Structural Calculations

for

NEW SINGLE-FAMILY DWELLING

Plummer Residence

9212 SE 33rd Pl

Mercer Island, WA 98040

1ST PLAN CHECK RESPONSE

prepared by:

O.G. Engineering, PLLC

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(206) 290-4608

Job No. 21006

Date: 7/27/22

Hazards by Location

Search Information

Address: 9212 SE 33rd Pl, Mercer Island, WA 98040, USA

Coordinates: 47.5818239, -122.2135532

Elevation: 46 ft

Timestamp: 2022-03-31T19:26:09.229Z

Hazard Type: Seismic

Reference Document: ASCE7-16

Risk Category: II

Site Class: D

Basic Parameters

Name	Value	Description
S_S	1.392	MCE_R ground motion (period=0.2s)
S_1	0.485	MCE_R ground motion (period=1.0s)
S_{MS}	1.392	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	0.928	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

SEISMIC DESIGN ORIGINALLY SUBMITTED FOR PERMIT BASED ON Sds = 1.11 (CONSERVATIVE --> OK BY INSPECTION --> NO SEISMIC DESIGN CHANGES REQUIRED)

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.903	Coefficient of risk (0.2s)
CR_1	0.897	Coefficient of risk (1.0s)
PGA	0.596	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.655	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)
SsRT	1.392	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.542	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	3.419	Factored deterministic acceleration value (0.2s)
S1RT	0.485	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.54	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	1.386	Factored deterministic acceleration value (1.0s)
PGAd	1.175	Factored deterministic acceleration value (PGA)

PANEL PATIO GUARD RAIL (REF C/C9)

$M = 200^{\#} \times 36" = 7.2 k{:}in$

USE HSS 1"½ x 1½" x ⅛ STAINLESS

$\frac{M_n}{\Omega} = \frac{ZF_y}{1.67} = \frac{0.301\ in^3 \times 46\ ksi}{1.67} = 8.3\ k{:}in$ OK

USE (4) ½"ϕ x 5" EMBED EPOXY ANCHORS @ 2 1/4, 5, 5 TYP. @

SIMPSON Strong-Tie®

Anchor Designer™ Software
Version 3.0.7947.0

Company:		Date:	7/27/2022
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

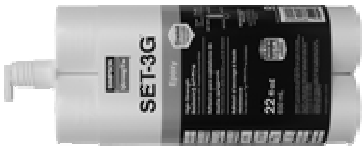
General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.375
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 7.25
c_{ac} (inch): 11.31
C_{min} (inch): 1.75
S_{min} (inch): 1.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 18.00
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
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 5.00 x 5.00 x 0.25

Recommended Anchor
Anchor Name: SET-3G - SET-3G w/ 3/8"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

