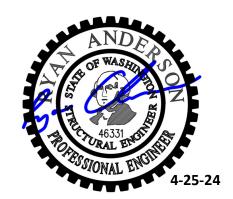


Structural Calculations For:

Arvind Residence Site Retaining Walls

3655 73rd Avenue SE Mercer Island, WA 98040



Prepared for: SK Designs, LLC

Job #: 13271-2023-01

Date: April 25, 2024



SEATTLE TACOMA

Cantilevered Retaining Wall

LIC# : KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - 6 ft

Code Reference

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

Criteria

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

Surcharge Loads

Surcharge Over Heel = 0.0 psf
Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0
Used for Sliding & Overturning

Axial Load Applied to Stem

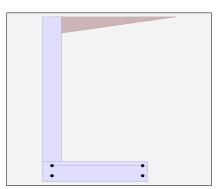
Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Soil Data

Allow Soil Bearing = 2,000.0 psf Equivalent Fluid Pressure Method Active Heel Pressure = 35.0 psf/ft Passive Pressure = 300.0 psf/ft Soil Density, Heel = 125.00 pcf Soil Density, Toe = 125.00 pcf Footing Soil Friction = 0.450 Soil height to ignore for passive pressure = 12.00 in			
Active Heel Pressure = 35.0 psf/ft = Passive Pressure = 300.0 psf/ft Soil Density, Heel = 125.00 pcf Soil Density, Toe = 125.00 pcf Footing Soil Friction = 0.450 Soil height to ignore			
Passive Pressure = 300.0 psf/ft Soil Density, Heel = 125.00 pcf Soil Density, Toe = 125.00 pcf Footing Soil Friction = 0.450 Soil height to ignore			
Soil Density, Heel = 125.00 pcf Soil Density, Toe = 125.00 pcf Footing Soil Friction = 0.450 Soil height to ignore		=	
Soil Density, Toe = 125.00 pcf Footing Soil Friction = 0.450 Soil height to ignore	Passive Pressure	=	300.0 psf/ft
Footing Soil Friction = 0.450 Soil height to ignore	Soil Density, Heel	=	125.00 pcf
Soil height to ignore	Soil Density, Toe	=	125.00 pcf
	Footing Soil Friction	=	0.450
		=	12.00 in

Lateral Load Applied to Stem

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



Project File: arvind.ec6

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

Project File: arvind.ec6

Cantilevered Retaining Wall LIC#: KW-06014947, Build:20.22.6.30

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - 6 ft

Design Summary			Stem Construction	_	Bottom			
			Design Height Above Ftg	 ft =	Stem OK 0.00			
Wall Stability Ratios			Wall Material Above "Ht"	=	Concrete			
Overturning	=	3.18 OK	Design Method	=	SD	SD	SD	
Sliding	=	2.05 OK	Thickness	=	8.00			
Global Stability	=	2.76	Rebar Size	=	# 4			
-			Rebar Spacing	=	12.00			
Total Bearing Load	=	3,311 lbs	Rebar Placed at	=	Edge			
resultant ecc.	_ = _	7.29 in	Design Data		0.070			
Eccentricity with			fb/FB + fa/Fa	=	0.372			
Soil Pressure @ Toe Soil Pressure @ Heel	=	1,798 psf OK 6 psf OK	Total Force @ Section	п				
Allowable	_	2,000 psf	Service Level	lbs =	4 000 0			
Soil Pressure Les			Strength Level	lbs =	1,008.0			
ACI Factored @ Toe	=	2,518 psf	MomentActual Service Level	ft-# =				
ACI Factored @ Heel	=	9 psf		ft-# =	2,016.0			
Footing Shear @ Toe	=	0.0 psi OK	Strength Level		•			
Footing Shear @ Heel	=	0.5 psi OK	MomentAllowable	=	5,412.6			
Allowable	=	75.0 psi	ShearActual					
			Service Level	psi =				
Sliding Calcs			Strength Level	psi=	13.4			
Lateral Sliding Force	=	817.2 lbs	ShearAllowable	psi=	75.0			
less 100% Passive Ford	e -	187.5 lbs	Anet (Masonry)	in2 =				
less 100% Friction Ford	e = -	1,490.1 lbs	Wall Weight	psf=	100.0			
Added Force Req'd	=	0.0 lbs OK	Rebar Depth 'd'	in =	6.25			
for 1.5 Stability	=	0.0 lbs OK						
			Masonry Data					
Vertical component of activ			f'm	psi=				
NOT considered in the calc	culatio	n of soil bearing	Fs	psi=				
Load Factors			Solid Grouting	=				
Building Code			Modular Ratio 'n'	=				
Dead Load		1.200	Equiv. Solid Thick.	=				
Live Load		1.600	Masonry Block Type	=	ASD			
Earth, H		1.600	Masonry Design Method Concrete Data		ASD			
Wind, W		1.600	f'c	psi=	2,500.0			
Seismic, E		1.000	Fy	psi =	60,000.0			

Project Title: Arvind Residence Engineer: ETC/RJA 13271-2023-01 Project ID: Project Descr: Site Retaining Walls

Project File: arvind.ec6

Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30 (c) ENERCALC INC 1983-2022 SWENSON SAY FAGET

