

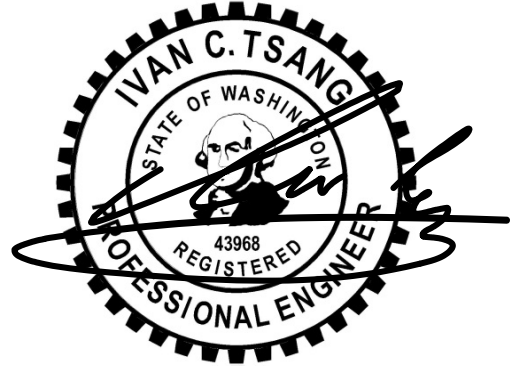
SUPPLEMENTAL STRUCTURAL CALCULATIONS FOR:

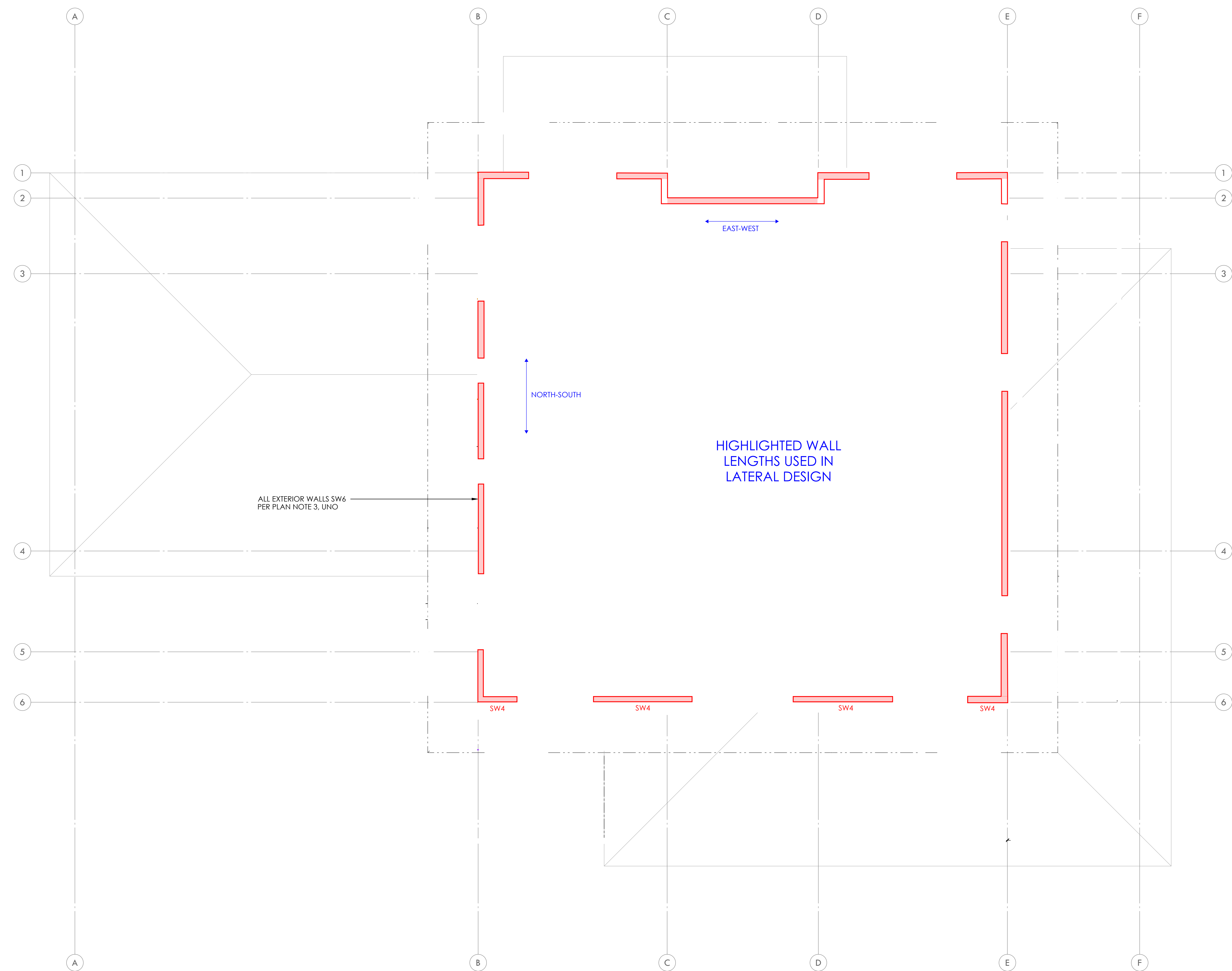
6427 E MERCER WAY

MERCER ISLAND, WA

ARCHITECT: CITIZEN DESIGN

JULY 16, 2025





SHEARWALL KEY PLAN
ROOF FRAMING PLAN
SECOND FLOOR WALLS SHOWN SOLID





6427 E MERCER WAY
MERCER ISLAND, WA



SECOND FLOOR WALLS SHOWN DASHED
MAIN FLOOR WALLS SHOWN SOLID



S2.3

CALE - 1/4" = 1'-0"

LATERAL ANALYSIS

- SEISMIC DESIGN LOADS

LEVEL	AREA	#/SF	WT	HT	W: Hi	% DISTRIB	V(k)
ROOF	2500	26.0	65.0	25.75'	1674	0.57	9.84
2ND FL	3070	25.0	76.75	12.5'	959	0.33	5.7
GARAGE ROOF	1080	22.5	24.3	12.75'	310	0.1	1.74
			$\Sigma = 166.05^k$		$\Sigma = 2943$		

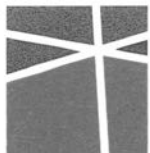
$$V_{SUR} = 0.149 \times 166.05^k = 24.74^k$$

$$V_{SALL} = 0.104 \times 166.05^k = \underline{\underline{17.28^k}}$$

- WIND DESIGN LOADS

LEVEL	TRIB HT		TOTAL
ROOF	9.75'	$(1 \times 13.3) + (5 \times 13.0) + (3.75 \times 12.6)$	$= 125.6 \text{ \#/,}$
2ND FLOOR	10.25'	$(1.25 \times 12.6) + (9 \times 12.2)$	$= 125.6 \text{ \#/,}$
GAR ROOF	8.25'	8.25×12.2	$= 100.7 \text{ \#/,}$

	N-S (L)	V(k)	E-W (L)	V(k)
ROOF	42.0	5.28	42.0	5.28
2ND FL	52.5	6.6	42.0	5.28
GAR ROOF	32.0	3.22		
		$\Sigma = \underline{\underline{15.1^k}}$		
			$\Sigma = \underline{\underline{10.56^k}}$	



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6427 E MERCER WAY
PROJECT

3/4/2025
DATE
0424.2025.01
PROJECT NO
JRF
DESIGN
L1
SHEET

NORTH - SOUTH EXPOSURE

() - SEISMIC VALUES

ROOF
R = 9'-0"

	$\xrightarrow{125.6 (234.3)}$ $\xleftarrow{42'}$	
R(k)	2.64 (4.92)	2.64 (4.92)
L(i)	$4.16 \times 2 + 7.16 + 6 + 4.5 = 25.98$	$8.83 + 16.16 + 5.41 = 30.4$
V(#)	102 (189)	87 (162)
SW	SW 6	SW 6
OT	0.9 (1.7)	0.78 (1.46)
HD	CS 16	CS 16
2w/H	$2 \times 4.16 / 9 \times 230$ $= 212 > 102 (189)$	> 1.0

SECOND FLOOR
R = 9'-0"

SECOND FLOOR
R=9'0"

R(k)	1.61 (0.87)	7.55 (8.64)	0.53 (0.98)	5.41 (6.79)
L(i)	6+8+6=20	12+8.25+15.75=36	8+4=12	3.83+6.5 +6.4=16.73
V(#)	81 (44)	210 (240)	44 (82)	323 (406)
SW	SW 6	SW 4	SW 6	SW 2
OT	-	1.89 (2.16)	-	2.91 (3.65)
OT (STACK)	-	2.79 (3.86)	-	-
HD	-	L STD 10 B	-	STD 14
HD (STACK)	-	STD 14	-	-
2w/H	>1.0	>1.0	$2 \times 4 / 9 \times 230$ $= 204 > 44 (82)$	$2 \times 3.83 / 9 \times 600$ $= 510 > 323 (406)$

$$\Sigma = 15.1 (17.28)$$



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DESIGN

L2
SHEET

EAST - WEST EXPOSURE

() - SEISMIC VALUES

ROOF
R=9'0"

(SOUTH)

(NORTH)

125.6 (234.3)
42'

R(L)	2.64 (4.92)	2.64 (4.92)
L(C)	$3' \times 2 + 7.83' \times 2 = 21.66$	$4' \times 4 + 12 = 28$
V(#)	122 (227)	94 (176)
SW	SW 4	SW 6
OT	1.1 (2.04)	0.85 (1.58) [A] - SEE BLW
HD	(2) CS16	CS16
Zw/H	$2 \times 3/9 \times 350 = 233 > 122 (227)$	$2 \times 4/9 \times 230 = 204 > 94 (176)$

SECOND FLOOR
R=9'0"125.6 (177.1)
42'

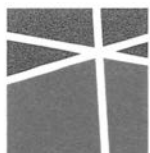
R(L)	5.28 (8.64)	5.28 (8.64)
L(C)	$4 + 4.25 + 4.83 + 3.58 + 27 = 43.66$	$4' \times 4 + 3.58' \times 2 = 23.16$
V(#)	121 (198)	228 (373)
SW	SW 4	SW 2
OT	1.1 (1.78)	2.05 (3.36)
OT (STACK)	2.2 (3.82)	2.9 (4.94)
HD	LSTD 8	STD 14 / (2) CS16
HD (STACK)	STD 14	HD 8
Zw/H	$2 \times 3.58/9 \times 350 = 278 > 121 (198)$	$2 \times 3.58/9 \times 600 = 477 > 228 (373)$

**WALLS AT BED 3 NOT
USED IN DESIGN -
SHEATHED AND NAILED
TO MATCH REST OF
ELEVATION

[A] - CHECK 0.6DL

$$0.6 \left[(40/2 + 6) \times 15_{psf} + 9 \times 15_{psf} \right] (12/2) = 1.89 > 0.85 (1.58)$$

NO HD REQD
AT 12' WALL



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PROJECT NO

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DESIGN

L3

SHEET

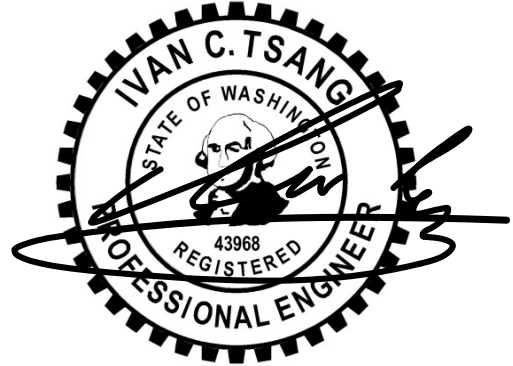
STRUCTURAL CALCULATIONS FOR:

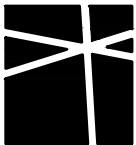
6427 E MERCER WAY

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ARCHITECT: CITIZEN DESIGN

JUNE 12, 2025





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98104

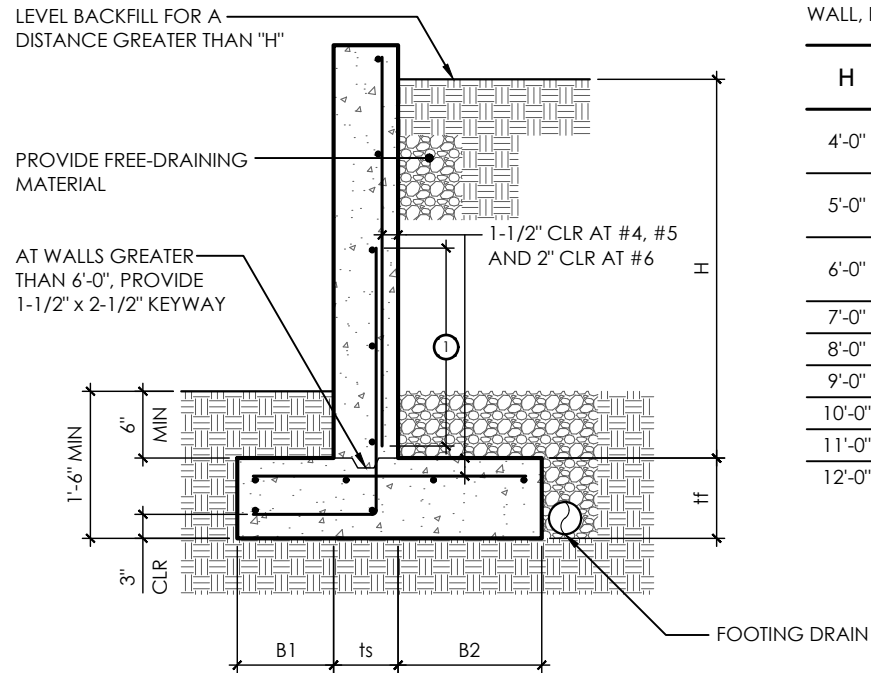
206.789.6038 T
206.789.6042 F

RETAINING WALL SCHEDULE w/ 9H - 2000 PSF
TITLE

NOTE:

WHERE RETAINED SOIL SUPPORTS A DRIVE SURFACE WITHIN A DISTANCE 'H' FROM THE FACE OF CONCRETE WALL, PROVIDE FOOTING, WALL, AND REINFORCING FOR A WALL 2'-0" HIGHER THAN ACTUAL 'H'(H+2)

H	B1	ts	B2	tf	STEM REINF		FOOTING REINF	
					VERT	HORIZ	TOP	LONG
4'-0"	6"	6"	1'-3"	9"	#4 AT 18"oc	#4 AT 16"oc	-	(3)#4
	6"	8"	1'-0"	9"	#4 AT 18"oc	#4 AT 12"oc	-	(3)#4
5'-0"	6"	6"	2'-0"	10"	#4 AT 18"oc	#4 AT 16"oc	-	(4)#4
	6"	8"	2'-0"	10"	#4 AT 12"oc	#4 AT 12"oc	-	(4)#4
6'-0"	9"	6"	2'-6"	10"	#4 AT 11"oc	#4 AT 16"oc	#4 AT 11"oc	(5)#4
	9"	8"	2'-3"	10"	#4 AT 12"oc	#4 AT 12"oc	#4 AT 11"oc	(5)#4
7'-0"	1'-3"	8"	2'-9"	10"	#4 AT 10"oc	#4 AT 12"oc	#4 AT 11"oc	(6)#4
8'-0"	1'-3"	8"	3'-6"	12"	#5 AT 11"oc	#4 AT 12"oc	#5 AT 14"oc	(5)#5
9'-0"	1'-6"	8"	4'-0"	12"	#5 AT 8"oc	#4 AT 12"oc	#5 AT 14"oc	(6)#5
10'-0"	1'-9"	8"	4'-6"	15"	#6 AT 8"oc	#4 AT 12"oc	#5 AT 11"oc	(8)#5
11'-0"	2'-0"	10"	5'-0"	15"	#6 AT 8"oc	#4 AT 10"oc	#5 AT 11"oc	(9)#5
12'-0"	2'-3"	12"	5'-3"	15"	#6 AT 8"oc	#5 AT 12"oc	#5 AT 10"oc	(9)#5



① LAP SPLICE - #4 = 32", #5 = 40", #6 = 48"

RETAINING WALL SCHEDULE

NOTE TO ENGINEER:

BEARING	2000 PSF
ACTIVE	35 PCF EFP
PASSIVE	250 PCF EFP
COEF FRICT	0.45
SEISMIC SURCHARGE	9H

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Cantilevered Retaining Wall

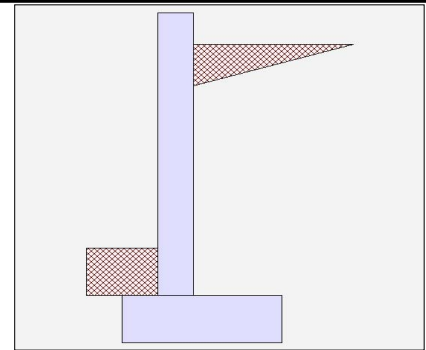
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

