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Subject:- Soil Mechanics:-

Q1) Part A)

i) Isobar:-

An isobar or pressure bulb is a stress contour or a line which connects all the points below the ground surface at which the vertical pressure is the same.
It will always occur below the surface. The area covered by isobar is called pressure bulb.

ii) Effective stresses:-

The stresses which are due to the self weight of the soil sample is termed as effective stresses (Se)

Mathimathically.

$$Se = \gamma \times Z$$

γ = unit weight of soil
Z = depth.

iii) **Compaction:-** The process in which the soil particles are brought close to each other in order to improve the engineering properties of soil.

→ It increases the bearing capacity of soil.

→ To reduce the permeability of soil.

→ to reduce the chances of settlement due to applied load.

iv) **shear strength.-** The maximum resistance to shear stresses before the failure is called shear strength.

The shear stresses developed when the soil is subjected to compressive load.

⇒ The shear strength is one of the principal property of soil because of which soil shows stability against the load.

P.T.O.

v) shear parameter.

angle of soil cohesion (c) and friction are the parameters of shear strength of soil. They can be determined by different laboratory tests.

x ——————— x

Q1) Part B)

Buossinesq's Theory of vertical stresses.

His theory (1885) is based on following assumptions

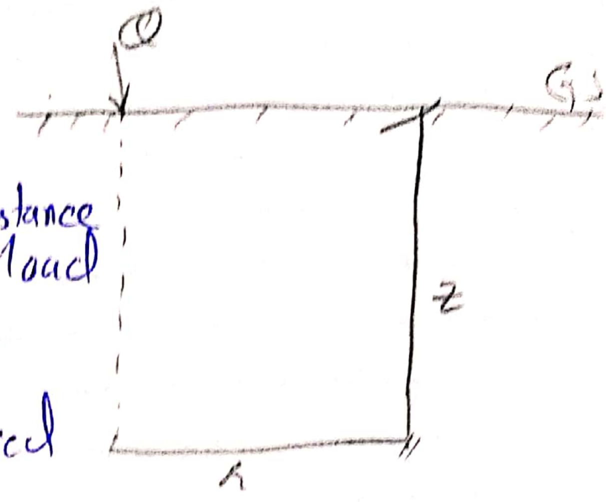
1) The soil medium is elastic. (The modules of elasticity throughout the soil sample)

2) The soil medium is homogeneous.
3) The soil is isotropic
4) The soil medium is semi-infinite
5) The soil sample is weightless and free from residual stresses.

P.T.O.

Point load cases.

Case 1



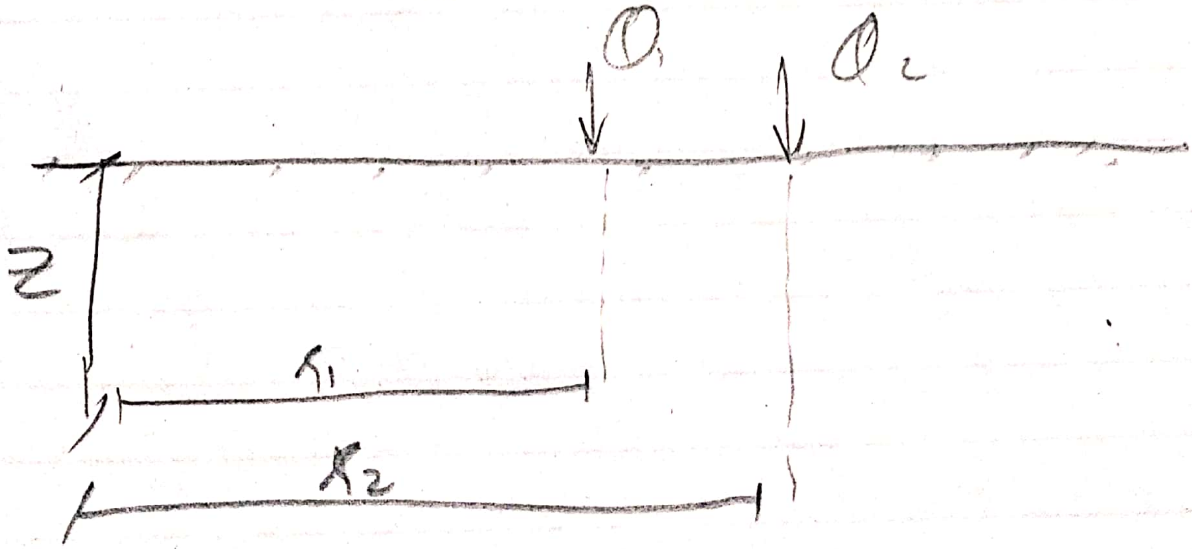
r is the distance between point where load is applied & the point where we are finding vertical stresses.

$$\delta_z = \frac{Q}{z^2} \times K_b$$

δ_z = vertical stresses at depth z
Q = point or concentric load.
K_b = Bousineq's contant.

