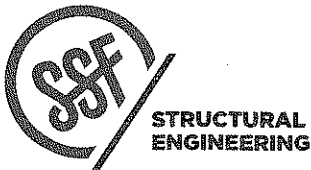
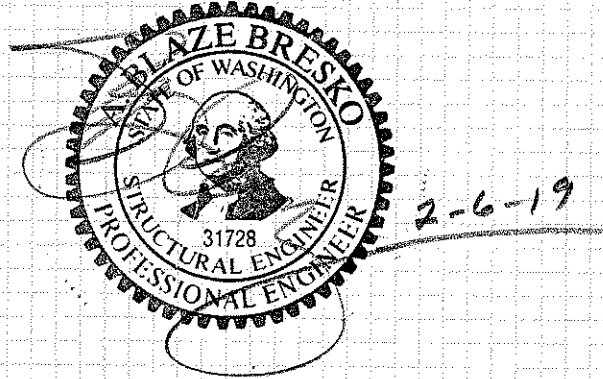


STRUCTURAL CALCULATIONS
FOR THE
PERLA RESIDENCE

42XX HOLLY LANE
MERCER IS., WA 98040

ARCHITECT:
STUART SILK ARCHITECTS
2400 N. 45TH ST.
SEATTLE, WA 98103



PERLA Residence
PROJECT _____

DATE _____
PROJ. _____
DESIGN Blaze Bresko
SHEET _____

Seismic Design Loads (ASCE 7-10)

Latitude 47.57
Longitude -122.235

Risk Category II Table 1.5-1
USE GROUP I
IMP. FACTOR 1 Table 1.5-2
SITE CLASS D Table 20.3-1
R = 6.5 Table 12.2-1

$S_s = 1.42$
 $S_1 = 0.54$
 $F_a = 1$ Table 11.4-1
 $F_v = 1.5$ Table 11.4-2
 $S_{DS} = 0.943$
 $S_{D1} = 0.540$

ASCE 7-10 Maps or the USGS Website (<http://geohazards.usgs.gov/>)
ASCE 7-10 Maps or the USGS Website (<http://geohazards.usgs.gov/>)

$C_{SULT} = 0.145$ Eqn. 12.8-2
 $C_{ASD} = 0.102$

Seismic Dead Load:
15 psf Roof
10 psf Floor
10 psf Wall

Wroof 20 psf
Wfloor 20 psf

Vertical Design Loads

Criteria
ASCE 7-10
IBC 2015

Dead Loads

Rfg+PV Panels	7.5 psf	Flooring	2.2 psf
1/2" Ply	1.5 psf	3/4" Ply	2.3 psf
Joists	2 psf	Joists	2 psf
Insulation	1 psf	5/8" GWB	2.5 psf
5/8" GWB	2.5 psf	Misc. Mech	1 psf
Misc. Mech	0.5 psf	Gypcrete	0 psf
	15 psf		10 psf
Use	15 psf	Use	10 psf

Live Loads

Roof 30 psf
Floor 40 psf

Soil Bearing 3000 psf



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Mercer Is, WA 98040

Date: 10/29/2018
Project #: 00101-2018-06
Design: Blaze
Sheet: Criteria 1

Wind Design Loads (ASCE 7-10)

Ch.27 Directional Procedure

Exposure: C
 Vasd = 85 mph
 K_d = 0.85
 I = 1
 G = 0.85

Vult by R.C. 110
 Table 26.6-1
 26.9.1

Roof Angle = 0 degrees
 Ground to top of roof = 25.00 ft
 Bottom of roof to top of roof = 0.00 ft
 (mean roof height) h = 25.00 ft

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C _p
Windward Wall	0.8
Leeward Wall	-0.5
Windward Roof	0.4
Leeward Roof	-0.6

*Note= C_p values are conservative worst case values

K_{zt} = 1.00

*site is located on the bottom half of any hill therefore, K_{zt} = 1.0

ASD

Pressures:

Ht	K _z	q _z	P _{w/w walls}	P _{lw/walls}	P _{walls (psf)}
0-15	0.85	13.43	9.13	6.58	15.71
15-20	0.90	14.22	9.67	6.58	16.25
20-25	0.94	14.85	10.10	6.58	16.68
25-30	0.98	15.48	10.53	6.58	17.11

P_{roof (psf)}
13.16



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Design: Blaze
Sheet: Criteria 2

USGS Design Maps Summary Report

User-Specified Input

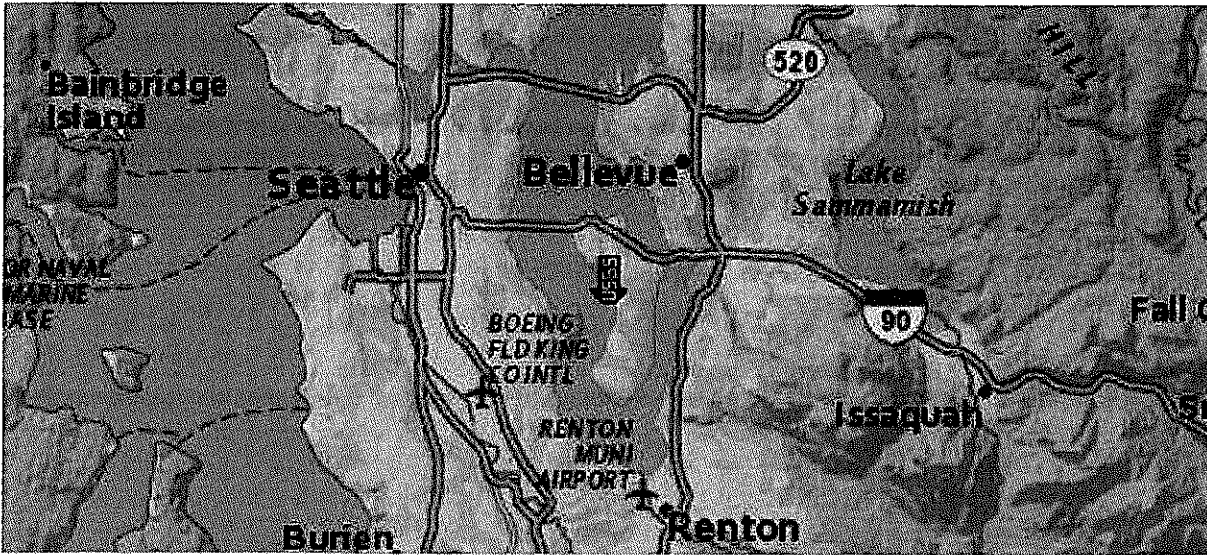
Report Title Perla Residence
Mon September 3, 2018 19:40:44 UTC

Building Code Reference Document ASCE 7-10 Standard
(which utilizes USGS hazard data available in 2008)

Site Coordinates 47.57°N, 122.235°W

Site Soil Classification Site Class D - "Stiff Soil"

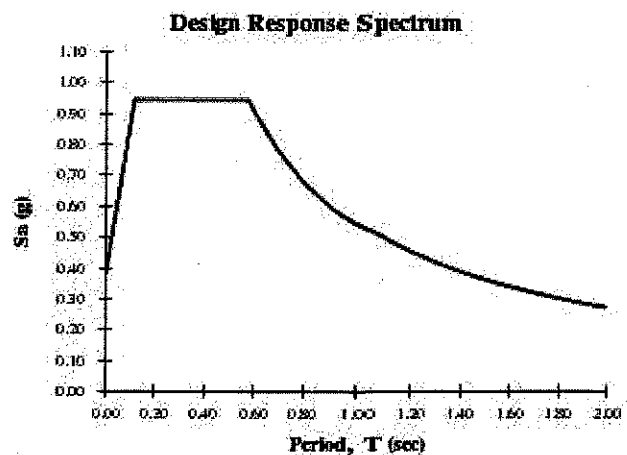
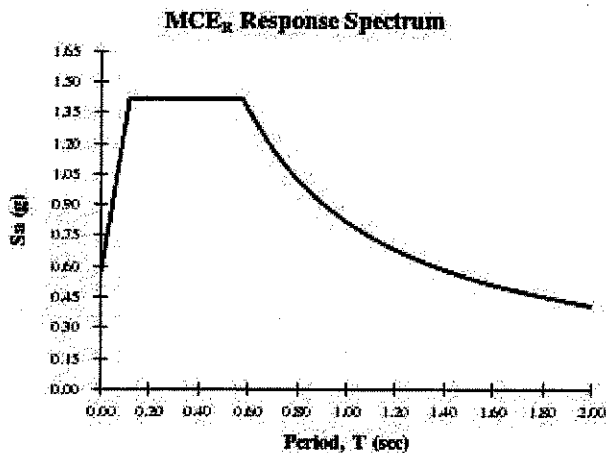
Risk Category I/II/III



USGS-Provided Output

$S_s = 1.415 \text{ g}$	$S_{MS} = 1.415 \text{ g}$	$S_{DS} = 0.944 \text{ g}$
$S_1 = 0.544 \text{ g}$	$S_{M1} = 0.816 \text{ g}$	$S_{D1} = 0.544 \text{ g}$

For information on how the S_s and S_1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.



For PGA_M , T_L , C_{RS} , and C_{R1} values, please view the detailed report.

LATERAL DESIGN

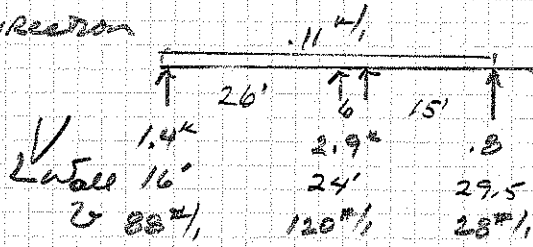
WIND DESIGN GOVERNS

$$W_{ROOF} = .017(2 + \frac{8.5}{2}) = .11 \text{ k/ft}$$

$$W_{FLR} = .017(\frac{10}{2} + \frac{8.5}{2} + 1.5) = .18 \text{ k/ft}$$

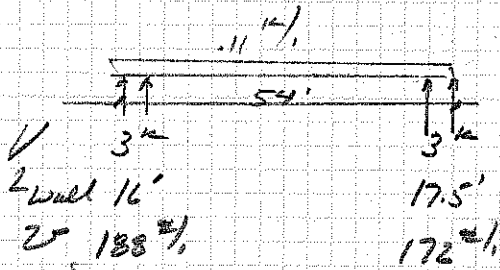
ROOF DESIGN

N-S DIRECTION



EXT WALLS
 1/2" PLY, 8d @ 6"
 $V_u = 230 \text{ #/ft}$, MIN
 NO H.D.'S REQ'D FOR LOW SHEARS

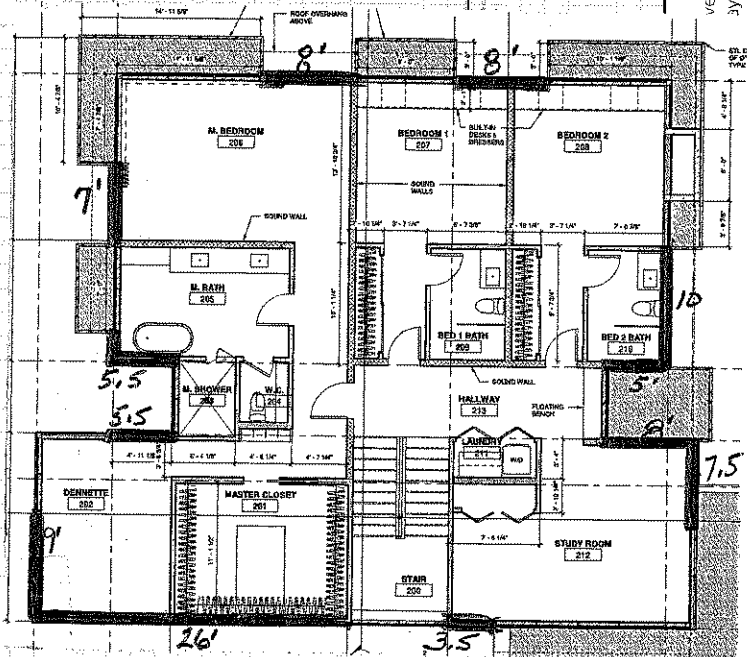
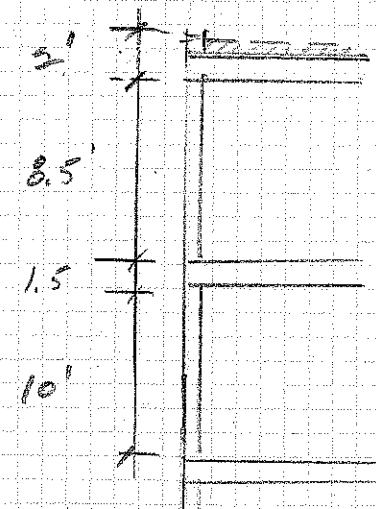
E-W DIRECTION



