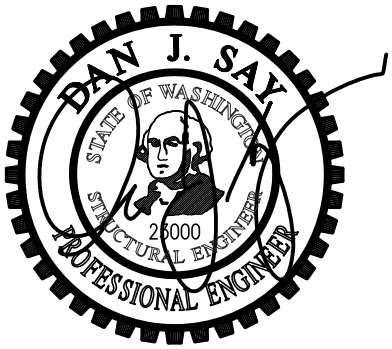
Structural Calculations for:

Yuan Residence

3611 W Mercer Way

Mercer Island, WA 98040



Prepared for: Brandt Design Group

Job #: 01519-2019-01-00

Date: July 16, 2019

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Criteria Sheet

Codes:

Structural:	IBC 2015
Loading:	ASCE 7-10
Wood:	NDS 2015
Steel:	AISC 360-10
Concrete:	ACI 318-14
Masonry:	TMS 402/602-13

Project Location:

Street & Number:	3611 W Mercer Way
City:	Mercer Island
State:	WA
ZIP:	98040
Latitude:	47.5776 N
Longitude:	-122.2461 W

Occupancy Category

Risk Category: II ASCE 7 Table 1.5-1

Seismic Load Summary:

Analysis Procedure:	Equivalent Lateral Force Procedure		
Lateral System:	Light-frame (Cold-formed Steel) Walls Sheathed with Wood Structural Panels Rated for Shear Resistance Or Steel Sheets		
R:	6.50	C_d=	4
Base Shear V =	31 kips	Ω_o=	2.5
S_S=	1.402	S_1=	0.54
S_{DS}=	0.93	S_{D1}=	0.54
C_s=	0.144	I_E=	1.0

Wind Load Summary:

V=	110	K_{ZT}=	1.00
Exposure =	C		

Dead Loads:

Roof			Garage Roof		
Roofing	2.5	psf	Green roof (4" sedum)	20	psf
5/8" Sheathing	2.25	psf	Typical Roof	15	psf
Rafters @ 24" oc	2.5	psf			
Misc./Mech.	1.5	psf	Use	35	psf
Ceiling Finish	2.8	psf			
Solar Panels	3.9				
	15.45	psf			
Use	15	psf			

Floor		
Finish Floor	1	psf
1 1/2" gyp	18.75	psf
1 1/8" Sheathing	4.1	psf
Joists @ 16" oc	3.5	psf
Misc./Mech.	2	psf
Ceiling Finish	2.8	
	32.15	psf
Use	36	psf

Live Loads:

Snow	25	psf
Floor	40	psf

Soils:

Allowable Bearing	1500	psf

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Seismic Design

ASCE 7-10 Seismic Analysis Equivalent Lateral Force Procedure

Seismic Force Resisting System: Per Table 12.2-1	System:	Bearing Wall Systems
	Type:	Light-frame (Cold-formed Steel) Walls Sheathed with Wood Structural Panels Rated for Shear Resistance Or Steel Sheets

Seismic Design Cat.	D	
Risk Category	II	I, II, or III, or IV per Table 1.5-1
Site Class	D	per soils report (D assumed, without soils report)
Diaphragm Flexibility	Flexible	Bearing Wall Systems

Ω_o	2.5	
S_S	1.402 g	2% in 50 yr, Latitude & Longitude lookup
S_1	0.54 g	2% in 50 yr, Latitude & Longitude lookup
h_n	29.8 ft	
R	6.50	
I_e	1.0	Table 1.5-2
C_d	4	
Ct	0.02	Table 12.8-2
x	0.75	Table 12.8-2
T	0.26 sec	Eq. 12.8-7
T_0	0.12 sec	
T_S	0.58 sec	
k	1.000	
Fa	1.00	Table 11.4-1
Fv	1.50	Table 11.4-2
S_{MS}	1.40 g	Eq. 11.4-1
S_{M1}	0.81 g	Eq. 11.4-2
S_{DS}	0.935 g	Eq. 11.4-3
S_{D1}	0.540 g	Eq. 11.4-4
Cs	***0.144 Controls***	Eq. 12.8-2
	0.325	Eq. 12.8-3 need not exceed, T < T_L
	0.010	Eq. 12.8-5 or 12.8-6 minimum
Cs, design	0.144	
Bldg. Weight	214.4 k	
V = C_SW	30.8 k	Eq. 12.8-1, Strength Level Base Shear
V = C_{Sasd}W	21.6 k	Eq. 12.8-1 ASD Base Shear

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

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

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

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

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

Vertical Distribution ASD ρ= 1.3

Level	h_x (ft)	W_x (k)	h_x^k (ft)	$W_x h_x^k$	Story Shear ASD			Diaphragm Force (ρ not included)				
					C_{vx} (%)	F_x (k)	SV (k)	$F_{px,calc}$	$F_{px,min}$	$F_{px,max}$	$F_{px,design}$	$\gamma=F_{px}/F_x$
Roof	29.8	84.7	29.8	2527	0.577	16.2	**16.2**	12.5	11.1	22.2	**12.5**	0.77
Main	14.3	130	14.3	1849	0.423	11.9	**28.1**	13.1	17.0	33.9	**17.0**	1.43
Σ		214.4		4375		**28.1**						

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Wind Design - MWFRS

ASCE 7-10 Chapter 27 - Directional Procedure

Design Method	ASD

Wind Coefficients

Exposure	C	
V=	110	mph
K_d=	0.85	Table 26.6-1
K_h=	1.13	Table 27.3-1
G=	0.85	26.9.4

Location and Building Dimensions

Calculate Kzt?	No	
Kzt	1.00	
Roof Type	Monoslope	
Roof Angle - Transverse Dir	5.9	degrees
Roof Angle - Long Dir	0	degrees
Ground to top of roof	59.83	ft
Bot of roof to top of roof	4.75	ft
Mean Roof Height, h	57.455	ft
Short Plan Dimension	36.5	ft
Long Plan Dimension	70.25	ft
Parapet ?	No	
Ground to top of parapet		ft
Average Parapet Height		ft
Ht of 2nd Level Above Grade	14.25	ft

Velocity Pressure at Mean Roof Height, q_h =	29.7	psf

Transverse Wind Pressures

L/B = 0.52 h/L = 1.57

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.50
Windward Roof	-1.3 / -0.18
Leeward Roof	-0.70

Wall Pressures (Unfactored): ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lwwalls}$	**P_{walls} (psf)**
0-15	0.85	22.38	15.22	12.60	**16.69**
15-20	0.9	23.70	16.11	12.60	**17.23**
20-25	0.94	24.75	16.83	12.60	**17.66**
25-30	0.98	25.80	17.55	12.60	**18.09**
30-40	1.04	27.38	18.62	12.60	**18.73**
41-50	1.09	28.70	19.52	12.60	**19.27**
51-60	1.13	29.75	20.23	12.60	**19.70**
61-70	1.17	30.81	20.95	12.60	**20.13**
71-80	1.21	31.86	21.66	12.60	**20.56**
81-90	1.24	32.65	22.20	12.60	**20.88**
91-100	1.26	33.18	22.56	12.60	**21.10**

Roof Pressures (Unfactored) ASD

Windward		Leeward	**Horiz Proj (psf)**
Max	Min		
-4.5	-32.8	-17.6	**4.80**

Longitudinal Wind Pressures

L/B = 1.92 h/L = 0.82

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.32
Windward Roof	-1.15 / -0.18
Leeward Roof	-0.70

Wall Pressures (Unfactored): ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lwwalls}$	**P_{walls} (psf)**
0-15	0.85	22.38	15.22	7.94	**13.90**
15-20	0.9	23.70	16.11	7.94	**14.43**
20-25	0.94	24.75	16.83	7.94	**14.86**
25-30	0.98	25.80	17.55	7.94	**15.29**
30-40	1.04	27.38	18.62	7.94	**15.94**
41-50	1.09	28.70	19.52	7.94	**16.47**
51-60	1.13	29.75	20.23	7.94	**16.90**
61-70	1.17	30.81	20.95	7.94	**17.33**
71-80	1.21	31.86	21.66	7.94	**17.76**
81-90	1.24	32.65	22.20	7.94	**18.09**
91-100	1.26	33.18	22.56	7.94	**18.30**

Roof Pressures (Unfactored) ASD

Windward		Leeward	**Horiz Proj (psf)**
Max	Min		
-4.5	-29.1	-17.6	**4.80**

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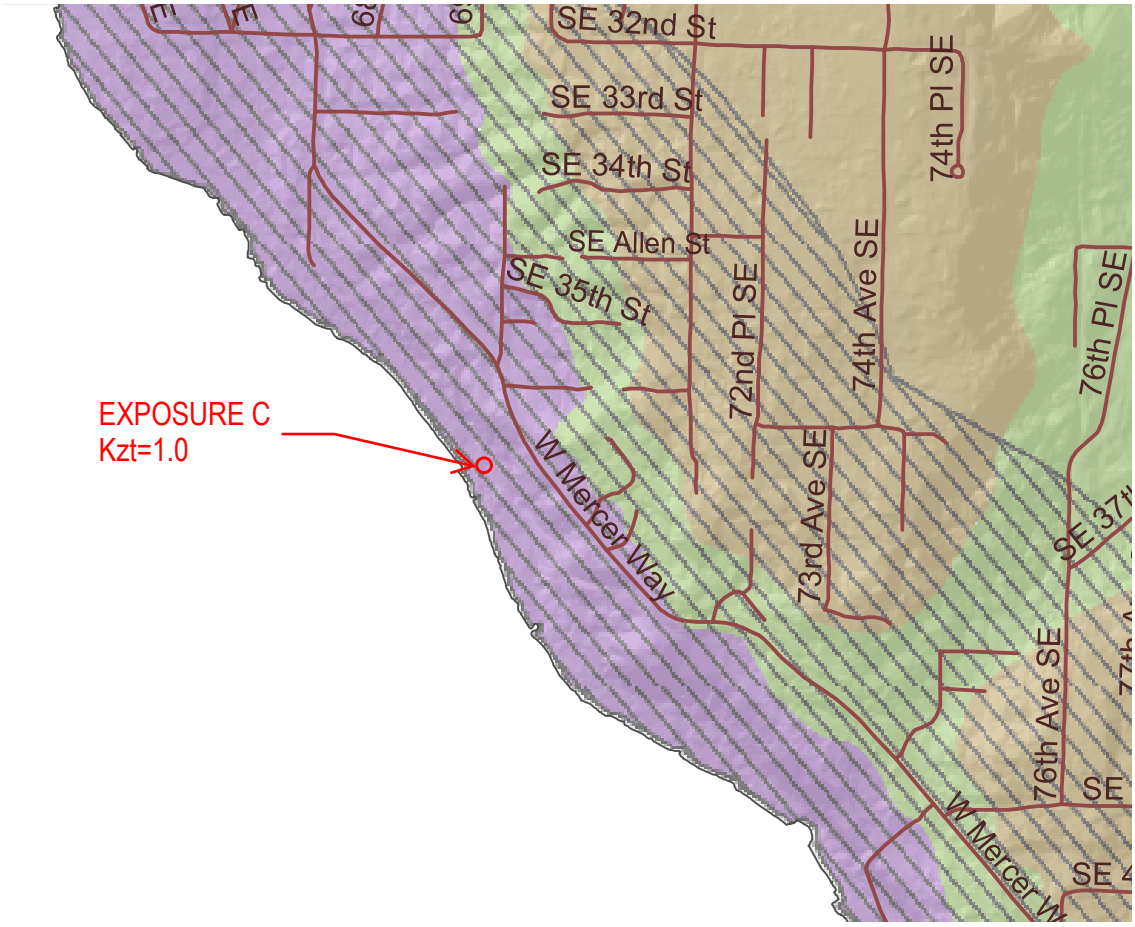

WIND EXPOSURE CATEGORIES:

Wind Exposure Category	
	Exposure 'C' (1500 feet from Lake)
	Exposure 'B' (all other areas)

WIND SPEED-UP (TOPOGRAPHIC EFFECT) - K_zt Factor :

K_zt Factor	
	$K_zt = 1.0$
	$K_zt = 1.3$
	$K_zt = 1.6$
	$K_zt = 1.9$

SSF STRUCTURAL ENGINEERING

Yuan Residence
PROJECT
Wind Criteria

4/30/2019
DATE

PROJ. #

SRW
DESIGN

SHEET

SEISMIC MASS

GARAGE ROOF

AREA = 790 FT² + 200 FT² = 990 FT²

W = 35 PSF (INCLUDING GREEN ROOF) + 10 PSF / 2 = 40 PSF

MASS = 790/990 FT² × 40 PSF = ~~36340 LB~~ 39600 LB

ROOF

AREA = ~~490~~ 2255 FT² / ~~490 FT²~~ + 10 FT² + 110 FT² + 1450 FT² + 195 FT² = ~~2455 FT²~~

W = 15 PSF + 10 PSF / 2 = 20 PSF

MASS = ~~49100 LB~~ 45100 LB

TOTAL ROOF: 39600 LB + ~~49100 LB~~ 45100 LB = ~~85440 LB~~ 84700 LB

(% MASS, GARAGE = ~~0.43~~ 0.47
% MASS, HOUSE = ~~0.57~~ 0.53)

MAIN FLOOR

AREA = 685 FT² + 10 FT² + 1445 FT² + 620 FT² = 2760 FT²

W = (2"/12) 150 PCF + 12 PSF + 10 PSF = 47 PSF

MASS = 2760 FT² (47 PSF) = 129720 LB

SEISMIC LOADS (MAIN)

0.53 (16.2K) = 8.6K

Fx, ROOF = ~~0.57 (16.3K) = 9.3K~~

Fx, MAIN = 11.8K

N/S

8.6K / 43' = 200 PLF

VEQ, ROOF = ~~9.3K / 43'~~ = ~~216 PLF~~

VEQ, MAIN = 11.8K / 43' = 274 PLF

E/W

8.6 K / 70' = 123 PLF

VEQ, ROOF = ~~9.3K / 70' = 133 PLF~~

VEQ, MAIN = 11.8K / 70' = 169 PLF

SEISMIC LOADS (GARAGE)

Fx, ROOF = ~~0.43 (16.3K) = 7K~~

0.47 (16.2K) = 7.6K

N/S

7.6 K / 31' = 245 PLF

VEQ, ROOF = ~~7K / 31' = 226 PLF~~

E/W

7.6K / 25' = 304 PLF

VEQ, ROOF = ~~9K / 85' = 280 PLF~~

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WIND

$P_{ROOF} = 4.8\,psf$

P_{WALLS} 0 to 15' = 16.7 psf

15' to 20' = 17.2 psf

20' to 25' = 17.7 psf

25' to 30' = 18.1 psf

AT GARAGE:

$V_{W,ROOF}$: 16.7 psf x 11'/2 = 92 plf

AT MAIN:

$V_{W,ROOF}$: 18.1 psf x 15'/2 = 136 plf

$V_{W,UPPER}$: 17.7 psf x 15'/2 + 17.2 psf x 15'/2 = 262 plf

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SSF STRUCTURAL ENGINEERING

PROJECT: YUAN RESIDENCE — LATERAL

DATE: 5/8/2019

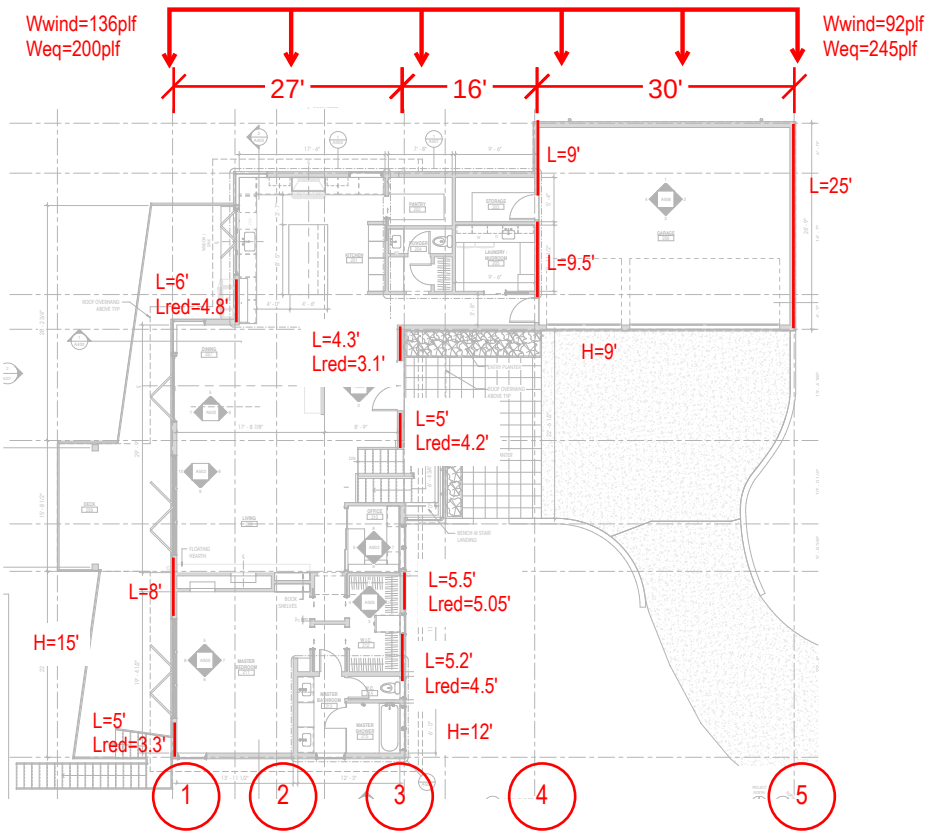
PROJ. #: SRW

DESIGN:

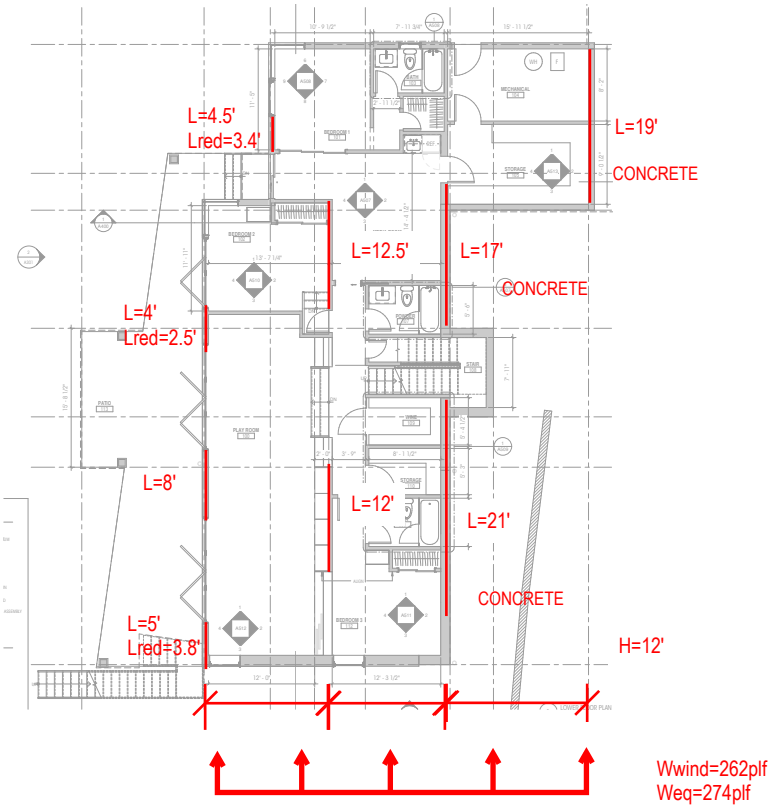
SHEET:

NORTH-SOUTH

ROOF



MAIN LEVEL



STRUCTURAL ENGINEERING

Yuan Residence (PROJECT)	2019-06-14 (DATE)
Lateral Design	
	PROJ. #
	SRW (DESIGN)
	SHEET

North-South

Level	Roof - Main				Roof - Main/Garage		Roof - Main/Garage		Roof - Garage	
Wall Line	1		2		3		4		5	
Lateral Force	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic
V (k)	1.836	2.7			2.924	4.3	2.468	5.275	1.38	3.675
L (ft)	19	19	8.5	8.5	20	20	18.5	18.5	25	25
L red (ft)	16.1	16.1	8.5	8.5	16.85	16.85	18.5	18.5	25	25
V (plf)	114	168	0	0	174	255	133	285	55	147
SW	W6		W6		W4		W4		W6	
H (ft)	15	15	0	0	12	12	9	9	9	9
OT (lb)	1449	2132	0	0	1754	2580	1201	2566	497	1323
Design OT (lb)	2132		0		2580		2566		1323	
Holdown	HDU2		NA		HDU4		HDU4		HDU2	

OT-DL

Level	Upper									
Wall Line	1		2		3		4		5	
Lateral Force	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic
V (k)	1.834	1.918	3.537	3.699	3.799	3.973	2.096	2.192		
V above (k)	1.836	2.7	0	0	2.924	4.3	2.468	5.275		
Total V (k)	3.67	4.618	3.537	3.699	6.723	8.273	4.564	7.467		
L (ft)	21.5	21.5	24.5	24.5	38	38	19	19		
L red (ft)	17.7	17.7	24.5	24.5	38	38	19	19		
V (plf)	207	261	144	151	177	218	240	393		
SW	W4		W6		W6		NA			
H (ft)	13	13	12	12	12	12	12	12		
OT (lb)	2219	2792	1732	1812	2123	2613	2883	4716		
Total OT (lb)	3669	4924	1732	1812	3877	5193	4083	7282		
Design OT (lb)	4924		1812		5193		7282			
Holdown	HDU5		HDU2		HDU5		NA			
					Concrete		Concrete			

STRUCTURAL ENGINEERING

Yuan Residence
PROJECT
Lateral Design

2019-06-14
DATE

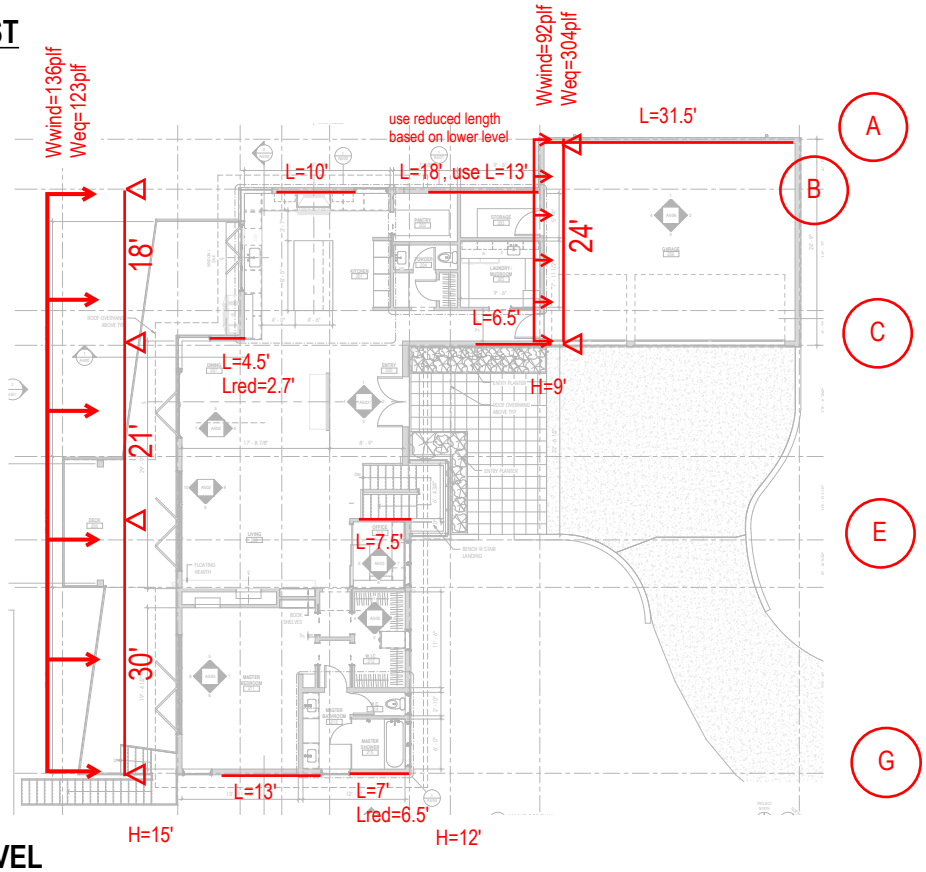
PROJ. #

SRW
DESIGN

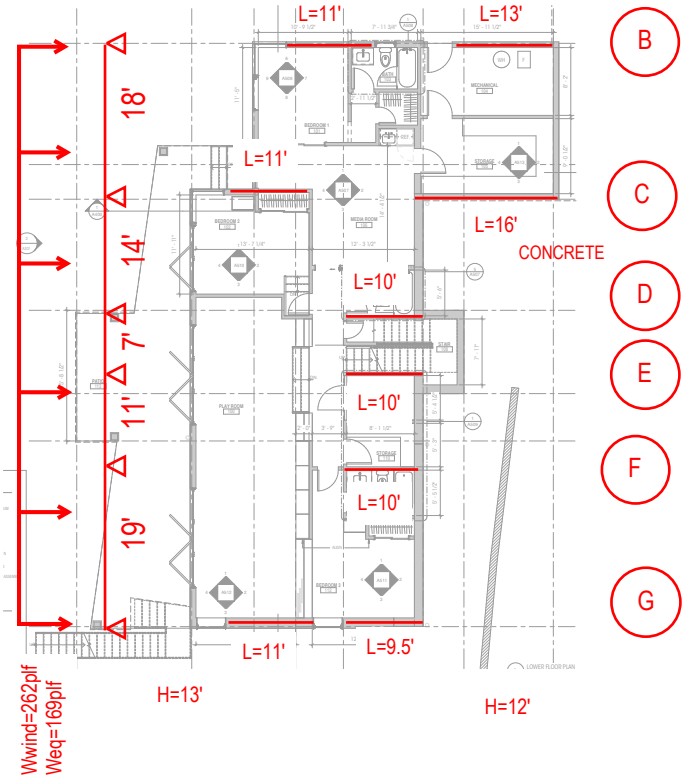
SHEET

EAST-WEST

ROOF



MAIN LEVEL



STRUCTURAL ENGINEERING

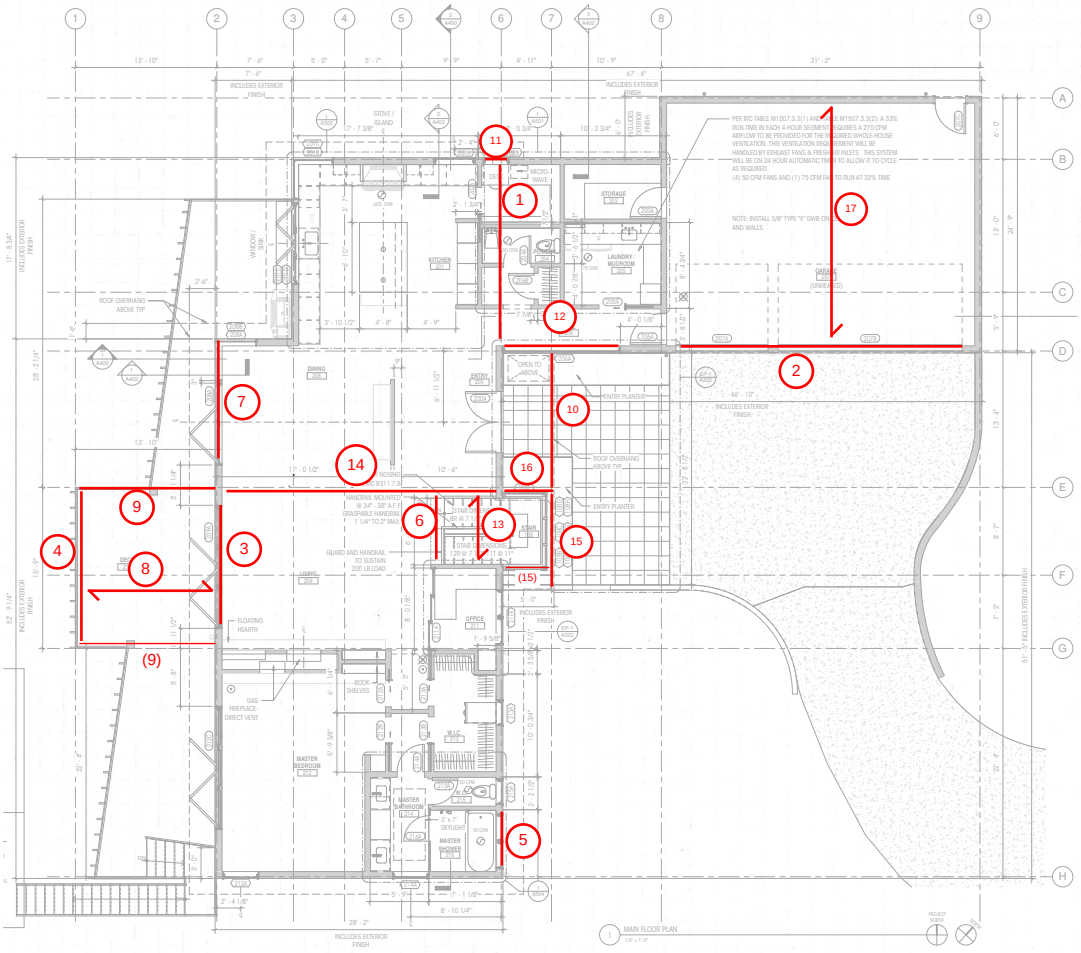
Yuan Residence (PROJECT)	2019-06-14 (DATE)
Lateral Design	
	PROJ. #
	SRW (DESIGN)
	SHEET

East-West

Level	Roof - Garage		Roof - Main											
Wall Line	A		B		C		D		E		F		G	
Lateral Force	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic			Wind	Seismic
V (k)	1.104	3.648	1.224	1.107	3.756	6.0465			3.468	3.1365			2.04	1.845
L (ft)	31.5	31.5	23	23	11	11	7	7	7.5	7.5			20	20
L red (ft)	31.5	31.5	23	23	9.2	9.2	6.35	6.35	7.5	7.5			19.5	19.5
V (plf)	35	116	53	48	408	657	0	0	462	418			105	95
SW	W6		W6		2W3		W6		W3				W6	
H (ft)	9	9	9	9	9	9	15	15	12	12			15	15
OT (lb)	315	1042	479	433	3073	4947	0	0	5549	5018			1530	1384
Design OT (lb)	1042		479		4947		0		5549				1530	
Holdown	NA		NA		HDU5		NA		HDU5				CS16	

Level	Upper													
Wall Line	A		B		C		D		E		F		G	
Lateral Force	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic	Wind	Seismic
V (k)			2.358	1.521	4.192	2.704	2.751	1.7745	2.358	1.521	3.93	2.535	2.489	1.6055
V above (k)			1.224	1.107	3.756	6.0465	0	0	3.468	3.1365	0	0	2.04	1.845
Total V (k)			3.582	2.628	7.948	8.7505	2.751	1.7745	5.826	4.6575	3.93	2.535	4.529	3.4505
L (ft)			24	24	27	27	10	10	10	10	10	10	20.5	20.5
L red (ft)			24	24	27	27	10	10	10	10	10	10	20.5	20.5
V (plf)			149	110	294	324	275	177	583	466	393	254	221	168
SW			W6		W4		W4		W2		W4		W6	
H (ft)			12	12	12	12	12	12	12	12	12	12	12	12
OT (lb)			1791	1314	3532	3889	3301	2129	6991	5589	4716	3042	2651	2020
Total OT (lb)			2270	1747	6606	8836	3301	2129	12540	10607	4716	3042	4181	3404
Design OT (lb)			2270		8836		3301		12540		4716		4181	
Holdown			HDU4		HDU11		HDU4		HDU14		HDU5		HDU4	

