Product Submittal/Substitution Request

TO:

PROJECT:

PROJECT LOCATION:

SPECIFIED ITEM:

Section | Page | Paragraph | Description

PRODUCT SUBMIT TAL / SUBSTITUTION REQUESTED:

DEWALT® Engineered By Powers® Screw-Bolt+ -

The attached submittal package includes the product description, specifications, drawings, and performance data for use in the evaluation of the request.

SUBMITTED BY:

Name: Signature:

Company:

Address:

Date: Telephone: Fax:

FOR USE BY THE ARCHITECT AND/OR ENGINEER

☐ **Approved** ☐ **Approved as Noted** ☐ **Not Approved**

(If not approved, please briefly explain why the product was not accepted.)

By: Date:

Remarks:

Questions or inquiries? Contact us at engineering@powers.com, or call 1.800.524.3244

DEWALT® Screw-Bolt+ Submittal Section:

Product Pages:

- General Information
- Installation Instructions
- Design Tables
- Ordering Information

Code Reports & Agency Listings:

- ICC–ES Evaluation Report: ESR–3889 (Cracked & Uncracked Concrete)
- ICC–ES Evaluation Report: ESR–4042 (Concrete Masonry Units)

GENERAL INFORMATION

SCREW-BOLT+™

High Performance Screw Anchor

PRODUCT DESCRIPTION

The Screw-Bolt+ anchor is a one piece, heavy duty screw anchor with a finished hex head or flat head (countersunk). It is simple to install, easy to identify and fully removable. The patented thread design, designed for use with standard ANSI drill bits, reduces installation torque and enhances productivity. The steel threads along the anchor body tap into the hole during installation to provide keyed engagement and allow for reduced edge and spacing distances. The Screw-Bolt+ is available as bright zinc-plated or mechanically galvanized plating. Suitable base materials include normal-weight concrete, sand-lightweight concrete, concrete over steel deck, concrete masonry and solid clay brick.

GENERAL APPLICATIONS AND USES

- Racking, shelving and material handling
- Support ledgers and sill plate attachments
- Barriers, guards and temporary supports
- Glazing and window attachments
- Retrofits, repairs and maintenance
- Fencing and railing
- Cracked and uncracked concrete
- Seismic and wind loading

FEATURES AND BENEFITS

+ Designed for standard ANSI tolerance drill bits
+ Patented thread design offers toughened threads for tapping high strength concrete
+ Low installation torque in concrete and masonry
+ Universal product for concrete and grouted/solid masonry
+ Ratchet teeth on underside of hex washer head lock against the fixture
+ Can be installed closer to a free edge than traditional expansion anchors
+ Fully removable and reinstallable in same hole (see www.DEWALT.com)
+ Fast installation with powered impact wrench, but can also be installed manually
+ Diameter, length and identifying marking stamped on head of each anchor
+ One-piece, finished head design

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3889 for concrete.
- International Code Council, Evaluation Service (ICC-ES), ESR-4042 for masonry.
- Code Compliant with the International Building Code/International Residential Code: 2018 IBC/IRC, 2015 IBC/IRC, 2012 IBC/IRC, and 2009 IBC/IRC
- Tested in accordance with ACI 355.2, ASTM E488 and ICC-ES AC193 for use in structural applications in concrete under the design provisions of ACI 318 (Strength Design Method)
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (Category 1 anchors)
- Evaluated and qualified by an accredited independent testing laboratory for sensitivity and reliability against brittle failure, e.g. hydrogen embrittlement

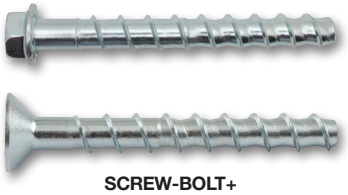
GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 - Post-Installed Concrete Anchors. Screw anchors shall be Screw-Bolt+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

MATERIAL SPECIFICATIONS

Anchor component		Specification
Anchor Body and hex washer head		Case hardened low carbon steel (see minimum strength properties on the next page)
Plating	Standard zinc plated version	Zinc plating according to ASTM B633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition.
	Mechanically galvanized version	Mechanically Galvanized Zinc plating according to ASTM B695, Class 55

SECTION CONTENTS



SCREW-BOLT+

HEAD STYLES

- Hex Washer Head or Flat Head

ANCHOR MATERIALS

- Zinc plated carbon steel or mechanically galvanized plating

ANCHOR SIZE RANGE (TYP.)

- 1/4" diameter through 3/4" diameter (see ordering information)

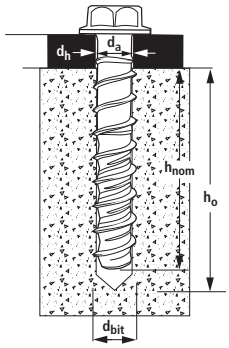
SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete
- Concrete over steel deck
- Grouted Concrete Masonry (CMU)
- Brick Masonry

TENSION ZONE CRACKED CONCRETE
SEISMIC REGION QUALIFICATION
CODE LISTED ICC-ES ESR-3889 CONCRETE
CODE LISTED ICC-ES ESR-4042 MASONRY
DDA DEWALT DESIGN ASSIST
DUSTX+ ANCHOR INSTALLATION SYSTEM

INSTALLATION SPECIFICATIONS (ASD)

Screw-Bolt+ Anchor Detail



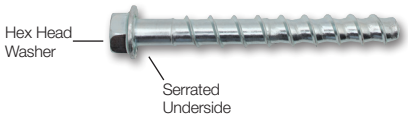
Nomenclature

d_a = Diameter of Anchor
d_{bit} = Diameter of Drill Bit
d_h = Diameter of Clearance Hole
h = Base Material Thickness. The value of h should be $1.5h_{nom}$ or 3", whichever is greater
h_{nom} = Minimum Nominal Embedment
h_o = Minimum Hole Depth

Head Marking

Legend

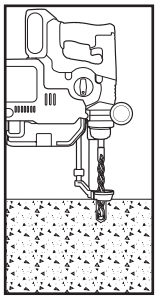
Diameter and Length Identification Mark



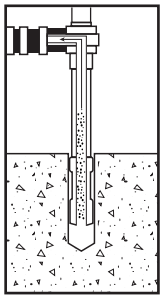
Legend

Diameter and Length Identification Mark

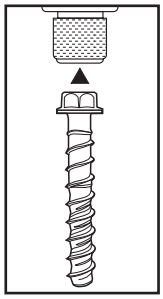
Installation Instructions for Screw-Bolt+ (Hex Head Version Illustrated, Flat Head Version Not Shown)



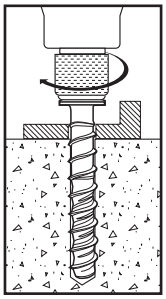
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI standard B212.15



Step 2
Remove dust and debris from hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created during drilling.



Step 3
Select a torque wrench or powered impact wrench and do not exceed the maximum torque, $T_{inst,max}$ or $T_{impact,max}$ respectively for the selected anchor diameter and embedment. Attach an appropriate sized hex socket/driver to the impact wrench. Mount the screw anchor head into the socket.



Step 4
Drive the anchor into the hole until the head of the anchor comes into contact with the fixture. The anchor must be snug after installation. Do not spin the hex socket off the anchor to disengage.

REFERENCE DATA (ASD)

Installation Specifications for Screw-Bolt+ in Concrete and Supplemental Information

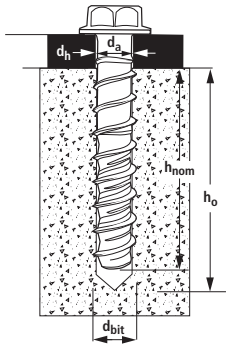
Anchor Property/Setting Information		Notation	Units	Nominal Anchor Diameter (inch)				
				1/4	3/8	1/2	5/8	3/4
Anchor outside diameter		d	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Nominal drill bit diameter (ANSI)		d_{bit}	in.	1/4	3/8	1/2	5/8	3/4
Minimum diameter of hole clearance in fixture		d_h	in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	7/8 (22.2)
Minimum embedment depth[2]		h_{nom}	in. (mm)	1 (25)	1-1/2 (38)	1-3/4 (44)	2-1/2 (64)	2-1/2 (64)
Minimum hole depth		h_o	in. (mm)	1-3/8 (35)	1-7/8 (48)	2-1/8 (54)	2-7/8 (73)	2-7/8 (73)
Minimum member thickness[1]		h_{min}	in. (mm)	3 (76)	3 (76)	3 (76)	3-3/4 (95)	3-3/4 (95)
Minimum edge distance		c_{min}	in. (mm)	1-1/2 (38)	1-1/2 (38)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)
Minimum spacing		s_{min}	in. (mm)	1-1/2 (38)	2 (51)	2-3/4 (70)	2-3/4 (70)	3 (76)
Max manual installation torque		$T_{inst,max}$	ft.-lbf. (N-m)	19 (26)	25 (34)	45 (61)	60 (81)	70 (95)
Max impact wrench power (torque)		$T_{impact,max}$	ft.-lbf. (N-m)	150 (203)	300 (407)	300 (407)	700 (950)	700 (950)
Hex Head	Impact wrench socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8
	Maximum head height	-	in.	21/64	3/8	31/64	37/64	43/64
	Maximum washer diameter	-	in.	37/64	3/4	1-1/16	1-1/8	1-13/32
Flat Head	Driver Size	-	in.	T-30	T-50	T-55	-	-
	Max head diameter	-	in.	17/32	57/64	1	-	-
	Countersunk angle	-	in.	82	82	82	-	-
Effective tensile stress area (screw anchor body)		A_{se}	in^2	0.045	0.094	0.176	0.274	0.399
Minimum ultimate strength		f_{uta}	ksi	100	105	115	95	95
Minimum yield strength		f_y	ksi	80	84	92	76	76

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

1. The minimum base material thickness shall be the greater of $1.5 \bullet h_{nom}$ or 3 inches.
2. See load capacities in normal weight concrete for additional embedment depths.

INSTALLATION SPECIFICATIONS (ASD)

Screw-Bolt+ Anchor Detail



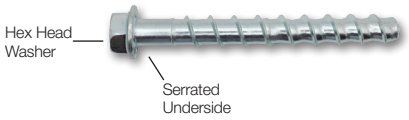
Nomenclature

d_a = Diameter of Anchor
d_{bit} = Diameter of Drill Bit
d_h = Diameter of Clearance Hole
h = Base Material Thickness. The value of h should be $1.5h_{nom}$ or 3", whichever is greater
h_{nom} = Minimum Nominal Embedment
h_o = Minimum Hole Depth

Head Marking

Legend

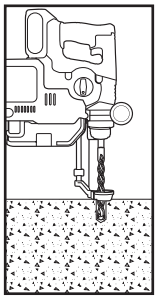
Diameter and Length Identification Mark



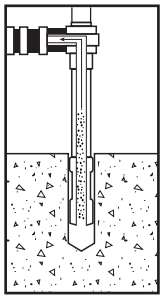
Legend

Diameter and Length Identification Mark

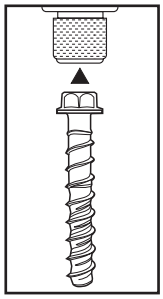
Installation Instructions for Screw-Bolt+ (Hex Head Version Illustrated, Flat Head Version Not Shown)



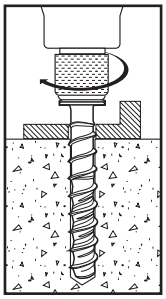
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI standard B212.15



Step 2
Remove dust and debris from hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created during drilling.



Step 3
Select a torque wrench or powered impact wrench and do not exceed the maximum torque, $T_{inst,max}$ or $T_{impact,max}$ respectively for the selected anchor diameter and embedment. Attach an appropriate sized hex socket/driver to the impact wrench. Mount the screw anchor head into the socket.



Step 4
Drive the anchor into the hole until the head of the anchor comes into contact with the fixture. The anchor must be snug after installation. Do not spin the hex socket off the anchor to disengage.

REFERENCE DATA (ASD)

Installation Specifications for Screw-Bolt+ in Concrete and Supplemental Information

Anchor Property/Setting Information		Notation	Units	Nominal Anchor Diameter (inch)				
				1/4	3/8	1/2	5/8	3/4
Anchor outside diameter		d	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Nominal drill bit diameter (ANSI)		d_{bit}	in.	1/4	3/8	1/2	5/8	3/4
Minimum diameter of hole clearance in fixture		d_h	in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	7/8 (22.2)
Minimum embedment depth[2]		h_{nom}	in. (mm)	1 (25)	1-1/2 (38)	1-3/4 (44)	2-1/2 (64)	2-1/2 (64)
Minimum hole depth		h_o	in. (mm)	1-3/8 (35)	1-7/8 (48)	2-1/8 (54)	2-7/8 (73)	2-7/8 (73)
Minimum member thickness[1]		h_{min}	in. (mm)	3 (76)	3 (76)	3 (76)	3-3/4 (95)	3-3/4 (95)
Minimum edge distance		c_{min}	in. (mm)	1-1/2 (38)	1-1/2 (38)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)
Minimum spacing		s_{min}	in. (mm)	1-1/2 (38)	2 (51)	2-3/4 (70)	2-3/4 (70)	3 (76)
Max manual installation torque		$T_{inst,max}$	ft.-lbf. (N-m)	19 (26)	25 (34)	45 (61)	60 (81)	70 (95)
Max impact wrench power (torque)		$T_{impact,max}$	ft.-lbf. (N-m)	150 (203)	300 (407)	300 (407)	700 (950)	700 (950)
Hex Head	Impact wrench socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8
	Maximum head height	-	in.	21/64	3/8	31/64	37/64	43/64
	Maximum washer diameter	-	in.	37/64	3/4	1-1/16	1-1/8	1-13/32
Flat Head	Driver Size	-	in.	T-30	T-50	T-55	-	-
	Max head diameter	-	in.	17/32	57/64	1	-	-
	Countersunk angle	-	in.	82	82	82	-	-
Effective tensile stress area (screw anchor body)		A_{se}	in^2	0.045	0.094	0.176	0.274	0.399
Minimum ultimate strength		f_{uta}	ksi	100	105	115	95	95
Minimum yield strength		f_y	ksi	80	84	92	76	76

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

1. The minimum base material thickness shall be the greater of $1.5 \bullet h_{nom}$ or 3 inches.
2. See load capacities in normal weight concrete for additional embedment depths.

Ultimate Load Capacities for Screw-Bolt+ in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)		f'c = 8,000 psi (55.2 MPa)	
		Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1 (25)	1,325 (5.9)	1,660 (7.4)	1,400 (6.2)	1,755 (7.8)	1,530 (6.8)	1,910 (8.5)	1,725 (7.7)	2,080 (9.3)	1,725 (7.7)	2,080 (9.3)
	1-5/8 (41)	2,835 (12.6)	1,660 (7.4)	2,995 (13.3)	1,755 (7.8)	3,265 (14.5)	1,910 (8.5)	3,265 (14.5)	2,080 (9.3)	3,265 (14.5)	2,080 (9.3)
	2-1/2 (64)	3,650 (16.2)	2,025 (9.0)	3,855 (17.1)	2,140 (9.5)	4,200 (18.7)	2,335 (10.4)	4,270 (19.0)	2,545 (11.3)	4,270 (19.0)	2,545 (11.3)
3/8	1-1/2 (38)	2,630 (11.7)	3,550 (15.8)	2,880 (12.8)	3,890 (17.3)	3,330 (14.8)	4,490 (20.0)	4,075 (18.1)	5,500 (24.5)	4,075 (18.1)	6,355 (28.3)
	2 (51)	3,670 (16.3)	4,320 (19.2)	4,020 (17.9)	4,735 (21.1)	4,645 (20.7)	5,465 (24.3)	4,725 (21.0)	6,345 (28.2)	5,455 (24.3)	6,345 (28.2)
	3-1/4 (83)	7,420 (33.0)	6,325 (28.1)	8,130 (36.2)	6,930 (30.8)	9,065 (40.3)	8,000 (35.6)	9,065 (40.3)	8,565 (38.1)	10,350 (46.0)	8,565 (38.1)
	4-1/2 (114)	10,905 (48.5)	6,325 (28.1)	11,945 (53.1)	6,930 (30.8)	13,795 (61.4)	8,000 (35.6)	15,075 (67.1)	8,565 (38.1)	15,075 (67.1)	8,565 (38.1)
1/2	1-3/4 (44)	2,840 (12.6)	5,985 (26.6)	3,115 (13.9)	6,555 (29.2)	3,595 (16.0)	7,570 (33.7)	4,400 (19.6)	9,270 (41.2)	4,400 (19.6)	10,705 (47.6)
	2-1/2 (64)	6,680 (29.7)	8,035 (35.7)	7,320 (32.6)	8,800 (39.1)	8,450 (37.6)	10,160 (45.2)	8,450 (37.6)	11,545 (51.4)	8,450 (37.6)	11,545 (51.4)
	4-1/4 (108)	13,260 (59.0)	9,395 (41.8)	14,525 (64.6)	10,290 (45.8)	16,480 (73.3)	11,885 (52.9)	16,480 (73.3)	13,520 (60.1)	16,480 (73.3)	13,520 (60.1)
	5-1/2 (140)	15,730 (70.0)	9,395 (41.8)	17,235 (76.7)	10,290 (45.8)	19,900 (88.5)	11,885 (52.9)	21,310 (94.8)	13,520 (60.1)	21,310 (94.8)	13,520 (60.1)
5/8	2-1/2 (64)	5,735 (25.5)	10,615 (47.2)	6,285 (28.0)	11,630 (51.7)	7,255 (32.3)	13,425 (59.7)	8,885 (39.5)	16,445 (73.2)	8,885 (39.5)	17,170 (76.4)
	3-1/4 (83)	9,755 (43.4)	12,065 (53.7)	10,685 (47.5)	13,220 (58.8)	12,340 (54.9)	15,265 (67.9)	12,340 (54.9)	17,170 (76.4)	12,340 (54.9)	17,170 (76.4)
	5 (127)	14,455 (64.3)	13,675 (60.8)	15,830 (70.4)	14,980 (66.6)	18,280 (81.3)	17,295 (76.9)	19,295 (85.8)	19,485 (86.7)	22,280 (99.1)	19,485 (86.7)
	6-1/4 (159)	20,520 (91.3)	13,675 (60.8)	22,475 (100.0)	14,980 (66.6)	25,955 (115.5)	17,295 (76.9)	31,785 (141.4)	19,485 (86.7)	31,785 (141.4)	19,485 (86.7)
3/4	2-1/2 (64)	6,035 (26.8)	11,615 (51.7)	6,610 (29.4)	12,725 (56.6)	7,635 (34.0)	14,690 (65.3)	9,350 (41.6)	17,995 (80.0)	9,350 (41.6)	20,775 (92.4)
	4-1/4 (108)	11,900 (52.9)	17,055 (75.9)	13,035 (58.0)	18,685 (83.1)	15,050 (66.9)	21,575 (96.0)	17,745 (78.9)	24,270 (108.0)	20,490 (91.1)	24,270 (108.0)
	5 (127)	19,020 (84.6)	17,055 (75.9)	20,835 (92.7)	18,685 (83.1)	24,055 (107.0)	21,575 (96.0)	29,460 (131.0)	24,270 (108.0)	29,460 (131.0)	24,270 (108.0)
	6-1/4 (159)	20,495 (91.2)	17,055 (75.9)	22,450 (99.9)	18,685 (83.1)	25,920 (115.3)	21,575 (96.0)	31,750 (141.2)	24,270 (108.0)	31,750 (141.2)	24,270 (108.0)

1. Tabulated load values are for anchors installed in uncracked concrete with no edge or spacing considerations. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

Allowable Load Capacities for Screw-Bolt+ in Normal-Weight Concrete[1,2,3,4,5]

Nominal Anchor Diameter in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)		f'c = 8,000 psi (55.2 MPa)	
		Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1 (25)	330 (1.5)	415 (1.8)	350 (1.6)	440 (2.0)	385 (1.7)	480 (2.1)	430 (1.9)	520 (2.3)	430 (1.9)	520 (2.3)
	1-5/8 (41)	710 (3.2)	415 (1.8)	750 (3.3)	440 (2.0)	815 (3.6)	480 (2.1)	815 (3.6)	520 (2.3)	815 (3.6)	520 (2.3)
	2-1/2 (64)	915 (4.1)	505 (2.2)	965 (4.3)	535 (2.4)	1,050 (4.7)	585 (2.6)	1,070 (4.8)	635 (2.8)	1,070 (4.8)	635 (2.8)
3/8	1-1/2 (38)	660 (2.9)	890 (4.0)	720 (3.2)	975 (4.3)	835 (3.7)	1,125 (5.0)	1,020 (4.5)	1,375 (6.1)	1,020 (4.5)	1,590 (7.1)
	2 (51)	920 (4.1)	1,080 (4.8)	1,005 (4.5)	1,185 (5.3)	1,160 (5.2)	1,365 (6.1)	1,180 (5.2)	1,585 (7.1)	1,365 (6.1)	1,585 (7.1)
	3-1/4 (83)	1,855 (8.3)	1,580 (7.0)	2,035 (9.1)	1,735 (7.7)	2,265 (10.1)	2,000 (8.9)	2,265 (10.1)	2,140 (9.5)	2,590 (11.5)	2,140 (9.5)
	4-1/2 (114)	2,725 (12.1)	1,580 (7.0)	2,985 (13.3)	1,735 (7.7)	3,450 (15.3)	2,000 (8.9)	3,770 (16.8)	2,140 (9.5)	3,770 (16.8)	2,140 (9.5)
1/2	1-3/4 (44)	710 (3.2)	1,495 (6.7)	780 (3.5)	1,640 (7.3)	900 (4.0)	1,895 (8.4)	1,100 (4.9)	2,320 (10.3)	1,100 (4.9)	2,675 (11.9)
	2-1/2 (64)	1,670 (7.4)	2,010 (8.9)	1,830 (8.1)	2,200 (9.8)	2,115 (9.4)	2,540 (11.3)	2,115 (9.4)	2,885 (12.8)	2,115 (9.4)	2,885 (12.8)
	4-1/4 (108)	3,315 (14.7)	2,350 (10.5)	3,630 (16.1)	2,575 (11.5)	4,120 (18.3)	2,970 (13.2)	4,120 (18.3)	3,380 (15.0)	4,120 (18.3)	3,380 (15.0)
	5-1/2 (140)	3,935 (17.5)	2,350 (10.5)	4,310 (19.2)	2,575 (11.5)	4,975 (22.1)	2,970 (13.2)	5,330 (23.7)	3,380 (15.0)	5,330 (23.7)	3,380 (15.0)
5/8	2-1/2 (64)	1,435 (6.4)	2,655 (11.8)	1,570 (7.0)	2,910 (12.9)	1,815 (8.1)	3,355 (14.9)	2,220 (9.9)	4,110 (18.3)	2,220 (9.9)	4,295 (19.1)
	3-1/4 (83)	2,440 (10.9)	3,015 (13.4)	2,670 (11.9)	3,305 (14.7)	3,085 (13.7)	3,815 (17.0)	3,085 (13.7)	4,295 (19.1)	3,085 (13.7)	4,295 (19.1)
	5 (127)	3,615 (16.1)	3,420 (15.2)	3,960 (17.6)	3,745 (16.7)	4,570 (20.3)	4,325 (19.2)	4,825 (21.5)	4,870 (21.7)	5,570 (24.8)	4,870 (21.7)
	6-1/4 (159)	5,130 (22.8)	3,420 (15.2)	5,620 (25.0)	3,745 (16.7)	6,490 (28.9)	4,325 (19.2)	7,945 (35.3)	4,870 (21.7)	7,945 (35.3)	4,870 (21.7)
3/4	2-1/2 (64)	1,510 (6.7)	2,905 (12.9)	1,655 (7.4)	3,180 (14.1)	1,910 (8.5)	3,675 (16.3)	2,340 (10.4)	4,500 (20.0)	2,340 (10.4)	5,195 (23.1)
	4-1/4 (108)	2,975 (13.2)	4,265 (19.0)	3,260 (14.5)	4,670 (20.8)	3,765 (16.7)	5,395 (24.0)	4,435 (19.7)	6,070 (27.0)	5,125 (22.8)	6,070 (27.0)
	5 (127)	4,755 (21.2)	4,265 (19.0)	5,210 (23.2)	4,670 (20.8)	6,015 (26.8)	5,395 (24.0)	7,365 (32.8)	6,070 (27.0)	7,365 (32.8)	6,070 (27.0)
	6-1/4 (159)	5,125 (22.8)	4,265 (19.0)	5,615 (25.0)	4,670 (20.8)	6,480 (28.8)	5,395 (24.0)	7,940 (35.3)	6,070 (27.0)	7,940 (35.3)	6,070 (27.0)

1. Tabulated load values are for anchors installed in uncracked concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor of 4.0 to average ultimate load capacities.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
5. For lightweight concrete multiply tabulated allowable load values by a reduction factor of 0.60.

LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT CONCRETE

Edge Distance Reduction Factors - Tension (F_{NC})

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Min. Edge Distance c_{min} (in)		1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4
Edge Distance (inches)	1-1/2	1.00	0.77	0.64	0.85	0.74	0.59	0.55	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	1.00	0.83	0.67	0.93	0.79	0.62	0.57	0.87	0.71	0.58	0.54	0.73	0.65	0.56	0.53	0.73	0.59	0.56	0.53
	2	1.00	0.88	0.71	1.00	0.84	0.65	0.59	0.94	0.76	0.60	0.56	0.78	0.68	0.58	0.54	0.78	0.61	0.58	0.54
	2-1/4	1.00	0.94	0.75	1.00	0.89	0.68	0.61	1.00	0.80	0.63	0.57	0.82	0.71	0.60	0.56	0.82	0.63	0.60	0.56
	2-1/2	1.00	1.00	0.78	1.00	0.95	0.71	0.63	1.00	0.84	0.65	0.59	0.87	0.75	0.62	0.57	0.87	0.66	0.62	0.57
	2-3/4	1.00	1.00	0.82	1.00	1.00	0.74	0.65	1.00	0.88	0.67	0.61	0.91	0.78	0.64	0.59	0.91	0.68	0.64	0.59
	3	1.00	1.00	0.86	1.00	1.00	0.77	0.67	1.00	0.92	0.69	0.62	0.96	0.81	0.66	0.60	0.96	0.70	0.66	0.60
	3-1/2	1.00	1.00	0.93	1.00	1.00	0.83	0.71	1.00	1.00	0.74	0.65	1.00	0.87	0.69	0.63	1.00	0.75	0.69	0.63
	4	1.00	1.00	1.00	1.00	1.00	0.88	0.75	1.00	1.00	0.78	0.69	1.00	0.94	0.73	0.66	1.00	0.79	0.73	0.66
	4-1/2	1.00	1.00	1.00	1.00	1.00	0.94	0.79	1.00	1.00	0.82	0.72	1.00	1.00	0.77	0.69	1.00	0.84	0.77	0.69
	5	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.87	0.75	1.00	1.00	0.81	0.72	1.00	0.89	0.81	0.72
	5-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.91	0.79	1.00	1.00	0.85	0.75	1.00	0.93	0.85	0.75
	6	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.96	0.82	1.00	1.00	0.89	0.78	1.00	0.98	0.89	0.78
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.85	1.00	1.00	0.92	0.81	1.00	1.00	0.92	0.81
	7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.96	0.84	1.00	1.00	0.96	0.84
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	1.00	0.87	1.00	1.00	1.00	0.87
	8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	0.90	1.00	1.00	1.00	0.90
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00	0.93	1.00	1.00	1.00	0.93
	9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.96
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	0.99
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Spacing Reduction Factors - Tension (F_{NS})

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Minimum Spacing s_{min} (in)		1-1/2	1-1/2	1-1/2	2	2	2	2	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	3	3	3	3
Spacing Distance (inches)	1-1/2	0.89	0.73	0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.94	0.77	0.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	1.00	0.80	0.70	0.88	0.77	0.67	0.63	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	1.00	0.83	0.72	0.93	0.80	0.69	0.64	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	1.00	0.86	0.74	0.97	0.83	0.70	0.65	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	1.00	0.89	0.76	1.00	0.86	0.72	0.66	0.92	0.78	0.67	0.64	0.80	0.73	0.65	0.63	-	-	-	-
	3	1.00	0.92	0.78	1.00	0.89	0.74	0.67	0.95	0.80	0.68	0.65	0.83	0.74	0.66	0.64	0.83	0.69	0.66	0.64
	3-1/2	1.00	0.99	0.82	1.00	0.94	0.77	0.70	1.00	0.85	0.71	0.67	0.88	0.78	0.68	0.65	0.88	0.71	0.68	0.65
	4	1.00	1.00	0.86	1.00	1.00	0.80	0.72	1.00	0.89	0.73	0.68	0.92	0.81	0.70	0.67	0.93	0.74	0.71	0.67
	4-1/2	1.00	1.00	0.90	1.00	1.00	0.83	0.74	1.00	0.93	0.75	0.70	0.97	0.85	0.72	0.68	0.97	0.76	0.73	0.69
	5	1.00	1.00	0.94	1.00	1.00	0.86	0.76	1.00	0.98	0.78	0.72	1.00	0.88	0.75	0.70	1.00	0.79	0.75	0.70
	5-1/2	1.00	1.00	0.97	1.00	1.00	0.89	0.78	1.00	1.00	0.80	0.74	1.00	0.92	0.77	0.72	1.00	0.81	0.77	0.72
	6	1.00	1.00	1.00	1.00	1.00	0.93	0.81	1.00	1.00	0.82	0.75	1.00	0.95	0.79	0.73	1.00	0.84	0.79	0.73
	6-1/2	1.00	1.00	1.00	1.00	1.00	0.96	0.83	1.00	1.00	0.85	0.77	1.00	0.98	0.81	0.75	1.00	0.86	0.81	0.75
	7	1.00	1.00	1.00	1.00	1.00	0.99	0.85	1.00	1.00	0.87	0.79	1.00	1.00	0.83	0.76	1.00	0.89	0.83	0.77
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00	1.00	0.90	0.81	1.00	1.00	0.85	0.78	1.00	0.91	0.85	0.78
	8	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	0.92	0.83	1.00	1.00	0.87	0.80	1.00	0.94	0.87	0.80
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.94	0.84	1.00	1.00	0.89	0.81	1.00	0.96	0.89	0.81
	9	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.97	0.86	1.00	1.00	0.91	0.83	1.00	0.99	0.91	0.83
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.99	0.88	1.00	1.00	0.93	0.84	1.00	1.00	0.93	0.85
	10	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00	0.90	1.00	1.00	0.95	0.86	1.00	1.00	0.95	0.86
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.97	0.88	1.00	1.00	0.97	0.88
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	0.99	0.89	1.00	1.00	0.99	0.89
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	0.91	1.00	1.00	1.00	0.91
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.92	1.00	1.00	1.00	0.93
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.96
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	0.99
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Edge Distance Reduction Factors - Shear (F_{VC})

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Min. Edge Distance c_{min}(in)		1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4
Edge Distance (inches)	1-1/2	0.58	0.63	0.59	0.40	0.37	0.31	0.32	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.68	0.73	0.69	0.46	0.43	0.36	0.38	0.35	0.31	0.30	0.31	0.27	0.26	0.25	0.26	0.26	0.22	0.22	0.23
	2	0.78	0.84	0.78	0.53	0.49	0.41	0.43	0.41	0.35	0.35	0.36	0.30	0.29	0.29	0.30	0.30	0.25	0.26	0.27
	2-1/4	0.87	0.94	0.88	0.59	0.55	0.46	0.48	0.46	0.40	0.39	0.40	0.34	0.33	0.32	0.33	0.33	0.28	0.29	0.30
	2-1/2	0.97	1.00	0.98	0.66	0.61	0.51	0.54	0.51	0.44	0.43	0.45	0.38	0.36	0.36	0.37	0.37	0.31	0.32	0.33
	2-3/4	1.00	1.00	1.00	0.73	0.67	0.56	0.59	0.56	0.49	0.48	0.49	0.42	0.40	0.40	0.41	0.41	0.34	0.35	0.37
	3	1.00	1.00	1.00	0.79	0.73	0.61	0.64	0.61	0.53	0.52	0.54	0.46	0.44	0.43	0.45	0.44	0.38	0.39	0.40
	3-1/2	1.00	1.00	1.00	0.92	0.85	0.72	0.75	0.71	0.62	0.61	0.63	0.53	0.51	0.50	0.52	0.52	0.44	0.45	0.47
	4	1.00	1.00	1.00	1.00	0.97	0.82	0.86	0.81	0.71	0.69	0.72	0.61	0.58	0.57	0.59	0.59	0.50	0.51	0.53
	4-1/2	1.00	1.00	1.00	1.00	1.00	0.92	0.97	0.91	0.80	0.78	0.81	0.68	0.66	0.65	0.67	0.67	0.56	0.58	0.60
	5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.87	0.90	0.76	0.73	0.72	0.74	0.74	0.63	0.64	0.66
	5-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.95	0.99	0.84	0.80	0.79	0.82	0.82	0.69	0.71	0.73
	6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.88	0.86	0.89	0.89	0.75	0.77	0.80
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.95	0.93	0.97	0.96	0.81	0.84	0.86
	7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	0.90	0.93
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.96	1.00
	8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Spacing Reduction Factors - Shear (F_{VS})

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Minimum Spacing s_{min} (in)		1-1/2	1-1/2	1-1/2	2	2	2	2	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	3	3	3	3
Spacing Distance (inches)	1-1/2	0.60	0.60	0.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.61	0.62	0.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.63	0.64	0.63	0.59	0.58	0.57	0.57	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.65	0.66	0.65	0.60	0.59	0.58	0.58	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.66	0.67	0.66	0.61	0.60	0.59	0.59	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	0.68	0.69	0.68	0.62	0.61	0.59	0.60	0.59	0.58	0.58	0.58	0.57	0.57	0.57	0.57	-	-	-	-
	3	0.69	0.71	0.70	0.63	0.62	0.60	0.61	0.60	0.59	0.59	0.59	0.58	0.57	0.57	0.57	0.57	0.56	0.56	0.57
	3-1/2	0.73	0.74	0.73	0.65	0.64	0.62	0.63	0.62	0.60	0.60	0.60	0.59	0.59	0.58	0.59	0.59	0.57	0.57	0.58
	4	0.76	0.78	0.76	0.68	0.66	0.64	0.64	0.64	0.62	0.62	0.62	0.60	0.60	0.60	0.60	0.60	0.58	0.59	0.59
	4-1/2	0.79	0.81	0.79	0.70	0.68	0.65	0.66	0.65	0.63	0.63	0.63	0.61	0.61	0.61	0.61	0.61	0.59	0.60	0.60
	5	0.82	0.85	0.83	0.72	0.70	0.67	0.68	0.67	0.65	0.64	0.65	0.63	0.62	0.62	0.62	0.62	0.60	0.61	0.61
	5-1/2	0.86	0.88	0.86	0.74	0.72	0.69	0.70	0.69	0.66	0.66	0.66	0.64	0.63	0.63	0.64	0.64	0.61	0.62	0.62
	6	0.89	0.92	0.89	0.76	0.74	0.70	0.71	0.70	0.68	0.67	0.68	0.65	0.65	0.64	0.65	0.65	0.63	0.63	0.63
	6-1/2	0.92	0.95	0.92	0.79	0.76	0.72	0.73	0.72	0.69	0.69	0.69	0.66	0.66	0.66	0.66	0.66	0.64	0.64	0.64
	7	0.95	0.99	0.96	0.81	0.78	0.74	0.75	0.74	0.71	0.70	0.71	0.68	0.67	0.67	0.67	0.67	0.65	0.65	0.66
	7-1/2	0.99	1.00	0.99	0.83	0.80	0.76	0.77	0.75	0.72	0.72	0.72	0.69	0.68	0.68	0.69	0.69	0.66	0.66	0.67
	8	1.00	1.00	1.00	0.85	0.82	0.77	0.79	0.77	0.74	0.73	0.74	0.70	0.69	0.69	0.70	0.70	0.67	0.67	0.68
	9	1.00	1.00	1.00	0.90	0.87	0.81	0.82	0.80	0.77	0.76	0.77	0.73	0.72	0.72	0.72	0.72	0.69	0.69	0.70
	10	1.00	1.00	1.00	0.94	0.91	0.84	0.86	0.84	0.80	0.79	0.80	0.75	0.74	0.74	0.75	0.75	0.71	0.71	0.72
	11	1.00	1.00	1.00	0.98	0.95	0.87	0.89	0.87	0.82	0.82	0.83	0.78	0.77	0.76	0.77	0.77	0.73	0.74	0.74
	12	1.00	1.00	1.00	1.00	0.99	0.91	0.93	0.91	0.85	0.85	0.86	0.80	0.79	0.79	0.80	0.80	0.75	0.76	0.77
	13	1.00	1.00	1.00	1.00	1.00	0.94	0.96	0.94	0.88	0.88	0.89	0.83	0.82	0.81	0.82	0.82	0.77	0.78	0.79
	14	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.97	0.91	0.90	0.92	0.85	0.84	0.84	0.85	0.85	0.79	0.80	0.81
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.93	0.95	0.88	0.86	0.86	0.87	0.87	0.81	0.82	0.83
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.96	0.98	0.91	0.89	0.88	0.90	0.90	0.83	0.84	0.85
	17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.93	0.91	0.91	0.92	0.92	0.86	0.86	0.88
	18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.94	0.93	0.95	0.94	0.88	0.89	0.90
	19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.96	0.95	0.97	0.97	0.90	0.91	0.92
	20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	1.00	0.99	0.92	0.93	0.94
	21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.95	0.97
	22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.97	0.99
	23	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.99	1.00
	24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Ultimate Load Capacities for Screw-Bolt+ in Normal-Weight Concrete at Minimum Edge[1,2]

Nominal Anchor Diameter d in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Edge Distance in. (mm)	Minimum Concrete Compressive Strength					
			f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)	
			Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1-5/8 (41)	1-1/2 (38)	2,060 (9.2)	1,300 (5.8)	2,260 (10.1)	1,420 (6.3)	2,600 (11.6)	1,640 (7.3)
	2-1/2 (64)		3,380 (15.0)	1,580 (7.0)	3,700 (16.5)	1,740 (7.7)	4,280 (19.0)	2,000 (8.9)
3/8	1-1/2 (38)	1-1/2 (38)	2,120 (9.4)	1,060 (4.7)	2,320 (10.3)	1,160 (5.2)	2,680 (11.9)	1,340 (6.0)
	2 (51)		2,600 (11.6)	1,560 (6.9)	2,840 (12.6)	1,700 (7.6)	3,280 (14.6)	1,960 (8.7)
	3-1/4 (83)		4,460 (19.8)	2,080 (9.3)	4,880 (21.7)	2,280 (10.1)	5,640 (25.1)	2,640 (11.7)
	4-1/2 (114)		7,680 (34.2)	2,080 (9.3)	8,420 (37.5)	2,280 (10.1)	9,720 (43.2)	2,640 (11.7)
1/2	1-3/4 (44)	1-3/4 (38)	2,840 (12.6)	2,040 (9.1)	3,115 (13.9)	2,220 (9.9)	3,595 (16.0)	2,580 (11.5)
	2-1/2 (64)		3,820 (17.0)	2,360 (10.5)	4,180 (18.6)	2,580 (11.5)	4,820 (21.4)	2,980 (13.3)
	4-1/4 (108)		6,860 (30.5)	3,280 (14.6)	7,520 (33.5)	3,580 (15.9)	8,680 (38.6)	4,140 (18.4)
	5-1/2 (140)		12,600 (56.0)	3,280 (14.6)	13,800 (61.4)	3,580 (15.9)	15,940 (70.9)	4,140 (18.4)
5/8	3-1/4 (83)	1-3/4 (44)	5,260 (23.4)	2,800 (12.5)	5,760 (25.6)	3,060 (13.6)	6,640 (29.5)	3,540 (15.7)
	5 (127)		8,360 (37.2)	3,660 (16.3)	9,160 (40.7)	4,020 (17.9)	10,580 (47.1)	4,640 (20.6)
	6-1/4 (159)		10,240 (45.5)	3,660 (16.3)	11,200 (49.8)	4,020 (17.9)	12,940 (57.6)	4,640 (20.6)
3/4	4-1/4 (108)	1-3/4 (44)	7,240 (32.2)	3,460 (15.4)	7,920 (35.2)	3,780 (16.8)	9,160 (40.7)	4,360 (19.4)
	5 (127)		9,140 (40.7)	3,460 (15.4)	10,020 (44.6)	3,780 (16.8)	11,560 (51.4)	4,360 (19.4)
	6-1/4 (159)		14,420 (64.1)	3,460 (15.4)	15,800 (70.3)	3,780 (16.8)	18,240 (81.1)	4,360 (19.4)

1. Tabulated load values are for anchors installed in uncracked concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

Allowable Load Capacities for Screw-Bolt+ in Normal-Weight Concrete at Minimum Edge[1,2,3,4,5]

Nominal Anchor Diameter d in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Edge Distance in. (mm)	Minimum Concrete Compressive Strength					
			f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)	
			Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1-5/8 (41)	1-1/2 (38)	515 (2.3)	325 (1.4)	565 (2.5)	355 (1.6)	650 (2.9)	410 (1.8)
	2-1/2 (64)		845 (3.8)	395 (1.8)	925 (4.1)	435 (1.9)	1,070 (4.8)	500 (2.2)
3/8	1-1/2 (38)	1-1/2 (38)	530 (2.4)	265 (1.2)	580 (2.6)	290 (1.3)	670 (3.0)	335 (1.5)
	2 (51)		650 (2.9)	390 (1.7)	710 (3.2)	425 (1.9)	820 (3.6)	490 (2.2)
	3-1/4 (83)		1,115 (5.0)	520 (2.3)	1,220 (5.4)	570 (2.5)	1,410 (6.3)	660 (2.9)
	4-1/2 (114)		1,920 (8.5)	520 (2.3)	2,105 (9.4)	570 (2.5)	2,430 (10.8)	660 (2.9)
1/2	1-3/4 (44)	1-3/4 (38)	710 (3.2)	510 (2.3)	780 (3.5)	555 (2.5)	900 (4.0)	645 (2.9)
	2-1/2 (64)		955 (4.2)	590 (2.6)	1,045 (4.6)	645 (2.9)	1,205 (5.4)	745 (3.3)
	4-1/4 (108)		1,715 (7.6)	820 (3.6)	1,880 (8.4)	895 (4.0)	2,170 (9.7)	1,035 (4.6)
	5-1/2 (140)		3,150 (14.0)	820 (3.6)	3,450 (15.3)	895 (4.0)	3,985 (17.7)	1,035 (4.6)
5/8	3-1/4 (83)	1-3/4 (44)	1,315 (5.8)	700 (3.1)	1,440 (6.4)	765 (3.4)	1,660 (7.4)	885 (3.9)
	5 (127)		2,090 (9.3)	915 (4.1)	2,290 (10.2)	1,005 (4.5)	2,645 (11.8)	1,160 (5.2)
	6-1/4 (159)		2,560 (11.4)	915 (4.1)	2,800 (12.5)	1,005 (4.5)	3,235 (14.4)	1,160 (5.2)
3/4	4-1/4 (108)	1-3/4 (44)	1,810 (8.1)	865 (3.8)	1,980 (8.8)	945 (4.2)	2,290 (10.2)	1,090 (4.8)
	5 (127)		2,285 (10.2)	865 (3.8)	2,505 (11.1)	945 (4.2)	2,890 (12.9)	1,090 (4.8)
	6-1/4 (159)		3,605 (16.0)	865 (3.8)	3,950 (17.6)	945 (4.2)	4,560 (20.3)	1,090 (4.8)

1. Tabulated load values are for anchors installed in uncracked concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor of 4.0 to average ultimate load capacities.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing distances are less that critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
5. For lightweight concrete multiply tabulated allowable load values by a reduction factor of 0.60.

Allowable Screw-Bolt+ Tension and Shear Load Capacities Installed into the face of Grout-Filled Concrete Masonry Units[1,2,3,4,5,6,7,8,9]

CODE LISTED
ICC-ES ESR-4042

Tension Load

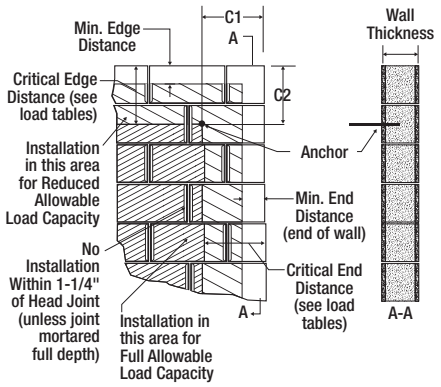
Anchor Diameter, d in.	Minimum Embedment h_{nom} in. (mm)	Allowable Load at c_{cr} and s_{cr} lbs (kN)	Spacing Distance, s			Edge or End Distance, c_2 or c_1 (see Illustration of Screw-Bolt+ Installed into Grouted Concrete Masonry Wall detail)		
			Critical Distance, s_{cr} in. (mm)	Minimum Distance, s_{min} in. (mm)	Allowable Load Factor at s_{min}	Critical Distance, c_{cr} in. (mm)	Minimum Distance, c_{min} in. (mm)	Allowable Load Factor at c_{min}
1/4	1-5/8 (41.3)	315 (1.4)	4 (101.6)	2 (50.8)	1.00 (no reduction)	3-3/4 (95.3)	1-1/4 (31.8)	0.60
	2-1/2 (63.5)	605 (2.7)						
3/8	2 (50.8)	450 (2.0)	6 (152.4)	3 (76.2)	1.00 (no reduction)	6 (152.4)	1-1/2 (38.1)	0.70
	3-1/4 (82.6)	1,085 (4.8)						
1/2	2-1/2 (63.5)	610 (2.7)	8 (203.2)	4 (101.6)	1.00 (no reduction)	8 (203.2)	2-5/8 (66.7)	0.75
	4-1/4 (108.0)	1,190 (5.3)						
5/8	3-1/4 (82.6)	880 (3.9)	10 (254.0)	4 (101.6)	1.00 (no reduction)	10 (254.0)	3-3/8 (85.7)	0.90
	5 (127.0)	1,270 (5.6)						
3/4	4 (101.6)	1,150 (5.1)	12 (304.8)	4 (101.6)	1.00 (no reduction)	12 (304.8)	4 (101.6)	1.00 (no reduction)
	6-1/4 (158.8)	1,355 (6.0)						

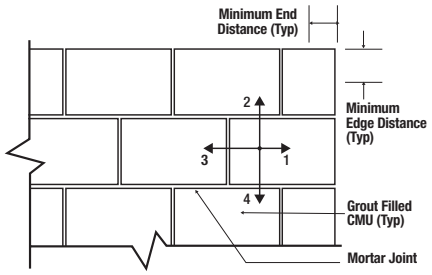
Shear Load

Anchor Diameter, d in.	Minimum Embedment h_{nom} in. (mm)	Allowable Load at c_{cr} and s_{cr} Direction 1 & 2 lbs[9] (kN)	Allowable Load at c_{cr} and s_{cr} Direction 3 & 4 lbs[9] (kN)	Spacing Distance, s			Edge or End Distance, c_2 or c_1 (see Illustration of Screw-Bolt+ Installed into Grouted Concrete Masonry Wall detail)			
				Critical Distance, s_{cr} in. (mm)	Minimum Distance, s_{min} in. (mm)	Allowable Load Factor at s_{min}	Critical Distance, c_{cr} in. (mm)	Minimum Distance, c_{min} in. (mm)	Allowable Load Factor at c_{min}	
									Load Perpendicular to Edge or End (Direction 1 & 2)[9]	Load Perpendicular to Edge or End (Direction 3 & 4)[9]
1/4	1-5/8 (41.3)	400 (1.8)	400 (1.8)	4 (101.6)	2 (50.8)	1.00 (no reduction)	3-3/4 (95.3)	1-1/4 (31.8)	0.35	1.00 (no reduction)
	2-1/2 (63.5)	505 (2.2)	505 (2.2)							
3/8	2 (50.8)	815 (3.6)	815 (3.6)	6 (152.4)	3 (76.2)	1.00 (no reduction)	6 (152.4)	1-1/2 (38.1)	0.27	1.00 (no reduction)
	3-1/4 (82.6)	935 (4.2)	935 (4.2)							
1/2	2-1/2 (63.5)	1,380 (6.1)	1,380 (6.1)	8 (203.2)	4 (101.6)	1.00 (no reduction)	8 (203.2)	2-5/8 (66.7)	0.20	1.00 (no reduction)
	4-1/4 (108.0)	2,180 (9.7)	2,180 (9.7)							
5/8	3-1/4 (82.6)	2,090 (9.3)	2,225 (9.9)	10 (254.0)	4 (101.6)	1.00 (no reduction)	10 (254.0)	3-3/8 (85.7)	0.23	1.00 (no reduction)
	5 (127.0)	2,640 (11.7)	2,640 (11.7)							
3/4	4 (101.6)	2,800 (12.5)	3,330 (14.8)	12 (304.8)	4 (101.6)	1.00 (no reduction)	12 (304.8)	4 (101.6)	0.25	1.00 (no reduction)
	6-1/4 (158.8)	3,100 (13.8)	3,685 (16.4)							

For SI: 1 inch = 25.4 mm; 1 lbs = 0.0044 kN, 1 psi = 0.006894 MPa.

1. All values are for anchors installed in fully grouted concrete masonry wall construction with materials meeting minimum compressive strength, f'm, of 1,500 psi (10.3 MPa). Concrete masonry units must be light-, medium, or normal-weight conforming to ASTM C90. Allowable loads are based on a safety factor of 5.0.
2. Anchors may be installed in any location in the face of the masonry wall (cell, web, bed joint) except within 1-1/4-inch from the of the vertical mortar joint (head joint), center-to-center, provided the minimum edge and end distances are maintained. Anchors may not be placed in the head joint unless the vertical joint is mortared full-depth.
3. A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor. See the Illustration of Screw-Bolt+ Anchors Installed into Grouted Concrete Masonry Wall figure.
4. The critical spacing distance, s_{cr}, is the anchor spacing where full load values in the table may be used. The minimum spacing distance, s_{min}, is the minimum anchor spacing for which values are available and installation is permitted. Spacing distance is measured from the centerline to centerline between two anchors.
5. The critical edge or end distance, c_{cr}, is the distance where full load values in the table may be used. The minimum edge or end distance, c_{min}, is the minimum distance for which values are available and installation is permitted. Edge or end distance is measured from anchor centerline to the closest unrestrained edge.
6. The tabulated values are applicable for anchors installed into the ends of grout-filled concrete masonry units (e.g. wall opening) where minimum edge distances are maintained.
7. Load values for anchors installed less than s_{cr} and c_{cr} must be multiplied by the appropriate load reduction factor based on actual spacing (s) or edge distance (c). Load factors are multiplicative; both spacing and edge reduction factors must be considered.
8. Linear interpolation of load values between minimum spacing (s_{min}) and critical spacing (s_{cr}) and between minimum edge or end distance (c_{min}) and critical edge or end distance (c_{cr}) is permitted.
9. See the Direction of Shear Loading in Relation to Edge and End of Masonry Wall figure for illustration of shear load directions.





1. Shear load perpendicular to End and parallel to Edge
2. Shear load perpendicular to Edge and parallel to End
3. Shear load parallel to Edge and perpendicular away from End
4. Shear load parallel to End and perpendicular to bottom of wall

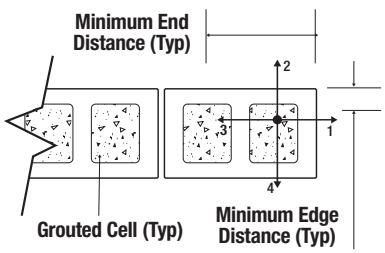
Allowable Screw-Bolt+ Tension and Shear Load Capacities Installed into the Tops of Grout-Filled Concrete Masonry Units[1,2,3,4,5,6,7,8,9,10]

CODE LISTED ICC-ES ESR-4042

Anchor Diameter d in.	Minimum Embedment h_{nom} in. (mm)	Minimum Spacing Distance in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Tension Load lbs (kN)	Shear Load, lb (kN)	
						Load Perpendicular to Edge of Masonry Wall (II to end)	Load Parallel to Edge of Masonry Wall (⊥ to end)
1/4	2-1/2 (63.5)	1-1/2 (38.1)	1-1/2 (38.1)	4 (101.6)	410 (1.8)	185 (0.8)	185 (0.8)
		1-1/2 (38.1)	3-1/2 (88.9)	4 (101.6)	485 (2.2)	215 (1.0)	215 (1.0)
3/8	3-1/4 (82.6)	2 (50.8)	1-1/2 (38.1)	4 (101.6)	625 (2.8)	225 (1.0)	505 (2.2)
		2 (50.8)	3-1/2 (88.9)	6 (152.4)	625 (2.8)	560 (2.5)	560 (2.5)
1/2	4-1/4 (108.0)	8 (203.2) (see Note 4 for reduced minimum spacing distances)	1-3/4 (44.5)	8 (203.2)	810 (3.6)	255 (1.1)	580 (2.6)
			3-3/4 (95.3)		1,210 (5.4)	645 (2.9)	1,030 (4.6)
5/8	5 (127.0)	10 (254.0)	1-3/4 (44.5)	10 (254.0)	900 (4.0)	260 (1.2)	950 (4.2)
3/4	6-1/4 (158.8)	12 (304.8)	1-3/4 (44.5)	12 (304.8)	1,215 (5.4)	260 (1.2)	990 (4.4)

For SI: 1 inch = 25.4 mm; 1 lbs = 0.0044 kN, 1 psi = 0.006894 MPa.

