0.205**<br>(5.2) | **1**<br>(25) | **1½**<br>(38) | A36 | — | **930**<br>(4.14) | **1,130**<br>(5.03) | — | — | — |
| Gas Actuated | GDP | **0.106**<br>(2.7) | ½<br>(13) | **1**<br>(25) | A36 | **285**<br>(1.27) | **225**<br>(1.00) | **205**<br>(0.91) | — | — | — |
| | | | ½<br>(13) | **1**<br>(25) | A572 Gr. 50 or A992 | — | **250**<br>(1.11) | **145**<br>(0.64) | — | — | — |
| | GDPS | **0.118/0.102**<br>(3.0/2.6) | ½<br>(13) | **1**<br>(25) | A36 | — | **180**<br>(0.80) | **265**<br>(1.18) | **225[8]**<br>(1.00) | **225[8]**<br>(1.00) | — |
| | | | ½<br>(13) | **1**<br>(25) | A572 Gr. 50 or A992 | — | **205**<br>(0.91) | **305**<br>(1.36) | **205[8]**<br>(0.91) | — | — |
| | GW-50 | **0.128/0.110**<br>(3.3/2.8) | ½<br>(13) | **1**<br>(25) | A36 | — | **400**<br>(1.78) | **345**<br>(1.53) | **310[9]**<br>(1.38) | — | — |
| | | | ½<br>(13) | **1**<br>(25) | A572 Gr. 50 or A992 | — | **380**<br>(1.69) | **325[9]**<br>(1.45) | **350[9]**<br>(1.56) | — | — |

1. The entire pointed portion of the fastener must penetrate through the steel to obtain the tabulated values, unless otherwise indicated.
2. The allowable shear values are for the fastener only. Members connected to the steel must be investigated separately in accordance with accepted design criteria.
3. Steel strength must comply with the minimum requirements of ASTM A 36 ($F_y$ = 36 ksi, $F_u$ = 58 ksi), ASTM A 572, Grade 50 ($F_y$ = 50 ksi, $F_u$ = 65 ksi), or ASTM A992 ($F_y$ = 50 ksi, $F_u$ = 65 ksi).
4. Based upon minimum penetration depth of 0.46" (11.7 mm).
5. Based upon minimum penetration depth of 0.58" (14.7 mm).
6. Based upon minimum penetration depth of 0.36" (9.1 mm).
7. The fastener must be driven to where the point of the fastener penetrates through the steel.
8. Based upon minimum penetration depth of 0.35" (8.9 mm).
9. Based upon minimum penetration depth of 0.25" (6.4 mm).
10. For stepped shank fasteners: (Diameter of shank above the step)/(Diameter of shank below the step)
11. The allowable load values listed are for static load conditions. Refer to ICC-ES ESR-2138 and ESR-2811 code reports for seismic load conditions.

## Spiral Knurl Pin Allowable Tension and Shear Loads in Cold-Formed Steel Studs

| Model No. | Shank Diameter in. (mm) | Minimum Edge Dist. in. (mm) | Minimum Spacing in. (mm) | Designation Thickness mil (gauge) | Allowable Loads Tension lb. (kN) | Shear lb. (kN) |
|---|---|---|---|---|---|---|
| GDPSK-138 | **0.106**<br>(2.8) | **13/16**<br>(2.1) | **4**<br>(102) | **33**<br>(20) | **30**<br>(0.13) | **70**<br>(0.31) |
| | | | | **43**<br>(18) | **48**<br>(0.21) | **89**<br>(0.40) |
| | | | | **54**<br>(16) | **92**<br>(0.41) | **150**<br>(0.67) |
| | | | | **68**<br>(14) | **73**<br>(0.32) | **218**<br>(0.97) |

1. Entire pointed portion of the fastener must penetrate through the cold-formed steel to obtain tabulated values.
2. The allowable tension and shear values are for the fastener only. Members connected to the cold-formed steel must be investigated separately in accordance with accepted design criteria.
3. Fastener is to be installed in the center of the stud flange.
4. Loads are based on cold-formed steel members with a minimum yield strength, $F_y$ = 33 ksi and tensile strength, $F_u$ = 45 ksi for 33 mil (20 ga.) and 43 mil (18 ga.), and minimum yield strength, $F_y$ = 50 ksi and tensile strength, $F_u$ = 65 ksi for 54 mil (16 ga.) and 68 mil (14 ga.)



**Typical GDPSK Installation**

**See p. 14 for an explanation of the load table icons.*

# Restoration Solutions

# A Strong Alliance for Stronger Structures

Through their alliance, Simpson Strong-Tie and Structural Technologies offer one-stop, end-to-end concrete strengthening and repair solutions with the best products, installation and support available.

## Integrated Design-Build Solutions

Simpson Strong-Tie, a leading provider of tested, code-listed, high-performance products and technical services for the construction industry, and Structural Technologies, a renowned provider of state-of-the-art infrastructure strengthening solutions and engineering support services, have formed a strategic alliance within North America.

This new alliance enables both companies to jointly deliver complete end-to-end repair and strengthening solutions to engineering professionals, general contractors and owners across multiple construction and repair markets. The combination of innovative products, design support, engineering partners and contracting services allows us to deliver fully integrated design-build solutions from initial problem investigation through final installation.

Simpson Strong-Tie offers decades of innovative engineer-supported products, cutting-edge testing capabilities, relentless customer service and dedicated field-engineering support.

Structural Technologies brings their deep industry knowledge, solutions, design support and technical services, along with licensed installers, to the alliance.

Together, we offer a uniquely integrated scope of technical knowledge and solutions for concrete and masonry strengthening and repair that ultimately better serves your needs and helps ensure stronger, safer, longer-lasting structures.

## One End-to-End Solution, Twice the Expertise

- Design, engineering and specification services
- Innovative product solutions
- Advanced testing capabilities
- Expert installation and maintenance service by licensed installers
- Dedicated customer service and onsite field engineers

Let us help you find the right solution for your project and budget. For additional information, visit **strongtie.com/alliance** or call (800) 999-5099 to discuss your project with a local field engineer.


Restoration Solutions

# **CSS V-WRAP™** FRP Composite Strengthening Systems

The Simpson Strong-Tie and Structural Technologies alliance has state-of-the-art composite strengthening systems that utilize lightweight, durable, and high-strength carbon and glass fibers bonded with adhesive resins. CSS V-Wrap products are used to increase or restore the load-carrying capacity, ductility, and seismic resistance to a variety of structures. Significant flexural, axial or shear strength gains can be realized with an easy-to-apply composite without adding significant weight or mass to the structure.

## PRODUCTS

### Carbon Fiber Composites

- Carbon Fiber Fabrics
- Carbon Fiber Precured Plates
- Carbon Fiber Grid (Fabric-Reinforced Cementitious Matrix/FRCM)
- Carbon Fiber Precured Bars
- Carbon Fiber Precured Anchors
- Carbon Fiber Anchors

### Glass Fiber Composites

- Glass Fiber Fabrics
- Glass Fiber Anchors

### Resins/Coatings

- 770 Epoxy Saturant
- PF Putty Filler
- FPS UL Listed Fire Protection System
- Tstrata TC Protective Acrylic Based Topcoat

Large Aspect Ratio Column Confinement

Shearwall Strengthening

FRP Coating, Flame and Smoke Resistance

Slab Flexural Strengthening

Transferring Diaphragm Chord Forces

Near-Surface-Mounted FRP Reinforcement

# Performance Coatings

## RPS-70-9 Epoxy Coating

**(Formerly FX-70-9)**

RPS-70-9 epoxy coating is a high-solids, two-component, moisture-tolerant, high-build protective coating designed to protect steel, concrete and wood.

### Features

- Excellent abrasion resistance in wastewater and other industrial applications
- Resists abrasion and staining
- Suitable for immersion service
- Can be applied to damp concrete
- Self-priming for most applications
- Can be fabric-reinforced for added durability
- Very low odor
- Can be applied by brush, roller or spray
- Excellent bond to common construction materials


### Where to Use

- Commercial and industrial applications requiring moderate chemical resistance
- Primary and secondary containment
- Water/wastewater: clarifiers, digesters, sludge thickener tanks, lift stations, manholes
- Marine applications: protection from salt spray and water intrusion in immersion service applications
- Fiber-reinforced polymer (FRP) topcoat
- Petrochemical applications
- Above- and below-grade applications
- Floor and wall coating

# **RPS-207** Slurry Seal

**(Formerly FX-207)**

RPS-207 slurry seal is a two-component, polymer-modified cementitious coating designed for fire insulation with FRP materials as well as waterproofing and damp-proofing concrete and masonry substrates. This product is part of the tested assembly in UL Design No. N861, which achieved a four-hour fire rating when subjected to ASTM E119/UL 263 full-scale fire testing.

### Features

- Trowel or slurry consistency
- Convenient pre-measured kit
- Excellent bond strength
- Can be applied by brush, roller, spray, or trowel
- UL listed (refer to UL Online Certifications Directory for the UL listing at **ul.com/database**)

### Where to Use

- Coating over FRP materials for fire insulation and flame/smoke spread resistance
- Horizontal and vertical surfaces
- Above-grade and below-grade applications
- Waterproofing and damp-proofing concrete and masonry
- Interior and exterior applications
- To protect concrete and masonry from freeze/thaw cycles




# **RPS-505** Water-Based Acrylic Coating

**(Formerly FX-505)**

RPS-505 water-based acrylic coating is a single-component, fast-drying, protective architectural coating for concrete, masonry and stucco.

### Features

- Excellent color retention
- 100% acrylic resin
- Good hiding properties
- Breathable
- Water based
- Fast drying
- Can be applied by brush, roller or spray
- Easy to clean
- Bonds well to concrete, masonry and FRP substrates
- Repels rain
- Excellent UV resistance

### Where to Use

- Commercial building façades
- Concrete and masonry substrates
- New and remedial applications
- Exterior applications
- Vertical and overhead surfaces
- Tilt-wall and precast panels
- Block and brick masonry
- Fiber-reinforced polymer (FRP) topcoat
- Retaining walls
- Various DOT applications

# General Concrete Repair

## **RPS-406** Zinc-Rich Primer

**(Formerly FX-406)**

RPS-406 zinc-rich primer is a single-component, fast-drying, zinc-rich coating designed to protect steel from corrosion by combining a barrier coating with the sacrificial galvanic protection of zinc.

### Features

- High-zinc content provides superior corrosion protection of steel
- Excellent bond to steel
- Can be shop- or field-applied
- Ready to use, simply stir and apply
- Single-component product
- Fast drying

### Where to Use

- Priming reinforcing steel to protect against corrosion
- As a corrosion-resistant steel primer for protective coating systems

NEW


## **RPS-752** Epoxy Bonding Agent

**(Formerly FX-752)**

RPS-752 epoxy bonding agent is a 100%-solids, two-component, moisture-tolerant epoxy system designed to increase the bond between freshly placed repair mortars or concrete mixes and existing concrete.

### Features

- Bonds to both damp and dry concrete
- Can be applied by brush, roller, spray or squeegee

### Where to Use

- Bonding new concrete or repair mortars to existing concrete

NEW

# **RPS-792LPL** Long Pot Life Epoxy Bonding Agent

**(Formerly FX-792LPL)**

RPS-792LPL long pot life epoxy bonding agent is a two-component, 100%-solids, moisture-tolerant epoxy resin designed to increase the bond between freshly placed repair mortars or concrete mixes and existing concrete.

NEW


### Features

- Bonds to both damp and dry concrete
- Can be applied by brush, roller, spray or squeegee
- 60-minute pot life at 70°F (21°C)
- 8-hour open time at 70°F (21°C) for repair mortar installation

### Where to Use

- Bonding new concrete or repair mortar to existing concrete
- For warm-weather applications
- Where longer open times are required

# **RPS-263** Rapid-Hardening Vertical/Overhead Repair Mortar

**(Formerly FX-263)**

RPS-263 rapid-hardening vertical/overhead repair mortar is a cementitious, single-component, fiber-reinforced, polymer-modified, silica-fume–enhanced, structural repair mortar with integral corrosion inhibitor designed for vertical and overhead applications.

NEW


### Features

- Ready to use — simply add potable water
- Fiber-reinforced
- High early strength
- High buildup to 3 in. (76 mm) per lift
- Excellent freeze/thaw resistance
- Excellent abrasion resistance
- Low permeability

### Where to Use

- Partial-depth concrete repairs
- Above-, below-, or on-grade applications
- Vertical and overhead applications
- Tunnels, bridges, balconies, parking decks, elevated structures, water treatment facilities and marine structure

# **CI-SLV** Super-Low-Viscosity Injection Epoxy

CI-SLV super-low-viscosity structural injection epoxy is a two-component, high-modulus, high-solids, moisture-tolerant epoxy specially designed for pressure injection, gravity feeding and flood coat filling of concrete cracks when substrate temperatures are between 60°F (16°C) to 90°F (32°C). Available in 3-gallon bulk kits or convenient side-by-side cartridges dispensed through a static mixing nozzle using either a manual or pneumatic dispensing tool.

### Features

- Chemically bonds with the concrete to provide a structural repair. CI-SLV seals the crack from moisture, protecting rebar in the concrete from corrosion.
- Moisture-tolerant, can be used on dry and damp surfaces.
- Low surface tension allows the material to effectively penetrate narrow cracks.
- Formulated for maximum penetration under pressure.
- Non-shrink and resistant to oils, salts and mild chemicals.
- Can be used with metered pressure-injection equipment.
- Freeze-thaw resistant.


**CI-SLV**

### Applications

- Pressure injection
- Gravity feed
- Underwater pressure injection
- Flood coat

### Product Information

| | |
|---|---|
| Mix Ratio/Type | 2:1 |
| Mixed Color | Clear |
| Crack Width | 0.002"–0.25" (0.05 mm–6 mm) |
| Shelf Life | 24 months |
| Storage Temperature | 45°F (7°C)–90°F (32°C) |
| Volatile Organic Compound (VOC) | 8 g/L mixed |
| Yield | 231 in.$^3$/US gal. (0.001 m$^3$/L) |
| For Flood-Coat Applications | 150–200 ft.$^2$/US gal. (3.7–4.9 m$^2$/L) depending on surface profile and porosity |
| Pot Life, 1 Quart | 6 minutes at 90°F (32°C)<br>25 minutes at 72°F (22°C) |
| Thin Film (5 mil)<br>Set Time at 72°F, ASTM D5895 | Set to touch: 4 hr.<br>Dry through: 9 hr. |
| Manufactured in the US using global materials | |

### Code Reports, Standards and Compliance

| | |
|---|---|
| ASTM C881 and AASHTO M235 | Type I/IV; Grade 1; Class C |

### Installation Instructions

Installation instructions are located at the following locations: pp. 210–215, product packaging or on the CI-SLV Technical Data Sheet at **strongtie.com/rps**.

### Accessories

See p. 209 for information on crack repair accessories.

## CI-SLV Packaging Information

| Model No. | Capacity (ounces) | Packaging Type | Package Quantity | Carton Quantity | Dispensing Tools | Mixing Nozzle |
|---|---|---|---|---|---|---|
| CISLV32 | 32 | Side-by-side cartridge | 1 | 5 | ADT30S, ADT30P | EMN022 (included) |
| CISLV3KT | 384 | 3-gallon bulk kit | 1 case of (3) gallon cans | — | Metering pumps offered by third-party manufacturers | — |

1. Cartridge estimation guidelines are available at **strongtie.com/apps**.

# CI-SLV Super-Low-Viscosity Injection Epoxy

## Technical Information

### Compressive Strength

| Cure Time | 60°F (16°C) psi (MPa) | 72°F (22°C) psi (MPa) | 90°F (32°C) psi (MPa) | Test Standard |
|---|---|---|---|---|
| 4-hour cure | — | — | 10,250 (70.7) | ASTM D695 |
| 8-hour cure | — | 4,450 (30.7) | 11,500 (79.3) | |
| 16-hour cure | 5,750 (39.6) | 10,200 (70.3) | 11,700 (80.7) | |
| 24-hour cure | 7,600 (52.4) | 11,250 (77.6) | 11,900 (82.0) | |
| 3-day cure | 12,800 (88.3) | 13,150 (90.7) | 12,250 (84.5) | |
| 7-day cure | 13,400 (92.4) | 13,300 (91.7) | 12,500 (86.2) | |
| 14-day cure | 13,700 (94.5) | 13,600 (93.8) | 12,500 (86.2) | |
| 28-day cure | 13,700 (94.5) | 14,200 (97.9) | 12,500 (86.2) | |

| Temperature Range | >60°F (16°C) | Test Standard |
|---|---|---|
| Epoxy Classification | Types I, IV; Grade I (LV) | ASTM C881 |
| Viscosity — mixed[1] | 150 cP | ASTM D2556 |
| Gel Time — 60 gram mass[1] | 40 minutes | ASTM C881 |
| Bond Strength, Slant Shear: | | ASTM C882 |
| Hardened to Hardened Concrete — 2-day cure[2] | 2,200 psi (15.2 MPa) | |
| Hardened to Hardened Concrete — 14-day cure[2] | 3,600 psi (24.8 MPa) | |
| Tensile Strength — 7-day cure[2] | 7,500 psi (51.7 MPa) | ASTM D638 |
| Elongation at Break — 7-day cure[2] | 2.14% | ASTM D638 |
| Flexural Strength — 7-day cure[2] | 7,300 psi (50.3 MPa) | ASTM D790 |
| Modulus of Elasticity in Compression — 7-day cure[2] | 318,000 psi (2,192.5 MPa) | ASTM D695 |
| Heat Deflection Temperature — 7-day cure[3] | 122°F (50°C) | ASTM D648 |
| Glass Transition Temperature — 7-day cure[3] | 128°F (53°C) | ASTM E1356 |
| Water Absorption — 14-day cure[4] | 0.57% | ASTM D570 |
| Linear Coefficient of Shrinkage[3] | 0.005 | ASTM D2566 |
| Coefficient of Thermal Expansion[3] | $2.89 \times 10^{-5}$ in./(in.°F)<br>$5.20 \times 10^{-5}$ cm/(cm°C) | ASTM C531 |
| Shore D Hardness — 24-hour cure[3] | 82 | ASTM D2240 |
| Shore D Hardness — 7-day cure[3] | 82 | ASTM D2240 |
| Adhesion to Concrete — 24-hour cure[3] | 1,100 psi (7.6 MPa) | ASTM D7234 |

1. Tested at 72°F (22°C).
2. Cured at 60°F (16°C).
3. Cured at 72°F (22°C).
4. Cured at 72°F (22°C), immersed in water 24 hours.

SIMPSON Strong-Tie

# CI-LV Low-Viscosity Injection Epoxy

CI-LV low-viscosity structural injection epoxy is a two-component, high-modulus, high-solids, moisture-tolerant epoxy specially designed for pressure injection, gravity feeding and flood coat filling of concrete cracks and for increasing the bond between freshly placed repair mortars or concrete mixes and existing concrete when substrate temperatures are between 40°F (4°C) to 90°F (32°C). Available in 3-gallon bulk kits or convenient side-by-side cartridges dispensed through a static mixing nozzle using either a manual or pneumatic dispensing tool.

## Features

- Chemically bonds with the concrete to provide a structural repair. CI-LV seals the crack from moisture, protecting rebar in the concrete from corrosion.
- Approved under NSF/ANSI Standard 61 (568 in.$^2$ /1,000 gal.).
- Moisture-tolerant, can be used on dry and damp surfaces.
- Low surface tension allows the material to effectively penetrate narrow cracks.
- Formulated for maximum penetration under pressure.
- Non-shrink and resistant to oils, salts and mild chemicals.
- Can be used with metered pressure-injection equipment.
- Freeze-thaw resistant.


CI-LV

## Applications

- Pressure injection
- Gravity feed
- Repair mortar
- Underwater pressure injection
- Flood coat
- Bonding agent

## Product Information

| | |
|---|---|
| Mix Ratio/Type | 2:1 |
| Mixed Color | Dark amber |
| Crack Width | 0.002"–0.25" (0.05 mm–6 mm) |
| Shelf Life | 24 months |
| Storage Temperature | 45°F (7°C)–90°F (32°C) |
| Base Material Temperature | 40°F (4°C)–90°F (32°C) |
| Volatile Organic Compound (VOC) | 2 g/L mixed |
| Yield | 231 in.$^3$/US gal. (0.001 m$^3$/L) |
| For Flood-Coat Applications | 150–200 ft.$^2$/US gal. (3.7–4.9 m$^2$/L) depending on surface profile and porosity |
| Pot Life, 1 Quart | 10 minutes at 90°F (32°C)<br>25 minutes at 72°F (22°C)<br>100 minutes at 50°F (10°C) |
| Thin Film (5 mil)<br>Set Time at 72°F, ASTM D5895 | Set to touch: 3 hr. 50 min.<br>Dry through: 6 hr. 15 min. |
| Manufactured in the US using global materials | |

## Code Reports, Standards and Compliance

| | |
|---|---|
| ASTM C881 and AASHTO M235 | Type I/II; Grade 1; Class B<br>Type I/IV and II/V, Grade 1; Class C |
| NSF/ANSI/CAN 61 | (568 in.$^2$ / 1,000 gal.) |

## Installation Instructions

Installation instructions are located at the following locations: pp. 210–215, product packaging or on the CI-LV Technical Data Sheet at **strongtie.com/rps**.

## Accessories

See p. 209 for information on crack repair accessories.

