

MYERS ENGINEERING

Addendum to Retaining Wall Calculations



Mark
Myers
2025.11.2
2 15:12:39
-08'00'

MUST BEAR ORIGINAL BLUE INK SIGNATURE OR
DIGITAL PDF SIGNATURE FOR PERMIT SUBMITTAL.

Project: RKK Construction
4115 78th Avenue Southeast
Mercer Island, WA

November 22, 2025

2021 INTERNATIONAL BUILDING CODE
100 MPH BASIC WIND, EXPOSURE C, $K_{zt} = 1.61$
RISK CATEGORY II - SOIL SITE CLASS D
SEISMIC DESIGN CATEGORY D (IBC)

3206 50th Street Court, Suite 210-B
Gig Harbor, WA 98335
Phone: 253-858-3248
Email: myengineer@centurytel.net

Myers Engineering LLC
 Mark Myers, PE
 3206 50th Street CT, Ste. 210-B
 Gig Harbor, WA 98335
 253-858-3248
 myengineer@centurytel.net

Project Title: 4115 78th AVE SE
 Engineer: Mark Myers, PE
 Project ID:
 Project Descr: SFR w/ Basement ADU

Printed: 22 NOV 2025, 3:04PM

Cantilevered Retaining Wall

Project File: 4115 78th AVE SE.ec6

LIC# : KW-06015659, Build:20.25.11.18

MYERS ENGINEERING

(c) ENERCALC, LLC 1982-2025

DESCRIPTION: 10ft Stem at Basement w/ Slab

Code References

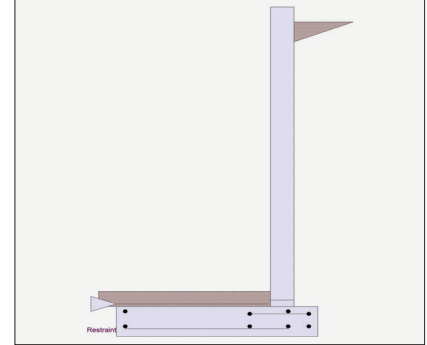
Governing Code : IBC 2018, CBC 2019
 Referenced Design Standard(s) : ACI 318-14

Criteria

Retained Height	=	9.50 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	150.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	1.3 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	=	0.0 psf (Strength Level)

Adjacent Footing Load

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

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Design Summary

Wall Stability Ratios

Overtuning = 1.58 OK
 Slab Resists All Sliding !
 Global Stability = 1.14
 Total Bearing Load = 3,786 lbs
 ...resultant ecc. = 4.79 in
 Eccentricity within middle third
 Soil Pressure @ Toe = 951 psf OK
 Soil Pressure @ Heel = 386 psf OK
 Allowable = 2,500 psf
 Soil Pressure Less Than Allowable
 ACI Factored @ Toe = 1,043 psf
 ACI Factored @ Heel = 423 psf
 Footing Shear @ Toe = 20.5 psi OK
 Footing Shear @ Heel = 20.2 psi OK
 Allowable = 75.0 psi

Sliding Calcs

Lateral Sliding Force = 2,096.4 lbs

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

Design Height Above Ftg

ft = Ratio > 1.0
 0.21 Stem OK
 Wall Material Above "Ht" = Concrete Concrete
 Design Method = SD SD SD SD
 Thickness = 8.00 8.00
 Rebar Size = # 4 # 5
 Rebar Spacing = 10.00 5.00
 Rebar Placed at = 6 in 6 in

Design Data

fb/FB + fa/Fa = 1.387 0.532

Total Force @ Section

Service Level lbs =
 Strength Level lbs = 2,653.9 2,768.8

Moment....Actual

Service Level ft-# =
 Strength Level ft-# = 8,567.2 9,132.1

Moment.....Allowable ft-# = 6,174.1 17,148.7

Shear....Actual

Service Level psi =
 Strength Level psi = 36.9 38.5

Shear.....Allowable psi = 75.0 75.0

Anet (Masonry) in2 =

Wall Weight psf = 100.0 100.0

Rebar Depth 'd' in = 6.00 6.00

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 2,500.0
 Fy psi = 60,000.0 60,000.0

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DESCRIPTION: 10ft Stem at Basement w/ Slab

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>
2nd Stem		
As (based on applied moment) :	0.3351 in2/ft	
(4/3) * As :	0.4468 in2/ft	Min Stem T&S Reinf Area 1.880 in2
200bd/fy : 200(12)(6)/60000 :	0.24 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 :
	=====	<u>One layer of :</u> <u>Two layers of :</u>
Required Area :	0.3351 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 :	0.8128 in2/ft	#6@ 27.50 in #6@ 55.00 in

