

Phillips Structural Engineering, PLLC Project ____ WEN HU Edgewood, Washington Sheet____of Me: Young Job No .: 10.094 By: TA Date: 4/4/19 Client: FOUTINGS LARGER THAN 94 1500 pst As = 0.0018 × 6 × h CAP = 1.2 12 (6) *4 EN 18" 42°×42° × 15 = (.56 iii 48 × 48 × 18 (C) # 4 Ev. 24 K (B) 455.4. 37K = 2.92 60° × 60° × 72° = 2.9 in (9) \$ 5 E.L. 45" 66" × 66 × 24" @ 60 FT6 PMax = 37" f a, bry = 37" (8"4×7%)+(2"4×5%") = 611 pi = . 74f . 45 @ 66" FTG PMX = 41" FCDrg = 41" SAME N 6" = 677 ps = . 276. 04 Max BRG \$ (.85fc) = .65 (.85) f. = .55fc OLS OVE TO VET STRENGTH FADTING < 2,0

Phillips Structural Engineering, PLLC Werth Project_ Edgewood, Washington Job No.: 10.094 By: 14 Date: 4/4/19 Me: Young Client: 12d = 0.148 / × 3 /4" 16d = 0.162" & 31/2" p = 31/4 - 3/4" - 11/2" = 1" = 6.84 31/2 - 3/41 - 1/2" = 11/2 = 7.76 Z = 118# × 1.6 × 1" (1118) ~ 128# E160 = 134 = 1.6 × 14/10(162) = 190" Mux 600 SUG 365 4" 6" 4" SWY 732 24" 31/5" (5%. 0.5. OK) -751UF SZ3 (89 443RF SW2 895 2/2" (17%. 05. 08) (2) o you & APBINE V Owy 1065 (2) @ 9"0x 2 1484016"0. V OUT ITO (2) 0 4" MIL ! CTTY Olive 1790 DW7 [2] 162 0 4'02 CAP = 140NF LTPY @ 16" Una CAR = 625# (12/1) = 469ME Mox LOAD = BUSNE 1608RE:

Phillips Structural Engineering, PLLC Project WEN HU Edgewood, Washington Sheet Job No.: 18.094 By: The Date: 4/4/19 Client: Me: Vorag OVER STL BM. JAMB to for performent GLO STANZ <n' - MAIN FUR w - 56.0 NB. Funn che = 15PSF OA 15 × (12/2 + 1.73/2) = 100 PUF Consister TTI WALL UMF. LOAD RXN = 10.08/ = 15B1= = 76pt x 32"/12 ZOZ# /315 V

etainPro (c) 1987-2016, Bu icense : KW-06061509 .icense To : Phillips Stru	ud 11. uctura	16.11.12 al Engineering		Cantilevered Retain	ing V	Vall	
Criteria				Soil Data			
Retained Height Wall height above soil Slope Behind Wall	= = =	5.00 ft 1.00 ft 0.00	•	Allow Soil Bearing = Equivalent Fluid Pressure Metho Active Heel Pressure = =	1,500.0 od 35.0) psf) psf/ft	
Height of Soil over Toe	=	0.00 in		Passive Pressure =	250.0) psf/ft	
Water height over heel	=	0.0 ft		Soil Density, Heel =	110.00) pcf	
-				Soil Density, Toe =	0.00) pcf	
				Footing Soil Friction =	0.525	5	
				Soil height to ignore for passive pressure =	12.00	in	
Surcharge Loads				Lateral Load Applied to	Stem		A
Surcharge Over Heel Used To Resist Sliding	g & O	0.0 psf verturning	•	Lateral Load = Height to Top =	0.0 # 0.00 ft	/ft	Ad Fo
NOT Used for Sliding	= & 0ve	0.0 Arturning		Height to Bottom =	0.00 ft		EC
			_	Load Type = Wir	nd (W)		VV Ec
Axial Load Applie	d to	Stem		(Se	rvice L	evel)	Ba
Axial Dead Load	=	360.0 lbs		Wind on Exposed Stem _	0.0 p	sf	
Axial Live Load Axial Load Eccentricity	= =	720.0 lbs 0.0 in		(Service Level)			Pc
Design Summary				Stem Construction		Bottom	(
Wall Stability Ratios				Design Height Above Ft	g ft=	0.00	Ì
Overturning	=	2.72 OK		Wall Material Above "Ht	" =	Concrete	Э
Sliding	=	1.00 OK		Design Method	=	LRFD)
Total Rearing Load	_	2 622 lbs		I NICKNESS Rebar Size	=	8.00 # 2) 1
resultant ecc.	_	2,022 ibs 2.57 in		Rebar Spacing	_	- # 16.00	•)
		-		Rebar Placed at	_	Edae	2
Soil Pressure @ Toe	=	1,341 psf C)K	Design Data		_~9	-
Soll Pressure @ Heel	=	506 psr C	ж	fb/FB + fa/Fa	=	0.28	5
Allowable Soil Pressure Less	= Thar	Allowable		Total Force @ Section			
ACI Factored @ Toe	=	1.877 psf		Service Level	lbs =		
ACI Factored @ Heel	=	708 psf		Strength Level	lbs =	700.0)
Footing Shear @ Toe	=	9.7 psi O	ĸ	MomentActual	4		
Footing Shear @ Heel	=	8.1 psi O	ĸ	Service Level	11-# = # #	1 466 -	7
Allowable	=	75.0 psi			II-# =	1,100.	r
Sliding Calcs				MomentAllowable	=	4,099.3	5
Lateral Sliding Force	=	612.6 lbs					
less 100% Passive Forc	e = -	20.0 lbs		Service Level	psi =		
less 100% Friction Force	e = •	998.7 lbs		Strength Level	psi =	9.3	3
Added Force Req'd	=	0.0 lbs O	Ж	ShearAllowable	psi =	75.0)
for 1.5 Stability	=	0.0 lbs C	Ж	Anet (Masonry)	in2 =		_
				Rehar Denth 'd'	IN =	6.25)
						0.20	
				Masonry Data		0.20	
				Masonry Data	psi =	0.20	

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

Load Eactors	
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

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



= ASD

psi = 60,000.0

psi =

2,500.0

Solid Grouting

Wall Weight

Concrete Data

f'c Fy

Masonry Design Method

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RetainPro (c) 1987-2016, Build 11. License : KW-06061509 License To : Phillips Structura	16.11.12 al Engineering	Cantilevered R	etaining Wa	all Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar A	ea Details			
Bottom Stem As (based on applied moment)	Vertica	I Reinforcing in2/ft	Horizontal Reinfo	prcing
(4/3) * As :	0.0583	in2/ft	Min Stem T&S R	einf Area 1.152 in2
200bd/fv : 200(12)(6.25)/60000): 0.25 in:	2/ft	Min Stem T&S R	einf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344	in2/ft	Horizontal Reinfo	prcing Options :
	=====	======	One laver of :	Two lavers of :
Required Area :	0.1344	in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.15 in:	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 Dimensions &Toe Width=Heel Width=Total Footing Width=Footing Thickness=Key Width=Key Depth=Key Distance from Toe=f'c =2,500 psiFy =Footing Concrete DensityFooting Concrete Density=Min. As %=Cover @ Top2.00	Strengths 1.17 ft 1.67 2.84 11.00 in 0.00 in 0.00 in 0.00 in 0.00 ft = 60,000 psi 150.00 pcf 0.0018 Btm= 3.00 in	Footing Desi Factored Pressure Mu' : Upward Mu' : Downward Mu: Design Actual 1-Way Shear Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Key Reinforcing Other Acceptable	gn Results <u>Toe</u> = 1,877 = 1,175 = 113 = 1,062 = 9.69 = 75.00 = None Spec = None Spec = None Spec Sizes & Spacin	Heel 708 psf 0 ft-# 415 ft-# 415 ft-# 8.12 psi 75.00 psi d d d d
		Heel: Not req'd: M Heel: Not req'd: M Key: No key def Min footing T&S r Min footing T&S r If one layer of hor #4@ 10.10 in #5@ 15.66 in #6@ 22.22 in	/lu < pni ⁻ 5^lambo /lu < phi*5*lambo ined einf Area einf Area per foo izontal bars:	la^sqrt(f'c)*Sm la*sqrt(f'c)*Sm t 0.24 in2 /ft If two layers of horizontal bars: #4@ 20.20 in #5@ 31.31 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING				R	ESISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	612.6	1.97	1,208.2	Soil Over Heel	=	551.8	2.34	1,290.4
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=	360.0	1.50	541.2
Load @ Stem Above Sc	oil =				* Axial Live Load on Stem	=	720.0	1.50	1,082.4
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tatal		C10.C	- o t M -	4 000 0	Stem Weight(s)	=	600.0	1.50	902.0
Total		012.0	0.1.1	1,206.2	Earth @ Stem Transitions	i =			
	=		=		Footing Weight	=	390.5	1.42	554.5
Resisting/Overturnin	g Rat	io	=	2.72	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 2,622.	3 lbs	Vert. Component	=			
					Total	=	1.902.3	lbs R.M.=	3.288.1

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall de	ue to settlem	nent of soil	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate only)	0.079	in	
The above calculation is not valid if the heel soil be	<u>earing pressure e</u>	exceeds that of the toe.	
because the wall would then tend to rotate into the	retained soil.		

RetainPro (c) 1987-2016,Build License : KW-06061509 License To : Phillips Struc	11.16.11.12 tural Engineering	Cantile	vered Retain	ning W	/all	Code: IBC 2015,ACI 318-14,ACI 530-1			
Criteria		Soil Data							
Retained Height = Wall height above soil = Slope Behind Wall = Height of Soil over Toe = Water height over heel =	= 6.00 ft = 1.00 ft = 0.00 = 0.00 in = 0.0 ft	Allow Soil Bea Equivalent Flu Active Heel Pr Passive Press Soil Density, H Soil Density, T Ecoting/ISoil F	ring = id Pressure Metho essure = ure = leel = ioe = riction =	1,500.0 od 35.0 250.0 110.00 0.00 0.525	psf psf/ft psf/ft pcf pcf				
		Soil height to i for passive p	gnore pressure =	12.00	in				
Surcharge Loads		Lateral Lo	ad Applied to	Stem		Adjacent Footing	Load		
Surcharge Over Heel Used To Resist Sliding & Surcharge Over Toe NOT Used for Sliding &	= 0.0 psf & Overturning = 0.0 Overturning	Lateral Load Height to To Height to Bo Load Type	= pp = ttom = = Wii	0.0 #/ 0.00 ft 0.00 ft ind (W)	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		
Axial Load Applied Axial Dead Load = Axial Live Load = Axial Load Eccentricity	= 360.0 lbs = 720.0 lbs	Wind on Expo (Service Lev	(Se osed Stem ₌ el)	ervice Le 0.0 ps	evel) sf	Base Above/Below Soil at Back of Wall Poisson's Ratio	= 0.0 ft = 0.300		
Design Summary		Stem Cor	nstruction		Bottom				
Wall Stability Ratios		Design	Height Above Ft	t g ft =	Stem Ok 0.00	()			
Overturning Sliding	= 2.76 OK = 1.56 OK	Wall M Desigr Thicks	laterial Above "Ht Method	t" = =	Concrete LRFD	9))			
Total Bearing Load	= 3,253 lbs = 4.03 in	Rebar	Size Spacing	=	# 4 16.00)			
Soil Pressure @ Toe = Soil Pressure @ Heel =	= 1,465 psf O = 394 psf O = 1,500 psf	K Design K fb/FB	Placed at Data + fa/Fa	=	Edge 0.492	2			
ACI Factored @ Toe	= 1,000 psr han Allowable = 2,052 psf = 551 psf	Total Ser Ser Stre	Force @ Section vice Level ength Level entActual	lbs = lbs =	1,008.0)			
Footing Shear @ Toe = Footing Shear @ Heel = Allowable =	= 13.6 psi O = 1.2 psi O = 75.0 psi	K Ser K Stre	vice Level ength Level	ft-# = ft-# =	2,016.0)			
Sliding Calcs Lateral Sliding Force = less 100% Passive Force =	= 837.2 lbs = - 20.0 lbs	Ser	vice Level	= psi =	4,099.3	5			
less 100% Friction Force Added Force Req'd for 1.5 Stability	= - 1,330.1 lbs = 0.0 lbs O = 0.0 lbs O	Stro Shear. K Anet (I	ength Level Allowable Masonry)	psi = psi = in2 =	13.4 75.0	L)			
		Rebar Masonr f'm Fs	Depth 'd' y Data	in = psi = psi =	6.25	5			
Vertical component of active NOT considered in the calcu Load Factors	e lateral soil pressur ulation of soil bearing	e IS Modula Wall V	ar Ratio 'n' Veight Term Factor	= = psf = =	100.0)			
Building Code Dead Load	IBC 2015,ACI 1.200	Equiv. Masor	Solid Thick. Iry Block Type	=	Medium \	Veight			

1.600

1.600

1.000

1.000

Live Load

Earth, H

Wind, W

Seismic, E

Concrete Data

f'c

Fy

Masonry Design Method

= ASD

psi = 60,000.0

2,500.0

psi =

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RetainPro (c) 1987-2016, Build 11 License : KW-06061509 License To : Phillips Structur	.16.11.12 al Engineering	Cantilevered R	etaining Wa	II Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar A	rea Details			
Bottom Stem As (based on applied moment	Vertica): 0.0755	Reinforcing I in2/ft	Horizontal Reinfo	rcing
(4/3) * As :	0.1007	in2/ft	Min Stem T&S Re	einf Area 1.344 in2
200bd/fy : 200(12)(6.25)/6000	0 : 0.25 in:	2/ft	Min Stem T&S Re	einf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344	in2/ft I	Horizontal Reinfo	rcing Options :
	=====	(One layer of :	Two layers of :
Required Area :	0.1344	in2/ft #	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.15 in:	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 Dimensions &	& Strengths	Footing Desig	gn Results	
Toe Width=Heel Width=Total Footing Width=Footing Thickness=Key Width=Key Depth=Key Distance from Toe=f'c2,500 psiFyFooting Concrete Density=Min. As %=Cover @ Top2.00	1.33 ft <u>2.17</u> 3.50 11.00 in 0.00 in 0.00 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 Other Acceptable S Toe: Not req'd: M Heel: Not req'd: M Key: No key defin	Toe = 2,052 = 1,646 = 146 = 1,500 = 13.59 = 75.00 = None Spector = None Spector = None Spector = None Spector Sizes & Spacing Mu < phi*5*lambda	Heel 551 psf 866 ft-# 1,081 ft-# 216 ft-# 1.23 psi 75.00 psi d d gs a*sqrt(f'c)*Sm a*sqrt(f'c)*Sm
		Min footing T&S re Min footing T&S re If one layer of hori #4@ 10.10 in #5@ 15.66 in #6@ 22.22 in	einf Area einf Area per foot zontal bars:	0.83 in2 0.24 in2 /ft If two layers of horizontal bars: #4@ 20.20 in #5@ 31.31 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)			RE	ESISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	837.2	2.31	1,930.2	Soil Over Heel	=	992.2	2.75	2,726.9
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	ן =	360.0	1.66	598.8
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	1.66	1,197.6
	=				Soil Over Toe	=			,
					Surcharge Over Toe	=			
Tatal		007.0	- o t M -	4 020 0	Stem Weight(s)	=	700.0	1.66	1,164.3
Iotai		837.2	0.1.Ivi.	1,930.2	Earth @ Stem Transitions	s =			
	=		=		Footing Weight	=	481.3	1.75	842.2
Resisting/Overturning	g Rat	io	=	2.76	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 3,253.	5 lbs	Vert. Component	=			
					Tota	l =	2.533.5	bs R.M.=	5,332.2

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wal	I due to settlem	nent of soil	
(Deflection due to wall bending not considered))		
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate on	ly) 0.081	in	
The above calculation is not valid if the heel so	<u>il bearing pressure e</u>	exceeds that of the toe.	
because the wall would then tend to rotate into	the retained soil.		

