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ULTIMATE STRENGTH LOAD COMBINATIONS (Concrete Design):

1.4D + 1.4H
1.2D + 1.6L + 1.6H + 0.5R
1.2D + 1.6R + 1.0L
1.2D + 1.6R + 0.8W
1.2D + 1.6W + 1.0L + 0.5R
1.2D + 1.0E + 1.0L + 0.2R
0.9D + 1.6W + 1.6H
0.9D + 1.0E + 1.6H

WORKING STRESS LOAD COMBINATIONS (Stability Checks and Masonry Design):

D + H
D + L + H
D + H + R
D + H + 0.75L + 0.75R
D + H + W
D + H + 0.7E
D + H + 0.75W + 0.75L + 0.75R
D + H + 0.525E + 0.75L + 0.75R
0.6D + W + H
0.6D + 0.7E + H

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RETAINING WALL RESISTING FORCES:

Allowable Soil Pressure = 3,000 psf.
Passive Equivalent Fluid Press. = 300.00 pcf.
Passive Soil Height = 1.00 ft.
Coefficient of Friction = 0.50
Cohesion = 0 psf.

Use Vertical Surcharge as Resisting Wt.? = Yes

Overturning Safety Factor = 1.50
Sliding Safety Factor = 1.50
Limit Reaction to Mid 1/3? = Yes

MATERIAL DATA:

Concrete Strength, f'c = 4.00 ksi.
Steel Yield Strength, Fy = 60.00 ksi.

Concrete Unit Weight = 145.00 pcf.
Soil Unit Weight = 110.00 pcf.
Fence Weight = 10.00 psf.

REINFORCING STEEL DATA:

Concrete cover to center of steel:
 Wall Inside Face = 2.50 in.
 Footing Heel (Top Face) = 2.50 in.
 Footing Toe (Bottom Face) = 3.50 in.

Minimum Ratios for Shrinkage and Temperature Reinf:

 Vertical Stem Reinf. = 0.0018
 Horizontal Stem Reinf. = 0.0020
 Footing Reinforcement = 0.0018

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S U M M A R Y O F R E S U L T S

DIMENSIONS:

Stem Height	= 12.00 ft.	Heel Length	= 10.83 ft.
Stem Thick. @ Top	= 12.00 in.	Toe Length	= 1.00 ft.
Stem Thick. @ Base	= 12.00 in.	Total Ftg. Width, B	= 12.83 ft.
Footing Thickness	= 12.00 in.	Key Depth	= 0.00 ft.
		Key Width	= 0.00 ft.

ANALYSIS RESULTS:

Max Brg Press. @ Toe	= 1,416 psf.	Sliding Force	= 4,068 Lb
@ Heel	= 352 psf.	Resisting Force	= 6,124 Lb
Allowable Brg. Press.	= 3,000 psf.	F.O.S.	= 1.51
Resultant Loc From C.L.	= 1.29 ft.	Overturn. Moment	= 18,206 ft-lb
Kern Point Loc., B/6	= 2.14 ft.	Resisting Moment	= 76,416 ft-lb
Limit Resultant To Mid 1/3?	= Yes	F.O.S.	= 4.20

DESIGN RESULTS: Design Method, Stem: USD, ACI 318-08 (Concrete)
Ftg.: Ultimate Strength ACI 318-08

	d (in.)	Mu (ft-k)	Vu (kip)	Phi Vn (kip)	As Flex. (in^2)	As Min. (in^2)	As T+S (in^2)
Stem :	9.50	23.09	5.58	10.81	0.565	0.380	0.431
Toe :	8.50	1.14	0.67	9.68	0.030	0.040	0.259
Heel :	9.50	26.11	2.30	10.81	0.643	0.380	0.259
Key :	0.00	0.00	0.00	0.00	0.000	0.000	0.000

- Notes: 1. Stem moments are positive if they cause tension on the soil face. Negative if they cause tension on the outside face. Stem shear is positive to the left as measured on a section cut below the top of wall.
2. Heel moments are positive if they cause tension in the top of the footing. Heel shear is positive up as measured on a section cut to the right of the end of the heel.
3. Toe moments are positive if they cause tension in the bottom of the footing. Toe shear is positive up as measured on a section cut to the left of the end of the toe.

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 S T A B I L I T Y A N A L Y S I S R E P O R T

Stability Analysis: Governing Combination = 0.6D + W + H

-----RESISTING FORCES-----				-----OVERTURNING FORCES-----			
Element	Weight	x Arm	= Moment	Element	Force	x Arm	= Moment
Soil	8,646		63,668	R at Top			
Ftg.	1,117	6.42	7,164	R at Bot.			
Stem	1,044	1.50	1,566	Horiz. EFP	3,803	4.33	16,478
Vert Sur	542	7.42	4,017	Vert Sur	266	6.50	1,728
Vert EFP				Horiz Sur			
Toe Sur.				Wind			
Fence Wt.				Horiz line			
V. line				Vert. line			
-----				-----			
Sum WT =	11,348	MR =	76,416	Sum F =	4,068	MOT =	18,206

Friction Force	=	5,674 Lb	F.O.S. Sliding	=	RF / F =	1.51
Passive Pressure	=	450 Lb	F.O.S. Overturn.	=	MR / MOT =	4.20
Cohesion	=	0 Lb				
		-----	Coef. Vert. Surcharge or Line Load			
Resist. Force, Sum RF =		6,124 Lb	to Horiz. = EFP / Soil Dens. =		0.409	

Resultant Loc From Toe,	X = (MR - MOT) / Sum WT	=	5.13 ft.
Eccentricity From Ftg. C.L., e = (B / 2) - X		=	1.29 ft.
Soil Pressure @ Toe	= (WT / B) * (1 + 6e/B)	=	1,416 psf.
Soil Pressure @ Heel	= (WT / B) * (1 - 6e/B)	=	352 psf.

