ms consultants inc.
engineers, architects, planners

job no 08326 sheet
made by JDS date 2/19
checked date
office INDIANAPOLIS
project SUMMIT 8

REAR ABUTMENT SHORING

SOIL/ROCK PROPERTIES

- See following page for geotech recommendations
  - 1040 to 1020: Backfill, 120 pcf, $\phi = 30°$
  - 1020 - 1004: Sand, 125 pcf, $\phi = 34°$
  - Rock: $Q_u = 5{,}500$ psi, $S_m = 165$ ksi
    $V = 0.2$ (Table C10.4.6.5-2) GSI = 50 (Figure 10.4.6.4-2)
    $E_r = 2{,}130{,}000$ psi (Table C10.4.6.5-1)

SURCHARGE

- 2' equiv. soil load (LL > 1' from wall) Use 120 pcf(2') = 240 psf (Table 3.11.6.4-2)

DESIGNS

1.) TIEBACK WALL W/ MAX 36' CUT

1) 1st Stage Shoring 8 calc, 12' cut w/ only SP (Strength + Service)

~~2) 2nd Stage shoring 8 calc, 22' cut w/ 1 tieback~~

~~3) 3rd Stage Shoring 8 calc, 32' cut w/ 2 tiebacks~~

4) Final Run Shoring 8 calc, 36' cut w/ 3 tiebacks (Strength + Service)

9) Lagging thickness check

10) Tieback Channel Support Check (ENERCALC)

11) Weld check for wedges @ Tieback (Excel)

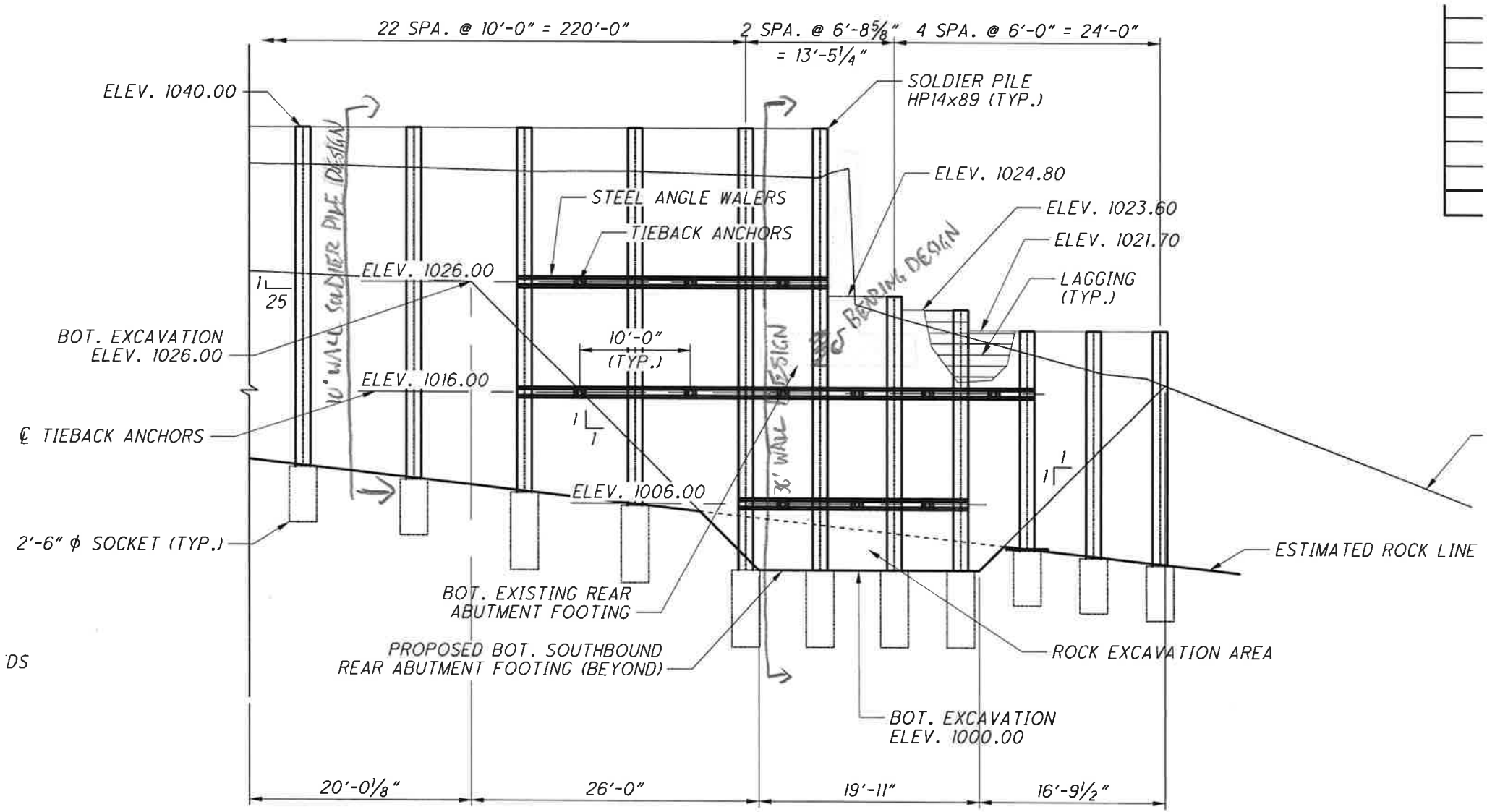
12) Existing footing breakout check (in place of 1 tieback location)

13) Tieback Soil Anchor Summary table

2.) SOLDIER PILE WALL W 10' CUT

1) Soldier Pile 10' Run (Strength + Service)

⇒ Use 12' initial run of tieback wall, conservative



TEMPORARY SHORING ELEVATION

Rear Abutment Soil Properties

SanGiorgio, John

From:
Sent:
To:
Cc:
Subject:

John,

The parameters we gave you were for the North side launch pit. So they are good for your 18 foot wall.

For your 36 foot wall what is the top of wall elevation and the dredge line elevation? By the drawing it looks like about 1040 and 1004, respectively.

Based on the top of rock your best option is a soldier pile wall with tie backs.

The soil between 1040 and 1020 based on the location and borings will be fill i.e. the existing ground elevation is 1020. You can use ODOT standard backfill, i.e. assume unit weight of 120 pcf and 30 degrees fee. Don't develop bond length for tie backs in this layer, it will be too variable.

For soil between 1020 – 1004 use 34 degrees and 125 pcf. For the bond strength in this layer use 3 kips per **square foot** (it's more dense than south side).

The Highly weathered sandstone 1004-1001 can be ignored.

The deeper sand stone should have a bond strength 28 kips per square foot.
Qu=5,500 psi or 792 kips per square foot s_m =165 ksf see AASHTO Figure 3.11.5.6-2—***Unfactored Simplified Earth Pressure Distributions for Permanent Non-gravity Cantilevered Walls with Discrete Vertical Wall Elements Embedded in Rock***. Unit weight 145 pcf.

Water is deeper than the boring; however, I would recommend using wood lagging to reduce surficial runoff accumulating behind the wall.

Since rock anchors are possible, incline the anchors steeply to encounter rock but no more than 1:1 H:V.

Procedurally I would

1) Calculate the max free standing height of a cantilever soldier prior to anchoring.
2) 2) Use this height as the height (or slightly less) of the first anchor.
3) 3) Using the maximum moment size your soldier pile. Don't go any deeper than 15 feet.
4) Next calculate the max height with one anchor to find the level of second anchor.

Again if you need any help and gary agrees we do this work a lot and could be a cost effective check.

Thanks,

Thomas L. Monaco, P.E.
Gannett Fleming Engineers and Architects, P.C.
Ext. 7463 tmonaco@gfnet.com
Excellence Delivered As Promised

SanGiorgio, John

From: Monaco, Thomas L. <tmonaco@GFNET.com>
Sent: Wednesday, August 28, 2019 10:05 AM
To: SanGiorgio, John
Cc: Zimmerman, Yuru L. ("Alex"); Dues, Eric F.; Besselman, Jack
Subject: RE: Summit 8 Shoring Walls for GWT

John,

Nice talking to you. To reiterate our conversation.

The depth of embedment into the rock for the tied back wall should be two diameters of the shaft (min).

Where no tie back are used 10 feet (but I don't think this applies anymore)

The passive resistance in the soil is three diameters unless spacing is closer than three diameters.

From: SanGiorgio, John <jsangiorgio@msconsultants.com>
Sent: Monday, August 26, 2019 3:50 PM
To: Monaco, Thomas L. <tmonaco@GFNET.com>
Cc: Zimmerman, Yuru L. ("Alex") <yzimmerman@gfnet.com>; Dues, Eric F. <edues@GFNET.com>; Besselman, Jack <jbesselman@msconsultants.com>
Subject: RE: Summit 8 Shoring Walls for GWT

Thomas,

Yes, I apologize those questions are at two separate locations. The first is for the soldier pile/tieback wall embedded into the sandstone. I had the soldier pile embedment there at 11' into rock, so that shouldn't be an issue.

The passive spacing question was for the soldier piles into the sand on the north side.

John SanGiorgio, PE
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Connect: Facebook | Twitter | LinkedIn | ms Blog

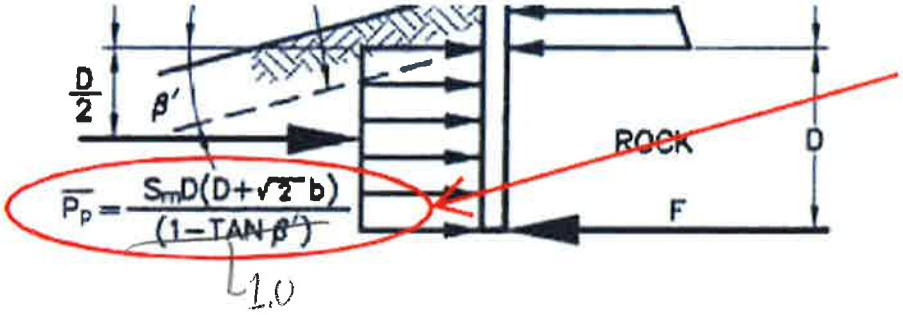
CONVERTING ROCK LAYER TO EQUIV. FORCE (PASSIVE)

e. SHEAR RESISTANCE OF ROCK

When soil is present on the passive side, the resistance is due to the passive resistance of the soil as shown in the previous sections. When rock is present, the resistance is due to the shear resistance of the rock and is calculated differently than passive pressure of soil.

Calculation of Shear Resistance of Rock

- The strength of the rock to be used for the shear resistance (TSF or KSF) should be given in the GER.
- AASHTO Figure 3.11.5.6-2 (see below) shows the resistance in rock as a uniform load. This uniform load is the force Pp divided by the embedment depth D. The calculation of the resisting force Pp is based on the equation shown below:



- The derivation of this formula is shown in **Attachment E.** The resistance is strictly over the width 'b' of the drilled shaft

INSERT ATTACHMENT 'E' PDF (AASHTO Figure 3.11.5.6-1 and Figure 3.11.5.6-2)

- Assuming 1' embed, $D = 1'$, $S_m = 165$ ksf, $b = 2.5'$

$$\overline{P_p} = S_m D(D+\sqrt{2}b) = (165\text{ ksf})(1')(1'+\sqrt{2}(2.5')) = 748\text{ k}$$

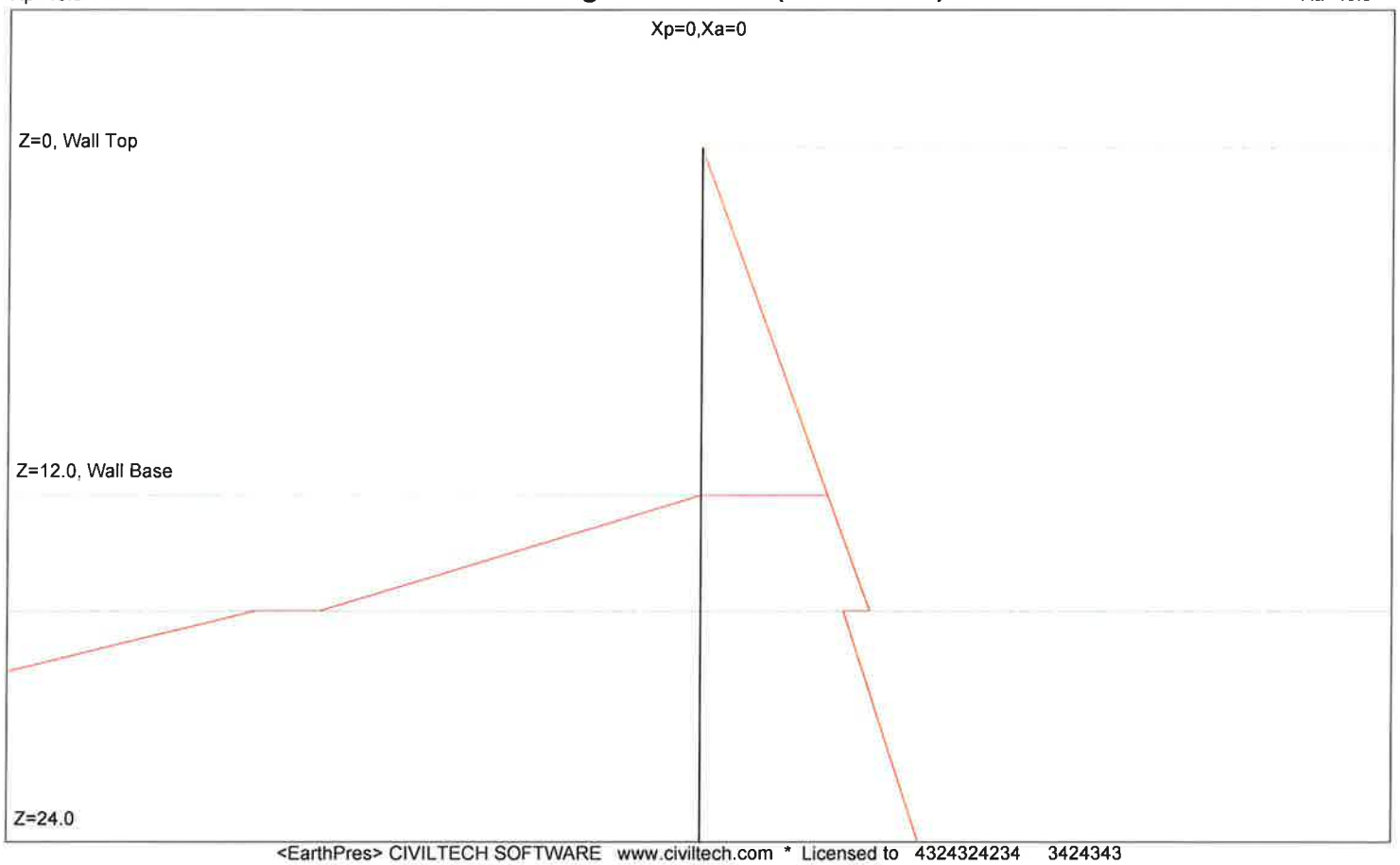
$$p = \frac{\overline{P_p}}{D \cdot b} = \frac{748\text{ k}}{(1')(2.5')} \quad 299\text{ ksf service}$$

$299\text{ ksf}(0.75) = 224\text{ ksf}$ strength

↑ L.F.

Summit 8 Receiving Pit

Launching Pit Soils 12' (Unfactored)



UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/28/2019 File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soil Pressures 12' Unfactored.ep8

* INPUT DATA *

Wall Height=12.0 Total Soil Types= 2

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	135.0	30	0.0	0	4	Fill
2	125.0	135.0	34	0.0	0	4	Sand

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	Fill
2	16.0	0.0	16.0	800.0	2	Sand

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	12.0	0.0	12.0	800.0	1	Fill
2	16.0	0.0	16.0	800.0	2	Sand

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 6. No Water Table

* OUTPUT RESULTS *

Total Force above Base= 2.88 per one linear foot (or meter) width along wall height
Total Static Force above Base= 2.88

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	12.00	0.48	0.0400	0.3333

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

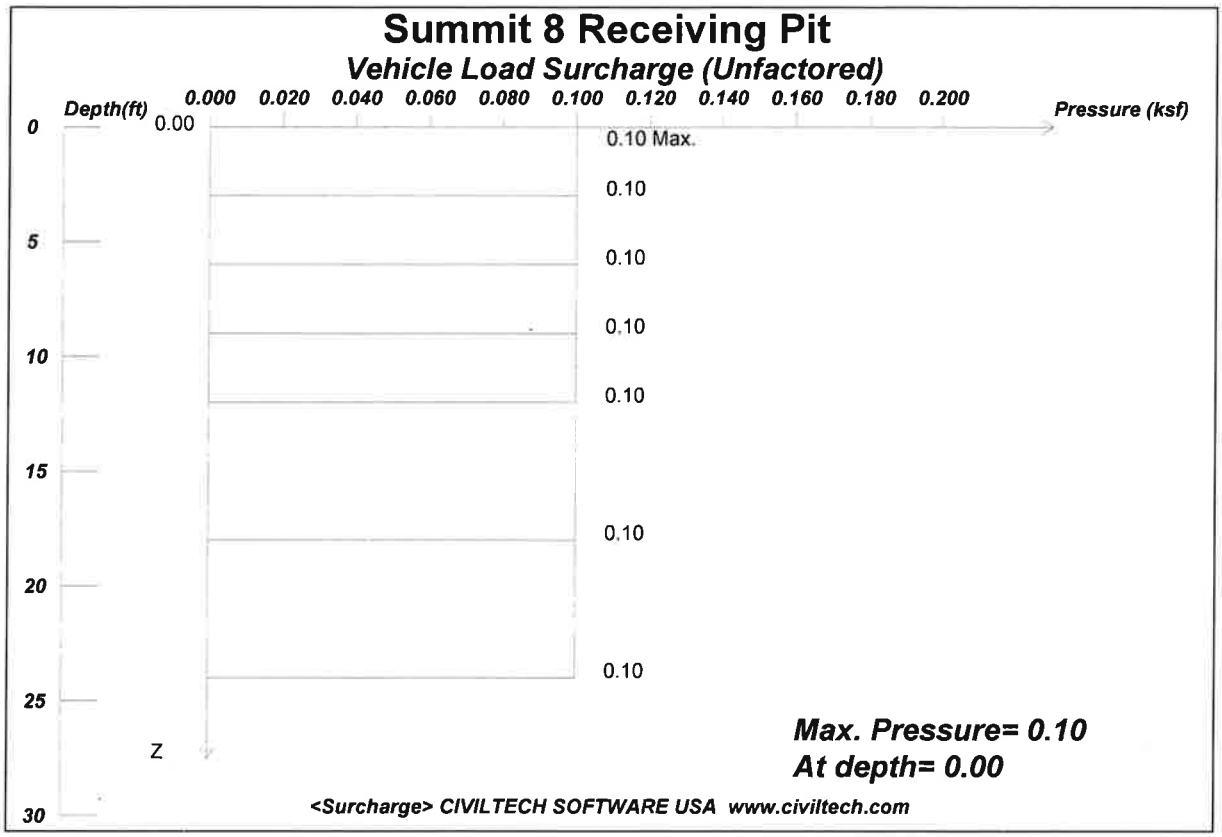
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
12.00	0.48	16.00	0.64	0.0400	0.3333
16.00	0.54	24.00	0.83	0.0356	0.2845

