Mosaic Panel Attachment Calculations:
Art Installation at Front St Parking Garage

Prepared at the Request of

Kathleen Crocetti

Tuesday, May 30, 2023
Job 22-48

Basis of Design:		Contents:		Sheet:
1.	ASCE 7-16	1.	Attachment Calculations	1-2
2.	2022 California Building Code	2.	Attachment Detail	3
		3.	Simpson Anchor Designer	4-8

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Seismic Design Based on ASCE 7-16 - Chapter 13 Seismic for Non-Structural Components

From the USGS web site, Ground Motion Design Parameter Calculator based on Site Longitude and Latitude

	SMs = Fa*Ss	1.664					
	SDs = 2/3 * SMs	1.11					
	SM1 = Fv*S1	1.07					
	SD1 = 2/3 * SM1	0.72					
	where Fa=	1	table 11.4-1				
	Fv=	1.7	table 11.4-2				
Site		**Latitude (Degrees)**	**Longitude (Degrees)**	**Ss**	**S1**	**SDs (g)**	**SD1 (g)**
Parking Garage- Soquel and Front Street				1.664	0.629	1.316	0.72

General Building Information

bearing wall system building type:	N/A		ASCE table 12.2-1
Occupancy Category	N/A		ASCE table 1-1
Average Roof Ht with respect to base, **h**	30		defined ASCE 12.8.2.1
Height of Attachement of Component, **z**	30		(if attached to ground z=0)

Seismic Design Force:

Fp=.4ap(Sds)Wp (1+2(z/h)) (13.3-1)
(Rp/Ip)

Fp= 1.05 Wp

where:

ap is component amp. Factor varies 1-2.5	1.0		ASCE table 13.5-1 or 13.6-1
Ip is component importance factor, varies 1-1.5	1		ASCE section 13.1.3, **1.5** if 1. life safety equipement 2. hazardous mat'l 3. necessary for bldg function
Rp is comp. response mod. Factor	1.5		ASCE table 13.5-1 or 13.6-1

Fp need not be greater than
Fp=1.6Sds(Ip)Wp = 2.1056 Wp ASCE 13.3-2

and Fp shall not be less than
Fp=0.3Sds(Ip)Wp= 0.3948 Wp ASCE 13.3-3

Governing Fp= 1.05 Wp

FOR THE SCULPTURE:

Wp= 50 lbs Weight of Component

Fp= 53 lbs Seismic Design Force

Use FP= 60 lbs

Vertical Seismic Force:

per ASCE 7-16 section 13.3.1.2. 0.2*Sds*Wp= **13 lbs**

note: component weight provided by artist based on weights on individual materials used in construction.

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22-48	Front St. garage	5-30-23	2
job no.	job name	date	page

Based on calculations on page 1:

Max tension = 10 lbs
shear = 13 lbs
} considering 6 bolts share load equally.

Factoring by $\Omega_o = 2.0$

$T_{max} = 20$ lbs

$V_{max} = 26$ lbs

anchors were checked using Simpson anchor designer. See next pages for calcs...

Summary: Use (6) ¼" ϕ x 2" long. galv Titen screws by Simpson with 1¾" embed.

