Q-RAILING SLIM BASE SHOE
Job No: 18-879

Gonzalo A Paz

Digitally signed by Gonzalo A Paz
DN: c=US, o=IdenTrust ACES Business Representative, ou=Eastern Engineering Group Company, cn=Gonzalo A Paz, 0.9.2342.19200300.100.1.1=A0109800000015 6B8D0811F0000E651
Date: 2018.09.18 11:16:02 -04'00'

BASE SHOE DESIGN

STRUCTURAL CALCULATIONS

GONZALO A. PAZ, STATE OF FLORIDA, PROFESSIONAL ENGINEER, LICENSE No. 60734.

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GONZALO A. PAZ LICENSE No 60734 STATE OF FLORIDA PROFESSIONAL ENGINEER

Prepared By:
☐ Raissa Lopez, PE
Lic. No. 59399
CAN # 26655

Prepared By:
☐ Gonzalo Paz , PE
Lic. No. 60734
CAN # 26655

Eastern
Engineering Group

DESIGN CRITERIA:

Calculations based on:

1. 2017 Florida Building Code
2. 2015 International Building Code
3. Minimum Design Loads for Buildings and Other Structures ASCE 7-10
4. Building Code Requirements for Structural Concrete ACI 318-08
5. American Institute of Steel Construction AISC-14ed
6. Aluminum Design Manual 2015
7. Specifications for the Design of Cold-Formed Stainless Steel Structural Members SEI/ASCE8-02

CALCULATION INDEX:

Total Pages =30

CALCULATION STATEMENT:

To the best of my knowledge, ability, belief and professional judgment, I hereby attest that the manual calculations and computer generated calculations are in compliance with the existing governing codes.

Prepared By:
☐ Raissa Lopez, PE
Lic. No. 59399
CAN # 26655

Prepared By:
☐ Gonzalo Paz , PE
Lic. No. 60734
CAN # 26655

3401 NW 82nd Ave, Suite 370, Miami, Florida 33122
Telf. (305) 599–8133 / Email: info@easterneg.com

Eastern
Engineering Group
3401 NW 82nd Ave.
Suite 370
Doral, FL. 33122
(305) 599-8133
info@easterneg.com
www.easterneg.com

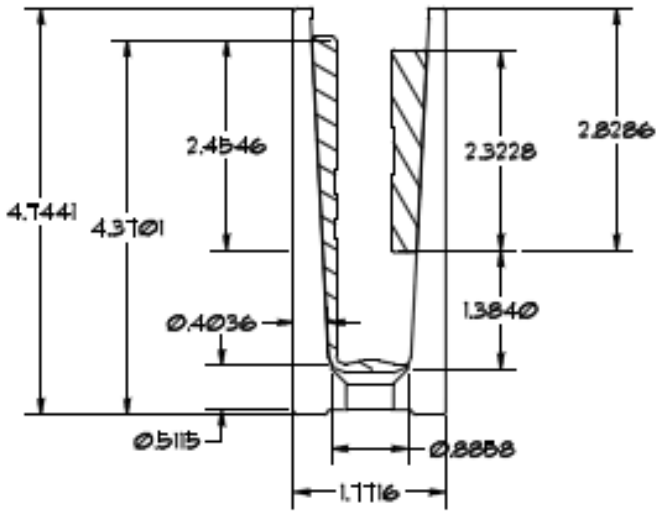
PROJ. NAME:

JOB NO. DATE:

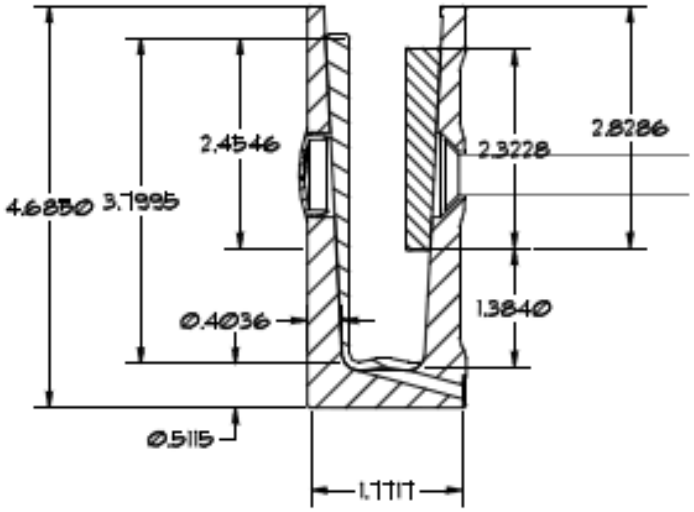
DESIGNED BY: PAGE:

REVIEWED BY:

BOTTOM MOUNTED
min Glass Width 38.35" (42.00" of glass in Cantilever)
min Glass Width 29.80" (38.25" of glass in Cantilever)



SIDE MOUNTED
min Glass Width 38.35" (42.00" of glass in Cantilever)



Slim Base Shoe Analysis

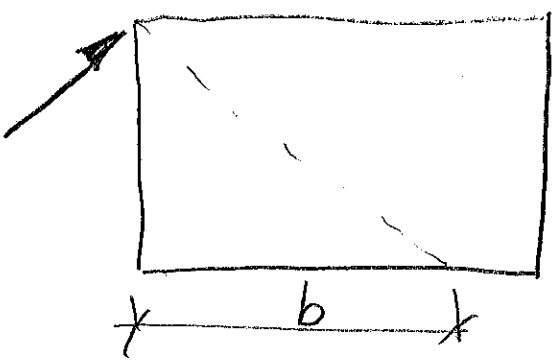
Interior Applications.

Minimal glass width for 9/16 Laminated glass

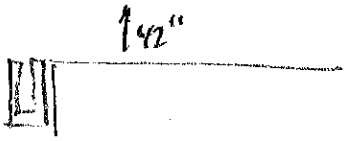
$$S_x = \frac{thk^2 \times b}{6} = \frac{(1/2)^2 \times b}{6} = \frac{1}{24} b$$

$$F_b = \frac{M_r \text{ Flexure}}{S.F} = \frac{24000}{4.00} = 6000 \text{ psi}$$

Loads 200 # at Top of Rail



For Side Mounted



$M_{max} = 200\# * 42" = 8400\ \#\text{-in}$

$$f_b = \frac{M}{S_x} \leq F_b = 6000\ psi$$

$$S_{x\,min} = M/F_b$$

$$\frac{1}{24} b = M/F_b$$

$$b_{min} = 24\, M/F_b = \frac{24 \times 8400}{6000} = 33.6"$$

For Bottom Mounted

$$M_{max} = 200\# * (42" - 4.75")$$

$$= 7450\ \#\text{-in}$$

$$f_b = M/S_x \leq F_b = 6000\ psi$$

$$S_{min} = M/F_b$$

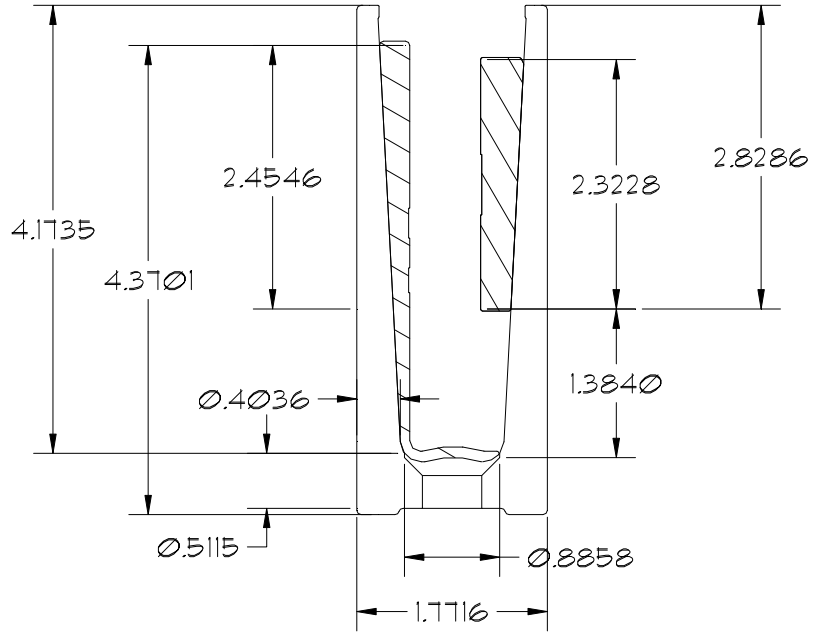
$$1/24\ b = M1/F_b$$

$$b_{min} = \frac{24 * 7450}{6000} = 29.8"$$

Eastern Engineering Group
3401 NW 82nd Avenue Suite 370, Doral, FL 33122-1052
T. 305.599.8133 • F. 305.599.8076 • www.easterneg.com

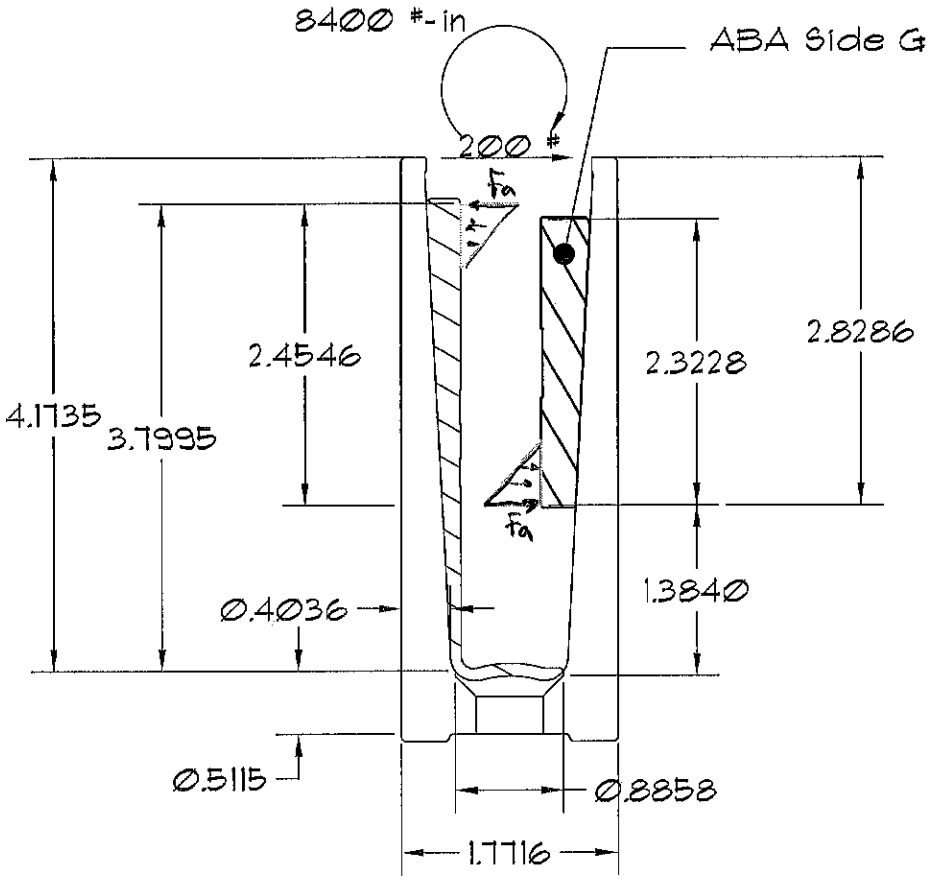
Slim Base Bottom Connected

42” Max Cantilever Glass.