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
12.00	0.00	16.00	1.44	0.360	3.0000
16.00	1.69	24.00	5.24	0.444	3.5509

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/28/2019 File Name: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soil Pressures 12' Unfactored.ep8



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Date: 8/28/2019 File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Vehicle Load Surc

Wall Height, H= 12 Load Depth at Surface, D= 0

Load Factor of Surcharge Loading = 1

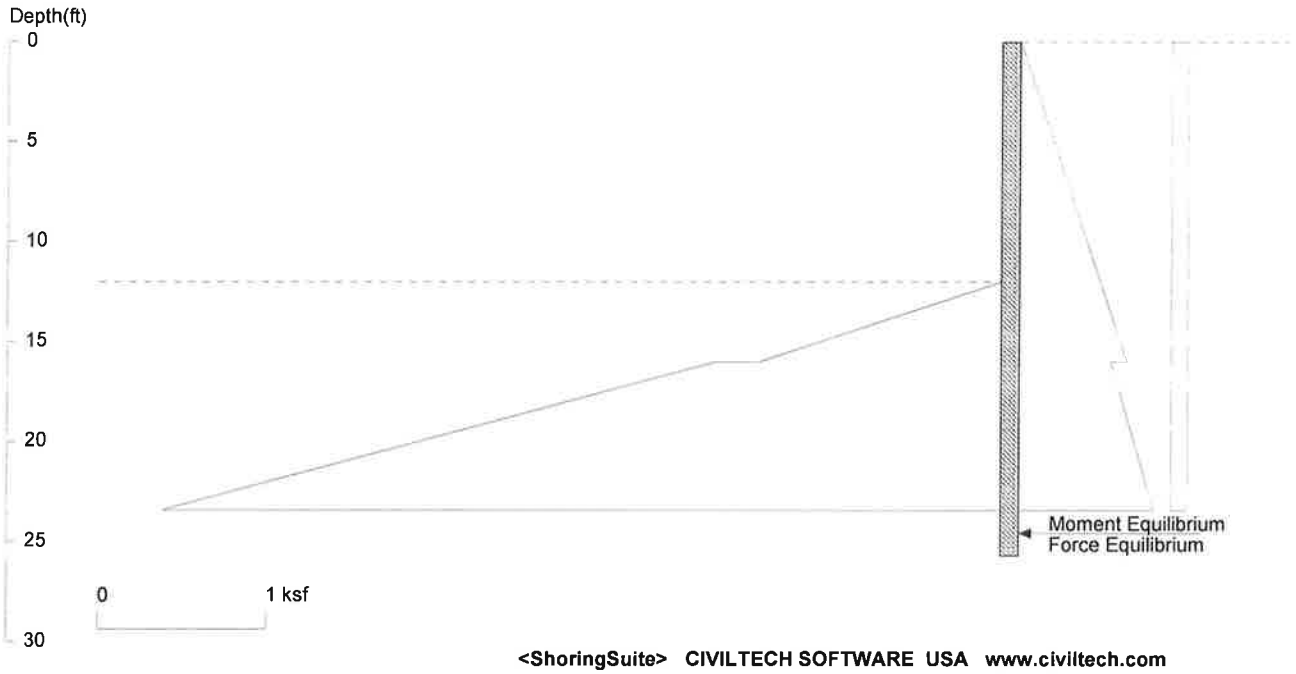
Semi-flexible Wall Condition -- Small movement or deflection are allowed.

Max. Pressure = 0.100 at depth = 0.00

Infinite Surcharge, Q=.240 Active Wedge Approach * (recommend)

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

Summit 8 Receiving Pit
Tieback Wall (Step 1 Cantilever) (Service)



<ShoringSuite> CIVILTECH SOFTWARE USA www.civiltech.com

Licensed to 4324324234 3424343 Date: 8/28/2019

File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soldier Pile Wall 12' Service.sh8

Wall Height=12.0 Pile Diameter=2.5 Pile Spacing=10.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=13.70 Min. Pile Length=25.70
MOMENT IN PILE: Max. Moment=359.57 per Pile Spacing=10.0 at Depth=17.82

PILE SELECTION:
Request Min. Section Modulus = 130.8 in3/pile=2142.65 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W14X90 has Section Modulus = 143.0 in3/pile=2343.34 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 1.41(in) based on E (ksi)=29000.00 and I (in4)/pile=999.0

$1.41" < 12(12') = 1.44"$ ✓

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	12.00	0.480	0.040000
*	Below	Base		
12.00	0.480	16.00	0.640	0.040000
16.00	0.542	108.0	3.794	0.035347
*	Sur-	charg		
0.000	0.100	0.600	0.100	0.000000
0.600	0.100	1.200	0.100	0.000000
1.200	0.100	1.800	0.100	0.000000
1.800	0.100	2.400	0.100	0.000000
2.400	0.100	3.000	0.100	0.000000
3.000	0.100	3.600	0.100	0.000000
3.600	0.100	4.200	0.100	0.000000
4.200	0.100	4.800	0.100	0.000000
4.800	0.100	5.400	0.100	0.000000
5.400	0.100	6.000	0.100	0.000000
6.000	0.100	6.600	0.100	0.000000
6.600	0.100	7.200	0.100	0.000000

7.200	0.100	7.800	0.100	0.000000
7.800	0.100	8.400	0.100	0.000000
8.400	0.100	9.000	0.100	0.000000
9.000	0.100	9.600	0.100	0.000000
9.600	0.100	10.20	0.100	0.000000
10.20	0.100	10.80	0.100	0.000000
10.80	0.100	11.40	0.100	0.000000
11.40	0.100	12.00	0.100	0.000000
12.00	0.100	13.20	0.100	0.000000
13.20	0.100	14.40	0.100	0.000000
14.40	0.100	15.60	0.100	0.000000
15.60	0.100	16.80	0.100	0.000000
16.80	0.100	18.00	0.100	0.000000
18.00	0.100	19.20	0.100	0.000000
19.20	0.100	20.40	0.100	0.000000
20.40	0.100	21.60	0.100	0.000000
21.60	0.100	22.80	0.100	0.000000
22.80	0.100	24.00	0.100	0.000000
24.00	0.100	26.40	0.100	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
12.00	0.000	16.00	1.440	0.360000
16.00	1.696	36	10.53	0.442166

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	10.00
2	12.00	2.50

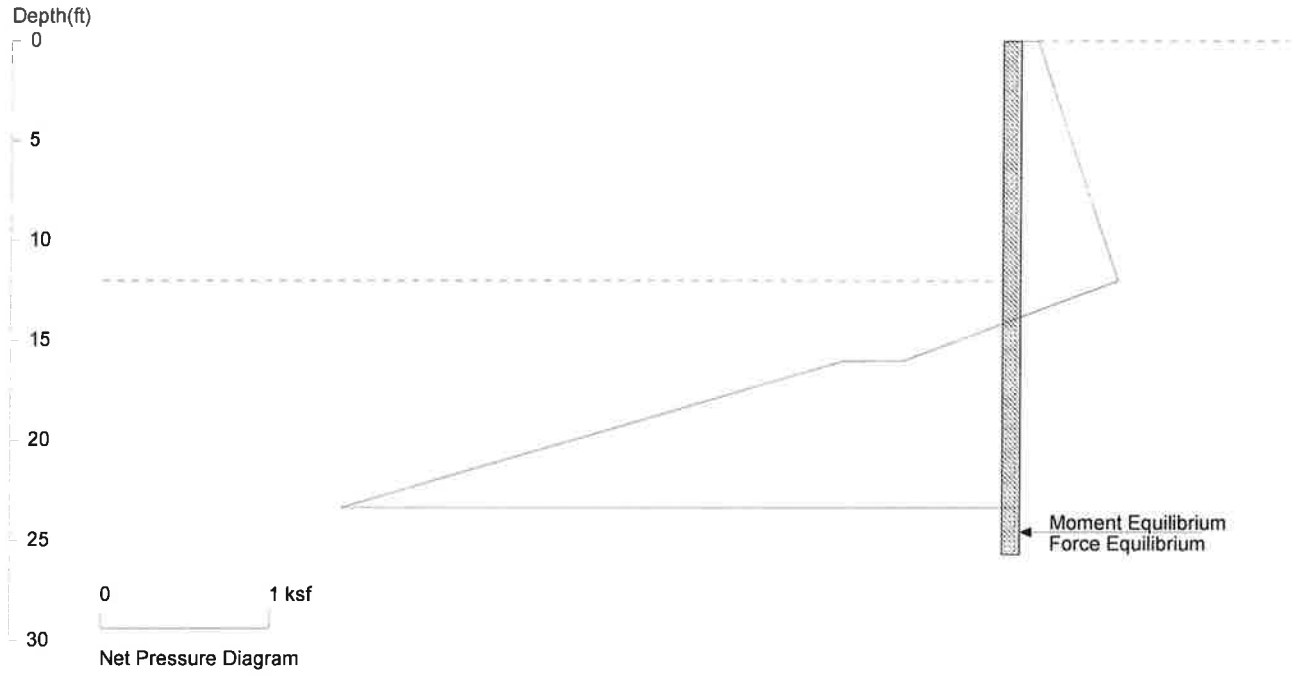
PASSIVE SPACING:

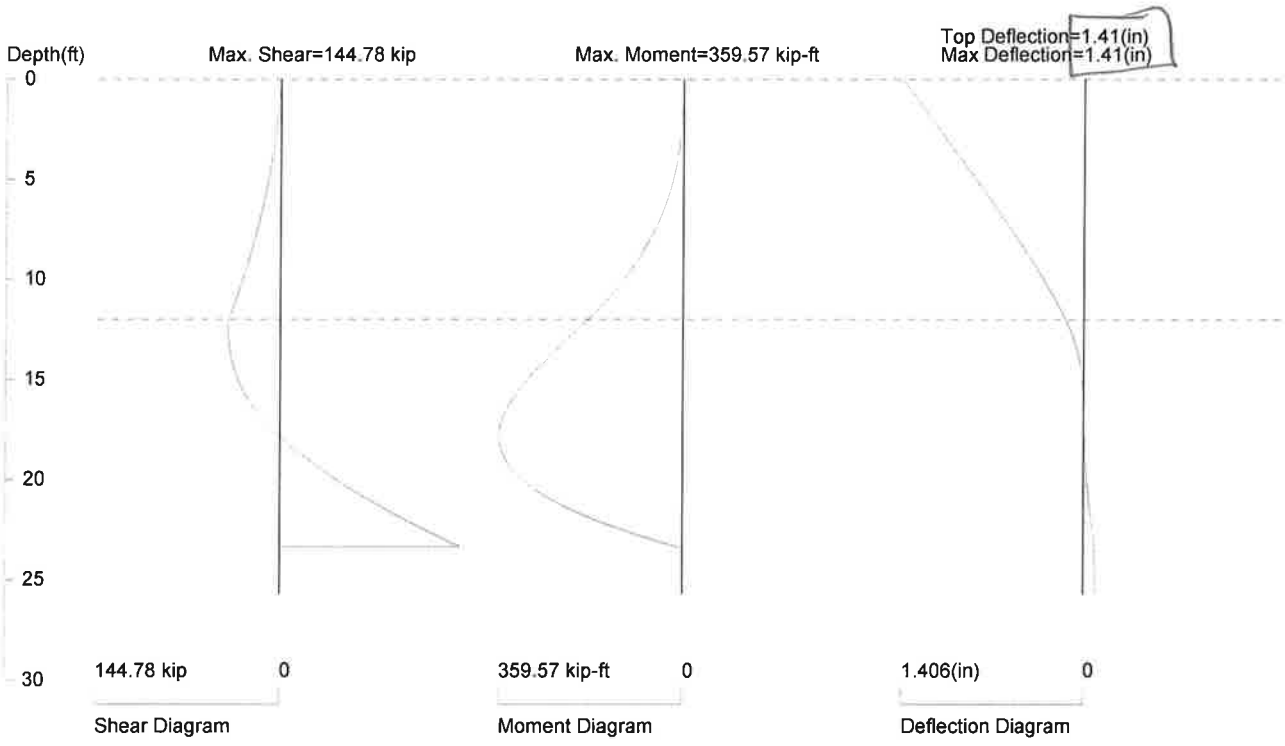
No.	Z depth	Spacing
1	12.00	7.50

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

Summit 8 Receiving Pit

Tieback Wall (Step 1 Cantilever) (Service)





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 10.0 foot or meter

User Input Pile, W14X90: E (ksi)=29000.0, I (in4)/pile=999.0

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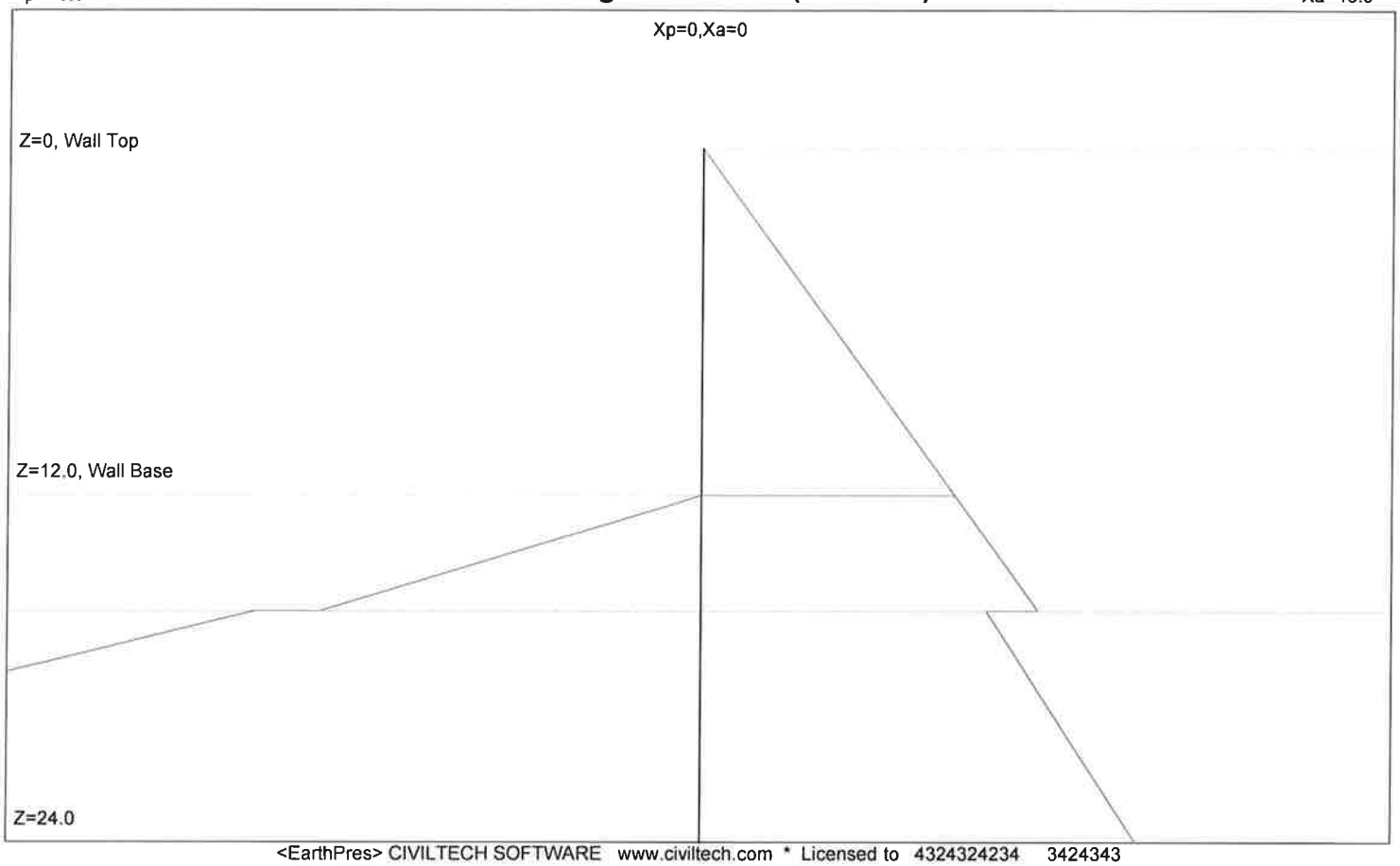
Summit 8 Receiving Pit

Launching Pit Soils 12' (Factored)



UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/28/2019 File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soil Pressures 12' Factored.ep8

* INPUT DATA *

Wall Height=12.0 Total Soil Types= 2

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	135.0	30	0.0	0	4	Fill
2	125.0	135.0	34	0.0	0	4	Sand

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	Fill
2	16.0	0.0	16.0	800.0	2	Sand

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	12.0	0.0	12.0	800.0	1	Fill
2	16.0	0.0	16.0	800.0	2	Sand

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 6. No Water Table

* OUTPUT RESULTS *

Total Force above Base= 4.32 per one linear foot (or meter) width along wall height
Total Static Force above Base= 4.32

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.5

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	12.00	0.72	0.0600	0.5000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.5

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
12.00	0.72	16.00	0.96	0.0600	0.5000
16.00	0.81	24.00	1.24	0.0533	0.4268

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
12.00	0.00	16.00	1.08	0.270	2.2500
16.00	1.26	24.00	3.93	0.333	2.6632

