MYERS ENGINEERING

RETAINING WALL CALCULATIONS



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Project: Addendum to Marbella Residence 2641 64th Street NW Gig Harbor, WA

February 12, 2021

2015 INTERNATIONAL BUILDING CODE 110 MPH WIND, EXPOSURE C, K_{zt} = 1.00 RISK CATEGORY II - SOIL SITE CLASS D SEISMIC DESIGN CATEGORY D (IBC)

3206 50th Street Court NW, Suite 210-B Gig Harbor, WA 98335 Phone: 253-858-3248

Email: myengineer@centurytel.net



Project Name/Number: marbella

8ft Stem Dsgnr: Mark Myers, PE

Description....

Page: 1 Date: 11 FEB 2021

This Wall in File: e:\my documents\drawings & calcs\richard fisher architects\rkk construction\marbe RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06057398 License To : MYERS ENGINEERING **Cantilevered Retaining Wall** Code: IBC 2018,ACI 318-14,TMS 402-16 Soil Data Criteria Allow Soil Bearing 2,500.0 psf Retained Height 7.50 ft Equivalent Fluid Pressure Method 0.50 ft Wall height above soil Active Heel Pressure 35.0 psf/ft Slope Behind Wall 0.00 Height of Soil over Toe 6.00 in Passive Pressure 300.0 psf/ft Water height over heel 0.0 ft Soil Density, Heel 125.00 pcf 125.00 pcf Soil Density, Toe

Surcharge Loads

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

Design Summary

Wall Stability Ratios Overturning 1.65 OK Slab Resists All Sliding!

Total Bearing Loadresultant ecc.	= =	2,060 lbs 10.24 in	
Soil Pressure @ Toe Soil Pressure @ Heel	=	1,291 psf 0 psf	
Allowable Soil Pressure Less	= Thai	2,500 psf n Allowable	
ACI Factored @ Toe ACI Factored @ Heel	=======================================	1,808 psf 0 psf	
Footing Shear @ Toe	=	24.4 psi	OK
Footing Shear @ Heel	=	10.3 psi	OK
Allowable	=	75.0 psi	
Sliding Calcs Lateral Sliding Force	=	1,215.3 lbs	

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

Load Factors Building Code	IBC 2018,ACI
Dead Load	1 400
Live Load	1.700
Earth, H	1.700
Wind, W	1.000
Seismic, E	1.000
Ocionio, L	1.000

Lateral Load Applied to Stem

Footing||Soil Friction

Soil height to ignore for passive pressure

Lateral Load	=	0.0 #/ft
Height to Top	=	0.00 ft
Height to Bottom	=	0.00 ft
Load Type	=	Wind (W)
		(Service Level)

Wind on Exposed Stem = (Strength Level)

0.0 psf

0.400

0.00 in

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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Stem Construction		2nd	Bottom	
		Stem OK	Stem OK	
Design Height Above Ft			0.00	
Wall Material Above "Ht	" =	00,10,010	Concrete	
Design Method	=	_,	LRFD	
Thickness	=	0.00	8.00	
Rebar Size	=	# 4	# 4	
Rebar Spacing	=	12.00	10.00	
Rebar Placed at	=	6 in	6 in	
Design Data		0.318	0.677	
fb/FB + fa/Fa	=	0.318	0.677	
Total Force @ Section	11			
Service Level	lbs =			
Strength Level	ibs =	899.9	1,673.4	
MomentActual	e			
Service Level	ft-#=			
Strength Level	ft-# =	.,	4,183.6	
MomentAllowable	ft-# =	5,187.6	6,174.1	
ShearActual				
Service Level	psi =			
Strength Level	psi =	12.5	23.2	
ShearAllowable	psi =	75.0	75.0	
Anet (Masonry)	in2 =			
Rebar Depth 'd'	in =	6.00	6.00	
Masonry Data —				
fm	psi=			
Fs	psi≃			
Solid Grouting	· =			
Modular Ratio 'n'	=			
Wall Weight	psf=	100.0	100.0	
Short Term Factor	=			
Equiv. Solid Thick.	=			
Masonry Block Type	=	Medium We	eight	
Masonry Design Method	=	ASD		
Concrete Data				
fc	psi =	2,500.0	2,500.0	
Fy	psi =	60,000.0	60,000.0	



Project Name/Number: marbella

8ft Stem Dsgnr: Mark Myers, PE

Horizontal Reinforcing

Description....

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Cantilevered Retaining Wall

Code: IBC 2018, ACI 318-14, TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem

As (based on applied moment): (4/3) * As:

200bd/fy: 200(12)(6)/60000: 0.0018bh: 0.0018(12)(8):

As (based on applied moment):

200bd/fy: 200(12)(6)/60000: 0.0018bh: 0.0018(12)(8):

Required Area:

Provided Area: Maximum Area:

Bottom Stem

(4/3) * As:

0.8128 in2/ft

0.1728 in2/ft 0.2 in2/ft

#5@ 19.38 in #6@ 27.50 in

One layer of:

#4@ 12.50 in

#5@ 38.75 in #6@ 55.00 in

Two layers of:

#4@ 25.00 in

Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

Vertical Reinforcing

Vertical Reinforcing

0.0645 in2/ft

0.086 in2/ft

0.1728 in2/ft

0.24 in2/ft

0.1636 in2/ft 0.2182 in2/ft

0.24 in2/ft

0.1728 in2/ft

0.2182 in2/ft 0.24 in2/ft 0.8128 in2/ft Horizontal Reinforcing

Min Stem T&S Reinf Area 0.384 in2

Min Stem T&S Reinf Area 1.152 in2

Horizontal Reinforcing Options:

Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft Horizontal Reinforcing Options:

One layer of: Two layers of: #4@ 12.50 in #4@ 25.00 in #5@ 19.38 in #5@ 38.75 in #6@ 27.50 in #6@ 55.00 in

Maximum Area: **Footing Data**

Required Area:

Provided Area:

Toe Width	=	2.50 ft
	-	
Heel Width	=	1.33
Total Footing Width	=	3.83
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.92 ft
	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	<u>Heel</u>					
=	1,808	0 psf					
=	50,091	0 ft-#					
=	9,844	330 ft-#					
=	3,354	330 ft-#					
=	24.40	10.32 psi					
=	75.00	40.00 psi					
=	#4@9.00 in						
=	None Spec'd						
=	None Spec'd						
	=	0.00 ft-lbs					
n, p	hiTu =	0.00 ft-lbs					
		= 1,808 = 50,091 = 9,844 = 3,354 = 24.40 = 75.00 = #4@9.00 in = None Spec'd = None Spec'd					

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

Other Acceptable Sizes & Spacings

Toe: (#4@ 11.11 in), #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 Heel: philm - phi5'lambda'sqrt(fc)'Sm

Key: No key defined

Min footing T&S reinf Area Min footing T&S reinf Area per foot 0.83 in2 0.22 in2 /ft

If one layer of horizontal bars:

If two layers of horizontal bars:

#4@ 11.11 in #5@ 17.22 in #6@ 24.44 in #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in



Project Name/Number: marbella

Title 8ft Stem
Dsgnr: Mark Myers, PE

Description....

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Cantilevered Retaining Wall

Code: IBC 2018, ACI 318-14, TMS 402-16

	۰۰۰۰۰۰۱	/ERTURNING			RE	SISTING	
Item	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,215.3	2.78	3,375.8	Soil Over HL (ab. water tbl)	624.7	3.50	2,186.3
HL Act Pres (be water tbl) Hydrostatic Force				Soil Over HL (bel. water tbl) Watre Table	·	3.50	2,186.3
	=			Sloped Soil Over Heel =			
	=			Surcharge Over Heel =			
	=			Adjacent Footing Load =			
— —	=			Axial Dead Load on Stem =			
	=			* Axial Live Load on Stem =			
oad @ Stem Above Soil	<u>-</u>			Soil Over Toe =	156.3	1.25	195.3
•				Surcharge Over Toe =			
				Stem Weight(s) =	800.0	2.83	2,266.7
_		_	-	Earth @ Stem Transitions=			
Total	= 1,215.3	O.T.M. =	3,375.8	Footing Weight =	479.1	1.92	918.2
				Key Weight =		2.92	
Resisting/Overturning	Ratio	=	1.65	Vert. Component =			
Vertical Loads used for	Soil Pressure	= 2,060.1	l lbs	Total =	2,060.1 II	os R.M.=	5,566.5

* 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

250.0 pci

Horizontal Defl @ Top of Wall (approximate only)

0.075 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.