Dead Load

Live Load

Earth, H

Wind, W

Seismic, E

RetainPro (c) 1987-2016, Build License : KW-06061509 License To : Phillins Strue	d 11.16.11.12	Cantilevered Retain	ning Wa		Code: IBC 2015,A	CI 318-14,ACI 530-1
Criteria		Soil Data				
Retained Height Wall height above soil Slope Behind Wall	= 7.00 ft = 1.00 ft = 0.00	Allow Soil Bearing = Equivalent Fluid Pressure Meth Active Heel Pressure = =	1,500.0 p od 35.0 p	sf sf/ft		
Height of Soil over Toe Water height over heel	= 0.00 in = 0.0 ft	Passive Pressure=Soil Density, Heel=Soil Density, Toe=Footing Soil Friction=Soil height to ignore for passive pressure=	250.0 ps 110.00 pc 0.00 pc 0.525 12.00 in	sf/ft cf cf	: :	
Surcharge Loads		Lateral Load Applied to	Stem		Adjacent Footing L	.oad
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding &	= 0.0 psf & Overturning = 0.0 Overturning	Lateral Load = Height to Top = Height to Bottom = Load Type = Wi	0.0 #/ft 0.00 ft 0.00 ft ind (W)		Adjacent Footing Load Footing Width Eccentricity Wall to Ftg CL Dist	= 0.0 lbs = 0.00 ft = 0.00 in = 0.00 ft
Axial Load Applied	to Stem	(S	ervice Leve	el)	Footing Type Base Above/Below Soil	Line Load
Axial Dead Load Axial Live Load Axial Load Eccentricity	= 360.0 lbs = 720.0 lbs = 0.0 in	Wind on Exposed Stem ₌ (Service Level)	0.0 psf		at Back of Wall Poisson's Ratio	= 0.0 ft = 0.300
Design Summary		Stem Construction	B	ottom		
Wall Stability Ratios Overturning Sliding	= 3.03 OK = 1.56 OK	Design Height Above F Wall Material Above "H Design Method	t g ft = t" = C =	0.00 0.00 Concrete		
Total Bearing Loadresultant ecc.	= 4,019 lbs = 4.20 in	Thickness Rebar Size Rebar Spacing Rebar Placed at	= = =	8.00 # 4 14.00 Edge		
Soil Pressure @ Toe Soil Pressure @ Heel Allowable	= 1,374 psf OK = 478 psf OK = 1,500 psf	fb/FB + fa/Fa Total Force @ Section	 = 1	0.686		
ACI Factored @ Toe ACI Factored @ Heel	= 1,923 psf = 670 psf	Service Level Strength Level MomentActual	lbs = lbs =	1,372.0		
Footing Shear @ Heel Allowable	= 2.6 psi OK = 75.0 psi	Service Level Strength Level MomentAllowable	ft-# = ft-# = =	3,201.3 4.665.4		
Lateral Sliding Force less 100% Passive Force less 100% Friction Force	= 1,096.8 lbs = - 20.0 lbs = - 1,732.1 lbs	Service Level Strength Level	psi = psi =	18.3		
Added Force Req'dfor 1.5 Stability	= 0.0 lbs OK = 0.0 lbs OK	ShearAllowable Anet (Masonry) Rebar Depth 'd'	psi = in2 = in =	75.0 6.25		
Vertical component of activ NOT considered in the calc	re lateral soil pressure culation of soil bearing	Masonry Data f'm Fs Solid Grouting IS Modular Ratio 'n' Wall Weight	psi = psi = = =	100.0		
Load Factors ————— Building Code	IBC 2015,ACI	Short Term Factor Equiv. Solid Thick.	= = =	100.0		

Fy

Concrete Data

f'c

Masonry Block Type

Masonry Design Method

1.200

1.600

1.600

1.000

1.000

= Medium Weight

2,500.0

= ASD

psi = 60,000.0

psi =

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Concrete Stem Rebar Area D	etails		
Bottom Stem As (based on applied moment) :	Vertical Reinforcing 0.1199 in2/ft	Horizontal Reinforcing	
(4/3) * As :	0.1599 in2/ft	Min Stem T&S Reinf Area	a 1.536 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area	a per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344 in2/ft	Horizontal Reinforcing Op	otions :
		One layer of : Two lay	yers of :
Required Area :	0.1599 in2/ft	#4@ 12.50 in #4@ 2	, 25.00 in
Provided Area :	0.1714 in2/ft	#5@ 19.38 in #5@ 3	38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in #6@ 9	55.00 in
Footing Dimensions & Stre	engths Footing D	esign Results	
Toe Width=Heel Width=Total Footing Width=Footing Thickness=Key Width=Key Depth=Key Distance from Toe=f'c =2,500 psiFy =f'c =2,500 psiFy =60Footing Concrete Density =15Min. As %=0.Cover @ Top2.00@ Btm:	1.67 ftFactored Press2.67Factored Press4.34Mu' : Upward11.00 inMu' : Downward0.00 inActual 1-Way St0.00 inActual 1-Way St0.00 ftToe Reinforcing0,000 psiHeel Reinforcing0,000 pcfKey Reinforcing0018Other Accepta1.00 inToe: #4@ 1Heel: Not redKey: No key	$\begin{array}{rrrr} \hline \textbf{Toe} & \textbf{Hee} \\ \textbf{ure} &= 1,923 & 67 \\ &= 2,458 & 1,73 \\ \textbf{d} &= 230 & 2,18 \\ &= 2,228 & 45 \\ \textbf{hear} &= 18.66 & 2.5 \\ \textbf{hear} &= 75.00 & 75.0 \\ \textbf{g} &= 8.4 & @ 10.10 \\ \textbf{in} &= 0.000 & \text{Spec'd} \\ \textbf{g} &= 0.000 & \text{Spec'd} \\ \textbf{hele Sizes \& Spacings} \\ \textbf{0.10 in, \#5@ 15.66 in, \#6@ 22} \\ \textbf{0.10 in, \#5@ 15.66 in, \#6@ 22} \\ \textbf{0'defined} \end{array}$	<u>I</u> 0 psf 1 ft-# 5 ft-# 4 ft-# 5 psi 0 psi 2.22 in, #7@ 30.30 in, #8@ 39.90 in, #9@ 5 ⊳)*Sm
	Min footing T Min footing T If one layer o #4@ 10.10 #5@ 15.66 #6@ 22.22	&S reinf Area 1.0 &S reinf Area per foot 0.2 f horizontal bars: If two in #40 S in #50 2 in #60	13 in2 24 in2 /ft layers of horizontal bars: @ 20.20 in @ 31.31 in @ 44.44 in

Summary of Overturning & Resisting Forces & Moments

OVERTURNING							RI	ESISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,096.8	2.64	2,894.3	Soil Over Heel	=	1,542.6	3.34	5,149.6
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	n =	360.0	2.00	721.2
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	2.00	1,442.4
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tetal		1 000 0	отм —	2 90 4 2	Stem Weight(s)	=	800.0	2.00	1,602.7
Total		1,090.0	0.1.1	2,094.3	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	596.8	2.17	1,294.9
Resisting/Overturnin	g Rat	io	=	3.03	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 4,019.	3 lbs	Vert. Component	=			
					Tota	al =	3,299.3	lbs R.M.=	8,768.4

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall	l due to settlem	nent of soil	
(Deflection due to wall bending not considered)	1		
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate on	ly) 0.070	in	
The above calculation is not valid if the heel so	il bearing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate into	the retained soil.		

etainPro (c) 1987-2016, Bu icense : KW-06061509 icense To : Phillips Stru	ud 11. uctura	16.11.12 al Engineering	Cantilevered Retai	ning V	Vall	Code: IBC 2015,A	CI 318-14,ACI	530-1
Criteria			Soil Data					
Retained Height Wall height above soil Slope Behind Wall	= = =	8.00 ft 1.00 ft 0.00	Allow Soil Bearing = Equivalent Fluid Pressure Met Active Heel Pressure =	1,500.0 hod 35.0	psf psf/ft			
Height of Soil over Toe	=	0.00 in	Passive Pressure =	250.0	psf/ft			
Water height over heel	=	0.0 ft	Soil Density, Heel = Soil Density, Toe = Execting	110.00 0.00	pcf pcf			
			Soil height to ignore for passive pressure =	12.00	in			
Surcharge Loads			Lateral Load Applied t	o Stem		Adjacent Footing I	_oad	٦.
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding	g & O = & Ove	0.0 psf verturning 0.0 erturning	Lateral Load = Height to Top = Height to Bottom =	0.0 #/ 0.00 ft 0.00 ft	/ft	Adjacent Footing Load Footing Width Eccentricity Wall to Ftg CL Dist	$\begin{array}{rcrr} = & 0.0 \text{ lb} \\ = & 0.00 \text{ ft} \\ = & 0.00 \text{ in} \\ = & 0.00 \text{ ft} \end{array}$	5
Axial Load Applie	d to	Stem	Load Type = V	Service Le	evel)	Footing Type	Line Load	
Axial Dead Load	=	360.0 lbs	Wind on Exposed Stem	0.0 p	sf	Base Above/Below Soil	= 0.0 ft	
Axial Live Load Axial Load Eccentricity	= =	720.0 lbs 0.0 in	(Service Level)	0.0 p		Poisson's Ratio	= 0.300	
Design Summary			Stem Construction		Bottom	,		
Wall Stability Ratios			Design Height Above I	Ftg ft =	0.00)		
Overturning	=	2.98 OK	Wall Material Above "	-lt" =	Concrete)		
Sliding	=	1.50 OK	Design Method	=)		
Total Bearing Load	=	4.783 lbs	Rebar Size	=	٥.00 # 4	}		
resultant ecc.	=	4.63 in	Rebar Spacing	=	10.00)		
Soil Pressure @ Toe	=	1.399 psf OK	Rebar Placed at	=	Edge	9		
Soil Pressure @ Heel	=	514 psf OK	fb/FB + fa/Fa	=	0.74	2		
Allowable	= Ther	1,500 psf	Total Force @ Section	n				
ACI Factored @ Toe	=	1.959 psf	Service Level	lbs =				
ACI Factored @ Heel	=	720 psf	Strength Level	lbs =	1,792.0)		
Footing Shear @ Toe	=	20.5 psi OK	MomentActual	ft_# _				
Footing Shear @ Heel	=	4.7 psi OK	Strength Level	ft-# =	4.778.	7		
Allowable	=	75.0 psi	MomentAllowable	=	6.444.1			
Iding Calcs					0,			
Lateral Silulity Force	= 	1,417.5 IDS 0.0 lbs	Service Level	psi =				
less 100% Friction Force) = -	2,133.3 lbs	Strength Level	psi =	23.9)		
Added Force Reg'd	=	0.0 lbs OK	ShearAllowable	, psi =	75.0)		
for 1.5 Stability	=	0.0 lbs OK	Anet (Masonry)	in2 =				
			Rebar Depth 'd'	in =	6.25	5		
			Masonry Data					
			r m Fe	psi =				
			Solid Groutina	= ieq				
ertical component of act	ive lat	teral soil pressure	S Modular Ratio 'n'	=				
IOT considered in the ca	Iculati	on of soil bearing	Wall Weight	psf =	100.0)		

Load Eactors	
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

. _

=

=

psi =

= ASD

psi = 60,000.0

= Medium Weight

2,500.0

Short Term Factor

Equiv. Solid Thick.

Concrete Data

f'c Fy

Masonry Block Type

Masonry Design Method

RetainPro (c) 1987-2016, Build 11. License : KW-06061509 License To : Phillips Structura	16.11.12 al Engineering	Cantilevered R	etaining Wa	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Ar	ea Details			
Bottom Stem As (based on applied moment)	: Vertical	Reinforcing I 2/ft	Horizontal Reinfo	rcing
(4/3) * As : 200bd/fy : 200(12)(6.25)/60000	0.2387 0 : 0.25 in2	in2/ft /	Min Stem T&S R Min Stem T&S R	einf Area 1.728 in2 einf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344	in2/ft I ====== (Horizontal Reinfo One layer of :	rcing Options : Two layers of :
Required Area : Provided Area : Maximum Area :	0.2387 0.24 in2 0.8467	in2/ft # /ft # in2/ft #	#4@ 12.50 in #5@ 19.38 in #6@ 27.50 in	#4@ 25.00 in #5@ 38.75 in #6@ 55.00 in
Footing Dimensions &	Strengths	Footing Desig	gn Results	
Toe Width=Heel Width=Total Footing Width=Footing Thickness=	2.00 ft <u>3.00</u> 5.00 12.00 in	Factored Pressure Mu' : Upward Mu' : Downward Mu: Design	Toe = 1,959 = 3,588 = 360 = 3,228	Heel 720 psf 2,484 ft-# 3,365 ft-# 881 ft-#
Key Width = Key Depth = Key Distance from Toe = f'c = 2,500 psi Fy = Footing Concrete Density =	0.00 in 0.00 in 0.00 ft = 60,000 psi 150.00 pcf	Actual 1-Way Shear Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Key Reinforcing	= 20.50 = 75.00 = # 4 @ 9.00 = None Spec' = None Spec'	4.65 psi 75.00 psi in d
Min. As % = Cover @ Top 2.00 @	0.0018 8 Btm= 3.00 in	Other Acceptable S Toe: #4@ 9.26 ir Heel: Not req'd: M Key: No key defi	Sizes & Spacin n, #5@ 14.35 in, /lu < phi*5*lambd ned	gs #6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46 a*sqrt(f ⁻ c)*Sm
		Min footing T&S re Min footing T&S re If one layer of hori #4@ 9.26 in #5@ 14.35 in #6@ 20.37 in	einf Area einf Area per foot izontal bars:	1.30 in2 0.26 in2 /ft If two layers of horizontal bars: #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	.			R	ESISTING		
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	=	1,417.5	3.00	4,252.5	Soil Over Heel	=	2,053.3	3.83	7,871.1	
Surcharge over Heel	=				Sloped Soil Over Heel	=				
Surcharge Over Toe	=				Surcharge Over Heel	=				
Adjacent Footing Load	=				Adjacent Footing Load	=				
Added Lateral Load	=				Axial Dead Load on Stem	=	360.0	2.33	840.0	
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	2.33	1,680.0	
	=				Soil Over Toe	=			,	
					Surcharge Over Toe	=				
Tatal		4 447 5	- 	4 050 5	Stem Weight(s)	=	900.0	2.33	2,100.0	
Iotai		1,417.5	0.1.1	4,252.5	Earth @ Stem Transitions	=			,	
	=		=		Footing Weight	=	750.0	2.50	1,875.0	
Resisting/Overturning	g Rat	io	=	2.98	Key Weight	=				
Vertical Loads used f	or So	il Pressure	= 4,783.	3 lbs	Vert. Component	=				
					Total	=	4,063.3	lbs R.M.=	12,686.1	

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall	l due to settlem	nent of soil	
(Deflection due to wall bending not considered)	1		
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate on	ly) 0.070	in	
The above calculation is not valid if the heel so	il bearing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate into	the retained soil.		