EXT WALLS W/6
 1/2" PLY, 8d @ 6"
 $V_u = 230 \text{ #/ft}$
 H.D. = $.188(8.5) = 1.6"$
 @ 16" HORIZ. END OF SHEAR WALLS

SHEAR WALLS

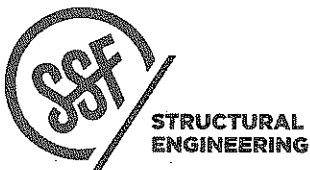
- 1/2" PLY 8d @ 6" 230 #/ft
- 1/2" PLY 8d @ 4" 350 #/ft
- 1/2" PLY 8d @ 3" 450 #/ft



UPPER FLOOR PLAN

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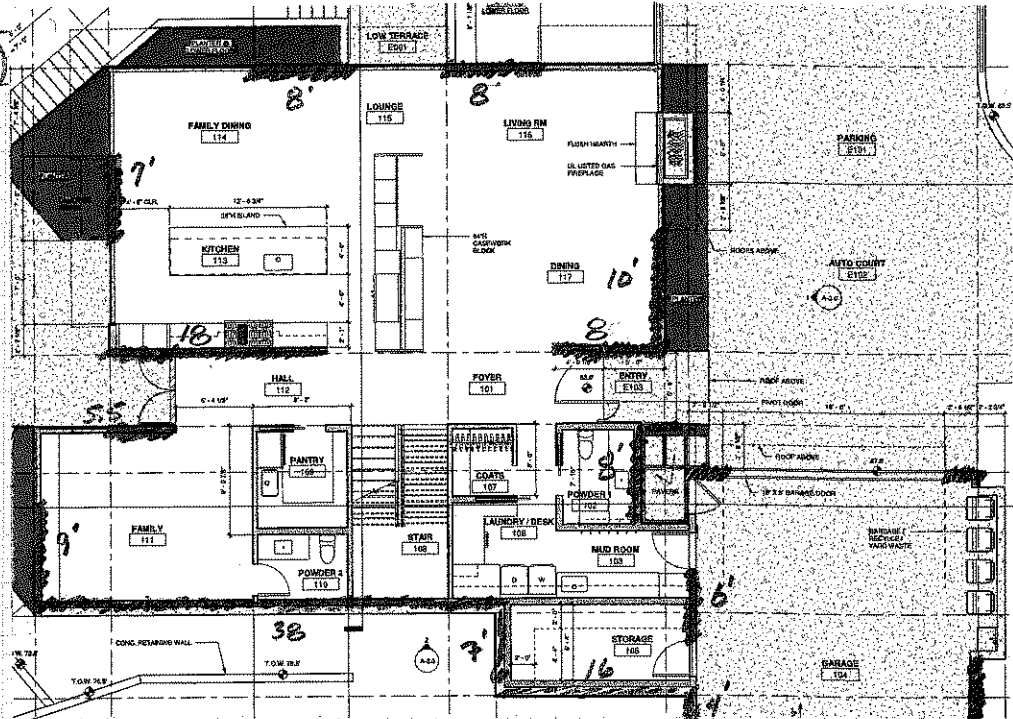
4

LATERAL DESIGN (Cont.)

UPP FLR DIAPH

N-S DIRECTION

	1.4 ^k	1.8 ^k	2.9 ^k	8 ^k
	26'	22'	12'	
V	3.7 ^k	7.2 ^k	4.9	
Lwall	16'	26'	77'	
W	231%	278%	64%	
	W6	W4	W6	
H.D.	2.3 ^k	2.8 ^k	-	
	2-C516	2-C516	-	
	HD03	HD02	-	



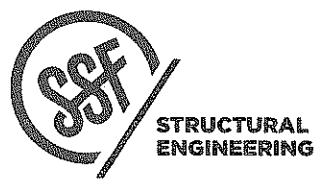
MAIN FLOOR PLAN

E-W DIRECTION

	3 ^k	1.2 ^k	3 ^k	1.1 ^k
	43'	30'		
V	7.3 ^k	10 ^k	1.7 ^k	
Lwall	16'	29'	8'	
W	436%	345%	212%	
	W3	W4	W6	
HD	4.5+1.5=6 ^k	HD04	1'	
	HD08			

Conc. Full HT Walls Around Perimeter
Below Main Floor at Basement Level

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DESIGNER [Signature] SHEET 51

For the purposes of Comparing Seismic vs Wind Forces
 The STRUCTURAL BASE FOR the plywood shear walls
 is ASSUMED TO BE AT THE MAIN FLOOR / Ground level
 Because the LATERAL FORCE SYSTEM CONSISTS OF
 FULL HT OR PARTIAL HT CONCRETE WALLS TO THE FOUNDATION
 (* NO WOOD SHEAR WALLS CONTINUE TO THE BASEMENT LEVEL *)
 The WOOD FRAME LATERAL SYSTEM IS 2-STORIES TALL

CHECK SEISMIC LOADINGS

$A_{roof} \approx 2500 \text{ ft}^2$

$A_{up flr} \approx 2500 \text{ ft}^2$

$A_{average} \approx 6000 \text{ ft}^2$

5600 ft²

Base Shear

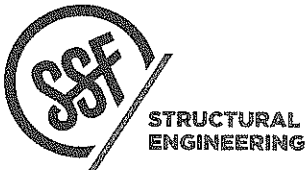
$V_b = .145 (5600) (.02 \text{ ksf}) = 16.5 \text{ k} (11.4 \text{ k ASD})$

WIND LATERAL FORCE = 16.8 k N-S DIR (ASD)
 19.0 k E-W DIR (ASD)

WIND GOVERNS BY A LOT IN BOTH DIRECTIONS

- IN THE CONCRETE FRAMING, SHEAR STRESSES ARE INSIGNIFICANT.

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5.5

SHEET

Roof Framing $D = 15'$
 $L = 25' + 5' = 30'$
 TYPICAL JOISTS 45 psf TOT

J1 $L = 26'$ (2) $11\frac{1}{8} \text{ TJS} / 230 @ 16$
 $W = .045(1.38) = .0621$
 $R = 1.06 \text{ k}$
 $M = 4.2 \text{ k}' (1.15)$
 $R = .39 \text{ k}$
 $M = 2.5 \text{ k}'$
 $\Delta = .89" = \frac{1}{35}$

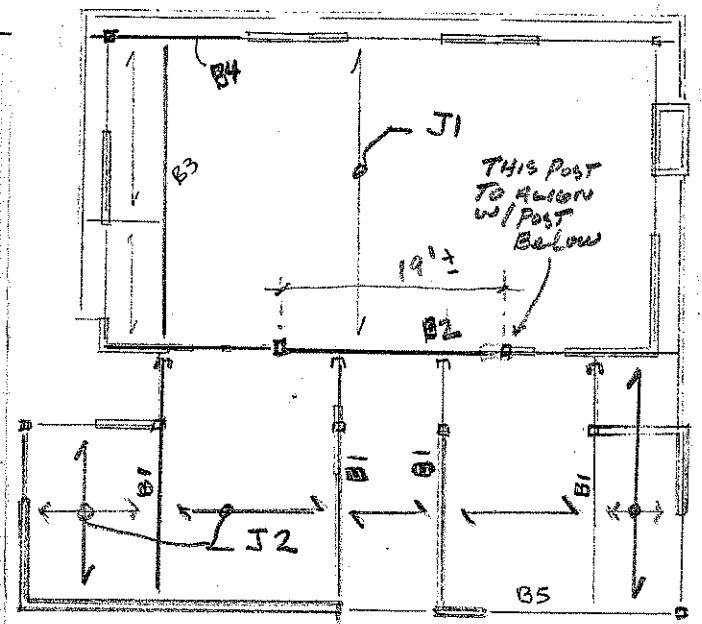
J2 $L_{max} = 15'$ $W = .045(2) = .09$
 $11\frac{1}{8} \text{ TJS} / 230 @ 24$
 $R = .68 \text{ k}$
 $M = 2.5 \text{ k}'$
 $\Delta = .3 = \frac{1}{609}$

BEAMS

B1 (WORST CASE)
 $W = .045(\frac{33}{2}) = .7425$
 $M = 10.3 \text{ k}'$
 $M = 9.3$ $3\frac{1}{2} \times 11\frac{1}{8} \text{ PSL}$
 $f_b = 1.50 \text{ ksi}$
 $\Delta = .37 = \frac{1}{485}$
 $\Delta = .13" \text{ (SIGNIFIES NO LOAD)}$
 TO B2 BEAM
 (3-STUD BRG) okay

B2 $L = 19'$
 $W = .045(\frac{26}{2}) = .5925$
 $R = 5.6 \text{ k}$
 $M = 26.4 \text{ k}'$
 $5'4 \times 11\frac{1}{8}$
 $f_b = 2.57 \text{ ksi}$
 $F_y = 120 \text{ psi}$
 $\Delta = 1.0" = \frac{1}{228}$
 $7 \times 11\frac{1}{8}$
 $\Delta = .8" = \frac{1}{286}$

B3 $L = 26'$
 $W = .045(3' TRIM) = .14$
 $R = 1.8 \text{ k}$
 $M = 11.8 \text{ k}'$
 $5'4 \times 11\frac{1}{8}$
 $f_b = 1.15 \text{ ksi}$
 $\Delta = .89" = \frac{1}{350}$

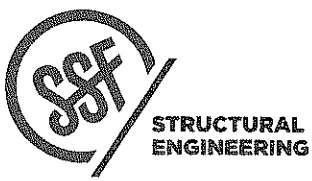


B4 $L = 12'$
 $W = .045(14) = .63$
 $R = 3.8 \text{ k}$
 $M = 11.3 \text{ k}'$
 $3\frac{1}{2} \times 11\frac{1}{8}$
 $f_b = 1.65 \text{ ksi}$
 $\Delta = .3" = \frac{1}{479}$

B5 $L = 16.5'$
 $P = 3.3 \text{ k max (B1)}$
 JOISTS ARE PARALLEL
 $M = \frac{PL}{4} = 13.6 \text{ k}'$
 $3\frac{1}{2} \times 11\frac{1}{8} \text{ PSL}$
 $f_b = 1.99 \text{ ksi}$
 $\Delta = .73" = \frac{1}{272}$

