Structural Design Associates
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STRUCTURAL CALCULATIONS

RETAINING WALL DESIGN
SDA Job # 9993

FEB 2 7 2024

ROJAS RETAINING WALLS
6236 EAST MERCER WAY
MERCER ISLAND, WA 98040
February 26, 2024

Project Title: ROJAS RETAINING WALLS
Engineer: CHRIS LALONDE
Project ID: SDA#9993
Project Descr: RETAINING WALLS

Cantilevered Retaining Wall

Project File: 9993.ec6

LIC# : KW-06014008, Build:20.22.12.28
Structural Design Associates

DESCRIPTION: 3.5'

Code Reference:

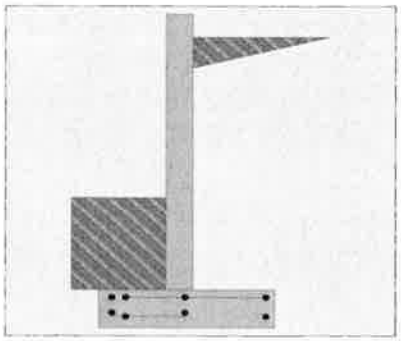
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	5.50 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	24.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	40.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	40.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	8.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	50.667
Total Seismic Force	=	320.889

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DESCRIPTION: 3.5'

Design Summary

Wall Stability Ratios

Overturning	=	1.62	OK
Sliding	=	2.23	OK
Global Stability	=	2.93	

Total Bearing Load	=	2,149 lbs	
...resultant ecc.	=	11.08 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	2,040 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,857 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	16.4 psi	OK
Footing Shear @ Heel	=	14.7 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,007.2 lbs	
less 100% Passive Force	-	1,383.1 lbs	
less 100% Friction Force	-	859.5 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

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

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	6.00		
Rebar Size	=	# 4		
Rebar Spacing	=	9.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.812**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	1,237.7		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	2,627.2		
Moment.....Allowable	=	3,232.2		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	24.3		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	75.0		
Rebar Depth 'd'	in =	4.25		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	40,000.0

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DESCRIPTION: 3.5'

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2228 in2/ft		
(4/3) * As :	0.297 in2/ft	Min Stem T&S Reinf Area 0.864 in2	
200bd/fy : 200(12)(4.25)/40000 :	0.255 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.255 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2667 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.8636 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	1.25 ft
Heel Width	=	2.00
Total Footing Width	=	3.25
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 psi Fy = 40,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	2,857	0 psf	
Mu' : Upward	=	1,790	10 ft-#	
Mu' : Downward	=	373	1,058 ft-#	
Mu: Design	=	1,417 OK	1,047 ft-#	OK
phiMn	=	4,264	4,912 ft-#	
Actual 1-Way Shear	=	16.44	14.71 psi	
Allow 1-Way Shear	=	75.00	75.00 psi	

Toe Reinforcing = # 4 @ 11.11 in
Heel Reinforcing = # 4 @ 11.11 in
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 55.55 in, #10@ 70.55 in

Heel: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 55.55 in, #10@ 70.55 in

Key: No key defined

Min footing T&S reinf Area 0.70 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

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DESCRIPTION: 3.5'

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		701.9	2.11	1,481.9	Soil Over HL (ab. water tbl)	907.5	2.50	2,268.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.50	2,268.8
Hydrostatic Force					Water Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	80.6	3.17	255.3	Surcharge Over Heel	= 60.0	2.50	150.0
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	= 275.0	0.63	171.9
Seismic Earth Load	=	224.6	3.17	711.3	Surcharge Over Toe	= 50.0	0.63	31.3
	=				Stem Weight(s)	= 450.0	1.50	675.0
Total	=	1,007.2	**O.T.M.** =	2,448.4	Earth @ Stem Transitions	=		
					Footing Weight	= 406.3	1.63	660.2
					Key Weight	=		
					Vert. Component	=		
					Total =	2,148.8 lbs	**R.M.=**	3,957.0

Resisting/Overturning Ratio = **1.62**
Vertical Loads used for Soil Pressure = 2,148.8 lbs

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

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.105	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 the retained soil.

Cantilevered Retaining Wall

DESCRIPTION: 3.5'

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) =	15.60 in
Development length for #4 bar specified in this stem design segment =	12.00 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	6.00 in
As Provided =	0.2667 in2/ft
As Required =	0.2550 in2/ft