ROOF KEY PLAN:



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STRUCTURAL ENGINEERING

Yuan Residence
PROJECT
Gravity Design

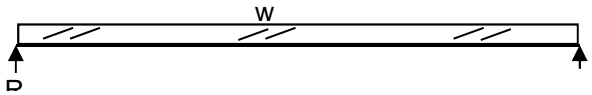
06/19/19
DATE

PROJ. #

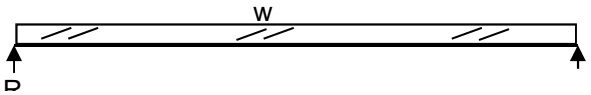
HAA
DESIGN

SHEET

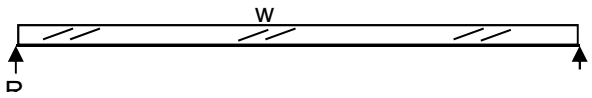
Beam		Roof B1		PSL	7	x 11 7/8
w=	420	plf		R=	3,717	lbs
L=	17.7	ft		M=	16,448	ft-lbs
b=	7.00	in		Fb=	1,200	psi
d=	11.88	in		Fv=	60	psi
E=	2000	ksi		Δ=	0.47	in
Cv=	0.99	≤1.0		l /	447	



Beam		Roof B4		HF	4	x 12
w=	280	plf		R=	1,960	lbs
L=	14	ft		M=	6,860	ft-lbs
b=	3.50	in		Fb=	1,115	psi
d=	11.25	in		Fv=	65	psi
E=	1300	ksi		Δ=	0.45	in
Cv=	1.00	≤1.0		l /	375	



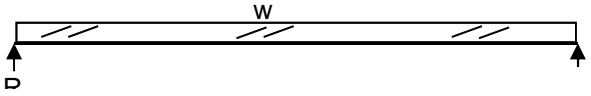
Upper beam 3		Roof B3		GL	5 1/8 x 18
w=	530	plf		R=	3,180	lbs
L=	12	ft		M=	9,540	ft-lbs
b=	5.13	in		Fb=	414	psi
d=	18.00	in		Fv=	39	psi
E=	1800	ksi		Δ=	0.055	in
Cv=	1.00	≤1.0		l /	2611	



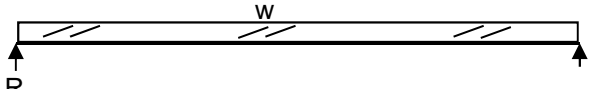
Steel Size					HSS12X4X3/8
I =	168	in⁴		Fy=	46	ksi
Δ =	0.05	in		Mn/Ω =	84.2	k-ft
l /	2837			Vn/Ω =	0.0	kips

Steel Size					HSS6X6X1/4
I =	28.6	in⁴		Fy=	46	ksi
Δ =	0.29	in		Mn/Ω =	25.7	k-ft
l /	576			Vn/Ω =	0.0	kips

Beam		Roof-B5		HF	3 x 8
w=	530	plf		R=	1,590	lbs
L=	6	ft		M=	2,385	ft-lbs
b=	3.00	in		Fb=	1,089	psi
d=	7.25	in		Fv=	88	psi
E=	1300	ksi		Δ=	0.12	in
Cv=	1.00	≤1.0		l /	577	

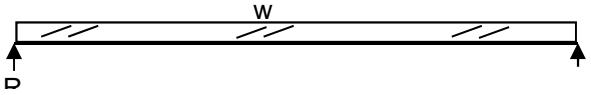


Lower beam 3		Roof B3a		PSL	3 1/2 x 16
w=	280	plf		R=	1,680	lbs
L=	12	ft		M=	5,040	ft-lbs
b=	3.50	in		Fb=	405	psi
d=	16.00	in		Fv=	35	psi
E=	2000	ksi		Δ=	0.055	in
Cv=	1.00	≤1.0		l /	2634	



Steel Size					HSS10X4X1/4
I =	74.7	in⁴		Fy=	46	ksi
Δ =	0.060	in		Mn/Ω =	43.6	k-ft
l /	2388			Vn/Ω =	0.0	kips

Beam		Roof-B6		LSL	3 1/2 x 11 7/8
w=	410	plf		R=	1,333	lbs
L=	6.5	ft		M=	2,165	ft-lbs
b=	3.50	in		Fb=	316	psi
d=	11.88	in		Fv=	33	psi
E=	1550	ksi		Δ=	0.02	in
Cv=	1.00	≤1.0		l /	3586	



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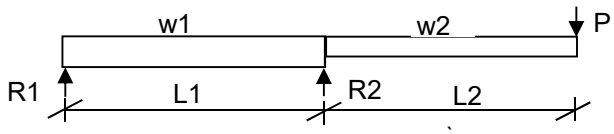
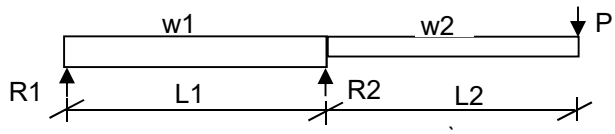
Project: Yuan Residence
Roof Beams

Date: 06/19/19
Project #:
Design: haa
Sheet: 1

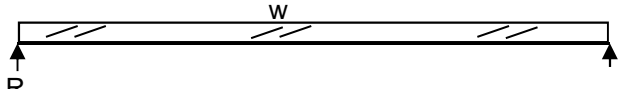
Beam		Roof-B7			LSL	3 1/2 x 11 7/8	
w1=	530	plf			R1=	1628	lbs
w2=	530	plf			R2=	4,859	lbs
L1=	8	ft			M+=	2,501	lb-ft
L2=	4	ft			M-=	4,386	lb-ft
X=	4.09	ft			Fb=	640	psi
P=	80	lbs			Fv=	79	psi
b=	3.50	in			Δspan=	0.028	in
d=	11.88	in			l span/	3,450	
E=	1,550	ksi			Δcant=	0.04	in
Cv=	1.00				l cant/	2,445	



Beam		Roof B9			DF-L	4 x 12	
w1=	70	plf			R1=	-1960	lbs
w2=	70	plf			R2=	4,900	lbs
L1=	7	ft			M+=	-	lb-ft
L2=	7	ft			M-=	15,435	lb-ft
X=	3.50	ft			Fb=	2,509	psi
P=	1,960	lbs			Fv=	91	psi
b=	3.50	in			Δspan=	(0.110)	in
d=	11.25	in			l span/	(761)	
E=	1,700	ksi			Δcant=	1.20	in
Cv=	1.00				l cant/	140	



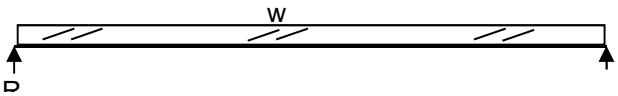
Beam		Roof B8			PSL	1 3/4 x 5 1/2	
w=	140	plf			R=	980	lbs
L=	14	ft			M=	3,430	ft-lbs
b=	1.75	in			Fb=	4,665	psi
d=	5.50	in			Fv=	143	psi
E=	2000	ksi			Δ=	2.49	in
Cv=	1.00	≤1.0			l /	67	



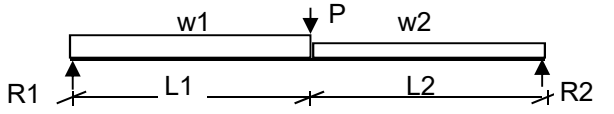
Steel Size					C6X8.2	
I =	13.1	in		Fy=	36	ksi
Δ =	0.32	in		Mn/Ω =	9.3	k-ft
l /	527			Vn/Ω =	13.7	kips

Steel Size					HSS6X6X5/8	
	Δ (in)	l /		Fy=	46	ksi
span	-0.049	-1726		Mn/Ω =	53.3	k-ft
cant.	0.53	317		Vn/Ω =	0.0	kips

Beam		Roof-B10			PSL	5 1/4 x 5 1/2	
w=	100	plf			R=	692	lbs
L=	13.8333333	ft			M=	2,392	ft-lbs
b=	5.25	in			Fb=	1,084	psi
d=	5.50	in			Fv=	34	psi
E=	2000	ksi			Δ=	0.57	in
Cv=	1.00	≤1.0			l /	293	



Beam		Roof B11			HF	3 x 10	
w1=	360	plf			R1 =	2,309	lbs
w2=	360	plf			R2 =	2,309	lbs
L1=	1.25	ft			M =	2,604	lb-ft
L2=	1.25	ft			Fb =	731	psi
X=	1.25	ft			Fv =	110	psi
P=	3,717	lbs			Δ=	0.01	in
b=	3.00	in			l /	3,206	
d=	9.25	in			Cv=	1.00	
E=	1,300	ksi					



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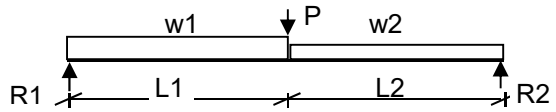
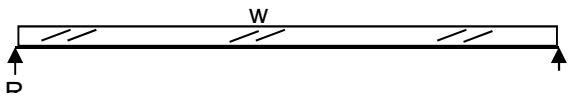
Roof Beams

Date: 06/19/19
Project #:
Design: haa
Sheet: 2

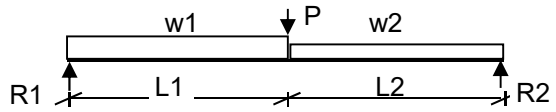
Beam		Roof-B12		LSL	3 1/2 x 11 7/8	
w1=	370	plf		R1 =	2,566	lbs
w2=	370	plf		R2 =	2,566	lbs
L1=	6	ft		M =	8,735	lb-ft
L2=	6	ft		Fb =	1,274	psi
X=	6.0	ft		Fv =	79	psi
P=	692	lbs		Δ=	0.28	in
b=	3.50	in		l /	506	
d=	11.88	in		Cv=	1.00	
E=	1,550	ksi				



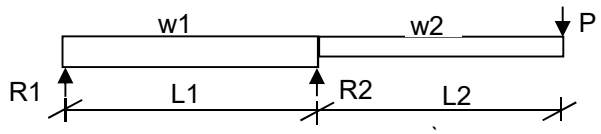
Beam		Roof-B13		HF	2 x 8	
w=	80	plf		R=	260	lbs
L=	6.5	ft		M=	423	ft-lbs
b=	1.50	in		Fb=	386	psi
d=	7.25	in		Fv=	29	psi
E=	1300	ksi		Δ=	0.05	in
Cv=	1.00	≤1.0		l /	1503	



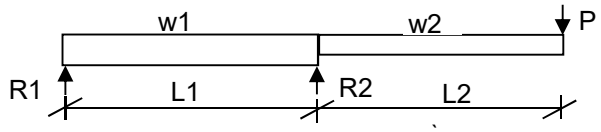
Beam		Roof-B14		PSL	5 1/4 x 11 7/8	
w1=	80	plf		R1 =	1,362	lbs
w2=	80	plf		R2 =	2,091	lbs
L1=	21	ft		M =	11,105	lb-ft
L2=	6	ft		Fb =	1,080	psi
X=	20.5	ft		Fv =	48	psi
P=	1,333	lbs		Δ=	0.70	in
b=	5.25	in		l /	456	
d=	11.88	in		Cv=	0.98	
E=	2,000	ksi				



Beam		Roof B15		PSL	3 1/2 x 5 1/2	
w1=	40	plf		R1=	92	lbs
w2=	100	plf		R2=	543	lbs
L1=	7.5	ft		M+=	106	lb-ft
L2=	2	ft		M-=	433	lb-ft
X=	3.75	ft		Fb=	295	psi
P=	160	lbs		Fv=	23	psi
b=	3.50	in		Δspan=	0.002	in
d=	5.50	in		l span/	40,360	
E=	2,000	ksi		Δcant=	0.02	in
Cv=	1.00			l cant/	2,210	



Beam		Roof B16		PSL	3 1/2 x 5 1/2	
w1=	130	plf		R1=	54	lbs
w2=	80	plf		R2=	1,330	lbs
L1=	4	ft		M+=	11	lb-ft
L2=	1	ft		M-=	824	lb-ft
X=	2.00	ft		Fb=	560	psi
P=	783.92	lbs		Fv=	64	psi
b=	3.50	in		Δspan=	(0.007)	in
d=	5.50	in		l span/	(6,902)	
E=	2,000	ksi		Δcant=	0.02	in
Cv=	1.00			l cant/	1,317	



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Project: Yuan Residence

Roof Beams

Date: 06/19/19

Project #:

Design: haa

Sheet: 3

Beam Analysis

Beam:		Beam				
Load		Dead	Live	Snow	Factored	Location
Distributed (k/ft)	w_1	**0.438**	**0.000**	**0.3125**	0.750	
	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	

Steel Beam Section	NONE

Support Locations and Reactions		
Number of Supports		3
Total Beam Length		**28.00**
Left End Condition		**Pinned**
Right End Condition		**Pinned**
R_1	1.029	**0.00**
R_2	14.335	**9.50**
R_3	5.636	**28.00**
R_4	0.000	**28.00**
R_5	0.000	**28.00**
R_6	0.000	**28.00**
R_7	0.000	**28.00**
R_8	0.000	**28.00**
R_9	0.000	**28.00**
R_{10}	0.000	**28.00**

Demand Output		
Location, ft		**9.49**
Shear, k	V =	-6.09
Moment, k-ft	M =	-24.02
Deflection, in	Δ =	0.00
Δ/Span		L/401330

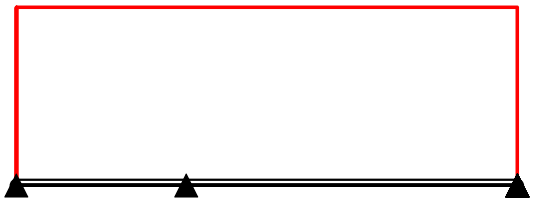
Load Factors	
Dead	**1.00**
Live	**1.00**
Snow	**1.00**

Stresses @ Input Location	
f_v (psi)	-124
f_b (psi)	-1681

Max/Min Stresses	
f_{v_MAX} (psi)	168
f_{v_MIN} (psi)	-124
f_{b_MAX} (psi)	1482
f_{b_MIN} (psi)	-1684

Beam Properties	
E (ksi)	**2000**
b (in)	**5.25**
d (in)	**14**
I (in^4)	**1200.5**
S (in^3)	**171.5**
A (in^2)	**73.5**
I (Override)	
S (Override)	
A (Override)	

Beam Loading Diagram



Span	V_{Left} (kips)	V_{Right} (kips)	M (-) (k-ft)	M (+) (k-ft)	Δ_{TL} (in)	@ x =	L/	Δ_{LL} (in)	@ x =	L/
Span 1	1.03	-6.10	-24.07	0.71	0.047 (↑)	6.38	L/2416	0	-	L/∞
Span 2	8.24	-5.64	-24.07	21.18	-0.459 (↓)	19.66	L/483	0	-	L/∞

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PROJECT Yuan Residence - Roof Beam 2

