TECHNICAL DATA SHEET

TDE / TLE

Denomination: **TDE screw anchor**	Codes: **TDE, TLE**		
Reference: **FT TDE-en**	Date: **16/01/2024**	Revision: 14	Page: **1 of 12**

ATLANTIS COATING

ZINC

CHARACTERISTICS

- Pilot hole in concrete needed; thread is created by the anchor during the installation process
- No special drill bit required; install using standard-sized ANSI tolerance drill bits
- Code listed under IBC/IRC in accordance with ICC-ES AC193 and ACI 355.2 for cracked and uncracked concrete and AC01 for masonry elements.
- Qualified for static, wind and seismic loading conditions
- Removable, leaving concrete surface flat. Ideal for temporary anchoring (e.g. formwork, bracing) or applications where fixtures may need to be moved
- Suitable when reduced edge distances or spacing required
- Atlantis (TDE) or zinc plated coating (TLE)

APPLICATIONS

- Structural fixings in cracked and uncracked concrete.
- Fixings in cracked and uncracked masonry elements
- Formwork and fixing
- Racking and shelving
- Attaching railings, handrails and ledgers
- Fixings of steel beams, channels, boilers, signals, stadium seatings, façade substructures, etc.
- TDE/TLE anchors have been tested in accordance with TAS 114-95 for corrosion resistance.

APPROVALS

ICC ES

ESR-4314
ESR-5216

MIAMI-DADE COUNTY APPROVED

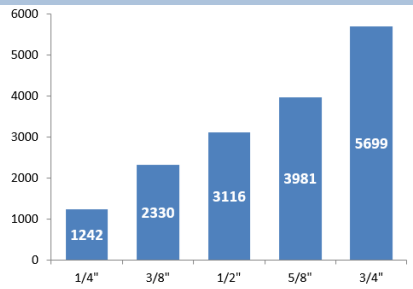
NOA 20-1103.16

Florida approval FL30477

Codes compliance:
IBC/IRC 2021, 2018, 2015, 2013, 2009
LABC/LARC 2023
CBC/CRC 2022
FBC 2023

BASE MATERIALS

ALLOWABLE TENSION LOADS FOR DEEP EMBEDMENT DEPTH IN 2500 psi UNCRACKED CONCRETE with α=1,48 [lb]



SIZES

1/4” – 3/4”

DRILL CONDITION

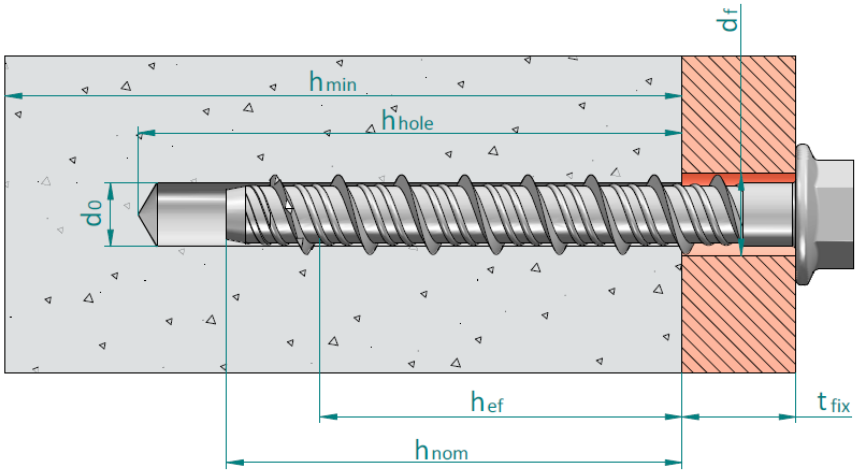
Dry

APPLICATION EXAMPLES

1. RANGE

ITEM	CÓDE		SIZE	PICTURE	COMPONENT	MATERIAL
1	**TDE**		1/4”- 3/4”		Hexagonal screw anchor	Carbon steel, Atlantis coating
2	**TLE**		1/4” - 3/4”		Hexagonal screw anchor	Carbon steel, zinc plated coating ≥ 0,0002 in