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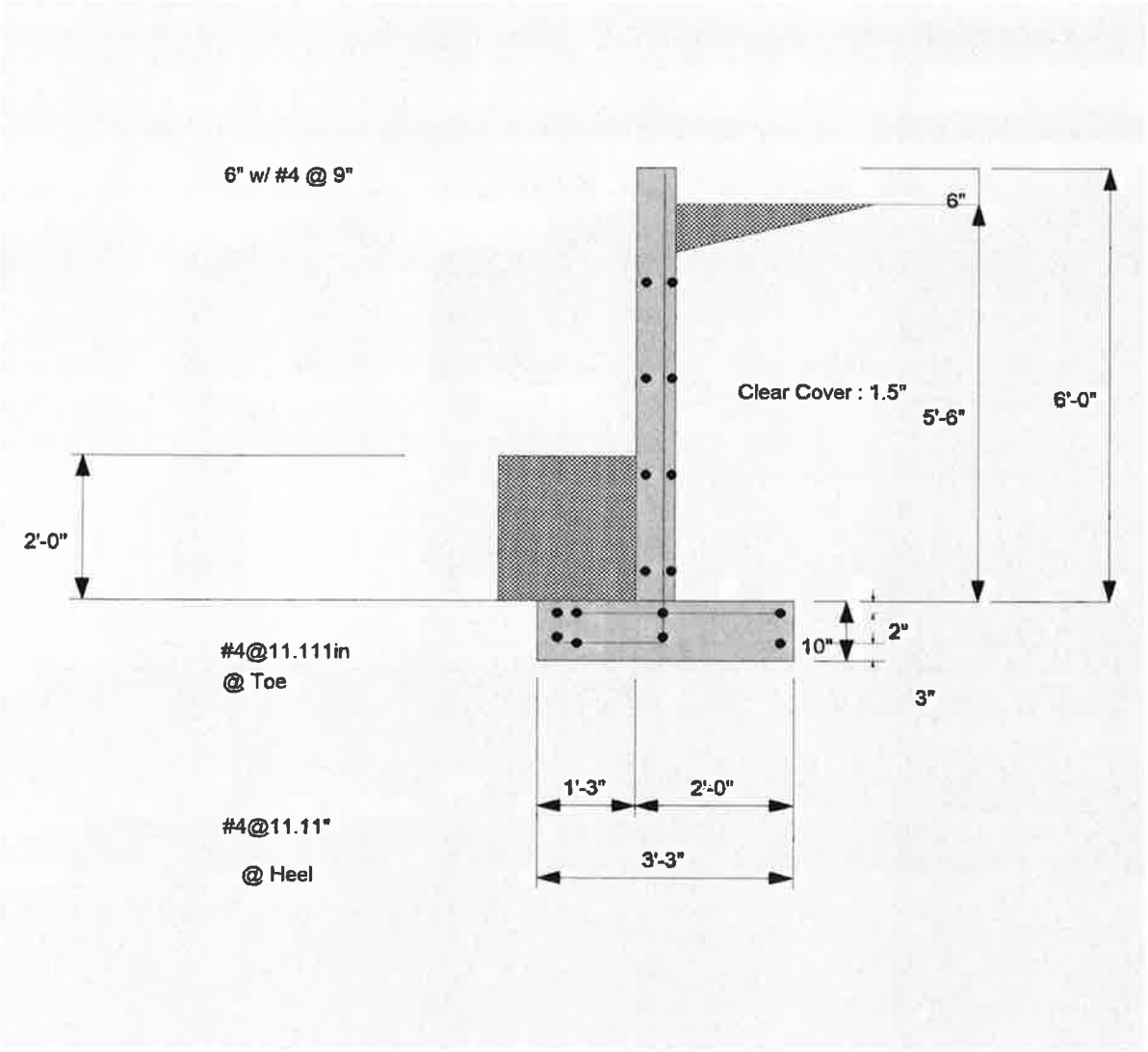
DESCRIPTION: 3.5'



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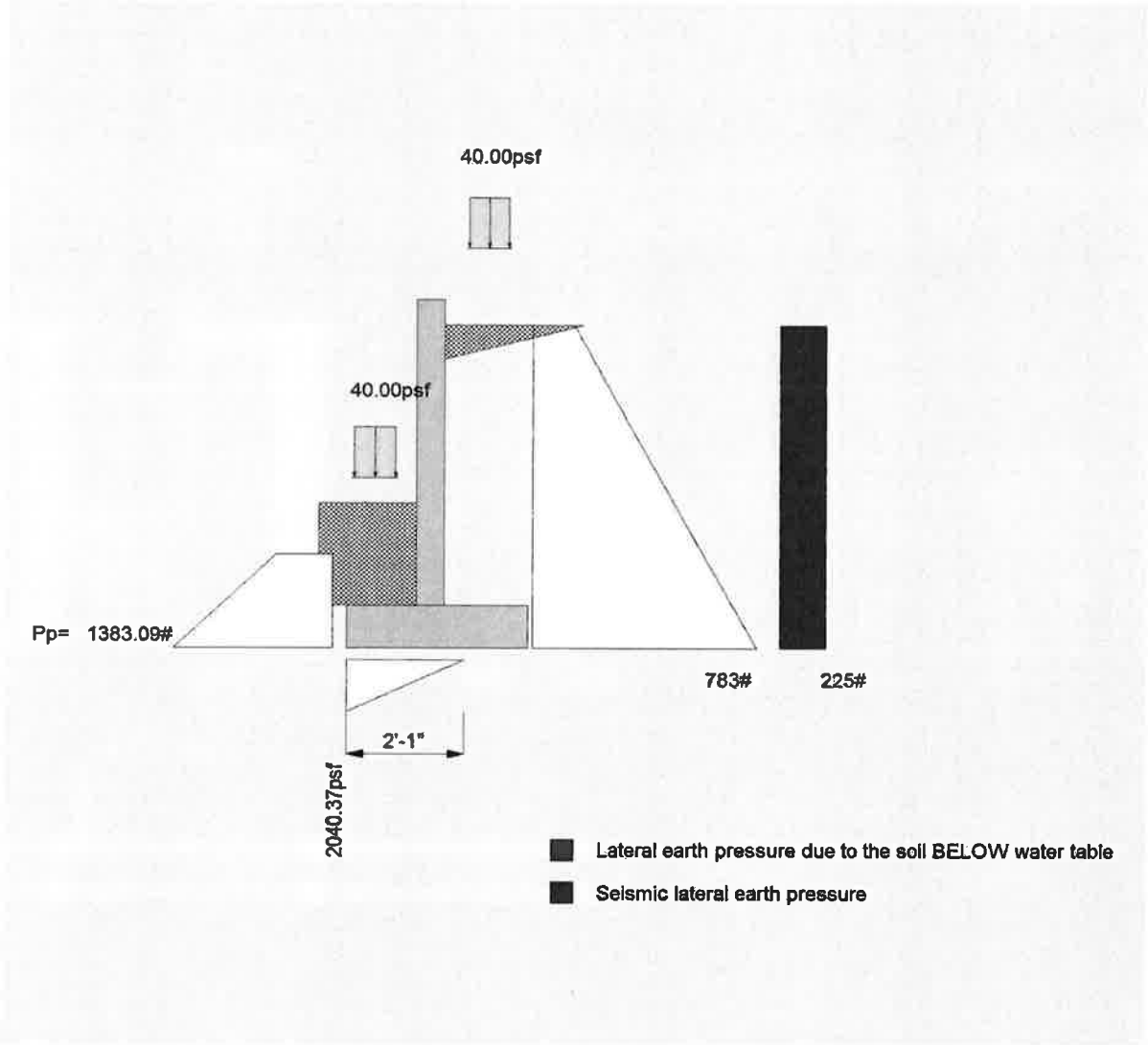
DESCRIPTION: 3.5'



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Cantilevered Retaining Wall

Project File: 9993.ec6

DESCRIPTION: 4'