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

Case 2



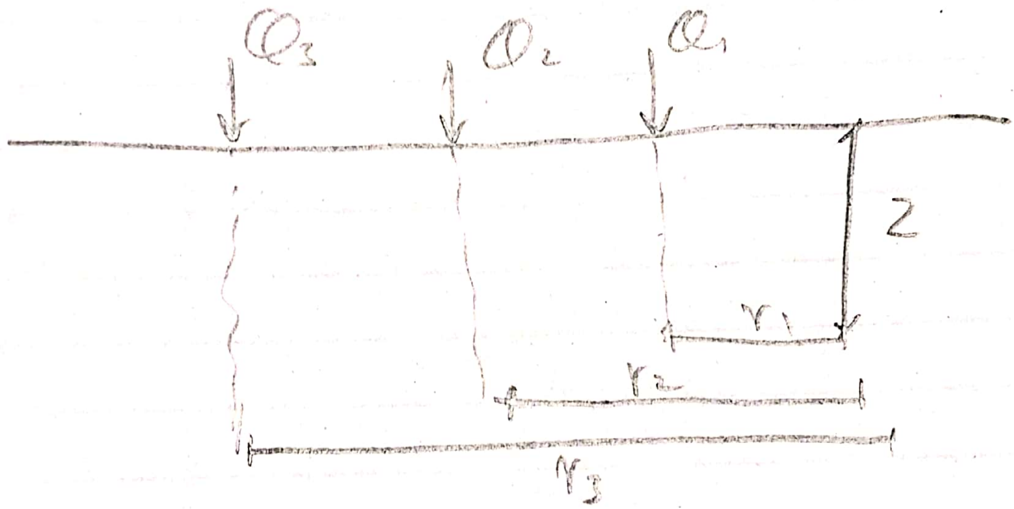
$$\sigma_T = \sigma_1 + \sigma_2$$

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

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



$$\sigma_T = \sigma_1 + \sigma_2 + \sigma_3$$

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

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

Q No : 2
Part : A

Given data :-

$V = 65\ ml = 0.00065 m^3$ As $1 ml = 10^{-6} m^3$

$W = 0.96 N$, $W_d = 0.785 N$

$G_s = 2.65$

Required :-

$S = ?$

Solution :-

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

$$\gamma_B = \frac{W}{V} = \frac{0.96}{0.000065} = 14769\ N/m^3$$

$\gamma_w = 9800 N/m^3$

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

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

$V_s = 0.000030 m^3$

$$V_s = \frac{W_s}{\gamma_s} = \frac{0.785}{25970}$$

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

$\gamma_s = G_s \times \gamma_w$

$\gamma_s = 2.65 \times 9800$

$\gamma_s = 25970 N/m^3$

also;

$V = V_v + V_s$

$V_v = V - V_s$

$V_v = 0.000065 - 0.000030$

$V_v = 0.000035 m^3$

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

$e = 1.167$

Putting all the values in (1) & solve it for S

$S = 0.527$ or 52.7%

Q No : 2
Part : B

Find:-
(i) γd.
(ii) OMC (Optimum moisture content).

Volumn of model = $950 cm^3$

Wt of the sample (g)	Water content %	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.

