Syed Jawwad

Soil Mechanics

7386

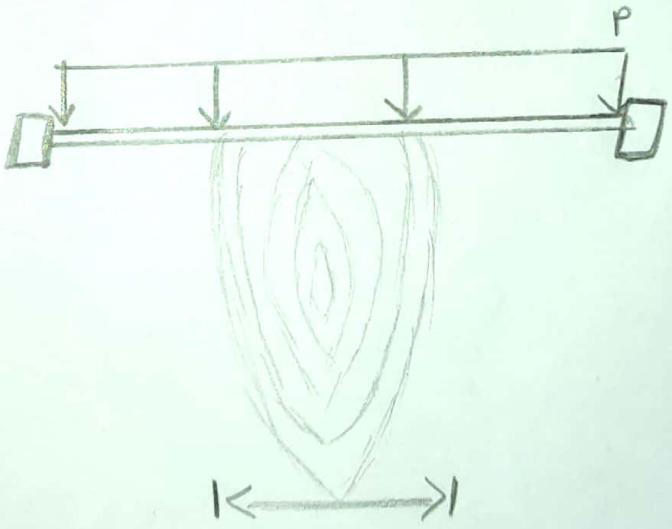
Summer Final Term

Q No# 1 (A)

Isobar :-

It is a line or curve joining the Points of Same Stresses (vertical) is termed as isobar.

-> Iso means same and bar means Pressure/Stresses
-> It will always be occured below the surface.
-> This will be the Point where most of the deflection will be occured due to vertical loads.
-> It's contour of equal vertical Stresses.
-> The area covered by the Isobar is called as Pressure bulb.
-> The Shape of Isobar is just like an onion. or Electric bulb.



Isobar / Pressure bulb / Onion

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 of which vertical stresses are needed.

COMPACTION:-

The process in which the soil particles are bought 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 particles 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 the soil. It is termed as shear strength.

Shear stresses produced when the surface 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 capacity components more than shear strength of soil.

SHEAR PARAMETER:-

The Shear Parameter Depends upon Cohesion (c) and friction angle (ϕ) and it Can also be determined by different Labortary tests which are used for different types of Soil.

Q1#b

Boussineq's Theory Assumptions:-

For this Boussineq made the following Assumptions

-> The Soil Sample is elastic Medium

-> The Soil Sample is homogeneous

-> The Soil Sample is isotrophic

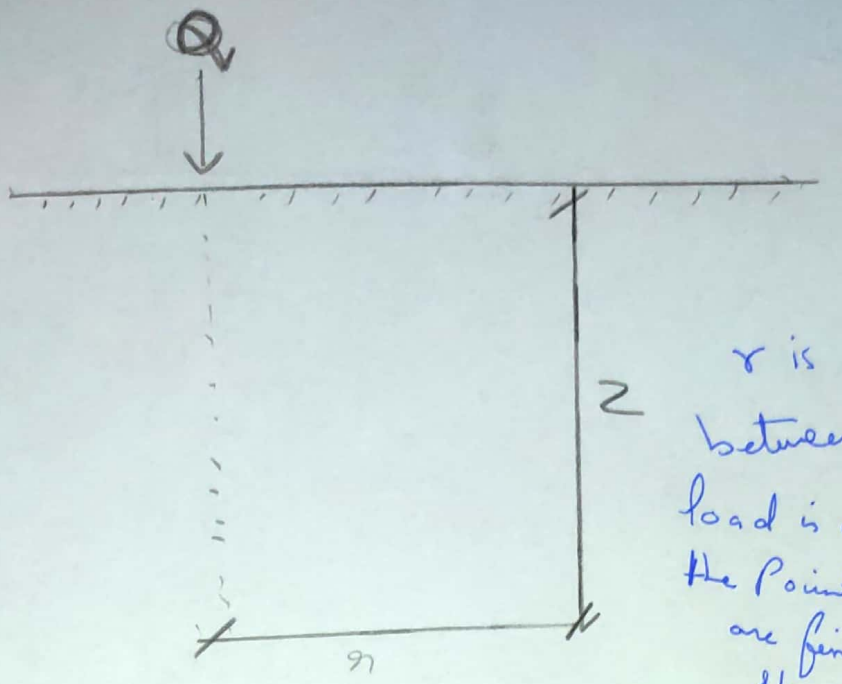
-> The Soil is weightless.

-> The Soil Sample is free from Residual Stresses

The Stresses which are produced before the application of load.

- The Soil mass is semi-infinite means it extends to infinity in the downward & lateral direction

CASE 1



r is the Distance between Point where load is applied and the Point where we are finding vertical Stresses.

