R3 SHORING CALCS

New Single Family Residence
5818 W Mercer Way
Mercer Island, WA

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ATLAS CONSULTING ENGINEERS INC.

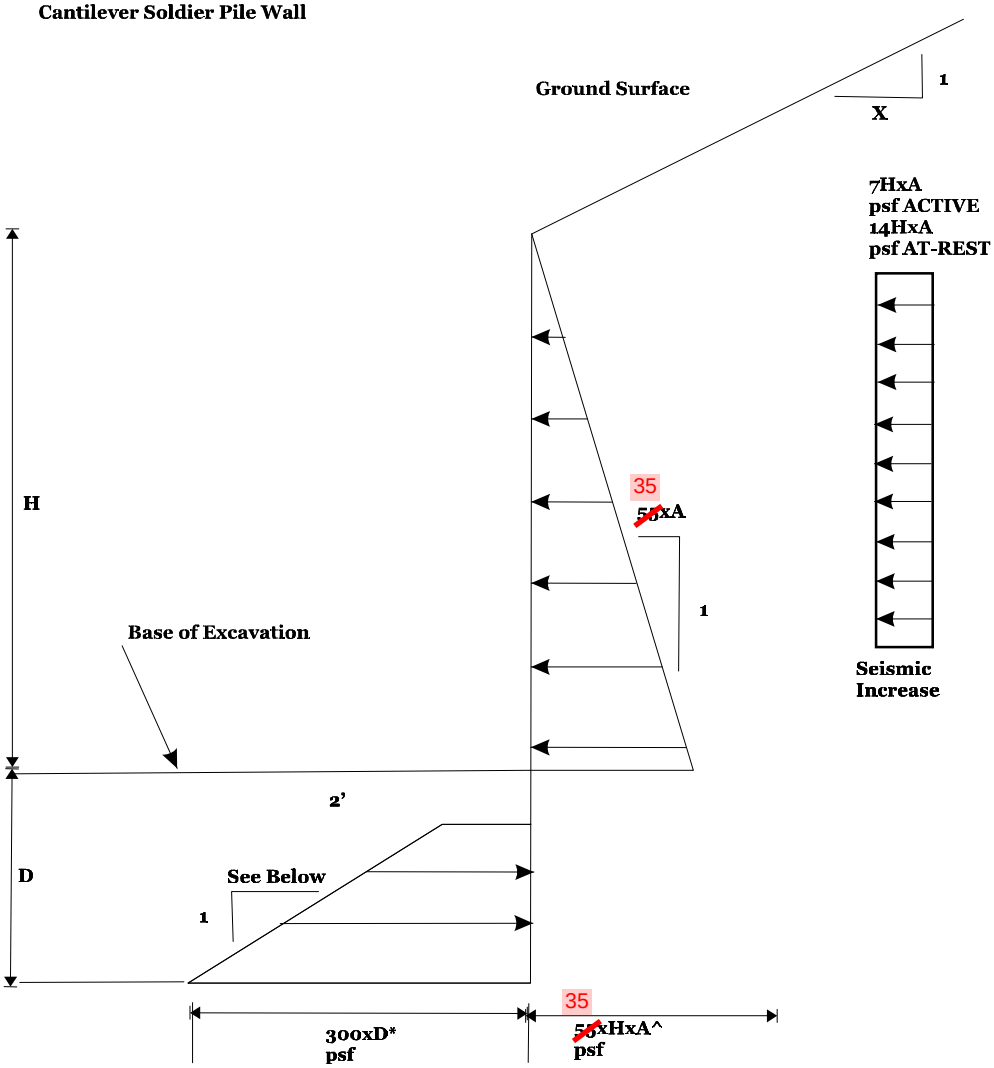
Project: 5818 W Mercer Way	By: JDA
Proj No: 269-2024	Date: 09/12/25

Summary

Update shoring calculations for revised soil pressure diagrams for piles using single and multiple rows of tiebacks, as provided by Cobalt Geosciences (see pages 2 - 4, note that design of cantilevered piles remain unaltered as they used a slightly higher soil pressure of 78.25 psf vs. updated soil pressure of 77 psf when considering the 1.4 adjustment factor). Note that AT-REST pressure of 55 pcf, plus 2:1 adjustment factor to account for backslope angle, was used in design.

See pages 5-28 for E1-E10 showing pile designs (moment equilibrium, shear, moment, deflection); wall height, pile diameter, pile spacing, wall type, and minimum embedment; and free body diagrams (soil pressures used, tie back no load zone and length derivation). Note that tieback lengths were derived using a 3 KLF tieback resitance; lengths of tiebacks was derived outside of program due to unique no-load zone and can be seen in each pile design.

Cantilever Soldier Pile Wall



*250 psf 0-8'
300 psf below 8'

Net Allowable Passive Pressure

Apparent Earth Pressure

^Active Value -
Use 55 for At-Rest

Earth Pressure Factor for Backslope	
Backslope, X:1	**Earth Pressure Factor (A)**
Flat	1
3H:1V	1.2
2H:1V	1.4

Legend

Shaded Area is No Load Zone

H	Height of Excavation in Feet
D	Soldier Pile Embedment in Feet
H1	Distance from Ground Surface to Uppermost Tieback in Feet
Th1	Horizontal Load in Uppermost Ground Anchor
P	Maximum Apparent Earth Pressure in Pounds per Square Foot (psf)

Notes:

1. Apparent earth pressure and surcharge act over the pile spacing above the base of the excavation.
2. Passive earth pressure acts over 2.5 times the concrete diameter of the soldier pile, or the pile spacing, whichever is less.
3. Passive pressure includes a factor of safety of 1.5.
4. Please notify us if there are any anticipated additional surcharge loads.

Not to Scale

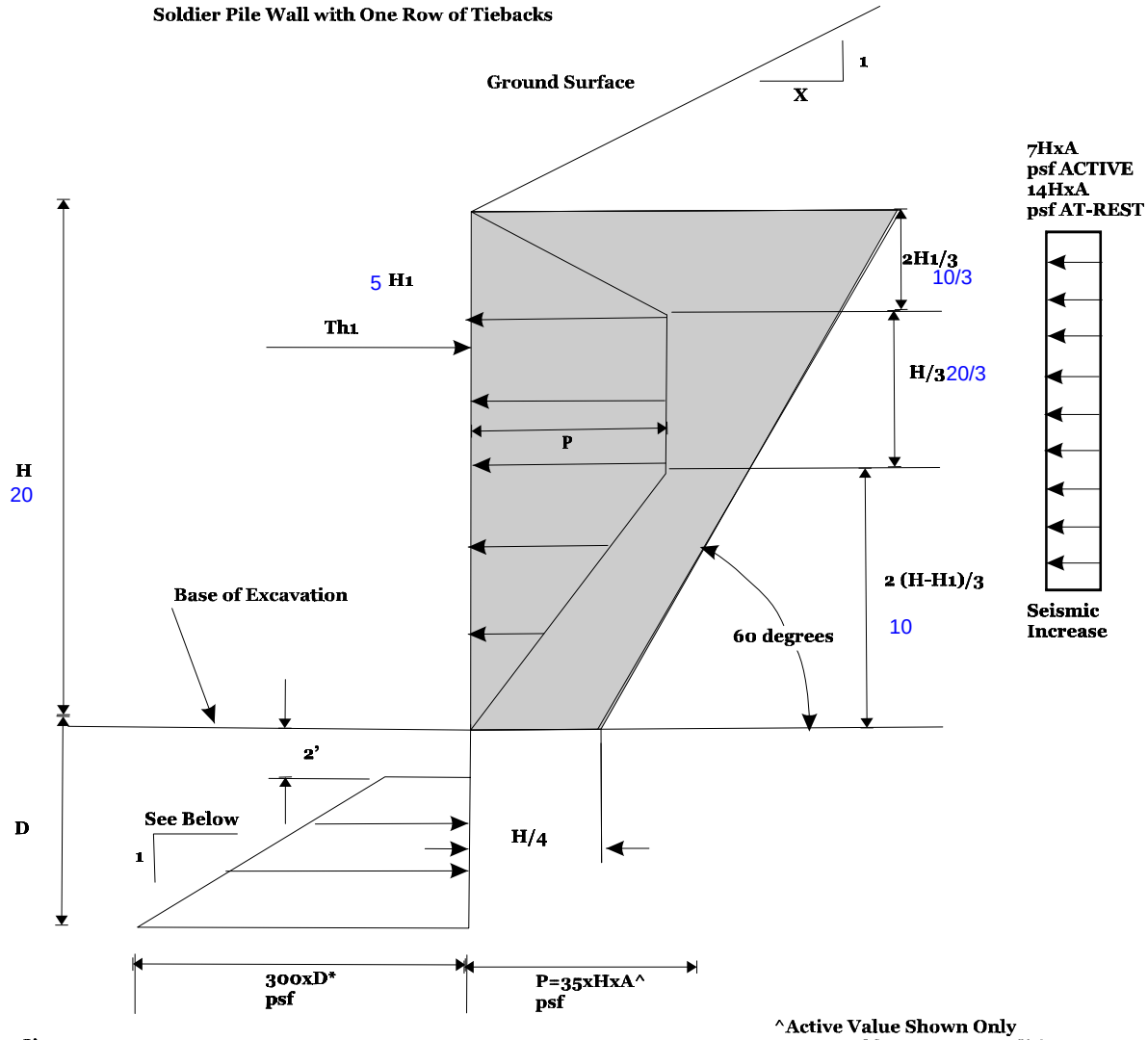
COBALT GEOSCIENCES

Proposed Residence
5818 W. Mercer Way
Mercer Island, Washington

Cantilever Soldier Pile Wall

Cobalt Geosciences, LLC
P.O. Box 82243
Kenmore, WA 98028
(206) 331-1097
www.cobaltgeo.com
cobaltgeo@gmail.com

Soldier Pile Wall with One Row of Tiebacks



*250 psf 0-8'
300 psf below 8'

Net Allowable Passive Pressure

Apparent Earth Pressure

^Active Value Shown Only
Use 55 psf for At-Rest Conditions

Earth Pressure Factor for Backslope	
Backslope, X:1	Earth Pressure Factor (A)
Flat	1
3H:1V	1.2
2H:1V	1.4

Legend

	Shaded Area is No Load Zone
H	Height of Excavation in Feet
D	Soldier Pile Embedment in Feet
H1	Distance from Ground Surface to Uppermost Tieback in Feet
Th1	Horizontal Load in Uppermost Ground Anchor
P	Maximum Apparent Earth Pressure in Pounds per Square Foot (psf)

Notes:

1. Apparent earth pressure and surcharge act over the pile spacing above the base of the excavation.
2. Passive earth pressure acts over 2.5 times the concrete diameter of the soldier pile, or the pile spacing, whichever is less.
3. Passive pressure includes a factor of safety of 1.5.
4. Please notify us if there are any anticipated additional surcharge loads.

Not to Scale

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Soldier Pile Wall with One Tieback

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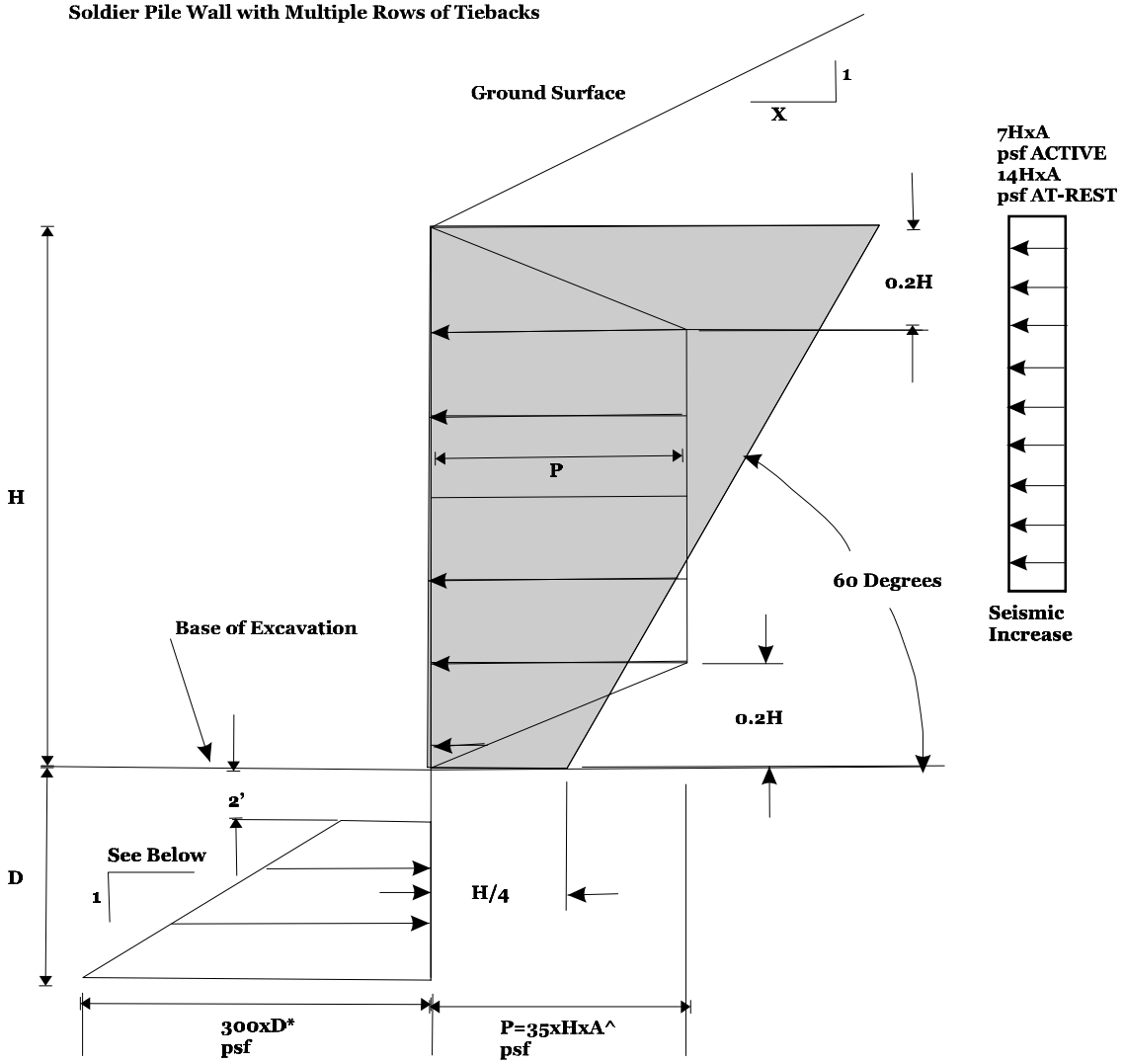
Soldier Pile Wall with Multiple Rows of Tiebacks



