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CV2302 - Geotechnical Engineering (Sem 2 2011-2012) Yes, U Can!

1\. a)

Sampling method: Thin wall sampler.

b) $\sigma_1 = 2 \times 17$ $\qquad$ $\sigma_2 = 8 \times 17$

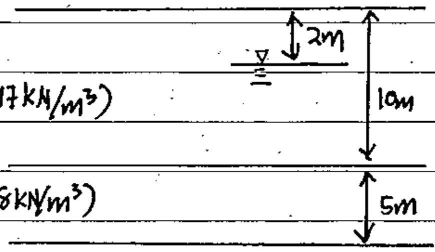
$= 34\ kN/m^2$ $\qquad$ $= 136\ kPa$

$u_1 = 0$ $\qquad$ $u_2 = 6 \times 9.81$

$\sigma_1' = 34 - 0$ $\qquad$ $= 58.86\ kPa$

$= 34\ kPa$ $\qquad$ $\sigma_2' = 136 - 58.86$

$= 77.14\ kPa$



$N_{CORR_1} = C_{N_1} N_1$ $\qquad$ $N_{CORR_2} = C_{N_2} N_2$

$= \sqrt{\frac{100}{34}}(6)$ $\qquad$ $= \sqrt{\frac{100}{77.14}}(20)$

$= 10.29$ $\qquad$ $= 22.77$

c) $I_P = LL - PL$

$= 63 - 32$

$= 31$

From graph, $\lambda = 0.92$

$C_u = \lambda C_{u,FVT}$

$= 0.92(26)$

$\doteq 23.92\ kPa$

2\. a) Rules.

I). The flow line and the equipotential line are perpendicular to each other.

II) For every element of flow net must be [illegible] to a square ($a \simeq b$)

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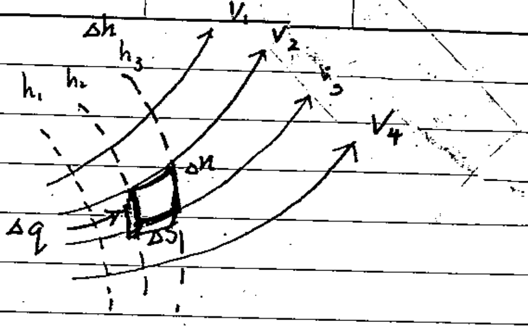
2. b) $q = N_f \Delta q$

$\Delta h = \frac{h}{N_d}$



$\Delta q = k i A$

$= k \frac{\Delta h}{\Delta s} \Delta n (1)$ ($\Delta S = \Delta n$, "curvilinear" squares)

$= k \Delta h$

$q = N_f k \Delta h$

$= N_f k \left(\frac{h}{N_d}\right)$

$= kh \frac{N_f}{N_d}$ #

c) i) $k = 5.5 \times 10^{-5} m/s$

$N_f = 4$

$N_d = 7$

$h = 7$

$q = kh \frac{N_f}{N_d}$

$= (5.5 \times 10^{-5})(7)\left(\frac{4}{7}\right)$

$= 2.2 \times 10^{-4} \ m^3/s/m$

ii) $\Delta h = \frac{7}{7}$

$= 1$

$h_A = 7 - 3.5(1)$

$= 3.5 \ m$

$h_{Az} = -0.8 \ m$

$h_A = h_{Ap} + h_{Az}$

$h_{Ap} = h_A - h_{Az}$

$= 3.5 - (-0.8)$

$= 4.3 \ m$

$u_A = h_{Ap} \gamma_w$

$= 4.3 (9.81)$

$= 42.183 \ kPa$

iii) For the exit gradient B.

$L_B = 0.8 m$.

$\therefore h_B = \frac{1}{4} \Delta h$.

$= 0.25 m$

$\therefore i = \frac{h}{L} = \frac{0.25}{0.8} = 0.3125$ #

Ans: The exit gradient is 0.3125.

2c) iv) $h_c = 7 - 1(1)$

$= 6\,m$

$h_{cz} = -16\,m$

$h_c = h_{cp} + h_{cz}$

$h_{cp} = h_c - h_{cz}$

$= 6 - (-16)$

$= 22\,m$

$u_c = h_{cp}\gamma_w$

$= 22(9.81)$

$= 215.82\ kPa$

$\sigma_c' = \sigma_c - u_c$

$= 16(19) - 215.82$

$= 88.18\ kPa$

3a) At rest lateral earth pressure: lateral earth pressure of the soil when there is no relative movement of wall.

