SUPPLEMENTAL STRUCTURAL CALCULATIONS FOR:

6221 83RD PL SE

MERCER ISLAND, WA

ARCHITECT: JULIAN WEBER ARCH + DESIGN

JANUARY 6, 2023





License To : MALSAM TSANG ENGINEERING							
ft							
ft							
in							
ít							

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.42 Ratio < 1.5!
Slab Resist	s All S	Sliding !
Total Bearing Loadresultant ecc.	= =	6,105 lbs 27.59 in
Soil Pressure @ Toe Soil Pressure @ Heel	= =	2,393 psf OK 0 psf OK
Soil Pressure Less	= Than	Allowable
ACI Factored @ Toe ACI Factored @ Heel	= =	3,350 psf 0 psf
Footing Shear @ Toe	=	51.4 psi OK
Footing Shear @ Heel	=	21.9 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	4.807.3 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data					
Allow Soil Bearing		=	2,666	6.0	psf
Equivalent Fluid Pressure	∍N	leth	od		
Active Heel Pressure		=	40	0.0	psf/ft
		_			
Passive Pressure		_	150	<u>م</u> ا	nsf/ft
		-	100	 	p31/10
Soli Density, Heel		=	120.	00	рст
Soil Density, Toe		=	120.	00	pcf
Footing Soil Friction		=	0.4	50	
Soil height to ignore					
for passive pressure		=	12.0	0	in
Lateral Load Appli	ec	l to	o Ste	m	
Lateral Load	=		108.0	#/	ft
Height to Top	=		12.00	ft	
Height to Bottom	=		0.00	ft	
Load Type	=	Se	ismic	(E)
		(S	ervice	Le	vel)
Wind on Exposed Stem (Service Level)	=		0.0	ps	f

Stem Construction Design Height Above Ftg ft = Wall Material Above "Ht" = Design Method = Thickness = Rebar Size = **Rebar Spacing** = Rebar Design fb/FB Total Se Str Mom Se Str Mome Shea Se St

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Restain			
Adjacent Footing	Load	ł	
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		0.04	

Code: IBC 2015,ACI 318-14,ACI 530-13

0.0 ft = at Back of Wall Poisson's Ratio 0.300 = Bottom Stem OK 0.00 Concrete LRFD 12.00 # 6 8.00

Rebar Placed at	=	Edge	
Design Data		0.007	
	=	0.997	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	5,904.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	26,208.0	
MomentAllowable	=	26,273.2	
ShearActual			
Service Level	psi =		
Strength Level	psi =	51.1	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	9.63	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	150.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weig	Jht
Masonry Design Method	=	ASD	
Concrete Data		0.500.0	

psi = 2,500.0 psi = 60,000.0

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINEERING	Cantilevered Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area Details		
Bottom Stem Vertica	I Reinforcing Horizontal Reinforcing	
As (based on applied moment) : 0.6258	in2/ft	
(4/3) * As : 0.8344	in2/ft Min Stem T&S Reinf A	rea 3.600 in2
200bd/fy : 200(12)(9.625)/60000 : 0.385 i	n2/ft Min Stem T&S Reinf A	rea per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) : 0.2592	in2/ft Horizontal Reinforcing	Options :
=====	====== One layer of : Two	b layers of :
Required Area : 0.6258	in2/ft #4@ 8.33 in #4@	@ 16.67 in
Provided Area : 0.66 in	2/ft #5@ 12.92 in #5	@ 25.83 in
Maximum Area : 1.3039	in2/ft #6@ 18.33 in #6	@ 36.67 in
Footing Data	Footing Design Results	l
Toe Width = 5.25 ft	Toe H	leel
Heel Width = <u>2.75</u>	Factored Pressure = 3,350	0 psf
Total Footing Width = 8.00	Mu': Upward = 364,019	0 ft-#
Footing Thickness = 15.00 in	Mu Design $=$ 26.573 2	,991 ft-# 991 ft-#
Key Width = 0.00 in	Actual 1-Way Shear = 51.38 2	1 91 nsi
Key Depth = 0.00 in	Allow 1-Way Shear = 75.00 4	0.00 psi
Key Distance from Toe = 0.00 ft	Toe Reinforcing = #6 @ 8.00 in	
$f'_{c} = 2,500 \text{ psi}$ Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00pcr	Footing Torsion Tu	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow Torsion phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable provide	
	supplemental design for footing tors	ion.
	Other Acceptable Sizes & Spacings	
	Toe: $#4@ 4.54$ in $#5@ 7.04$ in $#6@ 9$	99 in #7@ 13.63 in #8@ 17.95 in #9@ 22.7
	Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: No key defined	100 m, #1 G 10.00 m, #0 G 11.00 m, #0 G 22.1
	Min footing T&S reinf Area Min footing T&S reinf Area per foot If one layer of horizontal bars: If tr #4@ 7.41 in #5@ 11.48 in #6@ 16.30 in	2.59 in2 0.32 in2 /ft wo layers of horizontal bars: #4@ 14.81 in #5@ 22.96 in #6@ 32 59 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV		i		RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb)	3.511.3	4.42	15.508.0	Soil Over HL (ab. water tbl)	2,520.0	7.13	17,955.0
HL Act Pres (be water tb)	l)	-,			Soil Over HL (bel. water tbl) Watre Table		7.13	17,955.0
Buovant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	1,296.0	7.25	9,396.0	* Axial Live Load on Stem =			
Load @ Stem Above Soi	=				Soil Over Toe =	210.0	2.63	551.3
	=				Surcharge Over Toe =			
					Stem Weight(s) =	1,875.0	5.75	10,781.3
					Earth @ Stem Transitions =			
Total	=	4,807.3	O.T.M. =	24,904.0	Footing Weight =	1,500.0	4.00	6,000.0
					Key Weight =			
Resisting/Overturning	g Rat	io	=	1.42	Vert. Component =			
Vertical Loads used for	or So	il Pressure	= 6,105.	0 lbs	Total =	6,105.0 I	bs R.M.=	35,287.5
					* Axial live load NOT included i	n total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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	рсі
Horizontal Defl @ Top of Wall (approximate only)	0.104	in
The above calculation is not valid if the heel soil bearing pr	essure	exceeds that of the toe,

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	Criteria						
		_	0.00 (
	Retained Height	-	8.00 ft				
	Wall height above soil	=	0.50 ft				
	Slope Behind Wall	=	0.00				
	Height of Soil over Toe	=	4.00 in				
	Water height over heel	=	0.0 ft				

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Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning = 1.91 OK Slab Resists All Sliding ! **Total Bearing Load** 2,670 lbs = ...resultant ecc. 9.62 in = Soil Pressure @ Toe = 1,077 psf OK Soil Pressure @ Heel 11 psf OK = 2,000 psf Allowable Soil Pressure Less Than Allowable ACI Factored @ Toe 1,507 psf = ACI Factored @ Heel = 15 psf Footing Shear @ Toe 21.9 psi OK = Footing Shear @ Heel 9.7 psi OK = Allowable = 75.0 psi **Sliding Calcs** Lateral Sliding Force 1,620.0 lbs _

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing		=	2,000.0	psf
Equivalent Fluid Pressure	∍ N	leth	od	
Active Heel Pressure		=	40.0	psf/ft
		_		
		=	150.0	nof/ft
Passive Plessure		=	150.0	psi/it
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore				
for passive pressure		=	12.00	in
Lateral Load Appli	ec	l to	Stem	
Lateral Load	=		0.0 #/	ft
Height to Top	=		0.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	Wi	nd (W)	
		(Se	ervice Le	vel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Bottom **Stem Construction** Stem OK Design Height Above Ftg ft = 0.00 Wall Material Above "Ht" Concrete = **Design Method** = LRFD Thickness 8.00 = Rebar Size # 5 = **Rebar Spacing** 11.25 = Rebar Placed at 6.25 i = Design Data fb/FB + fa/Fa 0.626 = **Total Force @ Section** Service Level lbs = Strength Level lbs = 2,048.0 Moment....Actual ft-# =Service Level Strength Level ft-# = 5,461.3 ٨١١٨ - 1- 1 0 740 4 Moment. Shear... Serv Strer Shear... Anet (Ma Rebar D Masonry f'm Fs Solid Gr

MomentAllowable	=	8,719.4
ShearActual		
Service Level	psi =	
Strength Level	psi =	27.3
ShearAllowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
lasonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium W

Concrete Data		
Masonry Design Method	= ASD	
Masonry Block Type	= Medium Weigh	t
Equiv. Oolia Thiok.	-	

2,500.0 psi = psi = 60,000.0

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Concrete Stem Rebar Are	a Details			
Bottom Stem	Vertical	Reinforcing	Horizontal Reinfor	rcing
As (based on applied moment) . $(4/2) * A_2$	0.2040 1	12/1L	Ain Stom TOS De	sinf Area 1 622 in 2
(4/3) AS .	0.27261	12/1L I	VIIN Stern T&S RE	hill Alea 1.032 III2
2000d/1y 200(12)(6.25)/60000 .	0.25 INZ/		VIIII Sterii 105 Re	
0.0018bh : 0.0018(12)(8) :	0.1728 lf	12/ft F	Horizontal Reinfor	
	======	====== (One layer of :	I wo layers of :
Required Area :	0.25 in2/	ft #	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.3307 ir	n2/ft #	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 ir	n2/ft #	#6@ 27.50 in	#6@ 55.00 in
Footing Data		Footing Desig	gn Results	
Toe Width=Heel Width=Total Footing Width=Footing Thickness=Key Width=Key Depth=Key Distance from Toe=f'c =2,500 psiFy =Footing Concrete Density=Min. As %=Cover @ Top2.00@ B	3.25 ft 1.66 4.91 12.00 in 0.00 in 0.00 ft 60,000 psi 150.00 pcf 0.0018 tm.= 3.00 in	Factored Pressure Mu': Upward Mu': Downward Mu: Design Actual 1-Way Shear Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Key Reinforcing Footing Torsion, Tu Footing Allow. Torsio	Toe = 1,507 = 74,669 = 14,450 = 5,018 = 21.86 = 75.00 = #5 @ 12.00 = None Spec'c = None Spec'c = on, phi Tu =	Heel 15 psf 57 ft-# 657 ft-# 9.65 psi 40.00 psi in 1 0.00 ft-lbs 0.00 ft-lbs
		If torsion exceed	ds allowable, pro	ovide
		supplemental de	esign for footing	torsion.
		Other Acceptable S Toe: #4@ 9.25 in Heel: phiMn = phi ¹ . Key: No key defin	Sizes & Spacing , #5@ 14.35 in, # 5'lambda'sqrt(fc)' hed	ıs 6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46 Sm
		Min footing T&S re Min footing T&S re If one layer of horiz	einf Area inf Area per foot zontal bars:	1.27 in2 0.26 in2 /ft If two layers of horizontal bars:

0.26 in2 /tt If two layers of horizo #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

				IC			ESISTING	
Item		Force Ibs	Distance	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	1)	1.620.0	3.00	4.860.0	Soil Over HL (ab. water tbl)	953.6	4.41	4,208.6
HL Act Pres (be water tb	í)	,		,	Soil Over HL (bel. water tbl)		4.41	4,208.6
Hydrostatic Force	,				Watre Table			
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=				* Axial Live Load on Stem =			
Load @ Stem Above So	il =				Soil Over Toe =	130.0	1.63	211.3
	=				Surcharge Over Toe =			
					Stem Weight(s) =	850.0	3.58	3,045.8
					Earth @ Stem Transitions=			
Total	=	1,620.0	O.T.M. ₌	= 4,860.0	Footing Weight =	736.5	2.46	1,808.1
					Key Weight =			
Resisting/Overturnin	g Rat	io	=	1.91	Vert. Component =			
Vertical Loads used f	or So	il Pressure	= 2,67	0.1 lbs	Total =	2,670.1	lbs R.M.=	9,273.7
					* Axial live load NOT included	in total displa	yed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.052	in
The above calculation is not valid if the heel soil bearing pr	<u>essure e</u>	exceeds that of the toe,

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Criteria			
Retained Height	=	7.00 ft	
		7.00 1	
Wall height above soil	=	0.50 ft	
Slope Behind Wall	=	0.00	
Height of Soil over Toe	=	4.00 in	
Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.37 Ratio < 1.5!
Slab Resist	s All S	Sliding !
Total Bearing Loadresultant ecc.	= =	2,255 lbs 16.56 in
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe	= = Than =	1,812 psf OK 0 psf OK 2,666 psf Allowable 2,536 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	33.9 psi OK
Footing Shear @ Heel	=	12.1 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	1.668.2 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

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Soli Data				
Allow Soil Bearing Equivalent Fluid Pressure	e N	= leth	2,666.0 od) psf
Active Heel Pressure		=	40.0	0 psf/ft
		=		
Passive Pressure		=	150.0) psf/ft
Soil Density, Heel		=	120.00) pcf
Soil Density, Toe		=	120.00) pcf
Footing Soil Friction		=	0.450	C
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appli	iec	l to	Sten	า
Lateral Load	=		63.0 #	ŧ/ft
Height to Top	=		7.00 f	t
Height to Bottom	=		0.00 f	t
Load Type	=	Sei	ismic (I	Ξ)
		(Se	ervice L	evel)
Wind on Exposed Stem (Service Level)	=		0.0 p	osf

Ster D

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

em Construction		Bottom	
		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
I hickness	=	8.00	
Rebar Size	=	# 4	
Rebai Spacing	=	0.75	
Rebar Placed at	=	Edge	
fb/FB + fa/Fa	_	0 711	
Total Force @ Section	-	•	
	lbc –		
Strongth Lovel		2 000 0	
Moment Actual	105 =	2,009.0	
Service Level	ft_# _		
Strength Level	ft_# _	5 202 2	
	π- <i>π</i> –	3,202.2	
MomentAllowable	=	7,314.8	
ShearActual			
Service Level	psi =		
Strength Level	psi =	26.8	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	2,500.0	
Fy	psi =	60,000.0	

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Concrete Stem Rebar Area Details		
Bottom Stem Vertica	Reinforcing Horizontal Reinforcing	3
As (based on applied moment) : 0.1949	in2/ft	
(4/3) * As : 0.2599	in2/ft Min Stem T&S Reinf A	Area 1.440 in2
200bd/fy : 200(12)(6.25)/60000 : 0.25 in2	2/ft Min Stem T&S Reinf A	Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.1728	in2/ft Horizontal Reinforcing	y Options :
=====	One layer of : Tw	o layers of :
Required Area : 0.25 in2	2/ft #4@ 12.50 in #4	4@ 25.00 in
Provided Area : 0.2743	in2/ft #5@ 19.38 in #5	5@ 38.75 in
Maximum Area : 0.8467	in2/ft #6@ 27.50 in #6	3@ 55.00 in
Footing Data	Footing Design Results	
Toe Width = 2.75 ft	Toe	Heel
Heel Width = <u>1.67</u>	Factored Pressure = 2,536	0 psf
Total Footing Width = 4.42	Mu': Upward = 72,750	0 ft-#
Footing Thickness = 10.00 in	Mu Downward = $8,984$ Mu Design - 5.314	583 π-# 583 ft_#
Key Width = 0.00 in	Actual 1-Way Shear = 33.90 1	12 10 psi
Key Depth = 0.00 in	Allow 1-Way Shear = 75.00	40.00 psi
Key Distance from Toe = 0.00 ft	Toe Reinforcing = # 4 @ 9.00 in	
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = None Specia	
MIR. AS% = 0.0018 Cover @ Top 2.00 @ $Btm = 3.00$ in	Footing Allow Torsion, phi Tu	
	Found Anow. Torsion, print u =	0.00 11-105
	If torsion exceeds allowable, provide	e
	supplemental design for footing tors	sion.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 9.42 in, #5@ 14.60 in, #6@ Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: No key defined	20.72 in, #7@ 28.26 in, #8@ 37.21 in, #9@ 47
	Min footing T&S reinf Area	0.95 in2
	Min footing T&S reinf Area per foot	0.22 in2 /ft
	If one layer of horizontal bars: If	two layers of horizontal bars:
	#4@ 11.11 in	#4@ 22.22 in
	#5@ 17.22 in	#5@ 34.44 in
	#6@ 24.44 in	#o@ 48.89 IN

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV				R	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	I)	1.227.2	2.61	3.204.4	Soil Over HL (ab. water tbl)	842.8	3.92	3,302.4
HL Act Pres (be water tb Hvdrostatic Force	I)	.,		-,	Soil Over HL (bel. water tbl) Watre Table		3.92	3,302.4
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	441.0	4.33	1.911.0	* Axial Live Load on Stem =			
Load @ Stem Above Soi	=	-		,	Soil Over Toe =	110.0	1.38	151.3
	=				Surcharge Over Toe =			
					Stem Weight(s) =	750.0	3.08	2,312.5
					Earth @ Stem Transitions=			
Total	=	1,668.2	O.T.M. =	5,115.4	Footing Weight =	552.5	2.21	1,221.0
					Key Weight =			
Resisting/Overturning	g Rat	io	=	1.37	Vert. Component =			
Vertical Loads used f	or So	il Pressure	= 2,255.	3 lbs	Total =	2,255.3	lbs R.M.=	6,987.1
					* Axial live load NOT included	in total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.085	in
The above calculation is not valid if the heel soil bearing pr	ressure e	exceeds that of the toe,

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Criteria		
	_	=
Retained Height	-	7.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	4.00 in
Water height over heel	=	0.0 ft

١G

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.86 O	ĸ
Slab Resist	s All S	Sliding !	
Total Bearing Loadresultant ecc.	= =	2,014 lbs 8.66 in	
Soil Pressure @ Toe Soil Pressure @ Heel	= =	985 pst 0 pst	f OK f OK
Allowable Soil Pressure Less	= Than	2,000 pst	f
ACI Factored @ Toe	=	1,378 pst	f
ACI Factored @ Heel	=	0 pst	f
Footing Shear @ Toe	=	22.4 psi	OK
Footing Shear @ Heel	=	8.3 psi	OK
Allowable	=	75.0 psi	
Sliding Calcs			
Lateral Sliding Force	=	1,227.2 lbs	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soli Data					
Allow Soil Bearing Equivalent Fluid Pressure	e M	= leth	2,000 od	.0	psf
Active Heel Pressure		=	40	.0	psf/ft
		=			
Passive Pressure		=	150	.0	psf/ft
Soil Density, Heel		=	120.0	00	pcf
Soil Density, Toe		=	120.0	00	pcf
Footing Soil Friction		=	0.45	50	
Soil height to ignore for passive pressure		=	12.00	0	in
Lateral Load Appli	ec	l to	Ster	m	
Lateral Load Height to Top Height to Bottom	=		0.0 0.00 0.00	#/ ft ft	ft
Load Type	=	Wi (Se	nd (W) ervice) Le	vel)
Wind on Exposed Stem (Service Level)	=		0.0	ps	f

Bottom **Stem Construction** Stem OK Design Height Above Ftg ft = 0.00 Wall Material Above "Ht" = Concrete **Design Method** = LRFD Thickness 8.00 = Rebar Size # = **Rebar Spacing** 9.00 = Rebar Placed at Edge = Design Data fb/FB + fa/Fa 0.513 = **Total Force @ Section** Service Level lbs = Strength Level lbs = 1,568.0 Moment....Actual ft-# =Service Level Strength Level ft-# = 3,658.7 Moment.....Allowable 7,122.4 = Shear.....Actual Service Level noi – Strei Shear .. Anet (M Rebar D Masonry f'm Fs Solid G

Service Level	psi=	
Strength Level	psi =	20.9
ShearAllowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
lasonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium W

4

Masonry Block Type	=	Medium Weig	jht
Masonry Design Method	= b	ASD	
Concrete Data	psi =	2,500.0	

psi =	2,500.0
psi =	60,000.0

f'c Fy



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-	Concrete Stem Rebar Area Details			
	Bottom Stem Vertica As (based on applied moment) : 0.1371	I Reinforcing Horizo in2/ft	ntal Reinford	ing
	(4/3) * As : 0.1828	in2/ft Min St	em T&S Rei	nf Area 1.440 in2
	200bd/fv : 200(12)(6.25)/60000 : 0.25 in	2/ft Min St	em T&S Rei	nf Area per ft of stem Height : 0.192 in2/ft
	0.0018bh : 0.0018(12)(8) : 0.1728	in2/ft Horizo	ntal Reinford	sing Options :
	=====	====== One la	ver of :	Two lavers of :
	Required Area : 0.1828	in2/ft #4@ 1	2.50 in	#4@ 25.00 in
	Provided Area : 0.2667	in2/ft #5@ 1	9.38 in	#5@ 38.75 in
	Maximum Area : 0.8467	in2/ft #6@ 2	27.50 in	#6@ 55.00 in
	Footing Data	Footing Design R	esults	
	Toe Width = 2.75 ft Heel Width = 1.42 Total Footing Width = 1.42 Footing Thickness = 10.00 in Key Width = 0.00 in Key Depth = 0.00 in Key Distance from Toe = 0.00 ft f'c = $2,500 \text{ psi}$ Fy = $60,000 \text{ psi}$ Footing Concrete Density = 150.00 pcf Min. As % = 0.0018 Cover @ Top 2.00 @ Btm.= 3.00 in	Factored Pressure = Mu': Upward = Mu': Downward = Mu: Design = Actual 1-Way Shear = Allow 1-Way Shear = Toe Reinforcing = # Heel Reinforcing = M Key Reinforcing = N Footing Torsion, Tu Footing Allow. Torsion, phi If torsion exceeds allow supplemental design Other Acceptable Sizes Toe: #4@ 11.11 in, #50 Heel: phiMn = phi'5'lamb Key: No key defined Min footing T&S reinf Ar Min footing T&S reinf Ar If one layer of horizontal #4@ 11.11 in #5@ 17.22 in #6@ 24.44 in	Toe 1,378 48,532 8,984 3,296 22.43 75.00 4 @ 9.00 in lone Spec'd lone Spec'd lone Spec'd Tu = wable, prov for footing t & Spacings @ 17.22 in, # oda'sqrt(fc)'S ea ea per foot bars:	Heel 0 psf 17 ft-# 329 ft-# 311 ft-# 8.29 psi 40.00 psi 0.00 ft-lbs 0.00 ft-lbs 0.00 ft-lbs 0.00 ft-lbs 0.00 ft-lbs vide 0.00 ft-lbs forsion. 5 6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 im 0.90 in2 0.22 in2 /ft If two layers of horizontal bars: #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in
		#4@ 11.11 in #5@ 17.22 in #6@ 24.44 in		#4@ 22.22 in #5@ 34.44 in #6@ 48.90 in
		#0@ 24.44 III		#U@ 40.09 III

,	
#4@ 11.11 in	
#5@ 17.22 in	
#6@ 24.44 in	

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURI	VING.				RE	SISTING	
Item		Force lbs	Distand ft	e	Moment ft-#			Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	1)	1,227.2	2.6	1	3,204.4	Soil Over HL (ab. water th	ol)	632.8	3.79	2,400.4
HL Act Pres (be water tb	í)		-		, -	Soil Over HL (bel. water th	bl)		3.79	2,400.4
Hydrostatic Force						vvatre lable				
Buoyant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on Stem	=			
Added Lateral Load	=					* Axial Live Load on Stem	=			
Load @ Stem Above Sol	il =					Soil Over Toe	=	110.0	1.38	151.3
	=					Surcharge Over Toe	=			
						Stem Weight(s)	=	750.0	3.08	2,312.5
			_			Earth @ Stem Transitions	=			
Total	=	1,227.2	O.T.M.	=	3,204.4	Footing Weight	=	521.3	2.09	1,086.8
						Key Weight	=			
Resisting/Overturnin	g Rat	io	=		1.86	Vert. Component	=			
Vertical Loads used f	or So	il Pressure	= 2,	014.1	lbs	Total	=	2,014.1 I	bs R.M.=	5,951.0
						* Axial live load NOT include	ed in	total display	ed, or used fo	r overturning

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.049	in
The above calculation is not valid if the heel soil bearing pr	essure e	exceeds that of the toe,

L	icense To : MALSAM TS	SANG	ENGINEERIN	IG
	Criteria			
	Retained Height	=	5.00 ft	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	4.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	1.29 Ratio < 1.5!
Slab Resist	s All Sli	ding !
Total Bearing Loadresultant ecc.	= =	1,263 lbs 12.82 in
Soil Pressure @ Toe Soil Pressure @ Heel	= =	1,786 psf OK 0 psf OK
Allowable Soil Pressure Less	= Than A	2,666 psf Allowable
ACI Factored @ Toe ACI Factored @ Heel	=	2,500 psf 0 psf
Footing Shear @ Toe	=	18.1 psi OK
Allowable	=	4.4 psi OK 75.0 psi
Sliding Calcs		
Lateral Sliding Force	_	905.6 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soli Data				
Allow Soil Bearing Equivalent Fluid Pressur	e N	= leth	2,666.0 od) psf
Active Heel Pressure		=	40.0) psf/ft
		=		
Passive Pressure		=	150.0) psf/ft
Soil Density, Heel		=	120.00) pcf
Soil Density, Toe		=	120.00) pcf
Footing Soil Friction		=	0.450)
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Stem	n i
Lateral Load Height to Top	=		45.0 # 5.00 ft	/ft
	-	<u> </u>	0.00 m	- \
Load Type	=	Se (Se	ervice L	:) evel)
Wind on Exposed Stem (Service Level)	=		0.0 p	sf

Thickness

Rebar Size

Fy

Poisson's Ratio Bottom **Stem Construction** Stem OK 0.00 Design Height Above Ftg ft = Wall Material Above "Ht" = Concrete Design Method LRFD = 8.00 = = # 4

Rebar Spacing	=	10.00	
Rebar Placed at	=	Edge	
Design Data			
fb/FB + fa/Fa	=	0.307	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	1,075.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	1,979.2	
MomentAllowable	=	6,444.1	
ShearActual			
Service Level	psi =		
Strength Level	psi =	14.3	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium We	light
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	2,500.0	
Fy	psi =	60,000.0	

Restrain	•		
Adjacent Footing I	Load	d	1
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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Concrete Stem Rebar Area Details		
Bottom Stem Vertical	Reinforcing Horizontal Reinforcin)g
As (based on applied moment) : 0.0742	in2/ft	0
(4/3) * As : 0.0989	in2/ft Min Stem T&S Reinf	Area 1.056 in2
200bd/fy : 200(12)(6.25)/60000 : 0.25 in2	2/ft Min Stem T&S Reinf	Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.1728	in2/ft Horizontal Reinforcin	ig Options :
=====	One layer of : Tw	wo layers of :
Required Area : 0.1728	in2/ft #4@ 12.50 in #	#4@ 25.00 in
Provided Area : 0.24 in2	2/ft #5@ 19.38 in #	#5@ 38.75 in
Maximum Area : 0.8467	in2/ft #6@ 27.50 in #	#6@ 55.00 in
Footing Data	Footing Design Results	
Toe Width = 2.00 ft	Тое	Heel
Heel Width = 1.08	Factored Pressure = 2,500	0 psf
Total Footing Width = 3.08	Mu': Upward = 32,432	0 ft-#
Footing Thickness = 10.00 in	$Mu^{\circ}: Downward = 5,544$ $Mu^{\circ}: Design = 2.241$	87 ft-# 87 ft-#
Key Width = 0.00 in	Actual 1-Way Shear = 18.13	4.37 nsi
Key Depth = 0.00 in	Allow 1-Way Shear = 75.00	40.00 psi
Key Distance from Toe = 0.00 ft	Toe Reinforcing = $#4 @ 10.00$ in	
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = None Spec'd	
MIR. AS% = 0.0018 Cover @ Top 2.00 @ Btm = 3.00 in	Footing Mow Torsion phi Tu	
	Fooling Allow. Torsion, phi Tu =	0.00 It-IDS
	If torsion exceeds allowable, provid	
	supplemental design for footing to	rsion.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 11.11 in, #5@ 17.22 in, #6 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: No key defined	@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 I
	Min footing T&S reinf Area Min footing T&S reinf Area per foot If one layer of horizontal bars: If #4@ 11.11 in #5@ 17.22 in #6@ 24.44 in	0.67 in2 0.22 in2 /ft f two layers of horizontal bars: #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING			R	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb))	680.6	1.94	1.323.3	Soil Over HL (ab. water tbl)	248.0	2.87	712.6
HL Act Pres (be water tbl Hydrostatic Force)			.,	Soil Over HL (bel. water tbl) Watre Table		2.87	712.6
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	225.0	3.33	750.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil	=				Soil Over Toe =	80.0	1.00	80.0
	=				Surcharge Over Toe =			
					Stem Weight(s) =	550.0	2.33	1,283.3
					Earth @ Stem Transitions =			
Total	=	905.6	O.T.M. =	2,073.3	Footing Weight =	385.0	1.54	592.9
					Key Weight =			
Resisting/Overturning	g Rati	0	=	1.29	Vert. Component =			
Vertical Loads used for	or Soil	Pressure	= 1,263.0) lbs	Total =	1,263.0	lbs R.M.=	2,668.8
					* Axial live load NOT included in	n total displa	yed, or used fo	r overturning

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.089	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

L	License To : MALSAM TSANG ENGINEERING					
	Criteria					
	Retained Height	=	6.00 ft			
	Wall height above soil	=	0.50 ft			
	Slope Behind Wall	=	0.00			
	Height of Soil over Toe	=	4.00 in			
	Water height over heel	=	0.0 ft			

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

=

Design Summary

Wall Stability Ratios Overturning

Overturning	=	2.06 OK
Slab Resist	s All	Sliding !
Total Bearing Load	=	1,733 lbs
resultant ecc.	=	6.37 in
0 1 D 0 T		
Soil Pressure @ Toe	=	886 pst OK
Soil Pressure @ Heel	=	61 psf OK
Allowable	=	2,000 psf
Soil Pressure Less	Tha	n Allowable
ACI Factored @ Toe	=	1,240 psf
ACI Factored @ Heel	=	86 psf
Footing Shear @ Toe	=	16.6 psi OK
Footing Shear @ Heel	=	6.3 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	933.9 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing Equivalent Fluid Pressure	e N	= leth	2,000.0 od	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	150.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Stem	
Lateral Load Height to Top Height to Bottom	= = =		0.0 #/ 0.00 ft 0.00 ft	ft
Load Type	=	Wi (Se	ind (W) ervice Le	vel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Ste

Adjacent Footing I	.08		
Adjacent Footing Load	=	0.0 lbs	1
Footing Width	=	0.00 ft	
Eccentricity	=	0.00 in	

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

em Construction		Bottom	
		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	8.00	
Rebar Size	=	# 4	
Rebar Spacing	=	11.00	
Rebar Placed at	=	Edge	
Design Data			
tb/FB + ta/Fa	=	0.391	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	1,152.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	2,304.0	
MomentAllowable	=	5,883.6	
ShearActual			
Service Level	psi =		
Strength Level	psi =	15.4	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		

Masonry Block Type = Medium Weight Masonry Design Method = ASD

Concrete Data f'c

Fy

2,500.0 psi = psi = 60,000.0

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Concrete Stem Rebar Area Details			
Bottom Stem Vertica As (based on applied moment) : 0.0863	I Reinforcing in2/ft	Horizontal Reinforcin	g
(4/3) * As : 0.1151	in2/ft	Min Stem T&S Reinf	Area 1.248 in2
200bd/fv : 200(12)(6.25)/60000 : 0.25 in:	2/ft	Min Stem T&S Reinf	Area per ft of stem Height : 0,192 in2/ft
$0.0018bh \cdot 0.0018(12)(8) \cdot 0.1728$	in2/ft	Horizontal Reinforcin	
		One laver of Tv	yo lavers of :
Required Area : 0 1728		#4@ 12 50 in #	42 @ 25 00 in
Drovided Area : 0.1720	in2/ft	#4@ 12.30 in #	
Maximum Area . 0.2102	1112/11 in 0/ft	#0@ 07 F0 in #	
Maximum Area : 0.8467	In2/π	#6@ 27.50 In #	າຍພັງ 55.00 In
Footing Data	Footing Des	ign Results	
Toe Width = 2.25 ft		Тое	Heel
Heel Width = 1.41	Factored Pressure	= 1,240	86 psf
Total Footing Width = 3.66	Mu' : Upward	= 30,479	45 ft-#
Footing Thickness = 10.00 in	Mu' : Downward	= 6,014	280 ft-#
Key Width = 0.00 in	Mu: Design	= 2,039	235 ft-#
Key Depth = 0.00 in	Actual 1-Way Shea	r = 16.57	6.28 psi
Key Distance from Toe = 0.00 ft	Too Poinforcing	= 75.00 = #4 @ 11.00 in	40.00 psi
$f'_{C} = 2500 \text{ psi}$ Ev = 60.000 psi	Heel Reinforcing	= #4 @ 11.00 m = None Spec'd	
Footing Concrete Density = 150.00 psi	Key Reinforcing	= None Spec'd	
Min. As % = 0.0018	Footing Torsion, Tu	=	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow. Tors	ion, phi Tu 🛛 =	0.00 ft-lbs
	If torsion excee	eds allowable, provid	de
	supplemental of	design for footing to	rsion.
	Other Acceptable	Sizes & Spacings	
	Toe: #4@ 11.11 Heel: phiMn = ph Key: No key def	in, #5@ 17.22 in, #60 ii'5'lambda'sqrt(fc)'Sm iined	@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5
	Min footing T&S Min footing T&S r If one layer of ho	reinf Area reinf Area per foot rizontal bars: If	0.79 in2 0.22 in2 /ft two layers of horizontal bars:

#4@ 11.11 in #5@ 17.22 in #6@ 24.44 in 0.22 in2 /tt If two layers of horizo #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0\	ERTUR	NING.				RE	SISTING	
Item		Force lbs	Distand ft	ce	Moment ft-#	_		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	1)	933.9	2.28	3	2.127.2	Soil Over HL (ab. water	r tbl)	535.2	3.29	1,759.9
HL Act Pres (be water tb	í)					Soil Over HL (bel. wate	r tbl)		3.29	1,759.9
Hydrostatic Force	,					Watre Table				
Buoyant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on Ste	em =			
Added Lateral Load	=					* Axial Live Load on Sten	n =			
Load @ Stem Above So	il =					Soil Over Toe	=	90.0	1.13	101.3
	=					Surcharge Over Toe	=			
						Stem Weight(s)	=	650.0	2.58	1,679.2
						Earth @ Stem Transitio	ns=			
Total	=	933.9	O.T.M.	=	2,127.2	Footing Weight	=	457.5	1.83	837.2
						Key Weight	=			
Resisting/Overturnin	g Rat	io	=		2.06	Vert. Component	=			
Vertical Loads used f	or So	il Pressure	= 1,	732.7	lbs	Το	tal =	1,732.7	bs R.M.=	4,377.6
						* Axial live load NOT incl	uded ir	n total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.044	in
The above calculation is not valid if the heel soil bearing p	oressure (exceeds that of the toe,

icense To : MALSAM TS	SANG	ENGINEERI	٩G
Criteria			
Retained Height	=	6.00 ft	
Wall height above soil	=	0.50 ft	
Slope Behind Wall	=	0.00	
Height of Soil over Toe	=	4.00 in	
Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	1.24 Ratio < 1.5!
Slab Resists	s All Sl	iding !
Total Bearing Loadresultant ecc.	= =	1,596 lbs 16.50 in
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less	= = Than <i>A</i>	2,129 psf OK 0 psf OK 2,666 psf Allowable
ACI Factored @ Heel	=	2,901 psi 0 psf
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =	23.3 psi OK 7.9 psi OK 75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	1,257.9 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

..... .