1. All values are for anchors installed in fully grouted concrete masonry wall construction with materials meeting minimum compressive strength, f'm, of 1,500 psi (10.3 MPa). Concrete masonry units must be light-, medium, or normal-weight conforming to ASTM C90. Allowable loads are based on a safety factor of 5.0.
2. Anchors may be installed in any location in the top of the masonry wall except within 1-1/4-inch from the of the mortar joint (head joint), provided the minimum edge and end distances are maintained.
3. A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor. See Screw-Bolt+ Anchors Installed into the Top of Grouted Concrete Masonry Wall figure.
4. Minimum spacing distance for 1/2-inch-diameter anchors shall be 8 inches and may be reduced to 2 inches provided the allowable load reduction factor of 0.40 is applied. Linear interpolation may be used to determine the reduction factor for intermediate anchor spacing distances between 8 inches and 2 inches.
5. Spacing distance is measured from the centerline to centerline between two anchors.
6. Linear interpolation may be used to for 1/4-inch and 3/8-inch-diameter anchors to determine allowable loads for edge distances between 3-1/2-inches and 1-1/2-inches.
7. Linear interpolation may be used to for 1/2-inch-diameter anchors to determine allowable loads for edge distances between 3-3/4-inches and 1-3/4-inches.
8. The edge and end distance is measured from the anchor centerline to the closest unrestrained edge and end of the CMU block, respectively. See Screw-Bolt+ Anchors Installed into the Top of Grouted Concrete Masonry Wall figure.
9. Spacing distance is measured from the centerline to centerline between two anchors.
10. Allowable shear loads parallel and perpendicular to the edge of a masonry wall may be applied in or out of plane, respectively. See Screw-Bolt+ Anchors Installed into the Top of Grouted Concrete Masonry Wall figure.



1. Shear load perpendicular to End and parallel to Edge
2. Shear load perpendicular to Edge and parallel to End
3. Shear load parallel to Edge and perpendicular away from End
4. Shear load parallel to End and perpendicular to bottom of wall

Allowable Screw-Bolt+ Tension and Shear Load Capacities Installed into the Face of Brick Masonry Walls[1,2,3,4,5,6,7,8]

Tension Load									
Anchor Diameter, d in.	Minimum Embedment, h_{nom} in. (mm)	Allowable Load at c_{cr} and s_{cr} lbs (kN)	Spacing Distance, s			Edge or End Distance		
			Critical Distance, s_{cr} in. (mm)	Minimum Distance, s_{min} in. (mm)	Allowable Load Factor at s_{min} in. (mm)	Critical Distance, c_{cr} in. (mm)	Minimum Distance, c_{min} in. (mm)	Allowable Load Factor at c_{min}
1/4	1-5/8 (41.3)	550 (2.4)	4 (101.6)	2 (50.8)	0.60	3-3/4 (95.3)	1-1/4 (31.8)	0.25
	2-1/2 (63.5)	830 (3.7)						
3/8	2 (50.8)	905 (4.0)	6 (152.4)	3 (76.2)	0.60	6 (152.4)	1-1/2 (38.1)	0.50
	3-1/4 (82.6)	1,115 (5.0)						
1/2	2-1/2 (63.5)	1,015 (4.5)	8 (203.2)	4 (101.6)	0.60	8 (203.2)	2-5/8 (66.7)	0.50
	4-1/4 (108.0)	1,495 (6.7)						
5/8	3-1/4 (82.6)	1025 (4.6)	10 (254.0)	5 (127.0)	0.50	10 (254.0)	3-3/8 (85.7)	0.50
	5 (127.0)	2,015 (9.0)						
3/4	4 (101.6)	1,815 (8.1)	12 (304.8)	6 (152.4)	0.50	12 (304.8)	4 (101.6)	0.50
	6-1/4 (158.8)	2,400 (10.7)						

Shear Load								
Anchor Diameter, d in.	Minimum Embedment, h_{nom} in. (mm)	Allowable Load at c_{cr} and s_{cr} lbs (kN)	Spacing Distance, s			Edge or End Distance		
			Critical Distance, s_{cr} in. (mm)	Minimum Distance, s_{min} in. (mm)	Allowable Load Factor at s_{min} in. (mm)	Critical Distance, c_{cr} in. (mm)	Minimum Distance, c_{min} in. (mm)	Allowable Load Factor at c_{min} Load Perpendicular to Edge or End
1/4	1-5/8 (41.3)	405 (1.8)	4 (101.6)	2 (50.8)	0.70	3-3/4 (95.3)	1-1/4 (31.8)	0.20
	2-1/2 (63.5)	520 (2.3)						
3/8	2 (50.8)	930 (4.1)	6 (152.4)	3 (76.2)	0.70	6 (152.4)	1-1/2 (38.1)	0.20
	3-1/4 (82.6)	1,030 (4.6)						
1/2	2-1/2 (63.5)	1,055 (4.7)	8 (203.2)	4 (101.6)	0.65	8 (203.2)	2-5/8 (66.7)	0.25
	4-1/4 (108.0)	1,075 (4.8)						
5/8	3-1/4 (82.6)	1,700 (7.6)	10 (254.0)	5 (127.0)	0.50	10 (254.0)	3-3/8 (85.7)	0.40
	5 (127.0)	1,980 (8.8)						
3/4	4 (101.6)	1,700 (7.6)	12 (304.8)	6 (152.4)	0.50	12 (304.8)	4 (101.6)	0.55
	6-1/4 (158.8)	2,030 (9.0)						

For SI: 1 inch = 25.4 mm; 1 lbs = 0.0044 kN, 1 psi = 0.006894 MPa.

1. All values are for anchors installed in minimum two-wythe, solid clay brick masonry walls conforming to ASTM C62, grade SW minimum. Mortar must be type N, S or M. The base material must have a minimum compressive strength, f'm, of 2,000 psi (13.8 MPa). Allowable loads are based on a safety factor of 5.0.
2. Anchors may be installed in any location in the face of the masonry wall, provided the minimum edge and end distances are maintained.
3. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor.
4. The critical spacing distance, s_{cr}, is the anchor spacing where full load values in the table may be used. The minimum spacing distance, s_{min}, is the minimum anchor spacing for which values are available and installation is permitted. Spacing distance is measured from the centerline to centerline between two anchors.
5. The critical edge or end distance, c_{cr}, is the distance where full load values in the table may be used. The minimum edge or end distance, c_{min}, is the minimum distance for which values are available and installation is permitted. Edge or end distance is measured from anchor centerline to the closest unrestrained edge.
6. The tabulated values are applicable for anchors installed into wall openings where minimum edge distances are maintained.
7. Load values for anchors installed less than s_{cr} and c_{cr} must be multiplied by the appropriate load reduction factor based on actual spacing (s) or edge distance (c). Load factors are multiplicative; both spacing and edge reduction factors must be considered.
8. Linear interpolation of load values between minimum spacing (s_{min}) and critical spacing (s_{cr}) and between minimum edge or end distance (c_{min}) and critical edge or end distance (c_{cr}) is permitted.

INSTALLATION SPECIFICATIONS (SD)

Screw-Bolt+ Installation Specifications in Concrete and Supplemental Information[1,2,3,4]

CODE LISTED ICC-ES ESR-3889

Anchor Property/ Setting Information		Notation	Units	Nominal Anchor Diameter (inch)												
				1/4		3/8			1/2			5/8			3/4	
Head Style		-	-	Hex or Flat Head		Hex or Flat Head			Hex or Flat Head			Hex Head			Hex Head	
Nominal anchor diameter		d_a	in. (mm)	0.250 (6.35)		0.375 (9.525)			0.500 (12.7)			0.625 (15.9)			0.750 (19.05)	
Minimum diameter of hole clearance in fixture[8]		d_h	in. (mm)	3/8 (9.5)		1/2 (12.7)			5/8 (15.9)			3/4 (19.1)			7/8 (22.2)	
Drill bit diameter (ANSI)		d_{bit}	in.	1/4		3/8			1/2			5/8			7/8	
Minimum nominal embedment depth[5]		h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)	
Effective Embedment		h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)	
Minimum hole depth		h_{hole}	in. (mm)	2 (51)	2-7/8 (73)	2-3/8 (60)	2-7/8 (73)	3-5/8 (92)	2-7/8 (73)	3-3/8 (86)	4-5/8 (117)	3-5/8 (92)	4-3/8 (111)	5-3/8 (137)	4-5/8 (117)	
Minimum concrete member thickness		h_{min}	in. (mm)	3-1/4 (83)	4 (102)	3-1/2 (89)	4 (102)	5 (127)	4-1/2 (114)	5-1/4 (133)	6-3/4 (171)	5 (127)	6 (152)	7 (178)	6 (152)	
Minimum edge distance[6]		c_{min}	in. (mm)	1-1/2 (38)		c_{min} = 1-1/2 (38) for $s_{min} \geq$ 3 (76) s_{min} = 2 (51) for $c_{min} \geq$ 2 (51)			1-3/4 (44)			1-3/4 (44)			1-3/4 (44)	
Minimum spacing distance[6]		s_{min}	in. (mm)	1-1/2 (38)					2-3/4 (70)			2-3/4 (70)			3 (76)	
Minimum overall anchor length[7]		ℓ_{anch}	in.	1-3/4	2-5/8	2-1/2	3	4	3	4	5	4	5	6	5	
Maximum manual installation torque		$T_{inst,max}$	ft.-lbf. (N-m)	19 (26)	25 (34)	25 (34)	25 (34)	40 (54)	45 (61)	45 (61)	60 (81)	60 (81)			70 (95)	
Maximum impact wrench power (torque)		$T_{impact,max}$	ft.-lbf (N-m).	150 (203)		300 (407)			300 (407)			700 (950)			700 (950)	
Hex Head	Wrench socket size	-	in.	7/16		9/16			3/4			15/16			1-1/8	
	Maximum head height	-	in.	21/64		3/8			31/64			37/64			43/64	
	Max washer diameter	-	in.	37/64		3/4			1-1/16			1-1/8			1-13/32	
Flat Head	Driver size	-	in.	T-30		T-50			T-55			-			-	
	Max head diameter	-	in.	17/32		57/64			1			-			-	
	Countersunk angle	-	in.	82		82			82			-			-	
Effective tensile stress area (screw anchor body)		A_{se}	in² (mm²)	0.045 (29.0)		0.094 (60.6)			0.176 (113.5)			0.274 (176.8)			0.399 (257.4)	
Minimum specified ultimate strength		f_{uta}	ksi (N/mm²)	100 (690)		105 (724)			115 (794)			95 (656)			95 (656)	
Minimum specified yield strength		f_y	ksi (N/mm²)	80 (552)		84 (579)			92 (635)			76 (524)			76 (524)	
Mean axial stiffness[9]	Uncracked concrete	β_{uncr}	lbf/in	1,252,000		1,157,000			1,014,000			919,000			1,028,000	
	Cracked concrete	β_{cr}	lbf/in	355,000		330,000			349,000			378,000			419,000	

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. For installations in the topside of concrete-filled steel deck assemblies with minimum concrete member thickness, $h_{min,deck}$, of 2.5 inches above the upper flute (topping thickness). See the table for anchor setting information for installation on the top of concrete-filled steel deck assemblies and the top of concrete over steel deck installation detail.
3. For installations in the topside of concrete-filled steel deck assemblies with sand-lightweight concrete fill, the maximum installation torque, $T_{inst,max}$, is 18 ft.-lb.
4. For installations through the soffit of steel deck assemblies into concrete, see the design information table for installation in the soffit of concrete-filled steel deck assemblies and the installation details in the soffit of concrete over steel deck for the applicable steel deck profile. Tabulated minimum spacing values are based on anchors installed along the flute with axial spacing equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
5. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
6. Additional combinations for minimum edge distance, c_{min}, and minimum spacing distance, s_{min}, may be derived by linear interpolation between the given boundary values for the 3/8-inch diameter anchors.
7. The listed minimum overall anchor length is based on the anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth. The minimum nominal length for hex head anchors is measured from under the head to the tip of the anchor, the minimum nominal length for flat head anchors is measured from the top of the head to the tip of the anchor.
8. The minimum diameter of fixture hole clearance is for the body of the anchor to pass through structural steel members; clearance holes may be 1/8-inch less than tabulated values (same as nominal drill bit diameter) provided the screw anchors are installed through light gauge cold-formed steel members or wood members.
9. Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies with Minimum Topping Thickness[1,2,3,4]

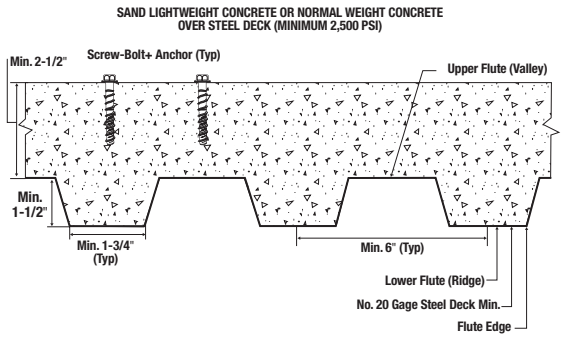
CODE LISTED
ICC-ES ESR-3889

Anchor Property / Setting Information		Notation	Units	Nominal Anchor Size (inch)		
				1/4	3/8	1/2
Head style		-	-	Hex Head or Flat Head	Hex Head or Flat Head	Hex Head or Flat Head
Nominal anchor diameter		d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)
Minimum diameter of hole clearance in fixture[8]		d_h	in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)
Nominal drill bit diameter (ANSI)		d_{bit}	in.	1/4	3/8	1/2
Minimum nominal embedment depth[5]		h_{nom}	in. (mm)	1-5/8 (41) / 2-1/2 (64)	2 (51)	2-1/2 (64)
Effective embedment		h_{ef}	in. (mm)	1.20 (30) / 1.94 (49)	1.33 (33)	1.75 (44)
Minimum hole depth		h_o	in. (mm)	2 (51) / 2-1/2 (64)	2-3/8 (60)	2-1/2 (64)
Minimum concrete member thickness (topping thickness)		$h_{min,deck}$	in. (mm)	2-1/2 (64) / 2-1/2 (64)	2-1/2 (64)	2-1/2 (64)
Minimum edge distance		$c_{min,deck,top}$	in. (mm)	1-1/2 (38)	2 (51)	2-1/2 (64)
Minimum spacing distance		$s_{min,deck,top}$	in. (mm)	1-1/2 (38)	2 (51)	2-1/2 (64)
Minimum nominal anchor length[6]		ℓ_{anch}	in.	1-3/4 / 2-5/8	2-1/2	3
Maximum impact wrench power (torque)		$T_{impact,max}$	ft.-lb. (N-m)	150 (203)	300 (407)	300 (407)
Max. manual installation torque		$T_{inst,max}$	ft.-lb. (N-m)	18[7] (26) / 25 (34)	25 (34)	45 (61)
Hex Head	Wrench socket size	-	in.	7/16	9/16	3/4
	Max. head height	-	in.	21/64	3/8	31/64
	Max. washer diameter	-	in.	37/64	3/4	1-1/16
Flat Head	Driver Size	-	in.	T-30	T-50	T-55
	Max head diameter	-	in.	17/32	57/64	1
	Countersunk angle	-	in.	82	82	82

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

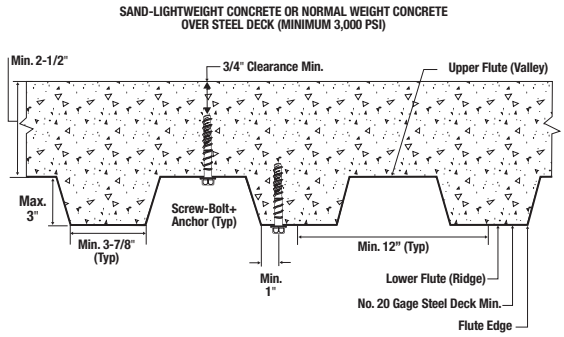
1. The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with this table, the anchor installation specifications in concrete table and the top of concrete over steel deck installation detail provided the concrete thickness above the upper flute meets the minimum thicknesses specified in this table. Minimum concrete member thickness, $h_{min,deck}$, refers to the concrete thickness above the upper flute (topping thickness). See the top of concrete over steel deck installation detail.
2. Applicable to the following conditions:
   For 1/4-inch-diameter anchors with 1-5/8-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 3-1/4-inch.
   For 1/4-inch-diameter anchors with 2-1/2-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 4-inch.
   For 3/8-inch-diameter anchors with 2-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 3-1/2-inch.
   For 1/2-inch-diameter anchors with 2-1/2-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 4-1/2-inch.
3. For all other anchor diameters and embedment depths, refer to the anchor installation specifications in concrete table for applicable values of h_{min}, c_{min} and s_{min}, which can be substituted for $h_{min,deck}$, $c_{min,deck,top}$ and $s_{min,deck,top}$, respectively.
4. Design capacities shall be based on calculations according to values in Tension Design Information and the Shear Design Information tables.
5. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
6. The listed minimum overall anchor length is based on the anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, including consideration of a fixture attachment. The minimum nominal length for hex head anchors is measured from under the head to the tip of the anchor, the minimum nominal length for flat head anchors is measured from the top of the head to the tip of the anchor.
7. For installations in the topside of concrete-filled steel deck assemblies with normal-weight concrete fill, a maximum installation torque, $T_{inst,max}$, of 19 ft.-lb is allowed.
8. The minimum diameter of fixture hole clearance is for the body of the anchor to pass through structural steel members; clearance holes may be 1/8-inch less than tabulated values (same as nominal drill bit diameter) provided the screw anchors are installed through light gauge cold-formed steel members or wood members.

Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies with Minimum Topping Thickness (See Dimensional Profile Requirements)[1,2]



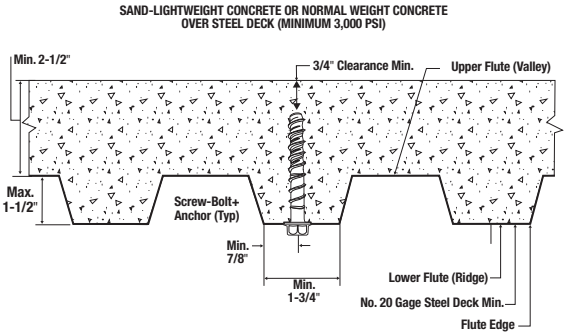
1. Anchors may be placed in the top side of concrete over steel deck profiles provided the minimum concrete thickness above the upper flute (topping thickness), minimum spacing distance and minimum edge distances are satisfied as given in Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies with Minimum Topping Thickness table.
2. For all other anchor diameters and embedment depths installed in the top of concrete over steel deck profiles with topping thickness greater than or equal to the minimum concrete member thicknesses given in the Installation Specifications in Concrete table, the minimum spacing distances and minimum edge distances must be used from the Installation Specifications in Concrete table, as applicable.

Screw-Bolt+ Installation Detail for Anchors in the Soffit of Concrete Over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)[1,2,3]



1. Anchors may be placed in the upper flute or lower flute of concrete-filled steel deck profiles provided the minimum hole clearance of 3/4-inch is satisfied for the selected anchor. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table.
2. Anchors in the lower flute may be installed with a maximum 15/16 -inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied (e.g. 1-1/4 -inch offset for 4-1/2-inch wide flute).
3. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table for design data.

Screw-Bolt+ Installation Detail for Anchors in the Soffit of Concrete Over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)[1,2,3]



1. Anchors may be placed in the upper flute or lower flute of the concrete-filled steel deck profiles provided the minimum hole clearance of 3/4-inch is satisfied for the selected anchor. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table.
2. Anchors in the lower flute may be installed in the center of the flute. An offset distance may be given proportionally for profiles with flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.
3. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table for design data.

STRENGTH DESIGN (SD)

Tension Design Information For Screw-Bolt+ Anchor In Concrete[1,2]

CODE LISTED ICC-ES ESR-3889

Design Characteristic	Notation	Units	Nominal Anchor Diameter											
			1/4		3/8			1/2			5/8			3/4
Anchor category	1, 2 or 3	-	1		1			1			1			1
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Steel Strength in Tension (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)														
Steel strength in tension	N_{sa}[10]	lb (kN)	4,535 (20.2)		8,730 (38.8)			20,475 (91.1)			26,260 (116.8)			38,165 (169.8)
Reduction factor for steel strength[3,4]	ϕ	-	0.65											
Concrete Breakout Strength in Tension (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)														
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Critical edge distance (uncracked concrete)	c_{ac}	in. (mm)	4.30 (109)	6.10 (155)	5.00 (127)	6.30 (160)	7.80 (198)	3.30 (84)	5.90 (150)	8.10 (206)	6.30 (160)	7.90 (201)	10.10 (257)	10.90 (277)
Critical edge distance, topside of concrete-filled steel decks with minimum topping thickness[9]	$c_{ac,deck,top}$	in. (mm)	3.00 (76)	4.00 (102)	3.50 (89)	-[11]	-[11]	6.00 (152)	-[11]	-[11]	-[11]	-[11]	-[11]	-[11]
Effectiveness factor for uncracked concrete	k_{uncr}	-	27	24	30	24	24	30	24	24	30	24	24	27
Effectiveness factor for cracked concrete	k_{cr}	-	17		17			17			21			17
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0		1.0			1.0			1.0			1.0
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)											
Pullout Strength in Tension (Non-Seismic Applications) (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)														
Characteristic pullout strength, uncracked concrete (2,500 psi)[6,10]	$N_{p,uncr}$	lb (kN)	See Note 7		See Note 7			See Note 7			See Note 7			See Note 7
Characteristic pullout strength, cracked concrete (2,500 psi)[6,10]	$N_{p,cr}$	lb (kN)	765 (3.4)	1,415 (6.3)	See Note 7			1,645 (7.3)	2,515 (11.2)	4,700 (20.9)	3,080 (13.7)	4,720 (21.0)	6,900 (30.7)	See Note 7
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)											
Pullout Strength in Tension for Seismic Applications (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)														
Characteristic pullout strength, seismic (2,500 psi)[6,8,10]	N_{eq}	lb	360 (1.6)	1,170 (5.2)	900 (4.0)	1,645 (7.3)	2,765 (12.3)	1,645 (7.3)	2,515 (11.2)	4,700 (20.9)	1,910 (8.5)	2,445 (10.9)	3,370 (15.0)	4,085 (18.2)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)											

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm^2; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 Section D.4.3(c), as applicable for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used.
4. The anchors are considered a brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. Select the appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) and use $\Psi_{c,N} = 1.0$.
6. For all design cases $\Psi_{c,P} = 1.0$. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 2,500 psi for 1/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 2{,}500)^{0.3}$ for psi or $(f'c / 17.2)^{0.3}$ for MPa. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 2,500 psi for 3/8-inch- to 3/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 2{,}500)^{0.5}$ for psi or $(f'c / 17.2)^{0.5}$ for MPa.
7. Pullout strength does not control design of indicated anchors and does not need to be calculated for indicated anchor size and embedment.
8. Reported values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5.Y
9. Anchors are permitted in the topside of concrete-filled steel deck assemblies in accordance with the Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies with Minimum Topping Thickness.
10. Anchors are permitted to be used in lightweight concrete provided the modification factor λa equal to 0.8λ is applied to all values of f'c affecting N_n.
11. Tabulated critical edge distance values, $c_{ac,deck,top}$, are for anchors installed in the top of concrete over steel deck profiles with a minimum concrete thickness, $h_{min,deck}$, of 2.5 inches above the upper flute (topping thickness). For minimum topping thickness greater than or equal to the minimum concrete member thicknesses, h_{min}, given in the Installation Specifications table, the associated critical edge distance, c_{ac}, for indicated anchor diameters and embedment depths may be used in the calculation of $\Psi_{cp,N}$ as applicable.

Shear Design Information for Screw-Bolt+ Anchor in Concrete[1,2,7,8]

CODE LISTED ICC-ES ESR-3889

Design Characteristic	Notation	Units	Nominal Anchor Diameter											
			1/4		3/8			1/2			5/8			3/4
Anchor category	1, 2 or 3	-	1		1			1			1			1
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Steel Strength in Shear (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)														
Steel strength in shear[5]	V_{sa}	lb (kN)	1,635 (7.3)	2,040 (9.1)	3,465 (15.4)	3,465 (15.4)	4,345 (19.3)	8,860 (39.4)	8,860 (39.4)	11,175 (49.7)	12,310 (54.8)	12,310 (54.8)	15,585 (69.3)	19,260 (85.7)
Reduction factor for steel strength[3,4]	ϕ	-	0.60											
Steel Strength in Shear for Seismic Applications (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)														
Steel strength in shear, seismic[6]	V_{eq}	lb (kN)	1,360 (6.1)	1,700 (7.7)	2,415 (10.9)	2,415 (10.9)	3,030 (13.6)	7,090 (31.9)	7,090 (31.9)	8,940 (40.2)	9,845 (44.3)	9,845 (44.3)	12,465 (56.1)	15,405 (69.3)
Reduction factor for steel strength in shear for seismic[3,4]	ϕ	-	0.60											
Concrete Breakout Strength in Shear (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)														
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)			0.500 (12.7)			0.625 (15.9)			0.750 (19.1)
Load bearing length of anchor	ℓ_e	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Reduction factor for concrete breakout[3]	ϕ	-	0.70 (Condition B)											
Pryout Strength in Shear (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)														
Coefficient for pryout strength	k_{cp}	-	1	1	1	1	1	1	1	2	1	2	2	2
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)											

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-17 17.2.3 or ACI 318-11 D.3.3, as applicable shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 Section D.4.4. For reinforcement that complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2 are used.
4. The anchors are considered a brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1.
5. Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of the calculated results using equation 17.5.1.2(b) of ACI 318-14 or equation D-29 in ACI 318-11 D.6.1.2.
6. Reported values for steel strength in shear are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.6 and must be used for design.
7. Anchors are permitted in the topside of concrete-filled steel deck assemblies in accordance with the Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies with Minimum Topping Thickness.
8. Anchors are permitted to be used in lightweight concrete in provided the modification factor λ_a equal to 0.8λ is applied to all values of f'c affecting N_n.

