



civil & structural  
engineering & planning



**Received by Email**

1/30/2023

# STRUCTURAL CALCULATIONS

Rose Hill Mukilteo

Shoring Design

3<sup>rd</sup> & Park Ave  
Mukilteo, WA 98275



### **Project Description**

The project involves the construction of new mixed-use building in Mukilteo, WA. A parking garage will be constructed below the commercial and residential space. The site slopes about one story from south to north. Approximately a 215' length of structural cantilevered concrete retaining walls up to 17' tall are required along the property lines. The rest of the site will utilize slope cuts. These retaining walls and slope cuts are designed per the recommendations from the geotechnical engineer.

### **Scope of Work**

Provide stamped structural calculations and drawings in accordance with the current building code and per the recommendations of the geotechnical engineer.

### **Basis of Design**

#### **Soldier Pile Walls**

[Per Nelson Geotechnical Associates, Inc. Report #8797822, dated 01/09/2023]

Active Pressure	40 pcf [per geotech]
At-Rest Pressure	60 pcf [per geotech]
Passive Pressure	200 psf (Includes Factor of Safety = 2.0) [per geotech]
Seismic Surcharge	8H psf [per geotech]



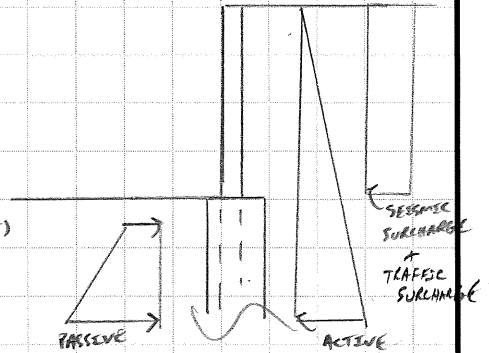
250 4th Ave. South  
Suite 200  
Edmonds, WA 98020

Description	Project Summary	By	BTJ	Date	01/27/23
		Checked		Date	
		Scale		Sheet No.	
Project	Rose Hill Mukilteo	Job No.	22332.10		1

## ROSE HILL MUKILTEO SHORING

### DESIGN CRITERIA

ACTIVE PRESSURE = 40pcf (PER GEOTECH)  
AT REST PRESSURE = 60pcf (PER GEOTECH)  
SEISMIC SURCHARGE = 8H (ASSUMED)  
PASSIVE PRESSURE = 200pcf \* 2.0 FACTOR OF SAFETY = 400pcf (ULT)  
IGNORE UPPER 1' PASSIVE PRESSURE  
TRAFFIC SURCHARGE = 80 psf



LC1 = D+H (FACTOR OF SAFETY = 1.5)  
LC2 = D+0.7E+H (FACTOR OF SAFETY = 1.1)  
LC3 = D+L+H (F.S. = 1.5)  
LC4 = D+0.525E+0.75L+H (F.S. = 1.1)

### PILE DESIGN

REFER TO WALL DESIGN SUMMARY & SHORING SUITE  
OUTPUTS TO FOLLOW



250 4th Ave. South  
Suite 200  
Edmonds, WA 98020  
425.778.8500  
www.cgengineering.com

Description

Project

ROSE HILL MUKILTEO

By

BTJ

Checked

Scale

Job No.

22332.10

Date 10/28/22

Date

Sheet No.

2

### Wall Design Summary

Retaining Height	LC	Spacing	Pile Dia.	Pile Size*	Min. Embed (ft)	Deflection (in)
17'-0"	LC1	5'-9"	30"	W21x111	20.4	1.16
	LC2	5'-9"	30"	W21x111	19.2	1.47
	LC3	5'-9"	30"	W21x111	22.3	1.72
	LC4	5'-9"	30"	W21x111	19.9	1.71
16'-0"	LC1	5'-9"	30"	W21x111	19.2	0.86
	LC2	5'-9"	30"	W21x111	18.1	1.12
	LC3	5'-9"	30"	W21x111	21.1	1.3
	LC4	5'-9"	30"	W21x111	18.8	1.3
14'-0"	LC1	5'-0"	30"	W18x86	16.0	0.63
	LC2	5'-0"	30"	W18x86	15.1	0.82
	LC3	5'-0"	30"	W18x86	17.8	1
	LC4	5'-0"	30"	W18x86	15.8	1
12'-0"	LC1	8'-0"	30"	W18x86	16.5	0.58
	LC2	8'-0"	30"	W18x86	15.6	0.75
	LC3	8'-0"	30"	W18x86	18.6	1
	LC4	8'-0"	30"	W18x86	16.5	0.95
10'-0"	LC1	8'-0"	24"	W14x61	15.0	0.63
	LC2	8'-0"	24"	W14x61	14.3	0.81
	LC3	8'-0"	24"	W14x61	17.4	1.2
	LC4	8'-0"	24"	W14x61	15.2	1.06
8'-0"	LC1	8'-0"	24"	W14x48	12.1	0.28
	LC2	8'-0"	24"	W14x48	11.5	0.36
	LC3	8'-0"	24"	W14x48	14.4	0.59
	LC4	8'-0"	24"	W14x48	12.6	0.52
6'-0"	LC1	8'-0"	24"	W10x33	9.2	0.22
	LC2	8'-0"	24"	W10x33	8.7	0.26
	LC3	8'-0"	24"	W10x33	11.4	0.5
	LC4	8'-0"	24"	W10x33	9.8	0.42

\*Refer to the Shoring Suite Outputs to follow

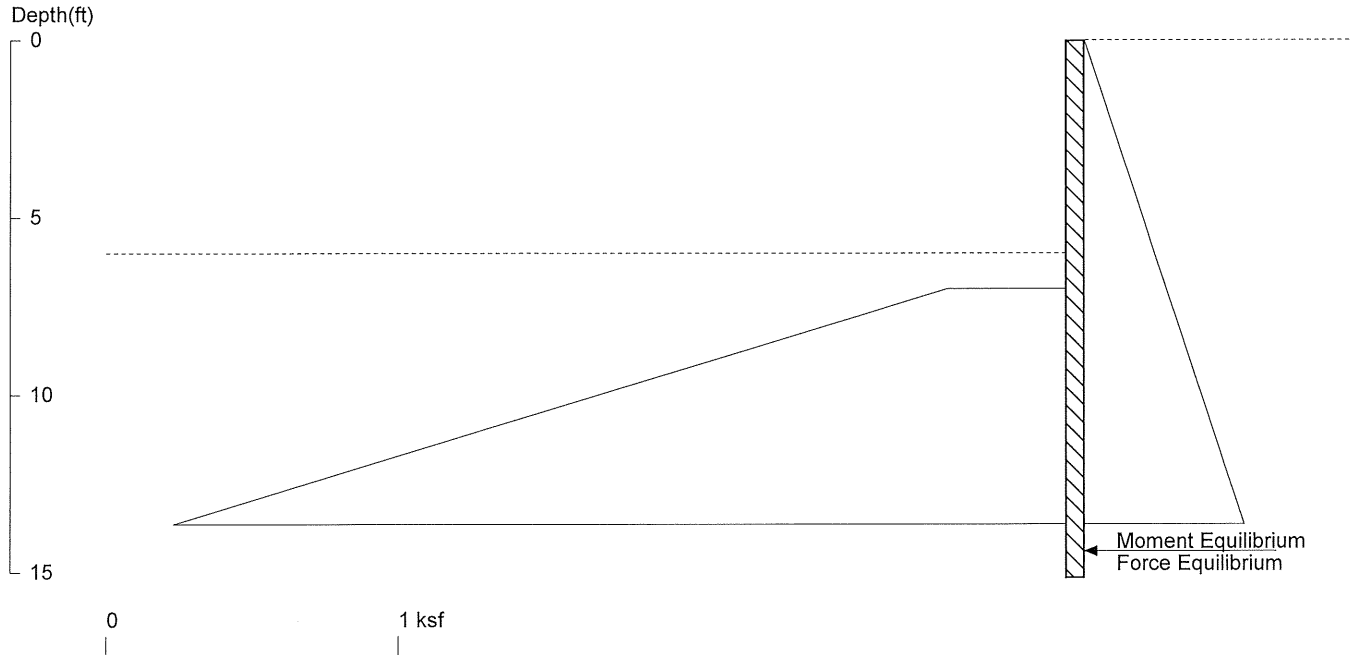
LC1=D+H FS=1.5  
 LC2=D+0.7E+H FS=1.1  
 LC3=D+L+H FS=1.5  
 LC4=D+0.525E+0.75L+H FS=1.1



250 4th Ave. South  
Suite 200  
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Description	Wall Design	By	BTJ	Date	01/27/23
		Checked		Date	
		Scale		Sheet No.	
Project	Rose Hill Mukilteo	Job No.	22332.10		<b>3</b>

# 6' Retained 8' o.c. (LC1=D+H)



<ShoringSuite> CIVILTECH SOFTWARE USA [www.civiltechsoftware.com](http://www.civiltechsoftware.com)

Licensed to 4324324234 3424343 Date: 1/27/2023  
File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\6' LC1 at 8.0' oc.sh8  
UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=6.0 Pile Diameter=2.0 Pile Spacing=8.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=9.16 Min. Pile Length=15.16  
MOMENT IN PILE: Max. Moment=29.67 per Pile Spacing=8.0 at Depth=10.09

## PILE SELECTION:

Request Min. Section Modulus = 10.8 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66  
Selected Pile, W10X33, S = 35.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus  
Top Deflection = 0.22(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 170.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040

## PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
7.0	0.40	800.0	317.60	0.400

## ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	6.00	2.00

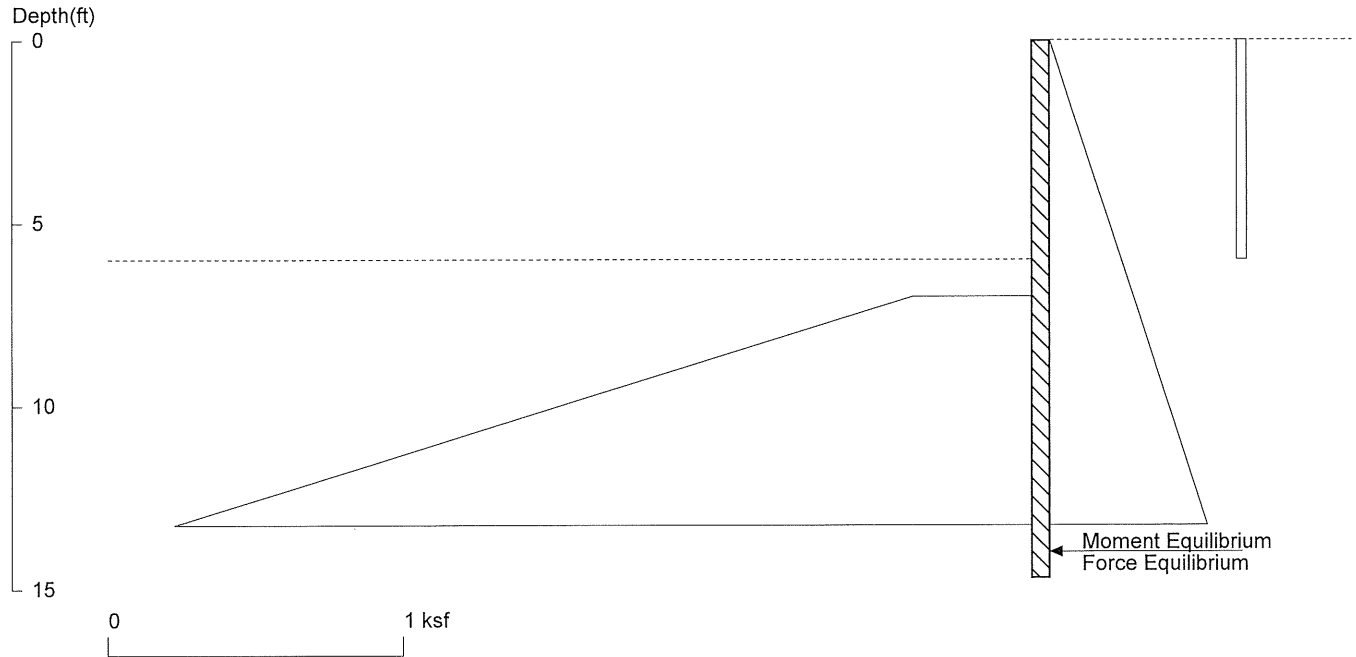
## PASSIVE SPACING:

No.	Z depth	Spacing
1	6.00	4.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 6' Retained

## 8' o.c. (LC2=D+0.7E+H)



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File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\6' LC2 at 8.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=6.0 Pile Diameter=2.0 Pile Spacing=8.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=8.71 Min. Pile Length=14.71

MOMENT IN PILE: Max. Moment=37.68 per Pile Spacing=8.0 at Depth=9.80

### PILE SELECTION:

Request Min. Section Modulus = 13.7 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W10X33, S = 35.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.26(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 170.0

### DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.034	6	0.034	

### PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
7.0	0.40	800.0	317.60	0.400

### ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	6.00	2.00

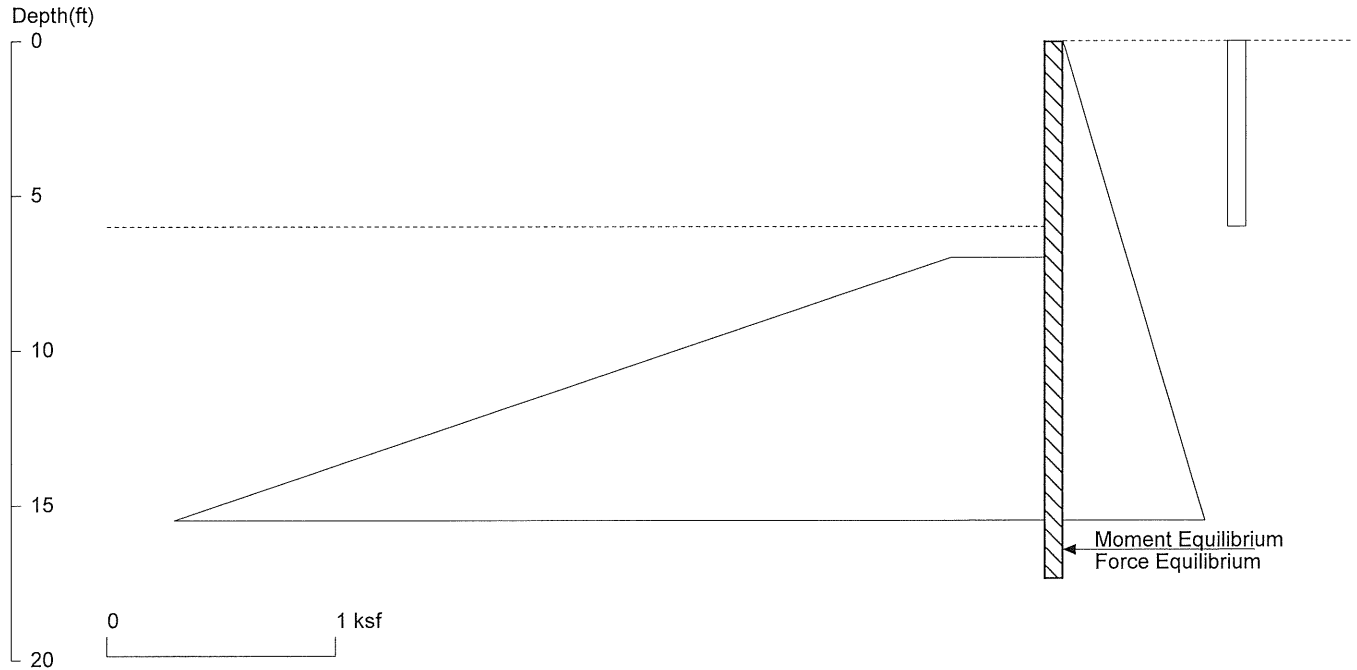
### PASSIVE SPACING:

No.	Z depth	Spacing
1	6.00	4.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 6' Retained

8' o.c. (LC3=D+L+H)



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File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\6' LC3 at 8.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=6.0 Pile Diameter=2.0 Pile Spacing=8.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=11.38 Min. Pile Length=17.38

MOMENT IN PILE: Max. Moment=58.80 per Pile Spacing=8.0 at Depth=11.05

## PILE SELECTION:

Request Min. Section Modulus = 21.4 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W10X33, S = 35.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.50(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 170.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.080	6	0.080	

## PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
7.0	0.40	800.0	317.60	0.400

## ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	6.00	2.00

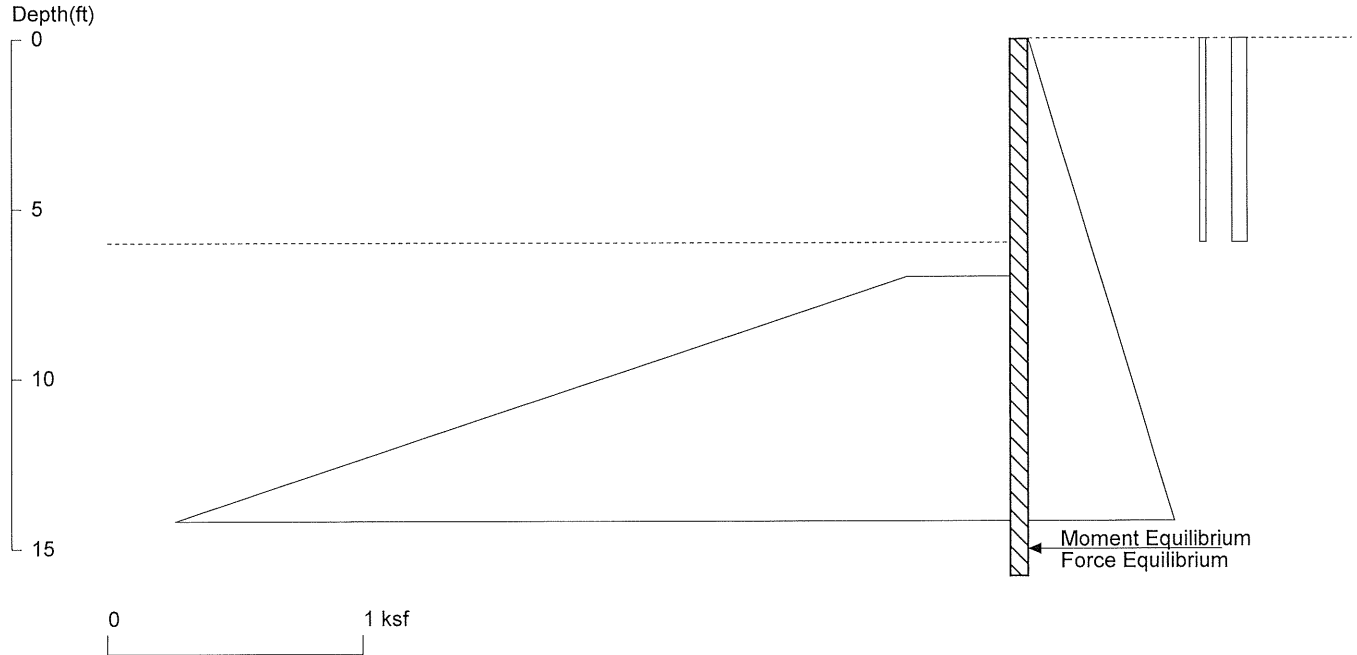
## PASSIVE SPACING:

No.	Z depth	Spacing
1	6.00	4.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 6' Retained

## 8' o.c. (LC4=D+0.525E+0.75L+H)



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UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=6.0      Pile Diameter=2.0      Pile Spacing=8.0      Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=9.83    Min. Pile Length=15.83

MOMENT IN PILE: Max. Moment=54.94 per Pile Spacing=8.0 at Depth=10.29

### PILE SELECTION:

Request Min. Section Modulus = 20.0 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W10X33, S = 35.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.42(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 170.0

### DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.025	6	0.025	
0	.06	6	0.060	

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
7.0	0.40	800.0	317.60	0.400

### ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	6.00	2.00

### PASSIVE SPACING:

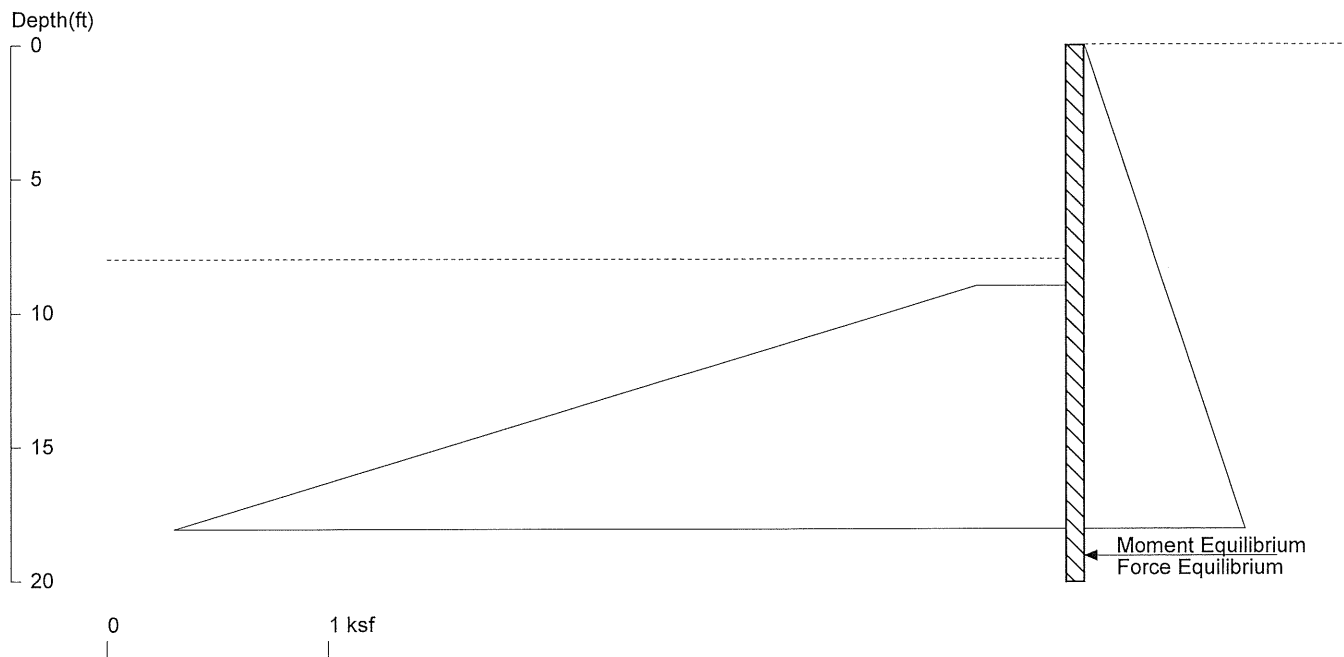
No.	Z depth	Spacing
1	6.00	4.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in



# 8' Retained

8' o.c. (LC1=D+H)



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File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\Shoring\Engineering\8' LC1 at 8.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

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

PILE LENGTH: Min. Embedment=12.08 Min. Pile Length=20.08

MOMENT IN PILE: Max. Moment=68.57 per Pile Spacing=8.0 at Depth=13.37

## PILE SELECTION:

Request Min. Section Modulus = 24.9 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W14X48, S = 70.3 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.28(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 485.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040

## PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
9.0	0.40	800.0	316.80	0.400

## ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	8.00	2.00

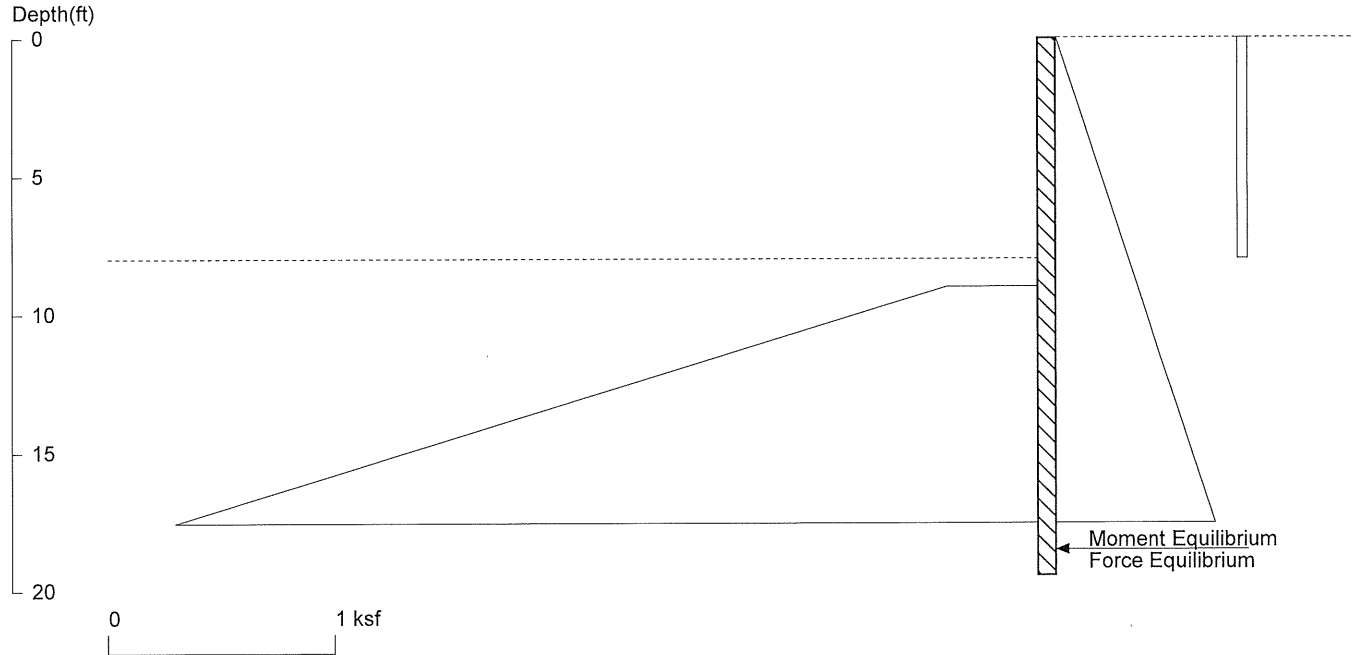
## PASSIVE SPACING:

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/ft<sup>3</sup>; Deflection - in

# 8' Retained

## 8' o.c. (LC2=D+0.7E+H)



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UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

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

PILE LENGTH: Min. Embedment=11.47 Min. Pile Length=19.47

MOMENT IN PILE: Max. Moment=86.94 per Pile Spacing=8.0 at Depth=12.98

### PILE SELECTION:

Request Min. Section Modulus = 31.6 in<sup>3</sup>/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

Selected Pile, W14X48, S = 70.3 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.36(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 485.0

### DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.045	8	0.045	

### PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
9.0	0.40	800.0	316.80	0.400

### ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	8.00	2.00

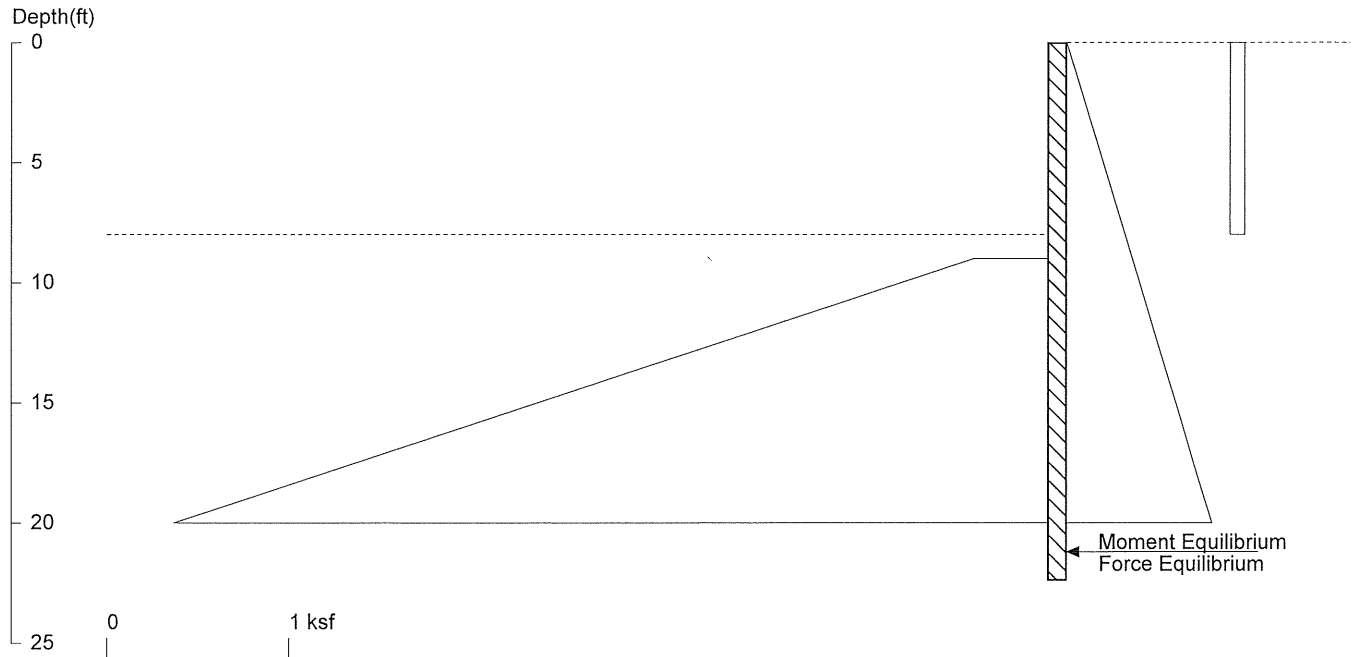
### PASSIVE SPACING:

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/ft<sup>3</sup>; Deflection - in

# 8' Retained

## 8' o.c. (LC3=D+L+H)



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Date: 1/27/2023

File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\8' LC3 at 8.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

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

PILE LENGTH: Min. Embedment=14.40 Min. Pile Length=22.40

MOMENT IN PILE: Max. Moment=119.15 per Pile Spacing=8.0 at Depth=14.37

### PILE SELECTION:

Request Min. Section Modulus = 43.3 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W14X48, S = 70.3 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.59(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 485.0

### DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.080	8	0.080	

### PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
9.0	0.40	800.0	316.80	0.400

### ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	8.00	2.00

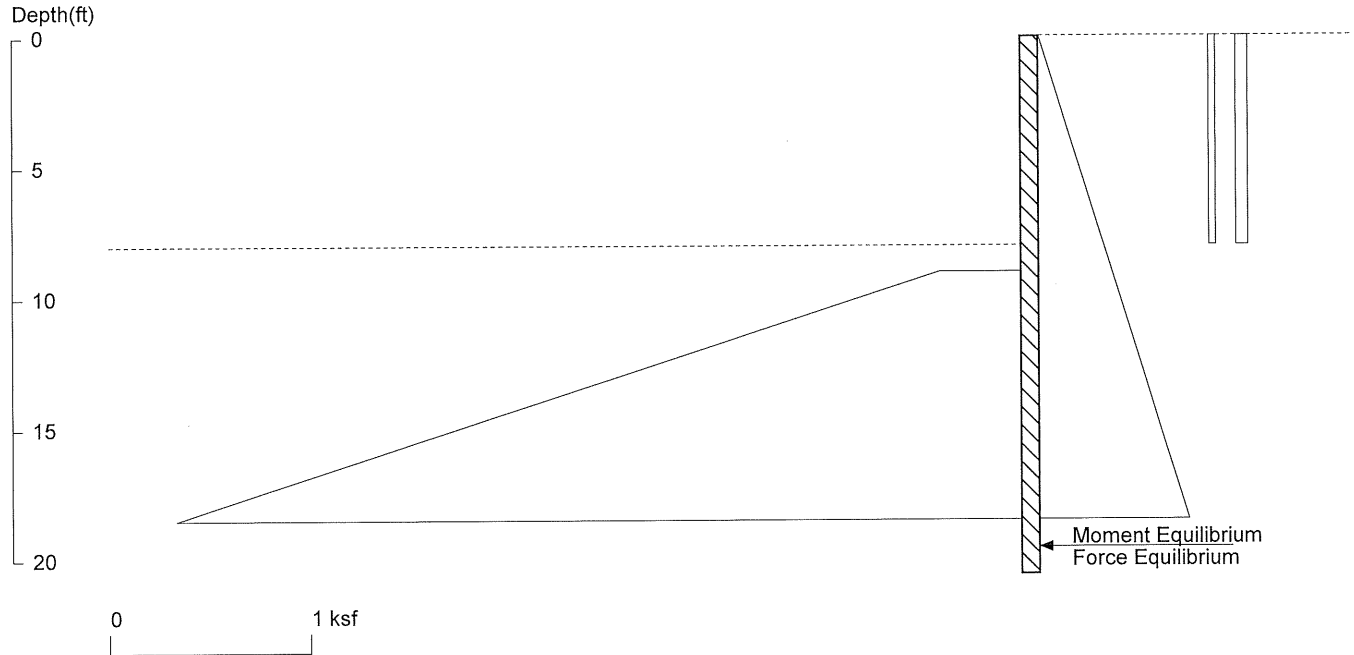
### PASSIVE SPACING:

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/ft<sup>3</sup>; Deflection - in

# 8' Retained

**8' o.c. (LC4=D+0.525E+0.75L+H)**



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Licensed to 4324324234 3424343 Date: 1/27/2023  
 File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\8' LC4 at 8.0' oc.sh8  
 UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

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

PILE LENGTH: Min. Embedment=12.58 Min. Pile Length=20.58  
 MOMENT IN PILE: Max. Moment=115.86 per Pile Spacing=8.0 at Depth=13.46

PILE SELECTION:  
 Request Min. Section Modulus = 42.1 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66  
 Selected Pile, W14X48, S = 70.3 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus  
 Top Deflection = 0.52(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 485.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.034	8	0.034	
0	.06	8	0.060	

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
9.0	0.40	800.0	316.80	0.400

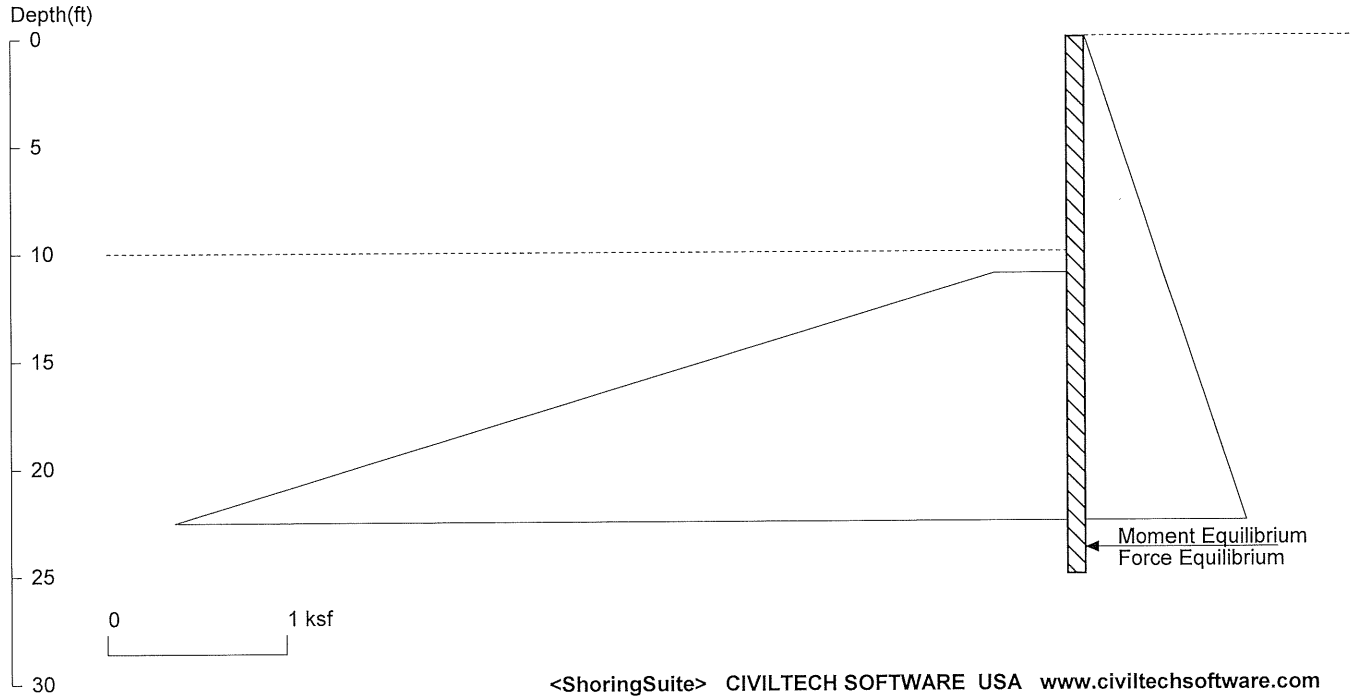
## ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	8.00	2.00

## PASSIVE SPACING:

No.	Z depth	Spacing
1	8.00	4.00

# 10' Retained 8' o.c. (LC1=D+H)



Licensed to 4324324234 3424343 Date: 1/27/2023  
 File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\10' LC1 at 8.0' oc.sh8  
 UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=10.0 Pile Diameter=2.0 Pile Spacing=8.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=15.02 Min. Pile Length=25.02  
 MOMENT IN PILE: Max. Moment=132.25 per Pile Spacing=8.0 at Depth=16.67

PILE SELECTION:  
 Request Min. Section Modulus = 48.1 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66  
 Selected Pile, W14X61, S = 92.2 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus  
 Top Deflection = 0.63(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 640.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
11.0	0.40	800.0	316.00	0.400

ACTIVE SPACING:

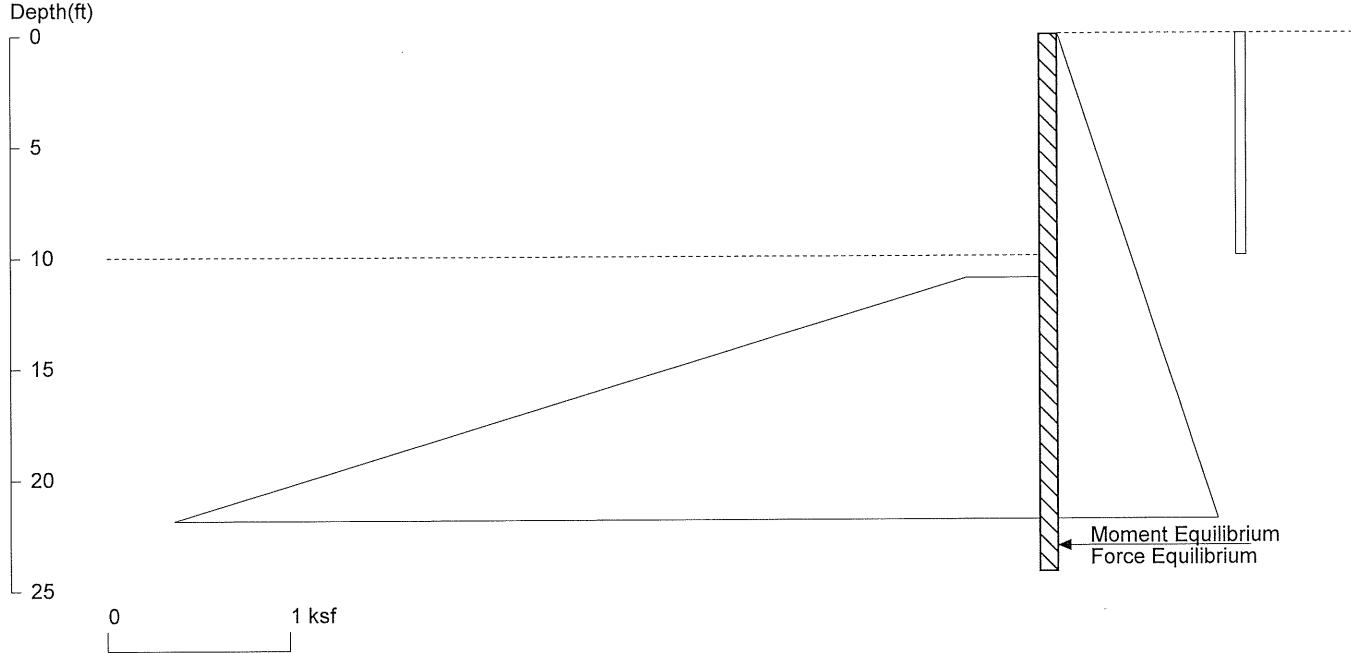
No.	Z depth	Spacing
1	0.00	8.00
2	10.00	2.00

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/ft<sup>3</sup>; Deflection - in

**10' Retained**  
8' o.c. ( $LC2=D+0.7E+H$ )



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File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\10' LC2 at 8.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=10.0      Pile Diameter=2.0      Pile Spacing=8.0      Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=14.25    Min. Pile Length=24.25

MOMENT IN PILE: Max. Moment=167.51 per Pile Spacing=8.0 at Depth=16.17

PILE SELECTION:

Request Min. Section Modulus =  $60.9 \text{ in}^3/\text{pile}$ ,  $F_y = 50 \text{ ksi} = 345 \text{ MPa}$ ,  $F_b/F_y = 0.66$

Selected Pile, W14X61, S = 92.2 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.81(in) based on E (ksi)= 29000.00, I (in4)/pile= 640.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.056	10	0.056	

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.)=1.1

Z1	P1	Z2	P2	Slope
11.0	0.40	800.0	316.00	0.400

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	10.00	2.00

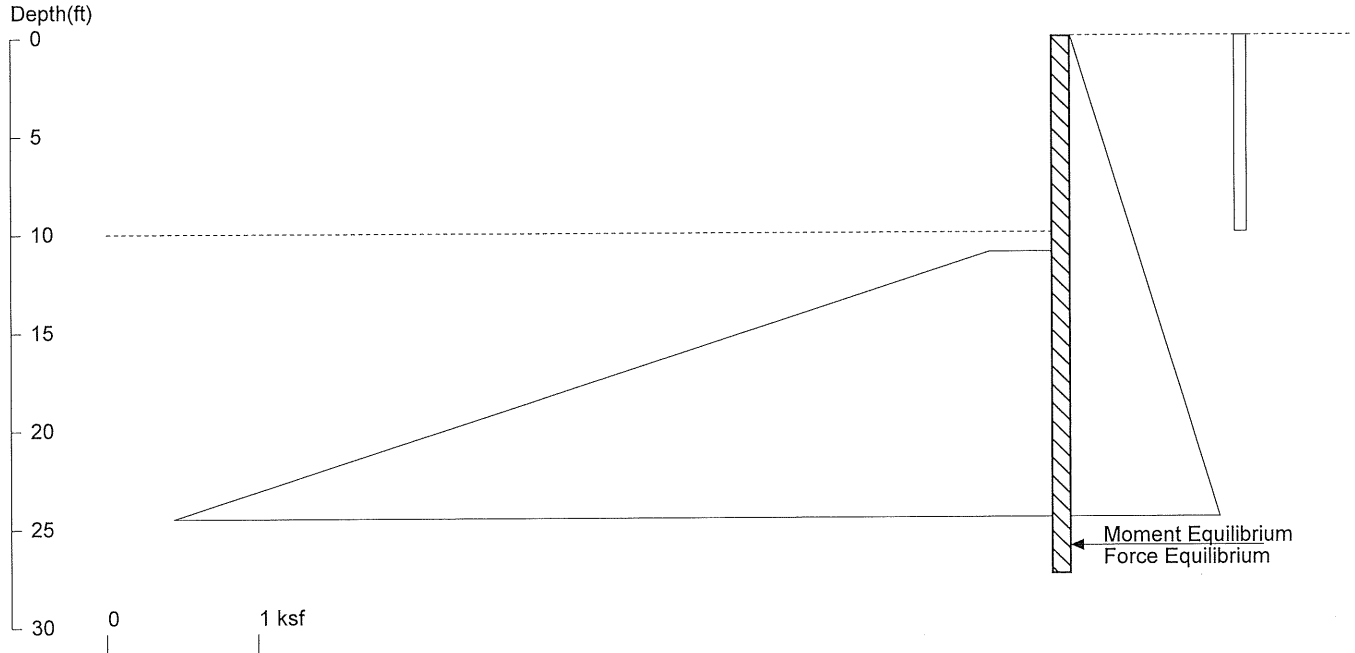
### PASSIVE SPACING:

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/ft<sup>3</sup>; Deflection - in

# 10' Retained

## 8' o.c. (LC3=D+L+H)



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File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\10' LC3 at 8.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=10.0 Pile Diameter=2.0 Pile Spacing=8.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=17.40 Min. Pile Length=27.40

MOMENT IN PILE: Max. Moment=210.21 per Pile Spacing=8.0 at Depth=17.68

### PILE SELECTION:

Request Min. Section Modulus = 76.4 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W14X61, S = 92.2 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 1.19(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 640.0

### DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.080	10	0.080	

### PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
11.0	0.40	800.0	316.00	0.400

### ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	10.00	2.00

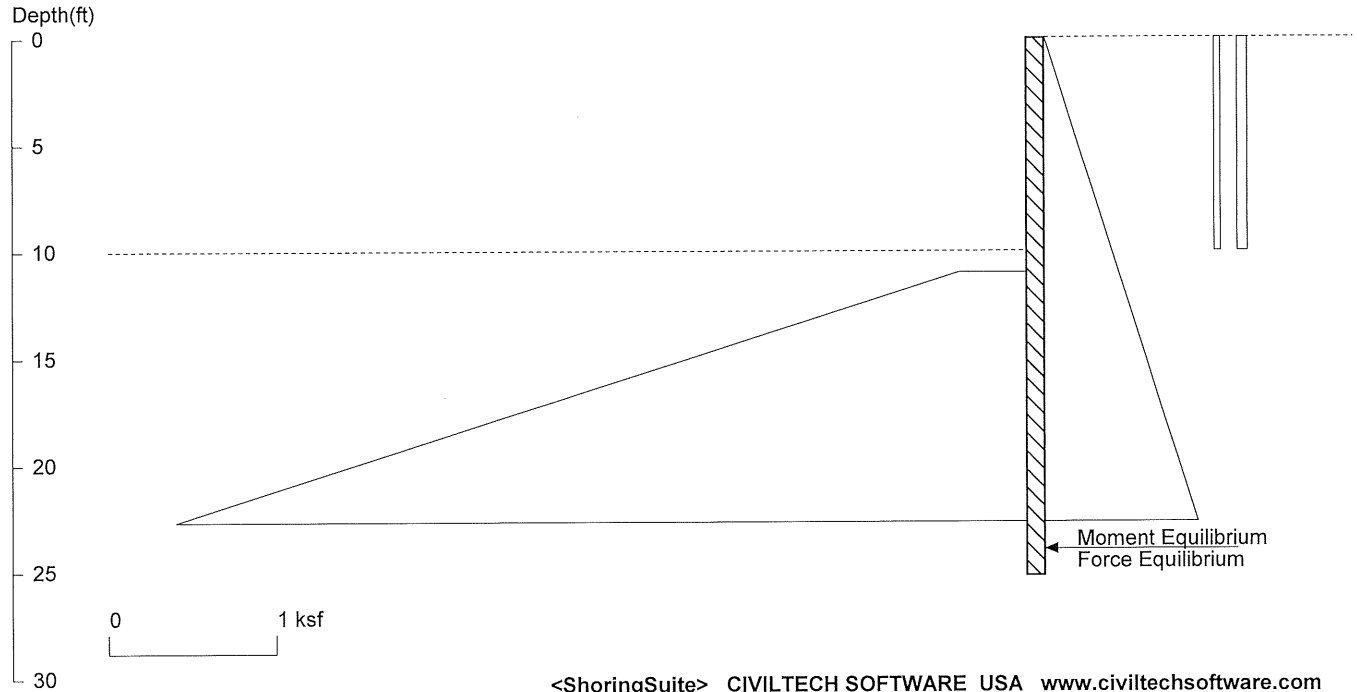
### PASSIVE SPACING:

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/ft<sup>3</sup>; Deflection - in

# 10' Retained

## 8' o.c. ( $LC4=D+0.525E+0.75L+H$ )



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 File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\10' LC4 at 8.0' oc.sh8  
 UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=10.0 Pile Diameter=2.0 Pile Spacing=8.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=15.21 Min. Pile Length=25.21  
 MOMENT IN PILE: Max. Moment=204.83 per Pile Spacing=8.0 at Depth=16.59

PILE SELECTION:  
 Request Min. Section Modulus = 74.5 in<sup>3</sup>/pile,  $F_y = 50 \text{ ksi} = 345 \text{ MPa}$ ,  $F_b/F_y = 0.66$   
 Selected Pile, W14X61,  $S = 92.2 \text{ in}^3/\text{pile}$  It is greater than Request Min. Section Modulus  
 Top Deflection = 1.06(in) based on  $E \text{ (ksi)} = 29000.00$ ,  $I \text{ (in}^4\text{)/pile} = 640.0$

### DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.037	10	0.037	
0	.06	10	0.060	

### PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
11.0	0.40	800.0	316.00	0.400

### ACTIVE SPACING:

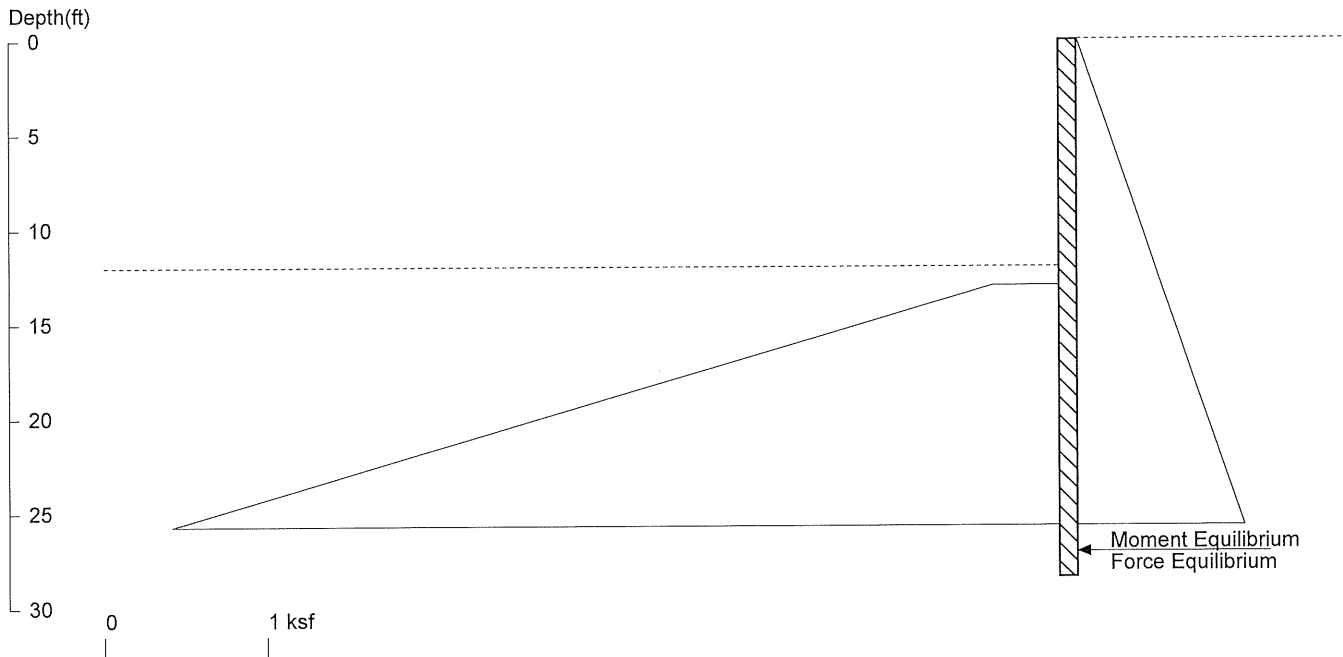
No.	Z depth	Spacing
1	0.00	8.00
2	10.00	2.00

### PASSIVE SPACING:

No.	Z depth	Spacing
1	10.00	4.00



**12' Retained**  
**8' o.c. (LC1=D+H)**



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UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=12.0      Pile Diameter=2.5      Pile Spacing=8.0      Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=16.45    Min. Pile Length=28.45

MOMENT IN PILE: Max. Moment=216.79 per Pile Spacing=8.0 at Depth=19.27

PILE SELECTION:

Request Min. Section Modulus = 78.8 in<sup>3</sup>/pile,  $F_y = 50 \text{ ksi} = 345 \text{ MPa}$ ,  $F_b/F_y = 0.66$

Selected Pile, W18X86, S = 166.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.58(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 1530.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
13.0	0.40	800.0	315.20	0.400

ACTIVE SPACING:

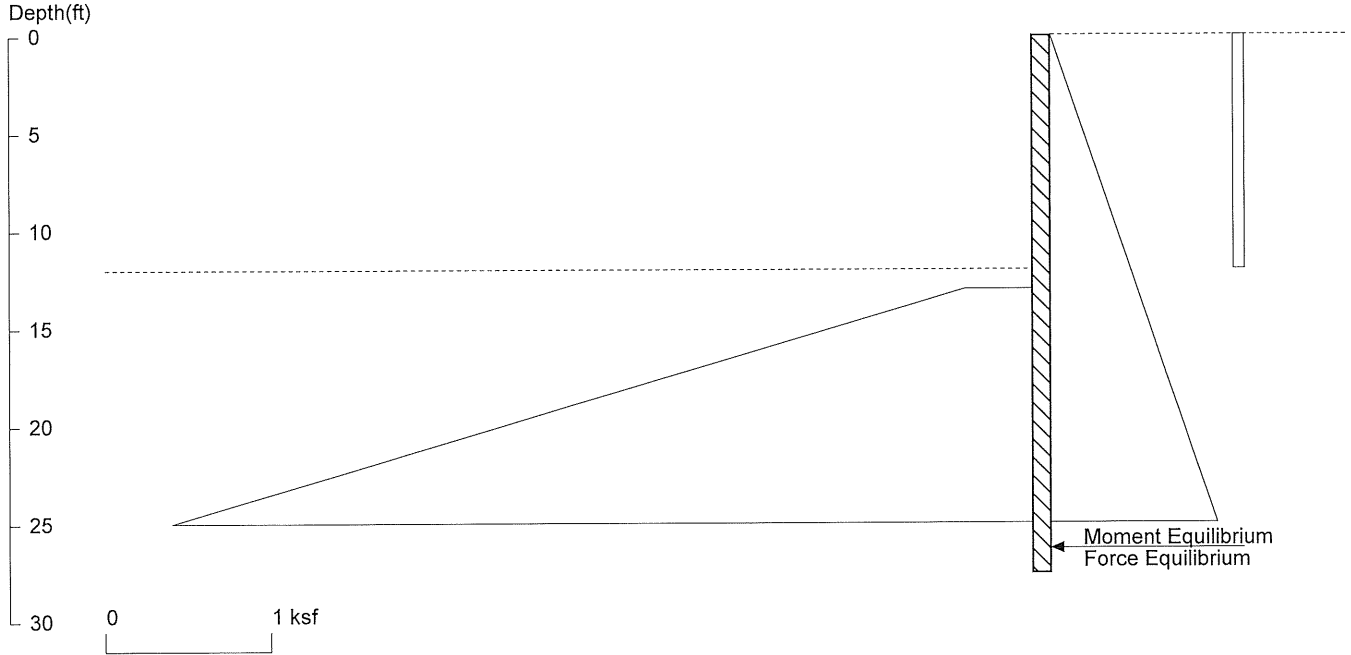
No.	Z depth	Spacing
1	0.00	8.00
2	12.00	2.50

### PASSIVE SPACING:

No.	Z depth	Spacing
1	12.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

**12' Retained**  
8' o.c. ( $LC2=D+0.7E+H$ )



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File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\12' LC2 at 8.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=12.0      Pile Diameter=2.5      Pile Spacing=8.0      Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=15.57    Min. Pile Length=27.57

MOMENT IN PILE: Max. Moment=274.51 per Pile Spacing=8.0 at Depth=18.70

PILE SELECTION:

Request Min. Section Modulus = 99.8 in<sup>3</sup>/pile,  $F_y = 50 \text{ ksi} = 345 \text{ MPa}$ ,  $F_b/F_y = 0.66$

Selected Pile, W18X86, S = 166.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.75(in) based on E (ksi)= 29000.00, I (in4)/pile= 1530.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.067	12	0.067	

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
13.0	0.40	800.0	315.20	0.400

