PRRWF20250002

Supplemental Structural Calculations

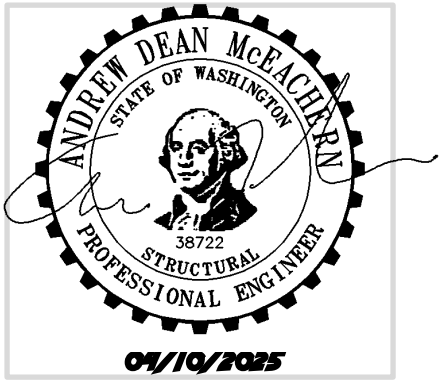
For

Wesley Bradley Park Phase II
Care Center Site Walls

Tacoma, WA

Project # 2220236.20

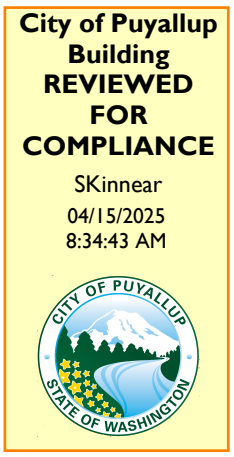
Project Principal Drew McEachern, PE, SE
Project Engineer Kyle Gysler, PE



Calculations required to be provided by the Permittee on site for all Inspections

Date:

April 2025



AHBL, Inc.
2215 North 30th
Tacoma, WA 98403
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26 AHBL, INC

DESCRIPTION: 7' Retaining Wall - w/ LL - Rev1

Code References

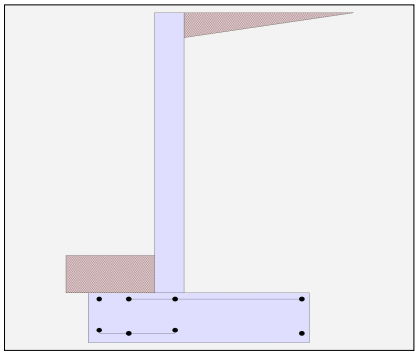
Calculations per IBC 2021, ACI 318-19, TMS 402-16

Criteria

Retained Height	=	7.50 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water table above bottom of footing	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	525.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.525
Soil height to ignore for passive pressure	=	24.00 in



Surcharge Loads

Surcharge Over Heel	=	100.0 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

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Project File: 2220236_care center redesign.ec6

DESCRIPTION: 7' Retaining Wall - w/ LL - Rev1

Design Summary

Wall Stability Ratios

Overturning	=	2.54	OK
Sliding	=	1.68	OK
Global Stability	=	2.55	

Total Bearing Load	=	5,139	lbs
...resultant ecc.	=	8.50	in
Eccentricity within middle third			
Soil Pressure @ Toe	=	1,678	psf OK
Soil Pressure @ Heel	=	136	psf OK
Allowable	=	3,000	psf
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,349	psf
ACI Factored @ Heel	=	191	psf
Footing Shear @ Toe	=	5.6	psi OK
Footing Shear @ Heel	=	10.3	psi OK
Allowable	=	82.2	psi

Sliding Calcs

Lateral Sliding Force	=	1,646.5	lbs
less 100% Passive Force	-	379.2	lbs
less 100% Friction Force	-	2,381.3	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	=	# 6		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.511**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	1,956.8		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	5,369.3		
Moment.....Allowable	=	10,495.0		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	29.0		
Shear.....Allowable	psi =	70.9		
Anet (Masonry)	in2 =			
Wall Weight	psf =	100.0		
Rebar Depth 'd'	in =	5.63		

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 =	4,000.0
Fy	psi =	60,000.0

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Cantilevered Retaining Wall

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DESCRIPTION: 7' Retaining Wall - w/ LL - Rev1

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2249 in2/ft		
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2249 in2/ft	#4@ 13.89 in	#4@ 27.78 in
Provided Area :	0.44 in2/ft	#5@ 21.53 in	#5@ 43.06 in
Maximum Area :	1.2192 in2/ft	#6@ 30.56 in	#6@ 61.11 in

Used #5 @ 12"oc (0.31sqin/ft...ok)

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	3.50
Total Footing Width	=	5.00
Footing Thickness	=	16.00 in

f'c = 3,000 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	=	2,349	191	psf
Mu' : Upward	=	2,400	2,403	ft-#
Mu' : Downward	=	419	5,579	ft-#
Mu: Design	=	1,981	3,176	ft-#
φ Mn	=	24,143	26,123	ft-#
Actual 1-Way Shear	=	5.60	10.28	psi
Allow 1-Way Shear	=	46.89	45.71	psi

Toe Reinforcing = # 6 @ 12.00 in
Heel Reinforcing = # 6 @ 12.00 in
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, φ Tn = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Key: No key defined

Min footing T&S reinf Area 1.73 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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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)		1,365.5	2.94	4,020.6	Soil Over HL (ab. water tbl)	2,337.5	3.58	8,376.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.58	8,376.0
Hydrostatic Force					Water Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	281.1	4.42	1,241.4	Surcharge Over Heel	= 283.3	3.58	1,015.3
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	= 165.0	0.75	123.8
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 750.0	1.83	1,375.0
					Earth @ Stem Transitions	=		
					Footing Weight	= 1,000.0	2.50	2,500.0
					Key Weight	=		
					Vert. Component	=		
Total	=	1,646.5	**O.T.M.** =	5,261.9	**Total =**	4,535.8 lbs	**R.M.=**	13,390.1

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

Resisting/Overturning Ratio = **2.54**
Vertical Loads used for Soil Pressure = 5,138.6 lbs

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.070	in

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

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DESCRIPTION: 7' Retaining Wall - w/ LL - Rev1

Rebar Lap & Embedment Lengths Information

Used #5 @ 12"oc
(0.31sqin/ft...ok)

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

Lap Splice length for #6 bar specified in this stem design segment (25.4.2.4a) =	22.20 in
Development length for #6 bar specified in this stem design segment =	17.08 in
Hooked embedment length into footing for #6 bar specified in this stem design segment =	10.35 in
As Provided =	0.4400 in2/ft
As Required =	0.2250 in2/ft

