

**Structural Calculations**

for

**NEW SINGLE-FAMILY DWELLING**

**Asdourian Residence**

5300 Butterworth Road

Mercer Island, WA 98040

*CYCLE 1 CORRECTION RESPONSE*

prepared by:

O.G. Engineering, PLLC

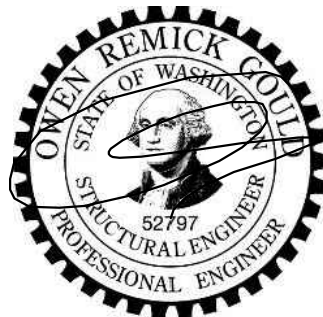
3201 1st Ave S, Ste 101

Seattle, WA, 98134

(206) 290-4608

Job No. 23010

Date: 5/15/24



REVISED ROOF FRAMING(A17) ROOF TENSILE STRENGTH RB14

$$P = \frac{SR}{(13+25)} \left( \frac{17\frac{1}{8}''}{2} \sqrt{\frac{17\frac{1}{8}''}{2}} \right) = \frac{1000}{2} + \frac{1919}{8} \text{ lb} \approx 51$$

SPAN = 10'6"

USE 3/4" x 9" LVL

REVISED FOUNDATIONSF12 GRADE BEAM / STEM WALL

LATERAL EARTH PRESSURES = 35 psf ACTIVE  
811 = 24 psf SURFACE

$$M_{STEM\ BASE} = \frac{(35 psf)(3')^3}{6} + \frac{(24 psf)(3')^2}{2} = \frac{160}{k} + \frac{110}{k} \frac{\#ft}{ft}$$

$$M_u = 1.6 \times 160 + 1.0 \times 110 = 371 \frac{\#ft}{ft} = 4.4 \frac{k \cdot in}{ft}$$

USE 8" STEM w/ #4 @ 12 VERT

$$a = \frac{A_s F_y}{0.85 f'_c b} = \frac{(0.2 in^2)(60 ksi)}{0.85 \times 3 ksi \times 12"} = 0.39"$$

$$\begin{aligned} \phi M_n &= \phi [A_s f_y (d - a/2)] = 0.9 [(0.2 \times 60) / (5.75" - \frac{0.39"}{2})] \\ &= 60 \frac{k \cdot in}{ft} > M_u \quad \underline{\underline{OK}} \end{aligned}$$

C5G1 DECK PATIO SLAB CANTILEVER

CANTILEVER = 6' max w/  $\frac{110+60}{20} \frac{\#ft}{ft}$

$$M_{max} = \frac{wL^2}{2} = \frac{(110+60)(6')^2}{2} = \frac{1980+1180}{k} \frac{\#ft}{ft}$$

$$M_u = 1.2 \times 1980 + 1.6 \times 1180 = 4100 \frac{\#ft}{ft} = 49.2 \frac{k \cdot in}{ft}$$

USE 8" SLAB w/ #5 @ 12 TOP BARS

$$a = 0.6" \rightarrow \phi M_n = 90.2 \frac{k \cdot in}{ft} > M_u \quad \underline{\underline{OK}}$$

**Multiple Simple Beam**

Project File: 23010\_ASD.ec6

LIC# : KW-06018000, Build:20.24.03.04

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**Description :** Revised Roof Framing

**Wood Beam Design :** RH7 - Roof Header Supporting RB14

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

BEAM Size : **3.5x9, GLB, Fully Braced**

Using Allowable Stress Design with IBC 2021 Load Combinations, Major Axis Bending

Wood Species : DF/DF

Wood Grade : 24F-V8

Fb - Tension	2400 psi	Fc - Prll	1650 psi	Fv	265 psi	Ebend- xx	1800 ksi	Density	31.21 pcf
Fb - Compr	2400 psi	Fc - Perp	650 psi	Ft	1100 psi	Eminbend - xx	950 ksi		

Applied Loads

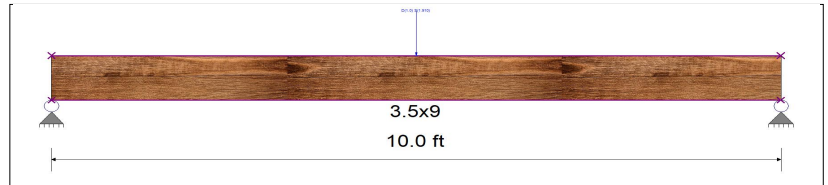
1Point: D = 1.0, S = 1.910 k @ 5.0 ft

Design Summary

Max fb/Fb Ratio = **0.669** : 1  
 fb : Actual : 1,847.62 psi at 5.000 ft in Span # 1  
 Fb : Allowable : 2,760.00 psi  
 Load Comb : +D+S

Max fv/FvRatio = **0.227** : 1  
 fv : Actual : 69.29 psi at 0.000 ft in Span # 1  
 Fv : Allowable : 304.75 psi  
 Load Comb : +D+S

Max Reactions (k)	<u>D</u>	<u>Lr</u>	<u>L</u>	<u>S</u>	<u>W</u>	<u>E</u>	<u>H</u>
Left Support	0.50			0.96			
Right Support	0.50			0.96			



