

STRUCTURAL CALCULATIONS

FOR

**CASTO SHEETPILE WALL
561 PALOUSE RD
CLE ELUM, WA 98922**

**SITE SPECIFIC
LATERAL AND VERTICAL
ANALYSIS AND DESIGN
(DO NOT REUSE)**

**FOR
DEVIN CASTO**

PROJECT #2020-0291

**BY
MC SQUARED, INC.**

NATHANIEL GAZAWAY, EIT

**REVIEWED BY
JESSE M. CHASE, PE, SE**



5/11/2022

SCOPE: CLIENT REQUESTED STRUCTURAL ENGINEERING TO PROVIDE DESIGN FOR A TEMPORARY SHEET PILE WALL IN KITTITAS COUNTY, WASHINGTON.

BASIS OF DESIGN IS DRAWINGS PROVIDED BY CLIENT. NO ANALYSIS AND DESIGN OF BRACING, TEMPORARY OR PERMANENT, REQUESTED OR CONDUCTED. ALL BRACING, TEMPORARY AND PERMANENT, SHALL BE RESPONSIBILITY OF CONTRACTOR.

LOADS: 2018 IBC/ASCE 7-16

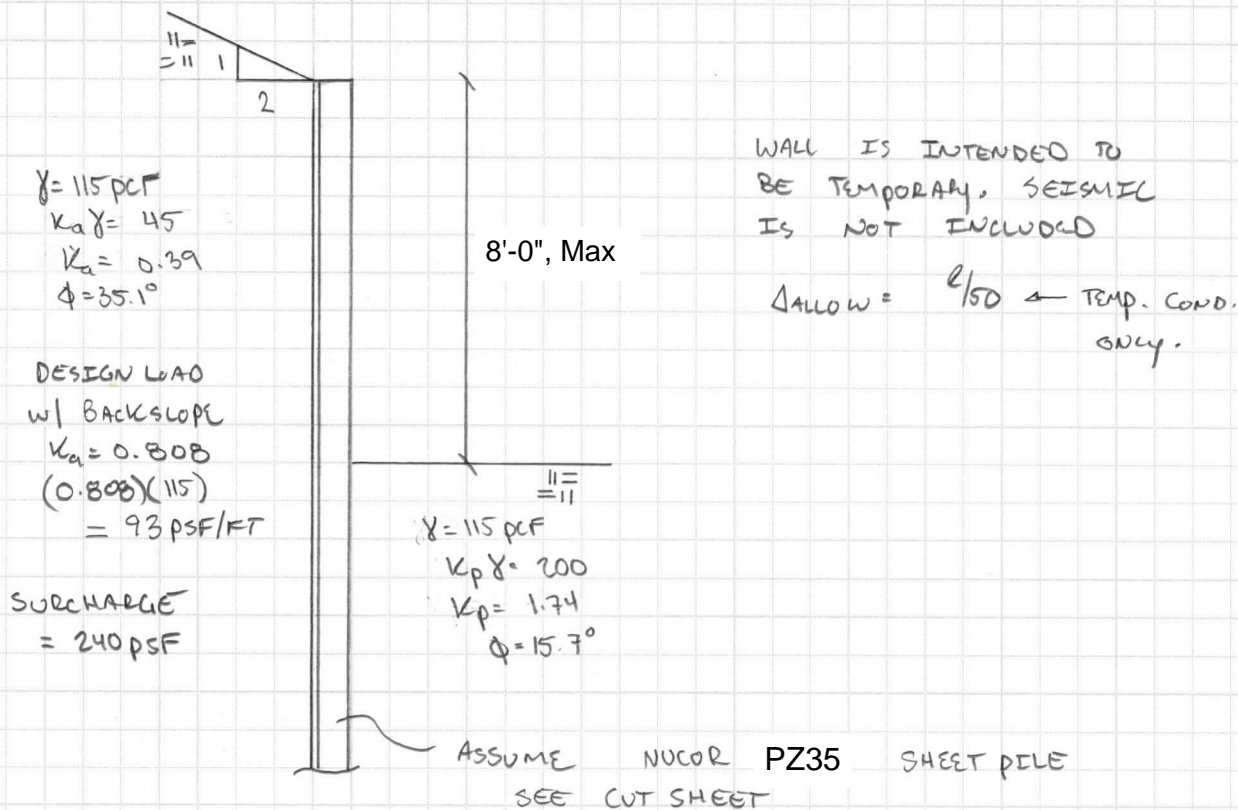
SOILS: PER QUALITY GEO REPORT, DATED 3-14-2022