Roof Framing

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6

UPPER FLOOR FRAMING

D=10
L=40

JOIST FRAMING

J1
L=26'
R=.65%,
M=4.24%

14" TJI/560 @ 12
M_{max} = 11.3 k'
Δ = .56" = 2/561
OR (2) 14" TJI/360 @ 16
Δ = .56"

J2
L=14'-6" max
R=.36%,
M=1.34%

14" TJI/210 @ 16
Δ = .14"

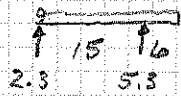
J3 (AT GARAGE)

W=45 psf ROOF
L=23'±

R=.69%,
M=3.97 k'
11" TJI/360 @ 16
R_u = 1.08"
M_{max} = 6.18 k'
Δ = .9" = 1/306

BEAMS

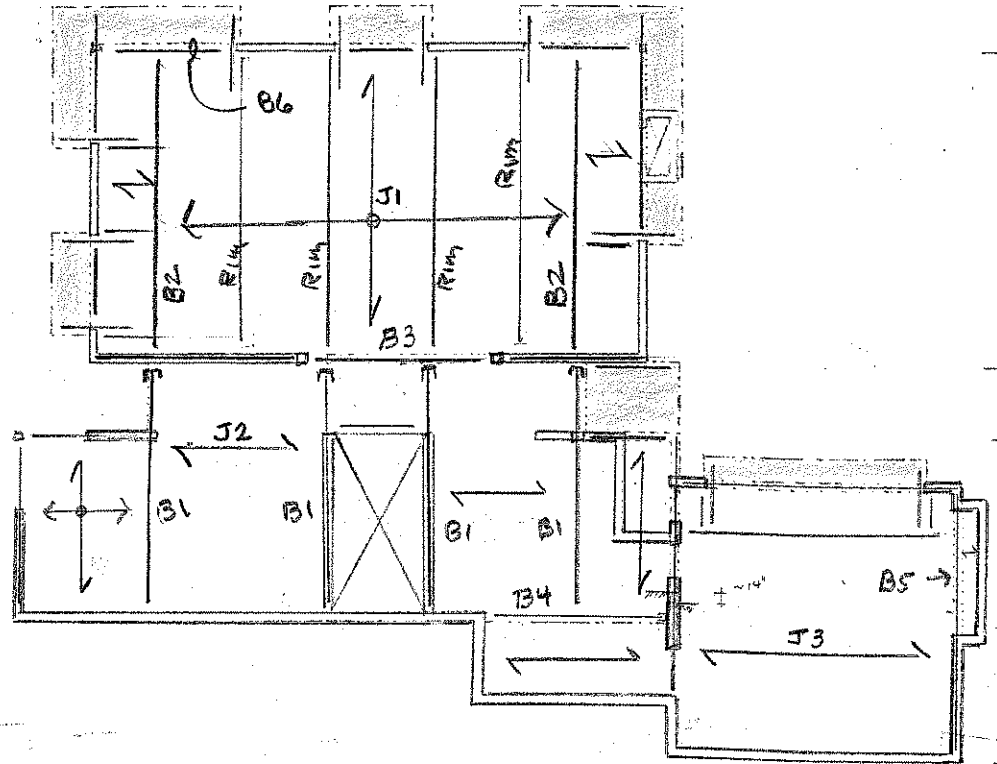
B1 W=.05(^{14.5}/₂) = .36%,
M₊ = 7.1 k'
M₋ = 6.5 k'



3 1/2" x 14"
f_b = .75 ksi
f_v = 83 psi
Δ = -.05" (INDICATES NO LOAD ON CENTRAL BEARING WALL)

B2 W=.05(²⁶/₂) = .52%,
L=26'
R=.24%,
M=12.7 k'

3 1/2" x 14"
f_b = 1.33 ksi
f_v = 54 psi
Δ = .88" = 1/356

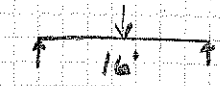


UPPER FLOOR FRAMING

B3 L=16'
W=.05(²⁶/₂) = .65%,
R=5.2 k',
M=20.8 k'

5 1/2" x 14"
f_b = 1.46 ksi
f_v = 91 psi
Δ = .36" = 2/530

B4 P=2.3 k'
R=1.2 k',
M=9.2 k'

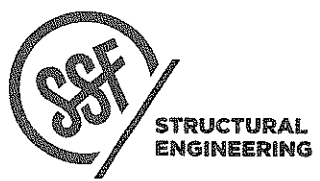


3 1/2" x 14"
f_b = 1.0 ksi
Δ = .2" = 2/995

B5 L=11'
W=.045(²³/₂) = .52%,
R=2.8 k',
M=7.8 k'

3 1/2" x 11 7/8"
f_b = 1.14 ksi
Δ = .17" = 1/756

B6 L=



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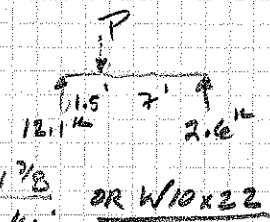
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SHEET 7

MAIN FLOOR FRAMING $D=10$
 $L=40$

TYPICAL JOISTS
 $L=18'$ max
1 1/8 T/J #10 @ 16"
 $L_u=18'-5"$ (FOR $W/480$)

B1 POINT LOAD FROM ABOVE

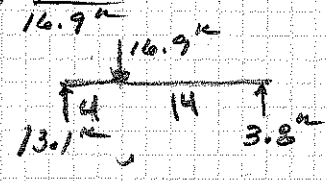
$R_F=5.16^k$
 $FLR=5.2+3.9=9.1$
 $P_{TOT}=14.7^k$
 $\eta=18.2^k$



PSL 5 7/8 x 11 7/8 OR W10x22
 $f_b=1.78^k/in$
 $f_v=291^k/in^2$
 $\Delta=.11"=1/906$

B2 POINT LOAD FROM ABOVE

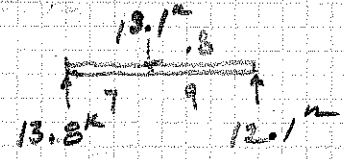
$R_F=5.2+.045(26)(7/8)=7.8^k$
 $FLR=5.2+.05(26)(7/8)=9.1^k$
 $\eta=52.6^k$



PSL 7x14
 $f_b=2.76^k/in$
 $f_v=291^k/in^2$
 $\Delta=.69"=1/313$
W10x22
 $f_b=27.2^k/in$
 $\Delta=.65"=1/334$

B3 $P=13.1^k$ max

$W=.05(16)=.8^k/in$
 $\eta=76.8^k$



W10x45
 $f_b=18.8^k/in$
 $\Delta=.43"=1/450$

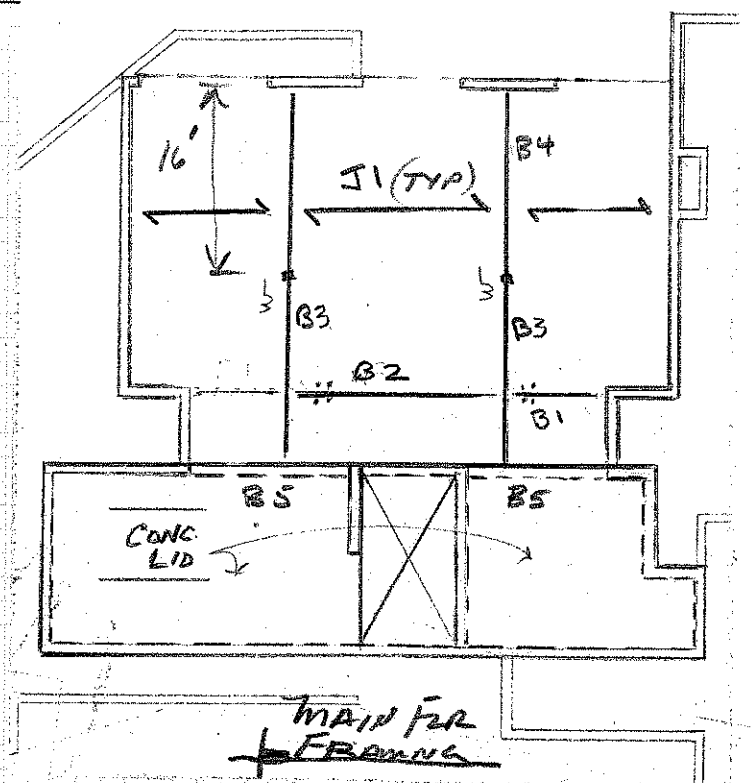
B4 $L=16'$

$W=.8^k/in$
 $R=6.4^k$
 $\eta=25.6^k$

PSL 7x11 7/8
 $f_b=1.87^k/in$
 $f_v=191^k/in^2$
 $\Delta=.55"=1/350$

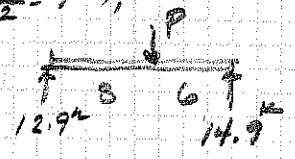
CONC. SLABS (8" SLAB)

$W_b=.11(12)+.04(16)=.2^k/in$ $M_o=5.6^k$
 $d=6"$ $A_s=.22^k/in^2$ USE #3 @ 12" EW
 $s=12$



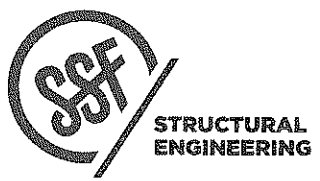
B5 $P_{B3}=13.8^k$

$W=(17.04)(7/8)=1^k/in$
 $\eta=71.3^k$



IF Framed AS A CONC. BRM

$M_o=95^k$ 12" w x 16" Deep
 $s=12$ $A_{s,req'd}=1.90^k/in^2$
 $d=13$ (2) #9's $A_s=2.0^k/in^2$
 $F_L=3^k/in$ #3 TIE @ 6" O/C
 $V_u=20^k$
 $V_s=.22(40)(13)=19^k$
 $V_u=2\sqrt{3000}(12)(13)=17^k$
 $\phi V_u=.85(19+17)=31^k$



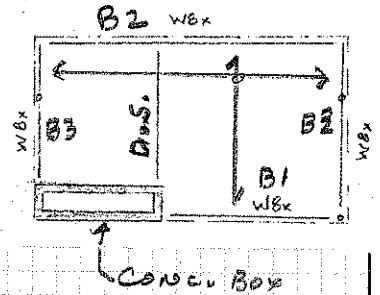
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Covered Deck Roof 45 PSF

Joists L=14' $9\frac{1}{2}$ TJI/210 @ 24" w=.09"/ft
 $R = .63$
 $M = 2.2$
 $R_w = 1$
 $M_w = 3.0$ (1.33)
 $A = .42 = 2/40$



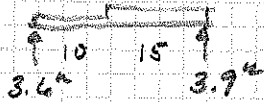
B1 L=15'
 $w = .045(7) = .32$
 $R = 2.4$
 $M = 8.9$
 $w/8 \times 13$
 $f_b = 10.9$ ksi
 $A = .31 = 2/576$
 OR Full-HP Conc. wall ...
 - REVISED PER ARCH -

LATERAL DESIGN OF WHELTER ROOF

$W_{roof} = .015(16)(26) = 5.9$
 Conc. shear walls $C_s = .9/5 = .18$
 $V_s = 5.9(.18) = 1$

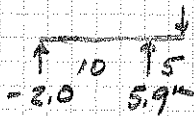
MAX DRAG STRUT LOAD = 1k
 ROTATION RESOLVED w/
 DRAG STRUTS FRAMED INTO
 CONC. WALLS, LOADS ARE TRIVIAL.

