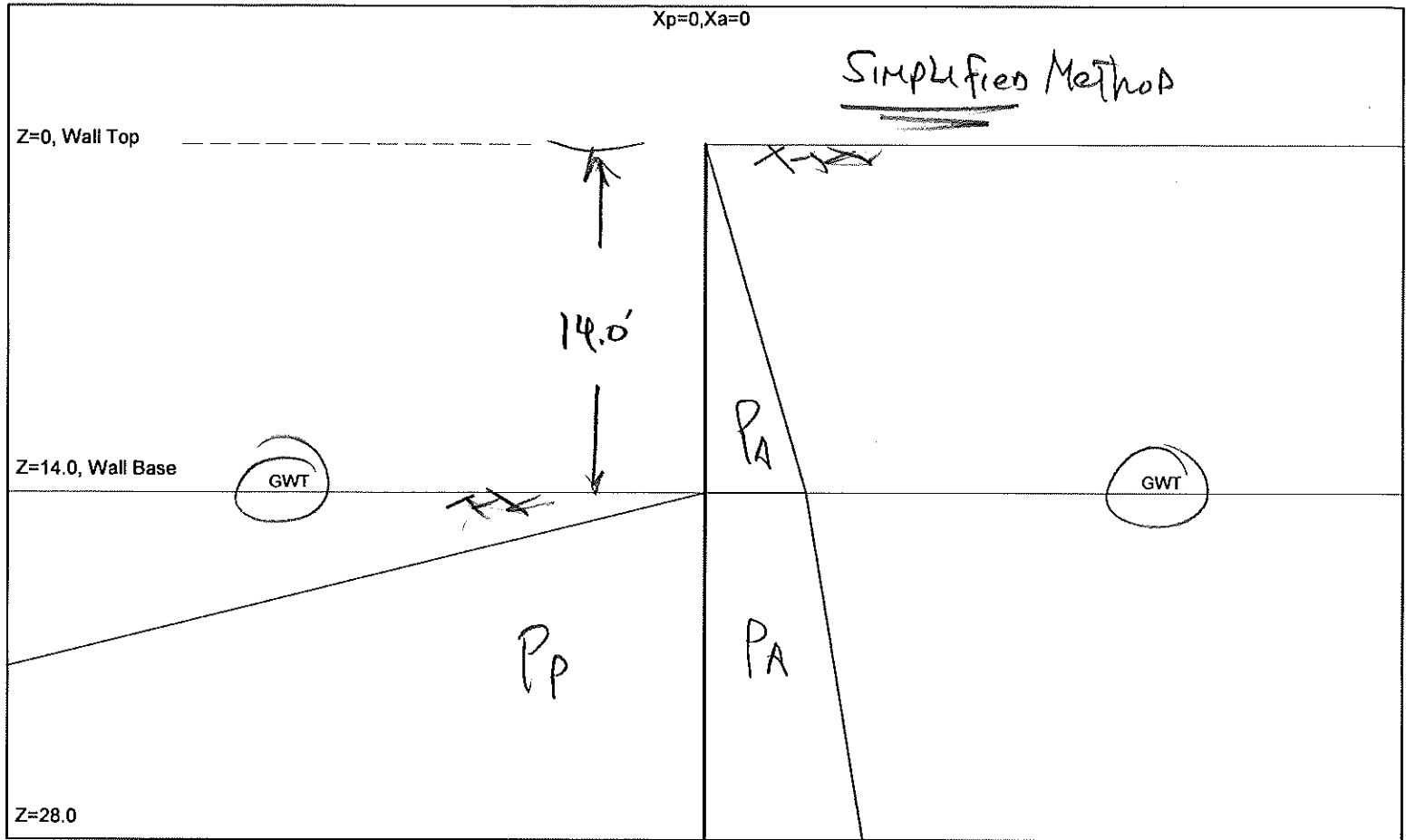


SIMPLIFIED VS. USS CONVENTIONAL

H = 14.0 Ka = 0.27 Kp = 6.55

Xp=56.0

Xa=56.0



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

Date: 12/7/2021

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SAME SOIL:
AS USS Ex. No. 1

* INPUT DATA *

Wall Height=14.0 Total Soil Types= 1

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	115.0	127.4	35	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	Sand

