BYKONEN
CARTER
QUINN

STRUCTURAL
ENGINEERING

STRUCTURAL CALCULATIONS

Steinborn Residence
8435 SE 47th PL,
Mercer Island, WA 98040

Ectypos Architecture
4212 W Mercer Way,
Mercer Island, WA 98040

September 23, 2022

Supplemental Calculations – Corrections 1 & Architectural Revisions

9/23/2022

2033 Sixth Avenue #995 Seattle, WA 98121 206-264-7784 www.BCQ-SE.com

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 3:11PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE Den/Guest Rm (9/S3.2)

Code Reference

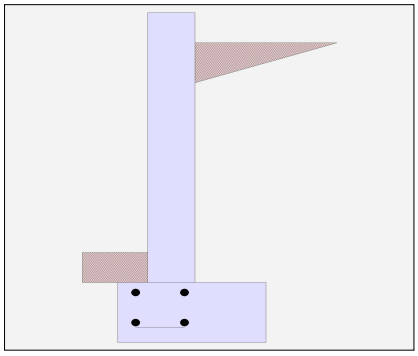
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	4.00 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	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	40.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	120.0 lbs
Axial Live Load	=	40.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

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DESCRIPTION: SE Den/Guest Rm (9/S3.2)

Design Summary

Wall Stability Ratios			
Overturning	=	1.67	OK
Sliding	=	1.51	OK
Global Stability	=	2.31	
Total Bearing Load	=	1,511 lbs	
...resultant ecc.	=	7.01 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	2,193 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	3,070 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	0.8 psi	OK
Footing Shear @ Heel	=	6.4 psi	OK
Allowable	=	75.0 psi	
Sliding Calcs			
Lateral Sliding Force	=	561.5 lbs	
less 100% Passive Force	-	187.5 lbs	
less 100% Friction Force	-	661.7 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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 4		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.155**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	590.8		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	840.2		
Moment.....Allowable	=	5,412.6		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	7.9		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	100.0		
Rebar Depth 'd'	in =	6.25		
Masonry Data				
f'm	psi =			
Fs	psi =			
Solid Grouting	=			
Modular Ratio 'n'	=			
Equiv. Solid Thick.	=			
Masonry Block Type	=			
Masonry Design Method	=	ASD		
Concrete Data				
f'c	psi =	2,500.0		
Fy	psi =	60,000.0		

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DESCRIPTION: SE Den/Guest Rm (9/S3.2)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0315 in2/ft		
(4/3) * As :	0.042 in2/ft	Min Stem T&S Reinf Area 0.864 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	0.42 ft
Heel Width	=	1.67
Total Footing Width	=	2.09
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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe		Heel	
Factored Pressure	=	3,070		0	psf
Mu' : Upward	=	243		9	ft-#
Mu' : Downward	=	23		434	ft-#
Mu: Design	=	221	OK	425	ft-# OK
phiMn	=	7,663		2,500	ft-#
Actual 1-Way Shear	=	0.80		6.45	psi
Allow 1-Way Shear	=	75.00		40.00	psi

Toe Reinforcing = # 4 @ 12.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 300.53 in, #5@ 465.82 in, #6@ 661.16 in, #7@ 864.00 in, #8@ 864.00 in, #9@ 864.00 in, #10@ 864.00 in

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

Key: No key defined

Min footing T&S reinf Area 0.54 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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DESCRIPTION: SE Den/Guest Rm (9/S3.2)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		500.0	1.67	833.3	Soil Over HL (ab. water tbl)	520.2	1.59	825.4
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		1.59	825.4
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	61.5	2.50	153.8	Surcharge Over Heel	= 40.0	1.59	63.5
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 120.0	0.75	90.4
Added Lateral Load	=				* Axial Live Load on Stem	= 40.0	0.75	30.1
Load @ Stem Above Soil	=				Soil Over Toe	= 27.3	0.21	5.7
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 450.0	0.75	339.0
					Earth @ Stem Transitions	=		
					Footing Weight	= 313.1	1.04	326.7
					Key Weight	=		
					Vert. Component	=		
Total	=	561.5	**O.T.M.** =	987.2	**Total =**	1,470.5 lbs	**R.M.=**	1,650.7

Resisting/Overturning Ratio = **1.67**

Vertical Loads used for Soil Pressure = 1,510.5 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)	0.131	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.

DESCRIPTION: SE Den/Guest Rm (9/S3.2)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	7.26 in
As Provided =	0.2000 in2/ft
As Required =	0.1728 in2/ft

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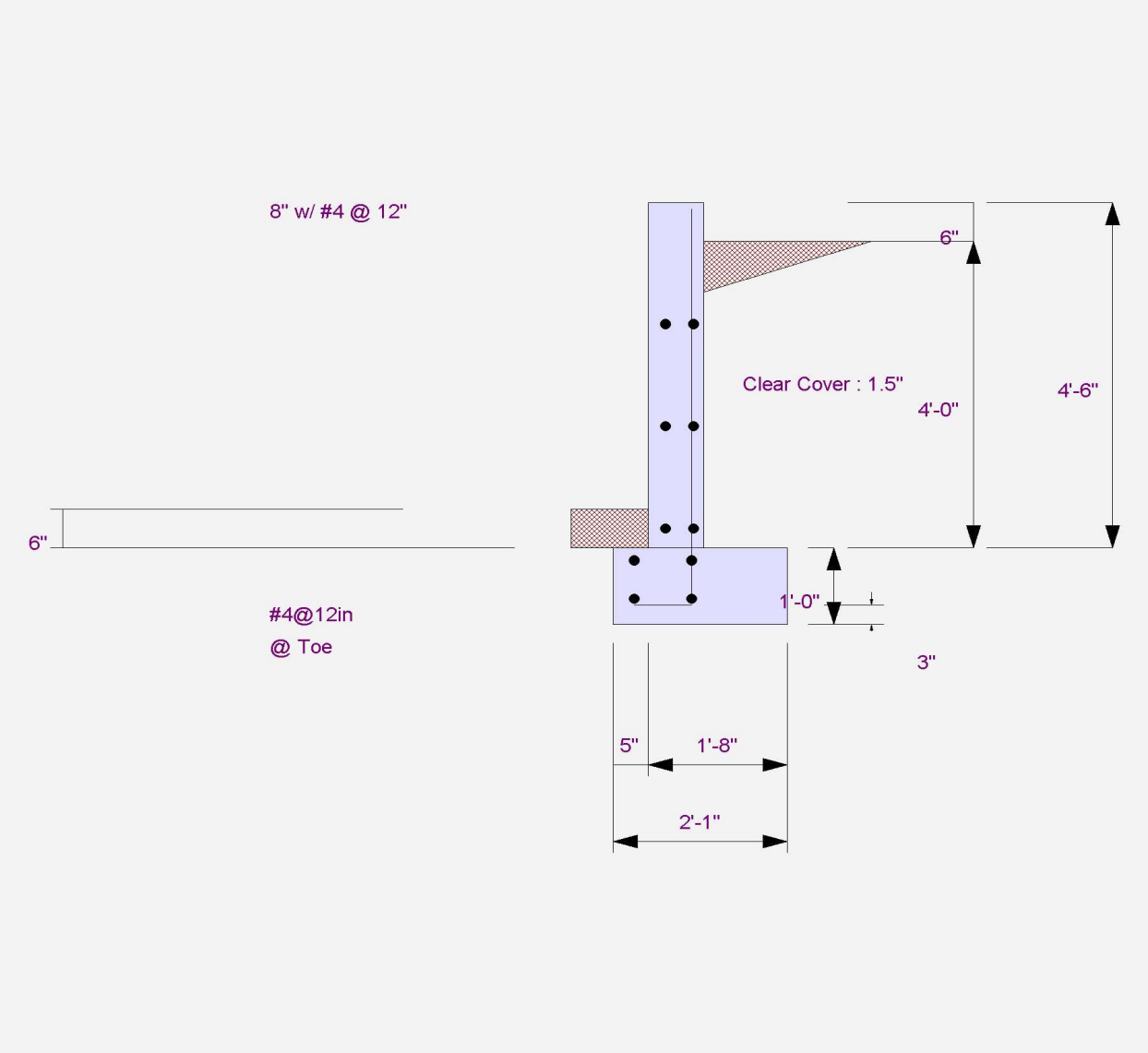

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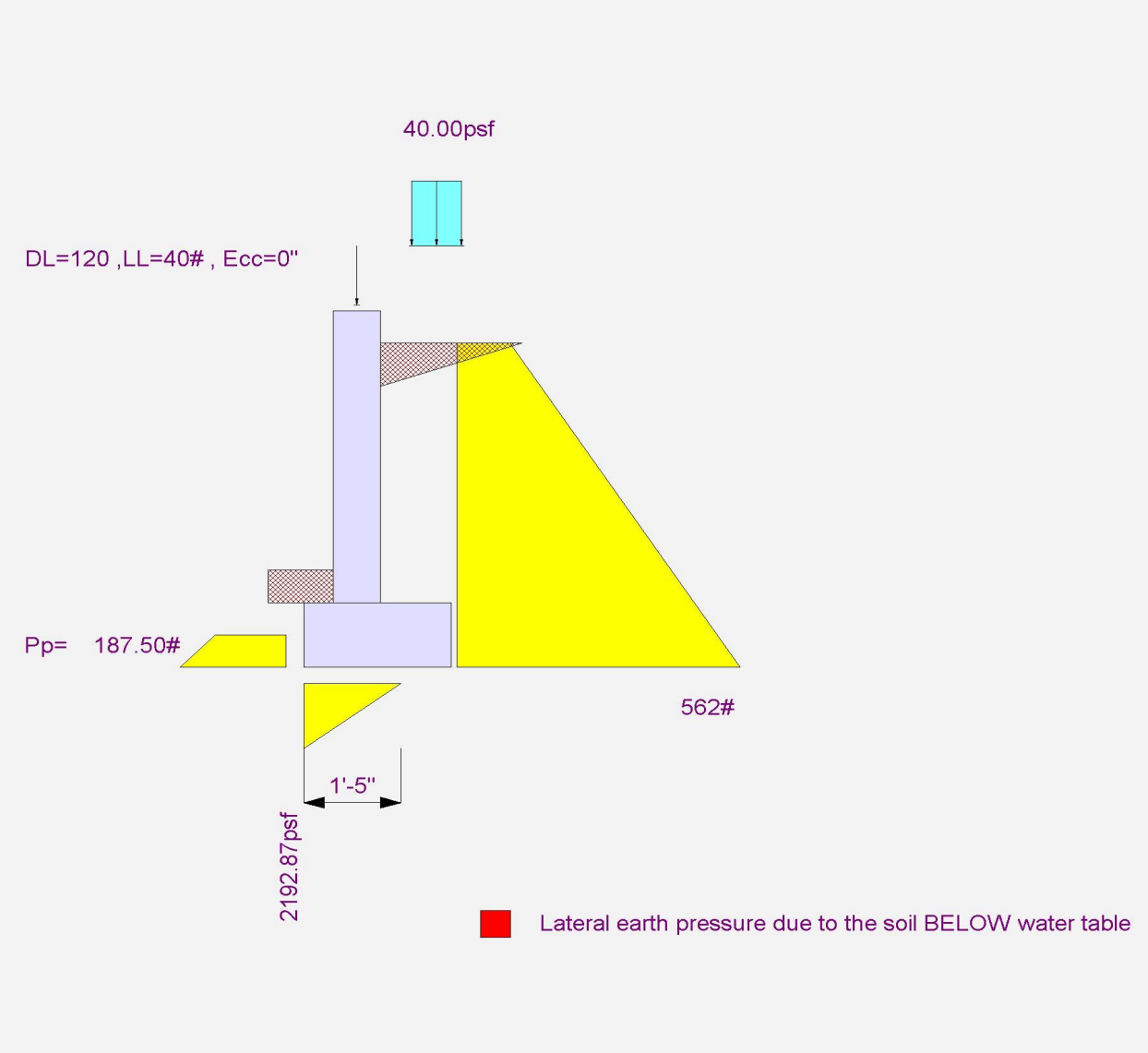
DESCRIPTION: SE Den/Guest Rm (9/S3.2)



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DESCRIPTION: Garage/ADU Step (12/S3.2)

Code Reference

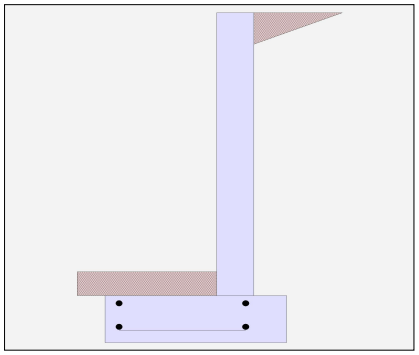
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.00 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	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	40.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	40.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

Axial Dead Load	=	840.0 lbs
Axial Live Load	=	560.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform		
Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	63.000
Total Seismic Force	=	441.000

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DESCRIPTION: Garage/ADU Step (12/S3.2)

Design Summary

Wall Stability Ratios

Overturning	=	1.99	OK
Sliding	=	1.26	Ratio < 1.5!
Global Stability	=	1.45	

Total Bearing Load	=	3,176	lbs
...resultant ecc.	=	6.60	in
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,969	psf OK
Soil Pressure @ Heel	=	0	psf OK
Allowable	=	5,332	psf
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,756	psf
ACI Factored @ Heel	=	0	psf
Footing Shear @ Toe	=	23.5	psi OK
Footing Shear @ Heel	=	10.9	psi OK
Allowable	=	75.0	psi

Sliding Calcs

Lateral Sliding Force	=	1,374.9	lbs
less 100% Passive Force	-	340.2	lbs
less 100% Friction Force	-	1,388.3	lbs
Added Force Req'd	=	0.0	lbs OK
....for 1.5 Stability	=	333.8	lbs NG

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

Load Factors

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

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 4		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.700**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	1,648.2		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	3,792.5		
Moment.....Allowable	=	5,412.6		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	22.0		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	100.0		
Rebar Depth 'd'	in =	6.25		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

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DESCRIPTION: Garage/ADU Step (12/S3.2)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1421 in2/ft		
(4/3) * As :	0.1895 in2/ft	Min Stem T&S Reinf Area 1.152 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1895 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	1.25
Total Footing Width	=	3.25
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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe		Heel	
Factored Pressure	=	2,756		0 psf	
Mu' : Upward	=	4,373		25 ft-#	
Mu' : Downward	=	644		639 ft-#	
Mu: Design	=	3,729	OK	614 ft-#	OK
phiMn	=	7,663		2,500 ft-#	
Actual 1-Way Shear	=	23.51		10.88 psi	
Allow 1-Way Shear	=	75.00		40.00 psi	

Toe Reinforcing = # 4 @ 12.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 17.76 in, #5@ 27.54 in, #6@ 39.09 in, #7@ 53.30 in, #8@ 70.18 in, #9@ 88.84 in, #10@ 112.83 in

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

Key: No key defined

Min footing T&S reinf Area 0.84 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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DESCRIPTION: Garage/ADU Step (12/S3.2)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		980.0	2.33	2,286.7	Soil Over HL (ab. water tbl)	455.0	2.96	1,346.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.96	1,346.0
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	86.2	3.50	301.5	Surcharge Over Heel	= 23.3	2.96	69.0
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 840.0	2.33	1,960.0
Added Lateral Load	=				* Axial Live Load on Stem	= 560.0	2.33	1,306.7
Load @ Stem Above Soil	=				Soil Over Toe	= 130.0	1.00	130.0
Seismic Earth Load	=	308.7	3.50	1,080.5	Surcharge Over Toe	= 80.0	1.00	80.0
	=				Stem Weight(s)	= 600.0	2.33	1,400.0
					Earth @ Stem Transitions	=		
					Footing Weight	= 487.5	1.63	792.2
					Key Weight	=		
					Vert. Component	= 469.2	3.25	1,525.0
Total	=	1,374.9	**O.T.M.** =	3,668.7	**Total =**	3,085.1 lbs	**R.M.=**	7,302.2

Resisting/Overturning Ratio = **1.99**

Vertical Loads used for Soil Pressure = 3,175.8 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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.

DESCRIPTION: Garage/ADU Step (12/S3.2)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	7.96 in
As Provided =	0.2000 in2/ft
As Required =	0.1895 in2/ft

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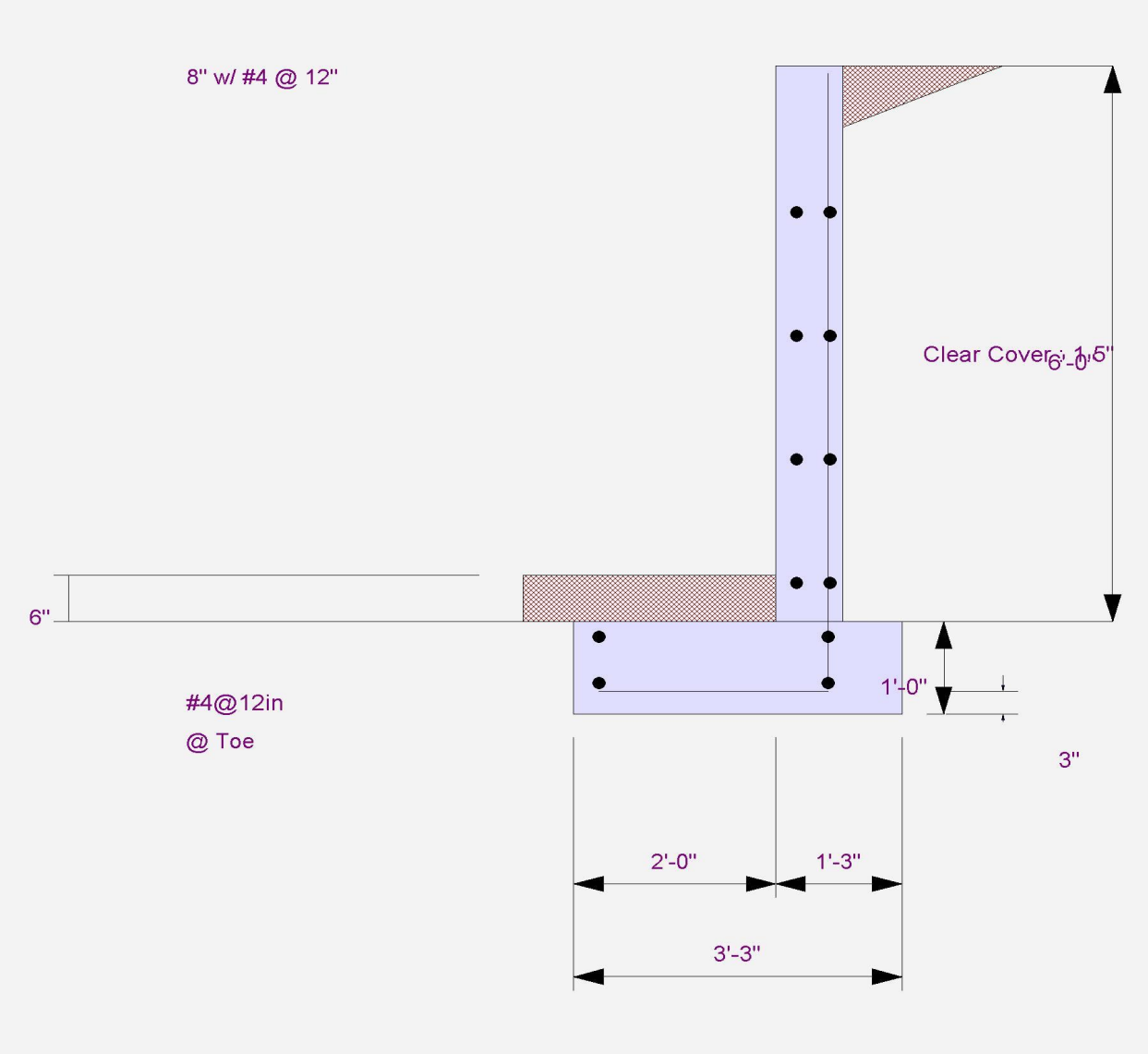

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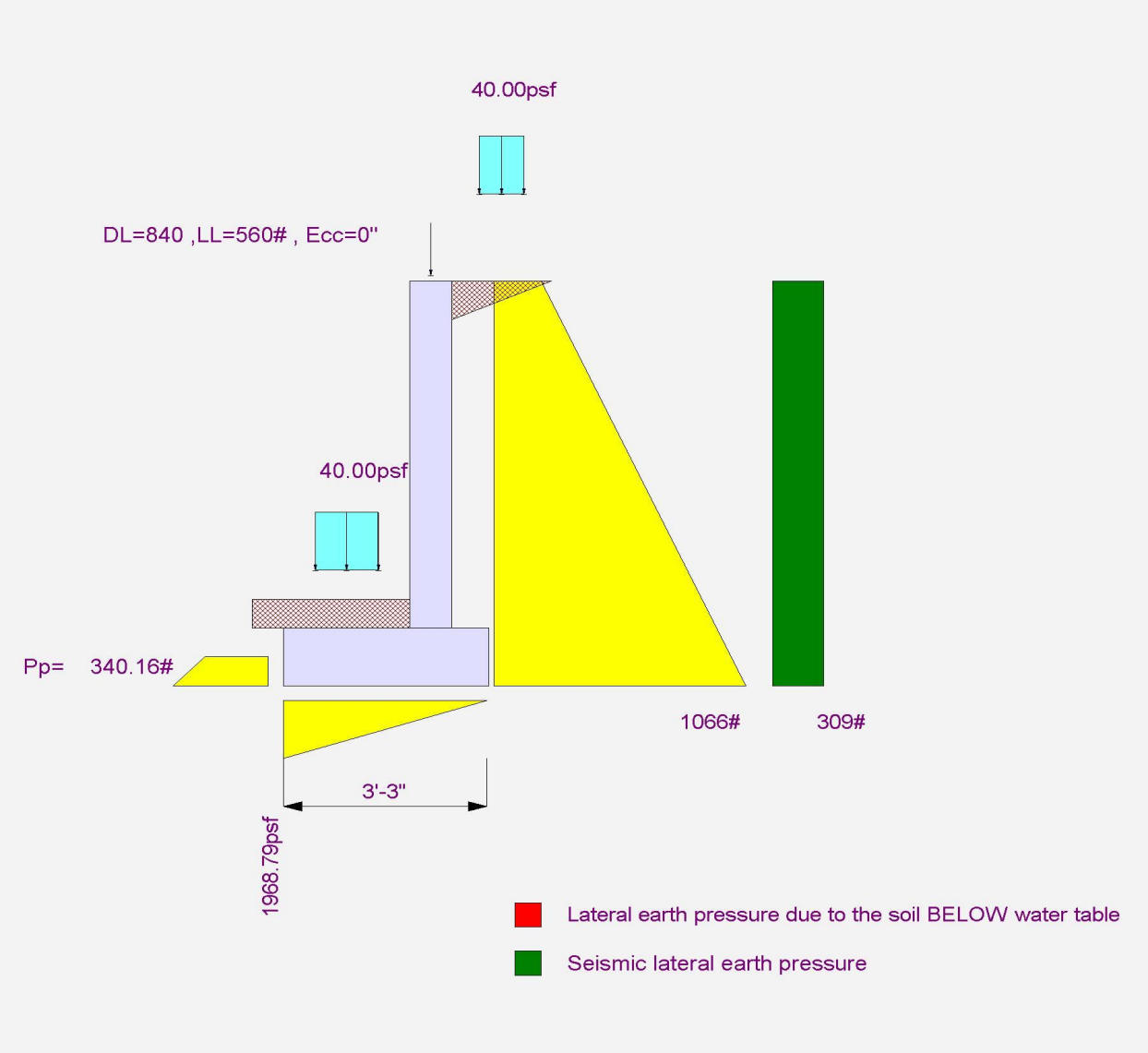

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DESCRIPTION: Garage/ADU Step (12/S3.2)

Code Reference

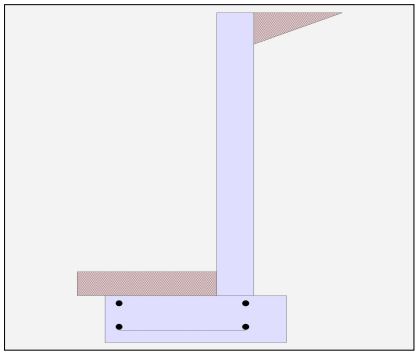
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.00 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	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	40.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	40.0
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	840.0 lbs
Axial Live Load	=	560.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage/ADU Step (12/S3.2)

Design Summary

Wall Stability Ratios

Overturning	=	2.82	OK
Sliding	=	1.62	OK
Global Stability	=	1.45	

Total Bearing Load	=	3,176	lbs
...resultant ecc.	=	2.51	in

Eccentricity within middle third

Soil Pressure @ Toe	=	1,355 psf	OK
Soil Pressure @ Heel	=	599 psf	OK
Allowable	=	4,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,897 psf	
ACI Factored @ Heel	=	839 psf	
Footing Shear @ Toe	=	17.0 psi	OK
Footing Shear @ Heel	=	7.5 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,066.2 lbs	
less 100% Passive Force	-	340.2 lbs	
less 100% Friction Force	-	1,388.3 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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 4		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Edge		

Design Data

fb/FB + fa/Fa	=	**0.491**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,270.2
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,658.5
Moment.....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	16.9
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage/ADU Step (12/S3.2)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0996 in2/ft		
(4/3) * As :	0.1328 in2/ft	Min Stem T&S Reinf Area 1.152 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	1.25
Total Footing Width	=	3.25
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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe		Heel	
Factored Pressure	=	1,897		839 psf	
Mu' : Upward	=	3,360		154 ft-#	
Mu' : Downward	=	644		639 ft-#	
Mu: Design	=	2,716	OK	485 ft-#	OK
phiMn	=	7,663		2,500 ft-#	
Actual 1-Way Shear	=	16.95		7.45 psi	
Allow 1-Way Shear	=	75.00		40.00 psi	

Toe Reinforcing = # 4 @ 12.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 24.40 in, #5@ 37.82 in, #6@ 53.68 in, #7@ 73.20 in, #8@ 96.38 in, #9@ 122.00 in, #10@ 154.94 in

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

Key: No key defined

Min footing T&S reinf Area 0.84 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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Project ID:
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Cantilevered Retaining Wall

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DESCRIPTION: Garage/ADU Step (12/S3.2)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		980.0	2.33	2,286.7	Soil Over HL (ab. water tbl)	455.0	2.96	1,346.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.96	1,346.0
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	86.2	3.50	301.5	Surcharge Over Heel	= 23.3	2.96	69.0
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 840.0	2.33	1,960.0
Added Lateral Load	=				* Axial Live Load on Stem	= 560.0	2.33	1,306.7
Load @ Stem Above Soil	=				Soil Over Toe	= 130.0	1.00	130.0
	=				Surcharge Over Toe	= 80.0	1.00	80.0
					Stem Weight(s)	= 600.0	2.33	1,400.0
					Earth @ Stem Transitions	=		
					Footing Weight	= 487.5	1.63	792.2
					Key Weight	=		
					Vert. Component	= 469.2	3.25	1,525.0
Total	=	1,066.2	**O.T.M.** =	2,588.2	**Total =**	3,085.1 lbs	**R.M.=**	7,302.2

Resisting/Overturning Ratio = **2.82**

Vertical Loads used for Soil Pressure = 3,175.8 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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.