icense : KW-06061509 icense To : Phillips Stru	ctura	al Engineering	Cantilevered Retain	ning W	/all	Code: IBC 2015,ACI 318-14,ACI 530-			
Criteria			Soil Data						
Retained Height Wall height above soil Slope Behind Wall Height of Soil over Toe Water height over heel	= = =	9.00 ft 1.00 ft 0.00 0.00 in 0.0 ft	Allow Soil Bearing = Equivalent Fluid Pressure Meth Active Heel Pressure = Passive Pressure = Soil Density, Heel = Soil Density, Toe = Footing Soil Friction = Soil height to ignore for passive pressure =	1,500.0 add 35.0 250.0 110.00 0.00 0.525 12.00	psf psf/ft psf/ft pcf pcf in				
Surcharge Loads			Lateral Load Applied to	o Stem		Adjacent Footing	load		
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding &	& O' = & Ove	0.0 psf verturning 0.0 erturning	Lateral Load = Height to Top = Height to Bottom = Load Type = W	0.0 #/ 0.00 ft 0.00 ft 'ind (W)	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		
Axial Load Applied Axial Dead Load Axial Live Load	=	360.0 lbs 720.0 lbs	(S Wind on Exposed Stem ₌ (Service Level)	ervice Le 0.0 ps	evel) sf	Base Above/Below Soil at Back of Wall Poisson's Ratio	= 0.0 ft		
Axial Load Eccentricity	=	0.0 in			Dettem		_ 0.000		
Design Summary			Stem Construction		Stem OK				
Overturning Sliding	=	3.11 OK 1.51 OK	Wall Material Above F Wall Material Above "H Design Method Thickness	rg π = t" = =	0.00 Concrete LRFD 8.00				
Total Bearing Loadresultant ecc.	= =	5,748 lbs 4.91 in	Rebar Size Rebar Spacing Rebar Placed at	= = =	# 5 11.00 Edge				
Soil Pressure @ Toe Soil Pressure @ Heel Allowable	= = =	1,426 psf OK 573 psf OK 1,500 psf	Design Data fb/FB + fa/Fa Total Force @ Section	= n	0.772	2			
ACI Factored @ Toe ACI Factored @ Heel	= =	1,996 psf 802 psf	Service Level Strength Level MomentActual	lbs = lbs =	2,268.0				
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =	25.0 psi OK 6.7 psi OK 75.0 psi	Service Level Strength Level Moment Allowable	ft-# = ft-# =	6,804.0)			
liding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force	= -	1,750.0 lbs 0.0 lbs 2,639.4 lbs	Service Level Strength Level	– psi =	30.5				
Added Force Req'd for 1.5 Stability	= =	0.0 lbs OK 0.0 lbs OK	ShearAllowable Anet (Masonry) Rebar Depth 'd'	psi = in2 = in =	75.0 6.19				
			Masonry Data f'm Fs Solid Grouting	psi = psi = =					
ertical component of activ IOT considered in the calc	ve lat culati	eral soil pressure IS on of soil bearing	5 Modular Ratio 'n' Wall Weight Short Term Factor	= psf = =	100.0	1			
Duilding Code			Equiv Solid Thick	_					

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

= Medium Weight

2,500.0

= ASD

psi = 60,000.0

psi =

Masonry Block Type

Concrete Data

f'c Fy

Masonry Design Method

RetainPro (c) 1987-2016, Build 11.16.11.1 License : KW-06061509 License To : Phillips Structural Eng	² Car ineering	ntilevered Re	etaining Wa	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area D	etails			
Bottom Stem As (based on applied moment) :	Vertical Reinfo 0.2576 in2/ft	prcing H	lorizontal Reinfo	prcing
(4/3) * As :	0.3435 in2/ft	Ν	lin Stem T&S R	einf Area 1.920 in2
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in2/ft	Ν	/lin Stem T&S R	einf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344 in2/ft	F	lorizontal Reinfo	prcing Options :
	==========	= C	One layer of :	Two layers of :
Required Area :	0.2576 in2/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 Dimensions & Stre	engths	Footing Desig	n 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 =60 Footing Concrete Density=Min. As %=0.Cover @ Top 2.00 @ Btm.	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	tored Pressure : Upward : Downward : Design ual 1-Way Shear w 1-Way Shear e Reinforcing el Reinforcing v Reinforcing rer Acceptable S Toe: #4@ 9.26 in Heel: Not req'd: M Key: No key defir	Toe = 1,996 = 4,659 = 456 = 4,203 = 25.03 = 75.00 = #5 @ 11.00 = None Spect Sizes & Spacing , #5@ 14.35 in, ju < phi*5*lambd	Heel 802 psf 4,008 ft-# 5,491 ft-# 1,483 ft-# 6.74 psi 75.00 psi 0 in d d gs #6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46 da*sqrt(fc)*Sm
	ן ה וו	Min footing T&S re Min footing T&S re f one layer of hori: #4@ 9.26 in #5@ 14.35 in #6@ 20.37 in	inf Area inf Area per foot zontal bars:	1.49 in2 t 0.26 in2 /ft If two layers of horizontal bars: #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)			RE	SISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,750.0	3.33	5,833.3	Soil Over Heel	=	2,805.0	4.33	12,155.0
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem) =	360.0	2.58	930.0
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	2.58	1,860.0
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tatal		4 750 0	- 	5 000 0	Stem Weight(s)	=	1,000.0	2.58	2,583.3
Iotai		1,750.0	0.1.1	5,833.3	Earth @ Stem Transitions	5=			
	=		=		Footing Weight	=	862.5	2.88	2,479.7
Resisting/Overturning	g Rat	io	=	3.11	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 5,747.	5 lbs	Vert. Component	=			
					Tota	l =	5.027.5	bs R.M.=	18.148.0

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall	l due to settlem	nent of soil	
(Deflection due to wall bending not considered)	1		
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate on	ly) 0.069	in	
The above calculation is not valid if the heel so	il bearing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate into	the retained soil.		

etainPro (c) 1987-2016, Buil icense : KW-06061509 icense To : Phillips Stru	ctur	al Engineering	Cantilevered Retai	ning W	Vall	Code: IBC 2015,ACI 318-14,ACI 530-1			
Criteria			Soil Data						
Retained Height Wall height above soil Slope Behind Wall	= = =	10.00 ft 1.00 ft 0.00	Allow Soil Bearing = Equivalent Fluid Pressure Met Active Heel Pressure =	1,500.0 hod 35.0	psf psf/ft				
Height of Soil over Toe	=	0.00 in	Passive Pressure =	250.0	psf/ft				
Water height over heel	=	0.0 ft	Soil Density, Heel =	110.00	pcf				
trator noight over neer		0.0 11	Soil Density, Toe =	0.00	pcf				
			Footing Soil Friction =	0.525	•				
			Soil height to ignore						
			for passive pressure =	12.00	in				
<u> </u>									
Surcharge Loads			Lateral Load Applied t	o Stem		Adjacent Footing	Load		
Surcharge Over Heel	=	0.0 psf	Lateral Load =	0.0 #/	′ft	Adjacent Footing Load	= 0	.0 lbs	
Surcharge Over Toe	=	0.0	Height to I op =	0.00 ft		Eccentricity	= 0.0	00 in	
NOT Used for Sliding 8		erturning				Wall to Ftg CL Dist	= 0.0	00 ft	
Axial Load Applied	d to	Stem	Load Type = V	Ana (vv) Sorvico La		Footing Type	Line I	oad	
Avial Decide and					evel)	Base Above/Below Soil	- 0	0 ft	
Axial Dead Load	=	360.0 IDS 720.0 lbs	(Service Level)	0.0 ps	St	at Back of Wall	- 0		
Axial Load Eccentricity	=	0.0 in				Poisson's Ratio	= 0.30	00	
Design Summary			Stem Construction		Bottom	,			
Nall Stability Ratios			Design Height Above F	tg ft =	0.00)			
Overturning	=	3.28 OK	Wall Material Above "H	-tt" =	Concrete	9			
Sliding	=	1.55 OK	Design Method	=)			
Total Bearing Load	=	7 014 lbs	Rebar Size	=	0.00 # 5				
resultant ecc.	=	4.67 in	Rebar Spacing	=	10.00)			
Cail Dragourg @ Tag		1 420 mot OK	Rebar Placed at	=	Edge)			
Soil Pressure @ Heel	=	684 nsf OK	Design Data			•			
Allowable	_	1,500 psf	tb/FB + ta/Fa	=	0.97	J			
Soil Pressure Less	Tha	n Allowable	Sorvice Level	ll lbo –					
ACI Factored @ Toe	=	1,987 psf	Strength Level	ibs = lhe -	2 800 0)			
ACI Factored @ Heel	=	957 pst	MomentActual	103 -	2,000.0	,			
Footing Shear @ Toe	=	23.3 psi OK	Service Level	ft-# =					
Fuoting Snear @ Heel	=	7.6 psi OK	Strength Level	ft-# =	9,333.3	3			
	-	70.0 pai	MomentAllowable	=	9,623.1				
Lateral Sliding Force	_	2 182 2 lhe							
less 100% Passive Force) = -	45.1 lbs	Service Level	psi =					
less 100% Friction Force	= -	3,304.3 lbs	Strength Level	psi =	37.7	7			
Added Force Req'd	=	0.0 lbs OK	ShearAllowable	psi =	75.0)			
for 1.5 Stability	=	0.0 lbs OK	Anet (Masonry)	in2 =					
			Rebar Depth 'd'	in =	6.19)			
			Masonry Data	n-!					
			r m Fs	psi =					
			Solid Groutina	μ <u>α</u> =					
ertical component of activ	ve la	teral soil pressure l	S Modular Ratio 'n'	=					
IOT considered in the cal	culat	ion of soil bearing	Wall Weight	psf =	100.0)			
oad Factors			Short Term Factor	. =					

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

=

psi =

= ASD

psi = 60,000.0

= Medium Weight

2,500.0

Equiv. Solid Thick.

Concrete Data

f'c Fy

Masonry Block Type Masonry Design Method

RetainPro (c) 1987-2016, Build 11.16.11. License : KW-06061509 License To : Phillips Structural Eng	12 gineering	Cantilevered R	etaining Wa	all Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area	Details			
Bottom Stem As (based on applied moment) :	Vertical 0.3534	Reinforcing n2/ft	Horizontal Reinfo	orcing
(4/3) * As :	0.4712	n2/ft	Min Stem T&S R	Reinf Area 2.112 in2
200bd/fy : 200(12)(6.1875)/60000 :	0.2475	n2/ft	Min Stem T&S R	Reinf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344	n2/ft	Horizontal Reinfo	prcing Options :
	======	=====	One layer of :	Two layers of :
Required Area :	0.3534	n2/ft	, #4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.372 in	2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382	n2/ft	#6@ 27.50 in	#6@ 55.00 in
Footing Dimensions & Str	enaths	Footing Desi	an 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 %=0Cover @ Top2.00@ Btm	2.67 ft 4.00 6.67 14.00 in 0.00 in 0.00 in 0.00 ft 50.00 psi 50.00 pcf 0.0018 = 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 Other Acceptable Toe: #4@ 7.94 in Heel: Not req'd: N Key: No key defi	Toe = 1,987 = 6,594 = 749 = 5,845 = 23.34 = 75.00 = # 5 @ 10.00 = None Spec' = None Spec' Sizes & Spacin n, #5@ 12.30 in, /u < phi*5*lambc ined	Heel 957 psf 6,270 ft-# 8,500 ft-# 2,230 ft-# 7.62 psi 75.00 psi 0 in 'd 'd 1gs #6@ 17.46 in, #7@ 23.81 in, #8@ 31.35 in, #9@ 39 da*sqrt(f'c)*Sm
		Min footing T&S r Min footing T&S r If one layer of hor #4@ 7.94 in #5@ 12.30 in #6@ 17.46 in	einf Area einf Area per foo izontal bars:	2.02 in2 t 0.30 in2 /ft If two layers of horizontal bars: #4@ 15.87 in #5@ 24.60 in #6@ 34.92 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)			RE	SISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,182.2	3.72	8,122.5	Soil Over Heel	=	3,666.7	5.00	18,345.6
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=	360.0	3.00	1,081.2
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	3.00	2,162.4
	=				Soil Over Toe	=			,
					Surcharge Over Toe	=			
Tatal		0.400.0	- 	0.400 5	Stem Weight(s)	=	1,100.0	3.00	3,303.7
Iotai		2,182.2	0.1.1	8,122.5	Earth @ Stem Transitions	=			
	=		=		Footing Weight	=	1,167.3	3.34	3,892.8
Resisting/Overturning	g Rat	io	=	3.28	Key Weight	=			
Vertical Loads used for	or So	il Pressure :	= 7,013.	9 lbs	Vert. Component	=			
					Total	=	6.293.9	bs R.M.=	26.623.2

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall	l due to settlen	<u>nent of soil</u>	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate onl	ly) 0.065	in	
The above calculation is not valid if the heel soi	I bearing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate into	the retained soil.		

etainPro (c) 1987-2016, Build cense : KW-06061509 icense To : Phillips Strue	d 11.16.11.12 ctural Engineering	Cantilevered Reta	ining V	Code: IBC 2015,/	ACI 318-14,ACI 530-	
Criteria		Soil Data				
Retained Height Wall height above soil Slope Behind Wall Height of Soil over Toe Water height over heel	= 5.00 ft = 1.00 ft = 0.00 = 0.00 in = 0.0 ft	Allow Soil Bearing = Equivalent Fluid Pressure Me Active Heel Pressure = Passive Pressure = Soil Density, Heel = Soil Density, Toe = Footing Soil Friction = Soil height to ignore = for passive pressure =	1,500.0 thod 250.0 110.00 0.525 12.00) psf) psf/ft) psf/ft) pcf) pcf ; in		
Surcharge Loads		Lateral Load Applied	to Stem		Adjacent Footing	Load
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding & Axial Load Applied	= 40.0 psf & Overturning = 0.0 Overturning to Stem	Lateral Load = Height to Top = Height to Bottom = Load Type = V	0.0 # 0.00 ft 0.00 ft Vind (W) Service L	/ft evel)	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
Axial Dead Load Axial Live Load Axial Load Eccentricity	= 360.0 lbs = 720.0 lbs = 0.0 in	Wind on Exposed Stem ₌ (Service Level)	0.0 p	sf	at Back of Wall Poisson's Ratio	= 0.0 ft = 0.300
Design Summary		Stem Construction		Bottom	,	
Vall Stability Ratios Overturning Sliding Total Bearing Load resultant ecc.	= 2.60 OK = 1.54 OK = 2,779 lbs = 3.43 in	Design Height Above Wall Material Above " Design Method Thickness Rebar Size Rebar Spacing	Ftg ft = Ht" = = = =	0.00 Concrete LRFE 8.00 # 4 16.00) 2)) 4)	
Soil Pressure @ Toe Soil Pressure @ Heel	= 1,456 psf C = 396 psf C	K Rebar Placed at Design Data K fb/FB + fa/Fa	=	Edge	7	
Allowable Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel Footing Shear @ Toe Footing Shear @ Heel Allowable	= 1,500 psf Than Allowable = 2,039 psf = 555 psf = 10.5 psi O = 0.5 psi O = 75.0 psi	K Service Level K Service Level MomentActual K Service Level Strength Level Strength Level MomentAllowable		801.8 1,421.2 4,099 3	2 3	
Iding Calcs Lateral Sliding Force less 100% Passive Force less 100% Friction Force Added Force Req'd for 1.5 Stability	= 687.9 lbs = 20.0 lbs = 1,080.9 lbs = 0.0 lbs 0 = 0.0 lbs 0	Service Level Strength Level K ShearAllowable K Anet (Masonry)	= psi = psi = in2 =	4,039.0 10.7 75.0	, ,)	
	_ 0.0 05 C	Rebar Depth 'd' Masonry Data	in =	6.25	5	

