SUMMIT ENGINEERING L.L.C.

Presents

Structural Calculations

for

Project/Client:

Anchorage for ADA Lift & Guardrail
Capital Center HS2 Cafeteria Upgrade
Beaverton, OR 97006

Architect:

Nate Carter
Solarc Architecture, Inc
Portland, OR 97227

Project No. 18-085
Date: November 6, 2018

Project Scope: ADA upgrades require the following engineering:

- Design post installed anchors to support ADA lift at stairs
- Design post installed anchors to support guardrail at stairs
- Minimum concrete for anchor install:
  - 5" slab on grade
  - 3000 psi concrete

Codes used: 2014 OREGON STRUCTURAL SPECIALTY CODE (IBC)

Loads Used:

Live load reactions are taken from the Savaria Delta Straight Inclined Platform Lift guide:
19-m09-2017, Part No. 000817

Note: this design is for base mounted stand only. No anchorage to the wall is assumed nor provided.

Structural details

Floor/support wall loads

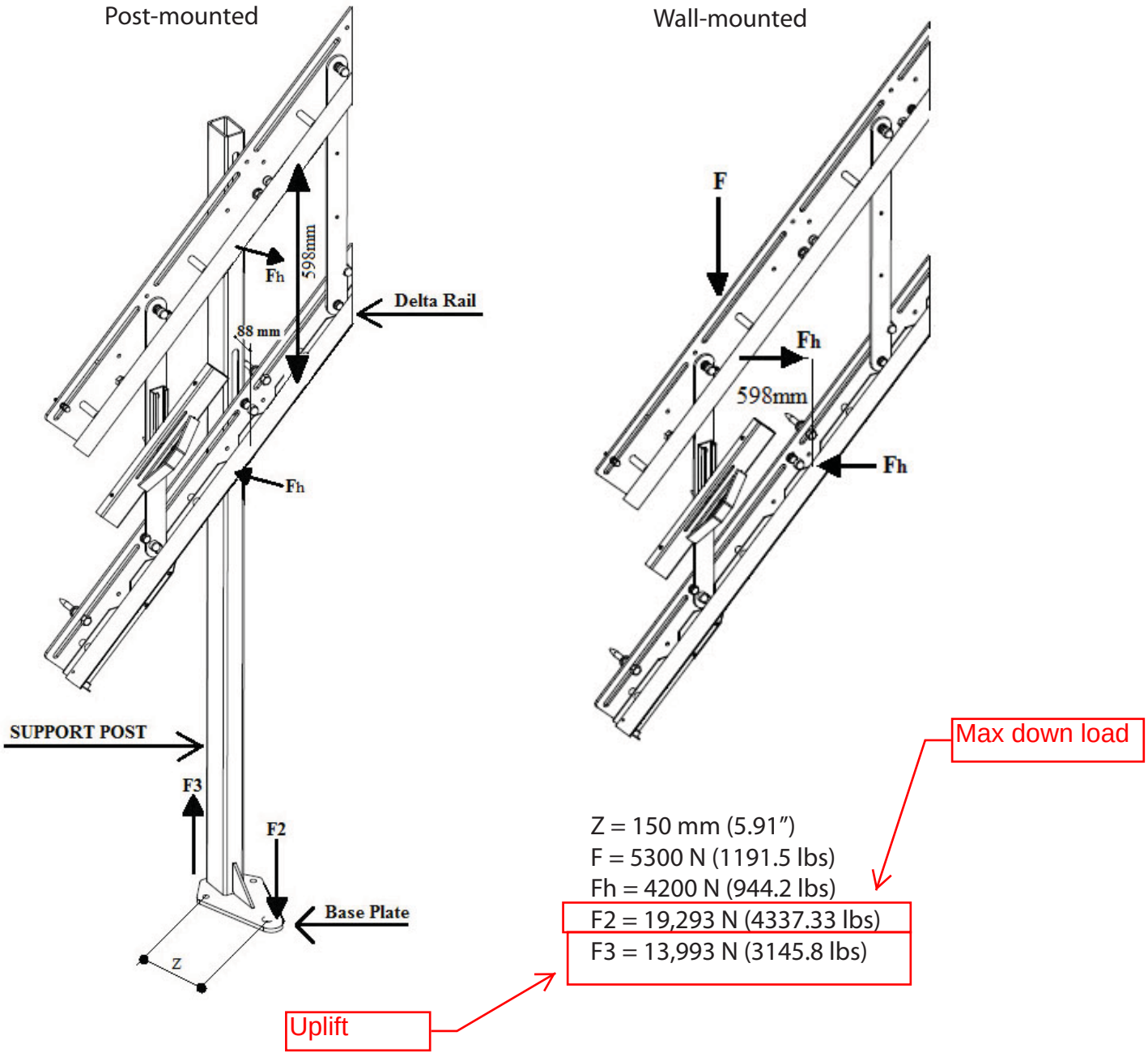
A qualified professional must ensure that the building and stairway will safely support all loads imposed by the lift equipment. Adequate structural support must be provided at the top landing, bottom landing and throughout the supporting wall along the stairs.

