Product Submittal/Substitution Request

TO:

PROJECT:

PROJECT LOCATION:

SPECIFIED ITEM:

Section | Page | Paragraph | Description

PRODUCT SUBMIT TAL / SUBSTITUTION REQUESTED:

DEWALT® Engineered By Powers® Atomic+ Undercut(R) -

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

SUBMITTED BY:

Name: Signature:

Company:

Address:

Date: Telephone: Fax:

FOR USE BY THE ARCHITECT AND/OR ENGINEER

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

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

By: Date:

Remarks:

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

DEWALT® Atomic+ Undercut(R) Submittal Section:

DEWALT
ENGINEERED BY Powers™

COMPETITIVE COMPARISON

ATOMIC+ UNDERCUT® VS. HILTI* HDA

Product Comparison

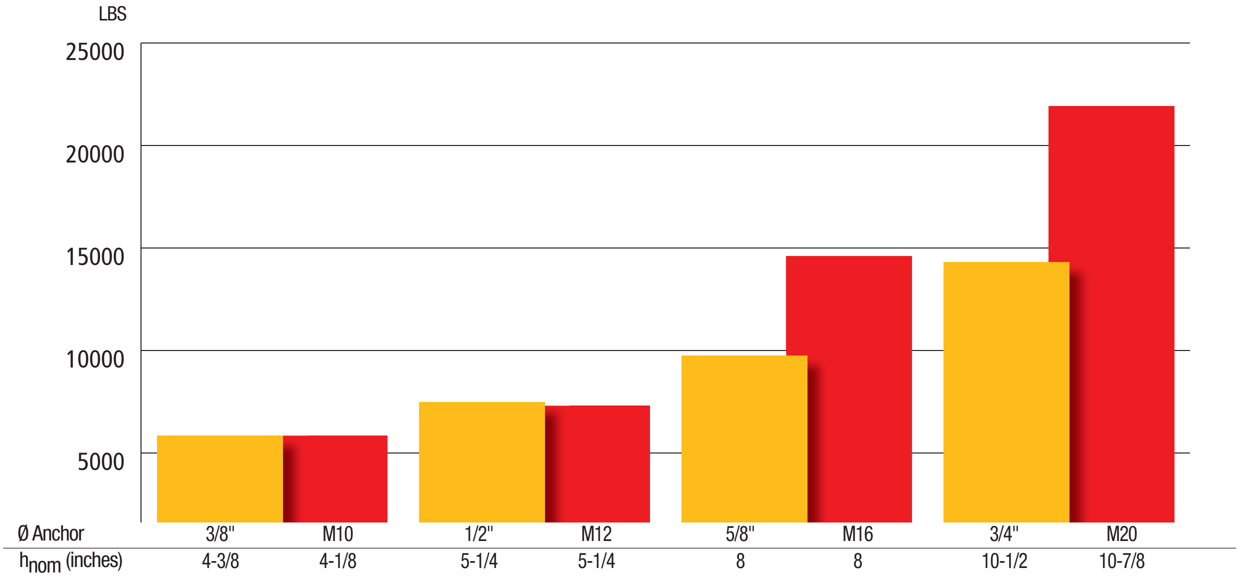
Product Name	Atomic+ Undercut	HDA
Company	DEWALT	Hilti*
Description	Carbon Steel Undercut Anchor	Carbon Steel Undercut Anchor
Size Range	3/8", 1/2", 5/8", 3/4"	M10, M12, M16, M20
ICC-ES ESR (concrete)	ESR-3067	ESR-1546
Issued	2016 June	2016 March
Cracked Concrete	Yes	Yes
Seismic	Yes	Yes

* Hilti is a registered trademark of Hilti Corporation

Factored Tension Loads Cracked Concrete

2500 psi

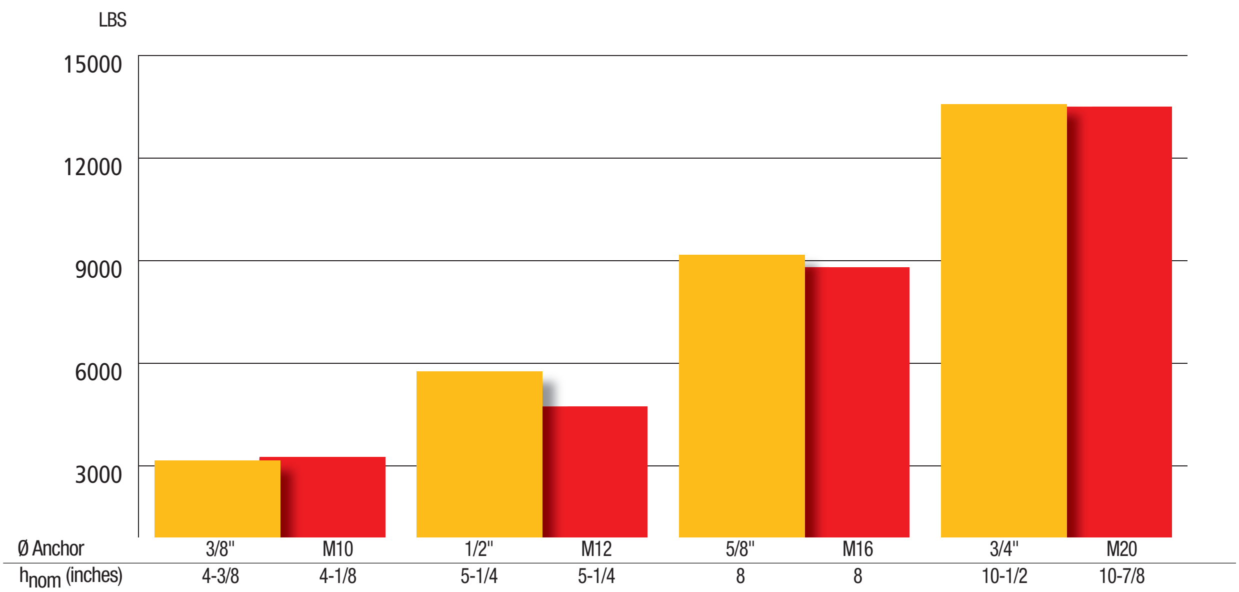
Atomic+ Undercut
HDA



Factored Shear Loads Cracked Concrete

2500 psi

Atomic+ Undercut
HDA



Source: ESR-3067 (Issued: 2016 June), ESR-1546 (Issued: 2016 March)

GENERAL INFORMATION

ATOMIC+ UNDERCUT®

Heavy Duty Undercut Anchor

PRODUCT DESCRIPTION

The Atomic+ Undercut anchor is designed for applications in cracked and uncracked concrete. The anchors are is available in standard ASTM A 36 steel, high strength ASTM A 193 Grade B7 steel and Type 316 stainless steel in Class 1 and Class 2 strength designations.

The Type 316 stainless steel version can be considered for exterior use and industrial applications where a high level of corrosion resistance is required.

The Atomic+ Undercut anchor is installed into a pre-drilled hole which has been enlarged at the bottom in the shape of a reversed cone using the undercut drill bit supplied by DEWALT. The result is an anchor which transfers load mainly through bearing, and unlike a typical expansion anchor is not dependent upon friction between the expansion sleeve and the concrete. Due to the use of a thick walled expansion sleeve, the load is distributed to a large area which can provide ductile behavior of the anchor even at relatively shallow embedments.

GENERAL APPLICATIONS AND USES

- Structural connections, beam and column anchorage
- Safety related attachments
- Tension zone applications
- Heavy duty loading
- Pipe supports, strut & base mounts
- Suspended equipment
- Seismic and wind loading

FEATURE AND BENEFITS

+ Consistent performance in high and low strength concrete
+ Anchors available for standard pre-set installations and for through bolt applications
+ Length ID code and identifying marking stamped on head of each anchor
+ Load transfers to concrete through bearing, not friction, behaves like a cast-in-place bolt
+ Bearing load transfer allows for closer spacing and edge distances
+ Can be designed for predictable ductile steel performance
+ Undercut created in seconds with durable undercutting tool

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3067
  Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, 2009 IRC, 2006 IBC, and 2006 IRC
- Tested in accordance with ACI 355.2/ASTM E488 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)

GUIDE SPECIFICATIONS

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

SECTION CONTENTS

ATOMIC+ UNDERCUT ASSEMBLY

THREAD VERSION

- UNC threaded stud

ANCHOR MATERIALS

- Zinc Plated Carbon Steel
- Type 316 Stainless Steel

ANCHOR SIZE RANGE (TYP.)

- 3/8" through 3/4" diameter

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Sand-lightweight concrete

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-3067
CONCRETE

DDA
DEWALT DESIGN ASSIST™

MATERIAL SPECIFICATIONS

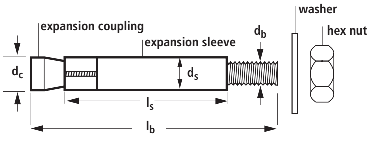
Anchor Component	Anchor Designation			
	Carbon Steel	High Strength Carbon Steel	Stainless Steel (Type 316)	High Strength Stainless Steel (Type 316)
Threaded Rod	ASTM A 36	ASTM A 193, Grade B7	ASTM A193, Grade B8M, Class 1	ASTM A193, Grade B8M, Class 2
Expansion Coupling (Cone)	ASTM A 108 12L14		ASTM A 274 S	
Expansion/Spacer Sleeve	ASTM A 513 Type 5		ASTM A 274 S	
Hex Nut	ASTM A 563, Grade C		ASTM A 194, Grade 8M	
Washer	ASTM F 844; Meets dimensional requirements of ANSI B18.22.1, Type A plain		Type 316 SS; Meets dimensional requirements of ANSI B18.22.1, Type A plain	
Plating	Zinc plating in accordance with ASTM B 633, SC1 (Fe/Zn 5) or equivalent; Minimum plating requirement for Mild Service Condition		Not applicable	

ANCHOR SPECIFICATIONS

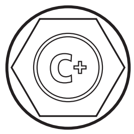
Dimensional Characteristics Table for Atomic+ Undercut

Anchor Designation	Anchor Type	Anchor Rod ASTM Designation	Rod Diameter, d_b (inch)	Anchor Length, l_b (inches)	Sleeve Length, l_s (inches)	Sleeve Diameter, d_s (inch)	Expansion Coupling Diameter d_c (inch)	Max. Fixture Thickness, t (inches)
03100SD	Standard	A 36	3/8	5-1/2	2-3/4	5/8	5/8	1-3/4
03102SD	Through bolt (TB)	A 36	3/8	5-1/2	4-1/2	5/8	5/8	1-3/4
03600SD	Standard	A 193, Grade B8M, Class 1	3/8	5-1/2	2-3/4	5/8	5/8	1-3/4
03602SD	Through bolt (TB)	A 193, Grade B8M, Class 1	3/8	5-1/2	4-1/2	5/8	5/8	1-3/4
03603SD	Standard	A193, Grade B8M, Class 2	3/8	6-3/4	4	5/8	5/8	1-3/4
03605SD	Through Bolt (TB)	A193, Grade B8M, Class 2	3/8	6-3/4	5-3/4	5/8	5/8	1-3/4
03104SD	Standard	A 193, Grade B7	3/8	6-3/4	4	5/8	5/8	1-3/4
03106SD	Through bolt (TB)	A 193, Grade B7	3/8	6-3/4	5-3/4	5/8	5/8	1-3/4
03108SD	Standard	A 36	1/2	7	4	3/4	3/4	1-3/4
03110SD	Through bolt (TB)	A 36	1/2	7	5-3/4	3/4	3/4	1-3/4
03608SD	Standard	A 193, Grade B8M, Class 1	1/2	7	4	3/4	3/4	1-3/4
03610SD	Through bolt (TB)	A 193, Grade B8M, Class 1	1/2	7	5-3/4	3/4	3/4	1-3/4
03609SD	Standard	A193, Grade B8M, Class 2	1/2	8	5	3/4	3/4	1-3/4
03613SD	Through Bolt (TB)	A193, Grade B8M, Class 2	1/2	8	6-3/4	3/4	3/4	1-3/4
03112SD	Standard	A 193, Grade B7	1/2	8	5	3/4	3/4	1-3/4
03114SD	Through bolt (TB)	A 193, Grade B7	1/2	8	6-3/4	3/4	3/4	1-3/4
03116SD	Standard	A 193, Grade B7	1/2	9-3/4	6-3/4	3/4	3/4	1-3/4
03118SD	Through bolt (TB)	A 193, Grade B7	1/2	9-3/4	8-1/2	3/4	3/4	1-3/4
03120SD	Standard	A 36	5/8	7-3/4	4-1/2	1	1	1-3/4
03122SD	Through bolt (TB)	A 36	5/8	7-3/4	6-1/4	1	1	1-3/4
03620SD	Standard	A 193, Grade B8M, Class 1	5/8	7-3/4	4-1/2	1	1	1-3/4
03622SD	Through bolt (TB)	A 193, Grade B8M, Class 1	5/8	7-3/4	6-1/4	1	1	1-3/4
03635SD	Standard	A193, Grade B8M, Class 2	5/8	10-3/4	7-1/2	1	1	1-3/4
03639SD	Through Bolt (TB)	A193, Grade B8M, Class 2	5/8	10-3/4	9-1/4	1	1	1-3/4
03124SD	Standard	A 193, Grade B7	5/8	10-3/4	7-1/2	1	1	1-3/4
03126SD	Through bolt (TB)	A 193, Grade B7	5/8	10-3/4	9-1/4	1	1	1-3/4
03128SD	Standard	A 193, Grade B7	5/8	12-1/4	9	1	1	1-3/4
03130SD	Through bolt (TB)	A 193, Grade B7	5/8	12-1/4	10-3/4	1	1	1-3/4
03132SD	Standard	A 36	3/4	8-5/8	5	1-1/8	1-1/8	1-3/4
03134SD	Through bolt (TB)	A 36	3/4	8-5/8	6-3/4	1-1/8	1-1/8	1-3/4
03632SD	Standard	A 193, Grade B8M, Class 1	3/4	8-5/8	5	1-1/8	1-1/8	1-3/4
03634SD	Through bolt (TB)	A 193, Grade B8M, Class 1	3/4	8-5/8	6-3/4	1-1/8	1-1/8	1-3/4
03648SD	Standard	A193, Grade B8M, Class 2	3/4	13-5/8	10	1-1/8	1-1/8	1-3/4
03649SD	Through Bolt (TB)	A193, Grade B8M, Class 2	3/4	13-5/8	11-3/4	1-1/8	1-1/8	1-3/4
03136SD	Standard	A 193, Grade B7	3/4	13-5/8	10	1-1/8	1-1/8	1-3/4
03138SD	Through bolt (TB)	A 193, Grade B7	3/4	13-5/8	11-3/4	1-1/8	1-1/8	1-3/4