*250 psf 0-8'
300 psf below 8'

Net Allowable Passive Pressure

Apparent Earth Pressure

^Active Value Shown Only
Use 55 psf for At-Rest Conditions

Earth Pressure Factor for Backslope	
Backslope, X:1	**Earth Pressure Factor (A)**
Flat	1
3H:1V	1.2
2H:1V	1.4

Legend

	Shaded Area is No Load Zone
H	Height of Excavation in Feet
D	Soldier Pile Embedment in Feet
H1	Distance from Ground Surface to Uppermost Tieback in Feet
Th1	Horizontal Load in Uppermost Ground Anchor
P	Maximum Apparent Earth Pressure in Pounds per Square Foot (psf)

Notes:

1. Apparent earth pressure and surcharge act over the pile spacing above the base of the excavation.
2. Passive earth pressure acts over 2.5 times the concrete diameter of the soldier pile, or the pile spacing, whichever is less.
3. Passive pressure includes a factor of safety of 1.5.
4. Please notify us if there are any anticipated additional surcharge loads.

Not to Scale

COBALT GEOSCIENCES

Proposed Residence
5818 W. Mercer Way
Mercer Island, Washington

Soldier Pile Wall with Two or More Tiebacks

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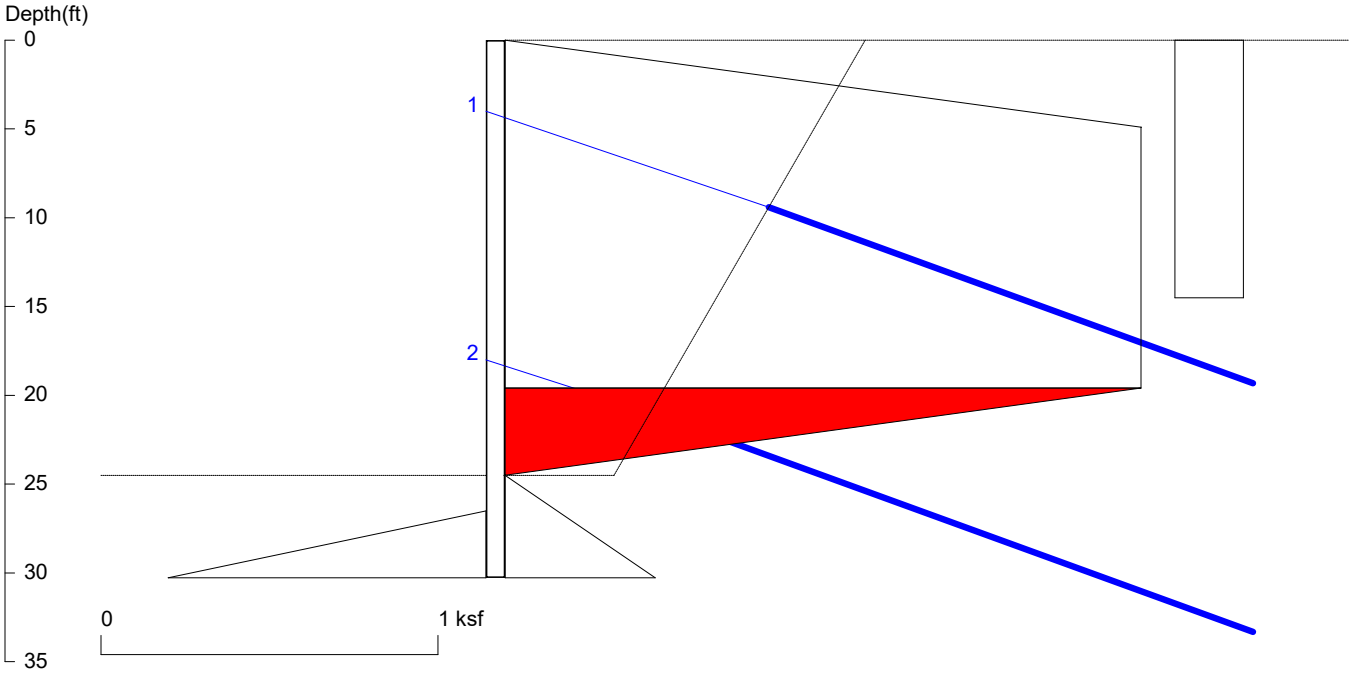
cobaltgeo@gmail.com

E1 (24.5 ft @ 6 ft oc)
Corner Pile Case



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File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E1_24.5 ft @ 6 ft o

Wall Height=24.5 Pile Diameter=2.0 Pile Spacing=6.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=5.77 Min. Pile Length=30.27
MOMENT IN PILE: Max. Moment=115.72 per Pile Spacing=6.0 at Depth=10.51

PILE SELECTION:
Request Min. Section Modulus = 42.1 in3/pile=689.55 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W16X31 has Section Modulus = 47.2 in3/pile=773.47 cm3/pile. It is greater than Min. Requirements!
Top Deflection = -0.13(in) based on E (ksi)=29000.00 and I (in4)/pile=375.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L free	Fixed Length
1. Tieback	4.0	20.0	6.0	59.6	56.0	20.4	1[illegible]8	3[illegible]0
2. Tieback	18.0	20.0	6.0	62.9	59.1	21.5	[illegible]	[illegible]

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	4.901	1.886	0.384921
4.901	1.886	19.59	1.886	0.000000
19.59	1.886	24.5	0	-0.38492
*	Below	Base		
24.5	0	124.5	7.700	.077
0	.203	14.5	0.203	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
26.5	0	34.5	2.000	.25

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	3.00
2	24.50	2.00

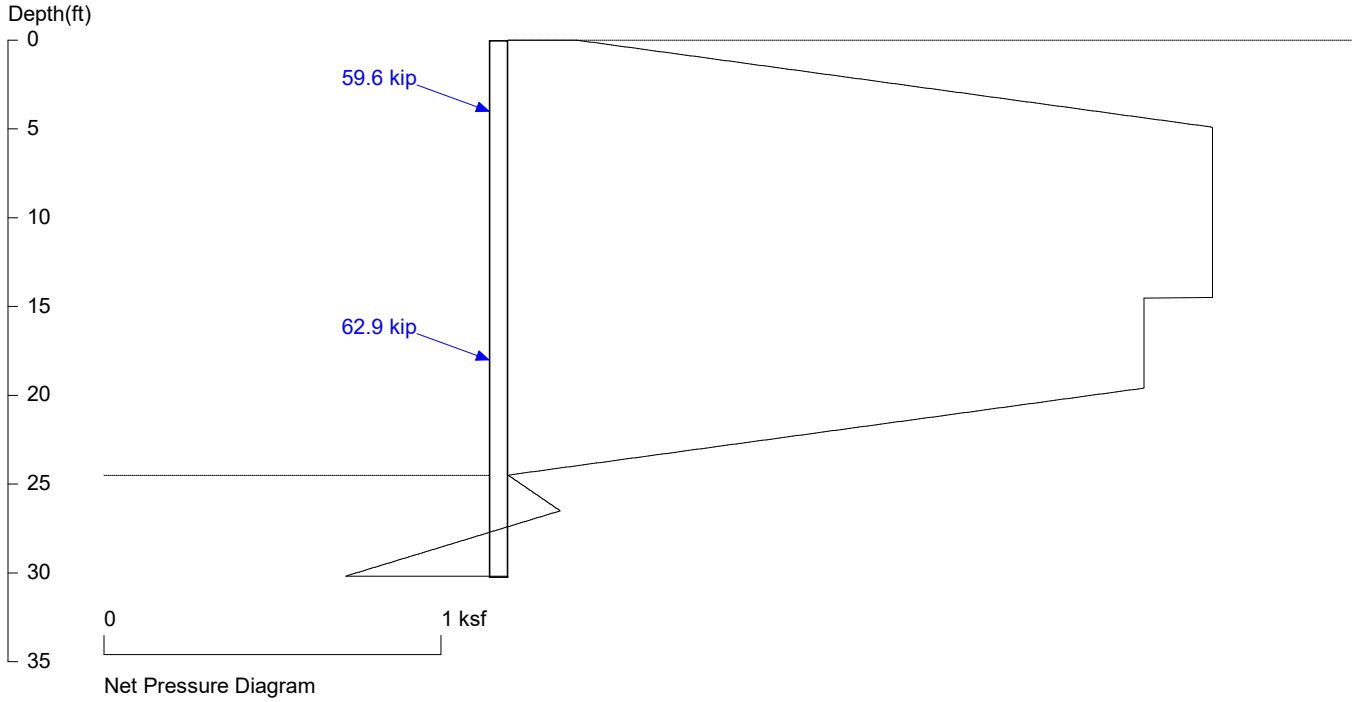
PASSIVE SPACING:

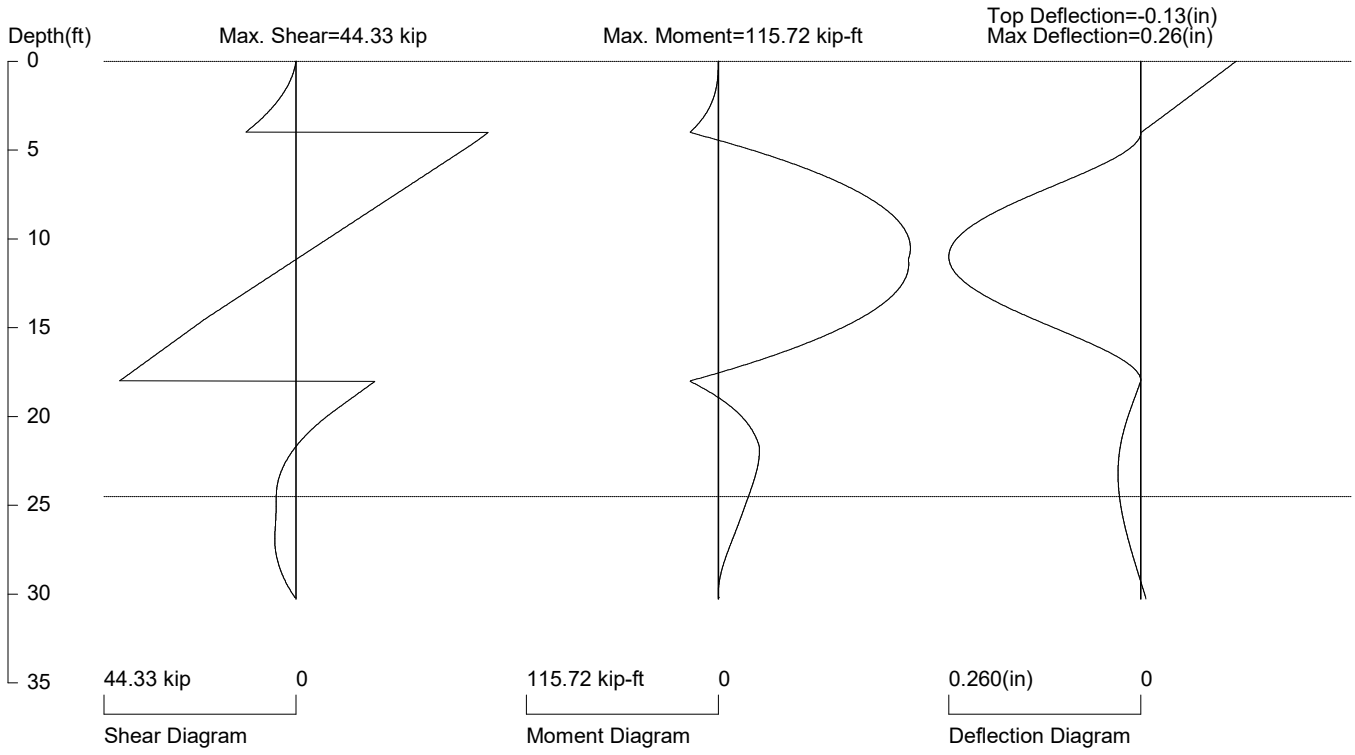
No.	Z depth	Spacing
1	24.50	4.00

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

E1 (24.5 ft @ 6 ft oc)