Water Table at Active Side:

Point	Z-water	X-water
1	14.0	0.0
2	14.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	14.0	0.0	14.0	800.0	1	Sand

Water Table at Passive Side:

Point	Z-water	X-water
1	14.0	0.0
2	14.0	800.0

Wall Friction Options: 3. Both sides (for formulary solution)

Wall Friction = 15

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

* OUTPUT RESULTS *

Total Force above Base= 3.04 per one linear foot (or meter) width along wall height

Total Static Force above Base= 3.04

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.089

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	14.00	0.43	0.0310	0.2698

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.089

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
14.00	0.43	28.00	0.68	0.0175	0.2698

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

Z1	Pp1	Z2	Pp2	Slope	Kp
14.00	0.00	28.00	5.96	0.426	6.5547

USE MULT.PLIER

TO MAKE

$K_A + K_P$ SAME

As in USS

Ex. No. 1

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

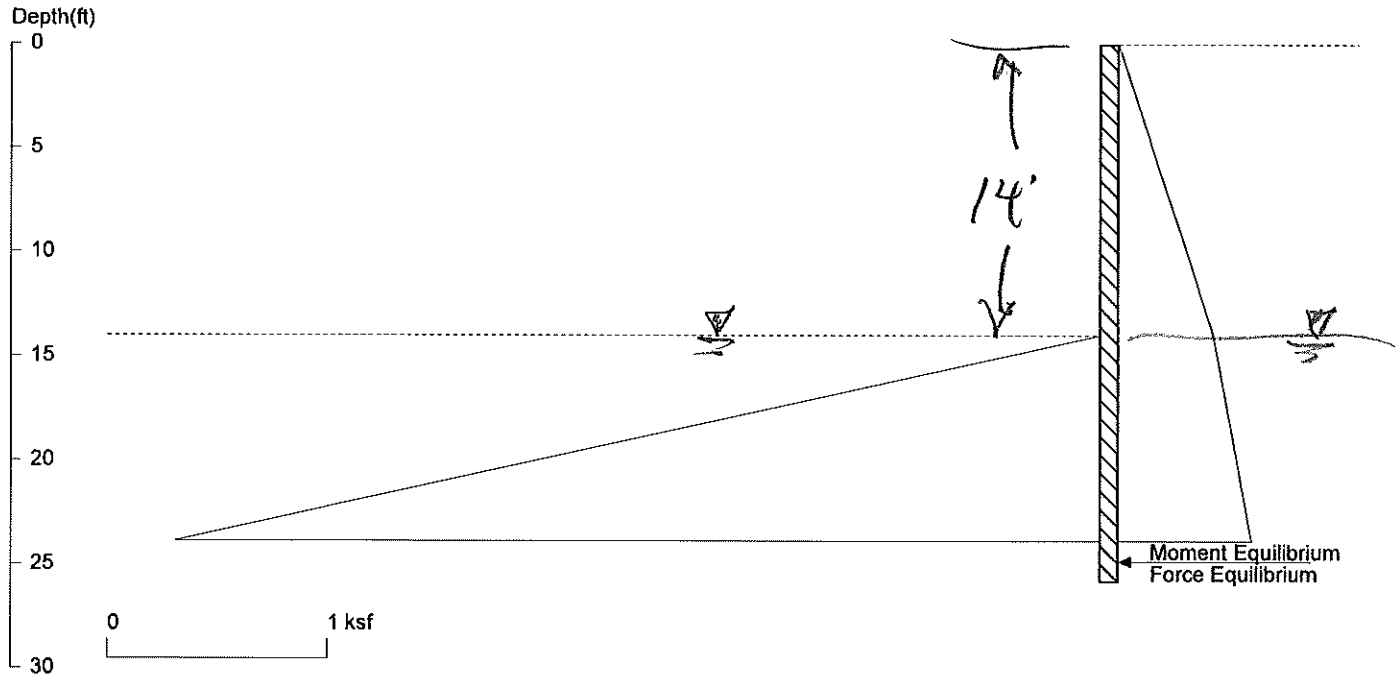
Date: 12/7/2021 File Name: O:\CivilTech\Shoring Suite\SIMPL. vs. USS CONV\14.0'.ep8

$$K_A = 0.27$$

$$K_P = 6.56$$

SIMPLIFIED VS. USS CONVENTIONAL

H = 14.0 Ka = 0.27 Kp = 6.55



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Date: 12/7/2021

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Wall Height=14.0

Pile Diameter=1.0

Pile Spacing=1.0

Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=9.86 Min. Pile Length=23.86

