

TO:

PROJECT:

PROJECT LOCATION:

SPECIFIED ITEM:

Section	Page	Paragraph	Description
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PRODUCT SUBMIT TAL / SUBSTITUTION REQUESTED:

DEWALT® Engineered By Powers® Power-Stud(R)+ SD2 -

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:

DEWALT® Power-Stud(R)+ SD2 Submittal Section:

Competitive Comparisons:

- DEWALT® Power-Stud(R)+ SD2 vs. HILTI* KWIK BOLT TZ

Product Pages:

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

Code Reports & Agency Listings:

- ICC-ES Approval: ESR-2502 (Cracked & Uncracked Concrete)

Other Items:

- Notes Page



Offline version available for download at www.dewaltdesignassist.com.

DEWALT developed the DEWALT Design Assist (DDA) anchor software to enable users to input technical data into a dynamic model environment-to visualize, consider, and specify anchors in today's changing engineering climate.

For a demonstration of the latest version of PDA, contact us at anchors@DEWALT.com

POWER-STUD+® SD2 VS. HILTI* KWIK BOLT TZ

Product Comparison

Product Name	Power-Stud+ SD2	Kwik Bolt TZ
Company	DeWALT	Hilti*
Description	Carbon steel wedge anchor with stainless steel clip	Carbon steel wedge anchor with stainless steel clip
Size Range (inch)	3/8, 1/2, 5/8, 3/4	3/8, 1/2, 5/8, 3/4
ICC-ES ESR (concrete)	ESR-2502	ESR-1917
Issued	2016 May	2016 Sept
Cracked Concrete	Yes	Yes
Seismic Approval	Yes	Yes
2.5 inch Topping of Steel Deck ¹	Yes	No
Steel Deck Soffit	Yes	Yes

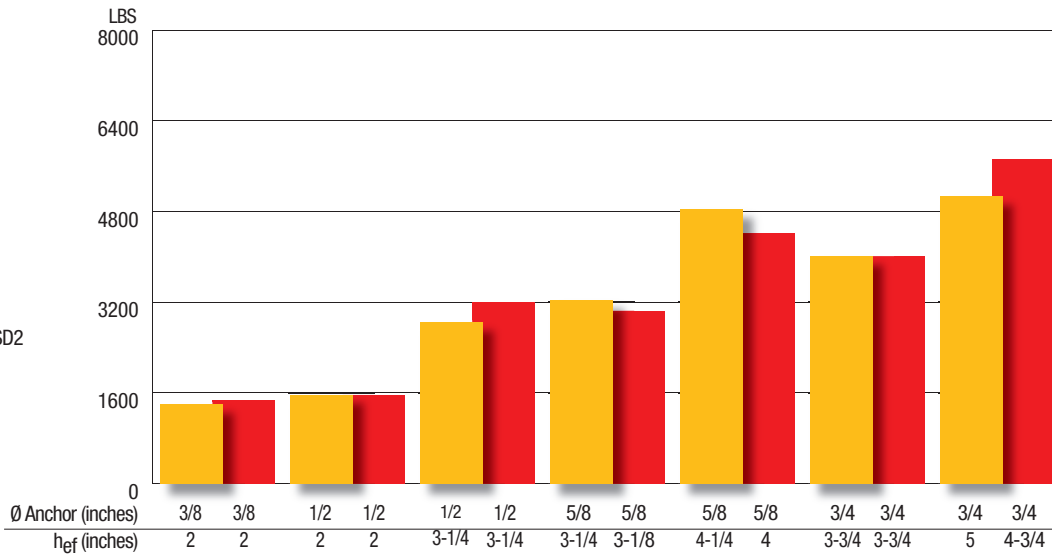
1. 2-inch effective embedment for 3/8-inch-diameter and 1/2-inch-diameter anchors.

* Hilti is a registered trademark of Hilti Corporation

Factored Loads Tension (lbs)

Cracked Concrete 2500 psi

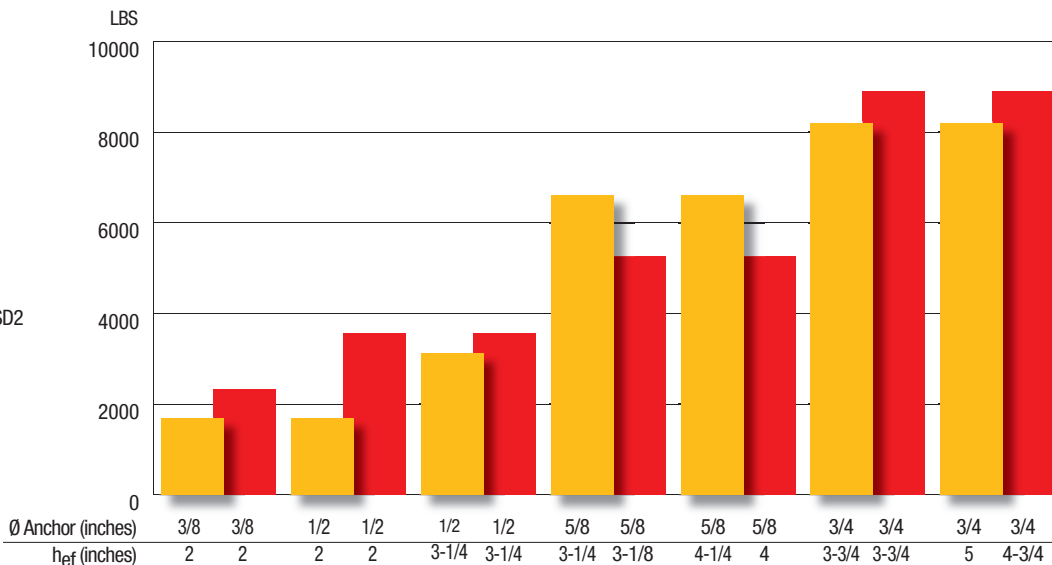
Power-Stud+ SD2
Hilti KBTZ



Factored Loads Shear (lbs)

Cracked Concrete 2500 psi

Power-Stud+ SD2
Hilti KBTZ



GENERAL INFORMATION

POWER-STUD® +SD2

High Performance Wedge Expansion Anchor

PRODUCT DESCRIPTION

The Power-Stud+ SD2 anchor is a fully threaded, torque-controlled, wedge expansion anchor which is designed for consistent performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck. The anchor is manufactured with a zinc plated carbon steel body and stainless steel expansion clip for premium performance.

GENERAL APPLICATIONS AND USES

- Structural connections, i.e., beam and column anchorage
- Utility and safety-related attachments
- Interior applications / low level corrosion environment
- Tension zone applications, i.e., cable trays and strut, pipe supports, fire sprinklers
- Seismic and wind loading
- Medium to heavy duty purposes

FEATURES AND BENEFITS

- + Consistent performance in high and low strength concrete
- + Nominal drill bit size is the same as the anchor diameter
- + Anchor can be installed through standard fixture holes
- + Length ID code and identifying marking stamped on head of each anchor
- + Anchor design allows for follow-up expansion after setting under tensile loading

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-2502 for cracked and uncracked concrete
- Code Compliant with the 2015, IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Tested in accordance with ACI 355.2 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318-14 Chapter 17 or ACI 318-11/08 Appendix D
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (Category 1 anchors)
- FM Global (Factory Mutual) - File No. 3033795, 3/8" and 1/2" diameters
Pipe hanger components for automatic sprinkler systems
- Underwriters Laboratories (UL Listed) - File No. EX1289 - See listing

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 09 - Post-Installed Concrete Anchors. Expansion anchors shall be Power-Stud+ SD2 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	Medium carbon steel
Hex nut	Carbon steel, ASTM A 563, Grade A
Washer	Carbon Steel, ASTM F 844; meets dimensional requirements of ANSI B18.22.2. Type A Plain
Expansion wedge (clip)	Type 316 Stainless Steel
Plating (anchor body, nut and washer)	Zinc plating according to ASTM B 633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition.

SECTION CONTENTS

General Information..... 1
 Material Specifications 1
 Installation Specifications 2
 Installation Instructions 3
 Performance Data 5
 Ordering Information..... 10



POWER-STUD+ SD2 ASSEMBLY

THREAD VERSION

- UNC threaded stud

ANCHOR MATERIALS

- Zinc plated carbon steel body with stainless steel expansion clip, zinc plated carbon steel nut and washer

ANCHOR SIZE RANGE (TYP.)

- 3/8" diameter through 3/4" diameter

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Sand-lightweight concrete
- Concrete over steel deck
- Grouted-filled concrete masonry (CMU)



INSTALLATION SPECIFICATIONS

Installation Table for Power-Stud+ SD2¹

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size							
			3/8"		1/2"		5/8"		3/4"	
Anchor diameter	d_a	in. (mm)	0.375 (9.5)		0.500 (12.7)		0.625 (15.9)		0.750 (19.1)	
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	7/16 (11.1)		9/16 (14.3)		11/16 (17.5)		13/16 (20.6)	
Nominal drill bit diameter	d_{bit}	in.	3/8 ANSI		1/2 ANSI		5/8 ANSI		3/4 ANSI	
Minimum nominal embedment depth ¹	h_{nom}	in. (mm)	2-3/8 (60)		2-1/2 (64)		3-3/4 (95)		3-7/8 (98)	
Effective embedment	h_{ef}	in. (mm)	2 (51)		2 (51)		3-1/4 (83)		3-1/4 (83)	
Minimum hole depth ²	h_o	in. (mm)	2-5/8 (67)		2-3/4 (70)		4 (102)		4-1/4 (108)	
Minimum concrete member thickness	h_{min}	in. (mm)	4 (102)		4-1/2 (114)		6 (152)		5-3/4 (146)	
Minimum overall anchor length ³	ℓ_{anch}	in. (mm)	3 (76.2)		3-3/4 (95)		4-1/2 (114)		4-3/4 (121)	
Minimum edge distance ²	C_{min}	in. (mm)	2-1/2 (63.5)		4 (102)		2-3/4 (70)		4-1/4 (108)	
Minimum spacing distance ²	S_{min}	in. (mm)	3-1/2 (88.9)		6 (152)		6 (152)		4-1/4 (108)	
Critical edge distance ²	C_{ac}	in. (mm)	6-1/2 (165.1)		8 (203)		10 (254)		8 (203)	
Installation torque	T_{inst}	ft.-lb. (N-m)	20 (27)		40 (54)		60 (81)		110 (149)	
Torque wrench socket size	-	in.	9/16		3/4		15/16		1-1/8	
Nut height	-	in.	21/64		7/16		35/64		41/64	

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

- The embedment depth, h_{nom} , is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
- For installations through the soffit of steel deck into concrete see the installation details in Figure A, B, and C. In addition, anchors shall have an axial spacing along the flute equal to the greater of $3h_w$ or 1.5 times the flute width. The hole diameter in the steel deck must not exceed the hole diameter in the concrete by more than 1/8-inch (3.2 mm).
- The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and possible fixture attachment.
- The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with the installation specifications and design information provided the concrete thickness above the upper flute meets the minimum thicknesses specified in the tables; see Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies table and installation detail D.

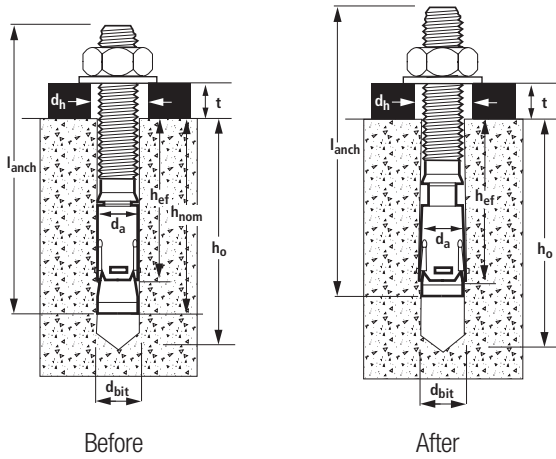
Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies^{3,4}

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size (inch)			
			3/8"		1/2"	
Nominal drill bit diameter	d_{bit}	in.	3/8 ANSI		1/2 ANSI	
Minimum nominal embedment depth ¹	h_{nom}	in. (mm)	2-3/8 (60)		2-1/2 (64)	
Effective embedment	h_{ef}	in. (mm)	2.00 (51)		2.00 (51)	
Minimum concrete member thickness ²	$h_{min,deck}$	in. (mm)	2-1/2 (64)		2-1/2 (64)	
Critical edge distance	$C_{ac,deck,top}$	in. (mm)	8 (203)		9 (229)	
Minimum edge distance	$C_{min,deck,top}$	in. (mm)	4 (102)		2-3/4 (70)	
Minimum spacing distance	$S_{min,deck,top}$	in. (mm)	3-1/2 (89)		6 (152)	
Minimum hole depth	h_o	in. (mm)	2-1/2 (64)		2-1/2 (64)	
Installation torque	T_{inst}	ft.-lb. (N-m)	20 (27)		40 (54)	
Torque wrench socket size	-	in.	9/16		3/4	
Nut height	-	in.	21/64		7/16	

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

- The embedment depth, h_{nom} , is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
- The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies provided the concrete thickness above the upper flute meets the minimum thicknesses specified in this table. Minimum concrete member thickness refers to the concrete thickness above the upper flute (topping thickness). See Installation Detail D.
- For all other anchor diameters and embedment depths, refer to the installation table for applicable values of h_{min} , C_{min} and S_{min} .
- Design capacities shall be based on calculations according to values in Tension and Shear Design Information for Anchors in Concrete tables.