Slim Base Bottom Connected, Steel Connection

(min Glass Width 33.6")

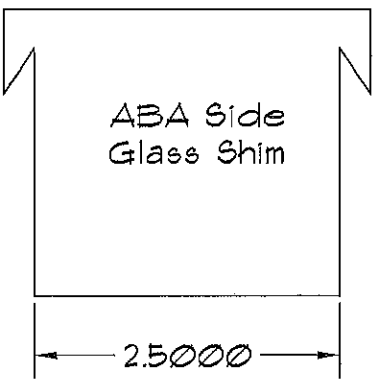


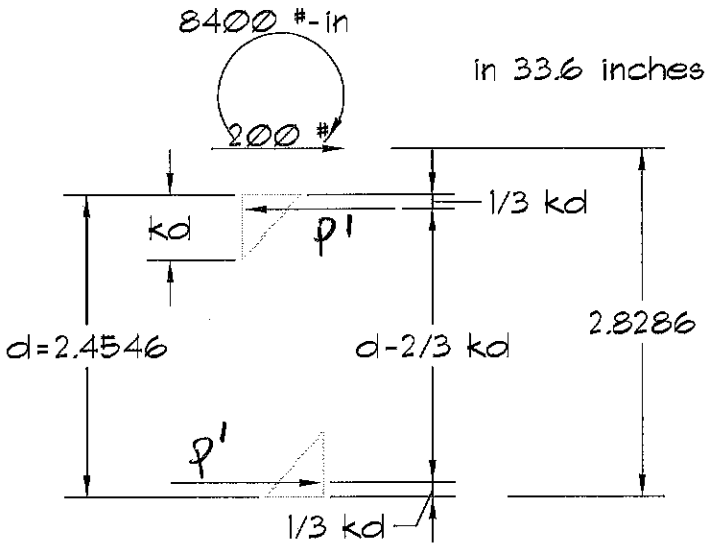
Max yield Comp. for ABA Side Glass Shim
65 Mpa = 9.42 ksi

Using a SF of 2.0

Allowable ABA Comp.
Fa = 4.710 ksi

b = 2.5"* No of ABA in min Glass Width





$p' = \frac{1}{2} Kd * Fa * b$

$$P' = \frac{1}{2} Kd * Fa * b$$

$\circlearrowleft$ @

$\Sigma M_o = 0$ $\qquad$ $Fa = 4710$ psi

$$8400 + 200 * (2.8286 - \tfrac{1}{3} Kd) - P' * (d - 2/3\, kd) = 0$$

$$8400 + 565.72 - \frac{200}{3} Kd - 2.4546 * P' + \tfrac{2}{3} P' Kd = 0$$

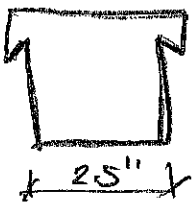
$$8965.72 - \frac{200}{3} Kd - 2.4546 * \frac{1}{2} Kd * Fa * b + \frac{2}{3} * \frac{1}{2} Kd\, Fab * Kd$$

$$8965.72 - \frac{200}{3} Kd - 1.2273\, Kd * Fa * b + \frac{1}{3} Kd^2 * Fa * b = 0$$

$- Kd\left(\frac{200}{3} + 1.2273 Fa * b\right)$

in 33.6"

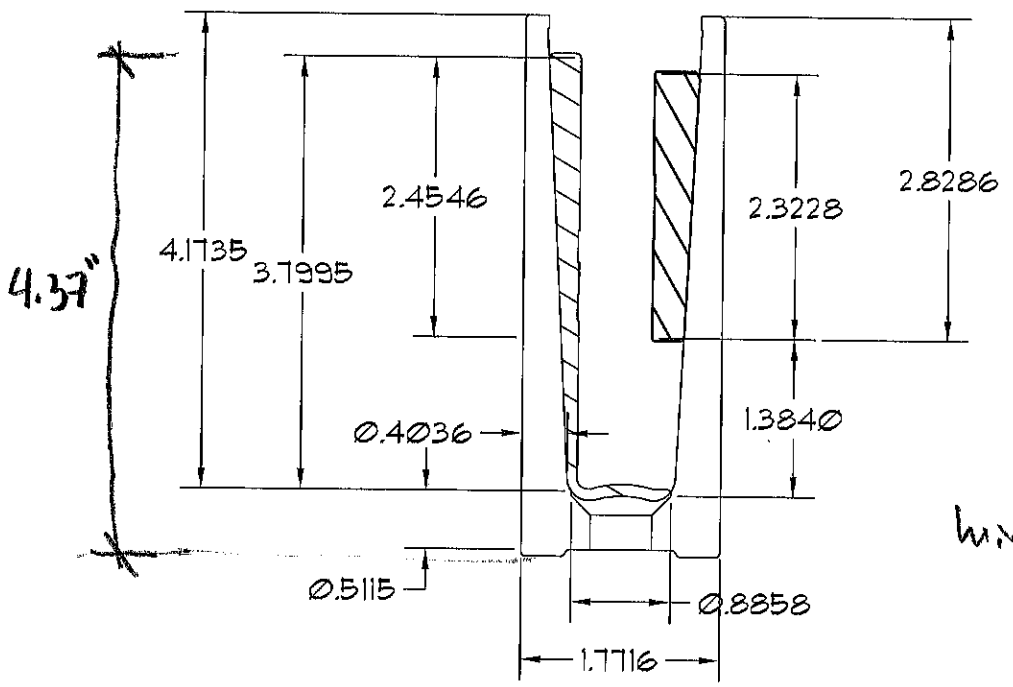
Each ABS glass Side



if spaced at 6" in 33.6"
there will be 6 pieces $b = 2.5 * 6 = 15"$
at 12" in 33.6 $b = 2.5 * 3 = 7.5"$

4710 psi

@	b	Kd	$P = \frac{1}{2} Kd * Fa * b$
6"	15	0.10639	3758
12"	7.5	0.21955	3878



min width = 33.6"

$$S_x\ Leg = \frac{\text{min width} * 0.4036^2}{6}$$

$$S_x\ base = 0.5115^2 \times \left[\text{min width} - 0.8858" \times \left(\frac{33.6"}{\text{bolt@}} + 1\right)\right]$$

$e_{leg} = 3.7995" - \frac{1}{3} Kd$

$e_{base} = 4.37" - \frac{1}{3} Kd.$

$M_{leg} = P' \times (3.7995 - \frac{1}{3} Kd)$

$M_{base} = P' \times 4.37 - \frac{1}{3} Kd$

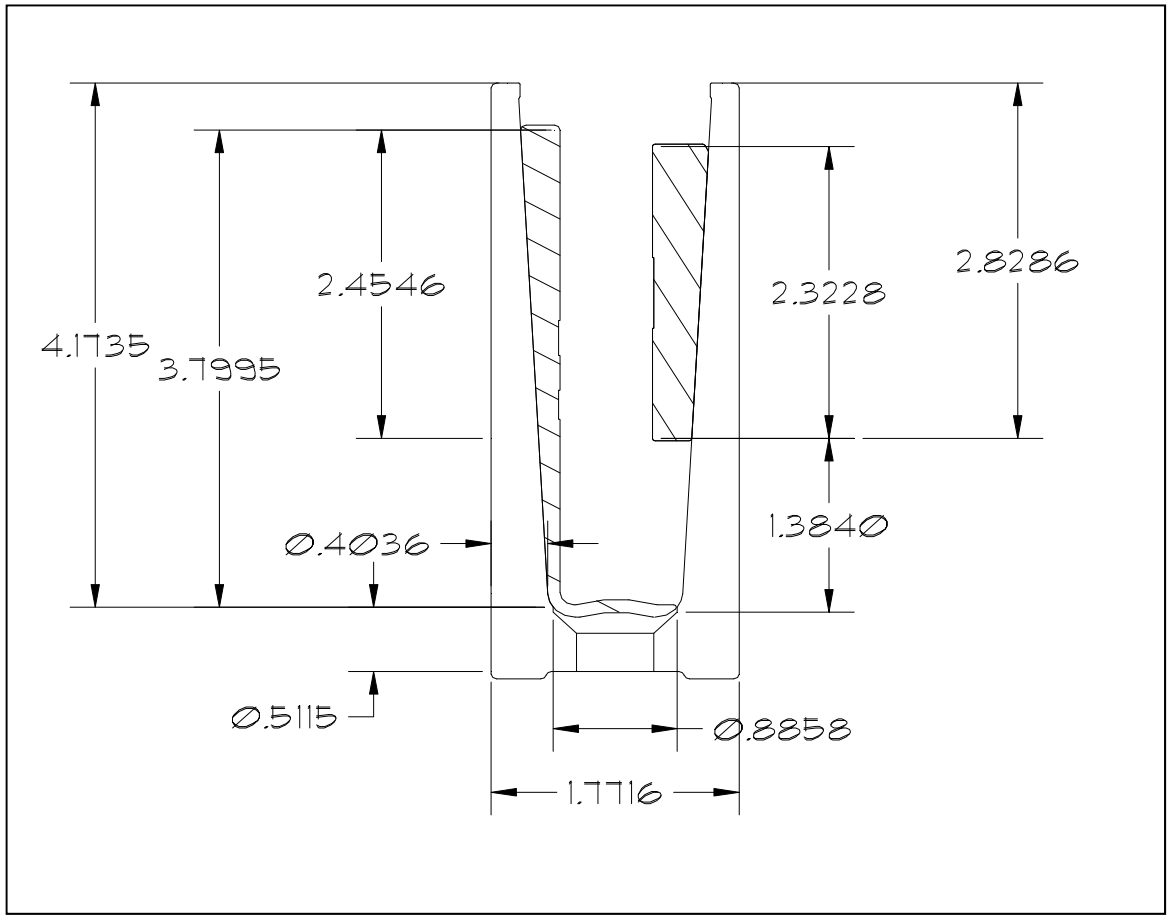
Kd	e_{leg}	e_{base}	S_x leg	S_x Base	M_{leg}	M_{base}	$f_{b\,leg}$	$f_{b\,base}$
0.1064	3.76	4.33	0.91 in^3	1.002 in^3	14146	16291	15.5 ksi	16.3 ksi
0.2196	3.73	3.73			14450	16663	15.8 ksi	16.6 ksi

