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structural engineering
5880 Commerce Blvd, Suite 105 • Rohnert Park, CA 94928 • (707)578-8185

Standard Pool Calculations

Cardamone-Matthews Residence
2335 Willow Creek Road, Duncan Mills, CA 95450

Job #	090048	
Date	8/1/19	
PE	TP	PM JMC
1	of	11

DESIGN CRITERIA

CALIFORNIA BUILDING CODE- 2016 EDITION

LATERAL LOADS

Soil EFP: 65 pcf

Water: 62.4 pcf

SOIL CRITERIA

Class 5 soil is assumed with allowable soil bearing pressure of 1500 psf per table 1806.2 in the California Building Code. MKM & Associates has not reviewed site soils conditions and is not responsible for general site stability or soil suitability for the proposed project. A review by a soil engineer or geologist may be desirable by the owner or required by the building official.

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Standard Pool Calculations

Resisting Moment of Pool Wall and Radius

Job	090048
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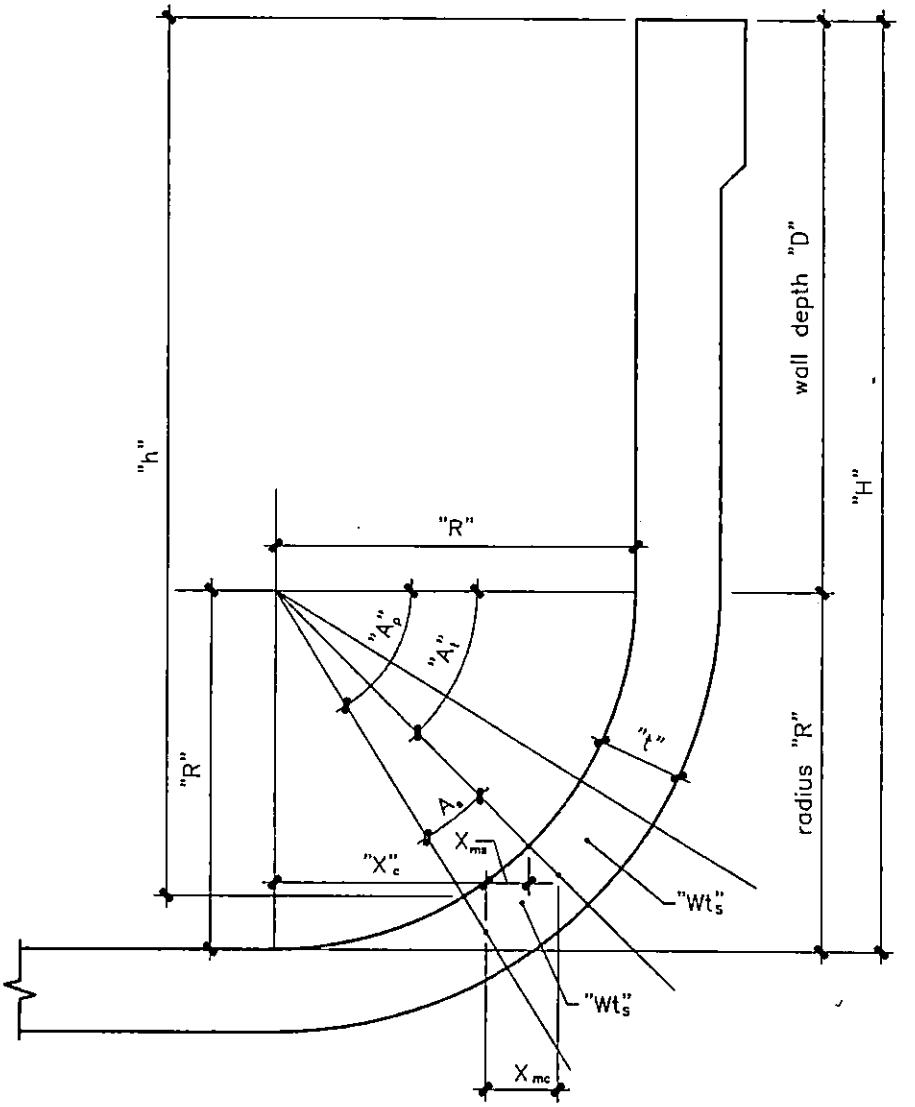

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Standard Pool Calculations

Job #	090048
Date	8/1/19
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Resisting Moment of Pool Wall and Radius

Spread Sheet Program:

R (ft), radius = Given

D (ft), depth of beginning of radius = Given

h (ft), depth to section (location being analyzed) = Given

t (in), thickness of shotcrete at section = Given

A_p (radians), angle of front of section
$= if(h - D > 0)\ then = \arcsin[(h - D)/R]\ otherwise = 0$

A_t (radians), total angle of section
$= if(h - D > 0)\ then = A_p(previous)\ otherwise = 0$

A_s (radians), angle of section
$= if(h - D > 0)\ then = A_p - A_t\ otherwise = 0$

x_c (ft), horizontal distance of lead centroid of section
$= if(h - D > 0)\ then = (R + t/2)\cos(A_p)\ otherwise = R + t/2$

x_{ms} (ft), moment arm of section
$= if(h - D > 0)\ then = (R + t/2)\cos(A_t + 1/2\,A_s) - x_c\ otherwise = 0$

L (ft), length of section
$= if(h - D > 0)\ then = 2\pi(R + t/2)(A_s/(2\pi))\ otherwise = h - h(previous)$

Wt_s (lbs), weight of section = Lt (140), (assume unit wt. of gunite & reinf. = 140 pcf)

Wt_{st} (lbs), total weight of previous section $= \sum Wt_s(previous)$

M_{se} (ft-lbs), resisting moment of section $x_{ms}Wt_s$

x_{mc} (ft), horizontal distance from previous section lead centroid to current section lead centroid
$= if(h - D > 0)\ then = x_c(previous) - x_c\ otherwise = 0$

M_t (ft-lbs), total resisting moment of current section $= M_t(previous) + M_{se} + Wt_{st}x_{mc}$

d_{eff} (in), effective shear depth $= d/\cos(A_t)$

φV_c (lbs), shear resistance $= 2\sqrt{f_c'}(bd_{eff})(0.75)$

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Standard Pool Calculations

Job 090048
Date 8/1/19
PE TP 4 of 11

Resisting Moment due to Wall and Radius												
Wall Radius (ft.)= 5						Depth to Radius (ft.)= 4.5						
h (ft.)	t (in.)	A_p (rad)	A_t (rad)	A_s (rad)	x_c (ft.)	x_{ms} (ft.)	x_{mc} (ft.)	L (ft.)	Wt_s (lb)	Wt_{st} (lb)	M_{se} (ft-lb)	M_t (ft-lb)
0	9	0.00	0.00	0.00	5.38	0.00	0.00	0.00	0	0	0	0
1	9	0.00	0.00	0.00	5.38	0.00	0.00	1.00	105	0	0	0
2	6	0.00	0.00	0.00	5.25	0.00	0.00	1.00	70	105	0	0
3	6	0.00	0.00	0.00	5.25	0.00	0.00	1.00	70	175	0	0
3.5	6	0.00	0.00	0.00	5.25	0.00	0.00	0.50	35	245	0	0
4	6	0.00	0.00	0.00	5.25	0.00	0.00	0.50	35	280	0	0
4.5	6	0.00	0.00	0.00	5.25	0.00	0.00	0.50	35	315	0	0
5	6	0.10	0.00	0.10	5.22	0.02	0.03	0.53	37	350	1	10
5.5	7	0.20	0.10	0.10	5.18	0.05	0.04	0.54	44	387	2	27
6	7	0.30	0.20	0.10	5.05	0.08	0.14	0.55	45	431	3	89
6.5	8	0.41	0.30	0.11	4.89	0.11	0.16	0.57	53	475	6	171
7	9	0.52	0.41	0.11	4.65	0.14	0.23	0.60	63	528	9	303
7.5	9	0.64	0.52	0.12	4.30	0.19	0.35	0.64	68	592	13	526
8	9	0.78	0.64	0.13	3.84	0.24	0.46	0.71	74	659	18	848
8.5	9	0.93	0.78	0.15	3.23	0.32	0.61	0.82	86	734	27	1325
9	10	1.12	0.93	0.19	2.36	0.46	0.86	1.04	122	819	56	2089
9.5	10	1.57	1.12	0.45	0.00	1.21	2.36	2.44	285	941	345	4656

