ANNÉE STRUCTURAL ENGINEERING, LLC

1801 18th Avenue South, Seattle, WA 98144 mike@anneestructural.com

January 23, 2025

City of Mercer Island
Attn: Community Planning & Development
9611 SE 36th Street
Mercer Island, WA 98040

Project: Biggs Residence, 2411 60th Ave SE #2407-071-SUB2

David Henderson:

I have reviewed the City of Mercer Island review correction notice and have the following response to the Structural item.

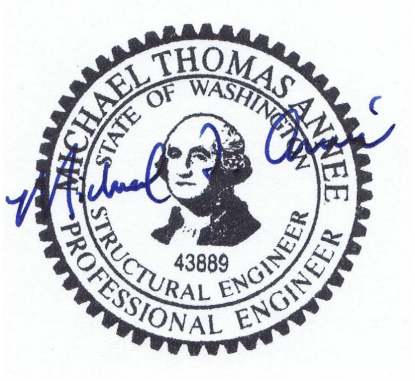
Sheet A1.1 Provide geoetechnical report and design for proposed 7' + high wall. Appears to be greater than 1:12 cut adjacent to the property line. Show limits of disturbance and any adjacent structures…….. Please clarify on plans and include as needed in design calculations.

Response: A retaining wall schedule has been added to the plans, reference 9/S3.4. The new wall location has been moved away from the property line and no longer appears to be surcharged by the driveway on the neighboring property. The walls also do not appear to be affected by the driveway on the property as the drive veers away from the wall as it gains elevation and should be outside the zone that would surcharge the wall. Please see the attached calculations for the retaining wall design.

If you have any questions concerning the responses or require additional information, please contact me via e-mail (mike@anneestructural.com) or phone (206-658-5169).

Sincerely,

Michael T. Année, SE
Année Structural Engineering, LLC



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 4'-0" Site Retaining Wall w/keyway

Code Reference

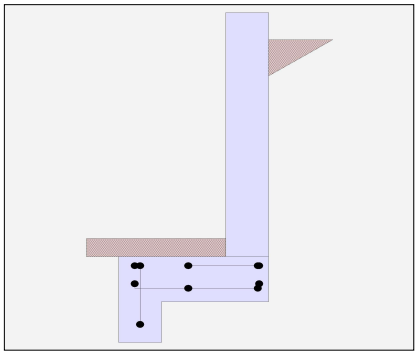
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	2,500.0 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	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

Axial Load Applied to Stem

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		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:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 4'-0" Site Retaining Wall w/keyway

Design Summary

Wall Stability Ratios

Overturning	=	1.76	OK
Sliding	=	1.62	OK
Global Stability	=	1.51	

Total Bearing Load	=	1,113 lbs	
...resultant ecc.	=	6.27 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	919 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,287 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	10.0 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	467.2 lbs	
less 100% Passive Force	-	401.0 lbs	
less 100% Friction Force	-	355.6 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	
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
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	11.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.116**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	512.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	682.7
Moment.....Allowable	=	5,883.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	6.8
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:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 4'-0" Site Retaining Wall w/keyway

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 :	0.2182 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	1.67 ft
Heel Width	=	0.67
Total Footing Width	=	2.33
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	9.00 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	Key	
Factored Pressure	=	1,287	0		psf
Mu' : Upward	=	1,275	0		ft-#
Mu' : Downward	=	281	0		ft-#
Mu: Design	=	994	0	330	ft-#
phiMn	=	7,724	OK - Flush	3,388	
Actual 1-Way Shear	=	10.00	0.00	14.95	psi
Allow 1-Way Shear	=	75.00	75.00	75.00	psi

Toe Reinforcing = # 4 @ 9.00 in
Heel Reinforcing = Flush heel condition. No reinforcing required.
Key Reinforcing = # 4 @ 12.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 55.55 in, #10@ 70.55 in

Heel: Flush heel condition. No reinforcing required.