2. INSTALLATION DETAILS IN CONCRETE

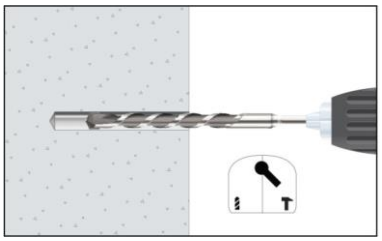


Parameter	Symbol	Units	Nominal anchor diameter									
			1/4"		3/8"		1/2"		5/8"		3/4"	
Drill bit diameter	d_0	in (mm)	1/4 (6,4)	1/4 (6,4)	3/8 (9.5)	3/8 (9.5)	1/2 (12.7)	1/2 (12.7)	5/8 (15.9)	5/8 (15.9)	3/4 (19.1)	3/4 (19.1)
Nominal embedment depth[1]	h_{nom}	in (mm)	1 5/8 (41)	2 1/2 (64)	2 1/2 (64)	3 1/4 (83)	3 (76)	4 1/4 (108)	3 1/4 (83)	5 (127)	4 (102)	6 1/4 (159)
Effective embedment depth	h_{ef}	in (mm)	1,23 (31)	1,98 (50)	1.85 (47)	2.49 (63)	2.21 (56)	3.27 (83)	2.36 (60)	3.85 (98)	2.97 (75)	4.89 (124)
Minimum hole depth	h_{hole}	in (mm)	2 (51)	2 7/8 (73)	2 3/4 (70)	3 1/2 (89)	3 3/8 (86)	4 5/8 (117)	3 5/8 (92)	5 3/8 (137)	4 3/8 (111)	6 5/8 (168)
Maximum fixture clearance Hole diameter	d_f	in (mm)	3/8 (9.5)	3/8 (9.5)	1/2 (12.7)	1/2 (12.7)	5/8 (15.9)	5/8 (15.9)	3/4 (19.1)	3/4 (19.1)	7/8 (22.2)	7/8 (22.2)
Maximum installation torque	$T_{inst.max}$	ft lb (Nm)	15 (20)	24 (33)	35 (47)	50 (68)	45 (61)	65 (88)	85 (115)	100 (136)	115 (156)	150 (203)
Maximum impact wrench torque rating	$T_{impact.max}$	ft lb (Nm)	150 (203)	150 (203)	380 (515)	380 (515)	380 (515)	380 (515)	380 (515)	380 (515)	380 (515)	380 (515)
Minimum concrete thickness	h_{min}	in (mm)	3 1/4 (83)	4 (102)	4 (102)	4 3/4 (121)	4 3/4 (121)	6 3/4 (171)	5 (127)	7 (178)	6 (152)	8 1/8 (206)
Critical edge distance	c_{ac}	in (mm)	2 1/2 (64)	3 (76)	4 (102)	5 (127)	4 1/2 (114)	5 (127)	3 3/4 (95)	7 (178)	4 1/2 (114)	8 (203)
Minimum edge distance	c_{min}	in (mm)	1 1/2 (38)	2 (51)	1 1/2 (38)	1 1/2 (38)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)
Minimum spacing	s_{min}	in (mm)	3 (76)	3 (76)	3 (76)	3 (76)	3 (76)	3 (76)	4 (102)	4 (102)	4 (102)	4 (102)
Minimum overall anchor length[2]	ℓ_{anch}	in (mm)	1 3/4 (44,5)	2 5/8 (66,7)	2 3/4 (70)	3 1/2 (89)	3 1/4 (82)	4 1/2 (114)	3 1/2 (89)	5 1/4 (133)	4 1/4 (108)	6 1/2 (165)
Spanner	Sw	in	7/16	7/16	9/16	9/16	3/4	3/4	15/16	15/16	1 1/8	1 1/8
Maximum fixture thickness	t_{fix}	in (mm)	L - 1,6 (L–41)	L - 2.5 (L-64)	L - 2.5 (L-64)	L–3.25 (L-.83)	L-3 (L-76)	L-4.25 (L-108)	L-3.25 (L-83)	L-5 (L-127)	L-4 (L-102)	L-6.25 (L-159)

For SI: 1 inch = 25.4 mm, 1 ft-lb = 1.356 Nm.

1. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
2. The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and possible fixture attachment.
3. Caution: holes in metal fixtures to be mounted should match the diameter specified in the table below.
4. Caution: oversized holes in base material will reduce or eliminate the mechanical interlock of the threads with the base material and reduce the anchor's load capacity
5. Caution: reuse of the anchor to achieve listed load values is not recommended

3. PRODUCT INSTALLATION IN CONCRETE



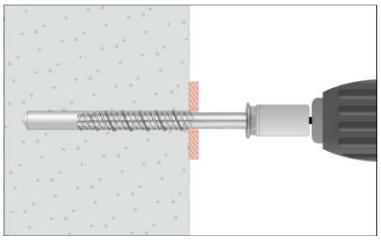
1. DRILL

Drill a hole into the base material of the correct diameter and depth using a drill bit that meets the requirements of ANSI B212.15

Caution: oversized holes in base material will reduce or eliminate the mechanical interlock of the threads with the base material and reduce the anchor's load capacity

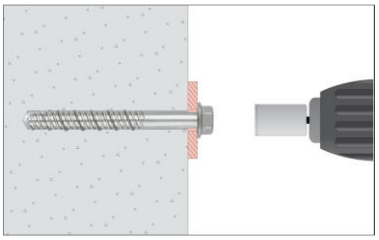
2. BLOW AND CLEAN

Remove dust and debris from hole using a hand pump, compressed air or a vacuum to remove loose particles left from drilling.



3. INSTALL

Select a powered impact wrench or a torque wrench that does not exceed the maximum torque $T_{impact,max}$ or $T_{ins,max}$ respectively. Attach an appropriate sized hex socket to the wrench. Mount the screw anchor head in the socket.

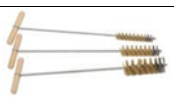


4. APPLY TORQUE

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

The screw anchor is permitted to be loosened by a maximum of one full turn and retightened with a torque wrench or a powered impact wrench to facilitate fixture attachment or realignment

Installation accessories

Code no.	Description	Box qty.	Image
MOBOMBA	Hand pump / Dust blower.	1	
MORCEPKIT	Kit 3 cleaning brushes	1	

4. DESIGN INFORMATION FOR CONCRETE APPLICATIONS

Tension design information[1,2]