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

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	=	0.0 psf (Service Level)

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****1.2 FOS w/ Seismic**

Overturning	=	1.49 Ratio < 1.5!
Sliding	=	1.32 Ratio < 1.5!
Total Bearing Load	=	1,236 lbs
...resultant ecc.	=	8.62 in
Soil Pressure @ Toe	=	2,024 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,833 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	1.2 psi OK
Footing Shear @ Heel	=	9.9 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	538.8 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	556.0 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	96.0 lbs NG

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

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.360
---------------	---	-------

Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	592.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	885.3
Moment.....Allowable	=	2,455.6

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	11.6
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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.05 in2/ft	
(4/3) * As :	0.0667 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
0.0012bh : 0.0012(12)(6) :	0.0864 in2/ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.0864 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	=	0.50 ft
Heel Width	=	1.75
Total Footing Width	=	2.25
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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 2,833	0 psf
Mu' : Upward	= 3,670	4 ft-#
Mu' : Downward	= 365	555 ft-#
Mu: Design	= 275	551 ft-#
Actual 1-Way Shear	= 1.24	9.90 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
Key: No key defined

Min footing T&S reinf Area	0.44	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 2018,ACI 318-14,TMS 402-16

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)	394.8	1.58	625.2	Soil Over HL (ab. water tbl)	600.0	1.63	975.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		1.63	975.0
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 =	144.0	2.75	396.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	45.0	0.25	11.3
				Surcharge Over Toe =			
				Stem Weight(s) =	337.5	0.75	253.1
				Earth @ Stem Transitions =			
				Footing Weight =	253.1	1.13	284.8
				Key Weight =			
				Vert. Component =			
Total	= 538.8	O.T.M. =	1,021.2	Total =	1 235.6 lbs	R.M.=	1 524.1
Resisting/Overturning Ratio			= 1.49				
Vertical Loads used for Soil Pressure =			1,235.6 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) 0.112 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

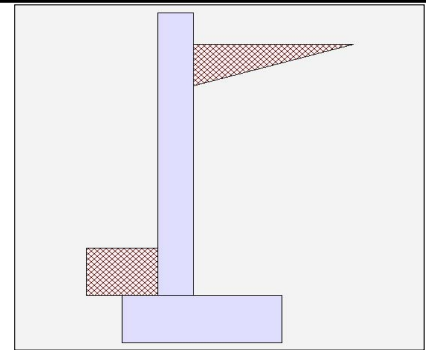
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

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

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	4.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.44 OK
Sliding	=	1.80 OK

Total Bearing Load	=	1,236 lbs
...resultant ecc.	=	4.77 in

Soil Pressure @ Toe	=	1,132 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,585 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.6 psi OK
Footing Shear @ Heel	=	4.5 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	394.8 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	556.0 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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.243
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	448.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	597.3

Moment.....Allowable

	=	2,455.6
--	---	---------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	8.8

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0338 in ² /ft	
(4/3) * As :	0.045 in ² /ft	Min Stem T&S Reinf Area 0.648 in ²
200bd/fy : 200(12)(4.25)/60000 :	0.17 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in ² /ft
0.0012bh : 0.0012(12)(6) :	0.0864 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.0864 in ² /ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.1333 in ² /ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in ² /ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	1.75
Total Footing Width	=	2.25
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,585	0 psf
Mu' : Upward	=	2,196	200 ft-#
Mu' : Downward	=	365	555 ft-#
Mu: Design	=	153	355 ft-#
Actual 1-Way Shear	=	0.64	4.53 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
Key: No key defined

Min footing T&S reinf Area	0.44	in ²
Min footing T&S reinf Area per foot	0.19	in ² /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 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	394.8	1.58	625.2	Soil Over HL (ab. water tbl)	600.0	1.63	975.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		1.63	975.0
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	45.0	0.25	11.3
				Surcharge Over Toe =			
				Stem Weight(s) =	337.5	0.75	253.1
				Earth @ Stem Transitions =			
				Footing Weight =	253.1	1.13	284.8
				Key Weight =			
				Vert. Component =			
Total	= 394.8	O.T.M. =	625.2	Total =	1,235.6 lbs	R.M.=	1,524.1
Resisting/Overturning Ratio	= 2.44						
Vertical Loads used for Soil Pressure =	1,235.6 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) 0.063 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

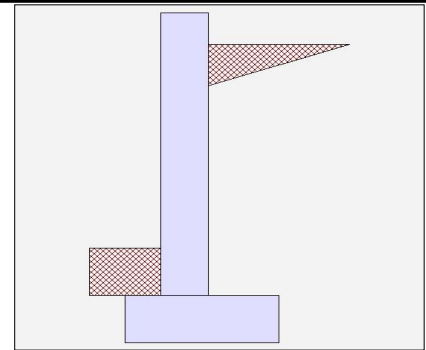
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

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

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	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	1.41 Ratio < 1.5!
Sliding	=	1.30 Ratio < 1.5!

Total Bearing Load	=	1,215 lbs
...resultant ecc.	=	8.81 in

Soil Pressure @ Toe	=	2,339 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,275 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	1.5 psi OK
Footing Shear @ Heel	=	8.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	538.8 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	546.7 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	105.4 lbs NG

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

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa	=	0.242
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	592.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	885.3

Moment.....Allowable	=	3,655.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	7.9

Shear.....Allowable	psi =	75.0
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Anet (Masonry)	in2 =	
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Rebar Depth 'd'	in =	6.25
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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

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) :	0.0332 in ² /ft	
(4/3) * As :	0.0442 in ² /ft	Min Stem T&S Reinf Area 0.864 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0012bh : 0.0012(12)(8) :	0.1152 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1152 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.1333 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	1.66
Total Footing Width	=	2.16
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,275	0 psf
Mu' : Upward	=	4,124	0 ft-#
Mu' : Downward	=	365	351 ft-#
Mu: Design	=	313	351 ft-#
Actual 1-Way Shear	=	1.45	8.41 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Key: No key defined

Min footing T&S reinf Area	0.42	in ²
Min footing T&S reinf Area per foot	0.19	in ² /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 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	394.8	1.58	625.2	Soil Over HL (ab. water tbl)	476.8	1.66	793.1
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		1.66	793.1
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 =	45.0	0.25	11.3
				Surcharge Over Toe =			
				Stem Weight(s) =	450.0	0.83	375.0
				Earth @ Stem Transitions =			
				Footing Weight =	243.0	1.08	262.4
				Key Weight =			
				Vert. Component =			
Total	= 538.8	O.T.M. =	1,021.2	Total =	1,214.8 lbs	R.M.=	1,441.8
Resisting/Overturning Ratio			= 1.41				
Vertical Loads used for Soil Pressure =			1,214.8 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) 0.135 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

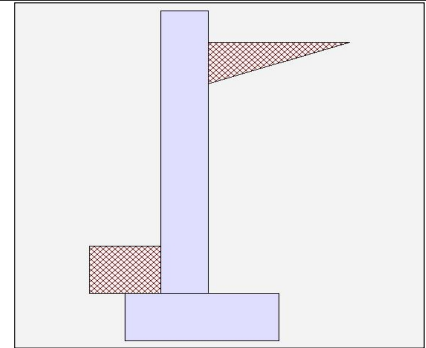
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

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

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	4.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.31 OK
Sliding	=	1.78 OK

Total Bearing Load	=	1,215 lbs
...resultant ecc.	=	4.89 in

Soil Pressure @ Toe	=	1,205 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,687 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.7 psi OK
Footing Shear @ Heel	=	4.8 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	394.8 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	546.7 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 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa	=	0.163
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	448.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	597.3

Moment.....Allowable

	=	3,655.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	6.0

Shear.....Allowable

	psi =	75.0
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Anet (Masonry)

	in2 =	
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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

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) :	0.0224 in ² /ft	
(4/3) * As :	0.0298 in ² /ft	Min Stem T&S Reinf Area 0.864 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0012bh : 0.0012(12)(8) :	0.1152 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1152 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.1333 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	1.66
Total Footing Width	=	2.16
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,687	0 psf
Mu' : Upward	=	2,321	86 ft-#
Mu' : Downward	=	365	351 ft-#
Mu: Design	=	163	265 ft-#
Actual 1-Way Shear	=	0.69	4.81 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Key: No key defined

Min footing T&S reinf Area	0.42	in ²
Min footing T&S reinf Area per foot	0.19	in ² /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 2018,ACI 318-14,TMS 402-16

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)	394.8	1.58	625.2	Soil Over HL (ab. water tbl)	476.8	1.66	793.1
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		1.66	793.1
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 =	45.0	0.25	11.3
=				Surcharge Over Toe =			
				Stem Weight(s) =	450.0	0.83	375.0
				Earth @ Stem Transitions =			
				Footing Weight =	243.0	1.08	262.4
				Key Weight =			
				Vert. Component =			

* 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) 0.070 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

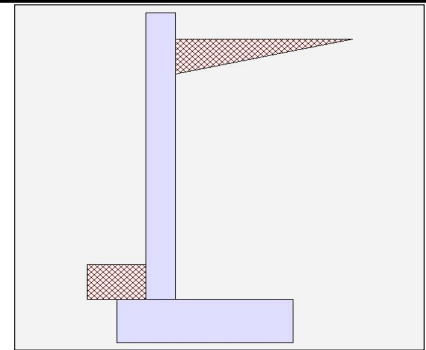
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	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	=	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		

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	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	1.72 OK
Sliding	=	1.30 Ratio < 1.5!

Total Bearing Load	=	2,028 lbs
...resultant ecc.	=	9.87 in

Soil Pressure @ Toe	=	1,995 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
		Soil Pressure Less Than Allowable
ACI Factored @ Toe	=	2,792 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.1 psi OK
Footing Shear @ Heel	=	10.5 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	820.5 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	912.4 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	162.1 lbs NG

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

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.704
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	925.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	1,729.2

Moment.....Allowable	=	2,455.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	18.1

Shear.....Allowable	psi =	75.0
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Anet (Masonry)	in2 =	
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Rebar Depth 'd'	in =	4.25
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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

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) :	0.0977 in ² /ft	
(4/3) * As :	0.1303 in ² /ft	Min Stem T&S Reinf Area 0.792 in ²
200bd/fy : 200(12)(4.25)/60000 :	0.17 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in ² /ft
0.0012bh : 0.0012(12)(6) :	0.0864 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1303 in ² /ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.1333 in ² /ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in ² /ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	2.50
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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 2,792	0 psf
Mu' : Upward	= 3,845	252 ft-#
Mu' : Downward	= 369	1,740 ft-#
Mu: Design	= 290	1,488 ft-#
Actual 1-Way Shear	= 0.12	10.49 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Key: No key defined

Min footing T&S reinf Area	0.65	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	595.5	1.94	1,157.9	Soil Over HL (ab. water tbl)	1,200.0	2.00	2,400.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.00	2,400.0
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 =	225.0	3.33	750.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	40.0	0.25	10.0
				Surcharge Over Toe =			
				Stem Weight(s) =	412.5	0.75	309.4
				Earth @ Stem Transitions =			
				Footing Weight =	375.0	1.50	562.5
				Key Weight =			
				Vert. Component =			
Total	= 820.5	O.T.M. =	1,907.9	Total =	2,027.5 lbs	R.M.=	3,281.9
Resisting/Overturning Ratio		= 1.72					
Vertical Loads used for Soil Pressure =		2,027.5 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) 0.102 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

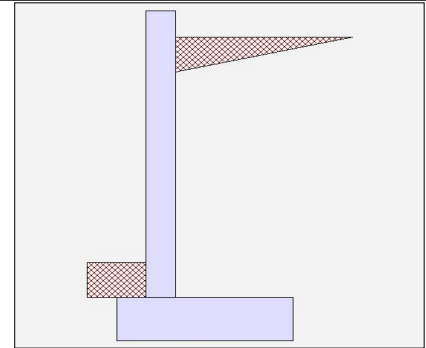
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	35.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footings 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	=	5.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.83 OK
Sliding	=	1.79 OK

Total Bearing Load	=	2,028 lbs
...resultant ecc.	=	5.43 in

Soil Pressure @ Toe	=	1,287 psf OK
Soil Pressure @ Heel	=	64 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,802 psf
ACI Factored @ Heel	=	90 psf
Footing Shear @ Toe	=	0.1 psi OK
Footing Shear @ Heel	=	4.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	595.5 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	912.4 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 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.475
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	700.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	1,166.7

Moment.....Allowable

	=	2,455.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	13.7

Shear.....Allowable

	psi =	75.0
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Anet (Masonry)

Rebar Depth 'd'	in =	4.25
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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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0659 in2/ft	
(4/3) * As :	0.0879 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
0.0012bh : 0.0012(12)(6) :	0.0864 in2/ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.0879 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	=	0.50 ft
Heel Width	=	2.50
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,802	90 psf
Mu' : Upward	=	2,561	941 ft-#
Mu' : Downward	=	369	1,740 ft-#
Mu: Design	=	183	799 ft-#
Actual 1-Way Shear	=	0.12	4.36 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 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 2018, ACI 318-14, TMS 402-16

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)	595.5	1.94	1,157.9	Soil Over HL (ab. water tbl)	1,200.0	2.00	2,400.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.00	2,400.0
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	40.0	0.25	10.0
				Surcharge Over Toe =			
				Stem Weight(s) =	412.5	0.75	309.4
				Earth @ Stem Transitions =			
				Footing Weight =	375.0	1.50	562.5
				Key Weight =			
				Vert. Component =			
Total	= 595.5	O.T.M. =	1,157.9	Total =	2,027.5 lbs	R.M.=	3,281.9
Resisting/Overturning Ratio			= 2.83				
Vertical Loads used for Soil Pressure =			2,027.5 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) 0.066 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

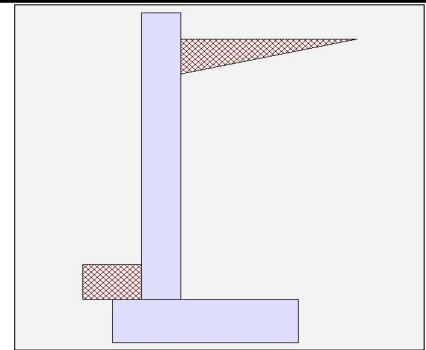
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

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	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	1.93 OK
Sliding	=	1.39 Ratio < 1.5!

