

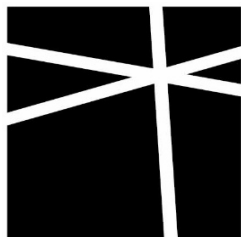
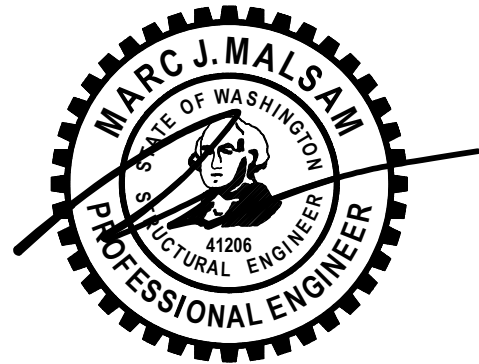
STRUCTURAL CALCULATIONS FOR:

2419 72ND AVE SE

MERCER ISLAND, WA
BASEMENT WALLS

CLIENT: SISI DUAN

APRIL 18, 2025



**MALSAM
TSANG**
STRUCTURAL
ENGINEERING

Horizontal Spinning Wall

Bearing Capacity = 2520 psf

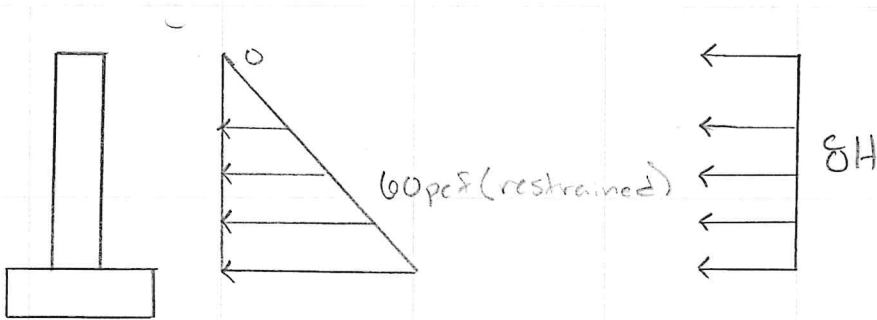
Seismic Surcharge = δH

Coefficient of Friction = 0.35

Passive Pressure = 200 psf

Lateral Earth Pressure (Restrained/Unrestrained) = 60 psf / 40 psf

Height = 8'



Worst Load Combo
1.6D + 1.0E

$M_{max} = 3/4 \times \text{Height}$
of Wall. Fasten Braces
Lower Portion of Wall

$$W = 1.6D + 1.0E = 1.6(60 \times 8 \times 3/4) + 1.0 \times (8 \times 8) = 640 \text{ psf}$$

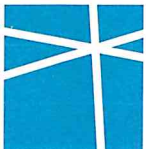
$$L = 15' \quad m = \frac{640 \times 15^2}{8} = 16 \text{ k-ft} \quad d = 10 - 2 - 0.75/2 = 7.625'$$

$$A_s \text{ req} = 0.506 \Rightarrow 0.506 \times 10/12 = 0.422 \Rightarrow \#6 @ 10" \text{ oc in } 10" \text{ wall}$$

$$V = (1.6 \times 60 \times 8 + 8 \times 8) \times 15/2 = 6.24 \text{ k}$$

$$\phi V_c = \phi 22 \sqrt{f'_c} b d = 0.75 \times 22 \times 1 \times \sqrt{2520} \times 12 \times 7.625 = 6.86 \text{ k} > 6.24 \text{ k} \checkmark$$

$\lambda = 1.0, \phi = 0.75$



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ENGINEERING

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SUITE 210
SEATTLE, WA 98104
T 206.789.6038
MALSAM-TSANG.COM