DESCRIPTION: Garage/ADU Step (12/S3.2)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	7.26 in
As Provided =	0.2000 in2/ft
As Required =	0.1728 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

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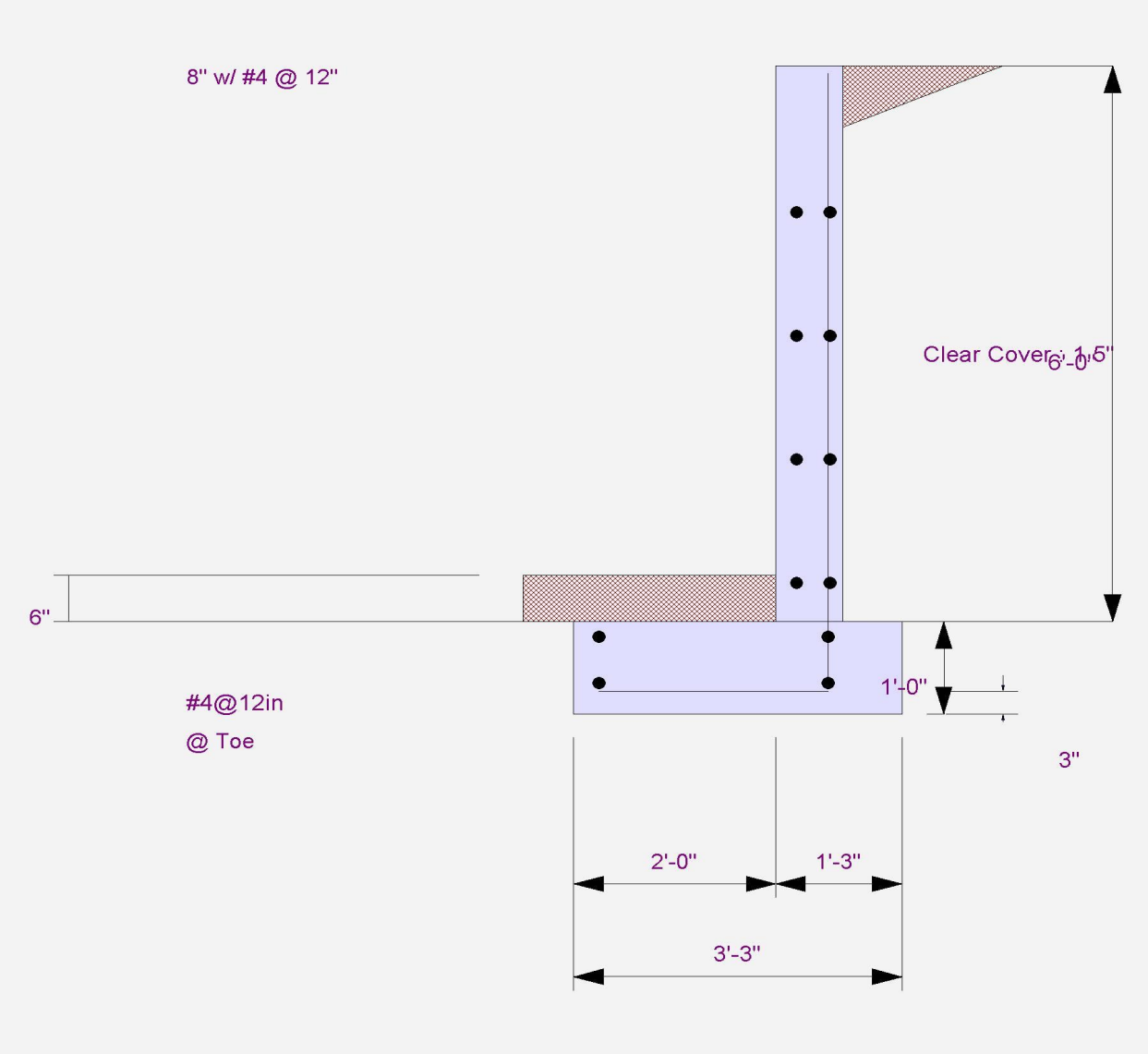
DESCRIPTION: Garage/ADU Step (12/S3.2)



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Project ID:
Project Descr:

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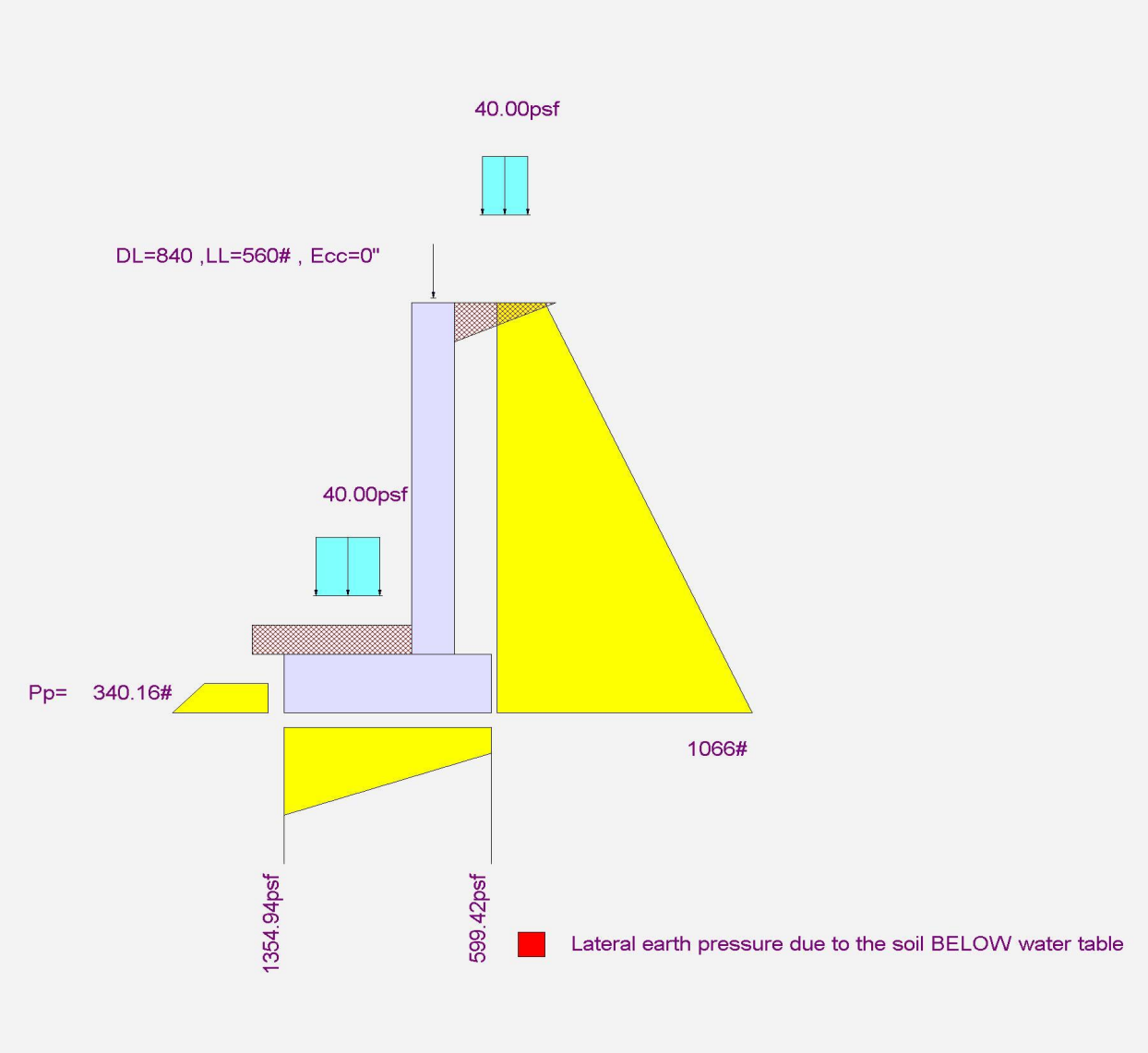
Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage/ADU Step (12/S3.2)



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Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)

Code Reference

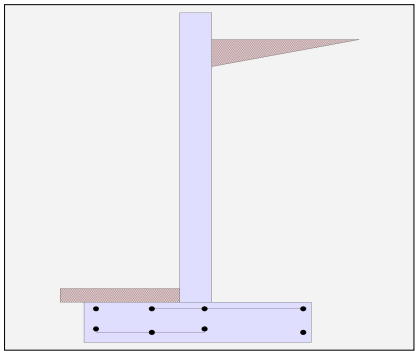
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	6.50 ft
Wall height above soil	=	0.67 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	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	40.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

Axial Dead Load	=	290.0 lbs
Axial Live Load	=	435.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform		
Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	67.500
Total Seismic Force	=	506.250

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)

Design Summary

Wall Stability Ratios

Overturning	=	2.44	OK
Sliding	=	1.37	Ratio < 1.5!
Global Stability	=	1.78	

Total Bearing Load	=	4,085	lbs
...resultant ecc.	=	6.49	in

Eccentricity within middle third

Soil Pressure @ Toe	=	1,447 psf	OK
Soil Pressure @ Heel	=	273 psf	OK
Allowable	=	5,332 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	2,026 psf	
ACI Factored @ Heel	=	382 psf	
Footing Shear @ Toe	=	19.7 psi	OK
Footing Shear @ Heel	=	9.4 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,571.7	lbs
less 100% Passive Force	-	266.7	lbs
less 100% Friction Force	-	1,884.7	lbs
Added Force Req'd	=	0.0	lbs OK
....for 1.5 Stability	=	206.1	lbs NG

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

Load Factors

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

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 4		
Rebar Spacing	=	10.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.740**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	1,918.8		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	4,771.3		
Moment.....Allowable	=	6,444.1		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	25.6		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	100.0		
Rebar Depth 'd'	in =	6.25		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 5:58PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1788 in2/ft		
(4/3) * As :	0.2383 in2/ft	Min Stem T&S Reinf Area 1.376 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2383 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.24 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	2.75
Total Footing Width	=	4.75
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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	2,026	382 psf	
Mu' : Upward	=	3,591	1,350 ft-#	
Mu' : Downward	=	464	2,730 ft-#	
Mu: Design	=	3,127 OK	1,380 ft-#	OK
phiMn	=	9,145	10,225 ft-#	
Actual 1-Way Shear	=	19.67	9.42 psi	
Allow 1-Way Shear	=	75.00	75.00 psi	

Toe Reinforcing = # 4 @ 10.00 in
Heel Reinforcing = # 4 @ 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@ 21.19 in, #5@ 32.85 in, #6@ 46.62 in, #7@ 63.58 in, #8@ 83.72 in, #9@ 105.97 in, #10@ 134.58 in

Heel: #4@ 53.88 in, #5@ 83.52 in, #6@ 118.55 in, #7@ 161.66 in, #8@ 212.86 in, #9@ 269.44 in, #10@ 342.19 in

Key: No key defined

Min footing T&S reinf Area 1.23 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

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		1,125.0	2.50	2,812.5	Soil Over HL (ab. water tbl)	1,760.4	3.71	6,528.2
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.71	6,528.2
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	92.3	3.75	346.2	Surcharge Over Heel	= 83.3	3.71	309.0
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 290.0	2.33	676.7
Added Lateral Load	=				* Axial Live Load on Stem	= 435.0	2.33	1,015.0
Load @ Stem Above Soil	=				Soil Over Toe	= 86.7	1.00	86.7
Seismic Earth Load	=	354.4	3.75	1,328.9	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 716.7	2.33	1,672.3
					Earth @ Stem Transitions	=		
					Footing Weight	= 712.5	2.38	1,692.2
					Key Weight	=		
					Vert. Component	=		
Total	=	1,571.7	**O.T.M.** =	4,487.6	**Total =**	3,649.6 lbs	**R.M.=**	10,965.1

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

Resisting/Overturning Ratio = **2.44**

Vertical Loads used for Soil Pressure = 4,084.6 lbs

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

Vertical component of active lateral soil pressure IS 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.

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	8.34 in
As Provided =	0.2400 in2/ft
As Required =	0.2383 in2/ft

Project Title:
Engineer:
Project ID:
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Cantilevered Retaining Wall

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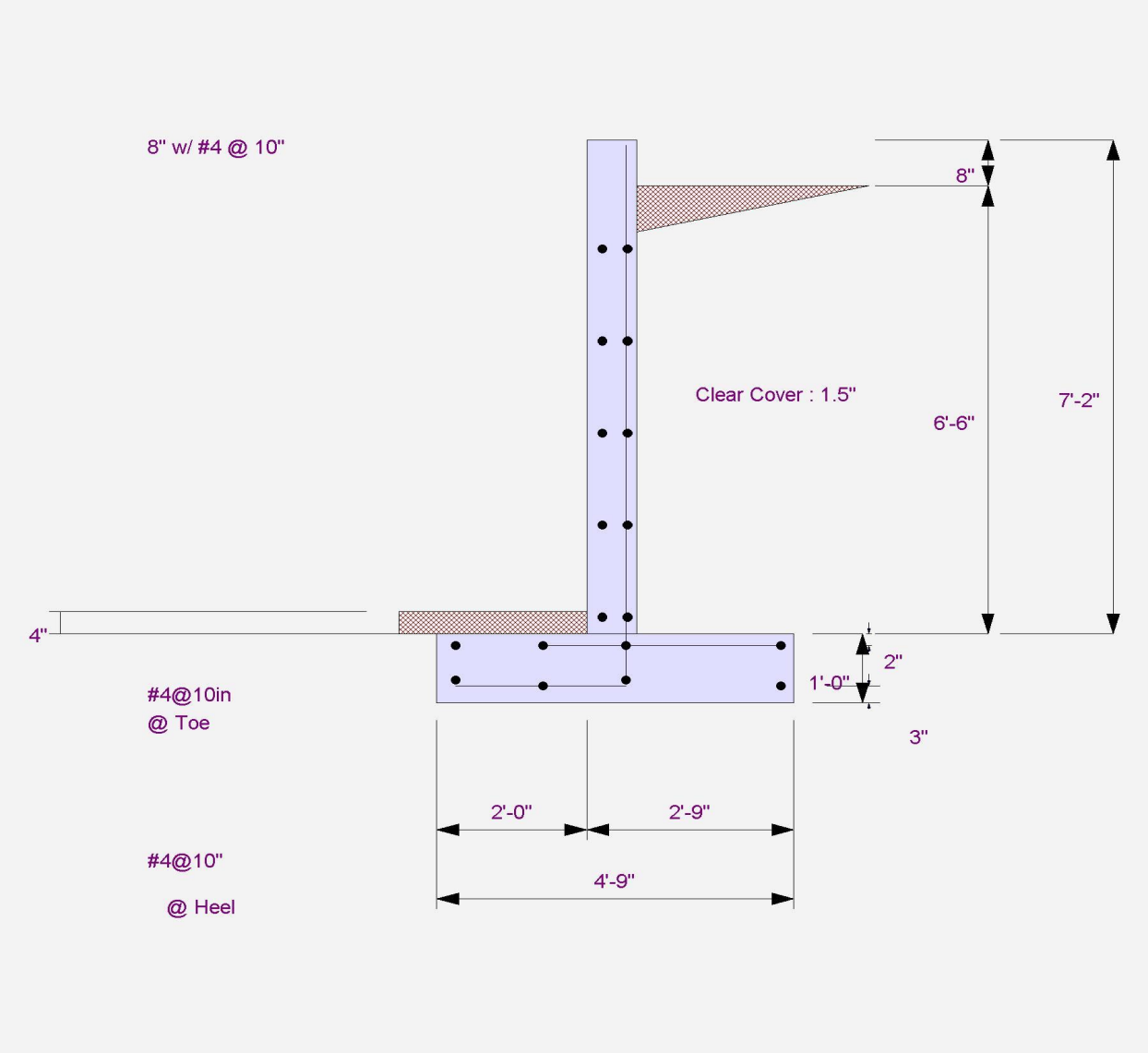
DESCRIPTION: SE @ ADU/Laundry (12/S3.1)



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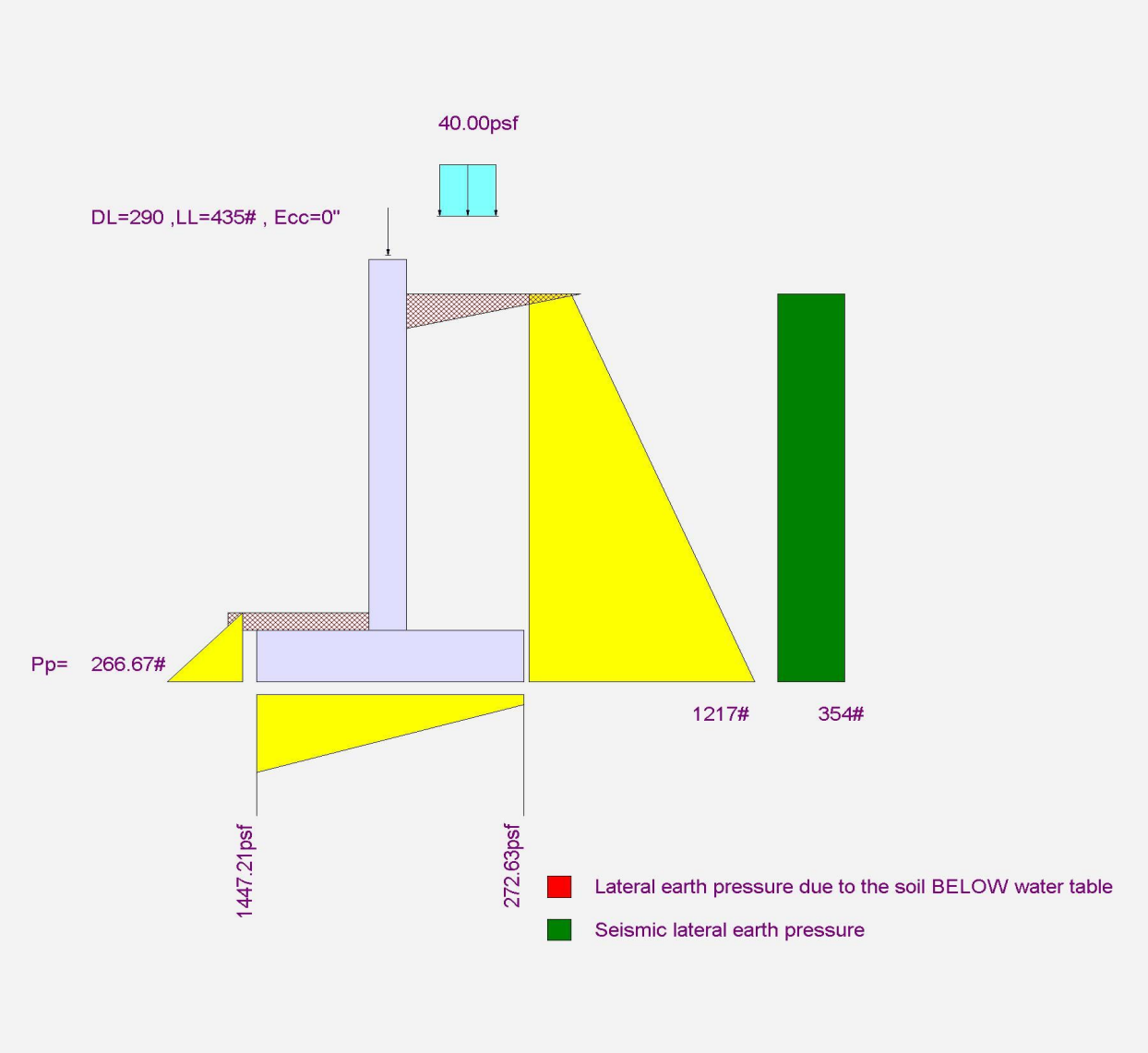
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 5:58PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)



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Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)

Code Reference

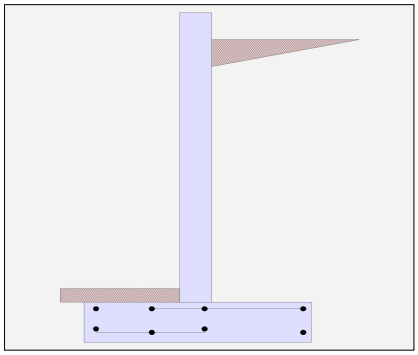
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	6.50 ft
Wall height above soil	=	0.67 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	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	40.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	290.0 lbs
Axial Live Load	=	435.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 5:59PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)

Design Summary

Wall Stability Ratios			
Overturning	=	3.47	OK
Sliding	=	1.77	OK
Global Stability	=	1.78	
Total Bearing Load	=	4,085 lbs	
...resultant ecc.	=	2.58 in	
Eccentricity within middle third			
Soil Pressure @ Toe	=	1,094 psf	OK
Soil Pressure @ Heel	=	626 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,531 psf	
ACI Factored @ Heel	=	876 psf	
Footing Shear @ Toe	=	15.1 psi	OK
Footing Shear @ Heel	=	4.3 psi	OK
Allowable	=	75.0 psi	
Sliding Calcs			
Lateral Sliding Force	=	1,217.3 lbs	
less 100% Passive Force	-	266.7 lbs	
less 100% Friction Force	-	1,884.7 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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 4		
Rebar Spacing	=	10.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.519**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	1,480.0		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	3,345.3		
Moment.....Allowable	=	6,444.1		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	19.7		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	100.0		
Rebar Depth 'd'	in =	6.25		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 5:59PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1253 in2/ft		
(4/3) * As :	0.1671 in2/ft	Min Stem T&S Reinf Area 1.376 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.24 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	2.75
Total Footing Width	=	4.75
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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	1,531	876	psf
Mu' : Upward	=	2,879	2,110	ft-#
Mu' : Downward	=	464	2,730	ft-#
Mu: Design	=	2,415 OK	620	ft-# OK
phiMn	=	9,145	10,225	ft-#
Actual 1-Way Shear	=	15.11	4.35	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 4 @ 10.00 in
Heel Reinforcing = # 4 @ 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@ 27.44 in, #5@ 42.53 in, #6@ 60.37 in, #7@ 82.32 in, #8@ 108.39 in, #9@ 137.20 in, #10@ 174.25 in

Heel: #4@ 119.89 in, #5@ 185.83 in, #6@ 263.76 in, #7@ 359.68 in, #8@ 473.58 in, #9@ 599.47 in, #10@ 761.33 in

Key: No key defined

Min footing T&S reinf Area 1.23 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

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 5:59PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		1,125.0	2.50	2,812.5	Soil Over HL (ab. water tbl)	1,760.4	3.71	6,528.2
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.71	6,528.2
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	92.3	3.75	346.2	Surcharge Over Heel	= 83.3	3.71	309.0
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 290.0	2.33	676.7
Added Lateral Load	=				* Axial Live Load on Stem	= 435.0	2.33	1,015.0
Load @ Stem Above Soil	=				Soil Over Toe	= 86.7	1.00	86.7
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 716.7	2.33	1,672.3
					Earth @ Stem Transitions	=		
					Footing Weight	= 712.5	2.38	1,692.2
					Key Weight	=		
					Vert. Component	=		
Total	=	1,217.3	**O.T.M.** =	3,158.7	**Total =**	3,649.6 lbs	**R.M.=**	10,965.1

Resisting/Overturning Ratio = **3.47**

Vertical Loads used for Soil Pressure = 4,084.6 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 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)	0.046	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.

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	6.05 in
As Provided =	0.2400 in2/ft
As Required =	0.1728 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

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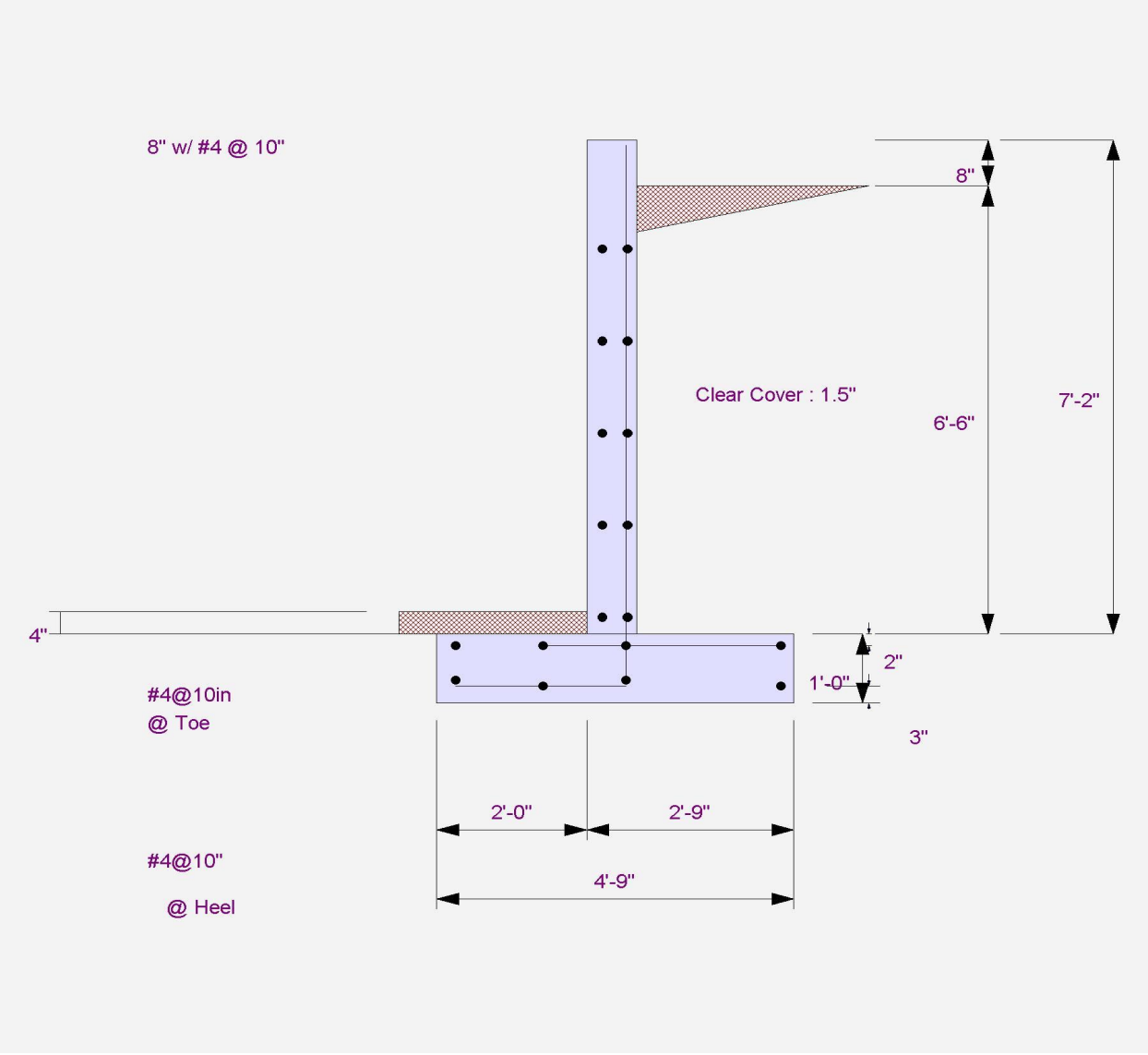
Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)



Project Title:
Engineer:
Project ID:
Project Descr:

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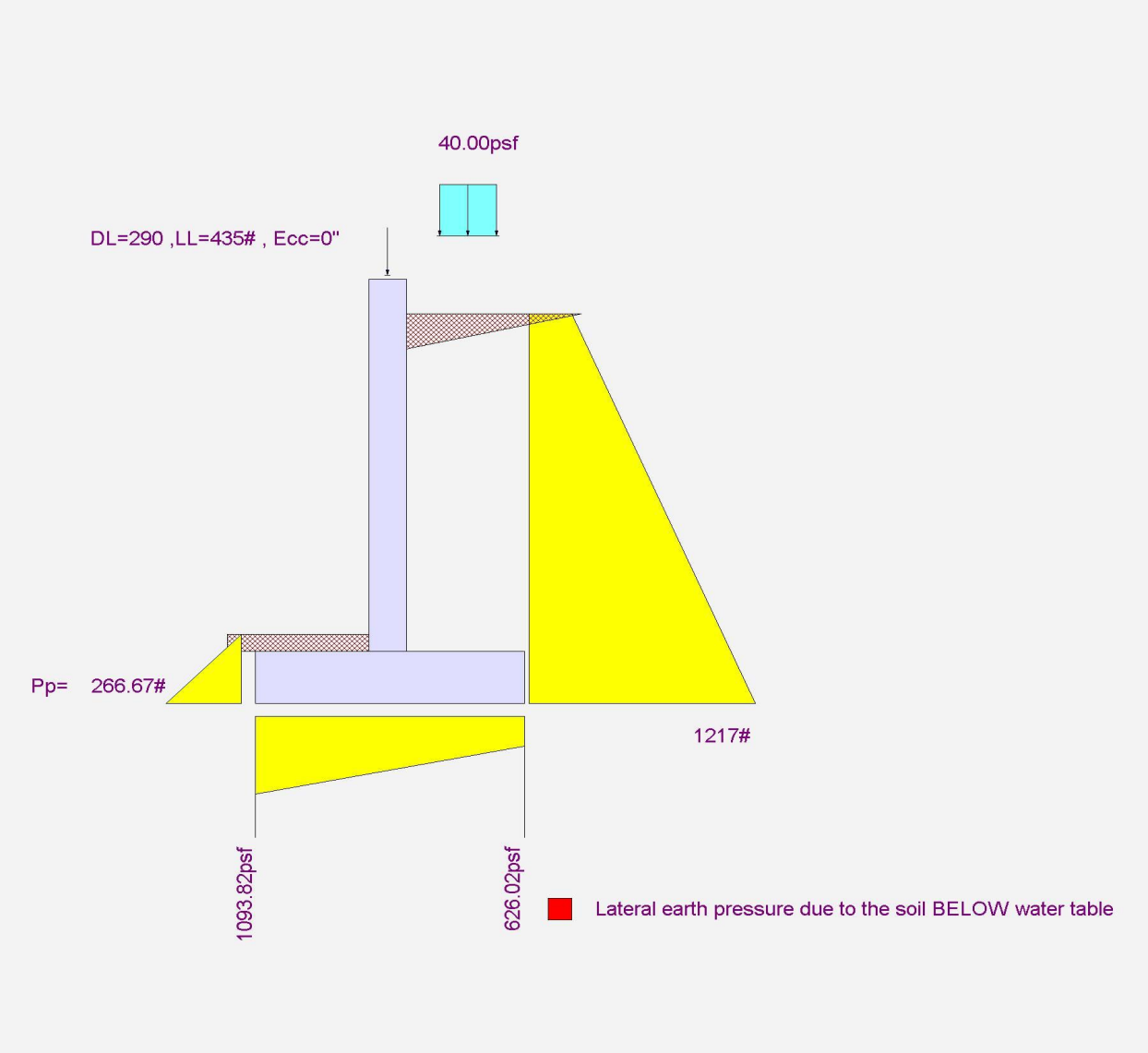
Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ ADU/Laundry (12/S3.1)



Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)

Code Reference

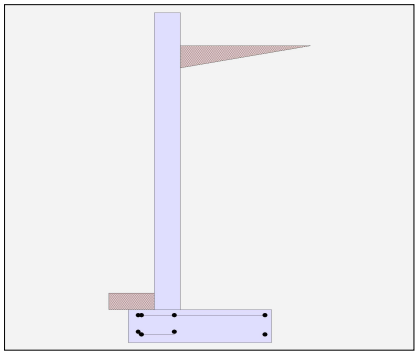
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	1.00 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	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Axial Load Applied to Stem

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Earth Pressure Seismic Load

Method : Triangular

Load at bottom of Triangular Distribution . . . . . = 9.000 psf (Strength)

Total Strength-Level Seismic Load. . . . . = 40.500 lbs

Total Service-Level Seismic Load. . . . . = 28.350 lbs

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 3:15PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)

Design Summary

Wall Stability Ratios

Overturning	=	2.19	OK
Sliding	=	1.49	Ratio < 1.5!
Global Stability	=	1.64	

Total Bearing Load	=	3,920	lbs
...resultant ecc.	=	12.68	in

Eccentricity outside middle third

Soil Pressure @ Toe	=	3,368	psf OK
Soil Pressure @ Heel	=	0	psf OK
Allowable	=	5,332	psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	4,715	psf
ACI Factored @ Heel	=	0	psf
Footing Shear @ Toe	=	0.1	psi OK
Footing Shear @ Heel	=	31.3	psi OK
Allowable	=	75.0	psi

Sliding Calcs

Lateral Sliding Force	=	1,648.4	lbs
less 100% Passive Force	-	337.5	lbs
less 100% Friction Force	-	2,113.0	lbs
Added Force Req'd	=	0.0	lbs OK
....for 1.5 Stability	=	22.0	lbs NG

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

Load Factors

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

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 5		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.682**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	2,080.0		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	5,546.7		
Moment.....Allowable	=	8,121.3		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	28.0		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	100.0		
Rebar Depth 'd'	in =	6.19		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.21 in2/ft		
(4/3) * As :	0.28 in2/ft	Min Stem T&S Reinf Area 1.728 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2475 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.31 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	=	0.67 ft
Heel Width	=	3.00
Total Footing Width	=	3.67
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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe		Heel	
Factored Pressure	=	4,715		0	psf
Mu' : Upward	=	946		333	ft-#
Mu' : Downward	=	57		6,783	ft-#
Mu: Design	=	889	OK	6,450	ft-# OK
phiMn	=	7,663		10,225	ft-#
Actual 1-Way Shear	=	0.12		31.32	psi
Allow 1-Way Shear	=	75.00		75.00	psi

Toe Reinforcing = # 4 @ 12.00 in
Heel Reinforcing = # 4 @ 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@ 74.56 in, #5@ 115.58 in, #6@ 164.05 in, #7@ 223.70 in, #8@ 294.54 in, #9@ 372.84 in, #10@ 473.51 in

Heel: #4@ 11.52 in, #5@ 17.87 in, #6@ 25.36 in, #7@ 34.58 in, #8@ 45.54 in, #9@ 57.64 in, #10@ 73.21 in

Key: No key defined

Min footing T&S reinf Area 0.95 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

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		1,620.0	3.00	4,860.0	Soil Over HL (ab. water tbl)	2,426.7	2.50	6,065.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.50	6,065.0
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	=	43.3	0.33	14.4
Seismic Earth Load	=	28.4	3.00	85.1	Surcharge Over Toe	=		
	=				Stem Weight(s)	=	900.0	1.00	899.4
					Earth @ Stem Transitions	=			
					Footing Weight	=	549.9	1.83	1,008.0
					Key Weight	=			
					Vert. Component	=	775.7	3.67	2,843.6
Total	=	1,648.4	**O.T.M.** =	4,945.1	**Total =**		4,695.5 lbs	**R.M.=**	10,830.4

Resisting/Overturning Ratio = **2.19**

Vertical Loads used for Soil Pressure = 3,919.9 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.230	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.