Power-Stud+ SD2 Anchor Detail



Head Marking



Legend

- Letter Code = Length Identification Mark
- '+' Symbol = Strength Design Compliant Anchor
- Number Code 2 = Carbon Steel Body and Stainless Steel Expansion Clip

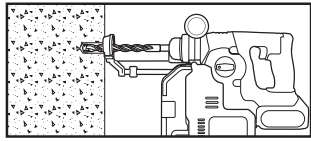
Length Identification

Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
From	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"
Up to but not including	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"

Length identification mark indicates overall length of anchor.

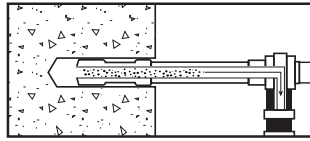
INSTALLATION INSTRUCTIONS

Installation Instructions for Power-Stud+ SD2



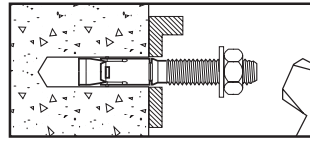
Step 1

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.



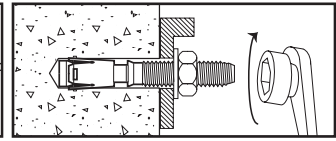
Step 2

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



Step 3

Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom} .



Step 4

Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst} .

Installation Detail A: Power-Stud+ SD2 Installed in the Soffit of Concrete over Steel Deck Floor and Roof Assemblies (see dimensional profile requirements)¹

<p>STRUCTURAL SAND-LIGHTWEIGHT CONCRETE OR NORMAL WEIGHT CONCRETE OVER STEEL DECK (MINIMUM 3,000 PSI)</p>	<ol style="list-style-type: none"> 1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with installation Detail A provided the minimum hole clearance is satisfied. Anchors in the lower flute of installation Detail A profiles may be installed with a maximum 1-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.
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Installation Detail B: Power-Stud+ SD2 Installed in the Soffit of Concrete over Steel Deck Floor and Roof Assemblies (see dimensional profile requirements)¹

<p>LIGHTWEIGHT CONCRETE OR NORMAL WEIGHT CONCRETE OVER STEEL DECK (MINIMUM 3,000 PSI)</p>	<ol style="list-style-type: none"> 1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Detail B provided the minimum hole clearance is satisfied. Anchors in the lower flute of Detail B 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.
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Installation Detail C: Power-Stud+ SD2 Installed in the Soffit of Concrete over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)^{1,2}

<p>STRUCTURAL SAND-LIGHTWEIGHT CONCRETE OR NORMAL WEIGHT CONCRETE OVER STEEL DECK (MINIMUM 3,000 PSI)</p>	<ol style="list-style-type: none"> 1. Anchors may be placed in the lower flute of the steel deck profiles in accordance with installation Detail C provided the minimum hole clearance is satisfied. Anchors in the lower flute of installation Detail C profiles may be installed with a maximum 1/8-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. 2. Anchors may be placed in the upper flute of the steel deck profiles in accordance with installation Detail C provided the concrete thickness above the upper flute is minimum 3-1/4-inch and a minimum hole clearance of 3/4-inch is satisfied.
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Installation Detail D: Installation Detail for Anchors in the Top of Concrete over Steel Deck Floor and Roof Assemblies (see dimensional profile requirements)^{1,2}

<p>LIGHTWEIGHT CONCRETE OR NORMAL WEIGHT CONCRETE OVER STEEL DECK (MINIMUM 2,500 PSI)</p>	<ol style="list-style-type: none"> 1. Anchors may be placed in the top side of concrete over steel deck profiles in accordance with Detail D provided the minimum concrete thickness above the upper flute (topping thickness) is as illustrated and the minimum spacing distance and minimum edge distances are satisfied as given in Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies Table. 2. For anchors installed in the top of concrete over steel deck profiles with concrete thickness above the upper flute (topping thickness) greater than or equal to the minimum concrete member thicknesses specified in Installation Table for the Power-Stud+ SD2, the minimum spacing distance and minimum edge distances may be used from this table, as applicable.
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PERFORMANCE DATA

Tension Design Information^{1,2,12}

CODE LISTED
ICC-ES ESR-2502



Design Characteristic	Notation	Units	Nominal Anchor Diameter (inch)						
			3/8	1/2	5/8	3/4			
Anchor category	1,2 or 3	-	1	1	1	1			
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)⁴									
Minimum specified yield strength (neck)	f_y	ksi (N/mm ²)	96.0 (662)	85.0 (586)	85.0 (586)	70.0 (483)			
Minimum specified ultimate tensile strength (neck)	f_{uta}	ksi (N/mm ²)	120.0 (827)	106.0 (731)	106.0 (731)	90.0 (620)			
Effective tensile stress area (neck)	$A_{se, N}$	in ² (mm ²)	0.0552 (35.6)	0.1007 (65.0)	0.1619 (104.5)	0.2359 (153.2)			
Steel strength in tension ⁵	N_{sa}	lb (kN)	6,625 (29.4)	10,445 (46.5)	13,080 (58.2)	21,230 (94.4)			
Reduction factor for steel strength ³	ϕ	-	0.75						
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)³									
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Effectiveness factor for uncracked concrete	k_{ucr}	-	24	24	24	24	24	24	
Effectiveness factor for cracked concrete	k_{cr}	-	17	17	17	17	17	17	
Modification factor for cracked and uncracked concrete ⁶	$\psi_{c,N}$	-	1.0 See note 5	1.0 See note 6	1.0 See note 6	1.0 See note 6	1.0 See note 6	1.0 See note 6	
Critical edge distance	c_{ac}	in. (mm)	See Installation Table						
Reduction factor for concrete breakout strength ³	ϕ	-	0.65 (Condition B)						
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)³									
Characteristic pullout strength, uncracked concrete (2,500 psi) ⁷	$N_{p,ucr}$	lb (kN)	2,775 (12.3)	See note 8	6,615 (29.4)	See note 8	See note 8	See note 8	See note 8
Characteristic pullout strength, cracked concrete (2,500 psi) ⁷	$N_{p,cr}$	lb (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See note 8	See note 8	7,795 (35.1)
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.5.3.3)³									
Characteristic pullout strength, seismic (2,500 psi) ^{7,10}	$N_{p,eq}$	lb (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See note 8	See note 8	7,795 (35.1)
Reduction factor for pullout strength ³	ϕ	-	0.65 (Condition B)						
Mean axial stiffness values service load range ¹¹	Uncracked concrete	β	lbf/in (kN/mm)	865,000 (151)	717,00 (126)	569,000 (100)	420,000 (74)		
	Cracked concrete	β	lbf/in (kN/mm)	49,500 (9)	57,000 (10)	64,500 (11)	72,000 (13)		

- The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318 D.3.3, as applicable, shall apply.
- Installation must comply with published instructions and details.
- 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, as applicable. 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 meets ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3 or ACI 318-11 D.4.3, 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, as applicable, are used.
- The Power-Stud+ SD2 is considered a ductile steel element in tension as defined by ACI 318-14 2.3 or ACI 318 D.1, as applicable.
- Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design in lieu of calculation.
- For all design cases use $\psi_{c,N} = 1.0$. Select appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{ucr}).
- For all design cases use $\psi_{c,P} = 1.0$. For concrete compressive strength greater than 2,500 psi, $N_{pn} = (\text{pullout strength value from table}) \times (\text{specified concrete compressive strength}/2500)$. For concrete over steel deck the value of 2500 must be replaced with the value of 3000.
For all anchors $n = 1/2$ with the exception of the 3/8" anchor size for cracked concrete where $n = 1/3$.
- Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
- Anchors are permitted to be used in sand-lightweight concrete provided the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n . λ shall be determined in accordance with the corresponding version of ACI 318.
- Tabulated values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5.
- Mean values shown; actual stiffness varies considerable depending on concrete strength, loading and geometry of application.
- Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies; see installation details A, B, C and D.

MECHANICAL ANCHORS

POWER-STUD® +SD2

High Performance Wedge Expansion Anchor

Shear Design Information^{1,2,8}
CODE LISTED
 ICC-ES ESR-2502


Design Characteristic	Notation	Units	Nominal Anchor Diameter (inch)					
			3/8	1/2	5/8	3/4		
Anchor category	1,2 or 3	-	1	1	1	1		
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)⁶								
Minimum specified yield strength (threads)	f_y	ksi (N/mm ²)	76.8 (530)	68.0 (469)	68.0 (469)	68.0 (469)	56.0 (386)	
Minimum specified ultimate tensile strength (threads)	f_{uta}	ksi (N/mm ²)	100.0 (690)	88.0 (607)	88.0 (607)	88.0 (607)	80.0 (551)	
Effective tensile stress area (threads)	$A_{se,v}$	in ² (mm ²)	0.0775 (50.0)	0.1419 (65.7)	0.2260 (104.9)	0.2260 (104.9)	0.3345 (215.8)	
Steel strength in shear ⁵	V_{sa}	lb (kN)	3,115 (13.9)	4,815 (21.4)	10,170 (45.2)	10,170 (45.2)	12,610 (56.1)	
Reduction factor for steel strength ³	ϕ	-	0.65					
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)⁶								
Load bearing length of anchor (h_{ef} or $8d_n$, whichever is less)	l_e	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95) 5.00 (127)
Reduction factor for concrete breakout strength ³	ϕ	-	0.70 (Condition B)					
PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)⁶								
Coefficient for prout strength 1.0 for $h_{ef} < 2.5$ in., 2.0 for $h_{ef} \geq 2.5$ in.	k_{cp}	-	1.0	1.0	2.0	2.0	2.0	2.0
Effective Embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95) 5.00 (127)
Reduction factor for pullout strength ³	ϕ	-	0.70 (Condition B)					
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 ⁷	$V_{sa,eq}$	lb (kN)	2,460 (11.0)	4,815 (21.4)	6,770 (30.1)	6,770 (30.1)	8,060 (35.9)	
Reduction factor for pullout strength ³	ϕ	-	0.65 (Condition B)					
1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318 D.3.3 shall apply, as applicable. 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 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 meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2 are used. 4. The Power-Stud+ SD2 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable. 5. Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and shall be used for design. 6. Anchors are permitted to be used in sand-lightweight concrete provided the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n . λ shall be determined in accordance with the corresponding version of ACI 318. 7. Reported values for steel strength in shear for seismic applications are based on test results per ACI 355.2, Section 9.6. 8. Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies; see installation details A, B, C and D.								

