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

SSF STRUCTURAL ENGINEERING

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TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402
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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	Ω_o=	2.5
S_S=	1.395	S_1=	0.486
S_{DS}=	1.12	S_{D1}=	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

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Project	
Criteria	
DATE	5/16/2023
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DESIGN	ENG
SHEET	1

Seismic Design

ASCE 7-16 Seismic Analysis | Equivalent Lateral Force Procedure | Apply Section 12.8.1.3 (Where Applicable)? Yes

Seismic Force Resisting System Per Table 12.2-1	System	Steel Systems Not Specifically Detailed for Seismic Resistance, Excluding Cantilevered Column Systems
	Type:	Per Above

Seismic Design Cat.	D	
Risk Category	II	I, II, or III, or IV per Table 1.5-1
Site Class	D (Default)	Assumed default soil properties, per 11.4.3.
Diaphragm Flexibility	Flexible	

Section 12.8.1.3

1. Regular Structure	No
2. ≤ 5 Stories above grade	Yes
3. T ≤ 0.5s	Yes
4. ρ = 1.0	Yes
5. Not Site Class E or F	Yes
6. Risk Category I or II	Yes

If all items above are met, S_{DS} may be taken as 1.0, but not less than 0.7*(Calculated S_{DS})

S_S	1.395 g	2% in 50 yr, Latitude & Longitude lookup
S_1	0.486 g	2% in 50 yr, Latitude & Longitude lookup
R	3.00	
C_d	3.0	
Ω_o	2.5	
I_e	1.00	Table 1.5-2
h_n	28.5 ft	
Ct	0.02	Table 12.8-2
x	0.75	Table 12.8-2
T_a	0.25 sec	
T	0.25 sec	Eq. 12.8-7
T_0	0.16 sec	
T_S	0.79 sec	
T_L	6.00 sec	
F_a	1.20	Table 11.4-1
F_v	1.81	Table 11.4-2
S_{MS}	1.67 g	Eq. 11.4-1
S_{M1}	1.32 g	Eq. 11.4-2
S_{DS}	1.116 g	Eq. 11.4-3
S_{D1}	0.882 g	Eq. 11.4-4
C_s	***0.372 Controls***	Eq. 12.8-2
	1.191	Eq. 12.8-3 need not exceed, T < T_L
	0.010	Eq. 12.8-5 or 12.8-6 minimum
C_s, design	0.372	Section 11.4.8 Exception 2 Applied
Bldg. Weight	166.1 k	
V = C_SW	61.8 k	Eq. 12.8-1, Strength Level Base Shear
V = C_{Sasd}W	43.3 k	Eq. 12.8-1 ASD Base Shear

Building Period Per Alternate Analysis

T (sec)	

Per Geotech Report

F_a	
F_v	

$$T_a = C_t h_n^x \quad \text{Eq. 12.8.7}$$

$$S_{MS} = F_a S_S \quad \text{Eq. 11.4-1}$$
$$S_{M1} = F_v S_1 \quad \text{Eq. 11.4-2}$$
$$S_{DS} = {}^2/_3\, S_{MS} \quad \text{Eq. 11.4-3}$$
$$S_{D1} = {}^2/_3\, S_{M1} \quad \text{Eq. 11.4-4}$$

$$C_S = \frac{S_{DS}}{(R/I_e)} \quad \text{Eq. 12.8-2}$$
$$C_S = \frac{S_{D1}}{T(R/I_e)} \quad \text{Eq. 12.8-3}$$
$$C_S = \frac{S_{D1} T_L}{T^2 (R/I_e)} \quad \text{Eq. 12.8-4}$$
$$C_S \geq 0.044 S_{DS} I_e \quad \text{Eq. 12.8-5}$$
$$C_S \geq 0.01 \quad \text{Eq. 12.8-5}$$
$$C_S \geq 0.5 \frac{S_1}{(R/I_e)} \quad \text{Eq. 12.8-6}$$

$$C_{VX} = w_x h_x^k / \sum_{i=1}^{n} w_x h_i^k \quad \text{Eq. 12.8-12}$$

$$F_{px} = {}^{\sum_{i=x}^{n} F_i}/_{\sum_{i=x}^{n} w_i}\, w_{px} \quad \text{Eq. 12.10-1}$$
$$F_{px} \geq 0.2 S_{DS} I_e w_{px} \quad \text{Eq. 12.10-2}$$
$$F_{px} \leq 0.4 S_{DS} I_e w_{px} \quad \text{Eq. 12.10-3}$$

Vertical Distribution Strength ρ= 1 k= 1.000

Level	h_x (ft)	W_x (k)	h_x^k (ft)	$W_x h_x^k$	Story Shear Strength			Diaphragm Force (ρ not included)				
					C_{vx} (%)	F_x (k)	SV (k)	$F_{px,calc}$	$F_{px,min}$	$F_{px,max}$	$F_{px,design}$	γ=F_{px}/F_x
3 - Ceiling	28.5	37.175	28.5	1059	0.360	22.2	**22.2**	22.2	8.3	16.6	**16.6**	0.75
3 -Floor	19.3	23.04	19.3	444	0.151	9.3	**31.5**	12.1	5.1	10.3	**10.3**	1.11
2 - Ceiling	19.0	45.1	19.0	857	0.291	18.0	**49.5**	21.2	10.1	20.1	**20.1**	1.12
2 -Floor	9.8	29	9.8	281	0.095	5.9	**55.4**	11.9	6.4	12.9	**11.9**	2.02
1 - Ceiling	9.5	32	9.5	304	0.103	6.4	**61.8**	11.9	7.1	14.3	**11.9**	1.87
Σ		166.1		2945		**61.8**						

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Project
Seismic Criteria

DATE 5/16/2023
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DESIGN ENG
SHEET 2

Wind Design - MWFRS

ASCE 7 Chapter 27 - Directional Procedure

Design Method	ASD

Wind Coefficients

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

Location and Building Dimensions

Calculate Kzt?	Yes	
Kzt	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

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

Wall Pressures (Unfactored): ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lwwalls}$	**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	$P_{ww\ walls}$	$P_{lwwalls}$	**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**

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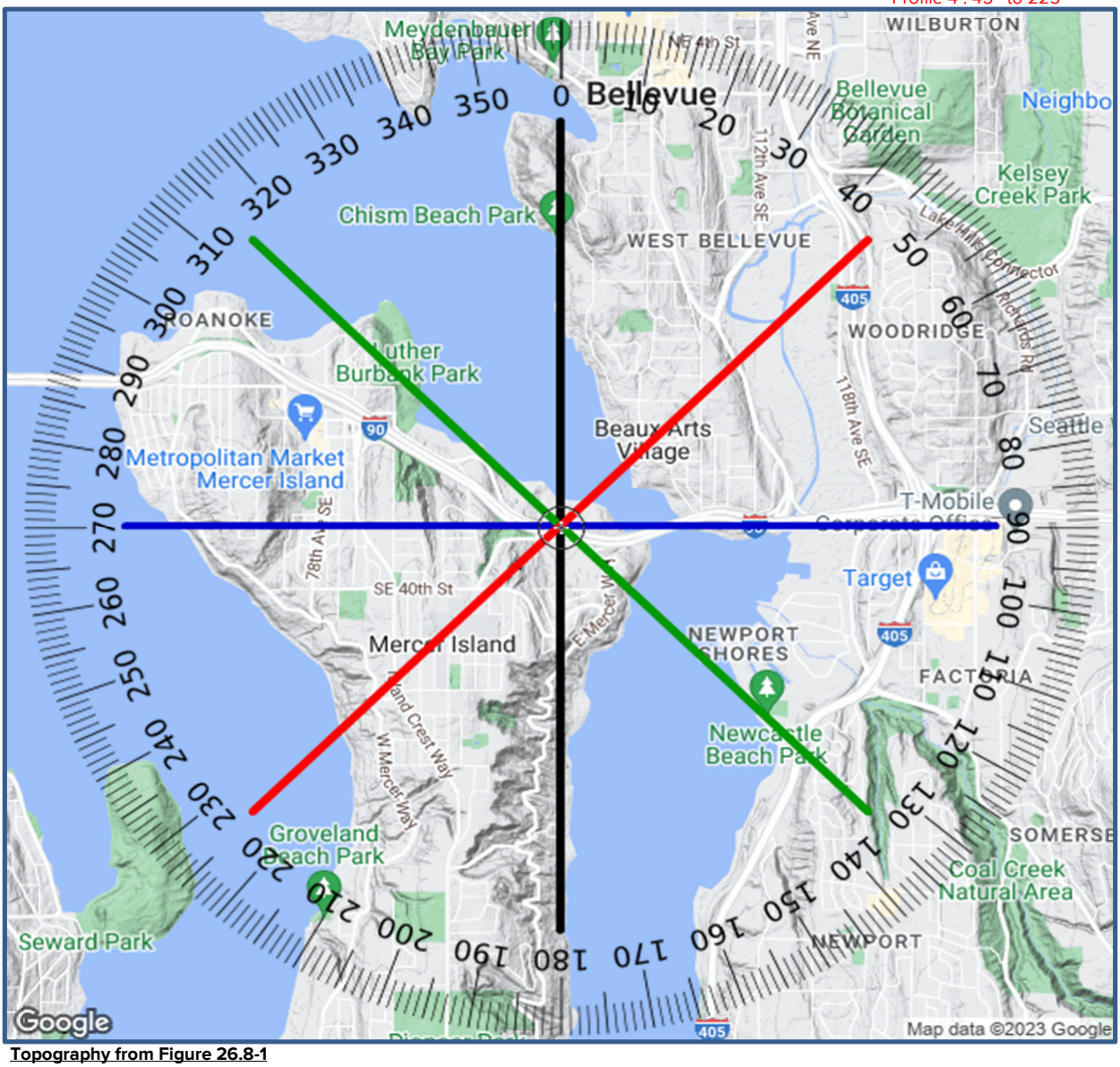
Site Address

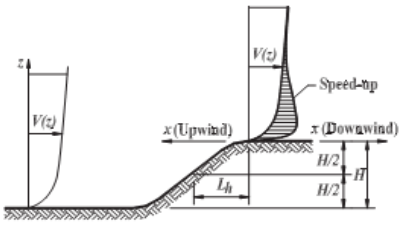
Address	3508 96th ave se			Wind Radius	2.00	Miles
City:	Mercer Islanc	State:	WA	Angle	0	˚
Lat Long	47.579168	-122.2105		Exposure	B	

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



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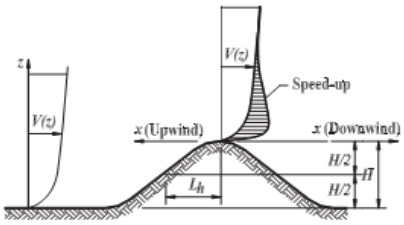

2-D RIDGE OR 3-D AXISYMMETRICAL HILL

$$K_{zt} = (1 + K_1 K_2 K_3)^2$$
$$K_1 = \text{Per Figure}$$
$$K_2 = (1 - |x|/\mu L_h)$$
$$K_3 = e^{-\gamma z / L_h}$$
$$K_{zt} = 1, \text{ If } H/Lh \le 0.2$$

PER FIGURE 26.8-1

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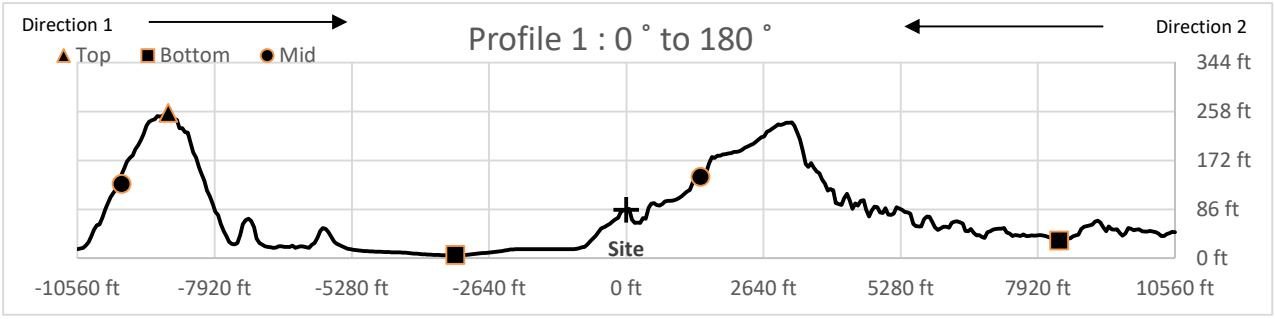
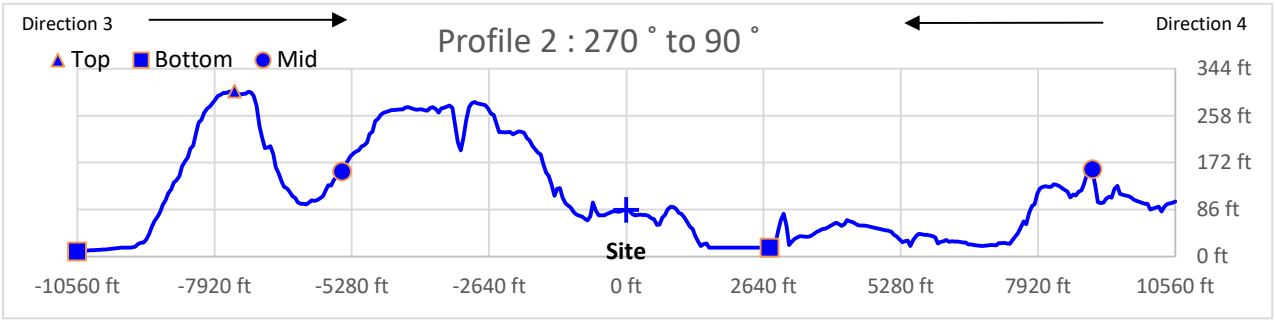
Project		DATE	5/16/2023
Kzt Calculations		PROJ. #	
		DESIGN	ENG
		SHEET	4





Direction 1 - 0 ˚to Site

Site Conditions (26.8.1)

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

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

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

Direction 2 - Site to 180 ˚

Site Conditions (26.8.1)

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

Terrain Data

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

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

Direction 3 - 270 ˚to Site

Site Conditions (26.8.1)

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

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

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

Direction 4 - Site to 90 ˚

Site Conditions (26.8.1)

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

Terrain Data

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

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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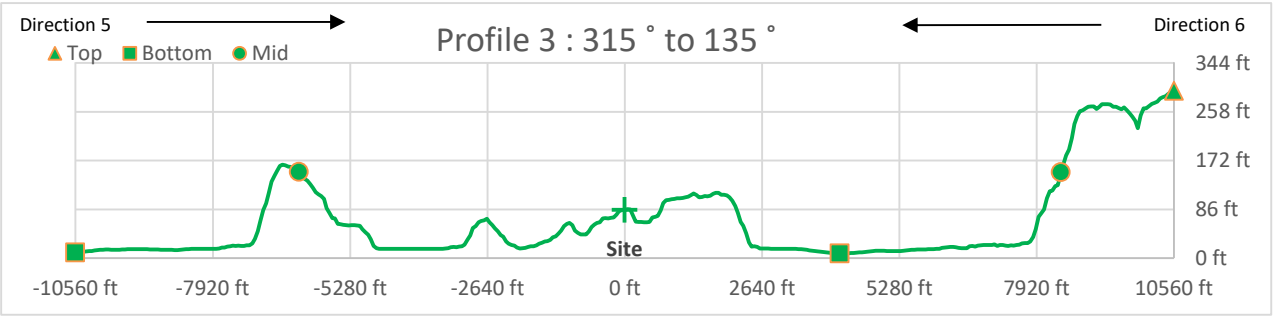
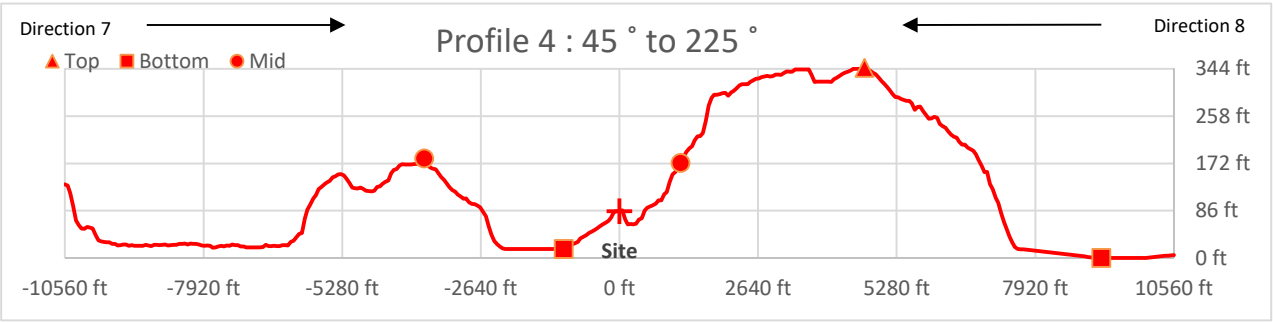
Project: Kzt Calculations

DATE: 5/16/2023
PROJ. #:
DESIGN: ENG
SHEET: 5





Direction 5 - 315 ˚to Site

Site Conditions (26.8.1)

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

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

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

Direction 6 - Site to 135 ˚

Site Conditions (26.8.1)

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

Terrain Data

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

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

Direction 7 - 45 ˚to Site

Site Conditions (26.8.1)

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

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

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

Direction 8 - Site to 225 ˚

Site Conditions (26.8.1)

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

Terrain Data

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

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	
DATE	5/16/2023
PROJ. #	
DESIGN	ENG
SHEET	6

ASCE 7-16 Wind Loads - Components and Cladding
Flat and Gable Roofs (θ ≤ 45°)

Part 1: Low-Rise Buildings (h ≤ 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, $p = q_h[(GC_p)-(GC_{Pi})]$

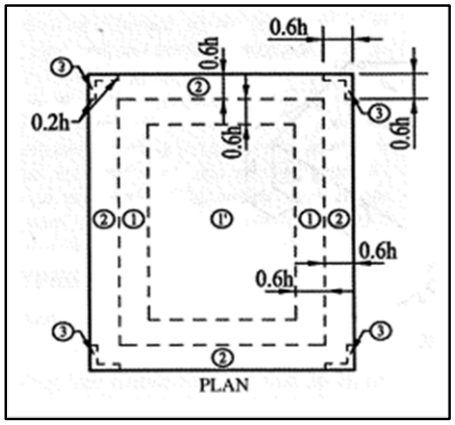
Design	ASD

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

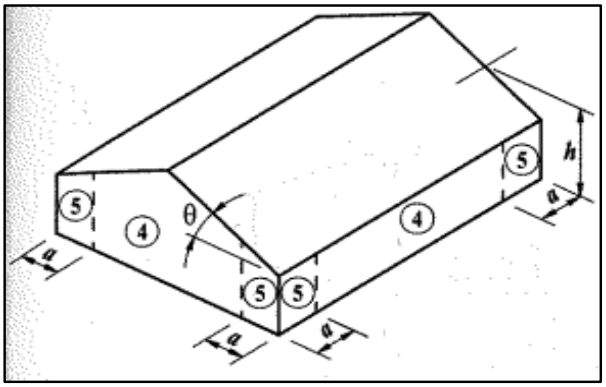
Design Wind Pressure (psf)

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.