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

Load Eactors	
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

iacent Footing Load						

Aujacent i ooting i	-uau	
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

	=	Concrete	
Design Method	=	LRFD	
Thickness	=	8.00	
Rebar Size	=	# 4	
Rebar Spacing	=	16.00	
Rebar Placed at	=	Edge	
Design Data			
fb/FB + fa/Fa	=	0.347	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	801.8	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	1,421.2	
MomentAllowable	=	4,099.3	
Service Level	psi =		
Strength Level	psi =	10.7	
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 We	eight
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	2,500.0	

psi = 60,000.0

Fy

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RetainPro (c) 1987-2016, Build 11.10 License : KW-06061509 License To : Phillips Structural	6.11.12 Engineering	Cantilevered R	etaining Wa	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Are	ea Details			
Bottom Stem	Vertical	Reinforcing I	Horizontal Reinfo	rcing
(4/3) * As :	0.071 in	2/ft	Min Stem T&S Re	einf Area 1,152 in2
200bd/fy : 200(12)(6.25)/60000	: 0.25 in2	/ft	Min Stem T&S Re	einf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344 i	in2/ft	Horizontal Reinfo	rcing Options :
	======	====== (One layer of :	Two layers of :
Required Area :	0.1344 i	in2/ft	, #4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.15 in2	/ft a	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 i	in2/ft	#6@ 27.50 in	#6@ 55.00 in
Footing Dimensions &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@	Strengths 1.17 ft 1.83 3.00 11.00 in 0.00 in 0.00 in 0.00 ft 60,000 psi 150.00 pcf 0.0018 Btm.= 3.00 in	Footing Design Factored Pressure Mu': Upward Mu': Downward Mu: Design Actual 1-Way Shear Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Key Reinforcing Cother Acceptable S Toe: Not req'd: N	Toe = 2,039 = 1,263 = 113 = 1,151 = 10.53 = 75.00 = None Spector = None Spector = None Spector = None Spector Sizes & Spacing /u < phi*5*lambda	Heel 555 psf 505 ft-# 602 ft-# 96 ft-# 0.53 psi 75.00 psi d gs a*sqrt(f'c)*Sm
		Heel: Not req'd: N Key: No key defi Min footing T&S r Min footing T&S r If one layer of hori #4@ 10.10 in #5@ 15.66 in #6@ 22 22 in	/u < phi*5*lambda ned einf Area einf Area per foot izontal bars:	0.71 in2 0.24 in2 /ft If two layers of horizontal bars: #4@ 20.20 in #5@ 31.31 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING				RES	SISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	612.6	1.97	1,208.2	Soil Over Heel	=	639.8	2.42	1,547.3
Surcharge over Heel	=	75.3	2.96	222.8	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	46.5	2.42	112.5
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=	360.0	1.50	541.2
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	1.50	1,082.4
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tetal		607.0	- отм —	1 424 0	Stem Weight(s)	=	600.0	1.50	902.0
Total		667.9	0.1.IVI.	1,431.0	Earth @ Stem Transitions	=			
	=		=		Footing Weight	=	412.5	1.50	618.8
Resisting/Overturning	g Rat	io	=	2.60	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 2,778.	9 lbs	Vert. Component	=			
					Total	=	2,058.9 lb	s R.M.=	3,721.8

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall	l due to settlen	nent of soil	
(Deflection due to wall bending not considered)	1		
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate onl	ly) 0.081	in	
The above calculation is not valid if the heel soi	il bearing pressure e	exceeds that of the toe,	
because the wall would then tend to rotate into	the retained soil.		

This Wall in File: C:\Phillips	s Structural	Engineeri	ng\D	ESIGN\RETAINING WALLS\car	ntileve	red wall ~ s	la		
RetainPro (c) 1987-2016, Bui License : KW-06061509 License To : Phillips Stru	ud 11.16.11.1	neering		Cantilevered Retain	ing V	Vall	Code: IBC 2015,A	\CI 3'	18-14,ACI 530-13
Criteria				Soil Data					
Retained Height Wall height above soil Slope Behind Wall	= 6.00 = 1.00 = 0.00	D ft D ft D	- / /	Allow Soil Bearing = 1 Equivalent Fluid Pressure Metho Active Heel Pressure = -	1,500.0 d 35.0) psf) psf/ft			
Height of Soil over Toe	= 0.00	0 in	I	= Passive Pressure =	250.0) psf/ft			
Water height over heel	= 0.0	D ft		Soil Density, Heel = Soil Density, Toe = Footing Soil Friction = Soil height to ignore for passive pressure =	110.00 0.00 0.525 12.00) pcf) pcf 5 in			
Surcharge Loads				Lateral Load Applied to	Sten	า	Adjacent Footing	_oad	
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding a	= 40.0 g & Overturn = 0.0 & Overturnin) psf ing) g	•	Lateral Load = Height to Top = Height to Bottom = Load Type = Win	0.0 # 0.00 ft 0.00 ft	#/ft t	Adjacent Footing Load Footing Width Eccentricity Wall to Ftg CL Dist	= = = =	0.0 lbs 0.00 ft 0.00 in 0.00 ft
Axial Load Applie	d to Stem			(Ser	rvice L	evel)	Footing Type		Line Load
Axial Dead Load	= 360.0) lbs		Wind on Exposed Stem _	0.0 p	sf	at Back of Wall	=	0.0 ft
Axial Live Load Axial Load Eccentricity	= 720.0 = 0.0	0 lbs 0 in		(Service Level)			Poisson's Ratio	=	0.300
Design Summary				Stem Construction		Bottom Stem OK			
Wall Stability Ratios				Design Height Above Ftg	ft =	0.00			
Sliding	= 2 = 1	.77 OK .50 OK		Wall Material Above "Ht" Design Method Thickness	' = = =	Concrete LRFD 8.00			
Total Bearing Loadresultant ecc.	= 3,4 = 3.	04 lbs .91 in		Rebar Size Rebar Spacing Babar Blaced et	=	# 4 16.00			
Soil Pressure @ Toe Soil Pressure @ Heel	= 1,3 = 4	81 psf C 35 psf C)K)K	fb/FB + fa/Fa	=	0.581			
Allowable Soil Prossure Loss	= 1,5	00 psf		Total Force @ Section					
ACI Factored @ Toe	= 1.9	able 133 psf		Service Level	lbs =				
ACI Factored @ Heel Footing Shear @ Toe	= 6	609 psf 5.7 psi C	ж	Strength Level MomentActual	lbs =	1,130.2			
Footing Shear @ Heel	=	2.1 psi C	Ж	Service Level	ft-# =	2 2 9 7 F			
Allowable	= 7	5.0 psi		Moment Allowable	-	2,302.0			
Sliding Calcs Lateral Sliding Force	= 92	5.2 lbs		Service Level	– nsi –	4,000.0			
less 100% Passive Force	e = - 20	0.0 lbs 9.1 lbs		Strength Level	nsi –	15 1			
Added Force Reald	- (nnlbs C	Ж	ShearAllowable	psi =	75.0			
for 1.5 Stability	= (0.0 lbs C	ЭK	Anet (Masonry)	in2 =				
				Rebar Depth 'd'	in =	6.25			
				Masonry Data f'm Fs Solid Grouting	psi = psi =				
Vertical component of act NOT considered in the ca	ive lateral so lculation of s	il pressur oil bearin	re IS Ig	Modular Ratio 'n' Wall Weight	= = psf =	100.0			
Load Factors				Short Term Factor	=				
Building Code	IBC 201	1 200		Equiv. Solid Thick. Masonny Block Type	=	Medium	Veight		
Live Load		1.200 1.600		Masonry Design Method	=	ASD	v cigilit		

psi =

2,500.0

psi = 60,000.0

Concrete Data

f'c

Fy

1.600

1.000

1.000

Earth, H

Wind, W

Seismic, E

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RetainPro (c) 1987-2016, Build 11. License : KW-06061509 License To : Phillips Structur	16.11.12 al Engineering	Cantilevered R	etaining Wa	all Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar A	rea Details			
Bottom Stem As (based on applied moment	Vertica) : 0.0893	I Reinforcing in2/ft	Horizontal Reinfo	orcing
(4/3) * As :	0.119 i	n2/ft	Min Stem T&S R	Reinf Area 1.344 in2
200bd/fy : 200(12)(6.25)/60000	0 : 0.25 in:	2/ft	Min Stem T&S R	Reinf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344	in2/ft	Horizontal Reinfo	orcing Options :
	=====		One layer of :	Two layers of :
Required Area :	0.1344	in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area	0.15 in:	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 Dimensions &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	A Strengths 1.50 ft 2.25 3.75 11.00 in 0.00 in 0.00 in 0.00 ft = 60,000 psi 150.00 pcf 0.0018 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 Cother Acceptable Toe: Not req'd: M Heel: Not req'd: M	gn Results <u>Toe</u> = 1,933 = 1,976 = 186 = 1,790 = 15.68 = 75.00 = None Spec = None Spec = None Spec Sizes & Spacin Au < phi*5*lambo Au < phi*5*lambo	Heel 609 psf 997 ft-# 1,280 ft-# 283 ft-# 2.06 psi 75.00 psi 'd 'd
		Min footing T&S r Min footing T&S r If one layer of hor #4@ 10.10 in #5@ 15.66 in #6@ 22.22 in	einf Area einf Area per foo izontal bars:	0.89 in2 at 0.24 in2 /ft If two layers of horizontal bars: #4@ 20.20 in #5@ 31.31 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	.			R	ESISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	837.2	2.31	1,930.2	Soil Over Heel	=	1,045.0	2.96	3,091.5
Surcharge over Heel	=	88.0	3.46	304.4	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	63.3	2.96	187.4
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	า =	360.0	1.83	660.0
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	1.83	1,320.0
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tetal		0.05.0	отм —	0.004.7	Stem Weight(s)	=	700.0	1.83	1,283.3
Total		925.Z	0.1.1	2,234.7	Earth @ Stem Transition	s =			
	=		=		Footing Weight	=	515.6	1.88	966.8
Resisting/Overturning	g Rat	io	=	2.77	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 3,404.	0 lbs	Vert. Component	=			
					Tota	ıl =	2,684.0	lbs R.M.=	6,188.9

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall	<u>due to settlen</u>	nent of soil	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate only	y) 0.072	in	
The above calculation is not valid if the heel soil	bearing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate into the	he retained soil.		

icense : KW-06061509 icense To : Phillips Stru	ictura	al Engineering	Cantilevered Re	taini	ng V	Vall	Code: IBC 2015,4	ACI 318-14,ACI
Criteria			Soil Data					
Retained Height Wall height above soil Slope Behind Wall Height of Soil over Toe Water height over heel	= = =	7.00 ft 1.00 ft 0.00 0.00 in 0.0 ft	Allow Soil Bearing Equivalent Fluid Pressure I Active Heel Pressure Passive Pressure Soil Density, Heel Soil Density, Toe Footing Soil Friction Soil height to ignore	= 1, Method = = = = 1 =	,500.0 35.0 250.0 10.00 0.525) psf) psf/ft) psf/ft) pcf 5		
· · · ·			for passive pressure	= 1	12.00	in 	: :	
Surcharge Loads			Lateral Load Applie	ed to S	Stem	1	Adjacent Footing	Load
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding a	g & Ov = & Ove	40.0 psf verturning 0.0 erturning	Lateral Load = Height to Top = Height to Bottom = Load Type =	= 0 = 0 = 0	0.0 # 0.00 ft 0.00 ft 0.00 ft	/ft	Adjacent Footing Load Footing Width Eccentricity Wall to Ftg CL Dist	= 0.0 lbs = 0.00 ft = 0.00 in = 0.00 ft
Axial Load Applie	d to	Stem		(Serv	vice L	evel)	Footing Type	Line Load
Axial Dead Load Axial Live Load Axial Load Eccentricity	= = =	360.0 lbs 720.0 lbs 0.0 in	Wind on Exposed Stem ₌ (Service Level)	:	0.0 p	sf	at Back of Wall Poisson's Ratio	= 0.0 ft = 0.300
Design Summary			Stem Construction	۱] _	Bottom	,	
Wall Stability Ratios			Design Height Abo	ve Ftg	ft =	0.00)	
Overturning	=	2.93 OK	Wall Material Abov	/e "Ht"	=	Concrete	9	
Sliding	=	1.50 OK	Design Method		=)	
Total Bearing Load	=	4.186 lbs	Rebar Size		=	8.00 # 4) 1	
resultant ecc.	=	4.49 in	Rebar Spacing		=	12.00)	
Soil Pressure @ Toe	=	1.395 nsf Ok	Rebar Placed at		=	Edge	9	
Soil Pressure @ Heel	=	466 psf Ok	th/EB + fa/Ea		_	89.0	4	
Allowable		1,500 psf	Total Force @ Se	ction	_	0.00	•	
Soil Pressure Less	Than	Allowable	Service Level		lbs =			
ACI Factored @ Toe	=	652 psr	Strength Level		lbs =	1,514.8	5	
Footing Shear @ Toe	=	20.3 psi OK	MomentActual					
Footing Shear @ Heel	=	4.1 psi OK	Service Level		tt-# =	3 700 4	2	
Allowable	=	75.0 psi	Strength Level		n-# =	5,700.	<u><</u>	
liding Calcs			womentAllowat	JIE	=	5,412.0)	
Lateral Sliding Force	=	1,197.5 lbs	Service Level		nsi =			
less 100% Passive Force	e = -	∠∪.∪ IDS 1.819.8 lbs	Strength Level		nsi –	20 3	>	
Added Force Regid	_	0.0 lbs OK	ShearAllowable	;	psi =	75.0	-)	
for 1.5 Stability	=	0.0 lbs Ok	Anet (Masonry)		in2 =			
			Rebar Depth 'd'		in =	6.25	5	
			f'm		psi =			

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

Load Eactors	
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

g Load 0.0 lbs 0.00 ft 0.00 in d = = = 0.00 ft = Line Load

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	=	12.00			
Rebar Placed at	=	Edge			
fb/FB + fa/Fa	=	0.684			
Total Force @ Section					
Service Level	lbs =				
Strength Level	lbs =	1,514.5			
MomentActual					
Service Level	ft-# =				
Strength Level	ft-# =	3,700.2			
MomentAllowable	=	5,412.6			
Service Level	psi =				
Strength Level	psi =	20.2			
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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RetainPro (c) 1987-2016, Build 11.16. License : KW-06061509 License To : Phillips Structural I	11.12 Engineering	Cantilevered R	etaining Wa	all Code: IBC 2015,ACI 318-14,ACI 530-1
Concrete Stem Rebar Area	a Details			
Bottom Stem As (based on applied moment) :	Vertical F 0.1386 ir	Reinforcing 12/ft	Horizontal Reinfo	orcing
(4/3) * As :	0.1848 ir	2/ft	Min Stem T&S R	Reinf Area 1.536 in2
200bd/fv : 200(12)(6.25)/60000 :	0.25 in2/	ft	Min Stem T&S R	Reinf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344 ir	2/ft	Horizontal Reinfo	orcing Options :
			One layer of :	Two layers of :
Required Area :	0.1848 ir	2/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 ir	12/ft	#6@ 27.50 in	#6@ 55.00 in
Footing Dimensions & S Toe Width = Heel Width = Total Footing Width =	1.75 ft 2.75 4.50	Footing Design Factored Pressure Mu': Upward	gn Results = 1,953 = 2,732	Heel 652 psf 1,851 ft-#
Footing Thickness = Key Width = Key Depth = Key Distance from Toe = f'c = 2,500 psi Fy = Footing Concrete Density =	11.00 in 0.00 in 0.00 in 0.00 ft 60,000 psi 150.00 pcf	Mu' : Downward Mu: Design Actual 1-Way Shear Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Key Reinforcing	= 253 = 2,479 = 20.31 = 75.00 = # 4 @ 10.1 = None Spec = None Spec	2,502 ft-# 651 ft-# 4.08 psi 75.00 psi 0 in 'd
Min. As % = Cover @ Top 2.00 @ B	0.0018 itm.= 3.00 in	Other Acceptable S Toe: #4@ 10.10 Heel: Not req'd: N Key: No key defi	Sizes & Spacir in, #5@ 15.66 ir /lu < phi*5*lambo ned	ngs n, #6@ 22.22 in, #7@ 30.30 in, #8@ 39.90 in, #9@ 5 da*sqrt(f'c)*Sm
		Min footing T&S r Min footing T&S r If one layer of hor #4@ 10.10 in #5@ 15.66 in #6@ 22.22 in	einf Area einf Area per foo izontal bars:	1.07 in2 t 0.24 in2 /ft If two layers of horizontal bars: #4@ 20.20 in #5@ 31.31 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING				RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,096.8	2.64	2,894.3	Soil Over Heel	=	1,604.2	3.46	5,547.7
Surcharge over Heel	=	100.8	3.96	398.8	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	83.3	3.46	288.2
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=	360.0	2.08	750.0
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	2.08	1,500.0
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tetal		1 107 5		2 202 4	Stem Weight(s)	=	800.0	2.08	1,666.7
Total		1,197.5	0.1.1	3,293.1	Earth @ Stem Transitions	=			
	=		=		Footing Weight	=	618.8	2.25	1,392.2
Resisting/Overturning	g Rat	io	=	2.93	Key Weight	=			
Vertical Loads used f	or So	il Pressure :	= 4,186.3	3 lbs	Vert. Component	=			
					Total	=	3,466.3 lb	s R.M.=	9,644.8

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall	l due to settlen	nent of soil	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate onl	ly) 0.069	in	
The above calculation is not valid if the heel soi	il bearing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate into	the retained soil.		