MECHANICAL ANCHORS
POWER-STUD® +SD2
 High Performance Wedge Expansion Anchor

Tension and Shear Design Data for Power-Stud+ SD2 Anchors in the Soffit of Concrete-Filled Steel Deck Assemblies^{1,2,7}

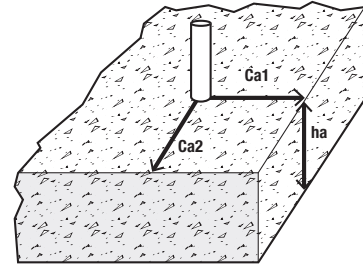
CODE LISTED
ICC-ES ESR-2502



Design Characteristics		Notation	Units	Nominal Anchor Size (inch)					
				0.375	0.5		0.625	0.75	
Anchor Category		1, 2 or 3	-	1	1		1	1	
Effective Embedment		h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)
Minimum Nominal Embedment Depth		h_{nom}	in. (mm)	2-3/8 (60)	2-1/2 (64)	3-3/4 (83)	3-7/8 (98)	4-7/8 (124)	4-1/2 (114)
Minimum Hole Depth		h_o	in. (mm)	2-5/8 (67)	2-3/4 (70)	4 (102)	4-1/4 (108)	5-1/4 (133)	5 (27)
PULLOUT STRENGTH IN TENSION FOR ANCHORS IN SOFFIT OF SAND LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK¹									
According to Detail A 4-1/2-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck ²	$N_{p,deck,uncr}$	lbf (kN)	1,855 (8.3)	2,065 (9.2)	3,930 (17.5)	4,665 (20.8)	7,365 (32.8)	4,900 (21.8)
	Characteristic pullout strength, cracked concrete over steel deck ^{2,3}	$N_{p,deck,cr}$	lbf (kN)	1,445 (6.4)	1,465 (6.5)	2,600 (11.6)	3,305 (14.7)	5,215 (23.2)	3,470 (15.4)
According to Detail B 3-7/8-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck ²	$N_{p,deck,uncr}$	lbf (kN)	2,235 (9.9)	2,785 (12.4)	5,600 (24.9)	4,480 (19.9)	7,265 (32.3)	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck ^{2,3}	$N_{p,deck,cr}$	lbf (kN)	1,745 (7.8)	1,975 (8.8)	3,695 (16.4)	3,175 (14.1)	5,145 (22.9)	Not Applicable
According to Detail C 1-3/4-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck ²	$N_{p,deck,uncr}$	lbf (kN)	1,600 (7.1)	2,025 (9.0)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck ^{2,3}	$N_{p,deck,cr}$	lbf (kN)	1,250 (5.6)	1,435 (6.4)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Reduction factor for pullout strength ⁶		ϕ	-	0.65					
STEEL STRENGTH IN SHEAR FOR ANCHORS IN SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL WEIGHT CONCRETE OVER STEEL DECK^{4,5}									
According to Detail A 4-1/2-inch-wide deck flute	Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lbf (kN)	2,170 (9.7)	3,815 (17.0)	5,040 (22.4)	4,015 (17.9)	6,670 (29.7)	4,325 (19.2)
	Steel strength in shear, seismic, concrete over steel deck	$V_{sa,deck,eq}$	lbf (kN)	1,715 (7.6)	3,815 (17.0)	5,040 (22.4)	2,675 (11.9)	4,445 (19.8)	2,820 (12.5)
According to Detail B 3-7/8-inch-wide deck flute	Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lbf (kN)	3,040 (13.5)	2,675 (11.9)	4,930 (21.9)	Not Applicable	Not Applicable	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck	$V_{sa,deck,eq}$	lbf (kN)	2,400 (10.6)	2,675 (11.9)	4,930 (21.9)	Not Applicable	Not Applicable	Not Applicable
According to Detail C 1-3/4-inch-wide deck flute	Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lbf (kN)	2,170 (9.7)	2,880 (12.8)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck	$V_{sa,deck,eq}$	lbf (kN)	1,715 (7.6)	2,880 (12.8)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Reduction factor for steel strength in shear, concrete over steel deck ⁶		ϕ	-	0.65					
<p>1. For all design cases $\Psi_{c,p} = 1.0$. For concrete compressive strength greater than 3,000 psi, $N_{pm} = (\text{pullout strength value from table}) * (\text{specified concrete compressive strength}/2500)^*$. For all anchors $n=1/2$ with exception of the 3/8-inch-diameter anchor size, where $n=1/3$.</p> <p>2. Values for $N_{p,deck}$ 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 (flute).</p> <p>3. Values for $N_{p,deck,cr}$ are applicable for seismic loading.</p> <p>4. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.</p> <p>5. Values for $V_{sa,deck}$ and $V_{sa,deck,eq}$ 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 17.5.2 or ACI 318 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, is not required for anchors installed in the deck soffit (flute).</p> <p>6. 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, as applicable. 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.</p> <p>7. Anchors shall have an axial spacing along the flute soffit equal to the greater of $3h_{ef}$ or 1.5 times the flute width.</p>									

Factored Design 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 318-18 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 (ϕ) 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.



MECHANICAL ANCHORS

POWER-STUD® +SD2
High Performance Wedge Expansion Anchor

Tension and Shear Design Strengths for Power-Stud+ SD2 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_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.)
3/8	2-3/8	1,405	1,685	1,495	1,845	1,645	2,025	1,885	2,025	2,075	2,025
1/2	2-1/2	1,565	1,685	1,710	1,845	1,975	2,130	2,420	2,605	2,795	3,010
	3-3/4	2,845	3,130	3,115	3,130	3,595	3,130	4,405	3,130	5,085	3,130
5/8	3-7/8	3,235	4,220	3,545	4,620	4,095	5,335	5,015	6,535	5,790	6,610
	4-7/8	4,840	6,610	5,305	6,610	6,125	6,610	7,500	6,610	8,660	6,610
3/4	4-1/2	4,010	7,590	4,395	8,195	5,075	8,195	6,215	8,195	7,175	8,195
	5-3/4	5,065	8,195	5,550	8,195	6,410	8,195	7,850	8,195	9,065	8,195

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

Tension and Shear Design Strengths for Power-Stud+ SD2 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_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.)
3/8	2-3/8	1,805	2,025	1,975	2,025	2,280	2,025	2,795	2,025	3,225	2,025
1/2	2-1/2	2,205	2,375	2,415	2,605	2,790	3,005	3,420	3,130	3,945	3,130
	3-3/4	4,300	3,130	4,710	3,130	5,440	3,130	6,660	3,130	7,690	3,130
5/8	3-7/8	4,570	5,905	5,005	6,470	5,780	6,610	7,080	6,610	8,175	6,610
	4-7/8	6,835	6,610	7,485	6,610	8,645	6,610	9,810	6,610	9,810	6,610
3/4	4-1/2	5,665	8,195	6,205	8,195	7,165	8,195	8,775	8,195	10,130	8,195
	5-3/4	8,720	8,195	9,555	8,195	11,030	8,195	13,510	8,195	15,600	8,195

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

Factored design strengths may be converted to allowable loads using an appropriate conversion factor, ϕ , for the controlling load combination. See ICC-ES ESR-2502 or contact DEWALT for more information regarding the procedure to convert factored design strengths to allowable loads.



Converted Allowable Loads for Power-Stud+ SD2 in Cracked Concrete^{1,2}

Nominal Anchor Size (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	
		$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)
3/8	2-3/8	1,005	1,205	1,070	1,320	1,175	1,445	1,345	1,445	1,480	1,445
1/2	2-1/2	1,120	1,205	1,220	1,320	1,410	1,520	1,730	1,860	1,995	2,150
	3-3/4	2,030	2,235	2,225	2,235	2,570	2,235	3,145	2,235	3,630	2,235
5/8	3-7/8	2,310	3,015	2,530	3,300	2,925	3,810	3,580	4,670	4,135	4,720
	4-7/8	3,455	4,720	3,790	4,720	4,375	4,720	5,355	4,720	6,185	4,720
3/4	4-1/2	2,865	5,420	3,140	5,855	3,625	5,855	4,440	5,855	5,125	5,855
	5-3/4	3,620	5,855	3,965	5,855	4,580	5,855	5,605	5,855	6,475	5,855

1. Allowable load values are calculated using a conversion factor, α , from Factored Design Strengths and conditions shown on the previous page.
2. Tabulated allowable load values assume 50% dead load and 50% live load, with controlling load combination 1.2D + 1.6L. Calculated weighted average for the conversion factor, α : $1.2(0.5) + 1.6(0.5) = 1.4$.

Converted Allowable Loads for Power-Stud+ SD2 in Uncracked Concrete^{1,2}

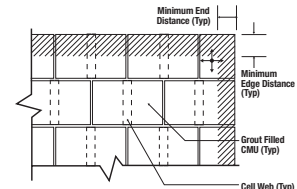
Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		$f'_c = 2,500$ psi		$f'_c = 3,000$ psi		$f'_c = 4,000$ psi		$f'_c = 6,000$ psi		$f'_c = 8,000$ psi	
		$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)
3/8	2-3/8	1,290	1,445	1,410	1,445	1,630	1,445	1,995	1,445	2,305	1,445
1/2	2-1/2	1,575	1,695	1,725	1,860	1,995	2,145	2,445	2,235	2,820	2,235
	3-3/4	3,070	2,235	3,365	2,235	3,885	2,235	4,755	2,235	5,495	2,235
5/8	3-7/8	3,265	4,220	3,575	4,620	4,130	4,720	5,055	4,720	5,840	4,720
	4-7/8	4,880	4,720	5,345	4,720	6,175	4,720	7,005	4,720	7,005	4,720
3/4	4-1/2	4,045	5,855	4,430	5,855	5,120	5,855	6,270	5,855	7,235	5,855
	5-3/4	6,230	5,855	6,825	5,855	7,880	5,855	9,650	5,855	11,145	5,855

1. Allowable load values are calculated using a conversion factor, α , from Factored Design Strengths and conditions shown on the previous page.
2. Tabulated allowable load values assume 50% dead load and 50% live load, with controlling load combination 1.2D + 1.6L. Calculated weighted average for the conversion factor, α : $1.2(0.5) + 1.6(0.5) = 1.4$.

Ultimate and Allowable Load Capacities for Power-Stud+ SD2 in Grouted Filled Concrete Masonry^{1,2,3}



Nominal Anchor Size in. (mm)	Minimum Embedment Depth (mm)	Installation Location ³	Minimum Masonry Compressive Strength, $f'_m = 1,500$ psi (10.4 MPa)			
			Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8 (9.5)	2-1/2 (50.8)	Wall Face/End Min. 2-1/2" Edge and End Distances	1,670 (7.4)	335 (1.5)	2,075 (9.2)	415 (1.8)
1/2 (12.7)	2-1/2 (50.8)	Wall Face/End Min. 3" Edge and End Distances	2,295 (10.2)	460 (2.0)	1,310 (5.8)	260 (1.2)
	3-3/4 (95.3)	Top of Wall Min. 1-3/4" Edge and 4" Edge Distances	3,320 (14.8)	665 (3.0)	1,140 (5.1)	230 (1.0)



Face Shell Permissible Anchor Locations (Un-hatched Area / Through Face Shell)

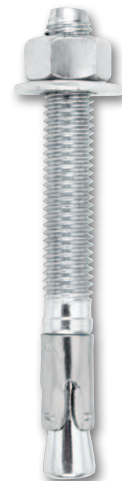
1. Tabulated load values are for anchors installed in minimum 6-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using and applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety.
3. Anchor installations into grouted masonry walls are limited to one per masonry cell.

ORDERING INFORMATION

Power-Stud+ SD2 (Carbon Steel Body with Stainless Steel Expansion Clip)

Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	Wt./100 (lbs.)	Suggested ANSI Carbide Drill Bit Cat. No.				
						Full Head SDS-Plus	SDS-Plus	SDS-Max	Hollow Bit SDS-Plus	Hollow Bit SDS-Max
7413SD2	3/8" x 3"	1-3/4"	50	300	10	DW5527	DW5427	-	-	-
7414SD2	3/8" x 3-1/2"	2-1/4"	50	300	12	DW5527	DW5427	-	-	-
7415SD2	3/8" x 3-3/4"	2-1/2"	50	300	13	DW5527	DW5427	-	-	-
7416SD2	3/8" x 5"	3-3/4"	50	300	16	DW55300	DW5429	-	-	-
7422SD2	1/2" x 3-3/4"	2-1/8"	50	200	23	DW5537	DW5437	DW5803	DWA54012	-
7423SD2	1/2" x 4-1/2"	2-7/8"	50	200	28	DW5539	DW5438	DW5803	DWA54012	-
7424SD2	1/2" x 5-1/2"	3-7/8"	50	150	32	DW5539	DW5438	DW5803	DWA54012	-
7426SD2	1/2" x 7"	5-3/8"	25	100	44	DW5539	DW5438	DW5803	DWA54012	-
7427SD2	1/2" x 8-1/2"	6-7/8"	25	100	46	DW5539	DW5439	DW5804	DWA54012	-
7435SD2	5/8" x 4-3/4"	2-7/8"	25	100	52	-	DW5446	DW5806	DWA54058	DWA58058
7433SD2	5/8" x 5"	3-1/8"	25	50	57	-	DW5446	DW5806	DWA54058	DWA58001
7434SD2	5/8" x 6"	4-1/8"	25	75	64	-	DW5446	DW5806	DWA54058	DWA58001
7436SD2	5/8" x 7"	5-1/8"	25	75	72	-	DW5447	DW5806	DWA54058	DWA58001
7438SD2	5/8" x 8-1/2"	6-5/8"	25	75	84	-	DW5447	DW5809	DWA54058	DWA58001
7442SD2	3/4" x 5-1/2"	3-1/4"	20	60	88	-	DW5453	DW5810	DWA54074	DWA58034
7444SD2	3/4" x 6-1/4"	4"	20	60	90	-	DW5455	DW5810	DWA54074	DWA58034
7446SD2	3/4" x 7"	4-3/4"	20	60	95	-	DW5455	DW5810	DWA54074	DWA58034
7448SD2	3/4" x 8-1/2"	6-1/4"	10	40	95	-	DW5455	DW5812	DWA54074	DWA58034

The published size includes the diameter and the overall length of the anchor.
 All anchors are packaged with nuts and washers.
 A manual hand pump is available (Cat. No. 08280).
 Hollow drill bits must be used with a dust extraction vacuum (Cat. No. DW012).



