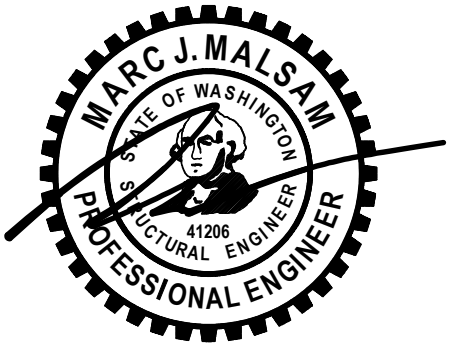
SUPPLEMENTAL STRUCTURAL CALCULATIONS FOR:

6221 83RD PL SE

MERCER ISLAND, WA

ARCHITECT: JULIAN WEBER ARCH + DESIGN

JANUARY 6, 2023



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STRUCTURAL ENGINEERING

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Cantilevered Retaining Wall

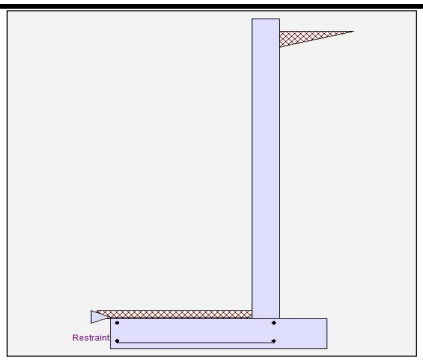
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	12.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	108.0 #/ft
...Height to Top	=	12.00 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.42	Ratio < 1.5!
Slab Resists All Sliding !			

Total Bearing Load	=	6,105 lbs	
...resultant ecc.	=	27.59 in	
Soil Pressure @ Toe	=	2,393 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	3,350 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	51.4 psi	OK
Footing Shear @ Heel	=	21.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	4,807.3 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	12.00
Rebar Size	=	# 6
Rebar Spacing	=	8.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.997**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	5,904.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	26,208.0
Moment.....Allowable	=	26,273.2
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	51.1
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	9.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	150.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.6258 in2/ft	
(4/3) * As :	0.8344 in2/ft	Min Stem T&S Reinf Area 3.600 in2
200bd/fy : 200(12)(9.625)/60000 :	0.385 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) :	0.2592 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.6258 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.66 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3039 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	5.25 ft
Heel Width	=	2.75
Total Footing Width	=	8.00
Footing Thickness	=	15.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	3,350	0 psf
Mu' : Upward	=	364,019	0 ft-#
Mu' : Downward	=	45,147	2,991 ft-#
Mu: Design	=	26,573	2,991 ft-#
Actual 1-Way Shear	=	51.38	21.91 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 6 @ 8.00 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@ 4.54 in, #5@ 7.04 in, #6@ 9.99 in, #7@ 13.63 in, #8@ 17.95 in, #9@ 22.7
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 2.59 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		3,511.3	4.42	15,508.0	Soil Over HL (ab. water tbl)	2,520.0	7.13	17,955.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		7.13	17,955.0
Hydrostatic Force					Watre Table			
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	=	1,296.0	7.25	9,396.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	210.0	2.63	551.3
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	1,875.0	5.75	10,781.3
					Earth @ Stem Transitions	=			
					Footing Weight	=	1,500.0	4.00	6,000.0
					Key Weight	=			
					Vert. Component	=			
Total	=	4,807.3	**O.T.M.** =	24,904.0	**Total =**		6,105.0 lbs	**R.M.=**	35,287.5

Resisting/Overturning Ratio = **1.42**
Vertical Loads used for Soil Pressure = 6,105.0 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.104	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.

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Cantilevered Retaining Wall

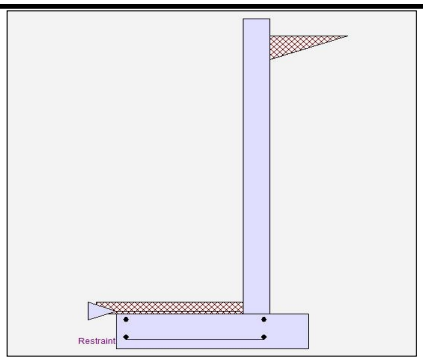
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.91	OK
Slab Resists All Sliding !			
Total Bearing Load	=	2,670 lbs	
...resultant ecc.	=	9.62 in	
Soil Pressure @ Toe	=	1,077 psf	OK
Soil Pressure @ Heel	=	11 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,507 psf	
ACI Factored @ Heel	=	15 psf	
Footing Shear @ Toe	=	21.9 psi	OK
Footing Shear @ Heel	=	9.7 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,620.0 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 5
Rebar Spacing	=	11.25
Rebar Placed at	=	6.25 i
Design Data		
fb/FB + fa/Fa	=	**0.626**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	2,048.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	5,461.3
Moment.....Allowable	=	8,719.4
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	27.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2046 in2/ft		
(4/3) * As :	0.2728 in2/ft	Min Stem T&S Reinf Area 1.632 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.25 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.3307 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.25 ft
Heel Width	=	1.66
Total Footing Width	=	4.91
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,507	15 psf
Mu' : Upward	=	74,669	57 ft-#
Mu' : Downward	=	14,450	657 ft-#
Mu: Design	=	5,018	600 ft-#
Actual 1-Way Shear	=	21.86	9.65 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 5 @ 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
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 1.27 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	1,620.0	3.00	4,860.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				953.6	4.41	4,208.6
Soil Over HL (bel. water tbl)					4.41	4,208.6
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 =				130.0	1.63	211.3
Surcharge Over Toe =						
Stem Weight(s) =				850.0	3.58	3,045.8
Earth @ Stem Transitions =						
Footing Weight =				736.5	2.46	1,808.1
Key Weight =						
Vert. Component =						
Total =	1,620.0	**O.T.M.** =	4,860.0	**Total =** 2,670.1 lbs	**R.M.=**	9,273.7

Resisting/Overturning Ratio = **1.91**
Vertical Loads used for Soil Pressure = 2,670.1 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.052	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.

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Cantilevered Retaining Wall

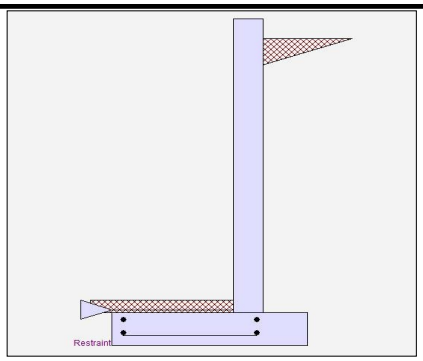
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	7.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	63.0 #/ft
...Height to Top	=	7.00 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.37	Ratio < 1.5!

Slab Resists All Sliding !

Total Bearing Load	=	2,255 lbs	
...resultant ecc.	=	16.56 in	
Soil Pressure @ Toe	=	1,812 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	2,536 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	33.9 psi	OK
Footing Shear @ Heel	=	12.1 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,668.2 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	8.75
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.711**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	2,009.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	5,202.2
Moment.....Allowable =	7,314.8
Shear.....Actual	
Service Level psi =	
Strength Level psi =	26.8
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1949 in2/ft		
(4/3) * As :	0.2599 in2/ft	Min Stem T&S Reinf Area 1.440 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.25 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2743 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.75 ft
Heel Width	=	1.67
Total Footing Width	=	4.42
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	2,536	0 psf
Mu' : Upward	=	72,750	0 ft-#
Mu' : Downward	=	8,984	583 ft-#
Mu: Design	=	5,314	583 ft-#
Actual 1-Way Shear	=	33.90	12.10 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, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.42 in, #5@ 14.60 in, #6@ 20.72 in, #7@ 28.26 in, #8@ 37.21 in, #9@ 47
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 0.95 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	1,227.2	2.61	3,204.4			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	441.0	4.33	1,911.0			
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				842.8	3.92	3,302.4
Soil Over HL (bel. water tbl)					3.92	3,302.4
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 =				110.0	1.38	151.3
Surcharge Over Toe =						
Stem Weight(s) =				750.0	3.08	2,312.5
Earth @ Stem Transitions =						
Footing Weight =				552.5	2.21	1,221.0
Key Weight =						
Vert. Component =						
Total =	1,668.2	**O.T.M.** =	5,115.4	**Total =** 2,255.3 lbs	**R.M.=**	6,987.1

Resisting/Overturning Ratio = **1.37**
Vertical Loads used for Soil Pressure = 2,255.3 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.085	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.

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Cantilevered Retaining Wall

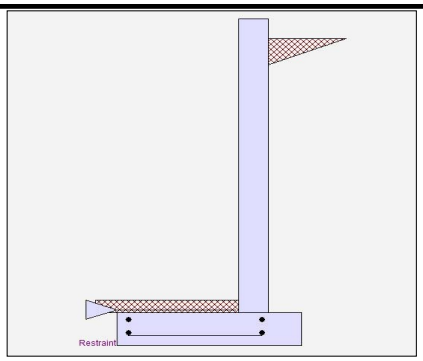
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	7.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.86	OK
Slab Resists All Sliding !			
Total Bearing Load	=	2,014 lbs	
...resultant ecc.	=	8.66 in	
Soil Pressure @ Toe	=	985 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,378 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	22.4 psi	OK
Footing Shear @ Heel	=	8.3 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,227.2 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	9.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.513**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	1,568.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	3,658.7
Moment.....Allowable =	7,122.4
Shear.....Actual	
Service Level psi =	
Strength Level psi =	20.9
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1371 in2/ft		
(4/3) * As :	0.1828 in2/ft	Min Stem T&S Reinf Area 1.440 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.1828 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2667 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.75 ft
Heel Width	=	1.42
Total Footing Width	=	4.17
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,378	0 psf
Mu' : Upward	=	48,532	17 ft-#
Mu' : Downward	=	8,984	329 ft-#
Mu: Design	=	3,296	311 ft-#
Actual 1-Way Shear	=	22.43	8.29 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, phi Tu	=	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 0.90 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	1,227.2	2.61	3,204.4			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				632.8	3.79	2,400.4
Soil Over HL (bel. water tbl)					3.79	2,400.4
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 =				110.0	1.38	151.3
Surcharge Over Toe =						
Stem Weight(s) =				750.0	3.08	2,312.5
Earth @ Stem Transitions =						
Footing Weight =				521.3	2.09	1,086.8
Key Weight =						
Vert. Component =						
Total =	1,227.2	**O.T.M.** =	3,204.4	**Total =** 2,014.1 lbs	**R.M.=**	5,951.0

Resisting/Overturning Ratio = **1.86**
Vertical Loads used for Soil Pressure = 2,014.1 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.049	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.

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Cantilevered Retaining Wall

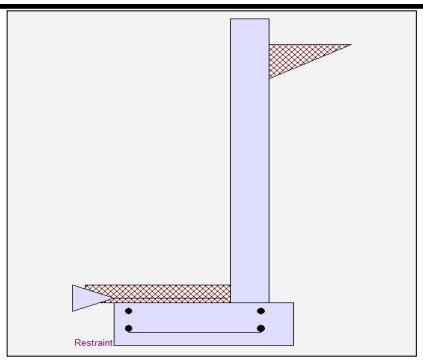
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	45.0 #/ft
...Height to Top	=	5.00 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.29	Ratio < 1.5!
Slab Resists All Sliding !			

Total Bearing Load	=	1,263	lbs
...resultant ecc.	=	12.82	in
Soil Pressure @ Toe	=	1,786 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,500 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	18.1 psi	OK
Footing Shear @ Heel	=	4.4 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	905.6 lbs

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	10.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.307**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,075.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,979.2
Moment.....Allowable	=	6,444.1
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	14.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0742 in2/ft		
(4/3) * As :	0.0989 in2/ft	Min Stem T&S Reinf Area 1.056 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.24 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	1.08
Total Footing Width	=	3.08
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	2,500	0	psf
Mu' : Upward	=	32,432	0	ft-#
Mu' : Downward	=	5,544	87	ft-#
Mu: Design	=	2,241	87	ft-#
Actual 1-Way Shear	=	18.13	4.37	psi
Allow 1-Way Shear	=	75.00	40.00	psi

Toe Reinforcing = # 4 @ 10.00 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@ 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 0.67 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	680.6	1.94	1,323.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	225.0	3.33	750.0			
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				248.0	2.87	712.6
Soil Over HL (bel. water tbl)					2.87	712.6
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 =				80.0	1.00	80.0
Surcharge Over Toe =						
Stem Weight(s) =				550.0	2.33	1,283.3
Earth @ Stem Transitions =						
Footing Weight =				385.0	1.54	592.9
Key Weight =						
Vert. Component =						
Total =	905.6	**O.T.M.** =	2,073.3	**Total =** 1,263.0 lbs	**R.M.=**	2,668.8

Resisting/Overturning Ratio = **1.29**
Vertical Loads used for Soil Pressure = 1,263.0 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.089	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.

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Cantilevered Retaining Wall

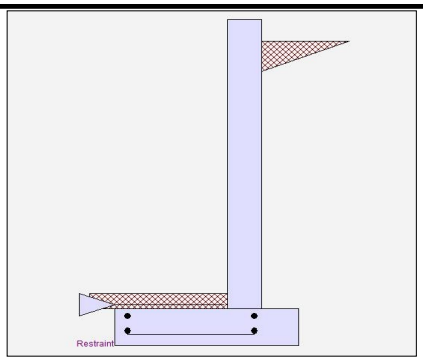
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.06	OK
Slab Resists All Sliding !			
Total Bearing Load	=	1,733 lbs	
...resultant ecc.	=	6.37 in	
Soil Pressure @ Toe	=	886 psf	OK
Soil Pressure @ Heel	=	61 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,240 psf	
ACI Factored @ Heel	=	86 psf	
Footing Shear @ Toe	=	16.6 psi	OK
Footing Shear @ Heel	=	6.3 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	933.9 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	11.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.391**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,152.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,304.0
Moment.....Allowable	=	5,883.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	15.4
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0863 in2/ft		
(4/3) * As :	0.1151 in2/ft	Min Stem T&S Reinf Area 1.248 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.2182 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.25 ft
Heel Width	=	1.41
Total Footing Width	=	3.66
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,240	86 psf
Mu' : Upward	=	30,479	45 ft-#
Mu' : Downward	=	6,014	280 ft-#
Mu: Design	=	2,039	235 ft-#
Actual 1-Way Shear	=	16.57	6.28 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, phi Tu = 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 0.79 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	933.9	2.28	2,127.2			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				535.2	3.29	1,759.9
Soil Over HL (bel. water tbl)					3.29	1,759.9
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 =				90.0	1.13	101.3
Surcharge Over Toe =						
Stem Weight(s) =				650.0	2.58	1,679.2
Earth @ Stem Transitions =						
Footing Weight =				457.5	1.83	837.2
Key Weight =						
Vert. Component =						
Total =	933.9	**O.T.M.** =	2,127.2	**Total =** 1,732.7 lbs	**R.M.=**	4,377.6

Resisting/Overturning Ratio = **2.06**
Vertical Loads used for Soil Pressure = 1,732.7 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.044	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.

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Cantilevered Retaining Wall

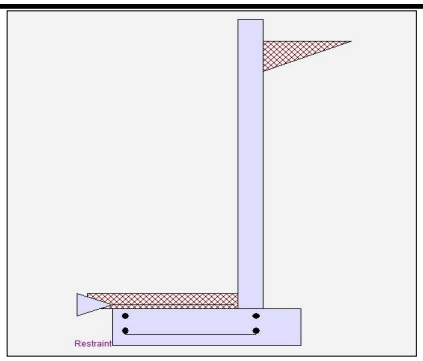
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	54.0 #/ft
...Height to Top	=	6.00 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.24	Ratio < 1.5!
Slab Resists All Sliding !			

