QNO.1):
(a):
Ans:1):Plastic Equillibrium: Plastic Equilibrium is the state of stress with in a soil mass or a portion there of that has been deformed to such an extent that its ultimate shearing resistance is mobilized.

2) Angular Distortion: Angular distortion is the ratio of the differential settlement δ and the disctance I between two point.

3) Compressive Index: compressive index is use to find the settlement in the normally consolidated clay. The total stress applied is larger than the stress in the field to which the soil sample has been undergone in the past this kind of clay soil is said to be normally consolidated clay.

4) Ultimate Bearing Capacity: It is the theoretical maximum pressure which the soil can be supported without failure.

5) Poission Ratio of soil: poission ratio is the negative ratio of transverse to axial strain.

QNO.1):

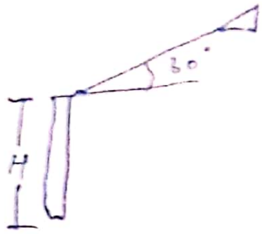
B): Given Data:

$H = 6m$, $C = 0$

$\phi = 30°$, $\gamma = 19.2\ KN/m^3$

Slope = $H = 1$, $V = 3$

Required:



$\frac{N_a}{b} = ?$, $\frac{V_a}{b} = ?$

Solution:

$$\frac{P_a}{b} = \frac{\gamma \times H^2 \times K_a}{2}$$

B

$$\tan B = \frac{1}{3}$$

$$B = \tan^{-1}\left(\frac{1}{3}\right)$$

$$B = 18°$$

$$K_a = \cos B = \frac{\cos B - \sqrt{\cos^2 B - \cos^2\phi}}{\cos B + \sqrt{\cos^2 B - \cos^2\phi}}$$

$$K_a = \cos(18) = \frac{\cos(18) - \sqrt{\cos^2 18 - \cos^2(30)}}{\cos(18) + \sqrt{\cos^2 18 - \cos^2(30)}}$$

$$K_a = 0.3948$$

$$K_a = 0.395$$

$$\frac{P_a}{b} = \frac{19.2 \times (6)^2 \times 0.395}{2}$$

$= 136.512\ KN/m$

$$\frac{N_a}{b} = \frac{P_a}{b} \cos B$$

$= 136.512 \times \cos(18)$

$= 129.83\ KN/m$

$$\frac{V_a}{b} = \frac{P_a}{b} \sin B$$

$= 136.512 \times \sin(18)$

$= 42.18\ KN/m$

Q NO. 2):

(a):

Ans: Bearing Capacity: In Geotecnical Engineering bearing capacity is define as the engineering property of soil due to which it resist the applied load. Denoted by q.

Factor Effecting Bearing Capacity:

1) Relative Density of Soil: If the relative density of soil is greater. The value of angle of internal friction will be greater Higher will be terzoghi bearing capacity factor due to which the value of bearing capacity will increase.

2) Depth of footing: Bearing capacity increase with increase depth of footing.

3) Width of Footing: With increasing width of footing, bearing capacity also increases.

4) Unit weight of Soil: Increasing unit weight of soil bearing capacity also increases.

5) Cohesion of soil: Bearing Capacity increase if the soil has high cohesion Value.

6) Water Table: Water table is indirect relation with the bearing capacity due to water the shear strength b/w the soil particals reduce hence bearing capacity decreases.

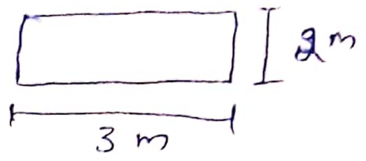
Q No.2):

(B):

Given Data:

$D = B \times L$

$= 2m \times 3m$



$D_f = 1.6m$

$FOS = 3$

$\gamma = 18\ KN/m^3$, $\phi = 20^\circ$, $C_u = 20\ KN/m^2$

$N_c = 14.8$, $N_q = 6.4$, $N_\gamma = 2.9$

Required:

Maximum safe load $= q_s = ?$

Solution:

As we know that

$q_u = CN_c s_c d_c i_c + qN_q s_q d_q i_q + \frac{1}{2}\gamma B N_\gamma s_\gamma d_\gamma i_\gamma$

Now $i_c = i_q = i_\gamma = 1$

Then

$q_u = CN_c s_c d_c + qN_q s_q d_q + 0.5\gamma B N_\gamma s_\gamma d_\gamma$

First find slope factor.

