

supplemental structural calculations for:

talerman-simon residence

**3879 west mercer way
mercero island washington**

client: floisand studio

Δ 8 january 2019



index:

**pr- plan review responses
fd- foundations**

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SHEET 50.1

NO COMMENTS

SHEET 51.1

■ UPUFT C CB66

WORST CASE - LOAD CASE 7

FHD MAX = 7.14K. (WIND)

$$FDL = \begin{matrix} 2.6K & + & 3.4K & = & 6.0K. & \times & 0.6 & = & 5.4K. \\ \text{COL. LOAD} & & \text{BEAM LOAD} & & & & & & \\ \text{FROM UPPER} & & \text{FROM MAIN} & & & & & & \\ \text{FLOOR} & & \text{FLOOR} & & & & & & \end{matrix}$$

$$\therefore \text{MAX. UPUFT} = \underline{1.74K.}$$

CB66 W/ DF/L COL. 4.7K. WIND IN CRACKED CONCRETE ✓

FOOTING F3.5 - 3'-6" x 3'-6" x 16"

$$DL = 16.3 \text{ CUFT} \times 150 \text{ PCF} = 2.44K. \checkmark$$

SHEET 51.2

■ CHANNEL TO CHANNEL CONNECTION

SEE NEW DETAIL 20/52.5

■ F# INDICATES FLUSH BEAM

■ IGNORING PASSIVE PRESSURE ON 18" OF EMBED. OF RETAINING WALLS - SEE REUSED RETAINING WALL CALCULATIONS

NOTE: REDESIGN W/ NO PASSIVE PRESSURE EXCEPT: DRNEWAY WALLS (W/NO HEEL) WHERE KEYS ARE USED TO ENGAGE PASSIVE PRESSURE

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RESIDENCE

client: FLOISAND STUDIO

date: 1-8-17

proj #: 2018-024

sheet: PR-1

(CONT)

W2 WALLS SPANNING HORIZONTALLY
REACTION INTO PERPENDICULAR WALL @
EACH END - CHECK FRICTION RESISTANCE
ON THESE

$$P_{MAX} = 6.62k.$$

RESISTANCE ON ① C (CE)

$$P_R = 8.67 \times 3600\# = 31.2k.$$

$$\therefore \text{FRICT. RESISTANCE} = 16.4k. = 2.48 \times P_{MAX} \checkmark$$

RESISTANCE ON ②

EQUAL & OPPOSITE REACTION FROM WALL ON ②

RESISTANCE ON ⑦ C (AA) & ⑧

$$EP = 6.62 + 4.06 = 10.68k.$$

$$P_R = 20.67 \times 3700\# = 76.48k.$$

$$\therefore \text{FRICT. RESISTANCE} = 40.15k. = 3.75 \times EP \checkmark$$

RESISTANCE ON ③

$$EP = 5.42 - 4.52 = 0.9k.$$

$$P_R = 12 \times 3700\# = 44.4k.$$

$$\therefore \text{FRICT RESISTANCE} = 23.31k. = 25.9 \times EP \checkmark$$

RESISTANCE ON ④

$$P_{MAX} = 6.32k.$$

$$P_R = 7 \times 2160 + 7,200 = 24.42k.$$

$$\therefore \text{FRICT RESISTANCE} = 12.82k = 2.03 \times P_{MAX}$$

RESISTANCE ON ①

$$P_{MAX} = 5.42k.$$

$$P_R = 8 \times 2100 = 16.8k.$$

$$\therefore \text{FRICT RESISTANCE} = 8.82k. = 1.63 \times P_{MAX}$$

NOTE: POSITIVE PRESSURE FROM ABUTTING WALLS
(FULL HEIGHT EXCEPT TOP 18") PROVIDE
MUCH ADDITIONAL RESISTANCE IN MANY CASES.

SHEET S1.2
 (& SHEET S1.3)

■ STRAPS AT REENTRANT CORNERS
 FOR SIMPLICITY USE ONE STRAP DESIGNED
 FOR WORST CASE

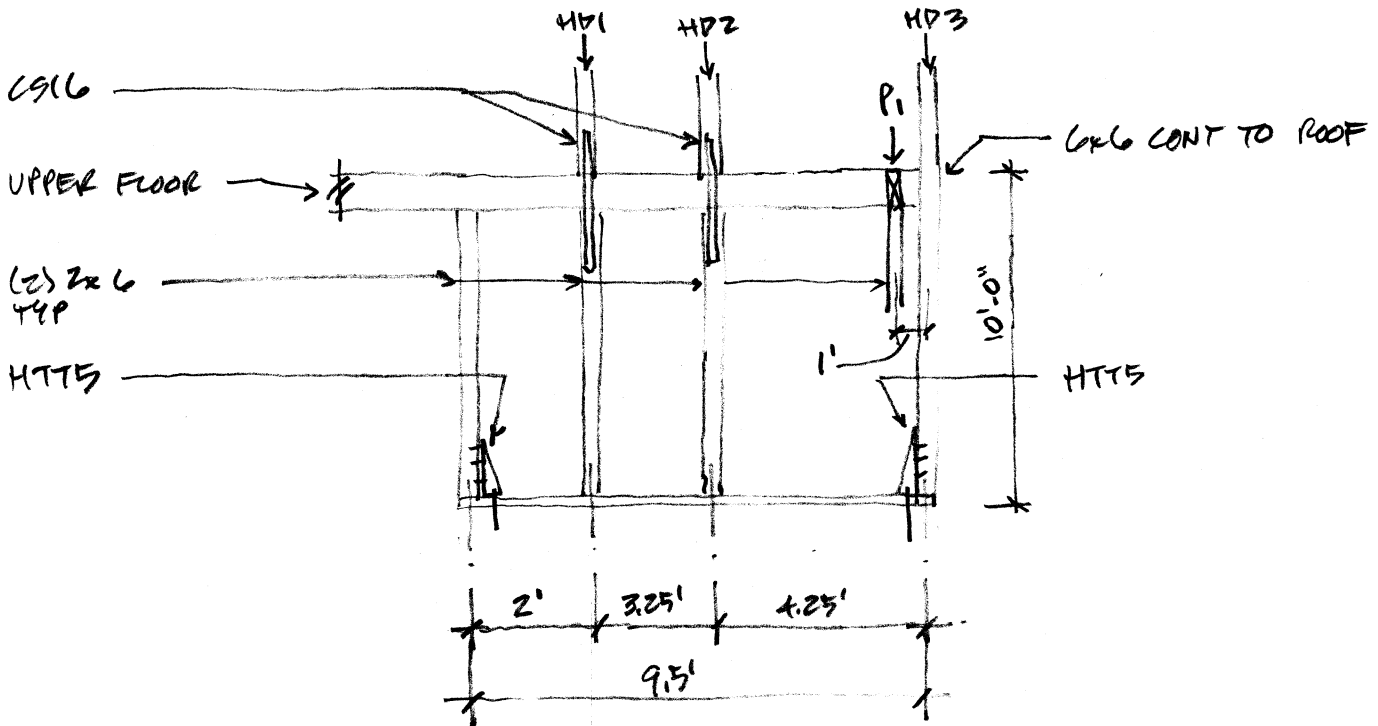
CMSTC16 4585 # CAPACITY [MAX SUB. DIAPH
 LOAD CONN LESS
 THAN 3,000#]
 NAILING TO FLUSH BEAM

(2) 16d SINKERS
 (2) ROWS @ 4 1/2" o.c. 6'-4" (MIN.)

EXTEND 1/3 RD DIAPH DEPTH / BURL.
 (2) ROWS @ 3" o.c.

SHEET S1.3

■ SHEAR WALL W/ DISCONTINUOUS HOLD-DOWNS (CS16s)
 SW3 WALL



ELEVATION FROM EXTERIOR

CONT ON PR-4 →

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■ CHECK WALL FOR LOAD CASE 7. (WORST CASE) (0.6 FL)

W = 3.41k

CASE A

M_{MAX} = 3.08 ft-k

M_{MIN} = φ
NO NET UPSET /
NEGATIVE BENDING.

+ WIND O.T.
= 3.41 ft-k

CASE B

+ WIND O.T.
= 3.41 ft-k

M_{MAX} = 5.62 ft-k

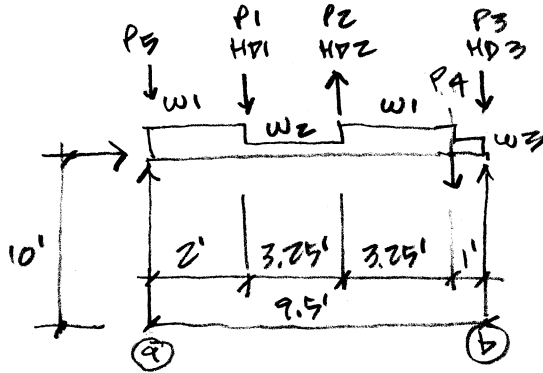
M_{MIN} = φ
NO NET UPSET /
NEGATIVE BENDING.