RetainPro (c) 1987-2016, Build .icense : KW-06061509 .icense To : Phillips Struc	11.16.11.12 tural Engineerin	Cantilevered Retain	Vall	Co		
Criteria			Soil Data			
Retained Height Wall height above soil Slope Behind Wall Height of Soil over Toe Water height over heel	= 8.00 ft = 1.00 ft = 0.00 = 0.00 in = 0.0 ft		Allow Soil Bearing=Equivalent Fluid Pressure MethActive Heel Pressure=Passive Pressure=Soil Density, Heel=Soil Density, Toe=Footing Soil Friction=Soil height to ignore	1,500.0 nod 250.0 110.00 0.525	psf psf/ft psf/ft pcf pcf	
Surcharge Loads			for passive pressure =	12.00	in	Adiad
Surcharge Over Heel Used To Resist Sliding & Surcharge Over Toe NOT Used for Sliding &	= 40.0 psf & Overturning = 0.0 Overturning		Lateral Load = Height to Top = Height to Bottom = Load Type = W	0.0 #, 0.00 ft 0.00 ft ind (W)	/ft	Adjace Footing Eccent Wall to Footing
Axial Dead Load Axial Live Load Axial Load Eccentricity	= 360.0 lbs = 720.0 lbs = 0.0 in	1	(S Wind on Exposed Stem ₌ (Service Level)	ervice Lo 0.0 p	evel) sf	Base A at Ba Poissor
Design Summary			Stem Construction		Bottom	
Wall Stability Ratios Overturning Sliding Total Bearing Load resultant ecc.	= 3.02 OF = 1.52 OF = 5,144 lbs = 5.08 in		Design Height Above F Wall Material Above "H Design Method Thickness Rebar Size Rebar Spacing	tg ft = t" = = = =	Stem OK 0.00 Concrete LRFD 8.00 # 4 9.00	<))))
Soil Pressure @ Toe Soil Pressure @ Heel Allowable	= 1,454 psf = 506 psf = 1,500 psf	OK OK	Rebar Placed at Design Data fb/FB + fa/Fa Total Force @ Section	= = n	Edge 0.762	2
ACI Factored @ Toe ACI Factored @ Heel Footing Shear @ Toe	= 2,035 psf = 708 psf = 21.4 psi	OK	Service Level Strength Level MomentActual Service Level	lbs = lbs = ft-# =	1,954.9)
Allowable	= 6.0 psi = 75.0 psi	UK	Strength Level MomentAllowable	ft-# = =	5,430.3 7,122.4	3
less 100% Passive Force less 100% Friction Force	= 1,532.0 IDS = 0.0 lbs = 2,322.7 lbs	Οĸ	Service Level Strength Level Shear Allowable	psi = psi = psi =	26.1 75 0)
for 1.5 Stability	= 0.0 lbs	OK	Anet (Masonry) Rebar Depth 'd' Masonry Data	in2 = in =	6.25	5

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

Load Eactors	
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

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





Fy

RetainPro (c) 1987-2016, Build 11.16.11. License : KW-06061509 License To : Phillips Structural Eng	¹² Car gineering	tilevered Reta	aining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area	Details			
Bottom Stem As (based on applied moment) :	Vertical Reinfo 0.2035 in2/ft	rcing Hor	rizontal Reinforc	ing
(4/3) * As : 200bd/fy : 200(12)(6.25)/60000 :	0.2713 in2/ft 0.25 in2/ft	Min Min	n Stem T&S Rein Stem T&S Rein	nf Area 1.728 in2 nf Area per ft of stem Height : 0 192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344 in2/ft	Hor	rizontal Reinforc	ing Options : Two layers of :
Required Area : Provided Area : Maximum Area :	0.25 in2/ft 0.2667 in2/ft 0.8467 in2/ft		@ 12.50 in @ 19.38 in @ 27.50 in	#4@ 25.00 in #5@ 38.75 in #6@ 55.00 in
Footing Dimensions & Str	engths F	Footing Design	Results	
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@ Btm	2.00 ft <u>3.25</u> 5.25 Mu' 12.00 in Mu' 0.00 in Actu 0.00 in Allo 0.00 ft Toe 0,000 psi Hee 50.00 pcf Key .0018 Oth = 3.00 in	tored Pressure = : Upward = Design = ual 1-Way Shear = w 1-Way Shear = Reinforcing = r Reinforcing = r Reinforcing = r Acceptable Siz foe: #4@ 9.26 in, # teel: Not req'd: Mu Key: No key defined	Toe 2,035 3,733 360 3,373 21.43 75.00 # 4 @ 9.00 in None Spec'd None Spec'd None Spec'd tes & Spacings #5@ 14.35 in, #6 < phi*5*lambda*d	Heel 708 psf 3,090 ft-# 4,338 ft-# 1,248 ft-# 6.01 psi 75.00 psi 5 5 6 6 9 20.37 in, #7 27.78 in, #8 8 36.57 in, #9 46 sqrt(f'c)*Sm
	N N If	Ain footing T&S reinf fin footing T&S reinf one layer of horizor #4@ 9.26 in #5@ 14.35 in #6@ 20.37 in	f Area f Area per foot ntal bars:	1.36 in2 0.26 in2 /ft If two layers of horizontal bars: #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)			RE	SISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,417.5	3.00	4,252.5	Soil Over Heel	=	2,273.3	3.96	8,998.6
Surcharge over Heel	=	114.5	4.50	515.5	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	103.3	3.96	409.0
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Sterr	ו =	360.0	2.33	840.0
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	2.33	1,680.0
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tetal		1 522 0	- 	4 769 0	Stem Weight(s)	=	900.0	2.33	2,100.0
TOLAI		1,552.0	0.1.Ivi.	4,700.0	Earth @ Stem Transitions	s =			
	=		=		Footing Weight	=	787.5	2.63	2,067.2
Resisting/Overturning	g Rat	io	=	3.02	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 5,144.	2 lbs	Vert. Component	=			
					Tota	l =	4,424.2 lk	s R.M.=	14,414.8

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall d	due to settlen	nent of soil	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate only)	0.069	in	
The above calculation is not valid if the heel soil b	earing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate into the	e retained soil.		

letainPro (c) 1987-2016, Bu icense : KW-06061509 .icense To : Phillips Stru	Cantilevered	Retai	ining V	Code: IBC 2015,ACI 318-14,ACI 53				
Criteria			Soil Data					
Retained Height	=	9.00 ft	Allow Soil Bearing	= sure Met	1,500.0) psf		and the second se
Wall height above soil Slope Behind Wall	=	1.00 ft 0.00	Active Heel Pressure	=	35.0) psf/ft		
Height of Soil over Toe	=	0.00 in	Passive Pressure	=	250.0	psf/ft		
Water height over heel	=	0.0 ft	Soil Density, Heel	=	110.00) pcf		
in allor mongine of on moor		01011	Soil Density, Toe	=	0.00	pcf		
			Footing Soil Friction	=	0.525			
			Soil height to ignore for passive pressure	e =	12.00	in		
Surcharge Loads			Lateral Load Ap	plied t	to Stem		Adjacent Footing	Load
Surcharge Over Heel		40.0 psf	Lateral Load	=	0.0 #/	/ft	Adjacent Footing Load	= 0.0 lbs
Used To Resist Sliding] & O _	verturning	Height to Top	=	0.00 ft		Footing Width	= 0.00 ft
NOT Used for Sliding	- & Ove	erturning	Height to Bottom	=	0.00 ft		Wall to Eta CL Dist	= 0.00 ft
Avial Load Applia	d to	Stom	Load Type	= V	Vind (W)		Footing Type	Line Load
	u (0	Stelli		(\$	Service Le	evel)	Base Above/Below Soi	
Axial Dead Load	=	360.0 lbs	Wind on Exposed Ste	em _	0.0 p	sf	at Back of Wall	= 0.0 ft
Axial Live Load Axial Load Eccentricity	= =	720.0 lbs 0.0 in	(Service Level)				Poisson's Ratio	= 0.300
Design Summary			Stem Construc	tion		Bottom	,	
Wall Stability Ratios			Design Height	Above I	Ftg ft =	0.00)	
Overturning	=	3.15 OK	Wall Material	Above "I	Ht" =	Concret	e	
Sliding	=	1.52 UK	Design Metho	d	=	LRFE)	
Total Bearing Load	_	6 156 lbs	I NICKNESS Rebar Size		=	8.00 #	5	
resultant ecc.	_	5.27 in	Rebar Spacing	r	_	11 0))	
			Rebar Placed	at	=	Eda	-	
Soil Pressure @ Toe	=	1,477 psf Oł	Design Data			-~9	-	
	=	5/5 pst Of	fb/FB + fa/Fa		=	0.86	6	
Soil Pressure Less	= Thar	n Allowable	Total Force @	Sectio	on			
ACI Factored @ Toe	=	2,068 psf	Service Lev	/el	lbs =			
ACI Factored @ Heel	=	805 psf	Strength Le	evel	lbs =	2,451.3	3	
Footing Shear @ Toe	=	26.1 psi Ok	MomentAc	tual	44 11			
Footing Shear @ Heel	=	8.2 psi Oł	Service Le	vei wol	11-# = f+ # _	7 629	7	
Allowable	=	75.0 psi	Strength Le		11-# =	0,020.		
liding Calcs			iviomentAlle	owable	=	8,809.0	J	
Lateral Sliding Force	=	1,877.3 lbs	One day 1		 !			
less 100% Passive Force	e = -	0.0 lbs	Service Lev	vel	psi =		_	
iess 100% Friction Force	e = -	2,853.8 lbs			psi =	33.0	J	
Added Force Req'd	=	0.0 lbs Of	SnearAllow		psi =	75.0	J	
for 1.5 Stability	=	0.0 lbs Of	Rebar Depth	/) 'd'	in2 = in =	6.1	9	
			Masonry Data		noi			

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

Load Eactors	
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

em Construction		Dottom	
		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=		
I hickness	=	8.00	
Rebar Size	=	# 5	
Rebai Spacing	=	11.00	
Rebar Placed at	=	Edge	
fb/FB + fa/Fa	_	0 866	
	-	0.000	
	lho –		
Service Level		0 454 0	
Moment Actual	IDS =	2,451.5	
Sorvice Level	ft # _		
Strongth Lovel	ft # _	7 629 7	
	11-# =	7,020.7	
MomentAllowable	=	8,809.0	
Service Level	psi =		
Strength Level	psi =	33.0	
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 Weig	ght
Masonry Design Method	=	ASD	
Concrete Data			
f'c	nsi =	2 500 0	

psi = 60,000.0

Fy

This Wall in File: C:\Phillips Structural Engineering\DESIGN\RETAINING WALLS\cantilevered wall ~ sla

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered R	etaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area Details			
Bottom Stem Vert As (based on applied moment) : 0.28	tical Reinforcing 889 in2/ft	Horizontal Reinforcing	
(4/3) * As : 0.38	852 in2/ft	Min Stem T&S Reinf Are	ea 1.920 in2
200bd/fv : 200(12)(6.1875)/60000 : 0.24	475 in2/ft	Min Stem T&S Reinf Are	ea per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) : 0.13	344 in2/ft	Horizontal Reinforcing C	Dotions :
===		One laver of : Two l	lavers of :
Required Area : 0.28	889 in2/ft	#4@ 12.50 in #4@	25.00 in
Provided Area 0.33	382 in2/ft	#5@ 19.38 in #5@	2 38.75 in
Maximum Area : 0.83	382 in2/ft	#6@ 27.50 in #6@	≥ 55.00 in
Footing Dimensions & StrengthsToe Width= 2.25 ft Heel Width= 3.75 Total Footing Width= 6.00 Footing Thickness= 12.00 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	Footing Design Factored Pressure Mu' : Upward Mu' : Downward Mu: Design Actual 1-Way Shear Allow 1-Way Shear Toe Reinforcing Heel Reinforcing Key Reinforcing Other Acceptable S Toe: #4@ 9.26 in Heel: Not req'd: M	Toe He 2,068 6 4,834 4,8 4,56 6,8 4,378 1,5 26.08 8 75.00 75 # 5 @ 11.00 in 1000 in None Spec'd None Spec'd Sizes & Spacings 1,435 in, #6@ 2 1u < phi*5*lambda*sqrt(201 305 psf 355 ft-# 307 ft-# 352 ft-# .18 psi .00 psi .00 psi 0.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46 f'c)*Sm
	Key: No key den Min footing T&S r Min footing T&S r If one layer of hor #4@ 9.26 in #5@ 14.35 in #6@ 20.37 in	einf Area 1 einf Area per foot 0 izontal bars: If tw # ##	.56 in2).26 in2 /ft /o layers of horizontal bars: 4@ 18.52 in 5@ 28.70 in 6@ 40.74 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNIN	G			RE	SISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,750.0	3.33	5,833.3	Soil Over Heel	=	3,052.5	4.46	13,609.1
Surcharge over Heel	=	127.3	5.00	636.4	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	123.3	4.46	549.9
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem) =	360.0	2.58	930.0
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	2.58	1,860.0
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Total		1 077 0	- 	6 460 7	Stem Weight(s)	=	1,000.0	2.58	2,583.3
TOLAI		1,077.3	0.1.1	0,409.7	Earth @ Stem Transitions	6=			
	=		=		Footing Weight	=	900.0	3.00	2,700.0
Resisting/Overturning	g Rat	io	=	3.15	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 6,155	.8 lbs	Vert. Component	=			
					Tota	l =	5,435.8	bs R.M.=	20,372.3

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall of	<u>due to settlen</u>	nent of soil	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate only)	0.068	in	
The above calculation is not valid if the heel soil b	pearing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate into th	ne retained soil.		