DESCRIPTION: Property Line - 6 ft

Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing Horizontal Reinforcing

As (based on applied moment): 0.0755 in2/ft

(4/3) * As: 0.1007 in2/ft Min Stem T&S Reinf Area 1.152 in2

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0018bh: 0.0018(12)(8): 0.1728 in2/ft Horizontal Reinforcing Options: One layer of : Two layers of : 0.1728 in2/ft #4@ 12.50 in #4@ 25.00 in

Required Area: Provided Area: 0.2 in2/ft #5@ 19.38 in #5@ 38.75 in Maximum Area: 0.8467 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width Heel Width Total Footing Wid Footing Thicknes		= = =	3	.00 ft . <u>67</u> .67
Key Width Key Depth Key Distance from	m Toe	= = =	0.	.00 in .00 in .00 ft
f'c = 2,500 Footing Concrete Min. As % Cover @ Top		y = = = @		

Footing Design Results

		<u>Toe</u>	<u>Heel</u>	
Factored Pressure	=	2,518	9 psf	
Mu' : Upward	=	0	3,126 ft-#	
Mu': Downward	=	0	4,736 ft-#	
Mu: Design	=	0 OK	1,610 ft-#	OK
phiMn	=	19,803	10,215 ft-#	
Actual 1-Way Shear	=	0.00	0.49 psi	
Allow 1-Way Shear	=	0.00	75.00 psi	
Toe Reinforcing	=	Flush toe condi	tion. No reinfor	cina re

condition. No reinforcing required.

Heel Reinforcing = #5@12.00 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: Flush toe condition. No reinforcing required.

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

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

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

Project File: arvind.ec6

Cantilevered Retaining Wall

DESCRIPTION: Property Line - 6 ft

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING.			RI	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tb	d)	817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	2,252.5	2.17	4,884.2
HL Act Pres (be water tb	,	• • • • •		1,00110	Soil Over HL (bel. water tbl)		2.17	4,884.2
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=				* Axial Live Load on Stem =			
Load @ Stem Above So	il =				Soil Over Toe =			
	=				Surcharge Over Toe =			
					Stem Weight(s) =	600.0	0.33	200.0
			—		Earth @ Stem Transitions=			
Total	=	817.2	O.T.M. =	1,861.3	Footing Weight =	458.8	1.84	841.8
					Key Weight =			
Resisting/Overturnin	_			3.18	Vert. Component =			
Vertical Loads used f	or Soi	I Pressure	= 3,311.3	lbs	Total =	3,311.3	bs R.M.=	5,926.0
					* Axial live load NOT included i	in total display	ed, or used fo	r overturnina

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci Horizontal Defl @ Top of Wall (approximate only) 0.082 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

SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

Project File: arvind.ec6

DESCRIPTION: Property Line - 6 ft

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

LIC#: KW-06014947, Build:20.22.6.30

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment = 18.72 in

Development length for #4 bar specified in this stem design segment = 14.40 in

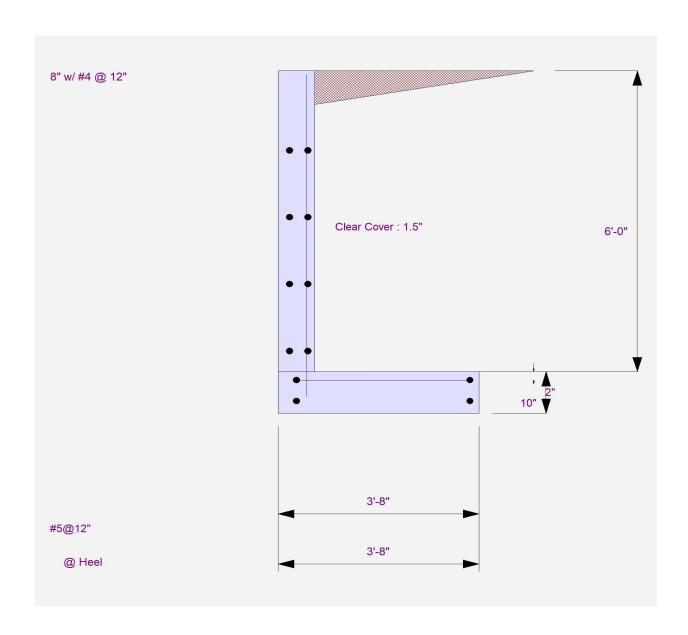
Hooked embedment length into footing for #4 bar specified in this stem design segment = 7.26 in As Provided = 0.2000 in 2/ft As Required = 0.1728 in 2/ft 0.1728 in 2/ft