Soli Data					
Allow Soil Bearing Equivalent Fluid Pressure	e M	= letho	2,666 od	.0	psf
Active Heel Pressure		=	40	.0	psf/ft
		=			
Passive Pressure		=	150	.0	psf/ft
Soil Density, Heel		=	120.0	00	pcf
Soil Density, Toe		=	120.0	00	pcf
Footing Soil Friction		=	0.45	50	
Soil height to ignore for passive pressure		=	12.0	0	in
Lateral Load Appli	ed	l to	Ste	m	
Lateral Load	=		54.0	#/1	ft
Height to Top	=		6.00	ft	
Height to Bottom	=		0.00	π	
Load Type	=	Sei	smic	(E))
		(Se	rvice	Le	vel)
Wind on Exposed Stem (Service Level)	=		0.0	ps	f

Restrain	•	
Adjacent Footing	Loa	d
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	
n			

Ste	em Construction		Bottom	
-	Design Height Above Etc		Stem OK	
	Design Height Above Ftg	ft =	0.00	
51	Vvali Material Above "Ht"	=	Concrete	
.0:	Design Method	=		
	Rebar Size	=	6.00 # 1	
	Rebar Spacing	_	# 4 11.00	
	Rebar Placed at	_	Edge	
	Design Data	-	Luge	
	fb/FB + fa/Fa	=	0.835	
	Total Force @ Section			
	Service Level	lbs =		
	Strength Level	lbs =	1,476.0	
	MomentActual		,	
	Service Level	ft-# =		
	Strength Level	ft-# =	3,276.0	
	MomentAllowable	=	3,920.0	
	ShearActual			
	Service Level	psi =		
	Strength Level	psi =	28.9	
	ShearAllowable	psi =	75.0	
	Anet (Masonry)	in2 =		
	Rebar Depth 'd'	in =	4.25	
	Masonry Data			
	f'm	psi =		
	Fs	psi =		
	Solid Grouting	=		
	Modular Ratio 'n'	=		
	Wall Weight	psf =	75.0	
	Short Term Factor	=		
	Equiv. Solid Thick.	=		
	Masonry Block Type	=	Medium W	/eight
	Masonry Design Method	=	ASD	
	Concrete Data		0.500.0	
		psi =	2,500.0	
	гу	psi =	60,000.0	

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Concrete Stem Rebar Area Details			
Bottom Stem Vertic As (based on applied moment) : 0.185	al Reinforcing	Horizontal Reinforc	ing
$(4/3) * \Delta c$	Q in 2/ft	Min Stom T&S Rei	nf Area 0.036 in 2
(4/3) A3. 0.240	0///1	Min Stom T&S Poir	nf Area por ft of stom Hoight : 0 144 in2/ft
$20000/19 \cdot 200(12)(4.23)/00000 \cdot 0.171$	Gin2/ft	Horizontal Bainfara	
0.0016011.0.0016(12)(0). 0.129	0 11/11		
==== 0.405		Une layer of :	
Required Area : 0.185	2 In2/ft	#4@ 16.67 In	#4@ 33.33 In
Provided Area : 0.218	2 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area : 0.575	7 in2/ft	#6@ 36.67 in	#6@ 73.33 in
Footing Data	Footing Desi	gn Results	
Toe Width = 2.50 ft		Тое	Heel
Heel Width = 1.25	Factored Pressure	= 2,981	0 psf
Total Footing Width = 3.75	Mu' : Upward	= 53,639	0 ft-#
Footing Thickness = 10.00 in	Mu' : Downward	= 7,425	285 ft-#
Key Width – 0.00 in	Mu: Design	= 3,851	285 ft-#
Key Depth = 0.00 in	Actual 1-Way Shear	r = 23.28	7.92 psi
Key Distance from Toe = 0.00 ft	Allow 1-way Shear	= 75.00	40.00 psi
$f_{0} = 2500 \text{ psi}$ Ev = 60.000 psi	Heel Reinforcing	= #4 @ 11.00 ll	11
Footing Concrete Density = 150.00 psi	Key Reinforcing	= None Spec'd	
Min. As $\% = 0.0018$	Footing Torsion, Tu	=	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow. Torsi	on, phi Tu 🛛 =	0.00 ft-lbs
	If torsion excee	ds allowable, prov	vide
	supplemental d	lesign for footing t	torsion.
	Other Acceptable	Sizes & Spacings	
	Toe: #4@ 11.11 Heel: phiMn = phi Key: No key defi	in, #5@ 17.22 in, # i'5'lambda'sqrt(fc)'S ined	16@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 m
	Min footing T&S r Min footing T&S r If one layer of hor	einf Area einf Area per foot izontal bars:	0.81 in2 0.22 in2 <i>/</i> ft If two layers of horizontal bars:

one layer or nonz
#4@ 11.11 in
#5@ 17.22 in
#6@ 24.44 in

0.22 in2 /it If two layers of horizo #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURN	ING		F	RESISTING	
Item		Force lbs	Distance ft	e Momen ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		933.9	2.28	2.127	Soil Over HL (ab. water tbl)	540.0	3.38	1,822.5
HL Act Pres (be water tbl) Hydrostatic Force				_,	Soil Over HL (bel. water tbl) Watre Table)	3.38	1,822.5
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	324.0	3.83	1.242	* Axial Live Load on Stem =			
Load @ Stem Above Soil	=			- ,	Soil Over Toe =	100.0	1.25	125.0
	_				Surcharge Over Toe =			
	-				Stem Weight(s) =	487.5	2.75	1,340.6
-			_		— Earth @ Stem Transitions =			
Total	=	1,257.9	0.T.M.	= 3,369	² Footing Weight =	468.8	1.88	878.9
					Key Weight =			
Resisting/Overturning	Ratic)	=	1.24	Vert. Component =			
Vertical Loads used for	r Soil	Pressure	= 1,5	96.3 lbs	Total =	1,596.3	lbs R.M.=	4,167.0
					* Axial live load NOT included	l in total displa	yed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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 p	ressure e	exceeds that of the toe,

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Criteria						
Retained Height	=	6.00 ft				
		0.00 II				
Wall height above soil	=	0.50 ft				
Slope Behind Wall	=	0.00				
Height of Soil over Toe	=	4.00 in				
Water height over heel	=	0.0 ft				

Surcharge Loads

Surcharge Over Heel 0.0 psf _ NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

=	2.13 OK
s All	Sliding !
= =	1,766 lbs 6.11 in
=	855 psf OK
=	87 psf OK
=	2,000 psf
Tha	n Allowable
=	1,197 psf
=	122 psf
=	16.2 psi OK
=	7.8 psi OK
=	75.0 psi
=	933.9 lbs
	= s All = = = = = = = = = = = = = = = = = = =

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

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Soli Data					
Allow Soil Bearing	e N	= leth	2,000. od	0 ps	sf
Active Heel Pressure	U 11	=	40.	0 ps	sf/ft
		=			
Passive Pressure		=	150.	0 ps	sf/ft
Soil Density, Heel		=	120.0	0 pc	f
Soil Density, Toe		=	120.0	0 pc	f
Footing Soil Friction		=	0.45	0	
Soil height to ignore for passive pressure		=	12.00) in	
Lateral Load Appl	iec	l to	Ster	n	
Lateral Load Height to Top Height to Bottom	= = =		0.0 0.00 0.00	#/ft ft ft	
Load Type	=	Wi (Se	nd (W) ervice l	_eve	el)
Wind on Exposed Stem (Service Level)	=		0.0	osf	

Stem C Des Wa De Th Re Re Re Desi fb/ То Мс Mo Sh Sh An Re Mas f'm Fs

50.0 psf/ft		
0.00 pcf		
).00 pcf		
450		
.00 in	Restaint	
em	Adjacent Footing I	_0
0 #/ft 0 ft	Adjacent Footing Load Footing Width	=
0 ft	Eccentricity	=
N)	Wall to Ftg CL Dist	=
e Level) 0 pcf	Footing Type Base Above/Below Soil	=
0 psi	at Back of Wall	
	FUISSUITS RALIU	=
Bottom		
Stem OK		
$\pi = 0.00$		
	;	
= LRFD)	

Restrain	•	
Adjacent Footing I	oa	d
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		Lingland

0.0 ft

0.300

m Construction		Bottom	
an construction		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	6.00	
Rebar Size	=	# 4	
Rebar Spacing	=	11.00	
Rebar Placed at	=	Edge	
fb/FB + fa/Fa	_	0 587	
Total Force @ Section	_	0.001	
Service Level	lhs –		
Strength Level	lbs –	1 152 0	
MomentActual	103 -	1,102.0	
Service Level	ft-# =		
Strength Level	ft-# =	2,304.0	
Moment Allowable	=	3 920 0	
Shear Actual		0,02010	
Service Level	nsi –		
Strength Level	poi –	22.6	
Shear Allowable	psi =	ZZ.0 75.0	
	psi=	75.0	
Anet (Masonry)	in2 =	4.05	
Rebai Deptin d	in =	4.25	
f'm	nsi –		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf=	75.0	
Short Term Factor	. =	-	
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	-
Concrete Data			
f'c	psi =	2,500.0	
Fy	psi =	60,000.0	

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Concrete Stem Rebar Area Details				
Bottom Stem Ve	rtical Reinforcing Horizon	tal Reinforcing		
As (based on applied moment) : 0.1	302 in2/ft	5		
(4/3) * As : 0.1	737 in2/ft Min Ste	m T&S Reinf Area 0	1.936 in2	
200bd/fy : 200(12)(4.25)/60000 : 0.1	7 in2/ft Min Ste	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft		
0.0018bh : 0.0018(12)(6) : 0.1	296 in2/ft Horizon	tal Reinforcing Optic	ons :	
==	======= One lay	er of : Two laye	rs of :	
Required Area : 0.1	7 in2/ft #4@ 16	.67 in #4@ 33	.33 in	
Provided Area : 0.2	2182 in2/ft #5@ 25	.83 in #5@ 51	.67 in	
Maximum Area : 0.5	5757 in2/ft #6@ 36	.67 in #6@ 73	.33 in	
Footing Data	Footing Design Res	sults		
Toe Width = 2.25 ft		Toe Heel		
Heel Width = 1.50	Factored Pressure =	1,197 122	psf	
Total Footing Width = 3.75	Mu': Upward =	29,827 109	ft-#	
Footing Thickness = 10.00 in	Mu': Downward =	6,014 507	ft-#	
Key Width = 0.00 in	Actual 1-Way Shear -	1,304 530	nci	
Key Depth = 0.00 in	Allow 1-Way Shear =	75.00 40.00	psi	
Key Distance from Toe = 0.00 ft	Toe Reinforcing = #4	1 @ 11.00 in	•	
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = No	ne Spec'd		
Footing Concrete Density = 150.00 pcf	Key Reinforcing = No	ine Spec'd		
Min. As $\%$ = 0.0018 Cover @ Tep 2.00 @ Rtm = 3.00 in	Footing Torsion, Tu	= 0.00) ft-lbs	
	Footing Allow. Torsion, phi i	u = 0.00	TT-IDS	
	If torsion exceeds allow	vable, provide		
	supplemental design fo	or footing torsion.		
	Other Acceptable Sizes &	Spacings		
	Toe: #4@ 11.11 in, #5@ Heel: phiMn = phi'5'lambo Key: No key defined	17.22 in, #6@ 24.4 la'sqrt(fc)'Sm	4 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5	
	Min footing T&S reinf Area Min footing T&S reinf Area If one layer of horizontal b #4@ 11.11 in #5@ 17.22 in #6@ 24.44 in	a 0.81 a per foot 0.22 ars: If two la #4@ #5@ #6@	in2 in2 /ft yers of horizontal bars: 22.22 in 34.44 in 48.89 in	

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

OVERTURNING						RI	RESISTING		
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#	
HL Act Pres (ab water tb	I)	933.9	2.28	2,127.2	Soil Over HL (ab. water tbl)	720.0	3.25	2,340.0	
HL Act Pres (be water tb	í)		-		Soil Over HL (bel. water tbl)		3.25	2,340.0	
Hydrostatic Force	,				Watre Table				
Buoyant Force	=				Sloped Soil Over Heel =				
Surcharge over Heel	=				Surcharge Over Heel =				
Surcharge Over Toe	=				Adjacent Footing Load =				
Adjacent Footing Load	=				Axial Dead Load on Stem =				
Added Lateral Load	=				* Axial Live Load on Stem =				
Load @ Stem Above Soi	1 =				Soil Over Toe =	90.0	1.13	101.3	
	=				Surcharge Over Toe =				
					Stem Weight(s) =	487.5	2.50	1,218.8	
					Earth @ Stem Transitions =				
Total	=	933.9	O.T.M. =	2,127.2	Footing Weight =	468.8	1.88	878.9	
					Key Weight =				
Resisting/Overturning	g Ratio	0	=	2.13	Vert. Component =				
Vertical Loads used for	or Soil	Pressure	= 1,766	.3 lbs	Total =	1,766.3	lbs R.M.=	4,538.9	
					* Axial live load NOT included	in total display	ed, or used fo	r overturning	

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.041	in
The above calculation is not valid if the heel soil bearing	pressure e	exceeds that of the toe,

L	icense To : MALSAM TS	SANG	ENGINEERI	١G
	Criteria			
	Retained Height	=	5.00 ft	
			5.00 1	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	4.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.78 OK	
Slab Resis	sts All \$	Sliding !	
Total Bearing Loadresultant ecc.	= =	1,222 lbs 6.82 in	
Soil Pressure @ Toe Soil Pressure @ Heel	=	962 psf O 0 psf O	K K
Allowable Soil Pressure Les	= s Thar	2,000 psf	
ACI Factored @ Toe ACI Factored @ Heel	=	1,346 psf 0 psf	
Footing Shear @ Toe	=	10.2 psi O	K
Allowable	=	3.7 psi O 75.0 psi	ĸ
Sliding Calcs			
Lateral Sliding Force	=	680.6 lbs	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing	e M	= leth	2,000.0	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	250.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appli	iec	l to	Stem	
Lateral Load Height to Top Height to Bottom	= = =		0.0 #/ 0.00 ft 0.00 ft	ft
Load Type	=	Wi (Se	ind (W) ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Bottom **Stem Construction** Stem OK Design Height Above Ftg ft = 0.00 Wall Material Above "Ht" = Concrete **Design Method** = LRFD Thickness 8.00 = Rebar Size # 4 = **Rebar Spacing** 11.00 = Rebar Placed at Edge = Design Data fb/FB + fa/Fa 0.226 = **Total Force @ Section** Service Level lbs = Strength Level lbs = 800.0 Moment....Actual ft-# =Service Level Strength Level ft-# = 1,333.3 Moment.....Allowable 5,883.6 = Shear.....Actual Servi Stren Shear Anet (Ma Rebar D Masonry f'm Fs Solid Gro

Service Level	psi =	
Strength Level	psi =	10.7
ShearAllowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
lasonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf=	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Maconry Block Type	_	Modium W

Concrete Data	
Masonry Design Method	= ASD
Masonry Block Type	 Medium Weight
Equiti Cona Tinona	—

f'c

Fy

2,500.0 psi = psi = 60,000.0



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Concrete Stem Rebar Area	Details		
Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.05 in2/ft		
(4/3) * As :	0.0666 in2/ft	Min Stem T&S Reinf Area	1.056 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area	per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Opt	tions :
		One layer of : Two lay	vers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in #4@ 2	25.00 in
Provided Area :	0.2182 in2/ft	#5@ 19.38 in #5@ 3	88.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in #6@ 5	5.00 in
Footing Data	Footing Des	sign Results	
Toe Width –	1 75 ft	Toe Heel	
Heel Width =	1.08 Factored Pressure	$rac{100}{100} = 1.346$) psf
Total Footing Width =	2.83 Mu' : Upward	= 19,058 0) ft-#
Footing Thickness =	10.00 in Mu' : Downward	= 3,638 74	4 ft-#
Key Width =	0.00 in Actual 4 May Cha	= 1,285 /4	+ ft-#
Key Depth =	0.00 in Actual 1-Way She	ar = 10.22 3.70) psi
Key Distance from Toe =	0.00 ft Toe Reinforcing	= None Spec'd	
f'c = 2,500 psi Fy = 60	0,000 psi Heel Reinforcing	= None Spec'd	
Footing Concrete Density = 1	50.00 pcf Key Reinforcing	= None Spec'd	
$\operatorname{Min.} \operatorname{As} \% = 0.$	0018 Footing Torsion, T	u = 0.0	00 ft-lbs
Cover @ Top 2.00 @ Btm.	= 3.00 in Footing Allow. Tor	sion, phi Tu = 0.0	00 ft-lbs
	If torsion exce	eds allowable, provide	
	supplemental	design for footing torsion.	
	Other Acceptable	e Sizes & Spacings	
	Toe: phiMn = p	ohi'5'lambda'sqrt(fc)'Sm	
	Heel: phiMn = p	phi'5'lambda'sqrt(fc)'Sm	
	Key. No key d	ennea	
	Min footing T&S	S reinf Area 0.61	l in2
	Min footing T&S	reinf Area per foot 0.22	2 in2 /ft
	If one layer of h	orizontal bars: If two l	ayers of horizontal bars:
	#4@ 11.11 in	#4@	2 22.22 in
	#ɔ@ 17.22 IN #6@ 24 44 in	#5@ #6@	2 34.44 III 2 48 89 in
	#0@ 24.44 III	#0@	

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

OVERTURNING							RF	SISTING		
Item		Force Ibs	Distanc ft	e	Moment ft-#	_		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	I)	680.6	1.94	1	1,323.3	Soil Over HL (ab. water	r tbl)	248.0	2.62	650.6
HL Act Pres (be water tb Hydrostatic Force	Í)					Soil Over HL (bel. wate Watre Table	r tbl)		2.62	650.6
Buoyant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on Ste	m =			
Added Lateral Load	=					* Axial Live Load on Sten	n =			
Load @ Stem Above Soi	=					Soil Over Toe	=	70.0	0.88	61.3
	=					Surcharge Over Toe	=			
	_					Stem Weight(s)	=	550.0	2.08	1,145.8
			_			Earth @ Stem Transitio	ns=			
Total	=	680.6	О.Т.М.	=	1,323.3	Footing Weight	=	353.8	1.42	500.6
						Key Weight	=			
Resisting/Overturning	g Rat	io	=	1	1.78	Vert. Component	=			
Vertical Loads used f	or So	il Pressure	= 1,2	221.8	lbs	Tot	tal =	1,221.8	bs R.M.=	2,358.2
						* Axial live load NOT incl	uded in	total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.052	in
The above calculation is not valid if the heel soil bearing pr	<u>essure e</u>	exceeds that of the toe,

License To : MALSAM TSANG ENGINEERING							
Criteria							
Retained Height	=	5.00 ft					
Wall height above soil	=	0.50 ft					
Slope Behind Wall	=	0.00					
Height of Soil over Toe	=	4.00 in					
Water height over heel	=	0.0 ft					

Surcharge Loads

Surcharge Over Heel 0.0 psf = NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.43 Ratio < 1.5!
Slab Resist	s All Sli	ding !
Total Bearing Loadresultant ecc.	= =	1,349 lbs 11.59 in
Soil Pressure @ Toe Soil Pressure @ Heel	= =	1,365 psf OK 0 psf OK
Allowable Soil Pressure Less	= Than A	2,000 psf Illowable
ACI Factored @ Toe ACI Factored @ Heel	= =	1,910 psf 0 psf
Footing Shear @ Toe	=	18.5 psi OK
Allowable	=	6.8 psi OK 75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	905.6 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data					
Allow Soil Bearing Equivalent Fluid Pressure	e M	= leth	2,000 od	.0	psf
Active Heel Pressure		=	40	.0	psf/ft
Passive Pressure		=	250	.0	psf/ft
Soil Density, Heel		=	120.0	00	pcf
Soil Density, Toe		=	120.0	00	pcf
Footing Soil Friction		=	0.45	50	
Soil height to ignore for passive pressure		=	12.0	0	in
Lateral Load Appli	ed	l to	Stei	m	
Lateral Load	=		45.0	#/	ft
Height to Top Height to Bottom	=		5.00 0.00	ft ft	
Load Type	=	Se	ismic	(E))
		(Se	ervice	Le	vel)
Wind on Exposed Stem (Service Level)	=		0.0	ps	f

Stem De ۷ Ľ Т F F F De f Т N Ν S S Α R Ма f F S

Fy

Code: IBC 2015,ACI 318-14,ACI 530-13

Restraint	•	
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		0.0.4

=

at Back of Wall

0.0 ft

vice Level)		Poisson's Ratio		=	0.300	
em Construction		Bottom				
Design Height Above Fto	ft =	Stem OK				
Wall Material Above "Ht"	=	Concrete				
Design Method	=	LRFD				
Thickness	=	6.00				
Rebar Size	=	# 4				
Rebar Spacing	=	11.00				
Rebar Placed at	=	Edge				
Design Data						
fb/FB + fa/Fa	=	0.483				
Total Force @ Section						
Service Level	lbs =					
Strength Level	lbs =	1,025.0				
MomentActual						
Service Level	ft-# =					
Strength Level	ft-# =	1,895.8				
MomentAllowable	=	3,920.0				
ShearActual						
Service Level	psi =					
Strength Level	psi =	20.1				
ShearAllowable	psi =	75.0				
Anet (Masonry)	in2 =					
Rebar Depth 'd'	in =	4.25				
Masonry Data						
f'm	psi =					
Fs	psi =					
Solid Grouting	=					
Modular Ratio 'n'	=					
Wall Weight	psf =	75.0				
Short Term Factor	=					
Equiv. Solid Thick.	=					
Masonry Block Type	=	Medium W	eight			
Masonry Design Method	=	ASD				
Concrete Data						
f'c	psi =	2,500.0				

psi = 60,000.0

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Concrete Stem Rebar Area D	etails		
Bottom Stem	Vertical Reinforcing	Horizontal Reinforcir	ng
A_3 (based on applied moment).	0.1072 m2/ft	Min Stom T&S Point	Area 0 702 in 2
(4/3) AS. 2006d/fy:200(12)(4.25)/60000.	0.1429 m2/ft	Min Stem T&S Reini	Area 0.752 IIIZ
0.0018bb : 0.0018(12)(4.23)(500000)	$0.17 \text{ m}^2/\text{ft}$	Horizontal Reinforcir	Area per it of stern height : 0.144 inz/it
0.0010011.0.0010(12)(0).	0.1290 m2/m		ing Options .
Required Area :		#4@ 16.67 in #	#4@ 33 33 in
Provided Area :	0.2182 in 2/ft	#5@ 25.83 in #	#5@ 51 67 in
Maximum Area :	0.5757 in2/ft	#6@ 36 67 in #	#6@ 73.33 in
Footing Data	Footing	Design Results	
Toe Width=Heel Width=Total Footing Width=Footing Thickness=Key Width=Key Depth=Key Distance from Toe=f'c = $2,500 \text{ psi}$ Fy =footing Concrete Density=Min. As %= $0.00000000000000000000000000000000000$	2.00 ft1.25Factored Press3.25Mu' : Upward0.00 inMu' : Downw0.00 inMu: Design0.00 inActual 1-Way0.00 inAllow 1-Way0.00 ftToe Reinford0.00 psiHeel Reinford0.00 pcfKey Reinford018Footing Torsa.300 inFooting Allow	$\begin{array}{rrrr} \hline \text{Toe} \\ \hline \text{essure} &= 1,910 \\ d &= 30,387 \\ \text{vard} &= 4,752 \\ &= 2,136 \\ \text{y Shear} &= 18.54 \\ \text{v Shear} &= 75.00 \\ \text{cing} &= \# 4 @ 11.00 \text{ in} \\ \text{rcing} &= \text{None Spec'd} \\ \text{cing} &= \text{None Spec'd} \\ \text{ion, Tu} &= w \\ \text{v. Torsion, phi Tu} &= 1 \\ \hline \end{array}$	Heel 0 psf 0 ft-# 245 ft-# 245 ft-# 6.80 psi 40.00 psi
	If torsior	n exceeds allowable, provi	de
	supplem	ental design for footing to	rsion.
	Other Accep Toe: #4@ Heel: phiN Key: No	otable Sizes & Spacings 11.11 in, #5@ 17.22 in, #6 In = phi'5'lambda'sqrt(fc)'Sm key defined	@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 າ
	Min footing Min footing If one laye #4@ 11 #5@ 17 #6@ 24	g T&S reinf Area g T&S reinf Area per foot r of horizontal bars: I .11 in .22 in .44 in	0.70 in2 0.22 in2 /ft f two layers of horizontal bars: #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)		R	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	680.6	1.94	1.323.3	Soil Over HL (ab. water tbl)	450.0	2.88	1,293.8
HL Act Pres (be water tbl Hydrostatic Force)			.,	Soil Over HL (bel. water tbl) Watre Table		2.88	1,293.8
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	225.0	3.33	750.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil	=				Soil Over Toe =	80.0	1.00	80.0
	=				Surcharge Over Toe =			
					Stem Weight(s) =	412.5	2.25	928.1
					Earth @ Stem Transitions=			
Total	=	905.6	O.T.M. =	2,073.3	Footing Weight =	406.3	1.63	660.2
					Key Weight =			
Resisting/Overturning	y Rati	io	=	1.43	Vert. Component =			
Vertical Loads used for	or Soi	I Pressure	= 1,348.	8 lbs	Total =	1,348.8	lbs R.M.=	2,962.0
					* Axial live load NOT included	in total displa	yed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.064	in
The above calculation is not valid if the heel soil bearing pro	<u>essure e</u>	exceeds that of the toe,

License To : MALSAM TSANG ENGINEERING							
	Criteria						
	Retained Height	=	5.00 ft				
	Wall beight above soil	_	0.50 ft				
	Slope Rehind Wall	_	0.50 ft				
		-	0.00				
	Height of Soll over 1 oe	=	4.00 In				
	Water height over heel	=	0.0 ft				

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.99 OK	
Slab Resist	s All S	Sliding !	
Total Bearing Loadresultant ecc.	= =	1,308 lbs 6.01 in	
Soil Pressure @ Toe Soil Pressure @ Heel	= =	872 psf OK 0 psf OK	
Allowable Soil Pressure Less	= Thar	2,000 psf Allowable	
ACI Factored @ Toe ACI Factored @ Heel	= =	1,221 psf 0 psf	
Footing Shear @ Toe	=	9.6 psi OK	
Footing Shear @ Heel	=	5.6 psi OK	
Allowable	=	75.0 psi	
Sliding Calcs			
Lateral Sliding Force	=	680.6 lbs	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing	e M	= leth	2,000.0 od	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	150.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Stem	
Lateral Load Height to Top Height to Bottom	= = =		0.0 #/ 0.00 ft 0.00 ft	ft
Load Type	=	Wi (Se	ind (W) ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Stem De W D TI R Re R Des fb Т Μ Μ S S A Re Ma f'n F S

Restrain				
Adjacent Footing Load				
Adjacent Footing Load =	0.0 lbs			

Code: IBC 2015,ACI 318-14,ACI 530-13

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

n Construction		Bottom	
eeine Heinkt Akeure Ete		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=		
I NICKNESS	=	6.00	
Rebar Spacing	=	# 4 12.00	
Rebar Discord of	_	TZ.00	
Design Data	=	Euge	
fb/FB + fa/Fa	=	0.369	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	800.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	1,333.3	
MomentAllowable	=	3,612.6	
ShearActual			
Service Level	psi =		
Strength Level	psi =	15.7	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	4.25	
lasonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf=	75.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weigh	t
Masonry Design Method	=	ASD	

Concrete Data

2,500.0 psi = f'c psi = 60,000.0 Fy

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Concrete Stem Rebar Area Details		
Bottom Stem Vertic	cal Reinforcing Horizontal Reinforcing	
As (based on applied moment) : 0.075	54 in2/ft	
(4/3) * As : 0.100	05 in2/ft Min Stem T&S Reinf Ar	rea 0.792 in2
200bd/fy:200(12)(4.25)/60000: 0.17 i	in2/ft Min Stem T&S Reinf Ar	rea per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) : 0.129	6 in2/ft Horizontal Reinforcing	Options :
====	====== One layer of : Two	layers of :
Required Area : 0.129	06 in2/ft #4@ 16.67 in #4@	@ 33.33 in
Provided Area : 0.2 in	2/ft #5@ 25.83 in #5@	@ 51.67 in
Maximum Area : 0.575	i7 in2/ft #6@ 36.67 in #6@	@ 73.33 in
Footing Data	Footing Design Results	
Toe Width= 1.75 ft Heel Width= 1.25 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 = $2,500 \text{ psi}$ Fy = $60,000 \text{ psi}$ Footing Concrete Density= 150.00 pcf Min. As %= 0.0018 Cover @ Top 2.00 @ Btm.= 3.00 in	ToeHFactored Pressure=1,221Mu': Upward=18,072Mu': Downward=3,638Mu: Design=1,203Actual 1-Way Shear=9.585Allow 1-Way Shear=40.0040Toe Reinforcing=None Spec'dHeel Reinforcing=None Spec'dFooting Torsion, Tu=Footing Allow. Torsion, phi Tu=If torsion exceeds allowable, providesupplemental design for footing torsiOther Acceptable Sizes & SpacingsToe:phiMn = phi'5'lambda'sqrt(fc)'SmHeel:phiMn = phi'5'lambda'sqrt(fc)'SmKey:No key definedMin footing T&S reinf Area0Min footing T&S reinf Area per foot0If one layer of horizontal bars:If tw#4@ 11.11 in##6@ 24.44 in#	eel 0 psf 28 ft-# 245 ft-# 216 ft-# 5.61 psi 0.00 psi 0.00 ft-lbs 0.00 ft-lbs 0.00 ft-lbs ion. 0.65 in2 0.22 in2 /tt vo layers of horizontal bars: ±4@ 22.22 in ±5@ 34.44 in ±6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0\		JING				RE	SISTING	
Item		Force lbs	Distanc	e	Moment ft-#	_		Force Ibs	Distance	Moment ft-#
HL Act Pres (ab water tb	1)	680.6	1.94	1	1.323.3	Soil Over HL (ab. wate	er tbl)	450.0	2.63	1,181.3
HL Act Pres (be water the Hydrostatic Force	I)				.,	Soil Over HL (bel. wat Watre Table	er tbl)		2.63	1,181.3
Buovant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on St	em =			
Added Lateral Load	=					* Axial Live Load on Ste	m =			
Load @ Stem Above So	il =					Soil Over Toe	=	70.0	0.88	61.3
	=					Surcharge Over Toe	=			
						Stem Weight(s)	=	412.5	2.00	825.0
			_			Earth @ Stem Transiti	ons=			
Total	=	680.6	О.Т.М.	=	1,323.3	Footing Weight	=	375.0	1.50	562.5
						Key Weight	=			
Resisting/Overturnin	g Rat	io	=		1.99	Vert. Component	=			
Vertical Loads used f	or So	il Pressure	= 1,	307.5	lbs	T	otal =	1,307.5 I	bs R.M.=	2,630.0
						* Axial live load NOT inc	luded ir	n total display	ed, or used fo	r overturning

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.044	in
The above calculation is not valid if the heel soil bearing p	oressure e	exceeds that of the toe,

License To : MALSAM TSANG ENGINEERING						
Criteria						
Retained Height	=	12.00 ft				
Wall height above soil	=	0.50 ft				
Slope Behind Wall	=	0.00				
Height of Soil over Toe	=	4.00 in				
Water height over heel	=	0.0 ft				

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning Slab Resis	= ts All	1.98 OK Sliding !
		Chang.
Total Bearing Load	=	5,641 lbs
resultant ecc.	=	12.76 in
Soil Pressure @ Toe	=	1,392 psf OK
Soil Pressure @ Heel	=	113 psf OK
Allowable	=	2,000 psf
Soil Pressure Less	Tha	n Allowable
ACI Factored @ Toe	=	1,949 psf
ACI Factored @ Heel	=	158 psf
Footing Shear @ Toe	=	34.5 psi OK
Footing Shear @ Heel	=	15.5 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	3,511.3 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing		=	2,000.0	psf
Equivalent Fluid Pressure Active Heel Pressure	эN	leth =	od 40.0	psf/ft
		_		
Passive Pressure		=	150.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appli	ec	l to	Stem	
Lateral Load Height to Top Height to Bottom	= = =		0.0 #/ 0.00 ft 0.00 ft	ft
Load Type	=	Wi (Se	ind (W) ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Stem Construction Bottom Stem O Desig Wal Des Thic Reb Reb Reb Desig fb/F Tota S S Mo Ś S Mor She 3 Ś She Ane Reb Maso f'm Fs Soli

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

Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	12.00	
Rebar Size	=	# 6	
Rebar Spacing	=	8.00	
Rebar Placed at	=	Edge	
Design Data		0 701	
TD/FB + Ta/Fa	=	0.701	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	4,608.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	18,432.0	
MomentAllowable	=	26,273.2	
ShearActual			
Service Level	psi =		
Strength Level	psi =	39.9	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	9.63	
lasonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf=	150.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium We	eight
Masonry Design Method	=	ASD	
New exects Deta			

Concrete Data f'c

Fy

psi = 2,500.0 psi = 60,000.0

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-	Concrete Stem Rebar Area Details			
	Bottom Stem Vertica As (based on applied moment) 0 4401	al Reinforcing	Horizontal Reinforcing	
	(4/3) * As : 0.5868	3 in2/ft	Min Stem T&S Reinf Area	a 3.600 in2
	200bd/fy : 200(12)(9.625)/60000 : 0.385	in2/ft	Min Stem T&S Reinf Area	a per ft of stem Height : 0.288 in2/ft
	0.0018bh : 0.0018(12)(12) : 0.2592	2 in2/ft	Horizontal Reinforcing O	ptions : avers of :
	Required Area : 0.4401	 in2/ft	#4@ 8.33 in #4@	16.67 in
	Provided Area : 0.66 in	2/ft	#5@ 12.92 in #5@	25.83 in
	Maximum Area : 1.3039) in2/ft	#6@ 18.33 in #6@	36.67 in
	Footing Data	Footing Desi	ign Results	
	Toe Width = 5.00 ft Heel Width = 2.50 Total Footing Width = 7.50 Footing Thickness = 15.00 in Key Width = 0.00 in Key Depth = 0.00 in Key Distance from Toe = 0.00 ft f'c = $2,500 \text{ psi}$ Fy = $60,000 \text{ psi}$ Footing Concrete Density = 150.00 pcf Min. As % = 0.0018 Cover @ Top 2.00 @ Btm.= 3.00 in	Factored Pressure Mu': Upward Mu': Downward Mu: Design Actual 1-Way Sheaa Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Footing Torsion, Tu Footing Allow. Torsi If torsion excee supplemental of Other Acceptable Toe: #4@ 5.67 i Heel: phiMn = ph Key: No key def Min footing T&S n Min footing T&S n If one layer of hon #4@ 7.41 in #5@ 11.48 in #6@ 16.30 in	Toe Her = 1,949 16 = 232,581 3' = 40,950 2,19 = 15,969 1,88 r = 34.47 15.5 = 75.00 40.0 = # 6 @ 11.00 in 10.0 = None Spec'd 10.0 = None Spec'd 10.0 = 0 0 0 eds allowable, provide 10.0 design for footing torsion 0 Sizes & Spacings 1.46@ 12.4 n'5'lambda'sqrt(fc)'Sm 11.00 reinf Area 2.4 reinf Area per foot 0.3 rizontal bars: If two #44 #51	 ali 58 psf 58 psf 12 ft+# 37 ft+# 36 ft-# 54 psi 00 psi .00 ft-lbs .00 ft-lbs .00 ft-lbs n. 17 in, #7@ 17.01 in, #8@ 22.40 in, #9@ 28. 43 in2 32 in2 /ft olayers of horizontal bars: @ 14.81 in @ 22.96 in @ 32.59 in
Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0\	ERTURN	IING.			R	ESISTING	
Item		Force lbs	Distanc ft	e	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	I)	3,511.3	4.42	2	15,508.0	Soil Over HL (ab. water tbl) 2,160.0	6.75	14,580.0
HL Act Pres (be water tb	í)	,				Soil Over HL (bel. water the	I)	6.75	14,580.0
Hydrostatic Force	,					Watre Table			
Buoyant Force	=					Sloped Soil Over Heel =			
Surcharge over Heel	=					Surcharge Over Heel =	:		
Surcharge Over Toe	=					Adjacent Footing Load =	:		
Adjacent Footing Load	=					Axial Dead Load on Stem =			
Added Lateral Load	=					* Axial Live Load on Stem =	:		
Load @ Stem Above Soi	=					Soil Over Toe =	= 200.0	2.50	500.0
	=					Surcharge Over Toe =	:		
						Stem Weight(s) =	1,875.0	5.50	10,312.5
			-			Earth @ Stem Transitions =	:		
Total	=	3,511.3	O.T.M.	=	15,508.0	Footing Weight =	1,406.3	3.75	5,273.4
						Key Weight =	:		
Resisting/Overturning	g Rat	io	=	1	.98	Vert. Component =	:		
Vertical Loads used f	or So	il Pressure	= 5,0	641.3	lbs	Total =	= 5,641.3	lbs R.M.=	30,665.9
						* Axial live load NOT include	d in total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.064	in
The above calculation is not valid if the heel soil bearing pro	<u>essure e</u>	exceeds that of the toe,

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	Criteria			I	
	Detained Lleight	=	4 00 ft		
		_	4.00 11		
	Wall height above soil	=	0.50 ft		
	Slope Behind Wall	=	0.00		
	Height of Soil over Toe	=	4.00 in		
	Water height over heel	=	0.0 ft		

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.45 Rati	> 0
Slab Resist	ts All	Sliding !	
Total Bearing Loadresultant ecc.	= =	1,095 lbs 9.18 in	
Soil Pressure @ Toe Soil Pressure @ Heel	=	1,392 psf 0 psf	OK OK
Allowable Soil Pressure Less	= Tha	2,000 psf n Allowable	
ACI Factored @ Toe ACI Factored @ Heel	= =	1,948 psf 0 psf	
Footing Shear @ Toe	=	9.4 psi	OK
Footing Shear @ Heel	=	2.6 psi	OK
	=	75.0 psi	
Latoral Sliding Force		644 0 lba	
Lateral Silulity FUICE	=	044.0 IDS	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing Equivalent Fluid Pressure	e M	= leth	2,000.0	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	150.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appli	iec	l to	Stem	
Lateral Load Height to Top Height to Bottom	= =		36.0 #/ 4.00 ft 0.00 ft	′ft
Load Type	=	Se (S	eismic (E ervice Le) evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

01

.... Dettem ~ . Rebar Depth 'd' 6.25 in = Masonry Data f'm psi = Fs psi = Solid Grouting = Modular Ratio 'n'

Code: IBC 2015,ACI 318-14,ACI 530-13

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

	Stem Construction		Бошот	
5	Design Usight Above Fts		Stem OK	
	Design Height Above Ftg	ft =	0.00	
	Wall Material Above "Ht"	=	Concrete	
< 1.	5! Design Method	=	LRFD	
	Thickness	=	8.00	
	Rebar Size	=	# 4	
	Rebar Spacing	=	9.00	
	Rebar Placed at	=	Edge	
ĸ	Design Data			
ĸ	fb/FB + fa/Fa	=	0.136	
IX.	Total Force @ Section			
	Service Level	lbs =		
	Strength Level	lbs =	656.0	
	MomentActual			
V	Service Level	ft-# =		
ĸ	Strength Level	ft-# =	970.7	
IX.	MomentAllowable	=	7,122.4	
	ShearActual			
	Service Level	psi =		
	Strength Level	psi =	8.7	
	ShearAllowable	psi =	75.0	
	Anet (Masonry)	in2 =		

L

= Wall Weight psf = 100.0 Short Term Factor = Equiv. Solid Thick. = Masonry Block Type Medium Weight =

Concrete Data			-
Masonry Design Me	thod =	ASD	
Masoni y Diock Type	. –	Mculum	vvcig

psi = 2,500.0 psi = 60,000.0

f'c

Fy

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINE	Cantilevered R	etaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area Det	ails		
Bottom Stem As (based on applied moment) :	Vertical Reinforcing 0.0364 in2/ft	Horizontal Reinforcing	
(4/3) * As :	0.0485 in2/ft	Min Stem T&S Reinf Area	0.864 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area	per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Op	tions :
		One laver of : Two lav	vers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in #4@ 2	25.00 in
Provided Area :	0.2667 in2/ft	#5@ 19.38 in #5@ 3	38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in #6@ 5	55.00 in
Footing Data	Footing Desig	gn Results	
Toe Width= 1.5 Heel Width= 1.0 Total Footing Width= 2.5 Footing Thickness= 12.0 Key Width= 0.0 Key Depth= 0.0 Key Distance from Toe= 0.0 f'c = $2,500$ psiFy = $60,00$ Footing Concrete Density= 150.0 Min. As %= 0.001 Cover @ Top 2.00 @ Btm= 3	0 ft 8 Factored Pressure 8 Mu': Upward 0 in Mu': Downward 0 in Actual 1-Way Shear 0 in Allow 1-Way Shear 0 ft Toe Reinforcing 0 psi Heel Reinforcing 0 pcf Key Reinforcing 8 Footing Torsion, Tu 8.00 in Footing Allow. Torsion	Toe Hee = 1,948 0 = 17,949 0 = 3,078 63 = 1,239 63 = 75.00 40.00 = # 4 @ 9.00 in 9.00 in = None Spec'd 0.00 = None Spec'd 0.00 = 0.00 0.00	l D psf D ft-# 5 ft-# D psi 0 psi 00 ft-lbs 00 ft-lbs
	If torsion exceed	ds allowable, provide	
	supplemental de	esign for footing torsion	I-
	Other Acceptable S Toe: #4@ 9.25 in Heel: phiMn = phi Key: No key defin	Sizes & Spacings n, #5@ 14.35 in, #6@ 20.3 '5'lambda'sqrt(fc)'Sm ned	37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46
	Min footing T&S re Min footing T&S re If one layer of hori	einf Area 0.6 einf Area per foot 0.20 izontal bars: If two	7 in2 6 in2 <i>f</i> t layers of horizontal bars:

one layer of horizo
#4@ 9.26 in
#5@ 14.35 in
#6@ 20.37 in

If two layers of horizontal bars: #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNIN	G		R	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HI Act Pres (ab water to	I)	500.0	1.67	833.3	Soil Over HL (ab. water tbl)) 198.4	2.37	470.9
HL Act Pres (be water tb) Hydrostatic Force	l)				Soil Over HL (bel. water tbl Watre Table)	2.37	470.9
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	144.0	3.00	432.0	* Axial Live Load on Stem =			
Load @ Stem Above Soi	=				Soil Over Toe =	60.0	0.75	45.0
	=				Surcharge Over Toe =			
					Stem Weight(s) =	450.0	1.83	825.0
					Earth @ Stem Transitions=			
Total	=	644.0	O.T.M. =	1,265.3	Footing Weight =	387.0	1.29	499.2
					Key Weight =			
Resisting/Overturning	g Rat	io	=	1.45	Vert. Component =			
Vertical Loads used for	or Soi	I Pressure	= 1,09	5.4 lbs	Total =	1,095.4	lbs R.M.=	1,840.1
					* Axial live load NOT included	d in total displa	yed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.067	in
The above calculation is not valid if the heel soil bearing	pressure e	exceeds that of the toe,

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Criteria			I		
Retained Height	=	4.00 ft			
Wall height above soil	=	0.50 ft			
Slope Behind Wall	=	0.00			
Height of Soil over Toe	=	4.00 in			
Water height over heel	=	0.0 ft			
	cense To : MALSAM TS Criteria Retained Height Wall height above soil Slope Behind Wall Height of Soil over Toe Water height over heel	cense To : MALSAM TSANG Criteria Retained Height = Wall height above soil = Slope Behind Wall = Height of Soil over Toe = Water height over heel =	cense To : MALSAM TSANG ENGINEERING Criteria Retained Height = 4.00 ft Wall height above soil = 0.50 ft Slope Behind Wall = 0.00 Height of Soil over Toe = 4.00 in Water height over heel = 0.0 ft		

Surcharge Loads

Surcharge Over Heel 0.0 psf = NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.89 OK
Slab Resis	ts All	Sliding !
Total Bearing Load	=	1,048 lbs
resultant ecc.	=	5.52 in
Soil Pressure @ Toe	=	991 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
Soil Pressure Less	s Tha	n Allowable
ACI Factored @ Toe	=	1,387 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	4.4 psi OK
Footing Shear @ Heel	=	2.5 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	500.0 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing Equivalent Fluid Pressur	e M	= leth	2,000.0	psf
Active Heel Pressure	•	=	40.0	psf/ft
		=		
Passive Pressure		=	150.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Stem	
Lateral Load	=		0.0 #/	'ft
Height to Top	=		0.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	W	ind (W)	
		(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)	¹ =		0.0 ps	sf

Stem Des W De T٢ Re Re Re Des fb/ Тс M M Sł Sł Ar Re Mas f'n Fs Sc M

Restraint		
Adjacent Footing	Load	
Adjacent Footing Load Footing Width	=	0.0 lbs 0.00 ft

Code: IBC 2015,ACI 318-14,ACI 530-13

i ooling 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

n Construction		Bottom	
Seeine Heinkt Aberra Et-		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
I hickness	=	8.00	
Rebar Size	=	# 4	
Rebai Spacing	=	9.00	
Rebar Placed at	=	Edge	
fb/FB + fa/Fa	=	0.095	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	512.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	682.7	
MomentAllowable	=	7,122.4	
ShearActual			
Service Level	psi =		
Strength Level	psi =	6.8	
ShearAllowable	, psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
lasonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium We	eight
Masonry Design Method	=	ASD	