Use 6061-T6 or 6005-T5

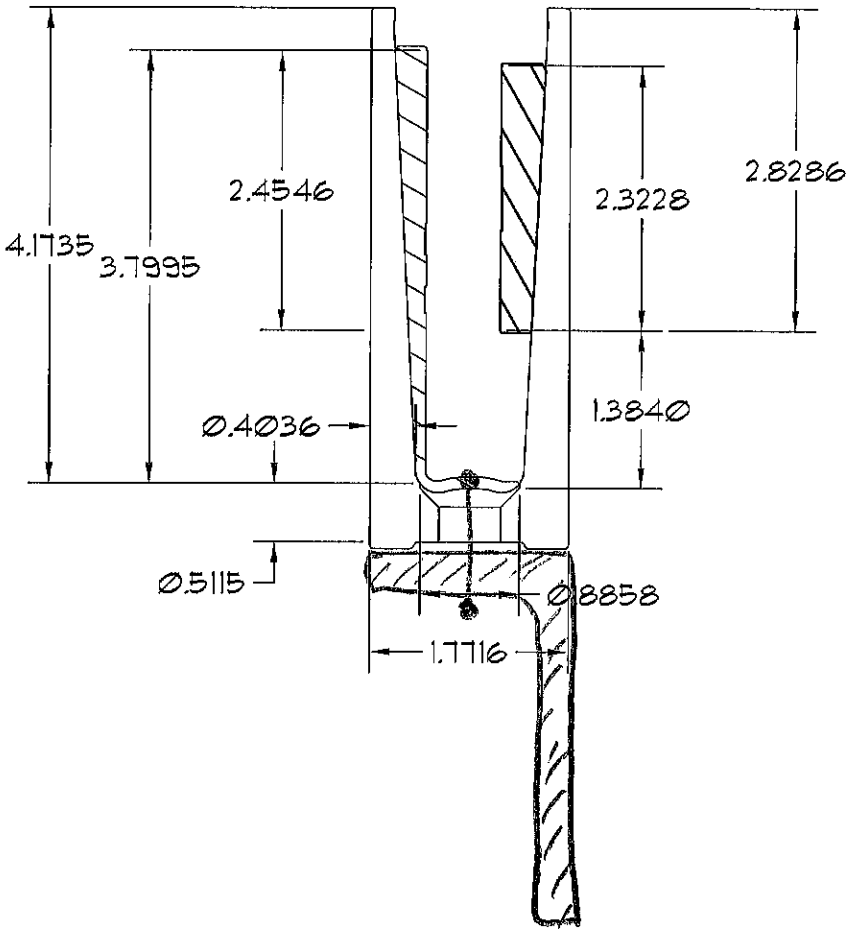
Bottom Mounted

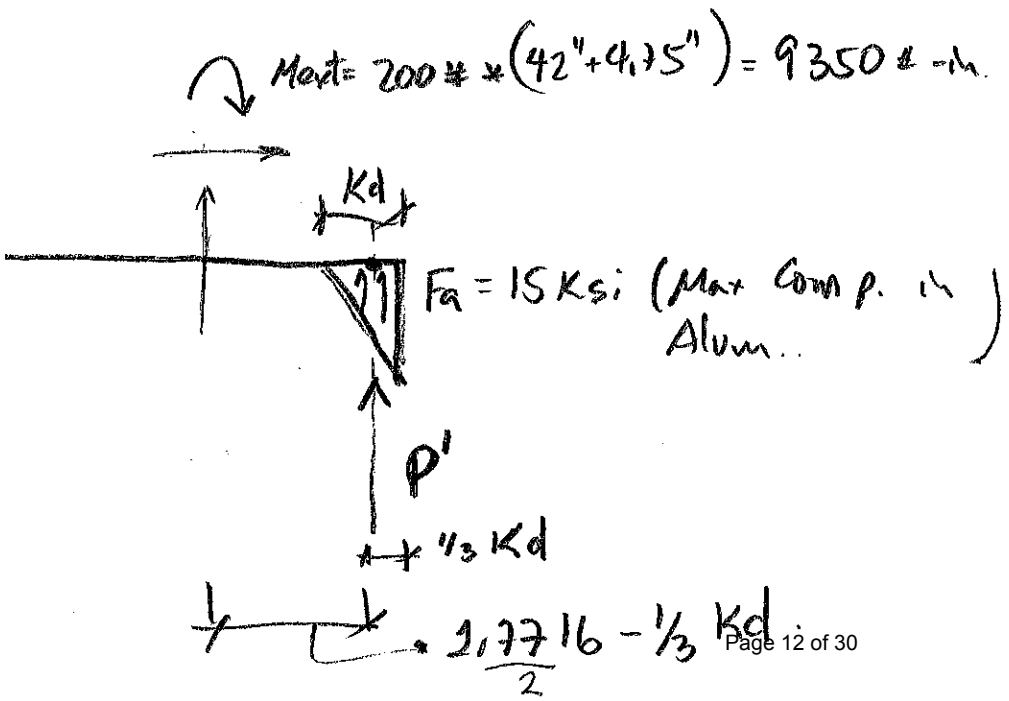
Data						Results	kd Roots		quadratic eq. values		
width	Glass Side @	# Sides	Fa	b	Mext	P'	Root1	Root2	a	b	c
33.6	6	6	4710	15	8400	3758.3	3.578338	0.106393	23550	-86775.4	8965.72
	12	3	4710	7.5	8400	3877.9	3.468006	0.219556	11775	-43421	8965.72

Kd	Glass Side @	P'	Sx at leg	Sx at Base	Bolt @	Ecc Leg	Ecc Base	M leg = Ecc * P'	M Base = Ecc * P'	Fb at Leg	Fb at Base
0.106393	6	3758.3	0.912201	1.001633	3	3.7640	4.3345	14146.5	16290.6	**15508**	**16264**
0.219556	12	3877.9				3.7263	4.2968	14450.3	16662.6	**15841**	**16635**



Slim Base Bottom Connected, Steel Connection





$\circlearrowleft \Sigma M_o = 0$

$$M_{ext} + T * (1.7716 - \tfrac{1}{3} Kd) = 0$$

$$T = P' = \tfrac{1}{2} Kd * Fa * b$$

b = Min width = 33.6"

Fa = 15000 psi

M_{ext} = 9350 #-in.

$$9350 - \tfrac{1}{2} Kd * Fa * b * \left(1.\frac{7716}{2} - \tfrac{1}{3} Kd\right) = 0$$

$$9350 - \frac{1.7716}{4} * Kd * Fa * b + \frac{1}{6} Kd^2 * Fa * b = 0$$

$$84000\, Kd^2 - 223\,221.6\, Kd + 9350 = 0$$

$$Kd = 0.0426$$

$T = \tfrac{1}{2} * 0.0426" * 15000 * 33.6$

$= 10\,735$ # if anchor @ 6"

No Anchors = $\frac{33.6}{6} + 1$

= 6 Anchor

Tension per Anchor = 1789 #

S.S Bolt Tension & Shear Stress Design 15th

Data:

$T_{bolt} := 1.789$ Tension in Anchor (kips)

$\Omega := 2.00$ ASD Factor=2.00

$V_{bolt} := 0.033$ Shear in Anchor (kips)

$F_{nv} := 31.50$ Nominal Shear Strength (ksi) Table J3.2 AISC 16.1-120 .....=0.563*Fu

$F_{nt} := 52.50$ Nominal Tensile Strength (ksi) Table J3.2 AISC 16.1-120.....=0.75*Fu

$D := 0.50$ Screw Diameter (in)

$n := 16.00$ Threads per in..... (AISC-Table 7-17 page 7-81)

$F_v := \frac{F_{nv}}{\Omega}$ $F_v = 15.75$ ksi

$F_t := \frac{F_{nt}}{\Omega}$ $F_t = 26.25$ ksi

$A_{tension} := 0.7854\left(D - \frac{0.9743}{n}\right)^2$ $A_{tension} = 0.15$ in^2

$A_{shear} := \pi \cdot \left(\frac{D}{2}\right)^2$ $A_{shear} = 0.196$ in^2

Check Shear

$f_v := \frac{V_{bolt}}{A_{shear}}$ $f_v = 0.17$ ksi

$V_{allow} := F_v \cdot A_{shear}$ $V_{allow} = 3.09$ kips

$SHEAR := \text{if}\left(f_v \le F_v, \text{"OK"}, \text{"NG"}\right)$ SHEAR = "OK"

Check Tension

$f_t := \frac{T_{bolt}}{A_{tension}}$ $f_t = 11.81$ ksi

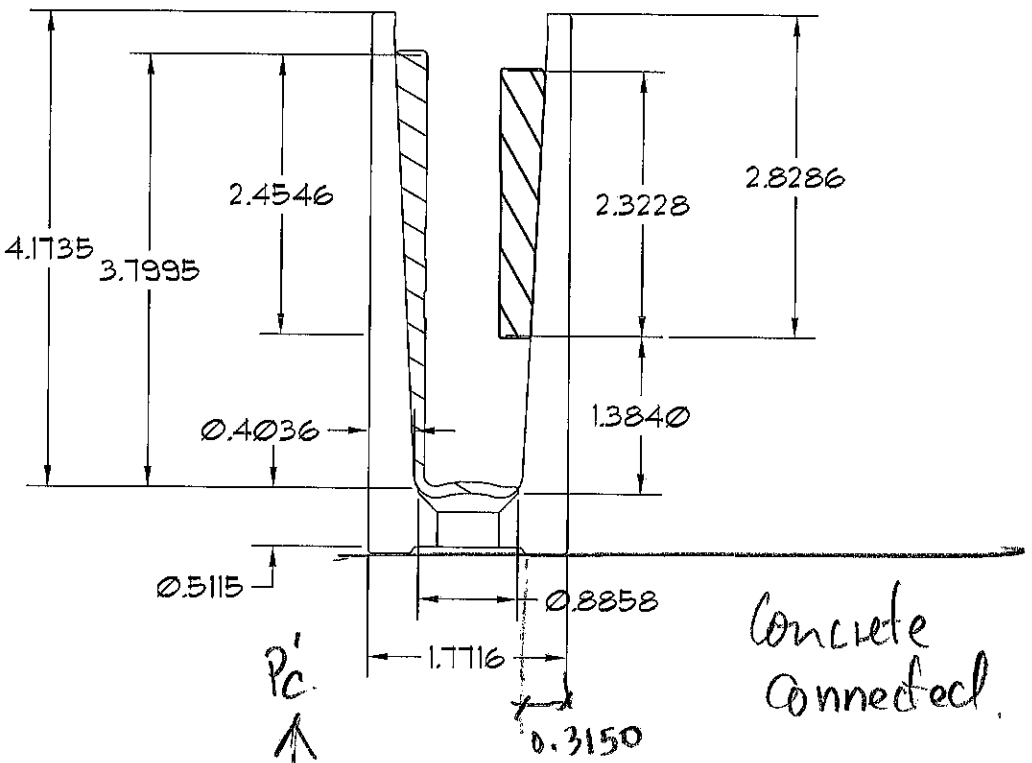
$F'_{nt} := \min\left(F_t, \max\left(0, 1.3F_t - \Omega \cdot \frac{F_t}{F_v} \cdot f_v\right)\right)$ $F'_{nt} = 26.25$ ksi