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>
Bottom Stem		
As (based on applied moment) :	0.3572 in2/ft	
(4/3) * As :	0.4763 in2/ft	Min Stem T&S Reinf Area 0.040 in2
200bd/fy : 200(12)(6)/60000 :	0.24 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 :
	=====	<u>One layer of :</u> <u>Two layers of :</u>
Required Area :	0.3572 in2/ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.744 in2/ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8128 in2/ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	4.33 ft
Heel Width	=	1.33
Total Footing Width	=	5.67
Footing Thickness	=	12.00 in

f _c =	2,500 psi	F _y =	60,000 psi
Footing Concrete Density	=	150.00 pcf	
Min. As %	=	0.0018	
Cover @ Top	3.00	@ Btm.=	3.00 in

Footing Design Results

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	=	1,043	423 psf
Mu' : Upward	=	8,310	99 ft-#
Mu' : Downward	=	2,309	1,244 ft-#
Mu: Design	=	6,001	1,145 ft-#
φ Mn	=	13,810	13,810 ft-#
Actual 1-Way Shear	=	20.50	20.25 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 5 @ 10.00 in	
Heel Reinforcing	=	# 5 @ 10.00 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@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Key: No key defined

Min footing T&S reinf Area	1.47 in2
Min footing T&S reinf Area per foot	0.26 in2 /ft
<u>If one layer of horizontal bars:</u>	<u>If two layers of horizontal bars:</u>
#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: 10ft Stem at Basement w/ Slab

Summary of Overturning & Resisting Forces & Moments

ItemOVERTURNING.....			RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,929.4	3.50	6,752.8	Soil Over HL (ab. water tbl)	696.3	5.33	3,713.3
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.33	
Hydrostatic Force				Water Table			
Buoyant Force	=			Sloped Soil Over Heel	=		
Surcharge over Heel	=	167.0	877.0	Surcharge Over Heel	=		
Surcharge Over Toe	=			Adjacent Footing Load	=		
Adjacent Footing Load	=			Axial Dead Load on Stem	=	150.0	715.6
Added Lateral Load	=			* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=			Soil Over Toe	=	238.3	516.3
	=			Surcharge Over Toe	=		
				Stem Weight(s)	=	1,000.0	4,666.3
				Earth @ Stem Transitions	=		
Total	=	2,096.4	O.T.M. = 7,629.8	Footing Weight	=	849.9	2,407.8
				Key Weight	=		
				Vert. Component	=		
Resisting/Overturning Ratio		=	1.58	Total =	2,934.5 lbs	R.M. =	12,019.3
Vertical Loads used for Soil Pressure =		3,786.2	lbs	* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.			

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci

Horizontal Defl @ Top of Wall (approximate only) 0.047 in

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

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DESCRIPTION: 10ft Stem at Basement w/ Slab

Rebar Lap & Embedment Lengths Information

Stem Design Segment: 2nd

Stem Design Height: 0.21 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

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 (25.4.2.3a) = 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 = 0.7440 in²/ft
As Required = 0.3572 in²/ft