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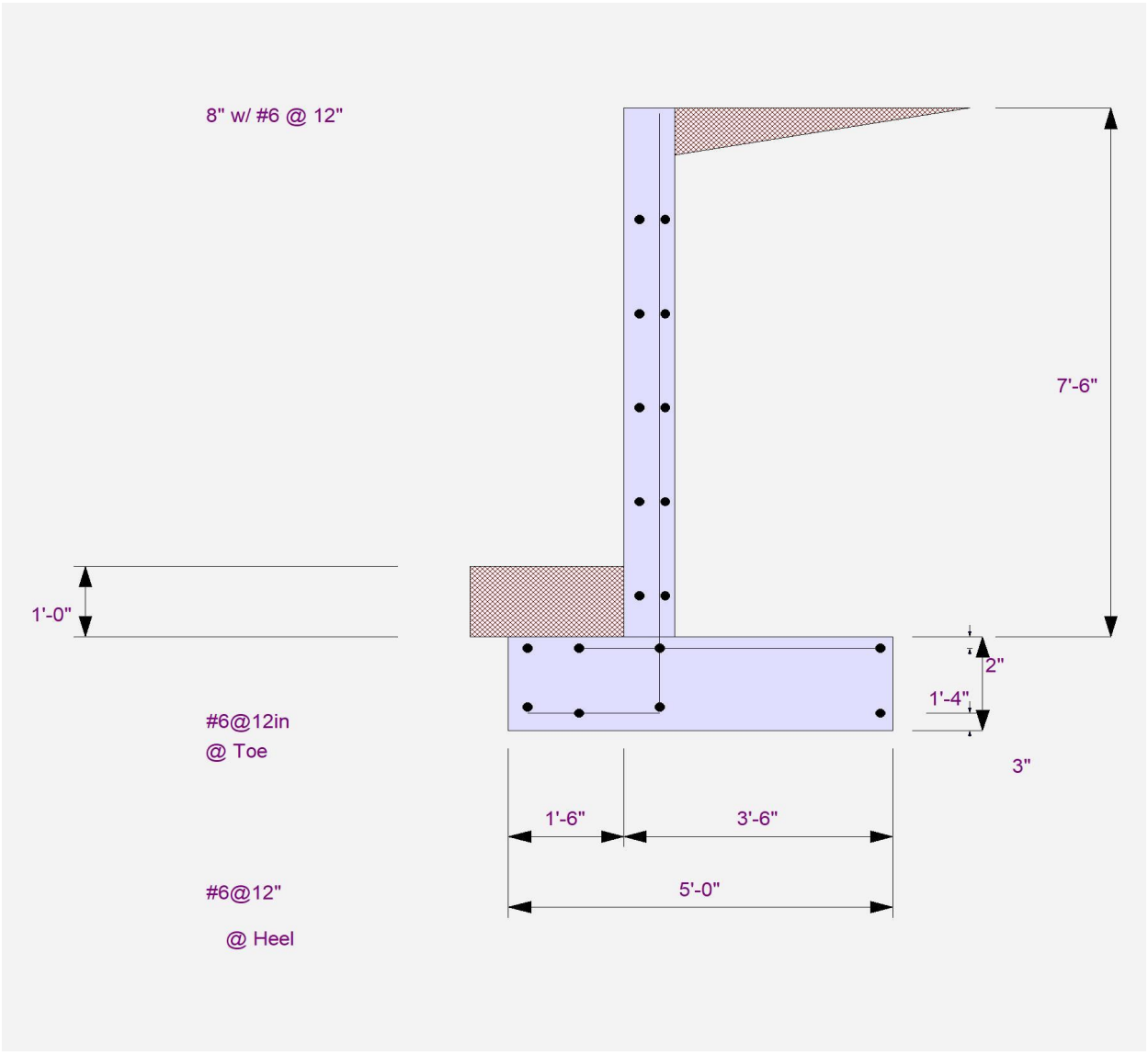

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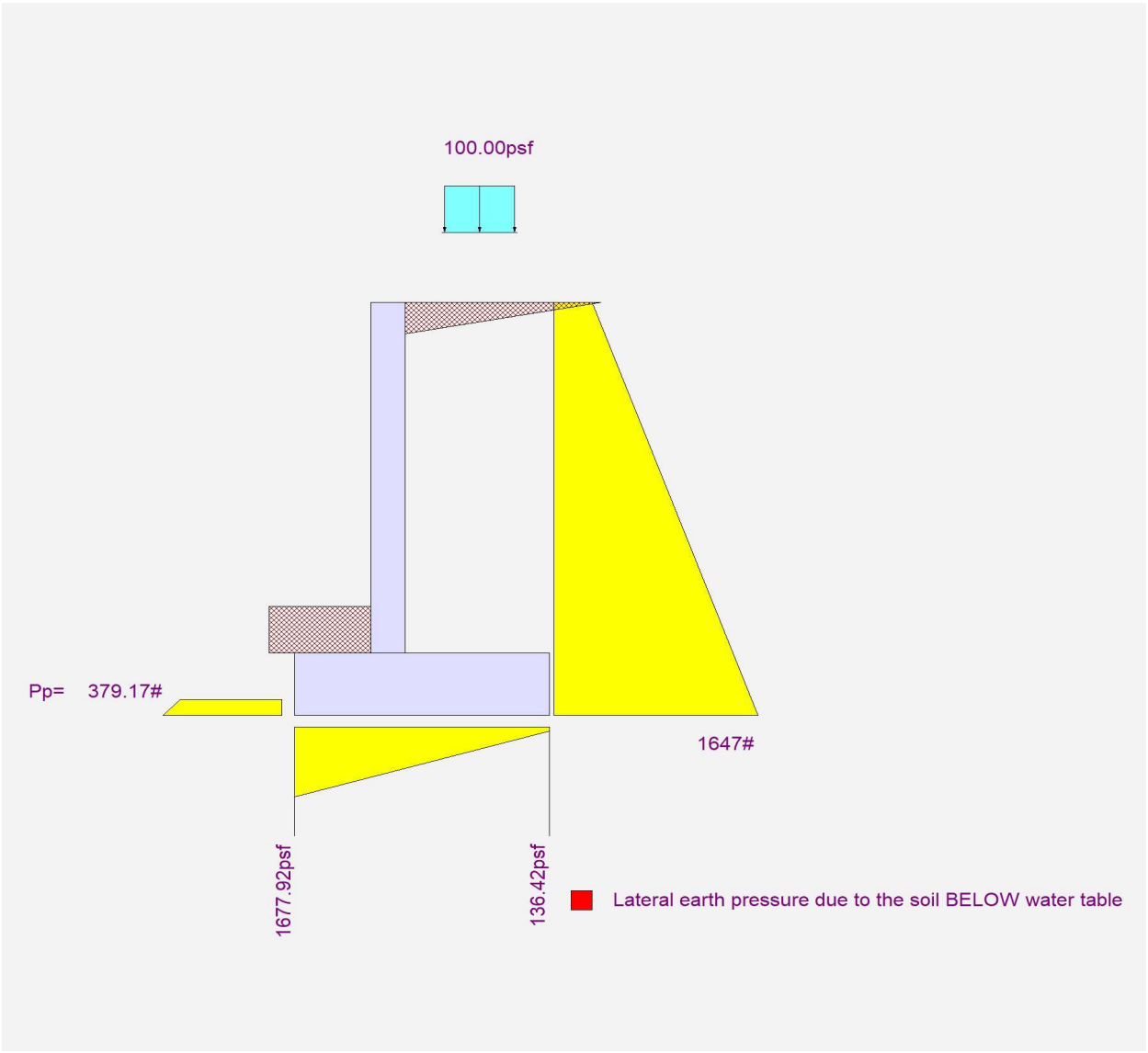

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DESCRIPTION: 7' Retaining Wall - w/ EQ - Rev1

Code References

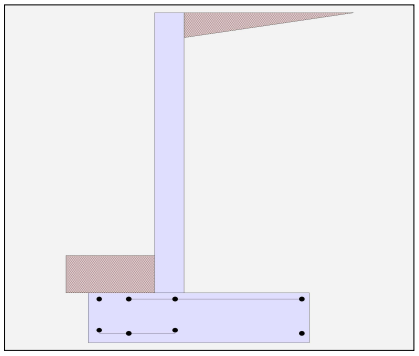
Calculations per IBC 2021, ACI 318-19, TMS 402-16

Criteria

Retained Height	=	7.50 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water table above bottom of footing	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	525.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.525
Soil height to ignore for passive pressure	=	22.50 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	=	8.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	70.667
Total Seismic Force	=	624.222