B2 L=25'
 $w_1 = .045(6) = .27$
 $w_2 = .045(9) = .32$
 $M = 23.8$



WBx31
 $f_b = 10.4$ ksi
 $A = .83 = 2/360$

B3 P=3.9k
 $M = 19.5$



WBx31
 $f_b = 8.5$ ksi
 $A = .26 = 2/454$

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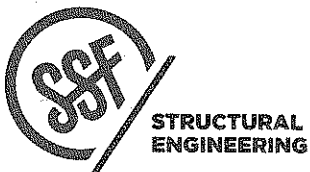
DATE

BY

DESIGN

SHEET

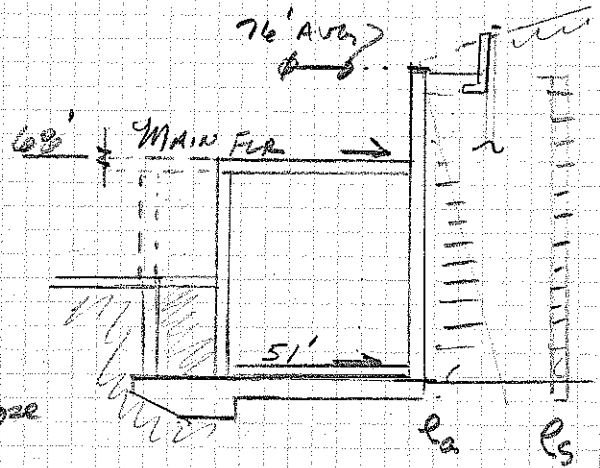
9



CONCRETE BUNKER DESIGN

LATERAL DESIGN OF CONCR. STRUCTURE
DUE TO PERMANENT LATERAL
EARTH PRESSURES

Retaining Wall in FINAL CONDITION
will BE INSTALLED IN FRONT
of wall, however, calculate
TOTAL LOADS BASED ON FULL
APPARENT LOADS w/ A 2:1 BACK SLOPE
BEHIND WALL

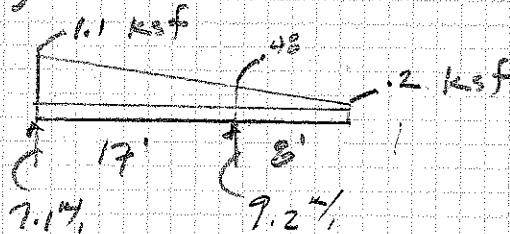
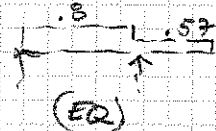


$$e_a = 35 \text{ psf (2:1 apparent slope)}$$

$$e_{\text{seismic}} = \frac{2}{3}(H) = \frac{2}{3}(25) = .20 \text{ ksf}$$

$$M_{-} = 18.3 \text{ k-ft}$$

$$M_{+} = 20.5 \text{ k-ft}$$



$$M_{u \text{ max}} = 20.5(1.6) = 32.8 \text{ k-ft}$$

CHECK CONCR. WALL IN PERM. CONDITION

$$d = 12" - (1.5 + \frac{5}{8}) = (10.35)$$

3512

$$f_c = 2500 \text{ psi}$$

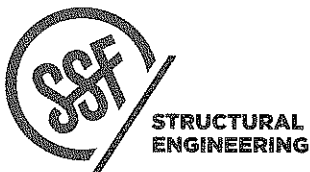
12" cover, wall

$$A_{s \text{ req'd}} = .78 \text{ m}^2 = \#8 @ 12" / c$$

$$A_s = .77 \text{ m}^2 / \text{ft}$$

$$\text{use } \#4 @ 12 \text{ E.F. Hoop}$$

$$\text{LOADING TO CONC. DIAPHR.} = 9.2 \text{ k-ft}$$



PERLA
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CONCRETE SHEAR WALL DESIGN

UNIFORM LOAD TO MAIN FLOOR
 = 9.2 k/ft

WALL STIFFNESS COMPARISONS

7' INTERIOR WALLS BRACED AT ELEV 58'

$$\Delta \alpha = \frac{10^3}{7^3} = 2.9$$



15' END WALLS

$$\Delta \alpha = \frac{17^3}{15^3} = 1.45$$

$$\frac{\Delta \alpha}{\Delta \alpha} = \frac{1.45}{2.9} = 0.5 \quad (15' \text{ WALLS TWICE AS STIFF})$$

$$V_{TOT} = 9.2 (35') = 322 \text{ k}$$

$$V_{15'} = \frac{322}{3} = 107 \text{ k} \quad (171 \text{ k LAFD})$$

$$V_{7'} = \frac{322}{6} = 54 \text{ k} \quad (86 \text{ k LAFD})$$

Neglecting Flange Contribution

$$M_u = 171 (15') = 2907 \text{ k}' \quad (12 \times 24" \text{ BOUNDARY ELEMENT EA END})$$

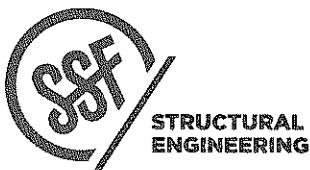
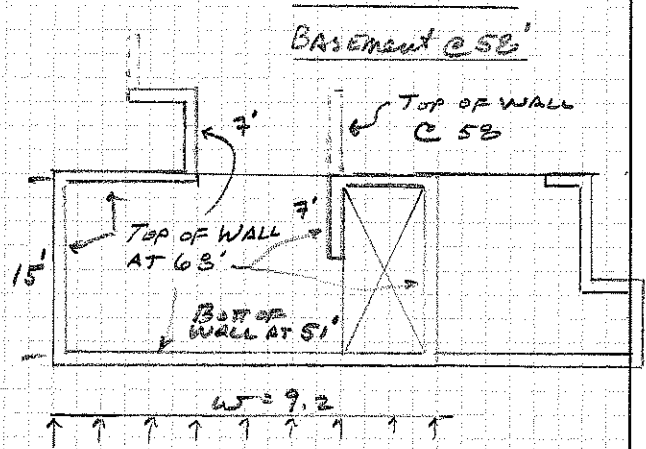
15' WALL 12x24 COLUMN
 $l = 168"$ $A_g = 3.95 \text{ m}^2$
 $b = 12"$ $(8) \#7's \quad A_s = 4.8 \text{ m}^2$
 $f_c = 2500$

$$\frac{M_u}{b l} = \frac{171}{12(168)} = 85 \text{ psi} = 1.7 \sqrt{f_c}$$

PROVIDE CLOSE TIE SPACING AT BOUNDARY

= 3 TIES @ 3" OC

w/ #4's @ 12" OC HORIZ EA FACE



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Concrete Bunker Global Overturning

MAIN FLR LOADING = 9.2 k/ft

GLOBAL OVERTURNING MOMENT = $9.2 (17') = 156 \text{ k-ft}$
 (includes seismic surcharge)

CALCULATE D.L.'S

$P_1 = .15 (25') = 3.8 \text{ k/ft}$ WALL

$P_2 = .1 (16') = .8 \text{ k/ft}$ SLAB MAIN FLR

$P_3 = 3.14 (.15) (30') = 2.4 \text{ k/ft}$ PILE AND WT

$P_4 = .21 (16') = 1.7 \text{ k/ft}$ BASEMENT FTG/SLAB
 $8.7 \text{ k/ft} = P_{TOT/2}$

$M_R = 8.7 (18') = 156 \text{ k-ft} \leq M_{OT}$

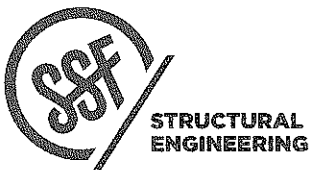
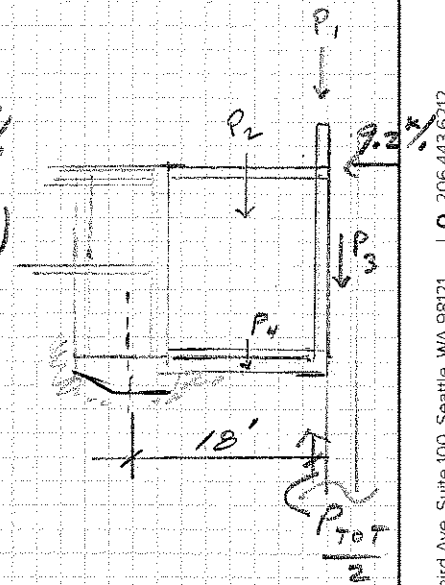
(NOTE: OVERTURNING includes seismic surcharge)

Check TOTAL LOADING ON RAKER FTG

AT EQUILIBRIUM $P_{max} = P_{TOT} = 8.7 (2) = 17.4 \text{ k/ft}$ (INCLUDES SEISMIC EFFECTS)

MINIMUM FTG WIDTH = $6'$

$S_{max} = \frac{17.4}{6} = 2900 \text{ psf}$ ✓



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DATE

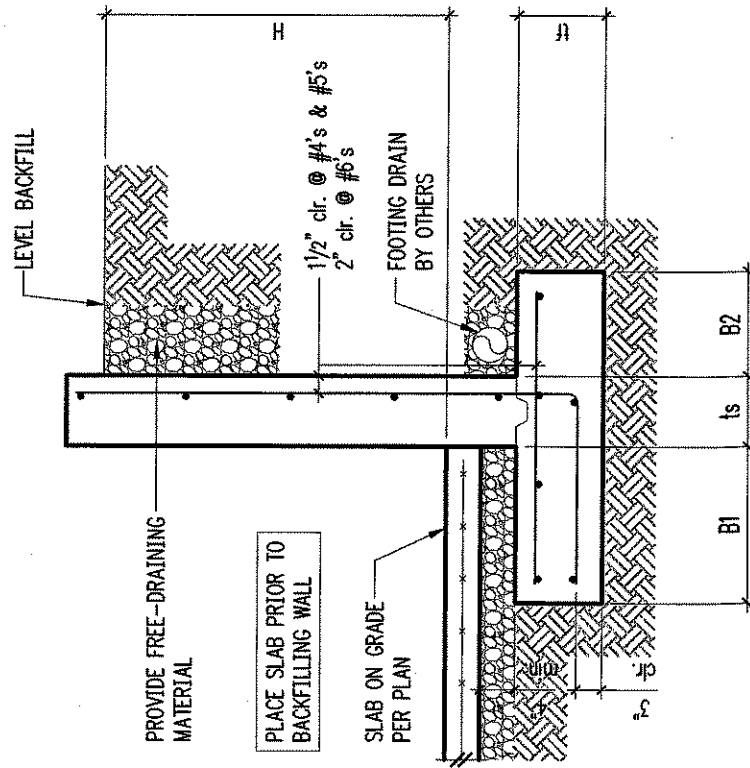
DESIGN

SHEET

12

Retaining Wall Schedule W/ Slab

H (ft.)	B1	ts	B2	tf	Stem Reinforcing		Footing Reinforcing	
					Vert.	Horiz.	Top	Longit.
3'-0"	5"	8"	5"	8"	#4 @ 18" oc	#4 @ 12" oc	-	(2)#4
4'-0"	1'-0"	8"	5"	8"	#4 @ 18" oc	#4 @ 12" oc	-	(2)#4
6'-0"	2'-3"	8"	5"	10"	#4 @ 12" oc	#4 @ 12" oc	-	(4)#4
8'-0"	2'-9"	8"	1'-0"	12"	#5 @ 12" oc	#4 @ 12" oc	#4 @ 18" oc	(6)#5
10'-0"	3'-9"	8"	1'-6"	18"	#7 @ 12" oc	#4 @ 12" oc	#4 @ 18" oc	(8)#5