Atomic+ Undercut Anchor Detail



Head Marking



Legend
Letter Code = Length Identification Mark
'+' Symbol = Strength Design Compliant Anchor (see ordering information)

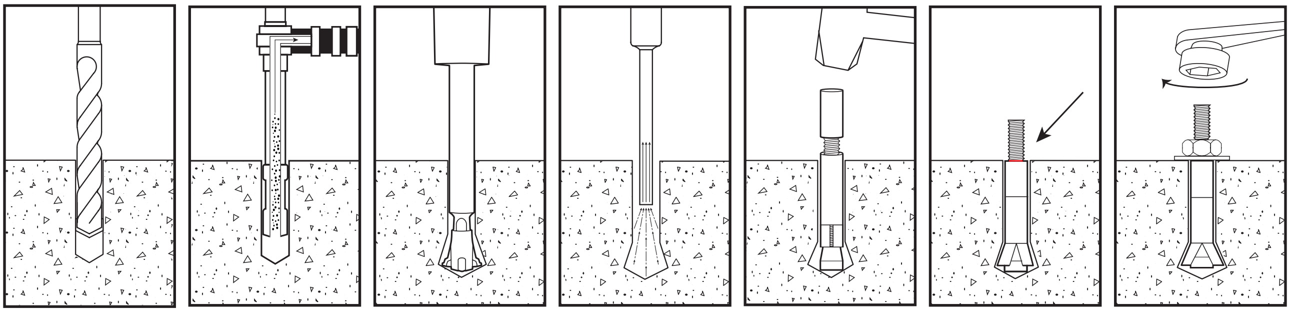
Length Identification

Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
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"	11"	12"
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"	12"	13"

Length identification mark indicates overall length of anchor.

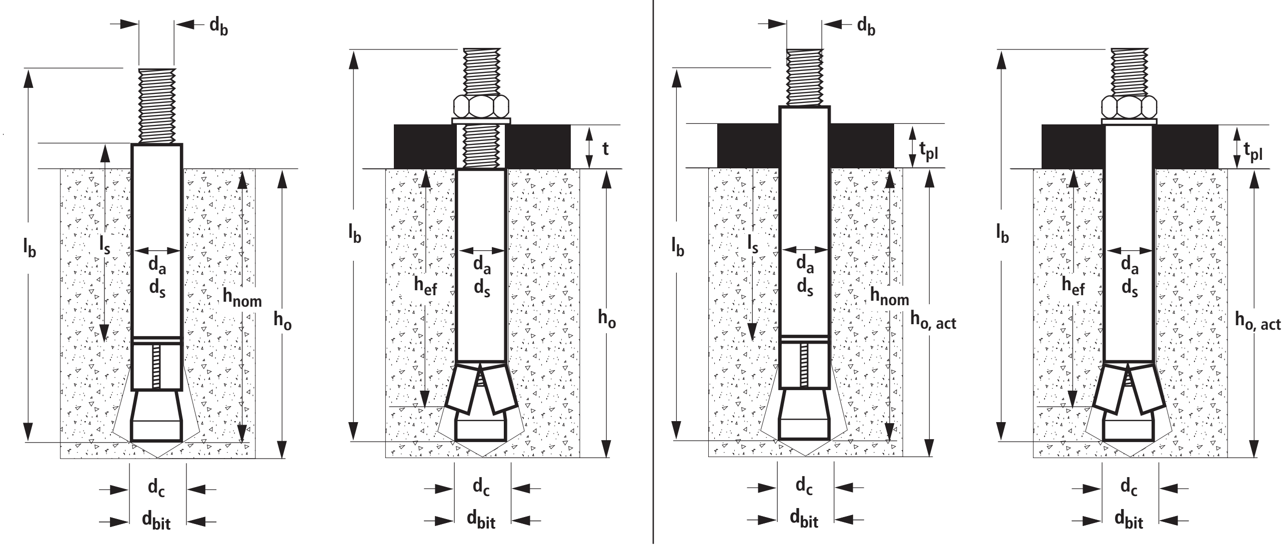
INSTALLATION INSTRUCTIONS

Installation Instructions for Atomic+ Undercut Anchors



1. Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.
2. Remove dust and debris from 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.
3. Insert the undercut bit and start the rotohammer. Undercutting is complete when the stopper sleeve is fully compressed (gap closed)
4. Remove dust and debris from the hole following drilling (e.g. suction, forced air)
5. Insert anchor into hole. Place setting sleeve over anchor and drive the expansion sleeve over the expansion coupling.
6. Verify that the setting mark is visible on the theaded rod above the sleeve.
7. Apply proper torque; Do not exceed maximum torque.

Atomic+ Undercut Anchor Detail (before and after application of setting sleeve and attachment)



Before After

Standard Type (Pre-set Version)

Before After

Through Bolt Type

Axial Stiffness Values, β, for Atomic+ Undercut Anchors in Normal-Weight Concrete[1]

Concrete State	Notation	Units	Nominal Anchor Size / Rod Diameter (inch)			
			3/8	1/2	5/8	3/4
Uncracked concrete	β_{min}	10^3 lbf/in	131			
	β_m	10^3 lbf/in	930			
	β_{max}	10^3 lbf/in	1,444			
Cracked concrete	β_{min}	10^3 lbf/in	91			
	β_m	10^3 lbf/in	394			
	β_{max}	10^3 lbf/in	1,724			

1. Valid for anchors with high strength threaded rod (A 193 Grade B7). For anchors with low strength threaded rod (A 36) values must be multiplied by 0.7.

INSTALLATION SPECIFICATIONS

Installation Specifications for Atomic+ Undercut Anchors

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter									
			3/8 inch		1/2 inch			5/8 inch			3/4 inch	
Outside anchor diameter	d_a	in. (mm)	0.625 (15.9)		0.750 (19.1)			1.000 (25.4)			1.125 (28.6)	
Minimum diameter of hole clearance in fixture[2]	d_h	in. (mm)	7/16 (11.1)		9/16 (14.3)			11/16 (17.5)			13/16 (20.6)	
Anchor rod designation, carbon steel	ASTM	-	A36	A193 Gr. B7	A36	A193 Grade B7		A36	A193 Grade B7		A36	A193 Gr. B7
Anchor rod designation, stainless steel	ASTM	-	A193 Gr. B8M Class 1	A193 Gr. B8M Class 2	A193 Gr. B8M Class 1	A193 Gr. B8M Class 2	-	A193 Gr. B8M Class 1	A193 Gr. B8M Class 2	-	A193 Gr. B8M Class 1	A193 Gr. B8M Class 2
Minimum nominal embedment depth	h_{nom}	in. (mm)	3-1/8 (79)	4-3/8 (111)	4-1/4 (108)	5-1/4 (133)	7 (178)	5 (127)	8 (203)	9-1/2 (241)	5-7/8 (149)	10-7/8 (276)
Effective embedment	h_{ef}	in. (mm)	2-3/4 (68)	4 (102)	4 (102)	5 (127)	6-3/4 (171)	4-1/2 (114)	7-1/2 (190)	9 (229)	5 (127)	10 (254)
Minimum hole depth[1]	h_o	in. (mm)	3-1/8 (79)	4-3/8 (111)	4-1/4 (108)	5-1/4 (133)	7 (178)	5 (127)	8 (204)	9-1/2 (241)	5-7/8 (149)	10-7/8 (276)
Minimum concrete member thickness	For h_{min1}	in. (mm)	5-1/2 (140)	8 (204)	8 (204)	10 (254)	13-1/2 (343)	9 (229)	15 (381)	18 (457)	10 (254)	20 (508)
	$c_{ac,1} \geq$	in. (mm)	4-1/8 (105)	6 (152)	6 (152)	7-1/2 (190)	10-1/8 (257)	6-3/4 (171)	11-1/4 (256)	13-1/2 (343)	7-1/2 (190)	15 (381)
	For h_{min2}	in. (mm)	4-3/8 (111)	6 (152)	6 (152)	7-1/2 (190)	10-1/8 (257)	6-3/4 (171)	11-1/4 (256)	13-1/2 (343)	7-1/2 (190)	15 (381)
	$c_{ac,2} \geq$	in. (mm)	5-1/2 (140)	10-1/4 (260)	9-1/4 (235)	13 (330)	20-1/4 (514)	9-1/2 (241)	21 (533)	27 (686)	10-1/2 (267)	30 (762)
Minimum edge distance	c_{min}	in. (mm)	2-1/4 (57)	3-1/4 (82)	3-1/4 (82)	4 (102)	5-3/8 (86)	3-5/8 (92)	6 (152)	7-1/4 (184)	4 (102)	8 (204)
Minimum spacing distance	s_{min}	in. (mm)	2-3/4 (70)	4 (102)	4 (102)	5 (127)	6-3/4 (171)	4-1/2 (114)	7-1/2 (190)	9 (229)	5 (127)	10 (254)
Maximum thickness of fixture	t	in. (mm)	1-3/4 (44)		1-3/4 (44)			1-3/4 (44)			1-3/4 (44)	
Maximum torque	T_{inst}	ft.-lbf.	26		44			60			133	
Torque wrench / socket size	-	in.	11/16		7/8			1-1/16			1-1/4	
Nut Height	-	in.	23/64		31/64			39/64			47/64	
Stop Drill Bit												
Nominal stop drill bit diameter	d_{bit}	in.	5/8 ANSI		3/4 ANSI			1 ANSI			1-1/8 ANSI	
Stop drill bit for anchor installation	-	-	3220SD	3221SD	3222SD	3223SD	3224SD	3225SD	3226SD	3227SD	3228SD	3229SD
Drilled hole depth of stop bit[1]	-	-	3-1/8	4-3/8	4-1/4	5-1/4	7	5	8	9-1/2	5-7/8	10-7/8
Stop drill bit shank type	-	-	SDS		SDS			SDS-Max			SDS-Max	
Undercut Drill Bit												
Nominal undercut drill bit diameter	d_{uc}	in.	5/8		3/4			1			1-1/8	
Undercut drill bit designation	-	-	3200SD		3201SD			3202SD			3203SD	
Maximum depth of hole for undercut drill bit	-	in. (mm)	9 (229)		10-1/4 (260)			12-1/4 (311)			13-1/2 (343)	
Undercut drill bit shank type	-	-	SDS		SDS			SDS-Max			SDS-Max	
Required impact drill energy	-	ft.-lbf.	1.6		2.5			3.2			4.0	
Setting Sleeve												
Recommended setting sleeve	-	-	3210SD		3211SD			3212SD			3213SD	

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

1. For through bolt applications, the actual hole depth is given by the minimum hole depth plus the maximum thickness of fixture less the thickness of the actual part(s) being fastened to the base material ($h_{o,act} = h_o + t - t_{pl}$).
2. For through bolt applications the minimum diameter of hole clearance in fixture is 1/16-inch larger than the nominal outside anchor diameter.