MOMENT IN PILE: Max. Moment=26.31 per Pile Spacing=1.0 at Depth=19.06

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	14.000	0.434	0.031029
*	Below	Base		
14.000	0.434	126.000	2.399	0.017538

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
14.000	0.000	126.000	47.718	0.426057

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	14.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft

Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

	USS CONV.	Simplified
EMBEDMENT w/o FS	≈ 10.5'	9.86'
MOMENT	26.0 FT-KIPS/LF	26.31 FT KIPS/LF

ADD 20% For FS ∴ D = 9.86' x 1.2 = 11.83'

SSP L = 11.83' + 14.0'

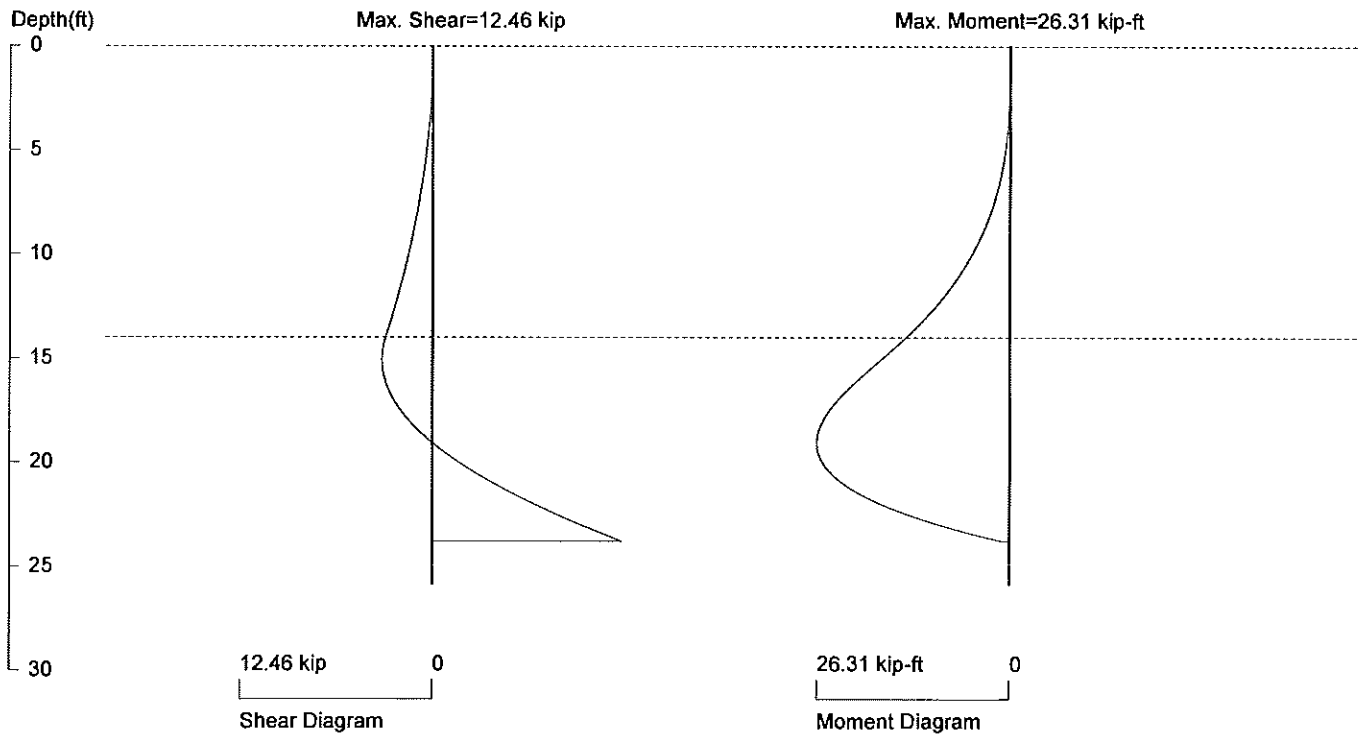
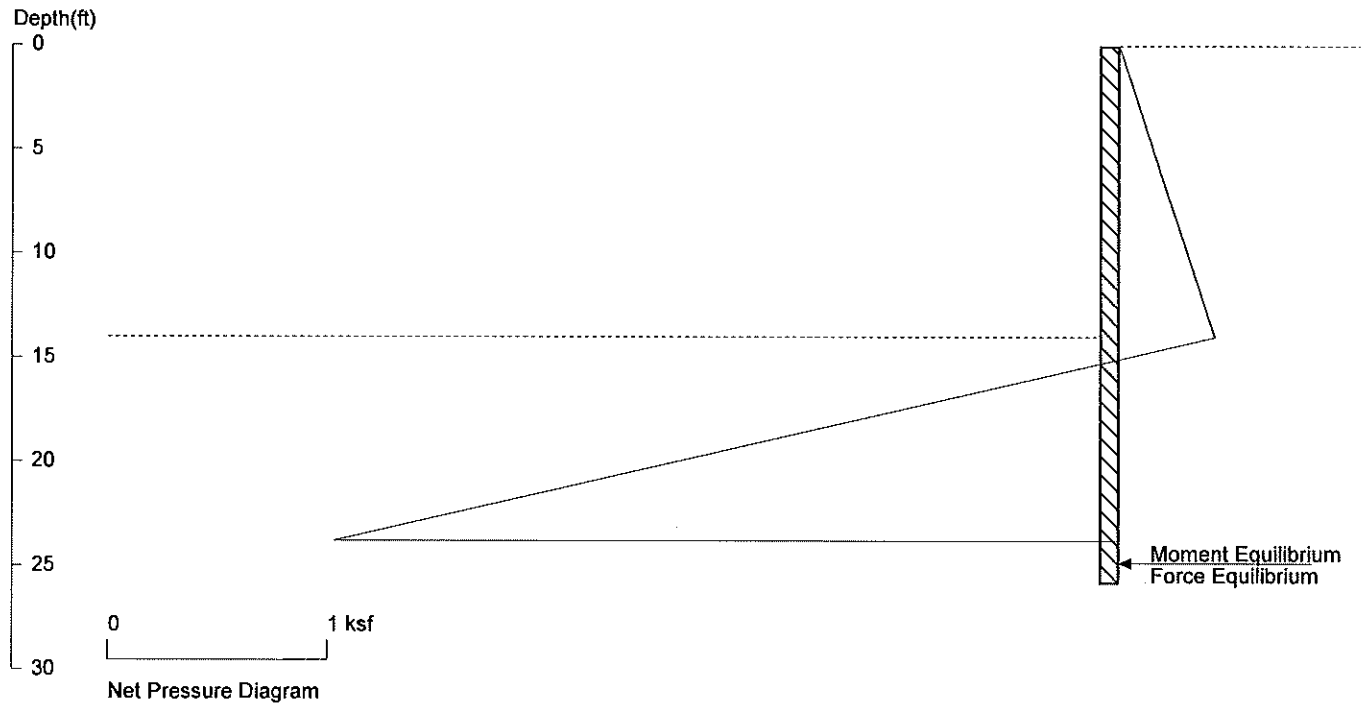
= 25.83' MIN.