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 D E T A I L E D D E S I G N R E P O R T

STEM DESIGN: Steel Design Comb = 1.2D + 1.6L + 1.6H + 0.5R
 Shr Strength @ Base, Phi Vn = 10.81 kip

Dist From Top (ft)	d (in.)	Mu (ft-k)	Vu (kip)	As Flex. (in^2)	As Min. (in^2)	As T+S (in^2)	As Reqd (in^2)	Comb
1.20	9.50	0.04	0.09	0.001	0.001	0.259	0.259	2
2.40	9.50	0.26	0.29	0.006	0.008	0.259	0.259	2
3.60	9.50	0.77	0.58	0.018	0.024	0.259	0.259	2
4.80	9.50	1.70	0.99	0.040	0.053	0.259	0.259	2
6.00	9.50	3.18	1.49	0.075	0.100	0.259	0.259	2
7.20	9.50	5.33	2.10	0.126	0.168	0.259	0.259	2
8.40	9.50	8.27	2.82	0.196	0.262	0.259	0.262	2
9.60	9.50	12.12	3.63	0.290	0.380	0.259	0.380	2
10.80	9.50	17.03	4.55	0.411	0.380	0.259	0.411	2
12.00	9.50	23.09	5.58	0.565	0.380	0.431	0.565	2

Vertical Stem Reinforcement:

Shear-Friction Steel Added at Stem Base (ACI 05 11.7), Avf = 0.172 in^2
 Available Length for Hook Embedment into Footing = 9.00 in.
 Available Length for Straight Embedment into Stem = 142.00 in.

	Development Length		Percent Develop.	Spac. (in.)	50% Cut Off (in.)
	Straight (in.)	Hook (in.)			
#4	12.00	6.64	100.00	4.25	50.19
#5	14.23	8.30	100.00	6.59	50.19
#6	17.08	9.96	90.35	8.45	50.19
#7	24.90	11.62	77.44	9.87	51.19
#8	28.46	13.28	67.76	11.37	52.69
#9	36.21	14.98	60.07	12.76	54.22
#10	45.90	16.87	53.36	14.40	55.93
#11	56.58	18.73	48.06	15.93	57.61

Horizontal Stem Reinforcement:

Area of steel for Shrinkage and Temp. Reinforcement = 0.288 in^2

	-----Spacing, in.-----		-----Total Bars-----	
	I.F. Only	EA. Face	I.F. Only	EA. Face
#4	8.33	16.67	18.00	10.00
#5	12.92	18.00	12.00	9.00
#6	18.00	18.00	9.00	9.00
#7	18.00	18.00	9.00	9.00
#8	18.00	18.00	9.00	9.00
#9	18.00	18.00	9.00	9.00
#10	18.00	18.00	9.00	9.00
#11	18.00	18.00	9.00	9.00

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TOE DESIGN:

- * Steel Design Comb. = 1.4D + 1.4H
- * Thickness Design Comb. = 1.4D + 1.4H
- * Available Length for Hook Embedment into Stem = 10.00 in.
- * Available Length for Straight Embed. into Toe = 10.00 in.

d (in.)	Mu (ft-k)	Vu (kip)	Phi Vn (kip)	As Flex. (in ²)	As Min. (in ²)	As T+S (in ²)	As Req'd (in ²)
8.50	1.14	0.67	9.68	0.030	0.040	0.259	0.259

	Development Length		Percent Develop.	Spac. (in.)
	Straight (in.)	Hook (in.)		
#4	12.00	6.64	83.33	7.72
#5	14.23	8.30	70.27	10.09
#6	17.08	9.96	58.56	11.93
#7	24.90	11.62	40.16	11.15
#8	28.46	13.28	35.14	12.85
#9	32.10	14.98	31.15	14.42
#10	36.14	16.87	27.67	16.27
#11	40.42	18.73	24.74	17.87

HEEL DESIGN:

- * Steel Design Comb. = 0.9D + 1.6W + 1.6H
- * Thickness Design Comb. = 1.2D + 1.6L + 1.6H + 0.5R
- * Available Length for Straight Embedment into Toe = 22.00 in.
- * Available Length for Straight Embedment into Heel = 128.00 in.

d (in.)	Mu (ft-k)	Vu (kip)	Phi Vn (kip)	As Flex. (in ²)	As Min. (in ²)	As T+S (in ²)	As Req'd (in ²)
9.50	26.11	2.30	10.81	0.643	0.380	0.259	0.643

	Development Length		Percent Develop.	Spac. (in.)
	Straight (in.)	Hook (in.)		
#4	12.00	6.64	100.00	3.73
#5	14.23	8.30	100.00	5.79
#6	17.08	9.96	100.00	8.21
#7	24.90	11.62	88.34	9.89
#8	28.46	13.28	77.30	11.40
#9	36.21	14.98	60.75	11.34
#10	45.90	16.87	47.93	11.36
#11	56.58	18.73	38.88	11.32

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LONGITUDINAL FOOTING REINFORCEMENT (TEMP & SHRINK ONLY):

	Spacing (in.)
#4	9.26
#5	14.35
#6	20.37
#7	27.78
#8	36.57
#9	46.30
#10	58.80
#11	72.22