STRONG-BOLT™ *Wedge Anchor for Cracked and Uncracked Concrete*

TESTED TO MEET IBC® 2006

SIMPSON StrongTie ANCHOR SYSTEMS

The Strong-Bolt™ is a wedge anchor specifically designed for optimum performance in both cracked and uncracked concrete; a requirement that the 2006 IBC places on post-installed anchors. Rigorously tested according to the latest industry-wide criteria, the Strong-Bolt anchor is proven to offer increased reliability in the most adverse conditions, including performance in cracked concrete under static and seismic loading. The proprietary tri-segmented clip has dual undercutting embossments on each segment which enable secondary or "follow-up" expansion if a crack forms and intersects the anchor location. This significantly increases the ability of the Strong-Bolt wedge anchor to carry load if the hole opened slightly due to a crack. The Strong-Bolt anchor sets like a standard wedge anchor and is available in Imperial fractional sizes.

FEATURES:

- Tri-segmented clip: Each segment is able to adjust independently increasing follow-up expansion should the hole increase in size as a result of a crack.
- Dual embossments on each clip segment: Allows the clip to undercut into the concrete increasing follow-up expansion should a crack occur.
- 316 stainless steel clip: In addition to superior corrosion resistance, a stainless steel clip offers better "memory". This memory contributes to the anchor's performance should the hole size increase due to a crack.
- Imperial fractional sized anchor: Fits most fixtures and installs with common drill bits sizes and tools. No need to buy additional tools to install a metric anchor and no special couplers needed.
- Installs like a standard wedge anchor: No complicated installation procedure. No need for special bits or installation tools.
- The head is stamped with the Simpson Strong-Tie® "≠" sign and size ID for easy post installation identification

MATERIAL: Carbon-steel stud with 316 stainless-steel clip

FINISH: Zinc plated

CODES: ICC-ES ESR-1771; City of L.A. RR25705; Florida FL 11506.6

⚠ The load tables list values based upon results from the most recent testing and may not reflect those in current code reports. Where code jurisdictions apply, consult the current reports for applicable load values.

TEST CRITERIA: The Strong-Bolt wedge anchor has been tested in accordance with ICC-ES's *Acceptance Criteria for Mechanical Anchors in Concrete Elements* (AC193) and ACI 355.2 for the following:

- Static tension and shear loading in cracked and uncracked concrete
- Seismic and wind loading in cracked and uncracked concrete
- Performance in cracked concrete
- Performance in lightweight concrete over metal deck

Vibratory Load Testing: A 150 lb. concrete block was suspended from a ½" diameter anchor embedded at 2¼" and vibrated for 12.6 million cycles at a frequency of 30 Hz and an amplitude of 0.025 inches. Subsequent load test showed no reduction in ultimate tension capacity.

DESIGN EXAMPLE See pages 24–25

INSTALLATION:

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

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

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

APPLICATION:

- Interior environment where low levels of moisture and corrosive chemicals are present.

SUGGESTED SPECIFICATIONS:

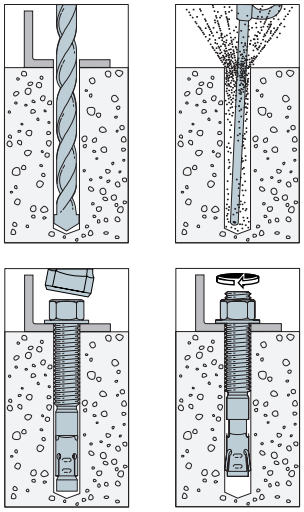
Wedge anchors shall be an imperial-sized steel threaded stud with an integral cone expander and a three-segment expansion clip. The stud shall be manufactured from carbon steel and the expansion clip shall have two undercutting embossments per segment and be manufactured from 316 stainless steel. The anchor shall have been tested and qualified for performance in cracked concrete per ACI 355.2 and ICC-ES AC193. Anchors shall be Strong-Bolt™ wedge anchors from Simpson Strong-Tie, Pleasanton, CA, and be installed following Simpson Strong-Tie instructions.

Strong-Bolt™ Wedge Anchor

Tri-Segmented Clip

ANCHOR DESIGNER ACI 318 Software Supported™

Installation Sequence



Strong-Bolt™ Anchor Installation Data

Strong-Bolt Dia. (in.)	½	⅝	¾	1
Bit Size (in.)	½	⅝	¾	1
Min. Fixture Hole (in.)	9⁄16	11⁄16	⅞	1⅛
Wrench Size (in.)	¾	15⁄16	1⅛	1½

Length Identification Head Marks on Strong-Bolt Anchors (corresponds to length of anchor – inches).