Wall Design													
EFP (PCF)= 65		f'_c= 2.5 ksi			f_y= 60 ksi								
		Soil			Resisting		Design						
h (ft.)	t (in.)	M_s (ft-lb)	V_s (lb)	M_U (ft-lb)	M_t (ft-lb)	M_U (ft-lb)	M_W (ft-lb)	M_U (ft-lb)	d (in.)	A_s (in^2/ft.)	V_U (lb)	$d_{eff.}$ (in)	ΦV_C (lb.)
0	9	0	0	0	0	0	0	0	5.75	0.00	0	5.75	5175
1	9	11	33	17	0	0	11	17	5.75	0.00	52	5.75	5175
2	6	87	130	139	0	0	87	139	2.75	0.02	208	2.75	2475
3	6	293	293	468	0	0	293	468	2.75	0.05	468	2.75	2475
3.5	6	464	398	743	0	0	464	743	2.75	0.08	637	2.75	2475
4	6	693	520	1109	0	0	693	1109	2.75	0.11	832	2.75	2475
4.5	6	987	658	1580	0	0	987	1580	2.75	0.14	1053	2.75	2475
5	6	1354	813	2167	10	12	1344	2155	2.75	0.19	1300	2.75	2475
5.5	7	1802	983	2884	27	32	1775	2851	3.75	0.18	1573	3.77	3392
6	7	2340	1170	3744	89	107	2251	3637	3.75	0.23	1872	3.83	3445
6.5	8	2975	1373	4760	171	205	2804	4555	4.75	0.23	2197	4.98	4481
7	9	3716	1593	5945	303	364	3413	5581	5.75	0.23	2548	6.27	5646
7.5	9	4570	1828	7313	526	631	4045	6682	5.75	0.27	2925	6.64	5976
8	9	5547	2080	8875	848	1017	4699	7857	5.75	0.33	3328	7.19	6469
8.5	9	6653	2348	10645	1325	1590	5328	9055	5.75	0.38	3757	8.05	7246
9	10	7898	2633	12636	2089	2507	5809	10129	6.75	0.36	4212	11.25	10125
9.5	10	9288	2933	14861	4656	5587	4632	9274	6.75	0.32	4693	15.49	13937

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PE TP

Resisting Moment due to Wall and Radius												
Wall Radius (ft.)= 4						Depth to Radius (ft.)= 3.5						
h (ft.)	t (in.)	A_p (rad)	A_t (rad)	A_s (rad)	x_c (ft.)	x_{ms} (ft.)	x_{mc} (ft.)	L (ft.)	Wt_s (lb)	Wt_{st} (lb)	M_{se} (ft-lb)	M_t (ft-lb)
0	9	0.00	0.00	0.00	4.38	0.00	0.00	0.00	0	0	0	0
1	9	0.00	0.00	0.00	4.38	0.00	0.00	1.00	105	0	0	0
2	6	0.00	0.00	0.00	4.25	0.00	0.00	1.00	70	105	0	0
3	6	0.00	0.00	0.00	4.25	0.00	0.00	1.00	70	175	0	0
3.5	6	0.00	0.00	0.00	4.25	0.00	0.00	0.50	35	245	0	0
4	6	0.13	0.00	0.13	4.22	0.02	0.03	0.53	37	280	1	10
4.5	6	0.25	0.13	0.13	4.12	0.06	0.10	0.54	38	317	2	45
5	6	0.38	0.25	0.13	3.94	0.10	0.18	0.56	39	355	4	111
5.5	7	0.52	0.38	0.14	3.72	0.14	0.22	0.60	49	394	7	206
6	7	0.68	0.52	0.15	3.35	0.19	0.37	0.65	53	443	10	378
6.5	8	0.85	0.68	0.17	2.87	0.27	0.48	0.75	70	496	19	637
7	8	1.07	0.85	0.22	2.10	0.40	0.77	0.94	88	566	35	1107
7.5	8	1.57	1.07	0.51	0.00	1.08	2.10	2.19	204	654	221	2701

