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exame→ Mid exam

Q1
a):→ Define the following terms:
1) plastic Equilibrium 2):→ Angular Distortion.
3):→ Compressive index 4):→ Ultimate Bearing capacity
5):→ Poission Ratio of soil.

Ans:→ (a)
1):→ Plastic Equilibrium:→ state of stress within a soil mass or portion there of that has been deformed to such an extent that its ultimate shearing resistance is mobilized is called plastic equilibrium.

2):→ Angular distortion:→

→ When two foundations support walls/colomns settle unequally it means the structure is subjected to angular distrosion.

3):→ Compressive index:→

→ The compressive index is used to find the settlement in the normally consolidated clay. The total stress applied is larger than the stress in the field to which the soil sample has been undergone in the past This kind of clayey soil is said to be normally consolidated clay.

4):→ Ultimate Bearing capacity:→

→ Ultimate bearing capacity is the theoretical maximum pressure which can be supported without failure allowable bearing capacity is the ultimate bearing capacity divided by a factor of safety. denoted by qu.

5):→ Poission ratio of soil:→

→ Plainly, Poission's ratio (n) is the negative of ratio of transversal strain to the axial strain in an elastic material, which is subjected to an uniaxial stress.

Q1:→

B):→ A 6m tall cantilever wall retaining the soil that has the following properties:

•→ $C = 0$ •→ $\phi = 30^\circ$ → $\gamma = 19.2\ kN/m^3$

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

Given Data

cohesion $(C) = 0$

Angle of Internal friction $(\phi) = 30^\circ$

unit weight of soil $(\gamma) = 19.2\ kN/m^3$

Horizontal slope $= 3$

vertical slope $= 1$

*):→ Required:→

Total normal force $(N_a/b) = ?$

Total shear force $(V_a/b) = ?$

Sol:→ As we know that

$$\frac{P_a}{b} = \frac{\gamma \cdot H^2 \cdot K_a}{2}$$

As $\tan(\beta) = \text{Perpendicular}/\text{Base}$

$$\tan(\beta) = 1/3$$

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

$$\beta = 18^\circ$$

Also K_a is given by

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

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

$$K_a = 0.395$$

Active force $\frac{P_a}{b} = \gamma \cdot H^2 \cdot K_a / 2$

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

$$\frac{P_a}{b} = 136.52 \text{ kN/m}$$

Normal force

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

$$\frac{N_a}{b} = 136.52 \times \cos(18)$$

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

Shear force

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

$$\frac{V_a}{b} = 136.57 \times \sin(18)$$

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

Q2:→

A):→ What is Bearing capacity. Also write factors effecting Bearing capacity?

(A)

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.

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

*):→ **Factors Effecting Bearing capacity:→**

i) 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_γ with increase of this (N_q, N_c, N_γ) the bearing capacity will increase. This will increase more for soil/sand

as compared with medium and loose.
Nq, Nc, Nr = Terzaghi bearing capacity factors.

ii):→ Depth of the Footing:→
→ with the increase of depth (df) 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.

iii):→ Breadth of the foundation:→
more the breath of foundation more will be the bearing capacity of soil.
→ It will be more in case of dense soil/sand as compared with loose as medium soil/sand.

iv):→ Unit weight of soil:→
Bearing capacity of soil 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/sand as compared with loose or medium soil/sand.

v):→ Water table:→

It has indirect relation with the bearing capacity of soil. Due to earness of ~~water to the~~ water table to the of footing the shear strength b/w the soil particles reduce hence the Bearing capacity decreases.

Q2:→

B:→ What is the maximum 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 1.6m below the ground surface the unit weight of soil is 18 KN/m³. The angle of shear resisting $\phi = 20°$ ($N_c = 14.8$, $N_q = 6.4$, $N_\gamma = 2.9$), unit cohesion $C_u = 20$ kN/m². use meyerhof analysis?

Given Data

Footing Dimensions = 2m×3m (b=3, h=2)

Factor of safety = 3

Depth of foundation (D_f) = 1.6m

unit weight of soil (γ) = 18 kN/m³

Angle of shear resistance (ϕ) = 20°

unit cohesion (C_u) = 20 kN/m²

$N_c = 14.8$

$N_q = 6.4$

$N_\gamma = 2.9$

Required:→

Maximum safe Load (q_s) = ?

Sol:→ According to mayerhof's Analysis.

$$q_u = c \cdot N_c \cdot S_c \cdot d_c + q \cdot N_q \cdot s_q \cdot d_q + \frac{1}{2} \gamma \cdot B \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma$$

⇒ For shape factors:→ (s_c, s_q, s_γ)

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

⇒ $\alpha = (45 + \phi/2)$

$$\alpha = 55°$$

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

$$S_c = 1.27$$

As $\phi > 10°$,

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

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

$$S_q = S_\gamma = 1.135$$

⇒ For Depth factors:→ (d_c, d_q, d_γ)

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

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

$$d_c = 1.22$$

Also $\phi > 10^\circ$

$d_q = d_\gamma = 1 + 0.1\,(D/B)\tan\phi$

$d_q = d_\gamma = 1 + 0.1\,(1.6/2)\tan(35)$

$d_q = d_\gamma = 1.11$

=> Inclination factor :→

For $\phi = 0^\circ$

$i_c = i_q = i_\gamma = 1$

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

$= (20)(14.8)(1.27)(1.22) + [(1.6 \times 18)](6.4)(1.135)(1.11) + \frac{1}{2}(18)(2)(2.9)(1.11)(1.135)$

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

As Net ultimate Bearing capacity is,

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

$= 762 - (1.6 \times 18)$

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

Net safe Bearing capacity is,

$q_{n.s} = \dfrac{q_{nu}}{F.O.S} = \dfrac{733.2}{3} = 244.4\ \text{kN/m}^2$

Safe Bearing capacity is,

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

$= 244.4 + (1.6 \times 18)$

$q_s = 273.2 \, kN/m^2$

This safe Bearing capacity over the whole footing will be,

$\Rightarrow A \times q_s = 273.2 (6 m^2)$

$= 1639.2 \, kN.$

Q3:→

A:→ what is settlement. what are its types explian in detail?

(A)
Ans:→ Settlement:→

→ When load is applied on the ground surface this will on the ground surface this will produce effective vertical stresses due to these stresses the effective

A):→ What 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 produced as result of which the movement will occuer in the downward direction. this downword movement is called settlement.

*):→ Types of settlement:→

→ on the basis of movenent 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 structure will settle equally in uniform settlement the failure 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 service such as water supply, electricity, sewage line, telephone etc may be decreased and the Structure will remain sound.

2):→ Differential settlement:→ ↔ Differential settlement in different parts of the same structure is called differential settlement.

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

Q3:→

B):→ 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 5m thickness.

(Given Data)

Compressive index of soil (c_c) = 0.31

Initial stress/Pressure (P_1) = 130 kN/m^2

Initial void ratio (e_0) = 1.02

Increased or Final stress/Pressure (P_2) = 170 kN/m

Stratum thickness (H) = 5m.

*): → Required: →

→ Final void ratio due to increased stress (e_1) = ?

Total (Consolidation) settlement (S_c) = ???

Sol: → As compressive index is given by,

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

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

$$\Rightarrow 0.31 \times 0.1165 = 1.02 - e_1$$

$$e_1 = 0.984$$

by formula

consolidation settlement is,

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

$$= \frac{5}{1+1.02} \times 0.31 \log_{10} (170/30)$$

$$= 0.0893 m \times 1000 mm$$

$$S_c = 89.3 mm$$