**STRUCTURAL
ENGINEERING**

2124 Third Avenue - Suite 100 - Seattle, WA 98121
p: 206.443.6212
ssfengineers.com

*NOTE: GEDFEZLH
PRESUMES
300 PCF W/FS
INCLUDED.
DESIGN CONSERVATIVE*

NOTE TO ENGINEER:

- SEISMIC SURCHARGE = 7H PSF
- SOIL DENSITY = 125 PCF
- EQUIVALENT FLUID PRESSURE = 35 PCF
- PASSIVE SOIL RESISTANCE = 350 PCF (WITHOUT FACTOR OF SAFETY)
- MINIMUM ALLOWABLE BEARING = 2000 PSF
- COEFFICIENT OF FRICTION = 0.45 (WITHOUT FACTOR OF SAFETY)



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Cantilevered Retaining Wall Design

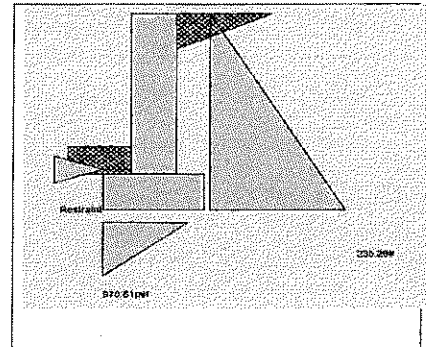
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	3.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.0 pcf
Soil Density, Toe	=	0.00 pcf
Footings||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios		
Overturning	=	1.87 OK
Slab Resists All Sliding !		
Total Bearing Load	=	605 lbs
...resultant ecc.	=	4.01 in
Soil Pressure @ Toe	=	971 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,165 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.8 psi OK
Footing Shear @ Heel	=	3.4 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	235.3 lbs

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of	=	1.00
Wind on Exposed Stem = (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Stem Construction

Design Height Above Ftg		ft =	0.00
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	8.00	
Rebar Size	=	# 4	
Rebar Spacing	=	18.00	
Rebar Placed at	=	Edge	
Design Data			
fb/FB + fa/Fa	=	0.069	
Total Force @ Section			
Service Level	lbs =		
Strength Leve	lbs =	252.0	
Moment....Actual			
Service Level	ft-# =		
Strength Leve	ft-# =	252.0	
Moment....Allowable	=	3,655.6	
Shear....Actual			
Service Level	psi =		
Strength Leve	psi =	3.4	
Shear....Allowable	psi =	75.0	
Wall Weight	psf =	100.0	
Rebar Depth 'd'	in =	6.25	

Masonry Data

f _m	psi =	
F _s	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data

f _c	psi =	2,500.0
F _y	psi =	60,000.0

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

Load Factors

Building Code	IBC 2012, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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 Seattle, WA 98121
 p: 206.443.6212

Title **Retaining Wall Schedule**
 Job # **CO-04-07** Dsgnr: **JR**
 Description....
3'-0" Retaining Wall w/ Slab

Page: _____
 Date: 29 JUL 2016

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Cantilevered Retaining Wall Design

Code: IBC 2012, ACI 318-11, ACI 530-11

Footing Dimensions & Strengths

Toe Width = 0.42 ft
 Heel Width = 1.08
 Total Footing Width = 1.50
 Footing Thickness = 8.00 in
 Key Width = 0.00 in
 Key Depth = 0.00 in
 Key Distance from Toe = 0.00 ft
 f_c = 2,500 psi F_y = 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	= 1,165	0 psf
Mu' : Upward	= 91	1 ft-#
Mu' : Downward	= 17	49 ft-#
Mu: Design	= 74	48 ft-#
Actual 1-Way Shear	= 0.77	3.39 psi
Allow 1-Way Shear	= 75.00	75.00 psi
Toe Reinforcing	= None Spec'd	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= None Spec'd	

NOTE:

M_u/M_n = 0.22
 5" I_{sh} + 3" COVER = 8"
OK BY INSPECTION

Other Acceptable Sizes & Spacings

Toe: #4@ 13.89 in, #5@ 21.53 in, #6@ 30.56 in, #7@ 41.67 in, #8@ 54.86 in, #9@ 6
 Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 235.3	1.22	287.6	Soil Over Heel	= 155.0	1.29	200.5
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
				Soil Over Toe	=	0.21	
				Surcharge Over Toe	=		
Total	235.3	O.T.M.	287.6	Stem Weight(s)	= 300.0	0.75	226.0
				Earth @ Stem Transitions	=		
				Footing Weight	= 150.0	0.75	112.5
				Key Weight	=		
Resisting/Overturning Ratio		=	1.87	Vert. Component	=		
Vertical Loads used for Soil Pressure =		605.0 lbs		Total =	605.0 lbs	R.M.=	539.0

* 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) 0.054 in

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



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Cantilevered Retaining Wall Design

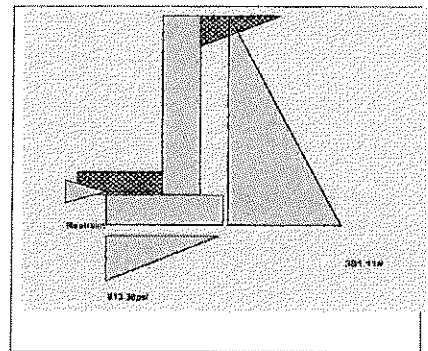
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footings||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	1.92 OK
Slab Resists All Sliding !		
Total Bearing Load	=	815 lbs
...resultant ecc.	=	4.47 in
Soil Pressure @ Toe	=	813 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	976 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	7.0 psi OK
Footing Shear @ Heel	=	4.1 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	381.1 lbs
-----------------------	---	-----------

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

Load Factors

Building Code	IBC 2012, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of	=	1.00
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Stem Construction

Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa	=	0.163
---------------	---	-------

Total Force @ Section

Service Level	lbs =	
Strength Leve	lbs =	448.0

Moment....Actual

Service Level	ft-# =	
Strength Leve	ft-# =	597.3

Moment....Allowable	=	3,655.6
---------------------	---	---------

Shear.....Actual

Service Level	psi =	
Strength Leve	psi =	6.0

Shear....Allowable	psi =	75.0
--------------------	-------	------

Wall Weight	psf =	100.0
-------------	-------	-------

Rebar Depth 'd'	in =	6.25
-----------------	------	------

Masonry Data

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

Concrete Data

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



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Title **Retaining Wall Schedule**
 Job # **CO-04-07** Dsgnr: **JR**
 Description....
4'-0" Retaining Wall w/ Slab

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 Date: 29 JUL 2016

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Cantilevered Retaining Wall Design

Code: IBC 2012, ACI 318-11, ACI 530-11

Footing Dimensions & Strengths

Toe Width = 1.00 ft
 Heel Width = 1.08
 Total Footing Width = 2.08
 Footing Thickness = 8.00 in
 Key Width = 0.00 in
 Key Depth = 0.00 in
 Key Distance from Toe = 0.00 ft
 f'c = 2,500 psi Fy = 60,000 psi
 Footing Concrete Density = 150.00 pcf
 Min. As % = 0.0018
 Cover @ Top 2.00 @ Btm = 3.00 in

Footing Design Results

	Toe	Heel
Factored Pressure =	976	0 psf
Mu' : Upward =	407	3 ft-#
Mu' : Downward =	98	62 ft-#
Mu: Design =	309	58 ft-#
Actual 1-Way Shear =	6.99	4.09 psi
Allow 1-Way Shear =	75.00	75.00 psi
Toe Reinforcing =	None Spec'd	
Heel Reinforcing =	None Spec'd	
Key Reinforcing =	None Spec'd	

NOTE :

M_u/M_n = 0.22
 5" I_{ch} + 3" COVER = 8"
OK BY INSPECTION

Other Acceptable Sizes & Spacings

Toe: #4@ 13.89 in, #5@ 21.53 in, #6@ 30.56 in, #7@ 41.67 in, #8@ 54.86 in, #9@ 6
 Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure =	381.1	1.56	592.8	Soil Over Heel =	206.7	1.87	387.2
Surcharge over Heel =				Sloped Soil Over Heel =			
Surcharge Over Toe =				Surcharge Over Heel =			
Adjacent Footing Load =				Adjacent Footing Load =			
Added Lateral Load =				Axial Dead Load on Stem =			
Load @ Stem Above Soil =				* Axial Live Load on Stem =			
				Soil Over Toe =		0.50	
				Surcharge Over Toe =			
Total	381.1	O.T.M.	592.8	Stem Weight(s) =	400.0	1.33	533.3
				Earth @ Stem Transitions =			
				Footing Weight =	208.0	1.04	216.3
Resisting/Overturning Ratio			= 1.92	Key Weight =			
Vertical Loads used for Soil Pressure =		814.7 lbs		Vert. Component =			
				Total =	814.7 lbs	R.M. =	1,136.8

* 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) 0.043 in

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



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Cantilevered Retaining Wall Design

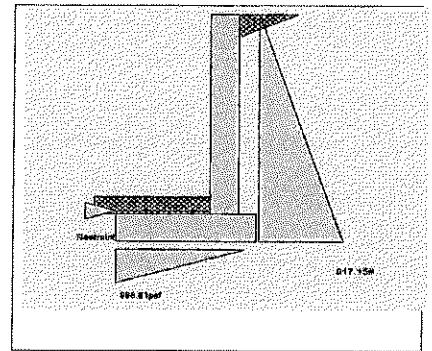
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.0 pcf
Soil Density, Toe	=	0.00 pcf
Footings|Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

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
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Design Summary

Wall Stability Ratios

Overturning	=	1.73 OK
Slab Resists All Sliding !		
Total Bearing Load	=	1,326 lbs
...resultant ecc.	=	7.77 in
Soil Pressure @ Toe	=	869 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,042 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	11.0 psi OK
Footing Shear @ Heel	=	4.8 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	817.2 lbs
-----------------------	---	-----------

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

Load Factors

Building Code		IBC 2012, ACI
Dead Load		1.200
Live Load		1.600
Earth, H		1.600
Wind, W		1.000
Seismic, E		1.000

Stem Construction

Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.372
Total Force @ Section		
Service Level	lbs =	
Strength Leve	lbs =	1,008.0
Moment....Actual		
Service Level	ft-# =	
Strength Leve	ft-# =	2,016.0
Moment....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Leve	psi =	13.4
Shear.....Allowable	psi =	75.0
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data

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

Concrete Data

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



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 Seattle, WA 98121
 p: 206.443.6212

Title **Retaining Wall Schedule**
 Job # **CO-04-07** Dsgnr: **JR**
 Description....
6'-0" Retaining Wall w/ Slab

Page: _____
 Date: 29 JUL 2016

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Cantilevered Retaining Wall Design