Max Deflections

Transient Downward	0.181 in	Total Downward	0.275 in
Ratio	664	Ratio	436
LC: S Only			
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
LC: LC:			

**Cantilevered Retaining Wall**

Project File: 23010\_ASD.ec6

LIC# : KW-06018000, Build:20.24.03.04

O.G. ENGINEERING, PLLC

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**DESCRIPTION:** North Site Wall (3'-0" max. retained height)

**Code Reference:**

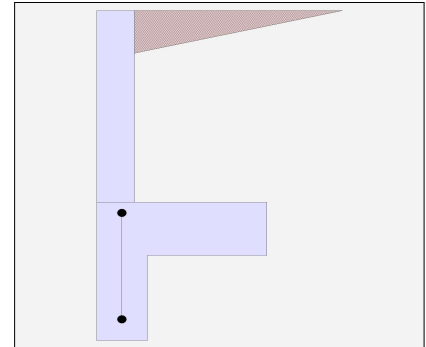
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

**Criteria**

Retained Height	=	3.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water table above bottom of footing	=	0.0 ft

**Soil Data**

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	45.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing  Soil Friction	=	0.000
Soil height to ignore for passive pressure	=	0.00 in



**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

**Lateral Load Applied to Stem**

Lateral Load	=	24.0 #/ft
...Height to Top	=	3.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

**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**

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**DESCRIPTION:** North Site Wall (3'-0" max. retained height)

**Design Summary**

**Wall Stability Ratios**

Overturning	=	2.24	OK
Sliding	=	1.54	OK
Global Stability	=	2.04	
Total Bearing Load	=	1,340 lbs	
...resultant ecc.	=	6.88 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,472 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,060 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	0.0 psi	OK
Footing Shear @ Heel	=	1.3 psi	OK
Allowable	=	82.2 psi	

**Sliding Calcs**

Lateral Sliding Force	=	381.0 lbs	
less 100% Passive Force	=	586.8 lbs	
less 100% Friction Force	=	0.0 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**

**Design Height Above Ftg**

ft =	Stem OK	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	SD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	3.75 i

**Design Data**

fb/FB + fa/Fa	=	0.135
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**Total Force @ Section**

Service Level	lbs =	
Strength Level	lbs =	396.0

**Moment....Actual**

Service Level	ft-# =	
Strength Level	ft-# =	432.0

Moment.....Allowable	=	3,198.0
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**Shear.....Actual**

Service Level	psi =	
Strength Level	psi =	8.8

Shear.....Allowable	psi =	82.2
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Anet (Masonry)	in2 =	
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Wall Weight	psf =	75.0
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Rebar Depth 'd'	in =	3.75
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**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 =	3,000.0
Fy	psi =	60,000.0

**Bottom**

SD SD SD SD SD

**Cantilevered Retaining Wall**

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**DESCRIPTION:** North Site Wall (3'-0" max. retained height)

**Concrete Stem Rebar Area Details**

	Vertical Reinforcing	Horizontal Reinforcing	
Bottom Stem			
As (based on applied moment) :	0.028 in2/ft		
(4/3) * As :	0.0373 in2/ft	Min Stem T&S Reinf Area 0.432 in2	
200bd/fy : 200(12)(3.75)/60000 :	0.15 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 :	
	=====	<u>One layer of :</u> <u>Two layers of :</u>	
Required Area :	0.1296 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.6096 in2/ft	#6@ 36.67 in	#6@ 73.33 in

**Footing Data**

Toe Width	=	0.00 ft
Heel Width	=	2.25
Total Footing Width	=	2.25
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	16.00 in
Key Distance from Toe	=	0.00 ft
f'c = 3,000 psi	Fy = 60,000 psi	
Footing Concrete Density = 150.00 pcf		
Min. As % = 0.0018		
Cover @ Top 2.00	@ Btm. = 3.00 in	

**Footing Design Results**

	Toe	Heel	Key	
Factored Pressure	= 2,060	0		psf
Mu' : Upward	= 0	319		ft-#
Mu' : Downward	= 0	836		ft-#
Mu: Design	= 0	517	533	ft-#
phiMn	= OK - Flush	1,753	3,424	
Actual 1-Way Shear	= 0.00	1.31	16.67	psi
Allow 1-Way Shear	= 0.00	43.82	82.16	psi
Toe Reinforcing	= Flush toe condition. No reinforcing required.			
Heel Reinforcing	= None Spec'd			
Key Reinforcing	= # 4 @ 12.00 in			
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:  $\phi Mn = \phi * 5 * \lambda * \sqrt{fc} * S_m$

Key: #4@ 13.88 in, #5@ 18 in, #6@ 18 in, #7@ 18 in

Min footing T&S reinf Area	0.49	in2
Min footing T&S reinf Area per foot	0.22	in2 /ft
<u>If one layer of horizontal bars:</u>		<u>If two layers of horizontal bars:</u>
#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**

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LIC# : KW-06018000, Build:20.24.03.04