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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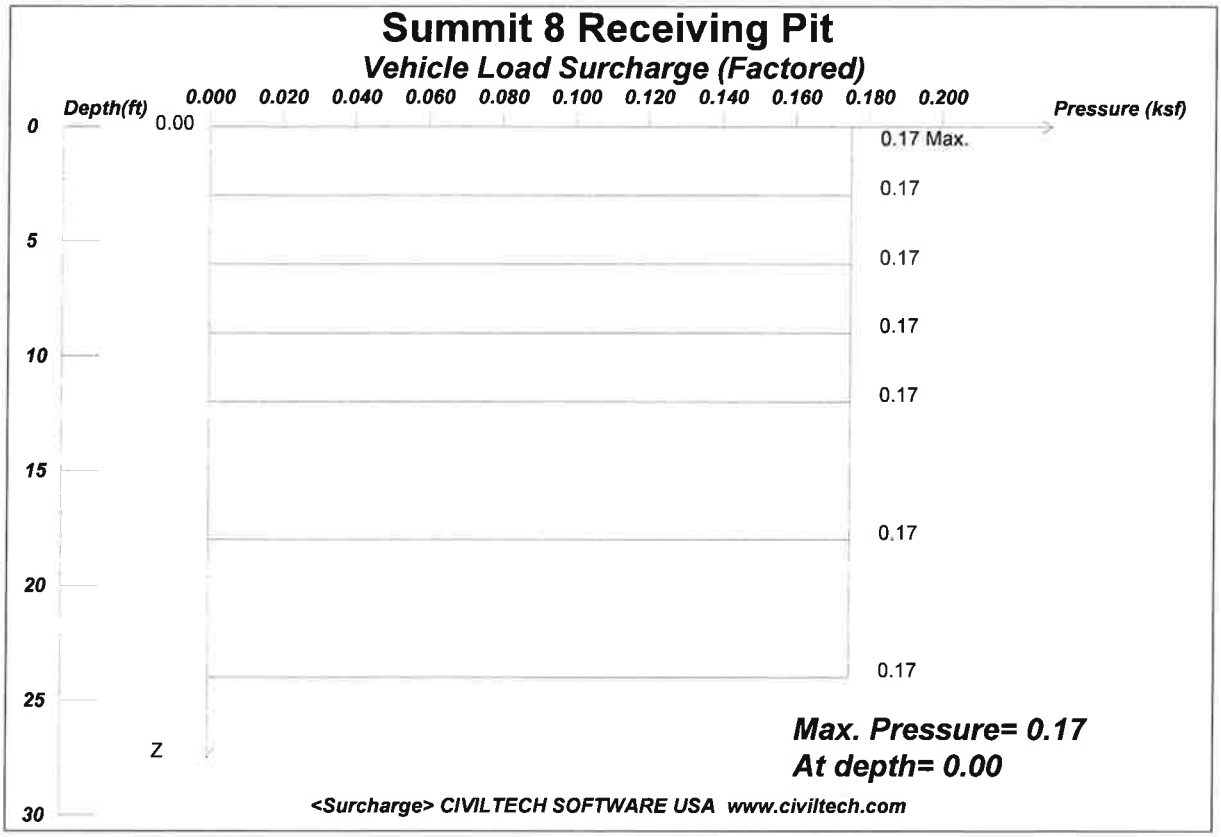

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Date: 8/28/2019 File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Vehicle Load Surc

Wall Height, H= 12 Load Depth at Surface, D= 0

Load Factor of Surcharge Loading = 1.75

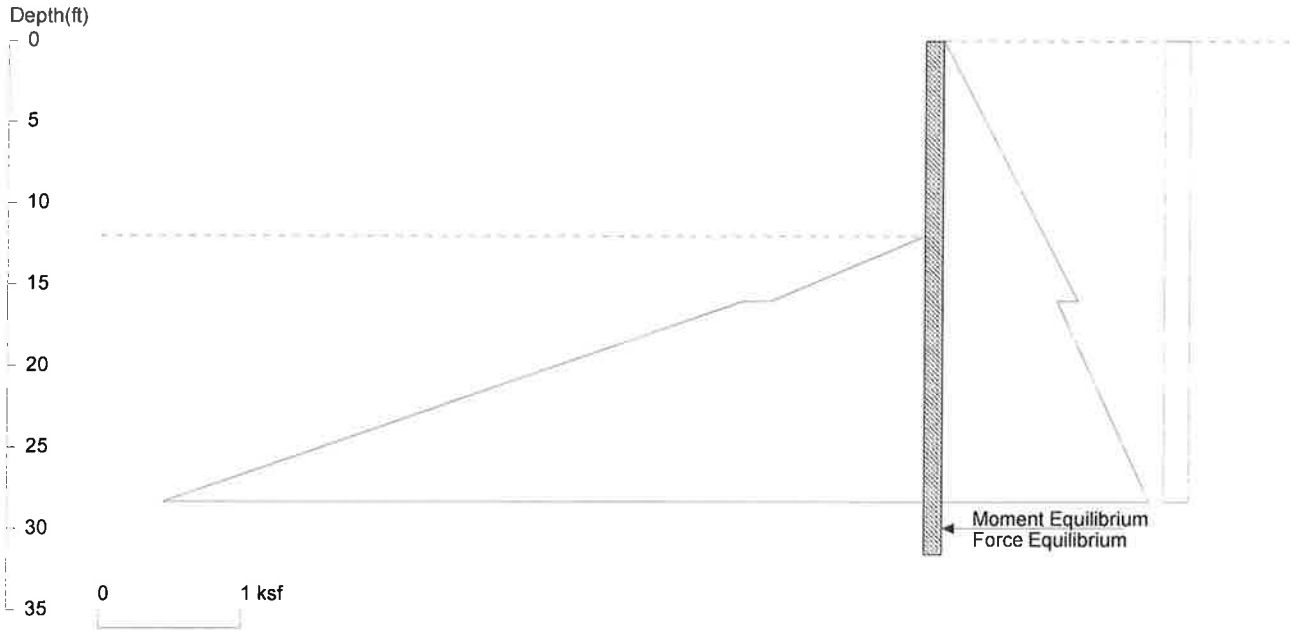
Semi-flexible Wall Condition -- Small movement or deflection are allowed.

Max. Pressure = 0.175 at depth = 0.00

Infinite Surcharge, Q=.240 Active Wedge Approach * (recommend)

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

Summit 8 Receiving Pit
Tieback Wall (Step 1 Cantilever) (Strength)



Licensed to 4324324234 3424343 Date: 8/28/2019

File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soldier Pile Wall 12' Strength.sh8

Wall Height=12.0 Pile Diameter=2.5 Pile Spacing=10.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=19.58 Min. Pile Length=31.58 Will be > 32' into rock
MOMENT IN PILE: Max. Moment=708.01 per Pile Spacing=10.0 at Depth=20.64

PILE SELECTION:
Request Min. Section Modulus = 257.5 in3/pile=4218.94 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
W14X90 has Section Modulus = 143.0 in3/pile=2343.34 cm3/pile. It is less than Min. Requirements!

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	12.000	0.720	0.060000
*	Below	Base		
12.000	0.720	16.000	0.960	0.060000
16.000	0.813	108.000	5.691	0.053021
*	Sur-	charge		
0.000	0.175	0.600	0.175	0.000000
0.600	0.175	1.200	0.175	0.000000
1.200	0.175	1.800	0.175	0.000000
1.800	0.175	2.400	0.175	0.000000
2.400	0.175	3.000	0.175	0.000000
3.000	0.175	3.600	0.175	0.000000
3.600	0.175	4.200	0.175	0.000000
4.200	0.175	4.800	0.175	0.000000
4.800	0.175	5.400	0.175	0.000000
5.400	0.175	6.000	0.175	0.000000
6.000	0.175	6.600	0.175	0.000000
6.600	0.175	7.200	0.175	0.000000
7.200	0.175	7.800	0.175	0.000000

7.800	0.175	8.400	0.175	0.000000
8.400	0.175	9.000	0.175	0.000000
9.000	0.175	9.600	0.175	0.000000
9.600	0.175	10.200	0.175	0.000000
10.200	0.175	10.800	0.175	0.000000
10.800	0.175	11.400	0.175	0.000000
11.400	0.175	12.000	0.175	0.000000
12.000	0.175	13.200	0.175	0.000000
13.200	0.175	14.400	0.175	0.000000
14.400	0.175	15.600	0.175	0.000000
15.600	0.175	16.800	0.175	0.000000
16.800	0.175	18.000	0.175	0.000000
18.000	0.175	19.200	0.175	0.000000
19.200	0.175	20.400	0.175	0.000000
20.400	0.175	21.600	0.175	0.000000
21.600	0.175	22.800	0.175	0.000000
22.800	0.175	24.000	0.175	0.000000
24.000	0.175	26.400	0.175	0.000000
26.400	0.175	28.800	0.175	0.000000
28.800	0.175	31.200	0.175	0.000000
31.200	0.175	33.600	0.175	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
12.000	0.000	16.000	1.080	0.270000
16.000	1.272	36	7.905	0.331625

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	10.00
2	12.00	2.50

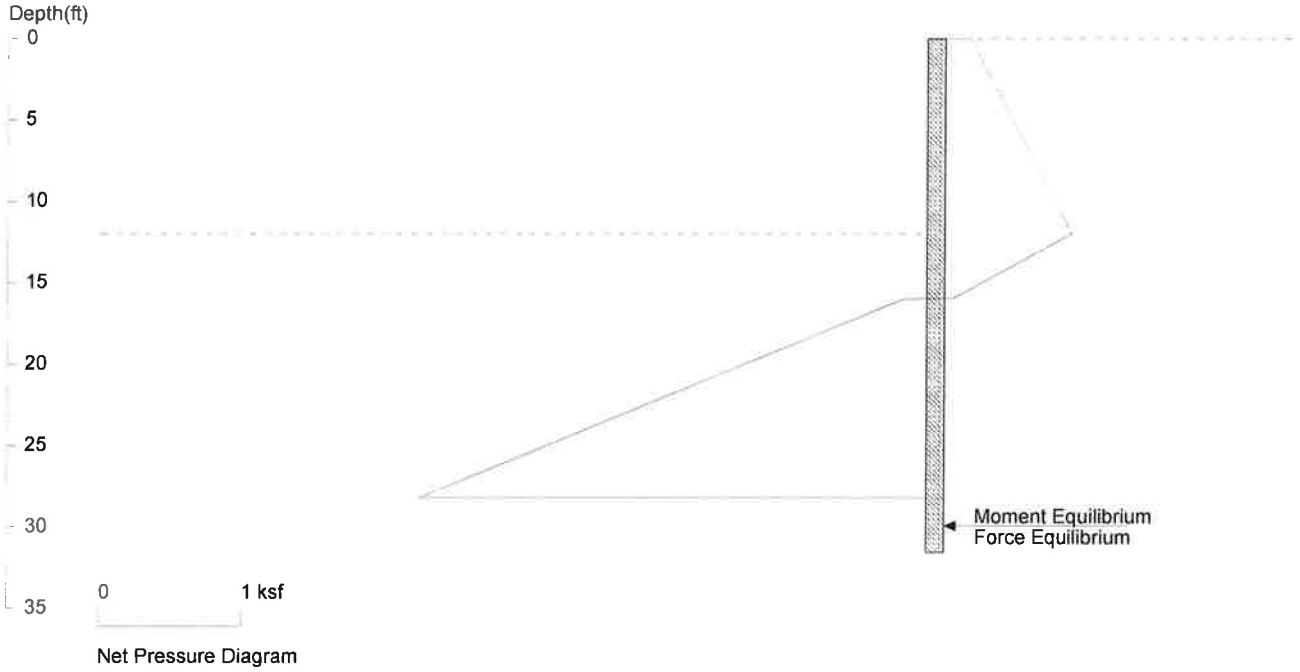
PASSIVE SPACING:

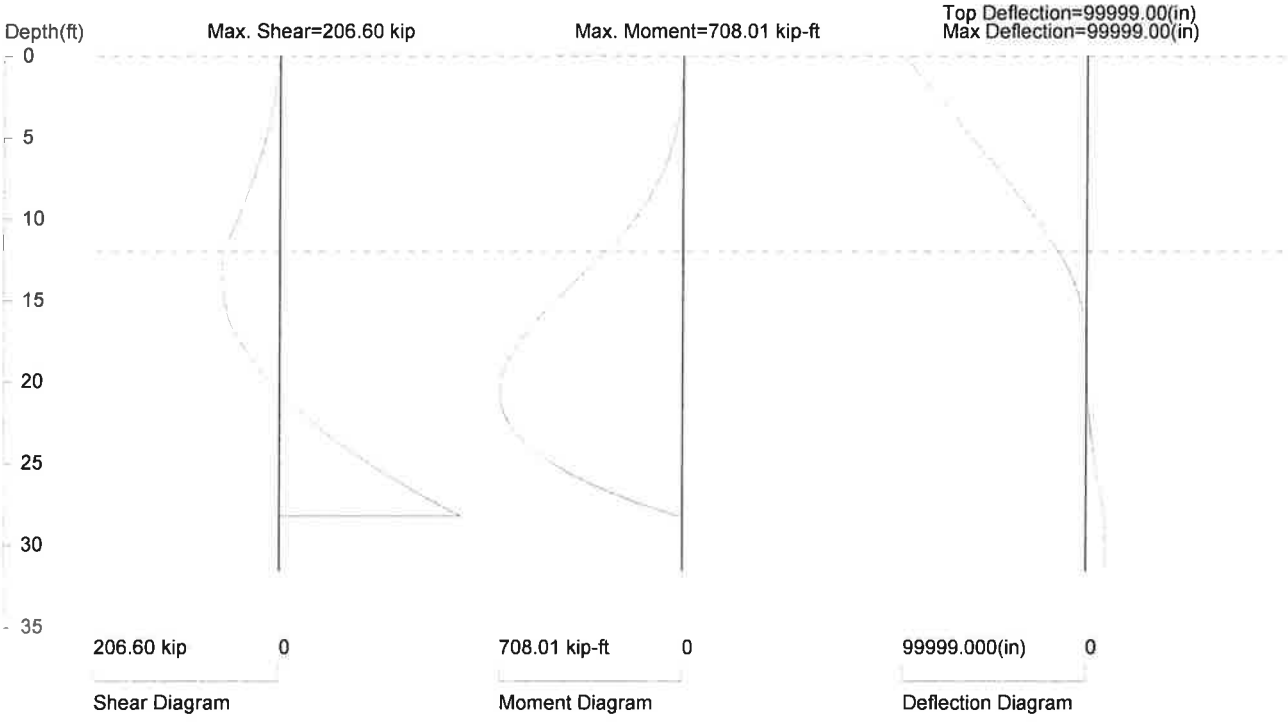
No.	Z depth	Spacing
1	12.00	7.50

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

Summit 8 Receiving Pit

Tieback Wall (Step 1 Cantilever) (Strength)





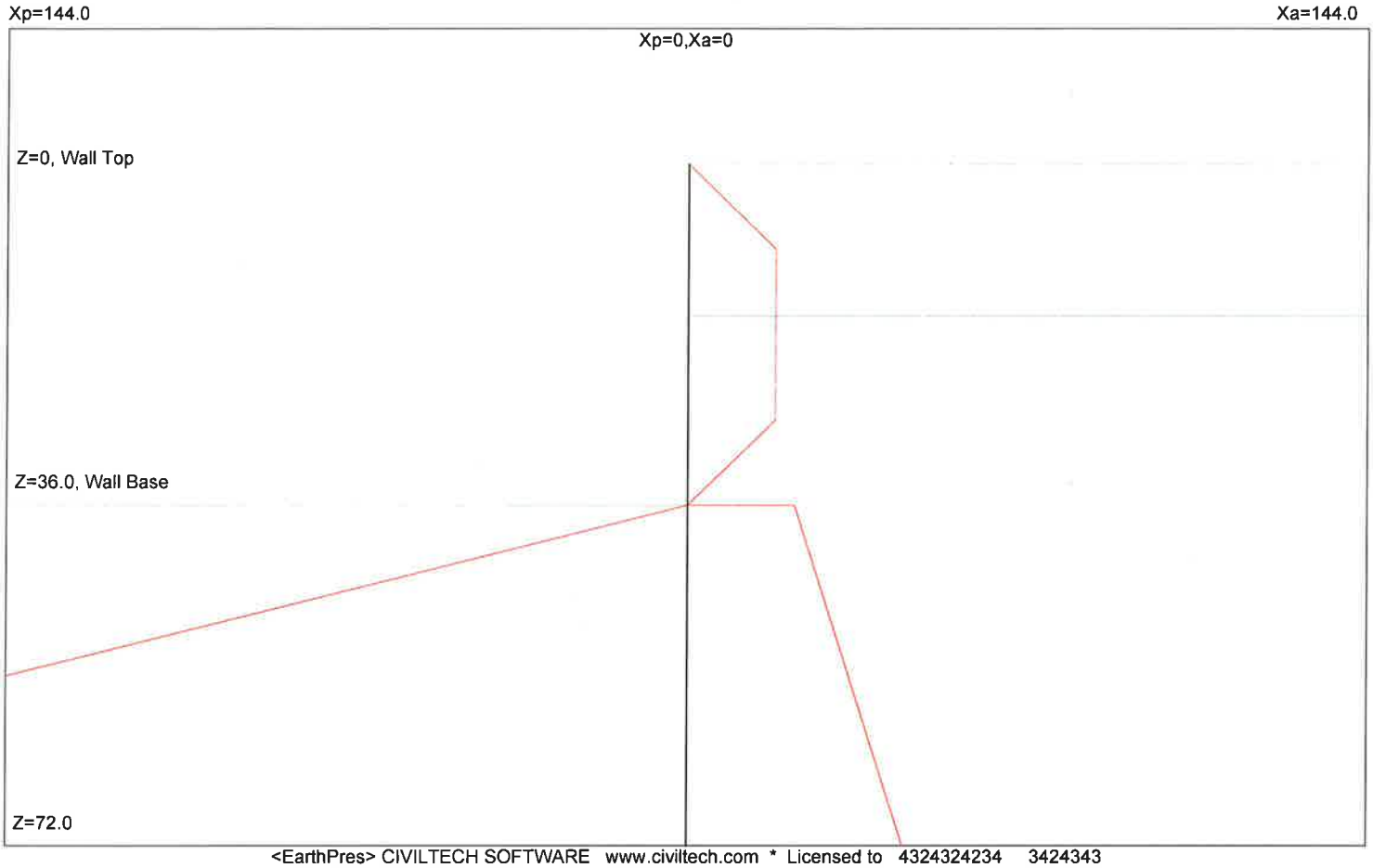
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 10.0 foot or meter

User Input Pile, W14X90 can't meet Section Requirements.: E (ksi)=29000.0, I (in4)/pile=99999.0

File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soldier Pile Wall 12' Strength.sh8

Summit 8 Receiving Pit
Soil Pressures 36' (Unfactored)