Wall Design													
EFP (PCF)= 65			f'_c= 2.5 ksi			f_y= 60 ksi							
		Soil			Resisting		Design						
h (ft.)	t (in.)	M_s (ft-lb)	V_s (lb)	M_U (ft-lb)	M_t (ft-lb)	M_U (ft-lb)	M_W (ft-lb)	M_U (ft-lb)	d (in.)	A_s (in^2/ft.)	V_U (lb)	$d_{eff.}$ (in)	ΦV_C (lb.)
0	9	0	0	0	0	0	0	0	5.75	0.00	0	5.75	5175
1	9	11	33	17	0	0	11	17	5.75	0.00	52	5.75	5175
2	6	87	130	139	0	0	87	139	2.75	0.02	208	2.75	2475
3	6	293	293	468	0	0	293	468	2.75	0.05	468	2.75	2475
3.5	6	464	398	743	0	0	464	743	2.75	0.08	637	2.75	2475
4	6	693	520	1109	10	12	683	1097	2.75	0.11	832	2.75	2475
4.5	6	987	658	1580	45	54	942	1526	2.75	0.13	1053	2.77	2495
5	6	1354	813	2167	111	133	1243	2034	2.75	0.18	1300	2.84	2556
5.5	7	1802	983	2884	206	247	1597	2637	3.75	0.16	1573	4.05	3641
6	8	2340	1170	3744	378	454	1962	3290	4.75	0.19	1872	5.48	4936
6.5	8	2975	1373	4760	637	765	2338	3995	4.75	0.20	2197	6.08	5476
7	8	3716	1593	5945	1107	1329	2608	4616	4.75	0.23	2548	7.18	6463
7.5	8	4570	1828	7313	2701	3241	1869	4071	4.75	0.20	2925	9.81	8830

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Resisting Moment due to Wall and Radius												
Wall Radius (ft.)= 1					Depth to Radius (ft.)= 3							
h (ft.)	t (in.)	A_p (rad)	A_t (rad)	A_s (rad)	x_c (ft.)	x_{ms} (ft.)	x_{mc} (ft.)	L (ft.)	Wt_s (lb)	Wt_{st} (lb)	M_{se} (ft-lb)	M_t (ft-lb)
0	9	0.00	0.00	0.00	1.38	0.00	0.00	0.00	0	0	0	0
1	9	0.00	0.00	0.00	1.38	0.00	0.00	1.00	105	0	0	0
2	6	0.00	0.00	0.00	1.25	0.00	0.00	1.00	70	105	0	0
3	6	0.00	0.00	0.00	1.25	0.00	0.00	1.00	70	175	0	0
3.5	6	0.52	0.00	0.52	1.08	0.12	0.17	0.65	46	245	6	47
4	6	1.57	0.52	1.05	0.00	0.63	1.08	1.31	92	291	57	419

Wall Design													
EFP (PCF)= 65			f'_c= 2.5	ksi		f_y= 60	ksi						
		Soil			Resisting		Design						
h (ft.)	t (in.)	M_s (ft-lb)	V_s (lb)	M_U (ft-lb)	M_t (ft-lb)	M_U (ft-lb)	M_W (ft-lb)	M_U (ft-lb)	d (in.)	A_s (in^2/ft.)	V_U (lb)	$d_{eff.}$ (in)	ΦV_C (lb.)
0	9	0	0	0	0	0	0	0	5.75	0.00	0	5.75	5175
1	9	11	33	17	0	0	11	17	5.75	0.00	52	5.75	5175
2	6	87	130	139	0	0	87	139	2.75	0.02	208	2.75	2475
3	6	293	293	468	0	0	293	468	2.75	0.05	468	2.75	2475
3.5	6	464	398	743	47	56	418	687	2.75	0.08	637	2.75	2475
4	6	693	520	1109	419	503	274	607	2.75	0.07	832	3.18	2858

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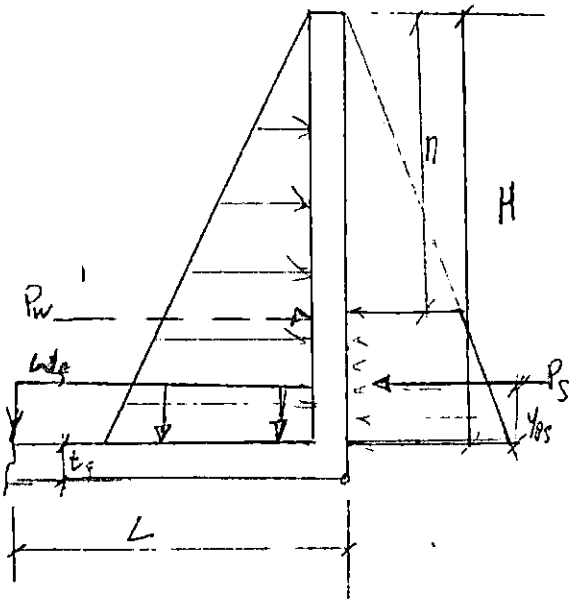
CHECK SOIL BEARING PRESSURE AT FILLED CONDITION;
(INADEQUATE SOIL SUPPORT)