PERFORMANCE DATA

Tension and Shear Design Information For Atomic+ Undercut Anchor in Concrete (For use with load combinations taken from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2)[1]

Anchor Property / Setting Information		Notation	Units	Nominal Anchor Diameter									
				3/8 inch		1/2 inch			5/8 inch			3/4 inch	
Anchor category		1,2 or 3	-	1									
Outside anchor diameter		$d_a[d_o]$[8]	in. (mm)	0.625 (15.9)		0.750 (19.1)			1.000 (25.4)			1.125 (28.6)	
Effective embedment		h_{ef}	in. (mm)	2-3/4 (68)	4 (102)	4 (102)	5 (127)	6-3/4 (171)	4-1/2 (114)	7-1/2 (190)	9 (229)	5 (127)	10 (254)
STEEL STRENGTH IN TENSION AND SHEAR[3]													
Tensile stress area of anchor rod steel		A_{se}	in.² (mm²)	0.0775 (50)		0.1419 (91)			0.2260 (146)			0.3345 (216)	
ASTM A36 ($f_y \geq$ 36 ksi) ASTM A193 Grade B7 ($f_y \geq$ 105 ksi)	Minimum specified yield strength of anchor rod[10]	f_y	ksi (N/mm²)	36 (248)	105 (723)	36 (248)	105 (723)	105 (723)	36 (248)	105 (723)	105 (723)	36 (248)	105 (723)
	Minimum specified ultimate tensile strength of anchor rod[10]	f_{uta}	ksi (N/mm²)	58 (400)	125 (860)	58 (400)	125 (860)	125 (860)	58 (400)	125 (860)	125 (860)	58 (400)	125 (860)
	Steel strength in tension, static[10]	N_{sa}	lb (kN)	4,495 (20.1)	9,685 (43.2)	8,230 (36.7)	17,735 (79.1)	17,735 (79.1)	13,100 (58.5)	28,250 (126.1)	28,250 (126.1)	19,400 (86.3)	41,810 (186.0)
	Steel strength in shear, static[9,10]	V_{sa}	lb (kN)	2,245 (10.0)	4,885 (21.7)	4,110 (18.4)	8,855 (39.5)	8,855 (39.5)	6,560 (29.3)	14,110 (63.0)	14,110 (63.0)	9,685 (43.2)	20,875 (93.2)
	Steel strength in shear, seismic[9,10]	V_{eq}	lb (kN)	2,245 (10.0)	4,885 (21.7)	4,110 (18.4)	8,855 (39.5)	8,855 (39.5)	6,560 (29.3)	14,110 (63.0)	14,110 (63.0)	9,685 (43.2)	20,875 (93.2)
ASTM A193 Grade B8M, Class 1 (fy >= 30 ksi) ASTM A193 Grade B8M, Class 2 (fy >= 95 ksi)	Minimum specified yield strength of anchor rod (Type 316 stainless steel anchor)	$f_{y,ss}$	ksi (N/mm²)	30 (205)	95 (655)	30 (205)	95 (655)	-	30 (205)	95 (655)	-	30 (205)	95 (655)
	Minimum specified ultimate tensile strength of anchor rod (Type 316 stainless steel anchor)	$f_{uta,ss}$	ksi (N/mm²)	75 (515)	105 (760)	75 (515)	105 (760)	-	75 (515)	105 (760)	-	75 (515)	105 (760)
	Steel strength in tension, static (Type 316 stainless steel anchor)[11]	$N_{sa,ss}$	lb (kN)	4,415 (19.6)	8,525 (37.9)	8,085 (36.0)	15,610 (69.4)	-	12,880 (57.3)	24,860 (110.6)	-	19,065 (84.8)	36,795 (163.7)
	Steel strength in shear, static (Type 316 stainless steel anchor)[11]	$V_{sa,ss}$	lb (kN)	2,210 (9.8)	4,265 (19.0)	4,045 (18.0)	7,805 (34.7)	-	6,440 (28.6)	12,430 (55.3)	-	9,535 (42.4)	18,400 (81.8)
Reduction factor for steel strength in tension[2]		ϕ	-	0.75									
Reduction factor for steel strength in shear[2]		ϕ	-	0.65									
CONCRETE BREAKOUT STRENGTH IN TENSION AND SHEAR[7]													
Effectiveness factor for uncracked concrete		k_{uncr}	-	30		30			30			30	
Effectiveness factor for cracked concrete		k_{cr}	-	24		24			24			24	
Modification factor for cracked and uncracked concrete[4]		$\Psi_{c,N}$	-	1.0 (See note 4)		1.0 (See note 4)			1.0 (See note 4)			1.0 (See note 4)	
Reduction factor for concrete breakout strength in tension[2]		ϕ	-	0.65 (Condition B)									
Reduction factor for concrete breakout strength in shear[2]		ϕ	-	0.70 (Condition B)									
PULLOUT STRENGTH IN TENSION[7]													
Characteristic pullout strength, uncracked concrete (2,500 psi)[5]		$N_{p,uncr}$	lb (kN)	See note 6		See note 6			See note 6			See note 6	
Characteristic pullout strength, cracked concrete (2,500 psi)[5]		$N_{p,cr}$	lb (kN)	See note 6	9,000 (40.2)	See note 6	11,500 (51.3)		See note 6	15,000 (67.0)		See note 6	22,000 (98.2)
Characteristic pullout strength, seismic (2,500 psi)[5,10]		N_{eq}	lb (kN)	See note 6	9,000 (40.2)	See note 6	11,500 (51.3)		See note 6	15,000 (67.0)		See note 6	22,000 (98.2)
Reduction factor for pullout strength[2]		ϕ	-	0.65 (Condition B)									
PRYOUT STRENGTH IN SHEAR[7]													
Coefficient for pryout strength		k_{cp}	-	2.0		2.0			2.0			2.0	
Reduction factor for pryout strength[2]		ϕ	-	0.70 (Condition B)									

For SI: 1 inch = 25.4 mm, 1 ksi = 6.895 MPa (N/mm²), 1 lbf = 0.0044 kN, 1 in² = 645 mm².

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. 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 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
3. Anchors are considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
4. For 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.
5. For all design cases $\Psi_{c,P}$ =1.0. For concrete compressive strength greater than 2,500 psi N_{pn} = (pullout strength from table)*(specified concrete compressive strength/2,500)$^{0.5}$.
6. Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
7. Anchors are permitted to be used in 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.
8. The notation in brackets is for the 2006 IBC.
9. Shear strength values are based on standard (pre-set) installation, and must be used for both standard (pre-set) and through-bolt installations.
10. These values are only applicable to carbon steel anchors; values are not established for stainless steel anchors.
11. Calculated using $f_{uta,ss}$ = 57 ksi (1.9fy) in accordance with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.

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, $h_a = h_{min2}$, and with the following conditions:
   - c_{a1} is greater than or equal to the critical edge distance, c_{ac} (table values based on $c_{a1} = c_{ac}$).
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.

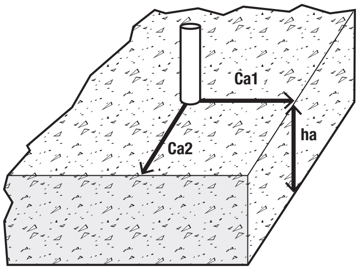
2- Calculations were performed according to ACI 318-14 Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength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

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

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

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

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



Tension and Shear Design Strength for Carbon Steel Atomic+ Undercut in Cracked Concrete

STRENGTH DESIGN TABLES

Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	Minimum Concrete Compressive Strength, f'c (psi)									
			2,500		3,000		4,000		6,000		8,000	
			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	3-1/8	A 36	3,370	1,460	3,370	1,460	3,370	1,460	3,370	1,460	3,370	1,460
	4-3/8	A 193, Gr. B7	5,850	3,175	6,410	3,175	7,265	3,175	7,265	3,175	7,265	3,175
1/2	4-1/4	A 36	6,175	2,670	6,175	2,670	6,175	2,670	6,175	2,670	6,175	2,670
	5-1/4	A 193, Gr. B7	7,475	5,755	8,190	5,755	9,455	5,755	11,580	5,755	13,300	5,755
	7	A 193, Gr. B7	7,475	5,755	8,190	5,755	9,455	5,755	11,580	5,755	13,300	5,755
5/8	5	A 36	7,445	4,265	8,155	4,265	9,420	4,265	9,825	4,265	9,825	4,265
	8	A 193, Gr. B7	9,750	9,170	10,680	9,170	12,335	9,170	15,105	9,170	17,440	9,170
	9-1/2	A 193, Gr. B7	9,750	9,170	10,680	9,170	12,335	9,170	15,105	9,170	17,440	9,170
3/4	5-7/8	A 36	8,720	6,410	9,555	6,410	11,030	6,410	13,510	6,410	14,550	6,410
	10-7/8	A 193, Gr. B7	14,300	13,570	15,665	13,570	18,090	13,570	22,155	13,570	25,580	13,570

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

Tension and Shear Design Strength for Carbon Steel Atomic+ Undercut in Uncracked Concrete

Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	Minimum Concrete Compressive Strength, f'c (psi)									
			2,500		3,000		4,000		6,000		8,000	
			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	3-1/8	A 36	3,370	1,460	3,370	1,460	3,370	1,460	3,370	1,460	3,370	1,460
	4-3/8	A 193, Gr. B7	7,265	3,175	7,265	3,175	7,265	3,175	7,265	3,175	7,265	3,175
1/2	4-1/4	A 36	6,175	2,670	6,175	2,670	6,175	2,670	6,175	2,670	6,175	2,670
	5-1/4	A 193, Gr. B7	10,900	5,755	11,940	5,755	13,300	5,755	13,300	5,755	13,300	5,755
	7	A 193, Gr. B7	13,300	5,755	13,300	5,755	13,300	5,755	13,300	5,755	13,300	5,755
5/8	5	A 36	9,305	4,265	9,825	4,265	9,825	4,265	9,825	4,265	9,825	4,265
	8	A 193, Gr. B7	20,025	9,170	21,190	9,170	21,190	9,170	21,190	9,170	21,190	9,170
	9-1/2	A 193, Gr. B7	21,190	9,170	21,190	9,170	21,190	9,170	21,190	9,170	21,190	9,170
3/4	5-7/8	A 36	10,900	6,410	11,940	6,410	13,790	6,410	14,550	6,410	14,550	6,410
	10-7/8	A 193, Gr. B7	30,830	13,570	31,360	13,570	31,360	13,570	31,360	13,570	31,360	13,570

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

Converted Allowable Loads for Carbon Steel Atomic+ Undercut in Cracked Concrete[1,2]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	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	3-1/8	A 36	2,405	1,045	2,405	1,045	2,405	1,045	2,405	1,045	2,405	1,045
	4-3/8	A 193, Gr. B7	4,180	2,270	4,580	2,270	5,190	2,270	5,190	2,270	5,190	2,270
1/2	4-1/4	A 36	4,410	1,905	4,410	1,905	4,410	1,905	4,410	1,905	4,410	1,905
	5-1/4	A 193, Gr. B7	5,340	4,110	5,850	4,110	6,755	4,110	8,270	4,110	9,500	4,110
	7	A 193, Gr. B7	5,340	4,110	5,850	4,110	6,755	4,110	8,270	4,110	9,500	4,110
5/8	5	A 36	5,320	3,045	5,825	3,045	6,730	3,045	7,020	3,045	7,020	3,045
	8	A 193, Gr. B7	6,965	6,550	7,630	6,550	8,810	6,550	10,790	6,550	12,455	6,550
	9-1/2	A 193, Gr. B7	6,965	6,550	7,630	6,550	8,810	6,550	10,790	6,550	12,455	6,550
3/4	5-7/8	A 36	6,230	4,580	6,825	4,580	7,880	4,580	9,650	4,580	10,395	4,580
	10-7/8	A 193, Gr. B7	10,215	9,695	11,190	9,695	12,920	9,695	15,825	9,695	18,270	9,695

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 Carbon Steel Atomic+ Undercut in Uncracked Concrete[1,2]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	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	3-1/8	A 36	2,405	1,045	2,405	1,045	2,405	1,045	2,405	1,045	2,405	1,045
	4-3/8	A 193, Gr. B7	5,190	2,270	5,190	2,270	5,190	2,270	5,190	2,270	5,190	2,270
1/2	4-1/4	A 36	4,410	1,905	4,410	1,905	4,410	1,905	4,410	1,905	4,410	1,905
	5-1/4	A 193, Gr. B7	7,785	4,110	8,530	4,110	9,500	4,110	9,500	4,110	9,500	4,110
	7	A 193, Gr. B7	9,500	4,110	9,500	4,110	9,500	4,110	9,500	4,110	9,500	4,110
5/8	5	A 36	6,645	3,045	7,020	3,045	7,020	3,045	7,020	3,045	7,020	3,045
	8	A 193, Gr. B7	14,305	6,550	15,135	6,550	15,135	6,550	15,135	6,550	15,135	6,550
	9-1/2	A 193, Gr. B7	15,135	6,550	15,135	6,550	15,135	6,550	15,135	6,550	15,135	6,550
3/4	5-7/8	A 36	7,785	4,580	8,530	4,580	9,850	4,580	10,395	4,580	10,395	4,580
	10-7/8	A 193, Gr. B7	22,020	9,695	22,400	9,695	22,400	9,695	22,400	9,695	22,400	9,695

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.

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, $h_a = h_{min2}$, and with the following conditions:
   - c_{a1} is greater than or equal to the critical edge distance, c_{ac} (table values based on $c_{a1} = c_{ac}$).
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.