Total Bearing Load	=	1,596	lbs
...resultant ecc.	=	16.50	in
Soil Pressure @ Toe	=	2,129 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,981 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	23.3 psi	OK
Footing Shear @ Heel	=	7.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,257.9 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	11.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.835**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,476.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	3,276.0
Moment.....Allowable	=	3,920.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	28.9
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.1852 in2/ft	
(4/3) * As :	0.2469 in2/ft	Min Stem T&S Reinf Area 0.936 in2
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.1852 in2/ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.2182 in2/ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	2.50 ft
Heel Width	=	1.25
Total Footing Width	=	3.75
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	2,981	0 psf
Mu' : Upward	=	53,639	0 ft-#
Mu' : Downward	=	7,425	285 ft-#
Mu: Design	=	3,851	285 ft-#
Actual 1-Way Shear	=	23.28	7.92 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, phi Tu = 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 0.81 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	933.9	2.28	2,127.2			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	324.0	3.83	1,242.0			
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				540.0	3.38	1,822.5
Soil Over HL (bel. water tbl)					3.38	1,822.5
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 =				100.0	1.25	125.0
Surcharge Over Toe =						
Stem Weight(s) =				487.5	2.75	1,340.6
Earth @ Stem Transitions =						
Footing Weight =				468.8	1.88	878.9
Key Weight =						
Vert. Component =						
Total =	1,257.9	**O.T.M.** =	3,369.2	**Total =** 1,596.3 lbs	**R.M.=**	4,167.0

Resisting/Overturning Ratio = **1.24**
Vertical Loads used for Soil Pressure = 1,596.3 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.103	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.

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Cantilevered Retaining Wall

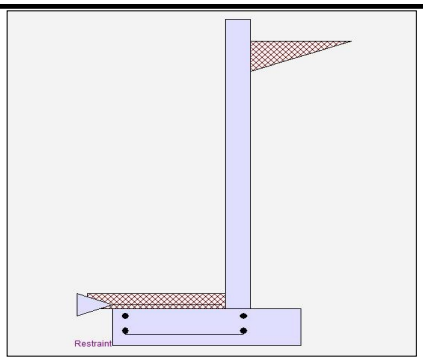
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.13	OK
Slab Resists All Sliding !			
Total Bearing Load	=	1,766 lbs	
...resultant ecc.	=	6.11 in	
Soil Pressure @ Toe	=	855 psf	OK
Soil Pressure @ Heel	=	87 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,197 psf	
ACI Factored @ Heel	=	122 psf	
Footing Shear @ Toe	=	16.2 psi	OK
Footing Shear @ Heel	=	7.8 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	933.9 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	11.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.587**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,152.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,304.0
Moment.....Allowable	=	3,920.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	22.6
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1302 in2/ft		
(4/3) * As :	0.1737 in2/ft	Min Stem T&S Reinf Area 0.936 in2	
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.17 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2182 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	2.25 ft
Heel Width	=	1.50
Total Footing Width	=	3.75
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,197	122	psf
Mu' : Upward	=	29,827	109	ft-#
Mu' : Downward	=	6,014	507	ft-#
Mu: Design	=	1,984	398	ft-#
Actual 1-Way Shear	=	16.17	7.80	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, phi Tu = 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 0.81 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	933.9	2.28	2,127.2			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				720.0	3.25	2,340.0
Soil Over HL (bel. water tbl)					3.25	2,340.0
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 =				90.0	1.13	101.3
Surcharge Over Toe =						
Stem Weight(s) =				487.5	2.50	1,218.8
Earth @ Stem Transitions =						
Footing Weight =				468.8	1.88	878.9
Key Weight =						
Vert. Component =						
Total =	933.9	**O.T.M.** =	2,127.2	**Total =** 1,766.3 lbs	**R.M.=**	4,538.9

Resisting/Overturning Ratio = **2.13**
Vertical Loads used for Soil Pressure = 1,766.3 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.041	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.

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Cantilevered Retaining Wall

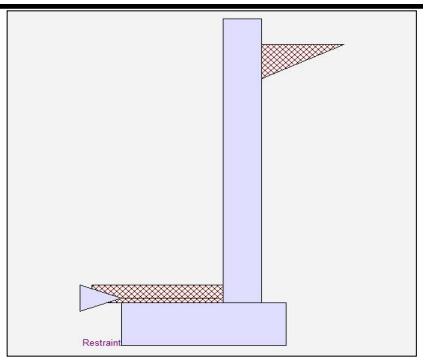
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		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 Resists All Sliding !			
Total Bearing Load	=	1,222 lbs	
...resultant ecc.	=	6.82 in	
Soil Pressure @ Toe	=	962 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,346 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	10.2 psi	OK
Footing Shear @ Heel	=	3.7 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	680.6 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	11.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.226**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	800.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	1,333.3
Moment.....Allowable =	5,883.6
Shear.....Actual	
Service Level psi =	
Strength Level psi =	10.7
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.05 in2/ft		
(4/3) * As :	0.0666 in2/ft	Min Stem T&S Reinf Area 1.056 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.2182 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	1.08
Total Footing Width	=	2.83
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,346	0 psf
Mu' : Upward	=	19,058	0 ft-#
Mu' : Downward	=	3,638	74 ft-#
Mu: Design	=	1,285	74 ft-#
Actual 1-Way Shear	=	10.22	3.70 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, phi Tu	=	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 0.61 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	680.6	1.94	1,323.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				248.0	2.62	650.6
Soil Over HL (bel. water tbl)					2.62	650.6
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 =				70.0	0.88	61.3
Surcharge Over Toe =						
Stem Weight(s) =				550.0	2.08	1,145.8
Earth @ Stem Transitions =						
Footing Weight =				353.8	1.42	500.6
Key Weight =						
Vert. Component =						
Total =	680.6	**O.T.M.** =	1,323.3	**Total =** 1,221.8 lbs	**R.M.=**	2,358.2

Resisting/Overturning Ratio = **1.78**
Vertical Loads used for Soil Pressure = 1,221.8 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.052	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.

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Cantilevered Retaining Wall

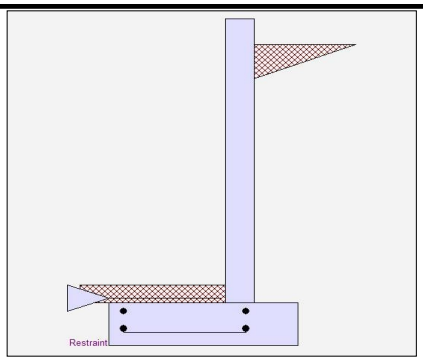
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	45.0 #/ft
...Height to Top	=	5.00 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.43	Ratio < 1.5!
Slab Resists All Sliding !			

Total Bearing Load	=	1,349	lbs
...resultant ecc.	=	11.59	in
Soil Pressure @ Toe	=	1,365 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,910 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	18.5 psi	OK
Footing Shear @ Heel	=	6.8 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	905.6 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	11.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.483**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,025.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,895.8
Moment.....Allowable	=	3,920.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	20.1
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.1072 in2/ft	
(4/3) * As :	0.1429 in2/ft	Min Stem T&S Reinf Area 0.792 in2
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.1429 in2/ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.2182 in2/ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	1.25
Total Footing Width	=	3.25
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,910	0 psf
Mu' : Upward	=	30,387	0 ft-#
Mu' : Downward	=	4,752	245 ft-#
Mu: Design	=	2,136	245 ft-#
Actual 1-Way Shear	=	18.54	6.80 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, phi Tu = 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 0.70 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		680.6	1.94	1,323.3	Soil Over HL (ab. water tbl)	450.0	2.88	1,293.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.88	1,293.8
Hydrostatic Force					Watre Table			
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	=	225.0	3.33	750.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	80.0	1.00	80.0
	=				Surcharge Over Toe	=			
					Stem Weight(s)	=	412.5	2.25	928.1
					Earth @ Stem Transitions	=			
					Footing Weight	=	406.3	1.63	660.2
					Key Weight	=			
					Vert. Component	=			
Total	=	905.6	**O.T.M.** =	2,073.3	**Total =**		1,348.8 lbs	**R.M.=**	2,962.0

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

Resisting/Overturning Ratio = **1.43**
Vertical Loads used for Soil Pressure = 1,348.8 lbs

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)	0.064	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.

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Cantilevered Retaining Wall

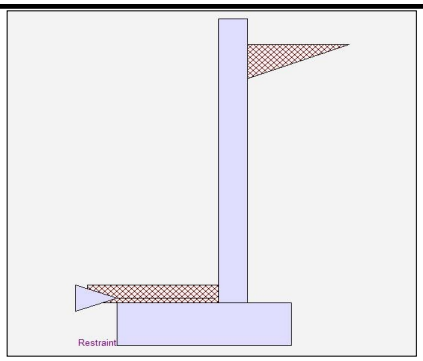
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.99	OK
Slab Resists All Sliding !			
Total Bearing Load	=	1,308 lbs	
...resultant ecc.	=	6.01 in	
Soil Pressure @ Toe	=	872 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,221 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	9.6 psi	OK
Footing Shear @ Heel	=	5.6 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	680.6 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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 =	LRFD
Thickness =	6.00
Rebar Size =	# 4
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.369**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	800.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	1,333.3
Moment.....Allowable =	3,612.6
Shear.....Actual	
Service Level psi =	
Strength Level psi =	15.7
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	4.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	75.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0754 in2/ft	
(4/3) * As :	0.1005 in2/ft	Min Stem T&S Reinf Area 0.792 in2
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.1296 in2/ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.2 in2/ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	1.25
Total Footing Width	=	3.00
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,221	0 psf
Mu' : Upward	=	18,072	28 ft-#
Mu' : Downward	=	3,638	245 ft-#
Mu: Design	=	1,203	216 ft-#
Actual 1-Way Shear	=	9.58	5.61 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, phi Tu	=	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 0.65 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	680.6	1.94	1,323.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				450.0	2.63	1,181.3
Soil Over HL (bel. water tbl)					2.63	1,181.3
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 =				70.0	0.88	61.3
Surcharge Over Toe =						
Stem Weight(s) =				412.5	2.00	825.0
Earth @ Stem Transitions =						
Footing Weight =				375.0	1.50	562.5
Key Weight =						
Vert. Component =						
Total =	680.6	**O.T.M.** =	1,323.3	**Total =** 1,307.5 lbs	**R.M.=**	2,630.0

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

Resisting/Overturning Ratio = **1.99**

Vertical Loads used for Soil Pressure = 1,307.5 lbs

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)	0.044	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.

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Cantilevered Retaining Wall

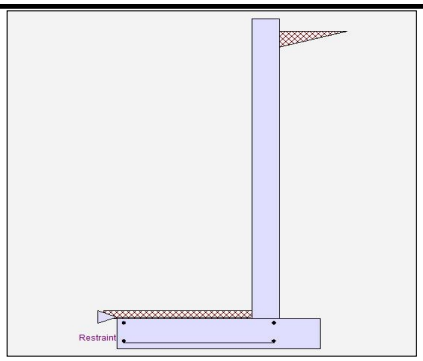
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	12.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.98	OK
Slab Resists All Sliding !			
Total Bearing Load	=	5,641 lbs	
...resultant ecc.	=	12.76 in	
Soil Pressure @ Toe	=	1,392 psf	OK
Soil Pressure @ Heel	=	113 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,949 psf	
ACI Factored @ Heel	=	158 psf	
Footing Shear @ Toe	=	34.5 psi	OK
Footing Shear @ Heel	=	15.5 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	3,511.3 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	12.00
Rebar Size	=	# 6
Rebar Spacing	=	8.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.701**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	4,608.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	18,432.0
Moment.....Allowable	=	26,273.2
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	39.9
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	9.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	150.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.4401 in2/ft		
(4/3) * As :	0.5868 in2/ft	Min Stem T&S Reinf Area 3.600 in2	
200bd/fy : 200(12)(9.625)/60000 :	0.385 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft	
0.0018bh : 0.0018(12)(12) :	0.2592 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.4401 in2/ft	#4@ 8.33 in	#4@ 16.67 in
Provided Area :	0.66 in2/ft	#5@ 12.92 in	#5@ 25.83 in
Maximum Area :	1.3039 in2/ft	#6@ 18.33 in	#6@ 36.67 in

Footing Data

Toe Width	=	5.00 ft
Heel Width	=	2.50
Total Footing Width	=	7.50
Footing Thickness	=	15.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,949	158	psf
Mu' : Upward	=	232,581	312	ft-#
Mu' : Downward	=	40,950	2,197	ft-#
Mu: Design	=	15,969	1,886	ft-#
Actual 1-Way Shear	=	34.47	15.54	psi
Allow 1-Way Shear	=	75.00	40.00	psi

Toe Reinforcing = # 6 @ 11.00 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@ 5.67 in, #5@ 8.79 in, #6@ 12.47 in, #7@ 17.01 in, #8@ 22.40 in, #9@ 28.
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 2.43 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	3,511.3	4.42	15,508.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				2,160.0	6.75	14,580.0
Soil Over HL (bel. water tbl)					6.75	14,580.0
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 =				200.0	2.50	500.0
Surcharge Over Toe =						
Stem Weight(s) =				1,875.0	5.50	10,312.5
Earth @ Stem Transitions =						
Footing Weight =				1,406.3	3.75	5,273.4
Key Weight =						
Vert. Component =						
Total =	3,511.3	**O.T.M.** =	15,508.0	**Total =** 5,641.3 lbs	**R.M.=**	30,665.9

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

Resisting/Overturning Ratio = **1.98**

Vertical Loads used for Soil Pressure = 5,641.3 lbs

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)	0.064	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.

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Cantilevered Retaining Wall

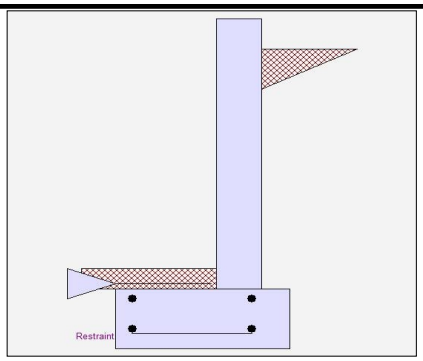
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	36.0 #/ft
...Height to Top	=	4.00 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.45	Ratio < 1.5!
Slab Resists All Sliding !			
Total Bearing Load	=	1,095 lbs	
...resultant ecc.	=	9.18 in	
Soil Pressure @ Toe	=	1,392 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,948 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	9.4 psi	OK
Footing Shear @ Heel	=	2.6 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	644.0 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	9.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.136**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	656.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	970.7
Moment.....Allowable =	7,122.4
Shear.....Actual	
Service Level psi =	
Strength Level psi =	8.7
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0364 in2/ft		
(4/3) * As :	0.0485 in2/ft	Min Stem T&S Reinf Area 0.864 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.2667 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	1.08
Total Footing Width	=	2.58
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,948	0 psf
Mu' : Upward	=	17,949	0 ft-#
Mu' : Downward	=	3,078	65 ft-#
Mu: Design	=	1,239	65 ft-#
Actual 1-Way Shear	=	9.43	2.60 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, 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
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 0.67 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		500.0	1.67	833.3	Soil Over HL (ab. water tbl)	198.4	2.37	470.9
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.37	470.9
Hydrostatic Force					Watre Table			
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	=	144.0	3.00	432.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	60.0	0.75	45.0
	=				Surcharge Over Toe	=			
					Stem Weight(s)	=	450.0	1.83	825.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	387.0	1.29	499.2
					Key Weight	=			
					Vert. Component	=			
Total	=	644.0	**O.T.M.** =	1,265.3	**Total =**		1,095.4 lbs	**R.M.=**	1,840.1

Resisting/Overturning Ratio = **1.45**
Vertical Loads used for Soil Pressure = 1,095.4 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.067	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.

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Cantilevered Retaining Wall

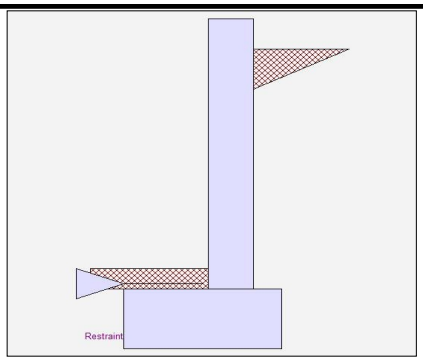
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.89	OK
Slab Resists All Sliding !			
Total Bearing Load	=	1,048 lbs	
...resultant ecc.	=	5.52 in	
Soil Pressure @ Toe	=	991 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,387 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	4.4 psi	OK
Footing Shear @ Heel	=	2.5 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	500.0 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	9.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.095**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	512.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	682.7
Moment.....Allowable =	7,122.4
Shear.....Actual	
Service Level psi =	
Strength Level psi =	6.8
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0256 in2/ft		
(4/3) * As :	0.0341 in2/ft	Min Stem T&S Reinf Area 0.864 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.2667 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	1.25 ft
Heel Width	=	1.08
Total Footing Width	=	2.33
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,387	0 psf
Mu' : Upward	=	10,443	1 ft-#
Mu' : Downward	=	2,138	65 ft-#
Mu: Design	=	692	64 ft-#
Actual 1-Way Shear	=	4.36	2.50 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, phi Tu	=	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 0.60 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	500.0	1.67	833.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				198.4	2.12	421.3
Soil Over HL (bel. water tbl)					2.12	421.3
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 =				50.0	0.63	31.3
Surcharge Over Toe =						
Stem Weight(s) =				450.0	1.58	712.5
Earth @ Stem Transitions =						
Footing Weight =				349.5	1.17	407.2
Key Weight =						
Vert. Component =						
Total =	500.0	**O.T.M.** =	833.3	**Total =** 1,047.9 lbs	**R.M.=**	1,572.2

Resisting/Overturning Ratio = **1.89**
Vertical Loads used for Soil Pressure = 1,047.9 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	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.