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #5 bar specified in this stem design segment =	23.40 in
Development length for #5 bar specified in this stem design segment =	18.00 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	8.38 in
As Provided =	0.3100 in2/ft
As Required =	0.2475 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

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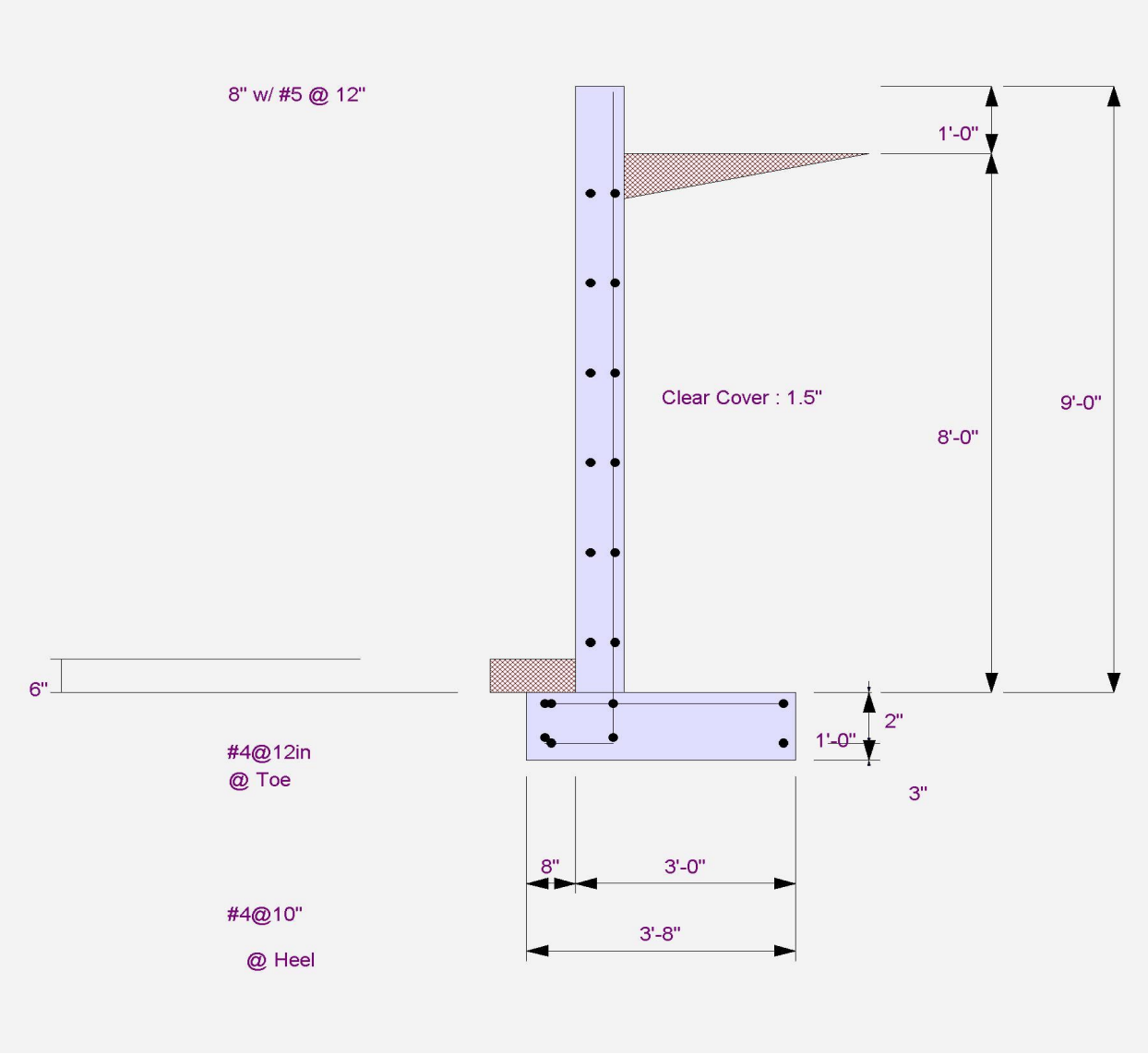
Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)



Project Title:
Engineer:
Project ID:
Project Descr:

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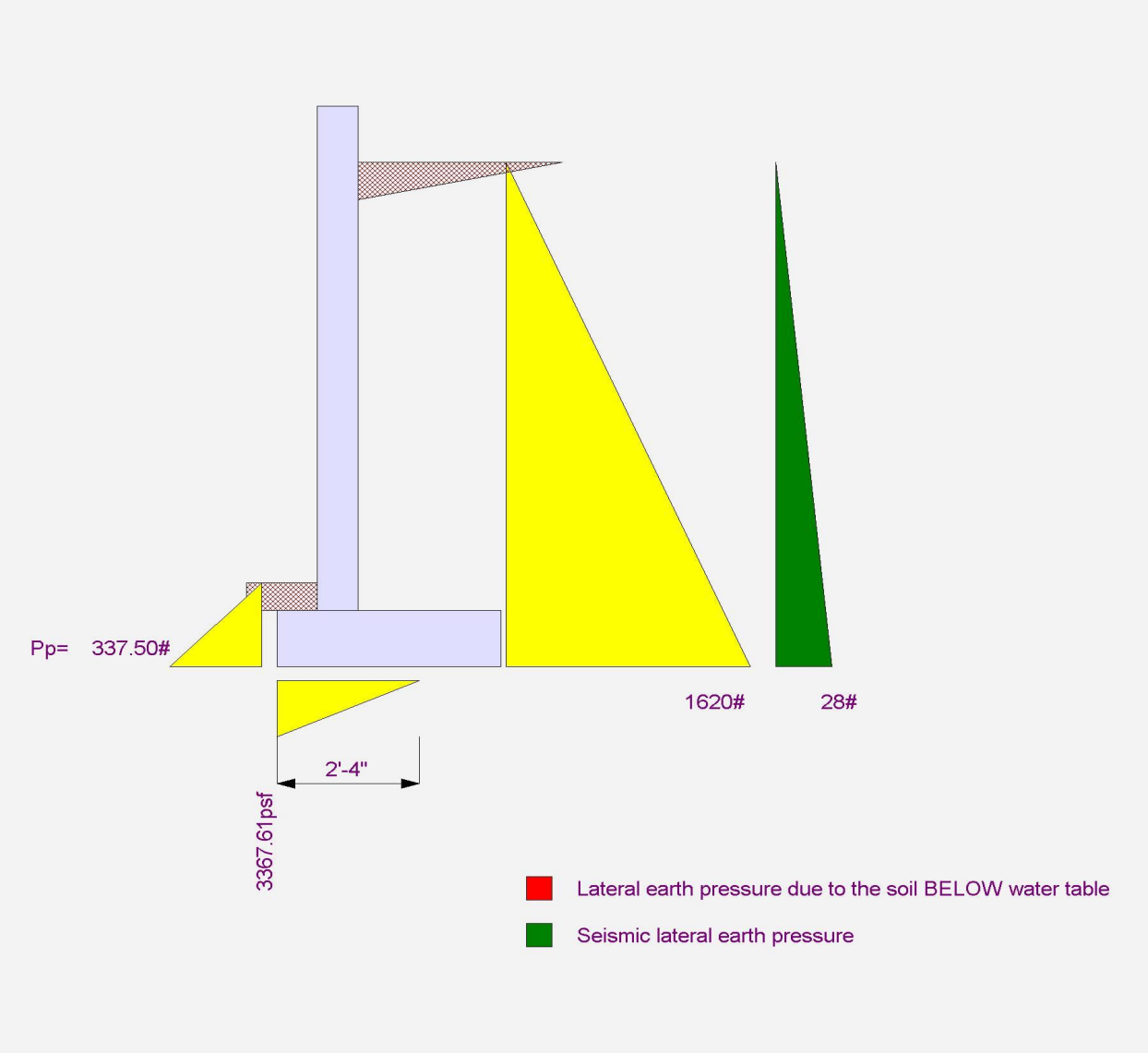
Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)



Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 3:14PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)

Code Reference

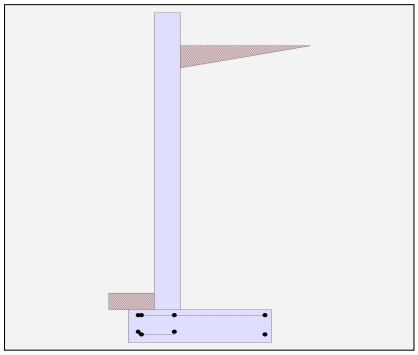
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	1.00 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	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Axial Load Applied to Stem

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 3:14PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)

Design Summary

Wall Stability Ratios

Overturning	=	2.23	OK
Sliding	=	1.51	OK
Global Stability	=	1.64	

Total Bearing Load	=	3,920	lbs
...resultant ecc.	=	12.42	in

Eccentricity outside middle third

Soil Pressure @ Toe	=	3,276 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	4,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	4,586 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	0.1 psi	OK
Footing Shear @ Heel	=	30.7 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,620.0 lbs	
less 100% Passive Force	-	337.5 lbs	
less 100% Friction Force	-	2,113.0 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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 5		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.672**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	2,048.0		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	5,461.3		
Moment.....Allowable	=	8,121.3		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	27.6		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	100.0		
Rebar Depth 'd'	in =	6.19		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2068 in2/ft		
(4/3) * As :	0.2757 in2/ft	Min Stem T&S Reinf Area 1.728 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2475 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.31 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	=	0.67 ft
Heel Width	=	3.00
Total Footing Width	=	3.67
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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe		Heel	
Factored Pressure	=	4,586		0	psf
Mu' : Upward	=	923		381	ft-#
Mu' : Downward	=	57		6,783	ft-#
Mu: Design	=	866	OK	6,402	ft-# OK
phiMn	=	7,663		10,225	ft-#
Actual 1-Way Shear	=	0.12		30.66	psi
Allow 1-Way Shear	=	75.00		75.00	psi

Toe Reinforcing = # 4 @ 12.00 in
Heel Reinforcing = # 4 @ 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@ 76.55 in, #5@ 118.66 in, #6@ 168.42 in, #7@ 229.67 in, #8@ 302.40 in, #9@ 382.79 in, #10@ 486.14 in

Heel: #4@ 11.61 in, #5@ 18.00 in, #6@ 25.55 in, #7@ 34.84 in, #8@ 45.88 in, #9@ 58.07 in, #10@ 73.76 in

Key: No key defined

Min footing T&S reinf Area 0.95 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

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,620.0	3.00	4,860.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
				Soil Over HL (ab. water tbl)	2,426.7	2.50	6,065.0
				Soil Over HL (bel. water tbl)		2.50	6,065.0
				Watre Table			
				Sloped Soil Over Heel =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =	43.3	0.33	14.4
				Surcharge Over Toe =			
				Stem Weight(s) =	900.0	1.00	899.4
				Earth @ Stem Transitions =			
				Footing Weight =	549.9	1.83	1,008.0
				Key Weight =			
				Vert. Component =	775.7	3.67	2,843.6
Total =	1,620.0	**O.T.M.** =	4,860.0	**Total =**	4,695.5 lbs	**R.M.=**	10,830.4

Resisting/Overturning Ratio = **2.23**

Vertical Loads used for Soil Pressure = 3,919.9 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.223	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.

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #5 bar specified in this stem design segment =	23.40 in
Development length for #5 bar specified in this stem design segment =	18.00 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	8.38 in
As Provided =	0.3100 in2/ft
As Required =	0.2475 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

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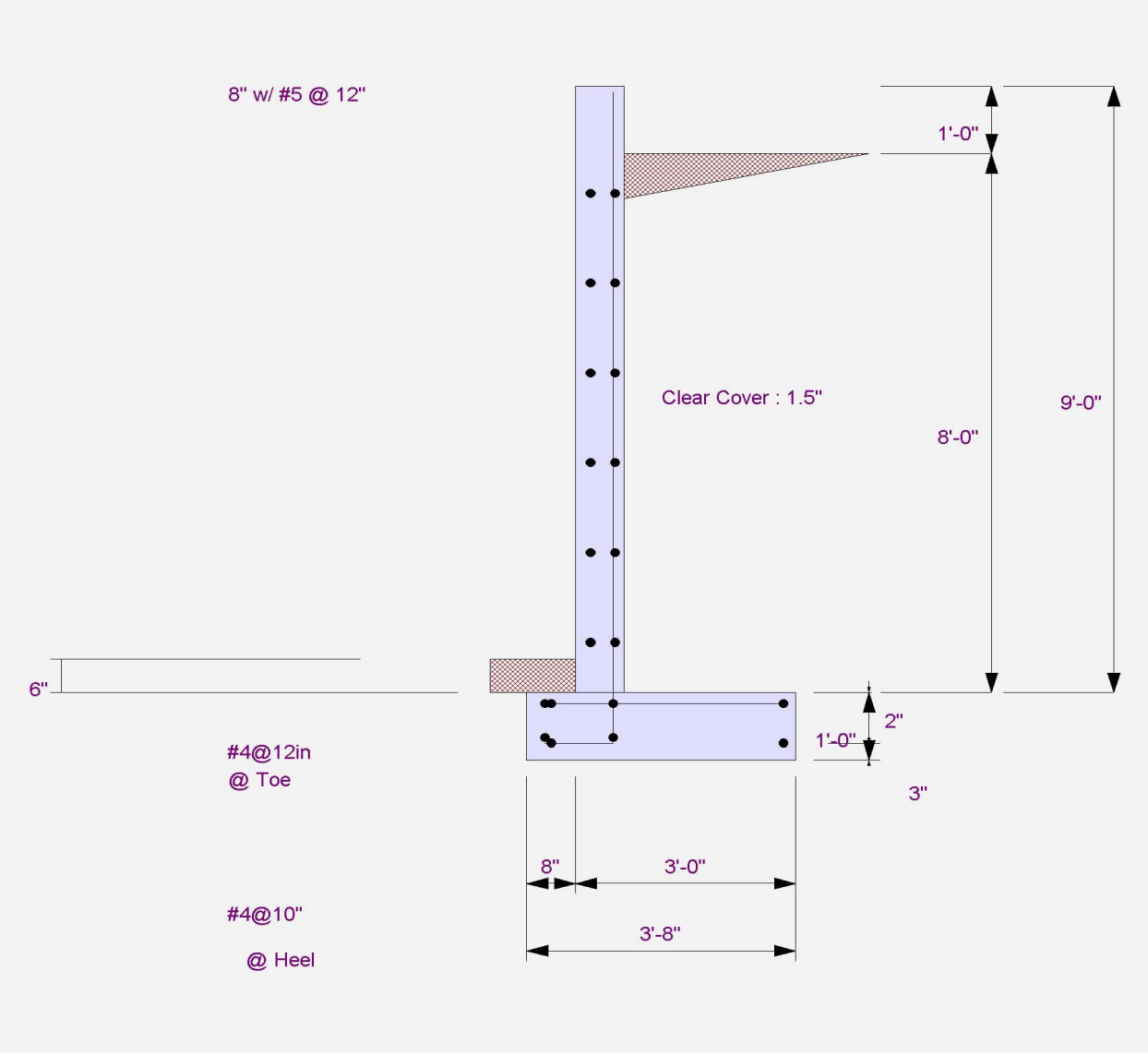
Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)



Project Title:
Engineer:
Project ID:
Project Descr:

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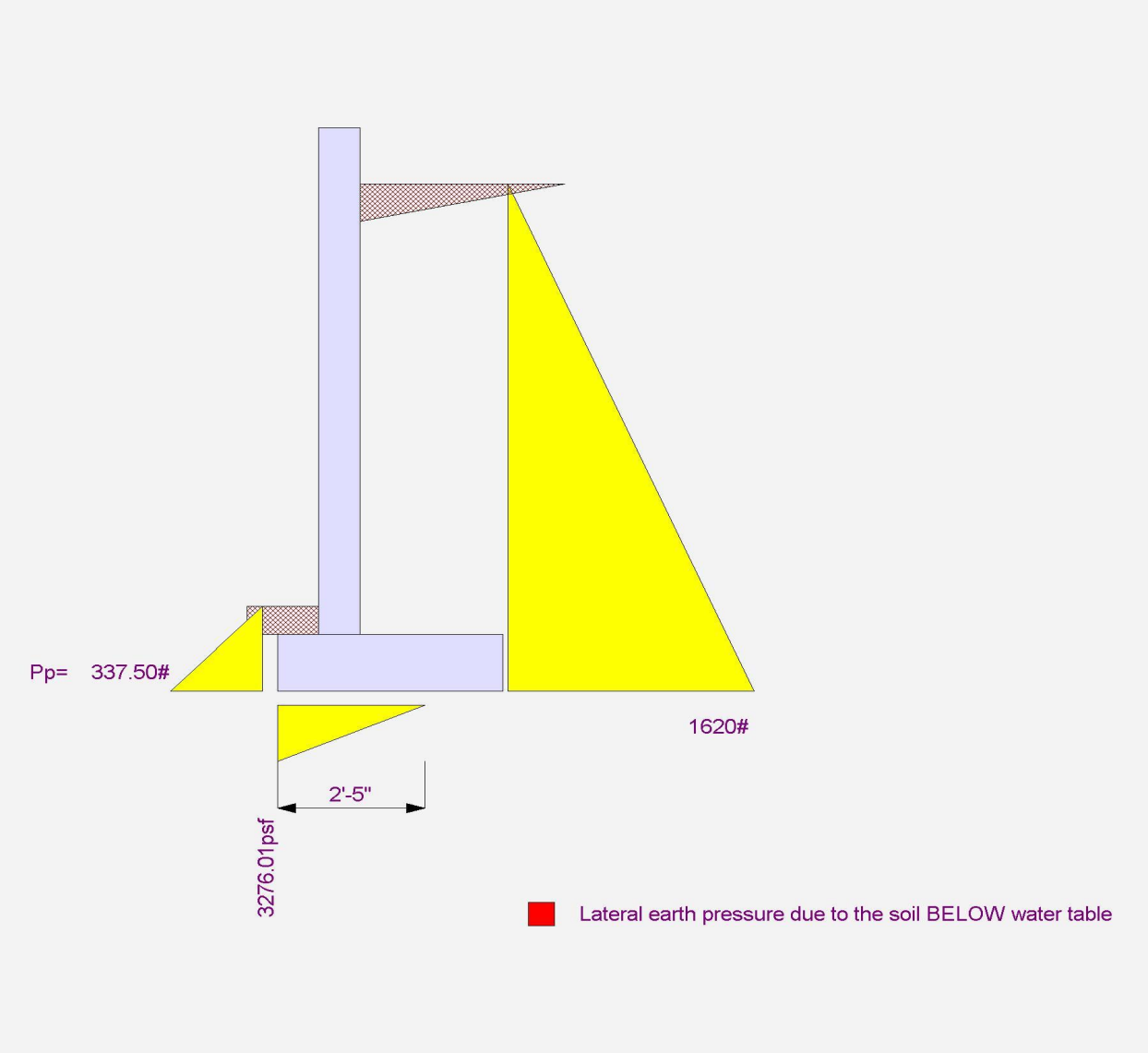
Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage wall at alley revised for shoring (11/S3.3)



Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: SE @ Ext wall (11/S3.1)

Code Reference

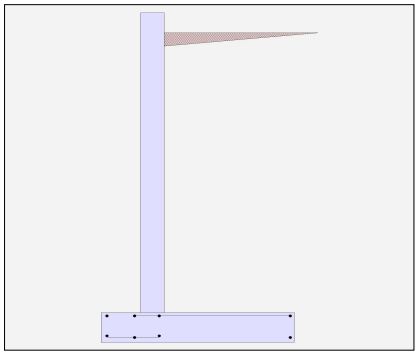
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	14.00 ft
Wall height above soil	=	1.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	139.500
Total Seismic Force	=	2,162.250

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 5:48PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ Ext wall (11/S3.1)

Design Summary

Wall Stability Ratios

Overturning	=	2.34	OK
Sliding	=	1.22	Ratio < 1.5!
Global Stability	=	1.57	

Total Bearing Load	=	16,398	lbs
...resultant ecc.	=	7.43	in
Eccentricity within middle third			
Soil Pressure @ Toe	=	2,512	psf OK
Soil Pressure @ Heel	=	941	psf OK
Allowable	=	5,332	psf
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	3,516	psf
ACI Factored @ Heel	=	1,317	psf
Footing Shear @ Toe	=	8.4	psi OK
Footing Shear @ Heel	=	31.5	psi OK
Allowable	=	75.0	psi

Sliding Calcs

Lateral Sliding Force	=	6,318.6	lbs
less 100% Passive Force	-	337.5	lbs
less 100% Friction Force	-	7,379.2	lbs
Added Force Req'd	=	0.0	lbs OK
....for 1.5 Stability	=	1,761.2	lbs NG

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

Load Factors

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

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	12.00		
Rebar Size	=	# 7		
Rebar Spacing	=	6.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.976**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	8,225.0		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	42,940.3		
Moment.....Allowable	=	43,991.1		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	71.7		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	150.0		
Rebar Depth 'd'	in =	9.56		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 5:48PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ Ext wall (11/S3.1)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	1.0323 in2/ft	
(4/3) * As :	1.3764 in2/ft	Min Stem T&S Reinf Area 4.320 in2
200bd/fy : 200(12)(9.5625)/60000 :	0.3825 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) :	0.2592 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	1.0323 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	1.2 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.2954 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	1.67 ft
Heel Width	=	6.50
Total Footing Width	=	8.17
Footing Thickness	=	18.00 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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	3,516	1,317	psf
Mu' : Upward	=	4,678	27,388	ft-#
Mu' : Downward	=	375	57,362	ft-#
Mu: Design	=	4,302 OK	29,975	ft-# OK
phiMn	=	53,815	39,347	ft-#
Actual 1-Way Shear	=	8.39	31.51	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 6 @ 6.00 in
Heel Reinforcing = # 6 @ 9.02 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@ 26.69 in, #5@ 41.38 in, #6@ 58.73 in, #7@ 80.09 in, #8@ 105.45 in, #9@ 133.49 in, #10@ 169.53 in

Heel: #4@ 4.10 in, #5@ 6.35 in, #6@ 9.02 in, #7@ 12.30 in, #8@ 16.20 in, #9@ 20.51 in, #10@ 26.05 in

Key: No key defined

Min footing T&S reinf Area 3.18 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 5:48PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ Ext wall (11/S3.1)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		4,805.0	5.17	24,825.8	Soil Over HL (ab. water tbl)	10,010.0	5.42	54,224.2
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		5.42	54,224.2
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=		
Seismic Earth Load	=	1,513.6	7.75	11,730.2	Surcharge Over Toe	=		
	=				Stem Weight(s)	=	2,250.0	2.17	4,875.8
					Earth @ Stem Transitions	=			
Total	=	6,318.6	**O.T.M.** =	36,556.0	Footing Weight	=	1,837.6	4.08	7,503.7
					Key Weight	=			
					Vert. Component	=	2,300.6	8.17	18,789.4
					Total =		16,398.2 lbs	**R.M.=**	85,393.0

Resisting/Overturning Ratio = **2.34**

Vertical Loads used for Soil Pressure = 16,398.2 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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.

DESCRIPTION: SE @ Ext wall (11/S3.1)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #7 bar specified in this stem design segment =	40.95 in
Development length for #7 bar specified in this stem design segment =	31.50 in
Hooked embedment length into footing for #7 bar specified in this stem design segment =	12.65 in
As Provided =	1.2000 in2/ft
As Required =	1.0323 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

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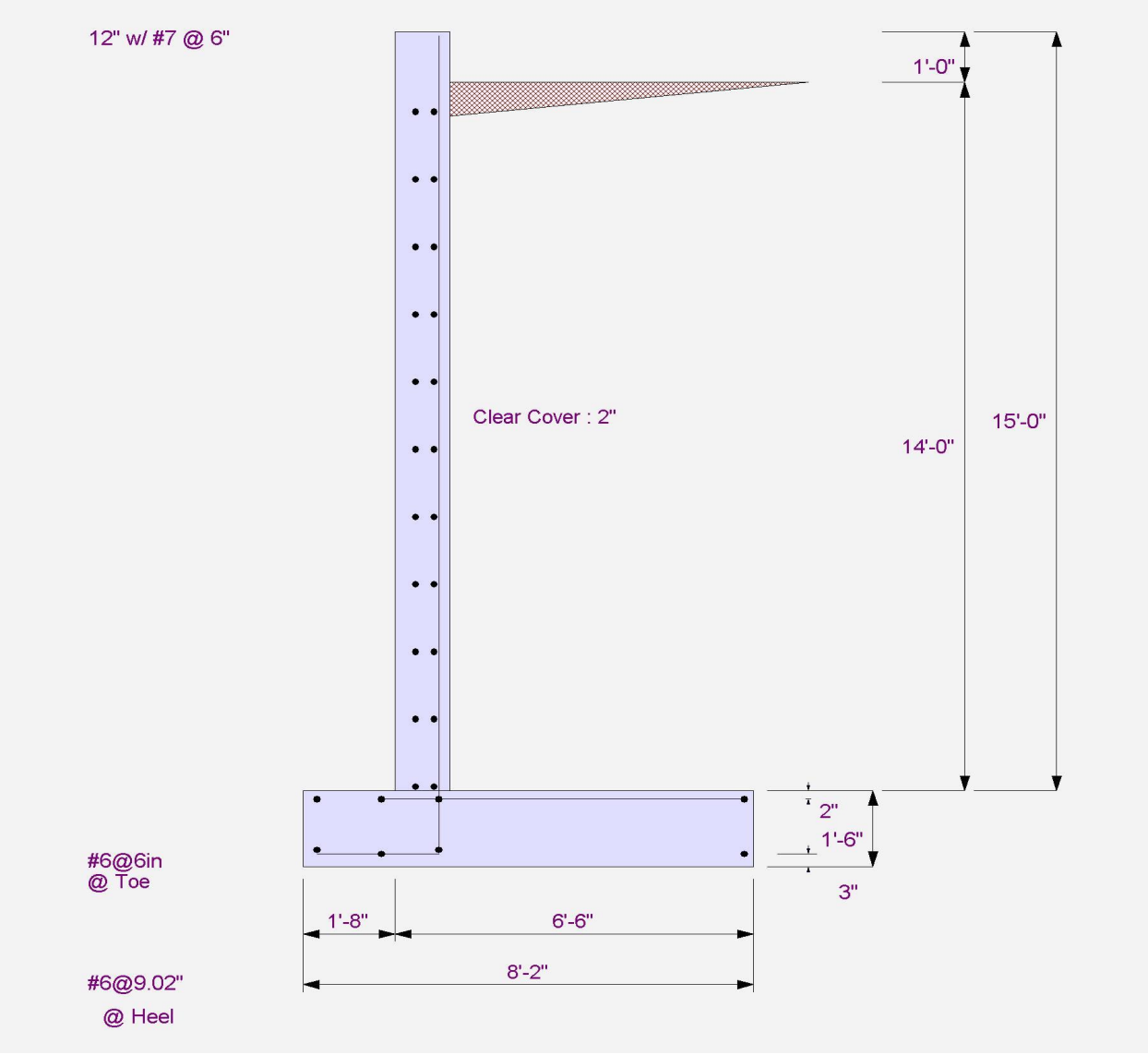
Cantilevered Retaining Wall

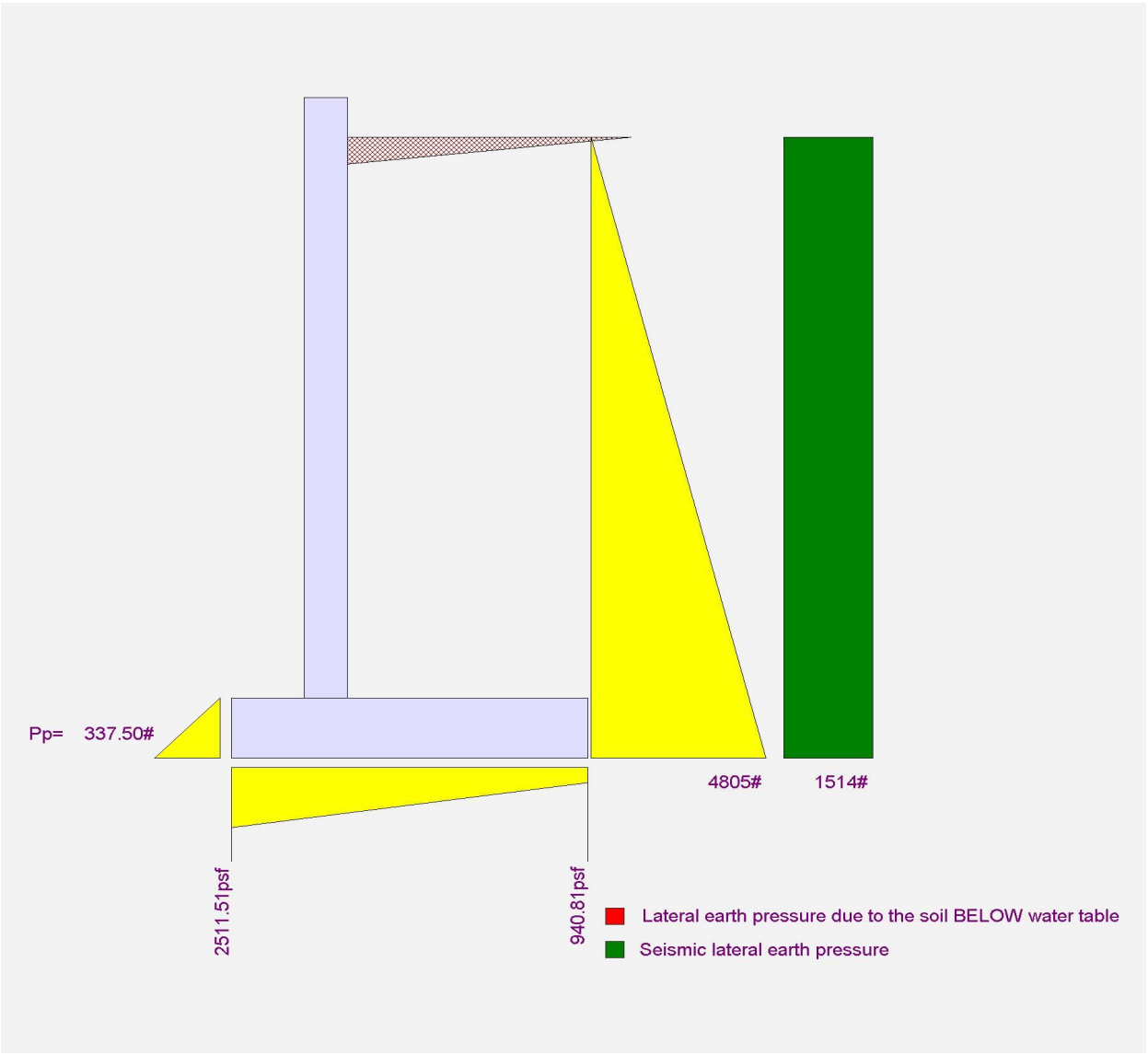
Project File: Foundations.ec6

DESCRIPTION: SE @ Ext wall (11/S3.1)



Cantilevered Retaining Wall

DESCRIPTION: SE @ Ext wall (11/S3.1)



Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 5:49PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ Ext wall (11/S3.1)

Code Reference

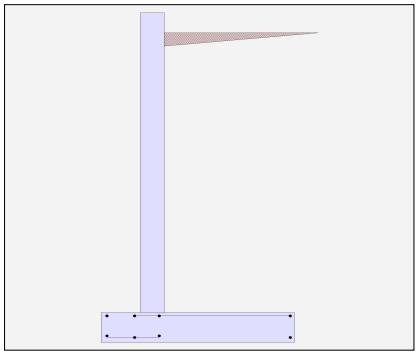
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	14.00 ft
Wall height above soil	=	1.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Axial Load Applied to Stem

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: SE @ Ext wall (11/S3.1)

Design Summary

Wall Stability Ratios

Overturning	=	3.44	OK
Sliding	=	1.61	OK
Global Stability	=	1.57	

Total Bearing Load	=	16,398	lbs
...resultant ecc.	=	2.55	in

Eccentricity within middle third

Soil Pressure @ Toe	=	1,456 psf	OK
Soil Pressure @ Heel	=	1,996 psf	OK
Allowable	=	4,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	2,039 psf	
ACI Factored @ Heel	=	2,794 psf	
Footing Shear @ Toe	=	4.7 psi	OK
Footing Shear @ Heel	=	17.2 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	4,805.0 lbs	
less 100% Passive Force	-	337.5 lbs	
less 100% Friction Force	-	7,379.2 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 considered in the calculation of soil bearing pressures.