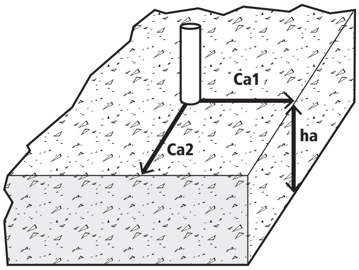
2- Calculations were performed according to ACI 318-14 Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength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

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

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

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

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



Tension and Shear Design Strength for Stainless Steel Atomic+ Undercut Anchor in Cracked Concrete

STRENGTH DESIGN SD TABLES

Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	Minimum Concrete Compressive Strength, f'c (psi)									
			2,500		3,000		4,000		6,000		8,000	
			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	3-1/8	A 193, Gr. B8M Class 1	3,310	1,435	3,310	1,435	3,310	1,435	3,310	1,435	3,310	1,435
	4-3/8	A 193, Gr. B8M Class 2	5,850	2,770	6,395	2,770	6,395	2,770	6,395	2,770	6,395	2,770
1/2	4-1/4	A 193, Gr. B8M Class 1	6,065	2,625	6,065	2,625	6,065	2,625	6,065	2,625	6,065	2,625
	5-1/4	A 193, Gr. B8M Class 2	7,475	5,075	8,190	5,075	9,455	5,075	11,580	5,075	11,705	5,075
5/8	5	A 193, Gr. B8M Class 1	7,445	4,185	8,155	4,185	9,420	4,185	9,660	4,185	9,660	4,185
	8	A 193, Gr. B8M Class 2	9,750	8,080	10,680	8,080	12,335	8,080	15,105	8,080	17,440	8,080
3/4	5-7/8	A 193, Gr. B8M Class 1	8,720	6,195	9,555	6,195	11,030	6,195	13,510	6,195	14,300	6,195
	10-7/8	A 193, Gr. B8M Class 2	14,300	11,955	15,665	11,955	18,090	11,955	22,155	11,955	25,580	11,955

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

Tension and Shear Design Strength for Stainless Steel Atomic+ Undercut Anchor in Uncracked Concrete

STRENGTH DESIGN SD TABLES

Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	Minimum Concrete Compressive Strength, f'c (psi)									
			2,500		3,000		4,000		6,000		8,000	
			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	3-1/8	A 193, Gr. B8M Class 1	3,310	1,435	3,310	1,435	3,310	1,435	3,310	1,435	3,310	1,435
	4-3/8	A 193, Gr. B8M Class 2	6,395	2,770	6,395	2,770	6,395	2,770	6,395	2,770	6,395	2,770
1/2	4-1/4	A 193, Gr. B8M Class 1	6,065	2,625	6,065	2,625	6,065	2,625	6,065	2,625	6,065	2,625
	5-1/4	A 193, Gr. B8M Class 2	10,900	5,075	11,705	5,075	11,705	5,075	11,705	5,075	11,705	5,075
5/8	5	A 193, Gr. B8M Class 1	9,305	4,185	9,660	4,185	9,660	4,185	9,660	4,185	9,660	4,185
	8	A 193, Gr. B8M Class 2	18,645	8,080	18,645	8,080	18,645	8,080	18,645	8,080	18,645	8,080
3/4	5-7/8	A 193, Gr. B8M Class 1	10,900	6,195	11,940	6,195	13,790	6,195	14,300	6,195	14,300	6,195
	10-7/8	A 193, Gr. B8M Class 2	27,595	11,955	27,595	11,955	27,595	11,955	27,595	11,955	27,595	11,955

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

Converted Allowable Loads for Stainless Steel Atomic+ Undercut in Cracked Concrete[1,2]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	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	3-1/8	A 193, Gr. B8M Class 1	2,365	1,025	2,365	1,025	2,365	1,025	2,365	1,025	2,365	1,025
	4-3/8	A 193, Gr. B8M Class 2	4,180	1,980	4,570	1,980	4,570	1,980	4,570	1,980	4,570	1,980
1/2	4-1/4	A 193, Gr. B8M Class 1	4,330	1,875	4,330	1,875	4,330	1,875	4,330	1,875	4,330	1,875
	5-1/4	A 193, Gr. B8M Class 2	5,340	3,625	5,850	3,625	6,755	3,625	8,270	3,625	8,360	3,625
5/8	5	A 193, Gr. B8M Class 1	5,320	2,990	5,825	2,990	6,730	2,990	6,900	2,990	6,900	2,990
	8	A 193, Gr. B8M Class 2	6,965	5,770	7,630	5,770	8,810	5,770	10,790	5,770	12,455	5,770
3/4	5-7/8	A 193, Gr. B8M Class 1	6,230	4,425	6,825	4,425	7,880	4,425	9,650	4,425	10,215	4,425
	10-7/8	A 193, Gr. B8M Class 2	10,215	8,540	11,190	8,540	12,920	8,540	15,825	8,540	18,270	8,540

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 Stainless Steel Atomic+ Undercut in Uncracked Concrete[1,2]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	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	3-1/8	A 193, Gr. B8M Class 1	2,365	1,025	2,365	1,025	2,365	1,025	2,365	1,025	2,365	1,025
	4-3/8	A 193, Gr. B8M Class 2	4,570	1,980	4,570	1,980	4,570	1,980	4,570	1,980	4,570	1,980
1/2	4-1/4	A 193, Gr. B8M Class 1	4,330	1,875	4,330	1,875	4,330	1,875	4,330	1,875	4,330	1,875
	5-1/4	A 193, Gr. B8M Class 2	7,785	3,625	8,360	3,625	8,360	3,625	8,360	3,625	8,360	3,625
5/8	5	A 193, Gr. B8M Class 1	6,645	2,990	6,900	2,990	6,900	2,990	6,900	2,990	6,900	2,990
	8	A 193, Gr. B8M Class 2	13,320	5,770	13,320	5,770	13,320	5,770	13,320	5,770	13,320	5,770
3/4	5-7/8	A 193, Gr. B8M Class 1	7,785	4,425	8,530	4,425	9,850	4,425	10,215	4,425	10,215	4,425
	10-7/8	A 193, Gr. B8M Class 2	19,710	8,540	19,710	8,540	19,710	8,540	19,710	8,540	19,710	8,540

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.

ORDERING INFORMATION

Atomic+ Undercut Anchor Zinc Plated Carbon Steel

Cat. No.	Anchor Rod ASTM Designation	Nominal Anchor Diameter	Anchor Outside Diameter	Overall Length	Required Undercut Bit (Cat. No.)	Required Stop Bit (Cat. No.)	Anchor Type	Std. Box
03100SD	ASTM A36	3/8"	5/8"	5-1/2"	03200SD	03220SD	Standard	20
03102SD	ASTM A36	3/8"	5/8"	5-1/2"		*	Through Bolt	20
03104SD	ASTM A193 Gr. B7	3/8"	5/8"	6-3/4"		03221SD	Standard	20
03106SD	ASTM A193 Gr. B7	3/8"	5/8"	6-3/4"		*	Through Bolt	20
03108SD	ASTM A36	1/2"	3/4"	7"	03201SD	03222SD	Standard	15
03110SD	ASTM A36	1/2"	3/4"	7"		*	Through Bolt	15
03112SD	ASTM A193 Gr. B7	1/2"	3/4"	8"		03223SD	Standard	15
03114SD	ASTM A193 Gr. B7	1/2"	3/4"	8"		*	Through Bolt	15
03116SD	ASTM A193 Gr. B7	1/2"	3/4"	9-3/4"		03224SD	Standard	15
03118SD	ASTM A193 Gr. B7	1/2"	3/4"	9-3/4"		*	Through Bolt	15
03120SD	ASTM A36	5/8"	1"	7-3/4"	03202SD	03225SD	Standard	10
03122SD	ASTM A36	5/8"	1"	7-3/4"		*	Through Bolt	10
03124SD	ASTM A193 Gr. B7	5/8"	1"	10-3/4"		03226SD	Standard	10
03126SD	ASTM A193 Gr. B7	5/8"	1"	10-3/4"		*	Through Bolt	10
03128SD	ASTM A193 Gr. B7	5/8"	1"	12-1/4"		03227SD	Standard	10
03130SD	ASTM A193 Gr. B7	5/8"	1"	12-1/4"		*	Through Bolt	10
03132SD	ASTM A36	3/4"	1-1/8"	8-5/8"	03203SD	03228SD	Standard	8
03134SD	ASTM A36	3/4"	1-1/8"	8-5/8"		*	Through Bolt	8
03136SD	ASTM A193 Gr. B7	3/4"	1-1/8"	13-5/8"		03229SD	Standard	8
03138SD	ASTM A193 Gr. B7	3/4"	1-1/8"	13-5/8"		*	Through Bolt	8

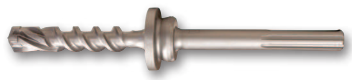
For availability of all anchor lengths please contact DEWALT.
*Contact DEWALT for appropriate drilling method and hardware

Atomic+ Undercut Anchor Type 316 Stainless Steel

Cat. No.	Anchor Rod ASTM Designation	Nominal Anchor Diameter	Anchor Outside Diameter	Overall Length	Required Undercut Bit (Cat. No.)	Required Stop Bit (Cat. No.)	Anchor Type	Std. Box
03600SD	ASTM A193, Grade B8M, Class 1	3/8"	5/8"	5-1/2"	03200SD	03220SD	Standard	20
03602SD	ASTM A193, Grade B8M, Class 1	3/8"	5/8"	5-1/2"		*	Through Bolt	20
03603SD	ASTM A193, Grade B8M, Class 2	3/8"	5/8"	6-3/4"		03221SD	Standard	20
03605SD	ASTM A193, Grade B8M, Class 2	3/8"	5/8"	6-3/4"		*	Through Bolt	20
03608SD	ASTM A193, Grade B8M, Class 1	1/2"	3/4"	7"	03201SD	03222SD	Standard	15
03610SD	ASTM A193, Grade B8M, Class 1	1/2"	3/4"	7"		*	Through Bolt	15
03609SD	ASTM A193, Grade B8M, Class 2	1/2"	3/4"	8"		03223SD	Standard	15
03613SD	ASTM A193, Grade B8M, Class 2	1/2"	3/4"	8"		*	Through Bolt	15
03620SD	ASTM A193, Grade B8M, Class 1	5/8"	1"	7-3/4"	03202SD	03225SD	Standard	10
03622SD	ASTM A193, Grade B8M, Class 1	5/8"	1"	7-3/4"		*	Through Bolt	10
03635SD	ASTM A193, Grade B8M, Class 2	5/8"	1"	10-3/4"		03226SD	Standard	10
03639SD	ASTM A193, Grade B8M, Class 2	5/8"	1"	10-3/4"		*	Through Bolt	10
03632SD	ASTM A193, Grade B8M, Class 1	3/4"	1-1/8"	8-5/8"	03203SD	03228SD	Standard	8
03634SD	ASTM A193, Grade B8M, Class 1	3/4"	1-1/8"	8-5/8"		*	Through Bolt	8
03648SD	ASTM A193, Grade B8M, Class 2	3/4"	1-1/8"	13-5/8"		03229SD	Standard	8
03649SD	ASTM A193, Grade B8M, Class 2	3/4"	1-1/8"	13-5/8"		*	Through Bolt	8

For availability of all anchor lengths please contact DEWALT.
*Contact DEWALT for appropriate drilling method and hardware

Stop Drill Bits



Cat. No.	Nominal Stop Drill Bit Diameter	Corresponding Nominal Anchor Diameter	Max. Drill Depth	Shank Type	Std. Tube
03220SD	5/8	3/8	3-1/8"	SDS	1
03221SD	5/8	3/8	4-3/8"	SDS	1
03222SD	3/4	1/2	4-1/4"	SDS	1
03223SD	3/4	1/2	5-1/4"	SDS	1
03224SD	3/4	1/2	7"	SDS	1
03225SD	1	5/8	5"	SDS-Max	1
03226SD	1	5/8	8"	SDS-Max	1
03227SD	1	5/8	9-1/2"	SDS-Max	1
03228SD	1-1/8	3/4	5-13/16"	SDS-Max	1
03229SD	1-1/8	3/4	10-13/16"	SDS-Max	1

The Stop Drill Bit creates a drill hole to the proper depth for standard installations of the Atomic+ Undercut anchor.
(For through bolt applications please contact DEWALT for appropriate drilling method and hardware)

Undercut Drill Bits

Cat. No.	Nominal Undercut Drill Bit Diameter	Corresponding Nominal Anchor Diameter	Maximum Depth of Hole	Shank Type	Std. Tube
03200SD	5/8	3/8	9"	SDS	1
03201SD	3/4	1/2	10-1/4"	SDS	1
03202SD	1	5/8	12-1/4"	SDS-Max	1
03203SD	1-1/8	3/4	13-1/2"	SDS-Max	1

The Undercut Drill Bit has a unique design that enlarges the bottom of the drill hole creating a reverse cone sized to receive the Atomic+ Undercut anchor.