Key: #4@ 13.88 in, #5@ 18 in, #6@ 18 in, #7@ 18 in

Min footing T&S reinf Area 0.50 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 4'-0" Site Retaining Wall w/keyway

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)	0.0	2.33	0.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.33	0.0
Hydrostatic Force				Water Table			
Buoyant Force =				Sloped Soil Over Hee =			
Surcharge over Heel =				Surcharge Over Heel =			
Surcharge Over Toe =				Adjacent Footing Load =			
Adjacent Footing Load =				Axial Dead Load on Stem =			
Added Lateral Load =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	72.2	0.83	60.2
=				Surcharge Over Toe =			
				Stem Weight(s) =	450.0	2.00	900.2
				Earth @ Stem Transitions =			
				Footing Weight =	291.7	1.17	340.4
				Key Weight =	75.0	0.33	25.0
				Vert. Component =			
Total =	467.2	**O.T.M.** =	752.7	**Total =**	889.0 lbs	**R.M.=**	1,325.8

Resisting/Overturning Ratio = **1.76**

Vertical Loads used for Soil Pressure = 1,112.7 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	200.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.062	in

DESCRIPTION: 4'-0" Site Retaining Wall w/keyway

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

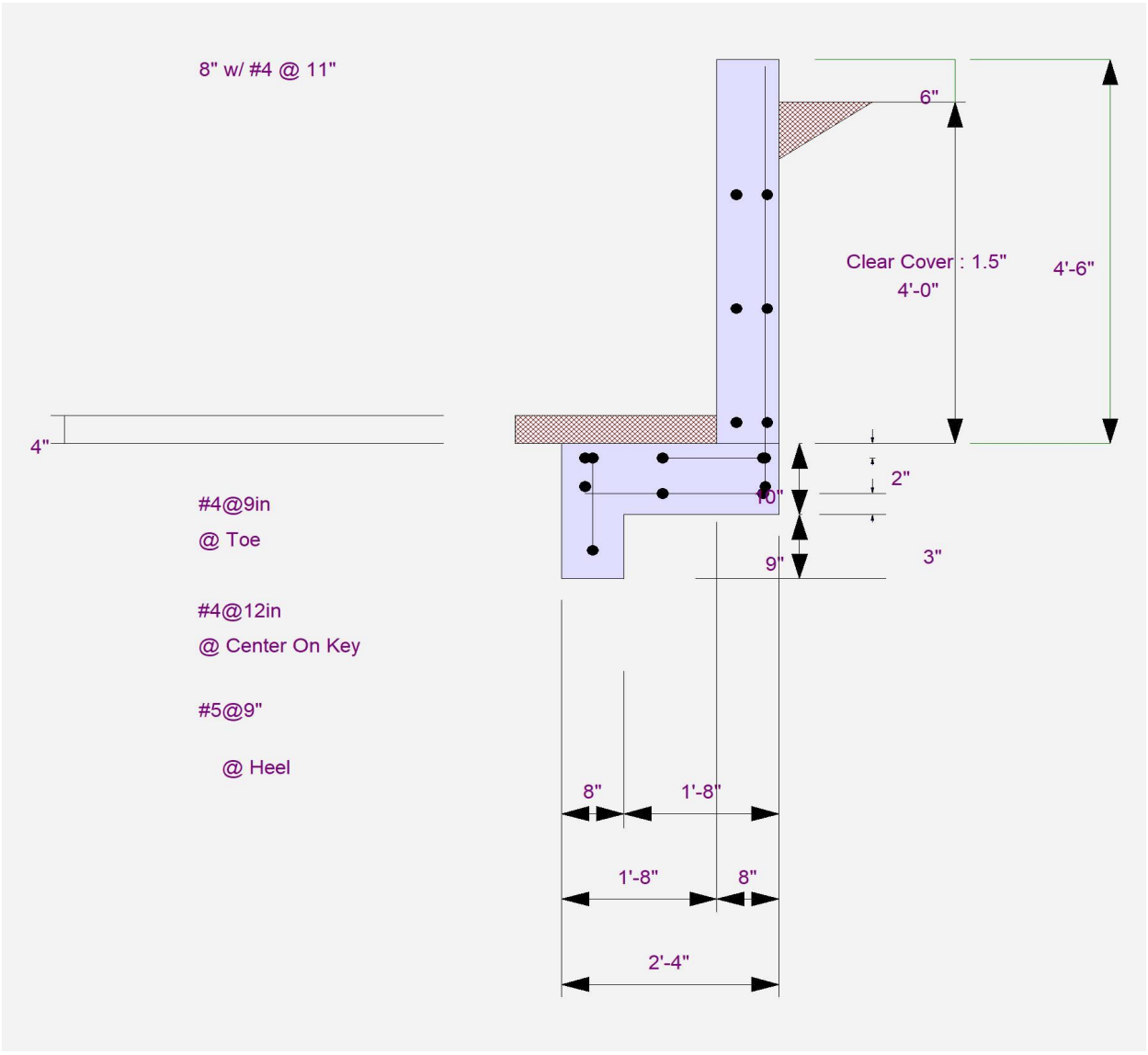
Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	6.65 in
As Provided =	0.2182 in2/ft
As Required =	0.1728 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 4'-0" Site Retaining Wall w/keyway

