GOVT. ENGINEERING COLLEGE, AJMER
DEPARTMENT OF CIVIL ENGINEERING
GEOTECHNICAL ENGG.

MID - TERM TEST - I M. M.: 10 TIME: 1 HOUR SESSION: 2018 - 19 VI SEMESTER

Q: 1. A Pole carries a vertical load of 200 kN. Determine the vertical stress increase at a depth of 5 m (a) directly below the pole and (b) at a radial distance of 2 m. (3)

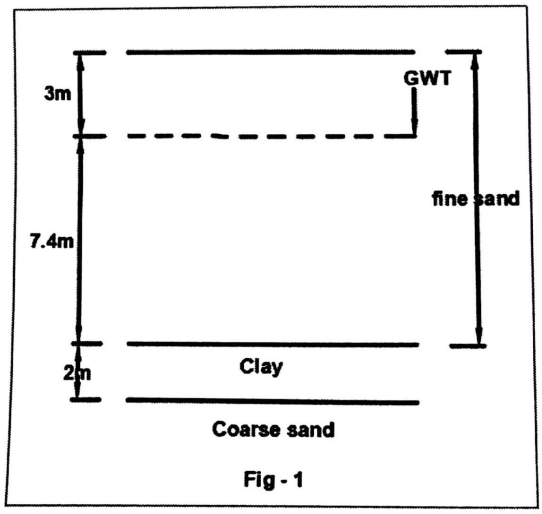

Fig - 1

Q: 2. The soil profile at a site for a proposed office building consists of a layer of fine sand 10.4 m thick above a layer of soft normally consolidated clay 2 m thick. Below the soft clay is a deposit of coarse sand. The groundwater table was observed at 3 m below ground level. The void ratio of the fine sand is 0.76 and the water content of the clay is 43%. The building will impose a vertical stress increase of 140 kPa at the middle of the clay layer. Estimate the primary consolidation settlement of the clay. Assume the soil above the water table to be saturated, Cc = 0.3 and Gs = 2.7 (for clay and sand). [see fig - 1.] (4)

Q: 3. Explain the procedure for determining the Rankine's active thrust by trial wedges. (3)

OR

Q: 3. Write down assumptions of the Terzaghi's one dimensional consolidation theory. (3)

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Solutions: Geotech Engg - II
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Solution: 1. Step: 1. Determine the load type, assume the load from the pole can be approximated by a point load.
Step 2: Use the Boussinesq's equation for point load

$$\sigma_Z = \frac{3Q}{2\pi Z^2}\left[\frac{1}{1+\left(\frac{r}{z}\right)^2}\right]^{\frac{5}{2}}$$

Z = 5 m, Q = 200 kN, under the load r = 0. Thus,

$$\sigma_Z = \frac{3Q}{2\pi Z^2} = \frac{3\times200}{2\times\pi\times5^2} = 3.819\,\frac{kN}{m^2} \quad Ans.$$

Step: 3. Determine the vertical stress at radial distance
Z = 5 m ; Q = 200 kN ; r = 2 m

$$\sigma_Z = \frac{3Q}{2\pi Z^2}\left[\frac{1}{1+\left(\frac{r}{z}\right)^2}\right]^{\frac{5}{2}} = \frac{3\times200}{2\times\pi\times5^2}\left[\frac{1}{1+\left(\frac{2}{5}\right)^2}\right]^{\frac{5}{2}} = 2.635\,\frac{kN}{m^2} \qquad Ans.$$

Solution: 2. e_0 (for sand) = 0.76; w (for clay) = 43%; H_0 = 2 m; $\Delta\sigma'$ = 140 kN/m²; Cc = 0.3 and G = 2.7 (for both fine sand and clay)

For sand $\gamma_{sat} = \frac{G+e}{1+e}\gamma_w = \frac{2.7+0.76}{1+0.76}\times 9.81 = 19.2855\ kN/m^3$

For Sand $\gamma' = \gamma_{sat} - \gamma_w = 19.2855 - 9.81 = 9.4755\ kN/m^3$

For clay $e_0 = wG = 0.43 \times 2.7 = 1.161$

For clay $\gamma' = \frac{G-1}{1+e}\gamma_w = \frac{2.7-1}{1+1.161}\times 9.81 = 7.7172\ kN/m^3$

Over burden pressure $\sigma_o' = (19.2855 \times 3) + (9.4755 \times 7.4) + (7.7172 \times 1) = 135.6924\ kN/m^2$

Hence, settlement $\rho_f = \frac{H_0}{1+e_0} C_C\, log\frac{\sigma'}{\Delta\sigma_0'} = \frac{2}{1+1.161}\times 0.3 \times log_{10}\left(\frac{140+135.6924}{140}\right) = 0.08171m = 8.171\ cm$ ans