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**DESCRIPTION:** North Site Wall (3'-0" max. retained height)

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....				.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	330.6	1.28	422.5	Soil Over HL (ab. water tbl)	577.5	1.38	794.1
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		1.38	794.1
Hydrostatic Force				Water 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 =	50.4	2.33	117.6	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =			
				Surcharge Over Toe =			
				Stem Weight(s) =	225.0	0.25	56.3
				Earth @ Stem Transitions =			
<b>Total</b>	= 381.0	<b>O.T.M.</b>	= 540.1	Footing Weight =	281.3	1.13	316.4
				Key Weight =	133.3	0.33	44.4
				Vert. Component =			
<b>Resisting/Overturning Ratio</b>		=	<b>2.24</b>	<b>Total =</b>	<b>1,217.1 lbs</b>	<b>R.M.=</b>	<b>1,211.2</b>
Vertical Loads used for Soil Pressure =		1,339.9 lbs		* 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 100.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.136 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

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LIC# : KW-06018000, Build:20.24.03.04

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**DESCRIPTION:** North Site Wall (3'-0" max. retained height)

### 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) = 17.09 in

Development length for #4 bar specified in this stem design segment = 13.15 in

Hooked embedment length into footing for #4 bar specified in this stem design segment = 6.00 in

As Provided = 0.2000 in<sup>2</sup>/ft

As Required = 0.1296 in<sup>2</sup>/ft

### Cantilevered Retaining Wall

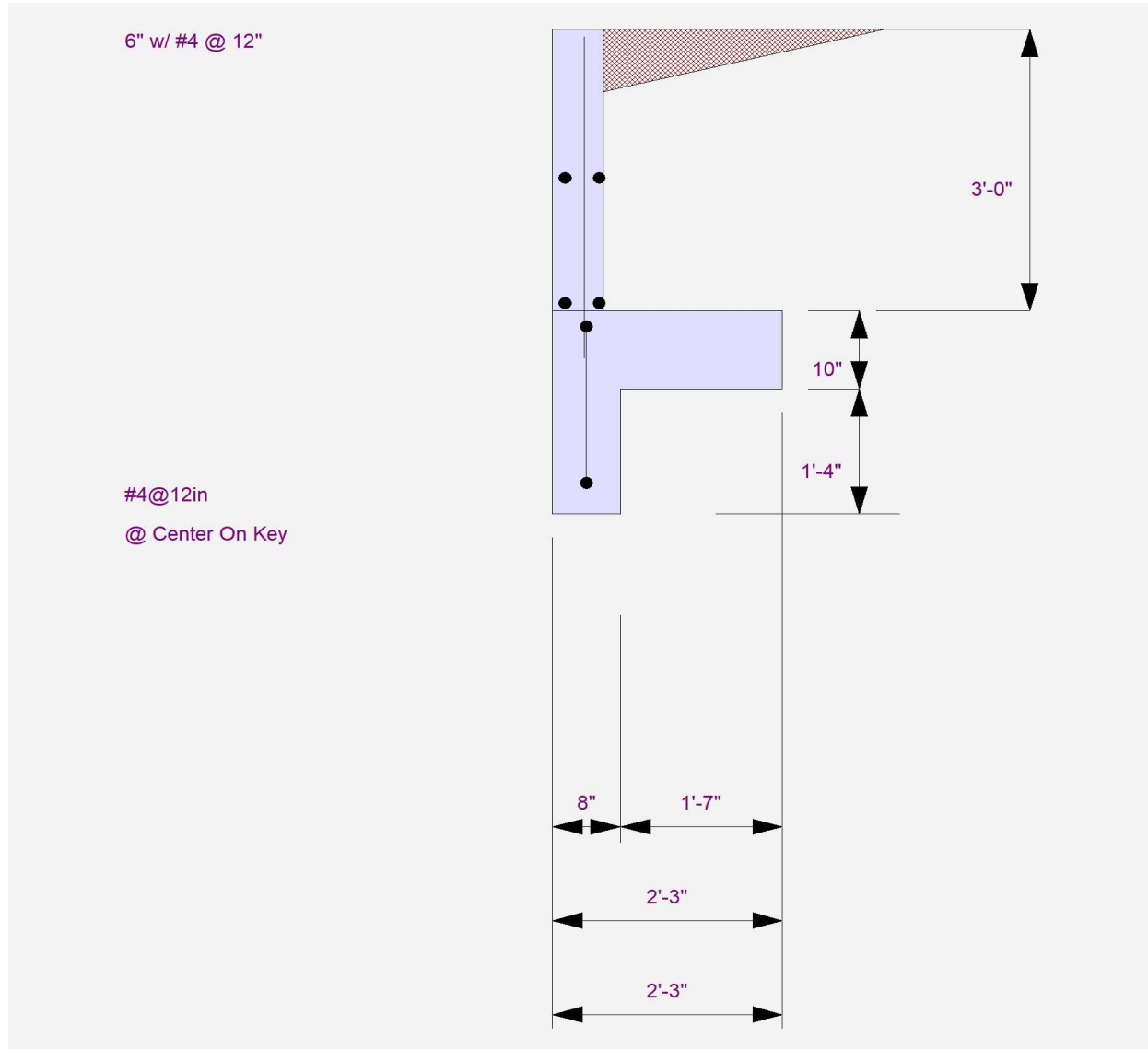
Project File: 23010\_ASD.ec6

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### Cantilevered Retaining Wall

