Brandon Nowakowski

10/10

ENCE 4340 Foundation Engineering Fall 2011 Homework # 4 (due: 10-31-2011)

Problem #1: Refer to Figure P9.1. Given: $L_1 = 3\text{m}$; $L_2 = 6m$; $\gamma = 17.3\ \text{kN/m}^3$; $\phi' = 30^0$; $\gamma_{sat} = 19.4\ \text{kN/m}^3$

(a) What is the theoretical depth of embedment, D?

(b) For a 30% increase in D, what should be the total length of the sheet piles?

(c) Determine the theoretical maximum moment of the sheet pile wall.

10/10

γ' = effective unit soil wt. $= \gamma_{sat} - \gamma_w =$

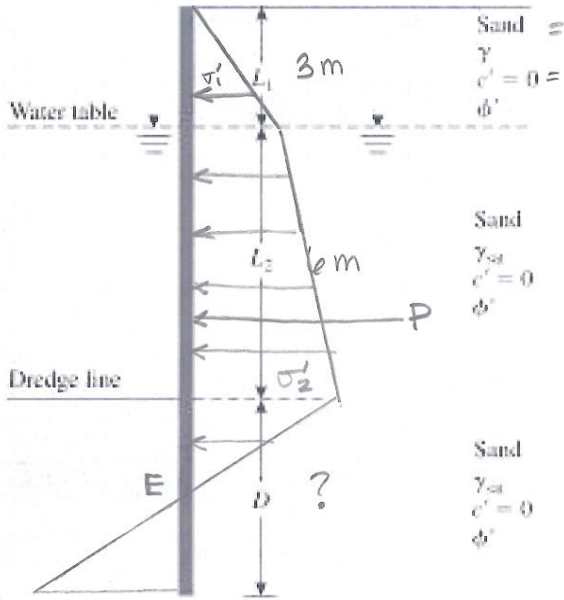

Figure P9.1

$= 19.4 - 9.81 = 9.59$

1) K_a & K_p

$K_a = \tan^2(45 - \frac{30}{2}) = 0.33$

$K_p = \tan^2(45 + \frac{30}{2}) = 3$

2) σ_1' & σ_2'

$\sigma_1' = \gamma L_1 K_p = 17.3(3)(0.33) = 17.18\ \text{KN/m}^2$

$\sigma_2' = [\gamma(L_1) + (\gamma_{sat} - \gamma_w)(L_2)](K_a)$

$= [17.3(3) + (19.4 - 9.81)(6\text{m})](0.33)$

$\sigma_2' = 36.12\ \text{KN/m}^2$

3) Calc. L_3

$L_3 = \sigma_2' / \gamma'(K_p - K_a)$

$= \frac{36.12}{(19.4 - 9.81)(3 - .33)} = 1.41\text{m}$

4) Calc. P

$P = \frac{1}{2}\sigma_1' L_1 + \sigma' L_1 + \frac{1}{2}(\sigma_2' - \sigma_1')L_2 + \frac{1}{2}\sigma_2' L_3$

$= .5(17.18)(3) + 36.12(3) + .5(36.12 - 17.18)(6\text{m})$

$+ .5(36.12)(1.41) = 216.41\ \text{KN/m}$

$P = 216.41\ \text{KN/m}$

5) Calculate $\bar{z}$

$\bar{z} = \frac{\Sigma M_E}{P} = \frac{891.1}{216.41} = 4.12\text{ m}$

$.5\sigma_1' L_1 = .5(17.18)(3) =$	25.77
$\sigma_1' L_2 = 17.18(6)$	103.08
$.5(\sigma_2' - \sigma_1')L_2 = .5(36.12 - 17.18)(6) =$	56.82
$.5\sigma_2' L_3 = .5(36.12)(1.41) =$	25.46

$\Sigma M_E = (25.77 \times 8.42) + (103.08 \times 4.42) + (56.82 \times 3.42) + (25.46 \times 0.95) = 891.1$

6) Calc σ_5'

$\sigma_5' = (\gamma L_1 + \gamma' L_2)K_p + \gamma' L_3(K_p - K_a)$

$= [17.3(3) + 9.59(6)]3 + 9.59(1.41)(3 - .33)$

$\sigma_5' = 364.42\ \text{KN/m}^2$

7) Calc $A_1 - A_4$:

$A_1 = \frac{\sigma_5'}{\gamma'(K_p - K_a)} = \frac{364.42}{9.59(3 - .33)} = 14.23$

