



University of Technology
Building and Construction Eng. Dept.
Final Exam / May 2014

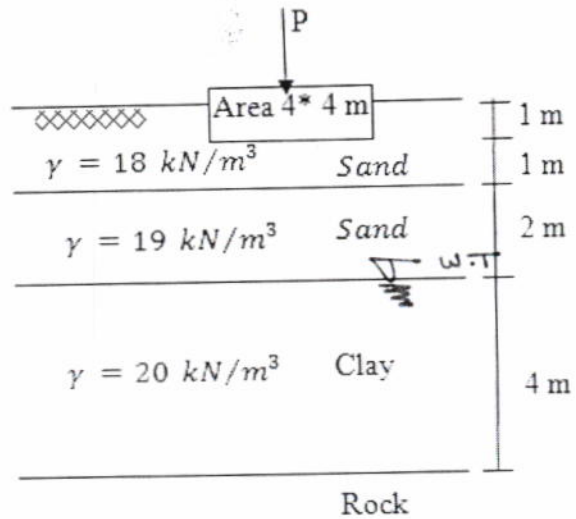
Subject : Soil Mechanics
Branch : All Branches

Class: 3rd Year
Time: 3 hrs.



Note: Answer Five Questions Only

Q1 a) For the foundation shown, determine the total applied load (p) that causes a consolidation settlement of (10) cm in the clay layer. Given that $e = 0.72 - 0.18 \log(\sigma_v / 100)$.

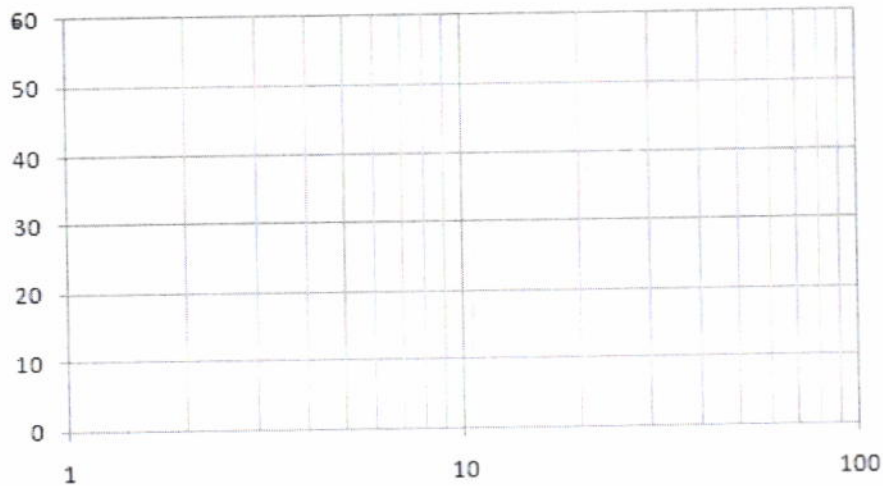


(14 marks)

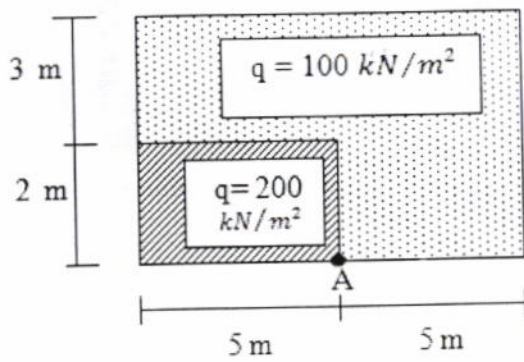
Q1 b) Find the liquid limit and the plasticity index if the plastic limit was 28%. Given that:

| Number of taps (عدد الضربات) | 6 | 8 | 12 | 26 | 28 | 31 |
|------------------------------|------|------|------|------|------|------|
| Water content % | 53.4 | 52.2 | 48.3 | 40.0 | 38.8 | 37.1 |

(6 marks)



Q2-a) Find the vertical stress increment under point A, $Z=5\text{m}$.



| | | | | | | |
|--------|-------|-------|-------|------|-------|-------|
| n | 2 | 1 | 0.6 | 0.4 | 0.6 | 0.4 |
| m | 1 | 1 | 1 | 1 | 2 | 2 |
| Factor | 0.198 | 0.176 | 0.135 | 0.10 | 0.155 | 0.114 |

(8 marks)

Q2-b) The following results were obtained from direct shear test on specimens of sand

