Strong-Bolt® 2 *Wedge Anchor for Cracked and Uncracked Concrete*

The Strong-Bolt® 2 wedge anchor is the next-generation solution for cracked and uncracked concrete. Following rigorous testing according to ICC-ES acceptance criteria, the Strong-Bolt 2 anchor received classification as a Category 1 anchor, the highest attainable anchor category for performance in cracked concrete under static and seismic loading. Available in stainless steel, it is code-listed by ICC-ES under the 2009 IBC requirements for post-installed anchors in cracked and uncracked concrete.

FEATURES:

- **Category 1 anchor classification:** The Strong-Bolt 2 anchor received classification as a Category 1 anchor, which is established by performance in reliability tests in accordance with AC193 and ACI355.2 test criteria. Category 1 is the highest attainable anchor category for reliability.
- **Tri-segmented clip:** Each segment adjusts independently, increasing follow-up expansion should the hole increase in size as a result of a crack
- **Dual embossments on each clip segment:** Enables clip to undercut into the concrete thereby increasing follow-up expansion should a crack occur
- **The ⅜" anchor solution approved for 3¼" concrete thickness:** The Strong-Bolt 2 anchor can be installed in cracked concrete with a minimum thickness of 3¼", including concrete-over-metal decking
- **High-strength alloy clip on carbon-steel anchors:** This special alloy clip offers improved performance
- **Standard (ANSI) fractional anchor:** Fits most fixtures and installs with common drill bit sizes and tools
- **Type 316 stainless-steel clip on stainless steel anchors:** In addition to superior corrosion resistance, a stainless-steel clip offers "memory" that contributes to the anchor's performance if the hole increases in size because of a crack

MATERIAL: Carbon-steel stud with special alloy clip; stainless-steel stud with stainless-steel clip

FINISH: Zinc-plated (carbon steel)

CODES: ICC-ES ESR-3037 (carbon and stainless steel in concrete); IAPMO ES ER-240 (carbon steel in CMU); City of Los Angeles RR25891; Underwriters Laboratories File Ex3605; Factory Mutual 3043442; Florida – Pending

TEST CRITERIA: The Strong-Bolt 2 wedge anchor has been tested in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC 193) 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

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

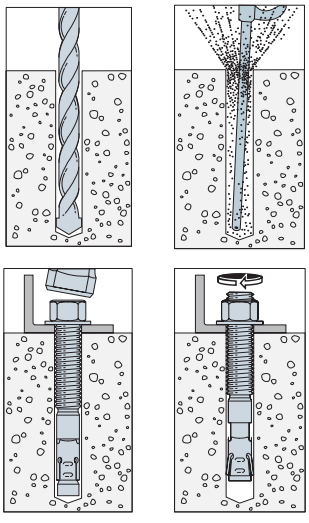
Caution: Oversized holes in the base material will make it difficult to set the anchor and will reduce the anchor's load capacity.

- 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 minimum hole 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.

DESIGN EXMPLE: See pages 233–234

Strong-Bolt® 2 Wedge Anchor

Installation Sequence



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

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

Strong-Bolt® 2 *Wedge Anchor Product Information*

Strong-Bolt® 2 Anchor Product Data

Size (in.)	Carbon Steel Model No.	316 Stainless Steel Model No.	Drill Bit Dia. (in.)	Thread Length (in.)	Quantity	
					Box	Carton
⅜ x 2¾	STB2-37234	STB2-372346SS	⅜	1 5/16	50	250
⅜ x 3	STB2-37300	STB2-373006SS	⅜	1 9/16	50	250
⅜ x 3½	STB2-37312	STB2-373126SS	⅜	2 1/16	50	250
⅜ x 3¾	STB2-37334	STB2-373346SS	⅜	2 5/16	50	250
⅜ x 5	STB2-37500	STB2-375006SS	⅜	3 9/16	50	200
⅜ x 7	STB2-37700	STB2-377006SS	⅜	5 9/16	50	200
½ x 3¾	STB2-50334	STB2-503346SS	½	2 1/16	25	125
½ x 4¼	STB2-50414	STB2-504146SS	½	2 9/16	25	100
½ x 4¾	STB2-50434	STB2-504346SS	½	3 1/16	25	100
½ x 5½	STB2-50512	STB2-505126SS	½	3 13/16	25	100
½ x 7	STB2-50700	STB2-507006SS	½	5 5/16	25	100
½ x 8½	STB2-50812	STB2-508126SS	½	6	25	50
½ x 10	STB2-50100	STB2-501006SS	½	6	25	50
⅝ x 4½	STB2-62412	STB2-624126SS	⅝	2 7/16	20	80
⅝ x 5	STB2-62500	STB2-625006SS	⅝	2 15/16	20	80
⅝ x 6	STB2-62600	STB2-626006SS	⅝	3 15/16	20	80
⅝ x 7	STB2-62700	STB2-627006SS	⅝	4 15/16	20	80
⅝ x 8½	STB2-62812	STB2-628126SS	⅝	6	20	40
⅝ x 10	STB2-62100	STB2-621006SS	⅝	6	10	20
¾ x 5½	STB2-75512	STB2-755126SS	¾	3 3/16	10	40
¾ x 6¼	STB2-75614	STB2-756146SS	¾	3 15/16	10	40
¾ x 7	STB2-75700	STB2-757006SS	¾	4 11/16	10	40
¾ x 8½	STB2-75812	STB2-758126SS	¾	6	10	20
¾ x 10	STB2-75100	STB2-751006SS	¾	6	10	20