Tension and Shear Design Information for Screw-Bolt+ Anchor in the Soffit (Through the Underside) of Concrete-Filled Steel Deck Assemblies[1,2,3,4,5,6]

CODE LISTED
ICC-ES ESR-3889

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (inch)											
			1/4		3/8			1/2			5/8			3/4
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Effective Embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Minimum hole depth	h_o	in. (mm)	1-3/4 (44)	2-5/8 (67)	2-1/8 (54)	2-5/8 (67)	3-3/8 (86)	2-5/8 (67)	3-1/8 (79)	4-3/8 (111)	3-3/8 (86)	4-1/8 (10.5)	5-1/8 (130)	4-3/8 (111)
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete (Minimum 3-7/8-inch-wide deck flute)														
Minimum concrete member thickness[7]	$h_{min,deck,total}$	in. (mm)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	6-1/4 (159)	6-1/4 (159)
Characteristic pullout strength, uncracked concrete over steel deck, (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,430 (6.4)	2,555 (11.4)	2,275 (10.1)	2,655 (11.8)	3,235 (14.4)	2,600 (11.6)	3,555 (15.8)	5,975 (26.6)	2,610 (11.6)	4,150 (18.5)	6,195 (27.6)	6,085 (27.1)
Characteristic pullout strength, cracked concrete over steel deck, (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	615 (2.7)	1,115 (5.0)	1,290 (5.7)	1,880 (8.4)	2,290 (10.2)	1,230 (5.5)	2,330 (10.4)	4,030 (17.9)	1,600 (7.1)	3,340 (14.9)	4,945 (22.0)	3,835 (17.1)
Characteristic pullout strength, cracked concrete over steel deck,seismic, (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	290 (1.3)	920 (4.1)	890 (4.0)	1,570 (7.0)	2,015 (9.0)	1,230 (5.5)	2,330 (10.4)	4,030 (17.9)	990 (4.4)	1,730 (7.7)	2,415 (10.7)	3,410 (15.2)
Reduction factor for pullout strength[8]	ϕ	-	0.65											
Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lb (kN)	1,155 (5.1)	2,595 (11.5)	2,470 (11.0)	2,470 (11.0)	3,225 (14.3)	2,435 (10.8)	2,435 (10.8)	5,845 (26.0)	2,650 (11.8)	2,650 (11.8)	6,325 (28.1)	5,175 (23.0)
Steel strength in shear, concrete over steel deck, seismic	$V_{sa,deck,eq}$	lb (kN)	960 (4.3)	2,165 (9.6)	1,725 (7.7)	1,900 (8.5)	2,250 (10.0)	1,950 (8.7)	2,095 (9.3)	4,675 (20.8)	2,120 (9.4)	2,325 (10.3)	5,060 (22.5)	4,140 (18.4)
Reduction factor for steel strength in shear for concrete over steel deck[8]	ϕ	-	0.60											
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete (Minimum 1-3/4-inch-wide deck flute)														
Minimum concrete member thickness[7]	$h_{min,deck,total}$	in. (mm)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	N/A		N/A			N/A
Characteristic pullout strength, uncracked concrete over steel deck, (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,760 (7.8)	2,075 (9.2)	1,440 (6.4)	2,135 (9.5)	3,190 (14.2)	1,720 (7.7)	N/A		N/A			N/A
Characteristic pullout strength, cracked concrete over steel deck, (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	760 (3.4)	910 (4.0)	815 (3.6)	1,510 (6.7)	2,260 (10.1)	1,280 (5.7)	N/A		N/A			N/A
Characteristic pullout strength, cracked concrete over steel deck,seismic, (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	355 (1.6)	750 (3.3)	565 (2.5)	1,260 (5.6)	1,985 (8.8)	1,280 (5.7)	N/A		N/A			N/A
Reduction factor for pullout strength[8]	ϕ	-	0.65						N/A		N/A			N/A
Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lb (kN)	1,880 (8.4)	2,315 (10.3)	2,115 (9.4)	2,115 (9.4)	2,820 (12.5)	2,095 (9.3)	N/A		N/A			N/A
Steel strength in shear, concrete over steel deck, seismic	$V_{sa,deck,eq}$	lb (kN)	1,565 (7.0)	1,930 (8.6)	1,475 (6.6)	1,625 (7.2)	1,965 (8.7)	1,675 (7.5)	N/A		N/A			N/A
Reduction factor for steel strength in shear for concrete over steel deck[8]	ϕ	-	0.60		0.60			0.60	N/A		N/A			N/A

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. Installation must comply with published instructions and details.
2. Values for $N_{p,deck}$ and $N_{p,deck,cr}$ are for sand-lightweight concrete (f'c, min = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318 D.5.2, as applicable, is not required for anchors installed in the deck soffit (through underside).
3. Values for $N_{p,deck,eq}$ are applicable for seismic loading and must be used in lieu of $N_{p,deck,cr}$.
4. For all design cases $\Psi_{c,P} = 1.0$. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 3,000 psi for 1/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 3{,}000)^{0.3}$ for psi or $(f'c / 17.2)^{0.3}$ for MPa. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 3,000 psi for 3/8-inch- to 3/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 3{,}000)^{0.5}$ for psi or $(f'c / 17.2)^{0.5}$ for MPa.
5. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.
6. Values of $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, are not required for anchors installed in the soffit (through underside).
7. The minimum concrete member thickness, $h_{min,deck,total}$, is the minimum overall thickness of the concrete-filled steel deck (depth and topping thickness).
8. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2. If the load combinations of ACI 318 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4 (ACI 318-08).

FACTORED RESISTANCE STRENGTH (ϕN_n AND ϕV_n) CALCULATED IN ACCORDANCE WITH ACI 318-14 CHAPTER 17:

1- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with minimum slab thickness, $h_a = h_{min}$, and with the following conditions:
- c_{a1} is greater than or equal to the critical edge distance, c_{ac} (table values based on $c_{a1} = c_{ac}$).
- c_{a2} is greater than or equal to 1.5 times c_{a1}.

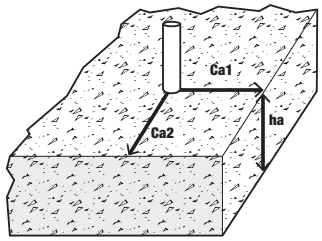
2- Calculations were performed according to ACI 318-14, Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

3- Strength reduction factors (ø) were based on ACI 318-14 Section 5.3 for load combinations. Condition B is assumed.

4- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.

5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14, Chapter 17.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14, Chapter 17. For other design conditions including seismic considerations please see ACI 318-14, Chapter 17.



Tension and Shear Design Strength Installed in Cracked Concrete

Nominal Anchor Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)
1/4	1-5/8	495	780	525	855	575	980	645	980	705	980
	2-1/2	920	1,225	970	1,225	1,060	1,225	1,195	1,225	1,305	1,225
3/8	2	845	915	930	1,000	1,070	1,155	1,315	1,415	1,515	1,635
	2-1/2	1,280	1,375	1,400	1,510	1,620	1,740	1,980	2,080	2,290	2,080
	3-1/4	2,040	2,200	2,235	2,410	2,580	2,605	3,165	2,605	3,650	2,605
1/2	2-1/2	1,070	1,270	1,170	1,395	1,355	1,610	1,655	1,970	1,915	2,275
	3	1,635	1,900	1,790	2,085	2,070	2,405	2,535	2,945	2,925	3,400
	4-1/4	3,055	4,325	3,345	4,735	3,865	5,470	4,735	6,695	5,465	6,705
5/8	3-1/4	1,850	1,995	2,030	2,185	2,345	2,525	2,870	3,090	3,315	3,570
	4	2,700	4,155	2,960	4,550	3,415	5,255	4,185	6,435	4,830	7,385
	5	3,980	6,040	4,360	6,615	5,035	7,640	6,165	9,350	7,120	9,350
3/4	4-1/4	2,985	6,135	3,270	6,720	3,780	7,760	4,625	9,505	5,340	10,975

□ - Anchor Pullout/Pryout Strength Controls ■ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strength Installed in Uncracked Concrete

Nominal Anchor Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)
1/4	1-5/8	1,155	980	1,265	980	1,460	980	1,785	980	2,065	980
	2-1/2	2,110	1,225	2,310	1,225	2,665	1,225	2,950	1,225	2,950	1,225
3/8	2	1,495	1,610	1,640	1,765	1,890	2,035	2,315	2,080	2,675	2,080
	2-1/2	1,805	1,945	1,980	2,080	2,285	2,080	2,795	2,080	3,230	2,080
	3-1/4	2,880	2,605	3,155	2,605	3,645	2,605	4,465	2,605	5,155	2,605
1/2	2-1/2	2,255	1,780	2,475	1,950	2,855	2,255	3,495	2,760	4,040	3,185
	3	2,495	2,685	2,730	2,940	3,155	3,395	3,865	4,160	4,460	4,805
	4-1/4	4,530	6,050	4,960	6,630	5,725	6,705	7,015	6,705	8,100	6,705
5/8	3-1/4	3,270	3,520	3,580	3,855	4,135	4,455	5,065	5,455	5,845	6,295
	4	3,810	5,815	4,175	6,370	4,820	7,355	5,905	7,385	6,820	7,385
	5	5,620	8,455	6,155	9,265	7,110	9,350	8,705	9,350	10,050	9,350
3/4	4-1/4	4,745	8,590	5,195	9,410	6,000	10,865	7,350	11,555	8,485	11,555

□ - Anchor Pullout/Pryout Strength Controls ■ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

FACTORED RESISTANCE STRENGTH (ϕN_n AND ϕV_n) CALCULATED IN ACCORDANCE WITH ACI 318-14, CHAPTER 17:

1- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with minimum slab thickness, $h_a = h_{min}$, and with the following conditions:
- c_{a1} is greater than or equal to the minimum edge distance, c_{min} (table values based on $c_{a1} = c_{min}$).
- c_{a2} is greater than or equal to 1.5 times c_{a1}.

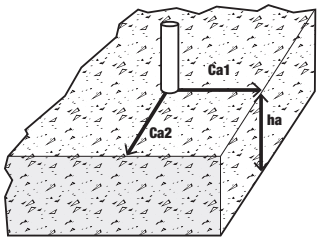
2- Calculations were performed according to ACI 318-14, Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

3- Strength reduction factors (ø) were based on ACI 318-14 Section 5.3 for load combinations. Condition B is assumed.

4- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.

5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14, Chapter 17.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14, Chapter 17. For other design conditions including seismic considerations please see ACI 318-14, Chapter 17.



Tension and Shear Design Strength at Minimum Edge Distance, c_{min} for Screw-Bolt+ in Cracked Concrete

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)
1/4	1-5/8	495	370	525	405	575	470	645	575	705	660
	2-1/2	920	450	970	495	1,060	570	1,195	700	1,305	810
3/8	2	785	445	860	485	990	560	1,215	685	1,405	790
	2-1/2	1,115	500	1,220	550	1,410	635	1,725	775	1,995	895
	3-1/4	1,685	595	1,845	650	2,130	755	2,610	920	3,015	1,065
1/2	2-1/2	1,070	675	1,170	740	1,355	855	1,655	1,045	1,915	1,205
	3	1,520	760	1,665	835	1,925	960	2,355	1,180	2,720	1,360
	4-1/4	2,595	935	2,840	1,025	3,280	1,180	4,015	1,445	4,640	1,670
5/8	3-1/4	1,585	800	1,735	875	2,005	1,010	2,455	1,240	2,835	1,430
	4	2,220	920	2,430	1,010	2,805	1,165	3,435	1,425	3,970	1,645
	5	3,160	1,045	3,460	1,145	3,995	1,325	4,895	1,620	5,650	1,870
3/4	4-1/4	2,430	985	2,660	1,080	3,075	1,245	3,765	1,525	4,345	1,760

□ - Anchor Pullout/Pryout Strength Controls ▣ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strength at Minimum Edge Distance, c_{min} for Screw-Bolt+ in Uncracked Concrete

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)
1/4	1-5/8	460	495	505	540	580	625	710	765	820	885
	2-1/2	860	635	940	695	1,085	800	1,330	980	1,535	1,130
3/8	2	550	595	605	650	700	750	855	920	990	1,065
	2-1/2	655	700	720	765	830	885	1,015	1,085	1,175	1,250
	3-1/4	1,095	835	1,200	915	1,385	1,055	1,695	1,290	1,955	1,490
1/2	2-1/2	1,615	945	1,770	1,035	2,045	1,195	2,505	1,465	2,890	1,690
	3	1,185	1,065	1,300	1,165	1,500	1,345	1,835	1,650	2,120	1,905
	4-1/4	2,190	1,310	2,400	1,430	2,770	1,655	3,390	2,025	3,915	2,340
5/8	3-1/4	1,495	1,120	1,635	1,225	1,890	1,415	2,310	1,735	2,670	2,000
	4	1,715	1,290	1,875	1,410	2,165	1,630	2,655	1,995	3,065	2,305
	5	2,470	1,465	2,705	1,605	3,125	1,855	3,830	2,270	4,420	2,620
3/4	4-1/4	1,635	1,380	1,790	1,510	2,070	1,745	2,535	2,135	2,925	2,465

□ - Anchor Pullout/Pryout Strength Controls ▣ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

ORDERING INFORMATION

Screw-Bolt+

Cat. No.			Anchor Size	Box Qty.	Ctn. Qty.	20V Max* SDS Plus Rotary Hammers			Flexvolt SDS Max
						DCH273P2DH 1" L-Shape	DCH133M2 1" D-Handle	DCH293R2 1-1/8" L-Shape w/ E-Clutch	DCH481X2 1-9/16" w/ E-Clutch
Hex Head		Flat Head				Carbide Bits			
Zinc Plated	Galvanized	Zinc Plated							
PFM1411000	-	-	1/4" x 1-1/4"	100	600	DW5517	DW5417	DW5417	-
PFM1411020	-	-	1/4" x 1-3/4"	100	600	DW5517	DW5417	DW5417	-
PFM1411060	-	-	1/4" x 2-1/4"	100	600	DW5517	DW5417	DW5417	-
PFM1411080	-	-	1/4" x 2-5/8"	100	500	DW5517	DW5417	DW5417	-
PFM1411100	-	PFM1411105	1/4" x 3"	100	500	DW5517	DW5417	DW5417	-
PFM1411160	-	-	3/8" x 1-3/4"	50	300	DW5527	DW5427	DW5427	-
PFM1411220	-	PFM1411225	3/8" x 2-1/2"	50	300	DW5527	DW5427	DW5427	-
PFM1411240	PFM1461240	PFM1411245	3/8" x 3"	50	250	DW5527	DW5427	DW5427	-
PFM1411280	PFM1461280	PFM1411285	3/8" x 4"	50	250	DW5527	DW5427	DW5427	-
PFM1411300	PFM1461300	-	3/8" x 5"	50	250	DW5529	DW5429	DW5429	-
PFM1411320	PFM1461320	-	3/8" x 6"	50	150	DW5529	DW5429	DW5429	-
PFM1411340	-	-	1/2" x 2"	50	200	DW5537	DW5437	DW5437	-
PFM1411360	-	-	1/2" x 2-1/2"	50	200	DW5537	DW5437	DW5437	-
PFM1411380	-	PFM1411385	1/2" x 3"	50	150	DW5537	DW5437	DW5437	-
PFM1411420	PFM1461420	PFM1411425	1/2" x 4"	50	150	DW5537	DW5437	DW5437	-
PFM1411460	PFM1461460	PFM1411465	1/2" x 5"	25	100	DW5538	DW5438	DW5438	-
PFM1411480	PFM1461480	-	1/2" x 6"	25	75	DW5538	DW5438	DW5438	-
PFM1411520	PFM1461520	-	1/2" x 8"	25	100	DW5538	DW5438	DW5438	-
PFM1411540	-	-	5/8" x 3"	25	100	DW5471	DW5446	DW5471	DW5806
PFM1411580	-	-	5/8" x 4"	25	100	DW5471	DW5446	DW5471	DW5806
PFM1411600	PFM1461600	-	5/8" x 5"	25	75	DW5471	DW5446	DW5471	DW5806
PFM1411640	PFM1461640	-	5/8" x 6"	25	75	DW5471	DW5446	DW5471	DW5806
PFM1411680	PFM1461680	-	5/8" x 8"	25	50	DW5471	DW5447	DW5471	DW5806
PFM1411700	-	-	3/4" x 3"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411720	-	-	3/4" x 4"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411760	-	-	3/4" x 5"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411800	PFM1461800	-	3/4" x 6"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411840	PFM1461850	-	3/4" x 8"	10	40	DW5474	DW5455	DW5474	DW5810
PFM1411880	-	-	3/4" x 10"	10	20	DW5475	DW5455	DW5475	DW5812

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for Strength Design.

The published size includes the diameter and length of the anchor measured from under the head for hex head parts and from the top of the head for flat head (countersunk) parts.

- Optimum Tool Match
- Maximum Tool Match
- Not Recommended

ICC EVALUATION SERVICE

ICC-ES Evaluation Report

ESR-3889

Reissued November 2019
Revised July 2020
This report is subject to renewal November 2020.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

DEWALT

ADDITIONAL LISTEE:

THE HILLMAN GROUP

EVALUATION SUBJECT:

SCREW-BOLT+™ ANCHORS AND HANGERMATE®+ ROD HANGER SCREW ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2018, 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2018, 2015, 2012 and 2009 *International Residential Code*® (IRC)

For evaluation for compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS), see ESR-3889 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

The Screw-Bolt+ anchors and Hangermate+ rod hanger screw anchors are used as anchorage in cracked and uncracked normal-weight concrete and lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) to resist static, wind and seismic tension and shear loads.

The $^1/_4$-inch-, $^3/_8$-inch- and $^1/_2$-inch-diameter (6.4 mm, 9.5 mm and 12.7 mm) Screw-Bolt+ anchors may be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The $^1/_4$-inch-, $^3/_8$-inch-, $^1/_2$-inch-, $^5/_8$-inch, and $^3/_4$-inch-diameter (6.4 mm 9.5 mm, 12.7 mm, 15.9 mm and 19.1 mm) Screw-Bolt+ anchors may be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa). The $^1/_4$-inch-, $^3/_8$-inch-, and $^1/_2$-inch-diameter (6.4 mm, 9.5 mm, and 12.7 mm) Hangermate+ anchors may be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

The anchors are an alternative to cast-in-place anchors described in Section 1901.3 of the 2018 and 2015 IBC, Section 1908 and 1909 of the 2012 IBC, and Sections 1911 and 1912 of the 2009 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 Screw-Bolt+ Anchors:

Screw-Bolt+ screw anchors are comprised of an anchor body with hex washer head or flat head (countersunk) style, in various lengths. Available diameters are $^1/_4$-inch, $^3/_8$-inch, $^1/_2$-inch, $^5/_8$-inch and $^3/_4$-inch (6.4 mm, 9.5 mm, 12.7 mm, 15.9 mm and 19.1 mm). The anchor body and hex washer head or flat head are manufactured from low-carbon steel which is case hardened and have minimum 0.0002-inch (5 µm) zinc plating in accordance with ASTM B633 or minimum 0.0021-inch (53 µm) mechanical zinc plating in accordance with ASTM B695, Class 55. The Screw-Bolt+ anchor is illustrated in Figures 1A and 1B. Product names for the report holder and for the additional listees are presented in the following table.

COMPANY NAME	PRODUCT NAME
DEWALT	Screw-Bolt+
The Hillman Group	Hillman Screw-Bolt+

The hex head of the anchor is formed with an integral washer and serrations on the underside. The anchor body is formed with dual lead threads and a chamfered tip. The screw anchors are installed in a predrilled hole with a powered impact wrench or torque wrench. The threads on the anchor tap into the sides of the predrilled hole and interlock with the base material during installation.

3.2 Hangermate+ Anchors:

Hangermate+ rod hanger screw anchors are comprised of

the following: a nominally $^1/_4$-inch-diameter one-piece anchor body, with a hex coupler head version containing internal threads that accepts threaded rods and bolts in $^1/_4$-inch and $^3/_8$-inch (6.4 mm and 9.5 mm) diameters; a stud head version containing external threads in $^3/_8$-inch (9.5 mm) diameter; or a nominally $^3/_8$-inch-diameter one-piece anchor body, with a hex coupler head version containing internal threads that accepts threaded rods and bolts in $^3/_8$-inch and $^1/_2$-inch (9.5 mm and 12.7 mm) diameters.

The anchor body and hex coupler head are manufactured from low-carbon steel which is case hardened, and have minimum 0.0002-inch (5 µm) zinc plating in accordance with ASTM B633. The Hangermate+ rod hanger screw anchor is illustrated in Figures 1A and 1B.

Product names for the report holder and for the additional listees are presented in the following table.

COMPANY NAME	PRODUCT NAME
DEWALT	Hangermate+
The Hillman Group	Hillman Hangermate+

The hex coupler head of the anchor is formed with serrations on the underside, and with internal threads into the topside that accepts threaded rods or threaded bolt steel insert elements. The anchor body is formed with dual lead threads and a chamfered tip. The anchors are installed in a predrilled hole with a powered impact wrench or torque wrench. The threads on the anchor body tap into the sides of the predrilled concrete hole and interlock with the base material during installation.

3.3 Threaded Steel Insert Elements for Hangermate+:

Threaded steel insert elements must be threaded into the Hangermate+ anchors to form a connection. The material properties of the steel inserts must comply national or international specifications (e.g., ASTM A36; ASTM A307, ASTM F1554, Grade 36; ASTM A307, SAE J429, Grade 2, ASTM A193, Grade B7), or equivalent.

3.4 Concrete:

Normal-weight and lightweight concrete must conform to Sections 1903 and 1905 of the IBC.

3.5 Steel Deck Panels:

Steel deck panels for anchors must comply with the configurations in Figures 5A, 5B, 6A and 6B of this report, and have a minimum base-metal thickness of 0.035 inch (0.89 mm) [No. 20 gage]. Steel deck must comply with ASTM A653/A 653M SS Grade 50, and have a minimum yield strength of 50 ksi (345 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with the 2018 and 2015 IBC, as well as Section R301.1.3 of the 2018 and 2015 IRC must be determined in accordance with ACI 318-14 Chapter 17 and this report.

Design strength of anchors complying with the 2012 IBC, as well as Section R301.1.3 of the 2012 IRC, must be determined in accordance with ACI 318-11 Appendix D and this report.

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

A design example in accordance with the 2018, 2015 and 2012 IBC is given in Figure 7 of this report.

Design parameters provided in Tables 3A, 3B, 4, 5 and 6 of this report are based on the 2018 and 2015 IBC (ACI 318-14) and the 2012 IBC (ACI 318-11) unless noted otherwise in Section 4.1.1 through 4.1.12 of this report.

The strength design of anchors must comply with ACI 318-14 17.3.1 or ACI 318-11 D.4.1, as applicable, except as required in ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Strength reduction factors, ϕ, as given in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, and noted in Tables 3A, 3B, 4, 5 and 6 of this report, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC, Section 5.3 of ACI 318-14, and Section 9.2 of ACI 318-11, as applicable. Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with Appendix C of ACI 318-11. The value of f'_c used in the calculation must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal static steel strength of a single anchor in tension, N_{sa}, calculated in accordance with ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, is given in Table 3 of this report. Strength reduction factors, ϕ, corresponding to brittle steel elements must be used.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal concrete breakout strength of a single anchor or a group of anchors in tension, N_{cb} or N_{cbg}, respectively, must be calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with modifications as described in this section. The basic concrete breakout strength of a single anchor in tension in cracked concrete, N_b, must be calculated according to ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of h_{ef} and k_{cr} as given in Table 3 of this report. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, must be calculated with the value of k_{uncr} as given in Tables 3A and 4 of this report and with $\psi_{c,N}$ = 1.0.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B, 6A and 6B, calculation of the concrete breakout strength in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, is not required.

4.1.4 Requirements for Static Pullout Strength in Tension, N_{pn}: The nominal pullout strength of a single anchor or a group of anchors, in accordance with ACI 318-14 17.4.3 or ACI 318-11 D.5.3, as applicable, in cracked and uncracked concrete, $N_{p,cr}$ and $N_{p,uncr}$, respectively, is given in Tables 3A and 4. In lieu of ACI 318-14 17.4.3.6 or ACI 318-11 D.5.3.6, as applicable, $\Psi_{c,P}$ = 1.0 for all design cases. The nominal pullout strength in cracked concrete may be adjusted by calculation according to Eq-1:

$$N_{pn,f'_c} = N_{p,cr}\left(\frac{f'_c}{2{,}500}\right)^n \text{ (lb, psi)} \quad \text{(Eq-1)}$$

$$N_{pn,f'_c} = N_{p,cr}\left(\frac{f'_c}{17.2}\right)^n \text{ (N, MPa)}$$

where f'_c is the specified concrete compressive strength and n is the factor defining the influence of concrete compressive strength on pullout strength. For the nominal $^1/_4$-inch-diameter anchors (i.e. $^1/_4$-inch-diameter anchor bodies), n is 0.3. For all other cases, n is 0.5.

In regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.3.6 or ACI 318-11

D.5.3.6, as applicable, the nominal pullout strength in tension of the anchors can be adjusted by calculation according to Eq-2:

$$N_{pn,f'_c} = N_{p,uncr}\left(\frac{f'_c}{2{,}500}\right)^n \text{ (lb, psi)} \qquad \text{(Eq-2)}$$

$$N_{pn,f'_c} = N_{p,uncr}\left(\frac{f'_c}{17.2}\right)^n \text{ (N,MPa)}$$

where f'_c is the specified concrete compressive strength and n is the factor defining the influence of concrete compressive strength on pullout strength. For the $^1/_4$-inch-diameter anchors, n is 0.3. For all other cases, n is 0.5.

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Tables 3A and 4 of this report, the pullout strength in tension need not be considered or evaluated.

The nominal pullout strength in tension of anchors installed in the upper and lower flute soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B, 6A and 6B, is provided in Tables 5 and 6. The nominal pullout strength in cracked concrete can be adjusted by calculation according to Eq-1, whereby the value of $N_{p,deck,cr}$ must be substituted for $N_{p,cr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator. The nominal pullout strength in uncracked concrete can be adjusted by calculation according to Eq-2, whereby the value of $N_{p,deck,uncr}$ must be substituted for $N_{p,uncr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator.

4.1.5 Requirements for Static Steel Strength in Shear, V_{sa}: The nominal steel strength in shear, V_{sa}, of a single anchor in accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, is given in Tables 3B and 4 of this report and must be used in lieu of the values derived by calculation from ACI 318-14 Eq, 17.5.1.2b or ACI 318-11, Eq. D-29, as applicable. Strength reduction factors, ϕ, corresponding to brittle steel elements must be used.

The nominal shear strength of anchors installed in the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, $V_{sa,deck}$, as shown in Figures 5A, 5B, 6A and 6B is given in Tables 5 and 6 of this report, in lieu of the values derived by calculation from ACI 318-14 Eq. 17.5.1.2b or ACI 318-11, Eq. D-29, as applicable.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: 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 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, with modifications as described in this section. The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the value of ℓ_e and d_a given in Tables 3B and 4 of this report.

For anchors installed in the topside of concrete-filled steel deck assemblies, 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 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, using the actual member topping thickness, $h_{min,deck}$, in the determination of A_{Vc}. Minimum member topping thickness for anchors in the topside of concrete-filled steel deck assemblies is given in Tables 1A, 1B and 2 of this report, as applicable.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B, 6A and 6B, calculation of the concrete breakout strength in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, is not required.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear, V_{cp} or V_{cpg}: The nominal concrete pryout strength of a single anchor or group of anchors, V_{cp} or V_{cpg}, respectively, must be calculated in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, using the value of k_{cp} provided in Tables 3B and 4, and the value of N_{cb} or N_{cbg} as calculated in Section 4.1.3 of this report.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B, 6A and 6B, calculation of the concrete pryout strength in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, is not required.