Load Factors

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

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	SD SD SD
Thickness	=	12.00
Rebar Size	=	# 7
Rebar Spacing	=	6.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa	=	**0.665**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	6,272.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	29,269.3
Moment.....Allowable	=	43,991.1
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	54.7
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	150.0
Rebar Depth 'd'	in =	9.56

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: SE @ Ext wall (11/S3.1)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.7036 in2/ft	
(4/3) * As :	0.9382 in2/ft	Min Stem T&S Reinf Area 4.320 in2
200bd/fy : 200(12)(9.5625)/60000 :	0.3825 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) :	0.2592 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.7036 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	1.2 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.2954 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	1.67 ft
Heel Width	=	6.50
Total Footing Width	=	8.17
Footing Thickness	=	18.00 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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	2,039	2,794	psf
Mu' : Upward	=	2,904	36,124	ft-#
Mu' : Downward	=	375	57,362	ft-#
Mu: Design	=	2,529 OK	21,238 ft-#	OK
phiMn	=	53,815	39,347	ft-#
Actual 1-Way Shear	=	4.72	17.25	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 6 @ 6.00 in
Heel Reinforcing = # 6 @ 9.02 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@ 45.41 in, #5@ 70.39 in, #6@ 99.91 in, #7@ 136.25 in, #8@ 179.40 in, #9@ 227.08 in, #10@ 288.40 in

Heel: #4@ 5.79 in, #5@ 8.97 in, #6@ 12.73 in, #7@ 17.37 in, #8@ 22.87 in, #9@ 28.95 in, #10@ 36.76 in

Key: No key defined

Min footing T&S reinf Area 3.18 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

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DESCRIPTION: SE @ Ext wall (11/S3.1)

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	4,805.0	5.17	24,825.8	Soil Over HL (ab. water tbl)	10,010.0	5.42	54,224.2
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.42	54,224.2
Hydrostatic Force				Watre Table			
Buoyant Force =				Sloped Soil Over Heel =			
Surcharge over Heel =				Surcharge Over Heel =			
Surcharge Over Toe =				Adjacent Footing Load =			
Adjacent Footing Load =				Axial Dead Load on Stem =			
Added Lateral Load =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =			
=				Surcharge Over Toe =			
				Stem Weight(s) =	2,250.0	2.17	4,875.8
				Earth @ Stem Transitions =			
				Footing Weight =	1,837.6	4.08	7,503.7
				Key Weight =			
				Vert. Component =	2,300.6	8.17	18,789.4
Total =	4,805.0	**O.T.M.** =	24,825.8	**Total =**	16,398.2 lbs	**R.M.=**	85,393.0

Resisting/Overturning Ratio = **3.44**

Vertical Loads used for Soil Pressure = 16,398.2 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.000	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.

DESCRIPTION: SE @ Ext wall (11/S3.1)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #7 bar specified in this stem design segment =	40.95 in
Development length for #7 bar specified in this stem design segment =	31.50 in
Hooked embedment length into footing for #7 bar specified in this stem design segment =	8.62 in
As Provided =	1.2000 in2/ft
As Required =	0.7036 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

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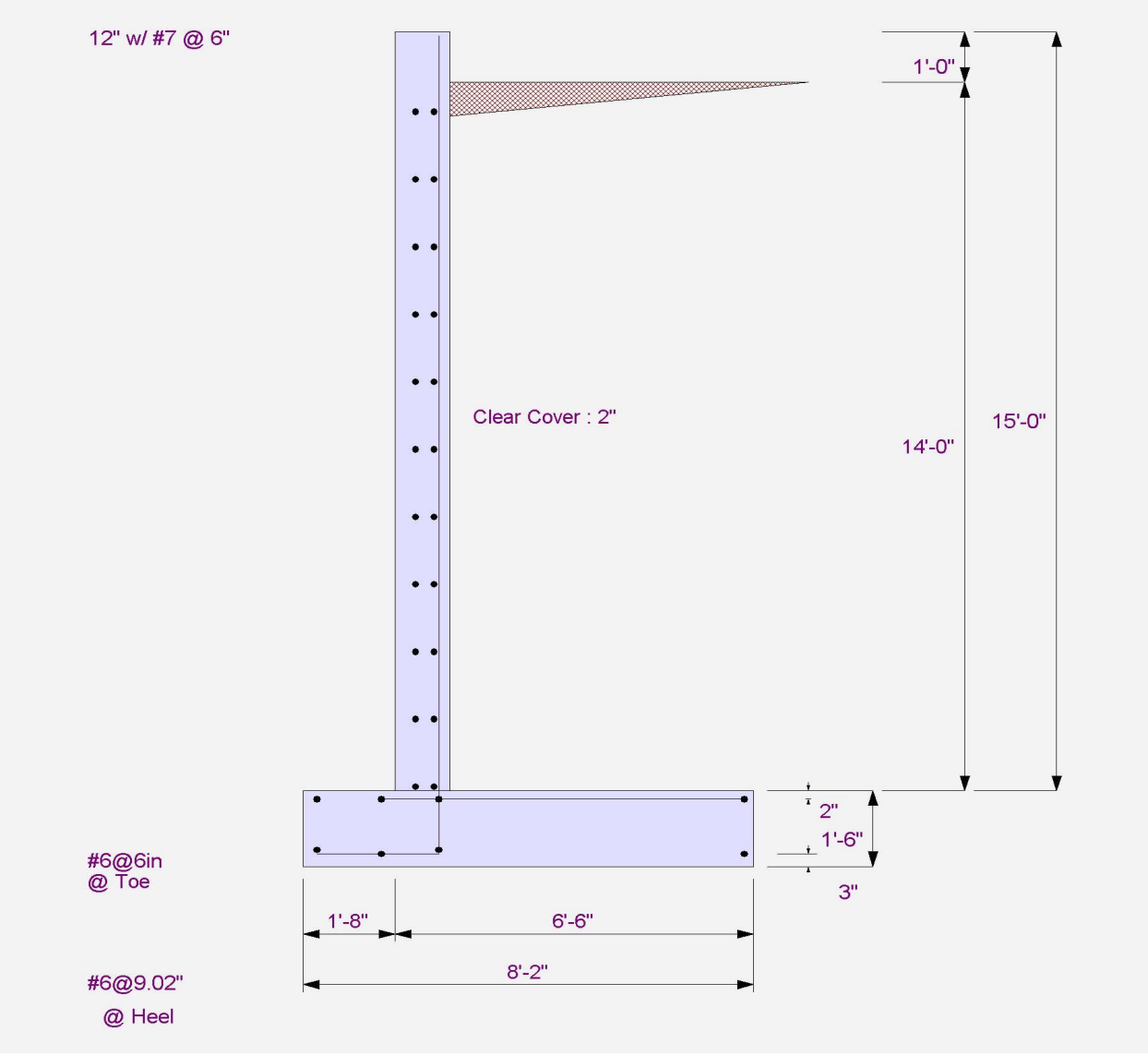
DESCRIPTION: SE @ Ext wall (11/S3.1)



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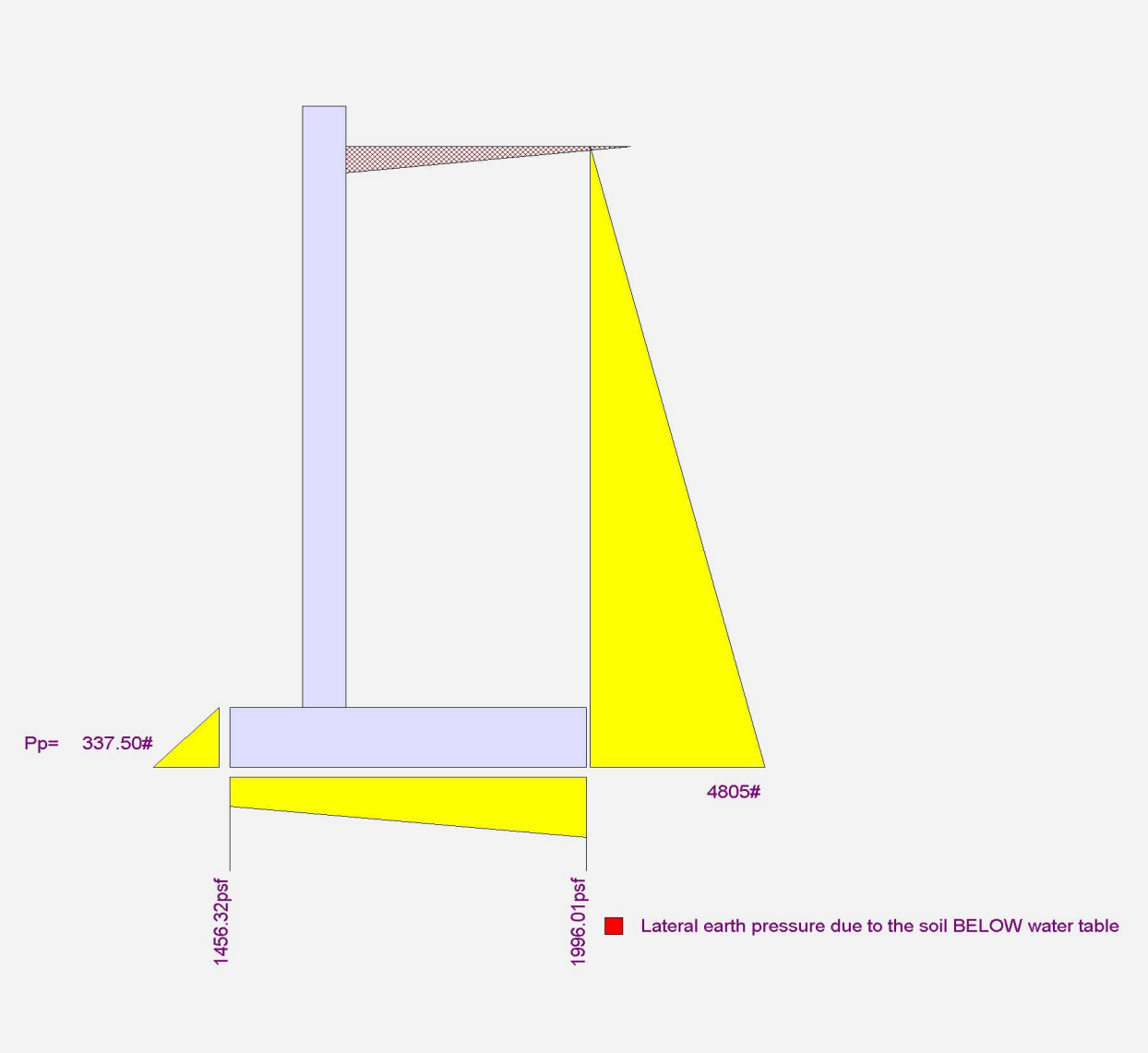
DESCRIPTION: SE @ Ext wall (11/S3.1)



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Engineer:
Project ID:
Project Descr:

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Project File: Foundations.ec6

DESCRIPTION: Garage Wall (12/S3.3)

Code Reference

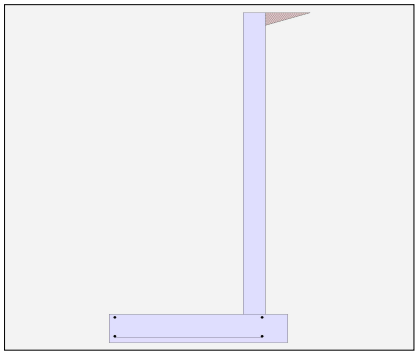
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	16.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	5.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	15.00 ft
...Height to Bottom	=	11.00 ft
Load Type	=	Earth (H) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform		
Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	157.500
Total Seismic Force	=	2,756.250

Project Title:
Engineer:
Project ID:
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Cantilevered Retaining Wall

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DESCRIPTION: Garage Wall (12/S3.3)

Design Summary

Wall Stability Ratios

Overturning	=	2.04	OK
Sliding	=	1.28	Ratio < 1.5!
Global Stability	=	5.62	

Total Bearing Load	=	6,280	lbs
...resultant ecc.	=	15.42	in
Eccentricity within middle third			
Soil Pressure @ Toe	=	1,541	psf OK
Soil Pressure @ Heel	=	29	psf OK
Allowable	=	5,332	psf
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,158	psf
ACI Factored @ Heel	=	40	psf
Footing Shear @ Toe	=	34.5	psi OK
Footing Shear @ Heel	=	18.9	psi OK
Allowable	=	75.0	psi

Sliding Calcs

Lateral Sliding Force	=	2,695.0	lbs
less 100% Passive Force	-	337.5	lbs
less 100% Friction Force	-	3,117.7	lbs
Added Force Req'd	=	0.0	lbs OK
....for 1.5 Stability	=	587.3	lbs NG

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

Load Factors

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

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	12.00		
Rebar Size	=	# 5		
Rebar Spacing	=	6.00		
Rebar Placed at	=	Edge		

Design Data

fb/FB + fa/Fa	=	**0.971**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,544.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	25,621.3
Moment.....Allowable	=	26,382.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	29.0
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	150.0
Rebar Depth 'd'	in =	10.19

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

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DESCRIPTION: Garage Wall (12/S3.3)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.5769 in2/ft	
(4/3) * As :	0.7692 in2/ft	Min Stem T&S Reinf Area 4.608 in2
200bd/fy : 200(12)(10.1875)/60000 :	0.4075 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 :	0.5769 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.62 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3801 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	6.00 ft
Heel Width	=	2.00
Total Footing Width	=	8.00
Footing Thickness	=	18.00 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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,158	40 psf
Mu' : Upward	=	29,313	64 ft-#
Mu' : Downward	=	4,860	2,420 ft-#
Mu: Design	=	24,453 OK	2,356 ft-# OK
phiMn	=	38,943	6,400 ft-#
Actual 1-Way Shear	=	34.52	18.91 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 5 @ 6.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 18.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 4.69 in, #5@ 7.28 in, #6@ 10.33 in, #7@ 14.09 in, #8@ 18.55 in, #9@ 23.48 in, #10@ 29.82 in

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

Key: No key defined

Min footing T&S reinf Area 3.11 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Project Title:
Engineer:
Project ID:
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Printed: 19 SEP 2022, 4:19PM

Cantilevered Retaining Wall

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DESCRIPTION: Garage Wall (12/S3.3)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		765.6	5.83	4,466.1	Soil Over HL (ab. water tbl)	2,080.0	7.50	15,600.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		7.50	15,600.0
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	=		
Seismic Earth Load	=	1,929.4	8.75	16,882.0	Surcharge Over Toe	=		
	=				Stem Weight(s)	=	2,400.0	6.50	15,600.0
					Earth @ Stem Transitions	=			
Total	=	2,695.0	**O.T.M.** =	21,348.2	Footing Weight	=	1,800.0	4.00	7,200.0
					Key Weight	=			
					Vert. Component	=	648.3	8.00	5,186.1
					Total =		6,928.3 lbs	**R.M.=**	43,586.1

Resisting/Overturning Ratio = **2.04**

Vertical Loads used for Soil Pressure = 6,280.0 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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.

DESCRIPTION: Garage Wall (12/S3.3)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #5 bar specified in this stem design segment =	23.40 in
Development length for #5 bar specified in this stem design segment =	18.00 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	9.77 in
As Provided =	0.6200 in2/ft
As Required =	0.5769 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

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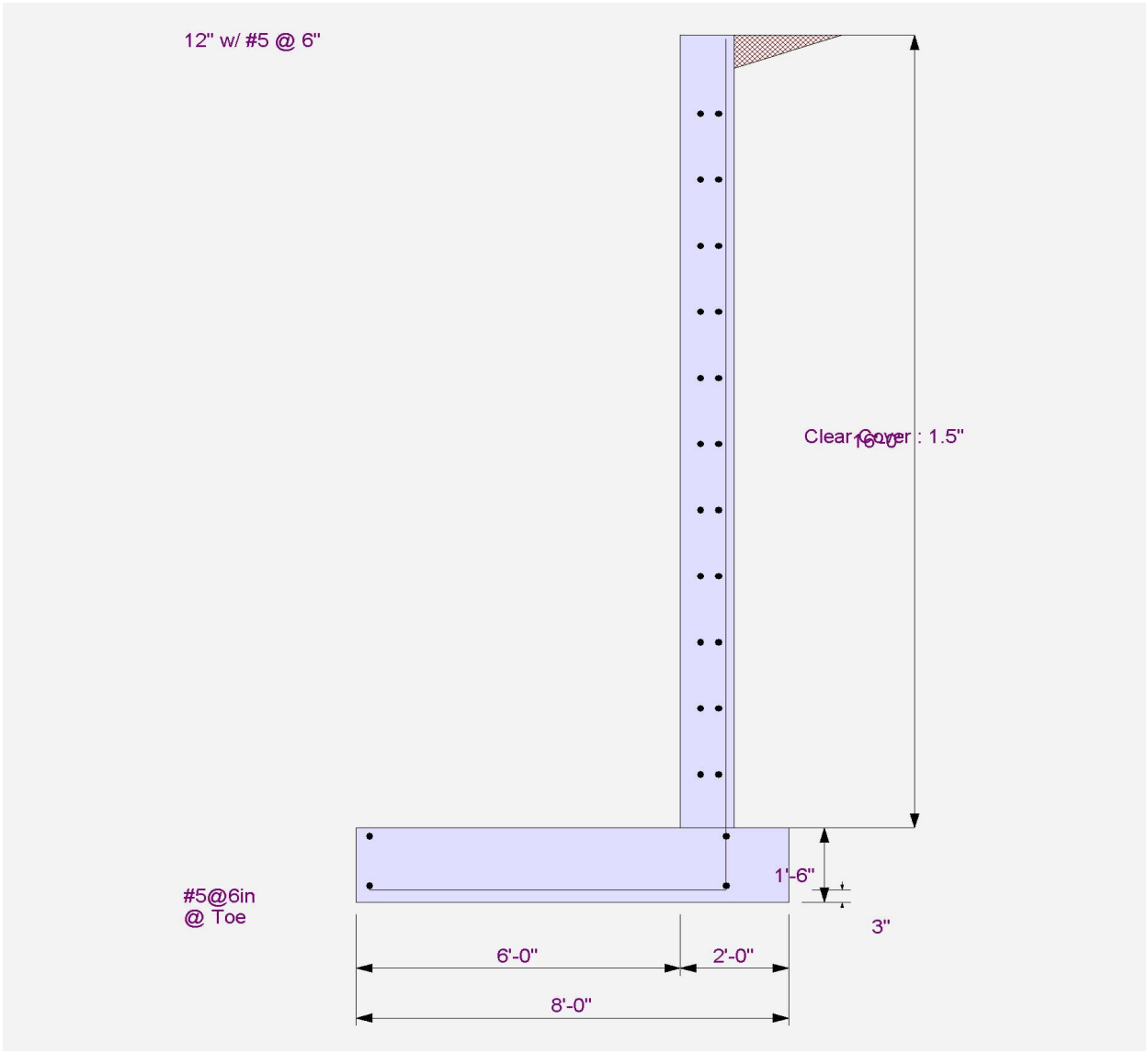
Cantilevered Retaining Wall

Project File: Foundations.ec6

LIC# : KW-06015393, Build:20.22.7.14 BYKONEN CARTER QUINN (c) ENERCALC INC 1983-2022

DESCRIPTION: Garage Wall (12/S3.3)



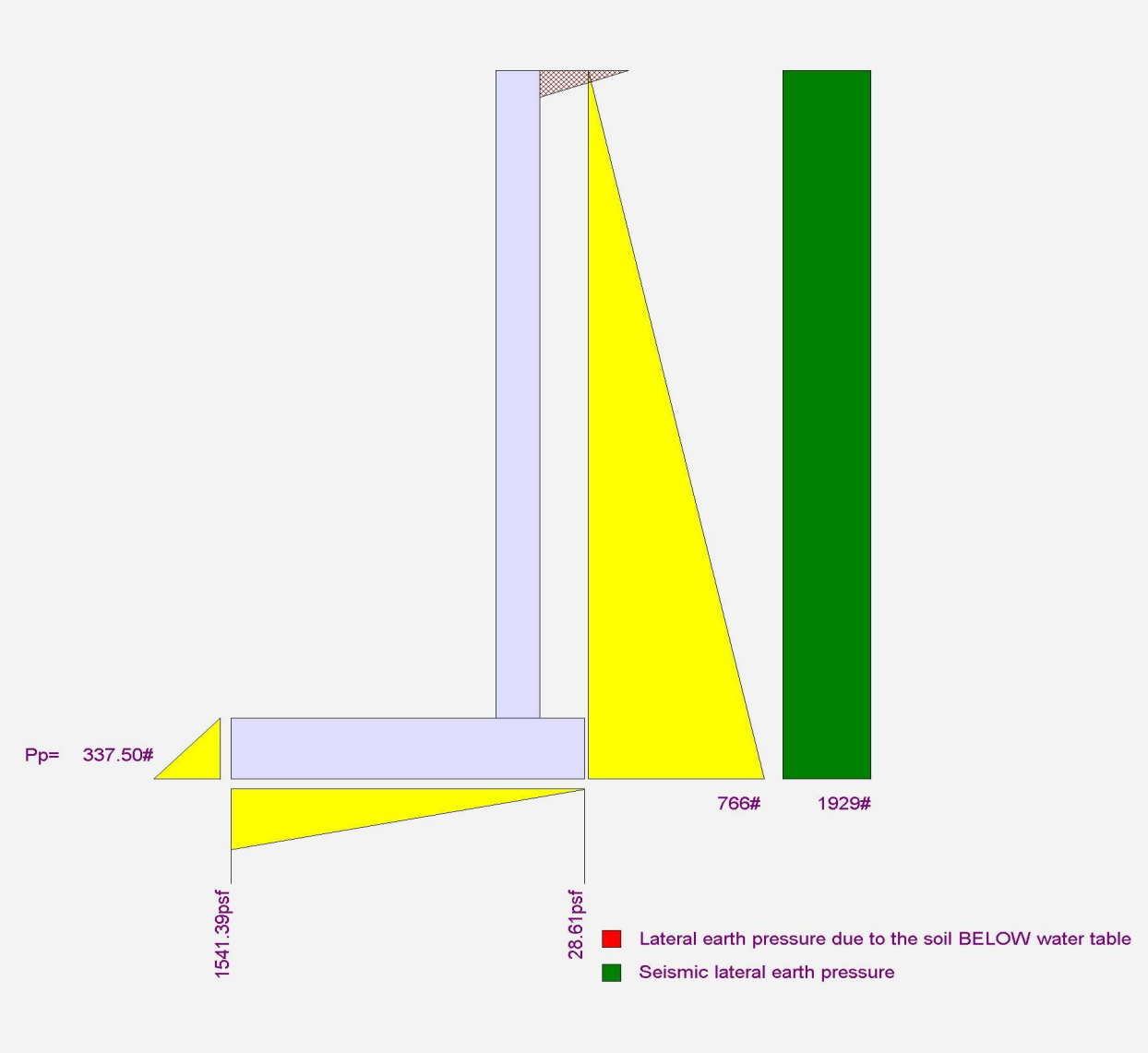
Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 4:19PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage Wall (12/S3.3)



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Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 4:20PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage Wall (12/S3.3)

Code Reference

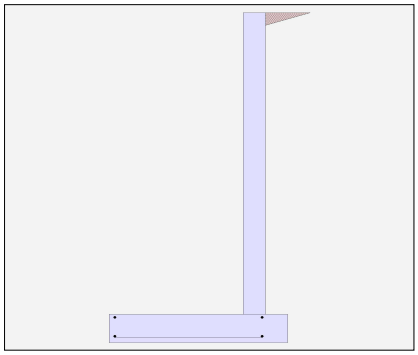
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	16.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	5.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Axial Load Applied to Stem

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

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	15.00 ft
...Height to Bottom	=	11.00 ft
Load Type	=	Earth (H) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

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

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 19 SEP 2022, 4:20PM

Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage Wall (12/S3.3)

Design Summary

Wall Stability Ratios

Overturning	=	9.76	OK
Sliding	=	4.51	OK
Global Stability	=	5.62	

Total Bearing Load	=	6,280 lbs	
...resultant ecc.	=	16.84 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	0 psf	OK
Soil Pressure @ Heel	=	1,612 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	0 psf	
ACI Factored @ Heel	=	2,257 psf	
Footing Shear @ Toe	=	10.0 psi	OK
Footing Shear @ Heel	=	8.8 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	765.6 lbs	
less 100% Passive Force	-	337.5 lbs	
less 100% Friction Force	-	3,117.7 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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	12.00		
Rebar Size	=	# 5		
Rebar Spacing	=	6.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.207**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	1,024.0		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	5,461.3		
Moment.....Allowable	=	26,382.0		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	8.4		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	150.0		
Rebar Depth 'd'	in =	10.19		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage Wall (12/S3.3)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.123 in2/ft		
(4/3) * As :	0.164 in2/ft	Min Stem T&S Reinf Area 4.608 in2	
200bd/fy : 200(12)(10.1875)/60000 :	0.4075 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 :	0.2592 in2/ft	#4@ 8.33 in	#4@ 16.67 in
Provided Area :	0.62 in2/ft	#5@ 12.92 in	#5@ 25.83 in
Maximum Area :	1.3801 in2/ft	#6@ 18.33 in	#6@ 36.67 in

Footing Data

Toe Width	=	6.00 ft
Heel Width	=	2.00
Total Footing Width	=	8.00
Footing Thickness	=	18.00 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 % = 0.0000
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe		Heel	
Factored Pressure	=	0		2,257 psf	
Mu' : Upward	=	9,373		1,080 ft-#	
Mu' : Downward	=	4,860		2,420 ft-#	
Mu: Design	=	4,513	OK	1,340 ft-#	OK
phiMn	=	38,943		6,400 ft-#	
Actual 1-Way Shear	=	10.04		8.81 psi	
Allow 1-Way Shear	=	75.00		40.00 psi	

Toe Reinforcing = # 5 @ 6.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 18.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 25.45 in, #5@ 39.45 in, #6@ 55.99 in, #7@ 76.35 in, #8@ 100.53 in, #9@ 127.26 in, #10@ 161.62 in

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

Key: No key defined

Min footing T&S reinf Area	3.11	in2
Min footing T&S reinf Area per foot	0.39	in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Project Title:
Engineer:
Project ID:
Project Descr:

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Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage Wall (12/S3.3)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		765.6	5.83	4,466.1	Soil Over HL (ab. water tbl)	2,080.0	7.50	15,600.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		7.50	15,600.0
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	=		
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	2,400.0	6.50	15,600.0
					Earth @ Stem Transitions	=		
					Footing Weight	=	1,800.0	4.00	7,200.0
					Key Weight	=			
					Vert. Component	=	648.3	8.00	5,186.1
Total	=	765.6	**O.T.M.** =	4,466.1	**Total =**		6,928.3 lbs	**R.M.=**	43,586.1

Resisting/Overturning Ratio = **9.76**

Vertical Loads used for Soil Pressure = 6,280.0 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.000	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.

