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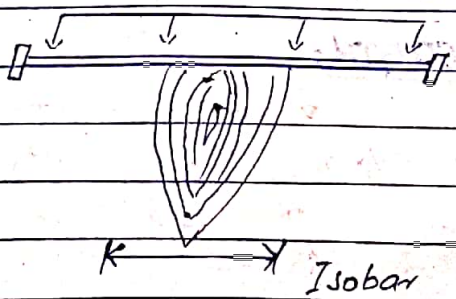
Q.1 (Part a) Define the following

ISOBAR:

* It is a line or curve joining the points of same stresses (vertical) is termed as Isobar
* Iso means same & bar means pressure / stress
* It will always accuse below the surface.
* This will be the point where most of the deflection will be accured due to vertical loads
* It is contour of equal vertical stresses
* The area covered by the isobar is called as pressure bulb.
* Mostly the failure or sattelment takes place here in this zone.
* This is the zone in which the stresses have significant effort on the sattelment of structure
* The shape of isobar is just like on electric bulb or onion



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EFFECTIVE STRESSES:

The stresses which are due to the self weight of the soil sample is termed as effected stresses "Se"

Mathematically

$$Se = \gamma \times Z$$

γ = Unit weight of soil

Z = depth at which vertical stresses are needed

COMPACTION:

- The process in which the soil partical are brought close to each other in order to improve the engineering properties of soil by some external efforts
- The compaction mostly take place in sand soil
- In this process the soil particals come close to each other because the air voids are reduced or removed in the soil

SHEAR STRENGTH:

- The resistance offered by the soil to the shear stresses before the failure of soil. It is termed

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as shear strength

▽ . Shear stresses produced when two suface slides with each other. The shear strength is the principal property of soil which directly or indirectly effect other properties of soil

▽ Such as bearing components more the shear strength of soil more will be its Bearing capacity

▽ Bearing capacity is ability of soil due to which it resists the load

▽ the failure of soil occure due to movement of partical soil no I due to breaking particals

▽ This shear strength is caused by the following factors.

→ the friction between the soil particals

→ the cohesion & adhesion b/w the soil particals.

→ the structure of partical & its interlocking surface slides with eachother

SHEAR PARAMETER:

The shear strength cohesion & friction angle can be determined by different laboratory tests for different types of soil. Direct shear test Then horizontal force or shearing is applied till the faliure

Q1 (Part B) Write the assumptions of Boussinesq's load.

ANS: **BUOSSINESQ'S THEORY:**

This theory is based on following assumptions.

⇒ The soil medimum is elastic (the mould of elasticity throughout the soil sample)

⇒ The soil medimum is homogenouous (the properties of soil are same at every point of the soil sample)

⇒ the soil is isotropic (the properties of soil are same in every direction of soil sample)

⇒ the soil medium is semi infinite (It is not total infinite)

$$S_z = \frac{Q}{Z^2} \times KB$$

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

Q = load

Z = depth at which vertical stresses is to be calculated

r = radial distance from the point of application of load to the point at which vertical stresses is to be calculated

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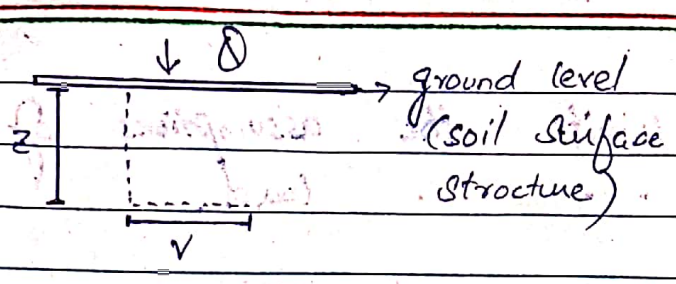
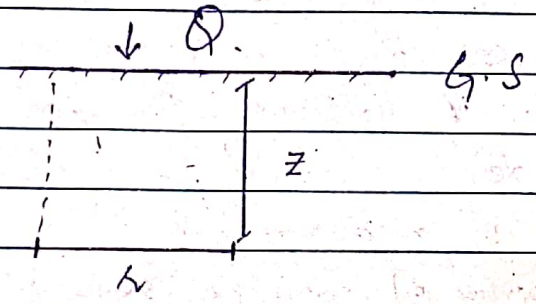


CASE # 1



r is the distance b/w point where load is applied & the point where we are finding vertical stress.