Project File: arvind.ec6

Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - 6 ft



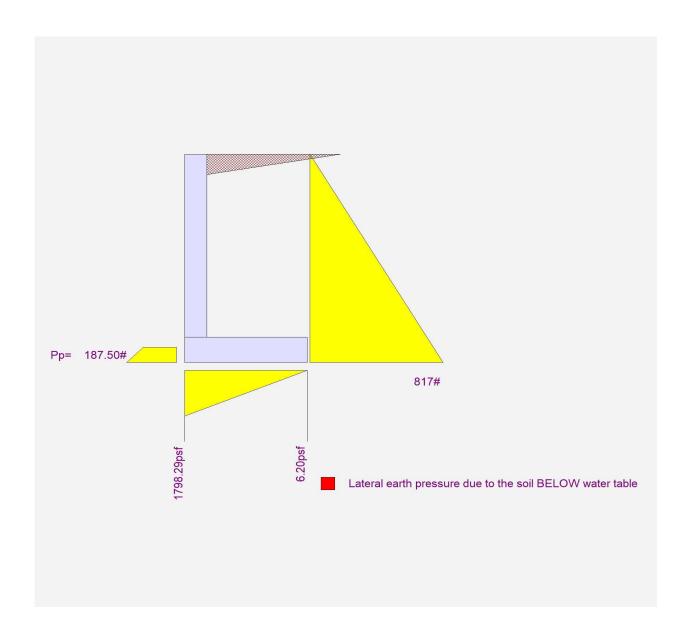
Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30

Project File: arvind.ec6

SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - 6 ft



Cantilevered Retaining Wall

LIC# : KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 6 ft

Code Reference.

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

Criteria

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

Soil Data

Allow Soil Bearing Equivalent Fluid Pressure		2,667.0 psf
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	125.00 pcf
Footing Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in

Project File: arvind.ec6

Surcharge Loads

Surcharge Over Heel	= 0.0 ps	sf
Used To Resist Sliding 8	& Overturning	
Surcharge Over Toe	= 0.0	
Used for Sliding & Overt	turning	

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 = 11.000
(Multiplier used on soil density)

Lateral Load Applied to Stem

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

Uniform Seismic Force = 75.167 Total Seismic Force = 513.639

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

Project File: arvind.ec6

Cantilevered Retaining Wall LIC#: KW-06014947, Build:20.22.6.30

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 6 ft

Design Summary			Stem Construction	_	Bottom			
			Design Height Above Ftg	 ft =	Stem OK 0.00			
Wall Stability Ratios			Wall Material Above "Ht"	=	Concrete			
Overturning	=	1.92 OK	Design Method	=	SD	SD	SD	
Sliding	=	1.43 Ratio < 1.5	THICKHESS	=	8.00			
Global Stability	=	2.53	Rebar Size	=	# 4			
			Rebar Spacing	=	12.00			
Total Bearing Load	=	3,311 lbs	Rebar Placed at	=	Edge			
resultant ecc.	_=	11.74 in	Design Data		0.622			
Eccentricity outside Soil Pressure @ Toe		ddle third 2,577 psf OK	fb/FB + fa/Fa Total Force @ Section	=	0.022			
Soil Pressure @ Heel	=	0 psf OK		п				
Allowable	_	2,667 _{psf}	Service Level	lbs =	4 450 0			
Soil Pressure Less	_		Strength Level MomentActual	lbs =	1,459.0			
ACI Factored @ Toe	=	3,608 psf		ft-# =				
ACI Factored @ Heel	=	0 psf	Strength Level	ft-# =	2 260 0			
Footing Shear @ Toe	=	0.0 psi OK	J		3,369.0			
Footing Shear @ Heel	=	6.8 psi OK	MomentAllowable	=	5,412.6			
Allowable	=	75.0 psi	ShearActual					
			Service Level	psi =				
Sliding Calcs			Strength Level	psi=	19.5			
Lateral Sliding Force	=	1,176.7 lbs	ShearAllowable	psi=	75.0			
less 100% Passive Force	e -	187.5 lbs	Anet (Masonry)	in2 =				
less 100% Friction Force	= -	1,490.1 lbs	Wall Weight	psf=	100.0			
Added Force Req'd	=	0.0 lbs OK	Rebar Depth 'd'	in=	6.25			
for 1.5 Stability	=	87.5 lbs NG	·					
			Masonry Data					
Vertical component of active			f'm	psi=				
NOT considered in the calcu	ulation	n of soil bearing	Fs	psi=				
L 1 F (Solid Grouting	=				
Load Factors Building Code			Modular Ratio 'n'	=				
Dead Load		1.200	Equiv. Solid Thick.	=				
Live Load		1.600	Masonry Block Type	=	400			
Earth, H		1.600	Masonry Design Method	=	ASD			
Wind, W		1.600	Concrete Data f'c	psi=	2,500.0			
Seismic, E		1.000	Fy	psi =	2,500.0 60,000.0			
Colonilo, L		1.000	ı y	psi =	00,000.0			

Project File: arvind.ec6

Cantilevered Retaining Wall

LIC# : KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 6 ft

Concrete Stem Rebar Area Details

Bottom Stem <u>Vertical Reinforcing</u> <u>Horizontal Reinforcing</u>

As (based on applied moment): 0.1262 in2/ft

(4/3) * As: 0.1683 in2/ft Min Stem T&S Reinf Area 1.152 in2

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0018bh: 0.0018(12)(8): 0.1728 in2/ft Horizontal Reinforcing Options: One layer of : Two layers of : Required Area: 0.1728 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: 0.2 in2/ft #5@ 19.38 in #5@ 38.75 in Maximum Area: 0.8467 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Data

