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Subject: Geotechnical & Foundation Engineering

Assignment# 02

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Q1

Part A

Name the Forces on dam

1) self-weight
2) Silt load
3) uplift load
4) Seismic load
5) Ice load
6) Hydrostatic Pressure
7) wave load

1) self weight: weight of masonary, concrete, or soil is the counterbalancing Force to withstand the effect of all forces enumerated hereinafter. ~~So~~ self weight is attribute to the gravity, and its magnitude is determined by the density of the material that constitute the structure i.e

$$P_{dw} = P_2 = \gamma V$$

2) Silt load: The silt is carried into the reservoir in the Form of density current and as suspended load. it is deposited against the upstream face of the dam. The Force exerted by the consolidated silt on the dam surface is calculated by Rankine's Formula

$$P_3 = \frac{\gamma_s h^2}{2}\left(\frac{1-\sin\theta}{1+\sin\theta}\right)$$

③ **uplift load**: The stored water in the dam has a tendency to seep through the soil below the Foundation. while seeping the ~~Fe~~. Flowing water exerts uplift pressure on the base of the dam.

It can be calculated by

$$P_u = \frac{1}{2} \gamma_w h B$$

④ **wave load**: wave are generated on the surface of the reservoir by the blowing winds which exert a pressure on the upper part of the dam above the water level. The pressure is calculated by

$$P_{wx} = 2.4 \gamma_w h_v^2$$

⑤ **Hydrostatic water pressure**

: is attributable to water standing against the surface of a hydraulic structure. it is customarily to determine the Force of hydrostatic pressure by resolving it into horizontal & vertical components. The horizontal component is expressed in meters of water column & exerts at the hight of h/3 above the base plane. The resultant horizontal Force is determined as

$$P_{wx} = 0.5 \gamma_w h^2$$

vertical component Force is determined as:

$$P_{wy} = \gamma_w A$$

Sol

Part B Define the Following

① Liquification of soil : Soil liquification ~~occur~~ ~~when~~ is one of the most important. geotechnical earthquake engineering During this phenomenon, pore water pressure increase as long as it will be equal to confining stresses. Hence, the effective confining stress becomes zero and the soil will not have any shear resistance.

② Buttress dam : In structural concept the buttress dam consist of a continous upstream face supported at regular intervals by downstream buttress. Such dam may be considered for conceptual purpose as a lightened version of the gravity dam. Buttress are triangular concrete wall which transmit the water pressure from the deck slab to the foundation

③ Infinit slope : The slope in which the area is infinite but the depth of the slope is finite. Such a slope is called infinite slope exple. Hills, mountain etc.

4) Pier Foundation

These are the vertical member which transmit the load of the structure to the hard strata.
The dia of the pier is more than 0.6m mostly pier are above the ground level.

(5) Dynamic load

is a method to assess a pile's bearing capacity by applying a dynamic load to the pile head (a falling mass), while recording acceleration and strain on the pile head

X ———————— X

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Q2 part A

⑤

Shallow Foundation $D_f \leq B$

According to Terzaghi the Shallow Foundation is the Foundation in which depth of the Foundation is less or equal to the width of the Foundation such as $D_f \leq B$

D_f = depth of Foundation
B = width of Foundation

According to Skempton

$$\frac{D_f}{B} \leq 2.5$$

→ The Foundation in which $\frac{D_f}{B} \leq 2.5$ then Foundation is called Shallow Foundation.

the selection of Foundation depend upon

① Depth at which safe bearing capacity exist.
② Condition & type of soil
③ load of the super structure.

Types of Shallow Foundation

1. wall Foundation / Strip Foundation
2. combined Foundation
3. Raft / Mat Foundation.
4. Strapped Foundation → in slope
5. Column Foundation / Isolated

1. wall Foundation : The Foundation which runs along the length of the wall & transmit the load of the wall to soil safely
It is also called Strip Foundation

2. Combined Foundation :- The Foundation which is made common For two or more column to the soil safely.
If the load of the column are uniform then combined ~~to the~~ Footing will regular in Shape but if the load is not uniform form each column than the Foundation will trapezoid in Shape.

