Structural Calculations For:

Kahan Spec Home

8613 West Mercer Way

Mercer Island, WA 98040

Prepared for: Brandt Design Group

Job #: 01519-2020-15

Date: November 30, 2020

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:	8163 West Mercer Way
City:	Mercer Islanc
State:	WA
ZIP:	98040
Latitude:	47.5283 N
Longitude:	-122.2325 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 (wood) Walls Sheathed with Wood Structural Panels Rated for Shear Resistance		
R:	6.50	C_d=	4
Base Shear V =	17 kips	Ω_o=	2.5
S_S=	1.467	S_1=	0.558
S_{DS}=	0.98	S_{D1}=	0.56
C_s=	0.150	I_E=	1.0

Wind Load Summary:

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

Dead Loads:

Roof		
Roofing	2.5	psf
1/2" Sheathing	1.8	psf
Trusses @ 24" oc	2.5	psf
Misc./Mech.	1.5	psf
Ceiling Finish	2.8	psf
Solar Panels	4	
	15	psf
Use	15	psf
Upper & Main Floor		
Finish Floor	1	psf
3/4" Sheathing	2.7	psf
Joists @ 16" oc	2.2	psf
Misc./Mech.	2	psf
Ceiling Finish	2.8	
	10.7	psf
Use	12	psf

Live Loads:

Snow	25	psf
Floor	40	psf

Soils:

Allowable Bearing	1500	psf

SSF STRUCTURAL ENGINEERING

2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
SEATTLE TACOMA
ssfengineers.com
SWENSON SAY FAGET

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 (wood) Walls Sheathed with Wood Structural Panels Rated for Shear Resistance

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	

Ω_o	2.5	
S_S	1.467 g	2% in 50 yr, Latitude & Longitude lookup
S_1	0.558 g	2% in 50 yr, Latitude & Longitude lookup
h_n	24.0 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	0.22 sec	Eq. 12.8-7
I_0	0.11 sec	
I_S	0.57 sec	
k	1.000	
Fa	1.00	Table 11.4-1
Fv	1.50	Table 11.4-2
S_{MS}	1.47 g	Eq. 11.4-1
S_{M1}	0.84 g	Eq. 11.4-2
S_{DS}	0.978 g	Eq. 11.4-3
S_{D1}	0.558 g	Eq. 11.4-4
Cs	***0.150 Controls***	Eq. 12.8-2
	0.396	Eq. 12.8-3 need not exceed, I < I_L
	0.010	Eq. 12.8-5 or 12.8-6 minimum
Cs, design	0.150	
Bldg. Weight	111.3 k	
V = C_SW	16.7 k	Eq. 12.8-1, Strength Level Base Shear
V = C_{Sasd}W	11.7 k	Eq. 12.8-1 ASD Base Shear

$T_a = C_t h_n^x$ Eq. 12.8.7

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

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

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

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

Vertical Distribution ASD ρ= 1

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)	$F_{px,calc}$	$F_{px,min}$	$F_{px,max}$	$F_{px,design}$	$\gamma=F_{px}/F_x$
3	24.0	50	24.0	1200	0.620	7.3	**7.3**	7.3	6.8	13.7	**7.3**	1.00
2	12.0	61	12.0	736	0.380	4.5	**11.7**	6.5	8.4	16.8	**8.4**	1.88
Σ		111.3		1936		**11.7**						

SSF STRUCTURAL ENGINEERING
SEATTLE TACOMA 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com
SWENSON SAY FAGÉT

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=	0.94	Table 27.3-1
G=	0.85	26.9.4

Location and Building Dimensions

Calculate Kzt?	No	
Kzt	1.00	
Roof Type	Gable	
Roof Angle - Transverse Dir	26	degrees
Roof Angle - Long Dir	26	degrees
Ground to top of roof	28	ft
Bot of roof to top of roof	8.5	ft
Mean Roof Height, h	23.75	ft
Short Plan Dimension	30	ft
Long Plan Dimension	60	ft
Parapet ?	No	
Ground to top of parapet		ft
Average Parapet Height		ft
Ht of 2nd Level Above Grade	15	ft

Velocity Pressure at Mean Roof Height, q_h =	24.6	psf

Transverse Wind Pressures

L/B = 0.50 h/L = 0.79

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.50
Windward Roof	-0.39 / 0.11
Leeward Roof	-0.60

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	10.46	**15.41**
15-20	0.9	23.70	16.11	10.46	**15.95**
20-25	0.94	24.75	16.83	10.46	**16.38**
25-30	0.98	25.80	17.55	10.46	**16.81**
30-40	1.04	27.38	18.62	10.46	**17.45**
41-50	1.09	28.70	19.52	10.46	**17.99**
51-60	1.13	29.75	20.23	10.46	**18.42**
61-70	1.17	30.81	20.95	10.46	**18.85**
71-80	1.21	31.86	21.66	10.46	**19.28**
81-90	1.24	32.65	22.20	10.46	**19.60**
91-100	1.26	33.18	22.56	10.46	**19.81**

Roof Pressures (Unfactored) ASD

Windward		Leeward	**Horiz Proj (psf)**
Max	Min		
2.2	-8.1	-12.6	**4.80**

Longitudinal Wind Pressures

L/B = 2.00 h/L = 0.40

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.30
Windward Roof	-0.25 / 0.24
Leeward Roof	-0.60

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	6.28	**12.90**
15-20	0.9	23.70	16.11	6.28	**13.44**
20-25	0.94	24.75	16.83	6.28	**13.86**
25-30	0.98	25.80	17.55	6.28	**14.29**
30-40	1.04	27.38	18.62	6.28	**14.94**
41-50	1.09	28.70	19.52	6.28	**15.48**
51-60	1.13	29.75	20.23	6.28	**15.91**
61-70	1.17	30.81	20.95	6.28	**16.34**
71-80	1.21	31.86	21.66	6.28	**16.77**
81-90	1.24	32.65	22.20	6.28	**17.09**
91-100	1.26	33.18	22.56	6.28	**17.30**

Roof Pressures (Unfactored) ASD

Windward		Leeward	**Horiz Proj (psf)**
Max	Min		
5.1	-5.2	-12.6	**4.80**

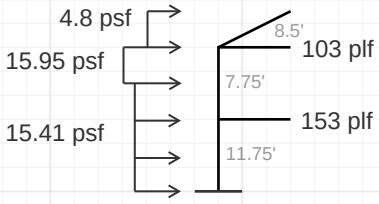
SWENSON SAY FAGÉT
SEATTLE TACOMA
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

Lateral Design

SWENSON SAY FAGÉT
ssfengineers.com
SEATTLE
TACOMA
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

Lateral Design

Wind Pressure Distribution



Seismic Story Shear

7.3+0.3=7.6 k

4.7+0.5=5.2 k

Add brick to seismic weight:

Vs-brick= 0.7*0.15*15psf*200 = 0.3k

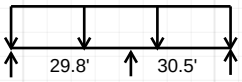
Vs-brick= 0.7*0.15*40psf*303 = 0.5k

Total Base Shear = 13.9 k

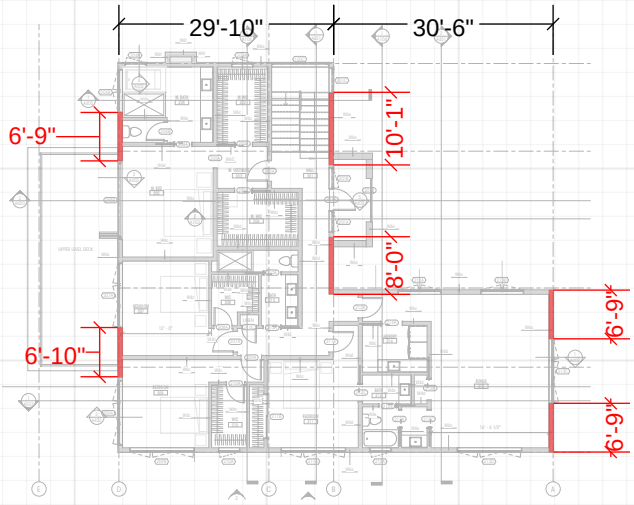
N-S Direction

Roof

w_w = 103 plf
w_E = 8.1k (SPLIT 70/30)



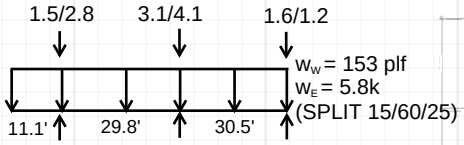
V(k) [W/E]	1.5/2.8	3.1/4.1	1.6/1.2
L(ft) [act/red]	13.6	18.1	13.5
v(plf)	206	227	148
SW	W6	W6	W6
OT(k)	1.6	1.2	1.1
HD	CS16	CS16	CS16



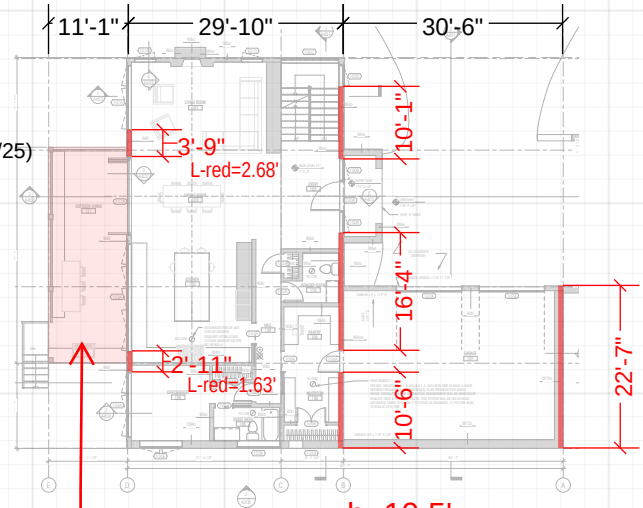
h=7.75'
h/2=3.875'
h/3.5=2.21'

N

Floor



V(k) [W/E]	3.8/5.4	7.7/6.6	3.9/1.9
L(ft) [act/red]	6.67/4.31	36.9	22.6
v(plf)	1253	209	173
SW	2W2-10	W6	W6
OT(k)	7.25	2.2	-
HD	HDU8	HDU2	-
ΣOT(k)	8.8	3.4	1.1
ΣHD	HDU11	HDU4	HDU2



Deck:
Veq deck = 0.9k
w = 0.9/11.1 = 78plf
M-deck= 4.7kft
M/d = 6.5kft/29ft = 163lbs --> DTT2Z

cantilever deck diaphragm

h=10.5'
h/2=5.25'
h/3.5=3'

N

SWENSON SAY FAGET
SEATTLE TACOMA
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

Lateral Design

Wind Pressure Distribution

Seismic Story Shear

7.3+0.8=8.1 k

4.5+1.3=5.8 k

Add brick to seismic weight:

Vs-brick= 0.7*0.15*40psf*200 = 0.84k

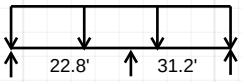
Vs-brick= 0.7*0.15*40psf*303 = 1.27k

Total Base Shear = 13.9 k

E-W Direction

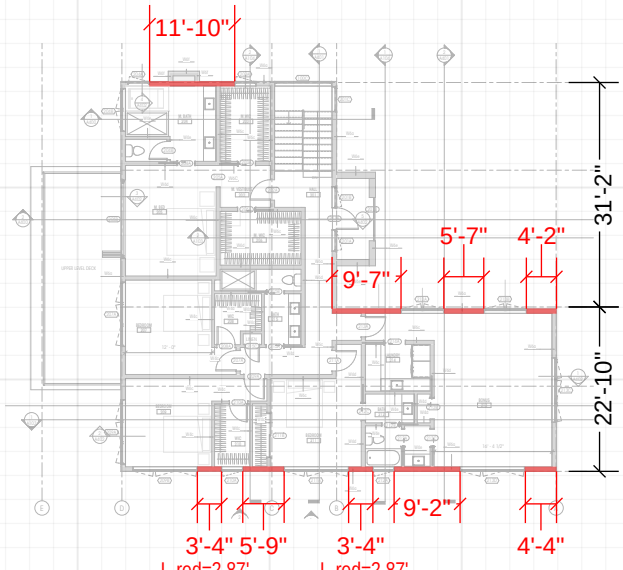
Roof

w_w = 103 plf
w_E = 8.1k/54'=150 plf

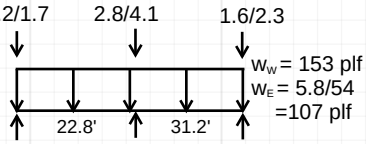


V(k) [W/E]	1.2/1.7	2.8/4.1	1.6/2.3
L(ft) [act/red]	25	19.33	11.83
v(plf)	68	212	194
SW	W6	W6	W6
OT(k)	-	1.6	1.5
HD	-	CS16	CS16

USE FTAO TO REDUCE HDS - SEE ATTACHED SPREADSHEET

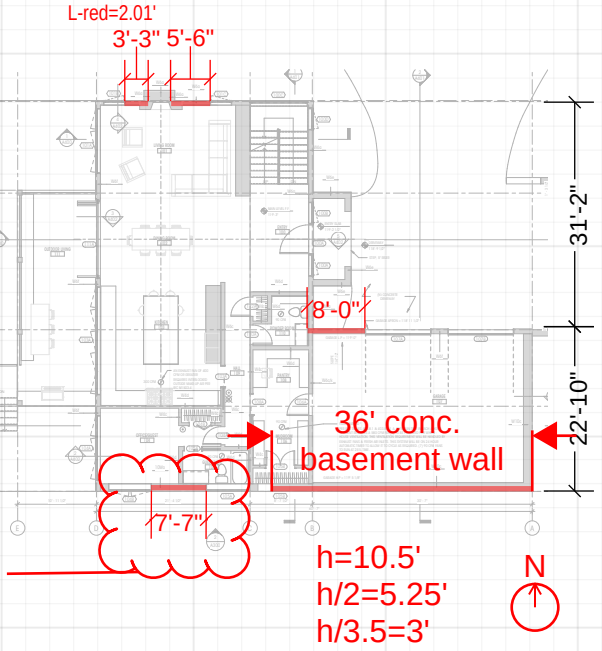


Floor



V(k) [W/E]	1.5/1.5	6.9/7.0	4.0/4.0
L(ft) [act/red]	7.5	8	8.75/7.5
v(plf)	200	875	533
SW	W6	2W3	W2
OT(k)	-	8.5	4.8
HD	-	HDU11	HDU4
ΣOT(k)	-	9.7	6.3
ΣHD	-	HDU11	HDU8

assume half of 2.9K/2.9K lateral load at gridline 5 to wood sw (h~4')

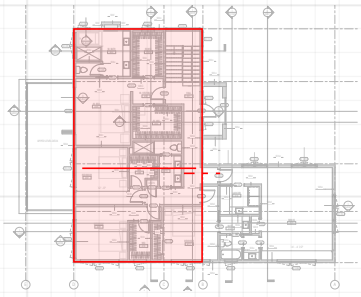


SWENSON SAY FAGET
SEATTLE TACOMA
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

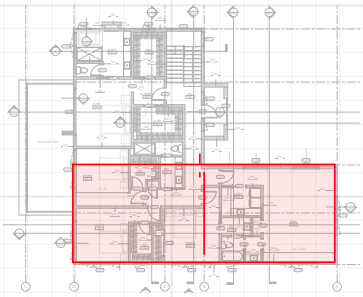
Lateral Design

Lateral continuity at roof:

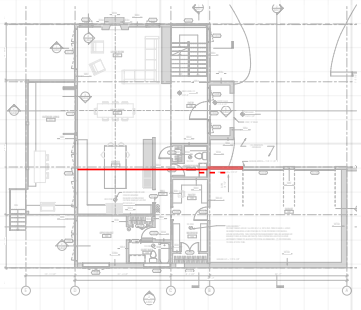
Drag load into middle line of shearwalls:
Awest/Atotal = 70%
Veq=4.1k*.7=2.9k*omega = 7.2k
Provide HDU8



Drag load into middle line of shearwalls:
Awest/Atotal = 60%
Veq=4.1k*.6=2.5k*omega = 6.2k
Provide HDU8



Drag load into 2W3 shearwall
Awest/Atotal = 75%
Veq=7k*.75=5.3k*omega = 13.1k
Provide HDU14
At steel beam: 13.1k/30ft * 18ft = 7.8k
Provide HDU8



SWENSON SAY FAGÉT
ssfengineers.com
SEATTLE
TACOMA
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

Force Transfer Around Openings Calculator

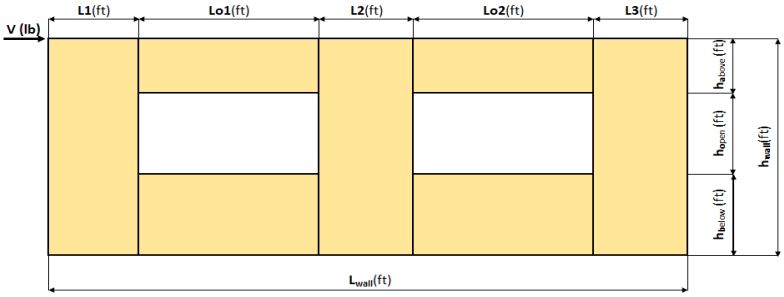
TWO OPENINGS

The force transfer around openings (FTAO) method of shear wall analysis is an approach that aims to reinforce the wall such that it performs as if there was no opening. This approach lends certain advantages over segmented shear walls: more versatility, because it allows for narrower wall segments while still meeting the height-to-width ratios and, often, fewer required hold-downs.