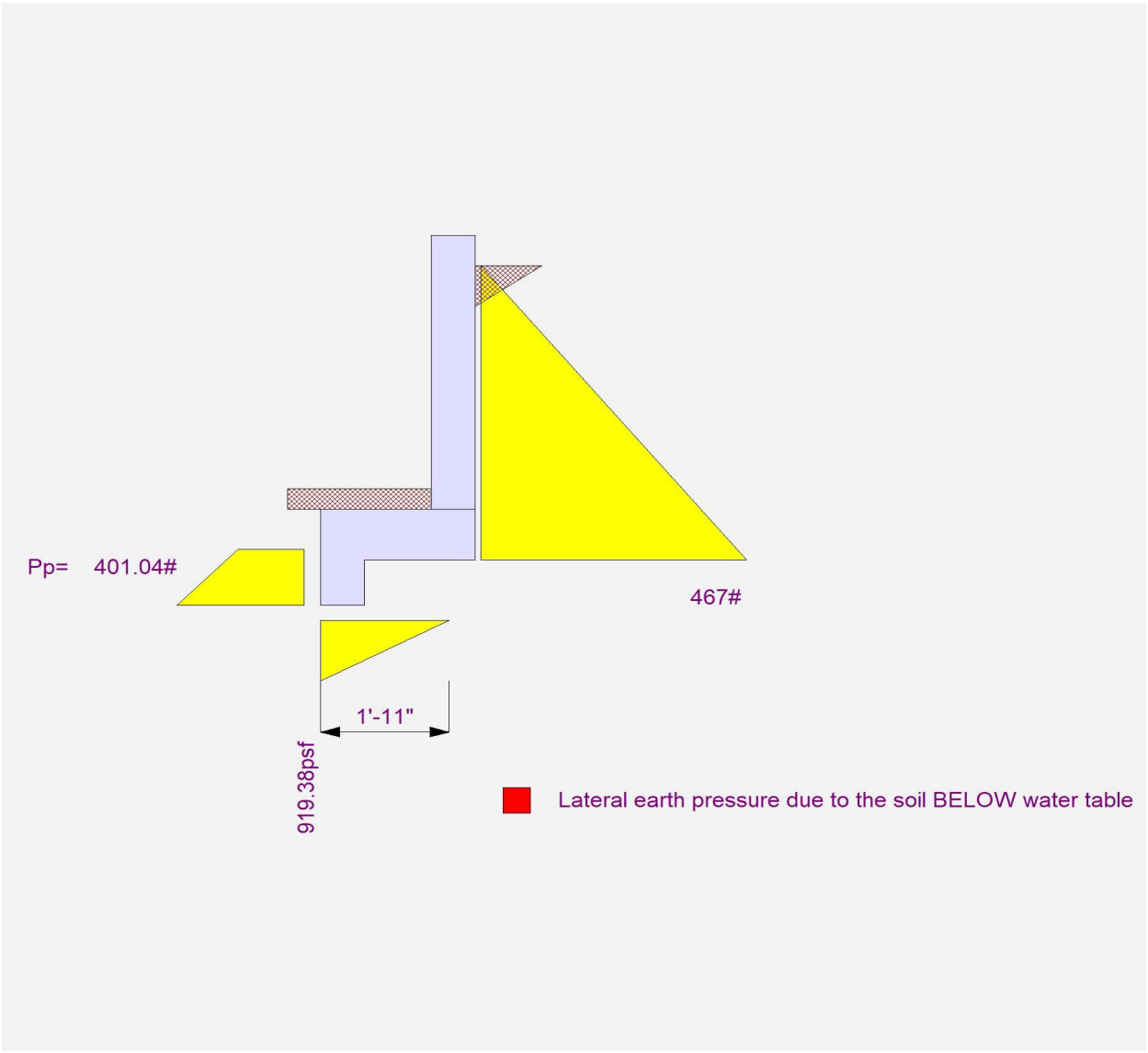


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 4'-0" Site Retaining Wall w/keyway



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 8'-0" Site Retaining Wall w/keyway

Code Reference

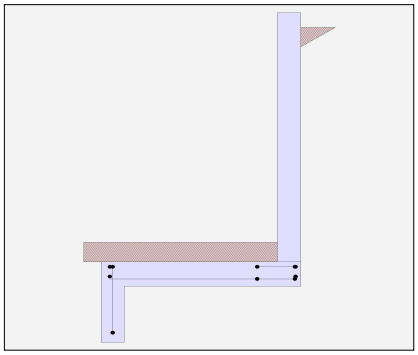
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	2,500.0 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	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

Axial Load Applied to Stem

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		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:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 8'-0" Site Retaining Wall w/keyway

Design Summary

Wall Stability Ratios

Overturning	=	1.71	OK
Sliding	=	1.59	OK
Global Stability	=	6.04	

Total Bearing Load	=	2,948 lbs	
...resultant ecc.	=	16.73 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	991 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,387 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	22.7 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,560.6 lbs	
less 100% Passive Force	-	1,601.0 lbs	
less 100% Friction Force	-	880.4 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	
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
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	6.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.525**
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	=	10,400.4
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	27.3
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:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 8'-0" Site Retaining Wall w/keyway

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2046 in2/ft		
