Mid Term Exam

Name = Jqyar Hussain

ID = 7877

Section = A

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Instructor = Engr- Liaqat Ali

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QNO1 A⇒ Define the following Terms

1. Plastic Equillibrium
2. Angular Distortion
3. Compressive Index
4. Ultimate Bearing Capacity
5. Poission Ratio of Soil.

1) Plastic Equilibrium:- Plastic Equilibrium state are these state when the soil will near to failure or verge to failure.

⇒ When the retaining soil is homogenous, Cohessonless Semi-Infinite and dry.

The friction resistance between the retained soil and retaining wall is neglected mean frictional resistance is zero.

The retained soil will be state of Plastic Equilibrium.

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2) Angular Distortion:-

When two foundation support wall/column settle unequally it means the structure is subjected to angular distortion.

OR

Angular distortion is the ratio of the differential settlement and the distance between point.

$$\beta = \frac{\delta}{L}$$

Where

β = Angular distortion

δ = Differential settlement

L = distance between two point.

3) Compressive Index =>

$$C_c = \frac{\Delta e}{\log_{10}\left(\frac{p_2}{p_1}\right)}$$

Where:

C_c = Compressive index

Δe = Change in void Ratio

P_1 = The pressure where the void ratio is e_1

P_2 = The Pressure where the void ratio is e_2

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Compressive Index in term of M_v

M_v = Change in volume per unit volume of compressible layer.

$$S_c = H \times M_v \times \Delta P$$

$$M_v = \frac{\Delta e / \Delta P}{1 + e_0}$$

4) Ultimate Bearing Capacity =>

The maximum pressure at the base of footing with shear failure in the soil. It is denoted by q_u.

By Formula:

$$q_u = CN_c S_c I_c d_c + qN_q S_q I_q d_q + 0.5 \gamma B N_\gamma S_\gamma I_\gamma d_\gamma$$

5) Poission Ratio of Soil:

Poission Ratio is a measure of the poission effect that described the expression or contraction of a material in the direction perpendicular to the direction of loading.

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The value of poission ratio is negative of the ratio of Transverse Strain to axial Strain.

QNO:1: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 included at a slope of 3 horizontal and 1 vertical The wall has move sufficient to develop action condition Determine ~~back of this~~ the total normal and Shearforce action on the back of this wall using Raulkines Theory:

Give Data

Height = H = 6m

$C = 0$

$\phi = 30^\circ$

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

Slope, H=3, V=1

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Required ⇒

$$\frac{Pa}{b} = ? \,, \quad \frac{Va}{b} = ?$$

Sol

As we know That

$$\frac{Pa}{b} = \frac{\gamma \times H^2 \times Ka}{2} \longrightarrow (1)$$

First of all we find β

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

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

As we know that

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

Now

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

$$Ka = 0.3948$$

$$\boxed{Ka = 0.395}$$

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eq① $\Rightarrow$ $\frac{P_a}{b} = \frac{\gamma \times H^2 \times K_a}{2} = \frac{19.2 \times 6^2 \times 0.395}{2}$

$$\frac{P_a}{b} = 136.512 \text{ KN/m}$$

To find Normal force $\left(\frac{N_a}{b}\right)$

As we know that

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

$$\frac{N_a}{b} = 136.512 \times \cos(18)$$

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

To find Shear Force $\left(\frac{V_a}{b}\right)$

As we know that

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

$$\frac{V_a}{b} = 136.512 \times \sin(18)$$

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

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Q.No2⇒ A ⇒ What is bearing capacity. Also write factor affecting bearing capacity:

Bearing Capacity

At is the Engineering property of soil beacause of which when Load is applied on the ground Surface and this load is resisted then such capacity of soil is called Bearing capacity.

Factor Affecting of Bearing capacity

1) Relative density of soil⇒ If the Relative density of soil is greater. the value of angle. of internal friction will be greater. Heigher will be Tarzaghi bearing capacity factor due to which the value of bearing capacity will increase

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2) Depth of Footing ⇒ The Bearing capacity increase with increase of depth of footing. higher will be Terzaghi bearing capacity factor.

3) Width of footing ⇒ If the width of footing increase the bearing capacity also increase and Higher will Terzaghi bearing capacity factor.

4) Unit weight of soil

The unit weight of the soil increase
The bearing capacity also increase.
It mean that the unit weight of soil is directly proportional to the bearing capacity.

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5) Cohesion of Soil ⇒ If the cohesive of the soil is more cohesion value. The bearing capacity is also increase with them.

6) Water Table ⇒ Water table is indirect relation with the bearing capacity due to water is the Shear Strength between the soil partical reduce hence bearing capacity is decrease.