4.1.8 Requirements for Seismic Design:

4.1.8.1 General: For load combinations including seismic loads, the design must be performed in accordance with ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Modifications to ACI 318-14 17.2.3 shall be applied under 2018 and 2015 IBC Section 1905.1.8. For the 2012 IBC, Section 1905.1.9 shall be omitted. Modifications to ACI 318-08 D.3.3 shall be applied under Section 1908.1.9 of the 2009 IBC.

The nominal steel strength and nominal concrete breakout strength for anchors in tension, and the nominal concrete breakout strength and pryout strength for anchors in shear, must be calculated according to ACI 318-14 17.4 and 17.5 or ACI 318-11 D.5 and D.6, respectively, as applicable, taking into account the corresponding values in Tables 3A, 3B and 4 of this report.

The anchors comply with ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, as brittle steel elements and must be designed in accordance with ACI 318-14 17.2.3.4, 17.2.3.5, 17.2.3.6, or 17.2.3.7; ACI 318-11 D.3.3.4, D.3.3.5, D.3.3.6 or D.3.3.7; or ACI 318-08 D.3.3.4, D.3.3.5 or D.3.3.6, as applicable.

The $^1/_4$-inch-diameter (6.4 mm), $^3/_8$-inch-diameter (9.5 mm), $^1/_2$-inch-diameter (12.7 mm), $^5/_8$-inch-diameter (15.9 mm) and $^3/_4$-inch-diameter (19.1 mm) Screw-Bolt+ anchors and the $^1/_4$-inch-diameter (6.4 mm), $^3/_8$-inch-diameter (9.5 mm) and $^1/_2$-inch-diameter (12.7 mm) Hangermate+ anchors may be installed in regions designated as IBC Seismic Design Categories A through F.

4.1.8.2 Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated according to ACI 318-14 17.4.1 and 17.4.2, or ACI 318-11 D.5.1 and D.5.2, respectively, as applicable, as described in Sections 4.1.2 and 4.1.3 of this report. In accordance with ACI 318-14 17.4.3.2 or ACI 318-11 D.5.3.2, as applicable, the appropriate value for nominal pullout strength in tension for seismic loads, $N_{p,eq}$ described in Table 3 of this report, must be used in lieu of N_p. $N_{p,eq}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report.

Where values for $N_{p,eq}$ are not provided in Tables 3A and 4, the pullout strength in tension for seismic forces need not be evaluated.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof

assemblies, the nominal pullout strength in tension for seismic loads, $N_{p,deck,eq}$, is provided in Tables 5 and 6 and must be used in lieu of $N_{p,cr}$. $N_{p,deck,eq}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report where the value of 3,000 psi or 20.7 MPa must be substituted for the value of 2,500 psi or 17.2 MPa in the denominator.

4.1.8.3 Seismic Shear: The nominal concrete breakout strength and pryout strength for anchors in shear must be calculated according to ACI 318-14 17.5.2 or 17.5.3, or ACI 318-11 D.6.2 and D.6.3, respectively, as applicable, as described in Sections 4.1.6 and 4.1.7 of this report. In accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, the appropriate value for nominal steel strength in shear for seismic loads, $V_{sa,eq}$, described in Tables 3B and 4 of this report, must be used in lieu of V_{sa}.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B, 6A and 6B, the appropriate value for nominal steel strength in shear for seismic loads, $V_{sa,deck,eq}$, described in Tables 5 and 6, must be used in lieu of V_{sa}.

4.1.9 Requirements for Interaction of Tensile and Shear Forces: The effects of combined tensile and shear forces must be determined in accordance with ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.10 Requirements for Critical Edge Distance, c_{ac}: In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, must be further multiplied by the factor $\psi_{cp,N}$ given by Eq-3:

$$\psi_{cp,N} = \frac{c}{c_{ac}} \qquad \text{(Eq-3)}$$

whereby the factor $\psi_{cp,N}$ need not be taken less than $\frac{1.5h_{ef}}{c_{ac}}$. For all other cases, $\psi_{cp,N}$ = 1.0. In lieu of using ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, values of c_{ac} provided in Tables 3A and 4 of this report must be used.

4.1.11 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: In lieu of ACI 318-14 17.7.1 and 17.7.3, or ACI 318-11 D.8.1 and D.8.3, respectively, as applicable, the values of s_{min} and c_{min} as given in Table 1 of this report must be used. In lieu of ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, minimum member thicknesses, h_{min}, as given in Tables 1A and 1B of this report must be used.

For anchors installed in the topside of concrete-filled steel deck assemblies, the anchors must be installed in accordance with Tables 1A, 1B and 2 and Figure 4 of this report.

For anchors installed through the soffit of steel deck assemblies, the anchors must be installed in accordance with Figures 5A, 5B, 6A, and 6B, and shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

4.1.12 Requirements for Lightweight Concrete: For the use of anchors in lightweight concrete, the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n.

For ACI 318-14 (2018 and 2015 IBC), ACI 318-11 (2012 IBC) and ACI 318-08 (2009 IBC), λ shall be determined in accordance with the corresponding version of ACI 318.

For anchors installed in the soffit of sand-lightweight concrete-filled steel deck and floor and roof assemblies, further reduction of the pullout values provided in this report is not required.

4.2 Allowable Stress Design (ASD):

4.2.1 General: Design values for use with allowable stress design load combinations calculated in accordance with Section 1605.3 of the IBC must be established using Eq-4 and Eq-5 as follows:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \qquad \text{(Eq-4)}$$

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha} \qquad \text{(Eq-5)}$$

where:

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

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

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-14 Chapter 17 and 2018 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9, and Section 4.1 of this report, as applicable (lbf or kN).

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 and 2018 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9, and Section 4.1 of this report, as applicable (lbf or kN).

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α must include all applicable factors to account for non-ductile failure modes and required over-strength.

The limits on edge distance, anchor spacing and member thickness as given in Tables 1A, 1B and 2 of this report must apply. An example of Allowable Stress Design tension values for illustrative purposes is shown in Table 7 of this report.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318-14 17.6 or ACI 318 (-11, -08) D.7, as applicable, as follows:

For shear loads $V \leq 0.2V_{allowable,ASD}$, the full allowable load in tension $T_{allowable,ASD}$ must be permitted.

For tension loads $T \leq 0.2T_{allowable,ASD}$, the full allowable load in shear $V_{allowable,ASD}$ must be permitted.

For all other cases: $\frac{T}{T_{allowable}} + \frac{V}{V_{allowable}} \leq 1.2$ (Eq-6)

4.3 Installation:

Installation parameters are provided in Tables 1A, 1B and 2, and Figures 1A, 2 and 3 of this report. Anchor locations must comply with this report and plans and specifications approved by the code official. The Screw-Bolt+ and Hangermate+ screw anchors must be installed according to the manufacturer's published installation instructions

and this report. Anchors must be installed in holes drilled using carbide-tipped masonry drill bits complying with ANSI B212.15.

The Screw-Bolt+ and Hangermate+ screw anchors are permitted to be loosened by a maximum of one full turn and retightened with a torque wrench or powered impact wrench to facilitate fixture attachment or realignment. Complete removal and reinstallation of the anchor is not allowed.

For anchor installation in the topside of concrete-filled steel deck assemblies, installation must comply with Tables 1A, 1B and 2 and Figure 4, as applicable.

For installation in the soffit of concrete on steel deck assemblies, the hole diameter in the steel deck must not exceed the diameter of the hole in the concrete by more than $^1/_8$ inch (3.2 mm). For member thickness and edge distance restrictions for installations into the soffit of concrete on steel deck assemblies, see Tables 5 and 6 and Figures 5A, 5B, 6A, and 6B.

4.4 Special Inspection:

Periodic special inspection is required, in accordance with Section 1705.1.1 and Table 1705.3 of the 2018 and 2015 IBC or 2012 IBC, as applicable; Section 1704.15 and Table 1704.4 of the 2009 IBC; or Section 1704.13 of the 2006 IBC, as applicable. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, drill bit size and type, anchor spacing, edge distances, concrete thickness, anchor embedment, maximum impact wrench power and adherence to the manufacturer's published installation instructions. The special inspector must be present as often as required in accordance with the "statement of special inspection."

5.0 CONDITIONS OF USE

The Screw-Bolt+ and Hangermate+ screw anchors described in this report comply with, or are a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The anchors must be installed in accordance with the manufacturer's published installation instructions and this report. In case of a conflict, this report governs.

5.2 Anchor sizes, dimensions, and minimum embedment depths are as set forth in this report.

5.3 The $^1/_4$-inch to $^3/_4$-inch (6.4 mm to 19.1 mm) Screw-Bolt+ anchors and $^1/_4$-inch- to $^1/_2$-inch-diameter (6.4 mm to 12.7 mm) Hangermate+ anchors must be installed in cracked and uncracked normal-weight concrete and lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

5.4 The $^1/_4$-inch to $^1/_2$-inch (6.4 mm to 12.7 mm) Screw-Bolt+ anchors may be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

5.5 The $^1/_4$-inch to $^3/_4$-inch (6.4 mm to 19.1 mm) Screw-Bolt+ anchors and $^1/_4$-inch- to $^1/_2$-inch-inch-diameter (6.4 mm to 12.7 mm) Hangermate+ anchors must be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

5.6 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55.2 MPa).

5.7 The concrete shall have attained its minimum design strength prior to installation of the anchors.

5.8 Strength design values must be established in accordance with Section 4.1 of this report.

5.9 Allowable design values must be established in accordance with Section 4.2 of this report.

5.10 Anchor spacing(s) and edge distance(s), and minimum member thickness, must comply with Tables 1A, 1B and 2, and Figures 4, 5A, 5B, 6A, and 6B of this report.

5.11 For anchors with a ¼-inch-diameter screw anchor body, installations using a manual torque wrench are limited to a maximum concrete compressive strength of 4,000 psi (27.6 MPa).

5.12 Reported values for the Hangermate+ with an internally threaded head do not consider the steel insert element which must be verified by the design professional. Shear design values in this report for the Hangermate+ with an internally threaded head are for threaded rod or steel inserts with an ultimate strength, $F_u \geq 125$ ksi; threaded rod or steel inserts with an F_u less than 125 ksi are allowed provided the steel strength shear values are multiplied by the ratio of F_u (ksi) of the steel insert and 125 ksi.

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

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

5.15 The $^1/_4$-inch- to $^3/_4$-inch-diameter (6.4 mm to 19.1 mm) Screw-Bolt+ anchors and $^1/_4$-inch- to $^1/_2$-inch-diameter (6.4 mm to 12.7 mm) Hangermate+ anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.

5.16 The $^1/_4$-inch- to $^3/_4$-inch-diameter (6.4 mm to 19.1 mm) Screw-Bolt+ anchors and $^1/_4$-inch- to $^1/_2$-inch-diameter (6.4 mm to 12.7 mm) Hangermate+ anchors may be used to resist short-term loading due to wind or seismic forces (Seismic Design Categories A through F under the IBC), subject to the conditions of this report.

5.17 Anchors are not permitted to support fire-resistance-rated construction. Where not otherwise prohibited by code, Screw-Bolt+ and Hangermate+ anchors are permitted for installation in fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support a fire-resistance-rated envelope or a fire-resistance-rated membrane, are

protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.

- Anchors are used to support nonstructural elements.

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

5.19 Use of carbon steel anchors with zinc plating in accordance with ASTM B633 as described in Section 3.1 and 3.2 of this report is limited to dry, interior locations.

5.20 Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood must be zinc-coated. Minimum coating weights for zinc-coated steel anchors must comply with ASTM B695, Class 55 as described in Section 3.1.

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

5.22 Screw-Bolt+ and Hangermate+ are manufactured under an approved quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated October 2017, (Editorially revised April 2018), which incorporates requirements in ACI 355.2-07 / ACI 355.2-04, for use in cracked and uncracked concrete; including Test No. 11 (AC193, Annex 1, Table 4.2) for reliability of screw anchors against brittle failure, and optional service-condition Test No. 18 and Test No. 19 (AC193, Annex 1, Table 4.2) for seismic tension and shear.

6.2 Quality control documentation.

7.0 IDENTIFICATION

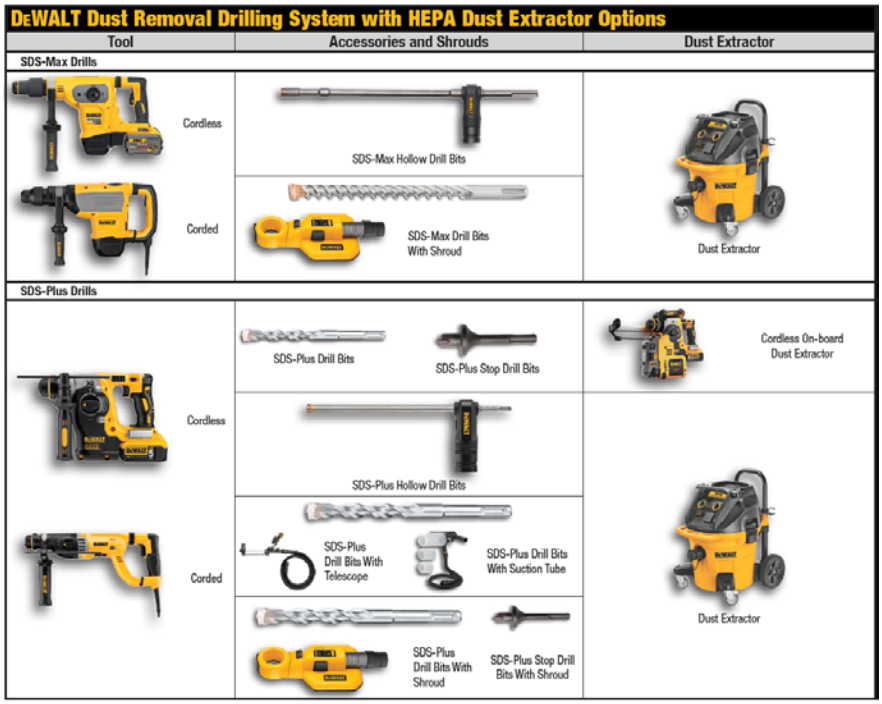
7.1 The Screw-Bolt+ and Hangermate+ screw anchors are identified in the field by dimensional characteristics and packaging. A diameter and length marking is stamped on the head of each Screw-Bolt+ anchor; these are visible after installation for verification. Packages are identified with the company name as set forth in Section 3.1 of this report; anchor name; part number; type; anchor size and length; and the evaluation report number (ESR-3889).

7.2 The report holder's contact information is as follows:

DEWALT
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.DEWALT.com
anchors@DEWALT.com

7.3 The additional listee's contact information is as follows:

THE HILLMAN GROUP
10590 HAMILTON AVENUE
CINCINNATI, OHIO 45231
info@hillmangroup.com



The DEWALT drilling systems shown collect and remove dust with a HEPA dust extractor during the hole drilling operation in dry base materials using hammer-drill (see step 1 of the manufacturer's printed installation instructions).

FIGURE A—EXAMPLES OF DEWALT DUST REMOVAL DRILLING SYSTEMS WITH HEPA DUST EXTRACTORS FOR ILLUSTRATION

TABLE A—INSTALLATION AND DESIGN INDEX[1]

Product Name	Installation Specifications	Tension Design Data			Shear Design Data		
		Concrete	Top of Steel Deck	Steel Deck Soffit	Concrete	Top of Steel Deck	Steel Deck Soffit
Screw-Bolt+	Tables 1A, 2 and 5	Table 3A	Table 3A	Table 5	Table 3B	Table 3B	Table 5
Hangermate+	Tables 1B and 6	Table 4	Table 4	Table 6	Table 4	Table 4	Table 6

Concrete Type	Concrete State	Anchor Nominal Size	Seismic Design Categories[2]
Normal-weight and lightweight	Cracked	1/4", 3/8", 1/2", 5/8", 3/4"	A through F
	Uncracked	1/4", 3/8", 1/2", 5/8", 3/4"	A and B

For **SI:** 1 inch = 25.4 mm. For **pound-inch** units: 1 mm = 0.03937 inch.

[1]Reference ACI 318-14 17.3.1.1 or ACI 318-11 D.4.1.1, as applicable. The controlling strength is decisive from all appropriate failure modes, as applicable (i.e. steel, concrete breakout, pullout, pryout) and design assumptions.
[2]See Section 4.1.8 for requirements for seismic design, where applicable.

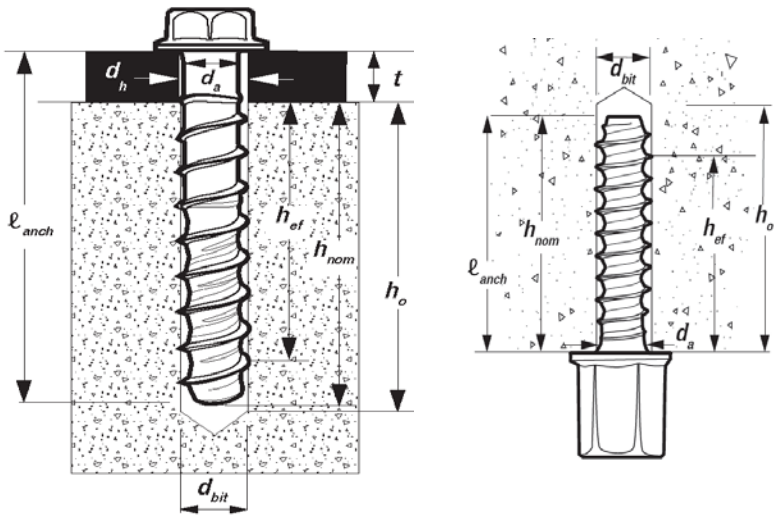
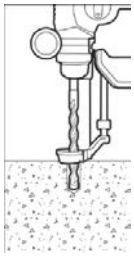
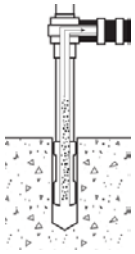


FIGURE 1A—SCREW-BOLT+ ANCHOR DETAIL (Left Picture) AND HANGERMATE+ ANCHOR DETAIL (Right Picture)

FIGURE 1B—SCREW-BOLT+ (Hex Head and Flat Head Versions) AND HANGERMATE+ (Bottom Pictures – Internally Threaded Head and External Thread Head Rod Hanger Versions)



1.) Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



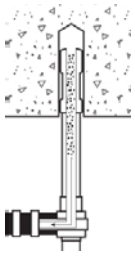
2.) Remove dust and debris from hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles left from drilling.

3.) Select a powered impact wrench or torque wrench and do not exceed the maximum torque, $T_{impact,max}$ or $T_{inst,max}$, respectively, for the selected anchor diameter and embedment (See Table 1A). Attach an appropriate sized hex socket to the wrench. Mount the screw anchor head into the socket.

4.) Drive the anchor with an impact wrench or torque wrench through the fixture and into the hole until the head of the anchor comes into contact with the fixture. The anchor must be snug after installation. Do not spin the hex socket off the anchor to disengage.

FIGURE 2—SCREW-BOLT+ INSTALLATION INSTRUCTIONS (Hex Head Version Illustrated, Flat Head Version is Not Shown)

1.) Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



2.) Remove dust and debris from hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles left from drilling.

3.) Select a powered impact wrench or torque wrench and do not exceed the maximum torque, $T_{impact,max}$ or $T_{inst,max}$, respectively, for the selected anchor diameter and embedment (See Table 1B). Attach an appropriate sized hex socket to the wrench. Mount the screw anchor head into the socket.

4.) Drive the anchor with an impact wrench or torque wrench through the fixture and into the hole until the head of the anchor comes into contact and snug with the member surface. Do not spin the hex socket off the anchor to disengage. Insert threaded rod or threaded bolt element into Hangermate+.

FIGURE 3—HANGERMATE+ INSTALLATION INSTRUCTIONS (Internally Threaded Rod Hanger Version Illustrated, External Thread Hanger Not Shown)

TABLE 1A—SCREW-BOLT+ ANCHOR INSTALLATION AND SUPPLEMENTAL INFORMATION[1,2,3]

Anchor Property / Setting Information		Notation	Units	Nominal Anchor Size (inch)											
				1/4		3/8			1/2			5/8			3/4
Head style		-	-	Hex Head or Flat Head		Hex Head or Flat Head			Hex Head or Flat Head			Hex Head			Hex Head
Nominal anchor diameter		d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)			0.500 (12.7)			0.625 (15.9)			0.750 (19.1)
Minimum diameter of fixture hole clearance[5]		d_h	in. (mm)	3/8 (9.5)		1/2 (12.7)			5/8 (15.9)			3/4 (19.1)			7/8 (22.2)
Nominal drill bit diameter (ANSI)		d_{bit}	in.	1/4		3/8			1/2			5/8			3/4
Minimum nominal embedment depth[6]		h_{nom}	in. (mm)	1 5/8 (41)	2 1/2 (64)	2 (51)	2 1/2 (64)	3 1/4 (83)	2 1/2 (64)	3 (76)	4 1/4 (108)	3 1/4 (83)	4 (102)	5 (127)	4 1/4 (108)
Effective embedment		h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)	2.39 (60)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (56)	2.88 (73)	3.73 (94)	3.08 (78)
Minimum hole depth		h_o	in. mm	2 (51)	2 7/8 (73)	2 3/8 (60)	2 7/8 (73)	3 5/8 (92)	2 7/8 (73)	3 3/8 (86)	4 5/8 (117)	3 5/8 (86)	4 3/8 (111)	5 3/8 (137)	4 5/8 (117)
Minimum concrete member thickness		h_{min}	in. (mm)	3 1/4 (83)	4 (102)	3 1/2 (89)	4 (102)	5 (127)	4 1/2 (114)	5 1/4 (133)	6 3/4 (171)	5 (127)	6 (152)	7 (178)	6 (152)
Minimum edge distance[7]		c_{min}	in. (mm)	1 1/2 (38)		c_{min} = 1 1/2 (38) for s_{min} ≥ 3 (76);			1 3/4 (44)			1 3/4 (44)			1 3/4 (44)
Minimum spacing distance[7]		s_{min}	in. (mm)	1 1/2 (38)		s_{min} = 2 (51) for c_{min} ≥ 2 (51)			2 3/4 (70)			2 3/4 (70)			3 (76)
Minimum nominal anchor length[8,9]		ℓ_{anch}	in.	1 3/4	2 5/8	2 1/2	3	4	3	4	5	4	5	6	5
Maximum impact wrench power (torque)		$T_{impact,max}$	ft.-lb. (N-m)	150 (203)		300 (407)			300 (407)			700 (949)			700 (949)
Max. manual installation torque		$T_{inst,max}$	ft.-lb. (N-m)	19 [4] (26)	25[4] (34)	25 (34)		40 (54)	45 (61)		60 (81)	60 (81)			70 (81)
Hex Head	Wrench socket size	-	in.	7/16		9/16			3/4			15/16			1 1/8
	Max. head height	-	in.	21/64		3/8			31/64			37/64			43/64
	Max. washer dia.	-	in.	37/64		3/4			1 1/16			1 1/8			1 13/32
Flat Head	Driver size	-	In.	T-30		T-50			T-55			-			-
	Max head diameter	-	In.	17/32		57/64			1			-			-
	Countersunk angle	-	In.	82		82			82			-			-
Effective tensile stress area (screw anchor body)		A_{se}	in.^{2} (mm^2)	0.045 (28.8)		0.094 (60.7)			0.176 (113.9)			0.274 (177.0)			0.399 (257.2)
Minimum specified ultimate strength		f_{uta}	psi (N/mm^2)	100,000 (690)		105,000 (724)			115,000 (793)			95,000 (658)			95,000 (658)
Minimum specified yield strength		f_{ya}	psi (N/mm^2)	80,000 (552)		84,000 (579)			92,000 (634)			76,000 (524)			76,000 (524)
Mean axial stiffness[10]	Uncracked concrete	β_{uncr}	lbf/in.	1,252,000		1,157,000			1,014,000			919,000			1,028,000
	Cracked concrete	β_{cr}	lbf/in.	355,000		330,000			349,000			378,000			419,000

For **SI:** 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 0.0069 N/mm^2 (MPa).

[1]The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.

[2]For installations in the topside of concrete-filled steel deck assemblies with minimum concrete member thickness, $h_{min,deck}$, of 2.5 inches above the upper flute (topping thickness), see Table 2 and the installation detail in Figure 4 of this report.

[3] For installations through the soffit of steel deck assemblies into concrete, see the installation detail in Figures 5A and 5B of this report.

[4] Installation with 1/4-inch-diameter anchors using a manual torque wrench is limited to a maximum concrete compressive strength of 4,000 psi (27.6 MPa). For installations into lightweight concrete with a nominal embedment depth of 1-5/8-inch, the maximum manual installation torque, $T_{inst,max}$, is 18 ft.-lb, as applicable.

[5]The minimum diameter of fixture hole clearance is for the body of the anchor to pass through structural steel members; clearance holes may be 1/8-inch less than tabulated values (same as nominal drill bit diameter) provided the screw anchors are installed through light gauge cold-formed steel members or wood members.

[6]The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.

[7]Additional combinations for minimum edge distance, c_{min}, and minimum spacing distance, s_{min}, may be derived by linear interpolation between the given boundary values for the 3/8-inch-diameter anchors.

[8]The listed minimum anchor length is based on the anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, including consideration of a fixture attachment. The minimum nominal length for hex head anchors is measured from under the head to the tip of the anchor, the minimum nominal length for flat head anchors is measured from the top of the head to the tip of the anchor.

[9]Hex head anchors with the following minimum lengths are also suitable for use with cold-formed steel members provided the nominal thickness of the fixture attachment does not exceed 20 gauge (0.036-inch base metal thickness):

For 3/8-inch-diameter anchors with 2 1/2-inch nominal embedment, 2 1/2-inch long anchors.
For 1/2-inch-diameter anchors with 2 1/2-inch nominal embedment, 2 1/2-inch long anchors.
For 1/2-inch-diameter anchors with 3-inch nominal embedment, 3-inch long anchors.
For 5/8-inch-diameter anchors with 4-inch nominal embedment, 4-inch long anchors.
For 5/8-inch-diameter anchors with 5-inch nominal embedment, 5-inch long anchors.