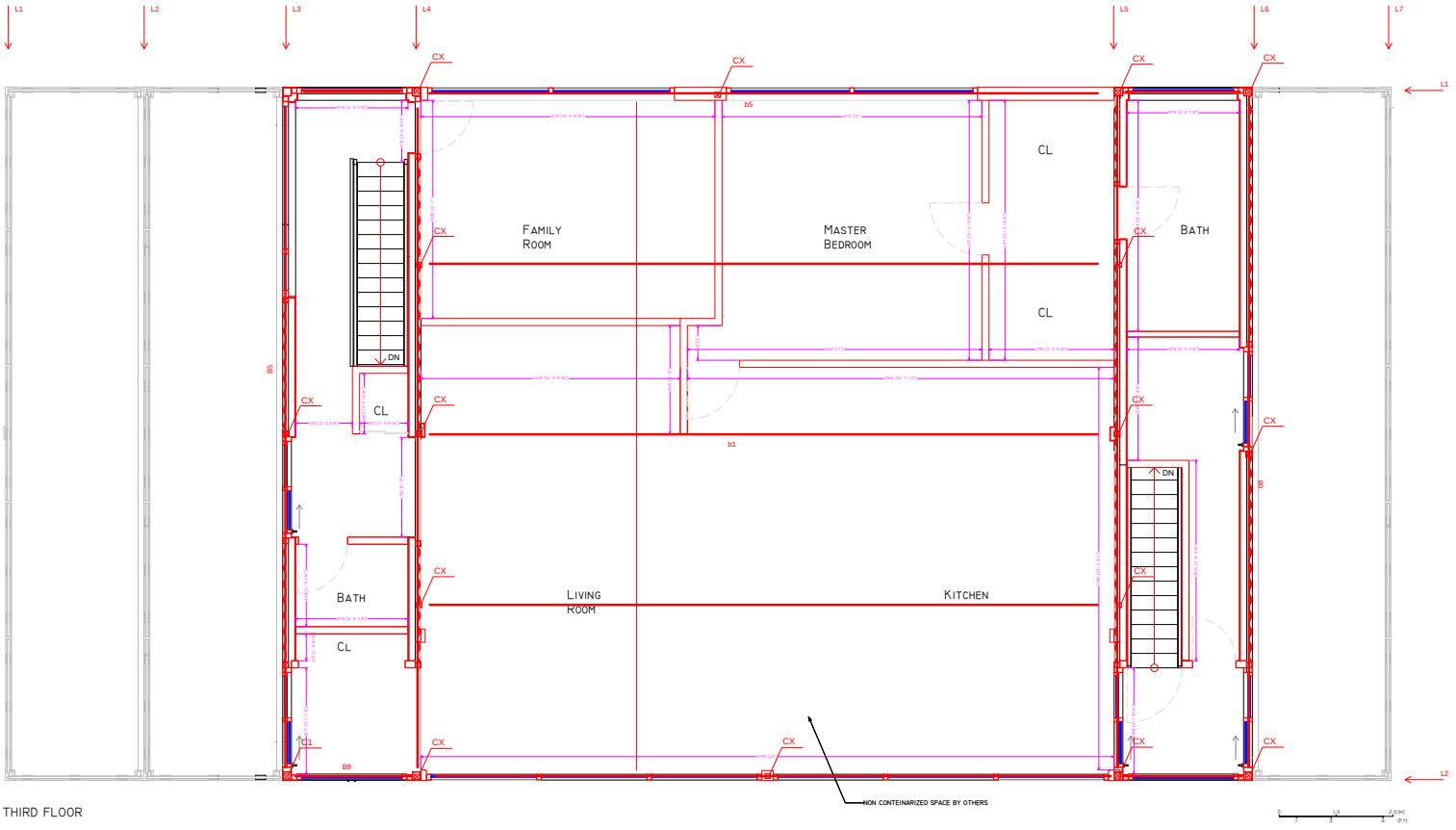
Flat & Gable Roofs θ ≤ 7 deg - Figure 30.3-2A



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 θ ≤ 10°.



THIRD FLOOR

ROOF PLAN

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	Design	
Sheet Title:	Drawn	Sheet

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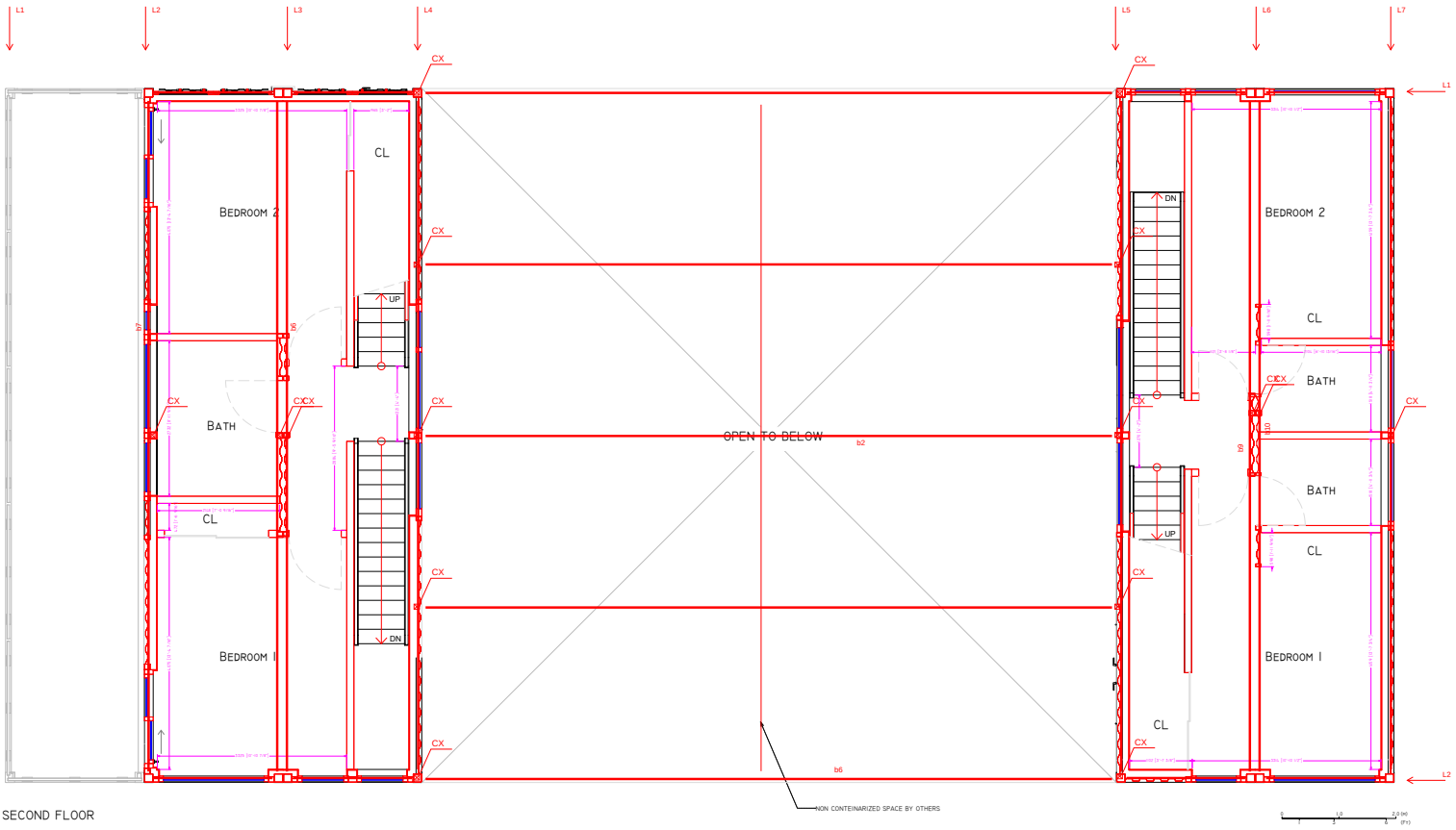

SECOND FLOOR

SECOND FLOOR PLAN

Project Title:	Date	SSF project no.

	Design	
Sheet Title:	Drawn	Sheet

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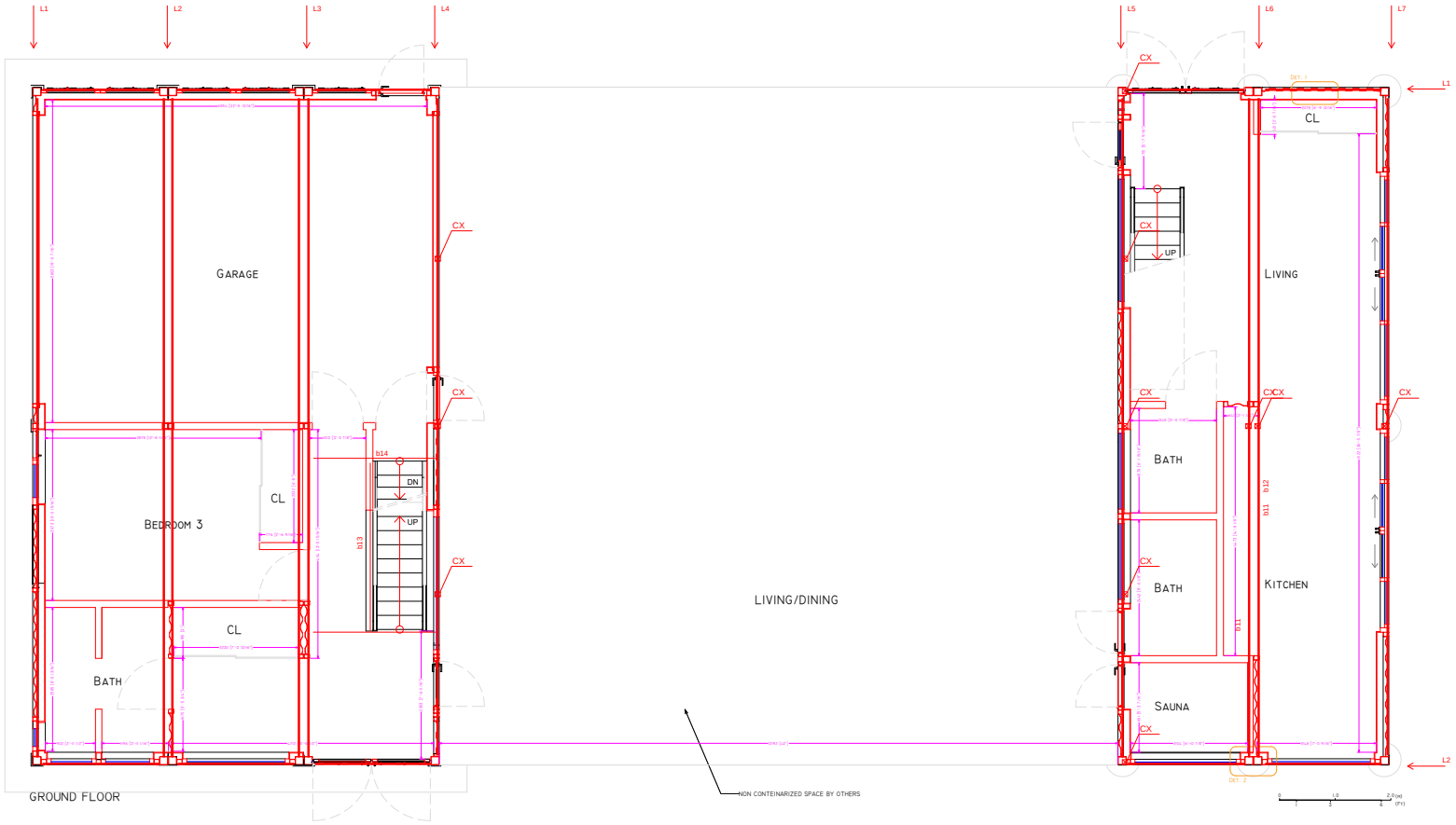

GROUND FLOOR

FIRST FLOOR PLAN

Project Title:	Date	SSF project no.
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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	22.2	
	TRIB	LENGTH	KIPS	KLF
L3	4	40	1.59	0.040
L4	24	40	9.51	0.238
L5	24	40	9.51	0.238
L6	4	40	1.59	0.040

3 - FLOOR		TOTAL	9.3	
	TRIB	LENGTH	KIPS	KLF
L2	8	40	2.33	0.058
L3	0	40	0.00	0.000
L4	8	40	2.33	0.058
L5	8	40	2.33	0.058
L6	0	40	0.00	0.000
L7	8	40	2.33	0.058

2 - CEILING		TOTAL	18	
	TRIB	LENGTH	KIPS	KLF
L2	8	40	2.00	0.050
L3	0	40	0.00	0.000
L4	28	40	7.00	0.175
L5	28	40	7.00	0.175
L6	0	40	0.00	0.000
L7	8	40	2.00	0.050

Y

3 - CEILING		TOTAL		22.2	
	TRIB	LENGTH	Area	KIPS	KLF
L1-1	20	56	1120	11.10	1.388
L1-2	0	0	0	0.00	0.000
L2-1	20	28	560	5.55	0.694
L2-2	20	28	560	5.55	0.694

3 - FLOOR		TOTAL		9.3	
	TRIB	LENGTH	Area	KIPS	KLF
L1-1	8	20	160	2.33	0.291
L1-2	0	20	0	0.00	0.000
L1-3	0	20	0	0.00	0.000
L1-4	8	20	160	2.33	0.291
L2-1	8	20	160	2.33	0.291
L2-2	0	20	0	0.00	0.000
L2-3	0	20	0	0.00	0.000
L2-4	8	20	160	2.33	0.291

2 - CEILING		TOTAL		18	
	TRIB	LENGTH	Area	KIPS	KLF
L1-1	8	20	160	4.50	0.563
L1-2	0	20	0	0.00	0.000
L1-3	0	20	0	0.00	0.000
L1-4	8	20	160	4.50	0.563
L2-1	8	20	160	4.50	0.563
L2-2	0	20	0	0.00	0.000
L2-3	0	20	0	0.00	0.000
L2-4	8	20	160	4.50	0.563

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	3.74	5.02
L2	0.00	3.12	5.12	0.00	0.00
L3	1.59	0.00	0.00	4.33	6.25
L4	9.51	12.63	19.63	20.22	20.86
L5	9.51	12.63	19.63	20.22	20.86
L6	1.59	0.00	0.00	3.74	5.02
L7	0.00	3.12	5.12	5.41	6.05

Length of wall needed

	3 -Ceiling	3 - Floor	2 - Ceiling	2 - Floor	1 - Ceiling
L1	0.00	0.00	0.00	9.35	12.55
L2	0.00	7.79	12.79	0.00	0.00
L3	3.96	0.00	0.00	10.82	15.62
L4	23.79	31.58	49.08	50.56	52.16
L5	23.79	31.58	49.08	50.56	52.16
L6	3.96	0.00	0.00	9.35	12.55
L7	0.00	7.79	12.79	13.53	15.13

	Kips	KLF
Max =	16	0.4

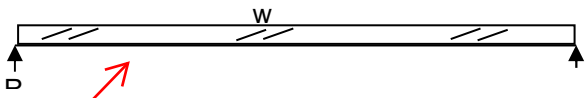
Loads over 16 kips require "End Wall" panel conditions

Beam Spreadsheet Key Plan

Key Plan Callout

Minimum Size

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



Reaction

Moment

Max Bending Stress

Max Shear Stress

Max Deflection

L/ Deflection Value

Beam Loading Diagram

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STRUCTURAL ENGINEERING

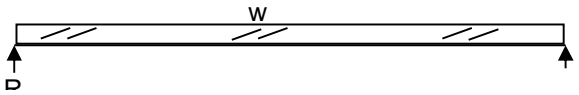
DATE

PROJ. #

DESIGN

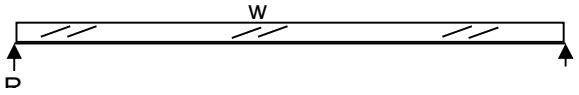
SHEET

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		l /	72	

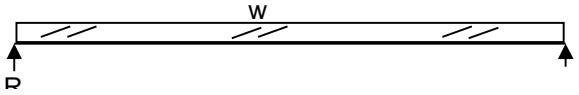


Steel Size				W12X120		
I =	1070	in⁴		Fy=	50	ksi
Δ =	0.74	in		Mn/Ω =	464.1	k-ft
l /	646			Vn/Ω =	138.8	kips

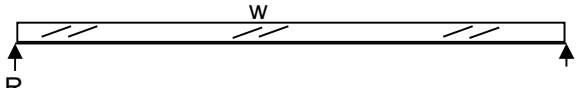
Beam	B2			HF	4 x 12	
w=	520	plf		R=	10,400	lbs
L=	40	ft		M=	104,000	ft-lbs
b=	3.50	in		Fb=	16,904	psi
d=	11.25	in		Fv=	378	psi
E=	1300	ksi		Δ=	55.48	in
Cv=	0.98	≤1.0		l /	9	



Steel Size				W14X109		
I =	1240	in⁴		Fy=	50	ksi
Δ =	0.83	in		Mn/Ω =	479.0	k-ft
l /	576			Vn/Ω =	118.6	kips

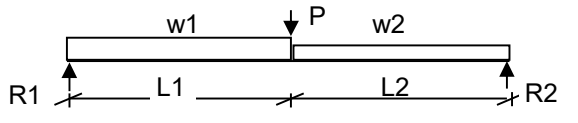


Beam	B5			HF	4 x 12	
w=	200	plf		R=	2,400	lbs
L=	24	ft		M=	14,400	ft-lbs
b=	3.50	in		Fb=	2,341	psi
d=	11.25	in		Fv=	84	psi
E=	1300	ksi		Δ=	2.77	in
Cv=	1.00	≤1.0		l /	104	



Steel Size				W10X19		
I =	96.3	in⁴		Fy=	50	ksi
Δ =	0.53	in		Mn/Ω =	53.9	k-ft
l /	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		l /	11	
d=	11.25	in		Cv=	0.98	
E=	1,300	ksi				



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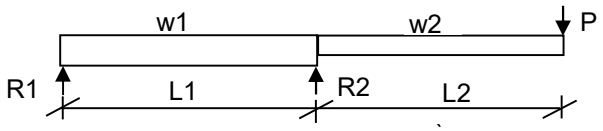
_____ Design: ENG

_____ Sheet: _____

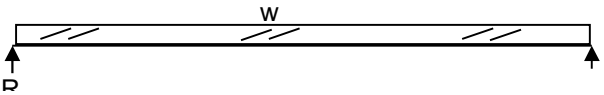
Steel Size					W14X109
I =	1240	in^4	Fy=	50	ksi
Δ =	0.673	in	Mn/Ω =	479.0	k-ft
l /	713		Vn/Ω =	209.0	kips

cant col		c1		DF-L	4	x 12
w1=		plf		R1=	-1750	lbs
w2=		plf		R2=	3,500	lbs
L1=	5	ft		M+=	-	lb-ft
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		l span/	(2,214)	
E=	1,700	ksi		Δcant=	0.26	in
Cv=	1.00			l cant/	415	