$$P_W = \frac{62.4_{PCF}(H^2)}{2}$$

$$M_{OW} = \frac{62.4(H^3)}{6}$$

$$W_{tf} = 62.4(H) + \left(\frac{t_f}{12}\right)(140)$$

$$P_S = EFP\left(\frac{\eta+H}{2}\right)(H-\eta)$$

$$P_S = \frac{\eta+H}{2}(H-\eta)\,EFP$$

$$\bar{Y}_{PS} = \frac{(H-\eta)(2\eta+H)}{3(H+\eta)}$$

$$M_{OT} = \frac{62.4(H^3)}{6}$$

$$M_{RES} = \left(62.4(H)+\left(\frac{t_f}{12}\right)140\right)(L^2)/2 + \frac{(H-\eta)^2 EFP\,(2\eta+H)}{6}$$

$H = 7.5'$ $\quad t_f = 9''$ $\quad L = 7'$:

$$M_{OT} = \frac{62.4(7.5')^3}{6} = 4388'\#$$

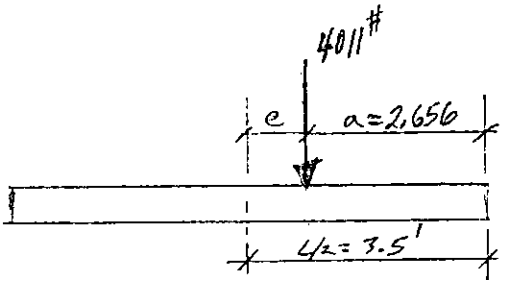
$$M_{RES} = \left(62.4(7.5)+\left(\frac{9}{12}\right)140\right)(7')^2/2 + \frac{(7.5-5)^2 55\,(2(5)+7.5)}{6} = 15041'\#$$

$$M_{NET} = 15041 - 4388 = 10653$$

$$\Sigma V = \left[62.4(7.5)+\left(\frac{9}{12}\right)140\right]7 = 4011\#$$

$$a = \frac{10653}{4011} = 2.656'$$

$$e = \frac{7}{2} - 2.656 = 0.844$$



$e = 3.5 - 2.656 = 0.844'$

$\frac{P}{A} \pm \frac{Mc}{I}$ $\quad c = 3.5'$ $\quad I = \frac{1}{12}(1')(7')^3 = 28.6\,ft^4$

$M = 0.844(4011) = 3385'\#$

$P = 4011\#$

$A = 7ft^2$ $\quad P/A = 573\ PSF$

$\frac{Mc}{I} = \frac{3385'(3.5)\ \#\cdot ft\cdot ft}{28.6\ ft^4} = 415\ PSF$

$q_{MAX} = 988\ PSF$ $\quad q_{MIN} = 158$ $\quad < 1000\ PSF$ OK

$H = 5.5'$ $\quad t_f = 9''$ $\quad L = 4.5'$:

$M_{OT} = 1730'\#$

$M_{RES} = \left(62.4(5.5) + \frac{9}{12}(140)\right)4.5^2/2 = 4538'\#$

$M_{NET} = 2807$ $\quad \Sigma V = 62.4(5.5) + \frac{9}{12}(140)(4.5) = 2017\#$

$a = \frac{2807}{2017} = 1.39'$ $\quad e = \frac{4.5}{2} - 1.39 = 0.858$

$q_{MAX} = \frac{2(2017)}{3(1.39)} = 967\ PSF < 1000\ PSF$ OK

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$H = 4'0''$ $t_s = 9''$ $L = 3$

$M_{OT} = 666\ ^{1}\!/_{\#}$

$M_{RES} = \left[(62.4 \times 4) + \frac{9}{12}(100)\right] \cdot 3^2/2 = 1596\ ^{1}\!/_{\#}$ $\quad \Sigma_H = 1064 \cdot H$