2419 72nd Ave SE
PROJECT
Basement Walls

4-18-25
DATE
5697-2025-01
PROJECT NO
SEG
DESIGN
VI
SHEET

Basement Wall

$$H = 9.5'$$

Max Vertical Loads

$$DL = 0.02(23 \times 0.5 + 6) + 0.15 \times 10 + 0.015 \times 14 \times 0.5 + 0.02 \times 1 + 0.015 \times 11 + 0.015 \times 13 \times 0.5$$
$$= 0.89 \text{ ksf} \times 1.2 = 1.07 \text{ ksf}$$

$$LL = 0.025(23 \times 0.5 + 6) + 0.04 \times 14 \times 0.5 + 0.025 \times 1 + 0.04 \times 13 \times 0.5$$
$$= 1.01 \text{ ksf} \times 1.6 = 1.61 \text{ ksf}$$

Seismic Surcharge

$$E = 8 \times 10.0 = 80 \text{ psf}$$

⇒ See Enercalc sheets for design

⇒ Diaphragm check

$$\text{Lateral into diaphragm: } W_s = 0.913 \text{ klf}$$

$$V_{\max} = 0.913 \times 21.5 / 2 = 9.82 \text{ k}$$

$$W_p = 9.82 / 28 = 351 \text{ psf} < 360 \text{ psf}$$

∴ Block Diaphragm @ 4" oc

Restrained Retaining Wall

Project File: prop cantilevers.EC6

LIC# : KW-06016391, Build:20.24.03.04

MALSAM TSANG ENGINEERING

(c) ENERCALC INC 1983-2023

DESCRIPTION: 9'-6" Basement Prop Cantilever_w/ 8H Seismic

Code Reference

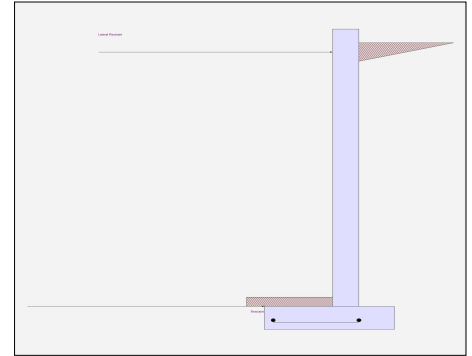
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	9.5 ft
Wall height above soil	=	0.5 ft
Total Wall Height	=	10.0 ft
Top Support Height	=	9.0 ft
Slope Behind Wall	=	0
Height of Soil over Toe	=	4 in

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
At-Rest Heel Pressure	=	60.0 psf/ft
	=	0.0 psf/ft
Passive Pressure	=	200.0 psf/ft
Soil Density	=	120 pcf
Footing Soil Frictior	=	0.35 psf
Soil height to ignore for passive pressure	=	12 in



Surcharge Loads

Surcharge Over Heel	=	psf
>>>NOT Used To Resist Sliding & Overturn		
Surcharge Over Toe	=	110 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	1,070.0 lbs
Axial Live Load	=	1,610.0 lbs
Axial Load Eccentricity	=	in

Earth Pressure Seismic Load

Uniform Lateral Load Applied to Stem

Lateral Load	=	80.0 #/ft
...Height to Top	=	9.50 ft
...Height to Bottom	=	ft
Load Type	=	Seismic (E)
		(Service Level)
Wind on Exposed Stem	=	0.00 psf
		(Service Level)
Wind acts left-to-right toward retention side.		

K_h Soil Density Multiplier = 0.0950 g Added seismic per unit area = 0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	lbs
Footing Width	=	ft
Eccentricity	=	in
Wall to Ftg CL Dist	=	ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	ft
Poisson's Ratio	=	0.3

Design Summary

Total Bearing Load	=	5,578.76 lbs
...resultant ecc.	=	0.0 in
Soil Pressure @ Toe	=	1,521.34 psf OK
Soil Pressure @ Heel	=	1,521.34 psf OK
Allowable	=	psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,001.23 psf
ACI Factored @ Heel	=	2,001.23 psf
Footing Shear @ Toe	=	28.878 psi OK
Footing Shear @ Heel	=	5.035 psi OK
Allowable	=	75.0 psi
Reaction at Top	=	912.83 lbs
Reaction at Bottom	=	3,056.38 lbs