Design characteristic		Notation	Units	Nominal anchor diameter									
				1/4"		3/8"		1/2"		5/8"		3/4"	
Nominal embedment depth		h_{nom}	in (mm)	1 5/8 (41)	2 1/2 (64)	2 ½ (64)	3 1/4 (83)	3 (76)	4 1/4 (108)	3 1/4 (83)	5 (127)	4 (102)	6 1/4 (159)
Anchor category		1, 2 or 3	-	2		1		1		1		1	
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)													
Minimum specified ultimate strength		f_{uta}	psi (N/mm²)	110.000 (758)		111,000 (765)		107,000 (738)		102,000 (703)		99,000 (683)	
Minimum specified yield strength		f_y	psi (N/mm²)	88.000 (607)		88,800 (612)		85,600 (590)		81,600 (563)		79,200 (546)	
Effective tensile stress area (screw anchor body)		$A_{se,N}$	in² (mm²)	0.0438 (28,3)		0.0943 (60.8)		0.1768 (114.1)		0.2703 (174.4)		0.3988 (257.3)	
Steel strength in tension[3]		N_{sa}	lb (kN)	4,820 (21,4)		10,467 (46.6)		18,918 (84.1)		27,571 (122.6)		39,481 (175.6)	
Strength reduction factor for steel failure in tension[4]		ϕ_{sa}	-	0.65									
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)													
Characteristic pullout strength, uncracked concrete (2,500 psi)[6,7]		$N_{p,uncr}$	lb (kN)	1,600 (7.12)	3,345 (14.87)	-	-	-	-	-	-	-	-
Characteristic pullout strength, cracked concrete (2,500 psi)[6,7]		$N_{p,cr}$	lb (kN)	730 (3.26)	1,330 (5.91)	-	-	3,223 (14.33)	-	-	-	-	-
Characteristic pullout strength, cracked concrete (2,500 psi), sesimic[6,7,8]		$N_{p,eq}$	lb (kN)	730 (3.26)	1,330 (5.91)	-	-	3,223 (14.33)	-	-	-	-	-
Normalization exponent	Uncracked concrete	n	-	0,42	0,37	-	-	0.50	-	-	-	-	-
	Cracked concrete	n	-	0,39	0,50	-	-	0,35	-	-	-	-	-
Strength reduction factor for pullout strength in tension[4]		ϕ_{cb}	-	0.55		0.65							
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)													
Effective embedment		h_{ef}	in (mm)	1,23 (31)	1,98 (50)	1.85 (47)	2.49 (63)	2.21 (56)	3.27 (83)	2.36 (60)	3.85 (98)	2.97 (75)	4.89 (124)
Effectiveness factor for uncracked concrete[9]		k_{uncr}	-	24	24	27	27	27	24	24	24	24	24
Effectiveness factor for cracked concrete[9]		k_{cr}	-	17	17	17	17	21	17	17	17	17	17
Critical edge distance		c_{ac}	in (mm)	2 1/2 (64)	3 (76)	4 (102)	5 (127)	4 1/2 (114)	5 (127)	3 3/4 (95)	7 (178)	4 1/2 (114)	8 (203)
Strength reduction factor for pullout strength in tension[4]		ϕ_p	-	0.55		0.65							
Axial stiffness in service load range	Uncracked concrete	β_{uncr}	lb/in (kN/mm)	214,520 (37,570)	178,090 (31,190)	63,150 (11,059)	207,850 (36,400)	139,250 (24,386)	140,060 (24,528)	222,870 (39,031)	254,980 (44,653)	292,630 (51,247)	305,530 (53,506)
	Cracked concrete	β_{cr}	lb/in (kN/mm)	186,270 (32,620)	178,950 (31,340)	63,150 (11,059)	174,020 (30,476)	130,385 (22,834)	140,060 (24,528)	105,130 (18,411)	192,280 (33,673)	160,050 (28,029)	165,525 (28,968)

For SI: 1 inch = 25.4 mm, 1 in² = 645 mm², 1 psi = 0,00689 N/mm²; 1 lb = 0,00445 kN, 1 lbf/in = 0,175 kN/mm

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318 D.3.3, as applicable, shall apply.
2. Installation must comply with published instructions and details.
3. Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design.
4. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
5. TDE / TLE screw anchor is considered a brittle steel element in tension as defined by ACI 318-14 2.3 or ACI 318 D.1, as applicable.
6. For concrete compressive strength greater than 2,500 psi, N_{pn} = (pullout strength value from table)*(specified concrete compressive strength/2500)^n
7. Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment
8. Reported values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5
9. Select appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{ucr}).
10. Mean values shown; actual stiffness varies considerable depending on concrete strength, loading and geometry of application.
11. Anchors are permitted to be used in sand-lightweight concrete provided that N_b, N_{eq} and N_{pn} are multiplied by a factor of 0.60.

Shear design information[1,2]

Design characteristic	Notation	Units	Nominal anchor diameter									
			1/4"		3/8"		1/2"		5/8"		3/4"	
Nominal embedment depth	h_{nom}	in (mm)	1 5/8 (41)	2 1/2 (64)	2 1/2 (64)	3 1/4 (83)	3 (76)	4 1/4 (108)	3 ¼ (83)	5 (127)	4 (102)	6 1/4 (159)
Anchor category	1, 2 or 3	-	2		1		1		1		1	
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[5]												
Minimum specified ultimate strength	f_{uta}	psi (N/mm^2)	110.000 (758)		111,000 (765)		107,000 (738)		102,000 (703)		99,000 (683)	
Minimum specified yield strength	f_y	psi (N/mm^2)	88.000 (607)		88,800 (612)		85,600 (590)		81,600 (563)		79,200 (546)	
Effective tensile stress area (screw anchor body)	$A_{se,V}$	in^2 (mm^2)	0.0438 (28,3)		0.0943 (60.8)		0.1768 (114.1)		0.2703 (174.4)		0.3988 (257.3)	
Steel strength in shear[3]	V_{sa}	lb (kN)	1,555 (6,92)	2,738 (12.18)	4,817 (21.43)	4,848 (21.57)	7,268 (32.33)	9,371 (41.68)	10,300 (45.81)	12,736 (56.65)	14,238 (63.33)	14,238 (63.33)
Steel strength in shear, seismic (2500 psi)[5]	$V_{sa,\ eq}$	lb (kN)	1,555 (6,92)	2,493 (11,09)	4,075 (18.13	4,075 (18.13)	5,075 (22.57)	7,142 (31.77)	8,029 (35.72)	10,302 (45.83)	12,105 (53.85)	12,105 (53.85)
Strength reduction factor for steel failure in shear[6]	ϕ_{sa}	-	0.60									
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)												
Nominal anchor diameter	d_0	in (mm)	1/4 (6,4)	1/4 (6,4)	3/8 (9.5)	3/8 (9.5)	1/2 (12.7)	1/2 (12.7)	5/8 (15.9)	5/8 (15.9)	3/4 (19.1)	3/4 (19.1)
Load bearing length of anchor	ℓ_e	in (mm)	1,23 (31)	1,98 (50)	1.85 (47)	2.49 (63)	2.21 (56)	3.27 (83)	2.36 (60)	3.85 (98)	2.97 75)	4.89 (124)
Strength reduction factor for concrete strength in shear[6]	ϕ_{cb}	-	0.70									
PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)												
Coefficient for pryout strength	k_{cp}	-	1.0	1.0	1.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0
Effective embedment depth	h_{ef}	in (mm)	1,23 (31)	1,98 (50)	1.85 (47)	2.49 (63)	2.21 (56)	3.27 (83)	2.36 (60)	3.85 (98)	2.97 (75)	4.89 (124)
Reduction factor for pryout strength in shear[6]	ϕ_{cp}	-	0.70									