**$\gamma = 115$ PCF
 $k_a = 0.39$
 $k_a = 0.808$ (W/ BACKSLOPE)
 $k_p = 1.74$
 $\phi = 35.1^\circ$**

SURCHARGE: 240 PSF

WALL IS INTENDED TO PROVIDE TEMPORARY SLOPE STABILITY TO AID IN THE CONSTRUCTION OF NEW STRUCTURE (BY OTHERS) ON THE PROPERTY. MINIMUM EMBEDMENT FOR TEMPORARY SHORING WALLS PER AASHTO.

SHEET PILE DESIGN SKETCH AND ASSUMED SOIL PROPERTIES



PRIVATE DRIVE EXISTS @ TOP OF SLOPE. A 240PSF SURCHARGE SHOULD BE INCLUDED IF WALL IS LOCATED WITHIN TOTAL WALL HEIGHT.

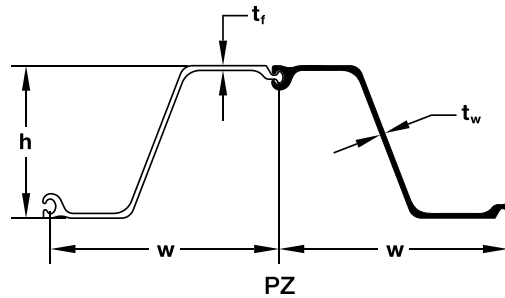
PER SHORING SUITE, ASSUMING AASHTO TEMPORARY SHORING ADD 20% EMBED $\rightarrow 34.74'$ SAY $35'$.

$$\text{MOMENT CAPACITY} = \frac{(0.6)(50)(48.5)}{12} = 121.25 \text{ FT-K}$$

$$\text{DEFLECTION ALLOW} = \frac{(8)(12)}{(50)} = \underline{\underline{1.92''}}$$

PZ

PZ Hot Rolled Steel Sheet Pile



SECTION	Width (w) in mm	Height (h) in mm	THICKNESS		Cross Sectional Area in ² /ft cm ² /m	WEIGHT		SECTION MODULUS		Moment of Inertia in ⁴ /ft cm ⁴ /m	COATING AREA	
			Flange (t _f) in mm	Web (t _w) in mm		Pile lb/ft kg/m	Wall lb/ft ² kg/m ²	Elastic in ³ /ft cm ³ /m	Plastic in ³ /ft cm ³ /m		Both Sides ft ² /ft of single m ² /m	Wall Surface ft ² /ft ² m ² /m ²
PZ 22	22.00 559	9.0 229	0.375 9.50	0.375 9.50	6.47 136.9	40.3 60.0	22.0 107.4	18.1 973	21.79 1171.4	84.38 11500	4.48 1.37	1.22 1.22
PZ 27	18.00 457	12.0 305	0.375 9.50	0.375 9.50	7.94 168.1	40.5 60.3	27.0 131.8	30.2 1620	36.49 1961.9	184.20 25200	4.48 1.37	1.49 1.49
PZ 35	22.64 575	14.9 378	0.600 15.21	0.500 12.67	10.29 217.8	66.0 98.2	35.0 170.9	48.5 2608	57.17 3073.5	361.22 49300	5.37 1.64	1.42 1.42
PZ 40	19.69 500	16.1 409	0.600 15.21	0.500 12.67	11.77 249.1	65.6 97.6	40.0 195.3	60.7 3263	71.92 3866.7	490.85 67000	5.37 1.64	1.64 1.64