Corner Pile Case





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.0 foot or meter

User Input Pile, W16X31: E (ksi)=29000.0, I (in4)/pile=375.0

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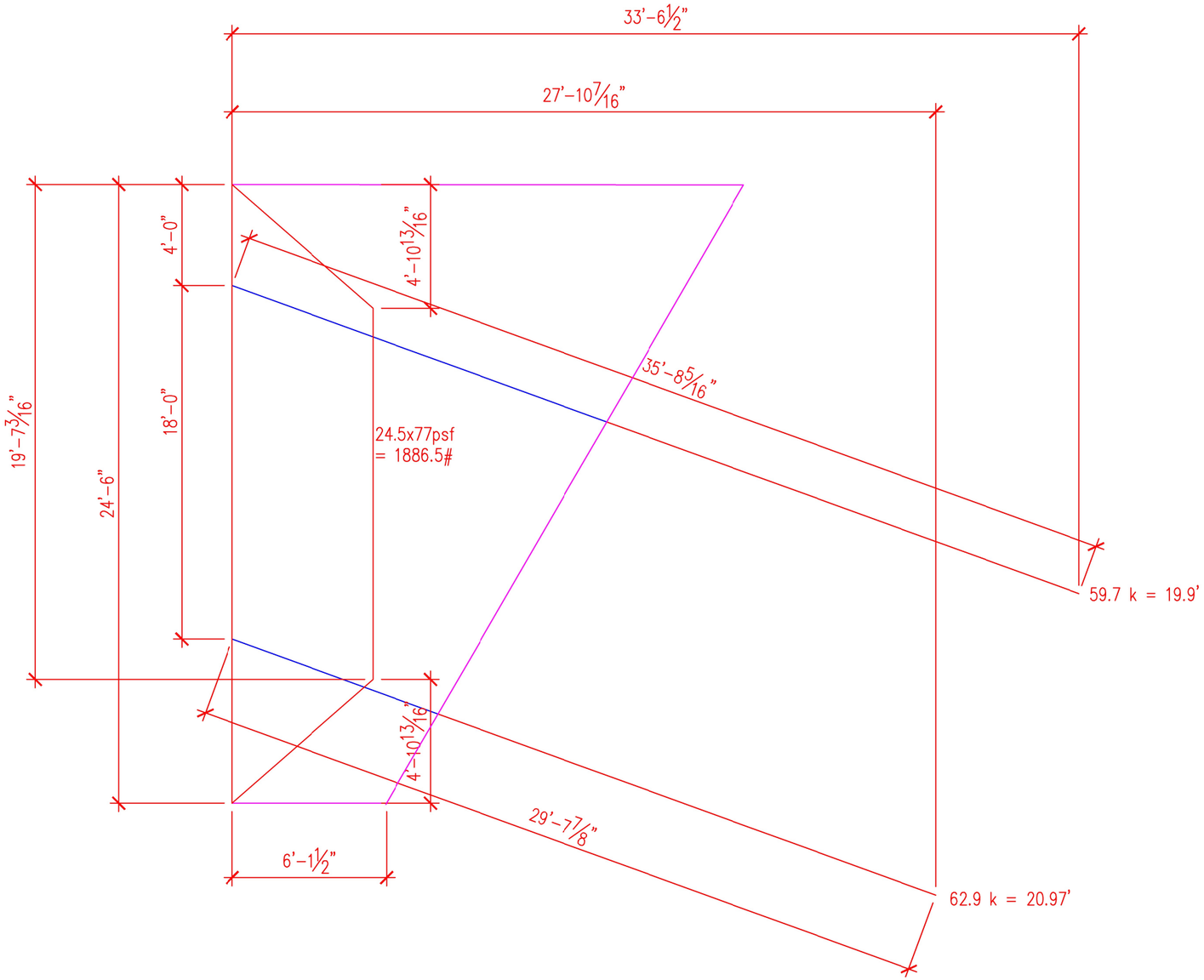
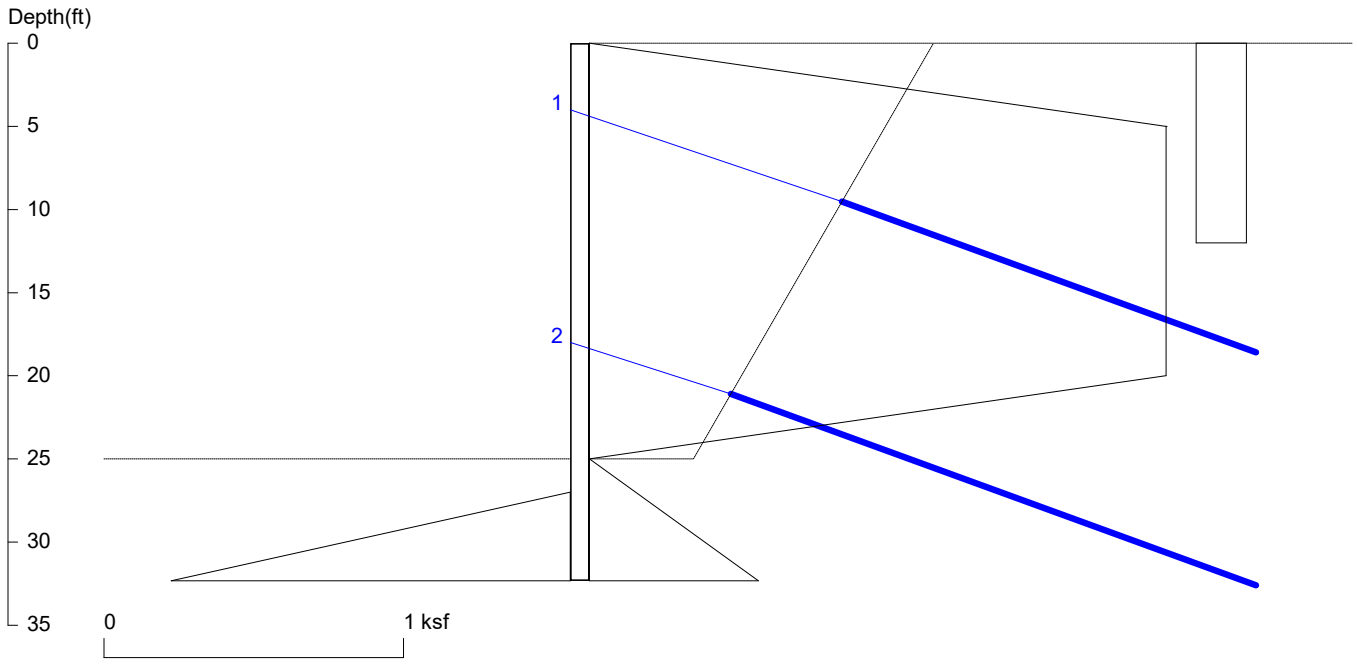
E1


33’-6½”
27’-10 7/16”
4’-0”
4’-10 13/16”
19’-7 3/16”
24’-6”
18’-0”
24.5x77psf
= 1886.5#
35’-8 5/16”
59.7 k = 19.9’
4’-10 13/16”
29’-7 7/8”
6’-1½”
62.9 k = 20.97’

E2, E4-E7 (25 ft @ 6 ft oc)



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File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E2, E4-E7_25 ft @

Wall Height=25.0 Pile Diameter=2.0 Pile Spacing=6.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=7.33 Min. Pile Length=32.33
MOMENT IN PILE: Max. Moment=228.14 per Pile Spacing=6.0 at Depth=10.47

PILE SELECTION:
Request Min. Section Modulus = 83.0 in3/pile=1359.47 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W16X57 has Section Modulus = 92.2 in3/pile=1510.88 cm3/pile. It is greater than Min. Requirements!
Top Deflection = -0.13(in) based on E (ksi)=29000.00 and I (in4)/pile=758.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L free	Fixed Length
1. Tieback	4.0	20.0	6.0	117.4	110.3	40.2	1 2	7 7
2. Tieback	18.0	20.0	6.0	130.6	122.7	44.7	9.1	3.

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	5	1.925	0.384918
5	1.925	20	1.925	0.000000
20	1.925	25	0	-0.38500
*	Below	Base	0.000	
25	0	125	9.625	0.077
0	.168	12	0.168	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
27	0	35	2.000	.25

ACTIVE SPACING:

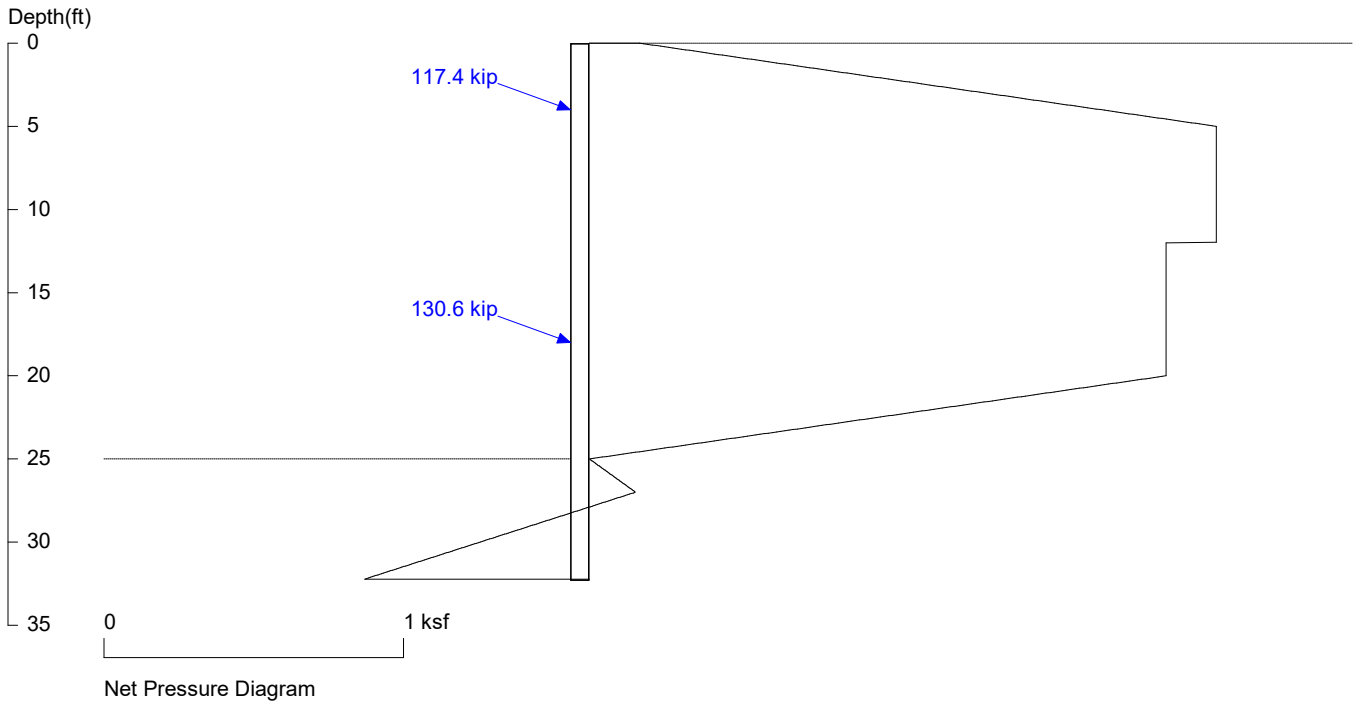
No.	Z depth	Spacing
1	0.00	6.00
2	25.00	2.00