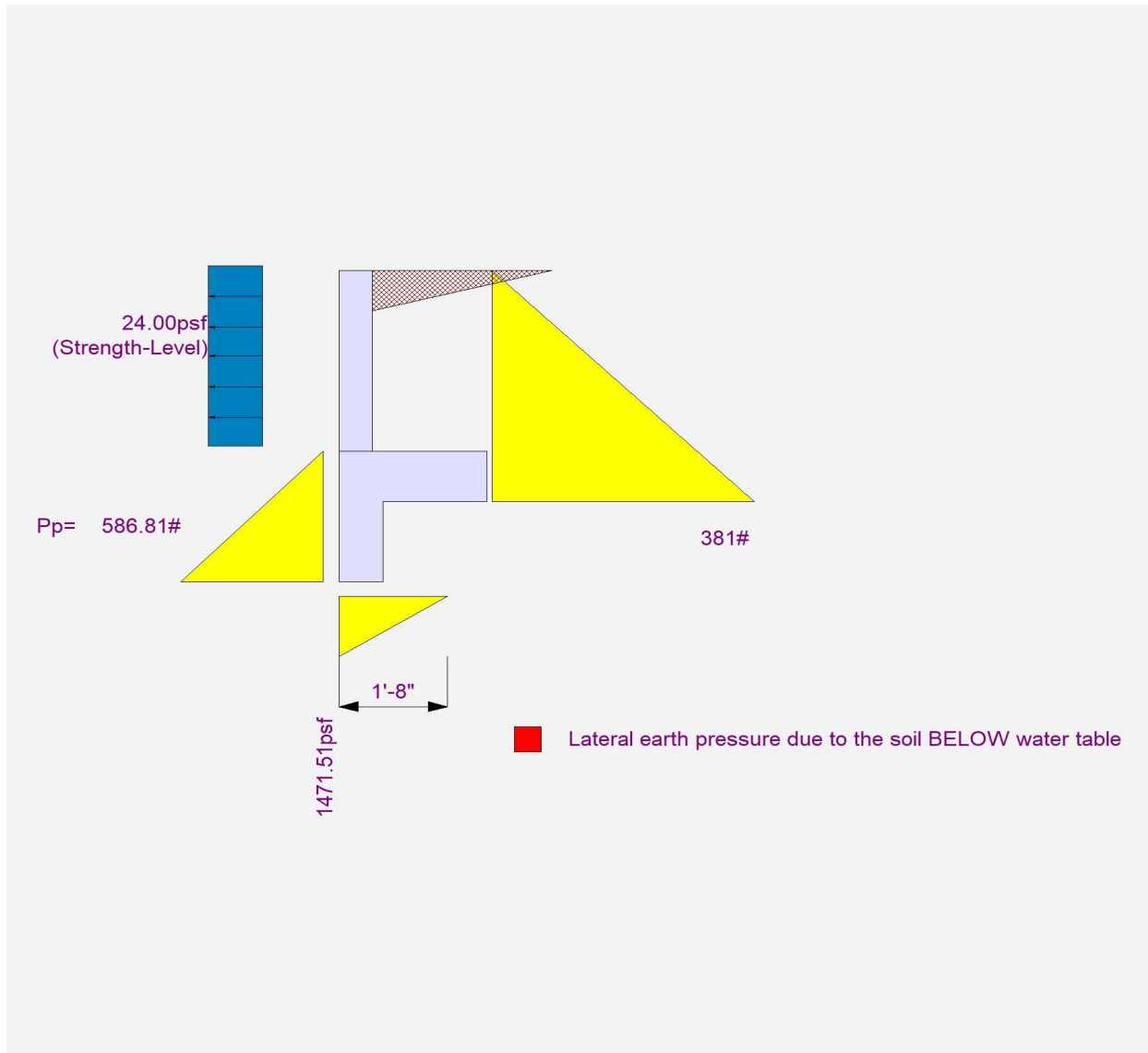
Project File: 23010\_ASD.ec6

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**DESCRIPTION:** North Site Wall (3'-0" max. retained height)



**Cantilevered Retaining Wall**

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LIC# : KW-06018000, Build:20.24.03.04

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**DESCRIPTION:** North Site Wall (2'-0" max. retained height)

**Code Reference:**

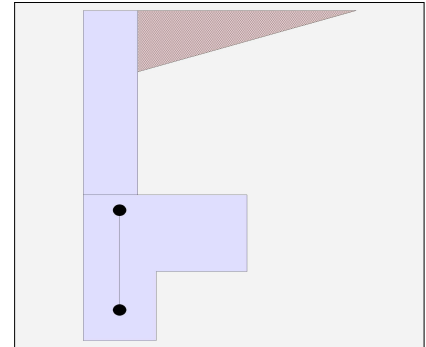
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