USE 28' Q

(= 14' + 14' Toe)

SIMPLIFIED VS. USS CONVENTIONAL

H = 14.0 Ka = 0.27 Kp = 6.55



PRESSURE, SHEAR, AND MOMENT DIAGRAM

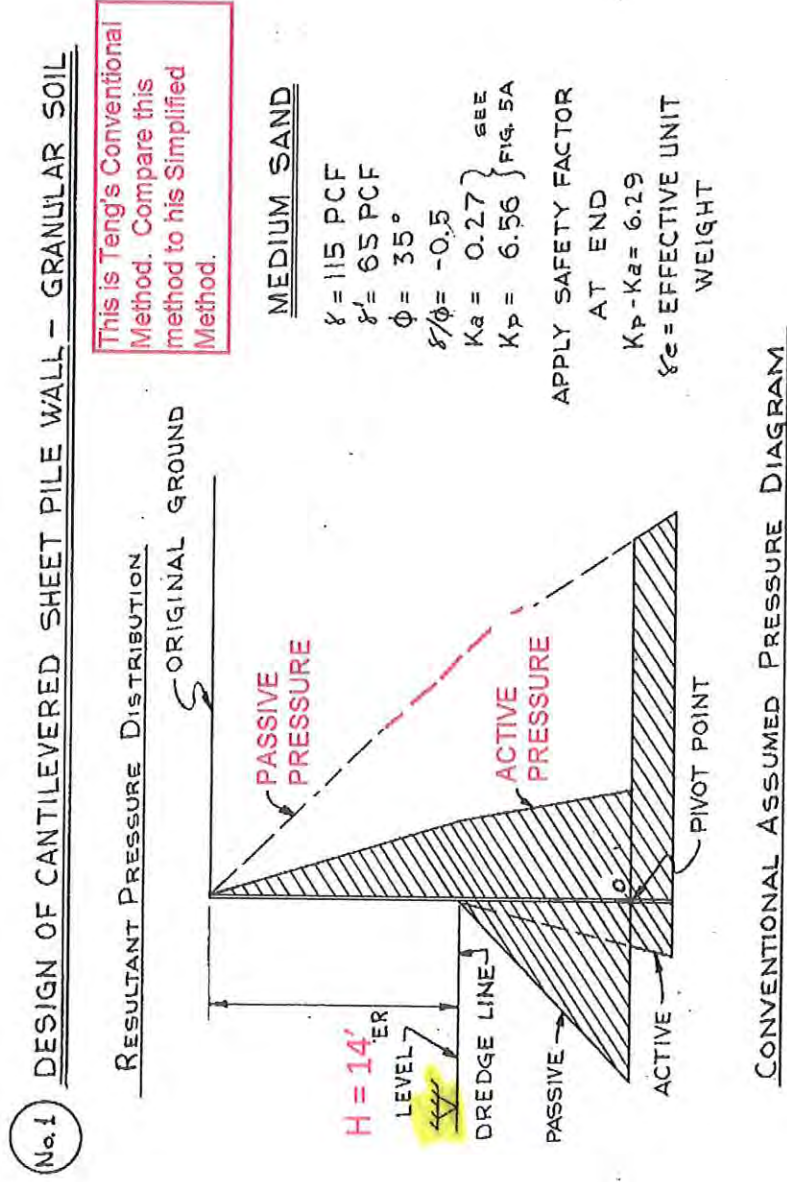
Based on pile spacing: 1.0 foot or meter

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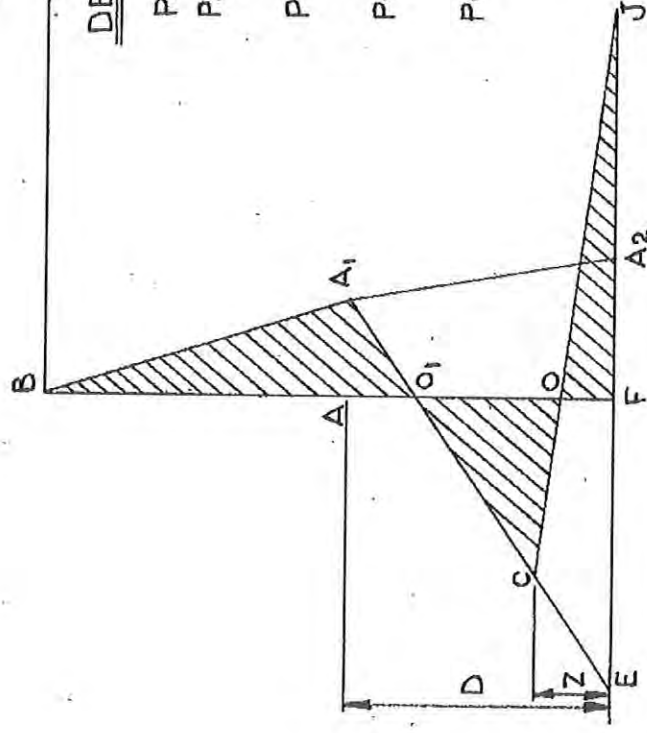
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Design of Cantilevered, Non-Gravity, SSP Wall (ASD) Teng's Conventional Method