PZ

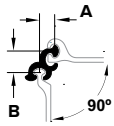
PZ Hot Rolled Steel Sheet Pile

Available Steel Grades

PZ		
ASTM	YIELD STRENGTH	
	ksi	MPa
A328	39	270
A572 Grade 50	50	345
A572 Grade 60	60	415
A588	50	345
A690	50	345

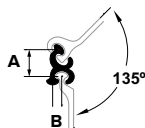
Highlighted fields represent the most commonly used and readily available steel grades.

Corner Piles



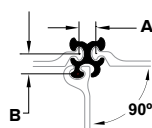
SKP90

Gr: A572 Gr. 60
Wt: 8.97 lb/ft
13.3 kg/m
A: 1.24"
31.5 mm
B: 1.76"
37.1 mm



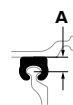
SKP45

Gr: A572 Gr. 60
Wt: 9.08 lb/ft
13.5 kg/m
A: 2.05"
52.1 mm
B: 0.70"
17.8 mm



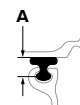
SKPT

Gr: A572 Gr. 60
Wt: 11.30 lb/ft
16.8 kg/m
A: 1.23"
31.2 mm
B: 1.46"
37.1 mm



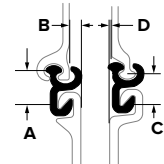
SKPF

Gr: S355 GP/ Gr. 60
Wt: 6.13 lb/ft
9.1 kg/m
A: 0.96"
24.4 mm



SKPM

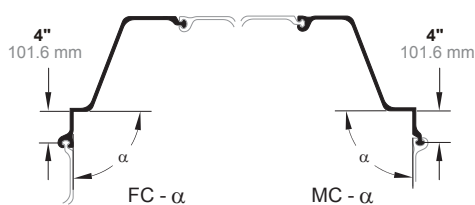
Gr: S355 GP/ Gr. 60
Wt: 6.13 lb/ft
9.1 kg/m
A: 1.26"
32.0 mm



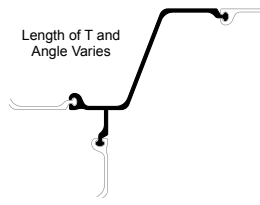
SKAP

Gr: A572 Gr. 60
Wt: 8.95 lb/ft 13.3 kg/m
A: 1.97" 50.0 mm
B: 0.69" 17.5 mm
C: 1.61" 40.9 mm
D: 0.02" 0.5 mm

Fabricated Corner Piles



Female or Male Corner



T Pile

Delivery Conditions & Tolerances

	ASTM A6
Mass	± 2.5%
Length	+ 5 inches - 0 inches

Maximum Rolled Lengths*

PZ	105.0 feet	(32.0 m)
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* Longer lengths may be possible upon request.

Interlock Combinations



Use menu item Settings > Printing & Title Block to set these five lines of information for your program.