MECHANICAL ANCHORS

POWER-STUD® +SD2
High Performance Wedge Expansion Anchor



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ICC-ES Evaluation Report

ESR-2502

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Reissued 05/2018
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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

**701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286**

EVALUATION SUBJECT:

**POWER-STUD®+ SD2 CARBON STEEL ANCHORS, POWER-STUD®+ SD4 STAINLESS
STEEL ANCHORS AND POWER-STUD®+ SD6 STAINLESS STEEL ANCHORS IN
CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)**



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ESR-2502

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

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

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EVALUATION SUBJECT:

**POWER-STUD®+ SD2 CARBON STEEL ANCHORS,
POWER-STUD®+ SD4 STAINLESS STEEL ANCHORS
AND POWER-STUD®+ SD6 STAINLESS STEEL
ANCHORS IN CRACKED AND UNCRACKED CONCRETE
(DEWALT / POWERS)**

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012, and 2009 *International Building Code*® (IBC)
- 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-2502 LABC and LARC Supplement](#).
- For evaluation for compliance with the *National Building Code of Canada*® (NBCC), see listing report [ELC-2502](#).

Property evaluated:

Structural

2.0 USES

The Power-Stud+ SD2 carbon steel anchors and SD4 and SD6 stainless steel anchors are used to anchor building

components to cracked and uncracked normal-weight 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 $\frac{3}{8}$ -inch- and $\frac{1}{2}$ -inch diameter (9.5 mm and 12.7 mm) Power-Stud+ SD2 carbon steel anchors may be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c , of 2,500 psi (17.2 MPa).

The $\frac{3}{8}$ -inch through $\frac{3}{4}$ -inch diameter (9.5 mm through 19.1 mm) Power-Stud+ SD2 carbon steel anchors may be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c , of 3,000 psi (20.7 MPa).

The anchors comply with Section 1901.3 of the 2015 IBC, Section 1909 of the 2012 IBC, and Section 1912 of the 2009 IBC. The anchors are an alternative to cast-in-place anchors described in Section 1908 of the 2012 IBC, and Section 1911 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 General:

The anchors are torque-controlled, mechanical expansion anchors comprised of an anchor body, expansion wedge (clip), washer and hex nut.

Product names for the report holder and the additional listee are presented in Table A of this report. The anchor body is comprised of a high-strength carbon or stainless steel rod threaded at one end and having a tapered mandrel at the other end. The tapered mandrel is enclosed by a three-section expansion clip which freely moves around the mandrel. The expansion clip movement is restrained by the mandrel taper and by a collar. On the stainless steel anchors, the mandrel taper has a knurling with the exception of the $\frac{1}{4}$ -inch-diameter (6.4 mm) anchors.

The anchors are installed in a predrilled hole with a hammer. When torque is applied to the nut of the installed anchor on the threaded end of the anchor body, the mandrel at the other end of the anchor is drawn into the expansion clip, forcing it outward into the sides of the predrilled hole in the base material. Installation instructions

and related information are set forth in Section 4.3, Tables 1, 2 and 6, and Figures A, 1, 3, 5A, 5B, 5C and 5D.

3.2 Power-Stud+ SD2 Carbon Steel Anchors:

The anchor body is manufactured from medium carbon steel and has minimum 0.0002-inch (5 μ m) zinc plating in accordance with ASTM B633. The expansion clip is manufactured from AISI Type 316 stainless steel. The washer conforms to ASTM F844. The hex nuts conform to ASTM A563, Grade A. The Power-Stud+ SD2 anchor is illustrated in Figure 2. Installation instructions and related information are set forth in Section 4.3, Tables 1 and 2, and Figures A, 1, 3, 5A, 5B, 5C and 5D.

3.3 Power-Stud+ SD4 and Power-Stud+ SD6 Stainless Steel Anchors:

The Power-Stud+ SD4 anchor body is manufactured from Type 304 stainless steel and the Power-Stud+ SD6 is manufactured from Type 316 stainless steel. The expansion clips and hex nuts are manufactured from Type 316 stainless steel. Washers are manufactured from 300 series stainless steel for the Power-Stud+ SD4 and Type 316 stainless steel for the Power-Stud+ SD6. The Power-Stud+ SD4 and Power-Stud+ SD6 anchors are illustrated in Figure 2. Installation instructions and related information are set forth in Section 4.3, Table 6, and Figures A, 1 and 3.

3.4 Concrete:

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

3.5 Steel Deck Panels (for SD2 anchors only):

Steel deck panels must comply with the configurations in Figure 5A and 5C of this report and have a minimum base-metal thickness of 0.035 inch (0.899 mm) [20 gage]. Steel deck must comply with the requirements of ASTM A653/A653M SS Grade 33, and have a minimum yield strength of 33 ksi (228 MPa) for Figures 5A and 5C.

Steel deck panels must comply with the configurations in Figure 5B of this report and have a minimum base-metal thickness of 0.035 inch (0.899 mm) [20 gage]. Steel deck must comply with requirements of ASTM A653/A653M SS Grade 50, and have a minimum yield strength of 50 ksi (345 MPa) for Figure 5B.

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with the 2015 IBC, as well as Section R301.1.3 of the 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 2015 and 2012 IBC is shown in Figure 6 of this report. Design parameters are based on the 2015 IBC (ACI 318-14) and the 2012 IBC (ACI 318-11) unless noted otherwise in Sections 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 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 3, 4, 5, 7 and 8 of this report, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC and Section 5.3 of ACI 318-14 or 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 must be limited to 8,000 psi (55.2 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa} : The nominal steel strength of a single anchor in tension, N_{sa} , is given in Tables 3 and 7 of this report. The values of N_{sa} for single anchors given in Tables 3 and 7 must be used and not be derived by calculation. For installation in the soffit of steel deck, the steel strength in tension is not decisive and need not be calculated.

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 group of anchors in tension, N_{cb} and 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, 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 Tables 3 and 7 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 $\psi_{c,N} = 1.0$ and using the value of k_{uncr} as given in Tables 3 and 7. The value of f'_c must be limited to 8,000 psi (55.2 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, 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 and 5C, 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 in tension 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 3 and 7 of this report. 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. In accordance with ACI 318-14 17.4.3.2 or ACI 318-11 D.5.3.2, as applicable, the nominal pullout strength in cracked concrete must be adjusted by calculation according to Eq-1:

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

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

where f'_c is the specified concrete compressive strength and whereby the exponent $n = 1/2$ for all anchor diameters with the exception of the $3/8$ -inch-diameter (9.5 mm) Power-Stud+ SD2 anchor size, where $n = 1/3$.

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 must be adjusted by calculation according to Eq-2:

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

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

where f'_c is the specified concrete compressive strength and whereby the exponent $n = 1/2$ for all anchors.

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Tables 3 or 7, the pullout strength in tension need not be evaluated.

The nominal pullout strength in tension of the 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 and 5C, is provided in Table 5. In accordance with ACI 318-14 17.4.3.2 or ACI 318-11 D.5.3.2, as applicable, the nominal pullout strength in cracked concrete must be calculated according to Eq-1, whereby the value of $N_{p,deck,cr}$ must be substituted for $N_{p,cr}$ and the values of 3,000 psi or 20.7 MPa must substitute for 2,500 psi or 17.2 MPa in the denominator. 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 strength in uncracked concrete must be calculated according to Eq-2, whereby the value of $N_{p,deck,uncr}$ must be substituted for $N_{p,uncr}$ and the values of 3,000 psi or 20.7 MPa must substitute for 2,500 psi or 17.2 MPa in the denominator.

4.1.5 Requirements for Static Steel Shear Capacity, 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 4 and 8 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. The shear strength $V_{sa,deck}$ of 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 and 5C, is given in Table 5.

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 values of l_e and d_a given in Tables 4 and 8. The value of f'_c must be limited to 8,000 psi (55.2 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete on steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, calculation of the concrete breakout strength in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2 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 a group of anchors in shear, V_{cp} or V_{cpg} , 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 4 and 8 and the value of N_{cb} or N_{cbg} as calculated in accordance with Section 4.1.3 of this report.

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

assemblies, as shown in Figures 5A, 5B and 5C, calculation of the concrete pryout strength in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3 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 Section 1905.1.8 of the 2015 IBC. 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 anchors comply with ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, as ductile 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; ACI 318-08 D.3.3.4, D.3.3.5 or D.3.3.6; or ACI 318-05 D.3.3.4 or D.3.3.5, as applicable. Strength reduction factors, ϕ , are given in Tables 3, 4, 5, 7 and 8. The anchors, except for the $1/4$ -inch-diameter (6.4 mm) stainless steel anchors, may be installed in regions designed as IBC Seismic Design Category 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 pullout strength in tension for seismic loads, $N_{p,eq}$ or $N_{p,deck,cr}$, described in Tables 3, 5 and 7 of this report, must be used in lieu of N_p . The values of $N_{p,eq}$ or $N_{p,deck,cr}$ can be adjusted for concrete strength as follows:

$$N_{eq,f'_c} = N_{eq} \left(\frac{f'_c}{2,500} \right)^n \quad (\text{lb, psi}) \quad (\text{Eq-3})$$

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

where f'_c is the specified concrete compressive strength and whereby the exponent $n = 1/2$ for all anchor diameters with the exception of the $3/8$ -inch-diameter (9.5 mm) Power-Stud+ SD2 anchor size where $n = 1/3$. In addition, for sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, 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.

Where values of $N_{p,eq}$ are not provided in Tables 3 and 7 of this report, the pullout strength in tension for seismic loads does not govern and need not be evaluated.

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 and 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, $V_{sa,eq}$ or $V_{sa,deck,eq}$, described in Tables 4, 5 and 8 of this report must be used in lieu of V_{sa} .

4.1.9 Interaction of Tensile and Shear Forces: For anchors or groups of anchors that are subject to the effects of combined tension and shear forces, the design must be performed in accordance with ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

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

$$\psi_{cp,N} = \frac{c}{c_{ac}} \quad (\text{Eq-4})$$

whereby the factor $\psi_{cp,N}$ need not be taken as less than $\frac{1.5h_{ef}}{c_{ac}}$. For all other cases $\psi_{cp,N} = 1.0$. In lieu of ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, values of c_{ac} provided in Tables 1, 2 and 6 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, values of c_{min} and s_{min} as given in Tables 1, 2 and 6 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 1, 2 and 6 must be used. Additional combinations for minimum edge distance, c_{min} , and spacing, s_{min} , may be derived from linear interpolation between the given boundary values as described in Figure 4.

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

For anchors installed in the top of concrete over steel deck assemblies, the anchors must be installed in accordance with Figure 5D.

4.1.12 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 (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: Where design values for use with allowable stress design (working stress design) load combinations in accordance with Section 1605.3 of the IBC are required, these are calculated using Eq-5 and Eq-6 as follows:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \quad (\text{Eq-5})$$

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha} \quad (\text{Eq-6})$$

where:

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

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

$$\phi N_n = \text{Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC}$$

Section 1908.1.9, and Section 4.1 of this report as applicable (lbf or N).

$$\phi V_n = \text{Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9, and Section 4.1 of this report as applicable (lbf or N).}$$

$$\alpha = \text{Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, } \alpha \text{ shall include all applicable factors to account for non-ductile failure modes and required over-strength.}$$

The requirements for member thickness, edge distance and spacing, as described in this report, must apply. An example of allowable stress design values for illustrative purposes is shown in Table 9 and Figure 6 of this report.