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Cantilevered Retaining Wall

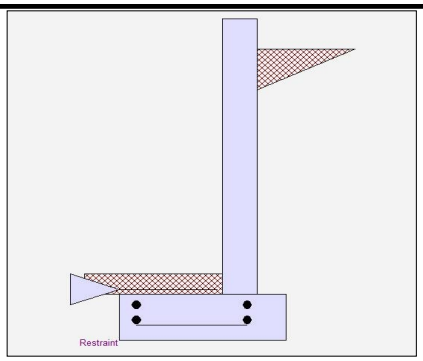
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	36.0 #/ft
...Height to Top	=	4.00 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.27	Ratio < 1.5!
Slab Resists All Sliding !			
Total Bearing Load	=	871 lbs	
...resultant ecc.	=	10.39 in	
Soil Pressure @ Toe	=	1,687 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,361 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	15.3 psi	OK
Footing Shear @ Heel	=	3.6 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	595.3 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.268**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	656.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	970.7
Moment.....Allowable	=	3,612.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	12.9
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0549 in2/ft	
(4/3) * As :	0.0732 in2/ft	Min Stem T&S Reinf Area 0.648 in2
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.1296 in2/ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.2 in2/ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	0.92
Total Footing Width	=	2.42
Footing Thickness	=	9.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	2,361	0 psf
Mu' : Upward	=	16,916	0 ft-#
Mu' : Downward	=	2,471	63 ft-#
Mu: Design	=	1,204	63 ft-#
Actual 1-Way Shear	=	15.34	3.56 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 4 @ 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@ 12.34 in, #5@ 19.13 in, #6@ 27.16 in, #7@ 37.03 in, #8@ 48.76 in, #9@ 6
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 0.47 in2
Min footing T&S reinf Area per foot 0.19 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 12.35 in	#4@ 24.69 in
#5@ 19.14 in	#5@ 38.27 in
#6@ 27.16 in	#6@ 54.32 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		451.3	1.58	714.5	Soil Over HL (ab. water tbl)	201.6	2.21	445.5
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.21	445.5
Hydrostatic Force					Watre Table			
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	=	144.0	2.75	396.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	60.0	0.75	45.0
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	337.5	1.75	590.6
					Earth @ Stem Transitions	=			
					Footing Weight	=	272.3	1.21	329.4
					Key Weight	=			
					Vert. Component	=			
Total	=	595.3	**O.T.M.** =	1,110.5	**Total =**	871.4 lbs	**R.M.=**	1,410.6

Resisting/Overturning Ratio = **1.27**
Vertical Loads used for Soil Pressure = 871.4 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.087	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.

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Cantilevered Retaining Wall

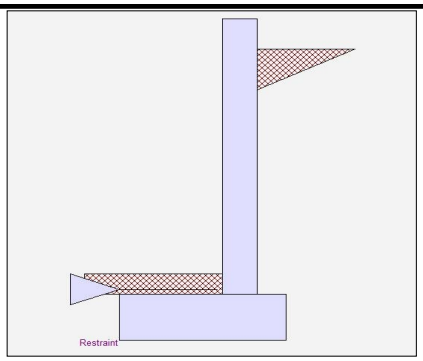
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.97	OK
Slab Resists All Sliding !			
Total Bearing Load	=	871 lbs	
...resultant ecc.	=	4.93 in	
Soil Pressure @ Toe	=	727 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,018 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	7.4 psi	OK
Footing Shear @ Heel	=	3.2 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	451.3 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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 =	LRFD
Thickness =	6.00
Rebar Size =	# 4
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.188**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	512.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	682.7
Moment.....Allowable =	3,612.6
Shear.....Actual	
Service Level psi =	
Strength Level psi =	10.0
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	4.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	75.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0386 in2/ft		
(4/3) * As :	0.0515 in2/ft	Min Stem T&S Reinf Area 0.648 in2	
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1296 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	0.92
Total Footing Width	=	2.42
Footing Thickness	=	9.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,018	0	psf
Mu' : Upward	=	10,876	4	ft-#
Mu' : Downward	=	2,471	63	ft-#
Mu: Design	=	700	58	ft-#
Actual 1-Way Shear	=	7.41	3.16	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, phi Tu	=	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 0.47 in2
Min footing T&S reinf Area per foot 0.19 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 12.35 in	#4@ 24.69 in
#5@ 19.14 in	#5@ 38.27 in
#6@ 27.16 in	#6@ 54.32 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	451.3	1.58	714.5			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
				Soil Over HL (ab. water tbl)	201.6	2.21	445.5
				Soil Over HL (bel. water tbl)		2.21	445.5
				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 =	60.0	0.75	45.0
				Surcharge Over Toe =			
				Stem Weight(s) =	337.5	1.75	590.6
				Earth @ Stem Transitions =			
				Footing Weight =	272.3	1.21	329.4
				Key Weight =			
				Vert. Component =			
Total =	451.3	**O.T.M.** =	714.5	**Total =**	871.4 lbs	**R.M.=**	1,410.6

Resisting/Overturning Ratio = **1.97**
Vertical Loads used for Soil Pressure = 871.4 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.038	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.

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Cantilevered Retaining Wall

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

Criteria

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

Soil Data

Allow Soil Bearing	=	0.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	0.0 psf/ft
	=	
Passive Pressure	=	0.0 psf/ft
Soil Density, Heel	=	0.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.000
Soil height to ignore for passive pressure	=	0.00 in

Surcharge Loads

Surcharge Over Heel = 0.0 psf
NOT Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0
NOT Used for Sliding & Overturning

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	(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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

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	=	0.00	OK
Sliding	=	0.00	OK
Total Bearing Load	=	0 lbs	
...resultant ecc.	=	3.00 in	
Soil Pressure @ Toe	=	0 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	0 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	0 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	25.9 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	67.1 psi	

Sliding Calcs

Lateral Sliding Force	=	0.0 lbs	
less 0 % Passive Force	= -	0.0 lbs	
less 0 % Friction Force	= -	0.0 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	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.000
Seismic, E	1.700

Stem Construction

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	3
Design Method =	LRFD
Thickness =	0.00
Rebar Size =	# 0
Rebar Spacing =	0.00
Rebar Placed at =	Center
Design Data	
fb/FB + fa/Fa =	**0.000**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	
Moment.....Allowable =	0.0
Shear.....Actual	
Service Level psi =	
Strength Level psi =	
Shear.....Allowable psi =	0.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	0.00
Masonry Data	
f'm psi =	1,500
Fs psi =	32,000
Solid Grouting =	No
Modular Ratio 'n' =	0.00
Wall Weight psf =	0.0
Short Term Factor =	1.000
Equiv. Solid Thick. in =	0.00
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	0.0

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Cantilevered Retaining Wall

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

Footing Data

Toe Width	=	0.00 ft
Heel Width	=	0.50
Total Footing Width	=	0.50
Footing Thickness	=	0.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,000 psi Fy = 60,000 psi
Footing Concrete Density = 0.00 pcf
Min. As % = 0.0000
Cover @ Top 0.00 @ Btm.= 0.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	0	0	psf
Mu' : Upward	=	0	0	ft-#
Mu' : Downward	=	0	0	ft-#
Mu: Design	=	0	0	ft-#
Actual 1-Way Shear	=	25.94	0.00	psi
Allow 1-Way Shear	=	35.78	35.78	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, phi Tu	=	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 0.00 in2
Min footing T&S reinf Area per foot 0.00 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 0.00 in	#4@ 0.00 in
#5@ 0.00 in	#5@ 0.00 in
#6@ 0.00 in	#6@ 0.00 in

Summary of Overturning & Resisting Forces & Moments

	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Item							
HL Act Pres (ab water tbl)				Soil Over HL (ab. water tbl)			
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)			
Hydrostatic Force				Watre Table			
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	=		
Load @ Stem Above Soil	=			Soil Over Toe	=		
	=			Surcharge Over Toe	=		
				Stem Weight(s)	=		
				Earth @ Stem Transitions	=		
				Footing Weight	=	0.25	
				Key Weight	=		
				Vert. Component	=		
Total	=	**O.T.M.**	=	**Total =**	lbs	**R.M.=**	

Resisting/Overturning Ratio =
Vertical Loads used for Soil Pressure = 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.038	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.

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Cantilevered Retaining Wall

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

Criteria

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

Soil Data

Allow Soil Bearing	=	0.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	0.0 psf/ft
	=	
Passive Pressure	=	0.0 psf/ft
Soil Density, Heel	=	0.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.000
Soil height to ignore for passive pressure	=	0.00 in

Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	(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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.000

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	=	0.00	OK
Sliding	=	0.00	OK
Total Bearing Load	=	0 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	0 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	0 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	0 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	25.9 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	67.1 psi	

Sliding Calcs

Lateral Sliding Force	=	0.0 lbs	
less 0 % Passive Force	= -	0.0 lbs	
less 0 % Friction Force	= -	0.0 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	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.000
Seismic, E	1.700

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	3
Design Method	=	LRFD
Thickness	=	0.00
Rebar Size	=	# 0
Rebar Spacing	=	0.00
Rebar Placed at	=	Center
Design Data		
fb/FB + fa/Fa	=	**0.000**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	
Moment.....Allowable	=	0.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	
Shear.....Allowable	psi =	0.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	0.00
Masonry Data		
f'm	psi =	1,500
Fs	psi =	0
Solid Grouting	=	No
Modular Ratio 'n'	=	0.00
Wall Weight	psf =	0.0
Short Term Factor	=	1.000
Equiv. Solid Thick.	in =	0.00
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	0.0

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Cantilevered Retaining Wall

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

Footing Data

Toe Width	=	0.00 ft
Heel Width	=	0.00
Total Footing Width	=	0.00
Footing Thickness	=	0.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,000 psi Fy = 60,000 psi
Footing Concrete Density = 0.00 pcf
Min. As % = 0.0000
Cover @ Top 0.00 @ Btm.= 0.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	0	0	psf
Mu' : Upward	=	0	0	ft-#
Mu' : Downward	=	0	0	ft-#
Mu: Design	=	0	0	ft-#
Actual 1-Way Shear	=	25.94	0.00	psi
Allow 1-Way Shear	=	35.78	35.78	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, phi Tu	=	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 0.00 in2
Min footing T&S reinf Area per foot 0.00 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 0.00 in	#4@ 0.00 in
#5@ 0.00 in	#5@ 0.00 in
#6@ 0.00 in	#6@ 0.00 in

Summary of Overturning & Resisting Forces & Moments

	.....OVERTURNING.....			.....RESISTING.....		
Item	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)				Soil Over HL (ab. water tbl)		
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		
Hydrostatic Force				Watre Table		
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	=	
Load @ Stem Above Soil	=			Soil Over Toe	=	
	=			Surcharge Over Toe	=	
				Stem Weight(s)	=	
				Earth @ Stem Transitions	=	
				Footing Weight	=	
				Key Weight	=	
				Vert. Component	=	
Total	=	**O.T.M.**	=	**Total =**	lbs	**R.M.=**

Resisting/Overturning Ratio =
Vertical Loads used for Soil Pressure = 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.038	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.

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Cantilevered Retaining Wall

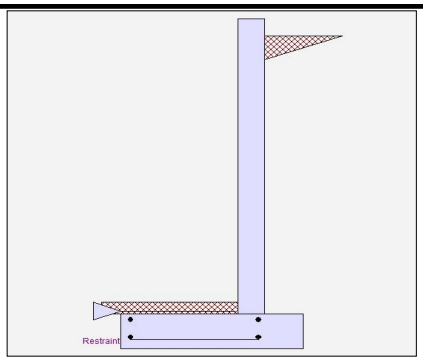
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	64.0 #/ft
...Height to Top	=	8.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	(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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.26	Ratio < 1.5!
Slab Resists All Sliding !			
Total Bearing Load	=	2,623 lbs	
...resultant ecc.	=	19.73 in	
Soil Pressure @ Toe	=	2,548 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	3,567 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	29.8 psi	OK
Footing Shear @ Heel	=	12.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,929.5 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	1.300
Seismic, E	1.000

Stem Construction

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 5
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.877**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	2,416.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	7,125.3
Moment.....Allowable =	8,121.3
Shear.....Actual	
Service Level psi =	
Strength Level psi =	32.5
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.2698 in2/ft	
(4/3) * As :	0.3597 in2/ft	Min Stem T&S Reinf Area 0.000 in2
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.2698 in2/ft	#4@ 0.00 in #4@ 0.00 in
Provided Area :	0.31 in2/ft	#5@ 0.00 in #5@ 0.00 in
Maximum Area :	0.8382 in2/ft	#6@ 0.00 in #6@ 0.00 in

Footing Data

Toe Width	=	3.00 ft
Heel Width	=	1.66
Total Footing Width	=	4.66
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	3,567	0 psf
Mu' : Upward	=	101,945	0 ft-#
Mu' : Downward	=	14,364	767 ft-#
Mu: Design	=	7,298	767 ft-#
Actual 1-Way Shear	=	29.75	12.86 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 5 @ 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@ 9.07 in, #5@ 14.07 in, #6@ 19.97 in, #7@ 27.23 in, #8@ 35.86 in, #9@ 45
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 0.00 in2
Min footing T&S reinf Area per foot 0.00 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 0.00 in	#4@ 0.00 in
#5@ 0.00 in	#5@ 0.00 in
#6@ 0.00 in	#6@ 0.00 in

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Cantilevered Retaining Wall

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

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)		1,417.5	3.00	4,252.5	Soil Over HL (ab. water tbl)	953.6	4.16	3,970.2
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		4.16	3,970.2
Hydrostatic Force					Watre Table			
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	=	512.0	5.00	2,560.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	120.0	1.50	180.0
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	850.0	3.33	2,833.3
					Earth @ Stem Transitions	=			
					Footing Weight	=	699.0	2.33	1,628.7
					Key Weight	=			
					Vert. Component	=			
Total	=	1,929.5	**O.T.M.** =	6,812.5	**Total =**		2,622.6 lbs	**R.M.=**	8,612.2

Resisting/Overturning Ratio = **1.26**
Vertical Loads used for Soil Pressure = 2,622.6 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.129	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.

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Cantilevered Retaining Wall

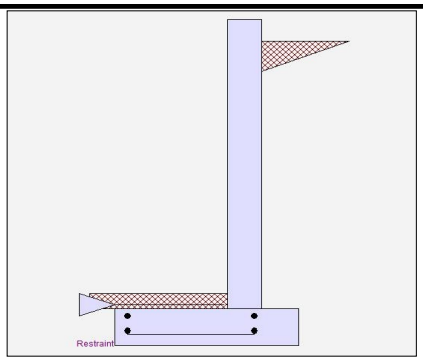
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	54.0 #/ft
...Height to Top	=	6.00 ft
...Height to Bottom	=	0.10 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.30	Ratio < 1.5!
Slab Resists All Sliding !			