Project Information

Code:	IBC
Designer:	HAA
Client:	Brandt
Project:	Kahan Spec Home
Wall Line:	Gridline 3 - Roof

Date: 11/17/2020



Shear Wall Calculation Variables

V	4100 lbf		Opening 1		Opening 2	Adj. Factor Method =	2bs/h
L1	9.58 ft	ha1	0.83 ft	ha2	0.83 ft	Wall Pier Aspect Ratio	Adj. Factor
L2	5.58 ft	ho1	5.50 ft	ho2	5.50 ft	P1=ho1/L1= 0.57	N/A
L3	4.17 ft	hb1	1.42 ft	hb2	1.42 ft	P2=ho2/L2= 0.99	N/A
h_{wall}	7.75 ft	Lo1	6.00 ft	Lo2	6.00 ft	P3=ho3/L3= 1.32	N/A
L_{wall}	31.33 ft						

1. Hold-down forces: $H = Vh_{wall}/L_{wall}$ 1014 lbf

2. Unit shear above + below opening

First opening: va1 = vb1 = H/(ha1+hb1) =	451 plf
Second opening: va2 = vb2 = H/(ha2+hb2) =	451 plf

3. Total boundary force above + below openings

First opening: O1 = va1 x (Lo1) =	2705 lbf
Second opening: O2 = va2 x (Lo2) =	2705 lbf

4. Corner forces

F1 = O1(L1)/(L1+L2) =	1709 lbf
F2 = O1(L2)/(L1+L2) =	995 lbf
F3 = O2(L2)/(L2+L3) =	1548 lbf
F4 = O2(L3)/(L2+L3) =	1157 lbf

5. Tributary length of openings

T1 = (L1*Lo1)/(L1+L2) =	3.79 ft
T2 = (L2*Lo1)/(L1+L2) =	2.21 ft
T3 = (L2*Lo2)/(L2+L3) =	3.43 ft
T4 = (L3*Lo2)/(L2+L3) =	2.57 ft

6. Unit shear beside opening

V1 = (V/L)(L1+T1)/L1 =	183 plf
V2 = (V/L)(T2+L2+T3)/L2 =	263 plf
V3 = (V/L)(T4+L3)/L3 =	211 plf
Check V1*L1+V2*L2+V3*L3=V?	4100 lbf **OK**

7. Resistance to corner forces

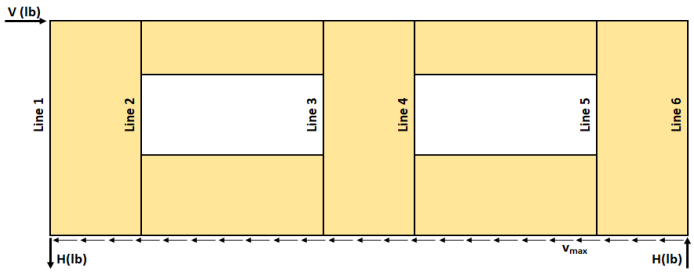
R1 = V1*L1 =	1750 lbf
R2 = V2*L2 =	1469 lbf
R3 = V3*L3 =	882 lbf

8. Difference corner force + resistance

R1-F1 =	41 lbf
R2-F2-F3 =	-1075 lbf
R3-F4 =	-275 lbf

9. Unit shear in corner zones

vc1 = (R1-F1)/L1 =	4 plf
vc2 = (R2-F2-F3)/L2 =	-193 plf
vc3 = (R3-F4)/L3 =	-66 plf



Check Summary of Shear Values for Two Openings

Line 1: vc1(ha1+hb1)+V1(ho1)=H?		10	1005	1014 lbf
Line 2: va1(ha1+hb1)-vc1(ha1+hb1)-V1(ho1)=0?	1014	10	1005	0
Line 3: vc2(ha1+hb1)+V2(ho1)-va1(ha1+hb1)=0?	-433	1448	1014	0
Line 4: va2(ha2+hb2)-V2(ho2)-vc2(ha2+hb2)=0?	1014	1448	-433	0
Line 5: va2(ha2+hb2)-vc3(ha2+hb2)-V3(ho2)=0?	1014	-148	1163	0
Line 6: vc3(ha2+hb2)+ V3(ho2) = H?		-148	1163	1014 lbf

Design Summary

Req. Sheathing Capacity	451 plf	**4-Term Deflection**		**3-Term Deflection**	
Req. Strap Force	1709 lbf	**4-Term Story Drift %**		**3-Term Story Drift %**	
Req. HD Force	1014 lbf	See Page 2		See Page 3	

Project Information

Code:	IBC	**Date:**	11/17/2020
Designer:	HAA		
Client:	Brandt		
Project:	Kahan Spec Home		
Wall Line:	Gridline 3 - Roof		

Shear Wall Deflection Calculation Variables

Sheathing:		Wood End Post Values:			Nail Type:	8d common	(penny weight)
Plywood	Sheathing Material	Species:	hem fir				
15/32	Performance Category	E:	1.30E+06	(psi)		Pier 1	Pier 3
APA Rated Sheathing	Grade		Qty	Stud Size	Nail Spacing:	6	6 (in.)
		Dimensions:	2	2x6	HD Capacity:	1705	1705 (lbf)
	Gt Override	A:	16.5	(in.^{2})	HD Deflection:		(in.)
	Ga Overide	A Override:		(in.^{2})			

Four-Term Equation Deflection Check

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_a + d_a\frac{h}{b} \qquad \text{(Equation 23-2)}$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	Pier 3-L	Pier 3-R	
Sheathing:	15/32	15/32	15/32	15/32	15/32	15/32	
Nail:	8d common	8d common	8d common	8d common	8d common	8d common	
v_{asd}:	183	183	263	263	211	211	(plf)
$v_{strength}$:	261	261	376	376	302	302	(plf)
E:	1.30E+06	1.30E+06	1.30E+06	1.30E+06	1.30E+06	1.30E+06	(psi)
h:	7.75	6.33	6.33	6.33	6.33	7.75	(ft)
A:	16.5	16.5	16.5	16.5	16.5	16.5	(in.^{2})
Gt:	27,000	27,000	27,000	27,000	27,000	27,000	(lbf/in.)
Nail Spacing:	6	6	6	6	6	6	(in.)
Vn:	130	130	188	188	151	151	(plf)
e:	0.0092	0.0092	0.0278	0.0278	0.0144	0.0144	(in.)
b:	9.58	9.58	5.58	5.58	4.17	4.17	(ft)
HD Capacity:	1705	1705	1705	1705	1705	1705	(lbf)
HD Defl:							(in.)

Check Total Deflection of Wall System

Pier 1 (left)				Pier 1 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.005	0.075	0.054		0.003	0.061	0.044	
		Sum	0.133			Sum	0.108
Pier 2 (left)				Pier 2 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.006	0.088	0.132		0.006	0.088	0.132	
		Sum	0.227			Sum	0.227
Pier 3 (left)				Pier 3 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.007	0.071	0.068		0.013	0.087	0.083	
		Sum	0.146			Sum	0.183

Total Defl.	
	(in.)
	%drift

Project Information

Code:	IBC	**Date:**	11/17/2020
Designer:	HAA		
Client:	Brandt		
Project:	Kahan Spec Home		
Wall Line:	Gridline 3 - Roof		

Three-Term Equation Deflection Check

$$\delta_{sw} = \frac{8vh^3}{EAb} + \frac{vh}{1000G_a} + \frac{h\Delta_a}{b} \qquad (4.3\text{-}1)$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	Pier 3-L	Pier 3-R	
Sheathing:	15/32	15/32	15/32	15/32	15/32	15/32	
Nail:	8d common	8d common	8d common	8d common	8d common	8d common	
v_{asd}:	183	183	263	263	211	211	(plf)
$v_{strength}$:	261	261	376	376	302	302	(plf)
E:	1.30E+06	1.30E+06	1.30E+06	1.30E+06	1.30E+06	1.30E+06	(psi)
h:	7.75	6.33	6.33	6.33	6.33	7.75	(ft)
A:	16.5	16.5	16.5	16.5	16.5	16.5	($in.^2$)
Ga:	10.0	10.0	10.0	10.0	10.0	10.0	(kips/in.)
b:	9.58	9.58	5.58	5.58	4.17	4.17	(ft)
HD Capacity:	1705	1705	1705	1705	1705	1705	(lbf)
HD Defl:							(in.)

Check Total Deflection of Wall System

Pier 1 (left)			Pier 1 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.005	0.202		0.003	0.165	
	Sum	0.207		Sum	0.168
Pier 2 (left)			Pier 2 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.006	0.238		0.006	0.238	
	Sum	0.244		Sum	0.244
Pier 3 (left)			Pier 3 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.007	0.191		0.013	0.234	
	Sum	0.198		Sum	0.247

Total Defl.	
	(in.)
	%drift

Comment: The 3-term equation is calibrated to be approximately equal to 4-term equation at 1.4*ASD capacity.

Gravity Design

SWENSON SAY FAGÉT
ssfengineers.com
SEATTLE
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

Gravity Design

Roof Framing

B1

L= 9'	f_b= 987 psi
w= 600 plf	f_v= 81 psi
R= 2.7 k	Δ= 0.125"
M= 6.1 k-ft	L/861

4x12

B2

L= 11'	f_b= 1147 psi
w= 600 plf	f_v= 93 psi
R= 3.3 k	Δ= 0.171"
M= 9.1 k-ft	L/770

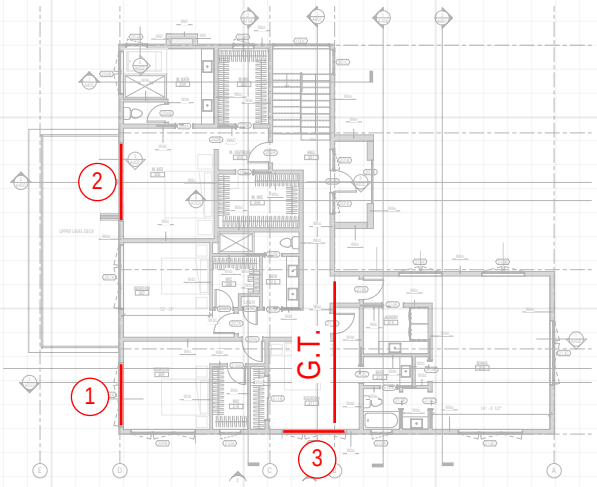
GL 3-1/8X13-1/2

B3

L= 18'	f_b= 1902 psi
w= 460 plf	f_v= 283 psi
P= 6.9 k (@ 7ft)	Δ= 0.16"
R= 6.4 k	L/668
M= 11.9 k-ft	

GL 3.125x12

Key plan



SWENSON SAY FAGÉT
ssfengineers.com
SEATTLE
TACOMA
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

Gravity Design

Upper Floor Framing

B1

L= 23' w= 69 plf Rxn= 0.8 k

14" TJI 360 @ 16" oc

B2

L= 22.5' DCR_M: 0.85
w= 780 plf DCR_V: 0.16
R= 8.7 k Δ= 0.65"
M= 49.4 k-ft L/414

W12x26

B3

L= 30' DCR_M= 0.68
w1= 69 plf DCR_V= 0.10
w2 = 286 plf Δ= 0.77"
P= 8.7 k (@ 17') L/466
P= 3.0 k (@ 31')
R= 8.74 k
M= 86 k-ft

W12x65

B4

L= 11' f_b= 1238 psi
w= 780 plf f_v= 103 psi
R= 4.3 k Δ= 0.21"
M= 11.8 k-ft L/637

LSL 3-1/2x14

B5

L= 11' f_b= 1041 psi
w= 984 plf f_v= 87 psi
R= 5.4 k Δ= 0.17"
M= 14.9 k-ft L/758

LVL (3) 1-3/4x14

B6

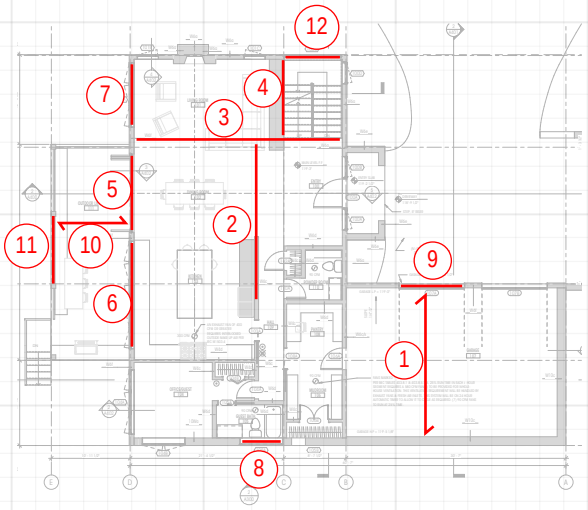
SEE ATTACHED
GL5-1/8x16-1/2

B7

L= 9' f_b= 1083 psi
w1= 546 plf f_v= 117 psi
w2 = 1146 plf Δ= 0.12"
P= 1.8 k (@ 6') L/939
R= 5.2 k
M= 10.3 k-ft

LSL 3-1/2x14

Key plan



B7 w/ ΩOT

L= 9' f_b= 1922 psi
w1= 546 plf f_v= 199 psi
w2 = 1146 plf Δ= 0.19"
P= 5.8 k (@ 6') L/577
R= 7.8 k
M= 18.3 k-ft

LSL 3-1/2x14

B8

L= 6' f_b= 1097 psi
w1= 169 plf f_v= 115 psi
w2 = 169 plf Δ= 0.05"
P= 4.3 k (@ 3.75') L/1435
R= 3.2 k
M= 6.7 k-ft

4x12

B9

L= 9.5' f_b= 2494 psi
w= 1058 plf f_v= 187 psi
R= 5.0 k Δ= 0.36"
M= 11.9 k-ft L/319

GL 3-1/8x10-1/2

B10

L= 11.5' f_b= 784 psi
w= 125 plf f_v= 53 psi
R= 0.7 k Δ= 0.21"
M= 2.1 k-ft L/649

2x12@16"OC

SWENSON SAY FAGÉT
SEATTLE TACOMA
ssfengineers.com
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

Gravity Design

Upper Floor (Cont.)

B11

L= 10'	f_b= 848 psi
w= 443 plf	f_v= 55 psi
R= 2.2 k	Δ= 0.17"
M= 5.5 k-ft	L/698

6x10 DF No.1

B12

L= 9'	f_b= 1063 psi
w= 230 plf	f_v= 62 psi
R= 1.0 k	Δ= 0.27"
M= 2.3 k-ft	L/394

(2) 2x8

SWENSON SAY FAGÉT
ssfengineers.com
SEATTLE
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

SINGLE-SPAN BEAM ANALYSIS

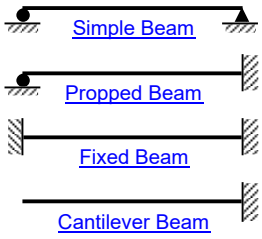
For Simple, Propped, Fixed, or Cantilever Beams

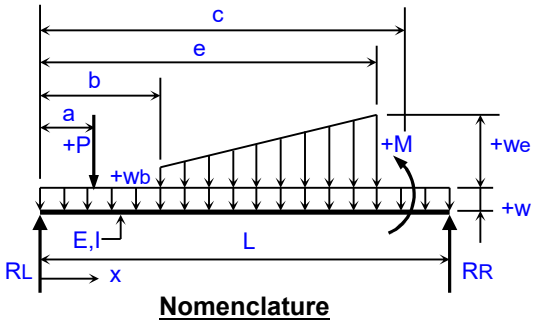
Job Name:	Kahan	Subject:	Upper Floor Beam 6		
Job Number:	01519-2020-15	Originator:	haa	Checker:	

Input Data:

Beam Data:

Span Type?	Simple	
Span, L =	15.0000	ft.
Modulus, E =	1800	ksi
Inertia, I =	1918.512	in.^4





Nomenclature

Beam Loadings:

Full Uniform:

w = 0.9836 kips/ft.

Distributed:	Start b (ft.)	Start wb (kips/ft.)	End e (ft.)	End we (kips/ft.)
#1:	0.0000	0.6000	2.0000	0.6000
#2:	11.0000	0.6000	15.0000	0.6000
#3:				
#4:				
#5:				
#6:				
#7:				
#8:				

Point Loads:	a (ft.)	P (kips)
#1:	2.0000	2.70
#2:	11.0000	2.70
#3:		
#4:		
#5:		
#6:	11.0000	0.00
#7:		
#8:		
#9:		
#10:		
#11:		
#12:		
#13:		
#14:		
#15:		

Moments:	c (ft.)	M (ft-kips)
#1:		
#2:		
#3:		
#4:		

Results:

Reactions:

RL =	11.877 k	RR =	11.88 k
ML =	N.A.	MR =	N.A.

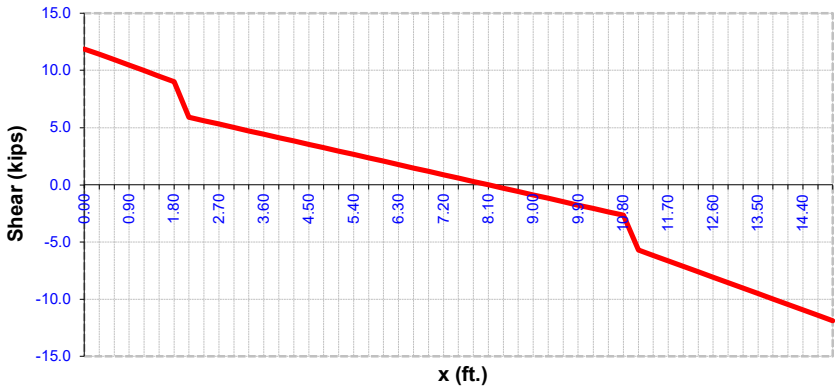
Maximum Moments:

+M(max) =	38.95 ft-k	@ x =	8.11 ft.
-M(max) =	0.00 ft-k	@ x =	0.00 ft.

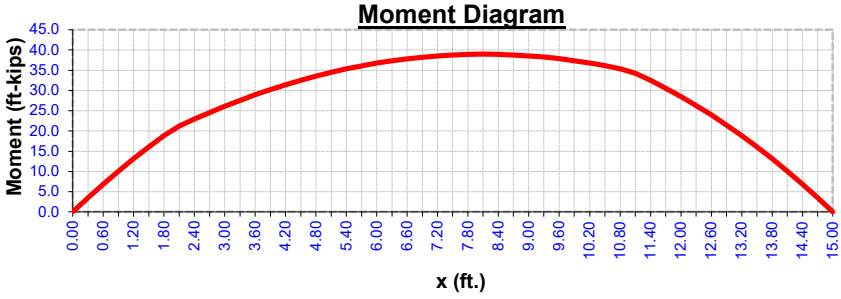
Maximum Deflections:

-Δ(max) =	-0.471 in.	@ x =	7.59 ft.
+Δ(max) =	0.000 in.	@ x =	0.00 ft.
Δ(ratio) =	L/382		

Shear Diagram



Moment Diagram



SINGLE-SPAN BEAM ANALYSIS

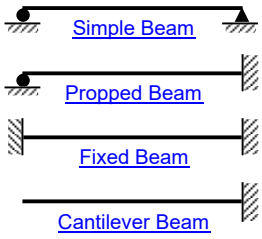
For Simple, Propped, Fixed, or Cantilever Beams

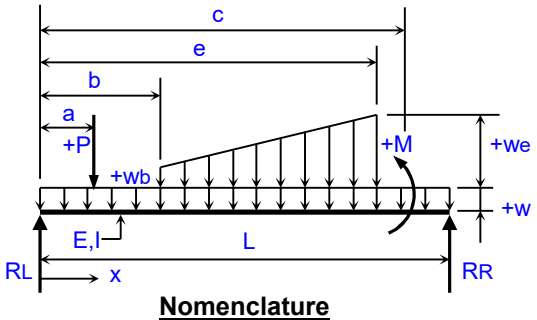
Job Name:	Kahan	Subject:	Upper Floor Beam 6		
Job Number:	01519-2020-15	Originator:	haa	Checker:	

Input Data:

Beam Data:

Span Type?	Simple	
Span, L =	15.0000	ft.
Modulus, E =	1800	ksi
Inertia, I =	1918.512	in.^4





Nomenclature

Beam Loadings:

Full Uniform:

w = 0.9836 kips/ft.

Distributed:	Start b (ft.)	Start wb (kips/ft.)	End e (ft.)	End we (kips/ft.)
#1:	0.0000	0.6000	2.0000	0.6000
#2:	11.0000	0.6000	15.0000	0.6000
#3:				
#4:				
#5:				
#6:				
#7:				
#8:				

Point Loads:	a (ft.)	P (kips)
#1:	2.0000	2.70
#2:	11.0000	2.70
#3:		
#4:		
#5:		
omega*ot =	11.0000	4.00
#7:		
#8:		
#9:		
#10:		
#11:		
#12:		
#13:		
#14:		
#15:		

Moments:	c (ft.)	M (ft-kips)
#1:		
#2:		
#3:		
#4:		

Results:

Reactions:

RL =	12.944 k	RR =	14.81 k
ML =	N.A.	MR =	N.A.

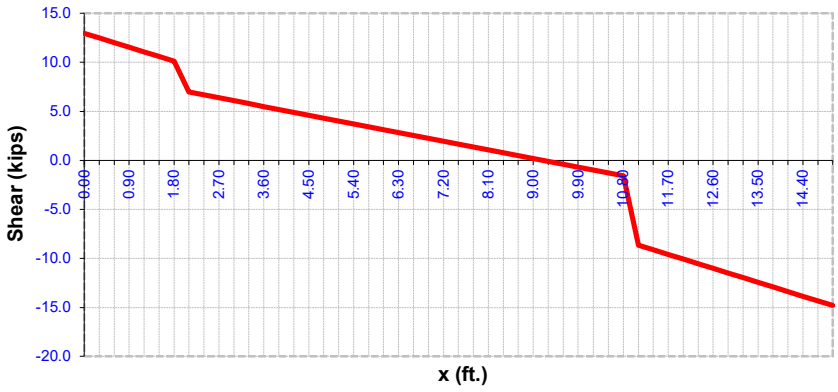
Maximum Moments:

+M(max) =	48.18 ft-k	@ x =	9.19 ft.
-M(max) =	0.00 ft-k	@ x =	0.00 ft.