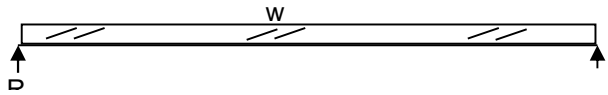


Steel Size				HSS6X6X1/4
	Δ (in)	l /	Fy=	50 ksi
span	-0.021	-2601	Mn/Ω =	27.9 k-ft
cant.	0.22	488	Vn/Ω =	0.0 kips

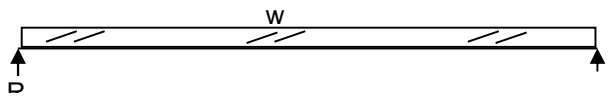
Beam		B13		HF	4	x 12
w=	232	plf		R=	1,508	lbs
L=	13	ft		M=	4,901	ft-lbs
b=	3.50	in		Fb=	797	psi
d=	11.25	in		Fv=	49	psi
E=	1300	ksi		Δ=	0.28	in
Cv=	1.00	≤1.0		l /	565	



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

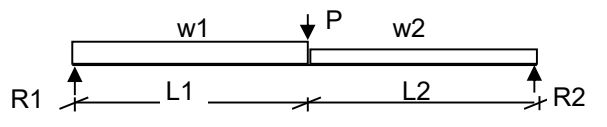


Hanger Door Col		c2		HF	4	x 12
w=	300	plf		R=	3,000	lbs
L=	20	ft		M=	15,000	ft-lbs
b=	3.50	in		Fb=	2,438	psi
d=	11.25	in		Fv=	104	psi
E=	1300	ksi		Δ=	2.00	in
Cv=	1.00	≤1.0		l /	120	



Steel Size				W8X18
I =	61.9	in^4	Fy=	50 ksi
Δ =	0.60	in	Mn/Ω =	42.4 k-ft
l /	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		l /	830	
d=	11.25	in		Cv=	1.00	
E=	1,300	ksi				



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Project: _____ *Date:* 04/25/23

_____ Project #: _____

_____ Design: ENG

_____ Sheet: _____

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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Project: _____ *Date:* 04/25/23

_____ Project #: _____

_____ Design: ENG

_____ Sheet: _____

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**

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

Load Factors	
Dead	**1.00**
Live	**1.00**
Roof Live	**1.00**
Seismic	**1.00**

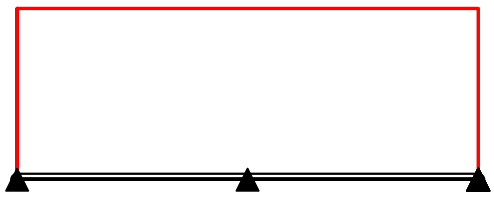
Stresses @ Input Location	
f_v (psi)	-65
f_b (psi)	7230

Max/Min Stresses	
f_{v_MAX} (psi)	865
f_{v_MIN} (psi)	-865
f_{b_MAX} (psi)	7342
f_{b_MIN} (psi)	-13059

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_n/Ω_v	46.9 k
S	8.27 in^3	$\phi_v V_n$	70.3 k
Z	10.2 in^3	M_n/Ω_b	25.4 k-ft
I	33.1 in^4	$\phi_b M_n$	38.3 k-ft

Beam Loading Diagram



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

DATE 4/25/2023
PROJ. #
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**

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

Load Factors	
Dead	**1.00**
Live	**1.00**
Roof Live	**1.00**
Seismic	**1.00**

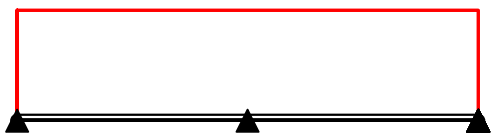
Stresses @ Input Location	
f_v (psi)	-114
f_b (psi)	14115

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

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_n/Ω_v	34.3 k
S	5.46 in^3	$\phi_v V_n$	51.5 k
Z	6.6 in^3	M_n/Ω_b	16.5 k-ft
I	16.4 in^4	$\phi_b M_n$	24.8 k-ft

Beam Loading Diagram



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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PROJECT Project

DATE 4/25/2023
PROJ. #
DESIGN ENG
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**

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

Load Factors	
Dead	**1.00**
Live	**1.00**
Roof Live	**1.00**
Seismic	**1.00**

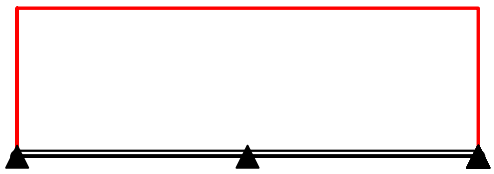
Stresses @ Input Location	
f_v (psi)	-98
f_b (psi)	12533

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

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_n/Ω_v	53.7 k
S	8.27 in^3	$\phi_v V_n$	80.6 k
Z	10.3 in^3	M_n/Ω_b	25.7 k-ft
I	24.8 in^4	$\phi_b M_n$	38.6 k-ft

Beam Loading Diagram



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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PROJECT Project

DATE 4/25/2023
PROJ. #
DESIGN ENG
SHEET 1

Beam Analysis

Beam:		Offset Celing (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**

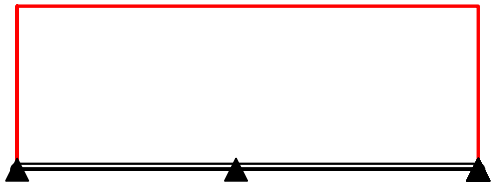
Stresses @ Input Location	
f_v (psi)	65
f_b (psi)	8070

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_n/Ω_v	46.9 k
S	8.27 in^3	$\phi_v V_n$	70.3 k
Z	10.2 in^3	M_n/Ω_b	25.4 k-ft
I	33.1 in^4	$\phi_b M_n$	38.3 k-ft

Beam Loading Diagram



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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STRUCTURAL ENGINEERING

PROJECT Project

DATE 4/25/2023
PROJ. #
DESIGN ENG
SHEET 1

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**

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

Load Factors	
Dead	**1.00**
Live	**1.00**
Roof Live	**1.00**
Seismic	**1.00**

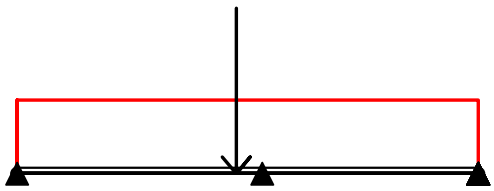
Stresses @ Input Location	
f_v (psi)	-36
f_b (psi)	10659

Max/Min Stresses	
f_{v_MAX} (psi)	706
f_{v_MIN} (psi)	-1648
f_{b_MAX} (psi)	10726
f_{b_MIN} (psi)	-17097

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_n/Ω_v	77.2 k
S	11.3 in^3	$\phi_v V_n$	116 k
Z	14.6 in^3	M_n/Ω_b	36.4 k-ft
I	34 in^4	$\phi_b M_n$	54.8 k-ft

Beam Loading Diagram



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

DATE 4/25/2023
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**

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

Load Factors	
Dead	**1.00**
Live	**1.00**
Roof Live	**1.00**
Seismic	**1.00**

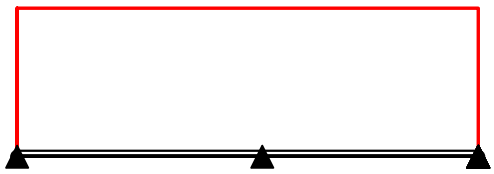
Stresses @ Input Location	
f_v (psi)	-72
f_b (psi)	11096

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

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_n/Ω_v	77.2 k
S	11.3 in^3	$\phi_v V_n$	116 k
Z	14.6 in^3	M_n/Ω_b	36.4 k-ft
I	34 in^4	$\phi_b M_n$	54.8 k-ft

Beam Loading Diagram



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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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**

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

Load Factors	
Dead	**1.00**
Live	**1.00**
Roof Live	**1.00**
Seismic	**1.00**

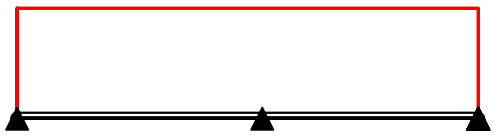
Stresses @ Input Location	
f_v (psi)	-77
f_b (psi)	11274

Max/Min Stresses	
f_{v_MAX} (psi)	936
f_{v_MIN} (psi)	-1010
f_{b_MAX} (psi)	11434
f_{b_MIN} (psi)	-16977

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_n/Ω_v	53.7 k
S	8.27 in^3	$\phi_v V_n$	80.6 k
Z	10.3 in^3	M_n/Ω_b	25.7 k-ft
I	24.8 in^4	$\phi_b M_n$	38.6 k-ft

Beam Loading Diagram



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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Beam Analysis

Beam:		Offset Celing (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**

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

Load Factors	
Dead	**1.00**
Live	**1.00**
Roof Live	**1.00**
Seismic	**1.00**

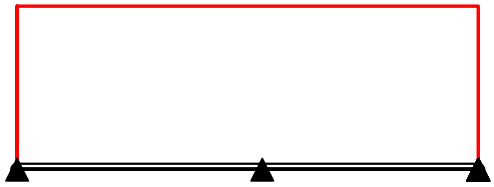
Stresses @ Input Location	
f_v (psi)	-66
f_b (psi)	8358

Max/Min Stresses	
f_{v_MAX} (psi)	800
f_{v_MIN} (psi)	-862
f_{b_MAX} (psi)	8489
f_{b_MIN} (psi)	-12624

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_n/Ω_v	46.9 k
S	8.27 in^3	$\phi_v V_n$	70.3 k
Z	10.2 in^3	M_n/Ω_b	25.4 k-ft
I	33.1 in^4	$\phi_b M_n$	38.3 k-ft

Beam Loading Diagram



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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DATE 4/25/2023
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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**

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

Load Factors	
Dead	**1.00**
Live	**1.00**
Roof Live	**1.00**
Seismic	**1.00**

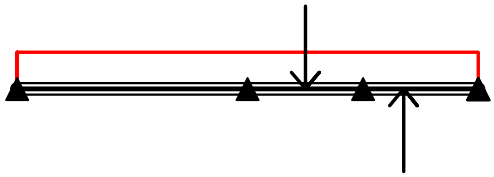
Stresses @ Input Location	
f_v (psi)	1034
f_b (psi)	-17433

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

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_n/Ω_v	34.3 k
S	5.46 in^3	$\phi_v V_n$	51.5 k
Z	6.6 in^3	M_n/Ω_b	16.5 k-ft
I	16.4 in^4	$\phi_b M_n$	24.8 k-ft

Beam Loading Diagram



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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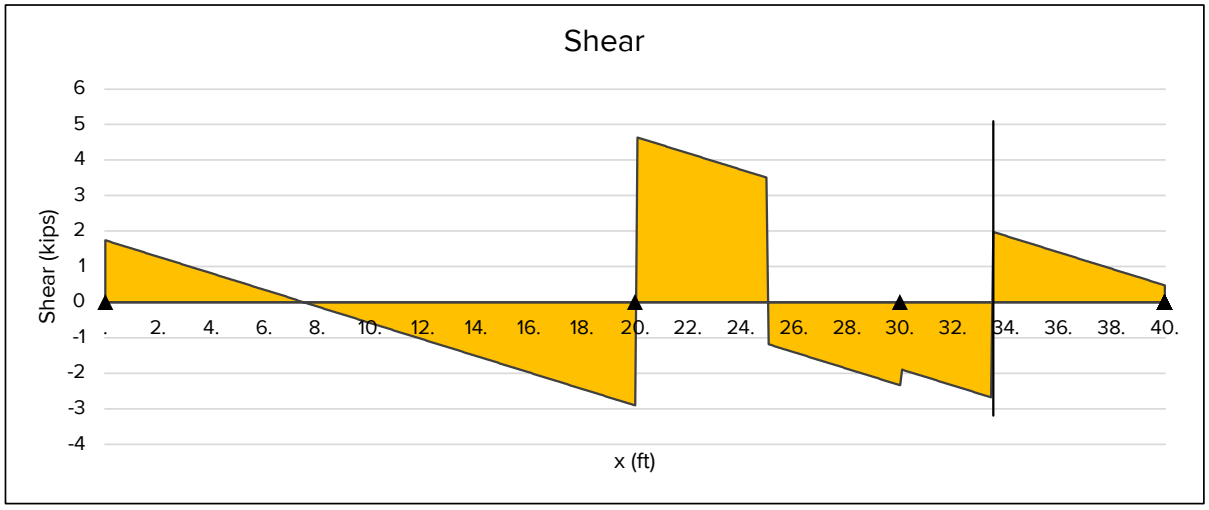
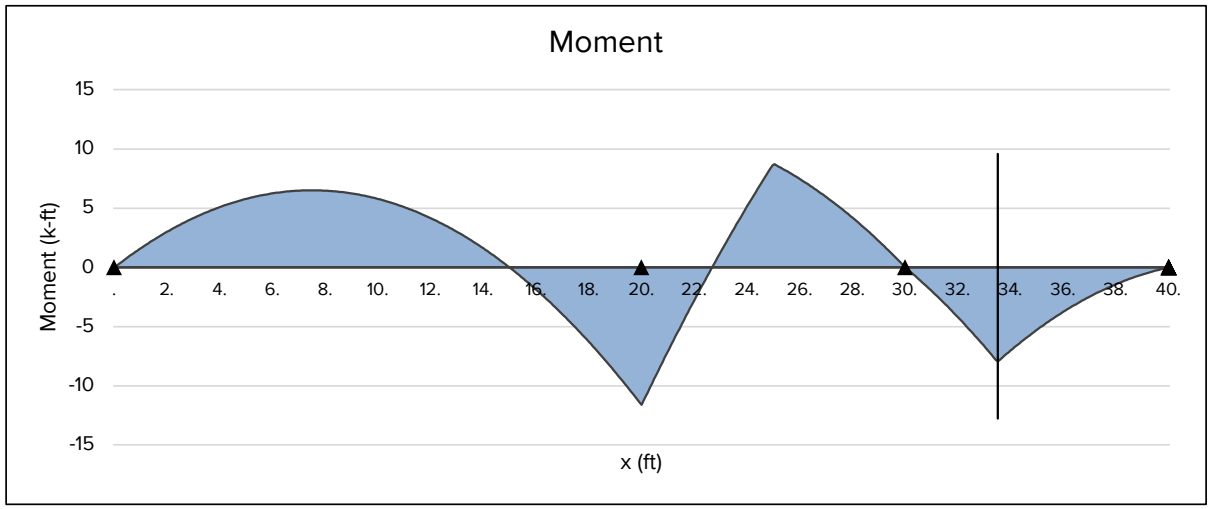
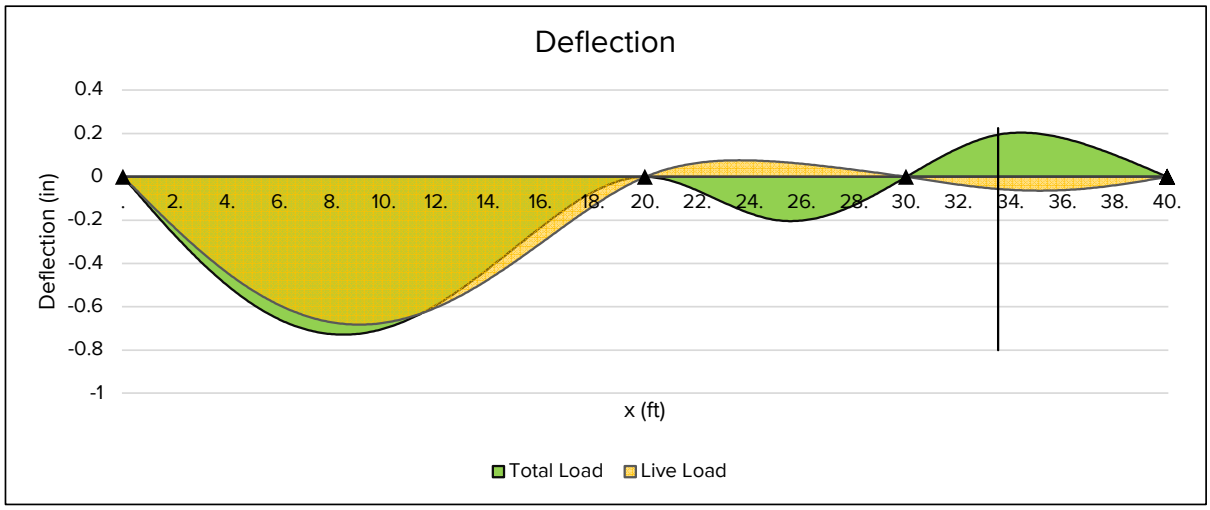
Beam Analysis







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Tube Connection (side bearing) calcs per AISC 360-10 Table K2.2

Main Member

H (in)	B (in)	t (in)
8	4	0.25

Side Member ($l_b = H_b/\sin\theta$)

H_b (in)	B_b (in)	t_b (in)	A_g (in2)	P_{allow} (kip) (side n	l_b (in)	b_{eoi} (in)
3	4	0.1875	2	30	3	3.333

Fy (ksi)
50

Fyb (ksi)
50

Unitless ratios of things

β (in/in)	β_{eop}	β_{eff}	Q_f	U	η	γ	θ (deg)
1.000	0.625	0.438	0.900	1.000	0.750	8.000	90

($\beta = B_b/B$) ($\eta = l_b/B$) ($\gamma = B/2t$)

Limit state: chord wall plastification, when β ≤ 0.85

Pn*sin(θ) (	Pn (kip)	Ω	P_{allow}		
#DIV/0!	#DIV/0!	1.5	#DIV/0!	(β =1)	**Not Applied**

Limit state: shear yielding (punching), when 0.85 < β ≤ 1- 1/γ or B/t < 10

Pn*sin(θ) (	Pn(kip)	Ω	P_{allow}			
82.5	82.5	1.58	52.2	(β =1)		**Not Applied**
				1-1/γ =	0.88	
				B/t =	16	

Limit state: Local yielding of chord sidewalls, when β = 1.0

Pn*sin(θ) (	Pn(kip)	Ω	P_{allow}		
106.3	106.3	1.5	70.8	(β =1)	**This limit state applies**

Limit state: Local crippling of chord sidewalls, when β = 1.0 and branches are in compression for cross connections

Pn*sin(θ) (	Pn(kip)	Ω	P_{allow}		
112.1	112.1	1.67	67.1	(β =1)	**This limit state applies**

Limit state: Local yielding of branch/branches due to uneven load distribution, when β > 0.85

Pn*sin(θ) (	Pn(kip)	Ω	P_{allow}		
111.7	111.7	1.58	70.7	(β =1)	**This limit state applies**

Limit State: Chord Wall Plastification, when $\beta \le 0.85$

$$P_n \sin\theta = F_y t^2 \left(\frac{2\eta}{(1-\beta)} + \frac{4}{\sqrt{1-\beta}} \right) Q_f \qquad \text{(K2-13)}$$

$\phi = 1.00$ (LRFD) $\qquad \Omega = 1.50$ (ASD)

Limit State: Shear Yielding (Punching), when $0.85 < \beta \le 1 - 1/\gamma$ or $B/t < 10$

$$P_n \sin\theta = 0.6 F_y t B \left(2\eta + 2\beta_{eop} \right) \qquad \text{(K2-14)}$$