Concrete Data f'c

Fy

2,500.0 psi = psi = 60,000.0

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Concrete Stem Rebar Area Details	6		
Bottom Stem	/ertical Reinforcing	Horizontal Reinforc	ing
As (based on applied moment) :).0256 in2/ft		5
(4/3) * As :	0.0341 in2/ft	Min Stem T&S Reir	nf Area 0.864 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reir	nf Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) :).1728 in2/ft	Horizontal Reinforc	ing Options :
=		One layer of :	Two layers of :
Required Area : 0).1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area : 0).2667 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area : 0).8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in
Footing Data	Footing Des	ign Results	
Toe Width = 1.25 ft		Toe	Heel
Heel Width = 1.08	Factored Pressure	= 1,387	0 psf
Total Footing Width = 2.33	Mu' : Upward	= 10,443	1 ft-#
Footing Thickness = 12.00 in	Mu' : Downward	= 2,138	65 ft-#
Key Width = 0.00 in	Actual 1-Way She	= 0.92	04 II-# 2 50 psi
Key Depth = 0.00 in	Allow 1-Way Shea	r = 40.00	40.00 psi
Key Distance from Toe = 0.00 ft	Toe Reinforcing	= None Spec'd	•
f'c = 2,500 psi Fy = 60,000 ps	i Heel Reinforcing	= None Spec'd	
Footing Concrete Density = 150.00pc	t Key Reinforcing	= None Spec'd	
MID. AS % = 0.0018 Cover @ Top 2.00 @ $Btm = 3.00$	in Easting Allow Tar		0.00 ft lbs
	Footing Allow. Tors		
	If torsion exce	eas allowable, prov	nde ersien
	supplemental		
	Other Acceptable	Sizes & Spacings	
	Toe: phiMn = pl Heel: phiMn = pl Key: No key de	hi'5'lambda'sqrt(fc)'Si hi'5'lambda'sqrt(fc)'Si fined	m m
	Min footing T&S Min footing T&S If one layer of ho #4@ 9.26 in #5@ 14.35 in #6@ 20.37 in	reinf Area reinf Area per foot prizontal bars:	0.60 in2 0.26 in2 /tt If two layers of horizontal bars: #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0	FRTURN	IING				RF	SISTING	
Item		Force lbs	Distanc ft	e Mo	ment t-#	_		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	500.0	1.67	7	833.3	Soil Over HL (ab. water	tbl)	198.4	2.12	421.3
HL Act Pres (be water tbl)					Soil Over HL (bel. wate	r tbl)		2.12	421.3
Hydrostatic Force						Watre Table				
Buoyant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on Ste	m =			
Added Lateral Load	=					* Axial Live Load on Stem	ר =			
Load @ Stem Above Soi	=					Soil Over Toe	=	50.0	0.63	31.3
	=					Surcharge Over Toe	=			
						Stem Weight(s)	=	450.0	1.58	712.5
			_			Earth @ Stem Transition	ns=			
Total	=	500.0	О.Т.М.	=	833.3	Footing Weight	=	349.5	1.17	407.2
						Key Weight	=			
Resisting/Overturning	g Rat	io	=	1.89		Vert. Component	=			
Vertical Loads used for	or So	il Pressure	= 1,0	047.9 lbs	5	Tot	al =	1,047.9	bs R.M.=	1,572.2
						* Axial live load NOT inclu	uded in	total display	ed, or used for	roverturning

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.053	in
The above calculation is not valid if the heel soil bearing p	ressure e	exceeds that of the toe,

L	icense To : MALSAM TSANG ENGINEERING									
	Criteria									
	Retained Height	=	4 00 ft							
	Wall height above soil	=	0.50 ft							
	Slope Behind Wall	=	0.00							
	Height of Soil over Toe	=	4.00 in							
	Water height over heel	=	0.0 ft							

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	1.27 Ratio < 1.5!
Slab Resist	s All Sli	iding !
Total Bearing Loadresultant ecc.	= =	871 lbs 10.39 in
Soil Pressure @ Toe Soil Pressure @ Heel Allowable	= =	1,687 psf_OK 0 psf_OK 2,000 psf
Soil Pressure Less	Than A	Allowable
ACI Factored @ Toe ACI Factored @ Heel	= =	2,361 psf 0 psf
Footing Shear @ Toe	=	15.3 psi OK
Footing Shear @ Heel	=	3.6 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	595.3 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing Equivalent Fluid Pressure	e M	= leth	2,000.0 od	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	250.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appli	ied	l to	Stem	
Lateral Load Height to Top Height to Bottom	=		36.0 #/ 4.00 ft 0.00 ft	ft
Load Type	=	Se (Se	eismic (E ervice Le) evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Sten D D Μ

Code: IBC 2015,ACI 318-14,ACI 530-13



=

=

0.0 ft

0.300

Base Above/Below Soil

at Back of Wall Poisson's Ratio

	_		
n Construction		Bottom	
eeine Heinht Abeur Ete		Stem OK	
Vesign Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
I NICKNESS	=	6.00	
Rebar Size	=	# 4	
	=	12.00	
Rebar Placed at	=	Edge	
fb/FB + fa/Fa	_	0 268	
Total Force @ Section	-	0.200	
	lle e		
	IDS =		
Strength Level	IDS =	656.0	
MomentActual	e. 11		
Service Level	π-# =		
Strength Level	ft-# =	970.7	
MomentAllowable	=	3,612.6	
ShearActual			
Service Level	psi =		
Strength Level	psi =	12.9	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	4.25	
lasonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	75.0	
Short Term Factor	- =		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium We	eight
Masonry Design Method	=	ASD	-
,		-	

Concrete Data f'c

Fy

2,500.0 psi = psi = 60,000.0

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINEERING	Cantilevered Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area Details		
Bottom Stem Vertica	al Reinforcing Horizontal Reinforcing	
As (based on applied moment) : 0.0549	9 in2/ft	
(4/3) * As : 0.0732	2 in2/ft Min Stem T&S Reinf Ar	ea 0.648 in2
200bd/fy : 200(12)(4.25)/60000 : 0.17 ir	n2/ft Min Stem T&S Reinf Ar	ea per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) : 0.1296	6 in2/ft Horizontal Reinforcing C	Options :
=====	One layer of : Two	layers of :
Required Area : 0.1296	6 in2/ft #4@ 16.67 in #4@	⊉ 33.33 in
Provided Area : 0.2 in2	2/ft #5@ 25.83 in #5@	⊉ 51.67 in
Maximum Area : 0.5757	7 in2/ft #6@ 36.67 in #6@	⊉ 73.33 in
Footing Data	Footing Design Results	
Toe Width = 1.50 ft	Toe H	eel
Heel Width = 0.92	Factored Pressure = 2,361	0 psf
Total Footing Width = 2.42	Mu' : Upward = 16,916	0 ft-#
Footing Thickness = 9.00 in	Mu': Downward = $2,471$	63 ft-#
Key Width = 0.00 in	Mu. Design = $1,204$ Actual 1-Way Shear = 15.34 3	03 II-#
Key Depth = 0.00 in	Allow 1-Way Shear = 75.00 40	.00 psi
Key Distance from Toe = 0.00 ft	Toe Reinforcing = $#4 @ 12.00$ in	
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = None Spec'd	
Min. As % = 0.0018	Footing Torsion, Tu =	
	Footing Allow. Torsion, phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable, provide	
	supplemental design for footing torsi	on.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 12.34 in, #5@ 19.13 in, #6@ Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: No key defined	27.16 in, #7@ 37.03 in, #8@ 48.76 in, #9@ 6
	Min footing T&S reinf Area0Min footing T&S reinf Area per foot0If one layer of horizontal bars:If tw#4@ 12.35 in#4#5@ 19.14 in#4#6@ 27.16 in#4	.47 in2 .19 in2 /ft ro layers of horizontal bars: 4@ 24.69 in 5@ 38.27 in 6@ 54.32 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING			RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HI Act Pres (ab water tbl))	451.3	1.58	714.5	Soil Over HL (ab. water tbl)	201.6	2.21	445.5
HL Act Pres (be water tbl) Hydrostatic Force)				Soil Over HL (bel. water tbl) Watre Table		2.21	445.5
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	144.0	2.75	396.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil	=	-	-		Soil Over Toe =	60.0	0.75	45.0
	=				Surcharge Over Toe =			
					Stem Weight(s) =	337.5	1.75	590.6
					Earth @ Stem Transitions=			
Total	=	595.3	O.T.M. =	1,110.5	Footing Weight =	272.3	1.21	329.4
					Key Weight =			
Resisting/Overturning	g Rati	0	=	1.27	Vert. Component =			
Vertical Loads used for	or Soil	Pressure	= 871.	4 lbs	Total =	871.4 I	bs R.M.=	1,410.6
					* Axial live load NOT included	in total display	ed, or used for	r overturning

resistance, but is included in total displayed, or used for overturning

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.087	in
The above calculation is not valid if the heel soil bearing p	oressure	exceeds that of the toe,

icense To : MALSAM TS	SANG	ENGINEERIN	G					
Criteria								
Retained Height	=	4.00 ft						
Wall height above soil	=	0.50 ft						
Slope Behind Wall	=	0.00						
Height of Soil over Toe	=	4.00 in						
Water height over heel	=	0.0 ft						

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning = 1.97 OK Slab Resists All Sliding ! **Total Bearing Load** 871 lbs = ...resultant ecc. 4.93 in = Soil Pressure @ Toe 727 psf OK = 0 psf OK Soil Pressure @ Heel = 2,000 psf Allowable _ Soil Pressure Less Than Allowable ACI Factored @ Toe 1,018 psf = ACI Factored @ Heel = 0 psf Footing Shear @ Toe 7.4 psi OK = Footing Shear @ Heel 3.2 psi OK = Allowable = 75.0 psi **Sliding Calcs** Lateral Sliding Force 451.3 lbs =

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing	∍ M	= leth	2,000.0	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	150.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appli	ec	l to	Stem	
Lateral Load Height to Top Height to Bottom	=		0.0 #/ 0.00 ft 0.00 ft	ft
Load Type	_	۱۸/		
Load Type	_	(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Stem C Desig Wal Des Thic Reb Reb Reb Desig fb/F Tota S S Mor S S Mor She S S Shea Ane Reb Maso f'm Fs Soli



m Construction		Bottom	
		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	6.00	
Rebar Size	=	# 4	
Rebar Spacing	=	12.00	
Rebar Placed at	=	Edge	
Design Data		0.400	
tb/FB + ta/Fa	=	0.188	
I otal Force @ Section			
Service Level	Ibs =		
Strength Level	lbs =	512.0	
MomentActual	e 11		
Service Level	π-# =		
Strength Level	ft-# =	682.7	
MomentAllowable	=	3,612.6	
ShearActual			
Service Level	psi =		
Strength Level	psi =	10.0	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	4.25	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	. =		
Modular Ratio 'n'	=		
Wall Weight	psf=	75.0	
Short Term Factor	. =		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	2,500.0	
Fy	psi =	60,000.0	
-	-		

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Concrete Stem Rebar Are	a Details			
Bottom Stem	Vertica	l Reinforcina	Horizontal Reinfor	cina
As (based on applied moment) :	0.0386	in2/ft		
(4/3) * As :	0.0515	in2/ft	Min Stem T&S Re	inf Area 0.648 in2
200bd/fy : 200(12)(4.25)/60000 :	0.17 in:	2/ft	Min Stem T&S Re	inf Area per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) :	0.1296	in2/ft	Horizontal Reinfor	cing Options :
	=====:	======	One layer of :	Two layers of :
Required Area :	0.1296	in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2 in2	/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757	in2/ft	#6@ 36.67 in	#6@ 73.33 in
Footing Data		Footing Desi	ign Results	
Toe Width -	1 50 ft		Toe	Heel
Heel Width =	0.92	Factored Pressure	= 1.018	0 psf
Total Footing Width =	2.42	Mu' : Upward	= 10,876	4 ft-#
Footing Thickness =	9.00 in	Mu' : Downward	= 2,471	63 ft-#
Key Width =	0.00 in	Mu: Design	= 700	58 ft-#
Key Depth =	0.00 in	Allow 1-Way Shear	= 40.00	40.00 psi
Key Distance from Toe =	0.00 ft	Toe Reinforcing	= None Spec'd	
f'c = 2,500 psi Fy =	60,000 psi	Heel Reinforcing	= None Spec'd	
Footing Concrete Density =	150.00 pcf	Key Reinforcing	= None Spec'd	
Min. As % =	0.0018	Footing Torsion, Tu	=	0.00 ft-lbs
Cover @ Top 2.00 @ Bi	.m.= 3.00 m	Footing Allow. Tors	ion, phi lu =	0.00 ft-lbs
		If torsion excee	eds allowable, pro lesion for footing	vide torsion
		Other Accentable		
			JIZES & Spacing	5 2m
		Heel: $phiMn = phi$	i'5'lambda'sqrt(fc)'	Sm
		Key: No key def	ined	
		Min footing T&S	reinf Area	0.47 in2
		Min footing T&S r	einf Area per foot	0.19 in2 <i>i</i> ft
		If one layer of hor	izontal bars:	If two layers of horizontal bars:
		#4@ 12.35 in		#4@ 24.69 in
		#5@ 19.14 in		#5@ 38.27 in
		#o@ 27.16 IN		#U@ 54.52 III

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING			RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		451.3	1.58	714.5	Soil Over HL (ab. water tbl)	201.6	2.21	445.5
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.21	445.5
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=				* Axial Live Load on Stem =			
Load @ Stem Above Soil	=				Soil Over Toe =	60.0	0.75	45.0
	=				Surcharge Over Toe =			
					Stem Weight(s) =	337.5	1.75	590.6
					Earth @ Stem Transitions =			
Total	=	451.3	O.T.M. =	714.5	Footing Weight =	272.3	1.21	329.4
					Key Weight =			
Resisting/Overturning	Ratio	כ	=	1.97	Vert. Component =			
Vertical Loads used fo	r Soil	Pressure	= 871.	.4 lbs	Total =	871.4	bs R.M.=	1,410.6
					* Axial live load NOT included i	n total displaye	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.038	in
The above calculation is not valid if the heel soil bearing pr	essure e	exceeds that of the toe,

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Criteria			
Retained Height	=	0.00 ft	
Wall height above soil	=	0.00 ft	
Slope Behind Wall	=	0.00	
Height of Soil over Toe	=	0.00 in	
Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applied to otem			
Axial Dead Load	=	0.0 lbs	
Axial Live Load	=	0.0 lbs	
Axial Load Eccentricity	=	0.0 in	
Decian Summery			

Design Summary

Wall Stability Ratios Overturning Sliding	=	0.00 OK 0.00 OK	
Total Bearing Loadresultant ecc.	=	0 lbs 3.00 in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Tha = =	0 psf Ol 0 psf Ol 0 psf an Allowable 0 psf 0 psf	< <
Footing Shear @ Toe Footing Shear @ Heel Allowable Sliding Calcs	= = =	25.9 psi Oł 0.0 psi Oł 67.1 psi	۲ ۲
Lateral Sliding Force less 0 % Passive Force less 0 % Friction Force Added Force Req'd for 1.5 Stability		0.0 lbs 0.0 lbs 0.0 lbs 0.0 lbs Of 0.0 lbs Of 0.0 lbs Of	< K

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.000
Seismic, E	1.700

Cantilevered Retaining Wall Soil Data Allow Soil Bearing 0.0 psf Equivalent Fluid Pressure Method Active Heel Pressure 0.0 psf/ft = = ~ ~ - 6/61

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Passive Pressure	:	=	0.0	psi/it	
Soil Density, Heel		=	0.00	pcf	
Soil Density, Toe		=	0.00	pcf	
Footing Soil Friction		=	0.000		
Soil height to ignore for passive pressure		=	0.00	in	
Lateral Load Applied to Stem					
	eu	10 3	Jiem		
Lateral Load	=		0.0 #/	ft	
Lateral Load Lateral Load Height to Top Height to Bottom	= = =		0.0 #/ 0.00 ft 0.00 ft	ft	
Lateral Load Height to Top Height to Bottom Load Type	= = = =		0.0 #/ 0.00 ft 0.00 ft	ft	
Lateral Load Height to Top Height to Bottom Load Type	= = =	(Serv	0.0 #/ 0.00 ft 0.00 ft vice Le	ft evel)	

Ster C Ν

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 0.0 ft = at Back of Wall Poisson's Ratio 0.300 =

Code: IBC 2018,ACI 318-14,TMS 402-16

em Construction	_	Bottom	
Design Usight Above Etc		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	3	
Design Method	=		
I NICKNESS	=	0.00	
Rebai Size	=	# 0	
Rebai Spacing	-	Contor	
Design Data	=	Center	
fb/FB + fa/Fa	=	0.000	
Total Force @ Section			
Service Level	lhs –		
Strength Level	lbs –		
MomentActual	103 -		
Service Level	ft-# =		
Strength Level	ft-# =		
Moment Allowable		0.0	
Sheer Actual	-	0.0	
ShearActual			
Service Level	psi =		
Strength Level	psi =		
ShearAllowable	psi =	0.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	0.00	
Masonry Data			
f'm -	psi =	1,500	
Fs	psi =	32,000	
Solid Grouting	=	NO 0.00	
Modular Ratio n	,=	0.00	
Wall Weight	pst =	0.0	
Short Term Factor	. =	1.000	
Equiv. Solid Thick.	in =	0.00	
wasonry Block Type	=		eignt
Masonry Design Method	=	ASD	
Concrete Data	nci –	2 500 0	
	psi =	2,500.0	
гу	psi =	0.0	

Code: IBC 2018, ACI 318-14, TMS 402-16

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Footing Data			
Toe Width	=	0.	00 ft
Heel Width	=	0.	50
Total Footing Width	= _	0.	50
Footing Thickness	=	0.0	00 in
Key Width	=	0.0	00 in
Key Depth	=	0.0	00 in
Key Distance from Toe	=	0.0	00 ft
f'c = 2,000 psi	Fy =	60,00	00 psi
Footing Concrete Densit	ty =	0.	00 pcf
Min. As %	=	0.000	00
Cover @ Top 0.00	@ E	8tm.=	0.00 in

Cantilevered Retaining Wall

Footing Desig				
		Toe	Heel	
Factored Pressure	=	0	0	psf
Mu' : Upward	=	0	0	ft-#
Mu' : Downward	=	0	0	ft-#
Mu: Design	=	0	0	ft-#
Actual 1-Way Shear	=	25.94	0.00	psi
Allow 1-Way Shear	=	35.78	35.78	, psi
Toe Reinforcing	=	None Spec'd		
Heel Reinforcing	=	None Spec'd		
Key Reinforcing	=	None Spec'd		
Footing Torsion, Tu		=	0.00) ft-lbs
Footing Allow. Torsion	п, p	hiTu =	0.00) ft-lbs
If torsion exceed	s a	llowable, provi	ide	
	-			

supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: phiMn = phi'5'lambda'sqrt(fc)'Sm Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: No key defined

Min footing T&S reinf Area	0.00 in2
Min footing T&S reinf Area per foot	0.00 in2 /ft
If one layer of horizontal bars:	If two layers of horizontal bars:
#4@_0.00 in	#4@_0.00 in
#5@_0.00 in	#5@_0.00 in
#6@_0.00 in	#6@_0.00 in

Summary of Overturning & Resisting Forces & Moments

	0	VERTURNING)		F	RESISTING	
Item	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water the HL Act Pres (be water the Hvdrostatic Force	l) l)			Soil Over HL (ab. water tbl) Soil Over HL (bel. water tbl) Watre Table			
Buoyant Force Surcharge over Heel Surcharge Over Toe Adjacent Footing Load Added Lateral Load Load @ Stem Above Soi	= = = = = =			Sloped Soil Over Heel = Surcharge Over Heel = Adjacent Footing Load = Axial Dead Load on Stem = * Axial Live Load on Stem = Soil Over Toe = Surcharge Over Toe = Stem Weight(s) =			
Total	=	O.T.M. =		Earth @ Stem Transitions= Footing Weight = Kev Weight =		0.25	
Resisting/Overturning Vertical Loads used for	g Ratio or Soil Pressure	=	lbs	Vert. Component = Total = * Axial live load NOT included	in total displa	bs R.M.=	

y resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINEERING	Cantilevered	l Retaining Wall	Code: IBC 2018,ACI 318-14,TMS 402-16
Tilt			
Horizontal Deflection at Top of Wall	due to settlem	ent of soil	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate only	y) 0.038	in	
The above calculation is not valid if the heel soil	l bearing pressure e	exceeds that of the toe,	
because the wall would then tend to rotate into t	the retained soil.		

License To : MALSAM TSANG ENGINEERING				
Criteria				
Retained Height	=	0.00 ft		
Wall height above soil	=	0.00 ft		
Slope Behind Wall	=	0.00		
Height of Soil over Toe	=	0.00 in		
Water height over heel	=	0.0 ft		

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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		
Decian Summony				

Design Summary

Wall Stability Ratios Overturning Sliding	= =	0.00 OK 0.00 OK
Total Bearing Loadresultant ecc.	= =	0 lbs 0.00 in
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Than Al = =	0 psf Ok 0 psf Ok 0 psf 0 psf lowable 0 psf 0 psf
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =	25.9 psi OK 0.0 psi OK 67.1 psi
Sliding Calcs Lateral Sliding Force less 0 % Passive Force less 0 % Friction Force Added Force Req'd for 1.5 Stability	= = • = =	0.0 lbs 0.0 lbs 0.0 lbs 0.0 lbs OK 0.0 lbs OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.000
Seismic, E	1.700

Cantilevered Retaining Wall Soil Data Allow Soil Bearing 0.0 psf Equivalent Fluid Pressure Method

Active Heel Pressure 0.0 psf/ft = = Passive Pressure 0.0 psf/ft = Soil Density, Heel = 0.00 pcf Soil Density, Toe 0.00 pcf = Footing||Soil Friction = 0.000 Soil height to ignore 0.00 in for passive pressure = Lateral Load Applied to Stem Lateral Load 0.0 #/ft = 0.00 ft ...Height to Top = ...Height to Bottom = 0.00 ft Load Type = (Service Level) Wind on Exposed Stem _ 0.0 psf (Service Level)

Stem Construction		Bottom	
Desire Usiek(Abase E(s		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	3	
Design Method	=	LRFD	
Thickness	=	0.00	
Rebar Size	=	# 0	
Rebar Spacing	=	0.00	
Rebar Placed at	=	Center	
Design Data		0.000	
	=	0.000	
I otal Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =		
MomentAllowable	=	0.0	
ShearActual			
Service Level	psi =		
Strength Level	psi =		
ShearAllowable	psi =	0.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	0.00	
Masonry Data			
f'm	psi =	1,500	
Fs	psi =	0	
Solid Grouting	=	No	
Modular Ratio 'n'	=	0.00	
Wall Weight	psf =	0.0	
Short Term Factor	=	1.000	

in =

psi =

psi =

= ASD

0.00 = Medium Weight

2,500.0

0.0

Equiv. Solid Thick.

Concrete Data

f'c Fy

Masonry Block Type Masonry Design Method

Code: IBC 2018, ACI 318-14, TMS 402-16

Adjacent Footing I	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	=	0.000

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Footing Data			
Toe Width	=	0.	00 ft
Heel Width	=	0.	00
Total Footing Width	= _	0.	00
Footing Thickness	=	0.0	00 in
Key Width	=	0.0	00 in
Key Depth	=	0.0	00 in
Key Distance from Toe	=	0.0	00 ft
f'c = 2,000 psi	Fy =	60,00	00 psi
Footing Concrete Densit	ty =	0.	00 pcf
Min. As %	=	0.00	00
Cover @ Top 0.00	@ E	8tm.=	0.00 in

Cantilevered Retaining Wall

Code: IBC 2018, ACI 318-14, TMS 402-16

Footing Desig					
		<u>Toe</u>	Heel		
Factored Pressure	=	0	0 psf		
Mu' : Upward	=	0	0 ft-#		
Mu' : Downward	=	0	0 ft-#		
Mu: Design	=	0	0 ft-#		
Actual 1-Way Shear	=	25.94	0.00 psi		
Allow 1-Way Shear	=	35.78	35.78 psi		
Toe Reinforcing	=	None Spec'd			
Heel Reinforcing	=	None Spec'd			
Key Reinforcing	=	None Spec'd			
Footing Torsion, Tu		=	0.00 ft-lbs		
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs					
If torsion exceeds allowable, provide					

Other Acceptable Sizes & Spacings

Toe: phiMn = phi'5'lambda'sqrt(fc)'Sm Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: No key defined

Min footing T&S reinf Area	0.00 in2
Min footing T&S reinf Area per foot	0.00 in2 /ft
If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 0.00 in	#4@ 0.00 in
#5@ 0.00 in	#5@ 0.00 in
#6@ 0.00 in	#6@ 0.00 in

Summary of Overturning & Resisting Forces & Moments

		VERTURNING)		RE	SISTING	
Item	Force lbs	Distance ft	ft-#		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tb HL Act Pres (be water tb Hydrostatic Force	I) I)			Soil Over HL (ab. water tbl) Soil Over HL (bel. water tbl) Watre Table			
Buoyant Force Surcharge over Heel Surcharge Over Toe Adjacent Footing Load Added Lateral Load Load @ Stem Above Soi	= = = = =			Sloped Soil Over Heel = Surcharge Over Heel = Adjacent Footing Load = Axial Dead Load on Stem = * Axial Live Load on Stem = Soil Over Toe = Surcharge Over Toe =			
Total Resisting/Overturning Vertical Loads used f	= g Ratio or Soil Pressur	O.T.M. = = e =	lbs	Stem Weight(s) = Earth @ Stem Transitions = Footing Weight = Key Weight = Vert. Component =		- - -	
		-		I otal = * Axial live load NOT included ii	ll Notal display	os K.M.=	overturning

overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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Tilt			
Horizontal Deflection at Top of Wall	due to settlem	ent of soil	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate only	y) 0.038	in	
The above calculation is not valid if the heel soil	l bearing pressure e	exceeds that of the toe,	
because the wall would then tend to rotate into t	the retained soil.		

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	Criteria			
	Retained Height	=	8.00 ft	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	4.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.26	Rat	i0 <
Slab Resist	s All S	Sliding !		
Total Bearing Loadresultant ecc.	=	2,623 19.73 i	bs n	
Soil Pressure @ Toe Soil Pressure @ Heel	= =	2,548 p 0 p	osf osf	OK OK
Allowable Soil Pressure Less	= Than	2,666 p	osf	
ACI Factored @ Toe	=	3,567 p	osf	
ACI Factored @ Heel	=	0 p	osf	
Footing Shear @ Toe	=	29.8 p	osi	OK
Footing Shear @ Heel	=	12.9 p	osi	OK
Allowable	=	75.0 p	osi	
Sliding Calcs				
Lateral Sliding Force	=	1,929.5 ll	bs	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

1.0 . .

Soli Data				
Allow Soil Bearing	∍ M	= eth	2,666.0	psf
Active Heel Pressure	5 11	=	35.0	psf/ft
		=		
Passive Pressure		=	250.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appli	ed	l to	Stem	
Lateral Load Height to Top Height to Bottom	= = =		64.0 #/ 8.00 ft 0.00 ft	ft
Load Type	=			
		(Se	ervice Le	evel)
Wind on Exposed Stem	=		0.0 ps	sf

Ste 1.5!

Restrain		
Adjacent Footing I	Loa	d
Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft

Code: IBC 2018,ACI 318-14,TMS 402-16

Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

m Construction		Bottom	
Design Height Above Ftg	ft =	Stem OK 0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	8.00	
Rebar Size	=	# 5	
Rebar Spacing	=	12.00	
Rebar Placed at	=	Edge	
Design Data			
fb/FB + fa/Fa	=	0.877	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	2,416.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	7,125.3	
MomentAllowable	=	8,121.3	
ShearActual			
Service Level	psi =		
Strength Level	psi =	32.5	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.19	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	2,500.0	
Fy	psi =	60,000.0	

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Concrete Stem Rebar Area Details			
Bottom Stem Vertic	al Reinforcing Ho	rizontal Reinfor	cina
As (based on applied moment) : 0.269	8 in2/ft	201101 1001101	
(4/3) * As : 0.359	7 in2/ft Mir	Stem T&S Re	inf Area 0.000 in2
200bd/fy : 200(12)(6.1875)/60000 : 0.247	5 in2/ft Mir	Stem T&S Re	inf Area per ft of stem Height : 0.000 in2/ft
0.0018bh : 0.0018(12)(8) : 0.172	8 in2/ft Hoi	rizontal Reinfor	cing Options :
====	====== On	e layer of :	Two layers of :
Required Area : 0.269	8 in2/ft #40	@ 0.00 in	#4@ 0.00 in
Provided Area : 0.31 i	n2/ft #50	@ 0.00 in	#5@ 0.00 in
Maximum Area : 0.838	2 in2/ft #60	@ 0.00 in	#6@ 0.00 in
Footing Data	Footing Design	Results	
Toe Width = 3.00 ft		Toe	Heel
Heel Width = 1.66	Factored Pressure =	= 3,567	0 psf
Total Footing Width = 4.66	Mu' : Upward =	= 101,945	0 ft-#
Footing Thickness = 12.00 in	Mu' : Downward =	= 14,364	767 ft-#
Key Width = 0.00 in	Mu. Design =	= 7,290 - 20.75	12.86 pci
Key Depth = 0.00 in	Allow 1-Way Shear =	= 75.00	40.00 psi
Key Distance from Toe = 0.00 ft	Toe Reinforcing =	# 5 @ 12.00	in
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing =	None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing =	 None Specid 	
Min. AS % = 0.0018 Cover @ Top 2.00 @ $Btm = 3.00$ in	Footing Allow Torsion	n hi Tu	
	Fooling Allow. Torsion,	philu =	
	If torsion exceeds	allowable, pro	torsion
	Other Acceptable Size	es & Spacing	S
	Heel: #4@ 9.07 in, # Heel: phiMn = phi'5'la Key: No key defined	5@ 14.07 in, # ambda'sqrt(fc)'; 1	6@ 19.97 in, #7@ 27.23 in, #8@ 35.86 in, #9@ 45 Sm
	Min footing T&S reinf	Area	0.00 in2
	Min footing T&S reinf	Area per foot	0.00 in2 /ft
	If one layer of horizor	ntal bars:	If two layers of horizontal bars:
	#4@ 0.00 in		#4@ 0.00 in
	#5@ 0.00 in #6@ 0.00 in		#5@ 0.00 in #6@ 0.00 in
	#0 🙂 0.00 III		

Cantilevered Retaining Wall

Code: IBC 2018, ACI 318-14, TMS 402-16

Summary of Overturning & Resisting Forces & Moments

		0				R	ESISTING	
Item		Force Ibs	Distance ft	Moment ft-#		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1.417.5	3.00	4.252.5	Soil Over HL (ab. water tbl)	953.6	4.16	3,970.2
HL Act Pres (be water tbl Hydrostatic Force)	, -		,	Soil Over HL (bel. water tbl) Watre Table		4.16	3,970.2
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	512.0	5.00	2.560.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil	=			,	Soil Over Toe =	120.0	1.50	180.0
	=				Surcharge Over Toe =			
					Stem Weight(s) =	850.0	3.33	2,833.3
					Earth @ Stem Transitions =			
Total	=	1,929.5	O.T.M. =	6,812.5	Footing Weight =	699.0	2.33	1,628.7
					Key Weight =			
Resisting/Overturning	g Rat	io	=	1.26	Vert. Component =			
Vertical Loads used for	or Soi	l Pressure	= 2,622.	6 lbs	Total =	2,622.6	lbs R.M.=	8,612.2
					* Axial live load NOT included i	n total display	ed, or used for	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.129	in
The above calculation is not valid if the heel soil bearing pre	essure e	exceeds that of the toe,

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	Criteria			
	Retained Height	=	6.00 ft	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	4.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	1.30 Ratio < 1.5!
Slab Resist	s All S	Sliding !
Total Bearing Loadresultant ecc.	= =	1,733 lbs 15.01 in
Soil Pressure @ Toe Soil Pressure @ Heel	=	1,993 psf OK 0 psf OK
Allowable Soil Pressure Less	= Than	2,666 psf Allowable
ACI Factored @ Toe ACI Factored @ Heel	= =	2,791 psf 0 psf
Footing Shear @ Toe	=	26.4 psi OK
Allowable	=	7.9 psi OK 75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	1.263.3 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data					
Allow Soil Bearing	• M	= leth	2,66 od	6.0	psf
Active Heel Pressure		=	4	0.0	psf/ft
		=			
Passive Pressure		=	15	0.0	psf/ft
Soil Density, Heel		=	120	.00	pcf
Soil Density, Toe		=	120	.00	pcf
Footing Soil Friction		=	0.4	150	
Soil height to ignore for passive pressure		=	12.(00	in
Lateral Load Appli	ed	l to	Ste	em	
Lateral Load Height to Top Height to Bottom	= = =		54.0 6.00 0.10) #/) ft) ft	ft
Load Type	=	Se (Se	ismic ervice	: (E) e Le) vel)
Wind on Exposed Stem (Service Level)	=		0.0) ps	f

Stem C Des Wa Des Thi Re Re Rel Desi fb/ Tot Мо Мо She

Restain		
Adjacent Footing I	oad	
Adjacent Footing Load Footing Width Eccentricity Wall to Ftg CL Dist Footing Type Base Above/Below Soil	= = =	0.0 lbs 0.00 ft 0.00 in 0.00 ft Line Load
at Back of Wall	=	0.0 ft

Code: IBC 2015,ACI 318-14,ACI 530-13

vice Level)		F	Poisson's Ratio	=	0.300	
em Construction		Bottom				
Design Height Above Etc	ft –	Stem OK				
Wall Material Above "Ht"	=	Concrete				
Design Method	=	LRFD				
Thickness	=	8.00				
Rebar Size	=	# 4				
Rebar Spacing	=	11.00				
Rebar Placed at	=	Edge				
Design Data		0.550				
tb/FB + ta/Fa	=	0.556				
Total Force @ Section						
Service Level	lbs =					
Strength Level	lbs =	1,476.0				
MomentActual						
Service Level	ft-# =					
Strength Level	ft-# =	3,276.0				
MomentAllowable	=	5,883.6				
ShearActual						
Service Level	psi =					
Strength Level	psi =	19.7				
ShearAllowable	psi =	75.0				
Anet (Masonry)	in2 =					
Rebar Depth 'd'	in =	6.25				
Masonry Data						
f'm	psi =					
Fs	psi =					
Solid Grouting	=					
Modular Ratio 'n'	=					
Wall Weight	psf =	100.0				
Short Term Factor	=					
Equiv. Solid Thick.	=					
Masonry Block Type	=	Medium W	'eight			
Masonry Design Method	=	ASD				
Concrete Data						
f'c	psi =	2,500.0				
Fy	psi =	60,000.0				

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Concrete Stem Rebar Area Details		
Bottom Stem Vertica As (based on applied moment) 0 1227	I Reinforcing Horizontal Reinforcir	Ŋ
$(4/3) * \Delta s^{-1}$ 0.1637	in2/ft Min Stem T&S Reinf	Area 1 248 in2
(-7,0) $(-7,0)$ $($	2/ft Min Stem T&S Reinf	Area per ft of stem Height : 0 192 in2/ft
0.0018bb : 0.0018(12)(8) : 0.1728	in2/ft Horizontal Reinforcir	A Ontions :
0.0010011.0.0010(12)(0).		ly options :
Beguired Area : 0.1728		$\#4 \otimes 25 \otimes 1$
Drawidad Area . 0.1720	in2/ft #4@ 12.50 in #	#4@ 25.00 III
Provided Area : 0.2182	In2/ft #5@ 19.38 In #	75 @ 38.75 IN
Maximum Area : 0.8467	in2/ft #6@ 27.50 in #	≠6@ 55.00 in ⊸
Footing Data	Footing Design Results	
Toe Width= 2.25 ft Heel Width= 1.41 Total Footing Width= 3.66 Footing Thickness= 10.00 in Key Width= 0.00 in Key Depth= 0.00 in Key Distance from Toe= 0.00 ft f'c = $2,500 \text{ psi}$ Fy = $60,000 \text{ psi}$ Footing Concrete Density= 150.00 pcf Min. As %= 0.0018 Cover @ Top 2.00 @ Btm.= 3.00 in	ToeFactored Pressure= $2,791$ Mu': Upward= $48,627$ Mu': Downward= $6,014$ Mu: Design= $3,551$ Actual 1-Way Shear= 26.40 Allow 1-Way Shear= 75.00 Toe Reinforcing=# 4 @ 11.00 inHeel Reinforcing=None Spec'dKey Reinforcing=None Spec'dFooting Torsion, Tu=Footing Allow. Torsion, phi Tu=If torsion exceeds allowable, provide	Heel 0 psf 0 ft-# 280 ft-# 7.85 psi 40.00 psi 0.00 ft-lbs 0.00 ft-lbs de
	supplemental design for footing to	rsion.
	Other Acceptable Sizes & Spacings Toe: #4@ 11.11 in, #5@ 17.22 in, #6 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: No key defined	@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 າ
	Min footing T&S reinf Area Min footing T&S reinf Area per foot If one layer of horizontal bars:	0.79 in2 0.22 in2 /ft f two layers of horizontal bars:

#4	4@	11.11	in
#\$	5@	17.22	in
#6	6@	24.44	in

If two layers of horiz #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

OVERTURNING				RESISTING				
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	933.9	2.28	2.127.2	Soil Over HL (ab. water tbl)	535.2	3.29	1,759.9
HL Act Pres (be water tbl Hydrostatic Force)			_,	Soil Over HL (bel. water tbl) Watre Table		3.29	1,759.9
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	329.4	3.78	1.246.2	* Axial Live Load on Stem =			
Load @ Stem Above Soi	=			, -	Soil Over Toe =	90.0	1.13	101.3
	=				Surcharge Over Toe =			
					Stem Weight(s) =	650.0	2.58	1,679.2
					Earth @ Stem Transitions=			
Total	=	1,263.3	O.T.M. =	3,373.4	Footing Weight =	457.5	1.83	837.2
					Key Weight =			
Resisting/Overturning	g Rat	io	=	1.30	Vert. Component =			
Vertical Loads used for	or Soi	I Pressure	= 1,732	.7 lbs	Total =	1,732.7	bs R.M.=	4,377.6
					* Axial live load NOT included	in total display	ed. or used fo	r overturnina

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.098	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

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_	icense To : MALSAM TSANG ENGINEERING					
	Criteria					
	Retained Height	=	11.00 ft			
	Wall height above soil	=	0.50 ft			
	Slope Behind Wall	=	0.00			
	Height of Soil over Toe	=	4.00 in			
	Water height over heel	=	0.0 ft			

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.34 Ratio < 1
Slab Resis	ts All	Sliding !
Total Bearing Load	=	4,987 lbs
resultant ecc.	=	27.81 in
Soil Pressure @ Toe	=	2,468 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,666 psf
Soil Pressure Less	s Thai	n Allowable
ACI Factored @ Toe	=	3,455 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	42.1 psi OK
Footing Shear @ Heel	=	17.4 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	4,090.3 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing		=	2,666.0	psf
Equivalent Fluid Pressure	eΝ	1eth	od	
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	150.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore				
for passive pressure		=	12.00	in
Lateral Load Appl	iec	d to	Stem	
Lateral Load	=		99.0 #/	′ft
Height to Top	=		11.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	Wi	ind (W)	
••		(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Dattam Stem D 1.5! D

15 **Adjacent Footing Load** 0.0 lbs Adjacent Footing Load =

Code: IBC 2015,ACI 318-14,ACI 530-13

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

em Construction		Dottom	
Design Height Above Etg	ft –	Stem OK	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	IRFD	
Thickness	=	10.00	
Rebar Size	=	# 6	
Rebar Spacing	=	8.00	
Rebar Placed at	=	Edge	
Design Data			
fb/FB + fa/Fa	=	0.992	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	4,961.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	20,186.8	
MomentAllowable	=	20,333.2	
ShearActual			
Service Level	psi =		
Strength Level	psi =	54.2	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	7.63	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	125.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		