$T_{allow} := F'_{nt} \cdot A_{tension}$ $T_{allow} = 3.98$ kips

$TENSION := \text{if}\left(T_{bolt} \le T_{allow}, \text{"OK"}, \text{"NG"}\right)$ TENSION= "OK"

Minimum Thread Length

$TL_{min} := \frac{2 \cdot T_{bolt}}{F_v \cdot \pi \cdot \left(D - \frac{0.9743}{n}\right)}$ $TL_{min} = 0.16$ in



Concrete Connected

P_c'

$M = 200\# \times 42"$

$= 8400\ \#\text{-in}$

$F_c' = 0.7 \times 3000\ psi$

T

0.3150"

$\frac{1.77"}{2} - \frac{0.3150}{2}$

$b = 29.8" + 4.75"$

$= 34.55"$

Total Tension in Bolt

$$T_{max} = \frac{8400 \text{ \#-in}}{\left(\frac{1.77}{2} - \frac{0.315}{2}\right)}$$

$= 11546$ # in $29.8" + 9.75 = 39.55"$

Check Concrete Bearing.

Max Conc Bearing $= 0.7 \times 3000 \text{ psi} \times 0.315" \times 29.8"$

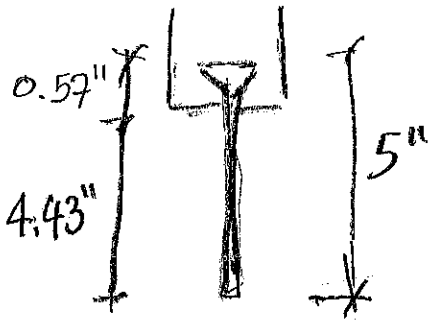
$= 19712$ # > 11546 (OK)

Use $b_{min} = 42"$ No of Anchors if spaced at 6" o.c. $= 7$

Tension per Anchor $= 11546 \text{ \#} / 7 = 1649$ #

Using Power Fasteners

½" ϕ x 5" Flat Head



Using 3½ Embedment ; 6" spacing

Edge Distance 6" min.

Spacing Factor = 0.86 ; Edge Dist Factor = 1.0

Allowable Tension = 1900 x 0.86

= 1634 #

$$\frac{\text{Actual Tension}}{\text{Allowable}} = \frac{1649\ \#}{1634\ \#} = 1.0$$ OK

INSTALLATION SPECIFICATIONS

Carbon Steel Hex Head Power-Bolt

Dimension	Anchor Diameter, *d*					
	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	5/16	3/8	1/2	5/8	3/4
Fixture Clearance Hole, d_h (in.)	5/16	3/8	7/16	9/16	11/16	13/16
Internal Bolt Size (UNC)	10-24	1/4-20	5/16-18	3/8-16	1/2-13	5/8-11
Head Height (in.)	7/64	11/64	13/64	15/64	5/16	25/64
Washer O.D., d_w (in.)	1/2	5/8	13/16	1	1-1/4	1-1/2
Wrench Size (in.)	5/16	7/16	1/2	9/16	3/4	15/16
Max Bolt Torque, T_{max} (ft-lbs)	4	12	25	45	100	120

Carbon Steel Flat Head Power-Bolt (80°–82° head)

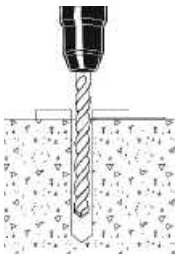
Dimension	Anchor Diameter, *d*		
	3/8"	1/2"	5/8"
ANSI Drill Bit Size, d_{bit} (in.)	3/8	1/2	5/8
Fixture Clearance Hole, d_h (in.)	7/16	9/16	11/16
Internal Bolt Size (UNC)	5/16-18	3/8-16	1/2-13
Head Height (in.)	15/64	1/4	21/64
Head Diameter, d_{hd} (in.)	3/4	7/8	1-1/8
Allen Wrench Size (in.)	7/32	5/16	3/8
Max Bolt Torque, T_{max} (ft-lbs)	25	45	100

Stainless Steel Hex Head Power-Bolt

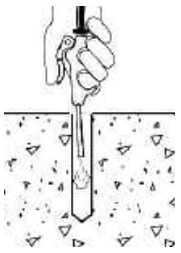
Dimension	Anchor Diameter, *d*				
	1/4"	3/8"	1/2"	5/8"	3/4"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	3/8	1/2	5/8	3/4
Fixture Clearance Hole, d_h (in.)	5/16	7/16	9/16	11/16	13/16
Internal Bolt Size (UNC)	10-24	5/16-18	3/8-16	1/2-13	5/8-11
Head Height (in.)	7/64	13/64	15/64	5/16	25/64
Washer O.D., d_w (in.)	1/2	13/16	1	1-1/4	1-1/2
Wrench Size (in.)	5/16	1/2	9/16	3/4	15/16
Max Bolt Torque, T_{max} (ft-lbs)	3	12	25	60	90

Installation Procedure

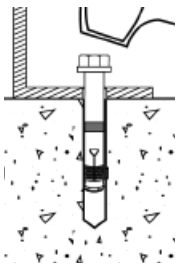
Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15.



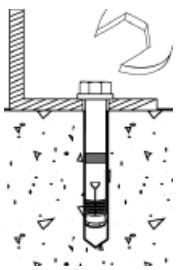
Blow the hole clean of dust and other material. Do not modify the anchor or advance the bolt in the anchor assembly prior to installation.

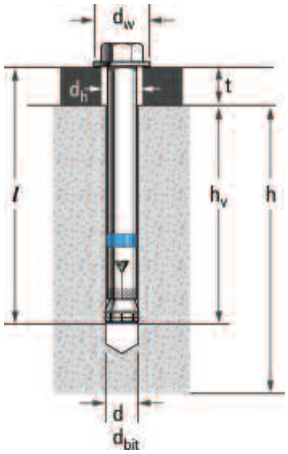


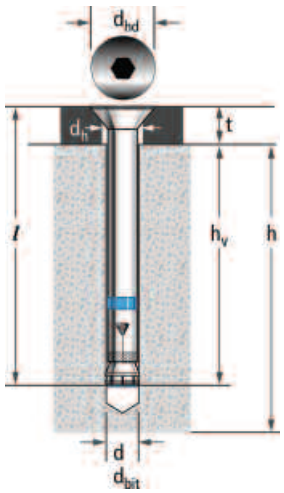
Drive the anchor through the fixture into the anchor hole until the bolt head is firmly seated against the fixture. Be sure the anchor is driven to the required embedment depth.



Tighten the anchor by turning the head 3 to 4 turns past finger tight.







Nomenclature

- *d* = Diameter of anchor
- d_{bit} = Diameter of drill bit
- d_h = Diameter of fixture clearance hole
- d_{hd} = Flat head diameter
- d_w = Diameter of washer
- *h* = Base material thickness. The minimum value of *h* should be 1.5h_v or 3", whichever is greater
- h_v = Minimum embedment depth
- l = Length of anchor
- *t* = Fixture thickness

PERFORMANCE DATA

Allowable Load Capacities for Carbon and Stainless Steel Power-Bolt in Normal-Weight Concrete[1,2,3]

Anchor Diameter d in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**6,000 psi** (41.4 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	1 1/4 (31.8)	295 (1.3)	515 (2.3)	345 (1.6)	525 (2.4)	395 (1.8)	535 (2.4)	415 (1.9)	530 (2.4)
	1 3/4 (44.5)	350 (1.6)	515 (2.3)	390 (1.8)	575 (2.6)	425 (1.9)	635 (2.9)	465 (2.1)	635 (2.9)
	2 1/2 (63.5)	470 (2.1)	515 (2.3)	485 (2.2)	680 (3.1)	500 (2.3)	845 (3.8)	525 (2.4)	845 (3.8)
5/16 (7.9)	1 1/2 (38.1)	580 (2.6)	700 (3.2)	610 (2.7)	750 (3.4)	635 (2.9)	800 (3.6)	655 (2.9)	800 (3.6)
	2 (50.8)	660 (3.0)	820 (3.7)	720 (3.2)	940 (4.2)	780 (3.5)	1,060 (4.8)	820 (3.7)	1,060 (4.8)
	3 (76.2)	720 (3.2)	860 (3.9)	835 (3.8)	1,105 (5.0)	945 (4.3)	1,345 (6.1)	1,065 (4.8)	1,345 (6.1)
3/8 (9.5)	2 (50.8)	875 (3.9)	995 (4.5)	1,010 (4.5)	1,300 (5.9)	1,145 (5.2)	1,605 (7.2)	1,480 (6.7)	1,860 (8.4)
	2 1/2 (63.5)	950 (4.3)	1,095 (4.9)	1,080 (4.9)	1,445 (6.5)	1,215 (5.5)	1,790 (8.1)	1,665 (7.5)	1,990 (9.0)
	3 1/2 (88.9)	1,100 (5.0)	1,245 (5.6)	1,300 (5.9)	1,705 (7.7)	1,500 (6.8)	2,165 (9.7)	1,790 (8.1)	2,165 (9.7)
1/2 (12.7)	2 1/2 (63.5)	1,225 (5.5)	1,710 (7.7)	1,430 (6.4)	1,885 (8.5)	1,630 (7.3)	2,055 (9.2)	1,830 (8.2)	2,055 (9.2)
	3 1/2 (88.9)	1,535 (6.9)	2,135 (9.6)	1,900 (8.6)	2,300 (10.4)	2,260 (10.2)	2,465 (11.1)	2,470 (11.1)	2,695 (12.1)
	5 (127.0)	1,815 (8.2)	2,535 (11.4)	2,120 (9.5)	2,810 (12.6)	2,425 (10.9)	3,080 (13.9)	2,735 (12.3)	3,080 (13.9)
5/8 (15.9)	2 3/4 (69.9)	1,340 (6.0)	1,995 (9.0)	1,635 (7.4)	2,495 (11.2)	1,925 (8.7)	2,995 (13.5)	2,125 (9.6)	2,995 (13.5)
	4 (101.6)	1,615 (7.3)	2,715 (12.2)	2,055 (9.2)	3,180 (14.3)	2,490 (11.2)	3,640 (16.4)	3,275 (14.7)	3,975 (17.9)
	6 (152.4)	2,350 (10.6)	3,445 (15.5)	2,645 (11.9)	4,060 (18.3)	2,935 (13.2)	4,670 (21.0)	3,895 (17.5)	4,670 (21.0)
3/4 (19.1)	3 (76.2)	1,915 (8.6)	3,095 (13.9)	2,145 (9.7)	3,560 (16.0)	2,375 (10.7)	4,025 (18.1)	2,695 (12.1)	4,025 (18.1)
	4 1/2 (114.3)	2,515 (11.3)	4,225 (19.0)	2,800 (12.6)	5,065 (22.8)	3,085 (13.9)	5,900 (26.6)	4,060 (18.3)	5,900 (26.6)
	7 (177.8)	2,945 (13.3)	5,660 (25.5)	3,360 (15.1)	6,470 (29.1)	3,775 (17.0)	7,280 (32.8)	5,495 (24.7)	7,280 (32.8)

