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SEC B

Geo tech

Qno # 1 (part - A)

Plastic equilibrium

Plastic equilibrium can be defined as, It is a state of Stress with in a Soil mass or a portion there of that has been deformed to Such an extent that its ultimate shearing resistance is mobolized.

Angular distortion (β)

It is the ratio of the differential Settlement (δ) and the distance l between two points. It must be remember that, It is crucial to understand beforehand the range of tilt and angular distortion that will possibly cause unacceptable damage to the structure.

OR

Angular distortion is also be defined as, when two foundations Support walls or Columns Settle un- equally it mean's that the Structure is Subjected to angular distortion. This is known as — Angular distortion.

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.

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

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 void ratio is e_2

In term of Mv.

Mv = change in volume per unit volume of Compressible layer

$$M_v = \frac{\frac{\Delta e}{\Delta p}}{1 + e_o}$$

Ultimate bearing Capacity. Pg #6

It denoted by q_{u}/m

In which Overburden pressure will be included. Ultimate bearing Capacity is the max pressure at the base of the footing which cause Shear failure in the Soil.

Three types of Shear failure

1) local Shear failure
2) general Shear failure
3) Punching Shear failure.

Poisson ratio of Soil

It can be defined as, It is the ratio of transverse contraction Strain to longitudnal extension strain in the direction of Stretching force. Tensile deformation is considered positive and Compressive deformation is Considered negative.

Qno # 1 (part - B)

Given data

$H = 6m$

$C = 0$

$\phi = 30^\circ$

$\gamma = 19.2\ kN/m^3$

Slope = horizontal = 1

Vertical = 3

To find :-

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

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

P - T - O

Solution:-

$$\frac{P_a}{b} = \frac{\gamma \times H^2 \times k_a}{2}$$

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

$\beta = 180^\circ$

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

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

$k_a =$

$k_a =$

Now

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

$$= 136.512\ kN/m$$

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

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

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

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

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

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

Qno # 2

(Part - A)

Bearing Capacity

It can be defined as, Engineering property of Soil which resist applied load.
It can also be called Internal strength of Soil.
It is denoted by "q"

Factor effecting bearing Capacity.

Factor's which effects bearing Capacity are following.

1) Relative density of Soil
2) Depth of footing
3) breath of foundation
4) Unit weight of Soil
5) Water. table.

Relative density of Soil

Greater the relative density of the Soil higher will be the value of angle of internal friction.

It is denoted by "φ"

higher the value of internal friction, higher will be the value of terzaghi bearing factors (N_c , N_q and N_γ)

Greater the value of N_c , N_γ & N_q will result into higher value of bearing Capacity.

Depth of footing

With increase of depth of 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.

Breadth of 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 as medium Soil/sand.

Water table

The water table is the upper Surface of the zone of saturation. The zone of saturation is where the pores and fractures of the ground are saturated with water. The water table is the Surface where the water head pressure is equal to the atmospheric pressure.

Unit weight of Soil

Bearing Capacity of Soil is directly proportional to unit weight of Soil

The bearing of Soil increases with increase in its unit weight.

It will be more in Case of dense Soil/sand as Compared with loose as medium Soil/sand.

Qno # 2 (part B) Pg #16

Given data

Dimensions = 2m x 3m

F.O.S = 3

ϕ = 20° C_u = $20 kN/m^2$

N_c = 14.8 N_q = 6.4 N_γ = 2.7

Required

Maximum safe load = q_s = ?

Solution

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

Now,

As $i_c = i_q = I_\gamma = 1$

$$q_u = C N_c S_c d_c + q N_q d_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma \quad \text{——— (1)}$$

As for finding Slope factor

$$\alpha = 45 + \phi/2 = 45 + \frac{20}{2}$$

$$\alpha = 55^\circ$$

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

$$\boxed{S_c = 1.3}$$

As $\phi > 10$

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

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

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

$$d_\gamma = d_q = 1.11$$

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

$d_c = 1.23$

∴ Putting values in eq (1) we get

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

$q_u = 762\ kN/m^2$

Now $q_{nu} = q_u - \bar{\sigma}$ $\bar{\sigma} = \gamma \times D_f$

$q.n.u = 762 - (18 \times 1.6)$

$q.n.u = 733.2\ kN/m^2$

Thus $q.n.s = \dfrac{q.n.u}{F.O.S} = \dfrac{733.2}{3}$

$q.n.s = 244.4\ kN/m^2$

Now

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

As $\bar{\delta} = \gamma \times D_f$

$$q_s = 244.4 + (18 \times 1.6)$$

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

So total Safe load

$$= A \times q_{.s}$$

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

$$\boxed{= 1639.2 \ kN}$$

Ans.

Qno # 3 (Part A) Pg #20

Settlement

When load is applied on the ground Surface this will produce effective verticle Stresses. due to these Stresses the effective verticle Strain will be produced as result of which the movement will occur in the downward direction.

This downward movement is known as Settlement.

Types of Settlement

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

1) Total Settlement.
2) Differential Settlement.

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 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 mostly the utility service such as water Supply, electricity, sewage line, telephone etc. may be decreased and the Structure will remain Sound.

Limitation for uniform or Total Settlement.

The Soil layer to which the load is to be transfer, Should be Sufficient in dealing to resist the load which is to be applied on it.

To spread the coming load over a large area.

Differential Settlement

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

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

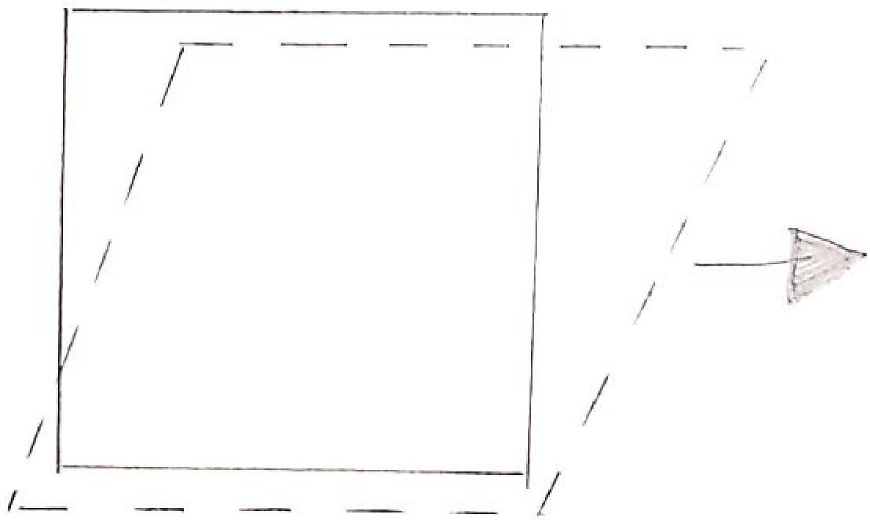
Types of differential Settlement

There are mainly two types of differential Settlement.

1) Tilt
2) Angulas distortion

Tilt

If the entire Structure rotate due to unequal Settlement is called tilt.



Angular distortion

When two foundations Support walls/columns Settle unequally if means the Structure is Subjected to angular distortion.

Qno # 3

(Part - B)

Given data

$C_c = 0.31$

$P_1 = 130\ KN/m^2$, $P_2 = 170\ KN/m^2$

$C_o = 1.02$

$H = 5m$

Required

$e = ?$

$S_c = ?$

Solution

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

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

Pg #27

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

$$e_1 = 0.983$$

Now

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

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

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

$$S_c = 0.08919 \times 1000$$

$$\boxed{S_c = 89.19 \text{ mm}}$$