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Signature:

Qno-1 (A): Define the following terms.

(i) plastic equilibrium
(ii) Angular Distortion
(iii) Compressive index.
(iv) ultimate bearing Capacity.
(v) Poission Ratio of Soil.

(1) Plastic equilibriume: "The State of Stress Within a Soil mass, or a Portion there, of that has been deformed to Such an extent that its ulitimate Shearing resistance is mobilized.

(2) Angular Distortion: Angular Distortion is defined as "The Ratio of the differential Settlement 'δ' and the distance b/w two Points".

Note :- It is Crucial to understand beforehand the range of tilt and angular Distortion that will Possibley Cause an unacceptable damage to the Structure.

Compressive Index:

Compressive index is used to find the Settlement in the ~~normally~~ normally Consolidated Clay.

• It is defined as " The total Stress applied is larger than the Stress in the field, to which the Soil Sample hass been undergone in the Past.

This Kind of Clayey Soil is Said to be normally Consolidated Clay..

ultimate bearing Capacity:

It is defined as " The total Pressure intensity at The base of foundation, which Would Cause Shear Failure is Called Ultimate bearing Capacity".

Simply " The Capacity of Soil to Support the applied to the ground." It is theoritical Max Pressure with Can Support without Failure.

Poison Ratio of Soil :- The Poisson of Soil is defined as " Poisson Ratio is the negative of ratio of transversal Strain to the axial Strain in an elastic material which is Subjected to an unaxial Stress."
The Poisson ratio of a Stable, isotropic, linear elastic material Cannot be Less then 1.0 nor greater than 0.5.

Q no -1 (b) : A 6m tall Cantiliver wall retaining the Soil, that has the following Properties

$C = 0$
$\phi = 30^\circ$
$\gamma = 19.2$ KN/m³.

And the ground Surface behind the wall is inclined at a Slop of 3 horizontal and 1 Verticle.

The wall has moved Sufficiently to develop active Condition. Determine the total normal and Shear forces acting on the back of this wall using Rankine theory.

Given data

$H = 6m$

$C = 0$

$\phi = 30^\circ$

$\gamma = 19.2$ K.N/m³

Slop H = 1, V = 3.

Required

$\frac{N_a}{b} = ?$, $\frac{V_a}{b} = ?$

Solution:

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

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

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

$\beta = 18^\circ$

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

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

$K_a = 0.3948$

$K_a = 0.395$

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

$P_a/b = 136.512\ kN/m$

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

$= 136.512 \times \cos\beta$

$\Rightarrow 129.83\ kN/m.$

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

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

$$= 42.18 \text{ kN/m}$$

Results :

$$N_{a/b} = 129.83 \text{ kN/m}$$

$$V_{a/b} = 42.18 \text{ kN/m.}$$

Q no 2 (a) : What is bearing Capacity? Also write factor affecting bearing Capacity.

Ans: **Bearing Capacity:**

The Engineering Properties of the Soil due to which, it resist the applied load.

It is Denoted by q.

OR

It is also defined as "the internal Strength of Soil is Called bearing Capacity".

Factor effecting bearing Capacity:

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

Relative Density of Soil:

More relative density of soil, more will be its angle of friction more will be N_q, N_c, N_γ, with increase of this, bearing capacity increases.

Depth of footing:

With increase in depth of footing, the bearing capacity will increase.

The increament will be more if the soil is dense.

Water table:

As water table comes near the surface, the B.C will decrease.

width of footing:

As the width increase, the Bearing capacity increase.

unit weight of Soil:

The B.C of Soil is direct proportional to unit weight of soil.

B.C increase with increase in unit-weight.

Q no 2 (b):

What is Maximum Safe load which Can be Supported by rectangular footing (2 x 3) m, with the factor of Saftey 3. The base of the footing is at 1.6m below the ground Surface. The unit weight of Soil is 18kN/m2. 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

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

$D = 1.6\ m$, factor of Safty = 3.

$\gamma = 18kN/m^3$.

$\theta = 20°$

$C_u = 20\ kN/m$.

$q_s = ?$

Solution:

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

First for Shape factor:

$$\alpha = (45 + \theta/2) = (45 + 20/2)$$

$$\alpha = 55^\circ$$

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

$$1.02 (2/3) \tan^2 (55)$$

$$S_c = 1.27 = 1.3.$$

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

$$= 1.1 (2/3) \tan^2 (55)$$

$$S_q = S_\gamma = 1.14$$

Depth factor:

$$D_c = 1 + 0.2 (D/B) \tan \alpha.$$

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

$$d_c = 1.23.$$

$$d_\gamma = d_q = 1 + 0.1 (D/B) \tan \alpha.$$

$$1 + 0.1 (1.6/2) \tan (55) = 1.11.$$

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

$(20 \times 14.83 \times 1.13 \times 1.23) + (18 \times 1.6 \times 6.4 \times 1.11 \times 1.14)$.

$+ (0.5 \times 20 \times 2 \times 2.9 \times 1.11 \times 1.14)$

$q_u = 762 \ kN/m^2$.

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

$\Rightarrow 762 - (18 \times 1.6)$ $\quad\quad \bar{\sigma} = \gamma \times D$.

$\Rightarrow 733.2 \ kN/m^2$.

$q_{ns} = \dfrac{q_{n.u}}{f.o.s}$

$\dfrac{733.2}{3} = 244.4 + (1.6 \times 18)$.

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

Total Safe load on Rec footing.

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

$1639.2 \ kN$.

Q.no 3: (a) What is Settlement? Explain it's types in details.

Ans: **Settlement:**

It is defined as "The downward movement od a Structure due the applied load, is Called Settlement".

The load applied will Produce downward movement which Creates Verticle Stress, because of those Verticle Stresses, the Verticle Strain Produces, which Cause the downward movement.

Types of Settlement

On The basis of movement, Settlement has two types.

1. Total Settlement
2. Differential Setllenent.

Total Settlement: It is a also Called Uniform Settlement. In this type of Settlement each Part of Structure will Settle down equally in all direction.

In unifor Settlement, the total Settlement mostly takes Place in Structure built on rigid footing, and also the failure is not much Considered as of differential of Settlement.

Differential Settlement: "The Settlement, which takes places in different Parts of Same Structure is known as Differential Settlement.

It is more dangerous than total Settlement.

Further more, Differential Settlement has 2 types.

~~Angular~~ (1) Angular Distortion

(2) Tilt.

Q no. 3: (b):

A Soil has Compressive inex of $C_c = 0.31$. At a Stress = 130 KN/m² The Void ratio was 1.02.

Calculate the following:

(1) The void ratio if the Stress on the Soil is increased to 170 KN/m².

(2) The total Settlement of the Stratum of 5m thickness.

Given

$C_c = 0.31$

$P_1 = 130 \, KN/m^2$.

$e_o = 1.02$

$P_2 = 180 \, KN/m^2$.

$H = 5m$.

Required:

Void ratio, $e_1 = ?$

$S_c = ?$

Solution :

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

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

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

$$e_1 = 0.54$$

Now;

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

$$= \frac{5}{1+1.02} \times 0.31 \log_{10}(170/130) \times 1000\ m.$$

$$S_c = 1003.427.$$

Results

$$e_1 = 0.54$$

$$S_c = 1003.427.$$