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Design Summary

Wall Stability Ratios

Overturning	=	2.08	OK
Sliding	=	1.52	OK
Global Stability	=	2.43	

Total Bearing Load	=	4,855 lbs	
...resultant ecc.	=	11.87 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,877 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	3,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,627 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	6.4 psi	OK
Footing Shear @ Heel	=	11.5 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs

Lateral Sliding Force	=	1,802.4 lbs	
less 100% Passive Force	-	506.3 lbs	
less 100% Friction Force	-	2,232.6 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	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 6		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.564**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	2,105.0		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	5,925.0		
Moment.....Allowable	=	10,495.0		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	31.2		
Shear.....Allowable	psi =	70.9		
Anet (Masonry)	in2 =			
Wall Weight	psf =	100.0		
Rebar Depth 'd'	in =	5.63		

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 =	4,000.0
Fy	psi =	60,000.0

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DESCRIPTION: 7' Retaining Wall - w/ EQ - Rev1

Used #5 @ 12"oc (0.31sqin/ft...ok)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2481 in2/ft		
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2481 in2/ft	#4@ 13.89 in	#4@ 27.78 in
Provided Area :	0.44 in2/ft	#5@ 21.53 in	#5@ 43.06 in
Maximum Area :	1.2192 in2/ft	#6@ 30.56 in	#6@ 61.11 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	3.50
Total Footing Width	=	5.00
Footing Thickness	=	16.00 in

f'c = 3,000 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	=	2,627	0	psf
Mu' : Upward	=	2,630	1,279	ft-#
Mu' : Downward	=	419	4,937	ft-#
Mu: Design	=	2,211	3,658	ft-#
φ Mn	=	24,143	26,123	ft-#
Actual 1-Way Shear	=	6.35	11.50	psi
Allow 1-Way Shear	=	46.89	45.71	psi

Toe Reinforcing = # 6 @ 12.00 in
Heel Reinforcing = # 6 @ 12.00 in
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, φ Tn = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Key: No key defined

Min footing T&S reinf Area 1.73 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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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)		1,365.5	2.94	4,020.6	Soil Over HL (ab. water tbl)	2,337.5	3.58	8,376.0
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.58	8,376.0
Hydrostatic Force					Water 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	=	165.0	0.75	123.8
Seismic Earth Load	=	437.0	4.42	1,929.9	Surcharge Over Toe	=		
	=				Stem Weight(s)	=	750.0	1.83	1,375.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	1,000.0	2.50	2,500.0
					Key Weight	=			
					Vert. Component	=			
Total	=	1,802.4	**O.T.M.** =	5,950.5	**Total =**		4,252.5 lbs	**R.M.=**	12,374.8

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

Resisting/Overturning Ratio = **2.08**
Vertical Loads used for Soil Pressure = 4,855.3 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 NOT considered in the calculation of Sliding Resistance.

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.078	in

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

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Rebar Lap & Embedment Lengths Information

Used #5 @ 12"oc (0.31sqin/ft...ok)

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

Lap Splice length for #6 bar specified in this stem design segment (25.4.2.4a) =	22.20 in
Development length for #6 bar specified in this stem design segment =	17.08 in
Hooked embedment length into footing for #6 bar specified in this stem design segment =	10.35 in
As Provided =	0.4400 in2/ft
As Required =	0.2481 in2/ft

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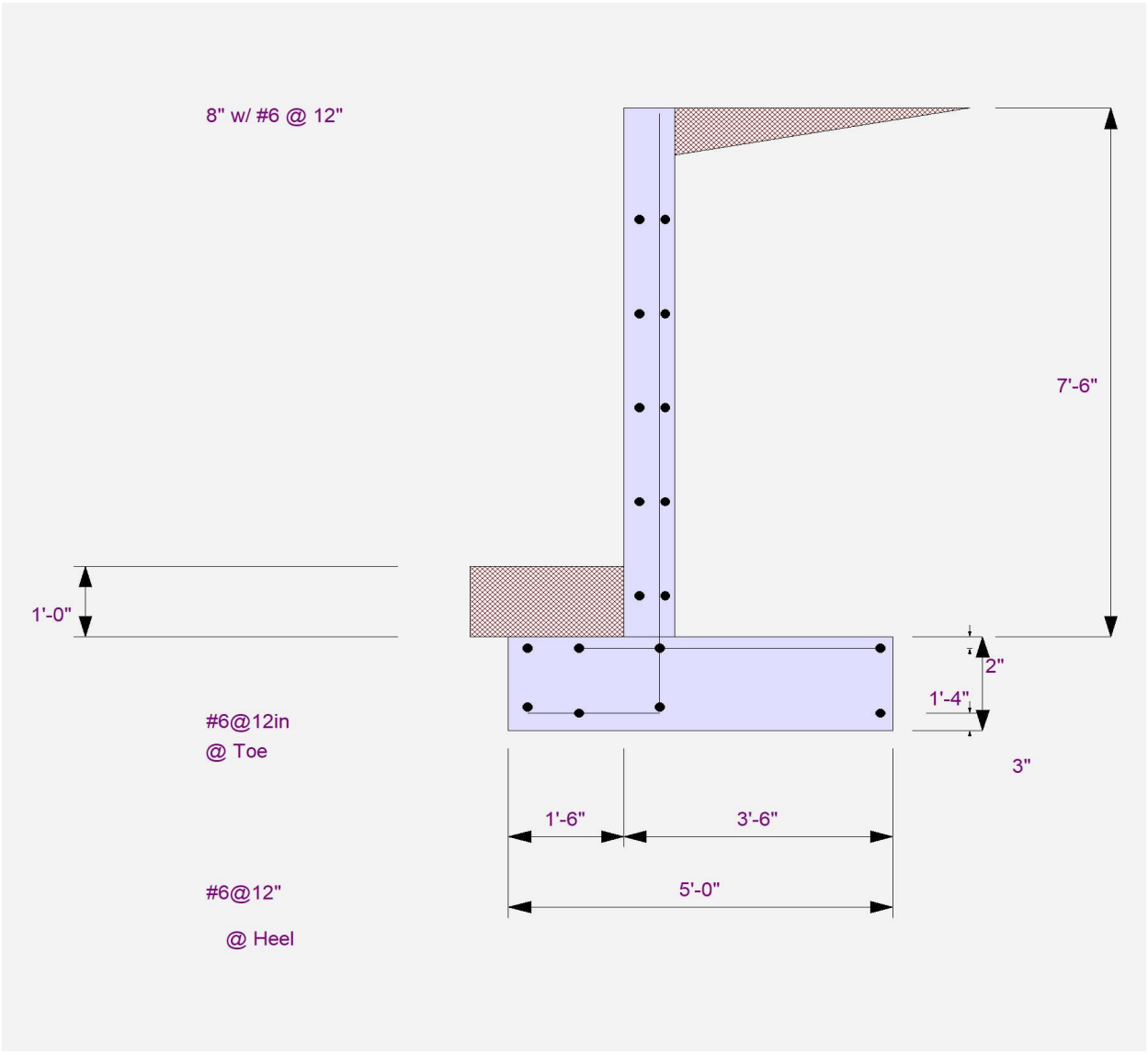
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 7' Retaining Wall - w/ EQ - Rev1