$\alpha = 45 + \phi/2 = 45 + \frac{20}{2}$

$\alpha = 55^\circ$

Now $s_c = 1 + 0.2(B/L)\tan^2\alpha$

$s_c = 1 + 0.2(2/3)\tan^2(55)$

$s_c = 1.3$

$\phi > 10$ Then $S\gamma = Sq = 1 + 0.1 (B/L) \tan^2 \alpha$

$S\gamma = Sq = 1 + 0.1 (\frac{2}{3}) \tan^2 (55)$

$S\gamma = Sq = 1.14$

Now $d\gamma = dq = 1 + 0.1 (D/B) \tan \alpha$

$d\gamma = dq = 1 + 0.1 (1.6/2) \tan (55)$

$d\gamma = dq = 1.11$

Now $dc = 1 + 0.2 (\frac{1.6}{2}) \tan(55)$

$dc = 1.23$

As

$q_u = CNc\, Sc\, dc + \gamma Nq\, Sq\, dq + 0.5 \gamma B N\gamma\, S\gamma\, d\gamma$

$q_u = (20 \times 14.8 \times 1.3 \times 1.23) + (18 \times 1.6) \times 6.4 \times 1.1 \times 1.4) + (0.5 \times 20 \times 2 \times 2.9 \times 1.11 \times 1.14)$

$q_u = 762 \ KN/m^2$

Now

$q_{n.u} = q_u - \bar{\delta}$ $\qquad \bar{\delta} = \gamma \times D_f$

$q_{n.u} = 762 - (18 \times 1.6)$

$q_{n.u} = 733.2 \ KN/m^2$

Then $q_{n.s} = \frac{q_{n.u}}{FOS} = \frac{733.2}{3} = 244.4 \ KN/m^2$

Now $q_s = q_{n.s} + \bar{\delta}$

$q_s = 244.4 + (18 + 1.6)$

$q_s = 273.2 \ KN/m^2$

Total safe load on Rectangular footing

$A \times q_s$

$(2 \times 3) \times 273.2$

1639.2 KN

Scanned with CamScanner

QNo.3):

(a):

Ans: Settlement: When load is applied on ground surface this will be produce effective vertical stress due to these stress the effective vertical strain will be produced as a result of which the movement will occure in downward movement is called settlement

Types of settlement: There are two types of settlement on basis of movement of structure.

1) Total settlement: This type of settlement is also called uniform settlement.

→ In total settlement each part of structure will settle equally.

→ In uniform settlement the failure of the structure is not much as considered as with the differential settlement.

→ A uniform settlement mostly occure in that structure. Which are constructed in rigid footing.

→ In this type of settlement the ultimate services such as water supply electricity, sewage, line telephone etc.

Limitation of Total settlement: The soil layer to which the load is to transfer should be sufficient in bearing to resist the load which is to be applied on it. To spread the coming load on large area.

Differential settlement:
Differential settlement in different part of same structure is called differential settlement

→ Differential settlement are more dangerous or andesirable as compare with total settlement, because they are cause more damage to a structure.

Types of Differential settlement:

1) Tilt:
If the entire structure rotate due to unequal settlement is called tilt.

2) Angular Distortion:
When two foundation support walls/column settle unequally its mean the structure to angular distortion.

QNo. 3):

(b):

Given Data:

$C_c = 0.31$

$P_1 = 130$

$e_o = 1.02$

$P_2 = 170\ KN/m^2$

$H = 5m$

Required:

$e_1 = ?$

$S_c = ?$

Solution: As we Know that

$$C_c = \frac{\Delta e}{\log\left(\frac{P_2}{P_1}\right)}$$

$$C_c = \frac{e_o - e_1}{\log\left(\frac{P_2}{P_1}\right)}$$

$$0.31 = \frac{1.02 - e_1}{\log\left(\frac{170}{130}\right)}$$

$$0.0361 = 1.02 - e_1$$

$$\boxed{e_1 = 0.984}$$

$S_c = ?$

As we know that

$$S_c = \frac{H}{1+e_o} \times C_c \log\left(\frac{P_2}{P_1}\right)$$

$$S_c = \frac{5}{1+0.02} \times 0.31 \log\left(\frac{170}{130}\right)$$

$$S_c = 0.08939\ m$$

$$\boxed{S_c = 89.3978\ mm}$$

Mid Term Exam

Geotecnical Engineering

ID # 7794

Section A