Total Bearing Load	=	2,181 lbs
...resultant ecc.	=	9.21 in

Soil Pressure @ Toe	=	1,790 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,506 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.1 psi OK
Footing Shear @ Heel	=	9.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	820.5 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	981.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	93.0 lbs NG

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

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.319
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	925.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	1,729.2

Moment.....Allowable

	=	5,412.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	12.3

Shear.....Allowable

	psi =	75.0
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Anet (Masonry)

Rebar Depth 'd'	in =	6.25
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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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0648 in2/ft	
(4/3) * As :	0.0864 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
0.0012bh : 0.0012(12)(8) :	0.1152 in2/ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1152 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	=	0.50 ft
Heel Width	=	2.66
Total Footing Width	=	3.16
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,506	0 psf
Mu' : Upward	=	3,501	351 ft-#
Mu' : Downward	=	369	1,728 ft-#
Mu: Design	=	261	1,377 ft-#
Actual 1-Way Shear	=	0.12	9.42 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
Key: No key defined

Min footing T&S reinf Area	0.68	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 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	595.5	1.94	1,157.9	Soil Over HL (ab. water tbl)	1,196.0	2.16	2,587.3
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.16	2,587.3
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 =	225.0	3.33	750.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	40.0	0.25	10.0
				Surcharge Over Toe =			
				Stem Weight(s) =	550.0	0.83	458.3
				Earth @ Stem Transitions =			
				Footing Weight =	395.0	1.58	624.1
				Key Weight =			
				Vert. Component =			
Total	= 820.5	O.T.M. =	1,907.9	Total =	2,181.0 lbs	R.M.=	3,679.8
Resisting/Overturning Ratio		= 1.93					
Vertical Loads used for Soil Pressure =		2,181.0 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) 0.087 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

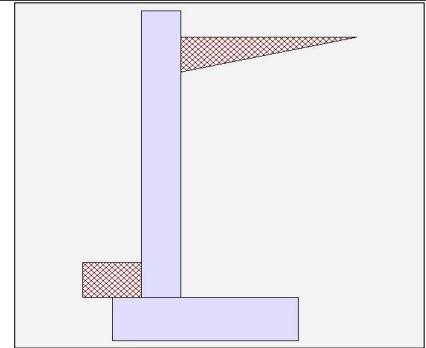
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	5.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	3.18 OK
Sliding	=	1.91 OK

Total Bearing Load	=	2,181 lbs
...resultant ecc.	=	5.08 in

Soil Pressure @ Toe	=	1,245 psf OK
Soil Pressure @ Heel	=	135 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,744 psf
ACI Factored @ Heel	=	189 psf
Footing Shear @ Toe	=	0.1 psi OK
Footing Shear @ Heel	=	4.0 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	595.5 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	981.5 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 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.215
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	700.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	1,166.7

Moment.....Allowable

	=	5,412.6
--	---	---------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	9.3

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

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) :	0.0437 in ² /ft	
(4/3) * As :	0.0583 in ² /ft	Min Stem T&S Reinf Area 1.056 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0012bh : 0.0012(12)(8) :	0.1152 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1152 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	2.66
Total Footing Width	=	3.16
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,744	189 psf
Mu' : Upward	=	2,492	1,025 ft-#
Mu' : Downward	=	369	1,728 ft-#
Mu: Design	=	177	704 ft-#
Actual 1-Way Shear	=	0.12	3.96 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
Key: No key defined

Min footing T&S reinf Area	0.68	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018, ACI 318-14, TMS 402-16

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)	595.5	1.94	1,157.9	Soil Over HL (ab. water tbl)	1,196.0	2.16	2,587.3
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.16	2,587.3
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	40.0	0.25	10.0
=				Surcharge Over Toe =			
				Stem Weight(s) =	550.0	0.83	458.3
				Earth @ Stem Transitions =			
				Footing Weight =	395.0	1.58	624.1
				Key Weight =			
				Vert. Component =			
Total	= 595.5	O.T.M. =	1,157.9	Total =	2,181.0 lbs	R.M. =	3,679.8
Resisting/Overturning Ratio			= 3.18				
Vertical Loads used for Soil Pressure =			2,181.0 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) 0.060 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

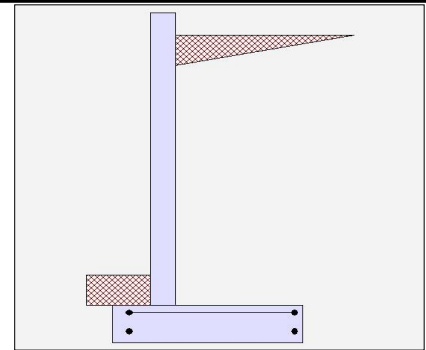
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

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	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	1.90 OK
Sliding	=	1.25 Ratio < 1.5!
Total Bearing Load	=	2,816 lbs
...resultant ecc.	=	10.63 in
Soil Pressure @ Toe	=	1,898 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
		Soil Pressure Less Than Allowable
ACI Factored @ Toe	=	2,657 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	5.0 psi OK
Footing Shear @ Heel	=	13.5 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	1,141.2 lbs
less 100% Passive Force	=	- 156.3 lbs
less 100% Friction Force	=	- 1,267.3 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	288.2 lbs NG

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.762
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,332.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,988.0
Moment.....Allowable	=	3,920.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	26.1
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

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

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) :	0.1689 in2/ft	
(4/3) * As :	0.2252 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	=	0.75 ft
Heel Width	=	3.00
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,657	0 psf
Mu' : Upward	=	8,213	756 ft-#
Mu' : Downward	=	830	3,169 ft-#
Mu: Design	=	615	2,413 ft-#
Actual 1-Way Shear	=	4.96	13.49 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 11.00 in	
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 & SpacingsToe: $\phi M_n = \phi' 5' \lambda \sqrt{f_c} S_m$

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

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 2018, ACI 318-14, TMS 402-16

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)	817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	1,800.0	2.50	4,500.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.50	4,500.0
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 =	324.0	3.83	1,242.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	60.0	0.38	22.5
				Surcharge Over Toe =			
				Stem Weight(s) =	487.5	1.00	487.5
				Earth @ Stem Transitions =			
				Footing Weight =	468.8	1.88	878.9
				Key Weight =			
				Vert. Component =			
Total	= 1,141.2	O.T.M. =	3,103.3	Total =	2,816.3 lbs	R.M. =	5,888.9
Resisting/Overturning Ratio			= 1.90				
Vertical Loads used for Soil Pressure =	2,816.3		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) 0.091 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

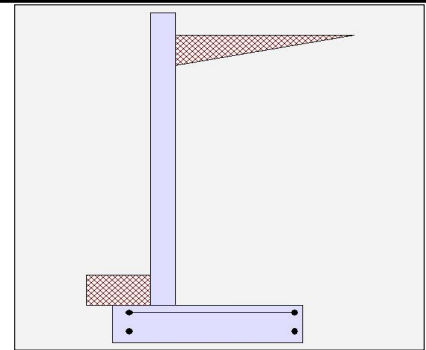
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	6.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	3.16 OK
Sliding	=	1.74 OK

Total Bearing Load	=	2,816 lbs
...resultant ecc.	=	5.34 in

Soil Pressure @ Toe	=	1,286 psf OK
Soil Pressure @ Heel	=	216 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		

ACI Factored @ Toe	=	1,800 psf
ACI Factored @ Heel	=	303 psf
Footing Shear @ Toe	=	3.2 psi OK
Footing Shear @ Heel	=	5.9 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	817.2 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	1,267.3 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 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.514
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,008.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	2,016.0

Moment.....Allowable

	=	3,920.0
--	---	---------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	19.8

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

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) :	0.114 in ² /ft	
(4/3) * As :	0.1519 in ² /ft	Min Stem T&S Reinf Area 0.936 in ²
200bd/fy : 200(12)(4.25)/60000 :	0.17 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in ² /ft
0.0018bh : 0.0018(12)(6) :	0.1296 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1519 in ² /ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.2182 in ² /ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in ² /ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	0.75 ft
Heel Width	=	3.00
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,800	303 psf
Mu' : Upward	=	5,737	1,986 ft-#
Mu' : Downward	=	830	3,169 ft-#
Mu: Design	=	409	1,182 ft-#
Actual 1-Way Shear	=	3.21	5.89 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 11.00 in	
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: $\phi M_n = \phi' 5' \lambda \sqrt{f_c} S_m$

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

Key: No key defined

Min footing T&S reinf Area	0.81	in ²
Min footing T&S reinf Area per foot	0.22	in ² /ft
If one layer 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	

If two layers of horizontal bars:

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Cantilevered Retaining Wall

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

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)	817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	1,800.0	2.50	4,500.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.50	4,500.0
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	60.0	0.38	22.5
				Surcharge Over Toe =			
				Stem Weight(s) =	487.5	1.00	487.5
				Earth @ Stem Transitions =			
				Footing Weight =	468.8	1.88	878.9
				Key Weight =			
				Vert. Component =			
Total	= 817.2	O.T.M. =	1,861.3	Total =	2,816.3 lbs	R.M.=	5,888.9
Resisting/Overturning Ratio			= 3.16				
Vertical Loads used for Soil Pressure =			2,816.3 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) 0.062 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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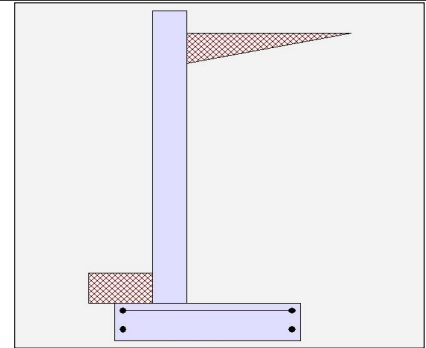
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	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		

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	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	1.83 OK
Sliding	=	1.23 Ratio < 1.5!

Total Bearing Load	=	2,783 lbs
...resultant ecc.	=	10.92 in

Soil Pressure @ Toe	=	2,016 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
		Soil Pressure Less Than Allowable
ACI Factored @ Toe	=	2,823 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	5.3 psi OK
Footing Shear @ Heel	=	15.0 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,141.2 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	1,252.2 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	303.3 lbs NG

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

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.552
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,332.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	2,988.0

Moment.....Allowable	=	5,412.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	17.8

Shear.....Allowable	psi =	75.0
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Anet (Masonry)	in2 =	
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Rebar Depth 'd'	in =	6.25
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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

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) :	0.1119 in ² /ft	
(4/3) * As :	0.1493 in ² /ft	Min Stem T&S Reinf Area 1.248 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0012bh : 0.0012(12)(8) :	0.1152 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1493 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	0.75 ft
Heel Width	=	2.91
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,823	0 psf
Mu' : Upward	=	8,663	414 ft-#
Mu' : Downward	=	830	2,552 ft-#
Mu: Design	=	653	2,138 ft-#
Actual 1-Way Shear	=	5.29	15.02 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 11.00 in	
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 & SpacingsToe: $\phi M_n = \phi' 5' \lambda \sqrt{f_c} S_m$

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

Key: No key defined

Min footing T&S reinf Area	0.79	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	1,615.2	2.54	4,099.9
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.54	4,099.9
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 =	324.0	3.83	1,242.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	60.0	0.38	22.5
				Surcharge Over Toe =			
				Stem Weight(s) =	650.0	1.08	704.2
				Earth @ Stem Transitions =			
				Footing Weight =	457.5	1.83	837.2
				Key Weight =			
				Vert. Component =			
Total	= 1,141.2	O.T.M. =	3,103.3	Total =	2,782.7 lbs	R.M. =	5,663.8
Resisting/Overturning Ratio		= 1.83					
Vertical Loads used for Soil Pressure =		2,782.7 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) 0.099 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

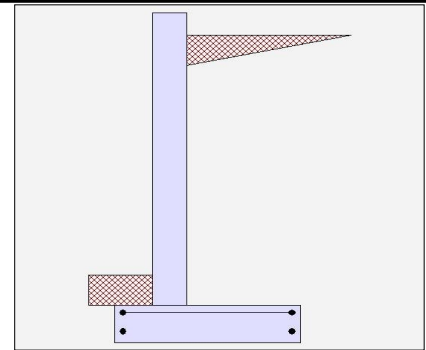
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	6.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	3.04 OK
Sliding	=	1.72 OK

Total Bearing Load	=	2,783 lbs
...resultant ecc.	=	5.56 in

Soil Pressure @ Toe	=	1,338 psf OK
Soil Pressure @ Heel	=	183 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,873 psf
ACI Factored @ Heel	=	256 psf
Footing Shear @ Toe	=	3.4 psi OK
Footing Shear @ Heel	=	6.5 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	817.2 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	1,252.2 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 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.372
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,008.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	2,016.0
Moment.....Allowable	=	5,412.6

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	13.4
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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0755 in ² /ft	
(4/3) * As :	0.1007 in ² /ft	Min Stem T&S Reinf Area 1.248 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0012bh : 0.0012(12)(8) :	0.1152 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1152 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	0.75 ft
Heel Width	=	2.91
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,873	256 psf
Mu' : Upward	=	5,949	1,475 ft-#
Mu' : Downward	=	830	2,552 ft-#
Mu: Design	=	427	1,077 ft-#
Actual 1-Way Shear	=	3.36	6.55 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 11.00 in	
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: $\phi M_n = \phi' 5' \lambda \sqrt{f_c} S_m$

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

Key: No key defined

Min footing T&S reinf Area	0.79	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	1,615.2	2.54	4,099.9
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.54	4,099.9
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 =	60.0	0.38	22.5
				Surcharge Over Toe =			
				Stem Weight(s) =	650.0	1.08	704.2
				Earth @ Stem Transitions =			
				Footing Weight =	457.5	1.83	837.2
				Key Weight =			
				Vert. Component =			
Total	= 817.2	O.T.M. =	1,861.3	Total =	2,782.7 lbs	R.M.=	5,663.8
Resisting/Overturning Ratio	= 3.04						
Vertical Loads used for Soil Pressure =	2,782.7 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) 0.066 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

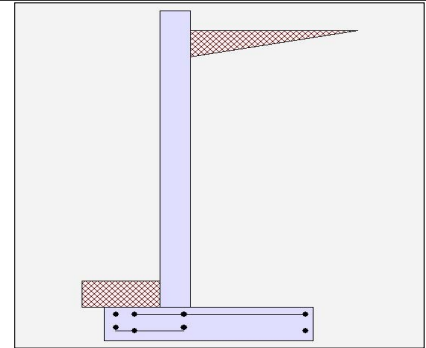
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	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	=	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		

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	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	2.16 OK
Sliding	=	1.21 Ratio < 1.5!
Total Bearing Load	=	3,737 lbs
...resultant ecc.	=	10.39 in
Soil Pressure @ Toe	=	1,702 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
		Soil Pressure Less Than Allowable
ACI Factored @ Toe	=	2,383 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	17.1 psi OK
Footing Shear @ Heel	=	22.7 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	1,514.8 lbs
less 100% Passive Force	=	- 156.3 lbs
less 100% Friction Force	=	- 1,681.6 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	434.4 lbs NG

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.767
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,898.8
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	4,944.9
Moment.....Allowable	=	6,444.1
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	25.3
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

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

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) :	0.1853 in ² /ft	
(4/3) * As :	0.247 in ² /ft	Min Stem T&S Reinf Area 1.440 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.247 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.24 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	1.25 ft
Heel Width	=	3.41
Total Footing Width	=	4.66
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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 2,383	0 psf
Mu' : Upward	= 20,218	1,370 ft-#
Mu' : Downward	= 2,691	5,084 ft-#
Mu: Design	= 1,461	3,713 ft-#
Actual 1-Way Shear	= 17.07	22.72 psi
Allow 1-Way Shear	= 75.00	75.00 psi
Toe Reinforcing	= # 4 @ 10.00 in	
Heel Reinforcing	= # 4 @ 11.00 in	
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: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5
 Key: No key defined

Min footing T&S reinf Area	1.01	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,073.8	2.61	2,803.9	Soil Over HL (ab. water tbl)	2,304.4	3.29	7,577.6
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.29	7,577.6
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 =	441.0	4.33	1,911.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	100.0	0.63	62.5
				Surcharge Over Toe =			
				Stem Weight(s) =	750.0	1.58	1,187.5
				Earth @ Stem Transitions =			
				Footing Weight =	582.5	2.33	1,357.2
				Key Weight =			
				Vert. Component =			
Total	= 1,514.8	O.T.M. =	4,714.9	Total =	3,736.9 lbs	R.M.=	10,184.9
Resisting/Overturning Ratio	= 2.16						
Vertical Loads used for Soil Pressure =	3,736.9 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) 0.076 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

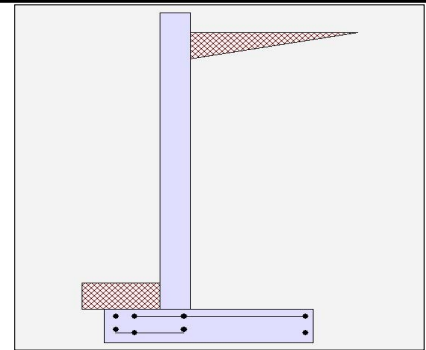
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	7.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	3.63 OK
Sliding	=	1.71 OK

Total Bearing Load	=	3,737 lbs
...resultant ecc.	=	4.26 in

Soil Pressure @ Toe	=	1,168 psf OK
Soil Pressure @ Heel	=	436 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		

ACI Factored @ Toe	=	1,636 psf
ACI Factored @ Heel	=	610 psf
Footing Shear @ Toe	=	11.3 psi OK
Footing Shear @ Heel	=	13.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,073.8 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	1,681.6 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	1.300
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.527
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,457.8

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	3,401.4

Moment.....Allowable

	=	6,444.1
--	---	---------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	19.4

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

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) :	0.1274 in ² /ft	
(4/3) * As :	0.1699 in ² /ft	Min Stem T&S Reinf Area 1.440 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1728 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.24 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	1.25 ft
Heel Width	=	3.41
Total Footing Width	=	4.66
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,636	610 psf
Mu' : Upward	=	14,474	3,052 ft-#
Mu' : Downward	=	2,691	5,084 ft-#
Mu: Design	=	982	2,032 ft-#
Actual 1-Way Shear	=	11.32	13.39 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 4 @ 10.00 in	
Heel Reinforcing	=	# 4 @ 11.00 in	
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: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5
 Key: No key defined

Min footing T&S reinf Area	1.01	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	1,073.8	2.61	2,803.9	Soil Over HL (ab. water tbl)	2,304.4	3.29	7,577.6
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.29	7,577.6
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	100.0	0.63	62.5
=				Surcharge Over Toe =			
				Stem Weight(s) =	750.0	1.58	1,187.5
				Earth @ Stem Transitions =			
				Footing Weight =	582.5	2.33	1,357.2
				Key Weight =			
				Vert. Component =			

* 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

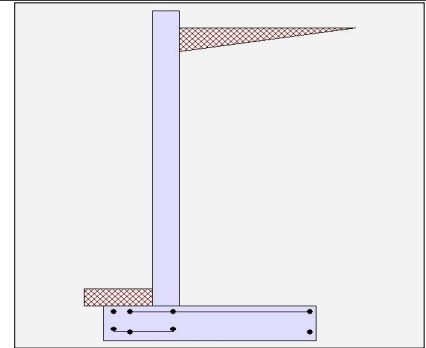
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	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	=	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		

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	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	2.23 OK
Sliding	=	1.23 Ratio < 1.5!

