2302
CV[redacted] - Geotechnical Engineering SEM2 2010/2011

~~SPT, ADV:~~

1 a) - Acquire penetration resistance in terms of blowcount "N" - number of blows for 300mm penetration
- Indirect measurement of soil strength and stiffness

SPT, DISADVANTAGE:
- Require preboring before conducting the test
- The soil samples obtained are disturbed

CPT, ADV:
- Acquire cone resistance q_c, shaft friction f_c, and pore pressure (piezocone)
- Continuous profiling of soil
- Indirect measurement of soil strength and stiffness
- Preboring is not required

CPT, DISADVANTAGE:
- No soil samples are obtained
- Not suitable for very stiff soils or gravelly soils

b)
$$N_{60} = \frac{E_M C_B C_S C_R N}{0.6}$$

$$= \frac{(0.75)(1.05)(1.2)(1)(20)}{0.6}$$

$$= 31.5$$

Correction for stress: $C_N = 10\left(\frac{1}{\sigma_z'}\right)^{0.5}$

$$= 10\left(\frac{1}{15\times10}\right)^{0.5}$$

$$= 0.816 \quad (\le 2)$$

$\therefore N_{corr} = 0.816 \times 31.5$

$= 25.7$

≈ 26

c)

$$(S_u)_{FV} = \frac{2T}{\pi D^3 (H/D + 1/3)}$$

$$= \frac{2 \times 42.24}{\pi (0.05)^3 \left(\frac{0.15}{0.05} + \frac{1}{3}\right)} \quad (Pa)$$

$$= 64.54 \text{ kPa}$$

Correction for $c_{u\,FVT}$.

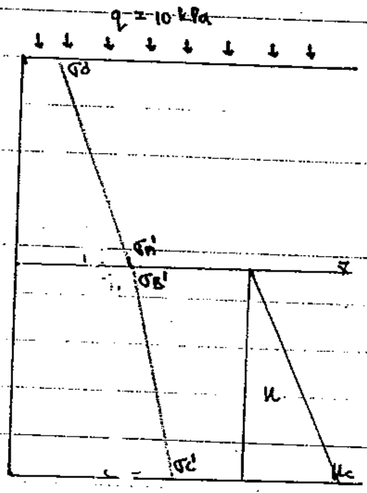
With PI = 50 → $\lambda = 0.8$ (The chart was not given in the Appendix at my time). See Notes!

$$\therefore C_{u\,corr} = 0.8 \times 64.54$$

$$= 51.6 \text{ kPa}$$

The real in-situ undrained shear str should be bigger than the calculated value, because even though that FVT is in-situ test, there may be disturbance happed to the soil during the test

d) (i)



Sand $\phi' = 30$, $\gamma = 20$ kN/m³, $K_a = \frac{1 - \sin 30}{1 + \sin 30} = \frac{1}{3}$

Clay $\phi' = 30$, $c' = 0$, $\gamma = 11$ kN/m³, $K_a = \frac{1 - \sin 30}{1 + \sin 30} = \frac{1}{3}$

$$\sigma_0' = \frac{1}{3}(10) = 3.3 \text{ kPa}$$

$$\sigma_A' = \frac{1}{3}(10 + 3 \times 20) = 23.3 \text{ kPa}$$

$$\sigma_B' = \frac{1}{3}(10 + 3 \times 20) - 2 \cancel{c'} \sqrt{\frac{1}{3}} = 23.3 \text{ kPa}$$

$$\sigma_C' = \frac{1}{3}(10 + 3 \times 20 + 3 \times 8) = 31.3 \text{ kPa}$$

$$u_c = 3 \times 10 = 30 \text{ kPa}$$

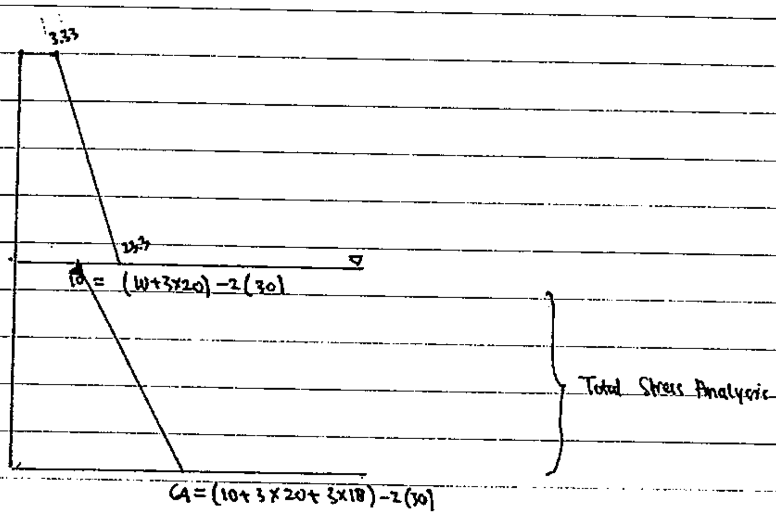
d) (ii) Assumption : Slip surface is straight plane