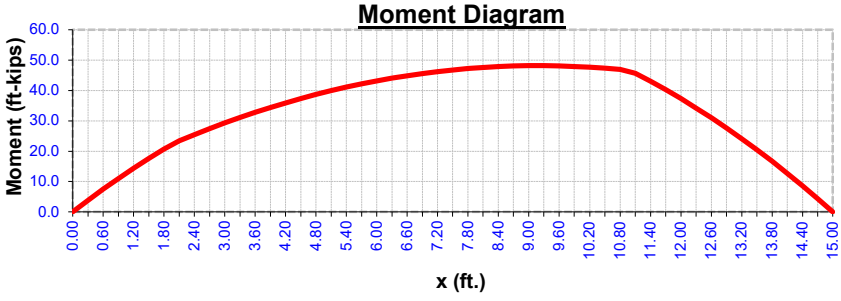
Maximum Deflections:

-Δ(max) =	-0.573 in.	@ x =	7.73 ft.
+Δ(max) =	0.000 in.	@ x =	0.00 ft.
Δ(ratio) =	L/314		

Shear Diagram



Moment Diagram



Gravity Design

Main Floor Framing

B1

L= 12'	f_b= 1078 psi
w= 286 plf	f_v= 86 psi
P= 3.0 k (@ mid-span)	Δ= 0.17"
R= 3.1 k	L/825
M= 10.3 k-ft	

LSL 3-1/2x14

B2

L= 22.5'	DCR_M: 0.85
w= 780 plf	DCR_V: 0.16
R= 8.7 k	Δ= 0.65"
M= 49.4 k-ft	L/414

W12x26

B3

L= 11'	f_b= 1238 psi
w= 780 plf	f_v= 103 psi
R= 4.3 k	Δ= 0.21"
M= 11.8 k-ft	L/637

LSL 3-1/2x14

B4

L= 6'	f_b= 689 psi
w= 546 plf	f_v= 66 psi
R= 1.6 k	Δ= 0.06"
M= 2.5 k-ft	L/1163

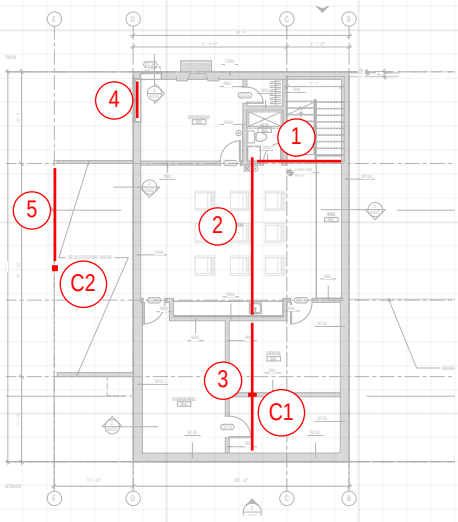
(2) 2x10

B5

L= 12'	f_b= 1837 psi
w= 540 plf	f_v= 170 psi
P= 5.5 k (@ 9.25')	Δ= 0.36"
R= 7.5 k	L/405
M= 18.8 k-ft	

GL 5-1/8x12

Key plan



SWENSON SAY FAGÉT
ssfengineers.com
SEATTLE
TACOMA
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

Column Buckling Calculations

NDS 2015

Column Geometry Data

Hem-Fir #2 Studs		
Hem-Fir Plates		
b	5.5	in
d	9	in
Le_1	9.10	ft
Le_2	9.10	ft
$le_{bending}$	8	ft

Column Design Values

F_b	850	psi
F_c	1300	psi
E'min	470	ksi
Fcperp	405	psi
cb	1.00	

Column Loading

P	18566	lbs
W_1	0	plf
M1	0	ft-lbs
W_2	0	plf
M2	0	ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C_D	1.00
Size Factor - C_F	1.00
Repetitive - C_r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C_D	1.00
Size Factor - C_F	1.00

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Bracing
No Brace
No Brace

Bearing
Area
Increase
No

Column Stability Factor Calculation

	Strong Axis		Weak Axis	
Fce_1	2624	psi	Fce_2 980	psi
Fc^*_1	1300	psi	Fc^*_2 1300	psi
Fce_1/Fc^*_1	2.019		Fce_2/Fc^*_2 0.754	
Cp_1	0.869		Cp_2 0.587	

Beam Stability Factor Calculation

	Strong Axis		Weak Axis	
Fbe_1	19747	psi	Fbe_2 42,258	psi
Fb'_1	850	psi	Fb'_2 850	psi
Fbe_1/Fb'_1	23.2		Fbe_2/Fb'_2 50	
le	8.0	ft		
CL_1	1.00			

Adjusted Allowable Stresses

	Strong Axis		Weak Axis	
Fc'_1	1129	psi	Fc'_2 763	psi
Fb'_1	848	psi	Fb'_2 850	psi

Imposed Column Stresses

	Strong Axis		Weak Axis	
fc_1	375	psi	fc_2 375	psi
fb_1	0	psi	fb_2 0	psi

Perpendicular to Grain Stress Check fcp/Fcp =	***375 / 405***	**OK**
Slenderness Check le/d	**12**	**OK**
Slenderness Check le/b	**20**	**OK**

(1) $$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

(2) $$\frac{fc}{F_{cE2}}+\left(\frac{f_{b1}}{F_{bE}}\right)^2<1.0$$

(3) $$\frac{f_c}{F_{c'}},\frac{f_{b1}}{F_{b1}'},\frac{f_{b2}}{F_{b2}'}<1.0$$

Allowable Stress Interaction Formula	**0.49**	**OK**

SSF STRUCTURAL ENGINEERING

2124 Third Avenue . Suite 100 . Seattle . WA 98121
www.swensonsayfaget.com
Office: 206.443.6212
Fax: 206.443.4870

Project: C1 - Main Floor Column
Date: *11/25/2020*
Project #: 01519-2020-15
Design: haa
Sheet: 18

Column Buckling Calculations

NDS 2015

Column Geometry Data

6X Posts Doug Fir - Larch #1		
Other		
b	5.5	in
d	5.5	in
Le_1	10.50	ft
Le_2	10.50	ft
$le_{bending}$	8	ft

Bracing

No Brace
No Brace

Column Design Values

F_b	1200	psi
F_c	1000	psi
E'min	580	ksi
Fcperp	650	psi
cb	1.00	

Bearing Area Increase
No

Column Loading

P	11428	lbs
W_1	0	plf
M1	0	ft-lbs
W_2	0	plf
M2	0	ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C_D	1.00
Size Factor - C_F	1.00
Repetitive - C_r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C_D	1.00
Size Factor - C_F	1.00

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Column Stability Factor Calculation

Strong Axis			Weak Axis		
Fce_1	908	psi	Fce_2	908	psi
Fc^*_1	1000	psi	Fc^*_2	1000	psi
Fce_1/Fc^*_1	0.908		Fce_2/Fc^*_2	0.908	
Cp_1	0.657		Cp_2	0.657	

Beam Stability Factor Calculation

Strong Axis			Weak Axis		
Fbe_1	39875	psi	Fbe_2	16,878	psi
Fb'_1	1200	psi	Fb'_2	1200	psi
Fbe_1/Fb'_1	33.2		Fbe_2/Fb'_2	14	
le	8.0	ft			
CL_1	1.00				

Adjusted Allowable Stresses

Strong Axis			Weak Axis		
Fc'_1	657	psi	Fc'_2	657	psi
Fb'_1	1200	psi	Fb'_2	1200	psi

Imposed Column Stresses

Strong Axis			Weak Axis		
fc_1	378	psi	fc_2	378	psi
fb_1	0	psi	fb_2	0	psi

Perpendicular to Grain Stress Check fcp/Fcp =	***378 / 650***	**OK**
Slenderness Check le/d	**23**	**OK**
Slenderness Check le/b	**23**	**OK**

(1) $$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

(2) $$\frac{fc}{F_{cE2}}+\left(\frac{f_{b1}}{F_{bE}}\right)^2<1.0$$

(3) $$\frac{f_c}{F_{c'}},\frac{f_{b1}}{F_{b1}'},\frac{f_{b2}}{F_{b2}'}<1.0$$

Allowable Stress Interaction Formula	**0.58**	**OK**

SSF STRUCTURAL ENGINEERING

2124 Third Avenue . Suite 100 . Seattle . WA 98121
www.swensonsayfaget.com
Office: 206.443.6212
Fax: 206.443.4870

Project: C2- Main floor deck post

Date: *11/25/2020*

Project #: 01519-2020-15

Design: haa

Sheet: 19

Gravity Design

Drilled pier design:

Calculate required depth into hard silt using skin friction (ignore end bearing):
Qallowable = fs-allowable * Asurface

fs-allowable = 900psf

Q-2ft dia = (900psf)(πdh) = 5.7h (klf*ft)

Q-3ft dia = (900psf)(π*3ft*h) = 8.5h (klf*ft)

Weight of pier(assuming 25ft length):
Wt-2ft dia. = 12 k
Wt-3ft dia. = 26.5k

Worst case column load @ basement:
P= 45k+26.5k < 8.5h
h > 8.4 ft
h = 10ft, add weight of pier and recheck:
P= 45k+26.5k+10.6k
h>9.6'

Provide 36"ø w/ 10ft embed into hard silt

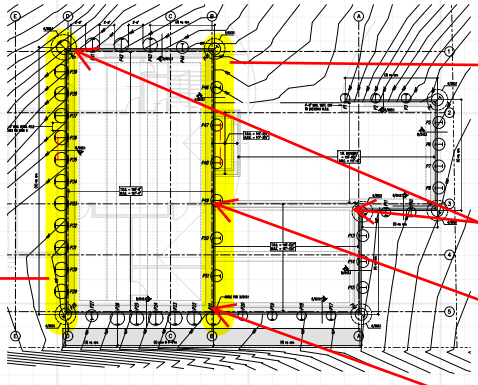
Worst case load (deck/interior pier)
P= 18k+12k < 5.7h
h > 5.3 ft
h = 6ft, add weight of pier and recheck:
P= 18k+12k+2.8k=32.8k
h>5.75'

Provide 24"ø w/ 6ft embed into hard silt

Size welded headed studs at piles:

5/8"ø x 6" stud shear capacity = 10k

Shoring pile spacing:



S=4'7"
wf=6.2klf
S*wf/2=14.3k/pile
# of studs required/pile = 14.3/10 = 1.4 -->2studs per pile

S=8'-0"
wf=4.5klf
S*wf/2=18k/pile
# of studs required/pile = 18/10 = 1.8 -->2studs per pile

corner: 30k --> min (3) studs

corner: 38k --> min (4) studs

corner: 45k --> min (5) studs

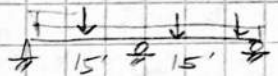
Provide 5/8"ø x 6" studs at 12" oc

SSF STRUCTURAL ENGINEERING
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
SEATTLE TACOMA
ssfengineers.com
SWENSON SAY FAGÉT

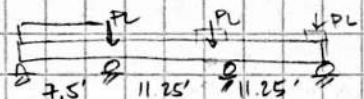
KAHAN - GRADE BEAM CALC

ASSUME:
$f'_c = 2500$ psi
$f_y = 60$ ksi
$\phi = 0.9$

GARAGE BEAM
i) START w/ $b = 24"$ $h = 12"$
ii) $M_f = 82$ kft
M_f w/ SLOT @ HDW11 = 228 kft



M IS TOO HIGH ... ADD PIER (PMS 5 IS IN ASD...)



$M_f = 31.6$ kft $V_f = 15.6$ k → GOVERNS (SHEAR)

WORST CASE INT. GRADE BEAM = BASEMENT G.B.
$L = 11$, $W_F = 2224$ PLF, $V_F = 12.2$ k $M_F = 33.6$ kft → GOVERNS
iii) ASSUME #5 BARS (3) TOP & BOTT. $\Rightarrow a = 3(.31)(60ksi)/(0.85(2.5)(24))$
$d = 12" + 3" - 0.625"/2 = 8.69"$ $= 1.094$ in
iv) $\phi M_n = \phi A_s F_y (d - a/2) = 0.9((3)(0.31 in^2)(60 ksi)(8.69" - 1.09"/2)$
$= 409$ kin $= 34.1$ kft
$34.1 > 33.6$ ✓OK
v.) $A_{s\max} = 2.69 in^2$
FOR $\phi = 0.9$ $A_s < 7/8\, A_{s\max}$
$0.93 < 2.35$ ✓OK
$A_{s\min} = 0.52 < 0.93$ ✓OK

vi) $\phi V_c = (0.75)2\sqrt{2500 psi}(24)(8.69) = 15.6$ k ≤ 15.6 k $= V_f$ ∴ ADD STIRRUPS
$\phi V_c = V_f$ ∴ PROVIDE $A_{v\min}$ #3 @ 4" oc
very tight → deeper grade beam?
FOR 6" spacing → $d = 12"$ ∴ TRY 24" wd x 15 dp.
(3) #5 TOP & BOTT $\Rightarrow \phi M_n = 46.6$ kft ≥ 33.6 kft
$\phi V_c = 21 > 15.6$
$< 15.6 \times 2$ ∴ ADD STIRRUPS #3 @ 6" oc

24" x 15" GR. BM w/ (3) #5 TOP & BOTT & #3 STIRRUPS @ 6" oc

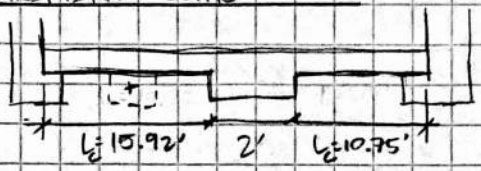
SWENSON SAY FAGÉT
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

KAHAN - STRUCTURAL SLAB

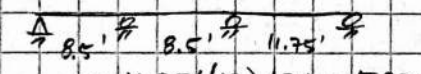
ASSUME:
- ONE WAY SLAB
- NO SUPERIMPOSED DEAD LOAD
- $f'_c = 2500$ psi
- $f_y = 60$ ksi
- TENSION CONTROLLED, $\phi = 0.9$

6" slab w/ #5's @ 12" oc Longit. & #3's @ 16" oc transv.

BASEMENT SLAB



i) h_{min} (one-end continuous) $= l/24 = 17(12)/24 = 8.5"$
9" slab required *NG (AIMING FOR 6")
ADD BRG LINE:



$h_{min} = 11.75'(12)/24 = 5.875"$ => 6" SLAB

ii) SELF WEIGHT = 150PLF(6"/12) = 75 PSF
LIVE LOAD = 40PSF
$w_f = 1.2(75\text{ PSF}) + 1.6(40\text{ PSF}) = 154$ PSF

iii) $+M_f = +1.9$ k-ft
$-M_f = -2.0$ k-ft

iv) $d = 3"$ (assume centered in slab)

v) $A_{s\,min} = 0.0018(12")(3") = 0.0648$ in²/ft

$$A_{s\,max} = \frac{(0.85 f'_c)\beta_1}{f_y}\left(\frac{3}{7}\right)bd = \frac{0.85(2.5\text{ksi})(0.85)}{60\text{ksi}}\left(\frac{3}{7}\right)(12")(3") = 0.46\text{ in}^2/\text{ft}$$

$$A_{s\,REQD} = \frac{0.85(2.5\text{ksi})(12")}{60\text{ksi}}\left[3" - \sqrt{(3")^2 - \frac{2(2.0\text{kft}\times 12"/\text{ft})}{0.9(0.85)(2.5\text{ksi})(12")}}\right] = 0.16\text{ in}^2$$

vi) ASSUME No. 5 bars
$s \le A_b/A_{s_R} \times 12 = 0.31/0.16 \times 12 = 23$ in => #5's @ 12" oc
$s_{max} = \min(3h, 18", s_f) = 12"$ ✓ok

vii) M_R, $A_s = 0.31$, $a = 0.729$ = 44 k-in = 3.67 k-ft > 2.0 ✓ok

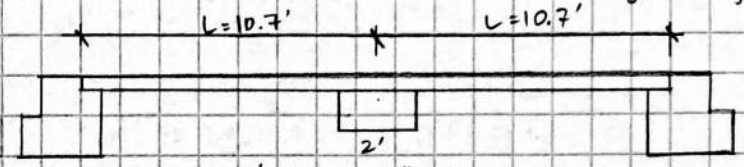
viii) Transverse reinf. = $A_{s\,req} = 0.0018bh = 0.1296$ $s = 0.2/0.13 = 18.5"$ #3@16" oc

SWENSON SAY FAGÉT
SEATTLE | TACOMA
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

KAHAN - SLAB CONT.

GARAGE SLAB

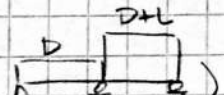
- STILL ASSUME ONE WAY, $f'c = 2.5$ksi, $f_y = 60$ksi, $\phi = 0.9$



i) $h_{min} = 10.7 \times 12/24 = 5.4'' \Rightarrow 6''$ SLAB

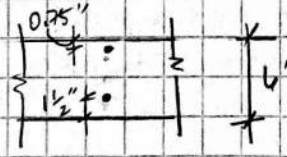
ii) SELF WEIGHT = 75 PSF
LIVE LOAD = 40 PSF
OR P = 3000lbs OVER 4½"x4½"
W_f = 154 PSF

iii) MAX MOMENT / SHEAR



$+M_f = 1.42$k-ft (skip loading)
$-M_f = -2.02$k-ft (D+L over full span)
$V_f = 1.03$
OR w/ 8K @ 5.35'
$+M_f = 11.1$k-ft
$-M_f = -16.25$k-ft
$V_f = 5.28$K w/ PL @ 11.2ft

iv) ASSUME (2) ROWS OF STEEL



$C_c = 0.75$ top
$C_c = 1\frac{1}{2}$" bottom

$d = 4.5''$ $d' = 5.25''$
$A_{s\,min} = 0.1$ in² $A_{s\,min} = 0.11$ in²
$A_{s\,max} = 0.7$ in² $A_{s\,max} = 0.81$ in²
TRY #5 @ 6" top = bott $s_{max} = 12''$

v) $\phi M_n = 10.98$ k-ft ≈ 11.1 k-ft VOK (1.01% DCR)

vi) Transverse Reinf: same as basement

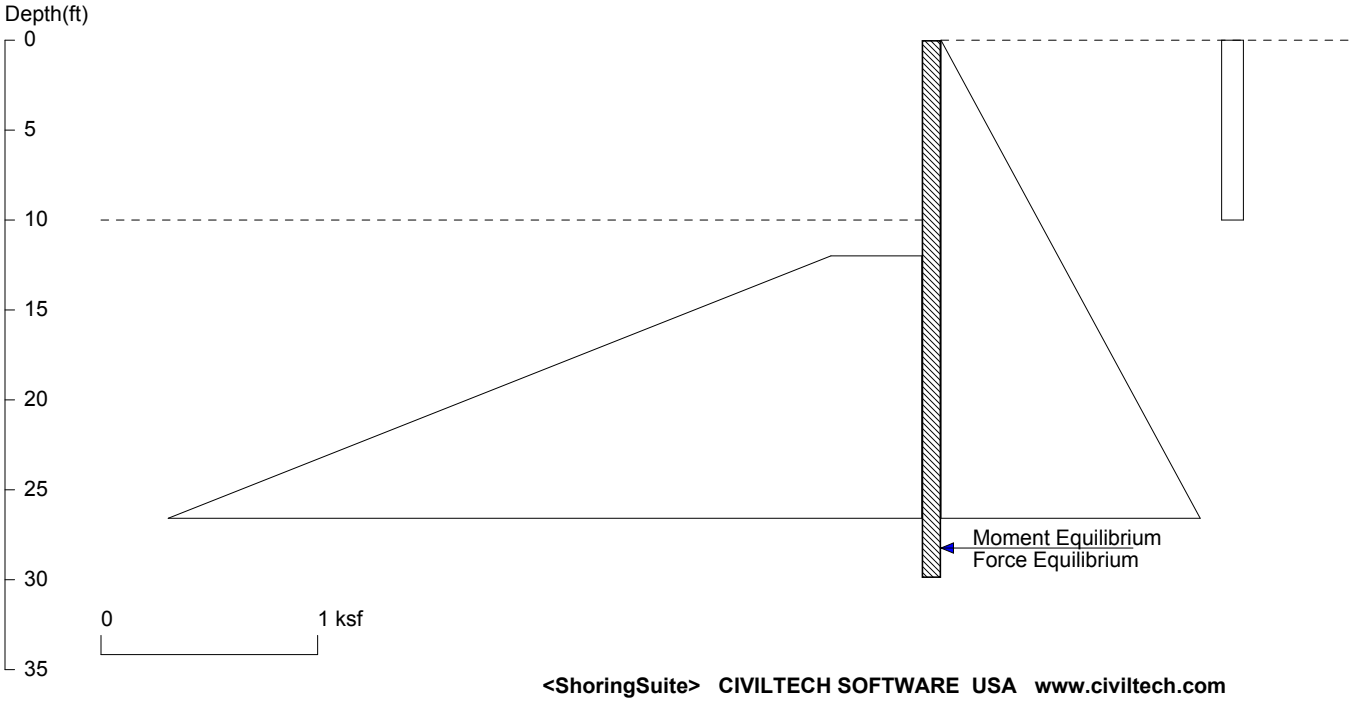
6" Slab w/ #5 @ 6" OC TOP & BOTT (longit.)
#2 @ 16" OC (Transverse)