Total Bearing Load	=	5,090 lbs
...resultant ecc.	=	11.85 in

Soil Pressure @ Toe	=	1,976 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,767 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	12.5 psi OK
Footing Shear @ Heel	=	16.2 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,993.5 lbs
less 100% Passive Force	=	- 156.3 lbs
less 100% Friction Force	=	- 2,290.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	543.5 lbs NG

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

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.804
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	2,368.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	7,082.7
Moment.....Allowable	=	8,809.0

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	31.9
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

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) :	0.2682 in ² /ft	
(4/3) * As :	0.3576 in ² /ft	Min Stem T&S Reinf Area 1.632 in ²
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.2682 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.3382 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8382 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	1.25 ft
Heel Width	=	4.16
Total Footing Width	=	5.41
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,767	0 psf
Mu' : Upward	=	23,839	3,030 ft-#
Mu' : Downward	=	2,363	8,127 ft-#
Mu: Design	=	1,790	5,097 ft-#
Actual 1-Way Shear	=	12.45	16.17 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 5 @ 11.00 in	
Heel Reinforcing	=	# 5 @ 14.00 in	
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: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46
 Key: No key defined

Min footing T&S reinf Area	1.40	in ²
Min footing T&S reinf Area per foot	0.26	in ² /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 2018, ACI 318-14, TMS 402-16

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)	1,417.5	3.00	4,252.5	Soil Over HL (ab. water tbl)	3,353.6	3.66	12,285.4
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.66	12,285.4
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 =	75.0	0.63	46.9
=				Surcharge Over Toe =			
				Stem Weight(s) =	850.0	1.58	1,345.8
				Earth @ Stem Transitions =			
				Footing Weight =	811.5	2.71	2,195.1
				Key Weight =			
				Vert. Component =			
Total	= 1,993.5	O.T.M. =	7,132.5	Total =	5,090.1 lbs	R.M. =	15,873.2
Resisting/Overturning Ratio		=	2.23				
Vertical Loads used for Soil Pressure =		5,090.1	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) 0.086 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

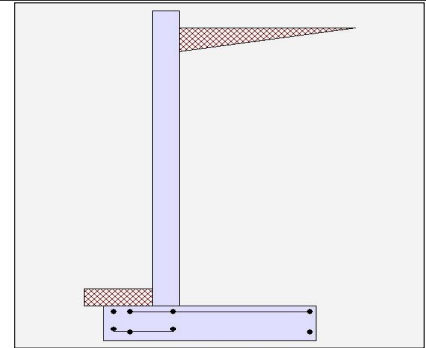
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	8.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	3.73 OK
Sliding	=	1.73 OK

Total Bearing Load	=	5,090 lbs
...resultant ecc.	=	5.06 in

Soil Pressure @ Toe	=	1,381 psf OK
Soil Pressure @ Heel	=	501 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,934 psf
ACI Factored @ Heel	=	701 psf
Footing Shear @ Toe	=	8.5 psi OK
Footing Shear @ Heel	=	7.1 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,417.5 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	2,290.5 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 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.542
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,792.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	4,778.7

Moment.....Allowable

	=	8,809.0
--	---	---------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	24.1

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

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) :	0.1809 in ² /ft	
(4/3) * As :	0.2413 in ² /ft	Min Stem T&S Reinf Area 1.632 in ²
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.2413 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.3382 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8382 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	1.25 ft
Heel Width	=	4.16
Total Footing Width	=	5.41
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,934	701 psf
Mu' : Upward	=	17,238	5,895 ft-#
Mu' : Downward	=	2,363	8,127 ft-#
Mu: Design	=	1,240	2,233 ft-#
Actual 1-Way Shear	=	8.48	7.15 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 5 @ 11.00 in	
Heel Reinforcing	=	# 5 @ 14.00 in	
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: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46
 Key: No key defined

Min footing T&S reinf Area	1.40	in ²
Min footing T&S reinf Area per foot	0.26	in ² /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 2018,ACI 318-14,TMS 402-16

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)	1,417.5	3.00	4,252.5	Soil Over HL (ab. water tbl)	3,353.6	3.66	12,285.4
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.66	12,285.4
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 =	75.0	0.63	46.9
				Surcharge Over Toe =			
				Stem Weight(s) =	850.0	1.58	1,345.8
				Earth @ Stem Transitions =			
				Footing Weight =	811.5	2.71	2,195.1
				Key Weight =			
				Vert. Component =			
Total	= 1,417.5	O.T.M. =	4,252.5	Total =	5,090.1 lbs	R.M.=	15,873.2
Resisting/Overturning Ratio			= 3.73				
Vertical Loads used for Soil Pressure =	5,090.1		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) 0.060 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

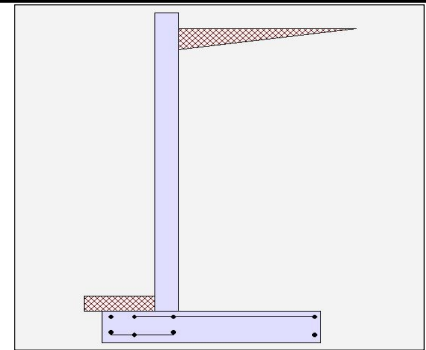
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	81.0 #/ft
...Height to Top	=	9.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	2.30 OK
Sliding	=	1.20 Ratio < 1.5!

Total Bearing Load	=	6,277 lbs
...resultant ecc.	=	12.55 in

Soil Pressure @ Toe	=	2,057 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,880 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	18.8 psi OK
Footing Shear @ Heel	=	19.6 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	2,479.0 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	2,824.6 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	737.7 lbs NG

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

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.854
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	2,997.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	10,084.5

Moment.....Allowable	=	11,799.2
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	40.4

Shear.....Allowable	psi =	75.0
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Anet (Masonry)	in2 =	
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Rebar Depth 'd'	in =	6.19
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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

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) :	0.3819 in2/ft	
(4/3) * As :	0.5091 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 :	0.3819 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	=	1.50 ft
Heel Width	=	4.66
Total Footing Width	=	6.16
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,880	0 psf
Mu' : Upward	=	35,695	4,795 ft-#
Mu' : Downward	=	3,402	11,769 ft-#
Mu: Design	=	2,691	6,973 ft-#
Actual 1-Way Shear	=	18.76	19.64 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 5 @ 8.00 in	
Heel Reinforcing	=	# 5 @ 14.00 in	
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: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46
 Key: No key defined

Min footing T&S reinf Area	1.60	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 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,750.0	3.33	5,833.3	Soil Over HL (ab. water tbl)	4,312.8	4.16	17,955.6
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		4.16	17,955.6
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 =	729.0	5.50	4,009.5	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	90.0	0.75	67.5
				Surcharge Over Toe =			
				Stem Weight(s) =	950.0	1.83	1,741.7
				Earth @ Stem Transitions =			
				Footing Weight =	924.0	3.08	2,845.9
				Key Weight =			
				Vert. Component =			
Total	= 2,479.0	O.T.M. =	9,842.8	Total =	6,276.8 lbs	R.M.=	22,610.7
Resisting/Overturning Ratio	= 2.30						
Vertical Loads used for Soil Pressure =	6,276.8 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) 0.088 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

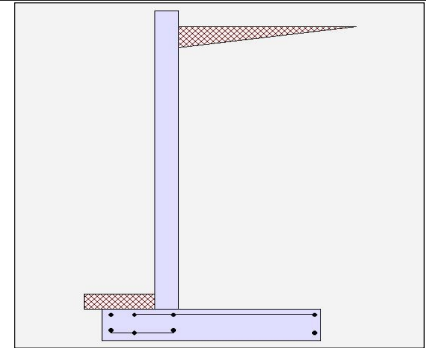
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	9.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	3.88 OK
Sliding	=	1.70 OK

Total Bearing Load	=	6,277 lbs
...resultant ecc.	=	4.88 in

Soil Pressure @ Toe	=	1,423 psf OK
Soil Pressure @ Heel	=	615 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,992 psf
ACI Factored @ Heel	=	861 psf
Footing Shear @ Toe	=	12.8 psi OK
Footing Shear @ Heel	=	8.7 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,750.0 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	2,824.6 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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.576
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	2,268.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	6,804.0

Moment.....Allowable

	=	11,799.2
--	---	----------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	30.5

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

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) :	0.2576 in2/ft	
(4/3) * As :	0.3435 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 :	0.2576 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	=	1.50 ft
Heel Width	=	4.66
Total Footing Width	=	6.16
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,992	861 psf
Mu' : Upward	=	25,655	8,813 ft-#
Mu' : Downward	=	3,402	11,769 ft-#
Mu: Design	=	1,854	2,955 ft-#
Actual 1-Way Shear	=	12.76	8.70 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 5 @ 8.00 in	
Heel Reinforcing	=	# 5 @ 14.00 in	
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: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46
 Key: No key defined

Min footing T&S reinf Area	1.60	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 2018,ACI 318-14,TMS 402-16

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)	1,750.0	3.33	5,833.3	Soil Over HL (ab. water tbl)	4,312.8	4.16	17,955.6
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		4.16	17,955.6
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	90.0	0.75	67.5
=				Surcharge Over Toe =			
				Stem Weight(s) =	950.0	1.83	1,741.7
				Earth @ Stem Transitions =			
				Footing Weight =	924.0	3.08	2,845.9
				Key Weight =			
				Vert. Component =			
Total	= 1,750.0	O.T.M.	= 5,833.3	Total	= 6,276.8 lbs	R.M.	= 22,610.7
Resisting/Overturning Ratio			= 3.88				
Vertical Loads used for Soil Pressure =			6,276.8 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) 0.061 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

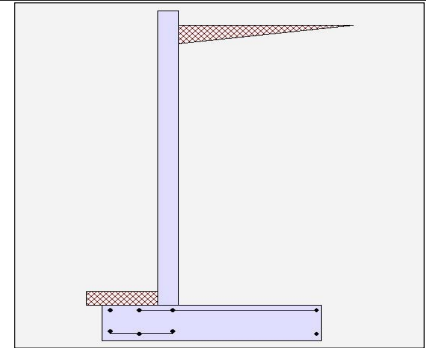
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	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	=	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		

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	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	2.29 OK
Sliding	=	1.22 Ratio < 1.5!

Total Bearing Load	=	7,843 lbs
...resultant ecc.	=	13.96 in

Soil Pressure @ Toe	=	2,282 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,195 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	15.4 psi OK
Footing Shear @ Heel	=	19.1 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	3,114.8 lbs
less 100% Passive Force	= -	257.8 lbs
less 100% Friction Force	= -	3,529.2 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	885.3 lbs NG

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

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.961
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	3,700.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	13,833.3
Moment.....Allowable	=	14,393.2

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	54.8
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

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) :	0.5793 in2/ft	
(4/3) * As :	0.7724 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 :	0.5793 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	=	1.75 ft
Heel Width	=	5.16
Total Footing Width	=	6.91
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,195	0 psf
Mu' : Upward	=	53,719	6,859 ft-#
Mu' : Downward	=	5,457	16,808 ft-#
Mu: Design	=	4,022	9,949 ft-#
Actual 1-Way Shear	=	15.43	19.10 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 6 @ 8.00 in	
Heel Reinforcing	=	# 5 @ 11.00 in	
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: #4@ 7.40 in, #5@ 11.48 in, #6@ 16.29 in, #7@ 22.22 in, #8@ 29.25 in, #9@ 37
 Key: No key defined

Min footing T&S reinf Area	2.24	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 2018,ACI 318-14,TMS 402-16

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)	2,214.8	3.75	8,305.7	Soil Over HL (ab. water tbl)	5,392.0	4.66	25,144.7
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		4.66	25,144.7
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 =	105.0	0.88	91.9
=				Surcharge Over Toe =			
				Stem Weight(s) =	1,050.0	2.08	2,187.5
				Earth @ Stem Transitions =			
				Footing Weight =	1,295.6	3.46	4,476.4
				Key Weight =			
				Vert. Component =			
Total	= 3,114.8	O.T.M. =	13,930.7	Total =	7,842.6 lbs	R.M.=	31,900.5
Resisting/Overturning Ratio			= 2.29				
Vertical Loads used for Soil Pressure =			7,842.6 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) 0.096 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

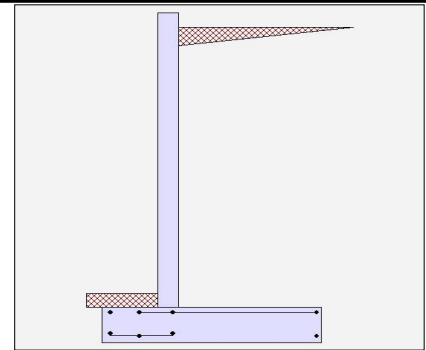
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	10.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	3.84 OK
Sliding	=	1.71 OK

Total Bearing Load	=	7,843 lbs
...resultant ecc.	=	5.36 in

Soil Pressure @ Toe	=	1,575 psf OK
Soil Pressure @ Heel	=	695 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,205 psf
ACI Factored @ Heel	=	973 psf
Footing Shear @ Toe	=	10.4 psi OK
Footing Shear @ Heel	=	8.7 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	2,214.8 lbs
less 100% Passive Force	= -	257.8 lbs
less 100% Friction Force	= -	3,529.2 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 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.648
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	2,800.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	9,333.3

Moment.....Allowable

	=	14,393.2
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	41.5

Shear.....Allowable

	psi =	75.0
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Anet (Masonry)

Rebar Depth 'd'	in =	5.63
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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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3909 in2/ft	
(4/3) * As :	0.5212 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 :	0.3909 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	=	1.75 ft
Heel Width	=	5.16
Total Footing Width	=	6.91
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,205	973 psf
Mu' : Upward	=	38,605	12,518 ft-#
Mu' : Downward	=	5,457	16,808 ft-#
Mu: Design	=	2,762	4,290 ft-#
Actual 1-Way Shear	=	10.40	8.73 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 6 @ 8.00 in	
Heel Reinforcing	=	# 5 @ 11.00 in	
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: #4@ 7.40 in, #5@ 11.48 in, #6@ 16.29 in, #7@ 22.22 in, #8@ 29.25 in, #9@ 37
 Key: No key defined

Min footing T&S reinf Area	2.24	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 2018, ACI 318-14, TMS 402-16

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)	2,214.8	3.75	8,305.7	Soil Over HL (ab. water tbl)	5,392.0	4.66	25,144.7
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		4.66	25,144.7
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	105.0	0.88	91.9
=				Surcharge Over Toe =			
				Stem Weight(s) =	1,050.0	2.08	2,187.5
				Earth @ Stem Transitions =			
				Footing Weight =	1,295.6	3.46	4,476.4
				Key Weight =			
				Vert. Component =			
				</			

* 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) 0.066 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

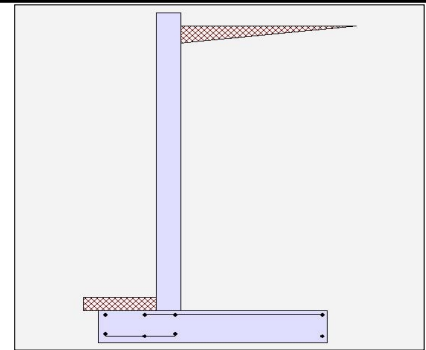
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	99.0 #/ft
...Height to Top	=	11.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	2.46 OK
Sliding	=	1.23 Ratio < 1.5!