## CI-LV Packaging Information

| Model No. | Capacity (ounces) | Packaging Type | Package Quantity | Carton Quantity | Dispensing Tools | Mixing Nozzle |
|---|---|---|---|---|---|---|
| CILV32 | 32 | Side-by-side cartridge | 1 | 5 | ADT30S, ADT30P | EMN022 (included) |
| CILV3KT | 384 | 3-gallon bulk kit | 1 case of (3) gallon cans | — | Metering pumps offered by third-party manufacturers | — |

1. Cartridge estimation guidelines are available at **strongtie.com/apps**.

# CI-LV Low-Viscosity Injection Epoxy



## Technical Information

### Compressive Strength

| Cure Time | 40°F (4°C) psi (MPa) | 60°F (16°C) psi (MPa) | 72°F (22°C) psi (MPa) | 90°F (32°C) psi (MPa) | Test Standard |
|---|---|---|---|---|---|
| 4-hour cure | — | — | — | 9,800 (67.6) | ASTM D695 |
| 8-hour cure | — | — | 5,000 (34.5) | 10,100 (69.6) | |
| 16-hour cure | — | — | 9,100 (62.7) | 10,350 (71.4) | |
| 24-hour cure | — | 6,250 (43.0) | 9,250 (63.8) | 10,450 (72) | |
| 3-day cure | 5,350 (36.9) | 10,800 (74.5) | 10,700 (73.8) | 11,150 (76.9) | |
| 7-day cure | 9,100 (62.7) | 11,250 (77.6) | 11,000 (75.8) | 11,150 (76.9) | |
| 14-day cure | 11,000 (75.8) | 11,800 (81.4) | 11,250 (77.6) | 11,150 (76.9) | |
| 28-day cure | 12,150 (83.8) | 12,000 (82.7) | 11,600 (80.0) | 11,450 (78.9) | |

| Temperature Range | Class B 40°–60°F (4°C–16°C) | Class C >60°F (16°C) | Test Standard |
|---|---|---|---|
| Epoxy Classification | Types I, II; Grade I (LV) | Types I, II, IV, V; Grade I (LV) | ASTM C881 |
| Viscosity — mixed[1] | 1,500 cP | 350 cP | ASTM D2556 |
| Gel Time — 60 gram mass[1] | 400 minutes | 45 minutes | ASTM C881 |
| Bond Strength, Slant Shear:<br>Hardened to Hardened Concrete — 2-day cure[2]<br>Hardened to Hardened Concrete — 14-day cure[2]<br>Fresh to Hardened Concrete — 14-day cure[3] | <br>1,100 psi (7.6 MPa)<br>2,150 psi (14.8 MPa)<br>1,850 psi (12.8 MPa) | <br>2,400 psi (16.5 MPa)<br>3,450 psi (23.8 MPa)<br>1,850 psi (12.8 MPa) | ASTM C882 |
| Tensile Strength — 7-day cure[2] | 5,550 psi (38.2 MPa) | 7,950 psi (54.8 MPa) | ASTM D638 |
| Elongation at Break — 7-day cure[2] | 2.2% | 3.2% | ASTM D638 |
| Flexural Strength — 14-day cure[2] | 5,500 psi (37.9 MPa) | 11,900 psi (82.0 MPa) | ASTM D790 |
| Modulus of Elasticity in Compression — 7-day cure[2] | 318,000 psi (2,190 MPa) | 382,000 psi (2,630MPa) | ASTM D695 |
| Heat Deflection Temperature — 7-day cure[3] | 127°F (53°C) | | ASTM D648 |
| Glass Transition Temperature — 7-day cure[3] | 136°F (58°C) | | ASTM E1356 |
| Water Absorption — 7-day cure[4] | 0.27% | | ASTM D570 |
| Linear Coefficient of Shrinkage[3] | 0.003 | | ASTM D2566 |
| Coefficient of Thermal Expansion[3] | $5.82 \times 10^{-5}$ in./(in.°F)<br>$1.05 \times 10^{-4}$ cm/(cm°C) | | ASTM C531 |
| Shore D Hardness — 24-hour cure[3] | 82 | | ASTM D2240 |
| Shore D Hardness — 7-day cure[3] | 82 | | ASTM D2240 |
| Adhesion to Concrete — 24-hour cure[3] | 1,100 psi (7.6 MPa) | | ASTM D7234 |

1. Class B tested at 50°F (10°C), Class C tested at 72°F (22°C).
2. Class B cured at 40°F (4°C), Class C cured at 60°F (16°C).
3. Cured at 72°F (22°C).
4. Cured at 72°F (22°C), immersed in water 24 hours.

## Technical Information — When Used As a Mortar

Tests performed at 1 part by volume of mixed CI-LV to 5 parts by volume of oven-dried sand.
Pot life: 120 minutes at 72°F.

### Compressive Strength

| Cure Time | 40°F (4°C) psi (MPa) | 60°F (16°C) psi (MPa) | 72°F (22°C) psi (MPa) | Test Standard |
|---|---|---|---|---|
| 1-day cure | 250 (1.7) | 6,650 (45.9) | 7,600 (52.4) | ASTM C579 |
| 7-day cure | 6,500 (44.8) | 7,200 (49.6) | 8,100 (55.8) | |
| 28-day cure | 6,600 (45.5) | 7,350 (50.7) | 8,400 (57.9) | |

| Temperature Range | 72°F (22°C) psi (MPa) | Test Standard |
|---|---|---|
| Flexural Strength — 7-day cure | 2,250 (15.5) | ASTM C580 |
| Tensile Strength — 7-day cure | 1,200 (8.3) | ASTM C307 |
| Bond Strength, Slant Shear:<br>Hardened to Fresh Mortar — 7-day cure | 1,350 (9.3) | ASTM C882 |

# **CI-LV FS** Low-Viscosity Fast-Setting Injection Epoxy

CI-LV FS low-viscosity fast-setting structural injection epoxy is a two-component, high-modulus, high-solids, moisture-tolerant epoxy specially designed for pressure injection of concrete cracks and for increasing the bond between freshly placed repair mortars or concrete mixes and existing concrete when substrate temperatures are between 40°F (4°C) to 90°F (32°C). Available in 3-gallon bulk kits or convenient side-by-side cartridges dispensed through a static mixing nozzle using either a manual, battery-powered or pneumatic dispensing tool.

## Features

- Chemically bonds with the concrete to provide a structural repair. CI-LV FS seals the crack from moisture, protecting rebar in the concrete from corrosion.
- Moisture-tolerant, can be used on dry and damp surfaces.
- Low surface tension allows the material to effectively penetrate narrow cracks.
- Formulated for maximum penetration under pressure.
- Non-shrink and resistant to oils, salts and mild chemicals.
- Can be used with metered pressure-injection equipment.
- Freeze-thaw resistant.


**CI-LV FS**

## Applications

- Pressure injection
- Gravity feed
- Bonding agent
- Underwater pressure injection
- Flood coat

## Product Information

| | |
|---|---|
| Mix Ratio/Type | 2:1 |
| Mixed Color | Amber |
| Crack Width | 0.016"–0.25" (0.4 mm–6 mm) |
| Shelf Life | 24 months |
| Storage Temperature | 45°F (7°C)–90°F (32°C) |
| Base Material Temperature | 40°F (4°C)–90°F (32°C) |
| Volatile Organic Compound (VOC) | 13 g/L mixed |
| Yield | 231 in.$^3$/US gal. (0.001 m$^3$/L) |
| For Flood-Coat Applications | 150–200 ft.$^2$/US gal. (3.7–4.9 m$^2$/L) depending on surface profile and porosity |
| Pot Life, 1 Quart | 10 minutes at 72°F (22°C)<br>28 minutes at 50°F (10°C) |
| Thin Film (5 mil)<br>Set Time at 72°F, ASTM D5895 | Set to touch: 1 hr. 45 min.<br>Dry through: 4 hr. |
| Manufactured in the US using global materials | |

## Code Reports, Standards and Compliance

| | |
|---|---|
| ASTM C881 and AASHTO M235 | Type I/II; Grade 1; Class B<br>Type I/IV, Grade 1; Class C |

## Installation Instructions

Installation instructions are located at the following locations: pp. 210–215, product packaging or on the CI-LV FS Technical Data Sheet at **strongtie.com/rps**.

## Accessories

See p. 209 for information on crack repair accessories.

## CI-LV FS Packaging Information

| Model No. | Capacity (ounces) | Packaging Type | Package Quantity | Carton Quantity | Dispensing Tools | Mixing Nozzle |
|---|---|---|---|---|---|---|
| CILVFS32 | 32 | Side-by-side cartridge | 1 | 5 | ADT30S, ADT30P | EMN022 (included) |
| CILVFS3KT | 384 | 3-gallon bulk kit | 1 case of (3) gallon cans | — | Metering pumps offered by third-party manufacturers | — |

1. Cartridge estimation guidelines are available at **strongtie.com/apps**.

# CI-LV FS Low-Viscosity Fast-Setting Injection Epoxy

## Technical Information

### Compressive Strength

| Cure Time | 23°F (–5°C) psi (MPa) | 40°F (4°C) psi (MPa) | 60°F (16°C) psi (MPa) | 72°F (22°C) psi (MPa) | Test Standard |
|---|---|---|---|---|---|
| 1-hour cure | — | — | — | 9,500 (65.5) | ASTM D695 |
| 2-hour cure | — | — | — | 11,250 (77.6) | |
| 4-hour cure | — | — | — | 11,600 (80.0) | |
| 8-hour cure | — | — | — | 11,700 (80.7) | |
| 16-hour cure | — | — | 7,150 (49.3) | 11,800 (81.4) | |
| 24-hour cure | — | — | 8,350 (57.6) | 11,800 (81.4) | |
| 3-day cure | — | 6,600 (45.5) | 12,800 (88.3) | 12,800 (88.3) | |
| 7-day cure | 2,250 (15.5) | 12,600 (86.9) | 13,700 (94.5) | 13,500 (93.1) | |
| 14-day cure | 2,850 (19.7) | 13,700 (94.5) | 14,500 (100.0) | 13,600 (93.8) | |
| 28-day cure | 2,900 (20.0) | 14,500 (100.0) | 15,200 (104.8) | 13,600 (93.8) | |

| Temperature Range | Class B 40°–60°F (4°C–16°C) | Class C >60°F (16°C) | Test Standard |
|---|---|---|---|
| Epoxy Classification | Types I, II; Grade 1 (LV) | Types I, IV; Grade 1 (LV) | ASTM C881 |
| Viscosity — mixed[1] | 2,000 cP | 600 cP | ASTM D2556 |
| Gel Time — 60 gram mass[1] | 55 minutes | 12 minutes | ASTM C881 |
| Bond Strength, Slant Shear:<br>Hardened to Hardened Concrete — 2-day cure[2]<br>Hardened to Hardened Concrete — 14-day cure[2]<br>Fresh to Hardened Concrete — 14-day cure[3] | <br>1,700 psi (11.7 MPa)<br>3,850 psi (26.5 MPa)<br>2,150 psi (14.8 MPa) | <br>3,650 psi (25.2)<br>4,000 psi (27.6 MPa)<br>2,150 psi (14.8 MPa) | ASTM C882 |
| Tensile Strength — 7-day cure[2] | 5,300 psi (36.5 MPa) | 7,900 psi (54.5 MPa) | ASTM D638 |
| Elongation at Break — 7-day cure[2] | 1.06% | 1.91% | ASTM D638 |
| Flexural Strength — 7-day cure[2] | 5,700 psi (39.3 MPa) | 9,350 psi (64.5 MPa) | ASTM D790 |
| Modulus of Elasticity in Compression — 7-day cure[2] | 442,000 psi (3,050 MPa) | 439,000 psi (3,030 MPa) | ASTM D695 |
| Heat Deflection Temperature — 7-day cure[3] | 122°F (50°C) | | ASTM D648 |
| Glass Transition Temperature — 7-day cure[3] | 132°F (56°C) | | ASTM E1356 |
| Water Absorption — 7-day cure[4] | 0.23% | | ASTM D570 |
| Linear Coefficient of Shrinkage[3] | 0.004 | | ASTM D2566 |
| Coefficient of Thermal Expansion[3] | $4.78 \times 10^{-5}$ in./(in.°F)<br>$8.60 \times 10^{-5}$ cm/(cm°C) | | ASTM C531 |
| Shore D Hardness — 24-hour cure[3] | 80 | | ASTM D2240 |
| Shore D Hardness — 7-day cure[3] | 82 | | ASTM D2240 |
| Adhesion to Concrete — 24-hour cure[3] | 1,100 psi (7.6 MPa) | | ASTM D7234 |

1. Class B tested at 50°F (10°C), Class C tested at 72°F (22°C).
2. Class B cured at 40°F (4°C), Class C cured at 60°F (16°C).
3. Cured at 72°F (22°C).
4. Cured at 72°F (22°C), immersed in water 24 hours.

## Technical Information — When Used As a Mortar

Tests performed at 1 part by volume of mixed CI-LV FS to 5 parts by volume of oven-dried sand.
Pot life: 40 minutes at 72°F (22°C).

### Compressive Strength

| Cure Time | 40°F (4°C) psi (MPa) | 60°F (16°C) psi (MPa) | 72°F (22°C) psi (MPa) | Test Standard |
|---|---|---|---|---|
| 1-day cure | 3,650 (25.2) | 7,800 (53.8) | 9,150 (63.1) | ASTM C579 |
| 7-day cure | 8,000 (55.2) | 8,850 (61.0) | 10,000 (68.9) | |
| 28-day cure | 8,100 (55.8) | 8,950 (61.7) | 10,150 (70.0) | |

| Temperature Range | 72°F (22°C) psi (MPa) | Test Standard |
|---|---|---|
| Flexural Strength — 7-day cure | 1,900 (13.1) | ASTM C580 |
| Tensile Strength — 7-day cure | 1,350 (9.3) | ASTM C307 |
| Bond Strength, Slant Shear:<br>Hardened to Fresh Mortar — 7-day cure | 1,800 (12.4) | ASTM C882 |

# **CI-LPL** Low-Viscosity Long-Pot-Life Injection Epoxy



CI-LPL long-pot-life structural injection epoxy is a two-component, high-modulus, high-solids, moisture-tolerant epoxy specially designed for pressure injection, gravity feeding and flood coat filling of concrete cracks when substrate temperatures are between 60°F (16°C) to 110°F (43°C). Available in 3-gallon bulk kits or convenient side-by-side cartridges dispensed through a static mixing nozzle using either a manual or pneumatic dispensing tool.

### Features

- Chemically bonds with the concrete to provide a structural repair. CI-LPL seals the crack from moisture, protecting rebar in the concrete from corrosion.
- Moisture-tolerant, can be used on dry and damp surfaces.
- Formulated for use in hot environments to 110°F.
- Low surface tension allows the material to effectively penetrate narrow cracks.
- Formulated for maximum penetration under pressure.
- Non-shrink and resistant to oils, salts and mild chemicals.
- Can be used with metered pressure-injection equipment.
- Freeze-thaw resistant.

### Applications

- Pressure injection
- Gravity feed
- Underwater pressure injection

### Product Information

| | |
|---|---|
| Mix Ratio/Type | 2:1 |
| Mixed Color | Amber |
| Crack Width | 0.016"–0.25" (0.4 mm–6 mm) |
| Shelf Life | 24 months |
| Storage Temperature | 45°F (7°C)–90°F (32°C) |
| Base Material Temperature | 60°F (16°C)–110°F (43°C) |
| Volatile Organic Compound (VOC) | < 1 g/L mixed |
| Yield | 231 in.$^3$/US gal. (0.001 m$^3$/L) |
| For Flood-Coat Applications | 150–200 ft.$^2$/US gal. (3.7–4.9 m$^2$/L)<br>depending on surface profile and porosity |
| Pot Life, 1 Quart | 20 minutes at 90°F (32°C)<br>60 minutes at 72°F (22°C) |
| Thin Film (5 mil)<br>Set Time at 72°F, ASTM D5895 | Set to touch: 6 hrs. 30 min.<br>Dry through: 16 hrs. 30 min. |
| Thin Film (5 mil)<br>Set Time at 95°F, ASTM D5895 | Set to touch: 3 hr.<br>Dry through: 4 hr. |
| Manufactured in the US using global materials | |


**CI-LPL**

### Code Reports, Standards and Compliance

ASTM C881 and AASHTO M235 — Type I/IV; Grade 1; Class C

### Installation Instructions

Installation instructions are located at the following locations: pp. 210–215, product packaging or on the CI-LPL Technical Data Sheet at **strongtie.com/rps**.

### Accessories

See p. 209 for information on crack repair accessories.

## CI-LPL Packaging Information

| Model No. | Capacity (ounces) | Packaging Type | Package Quantity | Carton Quantity | Dispensing Tools | Mixing Nozzle |
|---|---|---|---|---|---|---|
| CILPL32 | 32 | Side-by-side cartridge | 1 | 5 | ADT30S, ADT30P | EMN022 (included) |
| CILPL3KT | 384 | 3-gallon bulk kit | 1 case of (3) gallon cans | — | Metering pumps offered by third-party manufacturers | — |

1. Cartridge estimation guidelines are available at **strongtie.com/apps**.

# CI-LPL Low-Viscosity Long-Pot-Life Injection Epoxy



## Technical Information

### Compressive Strength

| Cure Time | 60°F (16°C) psi (MPa) | 72°F (22°C) psi (MPa) | 90°F (32°C) psi (MPa) | 110°F (43°C) psi (MPa) | Test Standard |
|---|---|---|---|---|---|
| 8-hour cure | — | — | 6,900 (47.6) | 10,000 (70.0) | ASTM D695 |
| 16-hour cure | — | — | 9,900 (68.3) | 10,100 (69.6) | |
| 24-hour cure | — | 6,800 (46.9) | 10,900 (75.2) | 10,200 (70.3) | |
| 3-day cure | 8,450 (58.3) | 9,900 (68.3) | 11,200 (77.2) | 10,200 (70.3) | |
| 7-day cure | 10,400 (71.7) | 10,800 (74.5) | 11,200 (77.2) | 10,200 (70.3) | |
| 14-day cure | 11,600 (80.0) | 11,500 (79.3) | 11,200 (77.2) | 10,200 (70.3) | |
| 28-day cure | 12,000 (82.7) | 11,700 (80.7) | 11,400 (78.6) | 10,400 (71.7) | |

| Temperature Range | 60°F (16°C) | 72°F (22°C) | 95°F (35°C) | Test Standard |
|---|---|---|---|---|
| Epoxy Classification | Types I, IV; Grade II (MV)[1] | Types I, IV; Grade I (LV)[1] | | ASTM C881 |
| Viscosity — mixed | 3,600 cP | 2,000 cP | 750 cP | ASTM D2556 |
| Gel Time — 60 gram mass | 420 minutes | 135 minutes | 40 minutes | ASTM C881 |
| Bond Strength, Slant Shear:<br>Hardened to Hardened Concrete — 2-day cure<br>Hardened to Hardened Concrete — 3-day cure<br>Hardened to Hardened Concrete — 14-day cure | 3,000 psi (20.7 MPa)[2]<br>—<br>— | —<br>1,375 psi (9.5 MPa)<br>1,500 psi (10.3 MPa) | 1,300 psi (9.0 MPa)<br>—<br>— | ASTM C882 |
| Tensile Strength — 7-day cure | 7,100 psi (49.0 MPa) | 8,000 psi (55.2 MPa) | 8,300 psi (57.2 MPa) | ASTM D638 |
| Elongation at Break — 7-day cure | 2.52% | 3.41% | 3.21% | ASTM D638 |
| Flexural Strength — 7-day cure | — | 11,400 psi (78.6 MPa) | — | ASTM D790 |
| Modulus of Elasticity in Compression — 7-day cure | 345,000 psi (2,378.7 MPa) | 349,000 psi (2,406.3 MPa) | 365,000 psi (2,516.6 MPa) | ASTM D695 |
| Heat Deflection Temperature — 7-day cure | — | 122°F (50°C) | | ASTM D648 |
| Glass Transition Temperature — 7-day cure | — | 135°F (57°C) | | ASTM E1356 |
| Water Absorption — 7-day cure[3] | — | 0.07% | | ASTM D570 |
| Linear Coefficient of Shrinkage | — | 0.001 | | ASTM D2566 |
| Coefficient of Thermal Expansion | — | $2.92 \times 10^{-5}$ in./(in.°F)<br>$5.26 \times 10^{-5}$ cm/(cm°C) | | ASTM C531 |
| Shore D Hardness — 24-hour cure | — | 78 | | ASTM D2240 |
| Shore D Hardness — 7-day cure | | 80 | | ASTM D2240 |
| Adhesion to Concrete — 24-hour cure | | 1,250 psi (8.8 MPa) | | ASTM D7234 |

1. Installation under damp conditions 72°F–110°F (22°C–43°C).
2. Tested using dry test specimens.
3. Cured at 72°F (22°C), immersed in water 24 hours.

SIMPSON Strong-Tie

# **CI-GV** Gel-Viscosity Injection Epoxy



CI-GV structural injection epoxy gel is a two-component, high-modulus, high-solids, moisture-tolerant, thixotropic epoxy designed for pressure injection of concrete cracks. CI-GV is suitable for vertical and horizontal crack sealing and general concrete repair applications when substrate temperatures are between 40°F (4°C) to 90°F (32°C). Available in 3-gallon bulk kits or convenient side-by-side cartridges dispensed through a static mixing nozzle using either a manual or pneumatic dispensing tool.

## Features

- Chemically bonds with the concrete to provide a structural repair. CI-GV seals the crack from moisture, protecting rebar in the concrete from corrosion.
- Gel-viscosity moisture-tolerant, can be used on dry and damp surfaces.
- Formulated for maximum penetration under pressure.
- Non-shrink and resistant to oils, salts and mild chemicals.
- Can be used with metered pressure-injection equipment.
- Freeze-thaw resistant.

## Applications

- Pressure injection
- Repair mortar
- Pick proof sealant
- Underwater pressure injection
- Bonding agent

## Product Information

| | |
|---|---|
| Mix Ratio/Type | 2:1 |
| Mixed Color | Concrete gray |
| Crack Width | 0.094"–0.25" (2.4 mm–6 mm) |
| Shelf Life | 24 months |
| Storage Temperature | 45°F (7°C)–90°F (32°C) |
| Base Material Temperature | 40°F (4°C)–90°F (32°C) |
| Volatile Organic Compound (VOC) | 10 g/L mixed |
| Yield | 231 in.$^3$/US gal. (0.001 m$^3$/L) |
| Pot Life, 1 Quart | 8 minutes at 90°F (32°C)<br>19 minutes at 72°F (22°C)<br>55 minutes at 50°F (10°C) |
| Thin Film (5 mil)<br>Set Time at 72°F, ASTM D5895 | Set to touch: 3 hr.<br>Dry through: 6 hr. |
| Manufactured in the US using global materials | |


**CI-GV**

## Code Reports, Standards and Compliance

| | |
|---|---|
| ASTM C881 and AASHTO M235 | Type I/II/V; Grade 3; Class B<br>Type I/IV and II/V, Grade 3; Class C |

## Installation Instructions

Installation instructions are located at the following locations: pp. 210–215, product packaging or on the CI-GV Technical Data Sheet at **strongtie.com/rps**.

## Accessories

See p. 209 for information on crack repair accessories.

