



Structural Calculations For:

Adams Cargotecture

3508 96th Ave SE

Mercer Island, WA 98040



Prepared for: Sam Adams

Job #: 13074-2022-01

Date: April 25, 2023



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Criteria Sheet

Codes

Structural IBC 2018
 Loading ASCE 7-16
 Wood: NDS 2018 / SDPWS 2015
 Steel: AISC 360-16
 Concrete: ACI 318-14
 Masonry: TMS 402/602-16

Project Location

Street & Number 3508 96th ave se
 City: Mercer Island State: WA
 ZIP: 98040
 Latitude: 47.5792 N
 Longitude: -122.2105 W
 Ground Elevation 85 ft

Occupancy Category

Risk Category: II ASCE 7 Table 1.5-1

Seismic Load Summary:

Analysis Procedure: Equivalent Lateral Force Procedure

Lateral System: Per Above

R: 3.00 $C_d = 3$
 Base Shear V = 62 kips $\Omega_o = 2.5$
 $S_s = 1.395$ $S_1 = 0.486$
 $S_{DS} = 1.12$ $S_{DI} = 0.88$
 $C_s = 0.372$ $I_E = 1.0$



Story Information

Stories Above Grade (Including Mezzanine Levels) 3

Horizontal and Vertical Irregularities:

Is the building a "Regular Structure"? (No horizontal or vertical irregularities) No

Wind Load Summary:

V = 98 $K_{ZT} = 1.00$
 Exposure = B

Dead Loads:

Roof		Floor	
Roofing	1 psf	Finish Floor	2 psf
1/2" Sheathing	1.8 psf	3/4" Sheathing	2.7 psf
Trusses @ 24" oc	2.5 psf	Joists @ 16" oc	2.2 psf
Misc./Mech.	1.5 psf	Misc./Mech.	2 psf
Ceiling Finish	2.8 psf	Ceiling Finish	2.8
Solar Panels	5 psf		11.7 psf
	15 psf	Use	12 psf
Use	15 psf	Add'l Seismic Weight	10 psf
Add'l Seismic Weight	5 psf	Seismic Weight	22 psf
Seismic Weight	20 psf		

Live Loads:

Roof	20 psf
Floor	40 psf
Deck	60 psf

Snow Loading Criteria:

Ground Snow, p_g	20 psf	Flat Roof Snow Load, p_f	25.0 psf	Importance Factor, I_s	1.00
Exposure Factor, C_e	1.00	Sloped Roof Snow Load, p_s	25.0 psf		
Thermal Factor, C_t	1.00	Slope Factor, C_s	0.61		

Soils:

Allowable Bearing	2000 psf	Active	55/35 pcf (Restrained/Unrestrained)
Sliding, μ	0.3	Seismic Surcharge	8H
Passive	250 pcf		

Soils Report Provided? No To be approved by the authority having jurisdiction, per 11.8.2 exception.

Site Specific Ground Motion Hazard Analysis Provided? No



Project _____
 Criteria _____

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 DESIGN ENG
 SHEET 1

Wind Design - MWFRS

ASCE 7 Chapter 27 - Directional Procedure

Design Method	ASD
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Wind Coefficients

Exposure	B	
V=	98	mph
K_d =	0.85	Table 26.6-1
K_e =	0.68	Table 26.10-1
K_g =	1.00	Table 26.9-1
G=	0.85	26.9.4

Transverse Wind Pressures

L/B = 0.50 h/L = 0.69

Pressure Coefficients from Figure 27.3-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.50
Windward Roof	-1.05 / -0.18
Leeward Roof	-0.58

Location and Building Dimensions

Calculate K_{zt} ?	Yes	
K_{zt}	1.00	
Roof Type	Monoslope	
Roof Slope - Transverse Dir	5	degrees
Roof Slope - Long Dir	0	degrees
Ground to top of roof	28	ft
Bot of roof to top of roof	1	ft
Mean Roof Height, h	27.5	ft
Short Plan Dimension	40	ft
Long Plan Dimension	80	ft
Parapet ?	No	
Ground to top of parapet		ft
Average Parapet Height		ft

Velocity Pressure at Mean Roof Height, q_h =	14.2	psf
--	------	-----

Wall Pressures (Unfactored):

ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lw\ walls}$	$P_{walls\ (psf)}$
0-15	0.57	11.88	8.08	6.05	9.6
15-20	0.62	12.92	8.78	6.05	9.6
20-25	0.66	13.75	9.35	6.05	9.6
25-30	0.7	14.58	9.92	6.05	9.6
30-40	0.76	15.83	10.77	6.05	10.1
41-50	0.81	16.88	11.48	6.05	10.5
51-60	0.85	17.71	12.04	6.05	10.9
61-70	0.89	18.54	12.61	6.05	11.2
71-80	0.93	19.38	13.18	6.05	11.5
81-90	0.96	20.00	13.60	6.05	11.8
91-100	0.99	20.63	14.03	6.05	12.0

Roof Pressures (Unfactored)

ASD

Windward		Leeward	Horiz Proj (psf)
Max	Min		
-2.2	-12.7	-7.0	4.80

Longitudinal Wind Pressures

L/B = 2.00 h/L = 0.34

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.30
Windward Roof	-0.9 / -0.18
Leeward Roof	-0.50

Wall Pressures (Unfactored):

ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lw\ walls}$	$P_{walls\ (psf)}$
0-15	0.57	11.88	8.08	3.63	9.60
15-20	0.62	12.92	8.78	3.63	9.60
20-25	0.66	13.75	9.35	3.63	9.60
25-30	0.7	14.58	9.92	3.63	9.60
30-40	0.76	15.83	10.77	3.63	9.60
41-50	0.81	16.88	11.48	3.63	9.60
51-60	0.85	17.71	12.04	3.63	9.60
61-70	0.89	18.54	12.61	3.63	9.74
71-80	0.93	19.38	13.18	3.63	10.08
81-90	0.96	20.00	13.60	3.63	10.34
91-100	0.99	20.63	14.03	3.63	10.59

Roof Pressures (Unfactored)

ASD

Windward		Leeward	Horiz Proj (psf)
Max	Min		
-2.2	-10.9	-6.1	4.80



Project _____
 Wind Criteria _____

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 DESIGN ENG
 SHEET 3

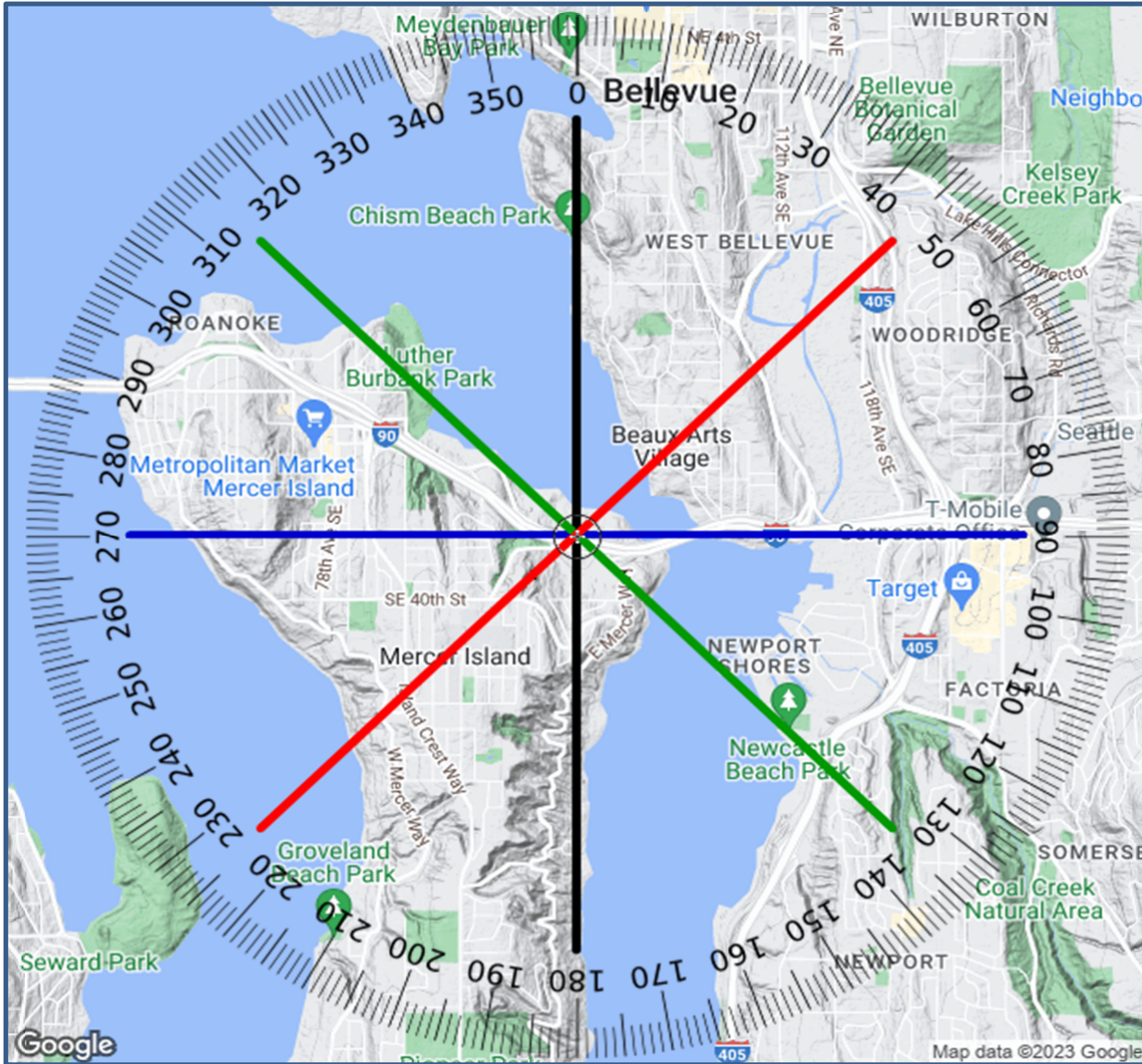
Site Address

Address 3508 96th ave se
 City: Mercer Island State: WA
 Lat Long 47.579168 -122.2105

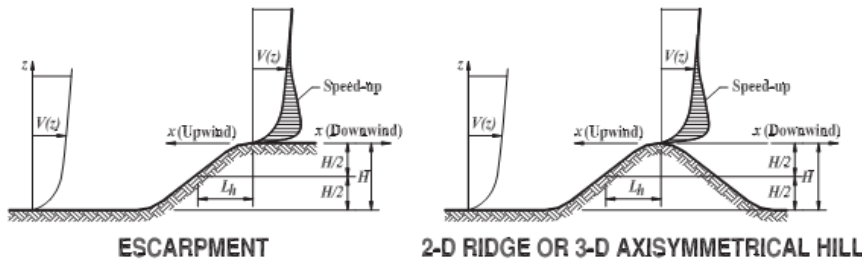
Wind Radius 2.00 Miles
 Angle 0°
 Exposure B

Profile 1: 0° to 180°
 Profile 2: 270° to 90°
 Profile 3: 315° to 135°
 Profile 4: 45° to 225°

SITE MAP



Topography from Figure 26.8-1



$$K_{zt} = (1 + K_1 K_2 K_3)^2$$

$K_1 =$ Per Figure

$$K_2 = (1 - |x|/\mu L_h)$$

$$K_3 = e^{-\gamma z/L_h}$$

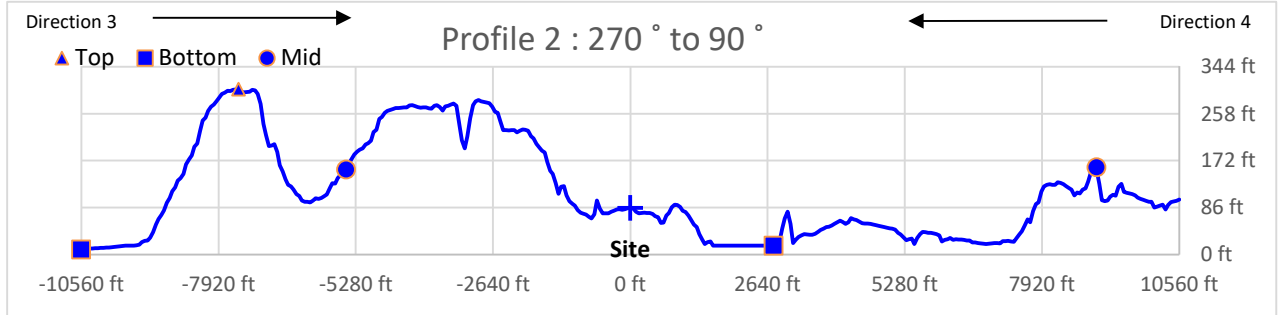
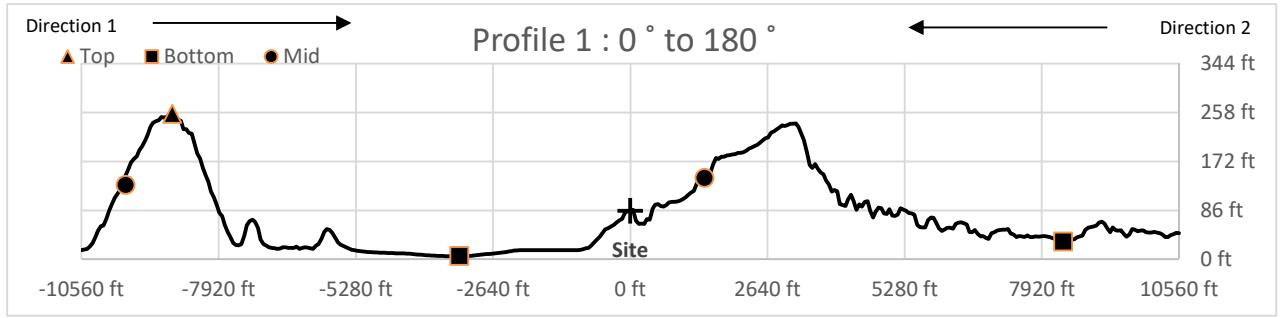
$$K_{zt} = 1, \text{ if } H/L_h \leq 0.2$$

PER FIGURE 26.8-1



Project _____
 Kzt Calculations _____

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 DESIGN ENG
 SHEET 4



Direction 1 - 0° to Site

Direction 2 - Site to 180°

Direction 3 - 270° to Site

Direction 4 - Site to 90°

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	Yes
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Terrain Data

Terrain	Ridge
Top of Hill Dist.	-8809
Bott. of Hill Dist.	-3290
L @ H/2	-9711
Site	downwnd
Top of Hill Elev.	255
Bott. of Hill Elev.	5
Site Elev.	84.9
Site Dist.	0
H/2	130

Terrain Data

Terrain	Ridge
Top of Hill Dist.	-8809
Bott. of Hill Dist.	8331
L @ H/2	1433
Site	upwnd
Top of Hill Elev.	255
Bott. of Hill Elev.	31
Site Elev.	84.9
Site Dist.	0
H/2	143

Terrain Data

Terrain	Ridge
Top of Hill Dist.	-7535
Bott. of Hill Dist.	-10560
L @ H/2	-5466
Site	downwnd
Top of Hill Elev.	303
Bott. of Hill Elev.	9
Site Elev.	84.9
Site Dist.	0
H/2	156

Terrain Data

Terrain	Ridge
Top of Hill Dist.	-7535
Bott. of Hill Dist.	2759
L @ H/2	8968
Site	upwnd
Top of Hill Elev.	303
Bott. of Hill Elev.	16
Site Elev.	84.9
Site Dist.	0
H/2	159

Kzt Calculations

H=	250
Lh=	902
x=	8809
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.36
K2=	0.00
k3=	0.91
H/Lh =	0.28
Kzt =	1.00

Kzt Calculations

H=	225
Lh=	10242
x=	8809
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.03
K2=	0.43
k3=	0.99
H/Lh =	0.02
Kzt =	1.00

Kzt Calculations

H=	294
Lh=	2069
x=	7535
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.18
K2=	0.00
k3=	0.96
H/Lh =	0.14
Kzt =	1.00

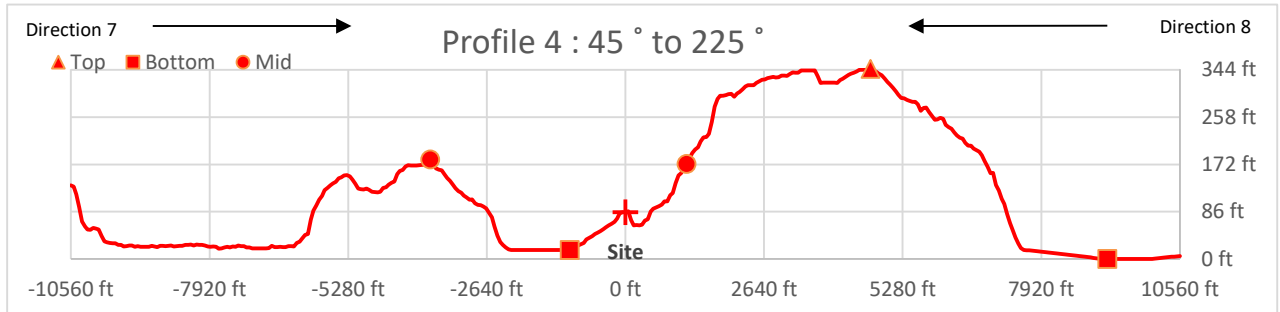
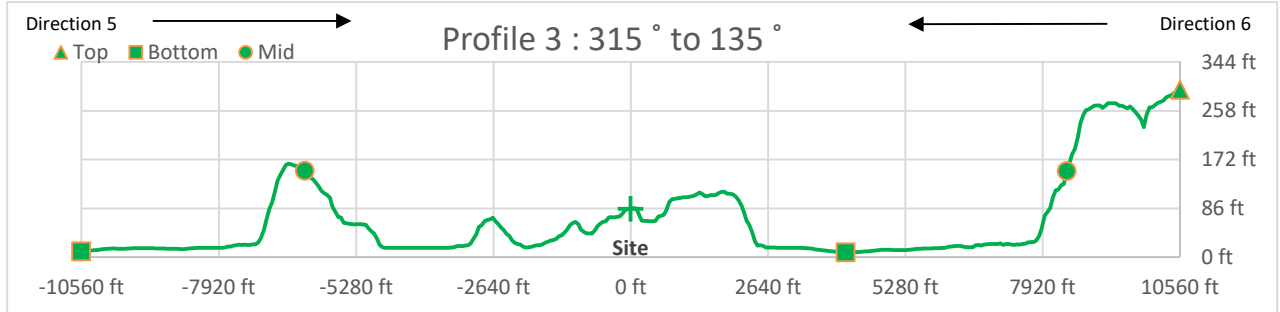
Kzt Calculations

H=	287
Lh=	16503
x=	7535
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.02
K2=	0.70
k3=	1.00
H/Lh =	0.02
Kzt =	1.00



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Kzt Calculations _____

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DESIGN ENG
SHEET 5



Direction 5 - 315° to Site

Direction 6 - Site to 135°

Direction 7 - 45° to Site

Direction 8 - Site to 225°

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Terrain Data

Terrain	Ridge
Top of Hill Dist.	10560
Bott. of Hill Dist.	-10560
L @ H/2	-6262
Site	upwind
Top of Hill Elev.	294
Bott. of Hill Elev.	9
Site Elev.	84.9
Site Dist.	0
H/2	152

Terrain Data

Terrain	Ridge
Top of Hill Dist.	10560
Bott. of Hill Dist.	4139
L @ H/2	8384
Site	downwind
Top of Hill Elev.	294
Bott. of Hill Elev.	8
Site Elev.	84.9
Site Dist.	0
H/2	151

Terrain Data

Terrain	Ridge
Top of Hill Dist.	4670
Bott. of Hill Dist.	-1061
L @ H/2	-3715
Site	upwind
Top of Hill Elev.	345
Bott. of Hill Elev.	16
Site Elev.	84.9
Site Dist.	0
H/2	181

Terrain Data

Terrain	Ridge
Top of Hill Dist.	4670
Bott. of Hill Dist.	9180
L @ H/2	1167
Site	downwind
Top of Hill Elev.	345
Bott. of Hill Elev.	0
Site Elev.	84.9
Site Dist.	0
H/2	173

Kzt Calculations

H=	285
Lh=	16822
x=	10560
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.02
K2=	0.58
k3=	1.00
H/Lh =	0.02
Kzt =	1.00

Kzt Calculations

H=	287
Lh=	2176
x=	10560
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.17
K2=	0.00
k3=	0.96
H/Lh =	0.13
Kzt =	1.00

Kzt Calculations

H=	329
Lh=	8385
x=	4670
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.05
K2=	0.63
k3=	0.99
H/Lh =	0.04
Kzt =	1.00

Kzt Calculations

H=	345
Lh=	3503
x=	4670
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.13
K2=	0.11
k3=	0.98
H/Lh =	0.10
Kzt =	1.00

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Project _____
Kzt Calculations _____

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DESIGN ENG
SHEET 6

ASCE 7-16 Wind Loads - Components and Cladding
Flat and Gable Roofs ($\theta \leq 45^\circ$)

Part 1: Low-Rise Buildings ($h \leq 60$ feet)
Section 30.3

Wind Coefficients

Exposure	B	
V=	98	mph
K_d =	0.85	Table 26.6-1
GC_p =	(Calculated from Ch. 30 Tables)	
GC_{pi} =	0.55	Table 26.13-1

Location and Building Dimensions

K_{zt} =	1.00	
K_z =	0.69	Table 26.10-1
K_e =	1.00	Table 26.9-1
Roof Angle, θ	5	degrees
Eave Height, h	28	ft

Design Wind Pressure, $p = q_h[(GC_p)-(GC_{pi})]$

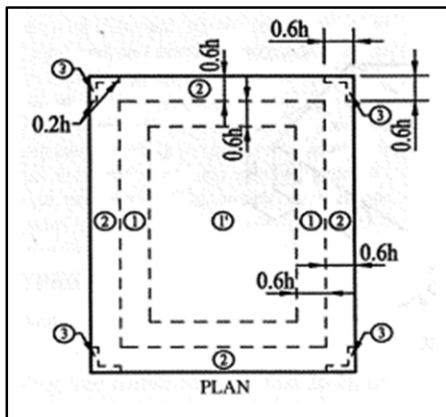
Velocity Pressure, $q_h = 0.00256K_dK_{zt}K_zK_eV^2 = 8.6$ psf (30.3-1)

Design	ASD
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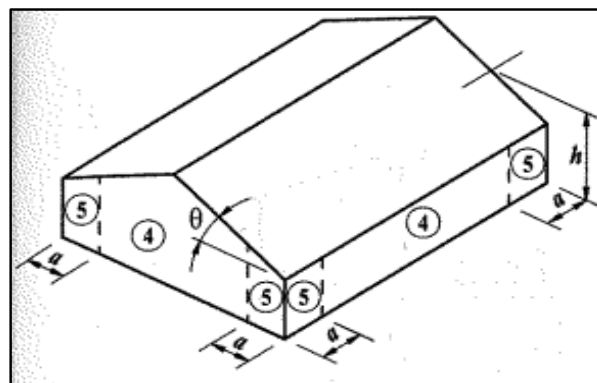
Design Wind Pressure (psf)

Component	Zone		Effective Wind Area (sq ft)					
			≤ 10	20	50	100	200	≥ 500
Flat or Gable Roofs 0 to 7 Deg	1	+	7.3*	7.0*	6.7*	6.4*	6.4*	6.4*
		-	-19.3	-18.3	-16.7	-15.7	-14.7	-13.3
		OH	-19.3	-19.1	-18.7	-18.5	-16.2	-13.3
	1'	+	7.3*	7.0*	6.7*	6.4*	6.4*	6.4*
		-	-12.5	-12.5	-12.5	-12.5	-11.2	-9.4*
		OH	-19.3	-19.1	-18.7	-18.5	-16.2	-13.3
	2	+	7.3*	7.0*	6.7*	6.4*	6.4*	6.4*
		-	-24.5	-23.1	-21.3	-19.9	-18.6	-16.7
		OH	-24.5	-22.6	-20.2	-18.4	-16.6	-14.2
	3	+	7.3*	7.0*	6.7*	6.4*	6.4*	6.4*
		-	-32.2	-29.5	-25.8	-23.1	-20.4	-16.7
		OH	-32.2	-29.0	-24.8	-21.6	-18.4	-14.2
Wall	4	+	12.5	12.0	11.5	11.1	10.7	10.1
		-	-13.2	-12.8	-12.3	-11.9	-11.4	-10.9
	5	+	12.5	12.0	11.5	11.1	10.7	10.1
		-	-15.5	-14.7	-13.6	-12.8	-12.0	-10.9
Parapet (Fig. 30.8-1)	Typ - LC A	+	31.8	30.3	28.2	26.8	25.4	23.4
	Typ - LC B	-	-25.7	-24.9	-23.8	-22.9	-22.1	-21.0
	Corner - LC A	+	44.7	41.5	37.3	34.2	31.0	26.9
	Corner - LC B	-	-28.0	-26.8	-25.1	-23.9	-22.7	-21.0

Note: * Indicates 10psf minimum wind pressure controls this load case for most buildings.



Flat & Gable Roofs $\theta \leq 7$ deg - Figure 30.3-2A



Wall Zones - Figure 30.3-1

a: 10 percent of least horizontal dimension or $0.4h$, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).

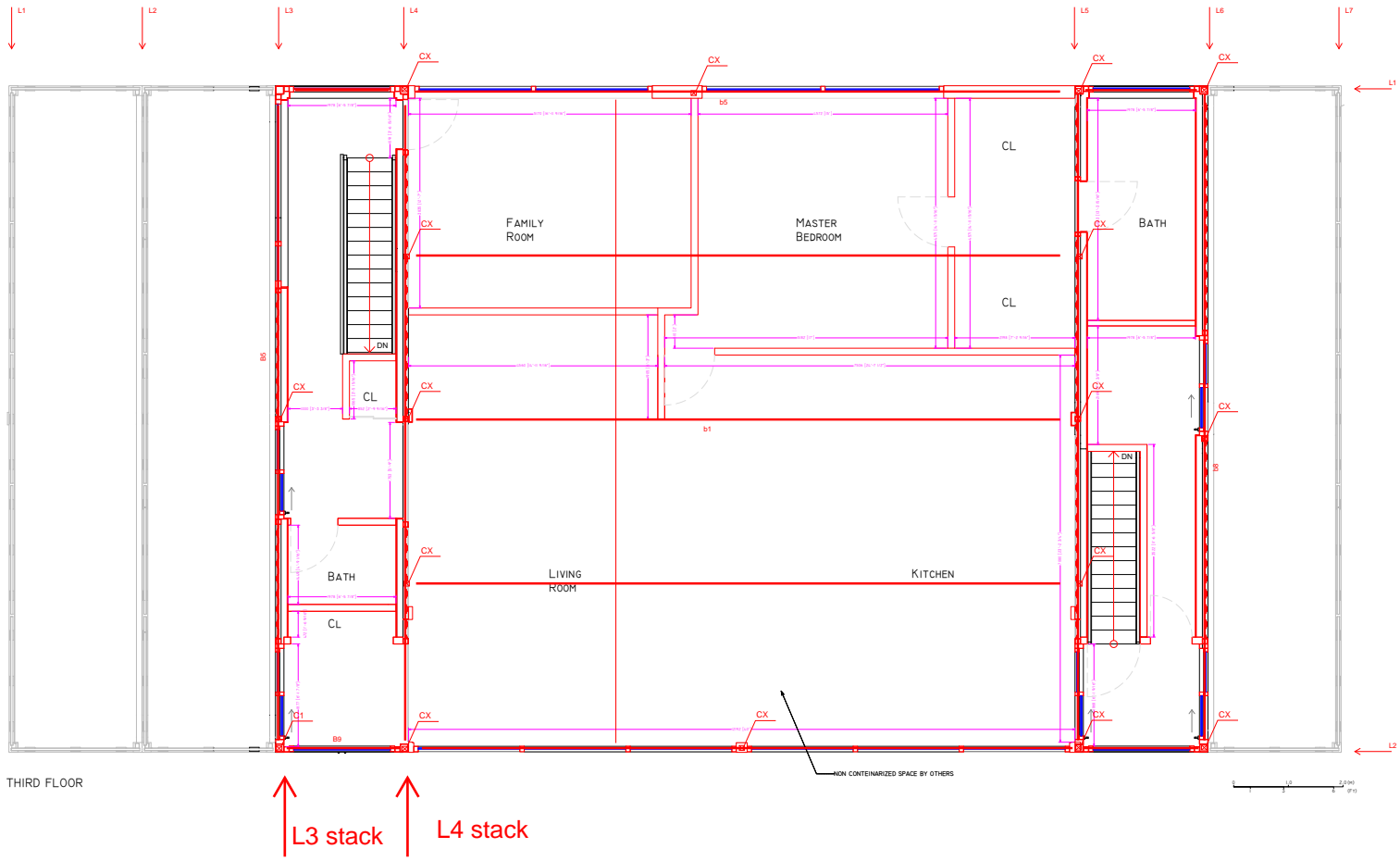
h: Mean roof height, in feet (meters), except that eave height shall be used for $\theta \leq 10^\circ$.