(4/3) * As :	0.2728 in2/ft	Min Stem T&S Reinf Area 1.632 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.25 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.4 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	=	5.08 ft
Heel Width	=	0.67
Total Footing Width	=	5.75
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	23.00 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	Key	
Factored Pressure	=	1,387	0		psf
Mu' : Upward	=	11,100	0		ft-#
Mu' : Downward	=	3,281	0		ft-#
Mu: Design	=	7,819	0	2,480	ft-#
phiMn	=	11,303	OK - Flush	3,388	
Actual 1-Way Shear	=	22.70	0.00	50.52	psi
Allow 1-Way Shear	=	75.00	75.00	75.00	psi

Toe Reinforcing = # 4 @ 6.00 in
Heel Reinforcing = Flush heel condition. No reinforcing required.
Key Reinforcing = # 4 @ 12.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 8.53 in, #5@ 13.23 in, #6@ 18.78 in, #7@ 25.61 in, #8@ 33.72 in, #9@ 42.69 in, #10@ 54.21 in

Heel: Flush heel condition. No reinforcing required.

Key: #4@ 15 in, #5@ 18 in, #6@ 18 in, #7@ 18 in, #

Min footing T&S reinf Area 1.24 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 8'-0" Site Retaining Wall w/keyway

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)		1,560.6	2.94	4,595.0	Soil Over HL (ab. water tbl)	0.0	5.75	0.2
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		5.75	0.2
Hydrostatic Force					Water Table			
Buoyant Force	=				Sloped Soil Over Hee	=		
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	440.5	2.54	1,119.6
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	850.0	5.42	4,603.9
					Earth @ Stem Transitions	=			
					Footing Weight	=	718.7	2.87	2,066.2
					Key Weight	=	191.7	0.33	63.9
					Vert. Component	=			
Total	=	1,560.6	**O.T.M.** =	4,595.0	**Total =**		2,200.9 lbs	**R.M.=**	7,853.8