### CI-GV Packaging Information

| Model No. | Capacity (ounces) | Packaging Type | Package Quantity | Carton Quantity | Dispensing Tools | Mixing Nozzle |
|---|---|---|---|---|---|---|
| CIGV32 | 32 | Side-by-side cartridge | 1 | 5 | ADT30S, ADT30P | EMN022 (included) |
| CIGV3KT | 384 | 3-gallon bulk kit | 1 case of (3) gallon cans | — | Metering pumps offered by third-party manufacturers | — |

1. Cartridge estimation guidelines are available at **strongtie.com/apps**.

# **CI-GV** Gel-Viscosity Injection Epoxy

## Technical Information

### Compressive Strength

| Cure Time | 40°F (4°C) psi (MPa) | 60°F (16°C) psi (MPa) | 72°F (22°C) psi (MPa) | 90°F (32°C) psi (MPa) | Test Standard |
|---|---|---|---|---|---|
| 4-hour cure | — | — | — | 9,150 (63.1) | ASTM D695 |
| 8-hour cure | — | — | 5,150 (35.5) | 9,800 (67.6) | |
| 16-hour cure | — | 3,100 (21.4) | 9,300 (64.1) | 10,200 (70.3) | |
| 24-hour cure | — | 6,800 (46.9) | 10,250 (70.7) | 10,250 (70.7) | |
| 3-day cure | 5,400 (37.2) | 10,500 (72.4) | 11,250 (77.6) | 10,250 (70.7) | |
| 7-day cure | 8,000 (55.2) | 11,700 (80.7) | 11,600 (80.0) | 10,400 (71.7) | |
| 14-day cure | 8,750 (60.3) | 12,150 (83.8) | 11,600 (80.0) | 10,600 (73.1) | |
| 28-day cure | 11,100 (76.5) | 12,400 (85.5) | 11,700 (80.7) | 10,800 (74.5) | |

| Temperature Range | Class B 40°–60°F (4°C–16°C) | Class C >60°F (16°C) | Test Standard |
|---|---|---|---|
| Epoxy Classification | Types I, II, V; Grade 3 | Types I, II, IV, V; Grade 3 | ASTM C881 |
| Gel Time — 60 gram mass[1] | 200 minutes | 30 minutes | ASTM C881 |
| Bond Strength, Slant Shear:<br>Hardened to Hardened Concrete — 2-day cure[2]<br>Hardened to Hardened Concrete — 14-day cure[2]<br>Fresh to Hardened Concrete — 14-day cure[3] | <br>1,250 psi (8.6 MPa)<br>3,650 psi(25.2 MPa)<br>3,130 psi (21.6 MPa) | <br>3,050 psi (21.0 MPa)<br>3,850 psi (26.5 MPa)<br>3,130 psi (21.6 MPa) | ASTM C882 |
| Flexural Strength — 7-day cure[2] | 4,400 psi (30.3 MPa) | 10,150 psi (70.0 MPa) | ASTM D790 |
| Modulus of Elasticity in Compression — 7-day cure[2] | 389,000 psi (2,680 MPa) | 454,000 psi (3,130 MPa) | ASTM D695 |
| Heat Deflection Temperature — 7-day cure[3] | 124°F (51°C) | | ASTM D648 |
| Glass Transition Temperature — 7-day cure[3] | 136°F (58°C) | | ASTM E1356 |
| Water Absorption — 14-day cure[4] | 0.31% | | ASTM D570 |
| Linear Coefficient of Shrinkage[3] | 0.001 | | ASTM D2566 |
| Coefficient of Thermal Expansion[3] | $2.32 \times 10^{-5}$ in./(in.°F)<br>$4.18 \times 10^{-5}$ cm/(cm°C) | | ASTM C531 |
| Shore D Hardness — 24-hour cure[3] | 74 | | ASTM D2240 |
| Shore D Hardness — 7-day cure[3] | 80 | | ASTM D2240 |
| Adhesion to Concrete — 24-hour cure[3] | 1,100 psi (7.6 MPa) | | ASTM D7234 |

1. Class B tested at 50°F (10°C), Class C tested at 72°F (22°C).
2. Class B cured at 40°F (4°C), Class C cured at 60°F (16°C).
3. Cured at 72°F (22°C).
4. Cured at 72°F (22°C), immersed in water 24 hours.

## Technical Information — When Used As a Mortar

Tests performed at 1 part by volume of mixed CI-GV to 1 part by volume of oven-dried sand.
Pot life: 30 minutes at 72°F (22°C).

### Compressive Strength

| Cure Time | 40°F (4°C) psi (MPa) | 60°F (16°C) psi (MPa) | 72°F (22°C) psi (MPa) | Test Standard |
|---|---|---|---|---|
| 1-day cure | — | 8,000 (55.2) | 9,200 (63.4) | ASTM C579 |
| 7-day cure | 8,600 (59.3) | 9,500 (65.5) | 10,200 (70.3) | |
| 28-day cure | 9,450 (65.2) | 9,600 (66.2) | 10,450 (72.0) | |

| Temperature Range | 72°F (22°C) psi (MPa) | Test Standard |
|---|---|---|
| Flexural Strength — 7-day cure | 4,050 (27.9) | ASTM C580 |
| Tensile Strength — 7-day cure | 2,000 (13.8) | ASTM C307 |
| Bond Strength, Slant Shear:<br>Hardened to Fresh Mortar — 7-day cure | 1,800 (12.4) | ASTM C882 |

# Crack-Pac® Injection Epoxy



Crack-Pac injection epoxy is designed to repair cracks in concrete ranging from 1/64" to 1/4" wide in concrete walls, floors, slabs, columns and beams. The mixed adhesive has the viscosity of a light oil and a low surface tension, allowing it to penetrate fine to medium-width cracks in dry, damp or wet conditions with excellent results. Resin is contained in the cartridge and hardener is contained in the nozzle.

## Features

- Dispenses with a standard caulking tool, no special dispensing tool needed
- Clean and easy to mix
- Seals out moisture, protecting rebar in the concrete from corrosion and flooring from moisture damage
- Chemically bonds with the concrete to restore strength
- Non-shrink material resistant to oils, salts and mild chemicals
- Freeze-thaw resistant

## Applications

- Pressure injection
- Gravity feed
- Underwater pressure injection

## Product Information

| | |
|---|---|
| Mix Ratio/Type | 8:1 |
| Mixed Color | Amber |
| Cure Color | Dark purple, fading to amber over time |
| Crack Width | 0.016"–0.25" (0.4 mm–6 mm) |
| Shelf Life | 24 months |
| Storage Temperature | 45°F (7°C)–90°F (32°C) |
| Base Material Temperature | 60°F (16°C)–90°F (32°C) |
| Volatile Organic Compound (VOC) | 6 g/L mixed |
| Yield | 16 in.$^3$/cartridge (0.0003 m$^3$/cartridge) |
| Pot Life, Cartridge | 50 minutes at 72°F (22°C)<br>10 minutes at 90°F (32°C) |
| Thin Film (20 mil)<br>Set Time at 72°F, ASTM D5895 | Set to touch: 7 hr.<br>Dry through: 14 hr. |
| Manufactured in the US using global materials | |


**Crack-Pac Injection Epoxy (ETIPAC2G10)**

## Code Reports, Standards and Compliance

ASTM C881 and AASHTO M235 — Type I, Grade 1, Class C

## Installation Instructions

Installation instructions are located at the following locations: pp. 210–215, product packaging or on the Crack-Pac Technical Data Sheet at **strongtie.com/rps**.

## Accessories

See p. 209 for information on crack repair accessories.



Crack-Pac Cartridge System

| Model No. | Capacity (ounces) | Cartridge Type | Carton Quantity | Dispensing Tool |
|---|---|---|---|---|
| ETIPAC2G10 | 9 | Single | 12 | CDT10S |
| ETIPAC2G10KT | 18 | Single | 2 (kits) | |

# Crack-Pac® Injection Epoxy



## Technical Information

### Compressive Strength

| Cure Time | 40°F (4°C) psi (MPa) | 60°F (16°C) psi (MPa) | 72°F (22°C) psi (MPa) | 90°F (32°C) psi (MPa) | Test Standard |
|---|---|---|---|---|---|
| 24-hour cure | — | 1,900 (13.1) | 4,400 (30.3) | 7,500 (51.7) | ASTM D695 |
| 72-hour cure | — | 8,000 (55.2) | 7,800 (53.8) | 9,000 (62.1) | |
| 7-day cure | 4,250 (29.3) | 9,000 (62.1) | 8,900 (61.4) | 9,200 (63.4) | |
| 14-day cure | 7,400 (51.0) | 10,000 (69.0) | 9,600 (66.4) | 9,400 (64.8) | |
| 28-day cure | 9,200 (63.4) | 12,200 (84.1) | 10,300 (71.3) | 9,600 (66.4) | |

| Temperature Range | Class C 60°F (16°C) — 90°F (32°C) | | Test Standard |
|---|---|---|---|
| Epoxy Classification | Types I; Grade 1 | | ASTM C881 |
| Viscosity — mixed[1] | 500 cP | | ASTM D2556 |
| Gel Time — mixed[1] | 105 minutes | | ASTM C881 |
| Bond Strength, Slant Shear:<br>Hardened to Hardened Concrete — 2-day cure<br>Hardened to Hardened Concrete — 14-day cure | <br>1,050 psi (7.2 MPa)[2]<br>1,500 psi (10.3 MPa)[2] | <br>1,230 psi (8.5 MPa)[3]<br>1,700 psi (11.7 MPa)[3] | ASTM C882 |
| Tensile Strength — 7-day cure | 6,100 psi (42.0 MPa)[2] | 6,150 psi (42.4 MPa)[3] | ASTM D638 |
| Tensile Elongation at Break — 7-day cure | 5.0%[2] | 7.5%[3] | ASTM D638 |
| Flexural Strength — 7-day cure | 9,600 psi (66.2 MPa)[2] | 9,200 psi (63.4 MPa)[3] | ASTM D790 |
| Modulus of Elasticity in Compression — 7-day cure | 307,000 psi (2,100 MPa)[2] | 264,000 psi (1,800 MPa)[3] | ASTM D695 |
| Water Absorption — 14-day cure[4] | 0.08% | | ASTM D570 |
| Linear Coefficient of Shrinkage[3] | 0.0014 | | ASTM D2566 |
| Coefficient of Thermal Expansion[3] | $3.46 \times 10^{-5}$ in./(in.°F)<br>$6.22 \times 10^{-5}$ cm/(cm°C) | | ASTM C531 |

1. Tested at 72°F (22°C).
2. Cured at 60°F (16°C).
3. Cured at 72°F (22°C).
4. Cured at 72°F (22°C), immersed in water 24 hours.


**Crack-Pac Kit (ETIPAC2G10KT)**

Crack-Pac injection epoxy is also available in the Crack-Pac Injection Kit (ETIPAC2G10KT). The kit includes everything needed to pressure inject cracks.

- 2 Crack-Pac cartridge/nozzle sets (ETIPAC2G10).
- 12 E-Z-Click™ injection ports.
- 2 E-Z-Click injection fittings with 12" tubing.
- 1 pint of ETR paste-over epoxy (8 oz. of resin + 8 oz. of hardener).
- 4 disposable wood paste-over applicators.
- 1 pair latex gloves.

# Crack-Pac® Flex-H2O™ Polyurethane Crack Sealer



The Crack-Pac Flex-H2O polyurethane injection resin seals leaking cracks, voids or fractures from $\frac{1}{32}$" to ¼" wide in concrete or solid masonry. Designed to perform in applications where water is seeping or mildly leaking from the crack, the polyurethane is packaged in the cartridge and an accelerator is packaged in the nozzle. When the resin encounters water as it is injected into the crack, it becomes an expanding foam that provides a flexible seal in leaking and non-leaking cracks.

### Features

- Can be dispensed with a standard caulking tool
- Can also be used on dry cracks if water is introduced to affected area
- Can be used with a reduced amount or without accelerator to slow down reaction time
- Expands to fill voids and seal the affected area
- Fast reacting — reaction begins within 1 minute after exposure to moisture; expansion may be completed within 3 minutes (depending on the amount of moisture and the ambient temperature)
- 20:1 expansion ratio (unrestricted rise) means less material needed

### Application Considerations

- Suitable for sealing cracks ranging from $\frac{1}{32}$" to ¼" wide in concrete and solid masonry.
- Suitable for repair of cracks in dry, damp and wet conditions with excellent results. Designed to perform in applications where water is seeping or mildly leaking from the crack.
- In order for components to mix properly, the resin and hardener must be conditioned to 60°F (16°C) to 90°F (32°C) before mixing.

**Shelf Life:** 12 months from the date of manufacture, unopened

**Base Material Temperature:** 60°F (16°C) to 90°F (32°C)

**Storage Conditions:** For best results, store in a dry area between 45°F (7°C) and 90°F (32°C). Product is very moisture sensitive.

**Installation Instructions:** See pp. 210–215

**Accessories:** See p. 209 for information on crack repair accessories.


**Crack-Pac Flex-H2O Crack Sealer (CPFH09)**

# Crack-Pac® Flex-H2O™ Polyurethane Crack Sealer


**Crack-Pac Flex-H2O Kit (CPFH09KT)**

Crack-Pac Flex-H2O injection epoxy is also available in the Crack-Pac Flex-H2O Injection Kit (CPFH09KT). The kit includes everything needed to pressure inject cracks.

- 2 Crack-Pac Flex-H2O cartridge/nozzle sets (CPFH09).
- 12 E-Z-Click™ injection ports.
- 2 E-Z-Click injection fittings with 12" tubing.
- 1 pint of ETR paste-over epoxy (8 oz. of resin + 8 oz. of hardener).
- 4 disposable wood paste-over applicators.
- 1 pair latex gloves.

## Crack-Pac Flex-H2O Packaging

| Model No. | Capacity | Cartridge Type | Carton Quantity | Dispensing Tool |
|---|---|---|---|---|
| CPFH09 | 9 ounces | Single | 12 | CDT10S |
| CPFH09KT | 18 ounces | Single | 2 (kits) | |
| FH05[1] | 5 gallons resin | Pail | 1 | — |
| | 16 ounces catalyst | | | |

1. For standard reaction time, use 30:1 resin to catalyst ration.
   For a faster reaction time, add more catalyst; for a slower reaction time, use less.

# **CI-PO** Paste-Over and Structural Repair Epoxy



CI-PO is a fast-curing, two-component, high-modulus, high-solids, moisture-tolerant, thixotropic epoxy designed for securing injection ports at the concrete surface prior to injection repair. CI-PO is suitable for general concrete repair applications when substrate temperatures are between 40°F (4°C) and 90°F (32°C). Available in 3-gallon bulk kits or convenient side-by-side cartridges dispensed through a static mixing nozzle using either a manual or a pneumatic dispensing tool.

### Features

- Dispenses with standard Crack Injection (CI) dispensing tools
- Chemically bonds with the concrete to provide a structural repair
- Gel-viscosity moisture-tolerant, can be used on dry and damp surfaces
- Non-shrink
- Can be used with metered pressure-injection equipment
- Freeze-thaw resistant

### Applications

- For adhesion of crack injection ports and paste-over of cracks up to ¼" (6 mm) in width
- For structural repairs
- As a pick-proof sealant

### Product Information

| | |
|---|---|
| Mix Ratio/Type | 2:1 |
| Cure Color | Concrete gray |
| Crack Width | 0.016"–0.25" (0.4 mm–6 mm) |
| Shelf Life | 24 months |
| Storage Temperature | 45°F (7°C)–90°F (32°C) |
| Base Material Temperature | 40°F (4°C)–90°F (32°C) |
| Volatile Organic Compound (VOC) | 2 g/L mixed |
| Yield | 231 in.$^3$/US gal. (0.001 m$^3$/L) |
| Thin Film (20 mil)<br>Set Time at 72°F, ASTM D5895 | Set to touch: 40 min.<br>Dry through: 2 hr. |
| Manufactured in the US using global materials | |


CI-PO

### Code Reports, Standards and Compliance

ASTM C881 and AASHTO M235 — Type I; Grade 3; Class B
Type I/IV; Grade 3; Class C

### Installation Instructions

Installation instructions are located at the following locations: pp. 210–215, product packaging or on the CI-PO Technical Data Sheet at **strongtie.com/rps**.

### Accessories

See p. 209 for information on crack repair accessories.

## CI-PO Cure Schedule

| Base Material Temperature | | Gel Time 60 grams ASTM C881 | Port Set Time ASTM D7234 |
|---|---|---|---|
| °F | °C | | |
| 40 | 4 | 18 minutes | 4 hours |
| 50 | 10 | 15 minutes | 2 hours |
| 72 | 22 | 5 minutes | 1 hour |
| 90 | 32 | 3 minutes | 45 minutes |

## CI-PO Packaging Information

| Model No. | Capacity (ounces) | Packaging Type | Packaging Quantity | Carton Quantity | Dispensing Tools | Mixing Nozzle |
|---|---|---|---|---|---|---|
| CIP032 | 32 | Side-by-side cartridge | 1 | 5 | ADT30S, ADT30P | AMN19Q |
| CIP03KT | 384 | 3-gallon bulk kit | 1 case of (3) gallon cans | — | Metering pumps offered by third party manufacturers | — |

# **CI-PO** Paste-Over and Structural Repair Epoxy

SIMPSON Strong-Tie

## Technical Information

### Compressive Strength

| Cure Time | 40°F (4°C) psi (MPa) | 60°F (16°C) psi (MPa) | 72°F (22°C) psi (MPa) | 90°F (32°C) psi (MPa) | Test Standard |
|---|---|---|---|---|---|
| 4-hour cure | — | 9,300 (64.1) | 13,000 (89.8) | 13,400 (92.4) | ASTM D695 |
| 8-hour cure | — | 11,500 (79.3) | 13,400 (92.4) | 13,400 (92.4) | |
| 16-hour cure | — | 12,000 (82.8) | 13,650 (94.1) | 13,400 (92.4) | |
| 24-hour cure | 7,800 (53.8) | 12,150 (83.8) | 13,750 (94.8) | 13,400 (92.4) | |
| 7-day cure | 9,350 (64.5) | 13,000 (89.7) | 13,750 (94.8) | 13,500 (93.1) | |

| Temperature Range | Class B 40°–60°F (4°C–16°C) | Class C >60°F (16°C) | Test Standard |
|---|---|---|---|
| Epoxy Classification | Types I; Grade 3[1] | Types I, IV; Grade 3[1] | ASTM C881 |
| Bond Strength, Slant Shear:<br>Hardened to Hardened Concrete — 2-day cure[2]<br>Hardened to Hardened Concrete — 14-day cure[2] | <br>1,300 psi (9.0 MPa)<br>1,650 psi (11.4 MPa) | <br>2,350 psi (16.2 MPa)<br>2,550 psi (17.6 MPa) | ASTM C882 |
| Flexural Strength — 7-day cure[2] | 1,900 psi (13.1 MPa) | 3,150 psi (21.7 MPa) | ASTM D790 |
| Modulus of Elasticity in Compression — 7-day cure[2] | 686,000 psi (4,730 MPa) | 681,000 psi (4,690 MPa) | ASTM D695 |
| Heat Deflection Temperature — 7-day cure[3] | 134°F (57°C) | | ASTM D648 |
| Glass Transition Temperature — 7-day cure[3] | 134°F (57°C) | | ASTM E1356 |
| Water Absorption — 14-day cure[4] | 0.26% | | ASTM D570 |
| Linear Coefficient of Shrinkage[3] | 0.0006 | | ASTM D2566 |
| Coefficient of Thermal Expansion[3] | $1.38 \times 10^{-5}$ in./(in.°F)<br>$2.49 \times 10^{-5}$ cm/(cm°C) | | ASTM C531 |
| Shore D Hardness — 24-hour cure[3] | 84 | | ASTM D2240 |
| Shore D Hardness — 7-day cure[3] | 85 | | ASTM D2240 |
| Adhesion to Concrete — 24-hour cure[3]<br>Adhesion to Dry Concrete<br>Adhesion to Surface Saturated Dry Concrete | <br>1,200 psi (8.3 MPa)<br>850 psi (5.9 MPa) | | ASTM D7234 |

1. Class B tested at 50°F (10°C), Class C tested at 72°F (22°C).
2. Class B cured at 40°F (4°C), Class C cured at 60°F (16°C).
3. Cured at 72°F (22°C).
4. Cured at 72°F (22°C), immersed in water 24 hours.

# **CIP-F / ETR** Paste-Over and Crack Sealants



CIP-F and ETR are fast-curing epoxies used to paste over and seal cracks while securing injection ports to the surface of concrete substrates prior to injecting an epoxy or urethane crack repair product. When properly mixed, the products will be a uniform gray color and can be left in place or removed after the repair is complete.

## Features

- 1:1 two component, high solids, epoxy amine based adhesive
- Non-sag paste consistency for horizontal, vertical or overhead applications
- Manufactured in the US using global materials

## CIP-F Flexible Paste-Over Adhesive and Crack Sealant

- Remains flexible after cure for easier removal
- Moderate substrate bond; peels away for removal
- Gel Time — 4 minutes at 72°F (22°C), 9 minutes at 40°F (4°C)
- Set Time — 1 hour at 72°F (22°C), and 3 hours at 40°F (4°C)
- Volatile organic compound (VOC) — 0 g/L

## ETR Concrete Repair and Paste-Over Epoxy

- Canisters are mixed manually and do not require dispensing tool
- Each package contains enough material to cover approximately eight lineal feet of cracks
- Gel Time — 6 minutes at 72°F (22°C), 10 minutes at 40°F (4°C)
- Set Time — 1 hour at 72°F (22°C), 2 hours at 60°F (16°C)
- Volatile organic compound (VOC) — 7 g/L
- Available in two 8 fl. oz. canisters

## Application Considerations

- Apply to concrete 40°F (4°C) or above. For best results, warm material to 65°F (16°C) or above prior to application.

**Shelf Life:** 24 months from date of manufacture, unopened for ETR; 12 months from date of manufacture, unopened for CIP-F

**Storage Conditions:** For best results, store between 45°F (7°C) and 90°F (32°C) for ETR; 60°F (16°C) – 95°F (35°C) for CIP-F

**Installation Instructions:** See pp. 210–215


CIP-F


ETR16

### Paste-Over and Crack Sealants

| Model No. | Capacity (oz.) | Cartridge | Mixing Nozzle | Dispensing Tool | Package Quantity | Carton Quantity |
|---|---|---|---|---|---|---|
| CIP-F22[1] | 22 | Side-by-side | EMNCIPF22 | EDT22S, EDTA22CKT, EDTA22P | 1 | 10 |
| ETR16 | 16 | — | — | — | 1 | 4 |

1. One EMNCIPF22 mixing nozzle is supplied with each cartridge.

# Crack Repair Accessories

**EMN022 Optimix®**
Mixing Nozzle

## Mixing Nozzles

| Model No. | Description | Package Quantity | Carton Quantity |
|---|---|---|---|
| EMNCIPF22-RP5² | Mixing nozzle for CIPF-22 epoxy | 5 | 5 |
| EMN022-RP6² | Optimix mixing nozzle for epoxies | 6 | 5 |
| AMN19Q-RP5 | Mixing nozzle for CIPO32 epoxy | 5 | 10 |

1. Use only appropriate Simpson Strong-Tie mixing nozzle in accordance with Simpson Strong-Tie instructions. Modification or improper use of mixing nozzle may impair epoxy performance.
2. Includes retaining nuts.

**E-Z-Click™**
Ports and Injection Fitting

**EIPX-EZ**
Corner Mount/
Drilled-In Port

**EIP-EZA**
Flush-Mount Port

## Injection Ports and Injection Fittings

| Model No. | Description | Hole Size (in.) | Package Contents | | Carton Quantity |
|---|---|---|---|---|---|
| | | | Ports | E-Z Click Injection Fitting | |
| EIP-EZAKT | E-Z Click flush mount injection ports | — | 20 | 1 | 5 kits |
| EIP-EZA | | — | 1 each | — | 100 |
| EIPX-EZKT | E-Z Click corner mount or drill in injection port | ⅝ | 20 | 1 | 5 kits |
| EIPX-EZ-RP20 | | | 20 | — | 5 packs of 20 |
| EIF-EZ | E-Z Click injection fitting | — | — | 1 each | 10 |

1. EIPX intended for use as a surface-mount port in corners and as a drilled-in port on flat surfaces.

Detailed information on the full line of Simpson Strong-Tie manual and pneumatic dispensing tools is available on **strongtie.com**.

# Crack Injection Guide

**Important:** These instructions are intended as recommended guidelines. Due to the variability of field conditions, selection of the proper material for the intended application and installation is the sole responsibility of the applicator.

Epoxy injection is an economical method of repairing non-moving cracks in concrete walls, slabs, columns and piers and is capable of restoring the concrete to its pre-cracked strength. Prior to doing any injection it is necessary to determine the cause of the crack. If the source of cracking has not been determined and remedied, the concrete may crack again.

