IQRA NATIONAL UNIVERSITY

PESHAWAR

ID: 7224

MODULE: 2012 Batch

SUBJECT: Geotechnical engineering

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QUESTION NO 1:- PART # A:

Define the following terms:

(1) Plastic equilibrium

(2) Angular distortion

(3) Compressive index

(4) Ullimate bearing capacity

(5) poission Ratio of soil

ANSWER

(1) PLASTIC EQUILIBRIUM:-

Plastic equilibrium state that when the soil near the failure or verge wo failure.

when the retaining soil is homogenous, cohessioness, semi-infinite and dry.

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

The retained soil will be in state of plastic equilibrium.

ANGULAR DISTORTION: -

When two foundations 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 two point.

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

where

β= angular distortion

∞ = differential settlement

L = distance between two points

3) COMPRESSIVE INDEX:-

$$C_c = \frac{\Delta e}{\Delta \log \sigma_{ef}}$$

Cc = compressive index

Δe = variation of void ratio

COMPRESSIVE INDEX IN TERM OF M_v

Mv = change in volume per unit volume of compressible layer.

Sc = H×Mv× Δp

(4) ULTIMATE BEARING CAPACITY:-

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

(5) ***POSSION RATIO OF SOIL:-***

Poission ratio is a measure of the possion effect that described the expansion or contraction of a material in the directions perpendicular to the direction of loading.

The value of passion ratio is negative of the ratio of transverse strain to axial strain.

QUESTION # 1 PART # B

GIVEN DATA: -

Hight = H = 6m

C = 0

Q = 30^0

r = 19.2 KN = KN/m^3

slope H = 3, V = 1

REQUIRED: -

$\frac{Na}{b} = ?$, $\frac{Va}{b} = ?$

SOLUTION:-

As we know that

$$\frac{Pa}{b} = \frac{r \times H2 \times Ka}{2}$$

First of all we will find β

Tanβ = $\frac{1}{3}$ *=>* $\beta = \tan^{-1}(\frac{1}{3})$

<u>B = 18⁰</u>

As we know that

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

Now

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

Ka = 0.3948

<u>Ka = 0.395</u>

Eq(1)=> $\frac{Pa}{b} = \frac{r \times H2 \times Ka}{2} = \frac{19.2 \times 36 \times 0.395}{2}$

$\frac{Pa}{b}$ *= 136.512 KN/m*

To find shear force ($\frac{Na}{b}$ *)*

As we know that

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

$\frac{Na}{b} = 136.83512 \times cos\,18$

<u>$\frac{Na}{b}$ = 129.83 KN/m</u>

T0 find shear force $(\frac{Va}{b})$

As we know that

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

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

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

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

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Question # 2: Part # A

BEARING CAPACITY:-

In geotechnical engineering bearing capacity is defined as the engineering property of the soil due to which it resist the applied load.

denoted by

In other words the internal stength of the soil is called bearing capacity.

FACTOR EFFECTING OF BEARING CAPASITY:

1- RELATIVE 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_o *with increase of this* (N_q N_c N_o).

The bearing capacity will increase.This will increase more for dense soil/sand as campact with medium and loose.

2-DEPTH OF THE FOOTING:-

With the increase of depth of the foundation the bearing capacity of the soil will increase.This increase will be more incase of dense sand/soil as compaced with loose or medium sand/soil.

3.BREATH OF THE FOUNDATION:-

The breath of the foundation more will be the bearing capacity of soil.

It will be more in case of density soil/sand as copaced with loose or medium soil/sand.

4.UNIT WEIGHT OF SOIL:-

Bearig capacity of soil is directly proportional to unit weight of soil.The bearing capacity of soil increase with increase its unit weight.It will be more in case of density soil/sand as compaced with loose or medium soill/sand.

5. water table:-

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

QUESTION # 2 PART # B :-

GIVEN DATA:-

L = 3m , b = 2m

Df = 1.6m

Fos = 3

r = 18 KN/m^3

c = 20 KN/m^2

Q = 20^0

Nc = 14.8 , Nq = 6.4

REQUIRED:-

Q_S = ?