**Criteria**

Retained Height	=	2.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water table above bottom of footing	=	0.0 ft

**Soil Data**

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	45.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing  Soil Friction	=	0.000
Soil height to ignore for passive pressure	=	0.00 in



**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

**Lateral Load Applied to Stem**

Lateral Load	=	16.0 #/ft
...Height to Top	=	2.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Service Level)

**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**

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**Design Summary**

**Wall Stability Ratios**

Overturning	=	2.00	OK
Sliding	=	1.54	OK
Global Stability	=	2.35	
Total Bearing Load	=	700 lbs	
...resultant ecc.	=	4.99 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,261 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,766 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	0.0 psi	OK
Footing Shear @ Heel	=	2.0 psi	OK
Allowable	=	82.2 psi	

**Sliding Calcs**

Lateral Sliding Force	=	203.0 lbs	
less 100% Passive Force	=	313.4 lbs	
less 100% Friction Force	=	0.0 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**

**Design Height Above Ftg**

ft =	0.00
Wall Material Above "Ht"	= Concrete
Design Method	= SD
Thickness	= 6.00
Rebar Size	= # 4
Rebar Spacing	= 12.00
Rebar Placed at	= 3.75 i

**Design Data**

fb/FB + fa/Fa	=	0.040
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**Total Force @ Section**

Service Level	lbs =	
Strength Level	lbs =	176.0

**Moment....Actual**

Service Level	ft-# =	
Strength Level	ft-# =	128.0

Moment.....Allowable	=	3,198.0
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**Shear.....Actual**

Service Level	psi =	
Strength Level	psi =	3.9

Shear.....Allowable	psi =	82.2
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Anet (Masonry)	in2 =	
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Wall Weight	psf =	75.0
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Rebar Depth 'd'	in =	3.75
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**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 =	3,000.0
Fy	psi =	60,000.0

**Bottom**

Stem OK					
Concrete					
SD	SD	SD	SD	SD	SD

**Cantilevered Retaining Wall**

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LIC# : KW-06018000, Build:20.24.03.04

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**DESCRIPTION:** North Site Wall (2'-0" max. retained height)

**Concrete Stem Rebar Area Details**

	Vertical Reinforcing	Horizontal Reinforcing
Bottom Stem		
As (based on applied moment) :	0.0083 in2/ft	
(4/3) * As :	0.0111 in2/ft	Min Stem T&S Reinf Area 0.288 in2
200bd/fy : 200(12)(3.75)/60000 :	0.15 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 :
	=====	<u>One layer of :</u> <u>Two layers of :</u>
Required Area :	0.1296 in2/ft	#4@ 16.67 in    #4@ 33.33 in
Provided Area :	0.2 in2/ft	#5@ 25.83 in    #5@ 51.67 in
Maximum Area :	0.6096 in2/ft	#6@ 36.67 in    #6@ 73.33 in

**Footing Data**

Toe Width	=	0.00 ft
Heel Width	=	1.50
Total Footing Width	=	1.50
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	9.00 in
Key Distance from Toe	=	0.00 ft
f'c = 3,000 psi	Fy = 60,000 psi	
Footing Concrete Density = 150.00 pcf		
Min. As % = 0.0018		
Cover @ Top 2.00	@ Btm. = 3.00 in	

**Footing Design Results**

	Toe	Heel	Key	
Factored Pressure	= 1,766	0		psf
Mu' : Upward	= 0	37		ft-#
Mu' : Downward	= 0	207		ft-#
Mu: Design	= 0	170		136 ft-#
phiMn	= OK - Flush	1,753		3,424
Actual 1-Way Shear	= 0.00	1.99		7.55 psi
Allow 1-Way Shear	= 0.00	43.82		82.16 psi
Toe Reinforcing	= Flush toe condition. No reinforcing required.			
Heel Reinforcing	= None Spec'd			
Key Reinforcing	= # 4 @ 12.00 in			
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:  $\phi Mn = \phi * 5 * \lambda * \sqrt{fc} * Sm$

Key: #4@ 13.88 in, #5@ 18 in, #6@ 18 in, #7@ 18 in

Min footing T&S reinf Area	0.32 in2
Min footing T&S reinf Area per foot	0.22 in2 /ft
<u>If one layer of horizontal bars:</u>	<u>If two layers of horizontal bars:</u>
#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

Project File: 23010\_ASD.ec6

LIC# : KW-06018000, Build:20.24.03.04

O.G. ENGINEERING, PLLC

(c) ENERCALC INC 1983-2023

**DESCRIPTION:** North Site Wall (2'-0" max. retained height)

### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
HL Act Pres (ab water tbl)	180.6	0.94	170.6	Soil Over HL (ab. water tbl)	220.0	1.00	220.0
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		1.00	220.0
Hydrostatic Force				Water 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 =	22.4	1.83	41.1	* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =			
				Surcharge Over Toe =			
				Stem Weight(s) =	150.0	0.25	37.5
				Earth @ Stem Transitions =			
<b>Total</b>	<b>= 203.0</b>	<b>O.T.M. =</b>	<b>211.7</b>	Footing Weight =	187.5	0.75	140.6
				Key Weight =	75.0	0.33	25.0
				Vert. Component =			
<b>Resisting/Overturning Ratio</b>		<b>= 2.00</b>		<b>Total =</b>	<b>632.5 lbs</b>	<b>R.M.=</b>	<b>423.1</b>
Vertical Loads used for Soil Pressure =		699.6 lbs		* 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 100.0 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