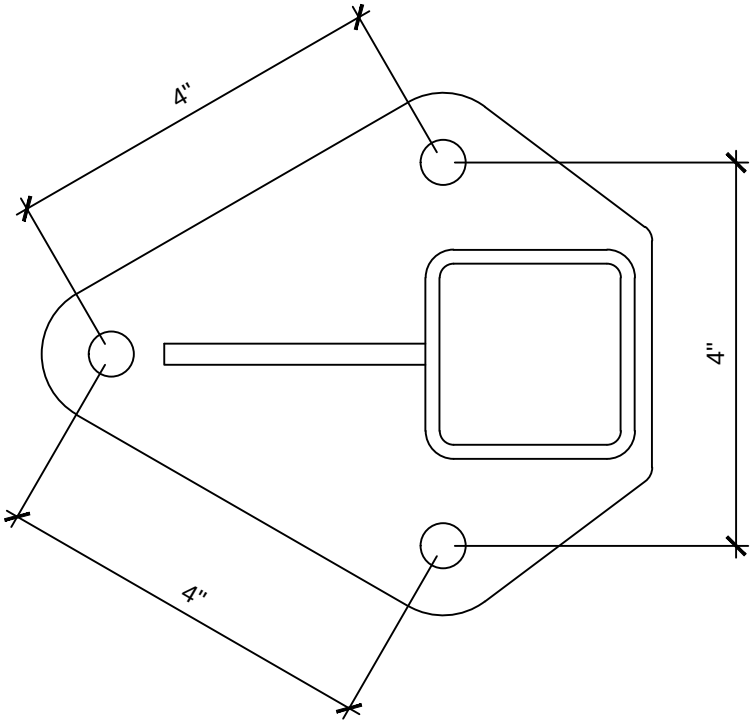
The pull-out force on the supporting wall will vary depending on the type of rail mounting used (wall brackets or support posts on the steps). Refer to the previous illustration of the guide rail mounting configurations.

All wood studs in the supporting wall must be anchored in the ceiling and the floor to meet the pull-out force requirements. Wood studs must be placed at 16" (404 mm) centres (minimum), solidly anchored in the floor and ceiling.

The floor load will vary depending on the type of rail mounting used (wall brackets or support posts on the steps).

Where required, the rail must be securely fastened to the structural support wall.





PROJECT NO:	18-002
DRAFT DATE:	31-OCT-2018
DRAWN BY:	
CHECKED BY:	