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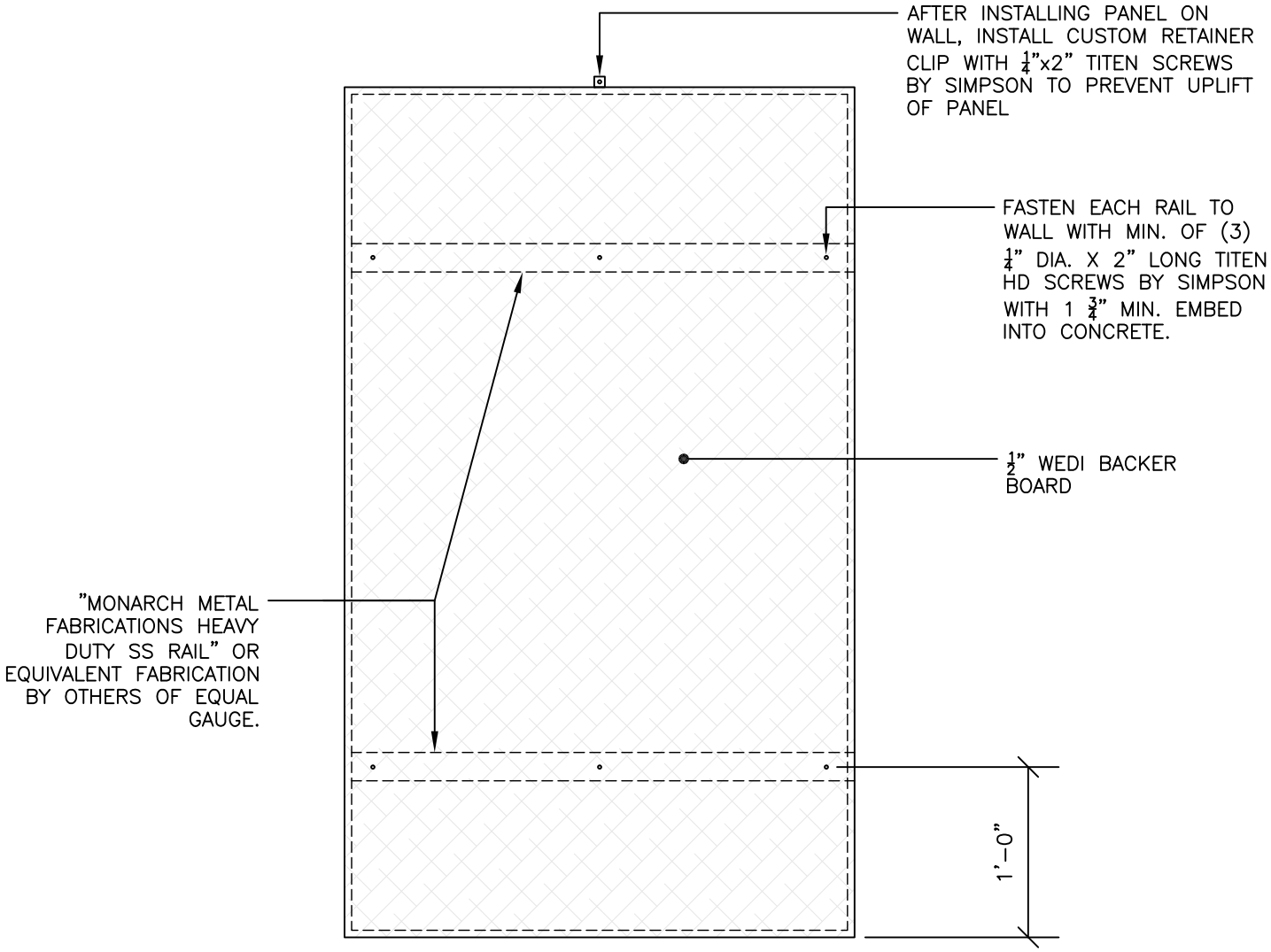

ENTIRE PART WEIGHT IS APPROX. 50 LBS MAX.

1 .	MOSAIC PANEL ATTACHMENT

SIMPSON Strong-Tie®

Anchor Designer™ Software
Version 3.0.7947.0

Company:		Date:	5/26/2023
Engineer:		Page:	1/5
Project:			
Address:			
Phone:			
E-mail:			

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 318-14
Units: Imperial units

Anchor Information:
Anchor type: Concrete screw
Material: Carbon Steel
Diameter (inch): 0.250
Nominal Embedment depth (inch): 1.750
Effective Embedment depth, h_{ef} (inch): 1.300
Code report: ICC-ES ESR-2713
Anchor category: 1
Anchor ductility: No
h_{min} (inch): 3.29
c_{ac} (inch): 3.44
C_{min} (inch): 1.50
S_{min} (inch): 1.50