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Equation Report

Coulomb equation for active earth pressure coefficient,

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

$$K_a(\text{Horiz}) = K_a \cos(90 + \delta - \alpha)$$

α 90.000 Clockwise angle from horizontal to back face of wall, degrees

ϕ 25.970 Angle of internal friction of selected soil, degrees

δ 0.000 Angle of friction at back of wall

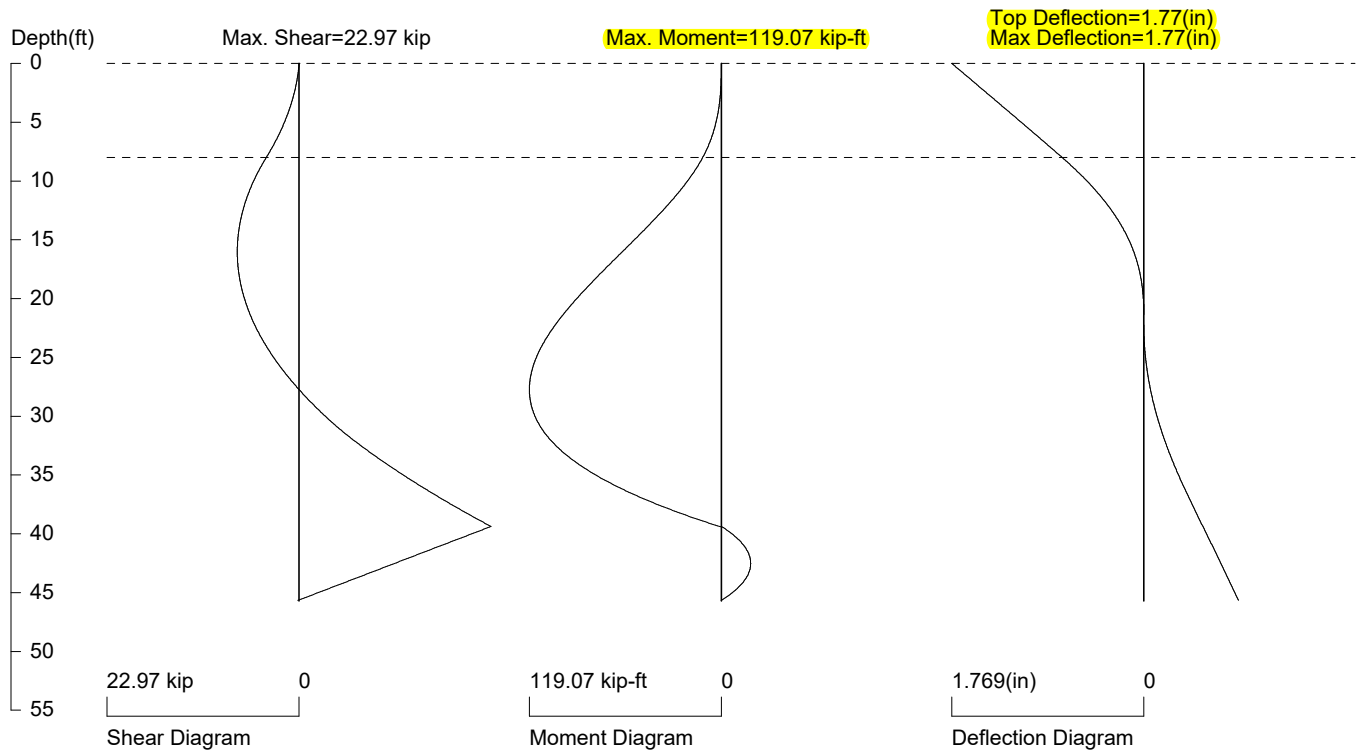
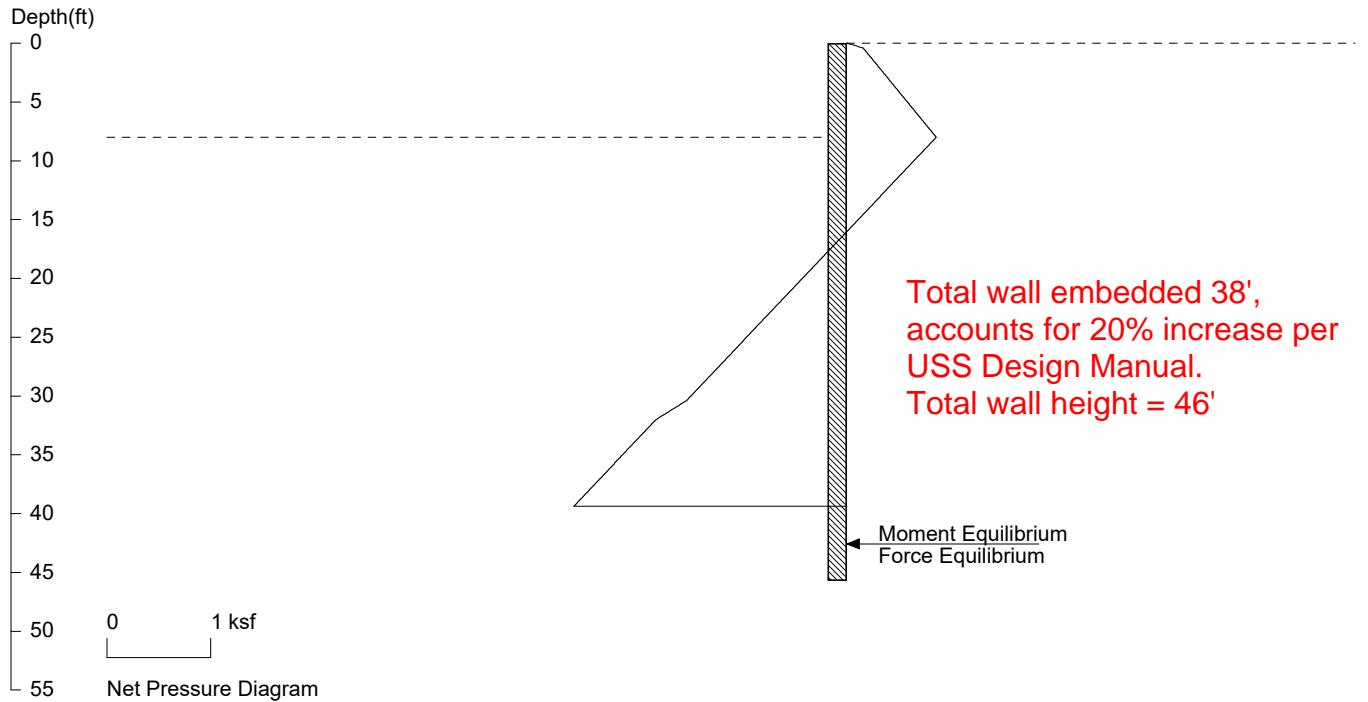
β 26.600 Angle of backfill slope from horizontal