Setting Sleeve for Undercut Anchors

Cat.. No.	Corresponding Nominal Anchor Diameter	Std. Box
03210SD	3/8	1
03211SD	1/2	1
03218SD	5/8	1
03213SD	3/4	1

Replacement Blade Assemblies for Undercut Drill Bit

Cat.. No.	Description	Std. Tube
03205SD	Atomic+ (3/8") Cutter Blade - 5/8"	1
03206SD	Atomic+ (1/2") Cutter Blade - 3/4"	1
03208SD	Atomic+ (5/8") Cutter Blade - 1"	1
03209SD	Atomic+ (3/4") Cutter Blade - 1-1/8"	1

Replacement Bow Jaws for Undercut Drill Bit

Cat.. No.	Description	Std. Tube
03212SD	3/8" Bow Jaw for 5/8" Hole	1
03215SD	1/2" Bow Jaw for 3/4" Hole	1
03216SD	5/8" Bow Jaw for 1" Hole	1
03217SD	3/4" Bow Jaw for 1-1/8" Hole	1

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ESR-3067

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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

EVALUATION SUBJECT:

ATOMIC+ UNDERCUT ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

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ESR-3067

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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

ADDITIONAL LISTEE:

POWERS FASTENERS

EVALUATION SUBJECT:

ATOMIC+ UNDERCUT® ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012, 2009, and 2006 *International Building Code®* (IBC)
- 2015, 2012, 2009, and 2006 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

The Atomic+ Undercut Anchors is used to resist static, wind, and seismic tension and shear loads in 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). The Atomic+ anchors comply as anchors installed in hardened concrete as described in Section 1901.3 of the 2015 IBC, Section 1909 of the 2012 IBC, and Section 1912 of the 2009 and 2006 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 and 2006 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 Atomic+ Undercut Anchors are displacement controlled undercut anchors. The Atomic+ Undercut Anchors are comprised of five components as shown in Figure 1. The expanded anchor sleeve creates a mechanical interlock with the surrounding concrete. The Atomic+ Undercut Anchors are available in standard (A36 and A193 designations) and through-bolted (A36-TB and A193-TB designations) versions with component dimensions as listed in Table 1. Sizes available include $^3/_8$-inch (9.5 mm), $^1/_2$-inch (12.7 mm), $^5/_8$-inch (15.9 mm), and $^3/_4$-inch (19.1 mm) diameters and various lengths. Table 1 shows anchor dimensions.

3.2 Anchor Materials:

3.2.1 Threaded Rods: The steel threaded rods used with the low-strength (A36 designation) anchors are ASTM A36 (F1554 Grade 36) low carbon steel and have a minimum 0.0002-inch (5 µm) zinc plating in accordance with ASTM B633, Type I. The steel threaded rods used with the high-strength (A193 designation) anchors comply with ASTM A193 Grade B7 and have a minimum 0.0002-inch (5 µm) yellow zinc plating in accordance with ASTM B633, Type II. A painted red setting mark (used for visual setting control) is provided on the threaded rod of both the low- and high-strength anchors.

3.2.2 Sleeves: The steel expansion sleeves comply with ASTM A513 Type 5 ERW DOM, with a minimum yield strength of 70,000 psi (483 MPa) and a minimum tensile strength of 80,000 psi (552 MPa). The sleeves have a minimum 0.0002-inch-thick (5 µm) yellow zinc plating in accordance with ASTM B633, Type II.

3.2.3 Coupling: The steel expansion couplings comply with ASTM A108 Type 12L14.

3.2.4 Nut and Washer: The hex nuts comply with ASTM A563, Grade A. The washers comply with ASTM F844.

3.3 Concrete:

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

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 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 and 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 and Section R301.1.3 of 2009 IRC must be in accordance with ACI 318-08 Appendix D and this report.

Design strength of anchors complying with the 2006 IBC and Section R301.1.3 of 2006 IRC must be in accordance with ACI 318-05 Appendix D and this report.

Design examples according to the 2015 IBC and 2012 IBC are given in Figures 5, 6, and 7 of this report. Design parameters are described in Tables 4 and 5 of this report and are based on the 2015 IBC (ACI 318-14) and 2012 IBC (ACI 318-11) unless noted otherwise in Sections 4.1.1 through 4.1.12. The strength design of anchors must comply with ACI 318-14 17.3.1 or ACI 318-11 D.4.1, except as required in ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Strength reduction factors, ϕ, as given in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, and Table 4 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 ACI 318-11 Appendix C.

The value of f'_c used in the calculations must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal steel strength of a single anchor in tension, N_{sa}, must be calculated in accordance with ACI 318-14 17.4.2.1 or ACI 318-11 D.5.1.2, as applicable. The resulting values of N_{sa} are described in Table 4 of this report. Strength reduction factors, ϕ, corresponding to ductile steel elements may be used.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal concrete breakout strength of a single anchor or 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, and modifications as described in this section. The basic concrete breakout strength of a single anchor in tension in regions where analysis indicates cracking, 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 described in Table 4 of this report. 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 Table 4 of this report.

4.1.4 Requirements for Static Pullout Strength in Tension, N_{pn}: The nominal pullout strength of a single anchor or a group of anchors in tension, in accordance with ACI 318-14 17.4.3 or ACI 318-11 D.5.3, as applicable, in cracked concrete, $N_{p,cr}$, is given in Table 4 of this report. For all design cases, $\Psi_{c,P}$ =1.0. 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:

$$N_{pn,f'c} = N_{p,cr}\sqrt{\frac{f'_c}{2{,}500}} \quad \text{(lb, psi)} \qquad \text{(Eq-1)}$$

$$N_{pn,f'c} = N_{p,cr}\sqrt{\frac{f'_c}{17.2}} \quad \text{(N, MPa)}$$

In uncracked concrete, pullout strength does not control and therefore need not be evaluated.

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

4.1.6 Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: The nominal static concrete breakout strength of a single anchor or a 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 must be calculated in accordance with ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, where the value of l_e used in ACI 318-14 Eq. 17.5.2.2a or ACI 318-11 Eq. D-33, as applicable, must be taken as h_{ef}, but no greater than $8d_a$, for the anchors with one tubular shell over full length of the embedment depth; or the value of l_e used in ACI 318-14 Eq. 17.5.2.2a or ACI 318-11 Eq. D-33, as applicable, must be taken as $2d_a$ for the anchors with a distance sleeve separated from the expansion sleeve.

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

4.1.8 Requirements for Seismic Design: General: For load combinations including seismic, 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 D.3.3 must be applied under Section 1908.1.9 of the 2009 IBC or Section 1908.1.16 of the 2006 IBC, as applicable.

The A36, A36-TB, A193, and A193-TB designated 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, and 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.

4.1.8.1 Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated in accordance with 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, $N_{p,eq}$, described in Table 4 of this report must be used in lieu of N_p. $N_{p,eq}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report.

4.1.8.2 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 D.6.1.2, as applicable, the appropriate value for nominal steel strength in shear for seismic loads $V_{sa,eq}$, described in Table 4 must be used in lieu of V_{sa}.

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

4.1.10 Requirements for Critical Edge Distance: 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 in the following equation:

$$\psi_{cp,N}=\frac{c}{c_{ac}} \qquad \text{(Eq-2)}$$

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} critical edge distance must be in accordance with Table 4 of this report.

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 s_{min} and c_{min} provided in Table 4 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 thickness, h_{min}, must be in accordance with Table 4 of this report.

4.1.12 Lightweight Concrete: For the use of anchors in lightweight concrete, the modification factor λ_a equal to 1.0λ 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 ACI 318-05 (2006 IBC), λ shall be taken as 0.75 for all lightweight concrete and 0.85 for sand-lightweight concrete. Linear interpolation shall be permitted if partial sand replacement is used. In addition, the pullout strengths $N_{p,cr}$ and N_{eq} shall be multiplied by the modification factor, λ_a, as applicable.

4.2 Allowable Stress Design:

4.2.1 General: For anchors designed using load combinations in accordance with IBC Section 1605.3 (Allowable Stress Design), allowable loads must be established using the equations below:

$$T_{allowable,ASD}=\frac{\phi N_n}{\alpha} \qquad \text{(Eq-3)}$$

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

where:

$T_{allowable,ASD}$ = Allowable tension load (lb or N).

$V_{allowable,ASD}$ = Allowable shear load (lb or N).

ϕN_n = 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, ACI 318-05 Appendix D and 2006 IBC Section 1908.1.16, and Section 4.1 of this report, as applicable (lb or N).

ϕV_n = 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, ACI 318-05 Appendix D and 2006 IBC Section 1908.1.16, and Section 4.1 of this report, as applicable (lb or N).

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

Limits on edge distance, anchor spacing, and member thickness as given in Table 4 must apply. An example of Allowable Stress Design tension values is given in Table 5.

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

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

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

For all other cases:

$$\frac{T}{T_{allowable}}+\frac{V}{V_{allowable}}\le 1.2 \qquad \text{(Eq-5)}$$

4.3 Installation:

Installation parameters are described in Tables 1 through 4 and Figures 2 through 5 of this report. Anchor locations must comply with the plans and specifications approved by the code official and this report. Anchors must be installed in accordance with the manufacturer's instructions and this report. Holes must be drilled normal to the concrete surface using carbide-tipped masonry stop drill bits complying with ANSI B212.15-1994 supplied by DEWALT / Powers. Remove dust and debris from the hole using a hand pump, compressed air or a vacuum. The undercut drill bit must then be inserted into the hole and drilled until the stopper sleeve is fully compressed and the gap is closed. Again, remove dust and debris from the hole using a hand pump, compressed air or a vacuum. The Atomic+ anchors must be inserted into the holes without nut and washer and the setting sleeve must be placed on the anchor and hammered to drive the expansion sleeve over the expansion coupling. Proper setting requires the red setting mark on the threaded rod to be visible above the expansion sleeve. The setting sleeve must be removed and the attachment must then be placed over the threaded rod and secured by the nut and washer. The maximum applied torque, T_{max}, must not exceed the values given in Table 3. Undercut drill bits and setting tools used are provided by DEWALT / Powers.

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; Section 1704.15 and Table 1704.4 of the 2009 IBC; or Section 1704.13 of the 2006 IBC, as applicable. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedure, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque and adherence to the manufacturer's printed installation instructions. The special inspector must be present as often as required in accordance with the "statement of special inspection." Under the IBC, additional requirements as set forth in Chapter 17 must be observed, where applicable.

5.0 CONDITIONS OF USE

The Atomic+ Undercut 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 Anchor sizes, dimensions, and minimum embedment depths are as set forth in the tables of this report.

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

5.3 Anchors must be limited to use in concrete with a specified strength, f'_c, from 2,500 to 8,500 psi (17.2 to 58.6 MPa).

5.4 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55.1 MPa).

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

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

5.7 Anchor spacing and edge distance, as well as minimum member thickness, must comply with Table 4 of this report.

5.8 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official for approval. 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.

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

5.10 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.

5.11 Anchors may be used to resist short-term loading due to wind or seismic forces, subject to the conditions of this report.

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

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

5.13 Use of zinc-coated carbon steel anchors must be limited to dry, interior locations.

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

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

5.16 Axial stiffness values are shown in Table A.

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 / 355.2-04, for use in cracked and uncracked concrete; including optional suitability tests for seismic tension and shear; and quality control documentation.

7.0 IDENTIFICATION

7.1 The anchors are identified by a length letter code head marking stamped on the exposed end of the rod, and packaging labeled with the company name and address, anchor name (Atomic+ Undercut), anchor size, and evaluation report number (ESR-3067).

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

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

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

POWERS FASTENERS
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.powers.com
engineering@powers.com

TABLE A—AXIAL STIFFNESS VALUES, β, FOR ATOMIC+ UNDERCUT ANCHORS IN NORMAL-WEIGHT CONCRETE[1]

Concrete State	Notation	Units	Nominal Anchor Size / Rod Diameter (inch)			
			$^{3}/_{8}$	$^{1}/_{2}$	$^{5}/_{8}$	$^{3}/_{4}$
Uncracked concrete	β_{min}	10^3 lbf/in. (kN/mm)	131 (23)			
	β_{m}	10^3 lbf/in. (kN/mm)	930 (163)			
	β_{max}	10^3 lbf/in. (kN/mm)	1,444 (253)			
Cracked concrete	β_{min}	10^3 lbf/in. (kN/mm)	91 (16)			
	β_{m}	10^3 lbf/in. (kN/mm)	394 (69)			
	β_{max}	10^3 lbf/in. (kN/mm)	1,724 (302)			

[1]Valid for anchors with high strength threaded rod (A 193 Grade B7). For anchors with low strength threaded rod (A36) values must be multiplied by 0.7.

