Midterm paper:

Name: Rizwan ullah khan

ID 7807

Section 'A'

Subject Geotech & Foundation Engg

Semester 6th

Submitted to: Engr. Liaquat Ali.

Name: Rizwan ullah khan ID# 7807

Section: A'

Q:1/ Part "A'

1/ Plastic Equilibrium:-

Plastic Equilibrium is a State when Permanent Changes occur or it is the Stage when irreversible Strain takes place due to the application of Constant Stress.

2) Angular Distortion:-

⇒ It is a type of diffrential Settelment.
⇒ It is the unequal settelment of two foundation Support walls / Columns of the Structure.

3) Compressive Index:-

⇒ It is a number that is used to find out the Settelment in the normally Consolidated Clay.
⇒ The total Stress applied is Larger then

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the Stress in the feild to which the Soil Sample has been undergone in the past.

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

4) **Ultimate Bearing Capacity:-**

The maximum pressure that is a Soil resist due to applied load without causing failure.

OR

The maximum pressure at the base of the footing which cause shear failure in the Soil.

5) **Poisson Ratio of Soil:-**

⇒ Poisson ratio represent a change in shape of a material while the volume is maintaned constant.

⇒ The Soil is descrete and Stratified mediums

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mostly not elastic and anis tropic.

Poisson's ratio in soil mechanics is a rather condition parameter.

Q:1/ Part B

Given data:

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

$\phi = 30^\circ$, $\gamma = 19.2 \, kN/m^3$

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

Required:

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

Soln:

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

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

$$\boxed{\beta = 18^\circ}$$

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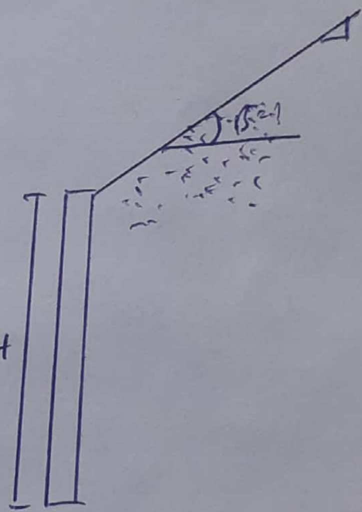
$$K_a = \cos\beta \times \frac{\cos\beta - \sqrt{\cos^2\beta - \cos^2\phi}}{\cos\beta + \sqrt{\cos^2\beta - \cos^2\phi}}$$

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

$$K_a = 0.3948$$

$$\boxed{K_a = 0.395}$$



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

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

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

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

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

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

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

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

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Q:- 2/ Part "A"

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.

In other words the internal strength of the Soil is called bearing Capacity.

Factor 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 N_q, N_c, N_r. With increase of this, the bearing Capacity will increase.

2) Depth of the footing:-

with the increase of depth of footing the bearing capacity of Soil will increase.

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3) **Breadth of foundation:-**

More the breadth of foundation more will be bearing capacity of soil.
It will be more in case of dense soil as compared with loose as medium soil.

iv) **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 its unit weight.

5) **Water table:-**

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

Q: 2) part B:

Given data:-

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

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

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Required:-

$$q_s = ?$$

Solution:-

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

For shape factor:-

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

$$\boxed{\alpha = 55^\circ}$$

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

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

$$S_c = 1.27 = 1.3$$

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

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

$$\boxed{S_q = S_\gamma = 1.14}$$

Depth factor:-

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

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

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$d_c = 1.23$

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

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

$\boxed{d_r = d_q = 1.11}$

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

$= (20 \times 14.8 \times 1.3 \times 1.25) + (18 \times 1.6) \times 6.4 \times 1.1 \times 1.14)$

$+ (0.5 \times 20 \times 2 \times 2.9 \times 1.4 \times 1.14)$

$q_u = 762\ kN/m^2$

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

$= 762 - (18 \times 1.6) = 733.2\ kN/m^2$ ($\bar{\sigma} = \gamma \times D$)

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

$q_s = 273.2\ kN/m^2$

Total safe load on Rectangular footing

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

$= 1639.2$ Ans

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Q:- 3/ Part "A"

Settelment:-

when load is applied on the ground surface This will 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 the down ward direction. This downward movement is called settelment.

Types of settelment:-

There are two type of settelment:
① Total settelment
② Differential settelment.

① Total settelment:-

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

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In uniform settelment the failure of the structure is not much as considered as with the diffrential settelment.

The total settelment mostly take place in the structure which are constructed in rigid footing. (raft)

In this type of settelment the utility service, sewage line, telephone, etc may be decreased and the structure will remain sound.

Limitation for Total settelment:-

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

2) Diffrential settlement:-

This settelment in diffrent parts of the same structure is called diffrential settelment.

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Diffrential settelment is more is more danger or undesirable as compared with total settelment becaus it cause more demage to a structure as compared to uniform settelment.

Type of diffrential settelment:-

① Tilt:-

If the entire structure rotate due to enequal ~~sted~~ settelment is called tilt.

② Angular Distortion:-

when two foundations support walls/columns settele unequally it means the structure is subject to angular distortion.

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Q:31 part 'B'

Given data:-

Compressive Index of soil (c_c) = 0.31
Initial Stress (P_1) = 130 kN/m²
Initial void ratio (e_0) = 1.02
Increased or final stress (P_2) = 170 kN/m²
Stratum thickness (H) = 5m

Required:-

Final void ratio (e_1) = ?
Total Settlement (S_c) = ?

Solution:-

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

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

$$\boxed{e_1 = 0.984}$$

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Total settlement is

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

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

$= 0.0893\ m \times 1000\ mm$

$$\boxed{S_c = 89.3\ mm}$$