CAPITAL CENTER HS2
CAFETERIA ADA UPGRADE
18640 NW WALKER ROAD
BEAVERTON, OREGON 97006

SOLARC ARCHITECTURE, INC
240 N BROADWAY ST, SUITE 308, PORTLAND, OR 97227
PH: 971.344.1919 | www.Solarc-A.com

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-11
Units: Imperial units

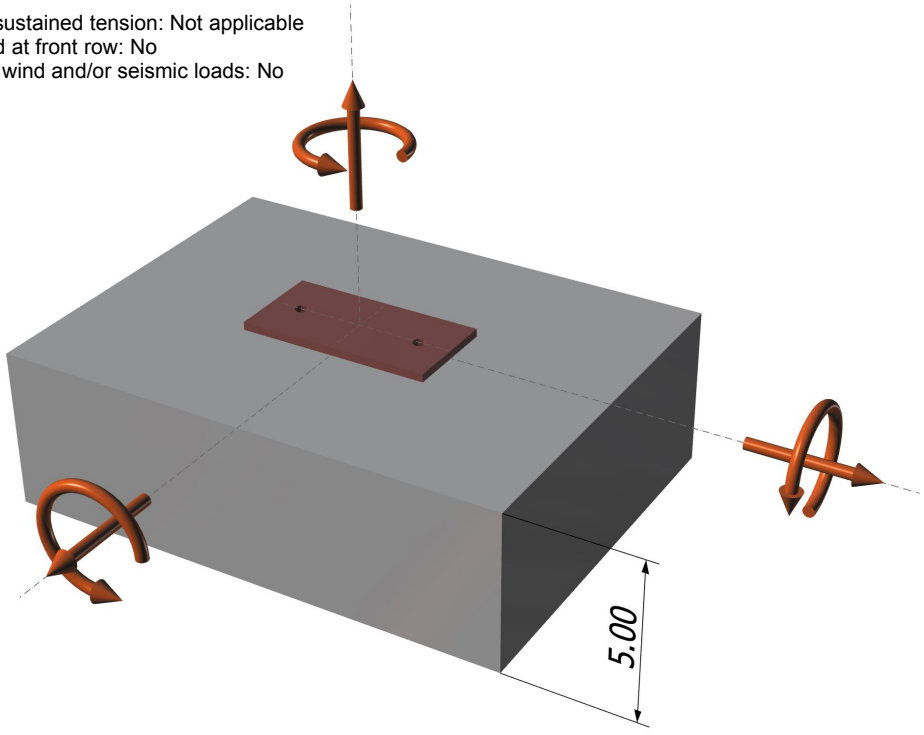
Anchor Information:
Anchor type: Torque controlled expansion anchor
Material: Carbon Steel
Diameter (inch): 0.375
Nominal Embedment depth (inch): 2.875
Effective Embedment depth, h_{ef} (inch): 2.500
Code report: ICC-ES ESR-3037
Anchor category: 1
Anchor ductility: Yes
h_{min} (inch): 4.50
c_{ac} (inch): 6.00
C_{min} (inch): 6.00
S_{min} (inch): 3.00

Load and Geometry
Load factor source: ACI 318 Section 9.2
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

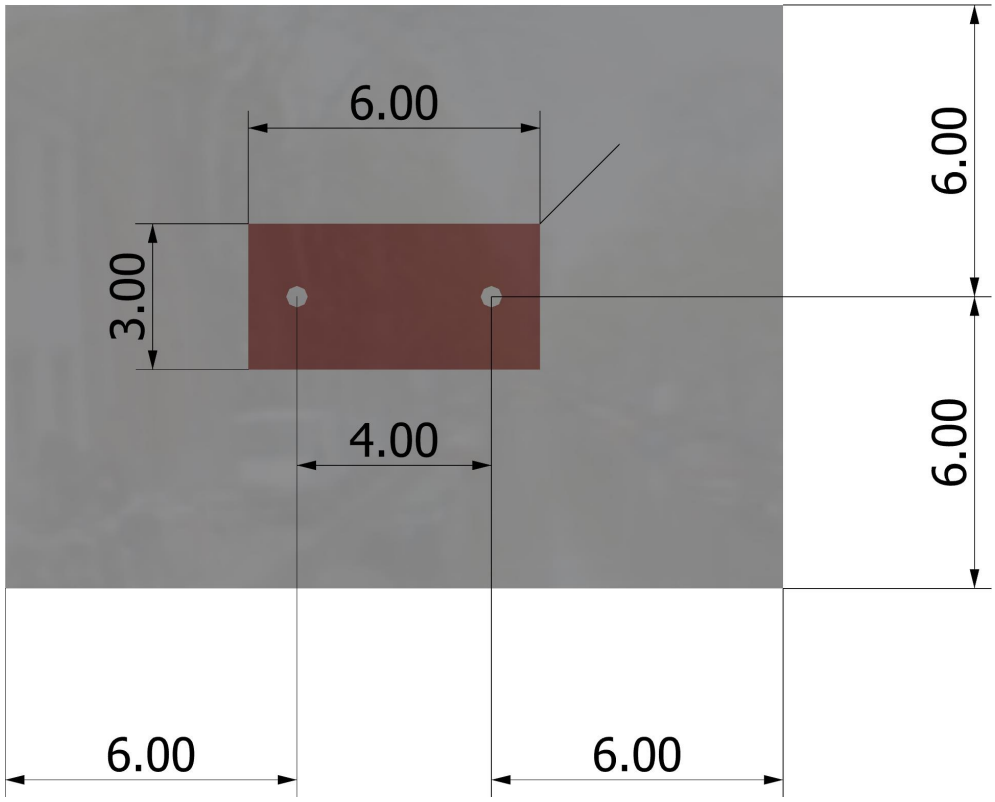
Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 5.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 3.00 x 6.00 x 0.25