Material Specifications

Carbon Steel - Zinc Plated[1]			
Component Materials			
Anchor Body	Nut	Washer	Clip
Carbon Steel	Carbon Steel ASTM A 563, Grade A	Carbon Steel ASTM F844	Carbon Steel ASTM A 568

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

Stainless Steel			
Component Materials			
Anchor Body	Nut	Washer	Clip
Type 316 Stainless Steel	Type 316 Stainless Steel	Type 316 Stainless Steel	Type 316 Stainless Steel

Carbon Steel Strong-Bolt® 2 Wedge Anchor Installation Information[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter – Carbon Steel							
			⅜ inch		½ inch		⅝ inch		¾ inch	
Installation Information										
Nominal Diameter	d_a[3]	in.	⅜		½		⅝		¾	
Drill Bit Diameter	d	in.	⅜		½		⅝		¾	
Baseplate Clearance Hole Diameter[2]	d_c	in.	7/16		9/16		11/16		⅞	
Installation Torque	T_{inst}	ft-lbf	30		60		90		150	
Nominal Embedment Depth	h_{nom}	in.	1⅞	2⅞	2¾	3⅞	3⅜	5⅛	4⅛	5¾
Effective Embedment Depth	h_{ef}	in.	1½	2½	2¼	3⅜	2¾	4½	3⅜	5
Minimum Hole Depth	h_{hole}	in.	2	3	3	4⅛	3⅝	5⅜	4⅜	6
Minimum Overall Anchor Length	ℓ_{anch}	in.	2¾	3½	3¾	5½	4½	6	5½	7
Critical Edge Distance	c_{ac}	in.	6½	6	6½	6½	7½	9	9	8
Minimum Edge Distance	c_{min}	in.	6		7	4	4	6½	6½	
	for $s \geq$	in.	—		—	—	—	—	8	
Minimum Spacing	s_{min}	in.	3		7	4	4	5	7	
	for $c \geq$	in.	—		—	—	—	—	8	
Minimum Concrete Thickness	h_{min}	in.	3¼	4½	4½	5½	6	5½	7⅞	6¾	8¾
Additional Data										
Yield Strength	f_{ya}	psi	92,000		85,000				70,000	
Tensile Strength	f_{uta}[4]	psi	115,000						110,000	
Minimum Tensile and Shear Stress Area	A_{se}	in²	0.0514		0.105		0.166		0.270	
Axial Stiffness in Service Load Range - Cracked and Uncracked Concrete	β	lb./in	34,820		63,570		91,370		118,840	

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D.
2. The clearance must comply with applicable code requirements for the connected element.
3. For the 2006 IBC, d_o replaces d_a.
4. For the 2003 IBC, f_{ut} replaces f_{uta}.