Project Name/Number: marbella

Title 8ft Stem
Dsgnr: Mark Myers, PE

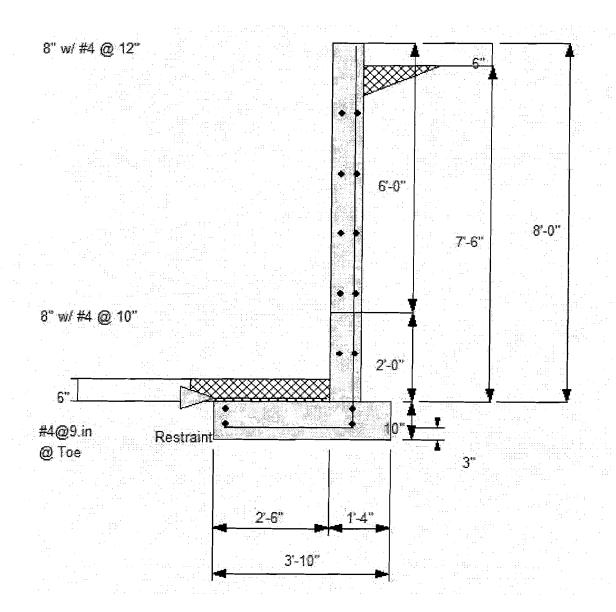
Description....

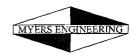
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Cantilevered Retaining Wall





Project Name/Number: marbella

Title 8ft Stem Dsgnr: Mark Myers, PE

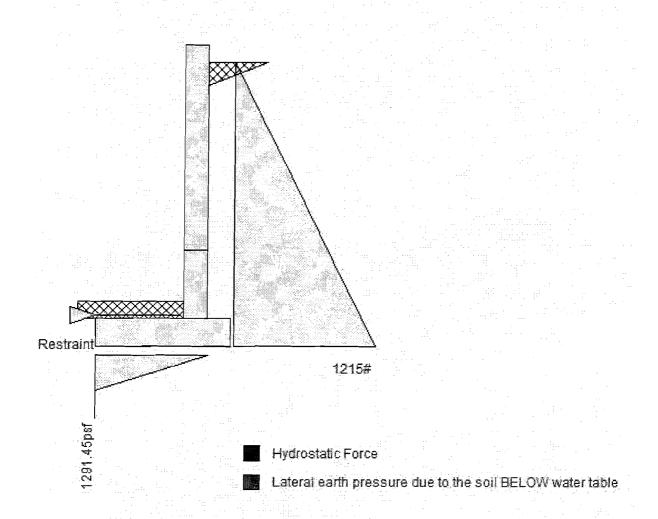
Description....

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Cantilevered Retaining Wall





(Multiplier used on soil density)

Dead Load

Live Load

Earth, H

Wind, W

Seismic, E

1.400

1.700

1.700

1.000

1.000

Mark Myers, P.E. Myers Engineering LLC 3206 50th St. Ct. NW, Ste 210-B Gig Harbor, WA 98335

Project Name/Number: marbella 8ft Stem w/ Seismic

Dsgnr. Mark Myers, PE

Description....

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RetainPro (c) 1987-2019, Build 11.20.03.31 Code: IBC 2018,ACI 318-14,TMS 402-16 Cantilevered Retaining Wall License: KW-06057398 License To: MYERS ENGINEERING Soil Data Criteria 3,333.3 psf Allow Soil Bearing 7.50 ft Retained Height Equivalent Fluid Pressure Method 0.50 ft Wall height above soil = Active Heel Pressure 35.0 psf/ft Slope Behind Wall 0.00 6.00 in Height of Soil over Toe Passive Pressure 300.0 psf/ft 0.0 ft Water height over heel 125.00 pcf Soil Density, Heel Soil Density, Toe 125.00 pcf Footing||Soil Friction 0.400 Soil height to ignore for passive pressure 0.00 in Surcharge Loads Lateral Load Applied to Stem Adjacent Footing Load Adjacent Footing Load 0.0 lbs Surcharge Over Heel 0.0 psf Lateral Load 0.0 #/ft Used To Resist Sliding & Overturning Footing Width 0.00 ft ... Height to Top 0.00 ft 0.0 psf Surcharge Over Toe **Eccentricity** 0.00 in ... Height to Bottom 0.00 ft Used for Sliding & Overturning Wall to Ftg CL Dist 0.00 ft Load Type Wind (W) Footing Type Line Load Axial Load Applied to Stem (Service Level) Base Above/Below Soil 0.0 ft Axial Dead Load 0.0 lbs 0.0 psf Wind on Exposed Stem = at Back of Wall Axial Live Load 0.0 lbs (Strength Level) Poisson's Ratio 0.300 Axial Load Eccentricity = 0.0 in **Earth Pressure Seismic Load** Method: Uniform Uniform Seismic Force = 50.000 6.000 Multiplier Used Total Seismic Force 416.667

Design Summary			Stem Construction		2nd_	Bottom	
		makene yés kanadakan kecaman dan dan	Desire Heiler Manage Ed		Stem OK	Stem OK	
Mall Ctability Dation			Design Height Above Ft	•	2.00	0.00	
Wall Stability Ratios Overturning	=	(1.21) Ratio <	Wall Material Above "Ht		Concrete	Concrete	
Slab Resis	oto All	~	Doorgii Motilou	=	LRFD	LRFD	
Slab Resi	515 AII	· OK w/		=	8.00	8.00	
Total Bearing Load	=	2,060 lbs 3e	SAIL Rebar Size	=	# 4	# 4	
Total Bearing Loadresultant ecc.	=	2,000 lbs		=	12.00	10.00	
resultant coo.		17.02 111	Rebar Placed at	=	6 in	6 in	
Soil Pressure @ Toe	=	2,900 psf OK	Design Data	=	0.463	0.905	
Soil Pressure @ Heel	=	0 psf OK	ID/FD + Id/Fd	=	0.463	0.505	
Allowable	=	3,333 _{psf}	Total Force @ Section				
Soil Pressure Les	s Thai		Service Level	lbs =			
ACI Factored @ Toe	=	4,061 psf	Strength Level	ibs =	1,174.9	2,048.4	
ACI Factored @ Heel	=	0 psf	MomentActual				
Footing Shear @ Toe	=	29.9 psi OK	Service Level	ft-# =			
Footing Shear @ Heel	=	10.3 psi OK	Strength Level	ft-# =	2,406.1	5,589.8	
Allowable	=	75.0 psi	MomentAllowable	ft-#=	5,187.6	6,174.1	
Sliding Calcs			ShearActual				
Lateral Sliding Force	_	1,506.9 lbs	Service Level	psi =			
Lateral Oliding 1 orde	=	1,500.9 108	Strength Level	•	16.2	20 5	
			•	psi =	16.3	28.5	
			ShearAllowable	psi =	75.0	75.0	
			Anet (Masonry)	in2 =			
			Rebar Depth 'd'	in =	6.00	6.00	
			Masonry Data ———				
			fm	psi≃			
			Fs	psi =			
ertical component of activ			Solid Grouting	=			
OT considered in the calc	ulation	n of soil bearing	Modular Ratio 'n'	=			
			Wall Weight	psf=	100.0	100.0	
_oad Factors			Short Term Factor	=			
Building Code	ΙB	C 2018,ACI	Equiv. Solid Thick.	=			
Dood Lood		4 400					

Masonry Block Type

Concrete Data

fc

Fy

Masonry Design Method

=

= ASD

psi =

Medium Weight

2,500.0

60,000.0

2,500.0

60,000.0



Project Name/Number: marbella

8ft Stem w/ Seismic Dsgnr: Mark Myers, PE

Description....

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200bd/fy: 200(12)(6)/60000:

Cantilevered Retaining Wall

Code: IBC 2018, ACI 318-14, TMS 402-16

Concrete	Stem	Rebar	Area	Details
	Ottill	i ve bui	\sim	

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment):	0.0941 in2/ft	
(4/3) * As :	0.1255 in2/ft	Min Stem T&S Reinf A

Min Stem T&S Reinf Area 1.152 in2 0.1255 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft 0.24 in2/ft

0.0018bh: 0.0018(12)(8): 0.1728 in2/ft Horizontal Reinforcing Options: Two layers of: One layer of: 0.1728 in2/ft #4@ 12.50 in #4@ 25.00 in Required Area: 0.2 in2/ft #5@ 19.38 in

Provided Area: #5@ 38.75 in Maximum Area: 0.8128 in 2/ft #6@ 27.50 in #6@ 55.00 in

Bottom Stem Horizontal Reinforcing Vertical Reinforcing

As (based on applied moment): 0.2186 in2/ft (4/3) * As: 0.2915 in2/ft Min Stem T&S Reinf Area 0.384 in2

200bd/fy: 200(12)(6)/60000: 0.24 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: 0.24 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: 0.24 in2/ft #5@ 19.38 in #5@ 38.75 in