<Figure 1>



<Figure 2>



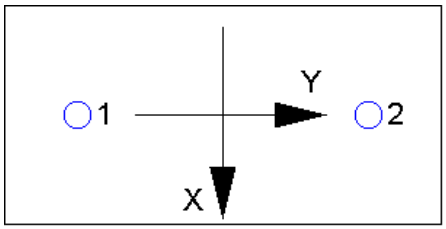
Recommended Anchor
Anchor Name: Strong-Bolt® 2 - 3/8"Ø CS Strong-Bolt 2, hnom:2.875" (73mm)
Code Report: ICC-ES ESR-3037

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	1573.0	0.0	0.0	0.0
2	1573.0	0.0	0.0	0.0
Sum	3146.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 3146
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. D.5.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
5600	0.75	4200

5. Concrete Breakout Strength of Anchor in Tension (Sec. D.5.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. D-6)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	3000	2.500	3681

$\phi N_{cbg} = \phi \, (A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. D.4.1 & Eq. D-4)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
86.25	56.25	6.00	1.000	1.000	1.00	1.000	3681	0.65	3668

6. Pullout Strength of Anchor in Tension (Sec. D.5.3)

$\phi N_{pn} = \phi \Psi_{c,P} \lambda_a N_p (f'_c / 2{,}500)^n$ (Sec. D.4.1, Eq. D-13 & Code Report)

$\Psi_{c,P}$	λ_a	N_p (lb)	f'_c (psi)	n	ϕ	ϕN_{pn} (lb)
1.0	1.00	2775	3000	0.50	0.65	1976

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	1573	4200	0.37	Pass
Concrete breakout	**3146**	**3668**	**0.86**	**Pass (Governs)**
Pullout	1573	1976	0.80	Pass

3/8"Ø CS Strong-Bolt 2, hnom:2.875" (73mm) meets the selected design criteria.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections D.8.1 and D.8.2 for torqued cast-in-place anchor is waived per designer option.

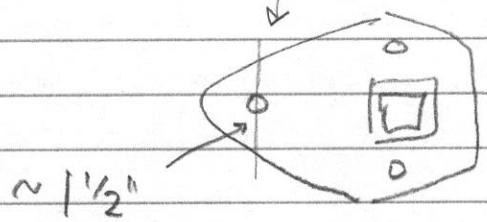
- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

DOWNWARD FORCE

CHECK SLAB:

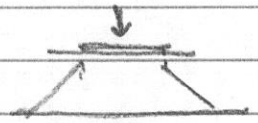
$P_{DOWN} = 4337^{\#}$



~ 1 1/2" WIDTH

SHEAR CAPACITY OF SLAB: 5" Deep 3000psi

PER ACI 14.5.5.1 $\frac{1}{3}\lambda\sqrt{f'_c}\,b_w h$ $\lambda = 1.0$



5x2 + 1.5 = 11.5"

perimeter = 11.5" x 2 = 23"

$= \frac{1}{3}\sqrt{3000psi}\,(23")(5")$

$= 8498^{\#} > 4337^{\#}$

* SLAB CAN RESIST THIS LOAD IN SHEAR ✓

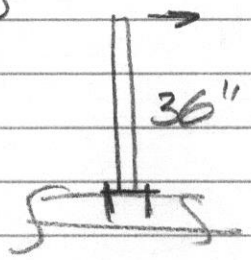
Bean. School ADA

GUARDRAIL

1½" STEEL PIPE:

48" MAX SPACING OF POSTS:

P = 200#



M = 7200# "

Pipe $M_n = \frac{Z f_y}{\Omega}$ $Z = .421$

$M_n = \frac{0.421 in^3 \times 35 ksi}{1.67}$

$= 8.8^{k"} > 7.2^{k"}$ ok

WELD @ BASE:
3/16"

○ - I WELD PER AISC CH. 8

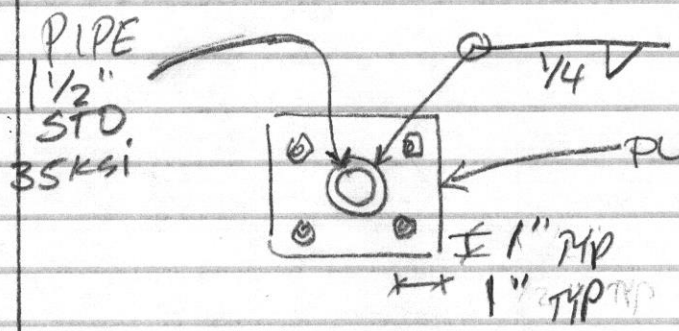
R = .75 + (.25)(.707)½ = .84" $I = \pi R^3 = 1.86 in^3$