Total Bearing Load	=	1,733	lbs
...resultant ecc.	=	15.01	in
Soil Pressure @ Toe	=	1,993 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,791 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	26.4 psi	OK
Footing Shear @ Heel	=	7.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,263.3 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	11.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.556**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,476.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	3,276.0
Moment.....Allowable	=	5,883.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	19.7
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.1227 in2/ft	
(4/3) * As :	0.1637 in2/ft	Min Stem T&S Reinf Area 1.248 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.2182 in2/ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	2.25 ft
Heel Width	=	1.41
Total Footing Width	=	3.66
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	2,791	0 psf
Mu' : Upward	=	48,627	0 ft-#
Mu' : Downward	=	6,014	280 ft-#
Mu: Design	=	3,551	280 ft-#
Actual 1-Way Shear	=	26.40	7.85 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, phi Tu = 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 0.79 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		933.9	2.28	2,127.2	Soil Over HL (ab. water tbl)	535.2	3.29	1,759.9
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.29	1,759.9
Hydrostatic Force					Watre Table			
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	=	329.4	3.78	1,246.2	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	90.0	1.13	101.3
	=				Surcharge Over Toe	=			
					Stem Weight(s)	=	650.0	2.58	1,679.2
					Earth @ Stem Transitions	=			
					Footing Weight	=	457.5	1.83	837.2
					Key Weight	=			
					Vert. Component	=			
Total	=	1,263.3	**O.T.M.** =	3,373.4	**Total =**		1,732.7 lbs	**R.M.=**	4,377.6

Resisting/Overturning Ratio = **1.30**
Vertical Loads used for Soil Pressure = 1,732.7 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.098	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.

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Cantilevered Retaining Wall

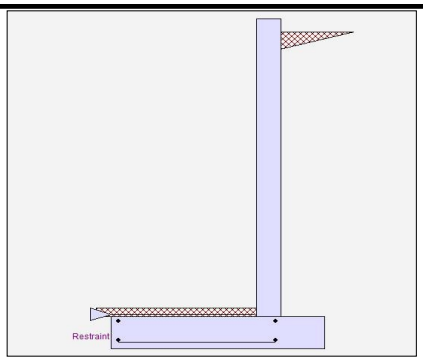
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	99.0 #/ft
...Height to Top	=	11.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

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	=	1.34	Ratio < 1.5!

Slab Resists All Sliding !

Total Bearing Load	=	4,987	lbs
...resultant ecc.	=	27.81	in
Soil Pressure @ Toe	=	2,468 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	3,455	psf
ACI Factored @ Heel	=	0	psf
Footing Shear @ Toe	=	42.1 psi	OK
Footing Shear @ Heel	=	17.4 psi	OK
Allowable	=	75.0	psi

Sliding Calcs

Lateral Sliding Force	=	4,090.3	lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 6
Rebar Spacing	=	8.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.992**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	4,961.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	20,186.8
Moment.....Allowable	=	20,333.2
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	54.2
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.614 in2/ft	
(4/3) * As :	0.8187 in2/ft	Min Stem T&S Reinf Area 2.760 in2
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.614 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.66 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.0329 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	5.00 ft
Heel Width	=	2.33
Total Footing Width	=	7.33
Footing Thickness	=	15.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	3,455	0 psf
Mu' : Upward	=	306,045	0 ft-#
Mu' : Downward	=	40,950	2,026 ft-#
Mu: Design	=	22,091	2,026 ft-#
Actual 1-Way Shear	=	42.13	17.36 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 6 @ 8.00 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@ 5.21 in, #5@ 8.08 in, #6@ 11.47 in, #7@ 15.65 in, #8@ 20.60 in, #9@ 26.
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 2.37 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	3,001.3	4.08	12,255.1			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	1,089.0	6.75	7,350.8			
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				1,975.6	6.58	13,002.7
Soil Over HL (bel. water tbl)					6.58	13,002.7
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 =				200.0	2.50	500.0
Surcharge Over Toe =						
Stem Weight(s) =				1,437.5	5.42	7,786.5
Earth @ Stem Transitions =						
Footing Weight =				1,374.4	3.67	5,037.1
Key Weight =						
Vert. Component =						
Total =	4,090.3	**O.T.M.** =	19,605.9	**Total =** 4,987.5 lbs	**R.M.=**	26,326.3

Resisting/Overturning Ratio = **1.34**
Vertical Loads used for Soil Pressure = 4,987.5 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.108	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.

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Cantilevered Retaining Wall

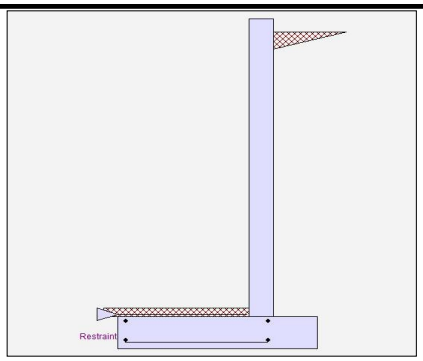
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.95	OK
Slab Resists All Sliding !			
Total Bearing Load	=	4,874 lbs	
...resultant ecc.	=	12.40 in	
Soil Pressure @ Toe	=	1,362 psf	OK
Soil Pressure @ Heel	=	66 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,906 psf	
ACI Factored @ Heel	=	92 psf	
Footing Shear @ Toe	=	29.4 psi	OK
Footing Shear @ Heel	=	14.6 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	3,001.3 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 6
Rebar Spacing	=	8.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.698**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,872.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	14,197.3
Moment.....Allowable	=	20,333.2
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	42.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.4318 in2/ft	
(4/3) * As :	0.5758 in2/ft	Min Stem T&S Reinf Area 2.760 in2
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.4318 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.66 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.0329 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	4.50 ft
Heel Width	=	2.33
Total Footing Width	=	6.83
Footing Thickness	=	15.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,906	92	psf
Mu' : Upward	=	183,187	251	ft-#
Mu' : Downward	=	33,170	2,026	ft-#
Mu: Design	=	12,501	1,775	ft-#
Actual 1-Way Shear	=	29.43	14.57	psi
Allow 1-Way Shear	=	75.00	40.00	psi

Toe Reinforcing = # 6 @ 11.00 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@ 7.24 in, #5@ 11.22 in, #6@ 15.93 in, #7@ 21.73 in, #8@ 28.61 in, #9@ 36
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 2.21 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	3,001.3	4.08	12,255.1	Soil Over HL (ab. water tbl)	1,975.6	6.08	12,014.9
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		6.08	12,014.9
Hydrostatic Force				Watre Table			
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 =			
Load @ Stem Above Soil =				Soil Over Toe =	180.0	2.25	405.0
=				Surcharge Over Toe =			
				Stem Weight(s) =	1,437.5	4.92	7,067.7
				Earth @ Stem Transitions =			
				Footing Weight =	1,280.6	3.42	4,373.3
				Key Weight =			
				Vert. Component =			
Total =	3,001.3	**O.T.M.** =	12,255.1	**Total =**	4,873.7 lbs	**R.M.=**	23,861.0

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

Resisting/Overturning Ratio = **1.95**
Vertical Loads used for Soil Pressure = 4,873.7 lbs

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)	0.064	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.

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Cantilevered Retaining Wall

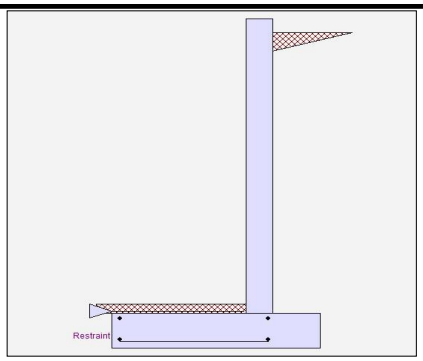
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	10.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	90.0 #/ft
...Height to Top	=	10.00 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.39	Ratio < 1.5!
Slab Resists All Sliding !			
Total Bearing Load	=	4,512 lbs	
...resultant ecc.	=	23.78 in	
Soil Pressure @ Toe	=	2,300 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	3,220 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	37.7 psi	OK
Footing Shear @ Heel	=	16.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	3,431.3 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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 =	LRFD
Thickness =	10.00
Rebar Size =	# 5
Rebar Spacing =	8.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.948**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	4,100.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	15,166.7
Moment.....Allowable =	15,984.2
Shear.....Actual	
Service Level psi =	
Strength Level psi =	41.7
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	8.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	125.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.4283 in2/ft	
(4/3) * As :	0.5711 in2/ft	Min Stem T&S Reinf Area 2.520 in2
200bd/fy : 200(12)(8.1875)/60000 :	0.3275 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.4283 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.465 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.1092 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	4.25 ft
Heel Width	=	2.33
Total Footing Width	=	6.58
Footing Thickness	=	15.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	3,220	0 psf
Mu' : Upward	=	223,025	0 ft-#
Mu' : Downward	=	29,586	1,865 ft-#
Mu: Design	=	16,120	1,865 ft-#
Actual 1-Way Shear	=	37.69	15.97 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 5 @ 8.00 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@ 5.61 in, #5@ 8.70 in, #6@ 12.36 in, #7@ 16.85 in, #8@ 22.19 in, #9@ 28.
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 2.13 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		2,531.3	3.75	9,492.2	Soil Over HL (ab. water tbl)	1,796.0	5.83	10,473.7
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		5.83	10,473.7
Hydrostatic Force					Watre Table			
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	=	900.0	6.25	5,625.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	170.0	2.13	361.3
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	1,312.5	4.67	6,125.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	1,233.8	3.29	4,059.0
					Key Weight	=			
					Vert. Component	=			
Total	=	3,431.3	**O.T.M.** =	15,117.2	**Total =**		4,512.3 lbs	**R.M.=**	21,019.0

Resisting/Overturning Ratio = **1.39**
Vertical Loads used for Soil Pressure = 4,512.3 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.102	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.

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Cantilevered Retaining Wall

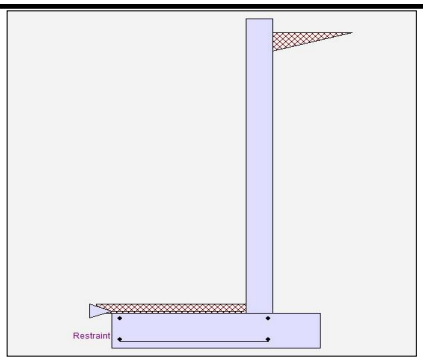
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	10.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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	=	2.21	OK

Slab Resists All Sliding !

Total Bearing Load	=	4,512 lbs	
...resultant ecc.	=	8.83 in	
Soil Pressure @ Toe	=	1,146 psf	OK
Soil Pressure @ Heel	=	226 psf	OK
Allowable	=	2,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,604 psf	
ACI Factored @ Heel	=	316 psf	
Footing Shear @ Toe	=	23.7 psi	OK
Footing Shear @ Heel	=	11.5 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,531.3 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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 =	LRFD
Thickness =	10.00
Rebar Size =	# 5
Rebar Spacing =	10.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.822**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	3,200.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	10,666.7
Moment.....Allowable =	12,971.1
Shear.....Actual	
Service Level psi =	
Strength Level psi =	32.6
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	8.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	125.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3012 in2/ft	
(4/3) * As :	0.4017 in2/ft	Min Stem T&S Reinf Area 2.520 in2
200bd/fy : 200(12)(8.1875)/60000 :	0.3275 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.3275 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.372 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.1092 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	4.25 ft
Heel Width	=	2.33
Total Footing Width	=	6.58
Footing Thickness	=	15.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,604	316 psf
Mu' : Upward	=	143,776	464 ft-#
Mu' : Downward	=	29,586	1,865 ft-#
Mu: Design	=	9,516	1,401 ft-#
Actual 1-Way Shear	=	23.68	11.54 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 5 @ 10.00 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@ 7.40 in, #5@ 11.48 in, #6@ 16.29 in, #7@ 22.22 in, #8@ 29.25 in, #9@ 37
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 2.13 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	2,531.3	3.75	9,492.2			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				1,796.0	5.83	10,473.7
Soil Over HL (bel. water tbl)					5.83	10,473.7
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 =				170.0	2.13	361.3
Surcharge Over Toe =						
Stem Weight(s) =				1,312.5	4.67	6,125.0
Earth @ Stem Transitions =						
Footing Weight =				1,233.8	3.29	4,059.0
Key Weight =						
Vert. Component =						
Total =	2,531.3	**O.T.M.** =	9,492.2	**Total =** 4,512.3 lbs	**R.M.=**	21,019.0

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

Resisting/Overturning Ratio = **2.21**

Vertical Loads used for Soil Pressure = 4,512.3 lbs

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)	0.051	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.

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Cantilevered Retaining Wall

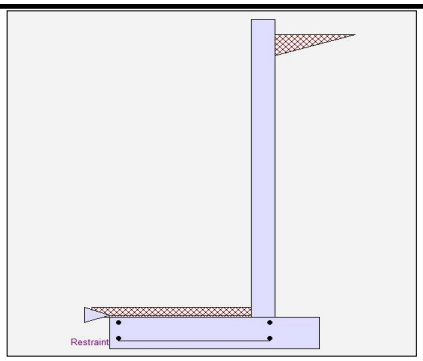
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	9.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	81.0 #/ft
...Height to Top	=	9.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.33	Ratio < 1.5!
Slab Resists All Sliding !			
Total Bearing Load	=	3,339 lbs	
...resultant ecc.	=	22.95 in	
Soil Pressure @ Toe	=	2,135 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,990 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	38.0 psi	OK
Footing Shear @ Heel	=	15.3 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,729.0 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 5
Rebar Spacing	=	8.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.937**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,321.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	11,056.5
Moment.....Allowable	=	11,799.2
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	44.7
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.19
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.4187 in2/ft		
(4/3) * As :	0.5582 in2/ft	Min Stem T&S Reinf Area 1.824 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 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 :	0.4187 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.465 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	4.00 ft
Heel Width	=	1.91
Total Footing Width	=	5.91
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	2,990	0	psf
Mu' : Upward	=	165,915	0	ft-#
Mu' : Downward	=	21,888	1,141	ft-#
Mu: Design	=	12,002	1,141	ft-#
Actual 1-Way Shear	=	37.96	15.29	psi
Allow 1-Way Shear	=	75.00	40.00	psi

Toe Reinforcing = # 5 @ 8.00 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@ 7.05 in, #5@ 10.94 in, #6@ 15.52 in, #7@ 21.17 in, #8@ 27.88 in, #9@ 35
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 1.53 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	2,000.0	3.33	6,666.7			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	729.0	5.50	4,009.5			
Load @ Stem Above Soil =						
=						
				Soil Over HL (ab. water tbl)	1,342.8	5.29	7,101.2
				Soil Over HL (bel. water tbl)		5.29	7,101.2
				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 =	160.0	2.00	320.0
				Surcharge Over Toe =			
				Stem Weight(s) =	950.0	4.33	4,116.7
				Earth @ Stem Transitions =			
				Footing Weight =	886.5	2.96	2,619.6
				Key Weight =			
				Vert. Component =			
Total =	2,729.0	**O.T.M.** =	10,676.2	**Total =**	3,339.3 lbs	**R.M.=**	14,157.4

Resisting/Overturning Ratio = **1.33**
Vertical Loads used for Soil Pressure = 3,339.3 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.095	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.

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Cantilevered Retaining Wall

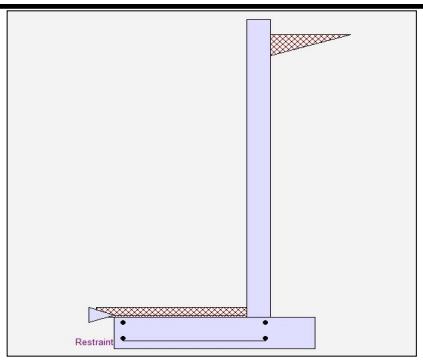
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	9.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.00	OK
Slab Resists All Sliding !			
Total Bearing Load	=	3,292 lbs	
...resultant ecc.	=	9.67 in	
Soil Pressure @ Toe	=	1,079 psf	OK
Soil Pressure @ Heel	=	85 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,510 psf	
ACI Factored @ Heel	=	118 psf	
Footing Shear @ Toe	=	26.6 psi	OK
Footing Shear @ Heel	=	12.5 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,000.0 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 5
Rebar Spacing =	8.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.659**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	2,592.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	7,776.0
Moment.....Allowable =	11,799.2
Shear.....Actual	
Service Level psi =	
Strength Level psi =	34.9
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2944 in2/ft		
(4/3) * As :	0.3926 in2/ft	Min Stem T&S Reinf Area 1.824 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 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 :	0.2944 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.465 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.75 ft
Heel Width	=	1.91
Total Footing Width	=	5.66
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,510	118	psf
Mu' : Upward	=	101,481	170	ft-#
Mu' : Downward	=	19,238	1,141	ft-#
Mu: Design	=	6,854	971	ft-#
Actual 1-Way Shear	=	26.60	12.48	psi
Allow 1-Way Shear	=	75.00	40.00	psi

Toe Reinforcing = # 5 @ 10.00 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
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 1.47 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	2,000.0	3.33	6,666.7			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				1,342.8	5.04	6,765.5
Soil Over HL (bel. water tbl)					5.04	6,765.5
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 =				150.0	1.88	281.3
Surcharge Over Toe =						
Stem Weight(s) =				950.0	4.08	3,879.2
Earth @ Stem Transitions =						
Footing Weight =				849.0	2.83	2,402.7
Key Weight =						
Vert. Component =						
Total =	2,000.0	**O.T.M.** =	6,666.7	**Total =** 3,291.8 lbs	**R.M.=**	13,328.6

Resisting/Overturning Ratio = **2.00**
Vertical Loads used for Soil Pressure = 3,291.8 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.050	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.