Sliding Calcs

Lateral Sliding Force	=	3,056.38 lbs
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Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Concrete Stem Construction

Thickness	=	8.00 in	F_y	=	60000 psi
Wall Weight	=	100.0 psf	f'_c	=	2500 psi
Stem is FIXED to top of footing					

	@ Top Support	Mmax Between Top & Base	@ Base of Wall
Design Height Above Ftg	Stem OK = 9.0 ft	Stem OK = 5.169 ft	Stem OK = 0.00 ft
Rebar Size	# 4	# 4	# 4
Rebar Spacing	12.00 in	12.00 in	8.00 in
Rebar Placed at	Edge	Edge	Edge
Rebar Depth 'd'	6.250 in	6.250 in	6.250 in
Design Data			
fb/FB + fa/Fa	= 0.003	0.529	0.768
Mu....Actual	= 14.0 ft-#	2,861.75 ft-#	6,116.70 ft-#
Mn * Phi....Allowable	= 5,412.60 ft-#	5,412.60 ft-#	7,959.60 ft-#
Shear Force @ this height	= 1,269.39 lbs		3,918.08 lbs
Shear....Actual	= 16.925 psi		52.241 psi
Shear.....Allowable	= 75.0 psi		75.0 psi

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.300
Seismic, E	1.000

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Restrained Retaining Wall

Project File: prop cantilevers.EC6

LIC# : KW-06016391, Build:20.24.03.04

MALSAM TSANG ENGINEERING

(c) ENERCALC INC 1983-2023

DESCRIPTION: 9'-6" Basement Prop Cantilever_w/ 8H Seismic

Footing Strengths & Dimensions

Toe Width	=	2.0 ft
Heel Width	=	1.667
Total Footing Width	=	3.667
Footing Thickness	=	10.0 in

f'c =	2500 psi	Fy =	60000 psi
Footing Concrete Density	=	150 pcf	
Min. As %	=	0.0018	
Cover @ Top =	2 in	@ Btm.=	3 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	2,001.23	2,001.23	psf
Mu' : Upward	=	4,002.46		ft-#
Mu' : Downward	=	748.0		ft-#
Mu: Design	=	3,254	-242	ft-#
Actual 1-Way Shear	=	28.878	5.035	psi
Allow 1-Way Shear	=	75.0	75.0	psi

Other Acceptable Sizes & Spacings:

Toe: # 4 @ 9.00 in	-or-	#4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33
Heel: None Spec'd	-or-	phiMn = phi * 5 * lambda * sqrt(fc) * Sm

Min footing T&S reinf Area	0.00	in2
Min footing T&S reinf Area per foot	0.00	in2 /ft
If one layer of horizontal bars:		If two layers of horizontal bars:
#4@ 0.00 in		#4@ 0.00 in
#5@ 0.00 in		#5@ 0.00 in
#6@ 0.00 in		#6@ 0.00 in

Summary of Forces on Footing : Slab RESISTS sliding, stem is FIXED at footing

Forces acting on footing for soil pressure

>>> Sliding Forces are restrained by the adjacent slab

Load & Moment Summary For Footing : For Soil Pressure Calcs

Moment @ Top of Footing Applied from Stem	=		-4,023.19 ft-#
Surcharge Over Heel	=	0.0 lbs	0.0 ft
Adjacent Footing Load	=	0.0 lbs	0.0 ft
Axial Dead Load on Stem	=	2,680.0 lbs	2.333 ft
Soil Over Toe	=	80.0 lbs	1.0 ft
Surcharge Over Toe	=	220.0 lbs	1.0 ft
Stem Weight	=	1,000.0 lbs	2.333 ft
Soil Over Heel	=	1,140.38 lbs	3.167 ft
Footing Weight	=	458.375 lbs	1.834 ft
Total Vertical Force	=	5,578.76 lbs	Base Moment = 9,315.30 ft-#

Stem is specified to be fixed to footing, and top restraint is assumed to react out any tendency for moment at the footing/soil interface, so uniform soil pressure is assumed.