DATE *6/19/2019*

PROJ. #

DESIGN haa

SHEET

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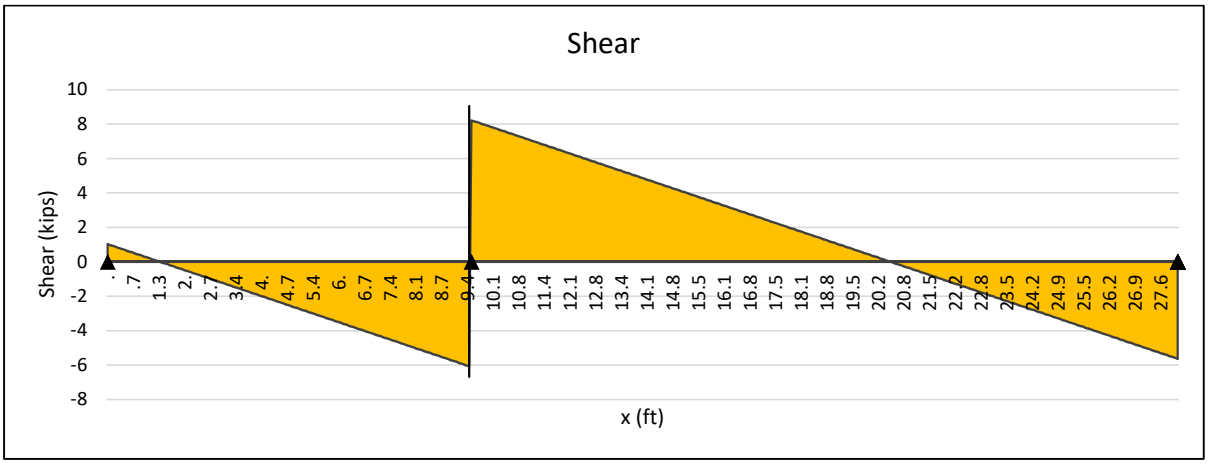
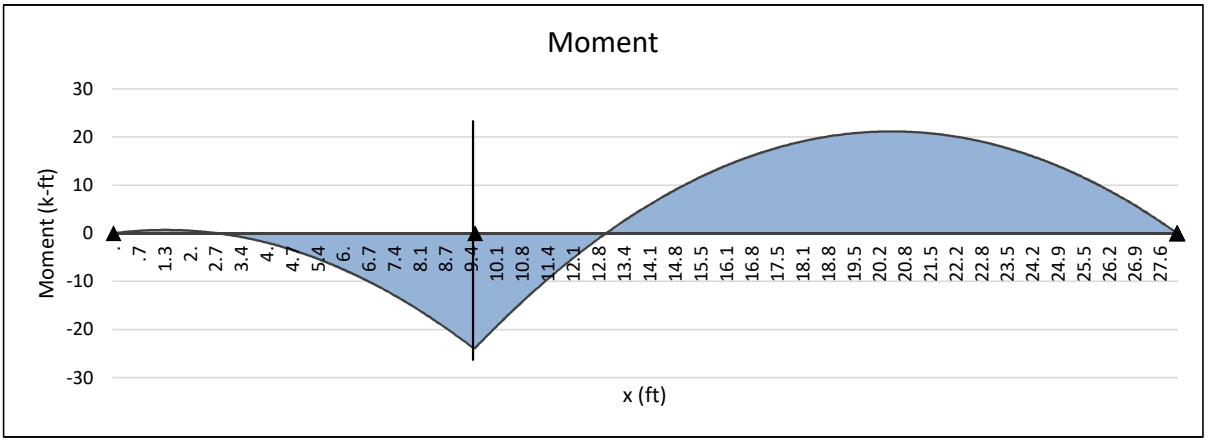
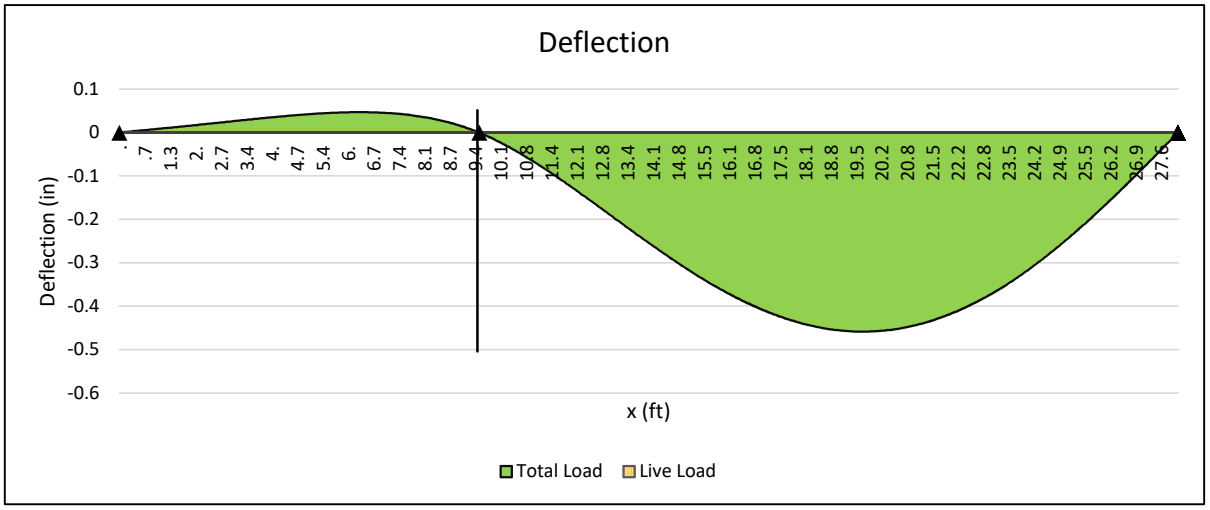
Beam Analysis







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PROJECT Yuan Residence - Roof Beam 2

DATE *6/19/2019*

PROJ. #

DESIGN haa

SHEET

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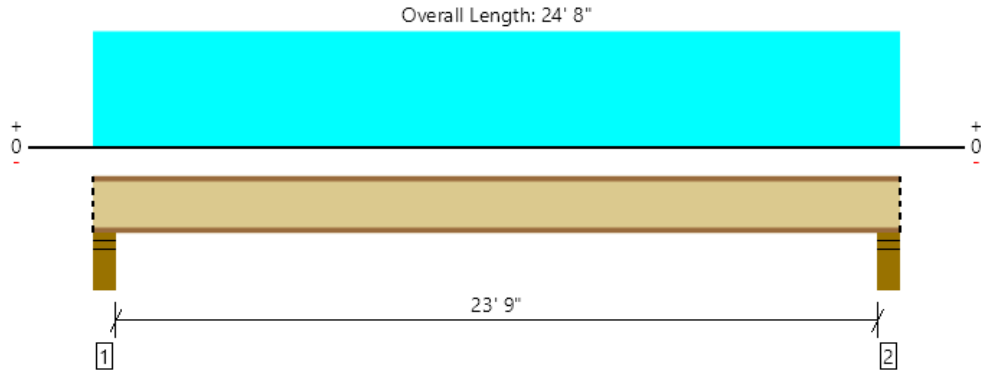
Level, Roof: Joist B17
1 piece(s) 11 7/8" TJI® 560 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	987 @ 4 1/2"	1984 (3.50")	Passed (50%)	1.15	1.0 D + 1.0 S (All Spans)
Shear (lbs)	950 @ 5 1/2"	2358	Passed (40%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	5720 @ 12' 4"	10925	Passed (52%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.423 @ 12' 4"	0.797	Passed (L/679)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	1.014 @ 12' 4"	1.196	Passed (L/283)	--	1.0 D + 1.0 S (All Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 7' 4" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 24' 8" o/c unless detailed otherwise.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Stud wall - HF	5.50"	5.50"	1.75"	576	411	987	Blocking
2 - Stud wall - HF	5.50"	5.50"	1.75"	576	411	987	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 24' 8"	16"	35.0	25.0	Default Load

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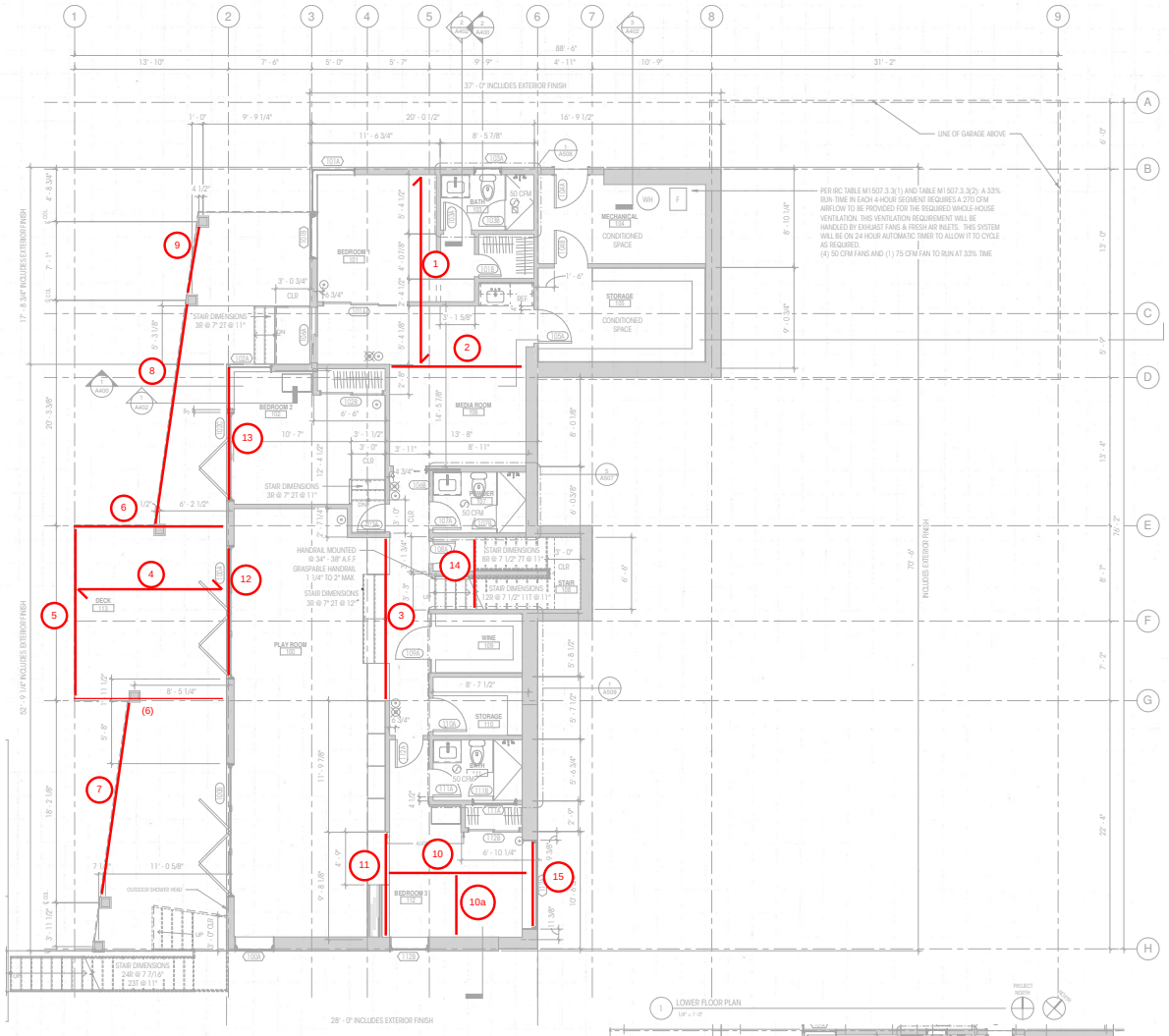
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Weyerhaeuser SUSTAINABLE FORESTRY INITIATIVE

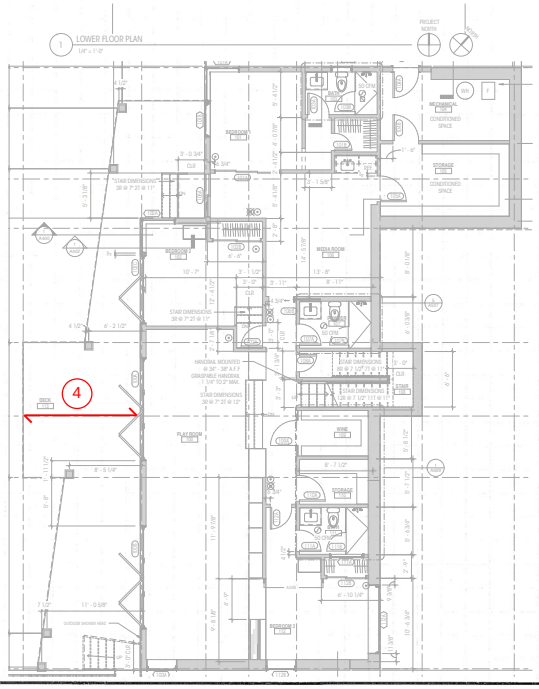
ForteWEB Software Operator	Job Notes
Holly SSF Engineers (817) 475-3103 hashford@ssfengineers.com	

MAIN FLOOR KEY PLAN:



LOWER FLOOR/DECK KEY PLAN:

(deck joists same as upper level)



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TACOMA
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934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

SSF STRUCTURAL ENGINEERING

Yuan Residence
PROJECT

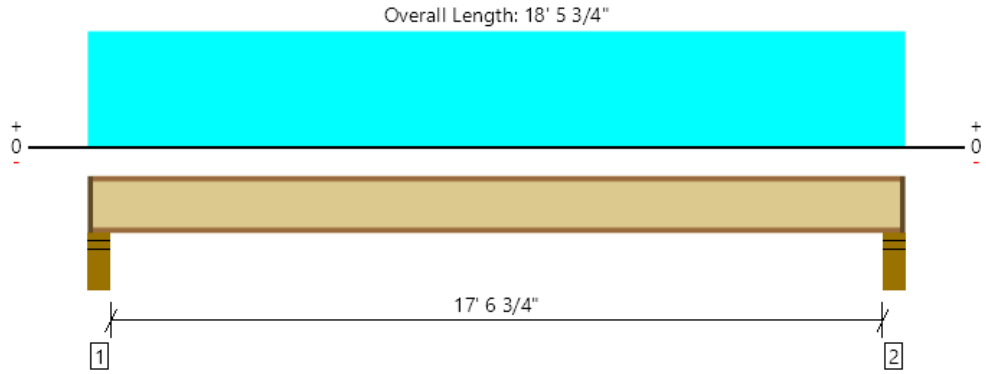
06/19/19
DATE

PROJ. #

HAA
DESIGN

SHEET

FLOOR, Floor: Joist B1
1 piece(s) 16" TJI® 230 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	926 @ 4 1/2"	1485 (3.50")	Passed (62%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	890 @ 5 1/2"	2190	Passed (41%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	3981 @ 9' 2 7/8"	5710	Passed (70%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.172 @ 9' 2 7/8"	0.443	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.326 @ 9' 2 7/8"	0.886	Passed (L/652)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	53	40	Passed	--	--

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 5' o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 18' 3" o/c unless detailed otherwise.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - HF	5.50"	4.25"	1.75"	444	493	937	1 1/4" Rim Board
2 - Stud wall - HF	5.50"	4.25"	1.75"	444	493	937	1 1/4" Rim Board

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 18' 5 3/4"	16"	36.0	40.0	Default Load

Weyerhaeuser Notes

Weyerhaeuser warrants that the sizing of its products will be in accordance with Weyerhaeuser product design criteria and published design values. Weyerhaeuser expressly disclaims any other warranties related to the software. Use of this software is not intended to circumvent the need for a design professional as determined by the authority having jurisdiction. The designer of record, builder or framer is responsible to assure that this calculation is compatible with the overall project. Accessories (Rim Board, Blocking Panels and Squash Blocks) are not designed by this software. Products manufactured at Weyerhaeuser facilities are third-party certified to sustainable forestry standards. Weyerhaeuser Engineered Lumber Products have been evaluated by ICC-ES under evaluation reports ESR-1153 and ESR-1387 and/or tested in accordance with applicable ASTM standards. For current code evaluation reports, Weyerhaeuser product literature and installation details refer to www.weyerhaeuser.com/woodproducts/document-library.