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

Strong-Bolt™ Anchor Product Data

Size (in.)	Model No.	Drill Bit Dia. (in.)	Thread Length (in.)	Quantity	
				Box	Carton
½ x 3¾	STB50334	½	2⁵⁄₁₆	25	125
½ x 4¼	STB50414		2¹³⁄₁₆	25	100
½ x 5½	STB50512		4¹⁄₁₆	25	100
½ x 7	STB50700		5⁹⁄₁₆	25	100
½ x 8½	STB50812		6	25	50
½ x 10	STB50100		6	25	50
⅝ x 4½	STB62412	⅝	2⅞	20	80
⅝ x 5	STB62500		3⅜	20	80
⅝ x 6	STB62600		4⅜	20	80
⅝ x 7	STB62700		5⅜	20	80
⅝ x 8½	STB62812		6	20	40
⅝ x 10	STB62100		6	10	20
¾ x 5½	STB75512	¾	3⅝	10	40
¾ x 6¼	STB75614		4⅜	10	40
¾ x 7	STB75700		5⅛	10	40
¾ x 8½	STB75812		6	10	20
¾ x 10	STB75100		6	10	20
1 x 7	STB100700	1	3½	5	20
1 x 10	STB1001000		3½	5	10
1 x 13	STB1001300		3½	5	10

1. The published length is the overall length of the anchor. Allow one anchor diameter for the nut and washer thickness plus the fixture thickness when selecting a length.

Material Specifications

Carbon Steel - Zinc Plated[1]			
Component Materials			
Anchor Body	Nut	Washer	Clip
Carbon Steel SAE J403, Grade 1030-1035 SAE J403, Grade 12L14	Carbon Steel ASTM A 563, Grade A	Carbon Steel ASTM F844	316 Stainless Steel

1. Zinc meets ASTM B 633, Class SC 1 (Fe / Zn 5), Type I.

Strong-Bolt™ Anchor Installation Information and Additional Data[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inch)										
			½			⅝			¾			1	
Installation Information													
Drill Bit Diameter	d	in.	½			⅝			¾			1	
Baseplate Clearance Hole Diameter	d_c	in.	9⁄16			11⁄16			⅞			1⅛	
Installation Torque	T_{inst}	ft-lb	50			85			180			230	
Embedment Depth	h_{nom}	in.	2¾	3⅞	5	3⅜	5⅛	6⅛	4⅛	5¾	7½	5¼	9¾
Critical Edge Distance	c_{ac}	in.	9	7⅞	6¾	11	9⅝	8¼	13½	11¾	10⅛	18	13½
Minimum Edge Distance	c_{min}	in.	4			5			6			8	
Minimum Spacing	s_{min}	in.	4			6¼			6¼			8	
Minimum Concrete Thickness	h_{min}	in.	4½	6	6¾	5½	7⅞	8¼	6¾	8¾	10⅛	9	13½
Additional Data													
Anchor Category	category	–	1						2				
Yield Strength	f_{ya}	psi	108,000									60,000	
Tensile Strength	f_{uta}	psi	125,000									78,000	
Minimum Tensile & Shear Stress Area	A_{se}	in^2	0.108			0.167			0.273			0.472	
Axial Stiffness in Service Load Range	β	lb/in.	125,000			141,000			225,000			299,600	

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

Strong-Bolt™ Anchor Tension Design Data[1]