Design of Cantilevered, Non-Gravity, SSP Wall (ASD) Teng's Conventional Method



DETERMINE WALL PRESSURES

$$PA_1 = \gamma_e HK_a = (115)(14.0)(0.27) = 435 \text{ PSF}$$

$$PA_2 = PA_1 + \gamma_e DK_a = 435 + (65)(0.27) D \\ = 435 + 17.6 D \approx 620$$

$$PE = \gamma_e' D(K_p - K_a) - PA_1 = 65D(6.29) - 435 \\ = 408.9D - 435 \approx 385$$

$$PJ = \gamma_e' D(K_p - K_a) + \gamma_e HK_p = 65D(6.29) \\ + 115(14)(6.56) = 14,855$$

$$PV = 408.9D + 10,562 \\ = 14,855$$

Design of Cantilevered, Non-Gravity, SSP Wall (ASD) Teng's Conventional Method

FROM STATICS, THE FOLLOWING CONDITIONS MUST BE SATISFIED
 (1) $\sum F_H = 0$ IN TERMS OF AREAS:

$$\text{OR} \quad \text{AREA (BAA}_1) + \text{AREA (AA}_1\text{A}_2\text{F)} + \text{AREA (ECU)} - \text{AREA (EA}_1\text{A}_2) = 0$$

$$\frac{1}{2} (H) PA_1 + (PA_1 + PA_2) \frac{D}{2} + (P_E + P_J) \frac{Z}{2} - (P_E + PA_2) \frac{D}{2} = 0 \quad \checkmark$$

SOLVING FOR Z:

$$Z = \frac{(P_E - PA_1) D - H PA_1}{P_E + P_J}$$

(2) $\sum M$ ABOUT ANY POINT IS ZERO

$$\sum M_F = \left[\frac{1}{2} (H) PA_1 (D + \frac{H}{3}) \right] + \left[(PA_1) \frac{D^2}{2} \right] + \left[(P_E + P_J) \frac{Z^2}{6} \right] - \left[(P_E + PA_2) \frac{D^2}{6} \right] + \left[(PA_2 - PA_1) \frac{D^2}{6} \right] = 0$$

METHOD OF SOLUTION:

1. ASSUME A DEPTH OF PENETRATION, D
2. CALCULATE Z
3. SUBSTITUTE Z INTO $\sum M_F$ AND CHECK IF ZERO. ADJUST D AND RECALCULATE IF NECESSARY.

TRY D = 10.5 FT.

Design of Cantilevered, Non-Gravity, SSP Wall (ASD)

Teng's Conventional Method

$$PA_1 = 435 \text{ PSF} \quad PA_2 = 620 \text{ PSF} \quad PJ = 14,855 \text{ PSF} \quad PE = 3858 \text{ PSF}$$

$$Z = \frac{(3858 - 435)(10.5) - (14)(435)}{14,855 + 3858} = \frac{29852}{18713} = 1.60 \text{ FT.}$$

$$\Sigma M_F = \left[\frac{1}{2} (14)(435)(10.5 + 4.67) \right] + \left[\frac{(435)(10.5)^2}{2} \right] + \left[(620 - 435) \frac{(10.5)^2}{6} \right] \\ + \left[(3858 + 14,855) \frac{(1.60)^2}{6} \right] - (3858 + 620) \frac{(10.5)^2}{6}$$

$$\Sigma M_F = 46,193 + 23,979 + 3,399 + 7,984 - 82,283$$

$$\Sigma M_F \neq 0$$

$$\Sigma M_F = -728 \text{ FT.-LB.} \quad \text{SAY O.K.} \quad \text{USE } D = 10.5 \text{ FT.}$$

Design of Cantilevered, Non-Gravity, SSP Wall (ASD)

Teng's Conventional Method

CANTILEVERED SHEET PILE WALL / 1. Granular Soil

TO ASSURE A MARGIN OF SAFETY, D MAY BE INCREASED BY

20 TO 40 % OR, ALTERNATELY, A REDUCED PASSIVE EARTH

PRESSURE COEFFICIENT COULD BE USED.