Cantilevered Retaining Wall

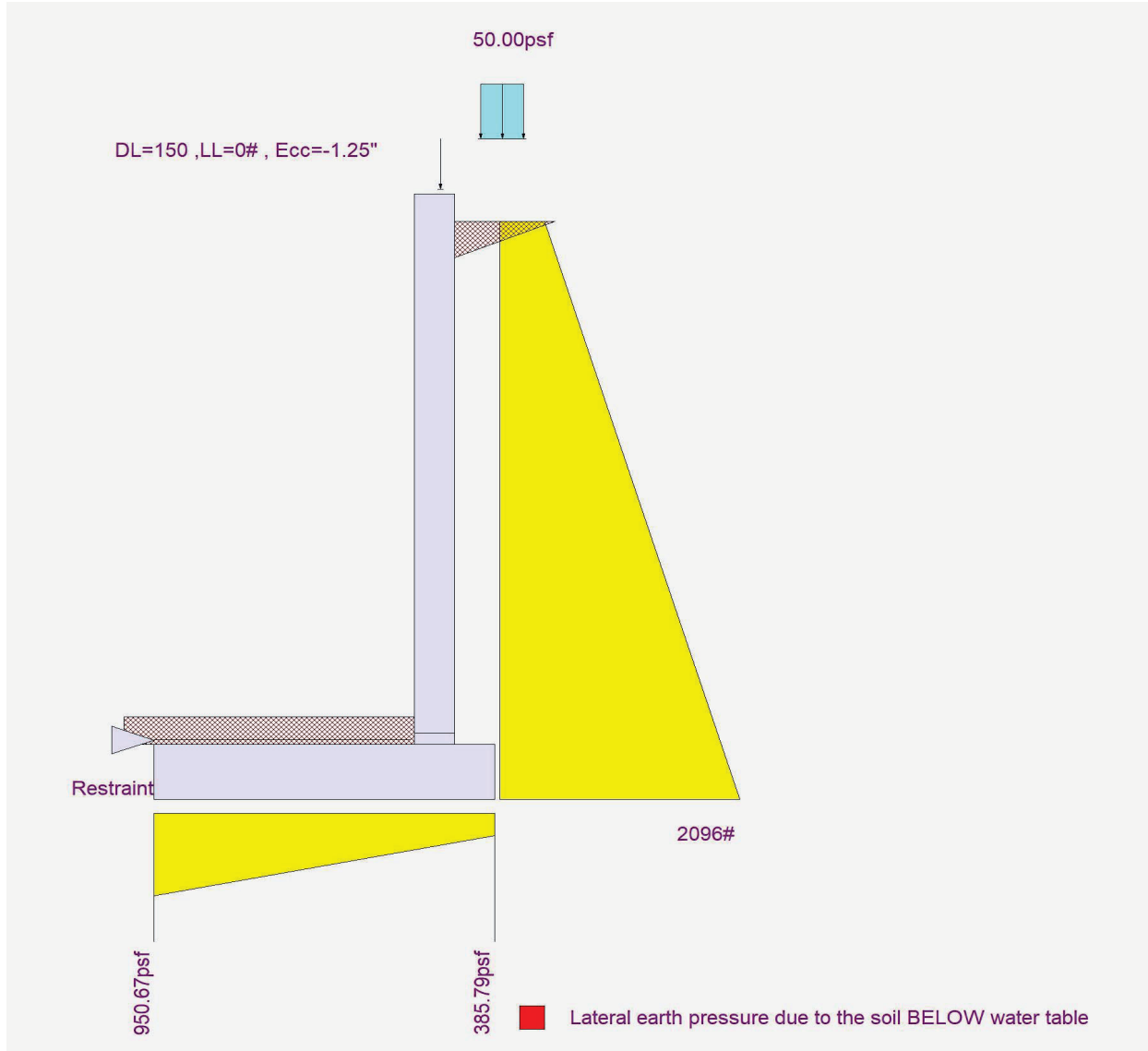
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Printed: 31 OCT 2025, 11:42AM

Cantilevered Retaining Wall

Project File: 4115 78th AVE SE.ec6

LIC# : KW-06015659, Build:20.25.10.02

MYERS ENGINEERING

(c) ENERCALC, LLC 1982-2025

DESCRIPTION: 10ft Stem at Basement w/ Slab & Seismic

Code References

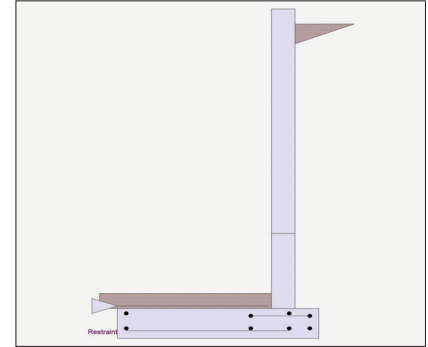
Governing Code : IBC 2018, CBC 2019
 Referenced Design Standard(s) : ACI 318-14

Criteria

Retained Height	=	9.50 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	150.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	1.3 in

Earth Pressure Seismic Load

Method	:	Uniform
Multiplier Used	=	8.000
(Multiplier used on soil density)		

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	=	0.0 psf (Strength Level)

Uniform Seismic Force	=	84.000
Total Seismic Force	=	882.000

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

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DESCRIPTION: 10ft Stem at Basement w/ Slab & Seismic

Design Summary

Wall Stability Ratios

Overturning	=	1.11	Ratio < 1.5!
Slab Resists All Sliding !			
Global Stability	=	1.14	
Total Bearing Load	=	3,786 lbs	
...resultant ecc.	=	15.06 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,600 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,756 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	29.0 psi	OK
Footing Shear @ Heel	=	23.2 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,713.8 lbs
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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