Inclination of slip surface : active → $\frac{\phi'}{2}+45$

passive → $45-\frac{\phi'}{2}$

The assumption is not realistic because in reality the slip surface is circular plane

(iii)



2 a) (i) $h = 6$

$N_f = 12$

$N_d = 6$

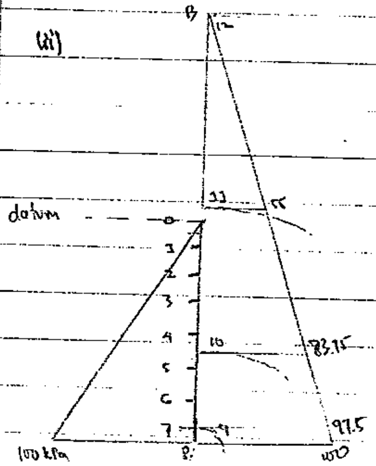
$\Delta h = \frac{6}{12} = 0.5$

$q = k h \, N_f / N_d$

$= 10^{-4} (6) \, (^{12}/_{6})$

$= 1.2 \times 10^{-3} \; m^3/s$

(ii)



Can also assume the length of unit block is 0.8m instead of 0.75m

$H = z + h_p$

$h_p = H - z$

Left

Point	Total Pressure	z (m)	hp (m)	u = hp × 10 (kPa)
0	0	0	0	0
1	1ΔH = 0.5	$-1(\frac{6}{8}) = -0.75$	1.25	12.5
2	2ΔH = 1	$-2(\frac{6}{8}) = -1.5$	2.5	25
3	3ΔH = 1.5	$-3(\frac{6}{8}) = -2.25$	3.75	37.5
4	4ΔH = 2	-3	5	50
5	5ΔH = 2.5	-3.75	6.25	62.5
6	6ΔH = 3	-4.5	7.5	75
7	7ΔH = 3.5	-5.25	8.75	87.5
8	8ΔH = 4.0	-6	10	100

Right

Point	Total Pressure	z (m)	hp (m)	u = hp × 10 (kPa)
12	12ΔH = 6	6	0	0
11	11ΔH = 5.5	≈0	5.5	55
10	10ΔH = 5	$\frac{-3-3.75}{2} = -3.375$	8.375	83.75
9	9ΔH = 4.5	-5.25	9.75	97.5
8	8ΔH = 4	-6	10	100

2 a) (iii) At point x, $H = 11\Delta h = 11 \times \frac{6}{12} = 5.5m$

$z = -2m$

$h_p = 5.5 - (-2) = 7.5m$

$u_x = 7.5 \times 10 = 75\ kPa$

$\sigma_x = 8 \times 20 = 160\ kPa$

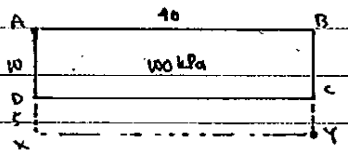
$\sigma_x' = 160 - 75 = 85\ kPa$

(iv) $i_{exit} = \frac{\Delta h}{\Delta s} = \frac{\left(\frac{6}{12}\right)}{0.8} = 0.625$

$i_c = \frac{\gamma_b}{\gamma_w} = \frac{20-10}{10} = 1$

2 b) $\sigma_{Y\,(15m)}$ = induced stress from q_1 + induced stress from q_2

– induced stress from q_1 ($\Delta\sigma_{Y1}$)



Block ABYX → $m = B/z = 15/15 = 1$

$n = L/z = 40/15 = 2.667$

Since The Chart only shows lines of n up to n=2

easier to use $m = 2.667$, $n = 1$ } interchangeably

$I_r \approx 0.205$

$\Delta\sigma_Y = 100 \times 0.205 = 20.5\ kPa$

Block DCYX → $m = B/z = 40/15 = 2.667$

$n = L/z = 5/15 = 0.333$

$I_r \approx 0.09$

$\Delta\sigma_Y = 100 \times 0.09 = 9\ kPa$

Hence $\Delta\sigma_{Y1} = 20.5 - 9 = 11.5\ kPa$

- Induced stress from q_2 ($\Delta\sigma_{y2}$)