DESCRIPTION: Garage Wall (12/S3.3)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #5 bar specified in this stem design segment =	23.40 in
Development length for #5 bar specified in this stem design segment =	18.00 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	6.00 in
As Provided =	0.6200 in2/ft
As Required =	0.2592 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

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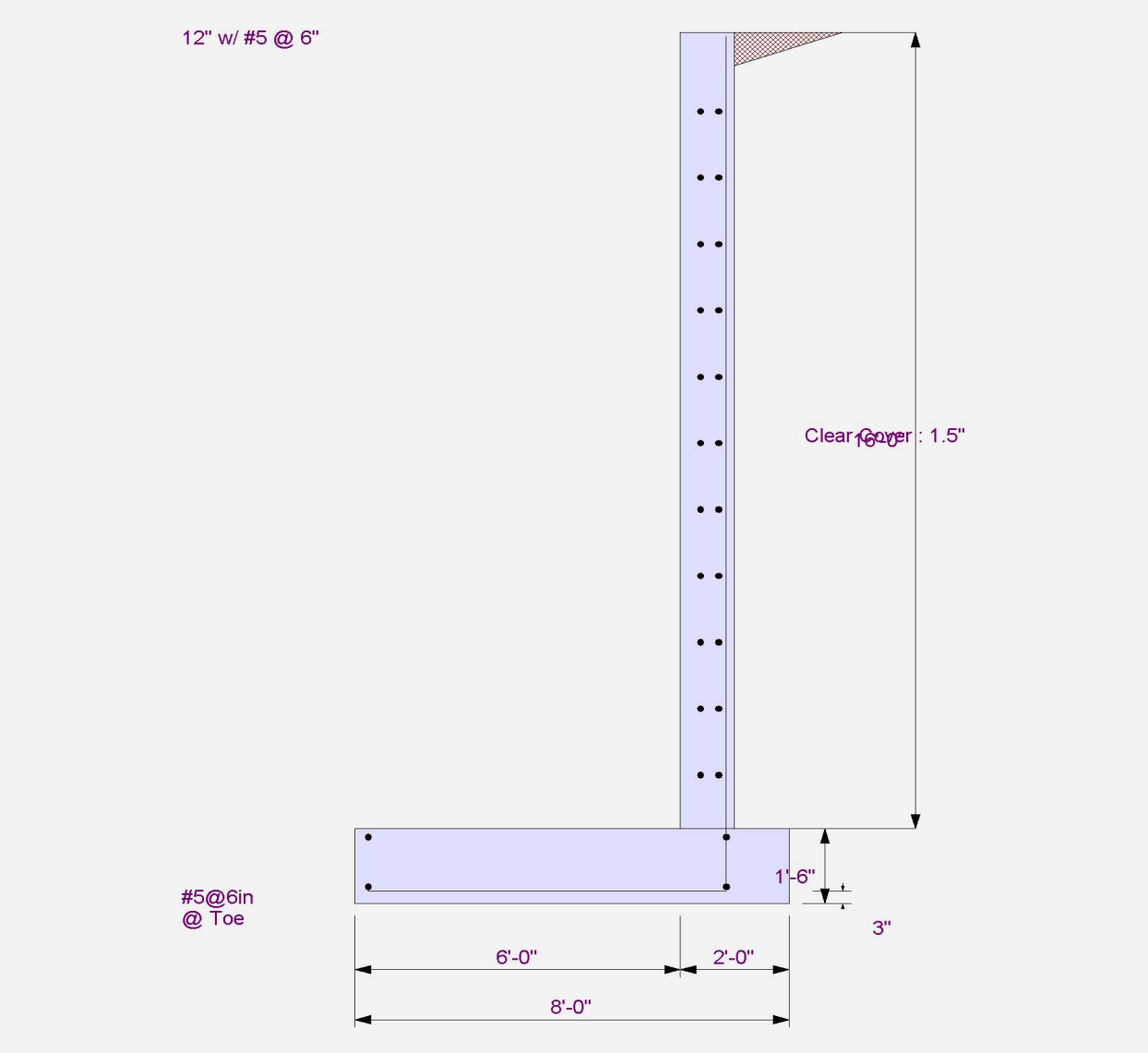
Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage Wall (12/S3.3)



Project Title:
Engineer:
Project ID:
Project Descr:

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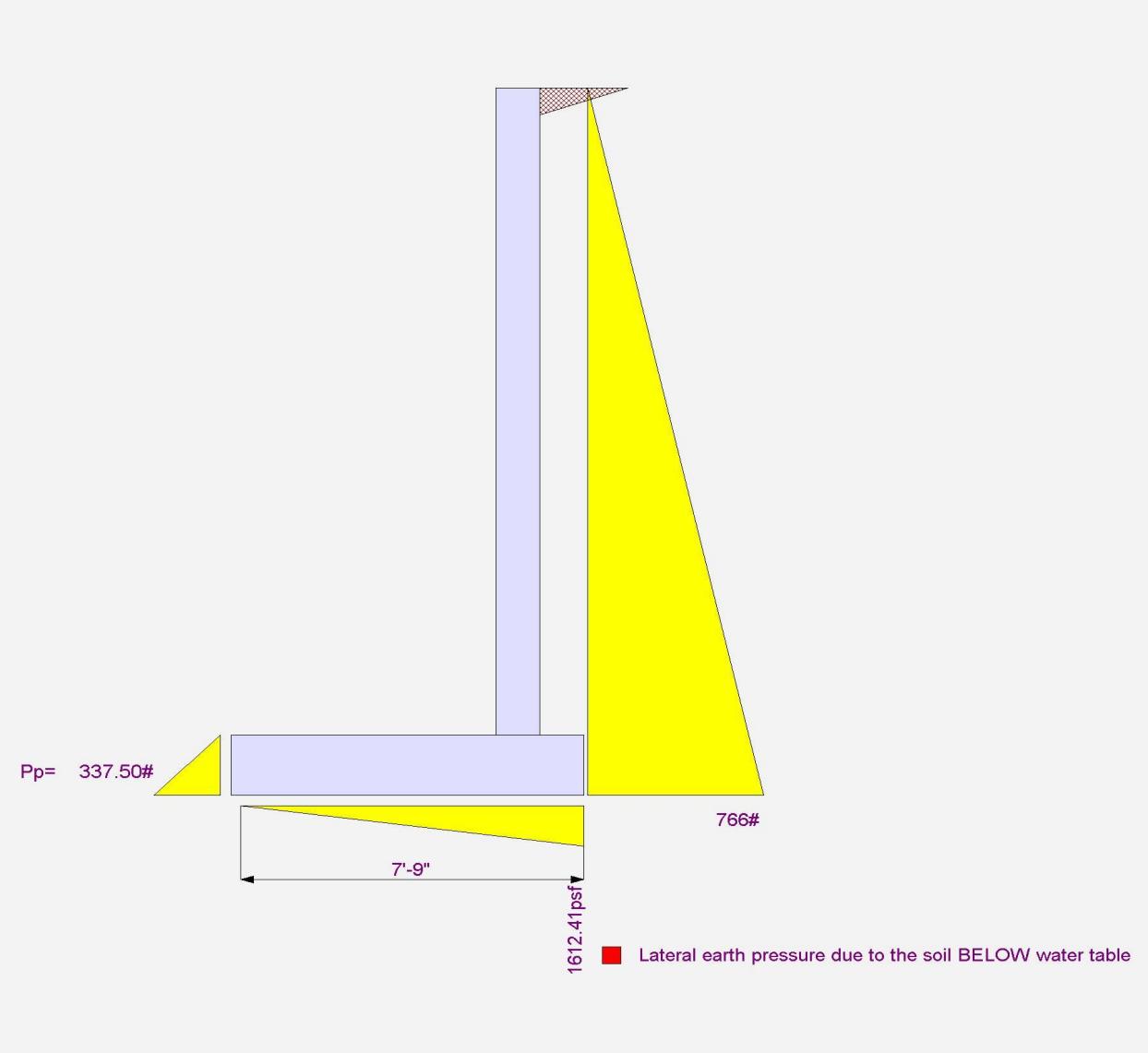
Cantilevered Retaining Wall

Project File: Foundations.ec6

DESCRIPTION: Garage Wall (12/S3.3)



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Cantilevered Retaining Wall

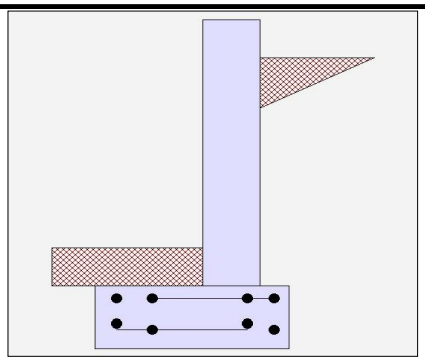
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	3.00 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	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	34.500
Total Seismic Force	=	132.250

Design Summary

Wall Stability Ratios

Overturning	=	2.64	OK
Sliding	=	1.40	Ratio < 1.5!
Total Bearing Load	=	902 lbs	
...resultant ecc.	=	0.77 in	
Soil Pressure @ Toe	=	281 psf	OK
Soil Pressure @ Heel	=	396 psf	OK
Allowable	=	5,332 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	393 psf	
ACI Factored @ Heel	=	554 psf	
Footing Shear @ Toe	=	1.5 psi	OK
Footing Shear @ Heel	=	2.8 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	386.5 lbs	
less 100% Passive Force	= -	136.1 lbs	
less 100% Friction Force	= -	405.9 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	37.7 lbs	NG

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.081**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	391.5
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	443.3
Moment.....Allowable =	5,412.6
Shear.....Actual	
Service Level psi =	
Strength Level psi =	5.2
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0166 in2/ft	
(4/3) * As :	0.0221 in2/ft	Min Stem T&S Reinf Area 0.672 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	1.25 ft
Heel Width	=	1.00
Total Footing Width	=	2.25
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	393	554	psf
Mu' : Upward	=	3,964	33	ft-#
Mu' : Downward	=	2,138	109	ft-#
Mu: Design	=	152	77	ft-#
Actual 1-Way Shear	=	1.49	2.78	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 4 @ 11.11 in
Heel Reinforcing = # 4 @ 11.11 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 0.49 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..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	293.9	1.28	375.5			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
Seismic Earth Load =	92.6	1.92	177.4			
=						
				Soil Over HL (ab. water tbl)	130.0	2.08	270.8
				Soil Over HL (bel. water tbl)		2.08	270.8
				Watre Table			
				Sloped Soil Over Heel =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =		0.63	
				Surcharge Over Toe =			
				Stem Weight(s) =	350.0	1.58	554.2
				Earth @ Stem Transitions =			
				Footing Weight =	281.3	1.13	316.4
				Key Weight =			
				Vert. Component =	140.7	2.25	316.6
Total =	386.5	**O.T.M.** =	553.0	**Total =**	902.0 lbs	**R.M.=**	1,458.0

Resisting/Overturning Ratio = **2.64**
Vertical Loads used for Soil Pressure = 902.0 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.014	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

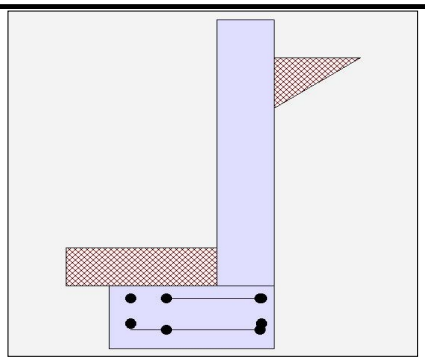
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	3.00 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	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	2.81	OK
Sliding	=	1.52	OK
Total Bearing Load	=	590 lbs	
...resultant ecc.	=	3.19 in	
Soil Pressure @ Toe	=	564 psf	OK
Soil Pressure @ Heel	=	52 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	789 psf	
ACI Factored @ Heel	=	73 psf	
Footing Shear @ Toe	=	3.7 psi	OK
Footing Shear @ Heel	=	2.5 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	293.9 lbs	
less 100% Passive Force	= -	116.7 lbs	
less 100% Friction Force	= -	328.7 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.053**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	288.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	288.0
Moment.....Allowable =	5,412.6
Shear.....Actual	
Service Level psi =	
Strength Level psi =	3.8
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0108 in2/ft		
(4/3) * As :	0.0144 in2/ft	Min Stem T&S Reinf Area 0.672 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	1.25 ft
Heel Width	=	0.67
Total Footing Width	=	1.92
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	=	789	73	psf
Mu' : Upward	=	5,936	0	ft-#
Mu' : Downward	=	2,138	0	ft-#
Mu: Design	=	317	0	ft-#
Actual 1-Way Shear	=	3.66	2.50	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 4 @ 11.11 in
Heel Reinforcing = # 4 @ 11.11 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 0.41 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..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	293.9	1.28	375.5			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				0.1	1.92	0.2
Soil Over HL (bel. water tbl)					1.92	0.2
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =					0.63	
Surcharge Over Toe =						
Stem Weight(s) =				350.0	1.58	554.2
Earth @ Stem Transitions =						
Footing Weight =				239.6	0.96	229.7
Key Weight =						
Vert. Component =				140.7	1.92	269.7
Total =	293.9	**O.T.M.** =	375.5	**Total =** 730.5 lbs	**R.M.=**	1,053.8

Resisting/Overturning Ratio = **2.81**
Vertical Loads used for Soil Pressure = 589.8 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.029	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.

This Wall in File: p:\studio ectypos\steinborn residence ectypos\calculations\retain schedule - site

Cantilevered Retaining Wall

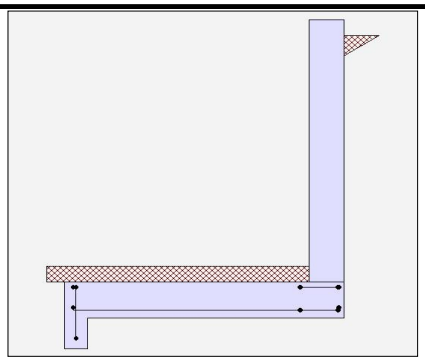
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	82.500
Total Seismic Force	=	756.250

Design Summary

Wall Stability Ratios

Overturning	=	2.66	OK
Sliding	=	1.23	Ratio < 1.5!
Total Bearing Load	=	3,230 lbs	
...resultant ecc.	=	13.72 in	
Soil Pressure @ Toe	=	750 psf	OK
Soil Pressure @ Heel	=	58 psf	OK
Allowable	=	5,332 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,050 psf	
ACI Factored @ Heel	=	81 psf	
Footing Shear @ Toe	=	17.7 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,209.9 lbs	
less 100% Passive Force	= -	1,066.7 lbs	
less 100% Friction Force	= -	1,641.9 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	606.4 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	12.00
Rebar Size =	# 5
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.591**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	2,708.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	8,101.3
Moment.....Allowable =	13,701.3
Shear.....Actual	
Service Level psi =	
Strength Level psi =	22.2
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	10.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	150.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1824 in2/ft		
(4/3) * As :	0.2432 in2/ft	Min Stem T&S Reinf Area 2.448 in2	
200bd/fy : 200(12)(10.1875)/60000 :	0.4075 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 :	0.2592 in2/ft	#4@ 8.33 in	#4@ 16.67 in
Provided Area :	0.31 in2/ft	#5@ 12.92 in	#5@ 25.83 in
Maximum Area :	1.3801 in2/ft	#6@ 18.33 in	#6@ 36.67 in

Footing Data

Toe Width	=	7.00 ft
Heel Width	=	1.00
Total Footing Width	=	8.00
Footing Thickness	=	14.00 in
Key Width	=	8.00 in
Key Depth	=	12.00 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	=	1,050	81 psf
Mu' : Upward	=	225,560	0 ft-#
Mu' : Downward	=	84,672	0 ft-#
Mu: Design	=	11,741	0 ft-#
Actual 1-Way Shear	=	17.74	0.00 psi
Allow 1-Way Shear	=	75.00	0.00 psi

Toe Reinforcing = # 5 @ 10.00 in
Heel Reinforcing = # 5 @ 10.00 in
Key Reinforcing = # 4 @ 13.88 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 7.02 in, #5@ 10.88 in, #6@ 15.45 in, #7@ 21.07 in, #8@ 27.74 in, #9@ 35
Heel: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Key: #4@ 13.88 in, #5@ 18 in, #6@ 18 in, #7@ 18 in, #8@ 18 i

Min footing T&S reinf Area 2.42 in2
Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.94 in	#4@ 15.87 in
#5@ 12.30 in	#5@ 24.60 in
#6@ 17.46 in	#6@ 34.92 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,680.6	3.06	5,135.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
Seismic Earth Load =	529.4	4.58	2,426.3			
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				455.0	3.50	1,592.5
Surcharge Over Toe =						
Stem Weight(s) =				1,275.0	7.50	9,562.5
Earth @ Stem Transitions =						
Footing Weight =				1,400.0	4.00	5,600.0
Key Weight =				100.0	0.33	33.3
Vert. Component =				418.6	8.00	3,348.7
Total =	2,209.9	**O.T.M.** =	7,561.3	**Total =** 3,648.6 lbs	**R.M.=**	20,137.0

Resisting/Overturning Ratio = **2.66**
Vertical Loads used for Soil Pressure = 3,230.0 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.022	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

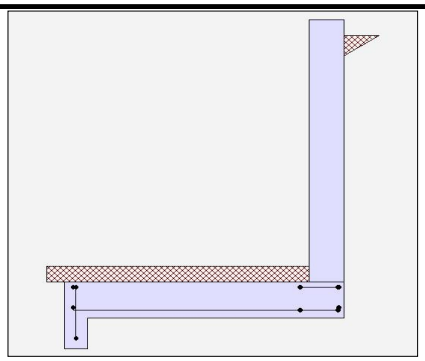
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	3.92	OK
Sliding	=	1.61	OK
Total Bearing Load	=	3,230 lbs	
...resultant ecc.	=	4.71 in	
Soil Pressure @ Toe	=	523 psf	OK
Soil Pressure @ Heel	=	285 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	732 psf	
ACI Factored @ Heel	=	399 psf	
Footing Shear @ Toe	=	14.1 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,680.6 lbs	
less 100% Passive Force	= -	1,066.7 lbs	
less 100% Friction Force	= -	1,641.9 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

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

Load Factors

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

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	12.00
Rebar Size	=	# 5
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.398**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	2,048.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	5,461.3
Moment.....Allowable	=	13,701.3
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	16.8
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	10.19
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	150.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.123 in2/ft	
(4/3) * As :	0.164 in2/ft	Min Stem T&S Reinf Area 2.448 in2
200bd/fy : 200(12)(10.1875)/60000 :	0.4075 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 :	0.2592 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.31 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3801 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	7.00 ft
Heel Width	=	1.00
Total Footing Width	=	8.00
Footing Thickness	=	14.00 in
Key Width	=	8.00 in
Key Depth	=	12.00 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	=	732	399 psf
Mu' : Upward	=	186,550	0 ft-#
Mu' : Downward	=	84,672	0 ft-#
Mu: Design	=	8,490	0 ft-#
Actual 1-Way Shear	=	14.11	0.00 psi
Allow 1-Way Shear	=	75.00	0.00 psi

Toe Reinforcing = # 5 @ 10.00 in
Heel Reinforcing = # 5 @ 10.00 in
Key Reinforcing = # 4 @ 13.88 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Heel: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Key: #4@ 13.88 in, #5@ 18 in, #6@ 18 in, #7@ 18 in, #8@ 18 i

Min footing T&S reinf Area 2.42 in2
Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.94 in	#4@ 15.87 in
#5@ 12.30 in	#5@ 24.60 in
#6@ 17.46 in	#6@ 34.92 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,680.6	3.06	5,135.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				455.0	3.50	1,592.5
Surcharge Over Toe =						
Stem Weight(s) =				1,275.0	7.50	9,562.5
Earth @ Stem Transitions =						
Footing Weight =				1,400.0	4.00	5,600.0
Key Weight =				100.0	0.33	33.3
Vert. Component =				418.6	8.00	3,348.7
Total =	1,680.6	**O.T.M.** =	5,135.0	**Total =** 3,648.6 lbs	**R.M.=**	20,137.0

Resisting/Overturning Ratio = **3.92**
Vertical Loads used for Soil Pressure = 3,230.0 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.015	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

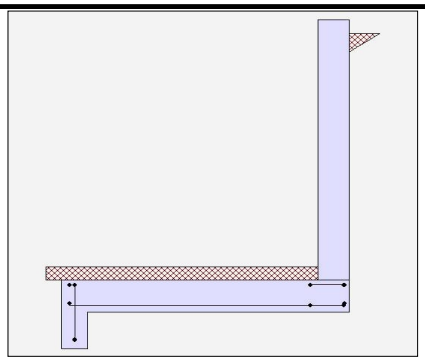
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	91.500
Total Seismic Force	=	930.250

Design Summary

Wall Stability Ratios

Overturning	=	2.62	OK
Sliding	=	1.20	Ratio < 1.5!
Total Bearing Load	=	3,747 lbs	
...resultant ecc.	=	17.32 in	
Soil Pressure @ Toe	=	784 psf	OK
Soil Pressure @ Heel	=	26 psf	OK
Allowable	=	5,332 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,098 psf	
ACI Factored @ Heel	=	36 psf	
Footing Shear @ Toe	=	21.1 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,718.4 lbs
less 100% Passive Force	= -	1,350.0 lbs
less 100% Friction Force	= -	1,917.7 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	809.9 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	12.00
Rebar Size =	# 5
Rebar Spacing =	8.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.569**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	3,415.5
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	11,481.8
Moment.....Allowable =	20,169.2
Shear.....Actual	
Service Level psi =	
Strength Level psi =	27.9
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	10.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	150.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.2585 in2/ft	
(4/3) * As :	0.3447 in2/ft	Min Stem T&S Reinf Area 2.736 in2
200bd/fy : 200(12)(10.1875)/60000 :	0.4075 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 :	0.3447 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.465 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3801 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	8.25 ft
Heel Width	=	1.00
Total Footing Width	=	9.25
Footing Thickness	=	14.00 in
Key Width	=	10.00 in
Key Depth	=	16.00 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	=	1,098	36 psf
Mu' : Upward	=	319,458	0 ft-#
Mu' : Downward	=	117,612	0 ft-#
Mu: Design	=	16,821	0 ft-#
Actual 1-Way Shear	=	21.11	0.00 psi
Allow 1-Way Shear	=	75.00	0.00 psi

Toe Reinforcing = # 5 @ 8.00 in
Heel Reinforcing = # 5 @ 8.00 in
Key Reinforcing = # 4 @ 10.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 5.71 in, #5@ 8.85 in, #6@ 12.57 in, #7@ 17.14 in, #8@ 22.57 in, #9@ 28.
Heel: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Key: #4@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 1

Min footing T&S reinf Area 2.80 in2
Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.94 in	#4@ 15.87 in
#5@ 12.30 in	#5@ 24.60 in
#6@ 17.46 in	#6@ 34.92 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	2,067.2	3.39	7,005.6			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
Seismic Earth Load =	651.2	5.08	3,310.1			
=						
Total =	2,718.4	**O.T.M.** =	10,315.7			
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				536.3	4.13	2,212.0
Surcharge Over Toe =						
Stem Weight(s) =				1,425.0	8.75	12,468.8
Earth @ Stem Transitions =						
Footing Weight =				1,618.8	4.63	7,486.7
Key Weight =				166.7	0.42	69.4
Vert. Component =				514.9	9.25	4,762.7
Total =				4,261.6 lbs	**R.M.=**	26,999.7

Resisting/Overturning Ratio = **2.62**
Vertical Loads used for Soil Pressure = 3,746.7 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.022	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

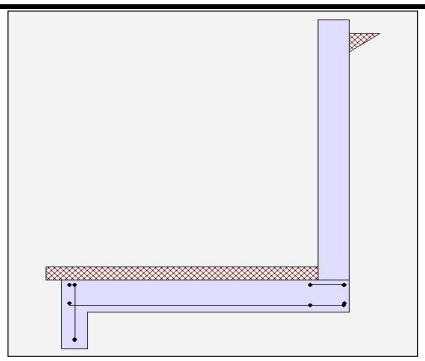
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	3.85	OK
Sliding	=	1.58	OK
Total Bearing Load	=	3,747 lbs	
...resultant ecc.	=	6.72 in	
Soil Pressure @ Toe	=	552 psf	OK
Soil Pressure @ Heel	=	258 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	773 psf	
ACI Factored @ Heel	=	361 psf	
Footing Shear @ Toe	=	17.3 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,067.2 lbs	
less 100% Passive Force	= -	1,350.0 lbs	
less 100% Friction Force	= -	1,917.7 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	12.00
Rebar Size =	# 5
Rebar Spacing =	8.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.385**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	2,592.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	7,776.0
Moment.....Allowable =	20,169.2
Shear.....Actual	
Service Level psi =	
Strength Level psi =	21.2
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	10.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	150.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1751 in2/ft		
(4/3) * As :	0.2335 in2/ft	Min Stem T&S Reinf Area 2.736 in2	
200bd/fy : 200(12)(10.1875)/60000 :	0.4075 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 :	0.2592 in2/ft	#4@ 8.33 in	#4@ 16.67 in
Provided Area :	0.465 in2/ft	#5@ 12.92 in	#5@ 25.83 in
Maximum Area :	1.3801 in2/ft	#6@ 18.33 in	#6@ 36.67 in

Footing Data

Toe Width	=	8.25 ft
Heel Width	=	1.00
Total Footing Width	=	9.25
Footing Thickness	=	14.00 in
Key Width	=	10.00 in
Key Depth	=	16.00 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	=	773	361	psf
Mu' : Upward	=	265,657	0	ft-#
Mu' : Downward	=	117,612	0	ft-#
Mu: Design	=	12,337	0	ft-#
Actual 1-Way Shear	=	17.25	0.00	psi
Allow 1-Way Shear	=	75.00	0.00	psi

Toe Reinforcing = # 5 @ 8.00 in
Heel Reinforcing = # 5 @ 8.00 in
Key Reinforcing = # 4 @ 10.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 6.68 in, #5@ 10.36 in, #6@ 14.70 in, #7@ 20.05 in, #8@ 26.40 in, #9@ 33
Heel: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Key: #4@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 1

Min footing T&S reinf Area 2.80 in2
Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.94 in	#4@ 15.87 in
#5@ 12.30 in	#5@ 24.60 in
#6@ 17.46 in	#6@ 34.92 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	2,067.2	3.39	7,005.6			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				536.3	4.13	2,212.0
Surcharge Over Toe =						
Stem Weight(s) =				1,425.0	8.75	12,468.8
Earth @ Stem Transitions =						
Footing Weight =				1,618.8	4.63	7,486.7
Key Weight =				166.7	0.42	69.4
Vert. Component =				514.9	9.25	4,762.7
Total =	2,067.2	**O.T.M.** =	7,005.6	**Total =** 4,261.6 lbs	**R.M.=**	26,999.7

Resisting/Overturning Ratio = **3.85**
Vertical Loads used for Soil Pressure = 3,746.7 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.016	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.

This Wall in File: p:\studio ectypos\steinborn residence ectypos\calculations\retain schedule - site

Cantilevered Retaining Wall

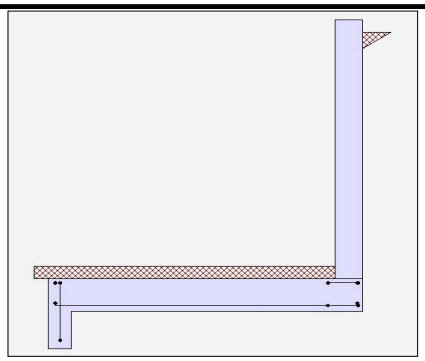
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	102.000
Total Seismic Force	=	1,156.000

Design Summary

Wall Stability Ratios

Overturning	=	2.82	OK
Sliding	=	1.20	Ratio < 1.5!
Total Bearing Load	=	4,679 lbs	
...resultant ecc.	=	19.31 in	
Soil Pressure @ Toe	=	773 psf	OK
Soil Pressure @ Heel	=	59 psf	OK
Allowable	=	5,332 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,082 psf	
ACI Factored @ Heel	=	83 psf	
Footing Shear @ Toe	=	20.2 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	3,378.1 lbs
less 100% Passive Force	= -	1,666.7 lbs
less 100% Friction Force	= -	2,393.4 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	1,007.1 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	12.00
Rebar Size =	# 6
Rebar Spacing =	10.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.737**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	4,220.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	15,766.7
Moment.....Allowable =	21,388.7
Shear.....Actual	
Service Level psi =	
Strength Level psi =	36.5
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	9.63
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	150.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3765 in2/ft	
(4/3) * As :	0.502 in2/ft	Min Stem T&S Reinf Area 3.024 in2
200bd/fy : 200(12)(9.625)/60000 :	0.385 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) :	0.2592 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.385 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.528 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	=	10.25 ft
Heel Width	=	1.00
Total Footing Width	=	11.25
Footing Thickness	=	16.00 in
Key Width	=	10.00 in
Key Depth	=	18.00 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	=	1,082	83 psf
Mu' : Upward	=	490,682	0 ft-#
Mu' : Downward	=	200,459	0 ft-#
Mu: Design	=	24,185	0 ft-#
Actual 1-Way Shear	=	20.19	0.00 psi
Allow 1-Way Shear	=	75.00	0.00 psi

Toe Reinforcing = # 6 @ 10.56 in
Heel Reinforcing = # 6 @ 15.27 in
Key Reinforcing = # 4 @ 10.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 4.80 in, #5@ 7.43 in, #6@ 10.56 in, #7@ 14.39 in, #8@ 18.96 in, #9@ 24.
Heel: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 20.83 in, #8@ 27.43 in, #9@ 34
Key: #4@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 1

Min footing T&S reinf Area 3.89 in2
Min footing T&S reinf Area per foot 0.35 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.94 in	#4@ 13.89 in
#5@ 10.76 in	#5@ 21.53 in
#6@ 15.28 in	#6@ 30.56 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	2,568.9	3.78	9,704.7			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
Seismic Earth Load =	809.2	5.67	4,585.5			
=						
Total =	3,378.1	**O.T.M.** =	14,290.2			
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				666.3	5.13	3,414.5
Surcharge Over Toe =						
Stem Weight(s) =				1,575.0	10.75	16,931.3
Earth @ Stem Transitions =						
Footing Weight =				2,250.0	5.63	12,656.3
Key Weight =				187.5	0.42	78.1
Vert. Component =				639.8	11.25	7,198.2
Total =				5,318.6 lbs	**R.M.=**	40,278.4

Resisting/Overturning Ratio = **2.82**
Vertical Loads used for Soil Pressure = 4,678.8 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.020	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

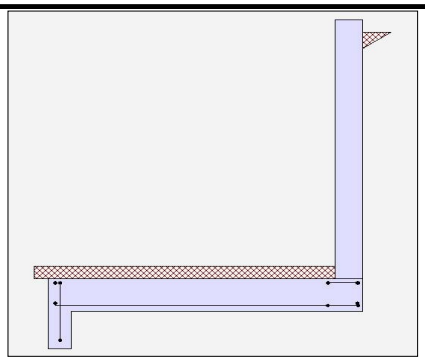
Code: IBC 2018,ACI 318-14,TMS 402-16

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	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	4.15	OK
Sliding	=	1.58	OK
Total Bearing Load	=	4,679 lbs	
...resultant ecc.	=	7.55 in	
Soil Pressure @ Toe	=	555 psf	OK
Soil Pressure @ Heel	=	276 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	778 psf	
ACI Factored @ Heel	=	387 psf	
Footing Shear @ Toe	=	16.8 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,568.9 lbs	
less 100% Passive Force	= -	1,666.7 lbs	
less 100% Friction Force	= -	2,393.4 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	12.00
Rebar Size =	# 6
Rebar Spacing =	10.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.498**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	3,200.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	10,666.7
Moment.....Allowable =	21,388.7
Shear.....Actual	
Service Level psi =	
Strength Level psi =	27.7
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	9.63
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	150.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.2547 in2/ft	
(4/3) * As :	0.3396 in2/ft	Min Stem T&S Reinf Area 3.024 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 :	0.3396 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.528 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	=	10.25 ft
Heel Width	=	1.00
Total Footing Width	=	11.25
Footing Thickness	=	16.00 in
Key Width	=	10.00 in
Key Depth	=	18.00 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	=	778	387 psf
Mu' : Upward	=	415,364	0 ft-#
Mu' : Downward	=	200,459	0 ft-#
Mu: Design	=	17,909	0 ft-#
Actual 1-Way Shear	=	16.80	0.00 psi
Allow 1-Way Shear	=	75.00	0.00 psi

Toe Reinforcing = # 6 @ 10.56 in
Heel Reinforcing = # 6 @ 15.27 in
Key Reinforcing = # 4 @ 10.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 5.50 in, #5@ 8.53 in, #6@ 12.12 in, #7@ 16.52 in, #8@ 21.76 in, #9@ 27.
Heel: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 20.83 in, #8@ 27.43 in, #9@ 34
Key: #4@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 1

Min footing T&S reinf Area 3.89 in2
Min footing T&S reinf Area per foot 0.35 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.94 in	#4@ 13.89 in
#5@ 10.76 in	#5@ 21.53 in
#6@ 15.28 in	#6@ 30.56 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	2,568.9	3.78	9,704.7			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				666.3	5.13	3,414.5
Surcharge Over Toe =						
Stem Weight(s) =				1,575.0	10.75	16,931.3
Earth @ Stem Transitions =						
Footing Weight =				2,250.0	5.63	12,656.3
Key Weight =				187.5	0.42	78.1
Vert. Component =				639.8	11.25	7,198.2
Total =	2,568.9	**O.T.M.** =	9,704.7	**Total =** 5,318.6 lbs	**R.M.=**	40,278.4

Resisting/Overturning Ratio = **4.15**
Vertical Loads used for Soil Pressure = 4,678.8 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.014	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

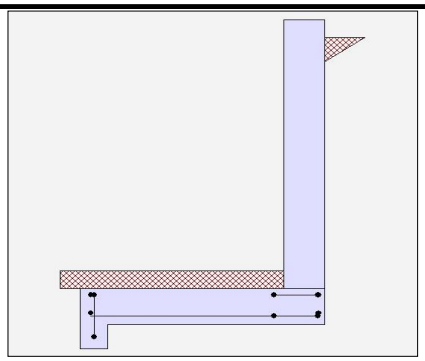
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	7.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	3.41	OK
Sliding	=	1.51	OK
Total Bearing Load	=	2,735 lbs	
...resultant ecc.	=	4.83 in	
Soil Pressure @ Toe	=	241 psf	OK
Soil Pressure @ Heel	=	565 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	337 psf	
ACI Factored @ Heel	=	791 psf	
Footing Shear @ Toe	=	9.1 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,280.0 lbs	
less 100% Passive Force	= -	704.2 lbs	
less 100% Friction Force	= -	1,231.0 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 considered in the calculation of soil bearing pressures.