## Materials

- CI-LV and CI-SLV for repair of hairline cracks (0.002") and those up to ¼" in width.
- CI-LV FS and CI-LPL for repair of fine to medium-width cracks (suggested width range: 1⁄64"–¼").
- CI-GV for repair of medium-width cracks (suggested width range: 3⁄32"–¼").
- Crack-Pac® injection epoxy for repair of fine to medium non-structural cracks (suggested width range: 1⁄64"–¼").
- Crack-Pac Flex-H2O polyurethane crack sealer for repair of fine- to medium-width cracks (suggested width range: 1⁄32"–¼").
- CI-PO, CIP-F and ETR are recommended for paste-over of crack surface and installation of injection ports.
- E-Z-Click™ injection ports, fittings and other suitable accessories.

### Estimating Guide for Epoxy Crack Injection

| Width of Crack (in.) | Concrete Thickness (in.) | CI-SLV, CI-LV, CI-LV FS, CI-LPL, CI-GV | Crack-Pac | Crack-Pac Flex-H2O |
|---|---|---|---|---|
| | | Approx. Coverage per 32 oz. Cartridge (linear ft.) | Approx. Coverage per 9 oz. Cartridge (linear ft.) | Approx. Coverage per 9 oz. Cartridge (linear ft.) |
| 1⁄64 | 4 | 69.4 | 18.4 | — |
| | 6 | 46.3 | 12.3 | — |
| | 8 | 34.6 | 9.2 | — |
| | 10 | 27.8 | 7.4 | — |
| 1⁄32 | 4 | 34.6 | 9.2 | 108.0 |
| | 6 | 23.1 | 6.1 | 72.0 |
| | 8 | 17.3 | 4.6 | 54.0 |
| | 10 | 13.8 | 3.7 | 43.2 |
| 1⁄16 | 4 | 17.3 | 4.6 | 54.0 |
| | 6 | 11.5 | 3.1 | 36.0 |
| | 8 | 8.7 | 2.3 | 27.0 |
| | 10 | 7.0 | 1.8 | 21.6 |
| ⅛ | 4 | 8.7 | 2.3 | 27.0 |
| | 6 | 5.8 | 1.5 | 18.0 |
| | 8 | 4.4 | 1.2 | 13.5 |
| | 10 | 3.5 | 0.9 | 10.8 |
| 3⁄16 | 4 | 5.8 | 1.5 | 18.0 |
| | 6 | 3.8 | 1.0 | 12.0 |
| | 8 | 2.9 | 0.8 | 9.0 |
| | 10 | 2.3 | 0.6 | 7.2 |
| ¼ | 4 | 4.4 | 1.2 | 13.5 |
| | 6 | 2.9 | 1.8 | 9.0 |
| | 8 | 2.2 | 0.6 | 6.8 |
| | 10 | 1.7 | 0.5 | 5.4 |

Coverage listed is approximate and will vary depending on waste and condition of concrete.

## Preparation of the Crack for Injection

Clean the crack and the surface surrounding it to allow the paste-over to bond to sound concrete. At a minimum, the surface to receive paste-over should be brushed with a wire brush. Oil, grease or other surface contaminant must be removed in order to allow the paste-over to bond properly. Take care not to impact any debris into the crack during cleaning. Using clean, oil-free compressed air, blow out the crack to remove any dust, debris or standing water. Best results will be obtained if the crack is dry at the time of injection. If water is continually seeping from the crack, the flow must be stopped in order for epoxy injection to yield a suitable repair. Other materials such as polyurethane resins may be required to repair an actively leaking crack.

For many applications, additional preparation is necessary in order to seal the crack. Where a surfacing material has been removed using an acid or chemical solvent, prepare the crack as follows:

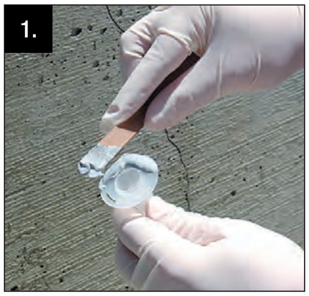
1. Using clean, compressed air, blow out any remaining debris and liquid.
2. Remove residue by high-pressure washing or steam cleaning.
3. Blow any remaining water from the crack with clean compressed air.

If a coating, sealant or paint has been applied to the concrete, it must be removed before placing the paste-over epoxy. Under the pressure of injection, these materials may lift and cause a leak. If the surface coating is covering the crack, it may be necessary to route out the opening of the crack in a "V" shape using a grinder in order to get past the surface contamination.

## Sealing of the Crack and Attachment of E-Z-Click™ Injection Ports

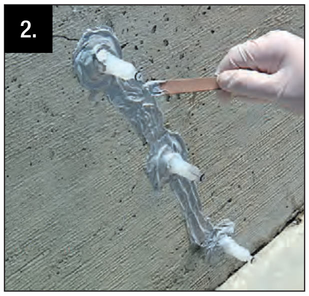
1. To adhere the port to the concrete, apply a small amount of paste-over around the bottom of the port base. Place the port at one end of the crack and repeat until the entire crack is ported. As a rule of thumb, injection ports should be placed 8" apart along the length of the crack.

**Important:** Do not allow paste-over to block the port or the crack under it, this is where epoxy must enter the crack.





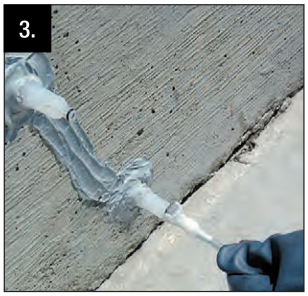
2. Using a putty knife or other paste-over tool, generously work paste-over along the entire length of the crack. Take care to mound the paste-over around the base of the port to approximately ¼" thick extending 1" out from the base of the port and to work out any holes in the material. It is recommended that the paste-over should be a minimum of 3⁄16" thick and 1" wide along the crack. Insufficient paste-over will result in leaks under the pressure of injection. If the crack passes completely through the concrete element, seal the back of the crack, if possible. If not, injection epoxy may be able to run out the backside of the crack, resulting in an ineffective repair.



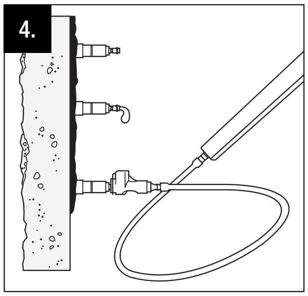

3. Allow the paste-over to harden before beginning injection. **Note:** CI-PO and ETR are a fast cure and when manually mixed may harden prematurely if left in a mixed mass on the mixing surface while installing ports. Spreading paste-over into a thin film (approximately ⅛") on the mixing surface will slow curing by allowing the heat from the reaction to dissipate.

## Injection Procedure for CI-SLV, CI-LV, CI-LV FS, CI-LPL, CI-GV and Crack-Pac® Injection Epoxy

1. Follow cartridge preparation instructions on the cartridge label. Verify the material flowing from the Optimix® mixing nozzle is a uniform and consistent color.
2. Attach the E-Z-Click™ fitting to the end of the nozzle by pushing the tubing over the barbs at the end of the nozzle. Make sure that all ports are pushed in to the open position.
3. Attach the E-Z-Click injection fitting to the first E-Z-Click port until it clicks into place. Make sure that the heads of all the ports are pushed in to the open position. In vertical applications, begin injection at the lowest port and work your way up. In a horizontal application start at one end of the crack and work your way to the other end.




4. Inject epoxy into the first port until it will no longer flow into the crack. If epoxy shows at the next port and the first port still accepts material, close the second port and continue to inject into the first port until it accepts no more epoxy. Continue closing ports where epoxy appears until the first port refuses epoxy. When the first port reaches the point of refusal, brace the base of the port and pull out gently on the head of the port to close it. Pulling too hard may dislodge the port from the surface of the concrete, causing a leak. Depress the metal tab on the head of the E-Z-Click fitting and remove it from the port.




5. Go to the last port where epoxy appeared while injecting the first port, open it, and continue injection at this port. If the epoxy has set up and the port is bonded closed, move to the next clean port and repeat the process until every portion of the crack has refused epoxy.

While this method may appear to leave some ports uninjected, it provides maximum pressure to force the epoxy into the smaller areas of the crack. Moving to the next port as soon as epoxy appears will allow the epoxy to travel along the wider parts of the crack to the next ports rather than force it into the crack before it travels to the next ports.

## Injection Tips

- If using a pneumatic dispensing tool, set the tool at a low setting when beginning injection and increase pressure if necessary to get the epoxy to flow.
- For narrow cracks it may be necessary to increase the pressure gradually until the epoxy begins to flow. It may also be necessary to wait a few minutes for the epoxy to fill the crack and travel to the next port.
- If desired, once the injection epoxy has cured, remove the injection ports and paste-over. Epoxy paste-over can be removed with a chisel, scraper, or grinder. The paste-over can be simply peeled off if CIP-F is used. Using a heat gun to soften the epoxy is recommended when using a chisel or scraper.
- Mixing nozzles can be used for multiple cartridges as long as the epoxy does not harden in the nozzle. For injection epoxies in side-by-side cartridges, care must be taken to ensure the level of material is the same on both parts of the cartridge. This can be done by checking for air in the cartridge and the positions of the wipers in the back of the cartridge. If the liquid levels are off by more than ⅛", then Step 1 from the injection procedures must be repeated.

## Troubleshooting

### Epoxy is flowing into the crack, but not showing up at the next port.

This most likely indicates that epoxy is running out of the unsealed backside of the crack. In this case, the application may require a gel viscosity injection epoxy (CI-GV) or may not be suitable for epoxy injection repair without excavation and sealing of the backside of the crack.

This may also indicate that either the crack expands and/or branches off under the surface of the concrete. Continue to inject and fill these voids. In situations where the crack penetrates completely through the concrete element and the backside of the concrete element cannot be sealed (e.g., basement walls, or footings with backfill), longer injection time may not force the epoxy to the next port.

### Epoxy is leaking from the pasted-over crack or around injection ports.

Stop injecting. If using a fast cure paste-over material (CI-PO, CIP-F or ETR), wipe off the leaking injection epoxy with a cotton cloth and reapply the paste-over material. Wait approximately 10 to 15 minutes to allow the paste-over to begin to harden. If the leak is large (e.g., the port broke off of the concrete surface), it is a good idea to wait approximately 30 minutes, or longer as necessary, to allow the paste-over to cure more completely. Check to see that the paste-over is hard before reinjecting or the paste-over or ports may leak. Another option for small leaks is to clean off the injection epoxy and use paraffin or crayon to seal the holes.

### More epoxy is being used than estimated.

This may indicate that the crack either expands or branches off below the surface. Continue to inject and fill these voids. This may also indicate that epoxy is running out of the backside of the crack. If the crack penetrates completely through the concrete element and cannot be sealed, the application may not be suitable for injection repair.

### Back pressure is preventing epoxy from flowing.

This can indicate several situations:

- The crack is not continuous and the portion being injected is full (see above instructions about injection after the port has reached refusal). See Step 4 on p. 212.
- The port is not aligned over the crack properly.
- The crack is blocked by debris.
- The injection epoxy used has too high of a viscosity.
- If the mixing nozzle has been allowed to sit for a few minutes full of epoxy, the material may have hardened in the nozzle.

Attach the E-Z-Click™ fitting to a port at another uninjected location on the crack and attempt to inject. If the epoxy still won't flow, chances are the epoxy has hardened in the nozzle.

### Less epoxy is being used than estimated.

This may indicate that the crack is shallower than originally thought, or the epoxy is not penetrating the crack sufficiently before moving to the next port. Reinject some ports with a lower viscosity epoxy to see if the crack will take more epoxy. Another option is to heat the epoxy to a temperature of 80–100°F, which will reduce its viscosity and allow it to penetrate into small cracks easier. The epoxy should be heated uniformly, do not overheat cartridge.

## Gravity-Feed Procedure

Some horizontal applications where complete penetration is not a requirement can be repaired using the gravity-feed method.

1. Follow cartridge preparation instructions on the cartridge label. Verify that the material flowing from the Optimix® mixing nozzle is a uniform and consistent color.
2. Starting at one end of the crack, slowly dispense epoxy into the crack, moving along the crack as it fills. It will probably be necessary to do multiple passes in order to fill the crack. It is possible that the epoxy will take some time to run into the crack, and the crack may appear empty several hours after the initial application. Reapply epoxy until the crack is filled.
3. In situations where the crack completely penetrates the member (e.g., concrete slab), the material may continue to run through the crack into the subgrade. It may be possible to use a small amount of course, dry sand to act as a barrier for the injection epoxy. Place the sand in the crack to a level no more than ¼ thickness of the member and apply the injection epoxy as described in step 2. The epoxy level will drop as it penetrates the sand, but should cure and provide a seal to the bottom of the crack. Reapply the epoxy until the crack is filled. In some cases, application of sand is impractical or not permitted and epoxy repair may not provide a complete and effective repair. Use of a gel viscosity injection epoxy (CI-GV) may permit a surface repair to the crack with partial penetration.

## Chemical Resistance of Injection Epoxies

Samples of Simpson Strong-Tie epoxies were immersed in the chemicals shown below for a maximum of three months. The samples were then tested according to ASTM D543 *Standard Practices for Evaluating the Resistance of Plastics to Chemical Changes*, Procedures I & II, and ASTM D2240 *Standard Test Method for Rubber Property–Durometer Hardness*.

Samples showing no visible damage and demonstrating statistically equivalent hardness as compared to control samples were classified as **"Resistant" (R)**. These epoxies are considered suitable for continuous exposure to the identified chemical.

Samples exhibiting slight damage, such as swelling or crazing, or not demonstrating equivalent hardness as compared to control samples were classified as **"Non-Resistant" (NR)**. These epoxies are considered suitable for periodic exposure to the identified chemical if the chemical will be diluted and washed away after exposure. Some manufacturers refer to this as "limited resistance" or "partial resistance" in their literature.

Samples that were completely destroyed by the chemical, or that demonstrated a significant loss in hardness after exposure were classified as **"Failed" (F)**. These epoxies are considered unsuitable for exposure to the identified chemical.

**Note:** In many actual service conditions, the majority of the injection epoxy is not exposed to the chemical and thus some period of time is required for the chemical to saturate the entire mass of repair material. The repair would be expected to maintain integrity and load-bearing capability until a significant portion of the injection epoxy is saturated.

### Data Table

| Chemical | Concentration | CI-LV | CI-LVFS | CI-LPL | CI-GV | CI-SLV |
|---|---|---|---|---|---|---|
| Acetic Acid | 10% | F | F | F | F | F |
| | pH = 3 | R | R | R | R | R |
| Acetone | 100% | F | F | F | NR | F |
| Aluminum Ammonium Sulfate (Ammonium Alum) | 10% | R | — | — | — | — |
| Aluminum Chloride | 10% | R | — | — | — | — |
| Aluminum Potassium Sulfate (Potassium Alum) | 10% | R | — | — | — | — |
| Aluminum Sulfate (Alum) | 15% | R | — | — | — | — |
| Ammonium Hydroxide (Ammonia) | 20% | R | R | R | R | R |
| | pH = 10 | R | R | R | R | R |
| Ammonium Sulfate | 15% | R | — | — | — | — |
| Antifreeze | 100% | R | R | R | R | R |
| Aviation Fuel (JP5) | 100% | R | R | R | R | R |
| Break Fluid | 100% | R | R | R | R | R |
| Calcium Hydroxide | 10% | R | R | R | R | R |
| Calcium Hypochlorite | 15% | R | R | R | R | R |
| Calcium Oxide | 5% | R | R | R | R | R |
| Chlorine (Sodium Dichloro-s-triazinetrione) | 2,000 ppm | R | R | R | R | R |
| Detergent (ASTM D543) | 100% | R | R | R | R | R |
| Diesel Oil | 100% | R | R | R | R | R |
| Ethyl Alcohol | 95% | F | F | NR | NR | F |
| | 50% | NR | NR | R | R | NR |
| Fluorosilicic Acid | 25% | R | — | — | — | — |
| Gasoline | 100% | NR | NR | R | R | NR |
| Hydrochloric Acid | 10% | NR | R | R | R | F |
| | pH = 3 | R | R | R | R | R |
| Hydrogen Peroxide | 12% | F | R | NR | R | F |
| Iron (II) Chloride (Ferrous Chloride) | 15% | R | — | — | — | — |
| Iron (III) Chloride (Ferric Chloride) | 15% | R | — | — | — | — |
| Isopropanol | 100% | R | R | R | R | R |
| Machine Oil | 100% | R | R | R | R | R |
| Methyl Ethyl Ketone | 100% | F | F | F | NR | F |
| Mineral Spirits | 100% | R | R | R | R | R |
| Motor Oil | 100% | R | R | R | R | R |
| Potassium Permanganate | 10% | R | — | — | — | — |
| Seawater (ASTM D1141) | 100% | R | R | R | R | R |
| Soap (ASTM D543) | 100% | R | R | R | R | R |
| Sodium Bicarbonate | 10% | R | — | — | — | — |
| Sodium Bisulfite | 15% | R | — | — | — | — |
| Sodium Carbonate | 15% | R | — | — | — | — |
| Sodium Fluoride | 10% | R | — | — | — | — |
| Sodium Hexafluorosilicate (Sodium Silicon Floride) | 50% | R | — | — | — | — |
| Sodium Hydrogen Sulfide | 15% | R | — | — | — | — |
| Sodium Hydroxide | 20% | R | R | R | R | R |
| | pH = 10 | R | R | R | R | R |
| Sodium Hypochlorite | 15% | R | R | R | R | R |
| Sodium Nitrate | 15% | R | — | — | — | — |
| Sodium Phosphate (Trisodium Phosphate) | 10% | R | — | — | — | — |
| Sodium Silicate | 10% | R | — | — | — | — |
| Sulfuric Acid | 10% | NR | R | R | NR | F |
| | pH = 3 | R | R | R | R | R |
| Toluene | 100% | R | R | R | R | R |
| Water | 100% | R | R | R | R | R |

1. "R" — Resistant, "NR" — Non-Resistant, "F" — Failed, "—" — Not tested

Restoration Solutions

## Injection Procedure for Crack-Pac® Flex-H2O™ Crack Sealer

1. Follow cartridge preparation instructions on the cartridge label. Verify that the material flowing from the nozzle is a uniform green color.
2. Attach the E-Z-Click™ fitting to the end of the nozzle by pushing the tubing over the barbs at the end of the nozzle. Make sure that all ports are pushed into the open position. If crack is dry, introduce a small amount of water (1–2 mL) into each open port using a dropper, pipet, syringe or squirt bottle.
3. Attach the E-Z-Click injection fitting to the first E-Z-Click port until it clicks into place. Make sure that the head of the port is pushed into the open position. In vertical applications, begin injection at the lowest port and work your way up. In a horizontal application, start at one end of the crack and work your way to the other end.
4. Inject polyurethane into the first port until material shows at the next port. Remove the E-Z-Click fitting by bracing the base of the port and pulling out gently on the head of the port to close it. Pulling too hard may dislodge the port from the surface of the concrete, causing a leak. Depress the metal tab on the head of the E-Z-Click fitting and remove it from the port.
5. Move to the next port and repeat until all ports have been injected.

## Injection Tips for Crack-Pac FlexH2O Crack Sealer

- For narrow cracks, it may be necessary to increase the pressure gradually until the polyurethane begins to flow. It may also be necessary to wait a few minutes for the material to fill the crack and travel to the next port.
- If desired, once the injection epoxy has cured, remove the injection ports and paste-over. Epoxy paste-over can be removed with a chisel, scraper, or grinder. The paste-over can be simply peeled off if CIP-F is used. Using a heat gun to soften the epoxy is recommended when using a chisel or scraper.

## Troubleshooting for Crack-Pac Flex-H2O Crack Sealer

### Polyurethane is flowing into the crack, but not showing up at the next port.

This can indicate several situations:

- That polyurethane is running out the unsealed backside of the crack.
- There is not enough water present to react with the polyurethane and generate foam.
- The crack either expands and/or branches off under the surface of the concrete.

Continue to inject and fill these voids. In situations where the crack penetrates completely through the concrete element, and the backside of the concrete element cannot be sealed (e.g., basement walls, or footings with backfill), longer injection time may not force the polyurethane to the next port. This most likely indicates that polyurethane is running out the unsealed backside of the crack. In this case, the application may require a gel viscosity injection epoxy (CI-GV) or may not be suitable for injection repair without excavation and sealing of the backside of the crack.

### Back pressure is preventing polyurethane from flowing.

This can indicate several situations:

- The crack is not continuous and the portion being injected is full.
- The port is not aligned over the crack properly.
- The crack is blocked by debris.

Attach the E-Z Click™ fitting to the next uninjected port on the crack and continue the injection.

### Polyurethane is leaking from the pasted-over crack or around injection ports.

Stop injecting. If using a fast cure paste-over material (CI-PO, CIP-F or ETR), wipe off the leaking polyurethane with a cotton cloth and reapply the paste-over material. Wait approximately 10–15 minutes to allow the paste-over to begin to harden. If the leak is large (e.g., the port broke off of the concrete surface), it is a good idea to wait approximately 30 minutes, or longer as necessary, to allow the paste-over to cure more completely. Check to see that the paste-over is hard before reinjecting or the paste-over or ports may leak.

Another option for small leaks is to clean off the injection adhesive and use paraffin or crayon to seal the holes.

### More polyurethane is being used than estimated.

This may indicate there is not enough water present to react with the polyurethane and generate foam. Introduce water into the port and continue to inject. Introduce water into subsequent ports prior to injection.

This may also indicate that the crack either expands or branches off below the surface. Continue to inject and fill these voids.

### Less polyurethane is being used than estimated.

This may indicate that the crack is shallower than originally thought, or the polyurethane is not penetrating the crack sufficiently before moving to the next port.

Ensure polyurethane foam presents at the next injection port before moving to that port or fill the crack at the port until rejection.

# Heli-Tie™ Helical Wall Tie



The Heli-Tie helical wall tie is a stainless-steel tie used to anchor building façades to structural members or to stabilize brick walls.

The helical design allows the tie to be driven quickly and easily into a predrilled pilot hole (or embedded into mortar joints in new construction) to provide a mechanical connection between a masonry façade and its backup material. As it is driven, the fins of the tie undercut the masonry to provide an expansion-free anchorage that will withstand tension and compression loads.

The Heli-Tie wall tie is installed into a predrilled hole using a proprietary setting tool with an SDS-plus® shank rotohammer to drive and countersink the tie. Heli-Tie wall ties perform in concrete and masonry as well as wood and steel studs.

**Heli-Tie Helical Wall Tie**

## Features

- Installs quickly and easily — with the rotohammer in hammer mode, the tie installs faster than competitive products.
- Provides an inconspicuous repair that preserves the appearance of the building. After installation, the tie is countersunk up to ½" below the surface, allowing the tie location to be patched.
- Larger core diameter provides higher torsional capacity, resulting in less deflection due to "uncoiling" under load.
- Fractionally sized anchor — no metric drill bits required.
- Patented manufacturing process results in a more uniform helix along the entire tie, allowing easier driving and better interlock with the substrate.