Maximum Area: 0.8128 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	2.5	0 ft
Heel Width	=	1.3	33
Total Footing Width	= -	3.8	33
Footing Thickness	=	10.0	0 in
Key Width	=	0.0	0 in
Key Depth	=	0.0	0 in
Key Distance from Toe	=	2.9	2 ft
fc = 2,500 psi	Fy =	60,00	0 psi
Footing Concrete Densit	y =	150.0	0 pcf
Min. As %	=	0.001	8
Cover @ Top 2.00	@ E	3tm.= 3	3 00 in

Footing Design Results

2019 A 9 C 1 A 9 C 1 A 9 C 1 A 1 A 1 A 1 A 1 A 1 A 1 A 1 A 1 A 1			
		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	4,061	0 psf
Mu' : Upward	=	70,135	0 ft-#
Mu': Downward	=	9,844	330 ft-#
Mu: Design	=	5,024	330 ft-#
Actual 1-Way Shear	=	29.91	10.32 psi
Allow 1-Way Shear	=	75.00	40.00 psi
Toe Reinforcing	=	#4@9.00 in	•
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	
Footing Torsion, Tu		=	0.00 ft-lbs
Footing Allow. Torsion	1, p	hiTu =	0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

To . #4@ 9.96 in, \$5@ 15.44 in, #6@ 21.92 in, #7@ 29.89 in, #8@ 39.36 in, #9@ 49 phiMn - phi 5'lambda'sqrt(fc)'Sm

Key: No key defined

Min footing T&S reinf Area Min footing T&S reinf Area per foot

If one layer of horizontal bars:

0.83 in2 in2 /ft 0.22 If two layers of horizontal bars:

#4@ 11.11 in

#4@ 22.22 in #5@ 34.44 in

#5@ 17.22 in #6@ 24.44 in

#6@ 48.89 in



Project Name/Number: marbella

resistance, but is included for soil pressure calculation.

8ft Stem w/ Seismic Dsgnr: Mark Myers, PE

Description....

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

HL Act Pres (ab water tbl)			0\	ERTURNING		-	R	ESISTING	
Soil Over HL (bel. water tbl) Soil Over HL (bel. water tbl	Item								
Buoyant Force = Sloped Soil Over Heel = Surcharge over Heel = Surcharge Over Heel = Surcharge Over Toe = Adjacent Footing Load = Axial Dead Load on Stem = Axial Live Load on Stem = Axial Live Load on Stem = Soil Over Toe = 156.3 1.25 195.3 Soil Over Toe = 156.3 1.25 195.3 Surcharge Over Toe = Stem Weight(s) = 800.0 2.83 2,266.7 Earth @ Stem Transitions = Footing Weight = 479.1 1.92 918.2 Key Weight = 2.92 Resisting/Overturning Ratio = 1.21 Vert. Component =	HL Act Pres (be water t	•	1,215.3	2.78	3,375.8	Soil Over HL (bel, water tbl)	624.7	· ·	2,186.3 2,186.3
Adjacent Footing Load Surcharge Over Toe Adjacent Footing Load Axial Dead Load on Stem =	Buoyant Force	=				Sloped Soil Over Heel =	,		
Surcharge Over Toe = Adjacent Footing Load = Adjacent Footing Load = Axial Dead Load on Stem = Added Lateral Load = * Axial Live Load on Stem = Load @ Stem Above Soil = Soil Over Toe = Seismic Earth Load = 291.7 4.17 1,215.3 Surcharge Over Toe = Stem Weight(s) = 800.0 2.83 2,266.7 Earth @ Stem Transitions = Footing Weight = 479.1 1.92 918.2 Key Weight = 2.92 Resisting/Overturning Ratio = 1.21 Vert. Component =	Surcharge over Heel	=				Surcharge Over Heel =			
*Axial Live Load on Stem = Soil Over Toe = 156.3 1.25 195.3	Surcharge Over Toe	=				Adjacent Footing Load =			
Soil Over Toe 156.3 1.25 195.3 195.3 195.3 195.3 195.3 195.3 195.3 195.3 195.3 195.3 195.3 195.3 195.3 195.3 195.3 195.3 195.3 19	Adjacent Footing Load	=				Axial Dead Load on Stem =			
Seismic Earth Load = 291.7	Added Lateral Load	=				* Axial Live Load on Stem =			
Stem Weight(s) = 800.0	Load @ Stem Above S	oil =				Soil Over Toe =	156.3	1.25	195.3
Stem Weight(s)	Seismic Earth Load	=	291.7	4.17	1,215.3	Surcharge Over Toe =			
Total = 1,506.9 O.T.M. = 4,591.0 Footing Weight = 479.1 1.92 918.2 Key Weight = 2.92 Resisting/Overturning Ratio = 1.21 Vert. Component =		=			,	Stem Weight(s) =	0.008	2.83	2,266.7
Key Weight = 2.92 Resisting/Overturning Ratio = 1.21 Vert. Component =	Total	-	4 500 0	~	4.504.0	Earth @ Stem Transitions=			
Resisting/Overturning Ratio = 1.21 Vert. Component =	lotai	=	1,506.9	O.1.M. =	4,591.0	Footing Weight =	479.1	1.92	918.2
Tota component						Key Weight =		2.92	
						Vert. Component =			
						* Axial live load NOT included in	n total display	red, or used for	r overturning

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

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

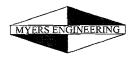
250.0 pci

Horizontal Defl @ Top of Wall (approximate only)

0.168 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.



Project Name/Number : marbella Title 8ft Stem w/ Seismic

Dsgnr: Mark Myers, PE

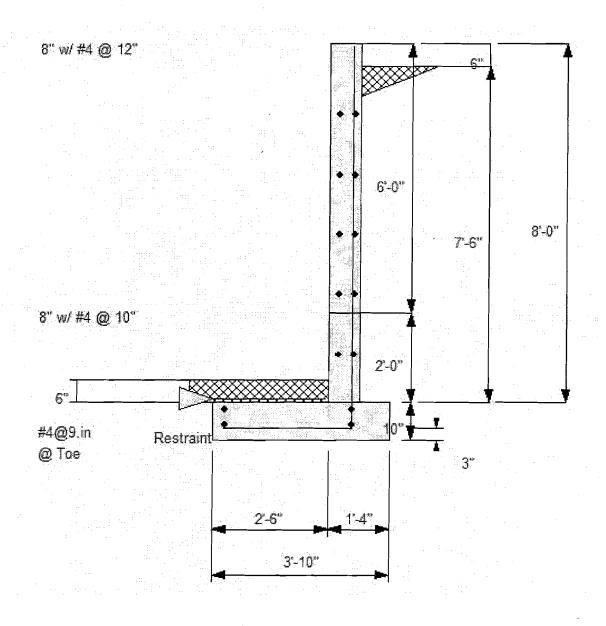
Description....

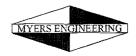
Page: 4 Date: 11 FEB 2021

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Cantilevered Retaining Wall





Project Name/Number : marbella Title 8ft Stem w/ Seismic

Dsgnr: Mark Myers, PE

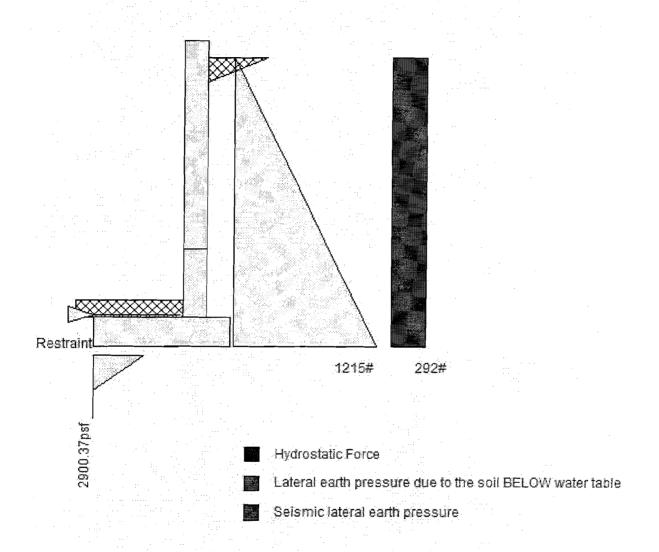
Description....

Page: 5 Date: 11 FEB 2021

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Cantilevered Retaining Wall





Project Name/Number : marbella

Title 6ft Stem
Dsgnr: Mark Myers, PE
Description....

