NAME :- MALIK Muhammad Afnan

Section :- "B"

ID :- 7839

Subject :- Geo-technical And Foundation

Department :- Civil Engineering

Semester :- "Six"

Q No 1
(A)

Ans:- (1) **Plastic Equilibrium:-**

Plastic equilibrium is a state when Permanent changes occur OR it is the stage when irresible Strain take place due to the application of Constant Stress.

2) **Angular Distortion:-**

→ It is a types of differential Settlement.

→ It is the unequal Sattlement of two Founclations Support walls/Columns of the Structure.

3) **Compressive Index :-**

→ It is a number that is used to find out the Settlement in the normally Consolidated Clay.

→ The total stress applied is larger than the stress in the field to which the soil sample is been undergone in the past. This kind of clay soil is solid to be normally Consolidated clay

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

4) **Ultimate Bearing Capacity :-** The maximum pressure that is a soil resists 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) **Poission Ratio Of Soil :-**

⇒ Poission ratio represents a change in shape of a material while the volume is maintained constant.

⇒ In soil terminology, Poission's ratio also know as the co-efficient of lateral expansion and it's affected by the following factors.

⇒ The soil is a descrete and stratified medium, mostly not elastic and

onisotropic.

⇒ The Soil is not deformed linearly.

Poission ratio in Soil mechanics is a rather Conditional Parameter.

Q No1 (B)

5

Given DATA:-

Angle of Internal Friction (ϕ) = 30°

unit weight of Soil (γ) = 19.2 KN/m^3

Horizontal Slope = 3

vertical slope = 1

Cohesion (c) = 0.

Required:-

Total Normal Force $\left(\frac{Na}{b}\right)$ = ?

Total Shear Force $\left(\frac{Va}{b}\right)$ = ?

Solution:-

As we know that

As the normal force is

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

$$= 136.52 \times \cos(18)$$

$= 136.52 \times \cos(18)$

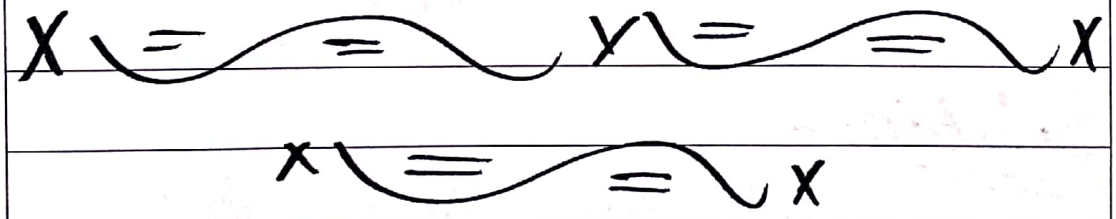
$$\frac{Na}{b} = 129.83 \text{ kN/m}.$$

Also the Shear force is,

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

$= 136.52 \times \sin(18)$

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



Q No 2 (A) 7

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.
It is denoted by q.
In other words the internal strength of the soil is called bearing Capacity.

Factors Effecting Bearing Capacity:-

1) **Reative 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 be increase.
This will increase more for dense soil/sand as compared with medium and base.
N_q, N_c, N_γ = Terzaghi bearing capacity factors.

2) **Depth Of the Footing:-** With the increase of the depth (df) of the foundation the bearing capacity of soil will increase.
This increase will be more incase 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 as medium Soil/Sand.

4) **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.

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

5) **Water Table :-** 10

As water table come near to footing, the bearing capacity get decrease.

Q No 2
(B)

Given Data :-

Factor of Safety = 3
Depth of Foundation (D_f) = 1.6m
unit weight of Soil (γ) = 18 KN/m^3
Angle of Shear resistance (ϕ) = 20°
Unit Cohesion (C_u) = 20 KN/m^2.
N_c = 14.8
N_q = 6.4
N_γ = 2.9

Footing Dimension = 2m x 3m (b=3, h=2)

Required :-

Maximum Safe load (q_s) = ?

Solution :-

According to Mayerhof's Analysis.