SHEAR FROM WIND

$= \frac{3.41}{9.5} = 359 \text{ plf}$

SW3 OK

NO ADDITIONAL SHEAR FROM
NON-CONT HOLD-DOWNS - PER WOOD
BEAM NEURAL ENGINEER BECAUSE
IT BEARS ON CONC. FDN.
T = C (TOP/BOT PLATES) = 624# ✓



$W_1 = .26 \text{ klf}$
 $W_2 = .06 \text{ klf}$
 $W_3 = .25 \text{ klf}$

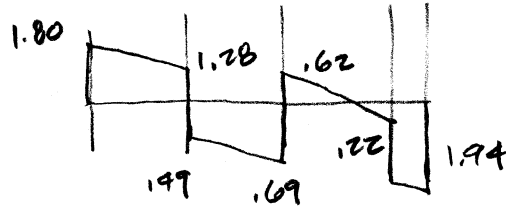
$HD1/2/3 = \pm 1.54 \text{ k}$

$P_1 = P_2 = .23 \text{ k}$

$P_3 = .40 \text{ k}$

$P_4 = 1.47 \text{ k}$

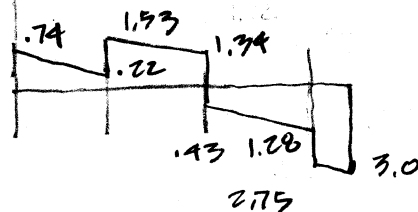
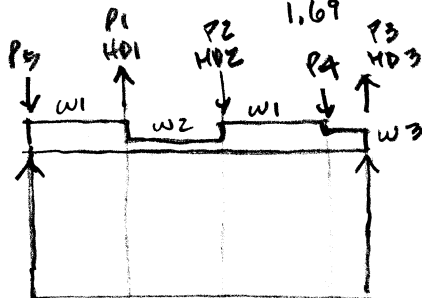
$P_5 = .25 \text{ k}$



$R_a = 1.80 - 3.59 = -1.79 \text{ k}$

$R_b = 1.94 + 0.40 + 3.59 = +5.93 \text{ k}$

W = 3.41k ←



$R_a = 0.74 + 3.59 + 1.25 = +4.58 \text{ k}$

$R_b = 3.0 - 3.59 + 0.40 = -0.19 \text{ k}$

WORST CASE COLUMN LOADS

a P_{MAX} = 4.58k. (2)X6 t_c = 278psi ✓
P_{MIN} = -3.34k. HTTS ✓
(IGNORING CONTRIB FROM PERWOOD BEAM)

b P_{MAX} = 5.93k. 6X6 t_c = 196psi ✓
P_{MIN} = -3.19k. HTTS ✓
(IGNORING CONTRIB FROM PERWOOD BEAM)

IN ACCORDANCE WITH SDPWS 4.3.4.2 -
 WALLS W/ $(h/b_s) \leq 2.0$ USE FULL CAPACITY OF SHEAR WALL
 CHECK REDUCED CAPACITIES FOR WALLS THAT EXCLUDE
 THIS ASPECT RATIO - IGNORE CONTRIBUTION FROM
 STRAPPING @ OPENINGS

UPPER FLOOR WALLS - $h = 8'-6\frac{3}{4}"$

\therefore CHECK WALLS W/ $b_s < 4'-3\frac{3}{8}"$
 $b_{s \text{ MIN}} = 2'-5\frac{3}{8}"$ [MIN ALLOWABLE
 WALL LENGTH]

GRID ① $b_{s \text{ MIN}} = 3'-4" \therefore h/b_s = 2.57$

\therefore ASPECT RATIO FACTOR = $1.25 - 0.125 \times h/b_s = \underline{0.928}$

$V_{\text{MAX}} = 138 \text{ plf}$ (PER LT-3)

SW1 $v_{\text{allow}}(\text{WIND}) = \left(\frac{0.93 \times 730}{2} \right) \times \underline{0.928} = 315 \text{ plf} \checkmark$

GRID ② $b_{s \text{ MIN}} = 3'-8\frac{1}{2}" \therefore h/b_s = 2.30$

\therefore ASPECT RATIO FACTOR = 0.961

$V_{\text{MAX}} = 104 \text{ plf}$ (PER LT-3)

SW2 $v_{\text{allow}}(\text{WIND}) = 326 \text{ plf} \checkmark$

GRID ③ $b_{s \text{ MIN}} = 2'-9" \therefore h/b_s = 3.11$

\therefore A.R.F = 0.861

$V_{\text{MAX}} = 244 \text{ plf}$ (PER LT-3)

SW2 $v_{\text{allow}}(\text{WIND}) = \left(\frac{.93 \times 1065}{2} \right) \times 0.861 = 426 \text{ plf} \checkmark$

GRID ④ $b_{s \text{ MIN}} = 3'-6\frac{3}{4}" \therefore h/b_s = 2.40$

\therefore A.R.F = 0.95

$V_{\text{MAX}} = 280 \text{ plf}$ (PER LT-3)

SW3 $v_{\text{allow}}(\text{WIND}) = \left(\frac{.93 \times 1370}{2} \right) \times 0.95 = 605 \text{ plf} \checkmark$

ALL OTHER UPPER FLOOR SHEAR WALLS LESS SLENDER

CONT
 →

SHEET 92.2
(CONT.)

WALL C LOW ROOF (ON GRID (AA)) [REDUNDANT WALL NOT PART OF PRIMARY LOAD RESISTANCE]

$$h_{MAX} = 12'-6"$$

$$b_s = 5'-0"$$

$$\therefore h/b_s = 2.50$$

$$\therefore A.R.F. = 0.94$$

$$v_{MAX} = 276 \text{ plf}$$

$$\underline{SW2} \text{ vallow (WIND)} = 464 \text{ plf} \checkmark$$

HAIN FLOOR WALLS - $h = 9'-0\frac{3}{4}"$

$$\therefore \text{CHECK WALLS w/ } b_s < 4'-6\frac{3}{8}"$$

$$b_{s \text{ MIN}} = 2'-7"$$

GRID ① $b_{s \text{ MIN}} = 3'-4" \therefore h/b_s = 2.72$

$$\therefore A.R.F. = 0.91$$

$$v_{MAX} = 596 \text{ plf (PER LT. 3)}$$

$$\underline{SW5} \text{ vallow (WIND)} = \left(\frac{2435}{2}\right) \times 0.91 = 1107 \text{ plf} \checkmark$$

GRID ⑤ $b_{s \text{ MIN}} = 3'-1" \therefore h/b_s = 2.94$

$$\therefore A.R.F. = 0.88$$

$$v_{MAX} = 239 \text{ plf (PER LT. 3)}$$

$$\underline{SW2} \text{ vallow (WIND)} = 437 \text{ plf} \checkmark$$

GRID ⑦ $b_{s \text{ MIN}} = 3'-6" \therefore h/b_s = 2.59$

$$\therefore A.R.F. = 0.93$$

$$v_{MAX} = 822 \text{ plf (PER LT. 4)}$$

$$\underline{SW5} \text{ vallow (WIND)} = 1128 \text{ plf} \checkmark$$

GRID ⑧ $b_{s \text{ MIN}} = 4'-2\frac{1}{16}" \therefore h/b_s = 2.16$

$$\therefore A.R.F. = 0.98$$

$$v_{MAX} = 660 \text{ plf (PER LT. 3)}$$

$$\underline{SW5} \text{ vallow (WIND)} = 1194 \text{ plf} \checkmark$$

GRID ⑥ $b_{s \text{ MIN}} = 3'-7\frac{1}{2}" \therefore h/b_s = 2.50$

$$\therefore A.R.F. = 0.94$$

$$v_{MAX} = 359 \text{ plf (PER LT. 3)}$$

$$\underline{SW3} \text{ vallow (WIND)} = 597 \text{ plf} \checkmark$$

CONT
→

SHEET 92.2
(CONT.)

BASEMENT SHEAR WALLS - $h = 8' - 8\frac{1}{4}"$
 \therefore CHECK WALLS w/ $b_s < 4' - 4\frac{1}{8}"$
 $b_s \text{ MIN} = 2' - 5\frac{7}{8}"$

GRID (A) $b_s \text{ MIN} = 2' - 5"$ - IGNORE SHORT WALLS
 $\therefore \Sigma l_w = 5.25'$
 $V = 1.13k$ $\therefore v = 214 \text{ plf}$ SWZ
 $F_{HD} = 2.14 - \text{DL}$ HTS

$\frac{1}{2}$ LOAD FROM
MAIN FLOOR DIAPHRAGM \rightarrow

RECHECK WALLS ON GRID (E)

$V = 1.13 + 3.59 = 3.72k$
 $\Sigma l_w = 24'$ $\therefore v = 155 \text{ plf}$ SWZ ✓
 $F_{HD} = 3.94 - \text{DL}$ HTS

SHEET 92.3 ■ DETAIL 11/92.3 (& OTHERS w/ LEDGERS)

$\bar{w}_{MAX} = 7' \times (40 + 15) = 385 \text{ plf}$
4x - (HEM FIR LEDGER)
 $\frac{3}{4}" \phi$ ANCHOR CAPACITY \perp GIRAN = 780 # \leftarrow
 $\frac{3}{4}" \phi$ TITEN HD IN 3,000 PSI CONC $V = 2,805 \#$
 $@ 16" \text{ o.c. } V_{MAX} = 586 \# / \text{FT}$ $> \bar{w}_{MAX}$.