(Stresses at Depth)

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

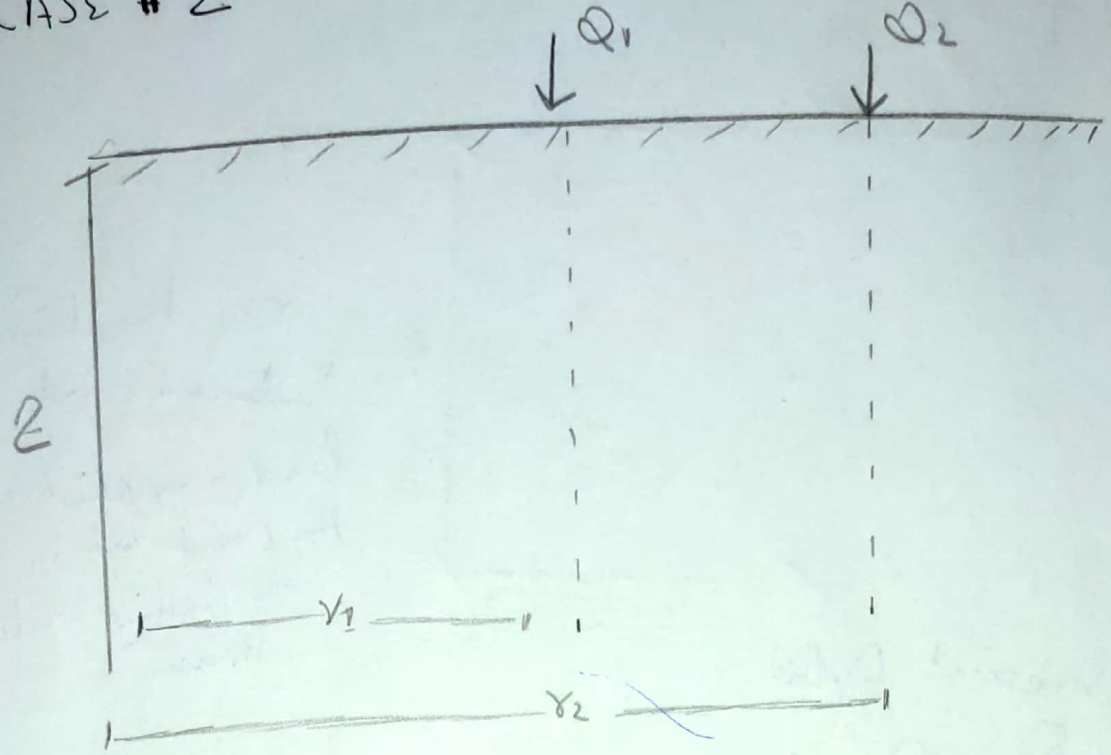
δ_z = vertical Stresses at Depth z

Q = Point or Concentric load

K_B = Boussinesq's Constant Coefficient

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

CASE # 2

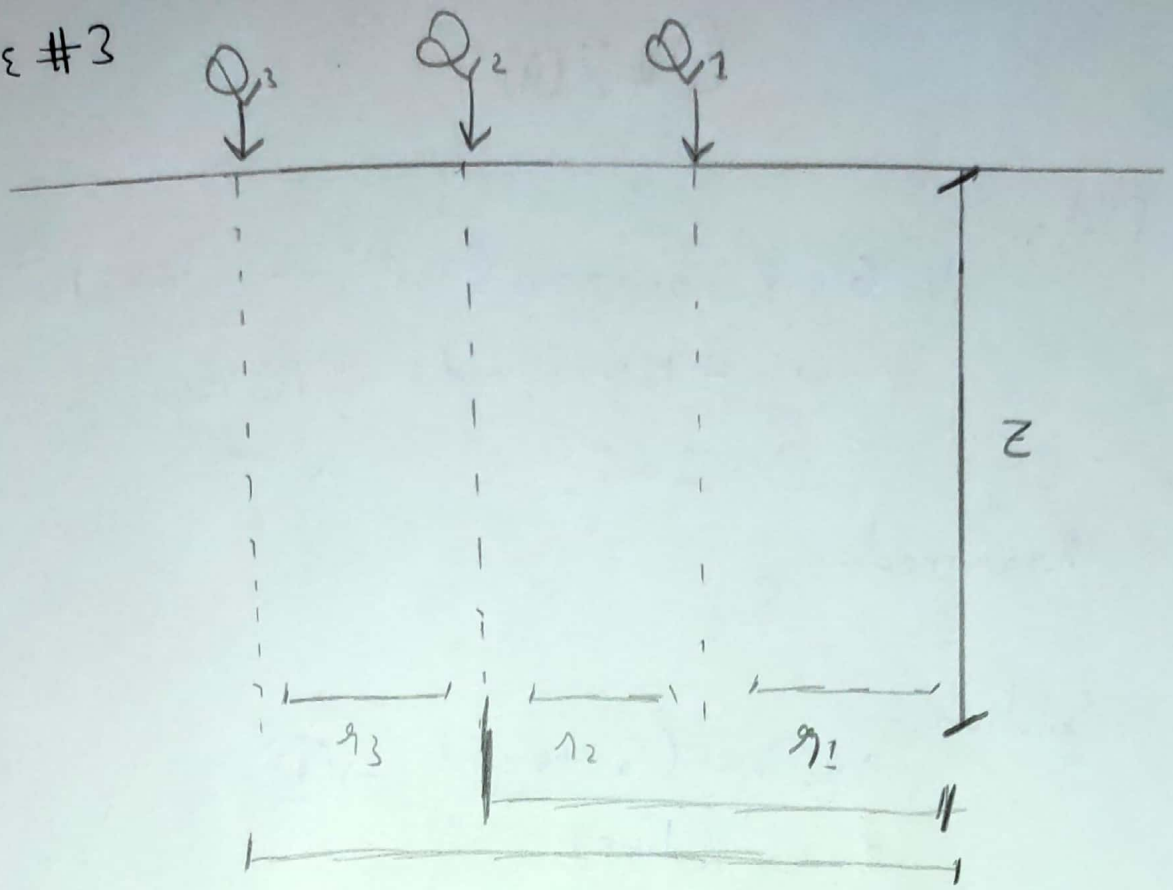


$$\delta_T = \delta_1 + \delta_2$$

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

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

CASE #3



$$\delta_T = \delta_1 + \delta_2 + \delta_3$$

$$= \frac{Q_1}{z^2} \times k_{\sigma 1} + \frac{Q_2}{z^2} \times k_{\sigma 2} + \frac{Q_3}{z^2} \times k_{\sigma 3}$$

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

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

Q#2(A)

Data:-

$V = 65mf = 0.000065 m^3$ $\quad As.\ Imf = 10^{-6} m^3$

$w = 0.96N$, $wd = 0.785N$

$G_s = 2.65$

Required:-

$S = ?$

Solution:-

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

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

$\gamma_w = 9800 N/m^3$

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

$V_s = 0.000030 m^3$

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

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

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

$\gamma_s = G_s \times \gamma_w$

$\gamma_s = 2.65 \times 9800$

$\gamma_s = 25970 N/m^3$

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

$e = 1.167$

Also

$V = V_v + V_s$

$V_v = V - V_s$

$V_v = 0.000065 - 0.000030$

$V_v = 0.000035 m^3$

Putting All the Values in eq(1) and Solve it for "S"

$S = 0.27$ or 27%.

52.7%

Q #2(B)

From the following data find

i) γ_d ii) OMC iii) Compaction Curve.

