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Name

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Subject paper

Geotechnical Engineering

Section

"A"

Semester

6th

Mid Exam

Date:

Question : 1

Q1 (a)

1: Plastic Equilibrium

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

When the retaining soil is homogenous, cohessionless, semi- infinite and dry.

The friction resistance b/w the rebaid soil and retaining wall is neglected ie mean fuctional resistance is zero.

The retained soil will be state of plastic equilibrium.

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2: Angular Distortion

When two foundation support wall / column settle unequally it mean the structure is subjected to angular distortion.

OR

Angular distestion is the ratio of the differential settlement and the distance b/w two point.

$$\beta = \frac{\delta}{l}$$

Where

β = Angular distortion

δ = Differential settlement.

l = distance b/w two point

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3. Compression Index:

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

Where

- C_c = Compressive index
- Δe = Change voide ratio
- P_1 = the pressure when the voide ratio is e_1
- P_2 = the pressure when the voide ratio is e_2.

In term of MV:

MV = Change is volume per unit volume of compressible layer.

$$S_c = H \times MV \times \Delta P$$

$$MV = \frac{\Delta e / \Delta P}{1 + e_0}$$

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4: Ulimate Bearing Capacity

The maximum pressure at the base of footing with shear faiture in the soil. It is denoted by q_u.

By formula:-

$$q_u = CN_c S_c I_c d_c + \gamma N_q S_q I_q d_q + 0.5 \gamma B N_r S_r I_r d_r.$$

5: Poission Ratio of Soil

Possion ratio is a measure of the poission effect. That described the expansion or contraction of a

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meterial in the direction perpendicular to the direction of Loading.

The value of poission ration is negative of the ratio of transverse stain to axial strain.

Q.1 (6)

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

$$C = 0 \quad , \quad \phi = 30^\circ \quad , \quad \gamma = 19.2 kN/m^3$$

And the ground surface behind the wall is incline at a shape slope of 3 horizontal

and 1 vertical.
The wall has moved sufficiently to develop action condition. Determine the total normal and shearforce acting on the back of this wall using Rankines Theory.

Given data:

Height = H = 6 m

C = 0

ϕ = 30°

γ = 19.2 kN/m³

Slope H = 3 , V = 1

Required:

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

Solution:-

As we know that

$$\frac{P_a}{b} = \frac{\gamma \times H^2 \times k_a}{2} \quad \text{--- eq (1)}$$

First of all we find β

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

$$\beta = 18^\circ$$

As we know that

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

Now:

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

$$k_a = 0.3948$$

$$\boxed{k_a = 0.395}$$

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eg ① =>

$$\frac{Pa}{b} = \frac{\gamma \times H^2 \times ka}{2} = \frac{19.2 \times 6^2 \times 0.395}{2}$$

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

To find Normal force $\left(\frac{Na}{b}\right)$

As we know that

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

$$= 136.5122 \cos(18)$$

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

To find shear force $\left(\frac{Va}{b}\right)$

As we know that

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

$\frac{V_a}{b} = 136.5122 \sin(18)$

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

Question: 2

Q2 (a)

Bearing Capacity

It is the Engineering property of soil because of which when load is applied on the ground surface and this Load is resisted then such capacity of soil is called bearing capacity.

Factor Affecting:

1: Relative desity of Soil

If the relative density of soil is greater. The value of angle of internal friction will be greater. Heigher will be Tarzaghi bearing capacity factor due to which the value of bearing Capcity will increase.

2: Depth of Footing

The bearing capcity increase with increase of depth of footing. higher will

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be Terzaghi bearing capacity factor.

3: Width of Footing

If the width of footing increase the bearing capacity also increase. and higher will terzaghi bearing capacity factor.

4: Unit Weight of Soil

The Unit weight of the soil increase the bearing capacity also increase.

It mean that the unit weight of soil is directly proportional to the bearing capacity.

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5: Cohesion of Soil:

If the Cohesion of the soil is more cohesion value, the bearing capacity is also increase with them.

6: Water table:

Water table is indirect relation with the bearing capacity due to water is the shear strength b/w the soil partical reduce hence bearing capacity is decrease.