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

Project Title:
Engineer:
Project ID:
Project Descr:

Restrained Retaining Wall

Project File: prop cantilevers.EC6

LIC# : KW-06016391, Build:20.24.03.04

MALSAM TSANG ENGINEERING

(c) ENERCALC INC 1983-2023

DESCRIPTION: 9'-6" Basement Prop Cantilever_w/ 8H Seismic

Rebar Lap & Embedment Lengths Information

Project Title:
Engineer:
Project ID:
Project Descr:

Restrained Retaining Wall

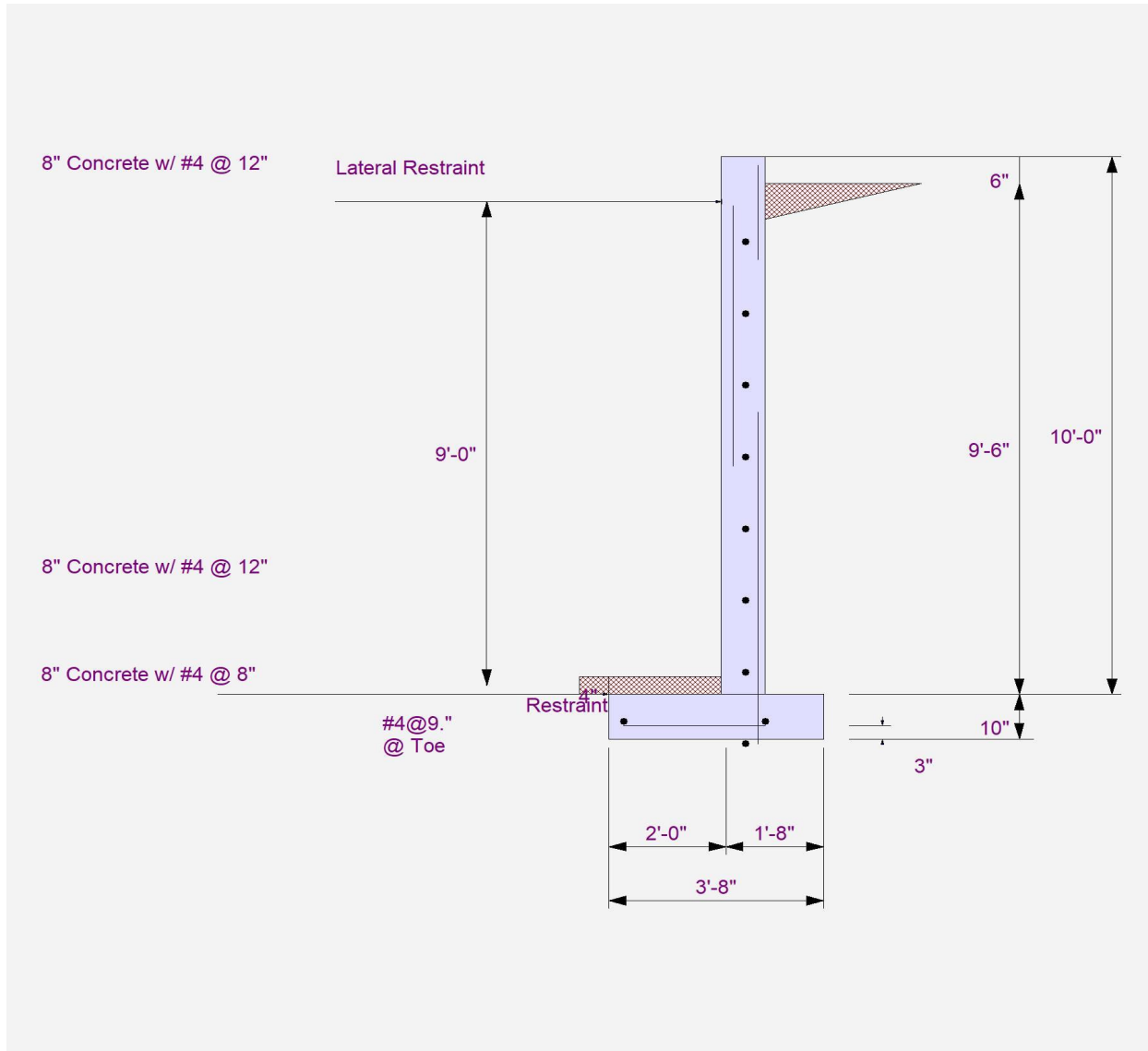
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Project Title:
Engineer:
Project ID:
Project Descr:

Restrained Retaining Wall

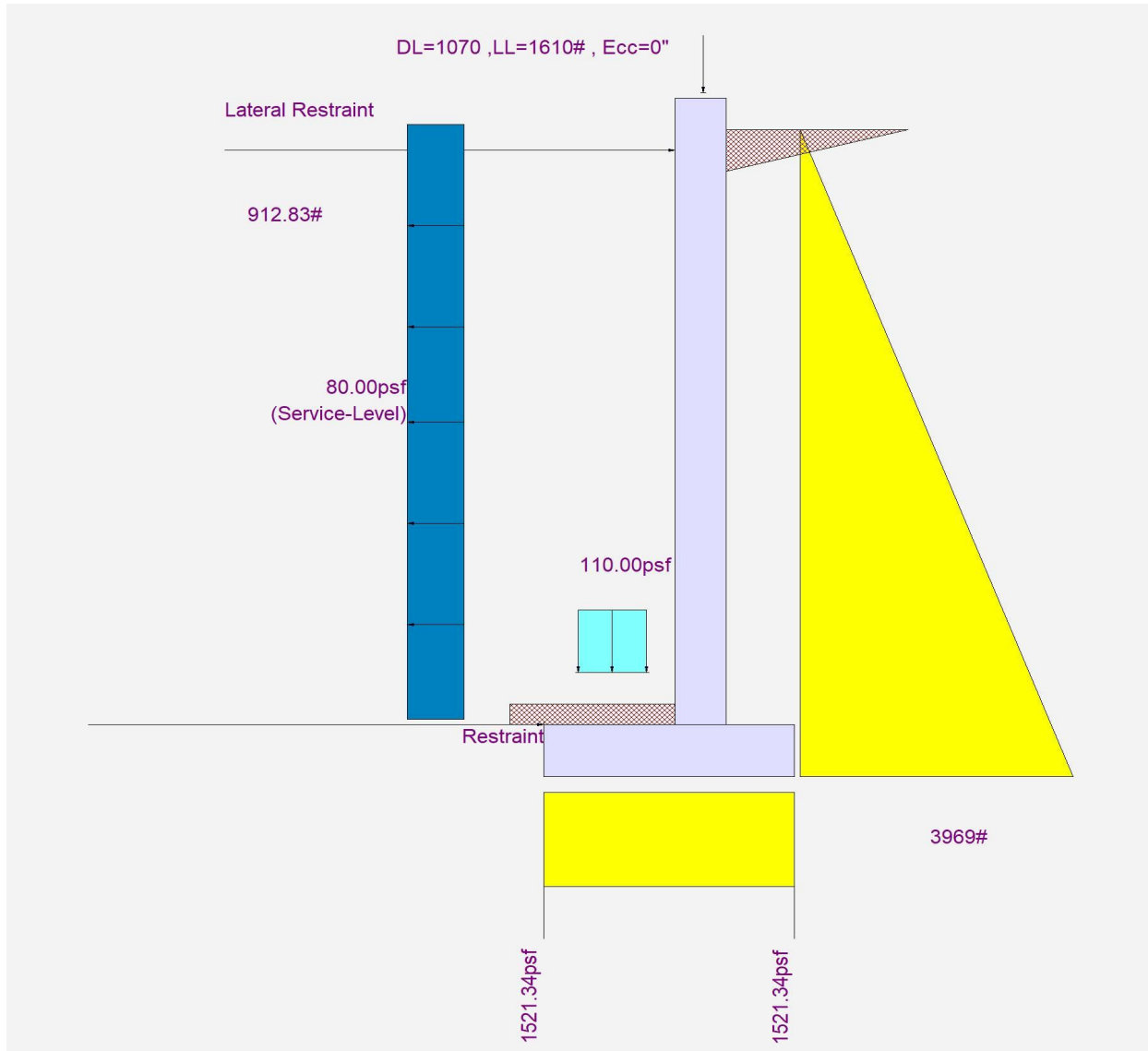
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Restrained Retaining Wall