Code: IBC 2012, ACI 318-11, ACI 530-11

Footing Dimensions & Strengths

Toe Width = 2.25 ft
 Heel Width = 1.08
 Total Footing Width = 3.33
 Footing Thickness = 10.00 in
 Key Width = 0.00 in
 Key Depth = 0.00 in
 Key Distance from Toe = 0.00 ft
 f_c = 2,500 psi F_y = 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 =	1,042	0 psf
Mu' : Upward =	1,990	0 ft-#
Mu' : Downward =	570	90 ft-#
Mu: Design =	1,421	90 ft-#
Actual 1-Way Shear =	10.97	4.79 psi
Allow 1-Way Shear =	75.00	75.00 psi
Toe Reinforcing =	None Spec'd	
Heel Reinforcing =	None Spec'd	
Key Reinforcing =	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.89 in, #9@ 5
 Heel: Not req'd: Mu < phi*5*lambda*sqrt(f_c)*S_m
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure =	817.2	2.28	1,861.3	Soil Over Heel =	310.0	3.12	968.2
Surcharge over Heel =				Sloped Soil Over Heel =			
Surcharge Over Toe =				Surcharge Over Heel =			
Adjacent Footing Load =				Adjacent Footing Load =			
Added Lateral Load =				Axial Dead Load on Stem =			
Load @ Stem Above Soil =				* Axial Live Load on Stem =			
				Soil Over Toe =		1.13	
				Surcharge Over Toe =			
Total	817.2	O.T.M.	1,861.3	Stem Weight(s) =	600.0	2.58	1,550.0
				Earth @ Stem Transitions =			
Resisting/Overturning Ratio			= 1.73	Footing Weight =	416.3	1.67	693.1
Vertical Loads used for Soil Pressure =		1,326.3 lbs		Key Weight =			
				Vert. Component =			
				Total =	1,326.3 lbs	R.M. =	3,211.3

* 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) 0.043 in

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



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Cantilevered Retaining Wall Design

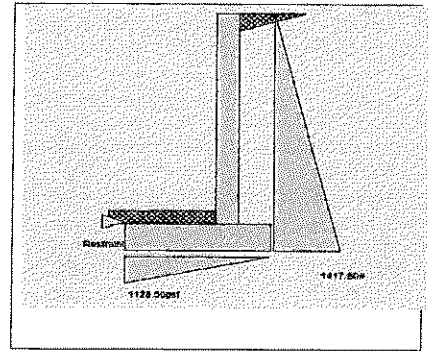
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footings|Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

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
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Design Summary

Wall Stability Ratios	
Overturning	= 1.84 OK Slab Resists All Sliding !
Total Bearing Load	= 2,455 lbs
...resultant ecc.	= 9.06 in
Soil Pressure @ Toe	= 1,128 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable	= 2,000 psf Soil Pressure Less Than Allowable
ACI Factored @ Toe	= 1,354 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 15.1 psi OK
Footing Shear @ Heel	= 10.8 psi OK
Allowable	= 75.0 psi
Sliding Calcs	
Lateral Sliding Force	= 1,417.5 lbs

Stem Construction

Design Height Above Ftg	
ft =	0.00
Wall Material Above "Ht"	= Concrete
Design Method	= LRFD
Thickness	= 8.00
Rebar Size	= # 5
Rebar Spacing	= 12.00
Rebar Placed at	= Edge

Design Data	
fb/FB + fa/Fa	= 0.588

Total Force @ Section	
Service Level	lbs =
Strength Leve	lbs = 1,792.0
Moment....Actual	
Service Level	ft-# =
Strength Leve	ft-# = 4,778.7
Moment....Allowable	= 8,121.3

Shear.....Actual	
Service Level	psi =
Strength Leve	psi = 24.1
Shear.....Allowable	psi = 75.0
Wall Weight	psf = 100.0
Rebar Depth 'd'	in = 6.19

Masonry Data	
f'm	psi =
Fs	psi =
Solid Grouting	=
Modular Ratio 'n'	=
Short Term Factor	=
Equiv. Solid Thick.	=
Masonry Block Type	= Medium Weight
Masonry Design Method	= ASD

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

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

Load Factors

Building Code	IBC 2012, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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Title Retaining Wall Schedule
 Job # CO-04-07 Dsgnr: JR
 Description....
 8'-0" Retaining Wall w/ Slab

Page: _____
 Date: 9 JUN 2016

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Cantilevered Retaining Wall Design

Code: IBC 2012, ACI 318-11, ACI 530-11

Footing Dimensions & Strengths

Toe Width = 2.75 ft
 Heel Width = 1.66 ft
 Total Footing Width = 4.41 ft
 Footing Thickness = 12.00 in
 Key Width = 0.00 in
 Key Depth = 0.00 in
 Key Distance from Toe = 0.00 ft
 f_c = 2,500 psi F_y = 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 =	1,354	0 psf
Mu' : Upward =	4,042	42 ft-#
Mu' : Downward =	964	681 ft-#
Mu: Design =	3,077	639 ft-#
Actual 1-Way Shear =	15.14	10.83 psi
Allow 1-Way Shear =	75.00	75.00 psi
Toe Reinforcing =	# 6 @ 12.00 in	
Heel Reinforcing =	# 6 @ 12.00 in	
Key Reinforcing =	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 9.26 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46
 Heel: Not req'd: Mu < phi*5*lambda*sqrt(f_c)*S_m
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure =	1,417.5	3.00	4,252.5	Soil Over Heel =	993.3	3.91	3,887.2
Surcharge over Heel =				Sloped Soil Over Heel =			
Surcharge Over Toe =				Surcharge Over Heel =			
Adjacent Footing Load =				Adjacent Footing Load =			
Added Lateral Load =				Axial Dead Load on Stem =			
Load @ Stem Above Soil =				* Axial Live Load on Stem =			
				Soil Over Toe =		1.38	
				Surcharge Over Toe =			
Total	1,417.5	O.T.M.	4,252.5	Stem Weight(s) =	800.0	3.08	2,466.7
				Earth @ Stem Transitions =			
				Footing Weight =	661.5	2.21	1,458.6
Resisting/Overturning Ratio			= 1.84	Key Weight =			
Vertical Loads used for Soil Pressure =		2,454.8 lbs		Vert. Component =			
				Total =	2,454.8 lbs	R.M. =	7,812.5

* 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) 0.057 in

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



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Cantilevered Retaining Wall Design

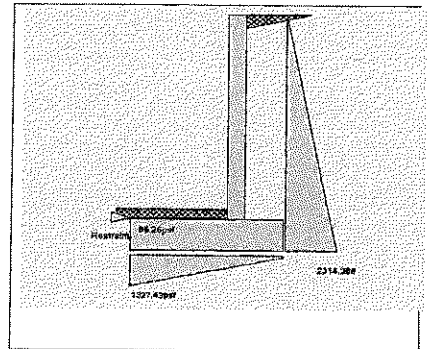
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	10.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.0 pcf
Soil Density, Toe	=	0.00 pcf
Footings|Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios	
Overturning	= 2.00 OK
Slab Resists All Sliding !	
Total Bearing Load	= 4,211 lbs
...resultant ecc.	= 10.25 in
Soil Pressure @ Toe	= 1,327 psf OK
Soil Pressure @ Heel	= 95 psf OK
Allowable	= 2,000 psf
Soil Pressure Less Than Allowable	
ACI Factored @ Toe	= 1,593 psf
ACI Factored @ Heel	= 114 psf
Footing Shear @ Toe	= 13.2 psi OK
Footing Shear @ Heel	= 11.9 psi OK
Allowable	= 75.0 psi
Sliding Calcs	
Lateral Sliding Force	= 2,314.4 lbs

Stem Construction

Design Height Above Ftg	
ft =	0.00
Wall Material Above "Ht"	= Concrete
Design Method	= LRFD
Thickness	= 8.00
Rebar Size	= # 7
Rebar Spacing	= 12.00
Rebar Placed at	= Edge
Design Data	
fb/FB + fa/Fa	= 0.712
Total Force @ Section	
Service Level	lbs =
Strength Leve	lbs = 2,800.0
Moment....Actual	
Service Level	ft-# =
Strength Leve	ft-# = 9,333.3
Moment....Allowable	= 13,107.2
Shear.....Actual	
Service Level	psi =
Strength Leve	psi = 41.9
Shear....Allowable	psi = 75.0
Wall Weight	psf = 100.0
Rebar Depth 'd'	in = 5.56

Masonry Data

f _m	psi =
F _s	psi =
Solid Grouting	=
Modular Ratio 'n'	=
Short Term Factor	=
Equiv. Solid Thick.	=
Masonry Block Type	= Medium Weight
Masonry Design Method	= ASD

Concrete Data

f _c	psi = 2,500.0
F _y	psi = 60,000.0

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

Load Factors

Building Code	IBC 2012, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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 p: 206.443.6212

Title **Retaining Wall Schedule**
 Job # **CO-04-07** Dsgnr: **JR**
 Description....
10'-0" Retaining Wall w/ Slab

Page: _____
 Date: 29 JUL 2016

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Cantilevered Retaining Wall Design

Code: IBC 2012, ACI 318-11, ACI 530-11

Footing Dimensions & Strengths

Toe Width	=	3.75 ft
Heel Width	=	2.17
Total Footing Width	=	5.92
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
fc =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm = 3.00 in

Footing Design Results

	Toe	Heel
Factored Pressure	= 1,593	114 psf
Mu' : Upward	= 9,005	271 ft-#
Mu' : Downward	= 2,426	2,000 ft-#
Mu: Design	= 6,579	1,730 ft-#
Actual 1-Way Shear	= 13.23	11.86 psi
Allow 1-Way Shear	= 75.00	75.00 psi
Toe Reinforcing	= # 7 @ 12.00 in	
Heel Reinforcing	= # 4 @ 18.00 in	
Key Reinforcing	= None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 6.17 in, #5@ 9.57 in, #6@ 13.58 in, #7@ 18.52 in, #8@ 24.38 in, #9@ 30.
 Heel: Not req'd: $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 2,314.4	3.83	8,871.8	Soil Over Heel	= 1,879.2	5.17	9,712.2
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
				Soil Over Toe	=	1.88	
				Surcharge Over Toe	=		
Total	2,314.4	O.T.M.	8,871.8	Stem Weight(s)	= 1,000.0	4.08	4,083.3
				Earth @ Stem Transitions	=		
				Footing Weight	= 1,332.0	2.96	3,942.7
				Key Weight	=		
				Vert. Component	=		
Resisting/Overturning Ratio		=	2.00	Total =	4,211.2 lbs	R.M. =	17,738.2
Vertical Loads used for Soil Pressure =		4,211.2 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.

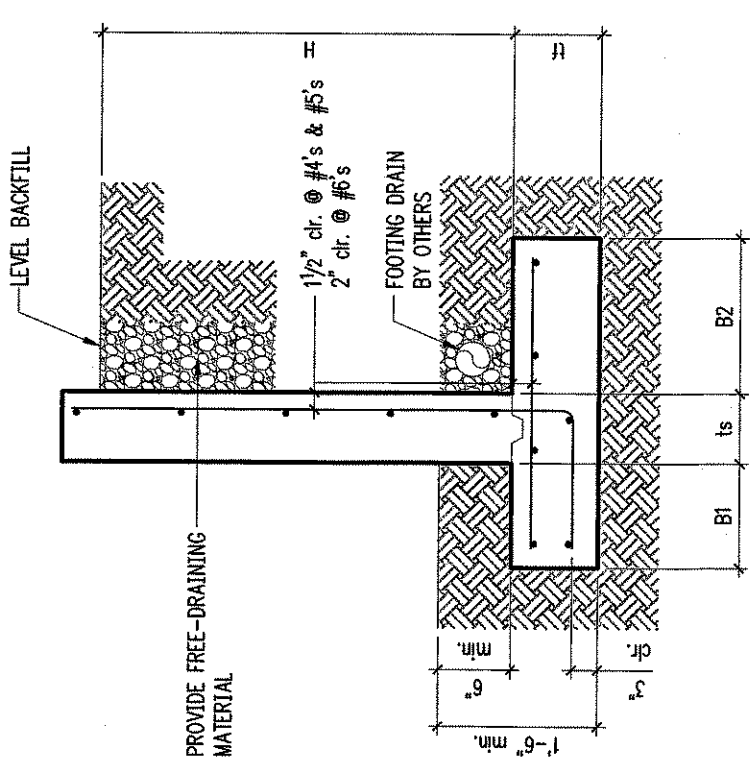
Tilt

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)	0.062 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.