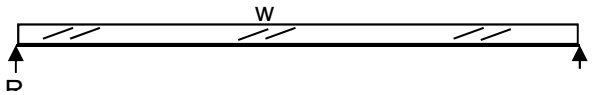
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Weyerhaeuser

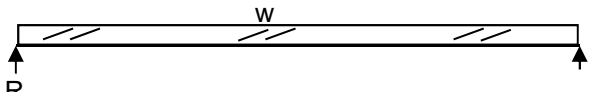
SUSTAINABLE FORESTRY INITIATIVE

ForteWEB Software Operator	Job Notes
Holly SSF Engineers (817) 475-3103 hashford@ssfengineers.com	

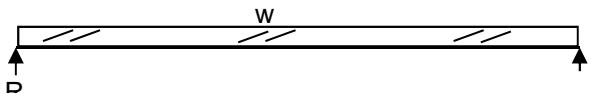
Beam		Main-B2		PSL	3 1/2 x 16	
w=	760	plf		R=	4,674	lbs
L=	12.3	ft		M=	14,373	ft-lbs
b=	3.50	in		Fb=	1,155	psi
d=	16.00	in		Fv=	98	psi
E=	2000	ksi		Δ=	0.16	in
Cv=	1.00	≤1.0		l /	901	



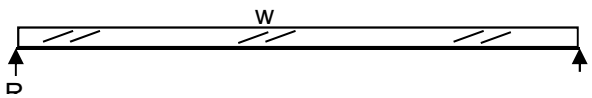
Beam		Main-B3		PSL	5 1/4 x 16	
w=	1007	plf		R=	7,553	lbs
L=	15	ft		M=	28,322	ft-lbs
b=	5.25	in		Fb=	1,517	psi
d=	16.00	in		Fv=	111	psi
E=	2000	ksi		Δ=	0.32	in
Cv=	1.00	≤1.0		l /	562	



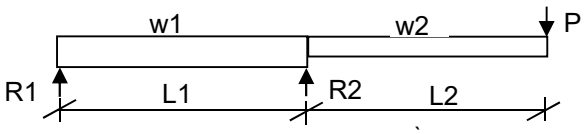
Beam		Main-B4		HF	2 x 12	
w=	70	plf		R=	490	lbs
L=	14	ft		M=	1,715	ft-lbs
b=	1.50	in		Fb=	650	psi
d=	11.25	in		Fv=	38	psi
E=	1300	ksi		Δ=	0.26	in
Cv=	1.00	≤1.0		l /	642	



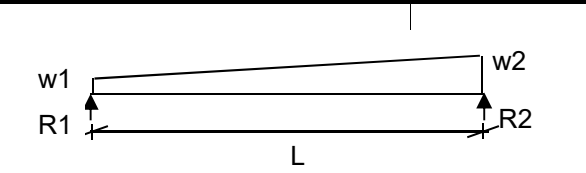
Beam		Main-B5		GL	5 1/8 x 13 1/2	
w=	490	plf		R=	3,553	lbs
L=	14.5	ft		M=	12,878	ft-lbs
b=	5.13	in		Fb=	993	psi
d=	13.50	in		Fv=	65	psi
E=	1800	ksi		Δ=	0.26	in
Cv=	1.00	≤1.0		l /	675	



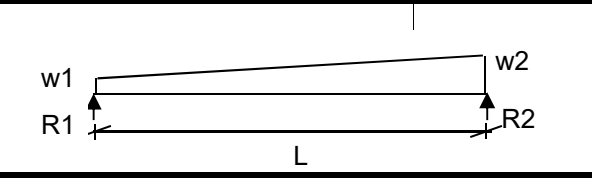
Beam		Main-B6		GL	6 3/4 x 15	
w1=	70	plf		R1=	-3430	lbs
w2=	35	plf		R2=	7,718	lbs
L1=	7	ft		M+=	-	lb-ft
L2=	7	ft		M-=	25,725	lb-ft
X=	4.00	ft		Fb=	1,220	psi
P=	3,553	lbs		Fv=	57	psi
b=	6.75	in		Δspan=	(0.040)	in
d=	15.00	in		l span/	(2,110)	
E=	1,800	ksi		Δcant=	0.42	in
Cv=	1.00			l cant/	400	



Beam		Main-B7		GL	6 3/4 x 13 1/2	
w1=	280	plf		R1 =	2,914	lbs
w2=	385	plf		R2 =	3,238	lbs
L=	18.50	ft		M =	14,165	lb-ft
b=	6.75	in		Fb =	829	psi
d=	13.50	in		Fv =	43	psi
E=	1,800	ksi		Δ=	0.35	in
Cv=	0.97			l /	631	



Beam		Main-B8		GL	6 3/4 x 13 1/2	
w1=	219	plf		R1 =	2,021	lbs
w2=	140	plf		R2 =	1,746	lbs
L=	21	ft		M =	9,945	lb-ft
b=	6.75	in		Fb =	582	psi
d=	13.50	in		Fv =	29	psi
E=	1,800	ksi		Δ=	0.31	in
Cv=	0.96			l /	800	



SSF STRUCTURAL ENGINEERING

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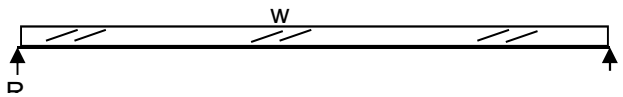
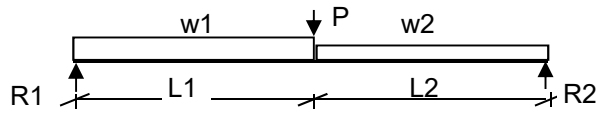
Project: Yuan Residence
Floor Beams

Date: 06/19/19
Project #:
Design: haa
Sheet: 1

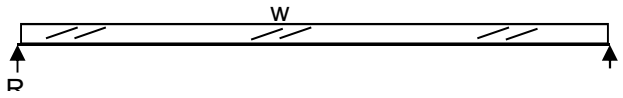
Beam		Main-B9		GL	6 3/4 x 13 1/2	
w=	385	plf		R=	1,781	lbs
L=	9.25	ft		M=	4,118	ft-lbs
b=	6.75	in		Fb=	241	psi
d=	13.50	in		Fv=	22	psi
E=	1800	ksi		Δ=	0.03	in
Cv=	1.00	≤1.0		l /	4360	



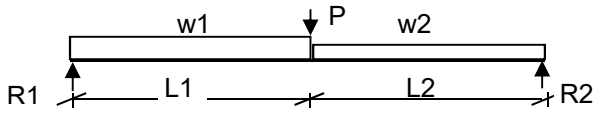
Beam		Main-B10		PSL	3 1/2 x 16	
w1=	101	plf		R1 =	1,293	lbs
w2=	101	plf		R2 =	1,411	lbs
L1=	6.67	ft		M =	6,370	lb-ft
L2=	5.67	ft		Fb =	512	psi
X=	6.7	ft		Fv =	34	psi
P=	1,455	lbs		Δ=	0.06	in
b=	3.50	in		l /	2,369	
d=	16.00	in		Cv=	1.00	
E=	2,000	ksi				



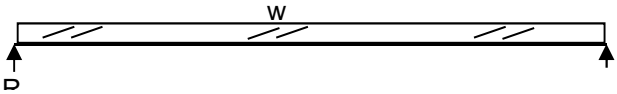
Beam		Main-B10a		PSL	3 1/2 x 16	
w=	466	plf		R=	1,455	lbs
L=	6.25	ft		M=	2,273	ft-lbs
b=	3.50	in		Fb=	183	psi
d=	16.00	in		Fv=	22	psi
E=	2000	ksi		Δ=	0.01	in
Cv=	1.00	≤1.0		l /	11213	



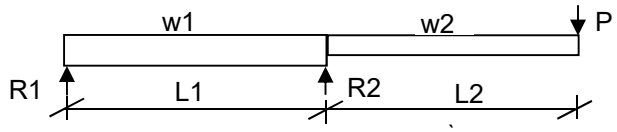
Beam		Main-B11		PSL	3 1/2 x 16	
w1=	722	plf		R1 =	4,071	lbs
w2=	1,007	plf		R2 =	5,126	lbs
L1=	6.25	ft		M =	11,340	lb-ft
L2=	3.25	ft		Fb =	911	psi
X=	6.3	ft		Fv =	101	psi
P=	1,411	lbs		Δ=	0.07	in
b=	3.50	in		l /	1,649	
d=	16.00	in		Cv=	1.00	
E=	2,000	ksi				



Beam		Main-B12		GL	5 1/8 x 22 1/2	
w=	1012.5	plf		R=	6,075	lbs
L=	12	ft		M=	18,225	ft-lbs
b=	5.13	in		Fb=	506	psi
d=	22.50	in		Fv=	54	psi
E=	1800	ksi		Δ=	L	in
Cv=	0.99	≤1.0		l /	#VALUE!	



Beam		Main-B13		PSL	3 1/2 x 16	
w1=	724	plf		R1=	2131	lbs
w2=	663	plf		R2=	6,512	lbs
L1=	8	ft		M+=	3,138	lb-ft
L2=	4	ft		M-=	6,111	lb-ft
X=	4.00	ft		Fb=	491	psi
P=	203	lbs		Fv=	72	psi
b=	3.50	in		Δspan=	0.010	in
d=	16.00	in		l span/	9,376	
E=	2,000	ksi		Δcant=	0.02	in
Cv=	1.00			l cant/	4,586	



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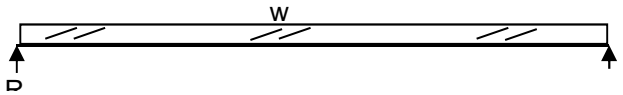
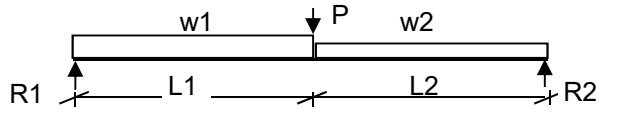
Project: Yuan Residence
Floor Beams

Date: 06/19/19
Project #:
Design: haa
Sheet: 2

Beam		Main-B14		PSL	3 1/2 x 16	
w=	684	plf		R=	2,223	lbs
L=	6.5	ft		M=	3,612	ft-lbs
b=	3.50	in		Fb=	290	psi
d=	16.00	in		Fv=	35	psi
E=	2000	ksi		Δ=	0.01	in
Cv=	1.00	≤1.0		l /	6784	



Beam		Main-B15		HF	5 x 12	
w1=	253	plf		R1 =	1,678	lbs
w2=	466	plf		R2 =	2,439	lbs
L1=	5	ft		M =	5,222	lb-ft
L2=	3	ft		Fb =	660	psi
X=	5.0	ft		Fv =	59	psi
P=	1,453	lbs		Δ=	0.07	in
b=	4.50	in		l /	1,304	
d=	11.25	in		Cv=	1.00	
E=	1,300	ksi				



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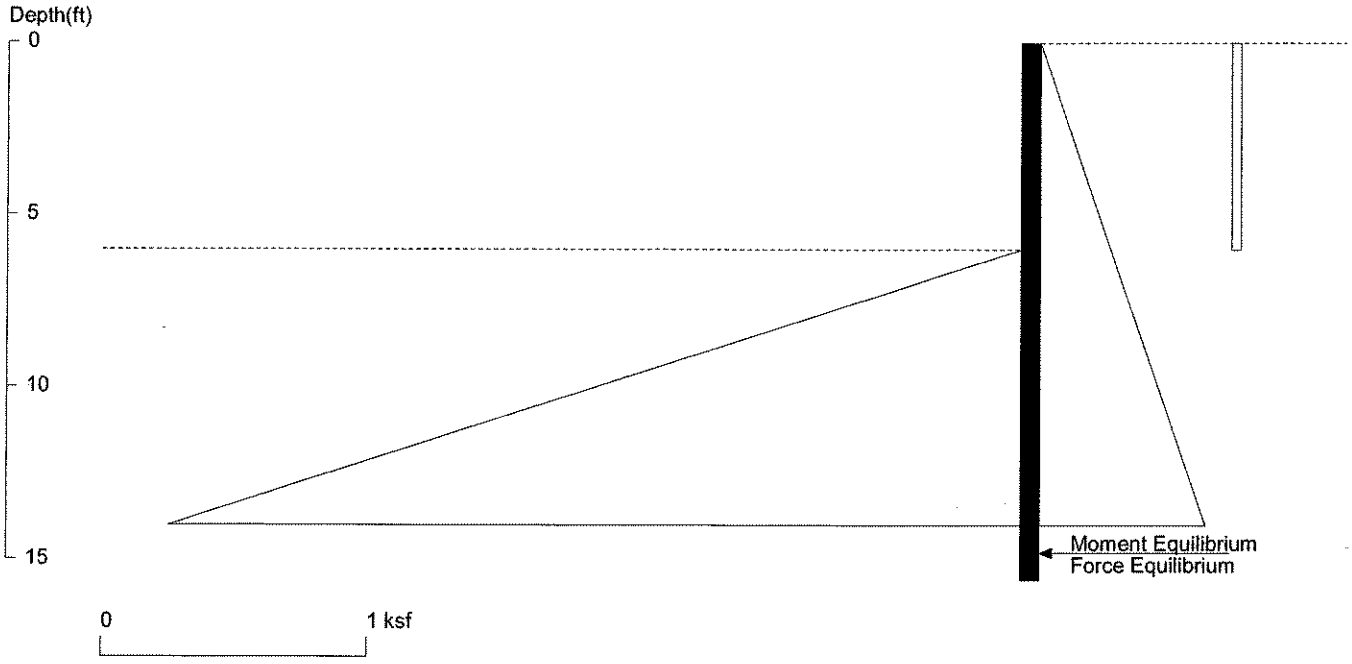
Project: Yuan Residence
Floor Beams

Date: 06/19/19
Project #:
Design: ENG
Sheet: 3

SHORING CALCULATIONS

Yuan Residence
East wall of driveway



<ShoringSuite> CIVILTECH SOFTWARE USA www.civiltech.com

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File: K:\2019\01519-2019-01 Yuan\Shoring\East wall of driveway.sh8

Wall Height=6.0 Pile Diameter=1.5 Pile Spacing=8.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=9.61 Min. Pile Length=15.61
MOMENT IN PILE: Max. Moment=42.21 per Pile Spacing=8.0 at Depth=10.18

PILE SELECTION:
Request Min. Section Modulus = 15.3 in3/pile=251.50 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W12X22 has Section Modulus = 25.4 in3/pile=416.23 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 0.35(in) based on E (ksi)=29000.00 and I (in4)/pile=156.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	50	2.250	.045
*eq				
0	.036	6	0.036	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
6	0	50	17.60	.4

ACTIVE SPACING:

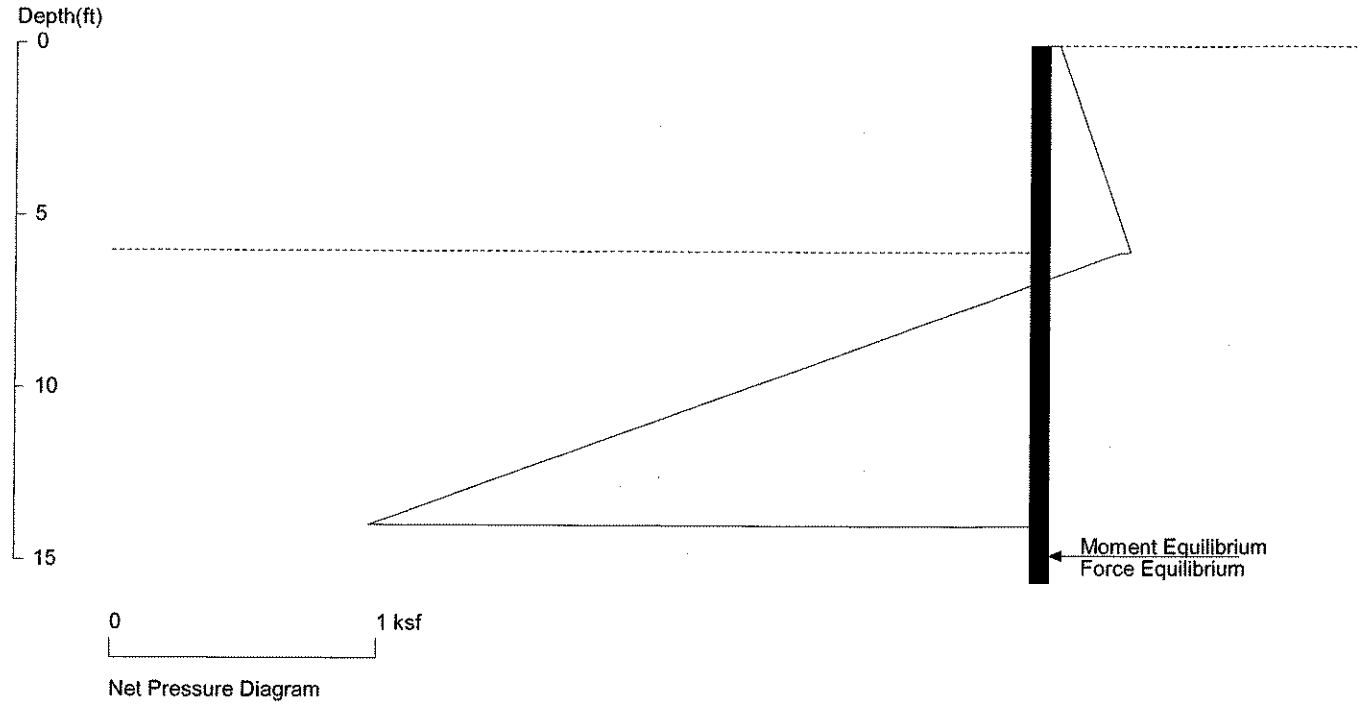
No.	Z depth	Spacing
1	0.00	8.00
2	6.00	1.50

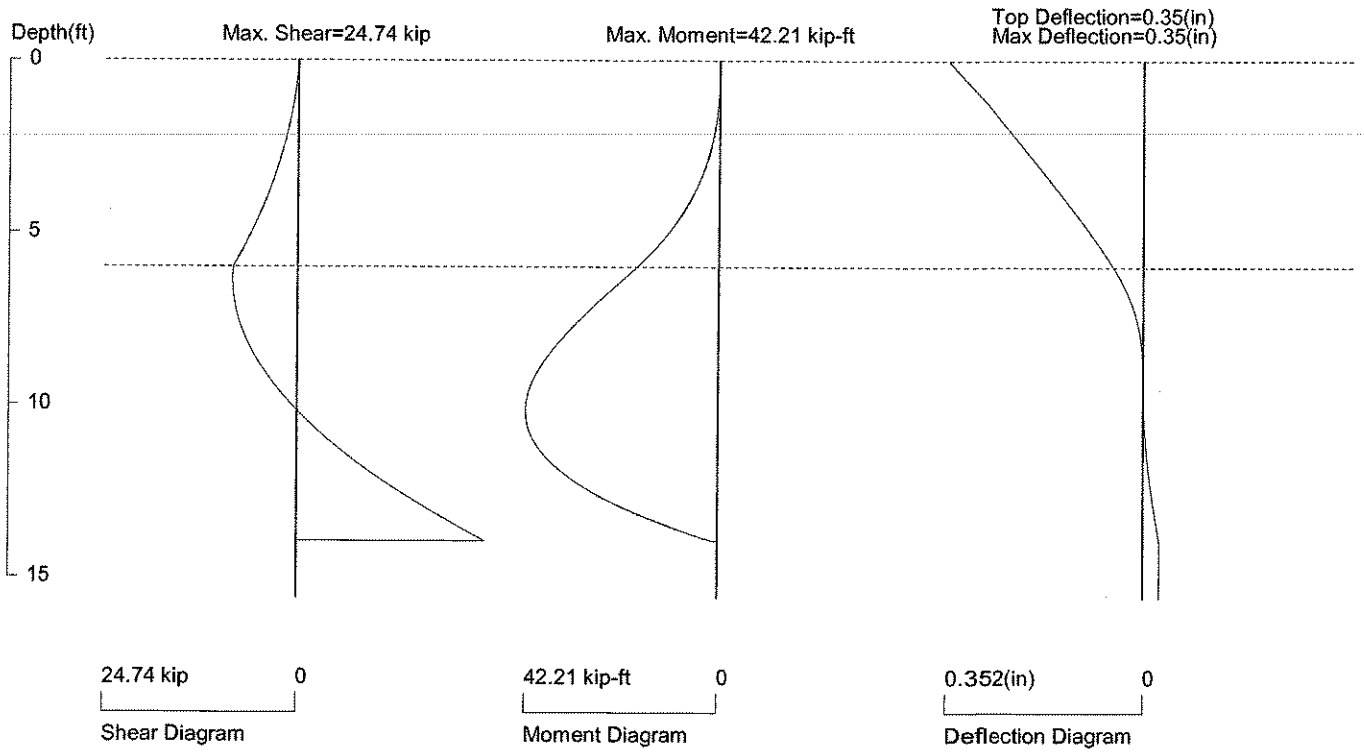
PASSIVE SPACING:

No.	Z depth	Spacing
1	6.00	3.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

Yuan Residence
East wall of driveway





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 8.0 foot or meter

User Input Pile, W12X22: E (ksi)=29000.0, I (in4)/pile=156.0

File: K:\2019\01519-2019-01 Yuan\Shoring\East wall of driveway.sh8

****

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software

www.civiltech.com

****

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

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Date: 4/22/2019 File: K:\2019\01519-2019-01 Yuan\Shoring\East wall of driveway.sh8

Title: Yuan Residence
Subtitle: East wall of driveway

**********INPUT DATA**********

Wall Type: 2. Soldier Pile, Drilled
Wall Height: 6.00
Pile Diameter: 1.50
Pile Spacing: 8.00
Factor of Safety (F.S.): 1.00
Lateral Support Type (Braces): 1. No
Top Brace Increase (Multi-Bracing): Add 15%*
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 50 ksi = 345 MPa
Allowable Fb/Fy: 0.66
Elastic Module, E: 29000.00
Moment of Inertia, I: 156.00
User Input Pile: W12X22

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	0	0	50	2.250	.045
2	*eq				
3	0	.036	6	0.036	0

* PASSIVE PRESSURE *

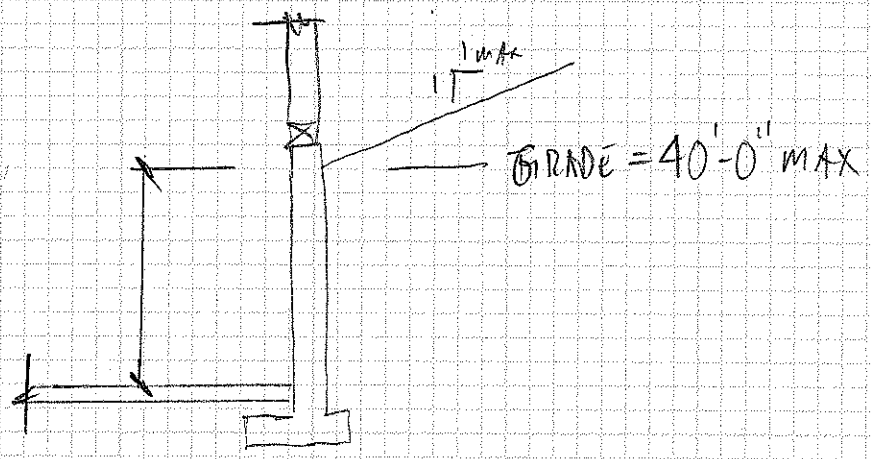
No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	6	0	50	17.60	.4

```
* ACTIVE SPACE *
 No.     Z depth          Spacing
-------------------------------------------------------------------------------
 1       0.00             8.00
 2       6.00             1.50
-------------------------------------------------------------------------------

* PASSIVE SPACE *
 No.     Z depth          Spacing
-------------------------------------------------------------------------------
 1       6.00             3.00
-------------------------------------------------------------------------------
*For Tieback:  Input1 = Diameter;  Input2 = Bond Strength
*For Plate:  Input1 = Diameter;  Input2 = Allowable Pressure
*For Deadman:  Input1 = Horz. Width;  Input2 = Passive Pressure;
*For Sheet Pile Anchor:  Input1 = Horz. Width;  Input2 = Passive Slope;


*********************************CALCULATION*********************************

   The calculated moment and shear are per pile spacing.  Sheet piles are per one
foot or meter; Soldier piles are per pile.

   Top Pressures start at depth =  0.00

          |       D1=0.00
          |
          |
       ==|==     D2=6.00
          |
          |
          |       D3=15.61

        D1 - TOP DEPTH
        D2 - EXCAVATION BASE
        D3 - PILE TIP

   MOMENT equilibrium   AT DEPTH=14.01  WITH EMBEDMENT OF 8.01
   FORCE equilibrium    AT DEPTH=15.61  WITH EMBEDMENT OF 9.61

   The program calculates an embedment for moment equilibrium, then increase the
embedment by 1.2


*********************************RESULTS*************************************

* EMBEDMENT Notes *
Based on USS Design Manual, first calculate embedment for moment equilibrium, then
increased the embedment to get the design depth.
The embedment for moment equilibrium is 8.01
The program calculates an embedment for moment equilibrium, then increase the
embedment by 1.2
The total desigh embedment is 9.61

Embedment Information:
If 20% increased, the total design embedment is 9.61
If 30% increased, the total design embedment is 10.41
If 40% increased, the total design embedment is 11.21
If 50% increased, the total design embedment is 12.01
```

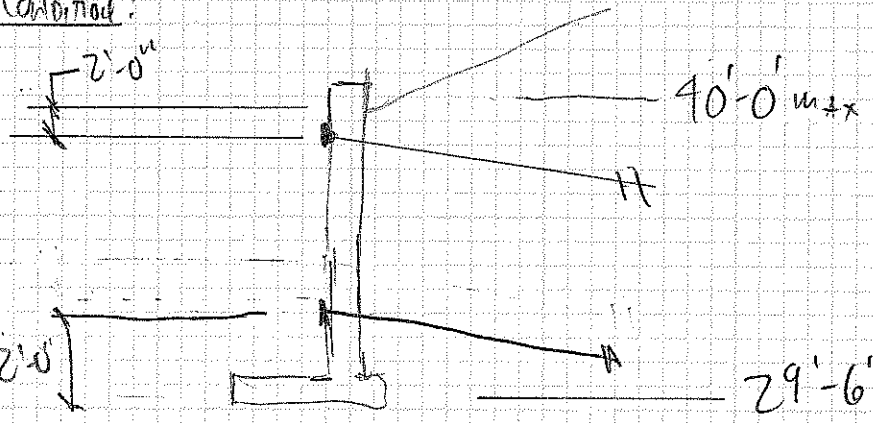
```
* MOMENT IN PILE (per pile spacing)*
Pile Spacing:  sheet piles are one foot or one meter; soldier piles are one pile.
Overall Maximum Moment = 42.21 at 10.18
Maximum Shear = 24.74
Moment and Shear are per pile spacing: 8.0 foot or meter

* VERTICAL LOADING *
Vertical Loading from Braces = 0.00
Vertical Loading from External Load = 0.00
Total Vertical Loading = 0.00


*****************************SPECIFIED PILE ***********************************

   Overall Maximum Moment = 42.21 at 10.18
   The pile selection is based on the magnitude of the moment only. Axial force is
neglected.

   Request Min. Section Modulus = 15.35 in3/pile = 251.50 cm3/pile, Fy= 50 ksi = 345
MPa, Fb/Fy=0.66

   W12X22 has been found in Soldier Pile list!
   (English Units):
   Area= 6.48 in.  Depth= 12.3 in.  Width= 4.03 in.  Height= 12 in.
   Flange thickness= 0.425 in.   Web thickness= 0.26 in.
   Ix= 156 in4/pile   Sx= 25.4 in3/pile   Iy= 4.66 in4/pile   Sy= 2.31 in3/pile
   (Metric Units):
   Ix= 64.93 x100cm4/pile   Sx= 416.23 cm3/pile   Iy= 1.94 x100cm4/pile   Sy= 37.85
cm3/pile


   The pile selection is based on the magnitude of the moment only. Axial force is
neglected.

   W12X22 is capable to support the shoring!
   Top deflection = 0.352(in)
   Max. deflection = 0.352(in)

********************** LAGGING SIZE ESTIMATION ************************
Max. Pressure above base = 0.31
Piles are more rigid than timber lagging, due to arching, only portion of pressures
are acting to lagging, 30-50% loading is suggested.
     If 50% loading is used for lagging design, Design Pressure = 0.15
     Pile Spacing =8.0, Max. Moment in lagging = 1.22
     For 4"x12" Timber, Section Modules S=23.47 in3.  The request allowable bending
strength, fb=M/S=0.63
     For 6"x12" Timber, Section Modules S=57.98 in3.  The request allowable bending
strength, fb=M/S=0.25

     If 30% loading is used for lagging design, Design Pressure = 0.09
     Pile Spacing =8.0, Max. Moment in lagging = 0.73
     For 4"x12" Timber, Section Modules S=23.47 in3.  The request allowable bending
strength, fb=M/S=0.38
     For 6"x12" Timber, Section Modules S=57.98 in3.  The request allowable bending
strength, fb=M/S=0.15

Unit: Pressure: ksf,  Spacing: ft,  Moment: kip-ft, Bending Strength, fb: ksi
```

HELICAL ANCHOR WALL

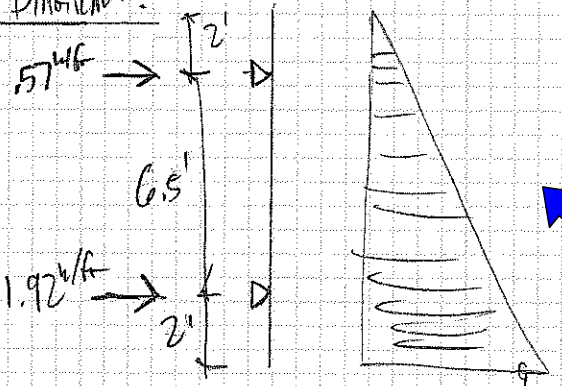
EXISTING



SHORED CONDITION:



LOADING DIAGRAM:



ACTIVE $(45^{PCF}(10.5') = 478^{PSF}$

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SSF STRUCTURAL ENGINEERING

PROJECT
DATE
PROJ. #
DESIGN
SHEET

WHALER DESIGN

$w = 1.92^{k/ft}$

$L = 8'-0"$

AS A MULTISPAN BM $M_{max} = 15.36^{k\text{-}ft}$

$R_{max} = 19.2^{k}$

USING CHANNEL $S_{req'd} = \frac{15.36^{k\text{-}ft}(12)}{36/1.67} = 8.5^{in^3}$ NO GOOD

USING TUBE $S_{req'd} = \frac{15.36^{k\text{-}ft}(12)}{46/1.67} = 6.7^{in^3}$

SELECT HSS 8x4x1/2 $S_y = 11.8^{in^3}$ OK

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SSF STRUCTURAL ENGINEERING

PROJECT

DATE

PROJ. #

DESIGN

SHEET

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

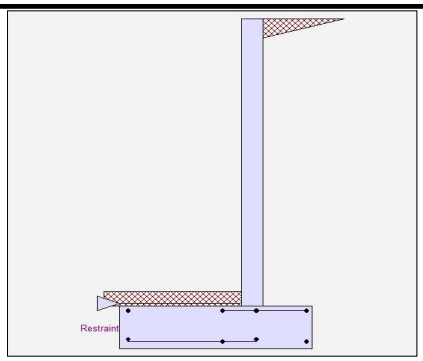
Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.00	OK

Slab Resists All Sliding !