Code Reference

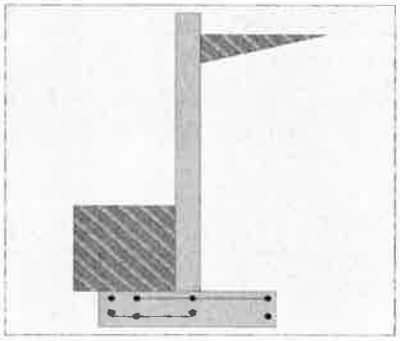
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	24.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	40.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	40.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	8.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	54.667
Total Seismic Force	=	373.556

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LIC# : KW-06014008, Build:20.22.12.28
Structural Design Associates

DESCRIPTION: 4'

Design Summary

Wall Stability Ratios

Overturning	=	1.57	OK
Sliding	=	2.00	OK
Global Stability	=	2.66	

Total Bearing Load	=	2,365 lbs	
...resultant ecc.	=	12.14 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	2,135 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,988 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	21.8 psi	OK
Footing Shear @ Heel	=	16.4 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,165.6 lbs	
less 100% Passive Force	-	1,383.1 lbs	
less 100% Friction Force	-	946.0 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

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

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	6.00		
Rebar Size	=	# 4		
Rebar Spacing	=	8.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.931**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	1,458.2		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	3,366.5		
Moment.....Allowable	=	3,612.6		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	28.6		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	75.0		
Rebar Depth 'd'	in =	4.25		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	40,000.0

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LIC# : KW-06014008, Build:20.22.12.28 Structural Design Associates (c) ENERCALC INC 1983-2022

DESCRIPTION: 4'

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2855 in2/ft		
(4/3) * As :	0.3806 in2/ft	Min Stem T&S Reinf Area 0.936 in2	
200bd/fy : 200(12)(4.25)/40000 :	0.255 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2855 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.3 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.8636 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	2.00
Total Footing Width	=	3.50
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 psi Fy = 40,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	2,988	0 psf	
Mu' : Upward	=	2,603	2 ft-#	
Mu' : Downward	=	538	1,132 ft-#	
Mu: Design	=	2,066 OK	1,129 ft-#	OK
phiMn	=	4,264	4,912 ft-#	
Actual 1-Way Shear	=	21.82	16.42 psi	
Allow 1-Way Shear	=	75.00	75.00 psi	

Toe Reinforcing = # 4 @ 11.11 in
Heel Reinforcing = # 4 @ 11.11 in
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 55.55 in, #10@ 70.55 in

Heel: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 55.55 in, #10@ 70.55 in

Key: No key defined

Min footing T&S reinf Area 0.76 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

Cantilevered Retaining Wall

LIC# : KW-06014008, Build:20.22.12.28 Structural Design Associates

DESCRIPTION: 4'

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	990.0	2.75	2,722.5
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.75	2,722.5
Hydrostatic Force					Water Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	87.0	3.42	297.1	Surcharge Over Heel	= 60.0	2.75	165.0
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	= 330.0	0.75	247.5
Seismic Earth Load	=	261.5	3.42	893.4	Surcharge Over Toe	= 60.0	0.75	45.0
	=				Stem Weight(s)	= 487.5	1.75	853.1
Total	=	1,165.6	**O.T.M.** =	3,051.9	Earth @ Stem Transitions	=		
					Footing Weight	= 437.5	1.75	765.6
					Key Weight	=		
					Vert. Component	=		
					Total =	2,365.0 lbs	**R.M.=**	4,798.8

Resisting/Overturning Ratio = **1.57**
Vertical Loads used for Soil Pressure = 2,365.0 lbs

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

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.110	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 the retained soil.

Cantilevered Retaining Wall

DESCRIPTION: 4'

Rebar Lap & Embedment Lengths Information

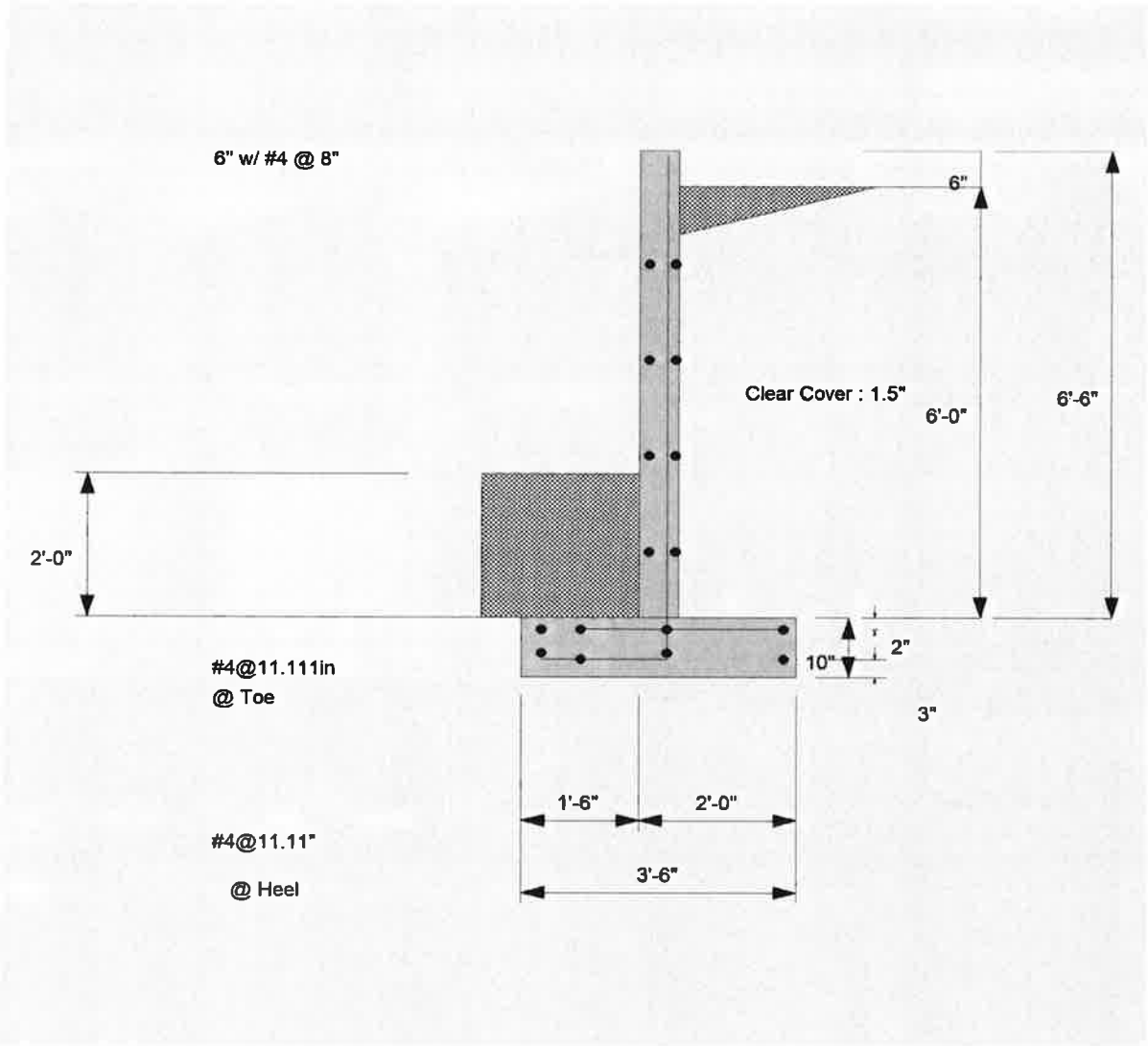
Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) =	15.60 in
Development length for #4 bar specified in this stem design segment =	12.00 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	6.00 in
As Provided =	0.3000 in2/ft
As Required =	0.2855 in2/ft