$r_m = \frac{P a e c}{I_p} = \frac{200\# \times 36" \times .75}{1.86} = 2.9 k/in$ ⇒ use 1/4" Fillet

$v_a = \frac{70 ksi \times .6}{\Omega = 2} \times 0.707 \times 1/4 = 3.71 k/in$

ok ✓

ANCHORS AT GUARDRAIL:



LOAD = 600 FT-LB MOMENT ok ✓

SIMPSON STRONG-BOLT 2
3/8"Ø w/ 2.875 x 3in EMBED

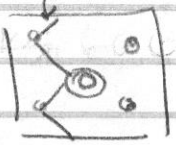
SPECIAL INSP.
IS REQ'D

BENDING ON PL:

TENSION RESISTANCE: $T = \frac{M}{D} = \frac{7200^{\#"}}{3"} = 2400^{\#}$

$$M_p = \frac{(2400^{\#})(1.9 \times 1.41) - 1"}{(2(2.679 - 1))}$$

$$= 1200^{\#"}/_{in}$$



$M_a R = 36^{k}/_{in^2} \times 0.6 \times 5 = 2.5^{k"}/_{in}$

3/8" PL ok ✓

$$S_R = \frac{5(.38)^2}{6} = 0.12$$

Company:		Date:	10/30/2018
Engineer:		Page:	1/4
Project:			
Address:			
Phone:			
E-mail:			

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Customer e-mail:
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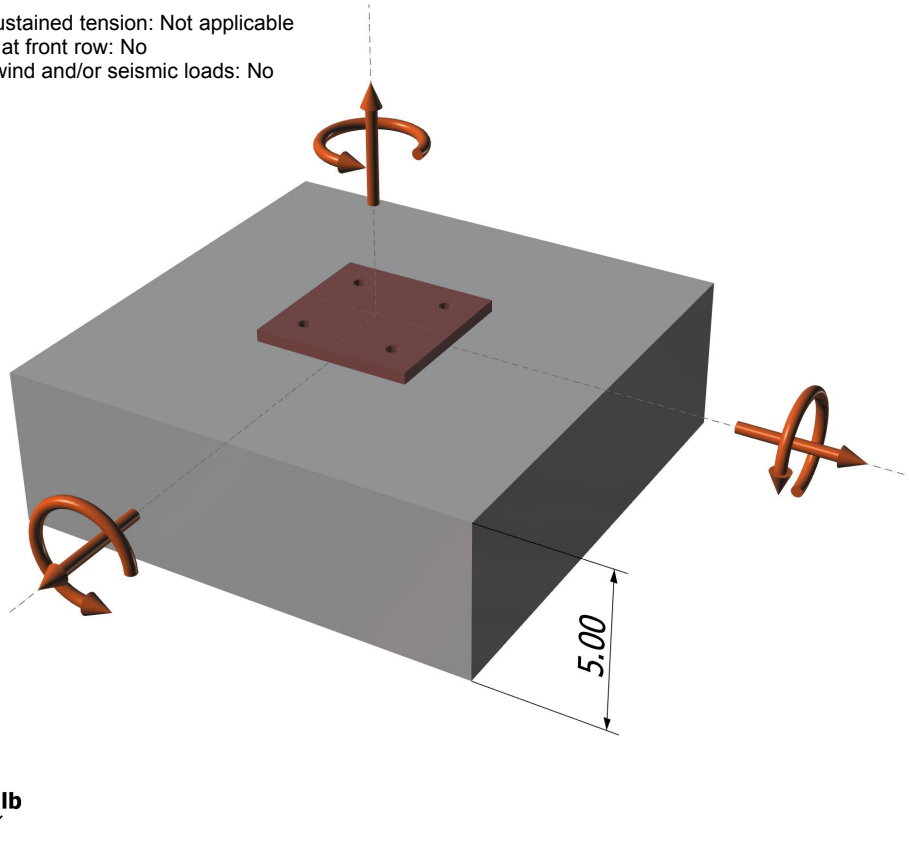
c_{ac} (inch): 6.00
C_{min} (inch): 6.00
S_{min} (inch): 3.00

