USN :

CMR Institute of Technology, Bangalore
DEPARTMENT OF CIVIL ENGINEERING
I - INTERNAL ASSESSMENT

Semester: 6-CBCS 2018
Subject: APPLIED GEOTECHNICAL ENGINEERING (18CV62)
Faculty: Ms Divya Viswanath

Date: 21 May 2021
Time: 09:00 AM - 10:30 AM
Max Marks: 50

Instructions to Students :

Answer all questions

Answer All Questions

Q.No			Marks	CO	PO	BT/CL
1	a	what are the geophysical methods of sub soil exploration? Explain any one method in detail with a neat sketch.	6	CO1	PO1,PO6	L2
	b	Define the following with reference to a neat sampling tube sketch: (a) Inside clearnace (b) Outside clearance (c) Area Ratio	4	CO1	PO1,PO6	L1
2	a	Derive the equation for vertical stress below the center of a circular area with uniform load intensity "q".	7	CO2	PO1,PO2	L3
	b	Explain the contact pressure distribution in sandy soil.	3	CO2	PO1,PO2	L2
3		Define an isobar. Construct an isobar with a vertical stress intensity of 40 kN/m2 when the ground surface is subjected to a concentrated load of 1000 kN.	10	CO2	PO1,PO2	L3
4	a	A concentrated load of 22.5 kN acts on the surface of a homogeneous soil mass of large extent. Find the stress intensity at a depth of 15 m at a horizontal distance of 7.5m and directly under the load. Use Boussinesq's analysis.	5	CO2	PO1,PO2	L3
	b	Explain electro-osmosis method of dewatering with a neat sketch.	5	CO1	PO1,PO6	L2
5	a	Briefly explain the soil exploration using wash boring method.	4	CO1	PO1,PO6	L2
	b	Estimate the ground water table level by Hvorslev's method, given the following data: Depth up to which water is bailed out=15m, water rise in 1 st day=0.80m, water rise on 2 nd day = 0.70m, water rise on 3 rd day = 0.60m.	6	CO1	PO1,PO6	L3

IAT-1-SOLUTION

APPLIED GEOTECHNICAL ENGINEERING (18CV62)

1.a.

Electrical resistivity method:

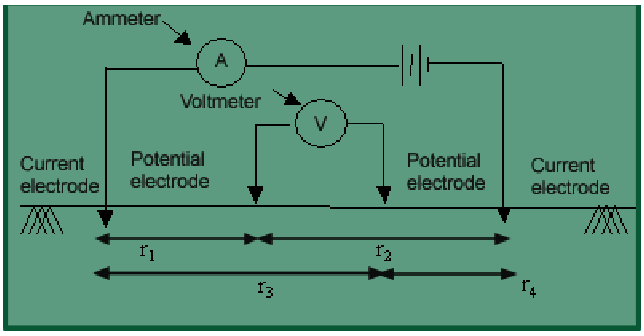
✓ Electrical resistivity method is based on the difference in the electrical conductivity or the electrical resistivity of different soils. Electrical resistivity method is based on the difference in the electrical conductivity or the electrical resistivity of different soils.

✓ Resistivity is defined as resistance in ohms between the opposite phases of a unit cube of a material.

✓ Four metal spikes that serves as electrodes are driven into the ground along a straight line at equal distances.

✓ A direct voltage is induced between outer electrodes and potential drop is measured between inner electrodes.

✓ Resistivity is given as, $\rho = 2\pi aR$ where a is the spacing between the electrodes.



1.b.

$$\text{Area ratio } A_r = \frac{Max. Cross\ sectional\ area\ of\ the\ cutting\ edge}{Area\ of\ the\ soil\ sample}$$

$$A_r = \frac{D_2{}^2 - D_1{}^2}{D_1{}^2} x\ 100$$

Where, D_1 = inner diameter of the cutting edge, D_2 = outer diameter of the cutting edge

For obtaining good quality undisturbed samples, the area ratio should be less than or equal to 10%.