SOLUTION:-

As we know that

$qu = CN_cS_cd_c + qn_qs_qd_q + 0.5\ r\ BN_rS_rd_rN_r$

NOW

$Ic = I_q = L_r = 1$

Thus,

$qu = CN_cS_cd_c + qn_qs_qd_q + 0.5\ r\ BN_rS_rd_rN_r$

First for the slope factor

$\infty = 45 + \frac{Q}{2}$

$\infty = 45 + \frac{26}{2}$

$\underline{\infty = 55^0}$

NOW

$\delta_c = 1 + 0.2 (\frac{B}{L}) Tan^2 \infty$

$\delta_c = 1+0.2 (\frac{2}{3}) (Tan^2(55)$

$\delta c = 1 + 0.2(\frac{2}{3}) Tan^2 (55)$

$\underline{\delta c = 1.3}$

$Q>10$, thus $\delta_r = S_q = 1 + 0.1(\frac{B}{L})Tan^2 \infty$

$\underline{\delta_r = \delta_q = 1.14}$

Depth factor:-

$d_c = 1 + 0.2(\frac{D}{B})Tan \infty$

$\underline{d_c = 1.23}$

NOW

$d_r = d_q = (\frac{D}{B}) Tan \infty$

$d_r = d_q = 0.1(\frac{1.6}{2}) Tan(55)$

$\underline{d_r = d_q = 1.11}$

$qu = CN_cS_cd_c + qn_qs_qd_q + 0.5\ r\ BN_rS_rd_rN_r$

$qu = (20*14.8*1.3*1.23) + (18*1.6)*6.4*1.1*1.24)+(0.5*20*2*2.9*1.11*1.14)$

$qu = 762\ KN/m^2$

NOW

$Q_{n.u} = qu - \delta$

$q_{n.u} = 762 – (18*1.6)$

$\underline{q_{n.u} = 733.2\ KN/m^3}$

Then

$q_{n.s} = \frac{Qn.u}{Fos} = \frac{733.2}{3}$

$\underline{q_{n.s} = 244.4\ KN/m^2}$

Now

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

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

$\underline{q_s = 273.2\ KN/m^3}$

Total safe load on rectangular footing

$(2 \times 3) \times 273.2$

$\underline{1639.2\ KN}$

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QUESTION # 3 PART # A

SETTLEMENT:-

when the load is applied on the ground suface this will be produce effective vertical stress. Due to these stresses the effective vertical strain will be produced as a result of which the movement wil occure in the downward movement is called sattlement.

- ***TYPES OF SETTLEMENT:-***

On the basis of movement of the structure it is diveded into two types.

1. *Total settlement*
2. *Differential sattlement*

1. ***Total settlement:-***

it is also called uniform settlement.In this type of settlement each part of structure will settle equally in uniform settlement the failure of the stucture is not much as considered as with the differential settlement.The total settlement mostly take place in the structure which are constructed in the regid footing.

In this type of settlement the utility service such as water supply electricity sewage line, telephone etc.may will remain sound.

- ***LIMITATION FOR UNIFORM/TOTAL SETTLEMENT:-***

The soil layer to which load is to be transfer should be sufficient in bearing to resist the load which is to be applied on it.

2. DIFFERENTIAL SETTLEMENT:-

Defferential settlement in different parts of the some structure is called differential settlement.Differential settlement is more danger or considerable as compaced with load uniform settlement because it cause more damage to a stucture as compared to total/uniform settlement.

- ***TYPES OF DIFFERENTIAL SETTLEMENT:-***

Defferential settlement are two types:-

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 walls/coloumns settle unequally it means the structure is subjected to angular distortion.

QUESTION NO 3:- PART # b

GIVIN DATA:-

Cc = 0.31

P_1 = 130 KN/m^3

e_0 = 1.02

p_2 = 170 KN/m^3

H = 5m

REQUIRED:-

E_1 = ?

S_c = ?

SOLUTION:-

As we know that

$$Cc = \frac{\Delta e}{log\ (\frac{p2}{p1})}$$

$$Cc = \frac{e0-e1}{log\ (\frac{p2}{p1})}$$

$$0.31 = \frac{1.02-e1}{log\ (\frac{170}{130})}$$

$$0.031 = \frac{1.02-e1}{0.1165}$$

0.0361 = 1.02 – e_1

e_1 = 1.02 – 0.0361

e_1 = 0.984

Sc = ? as we know that

$Sc = \frac{H}{1+e0} \times 0.31\, log(\frac{P2}{P1})$

$Sc = \frac{H}{1+1.02} \times 0.31\, log(\frac{170}{130})$

Sc = o.o8939m

Sc = 89.3978 mm

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end