Job#: 2016-001

Garage Thickened Edge Cont. Footing Calculator with Shearwall — SWL4

Check continuous footing of wall excluding point loads.
From previous sections and by inspection the foundation at the shearwall has the following applied loads.

(plf)	Dead Load	Floor Live	Roof Live or Snow	Wind
Roof	209	0	69	160
Wall(s)	156	0	0	0
Floor 1	50	50	0	0
Floor 2	0	0	0	0
Stemwall	150	0	0	0
Totals	565	50	69	160

Wall DL = 12 psf
Wall Hgt. = 13 ft
Winward Roof (Positive) MWFRS = 10 psf
Trib. Length = 16 ft

Note: Stem wall blocked out down to footing with thickened edge slab connected to footing with #4 verts @ 24" o/c with 90 deg hook into ftg. and 12" min. 90 deg hook into slab.

ASD Load Cases from ASCE 7-10:

2.) D + L =	615 plf	
3.) D + (Lr or S) =	634 plf	
6a.) D + .75L + .75(.6W) + .75(Lr or S) =	726 plf	(governs)

ρ_{conc} = 150 pcf
Steel Yield Strength = 60,000 psi
Conc. Comp. Strength = 3,000 psi
Soil Bearing Pressure = 1,500 psf
Reinf. Cover = 3 in
Reinf. Bar Size = 4
Soil Depth Above Ftg. = Thickened Edge Hgt. = 18 in
ρ_{soil} = 100 pcf
Stem Width = 6 in
Stem Hgt. = 24 in
Footing Width = 12 in
Footing Depth = 6 in

Bearing Calculations:

Applied Bearing Pressure	Q_{asd} =	726	psf
Eff. Allowable SBP	Q_e =	1,350	psf
Footing Width Required	W_{req} =	6.5	in
Footing Width	$W_{footing}$ =	**12**	in → **OK**

Strength Design Load Cases from ASCE 7-10:

1.) 1.4D =	791 plf	
2.) 1.2D + 1.6L + .5(Lr or S) =	793 plf	
3.) 1.2D + 1.6(Lr or S) + L =	838 plf	
4.) 1.2D + 1.0W + L + .5(Lr or S) =	923 plf	(governs)

Beam Shear Calculations (One Way Shear):

Ult. Applied Bearing Pressure	Q_u =	838	psf
Applied Beam Shear	V_u =	52	lbs
Allowable Beam Shear	V_c =	2,218	lbs (ACI 11-3)
Footing Depth Required	D_{req} =	0.1	in
Footing Depth	$D_{footing}$ =	**6.0**	in → **OK**

Beam Shear Calculations (One Way Shear):
Unreinforced Concrete

V_u =	210	lbs
V_c =	2,103	lbs (ACI 22-9)
D_{req} =	0.6	in
$D_{footing}$ =	**6.0**	in → **OK**

Bending Calculations:

	a =	0.26	in
Cantilever length	L_{cant} =	3.0	in
Factored Bending Moment	M_u =	314	in-lb
Moment Strength	M_n =	14,997	in-lb

Bending Calculations:
Unreinforced Concrete

S =	32.0	in^3
M_u =	314	in-lb
M_n =	5,258	in-lb (ACI 22-2)
D_{req} =	0.4	in
$D_{footing}$ =	**6.0**	in → **OK**

Transverse Reinforcement Calculations:

$M_u/\phi bd^2$	R_n =	5.8	psi
Steel Ratio	ρ =	0.0001	
Steel Req. based on Moment	$A_{s(1)}$ =	0.003	in^2
Steel Req. based on Shrink	$A_{s(2)}$ =	0.130	in^2 (ACI 7.12)
Controlling Reinf. Steel	$A_{s(req)}$ =	0.130	in^2
Required Spacing with #4 bars =		18.18	in o/c
Selected Transverse Spacing:	**#4 bars @**	**18**	**in o/c**
Reinforcement Area Provided	A_s =	0.131	in^2 → **OK**