**Material:** Type 304 stainless steel (Type 316 available by special order — contact Simpson Strong-Tie for details)

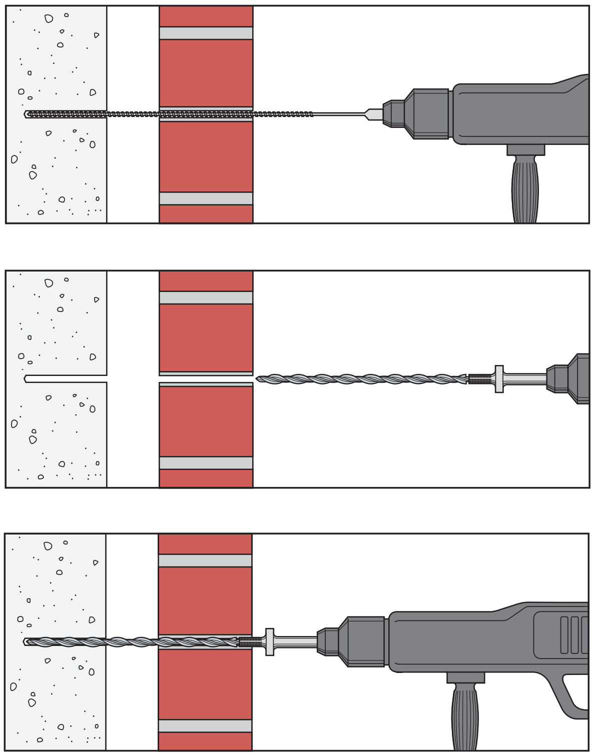
**Test Criteria:** CSA A370

Watch how to install Heli-Tie helical wall tie at **strongtie.com/helitie**.

## Installation

- Drill pilot hole through the façade material and into the backup material to the specified embedment depth + 1" using appropriate drill bit(s) in the chart below. Drill should be in rotation-only mode when drilling into soft masonry or into hollow backing material.
- Position blue end of the Heli-Tie fastener in the installation tool and insert the tie into the pilot hole.
- With the SDS-plus rotohammer in hammer mode, drive the tie until the tip of the installation tool enters the exterior surface of the masonry and countersinks the tie below the surface. Patch the hole in the façade with a matching masonry mortar.

## Installation Sequence



### Heli-Tie Helical Wall Tie Product Data

| Size (in.) | Model No. | Drill Bit Diameter (in.) | Quantity | |
|---|---|---|---|---|
| | | | Box | Carton |
| ⅜ x 7 | HELI37700A | 7/32 or 1/4 | 50 | 400 |
| ⅜ x 8 | HELI37800A | | 50 | 400 |
| ⅜ x 9 | HELI37900A | | 50 | 400 |
| ⅜ x 10 | HELI371000A | | 50 | 200 |
| ⅜ x 11 | HELI371100A | | 50 | 200 |
| ⅜ x 12 | HELI371200A | | 50 | 200 |
| ⅜ x 14 | HELI371400A | | 50 | 200 |
| ⅜ x 16 | HELI371600A | | 50 | 200 |
| ⅜ x 18 | HELI371800A | | 50 | 200 |
| ⅜ x 20 | HELI372000A | | 50 | 200 |

Special order lengths are also available; contact Simpson Strong-Tie for details.

# Heli-Tie™ Design Information

## Guide Tension Loads in Various Base Materials

| Size in. (mm) | Base Material | Anchor Location | Drill Bit Diameter in. | Min. Embed. Depth in. (mm) | Tension Load[1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Ultimate[2] lb. (kN) | Load at Max. Permitted Displ.[3] lb. (kN) | Standard Deviation lb. (kN) |
| 3/8 (9.0) | Solid brick[4] | Mortar bed joint | 7/32 | 3 (76) | 570 (2.5) | 240 (1.1) | 79 (0.4) |
| | | | 1/4 | | 365 (1.6) | 130 (0.6) | 46 (0.2) |
| | | Brick face | 7/32 | | 1,310 (5.8) | 565 (2.5) | 84 (0.4) |
| | | | 1/4 | | 815 (3.6) | 350 (1.6) | 60 (0.3) |
| | Hollow brick[5] | Mortar bed joint | 7/32 | | 530 (2.4) | 285 (1.3) | 79 (0.4) |
| | | Brick face | 7/32 | | 775 (3.4) | 405 (1.8) | 47 (0.2) |
| | | | 1/4 | | 510 (2.3) | 185 (0.8) | 20 (0.1) |
| | Grout-filled CMU[6] | Center of face shell | 7/32 | 2 3/4 (70) | 1,170 (5.2) | 405 (1.8) | 79 (0.4) |
| | | | 1/4 | | 830 (3.7) | 350 (1.6) | 60 (0.3) |
| | | Web | 7/32 | | 1,160 (5.2) | 440 (2.0) | 56 (0.2) |
| | | | 1/4 | | 810 (3.6) | 330 (1.5) | 100 (0.4) |
| | | Mortar bed joint | 7/32 | | 720 (3.2) | 320 (1.4) | 71 (0.3) |
| | | | 1/4 | | 530 (2.4) | 205 (0.9) | 58 (0.3) |
| | Hollow CMU[7] | Center of face shell | 7/32 | | 790 (3.5) | 305 (1.4) | 56 (0.2) |
| | | | 1/4 | | 505 (2.2) | 255 (1.1) | 46 (0.2) |
| | | Web | 7/32 | | 1,200 (5.3) | 445 (2.0) | 50 (0.2) |
| | | | 1/4 | | 675 (3.0) | 385 (1.7) | 96 (0.4) |
| | Normal-weight concrete[8] | — | 7/32 | 1 3/4 (44) | 880 (3.9) | 410 (1.8) | 76 (0.3) |
| | | | 1/4 | 2 3/4 (70) | 990 (4.4) | 380 (1.7) | 96 (0.4) |
| | 2x4 wood stud[9,11] | Center of thin edge | 7/32 | 2 3/4 (70) | 590 (2.6) | 370 (1.6) | 24 (0.1) |
| | | | 1/4 | | 450 (2.0) | 260 (1.2) | 6 (0.0) |
| | Metal stud[10,11] | Center of flange | 7/32 | 1 (25) | 200 (0.9) | 120 (0.5) | 8 (0.0) |
| | | | 1/4 | | 155 (0.7) | 95 (0.4) | 2 (0.0) |

**Caution:** Loads are guide values based on laboratory testing. Onsite testing shall be performed for verification of capacity since base material quality can vary widely.

1. Tabulated loads are guide values based on laboratory testing. Onsite testing shall be performed for verification of capacity since base material quality can vary widely.
2. Ultimate load is average load at failure of the base material. Heli-Tie fastener average ultimate steel strength is 3,885 lb. and does not govern.
3. Load at maximum permitted displacement is average load at displacement of 0.157 inches (4 mm). The designer shall apply a suitable factor of safety to these numbers to derive allowable service loads.
4. Solid brick values for nominal 4-inch-wide solid brick conforming to ASTM C62/C216, Grade SW. Type N mortar is prepared in accordance with IBC Section 2103.2.
5. Hollow brick values for nominal 4-inch-wide hollow brick conforming to ASTM C216/C652, Grade SW, Type HBS, Class H40V. Mortar is prepared in accordance with IBC Section 2103.2.
6. Grout-filled CMU values for nominal 8-inch-wide lightweight, medium-weight and normal-weight concrete masonry units. The masonry units must be fully grouted. Values for nominal 8-inch-wide concrete masonry units (CMU) with a minimum specified compressive strength of masonry, $f'_m$, at 28 days is 1,500 psi.
7. Hollow CMU values for 8-inch-wide lightweight, medium-weight and normal-weight concrete masonry units.
8. Normal-weight concrete values for concrete with minimum specified compressive strength of 2,500 psi.
9. 2x4 wood stud values for nominal 2x4 Spruce-Pine-Fir.
10. Metal stud values for 20-gauge C-shape metal stud.
11. For retrofits, due to difficulty of locating center of 2x4 or metal stud flange, install Heli-Tie from interior of building.
12. For new construction, anchor one end of tie into backup material. Embed other end into veneer mortar joint.

# Heli-Tie™ Design Information

Compression (Buckling) Loads[1]

| Size in. (mm) | Unsupported Length in. (mm) | Ultimate Compression Load[1] lb. (kN) |
|---|---|---|
| 3⁄8 (9.0) | 1 (25) | 1,905 (8.5) |
| | 2 (50) | 1,310 (5.8) |
| | 4 (100) | 980 (4.4) |
| | 6 (150) | 785 (3.5) |

1. The designer shall apply a suitable factor of safety to these numbers to derive allowable service loads.

### Heli-Tie Fastener Installation Tool — Model HELITOOL37A

Required for correct installation of Heli-Tie wall ties. Speeds up installation and automatically countersinks the tie into the façade material.

HELITOOL37A

### Heli-Tie Wall Tie Tension Tester — Model HELITEST37A

Recommended equipment for onsite testing to accurately determine load values in any specific structure, the Heli-Tie wall tie tension tester features a key specifically designed to grip the Heli-Tie fastener and provide accurate results. Replacement test keys sold separately (Model HELIKEY37A).

Contact Simpson Strong-Tie for Heli-Tie onsite testing procedures.

HELITEST37A

HELIKEY37A

For more information see **strongtie.com/helitie**.

SIMPSON Strong-Tie

# **Heli-Tie™** Helical Stitching Tie

The Simpson Strong-Tie Heli-Tie helical stitching tie provides a unique solution to the preservation and repair of damaged brick and masonry structures. Ties are grouted into existing masonry joints to repair cracks and increase strength with minimum disturbance. Made of Type 304 stainless steel, the Heli-Tie stitching tie features radial fins formed on the steel wire via cold rolling process, increasing the tensile strength of the tie.

**HELIST254000**

## Features

- Helical design distributes loads uniformly over a large surface area
- Installs into the mortar joint to provide an inconspicuous repair and preserve the appearance of the structure
- Type 304 stainless steel offers superior corrosion resistance to mild steel reinforcement
- Patented manufacturing process results in consistent, uniform helix configuration (US Patent 7,269,987)
- Batch number printed on each tie for easy identification and inspection

**HELIST254000:** ¼" x 40" stitching tie
(special lengths are available upon request)

**Material:** Type 304 stainless steel

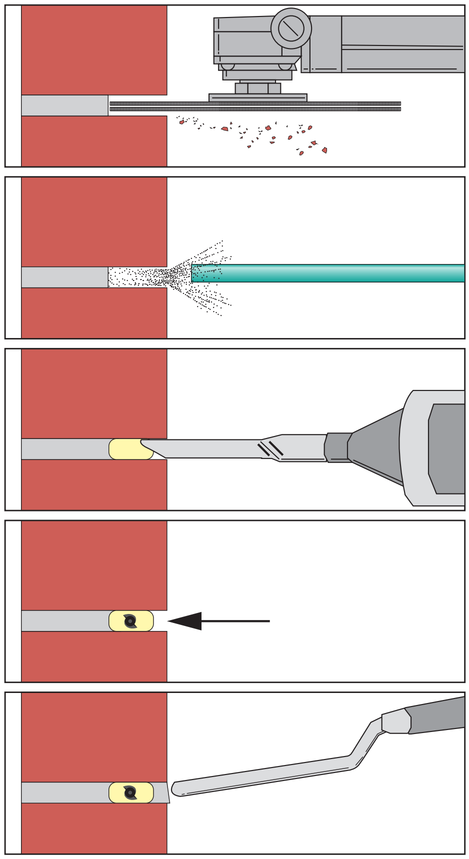
**Ordering Information:** Sold in tubes of 10

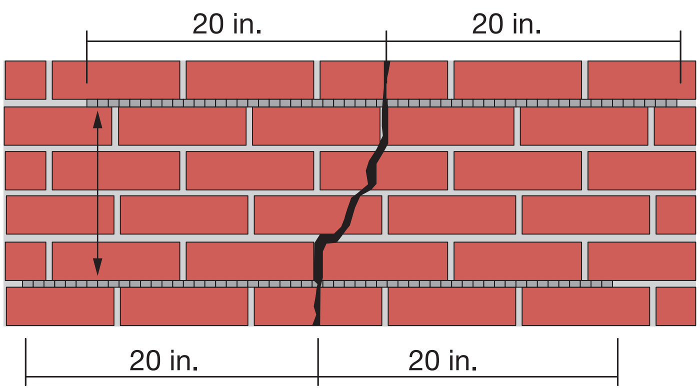
## Installation Instructions

- Chase bed joint 20" on either side of the affected area to a depth of approximately 1¼" with a rotary grinding wheel. Vertical spacing of installation sites should be 12" for red brick or "every other course" for concrete masonry units.
- Clear bed joint of all loose debris.
- Mix non-shrink repair grout or mortar per product instructions and place into the prepared bed joint, filling the void to approximately two-thirds of its depth. Simpson Strong-Tie RPS-263 Rapid-Hardening Vertical / Overhead Repair Mortar should be used.
- Embed the tie at one-half the depth of the void. Trowel displaced grout to fully encapsulate the tie.
- Fill any remaining voids and vertical cracks with non-shrink repair grout or other repair mortar to conceal repair site.

Watch how to install Heli-Tie helical stitching tie at **strongtie.com/helitie**.

## Installation Sequence








Restoration Solutions

# Carbide Drill Bits

# SDS-plus® Drill Bits

SIMPSON Strong-Tie

## SDS-plus Shank Bits — Retail Packs

| Diameter (in.) | Drilling Depth (in.) | Overall Length (in.) | Quantity (per pack) | Model No. |
|---|---|---|---|---|
| 5⁄32 | 4 | 6¼ | 25 | MDPL01506-R25 |
| 3⁄16 | 2 | 4¼ | 25 | MDPL01804-R25 |
| | 4 | 6¼ | 25 | MDPL01806-R25 |
| | 6 | 8¼ | 25 | MDPL01808-R25 |
| | 8 | 10 | 25 | MDPL01810-R25 |
| | 10 | 12 | 25 | MDPL01812-R25 |
| | 12 | 14 | 25 | MDPL01814-R25 |
| 7⁄32 | 4 | 6¼ | 25 | MDPL02106-R25 |
| | 6 | 8¼ | 25 | MDPL02108-R25 |
| | 8 | 10 | 25 | MDPL02110-R25 |
| ¼ | 2 | 4¼ | 25 | MDPL02504-R25 |
| | 4 | 6¼ | 25 | MDPL02506-R25 |
| | 6 | 8¼ | 25 | MDPL02508-R25 |
| | 8 | 10 | 25 | MDPL02510-R25 |
| 5⁄16 | 4 | 6¼ | 25 | MDPL03106-R25 |
| ⅜ | 4 | 6¼ | 25 | MDPL03706-R25 |
| | 10 | 12¼ | 25 | MDPL03712-R25 |
| ½ | 4 | 6¼ | 25 | MDPL05006-R25 |
| | 10 | 12¼ | 25 | MDPL05012-R25 |
| ⅝ | 6 | 8 | 20 | MDPL06208-R20 |


SDS-plus
Retail Packs

# SDS-plus® / SDS-max® Drill Bits

## SDS-plus Shank Bit

SDS-plus bits use an asymmetrical-parabolic flute for efficient energy transmission and dust removal.

### SDS-plus Shank Bits

| Diameter (in.) | Drilling Depth (in.) | Overall Length (in.) | Model No. |
|---|---|---|---|
| 5⁄32 | 2 | 4¼ | MDPL01504 |
| | 4 | 6¼ | MDPL01506 |
| 3⁄16 | 4 | 6¼ | MDPL01806 |
| | 6 | 8¼ | MDPL01808 |
| | 8 | 10 | MDPL01810 |
| | 10 | 12 | MDPL01812 |
| | 12 | 14 | MDPL01814 |
| 7⁄32 | 4 | 6¼ | MDPL02106 |
| | 6 | 8¼ | MDPL02108 |
| | 8 | 10 | MDPL02110 |
| | 14 | 16 | MDPL02116 |
| ¼ | 2 | 4¼ | MDPL02504 |
| | 4 | 6¼ | MDPL02506 |
| | 6 | 8¼ | MDPL02508 |
| | 8 | 10 | MDPL02510 |
| | 12 | 14 | MDPL02514 |
| | 14 | 16 | MDPL02516 |
| 5⁄16 | 4 | 6¼ | MDPL03106 |
| | 10 | 12 | MDPL03112 |
| ⅜ | 4 | 6¼ | MDPL03706 |
| | 8 | 10¼ | MDPL03710 |
| | 10 | 12¼ | MDPL03712 |
| | 16 | 18 | MDPL03718 |
| | 22 | 24 | MDPL03724 |
| 7⁄16 | 4 | 6¼ | MDPL04306 |
| | 10 | 12¼ | MDPL04312 |
| ½ | 4 | 6¼ | MDPL05006 |
| | 8 | 10¼ | MDPL05010 |
| | 10 | 12¼ | MDPL05012 |
| | 16 | 18 | MDPL05018 |
| | 22 | 24 | MDPL05024 |
| 9⁄16 | 4 | 6¼ | MDPL05606 |
| | 10 | 12¼ | MDPL05612 |
| | 16 | 18 | MDPL05618 |
| ⅝ | 6 | 8 | MDPL06208 |
| | 10 | 12 | MDPL06212 |
| | 16 | 18 | MDPL06218 |
| | 22 | 24 | MDPL06224 |
| 11⁄16 | 6 | 8 | MDPL06808 |
| ¾ | 6 | 8 | MDPL07508 |
| | 8 | 10 | MDPL07510 |
| | 10 | 12 | MDPL07512 |
| | 16 | 18 | MDPL07518 |
| | 22 | 24 | MDPL07524 |
| ⅞ | 6 | 8 | MDPL08708 |
| | 10 | 12¼ | MDPL08712 |
| | 16 | 18 | MDPL08718 |
| 1 | 8 | 10 | MDPL10010 |
| | 16 | 18 | MDPL10018 |

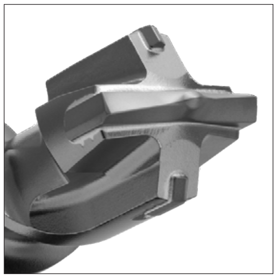
**SDS-plus Shank Bit**

### SDS-max and SDS-max Quad Head Shank Bits

| Diameter (in.) | Drilling Depth (in.) | Overall Length (in.) | Model No. |
|---|---|---|---|
| ⅜ | 7½ | 13 | MDMX03713 |
| ½ | 7½ | 13 | MDMX05013 |
| | 15½ | 21 | MDMX05021 |
| 9⁄16 | 7½ | 13 | MDMX05613 |
| | 15½ | 21 | MDMX05621 |
| ⅝ | 7½ | 13 | MDMX06213Q |
| | 15½ | 21 | MDMX06221Q |
| | 30½ | 36 | MDMX06236Q |
| 11⁄16 | 15½ | 21 | MDMX06821Q |
| ¾ | 8 | 13 | MDMX07513Q |
| | 17 | 21 | MDMX07521Q |
| | 31 | 36 | MDMX07536Q |
| 13⁄16 | 17 | 21 | MDMX08121Q |
| ⅞ | 8 | 13 | MDMX08713Q |
| | 17 | 21 | MDMX08721Q |
| 1 | 8 | 13 | MDMX10013Q |
| | 17 | 21 | MDMX10021Q |
| | 31 | 36 | MDMX10036Q |
| 1 1⁄16 | 18 | 23 | MDMX10623Q |
| 1⅛ | 12 | 17 | MDMX11217Q |
| | 17 | 21 | MDMX11221Q |
| | 31 | 36 | MDMX11236Q |
| 1¼ | 10 | 15 | MDMX12515Q |
| | 18 | 23 | MDMX12523Q |
| | 31 | 36 | MDMX12536Q |
| 1⅜ | 12 | 17 | MDMX13717Q |
| | 18 | 23 | MDMX13723Q |
| 1½ | 18 | 23 | MDMX15023Q |
| 1¾ | 18 | 23 | MDMX17523Q |
| 2 | 18 | 23 | MDMX20023Q |

Model numbers ending with "Q" denote Quad Head.

**SDS-max Shank Bit**



**Quad Head**
Model numbers ending with "Q" denote quad head bits.

SIMPSON Strong-Tie

# **Straight Shank** Drill Bits

### Straight Shank Bits

| Diameter (in.) | Drilling Depth (in.) | Overall Length (in.) | Model No. |
|---|---|---|---|
| ⅛ | 1⅜ | 3 | MDB01203 |
| 3/16 | 4 | 6 | MDB01806 |
| ¼ | 2⅛ | 4 | MDB02504 |
| | 4 | 6 | MDB02506 |
| | 10 | 12 | MDB02512 |
| 5/16 | 4 | 6 | MDB03106 |
| ⅜ | 4 | 6 | MDB03706 |
| | 10 | 12 | MDB03712 |
| 7/16 | 4 | 6 | MDB04306 |
| ½ | 4 | 6 | MDB05006 |
| | 10 | 12 | MDB05012 |
| ⅝ | 3½ | 6 | MDB06206 |
| ¾ | 4 | 6 | MDB07506 |

Straight Shank Bit

### Straight Shank Bits — Retail Packs

| Diameter (in.) | Drilling Depth (in.) | Overall Length (in.) | Quantity (per pack) | Model No. |
|---|---|---|---|---|
| 3/16 | 4 | 6 | 25 | MDB01806-R25 |
| ¼ | 2⅛ | 4 | 25 | MDB02504-R25 |
| | 4 | 6 | 25 | MDB02506-R25 |
| 5/16 | 4 | 6 | 25 | MDB03106-R25 |
| ⅜ | 4 | 6 | 25 | MDB03706-R25 |
| ½ | 4 | 6 | 25 | MDB05006-R25 |

Straight Shank Bits Retail Packs

### Straight Shank Bits — Retail Carded Packs

| Size (in.) | 1-Count Carded Pack | | 4-Count Carded Pack | |
|---|---|---|---|---|
| | Qty. Packs per Carton | Model No. | Qty. Packs per Carton | Model No. |
| 5/32 x 3½ | 10 | MDB15312C1 | | — |
| 5/32 x 4½ | 10 | MDB15412C1 | 10 | MDB15412C4 |
| 5/32 x 5½ | 10 | MDB15512C1 | | — |
| 3/16 x 3½ | 10 | MDB18312C1 | | — |
| 3/16 x 4½ | 10 | MDB18412C1 | 10 | MDB18412C4 |
| 3/16 x 5½ | 10 | MDB18512C1 | | — |

Straight Shank Bits Retail Carded Packs

# Core Bits

Simpson Strong-Tie core bits are made to the same exacting standards as our standard carbide-tipped drill bits. They utilize a centering bit to facilitate accurate drilling in combination hammer/drill mode.

### Core Bits with Centering Bit — SDS-max® Shank

| Diameter (in.) | Drilling Depth (in.) | Overall Length (in.) | Model No. |
|---|---|---|---|
| 2 | 6¼ | 22 | CBMX20022 |
| 2⅝ | 6¼ | 22 | CBMX26222 |
| 3⅛ | 6¼ | 22 | CBMX31222 |
| 3½ | 6¼ | 22 | CBMX35022 |
| 4 | 6¼ | 22 | CBMX40022 |
| 5 | 6¼ | 22 | CBMX50022 |

**Note:** With 1-piece bits, once coring is begun, the centering bit must be removed using ejector pin. Core bit bodies are 2-11/16" deep.