Total Bearing Load	=	9,621 lbs
...resultant ecc.	=	14.01 in

Soil Pressure @ Toe	=	2,328 psf OK
Soil Pressure @ Heel	=	129 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,259 psf
ACI Factored @ Heel	=	181 psf
Footing Shear @ Toe	=	20.6 psi OK
Footing Shear @ Heel	=	21.5 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	3,715.1 lbs
less 100% Passive Force	= -	257.8 lbs
less 100% Friction Force	= -	4,329.6 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	985.3 lbs NG

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

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.905
---------------	---	-------

Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	4,477.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	18,412.2

Moment.....Allowable

	=	20,333.2
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	48.9

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.56 in ² /ft	
(4/3) * As :	0.7467 in ² /ft	Min Stem T&S Reinf Area 2.760 in ²
200bd/fy : 200(12)(7.625)/60000 :	0.305 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in ² /ft
0.0018bh : 0.0018(12)(10) :	0.216 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.56 in ² /ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.66 in ² /ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.0329 in ² /ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	5.83
Total Footing Width	=	7.83
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,259	181 psf
Mu' : Upward	=	71,936	10,435 ft-#
Mu' : Downward	=	7,128	22,582 ft-#
Mu: Design	=	5,401	12,147 ft-#
Actual 1-Way Shear	=	20.63	21.51 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 6 @ 8.00 in	
Heel Reinforcing	=	# 5 @ 11.00 in	
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: #4@ 7.40 in, #5@ 11.48 in, #6@ 16.29 in, #7@ 22.22 in, #8@ 29.25 in, #9@ 37
 Key: No key defined

Min footing T&S reinf Area	2.54	in ²
Min footing T&S reinf Area per foot	0.32	in ² /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 2018, ACI 318-14, TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	2,626.1	4.08	10,723.2	Soil Over HL (ab. water tbl)	6,595.6	5.33	35,165.5
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.33	35,165.5
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 =	1,089.0	6.75	7,350.8	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	120.0	1.00	120.0
				Surcharge Over Toe =			
				Stem Weight(s) =	1,437.5	2.42	3,474.0
				Earth @ Stem Transitions =			
				Footing Weight =	1,468.1	3.92	5,747.7
				Key Weight =			
				Vert. Component =			
Total	= 3,715.1	O.T.M. =	18,074.0	Total =	9,621.2 lbs	R.M. =	44,507.2
Resisting/Overturning Ratio	= 2.46						
Vertical Loads used for Soil Pressure =	9,621.2 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) 0.095 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

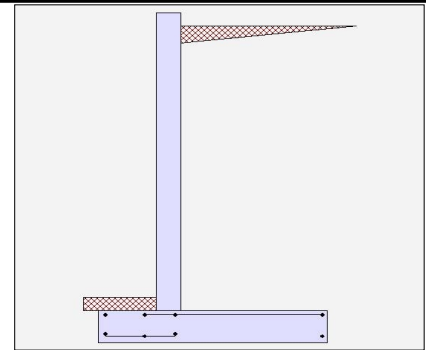
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	11.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	4.15 OK
Sliding	=	1.75 OK

Total Bearing Load	=	9,621 lbs
...resultant ecc.	=	4.84 in

Soil Pressure @ Toe	=	1,609 psf OK
Soil Pressure @ Heel	=	849 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,252 psf
ACI Factored @ Heel	=	1,188 psf
Footing Shear @ Toe	=	14.0 psi OK
Footing Shear @ Heel	=	9.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	2,626.1 lbs
less 100% Passive Force	= -	257.8 lbs
less 100% Friction Force	= -	4,329.6 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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.610
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	3,388.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	12,422.7

Moment.....Allowable

	=	20,333.2
--	---	----------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	37.0

Shear.....Allowable

	psi =	75.0
--	-------	------

Anet (Masonry)

	in2 =	
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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

Cantilevered Retaining Wall

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3778 in ² /ft	
(4/3) * As :	0.5038 in ² /ft	Min Stem T&S Reinf Area 2.760 in ²
200bd/fy : 200(12)(7.625)/60000 :	0.305 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in ² /ft
0.0018bh : 0.0018(12)(10) :	0.216 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.3778 in ² /ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.66 in ² /ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.0329 in ² /ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	5.83
Total Footing Width	=	7.83
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,252	1,188 psf
Mu' : Upward	=	51,881	17,659 ft-#
Mu' : Downward	=	7,128	22,582 ft-#
Mu: Design	=	3,729	4,924 ft-#
Actual 1-Way Shear	=	14.04	9.37 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 6 @ 8.00 in	
Heel Reinforcing	=	# 5 @ 11.00 in	
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: #4@ 7.40 in, #5@ 11.48 in, #6@ 16.29 in, #7@ 22.22 in, #8@ 29.25 in, #9@ 37
 Key: No key defined

Min footing T&S reinf Area	2.54	in ²
Min footing T&S reinf Area per foot	0.32	in ² /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 2018,ACI 318-14,TMS 402-16

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)	2,626.1	4.08	10,723.2	Soil Over HL (ab. water tbl)	6,595.6	5.33	35,165.5
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.33	35,165.5
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	120.0	1.00	120.0
				Surcharge Over Toe =			
				Stem Weight(s) =	1,437.5	2.42	3,474.0
				Earth @ Stem Transitions =			
				Footing Weight =	1,468.1	3.92	5,747.7
				Key Weight =			
				Vert. Component =			

* 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) 0.066 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

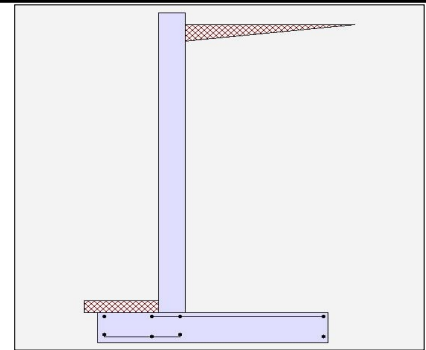
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	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	=	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		

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	=	0.0 psf (Service Level)

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		1.2 FOS w/ Seismic
Overturning	=	2.46 OK
Sliding	=	1.21 Ratio < 1.5!

Total Bearing Load	=	11,164 lbs
...resultant ecc.	=	14.96 in

Soil Pressure @ Toe	=	2,469 psf OK
Soil Pressure @ Heel	=	158 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,457 psf
ACI Factored @ Heel	=	221 psf
Footing Shear @ Toe	=	27.0 psi OK
Footing Shear @ Heel	=	25.6 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	4,368.3 lbs
less 100% Passive Force	=	- 257.8 lbs
less 100% Friction Force	=	- 5,023.7 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	1,271.0 lbs NG

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

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.909
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	5,328.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	23,904.0

Moment.....Allowable

	=	26,273.2
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	46.1

Shear.....Allowable

	psi =	75.0
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Anet (Masonry)

Rebar Depth 'd'	in =	9.63
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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

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) :	0.5708 in ² /ft	
(4/3) * As :	0.7611 in ² /ft	Min Stem T&S Reinf Area 3.600 in ²
200bd/fy : 200(12)(9.625)/60000 :	0.385 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in ² /ft
0.0018bh : 0.0018(12)(12) :	0.2592 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.5708 in ² /ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.66 in ² /ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3039 in ² /ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	2.25 ft
Heel Width	=	6.25
Total Footing Width	=	8.50
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,457	221 psf
Mu' : Upward	=	96,320	12,225 ft-#
Mu' : Downward	=	9,021	26,915 ft-#
Mu: Design	=	7,275	14,689 ft-#
Actual 1-Way Shear	=	27.05	25.65 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 6 @ 8.00 in	
Heel Reinforcing	=	# 5 @ 10.00 in	
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: #4@ 6.71 in, #5@ 10.41 in, #6@ 14.77 in, #7@ 20.15 in, #8@ 26.53 in, #9@ 33
 Key: No key defined

Min footing T&S reinf Area	2.75	in ²
Min footing T&S reinf Area per foot	0.32	in ² /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 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	3,072.3	4.42	13,569.5	Soil Over HL (ab. water tbl)	7,560.0	5.88	44,415.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.88	44,415.0
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 =	135.0	1.13	151.9
				Surcharge Over Toe =			
				Stem Weight(s) =	1,875.0	2.75	5,156.3
				Earth @ Stem Transitions =			
				Footing Weight =	1,593.8	4.25	6,773.4
				Key Weight =			
				Vert. Component =			
Total	= 4,368.3	O.T.M. =	22,965.5	Total =	11,163.8 lbs	R.M.=	56,496.6
Resisting/Overturning Ratio	= 2.46						
Vertical Loads used for Soil Pressure =	11,163.8 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) 0.101 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

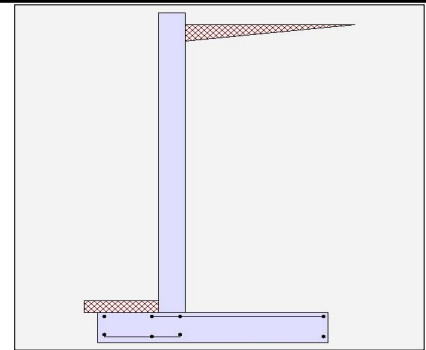
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	12.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	4.16 OK
Sliding	=	1.72 OK

Total Bearing Load	=	11,164 lbs
...resultant ecc.	=	4.86 in

Soil Pressure @ Toe	=	1,689 psf OK
Soil Pressure @ Heel	=	938 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,364 psf
ACI Factored @ Heel	=	1,313 psf
Footing Shear @ Toe	=	18.4 psi OK
Footing Shear @ Heel	=	11.0 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	3,072.3 lbs
less 100% Passive Force	= -	257.8 lbs
less 100% Friction Force	= -	5,023.7 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 2018, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.613
---------------	---	-------

Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	4,032.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	16,128.0

Moment.....Allowable

	=	26,273.2
--	---	----------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	34.9

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3851 in2/ft	
(4/3) * As :	0.5135 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 :	0.3851 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	=	2.25 ft
Heel Width	=	6.25
Total Footing Width	=	8.50
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	=	2,364	1,313 psf
Mu' : Upward	=	68,994	21,081 ft-#
Mu' : Downward	=	9,021	26,915 ft-#
Mu: Design	=	4,998	5,834 ft-#
Actual 1-Way Shear	=	18.38	11.03 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 6 @ 8.00 in	
Heel Reinforcing	=	# 5 @ 10.00 in	
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: #4@ 7.40 in, #5@ 11.48 in, #6@ 16.29 in, #7@ 22.22 in, #8@ 29.25 in, #9@ 37
 Key: No key defined

Min footing T&S reinf Area	2.75	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 2018,ACI 318-14,TMS 402-16

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)	3,072.3	4.42	13,569.5	Soil Over HL (ab. water tbl)	7,560.0	5.88	44,415.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.88	44,415.0
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	135.0	1.13	151.9
=				Surcharge Over Toe =			
				Stem Weight(s) =	1,875.0	2.75	5,156.3
				Earth @ Stem Transitions =			
				Footing Weight =	1,593.8	4.25	6,773.4
				Key Weight =			
				Vert. Component =			
Total	= 3,072.3	O.T.M. =	13,569.5	Total =	11,163.8 lbs	R.M. =	56,496.6
Resisting/Overturning Ratio	= 4.16						
Vertical Loads used for Soil Pressure =	11,163.8 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

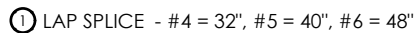
Horizontal Defl @ Top of Wall (approximate only) 0.069 in

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.



206.789.6038 T
206.789.6042 F

RETAINING WALL SCHEDULE w/ SLAB w/ 9H - 2000 PSF



WHERE RETAINED SOIL SUPPORTS A DRIVE SURFACE WITHIN A DISTANCE 'H' FROM THE FACE OF CONCRETE WALL, PROVIDE FOOTING, WALL, AND REINFORCING FOR A WALL 2'-0" HIGHER THAN ACTUAL 'H' (H+2)

H	B1	ts	B2	tf	STEM REINF		FTG REINF
					VERT	HORIZ	LONG
4'-0"	1'-0"	6"	9"	9"	#4 AT 18"oc	#4 AT 16"oc	(3)#4
	1'-3"	8"	5"	9"	#4 AT 18"oc	#4 AT 12"oc	(3)#4
5'-0"	1'-9"	6"	9"	10"	#4 AT 11"oc	#4 AT 16"oc	(4)#4
	1'-6"	8"	9"	10"	#4 AT 11"oc	#4 AT 12"oc	(4)#4
6'-0"	2'-3"	6"	9"	10"	#4 AT 11"oc	#4 AT 16"oc	(4)#4
	2'-0"	8"	9"	10"	#4 AT 11"oc	#4 AT 12"oc	(4)#4
7'-0"	2'-9"	8"	9"	10"	#4 AT 9"oc	#4 AT 12"oc	(5)#4
8'-0"	3'-3"	8"	1'-0"	12"	#5 AT 11"oc	#4 AT 12"oc	(5)#5
9'-0"	3'-6"	8"	1'-3"	12"	#5 AT 8"oc	#4 AT 12"oc	(5)#5
10'-0"	4'-3"	8"	1'-6"	15"	#6 AT 8"oc	#4 AT 12"oc	(7)#5
11'-0"	4'-9"	10"	1'-6"	15"	#6 AT 8"oc	#4 AT 10"oc	(8)#5
12'-0"	5'-3"	12"	1'-6"	15"	#6 AT 8"oc	#5 AT 12"oc	(9)#5

NOTE TO ENGINEER:

BEARING	2000 PSF
ACTIVE	35 PCF EFP
PASSIVE	Ø
COEF FRICT	0.45
SEISMIC SURCHARGE	9H

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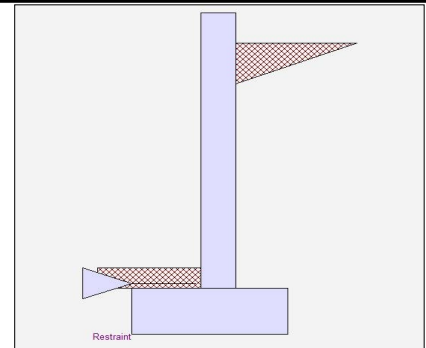
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	2,666.0 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		

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	=	0.0 psf (Service Level)

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 **1.2 FOS w/ Seismic**
 Overturning = 1.37 Ratio < 1.5!
 Slab Resists All Sliding !

Total Bearing Load	=	991 lbs
...resultant ecc.	=	8.89 in
Soil Pressure @ Toe	=	1,720 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,407 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	10.6 psi OK
Footing Shear @ Heel	=	6.3 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	538.8 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.360
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	592.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	885.3

Moment.....Allowable	=	2,455.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	11.6
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

Bottom

Stem OK
0.00

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.05 in2/ft	
(4/3) * As :	0.0667 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	=	1.00 ft
Heel Width	=	1.25
Total Footing Width	=	2.25
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,407	0 psf
Mu' : Upward	=	10,265	0 ft-#
Mu' : Downward	=	1,098	200 ft-#
Mu: Design	=	764	200 ft-#
Actual 1-Way Shear	=	10.59	6.35 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Key: No key defined

Min footing T&S reinf Area	0.44	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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Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	394.8	1.58	625.2	Soil Over HL (ab. water tbl)	360.0	1.88	675.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		1.88	675.0
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 =	144.0	2.75	396.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	40.0	0.50	20.0
				Surcharge Over Toe =			
				Stem Weight(s) =	337.5	1.25	421.9
				Earth @ Stem Transitions =			
				Footing Weight =	253.1	1.13	284.8
				Key Weight =			
				Vert. Component =			
Total	= 538.8	O.T.M. =	1,021.2	Total =	990.6 lbs	R.M.=	1,401.6
Resisting/Overturning Ratio			= 1.37				
Vertical Loads used for Soil Pressure =			990.6 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) 0.096 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

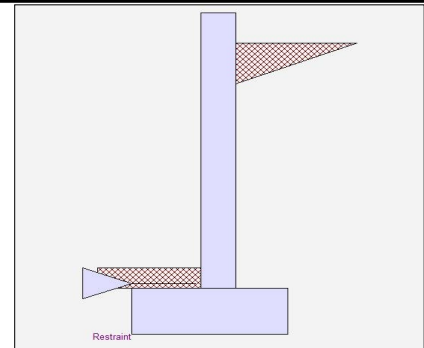
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	4.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.24 OK
Slab Resists All Sliding !		