Resisting/Overturning Ratio = **1.71**

Vertical Loads used for Soil Pressure = 2,948.1 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	200.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.051	in

Cantilevered Retaining Wall

DESCRIPTION: 8'-0" Site Retaining Wall w/keyway

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height: 0.00 ft above top of footing

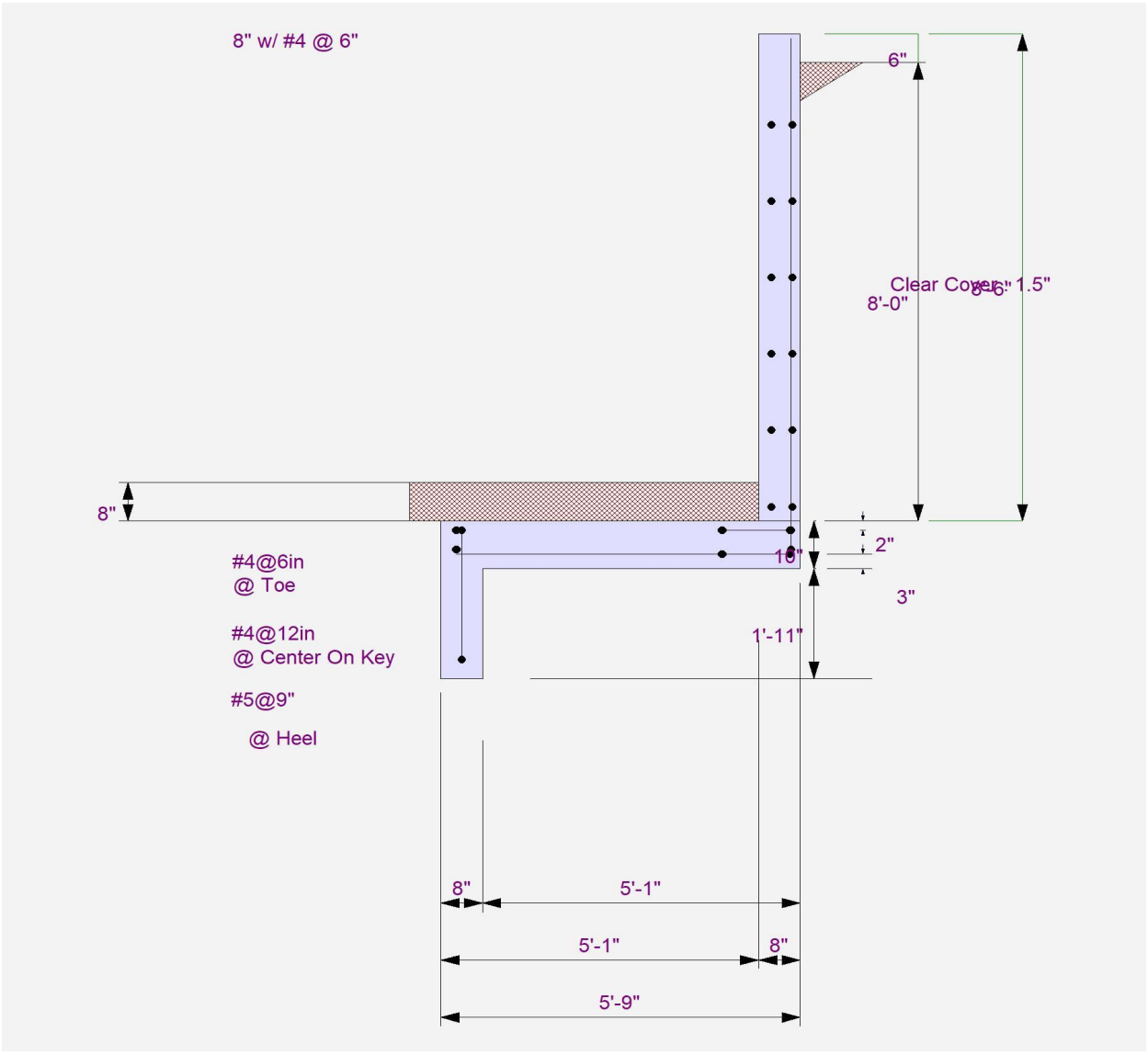
Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	6.00 in
As Provided =	0.4000 in2/ft
As Required =	0.2500 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 8'-0" Site Retaining Wall w/keyway