Cover @ Top

Toe Wid	lth	=	0.00 ft
Heel Wi	dth	=	3.67
Total Fo	oting Width	=	3.67
Footing	Thickness	=	10.00 in
Key Wid	lth	=	0.00 in
Key Dep	oth	=	0.00 in
Key Dis	tance from Toe	=	0.00 ft
f'c =			60,000 psi
Footing	Concrete Densit	y =	150.00 pcf
Min. As	%	=	0.0018

2.00

@ Btm.= 3.00 in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>	
Factored Pressure	=	3,608	0 psf	
Mu' : Upward	=	0	1,613 ft-#	
Mu': Downward	=	0	4,736 ft-#	
Mu: Design	=	0 OK	3,123 ft-#	OK
phiMn	=	19,803	10,215 ft-#	
Actual 1-Way Shear	=	0.00	6.79 psi	
Allow 1-Way Shear	=	0.00	75.00 psi	
Toe Reinforcing	=	Flush toe condi	tion. No reinfor	cina re

Toe Reinforcing = Flush toe condition. No reinforcing required.

Heel Reinforcing = # 5 @ 12.00 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: Flush toe condition. No reinforcing required.

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

If one layer of horizontal bars:

If two layers of horizontal bars:

#4@ 11.11 in #4@ 22.22 in #5@ 17.22 in #5@ 34.44 in #6@ 24.44 in #6@ 48.89 in

Arvind Residence Project Title: Engineer: ETC/RJA Project ID: 13271-2023-01 Project Descr: Site Retaining Walls

Project File: arvind.ec6

Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 6 ft

Summary of Overturning & Resisting Forces & Moments

	OVERTURNING						RESISTING		
Item		Force lbs	Distance ft	Moment ft-#	_		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water t	tbl)	817.2	2.28	1,861.3	Soil Over HL (ab. wat	er tbl)	2,252.5	2.17	4,884.2
HL Act Pres (be water the Hydrostatic Force	,			,	Soil Over HL (bel. wat Watre Table	ter tbl)		2.17	4,884.2
Buoyant Force	=				Sloped Soil Over Heel	=			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Load	= k			
Adjacent Footing Load	=				Axial Dead Load on St				
Added Lateral Load	=				* Axial Live Load on Ste	em =			
Load @ Stem Above S	oil =				Soil Over Toe	=			
Seismic Earth Load	=	359.5	3.42	1,228.5	Surcharge Over Toe	=			
	=				Stem Weight(s)	=	600.0	0.33	200.0
-		4 470 7		0.000.7	Earth @ Stem Transiti	ions=			
Total	=	1,176.7	O.T.M. =	3,089.7	Footing Weight	=	458.8	1.84	841.8
					Key Weight	=			
Resisting/Overturni	_		=	1.92	Vert. Component	=			
Vertical Loads used	for So	il Pressure	= 3,311.3	3 lbs	To	otal =	3,311.3 I	bs R.M.=	5,926.0
If seismic is included, t	the OT	M and slidir	g ratios		* Axial live load NOT inc resistance, but is inclu				overturning

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) 0.117 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

SWENSON SAY FAGET

Project File: arvind.ec6
(c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 6 ft

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

LIC#: KW-06014947, Build:20.22.6.30

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment = 18.72 in

Development length for #4 bar specified in this stem design segment = 14.40 in

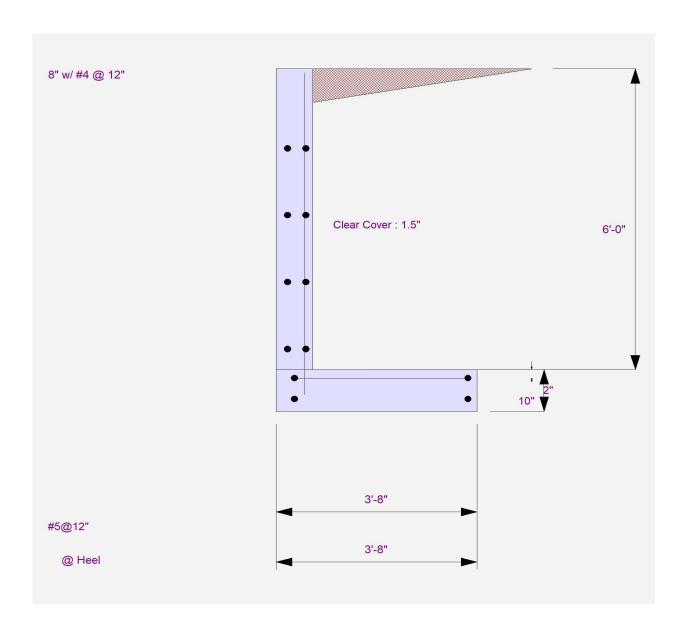
Hooked embedment length into footing for #4 bar specified in this stem design segment = 7.26 in As Provided = 0.2000 in2/ft As Required = 0.1728 in2/ft