Total Bearing Load	=	991 lbs
...resultant ecc.	=	4.09 in

Soil Pressure @ Toe	=	841 psf OK
Soil Pressure @ Heel	=	40 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,177 psf
ACI Factored @ Heel	=	56 psf
Footing Shear @ Toe	=	5.4 psi OK
Footing Shear @ Heel	=	4.2 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	394.8 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.243
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	448.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	597.3

Moment.....Allowable	=	2,455.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	8.8
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

Bottom

Stem OK

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0338 in ² /ft	
(4/3) * As :	0.045 in ² /ft	Min Stem T&S Reinf Area 0.648 in ²
200bd/fy : 200(12)(4.25)/60000 :	0.17 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in ² /ft
0.0018bh : 0.0018(12)(6) :	0.1296 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1296 in ² /ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.1333 in ² /ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in ² /ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	1.00 ft
Heel Width	=	1.25
Total Footing Width	=	2.25
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,177	56 psf
Mu' : Upward	=	6,066	51 ft-#
Mu' : Downward	=	1,098	200 ft-#
Mu: Design	=	414	149 ft-#
Actual 1-Way Shear	=	5.44	4.18 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
Key: No key defined

Min footing T&S reinf Area	0.44	in ²
Min footing T&S reinf Area per foot	0.19	in ² /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 2018,ACI 318-14,TMS 402-16

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)	394.8	1.58	625.2	Soil Over HL (ab. water tbl)	360.0	1.88	675.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		1.88	675.0
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	40.0	0.50	20.0
				Surcharge Over Toe =			
				Stem Weight(s) =	337.5	1.25	421.9
				Earth @ Stem Transitions =			
				Footing Weight =	253.1	1.13	284.8
				Key Weight =			
				Vert. Component =			
Total	= 394.8	O.T.M. =	625.2	Total =	990.6 lbs	R.M. =	1,401.6
Resisting/Overturning Ratio	= 2.24						
Vertical Loads used for Soil Pressure =	990.6 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) 0.047 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

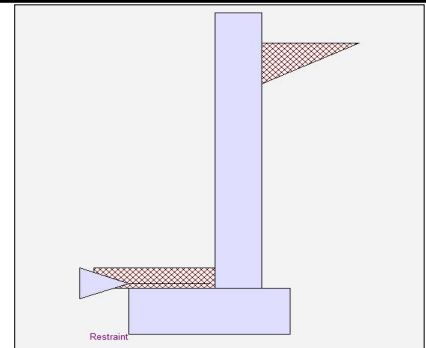
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	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	=	2,666.0 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		

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	=	0.0 psf (Service Level)

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 1.2 FOS w/ Seismic
Overturning = 1.44 Ratio < 1.5!
Slab Resists All Sliding !

Total Bearing Load	=	961 lbs
...resultant ecc.	=	8.37 in
Soil Pressure @ Toe	=	1,369 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,917 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	11.1 psi OK
Footing Shear @ Heel	=	3.5 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	538.8 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa	=	0.242
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	592.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	885.3

Moment.....Allowable

	=	3,655.6
--	---	---------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	7.9

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

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) :	0.0332 in ² /ft	
(4/3) * As :	0.0442 in ² /ft	Min Stem T&S Reinf Area 0.864 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1728 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.1333 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /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	=	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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,917	0 psf
Mu' : Upward	=	12,634	0 ft-#
Mu' : Downward	=	1,716	61 ft-#
Mu: Design	=	910	61 ft-#
Actual 1-Way Shear	=	11.09	3.50 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: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Heel: $\phi M_n = \phi'5'\lambda\sqrt{f_c}'S_m$
 Key: No key defined

Min footing T&S reinf Area	0.45	in ²
Min footing T&S reinf Area per foot	0.19	in ² /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 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	394.8	1.58	625.2	Soil Over HL (ab. water tbl)	198.4	2.12	421.3
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.12	421.3
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 =	144.0	2.75	396.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				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 =	262.1	1.17	305.4
				Key Weight =			
				Vert. Component =			
Total	= 538.8	O.T.M. =	1,021.2	Total =	960.5 lbs	R.M.=	1,470.4
Resisting/Overturning Ratio	= 1.44						
Vertical Loads used for Soil Pressure =	960.5 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) 0.073 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

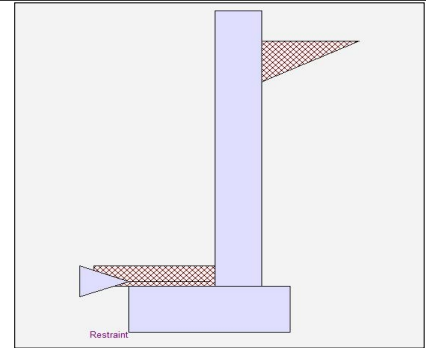
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	4.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.35 OK
Slab Resists All Sliding !		

Total Bearing Load	=	961 lbs
...resultant ecc.	=	3.42 in

Soil Pressure @ Toe	=	715 psf OK
Soil Pressure @ Heel	=	110 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,001 psf
ACI Factored @ Heel	=	154 psf
Footing Shear @ Toe	=	6.2 psi OK
Footing Shear @ Heel	=	2.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	394.8 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa	=	0.163
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	448.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	597.3

Moment.....Allowable	=	3,655.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	6.0
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

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) :	0.0224 in ² /ft	
(4/3) * As :	0.0298 in ² /ft	Min Stem T&S Reinf Area 0.864 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1728 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.1333 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /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	=	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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,001	154 psf
Mu' : Upward	=	7,962	17 ft-#
Mu' : Downward	=	1,716	61 ft-#
Mu: Design	=	521	43 ft-#
Actual 1-Way Shear	=	6.20	2.37 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: $\phi M_n = \phi' 5' \lambda \sqrt{f_c} S_m$
 Heel: $\phi M_n = \phi' 5' \lambda \sqrt{f_c} S_m$
 Key: No key defined

Min footing T&S reinf Area	0.45	in ²
Min footing T&S reinf Area per foot	0.19	in ² /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 2018, ACI 318-14, TMS 402-16

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)	394.8	1.58	625.2	Soil Over HL (ab. water tbl)	198.4	2.12	421.3
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.12	421.3
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				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 =	262.1	1.17	305.4
				Key Weight =			
				Vert. Component =			
Total	= 394.8	O.T.M. =	625.2	Total =	960.5 lbs	R.M. =	1,470.4
Resisting/Overturning Ratio	= 2.35						
Vertical Loads used for Soil Pressure =		960.5 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) 0.038 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

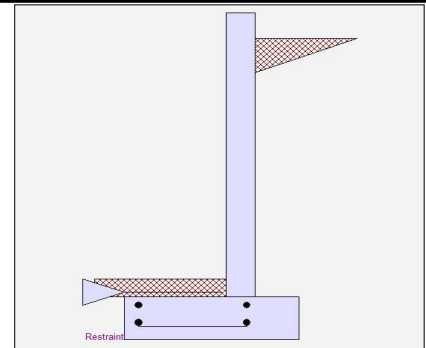
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	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	=	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		

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	=	0.0 psf (Service Level)

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	=	1.38 Ratio < 1.5!
Slab Resists All Sliding !		

Total Bearing Load	=	1,308 lbs
...resultant ecc.	=	11.37 in

Soil Pressure @ Toe	=	1,578 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,210 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	18.4 psi OK
Footing Shear @ Heel	=	6.8 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	820.5 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.441
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	925.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	1,729.2
Moment.....Allowable	=	3,920.0

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	18.1
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

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) :	0.0977 in ² /ft	
(4/3) * As :	0.1303 in ² /ft	Min Stem T&S Reinf Area 0.792 in ²
200bd/fy : 200(12)(4.25)/60000 :	0.17 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in ² /ft
0.0018bh : 0.0018(12)(6) :	0.1296 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1303 in ² /ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.2182 in ² /ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in ² /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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 2,210	0 psf
Mu' : Upward	= 26,309	0 ft-#
Mu' : Downward	= 3,638	245 ft-#
Mu: Design	= 1,889	245 ft-#
Actual 1-Way Shear	= 18.43	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	0.65	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	595.5	1.94	1,157.9	Soil Over HL (ab. water tbl)	450.0	2.63	1,181.3
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.63	1,181.3
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 =	225.0	3.33	750.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				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	= 820.5	O.T.M. =	1,907.9	Total =	1,307.5 lbs	R.M.=	2,630.0
Resisting/Overturning Ratio		= 1.38					
Vertical Loads used for Soil Pressure =		1,307.5 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) 0.080 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

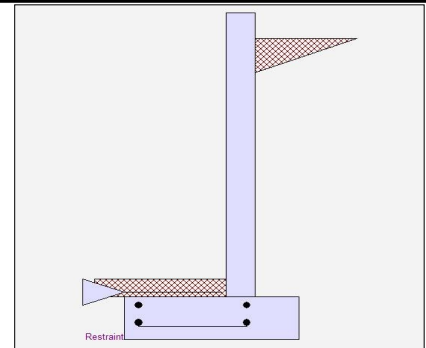
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	21.0 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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	5.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	3.79 OK
Slab Resists All Sliding !		

Total Bearing Load	=	1,308 lbs
...resultant ecc.	=	0.24 in

Soil Pressure @ Toe	=	453 psf OK
Soil Pressure @ Heel	=	419 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	634 psf
ACI Factored @ Heel	=	586 psf
Footing Shear @ Toe	=	6.4 psi OK
Footing Shear @ Heel	=	2.2 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	357.3 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.178
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	420.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	700.0

Moment.....Allowable	=	3,920.0
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	8.2
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

Bottom

Stem OK

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) :	0.0396 in ² /ft	
(4/3) * As :	0.0528 in ² /ft	Min Stem T&S Reinf Area 0.792 in ²
200bd/fy : 200(12)(4.25)/60000 :	0.17 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in ² /ft
0.0018bh : 0.0018(12)(6) :	0.1296 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1296 in ² /ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.2182 in ² /ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in ² /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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	634	586 psf
Mu' : Upward	=	11,484	166 ft-#
Mu' : Downward	=	3,638	245 ft-#
Mu: Design	=	654	79 ft-#
Actual 1-Way Shear	=	6.36	2.17 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	0.65	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	357.3	1.94	694.7	Soil Over HL (ab. water tbl)	450.0	2.63	1,181.3
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.63	1,181.3
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				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	= 357.3	O.T.M. =	694.7	Total =	1,307.5 lbs	R.M.=	2,630.0
Resisting/Overturning Ratio			= 3.79				
Vertical Loads used for Soil Pressure =	1,307.5		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) 0.023 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

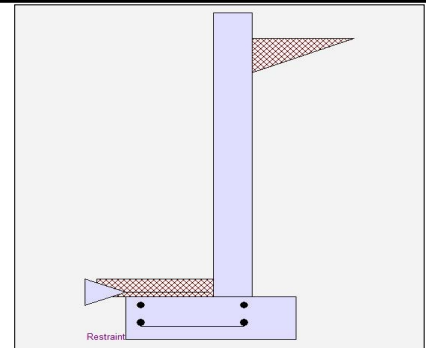
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	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	=	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		

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	=	0.0 psf (Service Level)

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****1.2 FOS w/ Seismic**

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

Total Bearing Load	=	1,420 lbs
...resultant ecc.	=	10.64 in

Soil Pressure @ Toe	=	1,666 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,332 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	18.0 psi OK
Footing Shear @ Heel	=	6.7 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	820.5 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.293
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	925.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	1,729.2

Moment.....Allowable	=	5,883.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	12.3

Shear.....Allowable	psi =	75.0
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Anet (Masonry)	in2 =	
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Rebar Depth 'd'	in =	6.25
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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

Bottom

Stem OK

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0648 in ² /ft	
(4/3) * As :	0.0864 in ² /ft	Min Stem T&S Reinf Area 1.056 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1728 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2182 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	1.41
Total Footing Width	=	2.91
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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 2,332	0 psf
Mu' : Upward	= 22,247	0 ft-#
Mu' : Downward	= 2,673	240 ft-#
Mu: Design	= 1,631	240 ft-#
Actual 1-Way Shear	= 17.97	6.74 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	0.63	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	595.5	1.94	1,157.9	Soil Over HL (ab. water tbl)	446.0	2.54	1,132.1
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.54	1,132.1
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 =	60.0	0.75	45.0
=				Surcharge Over Toe =			
				Stem Weight(s) =	550.0	1.83	1,008.3
				Earth @ Stem Transitions =			
				Footing Weight =	363.8	1.46	529.3
				Key Weight =			
				Vert. Component =			
Total	= 820.5	O.T.M. =	1,907.9	Total =	1,419.8 lbs	R.M.=	2,714.7
Resisting/Overturning Ratio		=	1.42				
Vertical Loads used for Soil Pressure =		1,419.8	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) 0.087 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

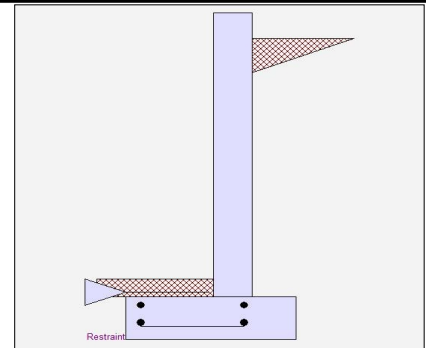
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	5.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	760.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary**Wall Stability Ratios**

Overturning	=	2.34 OK
Slab Resists All Sliding !		

Total Bearing Load	=	2,180 lbs
...resultant ecc.	=	1.22 in

Soil Pressure @ Toe	=	906 psf OK
Soil Pressure @ Heel	=	592 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,268 psf
ACI Factored @ Heel	=	829 psf
Footing Shear @ Toe	=	12.1 psi OK
Footing Shear @ Heel	=	0.1 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	595.5 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.198
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	700.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	1,166.7

Moment.....Allowable

	=	5,883.6
--	---	---------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	9.3

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0437 in ² /ft	
(4/3) * As :	0.0583 in ² /ft	Min Stem T&S Reinf Area 1.056 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1728 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2182 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	1.41
Total Footing Width	=	2.91
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	=	1,268	829 psf
Mu' : Upward	=	16,103	239 ft-#
Mu' : Downward	=	2,673	240 ft-#
Mu: Design	=	1,119	1 ft-#
Actual 1-Way Shear	=	12.06	0.12 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	0.63	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	595.5	1.94	1,157.9	Soil Over HL (ab. water tbl)	446.0	2.54	1,132.1
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.54	1,132.1
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 =	760.0	1.83	
Added Lateral Load =				* Axial Live Load on Stem =	760.0	1.83	1,393.3
Load @ Stem Above Soil =				Soil Over Toe =	60.0	0.75	45.0
				Surcharge Over Toe =			
				Stem Weight(s) =	550.0	1.83	1,008.3
				Earth @ Stem Transitions =			
				Footing Weight =	363.8	1.46	529.3
				Key Weight =			
				Vert. Component =			

* 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) 0.048 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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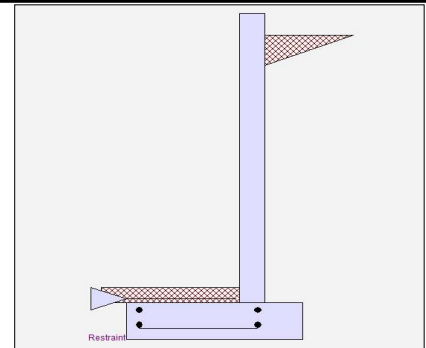
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	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		

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	=	0.0 psf (Service Level)

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****1.2 FOS w/ Seismic**

Overturning	=	1.22 Ratio < 1.5!
Slab Resists All Sliding !		