Eff. Depth to Top Layer of Steel
d = 2.25 in

(Transverse Reinforcment Unnecessary)

Development Length Calculations:

Note: Plain concrete adequate for bending, therefore development length not required.

spacing/cover dimension	c =	3.0	in
Transverse Reinf. Factor	$c + K_{tr}/d_b$ =	6	(use 2.5)
Length Req.	Ld =	13.0	in (ACI 12-1)
Length Available	Ld-sup =	0	in

λ =	1.0	(lightweight aggregate factor)
ψ_t =	1.0	(reinforcement location factor)
ψ_e =	1.0	(coating factor)
ψ_s =	0.8	(reinforcement size factor)
K_{tr} =	0.0	(transverse reinf. Index)

Longitudinal Reinforcement Calculations:

Steel Req. based on Shrink	$A_{s(2)}$ =	0.130	in^2 (ACI 7.12)
Controlling Reinf. Steel	$A_{s(req)}$ =	0.130	in^2
Required number of #4 bars =		0.66	
Selected Longitudinal Bars:		**1**	**- Cont. #4 bars**
Reinforcement Area Provided	A_s =	0.196	in^2 → **OK**

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Overturning Calculations:

ASCE 7-10 Load Case 7: .6D + .6W

Overturning Moment	M_O =	22,444	ft-lb	
Dead Load of Wall	DL_{wall} =	17,171	lbs	
Weight of Footing	W_{foot} =	2,438	lbs	
Weight of Soil Overburden	W_{soil} =	2,475	lbs	
Total Dead Load	DL =	22,083	lbs	
Resisting Moment	M_R =	358,851	ft-lb	
Overturning Safety Factor	SF =	**15.99**	> 1.67 →	**OK**

Horizontal Sliding Calculations:

Friction Sliding Resistance	F =	**5,521**	lbs →	**OK**

Bearing Calculations with Lateral Load:

Total Dead Load w/o Soil	N =	19,608	lbs	
Eccentricity of Resultant	e =	1.14	ft	(Resultant is inside the kern of the footing)
Kern Limit (L/6)	kern =	5.42	ft	
Max. Bearing Pressure	SBP_{max} =	**731**	psf	
Min. Bearing Pressure	SBP_{min} =	476	psf	
SBP Increase per Geotech	Fg =	1.00		(This increase should only be taken based on a geotech soils report)
Eff. Allowable SBP	Qe =	1,425	psf →	**OK**

Bearing Calculations with Lateral Load (Strength Design):

Ult. Overturning Moment	M_O =	37,407	ft-lb	
Ult. Dead Load w/o Soil	N =	32,445	lbs	
Eccentricity of Resultant	e =	1.15	ft	(Resultant is inside the kern of the footing)
Ult. Bearing Pressure	SBP_{ult} =	**1,211**	psf	

Strength Design Load Cases from ASCE 7-10:

4.) 1.2D + 1.0W + L + 0.5(Lr or S) = 922.5 plf

Beam Shear Calculations (One Way Shear):

Applied Beam Shear	V_u =	76	lbs	
Allowable Beam Shear	V_c =	2,218	lbs	(ACI 11-3)
Footing Depth Required	Dreq =	0.2	in	
Footing Depth	$D_{footing}$ =	**6.0**	in →	**OK**

Bending Calculations:

	a =	0.26	in	
Cantilever length	L_{cant} =	3.0	in	
Factored Bending Moment	M_u =	454	in-lb	
Moment Strength	M_n =	14,997	in-lb	

Transverse Reinforcement Calculations:

$M_u/\phi bd^2$	R_n =	8.3	psi	
Steel Ratio	ρ =	0.0001		
Steel Req. based on Moment	$A_{s(1)}$ =	0.004	in^2	
Steel Req. based on Shrink	$A_{s(2)}$ =	0.130	in^2	(ACI 7.12)
Controlling Reinf. Steel	$A_{s(req)}$ =	0.130	in^2	
Required Spacing with # bars =		18.18	in o/c	
Selected Transverse Spacing:	**#4 bars @**	**18**	**in o/c**	
Reinforcement Area Provided	A_s =	0.131	in^2 →	**OK**