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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	12.00
Rebar Size =	# 5
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.267**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	1,568.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	3,658.7
Moment.....Allowable =	13,701.3
Shear.....Actual	
Service Level psi =	
Strength Level psi =	12.8
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	10.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	150.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0824 in2/ft	
(4/3) * As :	0.1098 in2/ft	Min Stem T&S Reinf Area 2.160 in2
200bd/fy : 200(12)(10.1875)/60000 :	0.4075 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 :	0.2592 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.31 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	1.3801 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Data

Toe Width	=	5.00 ft
Heel Width	=	1.00
Total Footing Width	=	6.00
Footing Thickness	=	12.00 in
Key Width	=	8.00 in
Key Depth	=	8.00 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	=	337	791 psf
Mu' : Upward	=	69,467	0 ft-#
Mu' : Downward	=	38,700	0 ft-#
Mu: Design	=	2,564	0 ft-#
Actual 1-Way Shear	=	9.06	0.00 psi
Allow 1-Way Shear	=	75.00	0.00 psi

Toe Reinforcing = # 5 @ 12.00 in
Heel Reinforcing = # 5 @ 12.00 in
Key Reinforcing = # 4 @ 13.88 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 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: #4@ 13.88 in, #5@ 18 in, #6@ 18 in, #7@ 18 in, #8@ 18 i

Min footing T&S reinf Area 1.56 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..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,280.0	2.67	3,413.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				325.0	2.50	812.5
Surcharge Over Toe =						
Stem Weight(s) =				1,125.0	5.50	6,187.5
Earth @ Stem Transitions =						
Footing Weight =				900.0	3.00	2,700.0
Key Weight =				66.7	0.33	22.2
Vert. Component =				318.8	6.00	1,912.9
Total =	1,280.0	**O.T.M.** =	3,413.3	**Total =** 2,735.5 lbs	**R.M.=**	11,635.1

Resisting/Overturning Ratio = **3.41**
Vertical Loads used for Soil Pressure = 2,735.5 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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)	0.014	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

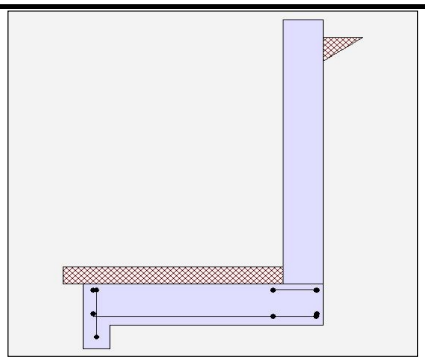
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	7.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	73.500
Total Seismic Force	=	600.250

Design Summary

Wall Stability Ratios

Overturning	=	2.28	OK
Sliding	=	1.21	Ratio < 1.5!
Total Bearing Load	=	2,567 lbs	
...resultant ecc.	=	13.44 in	
Soil Pressure @ Toe	=	910 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	5,332 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,274 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	16.2 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,754.1 lbs	
less 100% Passive Force	= -	816.7 lbs	
less 100% Friction Force	= -	1,304.5 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	509.9 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	12.00
Rebar Size =	# 5
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.398**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	2,082.5
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	5,459.4
Moment.....Allowable =	13,701.3
Shear.....Actual	
Service Level psi =	
Strength Level psi =	17.0
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	10.19
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

This Wall in File: p:\studio ectypos\steinborn residence ectypos\calculations\retain schedule - site

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) :	0.1229 in2/ft		
(4/3) * As :	0.1639 in2/ft	Min Stem T&S Reinf Area 2.160 in2	
200bd/fy : 200(12)(10.1875)/60000 :	0.4075 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 :	0.2592 in2/ft	#4@ 8.33 in	#4@ 16.67 in
Provided Area :	0.31 in2/ft	#5@ 12.92 in	#5@ 25.83 in
Maximum Area :	1.3801 in2/ft	#6@ 18.33 in	#6@ 36.67 in

Footing Data

Toe Width	=	5.00 ft
Heel Width	=	1.00
Total Footing Width	=	6.00
Footing Thickness	=	14.00 in
Key Width	=	8.00 in
Key Depth	=	8.00 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	=	1,274	0 psf
Mu' : Upward	=	134,652	0 ft-#
Mu' : Downward	=	43,200	0 ft-#
Mu: Design	=	7,621	0 ft-#
Actual 1-Way Shear	=	16.18	0.00 psi
Allow 1-Way Shear	=	75.00	0.00 psi

Toe Reinforcing = # 5 @ 11.48 in
Heel Reinforcing = # 5 @ 11.48 in
Key Reinforcing = # 4 @ 13.88 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Heel: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Key: #4@ 13.88 in, #5@ 18 in, #6@ 18 in, #7@ 18 in, #8@ 18 i

Min footing T&S reinf Area 1.81 in2
Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.94 in	#4@ 15.87 in
#5@ 12.30 in	#5@ 24.60 in
#6@ 17.46 in	#6@ 34.92 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,333.9	2.72	3,631.1			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
Seismic Earth Load =	420.2	4.08	1,715.7			
=						
Soil Over HL (ab. water tbl)						
Soil Over HL (bel. water tbl)						
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				325.0	2.50	812.5
Surcharge Over Toe =						
Stem Weight(s) =				1,125.0	5.50	6,187.5
Earth @ Stem Transitions =						
Footing Weight =				1,050.0	3.00	3,150.0
Key Weight =				66.7	0.33	22.2
Vert. Component =				332.2	6.00	1,993.4
Total =	1,754.1	**O.T.M.** =	5,346.9	**Total =** 2,898.9 lbs	**R.M.=**	12,165.6

Resisting/Overturning Ratio = **2.28**
Vertical Loads used for Soil Pressure = 2,566.7 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.032	in

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

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Cantilevered Retaining Wall

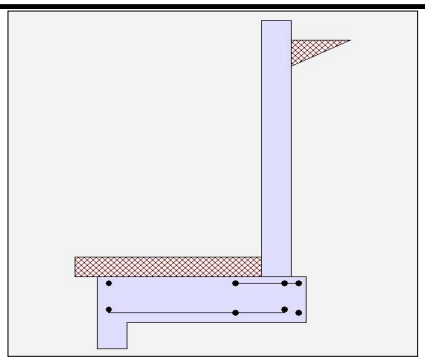
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

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

Soil Data

Allow Soil Bearing	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	3.44	OK
Sliding	=	1.90	OK
Total Bearing Load	=	2,032 lbs	
...resultant ecc.	=	6.26 in	
Soil Pressure @ Toe	=	727 psf	OK
Soil Pressure @ Heel	=	143 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,018 psf	
ACI Factored @ Heel	=	201 psf	
Footing Shear @ Toe	=	10.2 psi	OK
Footing Shear @ Heel	=	7.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,027.2 lbs	
less 100% Passive Force	= -	816.7 lbs	
less 100% Friction Force	= -	1,135.6 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.425**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	1,152.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	2,304.0
Moment.....Allowable =	5,412.6
Shear.....Actual	
Service Level psi =	
Strength Level psi =	15.4
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0863 in2/ft		
(4/3) * As :	0.1151 in2/ft	Min Stem T&S Reinf Area 1.248 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 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	=	3.67 ft
Heel Width	=	1.00
Total Footing Width	=	4.67
Footing Thickness	=	14.00 in
Key Width	=	8.00 in
Key Depth	=	8.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	1,018	201	psf
Mu' : Upward	=	64,874	12	ft-#
Mu' : Downward	=	23,236	326	ft-#
Mu: Design	=	3,470	314	ft-#
Actual 1-Way Shear	=	10.19	7.91	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 5 @ 12.00 in
Heel Reinforcing = # 5 @ 12.00 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@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Heel: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Key: phiMn = phi'5'lambda'sqrt(fc)'Sm

Min footing T&S reinf Area 1.41 in2
Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.94 in	#4@ 15.87 in
#5@ 12.30 in	#5@ 24.60 in
#6@ 17.46 in	#6@ 34.92 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,027.2	2.39	2,453.9			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				260.0	4.50	1,170.1
Soil Over HL (bel. water tbl)					4.50	1,170.1
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				238.4	1.83	437.0
Surcharge Over Toe =						
Stem Weight(s) =				650.0	4.00	2,600.2
Earth @ Stem Transitions =						
Footing Weight =				816.7	2.33	1,905.8
Key Weight =				66.7	0.33	22.2
Vert. Component =				491.8	4.67	2,295.4
Total =	1,027.2	**O.T.M.** =	2,453.9	**Total =** 2,523.6 lbs	**R.M.=**	8,430.8

Resisting/Overturning Ratio = **3.44**
Vertical Loads used for Soil Pressure = 2,031.7 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.028	in

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

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Cantilevered Retaining Wall

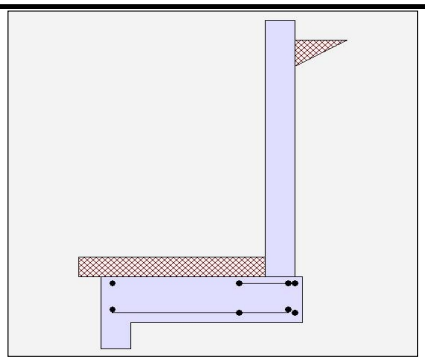
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

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

Soil Data

Allow Soil Bearing	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	64.500
Total Seismic Force	=	462.250

Design Summary

Wall Stability Ratios

Overturning	=	2.11	OK
Sliding	=	1.39	Ratio < 1.5!
Total Bearing Load	=	1,873 lbs	
...resultant ecc.	=	15.52 in	
Soil Pressure @ Toe	=	1,304 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	5,332 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,826 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	13.8 psi	OK
Footing Shear @ Heel	=	7.1 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,350.8 lbs	
less 100% Passive Force	= -	816.7 lbs	
less 100% Friction Force	= -	1,064.0 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	145.5 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 5
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.426**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	1,539.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	3,465.0
Moment.....Allowable =	8,121.3
Shear.....Actual	
Service Level psi =	
Strength Level psi =	20.7
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1312 in2/ft		
(4/3) * As :	0.1749 in2/ft	Min Stem T&S Reinf Area 1.248 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 :	0.1749 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.31 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.67 ft
Heel Width	=	0.83
Total Footing Width	=	4.50
Footing Thickness	=	14.00 in
Key Width	=	8.00 in
Key Depth	=	8.00 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	=	1,826	0	psf
Mu' : Upward	=	85,249	0	ft-#
Mu' : Downward	=	23,236	147	ft-#
Mu: Design	=	5,168	147	ft-#
Actual 1-Way Shear	=	13.83	7.09	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 5 @ 12.00 in
Heel Reinforcing = # 5 @ 12.00 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@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Heel: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39
Key: phiMn = phi'5'lambda'sqrt(fc)'Sm

Min footing T&S reinf Area 1.36 in2
Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.94 in	#4@ 15.87 in
#5@ 12.30 in	#5@ 24.60 in
#6@ 17.46 in	#6@ 34.92 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		1,027.2	2.39	2,453.9	Soil Over HL (ab. water tbl)	130.0	4.42	574.2
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		4.42	574.2
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	238.4	1.83	437.0
Seismic Earth Load	=	323.6	3.58	1,159.5	Surcharge Over Toe	=			
	=				Stem Weight(s)	=	650.0	4.00	2,600.2
					Earth @ Stem Transitions	=			
					Footing Weight	=	787.6	2.25	1,772.1
					Key Weight	=	66.7	0.33	22.2
					Vert. Component	=	491.8	4.50	2,213.4
Total	=	1,350.8	**O.T.M.** =	3,613.4	**Total =**		2,364.4 lbs	**R.M.=**	7,619.2

Resisting/Overturning Ratio = **2.11**
Vertical Loads used for Soil Pressure = 1,872.6 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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

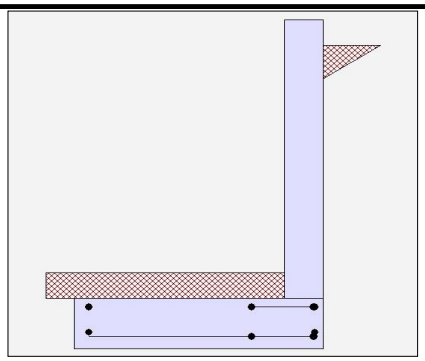
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	5.00 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	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	2.81	OK
Sliding	=	1.58	OK
Total Bearing Load	=	1,439 lbs	
...resultant ecc.	=	4.26 in	
Soil Pressure @ Toe	=	495 psf	OK
Soil Pressure @ Heel	=	169 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	693 psf	
ACI Factored @ Heel	=	236 psf	
Footing Shear @ Toe	=	7.3 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	720.0 lbs	
less 100% Passive Force	= -	337.5 lbs	
less 100% Friction Force	= -	802.5 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	9.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.187**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	800.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	1,333.3
Moment.....Allowable =	7,122.4
Shear.....Actual	
Service Level psi =	
Strength Level psi =	10.7
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.05 in2/ft		
(4/3) * As :	0.0666 in2/ft	Min Stem T&S Reinf Area 1.056 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2667 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.67 ft
Heel Width	=	0.67
Total Footing Width	=	4.33
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	693	236	psf
Mu' : Upward	=	45,528	0	ft-#
Mu' : Downward	=	20,816	0	ft-#
Mu: Design	=	2,059	0	ft-#
Actual 1-Way Shear	=	7.34	0.00	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 4 @ 9.00 in
Heel Reinforcing = # 4 @ 9.00 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 1.12 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..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	720.0	2.00	1,440.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
				Soil Over HL (ab. water tbl)	0.2	4.33	0.9
				Soil Over HL (bel. water tbl)		4.33	0.9
				Watre Table			
				Sloped Soil Over Heel =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =	238.4	1.83	437.0
				Surcharge Over Toe =			
				Stem Weight(s) =	550.0	4.00	2,200.2
				Earth @ Stem Transitions =			
				Footing Weight =	650.1	2.17	1,408.8
				Key Weight =			
				Vert. Component =			
Total =	720.0	**O.T.M.** =	1,440.0	**Total =**	1,438.7 lbs	**R.M.=**	4,046.9

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

Resisting/Overturning Ratio = **2.81**
Vertical Loads used for Soil Pressure = 1,438.7 lbs

Vertical component of active lateral soil pressure IS 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)	0.017	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

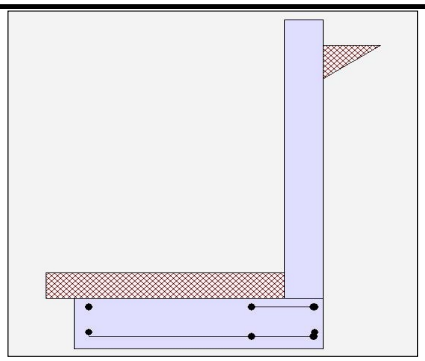
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	54.000
Total Seismic Force	=	324.000

Design Summary

Wall Stability Ratios

Overturning	=	2.61	OK
Sliding	=	1.20	Ratio < 1.5!
Total Bearing Load	=	1,439 lbs	
...resultant ecc.	=	9.93 in	
Soil Pressure @ Toe	=	716 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	5,332 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,003 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	10.1 psi	OK
Footing Shear @ Heel	=	4.8 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	946.8 lbs	
less 100% Passive Force	= -	337.5 lbs	
less 100% Friction Force	= -	802.5 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	280.2 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	9.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.281**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	1,070.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	2,008.3
Moment.....Allowable =	7,122.4
Shear.....Actual	
Service Level psi =	
Strength Level psi =	14.3
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0752 in2/ft		
(4/3) * As :	0.1003 in2/ft	Min Stem T&S Reinf Area 1.056 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2667 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.67 ft
Heel Width	=	0.67
Total Footing Width	=	4.33
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,003	0 psf
Mu' : Upward	=	56,286	0 ft-#
Mu' : Downward	=	20,816	0 ft-#
Mu: Design	=	2,956	0 ft-#
Actual 1-Way Shear	=	10.14	4.84 psi
Allow 1-Way Shear	=	75.00	75.00 psi

Toe Reinforcing = # 4 @ 9.00 in
Heel Reinforcing = # 4 @ 9.00 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 1.12 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..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	720.0	2.00	1,440.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
Seismic Earth Load =	226.8	3.00	680.4			
=						
Total =	946.8	**O.T.M.** =	2,120.4			
Soil Over HL (ab. water tbl)				0.2	4.33	0.9
Soil Over HL (bel. water tbl)					4.33	0.9
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				238.4	1.83	437.0
Surcharge Over Toe =						
Stem Weight(s) =				550.0	4.00	2,200.2
Earth @ Stem Transitions =						
Footing Weight =				650.1	2.17	1,408.8
Key Weight =						
Vert. Component =				344.7	4.33	1,494.1
				Total = 1,783.4 lbs	**R.M.=**	5,541.0

Resisting/Overturning Ratio = **2.61**
Vertical Loads used for Soil Pressure = 1,438.7 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.025	in

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

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Cantilevered Retaining Wall

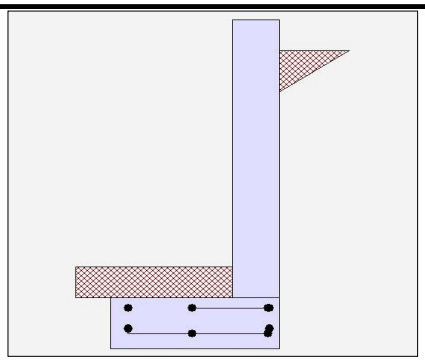
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

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

Soil Data

Allow Soil Bearing	=	4,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	2.58	OK
Sliding	=	1.62	OK
Total Bearing Load	=	866 lbs	
...resultant ecc.	=	5.50 in	
Soil Pressure @ Toe	=	769 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	4,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,077 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	8.3 psi	OK
Footing Shear @ Heel	=	4.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	467.2 lbs	
less 100% Passive Force	= -	266.7 lbs	
less 100% Friction Force	= -	490.4 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

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	10.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.105**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	512.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	682.7
Moment.....Allowable =	6,444.1
Shear.....Actual	
Service Level psi =	
Strength Level psi =	6.8
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

This Wall in File: p:\studio ectypos\steinborn residence ectypos\calculations\retain schedule - site

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) :	0.0256 in2/ft		
(4/3) * As :	0.0341 in2/ft	Min Stem T&S Reinf Area 0.864 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.24 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

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

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,077	0 psf
Mu' : Upward	=	14,665	0 ft-#
Mu' : Downward	=	4,190	0 ft-#
Mu: Design	=	873	0 ft-#
Actual 1-Way Shear	=	8.27	3.98 psi
Allow 1-Way Shear	=	75.00	75.00 psi

Toe Reinforcing = # 4 @ 11.11 in
Heel Reinforcing = # 4 @ 11.11 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 0.52 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	467.2	1.61	752.7			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				0.2	2.42	0.4
Soil Over HL (bel. water tbl)					2.42	0.4
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =				113.8	0.88	99.5
Surcharge Over Toe =						
Stem Weight(s) =				450.0	2.08	937.5
Earth @ Stem Transitions =						
Footing Weight =				302.1	1.21	365.1
Key Weight =						
Vert. Component =				223.7	2.42	540.7
Total =	467.2	**O.T.M.** =	752.7	**Total =** 1,089.8 lbs	**R.M.=**	1,943.3

Resisting/Overturning Ratio = **2.58**
Vertical Loads used for Soil Pressure = 866.0 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.040	in

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

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Cantilevered Retaining Wall

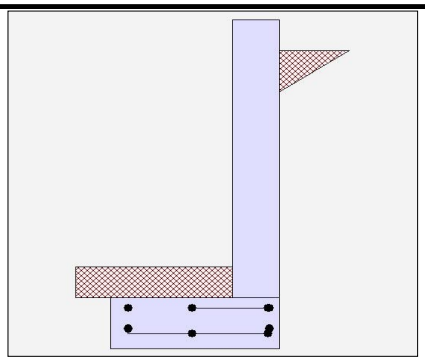
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

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

Soil Data

Allow Soil Bearing	=	5,332.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	130.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	10.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	9.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	43.500
Total Seismic Force	=	210.250

Design Summary

Wall Stability Ratios

Overturning	=	1.70	OK
Sliding	=	1.20	Ratio < 1.5!
Total Bearing Load	=	866 lbs	
...resultant ecc.	=	10.92 in	
Soil Pressure @ Toe	=	1,936 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	5,332 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,711 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	11.6 psi	OK
Footing Shear @ Heel	=	4.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	629.3 lbs	
less 100% Passive Force	= -	266.7 lbs	
less 100% Friction Force	= -	490.4 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	186.8 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

Bottom

Stem OK

Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	10.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.166**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	705.7
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,070.1
Moment.....Allowable	=	6,444.1
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	9.4
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0401 in2/ft		
(4/3) * As :	0.0535 in2/ft	Min Stem T&S Reinf Area 0.864 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.24 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

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

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,711	0 psf
Mu' : Upward	=	21,124	0 ft-#
Mu' : Downward	=	4,190	0 ft-#
Mu: Design	=	1,411	0 ft-#
Actual 1-Way Shear	=	11.61	3.98 psi
Allow 1-Way Shear	=	75.00	75.00 psi

Toe Reinforcing = # 4 @ 11.11 in
Heel Reinforcing = # 4 @ 11.11 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 0.52 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		467.2	1.61	752.7	Soil Over HL (ab. water tbl)	0.2	2.42	0.4
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.42	0.4
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	14.9	2.42	35.9	Surcharge Over Heel	= 0.0	2.42	0.0
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	= 113.8	0.88	99.5
Seismic Earth Load	=	147.2	2.42	355.7	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 450.0	2.08	937.5
					Earth @ Stem Transitions	=		
Total	=	629.3	**O.T.M.** =	1,144.4	Footing Weight	= 302.1	1.21	365.1
					Key Weight	=		
					Vert. Component	= 223.7	2.42	540.7
					Total =	1,089.8 lbs	**R.M.=**	1,943.3

Resisting/Overturning Ratio = **1.70**
Vertical Loads used for Soil Pressure = 866.1 lbs

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.

Tilt

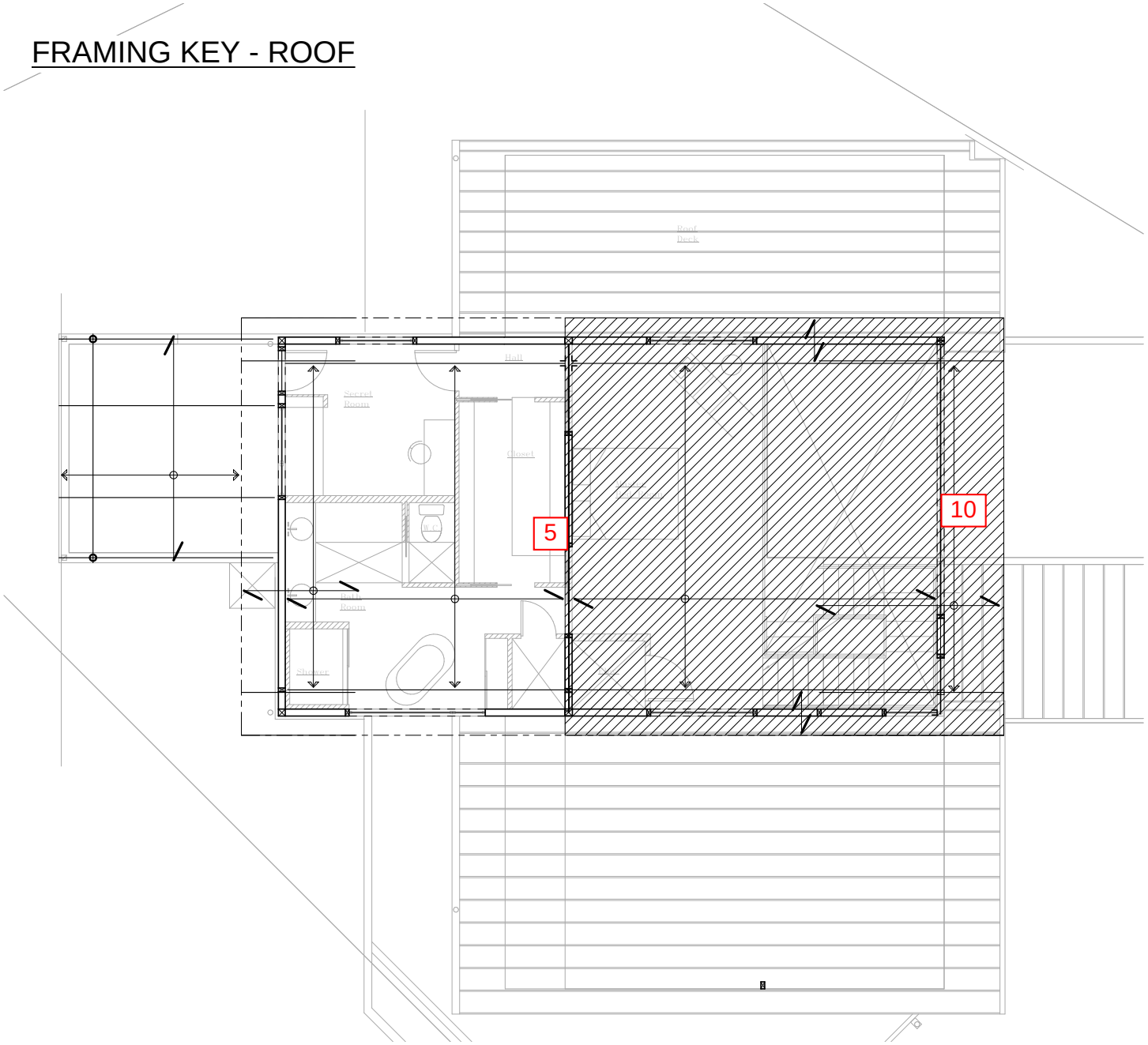
Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.100	in

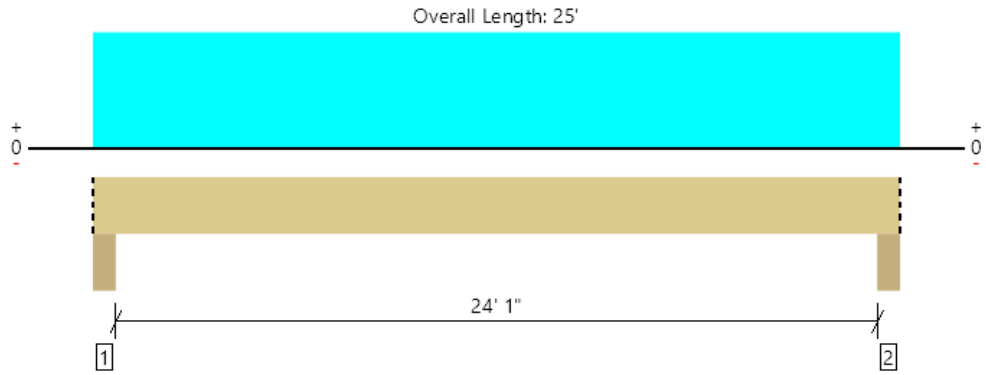
The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

FRAMING KEY - ROOF



Roof, 5/ Drop Beam

1 piece(s) 5 1/4" x 20" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	12504 @ 4"	18047 (5.50")	Passed (69%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	10378 @ 2' 1 1/2"	23345	Passed (44%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	74037 @ 12' 6"	80713	Passed (92%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.708 @ 12' 6"	1.217	Passed (L/412)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	1.099 @ 12' 6"	1.622	Passed (L/266)	--	1.0 D + 1.0 S (All Spans)

System : Roof
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/240) and TL (L/180).
- A 17% decrease in the moment capacity has been added to account for lateral stability.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Column - DF	5.50"	5.50"	3.81"	4441	8063	12504	Blocking
2 - Column - DF	5.50"	5.50"	3.81"	4441	8063	12504	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 25'	N/A	32.8	--	
1 - Uniform (PSF)	0 to 25' (Front)	21' 6"	15.0	30.0	Default Load

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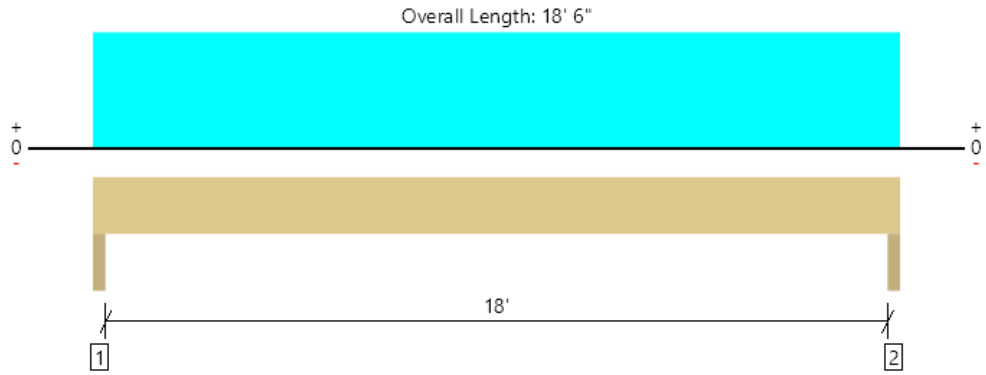
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Roof, 10/ Header

1 piece(s) 5 1/4" x 14" 2.0E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	6977 @ 1 1/2"	9844 (3.00")	Passed (71%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	5908 @ 1' 5"	16342	Passed (36%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	31401 @ 9' 3"	46854	Passed (67%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.539 @ 9' 3"	0.608	Passed (L/407)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.833 @ 9' 3"	0.913	Passed (L/263)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Trimmer - DF	3.00"	3.00"	2.13"	2467	4509	6977	None
2 - Trimmer - DF	3.00"	3.00"	2.13"	2467	4509	6977	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	18' 6" o/c	
Bottom Edge (Lu)	18' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 18' 6"	N/A	23.0	--	
1 - Uniform (PSF)	0 to 18' 6"	16' 3"	15.0	30.0	Snow