Cantilevered Retaining Wall

DESCRIPTION: 4'



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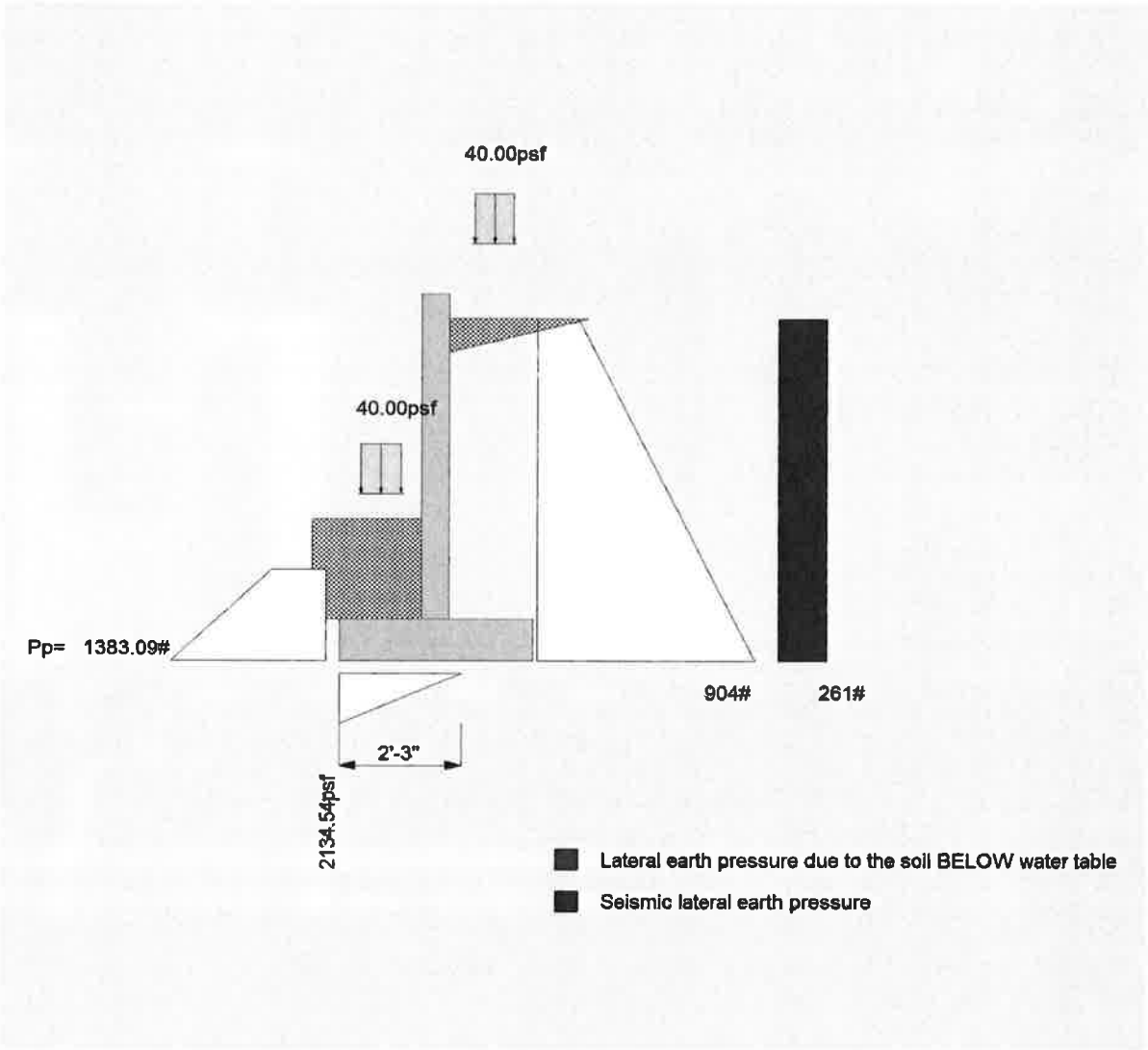

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Project Descr: RETAINING WALLS

Cantilevered Retaining Wall

Project File: 9993.ec6

DESCRIPTION: 4.5'

Code Reference:

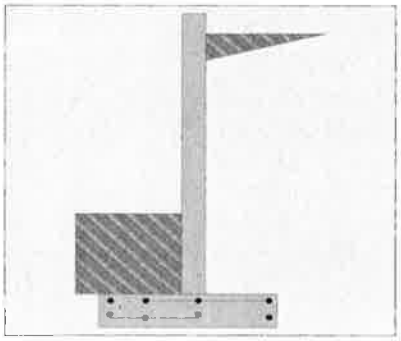
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	6.50 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	24.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	40.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	40.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	8.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	58.667
Total Seismic Force	=	430.222