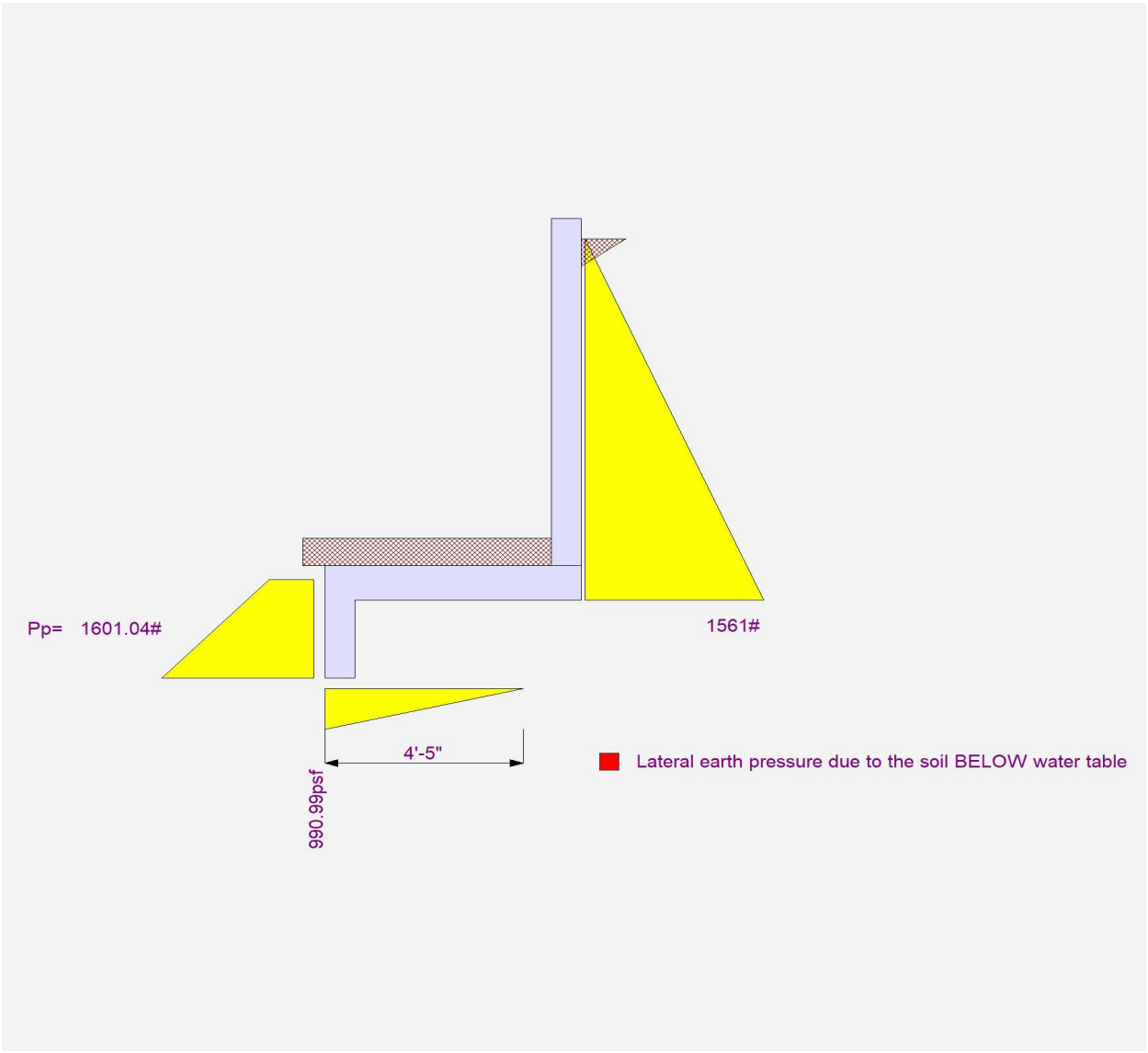


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 8'-0" Site Retaining Wall w/keyway