I_r similar to $\Delta\sigma_{y1}$

From Block HGYX $I_r \approx 0.205$

$\Delta\sigma_y = 200 \times 0.205 = 41$ kPa

From Block EFYX $I_r \approx 0.09$

$\Delta\sigma_y = 200 \times 0.09 = 18$ kPa

Hence $\Delta\sigma_{y2} = 41 - 18 = 23$ kPa

∴ Vertical stress 15m below point Y = 23 + 11.5 = 34.5 kPa

3 a)

(i) $FS = \dfrac{\text{resisting moment}}{\text{overturning moment}} = \dfrac{c_u L_a r}{Wd + Pt}$

$1.2 = \dfrac{(60)(19)(12)}{(1300)(4.6) + P(7)}$

↳ P = 774.3 kN

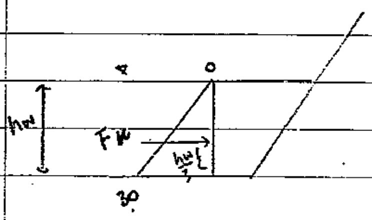
(ii) P_{max} ! happen when FS = 1

$FS = \dfrac{c_u L_a r}{Wd + Pt}$

$(1300)(4.6) + P_{max}(7) = (60)(19)(12)$

$P_{max} = 1100$ kN

3 a) (iii) Easiest approach, assume that the pore pressure (force) acting horizontally



$Fu = \frac{1}{2}(30)(3) = 45$ kPa

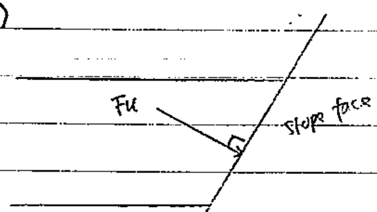
$$FS = \frac{\text{resisting moment}}{\text{overturning moment}} = \frac{Fu\,(H + hc - \frac{1}{3}hw) + Cu\,La\,r}{Wd + Pt}$$

$$1.2 = \frac{45(8+3.5-1) + (60)(19)(12)}{(1300)(4.6) + P(7)}$$

$P = 830.5$ kPa

~~Pore pressure act to all direction,~~ so there will be vertical component

! To be more accurate, assume the Fu act perpendicular to the slope face (and it will be tedious, must work on the lever arm)



b) Assumption: There is friction force in the interslices and the resultant interslices forces are parallel in which both force and moment equilibrium are satisfied

Because if assumption is not made, there will be many parameters that governing earth stability and that will make it impossible to assess the stability

c) Piezometer : to monitor ground water table level,

Inclinometer : to measure horizontal movements in the ground as a function of depth. Can be used to locate shear surfaces and monitoring the rate of shear displacement

1 a) General propose : to improve the quality of the soils

There are many methods for soil improvement and they may affect the soil properties such as:

- Increased the shear strength, → reduce the potential of slope stability problem
- decreased compressibility → reduce excessive settlement
- increased or decreased hydraulic conductivity (depends on application)
- decreased void ratio → further increase the strength and reduce compressibility and permeability

etc

b) For loose sands → the best method is to compact the soil, whilst
For soft clay → the best method is to consolidate the soil

Example:

Precompression or Installation of drainage.

In clay, these method are use to dissipate excessive pore pressure more effectively and thus improving the strength properties. But for sands, due to its nature, sands already have high conductivity. So the usage of such methods for sands is not effective. Improvement of sands properties can be achieved by densification / vibration

c) $Dr = \frac{e_{max} - e}{e_{max} - e_{min}}$

Pre densification → $0.25 = \frac{0.3 - e_0}{0.3 - 0.1}$

$e_0 = 0.25$

Post densification → $0.9 = \frac{0.3 - e_f}{0.3 - 0.1}$

$e_f = 0.12$

Expected settlement $\frac{\Delta H}{H} = \frac{\Delta e}{1 + e_0}$

$\Delta H = \frac{0.25 - 0.12}{1 + 0.25} \; 10\,m = 1.04\,m$

d) Compacted at wet optimum (have more oriented fabric structure) and thus reduce seepage thru dam