For SI: 1 inch = 25.4 mm, 1 in^2 = 645 mm^2, 1 psi = 0,00689 N/mm^2; 1 lb = 0,00445 kN

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318 D.3.3 shall apply, as applicable.
2. Installation must comply with published instructions and details.
3. Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and shall be used for design.
4. TDE / TLE is considered a brittle steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. Reported values for steel strength in shear for seismic applications are based on test results per ACI 355.2, Section 9.6
6. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of Φ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2 are used.
7. Anchors are permitted to be used in sand-lightweight concrete provided that V_b and V_{cp} are multiplied by a factor of 0.60.

Factored design strength (ΦN_n and ΦV_n) calculated in accordance with ACI 318-14:

1- Tabular values are provided for illustration and are applicable for single anchors installed in normal weight concrete with minimum slab thickness, $h_a = h_{min}$, and with the following conditions:
   - C_{a1} is greater than or equal to the critical edge distance, C_{ac} (table values based on $C_{a1} = C_{ac}$).
   - C_{a2} is greater than or equal to 1.5 times C_{a1}.
2- Calculations were performed according to ACI 318-14. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.
3- Strength reduction factors (Φ) were based on ACI 318-14 section 17.3.3 for load combinations. Condition B is assumed. Condition B is applied where supplementary reinforcement is not supplied.
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 section 17.6.
6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14. For other design conditions including seismic considerations please see ACI 318-14.

Tension and shear design strengths for TDE / TLE in cracked concrete

Nominal anchor diameter (in.)	Nominal embed. h_{nom} (in.)	Minimum concrete compressive strength									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)
1/4	1 5/8	403	812	417	889	441	933	478	933	505	933
	2 1/2	730	1,643	764	1,643	821	1,643	909	1,643	977	1,643
3/8	2 1/2	1.390	1.497	1.523	1.640	1.759	1.894	2.154	2.319	2.487	2.678
	3 ¼	2.171	2.338	2.378	2.561	2.746	2.909	3.363	2.909	3.883	2.909
1/2	3	2.095	2.415	2.163	2.645	2.275	3.054	2.442	3.741	2.568	4.320
	4 ¼	3.267	5.623	3.579	5.623	4.133	5.623	5.061	5.623	5.844	5.623
5/8	3 ¼	2.003	2.157	2.194	2.363	2.534	2.729	3.103	3.342	3.583	3.859
	5	4.147	7.642	4.572	7.642	5.279	7.642	6.466	7.642	7.466	7.642
3/4	4	2.828	6.091	3.098	6.672	3.577	7.704	4.381	8.543	5.059	8.543
	6 ¼	5.974	8.543	6.545	8.543	7.557	8.543	9.256	8.543	10.687	8.543
Color code:		Pullout		Concrete / pryout		Steel					

Tension and shear design strengths for TDE / TLE in uncracked concrete

Nominal anchor diameter (in.)	Nominal embed. h_{nom} (in.)	Minimum concrete compressive strength									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)
1/4	1 5/8	881	933	915	933	973	933	1,059	933	1,125	933
	2 1/2	1,839	1,643	1,902	1,643	2,006	1,643	2,162	1,643	2,280	1,643
3/8	2 1/2	2.208	2.378	2.419	2.605	2.793	2.890	3.421	2.890	3.950	2.890
	3 ¼	3.448	2.909	3.777	2.909	4.361	2.909	5.341	2.909	6.168	2.909
1/2	3	2.883	3.105	3.158	3.401	3.647	3.927	4.466	4.361	5.157	4.361
	4 ¼	4.612	5.623	5.053	5.623	5.834	5.623	7.145	5.623	8.251	5.623
5/8	3 ¼	2.828	3.045	3.098	3.336	3.577	3.852	4.381	4.718	5.059	5.448
	5	5.892	7.642	6.455	7.642	7.453	7.642	9.128	7.642	10.540	7.642
3/4	4	3.992	8.543	4.373	8.543	5.050	8.543	6185	8.543	7.142	8.543
	6 ¼	8.434	8.543	9.240	8.543	10.669	8.543	13.067	8.543	15.088	8.543
Color code:		Pullout		Concrete / pryout		Steel					

Converted allowable loads for TDE /TLE

ESR-4314 provides design information for load factor and characteristic resistance (LRFD), however allowable stress design (ASD) is still in use by some users. Translation of LRFD to ASD values is possible, however it is dependent on the levels of dead load and live load. Dead load is defined in the ACI 318 Building Code Requirements for Structural Concrete as "the weights of members, supported structure and permanent attachments that are likely to be present on a structure in service". Live load is defined in ACI 318-14 as "load that is not permanently applied to a structure, but is likely to occur during the service life of the structure (excluding environmental loads)". Examples of live loads are traffic on a walkway and non permanent loads associated with usage of a structure. Live load values are stipulated in the building code for various loading conditions and parts of structures.