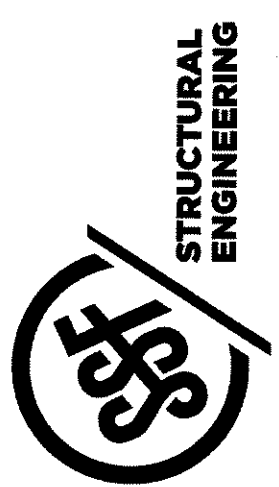


Retaining Wall Schedule

H (ft.)	B1	ts	B2	tf	Stem Reinforcing		Footing Reinforcing	
					Vert.	Horiz.	Top	Longit.
3'-0"	5"	8"	5"	8"	#4 @ 18" oc	#4 @ 12" oc	-	(2)#4
4'-0"	5"	8"	1'-0"	8"	#4 @ 18" oc	#4 @ 12" oc	#4 @ 18" oc	(2)#4
6'-0"	5"	8"	2'-3"	10"	#4 @ 12" oc	#4 @ 12" oc	#4 @ 12" oc	(4)#4
8'-0"	1'-0"	8"	2'-9"	12"	#5 @ 12" oc	#4 @ 12" oc	#5 @ 12" oc	(5)#5
10'-0"	1'-9"	8"	3'-9"	18"	#7 @ 12" oc	#4 @ 12" oc	#6 @ 12" oc	(8)#5

NOTE TO ENGINEER:

- SEISMIC SURCHARGE = 7H PSF
- SOIL DENSITY = 125 PCF
- EQUIVALENT FLUID PRESSURE = 35 PCF
- PASSIVE SOIL RESISTANCE = 350 PCF (WITHOUT FACTOR OF SAFETY)
- MINIMUM ALLOWABLE BEARING = 2000 PSF
- COEFFICIENT OF FRICTION = 0.45 (WITHOUT FACTOR OF SAFETY)



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 sseengineers.com



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Cantilevered Retaining Wall Design

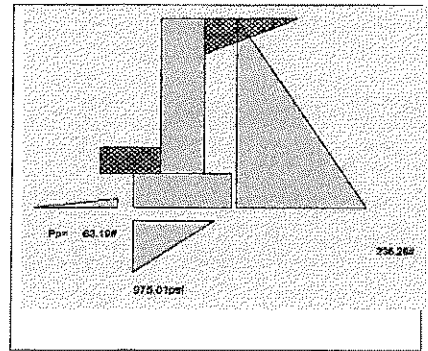
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	3.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.0 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios		
Overturning	=	1.87 OK
Sliding	=	1.43 Ratio < 1.5!
Total Bearing Load	=	606 lbs
...resultant ecc.	=	4.02 in
Soil Pressure @ Toe	=	975 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,170 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.7 psi OK
Footing Shear @ Heel	=	3.4 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	235.3 lbs
less 100% Passive Force	= -	63.2 lbs
less 100% Friction Force	= -	272.7 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	17.0 lbs NG

NOTE :
 1.5/1.43=1.05
CALL OK

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

Load Factors

Building Code	IBC 2012, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg		Bar Lap/Emb
Design Height Above "Ht"	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.069
Total Force @ Section		
Service Level	lbs =	
Strength Leve	lbs =	252.0
Moment....Actual		
Service Level	ft-# =	
Strength Leve	ft-# =	252.0
Moment....Allowable	=	3,655.6
Shear.....Actual		
Service Level	psi =	
Strength Leve	psi =	3.4
Shear....Allowable	psi =	75.0
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data

f _m	psi =	
F _s	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data

f _c	psi =	2,500.0
F _y	psi =	60,000.0



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 2124 Third Avenue - Suite 100
 Seattle, WA 98121
 p: 206.443.6212

Title Retaining Wall Schedule
 Job # 9 : Dsgnr: JR
 Description....
 3'-0" Retaining Wall

Page: _____
 Date: 29 JUL 2016

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Cantilevered Retaining Wall Design

Code: IBC 2012, ACI 318-11, ACI 530-11

Footing Dimensions & Strengths

Toe Width = 0.42 ft
 Heel Width = 1.08
 Total Footing Width = 1.50
 Footing Thickness = 8.00 in
 Key Width = 0.00 in
 Key Depth = 0.00 in
 Key Distance from Toe = 0.00 ft
 f_c = 2,500 psi F_y = 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	= 1,170	0 psf
Mu' : Upward	= 90	1 ft-#
Mu' : Downward	= 17	49 ft-#
Mu: Design	= 73	49 ft-#
Actual 1-Way Shear	= 0.71	3.41 psi
Allow 1-Way Shear	= 75.00	75.00 psi
Toe Reinforcing	= None Spec'd	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= None Spec'd	

NOTE:
 M_u/M_n = 0.22
 5" I_{db} + 3" COVER = 8"
 OK BY INSPECTION

Other Acceptable Sizes & Spacings

Toe: #4@ 13.89 in, #5@ 21.53 in, #6@ 30.56 in, #7@ 41.67 in, #8@ 54.86 in, #9@ 6
 Heel: Not req'd: Mu < phi*5*lambda*sqrt(f_c)*S_m
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 235.3	1.22	287.6	Soil Over Heel	= 156.1	1.29	201.5
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
				Soil Over Toe	=	0.21	
				Surcharge Over Toe	=		
Total	235.3	O.T.M.	287.6	Stem Weight(s)	= 300.0	0.75	224.8
				Earth @ Stem Transitions	=		
				Footing Weight	= 149.9	0.75	112.4
Resisting/Overturning Ratio		=	1.87	Key Weight	=		
Vertical Loads used for Soil Pressure	=	606.0 lbs		Vert. Component	=		
				Total =	606.0 lbs	R.M. =	538.7

* 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) 0.054 in

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



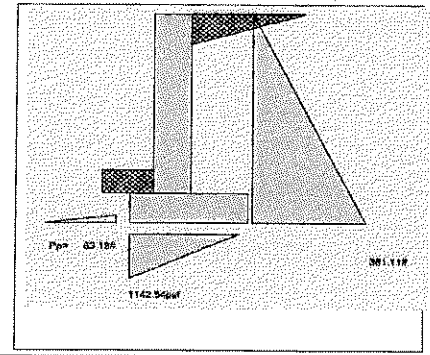
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Cantilevered Retaining Wall Design Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria		
Retained Height	=	4.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data		
Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.0 pcf
Soil Density, Toe	=	0.00 pcf
Footings|Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



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

Lateral Load Applied to Stem		
Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem (Service Level)	=	0.0 psf

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

Axial Load Applied to Stem		
Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary		
Wall Stability Ratios		
Overturning	=	2.21 OK
Sliding	=	1.48 Ratio < 1.5!
Total Bearing Load	=	1,110 lbs
...resultant ecc.	=	4.74 in
Soil Pressure @ Toe	=	1,143 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,371 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.9 psi OK
Footing Shear @ Heel	=	7.0 psi OK
Allowable	=	75.0 psi

Stem Construction		
Bottom		
Bar Lap/Emb		ft = 0.00
Design Height Above Ftg		ft = 0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.163
Total Force @ Section		
Service Level	lbs =	
Strength Leve	lbs =	448.0
Moment....Actual		
Service Level	ft-# =	
Strength Leve	ft-# =	597.3
Moment.....Allowable	=	3,655.6
Shear.....Actual		
Service Level	psi =	
Strength Leve	psi =	6.0
Shear.....Allowable	psi =	75.0
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

NOTE:
 1.5/1.48=1.01
 CALL OK

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

Load Factors		
Building Code		IBC 2012, ACI
Dead Load		1.200
Live Load		1.600
Earth, H		1.600
Wind, W		1.000
Seismic, E		1.000

Concrete Data		
fc	psi =	2,500.0
Fy	psi =	60,000.0



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Title Retaining Wall Schedule
 Job # 7 : Dsgnr: JR
 Description...
 4'-0" Retaining Wall

Page: _____
 Date: 29 JUL 2016

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Cantilevered Retaining Wall Design

Code: IBC 2012, ACI 318-11, ACI 530-11

Footing Dimensions & Strengths

Toe Width = 0.42 ft
 Heel Width = 1.67
 Total Footing Width = 2.09
 Footing Thickness = 8.00 in
 Key Width = 0.00 in
 Key Depth = 0.00 in
 Key Distance from Toe = 0.00 ft
 f_c = 2,500 psi F_y = 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	= 1,371	0 psf
Mu' : Upward	= 110	75 ft-#
Mu' : Downward	= 17	362 ft-#
Mu: Design	= 93	287 ft-#
Actual 1-Way Shear	= 0.86	6.99 psi
Allow 1-Way Shear	= 75.00	75.00 psi
Toe Reinforcing	= # 4 @ 18.00 in	
Heel Reinforcing	= # 4 @ 18.00 in	
Key Reinforcing	= None Spec'd	

NOTE:
 M_t/M_n = 0.22
 5" I_{db} + 3" COVER = 8"
 OK BY INSPECTION

Other Acceptable Sizes & Spacings

Toe: #4@ 13.89 in, #5@ 21.53 in, #6@ 30.56 in, #7@ 41.67 in, #8@ 54.86 in, #9@ 6
 Heel: Not req'd: Mu < phi*5*lambda*sqrt(f_c)*S_m
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 381.1	1.56	592.8	Soil Over Heel	= 501.7	1.58	794.8
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
				Soil Over Toe	=	0.21	
				Surcharge Over Toe	=		
Total	381.1	O.T.M.	592.8	Stem Weight(s)	= 400.0	0.75	299.7
				Earth @ Stem Transitions	=		
Resisting/Overturning Ratio		=	2.21	Footing Weight	= 208.6	1.04	217.6
Vertical Loads used for Soil Pressure =		1,110.3 lbs		Key Weight	=		
				Vert. Component	=		
				Total =	1,110.3 lbs	R.M. =	1,312.1

* 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) 0.061 in

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



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Cantilevered Retaining Wall Design

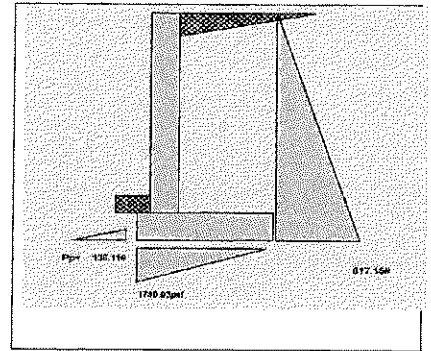
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.0 pcf
Soil Density, Toe	=	0.00 pcf
Footings|Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

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
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Design Summary

Wall Stability Ratios	
Overturning	= 2.50 OK
Sliding	= 1.65 OK
Total Bearing Load = 2,696 lbs	
...resultant ecc.	= 7.10 in
Soil Pressure @ Toe	= 1,740 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable	= 2,000 psf
Soil Pressure Less Than Allowable	
ACI Factored @ Toe	= 2,088 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 0.0 psi OK
Footing Shear @ Heel	= 9.7 psi OK
Allowable	= 75.0 psi
Sliding Calcs	
Lateral Sliding Force	= 817.2 lbs
less 100% Passive Force	= - 136.1 lbs
less 100% Friction Force	= - 1,213.3 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 : 1 Stability	= 0.0 lbs OK