Project File: arvind.ec6

Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 6 ft



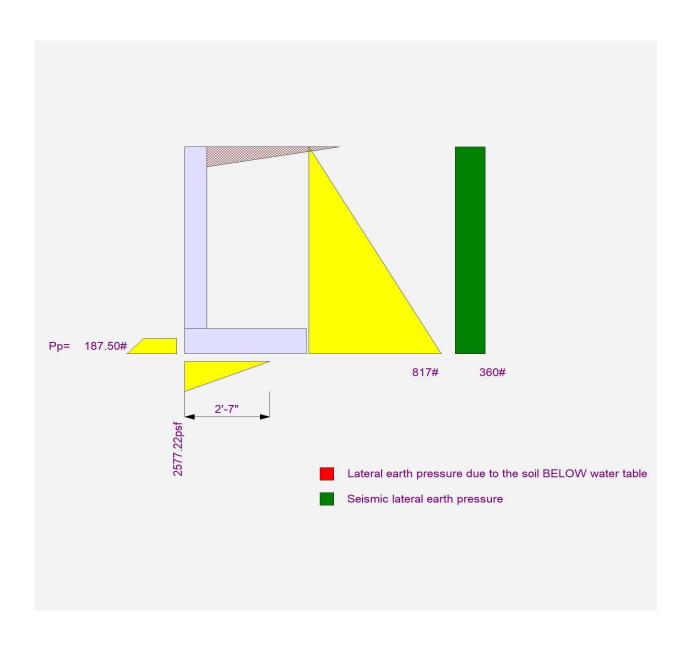
Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30

Project File: arvind.ec6

SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 6 ft



Cantilevered Retaining Wall

DESCRIPTION: Property Line - Seismic - 4 ft

Code Reference.

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

Criteria

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

Surcharge Loads

Surcharge Over Heel = 0.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe = 0.0 Used for Sliding & Overturning

Axial Load Applied to Stem

Earth Pressure Seismic Load

Method: Uniform

Multiplier Used = 11.000
(Multiplier used on soil density)

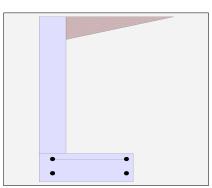
Soil Data

Allow Soil Bearing Equivalent Fluid Pressure		2,667.0 od	psf
Active Heel Pressure	=	35.0	psf/ft
	=		
Passive Pressure	=	300.0	psf/ft
Soil Density, Heel	=	125.00	pcf
Soil Density, Toe	=	125.00	pcf
Footing Soil Friction	=	0.450	
Soil height to ignore			
for passive pressure	=	12.00	in

Lateral Load Applied to Stem

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

Uniform Seismic Force = 53.167 Total Seismic Force = 256.972



Project File: arvind.ec6

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

Cantilevered Retaining Wall LIC#: KW-06014947, Build:20.22.6.30

SWENSON SAY FAGET

Project File: arvind.ec6
(c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 4 ft

Design Summary		S	tem Construction	_	Bottom			
			Design Height Above Ftg	 ft =	Stem OK 0.00			
Wall Stability Ratios			Wall Material Above "Ht"	=	Concrete			
Overturning	=	1.57 OK	Design Method	=	SD	SD	SD	
Sliding	=	1.48 Ratio < 1.5!	Thickness	=	8.00			
Global Stability	=	2.16	Rebar Size	=	# 4			
•			Rebar Spacing	=	12.00			
Total Bearing Load	=	1,523 lbs	Rebar Placed at	=	Edge			
resultant ecc.	=	9.05 in	Design Data		0.400			
Eccentricity outside			fb/FB + fa/Fa	=	0.188			
Soil Pressure @ Toe Soil Pressure @ Heel	=	2,472 psf OK 0 psf OK	Total Force @ Section					
Allowable	=	2,667 psf	Service Level	lbs =				
Soil Pressure Less			Strength Level	lbs =	660.7			
ACI Factored @ Toe	=	3,461 psf	MomentActual	ft-# =				
ACI Factored @ Heel	=	0 psf			4 000 7			
Footing Shear @ Toe	=	0.0 psi OK	3	ft-# =	1,022.7			
Footing Shear @ Heel	=	8.9 psi OK	MomentAllowable	=	5,412.6			
Allowable	=	75.0 psi	ShearActual					
		, and par	Service Level	psi =				
Sliding Calcs			Strength Level	psi =	8.8			
Lateral Sliding Force	=	588.7 lbs	ShearAllowable	psi =	75.0			
less 100% Passive Force		187.5 lbs	Anet (Masonry)	in2 =				
less 100% Friction Force	≡ -	685.3 lbs	Wall Weight	psf=	100.0			
Added Force Req'd	=	0.0 lbs OK	Rebar Depth 'd'	in=	6.25			
for 1.5 Stability	=	10.2 lbs NG	·					
			Masonry Data					
Vertical component of active			f'm —	psi=				
NOT considered in the calcu	ilation of	f soil bearing	Fs	psi=				
Load Factors			Solid Grouting	=				
Building Code			Modular Ratio 'n'	=				
Dead Load		1.200	Equiv. Solid Thick.	=				
Live Load		1.600	Masonry Block Type	=	ASD			
Earth, H		1.600	Masonry Design Method Concrete Data		AOD			
Wind, W		1.600	f'c	psi=	2,500.0			
Seismic, E		1.000	Fy	psi =	60,000.0			
			. ,	POI -	55,555.5			

Arvind Residence Project Title: Engineer: ETC/RJA 13271-2023-01 Project ID: Project Descr: Site Retaining Walls