Core Bit Transfers Energy Efficiently

Core Bit Center Pilot Bit (CTRBTF04304)

Ejector Key (CDBEJKEY)

# Demolition Bits



## Flat Chisels

General Concrete and Masonry Demolition

| Shank Type | Head Width (in.) | Overall Length (in.) | Model No. |
|---|---|---|---|
| SDS-max® | 1 | 12 | CHMXF10012 |
| | 1 | 18 | CHMXF10018 |
| Spline | 1 | 12 | CHSPF10012 |
| | 1 | 18 | CHSPF10018 |

Flat Chisel

## Bull-Point Chisels

General Concrete and Masonry Demolition

| Shank Type | Overall Length (in.) | Model No. |
|---|---|---|
| SDS-plus® | 10 | CHPLBP10 |
| SDS-max | 12 | CHMXBP12 |
| | 18 | CHMXBP18 |
| Spline | 12 | CHSPBP12 |
| | 18 | CHSPBP18 |

Bull-Point Chisel

## Asphalt Cutters

Asphalt, Hardpan and Compacted Soil Cutting

| Shank Type | Head Width (in.) | Overall Length (in.) | Model No. |
|---|---|---|---|
| SDS-max | 3½ | 16 | CHMXAC35016 |

Asphalt Cutter

## Ground Rod Drivers

Driving in Ground Rods

| Shank Type | Head Width (in.) | Overall Length (in.) | Model No. |
|---|---|---|---|
| SDS-max | ⅞ | 10¼ | CHMXRD08710 |
| Spline | ⅞ | 10¼ | CHSPRD08710 |

Ground Rod Driver

## Scrapers

Removing Tiles, Flooring and Other Materials

| Shank Type | Head Width (in.) | Overall Length (in.) | Model No. |
|---|---|---|---|
| SDS-plus | ¾ | 10 | CHPLF07510 |
| | 1½ | 10 | CHPLSC15010 |
| SDS-max | 2 | 12 | CHMXSCP20012 |
| Spline | 2 | 12 | CHSPSCP20012 |

Scraper

## Scalers

Removing Large Quantities of Material

| Shank Type | Head Width (in.) | Overall Length (in.) | Model No. |
|---|---|---|---|
| SDS-max | 1½ | 12 | CHMXSC15012 |
| | 2 | 12 | CHMXSC20012 |
| | 3 | 12 | CHMXSC30012 |
| Spline | 2 | 12 | CHSPSC20012 |
| | 3 | 12 | CHSPSC30012 |

Scaler

## Bushing Tools One Piece

Concrete and Asphalt Surface Roughening

| Shank Type | Head Width (in.) | Overall Length (in.) | Model No. |
|---|---|---|---|
| SDS-max | 1¾ | 9½ | CHMXBT17509 |
| Spline | 1¾ | 9¼ | CHSPBT17509 |

Bushing Tool Head

For additional carbide product availability, visit **strongtie.com** or see the current product guide (S-A-PG).

# Appendix

# Supplemental Topics for Anchors

I. Anchor Products for Corrosive Environments . . . . . . . . . . . . . . . . . . . . . . . . . 228–233

II. Base Materials . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 234

III. Anchor Failure Modes . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 234–235

IV. Corrosion Resistance. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 235–236

V. Mechanical Anchors . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .237

VI. Adhesive Anchors . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 238–243

# I. Anchor Products for Corrosive Environments

## Trusted quality, code approved and innovative stainless-steel anchors that can be installed in exterior and corrosive environments.

When it comes to anchorage, specifying a material that can withstand the environment is critical. Proper protection comes from materials that are capable of resisting corrosion while maintaining their strength.

Most anchor products are made from carbon steel. This material is easy to form into a screw or an expansion anchor and can be heat treated to increase its strength and durability. Steel is versatile but can weaken in a corrosive environment. Left unprotected, the iron in the steel will react with oxygen and moisture to form iron oxide — also known as rust.

## Environments

There are four levels of corrosive environments (as shown below).

### Minimum Corrosion Resistance Recommendations

| Corrosion Resistance Classification by Environment | Recommended Product Material or Coating |
|---|---|
| Low | Zinc plated |
| Medium | Mechanically galvanized (ASTM B695 — Class 55) |
| | Hot-dip galvanized (ASTM A153 — Class C) |
| High | Type 303 or 304 stainless steel |
| Severe | Type 316 stainless steel |

Appendix

# Quick Guide to Choosing the Right Stainless-Steel Grade

## High to Severe

A highly corrosive environment is a location where anchors are exposed to chemicals such as fertilizers, soil, acid rain and other corrosive elements. Examples of these environments include kitchens, industrial zones, food-processing facilities, wineries, breweries, outdoor facilities and severe exterior conditions.

Typical high-corrosive environment — central utility plants.

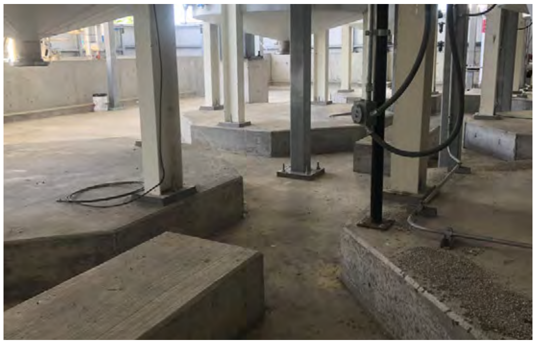
Typical high-corrosive environment — food-processing plants.

Typical severe-corrosive environment — wastewater treatment plants.

## Medium

A medium-level corrosive environment is typically a general exterior location where chlorides or corrosive chemical elements are not present. Anchors installed in interior conditions where the anchor is attaching to treated lumber may also require a medium-level corrosive-resistive anchor. Examples of elements at risk to medium-exposure corrosion are stadium seating, exterior handrails, exterior facade anchorages and other components of outdoor facilities.

Typical medium-corrosive environment — outdoor seating.



Typical medium-corrosive environment — exterior anchorage.

## Low

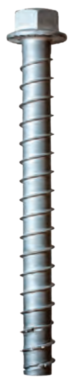
Finally, low-corrosive environments consist of interior dry spaces. Examples of such applications are warehouse racking, machinery installations, facility catwalk anchorage, interior furniture anchorages and so forth.

Typical low-corrosive environment — interior warehouse.

# Supplemental Topics for Anchors

Types 304, 316 and 410 stainless-steel products for your job.

| Anchor — Stainless-Steel Products | Type 304 | Type 316 | Type 410 |
|---|---|---|---|
| Drop-In (DIA) internally threaded anchor | ✓ | ✓ | |
| Sleeve-All® sleeve anchor | ✓ | | |
| Stainless-steel Titen HD® heavy-duty screw anchor | ✓ | ✓ | |
| Strong-Bolt® 2 stainless-steel wedge anchor | ✓ | ✓ | |
| Titen® stainless-steel concrete and masonry screw | | | ✓ |



**Stainless-Steel Titen HD**
Heavy-Duty Screw Anchor

**Stainless-Steel Titen HD Countersunk**
Heavy-Duty Screw Anchor

**Strong-Bolt 2**
Stainless-Steel Wedge Anchor

**Sleeve-All**
Sleeve Anchor

**Drop-In (DIA)**
Internally Threaded Anchor

**Stainless-Steel Titen**
Concrete and Masonry Screw

# Concrete Adhesives for Stainless-Steel Threaded Rod


## SET-3G™
### High-Strength Epoxy Adhesive

- Installs in dry, water-saturated, submerged or water-filled holes in base materials with temperatures between 40°F and 100°F
- NSF/ANSI standard 61 approved


## ET-3G™
### Epoxy Adhesive

- Ideal for general doweling and threaded rod application
- NSF/ANSI standard 61 approved


## AT-3G™
### High-Strength Hybrid Acrylic Adhesive

- Can be used in cold temperatures as low as 23°F
- NSF/ANSI standard 61 approved

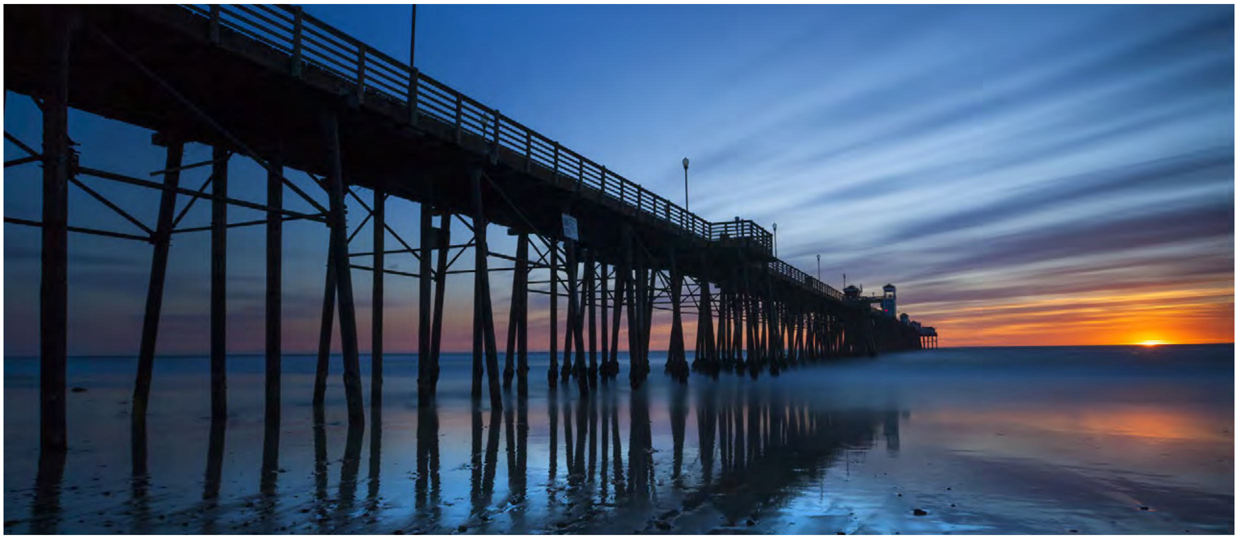
| Adhesive Anchor — Stainless Steel Rods | ASTM A193, Grade B8 and B8M (Types 304 and 316) | ASTM A593 CW (Types 304 and 316) | ASTM A193, Grade B6 (Type 410) |
|---|---|---|---|
| SET-3G | ✓ | ✓ | ✓ |
| ET-3G | ✓ | | ✓ |
| AT-3G | ✓ | | |

## When designing strong and durable anchorage solutions for high and severe corrosive environments, the two most commonly considered materials are Types 304 and 316 stainless steel.

Type 300 Series stainless-steel screw anchors have different corrosion-resistant properties for different environments. When matched to the appropriate environment and application, anchors made from Type 300 Series stainless steel will resist the effects of corrosion and maintain their strength and integrity. Type 316 is the optimal choice for applications in severe corrosive or extreme environments such as salt water, or when chemical or corrosive solutions are present. Type 304 is a cost-effective solution for high corrosive applications where the environment may be wet, moist or damp.

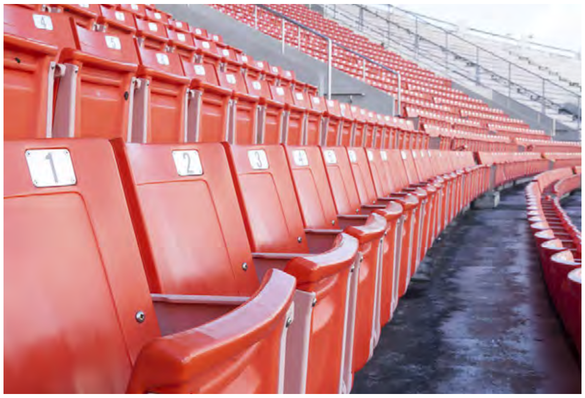
## Type 316 Stainless Steel

- Wastewater treatment
- Fertilizer storage buildings
- Sill plates in coastal environments
- Marine/port restoration
- Light rail (transportation)
- Agricultural facilities
- Pulp and paper mills
- Parking structures
- Tunnels
- Balconies in coastal environments
- Outdoor railings in coastal environments



# Type 304 Stainless Steel

- Stadium seating
- Curtain walls
- Clean rooms
- Central utility plant facilities
- Food-processing facilities
- Ledger bolts for decks
- DOT signs and fixtures
- Cooling towers
- Scaffolding
- Parking structures
- Balconies
- Refineries
- Breweries and wineries
- Fencing
- Outdoor railings



# II. Base Materials

"Base material" is a generic industry term that refers to the element or substrate to be anchored to. Base materials include concrete, brick, concrete block (CMU) and structural tile, to name a few. The most common type of base material where adhesive and mechanical anchors are used is concrete.

## Concrete

Concrete can be cast-in-place or precast concrete. Concrete has excellent compressive strength, but relatively low tensile strength. Cast-in-place (or sometimes called "poured in place") concrete is placed in forms erected on the building site. Cast-in-place concrete can be either normal-weight or lightweight concrete. Lightweight concrete is often specified when it is desirable to reduce the weight of the building structure.

Lightweight concrete differs from normal-weight concrete by the weight of aggregate used in the mixture. Normal-weight concrete has a unit weight of approximately 150 pounds per cubic foot compared to approximately 115 pounds per cubic foot for lightweight concrete.

The type of aggregate used in concrete can affect the tension capacity of an adhesive anchor. Presently, the relationship between aggregate properties and anchor performance is not well understood. Test results should not be assumed to be representative of expected performance in all types of concrete aggregate.

Prefabricated concrete is also referred to as "precast concrete". Precast concrete can be made at a prefabricating plant or site-cast in forms constructed on the job. Precast concrete members may be solid or may contain hollow cores. Many precast components have thinner cross sections than cast in place concrete. Precast concrete may use either normal or lightweight concrete. Reinforced concrete contains steel bars, cable, wire mesh or random glass fibers. The addition of reinforcing material enables concrete to resist tensile stresses which lead to cracking.

The compressive strength of concrete can range from 2,000 psi to over 12,000 psi, depending on the mixture and how it is cured. Most concrete mixes are designed to obtain the desired properties within 28 days after being cast.

## Concrete Masonry Units (CMU)

Block is typically formed with large hollow cores. Block with a minimum 75% solid cross section is called solid block even though it contains hollow cores. In many parts of the country building codes require steel reinforcing bars to be placed in the hollow cores, and the cores to be filled solid with grout.

In some areas of the eastern United States, past practice was to mix concrete with coal cinders to make cinder blocks. Although cinder blocks are no longer made, there are many existing buildings where they can be found. Cinder blocks require special attention as they soften with age.

## Brick

Clay brick is formed solid or with hollow cores. The use of either type will vary in different parts of the United States. Brick can be difficult to drill and anchor into. Most brick is hard and brittle. Old, red clay brick is often very soft and is easily over-drilled. Either of these situations can cause problems in drilling and anchoring. The most common use of brick today is for building facades (curtain wall or brick veneer) and not for structural applications. Brick facade is attached to the structure by the use of brick ties spaced at intervals throughout the wall. In older buildings, multiple widths, or "wythes" of solid brick were used to form the structural walls. Three and four wythe walls were common wall thicknesses.

## Clay Tile

Clay tile block is formed with hollow cores and narrow cavity wall cross sections. Clay tile is very brittle, making drilling difficult without breaking the block. Caution must be used in attempting to drill and fasten into clay tile.

# III. Anchor Failure Modes

Four different tension failure modes and three different shear failure modes are generally observed for post-installed anchors under tension loading.

Failure Modes

| Tension | Shear |
|---|---|
| Steel Fracture<br>Concrete Breakout<br>Pullout (Mechanical Anchor)<br>Bond Failure (Adhesive Anchor) | Steel Fracture<br>Concrete Breakout<br>Pryout |

**Breakout Failure** — Breakout failure occurs when the base material ruptures, often producing a cone-shaped failure surface when anchors are located away from edges, or producing a spall when anchors are located near edges. Breakout failure can occur for both mechanical and adhesive anchors and is generally observed at shallower embedment depths, and for installations at less than critical spacings or edge distances.

**Pullout Failure** — Pullout failure occurs when a mechanical anchor pulls out of the drilled hole, leaving the base material otherwise largely intact.

**Bond Failure** — Bond failure occurs when an adhesive anchor pulls out of the drilled hole due to an adhesion failure at the adhesive-to-base-material interface, or when there is a cohesive failure within the adhesive itself. When bond failure occurs, a shallow cone-shaped breakout failure surface will often form near the base material surface. This breakout surface is not the primary failure mechanism.

**Pryout Failure** — Pryout failure occurs for shallowly embedded anchors when a base material failure surface is pried out "behind" the anchor, opposite the direction of the applied shear force.

**Steel Fracture** — Steel fracture occurs when anchor spacings, edge distances and embedment depths are great enough to prevent the base-material–related failure modes listed above and the steel strength of the mechanical anchor or adhesive anchor insert is the limiting strength.

# IV. Corrosion Resistance

Many environments and materials can cause corrosion, including ocean salt air, fire-retardants, fumes, fertilizers, preservative-treated wood, de-icing salts, dissimilar metals and more. Metal fixtures, fasteners and anchors can corrode and lose load-carrying capacity when installed in corrosive environments or when installed in contact with corrosive materials.

The many variables present in a building environment make it impossible to accurately predict if, or when, corrosion will begin or reach a critical level. This relative uncertainty makes it crucial that specifiers and users are knowledgeable about the potential risks and select a product suitable for the intended use. It is also prudent that regular maintenance and periodic inspections are performed, especially for outdoor applications.

It is common to see some corrosion in outdoor applications. Even stainless steel can corrode. The presence of some corrosion does not mean that load capacity has been affected or that failure is imminent. If significant corrosion is apparent or suspected, then the fixtures, fasteners and connectors should be inspected by a qualified engineer or qualified inspector. Replacement of affected components may be appropriate.

## Chemical Attack

Chemical attack occurs when the anchor material is not resistant to a substance with which it is in contact. Chemical-resistant information regarding anchoring adhesives is found on pp. 242–243. Some wood-preservative chemicals and fire-retardant chemicals and retentions pose increased corrosion potential and are more corrosive to steel anchors and fasteners than others. Additional information on this subject is available at **strongtie.com**.

We have attempted to provide basic knowledge on the subject of corrosion here, but it is important to fully educate yourself by reviewing our technical bulletins on the topic (**strongtie.com/info**) and also by reviewing information, literature and evaluation reports published by others.

## Galvanic Corrosion

Galvanic corrosion occurs when two electrochemically dissimilar metals contact each other in the presence of an electrolyte (such as water) that acts as a conductive path for metal ions to move from the more anodic to the more cathodic metal. In the galvanic couple, the more anodic metal will corrode preferentially. The Galvanic Series of Metals table provides a qualitative guide to the potential for two metals to interact galvanically. Metals in the same group (see table) have similar electrochemical potentials. The farther the metals are apart on the table, the greater the difference in electrochemical potential, and the more rapidly galvanic corrosion will occur. Corrosion also increases with increasing conductivity of the electrolyte.

Good detailing practice, including the following, can help reduce the possibility of galvanic corrosion of anchors:

- Use of anchors and metals with similar electrochemical potentials
- Separating dissimilar metals with insulating materials
- Ensuring that the anchor is the cathode, when dissimilar materials are present
- Preventing exposure to and pooling of electrolytes.

Galvanic Series of Metals

| Corroded End (Anode) |
|---|
| Magnesium<br>Magnesium alloys<br>Zinc |
| Aluminum 1100<br>Cadmium<br>Aluminum 2024-T4<br>Iron and Steel |
| Lead<br>Tin<br>Nickel (active)<br>Inconel Ni-Cr alloy (active)<br>Hastelloy alloy C (active) |
| Brasses<br>Copper<br>Cu-Ni alloys<br>Monel |
| Nickel (passive) |
| 304 stainless steel (passive)<br>316 stainless steel (passive)<br>Hasteloy alloy C (passive) |
| Silver<br>Titanium<br>Graphite<br>Gold<br>Platinum |
| Protected End (Cathode) |

## Hydrogen-Assisted Stress-Corrosion Cracking

Some hardened fasteners may experience premature failure if exposed to moisture as a result of hydrogen-assisted stress-corrosion cracking. These fasteners are recommended specifically for use in dry, interior locations.

# Supplemental Topics for Anchors

## Guidelines for Selecting Corrosion-Resistant Anchors and Fasteners

**Evaluate the Application**
Consider the importance of the connection.

**Evaluate the Exposure**
Consider these moisture and treatment chemical exposure conditions:

- **Dry Service:** Generally INTERIOR applications and includes wall and ceiling cavities, raised floor applications in enclosed buildings that have been designed to prevent condensation and exposure to other sources of moisture. Prolonged exposure during construction should also be considered, as this may constitute a Wet Service or Elevated Service Condition.
- **Wet Service:** Generally EXTERIOR construction in conditions other than Elevated Service. These include Exterior Protected and Exposed and General Use Ground Contact as described by the AWPA UC4A.
- **Elevated Service:** Includes fumes, fertilizers, soil, some preservative-treated wood (AWPA UC4B and UC4C), industrial zones, acid rain and other corrosive elements.
- **Uncertain:** Unknown exposure, materials or treatment chemicals.
- **Ocean/Water Front:** Marine environments that include airborne chlorides and some splash. Environments with de-icing salts are included.
- **Treatment Chemicals:** See AWPA Use Category Designations. The preservative-treated wood supplier should provide all of the pertinent information about the wood being used. The information should include Use Category Designation, wood species group, wood treatment chemical and chemical retention. See appropriate evaluation reports for corrosion effects of treatment chemicals and fastener corrosion resistance recommendations.

**Use the Simpson Strong-Tie Corrosion Classification Table**
If the treatment chemical information is incomplete, Simpson Strong-Tie recommends the use of a Type 300 Series stainless-steel product. Also if the treatment chemical is not shown in the Corrosion Classification Table, then Simpson Strong-Tie has not evaluated it and cannot make any recommendations other than the use of coatings and materials in the Severe category. Manufacturers may independently provide test results of other product information; Simpson Strong-Tie expresses no opinion regarding such information.

### Minimum Corrosion Resistance Recommendations

| Corrosion Resistance Classification | Material or Coating |
|---|---|
| Low | ZN |
| | Zinc plated |
| Medium | Zinc plating with baked-on ceramic coating |
| | Mechanically galvanized (ASTM B695 – Class 65) |
| | Mechanically galvanized (ASTM B695 – Class 55) |
| | Hot-dip galvanized (ASTM A153 – Class C) |
| | Type 410 stainless steel with protective top coat |
| High | Type 303 or 304 stainless steel |
| Severe | Type 316 stainless steel |

### Corrosion Resistance Classifications

| Environment | Material to Be Fastened | | | | | | |
|---|---|---|---|---|---|---|---|
| | Untreated Wood or Other Material | Preservative-Treated Wood | | | | | Fire-Retardant-Treated Wood |
| | | SBX-DOT Zinc Borate | Chemical Retention ≤ AWPA, UC4A | Chemical Retention > AWPA, UC4A | ACZA | Other or Uncertain | |
| Dry Service | Low | Low | Low | High | Medium | High | Medium |
| Wet Service | Medium | N/A | Medium | High | High | High | High |
| Elevated Service | High | N/A | Severe | Severe | High | Severe | N/A |
| Uncertain | High | High | High | Severe | High | Severe | Severe |
| Ocean/Waterfront | Severe | N/A | Severe | Severe | Severe | Severe | N/A |

1. These are general guidelines that may not consider all application criteria. Refer to product-specific information for additional guidance.
2. Type 316/305/304 stainless-steel products are recommended where preservative-treated wood used in ground contact has chemical retention level greater than those for AWPA UC4A; CA-C, 0.15 pcf; CA-B, 0.21 pcf; micronized CA-C, 0.14 pcf; micronized CA-B, 0.15 pcf; ACQ-Type D (or C), 0.40 pcf.
3. Testing by Simpson Strong-Tie following ICC-ES AC257 showed that mechanical galvanization (ASTM B695, Class 55), Quik Guard coating, and Double Barrier coating will provide corrosion resistance equivalent to hot-dip galvanization (ASTM A153, Class D) in contact with chemically-treated wood in dry service and wet service exposures (AWPA UC1 – UC4A, ICC-ES AC257 Exposure Conditions 1 and 3) and will perform adequately subject to regular maintenance and periodic inspection.
4. Mechanical galvanizations C3 and N2000 should not be used in conditions that would be more corrosive than AWPA UC3A (exterior, aboveground, rapid water runoff).
5. If uncertain about Use Category, treatment chemical, or environment, use Types 316/305/304 stainless steel, silicon bronze or copper fasteners.
6. Some treated wood may have excess surface chemicals making it potentially more corrosive than lower retentions. If this condition is suspected, use Types 316/305/304 stainless steel, silicon bronze or copper fasteners.
7. Types 316/305/304 stainless steel, silicon bronze or copper fasteners are the best recommendation for ocean salt-air and other chloride-containing environments. Hot-dip galvanized fasteners with at least ASTM A153, Class C protection can also be an alternate for some applications in environments with ocean air and/or elevated wood moisture content.