Page : 1 Date: 11 FEB 2021

etainPro (c) 1987-2019, Bui cense : KW-06057398 cense To : MYERS ENC			Cantilevered Ret	air	ning V	Vall	Code: IBC 2018	3,ACI 31	18-14,TMS 402
Criteria			Soil Data		William or come and a second				
Retained Height Wall height above soil Slope Behind Wall Height of Soil over Toe Water height over heel	= = =	0.50 ft 0.00 6.00 in 0.0 ft	Allow Soil Bearing Equivalent Fluid Pressure M Active Heel Pressure Passive Pressure Soil Density, Heel Soil Density, Toe Footing Soil Friction Soil height to ignore for passive pressure		35.0	psf/ft psf/ft pcf pcf	Reman		
Surcharge Loads			Lateral Load Applied	d to	Stem	_	Adjacent Footin	g Load	
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe Used for Sliding & Ove	= rturnin	0.0 psf	Lateral Load =Height to Top =Height to Bottom = Load Type =		0.0 #/ 0.00 ft 0.00 ft nd (W)		Adjacent Footing Loa Footing Width Eccentricity Wall to Ftg CL Dist Footing Type	d = = = =	0.0 lbs 0.00 ft 0.00 in 0.00 ft Line Load
Axial Load Applied	3 (O S	CONTROL		(Se	ervice Le	•	Base Above/Below S	oil _	0.0 ft
Axial Dead Load Axial Live Load Axial Load Eccentricity	=======================================	0.0 lbs 0.0 lbs 0.0 in	Wind on Exposed Stem = (Strength Level)		0.0 ps	sf	at Back of Wall Poisson's Ratio	=	0.300
Design Summary			Stem Construction	S-V. 2008	Ţi —	2nd Stem Ol	Bottom Stem OK		
Wall Stability Ratios Overturning Slab Resis	= sts All	1.73 OK Sliding!	Design Height Above Wall Material Above Design Method Thickness		= = =	2.00 Concrete LRFI 8.00	0 0.00 e Concrete D LRFD 0 8.00		
Total Bearing Loadresultant ecc.	=	1,475 lbs 7.16 in	Rebar Size Rebar Spacing Rebar Placed at		=	# 4 12.00 6 ir	12.00		
Soil Pressure @ Toe Soil Pressure @ Heel Allowable	= = = The	1,335 psf OK 0 psf OK 2,500 psf	Design Data fb/FB + fa/Fa Total Force @ Sect Service Level	tion	= !bs =	0.08	1 0.318		_
Soil Pressure Les	sinar =	1 Allowable 1 868 psf	Strength Level		lbs=	364.4	899.9		

Overturning	=	1.73 OK	Denima Mathad	_	LDED	LDED	
•	ال ۸ مه		Design Method	=	LRFD	LRFD	
Slab Resis	is All	Skuing !	Thickness	=	8.00	8.00	
			Rebar Size	=	# 4	# 4	
Total Bearing Load	=	1,475 lbs	Rebar Spacing	=	12.00	12.00	
resultant ecc.	=	7.16 in	Rebar Placed at	=	6 in	6 in	
Soil Pressure @ Toe	=	1,335 psf OK	Design Data ————				
Soil Pressure @ Heel	=	0 psf OK	fb/FB + fa/Fa	=	0.081	0.318	
_		•	Total Force @ Section	1			
Allowable	=	2,500 psf	Service Level	lbs =			
Soil Pressure Less	s Inar		Strength Level	lbs =	364.4	899.9	
ACI Factored @ Toe	=	1,868 psf	•	105 -	304.4	059.5	
ACI Factored @ Heel	=	0 psf	MomentActual	64 11			
Footing Shear @ Toe	=	12.7 psi OK	Service Level	ft-# =			
Footing Shear @ Heel	=	7.7 psi OK	Strength Level	ft-# =	425.2	1,649.9	
Allowable	=	75.0 psi	MomentAllowable	ft-#=	5,187.6	5,187.6	
Sliding Calcs		•	ShearActual				
Lateral Sliding Force	=	701.9 lbs	Service Level	psi =			
•			Strength Level	psi=	5.1	12.5	
			ShearAllowable	psi =	75.0	75.0	
			Anet (Masonry)	in2 =			
			Rebar Depth 'd'	in =	6.00	6.00	
			Masonry Data				
			f'm	psi =			
			Fs	psi =			

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

Load Factors	
Building Code	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.000
Seismic, E	1.000

10/FB + 1a/Fa	_	0.001	0.510	
Total Force @ Section				
Service Level	lbs=			
Strength Level	lbs=	364.4	899.9	
MomentActual				
Service Level	ft-#=			
Strength Level	ft-# =	425.2	1,649.9	
MomentAllowable	ft-#=	5,187.6	5,187.6	
ShearActual				
Service Level	psi =			
Strength Level	psi=	5.1	12.5	
ShearAllowable	psi =	75.0	75.0	
Anet (Masonry)	in2 =			
Rebar Depth 'd'	in=	6.00	6.00	
Masonry Data				
fm	psi=			
Fs	psi =			
Solid Grouting	=			
Modular Ratio 'n'	=			
Wall Weight	psf=	100.0	100.0	
Short Term Factor	=			
Equiv. Solid Thick.	=			
Masonry Block Type	=	Medium Wo	eight	
Masonry Design Method	=	ASD		
Concrete Data				
fc	psi =	2,500.0	2,500.0	
Fy	psi =	60,000.0	60,000.0	



Project Name/Number: marbella

Horizontal Reinforcing Options:

Horizontal Reinforcing

Two layers of:

#4@ 25.00 in

#5@ 38.75 in

#6@ 55.00 in

6ft Stem

Dsgnr: Mark Myers, PE

Description....

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment):	0.0166 in2/ft	
(4/3) * As :	0.0222 in2/ft	Min Stem T&S Reinf Area 0.768 in2
200bd/fy: 200(12)(6)/60000:	0.24 in2/ft	Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

200bd/fy: 200(12)(6)/60000: 0.0018bh: 0.0018(12)(8): 0.1728 in2/ft

========= One layer of: Required Area: 0.1728 in2/ft #4@ 12.50 in Provided Area: 0.2 in2/ft #5@ 19.38 in Maximum Area: 0.8128 in2/ft #6@ 27.50 in

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.0645 in2/ft 0.086 in2/ft (4/3) * As:

Min Stem T&S Reinf Area 0.384 in2 200bd/fy: 200(12)(6)/60000: Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft 0.24 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: 0.2 in2/ft #5@ 19.38 in #5@ 38.75 in Maximum Area: 0.8128 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Data

I OCEIII	ig Dut	u				
Toe Wid	lth		=	1	.33 ft	
Heel Wi			=		.33	
Total Fo		idth (=		.67	
Footing	Thickne	SS	=	10	.00 in	
Key Wid	lth		=	0.	.00 in	
Key Dep	th		=	0.	.00 in	
Key Dist	ance fro	om Toe	=	2.	.92 ft	
fc =	2,50	0 psi	Fy =	60.0	00 ps	i
Footing (Concret	e Densit	y =		.00 pc	
Min. As	%		=	0.00	18	
Cover @	Top	2.00	@	Btm.=	3.00	in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>	
Factored Pressure	=	1,868	0	psf
Mu' : Upward	Ξ	15,914	1	ft-#
Mu': Downward	=	2,799	253	ft-#
Mu: Design	=	1,093	251	ft-#
Actual 1-Way Shear	=	12.71	7.70	psi
Allow 1-Way Shear	=	75.00	40.00	psi
Toe Reinforcing	=	#4@11.00 in		
Heel Reinforcing	=	None Spec'd		
Key Reinforcing	=	None Spec'd		
Footing Torsion, Tu		=	0.00	ft-lbs
Footing Allow. Torsion	n, p	hiTu ≃	0.00	ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5

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

Key: No key defined

Min footing T&S reinf Area 0.58 in2 Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4@ 11.11 in #4@ 22.22 in #5@ 17.22 in #5@ 34.44 in #6@ 24.44 in #6@ 48.89 in



Project Name/Number: marbella

resistance, but is included for soil pressure calculation.

6ft Stem

Dsgnr: Mark Myers, PE

Description....