Volume of Model = 950 cm^3

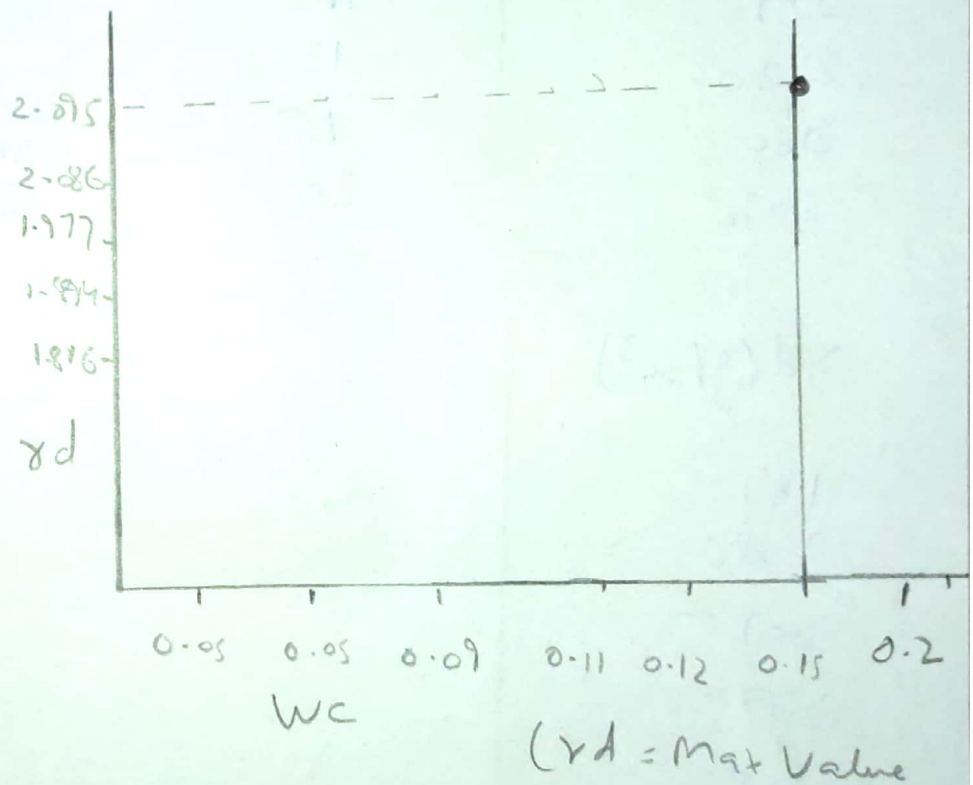
wt of Sample (g)	water Content (%)	Bulk Unit wt (g/cm^3)
1890	5	1890/950 = 1.989
2140	8	2140/950 = 2.253
2170	9	2170/950 = 2.284
2210	11	2210/950 = 2.326
2220	12	2220/950 = 2.337
2160	15	2160/950 = 2.274
2070	20	2070/950 = 2.179

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

wt of Sample (g)	Water Content (%)	Bulk unit weight (g/cm^3)
1890	5	1490/950 = 1.989
2140	8	2140
2170	9	~~1890~~/950 = 2.253
2210	11	2170 ~~1890~~/950 = 2.284
2220	12	2210/950 = ~~2.326~~ 2.326
2160	15	2220/950 = 2.337
2070	20	2160/950 = 2.274
		2070/950 = 2.179

Compaction Curve

γd (g/cm^3)
1.894
2.084
2.095
2.095
2.086
1.977
1.816



(γd = Mat Value

Q#3

CALIFORNIA BEARING RATIO TEST (CBR):-

This Method is used to findout the Strength of Sub-grade 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 mould is Cleared. Then mould is filled with prepared Soil Sample 1/3 Part of 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 containing the Soil Sample Specimen is placed in CBR machine Load is applied in such away that the Penetration load rate is 1.25mm/min or 0.05"/min.

$$\text{CBR Value} = \frac{\text{Load Required for Penetration of the Plunger in Soil Sample}}{\text{Penetration of plunger in Standard Material (Crushed Stones).}} \times 100$$

Standard load Required for "0.1"

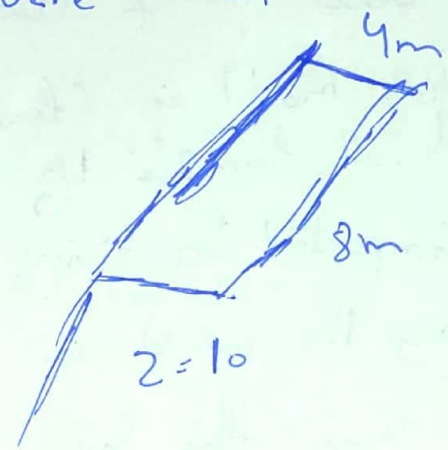
Vertical Stresses under Circular area

$$\sigma_z = q + I_f$$

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

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

Vertical Stresses under Uniformly loaded rectangular or Square Area



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

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

The longer side will be L

The shorter side will be B.

Q # 3(B)

1. PROBING :-

- It Consists of rod.
- The dia of rod is 1/4" - 1"
- Having a handle at the top of apparatus, for Pushing in and out Purpose.

2. AUGER BORING :-

This is performed by
- Hand operated Auger
- Power Operated Auger

- This is a simple method of Soil exploration.
- Max Depth for this Exploration 10m (32')

3. TEST PITS :-

Max Depth of this Pit is 5m - 6m

- This Test Pit are Performed where the boring is difficult.
- Specially in Case of gravelly Soil.

4. WASH BORING:-

- It Consists of Steel Pipe
- It's diameter is equal to 2"-8".
- It's 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.

5. PERCUSSION BORING:-

This Percussion boring is Performed upto a depth of 25m

- This is also called Cable tool drilling
- This is a method of heavy equipment.
- This is an expensive method, time Consuming boring.