TABLE 1—ATOMIC+ UNDERCUT ANCHOR DIMENSIONAL CHARACTERISTICS[1]

Anchor Designation	Anchor Type	Anchor Rod ASTM Designation	Rod Diameter, d_b (inch)	Anchor Length, l_b (inches)	Sleeve Length, l_s (inches)	Sleeve Diameter, d_s (inch)	Expansion Coupling Dia., d_c (inch)	Max. Fixture Thickness, t (inches)
03100SD	Standard	A36	$^{3}/_{8}$	$5^{1}/_{2}$	$2^{3}/_{4}$	$^{5}/_{8}$	$^{5}/_{8}$	$1^{3}/_{4}$
03102SD	Through bolt (TB)	A36	$^{3}/_{8}$	$5^{1}/_{2}$	$4^{1}/_{2}$	$^{5}/_{8}$	$^{5}/_{8}$	$1^{3}/_{4}$
03104SD	Standard	A193, Grade B7	$^{3}/_{8}$	$6^{3}/_{4}$	4	$^{5}/_{8}$	$^{5}/_{8}$	$1^{3}/_{4}$
03106SD	Through bolt (TB)	A193, Grade B7	$^{3}/_{8}$	$6^{3}/_{4}$	$5^{3}/_{4}$	$^{5}/_{8}$	$^{5}/_{8}$	$1^{3}/_{4}$
03108SD	Standard	A36	$^{1}/_{2}$	7	4	$^{3}/_{4}$	$^{3}/_{4}$	$1^{3}/_{4}$
03110SD	Through bolt (TB)	A36	$^{1}/_{2}$	7	$5^{3}/_{4}$	$^{3}/_{4}$	$^{3}/_{4}$	$1^{3}/_{4}$
03112SD	Standard	A193, Grade B7	$^{1}/_{2}$	8	5	$^{3}/_{4}$	$^{3}/_{4}$	$1^{3}/_{4}$
03114SD	Through bolt (TB)	A193, Grade B7	$^{1}/_{2}$	8	$6^{3}/_{4}$	$^{3}/_{4}$	$^{3}/_{4}$	$1^{3}/_{4}$
03116SD	Standard	A193, Grade B7	$^{1}/_{2}$	$9^{3}/_{4}$	$6^{3}/_{4}$	$^{3}/_{4}$	$^{3}/_{4}$	$1^{3}/_{4}$
03118SD	Through bolt (TB)	A193, Grade B7	$^{1}/_{2}$	$9^{3}/_{4}$	$8^{1}/_{2}$	$^{3}/_{4}$	$^{3}/_{4}$	$1^{3}/_{4}$
03120SD	Standard	A36	$^{5}/_{8}$	$7^{3}/_{4}$	$4^{1}/_{2}$	1	1	$1^{3}/_{4}$
03122SD	Through bolt (TB)	A36	$^{5}/_{8}$	$7^{3}/_{4}$	$6^{1}/_{4}$	1	1	$1^{3}/_{4}$
03124SD	Standard	A193, Grade B7	$^{5}/_{8}$	$10^{3}/_{4}$	$7^{1}/_{2}$	1	1	$1^{3}/_{4}$
03126SD	Through bolt (TB)	A193, Grade B7	$^{5}/_{8}$	$10^{3}/_{4}$	$9^{1}/_{4}$	1	1	$1^{3}/_{4}$
03128SD	Standard	A193, Grade B7	$^{5}/_{8}$	$12^{1}/_{4}$	9	1	1	$1^{3}/_{4}$
03130SD	Through bolt (TB)	A193, Grade B7	$^{5}/_{8}$	$12^{1}/_{4}$	$10^{3}/_{4}$	1	1	$1^{3}/_{4}$
03132SD	Standard	A36	$^{3}/_{4}$	$8^{5}/_{8}$	5	$1^{1}/_{8}$	$1^{1}/_{8}$	$1^{3}/_{4}$
03134SD	Through bolt (TB)	A36	$^{3}/_{4}$	$8^{5}/_{8}$	$6^{3}/_{4}$	$1^{1}/_{8}$	$1^{1}/_{8}$	$1^{3}/_{4}$
03136SD	Standard	A193, Grade B7	$^{3}/_{4}$	$13^{5}/_{8}$	10	$1^{1}/_{8}$	$1^{1}/_{8}$	$1^{3}/_{4}$
03138SD	Through bolt (TB)	A193, Grade B7	$^{3}/_{4}$	$13^{5}/_{8}$	$11^{3}/_{4}$	$1^{1}/_{8}$	$1^{1}/_{8}$	$1^{3}/_{4}$

For **SI:** 1 inch = 25.4 mm.

[1]Threaded anchor rod conforming to ASTM F1554, Grade 36 is equivalent to threaded anchor rod with ASTM A36 designation.

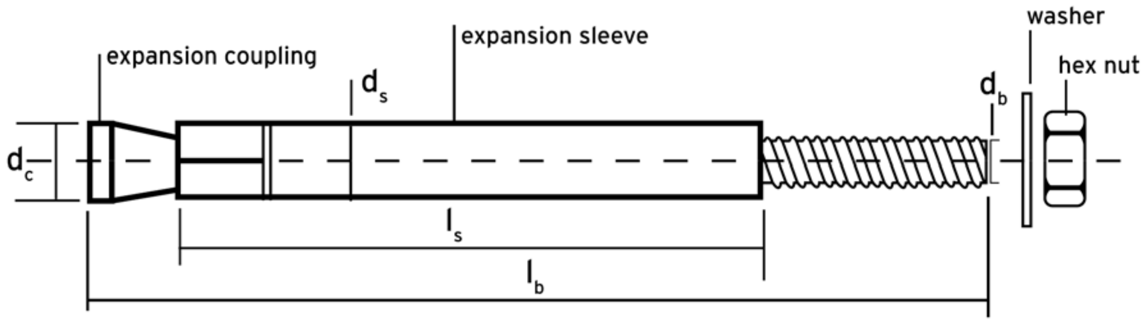


FIGURE 1—ATOMIC+ UNDERCUT ANCHOR ASSEMBLY

TABLE 2—ANCHOR LENGTH CODE IDENTIFICATION SYSTEM

Length ID marking on anchor rod head		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
Anchor length, l_b, (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	11	12	13
	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	12	13	14

For **SI:** 1 inch = 25.4 mm.

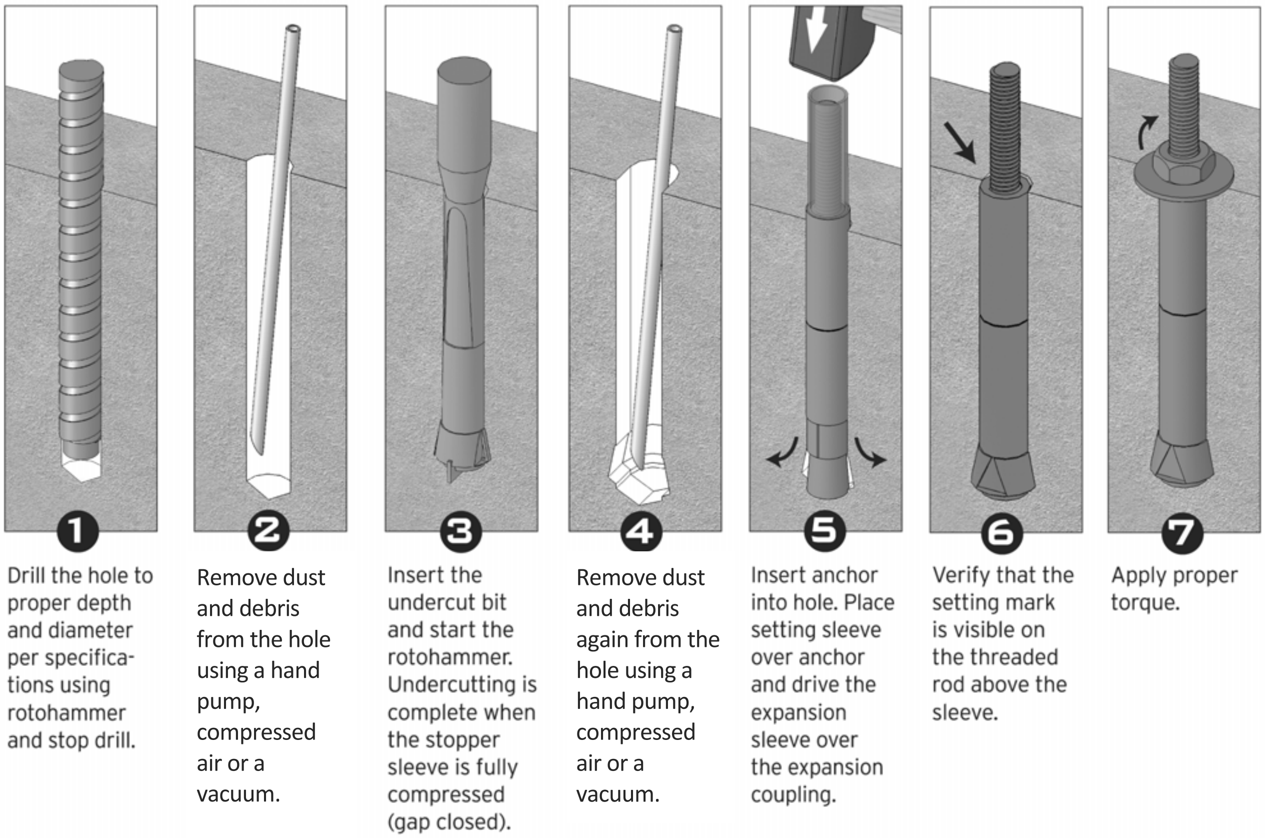


FIGURE 2—INSTALLATION OF ATOMIC+ UNDERCUT ANCHOR

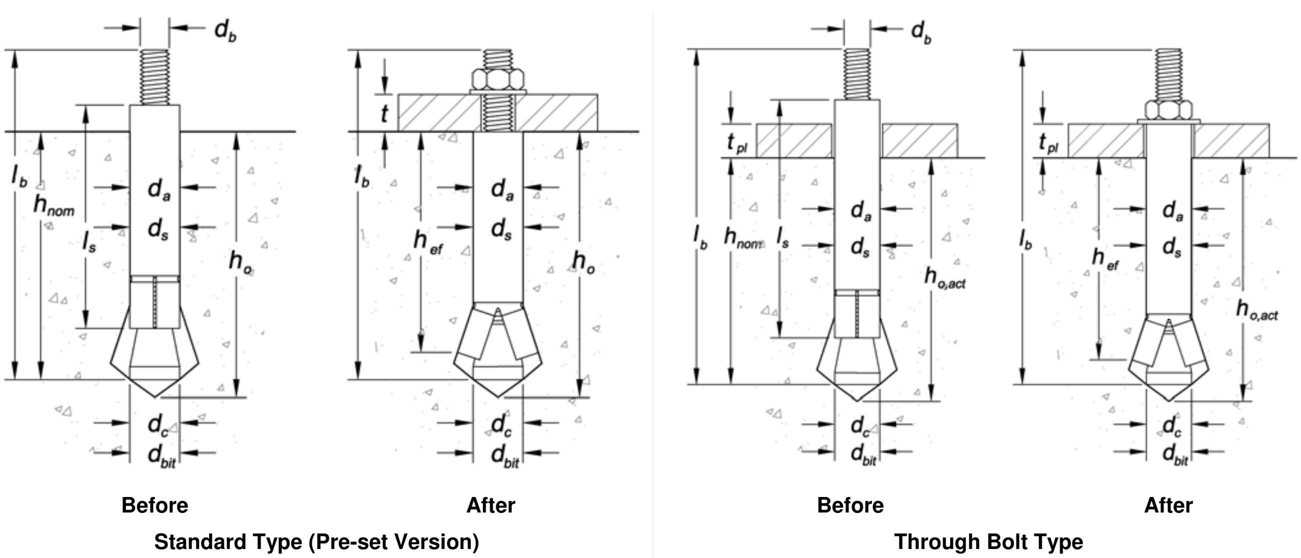


FIGURE 3—ATOMIC+ UNDERCUT ANCHOR DETAIL
BEFORE AND AFTER APPLICATION OF SETTING SLEEVE AND ATTACHMENT

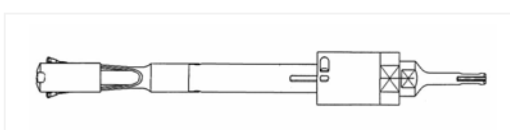
TABLE 3—ATOMIC+ UNDERCUT ANCHOR INSTALLATION SPECIFICATIONS

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size / Rod Diameter (inch)									
			3/8		1/2			5/8			3/4	
Outside anchor diameter	d_a [d_o][3]	in. (mm)	0.625 (15.9)		0.750 (19.1)			1.000 (25.4)			1.125 (28.6)	
Anchor rod designation	ASTM	-	A36	A193, Gr. B7	A36	A193, Grade B7		A36	A193, Grade B7		A36	A193, Gr. B7
Nominal embedment depth	h_{nom}	in. (mm)	3 1/8 (79)	4 3/8 (111)	4 1/4 (108)	5 1/4 (133)	7 (178)	5 (127)	8 (203)	9 1/2 (241)	5 7/8 (149)	10 7/8 (276)
Effective embedment depth	h_{ef}	in. (mm)	2 3/4 (70)	4 (102)	4 (102)	5 (127)	6 3/4 (171)	4 1/2 (114)	7 1/2 (190)	9 (229)	5 (127)	10 (254)
Minimum hole depth[1]	h_o	in. (mm)	3 1/8 (79)	4 3/8 (111)	4 1/4 (108)	5 1/4 (133)	7 (178)	5 (127)	8 (203)	9 1/2 (241)	5 7/8 (149)	10 7/8 (276)
Minimum diameter of hole clearance in fixture[2]	d_h	in. (mm)	7/16 (11.1)		9/16 (14.3)			11/16 (17.5)			13/16 (20.6)	
Maximum thickness of fixture	t	in. (mm)	1 3/4 (44)		1 3/4 (44)			1 3/4 (44)			1 3/4 (44)	
Maximum torque	T_{max}	ft.-lbf.	26		44			60			133	
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	
Stop Drill Bit												
Nominal stop drill bit diameter	d_{bit}	in.	5/8 ANSI		3/4 ANSI			1 ANSI			1 1/8 ANSI	
Stop drill bit for anchor installation	-	-	3220SD	3221SD	3222SD	3223SD	3224SD	3225SD	3226SD	3227SD	3228SD	3229SD
Drilled hole depth of stop bit[1]	-	in. (mm)	3 1/8 (79)	4 3/8 (111)	4 1/4 (108)	5 1/4 (133)	7 (178)	5 (127)	8 (203)	9 1/2 (241)	5 7/8 (149)	10 7/8 (276)
Stop drill bit shank type	-	-	SDS		SDS			SDS-Max			SDS-Max	
Undercut Drill Bit												
Nominal undercut drill bit diameter	d_{uc}	in.	5/8		3/4			1			1 1/8	
Undercut drill bit designation	-	-	3200SD		3201SD			3202SD			3203SD	
Maximum depth of hole for undercut drill bit	-	in. (mm)	9 (229)		10 1/4 (260)			12 1/4 (311)			13 1/2 (343)	
Undercut drill bit shank type	-	-	SDS		SDS			SDS-Max			SDS-Max	
Required impact drill energy	-	ft.-lbf.	1.6		2.5			3.2			4	
Setting Sleeve												
Recommended setting sleeve	-	-	3210SD		3211SD			3212SD			3213SD	