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Total		0\	ERTURNING)		RE	SISTING	
Soil Over HL (bel. water tbl) 2.33 1,068.7	item	Force	Distance	Moment		Force	Distance	
Watre Table	HL Act Pres (ab water tbl)	701.9	2.11	1,481.9	Soil Over HL (ab. water tbl)	458.1	2.33	1,068.7
Buoyant Force = Sloped Soil Over Heel = Surcharge over Heel = Surcharge Over Heel = Adjacent Footing Load = Adjacent Footing Load = Axial Dead Load on Stem = Axial Live Load on Stem = Axial Live Load on Stem = Soil Over Toe = Stem Weight(s) = 600.0 1.67 999.8 Earth @ Stem Transitions = Footing Weight = 333.3 1.33 444.2 Key Weight = 2.92 Resisting/Overturning Ratio = 1.73 Vert. Component =	, ,			·			2.33	1,068.7
Surcharge over Heel = Surcharge Over Heel = Adjacent Footing Load = Axial Dead Load on Stem = Axial Live Load on Stem = Soil Over Toe = Stem Weight(s) = 600.0 1.67 999.8 Total = 701.9 O.T.M. = 1,481.9 Footing Weight = 333.3 1.33 444.2 Resisting/Overturning Ratio = 1.73 Vert. Component = Surcharge Over Heel = Adjacent Footing Load = Axial Live Load on Stem = Axial Live Load on Stem = Soil Over Toe = Stem Veight(s) = 600.0 1.67 999.8	•				Sloped Soil Over Heel =			
Surcharge Over Toe = Adjacent Footing Load = Adjacent Footing Load = Axial Dead Load on Stem = Added Lateral Load = * Axial Live Load on Stem = Load @ Stem Above Soil = Soil Over Toe = Surcharge Over Toe Stem Weight(s) = Stem Weight(s) = 600.0 1.67 999.8 Earth @ Stem Transitions = Footing Weight = 333.3 1.33 444.2 Key Weight = 2.92 Resisting/Overturning Ratio = 1.73 Vert. Component =	•				Surcharge Over Heel =			
Adjacent Footing Load =	•				Adjacent Footing Load =			
Added Lateral Load =	•				Axial Dead Load on Stem =			
Soil Over Toe					* Axial Live Load on Stem =			
= Surcharge Over Toe = Stem Weight(s) = 600.0 1.67 999.8 Total = 701.9 O.T.M. = 1,481.9					Soil Over Toe =	83.3	0.67	55.5
Total = 701.9 O.T.M. = 1,481.9	=				Surcharge Over Toe =			
Total = 701.9 O.T.M. = 1,481.9 Footing Weight = 333.3 1.33 444.2 Key Weight = 2.92 Resisting/Overturning Ratio = 1.73 Vert. Component =					Stem Weight(s) =	600.0	1.67	999.8
Key Weight = 2.92 Resisting/Overturning Ratio = 1.73 Vert. Component =					Earth @ Stem Transitions=			
Resisting/Overturning Ratio = 1.73 Vert. Component =	Total =	701.9	O.T.M. =	1, 4 81.9	Footing Weight =	333.3	1.33	444.2
					Key Weight =		2.92	
			=		Vert. Component =			

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

250.0 pci

Horizontal Defl @ Top of Wall (approximate only)

0.083 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.



Project Name/Number : marbella

Title 6ft Stem
Dsgnr: Mark Myers, PE

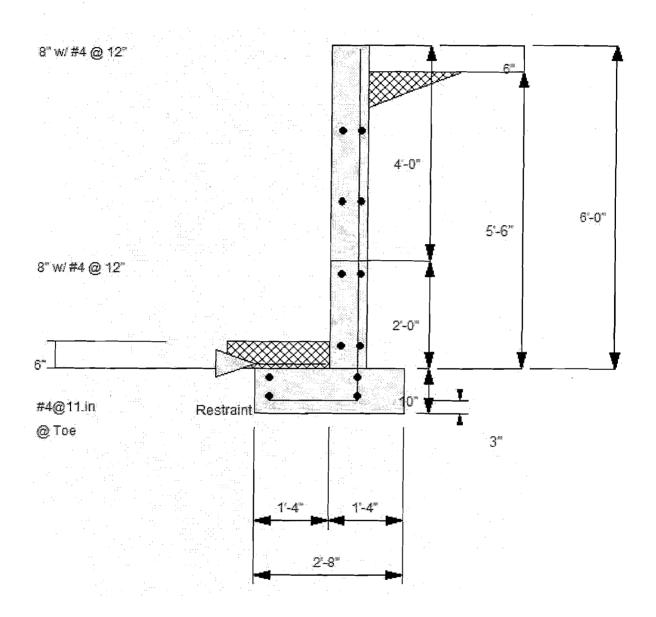
Description....

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Cantilevered Retaining Wall





Project Name/Number: marbella

Title 6ft Stem Dsgnr: Mark Myers, PE

Description....

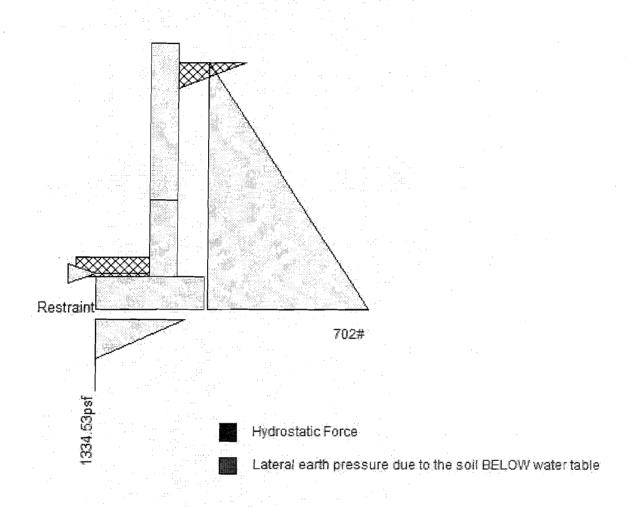
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Cantilevered Retaining Wall





Project Name/Number: marbella

6ft Stem w/ Seismic Dsgnr: Mark Myers, PE

Description....

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0.0 ft

0.300

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria	***************************************		
Retained Height	=	5.50 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 3,333.3 psf Allow Soil Bearing Equivalent Fluid Pressure Method Active Heel Pressure 35.0 psf/ft

Passive Pressure 300.0 psf/ft Soil Density, Heel 125.00 pcf Soil Density, Toe 125.00 pcf Footing||Soil Friction 0.400

Soil height to ignore for passive pressure

Wind on Exposed Stem =

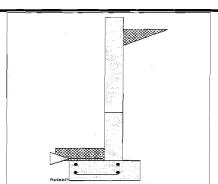
Stem Construction

0.00 in

0.0 psf

2nd

Stem OK



Surcharge Loads

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

Axial Load Applied to Stem

	××:	55/0 <mark>/00/0000 </mark>
Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used 6.000 (Multiplier used on soil density)

Design Summary

Sliding Calcs Lateral Sliding Force

Lateral Load Applied to Stem

Lateral LoadHeight to TopHeight to Bottom	= =	0.0 #/ft 0.00 ft 0.00 ft
Load Type	=	Wind (W) (Service Level)

(Strength Level)

Uniform Seismic Force = 38.000

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 Line Load

Base Above/Below Soil

at Back of Wall

Poisson's Ratio

Bottom

Stem OK

Total Seismic Force 240.667

Wall Stability Ratios		\sim	
Overturning	=	(1.27)Ratio < 1.5!	
Slab Resist	s All S	Sliding! OK W/	
		SeisMic	_
Total Bearing Load	=	1,475 lbs	
resultant ecc.	=	11.50 in	
			i
Soil Pressure @ Toe	=	2,622 psf OK	
Soil Pressure @ Heel	=	0 psf OK	
Allowable	=	3,333 _{psf}	
Soil Pressure Less	Than	Allowable	
ACI Factored @ Toe	=	3,671 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	21.3 psi OK	
•		•	
Footing Shear @ Heel	=	7.9 psi OK	
Allowable	=	75.0 psi	

870.4 lbs

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

Load Factors	
Building Code	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.000
Seismic, E	1.000

Design Height Above Fto	ft=	2.00	0.00	
Wall Material Above "Ht"		Concrete	Concrete	
! Design Method	=	LRFD	LRFD	
Thickness	=	8.00	8.00	
Rebar Size	=	# 4	# 4	
Rebar Spacing	=	12.00	12.00	
Rebar Placed at	=	6 in	6 in	
Design Data				
fb/FB + fa/Fa	=	0.126	0.428	
Total Force @ Section				
Service Level	lbs=			
Strength Level	lbs=	497.4	1,108.9	
MomentActual				
Service Level	ft-#=			
Strength Level	ft-#=	657.9	2,224.6	
MomentAllowable	ft-#=	5,187.6	5,187.6	
ShearActual				
Service Level	psi=			
Strength Level	psi=	6.9	15.4	
ShearAllowable	psi =	75.0	75.0	
Anet (Masonry)	in2 =			
Rebar Depth 'd'	in =	6.00	6.00	
Masonry Data				
fm	psi=			
Fs	psi =			
Solid Grouting	· =			
Modular Ratio 'n'	=			
Wall Weight	psf=	100.0	100.0	
Short Term Factor	· =			
Equiv. Solid Thick.	=			
Masonry Block Type	=	Medium We	eight	
Masonry Design Method	=	ASD		
Concrete Data				
fc ,	psi=	2,500.0	2,500.0	
Fy 16	psi =	60,000.0	60,000.0	



Project Name/Number: marbella

6ft Stem w/ Seismic Dsgnr: Mark Myers, PE

Description....

