1)

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Section; "B"

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Subject; Geotechnical Foundation

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2

Question # 01

Answer: 1: **Plastic Equilibrium:**

State of stress within a soil mass or a portion thereof that has been deformed to such an extent that its ultimate shearing resistance is mobilized.

2: **Angular Distortion:**

When two foundations support wall/columes settle unequally it mean that structure is subjected to angular distortion.

3: **Compressive Index:**

The compressive curve is plotted for effective stress versus void ratio. The void ratio is plotted using normal scale and effective stress is plotted using logarithm scale.

3)

4: Ultimate Bearing capacity:

Ultimate bearing capacity is the theoritical maximum pressure which can be supported without failure: allowable bearing capacity is the ultimate bearing capacity divided by a factor of safety.

5: Poission Ratio of Soil:

poission ratio is the negative ratio of transverse to axial strain. The poission's ratio of a stable, isotropic, Linear elastic material cannot be less than -1.0 nor greater than 0.5 with the later being a value typically associated with a perfectly incompressible material.

4

Part B

Answer:

Given data:

$H = 6m$
$C = 0$
$\phi = 30$
$\gamma = 19.2 \, KN/m^3$
Slope = Horizontal = 1
vertical = 3

Required:

$\frac{Na}{n} = ?$

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

Solution:

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

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

(5)

$B = 180°$

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

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

$Ka = 0.3948$

$Ka = 0.395$

now

$$\frac{Pa}{b} = \frac{19.2 \times (6)^2 \times 0.395}{2} = 136.572 \text{ kN/m}$$

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

$$\frac{Na}{b} = 136.512 \times \cos(18)$$

$$\boxed{\frac{Na}{b} = 129.83 \text{ kN/m}}$$

$$\frac{Va}{b} = \frac{Pa}{b} \sin\beta$$

$$\frac{Va}{b} = 136.512 \times \cos(18)$$

$$\boxed{\frac{Va}{b} = 42.18 \text{ kN/m}}$$

b)

Question # 02

Part (a)

Answer: **Bearing capacity:**

In Geotechnical Engineering bearing capacity is defined as the engineering property of the soil due to which it resist the applied ~~force~~ load.

It is denoted by q.

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

Factors Effecting Bearing capacity:

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, Nr with increase of this (Nq, Nc, Nr) the Bearing capacity will increase.

This will increase more for dense soil/sand as compared with medium and base. Nq, Nc, Nr Terzaghi Bearing capacity Factors.

7)

2: Depth of the Footing:

when the increase of depth (d_f) of the foundation the bearing capacity of soil 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 foundation more will be the bearing capacity of soil.

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

4: Unit weight of soil:

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

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

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5: Water Table:

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

Part B

Answer:

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;

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

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9)

First for the slope factor.

$$\alpha = \left[45 + \frac{\phi}{2}\right]$$

$$= \left[45 + \frac{20}{2}\right]$$

$$= 55^\circ$$

$$S_c = 1 + 0.2\frac{B}{L}\tan^2\alpha$$

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

$$= 1.27 \simeq 1.3$$

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

$$= 1 + 0.1\frac{2}{3}\tan^2 55$$

$$= 1.14$$

Depth Factor

$$d_c = 1 + 0.2\frac{D}{B}\tan\alpha$$

$$= 1 + 0.2\frac{1.6}{2}\tan 55$$

$$= 1.23$$

$$d_\gamma = d_q = 1 + 0.1\frac{D}{B}\tan\alpha$$

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

$$= 1.11$$

Now putting values

$q_u = (N_c \cdot S_c \cdot d_c \cdot i_c + q N_q \cdot d_q \cdot S_q \cdot i_q + \frac{1}{2} \gamma N_\gamma \cdot S_\gamma \cdot d_\gamma \cdot i_\gamma)$

$= (20 \times 14.8 \times 1.3 \times 1.23 \times 1) \times (18 \times 1.6 \times 6.4 \times 1.11 \times 1.11 \times 1)$

$+ (0.5 \times 20 \times 2 \times 2.9 \times 1.11 \times 1.14 \times 1)$

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

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

$= 762 - (18 \times 1.6)$

$= 733.2 \, kN/m^2$

$q_{n.s} = \frac{q_{n.u}}{F.O.S} = \frac{733.2}{3} = 244.4$

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

$= 244.4 + (18 \times 1.6)$

$= 273.2 \, kN/m^2$

Total safe load on rectangular footing

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

$= 1639.2 \, kN$

Question #03

Part "a"

Answer: 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 produced as result of which the moment will occur in the downward direction. This downward movement is called settlement.

Types of Settlement:

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

1: Total Settlement.

2: Differential Settlement.

1: Total Settlement:

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

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. In this type of settlement the utility services such as water supplies, electricity, sewage line, telephone etc may be decreased and the structure will remain sound.

Limitation For Uniform / Total Settlement:

The soil layer to which the load is to be transfer should sufficient in bearing to resist the load which is to be applied on it.

To spread the coming load over a large area.

2: Differential Settlement:

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

Differential settlement is more

undesirable as compared with total/uniform settlement. because it causes more damage to a structure as compared to total/uniform settlement.

Types of Differential Settlement:

Differential settlement is of two types.

1: Tilt

2: Angular Distortion

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part "B"

Answer:

Given data:

$C_c = 0.31$

$P_1 = 130 kN/m^2$

$P_2 = 170 kN/m^2$

$e_o = 1.02$

$H = 5m$

Required:

$e_1 = ?$

$S_c = ?$

14

Solution:

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

$$\frac{e_0 - e_1}{\log_{10}\left(\frac{P_2}{P_1}\right)}$$

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

$$e_1 = 0.983$$

now

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

$$= \frac{5}{1+0.2} \times 0.31 \log_{10}\left(\frac{170}{130}\right) \times 1000$$

$$= 2.47 \times 0.03611 \times 1000$$

$$= 0.089120 \times 1000$$

$$S_c = 89.39 MM$$