1. Allowable load capacities listed are calculated using and applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.
2. Allowable load capacities are multiplied by reduction factors found in the Design Criteria section when anchor spacing or edge distances are less than critical distances.
3. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

DESIGN CRITERIA (ALLOWABLE STRESS DESIGN)

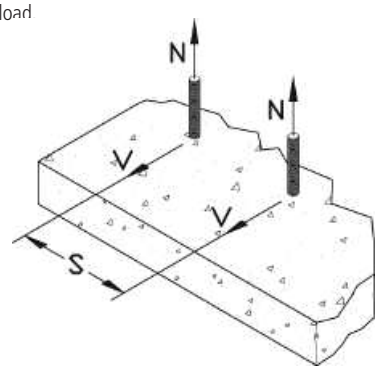
Load Adjustment Factors for Normal-Weight Concrete

Spacing, Tension (F_{NS}) & Shear (F_{VS})

Dia. (in.)		1/4			3/8			1/2			5/8			3/4		
h_v (in.)		1 1/4	1 3/4	2 1/2	2	2 1/2	3 1/2	2 1/2	3 1/2	5	2 3/4	4	6	3	4 1/2	7
s_{cr} (in.)		2 1/2	3 1/2	5	4	5	7	5	7	10	5 1/2	8	12	6	9	14
s_{min} (in.)		1 1/4	1 3/4	2 1/2	2	2 1/2	3 1/2	2 1/2	3 1/2	5	2 3/4	4	6	3	4 1/2	7
Spacing, s (inches)	1 1/4	0.50														
	1 3/4	0.70	0.50													
	2	0.80	0.57		0.50											
	2 1/2	1.00	0.71	0.50	0.63	0.50		0.50								
	2 3/4		0.79	0.55	0.69	0.55		0.55			0.50					
	3		0.86	0.60	0.75	0.60		0.60			0.55			0.50		
	3 1/2		1.00	0.70	0.88	0.70	0.50	0.70	0.50		0.64			0.58		
	4			0.80	1.00	0.80	0.57	0.80	0.57		0.73	0.50		0.67		
	4 1/2			0.90		0.90	0.64	0.90	0.64		0.82	0.56		0.75	0.50	
	5			1.00		1.00	0.71	1.00	0.71	0.50	0.91	0.63		0.83	0.56	
	5 1/2						0.79		0.79	0.55	1.00	0.69		0.92	0.61	
	6						0.86		0.86	0.60		0.75	0.50	1.00	0.67	
	7						1.00		1.00	0.70		0.88	0.58		0.78	0.50
	8									0.80		1.00	0.67		0.89	0.57
	9									0.90			0.75		1.00	0.64
	10									1.00			0.83			0.71
	12												1.00			0.86
	14															1.00

Notes: For anchors loaded in tension and shear, the critical spacing (s_{cr}) is equal to 2 embedment depths ($2\,h_v$) at which the anchor achieves 100% of load.

Minimum spacing (s_{min}) is equal to 1 embedment depth (h_v) at which the anchor achieves 50% of load.

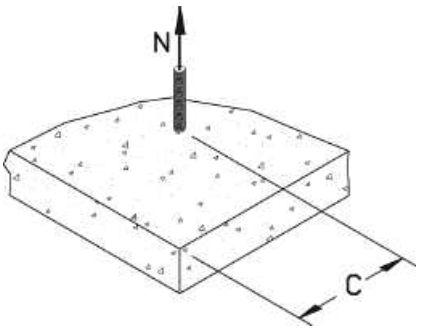


Edge Distance, Tension (F_{NC})

Dia. (in.)		1/4	3/8	1/2	5/8	3/4
c_{cr} (in.)		3	4 1/2	6	7 1/2	9
c_{min} (in.)		1 1/4	1 7/8	2 1/2	3 1/8	3 3/4
Edge Distance, c (inches)	1 1/4	0.70				
	1 5/8	0.76				
	1 7/8	0.81	0.70			
	2	0.83	0.71			
	2 1/2	0.91	0.77	0.70		
	3	1.00	0.83	0.74		
	3 1/8		0.84	0.75	0.70	
	3 3/4		0.91	0.81	0.74	0.70
	4		0.94	0.83	0.76	0.71
	4 1/2		1.00	0.87	0.79	0.74
	5			0.91	0.83	0.77
	6			1.00	0.90	0.83
	6 1/4				0.91	0.84
	7				0.97	0.89
	7 1/2				1.00	0.91
	8					0.94
	9					1.00

Notes: For anchors loaded in tension, the critical edge distance (c_{cr}) is equal to 12 anchor diameters ($12d$) at which the anchor achieves 100% of load.

Minimum edge distance (c_{min}) is equal to 5 anchor diameters ($5d$) at which the anchor achieves 70% of load.

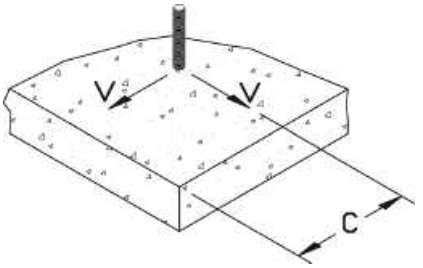


Edge Distance, Shear (F_{VC})

Dia. (in.)		1/4	3/8	1/2	5/8	3/4
c_{cr} (in.)		3	4 1/2	6	7 1/2	9
c_{min} (in.)		1 1/4	1 7/8	2 1/2	3 1/8	3 3/4
Edge Distance, c (inches)	1 1/4	0.35				
	1 5/8	0.49				
	1 7/8	0.58	0.35			
	2	0.63	0.38			
	2 1/2	0.81	0.50	0.35		
	3	1.00	0.63	0.44		
	3 1/8		0.66	0.47	0.35	
	3 3/4		0.81	0.58	0.44	0.35
	4		0.88	0.63	0.48	0.38
	4 1/2		1.00	0.72	0.55	0.44
	5			0.81	0.63	0.50
	6			1.00	0.78	0.63
	6 1/4				0.81	0.66
	7				0.93	0.75
	7 1/2				1.00	0.81
	8					0.88
	9					1.00

Notes: For anchors loaded in shear, the critical edge distance (c_{cr}) is equal to 12 anchor diameters ($12d$) at which the anchor achieves 100% of load.

Minimum edge distance (c_{min}) is equal to 5 anchor diameters ($5d$) at which the anchor achieves 35% of load.



ORDERING INFORMATION

Carbon Steel Hex Head Power-Bolt

Cat. No.	Anchor Size	Drill Dia.	Min. Embed.	Std. Box	Std. Carton	Wt./100
6900	1/4" x 1"	1/4"	7/8"	100	600	2
6902	1/4" x 1 3/4"	1/4"	1-1/4"	100	600	3
6906	1/4" x 3"	1/4"	1-1/4"	100	600	5
6907	5/16" x 1 3/4"	5/16"	1-1/2"	100	600	5
6908	5/16" x 2 1/2"	5/16"	1-1/2"	50	300	6
6909	5/16" x 3 1/2"	5/16"	1-1/2"	50	300	8
6911*	3/8" x 1 7/8"	3/8"	1-1/4"	50	300	6
6910	3/8" x 2 1/4"	3/8"	2"	50	300	8
6913	3/8" x 3"	3/8"	2"	50	300	11
6914	3/8" x 3 1/2"	3/8"	2"	50	300	12
6916	3/8" x 4"	3/8"	2"	50	300	14
6930	1/2" x 2 3/4"	1/2"	2-1/2"	50	200	16
6932	1/2" x 3 3/4"	1/2"	2-1/2"	25	150	21
6934	1/2" x 4 3/4"	1/2"	2-1/2"	25	150	26
6936	1/2" x 5 3/4"	1/2"	2-1/2"	25	150	32
6940	5/8" x 3"	5/8"	2-3/4"	20	120	28
6942	5/8" x 4"	5/8"	2-3/4"	15	90	40
6944	5/8" x 5"	5/8"	2-3/4"	15	90	47
6945	5/8" x 6"	5/8"	2-3/4"	15	90	57
6947	5/8" x 8 1/2"	5/8"	2-3/4"	10	40	77
6950	3/4" x 3 1/4"	3/4"	3"	15	90	47
6952	3/4" x 4 1/4"	3/4"	3"	10	60	58
6954	3/4" x 5 1/4"	3/4"	3"	10	60	70
6956	3/4" x 7 1/4"	3/4"	3"	10	40	105
6957	3/4" x 8 1/4"	3/4"	3"	10	40	110

The published length is measured from below the washer to the end of the anchor.
*This size does not have a compression ring.