# V. Mechanical Anchors

## Pre-Load Relaxation

Expansion anchors that have been set to the required installation torque in concrete will experience a reduction in pre-tension (due to torque) within several hours. This is known as pre-load relaxation. The high compression stresses placed on the concrete cause it to deform which results in a relaxation of the pre-tension force in the anchor. Tension in this context refers to the internal stresses induced in the anchor as a result of applied torque and does not refer to anchor capacity. Historical data shows it is normal for the initial tension values to decrease by as much as 40–60% within the first few hours after installation. Retorquing the anchor to the initial installation torque is not recommended or necessary.

## Anchors Adjacent to Abandoned Holes

Testing was performed on various anchor types including drop-in anchors, wedge-type anchors, screw anchors, and adhesive anchors adjacent to holes that have been abaondoned. Nominal anchor diameters of ¾ in. and smaller were included as part of this test program. The distance between the installed anchor and the abandoned hole(s) was measured as the center of the anchor to the center of the abandoned hole, as shown as distance "L" in Figure 1. The minimum distance "L" examined in these tests was two times the drilled hole diameter, "d." Figure 1: Example of Installed Anchor Adjacent to Abandoned Hole Based on the results of this test program, Simpson Strong-Tie suggests the following guidelines for tension performance of anchors near abandoned holes:

1. Anchors should not be installed closer than two times the drilled hole diameter (2d) away from an abandoned hole.
2. Anchors that are more than two inches away from abandoned holes do not require a reduction in capacity.
3. Expansion anchors, such as drop-in and wedge-type anchors, that are more than two times the drilled hole diameter (2d), but less than two inches from abandoned holes, should have a factor of 0.80 applied to their calculated tension capacity.
4. Concrete screws and adhesive anchors that are more than two times the drilled hole diameter (2d), but less than two inches from abandoned holes, should have a factor of 0.90 applied to their calculated tension capacity.
5. Where abandoned holes have been filled with a non-expansive grout or anchoring adhesive and allowed to completely cure, no reduction is necessary for anchors installed more than two times the drilled hole diameter (2d) away from the filled holes.

### Summary of Capacity Reductions Due to Abandoned Holes

| Anchor Type | Abandoned Hole Distance | Capacity Adjustment Factor |
|---|---|---|
| All types tested | L > 2" | 1.0 |
| Expansion anchors | 2d < L ≤ 2" | 0.8 |
| Concrete screws and adhesive anchors | 2d < L ≤ 2" | 0.9 |
| All types tested, with abadoned holes refilled as noted on item 5 above | L ≥ 2d | 1.0 |

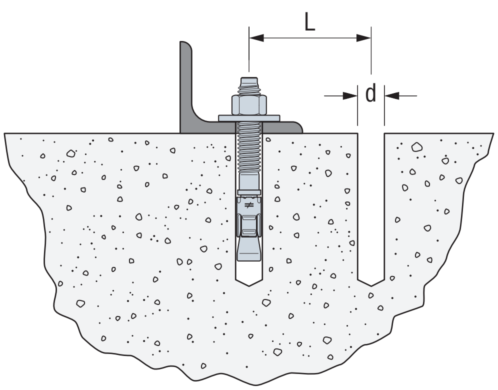



**Figure 1**
Example of Installed Anchor Adjacent to Abandoned Hole

# VI. Adhesive Anchors

## Installation into Green Concrete

The strength design data for adhesive anchors in this catalog are based on installations into concrete that is at least 21 days old. For anchors installed into concrete that has cured for less than 21 days, refer to the following modification factors that should be applied to the published adhesive bond strength.

| Products | Concrete Age When Installed | Concrete Age When Loaded | Bond Strength Factor |
|---|---|---|---|
| SET-3G<br>ET-3G<br>AT-3G | 14 days | 21 days | 1.0 |
| | | 14 days | 0.9 |
| | 7 days | 21 days | 1.0 |
| | | 7 days | 0.7 |

## Oversized Holes

The performance data for adhesive anchors are based upon anchor tests in which holes were drilled with carbide-tipped drill bits of the same diameter listed in the product's load table. Additional static tension tests were conducted to qualify anchors installed with SET-3G™, ET-3G™ and AT-3G™ adhesives for installation in holes with diameters larger than those listed in the load tables. The tables below indicate the acceptable range of drilled hole sizes and the corresponding tension-load reduction factor (if any). The same conclusions also apply to the published shear load values. Drilled holes outside of the accepted range shown in the charts are not recommended.

### SET-3G Adhesive — Acceptable Hole Diameter

| Insert Diameter (in.) | Acceptable Hole Diameter Range (in.) | Acceptable Load Reduction Factor |
|---|---|---|
| ½ | 9⁄16–¾ | 1.0 |
| ⅝ | 11⁄16–⅞ | 1.0 |
| ¾ | ⅞–1 | 1.0 |
| ⅞ | 1–1⅛ | 1.0 |
| 1 | 1⅛–1¼ | 1.0 |
| 1¼ | 1⅜–1½ | 1.0 |

### ET-3G Adhesive — Acceptable Hole Diameter

| Insert Diameter (in.) | Acceptable Hole Diameter Range (in.) | Acceptable Load Reduction Factor |
|---|---|---|
| ½ | ⅝–¾ | 1.0 |
| ⅝ | ¾–15⁄16 | 1.0 |
| ¾ | ⅞–1⅛ | 1.0 |
| ⅞ | 1–15⁄16 | 1.0 |
| 1 | 1⅛–1½ | 1.0 |
| 1¼ | 1⅜–1⅞ | 1.0 |

### AT-3G Adhesive — Acceptable Hole Diameter

| Insert Diameter (in.) | Acceptable Hole Diameter Range (in.) | Acceptable Load Reduction Factor |
|---|---|---|
| ⅜ | 7⁄16–½ | 1.0 |
| ½ | 9⁄16–⅝ | 1.0 |
| ⅝ | 11⁄16–¾ | 1.0 |

## Core-Drilled Holes

The performance data for adhesive anchors are based upon anchor tests in which holes were drilled with carbide-tipped drill bits. Additional static tension tests were conducted to qualify anchors installed with SET-3G™, ET-3G™ and AT-3G™ anchoring adhesives for installation in holes drilled with diamond-core bits. In these tests, the diameter of the diamond-core bit matched the diameter of the carbide-tipped drill bit recommended in the product's load table. SET-3G, ET-3G and AT-3G anchoring adhesives require a reduction factor of 0.7 be applied to the characteristic uncracked concrete bond strength ($\tau_k$). The same conclusions also apply to the published allowable shear loads. Tests conducted in core-drilled holes are for non-IBC jurisdictions.

## Installation in Damp, Wet and Submerged Environments

### SET-3G, ET-3G and AT-3G

The performance data for adhesive anchors using SET-3G, ET-3G and AT-3G adhesives are based upon tests according to ICC-ES AC308. This criteria requires adhesive anchors that are to be installed in outdoor environments to be tested in water-saturated concrete holes that have been cleaned with less than the amount of hole cleaning recommended by the manufacturer. A product's sensitivity to this installation condition is considered in determining the product's "Anchor Category" (strength reduction factor).

**ET-3G may be installed in dry or water-saturated concrete.**

**AT-3G may be installed in dry, water-saturated or water-filled holes in concrete.**

**SET-3G may be installed in dry, water-saturated and submerged concrete, or water-filled holes in concrete.**

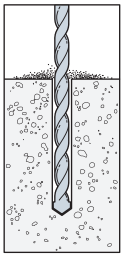
**Reliability Testing per ICC-ES AC308 is defined as:**

- Dry Concrete — Cured concrete whose moisture content is in equilibrium with surrounding non-precipitate atmospheric conditions.
- Water-Saturated Concrete — Concrete that has been exposed to water over a sufficient length of time to have the maximum possible amount of absorbed water into concrete pores to a depth equal to the anchor embedment.
- Submerged Concrete — Water-saturated concrete that is fully submerged at the time of hole drilling and anchor installation.
- Water-Filled Hole — Drilled hole in water-saturated concrete that is clean yet contains standing water at the time of installation.

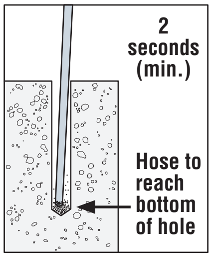
## Use of Vacuum in Lieu of Compressed Air

Based on tension tests conducted by Simpson Strong-Tie at our ISO 17025-accredited laboratory, it has been determined that holes for SET-3G™, ET-3G™ and AT-3G™ anchors may alternatively be cleared of concrete dust using a vacuum in place of compressed air. Note that the hose of the vacuum must be capable of reaching the bottom of the hole during vacuuming, similar to the compressed air nozzle. Additionally, the specified time duration for vacuuming must be the same as the time duration specified for compressed air. Lastly, the drilled holes must be brushed as is noted in the applicable evaluation reports. Please see the installation illustrations below for further details.

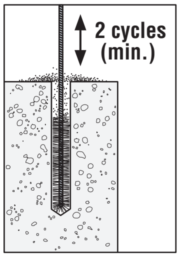
### **Hole Preparation —** Horizontal, Vertical and Overhead Applications (SET-3G and AT-3G)



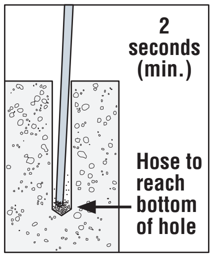
**1. Drill.** Drill hole to specified diameter and depth.




**2. Vacuum.** Remove dust from hole with vacuum for a minimum of two seconds. Vacuum hose must reach bottom of the hole.



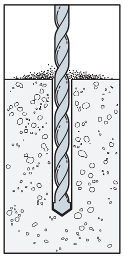

**3. Brush.** Clean with a steel wire brush for a minimum of two cycles. Brush should provide resistance to insertion. If no resistance is felt, the brush is worn and must be replaced.



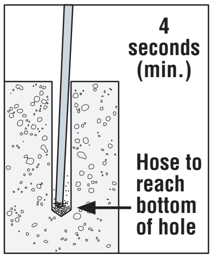

**4. Vacuum.** Remove dust from hole with vacuum for a minimum of two seconds. Vacuum hose must reach bottom of the hole.

Visit **strongtie.com** for proper brush part number.

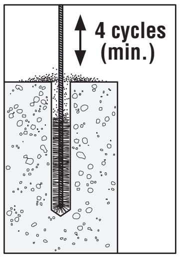
### **Hole Preparation —** Horizontal, Vertical and Overhead Applications (ET-3G)



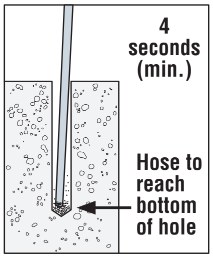
**1. Drill.** Drill hole to specified diameter and depth.




**2. Vacuum.** Remove dust from hole with vacuum for a minimum of four seconds. Vacuum hose must reach bottom of the hole.




**3. Brush.** Clean with a nylon brush for a minimum of four cycles. Brush should provide resistance to insertion. If no resistance is felt, the brush is worn and must be replaced.




**4. Vacuum.** Remove dust from hole with vacuum for a minimum of four seconds. Vacuum hose must reach bottom of the hole.

Visit **strongtie.com** for proper brush part number.

## AT-3G™ High-Strength Hybrid Acrylic Adhesive Installed at 0°F (−18°C)

The evaluation report for AT-3G adhesive (ICC-ES ESR-5026) specifies the concrete temperatures that are permitted during anchor installation, along with the corresponding gel times.

Based on the testing conducted by an independent testing and evaluation agency, the bond strength ($\tau_K$) published in the evaluation report shall be multiplied by a factor of 0.70 for installation temperatures that range between 0°F and 23°F (–18°C and –5°C).

The table below highlights the gel time and cure time associated with concrete temperatures between 0°F and 23°F (–18°C and –5°C). Installation instructions noted on the AT-3G cartridge label shall be followed.

### AT-3G Cure Schedule

| Concrete Temperature Range | | Gel Time (minutes) | Cure Time (hr.) |
|---|---|---|---|
| °F | °C | | |
| 0 to 23 | –18 to –5 | 75 | 24 |

It is noted that the temperature of the AT-3G cartridge shall be at least 65°F (18°C) when used for anchor installations into concrete that is between 0°F and 23°F (–18°C and –5°C).

## Epoxy-Coated Reinforcing Bar Installed with SET-3G™, ET-3G™ and AT-3G Anchoring Adhesives into Cracked and Uncracked Concrete.

***(For Anchorage Design in Accordance with ACI 318-19 Chapter 17 / ACI 318-14 Chapter 17 / ACI 318-11 Appendix D)***

The evaluation reports for SET-3G (ICC-ES ESR-4057), ET-3G (ICC-ES ESR-FPO) and AT-3G (ICC-ES ESR-5026) present the characteristic bond strength of the adhesives for uncoated reinforcing bar (rebar) installations in concrete. These values are based on testing in accordance with ACI 355.4 and the values are to be used in conjunction with ACI 318 Anchoring to Concrete provisions.

Based on testing conducted by Simpson Strong-Tie at our IAS accredited laboratory (accreditation number TL-284), it has been determined that SET-3G, ET-3G and AT-3G adhesives may be used with epoxy-coated rebar when a factor of 0.85 is applied to the published characteristic bond strength ($\tau_K$) published in the evaluation report for uncoated rebar.

## Chemical Resistance of Adhesive Anchors

- Samples of Simpson Strong-Tie anchoring adhesives were immersed in the chemicals shown here until they exhibited minimal weight change (indicating saturation) or for a maximum of three months.
- The samples were then tested according to ASTM D543 Standard Practices for Evaluating the Resistance of Plastics to Chemical Changes, Procedures I & II, and either ASTM D790 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials or ASTM D695 Standard Test Method for Compressive Properties of Rigid Plastics.
- In cases where mild chemicals were evaluated, the exposure was accelerated per ASTM D3045 Standard Practice for Heat Aging of Plastics Without Load.
- Samples showing no visible damage and demonstrating statistically equivalent strength and elastic modulus as compared to control samples were classified as **"Resistant" (R)**.
  - These adhesives are considered suitable for continuous exposure to the identified chemical when used as a part of an adhesive anchor assembly.
- Samples exhibiting slight damage, such as swelling or crazing, or not demonstrating both statistically equivalent strength and elastic modulus as compared to control samples were classified a **"Non-Resistant" (NR)**.
  - These adhesives are considered suitable for periodic exposure to the identified chemical if the chemical will be diluted and washed away from the adhesive anchor assembly after exposure, or if only emergency contact with the chemical is expected and subsequent replacement of the anchor would be undertaken.
  - Some manufacturers refer to this as "limited resistance" or "partial resistance" in their literature.
- Samples that were completely destroyed by the chemical, or that demonstrated a significant loss in strength after exposure were classified as **"Failed" (F)**.
  - These adhesives are considered unsuitable for exposure to the identified chemical.

**Note:** In most actual service conditions, the majority of the anchoring adhesive is not exposed to the chemical and thus some period of time is required for the chemical to saturate the entire adhesive. An adhesive anchor would be expected to maintain bond strength and creep resistance until a significant portion of the adhesive is saturated.

| Chemical | Concentration | SET-3G™ | ET-3G™ |
|---|---|---|---|
| Acetic Acid | Glacial | F | F |
| | 5% | F | F |
| Acetone | 100% | F | F |
| Aluminum Ammonium Sulfate (Ammonium Alum) | 10% | R | R |
| Aluminum Chloride | 10% | R | R |
| Aluminum Potassium Sulfate (Potassium Alum) | 10% | R | R |
| Aluminum Sulfate (Alum) | 15% | NR | R |
| Ammonium Hydroxide (Ammonia) | 28% | R | R |
| | 10% | R | R |
| | pH = 10 | R | R |
| Ammonium Nitrate | 15% | R | R |
| Ammonium Sulfate | 15% | R | R |
| Automotive Antifreeze | 50% | R | R |
| Aviation Fuel (JP5) | 100% | R | R |
| Brake Fluid (DOT3) | 100% | R | NR |
| Calcium Hydroxide | 10% | R | R |
| Calcium Hypochlorite (Chlorinated Lime) | 15% | R | R |
| Calcium Oxide (Lime) | 5% | R | R |
| Carbolic Acid | 10% | F | F |
| | 5% | NR | F |
| Carbon Tetrachloride | 100% | R | R |
| Chromic Acid | 40% | R | NR |
| Citric Acid | 10% | R | R |
| Copper Sulfate | 10% | R | R |
| Detergent (ASTM D543) | 100% | R | R |
| Diesel Oil | 100% | R | R |
| Ethanol, Aqueous | 95% | NR | F |
| | 50% | R | NR |
| Ethanol, Denatured | 100% | F | F |
| Ethylene Glycol | 100% | R | R |
| Fluorosilicic Acid | 25% | R | R |
| Formic Acid | Concentrated | F | F |
| | 10% | F | F |
| Gasoline | 100% | R | R |
| Hydrochloric Acid | Concentrated | F | F |
| | 10% | NR | NR |
| | pH = 3 | R | R |
| Hydrogen Peroxide | 30% | NR | F |
| | 3% | R | R |
| Iron (II) Chloride (Ferrous Chloride) | 15% | R | R |
| Iron (III) Chloride (Ferric Chloride) | 15% | R | R |
| Iron (III) Sulfate (Ferric Sulfate) | 10% | NR | R |
| Isopropanol | 100% | R | F |
| Lactic Acid | 85% | F | F |
| | 10% | NR | F |
| Machine Oil | 100% | R | R |
| Methanol | 100% | F | F |
| Methyl Ethyl Ketone | 100% | F | F |

# Supplemental Topics for Anchors

| Chemical | Concentration | SET-3G™ | ET-3G™ |
|---|---|---|---|
| Methyl Isobutyl Ketone | 100% | NR | NR |
| Mineral Oil | 100% | R | R |
| Mineral Spirits | 100% | R | R |
| Mixture of Amines[1] | 100% | F | F |
| Mixture of Aromatics[2] | 100% | R | NR |
| Motor Oil (5W30) | 100% | R | R |
| N,N-Diethyaniline | 100% | R | R |
| Nitric Acid | Concentrated | F | F |
| | 40% | F | F |
| | 10% | NR | R |
| | pH = 3 | R | R |
| Phosphoric Acid | 85% | F | F |
| | 40% | F | F |
| | 10% | F | F |
| | pH = 3 | R | R |
| Potassium Hydroxide | 40% | R | R |
| | 10% | R | R |
| | pH = 13.2 | R | R |
| Potassium Permanganate | 10% | R | R |
| Propylene Glycol | 100% | R | R |
| Seawater (ASTM D1141) | 100% | R | R |
| Soap (ASTM D543) | 100% | R | R |
| Sodium Bicarbonate | 10% | R | R |
| Sodium Bisulfite | 15% | R | R |
| Sodium Carbonate | 15% | R | R |
| Sodium Chloride | 15% | R | R |
| Sodium Fluoride | 10% | R | R |
| Sodium Hexafluorosilicate (Sodium Silicon Fluoride) | 5% | R | R |
| Sodium Hydrosulfide | 10% | R | R |
| Sodium Hydroxide | 60% | R | R |
| | 40% | R | R |
| | 10% | R | R |
| | pH = 10 | R | R |
| Sodium Hypochlorite (Bleach) | 25% | R | R |
| | 10% | R | R |
| Sodium Nitrate | 15% | R | R |
| Sodium Phosphate (Trisodium Phosphate) | 10% | R | R |
| Sodium Silicate | 50% | R | R |
| Sulfuric Acid | Concentrated | F | F |
| | 30% | F | NR |
| | 3% | NR | NR |
| | pH = 3 | R | R |
| Toluene | 100% | R | F |
| Triethanol Amine | 100% | R | NR |
| Turpentine | 100% | R | R |
| Water | 100% | R | R |
| Xylene | 100% | R | NR |

"R" – Resistant, "NR" – Non-Resistant, "F" – Failed, "—" – Not tested

1. Triethanol amine, n-butylamine, N,N-dimethylamine
2. Toluene, methyl naphthalene, xylene

# Glossary

**ACI** — American Concrete Institute

**ACRYLIC** — Polymer based on resins prepared from a combination of acrylic and methacrylic esters.

**ADHESIVE ANCHOR** — Typically, a threaded rod or rebar that is installed in a predrilled hole in a base material with a two-part chemical compound.

**ADMIXTURE** — A material other than water, aggregate or hydraulic cement used as an ingredient of concrete and added to concrete before or during its mixing to modify its properties.

**AERATED CONCRETE** — Concrete that has been mixed with air-entraining additives to protect against freeze-thaw damage and provide additional workability.

**AGGREGATE** — A granular material, such as sand, gravel, crushed stone and iron blast-furnace slag, used with a cementing medium to form a hydraulic cement concrete or mortar.

**AISC** — American Institute of Steel Construction

**ALLOWABLE LOAD** — The maximum design load that can be applied to an anchor. Allowable loads for mechanical and adhesive anchors are based on applying a factor of safety to the average ultimate load.

**ALLOWABLE STRESS DESIGN (ASD)** — A design method in which an anchor is selected such that service loads do not exceed the anchor's allowable load. The allowable load is the average ultimate load divided by a factor of safety.

**AMINE CURING AGENT** — Reactive ingredient used as a setting agent for epoxy resins to form highly crosslinked polymers.

**ANCHOR CATEGORY** — The classification for an anchor that is established by the performance of the anchor in reliability tests such as sensitivity to reduced installation effort for mechanical anchors or sensitivity to hole cleaning for adhesive anchors.

**ANSI** — American National Standards Institute

**ASTM** — American Society for Testing and Materials

**BASE MATERIAL** — The substrate (concrete, CMU, etc.) into which adhesive or mechanical anchors are to be installed.

**BOND STRENGTH** — The mechanical interlock or chemical bonding capacity of an adhesive to both the insert and the base material.

**BRICK** — A solid masonry unit of clay or shale formed into a rectangular prism while plastic and burned or fired in a kiln that may have cores or cells comprising less than 25% of the cross sectional area.