Inside Clearance

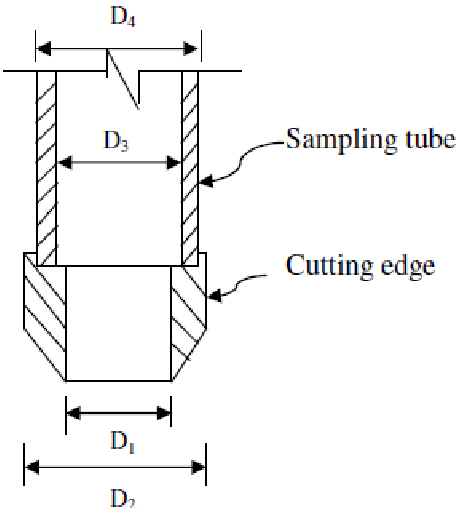
$$Ci = \frac{D_3 - D_1}{D_1} x\ 100$$

Where D_3 = inner diameter of the sample tube

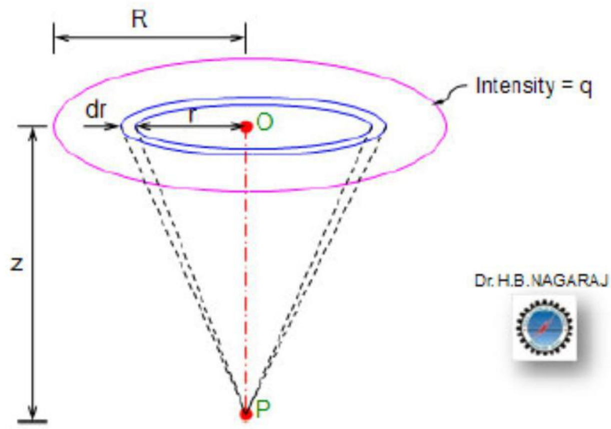
It helps in reducing the frictional drag on the sample, and also helps to retain the core. For an undisturbed sample, the inside clearance should be between 0.5 and 3%.

Outside Clearance

$$Co = \frac{D_2 - D_4}{D_4} \, x \, 100$$



2.a. Let q = intensity of the load per unit area and R = the radius of the loaded area.
Let us consider an elementary ring of radius r and thickness „dr‟ of the loaded area. The load on the elementary ring = q(2πr)dr.



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

$$\Delta\sigma_z = \frac{3(q2\pi r dr)}{2\pi}\frac{1}{Z^2}\left(\frac{1}{(1+(\frac{r}{Z})^2)^{\frac{5}{2}}}\right)$$

$$\Delta\sigma_z = \frac{3qrdr}{(r^2+Z^2)^{\frac{5}{2}}}Z^3$$

$$\sigma_z = 3\,q\,z^3 \int_0^R \frac{r\,dr}{(r^2+Z^2)^{\frac{5}{2}}}$$

$Let\ r^2 + Z^2 = u^2$ | when r = 0, $u = Z^2$

$2r\,dr = du$ | r = R, $u = R^2 + Z^2$

$$\sigma_z = 3\,q\,z^3 \int_{Z^2}^{R^2+Z^2} \frac{du}{2(u)^{\frac{5}{2}}}$$

$$\sigma_z = 3\,q\,z^3\left(\frac{1}{\left(\frac{-3}{2}\right)}\right)\left[u^{\frac{-3}{2}}\right]_{z^2}^{R^2+z^2}$$

$$= -qz^3\left[\frac{1}{(R^2+z^2)^{3/2}} - \frac{1}{(z^2)^{3/2}}\right]$$

$$= qz^3\left[\frac{1}{(z^2)^{3/2}} - \frac{1}{(R^2+z^2)^{3/2}}\right]$$

$$\boldsymbol{\sigma_z} = \left[1 - \left(\frac{1}{1+\left(\frac{R}{z}\right)^2}\right)^{\frac{3}{2}}\right]$$

2.b.

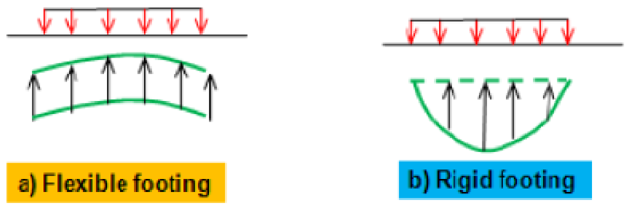
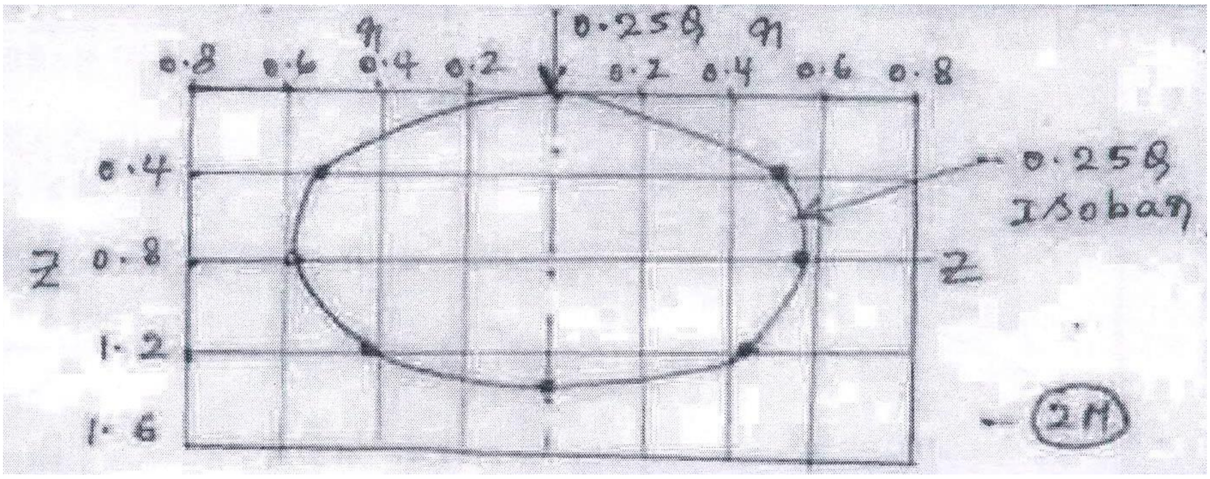


Fig a & b shows the qualitative contact pressure distribution under flexible and rigid footing resting on a sandy soil and subjected to a uniformly distributed load q. when the footing is flexible, the edges undergo a large settlement than at centre. The soil at centre is confined and therefore has a high modulus of elasticity and deflects less for the same contact pressure. The contact pressure is uniform. When the footing is rigid the settlement is uniform. The contact pressure is parabolic with zero intensity at the edge sand maximum at the centre.