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf
Date: 8/28/2019 File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soil Pressures 36' Unfactored.ep8

* INPUT DATA *

Wall Height=36.0 Total Soil Types= 2

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	135.0	30	0.0	0	4	Fill
2	125.0	135.0	34	0.0	0	4	Sand

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	Fill
2	16.0	0.0	16.0	800.0	2	Sand

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	36.0	0.0	36.0	800.0	2	Sand

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 6. No Water Table

* OUTPUT RESULTS *

Total Force above Base= 23.03 per one linear foot (or meter) width along wall height
Total Static Force above Base= 23.03. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	9.00	1.02	0.1137	0.9476
9.00	1.02	27.00	1.02	0.0000	0.0000
27.00	1.02	36.00	0.00	-0.1137	-0.9097

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

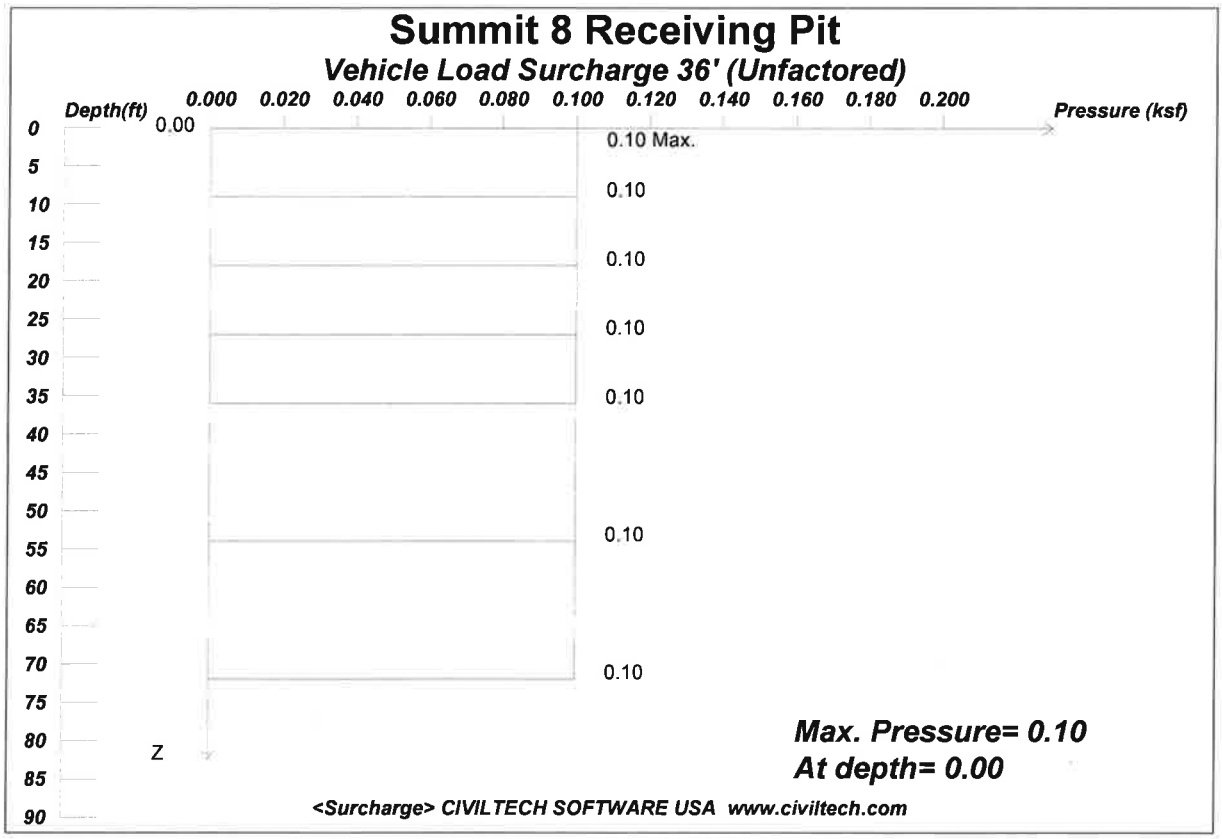
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
36.00	1.25	72.00	2.52	0.0353	0.2827

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
36.00	0.00	72.00	15.92	0.442	3.5371

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/28/2019 File Name: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soil Pressures 36' Unfactored.ep8



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Date: 8/28/2019 File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Vehicle Load Surc

Wall Height, H= 36 Load Depth at Surface, D= 0

Load Factor of Surcharge Loading = 1

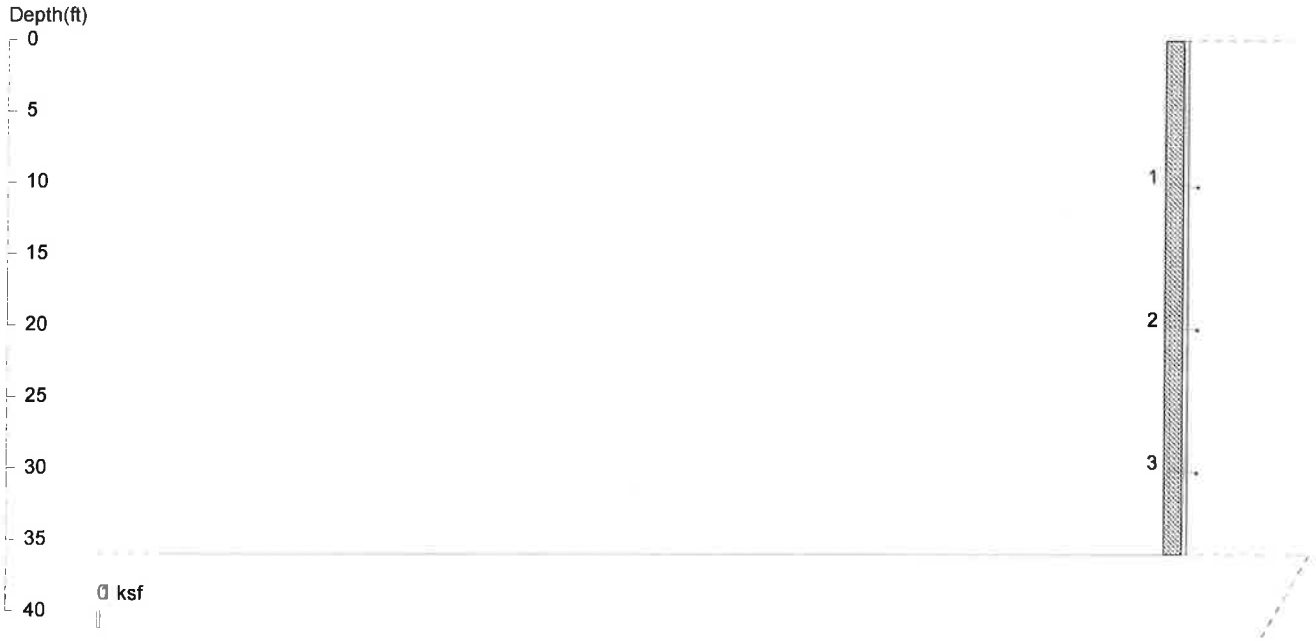
Semi-flexible Wall Condition -- Small movement or deflection are allowed.

Max. Pressure = 0.100 at depth = 0.00

Infinite Surcharge, Q=.240 Active Wedge Approach * (recommend)

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

Summit 8 Receiving Pit
Tieback Wall 36' (Final) (Unfactored)



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File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soldier Pile Run 36' Service.sh8

Wall Height=36.0 Pile Diameter=2.5 Pile Spacing=10.0 Wall Type: 2. Soldier Pile, Drilled

EMBED 5' MIN.

PILE LENGTH: Min. Embedment=0.01 (5~10ft is recommended!!!) Min. Pile Length=36.01

MOMENT IN PILE: Max. Moment=238.19 per Pile Spacing=10.0 at Depth=10.01

PILE SELECTION:

Request Min. Section Modulus = 86.6 in3/pile=1419.36 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

HP14X89 has Section Modulus = 131.0 in3/pile=2146.70 cm3/pile. It is greater than Min. Requirements!

Top Deflection = 0.45(in) based on E (ksi)=29000.00 and I (in4)/pile=904.0

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	10.0	15.0	10.0	151.5	146.4	39.2	21.5	32.2
2. Tieback	20.0	15.0	10.0	90.9	87.8	23.5	16.4	19.3
3. Tieback	30.0	15.0	10.0	70.7	68.3	18.3	11.2	15.0

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
*	Above	Base		
0.000	0.000	9.000	1.023	0.113716
9.000	1.023	27.00	1.023	0.000000
27.00	1.023	36.00	0.000	-0.11371
*	Below	Base		
36.00	1.250	252.0	8.883	0.035339
*	Sur-	charg		
0.000	0.100	1.800	0.100	0.000000
1.800	0.100	3.600	0.100	0.000000
3.600	0.100	5.400	0.100	0.000000
5.400	0.100	7.200	0.100	0.000000

7.200	0.100	9.000	0.100	0.000000
9.000	0.100	10.80	0.100	0.000000
10.80	0.100	12.60	0.100	0.000000
12.60	0.100	14.40	0.100	0.000000
14.40	0.100	16.20	0.100	0.000000
16.20	0.100	18.00	0.100	0.000000
18.00	0.100	19.80	0.100	0.000000
19.80	0.100	21.60	0.100	0.000000
21.60	0.100	23.40	0.100	0.000000
23.40	0.100	25.20	0.100	0.000000
25.20	0.100	27.00	0.100	0.000000
27.00	0.100	28.80	0.100	0.000000
28.80	0.100	30.60	0.100	0.000000
30.60	0.100	32.40	0.100	0.000000
32.40	0.100	34.20	0.100	0.000000
34.20	0.100	36.00	0.100	0.000000
36.00	0.100	39.60	0.100	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
36.00	299	46	299	0.0000

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	10.00
2	36.00	2.50

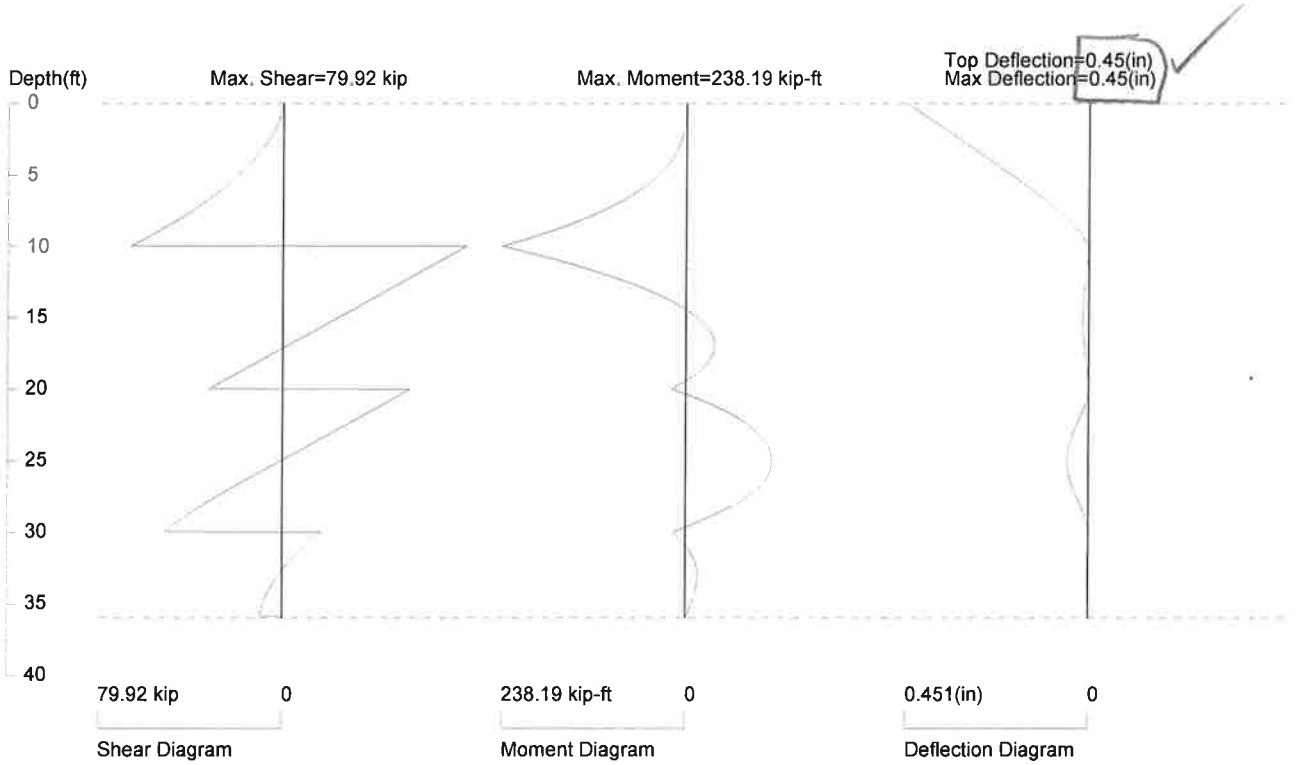
PASSIVE SPACING:

No.	Z depth	Spacing
1	36.00	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

Summit 8 Receiving Pit
Tieback Wall 36' (Final) (Unfactored)

Net Pressure Diagram



Shear Diagram | Moment Diagram | Deflection Diagram

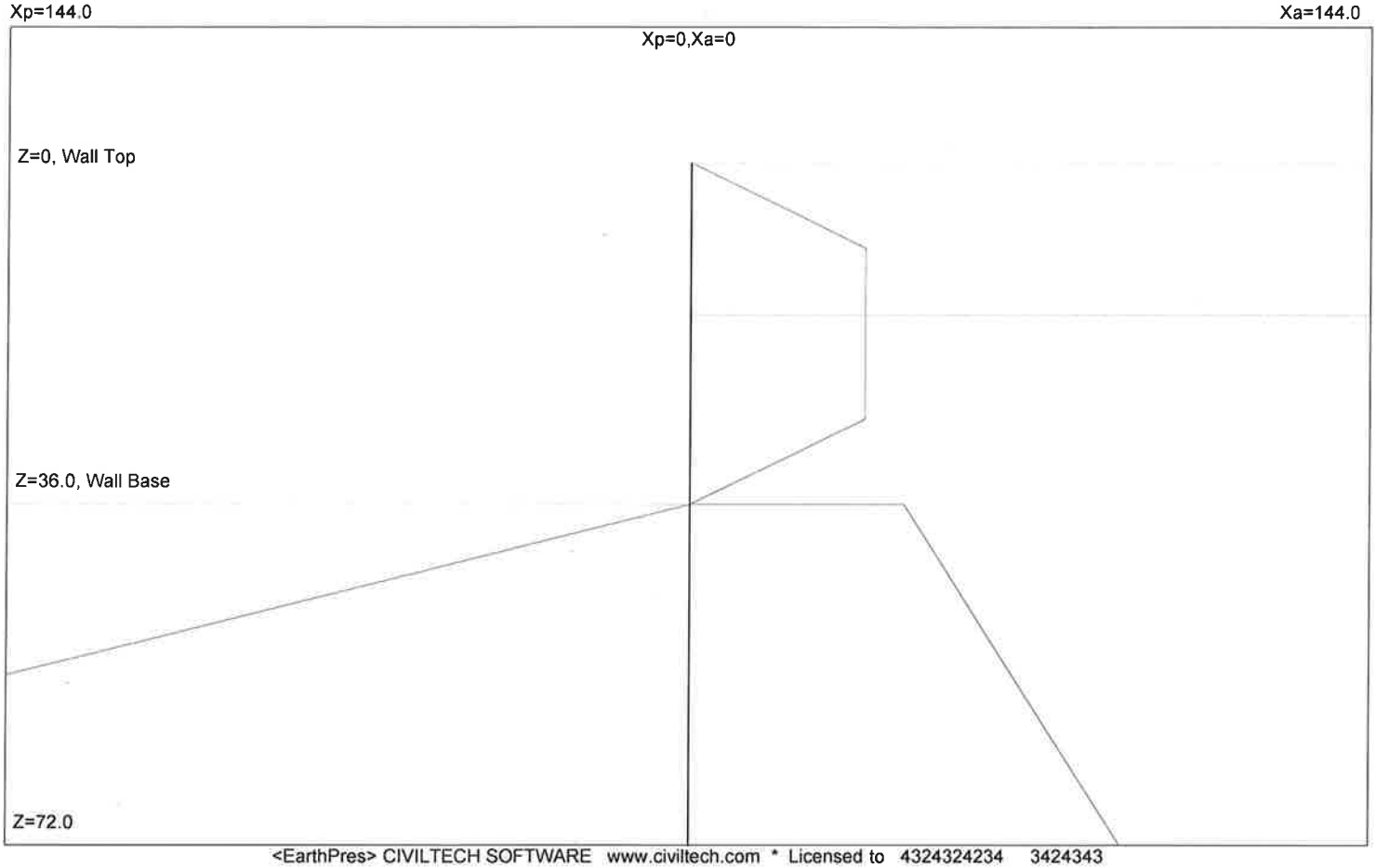
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 10.0 foot or meter

User Input Pile, HP14X89: E (ksi)=29000.0, I (in4)/pile=904.0

File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soldier Pile Run 36' Service.sh8

Summit 8 Receiving Pit
Soil Pressures 36' (Factored)



UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/28/2019 File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soil Pressures 36' Factored.ep8

* INPUT DATA *

Wall Height=36.0 Total Soil Types= 2

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	135.0	30	0.0	0	4	Fill
2	125.0	135.0	34	0.0	0	4	Sand

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	Fill
2	16.0	0.0	16.0	800.0	2	Sand

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	36.0	0.0	36.0	800.0	2	Sand

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 6. No Water Table

* OUTPUT RESULTS *

Total Force above Base= 34.54 per one linear foot (or meter) width along wall height
Total Static Force above Base= 34.54. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.5

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	9.00	1.54	0.1706	1.4214
9.00	1.54	27.00	1.54	0.0000	0.0000
27.00	1.54	36.00	0.00	-0.1706	-1.3646