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Q2 (b)

Given Data:

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

$D_f = 1.6m$

$FOS = 3$

$\gamma = 18 kN/m^3$

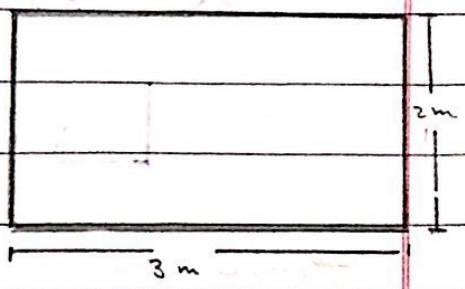
$C = 20 kN/m^2$

$\phi = 20^\circ$

$N_c = 14.8$

$N_q = 6.4$

$N_\gamma = 2.9$



Required:

$q_s = ?$

Solution:

As we know that

$$q_u = CN_c S_c I_c d_c + qN_q S_q I_q d_q + 0.5\gamma BN_\gamma S_\gamma d_\gamma I_\gamma$$

Now

$I_c = I_q = I_\gamma = 1$

Then:

$$q_u = cN_c s_c d_c + \bar{q} N_q s_q d_q + 0.5 \gamma B s_\gamma d_\gamma N_\gamma \quad (*)$$

first for the slope factor:

$$\alpha = 45 + \frac{\phi}{2} = 45 + \frac{26}{2}$$

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

Now

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

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

$$\boxed{s_c = 1.3}$$

$\alpha > 10$, then $s_\gamma = s_q = 1 + 0.1 \left(\frac{B}{L}\right) \tan^2 \alpha$

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

$$\boxed{s_\gamma = s_q = 1.14}$$

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Depth factor:

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

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

$$\therefore d_c = 1.23$$

Now

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

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

$$\boxed{d_\gamma = d_q = 1.11}$$

eq (A)

$$q_u = c N_c S_c d_c + \gamma N_q S_q d_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma$$

$$q_u = (20 \times 14.8 \times 1.3 \times 1.23) + ((18 \times 1.6) \times 6.4 \times 1.1 \times 1.14) + (0.5 \times 20 \times 2 \times 2.9 \times 1.11 \times 1.14)$$

$$q_u = 762 \text{ kN/m}^2$$

Now

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$$q_{n.u} = q_u - \bar{\delta}$$
$$= 762 - (18 \times 1.6)$$

$$q_{n.u} = 733.2 \text{ kN/m}^2$$

$$\boxed{q_{n.u} = 733.2 \text{ kN/m}^2}$$

Then

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

$$\boxed{q_{n.s} = 244.4 \text{ kN/m}^2}$$

Now:

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

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

Total safe Load + on rectangular factor:

$$A \propto q_s$$

(2×3) × 273.2

1639.2 kN

Question :- 3

Q3 (a)

Settlement :-

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

Types of Settlement:

Total Settlement:

This is the type of settlement also called uniform settlement.

In total settlement each part of stauctura will settle equally.

In uniform settlement the failtura of the stauctura is not much as considerd as with the differential settlement.

A uniform settlement mostly occures in the

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that structure which are constructed in the rigid footing.

In this types of settlement the utility services such as water supply, Electricity, sewage line, Telephone etc.

Limiton For total Settlement:

The soil layer to which the total load is to be transfer should be sufficient in bearing to resist the Load which is to be applied on it. To spread the coming

load over a large area.

Differential Settlement

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

Differential settlement are more dangerous or undesirable as compare to total settlement because they are cause more damage to a structure.

Types of Differential Settlement:

1:- Tilt
2:- Angular Distortion

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Tilt:

If the entire structure rotate due to unequal settlement is called tilt.

Angular Distortion

When two foundation support wall or column settle unequally its mean that the structure to angular distortion.

Q3 (B)

Given Data:

$C_c = 0.31$

$P_1 = 130\ kN/m^2$

$e_o = 1.02$

$P_2 = 170\ kN/m^2$

$H = 5\ m$

Required:

$e_1 = ?$

$S_c = ?$

Solution:

As we know that

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

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

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

$$0.31 = \frac{1.02 - e_1}{0.1165}$$

$$0.301 = 1.02 - e_1$$

$$e_1 = 1.02 - 0.0361$$

$$e_1 = 0.984$$

Now :-

$S_c = ?$

As we know that

$$S_c = \frac{H}{1+e_0} \alpha C_c \log(P_2/P_1)$$

$$S_c = \frac{5}{1+1.02} \alpha 0.31 \log(170/130)$$

$$S_c = 0.08939$$

$$\boxed{S_c = 89.3978 \text{ mm}}$$