icense : KW-06061509 icense To : Phillips Stru	id 11. [.] Ictura	16.11.12 Il Engineering	Cantilevered Retain	ning V	Vall	Cod
Criteria			Soil Data			
Retained Height Wall height above soil Slope Behind Wall	= = =	10.00 ft 1.00 ft 0.00	Allow Soil Bearing = Equivalent Fluid Pressure Meth Active Heel Pressure =	1,500.0 iod 35.0	psf psf/ft	
Height of Soil over Toe	=	0.00 in	Passive Pressure =	250.0	psf/ft	
Water height over heel	=	0.0 ft	Soil Density, Heel =	110.00	pcf	
			Soil Density, Toe = Footing Soil Friction =	0.00 0.525	pcf	
			Soil height to ignore for passive pressure =	12.00	in	
Surcharge Loads			Lateral Load Applied to	o Stem		Adjace
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding	g & Ov = & Ove	40.0 psf /erturning 0.0 rturning	Lateral Load = Height to Top = Height to Bottom =	0.0 #/ 0.00 ft 0.00 ft	′ft	Adjacent Footing
Axial Load Applie	d to	Stem	Load Type = W (S	ind (W) ervice Le	evel)	Footing
Axial Dead Load Axial Live Load Axial Load Eccentricity	= = =	360.0 lbs 720.0 lbs 0.0 in	Wind on Exposed Stem ₌ (Service Level)	0.0 ps	sf	at Bac Poisson'
Design Summary			Stem Construction		Bottom	
Wall Stability Ratios			Design Height Above F	tg ft =	0.00)
Overturning	=	3.29 OK	Wall Material Above "H	lt" =	Concrete	•
Siluliy	-	1.62 010	Design Method Thickness	=		
Total Bearing Load	=	7,385 lbs	Rebar Size	=	# 5	
resultant ecc.	=	4.74 in	Rebar Spacing	=	8.00)
Soil Pressure @ Toe	=	1.432 psf OK	Rebar Placed at	=	Edge	•
Soil Pressure @ Heel	=	702 psf OK	fb/FB + fa/Fa	_	0.877	7
Allowable	= Tk -	1,500 psf	Total Force @ Section	<u>-</u>		
Soli Pressure Less	i nar	Allowable 2 005 pef	Service Level	lbs =		
ACI Factored @ Heel	=	2,003 psi 983 psf	Strength Level	lbs =	3,003.6	i
Footing Shear @ Toe	=	24.7 psi OK	MomentActual	£1. 11		
Footing Shear @ Heel	=	8.9 psi OK	Strength Level	IT-# = ft_#	10 251 5	
Allowable	=	75.0 psi	Moment Allowable	-	11 700 2	, ,
Sliding Calcs			MomontAllowable	-	11,700.2	
Lateral Silding Force	=	2,324.3 lbs	Service Level	psi =		
less 100% Friction Force	= -	3,499.0 lbs	Strength Level	psi =	40.5	5
Added Force Rea'd	=	0.0 lbs OK	ShearAllowable	psi =	75.0)
for 1.5 Stability	=	0.0 lbs OK	Anet (Masonry)	in2 =		
-			Rebar Depth 'd'	in =	6.19)
			Masonry Data			
			f'm	nci		
			f'm Es	psi = psi =		

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

Load Eactors	
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

C 2015,ACI 318-14,ACI 530-13

alent Fluid Pressure Metho	d	P.0.				
Heel Pressure =	35.0	psf/ft				
	250 0	nef/ft				
ensity Heel -	250.0	psi/it				
ensity, Teen –	0.00	ncf				
allSoil Friction =	0.00	per				
eight to ignore	0.020					
passive pressure =	12.00	in				
				:		
eral Load Applied to	Stem		Adjacent Footin	ng Loa	d	
alload =	00#	/ft	Adjacent Footing Lo	ad =	0.0 lbs	
ght to Top =	0.00 ft		Footing Width	=	0.00 ft	
ght to Bottom =	0.00 ft		Eccentricity	=	0.00 in	
Type = Win	d (W)		Wall to Ftg CL Dist	=	0.00 ft	
(Sei	rvice Le	evel)	Footing Type	Soil	Line Load	
I on Exposed Stem _	0.0 p	sf	at Back of Wall	=	0.0 ft	
vice Level)			Poisson's Ratio	=	0.300	
em Construction		Stom Ok	,			
Design Height Above Ftg	ft =	0.00)			
Wall Material Above "Ht"	=	Concrete	;			
Design Method	=	LRFD)			
Thickness	=	8.00)			
Rebar Size	=	# 5				
Rebar Spacing	=	0.00 Edaa)			
Design Data	=	Edge)			
fb/FB + fa/Fa	=	0.877	7			
Total Force @ Section						
Service Level	lbs =					
Strength Level	lbs =	3,003.6	;			
MomentActual						
Service Level	ft-# =					
Strength Level	ft-# =	10,351.5	5			
MomentAllowable	=	11,799.2				
Sontion Loval	nc:					
Service Level	psi=	40.5				
Chor Allowable	psi =	40.5				
	psi =	75.0)			
Rebar Depth 'd'	in 2 =	6 10)			
Masonry Data		0.18	,			
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 \	Veight			
Masonry Design Method	=	ASD				
f'c	nsi =	2,500 0)			
Fy	psi =	60,000.0)			

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RetainPro (c) 1987-2016, Build 11.16.1 License : KW-06061509 License To : Phillips Structural E	1.12 ingineering	Cantilevered R	etaining Wa	all Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area	Details			
Bottom Stem As (based on applied moment) :	Vertical 0.392 in2	Reinforcing 2/ft	Horizontal Reinfo	orcing
(4/3) * As : 0.5226 i		n2/ft	Min Stem T&S R	Reinf Area 2.112 in2
200bd/fy : 200(12)(6.1875)/60000	: 0.2475 ir	n2/ft	Min Stem T&S R	Reinf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344 ir	n2/ft	Horizontal Reinfo	orcing Options :
	======		One layer of :	Two layers of :
Required Area :	0.392 in2	2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.465 in2	2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382 ir	n2/ft	#6@ 27.50 in	#6@ 55.00 in
Footing Dimensions & S	trengths	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 psiFyFooting Concrete Density=Min. As %=Cover @ Top2.00@ Bit	2.75 ft 4.17 6.92 14.00 in 0.00 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 Toe Reinforcing Heel Reinforcing Key Reinforcing Other Acceptable S Toe: #4@ 7.94 ir Heel: Not req'd: N Key: No key defi	Toe = 2,005 = 7,070 = 794 = 6,276 = 24.65 = 75.00 = # 5 @ 8.00 = None Spec' = None Spec' = None Spec' Sizes & Spacin n, #5@ 12.30 in, /u < phi*5*lambc	Heel 983 psf 7,090 ft-# 9,782 ft-# 2,692 ft-# 8.95 psi 75.00 psi in 'd 'd mgs #6@ 17.46 in, #7@ 23.81 in, #8@ 31.35 in, #9@ 39 da*sqrt(f'c)*Sm
		Min footing T&S r Min footing T&S r If one layer of hor #4@ 7.94 in #5@ 12.30 in #6@ 17.46 in	einf Area einf Area per foo izontal bars:	2.09 in2 ot 0.30 in2 /ft If two layers of horizontal bars: #4@ 15.87 in #5@ 24.60 in #6@ 34.92 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	J			RES	ISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,182.2	3.72	8,122.5	Soil Over Heel	=	3,853.7	5.17	19,917.0
Surcharge over Heel	=	142.1	5.58	793.5	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	140.1	5.17	724.3
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Sterr	ו =	360.0	3.08	1,110.0
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	3.08	2,220.0
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tetal		0 004 0	- 	9.016.0	Stem Weight(s)	=	1,100.0	3.08	3,391.7
Total		2,324.3	0.1.M.	8,916.0	Earth @ Stem Transitions	s =			
	=		=		Footing Weight	=	1,211.0	3.46	4,190.1
Resisting/Overturning	g Rat	io	=	3.29	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 7,384	.8 lbs	Vert. Component	=			
					Tota	l =	6,664.8 lbs	R.M.=	29,333.0

* 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.

RetainPro (c) 1987-2016, Build 11.16.11.12 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13				
Tilt							
Horizontal Deflection at Top of Wal	I due to settlen	nent of soil					
(Deflection due to wall bending not considered))						
Soil Spring Reaction Modulus	250.0	рсі					
Horizontal Defl @ Top of Wall (approximate on	ly) 0.063	in					
The above calculation is not valid if the heel so	il bearing pressure e	exceeds that of the toe.					
because the wall would then tend to rotate into	the retained soil.						

icense : KW-06061509 icense : KW-06061509 icense To : Phillips Stru	ic 11.17.04.04	Cantilevered Retain	ng W	/all	Code: IBC 2015,ACI 318-14,ACI 530-13		
Criteria		Soil Data					
Retained Height Wall height above soil Slope Behind Wall	= 5.00 ft = 1.00 ft = 0.00	Allow Soil Bearing = 1 Equivalent Fluid Pressure Metho Active Heel Pressure = =	,500.0 d 35.0	psf psf/ft		-	
Height of Soil over Toe Water height over heel	= 0.00 in = 0.0 ft	Passive Pressure=Soil Density, Heel=Soil Density, Toe=Footing Soil Friction=	250.0 110.00 0.00 0.525	psf/ft pcf pcf			
		Soil height to ignore for passive pressure =	12.00	in			
Surcharge Loads		Lateral Load Applied to	Stem		Adjacent Footing L	oad	
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding &	= 40.0 psf g & Overturning = 40.0 & Overturning	Lateral Load = Height to Top = Height to Bottom = Load Type = Win	0.0 #/f 0.00 ft 0.00 ft d (W)	ft 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	
Axial Dead Load Axial Live Load Axial Load Eccentricity	= 360.0 lbs = 720.0 lbs = 0.0 in	(Ser Wind on Exposed Stem ₌ (Service Level)	0.0 ps	sf	Base Above/Below Soil at Back of Wall Poisson's Ratio	= 0.0 ft = 0.300	
Design Summary		Stem Construction		Bottom			
Wall Stability Ratios Overturning Slab Resist	= 2.09 OK s All Sliding !	Design Height Above Ftg Wall Material Above "Ht" Design Method	ft = = =	Stem OK 0.00 Concrete LRFD			
Total Bearing Loadresultant ecc.	= 2,490 lbs = 2.48 in	Thickness Rebar Size Rebar Spacing	= = =	8.00 # 4 16.00			
Soil Pressure @ Toe Soil Pressure @ Heel Allowable	= 1,373 psf C = 499 psf C = 1,500 psf	K Design Data K fb/FB + fa/Fa	=	Edge 0.347			
Soil Pressure Less ACI Factored @ Toe ACI Factored @ Heel	Than Allowable = 1,923 psf = 699 psf	Service Level	lbs = lbs =	801.8			
Footing Shear @ Toe Footing Shear @ Heel Allowable	= 12.0 psi O = 0.2 psi O = 75.0 psi	K Service Level K Strength Level	ft-# = ft-# =	1,421.2			
Sliding Calcs Lateral Sliding Force	= 687.9 lbs	MomentAllowable Service Level	= psi =	4,099.3			
		Strength Level ShearAllowable	psi = psi =	10.7 75.0			
		Rebar Depth 'd' Masonry Data	in2 = in =	6.25			
		f'm Fs Solid Grouting	psi = psi = =				
/ertical component of acti NOT considered in the cal	ve lateral soil pressur culation of soil bearin	e IS Modular Ratio 'n' 9 Wall Weight Short Torm Easter	= psf =	100.0			
Load Factors Building Code Dead Load Live Load	IBC 2015,ACI 1.200 1.600	Snort Ferm Factor Equiv. Solid Thick. Masonry Block Type Masonry Design Method	= = =	Medium V ASD	/eight		

f'c

Fy

1.000

1.000

Wind, W

Seismic, E

psi =

2,500.0

psi = 60,000.0

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RetainPro (c) 1987-2017, Build 11.17.04.04 License : KW-06061509 License To : Phillips Structural Engin	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area De	tails		
Bottom Stem As (based on applied moment) :	Vertical Reinforcing 0.0532 in2/ft	Horizontal Reinforcing	
(4/3) * As :	0.071 in2/ft	Min Stem T&S Reinf Area	a 1.152 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area	a per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344 in2/ft	Horizontal Reinforcing Op	ptions :
	===========	One layer of : Two lay	yers of :
Required Area :	0.1344 in2/ft	#4@ 12.50 in #4@ 2	25.00 in
Provided Area :	0.15 in2/ft	#5@ 19.38 in #5@ 3	38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in #6@ \$	55.00 in
Footing Dimensions & Stren	gths Footing D	esign Results	
Toe Width=1Heel Width=1Total Footing Width=2Footing Thickness=11Key Width=0Key Depth=0Key Distance from Toe=0f'c =2,500 psiFy =60,0Footing Concrete Density=150Min. As %=0.00Cover @ Top2.00@ Btm.=	.33 ft.33.66.00 in.00 ft.00 psi.00 pcf.00 in.00 in.00 psi.00 pcf.00 in.00 pcf.00 pcf.00 in.00 pcf.00	Toe Hee ure 1,923 69 = 1,520 17 = 203 19 = 1,318 2 hear = 12.00 0.2 lear = 75.00 75.0 = None Spec'd 9 None Spec'd g = None Spec'd 9 ble Sizes & Spacings 1/2 (d: Mu < phi*5*lambda*sqrt(f'c)	J 9 psf 6 ft-# 6 ft-# 0 ft-# 5 psi 0 psi *Sm >)*Sm
	Min footing T Min footing T If one layer of #4@ 10.10 #5@ 15.66 #6@ 22.22	&S reinf Area 0.6 &S reinf Area per foot 0.2 f horizontal bars: If two in #40 in #50 in #50 in #60	i3 in2 24 in2 /ft layers of horizontal bars: @ 20.20 in @ 31.31 in @ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)			RESISTING	
Item		Force lbs	Distance ft	ft-#		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	612.6	1.97	1,208.2	Soil Over Heel =	364.8	2.33	849.5
Surcharge over Heel	=	75.3	2.96	222.8	Sloped Soil Over Heel =			
Surcharge Over Toe	=				Surcharge Over Heel =	26.5	2.33	61.8
Adjacent Footing Load	=				Adjacent Footing Load =			
Added Lateral Load	=				Axial Dead Load on Stem =	360.0	1.66	598.8
Load @ Stem Above So	il =				* Axial Live Load on Stem =	720.0	1.66	1,197.6
	=				Soil Over Toe =			
					Surcharge Over Toe =			
Tetal		607.0	- отм —	1 424 0	Stem Weight(s) =	600.0	1.66	998.0
Total		007.9	0.1.1	1,431.0	Earth @ Stem Transitions =			
	=		=		Footing Weight =	365.8	1.33	486.4
Resisting/Overturning	g Rat	io	=	2.09	Key Weight =			
Vertical Loads used f	or So	il Pressure	= 2,490.	3 lbs	Vert. Component =			
					Total =	1,717.1	 lbs R.M.=	2,994.5

* 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.

RetainPro (c) 1987-2017, Build 11.17.04.04 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-1				
Tilt							
Horizontal Deflection at Top of Wall	l due to settlen	nent of soil					
(Deflection due to wall bending not considered)							
Soil Spring Reaction Modulus	250.0	рсі					
Horizontal Defl @ Top of Wall (approximate onl	y) 0.086	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	the retained soil.						

Building Code

Dead Load

Live Load

Earth, H

Wind, W

Seismic, E

IBC 2015,ACI

1.200

1.600

1.600

1.000

1.000

tetainPro (c) 1987-2017,Bu license : KW-06061509 license To : Phillips Stru	ild 11. uctur	.17.04.04 al Engineering	Cantilevered Reta	ining W	Vall	Code: IBC 2015,ACI 318-14,ACI 530-1		
Criteria			Soil Data					
Retained Height Wall height above soil Slope Behind Wall	= = =	6.00 ft 1.00 ft 0.00	Allow Soil Bearing = Equivalent Fluid Pressure Met Active Heel Pressure =	1,500.0 thod 35.0	psf psf/ft		-	
Height of Soil over Toe	=	0.00 in	Passive Pressure =	250.0	psf/ft			
Water height over heel	=	0.0 ft	Soil Density, Heel =	110.00	pcf			
			Soil Density, Toe =	0.00	pcf			
			Footing Soil Friction =	0.525				
			Soil height to ignore for passive pressure =	12.00	in			
							•	
Surcharge Loads			Lateral Load Applied	to Stem		Adjacent Footing	Load	
Surcharge Over Heel	=	40.0 psf	Lateral Load =	0.0 #/	ft	Adjacent Footing Load	= 0.0	bs
Used To Resist Sliding	g & O	verturning	Height to Top =	0.00 ft		Footing Width	= 0.00	ft
NOT Used for Sliding	= & ೧۷/	0.0 erturning	Height to Bottom =	0.00 ft		Eccentricity	= 0.00	in G
			Load Type = V	Vind (W)		Wall to Ftg CL Dist		n
Axial Load Applie	d to	Stem	(3	Service Le	evel)	Base Above/Below Soil	LINE LUA	u
Axial Dead Load	=	360.0 lbs	Wind on Exposed Stem _	0.0 ps	sf	at Back of Wall	= 0.0	ft
Axial Live Load Axial Load Eccentricity	= =	720.0 lbs 0.0 in	(Service Level)			Poisson's Ratio	= 0.300	
Design Summary			Stem Construction		Bottom	,		
Nall Stability Ratios	_		Design Height Above	Ftg ft =	0.00)		
Slob Posici	- to All	1.96 OK	Wall Material Above "	Ht" =	Concrete	9		
Clab Resist		Olding :	Thickness	=	8.00)		
Total Bearing Load	=	2.743 lbs	Rebar Size	=	# 4			
resultant ecc.	=	3.11 in	Rebar Spacing	=	16.00)		
		1 000 mat OK	Rebar Placed at	=	Edge	9		
Soil Pressure @ 10e	=	1,290 psr OK 441 nsf OK	Design Data					
	_	1.500 pef	fb/FB + fa/Fa	=	0.58	1		
Soil Pressure Less	s Tha	n Allowable	Total Force @ Section	on "				
ACI Factored @ Toe	=	1,805 psf	Service Level	lbs =				
ACI Factored @ Heel	=	618 psf	Strength Level	IDS =	1,130.2	2		
Footing Shear @ Toe	=	17.9 psi OK	Service Level	ft_# _				
Footing Shear @ Heel	=	1.9 psi OK	Strength Level	ft-# =	2 382 4	5		
Allowable	=	75.0 psi	Moment Allowable	n <i>#</i> –	4,000 3)		
iliding Calcs			MomentAllowable	=	4,099.3)		
Lateral Sliding Force	=	925.2 lbs	Carries Laval					
			Service Level	psi=				
				psi =	15.1			
			SnearAllowable	psi =	75.0)		
			Anet (Masonry)	in2 =	0.01			
			Rebar Depth d	In =	6.25)		
			f'm	nci –				
			Fs	psi=				
			Solid Groutina	= 104				
ertical component of act	ive la	teral soil pressure I	S Modular Ratio 'n'	=				
IOT considered in the ca	Iculat	tion of soil bearing	Wall Weight	psf =	100.0)		
			Short Term Factor					

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= = Medium Weight

2,500.0

= ASD

psi = 60,000.0

psi =

Equiv. Solid Thick.