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Q No2 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 the soil is 18 KN/m³. The angle of shoar resisting $\Phi = 20$ [$N_c = 14.8$, $N_q = 6.4$ $N_r = 2.9$] unit cohesion $C_u = 20 kN/m^2$ Use Mayerhof Analysis.

Given Data

⇒ $L = 3m$, $B = 2m$

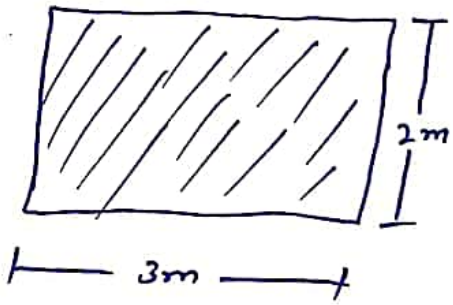
⇒ $Df = 1.6m$

⇒ $F.O.S = 3$

⇒ $\gamma = 18 KN/m^3$

⇒ $C = 20 KN/m^2$

⇒ $\Phi = 20^\circ$



⇒ $N_c = 14.8$, $N_q = 6.4$, $N_r = 2.9$

Required ⇒

$$q_s = ?$$

As we know that

$$q_u = CN_c S_c I_{cd} d_c + qN_q S_q I_{qd} d_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma I_\gamma$$

Now $I_c = I_q = I_\gamma = 1$

Thus

$$q_u = CN_c s_c d_c + qN_q s_q d_q + 0.5 \gamma_s S_\gamma d_\gamma N_\gamma \longrightarrow (*)$$

First for the Shape factor

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

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

Now

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

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

$$\boxed{S_c = 1.3}$$

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$\phi > 10$, then $S_\gamma = S_q = 1 + 0.1\left(\frac{B}{L}\right)\tan^2\alpha$

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

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

Depth Factor

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

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

$\boxed{d_c = 1.23}$

^low

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

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

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

$\boxed{q = \gamma \times D}$

eq (*)

$q_u = CN_c S_c d_c + qN_q S_q d_q + 0.5\,\gamma B N_\gamma S_\gamma d_\gamma$

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

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$q_u = 762\ kN/m^2$

Now

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

$q_{n.u} = 762 - (18 \times 1.6)$ $\quad \boxed{\bar{\delta} = \gamma \times D}$

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

Thus $q_{n.g} = \frac{q_{n.u}}{FOS} = \frac{733.2}{3}$

$\boxed{q_{n.g} = 244.4\ kN/m^2}$

Now

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

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

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

Total safe load on Rectangular footing

$A \times q_s$

$(2 \times 3) \times 2.73.2$

$\boxed{1639.2\ kN}$

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Q No 3 A ⇒ What is Settlement. What are the its types explain in detail.

Settlement

When the load is applied on the ground surface this will be produced effective vertical stress. due to these stress. The effective vertical strain will be produced as a result of which the movement will occure in the downword movement is called settlement.

Types of Settlement

There are two types of settlment on the basel of movement of structure.

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1) Total Settlement ⇒

⇒ This is the types of Settlement also called uniform Settlement.

⇒ In total 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.

⇒ A uniform Settlement mostly occure in that Structure which are constructed in rigid footing.

⇒ In this types of Settlement the utility services Such as water Supply, Electricity, Sawage line Telephone etc.

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Limition for Total Settlement

The soil layer to which the load is to be Transfer Should be Sufficient is bearing to result the load which is to be applied on it. To spread the coming load over a large area.

2) Differential Settlement

⇒ Differential Settlement is different part of some structure is called differential Settlement.

⇒ Differential Settlement are more dangerous or ondesirable as compare to total Settlement because they are cause more demage in a Structure.

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Type of Differential Settlement

1. Tilt
2) Angular Distortion:

1) **Tilt** ⇒ If the entire structure rotate due to unequal settlement is called Tilt.

2) **Angular Distortion** ⇒ When two foundation support wall or column settle unequally itis mean that the structure to angular distortion.

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Q No3 B A Soil has Compressive index $C_c = 0.31$ At a Stress 130 KN/m² the void ratio was 1.02 Calculate.

① The void ratio of the Stress on the Soil is increased to 170 KN/m²

② The total Settlement of the Stratum of 5m thickness

Give data

$C_c = 0.31$

$P_1 = 130$ KN/m²

$e_1 = 1.02$

$P_2 = 170$ KN/m²

$H = 5m$

Required ⇒ $e_1 = ?$

$S_c = ?$

Sol As we know that

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

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

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

$$0.31 = \frac{1.02 - e_1}{0.1165}$$

$$0.0361 = 1.02 - e_1$$

$$e_1 = 1.02 - 0.0361$$

$$\boxed{e_1 = 0.984}$$

(A) $S_c = ?$

As we know that

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

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

$$S_c = 0.08939\ m$$

$$\boxed{S_c = 89.3978\ mm}$$

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