Project File: arvind.ec6

Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 4 ft

Concrete Stem Rebar Area Details

Bottom Stem Horizontal Reinforcing Vertical Reinforcing

As (based on applied moment): 0.0383 in2/ft

(4/3) * As: 0.0511 in2/ft Min Stem T&S Reinf Area 0.768 in2

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0018bh: 0.0018(12)(8): 0.1728 in2/ft Horizontal Reinforcing Options: One layer of : Two layers of : 0.1728 in2/ft #4@ 12.50 in #4@ 25.00 in

Required Area: Provided Area: 0.2 in2/ft #5@ 19.38 in #5@ 38.75 in Maximum Area: 0.8467 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	0	.00 ft
Heel Width	=	2	.33
Total Footing Width	=	2	.33
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 =		00 psi
Footing Concrete Densi	ty =	150	.00 pcf
Min. As %	=	0.00	18
Cover @ Top 2.00	@	Btm.=	3.00 ir

Footing Design Results

		<u>Toe</u>	<u>Heel</u>	
Factored Pressure	=	3,461	0 psf	
Mu': Upward	=	0	85 ft-#	
Mu': Downward	=	0	1,038 ft-#	
Mu: Design	=	0 OK	953 ft-#	OK
phiMn	=	19,803	10,215 ft-#	
Actual 1-Way Shear	=	0.00	8.87 psi	
Allow 1-Way Shear	=	0.00	75.00 psi	
Toe Reinforcing	=	Flush toe condi	ition. No reinfor	cing req
Library Destructions		" F @ 40 00 '-		

quired.

Heel Reinforcing = #5 @ 12.00 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: Flush toe condition. No reinforcing required.

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

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

Arvind Residence Project Title: Engineer: ETC/RJA Project ID: 13271-2023-01 Project Descr: Site Retaining Walls

Project File: arvind.ec6

Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 4 ft

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)			RI	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#	_		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water th	ol)	408.8	1.61	658.7	Soil Over HL (ab. water	er tbl)	831.7	1.50	1,246.1
HL Act Pres (be water to Hydrostatic Force	,				Soil Over HL (bel. wate Watre Table	er tbl)		1.50	1,246.1
Buoyant Force	=				Sloped Soil Over Heel	=			
Surcharge over Heel	=				Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Load	=			
Adjacent Footing Load	=				Axial Dead Load on St				
Added Lateral Load	=				* Axial Live Load on Ster	m =			
Load @ Stem Above So	il =				Soil Over Toe	=			
Seismic Earth Load	=	179.9	2.42	434.7	Surcharge Over Toe	=			
	=				Stem Weight(s)	=	400.0	0.33	133.3
			- -		Earth @ Stem Transition	ons=			
Total	=	588.7	O.T.M. =	1,093.4	Footing Weight	=	291.3	1.17	339.3
					Key Weight	=			
Resisting/Overturning Ratio = 1.57					Vert. Component	=			
Vertical Loads used	for So	il Pressure	= 1,522.	9 lbs		otal =		bs R.M.=	1,718.8
If seismic is included, th	M and slidin	g ratios		 Axial live load NOT inc resistance, but is include 	luded in ded for s	total display soil pressure	ed, or used for calculation.	r overturning	

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) 0.118 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.

Project File: arvind.ec6

(c) ENERCALC INC 1983-2022

Cantilevered Retaining Wall

SWENSON SAY FAGET

DESCRIPTION: Property Line - Seismic - 4 ft

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

LIC#: KW-06014947, Build:20.22.6.30

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment = 18.72 in

Development length for #4 bar specified in this stem design segment = 14.40 in

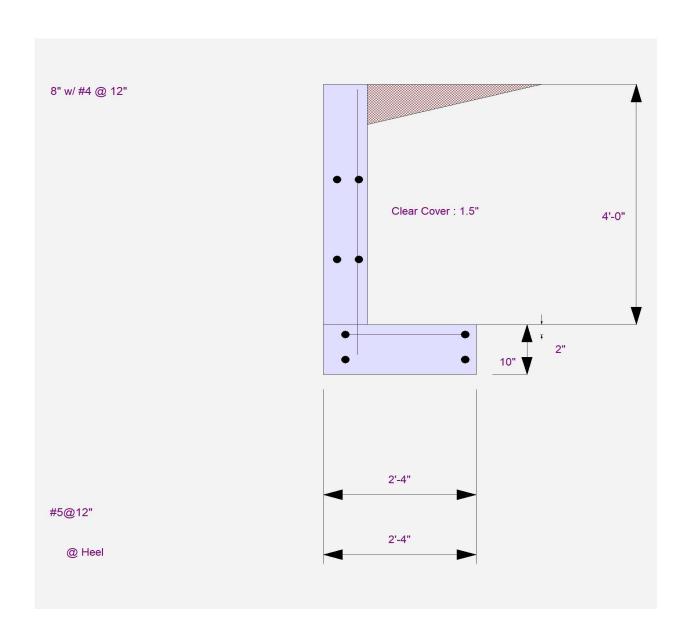
Hooked embedment length into footing for #4 bar specified in this stem design segment = 7.26 in
As Provided = 0.2000 in2/ft
As Required = 0.1728 in2/ft