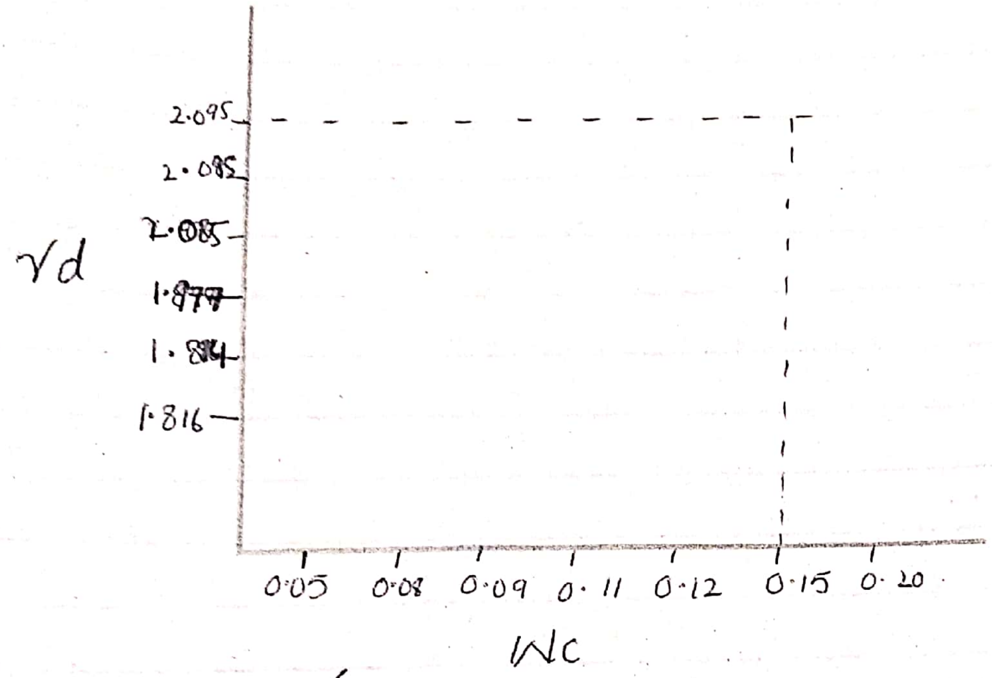
$$\gamma d = \frac{\gamma B}{1 + Wc}$$

γd (g/cm^3)
1.8494
2.086
2.095
2.095
2.086
1.977
1.816

Compaction Curve

P.T.O

Compaction Curve :-



(γd = max value.

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QNo : 4
Part : A.

California bearing ratio test :-

CBR Test :-

This method is used to find out the strength of subgrade used for the design of road. It is 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 mold is cleared. Then mould is filled with prepared Soil Sample 1/3 part at the mould is filled. The layer is compacted by giving 56 blows. distribution. In this way the mould is filled in five layers after fifth layer the soil placement is stopped. Then the mould which containing the soil sample specimen is placed in CBR machine.

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

CBR value = load required for penetration of the plunges in soil Sample / Standard load required for 0.1" penetration of plunges in a standard material (Crush Stones).

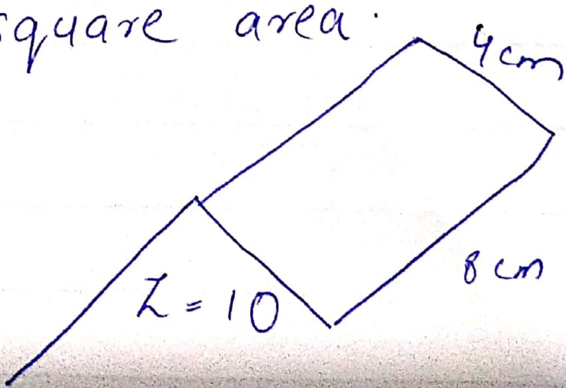
Vertical Stresses under Circular area

$S_z = q + I_f$

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

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

Vertical stresses under uniformly loaded rectangular or square area.



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

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

The longer side will be L.
The shorter side will be B.

Q No : 4
Part B (1)

1: PROBING (SOUNDINGS) :-

- It consist of a rod.
- The dia of rod is 1/4" - 1"
- Having a handle at the top of apparatus for pushing in & out purpose.
- length of the rod 5' to 13'

This rod is attached with a handle it is driven in to the ground. due to driving resistance to the rod and adhering particle to the rod with is pushed out tells us about the type and properties of soil.

2) **Auger Boring:** A common and relatively inexpensive method of obtaining disturbed soil samples is by augers boring. The depth to which auger borings may be taken is controlled by the depth to which the soil will not collapse and close an uncased hole. ~~by the~~

=> Hand Augers

Hand augering is the simplest method of obtaining sub soil samples. These borings are usually limited to 2m or 3m in depth.

=> Power Augers

There are two general types, the two person portable power auger & trailer mounted power auger.

P.T.O.

Test pits.

Test pitting can be defined as the process of excavating a pit for the purpose of carrying out the tests for different purposes in a trenchless projects.

- → Test pits are excavated to sample and investigate superficial deposits upto 4 to 5 meters and in soils that can stand ~~u~~ unsupported.
- → The test pit are performed where boring is difficult
- → specially in case of gravelly soil.

P.T.O.

4) Wash boring:-

→ This method consist of a steel pipe

→ The diameter is 2'-8".
→ length is equal to 5'-10"

→ In this method a pump is used to pump out soil + water is removed then the soil is tested in labs.

→ It is one of the most popular methods because it is fast, easy, inexpensive and uses minimal equipment.

→ However rocks & boulder cannot be diffused by this process.

→ The process is compromised of driving a casing through to make a hole in the ground

→ This enables drilling and soil sampling below the hole

→ for cutting forced water jets are used through the rocks within ~~soil~~ hole.

5) Precussion boring:-

This method uses contiual blows of heavy chisel or suspended bit to the soil and rock structures. During boring water is added to the hole and the slurry of disintegrated material is removed intermittently. ~~This~~

→ This method is good for all soil types. However soil & rock structures are generally disturbed.

x———————x

END