Concrete Data		0 500 0	
Masonry Design Method	=	ASD	
Masonry Block Type	=	Medium V	Veight
Equiv. Solid Thick.	=		

f'c

Fy

psi = 2,500.0 psi = 60,000.0

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINEERING	Cantilevered Retaining Wa	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area Details		
Bottom Stem Vertical	Reinforcing Horizontal Reinfor	cina
As (based on applied moment) : 0.614 in	2/ft	
(4/3) * As : 0.8187 i	n2/ft Min Stem T&S Re	inf Area 2.760 in2
200bd/fy : 200(12)(7.625)/60000 : 0.305 in	2/ft Min Stem T&S Re	inf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) : 0.216 in	2/ft Horizontal Reinfor	cing Options :
======	===== One layer of :	Two layers of :
Required Area : 0.614 in	2/ft #4@ 10.00 in	#4@ 20.00 in
Provided Area : 0.66 in2	/ft #5@ 15.50 in	#5@ 31.00 in
Maximum Area : 1.0329 i	n2/ft #6@ 22.00 in	#6@ 44.00 in
Footing Data	Footing Design Results	
Toe Width = 5.00 ft	Тое	Heel
Heel Width = <u>2.33</u>	Factored Pressure = 3,455	0 psf
Total Footing Width = 7.33	Mu' : Upward = 306,045	0 ft-#
Footing Thickness = 15.00 in	Mu': Downward = $40,950$ Mu: Dosign = 22,001	2,026 ft #
Key Width = 0.00 in	Actual 1-Way Shear $-$ 42.13	2,020 II-# 17 36 nei
Key Depth = 0.00 in	Allow 1-Way Shear = 75.00	40.00 psi
Key Distance from Toe = 0.00 ft	Toe Reinforcing = $\# 6 @ 8.00$ ir	' N
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = None Spec'd	0.00 <i>t</i> the
MIN. AS % = 0.0018 Cover @ Top 2.00 @ Btm = 3.00 in	Footing Torsion, Tu =	
Cover @ rop 2.00 @ Dun.= 5.00 m	Footing Allow. Torsion, phi Tu =	0.00 π-lbs
	If torsion exceeds allowable, pro	
	supplemental design for footing	torsion.
	Other Acceptable Sizes & Spacing	S
	Toe: #4@ 5.21 in, #5@ 8.08 in, #6 Heel: phiMn = phi'5'lambda'sqrt(fc)'\$ Key: No key defined	@ 11.47 in, #7@ 15.65 in, #8@ 20.60 in, #9@ 26. Sm
	Min footing T&S reinf Area Min footing T&S reinf Area per foot If one layer of horizontal bars: #4@ 7.41 in #5@ 11.48 in #6@ 16.30 in	2.37 in2 0.32 in2 /ft If two layers of horizontal bars: #4@ 14.81 in #5@ 22.96 in #6@ 32.59 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

OVERTURNING						RESISTING			
Item		Force lbs	Distance ft	Moment ft-#		Force Ibs	Distance ft	Moment ft-#	
HL Act Pres (ab water tb)	3,001.3	4.08	12,255.1	Soil Over HL (ab. water tbl)	1,975.6	6.58	13,002.7	
HL Act Pres (be water the Hvdrostatic Force)				Soil Over HL (bel. water tbl) Watre Table		6.58	13,002.7	
Buoyant Force	=				Sloped Soil Over Heel =				
Surcharge over Heel	=				Surcharge Over Heel =				
Surcharge Over Toe	=				Adjacent Footing Load =				
Adjacent Footing Load	=				Axial Dead Load on Stem =				
Added Lateral Load	=	1,089.0	6.75	7,350.8	* Axial Live Load on Stem =				
Load @ Stem Above Soi	=				Soil Over Toe =	200.0	2.50	500.0	
	=				Surcharge Over Toe =				
					Stem Weight(s) =	1,437.5	5.42	7,786.5	
					Earth @ Stem Transitions =				
Total	=	4,090.3	O.T.M. =	19,605.9	Footing Weight =	1,374.4	3.67	5,037.1	
					Key Weight =				
Resisting/Overturning	g Rat	io	=	1.34	Vert. Component =				
Vertical Loads used for	or So	il Pressure	= 4,987.	5 lbs	Total =	4,987.5 I	bs R.M.=	26,326.3	
					* Axial live load NOT included in	n total display	ed, or used for	r overturning	

resistance, but is included in total displayed, or used for overturning

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.108	in
The above calculation is not valid if the heel soil bearing	pressure e	exceeds that of the toe,

icense To : MALSAM TS	SANG	ENGINEER	NG
Criteria			
Retained Height	=	11.00 ft	
Wall height above soil	=	0.50 ft	
Slope Behind Wall	=	0.00	
Height of Soil over Toe	=	4.00 in	
Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios Overturning = 1.95 OK Slab Resists All Sliding ! **Total Bearing Load** 4,874 lbs = ...resultant ecc. 12.40 in = Soil Pressure @ Toe 1,362 psf OK = Soil Pressure @ Heel 66 psf OK = 2,000 psf Allowable = Soil Pressure Less Than Allowable ACI Factored @ Toe 1,906 psf = ACI Factored @ Heel 92 psf = Footing Shear @ Toe 29.4 psi OK =

Footing Shear @ Heel	=	14.6 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	3,001.3 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soli Data				
Allow Soil Bearing Equivalent Fluid Pressur	e N	= leth	2,000.0	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	150.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Stem	
Lateral Load Height to Top Height to Bottom	=		0.0 #/ 0.00 ft 0.00 ft	′ft
Load Type	=	W (S	ind (W) ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Stem D D M

Restrain		
Adjacent Footing I	oac	
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	_	0 0 ft
at Back of Wall	-	0.0 ft
Poisson's Ratio	=	0.300

Code: IBC 2015,ACI 318-14,ACI 530-13

em Construction		Bottom			
Design Height Above Etc	"	Stem OK			
Wall Material Above "Lit"	π=	0.00 Concrete			
	=				
Thickness	=	10 00			
Rebar Size	=	10.00			
Rebar Spacing	_	[#] 800			
Rebar Placed at	_	Edae			
Design Data		Luge			
fb/FB + fa/Fa	=	0.698			
Total Force @ Section					
Service Level	lbs =				
Strength Level	lbs =	3,872.0			
MomentActual		, -			
Service Level	ft-# =				
Strength Level	ft-# =	14,197.3			
MomentAllowable	=	20,333.2			
ShearActual					
Service Level	psi =				
Strength Level	psi =	42.3			
ShearAllowable	psi =	75.0			
Anet (Masonry)	in2 =				
Rebar Depth 'd'	in =	7.63			
Masonry Data					
f'm	psi =				
Fs	psi =				
Solid Grouting	=				
Modular Ratio 'n'	=				
Wall Weight	psf=	125.0			
Short Term Factor	=				
Equiv. Solid Thick.	=				
Masonry Block Type	=	Medium W	/eight		
Masonry Design Method	=	ASD			
Concrete Data					
f'c	psi =	2,500.0			
Fy	psi =	60,000.0			

tilevered Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
cing Horizontal Reinforcing	
5	
Min Stem T&S Reinf Area	2.760 in2
Min Stem T&S Reinf Area	per ft of stem Height : 0.240 in2/ft
Horizontal Reinforcing Opt	tions :
One layer of : Two lay	ers of :
#4@ 10.00 in #4@ 2	20.00 in
#5@ 15.50 in #5@ 3	\$1.00 in
#6@ 22.00 in #6@ 4	4.00 in
ooting Design Results	
ToeHeelored Pressure1,90692: Upward=183,187251: Downward=33,1702,026Design=12,5011,775al 1-Way Shear=29.4314.57w 1-Way Shear=75.0040.00Reinforcing=# 6 @ 11.00 inReinforcing=None Spec'ding Torsion, Tu=0.0ing Allow. Torsion, phi Tu=0.0it orsion exceeds allowable, provideupplemental design for footing torsion.or Acceptable Sizes & Spacingsbe:#4@ 7.24 in, #5@ 11.22 in, #6@ 15.9eel: phiMn = phi'5'lambda'sqrt(fc)'Smey: No key definedin footing T&S reinf Area2.21one layer of horizontal bars:If two la#4@ 7.41 in#4@#5@ 11.48 in#5@#6@ 16.30 in#6@	 ? psf ft.#) ft.#) ft.# ? psi) psi 10 ft-lbs 10 ft-lbs 10 ft-lbs .
	tilevered Retaining Wall The second

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

OVERTURNING							R	RESISTING			
Item		Force Ibs	Distanc	e	Moment ft-#		Force Ibs	Distance ft	Moment ft-#		
HL Act Pres (ab water tb	I)	3,001.3	4.08	3	12,255.1	Soil Over HL (ab. water tbl)	1,975.6	6.08	12,014.9		
HL Act Pres (be water tb Hydrostatic Force	Í)				·	Soil Over HL (bel. water tbl) Watre Table		6.08	12,014.9		
Buoyant Force	=					Sloped Soil Over Heel =					
Surcharge over Heel	=					Surcharge Over Heel =					
Surcharge Over Toe	=					Adjacent Footing Load =					
Adjacent Footing Load	=					Axial Dead Load on Stem =					
Added Lateral Load	=					* Axial Live Load on Stem =					
Load @ Stem Above Sol	il =					Soil Over Toe =	180.0	2.25	405.0		
	=					Surcharge Over Toe =					
						Stem Weight(s) =	1,437.5	4.92	7,067.7		
						Earth @ Stem Transitions=					
Total	=	3,001.3	О.Т.М.	=	12,255.1	Footing Weight =	1,280.6	3.42	4,373.3		
						Key Weight =					
Resisting/Overturnin	g Rat	io	=		1.95	Vert. Component =					
Vertical Loads used f	or So	il Pressure	= 4,8	873.7	lbs	Total =	4,873.7	lbs R.M.=	23,861.0		
						* Axial live load NOT included	in total displa	yed, or used fo	r overturning		

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.064	in
The above calculation is not valid if the heel soil bearing pro-	essure e	exceeds that of the toe,

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Criteria							
Retained Height	=	10.00 ft					
Wall height above soil	=	0.50 ft					
Slope Behind Wall	=	0.00					
Height of Soil over Toe	=	4.00 in					
Water height over heel	=	0.0 ft					

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.39 Ratio <
Slab Resis	ts All	Sliding !
Total Bearing Loadresultant ecc.	= =	4,512 lbs 23.78 in
Soil Pressure @ Toe Soil Pressure @ Heel	= =	2,300 psf OK 0 psf OK
Allowable Soil Pressure Less	= s Thai	2,666 psf n Allowable
ACI Factored @ Toe ACI Factored @ Heel	= =	3,220 psf 0 psf
Footing Shear @ Toe	=	37.7 psi OK
Footing Shear @ Heel	=	16.0 psi OK
Allowable Sliding Calcs	=	75.0 psi
Lateral Sliding Force	_	3 431 3 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

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Soli Data				
Allow Soil Bearing Equivalent Fluid Pressur	e N	= leth	2,666.0 od) psf
Active Heel Pressure		=	40.0) psf/ft
Desision Desision		=	450.0	
Passive Pressure		=	150.0) pst/ft
Soil Density, Heel		=	120.00) pcf
Soil Density, Toe		=	120.00) pcf
Footing Soil Friction		=	0.450)
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Stem	
Lateral Load	=		90.0 # 10.00 ft	/ft
Height to Bottom	=		0.00 ft	
Load Type	=	Se (Se	ismic (E ervice L	E) evel)
Wind on Exposed Stem (Service Level)	=		0.0 p	sf

Sten D 1.5! D Μ

f'c Fy

Restrant			
Adjacent Footing	Load	k	
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		0.0.4	

=

at Back of Wall

0.0 ft

Code: IBC 2015,ACI 318-14,ACI 530-13

			Poisson's Ratio	=	=	0.300
n Construction		Bottom				
esian Height Above Etc	ft –	Stem OK				
Wall Material Above "Ht"	=	Concrete				
Design Method	=	IRFD				
Thickness	=	10.00				
Rebar Size	=	# 5				
Rebar Spacing	=	8.00				
Rebar Placed at	=	Edge				
esign Data		0.049				
	=	0.940				
Total Force @ Section						
Service Level	lbs =					
Strength Level	lbs =	4,100.0				
MomentActual	.					
Service Level	π-# =					
Strength Level	ft-# =	15,166.7				
MomentAllowable	=	15,984.2				
ShearActual						
Service Level	psi =					
Strength Level	psi =	41.7				
ShearAllowable	, psi =	75.0				
Anet (Masonry)	in2 =					
Rebar Depth 'd'	in =	8.19				
lasonry Data						
f'm	psi =					
Fs	psi =					
Solid Grouting	=					

	г5	psi =		
	Solid Grouting	=		
	Modular Ratio 'n'	=		
	Wall Weight	psf =	125.0	
	Short Term Factor	=		
	Equiv. Solid Thick.	=		
	Masonry Block Type	=	Medium Weight	
	Masonry Design Method	=	ASD	
C	Concrete Data			

psi = 2,500.0

psi = 60,000.0

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINEERIN	Cantilevered Re	taining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area Details			
Bottom Stem	/ertical Reinforcing H	orizontal Reinforcing)
(4/3) * As :	0.5711 in2/ft M	in Stem T&S Reinf	Area 2.520 in2
200bd/fy : 200(12)(8.1875)/60000 :	.3275 in2/ft M	in Stem T&S Reinf	Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) : 0	0.216 in2/ft H	orizontal Reinforcing	9 Options :
=	O	ne layer of : Tw	o layers of :
Required Area : 0	0.4283 in2/ft #4	4@ 10.00 in #4	1@ 20.00 in
Provided Area : 0	0.465 in2/ft #	5@ 15.50 in #	5@ 31.00 in
Maximum Area : 1	.1092 in2/ft #6	6@ 22.00 in #0	5@ 44.00 in
Footing Data	Footing Desig	n Results	
Toe Width= 4.25 ft Heel Width= 2.33 Total Footing Width= 6.58 Footing Thickness= 15.00 in Key Width= 0.00 in Key Depth= 0.00 in Key Distance from Toe= 0.00 ft f'c = $2,500 \text{ psi}$ Fy = $60,000 \text{ ps}$ Footing Concrete Density= 150.00 pc Min. As %= 0.0018 Cover @ Top 2.00 @ Btm.=3.00	Factored Pressure Mu': Upward Mu': Downward Mu: Design Actual 1-Way Shear Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Footing Torsion, Tu Footing Allow. Torsion If torsion exceeds supplemental des Other Acceptable Si Toe: #4@ 5.61 in, Heel: phiMn = phi'5 Key: No key define Min footing T&S reii If one layer of horizo #4@ 7.41 in #5@ 11.48 in #6@ 16.30 in	Toe = 3,220 = 223,025 = 29,586 = 16,120 = 37.69 = 75.00 = # 5 @ 8.00 in = None Spec'd = None Spec'd = a, phi Tu = s allowable, provid sign for footing tor zes & Spacings #5@ 8.70 in, #6@ 1 'lambda'sqrt(fc)'Sm add onf Area onf Area ontal bars: If	Heel 0 psf 0 ft-# 1,865 ft-# 1,865 ft-# 15.97 psi 40.00 psi 0.00 ft-lbs 0.00 ft-lbs e sion. 2.36 in, #7@ 16.85 in, #8@ 22.19 in, #9@ 28. 2.13 in2 0.32 in2 /ft two layers of horizontal bars: #4@ 14.81 in #5@ 22.96 in #6@ 32.59 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	·		RI	SISTING	
Item		Force lbs	Distance ft	ft-#		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tb)	2.531.3	3.75	9.492.2	Soil Over HL (ab. water tbl)	1,796.0	5.83	10,473.7
HL Act Pres (be water tb) Hydrostatic Force	l)	2,001.0	0110	0,10212	Soil Over HL (bel. water tbl) Watre Table		5.83	10,473.7
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adiacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	900.0	6.25	5.625.0	* Axial Live Load on Stem =			
Load @ Stem Above Soi	=			-,	Soil Over Toe =	170.0	2.13	361.3
	=				Surcharge Over Toe =			
					Stem Weight(s) =	1,312.5	4.67	6,125.0
					Earth @ Stem Transitions =			
Total	=	3,431.3	0.T.M. =	15,117.2	Footing Weight =	1,233.8	3.29	4,059.0
					Key Weight =			
Resisting/Overturning	g Rat	io	=	1.39	Vert. Component =			
Vertical Loads used for	or Soi	l Pressure	= 4,512.	3 lbs	Total =	4,512.3	bs R.M.=	21,019.0
					* Axial live load NOT included in	n total display	ed, or used for	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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	рсі
Horizontal Defl @ Top of Wall (approximate only)	0.102	in
The above calculation is not valid if the heel soil bearing pr	essure	exceeds that of the toe,

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Criteria				
Retained Hei	ght	=	10.00 ft	
Wall height a	bove soil	=	0.50 ft	
Slope Behind	l Wall	=	0.00	
Height of Soi	l over Toe	=	4.00 in	
Water height	over heel	=	0.0 ft	

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Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios Overturning = 2.21 OK Slab Resists All Sliding ! **Total Bearing Load** 4,512 lbs = ...resultant ecc. 8.83 in = Soil Pressure @ Toe = 1,146 psf OK Soil Pressure @ Heel 226 psf OK = 2,000 psf Allowable Soil Pressure Less Than Allowable ACI Factored @ Toe 1,604 psf = ACI Factored @ Heel = 316 psf Footing Shear @ Toe 23.7 psi OK = Footing Shear @ Heel 11.5 psi OK = Allowable = 75.0 psi **Sliding Calcs** Lateral Sliding Force 2,531.3 lbs =

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing		=	2,000.0	psf
Equivalent Fluid Pressure	e N	leth	od	
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	150.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore				
for passive pressure		=	12.00	in
Lateral Load Appli	iec	l to	Stem	
Lateral Load	=		0.0 #/	ft
Height to Top	=		0.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	Wi	ind (W)	
		(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Stem Constru Design Heigh Wall Materia Design Meth Thickness **Rebar Size** Rebar Spaci Rebar Place Design Data fb/FB + fa/Fa **Total Force** Service L Strength I Moment....A Service L Strength Moment.....A Shear.....Act Service L Strength Shear....Allo Anet (Masor Rebar Depth Masonry Data f'm Fs Solid Groutir

Adjacent Footing Load 0.0 lbs Adjacent Footing Load = Footing Width 0.00 ft = 0.00 in Eccentricity = Wall to Ftg CL Dist 0.00 ft = Footing Type Line Load

Code: IBC 2015,ACI 318-14,ACI 530-13

(Base Above/Below Soil	_	0.0.#	
on Exposed Stem =	0.0 p	sf	at Back of Wall	=	0.0 11	
ce Level)			Poisson's Ratio	=	0.300	
		Dattana				
n Construction		Dottom	,			
esign Height Above Ftg	ft =	0.00)			
Wall Material Above "Ht"	=	Concrete)			
Design Method	=	LRFD)			
Thickness	=	10.00)			
Rebar Size	=	# 5	5			
Rebar Spacing	=	10.00)			
Rebar Placed at	=	Edge	9			
	_	0.82)			
	=	0.02	-			
	lha					
Service Level		2 200 0				
Strength Level	IDS =	3,200.0)			
Service Level	ft_# —					
Strength Level	ft_# -	10 666 7	7			
Moment Alloweble	ιι <i>π</i> –	12 071 1				
	=	12,971.1				
SnearActual						
Service Level	psi =					
Strength Level	psi =	32.6	6			
ShearAllowable	psi =	75.0)			
Anet (Masonry)	in2 =					
Rebar Depth 'd'	in =	8.19)			
lasonry Data						
f'm	psi =					
Fs	psi =					
Solid Grouting	=					
Modular Ratio n	=					
vvali vveight	pst =	125.0)			
Short Term Factor	=					
Equiv. Solid Thick.	=					
Masonry Block Type	=	Iviedium \	veignt			
Masonry Design Method	=	ASD				

Concrete Data f'c

Fy

2,500.0 psi = psi = 60,000.0

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINEERING	Cantilevered Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13			
Concrete Stem Rebar Area Details					
Bottom Stem Vertical	Reinforcing Horizontal Reinforc	ing			
As (based on applied moment) : 0.3012 i	n2/ft	5			
(4/3) * As : 0.4017 i	n2/ft Min Stem T&S Reir	nf Area 2.520 in2			
200bd/fy : 200(12)(8.1875)/60000 : 0.3275 i	n2/ft Min Stem T&S Reir	nf Area per ft of stem Height : 0.240 in2/ft			
0.0018bh : 0.0018(12)(10) : 0.216 in	2/ft Horizontal Reinforc	ing Options :			
=====	===== One layer of :	Two layers of :			
Required Area : 0.3275 i	n2/ft #4@ 10.00 in	#4@ 20.00 in			
Provided Area : 0.372 in	2/ft #5@ 15.50 in	#5@ 31.00 in			
Maximum Area : 1.1092 i	n2/ft #6@ 22.00 in	#6@ 44.00 in			
Footing Data	Footing Design Results				
Toe Width = 4.25 ft	Тое	Heel			
Heel Width = 2.33	Factored Pressure = 1,604	316 psf			
Total Footing Width = 6.58	Mu' : Upward = 143,776	464 ft-#			
Footing Thickness = 15.00 in	Mu': Downward = 29,586	1,865 ft-#			
Key Width = 0.00 in	Nu. Design = $9,510$	1,401 II-# 11 54 psi			
Key Depth = 0.00 in	Allow 1-Way Shear = 75.00	40.00 psi			
Key Distance from Toe = 0.00 ft	Toe Reinforcing = $#5 @ 10.00 ii$	n			
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd				
Footing Concrete Density = 150.00 pcf	Key Reinforcing = None Spec'd				
Min. As % = 0.0018	Footing Torsion, Tu =				
Cover @ rop 2.00 @ Bith.= 5.00 III	Footing Allow. Torsion, phi Tu =	0.00 ft-ids			
If torsion exceeds allowable, provide					
supplemental design for footing torsion.					
	Other Acceptable Sizes & Spacings				
	Toe: #4@ 7.40 in, #5@ 11.48 in, #6 Heel: phiMn = phi'5'lambda'sqrt(fc)'S Key: No key defined	@ 16.29 in, #7@ 22.22 in, #8@ 29.25 in, #9@ 37 m			
	Min footing T&S reinf Area Min footing T&S reinf Area per foot If one layer of horizontal bars: #4@ 7.41 in #5@ 11.48 in #6@ 16.30 in	2.13 in2 0.32 in2 /t If two layers of horizontal bars: #4@ 14.81 in #5@ 22.96 in #6@ 32.59 in			
Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0\	ERTURN	NING.			R	ESISTING	
Item		Force lbs	Distanc ft	e	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	1)	2.531.3	3.75	5	9.492.2	Soil Over HL (ab. water tbl)	1,796.0	5.83	10,473.7
HL Act Pres (be water tb	í)	,			-, -	Soil Over HL (bel. water tbl)		5.83	10,473.7
Hydrostatic Force	,					Watre Table			
Buoyant Force	=					Sloped Soil Over Heel =			
Surcharge over Heel	=					Surcharge Over Heel =			
Surcharge Over Toe	=					Adjacent Footing Load =			
Adjacent Footing Load	=					Axial Dead Load on Stem =			
Added Lateral Load	=					* Axial Live Load on Stem =			
Load @ Stem Above So	il =					Soil Over Toe =	170.0	2.13	361.3
	=					Surcharge Over Toe =			
						Stem Weight(s) =	1,312.5	4.67	6,125.0
						Earth @ Stem Transitions=			
Total	=	2,531.3	О.Т.М.	=	9,492.2	Footing Weight =	1,233.8	3.29	4,059.0
						Key Weight =			
Resisting/Overturnin	g Rat	tio	=	2	2.21	Vert. Component =			
Vertical Loads used f	or So	il Pressure	= 4,	512.3	lbs	Total =	4,512.3	lbs R.M.=	21,019.0
						* Axial live load NOT included	in total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.051	in
The above calculation is not valid if the heel soil bearing p	oressure	exceeds that of the toe,

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L	icense To : MALSAM TS	SANG	ENGINEERIN	G
	Criteria			
	Retained Height	=	9.00 ft	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	4.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning	=	1.33 Ratio <
Slab Resis	ts All	Sliding !
Total Bearing Loadresultant ecc.	= =	3,339 lbs 22.95 in
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less	= = = s Thai	2,135 psf OK 0 psf OK 2,666 psf n Allowable
ACI Factored @ Toe ACI Factored @ Heel	= =	2,990 psf 0 psf
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =	38.0 psi OK 15.3 psi OK 75.0 psi
Sliding Calcs Lateral Sliding Force	=	2.729.0 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data					
Allow Soil Bearing		=	2,666	.0	psf
Equivalent Fluid Pressur	e N	leth	od		
Active Heel Pressure		=	40	.0	psf/ft
		=			
Passive Pressure		=	150	.0	psf/ft
Soil Density, Heel		=	120.0	00	pcf
Soil Density, Toe		=	120.0)0	pcf
Footing Soil Friction		=	0.45	50	
Soil height to ignore					
for passive pressure		=	12.00	0	in
Lateral Load Appl	iec	l to	Ster	n	
Lateral Load	=		81.0	#/	ft
Height to Top	=		9.00	ft	
Height to Bottom	=		0.00	ft	
Load Type	=	Wi	ind (W)	
		(S	ervice	Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0	ps	f

Bottom De 1.5! E F F F De f Ν Ν S S Α F Ма

Restain			
Adjacent Footing	Loac	ł	
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

Poisson's Ratio

Code: IBC 2015,ACI 318-14,ACI 530-13

0.0 ft

0.300

Stem Construction

		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	8.00	
Rebar Size	=	# 5	
Rebar Spacing	=	8.00	
Rebar Placed at	=	Edge	
Design Data		0.027	
tb/FB + ta/Fa	=	0.937	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	3,321.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	11,056.5	
MomentAllowable	=	11,799.2	
ShearActual			
Service Level	psi =		
Strength Level	psi =	44.7	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.19	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	2,500.0	
Fy	psi =	60,000.0	

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-	Concrete Stem Rebar Area Details			
	Bottom Stem Vertica As (based on applied moment) : 0.4187	۱ Reinforcing ′ in2/ft	Horizontal Reinforcing	
	(4/3) * As : 0.5582	/ in2/ft	Min Stem T&S Reinf A	rea 1 824 in2
	200bd/fy · 200(12)(6 1875)/60000 · 0 2475	in2/ft	Min Stem T&S Reinf A	rea per ft of stem Height : 0 192 in2/ft
	0.0018 hb $\cdot 0.0018(12)(8)$ $\cdot 0.1728$	lin2/ft	Horizontal Reinforcing	Ontions :
				lavers of :
	Required Area : 0.4187	 ' in2/ft	#1@ 12.50 in $#1$	\square 25.00 in
	Provided Area : 0.4107	in2/ft	#4@ 12.30 in #40	@ 29.75 in
	Movimum Area : 0.202	112/11	#5@ 19.30 III #50	@ 55.00 in
		. inz/it	#6@ 27.50 III #6	@ 55.00 III
	Footing Data	Footing Des	ign Results	
	Toe Width= 4.00 ft Heel Width= 1.91 Total Footing Width=Footing Thickness=12.00 inKey Width= 0.00 in Key Depth= 0.00 in Key Distance from Toe= 0.00 ft f'c = $2,500 \text{ psi}$ Fy = $60,000 \text{ psi}$ Footing Concrete Density= 150.00 pcf Min. As %= 0.0018 Cover @ Top 2.00 @ Btm= 3.00 in	Factored Pressure Mu' : Upward Mu' : Downward Mu: Design Actual 1-Way Shear Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Key Reinforcing Footing Torsion, Tu Footing Allow. Tors	Toe H = $2,990$ = $165,915$ = $21,888$ $1,$ = $12,002$ $1,$ ar = 37.96 15 = 75.00 40 = 45 @ 8.00 in = None Spec'd = = ion, phi Tu = =	leel 0 psf 0 ft-#
		If torsion excee	eds allowable, provide	ion
		Toe: #4@ 7.05 i Heel: phiMn = ph Key: No key def	5/265 & Spacings in, #5@ 10.94 in, #6@ 1 ni'5'lambda'sqrt(fc)'Sm fined	15.52 in, #7@ 21.17 in, #8@ 27.88 in, #9@ 35
		Min footing T&S Min footing T&S If one layer of ho	reinf Area reinf Area per foot (rizontal bars: If tv	1.53 in2 0.26 in2 <i>I</i> ft wo layers of horizontal bars:

00	.,
#4@	9.26 in
#5@	14.35 in
#6@	20.37 in

0.26 in2 /tt If two layers of horizo #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

OVERTURNING					RESISTING			
Item		Force lbs	Distance ft	ft-#		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl))	2.000.0	3.33	6.666.7	Soil Over HL (ab. water tbl)	1,342.8	5.29	7,101.2
HL Act Pres (be water tbl))	_,	0.00	0,0001	Soil Over HL (bel. water tbl)		5.29	7,101.2
Hydrostatic Force	/				Watre Table			
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	729.0	5.50	4,009.5	* Axial Live Load on Stem =			
Load @ Stem Above Soil	=				Soil Over Toe =	160.0	2.00	320.0
	=				Surcharge Over Toe =			
					Stem Weight(s) =	950.0	4.33	4,116.7
					Earth @ Stem Transitions =			
Total	=	2,729.0	O.T.M. =	10,676.2	Footing Weight =	886.5	2.96	2,619.6
					Key Weight =			
Resisting/Overturning	j Ratio		=	1.33	Vert. Component =			
Vertical Loads used for	or Soil I	Pressure	= 3,339.3	3 lbs	Total =	3,339.3 lt	s R.M.=	14,157.4
					* Axial live load NOT included in	n total displave	ed. or used for	r overturnina

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.095	in
The above calculation is not valid if the heel soil bearing p	oressure e	exceeds that of the toe,

L	icense To : MALSAM TS	SANG	ENGINEERIN	G
	Criteria			
	Retained Height	=	9.00 ft	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	4.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios

Overturning = 2.00 OK Slab Resists All Sliding ! **Total Bearing Load** 3,292 lbs = ...resultant ecc. 9.67 in = Soil Pressure @ Toe = 1,079 psf OK Soil Pressure @ Heel 85 psf OK = 2,000 psf Allowable = Soil Pressure Less Than Allowable 1,510 psf ACI Factored @ Toe = ACI Factored @ Heel = 118 psf Footing Shear @ Toe 26.6 psi OK = Footing Shear @ Heel 12.5 psi OK = Allowable = 75.0 psi **Sliding Calcs** Lateral Sliding Force 2,000.0 lbs =

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing		=	2,000.0	psf
Equivalent Fluid Pressure	϶N	leth	od	
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	150.0	psf/ft
Soil Density, Heel		=	120.00	pcf
Soil Density, Toe		=	120.00	pcf
Footing Soil Friction		=	0.450	
Soil height to ignore				
for passive pressure		=	12.00	in
Lateral Load Appli	ec	l to	Stem	
Lateral Load	=		0.0 #/	ft
Height to Top	=		0.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	Wi	ind (W)	
		(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Stem D F De f N Ν 9 9 M

Restrain		
Adjacent Footing	Loac	1
Adjacent Footing Load	=	0.0 lb:
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

	_						
m Construction	_	Bottom					
Design Height Above Etc	"	Stem OK					
Wall Material Above "Ht"	π=	0.00 Conoroto					
Design Method	=						
Thickness	_	8.00					
Rehar Size	_	8.00 # 5					
Rebar Spacing	_	8.00					
Rebar Placed at	=	Edge					
Design Data		Lago		_			
fb/FB + fa/Fa	=	0.659					
Total Force @ Section							
Service Level	lbs =						
Strength Level	lbs =	2,592.0					
MomentActual							
Service Level	ft-# =						
Strength Level	ft-# =	7,776.0					
MomentAllowable	=	11,799.2					
ShearActual							
Service Level	psi =						
Strenath Level	nsi –	34 9					
Shear Allowable	nsi –	75.0					
Anet (Masonry)	in2 -	75.0					
Rebar Depth 'd'	in	6 1 9					
Masonry Data		0.19					
f'm	psi =						
Fs	psi =						
Solid Grouting	. =						
Modular Ratio 'n'	=						
Wall Weight	psf =	100.0					
Short Term Factor	=						
Equiv. Solid Thick.	=						
Masonry Block Type	=	Medium W	/eight				
Masonry Design Method	=	ASD					
Concrete Data							
f'c	psi =	2,500.0					
Fy	psi =	60,000.0					

Poisson's Ratio

Code: IBC 2015,ACI 318-14,ACI 530-13

lbs

0.300

=

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Concrete Stem Rebar Area Details		
Bottom Stem Vertica	Reinforcing Horizontal Reinforcing	a
As (based on applied moment): 0.2944	in2/ft	
(4/3) * As : 0.3926	in2/ft Min Stem T&S Reinf	Area 1.824 in2
200bd/fy : 200(12)(6.1875)/60000 : 0.2475	in2/ft Min Stem T&S Reinf	Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.1728	in2/ft Horizontal Reinforcing	g Options :
=====	One layer of : Tw	vo layers of :
Required Area : 0.2944	in2/ft #4@ 12.50 in #	4@ 25.00 in
Provided Area : 0.465 ii	n2/ft #5@ 19.38 in #	5@ 38.75 in
Maximum Area : 0.8382	in2/ft #6@ 27.50 in #	6@ 55.00 in
Footing Data	Footing Design Results	
Toe Width = 3.75 ft	Toe	Heel
Heel Width = 1.91	Factored Pressure = 1,510	118 psf
1 otal Footing Width = 5.66	Mu': Upward = 101,481	170 ft-#
Footing Thickness = 12.00 in	Mu: Design = 6.854	971 ft-#
Key Width = 0.00 in	Actual 1-Way Shear = 26.60	12.48 psi
Key Depth = 0.00 in	Allow 1-Way Shear = 75.00	40.00 psi
Key Distance from foe = 0.00 ft	Toe Reinforcing = $\# 5 @ 10.00$ in	
$f'_{c} = 2,500 \text{ psi}$ Fy = 60,000 psi Facting Concrete Density = 150,00 psf	Heel Reinforcing = None Spec'd	
Min As % = 0.0018	Footing Torsion, Tu =	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow. Torsion. phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable, provid	le
	supplemental design for footing to	rsion.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 9.25 in #5@ 14.35 in #6@	20.37 in. #7@ 27.77 in. #8@ 36.57 in. #9@ 46
	Heel: phiMn = phi/5'lambda'sqrt(fc)'Sm Key: No key defined	,,,,,,,
	Min footing T&S reinf Area	1.47 in2
	Min footing T&S reinf Area per foot	0.26 in2 /ft
	If one layer of horizontal bars: If	two layers of horizontal bars:
	#4@ 9.26 in	#4@ 18.52 in
	#5@ 14.35 in #6@ 20.37 in	#5@ 28.70 IN #6@ 40.74 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

				•		DI	SISTING	
Item		Force Ibs	Distance	Moment ft-#		Force Ibs	Distance	Moment ft-#
HL Act Pres (ab water tbl	I)	2,000.0	3.33	6,666.7	Soil Over HL (ab. water tbl)	1,342.8	5.04	6,765.5
HL Act Pres (be water tbl Hvdrostatic Force	I)			·	Soil Over HL (bel. water tbl) Watre Table		5.04	6,765.5
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=				* Axial Live Load on Stem =			
Load @ Stem Above Soil	=				Soil Over Toe =	150.0	1.88	281.3
	_				Surcharge Over Toe =			
	_				Stem Weight(s) =	950.0	4.08	3,879.2
					Earth @ Stem Transitions =			
Total	=	2,000.0	0.T.M. =	6,666.7	Footing Weight =	849.0	2.83	2,402.7
					Key Weight =			
Resisting/Overturning	g Ratio	2	=	2.00	Vert. Component =			
Vertical Loads used for	or Soil	Pressure	= 3,291.	8 lbs	Total =	3,291.8	bs R.M.=	13,328.6
					* Axial live load NOT included	in total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.050	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

Ĺ	License To : MALSAM TSANG ENGINEERING						
	Criteria						
	Retained Height	=	8.00 ft				
	Wall height above soil	=	0.50 ft				
	Slope Behind Wall	=	0.00				
	Height of Soil over Toe	=	4.00 in				
	Water height over heel	=	0.0 ft				

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	1.29 Ratio < 1
Slab Resis	ts All	Sliding !
Total Bearing Loadresultant ecc.	= =	2,718 lbs 21.21 in
Soil Pressure @ Toe Soil Pressure @ Heel	= =	2,231 psf OK 0 psf OK
Allowable Soil Pressure Less	= s Thai	2,666 psf n Allowable
ACI Factored @ Toe ACI Factored @ Heel	= =	3,123 psf 0 psf
Footing Shear @ Toe	=	30.6 psi OK
Allowable	=	11.0 psi OK 75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	2,196.0 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data					
Allow Soil Bearing Equivalent Fluid Pressure	e M	= leth	2,66 od	6.0	psf
Active Heel Pressure		=	4	0.0	psf/ft
		=			
Passive Pressure		=	15	0.0	psf/ft
Soil Density, Heel		=	120	.00	pcf
Soil Density, Toe		=	120	.00	pcf
Footing Soil Friction		=	0.4	450	
Soil height to ignore for passive pressure		=	12.	00	in
Lateral Load Appli	ed	l to	Ste	əm	
Lateral Load Height to Top Height to Bottom	= = =		72. 8.0 0.0	0 #/ 0 ft 0 ft	ft
Load Type	=	Se (Se	ismic ervice	c (E) e Le) vel)
Wind on Exposed Stem (Service Level)	=		0.0	0 ps	f

... Datta Ster C 1.5! D Ν

Restraine		
Adjacent Footing	Load	k
Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft

Code: IBC 2015,ACI 318-14,ACI 530-13

Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300
n		

em Construction		Bottom	
Design Height About Etc		Stem OK	
Wall Material Above Ftg	ft =	0.00 Conorata	
Wall Material Above Ht	=	Concrete	
	=		
Rebar Size	=	8.00 # 5	
Rebar Spacing	_	# 5 11 00	
Rebar Placed at	_	Edge	
Design Data	-	Luge	
fb/FB + fa/Fa	=	0.881	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	2.624.0	
MomentActual		_,	
Service Level	ft-# =		
Strength Level	ft-# =	7,765.3	
MomentAllowable	=	8,809.0	
ShearActual			
Service Level	psi =		
Strength Level	nsi –	35 3	
Shear Allowable	nsi –	75.0	
Anet (Masonry)	in2 =	10.0	
Rebar Depth 'd'	in	6 1 9	
Masonry Data		0.10	
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	2,500.0	
Fy	psi =	60,000.0	

icense : KW-06055289 icense To : MALSAM TSA	ANG EI	NGINEERING	Cantilevered F	Reta	ining Wa	Code: IBC 2015,ACI 318-14,ACI 5	530-13
Concrete Stem Reba	ar Are	a Details					
Bottom Stem		Vertical	Reinforcing	Horiz	ontal Reinfo	rcing	
As (based on applied mom	nent):	0.294 ir	n2/ft			-	
(4/3) * As : 0.392			12/ft	Min S	Stem T&S Re	einf Area 1.632 in2	
200bd/fy : 200(12)(6.1875)	/60000	: 0.2475	in2/ft	Min S	Stem T&S Re	einf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) : 0.172		0.1728	in2/ft	Horiz	ontal Reinfo	rcing Options :	
		======		One	ayer of :	Two layers of :	
Required Area :		0.294 ir	n2/ft	#4@	12.50 in	#4@ 25.00 in	
Provided Area :		0.3382	in2/ft	#5@	19.38 in	#5@ 38.75 in	
Maximum Area :		0.8382	in2/ft	#6@	27.50 in	#6@ 55.00 in	
Footing Data			Footing Des	ign F	Results		
Toe Width	=	3.50 ft			Тое	Heel	
Heel Width	= _	1.66	Factored Pressure	=	3,123	0 psf	
Total Footing Width	=	5.16	Mu' : Upward	=	122,714	0 ft-#	
Footing Thickness	=	12.00 in	Mu': Downward	=	16,758	657 ft-# 657 ft #	
Key Width	=	0.00 in	Actual 1-Way Shee	= .r _	0,030 30,62	11 03 psi	
Key Depth	=	0.00 in	Allow 1-Way Shear	· =	75.00	40.00 psi	
Key Distance from Toe	=	0.00 ft	Toe Reinforcing	=	# 5 @ 11.00) in	
f'c = 2,500 psi H Footing Concrete Density	Fy = =	60,000 psi 150.00 pcf	Heel Reinforcing Key Reinforcing	=	None Spec'o None Spec'o	d d	
Min. As %	=	0.0018	Footing Torsion, Tu	I	=	0.00 ft-lbs	
Cover @ Top 2.00	@ B	tm.= 3.00 in	Footing Allow. Tors	ion, pl	niTu =	0.00 ft-lbs	
			If torsion exce	eds al	lowable, pro	ovide	
			supplemental of	desig	n for footing	y torsion.	
			Other Acceptable	Sizes	& Spacing	gs	
			Toe: #4@ 7.50 Heel: phiMn = pł Key: No key de	in, #50 ni'5'lan fined	<pre>@ 11.63 in, # hbda'sqrt(fc)</pre>	#6@ 16.51 in, #7@ 22.51 in, #8@ 29.64 in, #9@ 3 'Sm	7
			Min footing T&S Min footing T&S If one layer of ho #4@ 9.26 in #5@ 14.35 in #6@ 20.37 in	reinf A reinf A rizonta	rea rea per foot al bars:	1.34 in2 0.26 in2 /ft If two layers of horizontal bars: #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in	