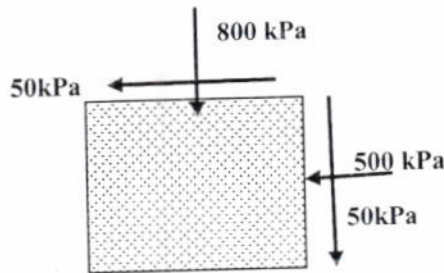
| | | |
|---|----|-----|
| Normal stress (kN/m^2) | 50 | 100 |
| Shear stress at failure (kN/m^2) | 49 | 93 |

- Determine the values of shear strength parameters.
- Would failure occur on a plane within a mass of this sand at a point where shear stress is 122 kN/m^2 and the effective normal stress is 246 kN/m^2 . (12 marks)

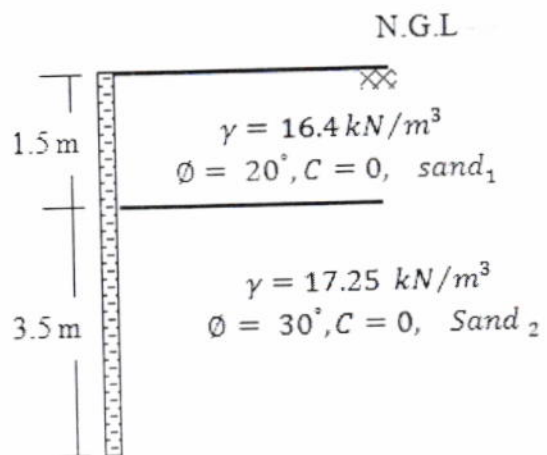
Q3-a)-The stresses on a sample of sand are given in figure below, find:

- Major and minor principal stresses and their orientation.
- Maximum and minimum shear stresses.

(10 marks)



Q3-b) A rigid retaining wall of 5 m height shown in the figure has two layers of backfill. The top layer to a depth of 1.5 m is sand 1, having $\phi = 20^\circ$, $c = 0$ and $\gamma = 16.4 \text{ kN/m}^3$. The bottom layer sand 2 having $\phi = 30^\circ$, $c = 0$ and $\gamma = 17.25 \text{ kN/m}^3$. Determine the resultant active earth pressure acting on the wall and its position.

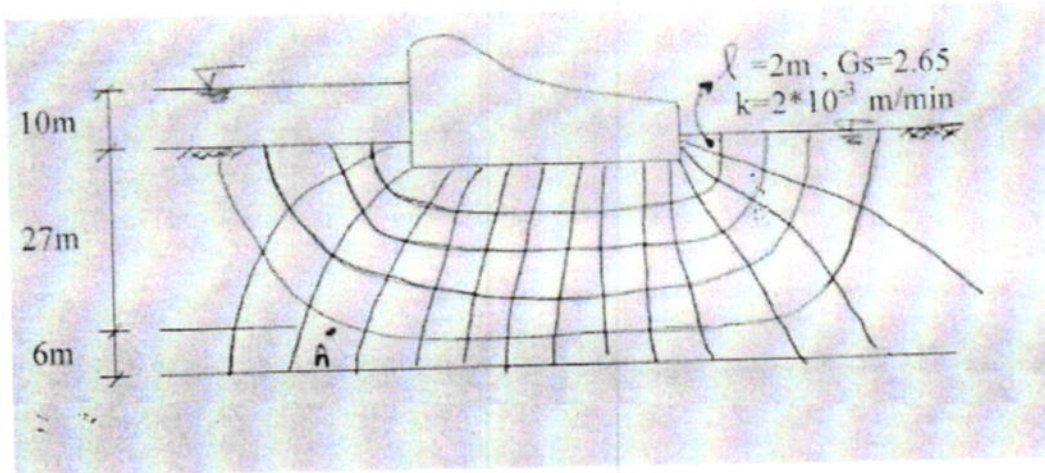


(10 marks)

To be continue

Q4-a) for the flow net shown find:

- 1- The flow under the dam (given the length of the dam = 50 m)
- 2- Pizometer reading at point A.
- 3- Facto of safety against piping.



(10 marks)

Q4-b) Given the data for a saturated clayey soil sample: $e_0 = 0.9$

at $\sigma = 100 \text{ kN/m}^2$, $C_c = 0.4$ and $k = 3 * 10^{-7} \text{ mm/sec}$

Compute: a) the void ratio at effective stress of 150 kN/m^2 .