Project File: arvind.ec6

Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 4 ft



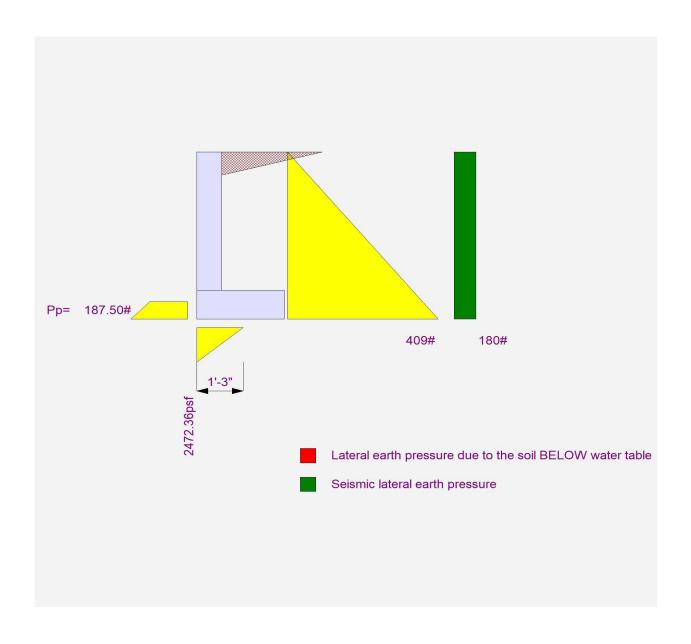
Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30

Project File: arvind.ec6

SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - Seismic - 4 ft



Cantilevered Retaining Wall

LIC# : KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - 4 ft

Code Reference

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

Criteria

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

Surcharge Loads

Surcharge Over Heel = 0.0 psf
Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0
Used for Sliding & Overturning

Axial Load Applied to Stem

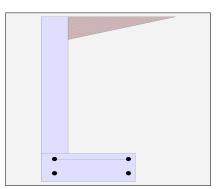
Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Soil Data

Allow Soil Bearing Equivalent Fluid Pressure		2,667.0 psf
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	125.00 pcf
Footing Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in

Lateral Load Applied to Stem

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



Project File: arvind.ec6

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

Project File: arvind.ec6

Cantilevered Retaining Wall LIC#: KW-06014947, Build:20.22.6.30

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - 4 ft

Design Summary			Stem Construction	_	Bottom		
			Design Height Above Ftg	 ft =	Stem OK 0.00		
Wall Stability Ratios			Wall Material Above "Ht"	=	Concrete		
Overturning	=	2.61 OK	Design Method	=	SD	SD	SD
Sliding	=	2.13 OK	Thickness	=	8.00	02	02
Global Stability	=	2.97	Rebar Size	=	# 4		
C.O.C. C.C.C			Rebar Spacing	=	12.00		
Total Bearing Load	=	1,523 lbs	Rebar Placed at	=	Edge		
resultant ecc.	=	5.63 in	Design Data ————				
Eccentricity outs	ide mic	ldle third	fb/FB + fa/Fa	=	0.110		
Soil Pressure @ Toe	=	1,459 psf OK	Total Force @ Section				
Soil Pressure @ Heel	=	0 psf OK	Service Level	lbs =			
Allowable	_=	2,667 psf	Strength Level	lbs =	448.0		
Soil Pressure Less			MomentActual				
ACI Factored @ Toe ACI Factored @ Heel	=	2,042 psf	Service Level	ft-# =			
	=	0 psf	Strength Level	ft-# =	597.3		
Footing Shear @ Toe	=	0.0 psi OK	MomentAllowable	=	5,412.6		
Footing Shear @ Heel	•	2.9 psi OK	ShearActual		,		
Allowable	=	= 75.0 psi	Service Level	psi=			
Oli dinana Ondon			Strength Level	psi =	6.0		
Sliding Calcs		400 0 11	ShearAllowable	psi =	75.0		
Lateral Sliding Force	=	408.8 lbs		•	75.0		
less 100% Passive Ford		187.5 lbs	Anet (Masonry)	in2 =	400.0		
less 100% Friction Force	_	685.3 lbs	Wall Weight	psf =	100.0		
Added Force Req'd	=	0.0 lbs OK	Rebar Depth 'd'	in =	6.25		
for 1.5 Stability	=	0.0 lbs OK	Masonry Data				
ertical component of activ	o lotor	ol acil proceura IC	f'm				
NOT considered in the calc		•	Fs	psi=			
101 considered in the calc	ulation	or son bearing	Solid Grouting	psi =			
Load Factors			Modular Ratio 'n'	=			
Building Code			Equiv. Solid Thick.	_			
Dead Load		1.200	Masonry Block Type	_			
Live Load		1.600	Masonry Design Method		ASD		
Earth, H		1.600	Concrete Data		,,,,,,		
Wind, W		1.600	f'c	psi=	2,500.0		
Seismic, E		1.000	Fy	psi =	60,000.0		

Project Title: Arvind Residence Engineer: ETC/RJA 13271-2023-01 Project ID: Project Descr: Site Retaining Walls

Project File: arvind.ec6

Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30 (c) ENERCALC INC 1983-2022 SWENSON SAY FAGET