Project _____ Date: 5/16/2023

 Project #: _____

 Design: ENG



ROOF PLAN

Project Title:

Date

SSF project no.

Design

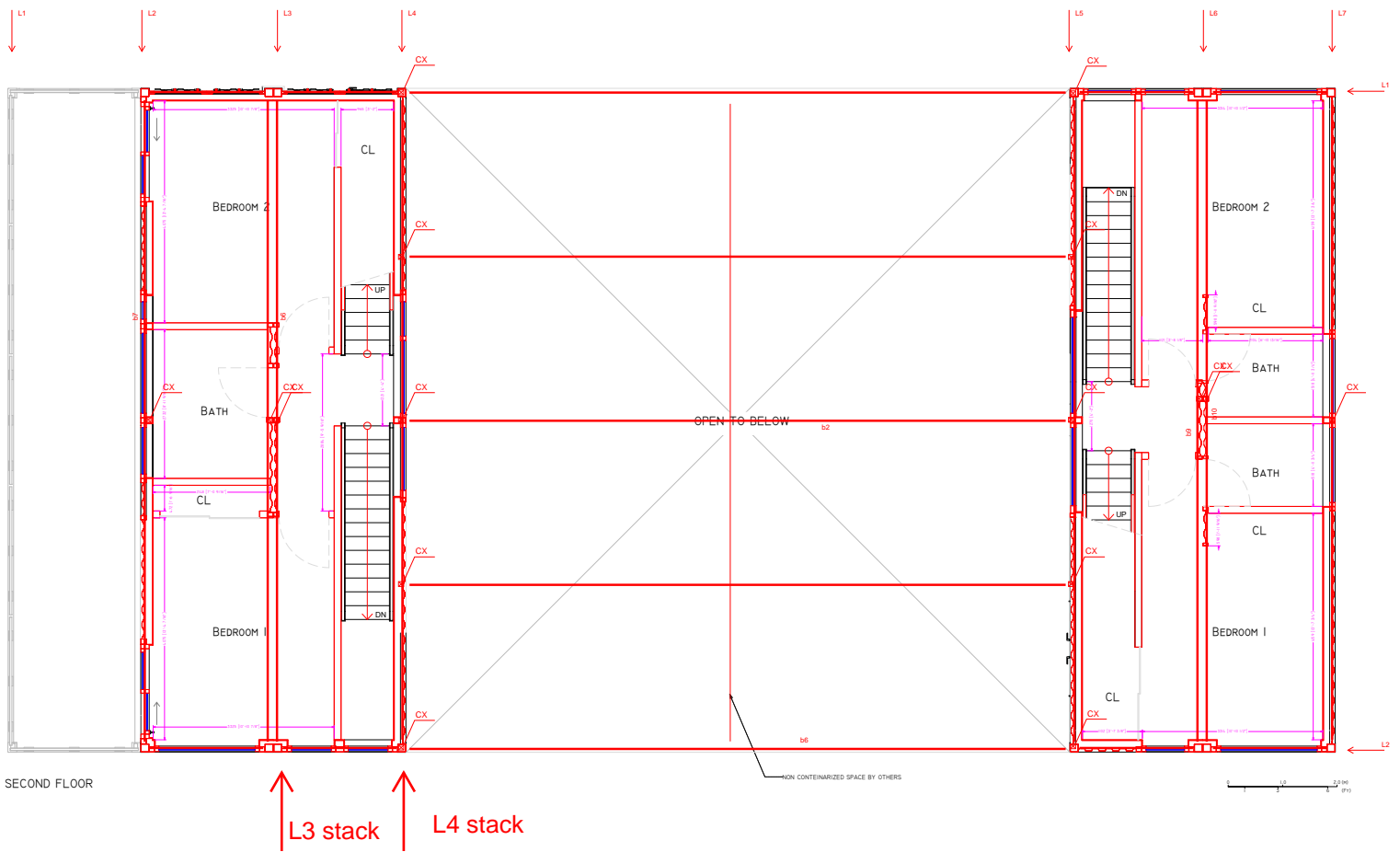
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SECOND FLOOR PLAN

Project Title:

Date

SSF project no.

Design

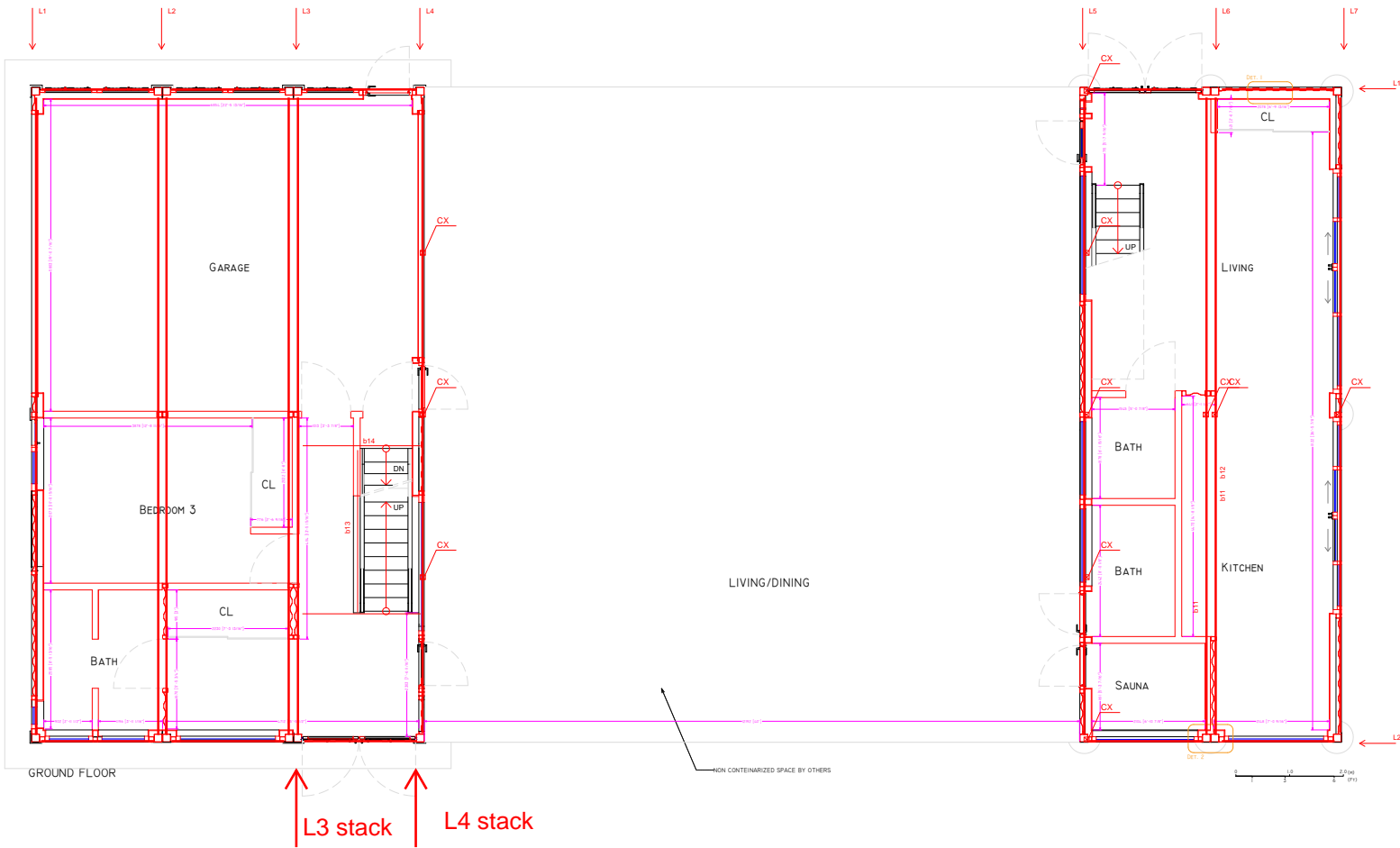
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**STRUCTURAL
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FIRST FLOOR PLAN

Project Title:

Date

SSF project no.

Design

Sheet Title:

Drawn

Sheet



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May 16, 2023

Lateral Spreadsheet Explanation

Re: Adams Cargo

Seismic loads are generated at the ceiling and floor of each cargo container and transferred through the floor diaphragm to the external walls at each level. The loads are distributed by tributary weight as the diaphragm is considered to be flexible. For instance, at the roof line (level 3 – ceiling) there are 4 walls of supporting labeled L3-L6 (see keyplan for locations). Walls L3 and L6 resist 4'x40' of seismic load where walls L4 and L5 resist 24'x40' due to the elevated floor between them. This process continues down through the structure to determine forces generated at each ceiling and floor.

External walls on each floor are used for lateral resistance, which due to the layout of the structure requires the diaphragm to transfer lateral loads from above horizontally out to the next wall of resistance. These loads are distributed by the same flexible diaphragm rules as the seismic weights and is accounted for in the seismic load distribution portion of the spreadsheet. Additional interior walls on the first floor are used for lateral resistance with the floor diaphragm transferring the load to be resolved through the concrete retaining walls.

While both ceilings and floor generate seismic load, only the ceiling levels are used for resistance as they are the members the walls (lateral resisting members) are attached to. For clarity sake the load is still reported at the floor levels in the spreadsheet, but the ceiling levels are the loads that dictate the design.

The containers are manufactured and tested per CFC Type AAA which requires the 40' long dimension of the containers to resist 16 kips of lateral force and the 8' short dimension to resist 32 kips of lateral force. For the purposes of this design we have assumed the long walls resist 400 plf as there are no continuously sheathed walls in that direction. That value is used to determine the length of wall needed as shown on the spreadsheet. In many situations the loads applied are larger than the available shearwall, and in some cases larger than 16 kips that could be provided. Where that occurs we are placing End Wall panels which mimic the 32 kips of capacity each end of the container has but in the longitudinal direction. These End Wall panels are used heavily along lines L4 and L5 as the majority of seismic loading occurs there. They are supported by intermediate corner castings to transfer the overturning forces down to the foundation.

In the Y direction (short container direction) there are symmetrical End Wall and welded door conditions along each container tower. These are all assumed to have 32 kips of lateral resistance, well capable of resisting the entire lateral force in that direction.

Seismic Loads Applied

X

3 - CEILING		TOTAL		33.4	
TRIB	LENGTH	KIPS	KLF		
L3	4	40	2.39	0.060	
L4	24	40	14.31	0.358	
L5	24	40	14.31	0.358	
L6	4	40	2.39	0.060	

Y

3 - CEILING		TOTAL		33.4	
TRIB	LENGTH	Area	KIPS	KLF	
L1-1	20	56	1120	16.70	2.088
L1-2	0	0	0	0.00	0.000
L2-1	20	28	560	8.35	1.044
L2-2	20	28	560	8.35	1.044

3 - FLOOR

3 - FLOOR		TOTAL		14	
TRIB	LENGTH	KIPS	KLF		
L2	8	40	3.50	0.088	
L3	0	40	0.00	0.000	
L4	8	40	3.50	0.088	
L5	8	40	3.50	0.088	
L6	0	40	0.00	0.000	
L7	8	40	3.50	0.088	

3 - FLOOR

3 - FLOOR		TOTAL		14	
TRIB	LENGTH	Area	KIPS	KLF	
L1-1	8	20	160	3.50	0.438
L1-2	0	20	0	0.00	0.000
L1-3	0	20	0	0.00	0.000
L1-4	8	20	160	3.50	0.438
L2-1	8	20	160	3.50	0.438
L2-2	0	20	0	0.00	0.000
L2-3	0	20	0	0.00	0.000
L2-4	8	20	160	3.50	0.438

2 - CEILING

2 - CEILING		TOTAL		27	
TRIB	LENGTH	KIPS	KLF		
L2	8	40	3.00	0.075	
L3	0	40	0.00	0.000	
L4	28	40	10.50	0.263	
L5	28	40	10.50	0.263	
L6	0	40	0.00	0.000	
L7	8	40	3.00	0.075	

2 - CEILING

2 - CEILING		TOTAL		27	
TRIB	LENGTH	Area	KIPS	KLF	
L1-1	8	20	160	6.75	0.844
L1-2	0	20	0	0.00	0.000
L1-3	0	20	0	0.00	0.000
L1-4	8	20	160	6.75	0.844
L2-1	8	20	160	6.75	0.844
L2-2	0	20	0	0.00	0.000
L2-3	0	20	0	0.00	0.000
L2-4	8	20	160	6.75	0.844

2 - floor	TOTAL	5.9		
	TRIB	LENGTH	KIPS	KLF
L1	8	40	1.18	0.030
L2	0	40	0.00	0.000
L3	12	40	1.77	0.044
L4	4	40	0.59	0.015
L5	4	40	0.59	0.015
L6	8	40	1.18	0.030
L7	4	40	0.59	0.015

2 - floor	TOTAL	5.9			
	TRIB	LENGTH	Area	KIPS	KLF
L1-1	8	20	160	1.48	0.184
L1-2	0	20	0	0.00	0.000
L1-3	0	20	0	0.00	0.000
L1-4	0	20	0	0.00	0.000
L1-5	8	20	160	1.48	0.184
L2-1	0	20	0	0.00	0.000
L2-2	8	20	160	1.48	0.184
L2-3	0	20	0	0.00	0.000
L2-4	8	20	160	1.48	0.184
L2-5	0	20	0	0.00	0.000

1 -Ceiling	TOTAL	6.4		
	TRIB	LENGTH	KIPS	KLF
L1	8	40	1.28	0.032
L2	0	40	0.00	0.000
L3	12	40	1.92	0.048
L4	4	40	0.64	0.016
L5	4	40	0.64	0.016
L6	8	40	1.28	0.032
L7	4	40	0.64	0.016

1 -Ceiling	TOTAL	6.4			
	TRIB	LENGTH	Area	KIPS	KLF
L1-1	8	20	160	1.60	0.200
L1-2	0	20	0	0.00	0.000
L1-3	0	20	0	0.00	0.000
L1-4	0	20	0	0.00	0.000
L1-5	8	20	160	1.60	0.200
L2-1	0	20	0	0.00	0.000
L2-2	8	20	160	1.60	0.200
L2-3	0	20	0	0.00	0.000
L2-4	8	20	160	1.60	0.200
L2-5	0	20	0	0.00	0.000

Seismic Load distribution

Total	3 -Ceiling	3 - Floor	2 - Ceiling	2 - Floor	1 - Ceiling
L1	0.00	0.00	0.00	5.03	6.31
L2	0.00	4.69	7.69	0.00	0.00
L3	2.39	0.00	0.00	5.62	7.54
L4	14.31	19.01	29.51	30.10	30.74
L5	14.31	19.01	29.51	30.10	30.74
L6	2.39	0.00	0.00	5.03	6.31
L7	0.00	4.69	7.69	7.99	8.63

Length of wall needed

	3 -Ceiling	3 - Floor	2 - Ceiling	2 - Floor	1 - Ceiling
L1	0.00	0.00	0.00	12.57	15.77
L2	0.00	11.73	19.23	0.00	0.00
L3	5.96	0.00	0.00	14.04	18.84
L4	35.79	47.52	73.77	75.24	76.84
L5	35.79	47.52	73.77	75.24	76.84
L6	5.96	0.00	0.00	12.57	15.77
L7	0.00	11.73	19.23	19.97	21.57

Kips KLF

Max = 16 0.4

Loads over 16 kips require "End Wall" panel conditions

Length of V3	3 - Ceiling	3 - Floor	2 - Ceiling	2 - Floor	1 - Ceiling
L1	0	0	0	0	16.5
L2	0		8.5		0
L3	23.83333	0	12		14.5
L4	10		10		10
L5	10		10		10
L6	27.41667	0	0		12.83333
L7	0		15.25		16.41667

Force	3 - Ceiling	3 - Floor	2 - Ceiling	2 - Floor	1 - Ceiling
L1	0	0	0	0	3.43987
L2	0	0	8.145378	0	0
L3	0.900899	0	0	0	4.677783
L4	12.88286	0	26.55643	0	27.66343
L5	12.88286	0	26.55643	0	27.66343
L6	0.783152	0	0	0	4.42269
L7	0	0	4.540047	0	4.729993

2

Force + Ov	3 - Ceiling	3 - Floor	2 - Ceiling	2 - Floor	1 - Ceiling
L1	0.00	0.00	0.00	0.00	6.88
L2	0.00	0.00	16.29	0.00	0.00
L3	1.80	0.00	0.00	0.00	9.36
L4	25.77	0.00	53.11	0.00	55.33
L5	25.77	0.00	53.11	0.00	55.33
L6	1.57	0.00	0.00	0.00	8.85
L7	0.00	0.00	9.08	0.00	9.46

Result Check Information

INFORMATION:
Analysis results could be inaccurate. This report might assist your validation efforts.
The following are heuristic and may or may not indicate problems.
Please check your results carefully.

INFORMATION:
Displacements appear to be within reason.

INFORMATION:
Stresses are less than yield or crushing strength.

Member Forces

(extreme rows: max and min)

Member	Fx Min K	Fx Max K	Vy K	Vz K	Torsion K-ft	My Min K-ft	My Max K-ft	Mz Min K-ft	Mz Max K-ft
BmX001	-0.1673 (51)	0.0868 (62)	5.6572 (51)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-6.7016 (44)	10.7766 (51)
BmX003	-2.0035 (45)	4.6160 (45)	3.7129 (45)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-11.7807 (45)	7.1649 (45)
BmX005	-3.4843 (44)	1.9139 (45)	-3.5309 (44)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-11.9529 (44)	5.1784 (44)
COL002	-4.5395 (44)	0.9974 (62)	-0.9415 (47)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-0.6020 (47)	0.3677 (61)
COL012	-4.1314 (44)	0.6479 (61)	6.7484 (45)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-3.7098 (45)	0.7508 (61)
COL013	-1.8349 (46)	0.6925 (62)	-3.5353 (45)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-0.1581 (61)	2.7560 (45)
COL040	-20.7353 (44)	0.5101 (61)	-7.0304 (45)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-0.8152 (43)	3.8422 (45)
COL041	-23.7373 (44)	0.0633 (61)	-0.2109 (52)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-0.9391 (62)	1.3551 (52)
COL044	-1.7339 (44)	0.0363 (61)	0.1487 (51)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-0.7107 (51)	0.6650 (51)

Member Stresses

(extreme rows: max and min)

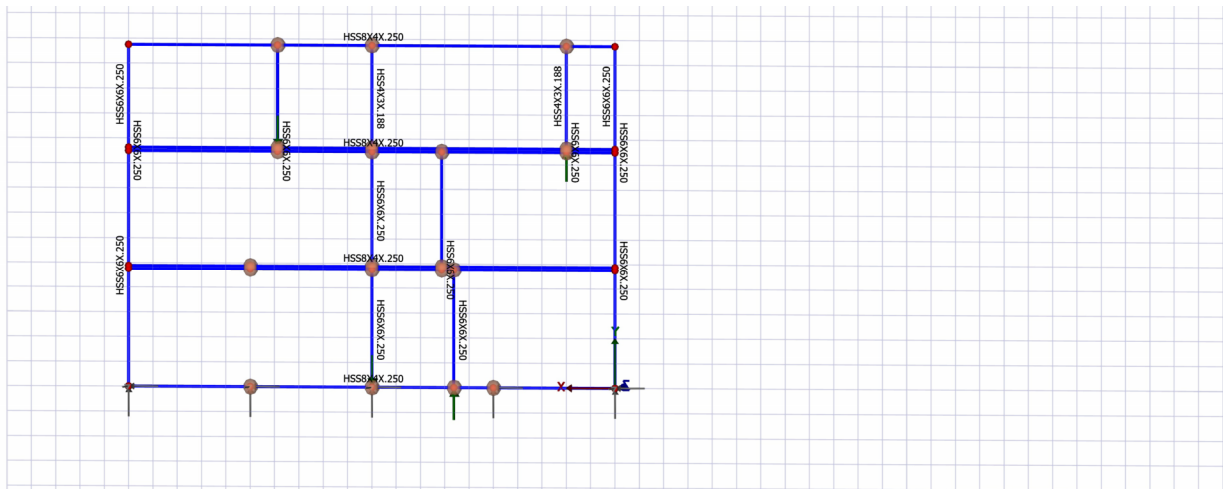
Member	fa Min Ksi	fa Max Ksi	fbv Min Ksi	fbv Max Ksi	fbz Min Ksi	fbz Max Ksi	fc comb Min Ksi	fc comb Max Ksi
BmX001	-0.0319 (51)	0.0166 (62)	0.0000 (62)	0.0000 (62)	-12.1713 (51)	12.1713 (51)	-12.2032 (51)	12.1393 (51)
BmX003	-0.3824 (45)	0.8809 (45)	0.0000 (62)	0.0000 (62)	-13.3053 (45)	13.3053 (45)	-13.6814 (45)	12.9292 (45)
BmX005	-0.6649 (44)	0.3653 (45)	0.0000 (62)	0.0000 (62)	-13.4998 (44)	13.4998 (44)	-13.7559 (44)	13.2437 (44)
COL002	-0.8663 (44)	0.1903 (62)	0.0000 (62)	0.0000 (62)	-0.7578 (47)	0.7578 (47)	-1.4629 (47)	0.6531 (62)
COL041	-4.5300 (44)	0.0121 (61)	0.0000 (62)	0.0000 (62)	-1.7057 (52)	1.7057 (52)	-5.7837 (44)	1.1942 (61)

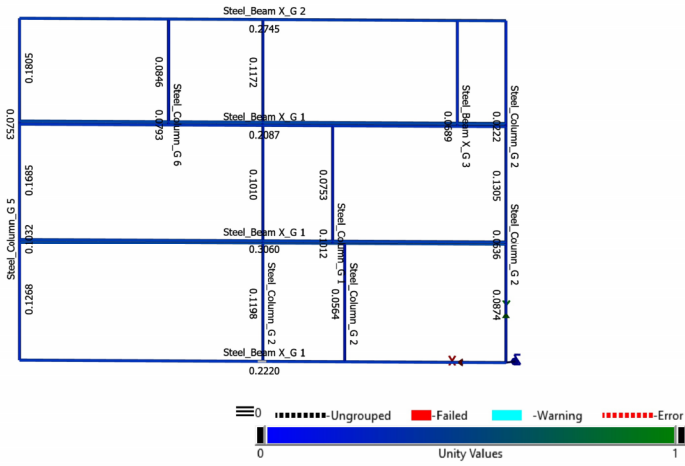
Member Unity Checks

Member	Section	Unity Check	Status	Result Case	Code Reference	Type	Design Group
BmX001	HSS8X4X.250	0.2220	Pass	6. 1.2D+E+L+0.2S »+X	H1-1b	Combined Check	Steel_Beam X_G 1
BmX002	HSS8X4X.250	0.4086	Pass	2. 1.2D+1.6L+0.5S	H1-1a	Combined Check	Steel_Beam X_G 1
BmX003	HSS8X4X.250	0.3060	Pass	2. 1.2D+1.6L+0.5S	H1-1b	Combined Check	Steel_Beam X_G 1
BmX004	HSS8X4X.250	0.2087	Pass	2. 1.2D+1.6L+0.5Lr	H1-1b	Combined Check	Steel_Beam X_G 1
BmX005	HSS8X4X.250	0.3874	Pass	2. 1.2D+1.6L+0.5Lr	H1-1a	Combined Check	Steel_Beam X_G 1
BmX006	HSS8X4X.250	0.2745	Pass	3. 1.2D+1.6Lr+L	H1-1b	Combined Check	Steel_Beam X_G 2
COL001	HSS6X6X.250	0.1209	Pass	3. 1.2D+1.6Lr+L	H1-1b	Combined Check	Steel_Column_G 4
COL002	HSS6X6X.250	0.0222	Pass	3. 1.2D+1.6Lr+0.5W	H1-1b	Combined Check	Steel_Column_G 2
COL003	HSS6X6X.250	0.1305	Pass	2. 1.2D+1.6L+0.5Lr	H1-1b	Combined Check	Steel_Column_G 2

Member Unity Checks (continued)

Member	Section	Unity Check	Status	Result Case	Code Reference	Type	Design Group
COL004	HSS6X6X.250	0.0636	Pass	2. 1.2D+1.6L+0.5Lr	H1-1b	Combined Check	Steel_Column_G 2
COL005	HSS6X6X.250	0.0874	Pass	2. 1.2D+1.6L+0.5Lr	H1-1b	Combined Check	Steel_Column_G 2
COL006	HSS6X6X.250	0.1268	Pass	2. 1.2D+1.6L+0.5Lr	H1-1b	Combined Check	Steel_Column_G 7
COL007	HSS6X6X.250	0.1032	Pass	2. 1.2D+1.6L+0.5S	H1-1b	Combined Check	Steel_Column_G 5
COL008	HSS6X6X.250	0.1685	Pass	2. 1.2D+1.6L+0.5Lr	H1-1b	Combined Check	Steel_Column_G 2
COL009	HSS6X6X.250	0.0753	Pass	1.2(D+F+T)+1.6(L+H)+.5Lr	G4-1	Strong Shear Check	Steel_Column_G 2
COL010	HSS6X6X.250	0.1805	Pass	3. 1.2D+1.6Lr+L	H1-1b	Combined Check	Steel_Column_G 2
COL011	HSS6X6X.250	0.0564	Pass	6. 1.2D+E+L+0.2S »+X	H1-1b	Combined Check	Steel_Column_G 2
COL012	HSS6X6X.250	0.1012	Pass	1.2(D+F+T)+1.6(L+H)+.5S	G4-1	Strong Shear Check	Steel_Column_G 1
COL013	HSS6X6X.250	0.0689	Pass	2. 1.2D+1.6L+0.5Lr	H1-1b	Combined Check	Steel_Beam X_G 3
COL014	HSS4X3X.188	0.0846	Pass	3. 1.2D+1.6Lr+L	H1-1b	Combined Check	Steel_Column_G 3
COL015	HSS6X6X.250	0.0793	Pass	1.2(D+F+T)+1.6(L+H)+.5Lr	G4-1	Strong Shear Check	Steel_Column_G 6
COL019	HSS4X3X.188	0.1402	Pass	3. 1.2D+1.6Lr+L	H1-1b	Combined Check	Steel_Column_G 3
COL037	HSS4X3X.188	0.1172	Pass	3. 1.2D+1.6Lr+L	E3-2	Axial Check	Steel_Column_G 3
COL038	HSS6X6X.250	0.0918	Pass	2. 1.2D+1.6L+0.5Lr	H1-1b	Combined Check	Steel_Column_G 2
COL039	HSS6X6X.250	0.1010	Pass	6. 1.2D+E+L+0.2S »-X	H1-1b	Combined Check	Steel_Column_G 2
COL040	HSS6X6X.250	0.1351	Pass	2. 1.2D+1.6L+0.5Lr	H1-1b	Combined Check	Steel_Column_G 2
COL041	HSS6X6X.250	0.1198	Pass	2. 1.2D+1.6L+0.5Lr	E3-2	Axial Check	Steel_Column_G 2
COL044	HSS4X3X.188	0.0753	Pass	6. 1.2D+E+L+0.2S »+X	H1-1b	Combined Check	Steel_Column_G 3





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Member Forces

(extreme rows: max and min)