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

[1]For through bolt applications the actual hole depth is given by the minimum hole depth plus the maximum thickness of fixture less the thickness of the actual part(s) being fastened to the base material ($h_{o,act} = h_o + t - t_{pl}$). See Figure 3.
[2]For through bolt applications the minimum diameter of hole clearance in fixture is 1/16-inch larger than the nominal outside anchor diameter.
[3]The notation in brackets is for the 2006 IBC.

Stop Drill Bit



Undercut Drill Bit

Stetting Sleeve

FIGURE 4—STOP DRILL BIT, UNDERCUT DRILL BIT AND SETTING SLEEVE

TABLE 4—ATOMIC+ UNDERCUT ANCHOR DESIGN INFORMATION
(For use with load combinations taken from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2)[1]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size / Rod Diameter (inch)									
			3/8		1/2			5/8			3/4	
Anchor category	1, 2, or 3	-	1		1			1			1	
Outside diameter of anchor	d_a [d_o][8]	in. (mm)	0.625 (15.9)		0.750 (19.1)			1.000 (25.4)			1.125 (28.6)	
Anchor rod designation	ASTM	-	A36	A193, Gr. B7	A36	A193, Grade B7		A36	A193, Grade B7		A36	A193, Gr. B7
Effective embedment depth	h_{ef}	in. (mm)	2 3/4 (70)	4 (102)	4 (102)	5 (127)	6 3/4 (171)	4 1/2 (114)	7 1/2 (190)	9 (229)	5 (127)	10 (254)
Minimum concrete member thickness	for $h_{min,1}$	in. (mm)	5 1/2 (140)	8 (203)	8 (203)	10 (254)	13 1/2 (343)	9 (229)	15 (381)	18 (457)	10 (254)	20 (508)
	$c_{ac,1}$ ≥	in. (mm)	4 1/8 (105)	6 (152)	6 (152)	7 1/2 (190)	10 1/8 (257)	6 3/4 (171)	11 1/4 (286)	13 1/2 (343)	7 1/2 (190)	15 (381)
	for $h_{min,2}$	in. (mm)	4 3/8 (105)	6 (152)	6 (152)	7 1/2 (190)	10 1/8 (257)	6 3/4 (171)	11 1/4 (286)	13 1/2 (343)	7 1/2 (190)	15 (381)
	$c_{ac,2}$ ≥	in. (mm)	5 1/2 (140)	10 1/4 (260)	9 1/4 (235)	13 (330)	20 1/4 (514)	9 1/2 (241)	21 (533)	27 (686)	10 1/2 (267)	30 (762)
Minimum edge distance	c_{min}	in. (mm)	2 1/4 (57)	3 1/4 (82)	3 1/4 (82)	4 (102)	5 3/8 (137)	3 3/8 (92)	6 (152)	7 1/4 (184)	4 (102)	8 (203)
Minimum spacing distance	s_{min}	in. (mm)	2 3/4 (70)	4 (102)	4 (102)	5 (127)	6 3/4 (171)	4 1/2 (114)	7 1/2 (190)	9 (229)	5 (127)	10 (254)
STEEL STRENGTH IN TENSION AND SHEAR[3]												
Minimum specified yield strength of anchor rod	f_y	ksi (N/mm^2)	36 (248)	105 (723)	36 (248)	105 (723)	105 (723)	36 (248)	105 (723)	105 (723)	36 (248)	105 (723)
Minimum specified ultimate tensile strength of anchor rod	f_{uta}	ksi (N/mm^2)	58 (400)	125 (860)	58 (400)	125 (860)	125 (860)	58 (400)	125 (860)	125 (860)	58 (400)	125 (860)
Tensile stress area of anchor rod steel	$A_{se,N}$ [A_{se}][8]	in.^{2} (mm^2)	0.0775 (50)		0.1419 (91)			0.2260 (146)			0.3345 (245)	
Steel strength in tension, static	N_{sa}	lb. (kN)	4,495 (20.1)	9,685 (43.2)	8,230 (36.7)	17,735 (79.1)	17,735 (79.1)	13,100 (58.5)	28,250 (126.1)	28,250 (126.1)	19,400 (86.3)	41,810 (186.0)
Steel strength in shear, static[9]	V_{sa}	lb. (kN)	2,245 (10.0)	4,855 (21.7)	4,110 (18.4)	8,855 (39.5)	8,855 (39.5)	6,560 (29.3)	14,110 (63.0)	14,110 (63.0)	9,685 (43.2)	20,875 (93.2)
Steel strength in shear, seismic[9]	$V_{sa,eq}$	lb. (kN)	2,245 (10)	4,855 (21.7)	4,110 (18.4)	8,855 (39.5)	8,855 (39.5)	6,560 (29.3)	14,110 (63)	14,110 (63)	9,685 (43.2)	20,875 (93.1)
Reduction factor for steel strength in tension[2]	ϕ	-	0.75									
Reduction factor for steel strength in shear[2]	ϕ	-	0.65									
CONCRETE BREAKOUT STRENGTH IN TENSION[7]												
Effectiveness factor uncracked concrete	k_{uncr}	-	30		30			30			30	
Effectiveness factor cracked concrete	k_{cr}	-	24		24			24			24	
Modification factor for cracked and uncracked concrete[4]	$\Psi_{c,N}$	-	1.0 (see note 4)		1.0 (see note 4)			1.0 (see note 4)			1.0 (see note 4)	
Reduction factor for concrete breakout strength in tension[2]	ϕ	-	0.65 (Condition B)									
Reduction factor for concrete breakout strength in shear[2]	ϕ	-	0.70 (Condition B)									
PULLOUT STRENGTH IN TENSION[7]												
Characteristic pullout strength, uncracked concrete (2,500 psi)	$N_{p,uncr}$	lb. (kN)	See note 6		See note 6			See note 6			See note 6	
Characteristic pullout strength, cracked concrete (2,500 psi)[5]	$N_{p,cr}$	lb. (kN)	See note 6	9,000 (40.2)	See note 6	11,500 (51.3)		See note 6	15,000 (67.0)		See note 6	22,000 (98.2)
Characteristic pullout strength, seismic (2,500 psi)[5]	$N_{p,eq}$	lb. (kN)	See note 6	9,000 (40.2)	See note 6	11,500 (51.3)		See note 6	15,000 (67.0)		See note 6	22,000 (98.2)
Reduction factor for pullout strength in tension[2]	ϕ	-	0.65 (Condition B)									
PRYOUT STRENGTH IN SHEAR[7]												
Coefficient for pryout strength	k_{cp}	-	2.0		2.0			2.0			2.0	
Reduction factor for pryout strength in shear[2]	ϕ	-	0.70 (Condition B)									

For **SI:** 1 inch = 25.4 mm, 1 ksi = 6.895 MPa (N/mm^2), 1 lbf = 0.0044 kN, 1 in^2 = 645 mm^2.

[1]The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
[2]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 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
[3]Anchors are considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
[4]For 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.
[5]For all design cases $\Psi_{c,P}$=1.0. For the calculation of N_{pn}, see Section 4.1.4 of this report.
[6]Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
[7]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.
[8]The notation in brackets is for the 2006 IBC.
[9]Shear strength values are based on standard (pre-set) installation, and must be used for both standard (pre-set) and through-bolt installations.

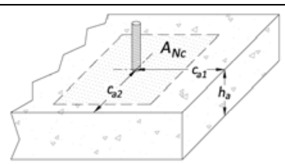
TABLE 5—EXAMPLE ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7,8,9]

Nominal Anchor Size (inch)	Nominal Embedment Depth (inches)	Effective Embedment (inches)	Anchor Rod Designation (ASTM)	Allowable Tension Load (pounds)
$^{3}/_{8}$	$3^{1}/_{8}$	$2^{3}/_{4}$	A36	2,280
	$4^{3}/_{8}$	4	A193, Grade B7	4,910
$^{1}/_{2}$	$4^{1}/_{4}$	4	A36	4,170
	$5^{1}/_{4}$	5	A193, Grade B7	7,365
	7	$6^{3}/_{4}$	A193, Grade B7	8,990
$^{5}/_{8}$	5	$4^{1}/_{2}$	A36	6,290
	8	$7^{1}/_{2}$	A193, Grade B7	13,530
	$9^{1}/_{2}$	9	A193, Grade B7	14,315
$^{3}/_{4}$	$5^{7}/_{8}$	5	A36	7,365
	$10^{7}/_{8}$	10	A193, Grade B7	20,830

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

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

Given: Calculate the factored resistance strength, $\boldsymbol{\phi N_n}$, and the allowable stress design value, $T_{allowable,ASD}$, for a $^{3}/_{8}$-inch undercut anchor with ASTM A193, Grade B7 anchor rod designation assuming the given conditions in Table 5.

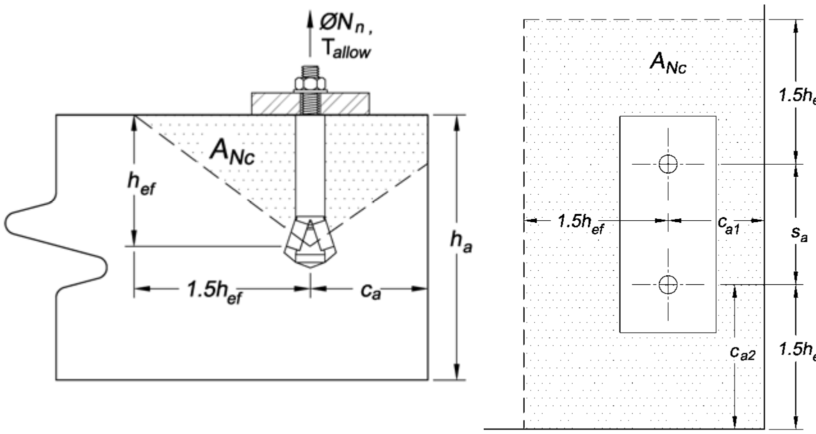


Calculation in accordance with ACI 318-14 Chapter 17, ACI 318-11 Appendix D and this report:	**ACI 318-14 Ref.**	**ACI 318-11 Ref.**	**Report Ref.**
Step 1. Calculate steel strength of a single anchor in tension: $\boldsymbol{\phi N_{sa}} = (0.75)(9{,}685) = 7{,}264\ lbs.$	17.4.1.2	D.5.1.2	Table 4
Step 2. Calculate concrete breakout strength of a single anchor in tension: $\phi N_{cb} = \phi \frac{A_{Nc}}{A_{Nc0}} \psi_{ed,N}\psi_{c,N}\psi_{cp,N}N_b$; $N_b = k_c\ \lambda_\alpha \sqrt{f'_c}(h_{ef})^{1.5}$; $N_b = (30)(1.0)\sqrt{2{,}500}(4.0)^{1.5} = 12{,}000\ lbs.$; $\boldsymbol{\phi N_{cb}} = (0.65)\frac{(144.0)}{(144.0)}(1.0)(1.0)(1.0)(12{,}000) = 7{,}800\ lbs.$	17.4.2.1	D.5.2.1	Table 4
Step 3. Calculate pullout strength of a single anchor: $\phi N_{pn} = \phi N_{p,uncr}\psi_{c,P}\left(\frac{f'_{c,act}}{2{,}500}\right)^{0.5}$; $\boldsymbol{\phi N_{pn}}$ = N/A, pullout strength does not control	17.4.2.2	D.5.2.2	Table 4
Step 4. Determine controlling factored resistance strength in tension: $\boldsymbol{\phi N_n} = \min\lvert\phi N_{sa}, \phi N_{cb}, \phi N_{pn}\rvert = \phi N_{sa} = 7{,}264\ lbs.$	17.3.1.1	D.4.1.1	-
Step 5. Calculate allowable stress design conversion factor for loading condition: Controlling load combination: 1.2*D* + 1.6*L* ; $\boldsymbol{\alpha}$ = 1.2(30%) + 1.6(70%) = 1.48	5.3	9.2	-
Step 6. Calculate the converted allowable stress design value: $\boldsymbol{T_{allowable,ASD} = \frac{\phi N_n}{\alpha} = \frac{7{,}264}{1.48} = 4{,}908\ lbs.}$	-	-	Section 4.2