3.

Depth z (m)	Influence factor I_B	$\frac{r}{z}$	r	σ_z
0.4	0.04	1.3025	0.5208	0.25q
0.8	0.16	0.7405	0.592	0.25q
1.2	0.36	0.345	0.414	0.25q
1.382	0.4775	0	0	0.25q



4.a.

$$\sigma_z = \frac{3 \times 22.5}{2\pi} \times \frac{1}{15^2} \times \left[\frac{1}{\left(1 + \left(\frac{7.5}{15}\right)^2\right)^{5/2}} \right]$$

$\underline{\sigma_z = 0.027 \text{ kN/m2}}$

$$\sigma_z = \frac{3 \times 22.5}{2\pi} \times \frac{1}{15^2} \times \left[\frac{1}{\left(1 + \left(\frac{0}{15}\right)^2\right)^{5/2}} \right]$$

$\underline{\sigma_z = 0.048 \text{ kN/m2}}$

4.b.

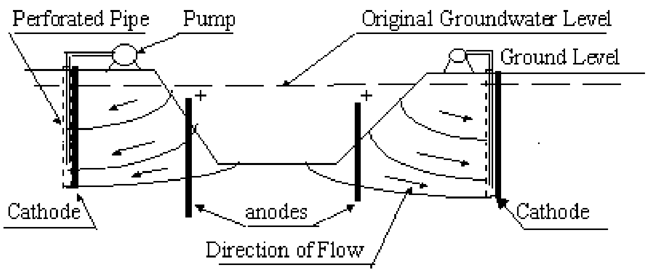
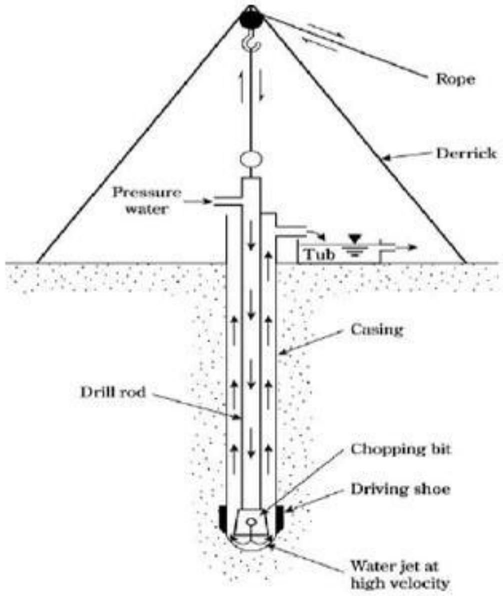


Fig. 8.8 Control of Groundwater by Electro-Osmosis Methods

Electro-osmosis is defined as “the movement of water (and whatever is contained in the water) through a porous media by applying a direct current (DC) field”. It is the only effective method of dewatering in deep clay soils.

As the surface of fine grained soil particles causes negative charge, the positive ions in solution are attracted towards the soil particles and concentrate near the surfaces. Upon application of the electro motive force between two electrodes in a soil medium the positive ions adjacent to the soil particles and the water molecules attached to the ions are attracted to the cathode and are repelled by the anode. The free water in the interior of the void spaces is carried along to the cathode by viscous flow. By making the cathode a well, water can be collected in the well and then pumped out.

5.a.



Suitable for all types of soils but not for rocks and boulders.

- ✓ It consists of driving a casing through which a hollow drill rod with a sharp chisel at the lower end is inserted.
- ✓ Water is forced under pressure through the drill rod.
- ✓ The resulting chopping and jetting action of the bit and water disintegrates soil.
- ✓ Cuttings are then forced up through the spacing between drill rod and casing.

5.b.

$$\boldsymbol{H_0} = \frac{\mathbf{0.8^2}}{\mathbf{0.8-0.70}} = \mathbf{6.4\ m}$$

$$\boldsymbol{H_1} = \frac{\mathbf{0.7^2}}{\mathbf{0.8-0.70}} = \mathbf{4.9\ m}$$

$$\boldsymbol{H_2} = \frac{\mathbf{0.6^2}}{\mathbf{0.7-0.6}} = \mathbf{3.6\ m}$$

First day, $h_{w1} = H_w - H_0 =$ <u>8.6 m</u>

Second day, $h_{w2} = H_w - (h_1 + h_2) - H_1 =$ <u>8.6 m</u>

Third day, $h_{w3} = H_w - (h_1 + h_2 + h_3) - H_2 =$ <u>9.3 m</u>

Depth of GWT, $h_w = \frac{h_{w1}+h_{w2}+h_{w3}}{3} =$ <u>8.833 m</u>