Paper : Geotechnical and Foundation Engineering.

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Q No. 1: A: Define the following terms:

1: Plastic Equilibrium:-

In this state the soil will near to failure or verge to failure.

2: Angular Distortion:-

β, is the ratio of the differential settlement & eavel the distance between two points. It is crucial to understand beforehand the range of tilt & angular distortion that will possibly cause unacceptable damage to the structure.

3:- Compressive Index:-

$$C_c = \frac{\Delta e}{\log_{10}\left(\frac{P_2}{P_1}\right)}.$$

where:

Δe = change in void ratio.

P_1 = Is the pressure when the void ratio is e_1.

P_2 : Is the pressure when the voids ratio is e_2.

In the Term of Mv:-

Mv = change in volume per unit volume of compressible layer.

$$Sc = Hv\, Mv\, \Delta P.$$

$$Mv = \frac{\frac{\Delta e}{\Delta P}}{1 + e_o}.$$

4:- Ultimate Bearing Capacity:-

The maximum pressure at the base of footing with steal failure in the soil. it is denoted by q_u.

5:- Poission Ratio of soil:-

Plainly, Poission ratio is the negative of ratio of transversal strain to the axial strain in an elastic material, which is subjected to an uniaxial stress.

Material Poission ratio:-

Saturated clay : 0.40 – 0.50.

Clay : 0.30 – 0.45.

Sand : 0.20 – 0.45

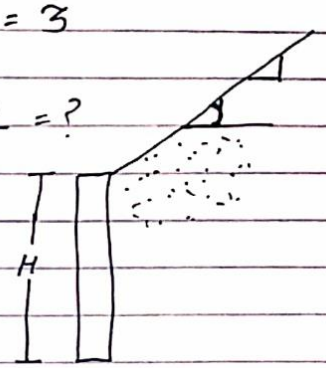
Q No. 1 B: A 6m tall cantilever ..... Theory.

Given data!

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

$\phi = 30°$, $\gamma = 19.2\ KN/m^3$

Slop: $H = 1$, $V = 3$



Required:

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

Sol:-

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

$\beta =$

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

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

$\beta = 18°$.

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

~~$K_o = \cos\beta \times \cos\beta - \sqrt{\cos}$~~

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

$K_o = 0.3948$.

$K_o = 0.395$.

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

$$\frac{P_a}{b} = 136.512 \text{ kN/m}^3$$

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

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

$$= 129.83 \text{ kN/m}^3$$

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

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

$$= 42.18 \text{ kN/m}^3.$$

Q No. 2 B: What is the maximum .....
..... Use Meyerhof analysis.

Given data!

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

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

$\phi = 20°$.

Required:-

$q_s = ?$

Sol:-

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

first for the shape factor.

$$\alpha = \left(45 + \frac{\phi}{2}\right) = \left(45 + \frac{20}{2}\right)$$

$$\alpha = 55°.$$

$$S_c = 1 + 0.2 \left(\frac{B}{L}\right) \tan^2 \alpha.$$

$$= 1 + 0.2 \left(\frac{B}{3}\right) \tan^2 (55).$$

$$S_c = 1.27 = 1.3.$$

$$S_q = S_\gamma = 1 + 0.1 \frac{B}{L} \tan^2 \alpha.$$

$$1 + 0.1 \left(\frac{2}{3}\right) \tan^2 (55).$$

$$S_q = S_\gamma = 1.14.$$

Depth factor:-

$$d_c = 1 + 0.2\left(\frac{D}{B}\right)\tan\alpha.$$

$$= 1 + 0.2\left(\frac{1.6}{2}\right)\tan(55).$$

$$d_x = 1.23.$$

$$d_r = d_q = 1 + (0.1)\times\left(\frac{D}{B}\right)\times\tan\alpha.$$

$$= 1 + 0.1\left(\frac{1.6}{2}\right)\tan(55).$$

$$= 1.11.$$

$$q_u = C\cdot N_c\cdot b_c\cdot d_c + q\cdot N_q\cdot d_q\cdot S_q + \frac{1}{2}\gamma\cdot B\cdot N_r\cdot d_\gamma\cdot S_\gamma$$

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

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

$$q_u = 762\ kN/m^2$$

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

$$= 762 - (18\times 1.6). = 733.2\ kN/m^2$$

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

$$q_s = q_{n.s} + \bar{\gamma} \Rightarrow 244.4 + (1.6\times 18) = 273.2\ kN/m^2$$

Total safe load on Rectangular footing $A\times q_s = (2\times 3)\times(273.2)$.

$$= 1639.2\ kN.$$

Q No: 2:1: What is bearing capacity. Also write factor effect bearing capacity.

Ans: **Bearing Capacity:-**

In Geotechnical engineering bearing capacity is defined as the engineering property of the soil due to which it resist the applied load. Denoted by q_f.

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

Factor Effect bearing capacity:

1) Rective density of the soil:-

More the relative density of the soil more will be its angle of friction. More will be the N_q, N_c N_γ. with increase of this (N_q, N_c, N_γ) the bearing capacity will increase.

This will more increase for dense soil sand as composed with the medium and loose.

N_q, N_c, N_γ = Terzaghi bearing capacity factors.

2) Depth of the footing:-

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

This increase will be more in case of dense sand/soil as compared with loose or medium sand/soil.

3: Breadth of the foundation:-

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

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

4:- Unit weight of soil:-

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

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

5:- Water table:-

As water table comes near to footing, the bearing capasity get decrease.

Q No. 3 A:- What is settlement. what are its typs explain in detail.

Ans: Settlement:-

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

Types of settelement:-

On the basis of movement of the structure it is divided into two types.

1: Total Settlement:-

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

In uniform settlement 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 (~~foot~~).

In this type of settlement the utility services such as water supply, electricity sewage line, telephone etc may be decreased

and the structure will remain sound.

Differential settlement:-

different settlement in different parts of the same structure is called differential settlement.

Differential settlement is more danger or undesirable as compared with total or uniform settlement, because it causes more damage to a structure as compared to total settlement.

Q NO:3 B: A soil has compressive ..... 5m thickness.

Given data!

$C_c = 0.31$, $P_1 = 130\ kN/m^2$

$C_o = 1.02$, $P_2 = 170\ kN/m^2$

$H = 5m$.

Required!

final void ratio due to increase stress $e_1 = ?$

Total (consolidation) settlement $S_c = ?$

Sol:-

As compressive Index is given by.

$$C_c = \frac{\Delta e}{\log_{10}\left(\frac{P_2}{P_1}\right)} = \frac{e_o - e_1}{\log_{10}\left(\frac{P_2}{P_1}\right)}$$

$$0.31 = \frac{1.02 - e_1}{\log_{10}\left(\frac{170}{130}\right)} \Rightarrow 0.31 \times 0.1165$$

$= 1.02 - e_1.$

$e_1 = 0.984.$

By formula.

Consolidation settlement is,

$$S_c = \frac{H}{1+e_0} \times C_c \log_{10}\left(\frac{P_2}{P_1}\right).$$

$$= \frac{5}{1+1.02} \times 0.31 \times \log_{10}\left(\frac{170}{130}\right).$$

$= 0.0893\,m \times 1000\,mm.$

$S_c = 89.3\,mm$