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Section	A
Subject	Geotechnical Engineering.
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Ans 1 (a)

Plastic Equilbrium:-

A body is said to be in state of plastic Equilbrium, If every Parts of Its on the verge of failure so this can be visualized by a perfectly rigid plastic model where with a stress strain relationshif If we assume that It is rigid & perfectly plastic so here the stress strain behaviour of the soil can be represented here by the rigid Perfectly plastic idealization.

Angular Distoration:-

When two foundations Support walls settle unequally It mean the structure is subjected to angular Distoration.

It is also known as relative distoration.

Ultimate Bearing Capacity:-

The maximum pressure at the base of footing which Cause Shear failure in the soil

Poission ratio of Soil:-

Poission ratio is a measure of poission effects that discribe the expansion of the material

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in the direction Perpendicular to the direction of loading. The value of poission ratio is the negitive of the ratio of transverse strain to axial strain.

Compressive Index:

It is used to find Settlement in the normally Consolidated clay. The totall stress applied is larger then the stress in the field. to which the Soil Sample has been undergoes in past. The kind of clayey Soil is Said to be normally Consolided clay.

B) ## Given Data

Cohession C = 0

Angle of Internal friction (Φ) = 30°

Unit weight of Soil γ = 19.2 KN/m²

Horizental Slope = 3

Vertical Slope = 1

Require

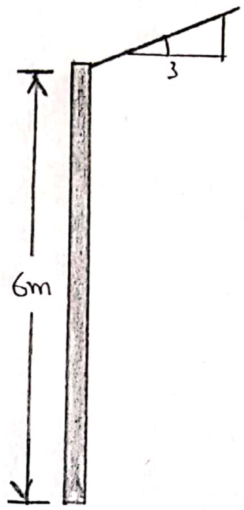
Total Normal force (Na/b) = ?

Total Shear force (Va/b) = ?

Solution:

As we know

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



$$\tan(\beta) = \frac{\text{Per}}{\text{Base}}$$

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

$$\boxed{\beta = 18^\circ}$$

Ka is given by

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

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

$$K_a = 0.951 \times \frac{0.951 - \sqrt{0.904 - 0.75}}{0.95 + \sqrt{0.904 + 0.75}}$$

$$\boxed{K_a = 0.395}$$

Now by formula

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

By Putting Value

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

$$\boxed{\frac{Pa}{b} = 136.52 \text{ KN/m}}$$

As the Normal force

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

Now put the values

$$\frac{Na}{b} = 136.52 \times \cos 18^\circ$$

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

Now we have to find shear force

$$\frac{Na}{b} = \frac{Pa}{b} \times \sin B$$

$$\frac{Va}{b} = \frac{Pa}{b} \times \sin B$$

$$\frac{Va}{b} = 136.52 \times \sin 18^\circ$$

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

2 Ans (A)

Bearing Capacity:-

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

Factors affecting Bearing Capacity

(i) Relative Density:-

Greater the value of relative density of soil higher will be the value of angle of internal friction (ϕ), higher the value of ϕ higher will be the value of Terzagh's bearing capacity factor. Due to which the value of bearing capacity will increase.

ii) Depth of footing:-

With the increase of depth of footing the bearing capacity of soil also increase.

(iii) Width of footing:-

Greater the width of footing greater will be the bearing capacity.

iv) Unit weight of Soil:-

By Increase of unit weight of Soil the bearing capacity will also Increase.

Water table:-

It has Indirect relation with bearing Capacity Due to Increase of water table, the Shear Strength b/w the Soil Particle reduce hence the baring Capacity decrease.

(B) Given Data

Footing Dimension (2x3m)

Depth of foundation = 1.6 m

FOS = 3

γ = 18 KN/m³

Angle of shear resistance = 20°

C_u = 20 KN/m²

N_c = 14.8

N_q = 6.4

N_γ = 2.9

Required

Maximam Safe load = ?

Solution

According to Mayerhof's Analysis

$q_u = c \cdot N_c \cdot S_c \cdot D_c + q \cdot N_q \cdot S_q + D_q + \frac{1}{2} \gamma \cdot B \cdot N_\gamma \cdot S_\gamma \cdot D_\gamma$

For shafe factor

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

$\alpha = 45 + \phi/2$

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

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

$\boxed{S_c = 1.27}$

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

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

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

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

For Depth Factor (d_c, d_q, d_γ)

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

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

$\boxed{d_c = 1.22}$

Also $\phi > 10^\circ$ So,

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

$d_q = d_\gamma = 1 + 0.1 (1.6/2) \tan 55$

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

INCLINATION FACTOR

For $\theta = 0$

$i_c = i_q = i_\gamma = 1$

By formula

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

$q_u = 20 \times 14.8 \times 1.27 (1.22) + (1.6 \times 18)(6.4)(1.35)(1.11) + \frac{1}{2}(18)(2)(2.9)(1.11)(1.35)$

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

Net ultimate Bearing Capacity

$q_{nu} = q_u - \sigma$

$q_{nu} = 762 - (1.6 \times 18)$

$\boxed{q_{nu} = 733.2 \text{ KN/m}^2}$

Safe bearing Capacity

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

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

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

Thus Safe bearing Capacity over the whole footing will be

$A \times q_s = 273.2 (6 m^2) = 1639.2 \text{ KN}$

(3) (A)

Settlement:-

When load is applied on a ground Surface this will produce effective verticle stresses due to this stresses the effective Vertical Strain will be produce as a result of which the movement will occur in the downward direction. This downward direction is called Settlement.

Types of Settlement:-

1) Total Settlement:-

It is also called Uniform Settlement

In this type of Settlement each Part of Structure will Settle equally.

⇒ The total Settlement mostly take place in the Structure which are Construted on Rigid footing.

2) Differential Settlement:-

Differential Settlement in different Parts of the Same Structure is called differential Settlement.

⇒ Different Settelment is more danger as Compare to total Settlement because it Cause more damage to Structure.

Types of Differential Settlement

Tilt:-

If the entire Structure Rotate unequal Settlement is called tilt.

Angular Distoration:

When two foundations Support walls Settle-unequally. It mean the structure is Subjected to angular Distoration.

(3) Ans (B)

Given Data

$C_c = 0.31$

$P_1 = 130\ KN/m^2$

Initial void Ratio = 1.02

Increase or final stress/pressure = 170 KN/m²

Strain thickness = 5m

Required

Final Void Ratio due to Increase Stress = ?

Total Consolidation Settlement = ?

Solution:-

As Compressive index is given by

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

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

$$\boxed{e_1 = 0.984}$$

By formula consolidation settlement is

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

$$S_c = \frac{5}{1+1.02} \times 0.31 \times \log_{10}(170/130) = 0.0893m \times 1000mm$$

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