To facilitate the translation of LRFD characteristic values to ASD values, a scenario of dead load and live load level is used to conservatively address the most common application as follows: 30% dead load; 70% live load. ACI 318-14 Equation (5.3.1b) provides a conversion factor of 1,48 which is divided into the LRFD characteristic resistances and multiplied by a ϕ factor (according to the failure type) to determine an equivalent ASD load.

It is the responsibility of the user to select the appropriate ASD values based on the example loadings shown in this document or alternative dead versus live loading that may be applicable to the specific design.

The ASD values are provided in the following tables for tension and shear for different concrete strengths. Other installation and design provisions in ESR-4314 must be followed.

Converted allowable loads for TDE /TLE in cracked concrete

Nominal anchor diameter (in.)	Nominal embed. h_{nom} (in.)	Minimum concrete compressive strength									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		$T_{allowable\ ASD}$ Tension (lb)	$V_{allowable\ ASD}$ Shear (lb)	$T_{allowable\ ASD}$ Tension (lb)	$V_{allowable\ ASD}$ Shear (lb)	$T_{allowable\ ASD}$ Tension (lb)	$V_{allowable\ ASD}$ Shear (lb)	$T_{allowable\ ASD}$ Tension (lb)	$V_{allowable\ ASD}$ Shear (lb)	$T_{allowable\ ASD}$ Tension (lb)	$V_{allowable\ ASD}$ Shear (lb)
1/4	1 5/8	272	548	282	601	298	630	323	630	341	630
	2 1/2	494	1,110	517	1,110	555	1,110	614	1,110	660	1,110
3/8	2 1/2	939	1.012	1.029	1.108	1.188	1.280	1.455	1.567	1.680	1.810
	3 ¼	1.467	1.580	1.607	1.730	1.855	1.965	2.272	1.965	2.624	1.965
1/2	3	1.415	1.632	1.461	1.787	1.537	2.064	1.650	2.528	1.735	2.919
	4 ¼	2.207	3.779	2.418	3.779	2.792	3.779	3.420	3.779	3.949	3.779
5/8	3 ¼	1.353	1.458	1.483	1.597	1.712	1.844	2.097	2.258	2.421	2.607
	5	2.820	5.163	3.089	5.163	3.587	5.163	4.369	5.163	5.045	5.163
3/4	4	1.911	4.115	2.093	4.508	2.417	5.206	2.960	5.772	3.418	5.772
	6 ¼	4.037	5.772	4.422	5.772	5.106	5.772	6.254	5.772	7.221	5.772

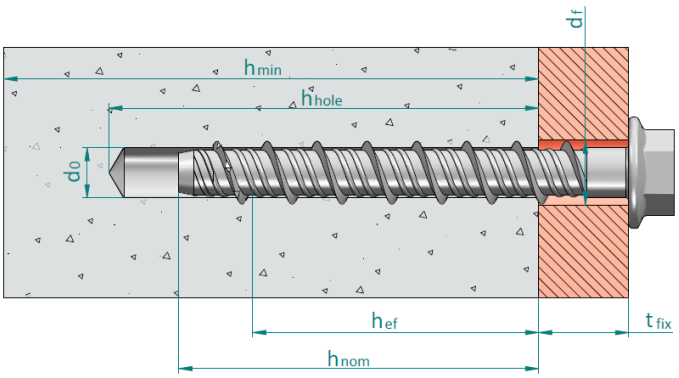
1. Allowable load values are calculated using a conversion factor, α, from factored design strengths.
2. Tabulated allowable load values assume 30% dead load and 70% live load, with controlling load combination 1,2D + 1,6L. Calculated weighted average for the conversion factor, α = 1,2*(0,3) + 1,6*(0,7) = 1,48.

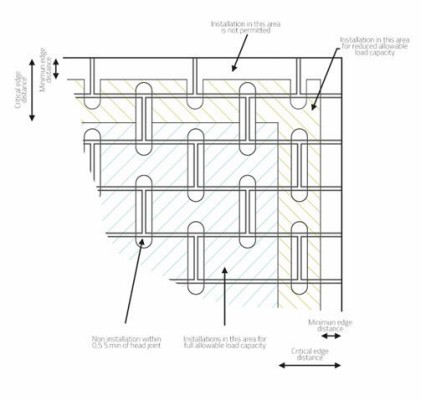
Converted allowable loads for TDE in uncracked concrete

Nominal anchor diameter (in.)	Nominal embed. h_{nom} (in.)	Minimum concrete compressive strength									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		$T_{allowable\ ASD}$ Tension (lb)	$V_{allowable\ ASD}$ Shear (lb)	$T_{allowable\ ASD}$ Tension (lb)	$V_{allowable\ ASD}$ Shear (lb)	$T_{allowable\ ASD}$ Tension (lb)	$V_{allowable\ ASD}$ Shear (lb)	$T_{allowable\ ASD}$ Tension (lb)	$V_{allowable\ ASD}$ Shear (lb)	$T_{allowable\ ASD}$ Tension (lb)	$V_{allowable\ ASD}$ Shear (lb)
1/4	1 5/8	595	630	619	630	657	630	715	630	760	630
	2 1/2	1,242	1,110	1,285	1,110	1,355	1,110	1,461	1,110	1,541	1,110
3/8	2 1/2	1.492	1.607	1.634	1760	1.887	1.953	2.311	2.116	2.669	1.953
	3 ¼	2.330	1.965	2.552	1.965	2.947	1.965	3.609	1.965	4.167	1.965
1/2	3	1.948	2.098	2.134	2.298	2.464	2.653	3.018	2.947	3.485	2.947
	4 ¼	3.116	3.799	3.414	3.799	3.942	3.799	4.828	3.799	5.575	3.799
5/8	3 ¼	1.911	2.058	2.093	2.254	2.417	2.603	2.960	3.188	3.418	3.681
	5	3.981	5.165	4.361	5.165	5.036	5.165	6.168	5.165	7.122	5.165
3/4	4	2.698	5.772	2.955	5.772	3.412	5.772	4.179	5.772	4.826	5.772
	6 ¼	5.699	5.772	6.243	5.772	7.209	5.772	8.829	5.772	10.195	5.772