Total Bearing Load	=	1,555 lbs
...resultant ecc.	=	15.83 in

Soil Pressure @ Toe	=	2,407 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,369 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	23.2 psi OK
Footing Shear @ Heel	=	7.9 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,141.2 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.762
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,332.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	2,988.0

Moment.....Allowable	=	3,920.0
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	26.1
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

Bottom

Stem OK

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.1689 in ² /ft	
(4/3) * As :	0.2252 in ² /ft	Min Stem T&S Reinf Area 0.936 in ²
200bd/fy : 200(12)(4.25)/60000 :	0.17 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in ² /ft
0.0018bh : 0.0018(12)(6) :	0.1296 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.17 in ² /ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.2182 in ² /ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in ² /ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	2.25 ft
Heel Width	=	1.25
Total Footing Width	=	3.50
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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 3,369	0 psf
Mu' : Upward	= 47,526	0 ft-#
Mu' : Downward	= 6,014	285 ft-#
Mu: Design	= 3,459	285 ft-#
Actual 1-Way Shear	= 23.22	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	0.76	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	540.0	3.13	1,687.5
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.13	1,687.5
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 =	324.0	3.83	1,242.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				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 =	437.5	1.75	765.6
				Key Weight =			
				Vert. Component =			
Total	= 1,141.2	O.T.M. =	3,103.3	Total =	1,555.0 lbs	R.M.=	3,773.1
Resisting/Overturning Ratio	= 1.22						
Vertical Loads used for Soil Pressure =	1,555.0 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) 0.124 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

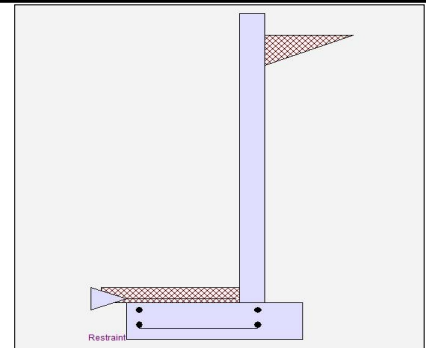
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	6.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.03 OK
Slab Resists All Sliding !		

Total Bearing Load	=	1,555 lbs
...resultant ecc.	=	6.25 in

Soil Pressure @ Toe	=	841 psf OK
Soil Pressure @ Heel	=	48 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,177 psf
ACI Factored @ Heel	=	67 psf
Footing Shear @ Toe	=	15.2 psi OK
Footing Shear @ Heel	=	6.5 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	817.2 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.514
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,008.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	2,016.0

Moment.....Allowable

	=	3,920.0
--	---	---------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	19.8

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

Bottom

Stem OK

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) :	0.114 in ² /ft	
(4/3) * As :	0.1519 in ² /ft	Min Stem T&S Reinf Area 0.936 in ²
200bd/fy : 200(12)(4.25)/60000 :	0.17 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in ² /ft
0.0018bh : 0.0018(12)(6) :	0.1296 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1519 in ² /ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.2182 in ² /ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.5757 in ² /ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	2.25 ft
Heel Width	=	1.25
Total Footing Width	=	3.50
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,177	67 psf
Mu' : Upward	=	28,527	41 ft-#
Mu' : Downward	=	6,014	285 ft-#
Mu: Design	=	1,876	244 ft-#
Actual 1-Way Shear	=	15.16	6.47 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	0.76	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	540.0	3.13	1,687.5
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.13	1,687.5
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				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 =	437.5	1.75	765.6
				Key Weight =			
				Vert. Component =			

* 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) 0.043 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

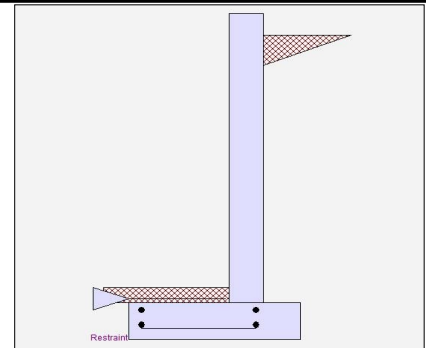
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

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	=	0.0 psf (Service Level)

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****1.2 FOS w/ Seismic**

Overturning	=	1.27 Ratio < 1.5!
Slab Resists All Sliding !		

Total Bearing Load	=	1,691 lbs
...resultant ecc.	=	14.46 in

Soil Pressure @ Toe	=	2,254 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,155 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	26.3 psi OK
Footing Shear @ Heel	=	7.9 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,141.2 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.507
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,332.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	2,988.0

Moment.....Allowable	=	5,883.6
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	17.8
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

Bottom

Stem OK

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) :	0.1119 in ² /ft	
(4/3) * As :	0.1493 in ² /ft	Min Stem T&S Reinf Area 1.248 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0012bh : 0.0012(12)(8) :	0.1152 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1493 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2182 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	1.41
Total Footing Width	=	3.41
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,155	0 psf
Mu' : Upward	=	42,616	0 ft-#
Mu' : Downward	=	4,752	280 ft-#
Mu: Design	=	3,155	280 ft-#
Actual 1-Way Shear	=	26.33	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	0.74	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	535.2	3.04	1,626.1
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.04	1,626.1
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 =	80.0	1.00	80.0
				Surcharge Over Toe =			
				Stem Weight(s) =	650.0	2.33	1,516.7
				Earth @ Stem Transitions =			
				Footing Weight =	426.3	1.71	726.8
				Key Weight =			
				Vert. Component =			
Total	= 1,141.2	O.T.M. =	3,103.3	Total =	1,691.5 lbs	R.M.=	3,949.5
Resisting/Overturning Ratio	= 1.27						
Vertical Loads used for Soil Pressure =	1,691.5 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) 0.119 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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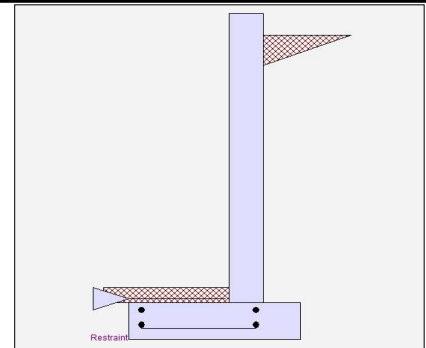
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	6.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.12 OK
Slab Resists All Sliding !		

Total Bearing Load	=	1,691 lbs
...resultant ecc.	=	5.64 in

Soil Pressure @ Toe	=	907 psf OK
Soil Pressure @ Heel	=	85 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,269 psf
ACI Factored @ Heel	=	120 psf
Footing Shear @ Toe	=	15.1 psi OK
Footing Shear @ Heel	=	6.0 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	817.2 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.342
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,008.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	2,016.0

Moment.....Allowable

	=	5,883.6
--	---	---------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	13.4

Shear.....Allowable

	psi =	75.0
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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

Bottom

Stem OK

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) :	0.0755 in ² /ft	
(4/3) * As :	0.1007 in ² /ft	Min Stem T&S Reinf Area 1.248 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0012bh : 0.0012(12)(8) :	0.1152 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1152 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2182 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	1.41
Total Footing Width	=	3.41
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,269	120 psf
Mu' : Upward	=	25,067	56 ft-#
Mu' : Downward	=	4,752	280 ft-#
Mu: Design	=	1,693	224 ft-#
Actual 1-Way Shear	=	15.13	5.95 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	0.74	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	535.2	3.04	1,626.1
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.04	1,626.1
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 =	80.0	1.00	80.0
				Surcharge Over Toe =			
				Stem Weight(s) =	650.0	2.33	1,516.7
				Earth @ Stem Transitions =			
				Footing Weight =	426.3	1.71	726.8
				Key Weight =			
				Vert. Component =			
Total	= 817.2	O.T.M. =	1,861.3	Total =	1,691.5 lbs	R.M.=	3,949.5
Resisting/Overturning Ratio	= 2.12						
Vertical Loads used for Soil Pressure =	1,691.5 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) 0.048 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

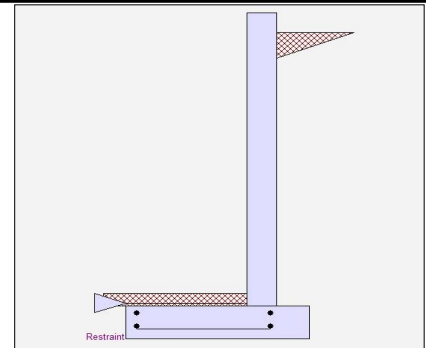
Code: IBC 2018, ACI 318-14, TMS 402-16

Criteria

Retained Height	=	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	=	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		

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	=	0.0 psf (Service Level)

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 1.2 FOS w/ Seismic
Overturning = 1.25 Ratio < 1.5!
Slab Resists All Sliding !

Total Bearing Load	=	2,004 lbs
...resultant ecc.	=	17.80 in
Soil Pressure @ Toe	=	2,240 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,135 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	29.9 psi OK
Footing Shear @ Heel	=	9.0 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,514.8 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 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	=	0.666
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,813.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	4,744.8

Moment.....Allowable

	=	7,122.4
--	---	---------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	24.2

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

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) :	0.1778 in ² /ft	
(4/3) * As :	0.237 in ² /ft	Min Stem T&S Reinf Area 1.440 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.237 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2667 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	2.75 ft
Heel Width	=	1.41
Total Footing Width	=	4.16
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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 3,135	0 psf
Mu' : Upward	= 72,512	0 ft-#
Mu' : Downward	= 8,984	320 ft-#
Mu: Design	= 5,294	320 ft-#
Actual 1-Way Shear	= 29.92	8.97 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@ 9.45 in, #5@ 14.65 in, #6@ 20.80 in, #7@ 28.37 in, #8@ 37.35 in, #9@ 47
 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
 Key: No key defined

Min footing T&S reinf Area	0.90	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	1,073.8	2.61	2,803.9	Soil Over HL (ab. water tbl)	624.4	3.79	2,365.4
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.79	2,365.4
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 =	110.0	1.38	151.3
=				Surcharge Over Toe =			
				Stem Weight(s) =	750.0	3.08	2,312.5
				Earth @ Stem Transitions =			
				Footing Weight =	520.0	2.08	1,081.6
				Key Weight =			
				Vert. Component =			
Total	= 1,514.8	O.T.M. =	4,714.9	Total =	2,004.4 lbs	R.M. =	5,910.8
Resisting/Overturning Ratio		= 1.25					
Vertical Loads used for Soil Pressure =		2,004.4 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) 0.112 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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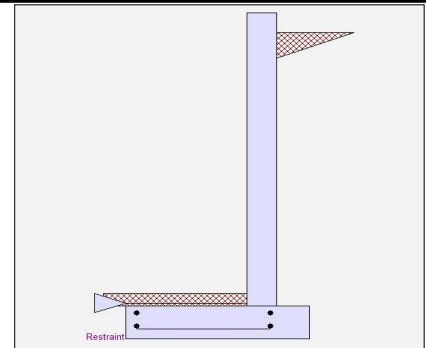
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	7.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.11 OK
Slab Resists All Sliding !		

Total Bearing Load	=	2,004 lbs
...resultant ecc.	=	6.36 in

Soil Pressure @ Toe	=	850 psf OK
Soil Pressure @ Heel	=	114 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,190 psf
ACI Factored @ Heel	=	159 psf
Footing Shear @ Toe	=	19.9 psi OK
Footing Shear @ Heel	=	7.0 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,073.8 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.449
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,372.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	3,201.3

Moment.....Allowable	=	7,122.4
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	18.3
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

Bottom

Stem OK

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.1199 in ² /ft	
(4/3) * As :	0.1599 in ² /ft	Min Stem T&S Reinf Area 1.440 in ²
200bd/fy : 200(12)(6.25)/60000 :	0.25 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.1728 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2667 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	2.75 ft
Heel Width	=	1.41
Total Footing Width	=	4.16
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	=	1,190	159 psf
Mu' : Upward	=	43,693	61 ft-#
Mu' : Downward	=	8,984	320 ft-#
Mu: Design	=	2,892	259 ft-#
Actual 1-Way Shear	=	19.89	7.02 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	in ²
Min footing T&S reinf Area per foot	0.22	in ² /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 2018,ACI 318-14,TMS 402-16

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)	1,073.8	2.61	2,803.9	Soil Over HL (ab. water tbl)	624.4	3.79	2,365.4
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.79	2,365.4
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 =	110.0	1.38	151.3
=				Surcharge Over Toe =			
				Stem Weight(s) =	750.0	3.08	2,312.5
				Earth @ Stem Transitions =			
				Footing Weight =	520.0	2.08	1,081.6
				Key Weight =			
				Vert. Component =			
Total	= 1,073.8	O.T.M. =	2,803.9	Total =	2,004.4 lbs	R.M. =	5,910.8
Resisting/Overturning Ratio	= 2.11						
Vertical Loads used for Soil Pressure =	2,004.4 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) 0.043 in

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

Cantilevered Retaining Wall

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) :	0.2682 in ² /ft	
(4/3) * As :	0.3576 in ² /ft	Min Stem T&S Reinf Area 1.632 in ²
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.2682 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.3382 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8382 in ² /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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 3,108	0 psf
Mu' : Upward	= 109,815	0 ft-#
Mu' : Downward	= 14,450	657 ft-#
Mu: Design	= 7,947	657 ft-#
Actual 1-Way Shear	= 30.57	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@ 8.33 in, #5@ 12.92 in, #6@ 18.34 in, #7@ 25.01 in, #8@ 32.93 in, #9@ 41
 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
 Key: No key defined

Min footing T&S reinf Area	1.27	in ²
Min footing T&S reinf Area per foot	0.26	in ² /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 2018, ACI 318-14, TMS 402-16

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)	1,417.5	3.00	4,252.5	Soil Over HL (ab. water tbl)	953.6	4.41	4,208.6
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		4.41	4,208.6
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 =	576.0	5.00	2,880.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				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	= 1,993.5	O.T.M. =	7,132.5	Total =	2,670.1 lbs	R.M.=	9,273.7
Resisting/Overturning Ratio		=	1.30				
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) 0.107 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

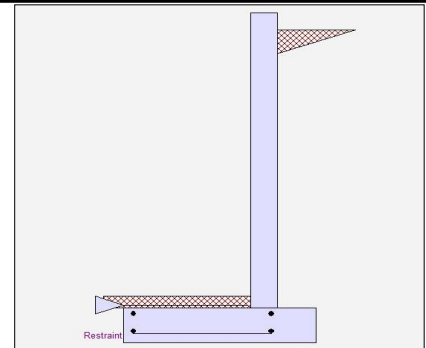
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	2,000.0 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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	8.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.18 OK
Slab Resists All Sliding !		

Total Bearing Load	=	2,670 lbs
...resultant ecc.	=	6.89 in

Soil Pressure @ Toe	=	926 psf OK
Soil Pressure @ Heel	=	162 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,296 psf
ACI Factored @ Heel	=	227 psf
Footing Shear @ Toe	=	19.3 psi OK
Footing Shear @ Heel	=	8.3 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,417.5 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.542
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,792.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	4,778.7

Moment.....Allowable	=	8,809.0
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	24.1
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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.1809 in ² /ft	
(4/3) * As :	0.2413 in ² /ft	Min Stem T&S Reinf Area 1.632 in ²
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.2413 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.3382 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8382 in ² /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	=	1,296	227 psf
Mu' : Upward	=	67,173	147 ft-#
Mu' : Downward	=	14,450	657 ft-#
Mu: Design	=	4,394	510 ft-#
Actual 1-Way Shear	=	19.31	8.25 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@ 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	in ²
Min footing T&S reinf Area per foot	0.26	in ² /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 2018, ACI 318-14, TMS 402-16

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)	1,417.5	3.00	4,252.5	Soil Over HL (ab. water tbl)	953.6	4.41	4,208.6
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		4.41	4,208.6
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				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	= 1,417.5	O.T.M. =	4,252.5	Total =	2,670.1 lbs	R.M.=	9,273.7
Resisting/Overturning Ratio		=	2.18				
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) 0.045 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.

Building Code	IBC 2018, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3819 in2/ft	
(4/3) * As :	0.5091 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 :	0.3819 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	=	3.50 ft
Heel Width	=	1.91
Total Footing Width	=	5.41
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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 3,681	0 psf
Mu' : Upward	= 145,930	0 ft-#
Mu' : Downward	= 16,758	1,141 ft-#
Mu: Design	= 10,764	1,141 ft-#
Actual 1-Way Shear	= 37.85	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	1.40	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 2018, ACI 318-14, TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	OVERTURNING.....				RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,750.0	3.33	5,833.3	Soil Over HL (ab. water tbl)	1,342.8	4.79	6,429.8
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		4.79	6,429.8
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 =	729.0	5.50	4,009.5	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	140.0	1.75	245.0
				Surcharge Over Toe =			
				Stem Weight(s) =	950.0	3.83	3,641.7
				Earth @ Stem Transitions =			
				Footing Weight =	811.5	2.71	2,195.1
				Key Weight =			
				Vert. Component =			
Total	= 2,479.0	O.T.M. =	9,842.8	Total =	3,244.3 lbs	R.M.=	12,511.5
Resisting/Overturning Ratio			= 1.27				
Vertical Loads used for Soil Pressure =			3,244.3 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) 0.128 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.