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNIN	G		RE	RESISTING			
Item	F	orce Ibs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#		
HI Act Pres (ab water tbl)		1.620.0	3.00	4.860.0	Soil Over HL (ab. water tbl)	953.6	4.66	4,447.0		
HL Act Pres (be water tbl) Hydrostatic Force		.,02010	0.00	.,00010	Soil Over HL (bel. water tbl) Watre Table)	4.66	4,447.0		
Buoyant Force	=				Sloped Soil Over Heel =					
Surcharge over Heel	=				Surcharge Over Heel =					
Surcharge Over Toe	=				Adjacent Footing Load =					
Adjacent Footing Load	=				Axial Dead Load on Stem =					
Added Lateral Load	=	576.0	5.00	2.880.0	* Axial Live Load on Stem =					
Load @ Stem Above Soil	=	01 010	0.00	2,00010	Soil Over Toe =	140.0	1.75	245.0		
	_				Surcharge Over Toe =					
	-				Stem Weight(s) =	850.0	3.83	3,258.3		
-					Earth @ Stem Transitions=					
Total	= 2	2,196.0	O.T.M. =	7,740.0	Footing Weight =	774.0	2.58	1,996.9		
					Key Weight =					
Resisting/Overturning	Ratio		=	1.29	Vert. Component =					
Vertical Loads used for	r Soil P	ressure =	= 2,717	.6 lbs	Total =	2,717.6	bs R.M.=	9,947.2		
					* Axial live load NOT included	d in total display	ed, or used for	r overturning		

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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	рсі
Horizontal Defl @ Top of Wall (approximate only)	0.102	in
The above calculation is not valid if the heel soil bearing pr	essure	exceeds that of the toe,

L	icense To : MALSAM TSANG ENGINEERING								
Criteria									
	Retained Height	=	5.00 ft						
	Wall height above soil	=	0.50 ft						
	Slope Behind Wall	=	0.00						
	Height of Soil over Toe	=	8.00 in						
	Water height over heel	=	0.0 ft						

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applica to otem						
Axial Dead Load	=	0.0 lbs				
Axial Live Load	=	0.0 lbs				
Axial Load Eccentricity	=	0.0 in				
Destant Original and						

Design Summary

Wall Stability Ratios Overturning Sliding	=		2.16 1.57	Ok	Č
Total Bearing Loadresultant ecc.	=		1,281 6.12	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Th: = =	an Al	710 39 2,000 lowabl 994 55	psf psf psf e psf psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		11.1 0.0 75.0	psi psi psi	OK OK
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		-	680.6 554.2 512.4 0.0 0.0	lbs lbs lbs lbs lbs	OK OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing		=	2,000.0	psf
Equivalent Fluid Pressure	϶N	1eth	od	
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore				
for passive pressure		=	12.00	in
· ·				
Lateral Load Appli	ec	d to	Stem	
Lateral Load	_		00#	/ft
Height to Ton	_		0.0 #/	n.
Height to Bottom	_		0.00 ft	
	-		0.00 II	
Load Type	=	Wi	nd (W)	
		(Se	ervice Le	evel)
Wind on Exposed Stem			0.0 m	sf
(Service Level)	=		0.0 p	51

Stem C Des Wa Des Thi Re Re Re Desi fb/ Tot Мо Мо Sh Sh An Rel Mas f'm Fs Sol Мо

Adjacent Footing	Load	
Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccontricity	_	0.00 in
	_	0.00 III

Code: IBC 2015,ACI 318-14,ACI 530-13

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

n Construction		Bottom	
osian Hoight Abovo Etc	"	Stem OK	
Wall Matarial Above "Ht"	II =	0.00 Concrete	
Design Method	_		
Thickness	_	8.00	
Rebar Size	_	# 4	
Rebar Spacing	=	11.00	
Rebar Placed at	=	Edge	
Design Data		9-	
fb/FB + fa/Fa	=	0.240	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	850.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	1,416.7	
MomentAllowable	=	5,883.6	
ShearActual			
Service Level	psi =		
Strength Level	psi =	11.3	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
lasonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf=	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium We	eight
Masonry Design Method	=	ASD	

Concrete Data f'c

Fy

2,500.0 psi = psi = 60,000.0

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Concrete Stem Rebar	Area Details				
Bottom Stem As (based on applied momen	t) : 0.0531	Reinforcing	Horizontal Re	einforcing	
(4/3) * As	0 0708	in2/ft	Min Stem T&	S Reinf Area 1	056 in2
$200 \text{ bd/fv} \cdot 200(12)(6.25)/6000$	0.25 in2	P/ft	Min Stem T&	S Reinf Area n	er ft of stem Height : 0 192 in2/ft
$0.0018bb \cdot 0.0018(12)(8) \cdot$	0.20112	in2/ft	Horizontal Re	inforcing Optic	ane .
0.0010011.0.0010(12)(0).	0.1720		Opo lovor of :		re of :
Required Area :	0 1729		011e layer 01 . #4@ 12 50 in	. 1 wo laye #4 @ 25	00 in
Required Area .	0.1720	iii2/it	#4@ 12.30 III #5@ 40.20 im	#4@ 23	
Provided Area :	0.2182	in2/ft i	#5@ 19.38 in	#5@ 38	.75 IN
Maximum Area :	0.8467	in2/ft	#6@ 27.50 in	#6@ 55	.00 in
Footing Data		Footing Desig	gn Results	\$	
Toe Width =	2.75 ft		Toe	Heel	
Heel Width =	0.67	Factored Pressure	= 99	94 55	psf
Total Footing Width =	3.42	Mu' : Upward	= 33,67	72 O t	ft-#
Footing Thickness =	10.00 in	Mu' : Downward	= 12,59	0 0	ft-#
Key Width =	12 00 in	Mu: Design	= 1,75	o6 01	
Key Depth =	8.00 in	Actual 1-Way Shear	= 11.0	0.03	psi
Key Distance from Toe =	1.00 ft	Allow 1-Way Shear	= 75.0	00 in 40.00	psi
fo - 2 500 poi Ev	- 60.000 poi	Heel Reinforcing	= #4@9.	.00 m bec'd	
Footing Concrete Density =	= 00,000 psi : 150.00 pcf	Kev Reinforcing	= #4@9	.26 in	
Min. As %	0.0018	Footing Torsion, Tu	=	= 0.00	ft-lbs
Cover @ Top 2.00	@ Btm.= 3.00 in	Footing Allow. Torsic	on. phi Tu =	= 0.00	ft-lbs
		If torsion exceed	ds allowable	. provide	
		supplemental de	esign for foo	ting torsion.	
Other Acceptable Sizes & Spacings Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18					
		Min footing T&S re Min footing T&S re If one layer of hori	einf Area einf Area per f zontal bars:	0.74 foot 0.22 If two lay	in2 in2 /ft yers of horizontal bars: 22.22 in

#4@ 11.11 in #5@ 17.22 in #6@ 24.44 in f two layers of hor #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0\	ERTURN	IING				R	ESISTING	
Item		Force lbs	Distanc ft	e	Moment ft-#			Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	I)	680.6	1.94	1	1,323.3	Soil Over HL (ab. wat	er tbl)	1.8	3.42	6.3
HL Act Pres (be water th	í)		-		,	Soil Over HL (bel. wa	ter tbl)		3.42	6.3
Hydrostatic Force						Watre Table				
Buoyant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	d =			
Adjacent Footing Load	=					Axial Dead Load on S	tem =			
Added Lateral Load	=					* Axial Live Load on Ste	em =			
Load @ Stem Above So	il =					Soil Over Toe	=	201.7	1.38	277.3
	=					Surcharge Over Toe	=			
						Stem Weight(s)	=	550.0	3.08	1,695.8
						Earth @ Stem Transiti	ions=			
Total	=	680.6	0.T.M.	=	1,323.3	Footing Weight	=	427.5	1.71	731.0
						Key Weight	=	100.0	1.50	150.0
Resisting/Overturnin	g Rat	io	=	2	2.16	Vert. Component	=			
Vertical Loads used f	or So	il Pressure	= 1,2	281.0	lbs	Т	otal =	1,281.0	lbs R.M.=	2,860.4
						* Axial live load NOT ind	cluded ir	n total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.032	in
The above calculation is not valid if the heel soil bearing p	ressure e	exceeds that of the toe,

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Criteria			
Retained Height	=	10.00 ft	
Wall height above so	il =	0.50 ft	
Slope Behind Wall	=	0.00	
Height of Soil over To	be =	6.00 in	
Water height over he	el =	0.0 ft	

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Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applica to otern						
Axial Dead Load	=	0.0 lbs				
Axial Live Load	=	0.0 lbs				
Axial Load Eccentricity	=	0.0 in				
D : 0						

Design Summary

Wall Stability Ratios Overturning Sliding	=		2.20 1.65	Ok Ok	Č.
Total Bearing Loadresultant ecc.	=		3,778 18.42	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Th: = =	an	838 0 2,000 Allowabl 1,173 0	psf psf psf e psf psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		18.1 1.9 75.0	psi psi psi	ok ok
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		-	2,531.3 2,666.7 1,511.1 0.0 0.0	lbs lbs lbs lbs lbs	OK OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soll Data				
Allow Soil Bearing Equivalent Fluid Pressur	re N	= leth	2,000.0	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Stem	
Lateral Load	=		0.0 #/	'ft
Height to Top	=		0.00 ft	
	=		0.00 II	
Load Type	=	W	ind (W)	
		(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)) =		0.0 ps	sf

Stem Construction Design Height Above Ftg ft = Wall Material Above "Ht" = **Design Method** = Thickness = Rebar Size = **Rebar Spacing** = Rebar Placed at = Design Data fb/FB + fa/Fa = **Total Force @ Section** Service Level lbs = Strength Level lbs = Moment....Actual ft-# =Service Level Strength Level ft-# = Moment.....Allowable = Shear.....Actual Service Level psi = Strength Level psi = Shear.....Allowable psi = Anet (Masonry) in2 = Rebar Depth 'd' 5.63 in = Masonry Data f'm psi = Fs psi = Solid Grouti Modular F

Adjacent Footing I	_oad	k
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	=	0.0 ft

Code: IBC 2015,ACI 318-14,ACI 530-13

Poisson's Ratio 0.300 = Bottom Stem OK 0.00 Concrete LRFD 8.00 # 6 8.00 Edge 0.787 3,400.0 11,333.3 14,393.2 50.4 75.0

at Back of Wall

	Solid Grouting	=		
	Modular Ratio 'n'	=		
	Wall Weight	psf =	100.0	
	Short Term Factor	=		
	Equiv. Solid Thick.	=		
	Masonry Block Type	=	Medium Weight	
	Masonry Design Method	=	ASD	
С	Concrete Data			-
	f'c	psi =	2,500.0	
	Fy	psi =	60,000.0	

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Concrete Stem Rebar Area Details			
Bottom Stem V	ertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) : 0.	4746 in2/ft	0	
(4/3) * As : 0.	6328 in2/ft	Min Stem T&S Reinf Area	a 2.016 in2
200bd/fy : 200(12)(5.625)/60000 : 0.	225 in2/ft	Min Stem T&S Reinf Area	a per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.	1728 in2/ft	Horizontal Reinforcing Op	otions :
=		One layer of : Two la	yers of :
Required Area : 0.	4746 in2/ft	#4@ 12.50 in #4@	25.00 in
Provided Area : 0.	66 in2/ft	#5@ 19.38 in #5@	38.75 in
Maximum Area : 0.	762 in2/ft	#6@ 27.50 in #6@	55.00 in
Footing Data	Footing Des	sign Results	
Toe Width = 8.25 ft		Toe Hee	9
Heel Width = 0.83	Factored Pressure	= 1,173	_ 0 psf
Total Footing Width = 9.08	Mu' : Upward	= 332,890	0 ft-#
Footing Thickness = 15.00 in	Mu' : Downward	= 138,643 2	5 ft-#
Key Width = 12.00 in	Mu: Design	= 16,187 2	5 II-#
Key Depth = 31.00 in	Actual 1-Way She	$a_1 = 10.11 1.9$ r = 75.00 40.0	iz psi i0 nsi
Key Distance from Toe = 1.00 ft	Toe Reinforcing	= #6@8.00 in	
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing	= None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing	= #5 @ 12.00 in	
Min. As % = 0.0018	Footing Lorsion, I	u = 0.	00 ft-lbs
Cover @ 10p 2.00 @ Btm.= 3.00 h	n Footing Allow. Tors	sion, phi Tu = $0.$	00 ft-lbs
	If torsion exce	eds allowable, provide	
	supplemental	design for footing torsior	1.
	Other Acceptable	e Sizes & Spacings	
	Toe: #4@ 5.59	in, #5@ 8.67 in, #6@ 12.3	0 in, #7@ 16.78 in, #8@ 22.10 in, #9@ 27.
	Heel: phiMn = p Key: #4@ 10 ir	hi'5'lambda'sqrt(fc)'Sm n, #5@ 15.5 in, #6@ 18 in, :	#7@ 18 in, #8@ 18 in
	Min footing T&S	reinf Area 2.9	4 in2
	Min footing T&S	reint Area per foot 0.3	2 in2 /ft
	If one layer of ho	orizontal bars: If two	layers of norizontal bars:
	#4@ 7.41 IN #5@ 11 40 in	#4@ #E @	世 14.81 ID 剤 22.06 in
	#6@ 16.30 in	#6@	22.50 m

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0		• •			DE	SISTING	
Item		Force lbs	Distance	Moment ft-#			Force Ibs	Distance	Moment ft-#
HL Act Pres (ab water tbl)	2,531.3	3.75	9,492.2	Soil Over HL (ab. wa	ter tbl)	183.3	9.00	1,650.0
HL Act Pres (be water tbl Hydrostatic Force)	,			Soil Over HL (bel. wa Watre Table	ater tbl)		9.00	1,650.0
Buovant Force	=				Sloped Soil Over Hee	el =			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Loa	d =			
Adjacent Footing Load	=				Axial Dead Load on S	Stem =			
Added Lateral Load	=				* Axial Live Load on St	em =			
Load @ Stem Above Soi	=				Soil Over Toe	=	453.8	4.13	1,871.7
	=				Surcharge Over Toe	=			
					Stem Weight(s)	=	1,050.0	8.58	9,012.5
					Earth @ Stem Transi	tions=			
Total	=	2,531.3	O.T.M. =	9,492.2	Footing Weight	=	1,703.1	4.54	7,735.0
					Key Weight	=	387.5	1.50	581.3
Resisting/Overturning	g Rati	io	=	2.20	Vert. Component	=			
Vertical Loads used for	or Soi	I Pressure	= 3,777.	7 lbs		Fotal =	3,777.7	bs R.M.=	20,850.5
					* Axial live load NOT in	ncluded in	n total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.027	in
The above calculation is not valid if the heel soil bearing p	oressure e	exceeds that of the toe,

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Ĺ	icense To : MALSAM TS	SANG	ENGINEERIN
	Criteria		
	Retained Height	=	11.00 ft
	Wall height above soil	=	0.50 ft
	Slope Behind Wall	=	0.00
	Height of Soil over Toe	=	6.00 in
	Water height over heel	=	0.0 ft

١G

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe = 0.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applied to otem					
Axial Dead Load	=	0.0 lbs			
Axial Live Load	=	0.0 lbs			
Axial Load Eccentricity	Ξ	0.0 in			
, Mai Loud Loochtholty	-	0.0 11			
Design Summary		,			

Design Summary

Wall Stability Ratios Overturning Sliding	=		2.17 1.67	Ok	Č
Total Bearing Loadresultant ecc.	=		4,424 17.96	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Tha = =	an A	906 26 2,000 Allowable 1,268 36	psf psf psf e psf psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		23.1 1.9 75.0	psi psi psi	ok ok
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability	= = =	-	3,001.3 3,234.4 1,769.5 0.0 0.0	lbs lbs lbs lbs lbs	OK OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soli Data				
Allow Soil Bearing Equivalent Fluid Pressure	e M	= leth	2,000. od	0 psf
Active Heel Pressure		=	40.	0 psf/ft
		=		
Passive Pressure		=	300.	0 psf/ft
Soil Density, Heel		=	110.0	0 pcf
Soil Density, Toe		=	110.0	0 pcf
Footing Soil Friction		=	0.40	0
Soil height to ignore for passive pressure		=	12.00) in
Lateral Load Appli	ec	l to	Sten	n
Lateral Load	=		; 0.0	#/ft ft
Height to Bottom	=		0.00 f	ft
Load Type	=	Wi	nd (W)	
		(Se	ervice L	_evel)

Stem Construction Design Height Above Ftg Wall Material Above "Ht" **Design Method** Thickness Rebar Size **Rebar Spacing** Rebar Placed at Design Data fb/FB + fa/Fa **Total Force @ Section** Service Level Strength Level Moment....Actual Service Level Strength Level Moment.....Allowable Shear.....Actual Service Level Strength Level Shear.....Allowable Anet (Masonry) in2 = Rebar Depth 'd' 9.63 in = Masonry Data f'm psi = Fs psi = Solid Grouting = Modular Ratio 'n' =

Wall Weight

Concrete Data

f'c Fy

Short Term Factor

Equiv. Solid Thick.

Masonry Block Type

Masonry Design Method

	vei)	Base Above/Below Soil
0.0 psf		at Back of Wall
		Poisson's Ratio
	Bottom	
	Stem OK	
ft =	0.00	
=	Concrete	
=	LRFD	
=	12.00	
=	# 6	
=	8.00	
=	Edge	
=	0.574	l de la constante de
lbs =		
lbs =	4,114.0	
rt-# =		
ft-# =	15,084.7	
=	26,273.2	
nci –		
h2i =		
psi =	35.6	
psi =	75.0	

150.0

Medium Weight

2,500.0

psf =

psi =

=

=

=

= ASD

psi = 60,000.0

Code: IBC 2015,ACI 318-14,ACI 530-13



Concrete Stem Rebar Area DetailsBottom StemVertical ReinforcingHorizontal ReinforcingAs (based on applied moment) :0.3602 in2/ftMin Stem T&S Reinf Area 3.312 in2(4/3) * As :0.4803 in2/ftMin Stem T&S Reinf Area 9.312 in2200bd/fy : 200(12)(9.625)/60000 :0.385 in2/ftMin Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft0.0018bh : 0.0018(12)(12) :0.2592 in2/ftHorizontal Reinforcing Options : One layer of :Two layers of :Required Area :0.385 in2/ft#4@ 8.33 inProvided Area :0.66 in2/ft#Stimum Area :1.3039 in2/ft#Goting Design Results	530-13
Bottom StemVertical ReinforcingHorizontal ReinforcingAs (based on applied moment) :0.3602 in2/ftMin Stem T&S Reinf Area 3.312 in2(4/3) * As :0.4803 in2/ftMin Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft200bd/fy : 200(12)(9.625)/60000 :0.385 in2/ftMin Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft0.0018bh : 0.0018(12)(12) :0.2592 in2/ftHorizontal Reinforcing Options : One layer of :Two layers of :Required Area :0.385 in2/ft#4@ 8.33 inProvided Area :0.66 in2/ft#S@ 12.92 in#5@ 25.83 inMaximum Area :1.3039 in2/ftFooting Design Results	
(4/3) * As : 0.4803 in2/ft Min Stem T&S Reinf Area 3.312 in2 200bd/fy : 200(12)(9.625)/60000 : 0.385 in2/ft Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft 0.0018bh : 0.0018(12)(12) : 0.2592 in2/ft Horizontal Reinforcing Options :	
200bd/fy : 200(12)(9.625)/60000 : 0.385 in2/ft Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft 0.0018bh : 0.0018(12)(12) : 0.2592 in2/ft Horizontal Reinforcing Options : ======= One layer of : Two layers of : Required Area : 0.385 in2/ft #4@ 8.33 in Provided Area : 0.66 in2/ft #5@ 12.92 in Maximum Area : 1.3039 in2/ft #6@ 18.33 in Footing Data Footing Design Results	
0.0018bh : 0.0018(12)(12) : 0.2592 in2/ft Horizontal Reinforcing Options : ====== One layer of : Two layers of : Required Area : 0.385 in2/ft #4@ 8.33 in #4@ 16.67 in Provided Area : 0.66 in2/ft #5@ 12.92 in #5@ 25.83 in Maximum Area : 1.3039 in2/ft #6@ 18.33 in #6@ 36.67 in Footing Data	
===== One layer of : Two layers of : Required Area : 0.385 in2/ft #4@ 8.33 in #4@ 16.67 in Provided Area : 0.66 in2/ft #5@ 12.92 in #5@ 25.83 in Maximum Area : 1.3039 in2/ft #6@ 18.33 in #6@ 36.67 in Footing Data	
Required Area : 0.385 in2/ft #4@ 8.33 in #4@ 16.67 in Provided Area : 0.66 in2/ft #5@ 12.92 in #5@ 25.83 in Maximum Area : 1.3039 in2/ft #6@ 18.33 in #6@ 36.67 in Footing Data	
Provided Area : 0.66 in2/ft #5@ 12.92 in #5@ 25.83 in Maximum Area : 1.3039 in2/ft #6@ 18.33 in #6@ 36.67 in Footing Data Footing Design Results	
Maximum Area : 1.3039 in2/ft #6@ 18.33 in #6@ 36.67 in Footing Data Footing Design Results	
Footing Data Footing Design Results	
Toe Width = 8.50 ft <u>Toe</u> <u>Heel</u>	
Heel Width = <u>1.00</u> Factored Pressure = 1,268 36 psf	
Footing Width = 9.50 Mu : Opward = 390,388 0 ft-#	
$Mu: Design = 20,268 \qquad 0 \text{ ft-}#$	
Key Width = 12.00 in Actual 1-Way Shear = 23.11 1.92 psi	
Key Depth = 36.00 In Allow 1-Way Shear = 75.00 40.00 psi	
Toe Reinforcing $= \#6 @ 8.00$ in	
f'c = 2,500 psi Fy = 60,000 psi Heel Reinforcing = None Specia Footing Concrete Density = 150.00 pcf Key Reinforcing = #5.@ 10.00 in	
Min. As $\%$ = 0.0018 Footing Torsion. Tu = 0.00 ft-lbs	
Cover @ Top 2.00 @ Btm.= 3.00 in Footing Allow. Torsion, phi Tu = 0.00 ft-lbs	
If torsion exceeds allowable, provide	
supplemental design for footing torsion.	
Other Acceptable Sizes & Spacings	
Toe: #4@ 5.21 in, #5@ 8.08 in, #6@ 11.47 in, #7@ 15.65 in, #8@ 20.60 in, #9@ 2 Heel: phiMn = phi5'lambda/sqrt(fc)'Sm	6.
Key: #4@ 7.29 in, #5@ 11.31 in, #6@ 16.05 in, #7@ 18 in, #8@	
Min footing T&S reinf Area3.08in2Min footing T&S reinf Area per foot0.32in2If one layer of horizontal bars:If two layers of horizontal bars:#4@ 7.41 in#4@ 14.81 in#5@ 11.48 in#5@ 22.96 in#6@ 16.20 in#5@ 22.50 in	

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0)		ING				R	ESISTING	
Item		Force Ibs	Distance	e	Moment ft-#	_		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tb HL Act Pres (be water tb Hvdrostatic Force	I) I)	3,001.3	4.08		12,255.1	Soil Over HL (ab. wat Soil Over HL (bel. wat Watre Table	er tbl) ter tbl)			
Buoyant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on St	tem =			
Added Lateral Load	=					* Axial Live Load on Ste	em =			
Load @ Stem Above Soi	il =					Soil Over Toe	=	467.5	4.25	1,986.9
	=					Surcharge Over Toe	=			
	_					Stem Weight(s)	=	1,725.0	9.00	15,525.0
			_			Earth @ Stem Transiti	ons=			
Total	=	3,001.3	O.T.M.	=	12,255.1	Footing Weight	=	1,781.3	4.75	8,460.9
						Key Weight	=	450.0	1.50	675.0
Resisting/Overturning	g Rat	io	=	2	2.17	Vert. Component	=			
Vertical Loads used f	or So	I Pressure	= 4,4	123.8	lbs	Te	otal =	4,423.8	lbs R.M.=	26,647.8
						* Axial live load NOT ind	cluded in	n total displa	yed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.030	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

Ľ	icense To : MALSAM TS	SANG	BENGINEER	NG
	Criteria			
	Retained Height	=	12.00 ft	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	6.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Aniai Luau Applied		Stem
Axial Dead Load	_	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	_	0.0 in
	-	
Design Summary		

Wall Stability Ratios Overturning Sliding	=	2.01 1.61	OK OK	
Total Bearing Loadresultant ecc.	= =	4,806 22.23	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel	=	979 0 2 000	psf psf	Ok Ok
Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= Than = =	Allowable 1,371 0	psi epsf	
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =	26.2 1.9 75.0	psi psi psi	OK OK
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force	= = • = •	3,511.3 3,726.0 1,922.3	lbs lbs lbs	
Added Force Req'd for 1.5 Stability	=	0.0 0.0	lbs Ibs	OK Ok

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing Equivalent Fluid Pressure	e N	= leth	2,000.0	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Stem	
Lateral Load	=		0.0 #/	ft
Height to Top	=		0.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	W	ind (W)	
		(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Bottom **Stem Construction** Stem OK Design Height Above Ftg ft = 0.00 Wall Material Above "Ht" Concrete = **Design Method** = LRFD Thickness 12.00 = Rebar Size # 6 = 7.00 **Rebar Spacing** = Rebar Placed at Edge = Design Data fb/FB + fa/Fa 0.660 = **Total Force @ Section** Service Level lbs = Strength Level lbs = 4,896.0 Moment....Actual Service Lev **н** 4 Strengt Moment... Shear.....A Service Streng Shear A Anet (Mas Rebar Dep Masonry D f'm Fs Solid Grou Modular R

Concrete Data

f'c Fy

Service Level	II-# =	
Strength Level	ft-# =	19,584.0
MomentAllowable	=	29,648.9
ShearActual		
Service Level	psi =	
Strength Level	psi =	42.4
ShearAllowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	9.63
lasonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	150.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight

Masonry Design Method = ASD 2,500.0 psi =

psi = 60,000.0

Code: IBC 2015,ACI 318-14,ACI 530-13



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Concrete Stem Rebar	Area Details			
Bottom Stem As (based on applied moment	Vertical): 0.4676	Reinforcing in2/ft	Horizontal Reinfor	cing
(4/3) * As :	0.6235	in2/ft	Min Stem T&S Re	inf Area 3.600 in2
200bd/fv : 200(12)(9.625)/600	00 : 0.385 ir	n2/ft	Min Stem T&S Re	inf Area per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) :	0.2592	in2/ft	Horizontal Reinfor	cing Options :
	======	======	One laver of	Two layers of .
Required Area	0 4676	in2/ft	#4@ 8.33 in	#4@ 16 67 in
Provided Area :	0.7543	in2/ft	#5@ 12 92 in	#5@ 25.83 in
Maximum Area :	1 3039	in2/ft	#6@ 18 33 in	#6@ 36 67 in
Footing Data		Footing Desig	an Results	
i comig bata		r ootning book	Jin Roodillo	
Toe Width=Heel Width=Total Footing Width=Footing Thickness=Key Width=Key Depth=Key Distance from Toe=fc =2,500 psiFyFooting Concrete Density=Min. As %=Cover @ Top2.00	9.25 ft <u>1.00</u> 10.25 15.00 in 12.00 in 40.00 in 1.00 ft = 60,000 psi 150.00 pcf 0.0018 2 Btm.= 3.00 in	Factored Pressure Mu': Upward Mu': Downward Mu: Design Actual 1-Way Shear Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Key Reinforcing Footing Torsion, Tu Footing Allow. Torsio	Toe = 1,371 = 482,651 = 174,291 = 25,697 = 26.19 = 75.00 = # 6 @ 7.00 ii = None Spec'c = # 5 @ 8.00 ii = on, phi Tu =	Heel 0 psf 0 ft:# 0 ft-# 1.92 psi 40.00 psi 0 0.00 ft-lbs 0.00 ft-lbs
		If torsion excee	ds allowable, pro	vide
		supplemental d	esign for footing	torsion.
		Other Acceptable S Toe: #4@ 4.69 ir Heel: phiMn = phi Key: #4@ 5.71 ir Min footing T&S re Min footing T&S re If one layer of hori	Sizes & Spacing 1, #5@ 7.28 in, #6 '5'lambda'sqrt(fc)' 1, #5@ 8.85 in, #6 einf Area einf Area per foot izontal bars:	s @ 10.33 in, #7@ 14.09 in, #8@ 18.56 in, #9@ 23. Sm @ 12.56 in, #7@ 17.13 in, # 3.32 in2 0.32 in2 /ft If two layers of horizontal bars:

#4@	7.41 in
#5@	11.48 in
#6@	16.30 in

If two layers of ho #4@ 14.81 in #5@ 22.96 in #6@ 32.59 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

	OV	ERTURNIN	IG			RESISTING			
Item		Force lbs	Distance ft	Moment ft-#	_		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb HL Act Pres (be water tb Hydrostatic Force Buoyant Force Surcharge over Heel Surcharge Over Toe Adjacent Footing Load)) = = = =	3,511.3	4.42	15,508.0	Soil Over HL (ab. water Soil Over HL (bel. water Watre Table Sloped Soil Over Heel Surcharge Over Heel Adjacent Footing Load Axial Dead Load on Ster	r tbl) r tbl) = = = :m =			
Added Lateral Load Load @ Stem Above Soi	= = =				Soil Over Toe Surcharge Over Toe	n = = =	508.8	4.63	2,353.0
Total	=	3,511.3	O.T.M. =	= 15,508.0	Stem Weight(s) Earth @ Stem Transitio Footing Weight Key Weight	= ns= = =	1,875.0 1,921.9 500.0	9.75 5.13 1.50	18,281.3 9,849.6 750.0
Resisting/Overturning Vertical Loads used for	g Rat i or Soi	i o I Pressure	= = 4,80	2.01 5.6 lbs	Vert. Component To * Axial live load NOT incl	= tal = uded ir	4,805.6	lbs R.M.=	31,233.8 r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.033 in	

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

Ľ	icense To : MALSAM TS	SANG	ENGINEERIN	١G
	Criteria			
	Retained Height	=	4.00 ft	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	8.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios Overturning Sliding	=		1.87 1.35	OK Rat	í io < 1.
Total Bearing Loadresultant ecc.	=		1,118 7.12	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe	= = Th: =	an Al	822 0 2,666 lowable 1,151	psf psf psf e psf	OK OK
Footing Shear @ Heel Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		0 10.2 2.7 75.0	psr psi psi psi	ok ok
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		:	611.2 375.0 447.3 0.0 94.5	lbs lbs lbs lbs lbs	OK NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data					
Allow Soil Bearing	e M	= leth	2,66 od	6.0	psf
Active Heel Pressure		=	4	0.0	psf/ft
		=			
Passive Pressure		=	25	0.0	psf/ft
Soil Density, Heel		=	110	.00	pcf
Soil Density, Toe		=	110	.00	pcf
Footing Soil Friction		=	0.4	100	
Soil height to ignore for passive pressure		=	12.	00	in
Lateral Load Appli	ec	l to	Ste	em	
Lateral Load Height to Top Height to Bottom	= = =		36.0 4.00 0.00) #/) ft) ft	ft
Load Type	=	Wi (Se	nd (V ervice	V) e Le	vel)
Wind on Exposed Stem	=		0.0) ps	f

Stem C Des Wa De .5! Thi Re Re Rel Des fb/ Tot Мо Мо Sh Sh An Rel Mas f'm Fs Sol

Masonry Design Method

Concrete Data

f'c

Fy

	•	
Adjacent Footing	Load	k
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

=

=

0.0 ft

0.300

Base Above/Below Soil

at Back of Wall

Poisson's Ratio

Code: IBC 2015,ACI 318-14,ACI 530-13

	_	
n Construction	_	Bottom
)esian Height Above Etc	f+	Stem OK
Wall Material Above "Ht"		0.00 Concrete
Design Method	_	
Thickness	_	8.00
Rebar Size	_	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		_~90
fb/FB + fa/Fa	=	0.203
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	731.2
MomentActual		
Service Level	ft-# =	
Strength Level	ft-# =	1,099.7
MomentAllowable	=	5,412.6
ShearActual		
Service Level	psi =	
Strength Level	psi =	9.7
ShearAllowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
lasonry Data		0.20
f'm	psi =	
Fs	psi =	
Solid Grouting	. =	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight

2,500.0 psi =

psi = 60,000.0

= ASD

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Concrete Stem Rebar Area Details		
Bottom Stem Vertical	Reinforcing Horizontal Reinforci	na
As (based on applied moment) : 0.0412 ir	n2/ft	5
(4/3) * As : 0.0549 ir	n2/ft Min Stem T&S Rein	If Area 0.864 in2
200bd/fy : 200(12)(6.25)/60000 : 0.25 in2/	/ft Min Stem T&S Rein	If Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.1728 ir	n2/ft Horizontal Reinforci	ng Options :
=====	===== One layer of : T	wo layers of :
Required Area : 0.1728 ir	n2/ft #4@ 12.50 in	#4@ 25.00 in
Provided Area : 0.2 in2/ft	t #5@ 19.38 in	#5@ 38.75 in
Maximum Area : 0.8467 ir	n2/ft #6@ 27.50 in	#6@ 55.00 in
Footing Data	Footing Design Results	
Toe Width = 2.00 ft	Тое	Heel
Heel Width = 1.00	Factored Pressure = 1,151	0 psf
Total Footing Width = 3.00	Mu' : Upward = 20,857	0 ft-#
Footing Thickness = 10.00 in	Mu': Downward = 6,664	44 ft-#
Key Width = 0.00 in	Mu: Design = $1,183$	44 II-# 2 74 poi
Key Depth = 6.00 in	Actual 1-Way Shear = 10.15 Allow 1-Way Shear = 75.00	40.00 psi
Key Distance from Toe = 0.00 ft	Toe Reinforcing = $#4 @ 9.00$ in	
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = None Spec'd	
Min. As $\% = 0.0018$	Footing Torsion, Tu =	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow. Torsion, phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable, prov	ide
	supplemental design for footing to	prsion.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 11.11 in, #5@ 17.22 in, #6 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sr Key: No key defined	}@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 n
	Min footing T&S reinf Area Min footing T&S reinf Area per foot If one layer of horizontal bars: #4@ 11.11 in #5@ 17.22 in #6@ 24.44 in	0.65 in2 0.22 in2 /ft If two layers of horizontal bars: #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING				R	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	1)	467.2	1.61	752.7	Soil Over HL (ab. water	tbl)	146.7	2.83	415.6
HL Act Pres (be water tb Hvdrostatic Force)	-	-	-	Soil Over HL (bel. water Watre Table	tbl)		2.83	415.6
Buoyant Force	=				Sloped Soil Over Heel	=			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Load	=			
Adjacent Footing Load	=				Axial Dead Load on Sten	n =			
Added Lateral Load	=	144.0	2.83	408.0	* Axial Live Load on Stem	=			
Load @ Stem Above Soi	=				Soil Over Toe	=	146.7	1.00	146.7
	=				Surcharge Over Toe	=			
					Stem Weight(s)	=	450.0	2.33	1,050.0
					Earth @ Stem Transition	S=			
Total	=	611.2	O.T.M. =	1,160.7	Footing Weight	=	375.0	1.50	562.5
					Key Weight	=			
Resisting/Overturning	g Rat	io	=	1.87	Vert. Component	=			
Vertical Loads used f	or Soi	il Pressure	= 1,118.	3 lbs	Tota	al =	1,118.3	bs R.M.=	2,174.7
					* Axial live load NOT inclue	ded in	total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.034	in
The above calculation is not valid if the heel soil bearing pr	essure e	exceeds that of the toe,

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Criteria						
Retained Height	=	4.00 ft				
Wall height above soil	=	0.50 ft				
Slope Behind Wall	=	0.00				
Height of Soil over Toe	=	8.00 in				
Water height over heel	=	0.0 ft				

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe = 0.0 NOT 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

Design Summary

Wall Stability Ra Overturning Sliding	atios	=		1.52 1.35	OK Rat	io < 1.
Total Bearing Lo	bad	=		940 9.74	lbs in	
Soil Pressure @ Soil Pressure @ Allowable Soil Press ACI Factored @	De Heel ure Less Toe	= = Tha =	an Al	970 0 2,666 lowable 1,357	psf psf psf e psf	OK OK
Footing Shear (Footing Shear (Allowable	@ Toe @ Heel	= = =		10.1 1.4 75.0	psi psi psi psi	ok ok
Sliding Calcs Lateral Sliding F less 100% Pass less 100% Fricti Added Force Re for 1.5 Stab	orce sive Force on Force eq'd ility		-	611.2 450.0 376.2 0.0 90.7	lbs lbs lbs lbs lbs	OK NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing Equivalent Fluid Pressure	e M	= letho	2,666.0 od	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appli	ec	l to	Stem	
Lateral Load Height to Top Height to Bottom	=		36.0 #/ 4.00 ft 0.00 ft	′ft
Load Type	_	W/ir	nd (W)	
		(Se	ervice Le	evel)

Ster C .5! D N

Adjacent Footing	Load		
Adjacent Footing Load	=	0.0 lbs	I
Footing Width	=	0.00 ft	
Eccentricity	=	0.00 in	

Code: IBC 2015,ACI 318-14,ACI 530-13

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

em Construction		Bottom	
Desire Haight Above Fts		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
I hickness	=	6.00	
Rebar Size	=	# 4	
Rebar Spacing	=	18.00	
Rebar Placed at	=	Edge	
fb/EB + fo/Eo	_	0 447	
Total Force @ Section	-	0.111	
	lha		
		704.0	
Strength Level	IDS =	731.2	
NomentActual	f+ # _		
	n-# =	4 000 7	
Strength Level	IT-# =	1,099.7	
MomentAllowable	=	2,455.6	
ShearActual			
Service Level	psi =		
Strength Level	psi =	14.3	
ShearAllowable	, psi =	75.0	
Anet (Masonrv)	in2 =		
Rebar Depth 'd'	in =	4.25	
Masonry Data			
f'm	psi =		
Fs	, psi =		
Solid Grouting	' =		
Modular Ratio 'n'	=		
Wall Weight	psf =	75.0	
Short Term Factor	. =		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	/eight
Masonry Design Method	=	ASD	-
Concrete Data			
f'c	psi =	2,500.0	
Fy	psi =	60,000.0	

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Concrete Stem Rebar Area Details		
Bottom Stem Vertical	Reinforcing Horizontal Reinforcing	g
As (based on applied moment) : 0.0622	in2/ft	
(4/3) * As : 0.0829	in2/ft Min Stem T&S Reinf	Area 0.648 in2
200bd/fy : 200(12)(4.25)/60000 : 0.17 in2	2/ft Min Stem T&S Reinf	Area per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) : 0.1296	in2/ft Horizontal Reinforcing	g Options :
=====	One layer of : Tw	vo layers of :
Required Area : 0.1296	in2/ft #4@ 16.67 in #	4@ 33.33 in
Provided Area : 0.1333	in2/ft #5@ 25.83 in #	±5@ 51.67 in
Maximum Area : 0.5757	in2/ft #6@ 36.67 in #	46@ 73.33 in
Footing Data	Footing Design Results	
Toe Width = 2.25 ft	Тое	Heel
Heel Width = 0.67	Factored Pressure = 1,357	0 psf
Total Footing Width = 2.92	Mu' : Upward = 25,332	0 ft-#
Footing Thickness = 10.00 in	Mu': Downward = 8,434	11 ft-#
Key Width = 0.00 in	Mu. Design = $1,408$	1 1 II-# 1 27 poi
Key Depth = 6.00 in	Actual 1-Way Shear = 75.00	40.00 psi
Key Distance from Toe = 0.00 ft	Toe Reinforcing = $#4 @ 9.00$ in	
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = None Spec'd	
Min. As $\%$ = 0.0018	Footing Torsion, Tu =	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow. Torsion, phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable, provid	le
	supplemental design for footing tor	rsion.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 11.11 in, #5@ 17.22 in, #60 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: No key defined	℗ 24.44 in, #7℗ 33.33 in, #8℗ 43.88 in, #9℗ 5
	Min footing T&S reinf Area Min footing T&S reinf Area per foot If one layer of horizontal bars: If #4@ 11.11 in #5@ 17.22 in #6@ 24.44 in	0.63 in2 0.22 in2 /ft two layers of horizontal bars: #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING			RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl))	467.2	1.61	752.7	Soil Over HL (ab. water tbl)	73.3	2.83	207.8
HL Act Pres (be water tbl) Hydrostatic Force)				Soil Over HL (bel. water tbl) Watre Table		2.83	207.8
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	_				Axial Dead Load on Stem =			
Added Lateral Load	_	144 0	2.83	408.0	* Axial Live Load on Stem =			
Load @ Stem Above Soil	=	111.0	2.00	100.0	Soil Over Toe =	165.0	1.13	185.6
	_				Surcharge Over Toe =			
	-				Stem Weight(s) =	337.5	2.50	843.8
					Earth @ Stem Transitions =			
Total	=	611.2	O.T.M. =	1,160.7	Footing Weight =	364.6	1.46	531.7
					Key Weight =			
Resisting/Overturning	Ratio	C	=	1.52	Vert. Component =			
Vertical Loads used for	or Soil	Pressure	= 940.	4 lbs	Total =	940.4 lt	os R.M.=	1,768.8
					* Axial live load NOT included i	n total displaye	ed, or used for	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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	рсі
Horizontal Defl @ Top of Wall (approximate only)	0.042	in
The above calculation is not valid if the heel soil bearing p	oressure (exceeds that of the toe,