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Design Summary

Wall Stability Ratios

Overturning	=	1.53	OK
Sliding	=	1.81	OK
Global Stability	=	2.44	

Total Bearing Load	=	2,581 lbs	
...resultant ecc.	=	13.31 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	2,246 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	3,145 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	27.1 psi	OK
Footing Shear @ Heel	=	17.8 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,335.6 lbs	
less 100% Passive Force	-	1,383.1 lbs	
less 100% Friction Force	= -	1,032.5 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

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

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	6.00		
Rebar Size	=	# 4		
Rebar Spacing	=	6.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	**0.896**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	1,696.7		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	4,232.7		
Moment.....Allowable	=	4,722.4		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	33.3		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	75.0		
Rebar Depth 'd'	in =	4.25		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	40,000.0

Cantilevered Retaining Wall

LIC# : KW-06014008, Build:20.22.12.28 Structural Design Associates

DESCRIPTION: 4.5'

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3589 in2/ft	
(4/3) * As :	0.4785 in2/ft	Min Stem T&S Reinf Area 1.008 in2
200bd/fy : 200(12)(4.25)/40000 :	0.255 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.3589 in2/ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.4 in2/ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.8636 in2/ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	2.00
Total Footing Width	=	3.75
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 psi Fy = 40,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	3,145	0 psf	
Mu' : Upward	=	3,593	0 ft-#	
Mu' : Downward	=	732	1,206 ft-#	
Mu: Design	=	2,861 OK	1,206 ft-#	OK
phiMn	=	4,264	4,912 ft-#	
Actual 1-Way Shear	=	27.14	17.85 psi	
Allow 1-Way Shear	=	75.00	75.00 psi	

Toe Reinforcing = # 4 @ 11.11 in
Heel Reinforcing = # 4 @ 11.11 in
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 55.55 in, #10@ 70.55 in

Heel: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 55.55 in, #10@ 70.55 in

Key: No key defined

Min footing T&S reinf Area 0.81 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

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LIC# : KW-06014008, Build:20.22.12.28 Structural Design Associates

DESCRIPTION: 4.5'

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		941.1	2.44	2,300.5	Soil Over HL (ab. water tbl)	1,072.5	3.00	3,217.5
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.00	3,217.5
Hydrostatic Force					Water Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	93.3	3.67	342.2	Surcharge Over Heel	= 60.0	3.00	180.0
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	= 385.0	0.88	336.9
Seismic Earth Load	=	301.2	3.67	1,104.2	Surcharge Over Toe	= 70.0	0.88	61.3
	=				Stem Weight(s)	= 525.0	2.00	1,050.0
Total	=	1,335.6	**O.T.M.** =	3,747.0	Earth @ Stem Transitions	=		
					Footing Weight	= 468.8	1.88	878.9
					Key Weight	=		
					Vert. Component	=		
					Total =	2,581.3 lbs	**R.M.**=	5,724.5

Resisting/Overturning Ratio = **1.53**
Vertical Loads used for Soil Pressure = 2,581.3 lbs

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

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.116	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 the retained soil.

Cantilevered Retaining Wall

DESCRIPTION: 4.5'

Rebar Lap & Embedment Lengths Information

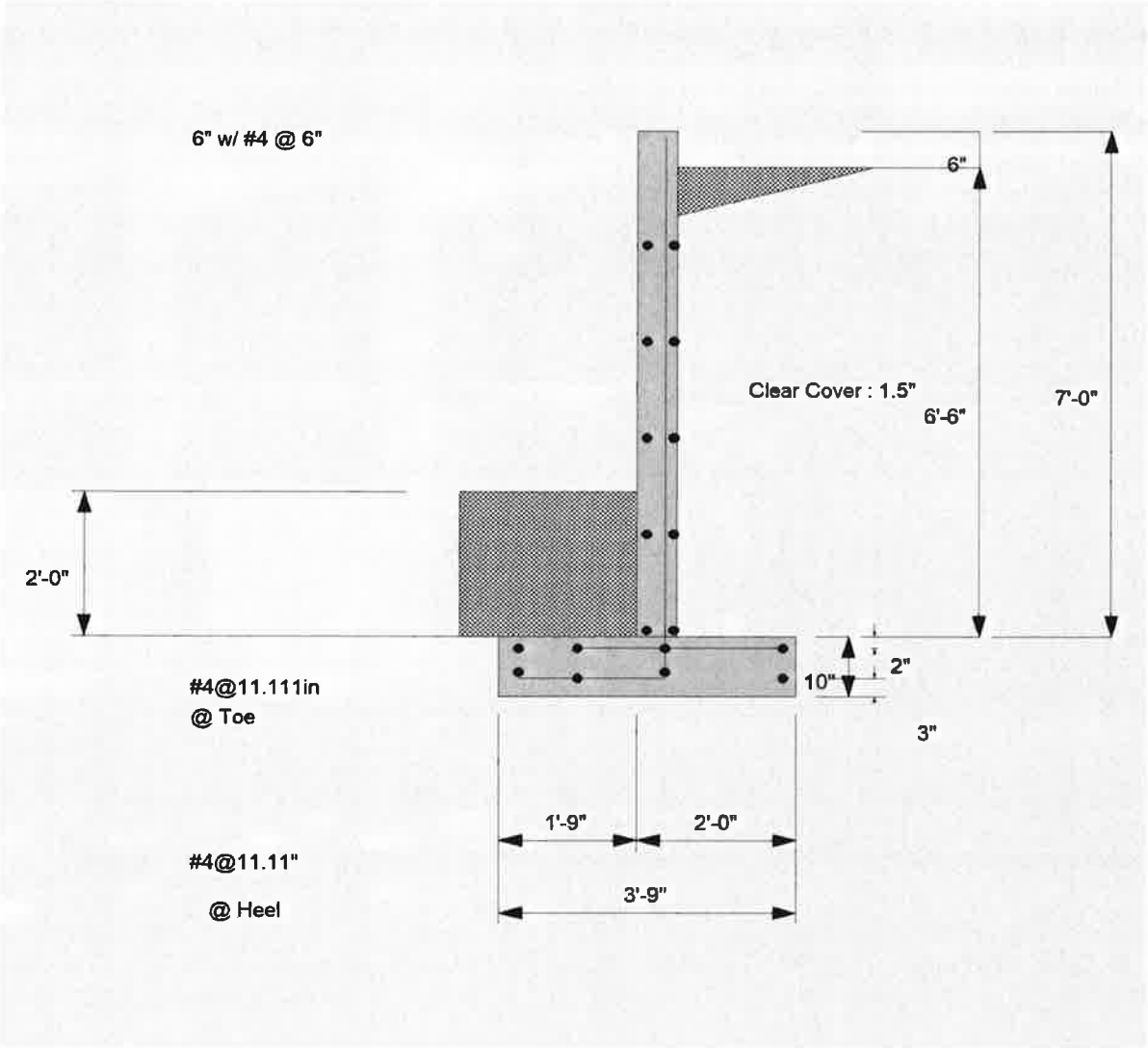
Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) =	15.60 in
Development length for #4 bar specified in this stem design segment =	12.00 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	6.00 in
As Provided =	0.4000 in2/ft
As Required =	0.3589 in2/ft

