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MID TERM EXAMINATION

QNO 1(a)

Define the following term

(a) Plastic Equilibrium:

A body of soil is said to be in state of plastic equilibrium if every part of soil is on the verge of failure is called plastic equilibrium.

(b) Angular Distortion:

It is defined as the ratio between the relative Deflection between two points in a foundation and the distance between them is called angular distortion

(c) Ultimate Bearing Capacity:

It is defined as, The gross pressure intensity at the base of foundation which would cause shear failure is called ultimate bearing capacity.

(d) Poission Ratio of Soil:

It is defined as, Poission ratio (n) is the negative of ratio of transversal strain to the axial strain in an elastic material which is subjected to an unaxial stress.

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 inclined at a slope of 3 horizontal and 1 vertical. 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:

$H = 6m$, $C = 0$, $d = 30^\circ$, $\gamma = 19.2\ KN/m^3$

slope $H = 1$, $V = 3$

REQUIRED:

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

SOLUTION:

$$\frac{Pa}{b} = \frac{\gamma + H^2 + ka}{2}$$

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

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

$B = 18^\circ$

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

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

$Ka = 0.3948$

$Ka = 0.395$

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

$Pa/b = 136.512$ KN/m

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

$= 136.512 \times \cos(18)$

$= 129.83$ KN/m

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

$= 136.512 \times \sin(18)$

$= 42.18$ KN/m

RESULT:

$Na/b = 129.83$ KN/m

$Va/b = 42.18$ KN/m.

Q NO 2 (a)

What is bearing capacity? Also write factor affecting bearing capacity

Bearing Capacity:

The engineering propecty of the soil due to which it resist the applied load.

Denoted by q.

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

Factor effecting bearing capacity:

1. Relative Density of soil
2. Depth of footing
3. Breadth of footing
4. unit weight of soil
5. water Table.

Relative Density of soil:

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

Depth of footing:

with the increase of depth of foundation the bearing capacity of soil will increase.

This increase will be more if soil is dense.

Breadth of foundation:

More the breadth of foundation more will be bearing capacity of soil.

Unit weight of Soil:

Bearing capacity of soil is directly proportional to unit weight of soil. The bearing capacity of soil increase with increase in unit - weight.

Water Table:

As water table come near surface bearing capacity decreases.

QNO 2 (b)

What is the maximum safe load which can be supported by rectangular footing 2m - by - 3m with factor of safety 3. The base of the footing is at 1.6m below the ground surface. The unit weight of soil is 18 N/m³. The angle of shear resisting $\phi = 20°$ ($N_c = 14.8$ $N_q = 6.4$ $N_r = 2.9$) unit cohesion $C_u = 20\ KN/m^2$. Use Mgerhot analysis.

GIVEN DATA:

$L = 3m$, $B = 2m$, $D = 1.6m$, F.O.S = 3, $r = 18\ KN/m^3$, $\phi = 20°$, $C_u = 20\ KN/m^2$.

REQUIREMENT: $q_s = ?$

SOLUTION:

$$q_u = CN_cS_cd_c + qN_qd_qS_q + \frac{1}{2} r.B.N_r.d_r.S_r$$

First for shape factor :

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

$\alpha = 55^\circ$

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

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

$Sc = 1.27 = 1.3$

$Sq = Sr = 1 + 0.1 \; B/L \; \tan^2 \alpha$

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

$Sq = Sr = 1.14$

Depth factor :

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

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

$dc = 1.23$

$dr = dq = 1 + 0.1 (D/B) \tan \alpha$

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

$= 1.11$

$qu = C. Nc. Sc. dc \times q. Nq. dq. Sq + \frac{1}{2} r. B. Nr. dr. Sr$

$(20 \times 1.48 \times 1.3 \times 1.23) + (18 \times 1.6) \times 64 \times 1.11 \times 1.14)$

$+ (0.5 \times 20 \times 2 \times 2.9 \times 1.11 \times 1.4)$

$qu = 762 KN/m^2$

$q_{n.u} = qu - \bar{s}$

$= 762 - (18 \times 1.6) \quad \bar{s} = r \times D$

$= 733.2 \; KN/m^2$

$q_{n.s} = \frac{q_{n.u}}{F.O.S}$

$= \frac{733.2}{3}$

$= 244.4 KN/m^2$

$q_s = q_{n-s} + s$

$244.4 + (1.6 \times 18)$

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

Total safe load on Rectangular footing

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

$= 1639.2 \text{ kN}$.

Q NO 3 (a)

What is settlement ? Explain types in detail.

Settlement :

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

Types of Settlement :

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

(1) total settlement
(2) Differential settlement.

(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 structure is not much considered as with differential settlement.

The total settlement mostly take place in the structure which are constructed on rigid floating.

Differential Settlement :

Differential Settlement in different part of same structure is called differential settlement.

Differential settlement is more danger then total settlement. It cause more damage to structure.

Types of differential settlement :

two types.

① Tilt

② Angular Distortion.

QNO 3 (b)

A soil has compresswie index $C_c = 0.31$. At a stress 130 K/m², the void ratio was 1.02. Calculate

→ The void ratio if the stress on the soil is increased to 170 kN/m².

→ The total settlement of the stratum of 5m thickness.

GIVEN :

$C_c = 0.31$, $P_1 = 130\ kN/m^2$, $e_e = 1.02$,

$P_2 = 170\ kN/m^2$, $H = 5m$

REQUIRED :

void ratio, $e_1 = ?$

$S_c = ?$

SOLUTION :

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

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

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

$$e_1 = 0.54$$

Now

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

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

$$S_c = 1003.427$$

RESULT :

$e_1 = 0.54$

$S_c = 1003.427$