L	License To : MALSAM TSANG ENGINEERING							
	Criteria							
	Retained Height	=	5.00 ft					
	Wall height above soil	=	0.50 ft					
	Slope Behind Wall	=	0.00					
	Height of Soil over Toe	=	8.00 in					
	Water height over heel	=	0.0 ft					

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios Overturning Sliding	=		1.38 1.18	Rat Rat	io < 1 io < 1
Total Bearing Loadresultant ecc.	= =		1,281 13.15	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe	= = Th: =	an Al	1,390 0 2,666 lowable 1,946	psf psf psf e psf	OK OK
ACI Factored @ Heel Footing Shear @ Toe	=		0 14.5	psf psi	OK
Footing Shear @ Heel Allowable	= =		0.0 75.0	, psi psi	OK
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		-	905.6 554.2 512.4 0.0 291.8	lbs lbs lbs lbs lbs	OK NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing Equivalent Fluid Pressu	re N	= leth	2,666.0) psf
Active Heel Pressure		=	40.0) psf/ft
		=		
Passive Pressure		=	300.0) psf/ft
Soil Density, Heel		=	110.00) pcf
Soil Density, Toe		=	110.00) pcf
Footing Soil Friction		=	0.400)
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load App	liec	d to	Stem	
Lateral Load Height to Top Height to Bottom	= = =		45.0 # 5.00 ft 0.00 ft	/ft
Load Type	=	W (S	ind (W) ervice L	evel)
Wind on Exposed Sten (Service Level)	י –		0.0 p	sf

Stem Construction Design Height Above I Wall Material Above "H .5! **Design Method** .5! Thickness Rebar Size **Rebar Spacing** Rebar Placed at Design Data fb/FB + fa/Fa **Total Force @ Section** Service Level lbs = Strength Level lbs = Moment....Actual Service Level ft-# = Strength Level ft-# = 2.147.9 Moment.....A Shear.....Ac Service L Strength Shear....Allo Anet (Masor Rebar Depth Masonry Data f'm Fs

o Stem		Adjacent Footing I	_0
45.0 #/ 5.00 ft 0.00 ft /ind (W) Service Le 0.0 pt	/ft evel) sf	Adjacent Footing Load Footing Width Eccentricity Wall to Ftg CL Dist Footing Type Base Above/Below Soil at Back of Wall Poisson's Ratio	=
Ftg ft = -t" = = = =	Bottom Stem OI Concrete LRFI 8.00 # 4 11.00 Edge	<pre></pre>	
=	0.36	5	

1,142.5

		_,		
Allowable	=	5,883.6		
tual				
_evel	psi =			
Level	psi =	15.2		
owable	psi =	75.0		
nry)	in2 =			
n 'd'	in =	6.25		
a ——				
	psi =			
	nsi –			

Solid Grouting = Modular Ratio 'n' = Wall Weight 100.0 psf = Short Term Factor = Equiv. Solid Thick. = = Medium Weight Masonry Block Type Masonry Design Method = ASD

Concrete Data f'c

Fy

2,500.0 psi = psi = 60,000.0

Code: IBC 2015,	ACI 318-14,ACI 530-13
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0.0 ft

0.300

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Concrete Stem Rebar Area Details		
Bottom Stem Vertica	al Reinforcing Horizontal Reinforcir	a
As (based on applied moment) : 0.0805	5 in2/ft	5
(4/3) * As : 0.1073	3 in2/ft Min Stem T&S Reinf	Area 1.056 in2
200bd/fy : 200(12)(6.25)/60000 : 0.25 ir	2/ft Min Stem T&S Reinf	Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.1728	3 in2/ft Horizontal Reinforcir	ng Options :
=====	One layer of : Ty	wo layers of :
Required Area : 0.1728	3 in2/ft #4@ 12.50 in #	#4@ 25.00 in
Provided Area : 0.2182	2 in2/ft #5@ 19.38 in #	#5@ 38.75 in
Maximum Area : 0.8467	7 in2/ft #6@ 27.50 in #	#6@ 55.00 in
Footing Data	Footing Design Results	
Toe Width = 2.75 ft	Тое	Heel
Heel Width =0.67	Factored Pressure = 1,946	0 psf
Total Footing Width = 3.42	Mu' : Upward = 45,959	0 ft-#
Footing Thickness = 10.00 in	Mu': Downward = 12,599 $Mu: Dosign = 2,780$	0 ft-#
Key Width = 12.00 in	Actual 1-Way Shear $=$ 14.51	0 03 psi
Key Depth = 8.00 in	Allow 1-Way Shear = 75.00	40.00 psi
Key Distance from Toe = 1.00 ft	Toe Reinforcing = $#4 @ 9.00$ in	•
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = $#4 @ 9.26$ in	
Min. As % = 0.0018	Footing Torsion, Tu =	
Cover @ rop 2.00 @ Bim.= 3.00 m	Footing Allow. Forsion, phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable, provide	de
	supplemental design for footing to	rsion.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 11.11 in, #5@ 17.22 in, #6	@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5
	Key: $#4@ 9.25$ in, $#5@ 14.35$ in, $#6@$	1 2 18 in, #7@ 18 in, #8@ 18
	Min footing T&S reinf Area	0.74 in2
	Min footing T&S reinf Area per foot	0.22 in2 /ft
	If one layer of horizontal bars:	f two layers of horizontal bars:
	#4@ 11.11 in	#4@ 22.22 in
	#5@ 17.22 in	#5@ 34.44 in
	#0@ 24.44 III	#U@ 40.03 III

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	G			RI	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#	_		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	680.6	1.94	1.323.3	Soil Over HL (ab. water	r tbl)	1.8	3.42	6.3
HL Act Pres (be water tbl Hydrostatic Force))			,	Soil Over HL (bel. wate Watre Table	r tbl)		3.42	6.3
Buovant Force	=				Sloped Soil Over Heel	=			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	_				Adjacent Footing Load	=			
Adjacent Footing Load	_				Axial Dead Load on Ste	m =			
Added Lateral Load	_	225.0	3 33	750.0	* Axial Live Load on Sten	า =			
I oad @ Stem Above Soil	=	220.0	0.00	100.0	Soil Over Toe	=	201.7	1.38	277.3
	· _				Surcharge Over Toe	=			
	-				Stem Weight(s)	=	550.0	3.08	1,695.8
					Earth @ Stem Transition	ns=			
Total	=	905.6	O.T.M. =	2,073.3	Footing Weight	=	427.5	1.71	731.0
					Key Weight	=	100.0	1.50	150.0
Resisting/Overturning	g Ratic)	=	1.38	Vert. Component	=			
Vertical Loads used for	or Soil	Pressure	= 1,281	.0 lbs	Tot	tal =	1,281.0	bs R.M.=	2,860.4
					* Axial live load NOT inclu	uded ir	total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.062	in
The above calculation is not valid if the heel soil bearing p	oressure e	exceeds that of the toe,

Ľ	icense To : MALSAM TSANG ENGINEERING						
	Criteria						
	Retained Height	=	6.00 ft				
			0.00 ft				
	vvali neight above soli	=	0.50 π				
	Slope Behind Wall	=	0.00				
	Height of Soil over Toe	=	8.00 in				
	Water height over heel	=	0.0 ft				

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios Overturning Sliding	=		1.28 1.24	Rat Rat	io < 1 io < 1
Total Bearing Loadresultant ecc.	= =		1,605 18.07	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe	= = Tha	n All	1,847 0 2,666 owable 2,585	psf psf psf e psf	OK OK
ACI Factored @ Heel	=		0 17.4	psf	OK
Footing Shear @ Heel Allowable	=		0.0 75.0	psi psi psi	OK
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability	= = • = =	1,	257.9 916.7 642.0 0.0 328.1	lbs lbs lbs lbs lbs	OK NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing Equivalent Fluid Pressur	e N	= leth	2,666.0 od	0 psf
Active Heel Pressure		=	40.	0 psf/ft
		=		· · · · ·
Passive Pressure		=	300.0	0 psf/ft
Soil Density, Heel		=	110.0	0 pcf
Soil Density, Toe		=	110.0	0 pcf
Footing Soil Friction		=	0.40	C
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	t to	Sten	n
Lateral Load	=		54.0 #	¢/ft
Height to Top	=		6.00 f	t
Height to Bottom	=		0.00 f	t
Load Type	=	Wi	ind (W)	
		(Se	ervice L	evel)
Wind on Exposed Stem (Service Level)	=		0.0 p	osf

Datta ... Stem C Des W .5! .5! De Th Re Re Re Des fb/ То Мо Mc Sh Sh An Re Mas f'm Fs So Мс W

Fy

Code: IBC 2015,ACI 318-14,ACI 530-13

Adjacent Footing Load 0.0 lbs Adjacent Footing Load = Footing Width Eccentricity 0.00 ft = 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

em Construction		Bottom	
Design Height Above Fts		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=		
I NICKNESS	=	8.00	
Rebar Spacing	=	# 4 10.00	
Rebai Spacing	-	10.00	
Design Data	=	Edge	
fb/FB + fa/Fa	=	0.575	
Total Force @ Section			
Service Level	lhs –		
Strength Level	lbs –	1 645 2	
MomentActual	100 -	1,040.2	
Service Level	ft-# =		
Strength Level	ft-# =	3,711.6	
MomentAllowable	=	6,444.1	
ShearActual			
Service Level	psi =		
Strength Level	psi =	21.9	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data			
ťc	psi =	2,500.0	

psi = 60,000.0

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Concrete Stem Rebar Are	a Details			
Bottom Stem As (based on applied moment) :	Vertical 0.1391	Reinforcing in2/ft	Horizontal Reinfor	cing
(4/3) * As :	0.1854	in2/ft	Min Stem T&S Re	inf Area 1.248 in2
200bd/fv : 200(12)(6.25)/60000 :	0.25 in2	2/ft	Min Stem T&S Re	inf Area per ft of stem Height : 0.192 in2/ft
0.0018bh : $0.0018(12)(8)$:	0.1728	in2/ft	Horizontal Reinfor	cing Options :
0.00100	======	======	One laver of	Two layers of :
Required Area	0 1854	in2/ft ::	#4@ 12 50 in	#4@ 25.00 in
Provided Area :	0.24 in2	2/ft ::	#5@ 19 38 in	#5@ 38 75 in
Maximum Area :	0.24 112	in2/ft	#6@ 27 50 in	#6@ 55.00 in
	0.0407			
Footing Data		Footing Desig	gn Results	
Toe Width =	3.50 ft		Toe	Heel
Heel Width =	0.67	Factored Pressure	= 2,585	0 psf
Total Footing Width =	4.17	Mu' : Upward	= 78,755	0 ft-#
Footing Thickness =	10.00 in	Mu' : Downward	= 20,409	0 ft-#
Key Width =	12.00 in	Mu: Design	= 4,862	0π-#
Key Depth =	14.00 in	Actual 1-Way Shear	= 17.44	0.04 psi
Key Distance from Toe =	1.00 ft	Toe Reinforcing	= 75.00 = #4 @ 8.00 ir	40.00 psi
f'c – 2,500 psi Ev –	60 000 nsi	Heel Reinforcing	= None Spec'd	
Footing Concrete Density =	150.00 pcf	Key Reinforcing	= #4 @ 9.00 ir	ר
Min. As %	0.0018	Footing Torsion, Tu	=	0.00 ft-lbs
Cover @ Top 2.00 @ B	tm.= 3.00 in	Footing Allow. Torsic	on, phi Tu 🛛 =	0.00 ft-lbs
		If torsion exceed	ds allowable, pro	vide
		supplemental de	esign for footing	torsion.
		Other Accentable 9	Sizes & Spacing	8
		Toe: #4@ 10.29 Heel: phiMn = phi Key: #4@ 9.25 ir	in, #5@ 15.96 in, # 5'lambda'sqrt(fc)'\$ n, #5@ 14.35 in, #	s #6@ 22.65 in, #7@ 30.89 in, #8@ 40.67 in, #9@ 5 Sm 6@ 18 in, #7@ 18 in, #8@ 18
		Min footing T&S re Min footing T&S re If one layer of hori	einf Area einf Area per foot zontal bars:	0.90 in2 0.22 in2 /ft If two layers of horizontal bars:

#4@ 11.11 in #5@ 17.22 in #6@ 24.44 in If two layers of hor #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV					R	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#	_		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	933.9	2.28	2.127.2	Soil Over HL (ab. water	tbl)	2.2	4.17	9.2
HL Act Pres (be water tbl Hydrostatic Force)			,	Soil Over HL (bel. water Watre Table	tbl)		4.17	9.2
Buoyant Force	=				Sloped Soil Over Heel	=			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Load	=			
Adjacent Footing Load	=				Axial Dead Load on Ster	m =			
Added Lateral Load	=	324.0	3.83	1.242.0	* Axial Live Load on Stem	=			
Load @ Stem Above Soi	=			.,	Soil Over Toe	=	256.7	1.75	449.2
	=				Surcharge Over Toe	=			
	_				Stem Weight(s)	=	650.0	3.83	2,491.7
					Earth @ Stem Transition	ns=			
Total	=	1,257.9	O.T.M. =	3,369.2	Footing Weight	=	521.3	2.09	1,086.8
					Key Weight	=	175.0	1.50	262.5
Resisting/Overturning	g Rat	io	=	1.28	Vert. Component	=			
Vertical Loads used for	or So	il Pressure	= 1,605.	1 lbs	Tota	al =	1,605.1	lbs R.M.=	4,299.3
					* Axial live load NOT inclu	ided in	total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.080	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

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Criteria							
	Retained Height	=	6.00 ft				
	Wall height above soil	=	0.50 ft				
	Slope Behind Wall	=	0.00				
	Height of Soil over Toe	=	8.00 in				
	Water height over heel	=	0.0 ft				

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios Overturning Sliding	=	1.42
Total Bearing Loadresultant ecc.	=	1,649 lbs 17.69 in
Soil Pressure @ Toe Soil Pressure @ Heel Allowable	= = =	1,279 psf OK 0 psf OK 2,666 psf
ACI Factored @ Toe ACI Factored @ Heel	= =	1,791 psf 0 psf
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =	16.3 psi OK 1.9 psi OK 75.0 psi
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability	= = • = • =	1,257.9 lbs 916.7 lbs 659.7 lbs 0.0 lbs OK 310.5 lbs NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soli Data				
Allow Soil Bearing Equivalent Fluid Pressur	e N	= leth	2,666.0	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Stem	
Lateral Load	=		54.0 #/	'ft
Height to Top Height to Bottom	=		6.00 ft 0.00 ft	
Load Type	=	Wi	ind (W)	
2000 .) po		(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)) =		0.0 ps	sf

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		-						
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		0.0.4						

=

at Back of Wall

0.0 ft

Code: IBC 2015,ACI 318-14,ACI 530-13

vice Level)		F	Poisson's Ratio	=	0.300	
m Construction		Bottom				
		Stem OK				
Design Height Above Ftg	ft =	0.00				
Wall Material Above "Ht"	=	Concrete				
Design Method	=	LRFD				
Thickness	=	6.00				
Rebar Size	=	# 4				
Rebar Spacing	=	9.00				
Rebar Placed at	=	Edge				
	_	0 785				
Total Force @ Section	-	01100				
	lbo –					
		4 0 4 5 0				
Strength Level	IDS =	1,645.2				
NomentActual	f+ # _					
Service Level	11-# =	2 744 6				
	II-# =	3,711.0				
MomentAllowable	=	4,722.4				
ShearActual						
Service Level	psi =					
Strength Level	psi =	32.3				
ShearAllowable	psi =	75.0				
Anet (Masonry)	in2 =					
Rebar Depth 'd'	in =	4.25				
Masonry Data						
f'm	psi =					
Fs	psi =					
Solid Grouting	=					
Modular Ratio 'n'	=					
Wall Weight	psf =	75.0				
Short Term Factor	=					
Equiv. Solid Thick.	=					
Masonry Block Type	=	Medium W	leight			
Masonry Design Method	=	ASD				
Concrete Data						
ťc	psi =	2,500.0				
Fy	psi =	60,000.0				

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Concrete Stem Rebar Area Details					
Bottom Stem Vertica As (based on applied moment) : 0.2098	I Reinforcing in2/ft	Horizontal Reinforcir	ng		
(4/3) * As : 0.2797	in2/ft	Min Stem T&S Reinf	(Area 0.936 in2		
200bd/fv · 200(12)(4 25)/60000 · 0 17 in	2/ft	Min Stem T&S Reinf	f Area per ft of stem Height · 0 144 in2/ft		
$0.0018bh \cdot 0.0018(12)(6) \cdot 0.1296$	in2/ft	Horizontal Reinforcir			
=====	======	One laver of T	wo lavers of		
Required Area : 0.2098	in2/ft	#4@ 16.67 in	#4@ 33 33 in		
Provided Area : 0.2667	in2/ft	#5@ 25.83 in	#5@ 51 67 in		
Maximum Area : 0.5757	in2/ft	#6@ 36 67 in	#6@ 73 33 in		
Footing Data	Footing Desi	ign Results			
Toe Width= 4.00 ft Heel Width= 0.67 Total Footing Width= 4.67 Footing Thickness= 10.00 in Key Width= 12.00 in Key Depth= 14.00 in Key Distance from Toe= 1.00 ft f'c = $2,500 \text{ psi}$ Fy = $60,000 \text{ psi}$ Footing Concrete Density= 150.00 pcf Min. As %= 0.0018 Cover @ Top 2.00 @ Btm=@ Btm= 3.00 in	Factored Pressure Mu' : Upward Mu' : Downward Mu: Design Actual 1-Way Shea Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Key Reinforcing Footing Torsion, Tu Footing Allow. Torsi	$\frac{\text{Toe}}{=} 1,791$ = 87,016 = 26,656 = 5,030 r = 16.31 = 75.00 = #4 @ 9.00 in = None Spec'd = #4 @ 9.26 in = = ion, phi Tu =	Heel 0 psf 0 ft-# 15 ft-# 1.91 psi 40.00 psi 0.00 ft-lbs 0.00 ft-lbs		
	If torsion excee	eds allowable, provi	de		
supplemental design for footing torsion.					
Other Acceptable Sizes & Spacings Toe: #4@ 9.95 in, #5@ 15.42 in, #6@ 21.89 in, #7@ 29.86 in, #8@ 39.31 in, #9@ 49 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18					
	Min footing T&S Min footing T&S r If one layer of hor	reinf Area reinf Area per foot rizontal bars: I	1.01 in2 0.22 in2 <i>I</i> ft f two layers of horizontal bars:		

#4@ 11.11 in #5@ 17.22 in #6@ 24.44 in If two layers of ho #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in
Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0\	ERTURNING			R	RESISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	1)	933.9	2.28	2.127.2	Soil Over HL (ab. water tbl)	110.0	4.58	504.2
HL Act Pres (be water tb	í)		-	,	Soil Over HL (bel. water tbl)		4.58	504.2
Hydrostatic Force	,				Watre Table			
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=	324.0	3.83	1.242.0	* Axial Live Load on Stem =			
Load @ Stem Above Soi	=			, -	Soil Over Toe =	293.3	2.00	586.7
	=				Surcharge Over Toe =			
					Stem Weight(s) =	487.5	4.25	2,071.9
					Earth @ Stem Transitions =			
Total	=	1,257.9	O.T.M. =	3,369.2	Footing Weight =	583.3	2.33	1,361.1
					Key Weight =	175.0	1.50	262.5
Resisting/Overturning	g Rat	io	=	1.42	Vert. Component =			
Vertical Loads used f	or So	il Pressure	= 1,649.	2 lbs	Total =	1,649.2	lbs R.M.=	4,786.3
					* Axial live load NOT included	in total displa	yed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.050	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

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	Criteria			I
	Retained Height	=	5.00 ft	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	8.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Dation					
Overturning	=		1 25	Rat	io ~ 1
Sliding	=		1.13	Rat	io < 1
Total Bearing Load	=		1,170	lbs	
resultant ecc.	=		15.74	in	
Soil Pressure @ Toe	=		1.779	psf	ОК
Soil Pressure @ Heel	=		0	psf	ОK
Allowable	=		2,666	psf	
Soil Pressure Less	Tha	an Al	lowable	ė	
ACI Factored @ Toe	=		2,491	psf	
ACI Factored @ Heel	=		0	psf	
Footing Shear @ Toe	=		11.6	psi	OK
Footing Shear @ Heel	=		1.9	psi	OK
Allowable	=		75.0	psi	
Sliding Calcs					
Lateral Sliding Force	=		905.6	lbs	
less 100% Passive Force	=	-	554.2	lbs	
less 100% Friction Force	=	-	468.0	lbs	
Added Force Reg'd	=		0.0	lbs	OK
for 1.5 Stability	=		336.2	lbs	NG
•					

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing	e M	= leth	2,666.0 od	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appli	iec	l to	Stem	
Lateral Load Height to Top Height to Bottom	= = =		45.0 #/ 5.00 ft 0.00 ft	ft
Load Type	=	Wi (Se	ind (W) ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

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Adjacent Ecoting		
	Luau	0.0.1
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	
m			

em Construction		вошот	
Design Height Above Etc	"	Stem OK	
Wall Material Above "Ht"	11 =	0.00 Conoroto	
	=		
Thickness	_	6.00	
Rebar Size	_	# 4	
Rebar Spacing	=	12.00	
Rebar Placed at	=	Edge	
Design Data		Lago	
fb/FB + fa/Fa	=	0.594	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	1,142.5	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	2,147.9	
MomentAllowable	=	3,612.6	
ShearActual			
Service Level	psi =		
Strength Level	psi =	22.4	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	4.25	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	75.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data	noi –	2 500 0	
TC Ev	psi =	2,000.0	
гу	psi≡	00,000.0	

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Concrete Stem Rebar Area Details		
Bottom Stem Vertical	Reinforcing Horizontal Reinforcing	
As (based on applied moment) \cdot 0.12141	in2/ft Min Stom T&S Doinf Ar	0 702 in 2
(4/3) AS. 0.10191	Min Stem T&S Reini Are	30.792 IIIZ
20000/1y . 200(12)(4.25)/60000 . 0.17 III2	in 2/ft Ivin Stein Tas Rein Are	
0.0018011.0.0018(12)(6).	Honzontal Reinforcing C	
Required Area : 0.1619 i	in2/ft #4@ 16.67 in #4@	2 33.33 in
Provided Area : 0.2 in2/f	ft #5@ 25.83 in #5@	2 51.67 in
Maximum Area : 0.5757 i	in2/ft #6@ 36.67 in #6@	2 73.33 in
Footing Data	Footing Design Results	
Toe Width= 3.00 ft Heel Width= 0.50 Total Footing Width= 3.50 Footing Thickness= 10.00 in Key Width= 12.00 in Key Depth= 8.00 in Key Distance from Toe= 1.00 ft f'c = $2,500 \text{ psi}$ Fy = $60,000 \text{ psi}$ Footing Concrete Density= 150.00 pcf Min. As %= 0.0018 Cover @ Top 2.00 @ Btm.= 3.00 in	ToeHeFactored Pressure= $2,491$ Mu': Upward= $50,350$ Mu': Downward= $14,994$ Mu: Design= $2,946$ Actual 1-Way Shear= 11.56 1.Allow 1-Way Shear= 75.00 40.Toe Reinforcing=# 4 @ 9.00 inHeel Reinforcing=# 4 @ 9.26 inFooting Torsion, Tu=(0)Footing Allow. Torsion, phi Tu=Contracting	el 0 psf 0 ft-# 0 ft-# .01 psi .00 psi
	If torsion exceeds allowable, provide	
	supplemental design for footing torsic	on.
	Other Acceptable Sizes & Spacings Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 2 Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: #4@ 9.25 in, #5@ 14.35 in, #6@ 18	24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 8 in, #7@ 18 in, #8@ 18
	Min footing T&S reinf Area0.Min footing T&S reinf Area per foot0.If one layer of horizontal bars:If two#4@ 11.11 in#4#5@ 17.22 in#5#6@ 24.44 in#6	.76 in2 .22 in2 /ft o layers of horizontal bars: 1@ 22.22 in 5@ 34.44 in 5@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

							P	ESISTING	
Item		Force Ibs	Distance	Moment ft-#	_		Force Ibs	Distance	Moment ft-#
HL Act Pres (ab water tb HL Act Pres (be water tb Hydrostatic Force	l) l)	680.6	1.94	1,323.3	Soil Over HL (ab. wate Soil Over HL (bel. wate Watre Table	er tbl) er tbl)			
Buoyant Force	=				Sloped Soil Over Heel	=			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Load	=			
Adjacent Footing Load	=				Axial Dead Load on St	em =			
Added Lateral Load	=	225.0	3.33	750.0	* Axial Live Load on Ste	m =			
Load @ Stem Above Sol	il =		0.00		Soil Over Toe	=	220.0	1.50	330.0
	_				Surcharge Over Toe	=			
	-				Stem Weight(s)	=	412.5	3.25	1,340.6
					Earth @ Stem Transition	ons=			
Total	=	905.6	O.T.M. =	2,073.3	Footing Weight	=	437.5	1.75	765.6
					Key Weight	=	100.0	1.50	150.0
Resisting/Overturnin	g Rat	io	=	1.25	Vert. Component	=			
Vertical Loads used f	or So	il Pressure	= 1,170.	0 lbs	To	otal =	1,170.0	lbs R.M.=	2,586.3
					* Axial live load NOT inc	luded i	n total displa	yed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.078	in
The above calculation is not valid if the heel soil bearing pro	<u>essure e</u>	exceeds that of the toe,

L	icense To : MALSAM TS	SANG	ENGINEERI	١G
	Criteria			
	Retained Height	=	7.00 ft	
			7.00 1	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	8.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios Overturning Sliding	= =	1.25
Total Bearing Loadresultant ecc.	= =	1,954 lbs 23.20 in
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less	= = Thar	1,999 psf OK 0 psf OK 2,666 psf Allowable
ACI Factored @ Toe ACI Factored @ Heel	= =	2,798 psf 0 psf
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =	19.9 psi OK 0.0 psi OK 75.0 psi
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability	= = • = •	1,668.2 lbs 1,200.0 lbs 781.5 lbs 0.0 lbs OK 520.8 lbs NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing Equivalent Fluid Pressur	e N	= leth	2,666.0	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Stem	
Lateral Load Height to Top Height to Bottom	= = =		63.0 #/ 7.00 ft 0.00 ft	ft
Load Type	=	W (S	ind (W) ervice Le	evel)
Wind on Exposed Stem (Service Level)	¹ =		0.0 ps	sf

Stem Construct Design Height Wall Material A .5! .5! Design Method Thickness Rebar Size Rebar Spacing Rebar Placed Design Data fb/FB + fa/Fa Total Force @ Service Lev Strength Lev Moment....Act Service Lev Strength Le Moment.....Allo Shear.....Actua Service Lev Strength Le Shear....Allow Anet (Masonry Rebar Depth **Masonry Data** f'm Fs

Adjacent Footing	Load	
Adiacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft

=

Line Load

0.0 ft

on Exposed Stem _	0.0 p	sf	at Back of Wall	=	0.0 π	
ce Level)			Poisson's Ratio	=	0.300	
n Construction		Bottom				
esian Height Above Ftc	ft –	Stem OK				
Wall Material Above "Ht"	=	Concrete	•			
Design Method	=	LRFD)			
Thickness	=	8.00				
Rebar Size	=	# 4	ļ			
Rebar Spacing	=	8.00)			
Rebar Placed at	=	Edge	•			
fb/FB + fa/Fa	=	0.740)			
Total Force @ Section						
Service Level	lbs =					
Strength Level	lbs =	2.239.3				
MomentActual		,				
Service Level	ft-# =					
Strength Level	ft-# =	5,893.9)			
MomentAllowable	=	7,959.6	;			
ShearActual						
Service Level	psi =					
Strength Level	psi =	29.9)			
ShearAllowable	psi =	75.0)			
Anet (Masonry)	in2 =					
Rebar Depth 'd'	in =	6.25	i			
lasonry Data						
f'm	psi =					
Fs	psi =					
Solid Grouting	=					
Modular Ratio 'n'	=					
Wall Weight	psf =	100.0)			

Footing Type

Base Above/Below Soil

Wall Weight Short Term Factor = Equiv. Solid Thick. = = Medium Weight Masonry Block Type Masonry Design Method = ASD Concrete Data

f'c

Fy

2,500.0 psi = psi = 60,000.0

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINEERING	Cantilevered Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area Details		
Bottom Stem Verti	ical Reinforcing Horizontal Reinforcing	
As (based on applied moment) : 0.22	08 in2/ft	
(4/3) * As : 0.29	44 in2/ft Min Stem T&S Reinf Ar	ea 1.440 in2
200bd/fy : 200(12)(6.25)/60000 : 0.25	in2/ft Min Stem T&S Reinf Ar	ea per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.17	28 in2/ft Horizontal Reinforcing (Options :
===:	One layer of : Two	layers of :
Required Area : 0.25	in2/ft #4@ 12.50 in #4@	25.00 in
Provided Area : 0.3 i	n2/ft #5@ 19.38 in #5@	2 38.75 in
Maximum Area : 0.84	67 in2/ft #6@ 27.50 in #6@	2 55.00 in
Footing Data	Footing Design Results	
Toe Width = 4.50 ft	Toe H	eel
Heel Width = <u>0.67</u>	Factored Pressure = 2,798	0 psf
Total Footing Width = 5.17	Mu': Upward = 126,315	0 ft-#
Footing Thickness = 10.00 in	Mu Downward = $33,737$ Mu Design = 7.715	0 ft-#
Key Width = 12.00 in	Actual 1-Way Shear = 19.86	0 / 1 / m
Key Depth = 18.00 in	Allow 1-Way Shear = 75.00 40	.00 psi
Key Distance from Toe = 1.00 ft	Toe Reinforcing = #4 @ 8.00 in	
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = #4 @ 9.00 in	
MIN. AS $\% = 0.0018$ Cover @ Top 2.00 @ Btm - 3.00 in	Footing Torsion, Tu =	
Cover @ rop 2.00 @ Dun.= 3.00 m	Footing Allow. Torsion, phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable, provide	
	supplemental design for footing torsi	on.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 8.65 in, #5@ 13.41 in, #6@ 1	9.03 in, #7@ 25.95 in, #8@ 34.17 in, #9@ 43
	Key: $#4@ 9.25$ in, $#5@ 14.35$ in, $#6@ 1$	8 in, #7@ 18 in, #8@ 18
	Min footing T&S reinf Area 1	.12 in2
	Min footing T&S reinf Area per foot 0	.22 in2 /ft
	If one layer of horizontal bars: If tw	o layers of horizontal bars:
	#4@ 11.11 in #	4@ 22.22 in
	#5@ 17.22 in #	5@ 34.44 IN
	#0@ 24.44 III #	0 40.05 11

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING				R	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#		Fo	brce bs	Distance ft	Moment ft-#
HL Act Pres (ab water tb)	1,227.2	2.61	3,204.4	Soil Over HL (ab. water th	ol)	2.6	5.17	13.3
HL Act Pres (be water tb) Hvdrostatic Force)				Soil Over HL (bel. water to Watre Table	bl)		5.17	13.3
Buoyant Force	=				Sloped Soil Over Heel	=			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Load	=			
Adjacent Footing Load	=				Axial Dead Load on Stem	=			
Added Lateral Load	=	441.0	4.33	1.911.0	* Axial Live Load on Stem	=			
Load @ Stem Above Soi	=			.,	Soil Over Toe	=	330.0	2.25	742.5
	=				Surcharge Over Toe	=			
	_				Stem Weight(s)	=	750.0	4.83	3,625.0
					Earth @ Stem Transitions	=			
Total	=	1,668.2	O.T.M. =	5,115.4	Footing Weight	=	646.3	2.59	1,670.6
					Key Weight	=	225.0	1.50	337.5
Resisting/Overturning	g Rat	io	=	1.25	Vert. Component	=			
Vertical Loads used for	or So	il Pressure	= 1,953.8	3 lbs	Total	= 1	,953.8	lbs R.M.=	6,388.8
					* Axial live load NOT include	ed in tota	al display	ed, or used for	overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.081	in
The above calculation is not valid if the heel soil bearing	pressure	exceeds that of the toe,

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EERING
ft
ft
in
ft

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applica to otem						
Axial Dead Load	=	0.0 lbs				
Axial Live Load	=	0.0 lbs				
Axial Load Eccentricity	=	0.0 in				
D : 0						

Design Summary

Wall Stability Ratios Overturning Sliding	=		2.26 1.57	Ok	
Total Bearing Loadresultant ecc.	=		1,283 6.41	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Tha = =	an Al	656 44 2,000 lowabl 918 62	psf psf psf e psf psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		10.4 1.5 75.0	psi psi psi	OK OK
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		-	680.6 554.2 513.0 0.0 0.0	lbs lbs lbs lbs lbs	OK OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing		=	2,000.0	psf
Equivalent Fluid Pressure	εN	1eth	od	
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil beight to ignore				
for passive pressure		=	12 00	in
			12.00	
Lateral Load Appli	ec	d to	Stem	
Lateral Load	=		0.0 #/	'ft
Height to Top	=		0.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	Wi	nd (W)	
21		(Se	ervice Í e	evel)
		,0,		,
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Stem C Desi Wa Des Thi Rel Rel Rel Desi fb/F Tot Мо Мо She Sh An Rel Mase f'm Fs Sol Мо

]
Adjacent Footing	Load	
Adjacent Footing Load	=	0.0 lb
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft

Code: IBC 2015,ACI 318-14,ACI 530-13

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

n Construction		Bottom	
anium Uniukt Akara Et-		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=		
I NICKNESS	=	6.00	
Rebai Size	=	# 4 16.00	
Rebai Spacing	-	10.00	
Repar Placed at	=	Eage	
fb/FB + fa/Fa	=	0.515	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	850.0	
MomentActual		000.0	
Service Level	ft-# =		
Strength Level	ft-# =	1,416.7	
MomentAllowable	=	2,749.3	
ShearActual			
Service Level	psi =		
Strength Level	psi =	16.7	
ShearAllowable	, psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	4.25	
lasonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf=	75.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concercto Data			

Concrete Data f'c

Fy

- psi = 2,500.0 psi = 60,000.0

Concrete Stem Rebar Area Details Bottom Stem Vertical Reinforcing Horizontal Reinforcing As (based on applied moment) : 0.0801 in2/ft (4/3) * As : 0.1068 in2/ft 200bd/fy : 200(12)(4.25)/60000 : 0.17 in2/ft Min Stem T&S Reinf Area 0.792 in2 0.0018(12)(6) : 0.12 fit Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft
Bottom Stem Vertical Reinforcing Horizontal Reinforcing As (based on applied moment) : 0.0801 in2/ft (4/3) * As : 0.1068 in2/ft (4/3) * As : 0.1068 in2/ft Min Stem T&S Reinf Area 0.792 in2 200bd/fy : 200(12)(4.25)/60000 : 0.17 in2/ft Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft 0.018bb : 0.0018(12)(6) : 0.1206 in2/ft Horizontal Reinforcing Options :
As (based on applied moment) : 0.0801 in2/ft (4/3) * As : 0.1068 in2/ft 200bd/fy : 200(12)(4.25)/60000 : 0.17 in2/ft Min Stem T&S Reinf Area 0.792 in2 0.0018(12)(6) : 0.17 in2/ft Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft D.0018(12)(6) : 0.120 in2/ft
(4/3) * As : 0.1068 in2/ft Min Stem T&S Reinf Area 0.792 in2 200bd/fy : 200(12)(4.25)/60000 : 0.17 in2/ft Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft 0.0018(12)(6) : 0.1206 in2/ft Horizontal Reinformia Options :
200bd/fy : 200(12)(4.25)/60000 : 0.17 in2/ft Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft
0.0018bb · 0.0018(12)(6) · 0.1206 in2/ft Horizontal Reinforcing Options ·
========== One layer of : Two layers of :
Required Area : 0.1296 in2/ft #4@ 16.67 in #4@ 33.33 in
Provided Area : 0.15 in2/ft #5@ 25.83 in #5@ 51.67 in
Maximum Area : 0.5757 in2/ft #6@ 36.67 in #6@ 73.33 in
Footing Data Footing Design Results
Toe Width = 3.00 ft Toe Heel
Heel Width = 0.67 Factored Pressure = 918 62 psf
Total Footing Width = 3.67 Mu': Upward = 36,951 1 ft-#
Footing Thickness = 10.00 in Mu': Downward = 14,994 13 ft-#
Key Width = 12.00 in Actual 4 Way Shoor = 10.44 1 50 pai
Key Depth = 8.00 in Actual 1-Way Shear = 75.00 40.00 psi
Key Distance from Toe = 1.00 ft Toe Reinforcing = $#4 @ 11.11 \text{ in}$
f'c = 2,500 psi Fy = 60,000 psi Heel Reinforcing = None Spec'd
Footing Concrete Density = 150.00 pcf Key Reinforcing = # 4 @ 9.26 in
Min. As % = 0.0018 Footing Torsion, Tu = 0.00 ft-lbs
Cover @ 1 op 2.00 @ Btm.= 3.00 In Footing Allow. Torsion, phi Tu = 0.00 ft-lbs
If torsion exceeds allowable, provide
supplemental design for footing torsion.
Other Acceptable Sizes & Spacings
Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Kov: #4@0.25 in #5@14.25 in #6@18 in #7@18 in #8@18
Key. #4@ 9.25 III, #5@ 14.55 III, #6@ 16 III, #7@ 16 III, #6@ 16
Min footing T&S reinf Area 0.79 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft
If one layer of horizontal bars: If two layers of horizontal bars:
#4@ 11.11 in #4@ 22.22 in #5@ 24.44 in
#5@ 17.22 III #5@ 54.44 III #6@ 24.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

ч у у		0)		IING				R	ESISTING	
Item		Force Ibs	Distanc	e	Moment ft-#	_		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	I)	680.6	1.94	1	1,323.3	Soil Over HL (ab. wat	er tbl)	91.7	3.58	328.5
HL Act Pres (be water tb Hydrostatic Force)				ŗ	Soil Over HL (bel. wat Watre Table	ter tbl)		3.58	328.5
Buoyant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on St	tem =			
Added Lateral Load	=					* Axial Live Load on Ste	em =			
Load @ Stem Above Soi	=					Soil Over Toe	=	220.0	1.50	330.0
	_					Surcharge Over Toe	=			
	_					Stem Weight(s)	=	412.5	3.25	1,340.6
			_			Earth @ Stem Transiti	ons=			
Total	=	680.6	O.T.M.	=	1,323.3	Footing Weight	=	458.3	1.83	840.3
						Key Weight	=	100.0	1.50	150.0
Resisting/Overturning	g Rat	io	=	2	.26	Vert. Component	=			
Vertical Loads used f	or So	il Pressure	= 1,2	282.5	lbs	Te	otal =	1,282.5	lbs R.M.=	2,989.4
						* Axial live load NOT ind	cluded ir	n total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.027	in
The above calculation is not valid if the heel soil bearing pre	essure e	exceeds that of the toe,

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Li	License To : MALSAM TSANG ENGINEERING							
	Criteria							
	Retained Height	=	8.00 ft					
	Wall height above soil	=	0.50 ft					
	Slope Behind Wall	=	0.00					
	Height of Soil over Toe	=	6.00 in					
	Water height over heel	=	0.0 ft					

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios Overturning Sliding	=		1.25 1.21	Rat Rat	io < 1 io < 1
Total Bearing Loadresultant ecc.	=		2,432 29.15	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less	= = Tha	n All	2,076 0 2,666 owabl	psf psf psf e	OK OK
ACI Factored @ Toe ACI Factored @ Heel	=		2,906 0	psf psf	
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		18.4 0.0 75.0	psi psi psi	OK OK
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability	= = • =	2 - 1	,196.0 ,687.5 972.9 0.0 633.6	lbs lbs lbs lbs lbs lbs	OK NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data					
Allow Soil Bearing		=	2,666.	0	psf
Equivalent Fluid Pressure	εN	1eth	od		
Active Heel Pressure		=	40.	0	psf/ft
		_			
Passiva Pressure		_	300	n	nef/ft
		-	440.0	~	p3//it
Soil Density, Heel		=	110.0	0	pct
Soil Density, Toe		=	110.0	0	pcf
Footing Soil Friction		=	0.40	0	
Soil height to ignore					
for passive pressure		=	12.00)	in
Lateral Load Appli	ec	d to	Ster	n	
Lateral Load	=		72.0#	¥/	ft
Height to Top	=		8.00 f	ť	
Height to Bottom	=		0.00 f	ť	
Load Type	=	W	ind (W)		
		(S	ervice L	_e	evel)
Wind on Exposed Stem (Service Level)	=		0.0	os	sf