$\phi = 0.95$ (LRFD) $\qquad \Omega = 1.58$ (ASD)

Limit State: Local Yielding of Chord Sidewalls, when $\beta = 1.0$

$$P_n \sin\theta = 2 F_y t \left(5k + N \right) \qquad \text{(K2-15)}$$

$\phi = 1.00$ (LRFD) $\qquad \Omega = 1.50$ (ASD)

Limit State: Local Crippling of Chord Sidewalls, when $\beta = 1.0$ and Branches are in Compression, for Cross-Connections

$$P_n \sin\theta = \left(\frac{48 t^3}{H - 3t} \right) \sqrt{E F_y} Q_f \qquad \text{(K2-17)}$$

$\phi = 0.90$ (LRFD) $\qquad \Omega = 1.67$ (ASD)

Limit State: Local Yielding of Branch/Branches Due to Uneven Load Distribution, when $\beta \ge 0.85$

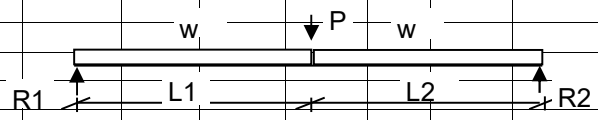
$$P_n = F_{yb} t_b \left(2H_b + 2b_{eoi} - 4t_b \right) \qquad \text{(K2-18)}$$

$\phi = 0.95$ (LRFD) $\qquad \Omega = 1.58$ (ASD)

$$b_{eoi} = \frac{10}{B/t} \left(\frac{F_y t}{F_{yb} t_b} \right) B_b \le B_b \qquad \text{(K2-19)}$$

Steel

Handrail Demands



w=	50	plf	-or-	P=	200	lbs
L handrail btwn posts	4	ft		I=	1.0	
				Ω=	1.67	

Distributed load			Point Load		
R=	100	lbs	R=	100	lbs
M=	100	ft lbs	M=	200	ft lbs

Minimum Acceptable Handrails

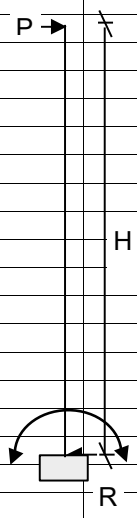
Solid Bar				X-X				
Fy (ksi)	t"		w"	I (in4)	S (in3)	Z (in3)	Mn/Ω (ft#)	
38	3/4	x	1	0.063	0.125	0.188	356	OK
38	1/2	x	2	0.333	0.33333	0.5	948	OK
38	5/8	x	1.5	0.176	0.23438	0.352	667	OK

HSS Rect/Square		X-X				
Fy (ksi)		I (in4)	S (in3)	Z (in3)	Mn/Ω (ft#)	
42	HSS4X4X1/4	7.8	3.900	4.690	9829.3	OK

Pipe/Round HSS		X-X				
Fy (ksi)		I (in4)	S (in3)	Z (in3)	Mn/Ω (ft#)	
42	HSS1.660X0.140	0.184	0.222	0.305	639.22	OK

Stanchion Demands

Spacing	4	ft	See above
Height above base	42	in	3.5 ft
P=	200	lbs	
M=	8400	inlbs	
	700	ftlbs	



Minimum Acceptable Stanchions

Solid Bar				X-X				
Fy (ksi)	t"		w"	I (in4)	S (in3)	Z (in3)	Mn/Ω (ft#)	
38	3/4	x	1.5	0.211	0.28125	0.422	800	OK
38	1/2	x	2	0.333	0.33333	0.5	948	OK
38	1 1/4	x	1.25	0.203	0.32552	0.488	926	OK

HSS Rect/Square		X-X				
Fy (ksi)		I (in4)	S (in3)	Z (in3)	Mn/Ω (ft#)	
42	HSS2X2X1/4	0.7	0.747	0.964	2020.4	OK

Pipe/Round HSS		X-X				
Fy (ksi)		I (in4)	S (in3)	Z (in3)	Mn/Ω (ft#)	
42	HSS1.900X0.120	0.251	0.264	0.356	746.11	OK

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STRUCTURAL ENGINEERING

Typical Guardrail Design

Typical Guardrail Demands

4ft0in Spacing

4/25/2023 DATE

PROJ. #

AGL DESIGN

1 SHEET

TENSION ANCHOR REINFORCEMENT

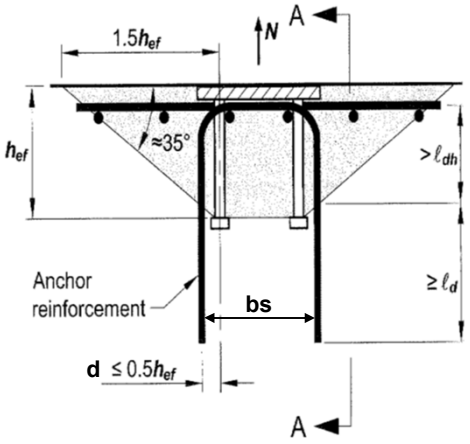
Per *Building Code Requirements for Structural Concrete*

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.



Elevation

DESIGN SATISFACTORY

Results:

Development Length (Section 12.2 or 21.7.5):

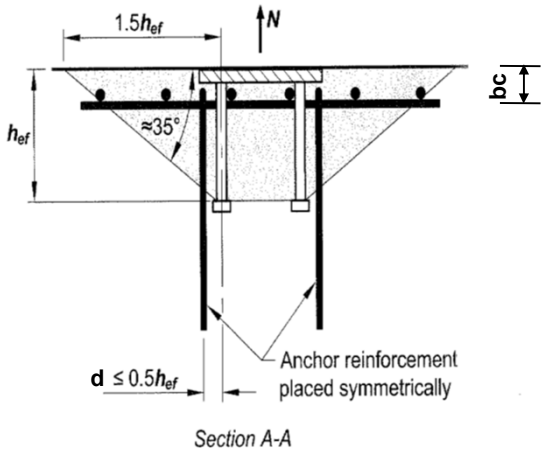
Ld = 37.50 in.

Required Anchor Embedment:

$hef_{,min}$ =	39.50	in.	$hef_{,min}$ = Ld+bc+0.7*d
$hef_{,prov}$ =	72.0	in.	

Anchor Reinforcement Strength(Section D.5.2.9):

$As_{,min}$ =	0.81	in^2	$As_{,min}$ = N/(0.75*fy)
$As_{,prov}$ =	1.23	in^2	



Section A-A

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_Y) =	0 ft-kips
Gravity Load Eccentricity (±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. (Qa) =	1.50 ksf
Overburdan Density (γs) =	120 psf
Net Ftg Wt? (γ_c-γ_s)	No

Column Dimensions and Location

Column Xc Dimension (Dx) =	6.00 in.
Column Yc Dimension (Dy) =	6.00 in.
Column Face from right (Cr) =	2.25 ft.
Column Face from left (Cl) =	2.25 ft.

Soil Bearing Check (Allowable)

Eccentricity =	0.00 ft.	
Leng. Soil Brg. Under Ftg.=	5.00 ft.	
qmax =	1.44 ksf	OK
qmin =	1.44 ksf	

Footing Dimensions

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

Soil Pressure Equations:

$e \le L/6$

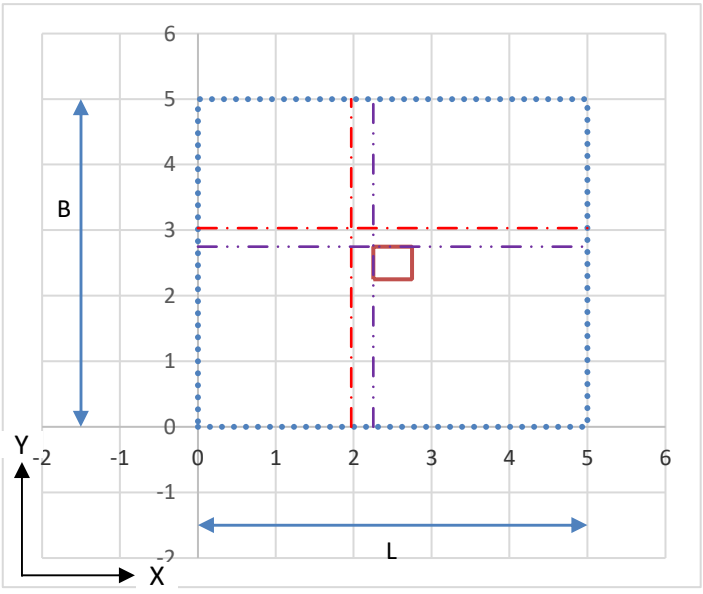
$qmax = \frac{Q}{LB}\left(1 + \frac{6e}{L}\right)$

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

$e > L/6$

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

$qmin = 0$



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STRUCTURAL ENGINEERING

PROJECT

DATE 5/5/2023

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 (cvr) =	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.
qmax =	1.86 ksf
qcolr =	1.86 ksf
qcoll =	1.86 ksf
qmin =	1.86 ksf

Flexural Design - X Direction (About Y-Axis)

Bar Size =	#4	
Bars =	5	
Mu =	24 ft-kips	
ØMn =	29 ft-kips	OK
ρ_{min} =	0.0018	
ρ_{req} =	0.0020	*Controls*
A_s Required =	0.79 sq. in.	
A_s Provided =	1.00 sq. in.	OK

Flexural Design - Y Direction (About X-Axis)

Bar Size =	#4	
Bars =	5	
Mu =	24 ft-kips	
ØMn =	29 ft-kips	OK
ρ_{min} =	0.0018	
ρ_{req} =	0.0020	*Controls*
A_s Required =	0.79 sq. in.	
A_s Provided =	1.00 sq. in.	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
$\gamma_s = 2/(\beta+1)$ =	1.00
Provide $A_{s,req}\gamma_s$ =	0.79 sq. in.

Provide evenly distributed bars in each direction.

Two-Way (Punching) Shear Design

b_o =	51 in	
vu =	44 kips	
Øvn =	54 kips	OK

Concrete Capacity Equations:

$$Mn = A_s F_y \left[d - \frac{1}{2}\left(\frac{A_s F_y}{0.85 f'c\, b} \right) \right]$$

$$vn = min \begin{pmatrix} 4\sqrt{f'c} \\ \left(2 + \frac{4}{\beta}\right)\sqrt{f'c} \\ \left(2 + \frac{\alpha_s d}{b_o}\right)\sqrt{f'c} \end{pmatrix} b_o d$$

$$Vn = 2\,\gamma\sqrt{f'c}\; b_w d$$

$$b_o = 2(Dx + d) + 2(Dy + d)$$

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

5/5/2023

PROJECT

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_Y) =	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. (Qa) =	1.50 ksf
Overburdan Density (γs) =	120 psf
Net Ftg Wt? (γ_c-γ_s)	No

Column Dimensions and Location

Column Xc Dimension (Dx) =	6.00 in.
Column Yc Dimension (Dy) =	6.00 in.
Column Face from right (Cr) =	1.25 ft.
Column Face from left (Cl) =	1.25 ft.

Soil Bearing Check (Allowable)

Eccentricity =	0.00 ft.	
Leng. Soil Brg. Under Ftg.=	3.00 ft.	
qmax =	1.15 ksf	OK
qmin =	1.15 ksf	

Footing Dimensions

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

Soil Pressure Equations:

$e \le L/6$

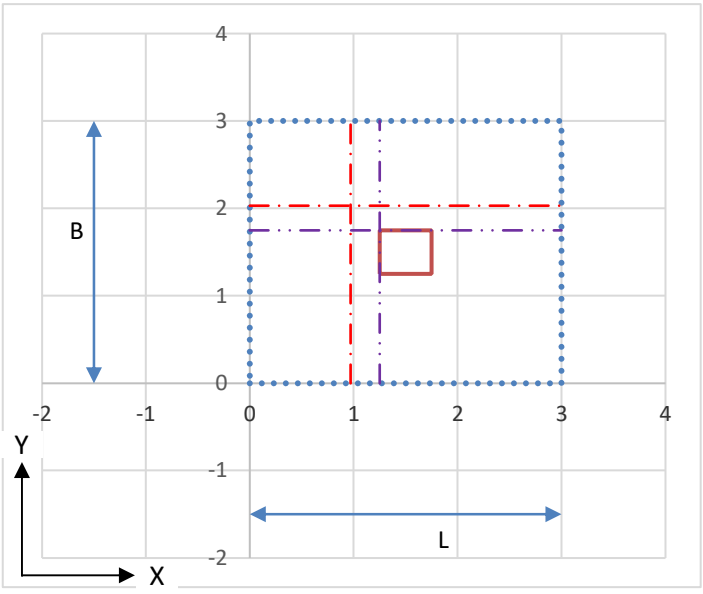
$$qmax = \frac{Q}{LB}\left(1 + \frac{6e}{L}\right)$$

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

$e > L/6$

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

$$qmin = 0$$



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5/5/2023

PROJECT

DATE

PROJ. #

DESIGN

SHEET

SSF STRUCTURAL ENGINEERING

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 (cvr) =	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.
qmax =	1.57 ksf
qcolr =	1.57 ksf
qcoll =	1.57 ksf
qmin =	1.57 ksf

Flexural Design - X Direction (About Y-Axis)

Bar Size =	#4	
Bars =	5	
Mu =	4 ft-kips	
ØMn =	29 ft-kips	OK
ρ_{min} =	0.0018	*Controls*
ρ_{req} =	0.0005	
A_s Required =	0.44 sq. in.	
A_s Provided =	1.00 sq. in.	OK

Flexural Design - Y Direction (About X-Axis)

Bar Size =	#4	
Bars =	5	
Mu =	4 ft-kips	
ØMn =	29 ft-kips	OK
ρ_{min} =	0.0018	*Controls*
ρ_{req} =	0.0005	
A_s Required =	0.44 sq. in.	
A_s Provided =	1.00 sq. in.	OK

One-Way Shear Design - X Direction

Vu =	5 kips	
ØVn =	20 kips	OK

β =	1.000
$\gamma_s = 2/(\beta+1)$ =	1.00
Provide $A_{s,req}\gamma_s$ =	0.44 sq. in.

Provide evenly distributed bars in each direction.

One-Way Shear Design - Y Direction

Vu =	5 kips	
ØVn =	20 kips	OK

Two-Way (Punching) Shear Design

b_o =	51 in	
vu =	12 kips	
Øvn =	54 kips	OK

Concrete Capacity Equations:

$$Mn = A_s F_y \left[d - \frac{1}{2}\left(\frac{A_s F_y}{0.85 f'c\, b} \right) \right]$$

$$vn = min \begin{pmatrix} 4\sqrt{f'c} \\ \left(2 + \frac{4}{\beta}\right)\sqrt{f'c} \\ \left(2 + \frac{\alpha_s d}{b_o}\right)\sqrt{f'c} \end{pmatrix} b_o d$$

$$Vn = 2\,\gamma\sqrt{f'c}\; b_w d$$

$$b_o = 2(Dx + d) + 2(Dy + d)$$

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

5/5/2023

PROJECT

DATE

PROJ. #

DESIGN

SHEET

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Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

Code Reference

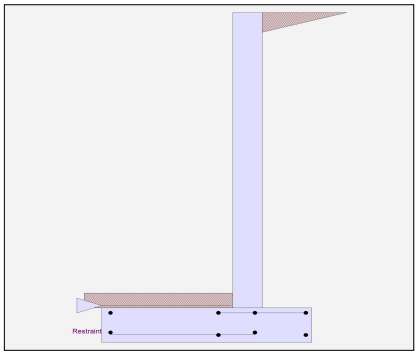
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

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 (Service Level)	=	0.0 psf

Adjacent Footing Load

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

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Cantilevered Retaining Wall

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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	

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

		Bottom
		Stem OK
Design Height Above Ftg	ft =	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
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:
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Project Descr:

Cantilevered Retaining Wall

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

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
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 :	
	==========	One layer of :	Two layers of :
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

		Toe	Heel	
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:	If two layers of horizontal bars:
#4@ 7.94 in	#4@ 15.87 in
#5@ 12.30 in	#5@ 24.60 in
#6@ 17.46 in	#6@ 34.92 in

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	2,182.2	3.72	8,122.5			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				1,770.8	5.29	9,370.7
Soil Over HL (bel. water tbl)					5.29	9,370.7
Watre Table						
Sloped Soil Over Hee =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =					1.88	
Surcharge Over Toe =						
Stem Weight(s) =				1,250.0	4.17	5,208.3
Earth @ Stem Transitions =						
Footing Weight =				1,050.0	3.00	3,150.0
Key Weight =						
Vert. Component =						
Total =	2,182.2	**O.T.M.** =	8,122.5	**Total =** 4,070.8 lbs	**R.M.=**	17,729.0

Resisting/Overturning Ratio = **2.18**

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

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

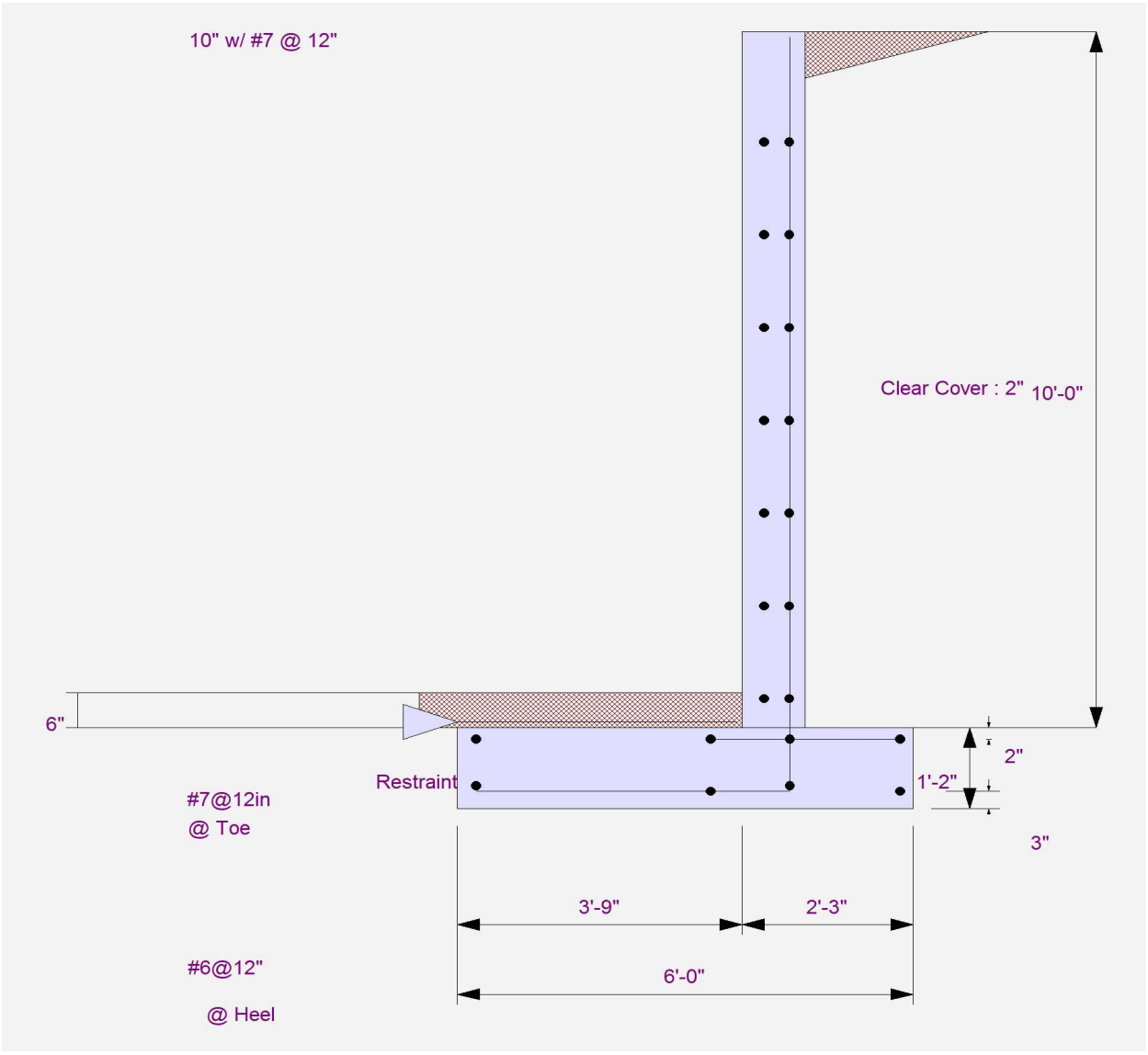
Lap Splice length for #7 bar specified in this stem design segment =	40.95 in
Development length for #7 bar specified in this stem design segment =	31.50 in
Hooked embedment length into footing for #7 bar specified in this stem design segment =	7.41 in
As Provided =	0.6000 in2/ft
As Required =	0.3025 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

