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Sec : "A"

Paper : Geotechical Theory Engg

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QNo: 1

Ⓐ part

① <u>Plastic Equilibrium</u> :-

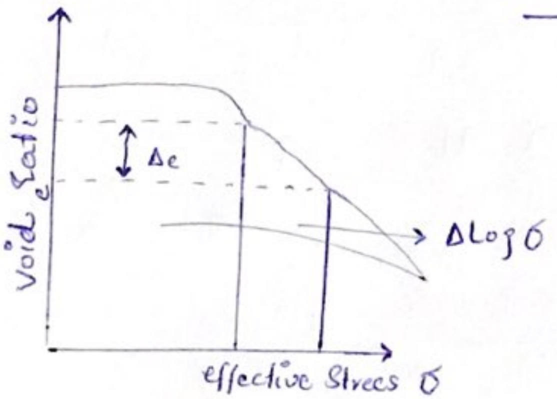
Plastic equilibrium in a Soil mass Can be Created by Rotating a retaining wall about its base either away from backfill For an active State or into backfill For passive State.

② <u>Angular Distortion</u> : δ/L

It is defined as the differential Settlement between two points divided by the distance between Them Less the tilt equals rotation of The entire building.

③ <u>Compressive Index</u> :

$$C_c = \frac{\Delta e}{\Delta \log_{10} \sigma_{ef}}$$



→ The Compressive index is used to find Settlement in normal Consolidated Clay

(4) Ultimate Bearing Capacity :

The ultimate bearing Capacity (q_u) as The pressure which would Cause Shear failure of The Supporting Soil immediat below and adjacement to foundations.

(5) Poission Ratio of Soil :

The Ratio of transverse Contraction Strain to Longitudnal extension Strain.

→ It is unit Less

$$\mu = \frac{\text{Lateral Strain}}{\text{Longitudnal Strain}}$$

Sand $\mu = 15 - .4$

clay $\mu = .1 - .5$

(B) part :

Given Data :

$C = 0$, $\phi = 30$ $\gamma = 19.2\ kN/m^3$

$H : V = 3 : 1$ $H = 6m$

$Ka = ?$ $Pa/b = ?$ $Va/b = ?$, $B = ?$

Sol.:

$$Pa/b = \frac{\gamma H^2 Ka \cos B}{2} , \quad Va/b = \frac{\gamma H^2 Ka \sin B}{2}$$

$$\tan\beta = P/B$$

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

$$B = 18.43 \Rightarrow 18^\circ$$

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

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

$$\frac{0.557}{1.34} = 0.415$$

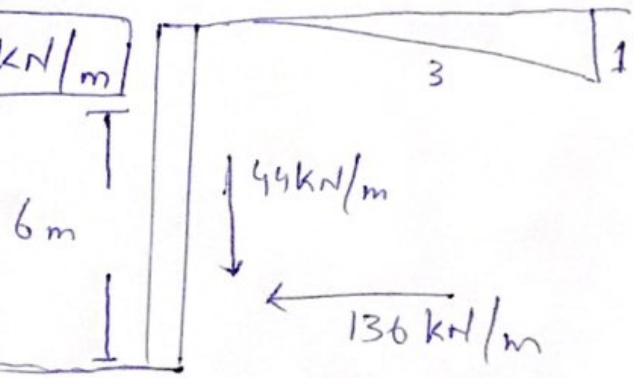
$$\boxed{K_a = .415}$$

$$P_a/b = \frac{\gamma H^2 K_a \cos\beta}{2} \Rightarrow \frac{(19.2)(6)^2(.41)(\cos 18)}{2}$$

$$P_a/b = \Rightarrow \boxed{136.40\ kN/m}$$

$$V_a/b = \frac{\gamma H^2 K_a \sin\beta}{2} \Rightarrow \frac{(19.2)(6)^2(.41)\sin 18}{2}$$

$$V_a/b = \boxed{44.32\ kN/m}$$



Q NO: 02

(A) part :

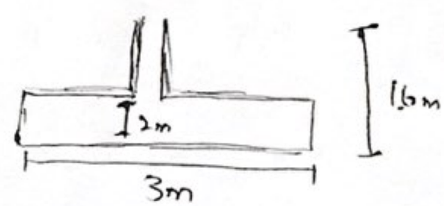
Bearing Capacity :

The bearing Capacity of the Soil is the maximum Load per unit area which the Soil will resist without any displacement.