Stem Construction

Design Data	
Design Height Above Ftg	ft = 0.00
Wall Material Above "Ht"	= Concrete
Design Method	= LRFD
Thickness	= 8.00
Rebar Size	= # 4
Rebar Spacing	= 12.00
Rebar Placed at	= Edge
Design Data	
fb/FB + fa/Fa	= 0.372
Total Force @ Section	
Service Level	lbs =
Strength Leve	lbs = 1,008.0
Moment....Actual	
Service Level	ft-# =
Strength Leve	ft-# = 2,016.0
Moment....Allowable	= 5,412.6
Shear.....Actual	
Service Level	psi =
Strength Leve	psi = 13.4
Shear.....Allowable	psi = 75.0
Wall Weight	psf = 100.0
Rebar Depth 'd'	in = 6.25

Masonry Data

fm	psi =
Fs	psi =
Solid Grouting	=
Modular Ratio 'n'	=
Short Term Factor	=
Equiv. Solid Thick.	=
Masonry Block Type	= Medium Weight
Masonry Design Method	= ASD

Concrete Data

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

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

Load Factors

Building Code	IBC 2012, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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Cantilevered Retaining Wall Design

Code: IBC 2012, ACI 318-11, ACI 530-11

Footing Dimensions & Strengths

Toe Width = 0.33 ft
 Heel Width = 2.92
 Total Footing Width = 3.25
 Footing Thickness = 10.00 in
 Key Width = 0.00 in
 Key Depth = 0.00 in
 Key Distance from Toe = 0.00 ft
 f_c = 2,500 psi F_y = 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 =	2,088	0 psf
Mu' : Upward =	110	1,044 ft-#
Mu' : Downward =	12	2,666 ft-#
Mu: Design =	97	1,622 ft-#
Actual 1-Way Shear =	0.00	9.74 psi
Allow 1-Way Shear =	75.00	75.00 psi
Toe Reinforcing =	# 4 @ 12.00 in	
Heel Reinforcing =	# 4 @ 12.00 in	
Key Reinforcing =	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.89 in, #9@ 5
 Heel: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.89 in, #9@ 5
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

Item	....OVERTURNING....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure =	817.2	2.28	1,861.3	Soil Over Heel =	1,690.0	2.12	3,588.4
Surcharge over Heel =				Sloped Soil Over Heel =			
Surcharge Over Toe =				Surcharge Over Heel =			
Adjacent Footing Load =				Adjacent Footing Load =			
Added Lateral Load =				Axial Dead Load on Stem =			
Load @ Stem Above Soil =				* Axial Live Load on Stem =			
				Soil Over Toe =		0.17	
				Surcharge Over Toe =			
Total	817.2	O.T.M.	1,861.3	Stem Weight(s) =	600.0	0.66	398.0
				Earth @ Stem Transitions =			
				Footing Weight =	406.3	1.63	660.2
Resisting/Overturning Ratio			= 2.50	Key Weight =			
Vertical Loads used for Soil Pressure =		2,696.3 lbs		Vert. Component =			
				Total =	2,696.3 lbs	R.M.=	4,646.6

* 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) 0.089 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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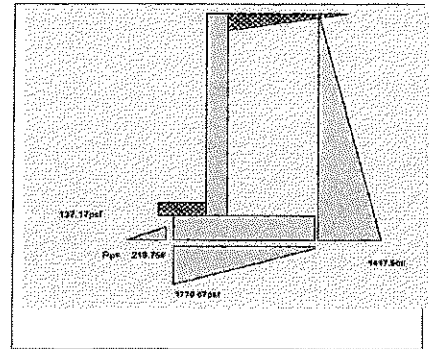
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.0 pcf
Soil Density, Toe	=	0.00 pcf
Footings||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

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
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Design Summary

Wall Stability Ratios	
Overturning	= 2.57 OK
Sliding	= 1.49 Ratio < 1.5!
Total Bearing Load	= 4,216 lbs
...resultant ecc.	= 7.57 in
Soil Pressure @ Toe	= 1,771 psf OK
Soil Pressure @ Heel	= 137 psf OK
Allowable	= 2,000 psf
Soil Pressure Less Than Allowable	
ACI Factored @ Toe	= 2,125 psf
ACI Factored @ Heel	= 165 psf
Footing Shear @ Toe	= 5.1 psi OK
Footing Shear @ Heel	= 14.6 psi OK
Allowable	= 75.0 psi
Sliding Calcs	
Lateral Sliding Force	= 1,417.5 lbs
less 100% Passive Force	= - 218.8 lbs
less 100% Friction Force	= - 1,897.4 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 : 1 Stability	= 10.1 lbs NG

NOTE :
1.5/1.49=1.01
CALL OK

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

Load Factors

Building Code	IBC 2012, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	
ft =	0.00
Wall Material Above "Ht"	= Concrete
Design Method	= LFRD
Thickness	= 8.00
Rebar Size	= # 5
Rebar Spacing	= 12.00
Rebar Placed at	= Edge
Design Data	
fb/FB + fa/Fa	= 0.588
Total Force @ Section	
Service Level	lbs =
Strength Leve	lbs = 1,792.0
Moment....Actual	
Service Level	ft-# =
Strength Leve	ft-# = 4,778.7
Moment....Allowable	= 8,121.3
Shear.....Actual	
Service Level	psi =
Strength Leve	psi = 24.1
Shear.....Allowable	psi = 75.0
Wall Weight	psf = 100.0
Rebar Depth 'd'	in = 6.19

Masonry Data

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

Concrete Data

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

Bottom

Stem OK



Swenson Say Faget
 2124 Third Avenue - Suite 100
 Seattle, WA 98121
 p: 206.443.6212

Title **Retaining Wall Schedule**
 Job # 3 : Dsgnr: JR
 Description...
 8'-0" Retaining Wall

Page: _____
 Date: 29 JUL 2016

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Cantilevered Retaining Wall Design

Code: IBC 2012, ACI 318-11, ACI 530-11

Footing Dimensions & Strengths

Toe Width = 1.00 ft
 Heel Width = 3.42
 Total Footing Width = 4.42
 Footing Thickness = 12.00 in
 Key Width = 0.00 in
 Key Depth = 0.00 in
 Key Distance from Toe = 0.00 ft
 f_c = 2,500 psi F_y = 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 =	2,125	165 psf
Mu' : Upward =	988	2,167 ft-#
Mu' : Downward =	128	5,231 ft-#
Mu: Design =	861	3,064 ft-#
Actual 1-Way Shear =	5.09	14.61 psi
Allow 1-Way Shear =	75.00	75.00 psi
Toe Reinforcing =	# 5 @ 12.00 in	
Heel Reinforcing =	# 5 @ 12.00 in	
Key Reinforcing =	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 9.26 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46
 Heel: #4@ 9.26 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure =	1,417.5	3.00	4,252.5	Soil Over Heel =	2,753.3	3.04	8,379.3
Surcharge over Heel =				Sloped Soil Over Heel =			
Surcharge Over Toe =				Surcharge Over Heel =			
Adjacent Footing Load =				Adjacent Footing Load =			
Added Lateral Load =				Axial Dead Load on Stem =			
Load @ Stem Above Soil =				* Axial Live Load on Stem =			
				Soil Over Toe =		0.50	
				Surcharge Over Toe =			
Total	1,417.5	O.T.M.	4,252.5	Stem Weight(s) =	800.0	1.33	1,066.7
				Earth @ Stem Transitions =			
				Footing Weight =	663.0	2.21	1,465.2
Resisting/Overturning Ratio			= 2.57	Key Weight =			
Vertical Loads used for Soil Pressure =		4,216.3 lbs		Vert. Component =			
				Total =	4,216.3 lbs	R.M. =	10,911.2

* 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) 0.089 in

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



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Cantilevered Retaining Wall Design

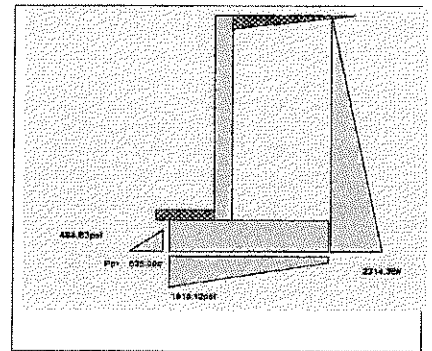
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	10.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.0 pcf
Soil Density, Toe	=	0.00 pcf
Footings||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios		
Overturning	=	2.99 OK
Sliding	=	1.60 OK
Total Bearing Load	=	7,080 lbs
...resultant ecc.	=	7.13 in
Soil Pressure @ Toe	=	1,810 psf OK
Soil Pressure @ Heel	=	485 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,172 psf
ACI Factored @ Heel	=	582 psf
Footing Shear @ Toe	=	5.4 psi OK
Footing Shear @ Heel	=	14.2 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	2,314.4 lbs
less 100% Passive Force	= -	525.0 lbs
less 100% Friction Force	= -	3,186.0 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 : 1 Stability	=	0.0 lbs OK

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of	=	1.00
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Stem Construction

Design Height Above Ftg		ft =	0.00	Stem OK
Wall Material Above "Ht"	=	Concrete		
Design Method	=	LRFD		
Thickness	=	8.00		
Rebar Size	=	# 7		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	0.712		
Total Force @ Section				
Service Level	lbs =			
Strength Leve	lbs =	2,800.0		
Moment....Actual				
Service Level	ft-# =			
Strength Leve	ft-# =	9,333.3		
Moment.....Allowable	=	13,107.2		
Shear.....Actual				
Service Level	psi =			
Strength Leve	psi =	41.9		
Shear.....Allowable	psi =	75.0		
Wall Weight	psf =	100.0		
Rebar Depth 'd'	in =	5.56		

Masonry Data

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

Concrete Data

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

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

Load Factors

Building Code	IBC 2012, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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Cantilevered Retaining Wall Design

Code: IBC 2012, ACI 318-11, ACI 530-11

Footing Dimensions & Strengths

Toe Width	=	1.75 ft
Heel Width	=	4.42
Total Footing Width	=	6.17
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f_c	=	2,500 psi
F_y	=	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	= 2,172	582 psf
Mu' : Upward	= 3,096	6,370 ft-#
Mu' : Downward	= 528	12,467 ft-#
Mu: Design	= 2,568	6,098 ft-#
Actual 1-Way Shear	= 5.39	14.22 psi
Allow 1-Way Shear	= 75.00	75.00 psi
Toe Reinforcing	= # 7 @ 12.00 in	
Heel Reinforcing	= # 6 @ 12.00 in	
Key Reinforcing	= None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 6.17 in, #5@ 9.57 in, #6@ 13.58 in, #7@ 18.52 in, #8@ 24.38 in, #9@ 30.
 Heel: Not req'd: $\mu < \phi * 5 * \lambda * \sqrt{f_c} * S_m$
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 2,314.4	3.83	8,871.8	Soil Over Heel	= 4,691.7	4.29	20,142.9
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
	=			Soil Over Toe	=	0.88	
	=			Surcharge Over Toe	=		
Total	2,314.4	O.T.M.	8,871.8	Stem Weight(s)	= 1,000.0	2.08	2,083.3
	=	=		Earth @ Stem Transitions	=		
Resisting/Overturning Ratio		=	2.99	Footing Weight	= 1,388.3	3.09	4,282.8
Vertical Loads used for Soil Pressure	=	7,079.9 lbs		Key Weight	=		
				Vert. Component	=		
				Total	= 7,079.9 lbs	R.M.=	26,509.0

* 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)	0.081 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.