Stainless-Steel Strong-Bolt® 2 Wedge Anchor Installation Information[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter							
			Stainless Steel							
			⅜ inch		½ inch		⅝ inch		¾ inch	
Installation Information										
Nominal Diameter	d_a[3]	in.	⅜		½		⅝		¾	
Drill Bit Diameter	d	in.	⅜		½		⅝		¾	
Baseplate Clearance Hole Diameter[2]	d_c	in.	7/16		9/16		11/16		⅞	
Installation Torque	T_{inst}	ft-lbf	30		60		80		150	
Nominal Embedment Depth	h_{nom}	in.	1 ⅞	2 ⅞	2 ¾	3 ⅞	3 ⅜	5 ⅛	4 ⅛	5 ¾
Effective Embedment Depth	h_{ef}	in.	1 ½	2 ½	2 ¼	3 ⅜	2 ¾	4 ½	3 ⅜	5
Minimum Hole Depth	h_{hole}	in.	2	3	3	4 ⅛	3 ⅝	5 ⅜	4 ⅜	6
Minimum Overall Anchor Length	ℓ_{anch}	in.	2 ¾	3 ½	3 ¾	5 ½	4 ½	6	5 ½	7
Critical Edge Distance	c_{ac}	in.	6 ½	8 ½	4 ½	7	7 ½	9	8	8
Minimum Edge Distance	c_{min}	in.	6		6 ½	5	4	4	6	
	for $s \geq$	in.	10		—	—	8	8	—	
Minimum Spacing	s_{min}	in.	3		8	5 ½	4	6 ¼	6 ½	
	for $c \geq$	in.	10		—	—	8	5 ½	—	
Minimum Concrete Thickness	h_{min}	in.	3 ¼	4 ½	4 ½	6	5 ½	7 ⅞	6 ¾	8 ¾
Additional Data										
Yield Strength	f_{ya}	psi	80,000		92,000		82,000		68,000	
Tensile Strength	f_{uta}[4]	psi	100,000		115,000		108,000		95,000	
Minimum Tensile and Shear Stress Area	A_{se}	in²	0.0514		0.105		0.166		0.270	
Axial Stiffness in Service Load Range - Cracked and Uncracked Concrete	β	lb./in	29,150		54,900		61,270		154,290	

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D.
2. The clearance must comply with applicable code requirements for the connected element.
3. For the 2006 IBC, d_o replaces d_a.
4. For the 2003 IBC, f_{ut} replaces f_{uta}.

Carbon Steel Strong-Bolt® 2 Wedge Anchor Tension Strength Design Data[1]



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See page 13 for an explanation of the load table icons

Characteristic	Symbol	Units	Nominal Anchor Diameter							
			Carbon Steel							
			⅜ inch		½ inch		⅝ inch		¾ inch	
Anchor Category	1,2 or 3	—	1							
Nominal Embedment Depth	h_{nom}	in.	1⅞	2⅞	2¾	3⅞	3⅜	5⅛	4⅛	5¾
Steel Strength in Tension (ACI 318 Section D.5.1)										
Steel Strength in Tension	N_{sa}	lb	5,600		12,100		19,070		29,700	
Strength Reduction Factor - Steel Failure[2]	ϕ_{sa}	—	0.75							
Concrete Breakout Strength in Tension (ACI 318 Section D.5.2)[8]										
Effective Embedment Depth	h_{ef}	in.	1½	2½	2¼	3⅜	2¾	4½	3⅜	5
Critical Edge Distance	c_{ac}	in.	6½	6	6½	7½	7½	9	9	8
Effectiveness Factor - Uncracked Concrete	k_{uncr}	—	24		24		24		24	
Effectiveness Factor - Cracked Concrete	k_{cr}	—	17		17		17		17	
Modification Factor	$\Psi_{c,N}$[7]	—	1.00		1.00		1.00		1.00	
Strength Reduction Factor - Concrete Breakout Failure[3]	ϕ_{cb}	—	0.65							
Pull-Out Strength in Tension (ACI 318 Section D.5.3)[8]										
Pull-Out Strength Cracked Concrete (f'_c = 2500 psi)	$N_{p,cr}$	lb	1,300[5]	2,775[5]	N/A[4]	3,735[5]	N/A[4]	6,895[5]	N/A[4]	8,500[5]
Pull-Out Strength Uncracked Concrete (f'_c = 2500 psi)	$N_{p,uncr}$	lb	N/A[4]	3,340[5]	3,615[5]	5,255[5]	N/A[4]	9,025[5]	7,115[5]	8,870[5]
Strength Reduction Factor - Pullout Failure[6]	ϕ_p	—	0.65							
Tensile Strength for Seismic Applications (ACI Section D.3.3.3)[8]										
Tension Strength of Single Anchor for Seismic Loads (f'_c = 2500 psi)	$N_{p,eq}$	lb	1,300[5]	2,775[5]	N/A[4]	3,735[5]	N/A[4]	6,895[5]	N/A[4]	8,500[5]
Strength Reduction Factor - Pullout Failure[6]	ϕ_{eq}	—	0.65							

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{sa} must be determined in accordance with ACI 318 D.4.5. Strong-Bolt® 2 anchors are ductile steel elements as defined in ACI 318 D.1.
3. The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4(c) for Condition B are met. Condition B applies where supplementary reinforcement is not provided. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4 for Condition A are met, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 D.4.5(c).
4. N/A (Not Applicable) denotes that pullout resistance does not need to be considered.
5. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 2{,}500 \text{ psi})^{0.5}$.
6. The tabulated value of ϕ_p or ϕ_{eq} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, appropriate value of ϕ must be determined in accordance with ACI 318 Section D.4.5(c).
7. For the 2003 IBC, Ψ_3 replaces $\Psi_{c,N}$.
8. For sand-lightweight concrete, in lieu of ACI 318 Section D.3.4, modify the value of concrete breakout strength, $N_{p,cr}$, $N_{p,uncr}$ and N_{eq} by 0.6. All-lightweight concrete is beyond the scope of this table.