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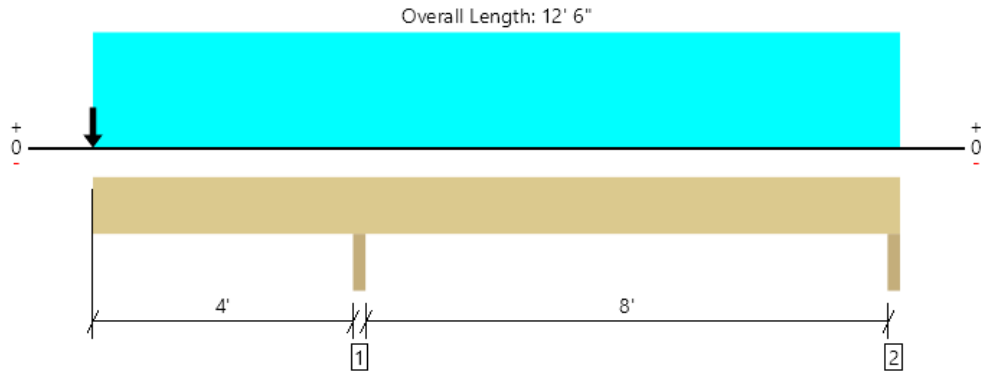
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Roof, Cantilever corner
3 piece(s) 2 x 10 HF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2439 @ 4' 1 1/2"	5468 (3.00")	Passed (45%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1329 @ 3' 2 3/4"	4787	Passed (28%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	-4997 @ 4' 1 1/2"	5750	Passed (87%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.233 @ 0	0.275	Passed (2L/424)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.345 @ 0	0.412	Passed (2L/288)	--	1.0 D + 1.0 S (Alt Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- -306 lbs uplift at support located at 12' 4 1/2". Strapping or other restraint may be required.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Trimmer - DF	3.00"	3.00"	1.50"	879	1560	2439	None
2 - Trimmer - DF	3.00"	3.00"	1.50"	-37	57/-269	20/-306	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	12' 6" o/c	
Bottom Edge (Lu)	10' 4" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 12' 6"	N/A	10.6	--	
1 - Uniform (PSF)	0 to 12' 6"	2'	15.0	30.0	Snow
2 - Point (lb)	0	N/A	335	669	

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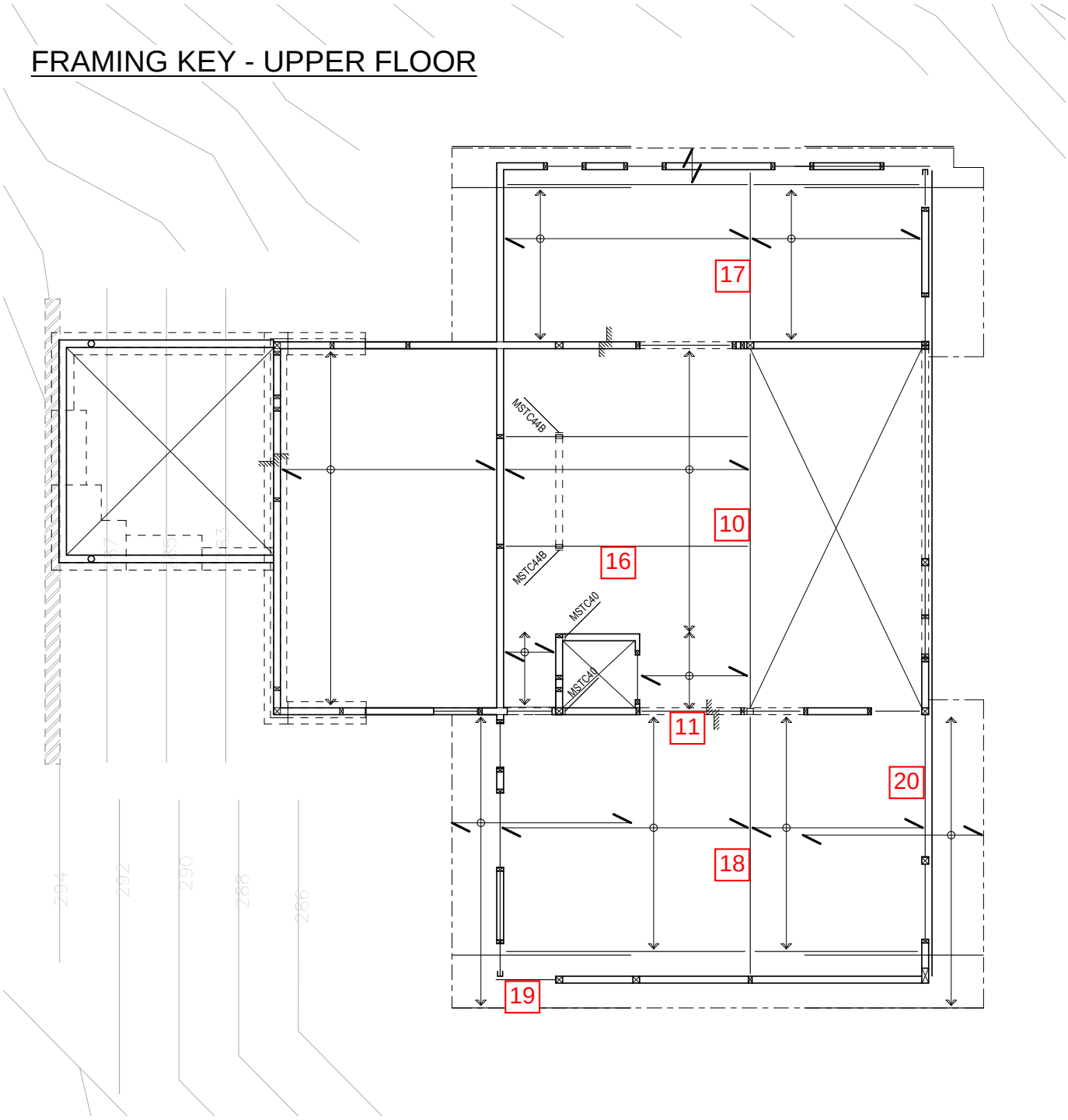
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Jane Johnson Bykonen Carter Quinn (206) 264-7784 jaj@bcq-se.com	

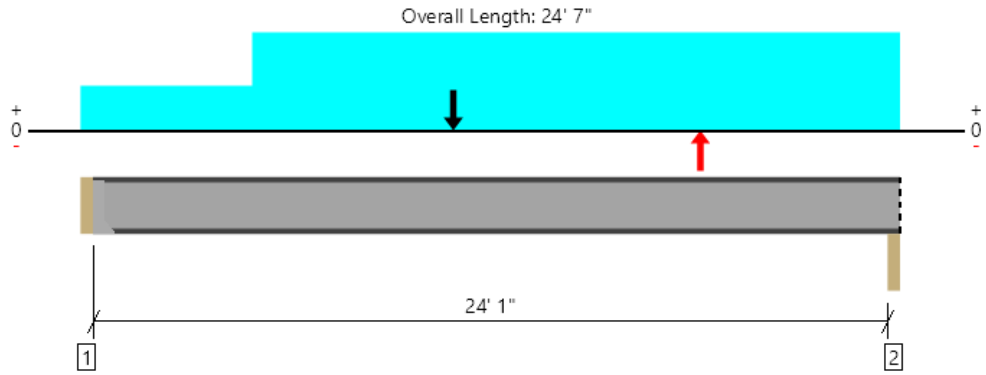
Weyerhaeuser

FRAMING KEY - UPPER FLOOR



Upper Floor, 10/ Steel beam

1 piece(s) W10X45 (A992) ASTM Steel



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	7268 @ 24' 5 1/2"	18647 (3.00")	Passed (39%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	7117 @ 24' 4"	70700	Passed (10%)	--	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	42684 @ 12' 7 1/16"	92760	Passed (46%)	--	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.337 @ 12' 5 1/4"	0.605	Passed (L/862)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.622 @ 12' 5 1/8"	1.210	Passed (L/467)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (C_b) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Seismic	Factored	
1 - Hanger on 10 1/8" DF beam	3.00"	Hanger[1]	1.50" / - [2]	2827	3261	374/-374	6088	See note [1]
2 - Column - DF	3.00"	3.00"	3.00"	3317	3952	374/-374	7268	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Seismic (1.60)	Comments
0 - Self Weight (PLF)	3" to 24' 7"	N/A	45.0	--	--	
1 - Uniform (PSF)	0 to 5'	3' 9"	28.0	40.0	-	Default Load
2 - Uniform (PSF)	5' to 24' 7"	8' 3"	28.0	40.0	-	Default Load
3 - Point (lb)	11'	N/A	-	-	1207	
4 - Point (lb)	18' 6"	N/A	-	-	-1207	

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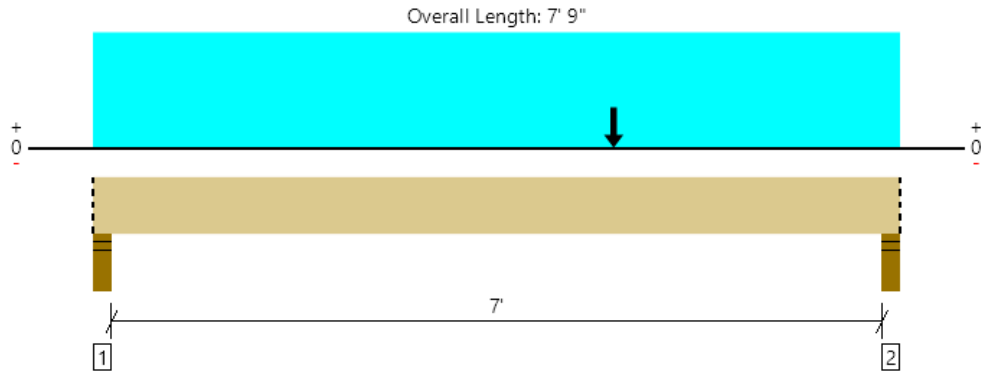
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Jane Johnson Bykonen Carter Quinn (206) 264-7784 jaj@bcq-se.com	

Weyerhaeuser

Upper Floor, 11/ Flush Beam

1 piece(s) 5 1/4" x 14" 2.0E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4142 @ 7' 6"	9568 (4.50")	Passed (43%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3937 @ 6' 2 1/2"	16342	Passed (24%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	9856 @ 5'	46854	Passed (21%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.029 @ 5'	0.181	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.044 @ 5'	0.363	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)

- Deflection criteria: LL (L/480) and TL (L/240).

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Stud wall - HF	4.50"	4.50"	1.50"	919	207	1505	2424	Blocking
2 - Stud wall - HF	4.50"	4.50"	1.95"	1492	207	2650	4142	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	Continuous	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 7' 9"	N/A	23.0	--	--	
1 - Uniform (PSF)	0 to 7' 9" (Front)	1' 4"	15.0	40.0	-	Default Load
2 - Uniform (PSF)	0 to 7' 9" (Top)	2'	15.0	-	30.0	
3 - Point (lb)	5' (Front)	N/A	1845	-	3690	Low roof beam

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ForteWEB Software Operator	Job Notes
Jane Johnson Bykonen Carter Quinn (206) 264-7784 jaj@bcq-se.com	

Weyerhaeuser

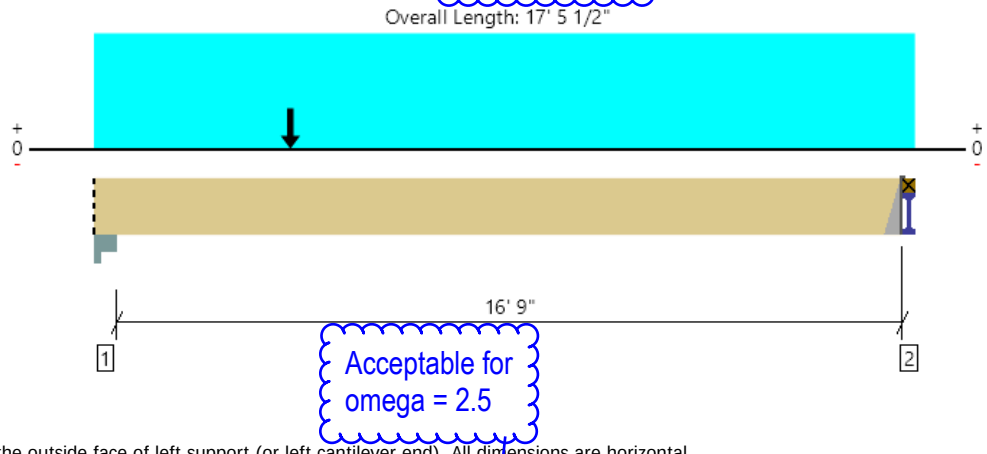
Upper Floor, 16/ Beam at hold-down - omega

1 piece(s) 3 1/2" x 14" 1.55E TimberStrand® LSL

An excessive uplift of -6711 lbs at support located at 4" failed this product.

An excessive uplift of -1840 lbs at support located at 17' 2 1/2" failed this product.

Acceptable for omega = 2.5



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2556 @ 17' 2 1/2"	4725 (1.50")	Passed (54%)	--	1.0 D + 0.7 E (All Spans)
Shear (lbs)	7364 @ 1' 7 1/2"	16203	Passed (45%)	1.60	1.0 D + 0.7 E (All Spans)
Moment (Ft-lbs)	28705 @ 4' 3"	34944	Passed (82%)	1.60	1.0 D + 0.7 E (All Spans)
Live Load Defl. (in)	-0.895 @ 7' 9"	0.422	Failed (L/226)	--	0.6 D - 0.7 E (All Spans)
Total Load Defl. (in)	0.977 @ 7' 9 15/16"	0.844	Failed (L/207)	--	1.0 D + 0.7 E (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Seismic	Factored	
1 - Column Cap - steel	5.50"	5.50"	2.36"	462	468	9983/-9983	7450/-6711	Blocking
2 - Hanger on Single 2X HF plate	3.00"	Hanger[1]	1.50"	454	463	3017/-3017	2566/-1840	See note [1]

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	9' 1" o/c	
Bottom Edge (Lu)	10' 9" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Top Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Seismic (1.60)	Comments
0 - Self Weight (PLF)	0 to 17' 2 1/2"	N/A	15.3	--	--	
1 - Uniform (PSF)	0 to 17' 5 1/2" (Front)	1' 4"	28.0	40.0	-	Default Load
2 - Point (lb)	4' 3" (Front)	N/A	-	-	13000	Omega=2.5

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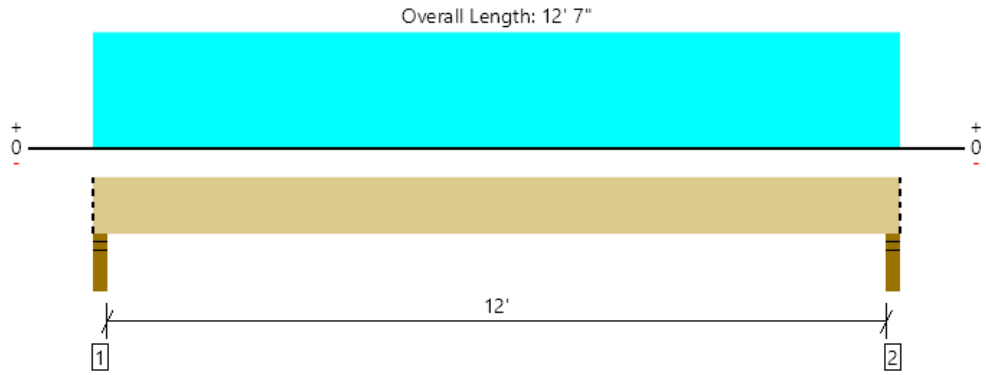
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Jane Johnson Bykonen Carter Quinn (206) 264-7784 jaj@bcq-se.com	

Weyerhaeuser

Upper Floor, 17/ Roof Beam

1 piece(s) 3 1/2" x 11 7/8" 2.0E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4116 @ 2"	4961 (3.50")	Passed (83%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3278 @ 1' 3 3/8"	9241	Passed (35%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	12272 @ 6' 3 1/2"	22888	Passed (54%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.244 @ 6' 3 1/2"	0.613	Passed (L/603)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.373 @ 6' 3 1/2"	0.817	Passed (L/394)	--	1.0 D + 1.0 S (All Spans)

System : Roof
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	3.50"	3.50"	2.90"	1426	2690	4116	Blocking
2 - Stud wall - HF	3.50"	3.50"	2.90"	1426	2690	4116	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	12' 7" o/c	
Bottom Edge (Lu)	12' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 12' 7"	N/A	13.0	--	
1 - Uniform (PSF)	0 to 12' 7" (Front)	14' 3"	15.0	30.0	Default Load

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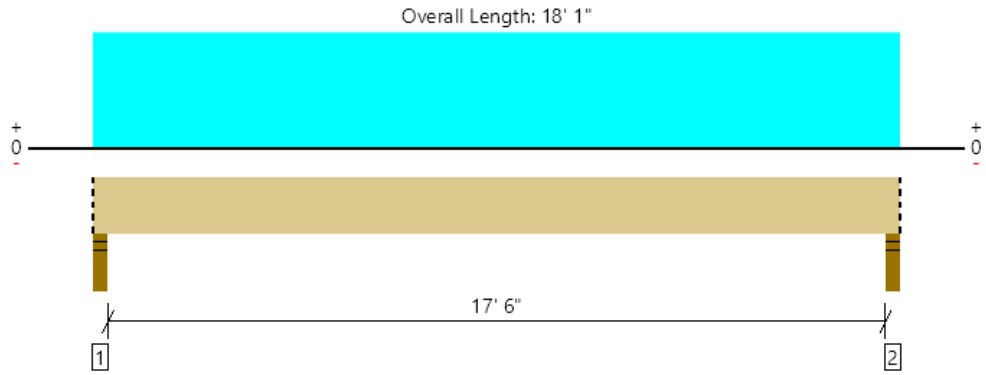
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Jane Johnson Bykonen Carter Quinn (206) 264-7784 jaj@bcq-se.com	

Weyerhaeuser

Upper Floor, 18/ Roof Beam

1 piece(s) 7" x 11 7/8" 2.0E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	6033 @ 2"	9923 (3.50")	Passed (61%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	5178 @ 1' 3 3/8"	18481	Passed (28%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	26279 @ 9' 1/2"	45776	Passed (57%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.512 @ 9' 1/2"	0.887	Passed (L/416)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.799 @ 9' 1/2"	1.183	Passed (L/266)	--	1.0 D + 1.0 S (All Spans)

System : Roof
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Member should be side-loaded from both sides of the member or braced to prevent rotation.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	3.50"	3.50"	2.13"	2168	3865	6033	Blocking
2 - Stud wall - HF	3.50"	3.50"	2.13"	2168	3865	6033	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	18' 1" o/c	
Bottom Edge (Lu)	18' 1" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 18' 1"	N/A	26.0	--	
1 - Uniform (PSF)	0 to 18' 1" (Front)	14' 3"	15.0	30.0	Default Load

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ForteWEB Software Operator	Job Notes
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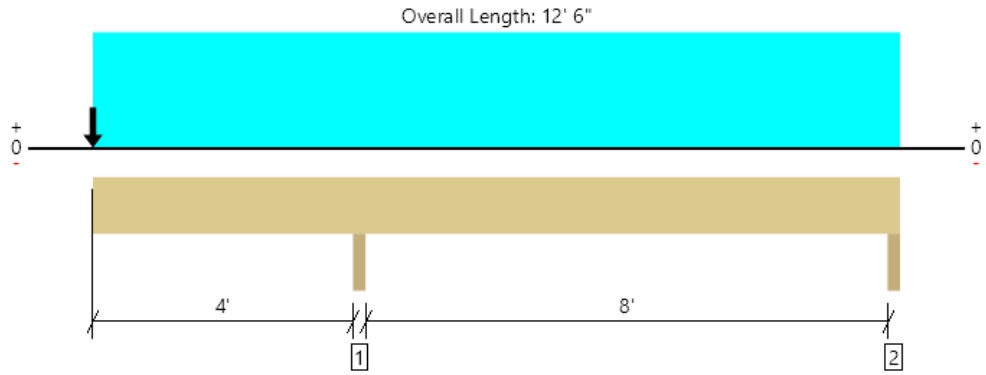
Weyerhaeuser

Upper Floor, 19/ Cantilever corner
3 piece(s) 2 x 10 HF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4544 @ 4' 1 1/2"	5468 (3.00")	Passed (83%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	2052 @ 5' 1/4"	4787	Passed (43%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	-4661 @ 4' 1 1/2"	5750	Passed (81%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.151 @ 0	0.275	Passed (2L/654)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.196 @ 0	0.412	Passed (2L/504)	--	1.0 D + 1.0 S (Alt Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Trimmer - DF	3.00"	3.00"	2.49"	1580	2964	4544	None
2 - Trimmer - DF	3.00"	3.00"	1.50"	487	1090	1577	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	12' 6" o/c	
Bottom Edge (Lu)	12' 3" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 12' 6"	N/A	10.6	--	
1 - Uniform (PSF)	0 to 12' 6"	10'	15.0	30.0	Snow
2 - Point (lb)	0	N/A	60	120	

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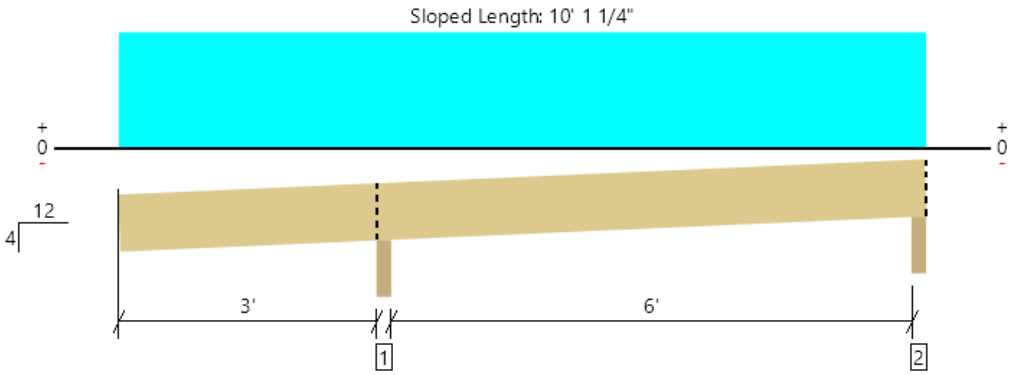
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Jane Johnson Bykonen Carter Quinn (206) 264-7784 jaj@bcq-se.com	

Weyerhaeuser

Upper Floor, Low roof 3ft cantilever
2 piece(s) 2 x 4 HF No.2 @ 24" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Member Length : 10' 2 3/8"

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 4/12

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	576 @ 3' 1 3/4"	4483 (3.50")	Passed (13%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	285 @ 3' 6 13/16"	1208	Passed (24%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	-404 @ 3' 1 3/4"	861	Passed (47%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.198 @ 0	0.332	Passed (2L/402)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.254 @ 0	0.442	Passed (2L/314)	--	1.0 D + 1.0 S (Alt Spans)

- Deflection criteria: LL (L/240) and TL (L/180).
- Overhang deflection criteria: LL (2L/240) and TL (2L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Beveled Plate - SPF	3.50"	3.50"	1.50"	223	353	576	Blocking
2 - Beveled Plate - SPF	3.50"	3.50"	1.50"	80	146	226	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	10' 1" o/c	
Bottom Edge (Lu)	10' 1" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 9' 7"	24"	15.0	25.0	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
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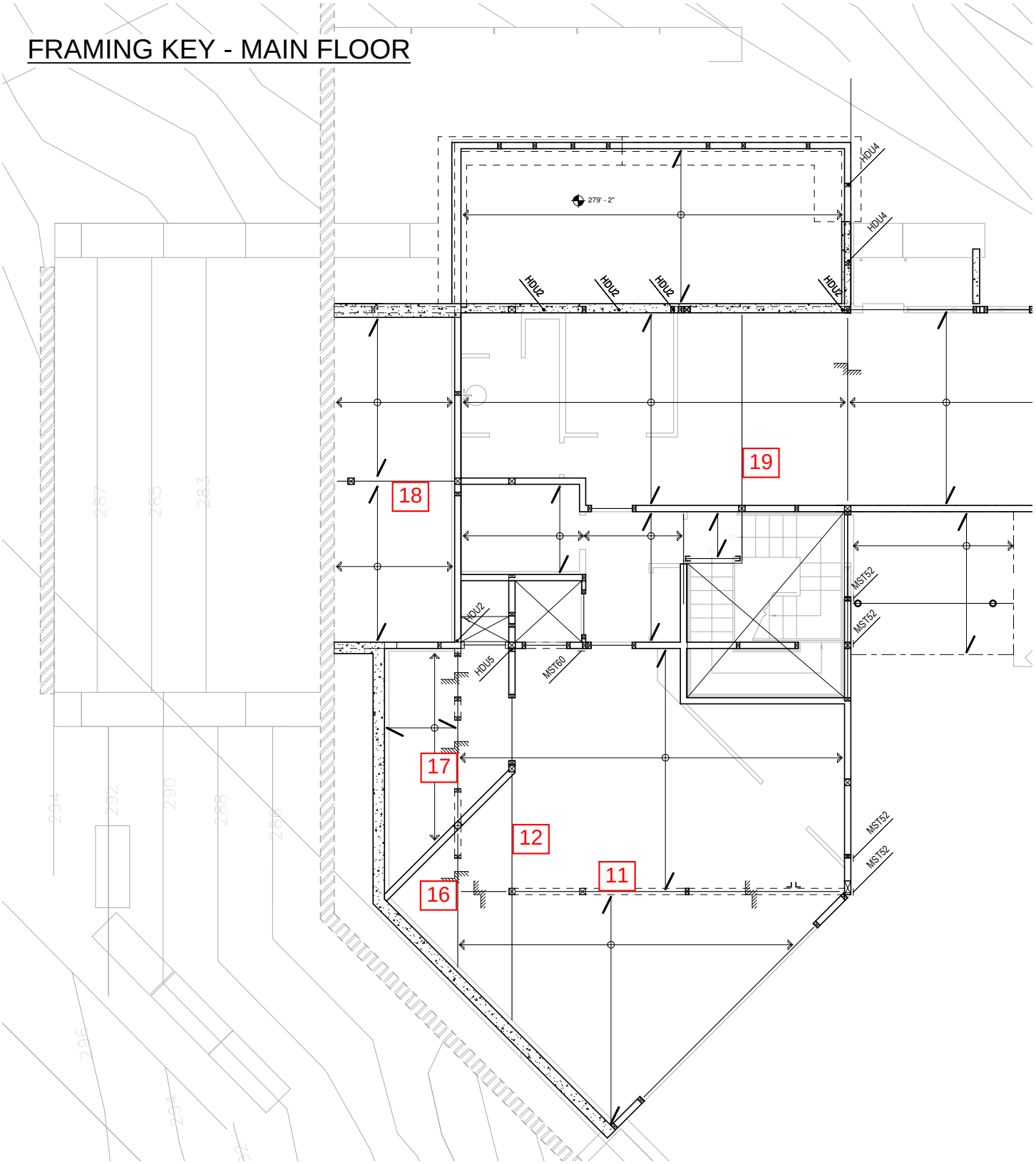
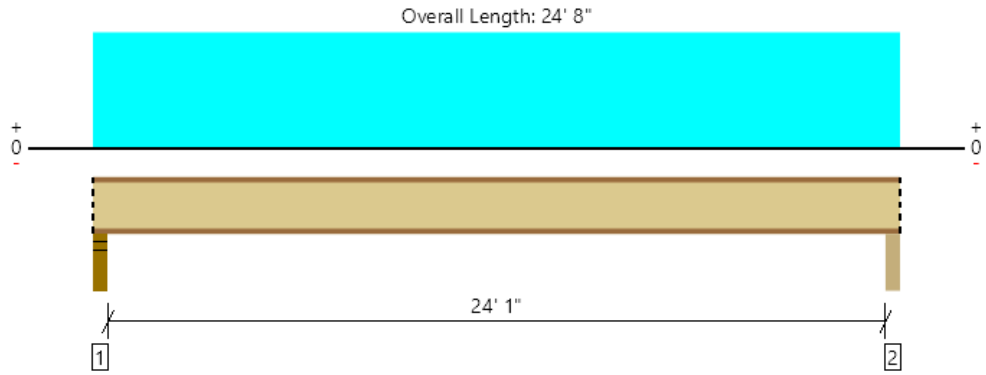
FRAMING KEY - MAIN FLOOR



Main Floor, Floor: Joist - 24'-1" span
2 piece(s) 14" TJI® 560 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1118 @ 2 1/2"	3450 (3.50")	Passed (32%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1092 @ 3 1/2"	4780	Passed (23%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	6665 @ 12' 4"	22550	Passed (30%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.235 @ 12' 4"	0.606	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.399 @ 12' 4"	1.212	Passed (L/729)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	47	45	Passed	--	--

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: Perpendicular Partitions, Pour Flooring Overlay.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - HF	3.50"	3.50"	1.75"	460	658	1118	Blocking
2 - Beam - HF	3.50"	3.50"	1.75"	460	658	1118	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	10' 9" o/c	
Bottom Edge (Lu)	24' 8" o/c	

•TJI joists are only analyzed using Maximum Allowable bracing solutions.
•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 24' 8"	16"	28.0	40.0	1.5" gyp

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ForteWEB Software Operator	Job Notes
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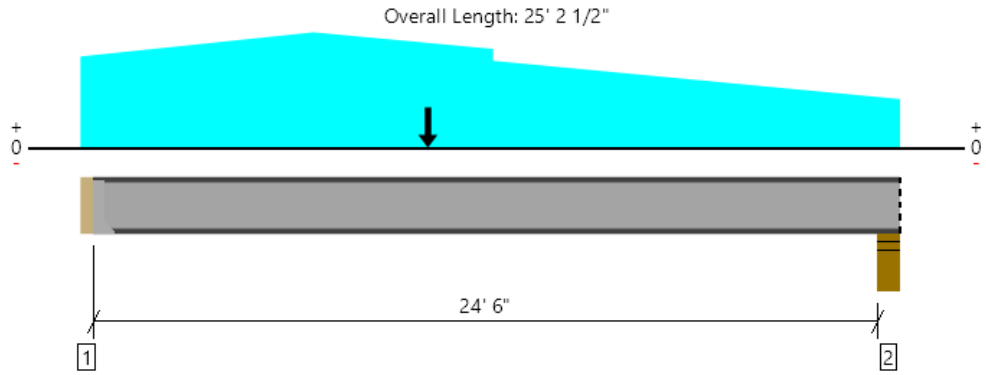
Weyerhaeuser