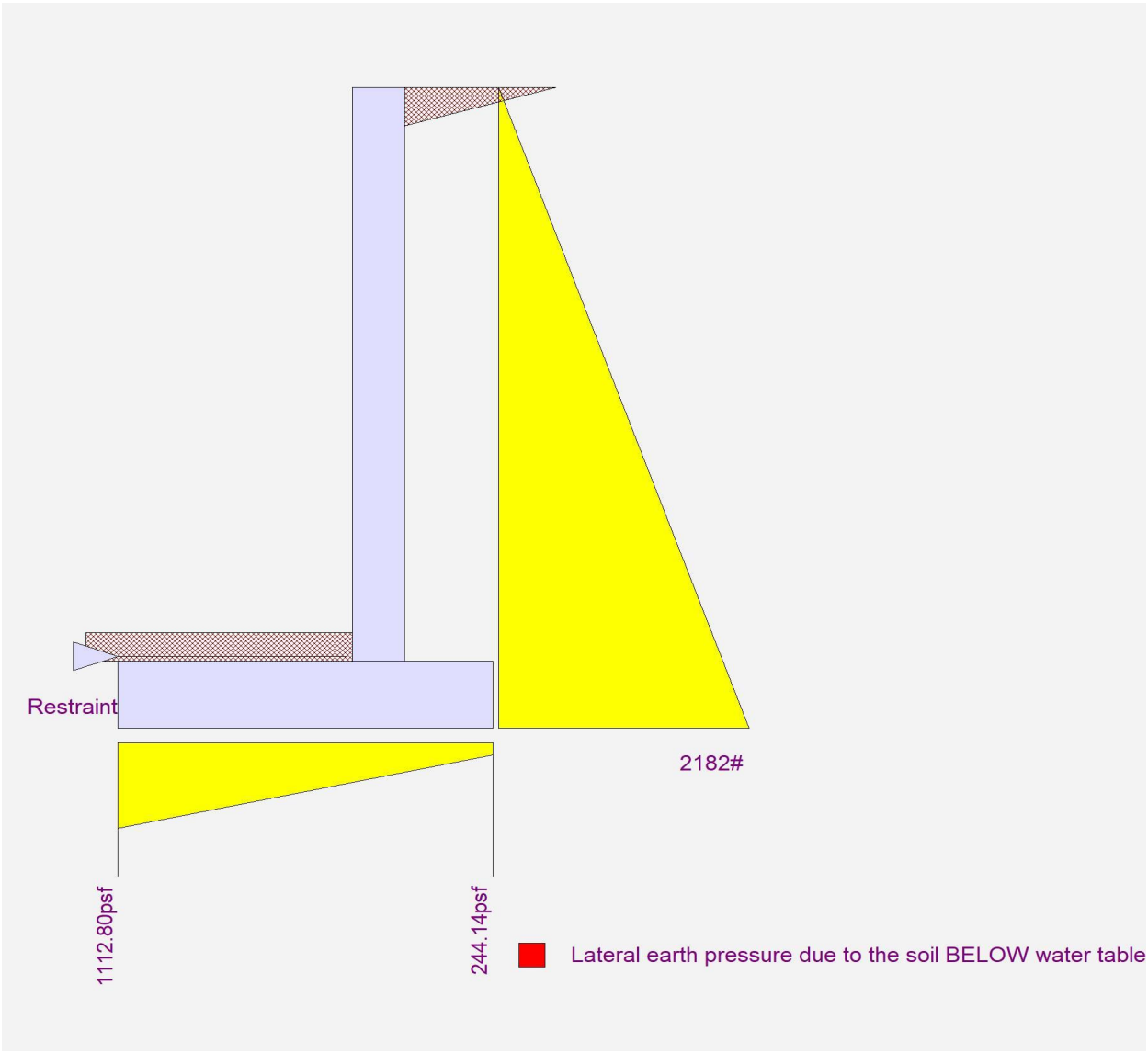


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

Code Reference

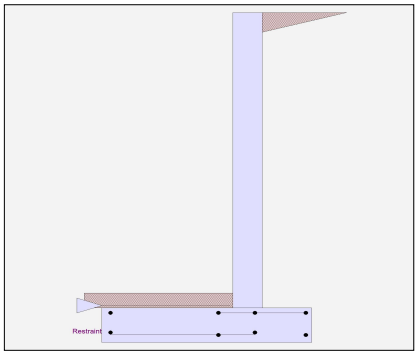
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

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		

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 (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform		
Multiplier Used	=	8.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	89.333
Total Seismic Force	=	997.556

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

		Bottom
		Stem OK
Design Height Above Ftg	ft =	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

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
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 :	
	==========	One layer of :	Two layers of :
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

		Toe	Heel	
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:	If two layers of horizontal bars:
#4@ 7.94 in	#4@ 15.87 in
#5@ 12.30 in	#5@ 24.60 in
#6@ 17.46 in	#6@ 34.92 in

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	2,182.2	3.72	8,122.5			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
Seismic Earth Load =	698.3	5.58	3,898.8			
=						
Total =	2,880.4	**O.T.M.** =	12,021.2			
				Soil Over HL (ab. water tbl)	1,770.8	5.29	9,370.7
				Soil Over HL (bel. water tbl)		5.29	9,370.7
				Watre Table			
				Sloped Soil Over Hee =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =		1.88	
				Surcharge Over Toe =			
				Stem Weight(s) =	1,250.0	4.17	5,208.3
				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.

Cantilevered Retaining Wall

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

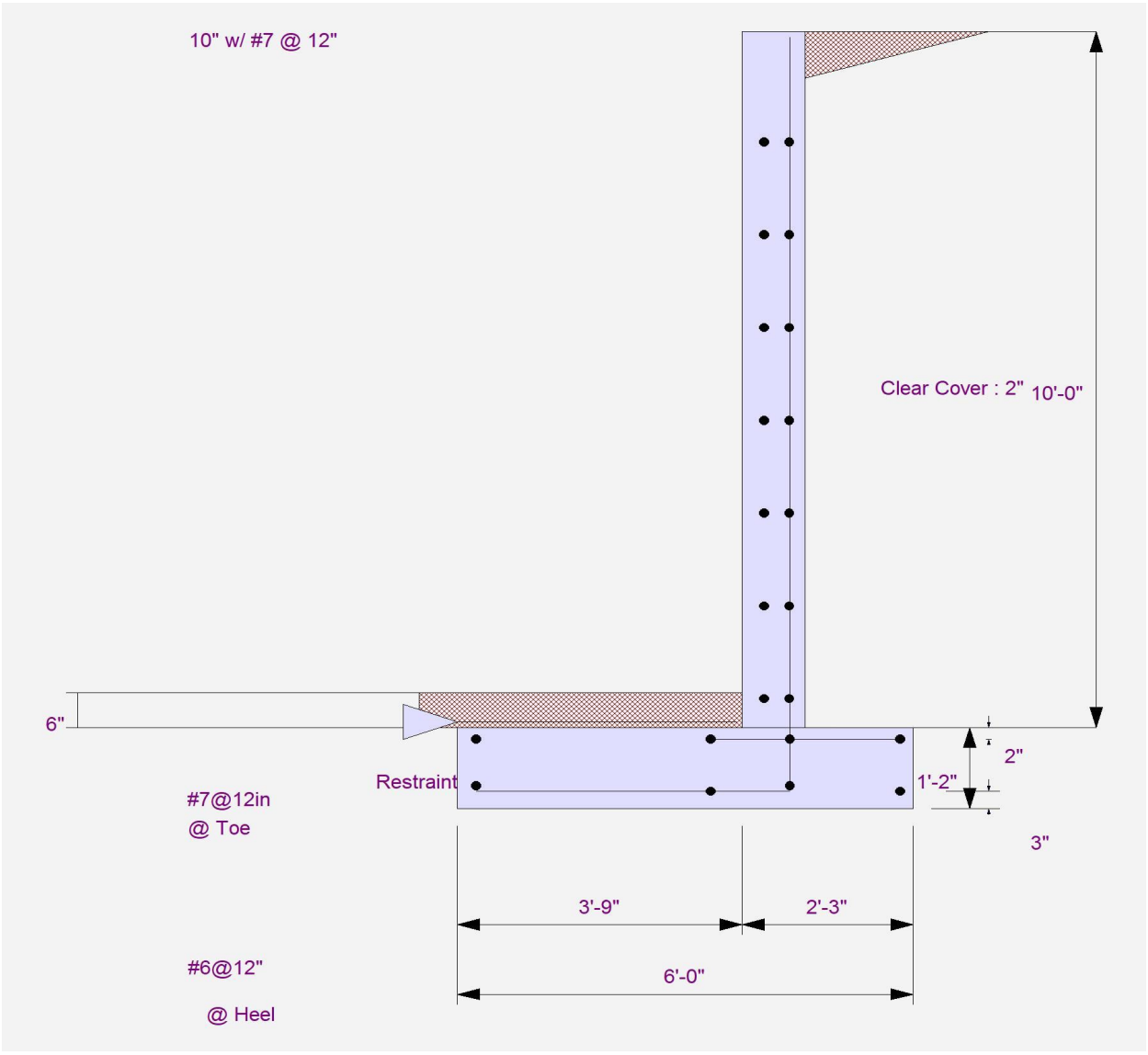
Lap Splice length for #7 bar specified in this stem design segment =	40.95 in
Development length for #7 bar specified in this stem design segment =	31.50 in
Hooked embedment length into footing for #7 bar specified in this stem design segment =	10.37 in
As Provided =	0.6000 in2/ft
As Required =	0.4234 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

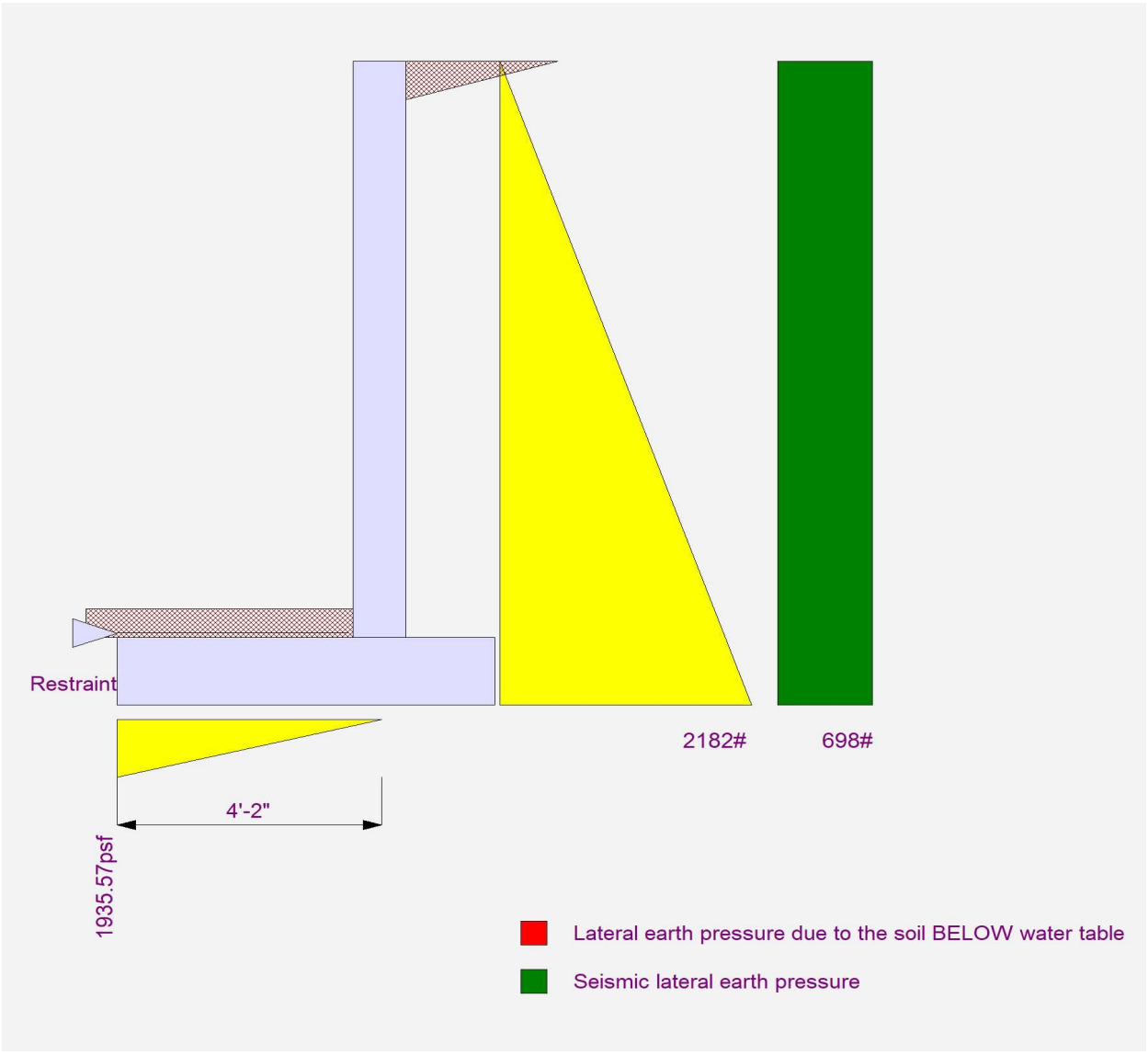


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

Code Reference

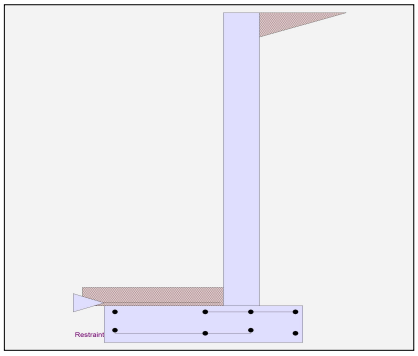
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

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 (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

		Bottom
		Stem OK
Design Height Above Ftg	ft =	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**
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
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	19.6
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

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
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 :	
	==========	One layer of :	Two layers of :
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

		Toe	Heel	
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:	If two layers of horizontal bars:
#4@ 9.26 in	#4@ 18.52 in
#5@ 14.35 in	#5@ 28.70 in
#6@ 20.37 in	#6@ 40.74 in

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,417.5	3.00	4,252.5			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
				Soil Over HL (ab. water tbl)	996.7	4.08	4,068.1
				Soil Over HL (bel. water tbl)		4.08	4,068.1
				Watre Table			
				Sloped Soil Over Hee =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =		1.38	
				Surcharge Over Toe =			
				Stem Weight(s) =	1,000.0	3.17	3,166.7
				Earth @ Stem Transitions =			
				Footing Weight =	687.0	2.29	1,573.2
				Key Weight =			
				Vert. Component =			
Total =	1,417.5	**O.T.M.** =	4,252.5	**Total =**	2,683.7 lbs	**R.M.=**	8,808.0

Resisting/Overturning Ratio = **2.07**

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.