Carbon Steel Flat Head Power-Bolt

Cat. No.	Anchor Size	Drill Dia.	Min. Embed.	Std. Box	Std. Carton	Wt./100
6981	3/8" x 3 3/4"	3/8"	2"	50	300	14
6982	3/8" x 5"	3/8"	2"	50	300	17
6983	3/8" x 6"	3/8"	2"	50	300	20
6984	1/2" x 5"	1/2"	2-1/2"	25	150	26
6987	5/8" x 5 1/2"	5/8"	2-3/4"	15	90	57

The published length is the overall length of the anchor.
The flat head Power-Bolt anchor has a hex key insert formed in the head of the bolt.
Each box contains an Allen wrench which matches the insert size.

Stainless Steel Hex Head Power-Bolt

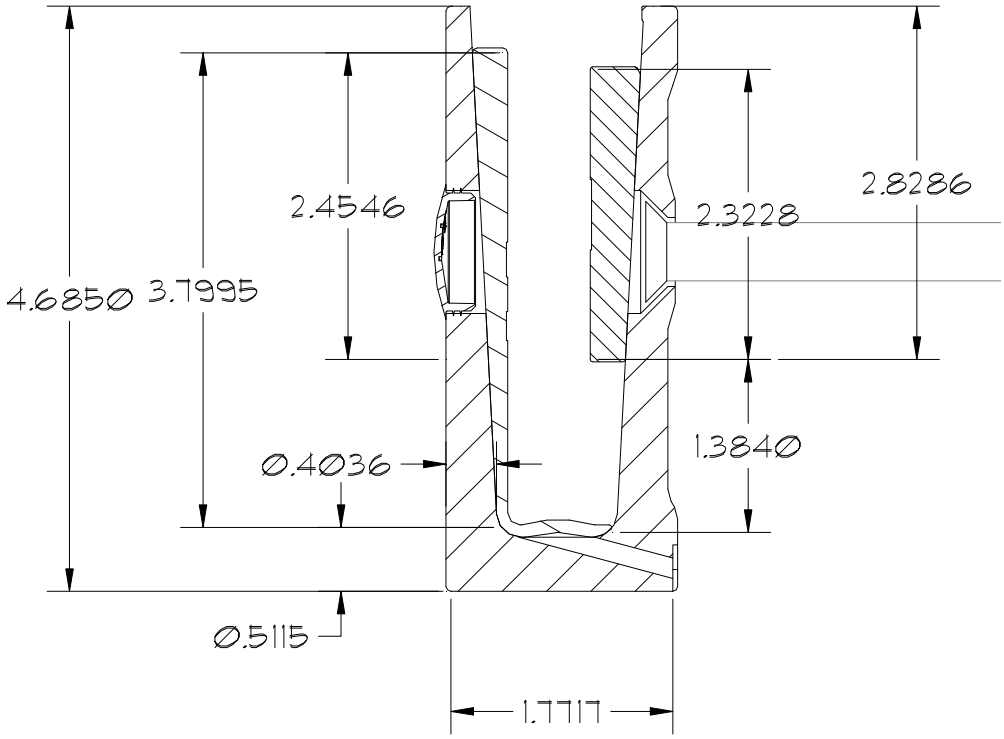
Cat. No.	Anchor Size	Drill Dia.	Min. Embed.	Std. Box	Std. Carton	Wt./100
5902	1/4" x 1 3/4"	1/4"	1-1/4"	100	600	3
5906	1/4" x 3"	1/4"	1-1/4"	100	600	5
5910	3/8" x 2 1/4"	3/8"	2"	50	300	10
5914	3/8" x 3 1/2"	3/8"	2"	50	300	12
5916	3/8" x 4"	3/8"	2"	50	300	14
5930	1/2" x 2 3/4"	1/2"	2-1/2"	50	200	16
5934	1/2" x 4 3/4"	1/2"	2-1/2"	25	150	26

The published length is measured from below the washer to the end of the anchor.

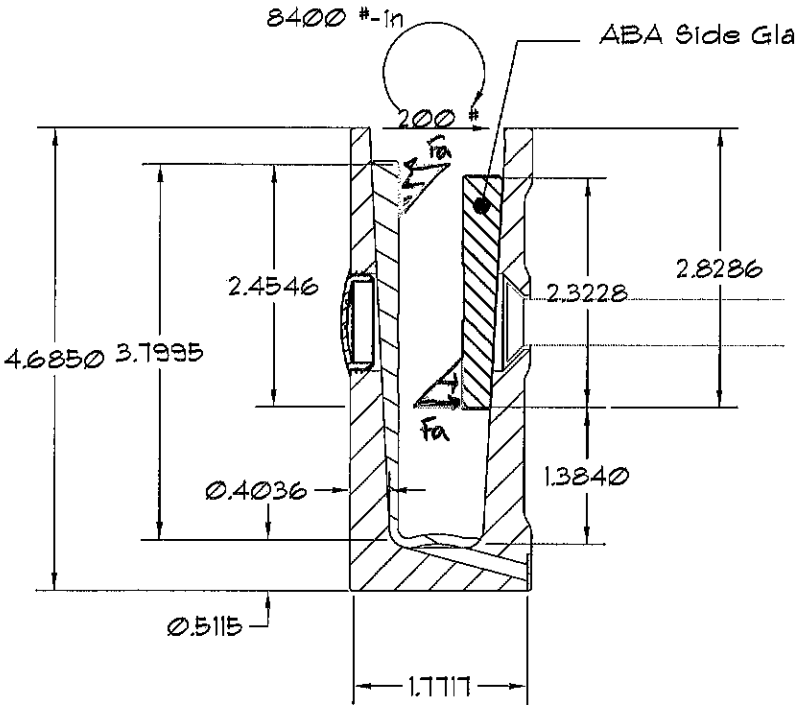
Eastern Engineering Group
3401 NW 82nd Avenue Suite 370, Doral, FL 33122-1052
T. 305.599.8133 • F. 305.599.8076 • www.easterneg.com

Slim Base Side Connected

42” Max Cantilever Glass.



SIDE MOUNTED (min Glass Width 33.6")

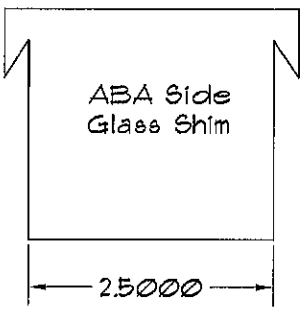


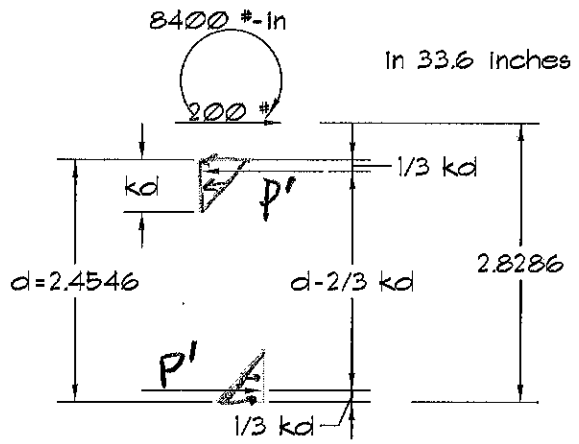
Max yield Comp. for ABA Side Glass Shim 65 Mpa = 9.42 ksi

Using a SF of 2.0

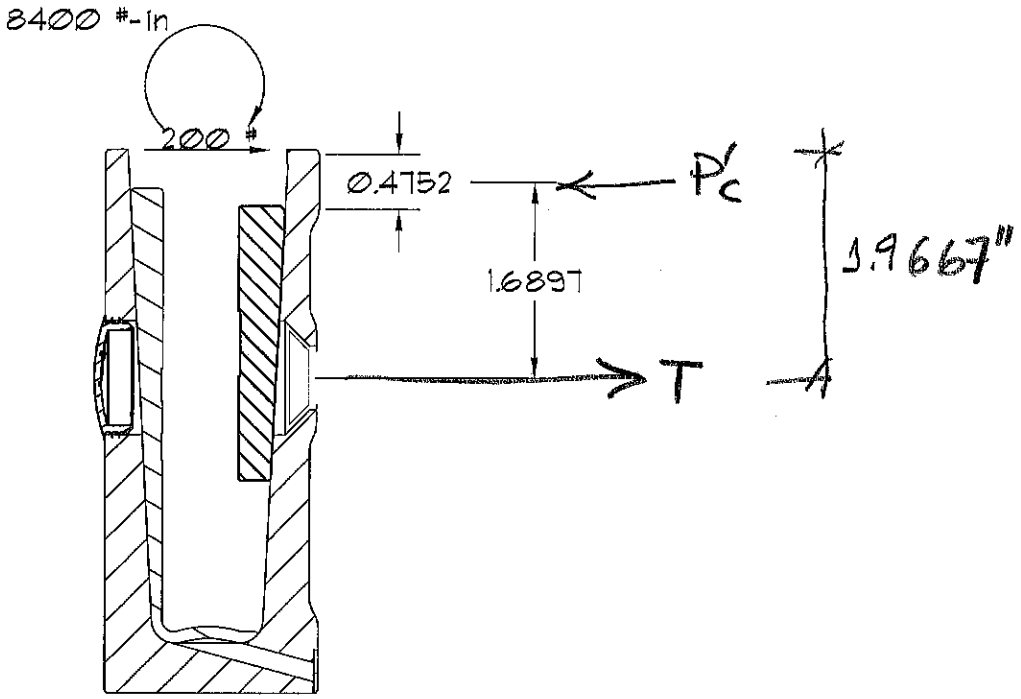
Allowable ABA Comp. Fa = 4.710 ksi

b = 2.5" * No of ABA in min Glass Width





Base and Legs same as previous Design



$$P'_c = \frac{8400 + (200 * 1.9667)}{1.6897} = 5204\ \#$$

Check concrete Bearing

$$f'_c = \frac{5204\ \#}{0.4752" * 33.6"} = 325\ psi \leq 0.3 * 3000\ psi\ (2100\ psi)$$

