David Dammon
ENCE4340

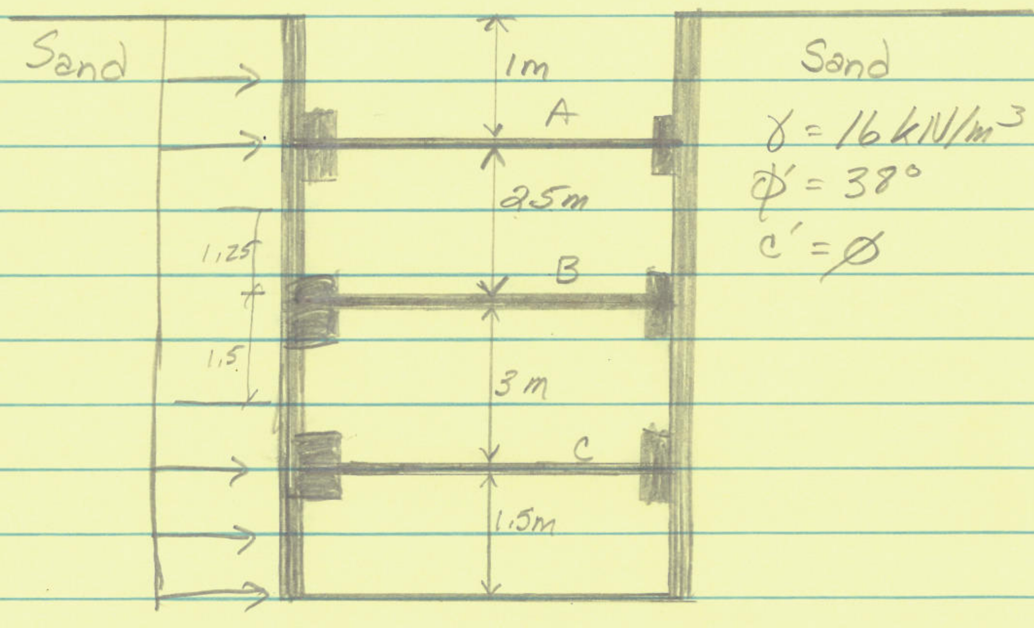
#10.2 For the braced cut described in Prob #10.1. Determine:

a) The sheet pile section modulus.

b) The section modulus of the wales @ level B

assume $\sigma_{all} = 170\ MN/m^2$

10.1. Given $\gamma = 16\ kN/m^3$, $\phi' = 38°$ & $c' = \phi$. Struts are 3.5m O.C.



[10.1]

$\sigma_{a\,sand} = 0.65\,\gamma\,H\,K_a$

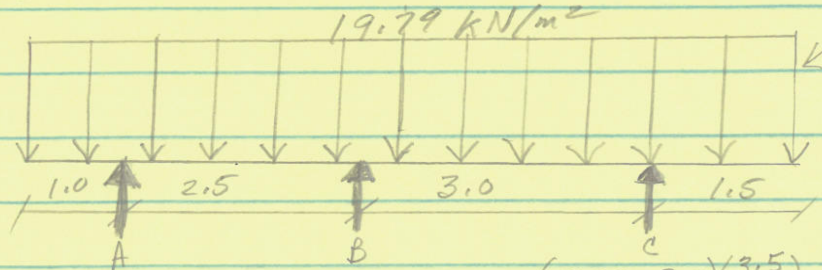
$= 0.65(16)(8)(0.2379)$

$\sigma_a = 19.79\ kN/m^2$

$K_a = \tan^2(45 - \frac{\phi'}{2})$

$\tan^2(45-19) = 0.2379$

10.2 cont



Looking left @B $\Sigma M_{B_1} = \emptyset$ $\quad A = \dfrac{(19.79 \times 3.5)\left(\frac{3.5}{2}\right)}{2.5} = 48.39 \text{ kN/m}$

$\Sigma F_y = \emptyset \quad B_1 = (19.79 \times 3.5) - 48.39 = 20.87 \text{ kNm}$

Looking right @B $\Sigma M_{B_2} = \emptyset$ $\quad C = \dfrac{(19.75 \times 4.5)(4.5/2)}{3} = 66.79 \text{ kN/m}$

$\Sigma F_y = \emptyset \quad B_2 = (19.79 \times 4.5) - 66.29 = 22.26 \text{ kN/m}$