4.2.2 Interaction of Tensile and Shear Forces: The interaction shall be calculated and consistent with ACI 318-14 17.6 or ACI 318 (-11, -08, -05) D.7, as applicable, as follows:

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

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

$$\text{For all other cases: } \frac{T}{T_{allowable}} + \frac{V}{V_{allowable}} \leq 1.2 \quad (\text{Eq-7})$$

4.3 Installation:

Installation parameters are provided in Tables 1, 2 and 6, and Figures A, 1, 3, 5A, 5B, 5C and 5D. Anchor locations must comply with this report and the plans and specifications approved by the code official. The Power-Stud+ SD2 carbon steel anchors and Power-Stud+ SD4 and Power-Stud+ SD6 stainless steel anchors must be installed according to manufacturer's published installation instructions and this report. Anchors must be installed in holes drilled into the concrete using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The nominal drill bit diameter must be equal to that of the anchor size. The minimum drilled hole depths are given in Tables 1, 2 and 6. Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling (see Figures A and 3). The anchor must be hammered into the predrilled hole until the proper nominal embedment depth is achieved. The nut must be tightened against the washer until the torque values specified in Tables 1, 2 and 6 are achieved.

For installation of SD2 anchors 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 $\frac{1}{8}$ inch (3.2 mm). For member thickness and edge distance requirements for installations into the soffit of concrete on steel deck assemblies, see Figure 5A, 5B and 5C.

4.4 Special Inspection:

Periodic special inspection is required, in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 IBC and 2012 IBC; or Section 1704.15 and Table 1704.4 of the 2009 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, hole cleaning procedure, anchor spacing, edge distances, concrete member thickness, anchor embedment, tightening torque and adherence to the manufacturer's 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 anchors described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 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 $\frac{1}{4}$ -inch-diameter (6.4 mm) anchors must be installed in uncracked normal-weight or lightweight concrete; $\frac{3}{8}$ -inch- to $\frac{3}{4}$ -inch-diameter (9.5 mm to 19.1 mm) 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); and installed in the soffit or in the top of cracked and uncracked normal weight or sand-lightweight concrete over steel deck profiles having a minimum specified compressive strength, f'_c , of 3,000 psi (20.7 MPa).
- 5.4 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55.2 MPa).
- 5.5 The concrete shall have attained its minimum design strength prior to installation of the anchors.
- 5.6 Strength Design values must be established in accordance with Section 4.1 of this report.
- 5.7 Allowable Stress Design values must be established in accordance with Section 4.2 of this report.
- 5.8 Anchor spacing(s) and edge distance(s), as well as minimum member thickness, must comply with Tables 1, 2 and 6, and Figures 5A, 5B, 5C and 5D.
- 5.9 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.
- 5.10 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.
- 5.11 Anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.
- 5.12 The $\frac{3}{8}$ -inch-diameter to $\frac{3}{4}$ -inch-diameter (9.5 mm to 19.1 mm) anchors may be used to resist short-term loading due to wind or seismic forces in locations designated as Seismic Design Categories A through F under the IBC, subject to the conditions of this report. The $\frac{1}{4}$ -inch-diameter (6.4 mm) anchors may

be used to resist short-term loading due to wind forces, and for seismic load combinations limited to structures assigned to Seismic Design Categories A and B under the IBC, subject to the conditions of this report.

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

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

5.14 Use of zinc-coated carbon steel anchors is limited to dry, interior locations.

5.15 Use of anchors made of stainless steel as specified in this report are permitted for exterior exposure or damp environments.

5.16 Use of anchors made of stainless steel as specified in this report are permitted for contact with preservative-treated and fire-retardant-treated wood.

5.17 Special inspection must be provided in accordance with Section 4.4 of this report.

5.18 Anchors are manufactured under an approved quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated October 2015, which incorporates requirements in ACI 355.2-07 / ACI 355.2-04, for use in cracked and uncracked concrete; including optional service-condition Test No. 18 and Test No. 19 (AC193, Annex 1, Table 4.2) for seismic tension and shear, respectively; and quality control documentation.

7.0 IDENTIFICATION

The anchors are identified by dimensional characteristics and packaging. A length letter code head marking is stamped on each anchor on the exposed threaded stud end which is visible after installation. Table D shows the length code identification system. For the Power-Stud+ SD2 anchors, a plus sign "+" and the number "2" are also visible after installation. For the Power-Stud+ SD4 and Power-Stud+ SD6 anchors, a plus sign "+" is also marked with a number on all anchors with the exception of the $\frac{1}{4}$ -inch-diameter (6.4 mm) anchors. The number "4" designates the Power-Stud+ SD4 and the number "6" designates the Power-Stud+ SD6. Packages are identified with the anchor name, type and size, the company name as set forth in Table A, and the evaluation report number (ESR-2502).

TABLE A—PRODUCT NAMES BY COMPANY AND DESIGN INDEX

Company Name	Product Name	Installation Specifications	Tesion Design Data			Shear Design Date		
			Concrete	Top of Concrete Over Steel Deck	Steel Deck Soffit	Concrete	Top of Concrete Over Steel Deck	Steel Deck Soffit
DEWALT	Power-Stud+ SD2	Table 1 and Table 2	Table 3	Table 3	Table 5	Table 4	Table 4	Table 5
	Power-Stud+ SD4 and Power-Stud+ SD6	Table 6	Table 7	Table 7	Not applicable	Table 8	Table 8	Not applicable
Powers Fasteners	Power-Stud+ SD2	Table 1 and Table 2	Table 3	Table 3	Table 5	Table 4	Table 4	Table 5
	Power-Stud+ SD4 and Power-Stud+ SD6	Table 6	Table 7	Table 7	Not applicable	Table 8	Table 8	Not applicable

TABLE B—POWER-STUD+ SD2, POWER-STUD+ SD4 AND POWER-STUD+ SD6 ANCHOR LENGTH CODE IDENTIFICATION SYSTEM

Length ID marking on threaded stud head		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Overall anchor length, ℓ_{anch} , (inches)	From	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10
	Up to but not including	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11

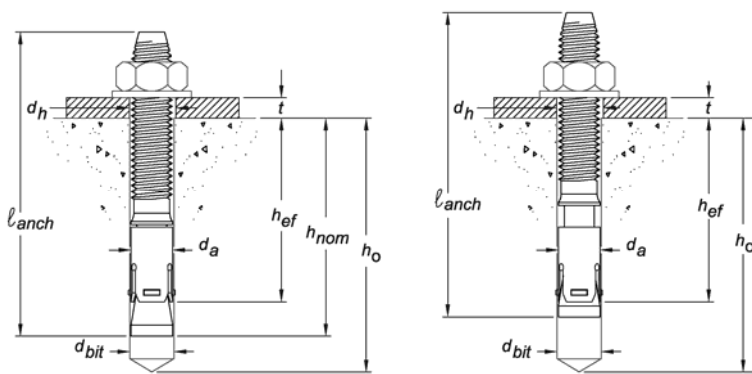


FIGURE 1—POWER-STUD+ SD2, POWER-STUD+ SD4 AND POWER-STUD+ SD6 ANCHOR DETAIL Before (Left Picture) and After (Right Picture) Application of Installation Torque

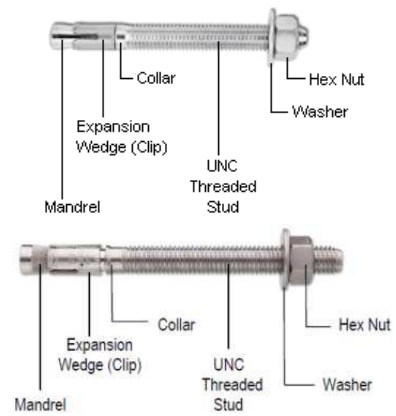


FIGURE 2—POWER-STUD+ SD2 (Top Picture), POWER-STUD+ SD4 AND POWER-STUD+ SD6 (Bottom Picture), ANCHOR ASSEMBLY

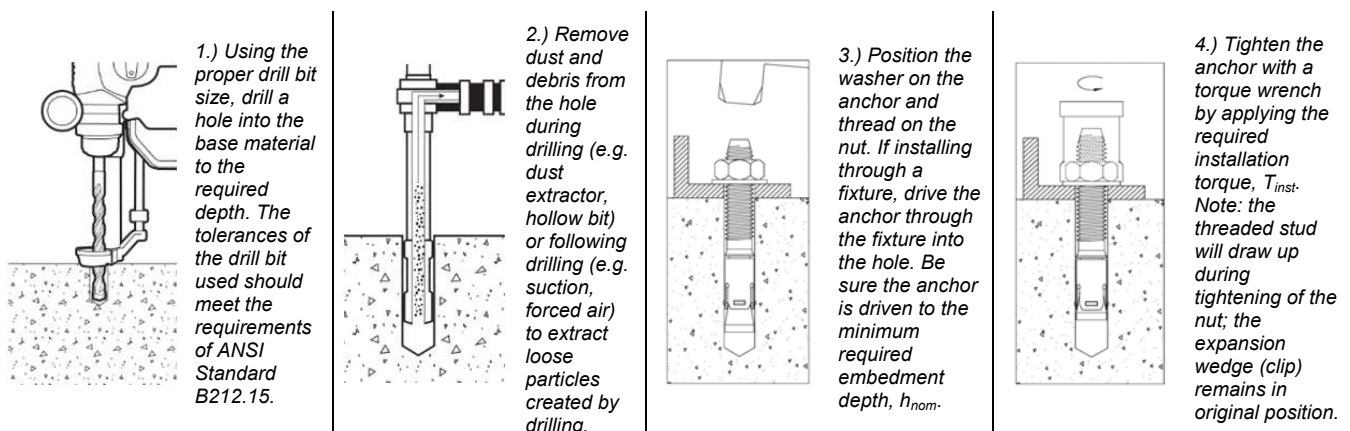


FIGURE 3— POWER-STUD+ SD2, POWER-STUD+ SD4 AND POWER-STUD+ SD6 INSTALLATION INSTRUCTIONS

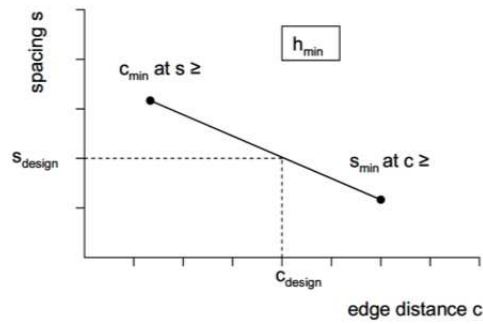



FIGURE 4—INTERPOLATION OF MINIMUM EDGE DISTANCE AND MINIMUM ANCHOR SPACING¹

¹This interpolation applies to the cases when two sets of minimum edge distances, c_{min} , and minimum spacing distances, s_{min} , are given in Tables 1, 2, and 6 for a given anchor diameter under the same effective embedment depth, h_{ef} , and corresponding minimum member thickness, t_{min} .

DEWALT Dust Removal Drilling Systems with HEPA Dust Extractor Options			
Tool	Accessories and Shrouds	HEPA Dust Extractor	
SDS-Max Drills			
 Cordless	 SDS-Max Hollow Drill Bit	 Dust Extractor	
	 Corded		 SDS-Max With Shroud
SDS-Plus Drills			
 Cordless	 SDS-Plus Bit		 Cordless Dust Extractor
	 Corded	 SDS-Plus Hollow Drill Bit	 Dust Extractor
 SDS-Plus With Telescope			
	 SDS-Plus With Shroud		

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-drills (see manufacturer’s published installation instructions).