$$K_a = 0.8082 = \frac{\sin^2(90.00 + 26.0)}{\sin^2 90.00 \sin(90.00 - 0.0) \left[1 + \sqrt{\frac{\sin(26.0 + 0.0) \sin(26.0 - 26.6)}{\sin(90.00 - 0.0) \sin(90.00 + 26.6)}} \right]^2}$$

$$K_a(\text{Horiz}) = 0.8082 = 0.8082 \cos(90 + 0.0 - 90.00)$$

*Accounts for back slope.

Description:

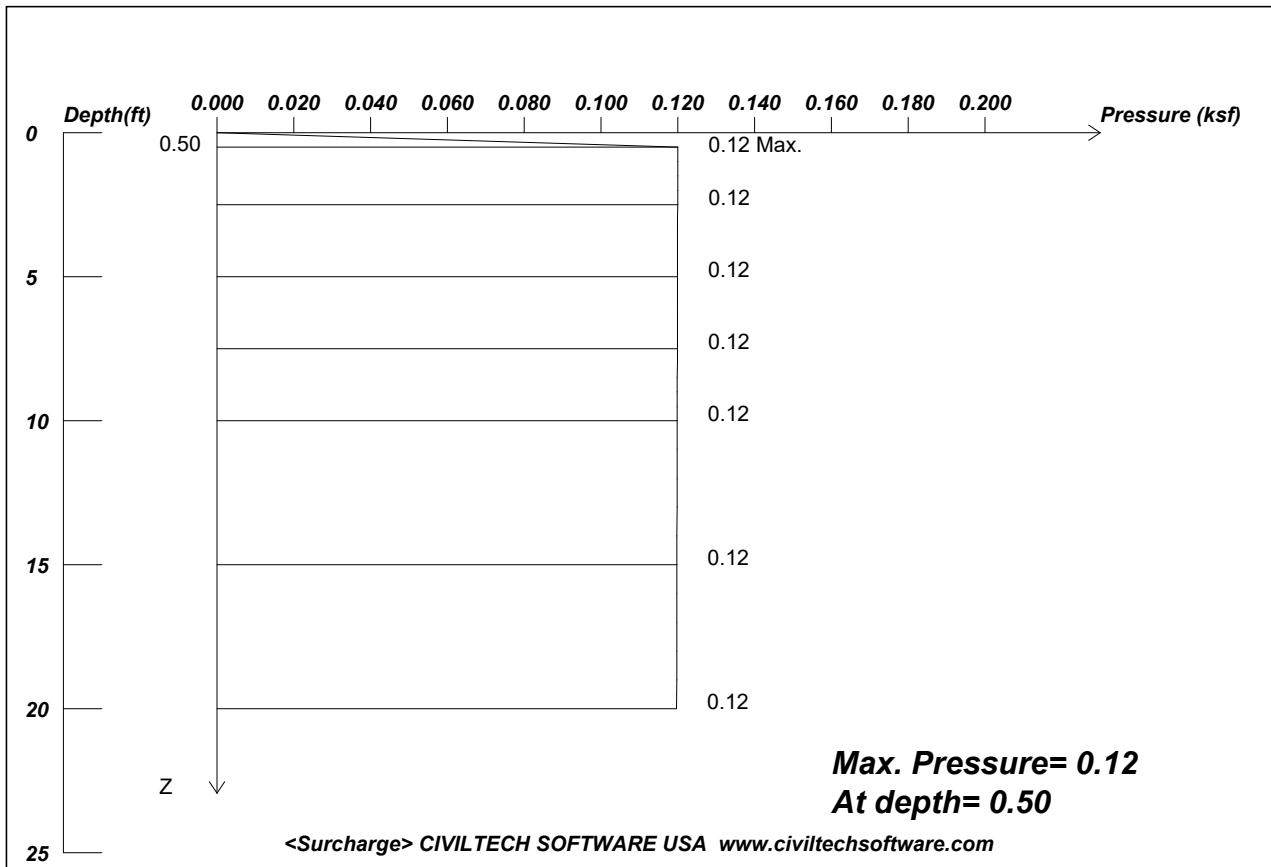


PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

User Input I: E (ksi)=29000.0, I (in⁴)/foot=361.2

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Date: 5/10/2022 File: M:\PROJECTS\Casto, Devin\2022-0291 - Casto Sheet Pile Wall (Cle Elum)\Documents\Surcharge