Stainless Steel Strong-Bolt® 2 Wedge Anchor Tension Strength Design Data[1]



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See page 13 for an explanation of the load table icons

Characteristic	Symbol	Units	Nominal Anchor Diameter							
			Stainless Steel							
			⅜ inch		½ inch		⅝ inch		¾ inch	
Anchor Category	1,2 or 3	—	1							
Nominal Embedment Depth	h_{nom}	in.	1⅞	2⅞	2¾	3⅞	3⅜	5⅛	4⅛	5¾
Steel Strength in Tension (ACI 318 Section D.5.1)										
Steel Strength in Tension	N_{sa}	lb	5,140		12,075		17,930		25,650	
Strength Reduction Factor - Steel Failure[2]	ϕ_{sa}	—	0.75							
Concrete Breakout Strength in Tension (ACI 318 Section D.5.2)[10]										
Effective Embedment Depth	h_{ef}	in.	1½	2½	2¼	3⅜	2¾	4½	3⅜	5
Critical Edge Distance	c_{ac}	in.	6½	8½	4½	7	7½	9	8	8
Effectiveness Factor - Uncracked Concrete	k_{uncr}	—	24		24		24		24	
Effectiveness Factor - Cracked Concrete	k_{cr}	—	17		17		17		17	
Modification Factor	$\psi_{c,N}$[9]	—	1.00		1.00		1.00		1.00	
Strength Reduction Factor - Concrete Breakout Failure[3]	ϕ_{cb}	—	0.65							
Pull-Out Strength in Tension (ACI 318 Section D.5.3)[10]										
Pull-Out Strength Cracked Concrete (f'_c = 2500 psi)	$N_{p,cr}$	lb	1,720[6]	3,145[6]	2,560[5]	4,305[5]	N/A[4]	6,545[7]	N/A[4]	8,230[5]
Pull-Out Strength Uncracked Concrete (f'_c = 2500 psi)	$N_{p,uncr}$	lb	N/A[4]	4,770[6]	3,230[5]	4,495[5]	N/A[4]	7,615[5]	7,725[7]	9,625[7]
Strength Reduction Factor - Pullout Failure[8]	ϕ_p	—	0.65							
Tensile Strength for Seismic Applications (ACI Section D.3.3.3)[10]										
Tension Strength of Single Anchor for Seismic Loads (f'_c = 2500 psi)	$N_{p,eq}$	lb	1,720[6]	2,830[6]	2,560[5]	4,305[5]	N/A[4]	6,545[7]	N/A[4]	8,230[5]
Strength Reduction Factor - Pullout Failure[8]	ϕ_{eq}	—	0.65							

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{sa} must be determined in accordance with ACI 318 D.4.5. Strong-Bolt® 2 anchors are ductile steel elements as defined in ACI 318 D.1.
3. The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4(c) for Condition B are met. Condition B applies where supplementary reinforcement is not provided. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4 for Condition A are met, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 D.4.5(c).
4. N/A (Not Applicable) denotes that pullout resistance does not need to be considered.
5. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 2{,}500 \text{ psi})^{0.5}$.
6. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 2{,}500 \text{ psi})^{0.3}$.
7. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 2{,}500 \text{ psi})^{0.4}$.
8. The tabulated value of ϕ_p or ϕ_{eq} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, appropriate value of ϕ must be determined in accordance with ACI 318 Section D.4.5(c).
9. For the 2003 IBC, ψ_3 replaces $\psi_{c,N}$.
10. For sand-lightweight concrete, in lieu of ACI 318 Section D.3.4, modify the value of concrete breakout strength, $N_{p,cr}$, $N_{p,uncr}$ and N_{eq} by 0.6. All-lightweight concrete is beyond the scope of this table.

Strong-Bolt® 2 *Wedge Anchor Performance Data*

Carbon Steel Strong-Bolt® 2 Wedge Anchor Shear Strength Design Data[1]