$$S_z = \frac{Q}{z^2} \times K_B$$

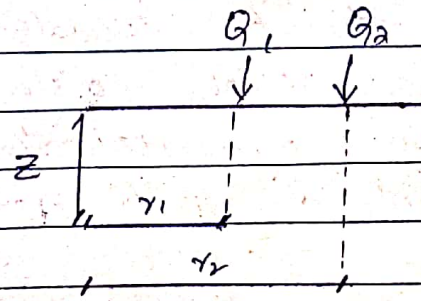
S_z = vertical stresses at depth z

Q = point or concentric load

K_B = Boussineq's constant / coefficient

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

CASE # 2



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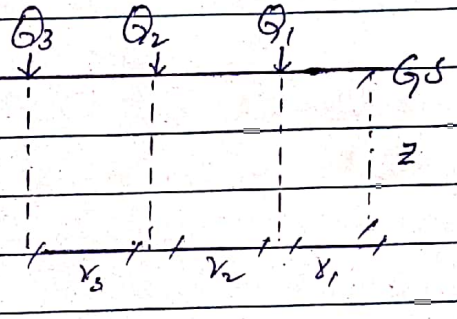
$$S_T = S_1 + S_2$$

$$= \left[\frac{Q_1}{Z^2} \times K_{B_1}\right] + \left[\frac{Q_2}{Z^2} \times K_{B_2}\right]$$

Total vertical stresses $= \left[\frac{Q_1}{Z^2} \times \frac{3/2\,\pi}{\left[1+\left(\frac{r_1}{Z}\right)^2\right]^{5/2}}\right] + \left[\frac{Q_2}{Z^2} \times \frac{3/2\,\pi}{\left[1+\left(\frac{r_2}{Z}\right)^2\right]^{5/2}}\right]$

CASE # 3



$$S_T = S_1 + S_2 + S_3$$

$$= \frac{Q_1}{Z^2} \times K_{B_1} + \frac{Q_2}{Z^2} \times K_{B_2} + \frac{Q_3}{Z^2} \times K_{B_3}$$

$$= \left[\frac{Q_1}{Z^2} \times \frac{3/2\,\pi}{\left[1+\left(\frac{r_2}{Z}\right)^2\right]^{5/2}}\right] + \left[\frac{Q_2}{Z^2} \times \frac{3/2\,\pi}{\left[1+\left(\frac{r_2}{Z}\right)^2\right]^{5/2}}\right]$$

$$+ \left[\frac{Q_3}{Z^2} \times \frac{3/2\,\pi}{\left[1+\left(\frac{r_3}{Z}\right)^2\right]^{5/2}}\right]$$

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Q2: (Part a) A sample of soil has a volume of 65 ml ..... degree of saturation.

GIVEN:

$V = 65ml = 0.000065 m^3$

$W = 0.96N$

$W_d = 0.785N$

$G_s = 2.65$

find:

$S = ?$

Sol:

$$\gamma_B = \gamma_w \times \frac{(G_s + e \times S)}{(1+e)} \rightarrow (1)$$

As we know that $\gamma_B = \frac{W}{V}$

$$\gamma_B = \frac{W}{V} \Rightarrow \frac{0.96}{0.000065} \Rightarrow \gamma_B = 1469\ N/m^3$$

given value of $\gamma_w = 9800\ N/m^3$

$$e = \frac{V_v}{V_s}$$

As we know $\Rightarrow V_s = 0.00030 m^3$

Also find $V_v \Rightarrow$ $V = V_v + V_s$

$V_v = V - V_s$

$V_v = 0.000065 - 0.000030 \Rightarrow 0.000035 m^3$

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As we know that,

$$e = \frac{V_v}{V_s}$$

$$e = \frac{0.000035}{0.000030}$$

$$e = 1.167$$

As $\gamma_s = \frac{W_s}{V_s}$

But

$$G_s = \frac{\gamma_s}{\gamma_w}$$

$$\gamma_s = G_s \times \gamma_w$$

$$\gamma_s = 2.65 \times 9800$$

$$\gamma_s = 25970 \ N/m^3$$

So $\gamma_s = \frac{W_s}{V_s}$

$$V_s = \frac{W_s}{\gamma_s}$$

$$V_s = \frac{0.785}{25970.}$$

$$V_s = 3.022 \times 10^{-5}.$$

Put all the values in eq (1)

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eq -①

$$\gamma_B = \gamma_w \times \frac{(G_s + e \times S)}{(1+e)}$$

$$S = \frac{G_s \times \gamma_B - e}{\rho \pm e + \gamma_w}$$

$$S = \frac{2.65 \times 14769 - 1.167}{9800 - 1.167}$$

$S = 0.527$ or 52.7% Answer

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Q2: (Part B) The following data was ..... the compaction curve

Sol:

Soil sample (grams)	Water content (%)
1890	5
2140	8
2170	9
2210	11
2220	12
2160	15
2070	20

As we know the volume of mould = 950 cm^3

Weight of Sample (Grams)	Water content (%)	γ_b Bulk unit wt (g/cm^3)
1890	5	1890/950 = 1.989
2140	8	2140/950 = 2.253
2170	9	2170/950 = 2.284
2210	11	2210/950 = 2.326
2220	12	2220/950 = 2.337
2160	15	2160/950 = 2.274
2070	20	2070/950 = 2.179

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As we know that.