SHEET 92.4

■ DETAIL 14/92.4 - REACTION OF BEAM B12 (SEE CALCULATION SHEET UF-2) = 10.32k.

ASSUMING $\frac{1}{2}$ LOAD IN EACH UMININATION = 5.16k.

$\frac{3}{4}" \phi$ LAG BOOT IN 5/4 PSL - 520 # / LAG

(12) LAGS = 6.24k $>$ REQ'D ✓

■ DETAIL 10/92.4 - REACTION OF BEAM B12 (SEE CALCULATION SHEET UF-2) = 10.32
TRANSFER $\frac{1}{2}$ LOAD TO EACH UMININATION = 5.16k
(12) LAGS = 6.24k $>$ REQ'D ✓

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client: FLOISKIND STUDIO

date: 1-7-19

proj #: 2018-02A

sheet: PR-7

SHEET 52.A

■ DETAIL A/52.A

(CONT.)

SHEAR WALL SCREWS @ (1) 2x - TOP PLATES

(1) 2x - SD 25412 } CAPACITY
(1) 2x - SD 25600 } (HEM FIR) = 1.60 x 190 = 304 #

SHEAR WALLS

MARK	DESIGN CAPACITY	SCREW SPACING
SW1	230 PCF	16" o.c.
SW2	350 PCF	10" o.c.
SW3	450 PCF	8" o.c.
SW4	600 PCF	6" o.c.
SW5	850 PCF	4" o.c.
SW6	1200 PCF	3" o.c.

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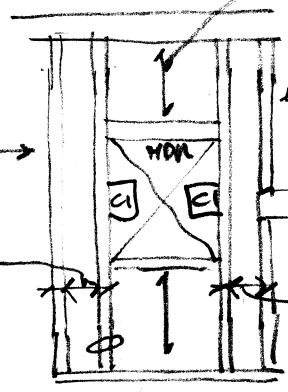
date: 1-8-19
proj #: 2018.024
sheet: PR-8

NOTE BRACING BY
LANDINGS & STAIRS NOT
FACTORED IN TO
BE CONSERVATIVE

WALL ON GRID ①

ABUTTING
EXTERNAL
WALL

NO STUDS



NON-CORNER BEARING.

WIND PRESSURE 21 PSF

COLUMNS ①

$h = 16.5'$ $M = 2.14 \text{ FT-K}$
 $\bar{w} = 67 \text{ PLF}$ $U = .52 \text{ K}$
 $C \times 6 \text{ (DF/L \#1)}$ $M_R = 4.144 \text{ FT-K}$
 $V_R = 5.49 \text{ K}$
 $\Delta \text{ WIND} = 4270 \text{ V}$

WALL ON GRID ②

LOW ROOF @ ENTRY & CONT 5/4 X 16 PSL DRAG
 STRUT BRACE / BREAK WALL - 2x6 @ 16" o.c.
 OK BY INSPECTION

WALL ON GRID ③

WIND LOAD & HEIGHT MATCH ① ABOVE BUT
 ADD ROOF LOAD

② $P_{DL} = 0.6 \text{ K}$
 $P_{SL} = 1.0 \text{ K}$

WORST CASE LOADING OF COL.
 LOAD CASE 6a.
 W/HOOD-DOWN LOAD INCLUDED

$P_{MAX} = 3.67 \text{ K}$

Cx8 COLUMNS USED

CONT
 →

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date: 1-8-19
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 sheet: FR-9

SHEET 91.3
CONT.



COL (C2)

Lx8
DF/L#1
F_c =
E =

P_{MAX} = 3.67k.
M_{MAX} = 1.01FK.
Q = 16.5
l/d = 76

Lx8 DF/L #1

F_c = 925 psi
E = 1.6E6 psi
F_b = 1350 psi

F'_c = 538 psi (1.60)

F'_b = 2160 psi (1.60)

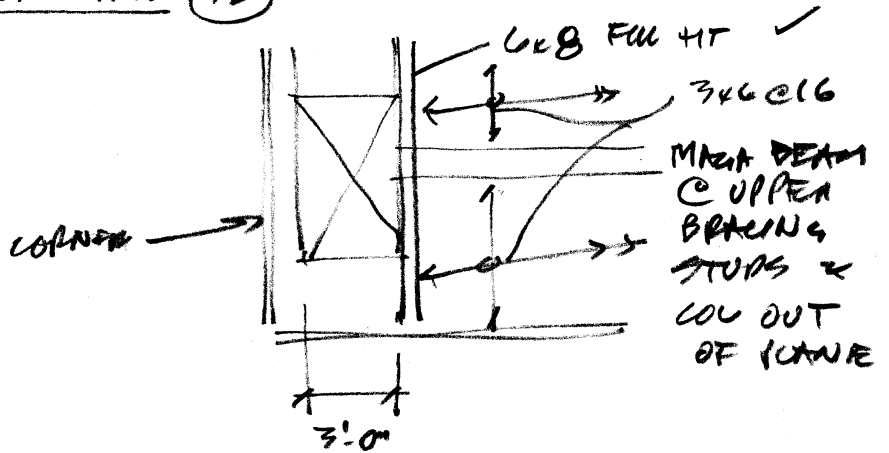
f_c = 89 psi
f_b = 511 psi

F_{CE} = 1015

COMBINED STRESS [EQ 3.9-3]

$$\left[\frac{89}{538}\right]^2 + \frac{511}{2160[1-(89/1015)]} = 0.29 < 1.0 \text{ OK}$$

WALL ON GRID (FB)



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proj #: 2018-02A

sheet: PR-10

FOUNDATIONS
SEE FP-5

SOIL (PER ZIPPER GEO)

- * 2,000 PSF BEARING
- 35 PCF ACTIVE
- 50 PCF AT REST
- * 0.35 COEFF OF FRICTION
- * 250 PCF PASSIVE
- * INCLUDING 1.5 F.O.S.

CONC

$f'_c = 3,000 \text{ psi}$
 $f_y = 60 \text{ ksi}$

FASTENERS & HOLD-DOWNS

HDQ8 FAB7

$d_e = 8\frac{1}{2}"$
 $F = 13"$

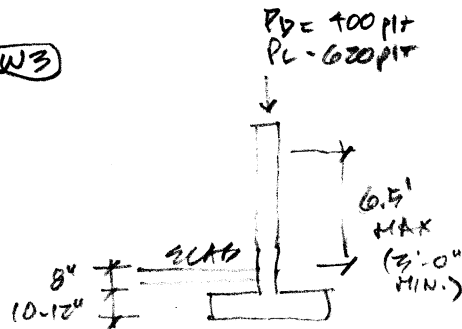
$\therefore D = 14"$
 $B = 2'-2"$

HDQ11 FAB

$d_e = 10\frac{1}{2}"$
 $F = 16"$

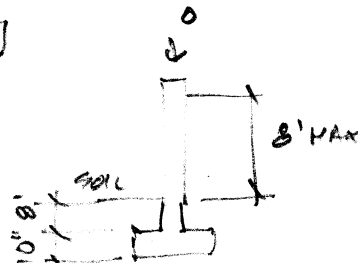
$\therefore D = 16"$
 $B = 2'-8"$

W3



$\Delta\Delta$ SEE FP-5-FD-7 @ HIGHER
& FP-8-FD-10 @ LOWER

W4



$\Delta\Delta$ SEE FP-11-FD-13 @ $H \leq 8'$
FD-14-FD-16 @ $H \leq 6'$
FD-17-FD-19 @ $H \leq 4'$

FOUNDATIONS

(F1) $P_{MAX} = 8.67 \text{ K}$
AB MIN. = 4.7 Φ
26 x 26 x 12"

(F2) $P_{MAX} = 6.99 \text{ K}$

(F3) AB MIN. = 3.78 Φ
26 x 26 x 12"

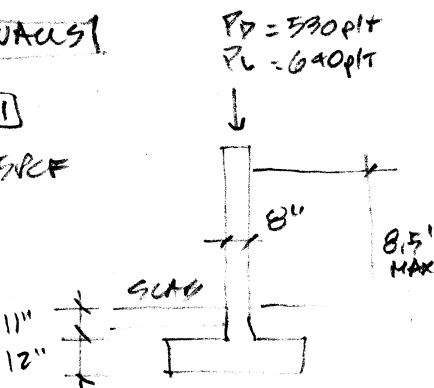
(F4) $P_{MAX} = 19.21 \text{ K}$

AB MIN. = 10.38 Φ
36 x 36 x 16"

WALLS

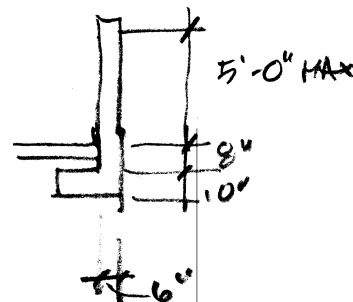
W1

35 PCF



$\Delta\Delta$ SEE FD-2-FD-4

DRIVEWAY RETAINING WALL



$\Delta\Delta$ SEE FD-20-FD-22 FOR $H \leq 5'$
FD-23-FD-25 FOR $H \leq 3'$
& FD-26 - FOR 2H:1V SLOPED BACKFILL

W2 WALLS SPANNING HORIZONTALLY

AT REST SEISMIC FORCE 35 PCF

$L_{MAX} = 7.33'$

$w_{u,MAX} = 765 \text{ plf}$ 8.5' MAX

$M_u = 5.14 \text{ FT.K}$

$K_n = 105'$

$d = 7"$

$F = .049$

$\therefore p = .002 \times 1.33 = .00266$

$\therefore A_s = .22 \text{ in}^2/\text{FT} = \#4 @ 10" o.c.$

$\Delta\Delta$ ADDED SEISMIC LOADS TO RETAINING WALLS

5H FOR WALT &

10H FOR RESTRAINTS.