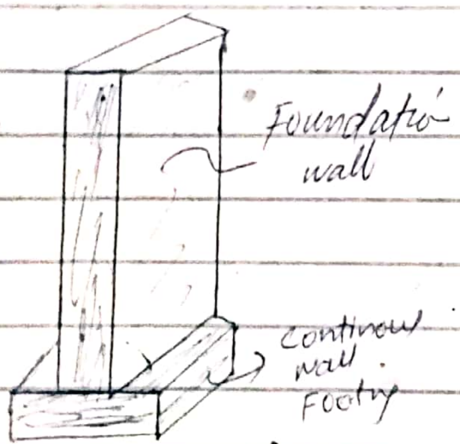
3. Raft/Mat Foundation :- The Foundation which covers the whole area under the structure. It is proposed in those area which have weak bearing capacity. the load of the super structure is heavy

(4) **Strapped Footing**

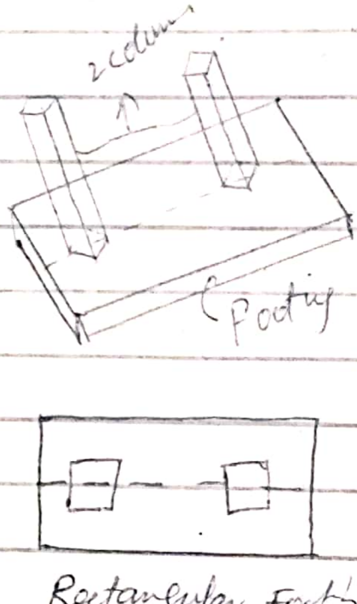
In this type of Footing the outer column is connected with inner column with a tie beam

(5) **Column Footing**

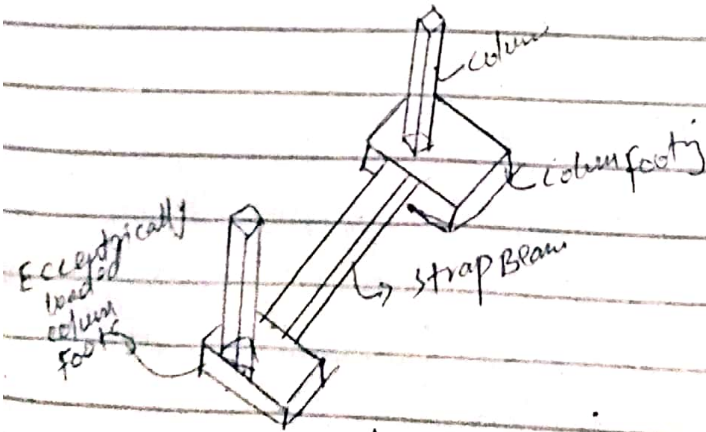
: The Footing which is made For a single column & transmit the load of the column in the soil safely. It may be rectangular, square, or circular in shape.



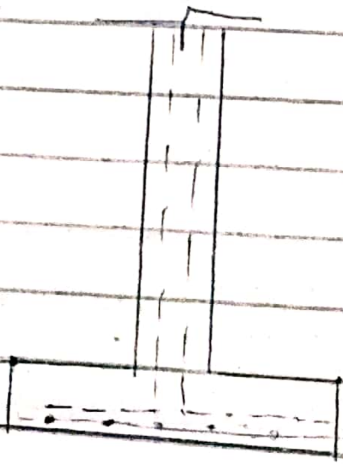
Wall Foundation



Combined Foundation



Strap Footing



Column Footing

Q2 part B

Method of Ground Improvement techniques:

(1) Remove & Replacement of soil :

- This is an oldest and simplest method
- this method is performed in loose soil.
- In this method the unsuitable soil is replaced with compacted fill.
- In this method the same soil is used to refill the higher compaction and better Engineering properties.
- This method is applicable above the ground water table.

(2) Dynamic compaction :- This method is used to Increase the bearing capacity of soil.

- this method also increase the consolidation Rate.
- This method also increase density of soil.
- In this method actually the densification take place.

(3) Vibro Compaction :-

- It is also called vibro densification.
- In this method the compaction take place at certain depth in granular soil through vibrator probe
- The vibrator probe is run by Electric motor
- The penetration of probe is enhance by ejecting water at the trip of Probe.

(4) Rapid Impact compaction

In this method Impact Energy is applied to Surface of ground as a result of which densification of soil take place upto a depth of 15 ft.
- The impact energy is actually applied through hydraulic ramp. The weight of ramp varies from 4–8 tones.

(5) vibro Concrete coloum

:- vibro concrete coloum is a ground improvement technique which transfer the load from weak Strata to hard Strata by using Strength Concrete.

