

QuickWall 7.0 - RETAINING WALL ANALYSIS AND DESIGN

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 Job ID :
 Job Description : Designed By :
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FOOTING DESIGN METHOD: Ultimate Strength ACI 318-08
 STEM DESIGN METHOD : Ultimate Strength ACI 318-08 (Concrete)
 WALL TYPE : Cantilever Retaining Wall

RETAINING WALL DIMENSIONS:

 Wall Stem Height = 12.00 ft.
 Stem Thickness @ Top = 12.00 in.
 Stem Thickness @ Bottom = 12.00 in.

 Footing Thickness = 12.00 in.
 Heel Width Min. = 1.00 ft. Design Heel Width = 6.08 ft.
 Max. = 20.00 ft.
 Toe Width Min. = 1.00 ft. Design Toe Width = 1.00 ft.
 Max. = 10.00 ft.
 Footing Key Depth = 0.00 ft. Design Key Depth = 0.00 ft.
 Footing Key Width = 0.00 ft. Design Key Width = 0.00 ft.
 BackFill Slope (Vert/Horiz) = 0.00 :12

RETAINING WALL LOADS:

 Horizontal Equivalent Fluid Pressure = 45.00 pcf. (Load Case = Soil)
 Backfill Height = 12.00 ft.
 Equivalent Fluid Pressure Angle = 0.00 deg.
 Vertical Surcharge on Backfill = 50 psf. (Load Case = Soil)
 Horizontal Surcharge = 0 psf. (Load Case = Soil)
 Vertical Surcharge on Toe = 0 psf. (Load Case = Soil)
 Wind Load on Fence = 0 psf. (Load Case = Wind)
 Fence Height = 0.00 ft.

Line Ld. No.	Type (H or V)	Magnitude (plf)	Dist. (x) (ft.)	Load Case
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Notes: 1. "H" = Horizontal loads. "V" = Vertical loads.
 2. Vertical loads are positive down.

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 + L + R + H
D + L + W + H
D + L + W + 0.5R + H
D + L + R + 0.5W + H
D + L + R + E/1.4 + H
D + E/1.4 + H

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

 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 = D + L + R + H

-----RESISTING FORCES-----				-----OVERTURNING FORCES-----			
Element	Weight	x Arm	= Moment	Element	Force	x Arm	= Moment
Soil	8,140		40,540	R at Top			
Ftg.	1,172	4.04	4,737	R at Bot.			
Stem	1,740	1.50	2,610	Horiz. EFP	3,803	4.33	16,478
Vert Sur	304	5.04	1,534	Vert Sur	266	6.50	1,728
Vert EFP				Horiz Sur			
Toe Sur.				Wind			
Fence Wt.				Horiz line			
V. line				Vert. line			
Sum WT =	11,356	MR =	49,420	Sum F =	4,068	MOT =	18,206

Friction Force	=	5,678 Lb	F.O.S. Sliding	=	RF / F =	1.51
Passive Pressure	=	450 Lb	F.O.S. Overturn.	=	MR / MOT =	2.71
Cohesion	=	0 Lb				
Resist. Force, Sum RF	=	6,128 Lb	Coef. Vert. Surcharge or Line Load to Horiz. = EFP / Soil Dens. =			0.409

Resultant Loc From Toe,	X = (MR - MOT) / Sum WT	=	2.75 ft.
Eccentricity From Ftg. C.L., e	= (B / 2) - X	=	1.29 ft.
Soil Pressure @ Toe	= (WT / B) * (1 + 6e/B)	=	2,753 psf.
Soil Pressure @ Heel	= (WT / B) * (1 - 6e/B)	=	57 psf.

 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 08 11.6), 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

TOE DESIGN:

- * Steel Design Comb. = $0.9D + 1.6W + 1.6H$
- * Thickness Design Comb. = $0.9D + 1.6W + 1.6H$
- * 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	1.94	1.18	9.68	0.051	0.068	0.259	0.259

	Development Length			
	Straight (in.)	Hook (in.)	Percent Develop.	Spac. (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. = $1.2D + 1.6L + 1.6H + 0.5R$
- * Thickness Design Comb. = $0.9D + 1.6W + 1.6H$
- * Available Length for Straight Embedment into Toe = 22.00 in.
- * Available Length for Straight Embedment into Heel = 71.00 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	23.35	5.04	10.81	0.571	0.380	0.259	0.571

	Development Length			
	Straight (in.)	Hook (in.)	Percent Develop.	Spac. (in.)
#4	12.00	6.64	100.00	4.20
#5	14.23	8.30	100.00	6.51
#6	17.08	9.96	100.00	9.24
#7	24.90	11.62	88.34	11.13
#8	28.46	13.28	77.30	12.83
#9	36.21	14.98	60.75	12.76
#10	45.90	16.87	47.93	12.78
#11	56.58	18.73	38.88	12.74

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