& IGNORING TOP 18" OF PASSIVE

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client: FORD AND STUDIO

date: $\Delta\Delta$ 1-8-19

proj #: 2018-024

sheet: FD-1

This Wall in File: C:\Users\nic\Documents\RetainPro 10 Project Files\talerman-simon.RPX

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Cantilevered Retaining Wall Design

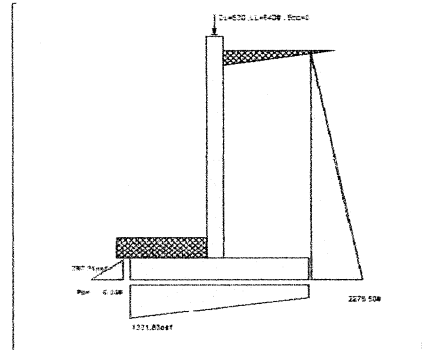
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	9.50 ft
Wall height above soil	=	0.67 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	11.00 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	=	0.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footings||Soil Friction	=	0.525
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 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	530.0 lbs
Axial Live Load	=	640.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Multiplier Used (Multiplier used on soil density)	=	5.000
---------------------------------------------------	---	-------

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	=	0.0 psf

Uniform Seismic Force	=	47.500
Total Seismic Force	=	498.750

Adjacent Footing Load

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

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Cantilevered Retaining Wall Design

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

Design Summary

Wall Stability Ratios

Overturning	=	3.41	OK
Sliding	=	1.56	OK
Total Bearing Load	=	7,417 lbs	
...resultant ecc.	=	3.60 in	
Soil Pressure @ Toe	=	1,332 psf	OK
Soil Pressure @ Heel	=	787 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,644 psf	
ACI Factored @ Heel	=	972 psf	
Footing Shear @ Toe	=	26.5 psi	OK
Footing Shear @ Heel	=	12.2 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	2,278.5 lbs	
less 100% Passive Force	= -	0.0 lbs	
less 100% Friction Force	= -	3,557.9 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 : 1 Stability	=	0.0 lbs	OK

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

Footing Dimensions & Strengths

Toe Width	=	3.00 ft
Heel Width	=	4.00
Total Footing Width	=	7.00
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c =	3,000 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm. = 3.00 in

Stem Construction

Design Height Above Ftg

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

Design Data

fb/FB + fa/Fa	=	0.846
Total Force @ Section	lbs =	2,978.3
Moment....Actual	ft-# =	10,145.6
Moment....Allowable	=	11,990.5
Shear....Actual	psi =	40.1
Shear....Allowable	psi =	82.2
Wall Weight	=	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 =	3,000.0
Fy	psi =	60,000.0

Footing Design Results

	Toe	Heel
Factored Pressure	= 1,644	972 psf
Mu' : Upward	= 6,967	5,992 ft-#
Mu' : Downward	= 1,716	8,600 ft-#
Mu: Design	= 5,251	2,608 ft-#
Actual 1-Way Shear	= 26.47	12.16 psi
Allow 1-Way Shear	= 82.16	82.16 psi
Toe Reinforcing	= # 5 @ 8.00 in	
Heel Reinforcing	= # 4 @ 16.00 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 < S * Fr
 Key: No key defined

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Cantilevered Retaining Wall Design

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			=	.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	= 1,929.4	3.50	6,752.8	Soil Over Heel	= 3,800.0	5.33	20,266.7
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	= 530.0	3.33	1,766.7
Load @ Stem Above Soil	=			* Axial Live Load on Stem	= 640.0	3.33	2,133.3
Seismic Earth Load	= 349.1	6.30	2,199.5	Soil Over Toe	=	1.50	
	=			Surcharge Over Toe	=		
Total	2,278.5	O.T.M.	8,952.3	Stem Weight(s)	= 1,017.0	3.33	3,390.0
	=	=		Earth @ Stem Transitions	= 380.0	3.83	1,456.7
Resisting/Overturning Ratio		=	3.41	Footing Weight	= 1,050.0	3.50	3,675.0
Vertical Loads used for Soil Pressure =		7,417.0 lbs		Key Weight	=		
				Vert. Component	=		
				Total =	6,777.0 lbs	R.M. =	30,555.0

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

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

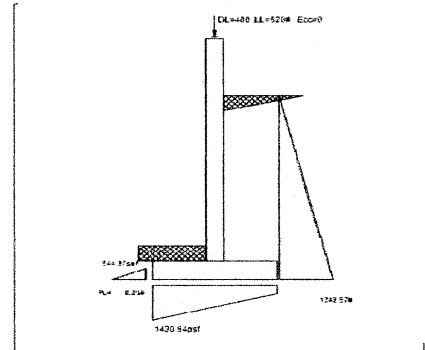
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	7.25 ft
Wall height above soil	=	2.50 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	8.00 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	=	0.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footings||Soil Friction	=	0.525
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 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	400.0 lbs
Axial Live Load	=	620.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Multiplier Used	=	5.000
(Multiplier used on soil density)		

Lateral Load Applied to Stem

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

Uniform Seismic Force	=	36.250
Total Seismic Force	=	293.021

Adjacent Footing Load

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

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Cantilevered Retaining Wall Design

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

Design Summary

Wall Stability Ratios

Overturning	=	2.89	OK
Sliding	=	1.55	OK
Total Bearing Load	=	4,612 lbs	
...resultant ecc.	=	4.19 in	
Soil Pressure @ Toe	=	1,431 psf	OK
Soil Pressure @ Heel	=	544 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,794 psf	
ACI Factored @ Heel	=	683 psf	
Footing Shear @ Toe	=	25.1 psi	OK
Footing Shear @ Heel	=	6.1 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	1,348.6 lbs	
less 100% Passive Force	= -	0.0 lbs	
less 100% Friction Force	= -	2,095.6 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 : 1 Stability	=	0.0 lbs	OK

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

Footing Dimensions & Strengths

Toe Width	=	2.00 ft
Heel Width	=	2.67
Total Footing Width	=	4.67
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c =	3,000 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm. = 3.00 in

Stem Construction

Design Height Above Ftg

ft =	Stem OK
0.00	
Wall Material Above "Ht"	= Concrete
Thickness	= 8.00
Rebar Size	= # 4
Rebar Spacing	= 10.00
Rebar Placed at	= Edge

Design Data

fb/FB + fa/Fa	=	0.694
Total Force @ Section	lbs =	1,734.6
Moment....Actual	ft-# =	4,509.4
Moment....Allowable	=	6,495.1
Shear....Actual	psi =	23.1
Shear....Allowable	psi =	82.2
Wall Weight	=	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 =	3,000.0
Fy	psi =	60,000.0

Footing Design Results

	Toe	Heel
Factored Pressure	= 1,794	683 psf
Mu' : Upward	= 3,270	1,688 ft-#
Mu' : Downward	= 494	2,396 ft-#
Mu: Design	= 2,777	708 ft-#
Actual 1-Way Shear	= 25.09	6.08 psi
Allow 1-Way Shear	= 82.16	82.16 psi
Toe Reinforcing	= # 4 @ 10.00 in	
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 < S * Fr
 Key: No key defined

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Cantilevered Retaining Wall Design

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			=	.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	= 1,143.5	2.69	3,081.0	Soil Over Heel	= 1,742.9	3.67	6,393.5
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	= 400.0	2.33	933.3
Load @ Stem Above Soil	=			* Axial Live Load on Stem	= 620.0	2.33	1,446.7
Seismic Earth Load	= 205.1	4.85	994.8	Soil Over Toe	=	1.00	
	=			Surcharge Over Toe	=		
Total	1,348.6	O.T.M.	4,075.8	Stem Weight(s)	= 975.0	2.33	2,275.0
	=	=		Earth @ Stem Transitions	= 290.0	2.83	821.7
Resisting/Overturning Ratio		=	2.89	Footing Weight	= 583.8	2.34	1,363.1
Vertical Loads used for Soil Pressure =		4,611.7 lbs		Key Weight	=		
				Vert. Component	=		
				Total =	3,991.7 lbs	R.M. =	11,786.6