[10]Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

TABLE 1B—HANGERMATE+ ANCHOR INSTALLATION AND SUPPLEMENTAL INFORMATION[1,2]

Anchor Property / Setting Information		Notation	Units	Nominal Anchor Size (inch)									
				1/4	3/8		3/8		3/8		1/2	
Coupler thread size (UNC)		-	in.	1/4 -20	3/8 -16		3/8 -16		3/8 -16		1/2 -13	
Coupler head style		-	-	Internally Threaded	Internally Threaded		External Thread		Internally Threaded		Internally Threaded	
Nominal anchor diameter (screw anchor body)		d_a	in. (mm)	0.250 (6.4)	0.250 (6.4)		0.250 (6.4)		0.375 (9.5)		0.375 (9.5)	
Nominal drill bit diameter (ANSI)		d_{bit}	in.	1/4	1/4		1/4		3/8		3/8	
Minimum nominal embedment depth[4]		h_{nom}	in. (mm)	1 5/8 (41)	1 5/8 (41)	2 1/2 (64)	1 5/8 (41)	2 1/2 (64)	2 (51)	2 1/2 (64)	2 (51)	2 1/2 (64)
Effective embedment		h_{ef}	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)	1.33 (33)	1.75 (44)
Minimum hole depth		h_o	in. mm	2 (51)	2 (51)	2 7/8 (73)	2 (51)	2 7/8 (73)	2 3/8 (60)	2 7/8 (73)	2 3/8 (60)	2 7/8 (73)
Minimum concrete member thickness		h_{min}	in. (mm)	3 1/4 (83)	3 1/4 (83)	4 (102)	3 1/4 (83)	4 (102)	3 1/2 (89)	4 (102)	3 1/2 (89)	4 (102)
Minimum edge distance[5]		c_{min}	in. (mm)	1 1/2 (38)	1 1/2 (38)		1 1/2 (38)		c_{min} = 1 1/2 (38) for $s_{min} \geq$ 3 (76);		c_{min} = 1 1/2 (38) for $s_{min} \geq$ 3 (76);	
Minimum spacing distance[5]		s_{min}	in. (mm)	1 1/2 (38)	1 1/2 (38)		1 1/2 (38)		s_{min} = 2 (51) for $c_{min} \geq$ 2 (51)		s_{min} = 2 (51) for $c_{min} \geq$ 2 (51)	
Nominal anchor length[6]		ℓ_{anch}	in.	1 5/8	1 5/8	2 1/2	1 5/8	2 1/2	2	2 1/2	2	2 1/2
Maximum impact wrench power (torque)		$T_{impact,max}$	ft.-lb. (N-m)	150 (203)	150 (203)		150 (203)		300 (407)		300 (407)	
Maximum manual installation torque		$T_{inst,max}$	ft.-lb. (N-m)	19 [3] (26)	19 [3] (26)	25 (34)	19 [3] (26)	25 (34)	25 (34)		25 (34)	
Coupler Head	Wrench socket size	-	in.	3/8	1/2		1/2		1/2		11/16	
	Max. head height	-	in.	33/64	43/64		1 3/16		43/64		53/64	
	Max. washer diameter	-	in.	1/2	21/32		21/32		21/32		31/32	
Effective tensile stress area (screw anchor body)		A_{se}	in.^{2} (mm^2)	0.045 (28.8)	0.045 (28.8)		0.045 (28.8)		0.094 (60.7)		0.094 (60.7)	
Minimum specified ultimate strength		f_{uta}	psi (N/mm^2)	115,000 (793)	115,000 (793)		115,000 (793)		100,000 (690)		100,000 (690)	
Minimum specified yield strength		f_{ya}	psi (N/mm^2)	92,000 (634)	92,000 (634)		92,000 (634)		80,000 (552)		80,000 (552)	
Mean axial stiffness[7]	Uncracked concrete	β_{uncr}	lbf/in.	1,381,000	1,381,000		1,381,000		1,157,000		1,157,000	
	Cracked concrete	β_{cr}	lbf/in.	318,000	318,000		318,000		330,000		330,000	

For **SI:** 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 0.0069 N/mm^2 (MPa).

[1]The information presented in this table is used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
[2]For installations through the soffit of steel deck assemblies into concrete, see Table 6 and the installation detail in Figures 6A and 6B of this report.
[3]For installations into lightweight concrete, the maximum manual installation torque, $T_{inst,max}$, is 18 ft.-lb.
[4]The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
[5]Additional combinations for minimum edge distance, c_{min}, and minimum spacing distance, s_{min}, may be derived by linear interpolation between the given boundary values for the nominal 3/8-inch-diameter anchors (screw anchor body diameter).
[6]The listed anchor length is based on coupler head anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth. The nominal anchor length is measured from under the coupler head to the tip of the anchor.
[7]Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

TABLE 2—ANCHOR SETTING INFORMATION FOR INSTALLATION ON THE TOP OF CONCRETE-FILLED STEEL DECK ASSEMBLIES WITH MINIMUM TOPPING THICKNESS[1,2,3,4,10]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)			
			1/4 Screw-Bolt+		3/8 Screw-Bolt+	1/2 Screw-Bolt+
Head style	-	-	Hex Head or Flat Head		Hex Head or Flat Head	Hex Head or Flat Head
Nominal anchor diameter (screw anchor body)	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)	0.500 (12.7)
Minimum diameter of hole clearance in fixture[5]	d_h	in. (mm)	3/8 (9.5)		1/2 (12.7)	5/8 (15.9)
Nominal drill bit diameter (ANSI)	d_{bit}	in.	1/4		3/8	1/2
Minimum nominal embedment depth[6]	h_{nom}	in. (mm)	1 5/8 (41)	2 1/2 (64)	2 (51)	2 1/2 (64)
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)
Minimum hole depth	h_o	in. mm	2 (51)	2 1/2 (64)	2 3/8 (60)	2 1/2 (64)
Minimum concrete member thickness (topping thickness)	$h_{min,deck}$	in. (mm)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)
Minimum edge distance	$c_{min,deck,top}$	in. (mm)	1 1/2 (38)		2 (51)	2 1/2 (64)
Minimum spacing distance	$s_{min,deck,top}$	in. (mm)	1 1/2 (38)		2 (51)	2 1/2 (64)
Minimum nominal anchor length[7,8]	ℓ_{anch}	in.	1 3/4	2 5/8	2 1/2	3
Maximum impact wrench power (torque)	$T_{impact,max}$	ft.-lb. (N-m)	150 (203)		300 (407)	300 (407)
Maximum manual installation torque	$T_{inst,max}$	ft.-lb. (N-m)	18[9] (26)	25[9] (34)	25 (34)	45 (61)

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

[1]The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with Section 4.3 of this report provided the concrete thickness above the upper flute meets the minimum thicknesses specified in this table. Minimum concrete member thickness, $h_{min,deck}$, refers to the concrete thickness above the upper flute (topping thickness). See Figure 4 of this report.

[2]Applicable to the following conditions:

For 1/4-inch-diameter anchors with 1 5/8-inch nominal embedment, 2 1/2-inch ≤ $h_{min,deck}$ < 3 1/4-inch.

For 1/4-inch-diameter anchors with 2 1/2-inch nominal embedment, 2 1/2-inch ≤ $h_{min,deck}$ < 4-inch.

For 3/8-inch-diameter anchors with 2-inch nominal embedment, 2 1/2-inch ≤ $h_{min,deck}$ < 3 1/2-inch.

For 1/2-inch-diameter anchors with 2 1/2-inch nominal embedment, 2 1/2-inch ≤ $h_{min,deck}$ < 4 1/2-inch.

[3]For all other anchor diameters and embedment depths, refer to Table 1 for applicable values of h_{min}, c_{min} and s_{min}, which can be substituted for $h_{min,deck}$, $c_{min,deck,top}$ and $s_{min,deck,top}$, respectively.

[4]Design capacities shall be based on calculations according to values in Tables 3A and 3B of this report.

[5]The minimum diameter of fixture hole clearance is for the body of the anchor to pass through structural steel members; clearance holes, may be 1/8-inch less than tabulated values (same as nominal drill bit diameter) provided the screw anchors are installed through light gauge cold-formed steel members or wood members.

[6]The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.

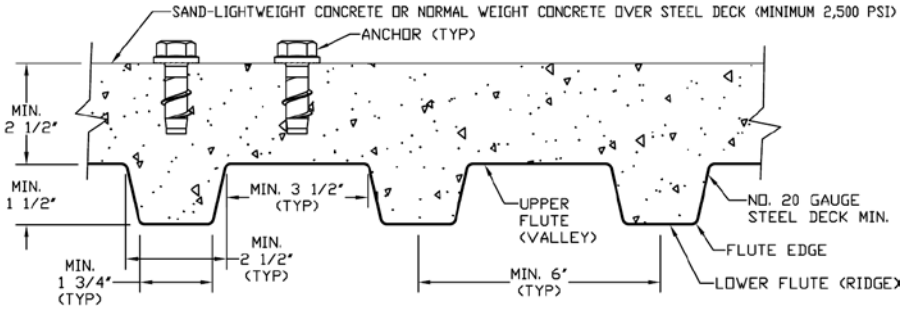
[7]The listed minimum overall anchor length is based on the anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, including consideration of a fixture attachment. The minimum nominal length of hex head anchors is measured from under the head to the tip of the anchor, the minimum nominal length for flat head anchors is measured from the top of the head to the tip of the anchor.

[8]Hex head anchors with the following minimum lengths are also suitable for use with cold-formed steel members provided the nominal thickness of the fixture attachment does not exceed 20 gauge (0.036-inch base metal thickness):

For 1/2-inch-diameter anchors with 2 1/2-inch nominal embedment, 2 1/2-inch long anchors

[9]Installation with 1/4-inch-diameter anchors using a manual torque wrench is limited to a maximum concrete compressive strength of 4,000 psi (27.6 MPa).

[10]For socket and driver sizes, head and washer diameter, head height and supplemental information see Table 1A.

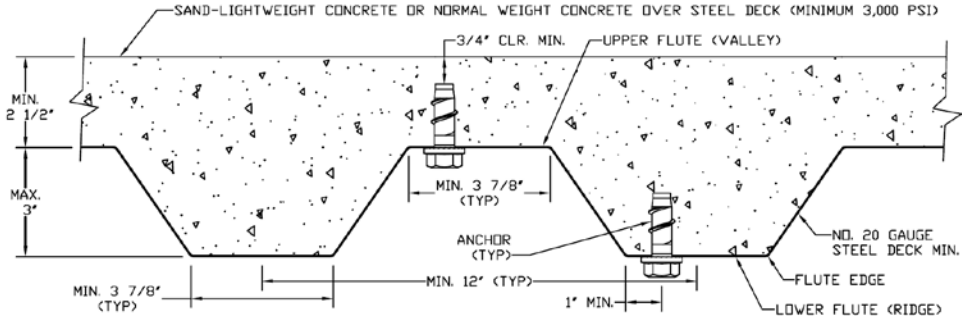


[1]Anchors may be placed in the top side of concrete over steel deck profiles in accordance with Figure 4 provided the minimum concrete thickness above the upper flute (topping thickness) is satisfied. See installation information given in Table 2 of this report.

[2]For all other anchor diameters and embedment depths installed in the top of concrete over steel deck profiles with topping thickness greater than or equal to the minimum concrete member thicknesses given in Table 1A, the minimum spacing distances and minimum edge distances must be used from Table 1A, as applicable.

[3]See Tables 3A and 3B of this report for design data.

FIGURE 4—INSTALLATION DETAIL FOR ANCHORS IN THE TOP OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES WITH MINIMUM TOPPING THICKNESS (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2,3]



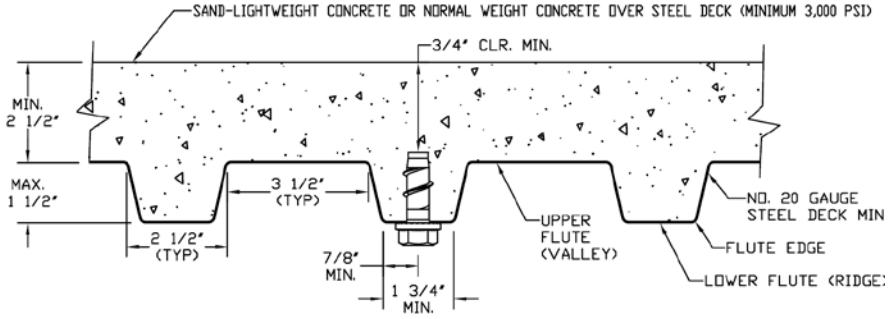
[1]Anchors may be placed in the upper flute or lower flute of concrete-filled steel deck profiles in accordance with Figure 5A provided the minimum hole clearance of $^3/_4$-inch is satisfied for the selected anchor.

[2]Anchors in the lower flute of Figure 5A profiles may be installed with a maximum $^{15}/_{16}$-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied (e.g. $1^1/_4$-inch offset for $4^1/_2$-inch wide flute).

[3]Minimum spacing for anchors installed in the lower flute must be equal to the greater of $3h_{ef}$ or 1.5 times flute width.

[4]See Table 5 of this report for design data.

FIGURE 5A—SCREW-BOLT+ INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2,3,4]



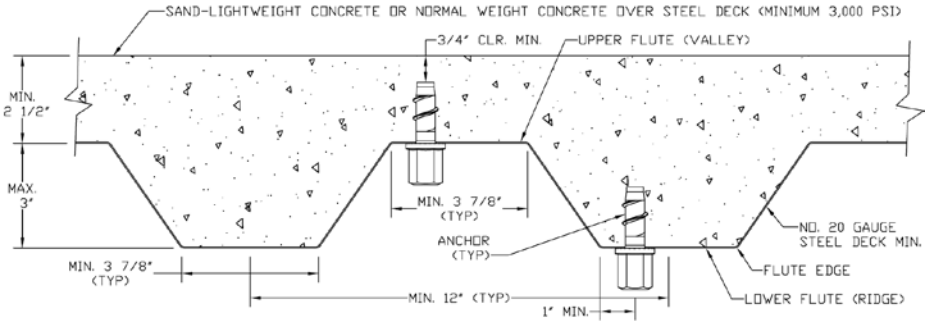
[1]Anchors may be placed in the upper flute or lower flute of the concrete-filled steel deck profiles in accordance with Figure 5B provided the minimum hole clearance of $^3/_4$-inch is satisfied for the selected anchor.

[2]Anchors in the lower flute of Figure 5B profiles may be installed in the center of the flute. An offset distance may be given proportionally for profiles with flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

[3]Minimum spacing for anchors installed in the lower flute must be equal to the greater of $3h_{ef}$ or 1.5 times flute width.

[4]See Table 5 of this report for design data.

FIGURE 5B— SCREW-BOLT+ INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2,3]



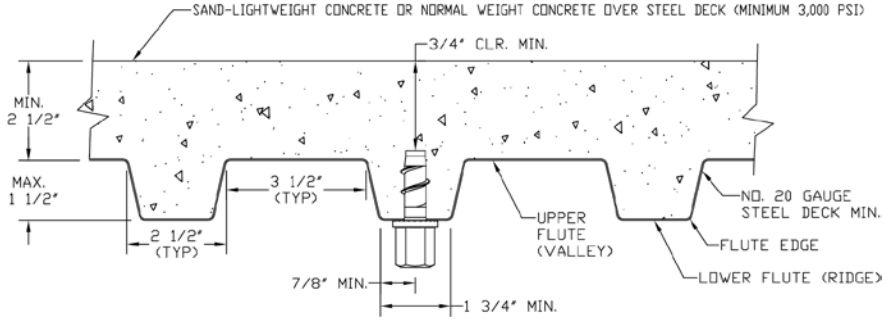
[1]Anchors may be placed in the upper flute or lower flute of the concrete-filled steel deck profiles in accordance with Figure 6A provided the minimum hole clearance of $^3/_4$-inch is satisfied for the selected anchor.

[2]Anchors in the lower flute of Figure 6A profiles may be installed with a maximum $^{15}/_{16}$-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied (e.g. $1^1/_4$-inch offset for $4^1/_2$-inch wide flute).

[3]Minimum spacing for anchors installed in the lower flute must be equal to the greater of $3h_{ef}$ or 1.5 times flute width

[4]See Table 6 of this report for design data.

FIGURE 6A—HANGERMATE+ INSTALLATION DETAIL FOR SCREW ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2,3]



[1]Anchors may be placed in the upper flute or lower flute of the concrete-filled steel deck profiles in accordance with Figure 6B provided the minimum hole clearance of $^3/_4$-inch is satisfied for the selected anchor.

[2]Anchors in the lower flute of Figure 6B profiles may be installed in the center of the flute. An offset distance may be given proportionally for profiles with flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

[3]Minimum spacing for anchors installed in the lower flute must be equal to the greater of $3h_{ef}$ or 1.5 times flute width.

[4]See Table 6 of this report for design data.

FIGURE 6B—HANGERMATE+ INSTALLATION DETAIL FOR SCREW ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQURIEMENTS)[1,2,3]

TABLE 3A—TENSION DESIGN INFORMATION FOR SCREW-BOLT+ ANCHORS IN CONCRETE[1,2,9]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)												
			1/4		3/8			1/2			5/8			3/4	
Anchor category	1, 2 or 3	-	1		1			1			1			1	
Head style	-	-	Hex Head or Flat Head		Hex Head or Flat Head			Hex Head or Flat Head			Hex Head			Hex Head	
Nominal anchor diameter (screw anchor body)	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)			0.500 (12.7)			0.625 (15.9)			0.750 (19.1)	
Minimum nominal embedment depth	h_{nom}	in. (mm)	1 5/8 (41)	2 1/2 (64)	2 (51)	2 1/2 (64)	3 1/4 (83)	2 1/2 (64)	3 (76)	4 1/4 (108)	3 1/4 (83)	4 (102)	5 (127)	4 1/4 (108)	
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)	2.39 (60)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (56)	2.88 (73)	3.73 (94)	3.08 (78)	
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)															
Steel strength in tension	N_{sa}	lb (kN)	4,535 (20.2)		8,730 (38.8)			20,475 (91.1)			26,260 (116.8)			38,165 (169.8)	
Reduction factor, steel strength[3,4]	ϕ	-	0.65		0.65			0.65			0.65			0.65	
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)															
Critical edge distance (uncracked concrete)	c_{ac}	in. (mm)	4.3 (110)	6.1 (156)	5.0 (127)	6.3 (160)	7.8 (298)	3.3 (83)	5.9 (150)	8.1 (205)	6.3 (159)	7.9 (201)	10.1 (255)	10.9 (277)	
Critical edge distance for topside of concrete-filled steel decks with minimum topping thickness (uncracked concrete)[11]	$c_{ac,deck,top}$	in. (mm)	3.0 (76)	4.0 (102)	3.5 (89)	- [11]	- [11]	6.0 (152)	- [11]	- [11]	- [11]	- [11]	- [11]	- [11]	
Effectiveness factor for uncracked concrete	k_{uncr}	-	27	24	30	24		30	24		30	24		27	
Effectiveness factor for cracked concrete	k_{cr}	-	17		17			17			21			17	
Modification factor, cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0		1.0			1.0			1.0			1.0	
Reduction factor, concrete breakout strength[3]	ϕ	-	0.65		0.65			0.65			0.65			0.65	
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)															
Pullout strength, uncracked concrete (2,500 psi)[6,10]	$N_{p,uncr}$	lb (kN)	See note 7		See note 7			See note 7			See note 7			See note 7	
Pullout strength, cracked concrete (2,500 psi)[6,10]	$N_{p,cr}$	lb (kN)	765 (3.4)	1,415 (6.3)	See note 7			1,645 (7.3)	2,515 (11.2)	4,700 (20.9)	3,080 (13.7	4,720 (21.0)	6,900 (30.7)	See note 7	
Reduction factor, pullout strength[3]	ϕ	-	0.65		0.65			0.65			0.65			0.65	
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)															
Pullout strength, seismic (2,500 psi)[6,8,10]	$N_{p,eq}$	lb (kN)	360 (1.6)	1,170 (5.2)	900 (4.0)	1,645 (7.3)	2,765 (12.3)	1,645 (7.3)	2,515 (11.2)	4,700 (20.9)	1,910 (8.5)	2,445 (10.9)	3,370 (15.0)	4,085 (18.2)	
Reduction factor, pullout strength, seismic[3]	ϕ	-	0.65		0.65			0.65			0.65			0.65	

For **SI:** 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 0.0069 N/mm^2 (MPa).

[1]The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.

[2]Installation must comply with manufacturer's published installation instructions and details.

[3]All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 Section D.4.3(c), as applicable for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used.

[4]The anchors are considered brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.

[5]Select the appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) and use $\psi_{c,N}$ = 1.0.

[6]For calculation of N_{pn} see Section 4.1.4 of this report. The characteristic pullout strength for concrete compressive strengths greater than 2,500 psi for 1/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'_c / 2{,}500)^{0.3}$ for psi or $(f'_c / 17.2)^{0.3}$ for MPa. The characteristic pullout strength for concrete compressive strengths greater than 2,500 psi for 3/8-inch- to 3/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'_c / 2{,}500)^{0.5}$ for psi or $(f'_c / 17.2)^{0.5}$ for MPa.

[7]Pullout strength does not control design of indicated anchors and does not need to be calculated for indicated anchor size and embedment.

[8]Reported values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5.

[9]Anchors are permitted in the topside of concrete-filled steel deck assemblies in accordance with Figure 4 of this report.

[10]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.

[11]Tabulated critical edge distance values, $c_{ac,deck,top}$, are for anchors installed in the top of concrete over steel deck profiles with a minimum concrete thickness, $h_{min,deck}$, of 2.5 inches above the upper flute (topping thickness). For minimum topping thickness greater than or equal to the minimum concrete member thicknesses, h_{min}, given in Table 1A, the associated critical edge distance, c_{ac}, for indicated anchor diameters and embedment depths may be used in the calculation of $\Psi_{cp,N}$, in accordance with Section 4.1.10 of this report, as applicable.

TABLE 3B—SHEAR DESIGN INFORMATION FOR SCREW-BOLT+ ANCHORS IN CONCRETE[1,2,7,8]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)										
			1/4		3/8			1/2			5/8		3/4
Anchor category	1, 2 or 3	-	1		1			1			1		1
Head style	-	-	Hex Head or Flat Head		Hex Head or Flat Head			Hex Head or Flat Head			Hex Head		Hex Head
Nominal anchor diameter (screw anchor body)	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)			0.500 (12.7)			0.625 (15.9)		0.750 (19.1)
Minimum nominal embedment depth	h_{nom}	in. (mm)	1 5/8 (41)	2 1/2 (64)	2 (51)	2 1/2 (64)	3 1/4 (83)	2 1/2 (64)	3 (76)	4 1/4 (108)	3 1/4 (83)	4 (102)	5 (127)	4 1/4 (108)
Effective embedment depth	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)	2.39 (60)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (56)	2.88 (73)	3.73 (94)	3.08 (78)
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)														
Steel strength in shear[5]	V_{sa}	lb (kN)	1,635 (7.3)	2,040 (9.1)	3,465 (15.4)		4,345 (19.3)	8,860 (39.4)		11,175 (49.7)	12,310 (54.8)		15,585 (69.3)	19,260 (85.7)
Reduction factor, steel strength[3,4]	ϕ	-	0.60		0.60			0.60			0.60			0.60
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)														
Steel strength in shear, seismic[6]	$V_{sa,eq}$	lb (kN)	1,360 (6.1)	1,700 (7.6)	2,415 (10.8)		3,030 (13.5)	7,090 (31.5)		8,940 (39.8)	9,845 (43.8)		12,465 (55.5)	15,405 (68.5)
Reduction factor, steel strength, seismic[3]	ϕ	-	0.60		0.60			0.60			0.60			0.60
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)														
Load bearing length of anchor	ℓ_e	in. (mm)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)	2.39 (60)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (56)	2.88 (73)	3.73 (94)	3.08 (78)
Reduction factor, concrete breakout strength[3]	ϕ	-	0.70		0.70			0.70			0.70			0.70
PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)														
Coefficient for pryout strength	k_{cp}	-	1		1			1		2	1	2		2
Reduction factor, pryout strength[3]	ϕ	-	0.70		0.70			0.70			0.70			0.70

For **SI:** 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 0.0069 N/mm^2 (MPa).

[1]The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-17 17.2.3 or ACI 318-11 D.3.3, as applicable shall apply.
[2]Installation must comply with manufacturer's published installation instructions and details.
[3]All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 Section D.4.4. For reinforcement that complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2 are used.
[4]The anchors are considered brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1.
[5]Reported values for steel strength in shear are based on tests per ACI 355.2, Section 9.4 and must be used for design in lieu of the calculated results using equation 17.5.1.2b of ACI 318-14 or equation D-29 in ACI 318-11 D.6.1.2.
[6]Reported values for steel strength in shear are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.6.
[7]Anchors are permitted in the topside of concrete-filled steel deck assemblies in accordance with Figure 4 of this report.
[8]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.

TABLE 4—TENSION AND SHEAR DESIGN INFORMATION FOR HANGERMATE+ ANCHORS IN CONCRETE[1,2,9,13]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)								
			1/4	3/8		3/8		3/8		1/2	
Anchor category	1, 2 or 3	-	1	1		1		1		1	
Coupler thread size (UNC)	-	in.	1/4 -20	3/8 -16		3/8 -16		3/8 -16		1/2 -13	
Coupler head style	-	-	Int. Threaded	Int. Threaded		Ext. Thread		Int. Threaded		Int. Threaded	
Nominal anchor diameter (screw anchor body)	d_a	in. (mm)	0.250 (6.4)	0.250 (6.4)		0.250 (6.4)		0.375 (9.5)		0.375 (9.5)	
Minimum nominal embedment depth	h_{nom}	in. (mm)	1 5/8 (41)	1 5/8 (41)	2 1/2 (64)	1 5/8 (41)	2 1/2 (64)	2 (51)	2 1/2 (64)	2 (51)	2 1/2 (64)
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)	1.33 (33)	1.75 (44)
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)											
Steel strength in tension	N_{sa}	lb (kN)	4,535 (20.2)	4,535 (20.2)		4,535 (20.2)		8,730 (38.8)		8,730 (38.8)	
Reduction factor, steel strength[3,4]	ϕ	-	0.65	0.65		0.65		0.65		0.65	
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)											
Critical edge distance (uncracked concrete)	c_{ac}	in. (mm)	4.3 (110)	4.3 (110)	6.1 (156)	4.3 (110)	6.1 (156)	5.0 (127)	6.3 (160)	5.0 (127)	6.3 (160)
Effectiveness factor for uncracked concrete	k_{uncr}	-	27	27	24	27	24	30	24	30	24
Effectiveness factor for cracked concrete	k_{cr}	-	17	17		17		17		17	
Modification factor, cracked and uncracked concrete[5]	$\psi_{c,N}$	-	1.0	1.0		1.0		1.0		1.0	
Reduction factor, concrete breakout strength[3]	ϕ	-	0.65	0.65		0.65		0.65		0.65	
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)											
Pullout strength, uncracked concrete (2,500 psi)[6,10]	$N_{p,uncr}$	lb (kN)	See note 7	See note 7		See note 7		See note 7		See note 7	
Pullout strength, cracked concrete (2,500 psi)[6,10]	$N_{p,cr}$	lb (kN)	765 (3.4)	765 (3.4)	1,415 (6.3)	765 (3.4)	1,415 (6.3)	See note 7		See note 7	
Reduction factor, pullout strength[3]	ϕ	-	0.65	0.65		0.65		0.65		0.65	
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)											
Pullout strength, seismic (2,500 psi)[6,8,10]	$N_{p,eq}$	lb (kN)	360 (1.6)	360 (1.6)	1,170 (5.2)	360 (1.6)	1,170 (5.2)	900 (4.0)	1,645 (7.3)	900 (4.0)	1,645 (7.3)
Reduction factor, pullout strength, seismic[3]	ϕ	-	0.65	0.65		0.65		0.65		0.65	
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)											
Steel strength in shear[11]	V_{sa}	lb (kN)	860 (3.8)	1,360 (6.1)		1,360 (6.1)		1,295 (5.8)		1,900 (8.5)	
Reduction factor, steel strength[3,4]	ϕ	-	0.60	0.60		0.60		0.60		0.60	
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)											
Steel strength in shear, seismic[12]	$V_{sa,eq}$	lb (kN)	600 (2.7)	695 (3.1)		695 (3.1)		800 (3.6)		800 (3.6)	
Reduction factor, steel strength, seismic[3,4]	ϕ	-	0.60	0.60		0.60		0.60		0.60	
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)											
Load bearing length of anchor	ℓ_e	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)	1.33 (33)	1.75 (44)
Reduction factor, concrete breakout strength[3]	ϕ	-	0.70	0.70		0.70		0.70		0.70	
PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)											
Coefficient for pryout strength	k_{cp}	-	1	1	1	1	1	1	1	1	1
Reduction factor, pryout strength[3]	ϕ	-	0.70	0.70		0.70		0.70		0.70	

For **SI:** 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 0.0069 N/mm^2 (MPa).