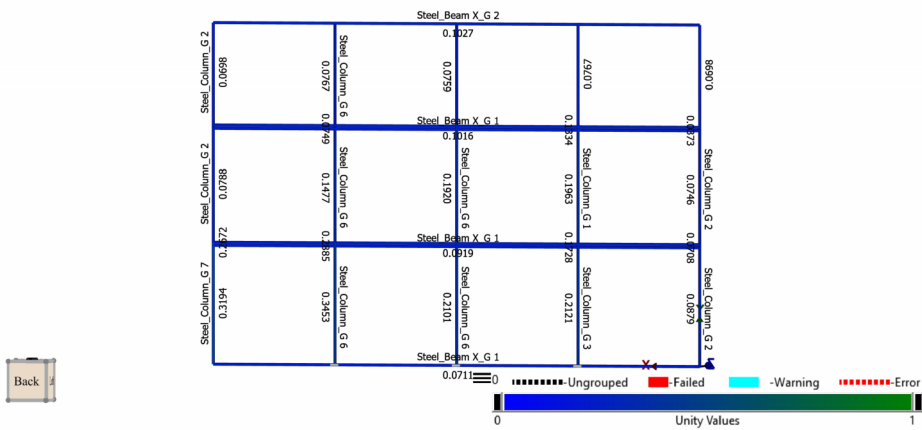
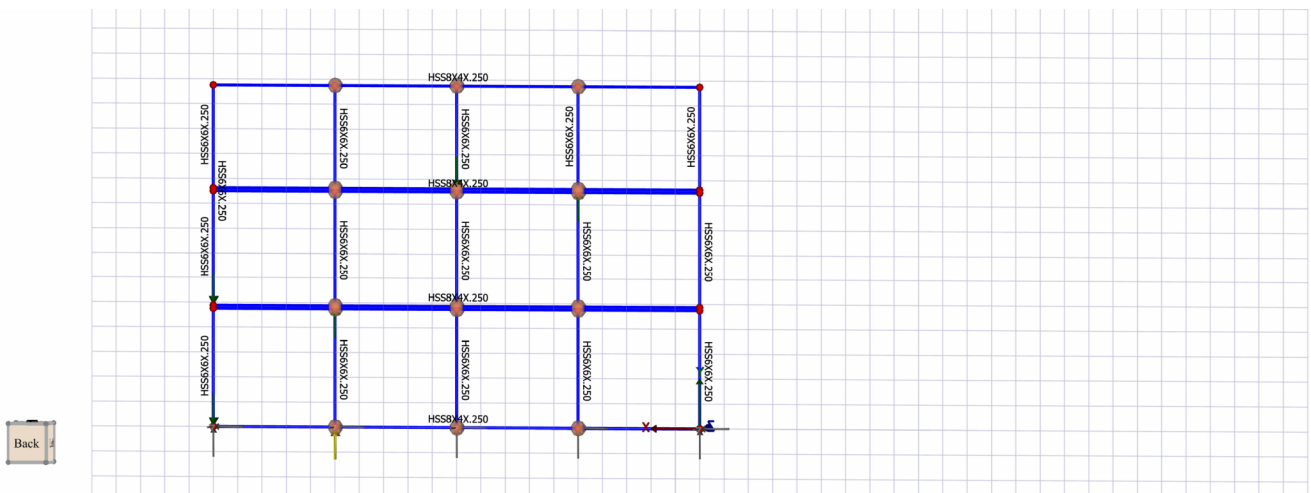
Member	Fx Min K	Fx Max K	Vy K	Vz K	Torsion K-ft	My Min K-ft	My Max K-ft	Mz Min K-ft	Mz Max K-ft
BmX004	-0.8985 (62)	1.3729 (51)	-1.3277 (51)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-4.2094 (51)	2.9599 (62)
BmX005	-1.2549 (51)	0.8431 (62)	-1.8660 (45)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-4.4430 (52)	2.9369 (61)
BmX006	-0.6230 (51)	0.3708 (62)	-2.1006 (47)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-4.1883 (51)	2.8746 (62)
COL001	-7.8328 (46)	0.2905 (62)	-0.5266 (51)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-2.1684 (51)	2.1759 (51)
COL007	-60.4447 (52)	51.5512 (61)	1.6325 (51)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-0.4327 (54)	1.0538 (44)
COL009	-8.8030 (46)	0.7941 (62)	1.8779 (51)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-0.9213 (45)	0.5138 (47)
COL018	-67.6885 (51)	48.5727 (62)	-0.0304 (45)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-0.2055 (45)	0.0829 (45)
COL038	-30.8900 (52)	23.6564 (61)	0.3743 (55)	0.0000 (62)	0.0000 (62)	0.0000 (62)	0.0000 (62)	-0.0816 (55)	0.0816 (51)

Member Unity Checks

Member	Section	Unity Check	Status	Result Case	Code Reference	Type	Design Group
BmX001	HSS8X4X.250	0.0711	Pass	2. 1.2D+1.6L+0.5S	F7-1	Strong Flexure Check	Steel_Beam X_G 1
BmX002	HSS8X4X.250	0.0830	Pass	7. 0.9D+E »-X	H1-1b	Combined Check	Steel_Beam X_G 1
BmX003	HSS8X4X.250	0.0919	Pass	6. 1.2D+E+L+0.2S »+X	H1-1b	Combined Check	Steel_Beam X_G 1
BmX004	HSS8X4X.250	0.0886	Pass	7. 0.9D+E »-X	H1-1b	Combined Check	Steel_Beam X_G 1
BmX005	HSS8X4X.250	0.1016	Pass	6. 1.2D+E+L+0.2S »+X	H1-1b	Combined Check	Steel_Beam X_G 1
BmX006	HSS8X4X.250	0.1027	Pass	6. 1.2D+E+L+0.2S »+X	H1-1b	Combined Check	Steel_Beam X_G 2
COL001	HSS6X6X.250	0.0698	Pass	3. 1.2D+1.6Lr+L	H1-1b	Combined Check	Steel_Column_G 4
COL002	HSS6X6X.250	0.0373	Pass	3. 1.2D+1.6Lr+L	E3-2	Axial Check	Steel_Column_G 2
COL003	HSS6X6X.250	0.0746	Pass	2. 1.2D+1.6L+0.5Lr	E3-2	Axial Check	Steel_Column_G 2
COL004	HSS6X6X.250	0.0708	Pass	2. 1.2D+1.6L+0.5Lr	E3-2	Axial Check	Steel_Column_G 2
COL005	HSS6X6X.250	0.0879	Pass	2. 1.2D+1.6L+0.5Lr	E3-2	Axial Check	Steel_Column_G 2
COL006	HSS6X6X.250	0.3194	Pass	6. 1.2D+E+L+0.2S »-X	H1-1a	Combined Check	Steel_Column_G 7
COL007	HSS6X6X.250	0.2672	Pass	6. 1.2D+E+L+0.2S »-X	H1-1a	Combined Check	Steel_Column_G 5
COL008	HSS6X6X.250	0.0788	Pass	6. 1.2D+E+L+0.2S »+X	H1-1b	Combined Check	Steel_Column_G 2
COL009	HSS6X6X.250	0.0373	Pass	3. 1.2D+1.6Lr+L	E3-2	Axial Check	Steel_Column_G 2
COL010	HSS6X6X.250	0.0698	Pass	3. 1.2D+1.6Lr+L	H1-1b	Combined Check	Steel_Column_G 2
COL011	HSS6X6X.250	0.2121	Pass	6. 1.2D+E+L+0.2S »+X	H1-1a	Combined Check	Steel_Column_G 3
COL012	HSS6X6X.250	0.1728	Pass	6. 1.2D+E+L+0.2S »+X	E3-2	Axial Check	Steel_Column_G 1
COL013	HSS6X6X.250	0.1334	Pass	6. 1.2D+E+L+0.2S »+X	E3-2	Axial Check	Steel_Column_G 3

Member Unity Checks (continued)

Member	Section	Unity Check	Status	Result Case	Code Reference	Type	Design Group
COL014	HSS6X6X.250	0.0767	Pass	3. 1.2D+1.6Lr+0.5W	E3-2	Axial Check	Steel_Column_G 6
COL015	HSS6X6X.250	0.0749	Pass	3. 1.2D+1.6Lr+L	E3-2	Axial Check	Steel_Column_G 6
COL016	HSS6X6X.250	0.1477	Pass	2. 1.2D+1.6L+0.5Lr	E3-2	Axial Check	Steel_Column_G 6
COL017	HSS6X6X.250	0.2885	Pass	6. 1.2D+E+L+0.2S »+X	H1-1a	Combined Check	Steel_Column_G 6
COL018	HSS6X6X.250	0.3453	Pass	6. 1.2D+E+L+0.2S »+X	H1-1a	Combined Check	Steel_Column_G 6
COL019	HSS6X6X.250	0.0767	Pass	3. 1.2D+1.6Lr+0.5W	E3-2	Axial Check	Steel_Column_G 3
COL037	HSS6X6X.250	0.0759	Pass	3. 1.2D+1.6Lr+L	E3-2	Axial Check	Steel_Column_G 6
COL038	HSS6X6X.250	0.1310	Pass	6. 1.2D+E+L+0.2S »-X	E3-2	Axial Check	Steel_Column_G 6
COL039	HSS6X6X.250	0.1920	Pass	6. 1.2D+E+L+0.2S »-X	E3-2	Axial Check	Steel_Column_G 6
COL040	HSS6X6X.250	0.1678	Pass	6. 1.2D+E+L+0.2S »-X	E3-2	Axial Check	Steel_Column_G 6
COL041	HSS6X6X.250	0.2101	Pass	6. 1.2D+E+L+0.2S »-X	H1-1a	Combined Check	Steel_Column_G 6
COL044	HSS6X6X.250	0.1963	Pass	6. 1.2D+E+L+0.2S »+X	E3-2	Axial Check	Steel_Column_G 1



Beam Spreadsheet Key Plan

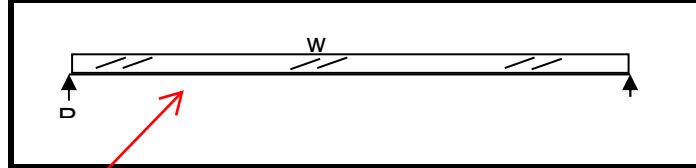
Key Plan Callout

Distributed Load
Length
Width
Depth
Modulus of Elasticity

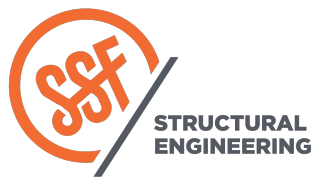
Beam	B1		HF 2 x 10	
w=	80	plf	R=	340 lbs
L=	8.5	ft	M=	723 ft-lbs
b=	1.50	in	Fb=	405 psi
d=	9.25	in	Fv=	30 psi
E=	1300	ksi	Δ =	0.07 in
Cv=	1.00	≤ 1.0	I/	1396

Minimum Size

Reaction
Moment
Max Bending Stress
Max Shear Stress
Max Deflection
L/ Deflection Value

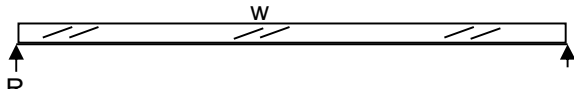


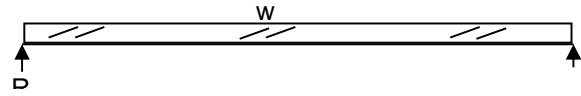
Beam Loading Diagram



DATE
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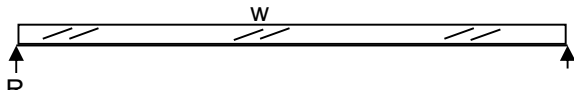
Beam		B1	GL	5 1/8 x 16 1/2
w=	400	plf	R=	8,000 lbs
L=	40	ft	M=	80,000 ft-lbs
b=	5.13	in	Fb=	4,128 psi
d=	16.50	in	Fv=	132 psi
E=	1800	ksi	Δ =	6.67 in
Cv=	0.91	≤ 1.0	I/	72



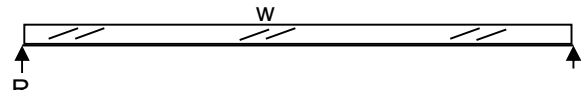


Steel Size		W12X120		
I=	1070	in	Fy=	50 ksi
Δ =	0.74	in	Mn/ Ω =	464.1 k-ft
I/	646		Vn/ Ω =	138.8 kips

Beam		B2	HF	4 x 12
w=	520	plf	R=	10,400 lbs
L=	40	ft	M=	104,000 ft-lbs
b=	3.50	in	Fb=	16,904 psi
d=	11.25	in	Fv=	378 psi
E=	1300	ksi	Δ =	55.48 in
Cv=	0.98	≤ 1.0	I/	9

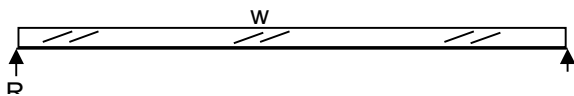


Beam		B5	HF	4 x 12
w=	200	plf	R=	2,400 lbs
L=	24	ft	M=	14,400 ft-lbs
b=	3.50	in	Fb=	2,341 psi
d=	11.25	in	Fv=	84 psi
E=	1300	ksi	Δ =	2.77 in
Cv=	1.00	≤ 1.0	I/	104

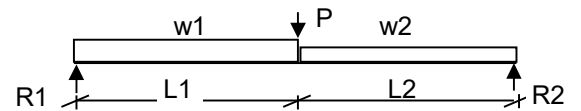


Steel Size		W14X109		
I=	1240	in	Fy=	50 ksi
Δ =	0.83	in	Mn/ Ω =	479.0 k-ft
I/	576		Vn/ Ω =	118.6 kips

Steel Size		W10X19		
I=	96.3	in	Fy=	50 ksi
Δ =	0.53	in	Mn/ Ω =	53.9 k-ft
I/	539		Vn/ Ω =	42.3 kips



Beam		B6	HF	4 x 12
w1=	260	plf	R1 =	7,200 lbs
w2=	260	plf	R2 =	7,200 lbs
L1=	20	ft	M =	92,000 lb-ft
L2=	20	ft	Fb =	14,954 psi
X=	20.0	ft	Fv =	265 psi
P=	4000	lbs	Δ =	44.81 in
b=	3.50	in	I/	11
d=	11.25	in	Cv=	0.98
E=	1,300	ksi		





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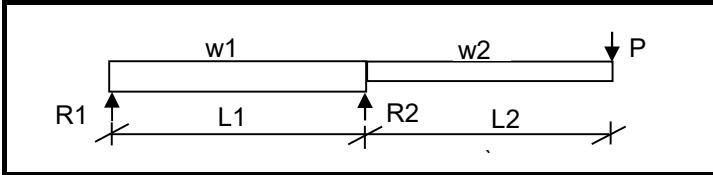
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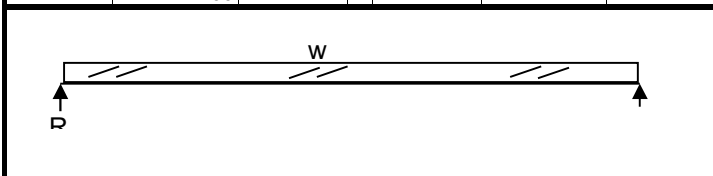
Steel Size		W14X109	
I =	1240 in ⁴	Fy =	50 ksi
Δ =	0.673 in	Mn/Ω =	479.0 k-ft
I /	713	Vn/Ω =	209.0 kips

cant col		c1		DF-L		4 x 12	
w1 =	plf	R1 =	-1750 lbs				
w2 =	plf	R2 =	3,500 lbs				
L1 =	5 ft	M+ =	-				
L2 =	5 ft	M- =	7,875 lb-ft				
X =	2.25 ft	Fb =	1,280 psi				
P =	1,750 lbs	Fv =	67 psi				
b =	3.50 in	Δspan =	(0.024) in				
d =	11.25 in	I span /	(2,214)				
E =	1,700 ksi	Δcant =	0.26 in				
Cv =	1.00	I cant /	415				

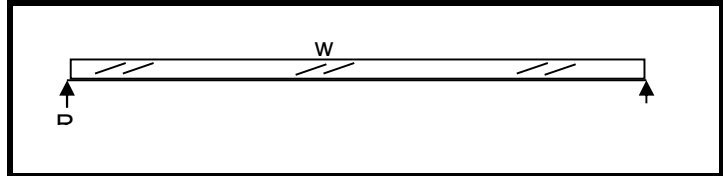


Steel Size		HSS6X6X1/4	
span	Δ (in)	I /	Fy = 50 ksi
	-0.021	-2601	Mn/Ω = 27.9 k-ft
cant.	0.22	488	Vn/Ω = 0.0 kips

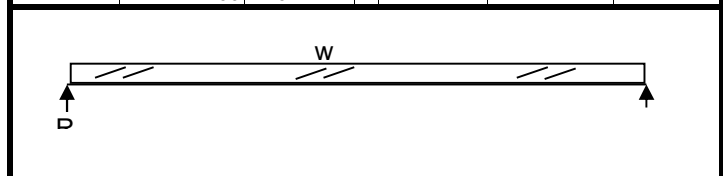
Beam		B13		HF		4 x 12	
w =	232 plf	R =	1,508 lbs				
L =	13 ft	M =	4,901 ft-lbs				
b =	3.50 in	Fb =	797 psi				
d =	11.25 in	Fv =	49 psi				
E =	1300 ksi	Δ =	0.28 in				
Cv =	1.00 ≤ 1.0	I /	565				



Steel Size		C5X9	
I =	8.89 in ⁴	Fy =	50 ksi
Δ =	0.58 in	Mn/Ω =	11.0 k-ft
I /	270	Vn/Ω =	25.5 kips

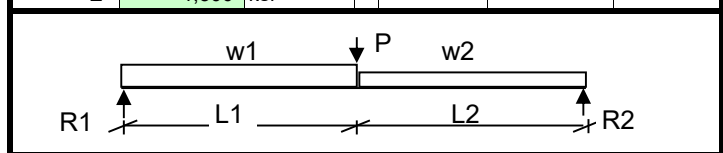


Hanger Door Col		c2		HF		4 x 12	
w =	300 plf	R =	3,000 lbs				
L =	20 ft	M =	15,000 ft-lbs				
b =	3.50 in	Fb =	2,438 psi				
d =	11.25 in	Fv =	104 psi				
E =	1300 ksi	Δ =	2.00 in				
Cv =	1.00 ≤ 1.0	I /	120				



Steel Size		W8X18	
I =	61.9 in ⁴	Fy =	50 ksi
Δ =	0.60 in	Mn/Ω =	42.4 k-ft
I /	399	Vn/Ω =	30.9 kips

Beam		b14		HF		4 x 12	
w1 =	77 plf	R1 =	1,809 lbs				
w2 =	77 plf	R2 =	1,809 lbs				
L1 =	4 ft	M =	6,619 lb-ft				
L2 =	4 ft	Fb =	1,076 psi				
X =	4.0 ft	Fv =	66 psi				
P =	3,000 lbs	Δ =	0.12 in				
b =	3.50 in	I /	830				
d =	11.25 in	Cv =	1.00				
E =	1,300 ksi						



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Steel Size		C5X9	
I =	8.89	in ⁴	Fy = 50 ksi
Δ =	0.242	in	Mn/Ω = 11.0 k-ft
I /	396		Vn/Ω = 45.0 kips



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 _____ Design: ENG
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Beam Analysis

Beam:		Roof Typical (b5)					
Load	Dead	Live	Roof Live	Seismic	Factored	Location	
Distributed (k/ft)	w ₁	0.080		0.100		0.180	
	w ₂					0.000	
	w ₃					0.000	
	w ₄					0.000	
	w ₅					0.000	
	w ₆					0.000	
	w ₇					0.000	
	w ₈					0.000	
	w ₉					0.000	
	w ₁₀					0.000	
Trapezoidal (k/ft/ft)	t ₁					0.000	
	t ₂					0.000	
	t ₃					0.000	
	t ₄					0.000	
	t ₅					0.000	
	t ₆					0.000	
Point (k)	P ₁					0.000	
	P ₂					0.000	
	P ₃					0.000	
	P ₄					0.000	
	P ₅					0.000	
	P ₆					0.000	
	P ₇					0.000	
	P ₈					0.000	
	P ₉					0.000	
	P ₁₀					0.000	

Support Locations and Reactions	
# of Supports	3
Total Beam Length	40.00
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	1.350 0.00
R ₂	4.500 20.00
R ₃	1.350 40.00
R ₄	0.000 40.00
R ₅	0.000 40.00
R ₆	0.000 40.00
R ₇	0.000 40.00
R ₈	0.000 40.00
R ₉	0.000 40.00
R ₁₀	0.000 40.00

Load Factors	
Dead	1.00
Live	1.00
Roof Live	1.00
Seismic	1.00

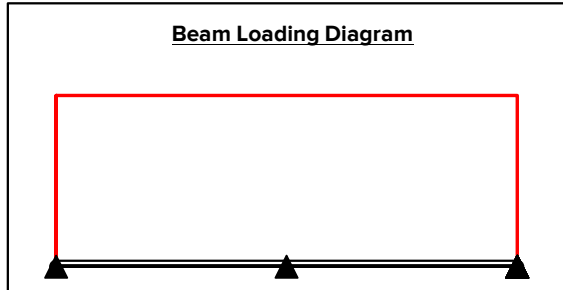
Stresses @ Input Location	
f _v (psi)	-65
f _b (psi)	7320

Max/Min Stresses	
f _v _MAX (psi)	865
f _v _MIN (psi)	-865
f _b _MAX (psi)	7342
f _b _MIN (psi)	-13059

Demand Output	
Location, ft	8.44
Shear, k	-0.17
Moment, k-ft M =	4.98
Deflection, in D =	-0.28
Δ/Span	L/855

Beam Properties	
E (ksi)	29000
b (in)	3.5
d (in)	12
I (in ⁴)	33.1
S (in ³)	8.27
A (in ²)	2.6
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section		HSS8x4x3/16	
F _y , ksi	50		
Beam Weight (plf)	14.53		
Axis of Bending	Strong		
Unbr. Length (L _b), ft	0		
C _b	1		
A _w	2.6 in ²	V _r /Ω _v	46.9 k
S	8.27 in ³	φ _v V _n	70.3 k
Z	10.2 in ³	M _r /Ω _b	25.4 k-ft
I	33.1 in ⁴	φ _b M _n	38.3 k-ft



Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{TL} (in)	@ x =	L/	Δ _{LL} (in)	@ x =	L/
Span 1	1.35	-2.25	-9	5.06	-0.281 (+)	8.4	L/854	0	0	L/∞
Span 2	2.25	-1.35	-9	5.06	-0.281 (+)	31.6	L/851	0	20.1	L/∞

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PROJECT Project

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DESIGN ENG

SHEET 1

Beam Analysis

Beam:		Floor Typical (B6)					
Load	Dead	Live	Roof Live	Seismic	Factored	Location	
Distributed (k/ft)	W ₁	0.072	0.160		0.232		
	W ₂				0.000		
	W ₃				0.000		
	W ₄				0.000		
	W ₅				0.000		
	W ₆				0.000		
	W ₇				0.000		
	W ₈				0.000		
	W ₉				0.000		
	W ₁₀				0.000		
Trapezoidal (k/ft/ft)	t ₁				0.000		
	t ₂				0.000		
	t ₃				0.000		
	t ₄				0.000		
	t ₅				0.000		
	t ₆				0.000		
Point (k)	P ₁				0.000		
	P ₂				0.000		
	P ₃				0.000		
	P ₄				0.000		
	P ₅				0.000		
	P ₆				0.000		
	P ₇				0.000		
	P ₈				0.000		
	P ₉				0.000		
	P ₁₀				0.000		

Support Locations and Reactions	
# of Supports	3
Total Beam Length	40.00
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	1.740 0.00
R ₂	5.800 20.00
R ₃	1.740 40.00
R ₄	0.000 40.00
R ₅	0.000 40.00
R ₆	0.000 40.00
R ₇	0.000 40.00
R ₈	0.000 40.00
R ₉	0.000 40.00
R ₁₀	0.000 40.00

Load Factors	
Dead	1.00
Live	1.00
Roof Live	1.00
Seismic	1.00

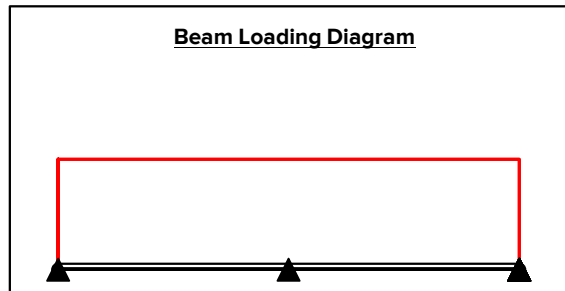
Stresses @ Input Location	
f _v (psi)	-114
f _b (psi)	14115

Max/Min Stresses	
f _{v_MAX} (psi)	1518
f _{v_MIN} (psi)	-1518
f _{b_MAX} (psi)	14330
f _{b_MIN} (psi)	-25495

Demand Output	
Location, ft	8.44
Shear, k	-0.22
Moment, k-ft M =	6.42
Deflection, in D =	-0.73
Δ/Span	L/329

Beam Properties	
E (ksi)	29000
b (in)	3.5
d (in)	12
I (in ⁴)	16.4
S (in ³)	5.46
A (in ²)	1.91
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section		HSS6x4x3/16	
F _y , ksi	50		
Beam Weight (plf)	11.97		
Axis of Bending	Strong		
Unbr. Length (L _b), ft	0		
C _b	1		
A _w	1.91 in ²	V _r /Ω _v	34.3 k
S	5.46 in ³	φ _v V _n	51.5 k
Z	6.6 in ³	M _r /Ω _b	16.5 k-ft
I	16.4 in ⁴	φ _b M _n	24.8 k-ft



Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{Tl} (in)	@ x =	L/	Δ _{Ll} (in)	@ x =	L/
Span 1	1.74	-2.9	-11.6	6.52	-0.73 (★)	8.4	L/329	-0.504 (★)	8.4	L/476
Span 2	2.9	-1.74	-11.6	6.52	-0.73 (★)	31.6	L/327	-0.504 (★)	31.6	L/474

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 SHEET 1

Beam Analysis

Beam:		Deck Typical (b7)					
Load	Dead	Live	Roof Live	Seismic	Factored	Location	
Distributed (k/ft)	W ₁	0.072	0.240			0.312	
	W ₂					0.000	
	W ₃					0.000	
	W ₄					0.000	
	W ₅					0.000	
	W ₆					0.000	
	W ₇					0.000	
	W ₈					0.000	
	W ₉					0.000	
	W ₁₀					0.000	
Trapezoidal (k/ft/ft)	t ₁					0.000	
	t ₂					0.000	
	t ₃					0.000	
	t ₄					0.000	
	t ₅					0.000	
	t ₆					0.000	
Point (k)	P ₁					0.000	
	P ₂					0.000	
	P ₃					0.000	
	P ₄					0.000	
	P ₅					0.000	
	P ₆					0.000	
	P ₇					0.000	
	P ₈					0.000	
	P ₉					0.000	
	P ₁₀					0.000	

Support Locations and Reactions	
# of Supports	3
Total Beam Length	40.00
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	2.340 0.00
R ₂	7.800 20.00
R ₃	2.340 40.00
R ₄	0.000 40.00
R ₅	0.000 40.00
R ₆	0.000 40.00
R ₇	0.000 40.00
R ₈	0.000 40.00
R ₉	0.000 40.00
R ₁₀	0.000 40.00

Load Factors	
Dead	1.00
Live	1.00
Roof Live	1.00
Seismic	1.00

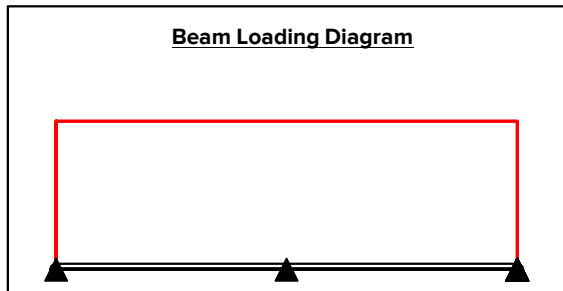
Stresses @ Input Location	
f _v (psi)	-98
f _b (psi)	12533

Max/Min Stresses	
f _{v_MAX} (psi)	1304
f _{v_MIN} (psi)	-1304
f _{b_MAX} (psi)	12726
f _{b_MIN} (psi)	-22636

Demand Output	
Location, ft	8.44
Shear, k	-0.29
Moment, k-ft M =	8.64
Deflection, in D =	-0.65
Δ/Span	L/369

Beam Properties	
E (ksi)	29000
b (in)	3.5
d (in)	12
I (in ⁴)	24.8
S (in ³)	8.27
A (in ²)	2.99
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section		HSS6x4x5/16	
F _y , ksi	50		
Beam Weight (plf)	19.08		
Axis of Bending	Strong		
Unbr. Length (L _b), ft	0		
C _b	1		
A _w	2.99 in ²	V _r /Ω _v	53.7 k
S	8.27 in ³	φ _v V _n	80.6 k
Z	10.3 in ³	M _r /Ω _b	25.7 k-ft
I	24.8 in ⁴	φ _b M _n	38.6 k-ft



Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{Tl} (in)	@ x =	L/	Δ _{Ll} (in)	@ x =	L/
Span 1	2.34	-3.9	-15.6	8.77	-0.65 (+)	8.4	L/369	-0.5 (+)	8.4	L/480
Span 2	3.9	-2.34	-15.6	8.77	-0.65 (+)	31.6	L/368	-0.5 (+)	31.6	L/478

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 SHEET 1 _____

Beam Analysis

Beam:		Offset Ceiling (b8)					
Load	Dead	Live	Roof Live	Seismic	Factored	Location	
Distributed (k/ft)	W ₁	0.072		0.100		0.172	
	W ₂					0.000	
	W ₃					0.000	
	W ₄					0.000	
	W ₅					0.000	
	W ₆					0.000	
	W ₇					0.000	
	W ₈					0.000	
	W ₉					0.000	
	W ₁₀					0.000	
Trapezoidal (k/ft/ft)	t ₁					0.000	
	t ₂					0.000	
	t ₃					0.000	
	t ₄					0.000	
	t ₅					0.000	
	t ₆					0.000	
Point (k)	P ₁					0.000	
	P ₂					0.000	
	P ₃					0.000	
	P ₄					0.000	
	P ₅					0.000	
	P ₆					0.000	
	P ₇					0.000	
	P ₈					0.000	
	P ₉					0.000	
	P ₁₀					0.000	

Support Locations and Reactions	
# of Supports	3
Total Beam Length	40.00
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	1.178 0.00
R ₂	4.309 19.00
R ₃	1.393 40.00
R ₄	0.000 40.00
R ₅	0.000 40.00
R ₆	0.000 40.00
R ₇	0.000 40.00
R ₈	0.000 40.00
R ₉	0.000 40.00
R ₁₀	0.000 40.00

Demand Output	
Location, ft	30.92
Shear, k	0.17
Moment, k-ft M =	5.56
Deflection, in D =	-0.36
Δ/Span	L/692

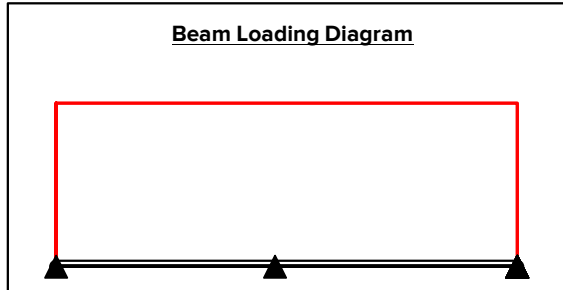
Load Factors	
Dead	1.00
Live	1.00
Roof Live	1.00
Seismic	1.00

Stresses @ Input Location	
f _v (psi)	65
f _b (psi)	8070

Max/Min Stresses	
f _v _MAX (psi)	669
f _v _MIN (psi)	-1115
f _b _MAX (psi)	9461
f _b _MIN (psi)	-16832

Beam Properties	
E (ksi)	29000
b (in)	3.5
d (in)	12
I (in ⁴)	33.1
S (in ³)	8.27
A (in ²)	2.6
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section		HSS8x4x3/16	
F _y , ksi	50		
Beam Weight (plf)	14.53		
Axis of Bending	Strong		
Unbr. Length (L _b), ft	0		
C _b	1		
A _w	2.6 in ²	V _r /Ω _v	46.9 k
S	8.27 in ³	φ _v V _n	70.3 k
Z	10.2 in ³	M _r /Ω _b	25.4 k-ft
I	33.1 in ⁴	φ _b M _n	38.3 k-ft



Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{TL} (in)	@ x =	L/	Δ _{LL} (in)	@ x =	L/
Span 1	1.74	-2.9	-11.6	6.52	-0.73 (★)	8.4	L/312	-0.504 (★)	8.4	L/451
Span 2	-2.68	-1.74	-11.6	6.52	-0.73 (★)	31.6	L/345	-0.504 (★)	31.6	L/499

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PROJECT Project

DATE 4/25/2023

PROJ. # _____

DESIGN ENG

SHEET 1

STRUCTURAL ENGINEERING

Beam Analysis

Beam:		Offset Floor w/ point (b9)					
Load	Dead	Live	Roof Live	Seismic	Factored	Location	
Distributed (k/ft)	w ₁	0.072	0.160			0.232	
	w ₂					0.000	
	w ₃					0.000	
	w ₄					0.000	
	w ₅					0.000	
	w ₆					0.000	
	w ₇					0.000	
	w ₈					0.000	
	w ₉					0.000	
	w ₁₀					0.000	
Trapezoidal (k/ft/ft)	t ₁					0.000	
	t ₂					0.000	
	t ₃					0.000	
	t ₄					0.000	
	t ₅					0.000	
	t ₆					0.000	
Point (k)	P ₁	1.91494		2.39368		4.309	19.00
	P ₂					0.000	
	P ₃					0.000	
	P ₄					0.000	
	P ₅					0.000	
	P ₆					0.000	
	P ₇					0.000	
	P ₈					0.000	
	P ₉					0.000	
	P ₁₀					0.000	

Support Locations and Reactions	
# of Supports	3
Total Beam Length	40.00
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	2.164 0.00
R ₂	10.108 21.25
R ₃	1.316 40.00
R ₄	0.000 40.00
R ₅	0.000 40.00
R ₆	0.000 40.00
R ₇	0.000 40.00
R ₈	0.000 40.00
R ₉	0.000 40.00
R ₁₀	0.000 40.00

Load Factors	
Dead	1.00
Live	1.00
Roof Live	1.00
Seismic	1.00

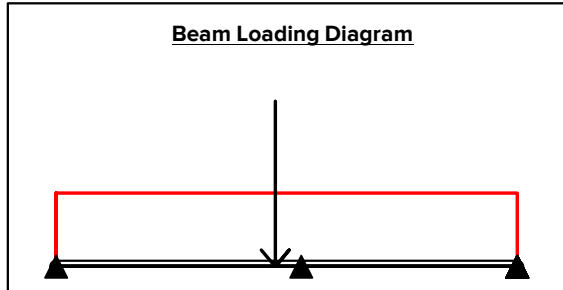
Stresses @ Input Location	
f _v (psi)	-36
f _b (psi)	10659

Max/Min Stresses	
f _v _MAX (psi)	706
f _v _MIN (psi)	-1648
f _b _MAX (psi)	10726
f _b _MIN (psi)	-17097

Demand Output	
Location, ft	10.00
Shear, k	-0.16
Moment, k-ft M =	10.04
Deflection, in D =	-0.76
Δ/Span	L/336

Beam Properties	
E (ksi)	29000
b (in)	3.5
d (in)	12
I (in ⁴)	34
S (in ³)	11.3
A (in ²)	4.29
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section		HSS6x4x1/2	
F _y , ksi	50		
Beam Weight (plf)	28.43		
Axis of Bending	Strong		
Unbr. Length (L _b), ft	0		
C _b	1		
A _w	4.29 in ²	V _r /Ω _v	77.2 k
S	11.3 in ³	φ _v V _n	116 k
Z	14.6 in ³	M _r /Ω _b	36.4 k-ft
I	34 in ⁴	φ _b M _n	54.8 k-ft



Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{Tl} (in)	@ x =	L/	Δ _{Ll} (in)	@ x =	L/
Span 1	2.16	-7.07	-16.1	10.1	-0.759 (+)	10	L/335	-0.353 (+)	9.3	L/721
Span 2	3.03	-1.32	-16.1	3.74	0.09 (+)	24.4	L/2496	-0.15 (+)	32.6	L/1498

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PROJECT Project _____

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PROJ. # _____

DESIGN ENG _____

SHEET 1 _____

Beam Analysis

Beam:		Deck offset (b10)					
Load	Dead	Live	Roof Live	Seismic	Factored	Location	
Distributed (k/ft)	W ₁	0.072	0.240			0.312	
	W ₂					0.000	
	W ₃					0.000	
	W ₄					0.000	
	W ₅					0.000	
	W ₆					0.000	
	W ₇					0.000	
	W ₈					0.000	
	W ₉					0.000	
	W ₁₀					0.000	
Trapezoidal (k/ft/ft)	t ₁					0.000	
	t ₂					0.000	
	t ₃					0.000	
	t ₄					0.000	
	t ₅					0.000	
	t ₆					0.000	
Point (k)	P ₁					0.000	
	P ₂					0.000	
	P ₃					0.000	
	P ₄					0.000	
	P ₅					0.000	
	P ₆					0.000	
	P ₇					0.000	
	P ₈					0.000	
	P ₉					0.000	
	P ₁₀					0.000	

Support Locations and Reactions	
# of Supports	3
Total Beam Length	40.00
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	2.572 0.00
R ₂	7.824 21.25
R ₃	2.083 40.00
R ₄	0.000 40.00
R ₅	0.000 40.00
R ₆	0.000 40.00
R ₇	0.000 40.00
R ₈	0.000 40.00
R ₉	0.000 40.00
R ₁₀	0.000 40.00

Load Factors	
Dead	1.00
Live	1.00
Roof Live	1.00
Seismic	1.00

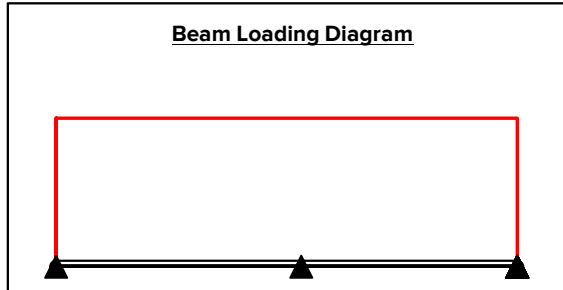
Stresses @ Input Location	
f _v (psi)	-72
f _b (psi)	11096

Max/Min Stresses	
f _{v_MAX} (psi)	879
f _{v_MIN} (psi)	-946
f _{b_MAX} (psi)	11257
f _{b_MIN} (psi)	-16779

Demand Output	
Location, ft	9.24
Shear, k	-0.31
Moment, k-ft M =	10.45
Deflection, in D =	-0.69
Δ/Span	L/371

Beam Properties	
E (ksi)	29000
b (in)	3.5
d (in)	12
I (in ⁴)	34
S (in ³)	11.3
A (in ²)	4.29
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section		HSS6x4x1/2	
F _y , ksi	50		
Beam Weight (plf)	28.43		
Axis of Bending	Strong		
Unbr. Length (L _b), ft	0		
C _b	1		
A _w	4.29 in ²	V _r /Ω _v	77.2 k
S	11.3 in ³	Φ _v V _n	116 k
Z	14.6 in ³	M _r /Ω _b	36.4 k-ft
I	34 in ⁴	Φ _b M _n	54.8 k-ft



Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{Tl} (in)	@ x =	L/	Δ _{Ll} (in)	@ x =	L/
Span 1	2.57	-4.06	-15.8	10.6	-0.688 (+)	9.3	L/370	-0.529 (+)	9.3	L/481
Span 2	3.77	-2.08	-15.8	6.95	-0.293 (+)	32.6	L/767	-0.226 (+)	32.6	L/994

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DESIGN ENG

SHEET 1

Beam Analysis

Beam:		Floor offset (b11)					
Load	Dead	Live	Roof Live	Seismic	Factored	Location	
Distributed (k/ft)	W ₁	0.072	0.160		0.232		
	W ₂				0.000		
	W ₃				0.000		
	W ₄				0.000		
	W ₅				0.000		
	W ₆				0.000		
	W ₇				0.000		
	W ₈				0.000		
	W ₉				0.000		
	W ₁₀				0.000		
Trapezoidal (k/ft/ft)	t ₁				0.000		
	t ₂				0.000		
	t ₃				0.000		
	t ₄				0.000		
	t ₅				0.000		
	t ₆				0.000		
Point (k)	P ₁				0.000		
	P ₂				0.000		
	P ₃				0.000		
	P ₄				0.000		
	P ₅				0.000		
	P ₆				0.000		
	P ₇				0.000		
	P ₈				0.000		
	P ₉				0.000		
	P ₁₀				0.000		

Support Locations and Reactions	
# of Supports	3
Total Beam Length	40.00
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	1.913 0.00
R ₂	5.818 21.25
R ₃	1.549 40.00
R ₄	0.000 40.00
R ₅	0.000 40.00
R ₆	0.000 40.00
R ₇	0.000 40.00
R ₈	0.000 40.00
R ₉	0.000 40.00
R ₁₀	0.000 40.00

Load Factors	
Dead	1.00
Live	1.00
Roof Live	1.00
Seismic	1.00

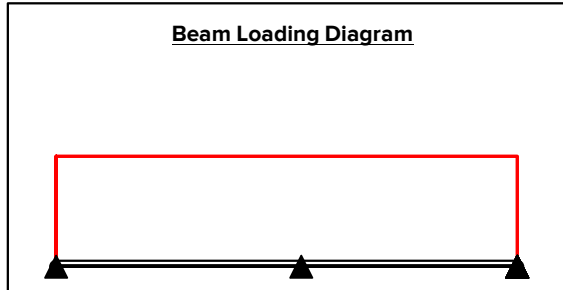
Stresses @ Input Location	
f _v (psi)	-77
f _b (psi)	11274

Max/Min Stresses	
f _v _MAX (psi)	936
f _v _MIN (psi)	-1010
f _b _MAX (psi)	11434
f _b _MIN (psi)	-16977

Demand Output	
Location, ft	9.24
Shear, k	-0.23
Moment, k-ft M =	7.77
Deflection, in D =	-0.70
Δ/Span	L/363

Beam Properties	
E (ksi)	29000
b (in)	3.5
d (in)	12
I (in ⁴)	24.8
S (in ³)	8.27
A (in ²)	2.99
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section		HSS6x4x5/16	
F _y , ksi	50		
Beam Weight (plf)	19.08		
Axis of Bending	Strong		
Unbr. Length (L _b), ft	0		
C _b	1		
A _w	2.99 in ²	V _r /Ω _v	53.7 k
S	8.27 in ³	φ _v V _n	80.6 k
Z	10.3 in ³	M _r /Ω _b	25.7 k-ft
I	24.8 in ⁴	φ _b M _n	38.6 k-ft



Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{Tl} (in)	@ x =	L/	Δ _{Ll} (in)	@ x =	L/
Span 1	1.91	-3.02	-11.7	7.88	-0.702 (+)	9.3	L/362	-0.484 (+)	9.3	L/526
Span 2	2.8	-1.55	-11.7	5.17	-0.299 (+)	32.6	L/751	-0.206 (+)	32.6	L/1090

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DESIGN ENG _____

SHEET 1 _____

Beam Analysis

Beam:		Offset Ceiling (b12)					
Load	Dead	Live	Roof Live	Seismic	Factored	Location	
Distributed (k/ft)	W ₁	0.072		0.100		0.172	
	W ₂					0.000	
	W ₃					0.000	
	W ₄					0.000	
	W ₅					0.000	
	W ₆					0.000	
	W ₇					0.000	
	W ₈					0.000	
	W ₉					0.000	
	W ₁₀					0.000	
Trapezoidal (k/ft/ft)	t ₁					0.000	
	t ₂					0.000	
	t ₃					0.000	
	t ₄					0.000	
	t ₅					0.000	
	t ₆					0.000	
Point (k)	P ₁					0.000	
	P ₂					0.000	
	P ₃					0.000	
	P ₄					0.000	
	P ₅					0.000	
	P ₆					0.000	
	P ₇					0.000	
	P ₈					0.000	
	P ₉					0.000	
	P ₁₀					0.000	

Support Locations and Reactions	
# of Supports	3
Total Beam Length	40.00
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	1.418 0.00
R ₂	4.313 21.25
R ₃	1.148 40.00
R ₄	0.000 40.00
R ₅	0.000 40.00
R ₆	0.000 40.00
R ₇	0.000 40.00
R ₈	0.000 40.00
R ₉	0.000 40.00
R ₁₀	0.000 40.00

Load Factors	
Dead	1.00
Live	1.00
Roof Live	1.00
Seismic	1.00

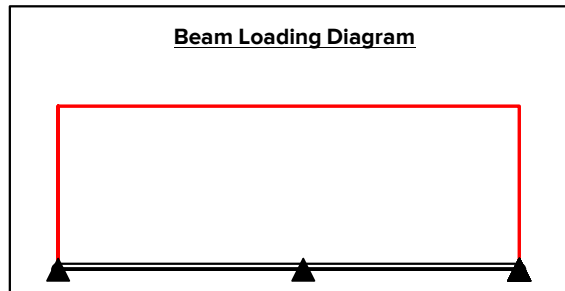
Stresses @ Input Location	
f _v (psi)	-66
f _b (psi)	8358

Max/Min Stresses	
f _v _MAX (psi)	800
f _v _MIN (psi)	-862
f _b _MAX (psi)	8489
f _b _MIN (psi)	-12624

Demand Output	
Location, ft	9.24
Shear, k	-0.17
Moment, k-ft M =	5.76
Deflection, in D =	-0.39
Δ/Span	L/654

Beam Properties	
E (ksi)	29000
b (in)	3.5
d (in)	12
I (in ⁴)	33.1
S (in ³)	8.27
A (in ²)	2.6
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section		HSS8x4x3/16	
F _y , ksi	50		
Beam Weight (plf)	14.53		
Axis of Bending	Strong		
Unbr. Length (L _b), ft	0		
C _b	1		
A _w	2.6 in ²	V _r /Ω _v	46.9 k
S	8.27 in ³	φ _v V _n	70.3 k
Z	10.2 in ³	M _r /Ω _b	25.4 k-ft
I	33.1 in ⁴	φ _b M _n	38.3 k-ft



Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{Tl} (in)	@ x =	L/	Δ _{Ll} (in)	@ x =	L/
Span 1	1.42	-2.24	-8.7	5.85	-0.39 (+)	9.3	L/652	0	0	L/∞
Span 2	2.08	-1.15	-8.7	3.83	-0.166 (+)	32.6	L/1353	0	21.3	L/∞

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DESIGN ENG

SHEET 1

Beam Analysis

Beam: floor w/ seismic overturning							
Load	Dead	Live	Roof Live	Seismic	Factored	Location	
Distributed (k/ft)	W ₁	0.072	0.160			0.232	
	W ₂					0.000	
	W ₃					0.000	
	W ₄					0.000	
	W ₅					0.000	
	W ₆					0.000	
	W ₇					0.000	
	W ₈					0.000	
	W ₉					0.000	
	W ₁₀					0.000	
Trapezoidal (k/ft/ft)	t ₁					0.000	
	t ₂					0.000	
	t ₃					0.000	
	t ₄					0.000	
	t ₅					0.000	
	t ₆					0.000	
Point (k)	P ₁				-4.6665	-4.667	33.50
	P ₂				4.6665	4.667	25.00
	P ₃					0.000	
	P ₄					0.000	
	P ₅					0.000	
	P ₆					0.000	
	P ₇					0.000	
	P ₈					0.000	
	P ₉					0.000	
	P ₁₀					0.000	

Support Locations and Reactions	
# of Supports	4
Total Beam Length	40.00
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	1.739 0.00
R ₂	7.557 20.00
R ₃	0.456 30.00
R ₄	-0.472 40.00
R ₅	0.000 40.00
R ₆	0.000 40.00
R ₇	0.000 40.00
R ₈	0.000 40.00
R ₉	0.000 40.00
R ₁₀	0.000 40.00

Load Factors	
Dead	1.00
Live	1.00
Roof Live	1.00
Seismic	1.00

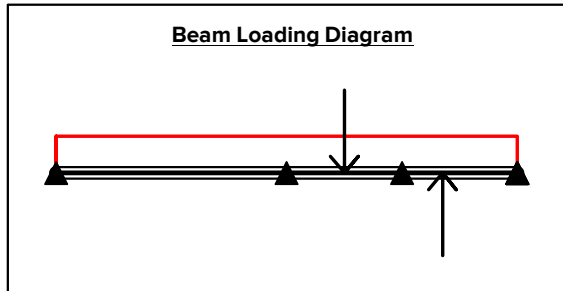
Stresses @ Input Location	
f _v (psi)	1034
f _b (psi)	-17433

Max/Min Stresses	
f _{v_MAX} (psi)	2440
f _{v_MIN} (psi)	-1518
f _{b_MAX} (psi)	19143
f _{b_MIN} (psi)	-25495

Demand Output	
Location, ft	33.52
Shear, k	1.98
Moment, k-ft M =	-7.93
Deflection, in D =	0.19
Δ/Span	L/616

Beam Properties	
E (ksi)	29000
b (in)	3.5
d (in)	12
I (in ⁴)	16.4
S (in ³)	5.46
A (in ²)	1.91
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section		HSS6x4x3/16	
F _y , ksi	50		
Beam Weight (plf)	11.97		
Axis of Bending	Strong		
Unbr. Length (L _b), ft	0		
C _b	1		
A _w	1.91 in ²	V _r /Ω _v	34.3 k
S	5.46 in ³	Φ _v V _n	51.5 k
Z	6.6 in ³	M _r /Ω _b	16.5 k-ft
I	16.4 in ⁴	Φ _b M _n	24.8 k-ft



Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{Tl} (in)	@ x =	L/	Δ _{Ll} (in)	@ x =	L/
Span 1	1.74	-2.9	-11.6	6.52	-0.729 (+)	8.4	L/329	-0.683 (+)	9	L/351
Span 2	4.66	-2.33	-11.6	8.71	-0.204 (+)	25.6	L/584	0.077 (+)	23.6	L/1546

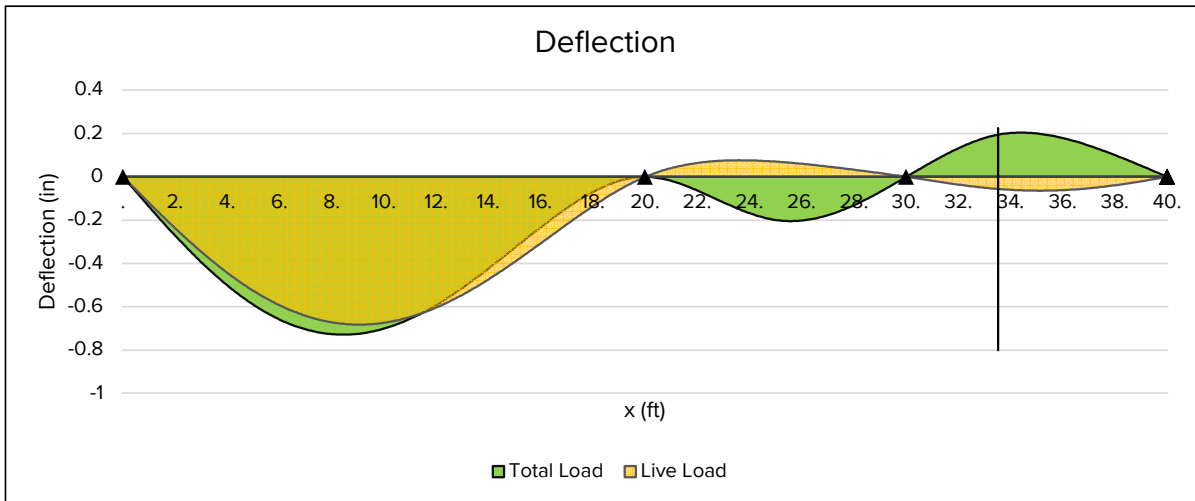
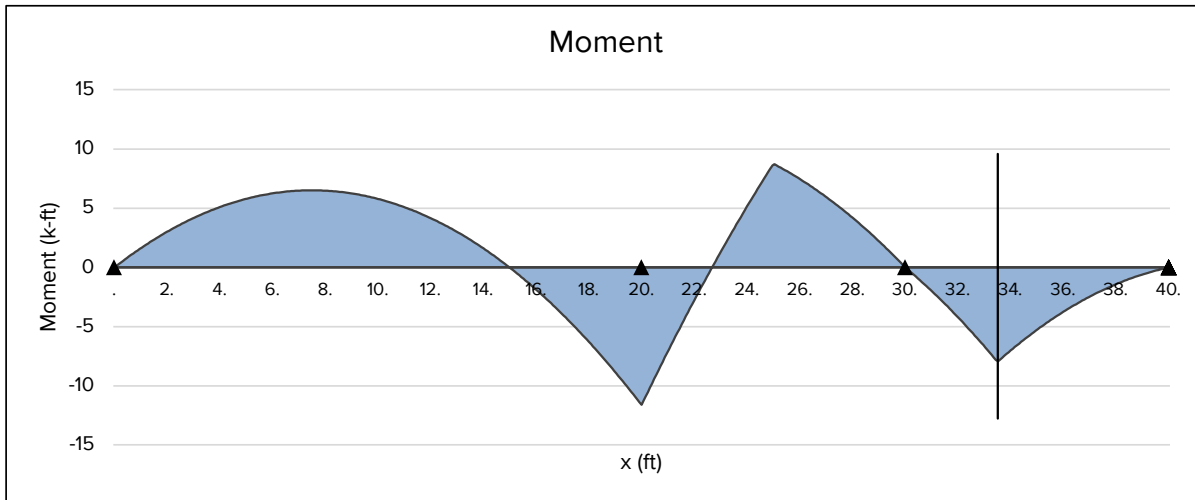
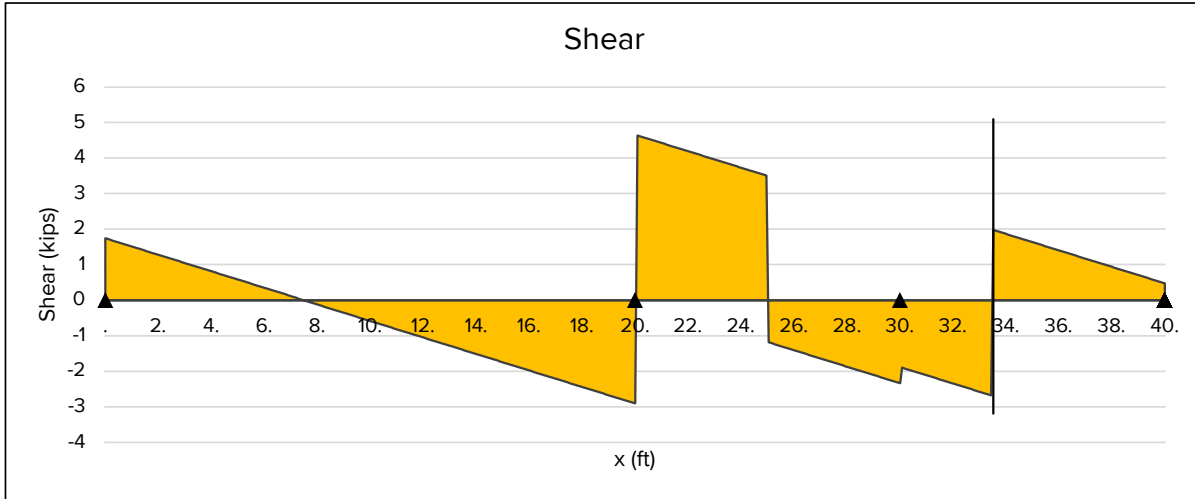
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 SHEET 1

Beam Analysis



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DATE 5/16/2023

PROJ. # _____

DESIGN ENG

SHEET 2

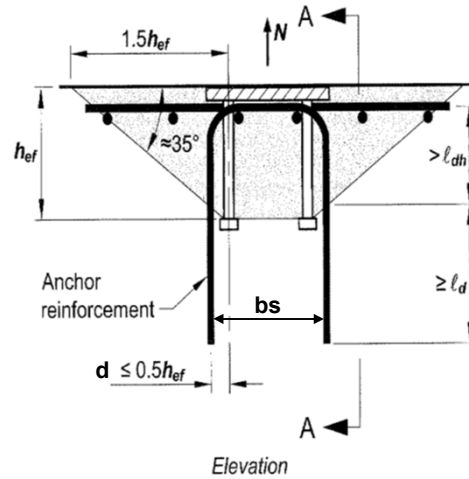
TENSION ANCHOR REINFORCEMENT

Per Building Code Requirements for Structural Concrete
Design of Anchor Reinforcement in place of Concrete Breakout Strength

Job Name:	Subject:	Date:	5/16/2023 15:06
Job Number:	Originator:	Checker:	

Input Data:

Req'd Anchor Reinf. Strength, N =	36.5	kips
Number of Vert. Reinf., Nr =	4	
Estimated Embedment, hef =	72	in.
Anchor Reinforcement Size =	5	(dia. = 0.625")
Reinforcing Yield Strength, fy =	60	ksi
Concrete Comp. Strength, f'c =	2.5	ksi
Lightweight Concrete?	No	
Epoxy Coated Bars?	No	
Ratio: As(required)/As(provided) =	1.00	
Seismic Design per Chapter 21?	Yes	
Center-to-Center Bar Spacing, bs =	6.00	in.
Clear Cover to Face of Bar, bc =	2.00	in.
Bolt-Reinf. Distance, d =	0.00	in.