Cantilevered Retaining Wall

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

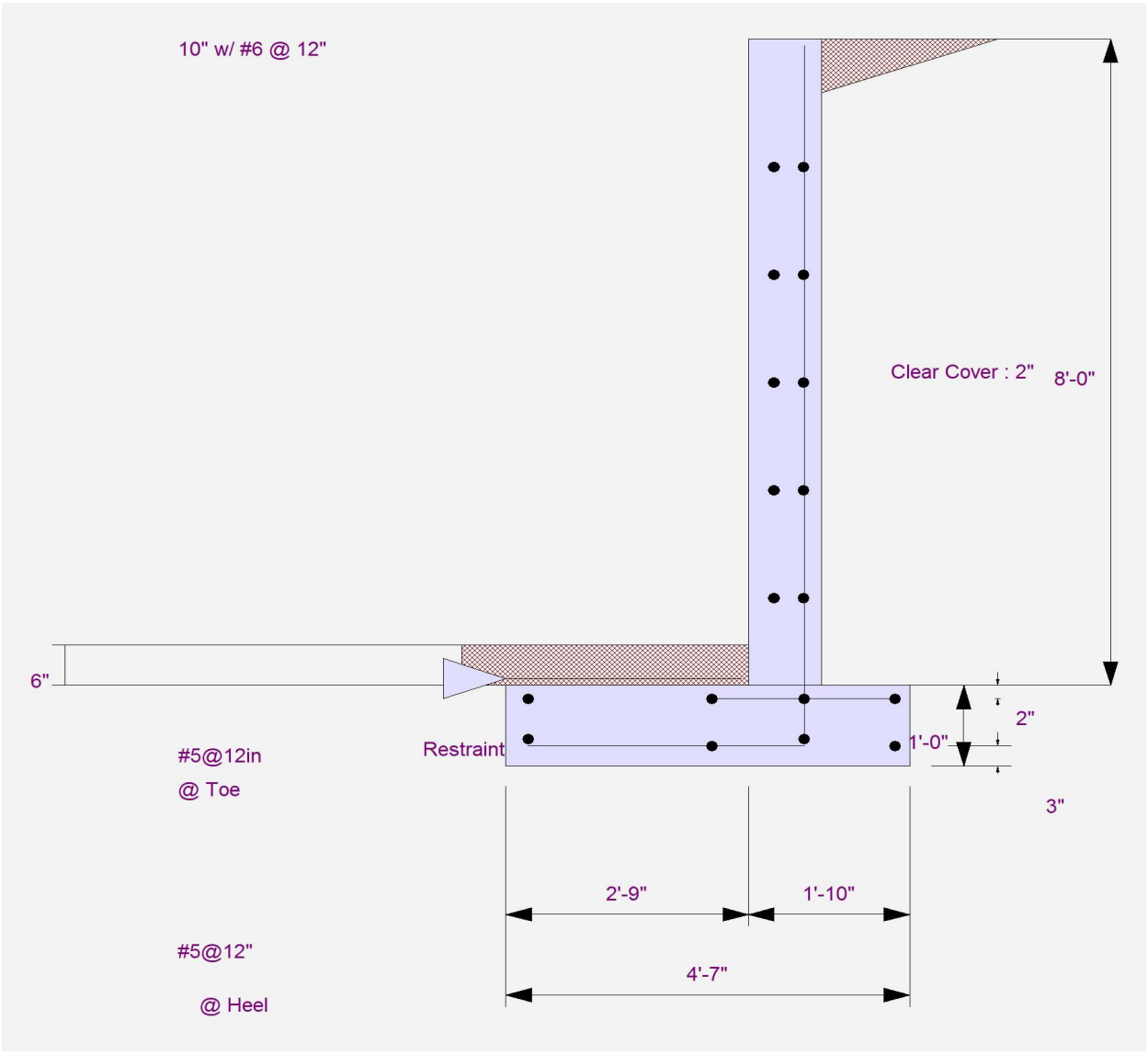
Lap Splice length for #6 bar specified in this stem design segment =	28.08 in
Development length for #6 bar specified in this stem design segment =	21.60 in
Hooked embedment length into footing for #6 bar specified in this stem design segment =	6.00 in
As Provided =	0.4400 in2/ft
As Required =	0.1938 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

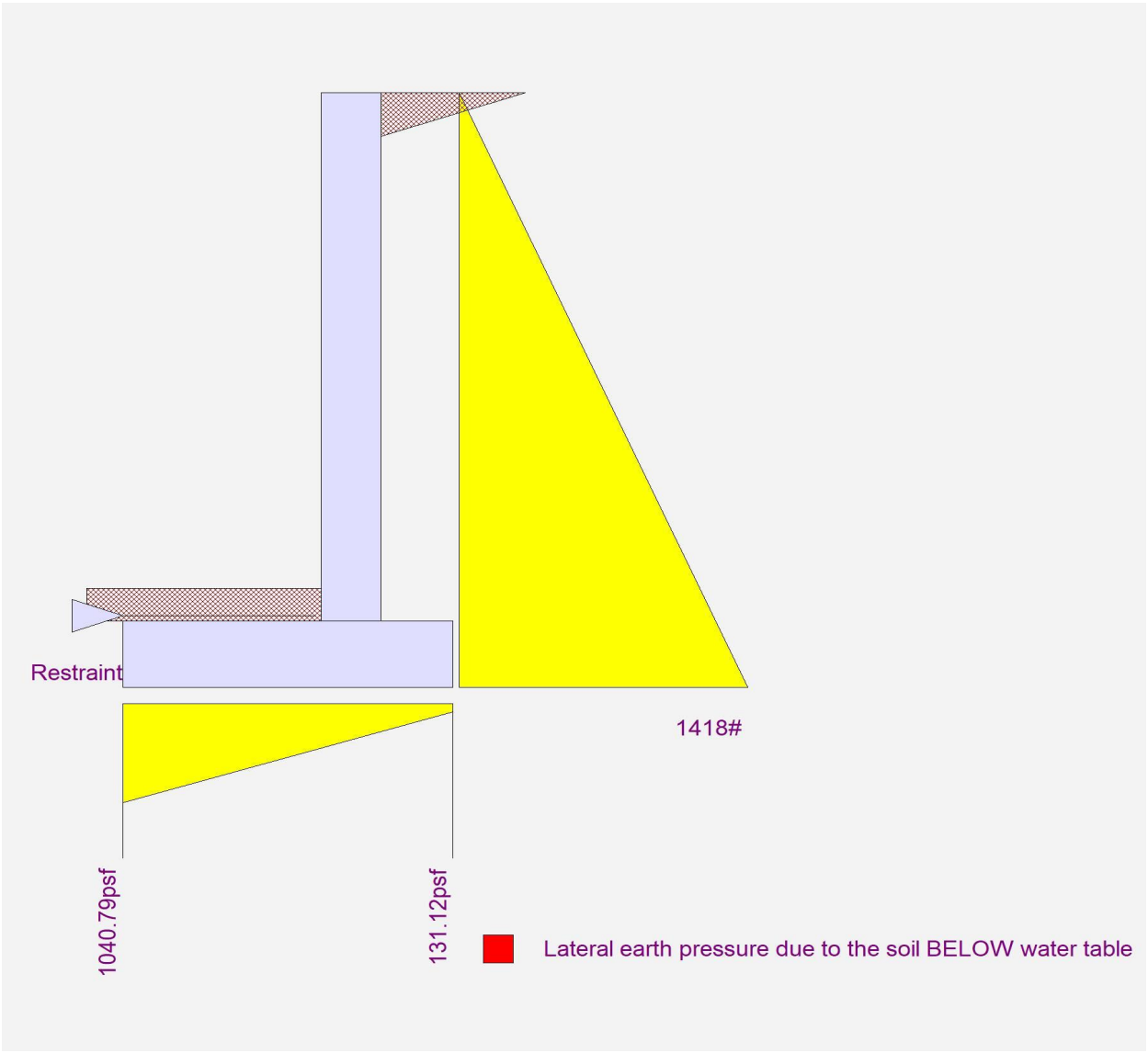


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

Code Reference

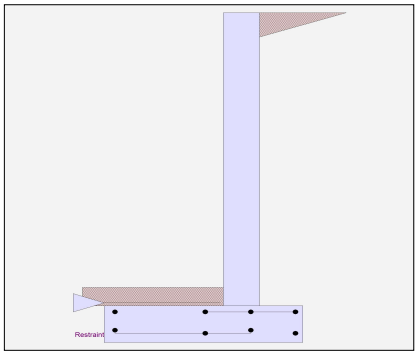
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

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		

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 (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform		
Multiplier Used	=	8.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	72.000
Total Seismic Force	=	648.000

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

		Bottom
		Stem OK
Design Height Above Ftg	ft =	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

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
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 :	
	==========	One layer of :	Two layers of :
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

		Toe	Heel	
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:	If two layers of horizontal bars:
#4@ 9.26 in	#4@ 18.52 in
#5@ 14.35 in	#5@ 28.70 in
#6@ 20.37 in	#6@ 40.74 in

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,417.5	3.00	4,252.5			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
Seismic Earth Load =	453.6	4.50	2,041.2			
=						
Total =	1,871.1	**O.T.M.** =	6,293.7			
				Soil Over HL (ab. water tbl)	996.7	4.08	4,068.1
				Soil Over HL (bel. water tbl)		4.08	4,068.1
				Watre Table			
				Sloped Soil Over Hee =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =		1.38	
				Surcharge Over Toe =			
				Stem Weight(s) =	1,000.0	3.17	3,166.7
				Earth @ Stem Transitions =			
				Footing Weight =	687.0	2.29	1,573.2
				Key Weight =			
				Vert. Component =			
				Total =	2,683.7 lbs	**R.M.=**	8,808.0

Resisting/Overturning Ratio = **1.40**

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.

Cantilevered Retaining Wall

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

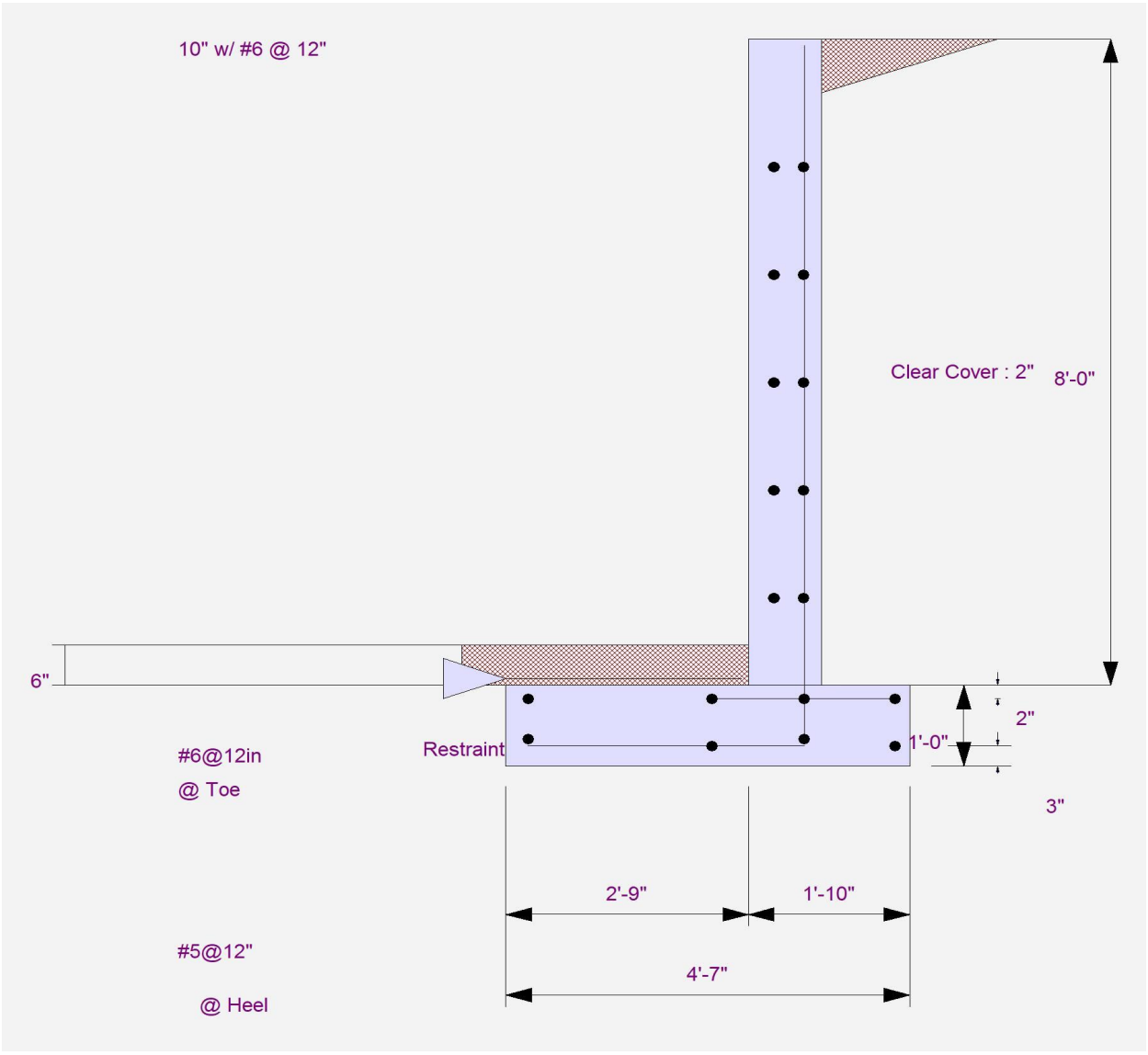
Lap Splice length for #6 bar specified in this stem design segment =	28.08 in
Development length for #6 bar specified in this stem design segment =	21.60 in
Hooked embedment length into footing for #6 bar specified in this stem design segment =	8.23 in
As Provided =	0.4400 in2/ft
As Required =	0.2872 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

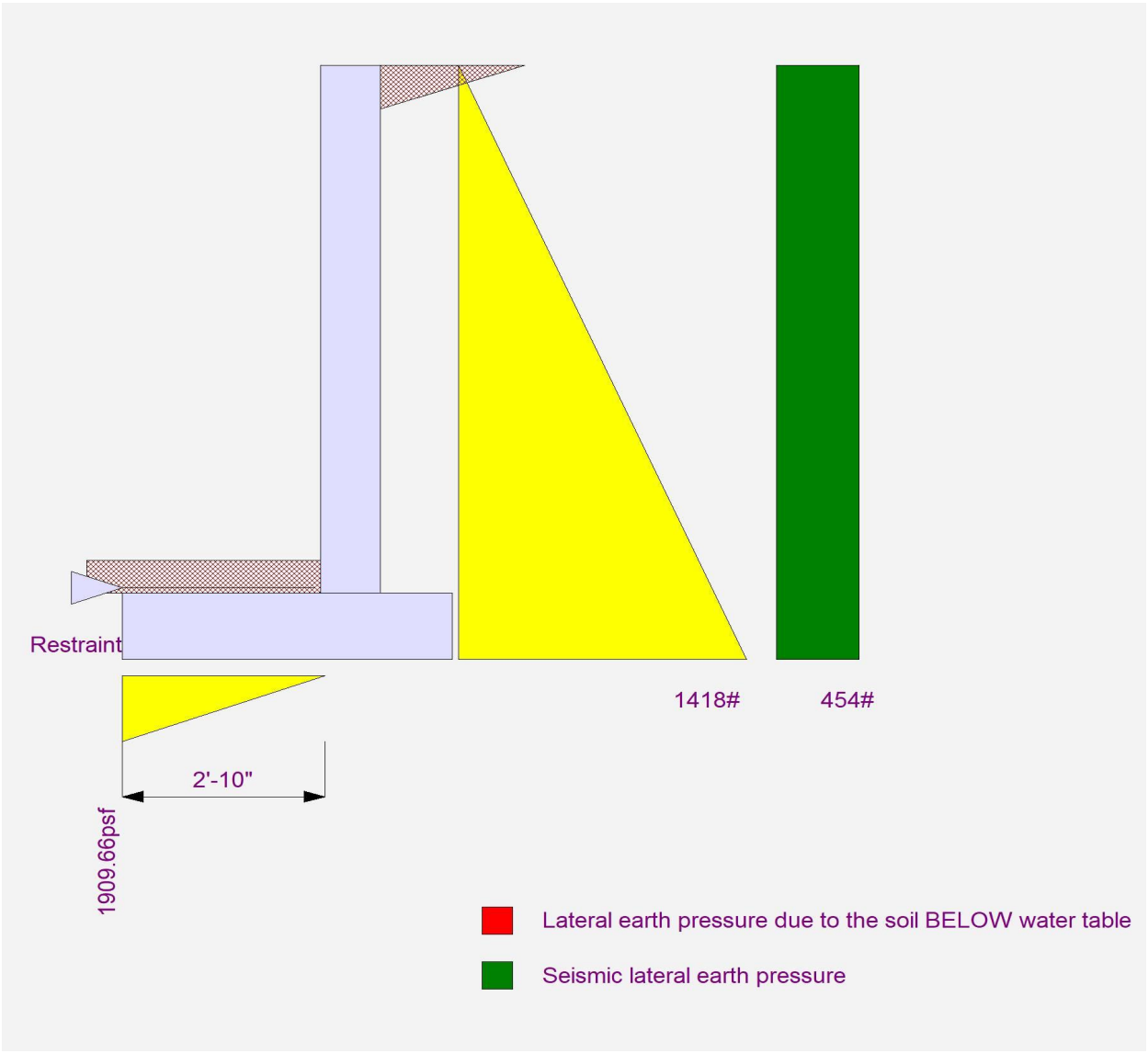


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

Code Reference

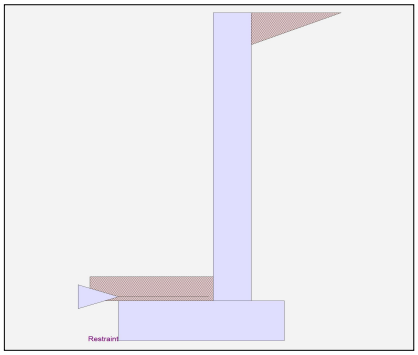
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

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 (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

		Bottom
		Stem OK
Design Height Above Ftg	ft =	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

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
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 :	
	==========	One layer of :	Two layers of :
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

		Toe	Heel	
Factored Pressure	=	1,794	0	psf
Mu' : Upward	=	1,865	0	ft-#
Mu' : Downward	=	314	179	ft-#
Mu: Design	=	1,552 OK	179	ft-# OK
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: phiMn = phi'5'lambda'sqrt(fc)'Sm

Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	817.2	2.28	1,861.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				437.5	2.63	1,149.9
Soil Over HL (bel. water tbl)					2.63	1,149.9
Watre Table						
Sloped Soil Over Hee =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =					0.84	
Surcharge Over Toe =						
Stem Weight(s) =				600.0	2.00	1,202.0
Earth @ Stem Transitions =						
Footing Weight =				365.0	1.46	532.9
Key Weight =						
Vert. Component =						
Total =	817.2	**O.T.M.** =	1,861.3	**Total =** 1,402.5 lbs	**R.M.=**	2,884.8

Resisting/Overturning Ratio = **1.55**

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.