*See page 10 for an explanation of the load table icons

Characteristic	Symbol	Units	Nominal Anchor Diameter (inch)										
			½			⅝			¾			1	
Embedment Depth	h_{nom}	in.	2¾	3⅞	5	3⅜	5⅛	6⅛	4⅛	5¾	7½	5¼	9¾
Steel Strength in Tension													
Nominal Steel Strength in Tension	N_{sa}	lb.	13,500			20,875			34,125			36,815	
Strength Reduction Factor – Steel Failure	ϕ	–	0.75[2]			0.75[2]			0.65[2]			0.75[2]	
Concrete Breakout Strength in Tension[9]													
Effective Embedment Depth	h_{ef}	in.	2.250	3.375	4.500	2.750	4.500	5.500	3.375	5.000	6.750	4.500	9.000
Critical Edge Distance[7]	c_{ac}	in.	9	7⅞	6¾	11	9⅝	8¼	13½	11¾	10⅛	18	13½
Effectiveness Factor – Uncracked Concrete	k_{uncr}	–	24										
Effectiveness Factor – Cracked Concrete	k_{cr}	–	17										
Ratio of k_{uncr}/k_{cr}	$\psi_{c,N}$	–	1.41										
Strength Reduction Factor – Concrete Breakout Failure	ϕ	–	0.65[8]						0.55[8]				
Pullout Strength in Tension[10]													
Nominal Pullout Strength Uncracked Concrete (f'_c = 2,500 psi)	$N_{pn,uncr}$	lb	–[3]	4,120[5]	4,600[5]	–[3]	7,250[4]	7,300[4]	–[3]	9,420[5]	12,115[5]	8,360[5]	9,690[5]
Nominal Pullout Strength Cracked Concrete (f'_c = 2,500 psi)	$N_{pn,cr}$	lb	–[3]	2,995[5]	2,995[5]	–[3]	5,200[4]	5,260[4]	–[3]	–[3]	9,850[5]	7,700[5]	11,185[5]
Strength Reduction Factor – Pullout Failure	ϕ	–	–	0.65[6]	0.65[6]	–	0.65[6]	0.65[6]	–	0.55[6]	0.55[6]	0.55[6]	0.55[6]
Pullout Strength in Tension for Seismic Applications[10]													
Nominal Pullout Strength of Single Anchor for Seismic Loads (f'_c = 2,500 psi)	N_{eq}	lb	–[3]	2,995[5]	2,995[5]	–[3]	5,200[4]	5,260[4]	–[3]	–[3]	9,850[5]	7,700[5]	11,185[5]
Strength Reduction Factor – Pullout Failure	ϕ	–	–	0.65[6]	0.65[6]	–	0.65[6]	0.65[6]	–	–	0.55[6]	0.55[6]	0.55[6]

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. The value of ϕ applies when the load combinations of ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, refer to Section D4.5 to determine the appropriate value of ϕ. The ¾ inch diameter is considered as a brittle steel element. The ½ inch, ⅝ inch, and 1 inch diameters are considered as ductile steel elements.
3. Pullout strength is not reported since concrete breakout controls.
4. Adjust the characteristic pullout resistance for other concrete compressive strengths by multiplying the tabular value by $(f'_{c,specified} / 2{,}500)^{0.7}$.
5. Adjust the characteristic pullout resistance for other concrete compressive strengths by multiplying the tabular value by $(f'_{c,specified} / 2{,}500)^{0.5}$.
6. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, refer to Section D4.5 to determine the appropriate value of ϕ.
7. The modification factor $\psi_{cp,N} = 1.0$ for cracked concrete. Otherwise, the modification actor for uncracked concrete without supplementary reinforcement to control splitting is either: (1) $\psi_{cp,N} = 1.0$ if $c_{a,min} \geq c_{ac}$ or (2) $\psi_{cp,N} = \frac{c_{a,min}}{c_{ac}} \geq \frac{1.5h_{ef}}{c_{ac}}$ if $c_{a,min} < c_{ac}$. The modification factor, $\psi_{cp,N}$ is applied to the nominal concrete breakout strength, N_{cb} or N_{cbg}.
8. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D4.4(c) for Condition B are met. If the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D4.4(c) for Condition A are met, refer to Section D4.4 to determine the appropriate value of ϕ. If the load combinations of ACI 318 Appendix C are used, refer to Section D4.5 to determine the appropriate value of ϕ.
9. For sand-lightweight concrete, in lieu of ACI 318 Section D.3.4, modify the value of N_n by multiplying all values of $\sqrt{f'_C}$ affecting N_n by 0.60. All-lightweight concrete is beyond the scope of this table.
10. For sand-lightweight concrete, modify the value of $N_{pn,cr}$, $N_{pn,uncr}$ and N_{eq} by 0.60. All-lightweight concrete is beyond the scope of this table.