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**DESCRIPTION:** North Site Wall (2'-0" max. retained height)

### 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) = 17.09 in

Development length for #4 bar specified in this stem design segment = 13.15 in

Hooked embedment length into footing for #4 bar specified in this stem design segment = 6.00 in

As Provided = 0.2000 in<sup>2</sup>/ft

As Required = 0.1296 in<sup>2</sup>/ft



**Cantilevered Retaining Wall**

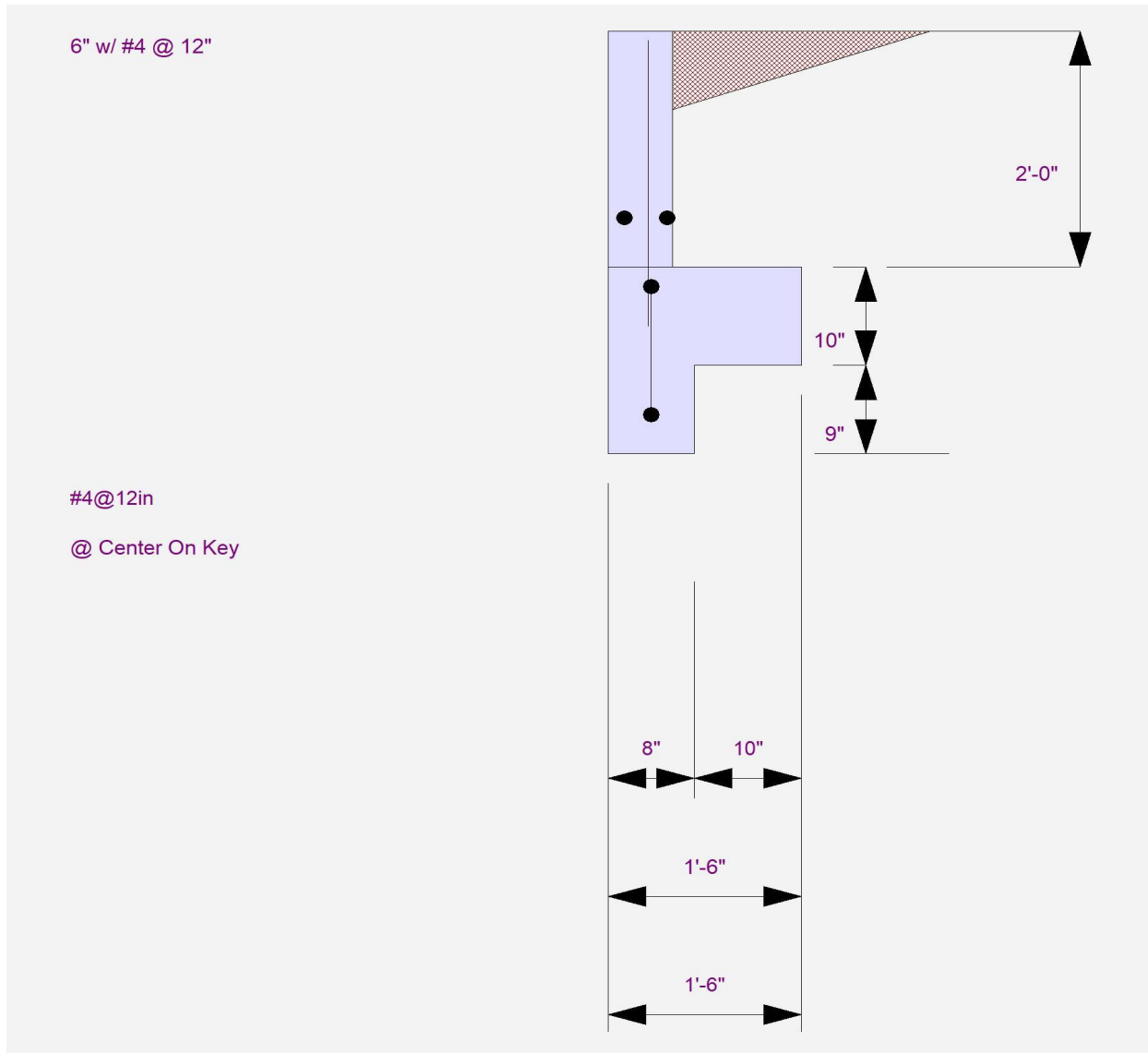
Project File: 23010\_ASD.ec6

LIC# : KW-06018000, Build:20.24.03.04

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**DESCRIPTION:** North Site Wall (2'-0" max. retained height)