Development Length Calculations:

spacing/cover dimension	c =	3.0	in	
Transverse Reinf. Factor	$c + K_{tr}/d_b$ =	6		(use 2.5)
Length Req.	Ld =	13.0	in	(ACI 12-1)
Length Available	Ld-sup =	0	in	

Note: Plain concrete adequate for bending, therefore development length not required.

Longitudinal Reinforcement Calculations:

Steel Req. based on Shrink	$A_{s(2)}$ =	0.130	in^2	(ACI 7.12)
Controlling Reinf. Steel	$A_{s(req)}$ =	0.130	in^2	
Required number of # bars =		0.66		
Selected Longitudinal Bars:		**1**	**- Cont. #4 bars**	
Reinforcement Area Provided	A_s =	0.196	in^2 →	**OK**

Shearwall, Footing and Stemwall Data

Length of SWL =	32.0	ft
Height of SWL =	13.0	ft
Hgt. of Floor btw. FND and SWL =	0.0	in
Length of Footing =	32.5	ft
Shear (V_{asd}) =	1,448	lbs
Shear (V_{ult}) =	2,413	lbs
Soil Friction Coef. =	0.25	
A_{ftg} =	32.5	ft^2
S_{ftg} =	176.0	ft^3
Thickened Edge Height @ Ftg. =	18.0	in
Thickened Edge Width @ Ftg. =	6.0	in

Beam Shear Calculations (One Way Shear):

Unreinforced Concrete

V_u =	303	lbs	
V_c =	2,103	lbs	(ACI 22-9)
Dreq =	0.9	in	
$D_{footing}$ =	**6.0**	in →	**OK**

Bending Calculations:

Unreinforced Concrete

S =	32.0	in^3	
M_u =	454	in-lb	
M_n =	5,258	in-lb	(ACI 22-2)
Dreq =	0.5	in	
$D_{footing}$ =	**6.0**	in →	**OK**

(Transverse Reinforcment Unnecessary)

λ =	1.0	(lightweight aggregate factor)
ψ_t =	1.0	(reinforcement location factor)
ψ_e =	1.0	(coating factor)
ψ_s =	0.8	(reinforcement size factor)
K_{tr} =	0.0	(transverse reinf. Index)

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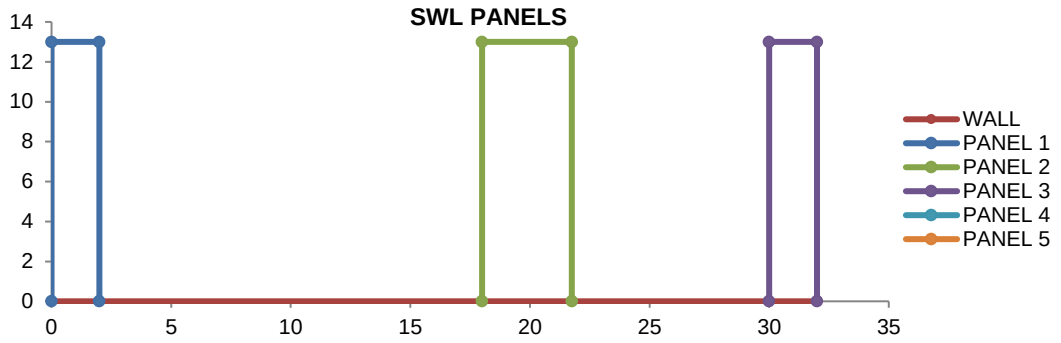
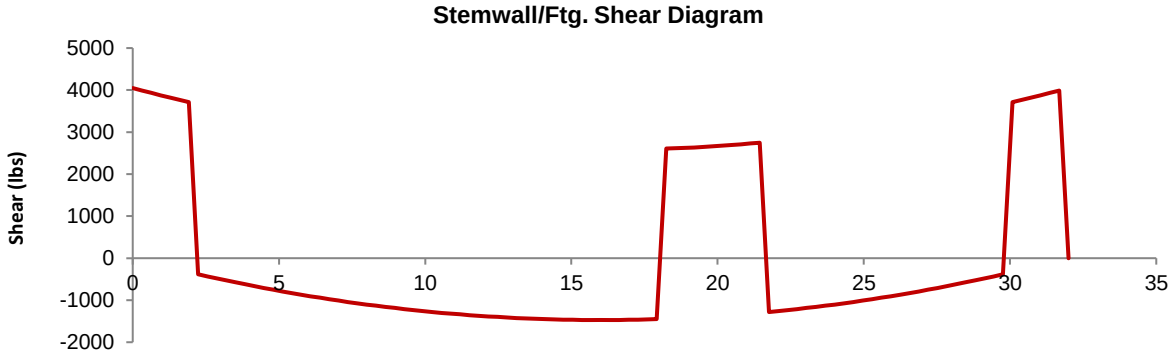
Shear Wall Panels for: SWL4 [Strength] [Strength]