Total Bearing Load	=	4,211 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	711 psf	OK
Soil Pressure @ Heel	=	711 psf	OK
Allowable	=	2,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	996 psf	
ACI Factored @ Heel	=	996 psf	
Footing Shear @ Toe	=	8.3 psi	OK
Footing Shear @ Heel	=	6.1 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,314.4 lbs

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

Load Factors

Building Code	IBC 2012,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 7
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.711**
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 =	13,107.2
Shear.....Actual	
Service Level psi =	
Strength Level psi =	41.9
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	5.56
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3955 in2/ft	
(4/3) * As :	0.5274 in2/ft	Min Stem T&S Reinf Area 1.920 in2
200bd/fy : 200(12)(5.5625)/60000 :	0.2225 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.3955 in2/ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.6 in2/ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.7535 in2/ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	3.75 ft
Heel Width	=	2.17
Total Footing Width	=	5.92
Footing Thickness	=	18.00 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	=	996	996	psf
Mu' : Upward	=	7,002	1,125	ft-#
Mu' : Downward	=	2,426	2,000	ft-#
Mu: Design	=	4,577	875	ft-#
Actual 1-Way Shear	=	8.29	6.06	psi
Allow 1-Way Shear	=	40.00	40.00	psi

Toe Reinforcing = # 7 @ 12.00 in
Heel Reinforcing = # 4 @ 18.00 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@ 6.16 in, #5@ 9.56 in, #6@ 13.57 in, #7@ 18.51 in, #8@ 24.37 in, #9@ 30.
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 2.30 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	8,871.8			
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)				1,879.2	5.17	9,712.2
Soil Over HL (bel. water tbl)					5.17	9,712.2
Watre Table						
Sloped Soil Over Heel =						
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) =				1,000.0	4.08	4,083.3
Earth @ Stem Transitions =						
Footing Weight =				1,332.0	2.96	3,942.7
Key Weight =						
Vert. Component =						
Total =	2,314.4	**O.T.M.** =	8,871.8	**Total =** 4,211.2 lbs	**R.M.=**	17,738.2

Resisting/Overturning Ratio = **2.00**
Vertical Loads used for Soil Pressure = 4,211.2 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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

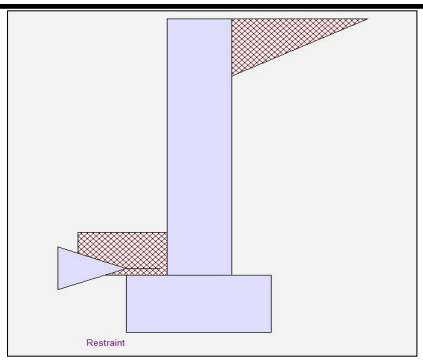
Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	2,667.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method : Uniform
Multiplier Used = 6.000
(Multiplier used on soil density)

Uniform Seismic Force = 22.000
Total Seismic Force = 80.667

Design Summary

Wall Stability Ratios
Overturning = 1.38 Ratio < 1.5!
Slab Resists All Sliding !

Total Bearing Load	=	605	lbs
...resultant ecc.	=	0.00	in
Soil Pressure @ Toe	=	403	psf OK
Soil Pressure @ Heel	=	403	psf OK
Allowable	=	2,667	psf
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	565	psf
ACI Factored @ Heel	=	565	psf
Footing Shear @ Toe	=	0.2	psi OK
Footing Shear @ Heel	=	0.0	psi OK
Allowable	=	75.0	psi

Sliding Calcs
Lateral Sliding Force = 291.7 lbs

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

Load Factors

Building Code	IBC 2012,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	18.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.095**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	318.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	351.0
Moment.....Allowable =	3,655.6
Shear.....Actual	
Service Level psi =	
Strength Level psi =	4.2
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0132 in2/ft	
(4/3) * As :	0.0175 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	=	565	565	psf
Mu' : Upward	=	50	48	ft-#
Mu' : Downward	=	17	49	ft-#
Mu: Design	=	33	0	ft-#
Actual 1-Way Shear	=	0.22	0.03	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: #4@ 13.88 in, #5@ 21.52 in, #6@ 30.55 in, #7@ 41.66 in, #8@ 54.85 in, #9@ 6
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*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

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	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 =						
Seismic Earth Load =	56.5	1.83	103.5			
=						
Soil Over HL (ab. water tbl)				1,879.2	5.17	200.5
Soil Over HL (bel. water tbl)					5.17	200.5
Watre Table						
Sloped Soil Over Heel =						
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 =	291.7	**O.T.M.** =	391.1	**Total =** 605.0 lbs	**R.M.=**	539.0

Resisting/Overturning Ratio = **1.38**
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.

If seismic is included, the OTM and sliding ratios
be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

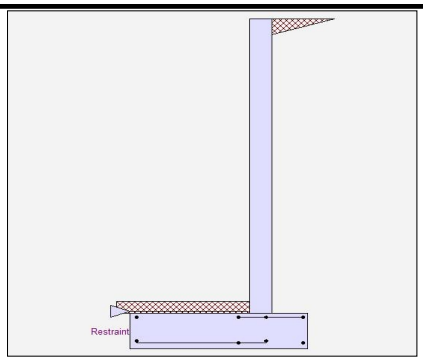
Code: IBC 2012,ACI 318-11,ACI 530-11

Criteria

Retained Height	=	12.50 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	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.58	OK

Slab Resists All Sliding !

Total Bearing Load	=	5,152 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	772 psf	OK
Soil Pressure @ Heel	=	772 psf	OK
Allowable	=	2,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,081 psf	
ACI Factored @ Heel	=	1,081 psf	
Footing Shear @ Toe	=	13.5 psi	OK
Footing Shear @ Heel	=	7.4 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	3,430.0 lbs

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

Load Factors

Building Code	IBC 2012,ACI
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	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 7
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.984**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	4,375.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	18,229.2
Moment.....Allowable	=	18,507.2
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	48.2
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.56
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.5592 in2/ft	
(4/3) * As :	0.7456 in2/ft	Min Stem T&S Reinf Area 3.000 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
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.5592 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	=	4.50 ft
Heel Width	=	2.17
Total Footing Width	=	6.67
Footing Thickness	=	18.00 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	=	1,081	1,081	psf
Mu' : Upward	=	10,949	966	ft-#
Mu' : Downward	=	3,493	1,916	ft-#
Mu: Design	=	7,455	950	ft-#
Actual 1-Way Shear	=	13.46	7.41	psi
Allow 1-Way Shear	=	75.00	40.00	psi

Toe Reinforcing = # 7 @ 12.00 in
Heel Reinforcing = # 4 @ 18.00 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@ 6.16 in, #5@ 9.56 in, #6@ 13.57 in, #7@ 18.51 in, #8@ 24.37 in, #9@ 30.
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 2.59 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	16,006.7			
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)				1,879.2	5.17	12,534.7
Soil Over HL (bel. water tbl)					5.17	12,534.7
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =					2.25	
Surcharge Over Toe =						
Stem Weight(s) =				1,562.5	4.92	7,682.3
Earth @ Stem Transitions =						
Footing Weight =				1,500.8	3.34	5,005.0
Key Weight =						
Vert. Component =						
Total =	3,430.0	**O.T.M.** =	16,006.7	**Total =** 5,151.8 lbs	**R.M.=**	25,222.0

Resisting/Overturning Ratio = **1.58**
Vertical Loads used for Soil Pressure = 5,151.8 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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

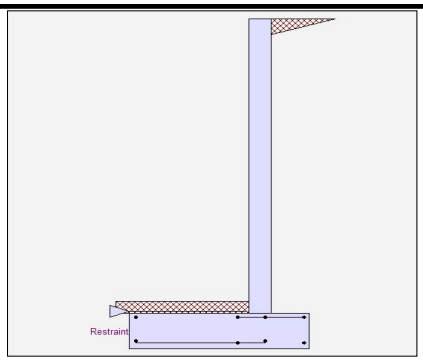
Code: IBC 2012,ACI 318-11,ACI 530-11

Criteria

Retained Height	=	12.50 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	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method : Uniform
Multiplier Used = 6.000
(Multiplier used on soil density)

Uniform Seismic Force = 84.000
Total Seismic Force = 1,176.000

Design Summary

Wall Stability Ratios
Overturning = 1.20 Ratio < 1.5!
Slab Resists All Sliding !

Total Bearing Load	=	5,295 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	784 psf	OK
Soil Pressure @ Heel	=	784 psf	OK
Allowable	=	2,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,098 psf	
ACI Factored @ Heel	=	1,098 psf	
Footing Shear @ Toe	=	13.8 psi	OK
Footing Shear @ Heel	=	7.7 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs
Lateral Sliding Force = 4,253.2 lbs

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

Load Factors

Building Code	IBC 2012,ACI
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	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 9
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.879**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	5,425.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	24,791.7
Moment.....Allowable	=	28,158.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	60.8
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.44
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.7739 in2/ft	
(4/3) * As :	1.0319 in2/ft	Min Stem T&S Reinf Area 3.000 in2
200bd/fy : 200(12)(7.4375)/60000 :	0.2975 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.7739 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	1 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.0075 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	4.50 ft
Heel Width	=	2.25
Total Footing Width	=	6.75
Footing Thickness	=	18.00 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	=	1,098	1,098 psf
Mu' : Upward	=	11,119	1,102 ft-#
Mu' : Downward	=	3,493	2,152 ft-#
Mu: Design	=	7,626	1,050 ft-#
Actual 1-Way Shear	=	13.78	7.72 psi
Allow 1-Way Shear	=	75.00	40.00 psi

Toe Reinforcing = # 7 @ 12.00 in
Heel Reinforcing = # 4 @ 18.00 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@ 6.16 in, #5@ 9.56 in, #6@ 13.57 in, #7@ 18.51 in, #8@ 24.37 in, #9@ 30.
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 2.62 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

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Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	16,006.7			
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 =						
Seismic Earth Load =	823.2	7.00	5,762.4			
=						
Soil Over HL (ab. water tbl)				1,879.2	5.17	13,373.5
Soil Over HL (bel. water tbl)					5.17	13,373.5
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =					2.25	
Surcharge Over Toe =						
Stem Weight(s) =				1,562.5	4.92	7,682.3
Earth @ Stem Transitions =						
Footing Weight =				1,518.8	3.38	5,125.8
Key Weight =						
Vert. Component =						
Total =	4,253.2	**O.T.M.** =	21,769.1	**Total =** 5,294.8 lbs	**R.M.=**	26,181.6

Resisting/Overturning Ratio = **1.20**
Vertical Loads used for Soil Pressure = 5,294.8 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
be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

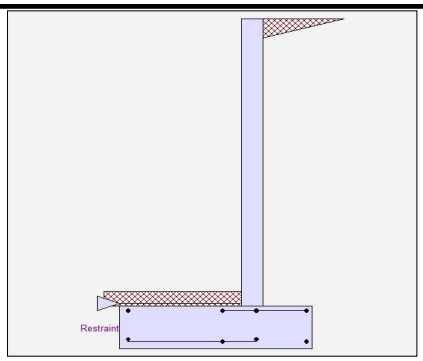
Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	2,667.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	6.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	69.000
Total Seismic Force	=	793.500

Design Summary

Wall Stability Ratios

Overturning	=	1.47	Ratio < 1.5!

Slab Resists All Sliding !

Total Bearing Load	=	4,211 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	711 psf	OK
Soil Pressure @ Heel	=	711 psf	OK
Allowable	=	2,667 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	996 psf	
ACI Factored @ Heel	=	996 psf	
Footing Shear @ Toe	=	8.3 psi	OK
Footing Shear @ Heel	=	6.1 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,869.8 lbs

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

Load Factors

Building Code	IBC 2012,ACI
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	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 7
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.974**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,490.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	12,783.3
Moment.....Allowable	=	13,107.2
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	52.3
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	5.56
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.5417 in2/ft		
(4/3) * As :	0.7223 in2/ft	Min Stem T&S Reinf Area 1.920 in2	
200bd/fy : 200(12)(5.5625)/60000 :	0.2225 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.5417 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.6 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.7535 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.75 ft
Heel Width	=	2.17
Total Footing Width	=	5.92
Footing Thickness	=	18.00 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	=	996	996	psf
Mu' : Upward	=	7,002	1,125	ft-#
Mu' : Downward	=	2,426	2,000	ft-#
Mu: Design	=	4,577	875	ft-#
Actual 1-Way Shear	=	8.29	6.06	psi
Allow 1-Way Shear	=	40.00	40.00	psi

Toe Reinforcing = # 7 @ 12.00 in
Heel Reinforcing = # 4 @ 18.00 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@ 6.16 in, #5@ 9.56 in, #6@ 13.57 in, #7@ 18.51 in, #8@ 24.37 in, #9@ 30.
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 2.30 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	8,871.8			
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 =	555.5	5.75	3,193.8			
=						
Soil Over HL (ab. water tbl)				1,879.2	5.17	9,712.2
Soil Over HL (bel. water tbl)					5.17	9,712.2
Watre Table						
Sloped Soil Over Heel =						
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) =				1,000.0	4.08	4,083.3
Earth @ Stem Transitions =						
Footing Weight =				1,332.0	2.96	3,942.7
Key Weight =						
Vert. Component =						
Total =	2,869.8	**O.T.M.** =	12,065.6	**Total =** 4,211.2 lbs	**R.M.=**	17,738.2

Resisting/Overturning Ratio = **1.47**
Vertical Loads used for Soil Pressure = 4,211.2 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
be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

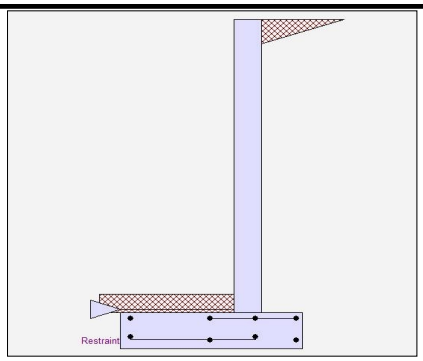
Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.84	OK

Slab Resists All Sliding !

Total Bearing Load	=	2,455 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	557 psf	OK
Soil Pressure @ Heel	=	557 psf	OK
Allowable	=	2,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	779 psf	
ACI Factored @ Heel	=	779 psf	
Footing Shear @ Toe	=	8.5 psi	OK
Footing Shear @ Heel	=	5.0 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	IBC 2012,ACI
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	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 5
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.587**
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	=	8,121.3
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	24.1
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.19
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1809 in2/ft		
(4/3) * As :	0.2413 in2/ft	Min Stem T&S Reinf Area 1.536 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	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2413 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	=	2.75 ft
Heel Width	=	1.66
Total Footing Width	=	4.41
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	=	779	779	psf
Mu' : Upward	=	2,947	384	ft-#
Mu' : Downward	=	964	681	ft-#
Mu: Design	=	1,983	296	ft-#
Actual 1-Way Shear	=	8.50	4.97	psi
Allow 1-Way Shear	=	40.00	40.00	psi

Toe Reinforcing = # 5 @ 12.00 in
Heel Reinforcing = # 4 @ 18.00 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@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 in, #9@ 46
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 1.14 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

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

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Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	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)				1,879.2	5.17	3,887.2
Soil Over HL (bel. water tbl)					5.17	3,887.2
Watre Table						
Sloped Soil Over Heel =						
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) =				800.0	3.08	2,466.7
Earth @ Stem Transitions =						
Footing Weight =				661.5	2.21	1,458.6
Key Weight =						
Vert. Component =						
Total =	1,417.5	**O.T.M.** =	4,252.5	**Total =** 2,454.8 lbs	**R.M.=**	7,812.5

Resisting/Overturning Ratio = **1.84**
Vertical Loads used for Soil Pressure = 2,454.8 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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

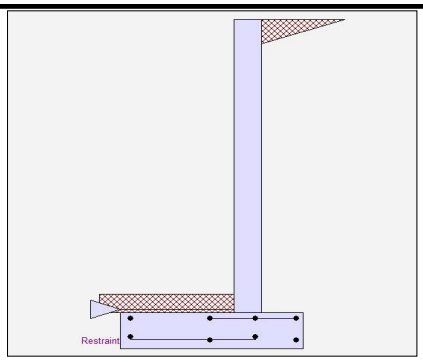
Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	2,667.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	6.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	54.000
Total Seismic Force	=	486.000

Design Summary

Wall Stability Ratios

Overturning	=	1.36	Ratio < 1.5!