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 6'-0" Site Retaining Wall w/keyway

Code Reference

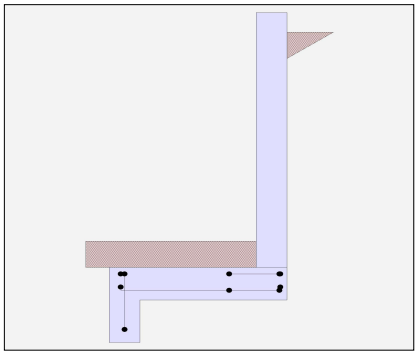
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	2,500.0 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	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

Axial Load Applied to Stem

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

Lateral Load Applied to Stem

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

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		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:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 6'-0" Site Retaining Wall w/keyway

Design Summary

Wall Stability Ratios

Overturning	=	1.72	OK
Sliding	=	1.56	OK
Global Stability	=	1.07	

Total Bearing Load	=	1,959	lbs
...resultant ecc.	=	10.80	in
Eccentricity outside middle third			
Soil Pressure @ Toe	=	991	psf OK
Soil Pressure @ Heel	=	0	psf OK
Allowable	=	2,500	psf
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,388	psf
ACI Factored @ Heel	=	0	psf
Footing Shear @ Toe	=	16.9	psi OK
Footing Shear @ Heel	=	0.0	psi OK
Allowable	=	75.0	psi

Sliding Calcs

Lateral Sliding Force	=	933.9	lbs
less 100% Passive Force	-	851.0	lbs
less 100% Friction Force	-	604.8	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
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	11.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.391**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,152.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,304.0
Moment.....Allowable	=	5,883.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	15.4
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
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:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 6'-0" Site Retaining Wall w/keyway

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0863 in2/ft		
(4/3) * As :	0.1151 in2/ft	Min Stem T&S Reinf Area 1.248 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2182 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.17 ft
Heel Width	=	0.67
Total Footing Width	=	3.83
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	13.00 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	Key	
Factored Pressure	=	1,388	0		psf
Mu' : Upward	=	4,552	0		ft-#
Mu' : Downward	=	1,274	0		ft-#
Mu: Design	=	3,278	0	757	ft-#
phiMn	=	6,376	OK - Flush	3,388	
Actual 1-Way Shear	=	16.90	0.00	25.62	psi
Allow 1-Way Shear	=	75.00	75.00	75.00	psi

Toe Reinforcing = # 4 @ 11.00 in
Heel Reinforcing = Flush heel condition. No reinforcing required.
Key Reinforcing = # 4 @ 12.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 55.55 in, #10@ 70.55 in

Heel: Flush heel condition. No reinforcing required.

Key: #4@ 13.88 in, #5@ 18 in, #6@ 18 in, #7@ 18 in

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

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 6'-0" Site Retaining Wall w/keyway

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	933.9	2.28	2,127.2	Soil Over HL (ab. water tbl)	0.0	3.83	0.1
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.83	0.1
Hydrostatic Force				Water Table			
Buoyant Force =				Sloped Soil Over Hee =			
Surcharge over Heel =				Surcharge Over Heel =			
Surcharge Over Toe =				Adjacent Footing Load =			
Adjacent Footing Load =				Axial Dead Load on Stem =			
Added Lateral Load =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =	274.5	1.58	434.6
=				Surcharge Over Toe =			
				Stem Weight(s) =	650.0	3.50	2,275.2
				Earth @ Stem Transitions =			
				Footing Weight =	479.2	1.92	918.6
				Key Weight =	108.3	0.33	36.1
				Vert. Component =			
Total =	933.9	**O.T.M.** =	2,127.2	**Total =**	1,512.0 lbs	**R.M.=**	3,664.6

Resisting/Overturning Ratio = **1.72**

Vertical Loads used for Soil Pressure = 1,959.2 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	200.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.058	in

DESCRIPTION: 6'-0" Site Retaining Wall w/keyway

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height: 0.00 ft above top of footing