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

TABLE 1—POWER-STUD+ SD2 ANCHOR INSTALLATION SPECIFICATIONS

ANCHOR PROPERTY AND SETTING INFORMATION	NOTATION	UNITS	NOMINAL ANCHOR SIZE ⁴ (inch)									
			³ / ₈	¹ / ₂		⁵ / ₈		³ / ₄				
Outside diameter of anchor	<i>d_a</i>	in. (mm)	0.375 (9.5)	0.500 (12.7)		0.625 (15.9)		0.750 (19.1)				
Minimum diameter of hole clearance in fixture	<i>d_h</i>	in. (mm)	⁷ / ₁₆ (11.1)	⁹ / ₁₆ (14.3)		¹¹ / ₁₆ (17.5)		¹³ / ₁₆ (20.6)				
Nominal drill bit diameter	<i>d_{bit}</i>	in.	³ / ₈ ANSI	¹ / ₂ ANSI		⁵ / ₈ ANSI		³ / ₄ ANSI				
Minimum nominal embedment depth ¹	<i>h_{nom}</i>	in. (mm)	²³ / ₈ (60)	²¹ / ₂ (64)	³³ / ₄ (83)	³⁷ / ₈ (98)	⁴⁷ / ₈ (124)	⁴¹ / ₂ (114)	⁵³ / ₄ (146)			
Effective embedment	<i>h_{ef}</i>	in. (mm)	2.00 (51)	2.00 (51)		3.25 (83)		4.25 (108)		3.75 (95)	5.00 (127)	
Minimum concrete member thickness	<i>h_{min}</i>	in. (mm)	4 (102)	⁴¹ / ₂ (114)	6 (152)	⁵³ / ₄ (146)	⁵³ / ₄ (146)	⁵³ / ₄ (146)	⁶¹ / ₂ (165)	8 (203)	7 (178)	10 (254)
Critical edge distance ²	<i>c_{ac}</i>	in. (mm)	⁶¹ / ₂ (165)	8 (203)		10 (254)		8 (203)	¹⁵³ / ₄ (400)	10 (254)	12 (305)	12 (305)
Minimum edge distance ²	<i>c_{min}</i>	in. (mm)	²¹ / ₂ (64)	4 (102)	²³ / ₄ (70)	4 (102)	²³ / ₄ (70)	⁴¹ / ₄ (108)	⁴¹ / ₄ (108)		5 (127)	⁴¹ / ₂ (114)
Minimum spacing distance ²	<i>s_{min}</i>	in. (mm)	³¹ / ₂ (89)	6 (152)	6 (152)	4 (102)	6 (152)	⁴¹ / ₄ (108)	⁴¹ / ₄ (108)		6 (152)	6 (152)
Minimum hole depth ²	<i>h_o</i>	in. (mm)	²⁵ / ₈ (67)	²³ / ₄ (70)		4 (102)		⁴¹ / ₄ (108)	⁵¹ / ₄ (133)		5 (127)	⁶¹ / ₄ (159)
Minimum overall anchor length ³	<i>ℓ_{anch}</i>	in. (mm)	3 (76)	³³ / ₄ (95)		⁴¹ / ₂ (114)		⁴³ / ₄ (121)	6 (152)		⁵¹ / ₂ (159)	7 (178)
Installation torque	<i>T_{inst}</i>	ft.-lb. (N-m)	20 (27)	40 (54)		60 (81)		110 (149)				
Torque wrench / socket size	-	in.	⁹ / ₁₆	³ / ₄		¹⁵ / ₁₆		¹ / ₈				
Nut height	-	In.	²¹ / ₆₄	⁷ / ₁₆		³⁵ / ₆₄		⁴¹ / ₆₄				

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

¹The embedment depth, *h_{nom}*, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.

²For installations through the soffit of steel deck into concrete see the installation details in Figures 5A, 5B and 5C of this report. In addition, anchors shall have an axial spacing along the flute soffit equal to the greater of 3*h_{ef}* or 1.5 times the flute width.

³The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and possible fixture attachment.

⁴The 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 as specified in Table 2 and Figure 5D of this report.

TABLE 2—POWER-STUD+ SD2 ANCHORS SETTING INFORMATION FOR INSTALLATION ON THE TOP OF CONCRETE-FILLED STEEL DECK ASSEMBLIES ACCORDING TO FIGURE 5D^{3,4,5}

ANCHOR PROPERTY AND SETTING INFORMATION	NOTATION	UNITS	NOMINAL ANCHOR SIZE (inch)			
			³ / ₈	¹ / ₂		³ / ₄
Nominal drill bit diameter	<i>d_{bit}</i>	in.	³ / ₈ ANSI		¹ / ₂ ANSI	
Minimum nominal embedment depth ¹	<i>h_{nom}</i>	in. (mm)	²³ / ₈ (60)		²¹ / ₂ (64)	
Effective embedment	<i>h_{ef}</i>	in. (mm)	2.00 (51)		2.00 (51)	
Minimum concrete member thickness ²	<i>h_{min,deck}</i>	in. (mm)	²¹ / ₂ (64)		²¹ / ₂ (64)	
Critical edge distance	<i>c_{ac,deck,top}</i>	in. (mm)	8 (203)		9 (229)	
Minimum edge distance	<i>c_{min,deck,top}</i>	in. (mm)	4 (102)	²³ / ₄ (70)	4 (102)	8 (203)
Minimum spacing distance	<i>s_{min,deck,top}</i>	in. (mm)	³¹ / ₂ (89)	6 (152)	8 (203)	4 (102)
Minimum hole depth	<i>h_o</i>	in. (mm)	²¹ / ₂ (64)		²¹ / ₂ (64)	
Installation torque	<i>T_{inst}</i>	ft.-lb. (N-m)	20 (27)		40 (54)	
Torque wrench / socket size	-	in.	⁹ / ₁₆		³ / ₄	
Nut height	-	In.	²¹ / ₆₄		⁷ / ₁₆	

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

¹The embedment depth, *h_{nom}*, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.

²The 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 refers to the concrete thickness above the upper flute (topping thickness). See Figure 5D of this report.

³For all other anchor diameters and embedment depths, refer to Table 1 for applicable values of *h_{min}*, *c_{min}* and *s_{min}*.

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

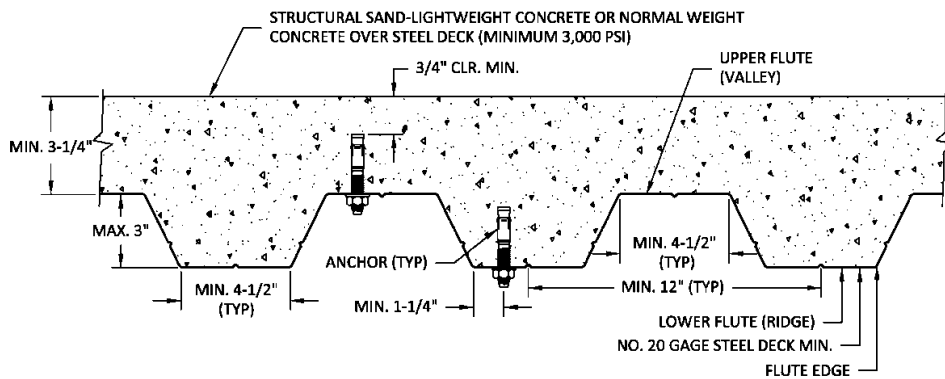


FIGURE 5A—POWER-STUD+ SD2 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)^{1,2}

¹ SD2 anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Figure 5A provided the minimum hole clearance is satisfied.

Anchors in the lower flute of Figure 5A profiles may be installed with a maximum 1-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.

² See Table 5 of this report for design data.

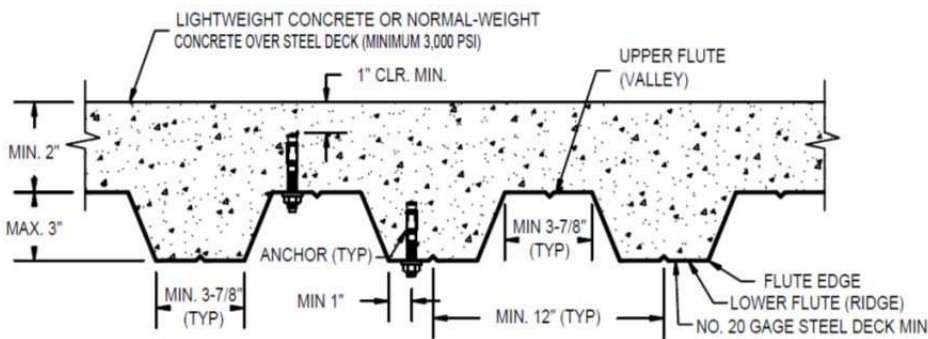


FIGURE 5B—POWER-STUD+ SD2 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)^{1,2}

¹ SD2 anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Figure 5B provided the minimum hole clearance is satisfied.

Anchors in the lower flute of Figure 5B 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.

² See Table 5 of this report for design data.

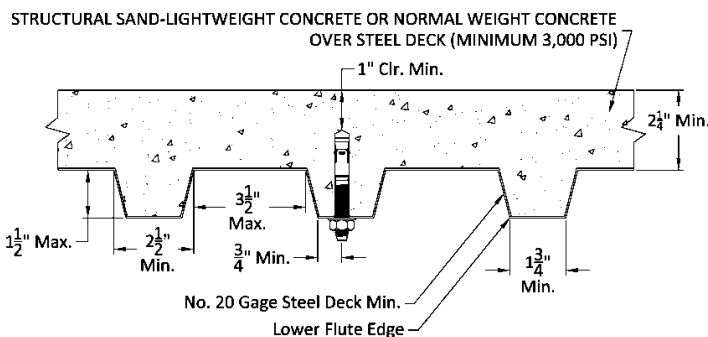


FIGURE 5C—POWER-STUD+ SD2 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)^{1,2,3}

¹ SD2 anchors may be placed in the lower flute of the steel deck profiles in accordance with Figure 5C provided the minimum hole clearance is satisfied.

Anchors in the lower flute of Figure 5C profiles may be installed with a maximum ¹/₈-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.

² Anchors may be placed in the upper flute of the steel deck profiles in accordance with Figure 5C provided the concrete thickness above the upper flute is minimum ³/₄-inch and a minimum hole clearance of ³/₄-inch is satisfied.

³ See table 5 of this report for design data.

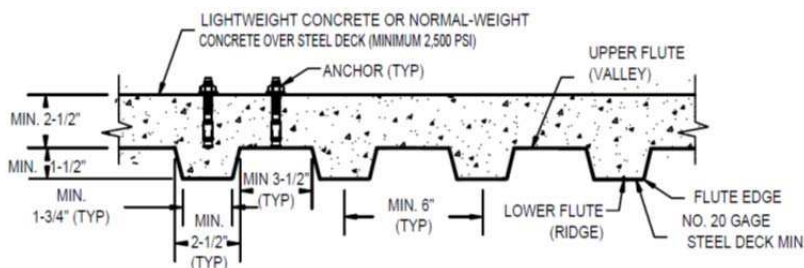


FIGURE 5D—INSTALLATION DETAIL FOR ANCHORS IN THE TOP OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)^{1,2}

¹ Anchors may be placed in the top side of concrete over steel deck profiles in accordance with Figure 5D provided the minimum concrete thickness above the upper flute (topping thickness) is as illustrated and minimum spacing distance and minimum edge distances are satisfied as given in Table 2 of this report.

² For anchors installed in the top of concrete over steel deck profiles with concrete thickness above the upper flute (topping thickness) greater than or equal to the minimum concrete member thicknesses specified in Table 1 the minimum spacing distance and minimum edge distances may be used from those tables, as applicable.

TABLE 3—TENSION DESIGN INFORMATION FOR POWER-STUD+ SD2 ANCHORS IN CONCRETE^{1,2,12}

Design Characteristic	Notation	Units	Nominal Anchor Size (inch)						
			³ / ₈	¹ / ₂	⁵ / ₈	³ / ₄			
Anchor category	1, 2 or 3	-	1	1	1	1			
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)⁴									
Minimum specified yield strength (neck)	f_y	ksi (N/mm ²)	96.0 (662)	85.0 (586)	85.0 (586)	85.0 (586)	70.0 (483)		
Minimum specified ultimate strength (neck)	f_{uta}	ksi (N/mm ²)	120.0 (827)	106.0 (731)	106.0 (731)	106.0 (731)	90.0 (620)		
Effective tensile stress area (neck)	$A_{se,N}$	in ² (mm ²)	0.0552 (35.6)	0.1007 (65.0)	0.1619 (104.5)	0.1619 (104.5)	0.2359 (153.2)		
Steel strength in tension ⁵	N_{sa}	lbf (kN)	6,625 (29.5)	10,445 (46.5)	13,080 (58.2)	13,080 (58.2)	21,230 (94.4)		
Reduction factor for steel strength ³	ϕ	-	0.75						
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)⁹									
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Effectiveness factor for uncracked concrete	k_{unscr}	-	24	24	24	24	24	24	
Effectiveness factor for cracked concrete	k_{cr}	-	17	17	17	17	17	17	
Modification factor for cracked and uncracked concrete ⁶	$\psi_{c,N}$	-	1.0 See note 6	1.0 See note 6	1.0 See note 6	1.0 See note 6	1.0 See note 6	1.0 See note 6	
Critical edge distance	c_{ac}	in. (mm)	See Table 1						
Reduction factor for concrete breakout strength in tension ³	ϕ	-	0.65 (Condition B)						
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)⁹									
Characteristic pullout strength, uncracked concrete (2,500 psi) ⁷	$N_{p,unscr}$	lbf (kN)	2,775 (12.3)	See note 8	6,615 (29.4)	See note 8	See note 8	See note 8	See note 8
Characteristic pullout strength, cracked concrete (2,500 psi) ⁷	$N_{p,cr}$	lbf (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See note 8	See note 8	7,795 (35.1)
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)⁹									
Characteristic pullout strength, seismic (2,500 psi) ^{7,10}	$N_{p,eq}$	lbf (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See note 8	See note 8	7,795 (35.1)
Reduction factor for pullout strength ³	ϕ	-	0.65 (Condition B)						
Mean axial stiffness values service load range ¹¹	Uncracked concrete	β	lbf/in. (kN/mm)	865,000 (1517)	717,000 (1258)	569,000 (998)	420,000 (747)		
	Cracked concrete	β	lbf/in. (kN/mm)	49,500 (87)	57,000 (100)	64,500 (113)	72,000 (126)		

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm², 1 lbf = 0.0044 kN.