**CAMA** — Concrete and Masonry Anchor Manufacturer's Association

**CAST-IN-PLACE ANCHOR** — A headed bolt, stud or hooked bolt installed into formwork prior to placing concrete.

**CHARACTERISTIC DESIGN VALUE** — The nominal strength for which there is 90% confidence that there is a 95% probability of the actual strength exceeding the nominal strength.

**CONCRETE** — A mixture of Portland cement or any other hydraulic cement, fine aggregate, coarse aggregate and water, with or without admixtures. Approximate weight is 150 pcf.

**CONCRETE BLOCK** — A solid concrete masonry unit (CMU) made from Portland cement, water, and aggregates.

**CONCRETE COMPRESSIVE STRENGTH ($f'_c$)** — The specified compressive load carrying capacity of concrete used in design, expressed in pounds per square inch (psi) or megapascals (MPa).

**CONCRETE MASONRY UNIT (CMU)** — A hollow or solid masonry unit made from cementitious materials, water and aggregates.

**CORE DRILL** — A method of drilling a smooth wall hole in a base material using a special drill attachment.

**CREEP** — Displacement under a sustained load over time.

**CURE TIME** — The elapsed time required for an adhesive anchor to develop its ultimate carrying capacity.

**DESIGN LOAD** — The calculated maximum load that is to be applied to the anchor for the life of the structure.

**DESIGN STRENGTH** — The nominal strength of an anchor calculated per ACI 318, ICC-ES AC193 or ICC-ES AC308 and then multiplied by a strength reduction factor ($\phi$).

**DROP-IN ANCHOR** — A post-installed mechanical anchor consisting of an internally-threaded steel shell and a tapered expander plug. The bottom end of the steel shell is slotted longitudinally into equal segments. The anchor is installed in a pre-drilled hole using a hammer and a hand-setting tool. The anchor is set when the tapered expander plug is driven toward the bottom end of the anchor such that the shoulder of the hand-setting tool makes contact with the top end of the anchor. A drop-in anchor may also be referred to as a displacement controlled expansion anchor.

**DUCTILITY** — A material under tensile stress with an elongation of at least 14% and an area reduction of at least 30% prior to rupture.

**DUCTILE ANCHOR SYSTEM** — The behavior of an anchor system where a ductile steel insert governs the design over concrete breakout, pullout and adhesive bond.

**DYNAMIC LOAD** — A load whose magnitude varies with time.

**EDGE DISTANCE:**

- **EDGE DISTANCE (C)** — The measure between the anchor centerline and the free edge of the concrete or masonry member.
- **CRITICAL EDGE DISTANCE ($C_{cr}$ or $C_{ac}$)** — The least edge distance at which the allowable load capacity of an anchor is applicable without reductions.
- **MINIMUM EDGE DISTANCE ($C_{min}$)** — The least edge distance at which the anchors are tested for recognition.

**EFFECTIVE EMBEDMENT DEPTH** — The dimension measured from the concrete surface to the deepest point at which the anchor tension load is transferred to the concrete.

**EMBEDMENT DEPTH** — The distance from the top surface of the base material to the installed end of the anchor. In the case of a post-installed mechanical anchor, the embedment depth is measured prior to application of the installation torque.

**EPOXY RESIN** — A viscous liquid containing epoxide groups that can be crosslinked into final form by means of a chemical reaction with a variety of setting agents.

# Glossary

**EXPANSION ANCHOR** — A mechanical fastener placed in hardened concrete or assembled masonry, designed to expand in a self-drilled or predrilled hole of a specified size and engage the sides of the hole in one or more locations to develop shear and/or tension resistance to applied loads without grout, adhesive or drypack.

**FATIGUE LOAD TEST** — A test in which the anchor is subjected to a specified load magnitude for 2 x $10^6$ cycles in order to establish the endurance limit of the anchor.

**GEL TIME** — The elapsed time at which an adhesive begins to increase in viscosity and becomes resistant to flow.

**GROUT** — A mixture of cementitious material and aggregate to which sufficient water is added to produce pouring consistency without segregation of the constituents.

**GROUTED MASONRY (or GROUT-FILLED MASONRY)** — Hollow-unit masonry in which the cells are filled solidly with grout. Also, double or triple-wythe wall construction in which the cavity(s) or collar joint(s) is filled solidly with grout.

**HOT-DIP GALVANIZED** — A part coated with a relatively thick layer of zinc by means of dipping the part in molten zinc.

**IAPMO UES** — IAPMO Uniform Evaluation Service. An ISO 17065 ANSI-accredited company that issues evaluation reports expressing a professional opinion as to a product's building code compliance.

**IBC** — International Building Code.

**ICC-ES** — ICC Evaluation Service. An ISO 17065 ANSI-accredited company that issues evaluation reports expressing a professional opinion as to a product's building code compliance.

**LEGACY ACCEPTANCE CRITERIA** — A past version of an ICC-ES anchor qualification criteria. These are no longer current standards, but are the basis for legacy allowable load data for anchors in concrete. These standards have been replaced by modern standards such as ICC-ES AC193 and AC308.

**LIGHTWEIGHT CONCRETE** — Concrete containing lightweight aggregate. The unit weight of lightweight concrete is not to exceed 115 pcf.

**MASONRY** — Brick, structural clay tile, stone, concrete masonry units or a combination thereof bonded together with mortar.

**MECHANICALLY GALVANIZED** — A part coated with a layer of zinc by means of mechanical impact. The thickest levels of mechanical galvanizing (ASTM B695, Class 55 or greater) are considered to be alternatives to hot-dip galvanizing and provide a medium level of corrosion resistance.

**MORTAR** — A mixture of cementitious materials, fine aggregate and water used to bond masonry units together.

**NOMINAL STRENGTH** — The strength of an element as calculated per ACI 318, ICC-ES AC193 or ICC-ES AC308.

**NORMAL WEIGHT CONCRETE** — Concrete containing normal weight aggregate. The unit weight of normal weight concrete is approximately 150 pcf.

**OBLIQUE LOAD** — A load that is applied to an anchor, which can be resolved into tension and shear components.

**PLAIN CONCRETE** — Structural concrete with no reinforcement or with less reinforcement than the minimum specified for reinforced concrete.

**PORTLAND CEMENT** — Hydraulic cement consisting of finely pulverized compounds of silica, lime and alumina.

**POST-INSTALLED ANCHOR** — Either a mechanical or adhesive anchor installed in a pre-drilled hole in the base material.

**POSTTENSIONING** — A method of prestressing in which tendons are tensioned after concrete has hardened.

**POT LIFE** — The length of time a mixed adhesive remains workable (flowable) before hardening.

**PRECAST CONCRETE** — A concrete structural element cast elsewhere than its final position in the structure.

**PRESTRESSED CONCRETE** — Structural concrete in which internal stresses have been introduced to reduce potential tensile stresses in concrete resulting from loads.

**PRETENSIONING** — A method of prestressing in which tendons are tensioned before concrete is placed.

**REBAR** — Deformed reinforcing steel which comply with ASTM A615.

**REINFORCED CONCRETE** — Structural concrete reinforced with no less than the minimum amount of prestressed tendons or nonprestressed reinforcement specified in ACI 318.

**REINFORCED MASONRY** — Masonry units and reinforcing steel bonded with mortar and/or grout in such a manner that the components act together in resisting forces.

**REQUIRED STRENGTH** — The factored loads and factored load combinations that must be resisted by an anchor.

**SCREEN TUBE** — Typically a wire or plastic mesh tube used with adhesives for anchoring into hollow base materials to prevent the adhesive from flowing uncontrolled into voids.

**SCREW ANCHOR** — A post-installed anchor that is a threaded mechanical fastener placed in a predrilled hole. The anchor derives its tensile holding strength from the mechanical interlock of the fastener threads with the grooves cut into the concrete during the anchor installation.

**SHEAR LOAD** — A load applied perpendicular to the axis of an anchor.

**SHOTCRETE** — Concrete that is pneumatically projected onto a surface at high velocity. Also known as gunite.

**SLEEVE ANCHOR** — A post-installed mechanical anchor consisting of a steel stud with nut and washer, threaded on the top end and a formed uniform tapered mandrel on the opposite end around which a full length expansion sleeve formed from sheet steel is positioned. The anchor is installed in a predrilled hole and set by tightening the nut by torquing thereby causing the expansion sleeve to expand over the tapered mandrel to engage the base material.

# Glossary

**SPACING:**

**SPACING (S)** — The measure between anchors, centerline-to-centerline distance.

**CRITICAL SPACING ($S_{cr}$)** — The least anchor spacing distance at which the allowable load capacity of an anchor is applicable such that the anchor is not influenced by neighboring anchors.

**MINIMUM SPACING ($S_{min}$)** — The least anchor spacing at which the anchors are tested for recognition.

**STAINLESS STEEL** — A family of iron alloys containing a minimum of 12% chromium. Type 316 stainless steel provides greater corrosion resistance than Type 303 or 304.

**STANDARD DEVIATION** — As it pertains to this catalog, a statistical measure of how widely dispersed the individual test results were from the published average ultimate loads.

**STATIC LOAD** — A load whose magnitude does not vary appreciably over time.

**STRENGTH DESIGN (SD)** — A design method in which an anchor is selected such that the anchor's design strength is equal to or greater than the anchor's required strength.

**STRENGTH REDUCTION FACTOR (φ)** — A factor applied to the nominal strength to allow for variations in material strengths and dimensions, inaccuracies in design equations, required ductility and reliability, and the importance of the anchor in the structure.

**TENDON** — In pretensioned applications, the tendon is the prestressing steel. In posttensioned applications, the tendon is a complete assembly consisting of anchorages, prestressing steel, and sheathing with coating for unbonded applications or ducts with grout for bonded applications.

**TENSION LOAD** — A load applied parallel to the axis of an anchor.

**THIXOTROPIC** — The ability of a fluid to become less viscous (resistant to flow) under shear, then thicken when the shear force is removed.

**TORQUE** — The measure of the force applied to produce rotational motion usually measured in foot-pounds. Torque is determined by multiplying the applied force by the distance from the pivot point to the point where the force is applied.

**ULTIMATE LOAD** — The average value of the maximum loads that were achieved when five or more samples of a given product were installed and statically load tested to failure under similar conditions. The ultimate load is used to derive the allowable load by applying a factor of safety.

**UNDERCUT ANCHOR** — A post-installed anchor that develops its tensile strength from the mechanical interlock provided by undercutting of the concrete at the embedded end of the anchor.

**UNREINFORCED MASONRY (URM)** — A form of clay brick masonry bearing wall construction consisting of multiple wythes periodically interconnected with header courses. In addition, this type of wall construction contains less than the minimum amounts of reinforcement as defined for reinforced masonry walls.

**WEDGE ANCHOR** — A post-installed mechanical anchor consisting of a steel stud with nut and washer, threaded on the top end and a formed uniform tapered mandrel on the opposite end around which an expansion clip formed from sheet steel is positioned. The anchor is installed in a predrilled hole and set by tightening the nut by torquing, thereby causing the expansion clip to expand over the tapered mandrel to engage the base material. A wedge anchor may also be referred to as a torque controlled expansion anchor.

**WYTHE** — A continuous vertical section of masonry one unit in thickness.

**ZINC PLATED** — A part coated with a relatively thin layer of zinc by means of electroplating.

SIMPSON Strong-Tie

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SIMPSON Strong-Tie

# Simpson Strong-Tie Limited Warranty

**Effective Date: March 18, 2021**

This Limited Warranty applies to all Simpson Strong-Tie products ("Products") purchased after the Effective Date while this Limited Warranty remains in effect, other than those Simpson Strong-Tie products that have a separate Limited Warranty applicable to such products. For purchases after the Effective Date, please consult strongtie.com/limited-warranties, as this Limited Warranty may be updated by Simpson from time to time. All future purchases of Products are subject to the terms of the Limited Warranty in effect as of the purchase date.

This Limited Warranty must be read in conjunction with all applicable General Notes, General Instructions for the Installer, General Instructions for the Designer, Building Codes, Corrosion Information, and Terms & Conditions of Sale, along with any other information or specifications published by Simpson Strong-Tie Company Inc. ("Simpson") or available on the strongtie.com website ("Website") or on the product package, label or product manual. All of this information is referred to collectively as the "Simpson Strong-Tie Documentation." All applicable Simpson Documentation must be carefully reviewed each time any Product is used.

Simpson Strong-Tie warrants, to the original purchaser only, that each Product will be free from substantial defects in materials, manufacturing and design if properly specified, installed, and maintained, and when used in accordance with the design limits and the structural, technical, and environmental specifications in the Simpson Strong-Tie Documentation. This Limited Warranty is void and does not apply to any (a) Product purchased from an unauthorized dealer, retailer or distributor, (b) Product deterioration or damage due to environmental conditions or inadequate or improper handling, transportation, storage or maintenance, (c) cosmetic defects, including discoloration, (d) failure or damage caused by improper installation, application, mixing or preparation, (e) use of a Product in temperatures or environmental conditions outside the ranges specified for such Product in the Simpson Strong-Tie Documentation, (f) use of a Product outside of its shelf-life specifications, (g) normal wear and tear, (h) failure or damage caused by the use of a Product with any fasteners, pins, screwstrips, products or accessories other than authentic Simpson Strong-Tie products, (i) Product that was subjected to negligence or excessive or improper use, including any use not in accordance with the Simpson Strong-Tie Documentation, (j) failure or damage caused by the building site, foundation, or any third-party products, building materials or components, (k) failure or damage caused by use of a Product in a structure that has a design or other defect or that does not comply with all applicable building codes, laws, rules and regulations, (l) modified Product, or any nonstandard use or application of a Product, (m) failure or damage caused by corrosion, termites or other wood destroying organisms, animal or insect activity, wood fungal decay, rot, mold, mildew, exposure to chemicals or other hazardous substances, a corrosive environment or materials, inadequate moisture protection, or premature deterioration of building materials, (n) failure or damage caused by an act of God, including any hurricane, earthquake, tornado, lightning, ice, snow, high wind, flood or other severe weather or natural phenomena, (o) installation services or workmanship, including any failure or damage caused by installation of any Product, whether or not in accordance with the Simpson Strong-Tie Documentation, or (p) failure or damage caused by the gross negligence, willful misconduct, or other acts or omissions of the builder, general contractor, installer or any third party, including the building owner. Notwithstanding the foregoing, Simpson Strong-Tie disclaims and does not provide any warranty related to the design of any custom-order or non-catalog Product.

Although Products are designed for a wide variety of uses, Simpson Strong-Tie assumes no liability for confirming that any Product is appropriate for an intended use, and each intended use of a Product must be reviewed and approved by qualified professionals. Each Product is designed for the load capacities and uses listed in the Simpson Strong-Tie Documentation, subject to the limitations and other information set forth in the Simpson Strong-Tie Documentation.

Due to the particular characteristics of potential impact events such as earthquakes and high velocity winds, the specific design and location of the structure, the building materials used, the quality of construction, or the condition of the soils or substrates involved, damage may nonetheless result to a structure and its contents even if the loads resulting from the impact event do not exceed Simpson Strong-Tie's specifications and the Products are properly installed in accordance with applicable building codes, laws, rules and regulations.

Product demonstrations, training, operator examinations, technical and customer support and other services provided by Simpson Strong-Tie are based on Simpson Strong-Tie's present knowledge and experience, are conducted for illustrative or instructive purposes only, do not constitute a warranty of Product capabilities, specifications or installation and do not modify the applicable Limited Warranty for Products set forth herein. Any services provided by Simpson Strong-Tie are provided without any representation or warranty of any kind, and Simpson Strong-Tie assumes no liability for any representations or statements made as part of such Product demonstrations, training, operator examinations or other services. In the event of any inconsistency between any information provided during any such demonstration or service, and the information in any applicable Simpson Strong-Tie Documentation, the information in the Simpson Strong-Tie Documentation shall govern. In the event of any inconsistency between any information provided on the Website, and the information in any other Simpson Strong-Tie Documentation, the information on the Website shall govern.

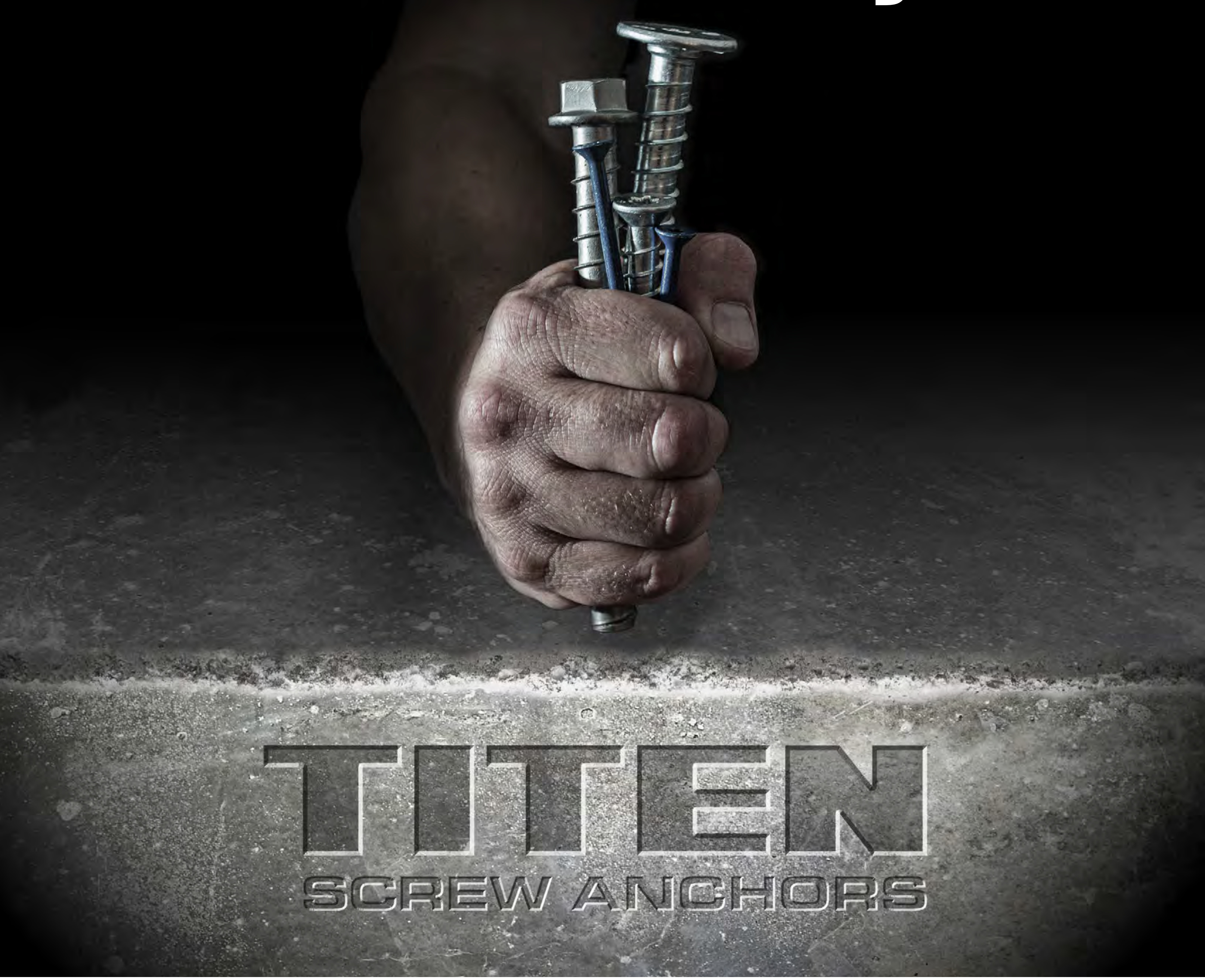
**ALL WARRANTY OBLIGATIONS OF SIMPSON STRONG-TIE SHALL BE LIMITED, AT SIMPSON STRONG-TIE'S ABSOLUTE DISCRETION, TO EITHER REPAIRING THE DEFECTIVE PRODUCT OR PROVIDING A REPLACEMENT FOR THE DEFECTIVE PRODUCT. THIS REMEDY CONSTITUTES SIMPSON STRONG-TIE'S SOLE OBLIGATION AND LIABILITY AND THE SOLE AND EXCLUSIVE REMEDY OF PURCHASER AND, WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, EXCLUDES ANY LABOR OR OTHER COSTS INCURRED IN CONNECTION WITH A WARRANTY CLAIM. PURCHASER ASSUMES ALL RISK AND LIABILITY ASSOCIATED WITH ANY USE OF THE PRODUCT, INCLUDING BUT NOT LIMITED TO SUITABILITY FOR ITS INTENDED USE.**

**THE LIMITED WARRANTY HEREIN IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, AND, WHERE LAWFUL, SIMPSON STRONG-TIE DISCLAIMS ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND WARRANTIES ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE. IN NO EVENT WILL SIMPSON STRONG-TIE BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR SPECIAL DAMAGES OR DIRECT OR INDIRECT LOSS OF ANY KIND, INCLUDING BUT NOT LIMITED TO PROPERTY DAMAGE, DEATH AND PERSONAL INJURY. SIMPSON STRONG-TIE'S ENTIRE LIABILITY IS LIMITED TO THE PURCHASE PRICE OF THE DEFECTIVE PRODUCT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, OR THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.**

To obtain warranty service, you must contact Simpson Strong-Tie promptly at (800) 999-5099 or at Simpson Strong-Tie Company Inc., 5956 West Las Positas Boulevard, Pleasanton, CA 94588, regarding any potential claim, no later than sixty (60) days after you discover the potential claim. Upon request by Simpson Strong-Tie, you must provide Simpson Strong-Tie with: (a) proof of purchase and written records evidencing, in reasonable detail, the date and manner of installation, application, mixing and preparation of the Products, as applicable, (b) a reasonable opportunity to inspect the site where the Product was installed, and (c) samples of the Products from the actual installation in sufficient quantities in order for Simpson Strong-Tie to perform testing to determine whether or not the Product failed as set forth herein. Simpson Strong-Tie may, in its absolute discretion, request that you return the allegedly defective Products to Simpson Strong-Tie, in which case Simpson Strong-Tie will issue a Return Materials Authorization (RMA), which must be completed and returned to Simpson Strong-Tie with the Product. Simpson Strong-Tie is not responsible for any costs or expenses incurred in connection with any inspection (other than by Simpson Strong-Tie employees) or in connection with the return of Products to Simpson Strong-Tie, but Simpson Strong-Tie shall bear all costs and expenses incurred in connection with the shipment of replacement Products in the event that Simpson Strong-Tie determines that the Product should be replaced in accordance with this Limited Warranty. If Simpson Strong-Tie elects to repair or replace the Product, Simpson Strong-Tie shall have a reasonable time to do so.

No one is authorized to change or add to this Limited Warranty. If at any time Simpson Strong-Tie does not enforce any of the terms, conditions or limitations stated in this Limited Warranty, Simpson Strong-Tie shall not have waived the benefit of said term, condition or limitation and can enforce it at any time. This Limited Warranty is extended only to the original purchaser and is not transferrable. It is not intended nor shall it be construed to create rights in any third party.

# Strength runs in the family.




The Titen® family of concrete and masonry anchoring solutions from Simpson Strong-Tie. Our broad range of versatile and innovative screw anchors is designed for maximum ease and efficiency — ensuring a quick, smooth installation every time. And our skilled field support teams are always available to assist on the jobsite.

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