Strong-Bolt™ Anchor Shear Design Data[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inch)										
			½			⅝			¾			1	
Embedment Depth	h_{nom}	in.	2¾	3⅞	5	3⅜	5⅛	6⅛	4⅛	5¾	7½	5¼	9¾
Steel Strength in Shear													
Nominal Steel Strength in Shear	V_{sa}	lb.	6,560			10,475			19,305			15,020	
Strength Reduction Factor – Steel Failure	ϕ	–	0.65[2]			0.65[2]			0.60[2]			0.65[2]	
Concrete Breakout Strength in Shear[5]													
Outside Diameter	d_o	in.	0.5			0.625			0.75			1.00	
Load Bearing Length of Anchor in Shear	ℓ_e	in.	2.25	3.375	4.00	2.75	4.50	5.00	3.375	5.00	6.00	4.50	8.00
Strength Reduction Factor – Concrete Breakout Failure	ϕ	–	0.70[3]										
Concrete Pryout Strength in Shear													
Coefficient for Pryout Strength	k_{cp}	–	1.0	2.0									
Strength Reduction Factor – Concrete Pryout Failure	ϕ	–	0.70[4]										
Steel Strength in Shear for Seismic Applications													
Nominal Steel Strength in Shear for Seismic Loads	V_{eq}	lb	6,560			8,380	9,715	10,475	15,445	17,305	19,305	15,020	
Strength Reduction Factor – Steel Failure	ϕ	–	0.65[2]			0.65[2]			0.60[2]			0.65[2]	

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. The value of ϕ applies when the load combinations of ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, refer to Section D4.5 to determine the appropriate value of ϕ. The ¾ inch diameter is considered as a brittle steel element. The ½ inch, ⅝ inch, and 1 inch diameters are considered as ductile steel elements.
3. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D4.4(c) for Condition B are met. If the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D4.4(c) for Condition A are met, refer to Section D4.4 to determine the appropriate value of ϕ. If the load combinations of ACI 318 Appendix C are used, refer to Section D4.5 to determine the appropriate value of ϕ.
4. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, refer to Section D4.5 to determine the appropriate value of ϕ.
5. For sand-lightweight concrete, in lieu of ACI 318 Section D.3.4, modify the value of V_n by multiplying all values of $\sqrt{f'_c}$ affecting V_n by 0.60. All-lightweight concrete is beyond the scope of this table.

Strong-Bolt™ Anchor Tension and Shear Data for Normal-Weight or Sand-Lightweight Concrete over Metal Deck[1,2]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inch)			
			½		⅝	
Embedment Depth	h_{nom}	in.	2¾	4½	3⅜	5⅝
Effective Embedment Depth	h_{ef}	in.	2.25	4.00	2.75	5.00
Installation Torque	T_{inst}	ft-lb	40	40	40	50
Pullout Resistance, concrete on metal deck (cracked)[3,4]	$N_{pn,deck,cr}$	lb	1,335[6]	1,905	2,835	3,665
Pullout Resistance, concrete on metal deck (uncracked)[3,4]	$N_{pn,deck,uncr}$	lb	1,830[6]	2,610	3,780	4,885
Steel Strength in Shear, concrete on metal deck[5]	$V_{st,deck}$	lb	4,405[6]	6,690	6,270	8,865

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. Concrete compressive strength shall be 3,000 psi minimum.
3. For anchors installed in the soffit of sand-lightweight or normal-weight concrete over metal deck floor and roof assemblies, as shown in Figure A, calculation of the concrete breakout strength may be omitted.
4. In accordance with ACI 318 Section D.5.3.2, the nominal pullout strength in cracked concrete for anchors installed in the soffit of sand-lightweight or normal-weight concrete over metal deck floor and roof assemblies $N_{pn,deck,cr}$ shall be substituted for $N_{pn,cr}$. Where analysis indicates no cracking at service loads, the normal pullout strength in uncracked concrete $N_{pn,deck,uncr}$ shall be substituted for $N_{pn,uncr}$.
5. In accordance with ACI 318 Section D.6.1.2 (c), the shear strength for anchors installed in the soffit of sand-lightweight or normal-weight-concrete-over-metal-deck floor and roof assemblies $V_{st,deck}$ shall be substituted for V_{sa}.
6. Values applicable to both the lower and the upper flute, see Figure A.
7. Minimum distance to edge of panel is $2h_{ef}$.

*See page 10 for an explanation of the load table icons

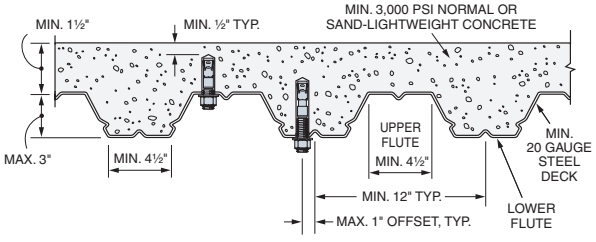


Figure A
Installation in Concrete over Metal Deck