Ground Improvement Technique

:- Ground improvement techniques are the techniques which are used to enhance the engineering property of soil in order to bear havey structural load. The main properties are steel strength, permeability, bearing capacity, stiffness etc.

Need of Ground Improvement techniques

:- The soil in which volumetric changes takes place due to Shrinkage and swelling such soil needs ground improvement techniques.

-> The Soil which is organic in nature
-> The soft soil also required ground improvement techniques.
-> The soil which is Sandy and gravely
- The Foundation in Sanitary damp places also required ground improvement techniques

Q3 (11)

Q: An infinitely long slope having a inclination of 26° in area is underlain by frim cohessive soil ($G = 2.72$ & $e = 0.50$) there is a thin, weak layer of soil 6m below and parallel to the slope surface ($c = 25 KN/m^2$, $\phi' = 16°$). Compute the factor of safety when the slope is dry. If ground water flow could occur parallel to the slope on the ground surface, what factor of safety would result?

Given data

$i = 26°$

$G.s = 2.72$

$e = 0.50$

$c = 25 KN/m^2$

$\phi = 16°$

$H = 6m$

Required

* F calculate for dry soil
* F calculate for wet soil

Sol:

$$F_c = \frac{c}{\gamma H \sin i \cos i} + \frac{\tan\phi}{\tan i}$$

In case of dry soil

$$\gamma = \gamma_d = \frac{G \times \gamma_w}{1+e} = \frac{2.72 \times 9.8}{1+0.50}$$

$$\boxed{\gamma = \gamma_d = 17.8}$$

$$F_c = \frac{25}{17.8 \times 6 \times \sin 26^\circ \times \cos 26^\circ} + \frac{\tan(16^\circ)}{\tan 26^\circ}$$

$$\boxed{F_c = 1.18}$$

If there is seepage of water in the soil

$$F_c = \frac{c}{\gamma H \sin i \times \cos i} + \left(\frac{\gamma'}{\gamma}\right)\frac{\tan\phi}{\tan i}$$

$$\gamma = \frac{G+e}{1+e}\gamma_w \Rightarrow \frac{2.72+0.50}{1+0.50} \times 9.8$$

$$\boxed{\gamma = 21.03\ KN/m^3}$$

$$\gamma' = \gamma - \gamma_w = 21.03 - 9.8$$

$$\boxed{\gamma' = 11.22\ KN/m^3}$$

$$F_c = \frac{25}{21.03 \times 6 \times \sin 26^\circ \cos 26^\circ} + \left(\frac{11.22}{21.03}\right)\frac{\tan 16^\circ}{\tan 26^\circ}$$

$$\boxed{F_c = 0.816}$$

Q4 part A — M — (13)

Q) It is proposed to construct a 10m high highway embankment with the following soil properties $c = 18.8\ KN/m^2$ $\gamma = 17\ KN/m^3$ & $\phi = 20^\circ$, what is the inclination required for the embankment if design $F_c = 1.5$ & $F_\phi = 1.0$?

Given data

$H = 10m$

$C = 18.8\ KN/m^2$

$\gamma = 17\ KN/m^3$

$\phi = 20^\circ$

$F_c = 1.5$

Required:

$i = ?$

Sol

$$S_n = \frac{C_m}{F_c \gamma H}$$

$$= \frac{18.8}{1.5 \times 17 \times 10}$$

$$S_n = 0.0737$$

According to chart

$S_n = 0.0737$

$\phi = 20^\circ$

$i = 47^\circ$

Q4 part B

Given Data

$H_W = 15m$

Bottom width of dam $= 15m$

~~Bottom width~~

unit weight of water $= \gamma_w = 1000 kg/m^3$

$\gamma_{concrete} = 1450 kg/m^3$

Angle of Friction of silt $\phi_s = 35^\circ$

F.B $= 3.5m$

$\gamma_{silt} = 1330 kg/m^3$

$H_{silt} = 2.5m$

Solution

Silt Pressure.

we know that

$$P_{silt} = \frac{\gamma_s h_s^2}{2}\left(\frac{1-\sin\theta}{1+\sin\theta}\right)$$

$$P_{silt} = \frac{1330 \times (2.5)^2}{2}\left(\frac{1-\sin(35^\circ)}{1+\sin(35^\circ)}\right)$$

$$\boxed{P_{silt} = 1126.3 \ kg/m}$$