One laver of:

#4@ 12.50 in

#5@ 19.38 in

#6@ 27.50 in

Horizontal Reinforcing

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Cantilevered Retaining Wall

Code: IBC 2018, ACI 318-14, TMS 402-16

Concrete	Stem	Rebar	Area	Details
----------	------	-------	------	----------------

2nd Stem Vertical Reinforcing Horizontal Reinforcing 0.0257 in2/ft As (based on applied moment): (4/3) * As:

Min Stem T&S Reinf Area 0.768 in2

200bd/fy: 200(12)(6)/60000:

0.0343 in2/ft 0.24 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:

Required Area: Provided Area: Maximum Area: 0.1728 in2/ft 0.2 in2/ft

Two lavers of: #4@ 25.00 in #5@ 38.75 in

0.8128 in2/ft

#6@ 55.00 in

Bottom Stem

As (based on applied moment):

0.087 in2/ft 0.116 in2/ft

Vertical Reinforcing

Min Stem T&S Reinf Area 0.384 in2

(4/3) * As: 200bd/fy: 200(12)(6)/60000:

0.24 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: Provided Area: Maximum Area: 0.1728 in2/ft 0.2 in2/ft 0.8128 in2/ft

#4@ 12.50 in #4@ 25.00 in #5@ 19.38 in #5@ 38.75 in #6@ 27.50 in #6@ 55.00 in

Footing Data

10.1			
Toe Width	=	1.3	3 ft
Heel Width	=	1.3	33
Total Footing Width	= -	2.6	7
Footing Thickness	=	10.0	0 in
Key Width	=	0.0	0 in
Key Depth	=	0.0	0 in
Key Distance from Toe	=	2.9	2 ft
fc = 2,500 psi	Fy =	60,00	0 psi
Footing Concrete Densit	ty =	150.0	0 pcf
Min. As %	=	0.001	8
Cover @ Top 2.00	@ E	3tm.= 3	3.00 in

Footing Design Results

Market Comment of the							
		<u>Toe</u>	<u>Heel</u>				
Factored Pressure	=	3,671	0 psf				
Mu' : Upward	=	23,736	0 ft-#				
Mu' : Downward	=	2,799	253 ft-#				
Mu: Design	=	1,745	253 ft-#				
Actual 1-Way Shear	=	21.29	7.90 psi				
Allow 1-Way Shear	=	75.00	40.00 psi				
Toe Reinforcing	=	#4@11.00 in					
Heel Reinforcing	=	None Spec'd					
Key Reinforcing	=	None Spec'd					
Footing Torsion, Tu		=	0.00 ft-lbs				
Footing Allow. Torsion	n, p	hiTu =	0.00 ft-lbs				

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

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5

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

Key: No key defined

Min footing T&S reinf Area Min footing T&S reinf Area per foot

in2 0.22 in2 /ft

If one layer of horizontal bars:

If two layers of horizontal bars:

#4@ 11.11 in #5@ 17.22 in #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

#6@ 24.44 in



Project Name/Number: marbella

resistance, but is included for soil pressure calculation.

6ft Stem w/ Seismic Dsgnr: Mark Myers, PE

Description....

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Cantilevered Retaining Wall

Code: IBC 2018.ACI 318-14.TMS 402-16

		OV	ERTURNING	j		RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	D)	701.9	2.11	1,481.9	Soil Over HL (ab. water tbl)	458.1	2.33	1,068.7
HL Act Pres (be water tb Hydrostatic Force	,			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Soil Over HL (bel. water tbl) Watre Table		2.33	1,068.7
Buoyant Force	=				Sloped Soil Over Hee =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=				* Axial Live Load on Stem =			
Load @ Stem Above Soi	l =			•	Soil Over Toe =	83.3	0.67	55.5
Seismic Earth Load	=	168.5	3.17	533.5	Surcharge Over Toe =			
	=				Stem Weight(s) =	600.0	1.67	999.8
					Earth @ Stem Transitions=			
Total	=	870.4	O.T.M. =	2,015.4	Footing Weight =	333.3	1.33	444.2
					Key Weight =		2.92	
Resisting/Overturning			=	1.27	Vert. Component =			
Vertical Loads used for	or Soil	Pressure :	= 1,474.	7 lbs	Total =	1,474.7	os R.M.=	2.568.2

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

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

250.0 pci

Horizontal Defl @ Top of Wall (approximate only)

0.164 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.



Project Name/Number : marbella

Title 6ft Stem w/ Seismic Dsgnr: Mark Myers, PE

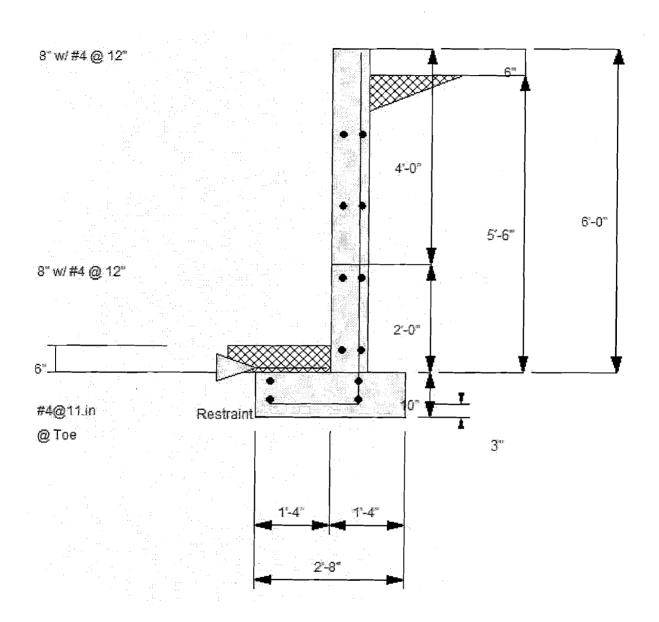
Description....

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Cantilevered Retaining Wall





Project Name/Number: marbella

Title 6ft Stem w/ Seismic Dsgnr: Mark Myers, PE

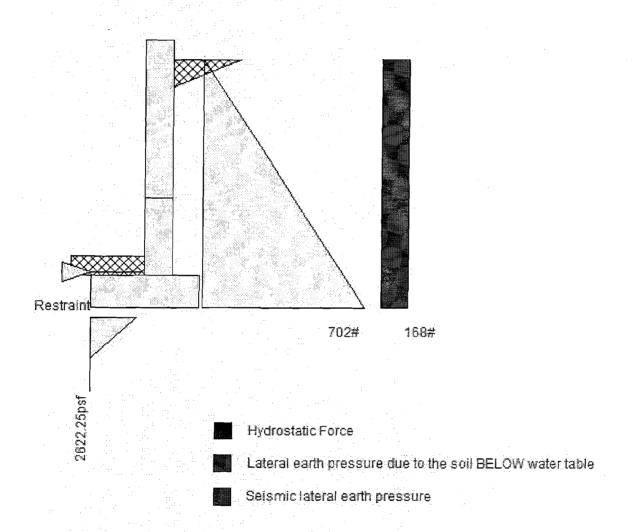
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Cantilevered Retaining Wall





Project Name/Number : marbella

4ft Stem Dsgnr: Mark Myers, PE

Description....

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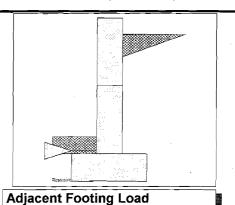
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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

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 Equivalent Fluid Pressure	= Meth	2,500.0 psf
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	125.00 pcf
Footing Soil Friction	=	0.400
Soil height to ignore for passive pressure	, =	0.00 in



Surcharge Loads

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

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricit	y =	0.0 in

4 -4	1 1	A I*I	to Stem
l ateral	า กลก	Anniiea	to Stem
I Lace Color	Loud	ADDITOU	CO OCCIII

Wind on Exposed Stem =

Stem Construction

(Strength Level)

==	0.0 #/ft
=	0.00 ft
=	0.00 ft
=	Wind (W)
	(Service Level)
	=

The second secon	Sec. 25.00	Marie Constitution and the constitution of the
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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Lateral Sliding Force

Wall Stability	Ratios			
Overturning	= 2.42	OK		
Stah Regiete All Stiding I				

Total Bearing Load	=	983 lbs
resultant ecc.	=	3.76 in
Soil Pressure @ Toe	=	953 psf OK
Soil Pressure @ Heel	=	30 psf OK
Allowable	=	2,500 psf
Soil Pressure Less	Thar	n Allowable
ACI Factored @ Toe	=	1,335 psf
ACI Factored @ Heel	=	42 psf
Footing Shear @ Toe	=	1.3 psi OK
Footing Shear @ Heel	=	3.7 psi OK
Allowable	=	75.0 psi
Sliding Calcs		

