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Section B

Semester 6th

Subject Geotechnical Engineering

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Question no 1 (a):

Define the following terms

Plastic Equilibrium:-

A body of soil is said in state of plastic equilibrium.

if every part of soil is on the verge of failure is called plastic equilibrium.

Angular Distortion:-

It is defined as the ratio between the relative Deflection between two points in a foundation and the distance between them is called angular distortion.

Compressive Index:-

Soil compressive Onder is define as

$$C = \frac{\Delta e}{\log_{10}(P_2/P_1)}$$

Δ = change in void ratio

P_1 = Pressure when void ratio is e

P_2 = when void ratio is e_2

Ultimate Bearing Capacity :-

It is defined as, the gross pressure intensity at the base of foundation which would cause shear failure is called ultimate bearing capacity.

Poission Ratio of Soil :-

It is defined as,

Position ration (n) is the negative of ratio of transversal strain to the axial strain in an elastic material which is subjected to an unaxial stress

Question no 1 (b):

A 6m tall cantiliver wall retaining the solid that has the following properties

- C = 0
- $\emptyset = 30°$
- $\gamma = 19.2\ kN/m^3$

And the ground surface behind the wall is inclined at a slope of 3 horizontal and 1 verticle. The wall has moved sufficiently to develop active condition Determine the total normal and shear forces acting on the back of his wall using Rankine theory

Given:- $H = 6m$, $C = 0$, $d = 30°$

$\gamma = 19.2\ kN/m^3$ slop $H = 1$, $V = 3$

Required:- $\frac{Na}{b} = ?$, $\frac{Va}{b} = ?$

Solution:-

$$\frac{Pa}{b} = \frac{\gamma + H^2 + ka}{2}$$

$$B = \tan \beta = 1/3$$

$$B = \tan^{-1}(1/3)$$

$\beta = 18°$

$$Ka = \cos\beta \times \frac{\cos\beta - \sqrt{\cos^2\beta - \cos^2\phi}}{\cos\beta + \sqrt{\cos^2\beta - \cos^2\phi}}$$

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

$$Ka = 0.3948$$

$$Ka = 0.395$$

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

$$Pa/b = 136.512 \text{ KN/m}$$

$$\frac{Na}{b} = \frac{Pa}{b} \cos\beta$$

$$= 13.6.512 \times \cos(18)$$

$$= 129.83 \text{ KN/m}$$

$$Na/b = \frac{Pa}{b} \sin\beta$$

$$= 136.512 \times \sin(18)$$

$$= 42.18 \text{ KN/m}$$

Result:-

$N_{a/b} = 129.83$ KN/m

$N_{a/b} = 42.18$ KN/m

Question no 2 (a):

What is bearing capacity? Also write factor affecting bearing capacity.

ANSWER:-

Bearing Capacity:-

The engineering property of the soil due to which it resist the applied load.

Denote by q:

On other words the internal strength of soil is called bearing capacity.

Factor Affecting bearing Capacity:-

(1) Relative Density of soil
(2) Depth of footing
(3) Breadth of footing
(4) Unit weight of soil.
(5) Water Table.

Relative Density of Soil:-

More relative density of soil more will be its angle of friction. More will be N_q, N_r, N_c with increase of this bearing capacity increases.

Depth of footing:-

With the increase of depth of foundation the bearing capacity of soil will increase.

This increase will be more if soil is dense

Breadth of foundation:-

More the breadth of foundation more will be bearing capacity of soil.

Unit weight of soil:-

Bearing capacity of soil is directly proportional to unit weight of soil The bearing capacity of soil increase with increase in unit-weight.

Water Tank:-

As water table come near surface bearing capacity decreases.

Question 2 (b):-

What is maximum safe load which can be supported by rectangular footing 2m-by-3m with factor of saftey 3. The base of the footing is at 1.6m below the ground surface The unit weight of soil is 18 KN/m². The angle of shear resisting $\Phi = 20°$ CNC = 14.8 Nq = 6.4 Nr = 2.9) unit conesion Cu = 20 KN/m².
Use Myeshot analysis.