Stem Constructio Design H Wall Ma .5! .5! Design Thickne Rebar S Rebar S Rebar F Design D fb/FB + Total F Serv Strer Momen Serv Strei Momen Shear... Serv Strei Shear... Anet (M Rebar D Masonry f'm Fs

ed	to Stem		Adjacent Footing Lo
	72.0 # 8.00 ft 0.00 ft Wind (W) (Service L 0.0 p	/ft evel) sf	Adjacent Footing Load Footing Width Eccentricity Wall to Ftg CL Dist Footing Type Base Above/Below Soil at Back of Wall Poisson's Ratio
n		Bottom	
ove	e Ftg ft = "Ht" = = = =	Stem OK 0.00 Concrete LRFD 8.00 # 5 10.00 Edge	
ect I	= lbs = lbs = ft-# = ft-# = e =	0.914 2,924.8 8,797.9 9,623.1	
I able	lbs = ft-# = ft-# = e =	2,924.8 8,797.9 9,623.1	

oad

Code: IBC 2015,ACI 318-14,ACI 530-13

Aujuoenti i ooting i	-044		
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	

		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	8.00	
Rebar Size	=	# 5	
Rebar Spacing	=	10.00	
Rebar Placed at	=	Edge	
besign Data		0.014	
ID/FB + Ia/Fa	=	0.914	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	2,924.8	
MomentActual	· · · ·		
Service Level	ft-# =		
Strength Level	ft-# =	8,797.9	
MomentAllowable	=	9,623.1	
ShearActual			
Service Level	psi =		
Strength Level	psi =	39.4	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.19	
lasonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	

Concrete Data f'c

Fy

psi =	2,500.0
psi =	60,000.0

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Concrete Stem Rebar Area Details		
Bottom Stem Vertica	Reinforcing Horizontal Reinforcing	
As (based on applied moment) : 0.3331	in2/ft	
(4/3) * As : 0.4442	in2/ft Min Stem T&S Reinf A	vrea 1.632 in2
200bd/fy : 200(12)(6.1875)/60000 : 0.2475	in2/ft Min Stem T&S Reinf A	area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.1728	in2/ft Horizontal Reinforcing	Options :
=====		b layers of :
Required Area : 0.3331	in2/ft #4@ 12.50 in #4	@ 25.00 in
Provided Area : 0.372 ir	n2/ft #5@ 19.38 in #5	@ 38.75 in
Maximum Area : 0.8382	in2/ft #6@ 27.50 in #6	@ 55.00 in
Footing Data	Footing Design Results	
Toe Width = 5.75 ft	Toe	leel
Heel Width =	Factored Pressure = 2,906	0 psf
Total Footing Width = 6.42	Mu': Upward = 203,027	0 ft-#
Footing Thickness = 12.00 in	Mu' : Downward = 56,934	0 ft-#
Key Width = 12.00 in	Mu: Design = $12,174$	0 π-#
Key Depth = 24.00 in	Actual 1-Way Shear = 75.00 4	0.04 psi
Key Distance from Toe = 1.00 ft	Toe Reinforcing = $\# 5 @ 10.00$ in	
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing $= #4 @ 9.00$ in	
Min. As % = 0.0018	Footing Torsion, Tu =	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 In	Footing Allow. Torsion, phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable, provide	3
	supplemental design for footing tors	sion.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 7.05 in, #5@ 10.94 in, #6@	15.52 in, #7@ 21.17 in, #8@ 27.88 in, #9@ 35
	Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm	
	Key: #4@ 9.25 In, #5@ 14.35 In, #6@	18 in, #7@ 18 in, #8@ 18
	Min footing T&S reinf Area	1.66 in2
	Min footing T&S reinf Area per foot	0.26 in2 /ft
	If one layer of horizontal bars: If t	wo layers of horizontal bars:
	#4@ 9.26 in	#4@ 18.52 in
	#5@ 14.35 IN #6@ 20.37 in	#5@ 28.70 IN #6@ 40.74 in
	#0@ 20.07 III	

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0\	ERTURNING			,R	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	I)	1,620.0	3.00	4,860.0	Soil Over HL (ab. water tbl) 2.9	6.42	18.8
HL Act Pres (be water tb Hydrostatic Force	I)				Soil Over HL (bel. water to Watre Table	1)	6.42	18.8
Buoyant Force	=				Sloped Soil Over Heel =	:		
Surcharge over Heel	=				Surcharge Over Heel =	:		
Surcharge Over Toe	=				Adjacent Footing Load =	:		
Adjacent Footing Load	=				Axial Dead Load on Stem =	:		
Added Lateral Load	=	576.0	5.00	2.880.0	* Axial Live Load on Stem =	:		
Load @ Stem Above Soi	=			,	Soil Over Toe =	316.3	2.88	909.2
	=				Surcharge Over Toe =	:		
					Stem Weight(s) =	850.0	6.08	5,170.8
					Earth @ Stem Transitions=	:		
Total	=	2,196.0	O.T.M. =	7,740.0	Footing Weight =	963.0	3.21	3,091.2
					Key Weight =	: 300.0	1.50	450.0
Resisting/Overturning	g Rat	io	=	1.25	Vert. Component =	:		
Vertical Loads used f	or So	il Pressure	= 2,432.	2 lbs	Total =	= 2,432.2	lbs R.M.=	9,640.1
					* Axial live load NOT include	d in total displa	ved, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.076	in
The above calculation is not valid if the heel soil bearing pro	essure e	exceeds that of the toe,

SANG	ENGINEERI	NG
=	9.00 ft	
=	0.50 ft	
=	0.00	
=	6.00 in	
=	0.0 ft	
	<u>SANG</u> = = = =	= 9.00 ft = 0.50 ft = 0.00 = 6.00 in = 0.0 ft

Surcharge Loads

Surcharge Over Heel 0.0 psf _ NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios			
Overturning	=	1 24 Ra	tio < 1
Sliding	=	1.13 Ra	tio < 1
Total Bearing Load	=	2,826 lbs	
resultant ecc.	=	35.06 in	
Soil Pressure @ Toe	=	2,063 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,666 psf	
Soil Pressure Less	Than	Allowable	
ACI Factored @ Toe	=	2,888 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	20.1 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	
Sliding Calcs			
Lateral Sliding Force	=	2.729.0 lbs	
less 100% Passive Force	= -	1,959.4 lbs	
less 100% Friction Force	= -	1,130.5 lbs	
Added Force Rea'd	=	0.0 lbs	OK
for 1.5 Stability	=	1,003.6 lbs	NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall Soil Data

Allow Soil Bearing Equivalent Fluid Pressure	e M	= leth	2,666.0 od	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore				
for passive pressure		=	12.00	in
Lateral Load Appli	ied	l to	Stem	
Latora: Loud / ppi				
Lateral Load	=		81.0 #/	ft
Height to Top	=		9.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	Wi	nd (W)	
		(Se	ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	f

Stem Construction Bottom Desig Wall .5! .5! D N

Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 5
Rebar Spacing	=	6.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.822
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,701.7
MomentActual		
Service Level	ft-# =	
Strength Level	ft-# =	12,526.7
MomentAllowable	=	15,222.0
ShearActual		
Service Level	psi =	
Strength Level	psi =	49.9
ShearAllowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.19
lasonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0

Code: IBC 2015,ACI 318-14,ACI 530-13

Adjacent Footing Load Adiacent Footing Load 0.0 lbs

Aujacont i ooting Load	_	0.0 103
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

	Stom OK	
	0.00	
=	Concrete	
=	LRFD	
=	8.00	
=	# 5	
=	6.00	
=	Edge	
	0 822	
=	0.022	
lha		
IDS =	0 704 7	
IDS =	3,701.7	
f + #		
II-# =	40 500 7	
π-# =	12,526.7	
=	15,222.0	
psi =		
psi =	49.9	
psi =	75.0	
in2 =		
in =	6.19	
psi =		
psi =		
=		
=		
	ft = = = = = = = = = = = = = = = = = = =	$\begin{array}{c} \text{Stem OK} \\ \text{ft} = & 0.00 \\ = & \text{Concrete} \\ = & \text{LRFD} \\ = & 8.00 \\ = & \# 5 \\ = & 6.00 \\ = & \text{Edge} \\ \end{array}$ $\begin{array}{c} \text{Ibs} = & \\ \text{Bs} = & \\ \text{Ibs} = & 3,701.7 \\ \text{ft-} \# = & 12,526.7 \\ = & 15,222.0 \\ \end{array}$ $\begin{array}{c} \text{psi} = & \\ \text{psi} = & 49.9 \\ \text{psi} = & 75.0 \\ \text{in} 2 = & \\ \text{in} = & 6.19 \\ \end{array}$

0		
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data

2,500.0 psi = f'c psi = 60,000.0 Fy

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Concrete Stem Rebar Area Details		
Bottom Stem Vertical	Reinforcing Horizontal Reinforcin	g
As (based on applied moment) : 0.4743	in2/ft	5
(4/3) * As : 0.6324	in2/ft Min Stem T&S Reinf	Area 1.824 in2
200bd/fy : 200(12)(6.1875)/60000 : 0.2475	in2/ft Min Stem T&S Reinf	Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.1728	in2/ft Horizontal Reinforcin	g Options :
=====	One layer of : Tw	vo layers of :
Required Area : 0.4743	in2/ft #4@ 12.50 in #	#4@ 25.00 in
Provided Area : 0.62 in2	2/ft #5@ 19.38 in #	t5@ 38.75 in
Maximum Area : 0.8382	in2/ft #6@ 27.50 in #	#6@ 55.00 in
Footing Data	Footing Design Results	
Toe Width = 7.00 ft	Тое	Heel
Heel Width = 0.67	Factored Pressure = 2,888	0 psf
Total Footing Width = 7.67	Mu': Upward = 289,000	0 ft-#
Footing Thickness = 12.00 in	Mu': Downward = 84,378 $Mu: Dosign = 17,052$	0 ft-#
Key Width = 12.00 in	Mu. Design = $17,052$ Actual 1-Way Shear = 20.07	0.04 nsi
Key Depth = 27.00 in	Allow 1-Way Shear = 75.00	40.00 psi
Key Distance from Toe = 1.00 ft	Toe Reinforcing = $#5 @ 8.00$ in	'
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = $#4 @ 9.00$ in	0.00 (t -
MIN. AS % = 0.0018 Cover @ Top 2.00 @ Btm = 3.00 in	Footing Torsion, Tu =	
Cover @ 10p 2.00 @ Dun.= 3.00 m	Footing Allow. Torsion, phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable, provid	
	supplemental design for footing to	rsion.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 5.18 in, #5@ 8.03 in, #6@	11.39 in, #7@ 15.54 in, #8@ 20.46 in, #9@ 25.
	Key: $#4@ 9.25$ in, $#5@ 14.35$ in, $#6@$	0 18 in, #7@ 18 in, #8@ 18
	Min footing T&S reinf Area	1.99 in2
	Min footing T&S reinf Area per foot	0.26 in2 /ft
	If one layer of horizontal bars:	two layers of horizontal bars:
	#4@ 9.26 in	#4@ 18.52 in
	#5@ 14.35 in #6@ 20.27 in	#5@ 28.70 IN #6@ 40.74 in
	#0@ 20.37 III	

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	·			R	ESISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	0	2.000.0	3.33	6.666.7	Soil Over HL (ab. water th	ol)	3.3	7.67	25.3
HL Act Pres (be water tb Hvdrostatic Force	l)	_,		-,	Soil Over HL (bel. water to Watre Table	bl)		7.67	25.3
Buoyant Force	=				Sloped Soil Over Heel	=			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Load	=			
Adjacent Footing Load	=				Axial Dead Load on Stem	=			
Added Lateral Load	=	729.0	5.50	4.009.5	* Axial Live Load on Stem	=			
Load @ Stem Above Soi	=			.,	Soil Over Toe	=	385.0	3.50	1,347.5
	=				Surcharge Over Toe	=			
	-				Stem Weight(s)	=	950.0	7.33	6,966.7
					Earth @ Stem Transitions	=			
Total	=	2,729.0	O.T.M. =	10,676.2	Footing Weight	=	1,150.5	3.84	4,412.2
					Key Weight	=	337.5	1.50	506.3
Resisting/Overturning	g Rati	io	=	1.24	Vert. Component	=			
Vertical Loads used f	or Soi	I Pressure	= 2,826.	3 lbs	Total	=	2,826.3	lbs R.M.=	13,257.9
					* Axial live load NOT includ	ed in	total displa	yed, or used for	overturning

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.071	in
The above calculation is not valid if the heel soil bearing p	oressure	exceeds that of the toe,

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	Criteria						
	Retained Height	=	10.00 ft				
	Wall height above soil	=	0.50 ft				
	Slope Behind Wall	=	0.00				
	Height of Soil over Toe	=	6.00 in				
	Water height over heel	=	0.0 ft				

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT 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

Design Summary

Wall Stability Ratios Overturning Sliding	= =	1.43 1.26	Rati Rati	0 < 1.5! 0 < 1.5!
Total Bearing Loadresultant ecc.	=	3,869 34.45	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Than =	1,544 0 2,666 Allowable 2,162	psf psf psf psf psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =	20.4 0.0 75.0	psi psi psi	OK OK
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability	= = • = • =	3,431.3 2,776.0 1,547.8 0.0 823.1	lbs lbs lbs lbs lbs	OK NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall Soil Data

Allow Soil Bearing	~ •	= loth	2,666.	0 psf	
Active Heel Pressure	5 10	=	40.0	0 psf/ft	
		=			
Passive Pressure		=	300.0	0 psf/ft	
Soil Density, Heel		=	110.0	0 pcf	
Soil Density, Toe		=	110.0	0 pcf	
Footing Soil Friction		=	0.40	0	
Soil height to ignore for passive pressure		=	12.00	in	
Lateral Load Appli	ec	l to	Sten	n	
Lateral Load Height to Top Height to Bottom	= =		90.0 # 10.00 f 0.00 f	‡/ft t t	
Load Type	=	Wi (Se	nd (W) ervice L	_evel)	
Wind on Exposed Stem (Service Level)	=		0.0 p	osf	

Stem De ١ Ľ F F F De f Ν Ν S Ś A F

Adjacent Footing	Load	ł	
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		0.0.4	

0.300

=

Code: IBC 2015,ACI 318-14,ACI 530-13

	~				
em Construction		Bottom			
Design Height Above Etc.	ft —	Stem OK			
Wall Material Above "Ht"		Concrete			
Design Method	_	IRFD			
Thickness	_	10.00			
Rebar Size	=	# 6			
Rebar Spacing	=	8.00			
Rebar Placed at	=	Edge			
Design Data		0		_	
fb/FB + fa/Fa	=	0.845			
Total Force @ Section					
Service Level	lbs =				
Strength Level	lbs =	4,570.0			
MomentActual					
Service Level	ft-# =				
Strength Level	ft-# =	17,183.3			
MomentAllowable	=	20,333.2			
ShearActual					
Service Level	psi =				
Strength Level	psi =	49.9			
ShearAllowable	psi =	75.0			
Anet (Masonry)	in2 =				
Rebar Depth 'd'	in =	7.63			
Masonry Data					
f'm	psi =				
Fs	psi =				
Solid Grouting	=				
Modular Ratio 'n'	=				
Wall Weight	psf =	125.0			
Short Term Factor	=				
Equiv. Solid Thick.	=				
Masonry Block Type	=	Medium W	/eight		
Masonry Design Method	=	ASD			
Concrete Data					
f'c	psi =	2,500.0			
Fy	psi =	60,000.0			

Poisson's Ratio

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Concrete Stem Rebar Area Details		
Bottom Stem Vertical	Reinforcing Horizontal Reinforcin	g
As (based on applied moment) : 0.5226 I	in2/it	Area 0 500 is 0
(4/3) * AS : 0.6968 0.6968	In2/ft Min Stem T&S Reinf	Area 2.520 In2
200bd/fy : 200(12)(7.625)/60000 : 0.305 in	12/ft Min Stem T&S Reinf	Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) : 0.216 in	12/ft Horizontal Reinforcin	ig Options :
	One layer of : Th	wo layers of :
Required Area : 0.5226 i	in2/ft #4@ 10.00 in #	#4@ 20.00 in
Provided Area : 0.66 in2	2/ft #5@ 15.50 in #	#5@ 31.00 in
Maximum Area : 1.0329 i	in2/ft #6@ 22.00 in #	∉6@ 44.00 in
Footing Data	Footing Design Results	
Toe Width = 8.25 ft	Тое	Heel
Heel Width = 0.83	Factored Pressure = 2,162	0 psf
Total Footing Width = 9.08	Mu' : Upward = 427,691	0 ft-#
Footing Thickness = 15.00 in	Mu' : Downward = 138,643	0 ft-#
Key Width = 12.00 in	Mu: Design = $24,087$	0 π-#
Key Depth = 32.00 in	Actual 1-Way Shear = 20.44 Allow 1-Way Shear = 75.00	40.00 psi
Key Distance from Toe = 1.00 ft	To Reinforcing = $\#6 @ 8.00$ in	40.00 p3i
f'c = 2,500 psi Ev = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = # 5 @ 12.00 in	
Min. As % = 0.0018	Footing Torsion, Tu =	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow. Torsion, phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable, provide	de
	supplemental design for footing to	rsion.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 5.01 in, #5@ 7.77 in, #6@	11.02 in, #7@ 15.03 in, #8@ 19.80 in, #9@ 25.
	Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm	1
	Key: #4@ 9.64 in, #5@ 14.94 in, #6@	2 18 in, #7@ 18 in, #8@ 18
	Min footing T&S reinf Area	2.94 in2
	Min footing T&S reinf Area per foot	0.32 in2 /ft
	If one layer of horizontal bars: If	f two layers of horizontal bars:
	#4@ 7.41 in	#4@ 14.81 in
	#5@ 11.48 in	#5@ 22.96 in
	#6@ 16.30 in	#6@ 32.59 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		OVERTURN	ING		R	ESISTING	
Item	Force lbs	Distanc	e Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	2.53	1.3 3.75	9.492.2	Soil Over HL (ab. water tb	l) 0.0	9.08	0.0
HL Act Pres (be water tbl) Hydrostatic Force	_,		-,	Soil Over HL (bel. water the Watre Table	ol)	9.08	0.0
Buovant Force	=			Sloped Soil Over Heel	=		
Surcharge over Heel	=			Surcharge Over Heel	=		
Surcharge Over Toe	=			Adjacent Footing Load	=		
Adjacent Footing Load	=			Axial Dead Load on Stem	=		
Added Lateral Load	= 900	0.0 6.25	5.625.0	* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=		-,	Soil Over Toe	= 453.8	4.13	1,871.7
	=			Surcharge Over Toe	=		
				Stem Weight(s)	= 1,312.5	8.67	11,375.0
				Earth @ Stem Transitions	=		
Total	= 3,43	1.3 O.T.M.	= 15,117.2	Footing Weight	= 1,703.1	4.54	7,735.0
				Key Weight	= 400.0	1.50	600.0
Resisting/Overturning	Ratio	=	1.43	Vert. Component	=		
Vertical Loads used for	r Soil Press	ure = 3,8	369.4 lbs	Total	= 3,869.4	lbs R.M.=	21,581.7
				* Axial live load NOT include	ed in total display	ved, or used fo	or overturning

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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	рсі
Horizontal Defl @ Top of Wall (approximate only)	0.050	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

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License To : MALSAM TSANG ENGINEERING						
	Criteria					
	Retained Height	=	11.00 ft			
	Wall height above soil	=	0.50 ft			
	Slope Behind Wall	=	0.00			
	Height of Soil over Toe	=	6.00 in			
	Water height over heel	=	0.0 ft			

Surcharge Loads

Surcharge Over Heel 0.0 psf = NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applied to Stem					
Avial Dood Lood		0.0 lba			
Axial Dead Load	=	0.0 lbs			
Axial Live Load	=	0.0 lbs			
Axial Load Eccentricity	=	0.0 in			

Design Summary

Wall Stability Ratios			
Overturning	=	1.36	Ratio < 1.5!
Sliding	=	1.22	Ratio < 1.5!
Total Bearing Load	=	4.424	lbs
resultant ecc.	=	37.90	in
Soil Pressure @ Toe	=	1,853	psf OK
Soil Pressure @ Heel	=	0	psf OK
Allowable	=	2,666	psf
Soil Pressure Less	Than	Allowable	
ACI Factored @ Toe	=	2,594	psf
ACI Factored @ Heel	=	0	psf
Footing Shear @ Toe	=	25.4	psi OK
Footing Shear @ Heel	=	0.0	psi OK
Allowable	=	75.0	psi
Sliding Calcs			
Lateral Sliding Force	_	4.090.3	lbs
less 100% Passive Force	= -	3.234.4	lbs
less 100% Friction Force	= -	1,769.5	lbs
Added Force Rea'd	=	0.0	lbs OK
for 1.5 Stability	=	1,131.5	lbs NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Fy

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing	e M	= leth	2,666.0) psf
Active Heel Pressure		=	40.0) psf/ft
		=		
Passive Pressure		=	300.0) psf/ft
Soil Density, Heel		=	110.00) pcf
Soil Density, Toe		=	110.00) pcf
Footing Soil Friction		=	0.400)
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	Sten	ו
Lateral Load Height to Top Height to Bottom	= = =		99.0 # 11.00 ft 0.00 ft	/ft
Load Type	=	W (S	ind (W) ervice L	evel)
Wind on Exposed Stem (Service Level)	=		0.0 p	sf

Botto **Stem Construction**

Adjacent Footing	Loa	d	
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	=	0.0 ft	

m			
Poisson's Ratio	=	0.300	
at back of Wall			

		A A A	
Design Height Above Ftg	ft =	Stem OK 0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	12.00	
Rebar Size	=	# 6	
Rebar Spacing	=	8.00	
Rebar Placed at	=	Edge	
Design Data		0.070	
tb/FB + ta/Fa	=	0.870	
I otal Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	5,529.7	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	22,871.0	
MomentAllowable	=	26,273.2	
ShearActual			
Service Level	psi =		
Strength Level	psi =	47.9	
ShearAllowable	, psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	9.63	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	150.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data			
ťc	psi =	2,500.0	
⊢y	psi =	60,000.0	

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINEERING	Cantilevered Reta	aining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area Details			
Bottom Stem Vert	tical Reinforcing Hor	izontal Reinforcino	
As (based on applied moment) : 0.54	l61 in2/ft		
(4/3) * As : 0.72	282 in2/ft Min	Stem T&S Reinf A	Area 3.312 in2
200bd/fy : 200(12)(9.625)/60000 : 0.38	35 in2/ft Min	Stem T&S Reinf A	Area per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) : 0.25	592 in2/ft Hor	izontal Reinforcing	Options :
===	======= One	e layer of : Tw	o layers of :
Required Area : 0.54	161 in2/ft #4@	2 8.33 in #4	@ 16.67 in
Provided Area : 0.66	6 in2/ft #5@	2 12.92 in #5	5@ 25.83 in
Maximum Area : 1.30	039 in2/ft #6@	2 18.33 in #6	6@ 36.67 in
Footing Data	Footing Design	Results	
Toe Width = 8.50 ft	-	Toe	Heel
Heel Width = 1.00	Factored Pressure =	2,594	0 psf
Total Footing Width = 9.50	Mu': Upward =	= 513,407	0 ft-#
Footing Thickness = 15.00 in	Mu: Design -	= 147,173 - 30,519	0 ft-# 0 ft-#
Key Width = 12.00 in	Actual 1-Way Shear	25 42	0.03 psi
Key Depth = 36.00 in	Allow 1-Way Shear =	= 75.00 4	40.00 psi
Key Distance from Toe = 1.00 ft	Toe Reinforcing =	# 6 @ 8.00 in	
$f'_{c} = 2,500 \text{ psi}$ Fy = 60,000 psi Footing Concrete Density = 150,00 psf	Heel Reinforcing =	None Spec'd	
Min As $\%$ = 0.0018	Footing Torsion Tu	=	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow, Torsion,	phiTu =	0.00 ft-lbs
	If torsion exceeds	allowable, provid	e
	supplemental desig	an for footing tor	sion.
	Other Acceptable Size	es & Spacings	
	Toe: #4@ 3.95 in. #	5@ 6.13 in. #6@ 8	70 in. #7@ 11.87 in. #8@ 15.62 in. #9@ 19.7
	Heel: phiMn = phi'5'la	ambda'sqrt(fc)'Sm	
	Key: #4@ 7.29 in, #	5@ 11.31 in, #6@	16.05 in, #7@ 18 in, #8@
	Min footing T&S reinf	Area	3.08 in2
	Min footing T&S reinf	Area per foot	0.32 in2 /ft
	If one layer of horizor	ital bars: If	two layers of horizontal bars:
	#4@ /.41 in #5@ 11.49 :∽		#4@ 14.81 IN #5@ 22.06 in
	#3@ 11.40 III #6@ 16.30 in		#3@ 22.50 m #6@ 32.59 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

ч у		0\		•			R	ESISTING	
Item		Force lbs	Distance	Moment ft-#	-		Force lbs	Distance	Moment ft-#
HL Act Pres (ab water tb HL Act Pres (be water tb Hydrostatic Force	l) l)	3,001.3	4.08	12,255.1	Soil Over HL (ab. wate Soil Over HL (bel. wat Watre Table	er tbl) er tbl)			
Buoyant Force	=				Sloped Soil Over Heel	=			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Load	=			
Adjacent Footing Load	=				Axial Dead Load on St	em =			
Added Lateral Load	=	1.089.0	6.75	7.350.8	* Axial Live Load on Ste	m =			
Load @ Stem Above Soi	il =	,		,	Soil Over Toe	=	467.5	4.25	1,986.9
	=				Surcharge Over Toe	=			
					Stem Weight(s)	=	1,725.0	9.00	15,525.0
					Earth @ Stem Transition	ons=			
Total	=	4,090.3	O.T.M. =	19,605.9	Footing Weight	=	1,781.3	4.75	8,460.9
					Key Weight	=	450.0	1.50	675.0
Resisting/Overturning	g Rat	tio	=	1.36	Vert. Component	=			
Vertical Loads used f	or So	il Pressure	= 4,423.	8 lbs	To	otal =	4,423.8	lbs R.M.=	26,647.8
					* Axial live load NOT inc	luded i	n total displa	yed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.062	in	
The above calculation is not valid if the heel soil bearing	pressure	exceeds that of	the toe,
	•		

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINEERING 411 . . Wall ~ . . . Criteria S A **Retained Height** = 12.00 ft Е Wall height above soil = 0.50 ft A Slope Behind Wall = 0.00 Height of Soil over Toe = 6.00 in Р Water height over heel 0.0 ft = S S F s I Surcharge Loads Surcharge Over Heel 0.0 psf Т NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning L Axial Load Applied to Stem Axial Dead Load 0.0 lbs Axial Live Load 0.0 lbs = Axial Load Eccentricity 0.0 in = **Design Summary** Sten Е Wall Stability Ratios Overturning = 1.25 Ratio < 1.5! 1.17 Ratio < 1.5! Sliding = **Total Bearing Load** 4,806 lbs = ...resultant ecc. 45.69 in = D Soil Pressure @ Toe = 2,432 psf OK Soil Pressure @ Heel 0 psf OK = 2,666 psf Allowable _ Soil Pressure Less Than Allowable ACI Factored @ Toe 3,405 psf = ACI Factored @ Heel = 0 psf Footing Shear @ Toe 27.4 psi OK = Footing Shear @ Heel 0.0 psi OK = Allowable = 75.0 psi **Sliding Calcs** Lateral Sliding Force 4,807.3 lbs = less 100% Passive Force = -3.726.0 lbs less 100% Friction Force = -1,922.3 lbs 0.0 lbs OK Added Force Reg'd =for 1.5 Stability 1,562.6 lbs NG = N

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered R	eτ	all	ning v	all
Soil Data				
llow Soil Bearing quivalent Fluid Pressure	ə N	= leth	2,666.0 nod	psf
ctive Heel Pressure		=	40.0	psf/ft
		=		
assive Pressure		=	300.0	psf/ft
oil Density, Heel		=	110.00	pcf
oil Density, Toe		=	110.00	pcf
ooting Soil Friction		=	0.400	
oil height to ignore				
for passive pressure		=	12.00	in
Lateral Load Appli	iec	l to	o Stem	
ateral Load	=		108.0 #/	ft
.Height to Top	=		12.00 ft	
.Height to Bottom	=		0.00 ft	
.oad Type	=	W	ind (W)	
		(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Adjacent Footing I	oa	d
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

	_		
em Construction		Bottom	
Design Height Above Fto	ft –	Stem OK	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	12.00	
Rebar Size	=	# 7	
Rebar Spacing	=	9.00	
Rebar Placed at	=	Edge	
Design Data		0.057	
tb/FB + ta/Fa	=	0.957	
I otal Force @ Section			
Service Level	IDS =		
Strength Level	Ibs =	6,580.8	
Sorvice Level	ft #		
Strongth Lovel	ft #	20 602 9	
	II-# =	29,092.0	
MomentAllowable	=	31,026.6	
ShearActual			
Service Level	psi =		
Strength Level	psi =	57.3	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	9.56	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio n	=	450.0	
vvali vveight	pst =	150.0	
Short Lerm Factor	=		
Equiv. Solid Thick.	=	Madium M	aight
Masonry Block Type	=		eign
Masonry Design Method	=	ASD	
	nsi –	2 500 0	
Fv	psi =	60.000.0	
• ,	P.C		

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Concrete Stem Rebar Area Details		
Bottom Stem Vertica	I Reinforcing Horizontal Reinforcing	
As (based on applied moment) . 0.7136	Min Chara T&C Dainf And	
(4/3) AS: 0.9518	in 2/ft Win Stem T&S Reinf Are	38 3.600 In2
200bd/fy:200(12)(9.5625)/60000: 0.3825	in2/ft IVIN Stem 1&S Reinf Are	a per ft of stem Height : 0.288 in2/ft
0.0018bh : 0.0018(12)(12) : 0.2592	Horizontal Reinforcing O	
===== Described Area (ayers of :
Required Area : 0.7138	1n2/πt #4@ 8.33 ln #4@	16.67 IN
Provided Area : 0.8 In2	/π #5@ 12.92 in #5@	25.83 IN
Maximum Area : 1.2954	- in2/ft #6@ 18.33 in #6@	2 36.67 m
Footing Data	Footing Design Results	
Toe Width = 9.25 ft Heel Width = 1.00 Total Footing Width = 10.25 Footing Thickness = 15.00 in Key Width = 12.00 in Key Depth = 40.00 in Key Distance from Toe = 1.00 ft fc = $2,500$ psi Fy = $60,000$ psi Footing Concrete Density = 150.00 pcf Min. As % = 0.0018 Cover @ Top 2.00 @ Btm.= 3.00 in	ToeHeFactored Pressure $=$ $3,405$ Mu': Upward $=$ $640,453$ Mu': Downward $=$ $174,291$ Mu: Design $=$ $38,847$ Actual 1-Way Shear $=$ 27.36 $0.$ Allow 1-Way Shear $=$ 75.00 $40.$ Toe Reinforcing $=$ $#7$ $@$ 9.00 inHeel Reinforcing $=$ $#7$ $@$ 9.00 inHeel Reinforcing $=$ $#5$ $@$ 8.00 inFooting Torsion, Tu $=$ C If torsion exceeds allowable, providesupplemental design for footing torsicOther Acceptable Sizes & SpacingsToe: $#4@$ 3.10 in, $#5@$ 4.81 in, $#6@$ 6.83 Heel: phiMn = phi'5'lambda'sqrt(fc)'SmKey: $#4@$ 5.71 in, $#5@$ 8.85 in, $#6@$ $12.$ Min footing T&S reinf Area $3.$ Min footing T&S reinf Area per foot $0.$ If one layer of horizontal bars:If two $#4@$ 7.41 in $#4$ $#5@$ 11.48 in $#5$ $#6@$ 16.30 in $#6$	1 0 psf 0 ft-# 0 ft-# 0 ft-# 0 ft-# 0.00 ft-lbs 00 psi 0.00 ft-lbs 0.00 ft-lbs 0.01 ft-lbs 0.00 ft-lbs 0.02 int, #7@ 9.32 in, #8@ 12.27 in, #9@ 15.54 56 in, #7@ 17.13 in, # .32 in2 ft 0 layers of horizontal bars: 1@ 14.81 in 0 layers of horizontal bars: 1@ 14.81 in 0 layers of horizontal bars: 1@ 32.96 in 0 layers of horizontal bars:

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

OVERTURNING							RESISTING			
Item		Force lbs	Distance ft	Moment ft-#	_		Force Ibs	Distance ft	Moment ft-#	
HL Act Pres (ab water to HL Act Pres (be water to Hvdrostatic Force	l) l)	3,511.3	4.42	15,508.0	Soil Over HL (ab. water Soil Over HL (bel. water Watre Table	r tbl) r tbl)				
Buoyant Force	=				Sloped Soil Over Heel	=				
Surcharge over Heel	=				Surcharge Over Heel	=				
Surcharge Over Toe	=				Adjacent Footing Load	=				
Adjacent Footing Load	=				Axial Dead Load on Ste	m =				
Added Lateral Load	=	1.296.0	7.25	9.396.0	* Axial Live Load on Stem) =				
Load @ Stem Above Soi	=	.,		-,	Soil Over Toe	=	508.8	4.63	2,353.0	
	=				Surcharge Over Toe	=				
	_				Stem Weight(s)	=	1,875.0	9.75	18,281.3	
					Earth @ Stem Transition	ns=				
Total	=	4,807.3	O.T.M. =	24,904.0	Footing Weight	=	1,921.9	5.13	9,849.6	
					Key Weight	=	500.0	1.50	750.0	
Resisting/Overturning	g Rat	io	=	1.25	Vert. Component	=				
Vertical Loads used for	or So	il Pressure	= 4,805	.6 lbs	Tot	al =	4,805.6	lbs R.M.=	31,233.8	
					* Axial live load NOT inclu	uded ir	total display	ed, or used fo	r overturning	

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.082	in
The above calculation is not valid if the heel soil bearing	pressure	exceeds that of the toe,

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Ľ	icense To : MALSAM TS	SANG	ENGINEERING
	Criteria		
	Retained Height	=	6.00 ft
	Wall height above soil	=	0.50 ft
	Slope Behind Wall	=	0.00
	Height of Soil over Toe	=	8.00 in
	Water height over heel	=	0.0 ft

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applica to otem							
Axial Dead Load	=	0.0 lbs					
Axial Live Load	=	0.0 lbs					
Axial Load Eccentricity	=	0.0 in					

Design Summary

Wall Stability Ratios Overturning Sliding	=		2.55 1.78	Ok Ok	Č.
Total Bearing Loadresultant ecc.	=		1,864 5.79	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Tha = =	an Al	681 148 2,000 lowabl 953 207	psf psf psf e psf psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		15.5 3.0 75.0	psi psi psi	OK OK
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		-	933.9 916.7 745.7 0.0 0.0	lbs lbs lbs lbs lbs	OK OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing		=	2,000.0	psf
Equivalent Fluid Pressure	϶N	1eth	od	
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore				
for passive pressure		=	12.00	in
Lateral Load Appli	ec	d to	Stem	
Lateral Load	=		0.0 #/	/ft
Height to Top	=		0.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	Wi	nd (W)	
		(Se	ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 p	sf

Stem Constr **Design Heig** Wall Mater Design Met Thickness Rebar Size Rebar Spa Rebar Plac Design Data fb/FB + fa/F **Total Forc** Service Strength Moment.... Service Strength Moment.... Shear.....A Service Strength Shear Al Anet (Maso Rebar Dept Masonry Da f'm Fs Solid Grout Modular Ra

		:
Adjacent Footing	Load	b
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

=

		F	Poisson's Ratio	=	0.300
n Construction		Bottom			
esign Height Above Fto	ft =	Stem OK 0.00			
Wall Material Above "Ht"	=	Concrete			
Design Method	=	LRFD			
Thickness	=	8.00			
Rebar Size	=	# 4			
Rebar Spacing	=	10.00			
Rebar Placed at Design Data	=	Edge			
fb/FB + fa/Fa	=	0.379			
Total Force @ Section					
Service Level	lbs =				
Strength Level	lbs =	1,224.0			
MomentActual					
Service Level	ft-# =				
Strength Level	ft-# =	2,448.0			
MomentAllowable	=	6,444.1			
ShearActual					
Service Level	psi =				
Strength Level	psi =	16.3			
ShearAllowable	psi =	75.0			
Anet (Masonry)	in2 =				
Rebar Depth 'd'	in =	6.25			
lasonry Data					
f'm	psi =				
Fs	psi =				
Solid Grouting	=				
Modular Ratio 'n'	=				
Wall Weight	psf =	100.0			
Short Term Factor	=				
Equiv. Solid Thick.	=				
Masonry Block Type	=	Medium W	leight		
Masonry Design Method	=	ASD			
concrete Data					

Base Above/Below Soil

at Back of Wall

Concrete Da f'c

Fy

2,500.0 psi = psi = 60,000.0 Code: IBC 2015,ACI 318-14,ACI 530-13

0.0 ft

<pre> letainPro (c) 1987-2019, Build 11.20.03.31 license : KW-06055289 License To : MALSAM TSANG ENGINEERING</pre>	Cantilevered Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area Details		
Bottom Stem Vertic As (based on applied moment) : 0.091	al Reinforcing Horizontal Reinforcing 7 in2/ft	
(4/3) * As : 0.122	3 in2/ft Min Stem T&S Reinf Are	a 1.248 in2
200bd/fy : 200(12)(6.25)/60000 : 0.25 i	n2/ft Min Stem T&S Reinf Are	a per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.172	8 in2/ft Horizontal Reinforcing O	ptions :
====:	One layer of : Two la	ayers of :
Required Area : 0.172	8 in2/ft #4@ 12.50 in #4@	25.00 in
Provided Area : 0.24 in	n2/ft #5@ 19.38 in #5@	38.75 in
Maximum Area : 0.846	7 in2/ft #6@ 27.50 in #6@	55.00 in
Footing Data	Footing Design Results	
Toe Width = 3.50 ft Heel Width = 1.00 Total Footing Width = 4.50 Footing Thickness = 10.00 in Key Width = 12.00 in Key Depth = 14.00 in Key Distance from Toe = 1.00 ft f'c = $2,500 \text{ psi}$ Fy = $60,000 \text{ psi}$ Footing Concrete Density = 150.00 pcf Min. As % = 0.0018 Cover @ Top 2.00 @ Btm.= 3.00 in	ToeHerFactored Pressure=95320Mu': Upward=55,82820Mu': Downward=20,40900Mu: Design=2,95240Actual 1-Way Shear=15.4830Allow 1-Way Shear=75.0040.0Toe Reinforcing=# 4 @ 11.00 inHeel Reinforcing=None Spec'dKey Reinforcing=# 4 @ 9.00 inFooting Torsion, Tu=00Footing Torsion, Tu=0If torsion exceeds allowable, providesupplemental design for footing torsioOther Acceptable Sizes & SpacingsToe:#4@ 11.11 in, #5@ 17.22 in, #6@ 2Heel: phiMn = phi'5'lambda'sqrt(fc)'SmKey:#4@ 9.25 in, #5@ 14.35 in, #6@ 18Min footing T&S reinf Area0.3Min footing T&S reinf Area0.4If one layer of horizontal bars:If two#4@ 11.11 in#4#5@ 17.22 in#5#6@ 24.44 in#6	el 07 psf 13 ft-# 13 ft-# 31 ft-# 91 ft-# 00 psi 00 psi 00 ft-lbs .00 ft-lbs .01 ft .02 in 2 ft .01 layers of horizontal bars: @ 22.22 in @ 34.44 in @ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

OVERTURNING						RESISTING				
Item		Force lbs	Distand ft	e	Moment ft-#	_		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	ol)	933.9	2.28	3	2.127.2	Soil Over HL (ab. wate	er tbl)	220.0	4.33	953.3
HL Act Pres (be water th)				,	Soil Over HL (bel. wat Watre Table	er tbl)		4.33	953.3
Buovant Force	_					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on St	em =			
Added Lateral Load	=					* Axial Live Load on Ste	m =			
Load @ Stem Above So	il =					Soil Over Toe	=	256.7	1.75	449.2
	=					Surcharge Over Toe	=			
						Stem Weight(s)	=	650.0	3.83	2,491.7
						Earth @ Stem Transiti	ons=			
Total	=	933.9	О.Т.М.	=	2,127.2	Footing Weight	=	562.5	2.25	1,265.6
						Key Weight	=	175.0	1.50	262.5
Resisting/Overturnin	g Rat	io	=	:	2.55	Vert. Component	=			
Vertical Loads used f	for So	il Pressure	= 1,	864.2	lbs	To	otal =	1,864.2	os R.M.=	5,422.3
						* Axial live load NOT inc	luded ir	n total displaye	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.027	in
The above calculation is not valid if the heel soil bearing pre	essure e	exceeds that of the toe,