Active lateral earth pressure: lateral earth pressure of the soil when the wall is moving away from the soil.

Passive lateral earth pressure: lateral earth pressure of the soil when the wall is moving toward the soil.

b) before the excavation:

$K_0 = (1 - \sin\phi')OCR^{0.5}$

$= (1 - \sin 32°)(1)^{0.5}$ (assume $OCR = 1$)

$= 0.47$

$\sigma_{Az}' = \sigma_A - u_A$

$= 2(20) - 1(9.81)$

$= 30.19\ kPa$

$\sigma_{Ax}' = K_0 \sigma_{Az}'$

$= 0.47(30.19)$

$= 14.19\ kPa$

after the excavation:

$K_a = \frac{1 - \sin\phi'}{1 + \sin\phi'}$

$= \frac{1 - \sin 32°}{1 + \sin 32°}$

$= 0.307$

$\sigma_{Az}' = \sigma_A - u_A$

$= 2(20) - 1(9.81)$

$= 30.19\ kPa$

$\sigma_{Ax}' = K_a \sigma_{Az}'$

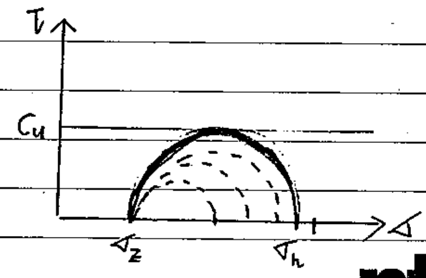
$= 0.307(30.19)$

$= 9.268\ kPa$

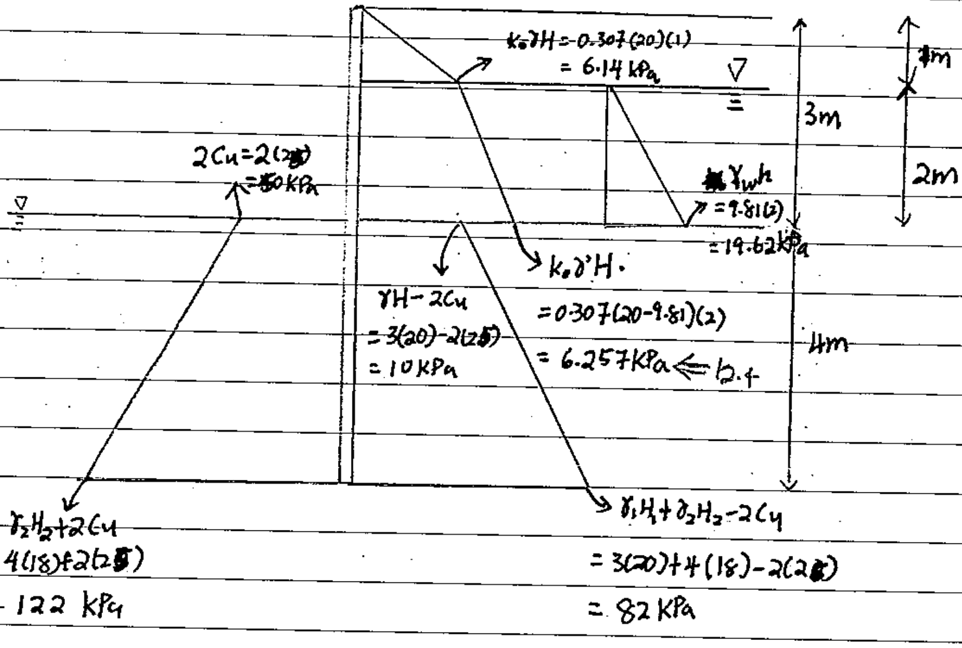
c) $R = C_u$

max $\sigma_h = \sigma_z + 2R$

$\sigma_h = \sigma_z + 2C_u$



3. d)



4a) For slope stability analysis, we have to know the soil profile, groundwater level and the geometric of the slope. By using these information, we are able to carry out slope stability analysis, By finding out the slope failure that have minimum factor of safety, we can then decide whether to strengthen the slope or it has sufficient strength to remain stability.
Site investigation work: Installation of piezometers, inclinometer and conventional surveying.
laboratory test : Direct shear test to find out shear strength of sand.