$B = 43.135 \text{ kN/m}$

Reaction @ A = 48.39 kN/m × 3.5 m (spacing) = 169.36 kN

@ B = 43.135 kN/m × 3.5 m = 150.97 kN

@ C = 66.79 kN/m × 3.5 m = 233.76 kN

$$M_{max} = \frac{wL^2}{8} = \frac{(19.79)(3)^2}{8} = \boxed{22.26 \text{ kN·m}}$$

a) $$S = \frac{M_{max}}{\sigma_{all}} = \frac{22.26 \text{ kN-m}}{170{,}000 \text{ kN/m}^2} = \boxed{1.31 \times 10^{-4} \text{ m}^3}$$

b) $$M_{max} = \frac{(B_1 + B_2)s^2}{8} = \frac{(20.87 + 22.26)(3.5\text{ m})^2}{8}$$ (s = spacing)

$$= 66.04 \text{ kN-m}$$

$$S_{wale} = \frac{66.04}{170{,}000} = \boxed{3.88 \times 10^{-4} \text{ m}^3}$$

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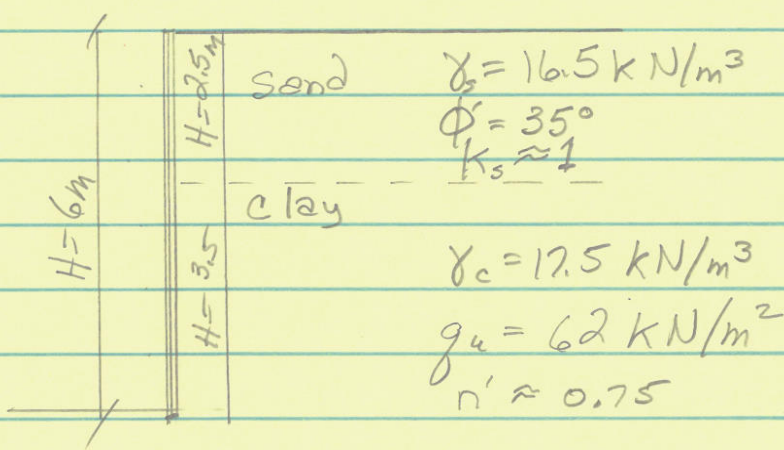
10.5

Refer to Fig below, Given $H = 6m$, $H_s = 2.5m$, $\gamma_s = 16.5 kN/m^3$; $\phi'_s = 35°$, $H_c = 3.5m$, $\gamma_c = 17.5 kN/m^3$ & unconfined compression strength of clay, $q_u = 62 kN/m^2$

a) Estimate the average cohesion (c_{av}) & average unit weight (γ_{av}) for the construction of the earth-pressure envelope.

b) plot the envelope



[10.4] a) $c_{av} = \frac{1}{2H}\left[\gamma_s K_s H_s^2 \tan\phi'_s + H_c n' q_u\right]$

$$= \frac{1}{2(6m)}\left[(16.5)(1)(2.5)^2(\tan 35°) + (3.5m)(0.75)(62)\right]$$

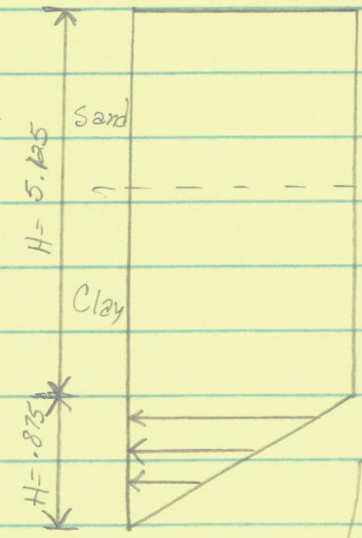
$$C_{av} = 19.58 \ kN/m^3$$

$$\gamma_{av} = \frac{1}{H}\left[\gamma_s H_s + H_c \gamma_c\right] = \frac{1}{6}\left[(16.5)(2.5) + (17.5)(3.5)\right]$$

$$\gamma_{av} = 17.08 \ kN/m^3$$

10.5 cont.

b)



the larger of:

$$\sigma_a = \gamma_{av} H \left[1 - \left(\frac{4c_{av}}{\gamma_{av} H}\right)\right] = (17.08)(6)\left[1 - \frac{4 \times 19.58}{(17.08)(6)}\right]$$

$$\sigma_a = 24.16 \text{ kN/m}^2$$

or

$$\sigma_a = 0.3\gamma H = 0.3(17.08)(6)$$

$$\boxed{\sigma_a = 30.74 \text{ kN/m}^2}$$

#10.8 Determine the sheet pile section modulus of #10.7
Use $\sigma_{all} = 170\ MN/m^2$