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

=> For shape factor:- (S_c, S_q, S_γ)

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

$$\rightarrow \quad \alpha = \left(45 + \frac{\phi}{2}\right).$$

$$= 45 + \frac{20}{2}$$

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

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

$$\boxed{S_c = 1.27}$$

As $\phi > 10^\circ$, $S_\circ$

$$S_q = S_\gamma = 1 + 0.1\left(\frac{B}{L}\right)\tan^2\alpha.$$

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

$$\boxed{S_q = S_\gamma = 1.135}$$

→ For depth factor:- (d_c, d_q, d_r)

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

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

$$\boxed{d_c = 1.22.}$$

Also $\phi > 10°$, So.

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

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

$$\boxed{d_q = d_r = 1.11}$$

Inclination factor:- For $Q = 0°$

$i_c = i_q = i_r = 1$

By using formula.

$q_u = CN_c \cdot S_c \cdot d_c + qN_q \cdot S_q \cdot d_q + \frac{1}{2} \cdot \gamma \cdot B \cdot N_\gamma \cdot d_\gamma \cdot S_\gamma$ (14)

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

$q_u = 762\ kN/m^2$

As Net ultimate Bearing Capacity is $q_{n.u} = q_u - \bar{s}$

$= 762 - (1.6 \times 18)$

($\because \bar{s}$ = over burden Pressure)

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

Net Safe Bearing Capacity is,

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

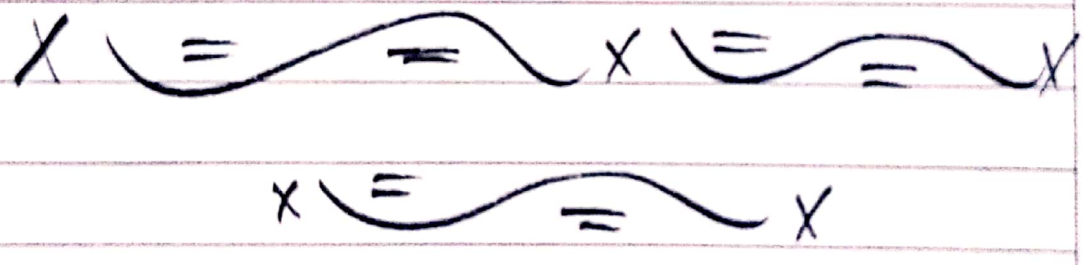
$= 244.4 + (1.6 \times 16)$

$q_s = 273.2\ KN/m^2$

This safe bearing Capacity over the whole footing will be,

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

$= 1639.2\ KN.$



Q No 3 (A) Ans (16)

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 a result of which the movement 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.

Total Settlement:-

It is also called uniform Settlement. In this types 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 most the taken place in the structure which are constructed in rigid footing (raft). In this types of Settlement, the

utility Services and an water Supply, electricity, Sewage line, telephone etc. may be decreased and the structure will remain Sound

Limitation For Total Settlement:-

The Soil layer to which the 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.

2) Differential Settlement:-

Different Settlement in different part of the same structure is called differential Settlement.

Differential Settlement is more danger or undesirable as Compared with total Settlement, because it's Cause more damage to a structure as Compared to total Settlement.

Types Of Differential Settlement :-

There are two types of differential Settlement.

1 **Tilt :-**

if the entire Structure rotate due to unequal Settlement is Called tilt.

2) **Angular Distortion :-**

when two Foundations Support walls

Settle unequally it means the Structure is subjected to angular distortion. (20)

QNO3
(B)

Given data:-

Initial void ratio (e_o) = 1.02.
Initial Stress/Pressure (P_1) = 130 KN/m^2
Compressive Index of Soil (C_c) = 0.31
Increased or Final Stress/Pressure (P_2) = 170 KN/m^2
Stratum thickness (H) = 5m

Required:-

Total (Consolidation) Settlement (S_c) = ?
Final void ratio due to increased Stress (e_1) = ?

Solution:-

As Compressive Index is given by,

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

Putting value:

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

$$\boxed{e_1 = 1.02}$$

By Formula

Consolidation Settlement is,

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

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

$$S_c = 0.0893\,m \times 1000\,mm$$

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