$A_2 = \frac{8P}{\gamma'(K_p - K_a)} = \frac{8(216.41)}{9.59(3 - .33)} = 67.61$

$A_3 = \frac{6P[2\bar{z}\gamma'(K_p - K_a) + \sigma_5']}{\gamma'^2(K_p - K_a)^2}$

$= \frac{6(216.41)[2(4.12)9.59(3 - 0.33)(364.42)]}{9.59^2(3 - .33)^2}$

$A_3 = 117.27$

$A_4 = \frac{P(6\bar{z}\sigma_5' + 4P)}{\gamma'^2(K_p - K_a)^2}$

$= \frac{216.41(6 \times 4.12 \times 364.42 + 4(216.41)}{9.59^2(3 - .33)^2}$

$A_4 = 3259.23$

8) Calc L_4

$L_4^4 + A_1 L_4^3 - A_2 L_4^2 - A_3 L_4 - A_4 = 0$

$L_4^4 + 14.23 L_4^3 - 67.61 L_4^2 - 117.27 L_4 - 3259.23 = 0$

$L_4 \approx 9\text{ m}$ ✓

$D = L_3 + L_4 = 10.41\text{ m}$

see back of sheet →

ENCE 4340 Foundation Engineering Fall 2011 Homework #4 (due: 10-31-2011)

Problem # 2 : Refer to Figure P9.10. Given : $L_1 = 2\text{m}; L_2 = 6m; l_1 = 1\text{m}; \gamma = 16\ \text{kN/m}^3; \phi' = 32^0;$

$\gamma_{sat} = 18.86\ \text{kN/m}^3; c = 27kN/m^2$

(a) Determine the theoretical depth of embedment, D.

(b) Calculate the anchor force per unit length of the sheet pile wall

Use the free earth support method

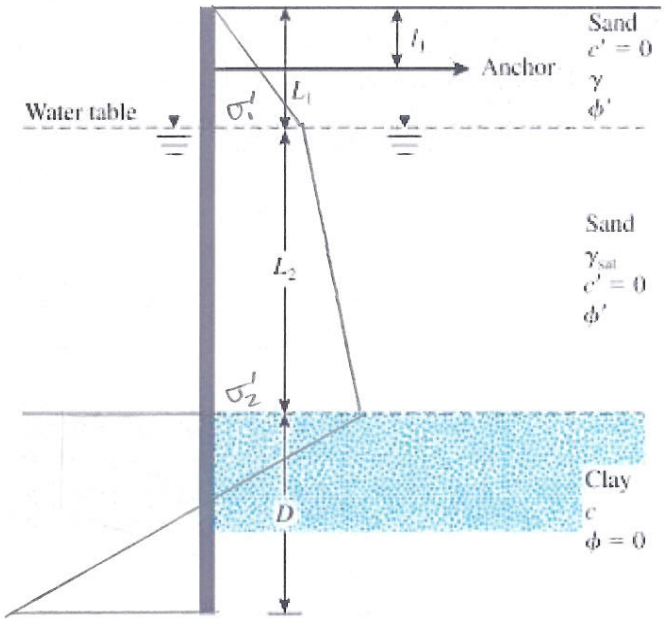

Figure P9.10

$K_a = \tan^2(45 - \frac{32}{2}) = 0.307$

$K_p = \tan^2(45 + \frac{32}{2}) = 3.255$

$\sigma_1' = 16(2)(0.307) = 9.82\ \text{KN/m}^2$

$\sigma_2' = [16(2) + 9.05(6)](0.307) = 26.5$

$P_1 = .5(2)(9.82) + 9.82(6) + .5(26.5 - 9.82)(6) = 118.8\ \text{KN/m}$

$\Sigma M_o = 0 = 9.82(6.67) + 58.92(3) + 50.04(2) - 118.8\bar{z}_1$

$\bar{z}_1 = 2.88\ \text{m}$

$\sigma_6 = 4(27) - (16 \times 2 \times (9.05 \times 6)) = 21.7\ \text{KN/m}^2$

$21.7D^2 + 2(21.7)D(2+6-1) - 2(118.8)(2+6-1-2.88) = 0$

$D = 2.7\text{m}$ ✓

$F = 118.8 - 21.7(2.7) = 60.2\ \text{KN/m}$

$F = 60.2\ \text{kN/m}$ ✓

10/10