1. Allowable load values are calculated using a conversion factor, α, from factored design strengths.
2. Tabulated allowable load values assume 30% dead load and 70% live load, with controlling load combination 1,2D + 1,6L. Calculated weighted average for the conversion factor, α = 1,2*(0,3) + 1,6*(0,7) = 1,48.

5. INSTALLATION DETAILS IN GROUTED CMU MASONRY





Parameter	Symbol	Units	Nominal anchor diameter									
			1/4"		3/8"		1/2"		5/8"		3/4"	
Drill bit diameter	d_0	in (mm)	1/4 (6.4)	1/4 (6.4)	3/8 (9.5)	3/8 (9.5)	1/2 (12.7)	1/2 (12.7)	5/8 (15.9)	5/8 (15.9)	3/4 (19.1)	3/4 (19.1)
Nominal embedment depth[1]	h_{nom}	in (mm)	1 5/8 (41)	2 1/2 (64)	2 (51)	3 1/4 (83)	2 1/2 (64)	4 1/4 (108)	3 1/4 (83)	5 (127)	4 (102)	6 1/4 (159)
Effective embedment depth	h_{ef}	in (mm)	1,23 (31)	1,98 (50)	1,42 (36)	2,49 (63)	1,78 (45)	3.27 (83)	2.36 (60)	3.85 (98)	2.97 (75)	4.89 (124)
Minimum hole depth	h_{hole}	in (mm)	2 (51)	2 7/8 (73)	2 3/8 (60)	3 5/8 (92)	2 7/8 (73)	4 5/8 (117)	3 5/8 (92)	5 3/8 (137)	4 3/8 (111)	6 5/8 (168)
Maximum fixture clearance Hole diameter	d_f	in (mm)	3/8 (9.5)	3/8 (9.5)	1/2 (12.7)	1/2 (12.7)	5/8 (15.9)	5/8 (15.9)	3/4 (19.1)	3/4 (19.1)	7/8 (22.2)	7/8 (22.2)
Maximum installation torque	T_{inst}	ft lb (Nm)	5 (7)	5 (7)	15 (20)	15 (20)	30 (41)	30 (41)	40 (54)	40 (54)	40 (54)	40 (54)
Maximum impact wrench torque rating	$T_{impact.max}$	ft lb (Nm)	150 (203)	150 (203)	380 (515)	380 (515)	380 (515)	380 (515)	380 (515)	380 (515)	380 (515)	380 (515)
Critical edge distance	C_{cr}	in (mm)	1,85 (47)	2,97 (75)	2,14 (54)	3,73 (95)	2,67 (68)	4,91 (125)	3,54 (90)	5,78 (147)	4,46 (113)	7,34 (186)
Minimum distance to the head joint	$c_{min,h,j}$	in (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Minimum edge distance field of wall	c_{min}	in (mm)	4 (102)	3 (76)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)
Minimum spacing field of wall	s_{min}	in (mm)	4 (102)	4 (102)	4 1/2 (114)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)
Minimum edge distance top of wall	c_{min}	in (mm)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)
Minimum spacing top of wall	s_{min}	in (mm)	4 1/2 (114)	4 1/2 (114)	4 1/2 (114)	4 1/2 (114)	5 1/2 (140)	5 1/2 (140)	6 1/2 (165)	6 1/2 (165)	8 1/2 (216)	8 1/2 (216)
Minimum overall anchor length[2]	ℓ_{anch}	in (mm)	1 3/4 (44)	2 5/8 (67)	2 1/4 (57)	3 1/2 (89)	2 3/4 (82)	4 1/2 (114)	3 1/2 (89)	5 1/4 (133)	4 1/4 (108)	6 1/2 (165)
Spanner	Sw	in	7/16	7/16	9/16	9/16	3/4	3/4	15/16	15/16	1 1/8	1 1/8
Maximum fixture thickness	t_{fix}	in (mm)	L - 1,6 (L–41)	L - 2.5 (L-64)	L - 2 (L-51)	L–3.25 (L-.83)	L-2,5 (L-64)	L-4.25 (L-108)	L-3.25 (L-83)	L-5 (L-127)	L-4 (L-102)	L-6.25 (L-159)

For SI: 1 inch = 25.4 mm, 1 ft-lb = 1.356 Nm.

1. The embedment depth, h_{nom}, is measured from the outside surface of the masonry member to the embedded end of the anchor.
2. The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and possible fixture attachment.
3. Caution: holes in metal fixtures to be mounted should match the diameter specified in the table below.
4. Caution: oversized holes in base material will reduce or eliminate the mechanical interlock of the threads with the base material and reduce the anchor's load capacity
5. Caution: reuse of the anchor to achieve listed load values is not recommended

6. PRODUCT INSTALLATION IN CMU MASONRY

1. DRILL

Drill a hole into the base material of the correct diameter and depth using a drill bit that meets the requirements of ANSI B212.15

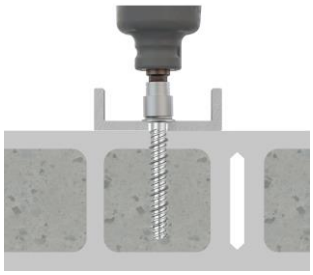
Caution: oversized holes in base material will reduce or eliminate the mechanical interlock of the threads with the base material and reduce the anchor's load capacity

2. BLOW AND CLEAN

Remove dust and debris from hole using a hand pump, compressed air or a vacuum to remove loose particles left from drilling.