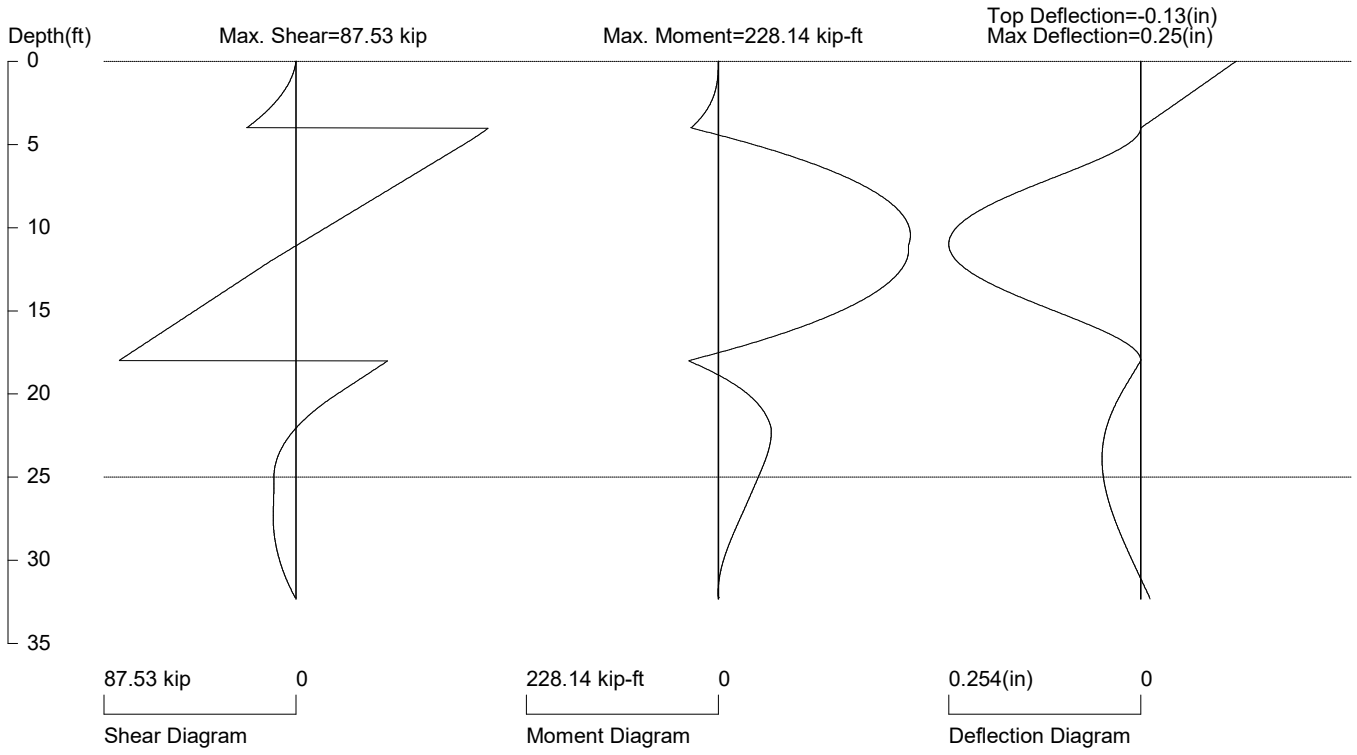
PASSIVE SPACING:

No.	Z depth	Spacing
1	25.00	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

E2, E4-E7 (25 ft @ 6 ft oc)





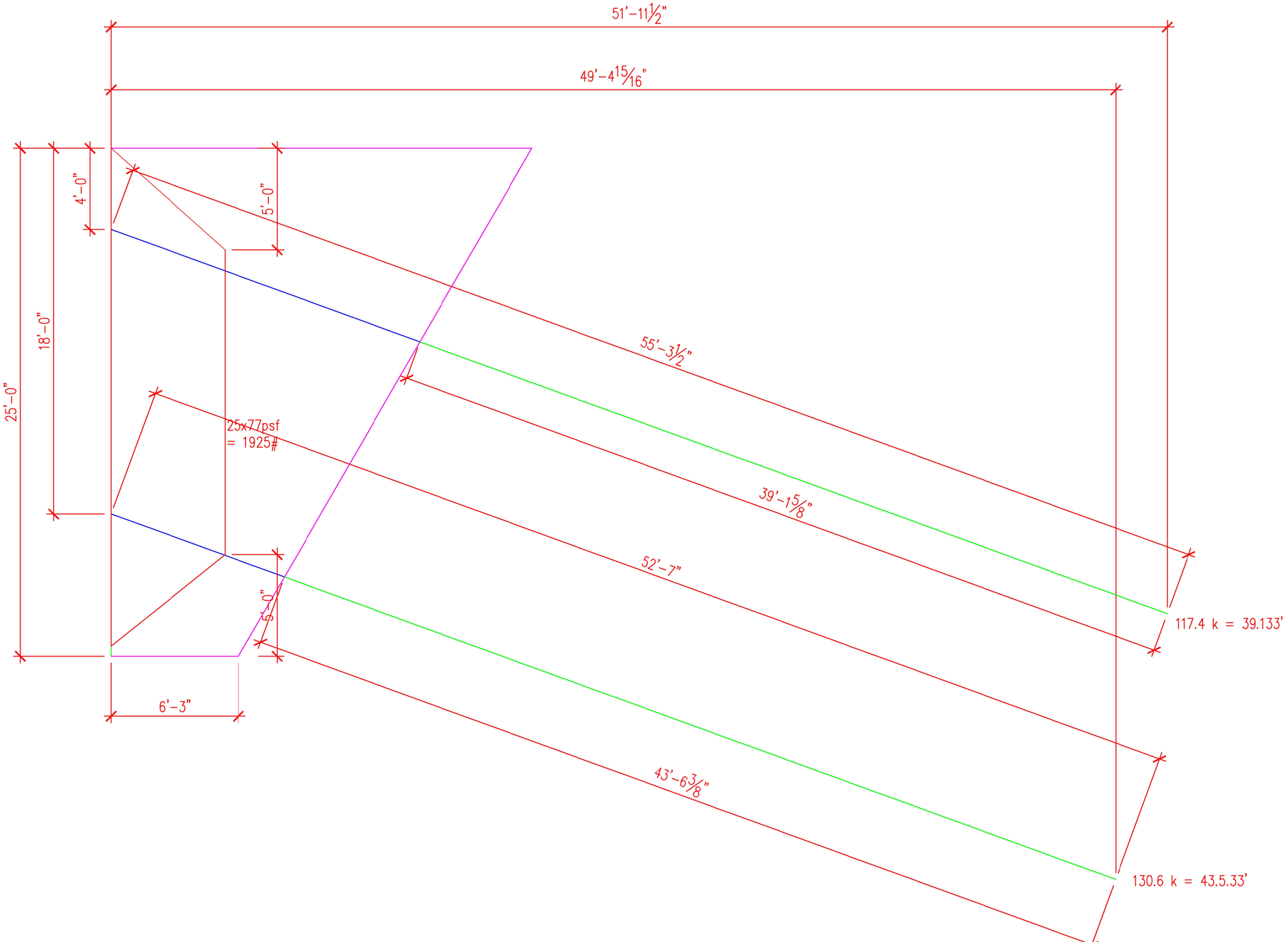
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.0 foot or meter

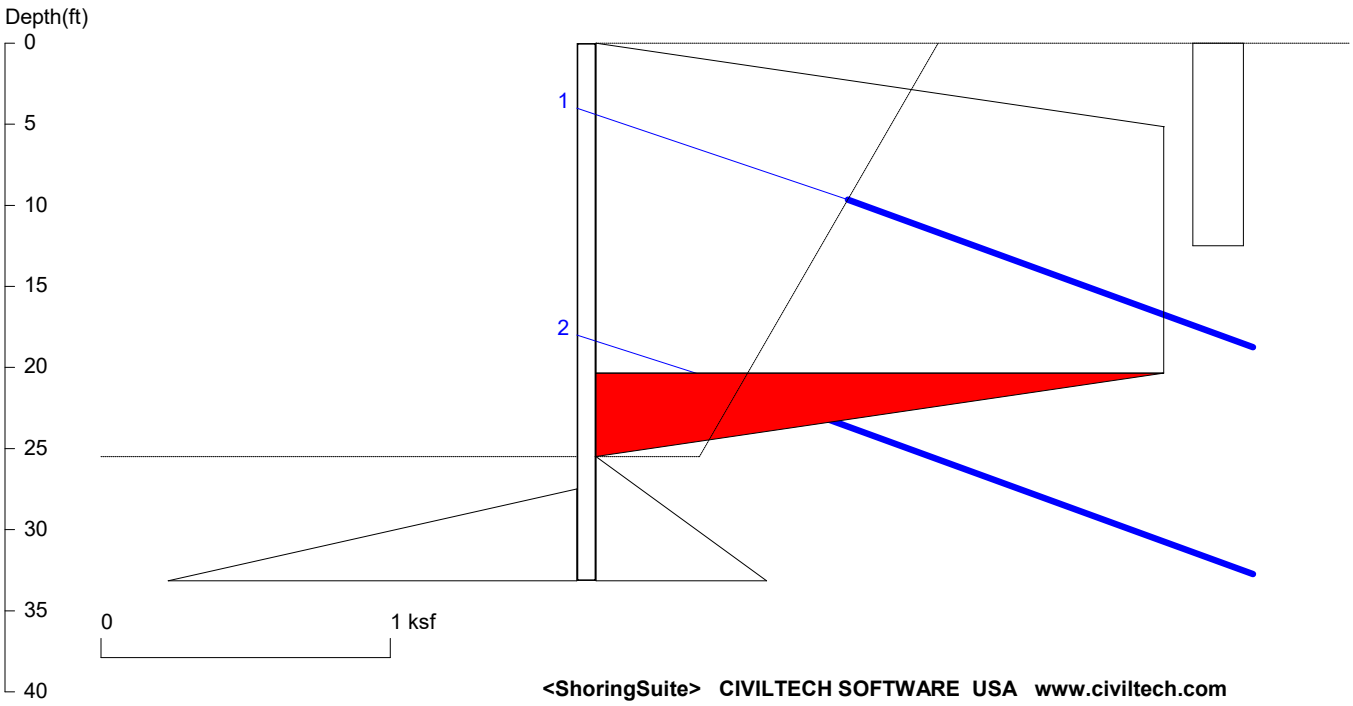
User Input Pile, W16X57: E (ksi)=29000.0, I (in4)/pile=758.0

File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E2, E4-E7_25 ft @ 6 ft oc (Tieback).SH8

E2, E4–E7


51'–11½"
49'–4 15/16"
4'–0"
5'–0"
25'–0"
18'–0"
55'–3½"
25x77psf
= 1925#
39'–1⅝"
52'–7"
117.4 k = 39.133'
5'–0"
6'–3"
43'–6⅜"
130.6 k = 43.5.33'

E3 (25.5 ft @ 6 ft oc)



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File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E3_25.5 ft @ 6 ft o

Wall Height=25.5 Pile Diameter=2.0 Pile Spacing=6.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=7.65 Min. Pile Length=33.15
MOMENT IN PILE: Max. Moment=234.39 per Pile Spacing=6.0 at Depth=10.48

PILE SELECTION:
Request Min. Section Modulus = 85.2 in3/pile=1396.74 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W16X57 has Section Modulus = 92.2 in3/pile=1510.88 cm3/pile. It is greater than Min. Requirements!
Top Deflection = -0.13(in) based on E (ksi)=29000.00 and I (in4)/pile=758.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L free	Fixed Length
1. Tieback	4.0	20.0	6.0	119.2	112.0	40.8	1 5	7 9
2. Tieback	18.0	20.0	6.0	137.5	129.2	47.0	9.4	7

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	5.151	1.963	0.381188
5.151	1.963	20.34	1.963	0.000000
20.34	1.963	25.5	0	-0.38118
*	Below	Base		
25.5	0	100	5.736	0.077
0	.175	12.5	0.175	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
27.5	0	35.5	2.000	.25

ACTIVE SPACING:

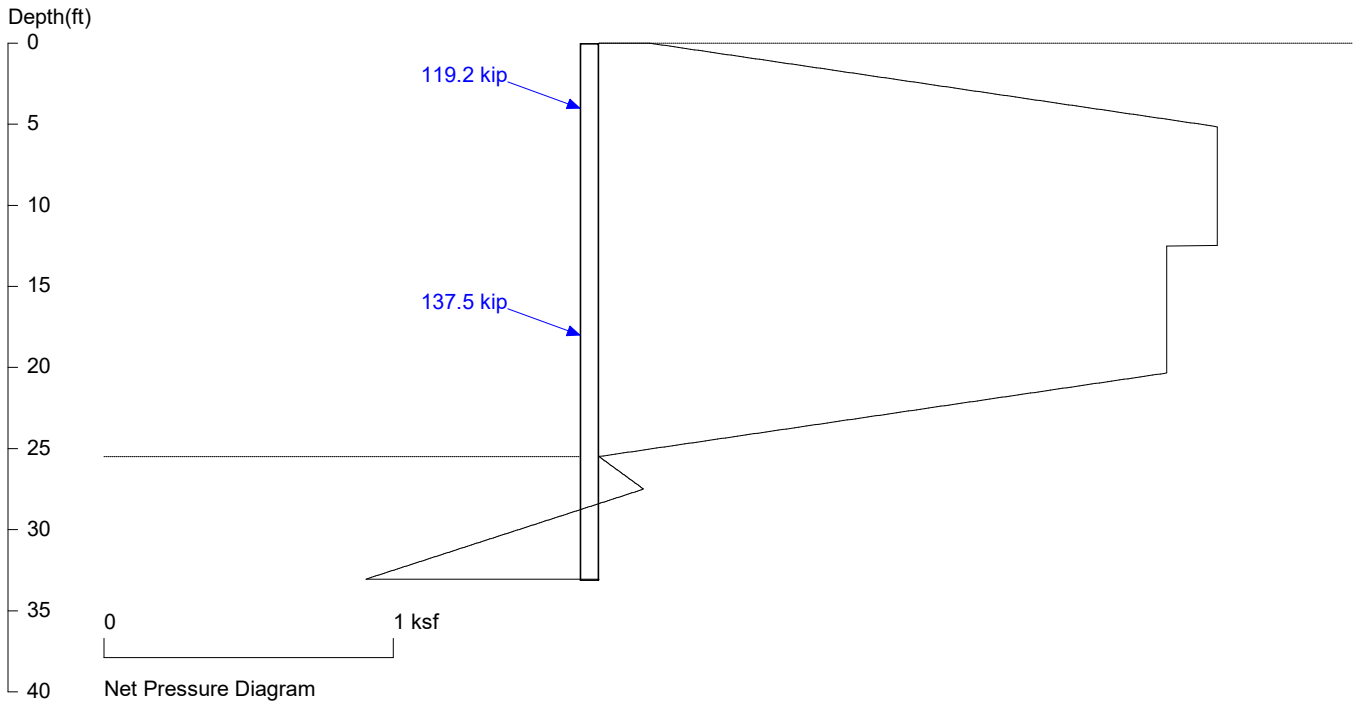
No.	Z depth	Spacing
1	0.00	6.00
2	25.50	2.00