Design Height Above Ftg

ft =

Wall Material Above "Ht" =

Design Method =

Thickness =

Rebar Size =

Rebar Spacing =

Rebar Placed at =

Design Data

fb/FB + fa/Fa =

Total Force @ Section

Service Level lbs =

Strength Level lbs =

Moment....Actual

Service Level ft-# =

Strength Level ft-# =

Moment.....Allowable ft-# =

Shear.....Actual

Service Level psi =

Strength Level psi =

Shear.....Allowable psi =

Anet (Masonry) in2 =

Wall Weight psf =

Rebar Depth 'd' in =

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 =

Fy psi =

2nd

Stem OK

2.50

Concrete

SD

8.00

4

10.00

6 in

0.949

0.753

lbs =

2,138.2

ft-# =

5,864.2

ft-# =

6,174.1

psi =

29.7

psi =

75.0

in2 =

100.0

in =

6.00

Bottom

Stem OK

0.00

Concrete

SD

8.00

5

5.00

6 in

0.753

3,566.8

12,922.6

17,148.7

49.5

75.0

60,000.0

60,000.0

SD

SD

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DESCRIPTION: 10ft Stem at Basement w/ Slab & Seismic

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>
2nd Stem		
As (based on applied moment) :	0.2294 in2/ft	
(4/3) * As :	0.3058 in2/ft	Min Stem T&S Reinf Area 1.440 in2
200bd/fy : 200(12)(6)/60000 :	0.24 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 :
	=====	<u>One layer of :</u> <u>Two layers of :</u>
Required Area :	0.24 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 :	0.8128 in2/ft	#6@ 27.50 in #6@ 55.00 in

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>
Bottom Stem		
As (based on applied moment) :	0.5055 in2/ft	
(4/3) * As :	0.674 in2/ft	Min Stem T&S Reinf Area 0.480 in2
200bd/fy : 200(12)(6)/60000 :	0.24 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 :
	=====	<u>One layer of :</u> <u>Two layers of :</u>
Required Area :	0.5055 in2/ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.744 in2/ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8128 in2/ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	4.33 ft
Heel Width	=	1.33
Total Footing Width	=	5.67
Footing Thickness	=	12.00 in
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	3.00	@ Btm.= 3.00 in

Footing Design Results

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	=	1,756	0 psf
Mu' : Upward	=	11,452	0 ft-#
Mu' : Downward	=	2,309	1,244 ft-#
Mu: Design	=	9,143	1,244 ft-#
φ Mn	=	13,810	13,810 ft-#
Actual 1-Way Shear	=	28.98	23.25 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 5 @ 10.00 in	
Heel Reinforcing	=	# 5 @ 10.00 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@ 7.24 in, #5@ 11.23 in, #6@ 15.94 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Key: No key defined

Min footing T&S reinf Area 1.47 in2
 Min footing T&S reinf Area per foot 0.26 in2 /ft

If one layer of horizontal bars:

#4@ 9.26 in
 #5@ 14.35 in
 #6@ 20.37 in

If two layers of horizontal bars:

#4@ 18.52 in
 #5@ 28.70 in
 #6@ 40.74 in

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Summary of Overturning & Resisting Forces & Moments

ItemOVERTURNING.....			RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,929.4	3.50	6,752.8	Soil Over HL (ab. water tbl)	696.3	5.33	3,713.3
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.33	3,713.3
Hydrostatic Force				Water Table			
Buoyant Force	=			Sloped Soil Over Heel	=		
Surcharge over Heel	=	167.0	877.0	Surcharge Over Heel	=		
Surcharge Over Toe	=			Adjacent Footing Load	=		
Adjacent Footing Load	=			Axial Dead Load on Stem	=	150.0	715.6
Added Lateral Load	=			* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=			Soil Over Toe	=	238.3	516.3
Seismic Earth Load	=	617.4	3,241.4	Surcharge Over Toe	=		
	=			Stem Weight(s)	=	1,000.0	4,666.3
	=			Earth @ Stem Transitions	=		
Total	=	2,713.8	O.T.M. = 10,871.2	Footing Weight	=	849.9	2,407.8
				Key Weight	=		
				Vert. Component	=		
Resisting/Overturning Ratio		=	1.11	Total =	2,934.5 lbs	R.M.=	12,019.3
Vertical Loads used for Soil Pressure	=	3,786.2	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) 0.078 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.