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

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) 0.083 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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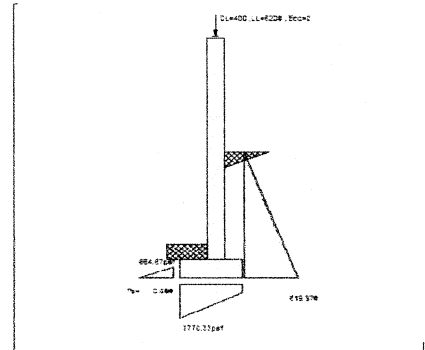
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	4.67 ft
Wall height above soil	=	5.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	8.00 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	=	0.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.525
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 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	400.0 lbs
Axial Live Load	=	620.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Multiplier Used (Multiplier used on soil density)	=	5.000
------------------------------------------------------	---	-------

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	=	0.0 psf

Uniform Seismic Force	=	23.350
Total Seismic Force	=	128.503

Adjacent Footing Load

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

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Cantilevered Retaining Wall Design

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

Design Summary

Wall Stability Ratios		
Overturning	=	2.56 OK
Sliding	=	1.88 OK
Total Bearing Load	=	2,837 lbs
...resultant ecc.	=	2.12 in
Soil Pressure @ Toe	=	1,770 psf OK
Soil Pressure @ Heel	=	665 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,279 psf
ACI Factored @ Heel	=	856 psf
Footing Shear @ Toe	=	10.9 psi OK
Footing Shear @ Heel	=	1.7 psi OK
Allowable	=	82.2 psi
Sliding Calcs (Vertical Component NOT Used)		
Lateral Sliding Force	=	620.0 lbs
less 100% Passive Force	= -	0.0 lbs
less 100% Friction Force	= -	1,163.8 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 : 1 Stability	=	0.0 lbs OK

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

Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	1.33
Total Footing Width	=	2.33
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c =	3,000 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm. = 3.00 in

Stem Construction

Design Height Above Ftg		ft =	As < Min %
Wall Material Above "Ht"	=	Concrete	0.00
Thickness	=	8.00	
Rebar Size	=	# 4	
Rebar Spacing	=	16.00	
Rebar Placed at	=	Center	
Design Data			
fb/FB + fa/Fa	=	No Good	
Total Force @ Section	lbs =	719.7	
Moment....Actual	ft-# =	1,205.2	
Moment....Allowable	=	2,600.4	
Shear....Actual	psi =	15.0	
Shear....Allowable	psi =	82.2	
Wall Weight	=	100.0	
Rebar Depth 'd'	in =	4.00	

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 =	3,000.0
Fy	psi =	60,000.0

Footing Design Results

	Toe	Heel
Factored Pressure	= 2,279	856 psf
Mu' : Upward	= 1,038	218 ft-#
Mu' : Downward	= 40	181 ft-#
Mu: Design	= 998	-37 ft-#
Actual 1-Way Shear	= 10.94	1.74 psi
Allow 1-Way Shear	= 82.16	82.16 psi
Toe Reinforcing	= # 4 @ 10.00 in	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd, Mu < S * Fr
 Heel: Not req'd, Mu < S * Fr
 Key: No key defined

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Cantilevered Retaining Wall Design

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	= 530.0	1.83	972.3	Soil Over Heel	= 371.7	2.00 742.8
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	= 400.0	1.33 533.3
Load @ Stem Above Soil	=			* Axial Live Load on Stem	= 620.0	1.33 826.7
Seismic Earth Load	= 90.0	3.30	297.0	Soil Over Toe	=	0.50
	=			Surcharge Over Toe	=	
Total	620.0	O.T.M.	1,269.3	Stem Weight(s)	= 967.0	1.33 1,289.3
	=	=		Earth @ Stem Transitions	= 186.8	1.83 342.5
Resisting/Overturning Ratio		=	2.56	Footing Weight	= 291.3	1.17 339.3
Vertical Loads used for Soil Pressure =		2,836.8	lbs	Key Weight	=	
				Vert. Component	=	
				Total =	2,216.8 lbs	R.M.= 3,247.3

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

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) 0.204 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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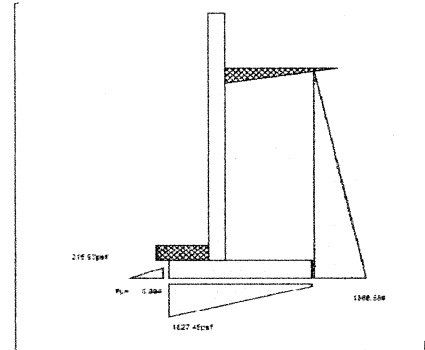
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	8.67 ft
Wall height above soil	=	2.50 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	8.00 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	=	0.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.525
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 psf
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

Earth Pressure Seismic Load

Multiplier Used	=	5.000
(Multiplier used on soil density)		

Lateral Load Applied to Stem

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

Uniform Seismic Force	=	43.350
Total Seismic Force	=	411.970

Adjacent Footing Load

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

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Cantilevered Retaining Wall Design

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

Design Summary

Wall Stability Ratios		
Overturning	=	2.71 OK
Sliding	=	1.58 OK
Total Bearing Load	=	5,619 lbs
...resultant ecc.	=	8.68 in
Soil Pressure @ Toe	=	1,827 psf OK
Soil Pressure @ Heel	=	216 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,193 psf
ACI Factored @ Heel	=	259 psf
Footing Shear @ Toe	=	21.5 psi OK
Footing Shear @ Heel	=	20.5 psi OK
Allowable	=	82.2 psi

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	1,868.9 lbs
less 100% Passive Force	= -	0.0 lbs
less 100% Friction Force	= -	2,950.1 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	0.0 lbs OK

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

Footing Dimensions & Strengths

Toe Width	=	1.50 ft
Heel Width	=	4.00
Total Footing Width	=	5.50
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f _c =	3,000 psi	F _y = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm. = 3.00 in

Stem Construction

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

Design Data

fb/FB + fa/Fa	=	0.643
Total Force @ Section	lbs =	2,480.6
Moment....Actual	ft-# =	7,712.0
Moment....Allowable	=	11,990.5
Shear.....Actual	psi =	33.4
Shear.....Allowable	psi =	82.2
Wall Weight	=	100.0
Rebar Depth 'd'	in =	6.19

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 =	3,000.0
F _y	psi =	60,000.0

Footing Design Results

	Toe	Heel
Factored Pressure	= 2,193	259 psf
Mu' : Upward	= 2,269	3,610 ft-#
Mu' : Downward	= 953	7,769 ft-#
Mu: Design	= 1,316	4,159 ft-#
Actual 1-Way Shear	= 21.46	20.49 psi
Allow 1-Way Shear	= 82.16	82.16 psi
Toe Reinforcing	= # 5 @ 10.00 in	
Heel Reinforcing	= # 4 @ 8.00 in	
Key Reinforcing	= None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd, Mu < S * Fr
 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

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Cantilevered Retaining Wall Design

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			=	.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	= 1,580.5	3.17	5,006.6	Soil Over Heel	= 3,468.0	3.83	13,294.0
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	=		
Seismic Earth Load	= 288.4	5.70	1,644.3	Soil Over Toe	=	0.75	
	=			Surcharge Over Toe	=		
Total	1,868.9	O.T.M.	6,651.0	Stem Weight(s)	= 1,117.0	1.83	2,047.8
	=	=		Earth @ Stem Transitions	= 346.8	2.33	809.2
Resisting/Overturning Ratio		=	2.71	Footing Weight	= 687.5	2.75	1,890.6
Vertical Loads used for Soil Pressure =		5,619.3 lbs		Key Weight	=		
				Vert. Component	=		
				Total =	5,619.3 lbs	R.M.=	18,041.7

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

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) 0.103 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

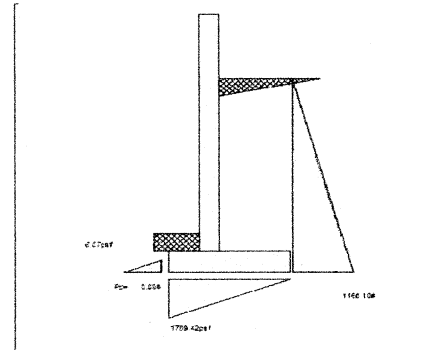
Code: IBC 2012,ACI 318-11,ACI 530-11

Criteria

Retained Height	=	6.67 ft
Wall height above soil	=	2.50 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	8.00 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	=	0.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.525
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 psf
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

Earth Pressure Seismic Load

Multiplier Used	=	5.000
(Multiplier used on soil density)		

Lateral Load Applied to Stem

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

Uniform Seismic Force	=	33.345
Total Seismic Force	=	250.165

Adjacent Footing Load

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

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Cantilevered Retaining Wall Design