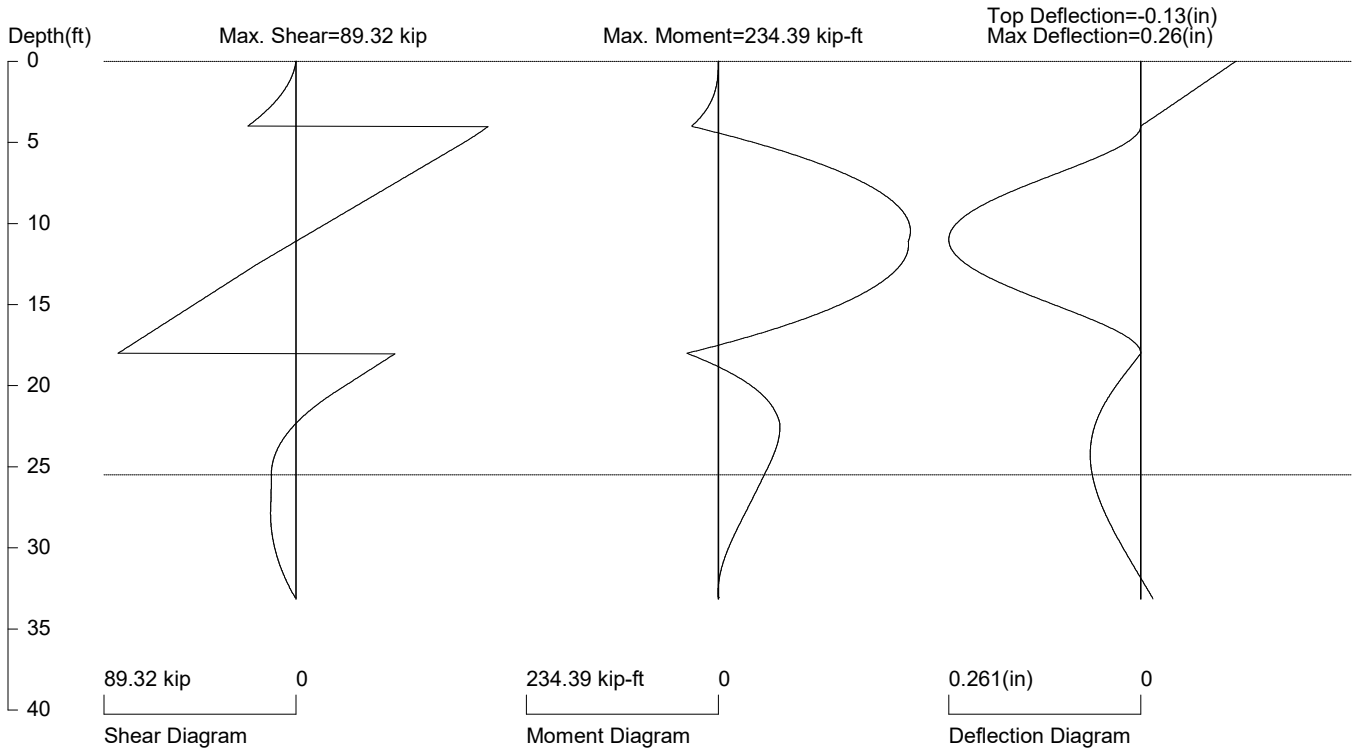
PASSIVE SPACING:

No.	Z depth	Spacing
1	25.50	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

E3 (25.5 ft @ 6 ft oc)





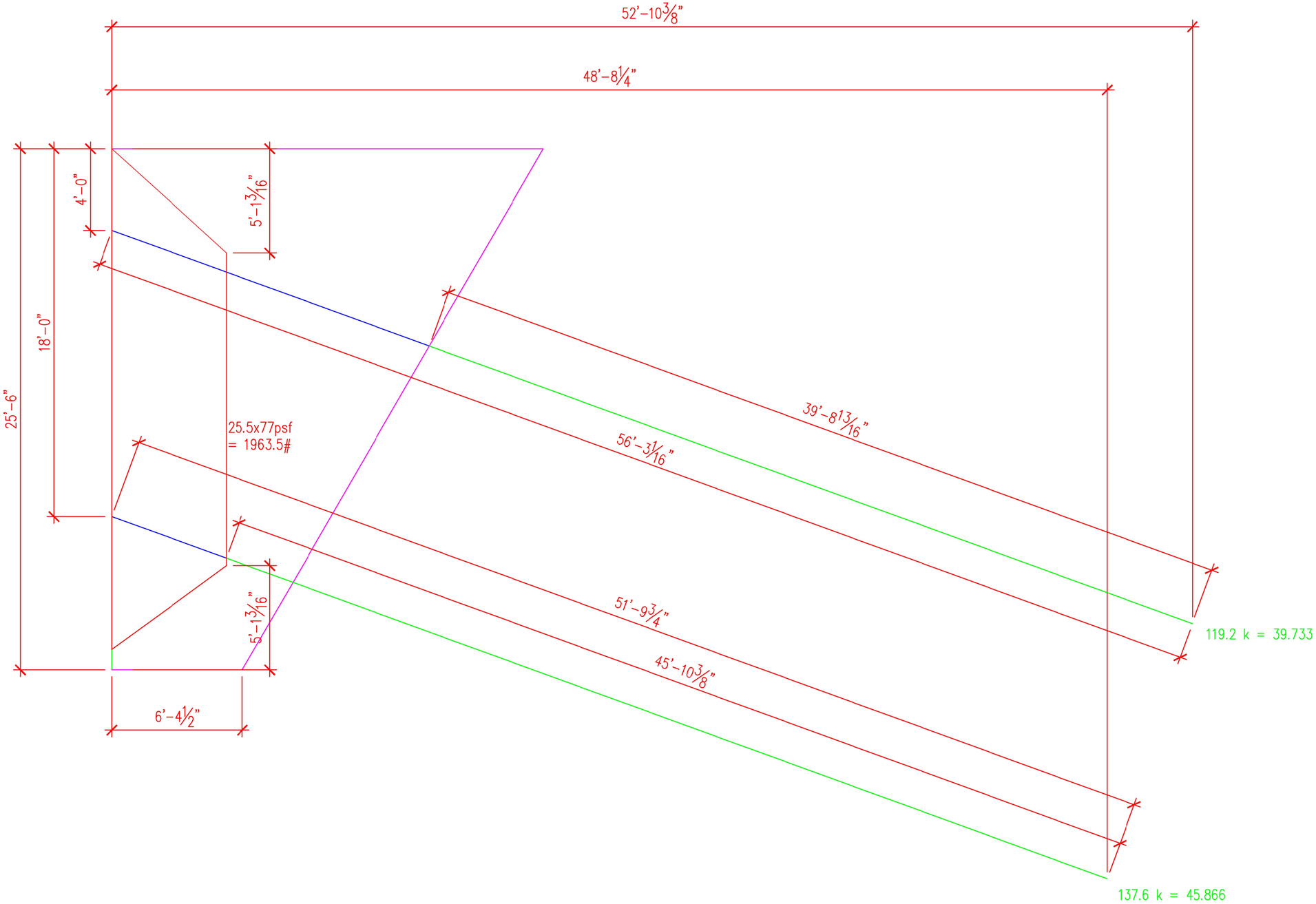
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.0 foot or meter

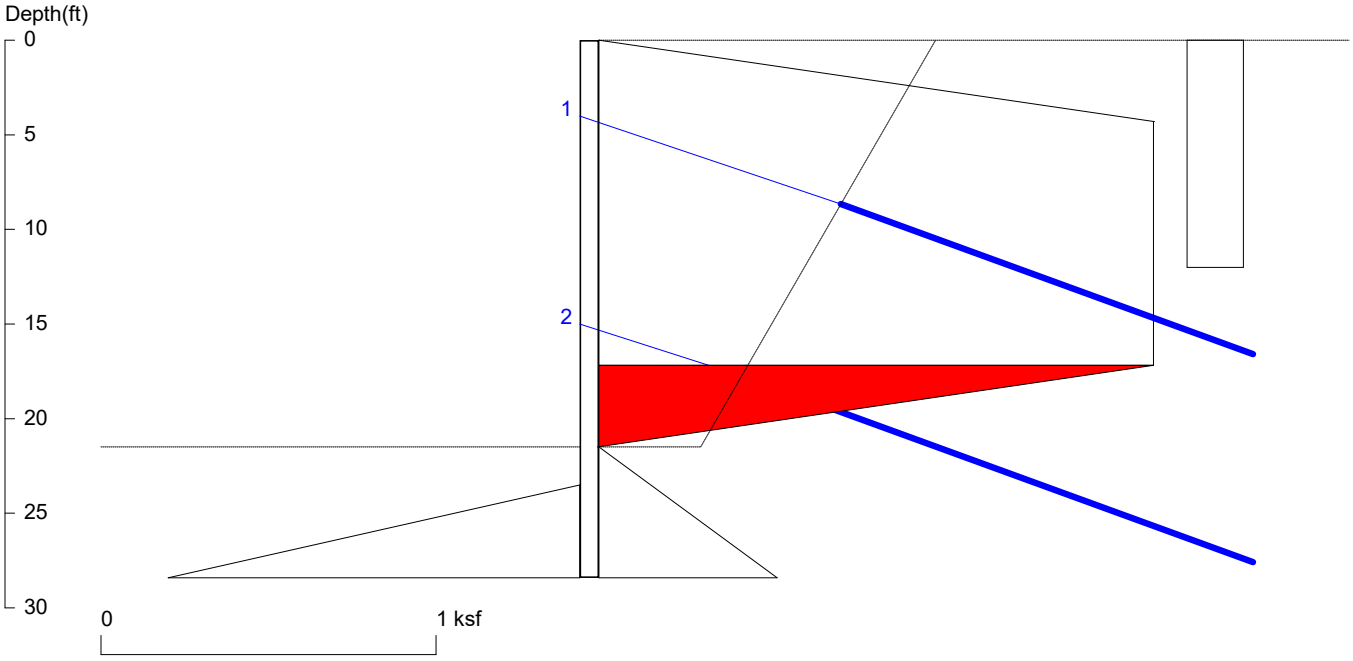
User Input Pile, W16X57: E (ksi)=29000.0, I (in4)/pile=758.0

File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E3_25.5 ft @ 6 ft oc (Tieback).SH8

E3


52'-10 3/8"
48'-8 1/4"
4'-0"
5'-1 3/16"
18'-0"
25'-6"
25.5x77psf
= 1963.5#
5'-1 3/16"
6'-4 1/2"
39'-8 13/16"
56'-3 1/16"
51'-9 3/4"
45'-10 3/8"
119.2 k = 39.733
137.6 k = 45.866

E8 (21.5 ft @ 6 ft oc)



<ShoringSuite> CIVILTECH SOFTWARE USA www.civiltech.com

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File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E8_21.5 ft @ 6 ft o

Wall Height=21.5 Pile Diameter=2.0 Pile Spacing=6.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=6.91 Min. Pile Length=28.41
MOMENT IN PILE: Max. Moment=118.91 per Pile Spacing=6.0 at Depth=9.26

PILE SELECTION:
Request Min. Section Modulus = 43.2 in3/pile=708.56 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W16X31 has Section Modulus = 47.2 in3/pile=773.47 cm3/pile. It is greater than Min. Requirements!
Top Deflection = -0.09(in) based on E (ksi)=29000.00 and I (in4)/pile=375.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L free	Fixed Length
1. Tieback	4.0	20.0	6.0	90.6	85.1	31.0	1[illegible]6	5[illegible]7
2. Tieback	15.0	20.0	6.0	95.0	89.3	32.5	[illegible]8.0	[illegible]0.[illegible]

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	4.302	1.655	0.384814
4.302	1.655	17.19	1.655	0.000000
17.19	1.655	21.5	0	-0.38481
*	Below	Base		
21.5	0	100	6.044	.077
0	.168	12	0.168	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
23.5	0	31.5	2.000	.25

ACTIVE SPACING:

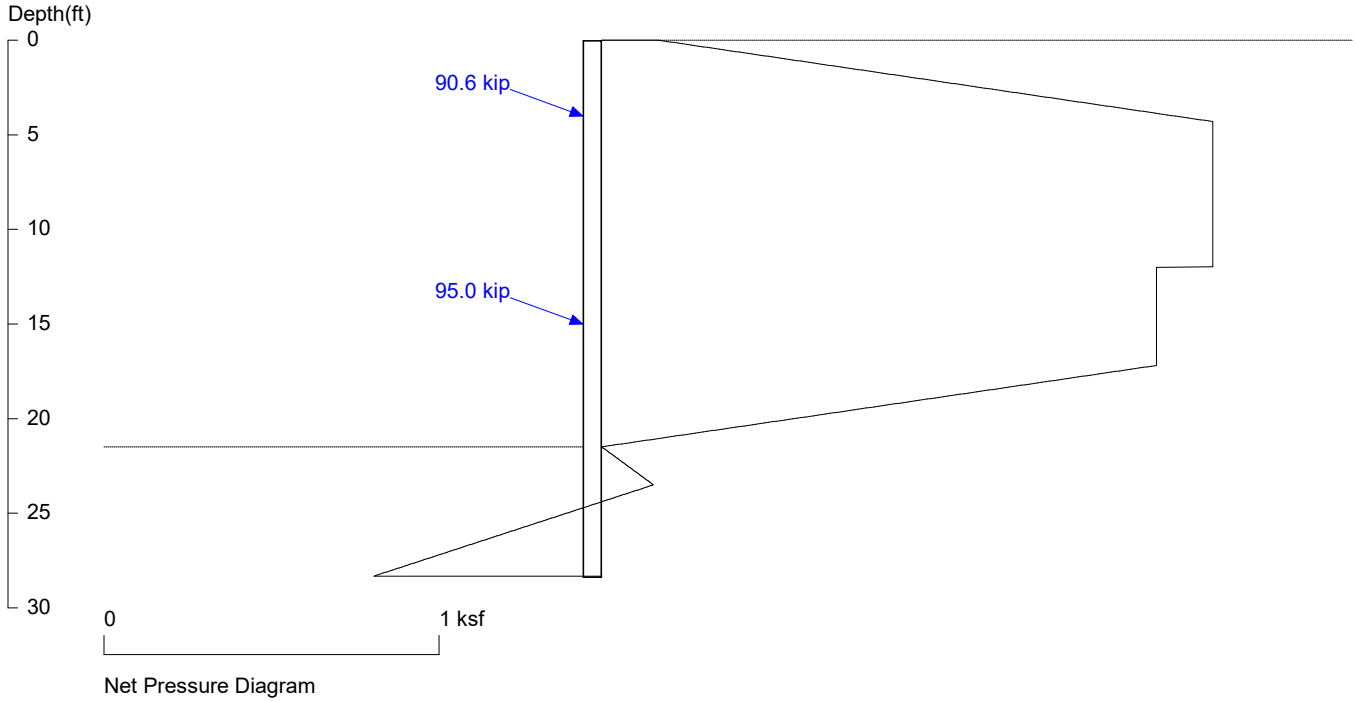
No.	Z depth	Spacing
1	0.00	6.00
2	21.50	2.00

PASSIVE SPACING:

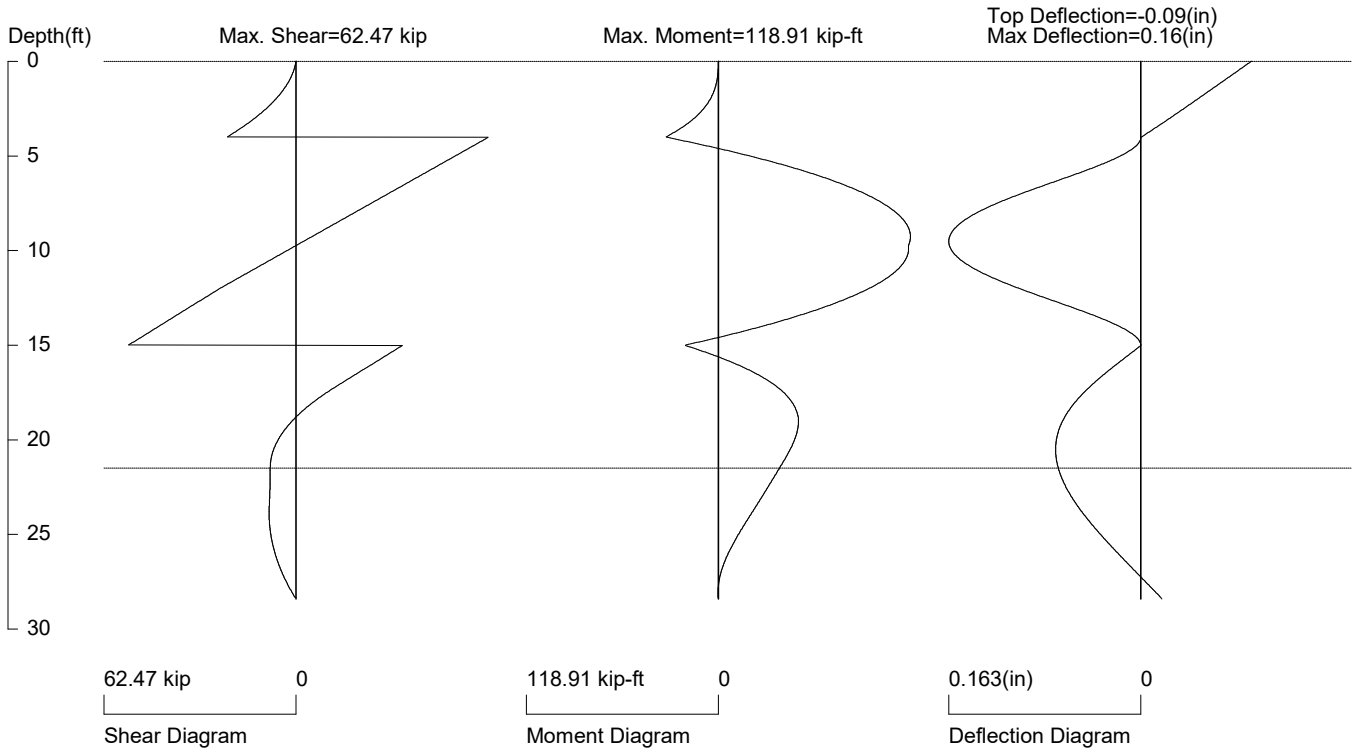
No.	Z depth	Spacing
1	21.50	4.00

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

E8 (21.5 ft @ 6 ft oc)



Net Pressure Diagram



Shear Diagram | Moment Diagram | Deflection Diagram

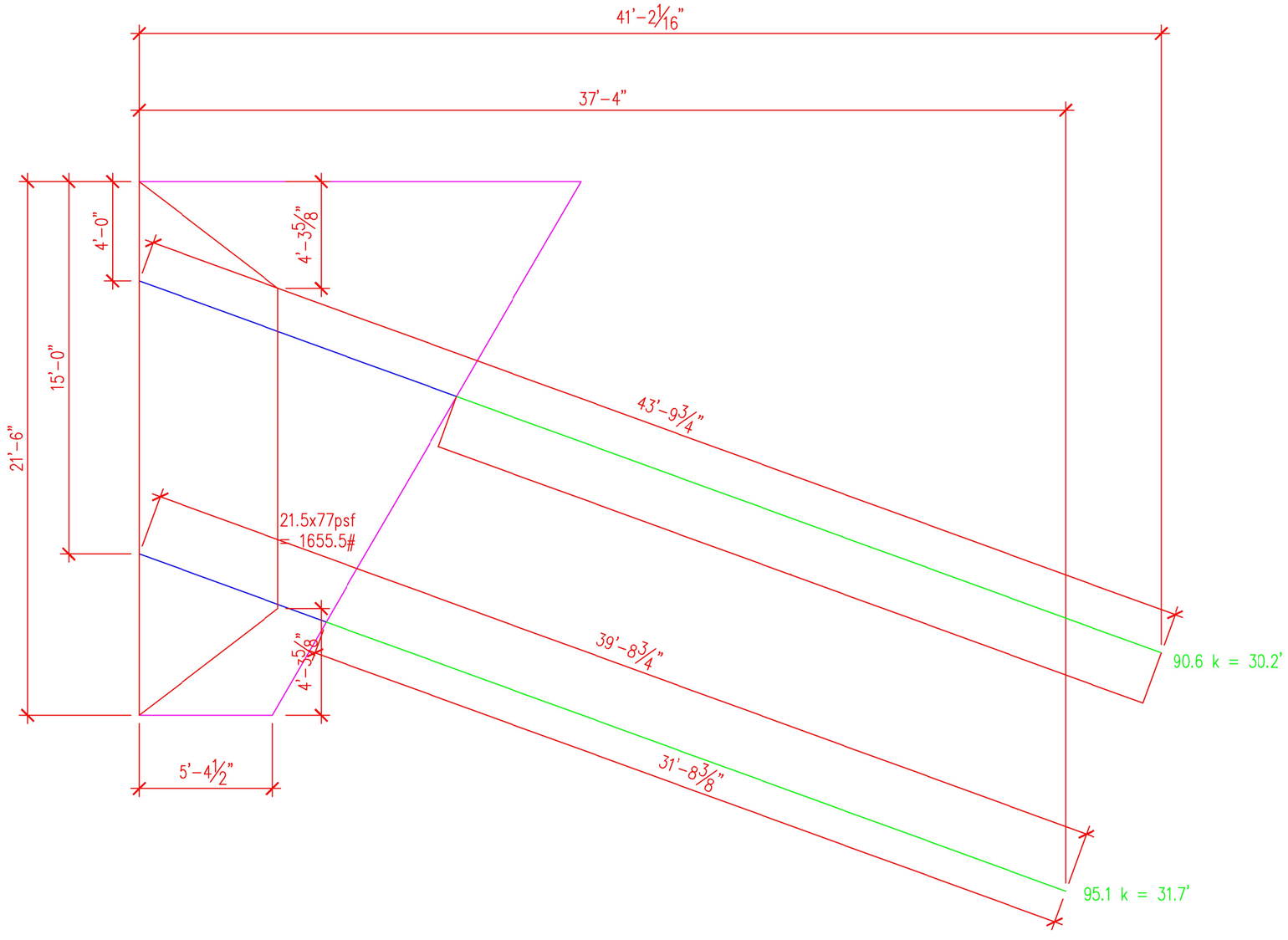
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.0 foot or meter

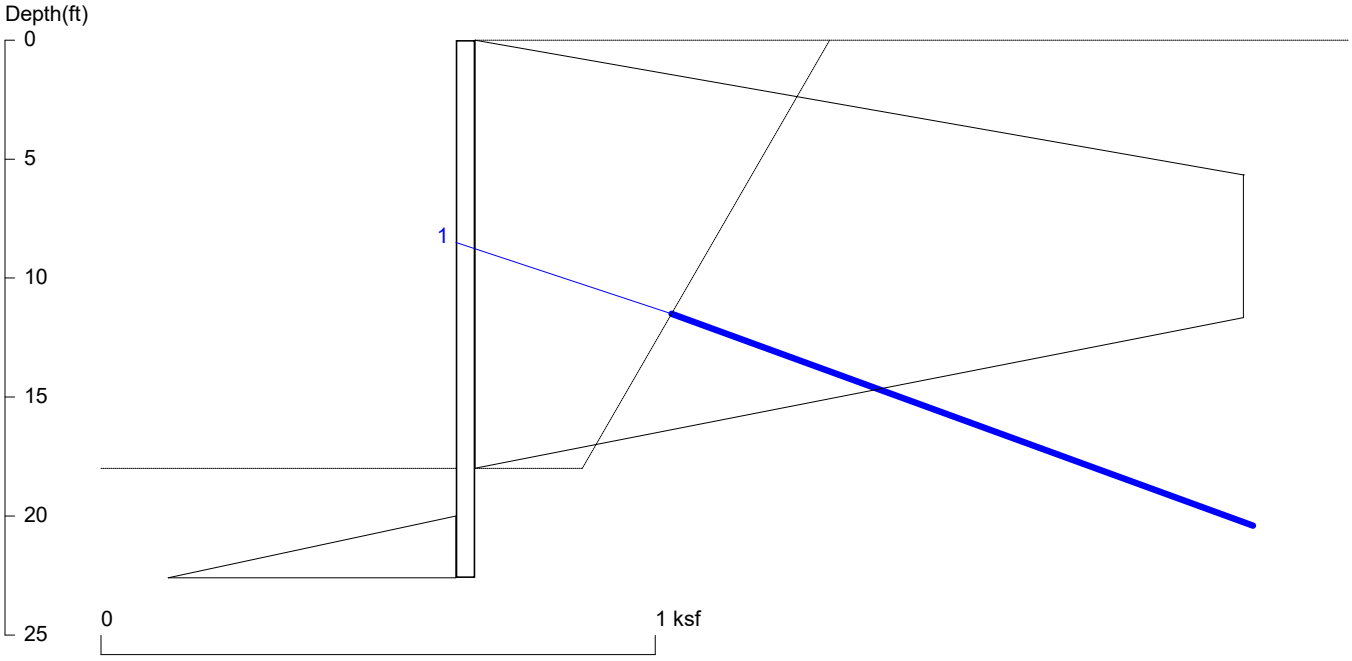
User Input Pile, W16X31: E (ksi)=29000.0, I (in4)/pile=375.0

File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E8_21.5 ft @ 6 ft oc (Tieback).SH8

E8


41'-2 1/16"
37'-4"
4'-0"
4'-3 5/8"
15'-0"
21'-6"
43'-9 3/4"
21.5x77psf
= 1655.5#
39'-8 3/4"
4'-3 5/8"
90.6 k = 30.2'
5'-4 1/2"
31'-8 3/8"
95.1 k = 31.7'

E9 (18 ft @ 6 ft oc)



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File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E9_18 ft @ 6 ft oc