Wall Height, H= 10 Load Depth at Surface, D= 0

Load Factor of Surcharge Loading = 1

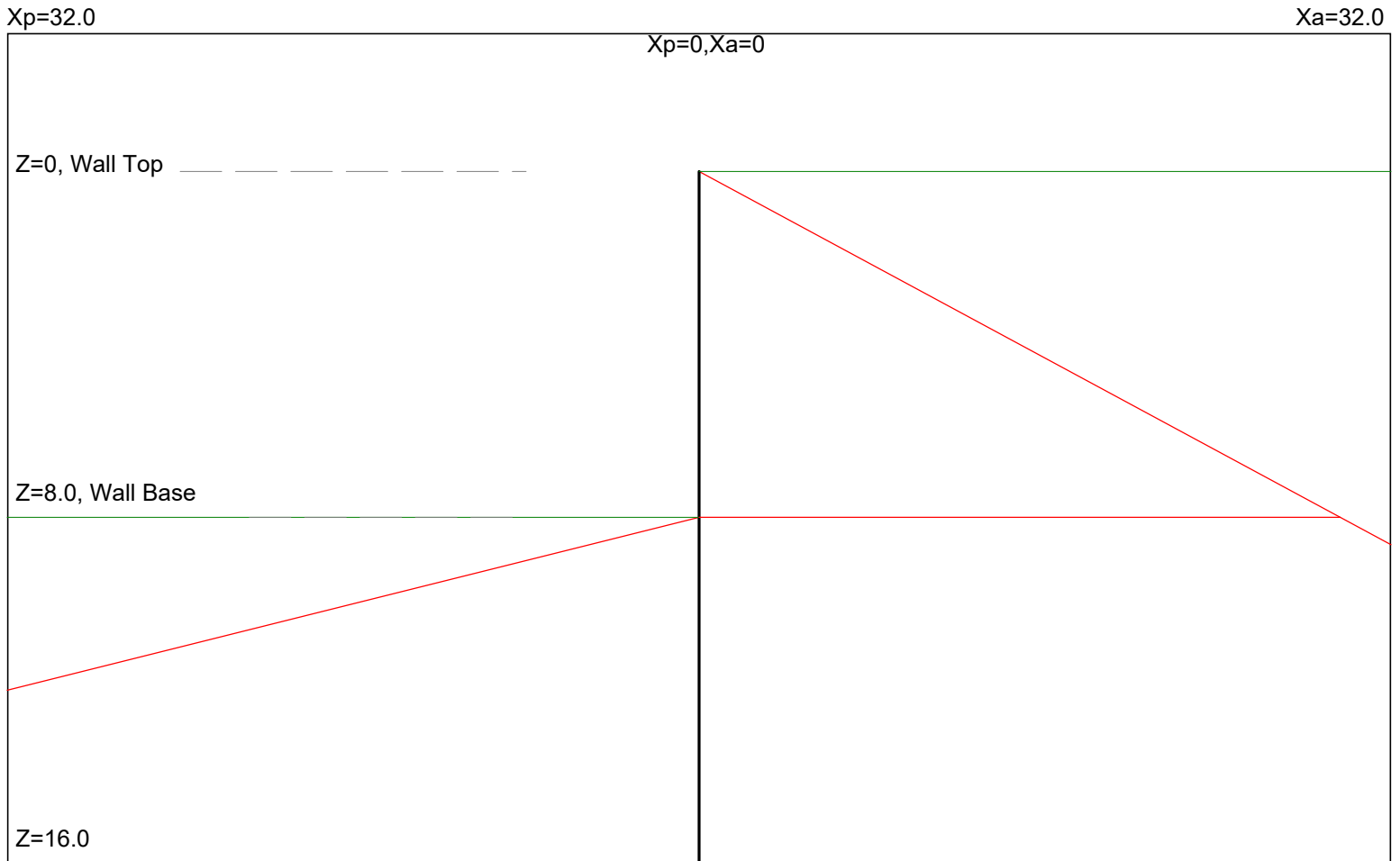
Flexible Wall Condition -- Movement or deflection are allowed.

Max. Pressure = 0.120 at depth = 0.50

Infinite Surcharge, Q=0.240

Wayne-Teng Equation (Modified Boussinesq)

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



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

Date: 5/11/2022 File: M:\PROJECTS\Casto, Devin\2022-0291 - Casto Sheet Pile Wall (Cle Elum)\Documents\Lateral Pressure.ep8

*** INPUT DATA ***

Wall Height=8.0 Total Soil Types= 2

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	115.2	115.2	6.1	0.0	0	4	Sand
2	115.2	115.2	15.7	0.0	0	4	Sand

Phi angle selected to provide active pressure equivalent to effects of back slope.

Ground Surface at Active Side:

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

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	8.0	0.0	8.0	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: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Eae (Total Force above Base)= 2.98 per one linear foot (or meter) width along wall height

Ea (Total Static Force above Base)= 2.98

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

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
0.00	0.00	8.00	0.74	0.0930	0.8072

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

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
8.00	0.74	16.00	1.49	0.0930	0.8072

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

Z1	Pp1	Z2	Pp2	Slope	Kp
8.00	0.00	16.00	1.61	0.201	1.7420

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

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