Load and Geometry
Load factor source: ACI 318 Section 9.2
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 5.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 5.00 x 5.00 x 0.38

<Figure 1>



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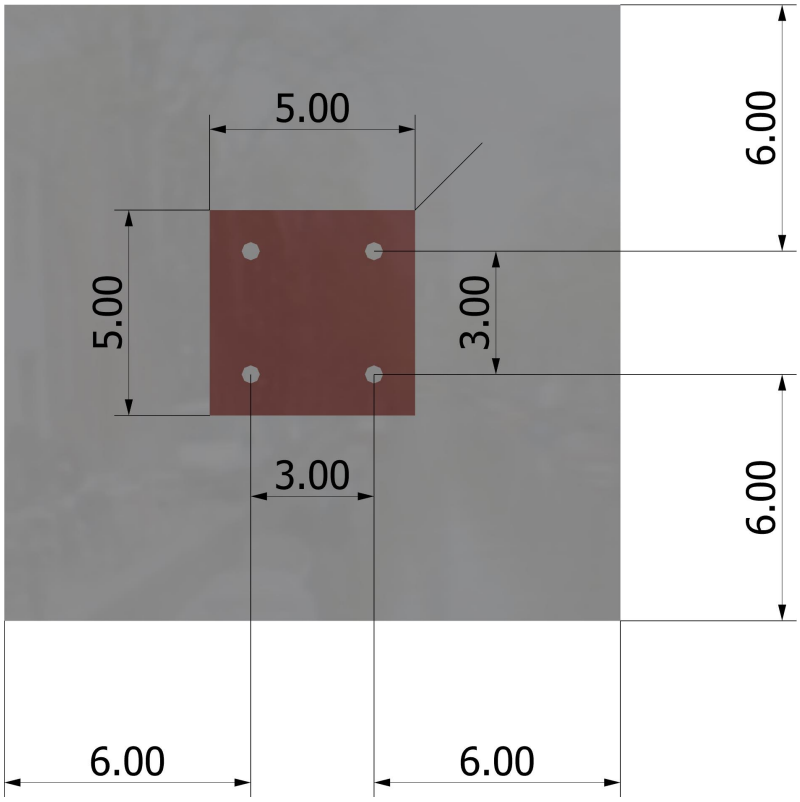

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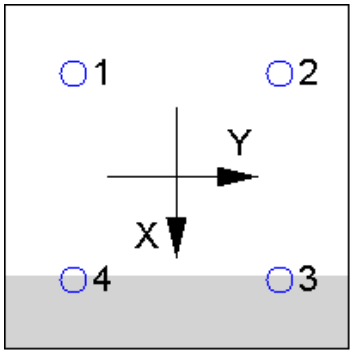
1	987.5	0.0	0.0	0.0
2	987.5	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
Sum	1975.1	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.17
Maximum concrete compression stress (psi): 745
Resultant tension force (lb): 1975
Resultant compression force (lb): 1975
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

<Figure 3>



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N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
5600	0.75	4200

5. Concrete Breakout Strength of Anchor in Tension (Sec. D.5.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. D-6)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	3000	2.500	3681

$\phi N_{cbg} = \phi \, (A_{Nc} / A_{Nco}) \, \Psi_{ec,N} \, \Psi_{ed,N} \, \Psi_{c,N} \, \Psi_{cp,N} N_b$ (Sec. D.4.1 & Eq. D-4)

A_{Nc} (in²)	A_{Nco} (in²)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
78.75	56.25	6.00	1.000	1.000	1.00	1.000	3681	0.65	3349

6. Pullout Strength of Anchor in Tension (Sec. D.5.3)

$\phi N_{pn} = \phi \Psi_{c,P} \lambda_a N_p (f'_c / 2{,}500)^n$ (Sec. D.4.1, Eq. D-13 & Code Report)

$\Psi_{c,P}$	λ_a	N_p (lb)	f'_c (psi)	n	ϕ	ϕN_{pn} (lb)
1.0	1.00	2775	3000	0.50	0.65	1976

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	988	4200	0.24	Pass
Concrete breakout	**1975**	**3349**	**0.59**	**Pass (Governs)**
Pullout	988	1976	0.50	Pass

3/8"Ø CS Strong-Bolt 2, hnom:2.875" (73mm) meets the selected design criteria.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections D.8.1 and D.8.2 for torqued cast-in-place anchor is waived per designer option.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.