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

Design Summary

Wall Stability Ratios		
Overturning	=	2.46 OK
Sliding	=	1.61 OK
Total Bearing Load	=	3,551 lbs
...resultant ecc.	=	7.95 in
Soil Pressure @ Toe	=	1,769 psf OK
Soil Pressure @ Heel	=	6 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,123 psf
ACI Factored @ Heel	=	7 psf
Footing Shear @ Toe	=	10.1 psi OK
Footing Shear @ Heel	=	12.6 psi OK
Allowable	=	82.2 psi

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	1,160.1 lbs
less 100% Passive Force	= -	0.0 lbs
less 100% Friction Force	= -	1,864.3 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	0.0 lbs OK

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

Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	3.00
Total Footing Width	=	4.00
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c =	3,000 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm. = 3.00 in

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa	=	0.644
Total Force @ Section	lbs =	1,467.7
Moment....Actual	ft-# =	3,509.9
Moment....Allowable	=	5,448.0
Shear....Actual	psi =	19.6
Shear....Allowable	psi =	82.2
Wall Weight	=	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 =	3,000.0
Fy	psi =	60,000.0

Footing Design Results

	Toe	Heel
Factored Pressure	= 2,123	7 psf
Mu' : Upward	= 973	1,140 ft-#
Mu' : Downward	= 451	3,023 ft-#
Mu: Design	= 522	1,883 ft-#
Actual 1-Way Shear	= 10.13	12.60 psi
Allow 1-Way Shear	= 82.16	82.16 psi
Toe Reinforcing	= # 4 @ 16.00 in	
Heel Reinforcing	= # 4 @ 10.00 in	
Key Reinforcing	= None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd, Mu < S * Fr
 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

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Cantilevered Retaining Wall Design

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			=	.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	= 985.0	2.50	2,463.2	Soil Over Heel	= 1,867.3	2.83	5,290.7
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	=		
Seismic Earth Load	= 175.1	4.50	788.3	Soil Over Toe	=	0.50	
	=			Surcharge Over Toe	=		
Total	1,160.1	O.T.M.	3,251.5	Stem Weight(s)	= 916.9	1.33	1,222.5
	=	=		Earth @ Stem Transitions	= 266.8	1.83	489.1
Resisting/Overturning Ratio		=	2.46	Footing Weight	= 500.0	2.00	1,000.0
Vertical Loads used for Soil Pressure =		3,551.0 lbs		Key Weight	=		
				Vert. Component	=		
				Total =	3,551.0 lbs	R.M.=	8,002.3

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

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) 0.113 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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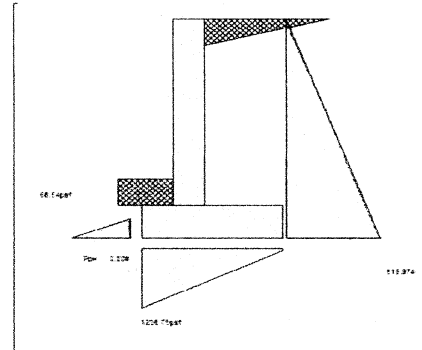
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	4.67 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	8.00 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	=	0.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.525
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 psf
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

Earth Pressure Seismic Load

Multiplier Used	=	5.000
(Multiplier used on soil density)		

Lateral Load Applied to Stem

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

Uniform Seismic Force	=	23.350
Total Seismic Force	=	128.503

Adjacent Footing Load

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

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Cantilevered Retaining Wall Design

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

Design Summary

Wall Stability Ratios		
Overturning	=	2.63 OK
Sliding	=	1.66 OK
Total Bearing Load	=	1,961 lbs
...resultant ecc.	=	5.37 in
Soil Pressure @ Toe	=	1,239 psf OK
Soil Pressure @ Heel	=	69 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,486 psf
ACI Factored @ Heel	=	82 psf
Allowable	=	82.2 psf
Soil Pressure Less Than Allowable		
Footing Shear @ Toe	=	1.9 psi OK
Footing Shear @ Heel	=	6.5 psi OK
Allowable	=	82.2 psi
Sliding Calcs (Vertical Component NOT Used)		
Lateral Sliding Force	=	620.0 lbs
less 100% Passive Force	= -	0.0 lbs
less 100% Friction Force	= -	1,029.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	0.0 lbs OK

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

Footing Dimensions & Strengths

Toe Width	=	0.67 ft
Heel Width	=	2.33
Total Footing Width	=	3.00
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f _c =	3,000 psi	F _y = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm. = 3.00 in

Stem Construction

Design Height Above Ftg		ft =	As < Min %	0.00
Wall Material Above "Ht"	=	Concrete		
Thickness	=	8.00		
Rebar Size	=	# 4		
Rebar Spacing	=	18.00		
Rebar Placed at	=	Center		
Design Data				
fb/FB + fa/Fa	=	No Good		
Total Force @ Section	lbs =	719.7		
Moment....Actual	ft-# =	1,205.2		
Moment....Allowable	=	2,321.3		
Shear.....Actual	psi =	15.0		
Shear.....Allowable	psi =	82.2		
Wall Weight	=	100.0		
Rebar Depth 'd'	in =	4.00		

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 =	3,000.0
F _y	psi =	60,000.0

Footing Design Results

	Toe	Heel
Factored Pressure	= 1,486	82 psf
Mu' : Upward	= 310	473 ft-#
Mu' : Downward	= 219	1,138 ft-#
Mu: Design	= 91	665 ft-#
Actual 1-Way Shear	= 1.94	6.49 psi
Allow 1-Way Shear	= 82.16	82.16 psi
Toe Reinforcing	= # 4 @ 18.00 in	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd, Mu < S * Fr
 Heel: Not req'd, Mu < S * Fr
 Key: No key defined

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Cantilevered Retaining Wall Design

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 530.0	1.83	972.3	Soil Over Heel	= 932.1	2.17	2,021.2
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	=		
Seismic Earth Load	= 90.0	3.30	297.0	Soil Over Toe	=	0.34	
	=			Surcharge Over Toe	=		
Total	620.0	O.T.M.	1,269.3	Stem Weight(s)	= 467.0	1.00	468.6
	=	=		Earth @ Stem Transitions	= 186.8	1.50	280.8
Resisting/Overturning Ratio		=	2.63	Footing Weight	= 375.0	1.50	562.5
Vertical Loads used for Soil Pressure =		1,960.9 lbs		Key Weight	=		
				Vert. Component	=		
				Total =	1,960.9 lbs	R.M. =	3,333.1

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

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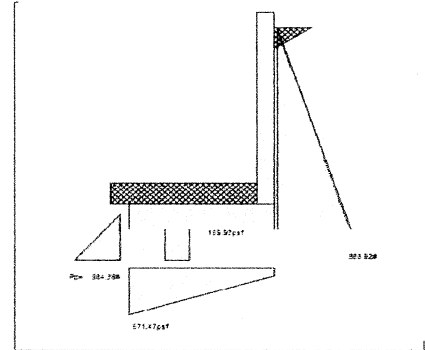
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	5.67 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	8.00 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	=	375.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footings||Soil Friction	=	0.525
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 psf
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

Earth Pressure Seismic Load

Multiplier Used	=	5.000
(Multiplier used on soil density)		

Lateral Load Applied to Stem

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

Uniform Seismic Force	=	28.345
Total Seismic Force	=	184.309

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

SEE FD - 32
 FOR CALCULATION OF
 SLIDING RESISTANCE

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Cantilevered Retaining Wall Design

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

Design Summary

Wall Stability Ratios		
Overturning	=	2.28 OK
Sliding	=	2.15 OK
Total Bearing Load	=	1,683 lbs
...resultant ecc.	=	4.77 in
Soil Pressure @ Toe	=	671 psf OK
Soil Pressure @ Heel	=	170 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	806 psf
ACI Factored @ Heel	=	204 psf
Footing Shear @ Toe	=	11.6 psi OK
Footing Shear @ Heel	=	0.0 psi OK
Allowable	=	82.2 psi
Sliding Calcs (Vertical Component NOT Used)		
Lateral Sliding Force	=	868.9 lbs
less 100% Passive Force	= -	984.4 lbs
less 100% Friction Force	= -	883.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	0.0 lbs OK

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

Footing Dimensions & Strengths

Toe Width	=	3.50 ft
Heel Width	=	0.50
Total Footing Width	=	4.00
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	12.00 in
Key Distance from Toe	=	1.00 ft
f'c =	3,000 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm. = 3.00 in

Stem Construction

Design Height Above Ftg		ft =	Stem OK 0.00
Wall Material Above "H"	=	Concrete	
Thickness	=	6.00	
Rebar Size	=	# 4	
Rebar Spacing	=	10.00	
Rebar Placed at	=	Center	
Design Data			
fb/FB + fa/Fa	=	0.722	
Total Force @ Section	lbs =	1,060.5	
Moment....Actual	ft-# =	2,155.9	
Moment....Allowable	=	2,985.1	
Shear....Actual	psi =	29.5	
Shear....Allowable	psi =	82.2	
Wall Weight	=	75.0	
Rebar Depth 'd'	in =	3.00	