Cantilevered Retaining Wall

DESCRIPTION: 4.5'



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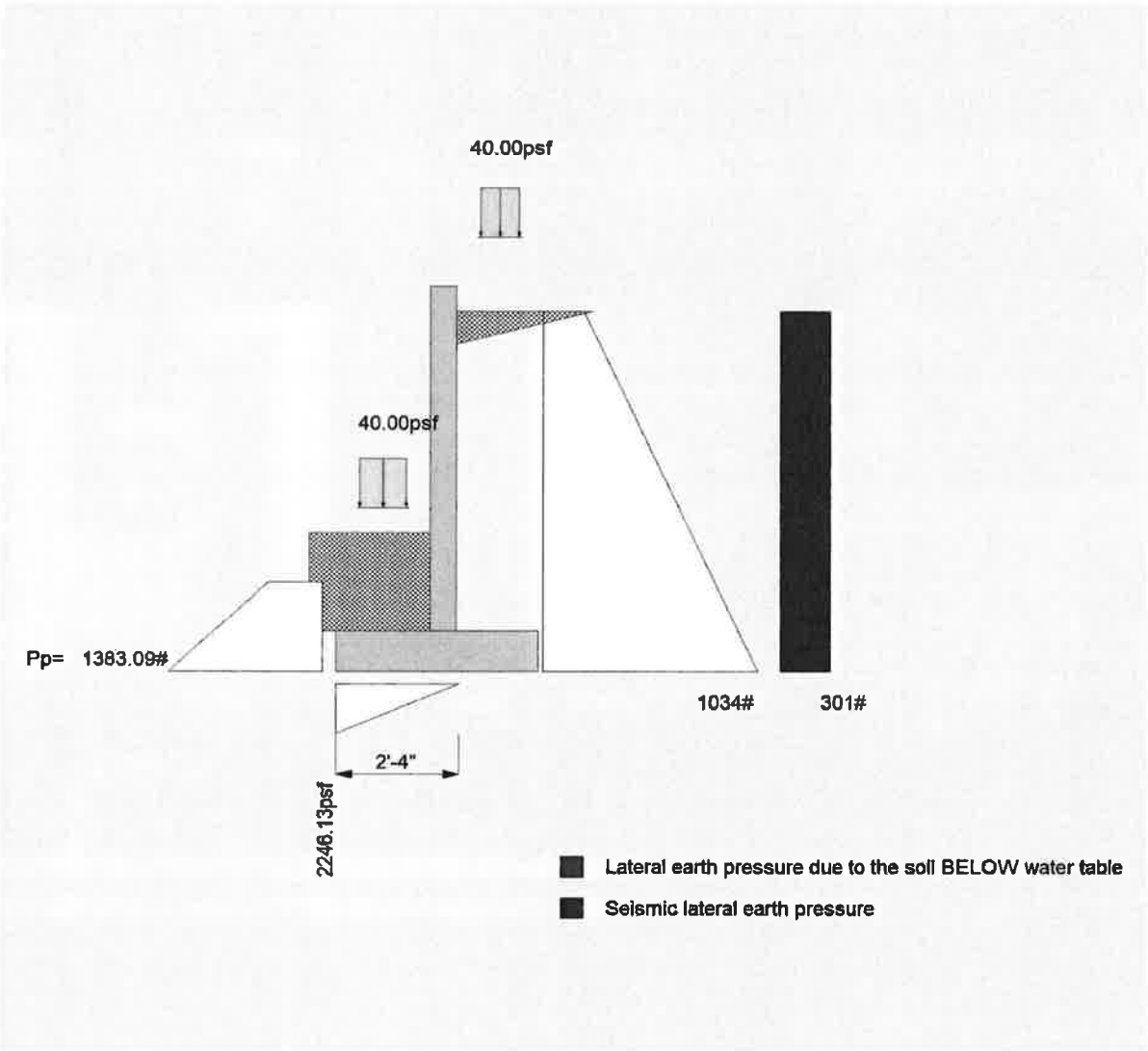
DESCRIPTION: 4.5'