Factors effecting Bearing Capacity :

- → Soil type → Foundation depth & width
- → Soil Weight and Surcharge.
- → Spacing between foundations
- → Earthquake and dynamic motion
- → frost action → Subsurface voids
- → Soil erosion & Seepage

(B) **part :**



Given data :

$D = 1.6m$, $L = 3m$, $B = 2m$

γ = Unit weight $= 18\ kN/m^3$

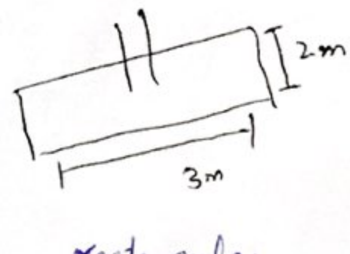
factor of Safety = 3

$\phi = 20^\circ$

$N_c = 14.8$

$N_q = 6.4$

$N_\gamma = 2.9$



rectangular Footing

Miyeshof Analysis :

Sol :
passive pressure Coefficient

$K_p = \tan^2\left(45 + \frac{20}{2}\right) = 2$

Shape factor :

$S_c = 1 + 0.2 k_p \left(B/L\right)$

$S_c = 1 + 0.2(2)\left(\frac{2}{3}\right) = 1.26$

$S_q = S_\gamma = 1 + 0.1 \times k_p \left(B/L\right) = 1.13$

$S_q = S_\gamma = 1.13$

Depth Factor :-

$D_c = 1 + 0.2\sqrt{k_p}\left(B/L\right) = 1.188 \approxeq \boxed{1.2}$

$D_q = D_\gamma = 1 + 0.1\sqrt{k_p}\left(D/B\right) = 1.113$

From equestion :

$N_c = 14.8$, $N_q = 6.4$, $N_\gamma = 2.9$, $\phi = 20°$

$Q_o = C N_c S_c D_c + \gamma D N_q S_q D_q + 0.5 \times \gamma B N_\gamma S_\gamma D_\gamma$

$Q_o = (20 \times 14.8 \times 1.26 \times 1.2) + (18 \times 1.6 \times 6.4 \times 1.13 \times 1.113)$
$+ (0.5 \times 18 \times 2 \times 2.9 \times 1.13 \times 1.113)$

$Q_u = 447.52 + 231.87 + 65.6514$

$Q_u = 745.04 \, kN/m^2$

Allowable Soil bearing Capacity

$$Q_a = \frac{Q_u}{F.S} = \frac{745.045}{3}$$

$Q_a = 248.34 \, kN/m^2$

Gross Allowable Load

$Q_{all} = 248.34 \times (2 \times 3)$

$Q = \boxed{1490.04 \, Newton}$

Q No: 03

(A) part:

Settlement:

It is The downward movement of ground Caused by a Load Consolidating The Soil below or Causing displacement of Soil.

Types:-

Total Settlement:

Also Known as The maximum Settlement. It is The Largest amount of Settlement experienced by any part of The Foundation. (δ_{max})

Maximum Differential Settlement:

The maximum differential Settlement is The Largest difference in Settlement between Two different Foundation Locations, it does not accur at Same Location.

Rate of Settlement:

It is often desirable to Know if The Settlement will occur during Construction as dead Load is applied to Soil.

(B) part :

Given Data

$C_c = 0.31$, $\sigma_o' = 130 kN/m^2$, $e_o = 1.02$

$\sigma' = 170 kN/m^2$

Required:

$e = ?$ → void Ratio

$\Delta H = ?$ → Total Settlement

(1) $e = e_o - C_c \log_{10} \frac{\sigma'}{\sigma_o'}$ (void Ratio when Stress increased)

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

$e = 0.98$

(2) Total Settlement of 5m Thickness

$\Delta H = H_o \frac{C_c}{1+e_o} \log_{10} \frac{\sigma'}{\sigma_o'}$

$\Delta H = \frac{(5)(.31)}{1+1.02} \log_{10} \left(\frac{170}{130}\right)$

$\Delta H = .771 \times .1165$

$\Delta H = 0.089 m$ Ans.