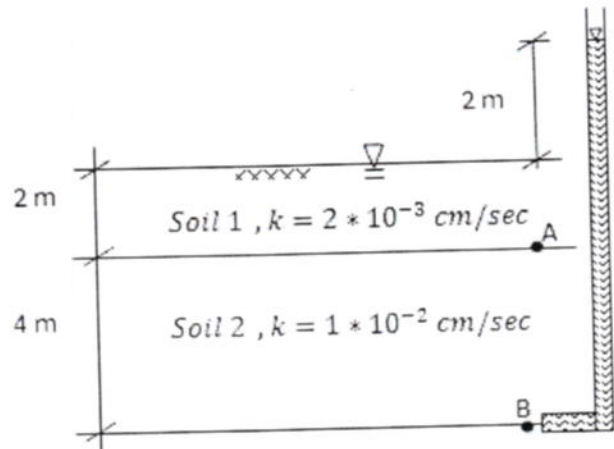
b) the final consolidation settlement, if the soil sample is taken from a stratum of 6m thickness.

c) the time required for 50% settlement, assuming two way drainage.

(10 marks)

Q5- a) For the soil profile shown, find

- a) the factor of safety against piping
- b) Pizometer reading at point A.
- c) Maximum height of pizometer reading at point B.



(10 marks)

Q.5.b Given : mass of wet sample = 254.1 gm , void ratio = 0.6133, volume of air = 1.9 cm^3 , mass of solids = 210 gm . Determine : Degree of saturation , Air content , Dry unit weight.

(10 marks)

Q.6 a) The results shown were obtained at failure in a series of triaxial test on specimens of saturated clay initially 38 mm in diameter and 76 mm long. Determine the values of the shear strength parameters with respect to

a) total stress b) effective stress.

| Type of test | All round pressure kN/m ² | Axial load (N) | Axial deformation (mm) | Volume change (ml) (cm ³) |
|--------------|---|-------------------|---------------------------|---|
| Undrained | 200 | 222 | 9.83 | - |
| | 400 | 215 | 10.06 | - |
| Drained | 200 | 467 | 10.81 | 6.6 |
| | 400 | 848 | 12.26 | 8.2 |

(10 marks)

Q6. B) Compare between two of the following :

- 1) Illite and Montmorlonite.
- 2) Total consolidation settlement in case of one and two way drainage for the same clay layer.
- 3) Relative density and relative compaction.

(10 marks)

Good Luck

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Q.1 a) $P'_0 = 2 \times 18 + 2 \times 19 + 2 \times 10 = 94 \text{ kN/m}^2$

$$e_0 = 0.72 - 0.18 \log \left(\frac{94}{100} \right) = 0.7248$$

$$\frac{10}{100} = \frac{0.7248 - e_f}{1 + 0.7248} \times 4 \Rightarrow e_f = 0.682$$

$$0.682 = 0.72 - 0.18 \log \frac{P'_f}{100} \Rightarrow P'_f = 162.55 \text{ kN/m}^2$$

$$\Delta p = 68.55$$

$$68.55 = \frac{\left(\frac{P}{16} - 1 \times 18 \right) \times 4 \times 4}{(4+5)(4+5)} \Rightarrow P = 5840 \text{ kN}$$

Q.1 b)

| | | |
|-----|----|-------|
| L.L | 41 | → 130 |
| P.L | 28 | |
| P.I | 13 | |

Q.2 a)

$$\left. \begin{aligned} m &= \frac{5}{5} = 1 \\ n &= \frac{5}{5} = 1 \end{aligned} \right\} \Rightarrow f = 0.176$$



$$2 \times 0.176 \times 100 = 35.2$$

$$\left. \begin{aligned} m &= \frac{5}{5} = 1 \\ n &= \frac{2}{5} = 0.4 \end{aligned} \right\} \Rightarrow f = 0.10 \quad 0.1 \times 100 = 10$$

$$35.2 + 10 = 45.2 \text{ kN/m}^2 \text{ vertical stress increment}$$

Q.2 b) $49 = C + 50 \tan \phi$

$$93 = C + 100 \tan \phi$$

$$\frac{44}{44} = \frac{50 \tan \phi}{50 \tan \phi} \Rightarrow \phi = 41.35^\circ$$

$$C = 5 \text{ kN/m}^2$$

for $\sigma = 246$

$$\tau = 221$$

So the failure will not occur