OK

if anchors @ 6" in 33.6" + 4.75" there will be

7 Anchors

Tension per Bolt = $\frac{5204\#}{7 \text{ Anchors}} = 743\#$

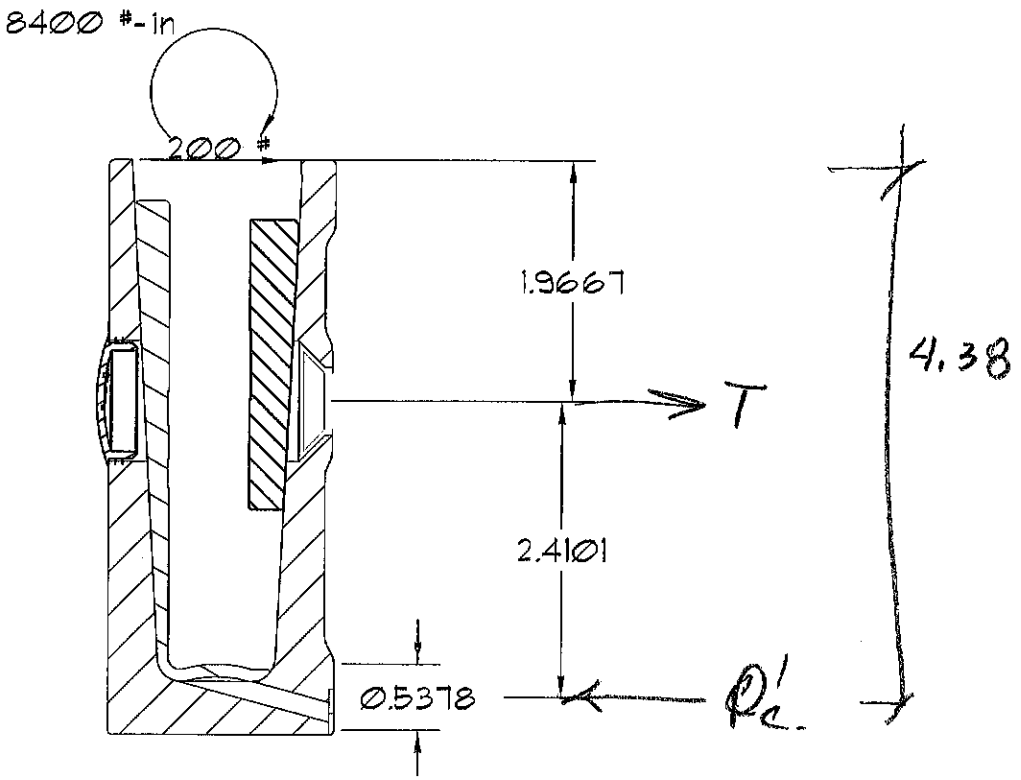
Using 3/8" Power fasteners with 6" Spacing 3½" Embedment and 1.97" Edge Distance.

Spacing factor = 0.86 for 6" spacing ; Edge Dist factor = 0.70 for 1.97"

Allowable Tension = 1300# * 0.86 * 0.7.

= 783# > 743#

OK



$$T_{\text{Total}} = \frac{8400\ \#\text{-in} + 200\ \# * 4.38\text{"}}{2.41} = 3849\ \#$$

$$T_{\text{per anchor}} = \frac{3849\ \#}{7} = 550\ \# \leq 783\ \#$$

OK

INSTALLATION SPECIFICATIONS

Carbon Steel Hex Head Power-Bolt

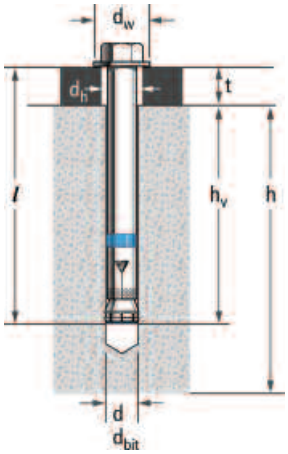
Dimension	Anchor Diameter, *d*					
	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	5/16	3/8	1/2	5/8	3/4
Fixture Clearance Hole, d_h (in.)	5/16	3/8	7/16	9/16	11/16	13/16
Internal Bolt Size (UNC)	10-24	1/4-20	5/16-18	3/8-16	1/2-13	5/8-11
Head Height (in.)	7/64	11/64	13/64	15/64	5/16	25/64
Washer O.D., d_w (in.)	1/2	5/8	13/16	1	1-1/4	1-1/2
Wrench Size (in.)	5/16	7/16	1/2	9/16	3/4	15/16
Max Bolt Torque, T_{max} (ft-lbs)	4	12	25	45	100	120

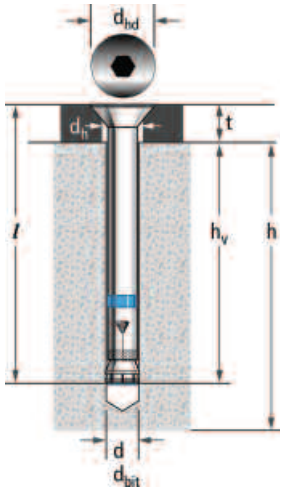
Carbon Steel Flat Head Power-Bolt (80°–82° head)

Dimension	Anchor Diameter, *d*		
	3/8"	1/2"	5/8"
ANSI Drill Bit Size, d_{bit} (in.)	3/8	1/2	5/8
Fixture Clearance Hole, d_h (in.)	7/16	9/16	11/16
Internal Bolt Size (UNC)	5/16-18	3/8-16	1/2-13
Head Height (in.)	15/64	1/4	21/64
Head Diameter, d_{hd} (in.)	3/4	7/8	1-1/8
Allen Wrench Size (in.)	7/32	5/16	3/8
Max Bolt Torque, T_{max} (ft-lbs)	25	45	100

Stainless Steel Hex Head Power-Bolt

Dimension	Anchor Diameter, *d*				
	1/4"	3/8"	1/2"	5/8"	3/4"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	3/8	1/2	5/8	3/4
Fixture Clearance Hole, d_h (in.)	5/16	7/16	9/16	11/16	13/16
Internal Bolt Size (UNC)	10-24	5/16-18	3/8-16	1/2-13	5/8-11
Head Height (in.)	7/64	13/64	15/64	5/16	25/64
Washer O.D., d_w (in.)	1/2	13/16	1	1-1/4	1-1/2
Wrench Size (in.)	5/16	1/2	9/16	3/4	15/16
Max Bolt Torque, T_{max} (ft-lbs)	3	12	25	60	90



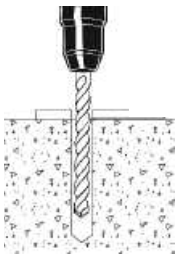


Nomenclature

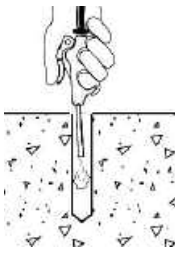
- d = Diameter of anchor
- d_{bit} = Diameter of drill bit
- d_h = Diameter of fixture clearance hole
- d_{hd} = Flat head diameter
- d_w = Diameter of washer
- h = Base material thickness. The minimum value of h should be $1.5h_v$ or 3", whichever is greater
- h_v = Minimum embedment depth
- l = Length of anchor
- t = Fixture thickness

Installation Procedure

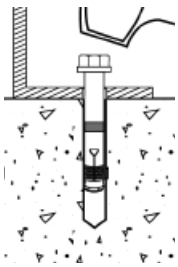
Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15.



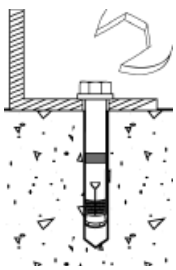
Blow the hole clean of dust and other material. Do not modify the anchor or advance the bolt in the anchor assembly prior to installation.



Drive the anchor through the fixture into the anchor hole until the bolt head is firmly seated against the fixture. Be sure the anchor is driven to the required embedment depth.



Tighten the anchor by turning the head 3 to 4 turns past finger tight.



PERFORMANCE DATA

Allowable Load Capacities for Carbon and Stainless Steel Power-Bolt in Normal-Weight Concrete[1,2,3]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**6,000 psi** (41.4 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	1 1/4 (31.8)	295 (1.3)	515 (2.3)	345 (1.6)	525 (2.4)	395 (1.8)	535 (2.4)	415 (1.9)	530 (2.4)
	1 3/4 (44.5)	350 (1.6)	515 (2.3)	390 (1.8)	575 (2.6)	425 (1.9)	635 (2.9)	465 (2.1)	635 (2.9)
	2 1/2 (63.5)	470 (2.1)	515 (2.3)	485 (2.2)	680 (3.1)	500 (2.3)	845 (3.8)	525 (2.4)	845 (3.8)
5/16 (7.9)	1 1/2 (38.1)	580 (2.6)	700 (3.2)	610 (2.7)	750 (3.4)	635 (2.9)	800 (3.6)	655 (2.9)	800 (3.6)
	2 (50.8)	660 (3.0)	820 (3.7)	720 (3.2)	940 (4.2)	780 (3.5)	1,060 (4.8)	820 (3.7)	1,060 (4.8)
	3 (76.2)	720 (3.2)	860 (3.9)	835 (3.8)	1,105 (5.0)	945 (4.3)	1,345 (6.1)	1,065 (4.8)	1,345 (6.1)
3/8 (9.5)	2 (50.8)	875 (3.9)	995 (4.5)	1,010 (4.5)	1,300 (5.9)	1,145 (5.2)	1,605 (7.2)	1,480 (6.7)	1,860 (8.4)
	2 1/2 (63.5)	950 (4.3)	1,095 (4.9)	1,080 (4.9)	1,445 (6.5)	1,215 (5.5)	1,790 (8.1)	1,665 (7.5)	1,990 (9.0)
	3 1/2 (88.9)	1,100 (5.0)	1,245 (5.6)	1,300 (5.9)	1,705 (7.7)	1,500 (6.8)	2,165 (9.7)	1,790 (8.1)	2,165 (9.7)
1/2 (12.7)	2 1/2 (63.5)	1,225 (5.5)	1,710 (7.7)	1,430 (6.4)	1,885 (8.5)	1,630 (7.3)	2,055 (9.2)	1,830 (8.2)	2,055 (9.2)
	3 1/2 (88.9)	1,535 (6.9)	2,135 (9.6)	1,900 (8.6)	2,300 (10.4)	2,260 (10.2)	2,465 (11.1)	2,470 (11.1)	2,695 (12.1)
	5 (127.0)	1,815 (8.2)	2,535 (11.4)	2,120 (9.5)	2,810 (12.6)	2,425 (10.9)	3,080 (13.9)	2,735 (12.3)	3,080 (13.9)
5/8 (15.9)	2 3/4 (69.9)	1,340 (6.0)	1,995 (9.0)	1,635 (7.4)	2,495 (11.2)	1,925 (8.7)	2,995 (13.5)	2,125 (9.6)	2,995 (13.5)
	4 (101.6)	1,615 (7.3)	2,715 (12.2)	2,055 (9.2)	3,180 (14.3)	2,490 (11.2)	3,640 (16.4)	3,275 (14.7)	3,975 (17.9)
	6 (152.4)	2,350 (10.6)	3,445 (15.5)	2,645 (11.9)	4,060 (18.3)	2,935 (13.2)	4,670 (21.0)	3,895 (17.5)	4,670 (21.0)
3/4 (19.1)	3 (76.2)	1,915 (8.6)	3,095 (13.9)	2,145 (9.7)	3,560 (16.0)	2,375 (10.7)	4,025 (18.1)	2,695 (12.1)	4,025 (18.1)
	4 1/2 (114.3)	2,515 (11.3)	4,225 (19.0)	2,800 (12.6)	5,065 (22.8)	3,085 (13.9)	5,900 (26.6)	4,060 (18.3)	5,900 (26.6)
	7 (177.8)	2,945 (13.3)	5,660 (25.5)	3,360 (15.1)	6,470 (29.1)	3,775 (17.0)	7,280 (32.8)	5,495 (24.7)	7,280 (32.8)