3. INSTALL

Select a powered impact wrench or a torque wrench that does not exceed the maximum torque $T_{impact,max}$ or $T_{ins,max}$ respectively. Attach an appropriately sized hex socket to the wrench. Mount the screw anchor head in the socket.



4. APPLY TORQUE

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

The screw anchor is permitted to be loosened by a maximum of one full turn and retightened with a torque wrench or a powered impact wrench to facilitate fixture attachment or realignment

Installation accessories

Code no.	Description	Box qty.	Image
MOBOMBA	Hand pump / Dust blower.	1	
MORCEPKIT	Kit 3 cleaning brushes	1	

7. DESIGN INFORMATION FOR CMU MASONRY APPLICATIONS

Tension design information[1,2]

Design characteristic		Notation	Units	Nominal anchor diameter									
				1/4"		3/8"		1/2"		5/8"		3/4"	
Nominal embedment depth		h_{nom}	in (mm)	1 5/8 (41)	2 1/2 (64)	2 (51)	3 1/4 (83)	2 1/2 (64)	4 1/4 (108)	3 1/4 (83)	5 (127)	4 (102)	6 1/4 (159)
Anchor category		1, 2 or 3	-	1		1		1		1		2	
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)													
Minimum specified ultimate strength		f_{uta}	psi (N/mm²)	110.000 (758)		111,000 (765)		107,000 (738)		102,000 (703)		99,000 (683)	
Minimum specified yield strength		f_y	psi (N/mm²)	88.000 (607)		88,800 (612)		85,600 (590)		81,600 (563)		79,200 (546)	
Effective tensile stress area (screw anchor body)		$A_{se,N}$	in² (mm²)	0.0438 (28,3)		0.0943 (60.8)		0.1768 (114.1)		0.2703 (174.4)		0.3988 (257.3)	
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)													
Characteristic pullout strength, uncracked masonry[6]		$N_{p,uncr}$	lb (kN)	917 (4.08)	2167 (9.64)	824 (3.66)	3,953 (17.58)	1,633 (7,26)	1,619 (7.20)	2,706 (12.04)	4,513 (20.08)	3,367 (14.98)	5,744 (25.55)
Characteristic pullout strength, cracked masonry[6]		$N_{p,cr}$	lb (kN)	--	--	437 (1.94)	2,097 (9.33)	873 (3.88)	866 (3.85)	2,591 (11.53)	4,321 (19.22)	2,894 (12.87)	3,791 (16.86)
Characteristic pullout strength, top of wall		N_{eq}	lb (kN)	917 (4.08)	1,975 (8.78)	824 (3.66)	1,175 (5.23)	1,485 (6.61)	1,619 (7.20)	1,747 (7.77)	3,306 (14.70)	3,303 (14.69)	4,082 (18.16)
Strength reduction factor for pullout strength in tension[4]		ϕ_{cb}	-	0.65								0.55	
Axial stiffness in service load range[6]	Uncracked masonry	β_{uncr}	lb/in (kN/mm)	105,563 (18,845)	121,349 (21,252)	122.681 (21,485)	121.349 (21,252)	170.136 (29,795)	87.954 (15,403)	119.675 (20,958)	124.779 (21,852)	110.495 (19,351)	226.287 (39,629)
	Cracked masonry	β_{cr}	lb/in (kN/mm)	--	--	144.644 (25,331)	76.812 (13,452)	78.069 (13,672)	113.586 19,892)	82.924 (14,522)	74.917 (13,120)	101.211 (17,725)	47.422 (8,305)
	Top of wall	β_{cr}	lb/in (kN/mm)	92,150 (16,138)	7,993 (1,400)	93,455 (16,367)	47,984 (8,403)	100,955 (17,680)	27,476 (4,812)	41,307 (7,234)	54,810 (9,599)	31,215 (5,467)	70,483 (12,344)
Coefficient of variation for axial stiffness in service load range	Uncracked masonry	v_{uncr}	%	65	33	66	33	55	30	43	57	29	37
	Cracked masonry	v_{uncr}	%	--	--	62	43	72	47	49	35	45	18
	Top of wall	v_{uncr}	%	37	55	77	22	45	34	44	25	42	51

For SI: 1 inch = 25.4 mm, 1 in² = 645 mm², 1 psi = 0,00689 N/mm²; 1 lb = 0,00445 kN, 1 lbf/in = 0,175 kN/mm

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17, ACI 318 Appendix D and AC 01, as applicable.
2. Installation must comply with published instructions and details.
3. Tabulated values for steel strength in tension are based on test results per AC01 and must be used for design.
4. All values of ϕ were determined from the load combinations of AC01 section 3.3.2.9.
5. TDE / TLE screw anchor is considered a brittle steel element in tension as defined by ACI 318-14 2.3 or ACI 318 D.1, as applicable.
6. Mean values shown; actual stiffness varies considerable depending on loading and geometry of application..