### Cantilevered Retaining Wall

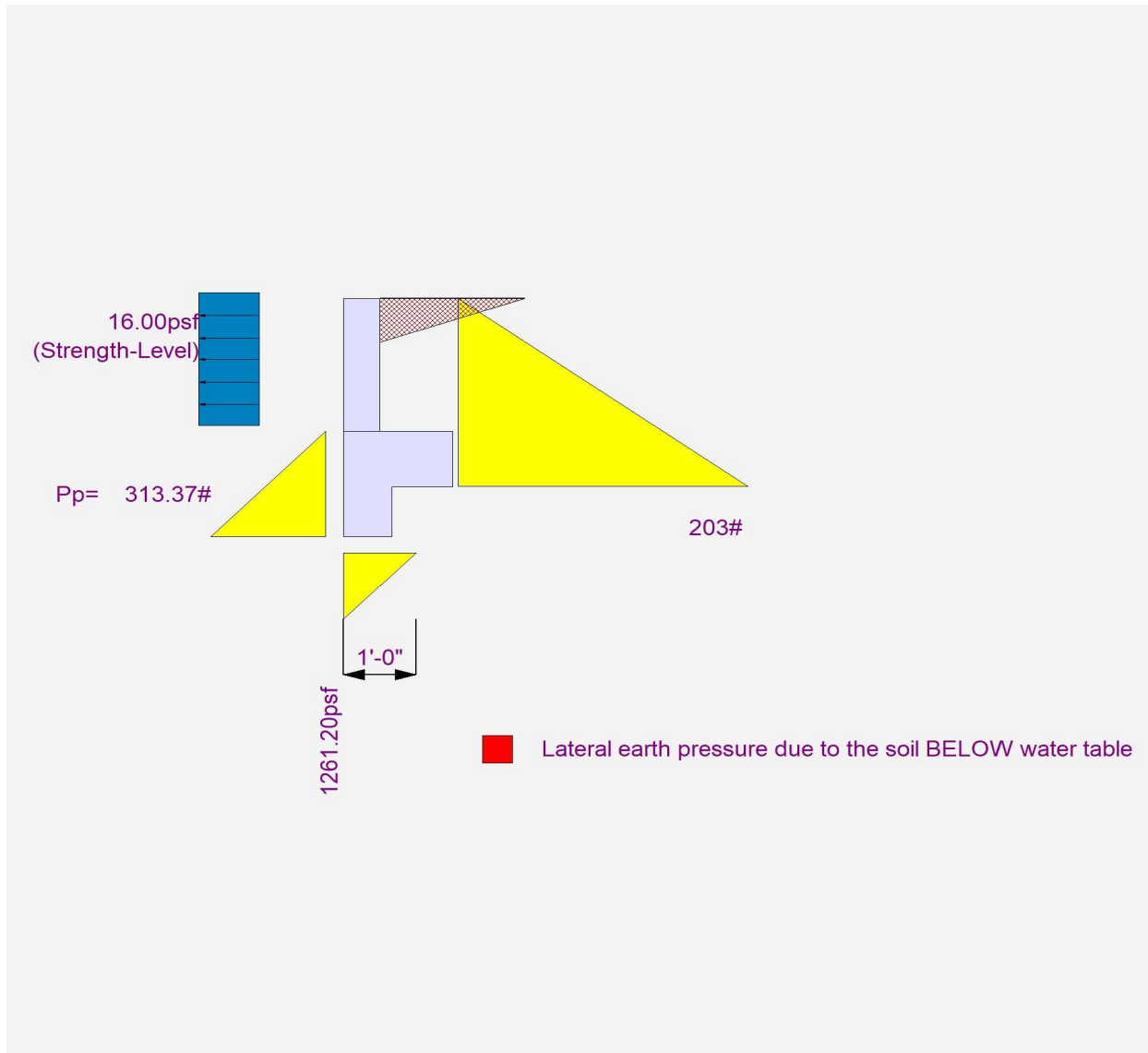
Project File: 23010\_ASD.ec6

LIC# : KW-06018000, Build:20.24.03.04

O.G. ENGINEERING, PLLC

(c) ENERCALC INC 1983-2023

**DESCRIPTION:** North Site Wall (2'-0" max. retained height)



REVISED SHEAR WALLS

Upper Floor Diaphragm

Walls in North-South Direction												
Wall	L (ft)	h (ft)	A <sub>T</sub> (sf)	Wall <sub>abv</sub> <sup>1</sup>	V <sub>abv</sub> <sup>2</sup> (lbs)	V <sub>cur</sub> <sup>3</sup> (lbs)	V <sup>4</sup> (lb)	v <sup>5</sup> (plf)	Wall Mark	h>2L?	2xL/h <sup>6</sup>	Capacity (plf)
MF.1	11.5	9	470	UF.1	2350	1422	3772	328	2	no	1	460
MF.2.1	6	9	188	UF.2	1164	570	1734	289	1	no	1	310
MF.2.2	6	9	188	UF.2	1164	570	1734	289	1	no	1	310
MF.2.3	4.25	9	133	UF.3	825	404	1228	289	1	yes	0.94	293
MF.28	11.25	10	160	none	0	484	484	43	1	no	1	310
MF.3.1	3	10	100	UF.3.1	287	303	589	196	2	yes	0.60	276
MF.3.2	3	10	100	UF.3.2	287	303	589	196	2	yes	0.60	276
MF.32.1	3	10	95	UF.32.1	229	287	517	172	2	yes	0.60	276
MF.32.2	3	10	95	UF.32.2	229	287	517	172	2	yes	0.60	276
MF.35.1*	10.75	10	70	UF.35	1232	211	1442	321	2	no	1	460
MF.35.2	11	10	170	UF.35	3010	515	3526	321	2	no	1	460
MF.4.1	7.5	10	605	UF.4	4502	1832	6334	845	4 STRUCT 1	no	1	870
MF.4.2	6.25	10	505	UF.4	3752	1526	5279	845	4 STRUCT 1	no	1	870
MF.46	7.75	10	900	none	0	2723	2723	351	2	no	1	460
MF.48.1	WSWH24	10	170	UF.5.1	1204	514	1718	N/A	WSWH24	N/A	N/A	4010 LBS
MF.48.2	WSWH24	10	170	UF.5.2	1204	514	1718	N/A	WSWH24	N/A	N/A	4010 LBS
MF.5.1	3	10	110	UF.6.1	745	333	1078	359	3	yes	0.60	360
MF.5.2	3	10	110	UF.6.2	745	333	1078	359	3	yes	0.60	360
MF.6.1	3	10	230	UF.6.3	803	696	1498	499	DBL 2	yes	0.60	552
MF.6.2	3	10	230	UF.6.4	803	696	1498	499	DBL 2	yes	0.60	552
MF.64.1	WSWH12	10	70	none	0	212	212	N/A	WSWH12	N/A	N/A	700 LBS
MF.64.2	WSWH12	10	70	none	0	212	212	N/A	WSWH12	N/A	N/A	700 LBS