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	12.00	2.50

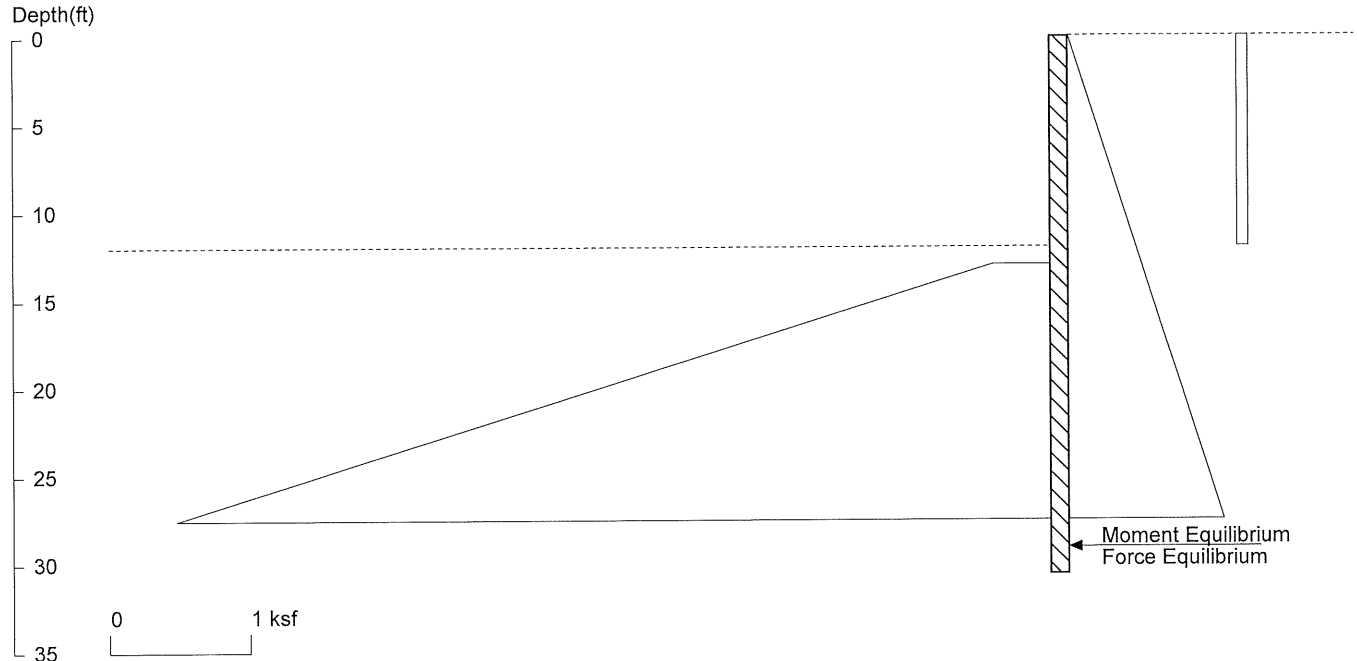
### PASSIVE SPACING:

No.	Z depth	Spacing
1	12.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 12' Retained

## 8' o.c. (LC3=D+L+H)



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File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\Shoring\Engineering\12' LC3 at 8.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=12.0 Pile Diameter=2.5 Pile Spacing=8.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=18.64 Min. Pile Length=30.64

MOMENT IN PILE: Max. Moment=322.18 per Pile Spacing=8.0 at Depth=20.17

### PILE SELECTION:

Request Min. Section Modulus = 117.2 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W18X86, S = 166.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 1.00(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 1530.0

### DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.080	12	0.080	

### PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
13.0	0.40	800.0	315.20	0.400

### ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	12.00	2.50

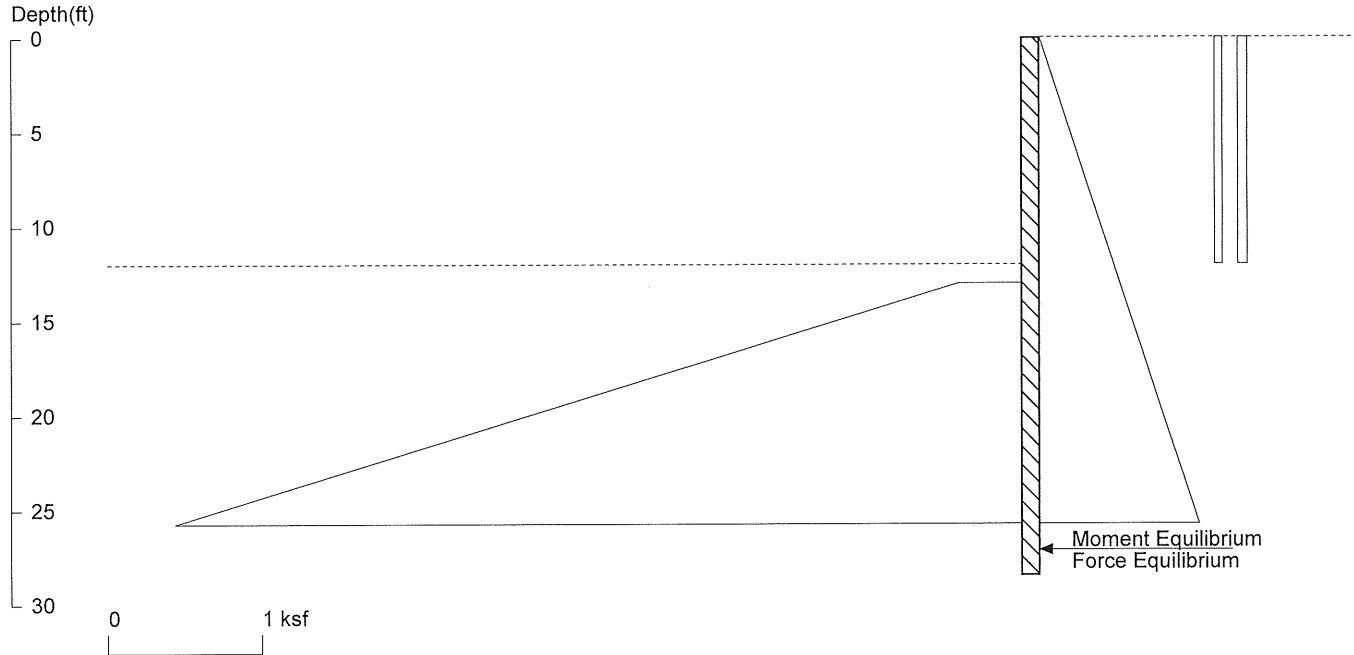
### PASSIVE SPACING:

No.	Z depth	Spacing
1	12.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 12' Retained

## 8' o.c. (LC4=D+0.525E+0.75L+H)



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File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\Shoring\Engineering\12' LC4 at 8.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=12.0 Pile Diameter=2.5 Pile Spacing=8.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=16.48 Min. Pile Length=28.48

MOMENT IN PILE: Max. Moment=327.69 per Pile Spacing=8.0 at Depth=19.07

### PILE SELECTION:

Request Min. Section Modulus = 119.2 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W18X86, S = 166.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.95(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 1530.0

### DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.050	12	0.050	
0	.06	12	0.060	

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
13.0	0.40	800.0	315.20	0.400

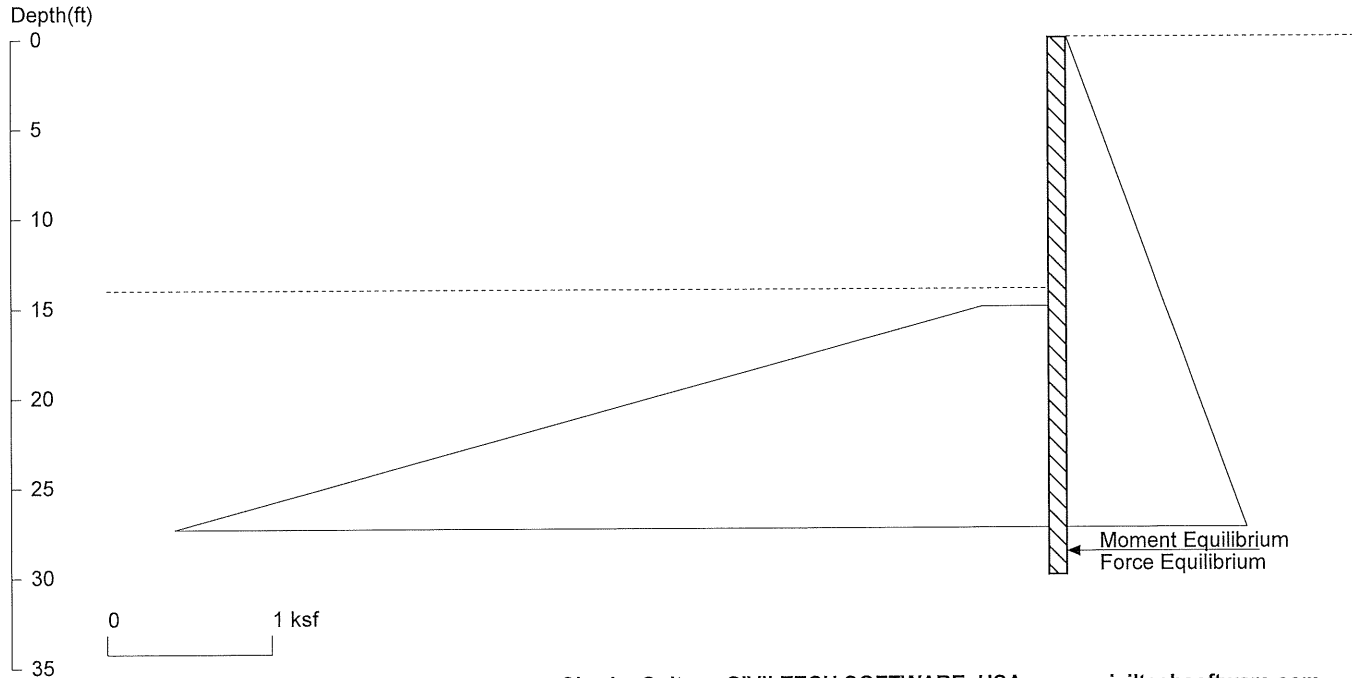
### ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	8.00
2	12.00	2.50

### PASSIVE SPACING:

No.	Z depth	Spacing
1	12.00	5.00

# 14' Retained 5' o.c. (LC1=D+H)



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Date: 1/27/2023

File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\14' LC1 at 5.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=14.0 Pile Diameter=2.5 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=15.97 Min. Pile Length=29.97

MOMENT IN PILE: Max. Moment=196.68 per Pile Spacing=5.0 at Depth=20.97

## PILE SELECTION:

Request Min. Section Modulus = 71.5 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W18X86, S = 166.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.63(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 1530.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
15.0	0.40	800.0	314.40	0.400

## ACTIVE SPACING:

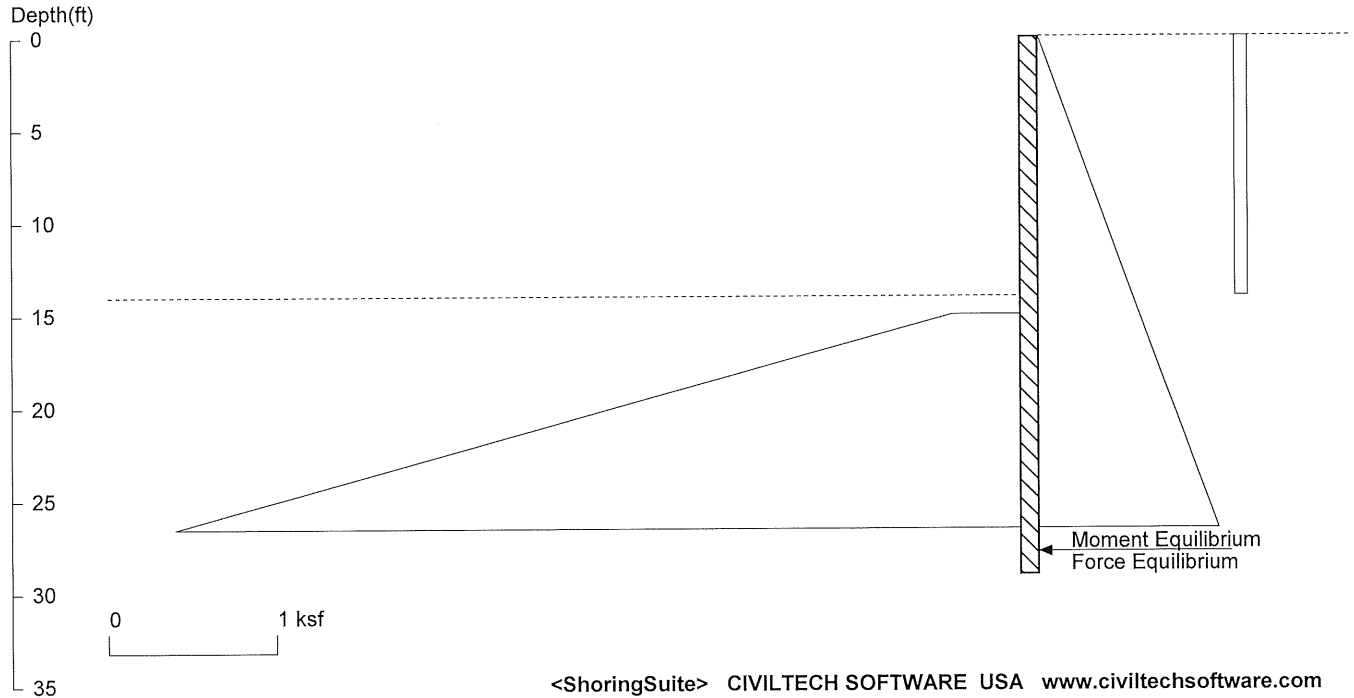
No.	Z depth	Spacing
1	0.00	5.00
2	14.00	2.50

## PASSIVE SPACING:

No.	Z depth	Spacing
1	14.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 14' Retained 5' o.c. (LC2=D+0.7E+H)



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 File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\14' LC2 at 5.0' oc.sh8  
 UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=14.0 Pile Diameter=2.5 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=15.05 Min. Pile Length=29.05  
 MOMENT IN PILE: Max. Moment=248.89 per Pile Spacing=5.0 at Depth=20.36

PILE SELECTION:  
 Request Min. Section Modulus = 90.5 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66  
 Selected Pile, W18X86, S = 166.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus  
 Top Deflection = 0.82(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 1530.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.078	14	0.078	

## PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
15.0	0.40	800.0	314.40	0.400

## ACTIVE SPACING:

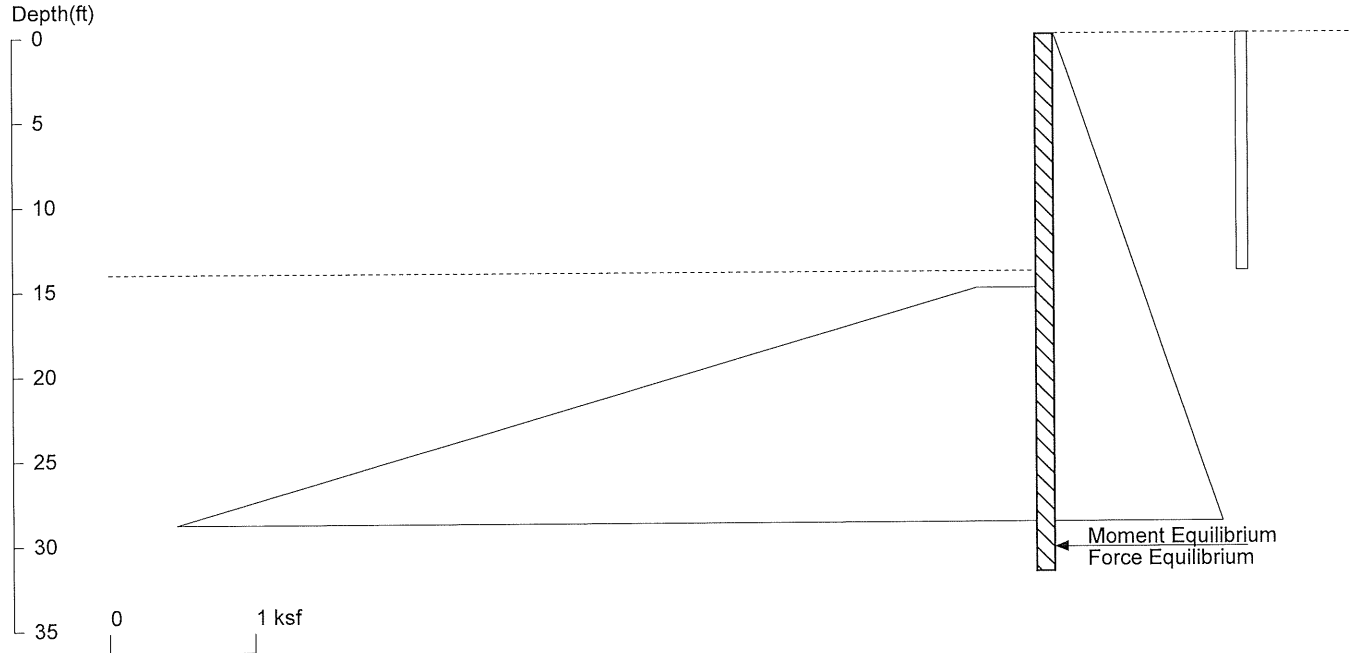
No.	Z depth	Spacing
1	0.00	5.00
2	14.00	2.50

## PASSIVE SPACING:

No.	Z depth	Spacing
1	14.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
 Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 14' Retained 5' o.c. (LC3=D+L+H)



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Date: 1/27/2023

File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\14' LC3 at 5.0' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=14.0 Pile Diameter=2.5 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=17.76 Min. Pile Length=31.76

MOMENT IN PILE: Max. Moment=277.06 per Pile Spacing=5.0 at Depth=21.72

## PILE SELECTION:

Request Min. Section Modulus = 100.7 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W18X86, S = 166.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 1.00(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 1530.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.080	14	0.080	

## PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
15.0	0.40	800.0	314.40	0.400

## ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	5.00
2	14.00	2.50

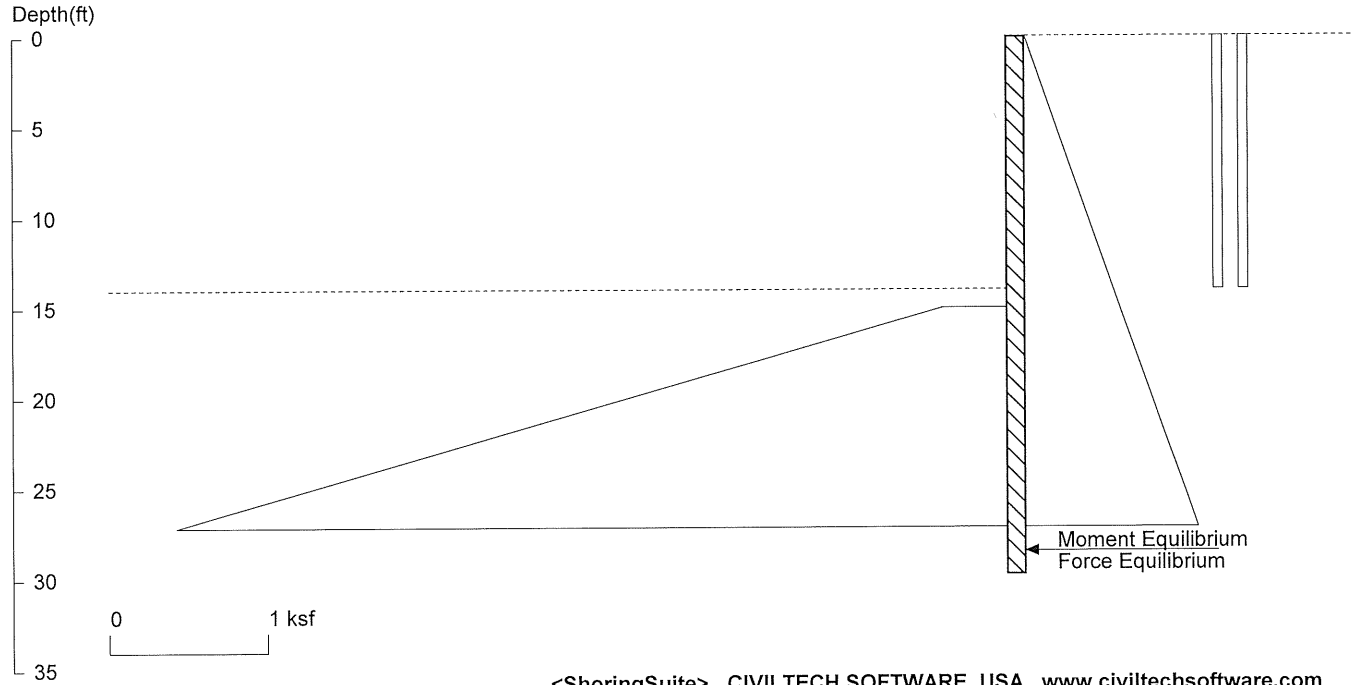
## PASSIVE SPACING:

No.	Z depth	Spacing
1	14.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 14' Retained

## 5' o.c. ( $LC4=D+0.525E+0.75L+H$ )



Licensed to 4324324234 3424343 Date: 1/27/2023  
 File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\14' LC4 at 5.0' oc.sh8  
 UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=14.0 Pile Diameter=2.5 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=15.76 Min. Pile Length=29.76  
 MOMENT IN PILE: Max. Moment=287.69 per Pile Spacing=5.0 at Depth=20.65

PILE SELECTION:  
 Request Min. Section Modulus = 104.6 in<sup>3</sup>/pile, F<sub>y</sub>= 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66  
 Selected Pile, W18X86, S = 166.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus  
 Top Deflection = 0.99(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 1530.0

### DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.059	14	0.059	
0	.060	14	0.060	

### PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
15.0	0.40	800.0	314.40	0.400

### ACTIVE SPACING:

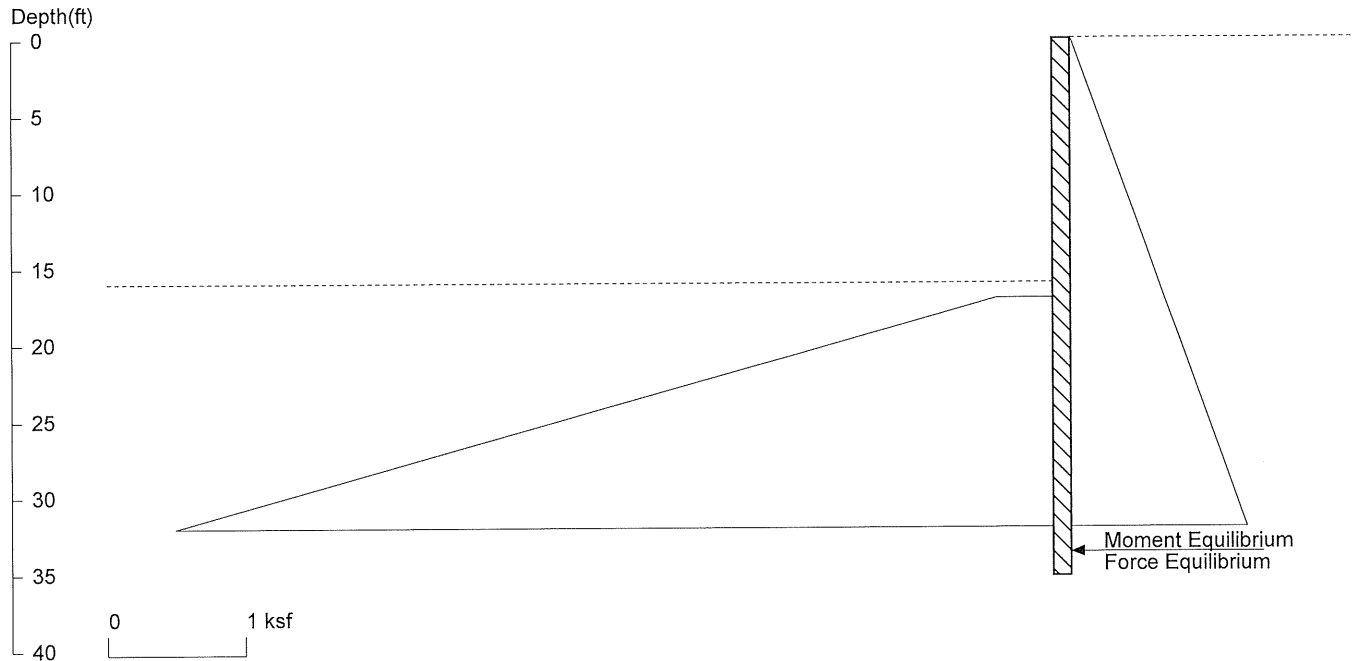
No.	Z depth	Spacing
1	0.00	5.00
2	14.00	2.50

### PASSIVE SPACING:

No.	Z depth	Spacing
1	14.00	5.00



# 16' Retained 5.75' o.c. (LC1=D+H)



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File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\Shoring\Engineering\16' LC1 at 5.75' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=16.0 Pile Diameter=2.5 Pile Spacing=5.8 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=19.21 Min. Pile Length=35.21

MOMENT IN PILE: Max. Moment=344.08 per Pile Spacing=5.8 at Depth=24.39

## PILE SELECTION:

Request Min. Section Modulus = 125.1 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W21X111, S = 249.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 0.86(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 2670.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
17.0	0.40	800.0	313.60	0.400

## ACTIVE SPACING:

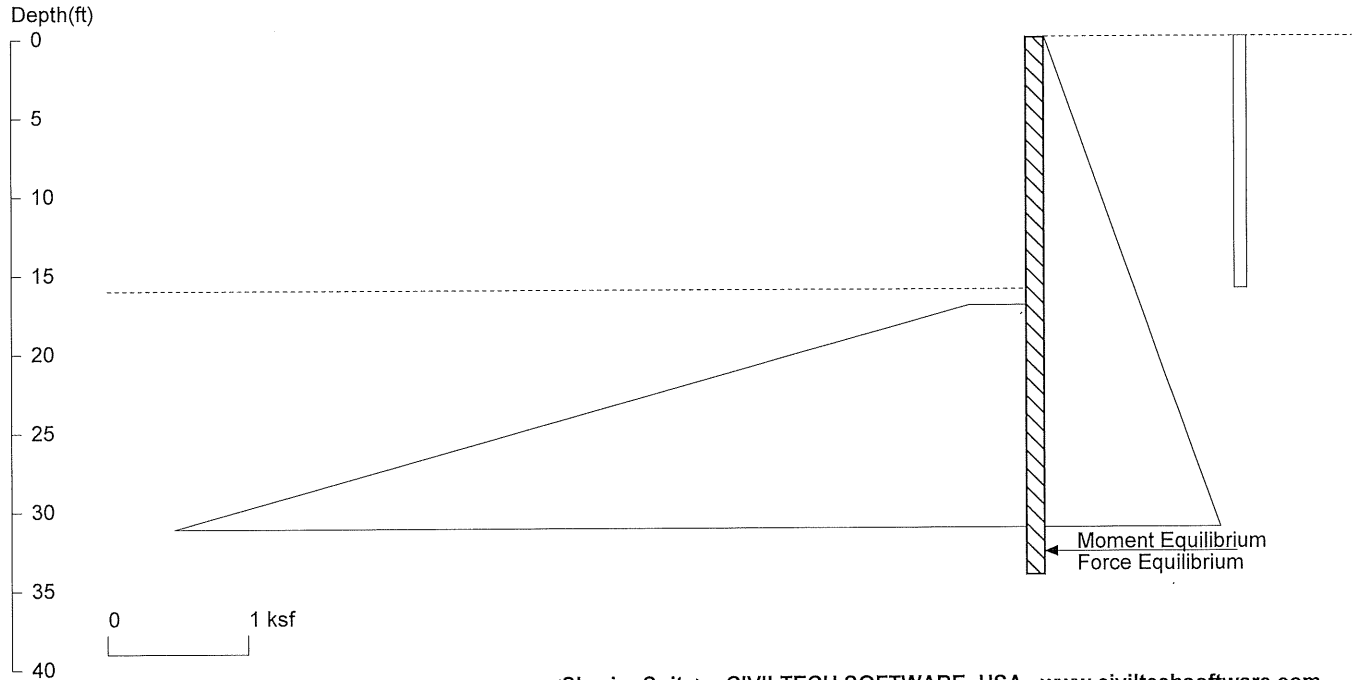
No.	Z depth	Spacing
1	0.00	5.75
2	16.00	2.50

## PASSIVE SPACING:

No.	Z depth	Spacing
1	16.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 16' Retained 5.75' o.c. (LC1=D+H)



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Date: 1/27/2023

File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\Shoring\Engineering\16' LC2 at 5.75' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=16.0 Pile Diameter=2.5 Pile Spacing=5.8 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=18.14 Min. Pile Length=34.14

MOMENT IN PILE: Max. Moment=436.79 per Pile Spacing=5.8 at Depth=23.68

## PILE SELECTION:

Request Min. Section Modulus = 158.8 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W21X111, S = 249.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 1.12(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 2670.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.090	16	0.090	

## PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
17.0	0.40	800.0	313.60	0.400

## ACTIVE SPACING:

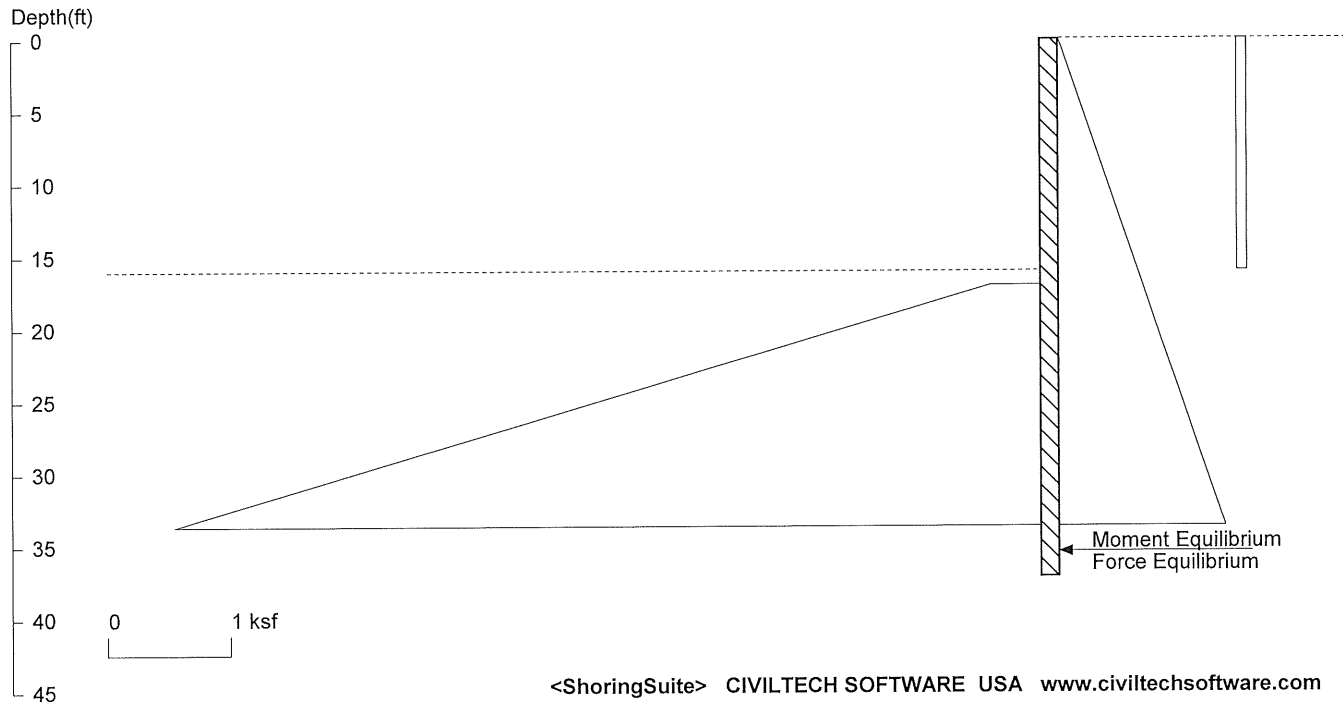
No.	Z depth	Spacing
1	0.00	5.75
2	16.00	2.50

## PASSIVE SPACING:

No.	Z depth	Spacing
1	16.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 16' Retained 5.75' o.c. (LC3=D+L+H)



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Date: 1/27/2023

File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\Shoring\Engineering\16' LC3 at 5.75' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=16.0 Pile Diameter=2.5 Pile Spacing=5.8 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=21.14 Min. Pile Length=37.14

MOMENT IN PILE: Max. Moment=467.79 per Pile Spacing=5.8 at Depth=25.20

## PILE SELECTION:

Request Min. Section Modulus = 170.1 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W21X111, S = 249.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 1.30(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 2670.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.080	16	0.080	0

## PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
17.0	0.40	800.0	313.60	0.400

## ACTIVE SPACING:

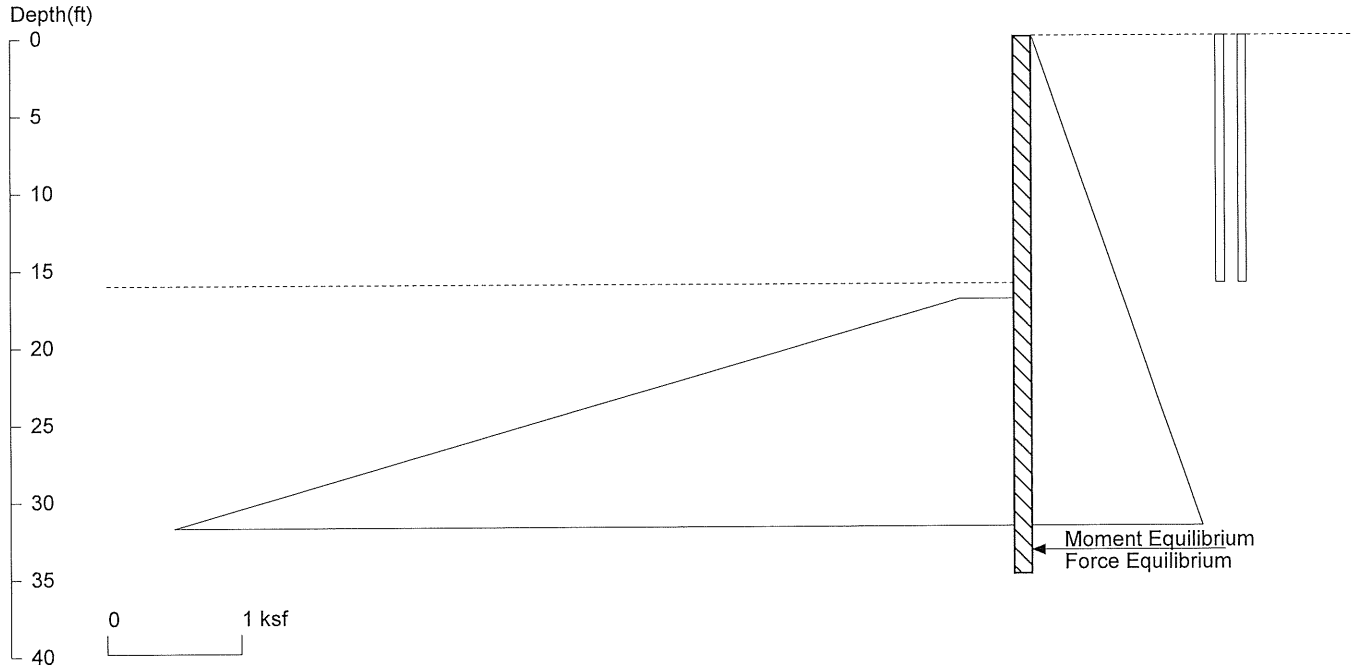
No.	Z depth	Spacing
1	0.00	5.75
2	16.00	2.50

## PASSIVE SPACING:

No.	Z depth	Spacing
1	16.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 16' Retained 5.75' o.c. (LC1=D+H)



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Date: 1/27/2023

File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\16' LC4 at 5.75' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=16.0 Pile Diameter=2.5 Pile Spacing=5.8 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=18.83 Min. Pile Length=34.83

MOMENT IN PILE: Max. Moment=490.73 per Pile Spacing=5.8 at Depth=23.98

## PILE SELECTION:

Request Min. Section Modulus = 178.4 in<sup>3</sup>/pile, F<sub>y</sub>= 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W21X111, S = 249.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 1.30(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 2670.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.067	16	0.067	
0	.060	16	0.060	

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
17.0	0.40	800.0	313.60	0.400

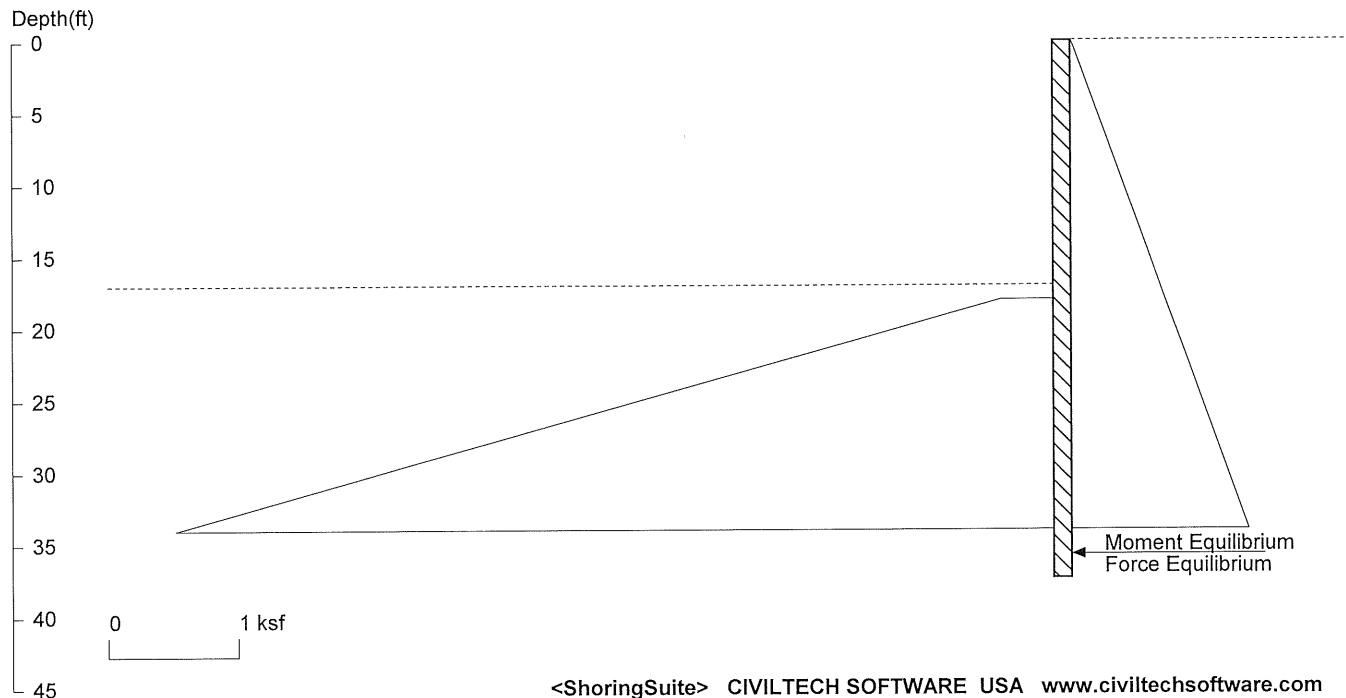
## ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	5.75
2	16.00	2.50

## PASSIVE SPACING:

No.	Z depth	Spacing
1	16.00	5.00

# 17' Retained 5.75' o.c. (LC1=D+H)



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Date: 1/27/2023

File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\17' LC1 at 5.75' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=17.0 Pile Diameter=2.5 Pile Spacing=5.8 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=20.40 Min. Pile Length=37.40

MOMENT IN PILE: Max. Moment=412.03 per Pile Spacing=5.8 at Depth=25.90

## PILE SELECTION:

Request Min. Section Modulus = 149.8 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W21X111, S = 249.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 1.16(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 2670.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040

PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
18.0	0.40	800.0	313.20	0.400

## ACTIVE SPACING:

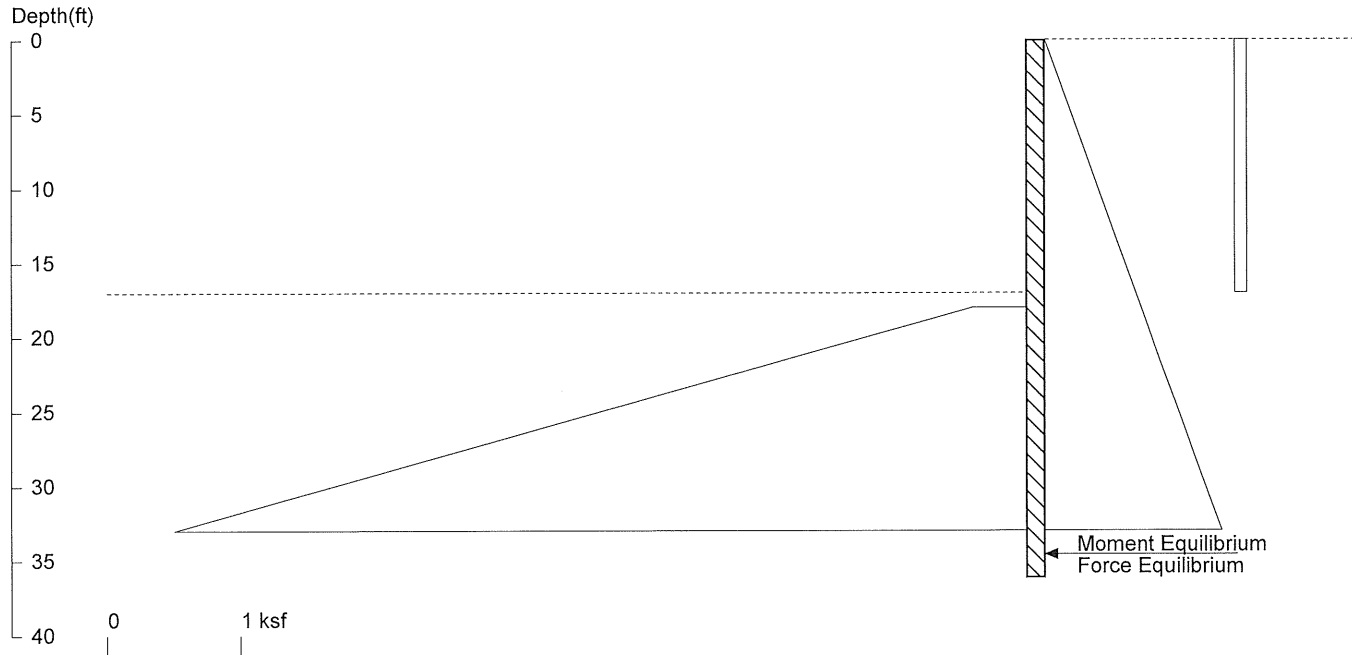
No.	Z depth	Spacing
1	0.00	5.75
2	17.00	2.50

## PASSIVE SPACING:

No.	Z depth	Spacing
1	17.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 17' Retained 5.75' o.c. (LC1=D+H)



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Date: 1/27/2023

File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\17' LC2 at 5.75' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=17.0 Pile Diameter=2.5 Pile Spacing=5.8 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=19.15 Min. Pile Length=36.15

MOMENT IN PILE: Max. Moment=513.92 per Pile Spacing=5.8 at Depth=25.13

## PILE SELECTION:

Request Min. Section Modulus = 186.9 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W21X111, S = 249.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 1.47(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 2670.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.090	17	0.090	

## PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
18.0	0.40	800.0	313.20	0.400

## ACTIVE SPACING:

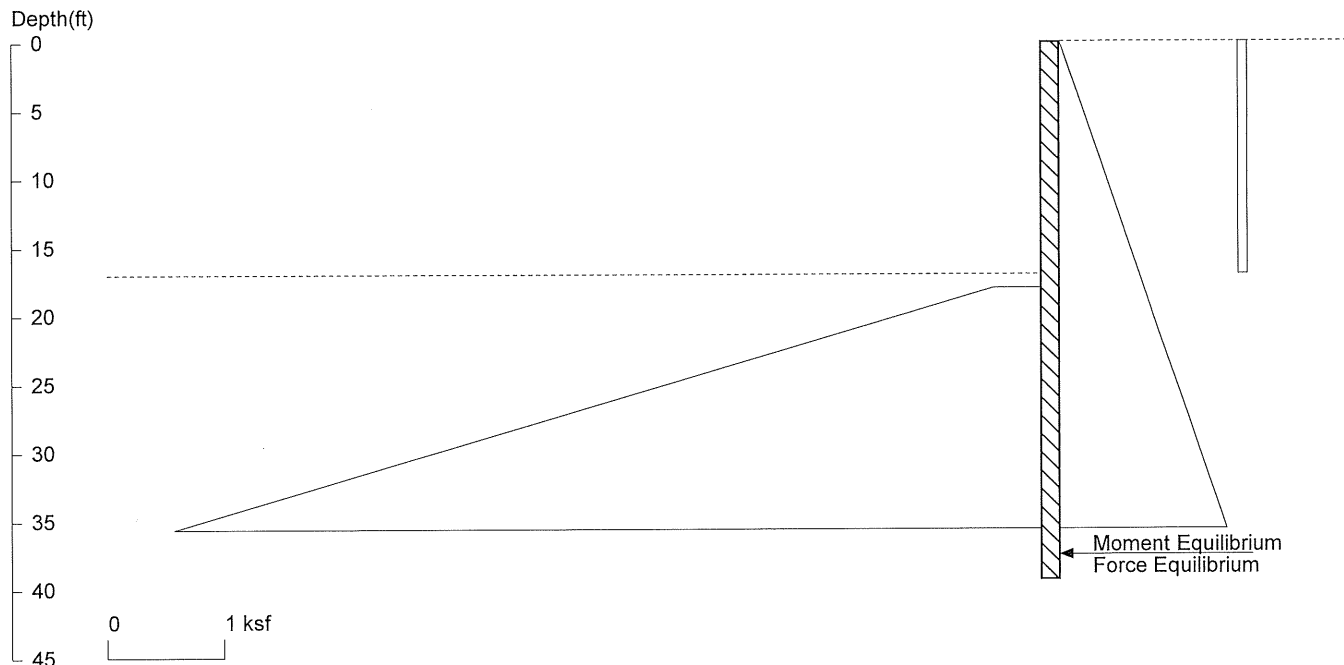
No.	Z depth	Spacing
1	0.00	5.75
2	17.00	2.50

## PASSIVE SPACING:

No.	Z depth	Spacing
1	17.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 17' Retained 5.75' o.c. (LC3=D+L+H)



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Date: 1/27/2023

File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\17' LC3 at 5.75' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=17.0 Pile Diameter=2.5 Pile Spacing=5.8 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=22.33 Min. Pile Length=39.33

MOMENT IN PILE: Max. Moment=551.43 per Pile Spacing=5.8 at Depth=26.70

## PILE SELECTION:

Request Min. Section Modulus = 200.5 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W21X111, S = 249.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 1.72(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 2670.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.080	17	0.080	0

## PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.5

Z1	P1	Z2	P2	Slope
18.0	0.40	800.0	313.20	0.400

## ACTIVE SPACING:

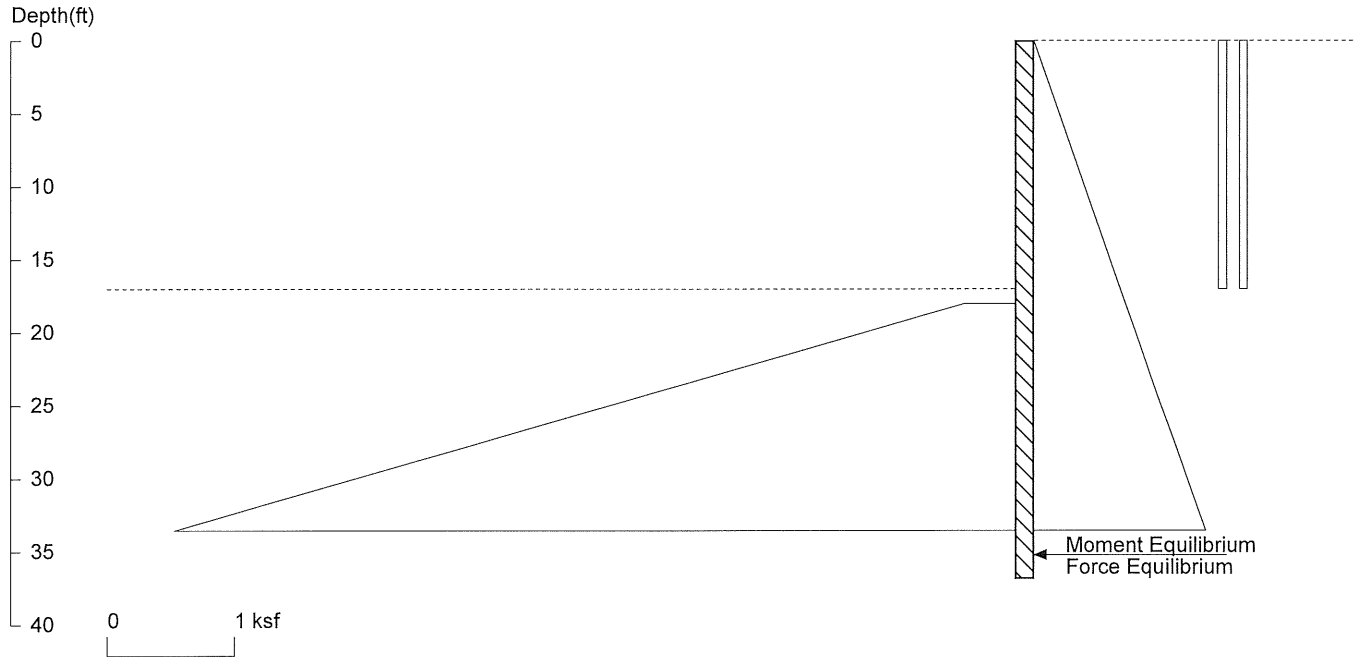
No.	Z depth	Spacing
1	0.00	5.75
2	17.00	2.50

## PASSIVE SPACING:

No.	Z depth	Spacing
1	17.00	5.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft  
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in

# 17' Retained 5.75' o.c. (LC1=D+H)



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Date: 1/27/2023

File: R:\\_2022 Projects\22332 Rose Hill Mukilteo\\_Shoring\Engineering\17' LC4 at 5.75' oc.sh8

UNITS: Dimension - ft; Force and Shear - kip; Pressure and Stress - ksf; Moment - kip-ft; Pres. Slope - kip/ft<sup>3</sup>; Deflection - in.

Wall Height=17.0 Pile Diameter=2.5 Pile Spacing=5.8 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=19.85 Min. Pile Length=36.85

MOMENT IN PILE: Max. Moment=574.59 per Pile Spacing=5.8 at Depth=25.42

## PILE SELECTION:

Request Min. Section Modulus = 208.9 in<sup>3</sup>/pile, F<sub>y</sub> = 50 ksi = 345 MPa, F<sub>b</sub>/F<sub>y</sub>=0.66

Selected Pile, W21X111, S = 249.0 in<sup>3</sup>/pile It is greater than Request Min. Section Modulus

Top Deflection = 1.71(in) based on E (ksi)= 29000.00, I (in<sup>4</sup>)/pile= 2670.0

## DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	800	32.00	.040
0	.067	17	0.067	
0	.060	17	0.060	

## PASSIVE PRESSURES: Pressures will be divided by a Factor of Safety (F.S.) =1.1

Z1	P1	Z2	P2	Slope
18.0	0.40	800.0	313.20	0.400

## ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	5.75
2	17.00	2.50

## PASSIVE SPACING:

No.	Z depth	Spacing
1	17.00	5.00



LAGGING DESIGN updated 7/21/2016**WALL GEOMETRY**

Wall Ht = 17 ft      Earth Pressure = 40 pcf      Traffic 80 psf  
 Pile Spacing = 5.5 ft      Seismic Load = 8 H psf

**DESIGN LOADS**

Soil Load = 637.50 plf      Worst case loading applied over "D" of bottom lagging  
 Seismic Load = 127.50 plf  
 Traffic Load = 75 plf

**GOVERNING LOADS**

Loads reduced by 50% per geotech

0.6\*(D+L+W+H) = 356.25 plf      ASCE 2.4.1 load case 7  
 0.6\*(D+0.7E+H) = 363.38 plf      ASCE 2.4.1 load case 8

**LAGGING PROPERTIES**

per 2018 NDS

Lagging Size = 4x12 HF#2  
 Pressure Treated = Yes  
 Load Duration = Permanent

W = 3.5 in	$C_D = 0.90$	$C_F = 1.10$	$C_{iFb} = 0.80$
D = 11.25 in	$C_{D \text{ seismic}} = 1.6$	$C_{fu} = 1.10$	$C_{iFv} = 1.00$
A = 39.38 in <sup>2</sup>	$C_{MFb} = 1.00$	$C_r = 1.15$	
S = 22.97 in <sup>3</sup>	$C_{MFv} = 0.97$		
$F_b = 850$	$F'_b = F_b * C_D * C_M * C_F * C_{fu} * C_i * C_r = 851.598 \text{ psi}$	$F'_{b \text{ seismic}} = 1513.95 \text{ psi}$	
$F_v = 150$	$F'_v = F_v * C_D * C_M * C_i = 130.95 \text{ psi}$	$F'_{v \text{ seismic}} = 186.24 \text{ psi}$	

**BENDING DESIGN**Load Case 7

$M_{MAX} = WL^2/8$       1347.1 Ft#  
 $fb = M/S = 703.8 \text{ psi}$   
 $fb/F'b = 82.6\%$

Load Case 8

$M_{MAX} = WL^2/8$       1374.0 Ft#  
 $fb = M/S = 717.851 \text{ psi}$   
 $fb/F'b = 47.4\%$

**SHEAR DESIGN**Load Case 7

$V_{MAX} = WL/2 = 979.7 \text{ \#}$   
 $fv = 3/2 * V/A = 37.32 \text{ psi}$   
 $fv/F'v = 28.5\%$

Load Case 8

$V_{MAX} = WL/2 = 999.3 \text{ \#}$   
 $fv = 3/2 * V/A = 38.07 \text{ psi}$   
 $fv/F'v = 20.4\%$

**SUMMARY**

Lagging Size = 4x12 HF#2      Governing Load Case = 0.6D+W+H  
 Max Pile Spacing = 5.5 ft      Bending Stress = 82.6%      OK  
 Max Retained Ht = 17 ft      Shear Stress = 28.5%      OK



250 4th Ave South  
 Suite 200  
 Edmonds, WA 98020

Description

Lagging Design

Project

NW WA Rehab Hospital

B.T.J.

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Scale

Job No.

Date

Date

Sheet No.

LAGGING DESIGN updated 7/21/2016**WALL GEOMETRY**

Wall Ht = 10 ft      Earth Pressure = 40 pcf      Traffic 80 psf  
 Pile Spacing = 7.5 ft      Seismic Load = 8 H psf

**DESIGN LOADS**

Soil Load = 375.00 plf      Worst case loading applied over "D" of bottom lagging  
 Seismic Load = 75.00 plf  
 Traffic Load = 75 plf

**GOVERNING LOADS**

Loads reduced by 50% per geotech

0.6\*(D+L+W+H) = 225.00 plf      ASCE 2.4.1 load case 7  
 0.6\*(D+0.7E+H) = 213.75 plf      ASCE 2.4.1 load case 8

**LAGGING PROPERTIES**

per 2018 NDS

Lagging Size = 4x12 HF#2  
 Pressure Treated = Yes  
 Load Duration = Permanent

W = 3.5 in	$C_D = 0.90$	$C_F = 1.10$	$C_{iFb} = 0.80$
D = 11.25 in	$C_{D \text{ seismic}} = 1.6$	$C_{fu} = 1.10$	$C_{iFv} = 1.00$
A = 39.38 in <sup>2</sup>	$C_{MFb} = 1.00$	$C_r = 1.15$	
S = 22.97 in <sup>3</sup>	$C_{MFv} = 0.97$		
$F_b = 850$	$F'_b = F_b * C_D * C_M * C_F * C_{fu} * C_i * C_r = 851.598 \text{ psi}$	$F'_{b \text{ seismic}} = 1513.95 \text{ psi}$	
$F_v = 150$	$F'_v = F_v * C_D * C_M * C_i = 130.95 \text{ psi}$	$F'_{v \text{ seismic}} = 186.24 \text{ psi}$	

**BENDING DESIGN**Load Case 7

$M_{MAX} = WL^2/8$       1582.0 Ft#  
 $fb = M/S = 826.5 \text{ psi}$   
 $fb/F'b = 97.1\%$

Load Case 8

$M_{MAX} = WL^2/8$       1502.9 Ft#  
 $fb = M/S = 785.204 \text{ psi}$   
 $fb/F'b = 51.9\%$

**SHEAR DESIGN**Load Case 7

$V_{MAX} = WL/2 = 843.8 \text{ #}$   
 $fv = 3/2 * V/A = 32.14 \text{ psi}$   
 $fv/F'v = 24.5\%$

Load Case 8

$V_{MAX} = WL/2 = 801.6 \text{ #}$   
 $fv = 3/2 * V/A = 30.54 \text{ psi}$   
 $fv/F'v = 16.4\%$

**SUMMARY**

Lagging Size = 4x12 HF#2      Governing Load Case = 0.6D+W+H  
 Max Pile Spacing = 7.5 ft      Bending Stress = 97.1%      OK  
 Max Retained Ht = 10 ft      Shear Stress = 24.5%      OK



250 4th Ave South  
 Suite 200  
 Edmonds, WA 98020

Description

Lagging Design

Project

NW WA Rehab Hospital

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Date

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Sheet No.