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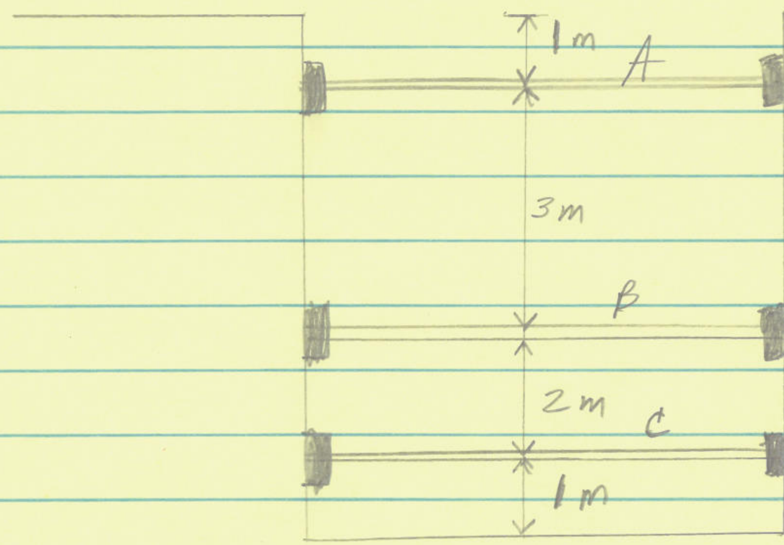
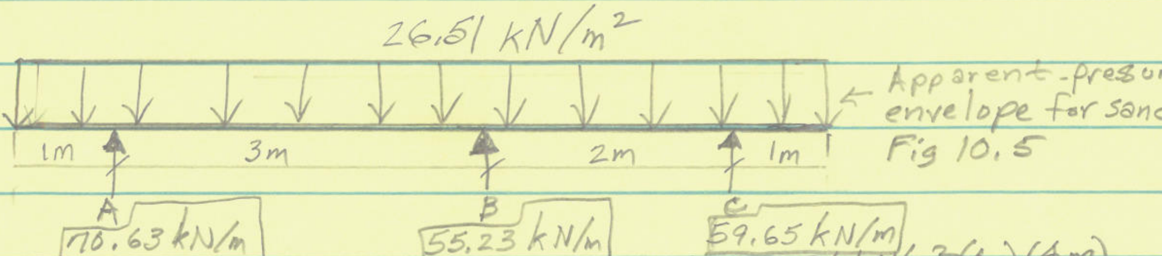
10.7 $\gamma = 17.5\ kN/m^3$, $c = 30\ kN/m^2$, struts 5m O.C.



$c = 30\ kN/m^2$
$\phi = \emptyset$
$\gamma = 17.5\ kN/m^3$
struts 5m O.C.

[10.1] $\sigma_a = 0.65\ \gamma H k_a$
$= 0.65(17.5)(7)(0.333)$
$= 26.51\ kN/m^2$

$k_a = \tan^2\left(45 - \frac{\phi'}{2}\right)$
$= \tan^2(45-15)$
$k_a = 0.333$



Looking Left from 'B' $\Sigma M_{B_1} = \emptyset$ $A = \frac{26.51\ kN/m^2 (4m)\left(\frac{4m}{2}\right)}{3m}$

$A = 70.63\ kN/m$

$B_1 = (26.51 \times 4m) - 70.63 = 35.35\ kN/m$

Looking right from 'B' $\Sigma M_B = \emptyset$ $C = \frac{(26.51)(3)(3/2)}{2} = 59.65\ kN/m$

$B_2 = (26.51 \times 3) - 59.65 = 19.88\ kN/m$

#10.8 Cont.

Reaction @ A = 70.63 × 5m O.C. = 353.15 kN

B = 55.23 × 5m O.C. = 276.15 kN

C = 59.65 × 5m O.C. = 298.25 kN

a) $M_{max} = \frac{wL^2}{8} = \frac{26.51 \times 3^2}{8} = 29.82 \text{ kN-m}$

$S = \frac{M_{max}}{\sigma_{all}} = \frac{29.82 \text{ kN-m}}{170{,}000 \text{ kN/m}^2} = 1.75 \times 10^{-4} \text{ m}^3$