[1]The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.

[2]Installation must comply with manufacturer's published installation instructions and details.

[3]All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 Section D.4.3(c), as applicable for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used.

[4]The anchors are considered a brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1.

[5]Select the appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) and use $\psi_{c,N}$ = 1.0.

[6]For calculation of N_{pn} see Section 4.1.4 of this report. The characteristic pullout strength for concrete compressive strengths greater than 2,500 psi for 1/4-inch-diameter anchors (screw anchor body diameter) may be increased by multiplying the value in the table by $(f'_c / 2{,}500)^{0.3}$ for psi or $(f'_c / 17.2)^{0.3}$ for MPa. The characteristic pullout strength for concrete compressive strengths greater than 2,500 psi for 3/8-inch-diameter anchors (screw anchor body diameter) may be increased by multiplying the value in the table by $(f'_c / 2{,}500)^{0.5}$ for psi or $(f'_c / 17.2)^{0.5}$ for MPa.

[7]Pullout strength does not control design of indicated anchors and does not need to be calculated for indicated anchor size and embedment.

[8]Reported values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5.

[9]Anchors are permitted in the topside of concrete-filled steel deck assemblies in accordance with Figure 4 of this report.

[10]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.

[11]Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of the calculated results using equation 17.5.1.2b of ACI 318-14 or equation D-29 in ACI 318-11 D.6.1.2.

[12]Reported values for steel strength in shear are for seismic applications and based on tests in accordance with ACI 355.2, Section 9.6.

[13]Hangermate+ shear values are for threaded rod or steel inserts with and ultimate strength, $F_u \geq 125$ ksi; threaded rod or steel inserts with an F_u less than 125 ksi are allowed provided the steel strength shear values are multiplied by the ratio of F_u (ksi) of the steel insert and 125 ksi.

TABLE 5—TENSION AND SHEAR DESIGN INFORMATION FOR SCREW-BOLT+ ANCHORS IN THE SOFFIT (THROUGH THE UNDERSIDE) OF CONCRETE-FILLED STEEL DECK ASSEMBLIES[1,2,3,4,5,6,7]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)											
			1/4		3/8			1/2			5/8			3/4
Anchor category	1, 2 or 3	-	1		1			1			1			1
Head style	-	-	Hex Head or Flat Head		Hex Head or Flat Head			Hex Head or Flat Head			Hex Head			Hex Head
Nominal anchor diameter (screw anchor body)	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)			0.500 (12.7)			0.625 (15.9)			0.750 (19.1)
Minimum nominal embedment depth	h_{nom}	in. (mm)	1 5/8 (41)	2 1/2 (64)	2 (51)	2 1/2 (64)	3 1/4 (83)	2 1/2 (64)	3 (76)	4 1/4 (108)	3 1/4 (83)	4 (102)	5 (127)	4 1/4 (108)
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)	2.39 (60)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (56)	2.88 (73)	3.73 (94)	3.08 (78)
Screw-Bolt+ Anchors Installed into Minimum 3 7/8-inch-wide Deck Flute (see Figure 5A)														
Minimum concrete member thickness[7]	$h_{min,deck,total}$	in. (mm)	5 1/2 (140)		5 1/2 (140)			5 1/2 (140)			5 1/2 (140)		6 1/4 (159)	6 1/4 (159)
Pullout strength, uncracked concrete (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,430 (6.4)	2,555 (11.4)	2,275 (10.1)	2,655 (11.8)	3,235 (14.4)	2,600 (11.6)	3,555 (15.8)	5,975 (26.6)	2,610 (11.6)	4,150 (18.5)	6,195 (27.6)	6,085 (27.1)
Pullout strength, cracked concrete (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	615 (2.7)	1,115 (5.0)	1,290 (5.1)	1,880 (8.4)	2,290 (10.2)	1,230 (5.5)	2,330 (10.4)	4,030 (17.9)	1,600 (7.1)	3,340 (14.9)	4,945 (22.0)	3,835 (17.1)
Pullout strength, seismic (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	290 (1.3)	920 (4.1)	890 (4.0)	1,570 (7.0)	2,015 (9.0)	1,230 (5.5)	2,330 (10.4)	4,030 (17.9)	990 (4.4)	1,730 (7.7)	2,415 (10.8)	3,410 (15.2)
Reduction factor, pullout strength[8]	ϕ	-	0.65		0.65			0.65			0.65			0.65
Steel strength in shear	$V_{sa,deck}$	lb (kN)	1,155 (5.1)	2,595 (11.6)	2,540 (11.3)	2,540 (11.3)	3,225 (14.4)	2,435 (10.8)	2,435 (10.8)	5,845 (26.0)	2,650 (11.8)	2,650 (11.8)	6,325 (28.1)	5,175 (23.0)
Steel strength in shear, seismic	$V_{sa,deck,eq}$	lb (kN)	960 (4.3)	2165 (9.6)	1,775 (7.9)	1,950 (8.7)	2,250 (10.0)	1,950 (8.7)	2,095 (9.3)	4,675 (20.8)	2,120 (9.4)	2,325 (10.3)	5,060 (22.5)	4,140 (18.4)
Reduction factor, steel strength in shear[8]	ϕ	-	0.60		0.60			0.60			0.60			0.60
Screw-Bolt+ Anchors Installed into Minimum 1 3/4-inch-wide Deck Flute (see Figure 5B)														
Minimum concrete member thickness[7]	$h_{min,deck,total}$	in. (mm)	4 (102)		4 (102)			4 (102)	N/A		N/A			N/A
Pullout strength, uncracked concrete (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,430 (6.4)	2,075 (9.2)	1,440 (6.4)	2,135 (9.5)	3,190 (14.2)	1,720 (7.6)	N/A		N/A			N/A
Pullout strength, cracked concrete (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	615 (2.7)	910 (4.0)	815 (3.6)	1,510 (6.7)	2,260 (10.0)	1280 (5.7)						
Pullout strength, seismic (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	290 (1.3)	750 (3.3)	565 (2.5)	1,260 (5.6)	1,985 (8.8)	1280 (5.7)						
Reduction factor, pullout strength[8]	ϕ	-	0.65		0.65			0.65						
Steel strength in shear	$V_{sa,deck}$	lb (kN)	1,155 (5.1)	2,315 (10.3)	2,115 (9.4)	2,115 (9.4)	2,820 (12.5)	2,095 (9.3)	N/A		N/A			N/A
Steel strength in shear, seismic	$V_{sa,deck,eq}$	lb (kN)	960 (4.3)	1,930 (8.6)	1,475 (6.6)	1,620 (5.6)	1,965 (8.7)	1,675 (7.5)						
Reduction factor, steel strength in shear[8]	ϕ	-	0.60		0.60			0.60						

For **SI:** 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 0.0069 N/mm^2 (MPa).

N/A = Not Applicable.

[1]Installation must comply with manufacturer's published installation instructions and details.

[2]Values for $N_{p,deck}$ and $N_{p,deck,cr}$ are for sand-lightweight concrete ($f'_{c,\,min}$ = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318 D.5.2, as applicable, is not required for anchors installed in the deck soffit (through underside).

[3]Values for $N_{p,deck,eq}$ are applicable for seismic loading; see Section 4.1.8.2 of this report.

[4]For the calculation of N_{pn}, see Section 4.1.4 of this report; for all design cases $\Psi_{c,P}$ = 1.0. The characteristic pullout strength for concrete compressive strengths greater than 3,000 psi for 1/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'_c / 3{,}000)^{0.3}$ for psi or $(f'_c / 17.2)^{0.3}$ for MPa. The characteristic pullout strength for concrete compressive strengths greater than 3,000 psi for 3/8-inch- to 3/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'_c / 3{,}000)^{0.5}$ for psi or $(f'_c / 17.2)^{0.5}$ for MPa.

[5]Shear loads for anchors installed through steel deck into concrete may be applied in any direction.

[6]Values of $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, are not required for anchors installed in the soffit (through underside).

[7]The minimum concrete member thickness, $h_{min,deck,total}$, is the minimum overall thickness of the concrete-filled steel deck (depth and topping thickness).

[8]All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2. If the load combinations of ACI 318 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4 (ACI 318-08).

TABLE 6—TENSION AND SHEAR DESIGN INFORMATION FOR HANGERMATE+ ANCHORS IN THE SOFFIT (THROUGH THE UNDERSIDE) OF CONCRETE-FILLED STEEL DECK ASSEMBLIES[1,2,3,4,5,6,9]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)								
			1/4	3/8		3/8		3/8		1/2	
Anchor category	1, 2 or 3	-	1	1		1		1		1	
Coupler thread size (UNC)	-	in.	1/4 -20	3/8 -16		3/8 -16		3/8 -16		1/2 -13	
Coupler head style	-	-	Int. Threaded	Int. Threaded		Ext. Thread		Int. Threaded		Int. Threaded	
Nominal anchor diameter (screw anchor body)	d_a	in. (mm)	0.250 (6.4)	0.250 (6.4)		0.250 (6.4)		0.375 (9.5)		0.375 (9.5)	
Minimum nominal embedment depth[4]	h_{nom}	in. (mm)	1 5/8 (41)	1 5/8 (41)	2 1/2 (64)	1 5/8 (41)	2 1/2 (64)	2 (51)	2 1/2 (64)	2 (51)	2 1/2 (64)
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)	1.33 (33)	1.75 (44)
Hangermate+ Anchors Installed into Minimum 3 7/8-inch-wide Deck Flute (See Figure 6A)											
Minimum concrete member thickness[7]	$h_{min,deck,total}$	in. (mm)	5 1/2 (140)	5 1/2 (140)		5 1/2 (140)		5 1/2 (140)		5 1/2 (140)	
Pullout strength, uncracked concrete (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,430 (6.4)	1,430 (6.4)	2,555 (11.4)	1,430 (6.4)	2,555 (11.4)	2,275 (10.1)	2,655 (11.8)	2,275 (10.1)	2,655 (11.8)
Pullout strength, cracked concrete (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	615 (2.7)	615 (2.7)	1,115 (5.0)	615 (2.7)	1,115 (5.0)	1,290 (5.1)	1,880 (8.4)	1,290 (5.1)	1,880 (8.4)
Pullout strength, seismic (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	290 (1.3)	290 (1.3)	920 (4.1)	290 (1.3)	920 (4.1)	890 (4.0)	1,570 (7.0)	890 (4.0)	1,570 (7.0)
Reduction factor, pullout strength[8]	ϕ	-	0.65	0.65		0.65		0.65		0.65	
Steel strength in shear	$V_{sa,deck}$	lb (kN)	1,205 (5.4)	1,205 (5.4)		1,205 (5.4)		1,360 (6.0)		2,740 (11.0)	
Steel strength in shear, seismic	$V_{sa,deck.eq}$	lb (kN)	615 (2.7)	615 (2.7)		615 (2.7)		965 (4.3)		1,040 (4.6)	
Reduction factor, steel strength in shear[8]	ϕ	-	0.60	0.60		0.60		0.60		0.60	
Hangermate+ Anchors Installed into Minimum 1 3/4-inch-wide Deck Flute (See Figure 6B)											
Minimum concrete member thickness[7]	$h_{min,deck,total}$	in. (mm)	4 (102)	4 (102)		4 (102)		4 (102)		4 (102)	
Pullout strength, uncracked concrete (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,430 (6.4)	1,430 (6.4)	2,075 (9.2)	1,430 (6.4)	2,075 (9.2)	1,440 (6.4)	2,135 (9.5)	1,440 (6.4)	2,135 (9.5)
Pullout strength, cracked concrete (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	615 (2.7)	615 (2.7)	910 (4.0)	615 (2.7)	910 (4.0)	815 (3.6)	1,510 (6.7)	815 (3.6)	1,510 (6.7)
Pullout strength, seismic (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	290 (1.3)	290 (1.3)	750 (3.3)	290 (1.3)	750 (3.3)	565 (2.5)	1,260 (5.6)	565 (2.5)	1,260 (5.6)
Reduction factor, pullout strength[8]	ϕ	-	0.65	0.65		0.65		0.65		0.65	
Steel strength in shear	$V_{sa,deck}$	lb (kN)	815 (3.6)	815 (3.6)		815 (3.6)		1,110 (4.9)		1,110 (4.9)	
Steel strength in shear, seismic	$V_{sa,deck.eq}$	lb (kN)	415 (1.8)	415 (1.8)		415 (1.8)		790 (3.5)		465 (2.1)	
Reduction factor, steel strength in shear[8]	ϕ	-	0.60	0.60		0.60		0.60		0.60	

For **SI:** 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 0.0069 N/mm^2 (MPa).

[1]Installation must comply with manufacturer's published installation instructions and details.

[2]Values for $N_{p,deck}$ and $N_{p,deck,cr}$ are for sand-lightweight concrete ($f'_{c,\,min}$ = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318 D.5.2, as applicable, is not required for anchors installed in the deck soffit (through underside).

[3]Values for $N_{p,deck,eq}$ are applicable for seismic loading; see Section 4.1.8.2 of this report.

[4]For the calculation of N_{pn}, see Section 4.1.4 of this report; for all design cases $\Psi_{c,P}$ = 1.0. The characteristic pullout strength for concrete compressive strengths greater than 3,000 psi for 1/4-inch-diameter anchors (screw anchor body diameter) may be increased by multiplying the value in the table by $(f'_c / 3{,}000)^{0.3}$ for psi or $(f'_c / 17.2)^{0.3}$ for MPa. The characteristic pullout strength for concrete compressive strengths greater than 3,000 psi for 3/8-inch-diameter anchors (screw anchor body diameter) may be increased by multiplying the value in the table by $(f'_c / 3{,}000)^{0.5}$ for psi or $(f'_c / 17.2)^{0.5}$ for MPa.

[5]Shear loads for anchors installed through steel deck into concrete may be applied in any direction.

[6]Values of $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, are not required for anchors installed in the soffit (through underside).

[7]The minimum concrete member thickness, $h_{min,deck,total}$, is the minimum overall thickness of the concrete-filled steel deck (depth and topping thickness).

[8]All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2. If the load combinations of ACI 318 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4 (ACI 318-08).

[9]Hangermate+ shear values are for threaded rod or steel inserts with and ultimate strength, $F_u \geq 125$ ksi; threaded rod or steel inserts with an F_u less than 125 ksi are allowed provided the steel strength shear values are multiplied by the ratio of F_u (ksi) of the steel insert and 125 ksi.

TABLE 7—EXAMPLE ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7,8,9]

Anchor	Nominal Anchor Diameter, (in.)	Nominal Embedment Depth, (in.)	Effective Embedment, (in.)	Allowable Tension Load, (lbs)
Screw-Bolt+	1/4 (Hex or Flat Head)	1 5/8	1.20	780
		2 1/2	1.94	1,425
	3/8 (Hex or Flat Head)	2	1.33	1,010
		2 1/2	1.75	1,220
		3 1/4	2.39	1,950
	1/2 (Hex or Flat Head)	2 1/2	1.75	1,525
		3	2.17	1,685
		4 1/4	3.23	3,060
	5/8 (Hex Head)	3 1/4	2.24	2,210
		4	2.88	2,575
		5	3.73	3,795
	3/4 (Hex Head)	4 1/4	3.08	3,205
Hangermate+	1/4 (1/4-20 coupler head)	1 5/8	1.20	780
		2 1/2	1.94	1,425
	1/4 (3/8-16 coupler head)	1 5/8	1.20	780
		2 1/2	1.94	1,425
	3/8 (3/8-16 coupler head)	2	1.33	1,010
		2 1/2	1.75	1,220
	3/8 (1/2-13 coupler head)	2	1.33	1,010
		2 1/2	1.75	1,220

For **SI:** 1 inch = 25.4 mm; 1 lbf = 0.0044 kN.

Illustrative Allowable Stress Design Values in Table 7 are applicable only when the following design assumptions are followed:
[1]Single anchor with static tension load only.
[2]Concrete determined to remain uncracked for the life of the anchorage.
[3]Load combinations from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, (no seismic loading).
[4]30% dead load and 70% live load, controlling load combination: 1.2*D* + 1.6*L*.
[5]Calculated of weighted average for α = 1.2(0.3) + 1.6(0.7) = 1.48.
[6] f'_c = 2,500 psi (normal weight concrete).
[7] $c_{a1} = c_{a2} \geq c_{ac}$.
[8] $h \geq h_{min}$.
[9]Values are for Condition B; supplementary reinforcement in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3 is not provided, as applicable.

Given: Calculate the factored strength design resistance in tension, $\boldsymbol{\phi N_n}$, and the allowable stress design value, $\boldsymbol{T_{allowable,ASD}}$, for a 1/2-inch diameter Screw-Bolt+ anchor with 3-inch nominal embedment assuming the given conditions in Table 7.

Calculation in accordance with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D and this report:	Code Ref.	Report Ref.
Step 1. Calculate steel strength of a single anchor in tension: $\boldsymbol{\phi N_{sa}} = (0.65)(20{,}475) = 13{,}309\ lbs.$	D.5.1.2 (318-11) 17.4.1.2 (318-14)	Table 3A §4.1.2
Step 2. Calculate concrete breakout strength of a single anchor in tension: $\phi N_{cb} = \phi \frac{A_{Nc}}{A_{Nc0}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$	D.5.2.1 (318-11) 17.4.2.1 (318-14)	Table 3A §4.1.3
$N_b = k_c \lambda_a \sqrt{f'_c} (h_{ef})^{1.5}$ $N_b = (24)(1.0)\sqrt{2{,}500}(2.17)^{1.5} = 3{,}836\ lbs.$ $\boldsymbol{\phi N_{cb}} = (0.65)\frac{(42.4)}{(42.4)}(1.0)(1.0)(1.0)(3{,}836) = 2{,}493\ lbs.$	D.5.2.2 (318-11) 17.4.2.2 (318-14)	Table 3A
Step 3. Calculate pullout strength: $\phi N_{pn} = \phi N_{p,uncr} \psi_{c,P}$ $\boldsymbol{\phi N_{pn}}$ = n/a (pullout strength does not control per reported design values)	D.5.3.2 (318-11) 17.4.3.2 (318-14)	Table 3A §4.1.4
Step 4. Determine controlling resistance strength in tension: $\boldsymbol{\phi N_n} = \min\left\|\phi N_{sa}, \phi N_{cb}, \phi N_{pn}\right\| = \phi N_{cb} = 2{,}493\ lbs.$	D.4.1.1 (318-11) 17.3.1.1 (318-14)	
Step 5. Calculate allowable stress design conversion factor for loading condition: Controlling load combination: 1.2*D* + 1.6*L* $\boldsymbol{\alpha}$ = 1.2(30%) + 1.6(70%) = 1.48	9.2 (ACI 318-11) 5.2 (ACI 318-14)	
Step 6. Calculate allowable stress design value $\boldsymbol{T_{allowable,ASD}} = \frac{\boldsymbol{\phi N_n}}{\boldsymbol{\alpha}} = \frac{\boldsymbol{2{,}493}}{\boldsymbol{1.48}} = \boldsymbol{1{,}685\ lbs}.$		§4.2

FIGURE 7—EXAMPLE STRENGTH DESIGN CALCULATION INCLUDING ASD CONVERSION, FOR ILLUSTRATIVE PURPOSES

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

SCREW-BOLT+™ ANCHORS AND HANGERMATE®+ ROD HANGER SCREW ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Screw-Bolt+ Screw Anchors and Hangermate+ Rod Hanger Screw Anchors in cracked and uncracked concrete, described in ICC-ES evaluation report ESR-3889, have also been evaluated for compliance with the codes noted below as adopted by Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2020 *City of Los Angeles Building Code* (LABC)
- 2020 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Screw-Bolt+ Screw Anchors and Hangermate+ Rod Hanger Screw Anchors in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-3889, comply with LABC Chapter 19, and LARC, and are subjected to the conditions of use described in this report.

3.0 CONDITIONS OF USE

The Screw-Bolt+ and Hangermate+ anchors described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-3889.
- The design, installation, conditions of use and labeling of the anchors are in accordance with the 2018 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-3889.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the evaluation report and tables are for the connection of the anchors to the concrete. The connection between the anchors and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragm applications, anchors shall be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2020-071.

This supplement expires concurrently with the evaluation report, reissued November 2019 and revised July 2020.

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

SCREW-BOLT+™ ANCHORS AND HANGERMATE®+ ROD HANGER SCREW ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Screw-Bolt+ Screw Anchors and Hangermate+ Rod Hanger Screw Anchors in Cracked and Uncracked Concrete, described in ICC-ES evaluation report ESR-3889, have also been evaluated for compliance with the codes noted below:

Compliance with the following codes:

- 2017 *Florida Building Code—Building*
- 2017 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Screw-Bolt+ Screw Anchors and Hangermate+ Rod Hanger Screw Anchors in Cracked and Uncracked Concrete described in Sections 2.0 through 7.0 of the evaluation report ESR-3889 comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2015 *International Building Code®* provisions noted in the evaluation report.

Use of the Screw-Bolt+ Screw Anchors and Hangermate+ Rod Hanger Screw Anchors in cracked and uncracked concrete as described in the evaluation report for use in dry, interior locations has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential*.

For products falling under Florida Rule 9N-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued November 2019 and revised July 2020.

ICC-ES Evaluation Report

ESR-4042

Reissued July 2020

This report is subject to renewal July 2021.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

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

REPORT HOLDER:

DEWALT

ADDITIONAL LISTEE:

THE HILLMAN GROUP

EVALUATION SUBJECT:

SCREW-BOLT+™ ANCHORS IN MASONRY (DEWALT)

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2018, 2015, 2012, and 2009 *International Building Code®* (IBC)
- 2018, 2015, 2012, and 2009 *International Residential Code®* (IRC)

For evaluation for compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS), see ESR-4042 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

The Screw-Bolt+ anchors described in Section 3.1 of this report are used to anchor building components to fully grouted concrete masonry walls to resist static, wind and earthquake tension and shear loads, as noted in Section 4.0 of this report.

The anchors are alternatives to Section 8.1.3 (2013 edition), or Section 2.1.4 (2011 or 2008 editions) of TMS 402/ACI 530/ASCE 5 as referenced in Section 2107.1 of the IBC. The anchor system may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 Screw-Bolt+ Anchors:

Screw-Bolt+ anchors are comprised of an anchor body with hex washer head or flat head (countersunk) style in various lengths. Available diameters are $^1/_4$-inch, $^3/_8$-inch, $^1/_2$-inch, $^5/_8$-inch and $^3/_4$-inch (6.4 mm, 9.5 mm, 12.7 mm, 15.9 mm and 19.1 mm). The anchor body and hex washer head or flat head are manufactured from low-carbon steel which is case hardened and have minimum 0.0002-inch (5 µm) zinc plating in accordance with ASTM B633 or minimum 0.0021-inch (53 µm) mechanical zinc plating in accordance with ASTM B695, Class 55. The Screw-Bolt+ anchor is illustrated in Table A. Product names for the report holder and for the additional listees are presented in the following table.

COMPANY NAME	PRODUCT NAME
DEWALT	Screw-Bolt+
The Hillman Group	Hillman Screw-Bolt+

The hex head of the anchor is formed with an integral washer and serrations on the underside. The anchor body is formed with dual lead threads and a chamfered tip. The screw anchors are installed in a predrilled hole with a powered impact wrench or torque wrench. The threads on the anchor tap into the sides of the predrilled hole and interlock with the base material during installation.

3.2 Grout-filled Concrete Masonry (Fully Grouted):

The compressive strength of masonry, f'_m, at 28 days must be a minimum of 1,500 psi (10.3 MPa). Fully grouted masonry walls must comply with Chapter 21 of the IBC and must be constructed from the following materials:

3.2.1 Concrete Masonry Units (CMUs): Concrete masonry walls must be constructed from minimum Grade N, light-, medium-, or normal weight closed end, concrete masonry units (CMUs) conforming to ASTM C90. The nominal CMU size is 8 inches wide by 8 inches high by 16 inches long.

3.2.2 Grout (for Grout-filled Concrete Masonry): Grout-filled concrete masonry units must be fully grouted with grout complying with Section 2103.3 of the 2018 and 2015 IBC, Section 2103.13 of the 2012 IBC, Section 2103.12 of the 2009 IBC, or Section R606.2.12 of the 2018 IRC, Section R606.2.11 of the 2015 IRC; Section R609.1.1 of the 2012 and 2009 IRC, as applicable. Alternatively, the grout must have a minimum compressive strength, when tested in accordance with ASTM C1019, equal to its specified strength, but not less than 2,000 psi (13.8 MPa).

3.2.3 Mortar: Mortar must be Types M, S or N prepared in accordance with Section 2103.2.1 of the 2018 and 2015 IBC, Section 2103.9 of the 2012 IBC, or Section 2103.8 of the 2009 IBC, or Section 606.2.8 of the 2018 IRC, Section R606.2.7 of the 2015 IRC, or Section R607.1 of the 2012, and 2009 IRC, as applicable.