FIGURE 5—ATOMIC+ UNDERCUT ANCHOR EXAMPLE STRENGTH DESIGN CALCULATION INCLUDING ASD CONVERSION FOR ILLUSTRATIVE PURPOSES

Given:
Two $^3/_8$" undercut anchors
A 193, Grade B7 designation
Concrete compressive strength:
(f'_c) = 4,000 psi
No supplemental reinforcement:
(Condition B per ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c))
Assume uncracked concrete, no seismic, no loading eccentricity and a rigid plate

h_a = 8.0 in.
h_{ef} = 4.0 in.
s_a = 5.0 in.
$c_{a1} = c_{a,min}$ = 4.0 in.
$c_{a2} \geq 1.5c_{a1}$



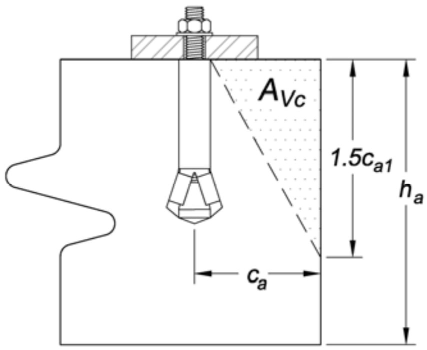
Calculate the factored resistance design strength in tension and equivalent allowable stress design load for the configuration.

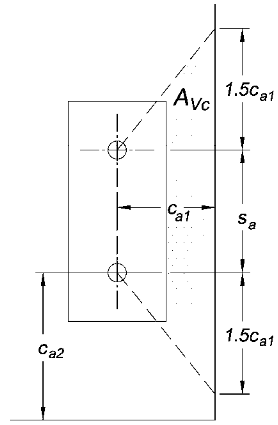
Calculation in accordance with ACI 318-14 Chapter 17, ACI 318-11 Appendix D and this report:	**ACI 318-14 Ref.**	**ACI 318-11 Ref.**	**Report Ref.**
Step 1. Verify minimum member thickness, spacing and edge distance: h_a = 8.0 in. ≥ h_{min} = 8.0 in. ∴ OK; s_a = 5.0 in. ≥ s_{min} = 4.0 in. ∴ OK; $c_{a,min}$ = 4.0 in. ≥ c_{min} = 3.25 in. ∴ OK	17.7	D.8	Table 4
Step 2. Calculate steel strength of anchor group in tension: $N_{sag} = nN_{sa}$ = (2)(9,685) = 19,370 lbs. Calculate steel capacity: ϕN_{sag} = 0.75 • 19,370 lbs. = **14,525 lbs.**	17.4.1.2	D.5.1.2	Table 4
Step 3. Calculate concrete breakout strength of anchor group in tension: $N_{cbg} = \frac{A_{Nc}}{A_{Nc0}}\psi_{ec,N}\psi_{ed,N}\psi_{c,N}\psi_{cp,N}N_b$	17.4.2.1(b)	D.5.2.1(b)	-
Step 3a. Calculate A_{Nco} and A_{Nc}: $A_{Nco} = 9h_{ef}^2 = 9 \cdot (4.0)^2$ = **144 in.^{2}**; $A_{Nc} = (c_{a1} + 1.5h_{ef}) \cdot (3.0\ h_{ef} + s_a)$ = (4.0 + 6.0)•(3.0 • 4.0 + 5.0) = **170 in.^{2}**	17.4.2.1(b)	D.5.2.1(b)	Table 4
Step 3b. Calculate $\psi_{ec,N} = \frac{1}{\left(1+\frac{2e'_N}{3h_{ef}}\right)} \leq 1.0$; $e'_N = 0$ ∴ $\psi_{ec,N}$ = **1.0**	17.4.2.4	D.5.2.4	-
Step 3c. Calculate $\psi_{ed,N}$ = 1.0 if $c_{a,min} \geq 1.5h_{ef}$; $\psi_{ed,N} = 0.7 + 0.3\frac{c_{a,min}}{1.5h_{ef}}$ if $c_{a,min} < 1.5h_{ef}$; $c_{a,min}$ =4.0 in. ≥ $1.5h_{ef}$ = 6.0 in. ∴ $\psi_{ed,N} = 0.7 + 0.3\frac{4.0}{6.0}$ = **0.90**	17.4.2.5	D.5.2.5	Table 4
Step 3d. Calculate $\psi_{c,N}$ = **1.0** (uncracked concrete)	17.4.2.6	D.5.2.6	Table 4
Step 3e. Calculate $\psi_{cp,N}$ = 1.0 if $c_{a,min} \geq c_{ac}$; $\psi_{cp,N} = \frac{c_{a,min}}{c_{ac}} \geq \frac{1.5h_{ef}}{c_{ac}}$ if $c_{a,min} < c_{ac}$; $c_{a,min}$ = 4.0 in. < c_{ac} = 6.0 in. ∴ $\psi_{cp,N} = \frac{c_{a,min}}{c_{ac}} \geq \frac{1.5h_{ef}}{c_{ac}} = \frac{4.0}{6.0} \geq \frac{6.0}{6.0}$ = **1.0**	17.4.2.7	D.5.2.7	Table 4
Step 3f. Calculate $N_b = k_{cr}\lambda_{\alpha}\sqrt{f'_c}\ h_{ef}^{1.5} = 30(1.0)\sqrt{4{,}000} \cdot 4.0^{1.5}$ = **15,180 lbs.**	17.4.2.2	D.5.2.2	Table 4
Step 3g. Calculate concrete breakout strength of anchor group in tension: N_{cbg} = (170/144) • 1.0 • 0.90 • 1.0 • 1.0 • 15,180 = 16,125 lbs. Calculate concrete breakout capacity = ϕN_{cbg} = 0.65 • 16,125 = **10,480 lbs.**	17.4.2.1(b)	D.5.2.1(b)	-
Step 4. Calculate nominal pullout strength of a single anchor in tension: $N_{pn} = \psi_{c,P} \cdot N_{pn,f'c}$ – Pullout does not control; therefore it needs not be considered.	17.4.3.1	D.5.3.1	-
Step 5. Determine controlling resistance strength of the anchor group in tension: $\phi N_n = \min\lvert\phi N_{sag}, \phi N_{cbg}, n\phi N_{pn}\rvert = \phi N_{cbg}$ = **10,480 lbs.**	17.3.1.1	D.4.1.1	-
Step 6. Calculate allowable stress design conversion factor for loading condition: Assume controlling load combination: 1.2*D* + 1.6*L* ; 50% Dead Load, 50% Live Load; α = 1.2(50%) + 1.6(50%) = **1.40**	5.3	9.2	-
Step 7. Calculate allowable stress design value: $T_{allowable,ASD} = \frac{\phi N_n}{\alpha} = \frac{10{,}480}{1.40}$ = **7,485 lbs.**	5.3	9.2	-

FIGURE 6—EXAMPLE CALCULATION FOR ATOMIC+ UNDERCUT ANCHORS

Given:
Two $^3/_8$" undercut anchors
A 193, Grade B7 designation
Concrete compressive strength:
(f'_c) = 3,000 psi
No supplemental reinforcement:
(Condition B per ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c))
Assume uncracked concrete, no seismic, no loading eccentricity and a rigid plate

h_a = 8.0 in.
h_{ef} = 4.0 in.
s_a = 5.0 in.
$c_{a1} = c_{a,min}$ = 4.0 in.
$c_{a2} \geq 1.5c_{a1}$





Calculate the factored resistance design strength in <u>shear</u> and equivalent allowable stress design load for the configuration.

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. Verify minimum member thickness, spacing and edge distance: h_a = 8.0 in. ≥ h_{min} = 8.0 in. ∴ OK s_a = 5.0 in. ≥ s_{min} = 4.0 in. ∴ OK $c_{a,min}$ = 4.0 in. ≥ c_{min} = 3.25 in. ∴ OK	17.7	D.8	Table 4
Step 2. Calculate steel strength of anchor group in shear: $V_{sag} = n \cdot V_{sa}$ = 2 • 4,855 lbs. = 9,710 lbs. Calculate steel capacity: ϕV_{sag} = 0.65 • 9,710 lbs. = **6,310 lbs**.	17.5.1.2	D.6.1.2	Table 4
Step 3. Calculate concrete breakout strength of anchor group in shear: $V_{cbg} = \frac{A_{Vc}}{A_{Vc0}} \psi_{ec,V} \psi_{ed,V} \psi_{c,V} \psi_{h,V} V_b$	17.5.2.1(b)	D.6.2.1(b)	-
Step 3a. Calculate A_{Vco} and A_{Vc} $A_{Vco} = 4.5\,(c_{a1})^2$ = 4.5 • $(4.0)^2$ = **72 in.²** $A_{Vc} = (1.5\,c_{a1}) \cdot (1.5\,c_{a1} + s_a + 1.5\,c_{a1})$ = (6.0)(6.0 + 6.0 + 6.0) = **108 in.²**	17.5.2.1	D.6.2.1	Table 4
Step 3b. Calculate $\psi_{ec,V} = \frac{1}{\left(1+\frac{2e'_N}{3c_{a1}}\right)} \leq 1.0$; $e'_V = 0$ ∴ $\psi_{ec,V}$ = **1.0**	17.5.2.5	D.6.2.5	-
Step 3c. Calculate $\psi_{ed,V}$ = 1.0 if $c_{a2} \geq 1.5c_{a1}$; $\psi_{ed,V} = 0.7 + 0.3\frac{c_{a2}}{1.5c_{a1}}$ if $c_{a2} < 1.5c_{a1}$ $c_{a2} \geq 1.5\,c_{a1}$ ∴ $\psi_{ed,V}$ = **1.0**	17.5.2.6	D.6.2.6	-
Step 3d. Calculate $\psi_{c,V}$ = **1.4** (uncracked concrete)	17.5.2.7	D.6.2.7	-
Step 3e. Calculate $\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}}$; for members where $h_a < 1.5c_{a1}$ $h_a = 8.0 \geq 1.5c_{a1} = 6.0$ ∴ $\psi_{h,V}$ = **1.0**	17.5.2.8	D.6.2.8	-
Step 3f. Calculate $V_b = 7\left(\frac{l_e}{d_a}\right)^{0.2} \lambda_\alpha \sqrt{d_a}\sqrt{f'_c}(c_{a1})^{1.5}$ $7\left(\frac{3.0}{0.625}\right)^{0.2}(1.0)\sqrt{0.625}\sqrt{4000}(4.0)^{1.5}$ = **3,830 lbs.**	17.5.2.2	D.6.2.2	Table 4
Step 3g. Calculate concrete breakout strength of anchor group in shear: V_{cbg} = (108/72) • 1.0 • 1.0 • 1.4 • 1.0 • 3,830 = 8,045 lbs. Calculate concrete breakout capacity = ϕV_{cbg} = 0.70 • 8,045 = **5,630 lbs.**	17.5.2.1(b)	D.6.2.1(b)	-
Step 4. Calculate nominal pryout strength of an anchor group in shear: $V_{cpg} = k_{cp} N_{cbg}$ = 2.0 • 17,455 lbs = 34,915 lbs. Calculate pryout capacity: ϕV_{cpg} = 0.70 • 34,915 lbs. = **24,440 lbs**.	17.5.3.1(b)	D.6.3.1(b)	Table 4
Step 5. Determine controlling resistance strength in shear: $\phi V_n = \min\left\|\phi V_{sag}, \phi V_{cbg}, \phi V_{cpg}\right\| = \phi V_{cbg}$ = **5,630 lbs.**	17.3.1.1	D.4.1.1	-
Step 6. Calculate allowable stress design conversion factor for loading condition: Controlling load combination: 1.2D + 1.6L ; 50% Dead Load, 50% Live Load α = 1.2(30%) + 1.6(70%) = **1.40**	5.3	9.2	-
Step 7. Calculate allowable stress design value: $V_{allowable,ASD} = \frac{\phi V_n}{\alpha} = \frac{5{,}630}{1.40}$ = **4,020 lbs.**	5.3	9.2	-

FIGURE 7—EXAMPLE CALCULATION FOR ATOMIC+ UNDERCUT ANCHORS