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 8.00
State: Cracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 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

Recommended Anchor
Anchor Name: Titen HD® - 1/4"Ø Titen HD, hnom:1.75" (44mm)
Code Report: ICC-ES ESR-2713

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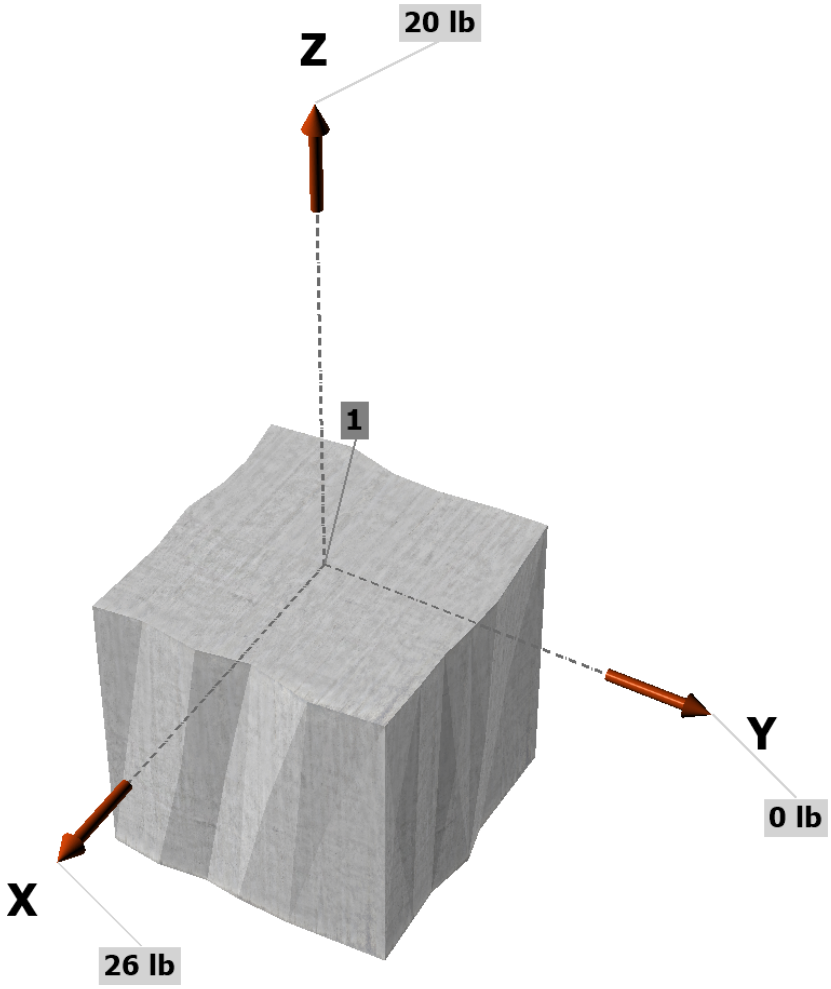
Company:		Date:	5/26/2023
Engineer:		Page:	2/5
Project:			
Address:			
Phone:			
E-mail:			

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.2 not applicable
Ductility section for shear: 17.2.3.5.2 not applicable
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

Strength level loads:

N_{ua} [lb]: 20
V_{uax} [lb]: 26
V_{uay} [lb]: 0

<Figure 1>



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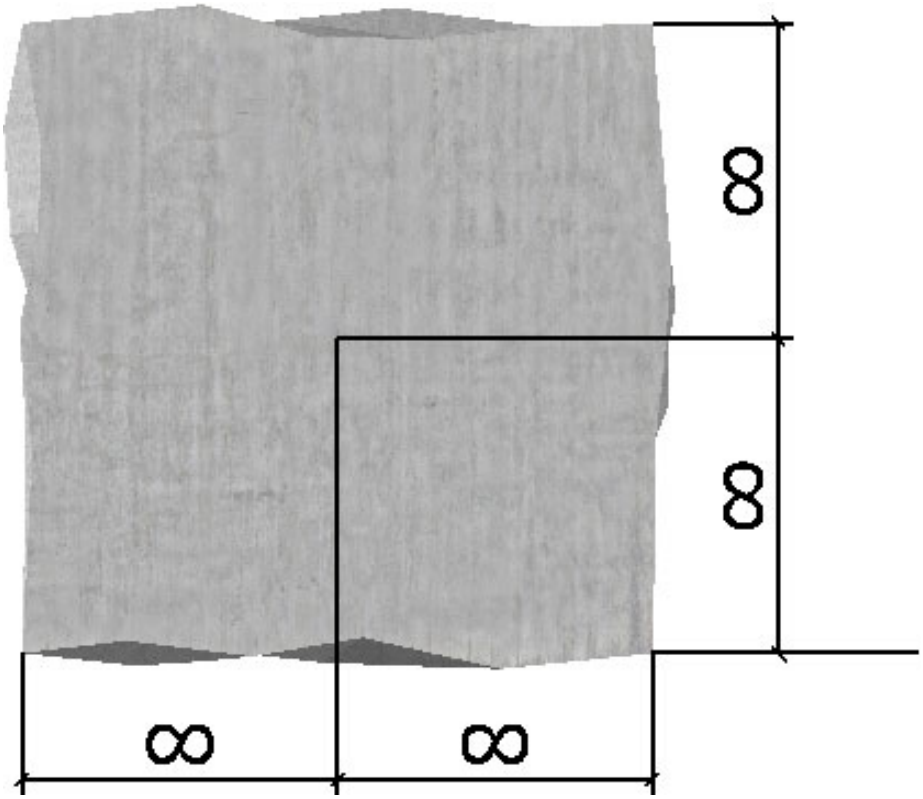
Company:		Date:	5/26/2023
Engineer:		Page:	3/5
Project:			
Address:			
Phone:			
E-mail:			

<Figure 2>



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Company:		Date:	5/26/2023
Engineer:		Page:	4/5
Project:			
Address:			
Phone:			
E-mail:			

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	20.0	26.0	0.0	26.0
Sum	20.0	26.0	0.0	26.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 20
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
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
5195	0.65	3377

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	1.300	1260

$0.75\phi N_{cb} = 0.75\phi (A_{Nc} / A_{Nco}) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2	$c_{a,min}$ (in)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cb}$ (lb)
15.21	15.21	-	1.000	1.00	1.000	1260	0.65	614

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi \Psi_{c,P} \lambda_a N_p (f'_c / 2{,}500)^n$ (Sec. 17.3.1, Eq. 17.4.3.1 & Code Report)

$\Psi_{c,P}$	λ_a	N_p (lb)	f'_c (psi)	n	ϕ	$0.75\phi N_{pn}$ (lb)
1.0	1.00	1222	2500	0.50	0.65	596

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Company:		Date:	5/26/2023
Engineer:		Page:	5/5
Project:			
Address:			
Phone:			
E-mail:			

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
1695	1.0	0.60	1017

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cp} = \phi k_{cp} N_{cb} = \phi k_{cp}(A_{Nc} / A_{Nco}) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.5.3.1a)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cp} (lb)
1.0	15.21	15.21	1.000	1.000	1.000	1260	0.70	882

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	20	3377	0.01	Pass
Concrete breakout	20	614	0.03	Pass
Pullout	**20**	**596**	**0.03**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	26	1017	0.03	Pass
Pryout	**26**	**882**	**0.03**	**Pass (Governs)**

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.03	0.00	3.4%	1.0	Pass

1/4"Ø Titen HD, hnom:1.75" (44mm) meets the selected design criteria.

12. Warnings

- Per designer input, the tensile component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor tensile force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.4.2 for tension need not be satisfied – designer to verify.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.5.2 for shear need not be satisfied – designer to verify.

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

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