See page 13 for an explanation of the load table icons

Characteristic	Symbol	Units	Nominal Anchor Diameter							
			Carbon Steel							
			⅜ inch		½ inch		⅝ inch		¾ inch	
Anchor Category	1,2 or 3	—	1							
Nominal Embedment Depth	h_{nom}	in.	1⅞	2⅞	2¾	3⅞	3⅜	5⅛	4⅛	5¾
Steel Strength in Shear (ACI 318 Section D.6.1)										
Steel Strength in Shear	V_{sa}	lb	1,800		7,235		11,035		14,480	
Strength Reduction Factor - Steel Failure[2]	ϕ_{sa}	—	0.65							
Concrete Breakout Strength in Shear (ACI 318 Section D.6.2)[6]										
Outside Diameter	d_a[5]	in.	0.375		0.500		0.625		0.750	
Load Bearing Length of Anchor in Shear	ℓ_e	in.	1.500	2.500	2.250	3.375	2.750	4.500	3.375	5.000
Strength Reduction Factor – Concrete Breakout Failure[3]	ϕ_{cb}	—	0.70							
Concrete Pryout Strength in Shear (ACI 318 Section D.6.3)										
Coefficient for Pryout Strength	k_{cp}	—	1.0	2.0	1.0	2.0	2.0		2.0	
Effective Embedment Depth	h_{ef}	in.	1½	2½	2¼	3⅜	2¾	4½	3⅜	5
Strength Reduction Factor – Concrete Pryout Failure[4]	ϕ_{cp}	—	0.70							
Steel Strength in Shear for Seismic Applications (ACI 318 Section D.3.3.3)										
Shear Strength of Single Anchor for Seismic Loads (f'_c = 2500 psi)	$V_{sa,eq}$	lb	1,800		6,510		9,930		11,775	
Strength Reduction Factor - Steel Failure[2]	ϕ_{sa}	—	0.65							

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{sa} must be determined in accordance with ACI 318 D.4.5. Strong-Bolt® 2 anchors are ductile steel elements as defined in ACI 318 D.1.
3. The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4(c) for Condition B are met. Condition B applies where supplementary reinforcement is not provided. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318 Section D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4 for Condition A are met, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 Section D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 Section D.4.5(c).
4. The tabulated value of ϕ_{cp} applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cp} must be determined in accordance with ACI 318 D.4.5(c).
5. For the 2006 IBC, d_o replaces d_a.
6. For sand-lightweight concrete, in lieu of ACI 318 Section D.3.4, modify the value of concrete breakout strength by 0.6. All-lightweight concrete is beyond the scope of this table.

* See page 13 for an explanation of the load table icons

Stainless-Steel Strong-Bolt® 2 Wedge Anchor Shear Strength Design Data[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter							
			Stainless Steel							
			⅜ inch		½ inch		⅝ inch		¾ inch	
Anchor Category	1,2 or 3	—	1							
Nominal Embedment Depth	h_{nom}	in.	1⅞	2⅞	2¾	3⅞	3⅜	5⅛	4⅛	5¾
Steel Strength in Shear (ACI 318 Section D.6.1)										
Steel Strength in Shear	V_{sa}	lb	3,085		7,245		6,745	10,760	15,045	
Strength Reduction Factor - Steel Failure[2]	ϕ_{sa}	—	0.65							
Concrete Breakout Strength in Shear (ACI 318 Section D.6.2)[6]										
Outside Diameter	d_a[5]	in.	0.375		0.500		0.625		0.750	
Load Bearing Length of Anchor in Shear	ℓ_e	in.	1.500	2.500	2.250	3.375	2.750	4.500	3.375	5.000
Strength Reduction Factor – Concrete Breakout Failure[3]	ϕ_{cb}	—	0.70							
Concrete Pryout Strength in Shear (ACI 318 Section D.6.3)										
Coefficient for Pryout Strength	k_{cp}	—	1.0	2.0	1.0	2.0	2.0		2.0	
Effective Embedment Depth	h_{ef}	in.	1½	2½	2¼	3⅜	2¾	4½	3⅜	5
Strength Reduction Factor – Concrete Pryout Failure[4]	ϕ_{cp}	—	0.70							
Steel Strength in Shear for Seismic Applications (ACI 318 Section D.3.3.3)										
Shear Strength of Single Anchor for Seismic Loads (f'_c = 2500 psi)	$V_{sa,eq}$	lb	3,085		6,100		6,745	10,760	13,620	
Strength Reduction Factor – Steel Failure[2]	ϕ_{sa}	—	0.65							

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{sa} must be determined in accordance with ACI 318 D.4.5. Strong-Bolt® 2 anchors are ductile steel elements as defined in ACI 318 D.1.
3. The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4(c) for Condition B are met. Condition B applies where supplementary reinforcement is not provided. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318 Section D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4 for Condition A are met, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 Section D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 Section D.4.5(c).
4. The tabulated value of ϕ_{cp} applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cp} must be determined in accordance with ACI 318 D.4.5(c).
5. For the 2006 IBC, d_o replaces d_a.
6. For sand-lightweight concrete, in lieu of ACI 318 Section D.3.4, modify the value of concrete breakout strength by 0.6. All-lightweight concrete is beyond the scope of this table.