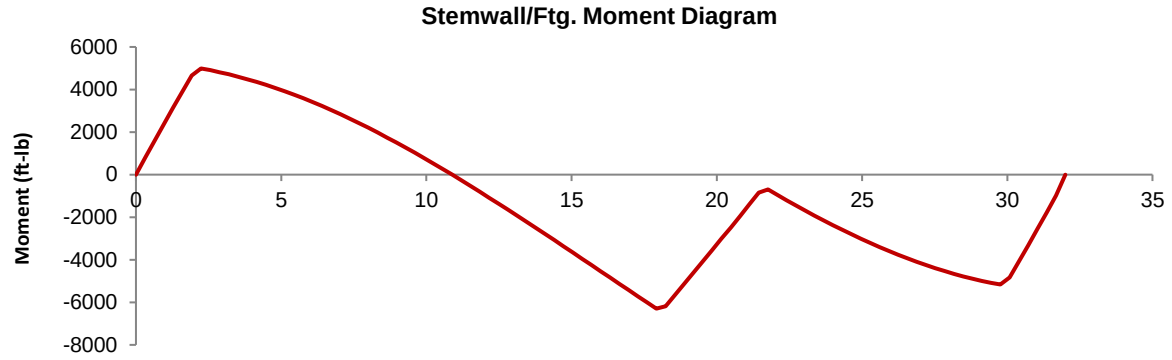
Panel #	a (ft)	b (ft)	Panel Width (ft)	Unit Shear (plf)	Height (ft)	Uplift (lbs)
1	0	2	2.0	311	13	4,048
2	18	21.75	3.8	311	13	4,048
3	30	32	2.0	311	13	4,048
4			0.0	0	0	0
5			0.0	0	0	0
			7.8			