Given data: L = 3m , B = 2m , D = 1.6m

F.O.S = 3 , γ = 18 KN/m² , $\Phi = 20°$

Cu = 20 KN/m²

Required:- qs = ?

Solution:- $q_u = CNC\ sed\ c + qNq\ dq\ sq + \frac{1}{2}\ \gamma B\ Nr\ dr\ sr$

First for shape factor:

$\alpha = (45 + \Phi/2) = (45 + 20/2)$

$\alpha = 55°$

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

$1.02 (2/3) \tan^2(55)$

$S_c = 1.27 = 1.3$

$S_q = S_r = 1 + 0.1 B/L \tan^2\alpha$

$= 1.1 (2/3) \tan^2(55)$

$S_q = S_r = 1.14$

Depth factor:-

$d_c = 1 + 0.2 (D/B) \tan\alpha$

$= 1 + 0.2 (1.6/2) \tan(55)$

$d_c = 1.23$

$d_r = d_v = 1 + 0.1 (D/B) \tan\alpha$

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

$= 1.11$

$q_u = C \cdot N_c \cdot S_c \cdot d_c \times q \cdot N_q \cdot d_q \cdot S_q + 1/2 \gamma \cdot B \cdot N_\gamma \cdot d_\gamma \cdot S_\gamma$

$(20 \times 14 \times 1.3 \times 1.23) + (18 \times 1.6) \times 6.4 \times 1.11 \times 1.14) +$

$(0.5 \times 20 \times 2 \times 2.9 \times 1.11 \times 1.14)$

$q_u = 762 \ KN/m^2$

$q_{n.u} = q_u - \bar{s}$

$= 762 - (18 \times 1.6) \quad \bar{s} = \gamma \times D$

$= 733.2 \ KN/m^2$

$q_{n.s} = \frac{q_{n.u}}{F.O.S}$

$= \frac{733.2}{2} = 244.4 \ KN/m^2$

$q_s = q_{u.s} + \delta$

$= 244.4 + (1.6 \times 18)$

$q_s = 273.2 \text{ KN/m}^2$

Total safe Load on Rectangular footing:

$A \times q_s = (2 \times 3) \times 273.2$

$= 1639.2 \text{ KN}$

Question 3 (a):-

What is settlement? Explain types in detail.

Answer:-

Settlement:- When load is applied on t ground surface this will produce effective vertical stresses, due to these stresses effective vertical strain will be produced as a result of which the movement will occur in downward direction. Thi downward movement is called settlement

Types of Settlement:-

On the basis of movement of the structure it is obtained into t types

(i) Total settlement
(ii) Differential settlement

Total Settlement:

It is also called uniform settlement. In this type of settlement each part of structure will settle equally.

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

The total settlement mostly take place in the structure which are constructed on rigid footing.

Differential settlement:-

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

Differential settlement is more danger then total settlement.

It cause more damage to structure.

Types of differential settlement:-

Two types

(i) Tilt

(ii) Angular distortion

Question 3 (b):

A soil has compressive index $C_c = 0.31$. At a stress 130 KN/m², the void ratio was 1.02. calculate

The void ratio if the stress on the soil is increased to 170 KN/m².

The total settlement of the stratum of 5m thickness.

Given:-

$C_c = 0.31$

$P_1 = 130\ KN/m^2$

$e_c = 1.02$

$P_2 = 180\ KN/m^2$

$H = 5\ m$

Required:- void ratio, $e_i = ?$

$S_c = ?$

Solution:-

$$C_c = \frac{\Delta e}{\log_{10}(P_2/P_1)}$$

$$C_c = \frac{e_0 - e_1}{\log_{10}(P_2/P_1)}$$

$$0.31 = \frac{1.02 - e_1}{\log_{10}(170/130)}$$

$$e_1 = 0.54$$

Now

$$Sc = \frac{H}{1+e_0} \times C_c \log_{10}(P_2/P_1)$$

$$= \frac{5}{1+1.02} \times 0.31 \log_{10}(170/130) \times 1000 \text{ mm}$$

$$Sc = 1003.427$$

Result:- $e_1 = 0.54$

$Sc = 1003.427$