Carbon Steel Strong-Bolt® 2 Wedge Anchor Tension and Shear Strength Design Data for the Soffit of Concrete Over Profile Steel Deck Floor and Roof Assemblies[1,2,6,8,9]

*See page 13 for an explanation of the load table icons

Characteristic	Symbol	Units	Nominal Anchor Diameter								
			Carbon Steel								
			Lower Flute							Upper Flute	
			⅜ inch		½ inch		⅝ inch		¾ inch	⅜ inch	½ inch
Nominal Embedment Depth	h_{nom}	in.	2	3 ⅜	2 ¾	4 ½	3 ⅜	5 ⅛	4 ⅛	2	2 ¾
Effective Embedment Depth	h_{ef}	in.	1 ⅝	3	2 ¼	4	2 ¾	5	3 ⅜	1 ⅝	2 ¼
Installation Torque	T_{inst}	ft-lbf	30		60		90		150	30	60
Pullout Strength, concrete on metal deck (cracked)[3,4]	$N_{p,deck,cr}$	lb	1,040[7]	2,615[7]	2,040[7]	2,730[7]	2,615[7]	4,990[7]	2,815[7]	1,340[7]	3,785[7]
Pullout Strength, concrete on metal deck (uncracked)[3,4]	$N_{p,deck,uncr}$	lb	1,765[7]	3,150[7]	2,580[7]	3,840[7]	3,685[7]	6,565[7]	3,800[7]	2,275[7]	4,795[7]
Pullout Strength, concrete on metal deck (seismic)[3,4]	$N_{p,deck,eq}$	lb	1,040[7]	2,615[7]	2,040[7]	2,730[7]	2,615[7]	4,990[7]	2,815[7]	1,340[7]	3,785[7]
Steel Strength in Shear, concrete on metal deck[5]	$V_{sa,deck}$	lb	1,595	3,490	2,135	4,580	2,640	7,000	4,535	3,545	5,920
Steel Strength in Shear, concrete on metal deck (seismic)[5]	$V_{sa,deck,eq}$	lb	1,595	3,490	1,920	4,120	2,375	6,300	3,690	3,545	5,330

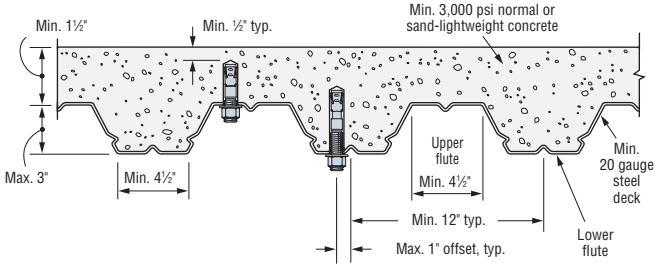
1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. Profile steel deck must comply with the configuration in the figure below, and have a minimum base-steel thickness of 0.035 inch [20 gauge]. Steel must comply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

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

*See page 13 for an explanation of the load table icons

Characteristic	Symbol	Units	Stainless Steel								
			Lower Flute							Upper Flute	
			⅜ inch		½ inch		⅝ inch		¾ inch	⅜ inch	½ inch
Nominal Embedment Depth	h_{nom}	in.	2	3 ⅜	2 ¾	4 ½	3 ⅜	5 ⅛	4 ⅛	2	2 ¾
Effective Embedment Depth	h_{ef}	in.	1 ⅝	3	2 ¼	4	2 ¾	5	3 ⅜	1 ⅝	2 ¼
Installation Torque	T_{inst}	ft-lbf	30		60		80		150	30	60
Pullout Strength, concrete on metal deck (cracked)[3]	$N_{p,deck,cr}$	lb	1,230[8]	2,605[8]	1,990[7]	2,550[7]	1,750[9]	4,020[9]	3,030[7]	1,550[8]	2,055[7]
Pullout Strength, concrete on metal deck (uncracked)[3]	$N_{p,deck,uncr}$	lb	1,580[8]	3,950[8]	2,475[7]	2,660[7]	2,470[7]	5,000[7]	4,275[9]	1,990[8]	2,560[7]
Pullout Strength, concrete on metal deck (seismic)[5]	$N_{p,deck,eq}$	lb	1,230[8]	2,345[8]	1,990[7]	2,550[7]	1,750[9]	4,020[9]	3,030[7]	1,550[8]	2,055[7]
Steel Strength in Shear, concrete on metal deck[4]	$V_{sa,deck}$	lb	2,285	3,085	3,430	4,680	3,235	5,430	6,135	3,085	5,955
Steel Strength in Shear, concrete on metal deck (seismic)[5]	$V_{sa,deck.eq}$	lb	2,285	3,085	2,400	3,275	3,235	5,430	5,520	3,085	4,170