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Concrete Beam

Project File: 9993.ec6

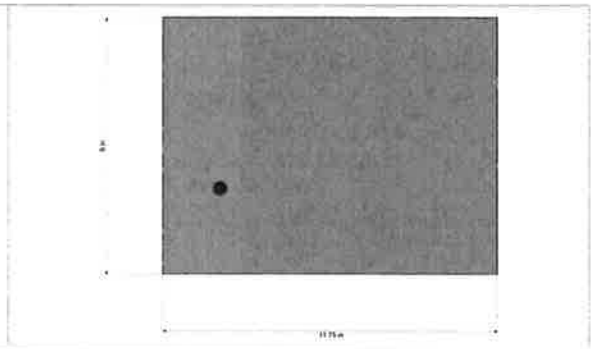
DESCRIPTION: CONCRETE STAIR

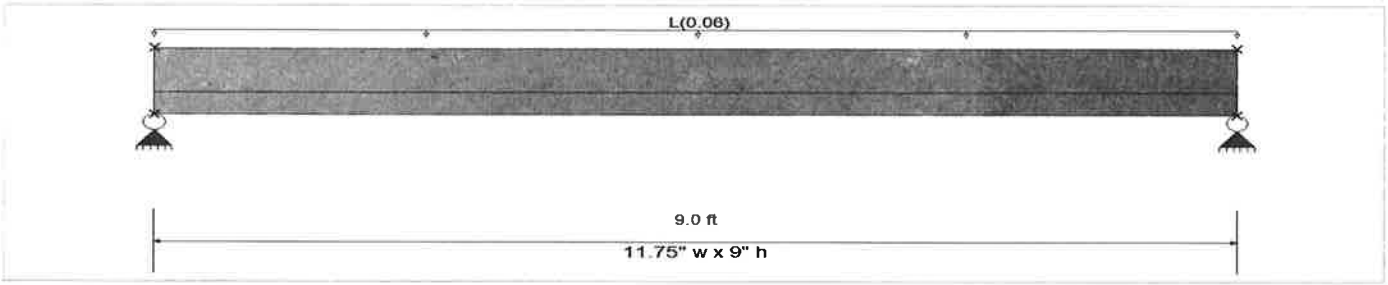
CODE REFERENCES

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

General Information

f'c	= 2.50 ksi	ϕ Phi Values	Flexure :	0.90	
fr = f'c^1/2 '7.50	= 375.0 psi		Shear :	0.750	
ψ Density	= 145.0 pcf	β 1	=	0.850	
λ LtWt Factor	= 1.0				
Elastic Modulus	= 2,850.0 ksi	Fy - Stirrups		40.0 ksi	
fy - Main Rebar	= 40.0 ksi	E - Stirrups	=	29,000.0 ksi	
E - Main Rebar	= 29,000.0 ksi	Stirrup Bar Size #		3	
		Number of Resisting Legs Per Stirrup	=	2	





Cross Section & Reinforcing Details

Rectangular Section, Width = 11.750 in, Height = 9.0 in
Span #1 Reinforcing....
1-#4 at 3.0 in from Bottom, from 0.0 to 9.0 ft in this span

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 0.060 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.647** : 1	
Section used for this span	**Typical Section**	
Mu : Applied	2.266	k-ft
Mn * Phi : Allowable	3.504	k-ft
Location of maximum on span	4.508	ft
Span # where maximum occurs	Span # 1	

Maximum Deflection

Max Downward Transient Deflection	0.004 in	Ratio = 24813	>=360.0	L Only
Max Upward Transient Deflection	0.000 in	Ratio = 0	<360.0	L Only
Max Downward Total Deflection	0.012 in	Ratio = 8942	>=180.0	Span: 1 : +D+L
Max Upward Total Deflection	0.000 in	Ratio = 0	<180.0	Span: 1 : +D+L

Vertical Reactions

Support notation : Far left is #1

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.749	0.749
Max Upward from Load Combinations	0.749	0.749
Max Upward from Load Cases	0.479	0.479
D Only	0.479	0.479
+D+L	0.749	0.749
+D+0.750L	0.682	0.682
+0.60D	0.288	0.288

Concrete Beam

DESCRIPTION: CONCRETE STAIR

Vertical Reactions

Support notation : Far left is #1

Load Combination	Support 1	Support 2
L Only	0.270	0.270

Detailed Shear Information

Load Combination	Span Number	Distance (ft)	'd' (in)	Vu Actual	(k) Design	Mu (k-ft)	d*Vu/Mu	Phi*Vc (k)	Comment	Phi*Vs (k)	Phi*Vn (k)	Spacing (in) Req'd	Suggest
+1.20D+1.60L	1	0.00	6.00	1.01	1.01	0.00	1.00	5.40	Vu < Phi*Vc / 2	at Reqd per	18.6	3.0	3.0
+1.20D+1.60L	1	0.10	6.00	0.99	0.99	0.10	1.00	5.40	Vu < Phi*Vc / 2	at Reqd per	18.6	3.0	3.0
+1.20D+1.60L	1	0.20	6.00	0.96	0.96	0.19	1.00	5.40	Vu < Phi*Vc / 2	at Reqd per	18.6	3.0	3.0
+1.20D+1.60L	1	0.30	6.00	0.94	0.94	0.29	1.00	5.40	Vu < Phi*Vc / 2	at Reqd per	18.6	3.0	3.0
+1.20D+1.60L	1	0.39	6.00	0.92	0.92	0.38	1.00	5.40	Vu < Phi*Vc / 2	at Reqd per	18.6	3.0	3.0
+1.20D+1.60L	1	0.49	6.00	0.90	0.90	0.47	0.96	5.38	Vu < Phi*Vc / 2	at Reqd per	18.6	3.0	3.0
+1.20D+1.60L	1	0.59	6.00	0.87	0.87	0.56	0.79	5.32	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	0.69	6.00	0.85	0.85	0.64	0.67	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	0.79	6.00	0.83	0.83	0.72	0.57	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	0.89	6.00	0.81	0.81	0.80	0.50	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	0.98	6.00	0.79	0.79	0.88	0.45	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	1.08	6.00	0.76	0.76	0.96	0.40	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	1.18	6.00	0.74	0.74	1.03	0.36	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	1.28	6.00	0.72	0.72	1.10	0.33	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	1.38	6.00	0.70	0.70	1.17	0.30	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	1.48	6.00	0.68	0.68	1.24	0.27	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	1.57	6.00	0.65	0.65	1.31	0.25	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	1.67	6.00	0.63	0.63	1.37	0.23	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	1.77	6.00	0.61	0.61	1.43	0.21	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	1.87	6.00	0.59	0.59	1.49	0.20	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	1.97	6.00	0.57	0.57	1.55	0.18	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	2.07	6.00	0.54	0.54	1.60	0.17	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	2.16	6.00	0.52	0.52	1.66	0.16	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	2.26	6.00	0.50	0.50	1.71	0.15	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	2.36	6.00	0.48	0.48	1.75	0.14	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	2.46	6.00	0.46	0.46	1.80	0.13	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	2.56	6.00	0.43	0.43	1.84	0.12	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	2.66	6.00	0.41	0.41	1.89	0.11	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	2.75	6.00	0.39	0.39	1.92	0.10	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	2.85	6.00	0.37	0.37	1.96	0.09	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	2.95	6.00	0.35	0.35	2.00	0.09	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	3.05	6.00	0.32	0.32	2.03	0.08	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	3.15	6.00	0.30	0.30	2.06	0.07	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	3.25	6.00	0.28	0.28	2.09	0.07	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	3.34	6.00	0.26	0.26	2.12	0.06	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	3.44	6.00	0.24	0.24	2.14	0.06	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	3.54	6.00	0.21	0.21	2.16	0.05	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	3.64	6.00	0.19	0.19	2.18	0.04	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	3.74	6.00	0.17	0.17	2.20	0.04	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	3.84	6.00	0.15	0.15	2.22	0.03	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	3.93	6.00	0.13	0.13	2.23	0.03	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	4.03	6.00	0.10	0.10	2.24	0.02	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	4.13	6.00	0.08	0.08	2.25	0.02	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	4.23	6.00	0.06	0.06	2.26	0.01	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	4.33	6.00	0.04	0.04	2.26	0.01	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	4.43	6.00	0.02	0.02	2.27	0.00	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	4.52	6.00	-0.01	0.01	2.27	0.00	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	4.62	6.00	-0.03	0.03	2.26	0.01	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	4.72	6.00	-0.05	0.05	2.26	0.01	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	4.82	6.00	-0.07	0.07	2.25	0.02	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	4.92	6.00	-0.09	0.09	2.25	0.02	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	5.02	6.00	-0.12	0.12	2.24	0.03	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	5.11	6.00	-0.14	0.14	2.22	0.03	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	5.21	6.00	-0.16	0.16	2.21	0.04	5.29	Vu < Phi*Vc / 2	at Reqd per	18.5	3.0	3.0