b) i) $\gamma = \gamma_{sat} = 20$ kN/m^3, $\phi' = 35°$, $\beta = 25°$, $z = 5$ m, $F = 1$

$$F = \frac{[\{(1-m)\gamma + m\gamma_{sat}\} z \cos^2\beta - m z \gamma_w \cos^2\beta] \tan\phi'}{\{(1-m)\gamma + m\gamma_{sat}\} z \sin\beta\cos\beta}$$

$$1 = \frac{[\{(1-m)(20) + m(20)\}(5)\cos^2(25°) - m(5)(9.81)\cos^2 25°] \tan 35°}{\{(1-m)(20) + m(20)\}(5) \sin 25° \cos 25°}$$

$$\frac{20(5)\sin 25° \cos 25°}{\tan 35°} = 20(5)\cos^2 25° - (5)(9.81)\cos^2 25° m$$

$$54.7 = 82.139 - 40.289m$$

$$m = 0.681$$

The height of the water table
$= mz$
$= 0.681(5)$
$= 3.405$

Yes, U Can!

ii) $u = m z \gamma_w \cos^2\beta$

$= (0.681)(5)(9.81)\cos^2 25°$

$= 27.44$ kPa

iii) $\gamma = \gamma_{sat} = 20 kN/m^3$, $\phi' = 35°$, $\beta = 25°$, $z = 5m$, $F = 1.5$

$$F = \frac{[\{(1-m)\gamma + (m)\gamma_{sat}\} z \cos^2\beta - m z \gamma_w \cos^2\beta]\tan\phi'}{[(1-m)(20) + m(20)](5)\sin 25°\cos 25°}$$

$$1.2 = \frac{[\{(1-m)(20) + m(20)\}(5)\cos^2 25° - m(5)(9.81)\cos^2 25°]\tan 35°}{[(1-m)(20) + m(20)](5)\sin 25°\cos 25°}$$

$$\frac{1.2(20)(5)\sin 25°\cos 25°}{\tan 35°} = 20(5)\cos^2 25° - (5)(9.81)\cos^2 25° m$$

$65.64 = 82.139 - 40.289m$

$m = 0.410$

The height of the water table

$= mz$

$= 0.41(5)$

$= 2.05$ m

iv) We can install water pump to lower the water level of the slope. It can also provide us the water level of the slope which can facilitate us in maintaining the water level.

5a) Objectives: I. To change the ground surface initial configuration to preference of ground configuration.

II. It is important to engineers not to create slope stability problem.

Stages: I. site investigation

II. slope stability analysis

III earthwork

IV. installation of piezometer or measurement device to monitor.

b) i) $C_R = \frac{\gamma_d}{\gamma_{dmax}} \times 100\%$

$0.95 = \frac{\gamma_d}{19}$

$\gamma_d = 18.05 kN/m^3$

$W_s = 18.05$ KN

$W_T = W_s + W_w$

$= W_s + wW_s$

$= (1+w)W_s$

$= (1.09)(18.05)$

$= 19.6745$ KN

$V_T = \frac{W_T}{\gamma}$

$= \frac{19.6745}{17}$

$= 1.157 m^3$

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ii) $\Delta W_w = W_s(12.5\% - 9\%)$

$= 18.05(0.035)$

$= 0.632 \text{ kN}$

$\Delta V_w = \frac{\Delta W_w}{\gamma_w}$

$= \frac{0.632}{9.81}$

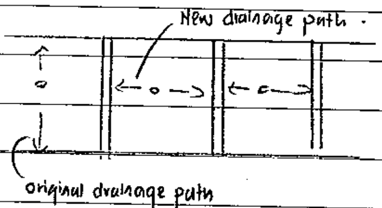
$= 0.0644 \text{ m}^3$

III) I. Sand Cone Test: To check the dry unit density of the sand.

II. Water Content Test: To check the water content of the compacted sand.

By using this 2 Test, we are able to find out the constructed fill specification.

c)



The installation of vertical drains can provide a shorter drainage path to the soil. Since under surcharge loading, excess pore water pressure will build up, these path will accelerate the dissipation of pore water pressure which will increase the rate of consolidation.

d) Grouting: Injection of special liquid or slurry materials, called grouts into the group to improve the soil or rocks.

a. Cementitious grouts.

b. Chemical grouts.

admixtures: Mixing the soil with admixture, e.g: Portland cement to increase strength of the soil and reduce their compressibility and hydraulic conductivity. It also reduce expansion in clays.