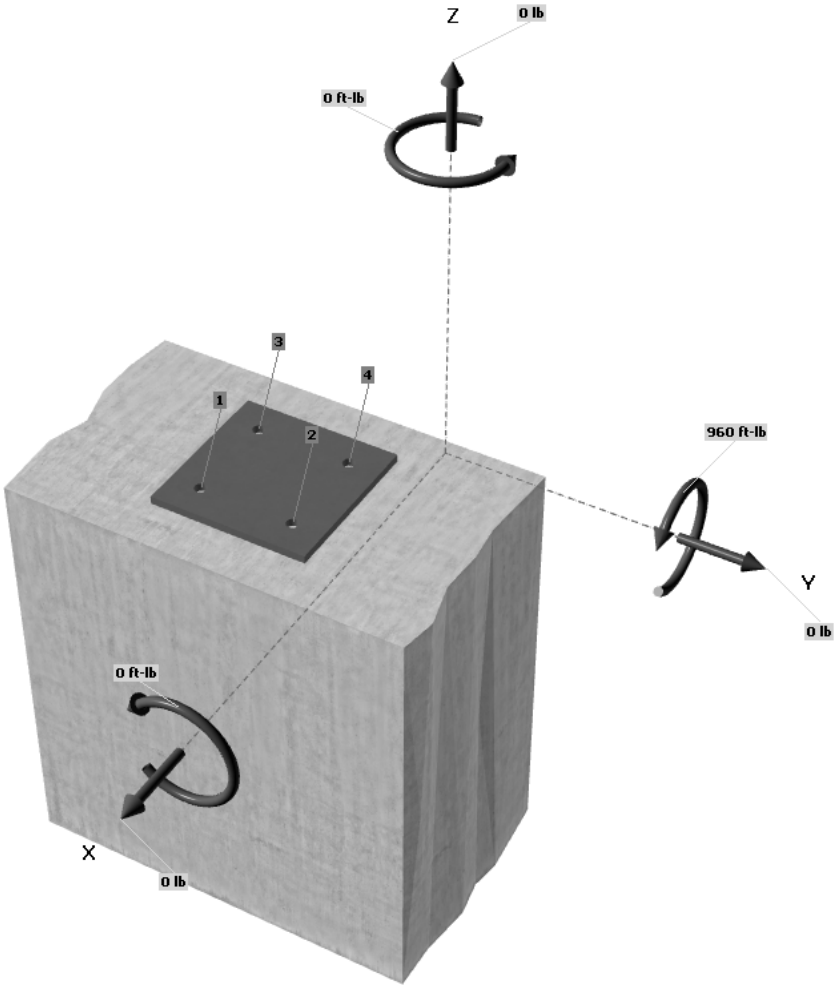


Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 0
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 960
M_{uz} [ft-lb]: 0

<Figure 1>



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Address:			
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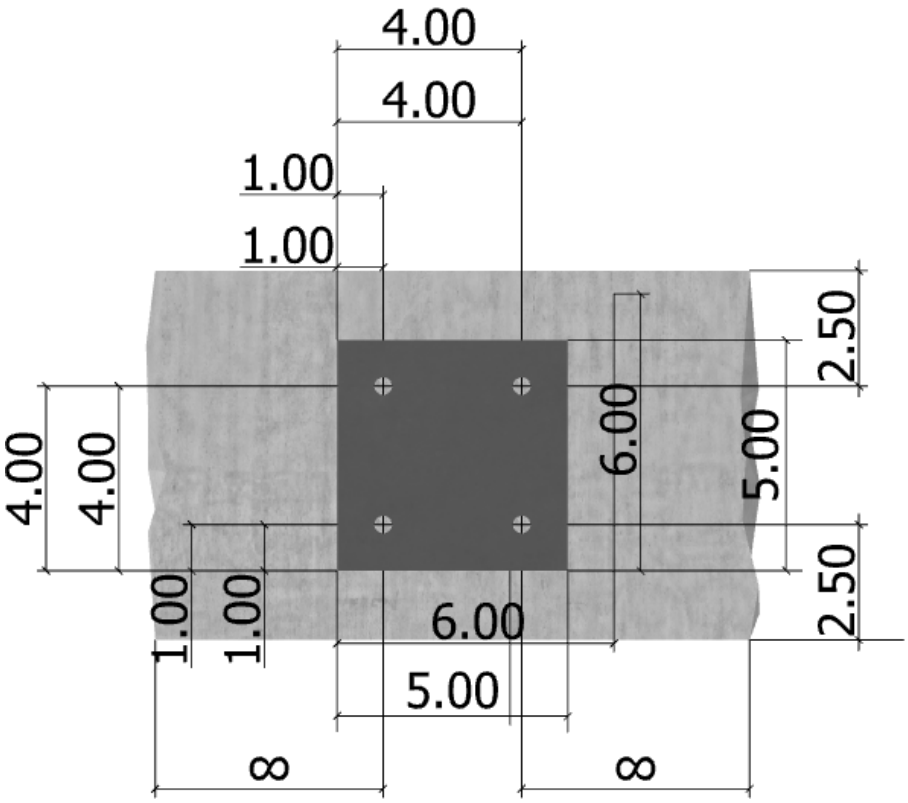
E-mail:			

<Figure 2>



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Company:		Date:	7/27/2022
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Address:			
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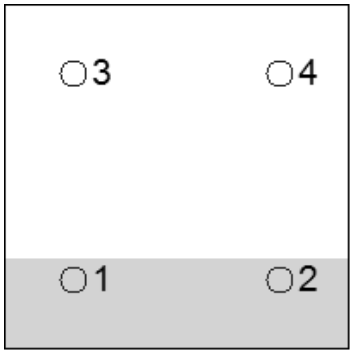
3. Resulting Anchor Forces

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	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	1615.7	0.0	0.0	0.0
4	1615.7	0.0	0.0	0.0
Sum	3231.5	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.23
Maximum concrete compression stress (psi): 989
Resultant tension force (lb): 3231
Resultant compression force (lb): 3232
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. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
4525	0.75	3394

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	6.000	12492

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

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)
168.00	324.00	2.50	1.000	0.783	1.00	1.000	12492	0.65	3298

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} (f'_c / 2{,}500)^n$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	f'_c (psi)	n	$\tau_{k,cr}$ (psi)
1448	1.00	1.00	2500	0.24	1448

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	1448	0.38	6.000	10235

$\phi N_{ag} = \phi (A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
111.68	120.53	5.49	2.50	1.000	0.837	1.000	10235	0.65	5157

11. Results

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

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	1616	3394	0.48	Pass
Concrete breakout	**3231**	**3298**	**0.98**	**Pass (Governs)**
Adhesive	3231	5157	0.63	Pass

SET-3G w/ 3/8"Ø F1554 Gr. 36 with hef = 6.000 inch meets the selected design criteria.