1. Allowable load capacities listed are calculated using and applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.
2. Allowable load capacities are multiplied by reduction factors found in the Design Criteria section when anchor spacing or edge distances are less than critical distances.
3. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

DESIGN CRITERIA (ALLOWABLE STRESS DESIGN)

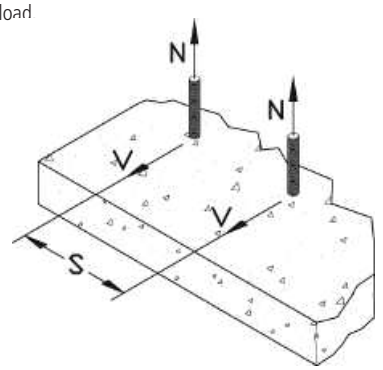
Load Adjustment Factors for Normal-Weight Concrete

Spacing, Tension (F_{NS}) & Shear (F_{VS})

Dia. (in.)		1/4			3/8			1/2			5/8			3/4		
h_v (in.)		1 1/4	1 3/4	2 1/2	2	2 1/2	3 1/2	2 1/2	3 1/2	5	2 3/4	4	6	3	4 1/2	7
s_{cr} (in.)		2 1/2	3 1/2	5	4	5	7	5	7	10	5 1/2	8	12	6	9	14
s_{min} (in.)		1 1/4	1 3/4	2 1/2	2	2 1/2	3 1/2	2 1/2	3 1/2	5	2 3/4	4	6	3	4 1/2	7
Spacing, s (inches)	1 1/4	0.50														
	1 3/4	0.70	0.50													
	2	0.80	0.57		0.50											
	2 1/2	1.00	0.71	0.50	0.63	0.50		0.50								
	2 3/4		0.79	0.55	0.69	0.55		0.55			0.50					
	3		0.86	0.60	0.75	0.60		0.60			0.55			0.50		
	3 1/2		1.00	0.70	0.88	0.70	0.50	0.70	0.50		0.64			0.58		
	4			0.80	1.00	0.80	0.57	0.80	0.57		0.73	0.50		0.67		
	4 1/2			0.90		0.90	0.64	0.90	0.64		0.82	0.56		0.75	0.50	
	5			1.00		1.00	0.71	1.00	0.71	0.50	0.91	0.63		0.83	0.56	
	5 1/2						0.79		0.79	0.55	1.00	0.69		0.92	0.61	
	6						0.86		0.86	0.60		0.75	0.50	1.00	0.67	
	7						1.00		1.00	0.70		0.88	0.58		0.78	0.50
	8									0.80		1.00	0.67		0.89	0.57
	9									0.90			0.75		1.00	0.64
	10									1.00			0.83			0.71
	12												1.00			0.86
	14															1.00

Notes: For anchors loaded in tension and shear, the critical spacing (s_{cr}) is equal to 2 embedment depths ($2\,h_v$) at which the anchor achieves 100% of load.

Minimum spacing (s_{min}) is equal to 1 embedment depth (h_v) at which the anchor achieves 50% of load

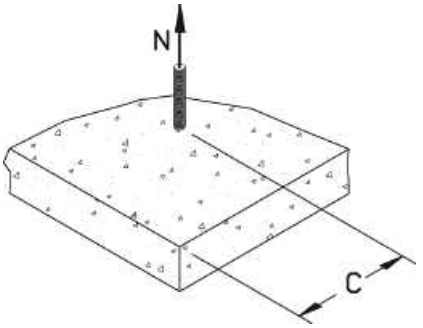


Edge Distance, Tension (F_{NC})

Dia. (in.)		1/4	3/8	1/2	5/8	3/4
c_{cr} (in.)		3	4 1/2	6	7 1/2	9
c_{min} (in.)		1 1/4	1 7/8	2 1/2	3 1/8	3 3/4
Edge Distance, c (inches)	1 1/4	0.70				
	1 5/8	0.76				
	1 7/8	0.81	0.70			
	2	0.83	0.71			
	2 1/2	0.91	0.77	0.70		
	3	1.00	0.83	0.74		
	3 1/8		0.84	0.75	0.70	
	3 3/4		0.91	0.81	0.74	0.70
	4		0.94	0.83	0.76	0.71
	4 1/2		1.00	0.87	0.79	0.74
	5			0.91	0.83	0.77
	6			1.00	0.90	0.83
	6 1/4				0.91	0.84
	7				0.97	0.89
	7 1/2				1.00	0.91
	8					0.94
	9					1.00

Notes: For anchors loaded in tension, the critical edge distance (c_{cr}) is equal to 12 anchor diameters ($12d$) at which the anchor achieves 100% of load.

Minimum edge distance (c_{min}) is equal to 5 anchor diameters ($5d$) at which the anchor achieves 70% of load.

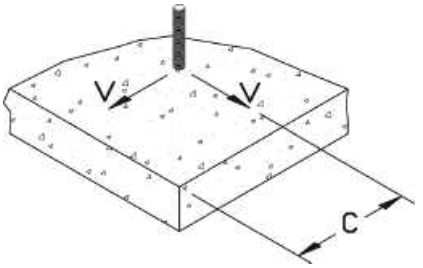


Edge Distance, Shear (F_{VC})

Dia. (in.)		1/4	3/8	1/2	5/8	3/4
c_{cr} (in.)		3	4 1/2	6	7 1/2	9
c_{min} (in.)		1 1/4	1 7/8	2 1/2	3 1/8	3 3/4
Edge Distance, c (inches)	1 1/4	0.35				
	1 5/8	0.49				
	1 7/8	0.58	0.35			
	2	0.63	0.38			
	2 1/2	0.81	0.50	0.35		
	3	1.00	0.63	0.44		
	3 1/8		0.66	0.47	0.35	
	3 3/4		0.81	0.58	0.44	0.35
	4		0.88	0.63	0.48	0.38
	4 1/2		1.00	0.72	0.55	0.44
	5			0.81	0.63	0.50
	6			1.00	0.78	0.63
	6 1/4				0.81	0.66
	7				0.93	0.75
	7 1/2				1.00	0.81
	8					0.88
	9					1.00

Notes: For anchors loaded in shear, the critical edge distance (c_{cr}) is equal to 12 anchor diameters ($12d$) at which the anchor achieves 100% of load.

Minimum edge distance (c_{min}) is equal to 5 anchor diameters ($5d$) at which the anchor achieves 35% of load.



ORDERING INFORMATION

Carbon Steel Hex Head Power-Bolt

Cat. No.	Anchor Size	Drill Dia.	Min. Embed.	Std. Box	Std. Carton	Wt./100
6900	1/4" x 1"	1/4"	7/8"	100	600	2
6902	1/4" x 1 3/4"	1/4"	1-1/4"	100	600	3
6906	1/4" x 3"	1/4"	1-1/4"	100	600	5
6907	5/16" x 1 3/4"	5/16"	1-1/2"	100	600	5
6908	5/16" x 2 1/2"	5/16"	1-1/2"	50	300	6
6909	5/16" x 3 1/2"	5/16"	1-1/2"	50	300	8
6911*	3/8" x 1 7/8"	3/8"	1-1/4"	50	300	6
6910	3/8" x 2 1/4"	3/8"	2"	50	300	8
6913	3/8" x 3"	3/8"	2"	50	300	11
6914	3/8" x 3 1/2"	3/8"	2"	50	300	12
6916	3/8" x 4"	3/8"	2"	50	300	14
6930	1/2" x 2 3/4"	1/2"	2-1/2"	50	200	16
6932	1/2" x 3 3/4"	1/2"	2-1/2"	25	150	21
6934	1/2" x 4 3/4"	1/2"	2-1/2"	25	150	26
6936	1/2" x 5 3/4"	1/2"	2-1/2"	25	150	32
6940	5/8" x 3"	5/8"	2-3/4"	20	120	28
6942	5/8" x 4"	5/8"	2-3/4"	15	90	40
6944	5/8" x 5"	5/8"	2-3/4"	15	90	47
6945	5/8" x 6"	5/8"	2-3/4"	15	90	57
6947	5/8" x 8 1/2"	5/8"	2-3/4"	10	40	77
6950	3/4" x 3 1/4"	3/4"	3"	15	90	47
6952	3/4" x 4 1/4"	3/4"	3"	10	60	58
6954	3/4" x 5 1/4"	3/4"	3"	10	60	70
6956	3/4" x 7 1/4"	3/4"	3"	10	40	105
6957	3/4" x 8 1/4"	3/4"	3"	10	40	110

The published length is measured from below the washer to the end of the anchor.
*This size does not have a compression ring.

Carbon Steel Flat Head Power-Bolt

Cat. No.	Anchor Size	Drill Dia.	Min. Embed.	Std. Box	Std. Carton	Wt./100
6981	3/8" x 3 3/4"	3/8"	2"	50	300	14
6982	3/8" x 5"	3/8"	2"	50	300	17
6983	3/8" x 6"	3/8"	2"	50	300	20
6984	1/2" x 5"	1/2"	2-1/2"	25	150	26
6987	5/8" x 5 1/2"	5/8"	2-3/4"	15	90	57

The published length is the overall length of the anchor.
The flat head Power-Bolt anchor has a hex key insert formed in the head of the bolt.
Each box contains an Allen wrench which matches the insert size.

Stainless Steel Hex Head Power-Bolt

Cat. No.	Anchor Size	Drill Dia.	Min. Embed.	Std. Box	Std. Carton	Wt./100
5902	1/4" x 1 3/4"	1/4"	1-1/4"	100	600	3
5906	1/4" x 3"	1/4"	1-1/4"	100	600	5
5910	3/8" x 2 1/4"	3/8"	2"	50	300	10
5914	3/8" x 3 1/2"	3/8"	2"	50	300	12
5916	3/8" x 4"	3/8"	2"	50	300	14
5930	1/2" x 2 3/4"	1/2"	2-1/2"	50	200	16
5934	1/2" x 4 3/4"	1/2"	2-1/2"	25	150	26

The published length is measured from below the washer to the end of the anchor.