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Cantilevered Retaining Wall

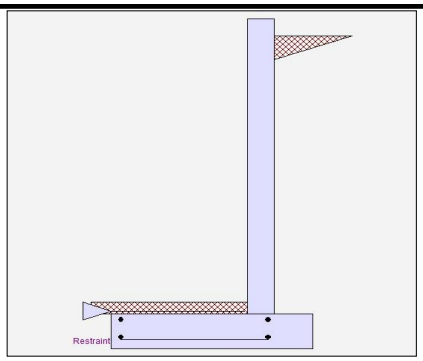
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	72.0 #/ft
...Height to Top	=	8.00 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.29	Ratio < 1.5!
Slab Resists All Sliding !			

Total Bearing Load	=	2,718	lbs
...resultant ecc.	=	21.21	in
Soil Pressure @ Toe	=	2,231 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	3,123 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	30.6 psi	OK
Footing Shear @ Heel	=	11.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,196.0 lbs

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

Load Factors

Building Code	IBC 2015,ACI
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	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 5
Rebar Spacing	=	11.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.881**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	2,624.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	7,765.3
Moment.....Allowable	=	8,809.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	35.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.19
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.294 in2/ft		
(4/3) * As :	0.392 in2/ft	Min Stem T&S Reinf Area 1.632 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 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 :	0.294 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.3382 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.50 ft
Heel Width	=	1.66
Total Footing Width	=	5.16
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	3,123	0 psf
Mu' : Upward	=	122,714	0 ft-#
Mu' : Downward	=	16,758	657 ft-#
Mu: Design	=	8,830	657 ft-#
Actual 1-Way Shear	=	30.62	11.03 psi
Allow 1-Way Shear	=	75.00	40.00 psi
Toe Reinforcing	=	# 5 @ 11.00 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@ 7.50 in, #5@ 11.63 in, #6@ 16.51 in, #7@ 22.51 in, #8@ 29.64 in, #9@ 37
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 1.34 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		1,620.0	3.00	4,860.0	Soil Over HL (ab. water tbl)	953.6	4.66	4,447.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		4.66	4,447.0
Hydrostatic Force					Watre Table			
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	=	576.0	5.00	2,880.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	140.0	1.75	245.0
	=				Surcharge Over Toe	=			
					Stem Weight(s)	=	850.0	3.83	3,258.3
					Earth @ Stem Transitions	=			
					Footing Weight	=	774.0	2.58	1,996.9
					Key Weight	=			
					Vert. Component	=			
Total	=	2,196.0	**O.T.M.** =	7,740.0	**Total =**		2,717.6 lbs	**R.M.=**	9,947.2

Resisting/Overturning Ratio = **1.29**
Vertical Loads used for Soil Pressure = 2,717.6 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.102	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.

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Cantilevered Retaining Wall

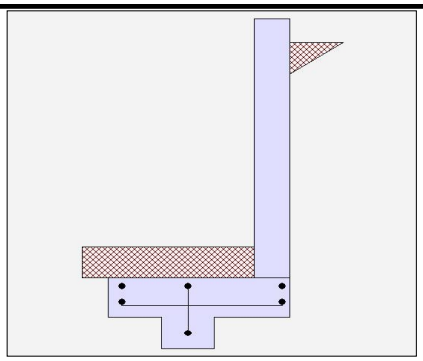
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.16	OK
Sliding	=	1.57	OK
Total Bearing Load	=	1,281 lbs	
...resultant ecc.	=	6.12 in	
Soil Pressure @ Toe	=	710 psf	OK
Soil Pressure @ Heel	=	39 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	994 psf	
ACI Factored @ Heel	=	55 psf	
Footing Shear @ Toe	=	11.1 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	680.6 lbs	
less 100% Passive Force	= -	554.2 lbs	
less 100% Friction Force	= -	512.4 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	11.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.240**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	850.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,416.7
Moment.....Allowable	=	5,883.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	11.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0531 in2/ft		
(4/3) * As :	0.0708 in2/ft	Min Stem T&S Reinf Area 1.056 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.2182 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.75 ft
Heel Width	=	0.67
Total Footing Width	=	3.42
Footing Thickness	=	10.00 in
Key Width	=	12.00 in
Key Depth	=	8.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	994	55	psf
Mu' : Upward	=	33,672	0	ft-#
Mu' : Downward	=	12,599	0	ft-#
Mu: Design	=	1,756	0	ft-#
Actual 1-Way Shear	=	11.07	0.03	psi
Allow 1-Way Shear	=	75.00	40.00	psi

Toe Reinforcing = # 4 @ 9.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.26 in
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@ 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: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 0.74 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	680.6	1.94	1,323.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				1.8	3.42	6.3
Soil Over HL (bel. water tbl)					3.42	6.3
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 =				201.7	1.38	277.3
Surcharge Over Toe =						
Stem Weight(s) =				550.0	3.08	1,695.8
Earth @ Stem Transitions =						
Footing Weight =				427.5	1.71	731.0
Key Weight =				100.0	1.50	150.0
Vert. Component =						
Total =	680.6	**O.T.M.** =	1,323.3	**Total =** 1,281.0 lbs	**R.M.=**	2,860.4

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

Resisting/Overturning Ratio = **2.16**
Vertical Loads used for Soil Pressure = 1,281.0 lbs

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)	0.032	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.

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Cantilevered Retaining Wall

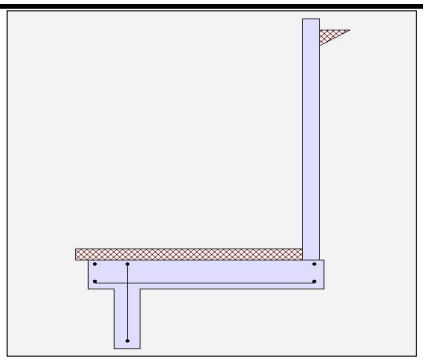
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	10.00 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	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.20	OK
Sliding	=	1.65	OK
Total Bearing Load	=	3,778 lbs	
...resultant ecc.	=	18.42 in	
Soil Pressure @ Toe	=	838 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,173 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	18.1 psi	OK
Footing Shear @ Heel	=	1.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,531.3 lbs	
less 100% Passive Force	= -	2,666.7 lbs	
less 100% Friction Force	= -	1,511.1 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 6
Rebar Spacing	=	8.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.787**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,400.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	11,333.3
Moment.....Allowable	=	14,393.2
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	50.4
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	5.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.4746 in2/ft		
(4/3) * As :	0.6328 in2/ft	Min Stem T&S Reinf Area 2.016 in2	
200bd/fy : 200(12)(5.625)/60000 :	0.225 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 :	0.4746 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.66 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.762 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	8.25 ft
Heel Width	=	0.83
Total Footing Width	=	9.08
Footing Thickness	=	15.00 in
Key Width	=	12.00 in
Key Depth	=	31.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	1,173	0 psf
Mu' : Upward	=	332,890	0 ft-#
Mu' : Downward	=	138,643	25 ft-#
Mu: Design	=	16,187	25 ft-#
Actual 1-Way Shear	=	18.11	1.92 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 6 @ 8.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 5 @ 12.00 in
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@ 5.59 in, #5@ 8.67 in, #6@ 12.30 in, #7@ 16.78 in, #8@ 22.10 in, #9@ 27.
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 10 in, #5@ 15.5 in, #6@ 18 in, #7@ 18 in, #8@ 18 in

Min footing T&S reinf Area 2.94 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	2,531.3	3.75	9,492.2			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				183.3	9.00	1,650.0
Soil Over HL (bel. water tbl)					9.00	1,650.0
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 =				453.8	4.13	1,871.7
Surcharge Over Toe =						
Stem Weight(s) =				1,050.0	8.58	9,012.5
Earth @ Stem Transitions =						
Footing Weight =				1,703.1	4.54	7,735.0
Key Weight =				387.5	1.50	581.3
Vert. Component =						
Total =	2,531.3	**O.T.M.** =	9,492.2	**Total =** 3,777.7 lbs	**R.M.=**	20,850.5

Resisting/Overturning Ratio = **2.20**
Vertical Loads used for Soil Pressure = 3,777.7 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.027	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.

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Cantilevered Retaining Wall

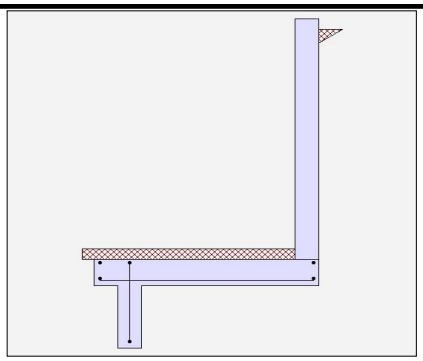
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.00 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	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.17	OK
Sliding	=	1.67	OK
Total Bearing Load	=	4,424 lbs	
...resultant ecc.	=	17.96 in	
Soil Pressure @ Toe	=	906 psf	OK
Soil Pressure @ Heel	=	26 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,268 psf	
ACI Factored @ Heel	=	36 psf	
Footing Shear @ Toe	=	23.1 psi	OK
Footing Shear @ Heel	=	1.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	3,001.3 lbs	
less 100% Passive Force	= -	3,234.4 lbs	
less 100% Friction Force	= -	1,769.5 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

Bottom

		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	12.00
Rebar Size	=	# 6
Rebar Spacing	=	8.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.574**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	4,114.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	15,084.7
Moment.....Allowable	=	26,273.2
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	35.6
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	9.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	150.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3602 in2/ft	
(4/3) * As :	0.4803 in2/ft	Min Stem T&S Reinf Area 3.312 in2
200bd/fy : 200(12)(9.625)/60000 :	0.385 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) :	0.2592 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.385 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.66 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3039 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	8.50 ft
Heel Width	=	1.00
Total Footing Width	=	9.50
Footing Thickness	=	15.00 in
Key Width	=	12.00 in
Key Depth	=	36.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	1,268	36 psf
Mu' : Upward	=	390,388	0 ft-#
Mu' : Downward	=	147,173	0 ft-#
Mu: Design	=	20,268	0 ft-#
Actual 1-Way Shear	=	23.11	1.92 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 6 @ 8.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 5 @ 10.00 in
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@ 5.21 in, #5@ 8.08 in, #6@ 11.47 in, #7@ 15.65 in, #8@ 20.60 in, #9@ 26.
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 7.29 in, #5@ 11.31 in, #6@ 16.05 in, #7@ 18 in, #8@

Min footing T&S reinf Area 3.08 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	3,001.3	4.08	12,255.1			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
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 =				467.5	4.25	1,986.9
Surcharge Over Toe =						
Stem Weight(s) =				1,725.0	9.00	15,525.0
Earth @ Stem Transitions =						
Footing Weight =				1,781.3	4.75	8,460.9
Key Weight =				450.0	1.50	675.0
Vert. Component =						
Total =	3,001.3	**O.T.M.** =	12,255.1	**Total =** 4,423.8 lbs	**R.M.=**	26,647.8

Resisting/Overturning Ratio = **2.17**
Vertical Loads used for Soil Pressure = 4,423.8 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.030	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.

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Cantilevered Retaining Wall

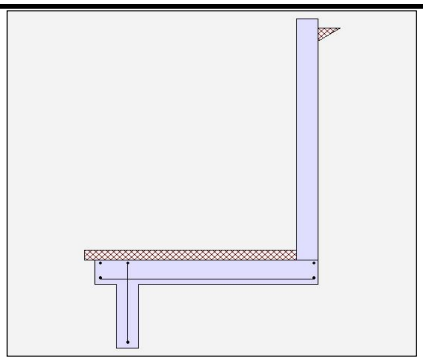
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	12.00 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	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.01	OK
Sliding	=	1.61	OK
Total Bearing Load	=	4,806 lbs	
...resultant ecc.	=	22.23 in	
Soil Pressure @ Toe	=	979 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,371 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	26.2 psi	OK
Footing Shear @ Heel	=	1.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	3,511.3 lbs	
less 100% Passive Force	= -	3,726.0 lbs	
less 100% Friction Force	= -	1,922.3 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	12.00
Rebar Size	=	# 6
Rebar Spacing	=	7.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.660**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	4,896.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	19,584.0
Moment.....Allowable	=	29,648.9
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	42.4
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	9.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	150.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.4676 in2/ft	
(4/3) * As :	0.6235 in2/ft	Min Stem T&S Reinf Area 3.600 in2
200bd/fy : 200(12)(9.625)/60000 :	0.385 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) :	0.2592 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.4676 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.7543 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3039 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	9.25 ft
Heel Width	=	1.00
Total Footing Width	=	10.25
Footing Thickness	=	15.00 in
Key Width	=	12.00 in
Key Depth	=	40.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	1,371	0 psf
Mu' : Upward	=	482,651	0 ft-#
Mu' : Downward	=	174,291	0 ft-#
Mu: Design	=	25,697	0 ft-#
Actual 1-Way Shear	=	26.19	1.92 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 6 @ 7.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 5 @ 8.00 in
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@ 4.69 in, #5@ 7.28 in, #6@ 10.33 in, #7@ 14.09 in, #8@ 18.56 in, #9@ 23.
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 5.71 in, #5@ 8.85 in, #6@ 12.56 in, #7@ 17.13 in, #

Min footing T&S reinf Area 3.32 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	3,511.3	4.42	15,508.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
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 =				508.8	4.63	2,353.0
Surcharge Over Toe =						
Stem Weight(s) =				1,875.0	9.75	18,281.3
Earth @ Stem Transitions =						
Footing Weight =				1,921.9	5.13	9,849.6
Key Weight =				500.0	1.50	750.0
Vert. Component =						
Total =	3,511.3	**O.T.M.** =	15,508.0	**Total =** 4,805.6 lbs	**R.M.=**	31,233.8

Resisting/Overturning Ratio = **2.01**
Vertical Loads used for Soil Pressure = 4,805.6 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.033	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.

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Cantilevered Retaining Wall

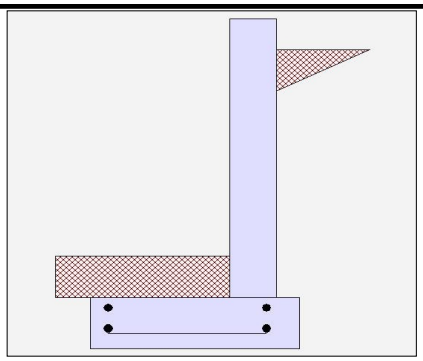
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	36.0 #/ft
...Height to Top	=	4.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.87	OK
Sliding	=	1.35	Ratio < 1.5!
Total Bearing Load	=	1,118 lbs	
...resultant ecc.	=	7.12 in	
Soil Pressure @ Toe	=	822 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,151 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	10.2 psi	OK
Footing Shear @ Heel	=	2.7 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	611.2 lbs	
less 100% Passive Force	= -	375.0 lbs	
less 100% Friction Force	= -	447.3 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	94.5 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.203**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	731.2
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,099.7
Moment.....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	9.7
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0412 in2/ft		
(4/3) * As :	0.0549 in2/ft	Min Stem T&S Reinf Area 0.864 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	1.00
Total Footing Width	=	3.00
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	6.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,151	0 psf
Mu' : Upward	=	20,857	0 ft-#
Mu' : Downward	=	6,664	44 ft-#
Mu: Design	=	1,183	44 ft-#
Actual 1-Way Shear	=	10.15	2.74 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, phi Tu = 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 0.65 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		467.2	1.61	752.7	Soil Over HL (ab. water tbl)	146.7	2.83	415.6
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.83	415.6
Hydrostatic Force					Watre Table			
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	=	144.0	2.83	408.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	146.7	1.00	146.7
	=				Surcharge Over Toe	=			
					Stem Weight(s)	=	450.0	2.33	1,050.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	375.0	1.50	562.5
					Key Weight	=			
					Vert. Component	=			
Total	=	611.2	**O.T.M.** =	1,160.7	**Total =**		1,118.3 lbs	**R.M.=**	2,174.7

Resisting/Overturning Ratio = **1.87**
Vertical Loads used for Soil Pressure = 1,118.3 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.034	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.