DESIGN SATISFACTORY

Results:

Development Length (Section 12.2 or 21.7.5):

$L_d = 37.50$ in.

Required Anchor Embedment:

$hef_{min} = 39.50$ in. $hef_{min} = L_d + bc + 0.7 \cdot d$
 $hef_{prov} = 72.0$ in.

Anchor Reinforcement Strength(Section D.5.2.9):

$A_{s,min} = 0.81$ in² $A_{s,min} = N / (0.75 \cdot f_y)$
 $A_{s,prov} = 1.23$ in²

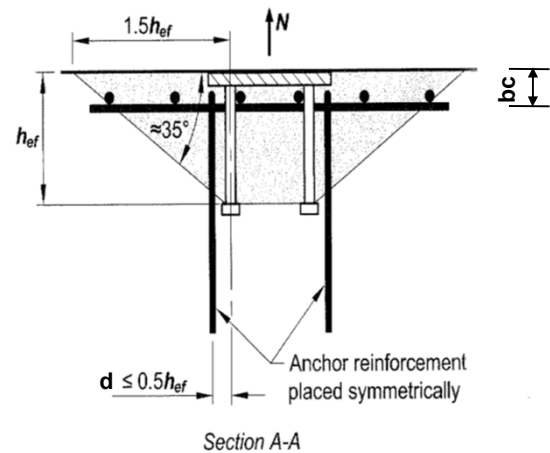


Fig. RD.5.2.9—Anchor reinforcement for tension.

Note: In situations where the edge distance, from centerline of bolts to edge of concrete, is less than 1.5 times the embedment depth, it is recommended that containment steel, such as stirrups, be used.

Comments:

Spread Footing Soil Bearing Design

Service Loads Loading

Dead Load =	15.2 kips
Live Load =	17.6 kips
Wind/EQ Load =	0.0 kips
Wind/EQ Moment (M_v) =	0 ft-kips
Gravity Load Eccentricity ($\pm X$) =	0.00 ft.
Footing Weight =	3.1 kips
Total Load =	35.9 kips
Total Moment =	0 ft-kips

Service Load Factors

DL	1
LL	1
EQ/Wind	1

Soil Properties

Allowable Soil Brg. (Q_a) =	1.50 ksf
Overburden Density (γ_s) =	120 psf
Net Ftg Wt? ($\gamma_c - \gamma_s$)	No

Column Dimensions and Location

Column Xc Dimension (D_x) =	6.00 in.
Column Yc Dimension (D_y) =	6.00 in.
Column Face from right (C_r) =	2.25 ft.
Column Face from left (C_l) =	2.25 ft.

Soil Bearing Check (Allowable)

Eccentricity =	0.00 ft.
Leng. Soil Brg. Under Ftg. =	5.00 ft.
q_{max} =	1.44 ksf
q_{min} =	1.44 ksf

OK

Footing Dimensions

L Dimension (X) =	5.00 ft.
B Dimension (Y) =	5.00 ft.
Footing Thickness (t) =	10.00 in.
Ftg Overburden (O_t) =	0.00 ft.

Soil Pressure Equations:

$$e \leq L/6$$

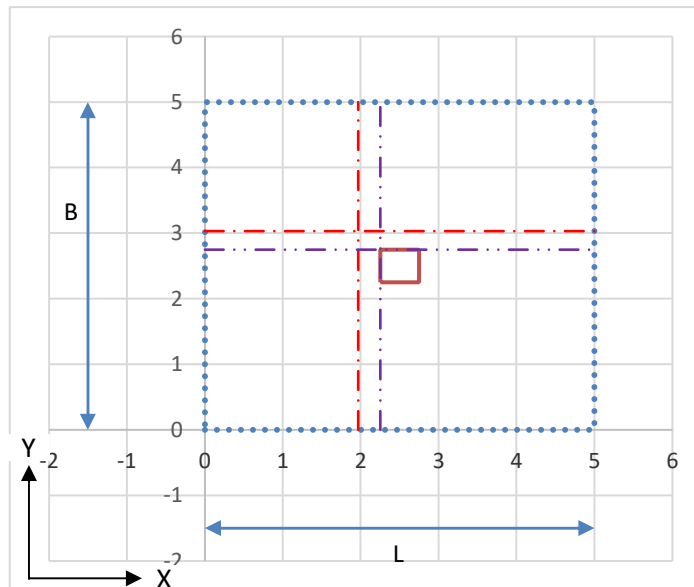
$$q_{max} = \frac{Q}{LB} \left(1 + \frac{6e}{L} \right)$$

$$q_{min} = \frac{Q}{LB} \left(1 - \frac{6e}{L} \right)$$

$$e > L/6$$

$$q_{max} = \frac{4Q}{3L(L-2e)}$$

$$q_{min} = 0$$



PROJECT _____

5/5/2023

DATE _____

PROJ. # _____

DESIGN _____

SHEET _____

Spread Footing Concrete Design - ACI 318-14

Footing Properties

Concrete Strength ($f'c$) =	3000 psi
Rebar Yield Strength (f_y) =	60000 psi
Reinforcing Clear Cover (c _{vr}) =	3.00 in.
Reinforcing Depth (d) =	6.75 in.

Strength Load Factors

DL	1
LL	1.6
EQ/Wind	1

Factored Loads

Factored Total Load =	46.5 kips
Factored Total moment =	0 ft-kips

Factored Moments and Shears

	Mu k-ft	Vu kips
X Right Side	24	18
X Left Side	24	18
Y Both Sides	24	18

Factored Bearing

Eccentricity =	0.00 ft.
Length of Soil Brg. Under Ftg. =	5.00 ft.
q _{max} =	1.86 ksf
q _{colr} =	1.86 ksf
q _{coll} =	1.86 ksf
q _{min} =	1.86 ksf

Flexural Design - X Direction (About Y-Axis)

Bar Size =	#4
Bars =	5
Mu =	24 ft-kips
ØMn =	29 ft-kips
ρ _{min} =	0.0018
ρ _{req} =	0.0020
A _s Required =	0.79 sq. in.
A _s Provided =	1.00 sq. in.

OK
Controls
OK

Flexural Design - Y Direction (About X-Axis)

Bar Size =	#4
Bars =	5
Mu =	24 ft-kips
ØMn =	29 ft-kips
ρ _{min} =	0.0018
ρ _{req} =	0.0020
A _s Required =	0.79 sq. in.
A _s Provided =	1.00 sq. in.

OK
Controls
OK

One-Way Shear Design - X Direction

Vu =	18 kips
ØVn =	33 kips

OK

One-Way Shear Design - Y Direction

Vu =	18 kips
ØVn =	33 kips

OK

β =	1.000
γ _s = 2/(β+1) =	1.00
Provide A _{s,req} γ _s =	0.79 sq. in.

Provide evenly distributed bars in each direction.

Two-Way (Punching) Shear Design

d _o =	51 in
vu =	44 kips
Øvn =	54 kips

OK

Concrete Capacity Equations:

$$Mn = A_s F_y \left[d - \frac{1}{2} \left(\frac{A_s F_y}{0.85 f'c b} \right) \right] \quad vn = \min \left(\begin{array}{l} 4\sqrt{f'c} \\ \left(2 + \frac{4}{\beta} \right) \sqrt{f'c} \\ \left(2 + \frac{\alpha_s d}{b_o} \right) \sqrt{f'c} \end{array} \right) b_o d$$

$$Vn = 2 \gamma \sqrt{f'c} b_w d \quad b_o = 2(Dx + d) + 2(Dy + d)$$

$$\beta = \max(Dx, Dy) / \min(Dx, Dy)$$

PROJECT _____

5/5/2023

DATE _____

PROJ. # _____

DESIGN _____

SHEET _____

Spread Footing Soil Bearing Design

Service Loads Loading

Dead Load =	3.0 kips
Live Load =	6.2 kips
Wind/EQ Load =	0.0 kips
Wind/EQ Moment (M _v) =	0 ft-kips
Gravity Load Eccentricity (±X)=	0.00 ft.
Footing Weight =	1.1 kips
Total Load =	10.4 kips
Total Moment =	0 ft-kips

Service Load Factors

DL	1
LL	1
EQ/Wind	1

Soil Properties

Allowable Soil Brg. (Q _a) =	1.50 ksf
Overburden Density (γ _s) =	120 psf
Net Ftg Wt? (γ _c -γ _s)	No

Column Dimensions and Location

Column Xc Dimension (D _x) =	6.00 in.
Column Yc Dimension (D _y) =	6.00 in.
Column Face from right (C _r) =	1.25 ft.
Column Face from left (C _l) =	1.25 ft.

Soil Bearing Check (Allowable)

Eccentricity =	0.00 ft.
Leng. Soil Brg. Under Ftg.=	3.00 ft.
q _{max} =	1.15 ksf
q _{min} =	1.15 ksf

OK

Footing Dimensions

L Dimension (X) =	3.00 ft.
B Dimension (Y) =	3.00 ft.
Footing Thickness (t) =	10.00 in.
Ftg Overburden (O _t) =	0.00 ft.

Soil Pressure Equations:

$$e \leq L/6$$

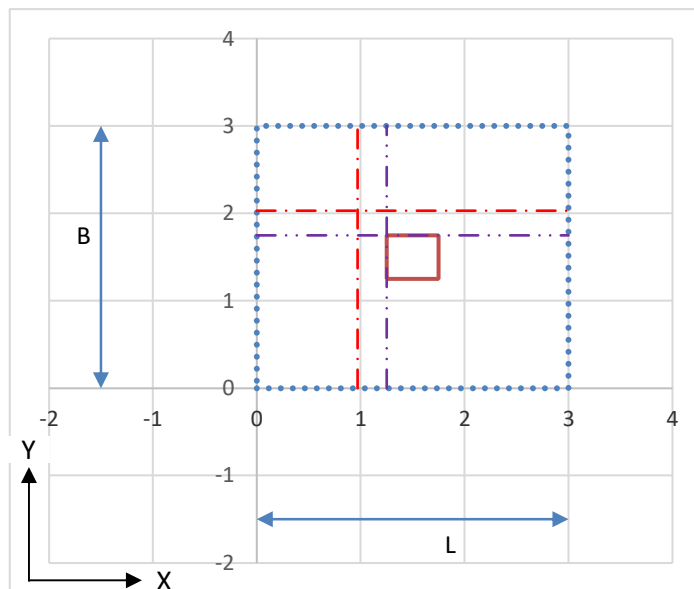
$$q_{max} = \frac{Q}{LB} \left(1 + \frac{6e}{L} \right)$$

$$q_{min} = \frac{Q}{LB} \left(1 - \frac{6e}{L} \right)$$

$$e > L/6$$

$$q_{max} = \frac{4Q}{3L(L-2e)}$$

$$q_{min} = 0$$



PROJECT _____

5/5/2023

DATE _____

PROJ. # _____

DESIGN _____

SHEET _____

Spread Footing Concrete Design - ACI 318-14

Footing Properties

Concrete Strength (f'_c) =	3000 psi
Rebar Yield Strength (f_y) =	60000 psi
Reinforcing Clear Cover (c _{vr}) =	3.00 in.
Reinforcing Depth (d) =	6.75 in.

Strength Load Factors

DL	1
LL	1.6
EQ/Wind	1

Factored Loads

Factored Total Load =	14.1 kips
Factored Total moment =	0 ft-kips

Factored Moments and Shears

	Mu k-ft	Vu kips
X Right Side	4	5
X Left Side	4	5
Y Both Sides	4	5

Factored Bearing

Eccentricity =	0.00 ft.
Length of Soil Brg. Under Ftg. =	3.00 ft.
q _{max} =	1.57 ksf
q _{colr} =	1.57 ksf
q _{coll} =	1.57 ksf
q _{min} =	1.57 ksf

Flexural Design - X Direction (About Y-Axis)

Bar Size =	#4
Bars =	5
Mu =	4 ft-kips
ØMn =	29 ft-kips
ρ _{min} =	0.0018
ρ _{req} =	0.0005
A _s Required =	0.44 sq. in.
A _s Provided =	1.00 sq. in.

OK Controls

Flexural Design - Y Direction (About X-Axis)

Bar Size =	#4
Bars =	5
Mu =	4 ft-kips
ØMn =	29 ft-kips
ρ _{min} =	0.0018
ρ _{req} =	0.0005
A _s Required =	0.44 sq. in.
A _s Provided =	1.00 sq. in.

OK Controls

One-Way Shear Design - X Direction

Vu =	5 kips
ØVn =	20 kips

OK

One-Way Shear Design - Y Direction

Vu =	5 kips
ØVn =	20 kips

OK

β =	1.000
γ _s = 2/(β+1) =	1.00
Provide A _{s,req} γ _s =	0.44 sq. in.

Provide evenly distributed bars in each direction.

Two-Way (Punching) Shear Design

d _o =	51 in
vu =	12 kips
Øvn =	54 kips

OK

Concrete Capacity Equations:

$$Mn = A_s F_y \left[d - \frac{1}{2} \left(\frac{A_s F_y}{0.85 f'_c b} \right) \right] \quad vn = \min \left(\begin{array}{l} 4\sqrt{f'_c} \\ \left(2 + \frac{4}{\beta} \right) \sqrt{f'_c} \\ \left(2 + \frac{\alpha_s d}{b_o} \right) \sqrt{f'_c} \end{array} \right) b_o d$$

$$Vn = 2 \gamma \sqrt{f'_c} b_w d \quad b_o = 2(Dx + d) + 2(Dy + d)$$

$$\beta = \max(Dx, Dy) / \min(Dx, Dy)$$

PROJECT _____

5/5/2023

DATE _____

PROJ. # _____

DESIGN _____

SHEET _____

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab

Code Reference

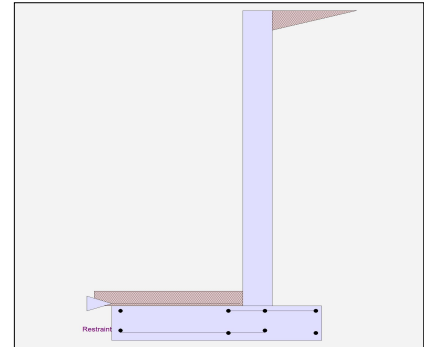
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 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	=	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	=	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

Project Title:
 Engineer:
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 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab

Design Summary

Wall Stability Ratios

Overturning	=	2.18	OK
Slab Resists All Sliding !			
Global Stability	=	1.17	
Total Bearing Load = 4,071 lbs			
...resultant ecc.	=	7.68 in	
Eccentricity within middle third			
Soil Pressure @ Toe	=	1,113 psf	OK
Soil Pressure @ Heel	=	244 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,558 psf	
ACI Factored @ Heel	=	342 psf	
Footing Shear @ Toe	=	21.8 psi	OK
Footing Shear @ Heel	=	12.6 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,182.2 lbs
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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	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	SD
Thickness	=	10.00
Rebar Size	=	# 7
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa	=	0.504
---------------	---	-------

Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	2,800.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	9,333.3

Moment.....Allowable	=	18,507.2
----------------------	---	----------

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	30.9

Shear.....Allowable	psi =	75.0
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Anet (Masonry)	in2 =	
----------------	-------	--

Wall Weight	psf =	125.0
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Rebar Depth 'd'	in =	7.56
-----------------	------	------

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 =	60,000.0

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>	
Bottom Stem			
As (based on applied moment) :	0.2863 in2/ft		
(4/3) * As :	0.3818 in2/ft	Min Stem T&S Reinf Area 2.400 in2	
200bd/fy : 200(12)(7.5625)/60000 :	0.3025 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0012bh : 0.0012(12)(10) :	0.144 in2/ft	Horizontal Reinforcing Options :	
	=====	<u>One layer of :</u> <u>Two layers of :</u>	
Required Area :	0.3025 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.6 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.0245 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	3.75 ft
Heel Width	=	2.25
Total Footing Width	=	6.00
Footing Thickness	=	14.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm.= 3.00 in

Footing Design Results

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	= 1,558	342 psf	
Mu' : Upward	= 9,173	439 ft-#	
Mu' : Downward	= 2,004	1,716 ft-#	
Mu: Design	= 7,169 OK	1,277 ft-#	OK
phiMn	= 26,613	21,993 ft-#	
Actual 1-Way Shear	= 21.83	12.57 psi	
Allow 1-Way Shear	= 75.00	75.00 psi	
Toe Reinforcing	= # 7 @ 12.00 in		
Heel Reinforcing	= # 6 @ 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: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39.68 in, #10@ 50.39 in

Heel: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39.68 in, #10@ 50.39 in

Key: No key defined

Min footing T&S reinf Area 1.81 in2
 Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars:

#4@ 7.94 in
 #5@ 12.30 in
 #6@ 17.46 in

If two layers of horizontal bars:

#4@ 15.87 in
 #5@ 24.60 in
 #6@ 34.92 in

Project Title:
 Engineer:
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Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab

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)	2,182.2	3.72	8,122.5	Soil Over HL (ab. water tbl)	1,770.8	5.29	9,370.7
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.29	9,370.7
Hydrostatic Force				Watre Table			
Buoyant Force =				Sloped Soil Over Hee =			
Surcharge over Heel =				Surcharge Over Heel =			
Surcharge Over Toe =				Adjacent Footing Load =			
Adjacent Footing Load =				Axial Dead Load on Stem=			
Added Lateral Load =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =		1.88	
				Surcharge Over Toe =			
				Stem Weight(s) =	1,250.0	4.17	5,208.3
				Earth @ Stem Transitions=			
Total	= 2,182.2	O.T.M.	= 8,122.5	Footing Weighl =	1,050.0	3.00	3,150.0
				Key Weight =			
				Vert. Component =			
Resisting/Overturning Ratio		=	2.18	Total =	4,070.8 lbs	R.M.=	17,729.0
Vertical Loads used for Soil Pressure =		4,070.8 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 250.0 pci
 Horizontal Defl @ Top of Wall (approximate only) 0.052 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 Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #7 bar specified in this stem design segment =	40.95 in
Development length for #7 bar specified in this stem design segment =	31.50 in
Hooked embedment length into footing for #7 bar specified in this stem design segment =	7.41 in
As Provided =	0.6000 in ² /ft
As Required =	0.3025 in ² /ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

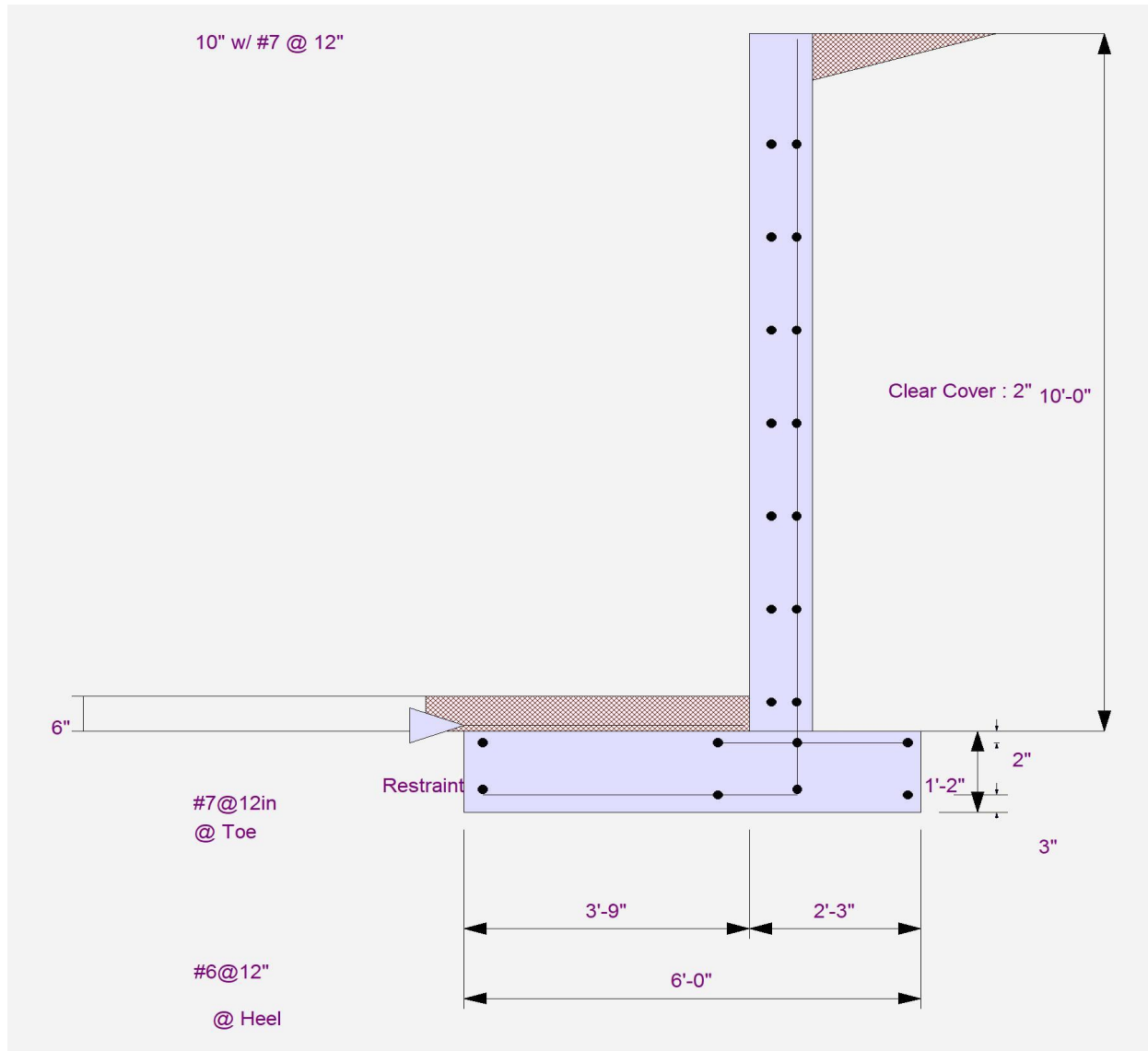
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LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

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DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

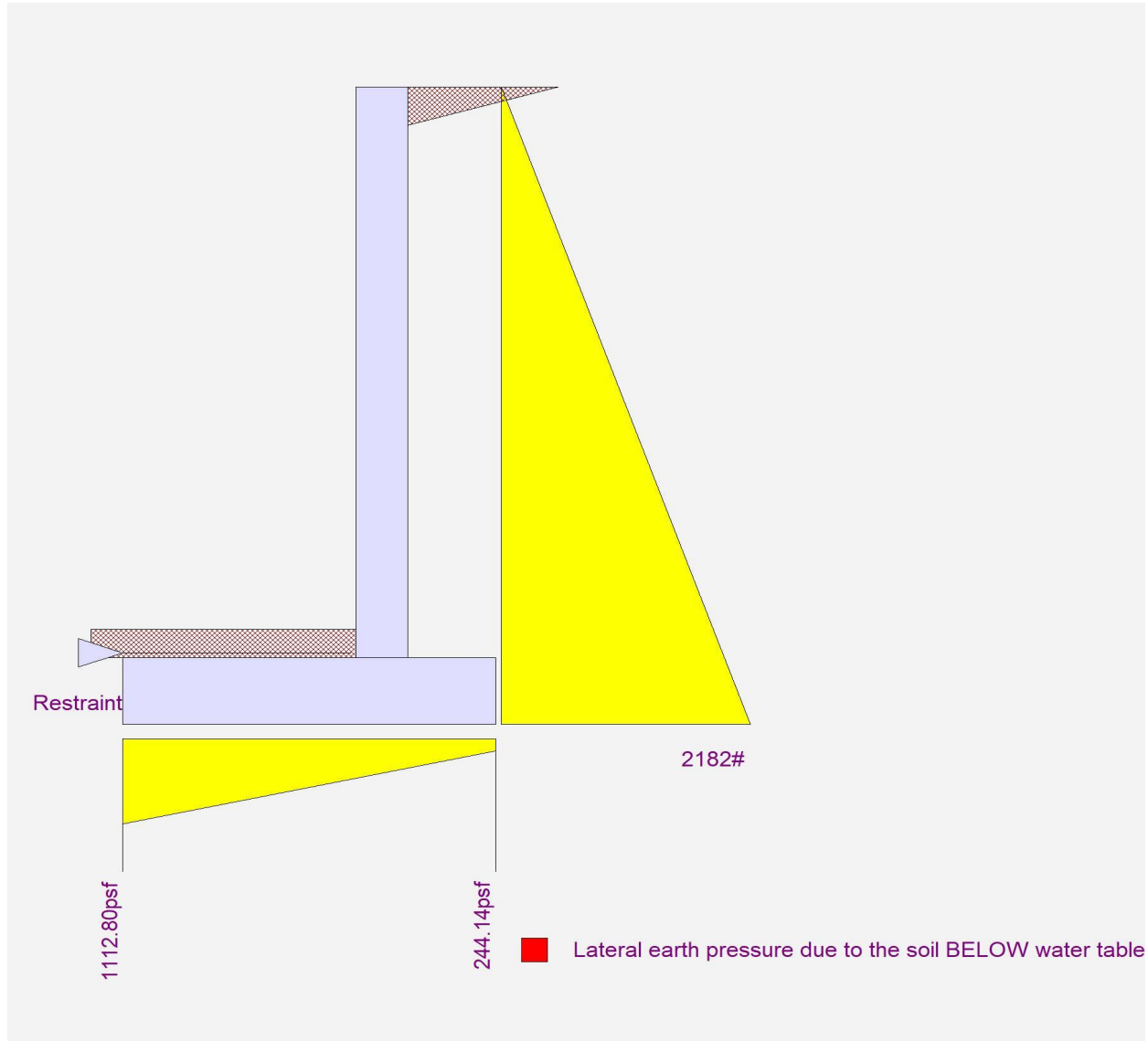
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LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

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DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab



Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab, w/ Seismic

Code Reference

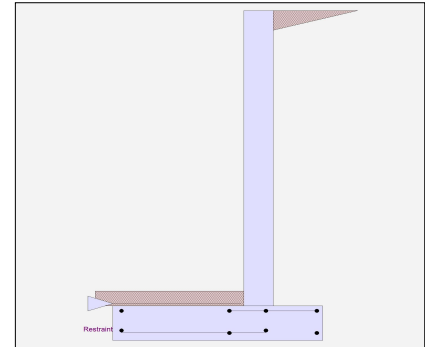
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 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

Earth Pressure Seismic Load

Method	:	Uniform
Multiplier Used	=	8.000
(Multiplier used on soil density)		

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	=	0.0 psf (Service Level)

Uniform Seismic Force	=	89.333
Total Seismic Force	=	997.556

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 Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab, w/ Seismic

Design Summary

Wall Stability Ratios

Overturning	=	1.47	Ratio < 1.5!
Slab Resists All Sliding !			
Global Stability	=	1.51	
Total Bearing Load	=	4,071 lbs	
...resultant ecc.	=	19.17 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,936 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,710 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	33.6 psi	OK
Footing Shear @ Heel	=	17.6 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force = 2,880.4 lbs

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	=	10.00
Rebar Size	=	# 7
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa = 0.745

Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	3,693.3

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	13,800.0

Moment.....Allowable = 18,507.2

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	40.7

Shear.....Allowable psi = 75.0

Anet (Masonry) in2 =

Wall Weight psf = 125.0

Rebar Depth 'd' in = 7.56

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 =	60,000.0

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab, w/ Seismic

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>	
Bottom Stem			
As (based on applied moment) :	0.4234 in2/ft		
(4/3) * As :	0.5645 in2/ft	Min Stem T&S Reinf Area 2.400 in2	
200bd/fy : 200(12)(7.5625)/60000 :	0.3025 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0012bh : 0.0012(12)(10) :	0.144 in2/ft	Horizontal Reinforcing Options :	
	=====	<u>One layer of :</u> <u>Two layers of :</u>	
Required Area :	0.4234 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.6 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.0245 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	3.75 ft
Heel Width	=	2.25
Total Footing Width	=	6.00
Footing Thickness	=	14.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm.= 3.00 in

Footing Design Results

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	=	2,710	0 psf
Mu' : Upward	=	13,391	0 ft-#
Mu' : Downward	=	2,004	1,716 ft-#
Mu: Design	=	11,387 OK	1,716 ft-# OK
phiMn	=	26,613	21,993 ft-#
Actual 1-Way Shear	=	33.63	17.55 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 7 @ 12.00 in	
Heel Reinforcing	=	# 6 @ 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: #4@ 7.24 in, #5@ 11.22 in, #6@ 15.93 in, #7@ 21.72 in, #8@ 28.60 in, #9@ 36.21 in, #10@ 45.98 in