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DESCRIPTION: 9'-6" Basement Prop Cantilever

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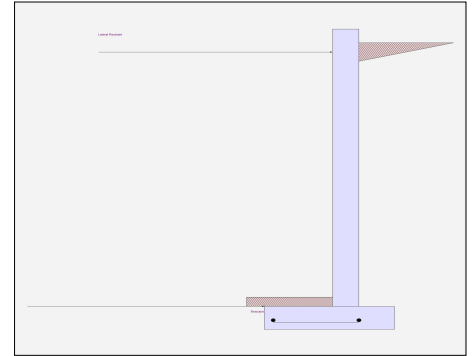
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	9.5 ft
Wall height above soil	=	0.5 ft
Total Wall Height	=	10.0 ft
Top Support Height	=	9.0 ft
Slope Behind Wall	=	0
Height of Soil over Toe	=	4 in

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
At-Rest Heel Pressure	=	60.0 psf/ft
	=	0.0 psf/ft
Passive Pressure	=	200.0 psf/ft
Soil Density	=	120 pcf
Footing Soil Frictior	=	0.35 psf
Soil height to ignore for passive pressure	=	12 in



Surcharge Loads

Surcharge Over Heel	=	psf
>>>NOT Used To Resist Sliding & Overturn		
Surcharge Over Toe	=	110 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	1,070.0 lbs
Axial Live Load	=	1,610.0 lbs
Axial Load Eccentricity	=	in

Earth Pressure Seismic Load

Uniform Lateral Load Applied to Stem

Lateral Load	=	#/ft
...Height to Top	=	ft
...Height to Bottom	=	ft
Load Type	=	Seismic (E)
		(Service Level)
Wind on Exposed Stem	=	0.00 psf
		(Service Level)
Wind acts left-to-right toward retention side.		

K_h Soil Density Multiplier = 0.0950 g Added seismic per unit area = 0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	lbs
Footing Width	=	ft
Eccentricity	=	in
Wall to Ftg CL Dist	=	ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	ft
Poisson's Ratio	=	0.3

Design Summary

Total Bearing Load	=	5,578.76 lbs
...resultant ecc.	=	0.0 in
Soil Pressure @ Toe	=	1,521.34 psf OK
Soil Pressure @ Heel	=	1,521.34 psf OK
Allowable	=	psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,001.23 psf
ACI Factored @ Heel	=	2,001.23 psf
Footing Shear @ Toe	=	28.878 psi OK
Footing Shear @ Heel	=	5.035 psi OK
Allowable	=	75.0 psi
Reaction at Top	=	592.83 lbs
Reaction at Bottom	=	2,608.38 lbs

Sliding Calcs

Lateral Sliding Force	=	2,608.38 lbs
-----------------------	---	--------------

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

Concrete Stem Construction

Thickness	=	8.00 in	F_y	=	60000 psi
Wall Weight	=	100.0 psf	f'_c	=	2500 psi
Stem is FIXED to top of footing					