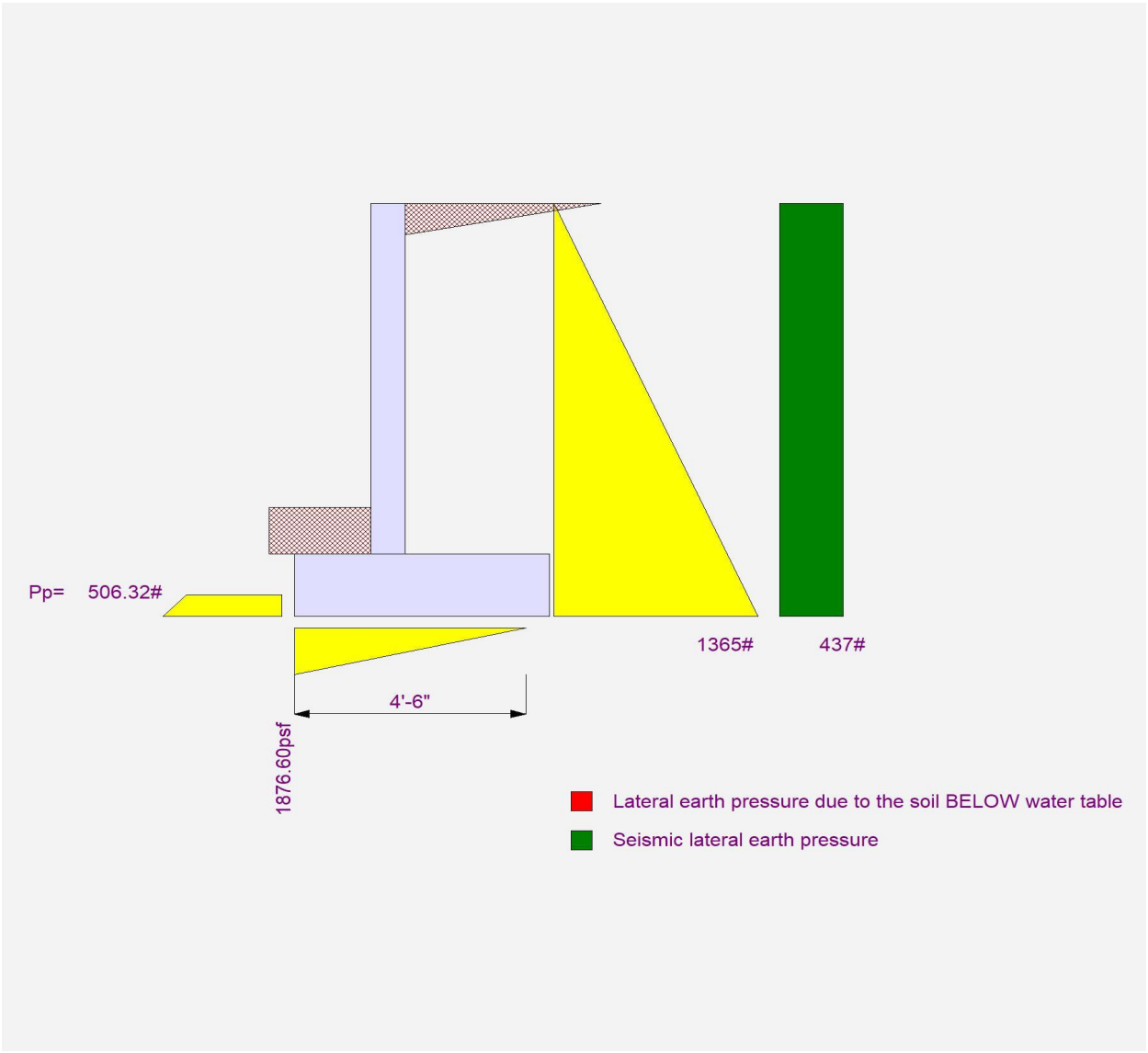
AHBL, Inc.
2215 North 30th
Tacoma, WA 98403
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 7' Retaining Wall - w/ EQ - Rev1



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2215 North 30th
Tacoma, WA 98403
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26 AHBL, INC

DESCRIPTION: 4' Retaining Wall - w/ LL - Rev1

Code References

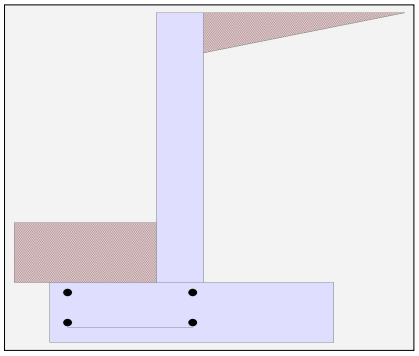
Calculations per IBC 2021, ACI 318-19, TMS 402-16

Criteria

Retained Height	=	4.50 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water table above bottom of footing	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	525.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.525
Soil height to ignore for passive pressure	=	24.00 in



Surcharge Loads

Surcharge Over Heel	=	100.0 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

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253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 4' Retaining Wall - w/ LL - Rev1

Design Summary

Wall Stability Ratios

Overturning	=	3.80	OK
Sliding	=	1.72	OK
Global Stability	=	1.72	

Total Bearing Load	=	2,540	lbs
...resultant ecc.	=	2.87	in
Eccentricity within middle third			
Soil Pressure @ Toe	=	783	psf OK
Soil Pressure @ Heel	=	370	psf OK
Allowable	=	3,000	psf
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,096	psf
ACI Factored @ Heel	=	518	psf
Footing Shear @ Toe	=	5.3	psi OK
Footing Shear @ Heel	=	4.3	psi OK
Allowable	=	82.2	psi

Sliding Calcs

Lateral Sliding Force	=	704.4	lbs
less 100% Passive Force	-	0.0	lbs
less 100% Friction Force	-	1,210.6	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	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 5		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.164**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	796.1		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	1,366.0		
Moment.....Allowable	=	8,312.6		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	10.7		
Shear.....Allowable	psi =	61.1		
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 =	4,000.0
Fy	psi =	60,000.0

AHBL, Inc.
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253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 4' Retaining Wall - w/ LL - Rev1

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0517 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@ 13.89 in	#4@ 27.78 in
Provided Area :	0.31 in2/ft	#5@ 21.53 in	#5@ 43.06 in
Maximum Area :	1.3411 in2/ft	#6@ 30.56 in	#6@ 61.11 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	2.50
Total Footing Width	=	4.00
Footing Thickness	=	12.00 in

f'c = 3,000 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	=	1,096	518	psf
Mu' : Upward	=	1,152	1,019	ft-#
Mu' : Downward	=	351	1,570	ft-#
Mu: Design	=	801	551	ft-#
φ Mn	=	11,695	2,739	ft-#
Actual 1-Way Shear	=	5.30	4.33	psi
Allow 1-Way Shear	=	47.26	43.82	psi

Toe Reinforcing = # 5 @ 12.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, φ Tn = 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@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

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

Key: No key defined

Min footing T&S reinf Area 1.04 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 Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 4' Retaining Wall - w/ LL - Rev1

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)		529.4	1.83	970.5	Soil Over HL (ab. water tbl)	907.5	3.08	2,798.1
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.08	2,798.1
Hydrostatic Force					Water Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	175.0	2.75	481.3	Surcharge Over Heel	= 183.3	3.08	565.3
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	= 165.0	0.75	123.8
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 450.0	1.83	825.0
					Earth @ Stem Transitions	=		
					Footing Weight	= 600.0	2.00	1,200.0
					Key Weight	=		
					Vert. Component	=		
Total	=	704.4	**O.T.M.** =	1,451.8	**Total =**	2,305.8 lbs	**R.M.=**	5,512.2

Resisting/Overturning Ratio = **3.80**
Vertical Loads used for Soil Pressure = 2,539.5 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)	0.024	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.