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



Strong-Bolt® 2 *Wedge Anchor Performance Data*

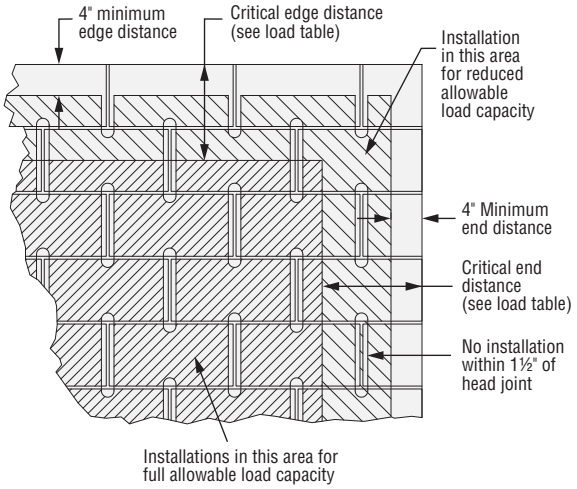
Carbon-Steel Strong-Bolt® 2 Wedge Anchor Tension and Shear Loads in 8-inch Lightweight, Medium-weight and Normal-Weight Grout-Filled CMU

* See page 13 for an explanation of the load table icons

Size in. (mm)	Drill Bit Dia. in.	Min. Embed. Depth. in. (mm)	Install. Torque ft-lbs (N-m)	Critical Edge Dist. in. (mm)	Critical End Dist. in. (mm)	Critical Spacing in. (mm)	Tension Load		Shear Load	
							Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)
Anchor Installed in the Face of the CMU Wall (See Figure 1)										
⅜ (9.5)	**⅜**	**2 ⅝** (67)	**20** (27.1)	**12** (305)	**12** (305)	**8** (203)	**2,185** (9.7)	**435** (1.9)	**3,875** (17.2)	**775** (3.4)
½ (12.7)	**½**	**3 ½** (89)	**35** (47.5)	**12** (305)	**12** (305)	**8** (203)	**2,645** (11.8)	**530** (2.4)	**5,055** (22.5)	**1,010** (4.5)
⅝ (15.9)	**⅝**	**4 ⅝** (111)	**55** (74.6)	**20** (508)	**20** (508)	**8** (203)	**4,460** (19.8)	**890** (4.0)	**8,815** (39.2)	**1,765** (7.9)
¾ (19.1)	**¾**	**5 ¼** (133)	**100** (135.6)	**20** (508)	**20** (508)	**8** (203)	**5,240** (23.3)	**1050** (4.7)	**12,450** (55.4)	**2,490** (11.1)

1. The tabulated allowable loads are based on a safety factor of 5.0 for installation under the IBC and IRC.
2. Listed loads may be applied to installations on the face of the CMU wall at least 1 ¼ inch away from headjoints.
3. Values for 8-inch wide concrete masonry units (CMU) with a minimum specified compressive strength of masonry, f'_m, at 28 days is 1500 psi.
4. Embedment depth is measured from the outside face of the concrete masonry unit.
5. Tension and shear loads may be combined using the parabolic interaction equation (n = 5/3).
6. Refer to allowable load adjustment factors for edge distance and spacing on page 105.

Figure 1



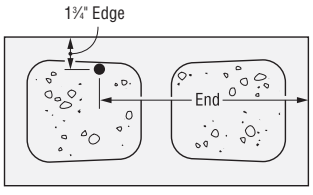
Carbon-Steel Strong-Bolt® 2 Wedge Anchor Tension and Shear Loads in 8-inch Lightweight, Medium-weight and Normal-Weight Grout-Filled CMU

* See page 13 for an explanation of the load table icons

Size in. (mm)	Drill Bit Dia. in.	Min. Embed. Depth. in. (mm)	Install. Torque ft-lbs (N-m)	Min. Edge. Dist. in. (mm)	Critical End Dist. in. (mm)	Critical Spacing in. (mm)	Tension Load		Shear Load Perp. To Edge		Shear Load Parallel To Edge	
							Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)
Anchor Installed in Cell Opening or Web (Top of Wall) (See Figure 2)												
½ (12.7)	**½**	**3½** (89)	**35** (47.5)	**1¾** (44)	**12** (305)	**8** (203)	**2,080** (9.3)	**415** (1.8)	**1,165** (5.2)	**235** (1.0)	3,360 (14.9)	670 (3.0)
⅝ (15.9)	**⅝**	**4⅜** (111)	**55** (74.6)	**1¾** (44)	**12** (305)	**8** (203)	**3,200** (14.2)	**640** (2.8)	**1,370** (6.1)	**275** (1.2)	3,845 (17.1)	770 (3.4)

1. The tabulated allowable loads are based on a safety factor of 5.0 for installation under the IBC and IRC.
2. Values for 8-inch wide concrete masonry units (CMU) with a minimum specified compressive strength of masonry, f'_m, at 28 days is 1500 psi.
3. Tension and shear loads may be combined using the parabolic interaction equation (n = 5/3).
4. Refer to allowable load adjustment factors for edge distance and spacing on page 105.