Ĺ	icense To : MALSAM TS	SANG	ENGINEERING	i
	Criteria			Ī
	Retained Height	=	6.00 ft	
	Wall height above soil	=	0.50 ft	
	Slope Behind Wall	=	0.00	
	Height of Soil over Toe	=	8.00 in	
	Water height over heel	=	0.0 ft	

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applica to otern						
Axial Dead Load	=	0.0 lbs				
Axial Live Load	=	0.0 lbs				
Axial Load Eccentricity	=	0.0 in				
D : 0						

Design Summary

Wall Stability Ratios Overturning Sliding	=		2.25 1.69	Ok Ok	Č
Total Bearing Loadresultant ecc.	=		1,649 8.65	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Th: = =	an Al	681 26 2,000 Iowabl 953 36	psf psf psf e psf psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		13.9 1.8 75.0	psi psi psi	OK OK
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		-	933.9 916.7 659.7 0.0 0.0	lbs lbs lbs lbs lbs	OK OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing Equivalent Fluid Pressur	e N	= leth	2,000.0	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appl	iec	l to	o Stem	
Lateral Load	=		0.0 #/	ft
Height to Top	=		0.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	w	ind (W)	
		(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Stem D F De f Ν Ν S 3 ł F M

Fy

		i
Adjacent Footing I	Load	d
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

Code: IBC 2015,ACI 318-14,ACI 530-13

em Construction		Bottom			
Dosign Hoight Above Etc	4	Stem OK			
Wall Material Above "Ht"	11 =	0.00 Conoroto			
Design Method	=				
Thickness	_	6.00			
Rebar Size	_	# 4			
Rebar Spacing	=	9.00			
Rebar Placed at	=	Edge			
Design Data					
fb/FB + fa/Fa	=	0.518			
Total Force @ Section					
Service Level	lbs =				
Strength Level	lbs =	1,224.0			
MomentActual	.				
Service Level	ft-# =				
Strength Level	ft-# =	2,448.0			
MomentAllowable	=	4,722.4			
ShearActual					
Service Level	psi =				
Strength Level	psi =	24.0			
ShearAllowable	psi =	75.0			
Anet (Masonry)	in2 =				
Rebar Depth 'd'	in =	4.25			
Masonry Data					
f'm	psi =				
Fs	psi =				
Solid Grouting	=				
Modular Ratio 'n'	=				
Wall Weight	psf =	75.0			
Short Term Factor	=				
Equiv. Solid Thick.	=				
Masonry Block Type	=	Medium W	eight		
Masonry Design Method	=	ASD			
Concrete Data		0 500 0			
T'C	psi =	2.500.0			

psi = 60,000.0

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Concrete Stem Rebar Area Details		
Bottom Stem Vertica	Reinforcing Horizontal Reinforcing	
As (based on applied moment) : 0.1384	in2/ft	
(4/3) * As : 0.1845	in2/ft Min Stem T&S Reinf Are	ea 0.936 in2
200bd/fy : 200(12)(4.25)/60000 : 0.17 in:	2/ft Min Stem T&S Reinf Are	ea per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) : 0.1296	in2/ft Horizontal Reinforcing C	Options :
=====	====== One layer of : Two I	ayers of :
Required Area : 0.17 in:	2/ft #4@ 16.67 in #4@	2 33.33 in
Provided Area : 0.2667	in2/ft #5@ 25.83 in #5@	2 51.67 in
Maximum Area : 0.5757	in2/ft #6@ 36.67 in #6@	9 73.33 in
Footing Data	Footing Design Results	
Toe Width = 4.00 ft	Toe He	el
Heel Width =0.67	Factored Pressure = 953	 36 psf
Total Footing Width = 4.67	Mu': Upward = 66,364	1 ft-#
Footing Thickness = 10.00 in	Mu': Downward = 26,656	15 ft #
Key Width = 12.00 in	Actual 1-Way Shear - 13.91 1	82 nei
Key Depth = 14.00 in	Allow 1-Way Shear = 75.00 40.	.00 psi
Key Distance from Toe = 1.00 ft	Toe Reinforcing = # 4 @ 11.00 in	•
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = $#4 @ 9.26$ in	
Min. As % = 0.0018 Cover @ Top 2.00 @ Btm = 3.00 in	Footing Torsion, Tu = (J.00 ft-IDS
Cover @ rop 2.00 @ Dim.= 3.00 m	Footing Allow. Forsion, phi Tu =	J.00 π-IDS
	If torsion exceeds allowable, provide	
	supplemental design for footing torsic	on.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 2	24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5
	Key: $#4@ 9.25$ in, $#5@ 14.35$ in, $#6@ 18$	8 in, #7@ 18 in, #8@ 18
	Min footing T&S reinf Area	.01 in2
	Min footing T&S reinf Area per foot 0.	.22 in2 /ft
	If one layer of horizontal bars: If two	o layers of horizontal bars:
	#4@ 11.11 in #4	↓@ 22.22 in
	#5@ 17.22 in #5	5@ 34.44 in
	#0@ 24.44 III #0	10.09 III

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0\		IING				R	ESISTING	
Item		Force Ibs	Distanc ft	e N	ft-#	_		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	I)	933.9	2.28	3	2.127.2	Soil Over HL (ab. wate	er tbl)	110.0	4.58	504.2
HL Act Pres (be water tb Hydrostatic Force	í)				,	Soil Over HL (bel. wat Watre Table	er tbl)		4.58	504.2
Buoyant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on St	em =			
Added Lateral Load	=					* Axial Live Load on Ste	m =			
Load @ Stem Above Soi	=					Soil Over Toe	=	293.3	2.00	586.7
	=					Surcharge Over Toe	=			
						Stem Weight(s)	=	487.5	4.25	2,071.9
			_			Earth @ Stem Transiti	ons=			
Total	=	933.9	0.T.M.	=	2,127.2	Footing Weight	=	583.3	2.33	1,361.1
						Key Weight	=	175.0	1.50	262.5
Resisting/Overturning	g Rat	io	=	2.2	25	Vert. Component	=			
Vertical Loads used f	or So	il Pressure	= 1,6	649.2 I	bs	To	otal =	1,649.2	lbs R.M.=	4,786.3
						* Axial live load NOT inc	cluded in	n total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.026	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

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	Criteria		
	Retained Height	=	4.00 ft
	Wall height above soil	=	0.50 ft
	Slope Behind Wall	=	0.00
	Height of Soil over Toe	=	8.00 in
	Water height over heel	=	0.0 ft

Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applied to otem						
		1				
Axial Dead Load	=	0.0 lbs				
Axial Live Load	=	0.0 lbs				
Axial Load Eccentricity	=	0.0 in				

Design Summary

Wall Stability Ratios Overturning Sliding	=		1.89 1.72	Ok Ok	
Total Bearing Loadresultant ecc.	=		882 5.45	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Th: =	an Al	779 0 2,000 lowabl 1,090	psf psf psf e psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		7.7 0.0 75.0	psi psi psi	ok ok
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		-	467.2 450.0 352.9 0.0 0.0	lbs lbs lbs lbs lbs	OK OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data					
Allow Soil Bearing	e M	= leth	2,000 od	.0	psf
Active Heel Pressure		=	40	.0	psf/ft
		=			
Passive Pressure		=	300	.0	psf/ft
Soil Density, Heel		=	110.0	00	pcf
Soil Density, Toe		=	110.0	00	pcf
Footing Soil Friction		=	0.40	00	
Soil height to ignore for passive pressure		=	12.0	0	in
Lateral Load Appli	ec	l to	Ste	m	
Lateral Load	=		0.0	#/	ft
Height to Top	=		0.00	ft 4	
Height to Bottom	=		0.00	π	
Load Type	=	Wi	ind (W)	
		(S	ervice	Le	vel)
Wind on Exposed Stem (Service Level)	=		0.0	ps	f

Ster Г D N

	•	•	
	•	•	
A	djacent Footing L	.oac	1

Code: IBC 2015,ACI 318-14,ACI 530-13

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

em Construction		Bottom		_			
Dosign Hoight Above Etc.	"	Stem OK			_		
Well Meterial Above "Ht"	π=	0.00 Concrete					
Design Mothod	=						
Thickness	=						
Rebar Size	_	± 4					
Rebar Spacing	_	12 00					
Rebar Placed at	_	Edge					
Design Data		Luge		_			
fb/FB + fa/Fa	=	0.134					
Total Force @ Section							
Service Level	lbs =						
Strength Level	lbs =	544.0					
MomentActual							
Service Level	ft-# =						
Strength Level	ft-# =	725.3					
MomentAllowable	=	5,412.6					
ShearActual							
Service Level	psi =						
Strength Level	nei –	73					
Shear Allowable	psi =	75 O					
Anet (Masonry)	102 -	75.0					
Pobar Dopth 'd'	in =	6.05					
Masonry Data	=	0.20					
f'm	nsi –						
Fs	psi =						
Solid Grouting	= 100						
Modular Ratio 'n'	=						
Wall Weight	psf =	100.0					
Short Term Factor	=						
Equiv. Solid Thick.	=						
Masonry Block Type	=	Medium W	/eiaht				
Masonry Design Method	=	ASD					
Concrete Data		-					

f'c

Fy

- 2,500.0 psi =
 - psi = 60,000.0

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Concrete Stem Rebar Area Details			
Bottom Stem Vertica As (based on applied moment) : 0.0272	Reinforcing H	Horizontal Reinfor	cing
(4/3) * As : 0.0362	in2/ft N	Min Stem T&S Re	inf Area 0.864 in2
200bd/fy : 200(12)(6.25)/60000 : 0.25 in2	2/ft N	vin Stem T&S Re	inf Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.1728	in2/ft ⊦	Horizontal Reinfor	cing Options :
=====	C	One layer of :	Two layers of :
Required Area : 0.1728	in2/ft #	#4@ 12.50 in	#4@ 25.00 in
Provided Area : 0.2 in2/	'ft #	#5@ 19.38 in	#5@ 38.75 in
Maximum Area : 0.8467	in2/ft #	#6@ 27.50 in	#6@ 55.00 in
Footing Data	Footing Desig	gn Results	
Toe Width = 1.75 ft		<u>Toe</u>	Heel
Heel Width = 0.67	Factored Pressure	= 1,090	0 psf
Footing Thickness 10.00 in	Mu' : Downward	= 14,073 = 5.102	0 ft-#
	Mu: Design	= 814	0 ft-#
Key Width = 0.00 in	Actual 1-Way Shear	= 7.74	0.03 psi
Key Distance from Toe $=$ 0.00 ft	Allow 1-Way Shear	= 75.00	40.00 psi
	Loe Reinforcing	= # 4 @ 9.00 ir	1
For $z = 2,500 \text{ psi}$ Fy = 60,000 psi Footing Concrete Density = 150.00 pcf	Key Reinforcing	= None Spec'd	
Min. As % = 0.0018	Footing Torsion, Tu	-	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow. Torsion	n, phi Tu 🛛 =	0.00 ft-lbs
	If torsion exceed	ls allowable, pro	vide
	supplemental de	sign for footing	torsion.
	Other Acceptable S	Sizes & Spacing	S
	Toe: #4@ 11.11 ir Heel: phiMn = phi's Key: No key defin	n, #5@ 17.22 in, a 5'lambda'sqrt(fc)'S ned	#6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 Sm
	Min footing T&S re Min footing T&S rei If one layer of horiz #4@ 11.11 in #5@ 17.22 in #6@ 24.44 in	inf Area inf Area per foot zontal bars:	0.52 in2 0.22 in2 /ft If two layers of horizontal bars: #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

OVERTURNING							RE	SISTING		
Item		Force lbs	Distand ft	ce Mo	oment t-#			Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	I)	467.2	1.61	1	752.7	Soil Over HL (ab. water t	tbl)	1.5	2.42	3.5
HL Act Pres (be water tb Hydrostatic Force	I)					Soil Over HL (bel. water Watre Table	tbl)		2.42	3.5
Buovant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on Stem	n =			
Added Lateral Load	=					* Axial Live Load on Stem	=			
Load @ Stem Above Soi	=					Soil Over Toe	=	128.3	0.88	112.3
	=					Surcharge Over Toe	=			
						Stem Weight(s)	=	450.0	2.08	937.5
						Earth @ Stem Transitions	s=			
Total	=	467.2	О.Т.М.	=	752.7	Footing Weight	=	302.5	1.21	366.0
						Key Weight	=			
Resisting/Overturning	g Rat	io	=	1.89		Vert. Component	=			
Vertical Loads used f	or So	il Pressure	=	882.3 lbs	6	Tota	al =	882.3 lb	s R.M.=	1,419.4
						* Axial live load NOT include	ded in	total displaye	d, or used for	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.040	in
The above calculation is not valid if the heel soil bearing pr	essure e	exceeds that of the toe,

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	Criteria		
	Detained Hainht	_	4.00 (1
	Retained Height	-	4.00 π
	Wall height above soil	=	0.50 ft
	Slope Behind Wall	=	0.00
	Height of Soil over Toe	=	8.00 in
	Water height over heel	=	0.0 ft

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Surcharge Loads

Surcharge Over Heel = 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe = 0.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Total Eoda Applica to otom							
Axial Dead Load	=	0.0 lbs					
Axial Live Load	=	0.0 lbs					
Axial Load Eccentricity	=	0.0 in					
		1					

Design Summary

Wall Stability Ratios Overturning Sliding	= =	2.35 1.77	OK OK	
Total Bearing Loadresultant ecc.	=	940 4.53	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe	= = Than Al	573 72 2,000 Ilowable 802	psf psf psf psf	Ok Ok
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =	6.5 1.2 75.0	psi psi psi psi	OK OK
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability	= = - = - =	467.2 450.0 376.2 0.0 0.0	lbs lbs lbs lbs lbs	OK Ok

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

	_			
Allow Soil Bearing Equivalent Fluid Pressure	e N	= leth	2,000.0 od	psf
Active Heel Pressure		=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore for passive pressure		=	12.00	in
Lateral Load Appli	iec	l to	Stem	
Lateral Load Appli	ec	l to	0.0 #/	′ft
Lateral Load Appli Lateral Load Height to Top	ec	l to	0.0 #/ 0.00 ft	′ft
Lateral Load Appli Lateral Load Height to Top Height to Bottom	= = =	l to	0.0 #/ 0.00 ft 0.00 ft	′ft
Lateral Load Appli Lateral Load Height to Top Height to Bottom Load Type	= = =	l to Wi	0.0 #/ 0.00 ft 0.00 ft nd (W)	′ft
Lateral Load Appli Lateral Load Height to Top Height to Bottom Load Type	ec = = =	l to Wir (Se	0.0 #/ 0.00 ft 0.00 ft 0.00 ft nd (W) ervice Le	(ft evel)

Stem Construction Bottom Stem OK Design Height Above Ftg 0.00 ft = Wall Material Above "Ht" = Concrete **Design Method** = LRFD Thickness 6.00 = Rebar Size # 4 = **Rebar Spacing** 18.00 = Rebar Placed at Edge = Design Data fb/FB + fa/Fa 0.295 = **Total Force @ Section** Service Level lbs = Strength Level lbs = 544.0 Moment....Actual ft-# =Service Level Strength Level ft-# = 725.3 Moment.....Allowable 2,455.6 = Shear.....Actual Service Level psi = Strength Level psi = 10.7 Shear.....Allowable psi = 75.0 Anet (Masonry) in2 = 4.25 Rebar Depth 'd' in = Masonry f'm Fs Solid G

f'c Fy

lasonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	. =	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight

Masonry Design Meth	od = ASD
Concrete Data	
f'c	psi = 2500.0

psi =	2,500.0
nsi =	60 000 0



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Concrete Stem Rebar Are	a Details			
Bottom Stem As (based on applied moment) :	Vertical 0.041 in	Reinforcing H	Horizontal Reinfor	cing
(4/3) * As :	0.0547 i	n2/ft	Vin Stem T&S Re	inf Area 0.648 in2
200bd/fv : 200(12)(4.25)/60000 :	0.17 in2	/ft N	Vin Stem T&S Re	inf Area per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6)	0.1296 i	n2/ft	Horizontal Reinfor	cing Options :
	======	====== (One laver of :	Two layers of :
Required Area	0 1296 i	n2/ft #	#4@ 16 67 in	#4@ 33.33 in
Provided Area :	0.12001	n2/ft #	#5@ 25.83 in	#5@ 51 67 in
Maximum Area :	0.1353 i	n2/ft #	#6@ 36 67 in	#6@ 73 33 in
	0.07071	Easting Desig		
Footing Data		Pooling Desig	JII Kesuits	
Toe Width=Heel Width=Total Footing Width=Footing Thickness=Key Width=Key Depth=Key Distance from Toe=f'c=2,500 psiFyFooting Concrete Density=Min. As %=Cover @ Top2.00@ Bit	2.25 ft 0.67 2.92 10.00 in 0.00 in 0.00 ft 60,000 psi 150.00 pcf 0.0018 tm.= 3.00 in	Factored Pressure Mu' : Upward Mu' : Downward Mu: Design Actual 1-Way Shear Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Key Reinforcing Footing Torsion, Tu Footing Allow. Torsio	Toe = 802 = 18,888 = 8,434 = 871 = 6.51 = 75.00 = # 4 @ 9.00 ir = None Spec'd = None Spec'd = on, phi Tu =	Heel 101 psf 2 ft-# 11 ft-# 9 ft-# 1.16 psi 40.00 psi 0.00 ft-lbs 0.00 ft-lbs
		If torsion exceed	ds allowable, pro	vide
		supplemental de	esign for footing	torsion.
		Other Acceptable S Toe: #4@ 11.11 i Heel: phiMn = phi ^t Key: No key defin	Sizes & Spacing n, #5@ 17.22 in, 5'lambda'sqrt(fc)'\$ ned	s #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5 Sm
		Min footing T&S re Min footing T&S re If one layer of horiz	einf Area einf Area per foot zontal bars:	0.63 in2 0.22 in2 <i>I</i> ft If two layers of horizontal bars:

	<i>xy</i> 01 01	110112
#4@	11.11	in
#5@	17.22	in
#6@	24.44	in

0.22 in2 /π If two layers of horizo #4@ 22.22 in #5@ 34.44 in #6@ 48.89 in
Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0	FRTUR				RF	SISTING	
Item		Force Ibs	Distand	ce Mo	oment t-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb)	467.2	1.6′	1	752.7	Soil Over HL (ab. water tbl)	73.3	2.83	207.8
HL Act Pres (be water th)	-	-			Soil Over HL (bel. water tbl))	2.83	207.8
Hydrostatic Force						vvatre l'adle			
Buoyant Force	=					Sloped Soil Over Heel =			
Surcharge over Heel	=					Surcharge Over Heel =			
Surcharge Over Toe	=					Adjacent Footing Load =			
Adjacent Footing Load	=					Axial Dead Load on Stem =			
Added Lateral Load	=					* Axial Live Load on Stem =			
Load @ Stem Above Soi	=					Soil Over Toe =	165.0	1.13	185.6
	_					Surcharge Over Toe =			
	-					Stem Weight(s) =	337.5	2.50	843.8
			_			Earth @ Stem Transitions =			
Total	=	467.2	0.T.M.	=	752.7	Footing Weight =	364.6	1.46	531.7
						Key Weight =			
Resisting/Overturning	g Rat	io	=	2.35		Vert. Component =			
Vertical Loads used for	or So	il Pressure	=	940.4 lbs	6	Total =	940.4	bs R.M.=	1,768.8
						* Axial live load NOT included	d in total display	ed, or used for	overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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 pre	essure e	exceeds that of the toe,

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Ľ	icense To : MALSAM TS	SANG	ENGINEERI
	Criteria		
	Retained Height	=	7.00 ft
	Wall height above soil	=	0.50 ft
	Slope Behind Wall	=	0.00
	Height of Soil over Toe	=	8.00 in
	Water height over heel	=	0.0 ft

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Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applica to otem							
Axial Dead Load	=	0.0 lbs					
Axial Live Load	=	0.0 lbs					
Axial Load Eccentricity	=	0.0 in					

Design Summary

Wall Stability Ratios Overturning Sliding	=		1.86 1.60	OK OK	Č
Total Bearing Loadresultant ecc.	=		1,904 12.14	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Th =	an	876 0 2,000 Allowable 1,227 0	psf psf psf e psf psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		19.2 0.0 75.0	psi psi psi	ok ok
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		-	1,227.2 1,200.0 761.7 0.0 0.0	lbs lbs lbs lbs lbs	OK OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soli Data				
Allow Soil Bearing Equivalent Fluid Pressure	e M	= leth	2,000. od	0 psf
Active Heel Pressure		=	40.	0 psf/ft
		=		
Passive Pressure		=	300.	0 psf/ft
Soil Density, Heel		=	110.0	0 pcf
Soil Density, Toe		=	110.0	0 pcf
Footing Soil Friction		=	0.40	0
Soil height to ignore for passive pressure		=	12.00) in
Lateral Load Appli	ec	l to	Sten	n
Lateral Load	=		; 0.0	#/ft ft
Height to Bottom	=		0.00 f	ft
Load Type	=	Wi	nd (W)	
		(Se	ervice L	_evel)

Stem Construction Bottom Stem OK Design Height Above Ftg ft = 0.00 Wall Material Above "Ht" = Concrete **Design Method** = LRFD Thickness 8.00 = Rebar Size # = **Rebar Spacing** 8.00 = Rebar Placed at Edge = Design Data fb/FB + fa/Fa 0.488 = **Total Force @ Section** Service Level lbs = Strength Level lbs = 1,666.0 Moment....Actual ft-# =Service Level Strength Level ft-# = 3,887.3 Moment.....Allowable 7,959.6 = Shear.....Actual Service L Strength Shear Allo Anet (Masor Rebar Depth Masonry Data f'm Fs Solid Grouti Modular Rat

f'c

Fy

SilearActual			
Service Level	psi =		
Strength Level	psi =	22.2	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
lasonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		

4

Concrete Data	
Masonry Design Method	= ASD
Masonry Block Type	= Medium Weight

2,500.0 psi = psi = 60,000.0

Code: IBC 2015,ACI 318-14,ACI 530-13



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Concrete Stem Rebar Area Details		
Bottom Stem Vertical	Reinforcing Horizontal Reinforc	ing
As (based on applied moment) : 0.1456	in2/ft	
(4/3) * As : 0.1942	in2/ft Min Stem T&S Rei	nf Area 1.440 in2
200bd/fy : 200(12)(6.25)/60000 : 0.25 in2	2/ft Min Stem T&S Rei	nf Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.1728	in2/ft Horizontal Reinford	ing Options :
=====	One layer of :	Two layers of :
Required Area : 0.1942	in2/ft #4@ 12.50 in	#4@ 25.00 in
Provided Area : 0.3 in2/	ft #5@ 19.38 in	#5@ 38.75 in
Maximum Area : 0.8467	in2/ft #6@ 27.50 in	#6@ 55.00 in
Footing Data	Footing Design Results	
Toe Width = 4.25 ft	Тое	Heel
Heel Width = 0.67	Factored Pressure = 1,227	0 psf
Total Footing Width = 4.92	Mu' : Upward = 89,622	0 ft-#
Footing Thickness = 10.00 in	Mu': Downward = 30,092	0 ft-#
Key Width = 12.00 in	Mu: Design = 4,961	0 ft-#
Key Depth = 18.00 in	Actual 1-Way Shear = 19.20	0.04 psi 40.00 psi
Key Distance from Toe = 1.00 ft	To Reinforcing = $#4@9.00$ in	40.00 poi
f'c = 2.500 psi Fy = 60.000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = # 4 @ 9.00 in	
Min. As $\%$ = 0.0018	Footing Torsion, Tu =	0.00 ft-lbs
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow. Torsion, phi Tu =	0.00 ft-lbs
	If torsion exceeds allowable, prov	vide
	supplemental design for footing t	orsion.
	Other Acceptable Sizes & Spacings	i
	Toe: #4@ 10.09 in, #5@ 15.64 in, #	6@ 22.20 in, #7@ 30.27 in, #8@ 39.86 in, #9@ 5
	Heel: phiMn = phi'5'lambda'sqrt(fc)'S	
	Key: #4@ 9.25 in, #5@ 14.35 in, #6	5@ 18 in, #7@ 18 in, #8@ 18
	Min footing T&S reinf Area	1.06 in2
	Min footing T&S reinf Area per foot	0.22 in2 /ft
	If one layer of horizontal bars:	If two layers of horizontal bars:
	#4@ 11.11 in	#4@ 22.22 in
	#5@ 17.22 IN #6@ 24.44 in	#5@ 48.80 in
	#U@ 24.44 III	#U @ 40.05 III

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0\	ERTURN	ING				RE	SISTING	
Item		Force lbs	Distand ft	e	Moment ft-#	_		Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	ol)	1,227.2	2.61	1	3,204.4	Soil Over HL (ab. wate	er tbl)	2.6	4.92	12.6
HL Act Pres (be water the Hydrostatic Force)					Soil Over HL (bel. wat Watre Table	er tbl)		4.92	12.6
Buovant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	_					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on St	em =			
Added Lateral Load	=					* Axial Live Load on Ste	m =			
Load @ Stem Above So	il =					Soil Over Toe	=	311.7	2.13	662.3
						Surcharge Over Toe	=			
	_					Stem Weight(s)	=	750.0	4.58	3,437.5
			_			Earth @ Stem Transition	ons=			
Total	=	1,227.2	O.T.M.	=	3,204.4	Footing Weight	=	615.0	2.46	1,512.9
						Key Weight	=	225.0	1.50	337.5
Resisting/Overturnin	g Rat	io	=	1	.86	Vert. Component	=			
Vertical Loads used f	for So	il Pressure	= 1,	904.2	lbs	To	otal =	1,904.2 lk	s R.M.=	5,962.8
						* Axial live load NOT inc	luded ir	n total displaye	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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)	0.037	in
The above calculation is not valid if the heel soil bearing pre	essure e	exceeds that of the toe,

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SANG	ENGINEERI	NG
=	8.00 ft	
=	0.50 ft	
=	0.00	
=	6.00 in	
=	0.0 ft	
	<u>SANG</u> = = = =	SANG ENGINEERII = 8.00 ft = 0.50 ft = 0.00 = 6.00 in = 0.0 ft

Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

/ Mai Loud / Applica to otom								
Axial Dead Load	=	0.0 lbs						
Axial Live Load	=	0.0 lbs						
Axial Load Eccentricity	=	0.0 in						
Destant Oceanies and								

Design Summary

Wall Stability Ratios Overturning Sliding	=		1.98 1.64	Ok Ok	Č.
Total Bearing Loadresultant ecc.	=		2,432 14.94	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Th: = =	an .	825 0 2,000 Allowabl 1,155 0	psf psf psf e psf psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		17.7 0.0 75.0	psi psi psi	ok ok
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		-	1,620.0 1,687.5 972.9 0.0 0.0	lbs lbs lbs lbs lbs	OK OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall Soil Data

Allow Soil Bearing Equivalent Fluid Pressur	_ N∕	= leth	2,000. od	.0	psf
Active Heel Pressure	0 10	=	40	.0	psf/ft
		=			
Passive Pressure		=	300.	.0	psf/ft
Soil Density, Heel		=	110.0	00	pcf
Soil Density, Toe		=	110.0	00	pcf
Footing Soil Friction		=	0.40	0	
Soil height to ignore for passive pressure		=	12.00	C	in
Lateral Load Appl	iec	l to	Ster	n	
Lateral Load Height to Top Height to Bottom	= = =		0.0 0.00 0.00	#/ˈ ft ft	ft
Load Type	=	Wi (Se	nd (W) ervice) Le	vel)
Wind on Exposed Stem (Service Level)	=		0.0	ps	f

Bo **Stem Construction** S Design Height Above Ftg ft = Wall Material Above "Ht" = С **Design Method** = Thickness = Rebar Size = **Rebar Spacing** = Rebar Placed at = Design Data fb/FB + fa/Fa = **Total Force @ Section** Service Level lbs = Strength Level lbs = 2, Moment....Actual ft-# = Service Level Strength Moment..... Shear.....A Service Strength Shear All Anet (Maso Rebar Dept Masonry Dat f'm Fs nsi – Solid Gro Modular

f/ft			
f			
f			
	Adjacent Footing	Load	
	Adjacent Footing Load	=	
	Footing Width	=	0
	Eccentricity	=	0
	Wall to Ftg CL Dist	=	0
l)	Footing Type		Line
	at Back of Wall	=	
	Doiscon's Potio	_	0.4
	r 0155011 5 Maliu	-	0.,
ttom			
	(
0.00)		
)		
8.00)		
# 5	5		
10.00)		
Edge	9		
0.60	2		
2.176.0)		
_, 0.0			

Level	ft-# =	5,802.7		
Allowable	=	9,623.1		
ctual				
Level	psi =			
n Level	psi =	29.3		
lowable	psi =	75.0		
onry)	in2 =			
th 'd'	in =	6.19		
ta ———				
	psi =			

15	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data f'c

Fy

2,500.0 psi = psi = 60,000.0

Code: IBC 2015,ACI 318-14,ACI 530-13

Adjacent Footing I	Load	t t	
Adjacent Footing Load	=	0.0 lbs	I
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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Concrete Stem Rebar Area Details		
Bottom Stem Vertical	Reinforcing Horizontal Reinforcing	
As (based on applied moment) : 0.2197	in2/ft	
(4/3) * As : 0.293 ir	2/ft Min Stem T&S Reinf A	Area 1.632 in2
200bd/fy : 200(12)(6.1875)/60000 : 0.2475	in2/ft Min Stem T&S Reinf A	Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) : 0.1728	in2/ft Horizontal Reinforcing	Options :
=====		b layers of :
Required Area : 0.2475	in2/ft #4@ 12.50 in #4	@ 25.00 in
Provided Area : 0.372 ir	n2/ft #5@ 19.38 in #5	i@ 38.75 in
Maximum Area : 0.8382	in2/ft #6@ 27.50 in #6	i@ 55.00 in
Footing Data	Footing Design Results	
Toe Width = 5.75 ft	Toe	leel
Heel Width = 0.67	Factored Pressure = 1,155	0 psf
Total Footing Width = 6.42	Mu': Upward = 154,644	0 ft-#
Footing Thickness = 12.00 in	Mu Design $=$ 56,934 Mu Design $=$ 8.143	0 ft-#
Key Width = 12.00 in	Actual 1-Way Shear = 17.68	0.04 nsi
Key Depth = 24.00 in	Allow 1-Way Shear = 75.00 4	0.00 psi
Key Distance from Toe = 1.00 ft	Toe Reinforcing = # 5 @ 10.00 in	·
f'c = 2,500 psi Fy = 60,000 psi	Heel Reinforcing = None Spec'd	
Footing Concrete Density = 150.00 pcf	Key Reinforcing = # 4 @ 9.00 in	
Min. AS% = 0.0018 Cover @ Top 2.00 @ $Btm = 3.00$ in	Footing Allow Torsion, phi Tu =	
	Found Anow. Torsion, print u =	0.00 11-105
	If torsion exceeds allowable, provide	3 Non
	supplemental design for footing tors	51011.
	Other Acceptable Sizes & Spacings	
	Toe: #4@ 8.13 in, #5@ 12.61 in, #6@	17.90 in, #7@ 24.41 in, #8@ 32.14 in, #9@ 40
	Key: #4@ 9.25 in, #5@ 14.35 in, #6@	18 in, #7@ 18 in, #8@ 18
	Min footing T&S reinf Area	1.66 in2
	Min footing T&S reinf Area per foot	0.26 in2 /ft
	If one layer of horizontal bars: If t	wo layers of horizontal bars:
	#4@ 9.26 in	#4@ 18.52 in
	#5@ 14.35 in	#5@ 28.70 in
	#0@ 20.37 III	#0@ 40.74 III

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Summary of Overturning & Resisting Forces & Moments

		0V	ERTURN	IING				RI	ESISTING	
Item		Force lbs	Distanc ft	e	Moment ft-#			Force Ibs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	I)	1,620.0	3.00)	4,860.0	Soil Over HL (ab. water the second se	bl)	2.9	6.42	18.8
HL Act Pres (be water tb Hvdrostatic Force	I)					Soil Over HL (bel. water t Watre Table	bl)		6.42	18.8
Buoyant Force	=					Sloped Soil Over Heel	=			
Surcharge over Heel	=					Surcharge Over Heel	=			
Surcharge Over Toe	=					Adjacent Footing Load	=			
Adjacent Footing Load	=					Axial Dead Load on Stem	=			
Added Lateral Load	=					* Axial Live Load on Stem	=			
Load @ Stem Above Soi	=					Soil Over Toe	=	316.3	2.88	909.2
	=					Surcharge Over Toe	=			
	_					Stem Weight(s)	=	850.0	6.08	5,170.8
						Earth @ Stem Transitions	i =			
Total	=	1,620.0	O.T.M.	=	4,860.0	Footing Weight	=	963.0	3.21	3,091.2
						Key Weight	=	300.0	1.50	450.0
Resisting/Overturning	g Rat	io	=	1	.98	Vert. Component	=			
Vertical Loads used f	or Soi	il Pressure	= 2,4	432.2	lbs	Total	=	2,432.2	lbs R.M.=	9,640.1
						* Axial live load NOT includ	led in	total display	ed, or used for	roverturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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) 0.030 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

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License To : MALSAM TSANG ENGINEERI							
	Criteria						
		_	0.004				
	Retained Height	=	9.00 ft				
	Wall height above soil	=	0.50 ft				
	Slope Behind Wall	=	0.00				
	Height of Soil over Toe	=	6.00 in				
	Water height over heel	=	0.0 ft				

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Surcharge Loads

Surcharge Over Heel 0.0 psf NOT Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 = NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Load Applica to otem							
Axial Dead Load	=	0.0 lbs					
Axial Live Load	=	0.0 lbs					
Axial Load Eccentricity	=	0.0 in					
Design Commence							

Design Summary

Wall Stability Ratios Overturning Sliding	=		1.99 1.54	Ok	(
Total Bearing Loadresultant ecc.	= =		2,826 18.03	lbs in	
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	= = Th: = =	an	808 0 2,000 Allowabl 1,131 0	psf psf psf e psf psf	OK OK
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =		19.7 0.0 75.0	psi psi psi	ok ok
Sliding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability		-	2,000.0 1,959.4 1,130.5 0.0 0.0	lbs lbs lbs lbs lbs	OK OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Cantilevered Retaining Wall

Soil Data				
Allow Soil Bearing		= loth	2,000.0	psf
Active Heel Pressure	JIV	=	40.0	psf/ft
		=		
Passive Pressure		=	300.0	psf/ft
Soil Density, Heel		=	110.00	pcf
Soil Density, Toe		=	110.00	pcf
Footing Soil Friction		=	0.400	
Soil height to ignore			40.00	
for passive pressure		=	12.00	in
Lateral Load Appli	ec	l to	Stem	
Lateral Load	=		0.0 #/	'ft
Height to Top	=		0.00 ft	
Height to Bottom	=		0.00 ft	
Load Type	=	Wi	ind (W)	
		(S	ervice Le	evel)
Wind on Exposed Stem (Service Level)	=		0.0 ps	sf

Bottom **Stem Construction** Stem OK Design Height Above Ftg ft = 0.00 Wall Material Above "Ht" Concrete = **Design Method** = LRFD Thickness 8.00 = Rebar Size # 5 = **Rebar Spacing** 8.00 = Rebar Placed at Edge = Design Data fb/FB + fa/Fa = **Total Force @ Section** Service Level lbs = Strength Level lbs = Moment....Actual ft-# =Service Level Strength Level ft-# = Moment.....Allowable = Shear.....Actual Service Level psi = Strength Level psi = Shear.....Allowable psi = Anet (Masonry) in2 = Rebar Depth 'd' in = Masonry Data f'm psi = Fs psi = Solid Grouting =

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

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0.700 2,754.0 8,262.0 11,799.2 37.1 75.0 6.19 Modular Ratio 'n' = Wall Weight 100.0 psf = Short Term Factor =

Equiv. Solid Thick. = Medium Weight Masonry Block Type = Masonry Design Method = ASD

Concrete Data f'c

Fy

2,500.0 psi =

psi = 60,000.0

RetainPro (c) 1987-2019, Build 11.20.03.31 License : KW-06055289 License To : MALSAM TSANG ENGINEERING	Cantilevered Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13			
Concrete Stem Rebar Area Details					
Bottom Stem Vertical As (based on applied moment) : 0.3128 i	Reinforcing Horizontal Reinforcir	ıg			
(4/3) * As : 0.4171 i	in2/ft Min Stem T&S Reinf	Area 1.824 in2			
200bd/fv : 200(12)(6.1875)/60000 : 0.2475 i	in2/ft Min Stem T&S Reinf	Area per ft of stem Height : 0.192 in2/ft			
0.0018bh : 0.0018(12)(8) : 0.1728 i	in2/ft Horizontal Reinforcir	a Options :			
=====		wo lavers of :			
Required Area : 0.3128 i	in2/ft #4@ 12.50 in #	#4@ 25.00 in			
Provided Area : 0.465 in	n2/ft #5@ 19.38 in #	#5@ 38.75 in			
Maximum Area : 0.8382 i	in2/ft #6@ 27.50 in #	#6@ 55.00 in			
Footing Data	Footing Design Results	1			
Toe Width = 7.00 ft	Toe				
Heel Width= 0.67 Total Footing Width= 7.67 Footing Thickness= 12.00 inKey Width= 12.00 inKey Depth= 27.00 inKey Distance from Toe= 1.00 ft	Factored Pressure = 1,131 Mu': Upward = 221,640 Mu': Downward = 84,378 Mu: Design = 11,439 Actual 1-Way Shear = 19.68 Allow 1-Way Shear = 75.00 Toe Reinforcing = # 5 @ 8.00 in	0 psf 0 ft-# 0 ft-# 0.04 psi 40.00 psi			
f'c = 2,500 psi $Fy = 60,000 psiFooting Concrete Density = 150.00 pcf$	Key Reinforcing = $#4 @ 9 00$ in				
Min. As % = 0.0018	Footing Torsion, Tu =	0.00 ft-lbs			
Cover @ Top 2.00 @ Btm.= 3.00 in	Footing Allow. Torsion, phi Tu =	0.00 ft-lbs			
	If torsion exceeds allowable, provide				
	supplemental design for footing to	rsion.			
	Other Acceptable Sizes & Spacings				
	Toe: #4@ 7.05 in, #5@ 10.94 in, #6@ Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm Key: #4@ 9.25 in, #5@ 14.35 in, #6@	ջ 15.52 in, #7@ 21.17 in, #8@ 27.88 in, #9@ 35 ՝ Ͽ 18 in, #7@ 18 in, #8@ 18			
	Min footing T&S reinf Area Min footing T&S reinf Area per foot If one layer of horizontal bars: In #4@ 9.26 in #5@ 14.35 in #6@ 20.37 in	1.99 in2 0.26 in2 /ft f two layers of horizontal bars: #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in			

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Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING				RI	ESISTING	
Item		Force lbs	Distance ft	ft-#	_		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	I)	2.000.0	3.33	6.666.7	Soil Over HL (ab. wat	er tbl)	3.3	7.67	25.3
HL Act Pres (be water tb	í)	,		-,	Soil Over HL (bel. wat	ter tbl)		7.67	25.3
Hydrostatic Force					Watre Table				
Buoyant Force	=				Sloped Soil Over Heel	=			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Load	=			
Adjacent Footing Load	=				Axial Dead Load on St	tem =			
Added Lateral Load	=				* Axial Live Load on Ste	em =			
Load @ Stem Above Soi	il =				Soil Over Toe	=	385.0	3.50	1,347.5
	=				Surcharge Over Toe	=			
	_				Stem Weight(s)	=	950.0	7.33	6,966.7
					Earth @ Stem Transiti	ons=			
Total	=	2,000.0	0.T.M. =	6,666.7	Footing Weight	=	1,150.5	3.84	4,412.2
					Key Weight	=	337.5	1.50	506.3
Resisting/Overturning	g Rati	io	=	1.99	Vert. Component	=			
Vertical Loads used f	or Soi	I Pressure	= 2,826.	3 lbs	T	otal =	2,826.3	lbs R.M.=	13,257.9
					* Axial live load NOT ind	cluded ir	n total display	ed, or used fo	r overturning

resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

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 pre-	essure e	exceeds that of the toe,