328.6 lbs

Stolli Golloti action	200		
Design Height Above Ftg	ft =	Stem OK 2.00	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	8.00	8.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	12.00	12.00
Rebar Placed at Design Data	=	6 in	6 in
fb/FB + fa/Fa	=	0.006	0.081
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs=	66.9	364.4
MomentActual			
Service Level	ft-# =		

0.0 psf

2nd

Bottom

Rebar Size	=	# 4	# 4	
Rebar Spacing	=	12.00	12.00	
Rebar Placed at	=	6 in	6 in	
Design Data				
fb/FB + fa/Fa	=	0.006	0.081	
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs=	66.9	364.4	
MomentActual				
Service Level	ft-# =			
Strength Level	ft-# =	33.5	425.2	
MomentAllowable	ft-#=	5,187.6	5,187.6	
ShearActual				
Service Level	psi =			
Strength Level	psi =	0.9	5.1	
ShearAllowable	psi =	75.0	75.0	
Anet (Masonry)	in2 =			
Rebar Depth 'd'	in =	6.00	6.00	
Masonry Data ———				
fm	psi=			
Fs	psi =			
Solid Grouting				
Modular Ratio 'n'	=			
Wall Weight	psf=	100.0	100.0	
Short Term Factor	=			
Equiv. Solid Thick.	=			
Masonry Block Type	=	Medium W	eight	
Masonry Design Method	=	ASD		
Concrete Data				
fc 	psi =	2,500.0	2,500.0	
Fy	psi =	60,000.0	60,000.0	

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

Load Factors Building Code Dead Load Live Load Earth, H	IBC 2018,ACI 1.400 1.700 1.700
Wind, W Seismic, E	1.000 1.000 1.000



Project Name/Number: marbella

4ft Stem Dsgnr: Mark Myers, PE

Horizontal Reinforcing

Description....

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

As (based on applied moment):

(4/3) * As:

200bd/fy: 200(12)(6)/60000: 0.0018bh: 0.0018(12)(8):

Required Area: Provided Area: Maximum Area:

2nd Stem

0.2 in2/ft 0.8128 in2/ft

One layer of: 0.1728 in2/ft #4@ 12.50 in

#5@ 19.38 in #6@ 27.50 in #5@ 38.75 in #6@ 55.00 in

Two layers of:

#4@ 25.00 in

Bottom Stem

As (based on applied moment): (4/3) * As:

200bd/fy: 200(12)(6)/60000: 0.0018bh: 0.0018(12)(8):

Required Area: Provided Area: Maximum Area: Vertical Reinforcing 0.0166 in2/ft

Vertical Reinforcing

0.0013 in2/ft

0.0017 in2/ft

0.1728 in2/ft

0.24 in2/ft

0.0222 in2/ft 0.24 in2/ft

0.1728 in2/ft ______

0.1728 in2/ft 0.2 in2/ft 0.8128 in2/ft Horizontal Reinforcing

Min Stem T&S Reinf Area 0.384 in2

Min Stem T&S Reinf Area 0.384 in2

Horizontal Reinforcing Options:

Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

Horizontal Reinforcing Options: One layer of: Two layers of:

#4@ 12.50 in #4@ 25.00 in #5@ 19.38 in #5@ 38.75 in #6@ 27.50 in #6@ 55.00 in

Footing Data

The second secon	00000000000000000000000000000000000000	·	talik salamanan da perandak
Toe Width		=	0.67 ft
Heel Width		=	1.33
Total Footing Wi	dth	= _	2.00
Footing Thicknes	SS	=	10.00 in
Key Width		=	0.00 in
Key Depth		=	0.00 in
Key Distance fro	m Toe	=	2.92 ft
fc = 2,500 Footing Concrete Min. As %		= = =	60,000 psi 150.00 pcf 0.0018
Cover @ Top	2.00	@ B	tm.= 3.00 in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>		
Factored Pressure	=	1,335	42 psf		
Mu' : Upward	=	3,179	41 ft-#		
Mu': Downward	=	701	175 ft-#		
Mu: Design	=	207	134 ft-#		
Actual 1-Way Shear	=	1.32	3.68 psi		
Allow 1-Way Shear	=	40.00	40.00 psi		
Toe Reinforcing	=	None Spec'd			
Heel Reinforcing	=	None Spec'd			
Key Reinforcing	=	None Spec'd			
Footing Torsion, Tu		=	0.00 ft-lbs		
Footing Allow. Torsion	0.00 ft-lbs				

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

Other Acceptable Sizes & Spacings

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

Key: No key defined

Min footing T&S reinf Area Min footing T&S reinf Area per foot

If one layer of horizontal bars: #4@ 11.11 in

0.43 in2 0.22 in2 /ft

If two layers of horizontal bars:

#4@ 22.22 in #5@ 17.22 in #5@ 34.44 in #6@ 24.44 in #6@ 48.89 in



Project Name/Number: marbella

Title 4ft Stem
Dsgnr: Mark Myers, PE

Description....

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

	1000000	/ERTURNING	orces & Mor		RE	SISTING	Salar Maria Cara Cara Cara Cara Cara Cara Cara
Item	Force lbs	Distance	Moment ft-#		Force	Distance	Moment ft-#
HL Act Pres (ab water tbl)	328.6	1.44	474.7	Soil Over HL (ab. water tbl)	291.5	1.67	485.9
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		1.67	485.9
Hydrostatic Force				Watre Table			
Buoyant Force =				Sloped Soil Over Hee =			
Surcharge over Heel =				Surcharge Over Heel =			
Surcharge Over Toe =				Adjacent Footing Load =			
Adjacent Footing Load =				Axial Dead Load on Stem =			
Added Lateral Load =				* Axial Live Load on Stem =			
_oad @ Stem Above Soil =				Soil Over Toe =	41.7	0.33	13.9
=				Surcharge Over Toe =			
				Stem Weight(s) =	400.0	1.00	400.1
				Earth @ Stem Transitions =			
Total =	328.6	O.T.M. =	474.7	Footing Weight =	250.0	1.00	250.0
				Key Weight =		2.92	
Resisting/Overturning Ra		=	2.42	Vert. Component =			
Vertical Loads used for Se	oil Pressure	= 983.2	2 lbs	Total =	983.2	os R.M.=	1,150.0

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

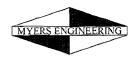
250.0 pci

Horizontal Defl @ Top of Wall (approximate only)

0.053 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.



Project Name/Number : marbella

Title 4ft Stem
Dsgnr: Mark Myers, PE

Description....

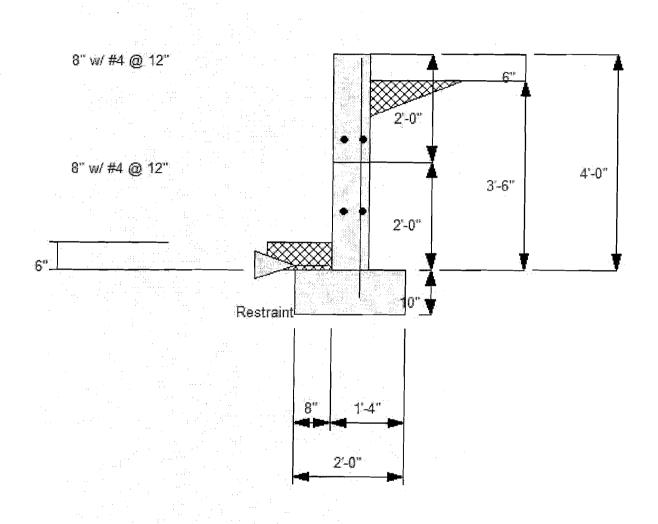
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Project Name/Number: marbella

Title 4ft Stem
Dsgnr: Mark Myers, PE

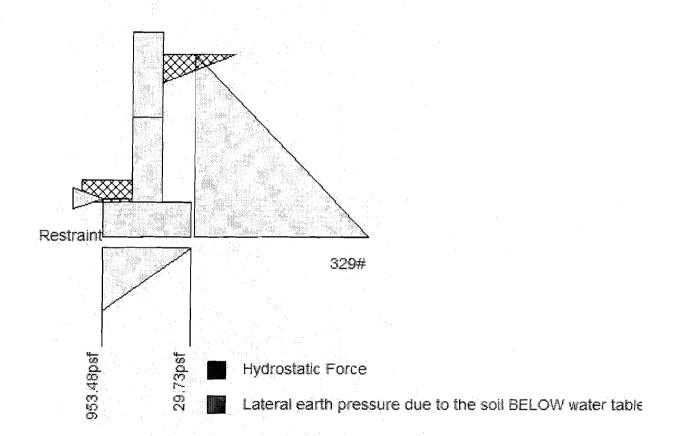
Description....

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Project Name/Number: marbella

4ft Stem w/ Seismic Dsgnr: Mark Myers, PE

Description....