Shear design information[1,2]

Design characteristic	Notation	Units	Nominal anchor diameter									
			1/4"		3/8"		1/2"		5/8"		3/4"	
Nominal embedment depth	h_{nom}	in (mm)	1 5/8 (41)	2 1/2 (64)	2 (51)	3 1/4 (83)	2 1/2 (64)	4 1/4 (108)	3 1/4 (83)	5 (127)	4 (102)	6 1/4 (159)
Anchor category	1, 2 or 3	-	1		1		1		1		2	
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[5]												
Minimum specified ultimate strength	f_{uta}	psi (N/mm^2)	110.000 (758)		111,000 (765)		107,000 (738)		102,000 (703)		99,000 (683)	
Minimum specified yield strength	f_y	psi (N/mm^2)	88.000 (607)		88,800 (612)		85,600 (590)		81,600 (563)		79,200 (546)	
Effective tensile stress area (screw anchor body)	$A_{se,V}$	in^2 (mm^2)	0.0438 (28,3)		0.0943 (60.8)		0.1768 (114.1)		0.2703 (174.4)		0.3988 (257.3)	
Steel strength in shear, field of wall[3]	V_{sa}	lb (kN)	1,959 (8.71)	1,959 (8.71)	3,220 (14.33)	3,220 (14.33)	3,837 (17.07)	5,524 (24.57)	6,463 (28.75)	7,700 (34.25)	8,973 (39.91)	9,427 (41.93)
Steel strength in shear, top of wall[5]	V_{sa}	lb (kN)	533 (2.37)	533 (2.37)	1,335 (5.94)	1,335 (5.94)	1,991 (8.86)	1,991 (8.86)	2,175 (9.67)	2,175 (9.67	4,203 (18.70)	4,203 (18.70)
Strength reduction factor for steel failure in shear[6]	ϕ_{sa}	-	0.60									

For SI: 1 inch = 25.4 mm, 1 in^2 = 645 mm^2, 1 psi = 0,00689 N/mm^2; 1 lb = 0,00445 kN

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable.
2. Installation must comply with published instructions and details.
3. Reported values for steel strength in shear are based on test results per AC 01 and shall be used for design.
4. All values of ϕ were determined from the load combinations of AC01 section 3.3.2.9

Factored design strength (ΦN_n and ΦV_n) calculated in accordance with ACI 318-14:

Tabular values are provided for illustration and are applicable for single anchors installed in fully grouted CMU masonry applications:
Edge distances C_{a1} are greater than or equal to the critical edge distance, C_{cr}.
Calculations were performed according to ACI 318-14 and AC 01.
Strength reduction factors (Φ) were based on AC01 section 3.3.2.9.
Tabular values are permitted for static loads only, seismic loading is not considered with these tables.
For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 section 17.6.
Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14 and AC 01. For other design conditions please see ACI 318-14and AC 01.

Tension and shear design strengths for TDE / TLE in masonry

Nominal anchor diameter (in.)	Nominal embed. h_{nom} (in.)	Uncracked masonry				Cracked masonry	
		Field of wall		Top of wall			
		ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)
1/4	1 5/8	596	1,186	596	323	--	--
	2 1/2	1,409	1,186	1,284	323	--	--
3/8	2	536	1,932	536	801	284	1,932
	3 ¼	2,569	1,932	764	801	1,363	1,932
1/2	2 ½	1,061	2,302	965	1,195	567	2,302
	4 ¼	1,052	3,314	1,052	1,195	563	3,314
5/8	3 ¼	1,759	3,878	1,136	1,305	1,684	3,878
	5	2,933	4,620	2,149	1,305	2,809	4,620
3/4	4	1,852	5,384	1,817	2,522	1,592	5,384
	6 ¼	3,159	5,656	2,245	2,522	2,085	5,656

Converted allowable loads for TDE /TLE

ESR-5216 provides design information for load factor and characteristic resistance (LRFD), however allowable stress design (ASD) is still in use by some users. Translation of LRFD to ASD values is possible, however it is dependent on the levels of dead load and live load. Dead load is defined in the ACI 318 Building Code Requirements for Structural Concrete as "the weights of members, supported structure and permanent attachments that are likely to be present on a structure in service". Live load is defined in ACI 318-14 as "load that is not permanently applied to a structure, but is likely to occur during the service life of the structure (excluding environmental loads)". Examples of live loads are traffic on a walkway and non-permanent loads associated with usage of a structure. Live load values are stipulated in the building code for various loading conditions and parts of structures.

To facilitate the translation of LRFD characteristic values to ASD values, a scenario of dead load and live load level is used to conservatively address the most common application as follows: 30% dead load; 70% live load. ACI 318-14 Equation (5.3.1b) provides a conversion factor of 1,48 which is divided into the LRFD characteristic resistances and multiplied by a ϕ factor (according to the failure type) to determine an equivalent ASD load.

It is the responsibility of the user to select the appropriate ASD values based on the example loadings shown in this document or alternative dead versus live loading that may be applicable to the specific design.

The ASD values are provided in the following tables for tension and shear for different concrete strengths. Other installation and design provisions in ESR-5216 must be followed.

Converted allowable loads for TDE /TLE in masonry

Nominal anchor diameter (in.)	Nominal embed. h_{nom} (in.)	Uncracked masonry				Cracked masonry	
		Field of wall		Top of wall			
		ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)	ΦN_n Tension (lb.)	ΦV_n Shear (lb.)
1/4	1 5/8	403	801	403	218	--	--
	2 1/2	952	801	867	218	--	--
3/8	2	362	1,305	362	541	192	1,305
	3 ¼	1,736	1,305	516	541	921	1,305
1/2	2 ½	717	1,556	652	807	383	1,556
	4 ¼	711	2,239	711	807	380	2,239
5/8	3 ¼	1,188	2,620	767	882	1,138	2,620
	5	1,982	3,122	1,452	882	1,898	3,122
3/4	4	1,251	3,638	1,227	1,704	1,075	3,638
	6 ¼	2,135	3,822	1,517	1,704	1,409	3,822

1. Allowable load values are calculated using a conversion factor, α, from factored design strengths.
2. Tabulated allowable load values assume 30% dead load and 70% live load, with controlling load combination 1,2D + 1,6L. Calculated weighted average for the conversion factor, α = 1,2*(0,3) + 1,6*(0,7) = 1,48.