Bhartiya institute of Engineering and Technology, Sikar.

Department of civil Engineering

Geotechnical Engineering-II (6CE2A).

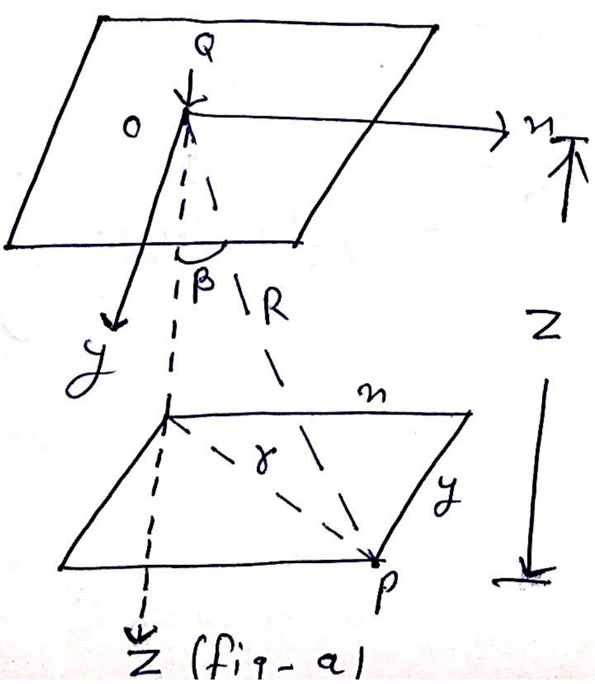
Max Marks = 20

Q1 (A) Dervie the expression for Vertical Stress due to concentrated load using Boussinesq Analysis.

ANS-1 (A) Boussinesq give the vertical stress due to concentrated load Solutions for the stress distribution in an elastic medium subjected to a concentrated load on its Surface.

fig Shows a horizontal Surface of the elastic medium Subjected to a point load Q at point o. The origin of the coordinates is taken at o. using logarithmic stress function for the Solution of elasticity problem. Boussinesq proved that the Polar stress σ_R at point P (x, y, z) is given by.

$$\sigma_R = \frac{3}{2\pi} \frac{Q \cos\beta}{R^2} \quad \text{— (i)}$$



(fig - a)

where R = polar distance b/w the origin - O and point P.

β = Angle which the line OP makes with the Vertical.

obiviously $R = \sqrt{x^2 + y^2 + z^2}$

or $R = \sqrt{r^2 + z^2}$ where $r^2 = x^2 + y^2$

and $\sin\beta = r/R$ and $\cos\beta = z/R$

The vertical stress (σ_z) at point P is given by.

$$\sigma_z = \sigma_R \cos^2\beta$$

$$\sigma_z = \frac{3}{2\pi}\left(\frac{Q\cos\beta}{R^2}\right)\cos^2\beta$$

$$\sigma_z = \frac{3Q}{2\pi}\frac{\cos^3\beta}{R^2}$$

$$\sigma_z = \frac{3Q}{2\pi}\frac{(z/R)^3}{R^2} = \frac{3Q}{2\pi}\cdot\frac{z^3}{R^5}$$

$$\sigma_z = \frac{3Q}{2\pi}\cdot\frac{1}{z^2}\cdot\frac{z^5}{R^5}$$

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

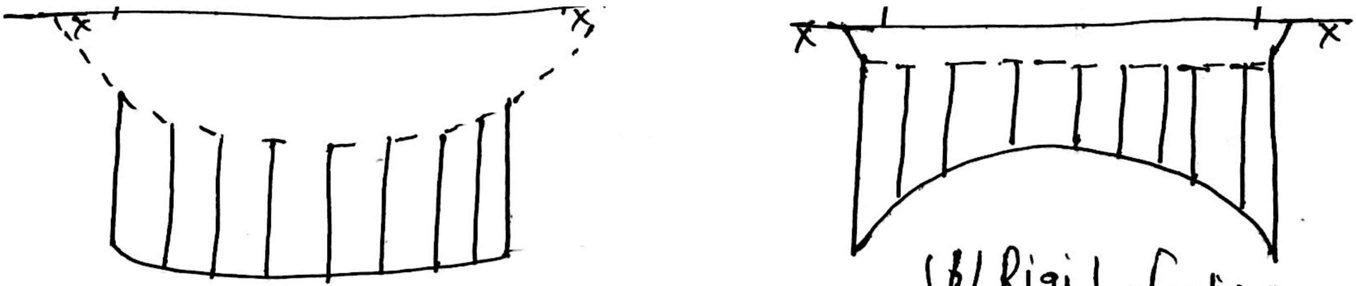
And

$$\sigma_z = \frac{3Q}{2\pi}\cdot\frac{1}{z^2}\left[\frac{1}{[1+(r/z)^2]^{5/2}}\right] \quad \text{— (ii)}$$

Q.2(B) What do you understand by contact pressure. Draw the Contact pressure distribution diagram for flexible and rigid footings on Sand and clayey Soil.

Ans.2(B) The upward pressure due to soil on the underside of the footing is known as contact pressure. It has been assumed that the footing is flexible and the contact pressure distribution is uniform and equal to (q). Actual footings are not flexible as assumed. The actual distribution of the contact pressure depend upon a factors such as the elastic properties of the footing material and soil, the thickness of footings.

Contact pressure on sand diagram →



(a) flexible footing) (b) Rigid footing.

(fig. contact pressure on Saturated clay.

Q03(c) Define the following terms–

(a) coefficient of compressibility.

(b) coefficient of Volume change.

(c) compression Index.

Ans (a)– Coefficient of compressibility → The coefficient of compressibility is defined as the decrease in void ratio per unit increase in effective stress.

$$a_v = \frac{-de}{d\bar{\sigma}}$$

Ans (b) coefficient of Volume change → The coefficient of Volume change is defined as the volumetric strain per unit increase in effective stress.

$$M_v = \frac{-\Delta V/V_0}{\Delta\bar{\sigma}}$$

where V_0 = initial Volume

Ans(c) Compression index → The compression index is equal to the slope of the linear portion of the void ratio.

Q04 (D) Write the Assumptions of Terzaghi's one-dimensional consolidation theory.

Ans04 - There are following Assumption's -

1. The Soil is homogeneous and isotropic.
2. The Soil is fully saturated.
3. Darcy's law is valid throughout the consolidation process.
4. The solid particles and water in the voids are incompressible. The consolidation occurs due to expulsion of water from particles.
5. The time log in consolidation is due to entirely to the low permeability of the soil.
6. The coefficient of permeability of the soil has the same value at all points, and it remains constant during the entire period of consolidation.