ID No 7786
Section A

Q2:- Define the following terms? Ahmed Shahzad

Plastic Equilibrium:

It is defined as state of permanent change of a matter when stressed. A body of soil is said to be in plastic equilibrium if every part of it's is on the verge of failure. So this can be visualized by a perfectly rigid plastic model where with a stress strain relationship if we assume its rigid and properly plastic.

Angular Distortion:-

When two foundations support walls settle unequally It means the structure is subjected to angular distortion It is also known relative rotation.

"OR"

The slope between two adjacent columns.

Ultimate bearing Capacity:-

The maximum bearing or pressure at the base of the footing which can cause shear failure in the soil. The soil must be capable of carrying the loads from any engineered structure placed upon it without a shear failure.

Poison ratio of Soil:-

When load is applied on soil it's contract or expand in the direction of load. Most material have poison ratio between 0.0 and 0.5.

Sand → 0.15-0.4, Silt → 0.3-0.35, Clay → 0.1-0.5

Compressive Index:-

Compressive Index is used to find the settlement in the normally consolidated clay. The total stress applied is larger than the stress in field, to which the soil sample has been undergone in the past. This kind of clay soil is said to be normally consolidated clay.

ID NO 7786

Q no 2 (b) DATA:-

Horizental slope : 3
Vertical Sope = 1
Cohesion (C) = 0
Unit weight of Soil (γ) = 19.2 kN/m²
Angle of Internal friction (φ) = 30°
Total Normal force (Na/b) = ?
Total Shear force (Va/b) = ?

Solution:-

As we know that $\frac{Pa}{b} = \frac{\gamma \times H^2 \times ka}{2}$

$\tan B = \frac{1}{3}$

$B = \tan^{-1}(\frac{1}{3})$

$B = 18$

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

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

$ka = 0.3948 \approx 0.395$

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

$\frac{Pa}{b} = 136.512$ kN/m

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

$= 136.512 \times \cos(18)$

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

$= 136.82 \times \sin(18)$

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

ID No 7786
Ahmed Shahzad.

Q: What is bearing Capacity? write it's factor?

Bearing Capacity:-

The property of soil due to which when load is applied on soil or ground surface and its resisted by the soil is called bearing capacity of soil.

Some of the factors effecting bearing capacity are.

i) Relative density
ii) Depth of footing
iii) Width of footing
iv) Unit weight of soil.
v) water table.

Relative density:-

Greater the value of relative density higher will be the value of internal friction (ϕ). and higher the value of internal friction higher will be tarzaghi bearing capacity

Depth of footing:-

Increase in deepth of footing will increase of bearing capacity.

Width of footing:-

The bearing capacity increase with increase of width of ~~bearing~~ footing. This will be maximum for dense soil as compared to loose soil.

Unit weight of Soil:-

If the unit ω of soil is greater then the bearing capacity of soil will also be increase

WATER TABLE:-

The nearer of water table to the soil will decrease it's bearing capacity. and farther of water table from soil will increase bearing capacity.

ID NO 7786

Q2 b:. find Maximum safe load use Mayerhof eq ?

Data:-

Base = 3 , height = 2 , Df = 1.6m
Factor of safety , FOS = 3
Unit weight of Soil (γ) = 18 kN/m^3
Angle of Shear Resistance (ϕ) = 20°
Unit Cohesion = 20kN/m^2
Nc = 14.8 , Na = 6.4 , Nr = 2.9
Maximum Safe load (q_s) = ?

Solution:-

$$q_u = CN_c S_{cd_c} i_c + q n_{qi_q} s_{qd_q} + \frac{1}{2} \gamma B N_r I_r d_r - (i)$$

Shape factor:-

$$\alpha = 45 + \frac{\phi}{2} \Rightarrow \alpha = 45 + \frac{20}{2} \Rightarrow \alpha = 55°$$

$$\Rightarrow S_c = 1 + 0.2 \frac{B}{L} \tan^2\alpha \Rightarrow 1 + 0.2(2/3)\tan^2 55 \Rightarrow S_c = 1.3$$

$$\Rightarrow S_q = S_r = 1 + 0.1 \frac{B}{L} \tan^2\alpha \Rightarrow 1 + 0.1(2/3)\tan^2 55 \Rightarrow S_r = 1.14$$

Depth Factor:-

$$\Rightarrow d_c = 1 + 0.2(D/B)\tan\alpha \Rightarrow 1 + 0.2\left(\frac{1.6}{2}\right)\tan 55 \Rightarrow d_c = 1.23$$

$$\Rightarrow d_r = d_q \Rightarrow 1 + 0.1\left(\frac{D}{B}\right)\tan\alpha \Rightarrow 1 + 0.1\left(\frac{1.6}{2}\right)\tan(55), \; d_q = 1.11$$

Put the values of Shape factor and depth in eq(i)

$$q_u = (20 \times 14.8 \times 1.3 \times 1.23 \times 1) + (18 \times 1.6) \times 6.4 \times 1.1 \times 1.11 \times 1) + \frac{1}{2}$$
$$(18)(12)(2.9)(1.11)(1.135)$$

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

Now $q_{nu} = q_u - \bar{s}$

$$q_{nu} = 762 - (1.6 \times 18) \Rightarrow 733.2 \text{ kN/m}^2$$

Net safe bearing capacity

$$q_s = q_{ns} + \bar{s}$$

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

The safe bearing capacity over the whole footing will be

$$q_s \times A = 273.2(6) \frac{kN m^2}{m^2} \Rightarrow \frac{kN\, m^2}{m^2}$$

$$q_s \times A = 1639.2 kN$$

ID No 7786

Q3 Define Settlement and it's types?

1(a) Settlement:-

When load is applied on ground surface this will produce vertical stresses due to this effective vertical strain will produce as a result of which the movement will produce in downward direction. This movement is called settlement.

Types Of Settlement:-

Total Settlement:-

In this each part of structure will settle down equally It is also called uniform settlement. The total settlement take place in the structure which have rigid footing

Differential Settlement:-

Differential settlement in different part of the structure is called differential settlement.
It cause more damage to a structure as compared to total settlement.
Differential settlement is more danger than total settlement.

Types of Differential Settlement:-

Tilt:- The entir structure rotate due to unequal settlement is called tilt.

Angular distortion:-

When two foundation support walls settle unequally, this mean structure is subjected to Angular distortion.

Causes of Soil Settlement:-

Weak bearing Soil.
Poor compaction
Poor drainage around the house
Irregular rainfall or drought
Addition to an existing house

ID No 7786
Section A

Q3 Calculate total settlement of structure?
(c)

Data:-

Initial Stress , $P_1 = 130\ kN/m^2$
Initial void ratio , $e_0 = 1.02$
final Stress , $P_2 = 170\ kN/m^2$
Compressive Index of soil , $C_c = 0.31$
final void ratio = ?
Total Settlement (S_c) = ?

Solution:-

Compressive Index is given by

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

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

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

$$\Rightarrow 0.31 \times 0.1105$$

$$\Rightarrow 1.02 - e_1$$

$$e_1 = 0.984$$

Now Settlement is

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

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

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

$$S_c = 89.3\,mm$$