Slab Resists All Sliding !

Total Bearing Load	=	2,466	lbs
...resultant ecc.	=	0.00	in
Soil Pressure @ Toe	=	558	psf OK
Soil Pressure @ Heel	=	558	psf OK
Allowable	=	2,667	psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	781	psf
ACI Factored @ Heel	=	781	psf
Footing Shear @ Toe	=	8.5	psi OK
Footing Shear @ Heel	=	5.0	psi OK
Allowable	=	75.0	psi

Sliding Calcs

Lateral Sliding Force	=	1,757.7	lbs

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

Load Factors

Building Code	IBC 2012,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 5
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.800**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	2,224.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	6,506.7
Moment.....Allowable =	8,121.3
Shear.....Actual	
Service Level psi =	
Strength Level psi =	30.0
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.19
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2464 in2/ft		
(4/3) * As :	0.3285 in2/ft	Min Stem T&S Reinf Area 1.536 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	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2475 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	=	2.75 ft
Heel Width	=	1.67
Total Footing Width	=	4.42
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	=	781	781	psf
Mu' : Upward	=	2,954	393	ft-#
Mu' : Downward	=	964	695	ft-#
Mu: Design	=	1,990	301	ft-#
Actual 1-Way Shear	=	8.53	5.01	psi
Allow 1-Way Shear	=	40.00	40.00	psi

Toe Reinforcing = # 5 @ 12.00 in
Heel Reinforcing = # 4 @ 18.00 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@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 in, #9@ 46
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 1.15 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

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	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 =	340.2	4.50	1,530.9			
=						
Soil Over HL (ab. water tbl)				1,879.2	5.17	3,931.4
Soil Over HL (bel. water tbl)					5.17	3,931.4
Watre Table						
Sloped Soil Over Heel =						
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) =				800.0	3.08	2,466.7
Earth @ Stem Transitions =						
Footing Weight =				663.0	2.21	1,465.2
Key Weight =						
Vert. Component =						
Total =	1,757.7	**O.T.M.** =	5,783.4	**Total =** 2,466.3 lbs	**R.M.=**	7,863.3

Resisting/Overturning Ratio = **1.36**
Vertical Loads used for Soil Pressure = 2,466.3 lbs

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

If seismic is included, the OTM and sliding ratios
be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

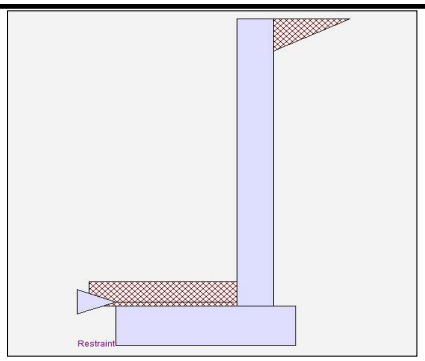
Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.73	OK

Slab Resists All Sliding !

Total Bearing Load	=	1,326 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	398 psf	OK
Soil Pressure @ Heel	=	398 psf	OK
Allowable	=	2,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	558 psf	
ACI Factored @ Heel	=	558 psf	
Footing Shear @ Toe	=	5.5 psi	OK
Footing Shear @ Heel	=	2.1 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	IBC 2012,ACI
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	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.371**
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	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	13.4
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0755 in2/ft		
(4/3) * As :	0.1007 in2/ft	Min Stem T&S Reinf Area 1.152 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.25 ft
Heel Width	=	1.08
Total Footing Width	=	3.33
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 psi Fy = 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	=	558	558	psf
Mu' : Upward	=	1,411	48	ft-#
Mu' : Downward	=	570	90	ft-#
Mu: Design	=	842	42	ft-#
Actual 1-Way Shear	=	5.47	2.12	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: #4@ 11.10 in, #5@ 17.21 in, #6@ 24.43 in, #7@ 33.32 in, #8@ 43.88 in, #9@ 5
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 0.72 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

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

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)	2,314.4	3.83	1,861.3	Soil Over HL (ab. water tbl)	1,879.2	5.17	968.2
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		5.17	968.2
Hydrostatic Force				Watre Table			
Buoyant Force	=			Sloped Soil Over Heel	=		
Surcharge over Heel	=			Surcharge Over Heel	=		
Surcharge Over Toe	=			Adjacent Footing Load	=		
Adjacent Footing Load	=			Axial Dead Load on Stem	=		
Added Lateral Load	=			* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=			Soil Over Toe	=	1.13	
	=			Surcharge Over Toe	=		
				Stem Weight(s)	=	600.0	2.58	1,550.0
				Earth @ Stem Transitions	=		
				Footing Weight	=	416.3	1.67	693.1
				Key Weight	=			
				Vert. Component	=			
Total	= 817.2	**O.T.M.** =	1,861.3	**Total =**	1,326.3 lbs	**R.M.=**	3,211.3

Resisting/Overturning Ratio = **1.73**
Vertical Loads used for Soil Pressure = 1,326.3 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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

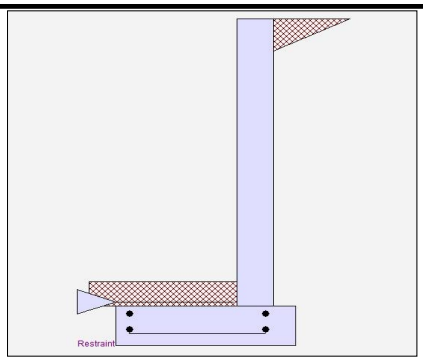
Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	2,667.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method : Uniform
Multiplier Used = 6.000
(Multiplier used on soil density)

Uniform Seismic Force = 41.000
Total Seismic Force = 280.167

Design Summary

Wall Stability Ratios
Overturning = 1.27 Ratio < 1.5!
Slab Resists All Sliding !

Total Bearing Load	=	1,326	lbs
...resultant ecc.	=	0.00	in
Soil Pressure @ Toe	=	398	psf OK
Soil Pressure @ Heel	=	398	psf OK
Allowable	=	2,667	psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	558	psf
ACI Factored @ Heel	=	558	psf
Footing Shear @ Toe	=	5.5	psi OK
Footing Shear @ Heel	=	2.1	psi OK
Allowable	=	75.0	psi

Sliding Calcs
Lateral Sliding Force = 1,013.3 lbs

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

Load Factors

Building Code	IBC 2012,ACI
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	=		LRFD
Thickness	=		8.00
Rebar Size	=		# 4
Rebar Spacing	=		12.00
Rebar Placed at	=		Edge
Design Data			
fb/FB + fa/Fa	=		**0.508**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		1,254.0
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		2,754.0
Moment.....Allowable	=		5,412.6
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		16.7
Shear.....Allowable	psi =		75.0
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =		6.25
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =		100.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=		Medium Weight
Masonry Design Method	=		ASD
Concrete Data			
f'c	psi =		2,500.0
Fy	psi =		60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.1032 in2/ft	
(4/3) * As :	0.1376 in2/ft	Min Stem T&S Reinf Area 1.152 in2
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in #4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in #5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in #6@ 55.00 in

Footing Data

Toe Width	=	2.25 ft
Heel Width	=	1.08
Total Footing Width	=	3.33
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 2,500 psi Fy = 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	=	558	558	psf
Mu' : Upward	=	1,411	48	ft-#
Mu' : Downward	=	570	90	ft-#
Mu: Design	=	842	42	ft-#
Actual 1-Way Shear	=	5.47	2.12	psi
Allow 1-Way Shear	=	40.00	40.00	psi

Toe Reinforcing = # 4 @ 12.00 in
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: #4@ 11.10 in, #5@ 17.21 in, #6@ 24.43 in, #7@ 33.32 in, #8@ 43.88 in, #9@ 5
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 0.72 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

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	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 =						
Seismic Earth Load =	196.1	3.42	670.1			
=						
Soil Over HL (ab. water tbl)				1,879.2	5.17	968.2
Soil Over HL (bel. water tbl)					5.17	968.2
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =					1.13	
Surcharge Over Toe =						
Stem Weight(s) =				600.0	2.58	1,550.0
Earth @ Stem Transitions =						
Footing Weight =				416.3	1.67	693.1
Key Weight =						
Vert. Component =						
Total =	1,013.3	**O.T.M.** =	2,531.4	**Total =** 1,326.3 lbs	**R.M.=**	3,211.3

Resisting/Overturning Ratio = **1.27**
Vertical Loads used for Soil Pressure = 1,326.3 lbs

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

If seismic is included, the OTM and sliding ratios
be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

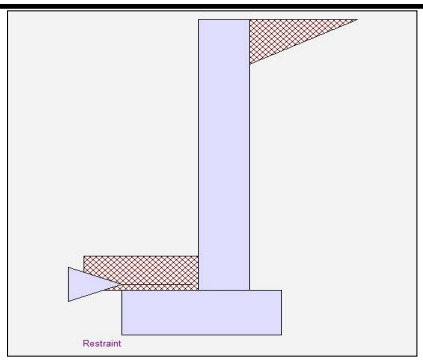
Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.92	OK
Slab Resists All Sliding !			
Total Bearing Load	=	815 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	392 psf	OK
Soil Pressure @ Heel	=	392 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	548 psf	
ACI Factored @ Heel	=	548 psf	
Footing Shear @ Toe	=	2.9 psi	OK
Footing Shear @ Heel	=	1.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	381.1 lbs

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

Load Factors

Building Code	IBC 2012,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	18.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.162**
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 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	1.08
Total Footing Width	=	2.08
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	=	548	548	psf
Mu' : Upward	=	274	47	ft-#
Mu' : Downward	=	98	62	ft-#
Mu: Design	=	177	15	ft-#
Actual 1-Way Shear	=	2.85	0.99	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: #4@ 13.88 in, #5@ 21.52 in, #6@ 30.55 in, #7@ 41.66 in, #8@ 54.85 in, #9@ 6
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area	0.36	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

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	592.8			
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)				1,879.2	5.17	387.2
Soil Over HL (bel. water tbl)					5.17	387.2
Watre Table						
Sloped Soil Over Heel =						
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 =				208.0	1.04	216.3
Key Weight =						
Vert. Component =						
Total =	381.1	**O.T.M.** =	592.8	**Total =** 814.7 lbs	**R.M.=**	1,136.8

Resisting/Overturning Ratio = **1.92**
Vertical Loads used for Soil Pressure = 814.7 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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

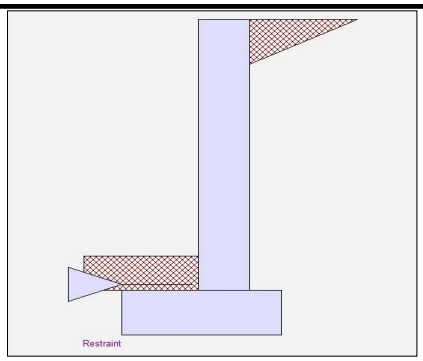
Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	2,667.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	6.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	28.000
Total Seismic Force	=	130.667

Design Summary

Wall Stability Ratios

Overturning	=	1.41	Ratio < 1.5!

Slab Resists All Sliding !

Total Bearing Load	=	815 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	392 psf	OK
Soil Pressure @ Heel	=	392 psf	OK
Allowable	=	2,667 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	548 psf	
ACI Factored @ Heel	=	548 psf	
Footing Shear @ Toe	=	2.9 psi	OK
Footing Shear @ Heel	=	1.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	472.6 lbs

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

Load Factors

Building Code	IBC 2012,ACI
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 =	LRFD
Thickness =	8.00
Rebar Size =	# 4
Rebar Spacing =	18.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	**0.224**
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	560.0
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	821.3
Moment.....Allowable =	3,655.6
Shear.....Actual	
Service Level psi =	
Strength Level psi =	7.5
Shear.....Allowable psi =	75.0
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	6.25
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	100.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	2,500.0
Fy psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0308 in2/ft	
(4/3) * As :	0.041 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	=	1.08
Total Footing Width	=	2.08
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	=	548	548	psf
Mu' : Upward	=	274	47	ft-#
Mu' : Downward	=	98	62	ft-#
Mu: Design	=	177	15	ft-#
Actual 1-Way Shear	=	2.85	0.99	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: #4@ 13.88 in, #5@ 21.52 in, #6@ 30.55 in, #7@ 41.66 in, #8@ 54.85 in, #9@ 6
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area	0.36	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

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	592.8			
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 =	91.5	2.33	213.4			
=						
Soil Over HL (ab. water tbl)				1,879.2	5.17	387.2
Soil Over HL (bel. water tbl)					5.17	387.2
Watre Table						
Sloped Soil Over Heel =						
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 =				208.0	1.04	216.3
Key Weight =						
Vert. Component =						
Total =	472.6	**O.T.M.** =	806.3	**Total =** 814.7 lbs	**R.M.=**	1,136.8

Resisting/Overturning Ratio = **1.41**
Vertical Loads used for Soil Pressure = 814.7 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
be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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)	0.000	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.

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

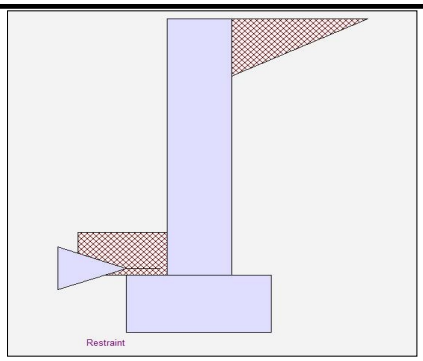
Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	400.0 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		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.87	OK
Slab Resists All Sliding !			
Total Bearing Load	=	605 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	403 psf	OK
Soil Pressure @ Heel	=	403 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	565 psf	
ACI Factored @ Heel	=	565 psf	
Footing Shear @ Toe	=	0.2 psi	OK
Footing Shear @ Heel	=	0.0 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	IBC 2012,ACI
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	=	LRFD
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 =	
Rebar Depth 'd'	in =	6.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	100.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	60,000.0

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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	=	565	565	psf
Mu' : Upward	=	50	48	ft-#
Mu' : Downward	=	17	49	ft-#
Mu: Design	=	33	0	ft-#
Actual 1-Way Shear	=	0.22	0.03	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: #4@ 13.88 in, #5@ 21.52 in, #6@ 30.55 in, #7@ 41.66 in, #8@ 54.85 in, #9@ 6
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*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

This Wall in File: K:\2019\01519-2019-01 Yuan\Calculations\pin piles\061819 Typical Detail Co-04-07.

Cantilevered Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

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)	2,314.4	3.83	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)				1,879.2	5.17	200.5
Soil Over HL (bel. water tbl)					5.17	200.5
Watre Table						
Sloped Soil Over Heel =						
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)	0.000	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.