SWENSON SAY FAGÉT
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

Shoring Design

SWENSON SAY FAGÉT
ssfengineers.com
SEATTLE
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

Kahan Spec Home
P1 - P3



Licensed to 4324324234 3424343 Date: 11/30/2020
File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\sHORING\P1-P3.sh8

Wall Height=10.0 Pile Diameter=2.0 Pile Spacing=6.3 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=19.89 Min. Pile Length=29.89
MOMENT IN PILE: Max. Moment=222.48 per Pile Spacing=6.3 at Depth=18.98

PILE SELECTION:
Request Min. Section Modulus = 80.9 in3/pile=1325.75 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W18X50 has Section Modulus = 88.9 in3/pile=1456.80 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 1.10(in) based on E (ksi)=29000.00 and I (in4)/pile=800.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	60	2.700	.045
*	eq			
0	.10	10	0.100	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
12	.42	60	10.50	.21

ACTIVE SPACING:

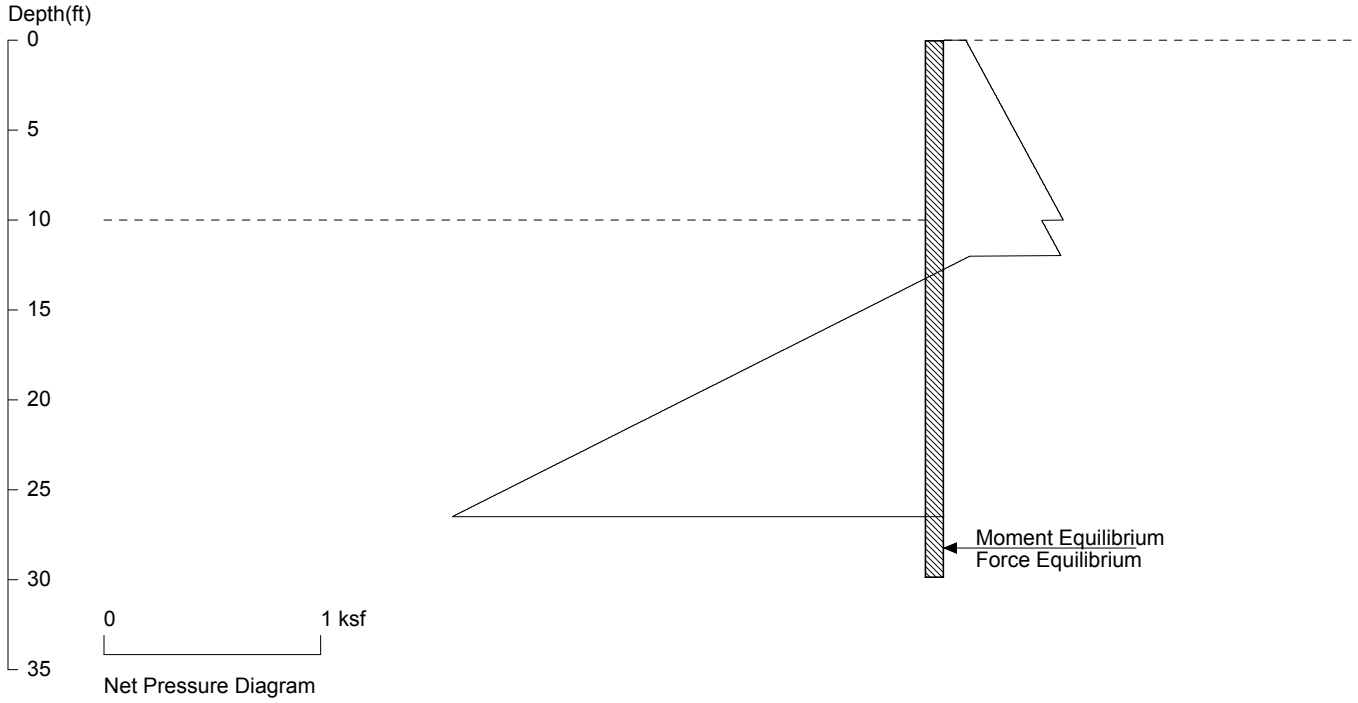
No.	Z depth	Spacing
1	0.00	6.33
2	10.00	2.00

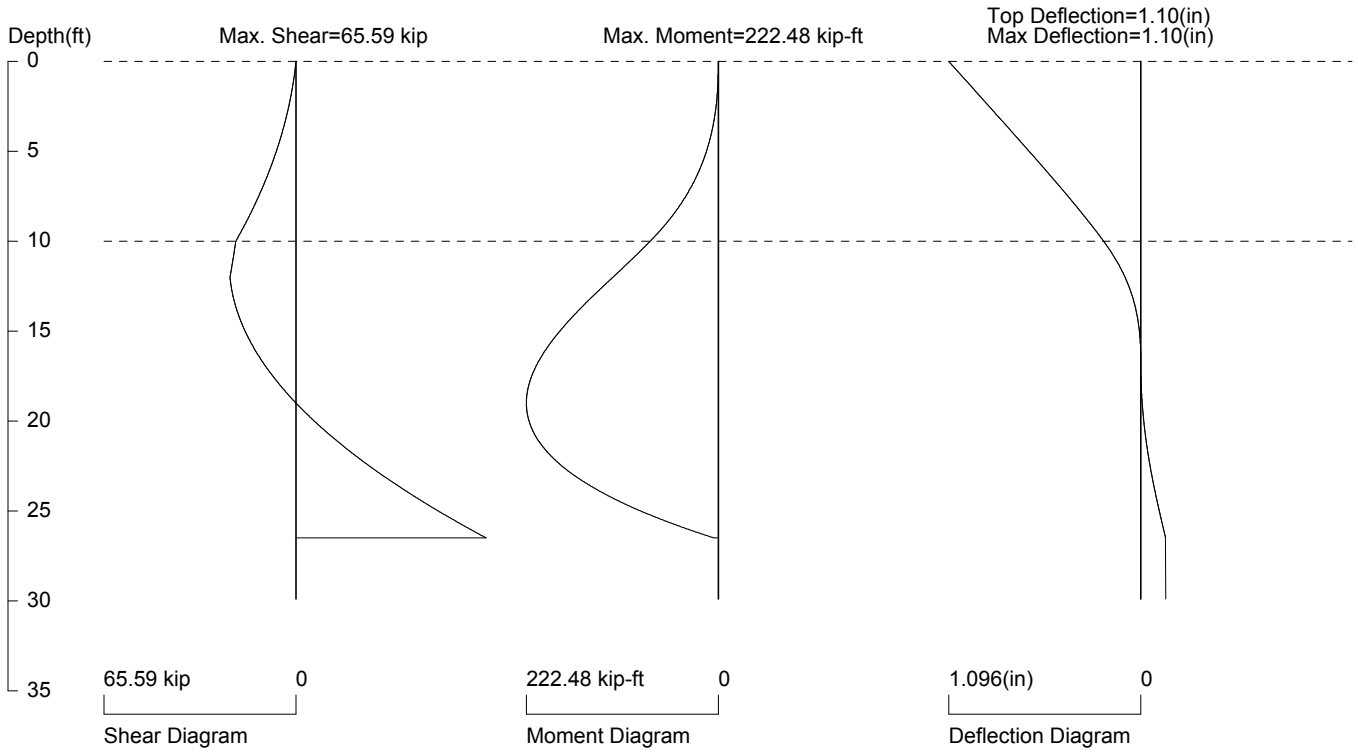
PASSIVE SPACING:

No.	Z depth	Spacing
1	10.00	4.00

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

Kahan Spec Home
P1 - P3





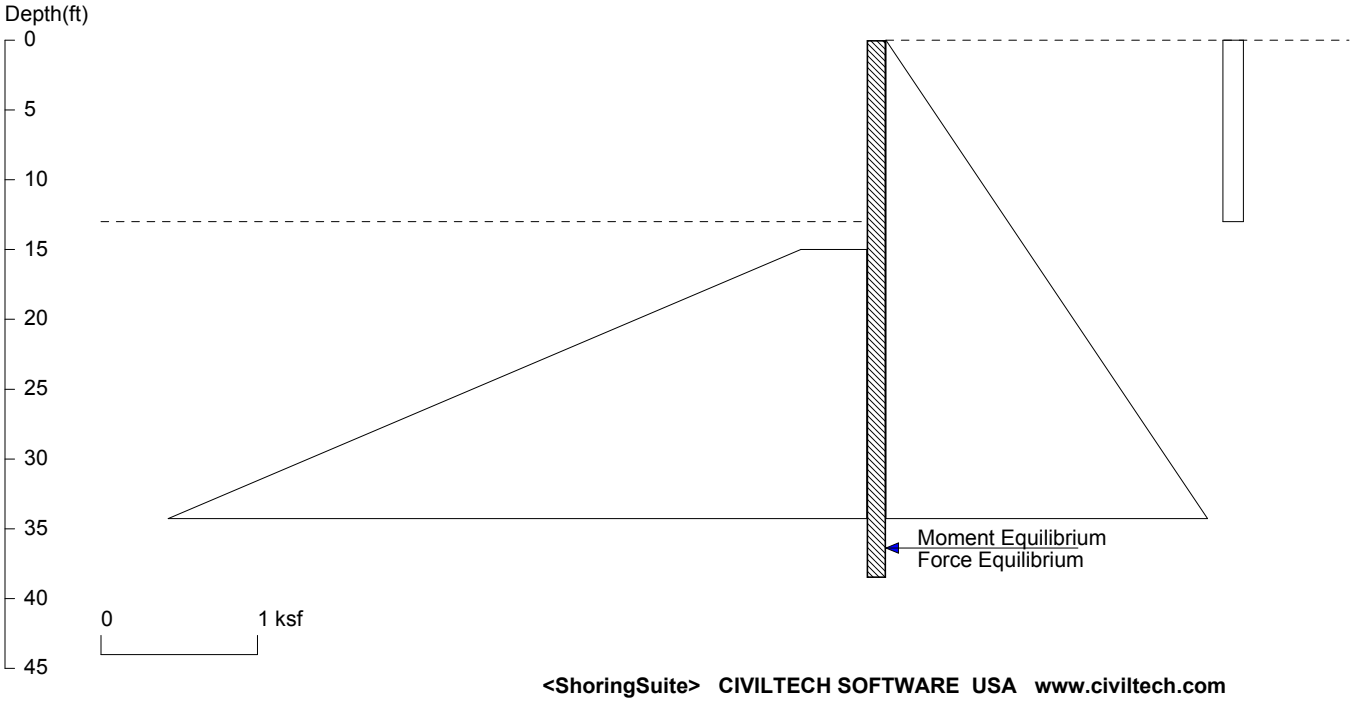
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.3 foot or meter

User Input Pile, W18X50: E (ksi)=29000.0, I (in4)/pile=800.0

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\sHORING\P1-P3.sh8

Kahan Spec Home
P4 - P9



Licensed to 4324324234 3424343 Date: 11/30/2020
File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P4-P9.sh8

Wall Height=13.0 Pile Diameter=2.5 Pile Spacing=4.5 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=25.51 Min. Pile Length=38.51
MOMENT IN PILE: Max. Moment=445.09 per Pile Spacing=4.5 at Depth=24.81

PILE SELECTION:
Request Min. Section Modulus = 161.9 in3/pile=2652.26 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W18X86 has Section Modulus = 166.0 in3/pile=2720.24 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 1.83(in) based on E (ksi)=29000.00 and I (in4)/pile=1530.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	60	3.600	.06
*	eq			
0	.13	13	0.130	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
15	.42	60	9.870	.21

ACTIVE SPACING:

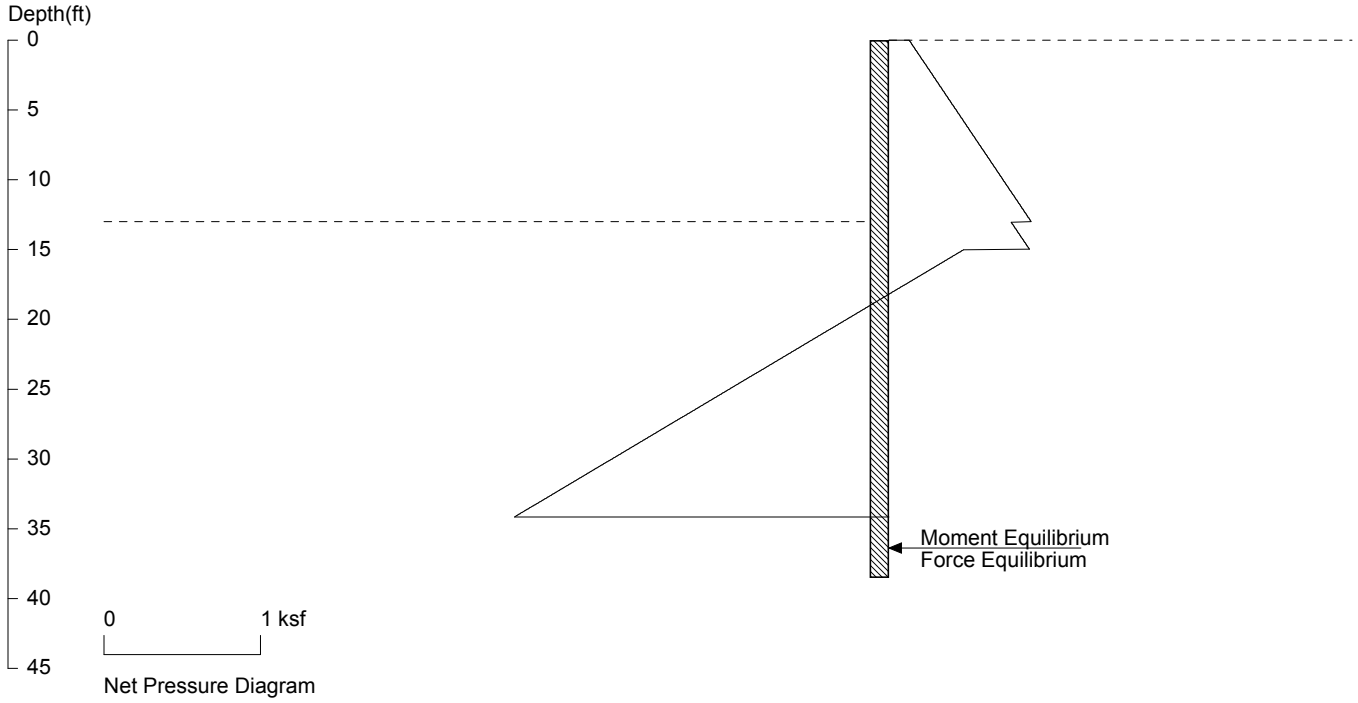
No.	Z depth	Spacing
1	0.00	4.50
2	13.00	2.50

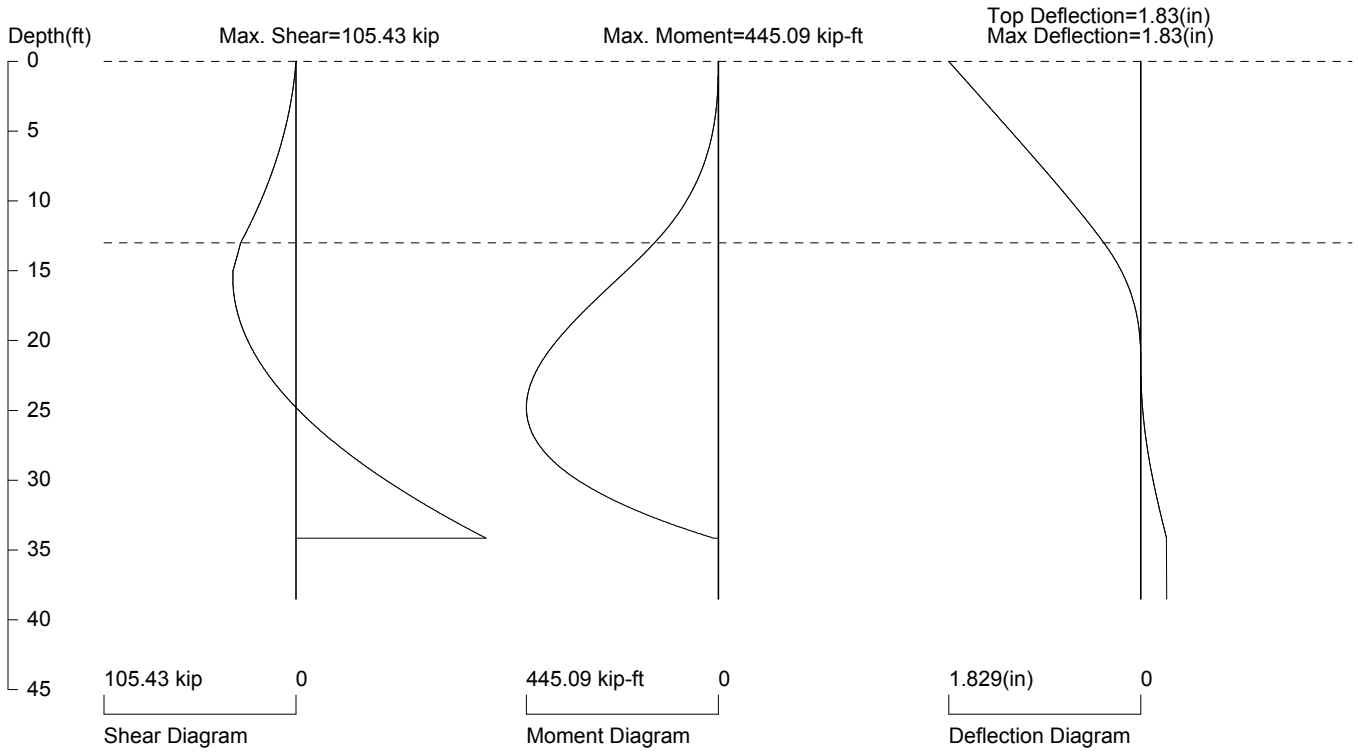
PASSIVE SPACING:

No.	Z depth	Spacing
1	13.00	4.50

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

Kahan Spec Home
P4 - P9





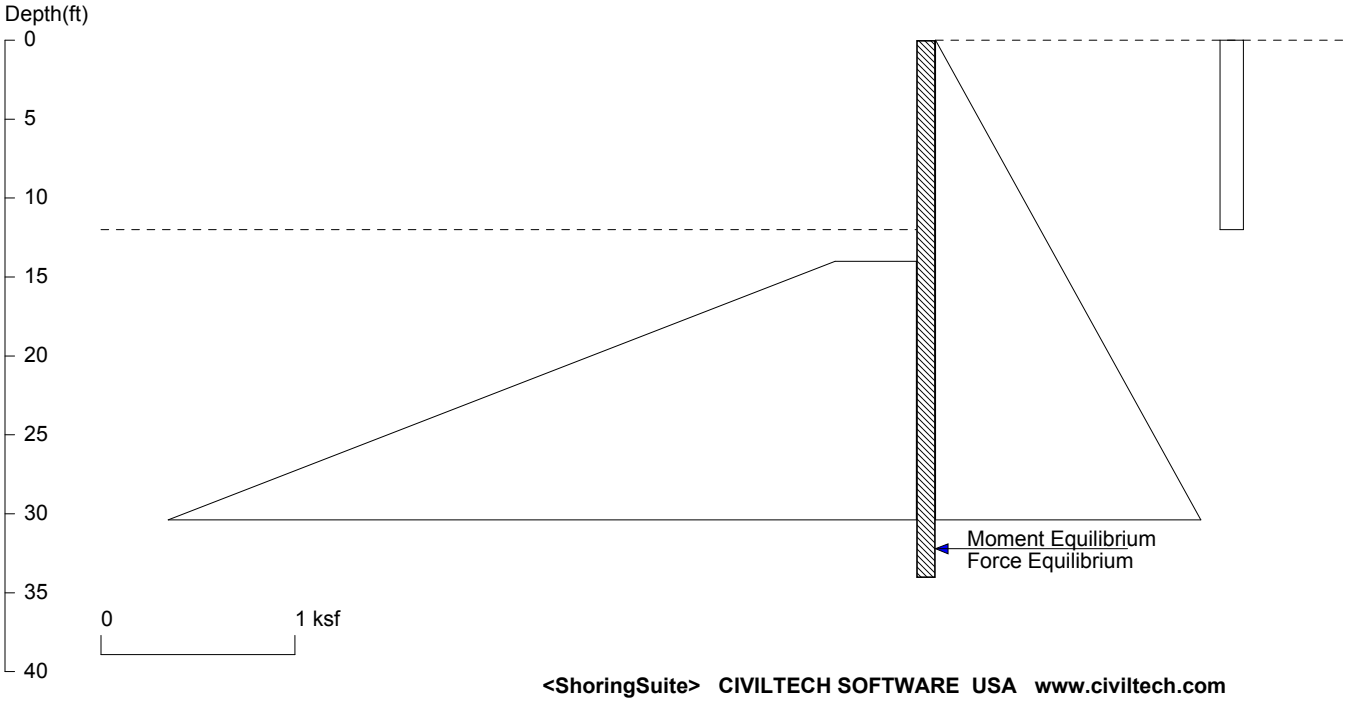
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 4.5 foot or meter