AHBL, Inc.
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253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 4' Retaining Wall - w/ LL - Rev1

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 (25.4.2.4a) =	18.50 in
Development length for #5 bar specified in this stem design segment =	14.23 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	7.87 in
As Provided =	0.3100 in2/ft
As Required =	0.1728 in2/ft

AHBL, Inc.
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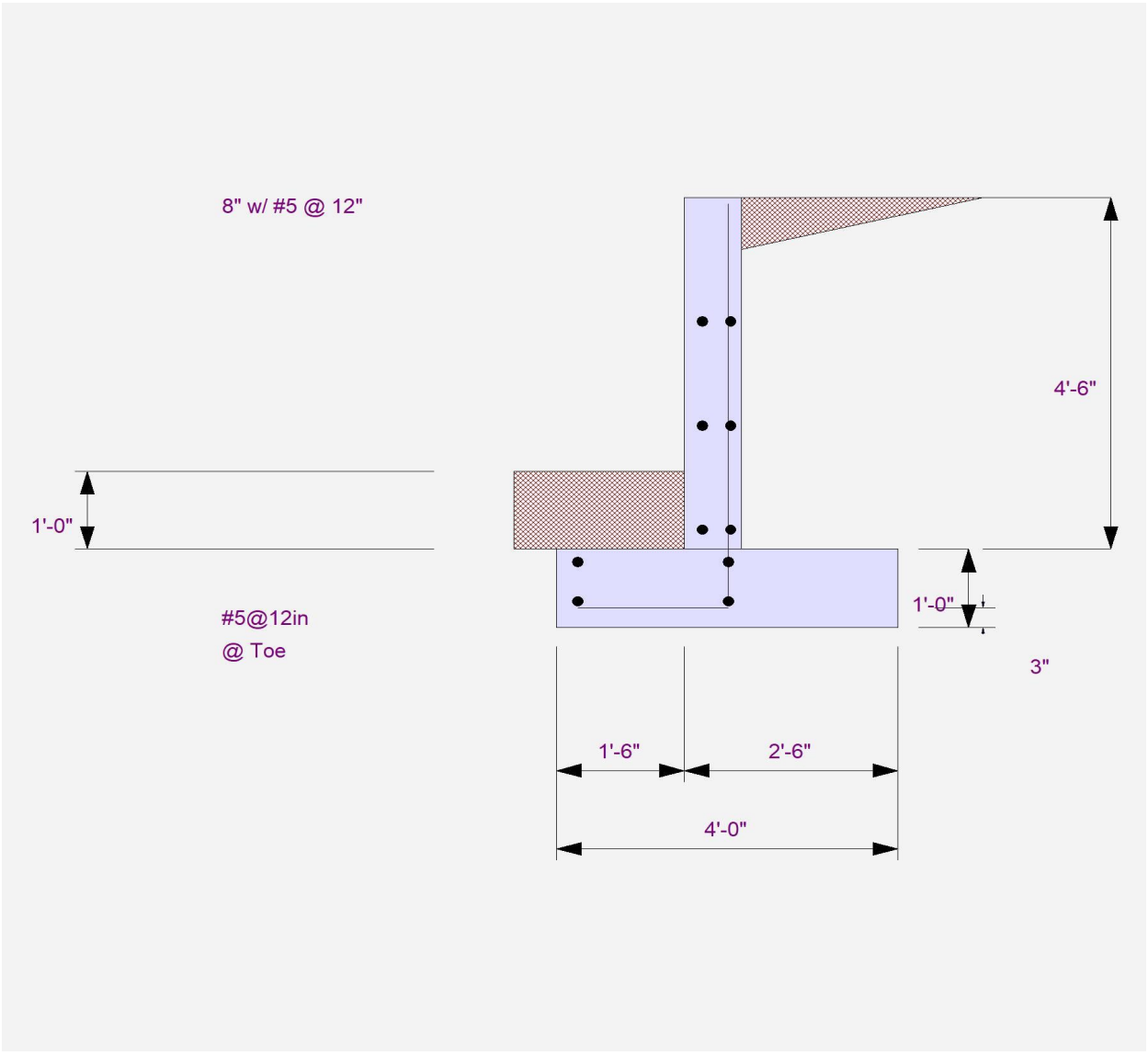
Tacoma, WA 98403
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 4' Retaining Wall - w/ LL - Rev1



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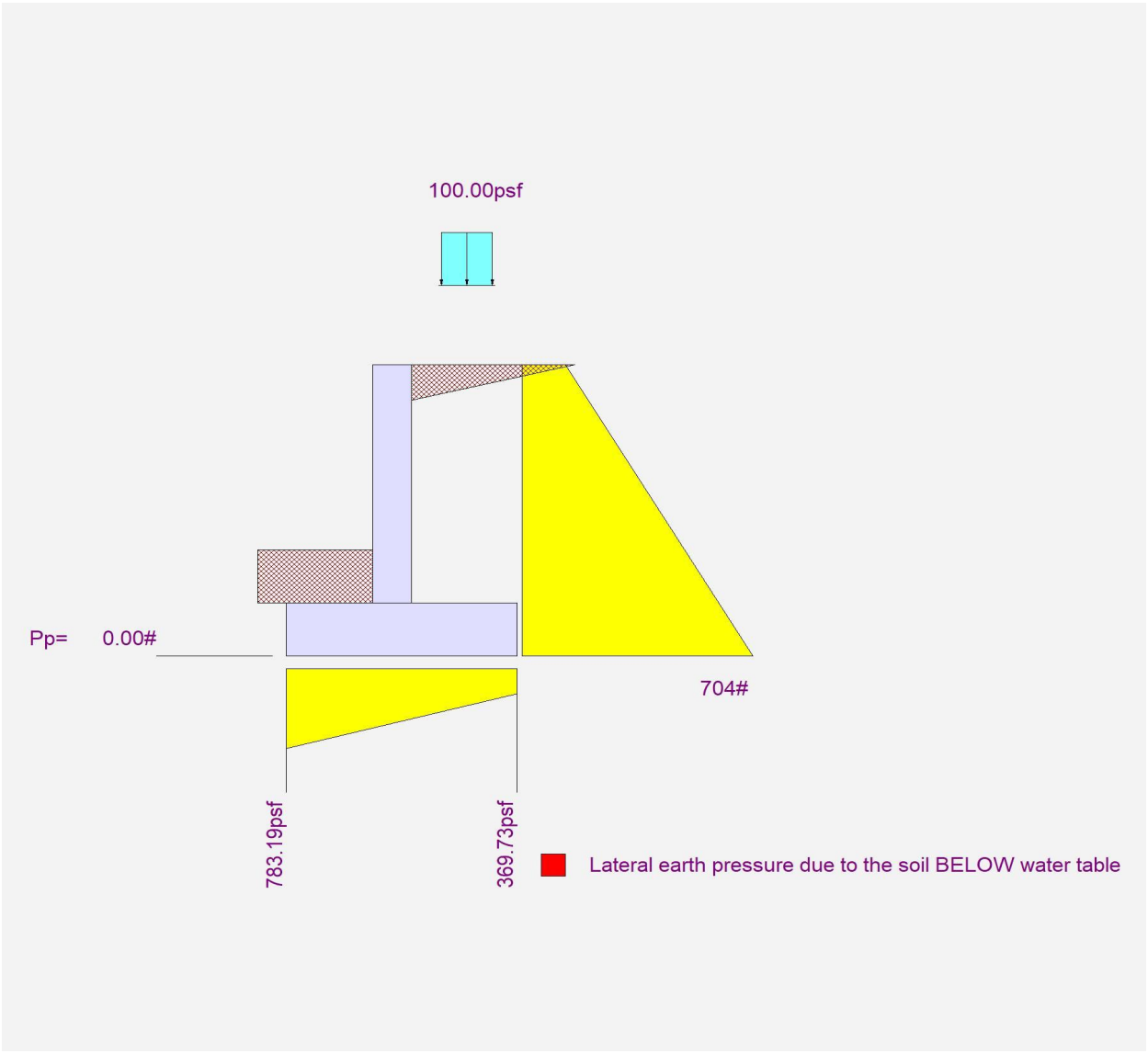
Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 4' Retaining Wall - w/ LL - Rev1