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.5

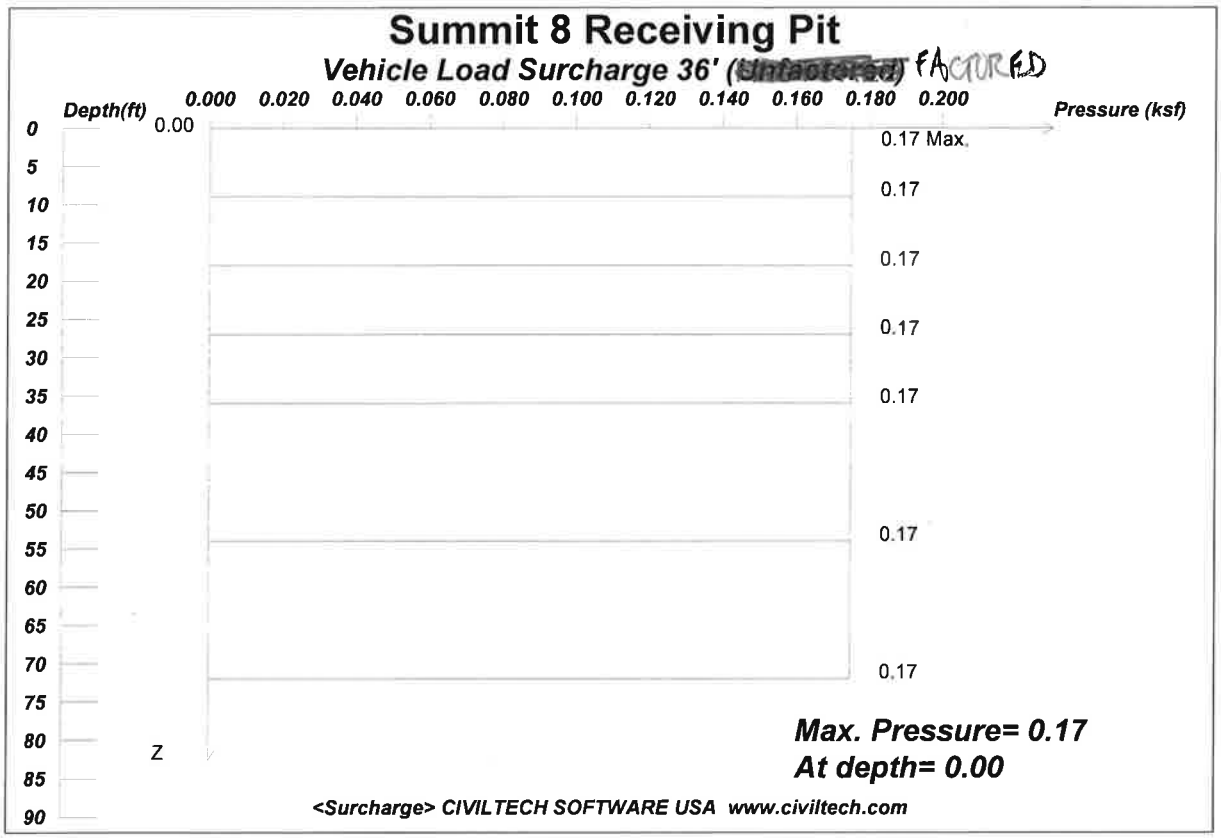
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
36.00	1.87	72.00	3.78	0.0530	0.4241

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
36.00	0.00	72.00	11.94	0.332	2.6528

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/28/2019 File Name: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soil Pressures 36' Factored.ep8



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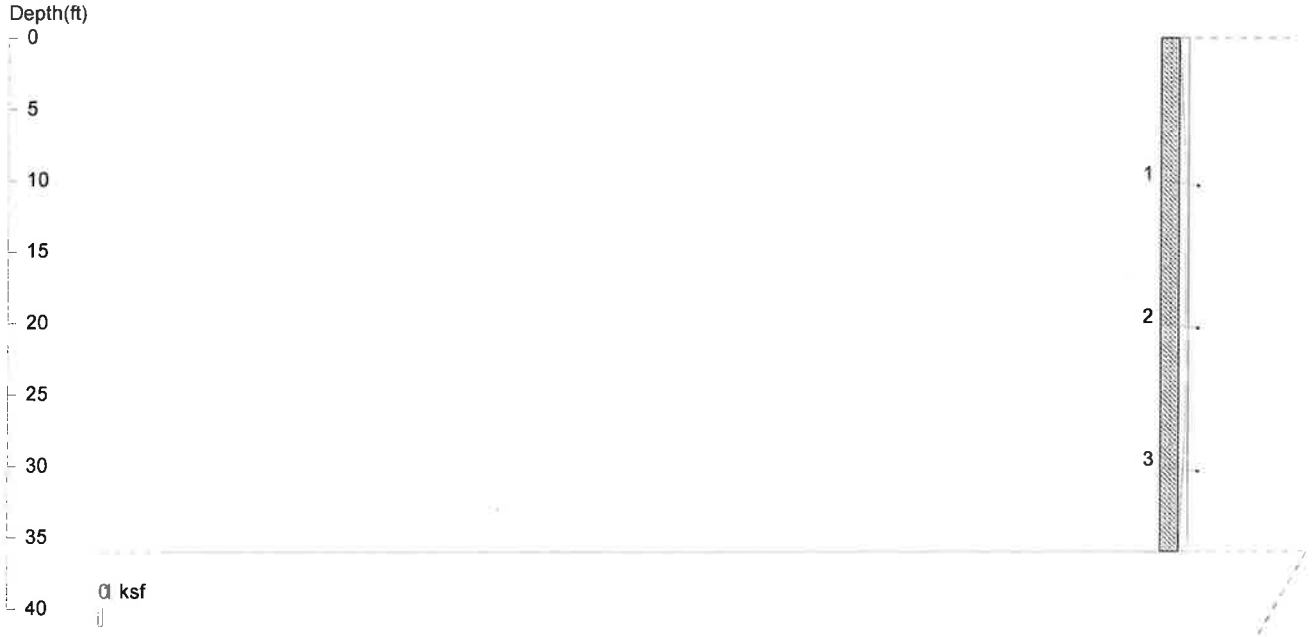
Date: 8/28/2019 File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Vehicle Load Surc

Wall Height, H= 36 Load Depth at Surface, D= 0
Load Factor of Surcharge Loading = 1.75
Semi-flexible Wall Condition -- Small movement or deflection are allowed.
Max. Pressure = 0.175 at depth = 0.00

Infinite Surcharge, Q=.240 Active Wedge Approach * (recommend)

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

Summit 8 Receiving Pit
Tieback Wall 36' (Final) (Strength)



Licensed to 4324324234 3424343 Date: 8/28/2019

File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soldier Pile Run 36' Strength.sh8

Wall Height=36.0 Pile Diameter=2.5 Pile Spacing=10.0 Wall Type: 2. Soldier Pile, Drilled

← EMBED. 5' MIN.

PILE LENGTH: Min. Embedment=0.01 (5~10ft is recommended!!!) Min. Pile Length=36.01

MOMENT IN PILE: Max. Moment=369.50 per Pile Spacing=10.0 at Depth=10.02

PILE SELECTION:

Request Min. Section Modulus = 134.4 in3/pile=2201.83 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

HP14X89 has Section Modulus = 131.0 in3/pile=2146.70 cm3/pile. It is less than Min. Requirements!

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	10.0	15.0	10.0	232.5	224.6	60.2	21.5	49.3
2. Tieback	20.0	15.0	10.0	137.7	133.0	35.6	16.4	29.2
3. Tieback	30.0	15.0	10.0	108.2	104.5	28.0	11.2	23.0

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
*	Above	Base		
0.000	0.000	9.000	1.535	0.170574
9.000	1.535	27.000	1.535	0.000000
27.000	1.535	36.000	0.000	-0.170574
*	Below	Base		
36.000	1.874	252.000	13.324	0.053009
*	Sur-	charge		
0.000	0.175	1.800	0.175	0.000000
1.800	0.175	3.600	0.175	0.000000
3.600	0.175	5.400	0.175	0.000000
5.400	0.175	7.200	0.175	0.000000
7.200	0.175	9.000	0.175	0.000000

9.000	0.175	10.800	0.175	0.000000
10.800	0.175	12.600	0.175	0.000000
12.600	0.175	14.400	0.175	0.000000
14.400	0.175	16.200	0.175	0.000000
16.200	0.175	18.000	0.175	0.000000
18.000	0.175	19.800	0.175	0.000000
19.800	0.175	21.600	0.175	0.000000
21.600	0.175	23.400	0.175	0.000000
23.400	0.175	25.200	0.175	0.000000
25.200	0.175	27.000	0.175	0.000000
27.000	0.175	28.800	0.175	0.000000
28.800	0.175	30.600	0.175	0.000000
30.600	0.175	32.400	0.175	0.000000
32.400	0.175	34.200	0.175	0.000000
34.200	0.175	36.000	0.175	0.000000
36.000	0.175	39.600	0.175	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
36	224	46	224	0.0000

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	10.00
2	36.00	2.50

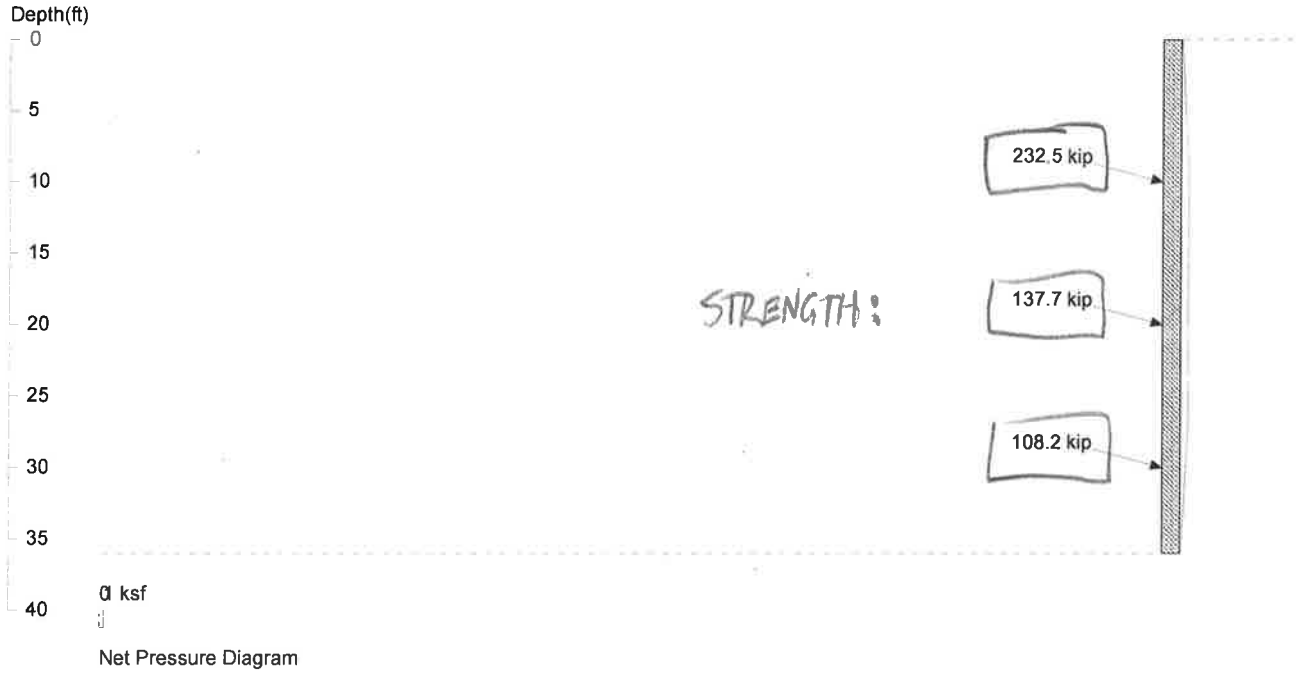
PASSIVE SPACING:

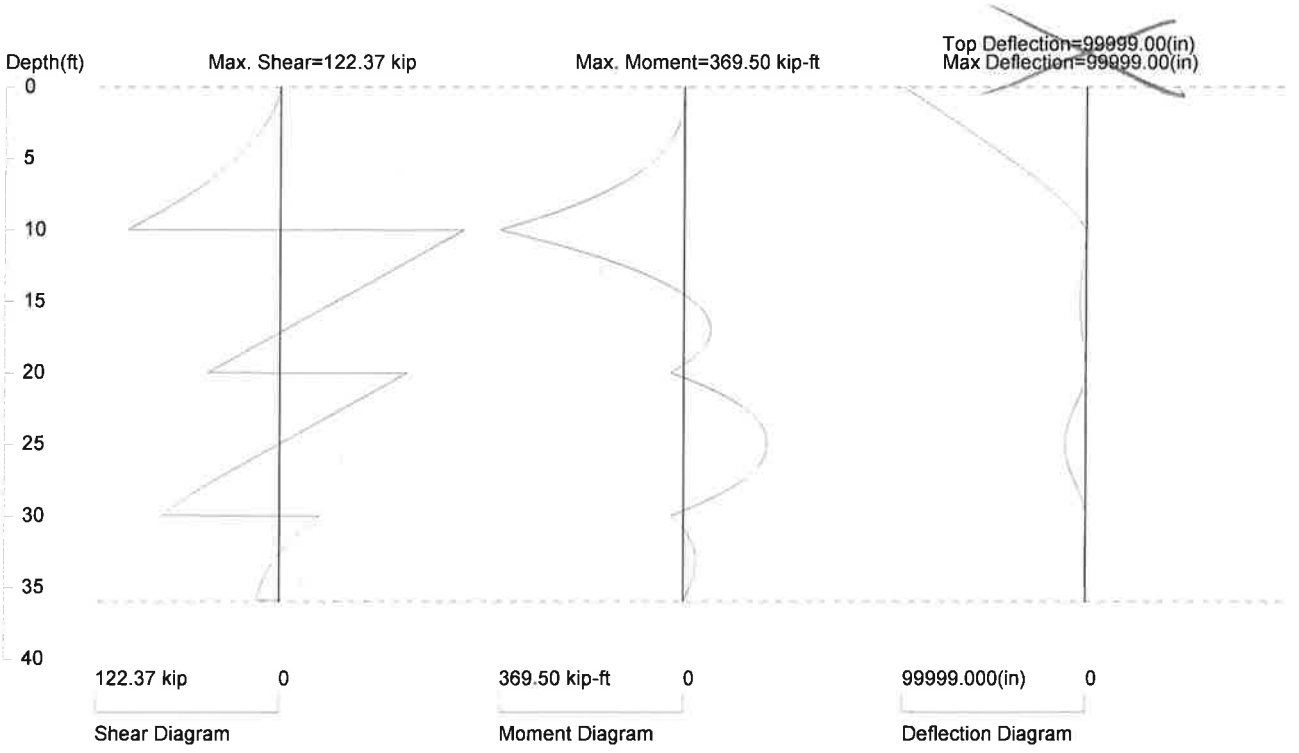
No.	Z depth	Spacing
1	36.00	5.00

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

Summit 8 Receiving Pit

Tieback Wall 36' (Final) (Strength)





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 10.0 foot or meter

User Input Pile, HP14X89 can't meet Section Requirements.: E (ksi)=29000.0, I (in4)/pile=99999.0

File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soldier Pile Run 36' Strength.sh8

JOB No.: 60-08326
PROJECT: SUMMIT 8
SUBJECT: ANCHORED TIE BACK SOLDIER PILE WALL
TOP ANCHOR OF 36' CUT LOCATION
DESIGN: J. SANGIORGIO DATE: 28-Aug-19 CHECK: _____ DATE: _____

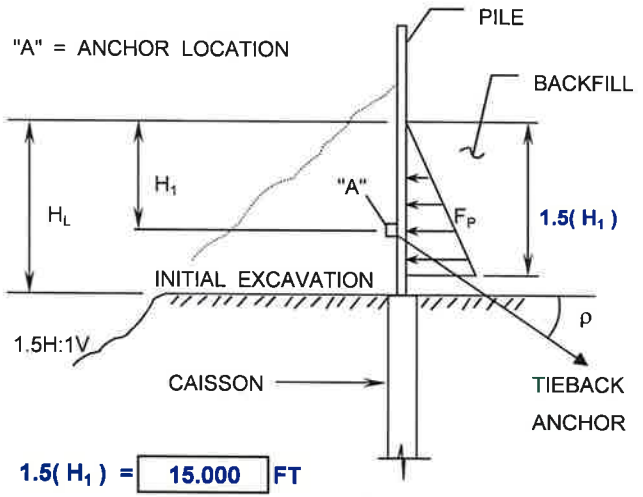
Ref.: Publication No. FHWA-IF-99-015, June 1999; Geotechnical Engineering Circular No. 4: "Ground Anchors and Anchored Systems"

CHECK THE PASSIVE RESISTANCE OF THE EXISTING SOIL NEEDED FOR FULL ANCHOR LOAD :
USE BACKFILL ELEVATION AT EL. 1036.00

ANCHOR IS LOCATED AT EL. 1026.00

α	=	90	Degrees	= 1.5708	radians	(Back of Wall Angle; For vertical face, α = 90°)
δ	=	15	Degrees	= 0.2618	radians	(Assumed Friction Angle Between Existing Fill and Permanent Wall Lagging)
ϕ	=	30	Degrees	= 0.5236	radians	(Effective Angle of Friction for Existing Fill)
β	=	0.00	Degrees	= 0.0000	radians	(Sloping Angle of Ground or Backfill behind wall at time of stressing)
ρ	=	15	Degrees	= 0.2618	radians	(Anchor Angle measured from horizontal)
γ	=	120.0	PCF, (Unit Weight of Fill)			
s	=	10.00	FT, (Caisson / Pile Spacing)			
H_1	=	10.00	FT, (Distance to Anchor from T/ Fill)			
H_L	=	36.00	FT, (Depth of Fill)			
T_A	=	151.50	KIPS, (Maximum Anchor Load, Service I)			

TLF = 1.33 (Performance Test Load Factor, BD-626M / Note 11)



UTILIZE COULOMB'S EQUATION FOR CALCULATING K_p :

$$K_p = \frac{\sin^2(\alpha - \phi)}{\sin^2\alpha \sin(\alpha+\delta)\left[1 - \sqrt{\frac{\sin(\phi+\delta)\sin(\phi+\beta)}{\sin(\alpha+\delta)\sin(\alpha+\beta)}}\right]^2}$$

K_p = 4.977

F_p = $[(1/2) \times (K_p)(\gamma)(1.5H_1)^2(s)]$ = $1.125(K_p)(\gamma)(H_1)^2(s)$