Cantilevered Retaining Wall

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

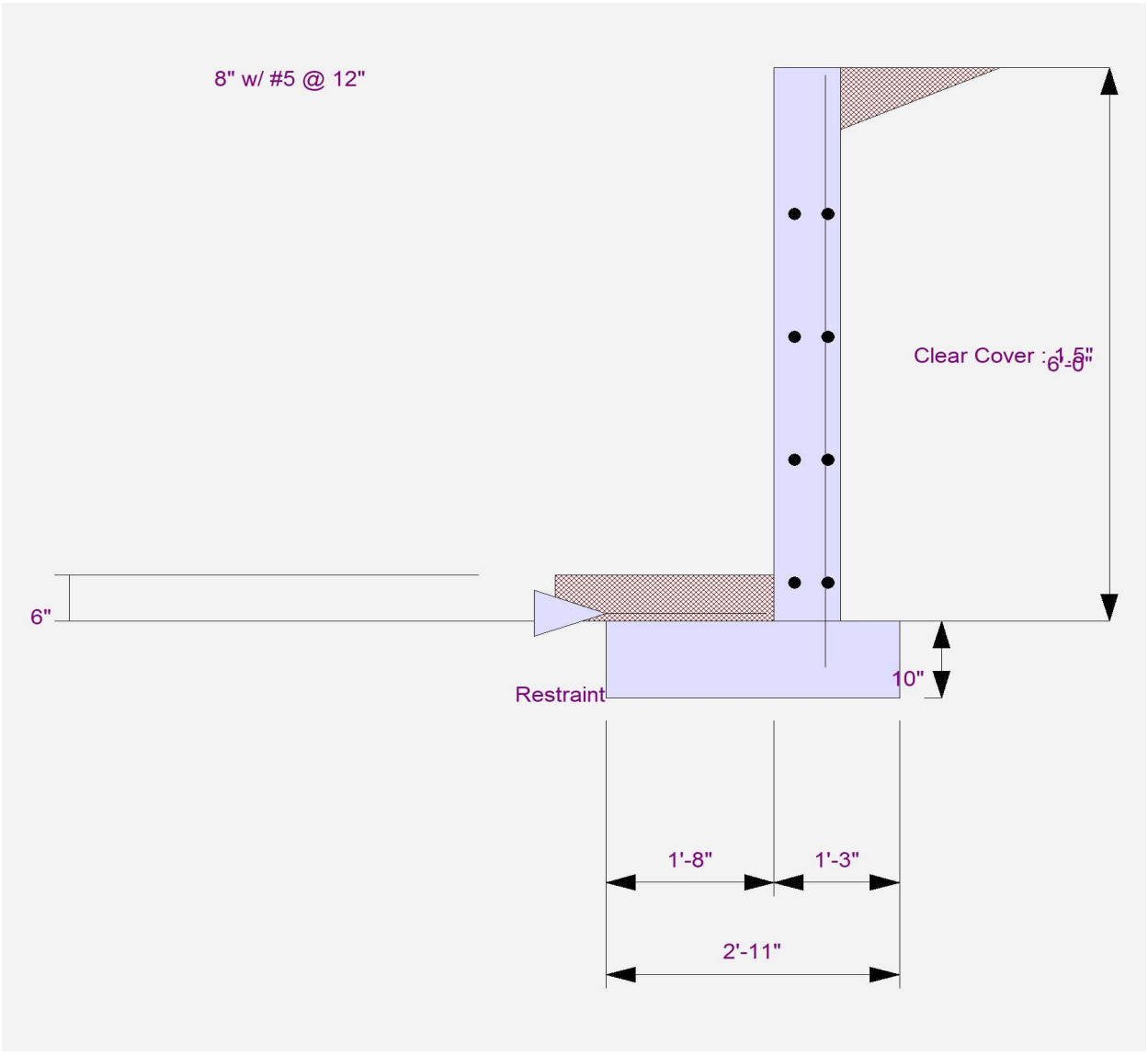
Lap Splice length for #5 bar specified in this stem design segment =	23.40 in
Development length for #5 bar specified in this stem design segment =	18.00 in
Hooked embedment length into footing for #5 bar specified in this stem design segment =	6.00 in
As Provided =	0.3100 in2/ft
As Required =	0.1152 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

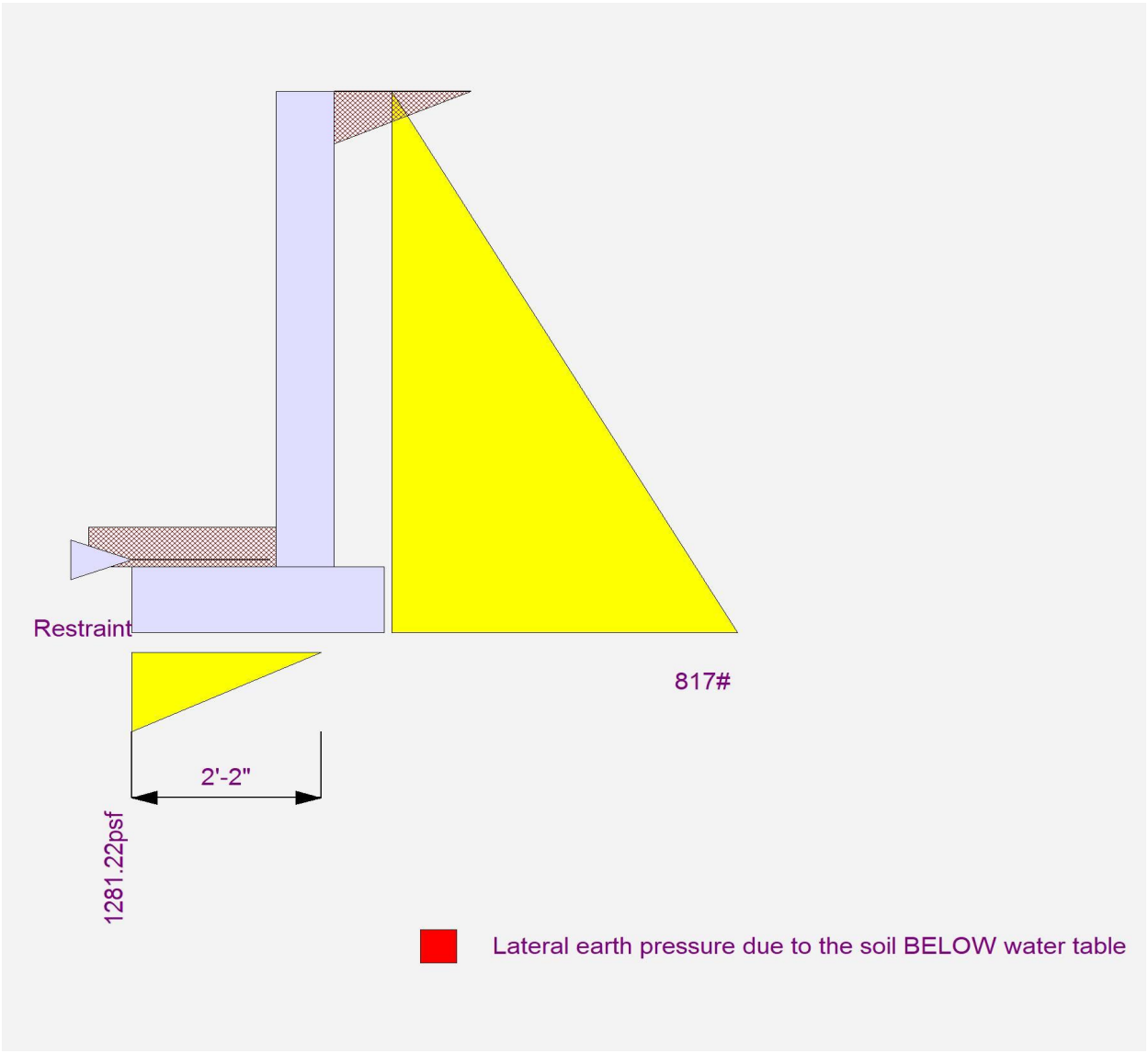


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

Code Reference

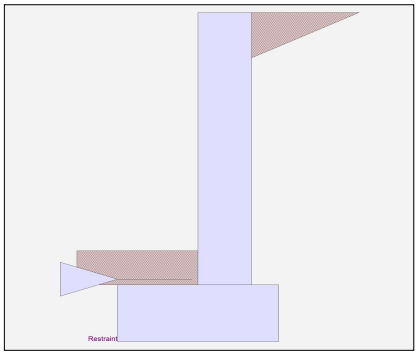
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

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 (Service Level)	=	0.0 psf

Adjacent Footing Load

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

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

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

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

		Bottom
		Stem OK
Design Height Above Ftg	ft =	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

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0224 in2/ft		
(4/3) * As :	0.0298 in2/ft	Min Stem T&S Reinf Area 0.768 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0012bh : 0.0012(12)(8) :	0.1152 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
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

		Toe		Heel	
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: phiMn = phi'5'lambda'sqrt(fc)'Sm

Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	408.8	1.61	658.7			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				166.7	1.83	305.6
Soil Over HL (bel. water tbl)					1.83	305.6
Watre Table						
Sloped Soil Over Hee =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =					0.50	
Surcharge Over Toe =						
Stem Weight(s) =				400.0	1.33	533.3
Earth @ Stem Transitions =						
Footing Weight =				250.0	1.00	250.0
Key Weight =						
Vert. Component =						
Total =	408.8	**O.T.M.** =	658.7	**Total =** 816.7 lbs	**R.M.=**	1,088.9

Resisting/Overturning Ratio = **1.65**

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

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

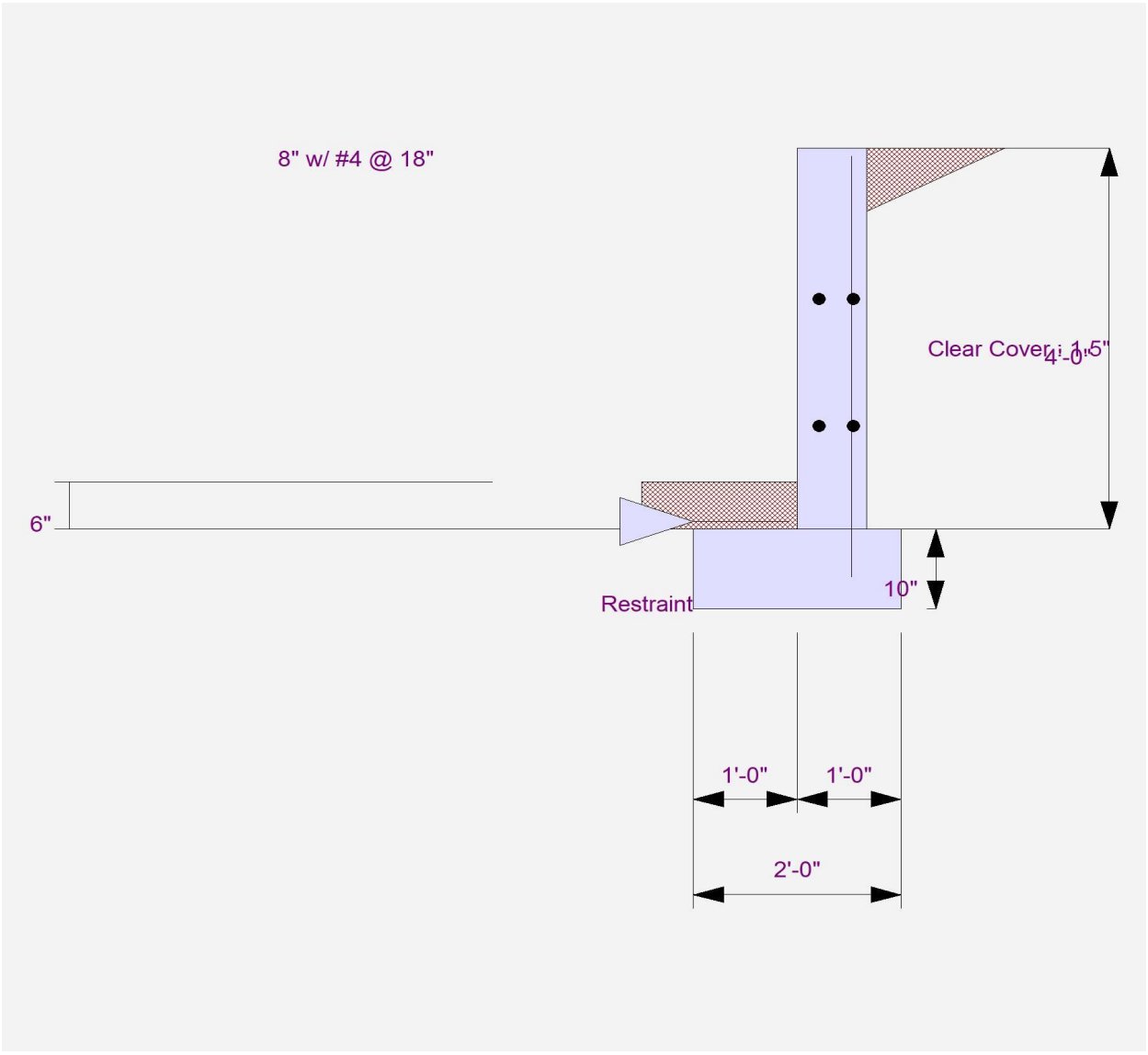
Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	7.26 in
As Provided =	0.1333 in2/ft
As Required =	0.1152 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

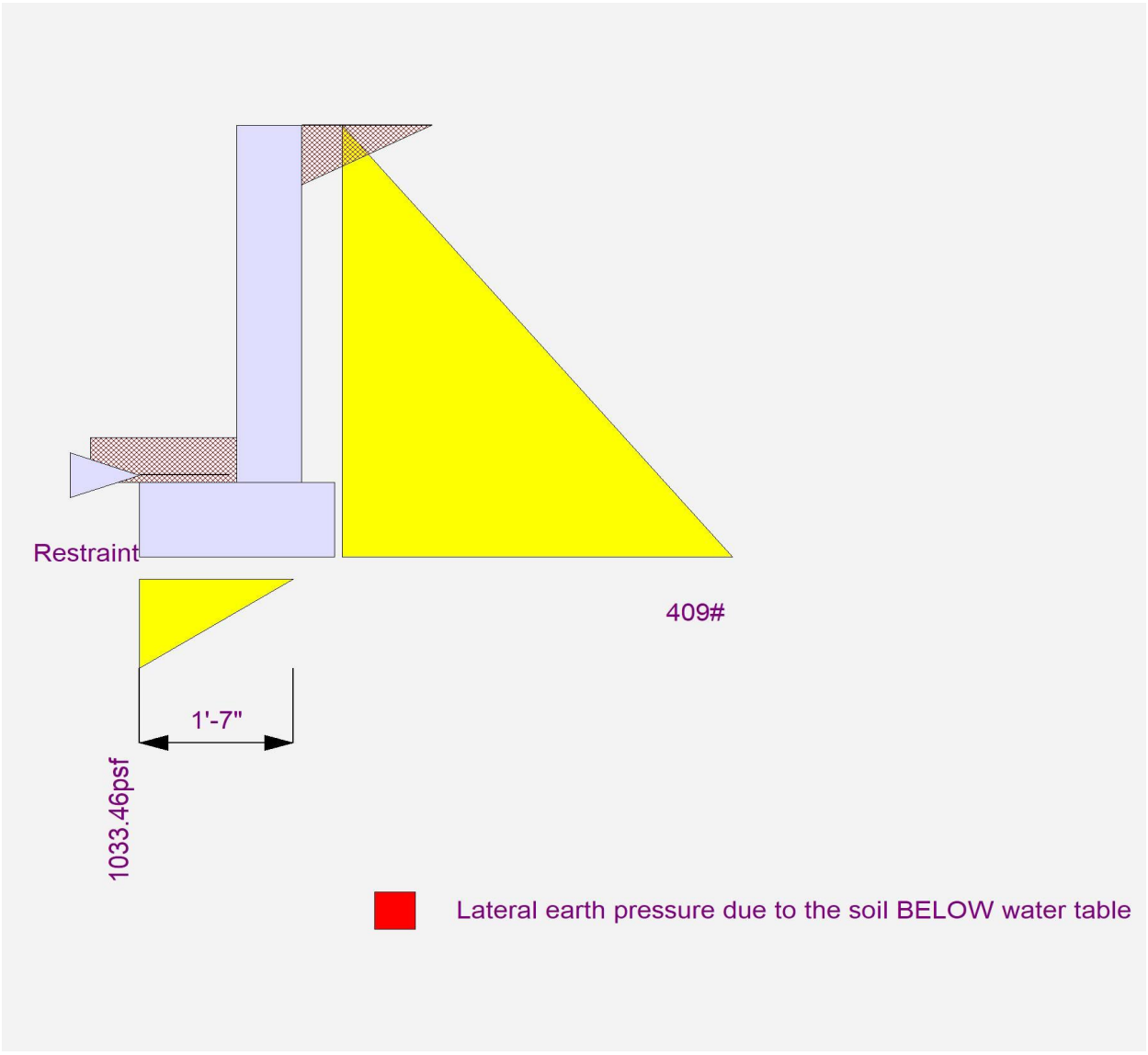


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

Code Reference

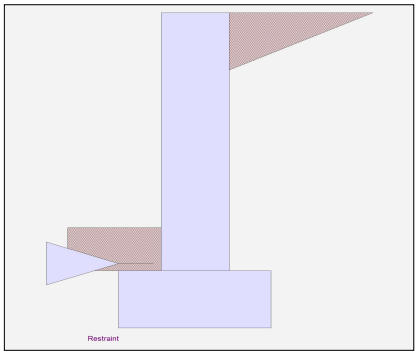
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

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 (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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	

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

		Bottom
		Stem OK
Design Height Above Ftg	ft =	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

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
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 :	
	==========	One layer of :	Two layers of :
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

		Toe		Heel	
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: phiMn = phi'5'lambda'sqrt(fc)'Sm

Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm

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:	If two layers of horizontal bars:
#4@ 13.89 in	#4@ 27.78 in
#5@ 21.53 in	#5@ 43.06 in
#6@ 30.56 in	#6@ 61.11 in

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	235.3	1.22	287.6			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
				Soil Over HL (ab. water tbl)	155.0	1.29	200.5
				Soil Over HL (bel. water tbl)		1.29	200.5
				Watre Table			
				Sloped Soil Over Hee =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =		0.21	
				Surcharge Over Toe =			
				Stem Weight(s) =	300.0	0.75	226.0
				Earth @ Stem Transitions =			
				Footing Weight =	150.0	0.75	112.5
				Key Weight =			
				Vert. Component =			
Total =	235.3	**O.T.M.** =	287.6	**Total =**	605.0 lbs	**R.M.=**	539.0

Resisting/Overturning Ratio = **1.87**

Vertical Loads used for Soil Pressure = 605.0 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)	0.054	in

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

Cantilevered Retaining Wall

DESCRIPTION: 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

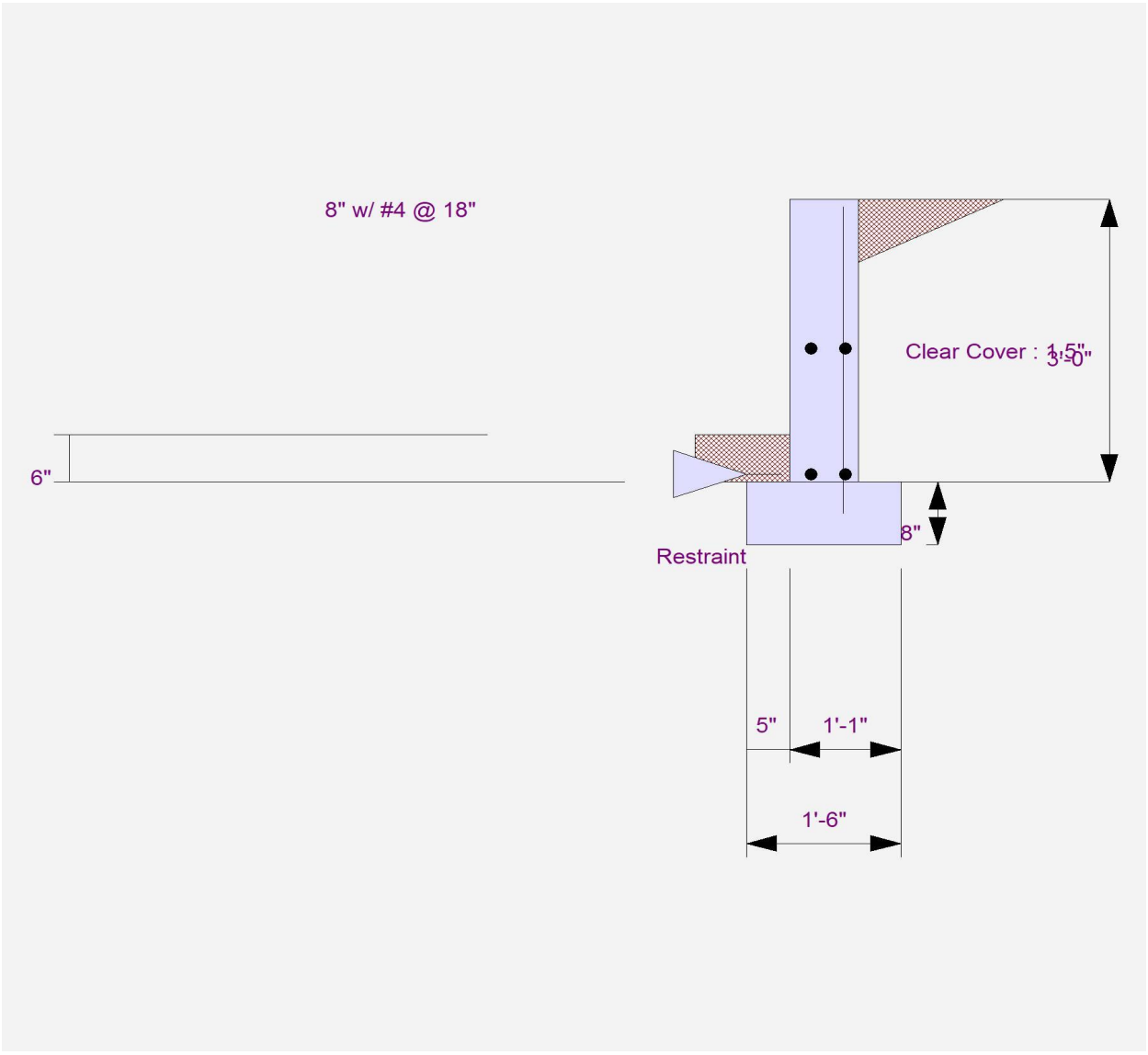
Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	7.26 in
As Provided =	0.1333 in2/ft
As Required =	0.1152 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