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253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26 AHBL, INC

DESCRIPTION: 4' Retaining Wall - w/ EQ - Rev1

Code Reference

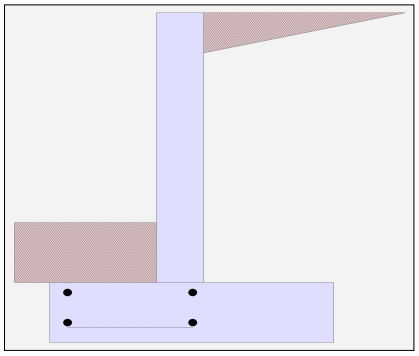
Calculations per IBC 2021, ACI 318-19, TMS 402-16

Criteria

Retained Height	=	4.50 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water table above bottom of footing	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	525.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.525
Soil height to ignore for passive pressure	=	24.00 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	=	8.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	44.000
Total Seismic Force	=	242.000

AHBL, Inc.
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Tacoma, WA 98403
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 4' Retaining Wall - w/ EQ - Rev1

Design Summary

Wall Stability Ratios

Overturning	=	3.44	OK
Sliding	=	1.59	OK
Global Stability	=	3.13	

Total Bearing Load	=	2,356	lbs
...resultant ecc.	=	4.15	in

Eccentricity within middle third

Soil Pressure @ Toe	=	806	psf	OK
Soil Pressure @ Heel	=	255	psf	OK
Allowable	=	3,000	psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,128	psf	
ACI Factored @ Heel	=	357	psf	
Footing Shear @ Toe	=	5.4	psi	OK
Footing Shear @ Heel	=	3.7	psi	OK
Allowable	=	82.2	psi	

Sliding Calcs

Lateral Sliding Force	=	698.8	lbs	
less 100% Passive Force	-	0.0	lbs	
less 100% Friction Force	-	1,114.3	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	=	# 5		
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 =	765.0		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	1,296.0		
Moment.....Allowable	=	8,312.6		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	10.3		
Shear.....Allowable	psi =	61.1		
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 =	4,000.0
Fy	psi =	60,000.0

AHBL, Inc.
2215 North 30th
Tacoma, WA 98403
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 4' Retaining Wall - w/ EQ - Rev1

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0491 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@ 13.89 in	#4@ 27.78 in
Provided Area :	0.31 in2/ft	#5@ 21.53 in	#5@ 43.06 in
Maximum Area :	1.3411 in2/ft	#6@ 30.56 in	#6@ 61.11 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	2.50
Total Footing Width	=	4.00
Footing Thickness	=	12.00 in

f'c = 3,000 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	=	1,128	357	psf
Mu' : Upward	=	1,161	798	ft-#
Mu' : Downward	=	351	1,301	ft-#
Mu: Design	=	810	502	ft-#
φ Mn	=	11,695	2,739	ft-#
Actual 1-Way Shear	=	5.40	3.67	psi
Allow 1-Way Shear	=	47.26	43.82	psi

Toe Reinforcing = # 5 @ 12.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, φ Tn = 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@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

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

Key: No key defined

Min footing T&S reinf Area 1.04 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

AHBL, Inc.
2215 North 30th
Tacoma, WA 98403
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 4' Retaining Wall - w/ EQ - Rev1

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)		529.4	1.83	970.5	Soil Over HL (ab. water tbl)	907.5	3.08	2,798.1
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.08	2,798.1
Hydrostatic Force					Water 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	=	165.0	0.75	123.8
Seismic Earth Load	=	169.4	2.75	465.9	Surcharge Over Toe	=		
	=				Stem Weight(s)	=	450.0	1.83	825.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	600.0	2.00	1,200.0
					Key Weight	=			
					Vert. Component	=			
Total	=	698.8	**O.T.M.** =	1,436.4	**Total =**		2,122.5 lbs	**R.M.=**	4,946.9

Resisting/Overturning Ratio = **3.44**
Vertical Loads used for Soil Pressure = 2,356.2 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 NOT considered in the calculation of Sliding Resistance.

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

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

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

AHBL, Inc.
2215 North 30th
Tacoma, WA 98403
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

DESCRIPTION: 4' Retaining Wall - w/ EQ - Rev1

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 (25.4.2.4a) =	18.50 in
Development length for #5 bar specified in this stem design segment =	14.23 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	7.87 in
As Provided =	0.3100 in2/ft
As Required =	0.1728 in2/ft

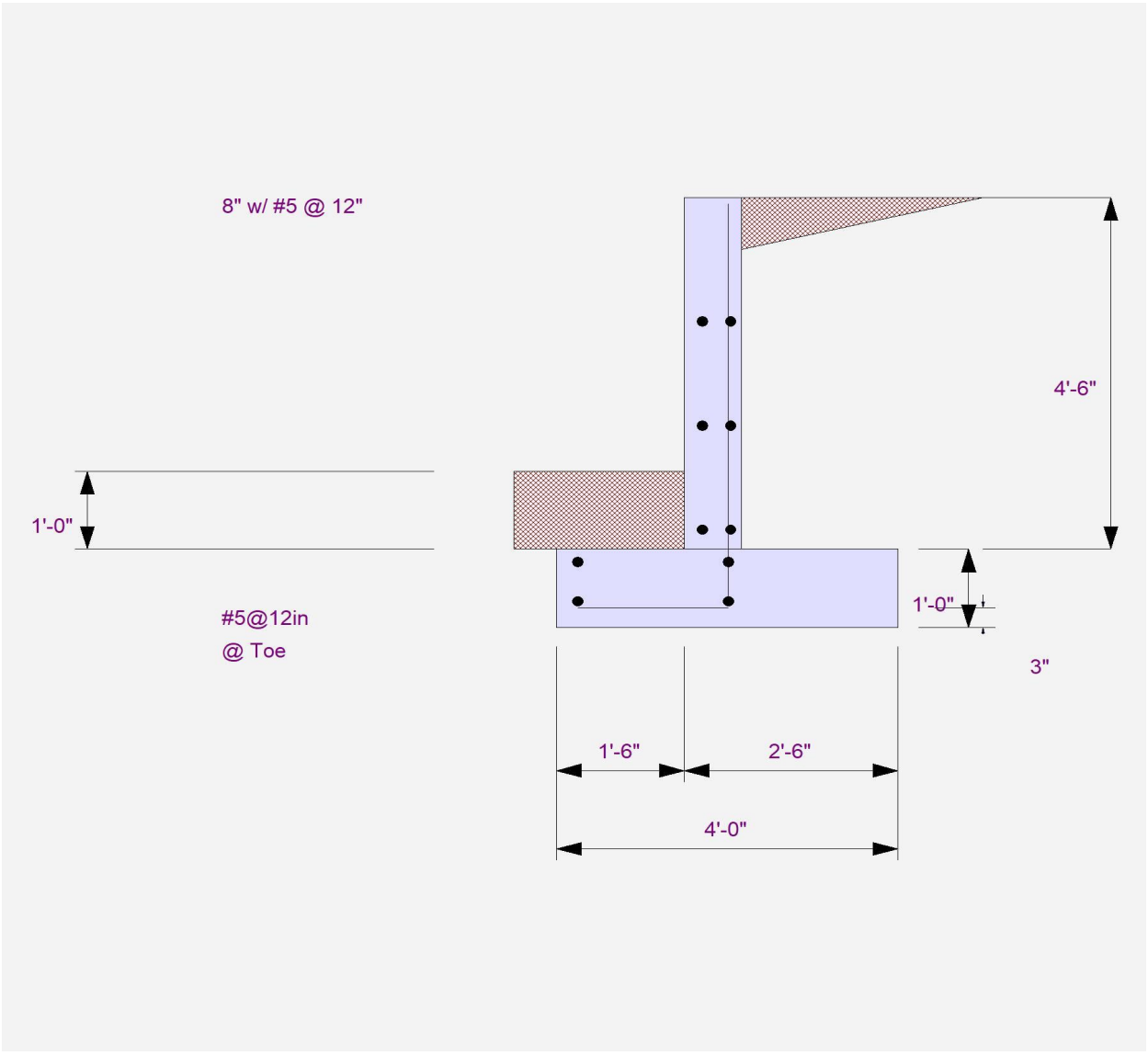
AHBL, Inc.
2215 North 30th
Tacoma, WA 98403
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