Heel: #4@ 7.93 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.80 in, #8@ 31.34 in, #9@ 39.68 in, #10@ 50.39 in

Key: No key defined

Min footing T&S reinf Area 1.81 in2
 Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars:

#4@ 7.94 in
 #5@ 12.30 in
 #6@ 17.46 in

If two layers of horizontal bars:

#4@ 15.87 in
 #5@ 24.60 in
 #6@ 34.92 in

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab, w/ Seismic

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)	2,182.2	3.72	8,122.5	Soil Over HL (ab. water tbl)	1,770.8	5.29	9,370.7
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.29	9,370.7
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =		1.88	
Seismic Earth Load =	698.3	5.58	3,898.8	Surcharge Over Toe =			
=				Stem Weight(s) =	1,250.0	4.17	5,208.3
Total	= 2,880.4	O.T.M. =	12,021.2	Earth @ Stem Transitions =			
				Footing Weight =	1,050.0	3.00	3,150.0
				Key Weight =			
				Vert. Component =			
				Total =	4,070.8 lbs	R.M. =	17,729.0
Resisting/Overturning Ratio		=	1.47				
Vertical Loads used for Soil Pressure =		4,070.8 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) 0.090 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 Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab, w/ Seismic

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #7 bar specified in this stem design segment =	40.95 in
Development length for #7 bar specified in this stem design segment =	31.50 in
Hooked embedment length into footing for #7 bar specified in this stem design segment =	10.37 in
As Provided =	0.6000 in ² /ft
As Required =	0.4234 in ² /ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

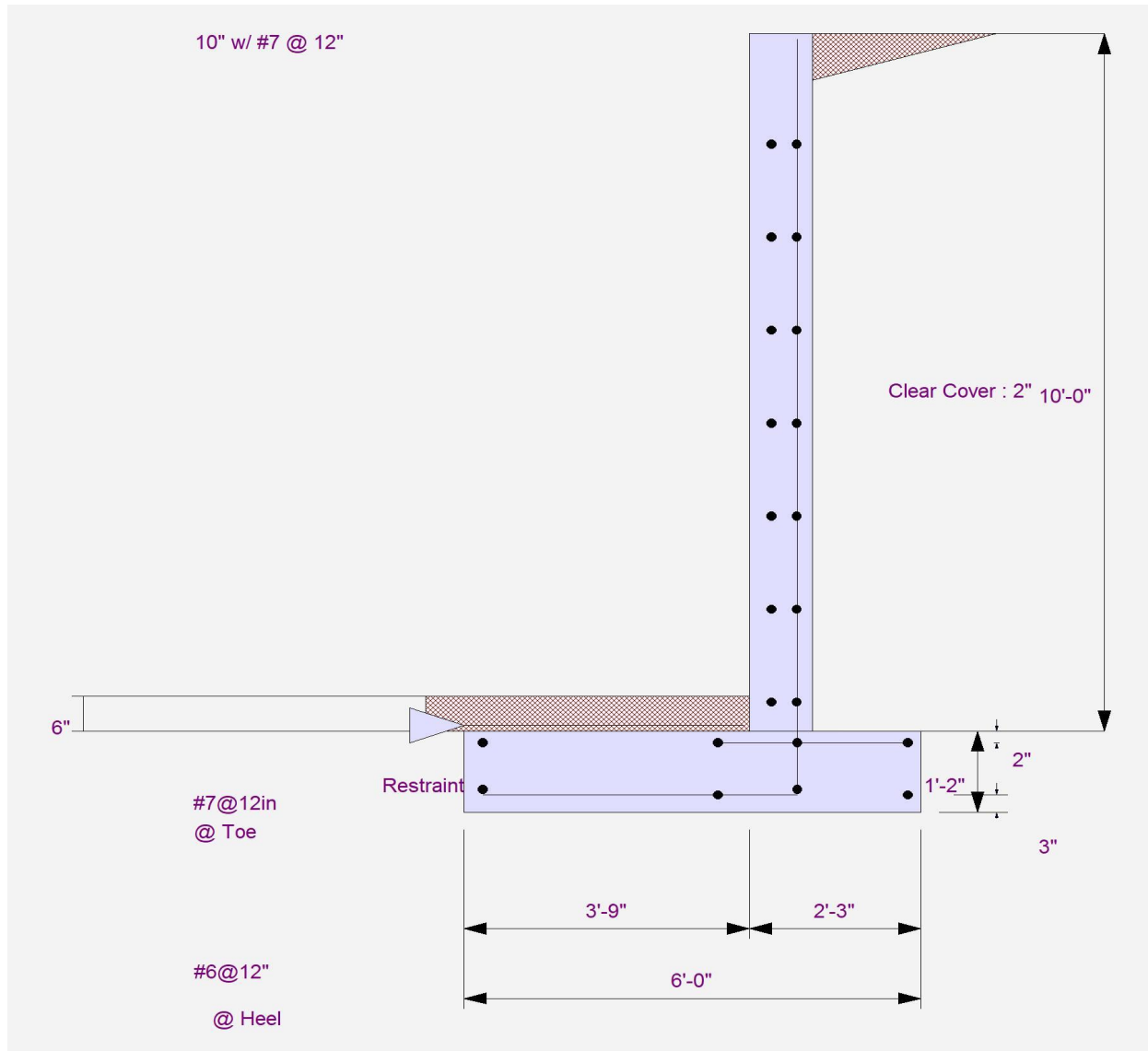
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LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab, w/ Seismic



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

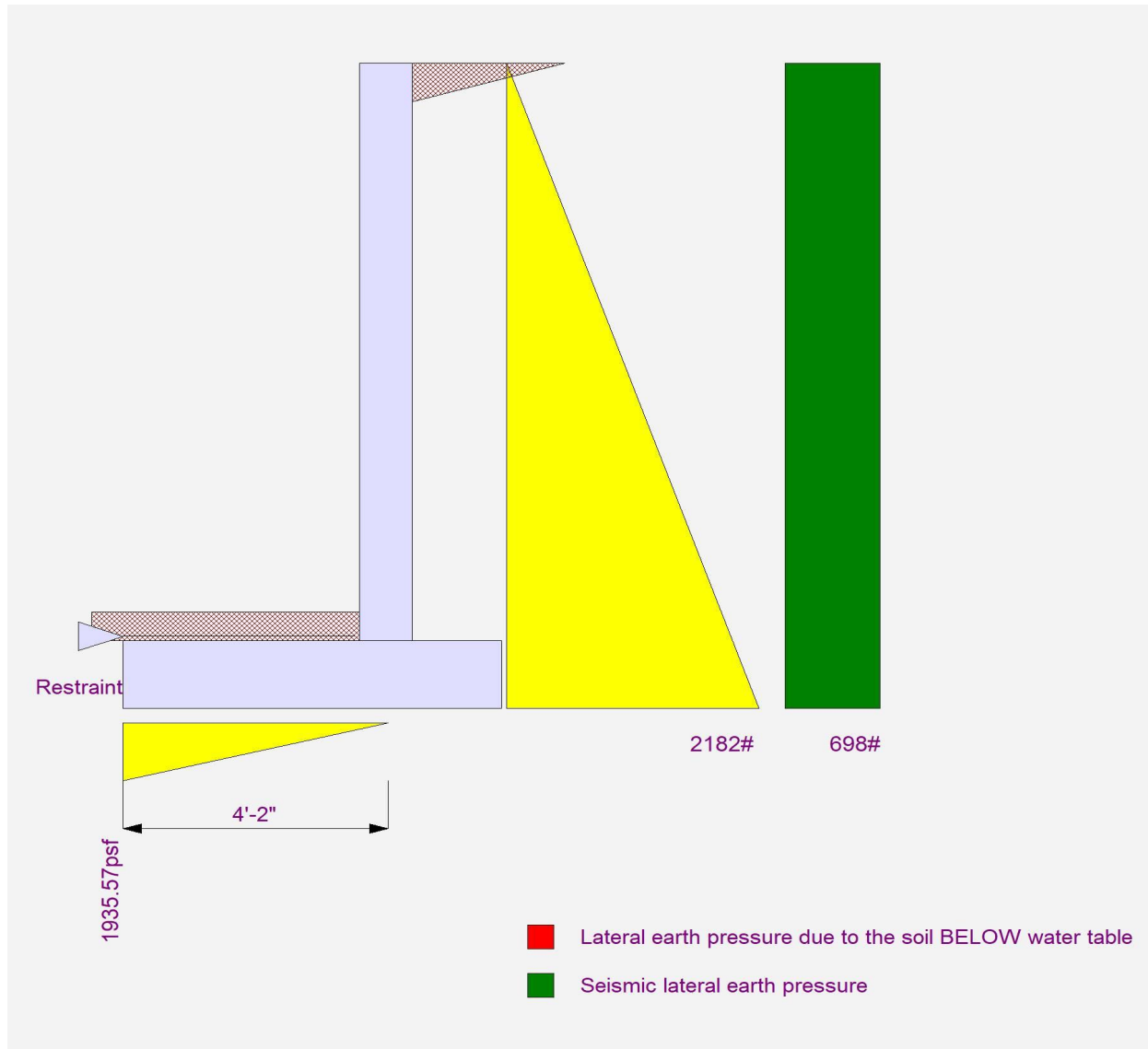
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LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 10'-0" Retaining Wall w/ Slab, w/ Seismic



Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab

Code Reference

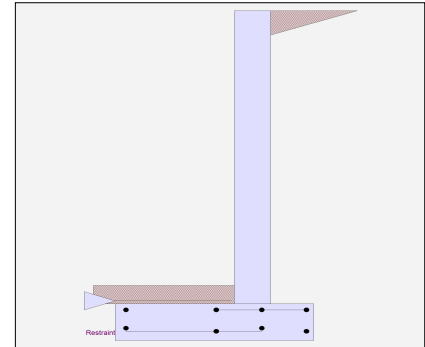
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 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	=	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	=	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

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab

Design Summary

Wall Stability Ratios

Overturning	=	2.07	OK
Slab Resists All Sliding !			
Global Stability	=	1.18	
Total Bearing Load	=	2,684 lbs	
...resultant ecc.	=	7.11 in	
Eccentricity within middle third			
Soil Pressure @ Toe	=	1,041 psf	OK
Soil Pressure @ Heel	=	131 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,457 psf	
ACI Factored @ Heel	=	184 psf	
Footing Shear @ Toe	=	17.9 psi	OK
Footing Shear @ Heel	=	9.2 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,417.5 lbs
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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	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	SD
Thickness	=	10.00
Rebar Size	=	# 6
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa	=	0.339
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Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,792.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	4,778.7

Moment.....Allowable	=	14,069.5
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Shear.....Actual

Service Level	psi =	
Strength Level	psi =	19.6

Shear.....Allowable	psi =	75.0
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Anet (Masonry)	in2 =	
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Wall Weight	psf =	125.0
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Rebar Depth 'd'	in =	7.63
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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 =	2,500.0
Fy	psi =	60,000.0

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>	
Bottom Stem			
As (based on applied moment) :	0.1453 in2/ft		
(4/3) * As :	0.1938 in2/ft	Min Stem T&S Reinf Area 1.920 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0012bh : 0.0012(12)(10) :	0.144 in2/ft	Horizontal Reinforcing Options :	
	=====	<u>One layer of :</u> <u>Two layers of :</u>	
Required Area :	0.1938 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.0329 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	2.75 ft
Heel Width	=	1.83
Total Footing Width	=	4.58
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c =	2,500 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

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	= 1,457	184 psf	
Mu' : Upward	= 4,546	137 ft-#	
Mu' : Downward	= 964	685 ft-#	
Mu: Design	= 3,582 OK	548 ft-#	OK
phiMn	= 11,610	13,005 ft-#	
Actual 1-Way Shear	= 17.88	9.25 psi	
Allow 1-Way Shear	= 75.00	75.00 psi	
Toe Reinforcing	= # 5 @ 12.00 in		
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: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Key: No key defined

Min footing T&S reinf Area 1.19 in2
 Min footing T&S reinf Area per foot 0.26 in2 /ft

If one layer of horizontal bars:

#4@ 9.26 in
 #5@ 14.35 in
 #6@ 20.37 in

If two layers of horizontal bars:

#4@ 18.52 in
 #5@ 28.70 in
 #6@ 40.74 in

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab

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)	1,417.5	3.00	4,252.5	Soil Over HL (ab. water tbl)	996.7	4.08	4,068.1
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		4.08	4,068.1
Hydrostatic Force				Watre Table			
Buoyant Force =				Sloped Soil Over Hee =			
Surcharge over Heel =				Surcharge Over Heel =			
Surcharge Over Toe =				Adjacent Footing Load =			
Adjacent Footing Load =				Axial Dead Load on Stem=			
Added Lateral Load =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =		1.38	
				Surcharge Over Toe =			
				Stem Weight(s) =	1,000.0	3.17	3,166.7
				Earth @ Stem Transitions=			
Total	= 1,417.5	O.T.M. =	4,252.5	Footing Weighl =	687.0	2.29	1,573.2
				Key Weight =			
				Vert. Component =			
Resisting/Overturning Ratio		= 2.07		Total =	2,683.7 lbs	R.M.=	8,808.0
Vertical Loads used for Soil Pressure =		2,683.7 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 250.0 pci
 Horizontal Defl @ Top of Wall (approximate only) 0.050 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #6 bar specified in this stem design segment =	28.08 in
Development length for #6 bar specified in this stem design segment =	21.60 in
Hooked embedment length into footing for #6 bar specified in this stem design segment =	6.00 in
As Provided =	0.4400 in ² /ft
As Required =	0.1938 in ² /ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

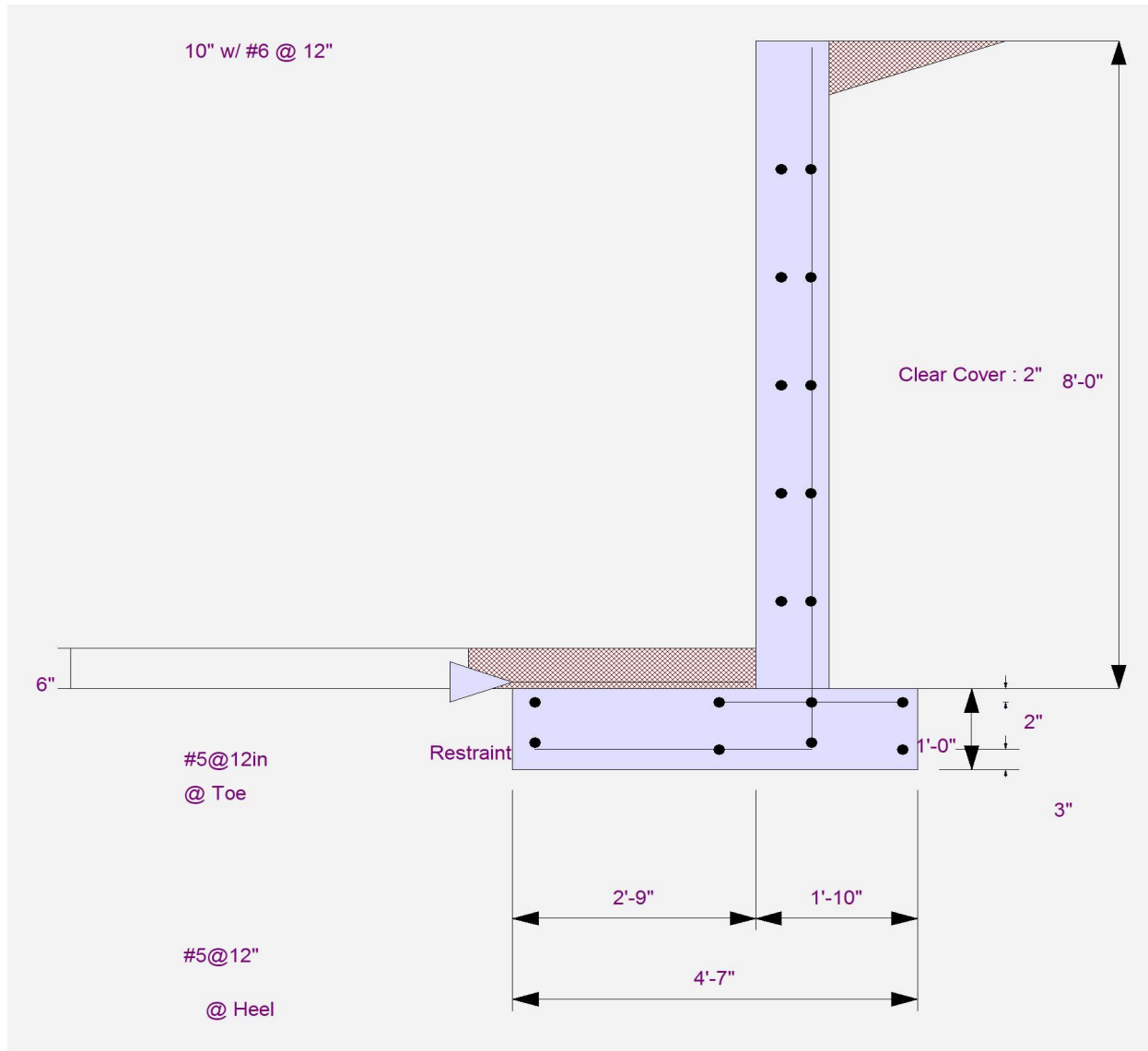
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LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

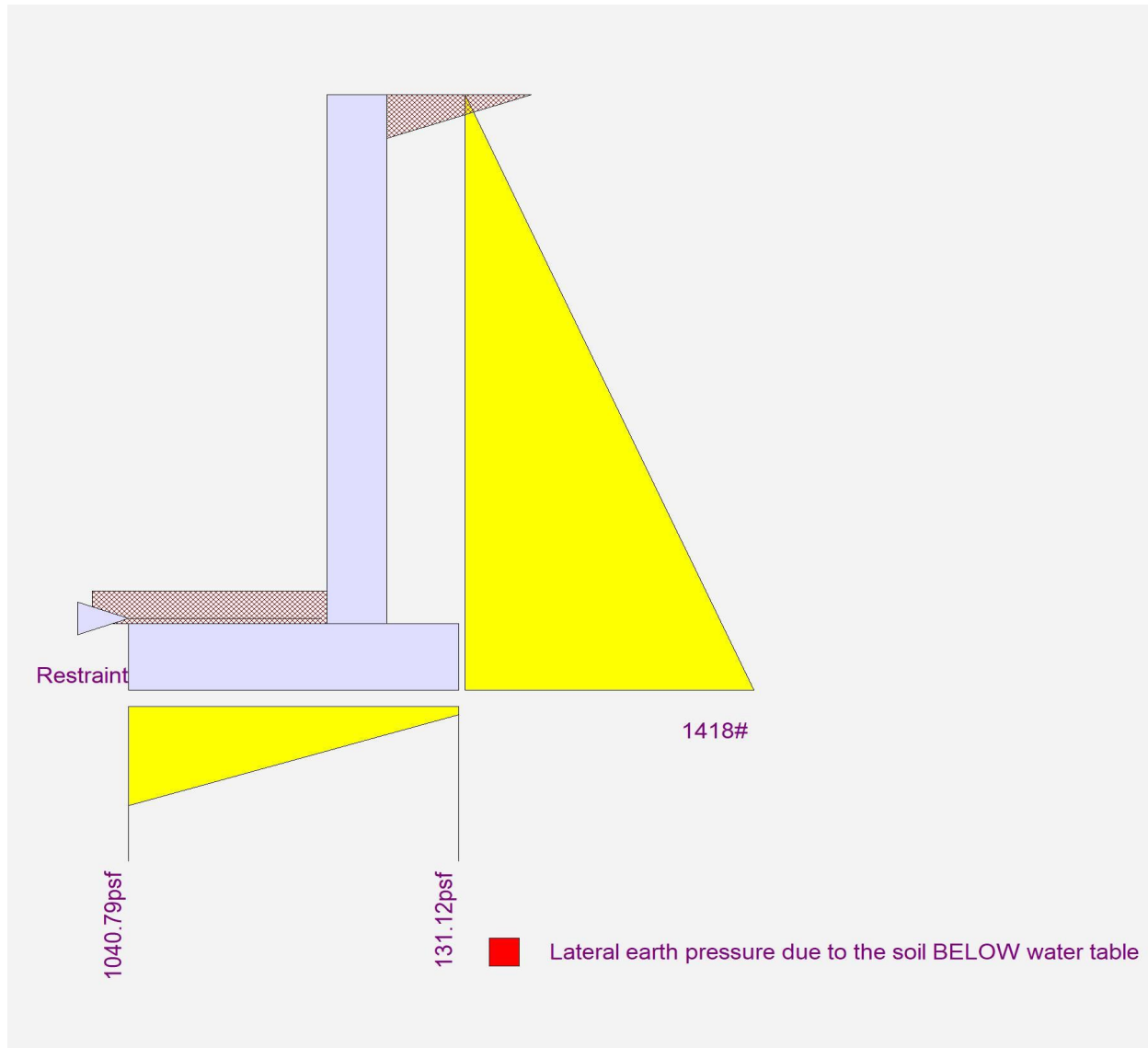
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LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab



Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab, w/ Seismic

Code Reference

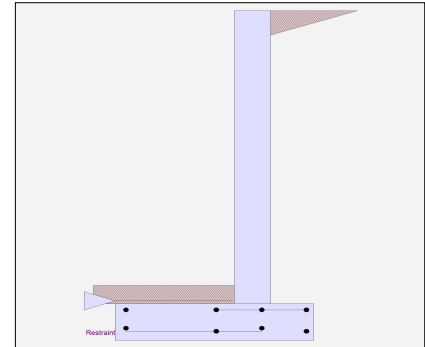
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 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

Earth Pressure Seismic Load

Method	:	Uniform
Multiplier Used	=	8.000
(Multiplier used on soil density)		

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	=	0.0 psf (Service Level)

Uniform Seismic Force	=	72.000
Total Seismic Force	=	648.000

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 Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab, w/ Seismic

Design Summary

Wall Stability Ratios

Overturning	=	1.40	Ratio < 1.5!
Slab Resists All Sliding !			
Global Stability	=	1.59	
Total Bearing Load	=	2,684 lbs	
...resultant ecc.	=	16.24 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,910 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,674 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	28.5 psi	OK
Footing Shear @ Heel	=	12.1 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force = 1,871.1 lbs

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	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	SD
Thickness	=	10.00
Rebar Size	=	# 6
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge

Design Data

fb/FB + fa/Fa = 0.503

Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	2,368.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	7,082.7

Moment.....Allowable = 14,069.5

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	25.9

Shear.....Allowable psi = 75.0

Anet (Masonry) in2 =

Wall Weight psf = 125.0

Rebar Depth 'd' in = 7.63

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 =	60,000.0

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab, w/ Seismic

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>	
Bottom Stem			
As (based on applied moment) :	0.2154 in2/ft		
(4/3) * As :	0.2872 in2/ft	Min Stem T&S Reinf Area 1.920 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0012bh : 0.0012(12)(10) :	0.144 in2/ft	Horizontal Reinforcing Options :	
	=====	<u>One layer of :</u> <u>Two layers of :</u>	
Required Area :	0.2872 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.0329 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	2.75 ft
Heel Width	=	1.83
Total Footing Width	=	4.58
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c =	2,500 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

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	= 2,674		0 psf
Mu' : Upward	= 6,812		0 ft-#
Mu' : Downward	= 964		685 ft-#
Mu: Design	= 5,848 OK		685 ft-# OK
phiMn	= 16,053		13,005 ft-#
Actual 1-Way Shear	= 28.47		12.06 psi
Allow 1-Way Shear	= 75.00		75.00 psi
Toe Reinforcing	= # 6 @ 12.00 in		
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: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Key: No key defined

Min footing T&S reinf Area 1.19 in2
 Min footing T&S reinf Area per foot 0.26 in2 /ft

If one layer of horizontal bars:

#4@ 9.26 in
 #5@ 14.35 in
 #6@ 20.37 in

If two layers of horizontal bars:

#4@ 18.52 in
 #5@ 28.70 in
 #6@ 40.74 in

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab, w/ Seismic

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)	1,417.5	3.00	4,252.5	Soil Over HL (ab. water tbl)	996.7	4.08	4,068.1
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		4.08	4,068.1
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 =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =		1.38	
Seismic Earth Load =	453.6	4.50	2,041.2	Surcharge Over Toe =			
=				Stem Weight(s) =	1,000.0	3.17	3,166.7
Total =	1,871.1	O.T.M. =	6,293.7	Earth @ Stem Transitions =			
				Footing Weight =	687.0	2.29	1,573.2
				Key Weight =			
				Vert. Component =			
Resisting/Overturning Ratio		=	1.40	Total =	2,683.7 lbs	R.M.=	8,808.0
Vertical Loads used for Soil Pressure =		2,683.7 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) 0.093 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 Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab, w/ Seismic

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #6 bar specified in this stem design segment =	28.08 in
Development length for #6 bar specified in this stem design segment =	21.60 in
Hooked embedment length into footing for #6 bar specified in this stem design segment =	8.23 in
As Provided =	0.4400 in ² /ft
As Required =	0.2872 in ² /ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

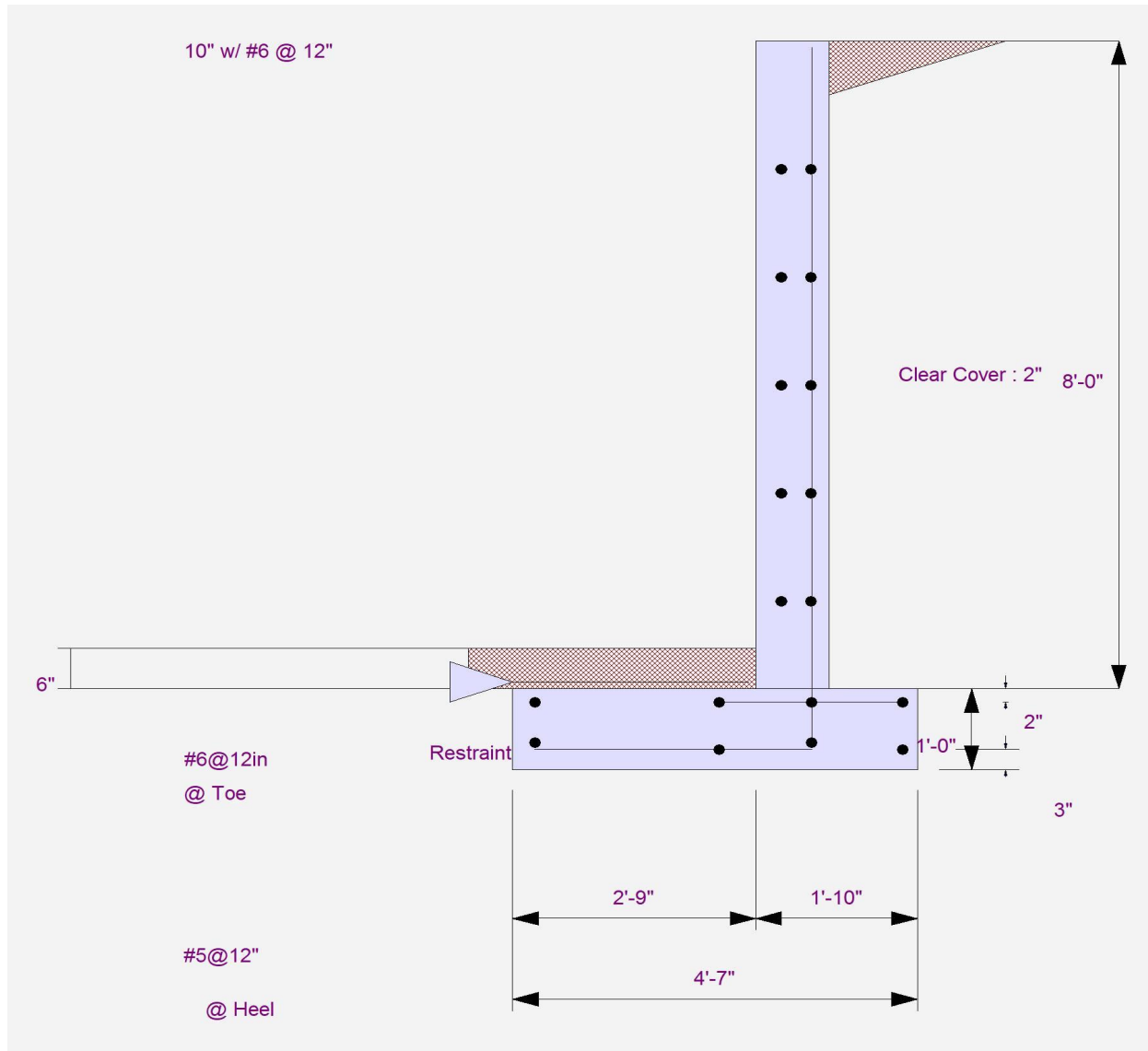
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LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab, w/ Seismic