Concrete Data

f'c

Fy

Masonry Block Type

Masonry Design Method

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RetainPro (c) 1987-2017, Build License : KW-06061509 License To : Phillips Struc	t 11.17.04.04 tural Engineer	Cantilevered R	etaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebai	r Area Detai	ls		
Bottom Stem As (based on applied mom	ent):	Vertical Reinforcing 0.0893 in2/ft	Horizontal Reinforci	ng
(4/3) * As :	,	0.119 in2/ft	Min Stem T&S Reir	f Area 1.344 in2
200bd/fy : 200(12)(6.25)/60	0000 :	0.25 in2/ft	Min Stem T&S Reir	f Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :		0.1344 in2/ft	Horizontal Reinforci	ng Options :
		===========	One layer of : T	wo layers of :
Required Area :		0.1344 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :		0.15 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 Dimension Toe Width Heel Width Total Footing Width Footing Thickness Key Width Key Depth Key Distance from Toe f'c = 2,500 psi F Footing Concrete Density Min. As % Cover @ Top 2.00	$\begin{array}{r} s & & Strengt \\ = & 1.75 \\ = & 1.42 \\ = & 3.17 \\ = & 11.00 \\ = & 0.00 \\ = & 0.00 \\ = & 0.00 \\ = & 0.00 \\ = & 0.001 \\ = & 0.0018 \\ @ Btm.= 3.0 \end{array}$	hs Footing Desi ft Factored Pressure Mu': Upward Mu': Downward Mu: Design Actual 1-Way Shear ft Toe Reinforcing psi Heel Reinforcing pcf Key Reinforcing 00 in Other Acceptable Toe: #4@ 10.10 Heel: Not req'd: I	gn Results <u>Toe</u> = 1,805 = 2,430 = 253 = 2,177 r = 17.87 = 75.00 = #4 @ 10.10 ir = None Spec'd = None Spec'd Sizes & Spacings 0 in, #5@ 15.66 in, # Mu < phi*5*lambda*:	Heel 618 psf 202 ft-# 290 ft-# 88 ft-# 1.94 psi 75.00 psi 6@ 22.22 in, #7@ 30.30 in, #8@ 39.90 in, #9@ 5 sqrt(f'c)*Sm
		Min footing T&S Min footing T&S If one layer of hou #4@ 10.10 in #5@ 15.66 in #6@ 22.22 in	reinf Area reinf Area per foot rizontal bars:	0.75 in2 0.24 in2 /ft If two layers of horizontal bars: #4@ 20.20 in #5@ 31.31 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	.			R	ESISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	837.2	2.31	1,930.2	Soil Over Heel	=	497.2	2.79	1,388.8
Surcharge over Heel	=	88.0	3.46	304.4	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	30.1	2.79	84.2
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	ן =	360.0	2.08	750.0
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	2.08	1,500.0
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tatal		005.0	- o t M -	0.004.7	Stem Weight(s)	=	700.0	2.08	1,458.3
Total		925.2	О.Т.М.	2,234.7	Earth @ Stem Transitions	s =			
	=		=		Footing Weight	=	435.9	1.59	690.9
Resisting/Overturning	g Rat	io	=	1.96	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 2,743.	2 lbs	Vert. Component	=			
					Tota	l =	2,023.2	lbs R.M.=	4,372.2

* 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.

RetainPro (c) 1987-2017, Build 11.17.04.04 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13				
Tilt							
Horizontal Deflection at Top of Wall	due to settlen	nent of soil					
(Deflection due to wall bending not considered)							
Soil Spring Reaction Modulus	250.0	pci					
Horizontal Defl @ Top of Wall (approximate only	/) 0.079	in					
The above calculation is not valid if the heel soil	bearing pressure e	exceeds that of the toe.					
because the wall would then tend to rotate into t	he retained soil.						

RetainPro (c) 1987-2017. Bui	s Struct	ural Enginee .04.04	ering\D		ntilever	red wall ~ s	la		
License : KW-06061509 License To : Phillips Stru	uctural	Engineering	g	Cantilevered Retain	ing V	Code: IBC 2015,ACI 318-14,ACI 530-13			
Criteria				Soil Data					
Retained Height Wall height above soil Slope Behind Wall Height of Soil over Toe Water height over heel	= = =	7.00 ft 1.00 ft 0.00 0.00 in 0.0 ft		Allow Soil Bearing = Equivalent Fluid Pressure Metho Active Heel Pressure = Passive Pressure = Soil Density, Heel = Soil Density, Toe = Footing Soil Friction = Soil height to ignore	1,500.0 d 35.0 250.0 110.00 0.525) psf) psf/ft) psf/ft) pcf) pcf			
				tor passive pressure =	12.00	111	1		
Surcharge Loads				Lateral Load Applied to	Stem		Adjacent Footing	Load	
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding & Axial Load Applie	g & Ove = & Overtu d to S	40.0 psf rturning 40.0 urning tem		Lateral Load = Height to Top = Height to Bottom = Load Type = Wir (Se	0.0 #, 0.00 ft 0.00 ft nd (W) rvice Le	/ft evel)	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	_
Axial Dead Load Axial Live Load Axial Load Eccentricity	= -	360.0 lbs 720.0 lbs 0.0 in		Wind on Exposed Stem _ (Service Level)	0.0 p	sf	at Back of Wall Poisson's Ratio	= 0.0 ft = 0.300	
Design Summary			Ì	Stem Construction		Bottom			
Wall Stability Ratios Overturning Slab Resist	= ts All Sli	1.68 OK ding !	(Design Height Above Ftg Wall Material Above "Ht" Design Method Thickness	g ft = ' = =	Concrete LRFD 8.00			
Total Bearing Loadresultant ecc.	= =	3,055 lbs 4.98 in		Rebar Size Rebar Spacing	=	# 4 12.00			
Soil Pressure @ Toe Soil Pressure @ Heel	= =	1,493 psf 252 psf	OK OK	Rebar Placed at Design Data fb/FB + fa/Fa	=	Edge 0.684			
Soil Pressure Less	= Than A	Allowable		Total Force @ Section Service Level	lbs =				
ACI Factored @ Toe ACI Factored @ Heel	=	2,091 psf 353 psf		Strength Level	lbs =	1,514.5			
Footing Shear @ Toe Footing Shear @ Heel	=	24.3 psi 4.5 psi	OK OK	Service Level	ft-# = ft-# -	3 700 2			
Allowable Sliding Calcs	=	75.0 psi		MomentAllowable	=	5,412.6			
Lateral Sliding Force	= .	1,197.5 lbs		Service Level Strength Level ShearAllowable Anet (Masonry) Rebar Depth 'd'	psi = psi = psi = in2 = in =	20.2 75.0 6.25			
Vertical component of acti NOT considered in the cal	ive later lculatior	al soil press of soil bear	ure IS	Masonry Data f'm Fs Solid Grouting Modular Ratio 'n' Wall Weight	psi = psi = = psf =	100.0			
Load Factors	100			Short Term Factor	=				
Dead Load Live Load	IRC	1.200 1.600		Masonry Block Type Masonry Design Method	=	Medium V ASD	Veight		
Earui, E Wind, W		1.000		f'c	psi =	2,500.0			

psi = 60,000.0

Fy

1.000

Seismic, E

RetainPro (c) 1987-2017, Build 11.17. License : KW-06061509 License To : Phillips Structural	.04.04 Engineering	Cantilevered R	etaining Wa	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area	a Details			
Bottom Stem As (based on applied moment) :	Vertical 0.1386	Reinforcing in2/ft	Horizontal Reinfo	rcing
(4/3) * As :	0.1848	in2/ft	Min Stem T&S Re	einf Area 1.536 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2	2/ft	Min Stem T&S Re	einf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344	in2/ft	Horizontal Reinfo	rcing Options :
	=====		One layer of :	Two layers of :
Required Area :	0.1848	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 Dimensions & S	Strengths	Footing Desi	gn Results	
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@ E	2.08 ft 1.42 3.50 11.00 in 0.00 in 0.00 ft 60,000 psi 150.00 pcf 0.0018 8tm.= 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 Other Acceptable Toe: #4@ 10.10 Heel: Not req'd: N Key: No key def	Toe = 2,091 = 3,778 = 495 = 3,283 7 = 24.26 = 75.00 = # 4 @ 10.10 = None Spector = None Spector Sizes & Spacing in, #5@ 15.66 in, /u < phi*5*lambda	Heel 353 psf 136 ft-# 327 ft-# 192 ft-# 4.53 psi 75.00 psi 0 in d gs #6@ 22.22 in, #7@ 30.30 in, #8@ 39.90 in, #9@ 5 a*sqrt(f'c)*Sm
		Min footing T&S r Min footing T&S r If one layer of hor #4@ 10.10 in #5@ 15.66 in #6@ 22.22 in	reinf Area einf Area per foot izontal bars:	0.83 in2 0.24 in2 /ft If two layers of horizontal bars: #4@ 20.20 in #5@ 31.31 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING.				RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,096.8	2.64	2,894.3	Soil Over Heel	=	580.1	3.12	1,811.7
Surcharge over Heel	=	100.8	3.96	398.8	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	30.1	3.12	94.1
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stern	n =	360.0	2.41	868.8
Load @ Stem Above So.	vil =				* Axial Live Load on Stem	=	720.0	2.41	1,737.6
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Total		1,197 5	о.т.м. —	3,293,1	Stem Weight(s)	=	800.0	2.41	1,930.7
i otai		1,107.0	0.1.00.	0,200.1	Earth @ Stem Transition	1S =			
	=		=		Footing Weight	=	481.3	1.75	842.2
Resisting/Overturning	g Rat	'io	=	1.68	Key Weight	=			
Vertical Loads used for	for So	il Pressure -	= 3,054.7	7 lbs	Vert. Component	_			
					Tota	<u>)</u> =	2 251 5 1	S RM =	5 547 5

* 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.

RetainPro (c) 1987-2017, Build 11.17.04.04 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall	due to settlen	nent of soil	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate only	y) 0.095	in	
The above calculation is not valid if the heel soil	bearing pressure	exceeds that of the toe.	
because the wall would then tend to rotate into t	the retained soil.		

Wind, W

Seismic, E

1.000

1.000

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RetainPro (c) 1987-2017, Bu License : KW-06061509 License To : Phillips Stru	ild 11.17.04.04 uctural Engineering	Cantilevered Retain	ing W	/all	Code: IBC 2015,A	CI 318-14,ACI 530-13
Criteria		Soil Data				
Retained Height Wall height above soil Slope Behind Wall Height of Soil over Toe Water height over heel	= 8.00 ft = 1.00 ft = 0.00 = 0.00 in = 0.0 ft	Allow Soil Bearing = Equivalent Fluid Pressure Method Active Heel Pressure = Passive Pressure = Soil Density, Heel = Soil Density, Toe = Footing Soil Friction = Soil height to ignore for passive pressure =	1,500.0 od 250.0 110.00 0.00 0.525 12.00	psf psf/ft psf/ft pcf pcf		
					_	
Surcharge Loads		Lateral Load Applied to	Stem		Adjacent Footing L	oad
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding Axial Load Applie Axial Dead Load Axial Live Load Axial Load Eccentricity	= 40.0 psf g & Overturning = 40.0 & Overturning ed to Stem = 360.0 lbs = 720.0 lbs = 0.0 in	Lateral Load = Height to Top = Height to Bottom = Load Type = Wir (Se Wind on Exposed Stem = (Service Level)	0.0 #/: 0.00 ft 0.00 ft nd (W) rvice Le 0.0 ps	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	= 0.0 lbs = 0.00 ft = 0.00 in = 0.00 ft Line Load = 0.0 ft = 0.300
Design Summary		Stem Construction		Bottom		
Well Stehility Detice				Stem OK		
Overturning Slab Resis Total Bearing Load resultant ecc.	= 1.59 OK ts All Sliding ! = 3,390 lbs = 6.36 in	Wall Material Above "Ht Design Method Thickness Rebar Size Rebar Spacing	y n= = = = =	Concrete LRFD 8.00 # 4 9.00		
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less	= 1,476 psf OK = 184 psf OK = 1,500 psf 5 Than Allowable	Rebar Placed at Design Data fb/FB + fa/Fa Total Force @ Section	=	Edge 0.762		
ACI Factored @ Toe ACI Factored @ Heel Footing Shear @ Toe Footing Shear @ Heel	= 2,066 psf = 258 psf = 26.7 psi OK = 5.8 psi OK	Service Level Strength Level MomentActual Service Level	lbs = lbs = ft-# =	1,954.9		
Allowable	= 75.0 psi	Strength Level MomentAllowable	ft-# = =	5,430.3 7,122.4		
Lateral Sliding Force	= 1,532.0 lbs	Service Level Strength Level ShearAllowable Anet (Masonry) Rebar Depth 'd'	psi = psi = psi = in2 = in =	26.1 75.0 6.25		
Vertical component of act NOT considered in the ca Load Factors Building Code Dead Load	ive lateral soil pressure lculation of soil bearing IBC 2015,ACI 1.200	Masonry Data f'm Fs Solid Grouting Modular Ratio 'n' Wall Weight Short Term Factor Equiv. Solid Thick. Masonry Block Type	psi = psi = = psf = = =	100.0 Medium V	√eight	
Live Load Earth, H Wind W	1.600 1.600 1.000	f'c	psi =	2,500.0		

Fy

psi = 60,000.0

RetainPro (c) 1987-2017, Build 11.17 License : KW-06061509 License To : Phillips Structural	.04.04 Engineering	Cantilevered R	etaining Wal	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Are	a Details			
Bottom Stem	Vertical F	Reinforcing	Horizontal Reinford	sing
As (based on applied moment) :	0.2035 ir	2/ft		0
(4/3) * As :	0.2713 ir	12/ft	Min Stem T&S Rei	nf Area 1.728 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/	ft	Min Stem T&S Rei	nf Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344 ir	12/ft	Horizontal Reinford	sing Options :
	======		One layer of :	Two layers of :
Required Area :	0.25 in2/	ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2667 ir	12/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 ir	12/ft	#6@ 27.50 in	#6@ 55.00 in
Footing Dimensions &	Strengths	Footing Desi	gn Results	
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@ I	2.67 ft 1.42 4.08 12.00 in 0.00 in 0.00 ft 60,000 psi 150.00 pcf 0.0018 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 Other Acceptable Toe: #4@ 9.26 i Heel: Not req'd: I Key: No key def	Toe = 2,066 = 5,948 = 868 = 5,080 r = 26.66 = 75.00 = # 4 @ 9.00 in = None Spec'd = None Spec'd Sizes & Spacing: n, #5@ 14.35 in, #4 Mu < phi*5*lambdat	Heel 258 psf 104 ft-# 366 ft-# 262 ft-# 5.77 psi 75.00 psi S 6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46 'sqrt(f'c)*Sm
		Min footing T&S Min footing T&S If one layer of hou #4@ 9.26 in #5@ 14.35 in #6@ 20.37 in	reinf Area reinf Area per foot rizontal bars:	1.06 in2 0.26 in2 /ft If two layers of horizontal bars: #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in

Summary of Overturning & Resisting Forces & Moments

		0V	ERTURNING)			R	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,417.5	3.00	4,252.5	Soil Over Heel	=	660.3	3.71	2,448.9
Surcharge over Heel	=	114.5	4.50	515.5	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	30.0	3.71	111.3
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ste	m =	360.0	3.00	1,080.1
Load @ Stem Above Sc	oil =				* Axial Live Load on Stem	ן =	720.0	3.00	2,160.2
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Total		1 522 0	- 	4 769 0	Stem Weight(s)	=	900.0	3.00	2,700.3
Total		1,552.0	0.1.Ivi.	4,766.0	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	612.6	2.04	1,250.9
Resisting/Overturnin	g Rat	tio	=	1.59	Key Weight	=			
Vertical Loads used f	for So	il Pressure	= 3,389.	6 lbs	Vert. Component	=			
					Tot	al =	2.562.9	lbs R.M.=	7.591.6

* 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.