Project File: 2220236_care center redesign.ec6

DESCRIPTION: 4' Retaining Wall - w/ EQ - Rev1



AHBL, Inc.
2215 North 30th
Tacoma, WA 98403
253.383.2422

Project Title: Wesley Bradley Park 2
Engineer: KBG
Project ID: 2220236.20
Project Descr: Care Center

Cantilevered Retaining Wall

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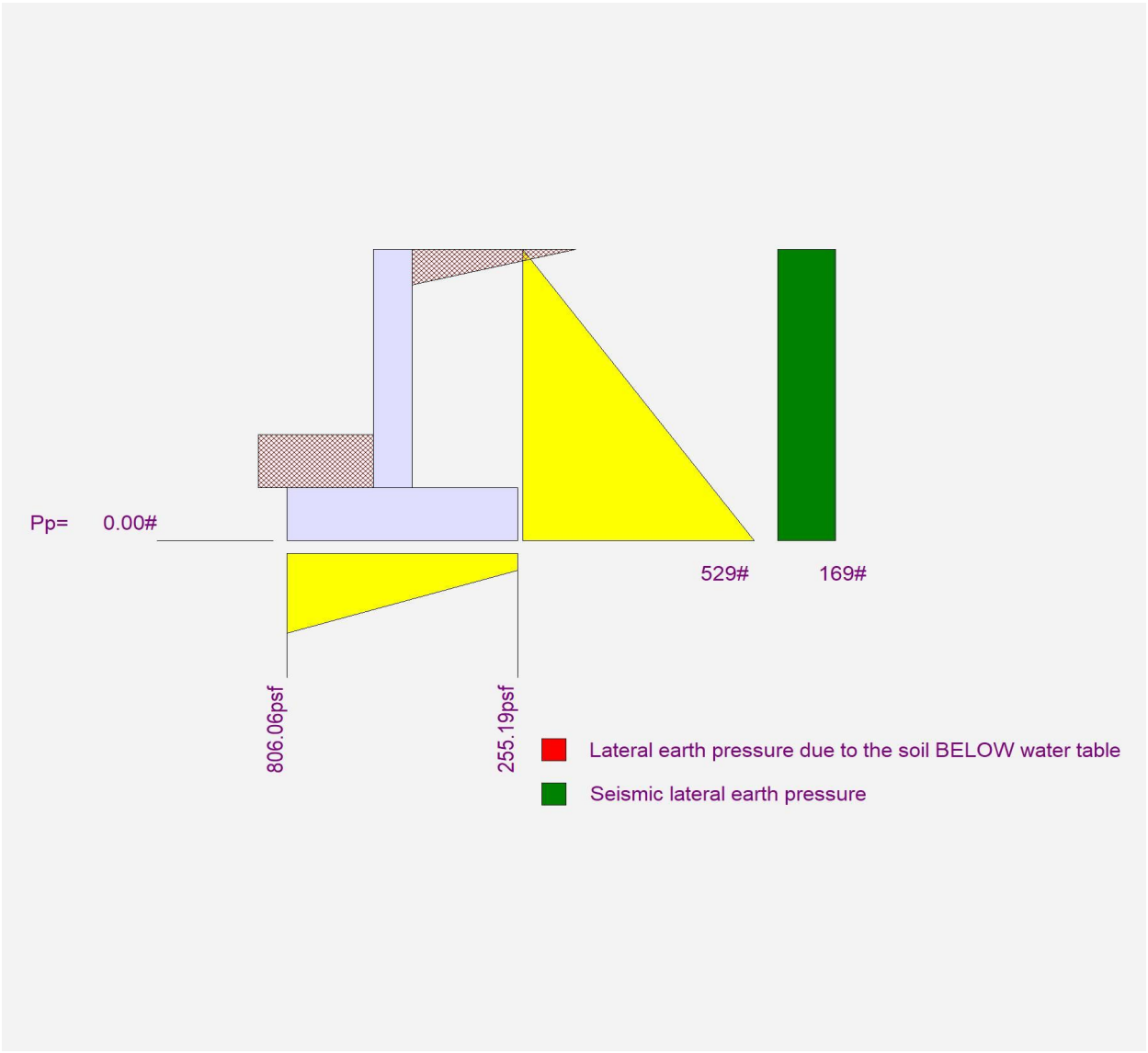


SIMPSON Strong-Tie®

Anchor Designer™ Software
Version 3.2.2309.2

Company:	AHBL	Date:	2/22/2023
Engineer:	KBG	Page:	1/5
Project:	Wesley Bradley Park 2		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location: Site Wall
Fastening description: Railing Anchorage

2. Input Data & Anchor Parameters

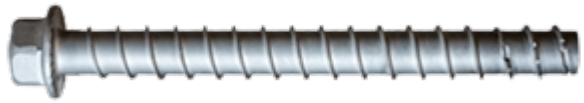
General
Design method:ACI 318-19
Units: Imperial units

Anchor Information:
Anchor type: Concrete screw
Material: Stainless Steel
Diameter (inch): 0.625
Nominal Embedment depth (inch): 4.750
Effective Embedment depth, h_{ef} (inch): 2.950
Code report: IAPMO UES ER-493
Anchor category: 1
Anchor ductility: Yes
h_{min} (inch): 7.25
c_{ac} (inch): 6.19
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 8.00
State: Cracked
Compressive strength, f'_c (psi): 4000
$\Psi_{c,V}$: 1.0
Reinforcement condition: Supplementary reinforcement not present
Supplemental edge reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 8.00 x 0.25