Figure 2



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

How to use these charts:

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

Edge or End Distance Tension (f_c)

* See page 13 for an explanation of the load table icons

C_{act} (in.)	Dia.	⅜	½	⅝	¾
	E	2 ⅝	3 ½	4 ⅜	5 ¼
	C_{cr}	12	12	20	20
	C_{min}	4	4	4	4
	f_{cmin}	1.00	1.00	1.00	0.97
4		1.00	1.00	1.00	0.97
6		1.00	1.00	1.00	0.97
8		1.00	1.00	1.00	0.98
10		1.00	1.00	1.00	0.98
12		1.00	1.00	1.00	0.99
14				1.00	0.99
16				1.00	0.99
18				1.00	1.00
20				1.00	1.00

Edge or End Distance Shear (f_c)

* See page 13 for an explanation of the load table icons

C_{act} (in.)	Dia.	⅜	½	⅝	¾
	E	2 ⅝	3 ½	4 ⅜	5 ¼
	C_{cr}	12	12	20	20
	C_{min}	4	4	4	4
	f_{cmin}	0.71	0.60	0.36	0.28
4		0.71	0.60	0.36	0.28
6		0.78	0.70	0.44	0.37
8		0.86	0.80	0.52	0.46
10		0.93	0.90	0.60	0.55
12		1.00	1.00	0.68	0.64
14				0.76	0.73
16				0.84	0.82
18				0.92	0.91
20				1.00	1.00

Spacing Tension (f_s)

* See page 13 for an explanation of the load table icons

S_{act} (in.)	Dia.	⅜	½	⅝	¾
	E	2 ⅝	3 ½	4 ⅜	5 ¼
	S_{cr}	8	8	8	8
	S_{min}	4	4	4	4
	f_{smin}	1.00	0.93	0.86	0.80
4		1.00	0.93	0.86	0.80
6		1.00	0.97	0.93	0.90
8		1.00	1.00	1.00	1.00

Spacing Shear (f_s)

* See page 13 for an explanation of the load table icons

S_{act} (in.)	Dia.	⅜	½	⅝	¾
	E	2 ⅝	3 ½	4 ⅜	5 ¼
	S_{cr}	8	8	8	8
	S_{min}	4	4	4	4
	f_{smin}	1.00	1.00	1.00	1.00
4		1.00	1.00	1.00	1.00
6		1.00	1.00	1.00	1.00
8		1.00	1.00	1.00	1.00

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

How to use these charts:

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

End Distance Tension (f_c)

S_{act} (in.)	Dia.	½	⅝
	E	3 ½	4 ⅜
	C_{cr}	12	12
	C_{min}	4	4
	f_{cmin}	1.00	1.00
4		1.00	1.00
6		1.00	1.00
8		1.00	1.00
10		1.00	1.00
12		1.00	1.00

End Distance Shear Perpendicular to Edge (f_c)

C_{act} (in.)	Dia.	½	⅝
	E	3 ½	4 ⅜
	C_{cr}	12	12
	C_{min}	4	4
	f_{cmin}	0.90	0.83
4		0.90	0.83
6		0.93	0.87
8		0.95	0.92
10		0.98	0.96
12		1.00	1.00

End Distance Shear Parallel to Edge (f_c)

C_{act} (in.)	Dia.	½	⅝
	E	3 ½	4 ⅜
	C_{cr}	12	12
	C_{min}	4	4
	f_{cmin}	0.53	0.50
4		0.53	0.50
6		0.65	0.63
8		0.77	0.75
10		0.88	0.88
12		1.00	1.00

Spacing Tension (f_s)

S_{act} (in.)	Dia.	½	⅝
	E	3 ½	4 ⅜
	S_{cr}	8	8
	S_{min}	4	4
	f_{smin}	0.93	0.86
4		0.93	0.86
6		0.97	0.93
8		1.00	1.00

Spacing Shear Perpendicular or Parallel to Edge (f_s)

* See page 13 for an explanation of the load table icons

S_{act} (in.)	Dia.	½	⅝
	E	3 ½	4 ⅜
	S_{cr}	8	8
	S_{min}	4	4
	f_{smin}	1.00	1.00
4		1.00	1.00
6		1.00	1.00
8		1.00	1.00