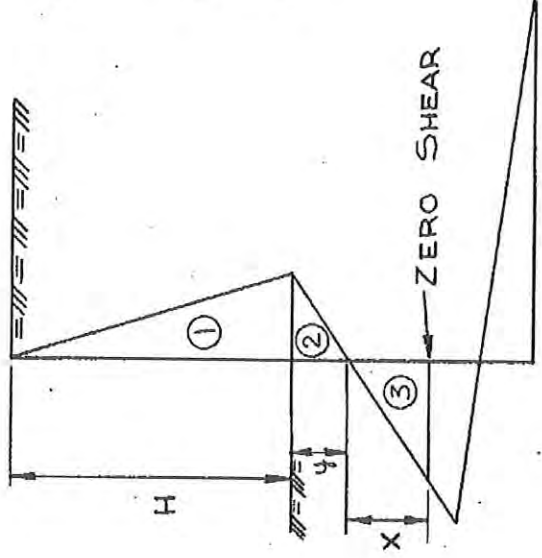
$$10.5' \times 120\% = 12.6'$$

USE $D = 13.5$ FT. (INCREASE = ~~28.5%~~) Remember, US Steel sells steel!

$$\text{Length of SSP per Conventional Method} = 14.0' + (10.5' \times 1.2) = 26.6'$$

$$\text{Length of SSP per Simplified Method (Covitch)} = 14.0' + (9.86' \times 1.2) = 25.8' \quad \Delta = 9\frac{1}{4}''$$

Design of Cantilevered, Non-Gravity, SSP Wall (ASD) Teng's Conventional Method



$$\frac{1}{2} \gamma' (K_P - K_a) X^2 = P_1 + P_2$$

$$X^2 = \frac{2(P_1 + P_2)}{\gamma' (K_P - K_a)}$$

$$y = \frac{P_{A1}}{\gamma' (K_P - K_a)} = \frac{435}{65(6.29)} = 1.06 \text{ FT.}$$

SAY 1.0 FT.

$$P_1 = \frac{1}{2} P_A, H = \frac{1}{2} (435)(14) = 3040 \text{ LB}$$

$$P_2 = \frac{1}{2} P_A, y = \frac{1}{2} (435)(1.0) = 218 \text{ LB.}$$

Locate Point of Zero Shear
in order to calculate the
Maximum Moment in SSP

Design of Cantilevered, Non-Gravity, SSP Wall (ASD) Teng's Conventional Method

CANTILEVERED SHEET PILE WALL / 1. Granular Soil

$$X_2 = \frac{2(3040 + 218)}{65(6.29)} = \frac{2(3258)}{407} = 16$$

$$X = 4.0 \text{ FEET}$$

MAXIMUM MOMENT

$$P_3 = \frac{1}{2} \gamma' (K_P - K_A) X^2 = P_1 + P_2 = 3280 \text{ LB.}$$

$$M_{MAX} = P_1 e_1 + P_2 e_2 - P_3 e_3$$

$$M_{MAX} = 3040 \left(\frac{14}{3} + 1.0 + 4.0 \right)$$

$$+ 218 \left(\frac{2(1)}{3} + 4.0 \right)$$

$$- 3280 \left(\frac{4.0}{3} \right)$$

$$M_{MAX} = 29,300 + 1030 - 4360 = 26,000 \text{ FT. LBS.}$$

Per Conventional Method

$$M_{ux} = 26,310 \text{ FT. LBS / LF Per Simplified Method}$$

Ref: Steel Sheet Piling Design Manual, United States Steel, 1970, Ex. No. 1, Pg. 88

$$M_{cm} \quad M_{SM} \\ 26,000 \approx 26,310$$