Recommended Anchor
Anchor Name: Titen HD® Stainless Steel - 5/8"Ø SS Titen HD, hnom:4.75" (121mm)
Code Report: IAPMO UES ER-493

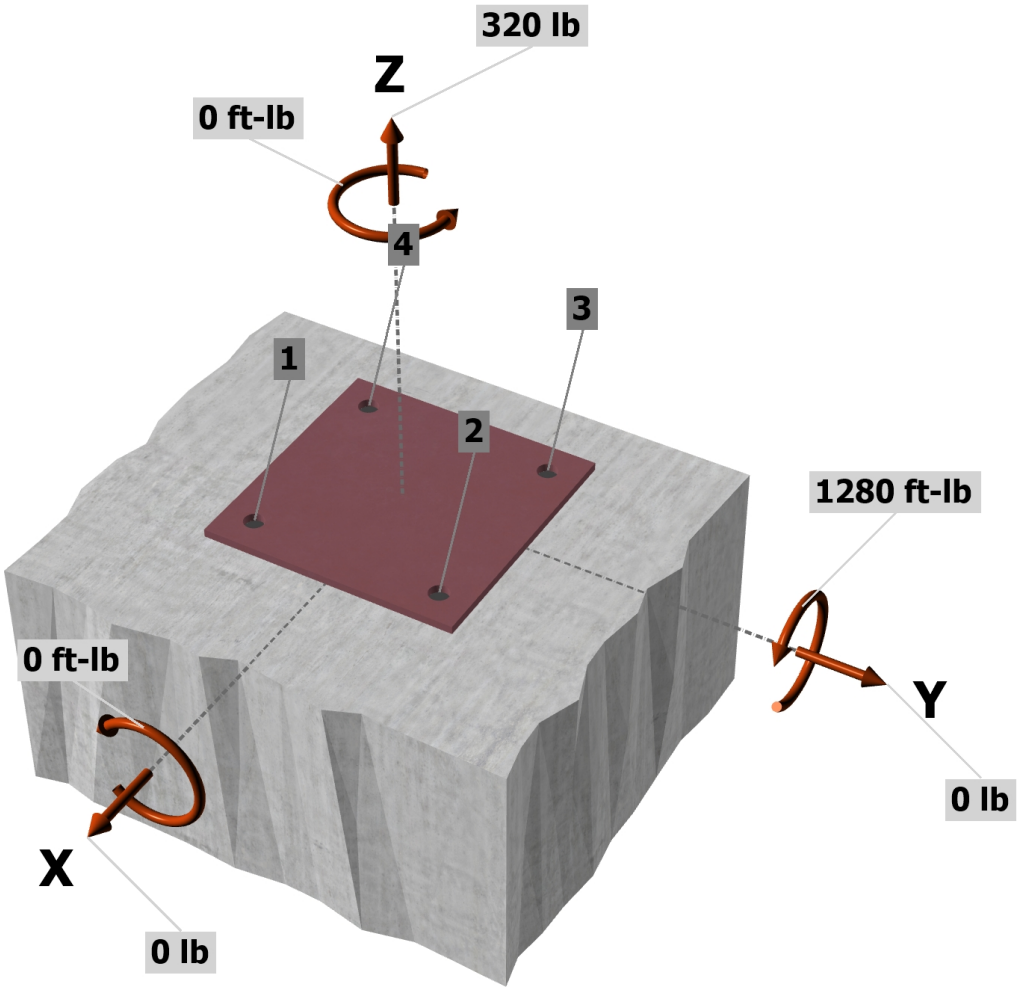


Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

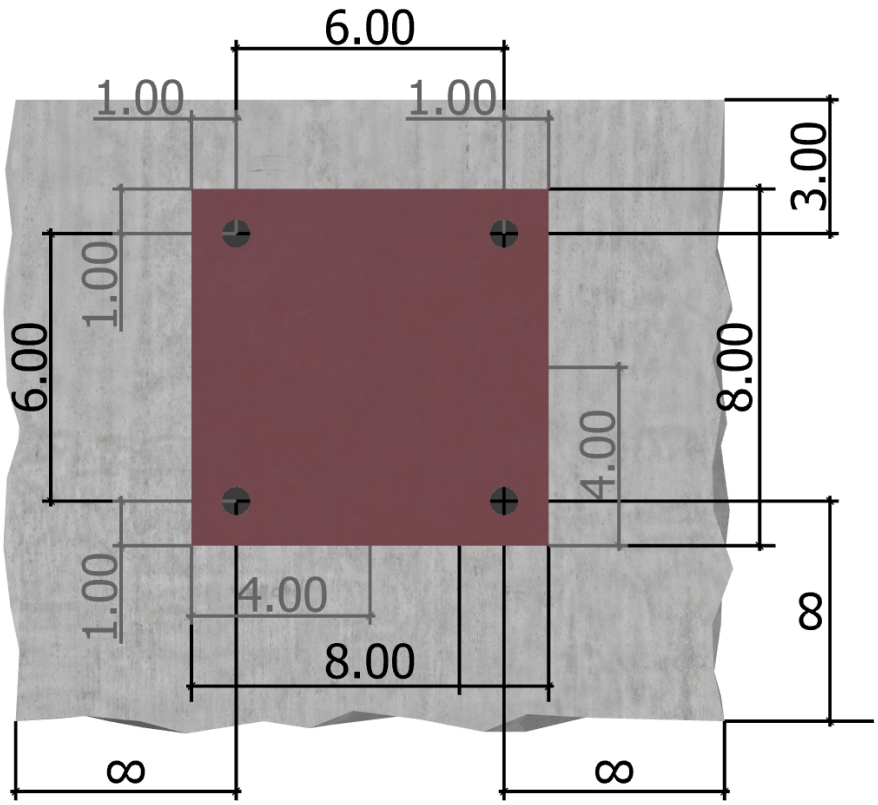
Strength level loads:

N_{ua} [lb]: 320
V_{uax} [lb]: 0
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 1280
M_{uz} [ft-lb]: 0

<Figure 1>



<Figure 2>

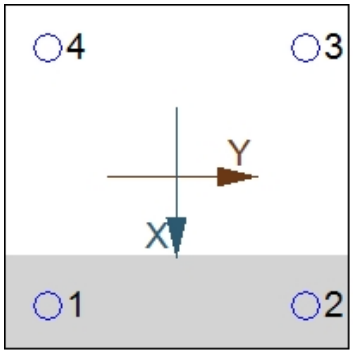


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	1306.7	0.0	0.0	0.0
4	1306.7	0.0	0.0	0.0
Sum	2613.4	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.06
Maximum concrete compression stress (psi): 264
Resultant tension force (lb): 2613
Resultant compression force (lb): 2293
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.6.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
28723	0.75	21542

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.6.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.6.2.2.1)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	4000	2.950	5448

$\phi N_{cbg} = \phi \, (A_{Nc} / A_{Nco}) \, \Psi_{ec,N} \, \Psi_{ed,N} \, \Psi_{c,N} \, \Psi_{cp,N} N_b$ (Sec. 17.5.1.2 & Eq. 17.6.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
110.26	78.32	3.00	1.000	0.903	1.00	1.000	5448	0.65	4503

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.8)

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	1307	21542	0.06	Pass
Concrete breakout	**2613**	**4503**	**0.58**	**Pass (Governs)**

5/8"Ø SS Titen HD, hnom:4.75" (121mm) meets the selected design criteria.

12. Warnings

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.