DESCRIPTION: Property Line - 4 ft

Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing Horizontal Reinforcing

As (based on applied moment): 0.0224 in2/ft

(4/3) * As: 0.0298 in2/ft Min Stem T&S Reinf Area 0.768 in2

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0018bh: 0.0018(12)(8): 0.1728 in2/ft Horizontal Reinforcing Options: Two layers of : One layer of : #4@ 25.00 in Required Area: 0.1728 in2/ft #4@ 12.50 in Provided Area: 0.2 in2/ft #5@ 19.38 in #5@ 38.75 in Maximum Area: 0.8467 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width		=	0	.00 ft
Heel Width		=		.33
Total Footing Wid	dth	=	2	.33
Footing Thicknes	s	=	10.	.00 in
Key Width		=	0.	.00 in
Key Depth		=	0.	.00 in
Key Distance from	m Toe	=	0.	.00 ft
f'c = 2,500		Fy =		00 psi
Footing Concrete	Densit	y =		.00 pcf
Min. As %		=	0.00	18
Cover @ Top	2.00	@	Btm.=	3.00 in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>	
Factored Pressure	=	2,042	0 psf	
Mu' : Upward	=	0	468 ft-#	
Mu': Downward	=	0	1,038 ft-#	
Mu: Design	=	0 OK	569 ft-#	OK
phiMn	=	19,803	10,215 ft-#	
Actual 1-Way Shear	=	0.00	2.88 psi	
Allow 1-Way Shear	=	0.00	75.00 psi	
Toe Reinforcing	=	Flush toe condi	ition. No reinfor	cing req

quired.

Heel Reinforcing = #5@12.00 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: Flush toe condition. No reinforcing required.

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

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

Project File: arvind.ec6

Cantilevered Retaining Wall

DESCRIPTION: Property Line - 4 ft

Summary of Overturning & Resisting Forces & Moments

		OV Force	ERTURNING Distance	 Moment		RE	SISTING Distance	Moment
Item		lbs	ft	ft-#		lbs	ft	ft-#
HL Act Pres (ab water tb	d)	408.8	1.61	658.7	Soil Over HL (ab. water tbl)	831.7	1.50	1,246.1
HL Act Pres (be water to Hydrostatic Force	,				Soil Over HL (bel. water tbl) Watre Table		1.50	1,246.1
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=				Surcharge Over Heel =			
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=				* Axial Live Load on Stem =			
Load @ Stem Above So	il =				Soil Over Toe =			
	=				Surcharge Over Toe =			
					Stem Weight(s) =	400.0	0.33	133.3
					Earth @ Stem Transitions =			
Total	=	408.8	O.T.M. =	658.7	Footing Weight =	291.3	1.17	339.3
					Key Weight =			
Resisting/Overturnin	g Rat	io	=	2.61	Vert. Component =			
Vertical Loads used f	or So	il Pressure	= 1,522.9) lbs	Total =	1,522.9 lb	s R.M.=	1,718.8
					* Axial live load NOT included	in total displaye	d, or used fo	r overturning

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci Horizontal Defl @ Top of Wall (approximate only) 0.070 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

SWENSON SAY FAGET

Project File: arvind.ec6
(c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - 4 ft

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

LIC#: KW-06014947, Build:20.22.6.30

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment = 18.72 in

Development length for #4 bar specified in this stem design segment = 14.40 in

Hooked embedment length into footing for #4 bar specified in this stem design segment = 7.26 in

As Provided = 0.2000 in2/ft

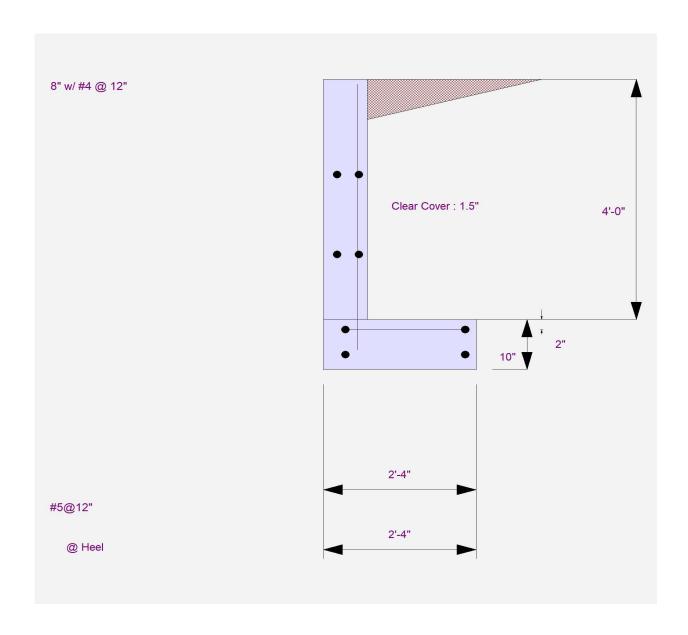
As Required = 0.1728 in2/ft

Project File: arvind.ec6

Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - 4 ft



Project File: arvind.ec6

Cantilevered Retaining Wall

LIC#: KW-06014947, Build:20.22.6.30 SWENSON SAY FAGET (c) ENERCALC INC 1983-2022

DESCRIPTION: Property Line - 4 ft