Wall Height=18.0 Pile Diameter=2.0 Pile Spacing=6.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=4.60 (5~10ft is recommended!!!) Min. Pile Length=22.60
MOMENT IN PILE: Max. Moment=144.53 per Pile Spacing=6.0 at Depth=8.50

PILE SELECTION:
Request Min. Section Modulus = 52.6 in3/pile=861.24 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W16X36 has Section Modulus = 56.5 in3/pile=925.87 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 0.53(in) based on E (ksi)=29000.00 and I (in4)/pile=448.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	8.5	20.0	6.0	103.3	97.0	35.3	8.3	6.7

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	5.666	1.386	0.244588
5.666	1.386	11.66	1.386	0.000000
11.66	1.386	18	0	-0.21884

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
20	0	28	1.600	.20

ACTIVE SPACING:

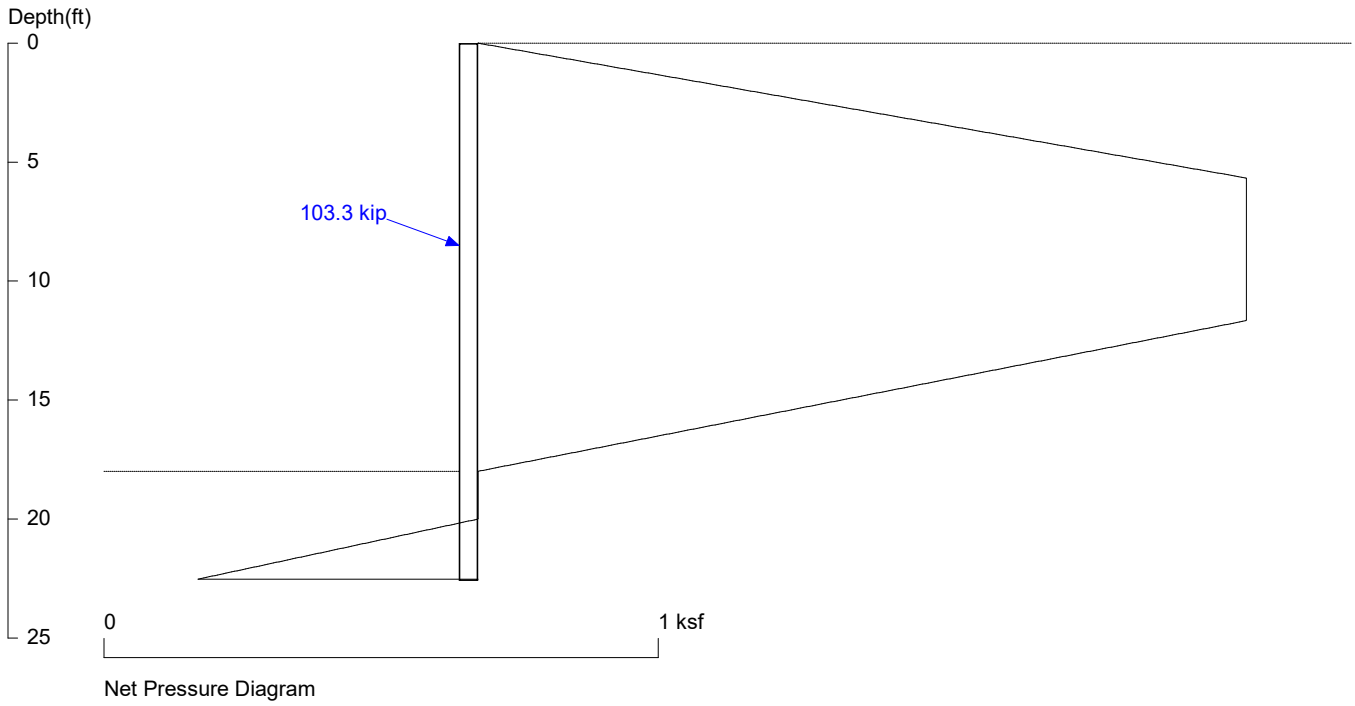
No.	Z depth	Spacing
1	0.00	6.00
2	18.00	2.00

PASSIVE SPACING:

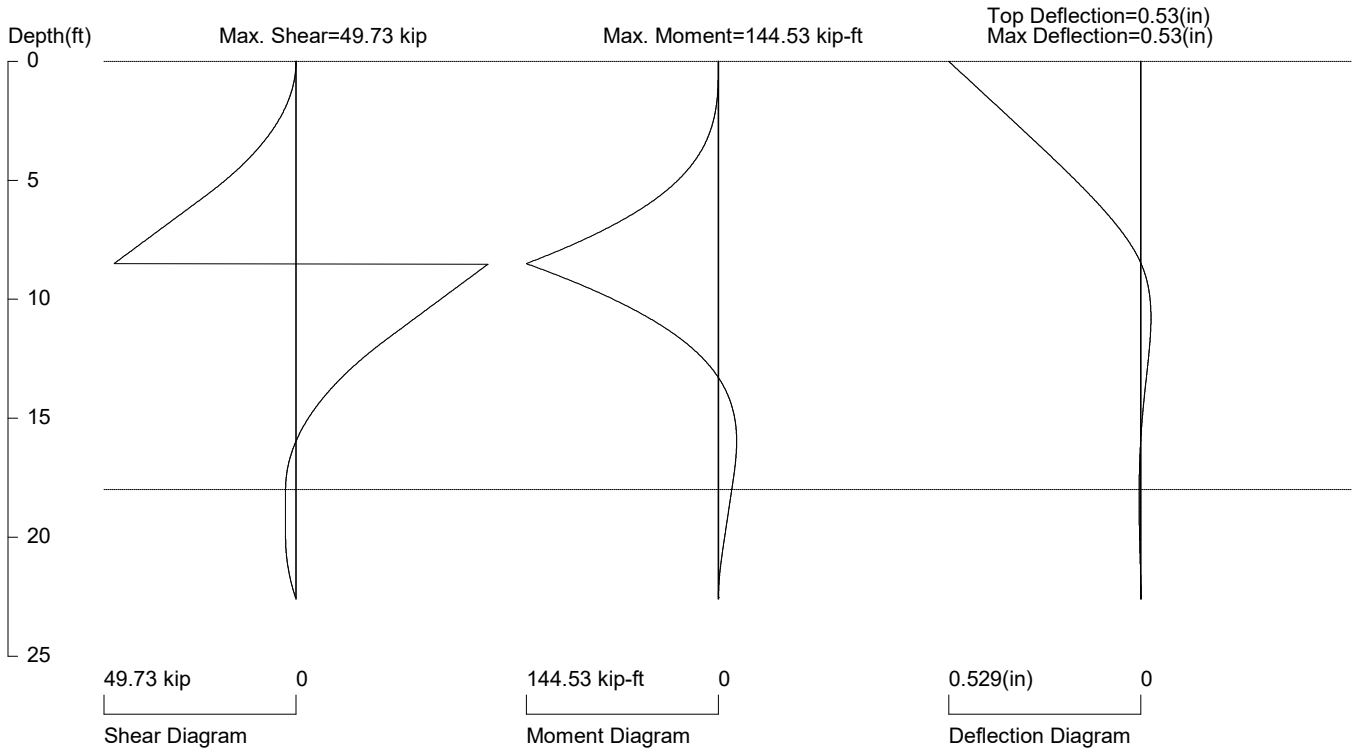
No.	Z depth	Spacing
1	18.00	4.00

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

E9 (18 ft @ 6 ft oc)



Net Pressure Diagram



Shear Diagram | Moment Diagram | Deflection Diagram

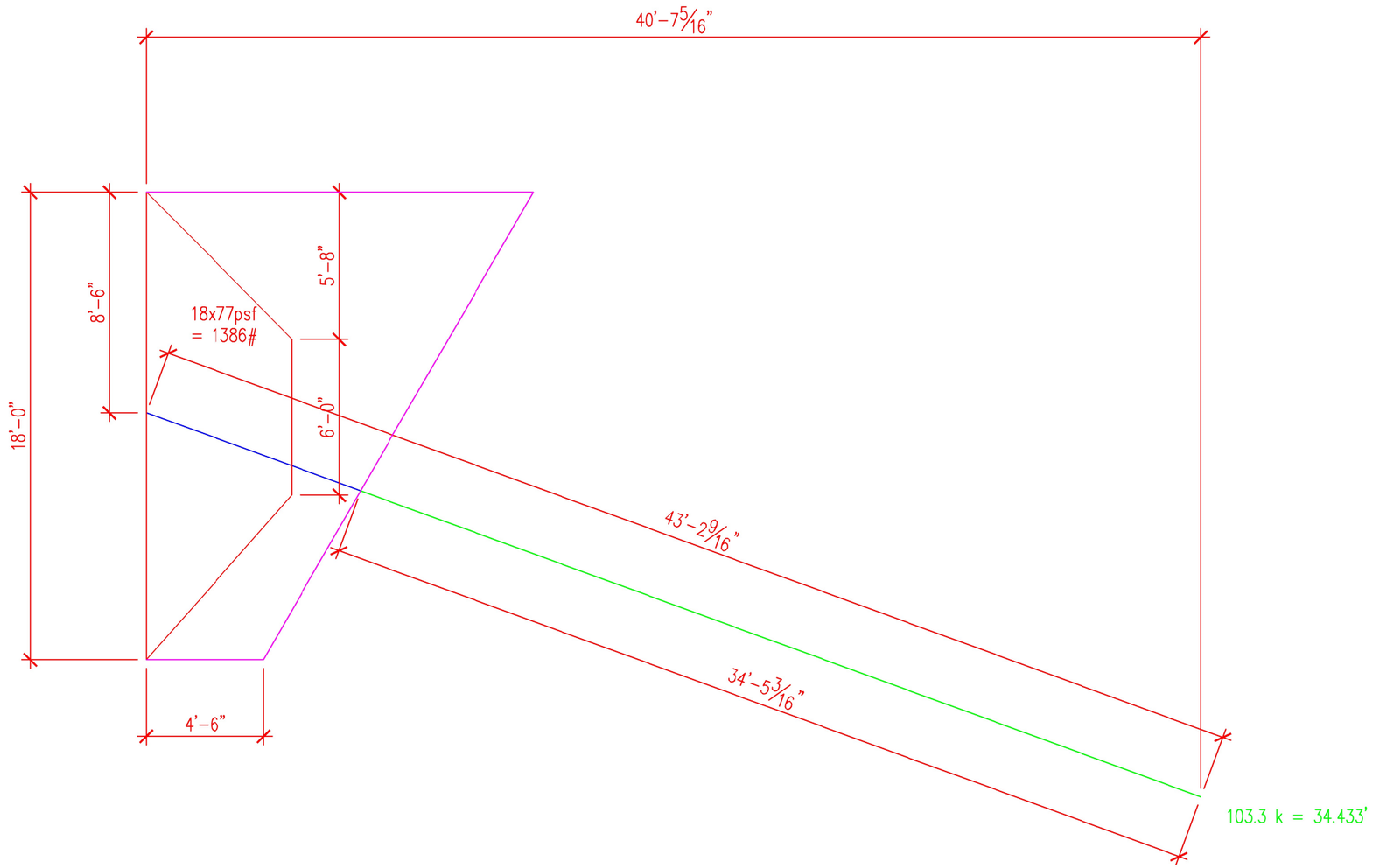
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.0 foot or meter

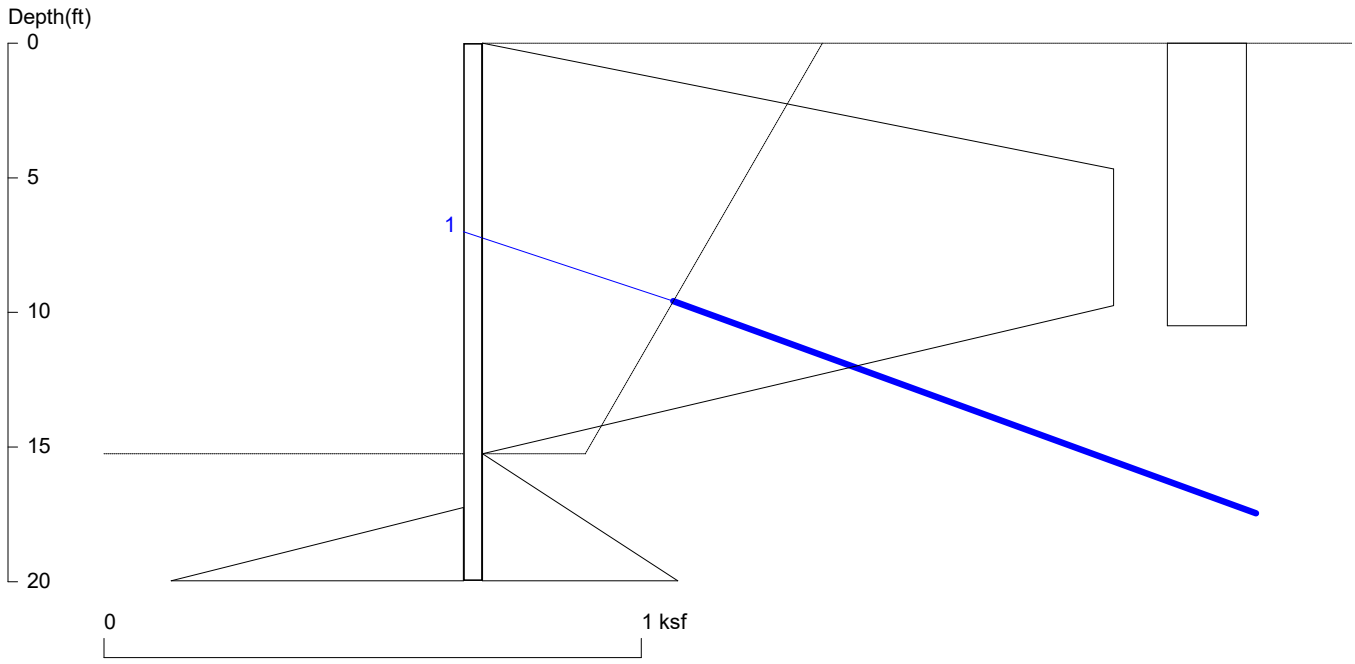
User Input Pile, W16X36: E (ksi)=29000.0, I (in4)/pile=448.0