12. Warnings

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

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

Cantilevered Retaining Wall

DESCRIPTION: F10 - Paver Patio Retaining Wall

Code Reference

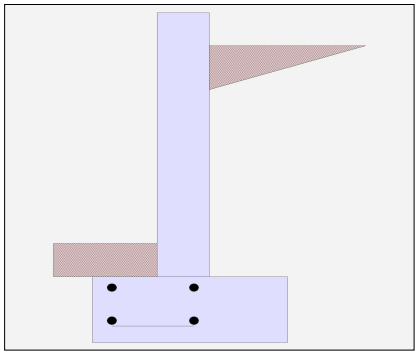
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	3.50 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,325.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	28.0 #/ft
...Height to Top	=	3.50 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Cantilevered Retaining Wall

Project File: 21006_Plummer.ec6

DESCRIPTION: F10 - Paver Patio Retaining Wall

Design Summary

Wall Stability Ratios			
Overturning	=	2.33	OK
Sliding	=	1.55	OK
Global Stability	=	3.05	
Total Bearing Load	=	1,285 lbs	
...resultant ecc.	=	5.03 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,032 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	3,325 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,444 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	1.3 psi	OK
Footing Shear @ Heel	=	3.7 psi	OK
Allowable	=	82.2 psi	
Sliding Calcs			
Lateral Sliding Force	=	452.4 lbs	
less 100% Passive Force	-	187.5 lbs	
less 100% Friction Force	-	514.2 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 5		
Rebar Spacing	=	12.00		
Rebar Placed at	=	5.69 i		
Design Data				
fb/FB + fa/Fa	=	**0.076**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	441.0		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	571.7		
Moment.....Allowable	=	7,512.3		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	6.5		
Shear.....Allowable	psi =	82.2		
Anet (Masonry)	in2 =			
Wall Weight	psf =	100.0		
Rebar Depth 'd'	in =	5.69		
Masonry Data				
f'm	psi =			
Fs	psi =			
Solid Grouting	=			
Modular Ratio 'n'	=			
Equiv. Solid Thick.	=			
Masonry Block Type	=			
Masonry Design Method	=	ASD		
Concrete Data				
f'c	psi =	3,000.0		
Fy	psi =	60,000.0		

Cantilevered Retaining Wall

Project File: 21006_Plummer.ec6

DESCRIPTION: F10 - Paver Patio Retaining Wall

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0237 in2/ft		
(4/3) * As :	0.0315 in2/ft	Min Stem T&S Reinf Area 0.768 in2	
200bd/fy : 200(12)(5.69)/60000 :	0.2276 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.31 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.925 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	0.83 ft
Heel Width	=	1.67
Total Footing Width	=	2.50
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe		Heel	
Factored Pressure	=	1,444		0	psf
Mu' : Upward	=	442		95	ft-#
Mu' : Downward	=	89		365	ft-#
Mu: Design	=	353	OK	270	ft-# OK
phiMn	=	27,464		2,739	ft-#
Actual 1-Way Shear	=	1.34		3.68	psi
Allow 1-Way Shear	=	82.16		43.82	psi

Toe Reinforcing = # 8 @ 12.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm

Key: No key defined

Min footing T&S reinf Area 0.65 in2
Min footing T&S reinf Area per foot 0.26 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 9.26 in	#4@ 18.52 in
#5@ 14.35 in	#5@ 28.70 in
#6@ 20.37 in	#6@ 40.74 in

Cantilevered Retaining Wall

Project File: 21006_Plummer.ec6

DESCRIPTION: F10 - Paver Patio Retaining Wall

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	354.4	1.50	531.6			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	98.0	2.75	269.5			
Load @ Stem Above Soil =						
=						
				Soil Over HL (ab. water tbl)	456.5	2.00	912.3
				Soil Over HL (bel. water tbl)		2.00	912.3
				Watre Table			
				Sloped Soil Over Heel =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =	54.0	0.42	22.4
				Surcharge Over Toe =			
				Stem Weight(s) =	400.0	1.16	465.3
				Earth @ Stem Transitions =			
				Footing Weight =	375.0	1.25	468.8
				Key Weight =			
				Vert. Component =			
Total =	452.4	**O.T.M.** =	801.1	**Total =**	1,285.5 lbs	**R.M.=**	1,868.7