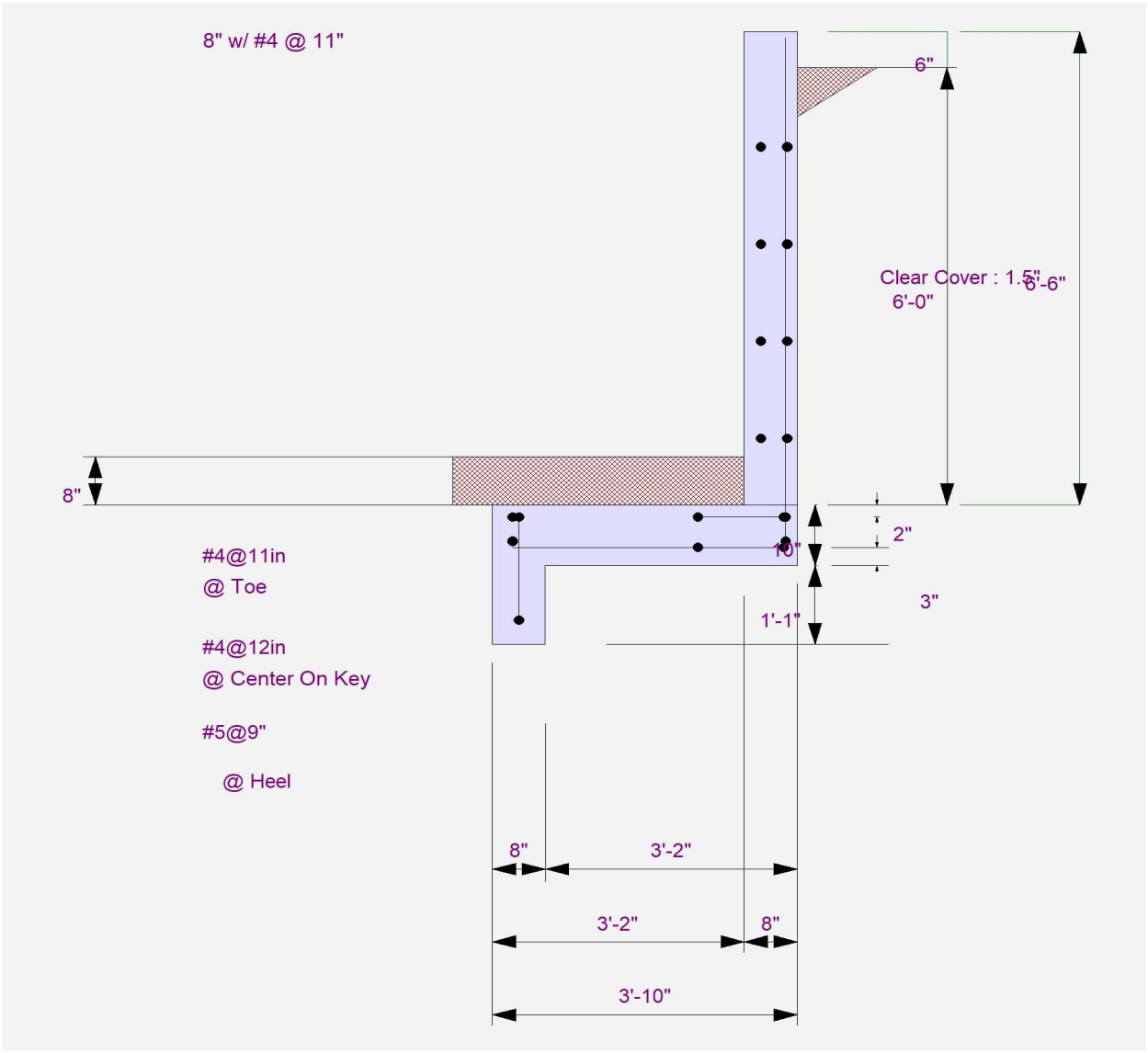
Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	6.65 in
As Provided =	0.2182 in2/ft
As Required =	0.1728 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 6'-0" Site Retaining Wall w/keyway



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Biggs retaining walls.ec6

DESCRIPTION: 6'-0" Site Retaining Wall w/keyway