	@ Top Support	Mmax Between Top & Base	@ Base of Wall
Design Height Above Ftg	Stem OK = 9.0 ft	Stem OK = 5.096 ft	Stem OK = 0.00 ft
Rebar Size	# 4	# 4	# 4
Rebar Spacing	12.00 in	12.00 in	8.00 in
Rebar Placed at	Edge	Edge	Edge
Rebar Depth 'd'	6.250 in	6.250 in	6.250 in
Design Data			
fb/FB + fa/Fa	= 0.000	0.434	0.647
Mu....Actual	= 2.0 ft-#	2,350.17 ft-#	5,150.70 ft-#
Mn * Phi....Allowable	= 5,412.60 ft-#	5,412.60 ft-#	7,959.60 ft-#
Shear Force @ this height	= 939.92 lbs		3,380.08 lbs
Shear....Actual	= 12.532 psi		45.068 psi
Shear.....Allowable	= 75.0 psi		75.0 psi

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.300
Seismic, E	1.000

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Restrained Retaining Wall

Project File: prop cantilevers.EC6

LIC# : KW-06016391, Build:20.24.03.04

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Footing Strengths & Dimensions

Toe Width	=	2.0 ft
Heel Width	=	1.667
Total Footing Width	=	3.667
Footing Thickness	=	10.0 in

f'c =	2500 psi	Fy =	60000 psi
Footing Concrete Density	=	150 pcf	
Min. As %	=	0.0018	
Cover @ Top =	2 in	@ Btm.=	3 in

Footing Design Results

	Toe	Heel	
Factored Pressure	= 2,001.23	2,001.23	psf
Mu' : Upward	= 4,002.46		ft-#
Mu' : Downward	= 748.0		ft-#
Mu: Design	= 3,254	-242	ft-#
Actual 1-Way Shear	= 28.878	5.035	psi
Allow 1-Way Shear	= 75.0	75.0	psi

Other Acceptable Sizes & Spacings:

Toe: # 4 @ 9.00 in	-or-	#4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33
Heel: None Spec'd	-or-	phiMn = phi * 5 * lambda * sqrt(fc) * Sm

Min footing T&S reinf Area	0.00	in2
Min footing T&S reinf Area per foot	0.00	in2 /ft
If one layer of horizontal bars:	If two layers of horizontal bars:	
#4@ 0.00 in	#4@	0.00 in
#5@ 0.00 in	#5@	0.00 in
#6@ 0.00 in	#6@	0.00 in

Summary of Forces on Footing : Slab RESISTS sliding, stem is FIXED at footing

Forces acting on footing for soil pressure

>>> Sliding Forces are restrained by the adjacent slab

Load & Moment Summary For Footing : For Soil Pressure Calcs

Moment @ Top of Footing Applied from Stem	=	-3,219.19 ft-#
Surcharge Over Heel	=	0.0 lbs 0.0 ft 0.0 ft-#
Adjacent Footing Load	=	0.0 lbs 0.0 ft 0.0 ft-#
Axial Dead Load on Stem	=	2,680.0 lbs 2.333 ft 6,253.33 ft-#
Soil Over Toe	=	80.0 lbs 1.0 ft 80.0 ft-#
Surcharge Over Toe	=	220.0 lbs 1.0 ft 220.0 ft-#
Stem Weight	=	1,000.0 lbs 2.333 ft 2,333.33 ft-#
Soil Over Heel	=	1,140.38 lbs 3.167 ft 3,611.39 ft-#
Footing Weight	=	458.375 lbs 1.834 ft 840.43 ft-#
Total Vertical Force	=	5,578.76 lbs Base Moment = 10,119.3 ft-#

Stem is specified to be fixed to footing, and top restraint is assumed to react out any tendency for moment at the footing/soil interface, so uniform soil pressure is assumed.