F_p = 671.83 KIPS

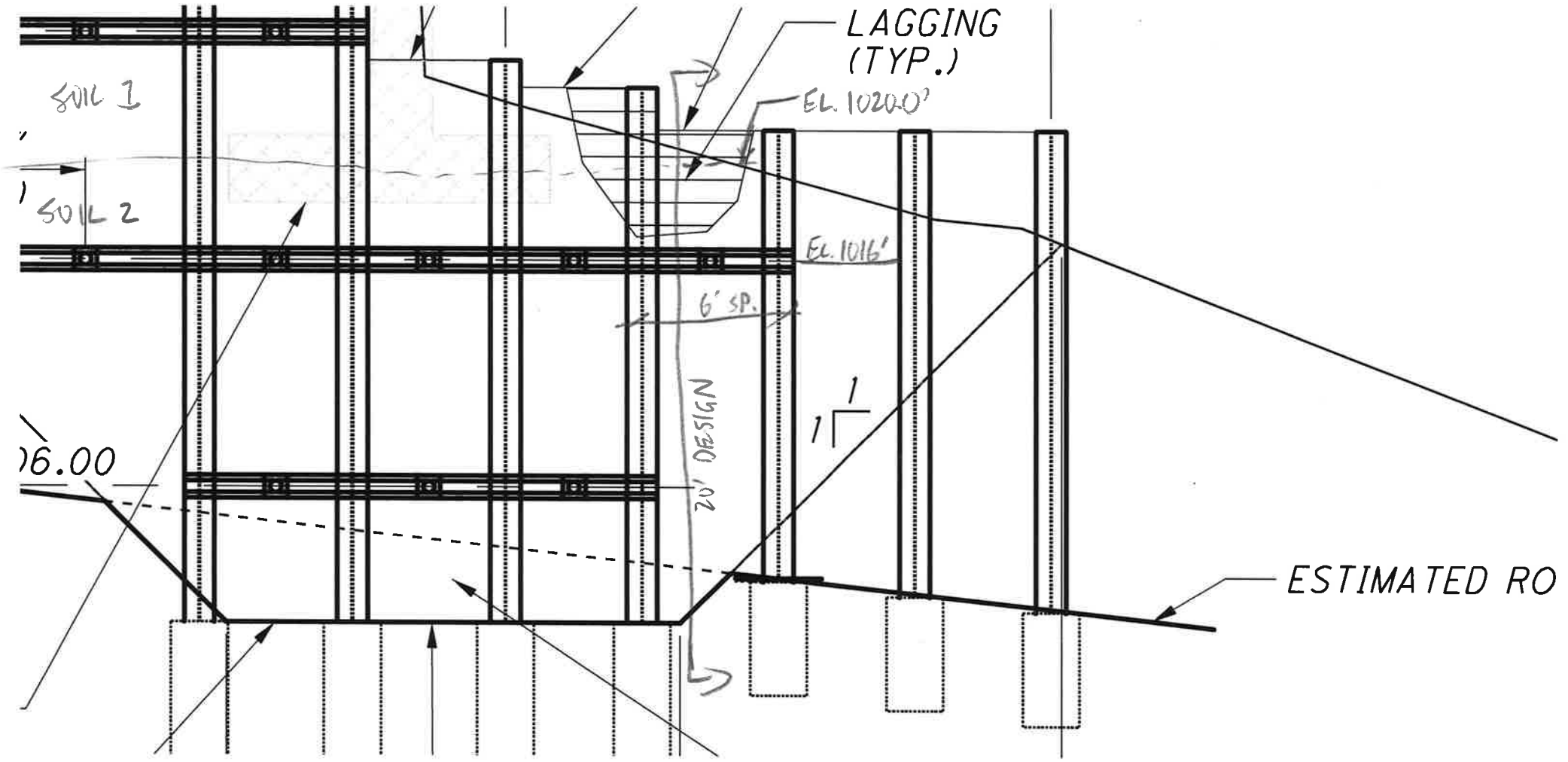
1.5(H_1) = 15.000 FT

H_L = 36.000 FT > 1.5(H_1) OK

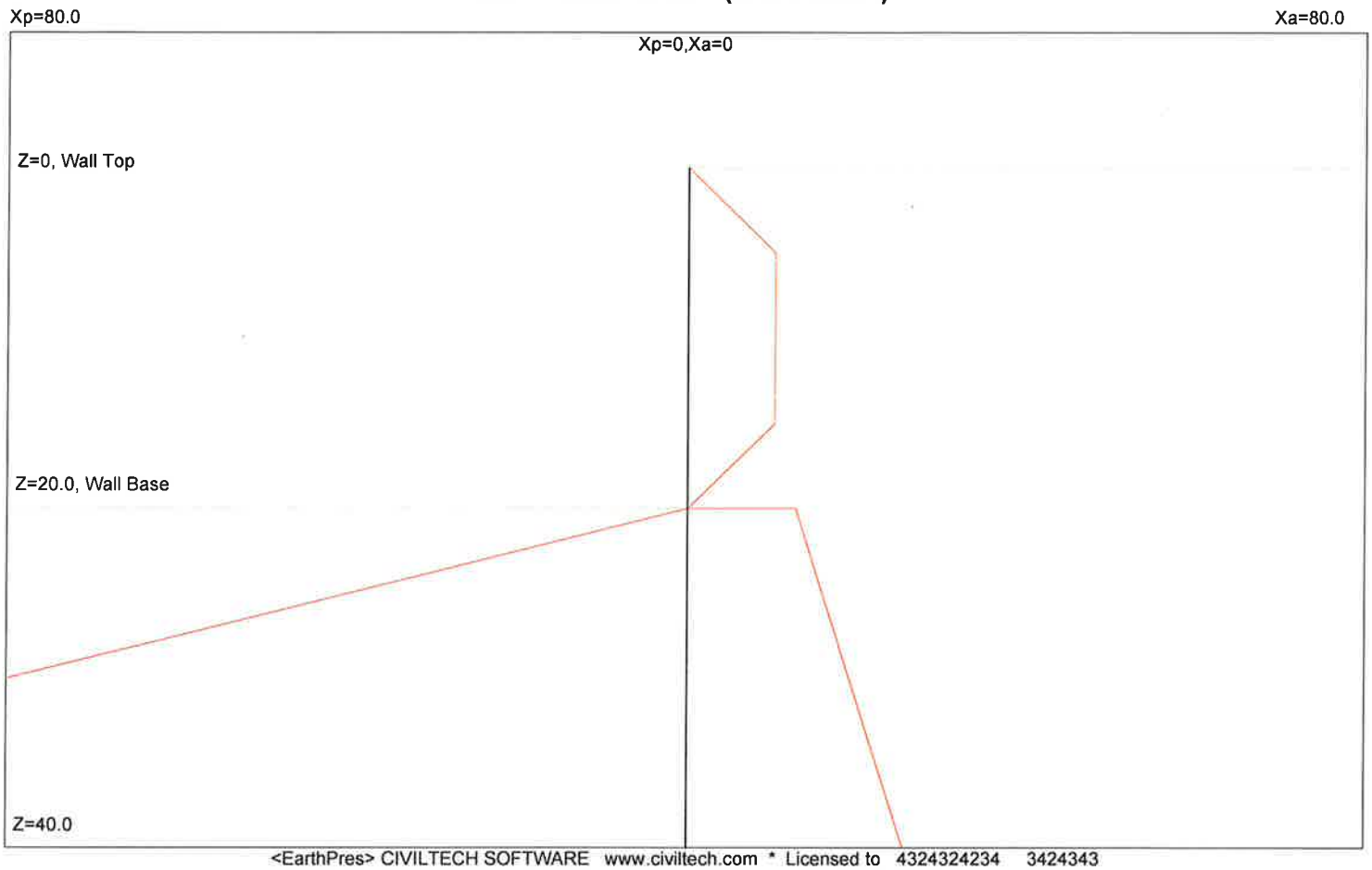
FACTOR OF SAFETY = (F_p) / [(Maximum Anchor Load) x (cos ρ) x (Test Load Factor)] > 1.50, (AS PER FHWA-IF-99-015)

FACTOR OF SAFETY (F.S.) = 3.45 > 1.50 OK

CHECKING MOST SHALLOW ANCHOR



Summit 8 Receiving Pit
Soil Pressures 20' (Unfactored)



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf
Date: 8/29/2019 File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soil Pressures 20' Unfactored.ep8

* INPUT DATA *

Wall Height=20.0 Total Soil Types= 2

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	135.0	30	0.0	0	4	Fill
2	125.0	135.0	34	0.0	0	4	Sand

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	2	Sand

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	20.0	0.0	20.0	800.0	2	Sand

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 6. No Water Table

* OUTPUT RESULTS *

Total Force above Base= 7.07 per one linear foot (or meter) width along wall height
Total Static Force above Base= 7.07. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	5.00	0.57	0.1131	0.9047
5.00	0.57	15.00	0.57	0.0000	0.0000
15.00	0.57	20.00	0.00	-0.1131	-0.9047

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

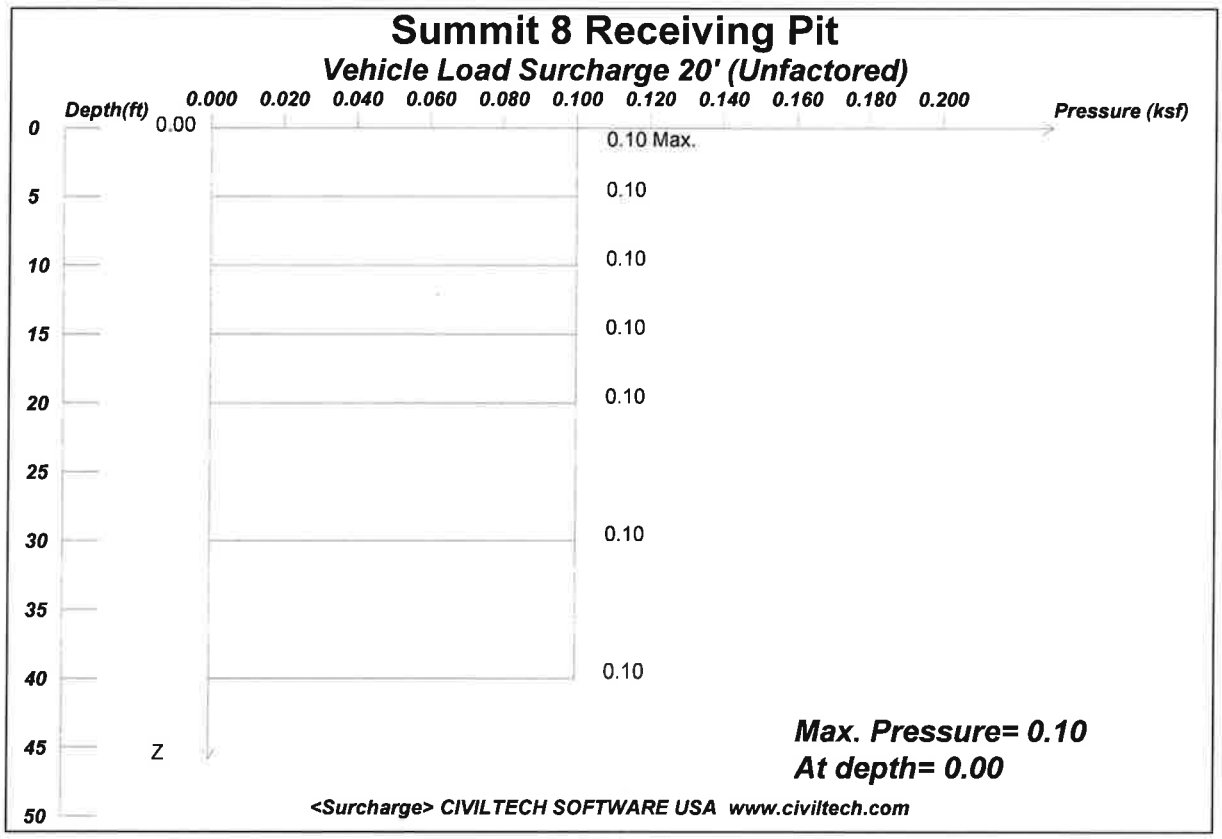
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
20.00	0.71	40.00	1.41	0.0353	0.2827

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
20.00	0.00	40.00	8.84	0.442	3.5371

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/29/2019 File Name: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soil Pressures 20' Unfactored.ep8



Licensed to 4324324234 3424343

Date: 8/29/2019 File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Vehicle Load Surc

Wall Height, H= 20 Load Depth at Surface, D= 0

Load Factor of Surcharge Loading = 1

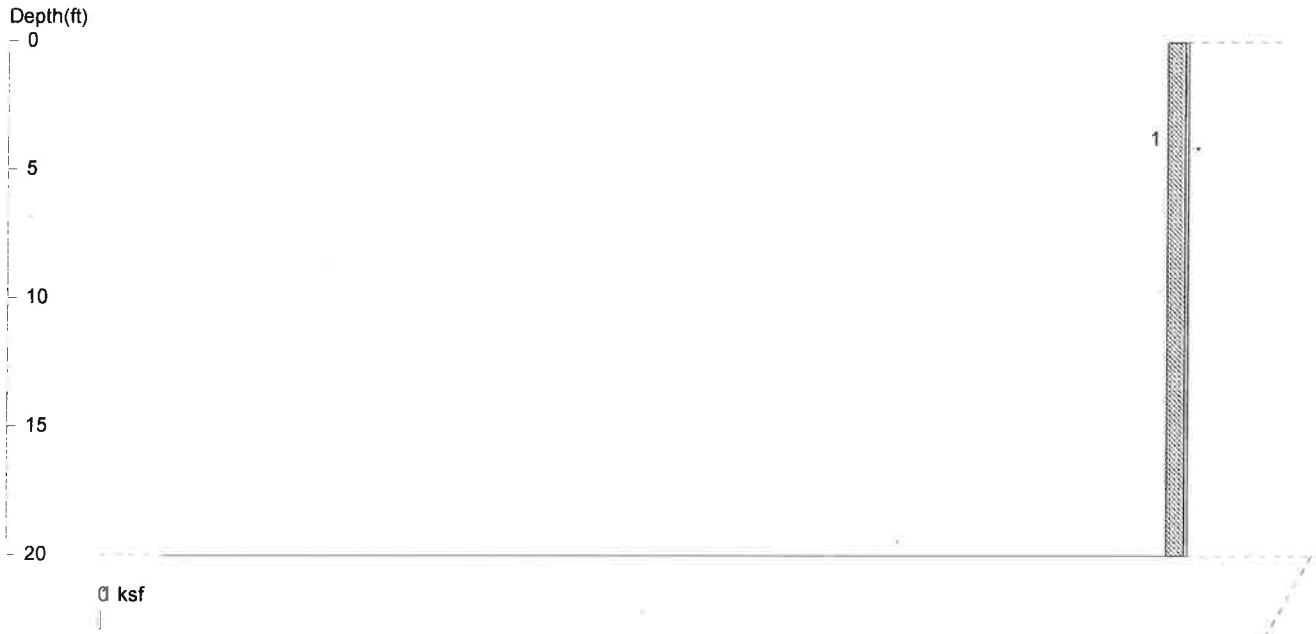
Semi-flexible Wall Condition -- Small movement or deflection are allowed.

Max. Pressure = 0.100 at depth = 0.00

Infinite Surcharge, Q=.240 Active Wedge Approach * (recommend)

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

Summit 8 Receiving Pit
Soil Pressures 20' (Unfactored)



<ShoringSuite> CIVILTECH SOFTWARE USA www.civiltech.com

Licensed to 4324324234 3424343 Date: 8/29/2019

File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soldier Pile Run 20' Service.sh8

Wall Height=20.0 Pile Diameter=2.5 Pile Spacing=6.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=0.01 (5~10ft is recommended!!!) Min. Pile Length=20.01
MOMENT IN PILE: Max. Moment=114.93 per Pile Spacing=6.0 at Depth=11.98

PILE SELECTION:
Request Min. Section Modulus = 41.8 in3/pile=684.86 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
HP14X89 has Section Modulus = 131.0 in3/pile=2146.70 cm3/pile. It is greater than Min. Requirements!
Top Deflection = -0.15(in) based on E (ksi)=29000.00 and I (in4)/pile=904.0

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	15.0	6.0	40.7	39.3	10.5	12.8	8.6

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
*	Above	Base		
0.000	0.000	5.000	0.565	0.113086
5.000	0.565	15.000	0.565	0.000000
15.000	0.565	20.000	0.000	-0.113086
*	Below	Base		
20.000	0.707	160.000	5.654	0.035339
*	Sur-	charge		
0.000	0.100	1.000	0.100	0.000000
1.000	0.100	2.000	0.100	0.000000
2.000	0.100	3.000	0.100	0.000000
3.000	0.100	4.000	0.100	0.000000
4.000	0.100	5.000	0.100	0.000000
5.000	0.100	6.000	0.100	0.000000

6.000	0.100	7.000	0.100	0.000000
7.000	0.100	8.000	0.100	0.000000
8.000	0.100	9.000	0.100	0.000000
9.000	0.100	10.000	0.100	0.000000
10.000	0.100	11.000	0.100	0.000000
11.000	0.100	12.000	0.100	0.000000
12.000	0.100	13.000	0.100	0.000000
13.000	0.100	14.000	0.100	0.000000
14.000	0.100	15.000	0.100	0.000000
15.000	0.100	16.000	0.100	0.000000
16.000	0.100	17.000	0.100	0.000000
17.000	0.100	18.000	0.100	0.000000
18.000	0.100	19.000	0.100	0.000000
19.000	0.100	20.000	0.100	0.000000
20.000	0.100	22.000	0.100	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
20.000	299	30	299	0.0000

ACTIVE SPACING:

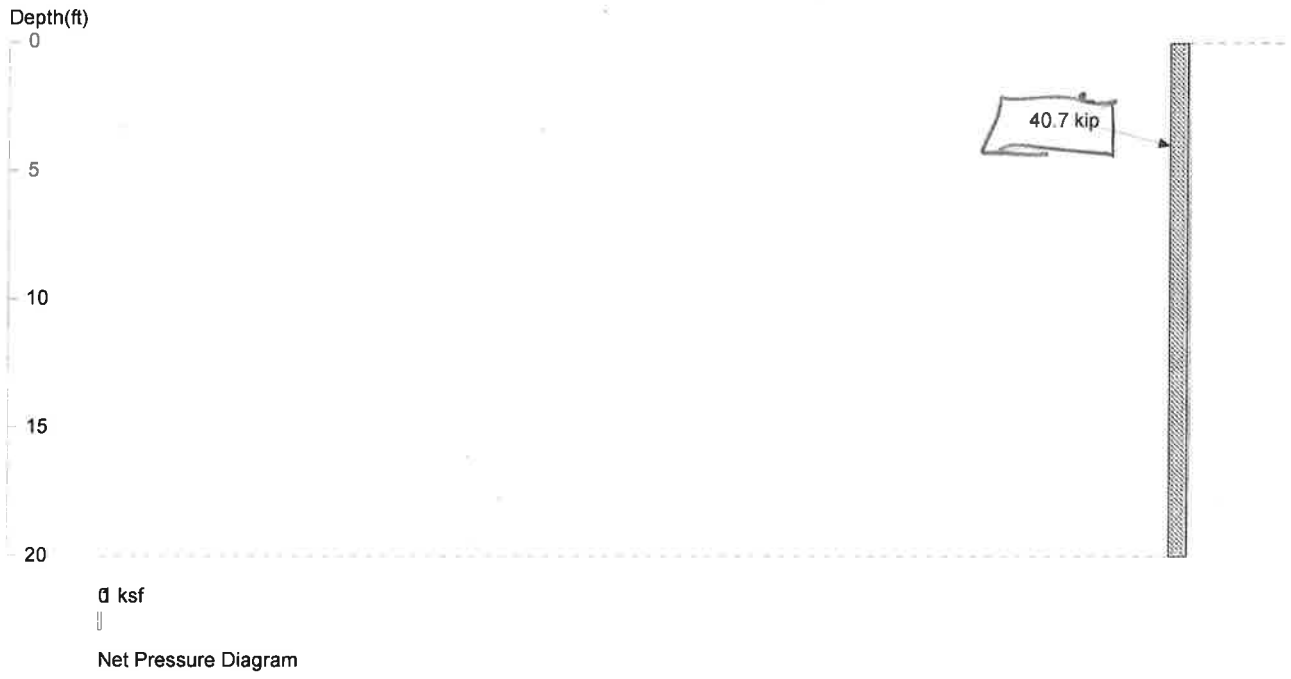
No.	Z depth	Spacing
1	0.00	6.00
2	20.00	2.50

PASSIVE SPACING:

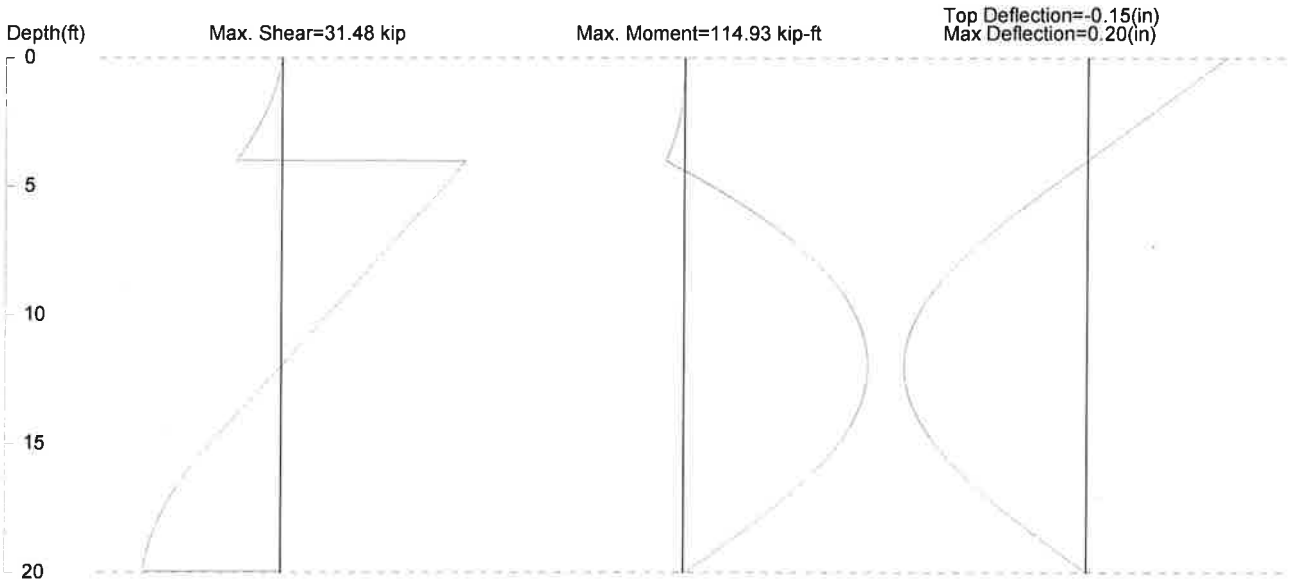
No.	Z depth	Spacing
1	20.00	6.00

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

Summit 8 Receiving Pit
Soil Pressures 20' (Unfactored)



Net Pressure Diagram



31.48 kip 0 — Shear Diagram

114.93 kip-ft 0 — Moment Diagram

0.198(in) 0 — Deflection Diagram

PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.0 foot or meter

User Input Pile, HP14X89: E (ksi)=29000.0, I (in4)/pile=904.0

File: N:\03\60\08326\structures\engapps\ee. Launching Pit\Shoring\Rear Abutment\Soldier Pile Run 20' Service.sh8

JOB No.: 60-08326
PROJECT: SUMMIT 8
SUBJECT: ANCHORED TIE BACK SOLDIER PILE WALL
TOP ANCHOR OF SINGLE TIE BACK LOCATION
DESIGN: J. SANGIORGIO DATE: 29-Aug-19 CHECK: _____ DATE: _____

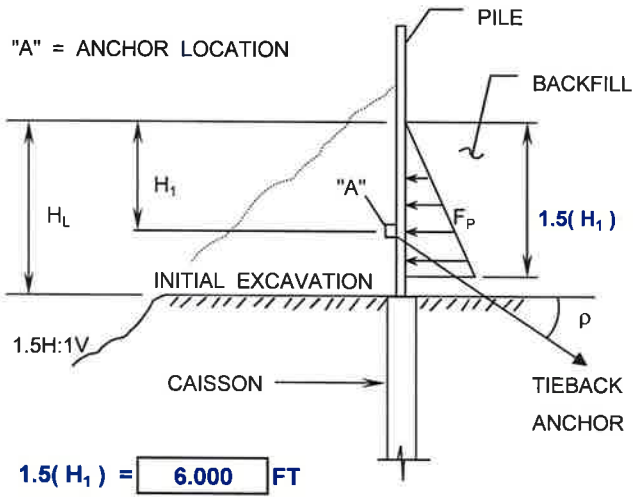
Ref.: Publication No. FHWA-IF-99-015, June 1999; Geotechnical Engineering Circular No. 4: "Ground Anchors and Anchored Systems"

CHECK THE PASSIVE RESISTANCE OF THE EXISTING SOIL NEEDED FOR FULL ANCHOR LOAD :
USE BACKFILL ELEVATION AT EL. ~~1030.00~~ 1020.0'

ANCHOR IS LOCATED AT EL. ~~1026.00~~ 1016.0'

α	=	90	Degrees	= 1.5708	radians	(Back of Wall Angle; For vertical face, α = 90°)
δ	=	15	Degrees	= 0.2618	radians	(Assumed Friction Angle Between Existing Fill and Permanent Wall Lagging)
ϕ	=	34	Degrees	= 0.5934	radians	(Effective Angle of Friction for Existing Fill)
β	=	0.00	Degrees	= 0.0000	radians	(Sloping Angle of Ground or Backfill behind wall at time of stressing)
ρ	=	15	Degrees	= 0.2618	radians	(Anchor Angle measured from horizontal)
γ	=	125.0	PCF, (Unit Weight of Fill)			
s	=	6.00	FT, (Caisson / Pile Spacing)			
H_1	=	4.00	FT, (Distance to Anchor from T/ Fill)			
H_L	=	30.00	FT, (Depth of Fill)			
T_A	=	41.00	KIPS, (Maximum Anchor Load, Service I)			

TLF = 1.33 (Performance Test Load Factor, BD-626M / Note 11)



UTILIZE COULOMB'S EQUATION FOR CALCULATING K_p :

$$K_p = \frac{\sin^2(\alpha - \phi)}{\sin^2\alpha\sin(\alpha+\delta)\left[1 - \sqrt{\frac{\sin(\phi+\delta)\sin(\phi+\beta)}{\sin(\alpha+\delta)\sin(\alpha+\beta)}}\right]^2}$$

K_p = 6.191

F_p = [(1/2) x (K_p)(γ)(1.5H_1)^2(s)] = 1.125(K_p)(γ)(H_1)^2(s)

F_p = 83.59 KIPS

1.5(H_1) = 6.000 FT

H_L = 30.000 FT > 1.5(H_1) OK

FACTOR OF SAFETY = (F_p) / [(Maximum Anchor Load) x (cos ρ) x (Test Load Factor)] > 1.50, (AS PER FHWA-IF-99-015)

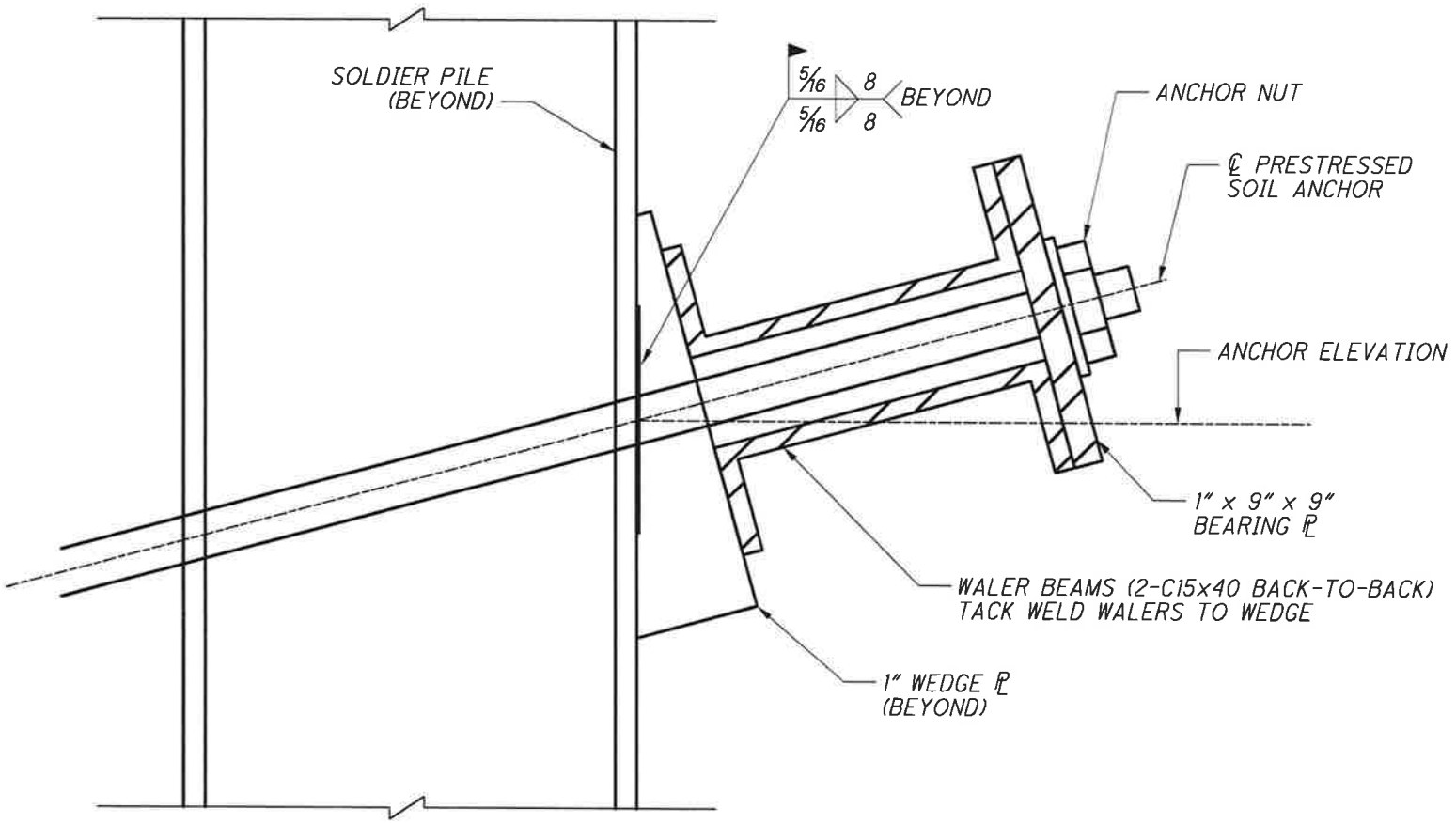
FACTOR OF SAFETY (F.S.) = 1.59 > 1.50 OK ✓

Table 2. Recommended thicknesses of wood lagging.

	Soil Description	Unified Classification	Depth	Recommended Thicknesses of Lagging (roughcut) for Clear Spans of: 5'	6'	7'	8'	9'	10'
COMPETENT SOILS	Silts or fine sand and silt above water table	ML, SM-ML	0' to 25'	2"	3"	3"	3"	4"	4"
	Sands and gravels (medium dense to dense).	GW, GP, GM, GC, SW, SP, SM							
	Clays (stiff to very stiff); non-fissured.	CL, CH	25' to 60'	3"	3"	3"	4"	4"	5"
	Clays, medium consistency and $\frac{\gamma H}{S_u} < 5$.	CL, CH							
DIFFICULT SOILS	Sands and silty sands, (loose).	SW, SP, SM	0' to 25'	3"	3"	3"	4"	4"	5"
	Clayey sands (medium dense to dense) below water table.	SC							
	Clays, heavily over-consolidated fissured.	CL, CH	25' to 60'	3"	3"	4"	4"	5"	5"
	Cohesionless silt or fine sand and silt below water table.	ML; SM-ML							
* POTENTIALLY DANGEROUS SOILS	Soft clays $\frac{\gamma H}{S_u} > 5$.	CL, CH	0' to 15'	3"	3"	4"	5"	--	--
	Slightly plastic silts below water table.	ML	15' to 25'	3"	4"	5"	6"	--	--
	Clayey sands (loose), below water table.	SC	25' to 35'	4"	5"	6"	--	--	--

Note:
* In the category of "potentially dangerous soils", use of lagging is questionable.

TIEBACK DETAIL



SOLDIE
PILE (TYF

BOT. PROP.
EXCAVATION

ms consultants, inc.
engineers, architects, planners

Job No:	08326	Sheet:	
Design:	JDS	Date:	08/28/19
Check:		Date:	
Office:	Indianapolis		
Project:	SUM-8-0199 L/R		
Element:	Connection Forces Summary		

Governing Intermediate Diaphragm		
	SER II	STR I
	P (kips)	P (kips)
Tie 1	151.5	232.5
Tie 2	90.9	137.7
Tie 3	70.7	108.2

Tieback Angle	15.00

Vertical/Horizontal Forces				
	SER II		STR I	
	Fx	Fy	Fx	Fy
Tie 1	146.34	39.21	224.58	60.18
Tie 2	87.80	23.53	133.01	35.64
Tie 3	68.29	18.30	104.51	28.00

Steel Beam

Lic. # : KW-06003862 — **Licensee : ms consultants**

Description : Tieback Channel Support · 2 spans used, min. continuous is 3-span. Conserv.

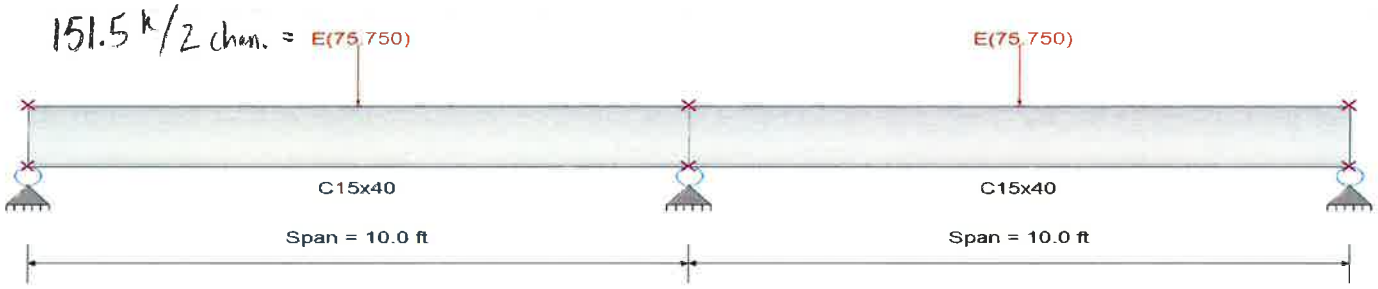
CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : IBC 2018

Material Properties

Analysis Method : Load Resistance Factor Design
Beam Bracing : Completely Unbraced
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Loads on all spans...
Point Load : E = 75.750 k, Starting at : 5.0 ft and placed every 10.0 ft thereafter

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.661 : 1	Maximum Shear Stress Ratio =	0.249 : 1
Section used for this span	C15x40	Section used for this span	C15x40
Mu : Applied	142.631 k-ft	Vu : Applied	52.378 k
Mn * Phi : Allowable	215.625 k-ft	Vn * Phi : Allowable	210.60 k
Load Combination	+1.20D+0.50L+0.70S+E+1.60H	Load Combination	+1.20D+0.50L+0.70S+E+1.60H
Location of maximum on span	10.000 ft	Location of maximum on span	10.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.122 in	Ratio =	986 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.086 in	Ratio =	1403 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	Summary of Shear Values VuMax	Vnx	Phi*Vnx
+1.40D+1.60H													
Dsgn. L = 10.00 ft	1	0.003	0.002	0.39	-0.70	0.70	239.58	215.63	2.08	1.00	0.35	234.00	210.60
Dsgn. L = 10.00 ft	2	0.003	0.002	0.39	-0.70	0.70	239.58	215.63	2.08	1.00	0.35	234.00	210.60
+1.20D+0.50Lr+1.60L+1.60H													
Dsgn. L = 10.00 ft	1	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
Dsgn. L = 10.00 ft	2	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
+1.20D+1.60L+0.50S+1.60H													
Dsgn. L = 10.00 ft	1	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
Dsgn. L = 10.00 ft	2	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
+1.20D+1.60Lr+0.50L+1.60H													
Dsgn. L = 10.00 ft	1	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
Dsgn. L = 10.00 ft	2	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
+1.20D+1.60Lr+0.50W+1.60H													
Dsgn. L = 10.00 ft	1	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
Dsgn. L = 10.00 ft	2	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
+1.20D+0.50L+1.60S+1.60H													
Dsgn. L = 10.00 ft	1	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
Dsgn. L = 10.00 ft	2	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
+1.20D+1.60S+0.50W+1.60H													
Dsgn. L = 10.00 ft	1	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
Dsgn. L = 10.00 ft	2	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
+1.20D+0.50Lr+0.50L+W+1.60H													
Dsgn. L = 10.00 ft	1	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60

