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i- Plastic Equillibrium:

Plastic equillibrium is the state of stress with in a soil mass that has been deformed to such as extent thats it ultimate shearing resistance is mobilized.

ii- Angular distortion:

Angular distortion is the ratio of the differential settlement δ and the length L b/w two points.

iii- Compressive Index:

The compression curve is plotted for effective stress versus void ratio. The void ratio is plotted using normal scale & effective stress is plotted using logarithm scale.

The scale taken from virgin compression curve is termed as compression index.

iv - Ultimate bearing Capacity:

Ultimate bearing capacity is the theoritical maxi. pressure which can be supported with out failure; allowable bearing capacity divided by a factor of Safety.

V- POISSON'S Ratio:

Poission's ratio is the negative of tranversal strain to the axial strain in an elastic material, which is subjected to an uniaxial stress.

Q1: A 6 m tall cantiveler wall retaining the soil that has the following properties

$C = 0$

$\phi = 30^\circ$

$\gamma = 19.2\ KN/m^2$

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

Given Data:

$H = 6m$ $\quad C = 0$

$\phi = 30^\circ$ $\quad \gamma = 19.2\ KN/m^3$

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

Required:

$$\frac{Na}{b} = ?\ ,\quad \frac{Va}{b} = ?$$

Solution:

$$\frac{Pa}{b} = \frac{\gamma \times H^2 \times Ka}{2}$$

$B =$

$$\tan B = 1/3$$

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

$$B = 18^\circ$$

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

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

$k_a = 0.3948$

$k_a = 0.395$

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

$$= 136.512 \text{ kN/m}$$

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

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

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

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

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

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

A- What is bearing capacity. Also write factor effecting Bearing capacity.

Ans: **Bearing Capacity:** It can be defined as;

" The capacity of the soil to bear the loads comming from the foundation. The pressure which the soil can easily with stand against load is called allowable bearing pressure."

Factor Effecting of Bearing Capacity: There are some factor effecting of bearing capacity which can be discussed below;

1- **Relative Density of the Soil:** More the relative density of the soil more will be its angle of friction. More will be the Nq, Nc, Nγ with increase of this (Nq, Nc, Nγ) the bearing capacity will increase more for dense soil / sand as compared with medium and base. Nq, Nc, Nγ, Telzaghi bearing capacity factors.

2- Breadth of footing:

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

It will be more in case of dense soil|sand as compared with loose or medium soil|sand.

3- Depth of the footing:

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

The increase will more in case of dense soil|sand as compared with loose or medium sand|soil.

4- Water table:

As the water table comes near to footing, the bearing capacity get decreases.

5- Unit Weight of Soil:

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

It will be more in case of dense soil | sand as compared with base loose or medium soil | sand.

B- What is the maxi safe load which can be supported by rectangular footing 2m by 3m with a safety factor of 3. The base of the footing is at 1.6 below the ground surface. The unit weight of the soil is 18 kN/m^3. The angle of shear resisting $\phi = 20^\circ$ ($N_c = 14.8$, $N_q = 6.4$, $N_\gamma = 2.9$). Unit cohension $C_u = 20\ kN/m^2$. Use Meyerhof analysis.

GIVEN DATA:

$L = 3m$, $B = 2m$, $D_f = 1.6m$

F.O.S = 3 $\gamma = 18\ kN/m^3$, $C = 20\ kN/m^2$

$\phi = 20^\circ$

REQUIRED: $q_s = ?$

Solution:

$$q = C\, N_c\, S_c \cdot d_c + q\, N_q \cdot d_q \cdot S_q + \frac{1}{2}\,\gamma \cdot B \cdot N_\gamma \cdot d_\gamma \cdot S_\gamma$$

For the shape factors

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

$$\alpha = 55^\circ$$

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

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

$$S_c = 1.27 = 1.3$$

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

$$S_q = S_\gamma = 1 + 0.1\,(2/3)\tan^2(55)$$

$S_q = S_\gamma = 1.14$

Depth Factors:

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

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

$d_c = 1.23$

$d_\gamma = d_q = 1 + 0.1 \times (D/B) \times \tan\alpha$

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

$= 1.11$

$q_u = c.N_c.S_c.d_c + q.N_q.d_q.S_q + \frac{1}{2}\gamma.B.N_\gamma.d_\gamma.S_\gamma$

$= (20 \times 14.8 \times 1.3 \times 1.23) + (18 \times 1.6) \times 6.4 \times 1.1 \times 1.14)$

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

$q_u = 762\ KN/m^2$

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

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

$= 733.2\ KN/m^2$

$q_{ns} = \frac{q_{n.u}}{F.O.S} = \frac{733.2}{3} = 244.4\ KN/m^2$

$q_s = q_{n.s} + \bar{\sigma} = 244.4 + (1.6 \times 18)$

$q_s = 273.2\ KN/m^2$

Total Safe load on Rectangular footing

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

$= 1639.2\ KN.$

Q3) :

A - What is settlement . what are its types explain in detail .

Ans: **Settlement :**

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

Types of Settlement :

There are some types of settlement which are given below;

1 - Differential Settlement

2 - Total Settlement

1 - Differential Settlement :

Different settlement in different parts of the same structure is known as differential settlement.

Differential settlement is more changes as compared with total / uniform settlement , because it cause more demage to a structure as compared to total / uniform settlement .

Further of differential settlement are given below;

TILT: If the entire structure rotates due to unequal settlement is known as tilt.

Angular distortion: When two foundation support walls/columns settle unequally its means the subject is angular distortion.

2- Total Settlement:- It is also known as uniform settlement. In this type of settlement each part of structure will settle equally.

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

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

8- A soil has compressive index $C_c = 0.31$. At a stress $130\ kN/m^2$, the void ratio was 1.02. Calculate

1- The void ratio if the stress on the soil is increased to $170\ kN/m^2$.

2- The total settlement of the stratum of 5 m thickness.

Given Data:

$C_c = 0.31$

$P_1 = 130\ kN/m^2$

$e_o = 1.02$

$P_2 = 170\ kN/m^2$

$H = 6\ m$

Required:

$e_1 = ?$

$S_c = ?$

Solution:

As we know that

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

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

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

$e_1 = 1.425$

now;

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

$$S_c = \frac{6}{1+1.425} \times 0.31 \times \log_{10}\left(\frac{170}{130}\right) \times 1000\,mm$$

$$S_c = 7.425 \times 0.31 \times 1.307 \times 1000 \; mm$$

$$S_c = 2,95.37 \; mm.$$