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

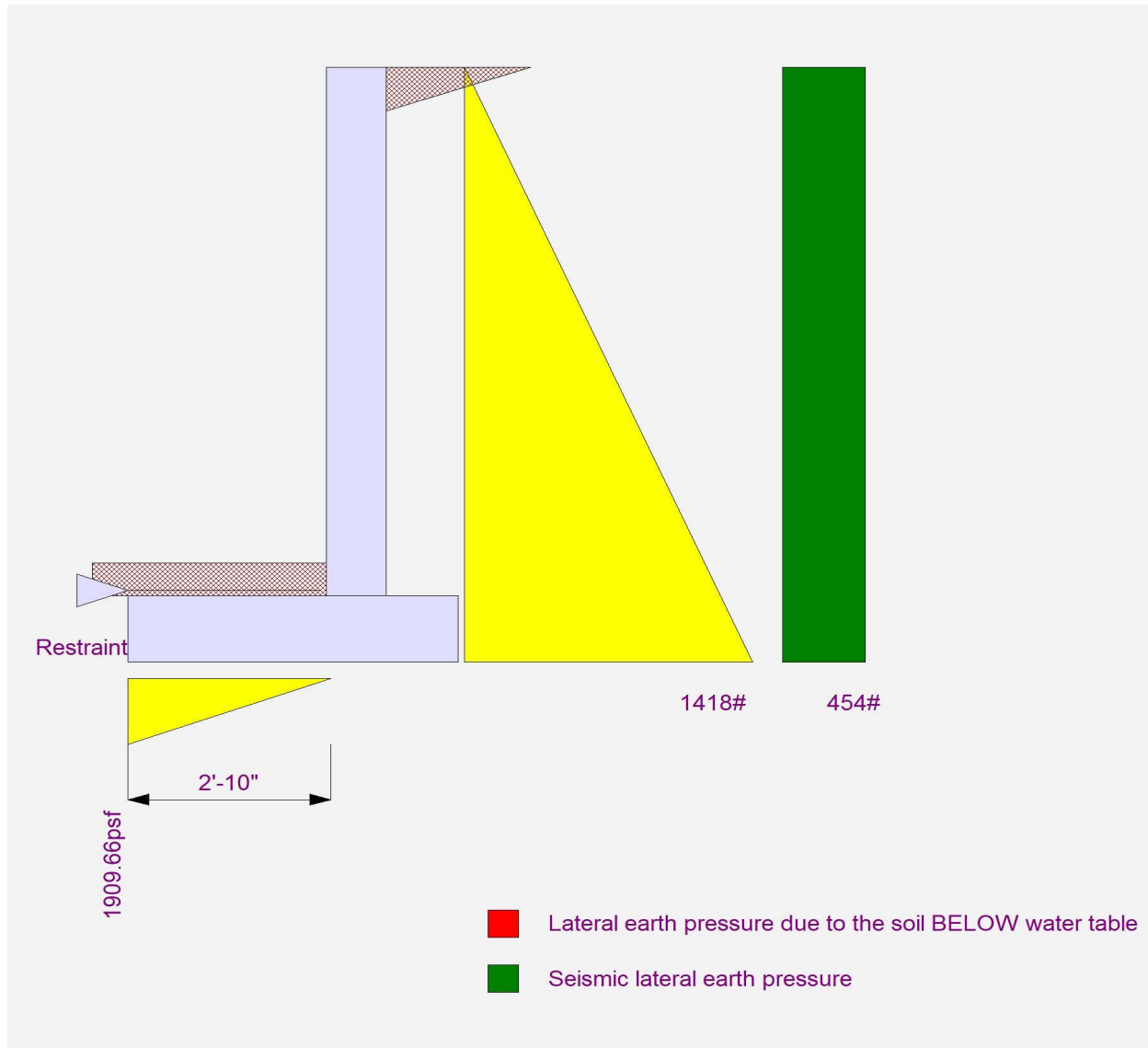
Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 8'-0" Retaining Wall w/ Slab, w/ Seismic



Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Retaining Wall w/ Slab

Code Reference

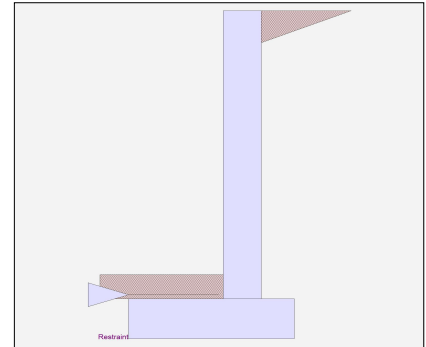
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 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	=	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	=	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

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Retaining Wall w/ Slab

Design Summary

Wall Stability Ratios

Overturning	=	1.55	OK
Slab Resists All Sliding !			
Global Stability	=	1.07	
Total Bearing Load	=	1,403 lbs	
...resultant ecc.	=	8.76 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,281 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,794 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	12.7 psi	OK
Footing Shear @ Heel	=	6.4 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	817.2 lbs
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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	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	SD
Thickness	=	8.00
Rebar Size	=	# 5
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.248
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,008.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,016.0
Moment.....Allowable	=	8,121.3
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	13.6
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.19

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 =	60,000.0

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Retaining Wall w/ Slab

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>	
Bottom Stem			
As (based on applied moment) :	0.0763 in2/ft		
(4/3) * As :	0.1018 in2/ft	Min Stem T&S Reinf Area 1.152 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0012bh : 0.0012(12)(8) :	0.1152 in2/ft	Horizontal Reinforcing Options :	
	=====	<u>One layer of :</u> <u>Two layers of :</u>	
Required Area :	0.1152 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.31 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8382 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	1.67 ft
Heel Width	=	1.25
Total Footing Width	=	2.92
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 = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm.= 3.00 in

Footing Design Results

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	= 1,794		0 psf
Mu' : Upward	= 1,865		0 ft-#
Mu' : Downward	= 314		179 ft-#
Mu: Design	= 1,552		OK 179 ft-#
phiMn	= 1,600		1,600 ft-#
Actual 1-Way Shear	= 12.71		6.38 psi
Allow 1-Way Shear	= 40.00		40.00 psi
Toe Reinforcing	= None Spec'd		
Heel Reinforcing	= None Spec'd		
Key Reinforcing	= None Spec'd		
Footing Torsion, Tu	=		0.00 ft-lbs
Footing Allow. Torsion, phi Tu	=		0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: $\phi M_n = \phi'5' \lambda \sqrt{f_c} S_m$

Heel: $\phi M_n = \phi'5' \lambda \sqrt{f_c} S_m$

Key: No key defined

Min footing T&S reinf Area 0.63 in2
 Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:

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

If two layers of horizontal bars:

#4@ 22.22 in
 #5@ 34.44 in
 #6@ 48.89 in

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Retaining Wall w/ Slab

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)	817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)	437.5	2.63	1,149.9
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.63	1,149.9
Hydrostatic Force				Watre Table			
Buoyant Force =				Sloped Soil Over Hee =			
Surcharge over Heel =				Surcharge Over Heel =			
Surcharge Over Toe =				Adjacent Footing Load =			
Adjacent Footing Load =				Axial Dead Load on Stem=			
Added Lateral Load =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =		0.84	
				Surcharge Over Toe =			
				Stem Weight(s) =	600.0	2.00	1,202.0
				Earth @ Stem Transitions=			
Total	= 817.2	O.T.M.	= 1,861.3	Footing Weighl =	365.0	1.46	532.9
				Key Weight =			
				Vert. Component =			
Resisting/Overturning Ratio		=	1.55	Total =	1,402.5 lbs	R.M.=	2,884.8
Vertical Loads used for Soil Pressure =		1,402.5 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 250.0 pci
 Horizontal Defl @ Top of Wall (approximate only) 0.073 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 Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Retaining Wall w/ Slab

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #5 bar specified in this stem design segment =	23.40 in
Development length for #5 bar specified in this stem design segment =	18.00 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	6.00 in
As Provided =	0.3100 in ² /ft
As Required =	0.1152 in ² /ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

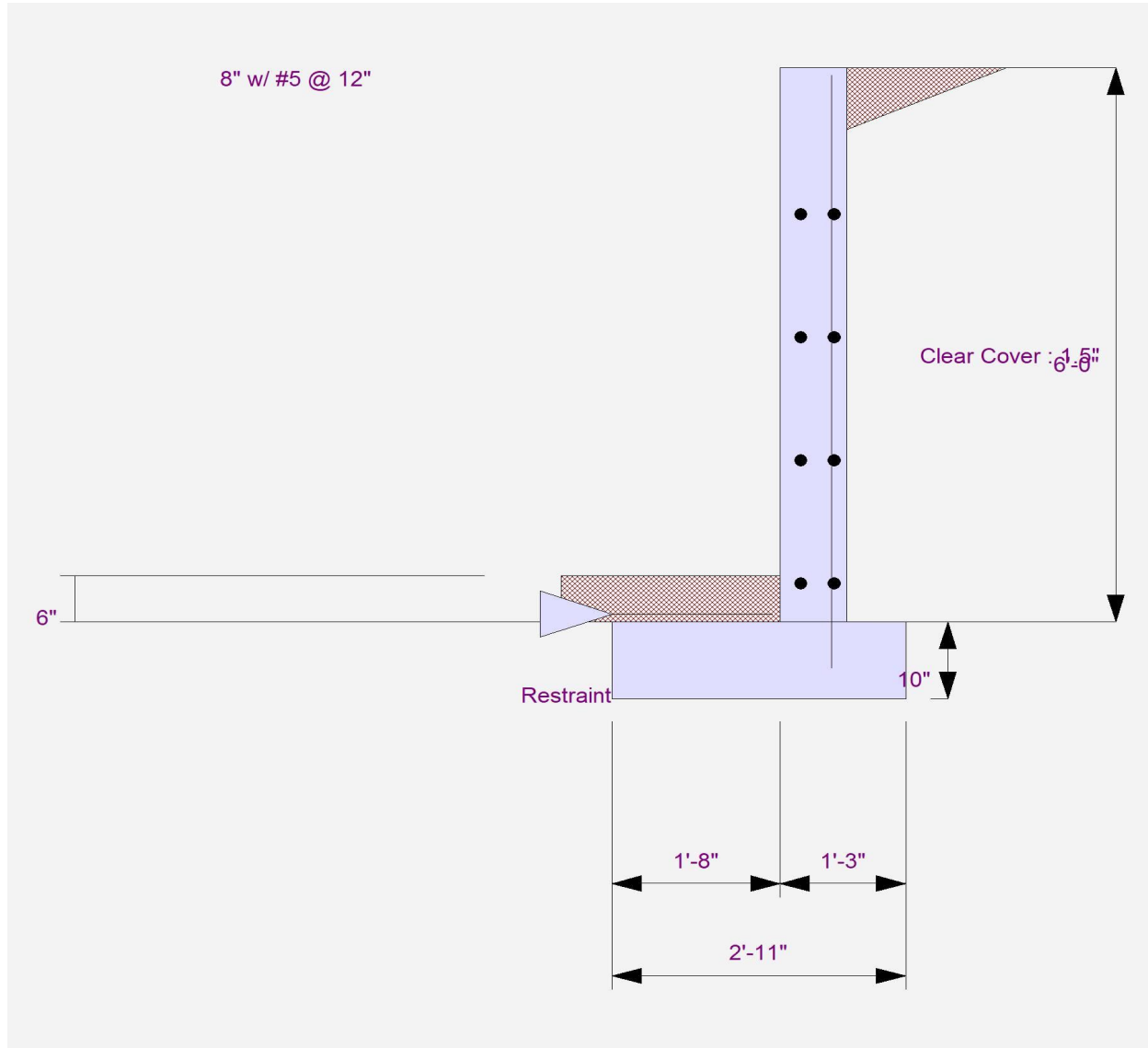
Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

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DESCRIPTION: Retaining Wall Schedule 6'-0" Retaining Wall w/ Slab



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

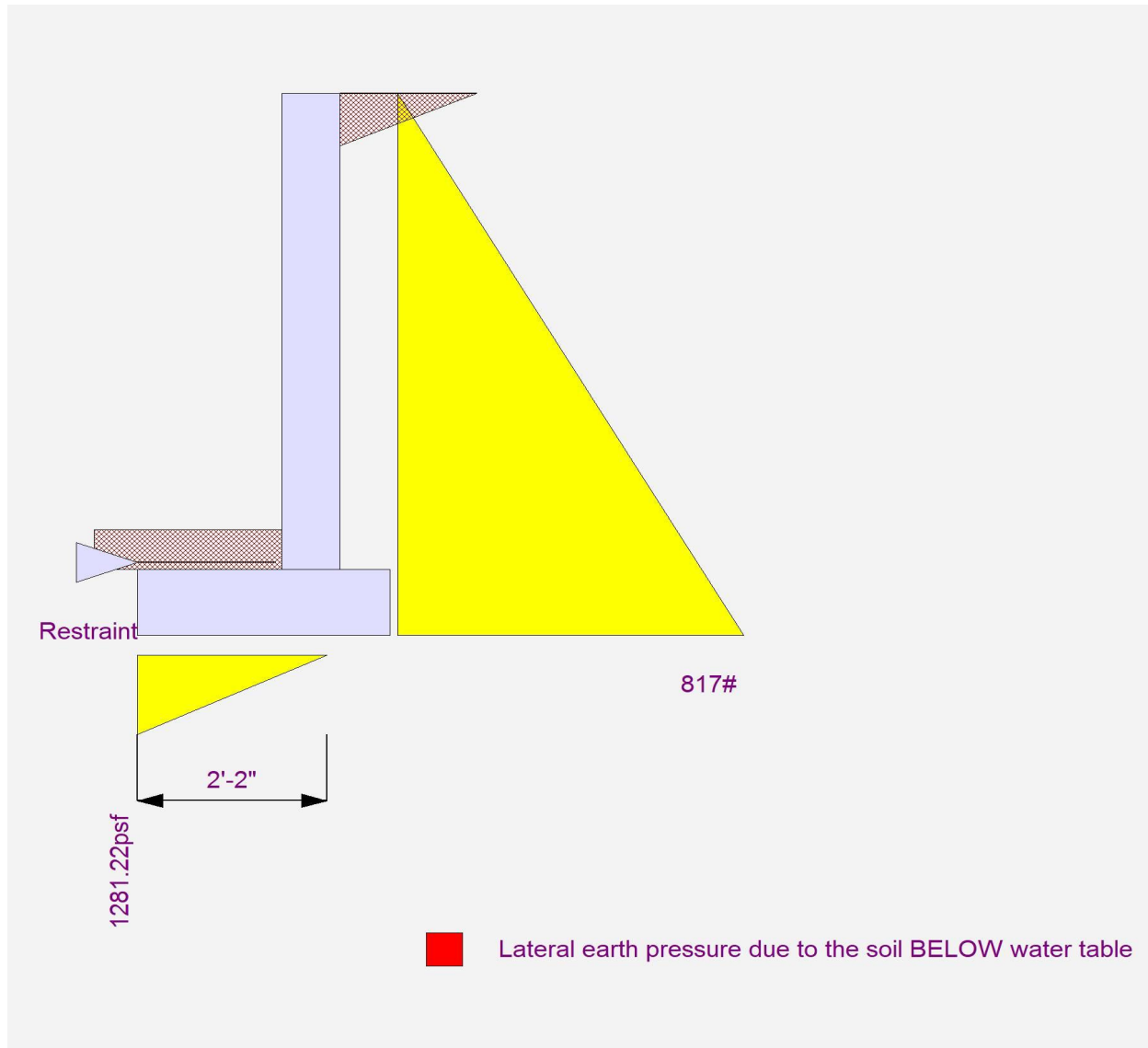
Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Retaining Wall w/ Slab



Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Retaining Wall w/ Slab

Code Reference

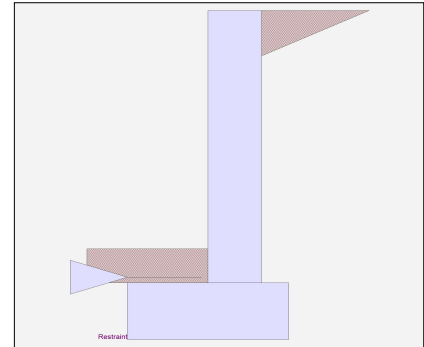
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 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	=	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	=	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

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Retaining Wall w/ Slab

Design Summary

Wall Stability Ratios

Overturning	=	1.65	OK
Slab Resists All Sliding !			
Global Stability	=	1.28	
Total Bearing Load	=	817 lbs	
...resultant ecc.	=	5.68 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,033 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,447 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	4.7 psi	OK
Footing Shear @ Heel	=	2.6 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	408.8 lbs
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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	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	SD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.163
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	448.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	597.3
Moment.....Allowable	=	3,655.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	6.0
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

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 =	60,000.0

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Retaining Wall w/ Slab

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>	
Bottom Stem			
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	
0.0012bh : 0.0012(12)(8) :	0.1152 in2/ft	Horizontal Reinforcing Options :	
	=====	<u>One layer of :</u> <u>Two layers of :</u>	
Required Area :	0.1152 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.1333 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	=	1.00 ft
Heel Width	=	1.00
Total Footing Width	=	2.00
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c = 2,500 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

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	= 1,447		0 psf
Mu' : Upward	= 571		0 ft-#
Mu' : Downward	= 113		42 ft-#
Mu: Design	= 458 OK		42 ft-# OK
phiMn	= 1,600		1,600 ft-#
Actual 1-Way Shear	= 4.71		2.60 psi
Allow 1-Way Shear	= 40.00		40.00 psi
Toe Reinforcing	= None Spec'd		
Heel Reinforcing	= None Spec'd		
Key Reinforcing	= None Spec'd		
Footing Torsion, Tu	=		0.00 ft-lbs
Footing Allow. Torsion, phi Tu	=		0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: $\phi_i M_n = \phi_i' 5' \lambda \sqrt{f_c'} S_m$

Heel: $\phi_i M_n = \phi_i' 5' \lambda \sqrt{f_c'} S_m$

Key: No key defined

Min footing T&S reinf Area 0.43 in2
 Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:

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

If two layers of horizontal bars:

#4@ 22.22 in
 #5@ 34.44 in
 #6@ 48.89 in

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Retaining Wall w/ Slab

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)	408.8	1.61	658.7	Soil Over HL (ab. water tbl)	166.7	1.83	305.6
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		1.83	305.6
Hydrostatic Force				Watre Table			
Buoyant Force =				Sloped Soil Over Hee =			
Surcharge over Heel =				Surcharge Over Heel =			
Surcharge Over Toe =				Adjacent Footing Load =			
Adjacent Footing Load =				Axial Dead Load on Stem =			
Added Lateral Load =				* Axial Live Load on Stem =			
Load @ Stem Above Soil =				Soil Over Toe =		0.50	
				Surcharge Over Toe =			
				Stem Weight(s) =	400.0	1.33	533.3
				Earth @ Stem Transitions =			
Total	= 408.8	O.T.M.	= 658.7	Footing Weighl =	250.0	1.00	250.0
				Key Weight =			
				Vert. Component =			
Resisting/Overturning Ratio		=	1.65	Total =	816.7 lbs	R.M.=	1,088.9
Vertical Loads used for Soil Pressure =			816.7 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 250.0 pci
 Horizontal Defl @ Top of Wall (approximate only) 0.057 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 Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Retaining Wall w/ Slab

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 =	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 =	0.1333 in ² /ft
As Required =	0.1152 in ² /ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

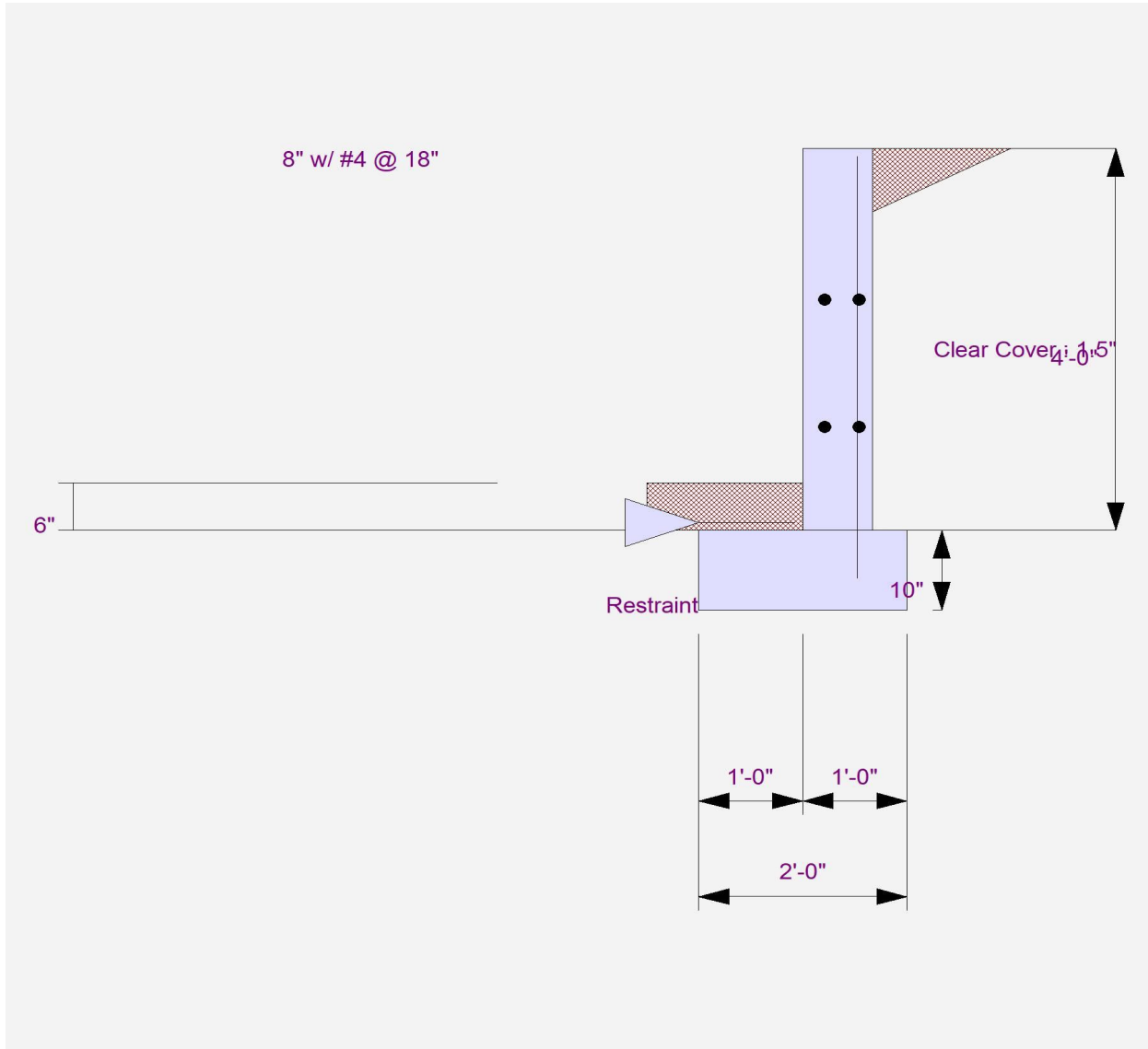
Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Retaining Wall w/ Slab



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

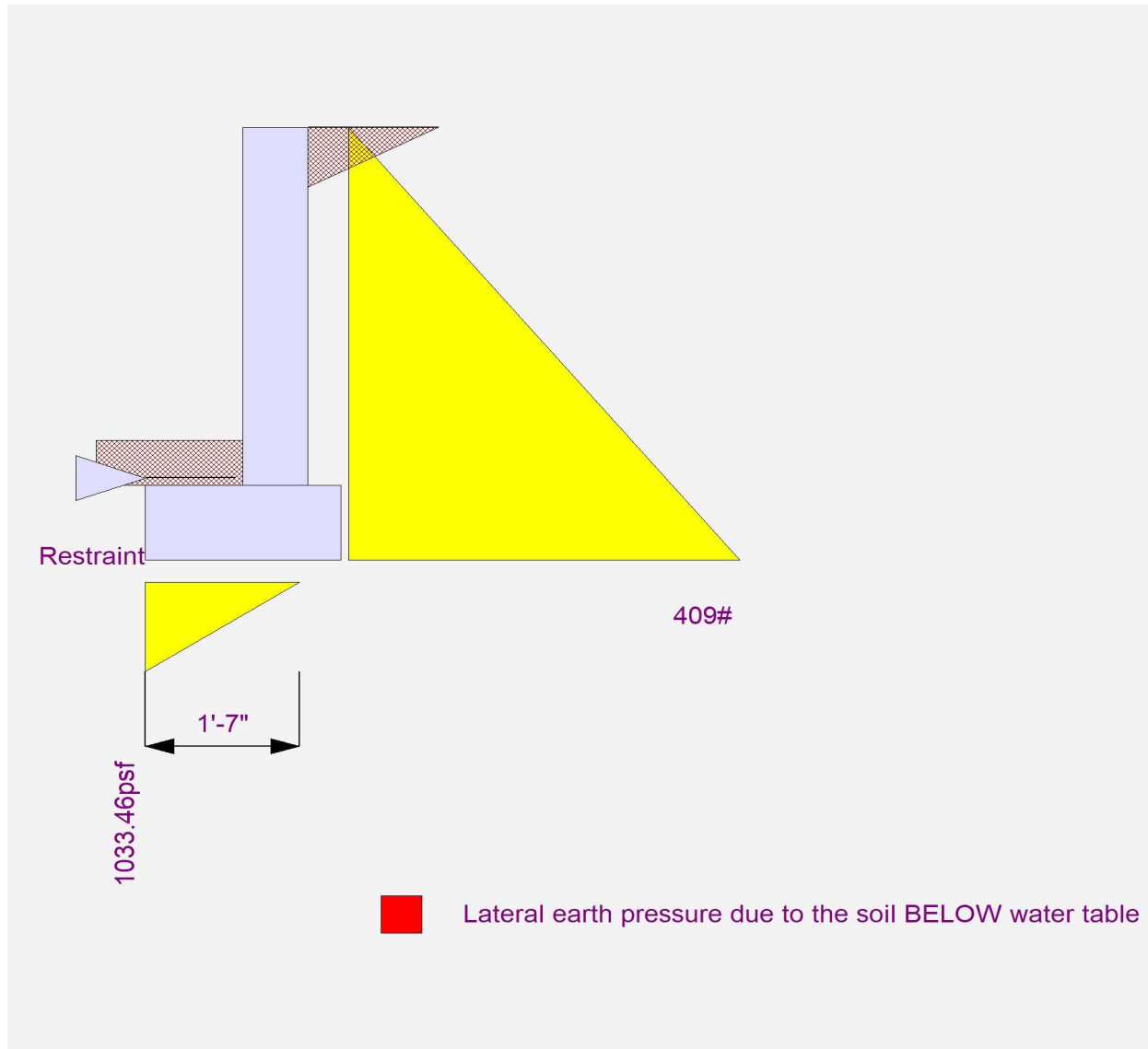
Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Retaining Wall w/ Slab



Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 3'-0" Retaining Wall w/ Slab

Code Reference

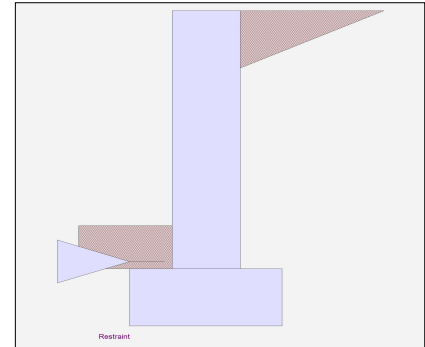
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	3.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 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	=	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	=	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

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 3'-0" Retaining Wall w/ Slab

Design Summary

Wall Stability Ratios

Overturning	=	1.87	OK
Slab Resists All Sliding !			
Global Stability	=	1.88	
Total Bearing Load	=	605 lbs	
...resultant ecc.	=	4.01 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	971 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,359 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	0.7 psi	OK
Footing Shear @ Heel	=	3.1 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	235.3 lbs
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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	1.000
Seismic, E	1.000

Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	SD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	18.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.068
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	252.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	252.0
Moment.....Allowable	=	3,655.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	3.4
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

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 =	60,000.0

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 3'-0" Retaining Wall w/ Slab

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>	
Bottom Stem			
As (based on applied moment) :	0.0094 in2/ft		
(4/3) * As :	0.0126 in2/ft	Min Stem T&S Reinf Area 0.576 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	
0.0012bh : 0.0012(12)(8) :	0.1152 in2/ft	Horizontal Reinforcing Options :	
	=====	<u>One layer of :</u> <u>Two layers of :</u>	
Required Area :	0.1152 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.1333 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	=	0.42 ft
Heel Width	=	1.08
Total Footing Width	=	1.50
Footing Thickness	=	8.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c = 2,500 psi	Fy = 60,000 psi	
Footing Concrete Density = 150.00 pcf		
Min. As % = 0.0018		
Cover @ Top 2.00	@ Btm.= 3.00 in	

Footing Design Results

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	= 1,359		0 psf
Mu' : Upward	= 106		1 ft-#
Mu' : Downward	= 17		49 ft-#
Mu: Design	= 89 OK		48 ft-# OK
phiMn	= 900		900 ft-#
Actual 1-Way Shear	= 0.70		3.08 psi
Allow 1-Way Shear	= 40.00		40.00 psi
Toe Reinforcing	= None Spec'd		
Heel Reinforcing	= None Spec'd		
Key Reinforcing	= None Spec'd		
Footing Torsion, Tu	=		0.00 ft-lbs
Footing Allow. Torsion, phi Tu	=		0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: $\phi M_n = \phi'5' \lambda \sqrt{f_c} S_m$

Heel: $\phi M_n = \phi'5' \lambda \sqrt{f_c} S_m$

Key: No key defined

Min footing T&S reinf Area 0.26 in2
 Min footing T&S reinf Area per foot 0.17 in2 /ft

If one layer of horizontal bars:

#4@ 13.89 in
 #5@ 21.53 in
 #6@ 30.56 in

If two layers of horizontal bars:

#4@ 27.78 in
 #5@ 43.06 in
 #6@ 61.11 in

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 3'-0" Retaining Wall w/ Slab

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 =	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 =	0.1333 in ² /ft
As Required =	0.1152 in ² /ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

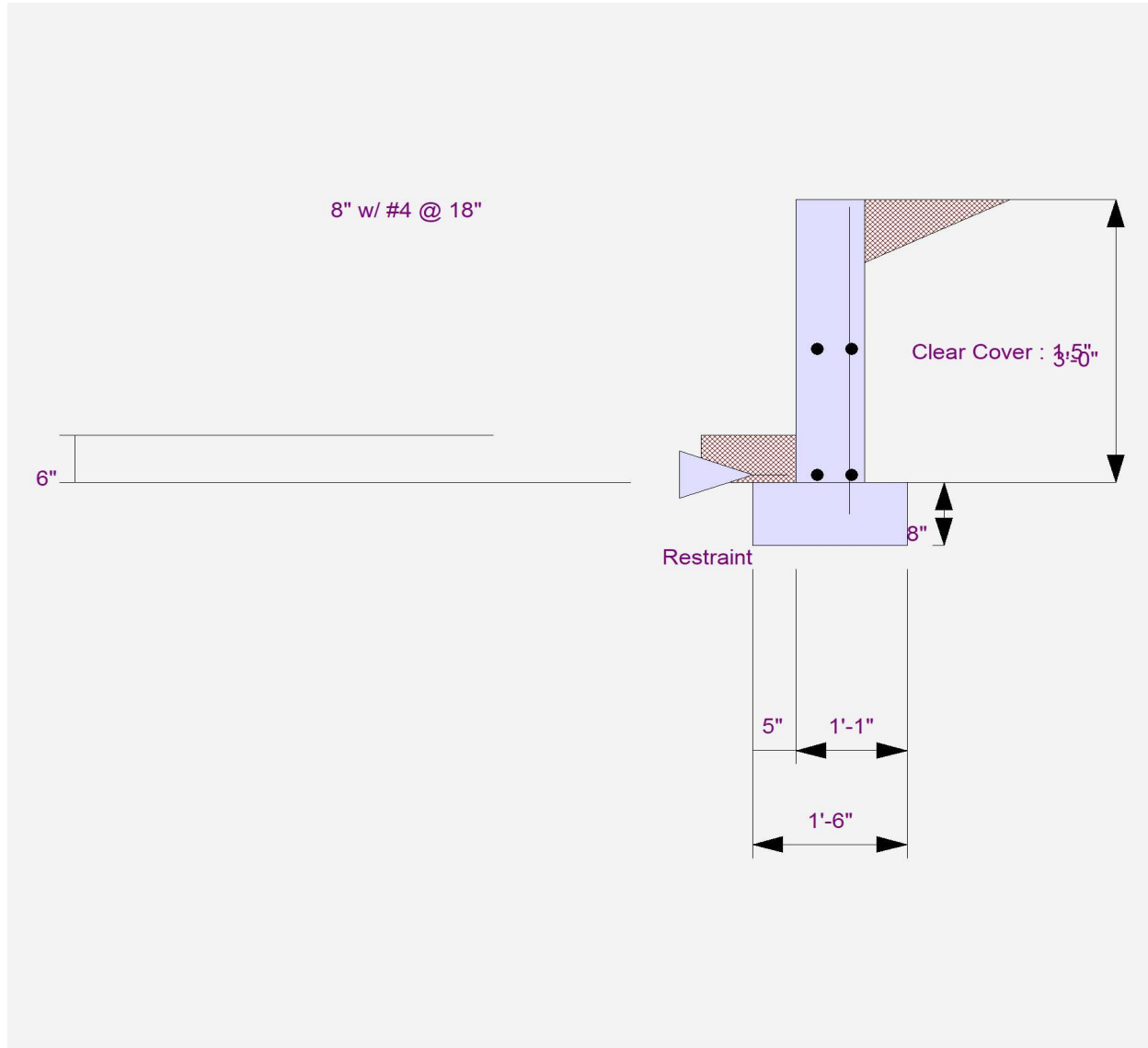
Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 3'-0" Retaining Wall w/ Slab



Cantilevered Retaining Wall

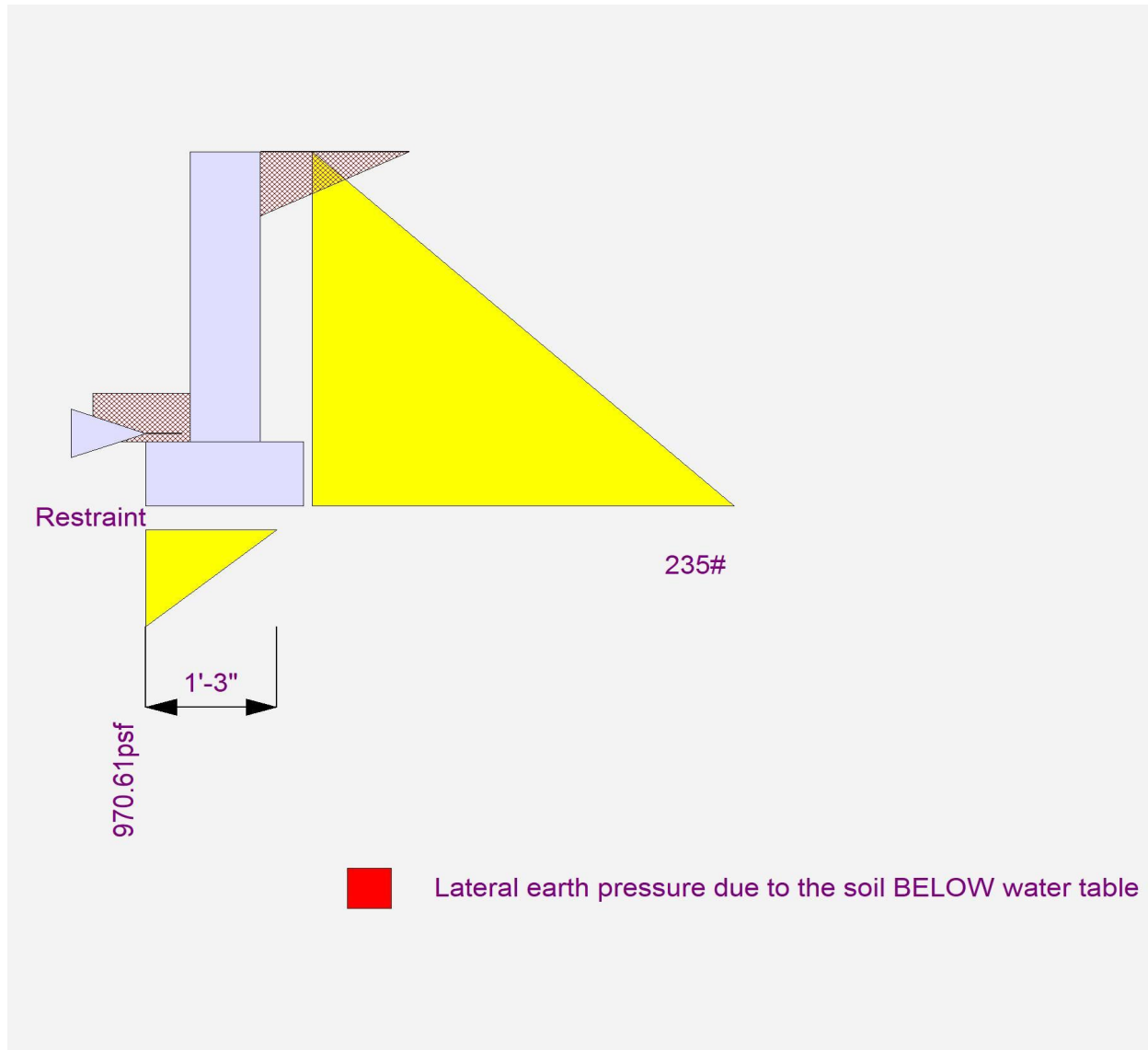
Project File: Typical Detail Co-04-07a_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 3'-0" Retaining Wall w/ Slab



Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Property Line Retaining Wall w/ Key

Code Reference

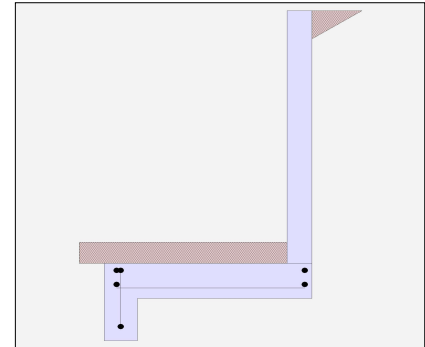
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 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	=	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	=	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

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Property Line Retaining Wall w/ Key

Design Summary

Wall Stability Ratios

Overturning	=	1.55	OK
Sliding	=	1.54	OK
Global Stability	=	15.08	
Total Bearing Load	=	1,071 lbs	
...resultant ecc.	=	13.56 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	748 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,047 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	9.2 psi	OK
Footing Shear @ Heel	=	2.7 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	817.2 lbs	
less 100% Passive Force	-	777.8 lbs	
less 100% Friction Force	= -	482.1 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	1.000
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	=	Edge

Design Data

fb/FB + fa/Fa = 0.558

Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	1,008.0

Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	2,016.0

Moment.....Allowable = 3,612.6

Shear.....Actual

Service Level	psi =	
Strength Level	psi =	19.8

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 =	60,000.0

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Property Line Retaining Wall w/ Key

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>	
Bottom Stem			
As (based on applied moment) :	0.114 in ² /ft		
(4/3) * As :	0.1519 in ² /ft	Min Stem T&S Reinf Area 0.864 in ²	
200bd/fy : 200(12)(4.25)/60000 :	0.17 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in ² /ft	
0.0012bh : 0.0012(12)(6) :	0.0864 in ² /ft	Horizontal Reinforcing Options :	
	=====	<u>One layer of :</u> <u>Two layers of :</u>	
Required Area :	0.1519 in ² /ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2 in ² /ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757 in ² /ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	3.67 ft
Heel Width	=	0.50
Total Footing Width	=	4.17
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	12.00 in
Key Distance from Toe	=	0.00 ft
f'c = 2,500 psi	Fy = 60,000 psi	
Footing Concrete Density = 150.00 pcf		
Min. As % = 0.0018		
Cover @ Top 2.00	@ Btm. = 3.00 in	

Footing Design Results

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	= 1,047		0 psf
Mu' : Upward	= 4,072		0 ft-#
Mu' : Downward	= 1,515		0 ft-#
Mu: Design	= 2,557 OK		0 ft-# OK
phiMn	= 8,820	OK - Flush	
Actual 1-Way Shear	= 9.20	2.71 psi	
Allow 1-Way Shear	= 75.00	40.00 psi	
Toe Reinforcing	= # 5 @ 12.00 in		
Heel Reinforcing	= Flush heel condition. No reinforcing required.		
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: #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: Flush heel condition. No reinforcing required.

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

Min footing T&S reinf Area 0.90 in²
 Min footing T&S reinf Area per foot 0.22 in²/ft

If one layer of horizontal bars:

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

If two layers of horizontal bars:

#4@ 22.22 in
 #5@ 34.44 in
 #6@ 48.89 in

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Property Line Retaining Wall w/ Key

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 =	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 =	6.38 in
As Provided =	0.2000 in ² /ft
As Required =	0.1519 in ² /ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

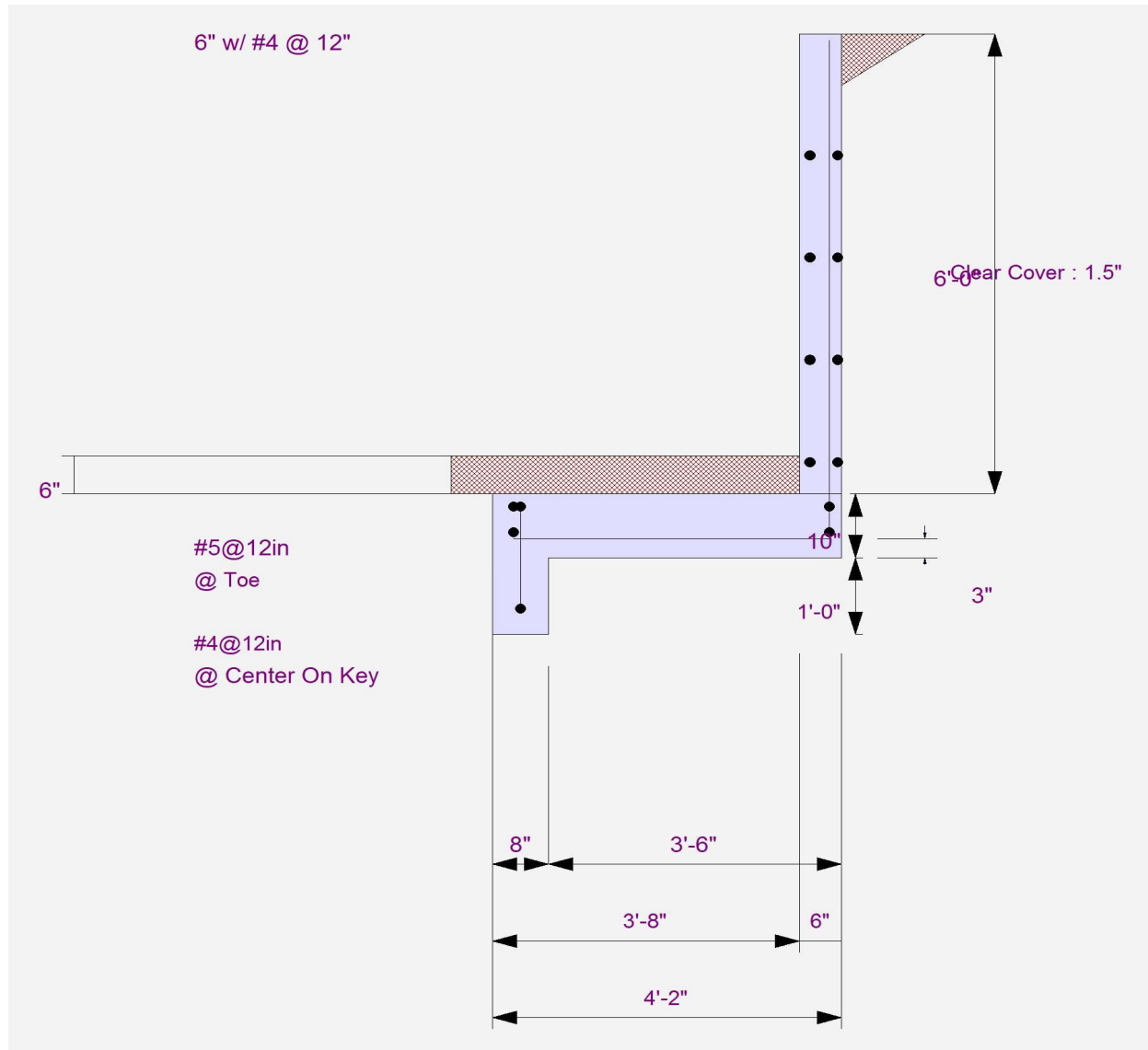
Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Property Line Retaining Wall w/ Key



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

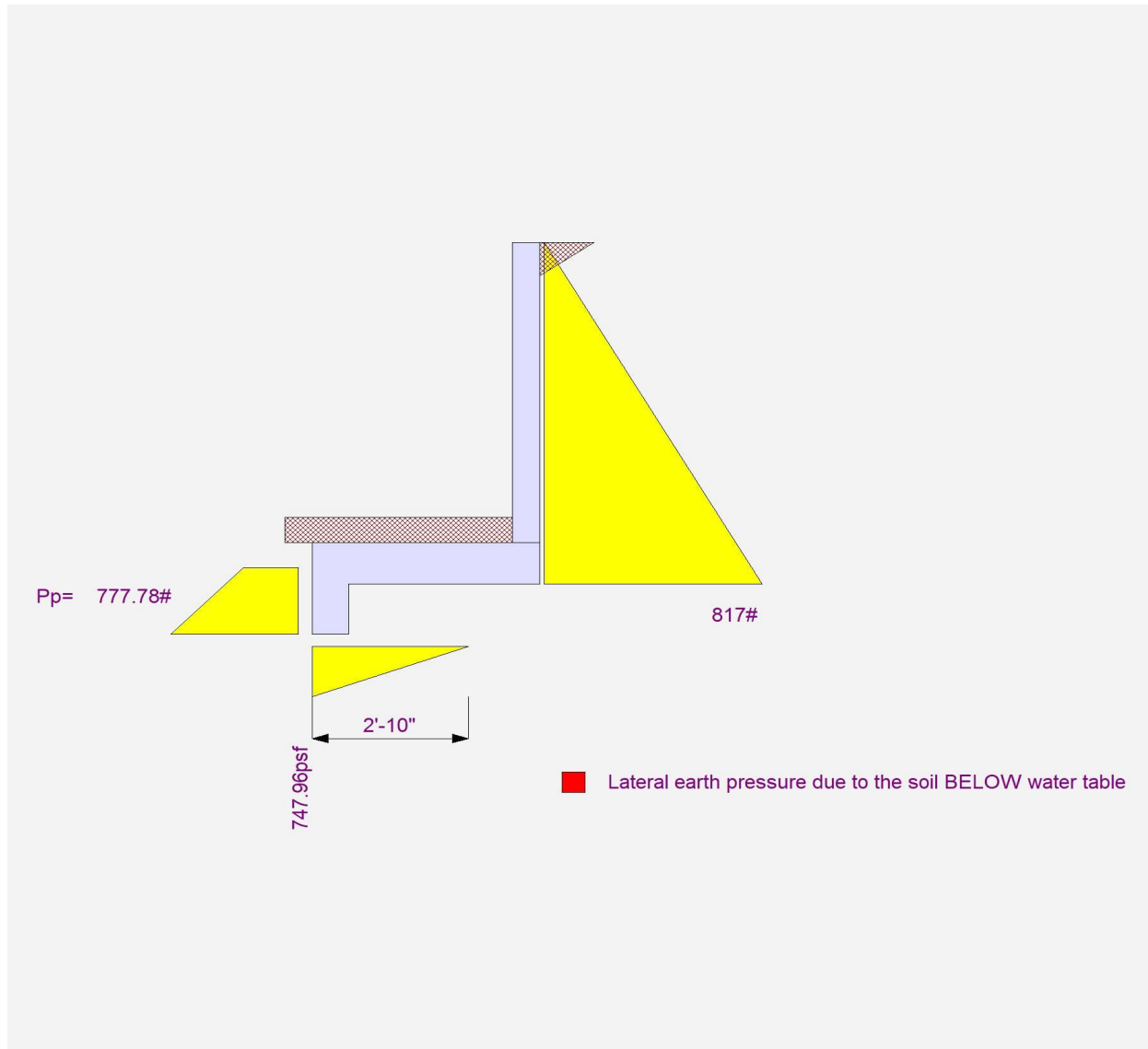
Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 6'-0" Property Line Retaining Wall w/ Key



Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Property Line Retaining Wall w/ Key

Code Reference

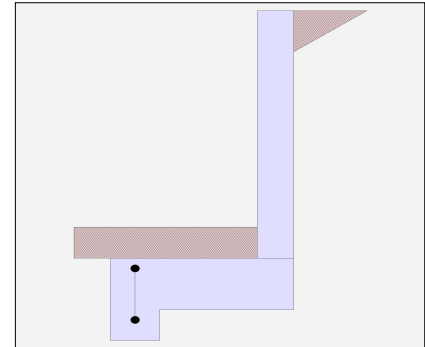
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	125.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 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	=	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	=	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

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Property Line Retaining Wall w/ Key

Design Summary

Wall Stability Ratios

Overturning = 1.64 OK
 Sliding = 1.74 OK
 Global Stability = 165.16

Total Bearing Load = 663 lbs
 ...resultant ecc. = 7.33 in

Eccentricity outside middle third

Soil Pressure @ Toe = 691 psf OK
 Soil Pressure @ Heel = 0 psf OK
 Allowable = 1,500 psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe = 967 psf
 ACI Factored @ Heel = 0 psf
 Footing Shear @ Toe = 5.3 psi OK
 Footing Shear @ Heel = 2.7 psi OK
 Allowable = 75.0 psi

Sliding Calcs

Lateral Sliding Force = 408.8 lbs
 less 100% Passive Force = 413.2 lbs
 less 100% Friction Force = 298.1 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 = 1.000
 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 = Edge

Design Data

fb/FB + fa/Fa = 0.165

Total Force @ Section

Service Level lbs =
 Strength Level lbs = 448.0

Moment....Actual

Service Level ft-# =
 Strength Level ft-# = 597.3

Moment.....Allowable = 3,612.6

Shear.....Actual

Service Level psi =
 Strength Level psi = 8.8

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 = 60,000.0

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Property Line Retaining Wall w/ Key

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>	
Bottom Stem			
As (based on applied moment) :	0.0338 in2/ft		
(4/3) * As :	0.045 in2/ft	Min Stem T&S Reinf Area 0.576 in2	
200bd/fy : 200(12)(4.25)/60000 :	0.17 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0012bh : 0.0012(12)(6) :	0.0864 in2/ft	Horizontal Reinforcing Options :	
	=====	<u>One layer of :</u> <u>Two layers of :</u>	
Required Area :	0.0864 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.5757 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	2.00 ft
Heel Width	=	0.50
Total Footing Width	=	2.50
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	6.00 in
Key Distance from Toe	=	0.00 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm.= 3.00 in

Footing Design Results

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	=	967	0 psf
Mu' : Upward	=	1,262	0 ft-#
Mu' : Downward	=	450	0 ft-#
Mu: Design	=	812 OK	0 ft-# OK
phiMn	=	1,600	OK - Flush
Actual 1-Way Shear	=	5.31	2.71 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	Flush heel condition. No reinforcing required.	
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: $\phi M_n = \phi'5' \lambda \sqrt{f_c}' S_m$

Heel: Flush heel condition. No reinforcing required.

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

Min footing T&S reinf Area	0.54	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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

(c) ENERCALC INC 1983-2022

DESCRIPTION: Retaining Wall Schedule 4'-0" Property Line Retaining Wall w/ Key

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 =	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 =	6.00 in
As Provided =	0.2000 in ² /ft
As Required =	0.0864 in ² /ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

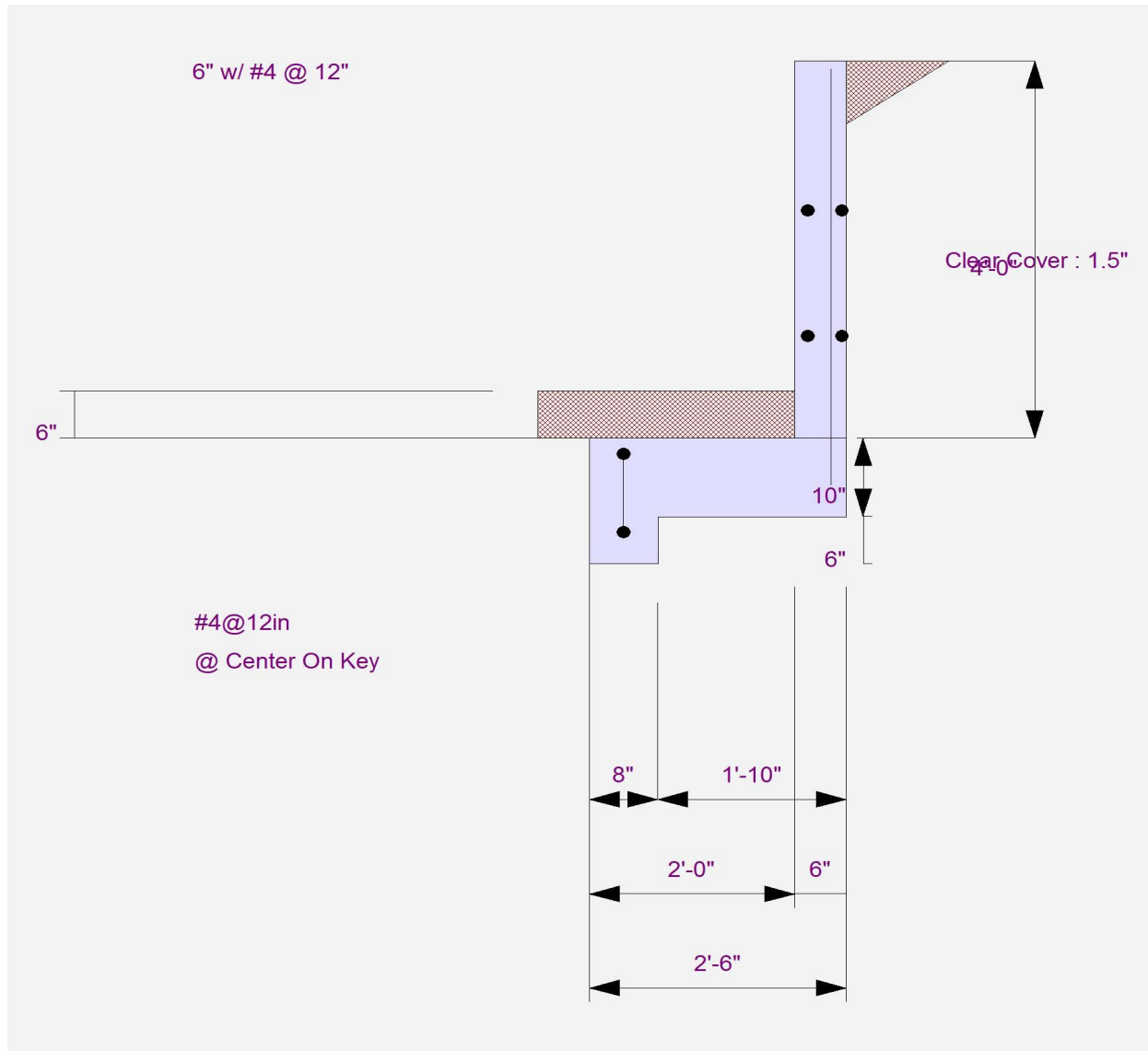
Project File: Typical Detail Co-04-08b_IBC2018.EC6

LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

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DESCRIPTION: Retaining Wall Schedule 4'-0" Property Line Retaining Wall w/ Key



Project Title:
Engineer:
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Cantilevered Retaining Wall

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LIC# : KW-06014947, Build:20.22.8.17

SWENSON SAY FAGET

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DESCRIPTION: Retaining Wall Schedule 4'-0" Property Line Retaining Wall w/ Key