RetainPro (c) 1987-2017, Build 11.17.04.04 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	l Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wa	all due to settlen	nent of soil	
(Deflection due to wall bending not considered	d)		
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate o	only) 0.090	in	
The above calculation is not valid if the heel se	oil bearing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate inte	o the retained soil.		

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RetainPro (c) 1987-2017, Bui License : KW-06061509 License To : Phillips Stru	ild 11.17.04.04 uctural Engineering	Cantilevered Retain	ing W	all	Code: IBC 2015,A	CI 318-14,ACI 530-13
Criteria		Soil Data				
Retained Height Wall height above soil Slope Behind Wall Height of Soil over Toe Water height over heel	= 9.00 ft = 1.00 ft = 0.00 = 0.00 in = 0.0 ft	Allow Soil Bearing = Equivalent Fluid Pressure Method Active Heel Pressure = Passive Pressure = Soil Density, Heel = Soil Density, Toe = Footing Soil Friction = Soil height to ignore for passive pressure	1,500.0 d 35.0 250.0 110.00 0.00 0.525 12.00	psf psf/ft psf/ft pcf pcf in		
			0			
Surcharge Loads		Lateral Load Applied to	Stem	Adj	acent Footing L	oad
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding & Axial Load Applie Axial Dead Load Axial Live Load Axial Load Eccentricity	= 40.0 psf g & Overturning = 40.0 & Overturning d to Stem = 360.0 lbs = 720.0 lbs = 0.0 in	Lateral Load = Height to Top = Height to Bottom = Load Type = Wir (Se Wind on Exposed Stem (Service Level)	0.0 #/f 0.00 ft 0.00 ft id (W) rvice Le 0.0 ps	t Adja Foot Ecce Wall vel) Foot Bass f at Pois	cent Footing Load ing Width entricity to Ftg CL Dist ing Type e Above/Below Soil Back of Wall son's Ratio	= 0.0 lbs = 0.00 ft = 0.00 in = 0.00 ft Line Load = 0.0 ft = 0.300
Design Summary		Stem Construction		Bottom		
Wall Stability Ratios		Design Height Above Etc	1 ft_	Stem OK		
Overturning Slab Resist	= 1.59 OK ts All Sliding !	Wall Material Above "Ht Design Method Thickness	= = =	Concrete LRFD 8.00		
Total Bearing Loadresultant ecc.	= 3,781 lbs = 7.53 in	Rebar Size Rebar Spacing	= =	# 5 11.00		
Soil Pressure @ Toe Soil Pressure @ Heel	= 1,427 psf O = 165 psf O 1 500 psf	K Design Data K fb/FB + fa/Fa	=	Edge 0.866		
Soil Pressure Less	Than Allowable	Total Force @ Section Service Level	lbs =			
ACI Factored @ Heel	= 1,990 psi = 231 psf	Strength Level MomentActual	lbs =	2,451.3		
Footing Shear @ Heel	= 31.9 psi O = 7.6 psi O	K Service Level	ft-# = ft-# =	7 628 7		
Allowable	= 75.0 psi	MomentAllowable	=	8,809.0		
Lateral Sliding Force	= 1,877.3 lbs	Service Level Strength Level ShearAllowable Anet (Masonry) Rebar Depth 'd' Masonry Data	psi = psi = psi = in2 = in =	33.0 75.0 6.19		
Vertical component of acti NOT considered in the cal	ive lateral soil pressur lculation of soil bearin	f'm Fs Solid Grouting e IS Modular Ratio 'n' Wall Weight	psi = psi = = psf =	100.0		
Load Factors Building Code	IBC 2015,ACI	Short Term Factor Equiv. Solid Thick.	=		-4	
Dead Load Live Load Farth H	1.200 1.600	Masonry Block Type Masonry Design Method	=	iviedium Weigl ASD	าเ	
Wind, W	1.000	f'c	psi =	2,500.0		

psi = 60,000.0

Fy

1.000

Seismic, E

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RetainPro (c) 1987-2017, Build 11.17.04.04 License : KW-06061509 License To : Phillips Structural Engine	Cantilevere	d Retaining 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 0.2889 in2/ft	Horizontal Reinforcing	
(4/3) * As :	0.3852 in2/ft	Min Stem T&S Reinf Are	a 1.920 in2
200bd/fv : 200(12)(6.1875)/60000 :	0.2475 in2/ft	Min Stem T&S Reinf Are	a per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) :	0.1344 in2/ft	Horizontal Reinforcing O	ptions :
		One laver of : Two la	avers of :
Required Area :	0.2889 in2/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 Dimensions & StrengToe Width=3.Heel Width=1.Total Footing Width=4.Footing Thickness=12.Key Width=0.Key Depth=0.Key Distance from Toe=0.f'c =2,500 psi<	gthsFooting I25 ft5075Factored Press75Mu' : Upward00 inMu' : Downward00 inActual 1-Way S00 inActual 1-Way S00 inAllow 1-Way S00 ftToe Reinforcing00 psiHeel Reinforcing18Other Accepta3.00 inToe: #4@ S400 inHeel Reinforcing	Design Results Toe He sure = 1,998 23 = 8,423 11 d = 1,289 44 = 7,134 34 Shear = 31.92 7.1 hear = 75.00 75.1 g = $# 5 @ 11.00 inng = None Spec'dg = None Spec'dable Sizes & Spacings9.26 in, \# 5 @ 14.35 \text{ in}, \# 6 @ 200 g'dt Mu < phi 55*lambda*sqrt(f)$	el 31 psf 16 ft-# 97 ft-# 81 ft-# 65 psi 00 psi 0.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46
	Key: No ke Min footing ⁻ Min footing ⁻ If one layer o #4@ 9.26 #5@ 14.3 #6@ 20.3	y defined T&S reinf Area 1. T&S reinf Area per foot 0. of horizontal bars: If two S in #4 5 in #5 7 in #6	23 in2 26 in2 /ft o layers of horizontal bars: 1@ 18.52 in 5@ 28.70 in 3@ 40.74 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	.			R	ESISTING	
Item		Force lbs	Distance ft	ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,750.0	3.33	5,833.3	Soil Over Heel	=	825.0	4.33	3,575.0
Surcharge over Heel	=	127.3	5.00	636.4	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	33.3	4.33	144.4
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	3.58	1,290.0
Load @ Stem Above So	il =				* Axial Live Load on Stem	ו =	720.0	3.58	2,580.0
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tetal		1 077 0		6 460 7	Stem Weight(s)	=	1,000.0	3.58	3,583.3
Total		1,077.3	0.1.1	0,409.7	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	712.5	2.38	1,692.2
Resisting/Overturning	g Rat	io	=	1.59	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 3,780.	8 lbs	Vert. Component	=			
					Tot	al =	2,930.8	lbs R.M.=	10,285.0

* 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.

RetainPro (c) 1987-2017, Build 11.17.04.04 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered	d Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Tilt			
Horizontal Deflection at Top of Wall	due to settlen	nent of soil	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	pci	
Horizontal Defl @ Top of Wall (approximate only	/) 0.083	in	
The above calculation is not valid if the heel soil	bearing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate into t	he retained soil.		

RetainPro (c) 1987-2017, Build 11.17.04.04 License : KW-06061509 License To : Phillips Structural Engineering		Cantilevered Retain	ing V	red wall ~ s Vall	Code: IBC 2015,4	ACI 318-14,ACI 530-13
Criteria		Soil Data				
Retained Height Wall height above soil Slope Behind Wall Height of Soil over Toe Water height over heel	= 10.00 ft = 1.00 ft = 0.00 = 0.00 in = 0.0 ft	Allow Soil Bearing = Equivalent Fluid Pressure Method Active Heel Pressure = Passive Pressure = Soil Density, Heel = Soil Density, Toe = Footing Soil Friction = Soil height to ignore for passive pressure =	1,500.0 xd 250.0 110.00 0.00 0.525 12.00) psf) psf/ft) psf/ft) pcf) pcf j in	Þy	
Surcharge Loads		Lateral Load Applied to	Stem		Adjacent Footing	Load
Surcharge Over Heel Used To Resist Sliding Surcharge Over Toe NOT Used for Sliding & Axial Load Applie Axial Dead Load	= 40.0 psf & Overturning = 40.0 & Overturning d to Stem = 360.0 lbs	Lateral Load = Height to Top = Height to Bottom = Load Type = Wir (Se Wind on Exposed Stem _	0.0 #, 0.00 ft 0.00 ft nd (W) ervice Lo 0.0 p	/ft evel) sf	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 = 0.0 ft
Axial Live Load Axial Load Eccentricity	= 720.0 lbs = 0.0 in	(Service Level)	010 p		Poisson's Ratio	= 0.300
Design Summary		Stem Construction		Bottom		
Wall Stability Ratios Overturning Slab Resist	= 1.72 OK s All Sliding !	Design Height Above Ft Wall Material Above "Ht Design Method Thickness] ft = " = =	Concrete LRFD		
Total Bearing Load resultant ecc.	= 4,481 lbs = 8.20 in	Rebar Size Rebar Spacing	=	# 5 8.00		
Soil Pressure @ Toe Soil Pressure @ Heel Allowable	= 1,422 psf OK = 207 psf OK = 1,500 psf	fb/FB + fa/Fa	=	0.877		
ACI Factored @ Toe ACI Factored @ Heel	= 1,991 psf = 290 psf	Service Level Strength Level Moment Actual	lbs = lbs =	3,003.6		
Footing Shear @ Toe Footing Shear @ Heel Allowable	= 37.4 psi OK = 11.2 psi OK = 75.0 psi	Service Level Strength Level MomentAllowable	ft-# = ft-# = =	10,351.5 11,799.2		
Lateral Sliding Force	= 2,257.5 lbs	Service Level Strength Level ShearAllowable Anet (Masonry) Rebar Depth 'd'	psi = psi = psi = in2 = in =	40.5 75.0 6.19		
Vertical component of acti NOT considered in the cal	ve lateral soil pressure I culation of soil bearing	f'm Fs Solid Grouting S Modular Ratio 'n' Wall Weight	psi = psi = = psf =	100.0		
Load Factors — Building Code Dead Load Live Load Farth H	IBC 2015,ACI 1.200 1.600	Short Term Factor Equiv. Solid Thick. Masonry Block Type Masonry Design Method Concrete Data	= = =	Medium W ASD	/eight	
Wind, W	1.000	f'c	psi =	2,500.0		

psi = 60,000.0

Fy

1.000

Seismic, E

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RetainPro (c) 1987-2017, Build 11.17.04.04 License : KW-06061509 License To : Phillips Structural Engineering	Cantilevered I	Retaining Wall	Code: IBC 2015,ACI 318-14,ACI 530-13
Concrete Stem Rebar Area Details			
Bottom Stem Ver As (based on applied moment) : 0.3	tical Reinforcing 92 in2/ft	Horizontal Reinforcing	I
(4/3) * As : 0.52	226 in2/ft	Min Stem T&S Reinf A	Area 2.112 in2
200bd/fv : 200(12)(6.1875)/60000 : 0.24	475 in2/ft	Min Stem T&S Reinf A	Area per ft of stem Height : 0.192 in2/ft
0.0014bh : 0.0014(12)(8) : 0.1	344 in2/ft	Horizontal Reinforcing	Options :
===		One layer of : Two	o layers of :
Required Area : 0.3	92 in2/ft	, #4@ 12.50 in #4	↓@ 25.00 in
Provided Area : 0.40	65 in2/ft	#5@ 19.38 in #5	5@ 38.75 in
Maximum Area : 0.8	382 in2/ft	#6@ 27.50 in #6	3@ 55.00 in
Footing Dimensions & Strengths	Footing Des	ign Results	
Toe Width= 3.67 ft Heel Width= 1.83 Total Footing Width= 5.50 Footing Thickness= 12.00 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 Shea Allow 1-Way Shea Toe Reinforcing Heel Reinforcing Key Reinforcing Other Acceptable Toe: #4@ 7.20 Heel: Not req'd: Key: No key de	Toe I = 1,991 = 10,845 = 1,641 = 9,204 ar = ar = ar = 75.00 7 = # 5 @ 8.00 in = None Spec'd = None Spec'd e Sizes & Spacings in, #5@ 11.16 in, #6@ Mu < phi*5*lambda*squ	<u>leel</u> 290 psf 279 ft-# ,064 ft-# 784 ft-# 1.18 psi '5.00 psi 15.84 in, #7@ 21.60 in, #8@ 28.44 in, #9@ 36 rt(f ^c)*Sm
	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: If	1.43 in2 0.26 in2 /ft two layers of horizontal bars: #4@ 18.52 in #5@ 28.70 in #6@ 40.74 in

Summary of Overturning & Resisting Forces & Moments

OVERTURNING					RESISTING				
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,117.5	3.67	7,764.2	Soil Over Heel	=	1,283.0	4.92	6,308.1
Surcharge over Heel	=	140.0	5.50	770.0	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	46.7	4.92	229.4
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	า =	360.0	4.00	1,440.1
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	4.00	2,880.2
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Tetal		0.524.2	Stem Weight(s)	=	1,100.0	4.00	4,400.4		
Total		2,257.5	0.1.1	0,034.2	Earth @ Stem Transition				
	=		=		Footing Weight	=	825.0	2.75	2,268.8
Resisting/Overturning	g Rat	io	=	1.72	Key Weight	=			
Vertical Loads used for Soil Pressure = 4,481.3 lbs		Vert. Component	=						
					Tota	ıl =	3,614.6 lbs	R.M.=	14,646.8

* 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.

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Tilt			
Horizontal Deflection at Top of Wall	due to settlen	nent of soil	
(Deflection due to wall bending not considered)			
Soil Spring Reaction Modulus	250.0	рсі	
Horizontal Defl @ Top of Wall (approximate only	/) 0.079	in	
The above calculation is not valid if the heel soil	bearing pressure e	exceeds that of the toe.	
because the wall would then tend to rotate into t	he retained soil.		