Main Floor, 11/Steel Beam

1 piece(s) W14X61 (A992) ASTM Steel



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	14290 @ 24' 10 1/2"	22275 (5.50")	Passed (64%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	18029 @ 3"	104250	Passed (17%)	--	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	113662 @ 10' 6"	175156	Passed (65%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.301 @ 12' 2 1/4"	0.616	Passed (L/980)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.631 @ 12' 3 1/16"	1.231	Passed (L/468)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Bearing reinforcement may be required for support located at 0".
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (Cb) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Hanger on 13 7/8" HF beam	3.00"	Hanger[1]	1.50" / - [2]	9254	9078	754	2256	18332	See note [1]
2 - Stud wall - HF	5.50"	5.50"	5.50"	7710	6580	759	1609	14290	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (non-snow: 1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	3" to 25' 2 1/2"	N/A	61.0	--	--	--	
1 - Uniform (PSF)	0 to 12' 6"	9'	28.0	40.0	-	-	Floor
2 - Uniform (PSF)	12' 6" to 25' 2 1/2"	6' 6"	28.0	40.0	-	-	Floor
3 - Tapered (PSF)	0 to 7'	5' to 9'	25.0	60.0	-	-	Deck
4 - Tapered (PSF)	7' to 25' 2 1/2"	9' to 0	25.0	60.0	-	-	Deck
5 - Uniform (PLF)	0 to 25' 2 1/2"	N/A	150.0	-	-	-	Wall weight
6 - Uniform (PSF)	0 to 25' 2 1/2"	2'	15.0	-	30.0	-	Roof
7 - Point (lb)	10' 6"	N/A	2168	-	-	3865	Linked from: 18/ Roof Beam, Support 1

ForteWEB Software Operator	Job Notes
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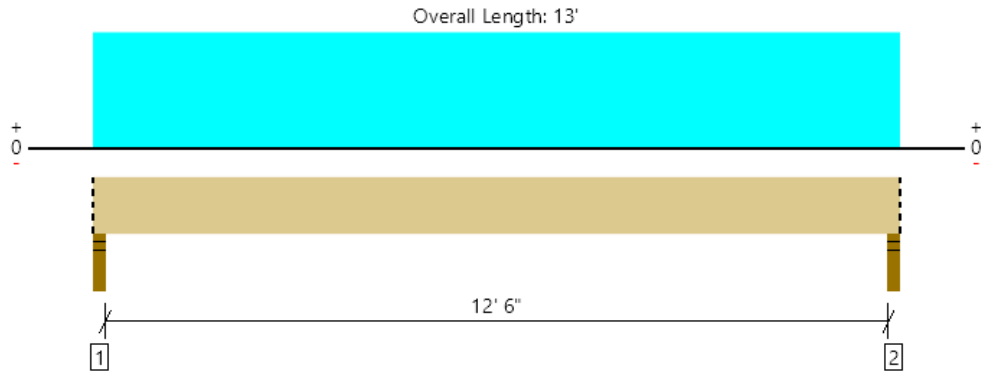
Main Floor, 17/Deck Beam

1 piece(s) 5 1/4" x 14" 2.0E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	5681 @ 1 1/2"	6379 (3.00")	Passed (89%)	--	1.0 D + 0.75 L + 0.75 Lr (All Spans)
Shear (lbs)	3629 @ 1' 5"	14210	Passed (26%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	14508 @ 6' 6"	40743	Passed (36%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.117 @ 6' 6"	0.319	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 Lr (All Spans)
Total Load Defl. (in)	0.244 @ 6' 6"	0.637	Passed (L/626)	--	1.0 D + 0.75 L + 0.75 Lr (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Factored	
1 - Stud wall - HF	3.00"	3.00"	2.67"	2951	1690	1950	5681	Blocking
2 - Stud wall - HF	3.00"	3.00"	2.67"	2951	1690	1950	5681	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	13' o/c	
Bottom Edge (Lu)	13' o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (non-snow: 1.25)	Comments
0 - Self Weight (PLF)	0 to 13'	N/A	23.0	--	--	
1 - Uniform (PSF)	0 to 13' (Front)	2'	28.0	40.0	-	Floor
2 - Uniform (PSF)	0 to 13' (Front)	3'	25.0	60.0	-	Deck
3 - Uniform (PSF)	0 to 13' (Front)	10'	15.0	-	30.0	Roof
4 - Uniform (PLF)	0 to 13' (Front)	N/A	150.0	-	-	Wall wt

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ForteWEB Software Operator	Job Notes
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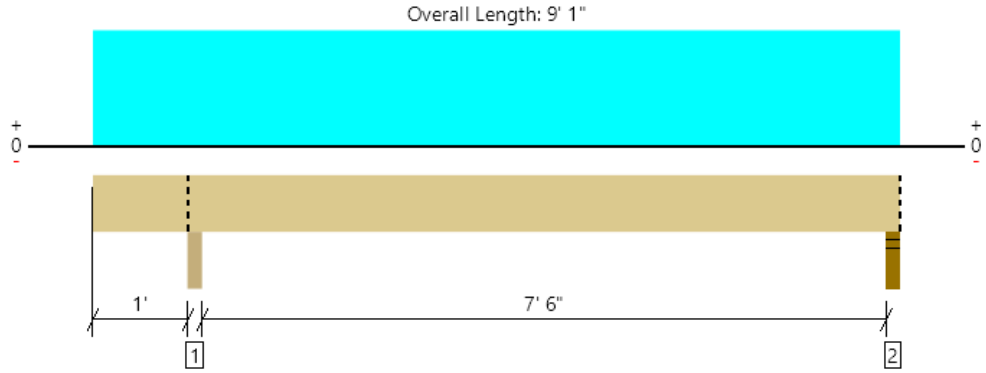
Main Floor, 18/ Platform Beam
1 piece(s) 4 x 12 HF No.1



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	3427 @ 1' 1 3/4"	4961 (3.50")	Passed (69%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1934 @ 2' 2 3/4"	3938	Passed (49%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	4995 @ 5' 11/16"	6477	Passed (77%)	1.00	1.0 D + 1.0 L (Alt Spans)
Live Load Defl. (in)	0.063 @ 5' 3/8"	0.259	Passed (L/999+)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.087 @ 5' 7/16"	0.389	Passed (L/999+)	--	1.0 D + 1.0 L (Alt Spans)

System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- A 1.8% decrease in the moment capacity has been added to account for lateral stability.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Column - HF	3.50"	3.50"	2.42"	972	2456	3427	Blocking
2 - Stud wall - HF	3.50"	3.50"	1.90"	754	1945/-41	2699	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 9' 1"	N/A	10.0	--	
1 - Uniform (PSF)	0 to 9' 1" (Front)	12'	15.0	40.0	Default Load

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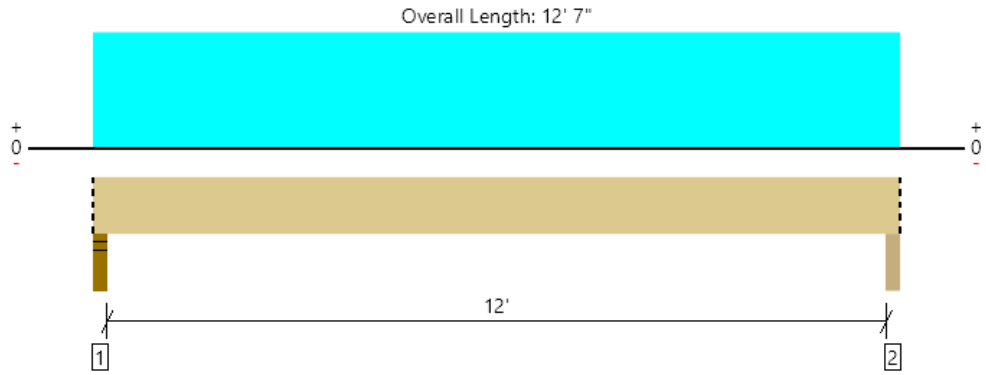
Main Floor, Platform Joist
1 piece(s) 2 x 10 HF No.2 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	461 @ 2 1/2"	2126 (3.50")	Passed (22%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	383 @ 1' 3/4"	1388	Passed (28%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1357 @ 6' 3 1/2"	1917	Passed (71%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.204 @ 6' 3 1/2"	0.304	Passed (L/714)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.281 @ 6' 3 1/2"	0.608	Passed (L/519)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	N/A	N/A	N/A	--	N/A

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.
- No composite action between deck and joist was considered in analysis.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - HF	3.50"	3.50"	1.50"	126	336	461	Blocking
2 - Beam - HF	3.50"	3.50"	1.50"	126	336	461	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	6' 10" o/c	
Bottom Edge (Lu)	12' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 12' 7"	16"	15.0	40.0	Default Load

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MASSING

	Uniform Loads (PSF)			Area (SF)		∑ w (k)
ROOF	*Misc*	*Partitions*				
	15	6.5		1385		29.8

	Uniform Loads (PSF)			Area (SF)	Green Roof (k)	∑ w (k)
FLOORS	*Misc*	*Partitions*	*Gyp top*			
UPPER	15	13	13	1522	0.0	62.4
MAIN	15	13	13	1804		74.0

SEISMIC

DESIGN PARAMETERS

Site Class =	D	**S_S =**	1.439
Risk Cat. =	II	**S_1 =**	0.500
S_{DS} =	0.959	**f_a =**	1.00
R =	6.50	**f_v =**	1.80
Cs =	0.148	k =	1.0

ASCE 7-16 Equivalent Lateral Force Prcedure, 12.8 — **ASD**

Level	Area (SF)	Unit DL (PSF)	w (k)	h^k (ft)	(w)(h^k)	C_{vx}	F_x (k)	0.7E (k)
ROOF	1385	21.5	29.8	30.0	893	32%	7.9	5.5
UPPER	1522	41.0	62.4	19.2	1196	43%	10.6	7.4
MAIN	1522	41.0	74.0	9.2	678	25%	6.0	4.2
Σ			166.1	24.5	2768	100%		
Base Shear							**24.5**	

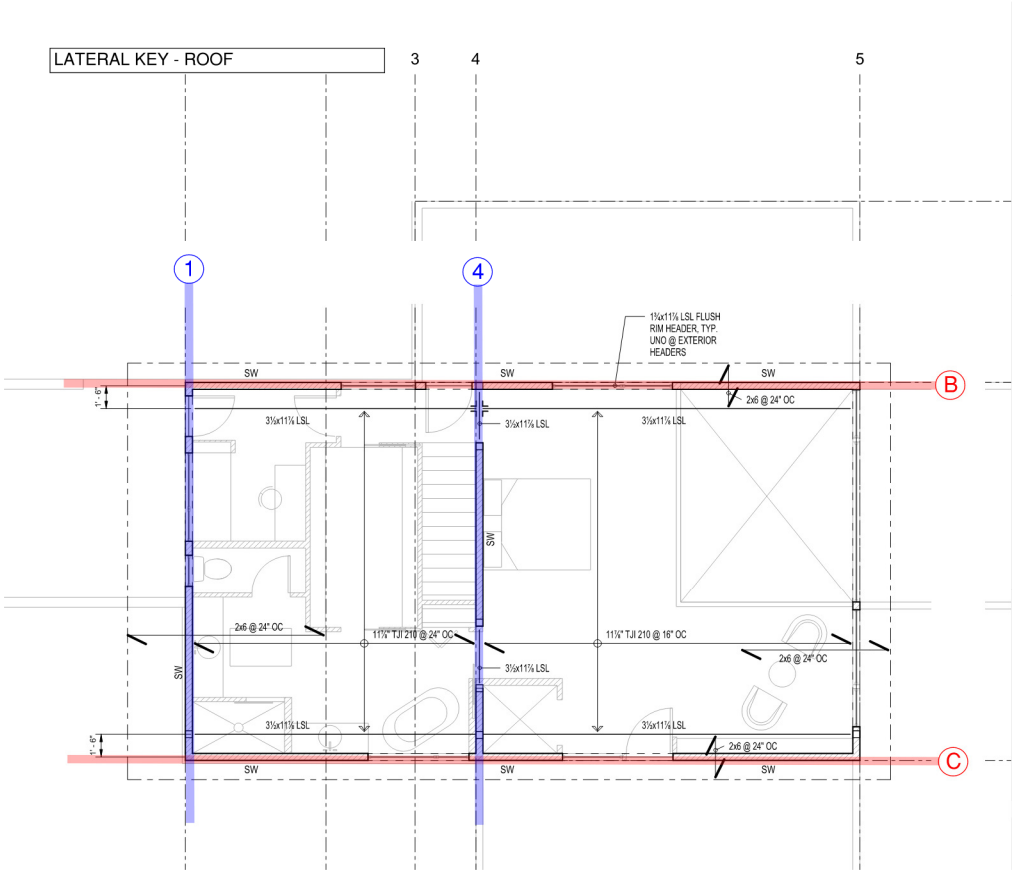
WIND

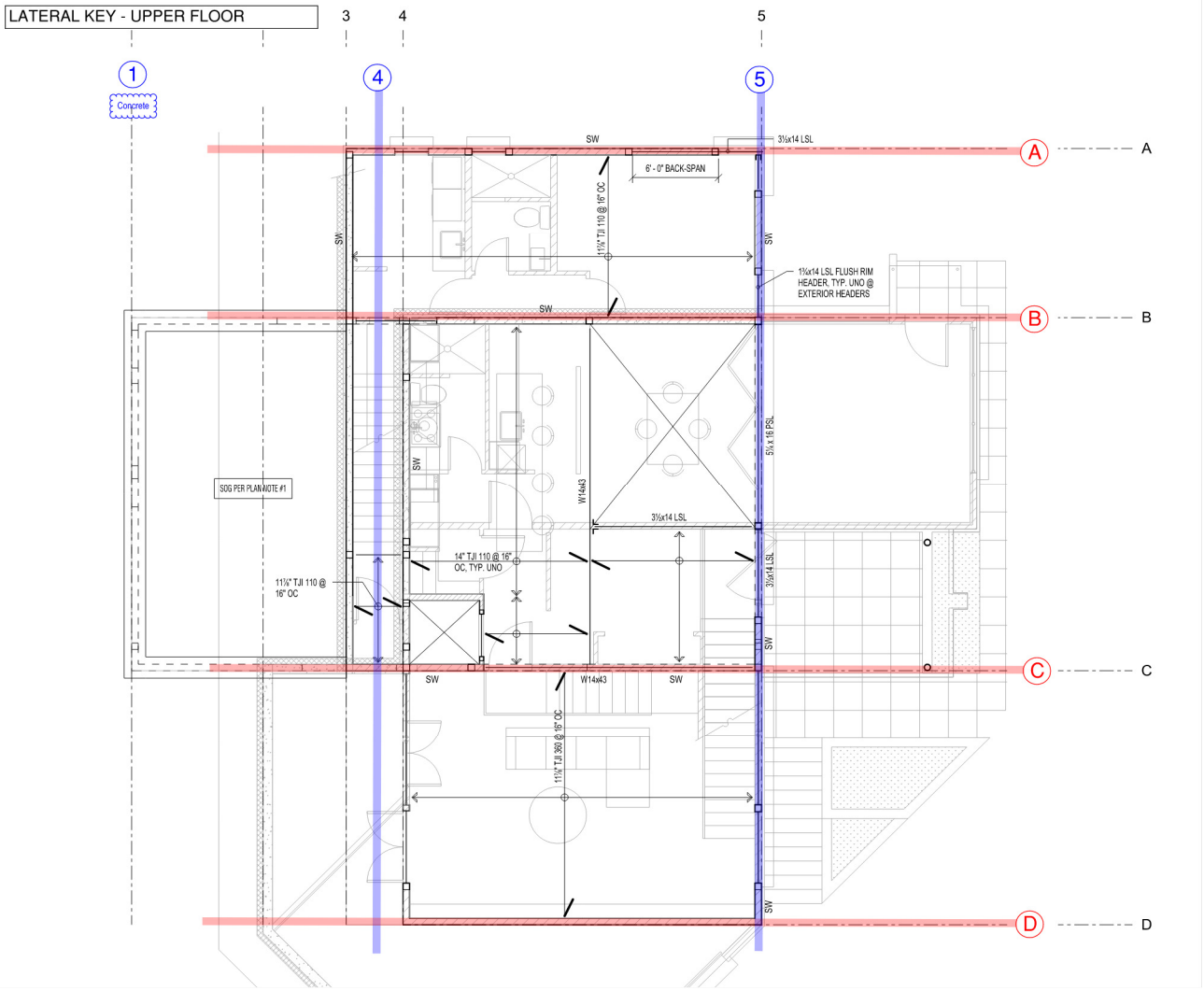
DESIGN PARAMETERS

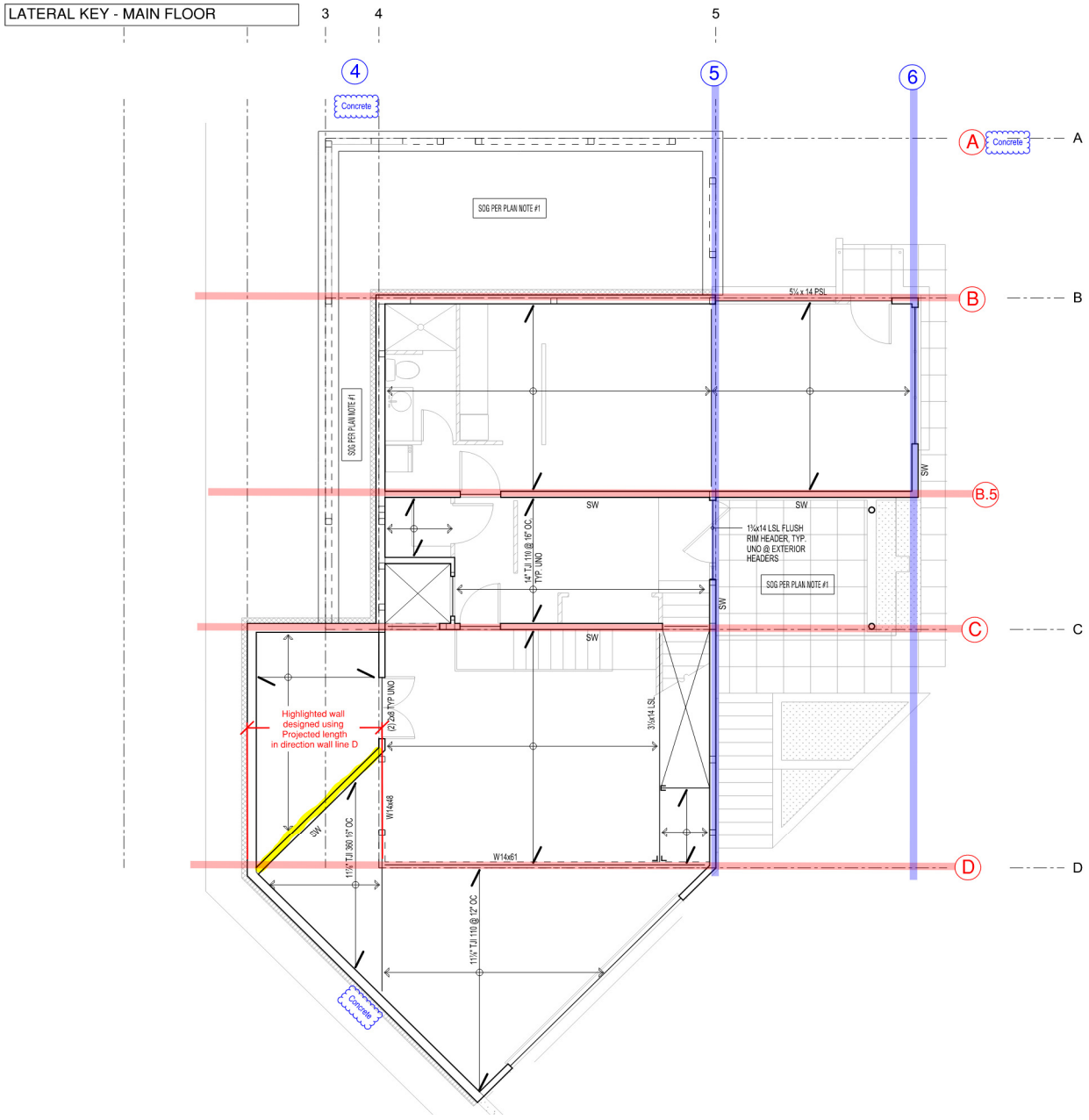
V (mph) =	97	**G =**	0.85	**L/B =**	0.57			**L/B =**	1.76		
Exposure Cat. =	C	**Gcpi =**	0.18	**Cp =**	*Windward Wall*	0.80		**Cp =**	*Windward Wall*	0.80	
K_{zt} =	1.60	**K_z=**	0.98		*Leeward Wall*	-0.50			*Leeward Wall*	-0.35	
K_d =	0.85	**q_z=**	32.1		*Side Wall*	-0.70			*Side Wall*	-0.70	
Roof Slope (in/ft) =	1:12			**h/L=**	1.23			**h/L=**	0.70		
					Roof	-1.30	-0.18		*Roof*	-0.90	-0.18

ASCE 7-16 MWFRS Directional Procedure 27.3.1 — **ASD**

ROOF	**h (ft)**	**Direction**	**Wall Area**	**K_h**	**q_h**	**Wall (PSF)**	**Roof (PSF)**	**Roof (k)**	**F_x (k)**	**06W (k)**
HORIZONTAL PROJECTION	30.0	*PARALLEL TO WL-A*	135	0.98	32.1	35.5	30.6	1.3	4.8	2.9
		PARALLEL TO WL-1	238	0.98	32.1	31.3	19.6	1.4	7.5	4.5
UPPER	**h (ft)**	**Direction**	**Wall Area**		**q_h**	**Wall (PSF)**			**F_x (k)**	**06W (k)**
HORIZONTAL PROJECTION	19.2	*PARALLEL TO WL-A*	573	0.90	29.5	34.4			19.7	11.8
		PARALLEL TO WL-1	458	0.90	29.5	30.6			14.0	8.4
MAIN	**h (ft)**	**Direction**	**Wall Area**		**q_h**	**Wall (PSF)**			**F_x (k)**	**06W (k)**
HORIZONTAL PROJECTION	9.2	*PARALLEL TO WL-A*	688	0.85	27.8	33.7			23.2	13.9
		PARALLEL TO WL-1	278	0.85	27.8	30.1			8.4	5.0
Base Shear - Parallel to Wall Line A									**47.7**	
Base Shear - Parallel to Wall Line 1									**29.8**	


LATERAL KEY - ROOF
3
4
5
1
4
B
C
1¾x11¾ LSL FLUSH RIM HEADER, TYP. UNO @ EXTERIOR HEADERS
SW
2x6 @ 24" OC
3½x11¾ LSL
11¾" TJI 210 @ 24" OC
11¾" TJI 210 @ 16" OC
1'-6"


LATERAL KEY - UPPER FLOOR
3
4
5
1
Concrete
4
5
A
B
C
D
SW
3½x14 LSL
6' - 0" BACK-SPAN
11⅞" TJI 110 @ 16" OC
1¾x14 LSL FLUSH RIM HEADER, TYP. UNO @ EXTERIOR HEADERS
5¼ x 16 PSL
W14x43
SOG PER PLAN NOTE #1
14" TJI 110 @ 16" OC, TYP. UNO
11⅞" TJI 110 @ 16" OC
11⅞" TJI 360 @ 16" OC


LATERAL KEY - MAIN FLOOR
3
4
5
4
5
6
Concrete
A
Concrete
A
SOG PER PLAN NOTE #1
5¼ x 14 PSL
B
B
SOG PER PLAN NOTE #1
SW
SW
SW
B.5
14" TJI 110 @ 16" OC TYP. UNO
1¾x14 LSL FLUSH RIM HEADER TYP. UNO @ EXTERIOR HEADERS
SOG PER PLAN NOTE #1
SW
C
C
SW
Highlighted wall designed using Projected length in direction wall line D
(2)2x6 TYP UNO
3½x14 LSL
W14x46
SW
11⅞" TJI 360 @ 12" OC
W14x61
D
D
11⅞" TJI 110 @ 12" OC
Concrete

1. Shear wall demands have been increased where seismic controls design and h/L is greater than 2:1 per SDPWS Table 4.3.4. Where wind controls design, shearwall demands have been decreased 40% per IBC 2306.3.

WALL LINE A

UPPER		**WIND TRIB =**	11%		**ΣL =**	14.25						
		0.6W (k) =	1.30									
		SEISMIC TRIB =	11%									
		0.7E (k) =	0.82								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	9.4	14.3	0.66	1.00	65	57	SW 1	240	0.6	0.47	0.6	0.3
Concrete												

WALL LINE B

ROOF		**WIND TRIB =**	50%	**OPEN FRONT**	**ΣL =**	30.75						
		0.6W (k) =	1.45	1.75								
		SEISMIC TRIB =	50%									
		0.7E (k) =	2.77	2.16							*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	10.2	3.8	2.72	0.73	41	123	SW 1	240	0.9	0.47	0.2	0.8
1	10.2	15.0	0.68	1.00	41	90	SW 1	240	0.9	0.47	0.7	0.6
1	10.2	12.0	0.85	1.00	41	90	SW 1	240	0.9	0.47	0.6	0.6
UPPER		**WIND TRIB =**	33%		**ΣL =**	18.00						
		0.6W (k) =	5.65									
		SEISMIC TRIB =	33%									
		0.7E (k) =	5.22								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	9.4	5.5	1.70	1.00	224	290	SW 2	355	2.7	0.47	0.2	2.6
1	9.4	12.5	0.75	1.00	224	290	SW 2	355	2.7	0.47	0.5	2.4
Concrete												

OPEN FRONT		Mmax	V	v
	W (ft)	(k-ft)	(k)	(plf)
0.6W (k) =	24.5	42.95	1.75	0.057
0.7E (k) =	24.5	52.94	2.16	0.070

WALL LINE B.5

MAIN		**WIND TRIB =**	21%									
		0.6W (k) =	2.92									
		SEISMIC TRIB =	23%									
		0.7E (k) =	0.97								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	9.4	15.0	0.63	1.00	72	33	SW 1	240	0.7	0.47	0.7	0.3
1	9.4	14.0	0.67	1.00	72	33	SW 1	240	0.7	0.47	0.6	0.4
Concrete												

WALL LINE C

ROOF		**WIND TRIB =**	50%	**OPEN FRONT**	**ΣL =**	14.00						
		0.6W (k) =	1.45	1.75								
		SEISMIC TRIB =	50%									
		0.7E (k) =	2.77	2.16							*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	10.2	4.0	2.55	0.78	89	252	SW 2	355	2.0	0.47	0.2	1.9
1	10.2	10.0	1.02	1.00	89	198	SW 2	355	2.0	0.47	0.5	1.8
UPPER		**WIND TRIB =**	39%		**ΣL =**	14.40						
		0.6W (k) =	6.06									
		SEISMIC TRIB =	39%									
		0.7E (k) =	5.66								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	9.4	5.9	1.59	1.00	300	393	SW 3	455	3.7	0.47	0.3	3.6
2	9.4	4.3	2.21	0.91	300	434	SW 3	455	3.7	0.47	0.2	3.6
MAIN		**WIND TRIB =**	23%		**ΣL =**	21.60						
		0.6W (k) =	9.25									
		SEISMIC TRIB =	26%									
		0.7E (k) =	6.76								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	9.4	12.0	0.78	1.00	306	313	SW 4	595	2.9	0.47	0.5	2.7
1	9.4	4.0	2.34	0.85	306	367	SW 4	595	2.9	0.47	0.2	2.8
1	9.4	5.6	1.67	1.00	306	313	SW 4	595	2.9	0.47	0.2	2.8
Concrete												

OPEN FRONT		Mmax	V	v
	W (ft)	(k-ft)	(k)	(plf)
0.6W (k) =	24.5	42.95	1.75	0.125
0.7E (k) =	24.5	52.94	2.16	0.154

WALL LINE D

UPPER		**WIND TRIB =**	17%		**ΣL =**	20.00						
		0.6W (k) =	2.01									
		SEISMIC TRIB =	17%									
		0.7E (k) =	1.26								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	$2/(h/L)^1$	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	9.4	20.0	0.47	1.00	72	63	SW 1	240	0.7	0.47	0.9	0.2
MAIN		**WIND TRIB =**	43%		**ΣL =**	12.00						
		0.6W (k) =	7.98									
		SEISMIC TRIB =	35%									
		0.7E (k) =	2.73								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	$2/(h/L)^1$	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	9.4	12.0	0.78	1.00	475	228	SW 4	595	4.5	0.47	0.5	4.2

1. Shear wall demands have been increased where seismic controls design and h/L is greater than 2:1 per SDPWS Table 4.3.4. Where wind controls design, shearwall demands have been decreased 40% per IBC 2306.3.

WALL LINE 1

ROOF		**WIND TRIB =**	22%		**ΣL =**	11.30						
		0.6W (k) =	0.99									
		SEISMIC TRIB =	22%									
		0.7E (k) =	1.22								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	10.2	11.3	0.90	1.00	63	108	SW 1	240	1.1	0.47	0.5	0.8
Concrete												

WALL LINE 4

ROOF		**WIND TRIB =**	78%		**ΣL =**	11.80						
		0.6W (k) =	3.51									
		SEISMIC TRIB =	78%									
		0.7E (k) =	4.32								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	10.2	7.0	1.46	1.00	212	366	SW 3	455	3.7	0.47	0.3	3.6
1	10.2	4.8	2.13	0.94	212	389	SW 3	455	3.7	0.47	0.2	3.6
UPPER		**WIND TRIB =**	50%		**ΣL =**	36.50						
		0.6W (k) =	7.71									
		SEISMIC TRIB =	50%									
		0.7E (k) =	8.03								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	9.4	24.5	0.38	1.00	151	220	SW 1	240	2.1	0.47	1.1	1.5
1	9.4	12.0	0.78	1.00	151	220	SW 1	240	2.1	0.47	0.5	1.8
Concrete												

OPEN FRONT

	D/2 (ft)	Mmax (k-ft)
0.6W (k) =	12.25	42.95
0.7E (k) =	12.25	52.94

WALL LINE 5

UPPER		**WIND TRIB =**	50%		**ΣL =**	12.70						
		0.6W (k) =	4.20									
		SEISMIC TRIB =	50%									
		0.7E (k) =	3.71								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	9.4	6.0	1.56	1.00	236	292	SW 3	455	2.7	0.47	0.3	2.6
1	9.4	3.8	2.47	0.81	236	360	SW 3	455	2.7	0.47	0.2	2.7
1	9.4	2.9	3.23	0.62	236	472	SW 3	455	2.7	0.47	0.1	2.7
MAIN		**WIND TRIB =**	50%		**ΣL =**	21.00						
		0.6W (k) =	6.71									
		SEISMIC TRIB =	47%									
		0.7E (k) =	5.69								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	8.5	21.0	0.41	1.00	228	271	SW 3	455	2.3	0.47	0.8	1.9
Concrete												

WALL LINE 6

MAIN		**WIND TRIB =**	18%		**ΣL =**	3.80						
		0.6W (k) =	0.90									
		SEISMIC TRIB =	6%									
		0.7E (k) =	0.25								*Wall weight*	
Segment Count	HT (ft)	LENGTH (ft)	h/L	2/(h/L)[1]	0.6W (plf)	0.7E (plf)	SW	SW Cap (plf)	Tension (k)	0.6-0.14Sds	[0.6-0.14Sds]D (k)	Net T (k)
1	8.5	3.8	2.25	0.89	170	75	SW 1	240	1.4	0.47	0.2	1.4
Concrete												