Resisting/Overturning Ratio = **2.33**

Vertical Loads used for Soil Pressure = 1,285.5 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	100.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.115	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

Cantilevered Retaining Wall

DESCRIPTION: F10 - Paver Patio Retaining Wall

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #5 bar specified in this stem design segment =	21.36 in
Development length for #5 bar specified in this stem design segment =	16.43 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	6.00 in
As Provided =	0.3100 in2/ft
As Required =	0.1728 in2/ft

Cantilevered Retaining Wall

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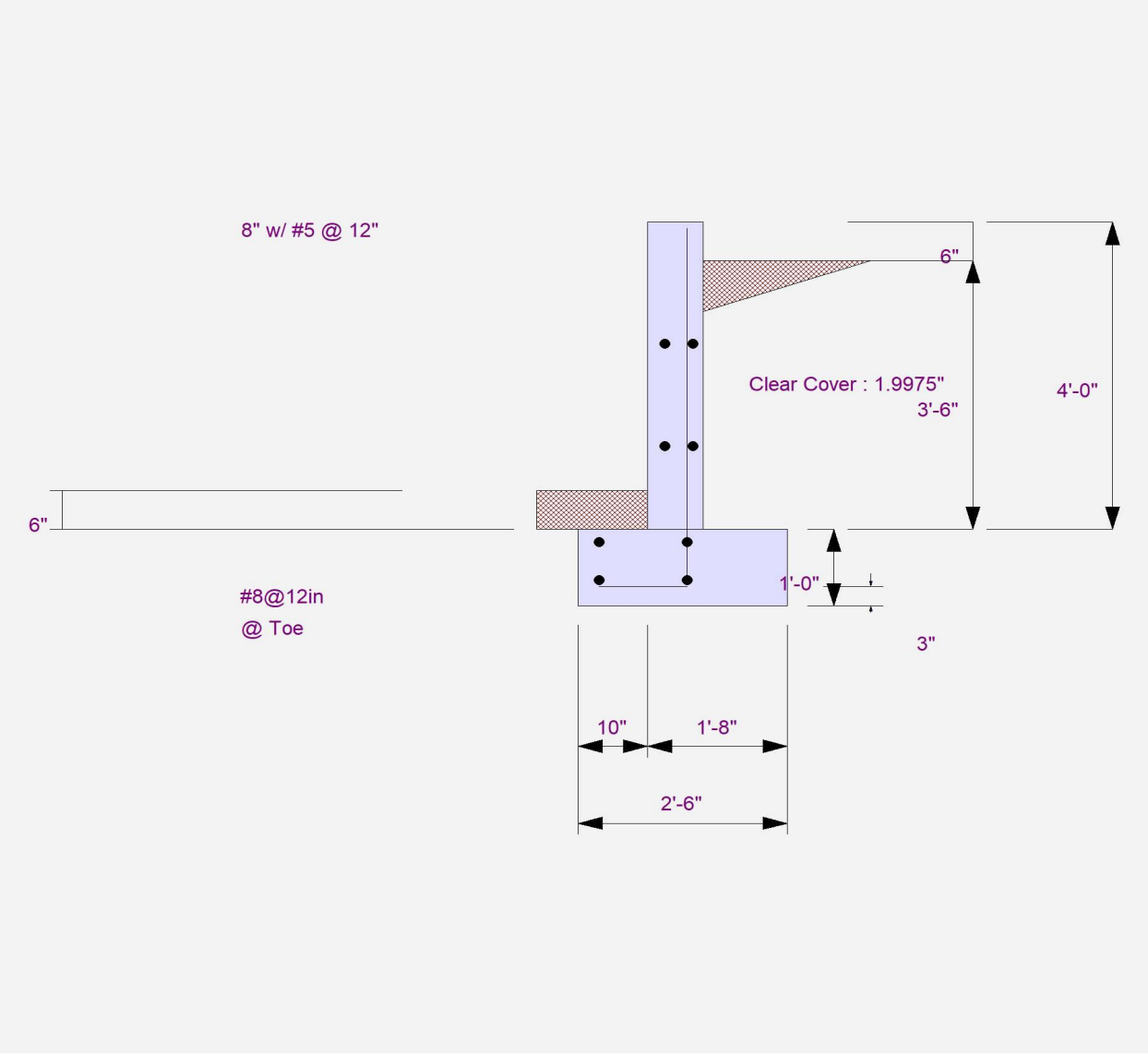

Cantilevered Retaining Wall

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