¹The 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.

²Installation must comply with published instructions and details.

³All 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, as applicable. 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 meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3 or ACI 318-11 D.4.3, 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, as applicable, are used.

⁴The Power-Stud+ SD2 is considered a ductile steel element in tension as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.

⁵Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design in lieu of calculation.

⁶For all design cases $\psi_{c,N}=1.0$. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{unscr}) must be used.

⁷For all design cases $\psi_{c,P}=1.0$. For the calculation of N_{pn} , see Section 4.1.4 of this report.

⁸Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.

⁹Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.

¹⁰Tabulated values for characteristic pullout strength in tension are for seismic applications are based on test results per ACI 355.2, Section 9.5.

¹¹Actual stiffness of the mean value varies considerably depending on concrete strength, loading and geometry of application.

¹²Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies, see Section 4.1 and Figures 5A, 5B, 5C and 5D of this report.

TABLE 4—SHEAR DESIGN INFORMATION FOR POWER-STUD+ SD2 ANCHORS IN CONCRETE^{1,2,8}

Design Characteristic	Notation	Units	Nominal Anchor Diameter (inch)						
			³ / ₈	¹ / ₂	⁵ / ₈	³ / ₄			
Anchor category	1, 2 or 3	-	1	1	1	1	1	1	1
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)⁴									
Minimum specified yield strength (threads)	f_y	ksi (N/mm ²)	76.8 (530)	68.0 (469)	68.0 (469)	68.0 (469)	68.0 (469)	68.0 (469)	56.0 (386)
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm ²)	100.0 (690)	88.0 (607)	88.0 (607)	88.0 (607)	88.0 (607)	88.0 (607)	80.0 (551)
Effective tensile stress area (threads)	$A_{se,v}$	in ² (mm ²)	0.0775 (50.0)	0.1419 (65.7)	0.1419 (65.7)	0.2260 (104.9)	0.2260 (104.9)	0.2260 (104.9)	0.3345 (215.8)
Steel strength in shear ⁵	V_{sa}	lbf (kN)	3,115 (13.9)	4,815 (21.4)	4,815 (21.4)	10,170 (45.2)	10,170 (45.2)	10,170 (45.2)	12,610 (56.1)
Reduction factor for steel strength ³	ϕ	-	0.65						
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)⁶									
Load-bearing length of anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Nominal anchor diameter	d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.500 (12.7)	0.625 (15.9)	0.625 (15.9)	0.750 (19.1)	0.750 (19.1)
Reduction factor for concrete breakout strength in shear ³	ϕ	-	0.70 (Condition B)						
PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)⁶									
Coefficient for prout strength (1.0 for $h_{ef} < 2.5$ in., 2.0 for $h_{ef} \geq 2.5$ in.)	k_{cp}	-	1.0	1.0	2.0	2.0	2.0	2.0	2.0
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Reduction factor for prout strength ³	ϕ	-	0.70 (Condition B)						
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 ⁷	$V_{sa,eq}$	lbf (kN)	2,460 (11.0)	4,815 (21.4)	4,815 (21.4)	6,770 (30.1)	6,770 (30.1)	6,770 (30.1)	8,060 (35.9)
Reduction factor for steel strength in shear, seismic ³	ϕ	-	0.65						

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm², 1 lbf = 0.0044 kN.

¹The 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.

²Installation must comply with published instructions and details.

³All 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, as applicable. 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 meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3 or ACI 318-11 D.4.3, 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, as applicable, are used.

⁴The Power-Stud+ SD2 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.

⁵Tabulated values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design.

⁶Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.

⁷Tabulated values for steel strength in shear are for seismic applications are based on test results per ACI 355.2, Section 9.6.

⁸Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies, see Section 4.1 and Figures 5A, 5B, 5C and 5D of this report.

TABLE 5—TENSION AND SHEAR DESIGN DATA FOR POWER-STUD+ SD2 ANCHORS IN THE SOFFIT OF CONCRETE-FILLED STEEL DECK ASSEMBLIES^{1,2,7,8}

Design Characteristic		Notation	Units	Nominal Anchor Size (inch)					
				³ / ₈	¹ / ₂	⁵ / ₈	³ / ₄		
Anchor category		1, 2 or 3	-	1	1	1	1	1	
Effective embedment		h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)
Minimum nominal embedment depth		h_{nom}	in. (mm)	² / ₈ (60)	¹ / ₂ (64)	³ / ₄ (83)	⁷ / ₈ (98)	⁴ / ₈ (124)	¹ / ₂ (114)
Minimum hole depth		h_o	in. (mm)	⁵ / ₈ (67)	³ / ₄ (70)	4 (102)	¹ / ₄ (108)	⁵ / ₄ (133)	5 (127)
PULLOUT STRENGTH IN TENSION FOR ANCHORS IN SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK¹									
According to Figure 5A 4 ¹ / ₂ -inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck ²	$N_{p,deck,uncr}$	lbf (kN)	1,855 (8.3)	2,065 (9.2)	3,930 (17.5)	4,665 (20.8)	7,365 (32.8)	4,900 (21.8)
	Characteristic pullout strength, cracked concrete over steel deck ^{2,3}	$N_{p,deck,cr}$	lbf (kN)	1,445 (6.4)	1,465 (6.5)	2,600 (11.6)	3,305 (14.7)	5,215 (23.2)	3,470 (15.4)
According to Figure 5B 3 ⁷ / ₈ -inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck ²	$N_{p,deck,uncr}$	lbf (kN)	2,235 (9.9)	2,785 (12.4)	5,600 (24.9)	4,480 (19.9)	7,265 (32.3)	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck ^{2,3}	$N_{p,deck,cr}$	lbf (kN)	1,745 (7.8)	1,975 (8.8)	3,695 (16.4)	3,175 (14.1)	5,145 (22.9)	
According to Figure 5C 1 ³ / ₄ -inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck ²	$N_{p,deck,uncr}$	lbf (kN)	1,600 (7.1)	2,025 (9.0)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck ^{2,3}	$N_{p,deck,cr}$	lbf (kN)	1,250 (5.6)	1,435 (6.4)				
Reduction factor for pullout strength ⁶		ϕ	-	0.65 (Condition B)					
STEEL STRENGTH IN SHEAR FOR ANCHORS IN SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK⁴									
According to Figure 5A 4 ¹ / ₂ -inch-wide deck flute	Steel strength in shear, concrete over steel deck ⁵	$V_{sa,deck}$	lbf (kN)	2,170 (9.7)	3,815 (17.0)	5,040 (22.4)	4,015 (17.9)	6,670 (29.7)	4,325 (19.2)
	Steel strength in shear, seismic, concrete over steel deck ⁵	$V_{sa,deck,eq}$	lbf (kN)	1,715 (7.6)	3,815 (17.0)	5,040 (22.4)	2,675 (11.9)	4,445 (19.8)	2,820 (12.5)
According to Figure 5B 3 ⁷ / ₈ -inch-wide deck flute	Steel strength in shear, concrete over steel deck ⁵	$V_{sa,deck}$	lbf (kN)	3,040 (13.5)	2,675 (11.9)	4,930 (21.9)	5,370 (23.9)	6,070 (27.0)	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck ⁵	$V_{sa,deck,eq}$	lbf (kN)	2,400 (10.6)	2,675 (11.9)	4,930 (21.9)	3,580 (15.9)	4,045 (18.0)	
According to Figure 5C 1 ³ / ₄ -inch-wide deck flute	Steel strength in shear, concrete over steel deck ⁵	$V_{sa,deck}$	lbf (kN)	2,170 (9.7)	2,880 (12.8)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck ⁵	$V_{sa,deck,eq}$	lbf (kN)	1,715 (7.6)	2,880 (12.8)				
Reduction factor for steel strength in shear, concrete over steel deck ⁶		ϕ	-	0.65					

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm², 1 lbf = 0.0044 kN.

¹For all design cases $\Psi_{c,p} = 1.0$. For the calculation of N_{pn} , see Section 4.1.4 of this report.

²Values for $N_{p,deck}$ 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 318-11 D.5.2, as applicable, is not required for anchors installed in the deck soffit (flute).

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

⁴Shear loads for anchors installed through steel deck into concrete may be applied in any direction.

⁵Values for $V_{sa,deck}$ and $V_{sa,deck,eq}$ 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 17.5.2 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, is not required for anchors installed in the deck soffit (flute).

⁶All 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, as applicable. 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.

⁷Installations must comply with Sections 4.1.11 and 4.3 and Figures 5A, 5B and 5C of this report.

⁸Anchors shall have an axial spacing along the flute soffit equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

TABLE 6—POWER-STUD+ SD4 AND POWER-STUD+ SD6 STAINLESS STEEL ANCHOR INSTALLATION SPECIFICATIONS

ANCHOR PROPERTY AND SETTING INFORMATION	NOTATION	UNITS	NOMINAL ANCHOR SIZE ³ (inch)								
			1/4	3/8	1/2	5/8	3/4				
Outside diameter of anchor	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 hole clearance in fixture	d_h	in. (mm)	5/16 (7.9)	7/16 (11.1)	9/16 (14.3)	11/16 (17.5)	13/16 (20.6)				
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI	1/2 ANSI	5/8 ANSI	3/4 ANSI				
Minimum nominal embedment depth ¹	h_{nom}	in. (mm)	3/4 (44)	7/8 (48)	2 1/2 (64)	3 1/4 (83)	4 1/2 (114)				
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75 (95)				
Minimum concrete member thickness	h_{min}	in. (mm)	3/4 (83)	3/4 (83)	4 (102)	4 (102)	5 (127)	6 (152)			
Critical edge distance	c_{ac}	in. (mm)	5 (127)	5 (127)	7 1/2 (191)	9 1/2 (241)	9 (229)				
Minimum edge distance	c_{min}	in. (mm)	3 1/4 (45)	3 (76)	3 1/2 (89)	6 (8)	3 (76)	4 1/2 (114)	8 1/2 (216)	5 (127)	9 (229)
Minimum spacing distance	s_{min}	in. (mm)	2 (51)	5 1/2 (140)	3 (76)	3 (76)	6 (8)	8 1/2 (216)	5 (127)	9 (229)	5 (127)
Minimum hole depth	h_o	in. (mm)	1 7/8 (48)	2 (51)	2 5/8 (67)	3 1/2 (89)	4 3/4 (121)				
Minimum overall anchor length ²	l_{anch}	in. (mm)	2 1/4 (57)	2 3/4 (70)	3 3/4 (95)	4 1/2 (114)	5 1/2 (140)				
Installation torque	T_{inst}	ft.-lb. (N-m)	6 (8)	25 (34)	40 (54)	60 (81)	110 (149)				
Torque wrench / socket size	-	in.	7/16	9/16	3/4	15/16	1 1/8				
Nut height	-	In.	7/32	21/64	7/16	35/64	41/64				

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

¹The embedment depth, h_{nom} , is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.

²The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and possible fixture attachment.

³The anchors may be installed in the top 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.