Myers Engineering LLC
Mark Myers, PE
3206 50th Street CT, Ste. 210-B
Gig Harbor, WA 98335
253-858-3248
myengineer@centurytel.net

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU

Printed: 31 OCT 2025, 11:42AM

Cantilevered Retaining Wall

Project File: 4115 78th AVE SE.ec6

LIC# : KW-06015659, Build:20.25.10.02

MYERS ENGINEERING

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DESCRIPTION: 10ft Stem at Basement w/ Slab & Seismic

Rebar Lap & Embedment Lengths Information

Stem Design Segment: 2nd

Stem Design Height: 2.50 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

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 (25.4.2.3a) = 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 = 7.13 in
As Provided = 0.7440 in²/ft
As Required = 0.5055 in²/ft

Cantilevered Retaining Wall

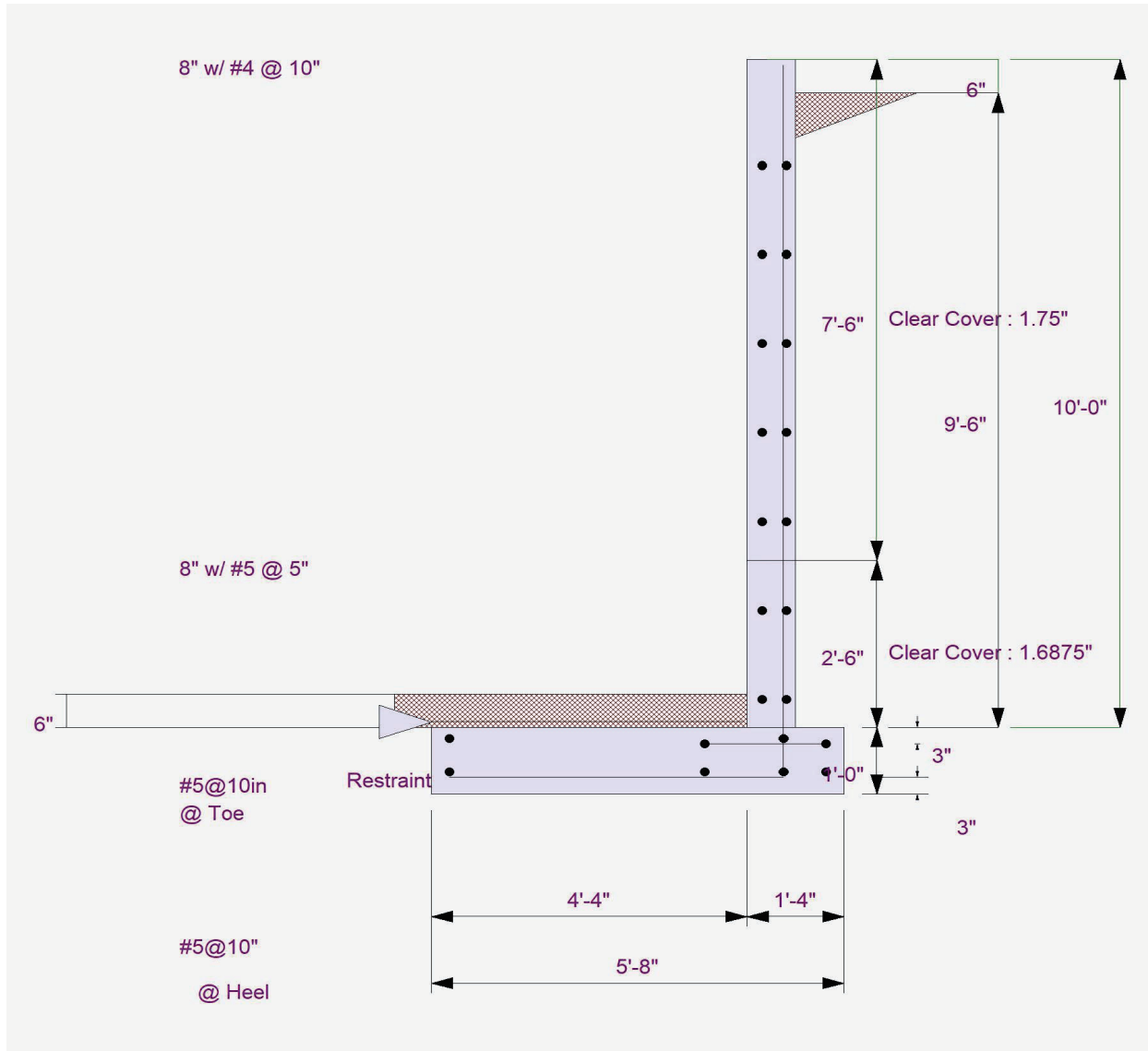
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