File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E9_18 ft @ 6 ft oc (Tieback).SH8

E9


40'-7 5/16"
8'-6"
5'-8"
18x77psf
= 1386#
18'-0"
6'-0"
43'-2 9/16"
34'-5 3/16"
4'-6"
103.3 k = 34.433'

E10 (15.25 ft @ 6 ft oc)



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File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E10_15.25 ft @ 6 f

Wall Height=15.3 Pile Diameter=2.0 Pile Spacing=6.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=4.72 (5~10ft is recommended!!!) Min. Pile Length=19.97
MOMENT IN PILE: Max. Moment=104.66 per Pile Spacing=6.0 at Depth=7.00

PILE SELECTION:
Request Min. Section Modulus = 38.1 in3/pile=623.68 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W16X26 has Section Modulus = 38.4 in3/pile=629.26 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 0.42(in) based on E (ksi)=29000.00 and I (in4)/pile=301.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	7.0	20.0	6.0	84.8	79.6	29.0	7.5	5.0

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	4.66666667	1.17425	0.251625
4.66666666667	1.17425	9.75	1.17425	0.000000
9.75	1.17425	15.25	0	-0.213500
*	Below	Base		
15.25	0	100	6.526	.077
0	.147	10.5	.147	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
17.25	0	25.25	1.600	.2

ACTIVE SPACING:

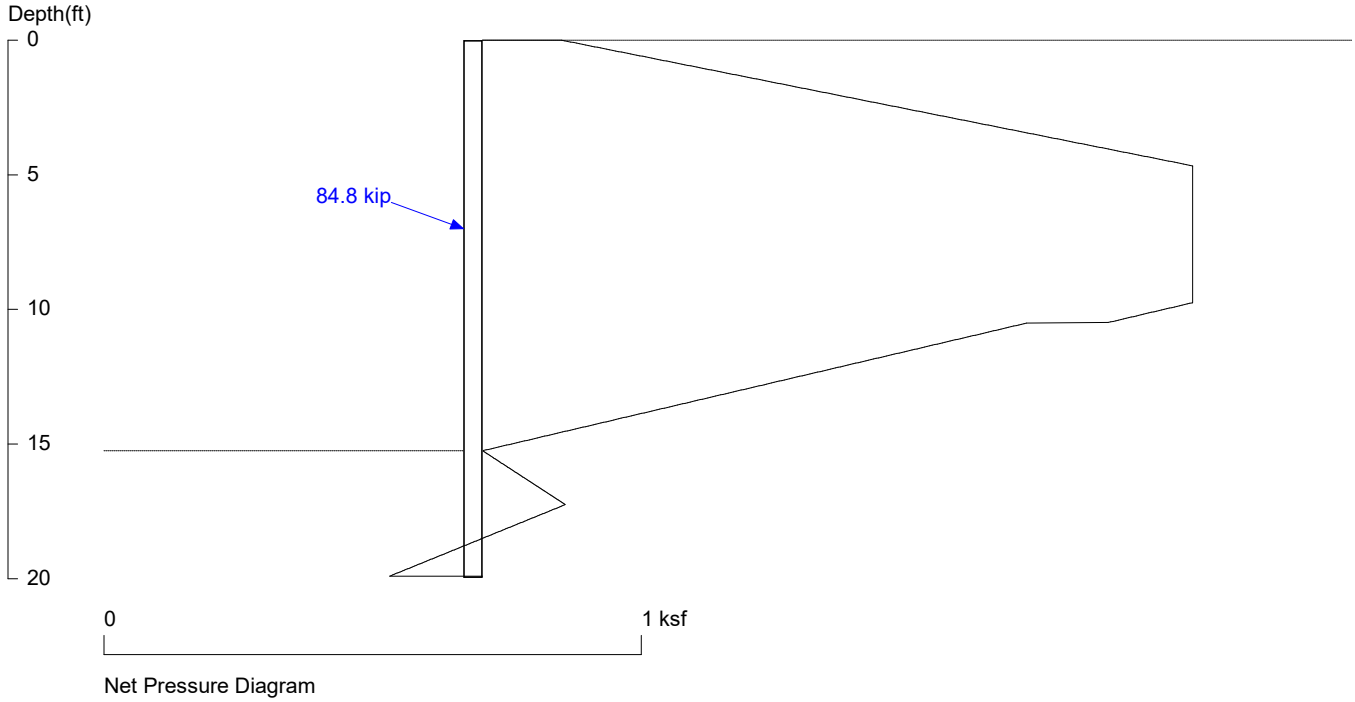
No.	Z depth	Spacing
1	0.00	6.00
2	15.25	2.00

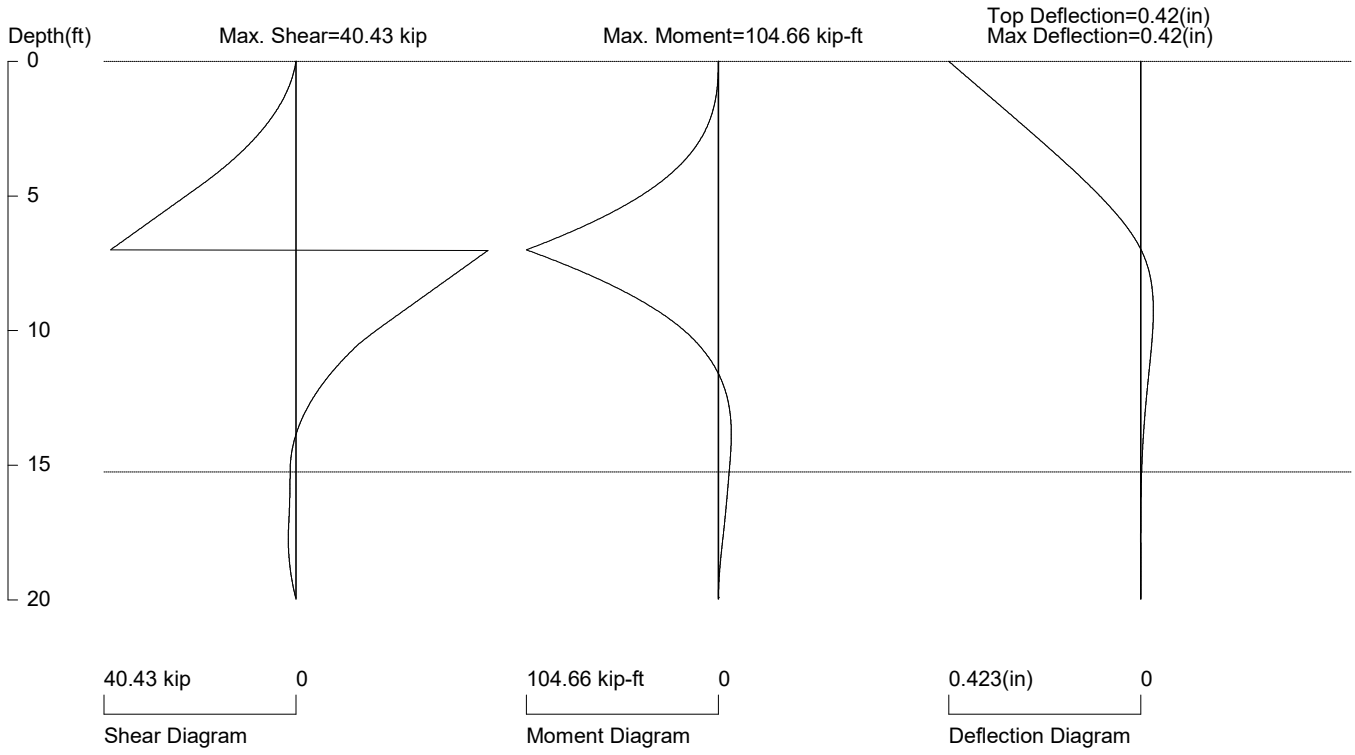
PASSIVE SPACING:

No.	Z depth	Spacing
1	15.25	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

E10 (15.25 ft @ 6 ft oc)





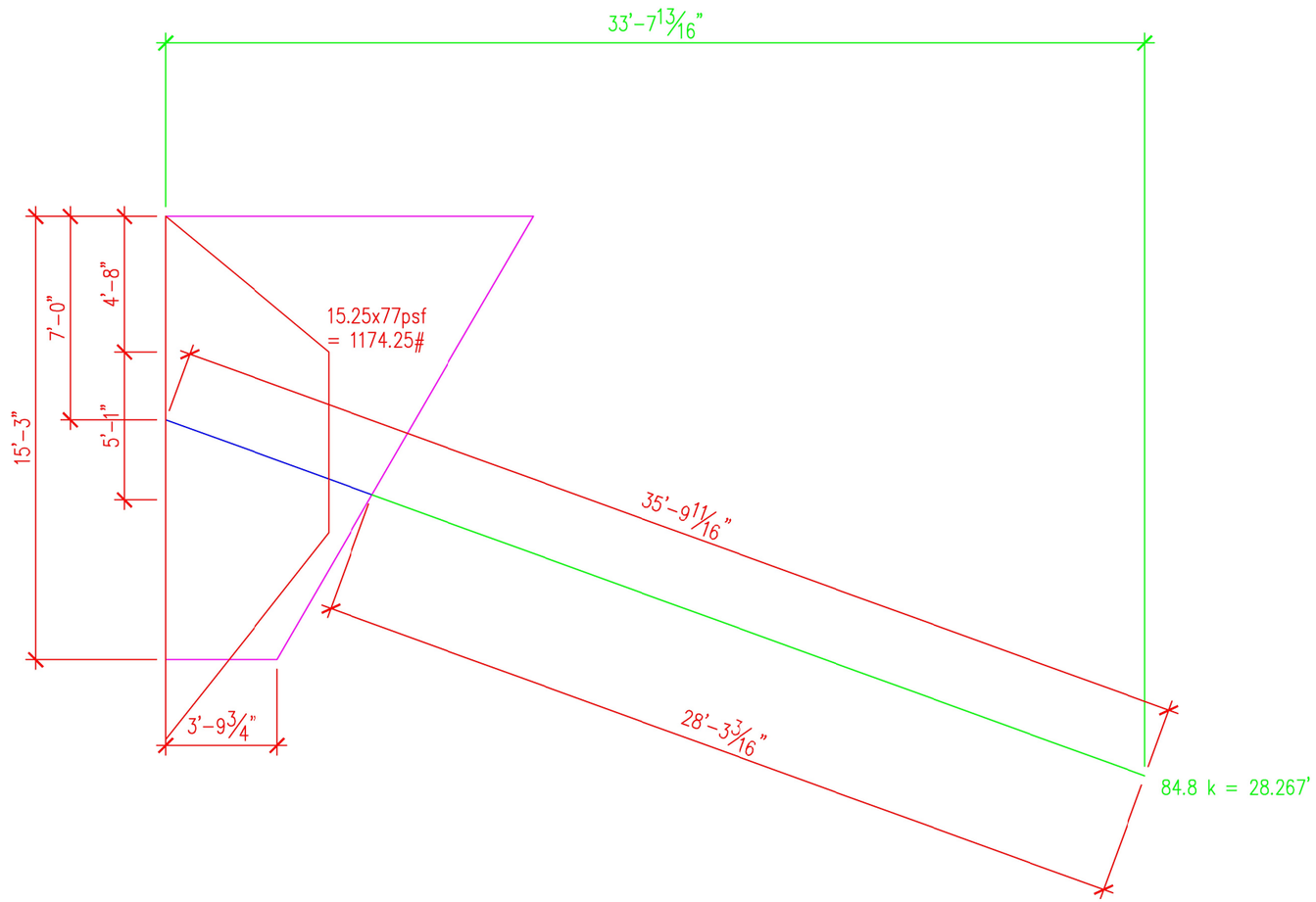
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.0 foot or meter

User Input Pile, W16X26: E (ksi)=29000.0, I (in4)/pile=301.0

File: C:\Users\javid\OneDrive\Desktop\Atlas Projects\269-2024 (5818 West Mercer)\Shoring\R3 Updated\E10_15.25 ft @ 6 ft oc (Tieback).SH8

E10


33'-7 13/16"
15.25x77psf
= 1174.25#
7'-0"
4'-8"
15'-3"
5'-1"
35'-9 11/16"
28'-3 3/16"
3'-9 3/4"
84.8 k = 28.267'