Stem OK

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) :	0.2576 in ² /ft	
(4/3) * As :	0.3435 in ² /ft	Min Stem T&S Reinf Area 1.824 in ²
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.2576 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.465 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8382 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	3.50 ft
Heel Width	=	1.91
Total Footing Width	=	5.41
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	=	1,442	238 psf
Mu' : Upward	=	86,872	255 ft-#
Mu' : Downward	=	16,758	1,141 ft-#
Mu: Design	=	5,843	886 ft-#
Actual 1-Way Shear	=	24.27	11.40 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@ 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	1.40	in ²
Min footing T&S reinf Area per foot	0.26	in ² /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 2018, ACI 318-14, TMS 402-16

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)	1,750.0	3.33	5,833.3	Soil Over HL (ab. water tbl)	1,342.8	4.79	6,429.8
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		4.79	6,429.8
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	140.0	1.75	245.0
=				Surcharge Over Toe =			
				Stem Weight(s) =	950.0	3.83	3,641.7
				Earth @ Stem Transitions =			
				Footing Weight =	811.5	2.71	2,195.1
				Key Weight =			
				Vert. Component =			
				</			

* 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

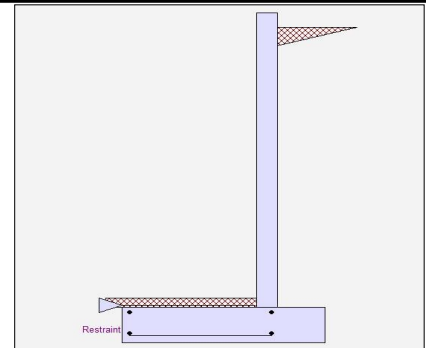
Code: IBC 2018, ACI 318-14, TMS 402-16

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	=	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		

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	=	0.0 psf (Service Level)

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****1.2 FOS w/ Seismic**

Overturning	=	1.38 Ratio < 1.5!
Slab Resists All Sliding !		

Total Bearing Load	=	4,214 lbs
...resultant ecc.	=	23.53 in

Soil Pressure @ Toe	=	2,257 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,160 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	35.3 psi OK
Footing Shear @ Heel	=	15.9 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	3,114.8 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.961
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	3,700.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	13,833.3

Moment.....Allowable

	=	14,393.2
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	54.8

Shear.....Allowable

	psi =	75.0
--	-------	------

Anet (Masonry)

	in2 =	
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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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.5793 in ² /ft	
(4/3) * As :	0.7724 in ² /ft	Min Stem T&S Reinf Area 2.016 in ²
200bd/fy : 200(12)(5.625)/60000 :	0.225 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.5793 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.66 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.762 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	4.25 ft
Heel Width	=	2.16
Total Footing Width	=	6.41
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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 3,160	0 psf
Mu' : Upward	= 212,775	0 ft-#
Mu' : Downward	= 29,586	1,857 ft-#
Mu: Design	= 15,266	1,857 ft-#
Actual 1-Way Shear	= 35.26	15.94 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@ 5.93 in, #5@ 9.19 in, #6@ 13.05 in, #7@ 17.79 in, #8@ 23.43 in, #9@ 29.
 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
 Key: No key defined

Min footing T&S reinf Area	2.08	in ²
Min footing T&S reinf Area per foot	0.32	in ² /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 2018,ACI 318-14,TMS 402-16

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)	2,214.8	3.75	8,305.7	Soil Over HL (ab. water tbl)	1,792.0	5.66	10,148.7
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.66	10,148.7
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) =	1,050.0	4.58	4,812.5
				Earth @ Stem Transitions =			
				Footing Weight =	1,201.9	3.21	3,852.0
				Key Weight =			
				Vert. Component =			
Total	= 3,114.8	O.T.M. =	13,930.7	Total =	4,213.9 lbs	R.M.=	19,174.5
Resisting/Overturning Ratio		= 1.38					
Vertical Loads used for Soil Pressure =		4,213.9 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) 0.103 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

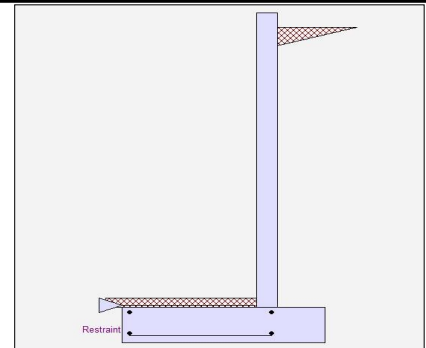
Code: IBC 2018, ACI 318-14, TMS 402-16

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	=	35.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footings 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	=	10.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.31 OK
Slab Resists All Sliding !		

Total Bearing Load	=	4,214 lbs
...resultant ecc.	=	7.51 in

Soil Pressure @ Toe	=	1,042 psf OK
Soil Pressure @ Heel	=	272 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,459 psf
ACI Factored @ Heel	=	381 psf
Footing Shear @ Toe	=	21.3 psi OK
Footing Shear @ Heel	=	11.1 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	2,214.8 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.648
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	2,800.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	9,333.3

Moment.....Allowable

	=	14,393.2
--	---	----------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	41.5

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

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) :	0.3909 in ² /ft	
(4/3) * As :	0.5212 in ² /ft	Min Stem T&S Reinf Area 2.016 in ²
200bd/fy : 200(12)(5.625)/60000 :	0.225 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in ² /ft
0.0018bh : 0.0018(12)(8) :	0.1728 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.3909 in ² /ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.66 in ² /ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.762 in ² /ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	4.25 ft
Heel Width	=	2.16
Total Footing Width	=	6.41
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	=	1,459	381 psf
Mu' : Upward	=	132,339	519 ft-#
Mu' : Downward	=	29,586	1,857 ft-#
Mu: Design	=	8,563	1,338 ft-#
Actual 1-Way Shear	=	21.31	11.09 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@ 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	2.08	in ²
Min footing T&S reinf Area per foot	0.32	in ² /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 2018,ACI 318-14,TMS 402-16

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)	2,214.8	3.75	8,305.7	Soil Over HL (ab. water tbl)	1,792.0	5.66	10,148.7
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.66	10,148.7
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	=			* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=			Soil Over Toe	=	170.0	361.3
	=			Surcharge Over Toe	=		
				Stem Weight(s)	=	1,050.0	4,812.5
				Earth @ Stem Transitions	=		
				Footing Weight	=	1,201.9	3,852.0
				Key Weight	=		
				Vert. Component	=		
				</			

* 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) 0.047 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

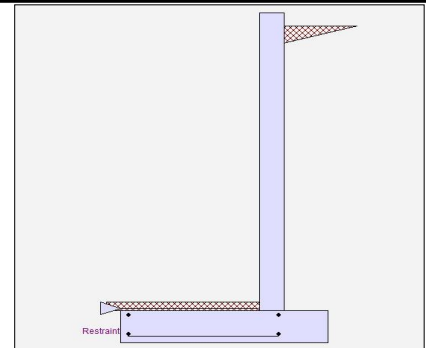
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	99.0 #/ft
...Height to Top	=	11.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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 **1.2 FOS w/ Seismic**
 Overturning = 1.39 Ratio < 1.5!
 Slab Resists All Sliding !

Total Bearing Load	=	4,931 lbs
...resultant ecc.	=	25.41 in
Soil Pressure @ Toe	=	2,311 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,236 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	41.5 psi OK
Footing Shear @ Heel	=	17.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	3,715.1 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.905
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	4,477.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	18,412.2

Moment.....Allowable

	=	20,333.2
--	---	----------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	48.9

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.56 in ² /ft	
(4/3) * As :	0.7467 in ² /ft	Min Stem T&S Reinf Area 2.760 in ²
200bd/fy : 200(12)(7.625)/60000 :	0.305 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in ² /ft
0.0018bh : 0.0018(12)(10) :	0.216 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.56 in ² /ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.66 in ² /ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.0329 in ² /ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	4.75 ft
Heel Width	=	2.33
Total Footing Width	=	7.08
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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 3,236	0 psf
Mu' : Upward	= 275,651	0 ft-#
Mu' : Downward	= 36,957	2,026 ft-#
Mu: Design	= 19,891	2,026 ft-#
Actual 1-Way Shear	= 41.46	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	2.29	in ²
Min footing T&S reinf Area per foot	0.32	in ² /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 2018,ACI 318-14,TMS 402-16

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)	2,626.1	4.08	10,723.2	Soil Over HL (ab. water tbl)	1,975.6	6.33	12,508.8
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		6.33	12,508.8
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 =	1,089.0	6.75	7,350.8	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	190.0	2.38	451.3
				Surcharge Over Toe =			
				Stem Weight(s) =	1,437.5	5.17	7,427.1
				Earth @ Stem Transitions =			
				Footing Weight =	1,327.5	3.54	4,699.4
				Key Weight =			
				Vert. Component =			
Total	= 3,715.1	O.T.M. =	18,074.0	Total =	4,930.6 lbs	R.M.=	25,086.5
Resisting/Overturning Ratio		= 1.39					
Vertical Loads used for Soil Pressure =		4,930.6	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) 0.104 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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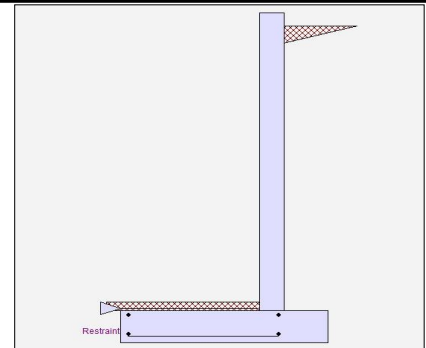
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	11.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.34 OK
Slab Resists All Sliding !		

Total Bearing Load	=	4,931 lbs
...resultant ecc.	=	7.52 in

Soil Pressure @ Toe	=	1,066 psf OK
Soil Pressure @ Heel	=	326 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,493 psf
ACI Factored @ Heel	=	457 psf
Footing Shear @ Toe	=	25.5 psi OK
Footing Shear @ Heel	=	11.9 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	2,626.1 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.610
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	3,388.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	12,422.7

Moment.....Allowable

	=	20,333.2
--	---	----------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	37.0
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

Bottom

Stem OK

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3778 in ² /ft	
(4/3) * As :	0.5038 in ² /ft	Min Stem T&S Reinf Area 2.760 in ²
200bd/fy : 200(12)(7.625)/60000 :	0.305 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in ² /ft
0.0018bh : 0.0018(12)(10) :	0.216 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.3778 in ² /ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.66 in ² /ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.0329 in ² /ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	4.75 ft
Heel Width	=	2.33
Total Footing Width	=	7.08
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,493	457 psf
Mu' : Upward	=	170,746	594 ft-#
Mu' : Downward	=	36,957	2,026 ft-#
Mu: Design	=	11,149	1,432 ft-#
Actual 1-Way Shear	=	25.46	11.92 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@ 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	2.29	in ²
Min footing T&S reinf Area per foot	0.32	in ² /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 2018,ACI 318-14,TMS 402-16

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)	2,626.1	4.08	10,723.2	Soil Over HL (ab. water tbl)	1,975.6	6.33	12,508.8
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		6.33	12,508.8
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	190.0	2.38	451.3
				Surcharge Over Toe =			
				Stem Weight(s) =	1,437.5	5.17	7,427.1
				Earth @ Stem Transitions =			
				Footing Weight =	1,327.5	3.54	4,699.4
				Key Weight =			
				Vert. Component =			

* 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) 0.048 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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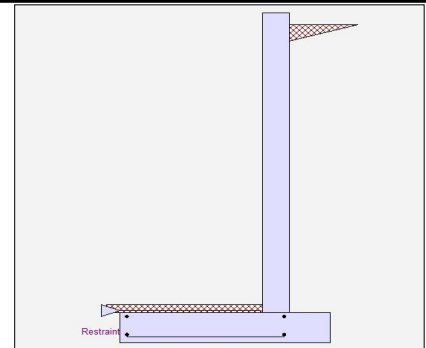
Code: IBC 2018, ACI 318-14, TMS 402-16

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	=	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		

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	=	0.0 psf (Service Level)

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 **1.2 FOS w/ Seismic**
 Overturning = 1.40 Ratio < 1.5!
 Slab Resists All Sliding !

Total Bearing Load	=	5,698 lbs
...resultant ecc.	=	27.30 in
Soil Pressure @ Toe	=	2,374 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,324 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	48.2 psi OK
Footing Shear @ Heel	=	18.8 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	4,368.3 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.909
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	5,328.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	23,904.0

Moment.....Allowable

	=	26,273.2
--	---	----------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	46.1

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.5708 in ² /ft	
(4/3) * As :	0.7611 in ² /ft	Min Stem T&S Reinf Area 3.600 in ²
200bd/fy : 200(12)(9.625)/60000 :	0.385 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in ² /ft
0.0018bh : 0.0018(12)(12) :	0.2592 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.5708 in ² /ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.66 in ² /ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3039 in ² /ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	5.25 ft
Heel Width	=	2.50
Total Footing Width	=	7.75
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

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 3,324	0 psf
Mu' : Upward	= 349,395	0 ft-#
Mu' : Downward	= 45,147	2,197 ft-#
Mu: Design	= 25,354	2,197 ft-#
Actual 1-Way Shear	= 48.17	18.78 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@ 4.76 in, #5@ 7.38 in, #6@ 10.47 in, #7@ 14.28 in, #8@ 18.81 in, #9@ 23.
 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
 Key: No key defined

Min footing T&S reinf Area	2.51	in ²
Min footing T&S reinf Area per foot	0.32	in ² /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 2018,ACI 318-14,TMS 402-16

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)	3,072.3	4.42	13,569.5	Soil Over HL (ab. water tbl)	2,160.0	7.00	15,120.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		7.00	15,120.0
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 =	1,453.1	3.88	5,630.9
				Key Weight =			
				Vert. Component =			
Total	= 4,368.3	O.T.M. =	22,965.5	Total =	5,698.1 lbs	R.M.=	32,083.4
Resisting/Overturning Ratio		= 1.40					
Vertical Loads used for Soil Pressure =		5,698.1 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) 0.106 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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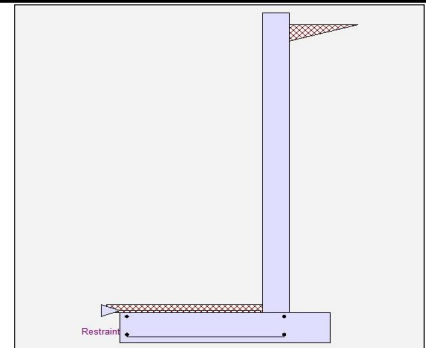
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	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		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	12.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

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	=	2.36 OK
Slab Resists All Sliding !		

Total Bearing Load	=	5,698 lbs
...resultant ecc.	=	7.51 in

Soil Pressure @ Toe	=	1,092 psf OK
Soil Pressure @ Heel	=	379 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,528 psf
ACI Factored @ Heel	=	531 psf
Footing Shear @ Toe	=	29.9 psi OK
Footing Shear @ Heel	=	12.7 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	3,072.3 lbs
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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	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

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	=	0.613
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	4,032.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	16,128.0

Moment.....Allowable

	=	26,273.2
--	---	----------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	34.9

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3851 in ² /ft	
(4/3) * As :	0.5135 in ² /ft	Min Stem T&S Reinf Area 3.600 in ²
200bd/fy : 200(12)(9.625)/60000 :	0.385 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in ² /ft
0.0018bh : 0.0018(12)(12) :	0.2592 in ² /ft	Horizontal Reinforcing Options :
	=====	One layer of : Two layers of :
Required Area :	0.3851 in ² /ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.66 in ² /ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3039 in ² /ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	5.25 ft
Heel Width	=	2.50
Total Footing Width	=	7.75
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

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,528	531 psf
Mu' : Upward	=	215,461	669 ft-#
Mu' : Downward	=	45,147	2,197 ft-#
Mu: Design	=	14,193	1,528 ft-#
Actual 1-Way Shear	=	29.95	12.75 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@ 6.38 in, #5@ 9.89 in, #6@ 14.03 in, #7@ 19.14 in, #8@ 25.20 in, #9@ 31.
 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
 Key: No key defined

Min footing T&S reinf Area	2.51	in ²
Min footing T&S reinf Area per foot	0.32	in ² /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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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.