Bottom

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 =	3,000.0
Fy	psi =	60,000.0

Footing Design Results

	Toe	Heel
Factored Pressure	= 806	204 psf
Mu' : Upward	= 3,860	0 ft-#
Mu' : Downward	= 1,507	0 ft-#
Mu: Design	= 2,353	0 ft-#
Actual 1-Way Shear	= 11.58	0.00 psi
Allow 1-Way Shear	= 82.16	0.00 psi
Toe Reinforcing	= # 4 @ 10.00 in	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= # 4 @ 10.00 in	

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 < S * Fr
 Key: #4@ 14.14 in, #5@ 21.78 in, #6@ 30.81 in, #7@ 41.92 in,

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Cantilevered Retaining Wall Design

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....				.....RESISTING.....				
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#		
Heel Active Pressure	=	739.9	2.17	1,603.7	Soil Over Heel	=	4.00		
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	=			
Seismic Earth Load	=	129.0	3.90	503.3	Soil Over Toe	=	280.0	1.75	490.0
	=				Surcharge Over Toe	=			
Total		868.9	O.T.M.	2,107.0	Stem Weight(s)	=	462.7	3.75	1,735.0
	=		=		Earth @ Stem Transitions	=	340.1	4.25	1,445.6
Resisting/Overturning Ratio			=	2.28	Footing Weight	=	500.0	2.00	1,000.0
Vertical Loads used for Soil Pressure =				1,682.8 lbs	Key Weight	=	100.0	1.33	133.3
					Vert. Component	=			
					Total =		1,682.8 lbs	R.M.=	4,804.0

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

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) 0.029 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

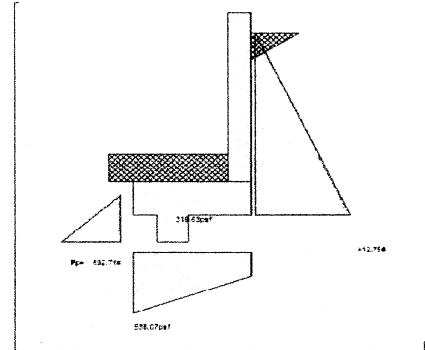
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	3.67 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	8.00 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	=	375.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.525
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 psf
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

Earth Pressure Seismic Load

Multiplier Used	=	5.000
(Multiplier used on soil density)		

Lateral Load Applied to Stem

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

Uniform Seismic Force	=	18.350
Total Seismic Force	=	82.636

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

SEE FD-32
 FOR CALCULATION OF
 SLIDING RESISTANCE

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Cantilevered Retaining Wall Design

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

Design Summary

Wall Stability Ratios		
Overturning	=	2.78 OK
Sliding	=	3.04 OK
Total Bearing Load	=	1,072 lbs
...resultant ecc.	=	1.27 in
Soil Pressure @ Toe	=	538 psf OK
Soil Pressure @ Heel	=	320 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	646 psf
ACI Factored @ Heel	=	384 psf
Footing Shear @ Toe	=	5.4 psi OK
Footing Shear @ Heel	=	0.0 psi OK
Allowable	=	82.2 psi

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	412.7 lbs
less 100% Passive Force	= -	692.7 lbs
less 100% Friction Force	= -	562.9 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	0.0 lbs OK

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

Footing Dimensions & Strengths

Toe Width	=	2.00 ft
Heel Width	=	0.50
Total Footing Width	=	2.50
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	8.00 in
Key Distance from Toe	=	0.50 ft
f _c =	3,000 psi	F _y = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm. = 3.00 in

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Center

Design Data

fb/FB + fa/Fa	=	0.340
Total Force @ Section	lbs =	444.5
Moment....Actual	ft-# =	584.9
Moment....Allowable	=	1,721.3
Shear....Actual	psi =	12.3
Shear....Allowable	psi =	82.2
Wall Weight	=	75.0
Rebar Depth 'd'	in =	3.00

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 =	3,000.0
F _y	psi =	60,000.0

Footing Design Results

	Toe	Heel
Factored Pressure	= 646	384 psf
Mu' : Upward	= 1,152	0 ft-#
Mu' : Downward	= 492	0 ft-#
Mu: Design	= 660	0 ft-#
Actual 1-Way Shear	= 5.44	0.00 psi
Allow 1-Way Shear	= 82.16	0.00 psi
Toe Reinforcing	= # 4 @ 18.00 in	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= # 4 @ 14.14 in	

Other Acceptable Sizes & Spacings

Toe: Not req'd, Mu < S * Fr
 Heel: Not req'd, Mu < S * Fr
 Key: #4@ 14.14 in, #5@ 21.78 in, #6@ 30.81 in, #7@ 41.92 in,

giraf design
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 seattle wa 98115-2842
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Title **talerman-simon residence**
 Job # **2018-024** Dsgnr: **nic**
 Description....
 driveway wall 3'-0"max.

Page: **FD-25**
 Date: 8 JAN 2019

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Cantilevered Retaining Wall Design

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			=	.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	= 354.9	1.50	532.7	Soil Over Heel	=	2.50	
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	=		
Seismic Earth Load	= 57.8	2.70	156.3	Soil Over Toe	= 160.0	1.00	160.0
	=			Surcharge Over Toe	=		
Total	412.7	O.T.M.	689.0	Stem Weight(s)	= 312.8	2.25	703.7
	=	=		Earth @ Stem Transitions	= 220.2	2.75	605.6
Resisting/Overturning Ratio		=	2.78	Footing Weight	= 312.5	1.25	390.6
Vertical Loads used for Soil Pressure =		1,072.1 lbs		Key Weight	= 66.7	0.83	55.6
				Vert. Component	=		
				Total =	1,072.1 lbs	R.M.=	1,915.4

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

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

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

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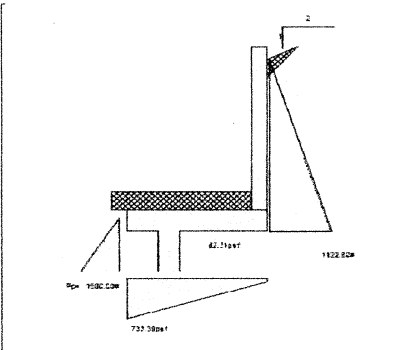
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	5.67 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	2.00 : 1
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	47.0 psf/ft
	=	
Passive Pressure	=	375.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.525
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 psf
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

Earth Pressure Seismic Load

Multiplier Used	=	5.000
(Multiplier used on soil density)		

Lateral Load Applied to Stem

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

Uniform Seismic Force	=	28.345
Total Seismic Force	=	184.309

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

SEE FD-33
 FOR CALCULATION OF
 SLIDING RESISTANCE

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Cantilevered Retaining Wall Design

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

Design Summary

Wall Stability Ratios

Overturning	=	2.14	OK
Sliding	=	2.19	OK
Total Bearing Load	=	1,835	lbs
...resultant ecc.	=	7.18	in
Soil Pressure @ Toe	=	733	psf OK
Soil Pressure @ Heel	=	82	psf OK
Allowable	=	2,000	psf
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	880	psf
ACI Factored @ Heel	=	99	psf
Footing Shear @ Toe	=	13.4	psi OK
Footing Shear @ Heel	=	0.0	psi OK
Allowable	=	82.2	psi

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	1,122.6	lbs
less 100% Passive Force	= -	1,500.0	lbs
less 100% Friction Force	= -	963.5	lbs
Added Force Req'd	=	0.0	lbs OK
....for 1.5 : 1 Stability	=	0.0	lbs OK

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

Footing Dimensions & Strengths

Toe Width	=	4.00	ft
Heel Width	=	0.50	
Total Footing Width	=	4.50	
Footing Thickness	=	10.00	in
Key Width	=	8.00	in
Key Depth	=	18.00	in
Key Distance from Toe	=	1.00	ft
f'c =	3,000	psi	Fy = 60,000
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0018	
Cover @ Top	2.00	@ Btm.=	3.00 in

Stem Construction

Design Height Above Ftg

ft =	Stem OK
0.00	
Wall Material Above "Ht"	= Concrete
Thickness	= 6.00
Rebar Size	= # 4
Rebar Spacing	= 8.00
Rebar Placed at	= Center

Design Data

fb/FB + fa/Fa	=	0.750
Total Force @ Section	lbs =	1,369.1
Moment....Actual	ft-# =	2,738.9
Moment....Allowable	=	3,651.8
Shear.....Actual	psi =	38.0
Shear.....Allowable	psi =	82.2
Wall Weight	=	75.0
Rebar Depth 'd'	in =	3.00

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 =	3,000.0
Fy	psi =	60,000.0

Footing Design Results

	Toe	Heel
Factored Pressure	= 880	99 psf
Mu' : Upward	= 5,189	0 ft-#
Mu' : Downward	= 1,968	0 ft-#
Mu: Design	= 3,221	0 ft-#
Actual 1-Way Shear	= 13.38	0.00 psi
Allow 1-Way Shear	= 82.16	0.00 psi
Toe Reinforcing	= # 4 @ 10.00 in	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= # 4 @ 8.00 in	