User Input Pile, W18X86: E (ksi)=29000.0, I (in4)/pile=1530.0

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P4-P9.sh8

Kahan Spec Home
P10 - P12



<ShoringSuite> CIVILTECH SOFTWARE USA www.civiltech.com

Licensed to 4324324234 3424343 Date: 11/30/2020
File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P10-P12.sh8

Wall Height=12.0 Pile Diameter=2.0 Pile Spacing=5.3 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=22.05 Min. Pile Length=34.05
MOMENT IN PILE: Max. Moment=302.68 per Pile Spacing=5.3 at Depth=21.93

PILE SELECTION:
Request Min. Section Modulus = 110.1 in3/pile=1803.62 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W18X65 has Section Modulus = 117.0 in3/pile=1917.28 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 1.50(in) based on E (ksi)=29000.00 and I (in4)/pile=1070.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	60	2.700	.045
*	eq			
0	.12	12	0.120	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
14	.42	60	10.08	.21

ACTIVE SPACING:

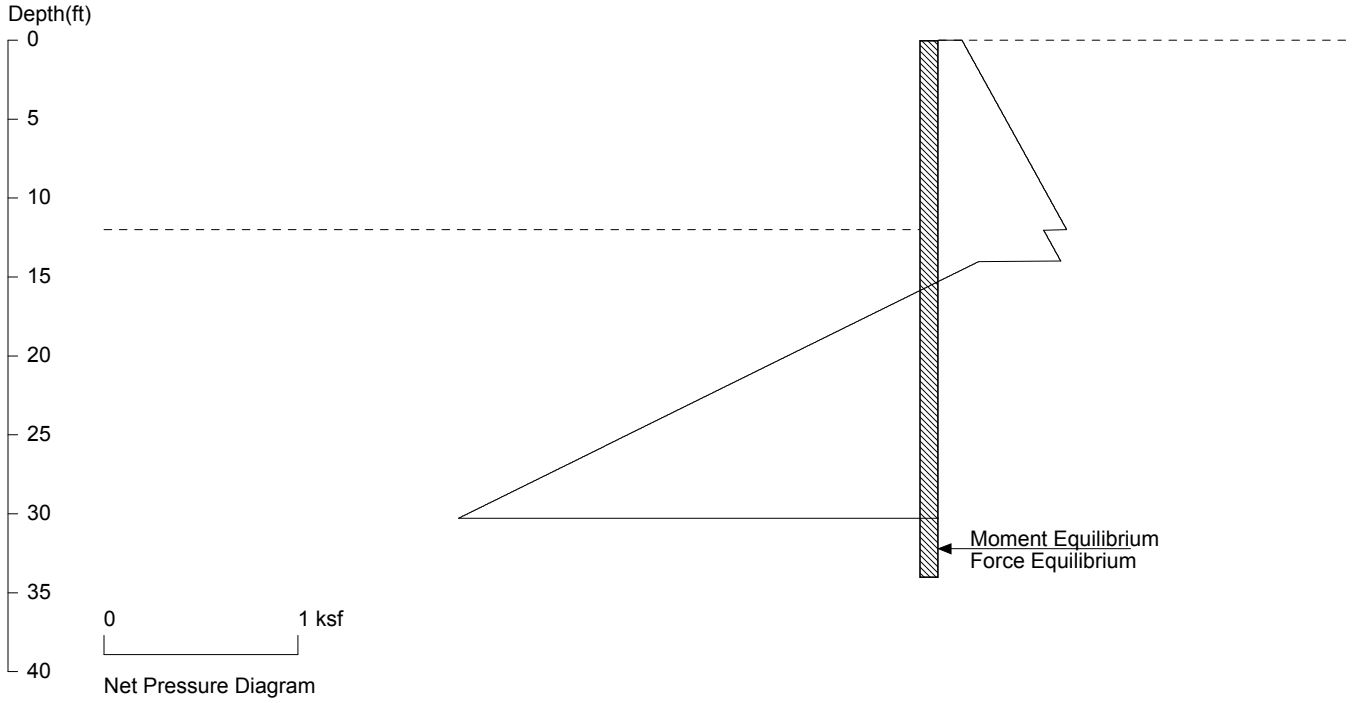
No.	Z depth	Spacing
1	0.00	5.25
2	12.00	2.00

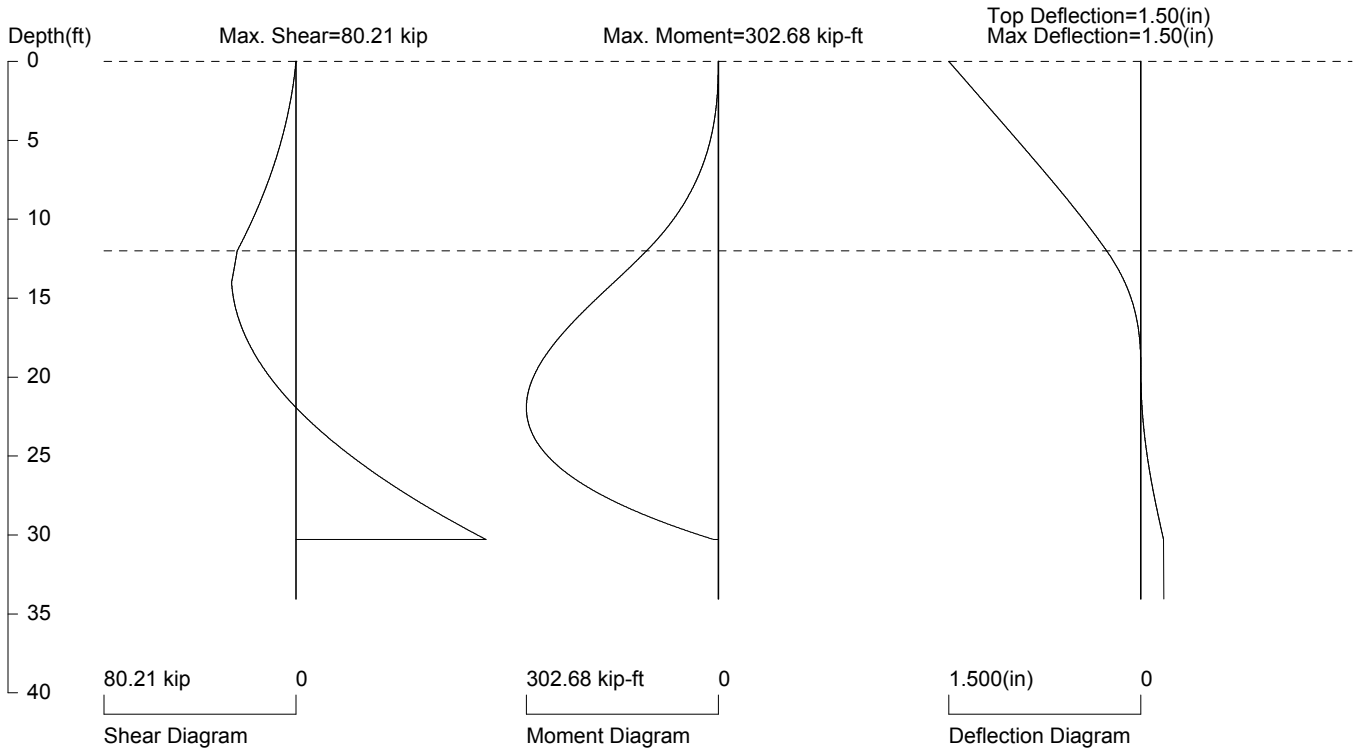
PASSIVE SPACING:

No.	Z depth	Spacing
1	12.00	4.00

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

Kahan Spec Home
P10 - P12





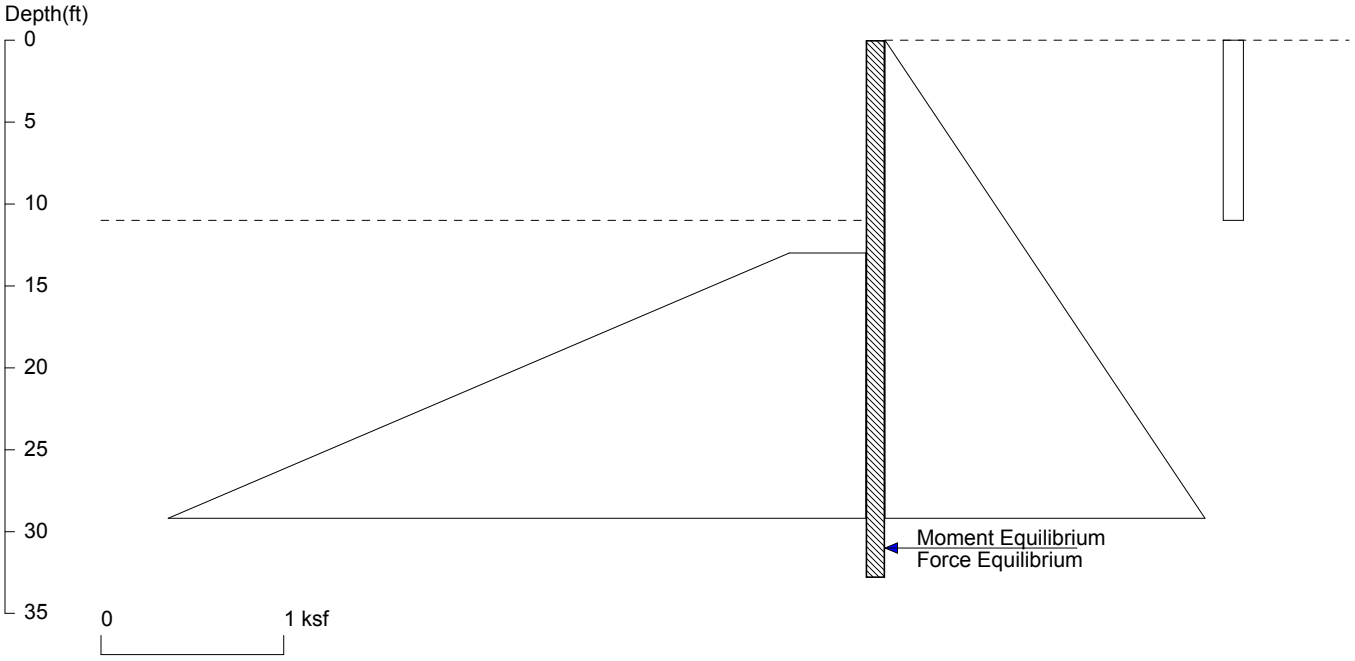
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.3 foot or meter

User Input Pile, W18X65: E (ksi)=29000.0, I (in4)/pile=1070.0

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P10-P12.sh8

Kahan Spec Home
P13 - P16



Licensed to 4324324234 3424343 Date: 11/30/2020
File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P13-P16.sh8

Wall Height=11.0 Pile Diameter=2.5 Pile Spacing=5.5 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=21.82 Min. Pile Length=32.82
MOMENT IN PILE: Max. Moment=326.71 per Pile Spacing=5.5 at Depth=21.04

PILE SELECTION:
Request Min. Section Modulus = 118.8 in3/pile=1946.84 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W18X86 has Section Modulus = 166.0 in3/pile=2720.24 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 0.98(in) based on E (ksi)=29000.00 and I (in4)/pile=1530.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	60	3.600	.06
*	eq			
0	.11	11	0.110	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
13	.42	60	10.29	.21

ACTIVE SPACING:

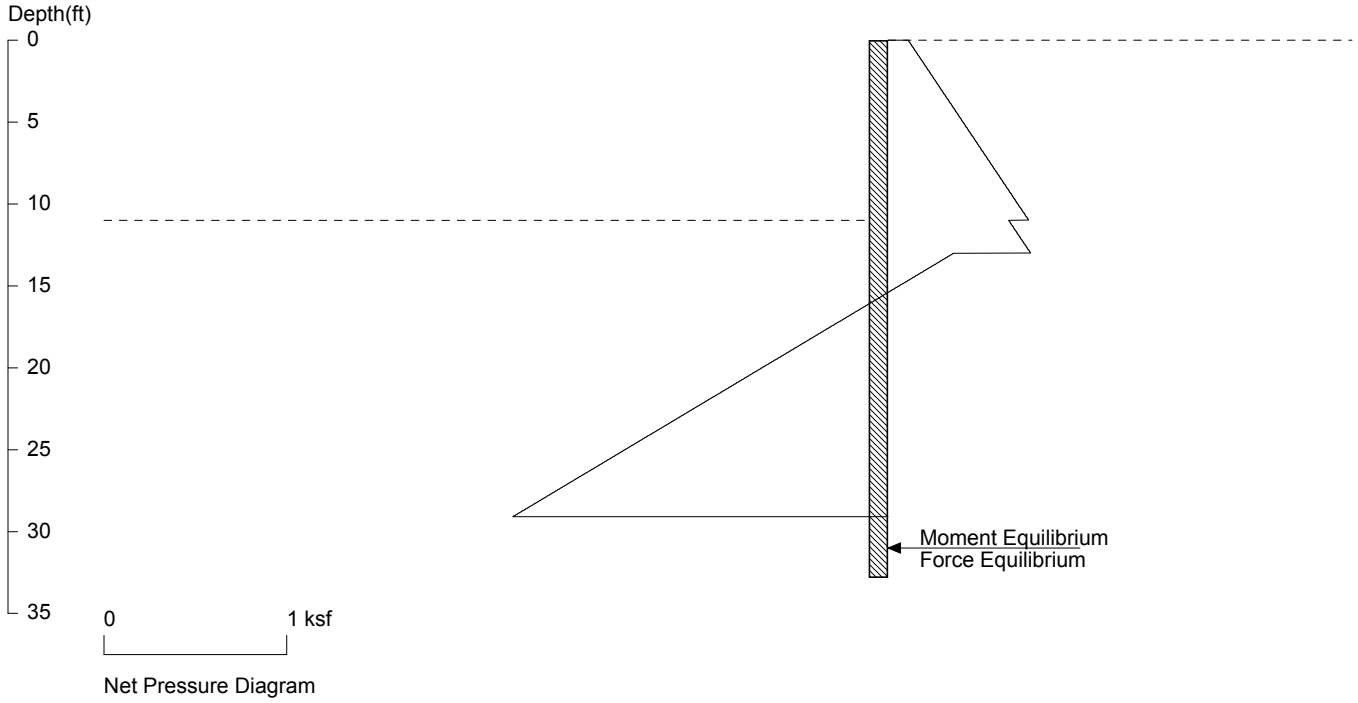
No.	Z depth	Spacing
1	0.00	5.50
2	11.00	2.50

PASSIVE SPACING:

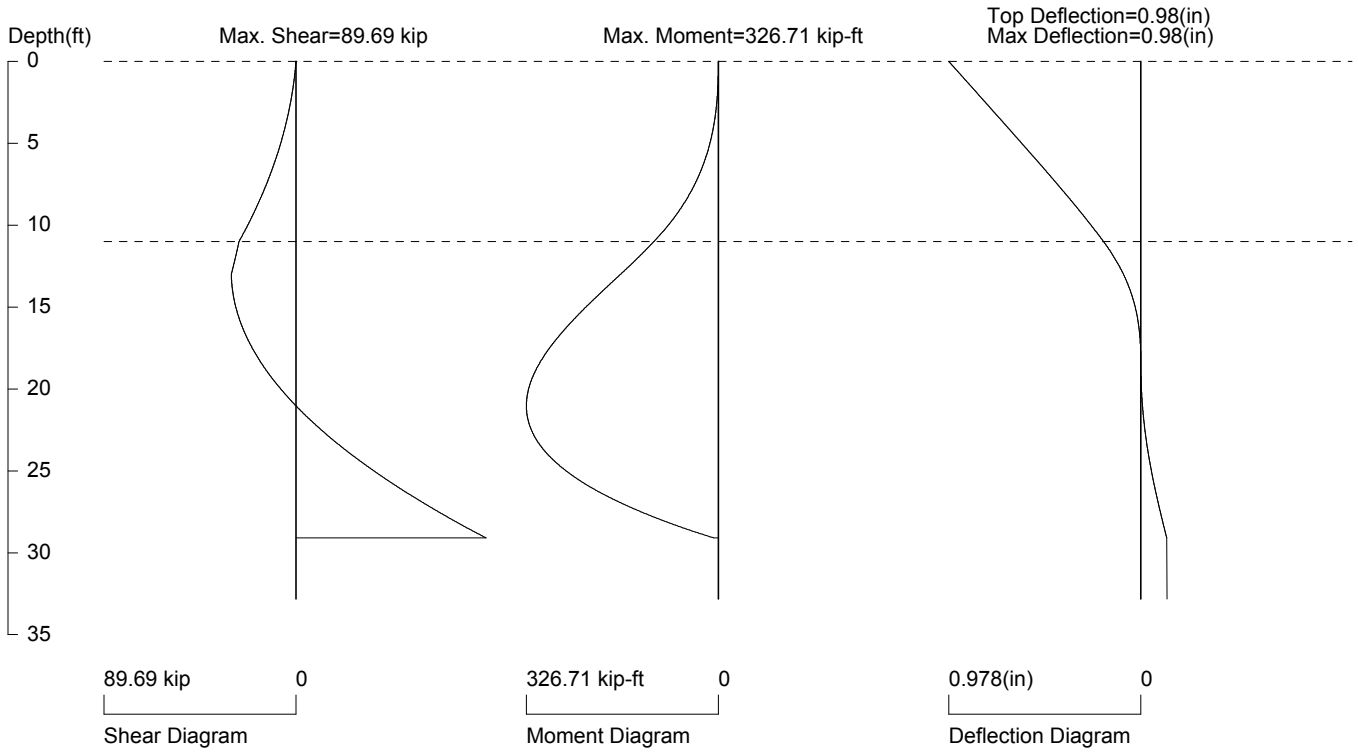
No.	Z depth	Spacing
1	11.00	5.00

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

Kahan Spec Home
P13 - P16



Net Pressure Diagram



Shear Diagram | Moment Diagram | Deflection Diagram

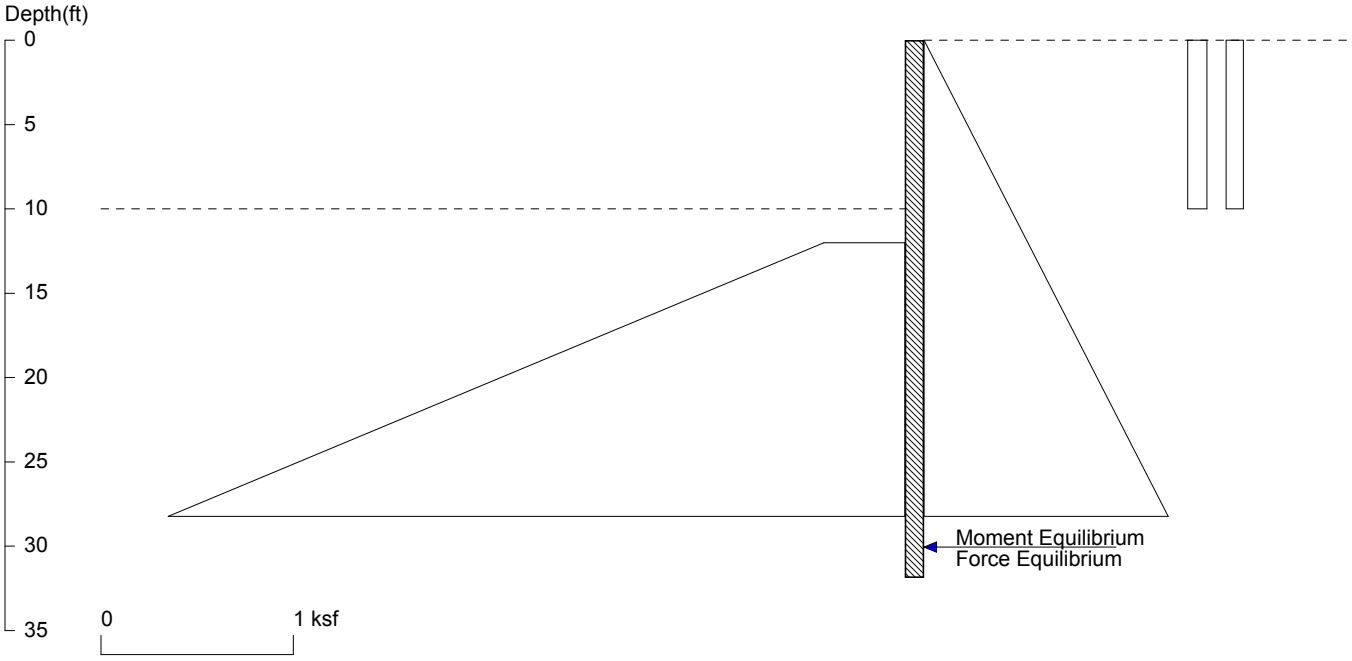
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.5 foot or meter