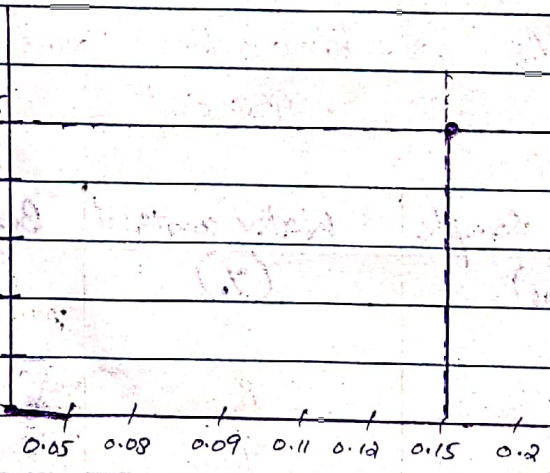
$$\gamma_d = \frac{\gamma_b}{1+w}$$

"eg"

$$\gamma_d = \frac{1.98}{1+0.05} = 1.89$$

γ_d (g/cm^3)
1.894
2.086
2.095
2.095
2.086
1.977
1.816

⇒ Compaction curve



(γ_d = Max value)

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Q No 4 (part a) Explain CBR test ..... investigation

CALIFORNIA BEARING RATIO TEST: (CBR)

This method is used to find out the strength of subgrade used for the design of road It is deep developed by california state of highway department

In this method 5kg of soil specimen is taken then water is added to it until it reaches to OMC then the CBR mould is cleared Then mould is filled with prepared soil sample 1/3 part of the mould is filled the layer is compacted by giving 56 blows distribution In this way the mould is filled in five layers after the fifth layer the soil placement is stopped Then the mould which containg the soil sample specimen is placed in CBR machine

Load is applied in such way that the penetration load value/rate is 1.25 mm/min or 0.05"/min

CBR value = load required for Penetration of the plunger in soil sample / Standerd load required for 0.1" Penetration of plunger in standerd Material (crused stones) x 100

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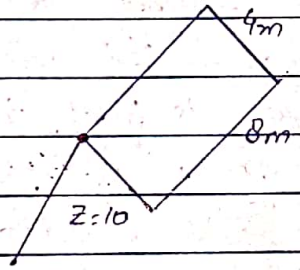
Vertical Stresses under Circular area

$$S_z = q_r + I_f$$

$$I_f = I_c = \frac{1}{\left[1+\left(\frac{D}{2r}\right)^2\right]^{3/2}}$$

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

Vertical Stresses under uniformly loaded rectangular or square area



$$S_z = \frac{\Sigma}{4\pi}\left[\frac{2mn(m^2+n^2+1)^{1/2}}{(m^2+n^2+m^2n^2+1)} \times \frac{(m^2+n^2+2)}{(m^2+n^2+1)} + \tan^{-1} x \frac{(2mn(m^2+n^2+1)^{1/2}}{(m^2+n^2-m^2n^2+1}\right]$$

$$m = \frac{L}{z}, \quad n = \frac{B}{z}$$

the longer side will be L

the shorter side will be B

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Q 3 (Part B) Explain the following in detail

PROBING:

* It consist of rod.
* The dia of rod is 1/4 - 1"
* Having a handle at the top of apparatus, for pushing in the and out purpose

AUGER BORING:

This is performed by

→ Hand operated Auger
→ Power operated Auger
→ This is simple method of soil exploration
→ Max depth for this exploration 10 m (32')

TEST PITS:

ø Max depth of this pit is 5m - 6m
ø This test pit are performed where the bore is difficult
ø Specilly in case of gravelly soil

WASH BORING:

Δ It consist of steel pipe
Δ Its diameter equal to 2" - 8"

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- Its length is equal 5' - 10'
- In this method a pump is used to pump out soil + water is removed then the soil is tested in labs.

PERCUSSION BORING:

+ This percussion boring is performed upto a depth of 25m
+ this is also called cable tool drilling
+ This is the method of heavy equipment
+ This is an ~~expension~~ expencive method, its time consuming boring