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Cantilevered Retaining Wall

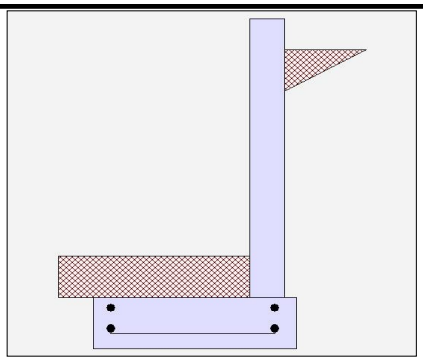
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	36.0 #/ft
...Height to Top	=	4.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.52	OK
Sliding	=	1.35	Ratio < 1.5!
Total Bearing Load	=	940 lbs	
...resultant ecc.	=	9.74 in	
Soil Pressure @ Toe	=	970 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,357 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	10.1 psi	OK
Footing Shear @ Heel	=	1.4 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	611.2 lbs	
less 100% Passive Force	= -	450.0 lbs	
less 100% Friction Force	= -	376.2 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	90.7 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.447**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	731.2
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,099.7
Moment.....Allowable	=	2,455.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	14.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0622 in2/ft		
(4/3) * As :	0.0829 in2/ft	Min Stem T&S Reinf Area 0.648 in2	
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1296 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.1333 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	2.25 ft
Heel Width	=	0.67
Total Footing Width	=	2.92
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	6.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,357	0 psf
Mu' : Upward	=	25,332	0 ft-#
Mu' : Downward	=	8,434	11 ft-#
Mu: Design	=	1,408	11 ft-#
Actual 1-Way Shear	=	10.08	1.37 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, phi Tu = 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 0.63 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		467.2	1.61	752.7	Soil Over HL (ab. water tbl)	73.3	2.83	207.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.83	207.8
Hydrostatic Force					Watre Table			
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	=	144.0	2.83	408.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	165.0	1.13	185.6
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	337.5	2.50	843.8
					Earth @ Stem Transitions	=			
					Footing Weight	=	364.6	1.46	531.7
					Key Weight	=			
					Vert. Component	=			
Total	=	611.2	**O.T.M.** =	1,160.7	**Total =**		940.4 lbs	**R.M.=**	1,768.8

Resisting/Overturning Ratio = **1.52**
Vertical Loads used for Soil Pressure = 940.4 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.042	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.

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Cantilevered Retaining Wall

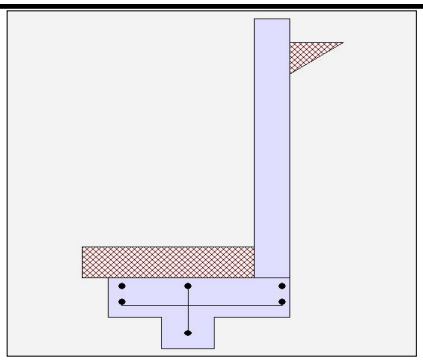
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	45.0 #/ft
...Height to Top	=	5.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.38	Ratio < 1.5!
Sliding	=	1.18	Ratio < 1.5!
Total Bearing Load	=	1,281 lbs	
...resultant ecc.	=	13.15 in	
Soil Pressure @ Toe	=	1,390 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,946 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	14.5 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	905.6 lbs	
less 100% Passive Force	= -	554.2 lbs	
less 100% Friction Force	= -	512.4 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	291.8 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	11.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.365**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,142.5
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,147.9
Moment.....Allowable	=	5,883.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	15.2
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0805 in2/ft	
(4/3) * As :	0.1073 in2/ft	Min Stem T&S Reinf Area 1.056 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.2182 in2/ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	2.75 ft
Heel Width	=	0.67
Total Footing Width	=	3.42
Footing Thickness	=	10.00 in
Key Width	=	12.00 in
Key Depth	=	8.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	1,946	0 psf
Mu' : Upward	=	45,959	0 ft-#
Mu' : Downward	=	12,599	0 ft-#
Mu: Design	=	2,780	0 ft-#
Actual 1-Way Shear	=	14.51	0.03 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 4 @ 9.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.26 in
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@ 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: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 0.74 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	680.6	1.94	1,323.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	225.0	3.33	750.0			
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				1.8	3.42	6.3
Soil Over HL (bel. water tbl)					3.42	6.3
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 =				201.7	1.38	277.3
Surcharge Over Toe =						
Stem Weight(s) =				550.0	3.08	1,695.8
Earth @ Stem Transitions =						
Footing Weight =				427.5	1.71	731.0
Key Weight =				100.0	1.50	150.0
Vert. Component =						
Total =	905.6	**O.T.M.** =	2,073.3	**Total =** 1,281.0 lbs	**R.M.=**	2,860.4

Resisting/Overturning Ratio = **1.38**
Vertical Loads used for Soil Pressure = 1,281.0 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.062	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.

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Cantilevered Retaining Wall

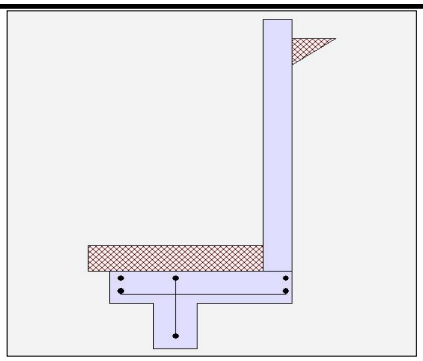
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	54.0 #/ft
...Height to Top	=	6.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.28	Ratio < 1.5!
Sliding	=	1.24	Ratio < 1.5!
Total Bearing Load	=	1,605 lbs	
...resultant ecc.	=	18.07 in	
Soil Pressure @ Toe	=	1,847 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,585 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	17.4 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,257.9 lbs	
less 100% Passive Force	= -	916.7 lbs	
less 100% Friction Force	= -	642.0 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	328.1 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	10.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.575**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,645.2
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	3,711.6
Moment.....Allowable	=	6,444.1
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	21.9
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1391 in2/ft		
(4/3) * As :	0.1854 in2/ft	Min Stem T&S Reinf Area 1.248 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.1854 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 :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.50 ft
Heel Width	=	0.67
Total Footing Width	=	4.17
Footing Thickness	=	10.00 in
Key Width	=	12.00 in
Key Depth	=	14.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	2,585	0 psf
Mu' : Upward	=	78,755	0 ft-#
Mu' : Downward	=	20,409	0 ft-#
Mu: Design	=	4,862	0 ft-#
Actual 1-Way Shear	=	17.44	0.04 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 4 @ 8.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.00 in
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@ 10.29 in, #5@ 15.96 in, #6@ 22.65 in, #7@ 30.89 in, #8@ 40.67 in, #9@ 5
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 0.90 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		933.9	2.28	2,127.2	Soil Over HL (ab. water tbl)	2.2	4.17	9.2
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		4.17	9.2
Hydrostatic Force					Watre Table			
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	=	324.0	3.83	1,242.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	256.7	1.75	449.2
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	650.0	3.83	2,491.7
					Earth @ Stem Transitions	=			
					Footing Weight	=	521.3	2.09	1,086.8
					Key Weight	=	175.0	1.50	262.5
					Vert. Component	=			
Total	=	1,257.9	**O.T.M.** =	3,369.2	**Total =**		1,605.1 lbs	**R.M.=**	4,299.3

Resisting/Overturning Ratio = **1.28**
Vertical Loads used for Soil Pressure = 1,605.1 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.080	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.

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Cantilevered Retaining Wall

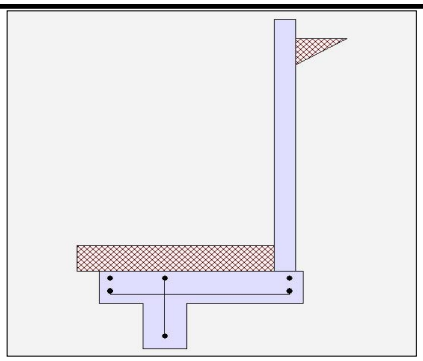
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	54.0 #/ft
...Height to Top	=	6.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.42	Ratio < 1.5!
Sliding	=	1.25	Ratio < 1.5!
Total Bearing Load	=	1,649 lbs	
...resultant ecc.	=	17.69 in	
Soil Pressure @ Toe	=	1,279 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,791 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	16.3 psi	OK
Footing Shear @ Heel	=	1.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,257.9 lbs	
less 100% Passive Force	= -	916.7 lbs	
less 100% Friction Force	= -	659.7 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	310.5 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	9.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.785**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,645.2
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	3,711.6
Moment.....Allowable	=	4,722.4
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	32.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2098 in2/ft		
(4/3) * As :	0.2797 in2/ft	Min Stem T&S Reinf Area 0.936 in2	
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2098 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2667 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	4.00 ft
Heel Width	=	0.67
Total Footing Width	=	4.67
Footing Thickness	=	10.00 in
Key Width	=	12.00 in
Key Depth	=	14.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	1,791	0 psf
Mu' : Upward	=	87,016	0 ft-#
Mu' : Downward	=	26,656	15 ft-#
Mu: Design	=	5,030	15 ft-#
Actual 1-Way Shear	=	16.31	1.91 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 4 @ 9.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.26 in
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@ 9.95 in, #5@ 15.42 in, #6@ 21.89 in, #7@ 29.86 in, #8@ 39.31 in, #9@ 49
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 1.01 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	933.9	2.28	2,127.2			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	324.0	3.83	1,242.0			
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				110.0	4.58	504.2
Soil Over HL (bel. water tbl)					4.58	504.2
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 =				293.3	2.00	586.7
Surcharge Over Toe =						
Stem Weight(s) =				487.5	4.25	2,071.9
Earth @ Stem Transitions =						
Footing Weight =				583.3	2.33	1,361.1
Key Weight =				175.0	1.50	262.5
Vert. Component =						
Total =	1,257.9	**O.T.M.** =	3,369.2	**Total =** 1,649.2 lbs	**R.M.=**	4,786.3

Resisting/Overturning Ratio = **1.42**
Vertical Loads used for Soil Pressure = 1,649.2 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.050	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.

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Cantilevered Retaining Wall

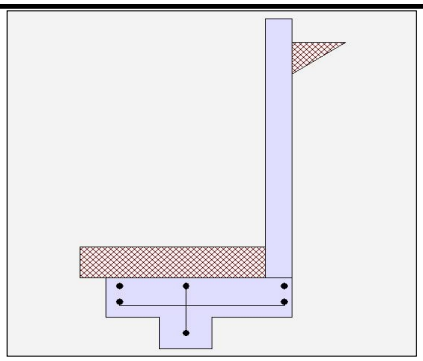
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	45.0 #/ft
...Height to Top	=	5.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.25	Ratio < 1.5!
Sliding	=	1.13	Ratio < 1.5!
Total Bearing Load	=	1,170 lbs	
...resultant ecc.	=	15.74 in	
Soil Pressure @ Toe	=	1,779 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,491 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	11.6 psi	OK
Footing Shear @ Heel	=	1.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	905.6 lbs	
less 100% Passive Force	= -	554.2 lbs	
less 100% Friction Force	= -	468.0 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	336.2 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.594**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,142.5
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,147.9
Moment.....Allowable	=	3,612.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	22.4
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1214 in2/ft		
(4/3) * As :	0.1619 in2/ft	Min Stem T&S Reinf Area 0.792 in2	
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1619 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	3.00 ft
Heel Width	=	0.50
Total Footing Width	=	3.50
Footing Thickness	=	10.00 in
Key Width	=	12.00 in
Key Depth	=	8.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	2,491	0 psf
Mu' : Upward	=	50,350	0 ft-#
Mu' : Downward	=	14,994	0 ft-#
Mu: Design	=	2,946	0 ft-#
Actual 1-Way Shear	=	11.56	1.91 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 4 @ 9.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.26 in
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@ 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: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 0.76 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	680.6	1.94	1,323.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	225.0	3.33	750.0			
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
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 =				220.0	1.50	330.0
Surcharge Over Toe =						
Stem Weight(s) =				412.5	3.25	1,340.6
Earth @ Stem Transitions =						
Footing Weight =				437.5	1.75	765.6
Key Weight =				100.0	1.50	150.0
Vert. Component =						
Total =	905.6	**O.T.M.** =	2,073.3	**Total =** 1,170.0 lbs	**R.M.=**	2,586.3

Resisting/Overturning Ratio = **1.25**
Vertical Loads used for Soil Pressure = 1,170.0 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.078	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.

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Cantilevered Retaining Wall

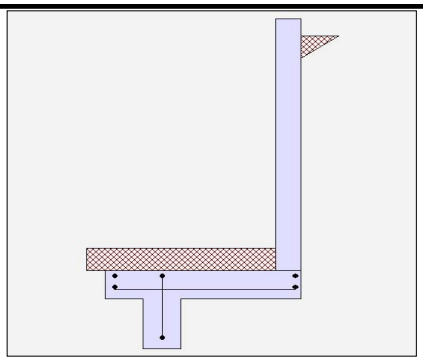
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	7.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	63.0 #/ft
...Height to Top	=	7.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.25	Ratio < 1.5!
Sliding	=	1.19	Ratio < 1.5!
Total Bearing Load	=	1,954 lbs	
...resultant ecc.	=	23.20 in	
Soil Pressure @ Toe	=	1,999 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,798 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	19.9 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,668.2 lbs	
less 100% Passive Force	= -	1,200.0 lbs	
less 100% Friction Force	= -	781.5 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	520.8 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	8.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.740**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	2,239.3
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	5,893.9
Moment.....Allowable =	7,959.6
Shear.....Actual	
Service Level psi =	
Strength Level psi =	29.9
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2208 in2/ft		
(4/3) * As :	0.2944 in2/ft	Min Stem T&S Reinf Area 1.440 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.25 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.3 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	4.50 ft
Heel Width	=	0.67
Total Footing Width	=	5.17
Footing Thickness	=	10.00 in
Key Width	=	12.00 in
Key Depth	=	18.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	2,798	0 psf
Mu' : Upward	=	126,315	0 ft-#
Mu' : Downward	=	33,737	0 ft-#
Mu: Design	=	7,715	0 ft-#
Actual 1-Way Shear	=	19.86	0.04 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 4 @ 8.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.00 in
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@ 8.65 in, #5@ 13.41 in, #6@ 19.03 in, #7@ 25.95 in, #8@ 34.17 in, #9@ 43
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 1.12 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		1,227.2	2.61	3,204.4	Soil Over HL (ab. water tbl)	2.6	5.17	13.3
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		5.17	13.3
Hydrostatic Force					Watre Table			
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	=	441.0	4.33	1,911.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	330.0	2.25	742.5
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	750.0	4.83	3,625.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	646.3	2.59	1,670.6
					Key Weight	=	225.0	1.50	337.5
					Vert. Component	=			
Total	=	1,668.2	**O.T.M.** =	5,115.4	**Total =**		1,953.8 lbs	**R.M.=**	6,388.8

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

Resisting/Overturning Ratio = **1.25**
Vertical Loads used for Soil Pressure = 1,953.8 lbs

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)	0.081	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.