User Input Pile, W18X86: E (ksi)=29000.0, I (in4)/pile=1530.0

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P13-P16.sh8

Kahan Spec Home
P17 - P20



Licensed to 4324324234 3424343 Date: 11/30/2020
File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P17-P20.sh8

Wall Height=10.0 Pile Diameter=2.0 Pile Spacing=6.3 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=21.87 Min. Pile Length=31.87
MOMENT IN PILE: Max. Moment=300.24 per Pile Spacing=6.3 at Depth=19.88

PILE SELECTION:
Request Min. Section Modulus = 109.2 in3/pile=1789.13 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W18X65 has Section Modulus = 117.0 in3/pile=1917.28 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 1.23(in) based on E (ksi)=29000.00 and I (in4)/pile=1070.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	60	2.700	.045
*	eq			
0	.1	10	0.100	0
*	traff			
0	.09	10	0.090	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
12	.42	60	10.50	.21

ACTIVE SPACING:

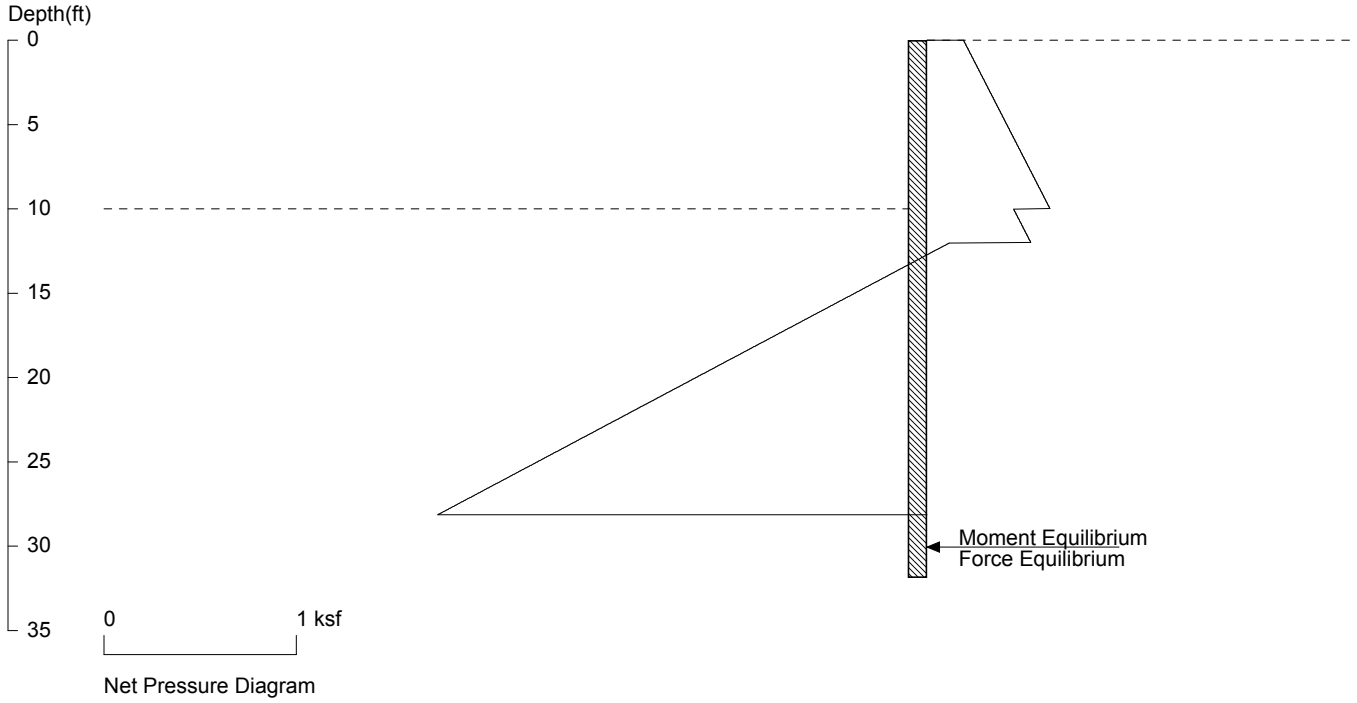
No.	Z depth	Spacing
1	0.00	6.25
2	10.00	2.00

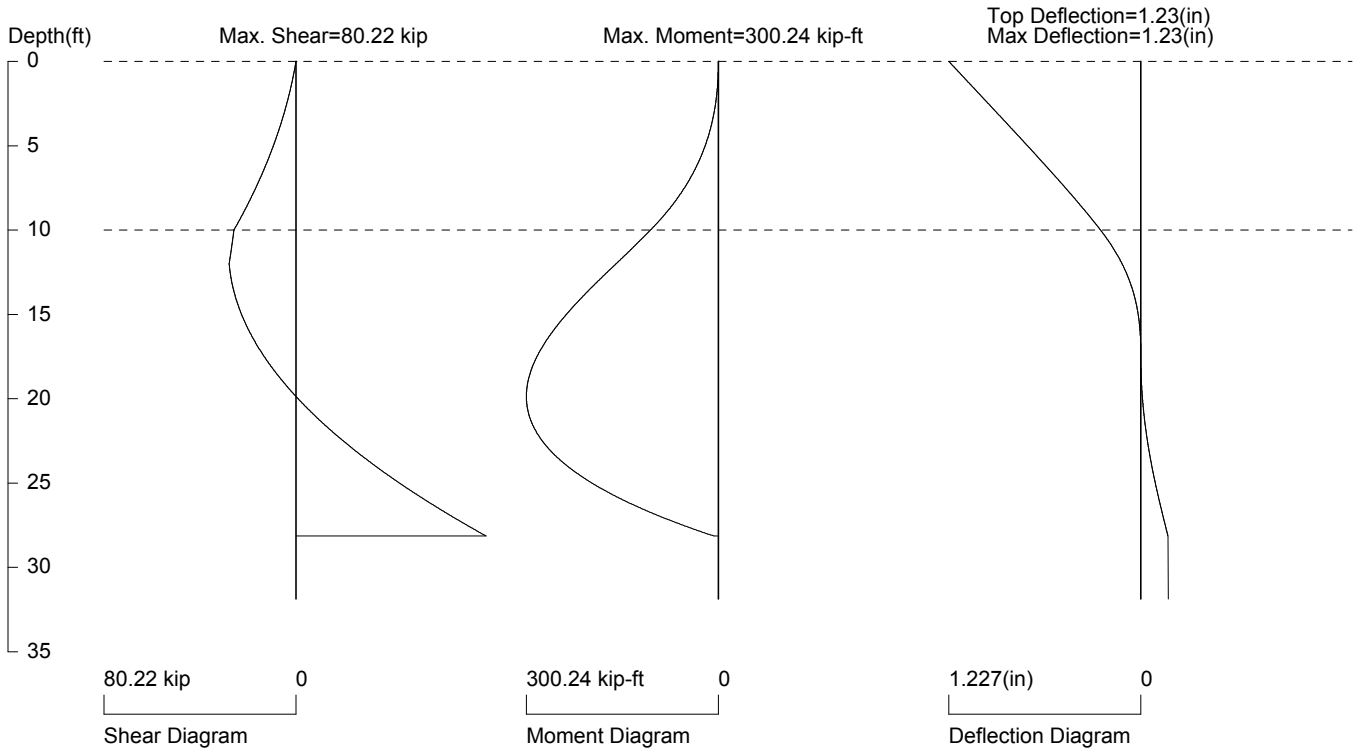
PASSIVE SPACING:

No.	Z depth	Spacing
1	10.00	4.00

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

Kahan Spec Home
P17 - P20





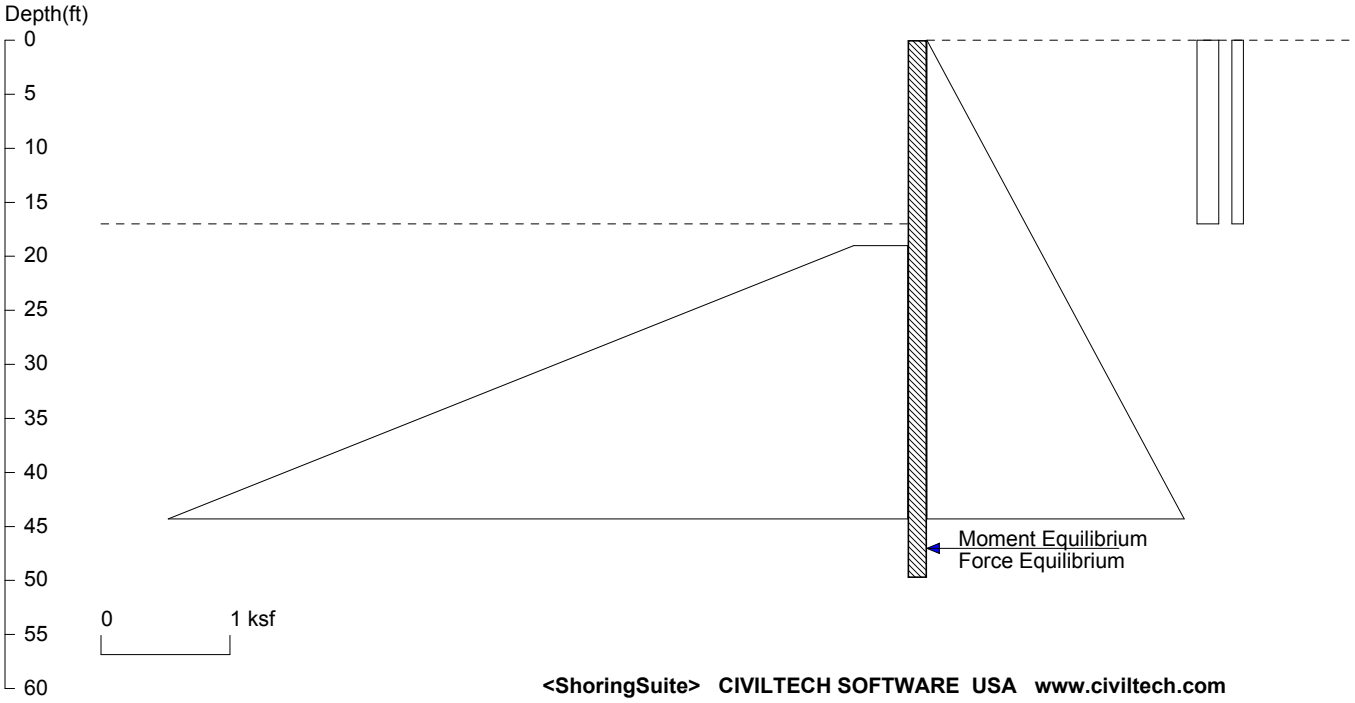
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.3 foot or meter

User Input Pile, W18X65: E (ksi)=29000.0, I (in4)/pile=1070.0

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P17-P20.sh8

Kahan Spec Home
P21 - P26



Licensed to 4324324234 3424343 Date: 11/30/2020
File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P21-P26.sh8

Wall Height=17.0 Pile Diameter=3.0 Pile Spacing=4.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=32.75 Min. Pile Length=49.75
MOMENT IN PILE: Max. Moment=837.62 per Pile Spacing=4.0 at Depth=32.08

PILE SELECTION:
Request Min. Section Modulus = 304.6 in3/pile=4991.29 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W30X124 has Section Modulus = 355.0 in3/pile=5817.39 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 1.69(in) based on E (ksi)=29000.00 and I (in4)/pile=5360.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	60	2.700	.045
*	eq			
0	.17	17	0.170	0
*	traff			
0	.09	17	0.090	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
19	.42	60	9.030	.21

ACTIVE SPACING:

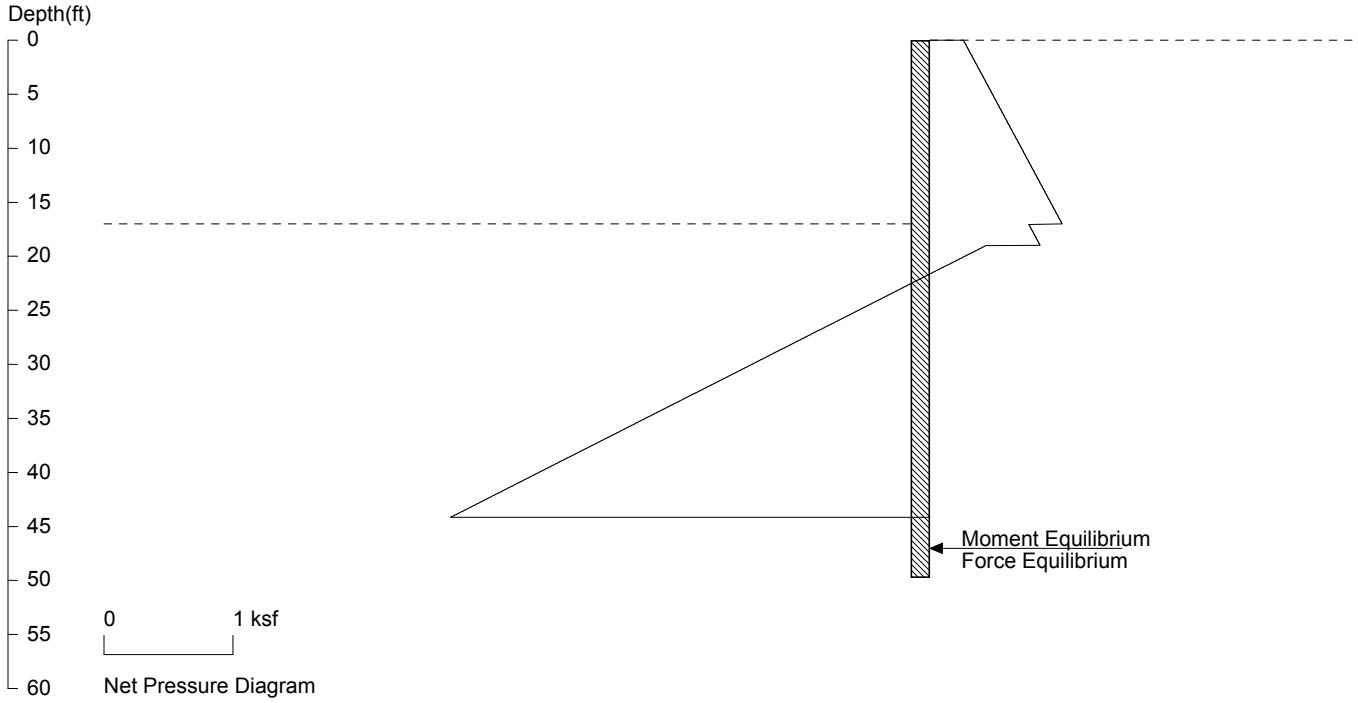
No.	Z depth	Spacing
1	0.00	4.00
2	17.00	3.00

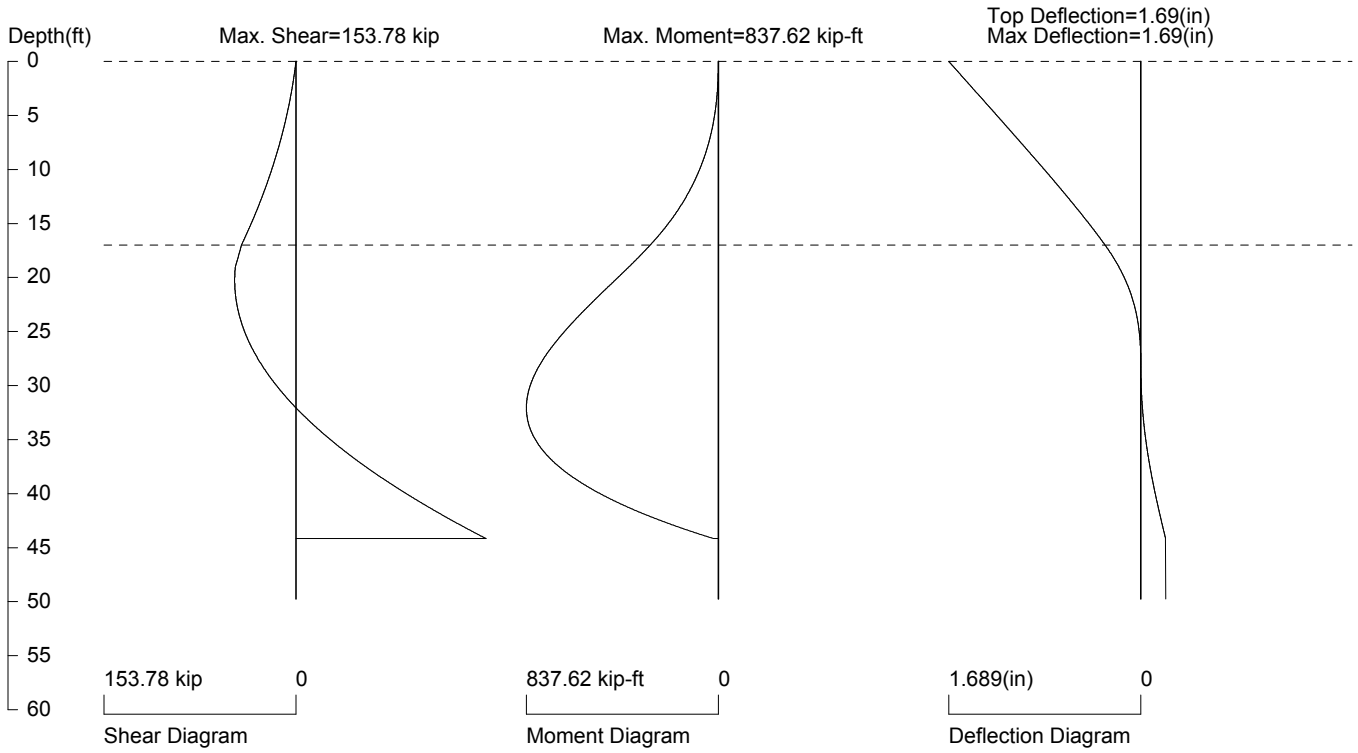
PASSIVE SPACING:

No.	Z depth	Spacing
1	17.00	4.00

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

Kahan Spec Home
P21 - P26





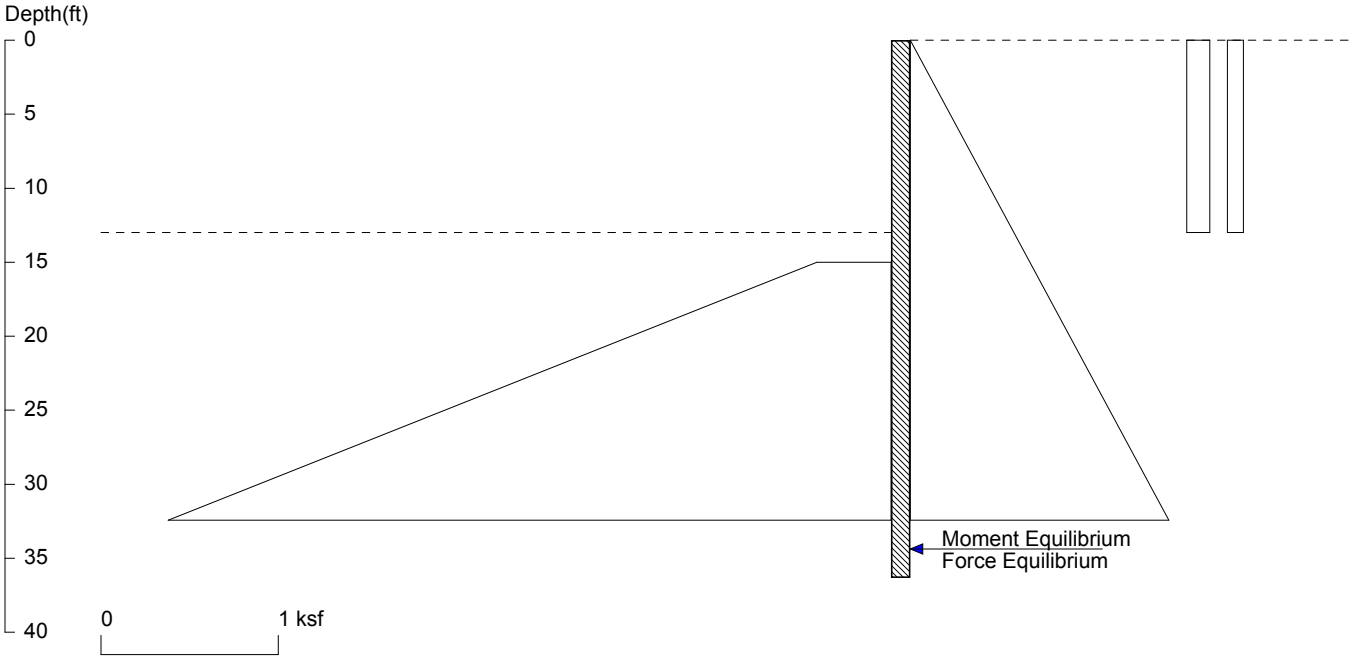
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 4.0 foot or meter

User Input Pile, W30X124: E (ksi)=29000.0, I (in4)/pile=5360.0

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P21-P26.sh8

Kahan Spec Home
P27 - P28



Licensed to 4324324234 3424343 Date: 11/30/2020
File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P27-P28.sh8

Wall Height=13.0 Pile Diameter=2.5 Pile Spacing=4.9 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=23.32 Min. Pile Length=36.32
MOMENT IN PILE: Max. Moment=435.92 per Pile Spacing=4.9 at Depth=23.46

PILE SELECTION:
Request Min. Section Modulus = 158.5 in3/pile=2597.58 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W18X86 has Section Modulus = 166.0 in3/pile=2720.24 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 1.76(in) based on E (ksi)=29000.00 and I (in4)/pile=1530.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	60	2.700	.045
*	eq			
0	.13	13	0.130	0
*	traff			
0	.09	13	0.090	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
15	.42	60	9.870	.21

ACTIVE SPACING:

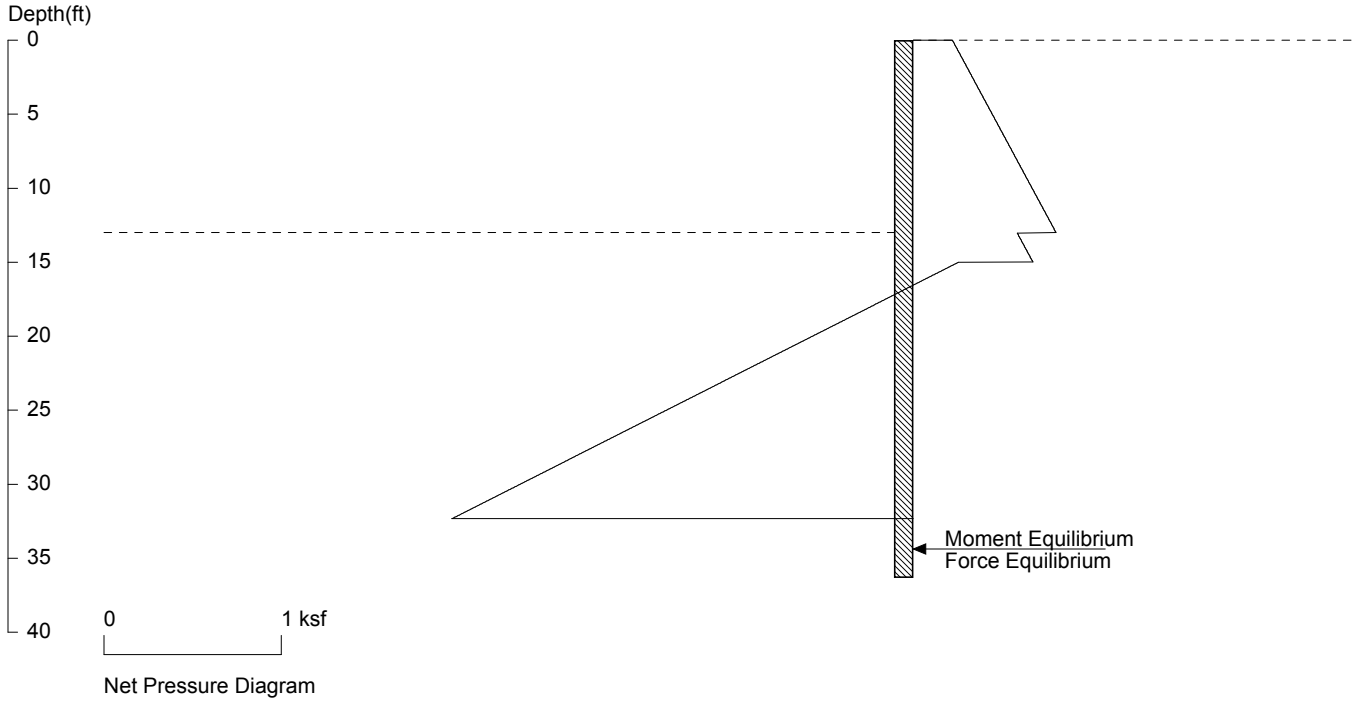
No.	Z depth	Spacing
1	0.00	4.88
2	13.00	2.50

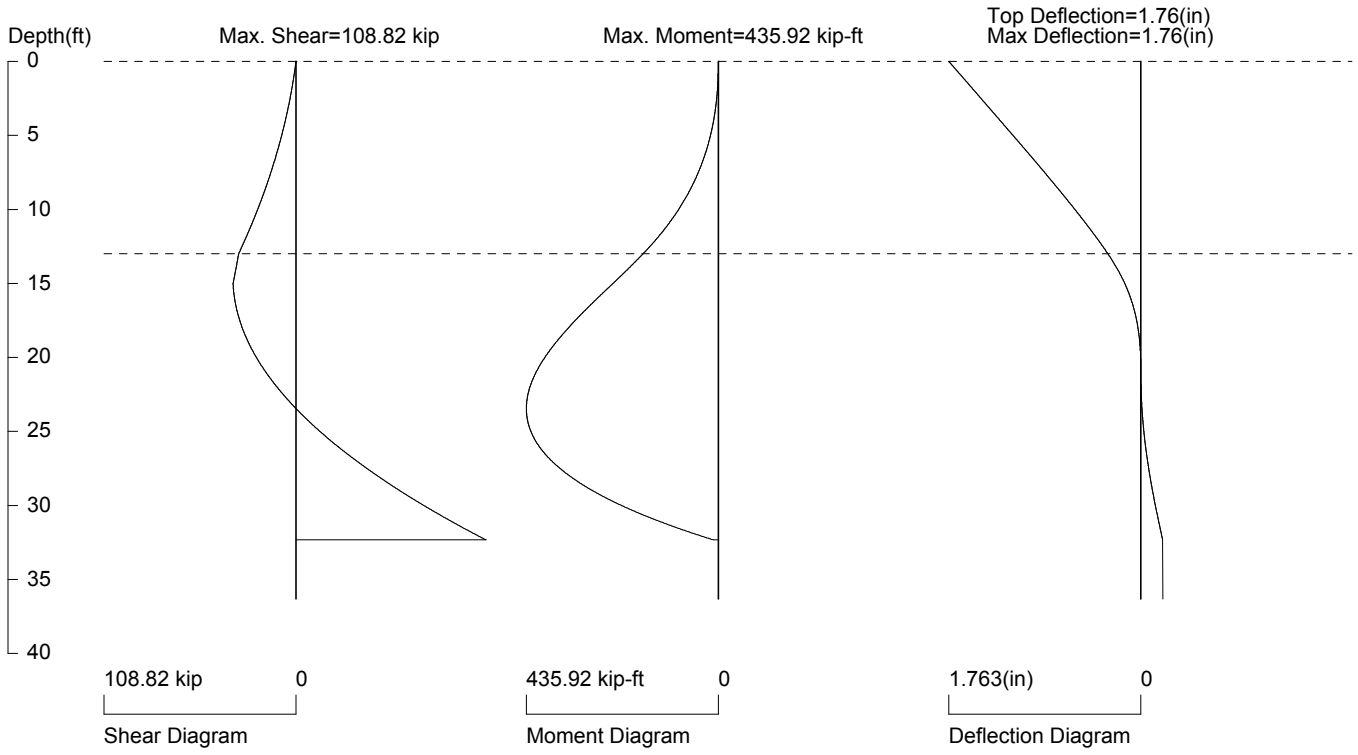
PASSIVE SPACING:

No.	Z depth	Spacing
1	13.00	4.88

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

Kahan Spec Home
P27 - P28





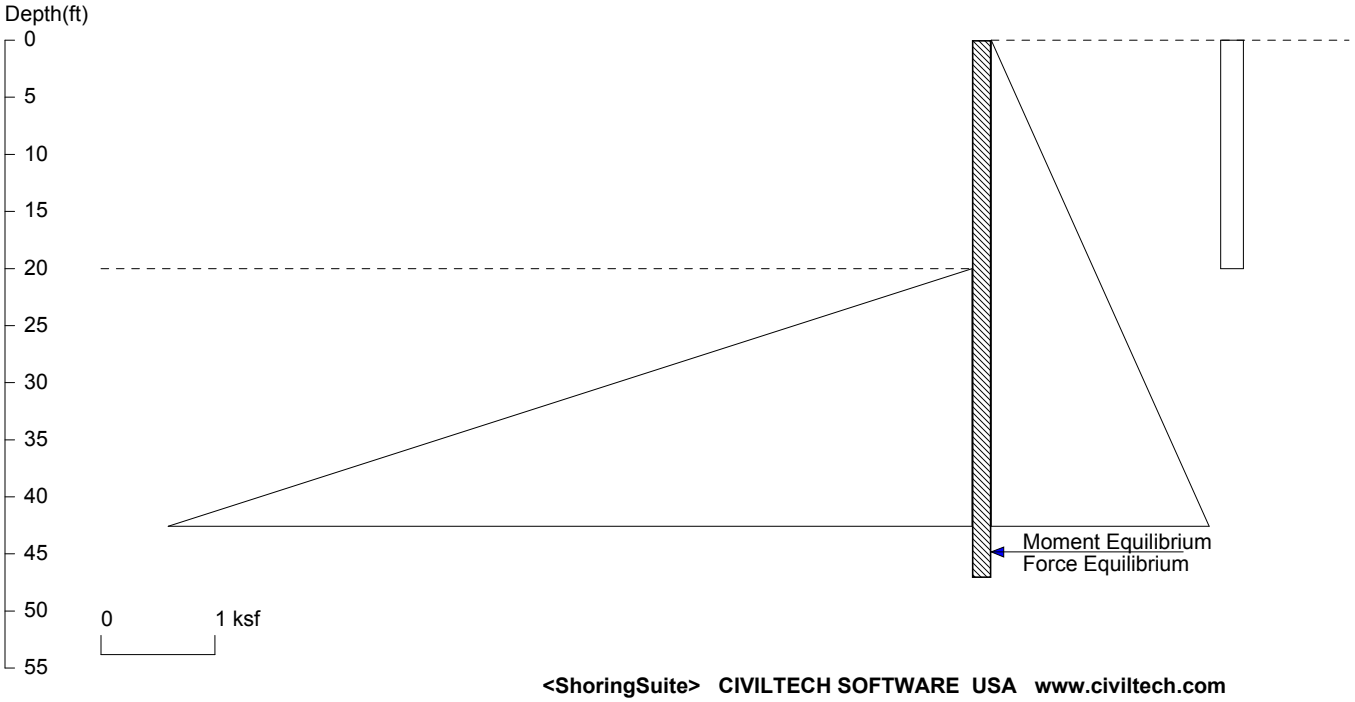
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 4.9 foot or meter

User Input Pile, W18X86: E (ksi)=29000.0, I (in4)/pile=1530.0

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P27-P28.sh8

Kahan Spec Home
P29 - P44



Licensed to 4324324234 3424343 Date: 11/30/2020
File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P29-P44.sh8

Wall Height=20.0 Pile Diameter=3.0 Pile Spacing=4.6 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=27.09 Min. Pile Length=47.09
MOMENT IN PILE: Max. Moment=992.99 per Pile Spacing=4.6 at Depth=31.88

PILE SELECTION:
Request Min. Section Modulus = 361.1 in3/pile=5917.16 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W30X132 has Section Modulus = 380.0 in3/pile=6227.06 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 2.05(in) based on E (ksi)=29000.00 and I (in4)/pile=5770.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	60	2.700	.045
*	eq			
0	.2	20	0.200	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
20	0	60	12.52	.313

ACTIVE SPACING:

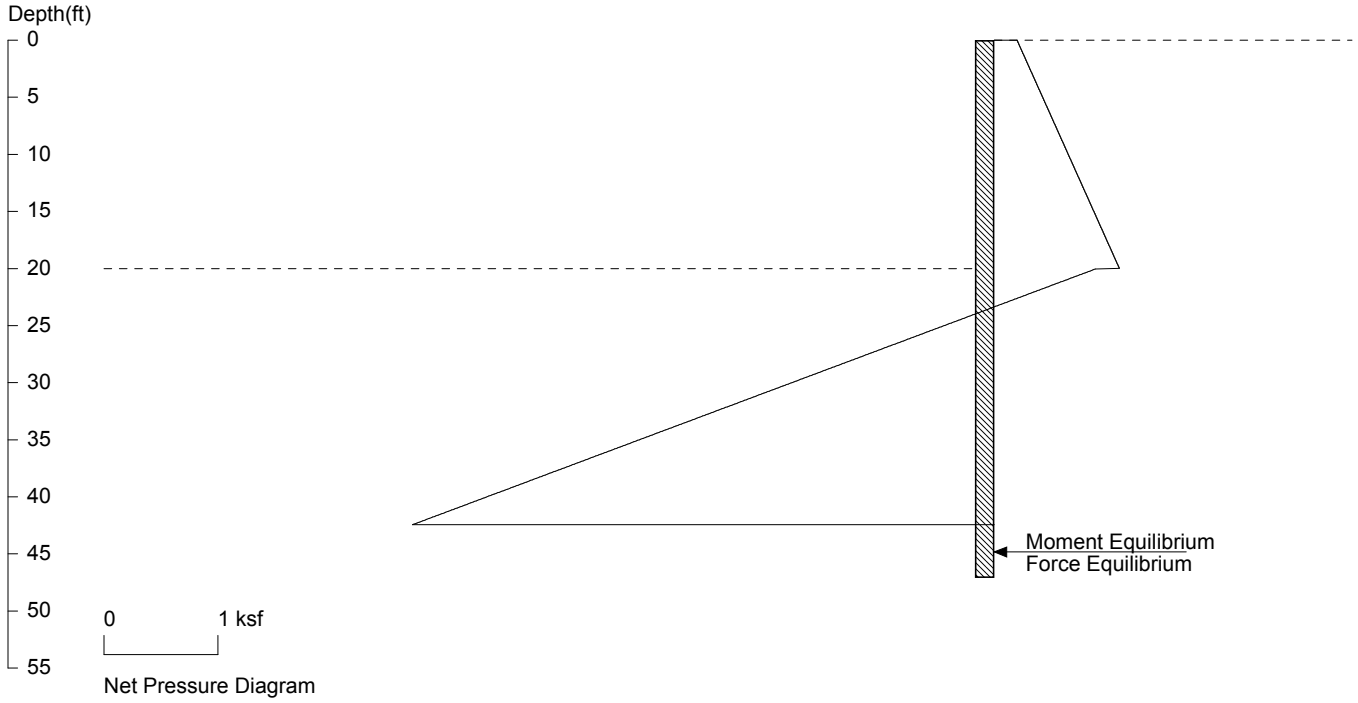
No.	Z depth	Spacing
1	0.00	4.58
2	20.00	3.00

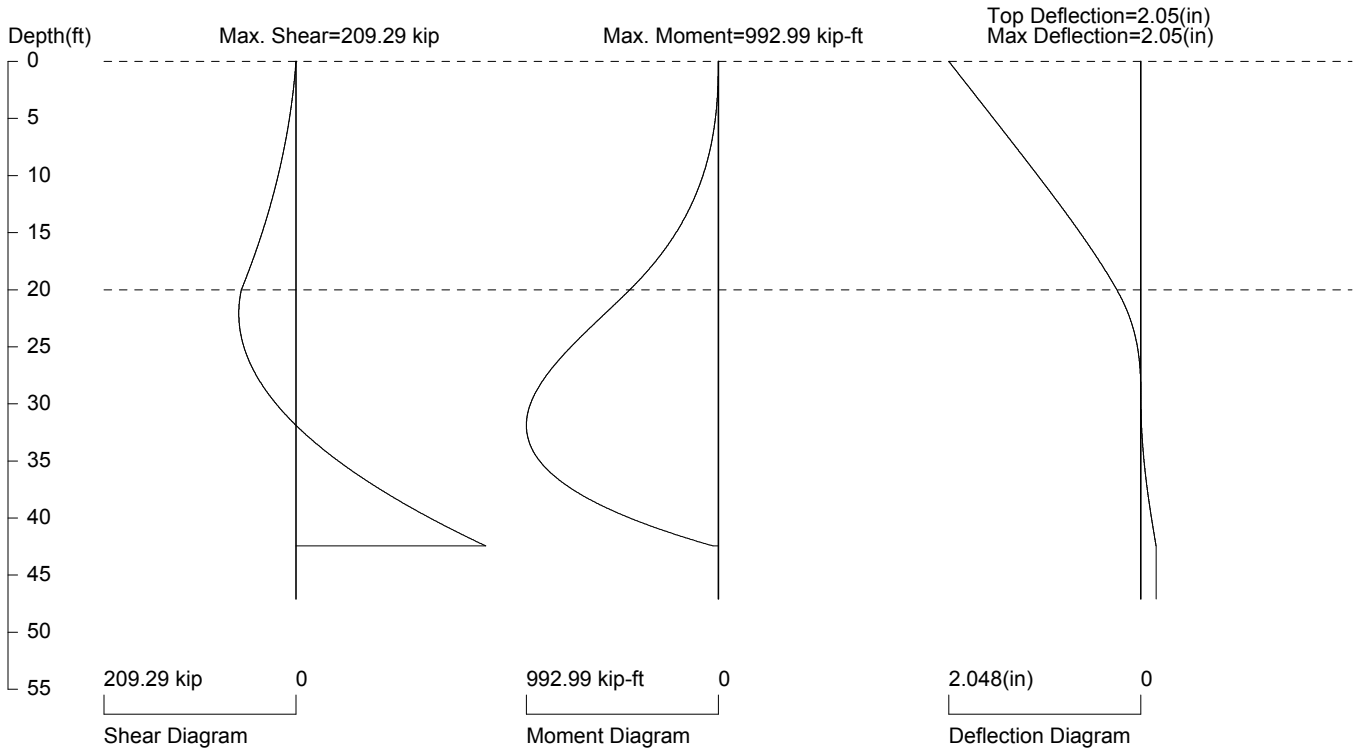
PASSIVE SPACING:

No.	Z depth	Spacing
1	20.00	4.58

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

Kahan Spec Home
P29 - P44





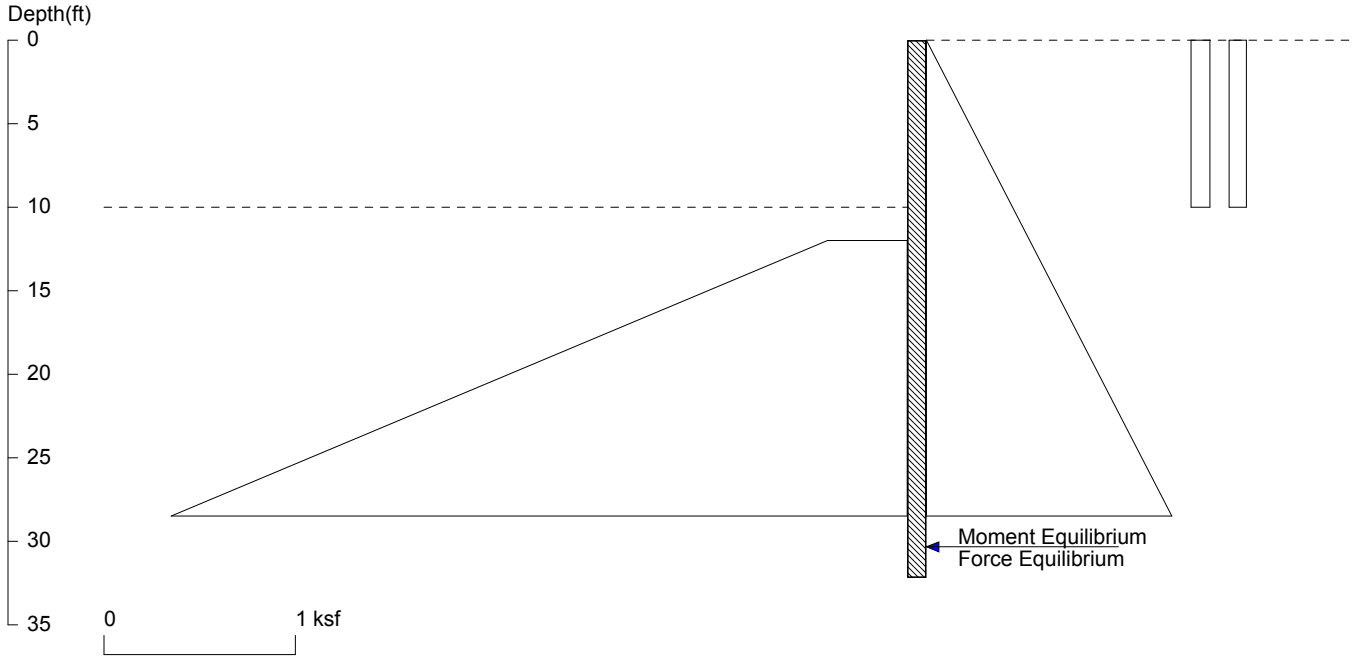
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 4.6 foot or meter

User Input Pile, W30X132: E (ksi)=29000.0, I (in4)/pile=5770.0

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P29-P44.sh8

Kahan Spec Home
P45 - P52



Licensed to 4324324234 3424343 Date: 11/30/2020
File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P45-P52.sh8

Wall Height=10.0 Pile Diameter=2.5 Pile Spacing=8.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=22.19 Min. Pile Length=32.19
MOMENT IN PILE: Max. Moment=387.53 per Pile Spacing=8.0 at Depth=20.00

PILE SELECTION:
Request Min. Section Modulus = 140.9 in3/pile=2309.28 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W18X86 has Section Modulus = 166.0 in3/pile=2720.24 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 1.12(in) based on E (ksi)=29000.00 and I (in4)/pile=1530.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	60	2.700	.045
*	eq			
0	.1	10	0.100	0
*	traff			
0	.09	10	0.090	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
12	.417	60	10.40	.208

ACTIVE SPACING:

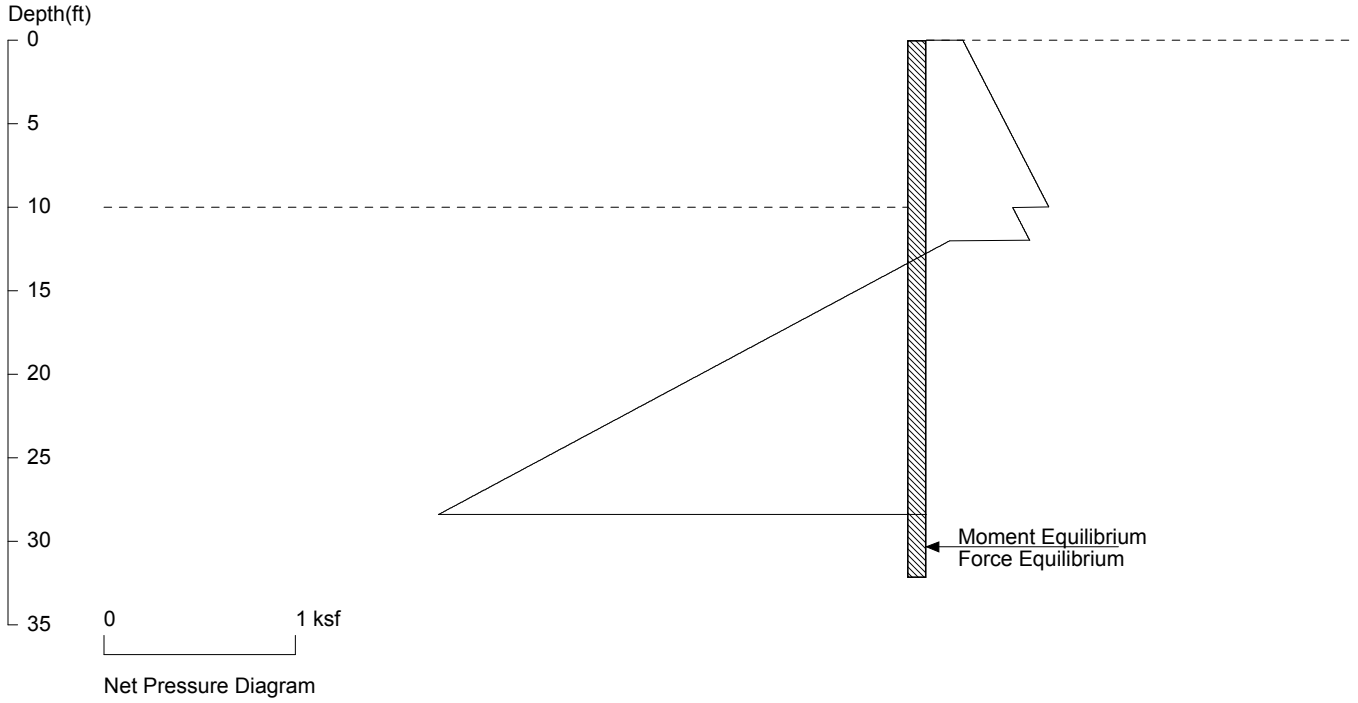
No.	Z depth	Spacing
1	0.00	8.00
2	10.00	2.50

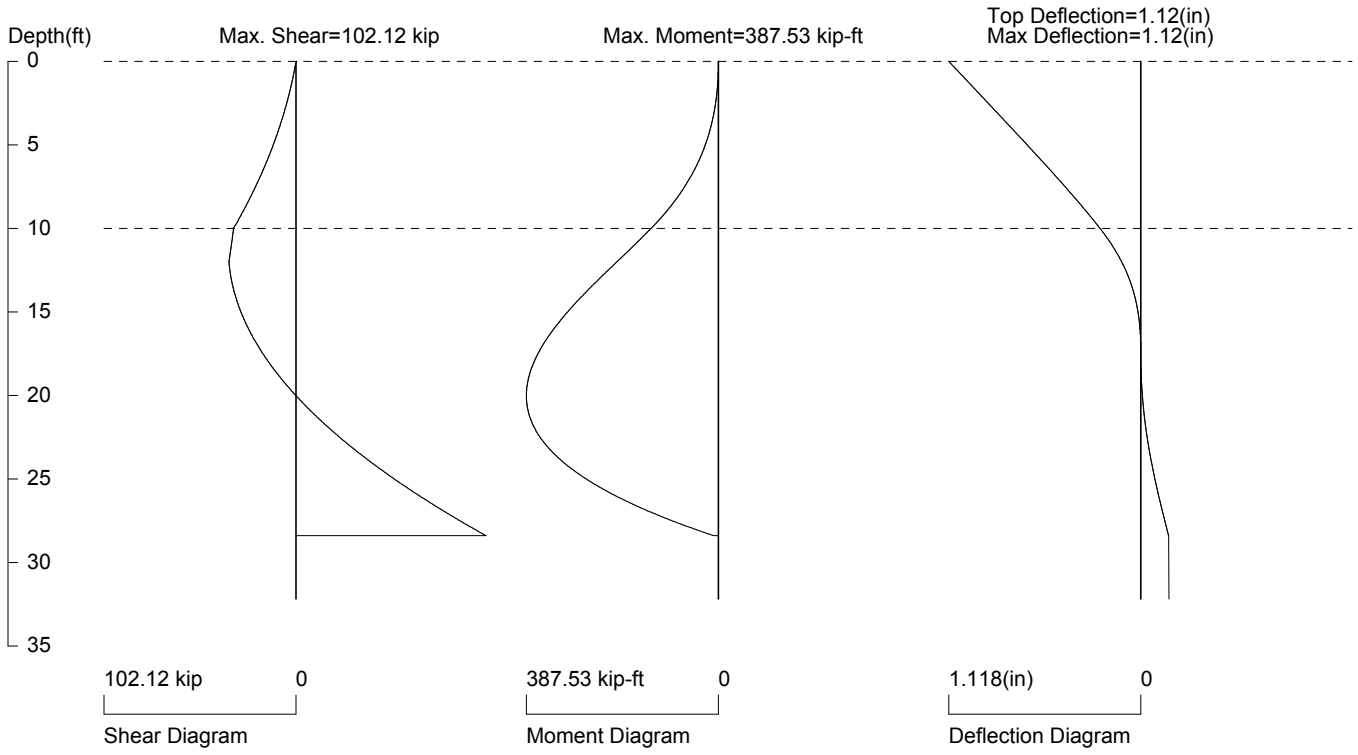
PASSIVE SPACING:

No.	Z depth	Spacing
1	10.00	5.00

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

Kahan Spec Home
P45 - P52





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

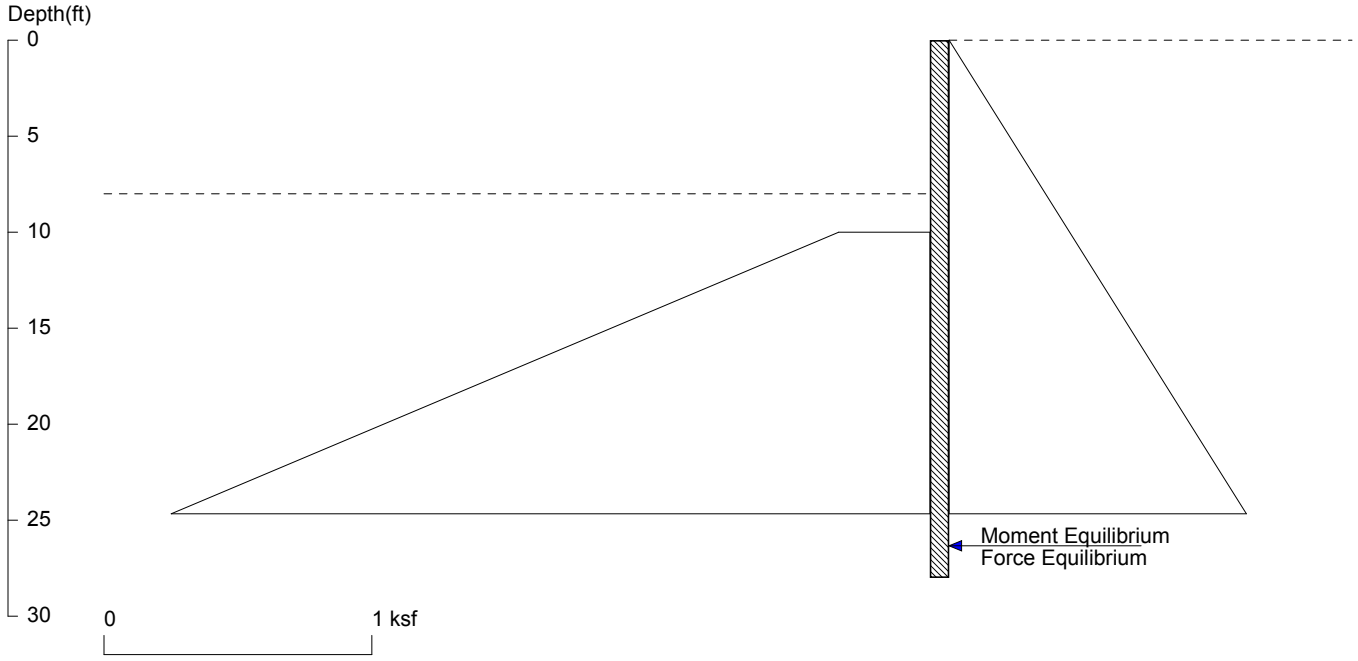
Based on pile spacing: 8.0 foot or meter

User Input Pile, W18X86: E (ksi)=29000.0, I (in4)/pile=1530.0

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P45-P52.sh8

Kahan Spec Home

P53-P54



Licensed to 4324324234 3424343 Date: 11/30/2020

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P53-P54.sh8

Wall Height=8.0 Pile Diameter=2.0 Pile Spacing=12.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=19.99 Min. Pile Length=27.99

MOMENT IN PILE: Max. Moment=169.66 per Pile Spacing=12.0 at Depth=17.26

PILE SELECTION:

Request Min. Section Modulus = 61.7 in3/pile=1011.01 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

W18X50 has Section Modulus = 88.9 in3/pile=1456.80 cm3/pile. It is greater than Min. Requirements!

Top Deflection = 0.63(in) based on E (ksi)=29000.00 and I (in4)/pile=800.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	60	2.700	.045

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
10	.34	60	8.840	.17

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	12.00
2	8.00	2.00

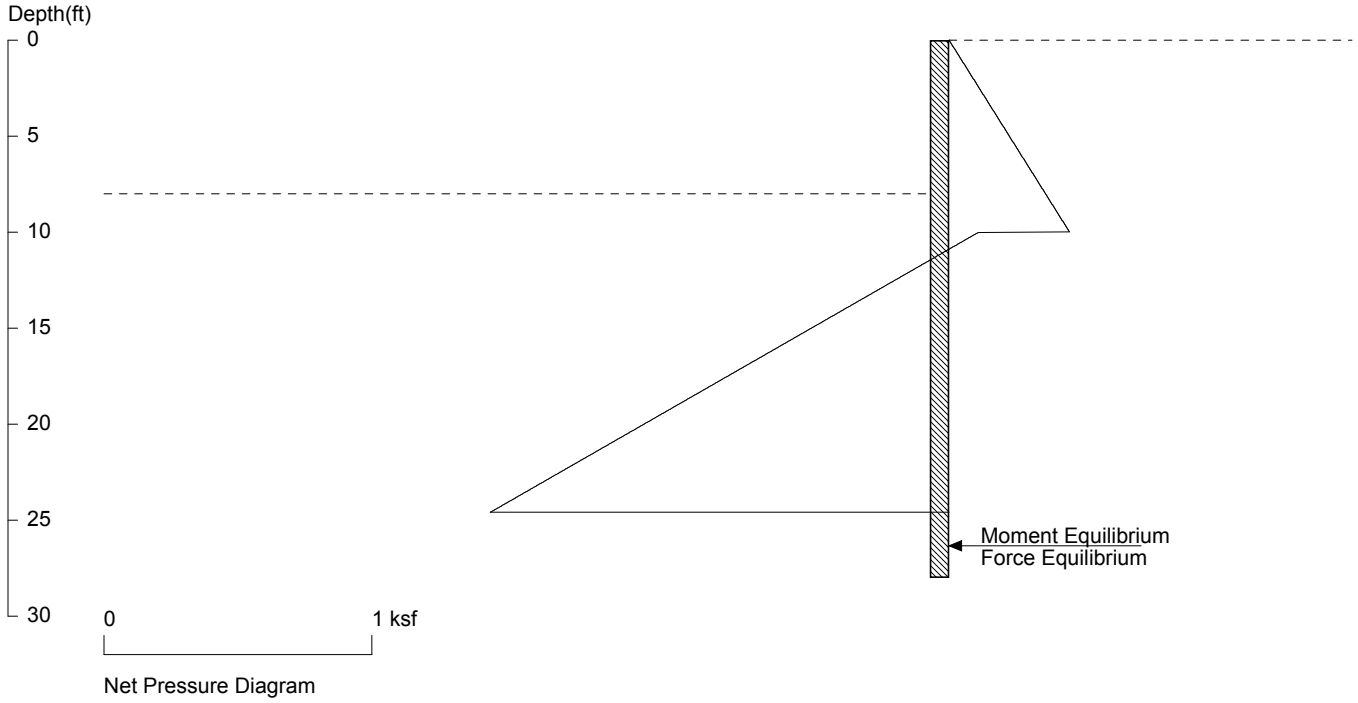
PASSIVE SPACING:

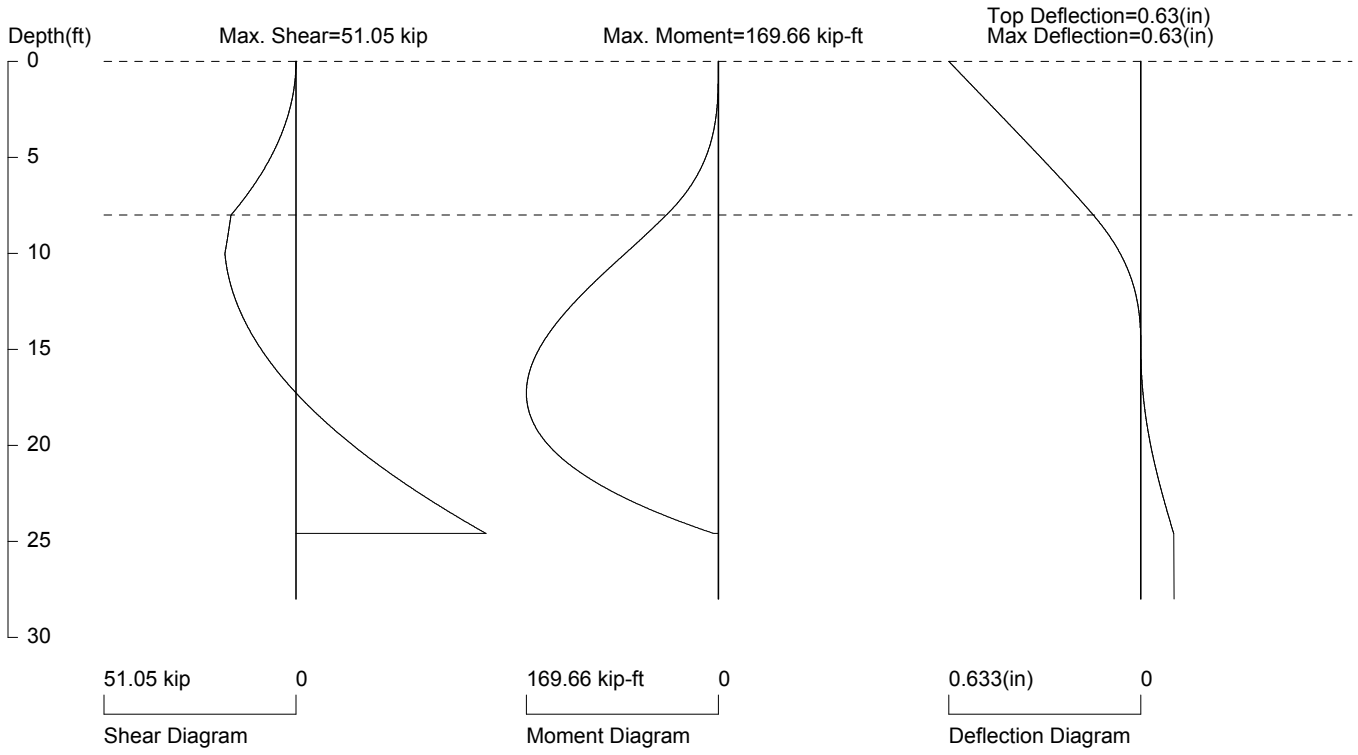
No.	Z depth	Spacing
1	8.00	4.00

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

Kahan Spec Home

P53-P54





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 12.0 foot or meter

User Input Pile, W18X50: E (ksi)=29000.0, I (in4)/pile=800.0

File: K:\2020\01519-2020-15 Kahan Spec Home\engineering\Shoring\P53-P54.sh8