TABLE 7—TENSION DESIGN INFORMATION FOR POWER-STUD+ SD4 AND POWER-STUD+ SD6 STAINLESS STEEL ANCHORS IN CONCRETE^{1,8}

Design Characteristic	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	
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)								
Minimum specified yield strength (neck)	f_y	ksi (N/mm ²)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)	
Minimum specified ultimate strength (neck)	f_{uta}	ksi (N/mm ²)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 (621)	
Effective tensile stress area (neck)	$A_{se,N}$	in ² (mm ²)	0.0249 (16.1)	0.0530 (34.2)	0.1020 (65.8)	0.1630 (105.2)	0.238 (151)	
Steel strength in tension	N_{sa}	lbf (kN)	2,240 (10.0)	4,780 (21.3)	9,160 (40.8)	14,635 (65.1)	21,380 (95.1)	
Reduction factor for steel strength ^{2,3}	ϕ	-	0.75					
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)⁷								
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75 (95)	
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24	24	24	24	
Effectiveness factor for cracked concrete	k_{cr}	-	Not applicable	17	21	21	21	
Modification factor for cracked and uncracked concrete	$\psi_{c,N}$	-	1.0 See note 5	1.0 See note 5	1.0 See note 5	1.0 See note 5	1.0 See note 5	
Critical edge distance	c_{ac}	in. (mm)	See Table 6					
Reduction factor for concrete breakout strength in tension ⁴	ϕ	-	0.65 (Condition B)					
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)⁸								
Characteristic pullout strength, uncracked concrete (2,500 psi) ⁶	$N_{p,uncr}$	lbf (kN)	1,510 (6.7)	See note 7	See note 7	See note 7	8,520 (37.8)	
Characteristic pullout strength, cracked concrete (2,500 psi) ⁵	$N_{p,cr}$	lbf (kN)	Not applicable	1,645 (7.3)	See note 7	See note 7	See note 7	
Reduction factor for pullout strength ⁴	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)⁸								
Characteristic pullout strength, seismic (2,500 psi) ^{6,9}	$N_{p,eq}$	lbf (kN)	Not applicable	1,645 (7.3)	See note 7	See note 7	See note 7	
Reduction factor for pullout strength ⁴	ϕ	-	0.65 (Condition B)					
Mean axial stiffness values for service load range ¹⁰	Uncracked concrete	β	lbf/in (kN/mm)	171,400 (30,060)	490,000 (86,000)	459,000 (80,500)	234,000 (41,000)	395,000 (69,300)
	Cracked concrete	β	lbf/in (kN/mm)	Not applicable	228,000 (40,000)	392,000 (68,800)	193,000 (33,800)	76,600 (13,400)

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm², 1 lbf = 0.0044 kN.

¹The 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.

²The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.4.

³The anchors are ductile steel elements as defined in ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.

⁴The tabulated value of ϕ for concrete breakout strength and pullout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength and pullout strength must be determined in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for concrete breakout strength and pullout strength must be determined in accordance with ACI 318-11 D.4.4.

⁵For all design cases $\psi_{c,N}=1.0$. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.

⁶For all design cases $\psi_{c,P}=1.0$. For the calculation of N_{pn} , see Section 4.1.4 of this report.

⁷Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.

⁸Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.

⁹Tabulated values for characteristic pullout strength in tension are for seismic applications are based on test results per ACI 355.2, Section 9.5.

¹⁰Actual stiffness of the mean value varies depending on concrete strength, loading and geometry of application.

TABLE 8—SHEAR DESIGN INFORMATION FOR POWER-STUD+ SD4 AND POWER-STUD+ SD6 STAINLESS STEEL ANCHORS IN CONCRETE^{1,7}

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
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)⁴							
Minimum specified yield strength (threads)	f_y	ksi (N/mm ²)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm ²)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 (621)
Effective shear stress area (threads)	$A_{se,v}[A_{se}]^9$	in ² (mm ²)	0.0318 (20.5)	0.0780 (50.3)	0.142 (91.6)	0.226 (145.8)	0.334 (212)
Steel strength in shear ⁶	V_{sa}	lbf (kN)	1,115 (5.0)	1,470 (6.6)	3,170 (14.1)	7,455 (33.2)	11,955 (53.2)
Reduction factor for steel strength ^{2,3}	ϕ	-	0.65				
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)							
Load-bearing length of anchor (h_{ef} or $8d_a$, whichever is less)	l_e	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75
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)
Reduction factor for concrete breakout strength in shear ⁴	ϕ	-	0.70 (Condition B)				
PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)							
Coefficient for prout strength	k_{cp}	-	1.0	1.0	1.0	2.0	2.0
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3 ³ / ₄ (95)
Reduction factor for prout strength ⁵	ϕ	-	0.70 (Condition B)				
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 ⁸	$V_{sa,eq}$	lbf (kN)	Not applicable	1,305 (5.8)	2,765 (12.3)	5,240 (23.3)	7,745 (34.45)
Reduction factor for steel strength in shear, seismic ²	ϕ	-	0.65				

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm², 1 lbf = 0.0044 kN.

¹The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 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.

²The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.4.

³The anchors are ductile steel elements as defined in ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.

⁴The tabulated value of ϕ for concrete breakout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 14.3.3 or ACI 318-11 D.4.3, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-11 D.4.4.

⁵The tabulated value of ϕ for prout strength applies if the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 Section 9.2 are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for prout strength must be determined in accordance with ACI 318-11 D.4.4, Condition B.

⁶Tabulated values for steel strength in shear must be used for design.

⁷Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.

⁸Tabulated values for steel strength in shear are for seismic applications are based on test results per ACI 355.2, Section 9.6.

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

Nominal Anchor Diameter (in.)	Product	Nominal Embedment Depth (in.)	Effective Embedment (in.)	Allowable Tension Load (pounds)
1/4	Power-Stud+ SD4 and Power-Stud+ SD6	1 3/4	1.50	665
3/8	Power-Stud+ SD2	2 3/8	2.00	1,220
	Power-Stud+ SD4 and Power-Stud+ SD6	1 7/8	1.50	970
1/2	Power-Stud+ SD2	2 1/2	2.00	1,490
	Power-Stud+ SD4 and Power-Stud+ SD6	2 1/2	2.00	1,865
	Power-Stud+ SD2	3 3/4	3.25	2,905
5/8	Power-Stud+ SD4 and Power-Stud+ SD6	3 1/4	2.75	2,405
	Power-Stud+ SD2	3 7/8	3.25	3,090
	Power-Stud+ SD2	4 7/8	4.25	4,615
3/4	Power-Stud+ SD4 and Power-Stud+ SD6	4 1/2	3.75	3,740
	Power-Stud+ SD2	4 1/2	3.75	3,825
	Power-Stud+ SD2	5 3/4	5.00	5,890

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

¹Single anchor with static tension load only.

²Concrete determined to remain uncracked for the life of the anchorage.

³Load combinations from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable (no seismic loading considered).

⁴30% dead load and 70% live load, controlling load combination 1.2D + 1.6L.

⁵Calculation of weighted average for $\alpha = 1.2(0.3) + 1.6(0.7) = 1.48$.

⁶ $f'_c = 2,500$ psi (normal weight concrete).

⁷ $c_{a1} = c_{a2} \geq c_{ac}$.

⁸ $h \geq h_{min}$.

⁹Values are for Condition B where supplementary reinforcement in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided.

Given: Calculate the factored strength design resistance in tension, ϕN_n , and the allowable stress design value, $T_{allowable,ASD}$, for a 3/8-inch diameter Power-Stud+ SD2 anchor assuming the given conditions in Table 7.			
Calculation in accordance with ACI 318-14 Chapter 17, ACI 318-11 Appendix D and this report:	ACI 318-14 Ref.	ACI 318-11 Ref.	Report Ref.
Step 1. Calculate steel strength of a single anchor in tension: $\phi N_{sa} = (0.75)(6,625) = 4,969 \text{ lbs.}$	17.4.1.2	D.5.1.2	Table 3
Step 2. Calculate concrete breakout strength of a single anchor in tension: $\phi N_{cb} = \phi \frac{A_{Nc}}{A_{Nc0}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$ $N_b = k_c \lambda_a \sqrt{f'_c} (h_{ef})^{1.5}$ $N_b = (24)(1.0) \sqrt{2,500} (2.0)^{1.5} = 3,394 \text{ lbs.}$ $\phi N_{cb} = (0.65) \frac{(36.0)}{(36.0)} (1.0)(1.0)(1.0)(3,394) = 2,206 \text{ lbs.}$	17.4.2.1	D.5.2.1	Table 3
Step 3. Calculate pullout strength of a single anchor: $\phi N_{pn} = \phi N_{p,uncr} \psi_{c,P} \left(\frac{f'_c}{2,500} \right)^n$ $\phi N_{pn} = (0.65)(2,775)(1.0)(1.0)^{0.5} = 1,804 \text{ lbs.}$	17.4.2.2	D.5.2.2	Table 3
Step 4. Determine controlling factored resistance strength in tension: $\phi N_n = \min[\phi N_{sa}, \phi N_{cb}, \phi N_{pn}] = \phi N_{pn} = 1,804 \text{ lbs.}$	17.3.1.1	D.4.1.1	-
Step 5. Calculate allowable stress design conversion factor for loading condition: Controlling load combination: 1.2D + 1.6L $\alpha = 1.2(30\%) + 1.6(70\%) = 1.48$	5.3	9.2	-
Step 6. Calculate allowable stress design value: $T_{allowable,ASD} = \frac{\phi N_n}{\alpha} = \frac{1,804}{1.48} = 1,220 \text{ lbs.}$	-	-	§ 4.2

FIGURE 6—EXAMPLE STRENGTH DESIGN CALCULATION INCLUDING ASD CONVERSION FOR ILLUSTRATIVE PURPOSES

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EVALUATION SUBJECT:

POWER-STUD® + SD2 CARBON STEEL ANCHORS, POWER-STUD® + SD4 STAINLESS STEEL ANCHORS AND POWER-STUD® + SD6 STAINLESS STEEL ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Power-Stud® + SD2 carbon steel anchors, Power-Stud® + SD4 stainless steel anchors and Power-Stud® + SD6 stainless steel anchors in cracked and uncracked concrete, described in ICC-ES master evaluation report [ESR-2502](#), 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:

- 2017 *City of Los Angeles Building Code* (LABC)
- 2017 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Power-Stud® + SD2 carbon steel anchors, Power-Stud® + SD4 stainless steel anchors and Power-Stud® + SD6 stainless steel anchors in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the master evaluation report [ESR-2502](#), 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 Power-Stud® + SD2 carbon steel anchors, Power-Stud® + SD4 stainless steel anchors and Power-Stud® + SD6 stainless steel anchors described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the master evaluation report [ESR-2502](#).
- The design, installation, conditions of use and labeling of the anchors are in accordance with the 2015 *International Building Code*® (2015 IBC) provisions noted in the master evaluation report [ESR-2502](#).
- 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 master 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).

This supplement expires concurrently with the master report, reissued May 2018.

ICC-ES Evaluation Report

ESR-2502 FBC Supplement

Reissued May 2018

This report is subject to renewal May 2019.

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DIVISION: 03 00 00—CONCRETE

Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS

Section: 05 05 19—Post-Installed Concrete Anchors

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EVALUATION SUBJECT:

POWER-STUD® + SD2 CARBON STEEL ANCHORS, POWER-STUD® + SD4 STAINLESS STEEL ANCHORS AND POWER-STUD® + SD6 STAINLESS STEEL ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Power-Stud+ SD2 Anchors, Power-Stud+ SD4 Stainless Steel Anchors and Power-Stud+ SD6 Stainless Steel Anchors in Cracked and Uncracked Concrete, recognized in ICC-ES master evaluation report ESR-2502, have also been evaluated for compliance with the codes noted below:

Compliance with the following codes:

- 2014 and 2010 *Florida Building Code—Building*
- 2014 and 2010 *Florida Building Code—Residential*

2.0 PURPOSE OF THIS SUPPLEMENT

The Power-Stud+ SD2 Carbon Steel Anchors, Power-Stud+ SD4 Stainless Steel Anchors and Power-Stud+ SD6 Stainless Steel Anchors in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-2502, comply with the 2014 and 2010 *Florida Building Code—Building* and the 2014 and 2010 *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2012 *International Building Code*® (IBC) provisions noted in the master evaluation report and the following conditions apply:

- Design wind loads must be based on Section 1609 of the 2014 and 2010 *Florida Building Code—Building* or Section R301.2.1.1 of the 2014 and 2010 *Florida Building Code—Residential*, as applicable.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the 2014 and 2010 *Florida Building Code—Building*, as applicable.

Use of the Power-Stud+ SD2 Anchors in cracked and uncracked concrete for compliance with the High-Velocity Hurricane Zone provisions of the 2014 and 2010 *Florida Building Code—Building* and the 2014 and 2010 *Florida Building Code—Residential*, has not been evaluated, and is outside the scope of this supplemental report.

Use of the Power-Stud+ SD4 Stainless Steel Anchors and Power-Stud+ SD6 Stainless Steel Anchors in cracked and uncracked concrete has also been found to be in compliance with the High-Velocity Hurricane Zone (HVHZ) provisions of the 2014 and 2010 *Florida Building Code—Building* and the 2014 and 2010 *Florida Building Code—Residential*, provided that the design wind loads for use of the anchors in the HVHZ are based on Section 1620 of the *Florida Building Code—Building*.

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 master report, reissued May 2018.