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Cantilevered Retaining Wall

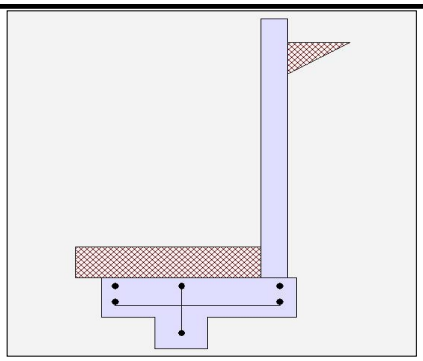
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.26	OK
Sliding	=	1.57	OK
Total Bearing Load	=	1,283 lbs	
...resultant ecc.	=	6.41 in	
Soil Pressure @ Toe	=	656 psf	OK
Soil Pressure @ Heel	=	44 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	918 psf	
ACI Factored @ Heel	=	62 psf	
Footing Shear @ Toe	=	10.4 psi	OK
Footing Shear @ Heel	=	1.5 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	680.6 lbs	
less 100% Passive Force	= -	554.2 lbs	
less 100% Friction Force	= -	513.0 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	16.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.515**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	850.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,416.7
Moment.....Allowable	=	2,749.3
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	16.7
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0801 in2/ft		
(4/3) * As :	0.1068 in2/ft	Min Stem T&S Reinf Area 0.792 in2	
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1296 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.15 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	3.00 ft
Heel Width	=	0.67
Total Footing Width	=	3.67
Footing Thickness	=	10.00 in
Key Width	=	12.00 in
Key Depth	=	8.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	918	62	psf
Mu' : Upward	=	36,951	1	ft-#
Mu' : Downward	=	14,994	13	ft-#
Mu: Design	=	1,830	12	ft-#
Actual 1-Way Shear	=	10.44	1.50	psi
Allow 1-Way Shear	=	75.00	40.00	psi

Toe Reinforcing = # 4 @ 11.11 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.26 in
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@ 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: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 0.79 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	680.6	1.94	1,323.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				91.7	3.58	328.5
Soil Over HL (bel. water tbl)					3.58	328.5
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 =				220.0	1.50	330.0
Surcharge Over Toe =						
Stem Weight(s) =				412.5	3.25	1,340.6
Earth @ Stem Transitions =						
Footing Weight =				458.3	1.83	840.3
Key Weight =				100.0	1.50	150.0
Vert. Component =						
Total =	680.6	**O.T.M.** =	1,323.3	**Total =** 1,282.5 lbs	**R.M.=**	2,989.4

Resisting/Overturning Ratio = **2.26**
Vertical Loads used for Soil Pressure = 1,282.5 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.027	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.

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Cantilevered Retaining Wall

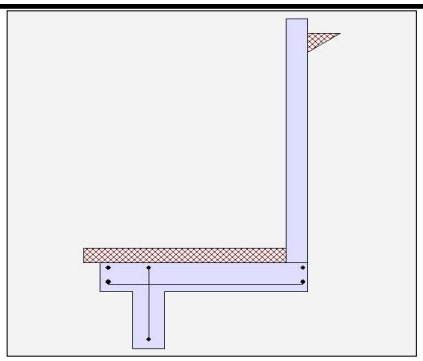
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	8.00 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	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	72.0 #/ft
...Height to Top	=	8.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.25	Ratio < 1.5!
Sliding	=	1.21	Ratio < 1.5!
Total Bearing Load	=	2,432 lbs	
...resultant ecc.	=	29.15 in	
Soil Pressure @ Toe	=	2,076 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,906 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	18.4 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,196.0 lbs	
less 100% Passive Force	= -	1,687.5 lbs	
less 100% Friction Force	= -	972.9 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	633.6 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 5
Rebar Spacing	=	10.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.914**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	2,924.8
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	8,797.9
Moment.....Allowable	=	9,623.1
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	39.4
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.19
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.3331 in2/ft		
(4/3) * As :	0.4442 in2/ft	Min Stem T&S Reinf Area 1.632 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 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 :	0.3331 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.372 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	5.75 ft
Heel Width	=	0.67
Total Footing Width	=	6.42
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	24.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	2,906	0 psf
Mu' : Upward	=	203,027	0 ft-#
Mu' : Downward	=	56,934	0 ft-#
Mu: Design	=	12,174	0 ft-#
Actual 1-Way Shear	=	18.38	0.04 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 5 @ 10.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.00 in
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@ 7.05 in, #5@ 10.94 in, #6@ 15.52 in, #7@ 21.17 in, #8@ 27.88 in, #9@ 35
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 1.66 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		1,620.0	3.00	4,860.0	Soil Over HL (ab. water tbl)	2.9	6.42	18.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		6.42	18.8
Hydrostatic Force					Watre Table			
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	=	576.0	5.00	2,880.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	316.3	2.88	909.2
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	850.0	6.08	5,170.8
					Earth @ Stem Transitions	=			
					Footing Weight	=	963.0	3.21	3,091.2
					Key Weight	=	300.0	1.50	450.0
					Vert. Component	=			
Total	=	2,196.0	**O.T.M.** =	7,740.0	**Total =**		2,432.2 lbs	**R.M.=**	9,640.1

Resisting/Overturning Ratio = **1.25**
Vertical Loads used for Soil Pressure = 2,432.2 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.076	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.

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Cantilevered Retaining Wall

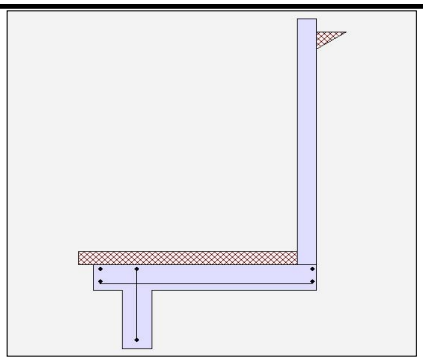
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	9.00 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	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	81.0 #/ft
...Height to Top	=	9.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.24	Ratio < 1.5!
Sliding	=	1.13	Ratio < 1.5!
Total Bearing Load	=	2,826 lbs	
...resultant ecc.	=	35.06 in	
Soil Pressure @ Toe	=	2,063 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,888 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	20.1 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,729.0 lbs	
less 100% Passive Force	= -	1,959.4 lbs	
less 100% Friction Force	= -	1,130.5 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	1,003.6 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 5
Rebar Spacing	=	6.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.822**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,701.7
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	12,526.7
Moment.....Allowable	=	15,222.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	49.9
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.19
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.4743 in2/ft		
(4/3) * As :	0.6324 in2/ft	Min Stem T&S Reinf Area 1.824 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 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 :	0.4743 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.62 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	7.00 ft
Heel Width	=	0.67
Total Footing Width	=	7.67
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	27.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	2,888	0 psf
Mu' : Upward	=	289,000	0 ft-#
Mu' : Downward	=	84,378	0 ft-#
Mu: Design	=	17,052	0 ft-#
Actual 1-Way Shear	=	20.07	0.04 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 5 @ 8.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.00 in
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@ 5.18 in, #5@ 8.03 in, #6@ 11.39 in, #7@ 15.54 in, #8@ 20.46 in, #9@ 25.
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 1.99 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		2,000.0	3.33	6,666.7	Soil Over HL (ab. water tbl)	3.3	7.67	25.3
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		7.67	25.3
Hydrostatic Force					Watre Table			
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	=	729.0	5.50	4,009.5	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	385.0	3.50	1,347.5
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	950.0	7.33	6,966.7
					Earth @ Stem Transitions	=			
					Footing Weight	=	1,150.5	3.84	4,412.2
					Key Weight	=	337.5	1.50	506.3
					Vert. Component	=			
Total	=	2,729.0	**O.T.M.** =	10,676.2	**Total =**		2,826.3 lbs	**R.M.=**	13,257.9

Resisting/Overturning Ratio = **1.24**
Vertical Loads used for Soil Pressure = 2,826.3 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	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.

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Cantilevered Retaining Wall

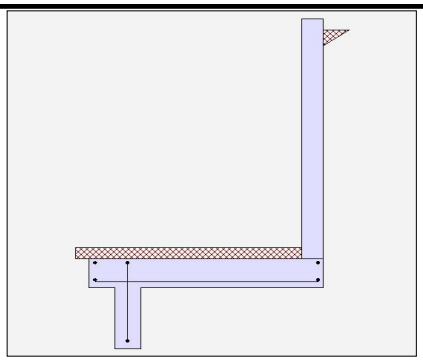
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	10.00 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	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	90.0 #/ft
...Height to Top	=	10.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.43	Ratio < 1.5!
Sliding	=	1.26	Ratio < 1.5!
Total Bearing Load	=	3,869 lbs	
...resultant ecc.	=	34.45 in	
Soil Pressure @ Toe	=	1,544 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,162 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	20.4 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	3,431.3 lbs	
less 100% Passive Force	= -	2,776.0 lbs	
less 100% Friction Force	= -	1,547.8 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	823.1 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	10.00
Rebar Size =	# 6
Rebar Spacing =	8.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.845**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	4,570.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	17,183.3
Moment.....Allowable =	20,333.2
Shear.....Actual	
Service Level psi =	
Strength Level psi =	49.9
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	7.63
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	125.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.5226 in2/ft		
(4/3) * As :	0.6968 in2/ft	Min Stem T&S Reinf Area 2.520 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.5226 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.66 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.0329 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	8.25 ft
Heel Width	=	0.83
Total Footing Width	=	9.08
Footing Thickness	=	15.00 in
Key Width	=	12.00 in
Key Depth	=	32.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	2,162	0 psf
Mu' : Upward	=	427,691	0 ft-#
Mu' : Downward	=	138,643	0 ft-#
Mu: Design	=	24,087	0 ft-#
Actual 1-Way Shear	=	20.44	0.03 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 6 @ 8.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 5 @ 12.00 in
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@ 5.01 in, #5@ 7.77 in, #6@ 11.02 in, #7@ 15.03 in, #8@ 19.80 in, #9@ 25.
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 9.64 in, #5@ 14.94 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 2.94 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)		2,531.3	3.75	9,492.2	Soil Over HL (ab. water tbl)	0.0	9.08	0.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		9.08	0.0
Hydrostatic Force					Watre Table			
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	=	900.0	6.25	5,625.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	453.8	4.13	1,871.7
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	1,312.5	8.67	11,375.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	1,703.1	4.54	7,735.0
					Key Weight	=	400.0	1.50	600.0
					Vert. Component	=			
Total	=	3,431.3	**O.T.M.** =	15,117.2	**Total =**		3,869.4 lbs	**R.M.=**	21,581.7

Resisting/Overturning Ratio = **1.43**
Vertical Loads used for Soil Pressure = 3,869.4 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.050	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.

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Cantilevered Retaining Wall

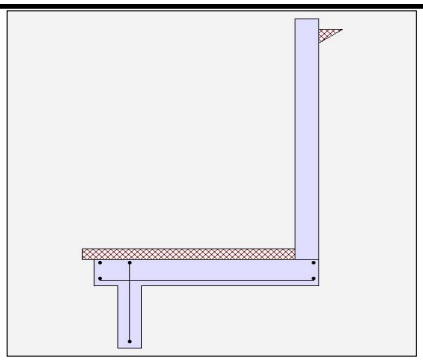
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.00 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	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	99.0 #/ft
...Height to Top	=	11.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.36	Ratio < 1.5!
Sliding	=	1.22	Ratio < 1.5!
Total Bearing Load	=	4,424 lbs	
...resultant ecc.	=	37.90 in	
Soil Pressure @ Toe	=	1,853 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,594 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	25.4 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	4,090.3 lbs	
less 100% Passive Force	= -	3,234.4 lbs	
less 100% Friction Force	= -	1,769.5 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	1,131.5 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	12.00
Rebar Size =	# 6
Rebar Spacing =	8.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.870**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	5,529.7
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	22,871.0
Moment.....Allowable =	26,273.2
Shear.....Actual	
Service Level psi =	
Strength Level psi =	47.9
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	9.63
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	150.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.5461 in2/ft	
(4/3) * As :	0.7282 in2/ft	Min Stem T&S Reinf Area 3.312 in2
200bd/fy : 200(12)(9.625)/60000 :	0.385 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) :	0.2592 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.5461 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.66 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3039 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	8.50 ft
Heel Width	=	1.00
Total Footing Width	=	9.50
Footing Thickness	=	15.00 in
Key Width	=	12.00 in
Key Depth	=	36.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	2,594	0 psf
Mu' : Upward	=	513,407	0 ft-#
Mu' : Downward	=	147,173	0 ft-#
Mu: Design	=	30,519	0 ft-#
Actual 1-Way Shear	=	25.42	0.03 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 6 @ 8.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 5 @ 10.00 in
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@ 3.95 in, #5@ 6.13 in, #6@ 8.70 in, #7@ 11.87 in, #8@ 15.62 in, #9@ 19.7
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 7.29 in, #5@ 11.31 in, #6@ 16.05 in, #7@ 18 in, #8@

Min footing T&S reinf Area 3.08 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	3,001.3	4.08	12,255.1			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	1,089.0	6.75	7,350.8			
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
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 =				467.5	4.25	1,986.9
Surcharge Over Toe =						
Stem Weight(s) =				1,725.0	9.00	15,525.0
Earth @ Stem Transitions =						
Footing Weight =				1,781.3	4.75	8,460.9
Key Weight =				450.0	1.50	675.0
Vert. Component =						
Total =	4,090.3	**O.T.M.** =	19,605.9	**Total =** 4,423.8 lbs	**R.M.=**	26,647.8

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

Resisting/Overturning Ratio = **1.36**

Vertical Loads used for Soil Pressure = 4,423.8 lbs

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)	0.062	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.

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Cantilevered Retaining Wall

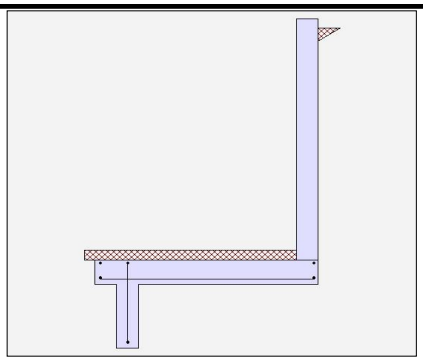
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	12.00 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	=	2,666.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	108.0 #/ft
...Height to Top	=	12.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.25	Ratio < 1.5!
Sliding	=	1.17	Ratio < 1.5!
Total Bearing Load	=	4,806 lbs	
...resultant ecc.	=	45.69 in	
Soil Pressure @ Toe	=	2,432 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	3,405 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	27.4 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	4,807.3 lbs	
less 100% Passive Force	= -	3,726.0 lbs	
less 100% Friction Force	= -	1,922.3 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	1,562.6 lbs	NG

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	12.00
Rebar Size	=	# 7
Rebar Spacing	=	9.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.957**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	6,580.8
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	29,692.8
Moment.....Allowable	=	31,026.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	57.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	9.56
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	150.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.7138 in2/ft	
(4/3) * As :	0.9518 in2/ft	Min Stem T&S Reinf Area 3.600 in2
200bd/fy : 200(12)(9.5625)/60000 :	0.3825 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) :	0.2592 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.7138 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.8 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.2954 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	9.25 ft
Heel Width	=	1.00
Total Footing Width	=	10.25
Footing Thickness	=	15.00 in
Key Width	=	12.00 in
Key Depth	=	40.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	3,405	0 psf
Mu' : Upward	=	640,453	0 ft-#
Mu' : Downward	=	174,291	0 ft-#
Mu: Design	=	38,847	0 ft-#
Actual 1-Way Shear	=	27.36	0.03 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 7 @ 9.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 5 @ 8.00 in
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@ 3.10 in, #5@ 4.81 in, #6@ 6.83 in, #7@ 9.32 in, #8@ 12.27 in, #9@ 15.54
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 5.71 in, #5@ 8.85 in, #6@ 12.56 in, #7@ 17.13 in, #

Min footing T&S reinf Area 3.32 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	3,511.3	4.42	15,508.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =	1,296.0	7.25	9,396.0			
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
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 =				508.8	4.63	2,353.0
Surcharge Over Toe =						
Stem Weight(s) =				1,875.0	9.75	18,281.3
Earth @ Stem Transitions =						
Footing Weight =				1,921.9	5.13	9,849.6
Key Weight =				500.0	1.50	750.0
Vert. Component =						
Total =	4,807.3	**O.T.M.** =	24,904.0	**Total =** 4,805.6 lbs	**R.M.=**	31,233.8

Resisting/Overturning Ratio = **1.25**
Vertical Loads used for Soil Pressure = 4,805.6 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.082	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.