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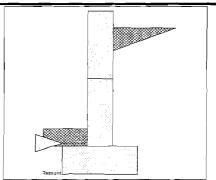
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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

-
3.50 ft
0.50 ft
0.00
6.00 in
0.0 ft

Soil Data		
Allow Soil Bearing	=	3,333.3 psf
Equivalent Fluid Pressure	Meth	nod
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	125.00 pcf
Footing Soil Friction	=	0.400



Surcharge Loads

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

Earth Pressure Seismic Load

Method: Uniform Multiplier Used 6.000 (Multiplier used on soil density)

Lateral Load	=	0.0 #/ft
Height to Top	=	0.00 ft
Height to Bottom	=	0.00 ft
Load Type	=	Wind (W)
		(Service Level)

Wind on Exposed Stem = 0.0 psf (Strength Level)

Uniform Seismic Force = 26.000

Adjacent Footing Load

Adjacent i obting	LUau	
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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.78 OK
Slab Resist	s All	Sliding!
Total Bearing Loadresultant ecc.	===	983 lbs 5.84 in
Soil Pressure @ Toe Soil Pressure @ Heel	=	1,278 psf OK 0 psf OK
Allowable Soil Pressure Less	= Thai	3,333 _{psf} n Allowable
ACI Factored @ Toe ACI Factored @ Heel	=	1,789 psf 0 psf
Footing Shear @ Toe Footing Shear @ Heel	= =	1.9 psi OK
Allowable	=	5.2 psi OK 75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	407.5 lbs

Total Sei	ismic Force	=	112.667
Chara	0		

Stem Construction		2nd	Bottom	
Design Height Above Ftg	; ft=	Stem OK 2.00	Stem OK 0.00	
Wall Material Above "Ht		Concrete	Concrete	
Design Method	=	LRFD	LRFD	
Thickness	=	8.00	8.00	
Rebar Size	=	# 4	# 4	
Rebar Spacing	=	12.00	12.00	
Rebar Placed at	=	6 in	6 in	
Design Data				
fb/FB + fa/Fa	=	0.012	0.112	
Total Force @ Section				
Service Level	lbs=			
Strength Level	lbs=	105.9	455.4	
MomentActual				
Service Level	ft-#=			
Strength Level	ft-# =	62.7	584.4	
MomentAllowable	ft-#=	5,187.6	5,187.6	
ShearActual				
Service Level	psi=			
Strength Level	psi =	1.5	6.3	
ShearAllowable	psi ≃	75.0	75.0	
Anet (Masonry)	in2 =			
Rebar Depth 'd'	in=	6.00	6.00	
Masonry Data				_
fm	psi=			
Fs	psi =			
Solid Grouting	=			
Modular Ratio 'n'	=			
Wall Weight	psf=	100.0	100.0	
Short Term Factor	=			
Equiv. Solid Thick.	=			
Masonry Block Type	=	Medium We	eight	
Masonry Design Method	=	ASD		
Concrete Data				
fc _	psi =	2,500.0	2,500.0	
Fy 26	psi =	60,000.0	60,000.0	

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

Load Factors	
Building Code	IBC 2018.ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind. W	1.000
Seismic, E	1.000
	1.000



Project Name/Number: marbella

4ft Stem w/ Seismic Dsgnr: Mark Myers, PE

Description....

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing			
As (based on applied moment):	0.0025 in2/ft				
(4/3) * As:	0.0033 in2/ft	Min Stem T&S Reinf Area 0.384 in2			
200bd/fy: 200(12)(6)/60000:	0.24 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:	0.2 in2/ft	#5@ 19.38 in #5@ 38.75 in			
Maximum Area :	0.8128 in2/ft	#6@ 27.50 in #6@ 55.00 in			
Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing			
As (based on applied moment):	0.0229 in2/ft				

(4/3)	* As	:

0.0305 in2/ft

Min Stem T&S Reinf Area 0.384 in2

200bd/fy: 200(12)(6)/60000: 0.0018bh: 0.0018(12)(8):

0.24 in2/ft 0.1728 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft Horizontal Reinforcing Options:

Required Area:

0.1728 in2/ft

Two layers of: #4@ 25.00 in

Provided Area: Maximum Area:

0.2 in2/ft #5@ 19.38 in #5@ 38.75 in 0.8128 in2/ft #6@ 27.50 in

#6@ 55.00 in

Footing Data

Access and Cold States and Commence and Cold States and Cold S	900000000000000000000000000000000000000	Baselonia (1977) (Salabara)	ener i e i e i e i e i e i e i e i e i e i
Toe Width	=	= 0	.67 ft
Heel Width	=	- 1	.33
Total Footing Wid	ith =	= 2	.00
Footing Thickness	s =	= 10	.00 in
Key Width	=	= 0.	.00 in
Key Depth	=	= 0.	.00 in
Key Distance from	n Toe =	= 2.	.92 ft
fc = 2,500 Footing Concrete Min. As %	Density =	150 0.00	
Cover @ Top	2.00	@ Btm.=	3.00 in

Footing Design Results

7.200	Maria	000000000000000000000000000000000000000	220.000
		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,789	0 psf
Mu' : Upward	=	4,085	2 ft-#
Mu' : Downward	=	701	175 ft-#
Mu: Design	=	282	173 ft-#
Actual 1-Way Shear	=	1.87	5.21 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	-
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	
Footing Torsion, Tu		=	0.00 ft-lbs
Footing Allow. Torsion	1, p	hiTu =	0.00 ft-lbs

One layer of :

#4@ 12.50 in

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

Other Acceptable Sizes & Spacings

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

Key: No key defined

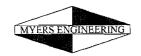
Min footing T&S reinf Area Min footing T&S reinf Area per foot 0.43 in2 0.22 in2 /ft

If one layer of horizontal bars:

If two layers of horizontal bars:

#4@ 11.11 in #5@ 17.22 in #6@ 24.44 in

#4@ 22.22 in #5@ 34.44 in #6@ 48.89 in



Project Name/Number: marbella

4ft Stem w/ Seismic Dsgnr: Mark Myers, PE

Description....

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

OVERTURNING					RESISTING		
Item	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	328.6	1.44	474.7	Soil Over HL (ab. water tbl)	291.5	1.67	485.9
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl) Watre Table		1.67	485.9
Buoyant Force =				Sloped Soil Over Heel =			
Surcharge over Heel =				Surcharge Over Heel =			
Surcharge Over Toe =				Adjacent Footing Load =			
Adjacent Footing Load =				Axial Dead Load on Stem =			
Added Lateral Load =				* Axial Live Load on Stem =			
.oad @ Stem Above Soil =				Soil Over Toe =	41.7	0.33	13.9
Seismic Earth Load =	78.9	2.17	170.9	Surcharge Over Toe =			
=				Stem Weight(s) =	400.0	1.00	400.1
-	107.5			Earth @ Stem Transitions=			
Total =	407.5	O.T.M. =	645.5	Footing Weight =	250.0	1.00	250.0
				Key Weight =		2.92	
Resisting/Overturning Ra		=	1.78	Vert. Component =			
Vertical Loads used for So	on Pressure	= 983.2	2 lbs	Total =	983.2 lb	s R.M.=	1,150.0

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

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

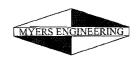
250.0 pci

Horizontal Defl @ Top of Wall (approximate only)

0.071 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.



Project Name/Number : marbella
Title 4ft Stem w/ Seismic
Dsgnr: Mark Myers, PE

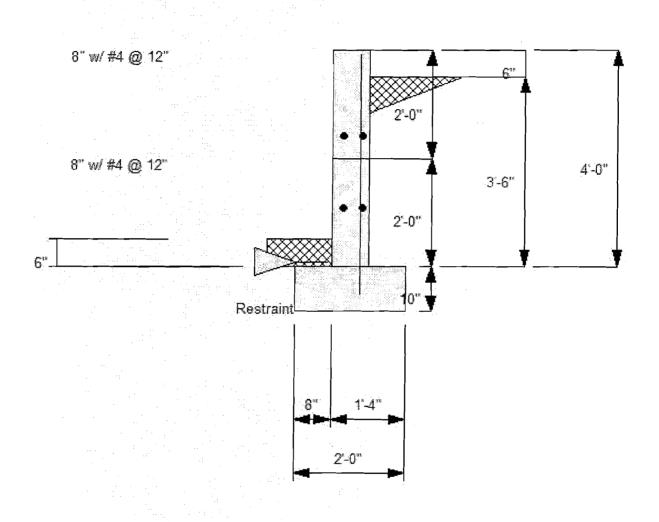
Description....

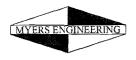
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Project Name/Number : marbella

Title 4ft Stem w/ Seismic Dsgnr: Mark Myers, PE

Description....

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Cantilevered Retaining Wall