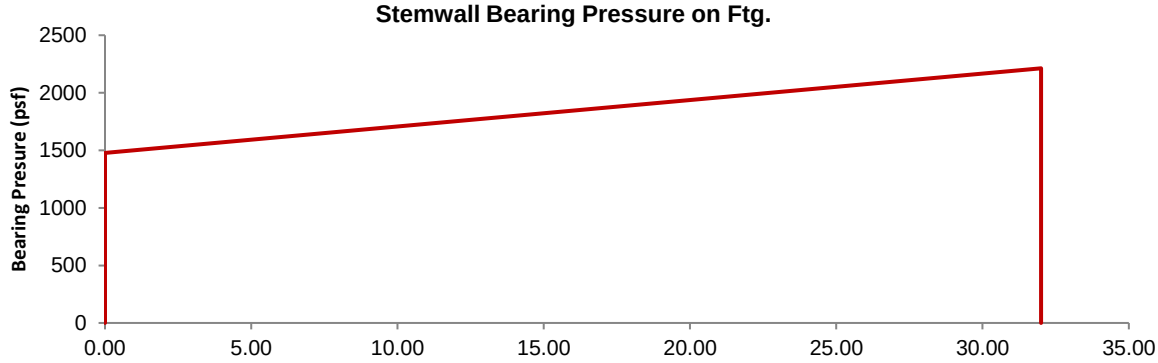
Stemwall/Ftg. Loads

Max. Shear =	4,048	lbs
Max. Moment Pos. =	4,988	ft-lbs
Max. Moment Neg. =	-6,297	ft-lbs
Max. Bearing =	2,213	psi
Min. Bearing =	1,477	psi









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Thickened Edge/Footing Reinforced Concrete Beam Calculations:

The footing/thickened edge at shearwalls is designed with reinforcement top and bottom due to the transient and complex nature of the applied bending moments

Reinforcement Area Provided Top	A_s =	0.196	in^2	Reinf. Bar Size Top =	4	
Reinforcement Area Provided Bottom	A_s =	0.196	in^2	Number of Top Bars =	**1**	**- Cont. #4**
				Reinf. Cover Top =	2	in

Bending Calculations Top:

Conc. Comp. Block	a =	0.38	in	Reinf. Bar Size Bottom =	4	
Factored Bending Moment Neg.	M_u =	75,561	in-lb	Number of Bottom Bars =	**1**	**- Cont. #4**
Moment Strength	M_n =	228,571	in-lb	Reinf. Cover Bottom =	3	in

Reinforcement Calculations Top:

				Thickened Edge Width =	6	in
$M_u/\phi bd^2$	R_n =	29.6	psi	Footing Width =	12	in
Steel Ratio	ρ =	0.0005		Total Height of Ftg. and Thickened Edge =	24	in
Steel Req. based on Moment	$A_{s(1)}$ =	0.065	in^2			
Controlling Reinf. Steel	$A_{s(req)}$ =	0.065	in^2	Eff. Depth to Steel		
Required number of #4 bars =		0.33		d_{top} =	21.75	in
Selected Top Longitudinal Bars:		**1**	**- Cont. #4 bars**	d_{bot} =	20.75	in
Reinforcement Area Provided	A_s =	0.196	in^2 → **OK**			

Bending Calculations Bottom:

Conc. Comp. Block	a =	0.77	in
Factored Bending Moment Pos.	M_u =	59,856	in-lb
Moment Strength	M_n =	215,928	in-lb

Note: Rectangular stress block is wholly contained in flange, design as rectangular beam.

Reinforcement Calculations Bottom:

$M_u/\phi bd^2$	R_n =	25.7	psi	Note:
Steel Ratio	ρ =	0.0004		
Steel Req. based on Moment	$A_{s(1)}$ =	0.054	in^2	
Controlling Reinf. Steel	$A_{s(req)}$ =	0.054	in^2	
Required number of #4 bars =		0.27		
Selected Bottom Longitudinal Bars:		**1**	**- Cont. #4 bars**	
Reinforcement Area Provided	A_s =	0.196	in^2 → **OK**	

We are designing the combined thickened edge and strip footing as a T-shaped beam. This assumption holds true provided that #4 vertical bars are installed at a max. 24" o/c spacing.

Reinforcement Calculations Shrinkage and Temp.:

Steel Req. based on Shrink	$A_{s(2)}$ =	0.259	in^2 (ACI 7.12)
Total Reinforcement Area Provided	A_s =	0.393	in^2 → **OK**

Beam Shear Calculations (One Way Shear):

Applied Beam Shear	V_u =	4,048	lbs
Allowable Beam Shear (without reinf.)	V_c =	10,229	lbs (ACI 11-3) → **OK**

(Shear Reinforcement not required)

Use #4 Vertical Bars @ 12" o/c for high shear locations.
Use #4 Vertical Bars @ 24" o/c for all other locations.