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

Project Title:
Engineer:
Project ID:
Project Descr:

Restrained Retaining Wall

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Rebar Lap & Embedment Lengths Information

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Project ID:
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Restrained Retaining Wall

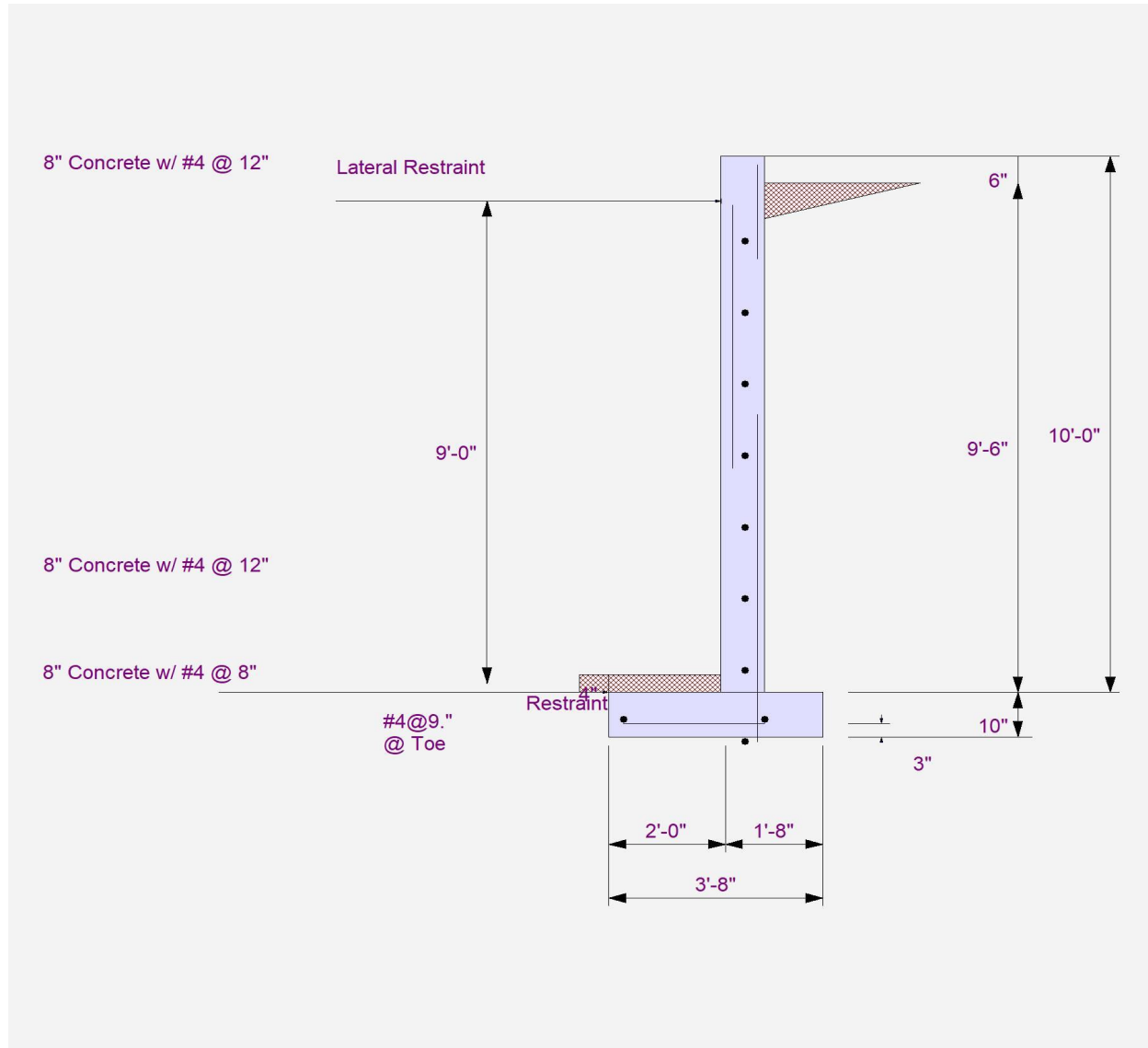
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