$M_{NET} = 930$

$a = \frac{930}{1064} = 0.874$

$q_{MAX} = \frac{2(1064)}{3(0.874)} = 811\ PSF < 1000$ OK

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Wall Design for Water Pressure With Inadequate Soil Support													
EFP (PCF)=	62.4	f'_c=	2.5	ksi	f_y=	60	ksi		Neglect upper 5' of soil				
		Water			Resisting		Design						
h (ft.)	t (in.)	M_s (ft-lb)	V_s (lb)	M_U (ft-lb)	M_t (ft-lb)	M_U (ft-lb)	M_W (ft-lb)	M_U (ft-lb)	d (in.)	A_s (in^2/ft.)	V_U (lb)	$d_{eff.}$ (in)	ΦV_C (lb.)
0	9	0	0	0	0	0	0	0	3.75	0.00	0	3.75	3375
1	9	10	31	17	0	0	10	17	3.75	0.00	49.92	3.75	3375
2	7	83	125	133	0	0	83	133	3.75	0.01	199.7	3.75	3375
3	7	281	281	449	0	0	281	449	3.75	0.04	449.3	3.75	3375
3.5	7	446	382	713	0	0	446	713	3.75	0.06	611.5	3.75	3375
4	7	666	499	1065	0	0	666	1065	3.75	0.09	798.7	3.75	3375
4.5	7	948	632	1516	0	0	948	1516	3.75	0.12	1011	3.75	3375
5	7	1300	780	2080	0	0	1300	2080	3.75	0.15	1248	3.75	3375

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Resisting Moment due to Wall and Radius

Wall Radius (ft.)= 0 Depth to Radius (ft.)= 7.5

h (ft.)	t (in.)	A_p (rad)	A_t (rad)	A_s (rad)	x_c (ft.)	x_{ms} (ft.)	x_{mc} (ft.)	L (ft.)	Wt_s (lb)	Wt_{st} (lb)	M_{se} (ft-lb)	M_t (ft-lb)
0	6.25	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0	0	0	0
1	6.25	0.00	0.00	0.00	0.26	0.00	0.00	1.00	73	0	0	0
2	6.25	0.00	0.00	0.00	0.26	0.00	0.00	1.00	73	73	0	0
3	6.25	0.00	0.00	0.00	0.26	0.00	0.00	1.00	73	146	0	0
3.5	6.25	0.00	0.00	0.00	0.26	0.00	0.00	0.50	36	219	0	0
4	6.25	0.00	0.00	0.00	0.26	0.00	0.00	0.50	36	255	0	0
4.5	6.25	0.00	0.00	0.00	0.26	0.00	0.00	0.50	36	292	0	0
5	6.25	0.00	0.00	0.00	0.26	0.00	0.00	0.50	36	328	0	0
5.5	8.25	0.00	0.00	0.00	0.34	0.00	0.00	0.50	48	365	0	0
6	8.25	0.00	0.00	0.00	0.34	0.00	0.00	0.50	48	413	0	0
6.5	8.25	0.00	0.00	0.00	0.34	0.00	0.00	0.50	48	461	0	0
7	8.25	0.00	0.00	0.00	0.34	0.00	0.00	0.50	48	509	0	0
7.5	8.25	0.00	0.00	0.00	0.34	0.00	0.00	0.50	48	557	0	0

Wall Design

EFP (PCF)= 65 f'_c= 2.5 ksi f_y= 60 ksi

		Soil			Resisting		Design						
h (ft.)	t (in.)	M_s (ft-lb)	V_s (lb)	M_U (ft-lb)	M_t (ft-lb)	M_U (ft-lb)	M_W (ft-lb)	M_U (ft-lb)	d (in.)	A_s (in^2/ft.)	V_U (lb)	$d_{eff.}$ (in)	ΦV_C (lb.)
0	6	0	0	0	0	0	0	0	2.75	0.00	0	2.75	2475
1	6	11	33	17	0	0	11	17	2.75	0.00	52	2.75	2475
2	6	87	130	139	0	0	87	139	2.75	0.02	208	2.75	2475
3	6	293	293	468	0	0	293	468	2.75	0.05	468	2.75	2475
3.5	6	464	398	743	0	0	464	743	2.75	0.08	637	2.75	2475
4	6.5	693	520	1109	0	0	693	1109	3.25	0.10	832	3.25	2925
4.5	8	987	658	1580	0	0	987	1580	4.75	0.10	1053	4.75	4275
5	8	1354	813	2167	0	0	1354	2167	4.75	0.14	1300	4.75	4275
5.5	8	1802	983	2884	0	0	1802	2884	4.75	0.19	1573	4.75	4275
6	8	2340	1170	3744	0	0	2340	3744	4.75	0.19	1872	4.75	4275
6.5	8	2975	1373	4760	0	0	2975	4760	4.75	0.24	2197	4.75	4275
7	9	3716	1593	5945	0	0	3716	5945	5.75	0.24	2548	5.75	5175
7.5	9	4570	1828	7313	0	0	4570	7313	5.75	0.30	2925	5.75	5175

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