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Cantilevered Retaining Wall

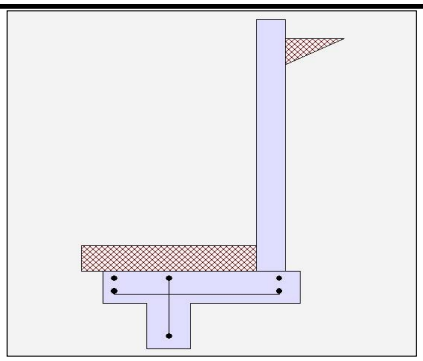
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.55	OK
Sliding	=	1.78	OK
Total Bearing Load	=	1,864 lbs	
...resultant ecc.	=	5.79 in	
Soil Pressure @ Toe	=	681 psf	OK
Soil Pressure @ Heel	=	148 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	953 psf	
ACI Factored @ Heel	=	207 psf	
Footing Shear @ Toe	=	15.5 psi	OK
Footing Shear @ Heel	=	3.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	933.9 lbs	
less 100% Passive Force	= -	916.7 lbs	
less 100% Friction Force	= -	745.7 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	10.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.379**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	1,224.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	2,448.0
Moment.....Allowable =	6,444.1
Shear.....Actual	
Service Level psi =	
Strength Level psi =	16.3
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0917 in2/ft		
(4/3) * As :	0.1223 in2/ft	Min Stem T&S Reinf Area 1.248 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.24 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.50 ft
Heel Width	=	1.00
Total Footing Width	=	4.50
Footing Thickness	=	10.00 in
Key Width	=	12.00 in
Key Depth	=	14.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	953	207	psf
Mu' : Upward	=	55,828	13	ft-#
Mu' : Downward	=	20,409	61	ft-#
Mu: Design	=	2,952	49	ft-#
Actual 1-Way Shear	=	15.48	3.00	psi
Allow 1-Way Shear	=	75.00	40.00	psi

Toe Reinforcing = # 4 @ 11.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.00 in
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@ 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: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 0.97 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	933.9	2.28	2,127.2			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				220.0	4.33	953.3
Soil Over HL (bel. water tbl)					4.33	953.3
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 =				256.7	1.75	449.2
Surcharge Over Toe =						
Stem Weight(s) =				650.0	3.83	2,491.7
Earth @ Stem Transitions =						
Footing Weight =				562.5	2.25	1,265.6
Key Weight =				175.0	1.50	262.5
Vert. Component =						
Total =	933.9	**O.T.M.** =	2,127.2	**Total =** 1,864.2 lbs	**R.M.=**	5,422.3

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

Resisting/Overturning Ratio = **2.55**
Vertical Loads used for Soil Pressure = 1,864.2 lbs

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)	0.027	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.

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Cantilevered Retaining Wall

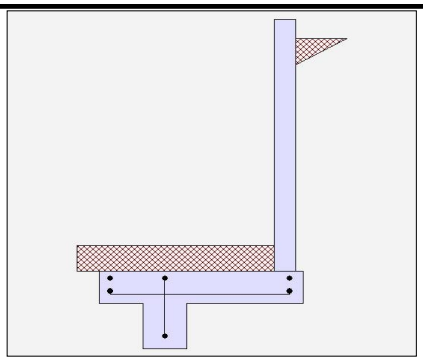
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.25	OK
Sliding	=	1.69	OK
Total Bearing Load	=	1,649 lbs	
...resultant ecc.	=	8.65 in	
Soil Pressure @ Toe	=	681 psf	OK
Soil Pressure @ Heel	=	26 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	953 psf	
ACI Factored @ Heel	=	36 psf	
Footing Shear @ Toe	=	13.9 psi	OK
Footing Shear @ Heel	=	1.8 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	933.9 lbs	
less 100% Passive Force	= -	916.7 lbs	
less 100% Friction Force	= -	659.7 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	9.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.518**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,224.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,448.0
Moment.....Allowable	=	4,722.4
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	24.0
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1384 in2/ft		
(4/3) * As :	0.1845 in2/ft	Min Stem T&S Reinf Area 0.936 in2	
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.17 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2667 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	4.00 ft
Heel Width	=	0.67
Total Footing Width	=	4.67
Footing Thickness	=	10.00 in
Key Width	=	12.00 in
Key Depth	=	14.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	953	36 psf
Mu' : Upward	=	66,364	1 ft-#
Mu' : Downward	=	26,656	15 ft-#
Mu: Design	=	3,309	15 ft-#
Actual 1-Way Shear	=	13.91	1.82 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 4 @ 11.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.26 in
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@ 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: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 1.01 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	933.9	2.28	2,127.2			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				110.0	4.58	504.2
Soil Over HL (bel. water tbl)					4.58	504.2
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 =				293.3	2.00	586.7
Surcharge Over Toe =						
Stem Weight(s) =				487.5	4.25	2,071.9
Earth @ Stem Transitions =						
Footing Weight =				583.3	2.33	1,361.1
Key Weight =				175.0	1.50	262.5
Vert. Component =						
Total =	933.9	**O.T.M.** =	2,127.2	**Total =** 1,649.2 lbs	**R.M.=**	4,786.3

Resisting/Overturning Ratio = **2.25**
Vertical Loads used for Soil Pressure = 1,649.2 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.026	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.

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Cantilevered Retaining Wall

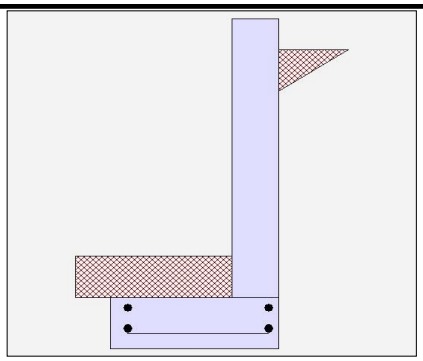
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.89	OK
Sliding	=	1.72	OK
Total Bearing Load	=	882 lbs	
...resultant ecc.	=	5.45 in	
Soil Pressure @ Toe	=	779 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,090 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	7.7 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	467.2 lbs	
less 100% Passive Force	= -	450.0 lbs	
less 100% Friction Force	= -	352.9 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.134**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	544.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	725.3
Moment.....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	7.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0272 in2/ft		
(4/3) * As :	0.0362 in2/ft	Min Stem T&S Reinf Area 0.864 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	0.67
Total Footing Width	=	2.42
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	6.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	1,090	0 psf
Mu' : Upward	=	14,873	0 ft-#
Mu' : Downward	=	5,102	0 ft-#
Mu: Design	=	814	0 ft-#
Actual 1-Way Shear	=	7.74	0.03 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, phi Tu = 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 0.52 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	467.2	1.61	752.7			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				1.5	2.42	3.5
Soil Over HL (bel. water tbl)					2.42	3.5
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 =				128.3	0.88	112.3
Surcharge Over Toe =						
Stem Weight(s) =				450.0	2.08	937.5
Earth @ Stem Transitions =						
Footing Weight =				302.5	1.21	366.0
Key Weight =						
Vert. Component =						
Total =	467.2	**O.T.M.** =	752.7	**Total =** 882.3 lbs	**R.M.=**	1,419.4

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

Resisting/Overturning Ratio = **1.89**
Vertical Loads used for Soil Pressure = 882.3 lbs

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)	0.040	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.

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Cantilevered Retaining Wall

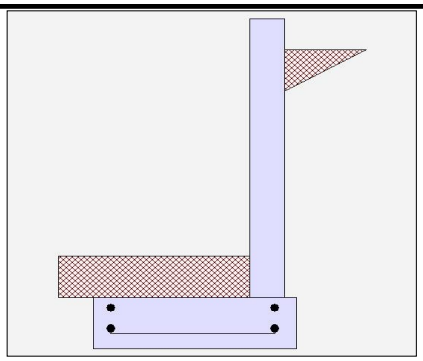
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.35	OK
Sliding	=	1.77	OK
Total Bearing Load	=	940 lbs	
...resultant ecc.	=	4.53 in	
Soil Pressure @ Toe	=	573 psf	OK
Soil Pressure @ Heel	=	72 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	802 psf	
ACI Factored @ Heel	=	101 psf	
Footing Shear @ Toe	=	6.5 psi	OK
Footing Shear @ Heel	=	1.2 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	467.2 lbs	
less 100% Passive Force	= -	450.0 lbs	
less 100% Friction Force	= -	376.2 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.295**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	544.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	725.3
Moment.....Allowable	=	2,455.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	10.7
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.041 in2/ft		
(4/3) * As :	0.0547 in2/ft	Min Stem T&S Reinf Area 0.648 in2	
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1296 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.1333 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	2.25 ft
Heel Width	=	0.67
Total Footing Width	=	2.92
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	6.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 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	=	802	101 psf
Mu' : Upward	=	18,888	2 ft-#
Mu' : Downward	=	8,434	11 ft-#
Mu: Design	=	871	9 ft-#
Actual 1-Way Shear	=	6.51	1.16 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, phi Tu	=	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 0.63 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	467.2	1.61	752.7			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				73.3	2.83	207.8
Soil Over HL (bel. water tbl)					2.83	207.8
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 =				165.0	1.13	185.6
Surcharge Over Toe =						
Stem Weight(s) =				337.5	2.50	843.8
Earth @ Stem Transitions =						
Footing Weight =				364.6	1.46	531.7
Key Weight =						
Vert. Component =						
Total =	467.2	**O.T.M.** =	752.7	**Total =** 940.4 lbs	**R.M.=**	1,768.8

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

Resisting/Overturning Ratio = **2.35**
Vertical Loads used for Soil Pressure = 940.4 lbs

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)	0.025	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.

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Cantilevered Retaining Wall

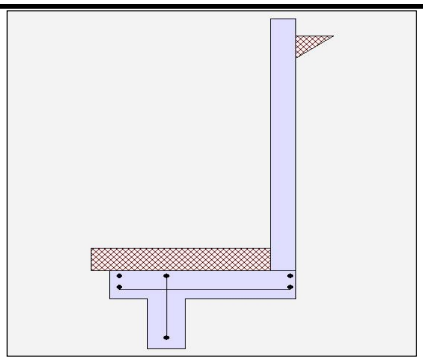
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	7.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.86	OK
Sliding	=	1.60	OK
Total Bearing Load	=	1,904 lbs	
...resultant ecc.	=	12.14 in	
Soil Pressure @ Toe	=	876 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,227 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	19.2 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,227.2 lbs	
less 100% Passive Force	= -	1,200.0 lbs	
less 100% Friction Force	= -	761.7 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	8.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.488**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,666.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	3,887.3
Moment.....Allowable	=	7,959.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	22.2
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1456 in2/ft		
(4/3) * As :	0.1942 in2/ft	Min Stem T&S Reinf Area 1.440 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 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 :	0.1942 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.3 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	4.25 ft
Heel Width	=	0.67
Total Footing Width	=	4.92
Footing Thickness	=	10.00 in
Key Width	=	12.00 in
Key Depth	=	18.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	1,227	0 psf
Mu' : Upward	=	89,622	0 ft-#
Mu' : Downward	=	30,092	0 ft-#
Mu: Design	=	4,961	0 ft-#
Actual 1-Way Shear	=	19.20	0.04 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 4 @ 9.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.00 in
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@ 10.09 in, #5@ 15.64 in, #6@ 22.20 in, #7@ 30.27 in, #8@ 39.86 in, #9@ 5
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 1.06 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	1,227.2	2.61	3,204.4			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				2.6	4.92	12.6
Soil Over HL (bel. water tbl)					4.92	12.6
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 =				311.7	2.13	662.3
Surcharge Over Toe =						
Stem Weight(s) =				750.0	4.58	3,437.5
Earth @ Stem Transitions =						
Footing Weight =				615.0	2.46	1,512.9
Key Weight =				225.0	1.50	337.5
Vert. Component =						
Total =	1,227.2	**O.T.M.** =	3,204.4	**Total =** 1,904.2 lbs	**R.M.=**	5,962.8

Resisting/Overturning Ratio = **1.86**
Vertical Loads used for Soil Pressure = 1,904.2 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.037	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.

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Cantilevered Retaining Wall

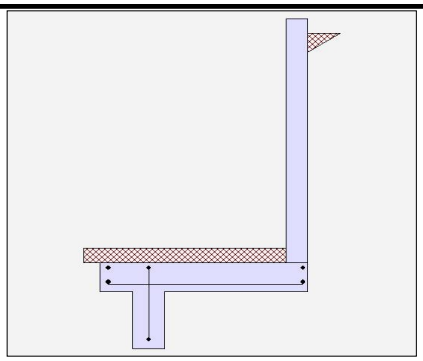
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	8.00 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	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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	=	1.98	OK
Sliding	=	1.64	OK
Total Bearing Load	=	2,432 lbs	
...resultant ecc.	=	14.94 in	
Soil Pressure @ Toe	=	825 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,155 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	17.7 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,620.0 lbs	
less 100% Passive Force	= -	1,687.5 lbs	
less 100% Friction Force	= -	972.9 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 5
Rebar Spacing	=	10.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.602**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	2,176.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	5,802.7
Moment.....Allowable	=	9,623.1
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	29.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.19
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2197 in2/ft		
(4/3) * As :	0.293 in2/ft	Min Stem T&S Reinf Area 1.632 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 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 :	0.2475 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.372 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	5.75 ft
Heel Width	=	0.67
Total Footing Width	=	6.42
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	24.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	1,155	0 psf
Mu' : Upward	=	154,644	0 ft-#
Mu' : Downward	=	56,934	0 ft-#
Mu: Design	=	8,143	0 ft-#
Actual 1-Way Shear	=	17.68	0.04 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 5 @ 10.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.00 in
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@ 8.13 in, #5@ 12.61 in, #6@ 17.90 in, #7@ 24.41 in, #8@ 32.14 in, #9@ 40
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 1.66 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	1,620.0	3.00	4,860.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				2.9	6.42	18.8
Soil Over HL (bel. water tbl)					6.42	18.8
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 =				316.3	2.88	909.2
Surcharge Over Toe =						
Stem Weight(s) =				850.0	6.08	5,170.8
Earth @ Stem Transitions =						
Footing Weight =				963.0	3.21	3,091.2
Key Weight =				300.0	1.50	450.0
Vert. Component =						
Total =	1,620.0	**O.T.M.** =	4,860.0	**Total =** 2,432.2 lbs	**R.M.=**	9,640.1

Resisting/Overturning Ratio = **1.98**
Vertical Loads used for Soil Pressure = 2,432.2 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.030	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.

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Cantilevered Retaining Wall

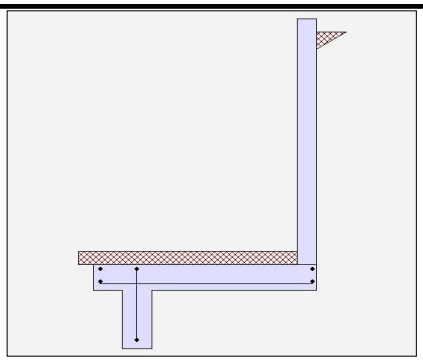
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	9.00 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	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT 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	=	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 (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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.99	OK
Sliding	=	1.54	OK
Total Bearing Load	=	2,826 lbs	
...resultant ecc.	=	18.03 in	
Soil Pressure @ Toe	=	808 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,131 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	19.7 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,000.0 lbs	
less 100% Passive Force	= -	1,959.4 lbs	
less 100% Friction Force	= -	1,130.5 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	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 5
Rebar Spacing =	8.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.700**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	2,754.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	8,262.0
Moment.....Allowable =	11,799.2
Shear.....Actual	
Service Level psi =	
Strength Level psi =	37.1
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.3128 in2/ft		
(4/3) * As :	0.4171 in2/ft	Min Stem T&S Reinf Area 1.824 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 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 :	0.3128 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.465 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	7.00 ft
Heel Width	=	0.67
Total Footing Width	=	7.67
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	27.00 in
Key Distance from Toe	=	1.00 ft

f'c = 2,500 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	=	1,131	0 psf
Mu' : Upward	=	221,640	0 ft-#
Mu' : Downward	=	84,378	0 ft-#
Mu: Design	=	11,439	0 ft-#
Actual 1-Way Shear	=	19.68	0.04 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 5 @ 8.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 9.00 in
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@ 7.05 in, #5@ 10.94 in, #6@ 15.52 in, #7@ 21.17 in, #8@ 27.88 in, #9@ 35
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18

Min footing T&S reinf Area 1.99 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

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

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)	2,000.0	3.33	6,666.7			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				3.3	7.67	25.3
Soil Over HL (bel. water tbl)					7.67	25.3
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 =				385.0	3.50	1,347.5
Surcharge Over Toe =						
Stem Weight(s) =				950.0	7.33	6,966.7
Earth @ Stem Transitions =						
Footing Weight =				1,150.5	3.84	4,412.2
Key Weight =				337.5	1.50	506.3
Vert. Component =						
Total =	2,000.0	**O.T.M.** =	6,666.7	**Total =** 2,826.3 lbs	**R.M.=**	13,257.9

Resisting/Overturning Ratio = **1.99**
Vertical Loads used for Soil Pressure = 2,826.3 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	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.028	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.