Concrete Beam

DESCRIPTION: CONCRETE STAIR

Detailed Shear Information

Load Combination	Span Number	Distance (ft)	'd' (in)	Vu Actual	(k) Design	Mu (k-ft)	d*Vu/Mu	Phi*Vc (k)	Comment	Phi*Vs (k)	Phi*Vn (k)	Spacing (in) Req'd	Suggest
+1.20D+1.60L	1	5.31	6.00	-0.18	0.18	2.19	0.04	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	5.41	6.00	-0.20	0.20	2.17	0.05	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	5.51	6.00	-0.23	0.23	2.15	0.05	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	5.61	6.00	-0.25	0.25	2.13	0.06	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	5.70	6.00	-0.27	0.27	2.10	0.06	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	5.80	6.00	-0.29	0.29	2.08	0.07	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	5.90	6.00	-0.31	0.31	2.05	0.08	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.00	6.00	-0.34	0.34	2.01	0.08	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.10	6.00	-0.36	0.36	1.98	0.09	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.20	6.00	-0.38	0.38	1.94	0.10	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.30	6.00	-0.40	0.40	1.91	0.11	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.39	6.00	-0.42	0.42	1.86	0.11	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.49	6.00	-0.45	0.45	1.82	0.12	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.59	6.00	-0.47	0.47	1.78	0.13	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.69	6.00	-0.49	0.49	1.73	0.14	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.79	6.00	-0.51	0.51	1.68	0.15	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.89	6.00	-0.53	0.53	1.63	0.16	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	6.98	6.00	-0.56	0.56	1.58	0.18	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	7.08	6.00	-0.58	0.58	1.52	0.19	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	7.18	6.00	-0.60	0.60	1.46	0.21	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	7.28	6.00	-0.62	0.62	1.40	0.22	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	7.38	6.00	-0.64	0.64	1.34	0.24	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	7.48	6.00	-0.67	0.67	1.28	0.26	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	7.57	6.00	-0.69	0.69	1.21	0.28	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	7.67	6.00	-0.71	0.71	1.14	0.31	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	7.77	6.00	-0.73	0.73	1.07	0.34	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	7.87	6.00	-0.75	0.75	1.00	0.38	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	7.97	6.00	-0.78	0.78	0.92	0.42	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	8.07	6.00	-0.80	0.80	0.84	0.47	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	8.16	6.00	-0.82	0.82	0.76	0.54	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	8.26	6.00	-0.84	0.84	0.68	0.62	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	8.36	6.00	-0.86	0.86	0.60	0.72	5.29	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	8.46	6.00	-0.89	0.89	0.51	0.87	5.35	Vu < Phi*Vc / 2	Reqd per	18.5	3.0	3.0
+1.20D+1.60L	1	8.56	6.00	-0.91	0.91	0.42	1.00	5.40	Vu < Phi*Vc / 2	Reqd per	18.6	3.0	3.0
+1.20D+1.60L	1	8.66	6.00	-0.93	0.93	0.33	1.00	5.40	Vu < Phi*Vc / 2	Reqd per	18.6	3.0	3.0
+1.20D+1.60L	1	8.75	6.00	-0.95	0.95	0.24	1.00	5.40	Vu < Phi*Vc / 2	Reqd per	18.6	3.0	3.0
+1.20D+1.60L	1	8.85	6.00	-0.97	0.97	0.15	1.00	5.40	Vu < Phi*Vc / 2	Reqd per	18.6	3.0	3.0
+1.20D+1.60L	1	8.95	6.00	-1.00	1.00	0.05	1.00	5.40	Vu < Phi*Vc / 2	Reqd per	18.6	3.0	3.0

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment	Span #	Location (ft) along Beam	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
MAXimum BENDING Envelope					
Span # 1	1	9.000	2.27	3.50	0.65
+1.40D					
Span # 1	1	9.000	1.51	3.50	0.43
+1.20D+1.60L					
Span # 1	1	9.000	2.27	3.50	0.65
+1.20D+0.50L					
Span # 1	1	9.000	1.60	3.50	0.46
+1.20D					
Span # 1	1	9.000	1.29	3.50	0.37
+0.90D					
Span # 1	1	9.000	0.97	3.50	0.28

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl (in)	Location in Span (ft	Load Combination	Max. "+" Defl (in)	Location in Span (ft
+D+L	1	0.0121	4.500		0.0000	0.000