MF.7.1	WSWH12	10	150	none	0	454	454	N/A	WSWH12	N/A	N/A	700 LBS
MF.7.2	WSWH12	10	150	none	0	454	454	N/A	WSWH12	N/A	N/A	700 LBS
MF.7.3	WSWH12	10	50	none	0	151	151	N/A	WSWH12	N/A	N/A	700 LBS
MF.7.4	WSWH12	10	50	none	0	151	151	N/A	WSWH12	N/A	N/A	700 LBS

Holdowns for Walls in North-South Direction										
Wall	OTM' (lb-ft)	w <sub>DL</sub> <sup>8</sup> (plf)	P <sub>DLEND</sub> <sup>9</sup> (lb)	RM <sup>10</sup> (lb-ft)	T <sub>end</sub> <sup>11</sup> (lb)	T <sub>abv</sub> <sup>12</sup> (lb)	T <sup>13</sup> (lb)	Holdown	Capacity	
MF.1	33950	100	400	4922	2524	2524	2524	HDU2	3075	
MF.2.1	15604	70	280	1291	2386		2386	HDU2	3075	
MF.2.2	15604	70	280	1291	2386	2944	5330	HDU5	5645	
MF.2.3	11053	70	280	800	2412	2983	5395	HDU5	5645	
MF.28	4841	70	280	3327	135		135	NONE	#N/A	
MF.3.1	5892	100	400	724	1722	691	2414	HDU2	3075	
MF.3.2	5892	100	400	724	1722	691	2414	HDU2	3075	
MF.32.1	5167	100	400	724	1481	491	1972	HDU2	3075	
MF.32.2	5167	100	400	724	1481	491	1972	HDU2	3075	
MF.35.1*	14423	100	400	4424	930		930	HDU2	3075	
MF.35.2	35257	70	280	3211	2913		2913	HDU2	3075	
MF.4.1	63342	70	280	1786	8207		8207	HDU11	9535	
MF.4.2	52785	70	280	1368	8227		8227	HDU11	9535	
MF.46	27228	250	250	4146	2978		2978	HDU2	3075	
MF.48.1	17181	N/A	N/A	N/A	N/A		11508	SB1x30	13090	
MF.48.2	17181	N/A	N/A	N/A	N/A		11508	SB1x30	13090	
MF.5.1	10780	100	400	724	3352		3352	HDU4	4565	
MF.5.2	10780	100	400	724	3352		3352	HDU4	4565	
MF.6.1	14984	220	880	1594	4463	2297	6760	HDU8	7870	
MF.6.2	14984	220	880	1594	4463	2297	6760	HDU8	7870	
MF.64.1	2118	N/A	N/A	N/A	N/A		3252	SB1x30	13090	
MF.64.2	2118	N/A	N/A	N/A	N/A		3252	SB1x30	13090	
MF.7.1	4538	N/A	N/A	N/A	N/A		6969	SB1x30	13090	
MF.7.2	4538	N/A	N/A	N/A	N/A		6969	SB1x30	13090	
MF.7.3	1513	N/A	N/A	N/A	N/A		2323	SB1x30	13090	
MF.7.4	1513	N/A	N/A	N/A	N/A		2323	SB1x30	13090	

Close enough