Steel Beam

Lic. # : KW-06003862 — Licensee : ms consultants

Description : Tieback Channel Support

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	Summary of Shear Values VuMax	Vnx	Phi*Vnx
Dsgn. L = 10.00 ft	2	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
+1.20D+0.50L+0.50S+W+1.60H													
Dsgn. L = 10.00 ft	1	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
Dsgn. L = 10.00 ft	2	0.003	0.001	0.34	-0.60	0.60	239.58	215.63	2.08	1.00	0.30	234.00	210.60
+1.20D+0.50L+0.70S+E+1.60H													
Dsgn. L = 10.00 ft	1	0.661	0.249	118.66	-142.63	142.63	239.58	215.63	1.70	1.00	52.38	234.00	210.60
Dsgn. L = 10.00 ft	2	0.661	0.249	118.66	-142.63	142.63	239.58	215.63	1.70	1.00	52.38	234.00	210.60
+0.90D+W+0.90H													
Dsgn. L = 10.00 ft	1	0.002	0.001	0.25	-0.45	0.45	239.58	215.63	2.08	1.00	0.22	234.00	210.60
Dsgn. L = 10.00 ft	2	0.002	0.001	0.25	-0.45	0.45	239.58	215.63	2.08	1.00	0.22	234.00	210.60
+0.90D+E+0.90H													
Dsgn. L = 10.00 ft	1	0.661	0.248	118.58	-142.48	142.48	239.58	215.63	1.70	1.00	52.30	234.00	210.60
Dsgn. L = 10.00 ft	2	0.661	0.248	118.58	-142.48	142.48	239.58	215.63	1.70	1.00	52.30	234.00	210.60

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
E Only	1	0.1217	4.480		0.0000	0.000
E Only	2	0.1208	5.560		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 — Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	23.672	104.156	23.672
Overall MINimum	0.090	0.300	0.090
+D+H	0.150	0.500	0.150
+D+L+H	0.150	0.500	0.150
+D+Lr+H	0.150	0.500	0.150
+D+S+H	0.150	0.500	0.150
+D+0.750Lr+0.750L+H	0.150	0.500	0.150
+D+0.750L+0.750S+H	0.150	0.500	0.150
+D+0.60W+H	0.150	0.500	0.150
+D+0.70E+H	16.720	73.409	16.720
+D+0.750Lr+0.750L+0.450W+H	0.150	0.500	0.150
+D+0.750L+0.750S+0.450W+H	0.150	0.500	0.150
+D+0.750L+0.750S+0.5250E+H	12.578	55.182	12.578
+0.60D+0.60W+0.60H	0.090	0.300	0.090
+0.60D+0.70E+0.60H	16.660	73.209	16.660
D Only	0.150	0.500	0.150
Lr Only			
L Only			
S Only			
W Only			
E Only	23.672	104.156	23.672
H Only			

MAX TIEBACK 1 VERTICAL FORCE	60.18	k	STR I
MAX TIEBACK 2 VERTICAL FORCE	35.64	k	STR I
MAX TIEBACK 3 VERTICAL FORCE	28.00	k	STR I

Factored Fillet Weld Resistance (6.13.3.2.4)

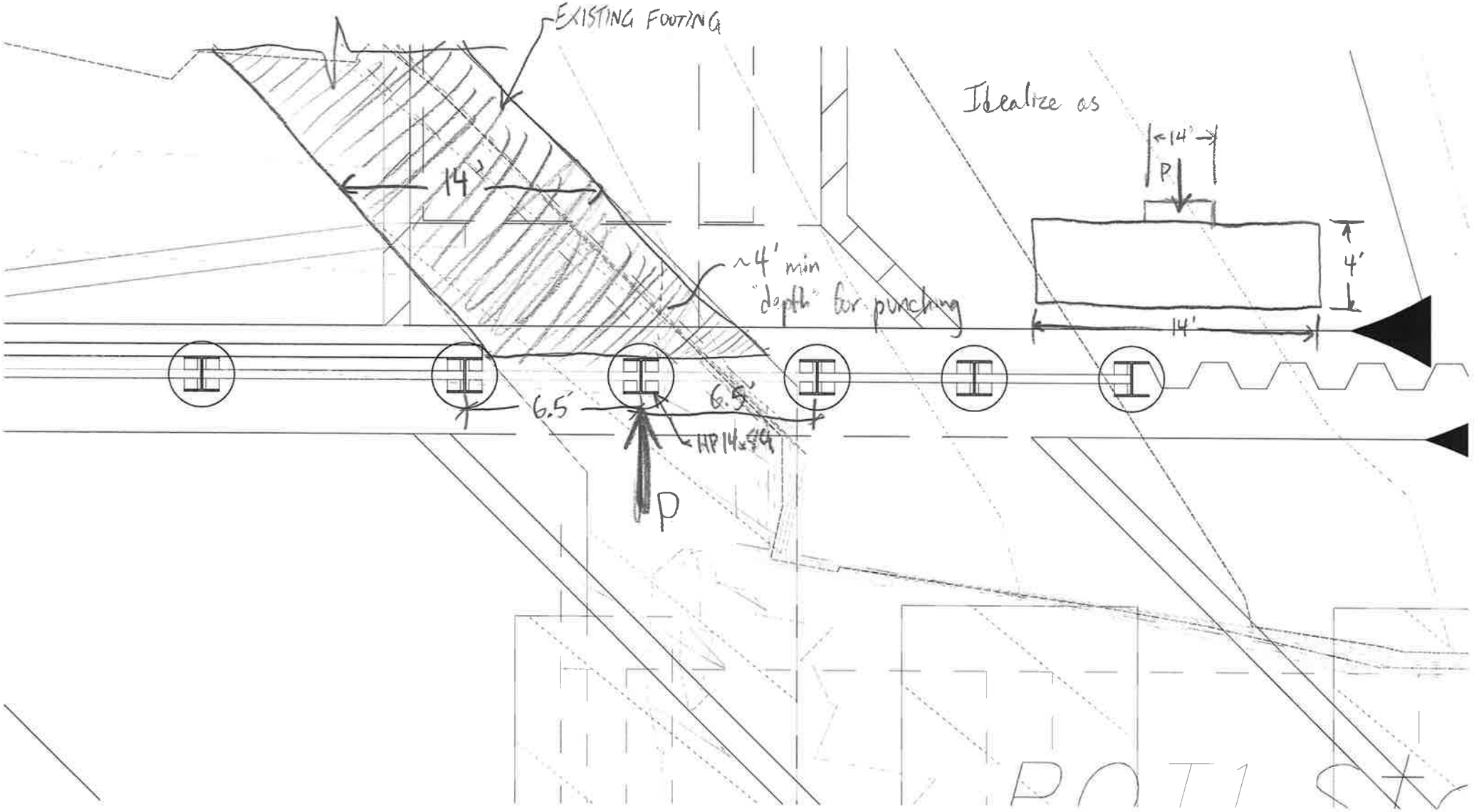
$R_r = 0.6\,\phi_{e2}\,F_{exx}$ (6.13.3.2.4b-1)

ϕ_{e2} =	0.8		(6.5.4.2)
F_{exx} =	70	ksi	
Fillet Weld Size =	4/16	in	
Throat =	0.177	in	
R_r =	5.940	k/in	
V_{ub} =	60.18	k	
Required Length =	10.131	in	
Length Available =	15.000	in	(C15x40)
Length Provided =	6.000	in	
Required Overlap =	2.816	in	
Provided Overlap =	1.000	in (each side and end, neglecting 1/4" at the end of each leg)	
Rr Provided =	92.07	k	

V_{ub}= 60.18 k ≤ R_r Provided= 92.07 k GOOD

EXISTING FOOTING PILE SUPPORT

(Breakout Check)



P = 2nd trebuck load (approx. location, conserv. as trebucks share load)

General Footing

Lic. # : KW-06003862 — Licensee : ms consultants

Description : Existing Footing Breakout Check

Code References

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : IBC 2018

General Information

Material Properties

f'c : Concrete 28 day strength	=	3.0 ksi (Assumed)
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.02 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Soil Design Values

Allowable Soil Bearing	=	8.0 ksf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Increases based on footing Depth

Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth	=	ksf
when footing base is below	=	ft

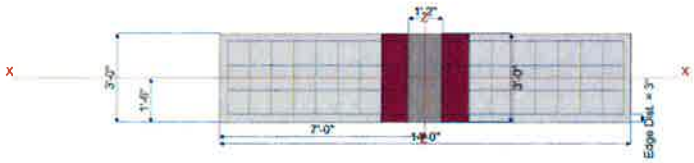
Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=	ksf
when max. length or width is greater than	=	ft

Dimensions

Width parallel to X-X Axis	=	14.0 ft
Length parallel to Z-Z Axis	=	3.0 ft
Footing Thickness	=	48.0 in

Pedestal dimensions...		
px : parallel to X-X Axis	=	14.0 in
pz : parallel to Z-Z Axis	=	36.0 in
Height	=	14.0 in
Rebar Centerline to Edge of Concrete...		
at Bottom of footing	=	3.0 in



Reinforcing

Bars parallel to X-X Axis		
Number of Bars	=	4.0
Reinforcing Bar Size	=	# 8
Bars parallel to Z-Z Axis		
Number of Bars	=	19.0
Reinforcing Bar Size	=	# 8

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	ıg Z-Z Axis
# Bars required within zone	35.3 %
# Bars required on each side of zone	64.7 %

Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=							151.5	k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

General Footing

Lic. # : KW-06003862 — Licensee : ms consultants

Description : Existing Footing Breakout Check

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.5234	Soil Bearing	4.187 ksf	8.0 ksf	+D+0.750L+0.750S+0.5250E+H about Z-...
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.5701	Z Flexure (+X)	118.814 k-ft/ft	208.405 k-ft/ft	+1.40D+1.60H
PASS	0.5701	Z Flexure (-X)	118.814 k-ft/ft	208.405 k-ft/ft	+1.40D+1.60H
PASS	0.0	X Flexure (+Z)	0.0 k-ft/ft	0.0 k-ft/ft	No Moment
PASS	0.0	X Flexure (-Z)	0.0 k-ft/ft	0.0 k-ft/ft	No Moment
PASS	0.3460	1-way Shear (+X)	28.430 psi	82.158 psi	+1.40D+1.60H
PASS	n/a	1-way Shear (-X)	28.430 psi	82.158 psi	+1.40D+1.60H
PASS	n/a	1-way Shear (+Z)	0.0 psi	82.158 psi	n/a
PASS	n/a	1-way Shear (-Z)	0.0 psi	82.158 psi	n/a
PASS	0.0	2-way Punching	0.0 psi	0.0 psi	n/a

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location: Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, +D+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +D+L+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +D+Lr+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +D+S+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +D+0.750Lr+0.750L+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +D+0.750L+0.750S+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +D+0.60W+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +D+0.70E+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +D+0.750Lr+0.750L+0.450W+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +D+0.750L+0.750S+0.450W+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +D+0.750L+0.750S+0.5250E+H	8.0	n/a	0.0	4.187	4.187	n/a	n/a	0.523
X-X, +0.60D+0.60W+0.60H	8.0	n/a	0.0	2.512	2.512	n/a	n/a	0.314
X-X, +0.60D+0.70E+0.60H	8.0	n/a	0.0	2.512	2.512	n/a	n/a	0.314
Z-Z, +D+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +D+L+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +D+Lr+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +D+S+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +D+0.750Lr+0.750L+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +D+0.750L+0.750S+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +D+0.60W+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +D+0.70E+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +D+0.750Lr+0.750L+0.450W+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +D+0.750L+0.750S+0.450W+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +D+0.750L+0.750S+0.5250E+H	8.0	0.0	n/a	n/a	n/a	4.187	4.187	0.523
Z-Z, +0.60D+0.60W+0.60H	8.0	0.0	n/a	n/a	n/a	2.512	2.512	0.314
Z-Z, +0.60D+0.70E+0.60H	8.0	0.0	n/a	n/a	n/a	2.512	2.512	0.314

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturning				

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

General Footing

Lic. # : KW-06003862 — Licensee : ms consultants

Description : Existing Footing Breakout Check

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D+1.60H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.40D+1.60H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+0.50Lr+1.60L+1.60H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+0.50Lr+1.60L+1.60H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+1.60L+0.50S+1.60H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+1.60L+0.50S+1.60H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+1.60Lr+0.50L+1.60H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+1.60Lr+0.50L+1.60H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+1.60Lr+0.50W+1.60H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+1.60Lr+0.50W+1.60H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+0.50L+1.60S+1.60H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+0.50L+1.60S+1.60H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+1.60S+0.50W+1.60H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+1.60S+0.50W+1.60H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+0.50Lr+0.50L+W+1.60H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+0.50Lr+0.50L+W+1.60H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+0.50L+0.50S+W+1.60H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+0.50L+0.50S+W+1.60H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+0.50L+0.70S+E+1.60H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +1.20D+0.50L+0.70S+E+1.60H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +0.90D+W+0.90H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +0.90D+W+0.90H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +0.90D+E+0.90H	0.0	+Z	Top	1.0368	Min Temp %	1.072	212.038	OK
X-X, +0.90D+E+0.90H	0.0	-Z	Top	1.0368	Min Temp %	1.072	212.038	OK
Z-Z, +1.40D+1.60H	118.814	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.40D+1.60H	118.814	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+0.50Lr+1.60L+1.60H	118.814	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+0.50Lr+1.60L+1.60H	118.814	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+1.60L+0.50S+1.60H	118.814	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+1.60L+0.50S+1.60H	118.814	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+1.60Lr+0.50L+1.60H	118.814	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+1.60Lr+0.50L+1.60H	118.814	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+1.60Lr+0.50W+1.60H	118.814	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+1.60Lr+0.50W+1.60H	118.814	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+0.50L+1.60S+1.60H	118.814	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+0.50L+1.60S+1.60H	118.814	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+1.60S+0.50W+1.60H	118.814	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+1.60S+0.50W+1.60H	118.814	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+0.50Lr+0.50L+W+1.60H	118.814	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+0.50Lr+0.50L+W+1.60H	118.814	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+0.50L+0.50S+W+1.60H	118.814	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+0.50L+0.50S+W+1.60H	118.814	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+0.50L+0.70S+E+1.60H	118.814	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +1.20D+0.50L+0.70S+E+1.60H	118.814	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +0.90D+W+0.90H	66.833	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +0.90D+W+0.90H	66.833	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +0.90D+E+0.90H	66.833	-X	Bottom	1.0368	Min Temp %	1.053	208.405	OK
Z-Z, +0.90D+E+0.90H	66.833	+X	Bottom	1.0368	Min Temp %	1.053	208.405	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D+1.60H	28.43 psi	28.43 psi	0.00 psi	0.00 psi	28.43 psi	82.16 psi	0.35	0.00
+1.20D+0.50Lr+1.60L+1.60H	28.43 psi	28.43 psi	0.00 psi	0.00 psi	28.43 psi	82.16 psi	0.35	0.00
+1.20D+1.60L+0.50S+1.60H	28.43 psi	28.43 psi	0.00 psi	0.00 psi	28.43 psi	82.16 psi	0.35	0.00
+1.20D+1.60Lr+0.50L+1.60H	28.43 psi	28.43 psi	0.00 psi	0.00 psi	28.43 psi	82.16 psi	0.35	0.00
+1.20D+1.60Lr+0.50W+1.60H	28.43 psi	28.43 psi	0.00 psi	0.00 psi	28.43 psi	82.16 psi	0.35	0.00
+1.20D+0.50L+1.60S+1.60H	28.43 psi	28.43 psi	0.00 psi	0.00 psi	28.43 psi	82.16 psi	0.35	0.00
+1.20D+1.60S+0.50W+1.60H	28.43 psi	28.43 psi	0.00 psi	0.00 psi	28.43 psi	82.16 psi	0.35	0.00
+1.20D+0.50Lr+0.50L+W+1.60H	28.43 psi	28.43 psi	0.00 psi	0.00 psi	28.43 psi	82.16 psi	0.35	0.00
+1.20D+0.50L+0.50S+W+1.60H	28.43 psi	28.43 psi	0.00 psi	0.00 psi	28.43 psi	82.16 psi	0.35	0.00
+1.20D+0.50L+0.70S+E+1.60H	28.43 psi	28.43 psi	0.00 psi	0.00 psi	28.43 psi	82.16 psi	0.35	0.00
+0.90D+W+0.90H	15.99 psi	15.99 psi	0.00 psi	0.00 psi	15.99 psi	82.16 psi	0.19	0.00

General Footing

Lic. # : KW-06003862 Licensee : ms consultants

Description : Existing Footing Breakout Check

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+0.90D+E+0.90H	15.99 psi	15.99 psi	0.00 psi	0.00 psi	15.99 psi	82.16 psi	0.19	0.00
							All units k	

Two-Way "Punching" Shear

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D+1.60H	0.00 psi	146.06 psi	0	OK
+1.20D+0.50Lr+1.60L+1.60H	0.00 psi	146.06 psi	0	OK
+1.20D+1.60L+0.50S+1.60H	0.00 psi	146.06 psi	0	OK
+1.20D+1.60Lr+0.50L+1.60H	0.00 psi	146.06 psi	0	OK
+1.20D+1.60Lr+0.50W+1.60H	0.00 psi	146.06 psi	0	OK
+1.20D+0.50L+1.60S+1.60H	0.00 psi	146.06 psi	0	OK
+1.20D+1.60S+0.50W+1.60H	0.00 psi	146.06 psi	0	OK
+1.20D+0.50Lr+0.50L+W+1.60H	0.00 psi	146.06 psi	0	OK
+1.20D+0.50L+0.50S+W+1.60H	0.00 psi	146.06 psi	0	OK
+1.20D+0.50L+0.70S+E+1.60H	0.00 psi	146.06 psi	0	OK
+0.90D+W+0.90H	0.00 psi	146.06 psi	0	OK
+0.90D+E+0.90H	0.00 psi	146.06 psi	0	OK

PRESTRESSED SOIL ANCHOR SCHEDULE					
ANCHOR LAYER NUMBER	ELEVATION	NO. REQUIRED	DESIGN LOAD		MIN. UNBONDED LENGTH
			SERVICE	STRENGTH	
-	-	-	(kip)		(ft)
1	1026.00	3	151.5	232.5	22
2	1016.00	6	90.9	137.7	17
3	1006.00	3	70.7	108.2	12