4.0 DESIGN AND INSTALLATION

4.1 Allowable Stress Design:

4.1.1 Design of Anchors Installed in Fully Grouted CMU Masonry: The design load values for anchors described in this report are based on allowable stress design (ASD), as an alternative to Section 8.1.3 (2013 edition), or Section 2.1.4 of TMS 402/ACI 530/ASCE 5 (2011 or 2008 editions) as referenced in Section 2107.1 of the IBC. For use under the IRC, an engineered design in accordance with R301.1.3 must be submitted to the code official. Allowable tension and shear loads for installation in grout-filled masonry walls are noted in Tables 1 through 3 of this report.

Allowable stress design tension and shear load values given in Tables 2 and 3 in grout-filled concrete masonry may be used to resist long-term loads, such as gravity loads, and short-term loads, such as wind and seismic.

The allowable loads for anchors installed in fully grout-filled concrete masonry or hollow masonry subjected to combined tension and shear forces must be determined by the following equation:

$$\left(\frac{P_s}{P_t}\right)^n + \left(\frac{V_s}{V_t}\right)^n \leq 1$$

where:

P_s = Applied service tension load (lbf or kN).

P_t = Allowable service tension load (lbf or kN).

V_s = Applied service shear load (lbf or kN).

V_t = Allowable service shear load (lbf or kN).

n = $^5/_3$ for the $^1/_2$-inch, $^5/_8$-inch and $^3/_4$-inch (9.5 mm, 12.7 mm, 15.9 mm and 19.1 mm) anchors installed in the face of grout-filled concrete masonry.

n = 1 for the $^1/_4$-inch and $^3/_8$-inch (6.4 mm and 9.5 mm) anchors installed in the face of grout-filled concrete masonry and all anchor diameters installed in the top of grout-filled concrete masonry.

4.1.2 Requirements for Minimum Spacing and Minimum Edge: Critical and minimum spacing and edge distance values, with appropriate reduction values, where applicable, are given in Tables 2 and 3 for fully grouted concrete masonry. Linear interpolation may be used to determine the allowable load reduction factor for intermediate anchor spacing and edge distances.

4.2 Installation:

Anchors must be installed in accordance with this report and the manufacturer's printed installation instructions (MPII) represented in Figure 1. The anchors must not be installed until the base material has reached its minimum designated compressive strength. The drill bit size, hole diameter, embedment depth, spacing, edge distance and base material must comply with the requirements of this report. Installation procedures and locations must be in accordance with Tables 1, 2 and 3 as well as Figures A, 1, 2, 3 and 4 of this report, as applicable.

4.3 Special Inspection:

Anchor must be installed with special inspections in accordance with IBC Section 1704 and 1705, and are also applicable for installations under the IRC.

For screw anchors installed with special inspection, the following items, as applicable, must be inspected: anchor type, anchor dimensions, masonry type, masonry dimensions and compressive strength, drill bit size, anchor spacing, edge distances, embedment, and adherence to the manufacturer's printed installation instructions (MPII).

5.0 CONDITIONS OF USE

The Screw-Bolt+™ anchors described in this report are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The anchors must be identified and installed in accordance with this report and the MPII. In the event of a conflict between the instructions in this report and the manufacturer's instructions, this report must govern.

5.2 Anchor sizes, dimensions, and minimum embedment depths are as set forth in this report.

5.3 Anchors resisting static and wind tension and shear loads in concrete masonry must be designed in accordance with Section 4.1 of this report.

5.4 For installations in grouted concrete masonry, anchors are recognized to dead, live, seismic and wind tension and shear load applications. When using the basic load combinations in accordance with IBC Section 1605.3.1.1, allowable loads are not permitted to be increased for wind or seismic loading. When using the alternative basic load combinations in 2009 IBC Section 1605.3.2 that include wind or seismic loads, the allowable loads for anchors are permitted to be increased by $33^1/_3$ percent, or the alternative basic load combinations may be multiplied by a factor of 0.75. For the 2018, 2015 and 2012 IBC, the allowable loads or load combinations for these anchors must not be adjusted.

5.5 Anchors must be installed in holes predrilled in substrates described in this report, using carbide-tipped drill bits complying with ANSI B212.15-1994.

5.6 The grout and mortar shall have attained its minimum design strength prior to installation of the anchors.

5.7 Prior to installation, calculations demonstrating that the applied loads are less than the allowable loads described in this report must be submitted to the code official for approval. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is being constructed.

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

5.9 Where not otherwise prohibited by the code, anchors are permitted for installation in fire-resistance-rated construction provided at least one of the following conditions is fulfilled:

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

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

5.11 Use of carbon steel anchors with zinc plating in accordance with ASTM B633 as described in Section 3.1 of this report is limited to dry interior locations. Use of anchors in an interior damp environment must have mechanical zinc plating in accordance with ASTM B695, Class 55.

5.12 Steel anchoring elements in contact with preservative-treated wood or fire-retardant-treated wood must be in accordance with ASTM B695, Class 55.

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

5.14 The Screw-Bolt+ anchors are manufactured under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Pre-drilled Fasteners (Screw Anchors) in Masonry (AC106), dated November 2015, including tests for seismic qualification, edge distance and spacing, and installations for the top of fully-grouted CMU wall construction.

6.2 Quality-control documentation.

7.0 IDENTIFICATION

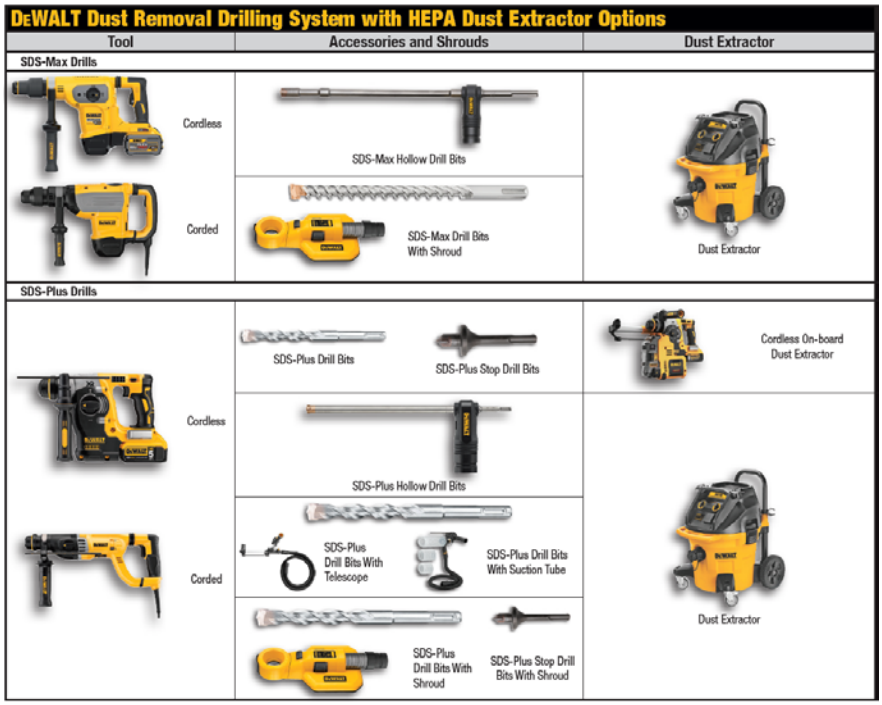
7.1 Screw-Bolt+ anchors are identified in the field by dimensional characteristics and packaging. A diameter and length marking is stamped on the head of each Screw-Bolt+ anchor; these are visible after installation for verification. Packages are identified with the company name as set forth in Section 3.1 of this report; anchor name; part number; type; anchor size and length; and the evaluation report number (ESR-4042).

7.2 The report holder's contact information is the following:

DEWALT
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.DEWALT.com
anchors@DEWALT.com

7.3 The Additional Listee's contact information is the following:

THE HILLMAN GROUP
10590 HAMILTON AVENUE
CINCINNATI, OHIO 45231
info@hillmangroup.com



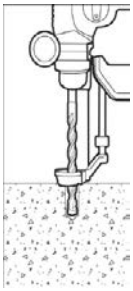
The DEWALT drilling systems shown collect and remove dust with a HEPA dust extractor during the hole drilling operation in dry base materials using hammer-drill (see step 1 of the manufacturer's printed installation instructions).

FIGURE A—EXAMPLES OF DEWALT DUST REMOVAL DRILLING SYSTEMS WITH HEPA DUST EXTRACTORS FOR ILLUSTRATION

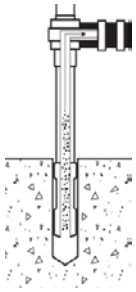
TABLE A—DESIGN TABLE INDEX AND ANCHOR ILLUSTRATION[1]

Adhesive	Base Material	Anchor Sizes (inch)	Allowable Load Data	Screw-Bolt+ Ilustration Hex Head and Flat Head Versions
Screw-Bolt+	Grout-filled Concrete Masonry	$^1/_4$, $^3/_8$, $^1/_2$, $^5/_8$, $^3/_4$	Table 1 (wall faces and openings)	
		$^1/_2$, $^5/_8$, $^3/_4$	Table 2 (top of wall)	

[1]Design must be in accordance with Section 4.1 of this report and applicable allowable load data for the given conditions, as applicable.

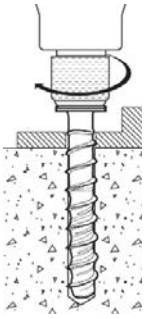


1.) Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15.



2.) Remove dust and debris from hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles left from drilling.

3.) Select a powered impact wrench or torque wrench and do not exceed the maximum torque, $T_{impact,max}$ or $T_{inst,max}$, respectively, for the selected anchor diameter and embedment (See Table 1). Attach an appropriate sized hex socket to the wrench. Mount the screw anchor head into the socket.



4.) Drive the anchor with an impact wrench or torque wrench through the fixture and into the hole until the head of the anchor comes into contact with the fixture. The anchor must be snug after installation. Do not spin the hex socket off the anchor to disengage.

FIGURE 1—SCREW-BOLT+ INSTALLATION INSTRUCTIONS, MPII (Hex Head Version Illustrated, Flat Head Version Not Shown)

TABLE 1—SCREW-BOLT+ ANCHOR INSTALLATION AND SUPPLEMENTAL INFORMATION

Anchor Property / Setting Information		Notation	Units	Nominal Anchor Size (inch)									
				$^1/_4$		$^3/_8$		$^1/_2$		$^5/_8$		$^3/_4$	
Head style		-	-	Hex Head or Flat Head		Hex Head or Flat Head		Hex Head or Flat Head		Hex Head		Hex Head	
Nominal anchor diameter		d_a	in.	0.250		0.375		0.500		0.625		0.750	
Minimum diameter of fixture hole clearance[8]		d_h	in.	$^3/_8$		$^1/_2$		$^5/_8$		$^3/_4$		$^7/_8$	
Nominal carbide drill bit Diameter (ANSI)		d_{bit}	in.	$^1/_4$		$^3/_8$		$^1/_2$		$^5/_8$		$^3/_4$	
Minimum nominal embedment depth[1]		h_{nom}	in.	$1^5/_8$	$2^1/_2$	2	$3^1/_4$	$2^1/_2$	$4^1/_4$	$3^1/_4$	5	4	$6^1/_4$
Minimum hole depth		h_o	in.	2	$2^7/_8$	$2^3/_8$	$3^5/_8$	$2^7/_8$	$4^5/_8$	$3^5/_8$	$5^3/_8$	$4^3/_8$	$6^5/_8$
Critical edge distance[2]		c_{cr}	in.	See Table 2 for anchors installed in wall faces[7] See Table 3 for anchors installed in the top of grout-filled concrete masonry									
Minimum edge distance[3]		c_{min}	in.										
Critical spacing distance[2]		s_{cr}	in.	See Table 2 for anchors installed in wall faces[7] See Table 3 for anchors installed in the top of grout-filled concrete masonry									
Minimum spacing distance[3]		s_{min}	in.										
Minimum nominal anchor length[4,9]		ℓ_{anch}	in.	$1^3/_4$	$2^5/_8$	$2^1/_2$	4	3	5	4	6	5	8
Maximum impact wrench power (torque rating)[5]		$T_{impact,max}$	ft.-lb.	150		300		300		300		300	
Max. manual installation torque[6]		$T_{inst,max}$	ft.-lb.	18	25	25	40	45	60	60		70	
Hex Head	Wrench socket size	-	in.	$^7/_{16}$		$^9/_{16}$		$^3/_4$		$^{15}/_{16}$		$1^1/_8$	
Hex Head	Max. head height	-	in.	$^{21}/_{64}$		$^3/_8$		$^{31}/_{64}$		$^{37}/_{64}$		$^{43}/_{64}$	
Hex Head	Max. washer dia.	-	in.	$^{37}/_{64}$		$^3/_4$		$1^1/_{16}$		$1^1/_8$		$1^{13}/_{32}$	
Flat Head	Driver size	-	In.	T-30		T-50		T-55		-		-	
Flat Head	Max head diameter	-	in.	$^{17}/_{32}$		$^{57}/_{64}$		1		-		-	
Flat Head	Countersunk angle	-	In.	82		82		82		-		-	
Effective tensile stress area (screw anchor body)		A_{se}	in.^{2}	0.045		0.094		0.176		0.274		0.399	
Minimum specified ultimate strength		f_{uta}	psi	100,000		105,000		115,000		95,000		95,000	
Minimum specified yield strength		f_{ya}	psi	80,000		84,000		92,000		76,000		76,000	

For **SI:** 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 0.0069 N/mm^2 (MPa).

[1]The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
[2]Critical spacing and edge distances are the anchor distances for which no reduction in load capacity is required.
[3]Minimum spacing and edge distances are the smallest anchor distances allowed for installation.
[4]The listed minimum anchor length is based on the anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, including consideration of a fixture attachment. The minimum nominal length for hex head anchors is measured from under the head to the tip of the anchor, the minimum nominal length for flat head anchors is measured from the top of the head to the tip of the anchor.
[5]Due to the variability in measurement procedures, the published torque of an impact tool may not correlate with the listed maximum impact wrench power. Over-torquing post-installed anchors can damage the anchor and/or reduce its holding capacity.
[6]Maximum manual installation torque is provided for installations using a calibrated torque wrench.
[7]Installations in wall faces are applicable for screw anchors in the ends of grout-filled concrete masonry units where minimum edge and end distances are maintained.
[8]The minimum diameter of fixture hole clearance is for the body of the anchor to pass through structural steel members; clearance holes may be $^1/_8$-inch less than tabulated values (same as nominal drill bit diameter) provided the screw anchors are installed through light gauge cold-formed steel members or wood members.
[9]Hex head anchors with the following minimum anchor lengths are also suitable for use with cold-formed steel members provided the nominal thickness of the fixture attachment does not exceed 20 gauge (0.036-inch base metal thickness):
For $^1/_2$-inch-diameter anchors with $2^1/_2$-inch nominal embedment, $2^1/_2$-inch long anchors.
For $^5/_8$-inch-diameter anchors with 5-inch nominal embedment, 5-inch long anchors.
For $^3/_4$-inch-diameter anchors with 4-inch nominal embedment, 4-inch long anchors.

TABLE 2—ALLOWABLE SCREW-BOLT+ TENSION AND SHEAR LOAD CAPACITIES INSTALLED INTO GROUT-FILLED CONCRETE MASONRY UNITS[1,2,3,4,5,6,7,8,9]

TENSION LOAD								
Anchor Diameter, *d* (inches)	**Minimum Embedment, h_{nom} (inches)**	**Allowable Load at c_{cr} and s_{cr} (pounds)**	**Spacing Distance, s**			**Edge or End Distance, c_2 or c_1 (see Figure 2)**		
			Critical Distance, s_{cr} (inches)	**Minimum Distance, s_{min} (inches)**	**Allowable Load Factor at s_{min}**	**Critical Distance, c_{cr} (inches)**	**Minimum Distance, c_{min} (inches)**	**Allowable Load Factor at c_{min}**
1/4	1 5/8	315	4	2	1.0 (no reduction)	3 3/4	1 1/4	0.60
	2 1/2	605						
3/8	2	450	6	3	1.0 (no reduction)	6	1 1/2	0.70
	3 1/4	1,085						
1/2	2 1/2	610	8	4	1.0 (no reduction)	8	2 5/8	0.75
	4 1/4	1,190						
5/8	3 1/4	880	10	4	1.0 (no reduction)	10	3 3/8	0.90
	5	1,270						
3/4	4	1,150	12	4	1.0 (no reduction)	12	4	1.0 (no reduction)
	6 1/4	1,355						

SHEAR LOAD										
Anchor Diameter, *d* (inches)	**Minimum Embedment, h_{nom} (inches)**	**Allowable Load at c_{cr} and s_{cr}, Direction 1 & 2 (pounds)[10]**	**Allowable Load at c_{cr} and s_{cr}, Direction 3 & 4 (pounds)[10]**	**Spacing Distance, s**			**Edge or End Distance, c_2 or c_1 (see Figure 2)**			
				Critical Distance, s_{cr} (inches)	**Minimum Distance, s_{min} (inches)**	**Allowable Load Factor at s_{min}**	**Critical Distance, c_{cr} (inches)**	**Minimum Distance, c_{min} (inches)**	**Allowable Load Factor at c_{min}**	
									Load Perpendicular to Edge or End (Direction 1 & 2)	**Load Parallel to Edge or End (Direction 3 & 4)**
1/4	1 5/8	400	400	4	2	1.0 (no reduction)	3 3/4	1 1/4	0.35	1.0 (no reduction)
	2 1/2	505	505							
3/8	2	815	815	6	3	1.0 (no reduction)	6	1 1/2	0.27	1.0 (no reduction)
	3 1/4	935	935							
1/2	2 1/2	1,380	1,380	8	4	1.0 (no reduction)	8	2 5/8	0.20	1.0 (no reduction)
	4 1/4	2,180	2,180							
5/8	3 1/4	2,090	2,225	10	4	1.0 (no reduction)	10	3 3/8	0.23	1.0 (no reduction)
	5	2,640	2,640							
3/4	4	2,800	3,330	12	4	1.0 (no reduction)	12	4	0.25	1.0 (no reduction)
	6 1/4	3,100	3,685							

For **SI:** 1 inch = 25.4 mm; 1 lbs = 0.0044 kN, 1 psi = 0.006894 MPa.

[1]All values are for anchors installed in fully grouted concrete masonry wall construction with materials in compliance with Section 3.2 of this report. Concrete masonry units must be light-, medium, or normal-weight conforming to ASTM C90. Allowable loads are based on a safety factor of 5.0.

[2]Anchors are recognized to dead, live, seismic and wind tension and shear load applications. See Sections 4.1 and 5.4 of this report for design with load combinations. For combined loading, see Section 4.1 of this report.

[3]Anchors may be installed in any location in the face of the masonry wall (cell, web, bed joint) except within 1 1/4 inch from the of the vertical mortar joint (head joint), center-to-center, provided the minimum edge and end distances are maintained.

[4]A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor. See Figure 2 of this report.

[5]The critical spacing distance, s_{cr}, is the anchor spacing where full load values in the table may be used. The minimum spacing distance, s_{min}, is the minimum anchor spacing for which values are available and installation is permitted. Spacing distance is measured from the centerline to centerline between two anchors.

[6]The critical edge or end distance, c_{cr}, is the distance where full load values in the table may be used. The minimum edge or end distance, c_{min}, is the minimum distance for which values are available and installation is permitted. Edge or end distance is measured from anchor centerline to the closest unrestrained edge.

[7]The tabulated values are applicable for anchors installed into the ends of grout-filled concrete masonry units (e.g. wall opening) where minimum edge distances are maintained.

[8]Load values for anchors installed less than s_{cr} and c_{cr} must be multiplied by the appropriate load reduction factor based on actual spacing (s) or edge distance (c). Load factors are multiplicative; both spacing and edge reduction factors must be considered.

[9]Linear interpolation of load values between minimum spacing (s_{min}) and critical spacing (s_{cr}) and between minimum edge or end distance (c_{min}) and critical edge or end distance (c_{cr}) is permitted.

[10]See Figure 3 for illustration of shear load directions.

TABLE 3—ALLOWABLE SCREW-BOLT+ TENSION AND SHEAR LOADS FOR THREADED RODS INSTALLED INTO THE TOPS OF GROUT-FILLED CONCRETE MASONRY UNITS[1,2,3,4,5,6,7,8,9,10]

Anchor Diameter *d* (inches)	Minimum Embedment h_{nom} (inches)	Minimum Spacing Distance (inches)	Minimum Edge Distance, (inches)	Minimum End Distance, (inches)	Tension Load (pounds)	Shear Load (pounds)	
						Load Perpendicular to Edge of Masonry Wall (II to end)	Load Parallel to Edge of Masonry Wall (⊥ to end)
1/2	4 1/4	8 (see Note 5 for reduced minimum spacing distances)	3 3/4	8	1,210	255	580
			1 3/4		810		
5/8	5	10	1 3/4	10	900	260	950
3/4	6 1/4	12	1 3/4	12	1,215	260	990

For **SI:** 1 inch = 25.4 mm; 1 lbs = 0.0044 kN, 1 psi = 0.006894 MPa.

[1] All values are for anchors installed in fully grouted concrete masonry wall construction with materials in compliance with Section 3.2 of this report. Concrete masonry units must be light-, medium, or normal-weight conforming to ASTM C90. Allowable loads are based on a safety factor of 5.0.
[2]Anchors are recognized to dead, live, seismic and wind tension and shear load applications. See Sections 4.1 and 5.4 of this report for design with load combinations. For combined loading, see Section 4.1 of this report.
[3]Anchors may be installed in any location in the top of the masonry wall except within 1 1/4 inch from the mortar joint (head joint), provided the minimum edge and end distances are maintained.
[4]A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor. See Figure 4 of this report.
[5]Minimum spacing distance for 1/2-inch-diameter anchors shall be 8 inches and may be reduced to 2 inches provided the allowable load reduction factor of 0.40 is applied. Linear interpolation may be used to determine the reduction factor for intermediate anchor spacing distances between 8 inches and 2 inches.
[6]Spacing distance is measured from the centerline to centerline between two anchors.
[7]Linear interpolation may be used to for 1/2-inch-diameter anchors to determine allowable loads for edge distances between 3 3/4 inches and 1 3/4 inches.
[8]The edge and end distance is measured from the anchor centerline to the closest unrestrained edge and end of the CMU block, respectively. See Figure 4 of this report for an illustration of the top of grouted masonry walls.
[9]Spacing distance is measured from the centerline to centerline between two anchors.
[10]Allowable shear loads parallel and perpendicular to the edge of a masonry wall may be applied in or out of plane, respectively. See Figure 4.

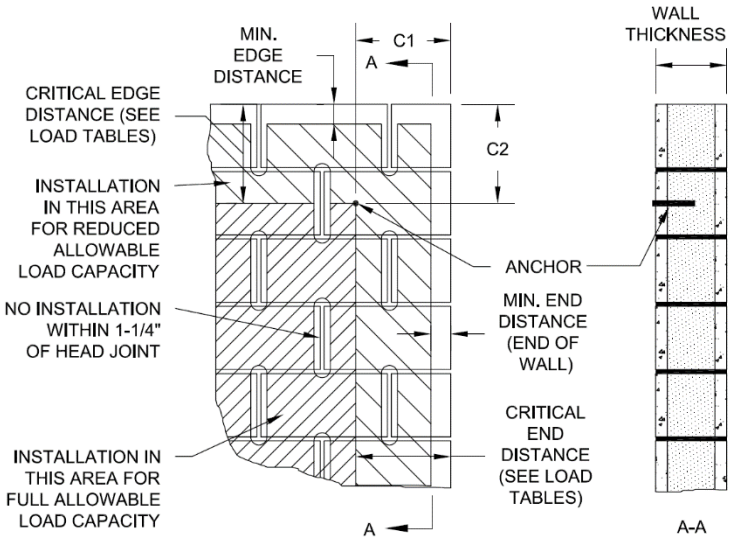
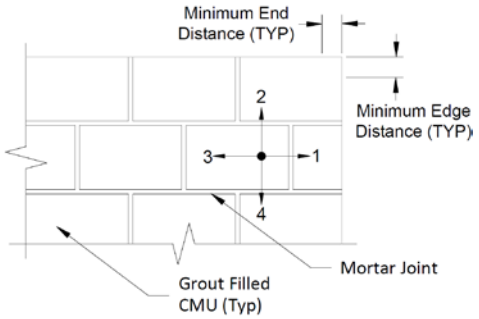
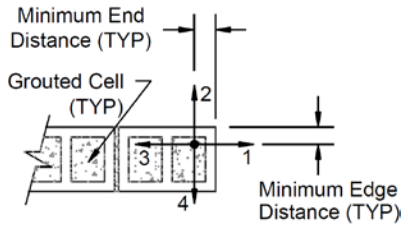


FIGURE 2—ILLUSTRATION OF SCREW-BOLT+ ANCHORS INSTALLED INTO GROUTED CONCRETE MASONRY WALL



(1) Shear load perpendicular to End and parallel to Edge
(2) Shear load perpendicular to Edge and parallel to End
(3) Shear load parallel to Edge and perpendicular away from End
(4) Shear load parallel to End and perpendicular to bottom of wall

FIGURE 3—DIRECTION OF SHEAR LOADING IN RELATION TO EDGE AND END OF MASONRY WALL



(1) Shear load parallel to Edge and perpendicular to End
(2) Shear load parallel to End and perpendicular to Edge
(3) Shear load parallel to Edge and perpendicular away from End
(4) Shear load parallel to End and perpendicular to opposite Edge

FIGURE 4—SCREW-BOLT+ ANCHORS INSTALLED INTO THE TOP OF GROUTED CONCRETE MASONRY WALL

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

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

SCREW-BOLT+™ ANCHORS IN MASONRY (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Screw-Bolt+ Anchors in Masonry, described in ICC-ES evaluation report ESR-4042, have also been evaluated for compliance with the codes noted below as adopted by Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2020 *City of Los Angeles Building Code* (LABC)
- 2020 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Screw-Bolt+ Anchors in Masonry, described in Sections 2.0 through 7.0 of the evaluation report ESR-4042, comply with LABC Chapter 21, and LARC, and are subjected to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Screw-Bolt+ Anchors in Masonry described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-4042.
- The design, installation, conditions of use and labeling of the anchors are in accordance with the 2018 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-4042.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable design values listed in the evaluation report and tables are for the connection of the anchors to masonry substrate. The connection between the anchors and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragm applications, anchors shall be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2020-071.

This supplement expires concurrently with the evaluation report, reissued July 2020.

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

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

SCREW-BOLT+™ ANCHORS IN MASONRY (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Screw-Bolt+ Anchors in Masonry, described in ICC-ES evaluation report ESR-4042, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2017 *Florida Building Code—Building*
- 2017 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Screw-Bolt+ Anchors in Masonry, described in Sections 2.0 through 7.0 of the evaluation report ESR-4042, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2015 *International Building Code*® provisions noted in the report.

Use of Screw-Bolt+ Anchors in Masonry for compliance with the High-velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* has not been evaluated, and is outside the scope of this supplemental report.

For products falling under Florida Rule 9N-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued July 2020.