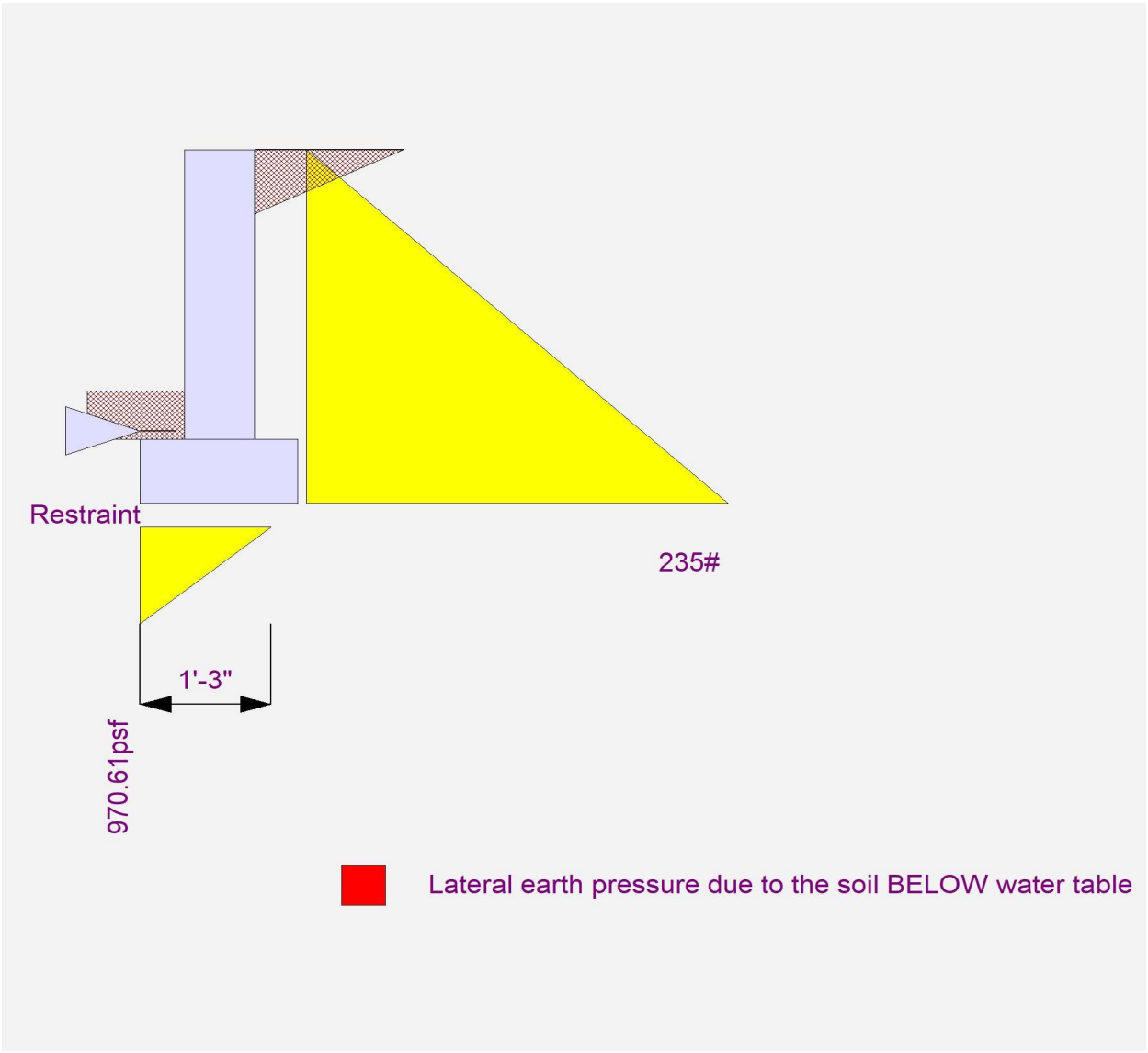


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

Code Reference

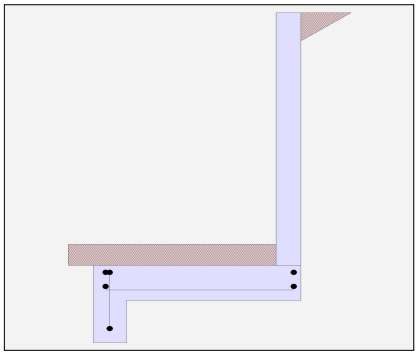
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

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 (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.114 in2/ft		
(4/3) * As :	0.1519 in2/ft	Min Stem T&S Reinf Area 0.864 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 :	
	==========	One layer of :	Two layers of :
Required Area :	0.1519 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	=	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

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		817.2	2.28	1,861.3	Soil Over HL (ab. water tbl)			
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)			
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	=	1.84	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	450.0	3.92	1,764.0
					Earth @ Stem Transitions	=		
					Footing Weight	=	521.3	2.09	1,086.8
					Key Weight	=	100.0	0.33	33.3
					Vert. Component	=			
Total	=	817.2	**O.T.M.** =	1,861.3	**Total =**		1,071.3 lbs	**R.M.=**	2,884.1

Resisting/Overturning Ratio = **1.55**

Vertical Loads used for Soil Pressure = 1,071.3 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)	0.030	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-04-08b_IBC2018.EC6

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

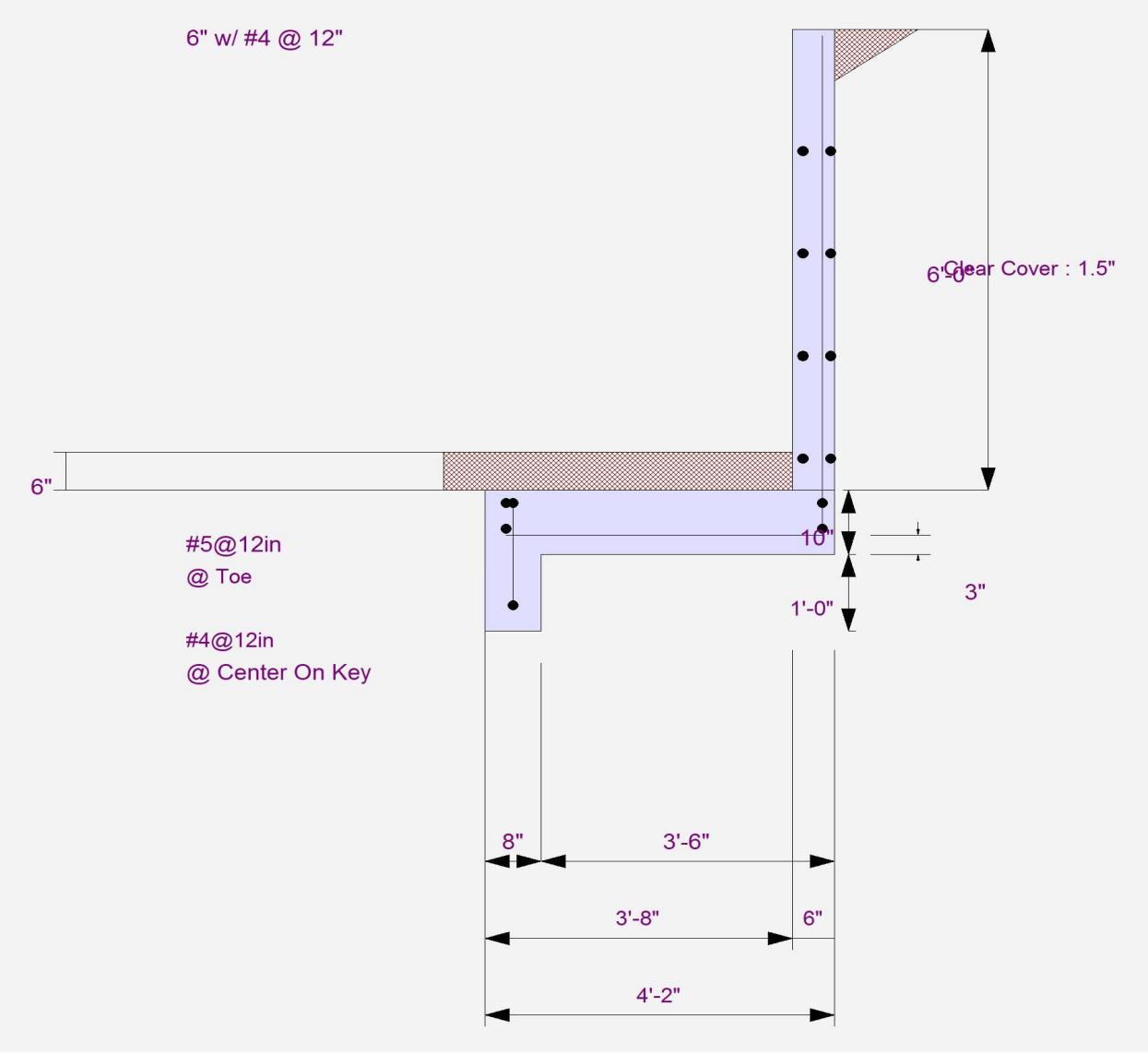
Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	6.38 in
As Provided =	0.2000 in2/ft
As Required =	0.1519 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

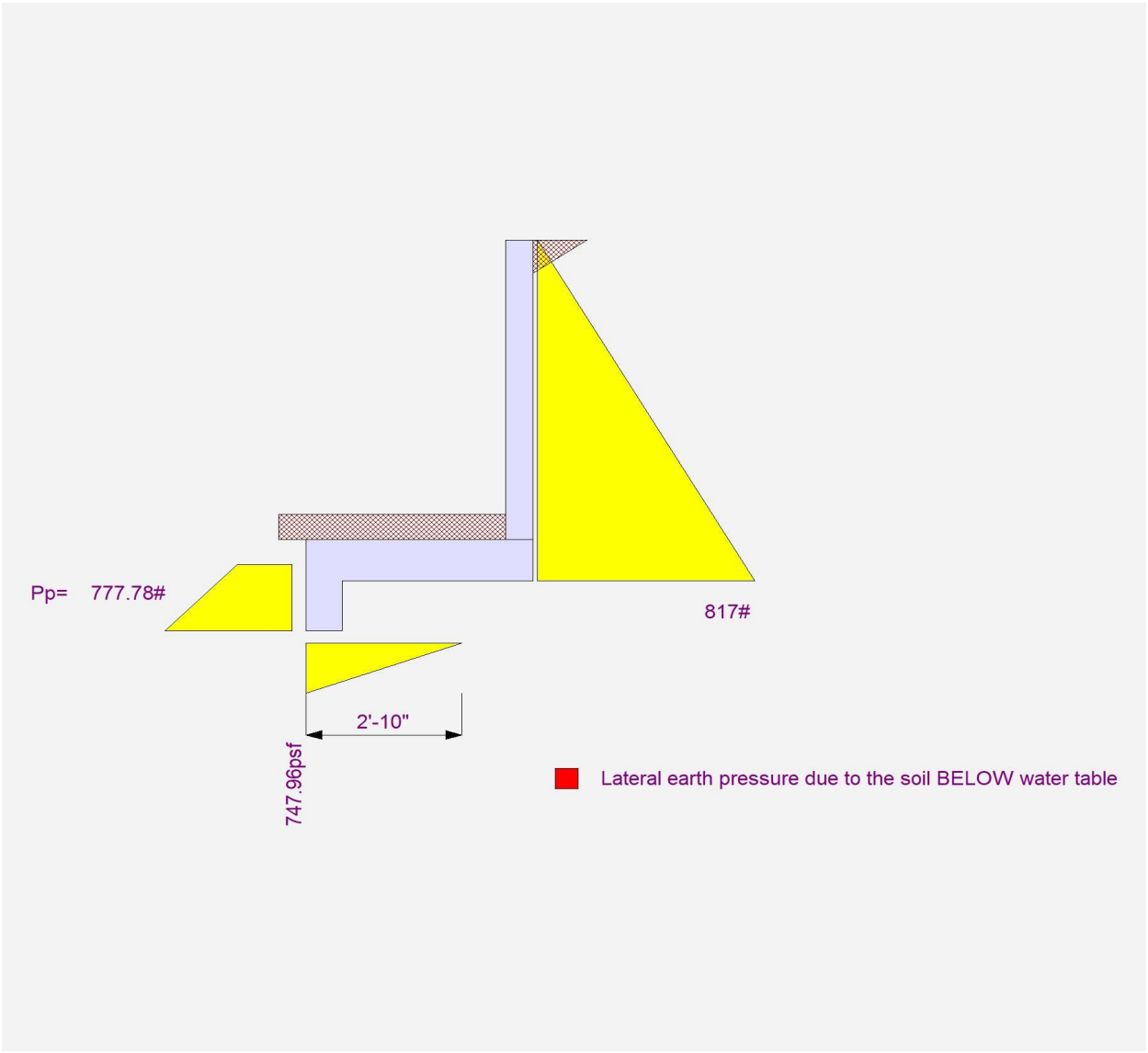


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

Code Reference

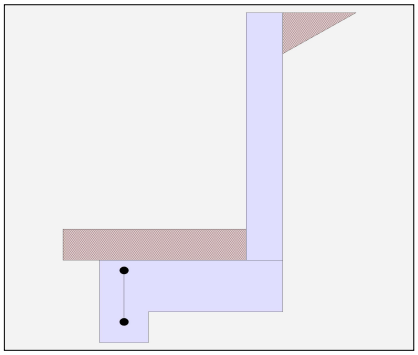
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

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 (Service Level)	=	0.0 psf

Adjacent Footing Load

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

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

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
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 :	
	==========	One layer of :	Two layers of :
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

		Toe	Heel	
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: phiMn = phi'5'lambda'sqrt(fc)'Sm

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

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		408.8	1.61	658.7	Soil Over HL (ab. water tbl)			
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)			
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	=	1.00	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	=	300.0	2.25	675.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	312.5	1.25	390.6
					Key Weight	=	50.0	0.33	16.7
					Vert. Component	=			
Total	=	408.8	**O.T.M.** =	658.7	**Total =**		662.5 lbs	**R.M.=**	1,082.3

Resisting/Overturning Ratio = **1.64**

Vertical Loads used for Soil Pressure = 662.5 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)	0.031	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-04-08b_IBC2018.EC6

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

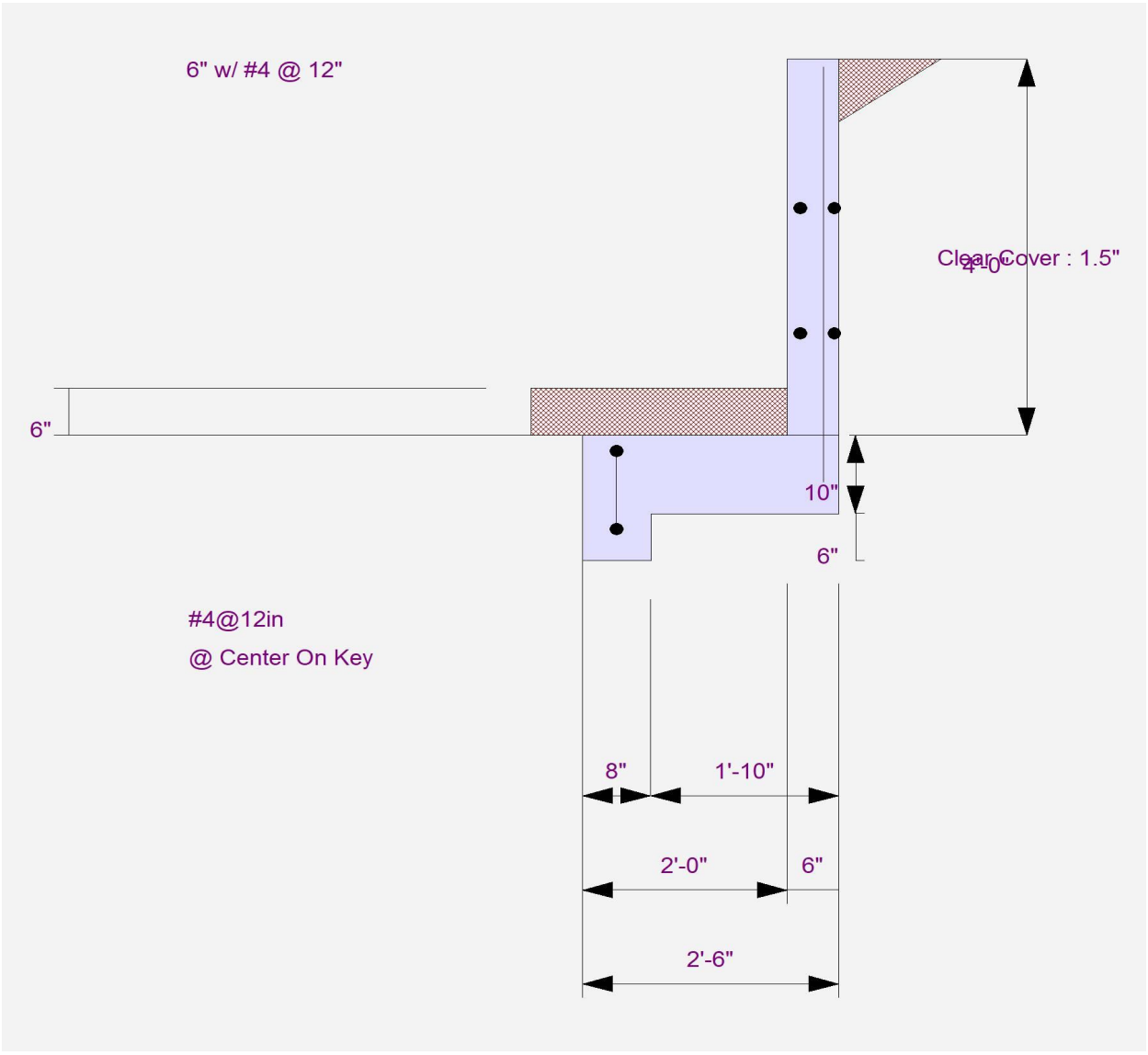
Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	6.00 in
As Provided =	0.2000 in2/ft
As Required =	0.0864 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

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

DESCRIPTION: Retaining Wall Schedule 4'-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

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