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 < S * Fr
 Key: #4@ 14.14 in, #5@ 21.78 in, #6@ 30.81 in, #7@ 41.92 in,

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Cantilevered Retaining Wall Design

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	= 993.6	2.17	2,153.5	Soil Over Heel	=	4.50
Surcharge over Heel	=			Sloped Soil Over Heel	=	4.50
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	=	
Seismic Earth Load	= 129.0	3.90	503.3	Soil Over Toe	= 320.0	2.00 640.0
	=			Surcharge Over Toe	=	
Total	1,122.6	O.T.M.	2,656.9	Stem Weight(s)	= 462.7	4.25 1,966.4
	=	=		Earth @ Stem Transitions	= 340.1	4.75 1,615.7
Resisting/Overturning Ratio		=	2.14	Footing Weight	= 562.5	2.25 1,265.6
Vertical Loads used for Soil Pressure =		1,835.3 lbs		Key Weight	= 150.0	1.33 200.0
Vertical component of active pressure NOT used for soil pressure				Vert. Component	=	
				Total =	1,835.3 lbs	R.M.= 5,687.7

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

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) 0.028 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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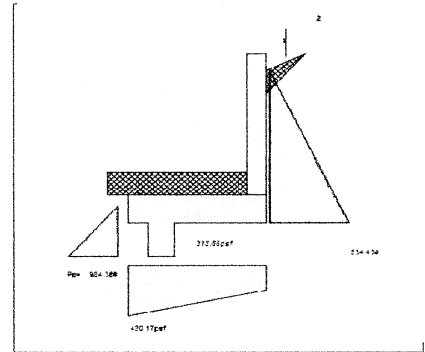
Code: IBC 2012, ACI 318-11, ACI 530-11

Criteria

Retained Height	=	3.67 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	2.00 : 1
Height of Soil over Toe	=	8.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	47.0 psf/ft
	=	
Passive Pressure	=	375.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.525
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 psf
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

Earth Pressure Seismic Load

Multiplier Used	=	5.000
(Multiplier used on soil density)		

Lateral Load Applied to Stem

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

Uniform Seismic Force	=	18.350
Total Seismic Force	=	82.636

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

SEE FD-33
 FOR CALCULATION OF
 SLIDING RESISTANCE

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Cantilevered Retaining Wall Design

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

Design Summary

Wall Stability Ratios

Overturning	=	3.50	OK
Sliding	=	3.13	OK
Total Bearing Load	=	1,310 lbs	
...resultant ecc.	=	1.04 in	
Soil Pressure @ Toe	=	430 psf	OK
Soil Pressure @ Heel	=	319 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	516 psf	
ACI Factored @ Heel	=	382 psf	
Footing Shear @ Toe	=	6.0 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	534.4 lbs	
less 100% Passive Force	= -	984.4 lbs	
less 100% Friction Force	= -	688.0 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 : 1 Stability	=	0.0 lbs	OK

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

Footing Dimensions & Strengths

Toe Width	=	3.00 ft
Heel Width	=	0.50
Total Footing Width	=	3.50
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	12.00 in
Key Distance from Toe	=	0.50 ft
f _c =	3,000 psi	F _y = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm.= 3.00 in

Stem Construction

Design Height Above Ftg

ft =	Stem OK	0.00
Wall Material Above "H"	=	Concrete
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	16.00
Rebar Placed at	=	Center

Design Data

fb/FB + fa/Fa	=	0.386
Total Force @ Section	lbs =	573.8
Moment....Actual	ft-# =	743.1
Moment....Allowable	=	1,925.4
Shear....Actual	psi =	15.9
Shear....Allowable	psi =	82.2
Wall Weight	=	75.0
Rebar Depth 'd'	in =	3.00

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 =	3,000.0
F _y	psi =	60,000.0

Footing Design Results

	Toe	Heel
Factored Pressure	= 516	382 psf
Mu' : Upward	= 2,151	0 ft-#
Mu' : Downward	= 1,107	0 ft-#
Mu: Design	= 1,044	0 ft-#
Actual 1-Way Shear	= 6.03	0.00 psi
Allow 1-Way Shear	= 82.16	0.00 psi
Toe Reinforcing	= # 4 @ 16.00 in	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= # 4 @ 14.14 in	

Other Acceptable Sizes & Spacings

Toe: Not req'd, Mu < S * Fr
 Heel: Not req'd, Mu < S * Fr
 Key: #4@ 14.14 in, #5@ 21.78 in, #6@ 30.81 in, #7@ 41.92 in,

This Wall in File: C:\Users\nic\Documents\RetainPro 10 Project Files\talerman-simon.RPX

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Cantilevered Retaining Wall Design

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	= 476.6	1.50	715.4	Soil Over Heel	=	3.50
Surcharge over Heel	=			Sloped Soil Over Heel	=	3.50
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	=	
Seismic Earth Load	= 57.8	2.70	156.3	Soil Over Toe	= 240.0	1.50 360.0
	=			Surcharge Over Toe	=	
Total	534.4	O.T.M.	871.7	Stem Weight(s)	= 312.8	3.25 1,016.4
	=	=		Earth @ Stem Transitions	= 220.2	3.75 825.8
Resisting/Overturning Ratio		=	3.50	Footing Weight	= 437.5	1.75 765.6
Vertical Loads used for Soil Pressure	=	1,310.5 lbs		Key Weight	= 100.0	0.83 83.3
				Vert. Component	=	
				Total =	1,310.5 lbs	R.M. = 3,051.1

Vertical component of active pressure NOT used for soil pressure

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

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) 0.014 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.

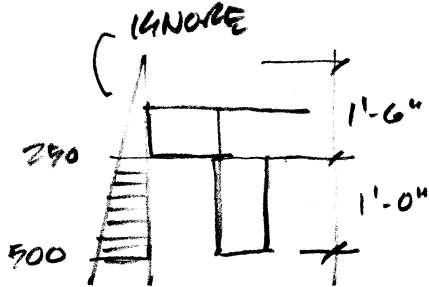
DRIVEWAY WALL W/ FLAT BACKFILL

5'-0" RETAINING (SEE FD-20 - FD-22)

INCLUDING F.O.S.

$$DL = 1683 \text{ PLF} - \text{FRICTIONAL RESISTANCE} = .35 \times 1683 = 589 \text{ PLF}$$

SLIDING
869 PLF



250 PCF
INCLUDING F.O.S.

PRESSIVE RESISTANCE
375 PLF

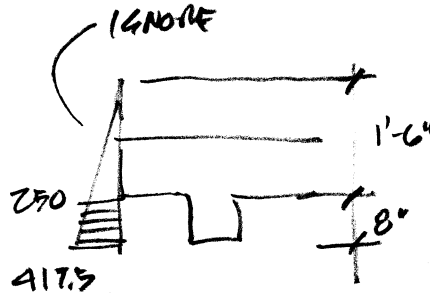
∴ SLIDING RESISTANCE = 964 PLF

DRIVEWAY WALL W/ FLAT BACKFILL

3'-0" RETAINING (SEE FD-23 - FD-25)

$$DL = 1072 \text{ PLF} - \text{FRICTIONAL RESISTANCE} = .35 \times 1072 = 375 \text{ PLF}$$

SLIDING
413 PLF



PRESSIVE RESISTANCE
224 PLF

∴ SLIDING RESISTANCE = 599 PLF

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RESIDENCE

date: 1-8-19

proj #: 2018-024

client: FLOISAND

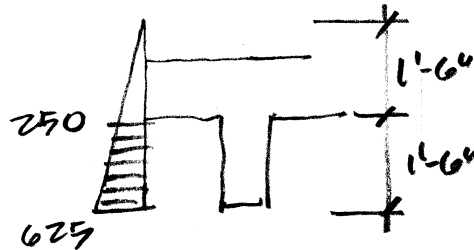
sheet: FD-32

DRIVEWAY WALL W/ SLOPED BACKFILL

5'-0" RETAINING (SEE FD-26 - FD-28)

DL = 1835 PCF - SLIDING RESISTANCE = $.35 \times 1835$
= 642 PCF

SLIDING
1123 PCF
←



PASSIVE RESISTANCE
656 PCF

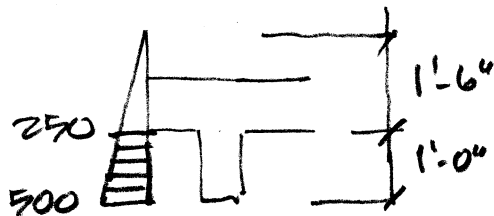
∴ SLIDING RESISTANCE =
→ 1298 PCF

DRIVEWAY WALL W/ SLOPED BACKFILL

3'-0" RETAINING (SEE FD-29 - FD-31)

DL = 1310 PCF - SLIDING RESISTANCE = $.35 \times 1310$
= 459 PCF

SLIDING
535 PCF
←



PASSIVE RESISTANCE
375 PCF

∴ SLIDING RESISTANCE =
834 PCF

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