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Sec :- A

Subject :- Geo tec Engineering

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Final Term Exam.

Q1) Name the force acting on dam. Explain any five of them in detail.

Following are the forces acting on dams:

1) Water Pressure
2) Uplift Pressure
3) Wave Pressure
4) Silt Pressure
5) Ice Pressure
6) Self Pressure weight of the Pitless dam.
7) Seismic forces.

1) "Self weight of dam:-"

The weight of the dam and its foundation is a major resisting force - It can be computed using the following equation.

$$W = \gamma_m \text{ Volume}$$

Where

γ_m : unit weight of dam material

2) "Silt Pressure:-"

It is the pressure that is caused by the deposition of the silt in the bed of the dam causing at h/3 from the base

and can be computed using equation:

$$P_{silt} = 0.5 \gamma_s h^2 K_a$$

where K_a = Coefficent of active earth presure of silt which is equal to $\frac{1-\sin\phi}{1+\sin\phi}$

ϕ = Angle of internal friction of soil, Cohesion neglected.

γ = Submerged unit weight of silt material

h = height of silt deposited.

3) "Wave Pressure:-"

Waves are generated on the surface of the reservoir by the blowing winds which exert the pressure on the upper part of the dam above the water level. This pressure is calculated by the following formula:

$$P_w = 2.4 \gamma_w h_w$$

Waves pressure depends upon wave height which is given by:

For $F < 32$ km:

$$h_w = 0.32\sqrt{P_v} + 0.763 - 0.27 \times F^{1/4}$$

For $F > 32$ km:

$$h_w = 0.32\sqrt{VP}$$

Where;

h_w = Height of water from the top of crest to bottom of trough in meters.

V = Wind velocity in km/hours

F = fetch or straight length of water expanse in km.

- The maximum pressure intensity due to wave action occurs when it acts at 0.5.

Total force due to wave action is given by:

$$P_w = 0.5(2.4\gamma_w h_w)\ 3/8 h_w$$

4) **"Ice Pressure:-"** The ice which may beformed on the water surface of the reservoir in Cold countries may sometime melt and expand. The dam face is subjected on the thrust & exerted by the ~~thrust/pressure~~ - expanding ice. This force acts linearly along the length of the dam and at the reservoir level. The magnitude of these forces varies from 250 to 1500 KN/sq.m depending upon the temperature.

5) **"Sesimic forces:-"** Dynamic load created due to earthquakes must be considered in the design

of all major dam located in high sisk. sesimic region - ~~and~~ during ~~dam~~ Earthquake Pressure waves in every possible direction. However, it has to be resolved into vertical and horizental components for the design purposes. The horizental component had greater effect. seismic vibrations influence both dam body and water in the reservoir of the dam. so the generated dynamic load are due to inertia of the dam and hydro-dynamic forces by the water in the reservior.

b) Define the following terms.

1) "Liquification of Soil:-" Effective stresses are the stresses which keep the soil particles in contact with each other if the effective stresses decreases the soil lose its strength. When the effective stresses become zero then soil will change to liquified state

2) "Buttress Dam:-" The buttress dam is a dam with a solid, water tight upstream side that is supported at interval on the downstream side by a series of butteress - The dam wall may be straight or curved. Most

buttries are made of reinforced concrete and are heavy, pushing the dam into ground.

3) **Infinite Slope:-**

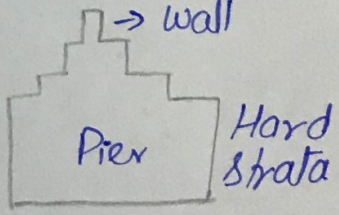
The slope which have infinite area and finite depth such a slope is called infinite slope.

Example: Natural slope i.e Hills, Mountains, deserts etc.

In infinate slope the failure will be in the form of sliding.

4) **Pier Foundation:-**

The vertical member which have larger dia as compared to pile and transmit the load of structure to the underground soil. They are constructed by Cast in-situ process



5) **Dynamic Load:-**

Dynamic load occurs when loading conditions are changing with time. It may be in the form of earthquake, operation of heavy machinery, waves motion, wind etc. Dynamic load causes settlement.

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Q2)a) Define shallow Foundation - Explain types of shallow foundation in detail with appropriate sketch.

"Shallow Foundation:-"

According to terzaghi, the foundation in which the depth of the foundation is less orequal to width of the foundation is called shallow foundation - $D_f \leq B$ -

"According to skempton:-"

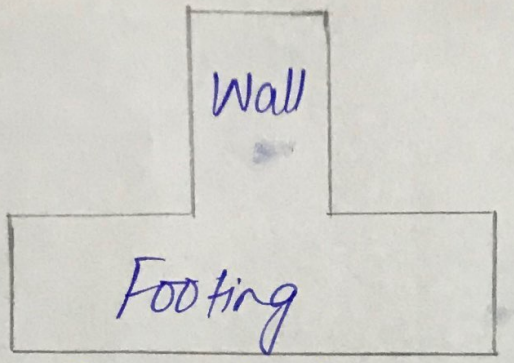
The foundation in which D_f/B ratio is less then orequal to 2.5 then the foundation is called shallow foundation.

"Types of shallow foundation:-"

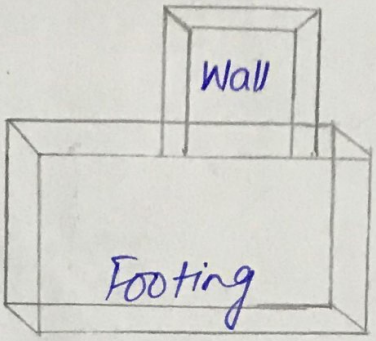
1) Wall footing -
2) Combined footing -
3) Raft / Mat footing -
4) Strapped footing -
5) Column / Isolated footing -
6) Slopped footing.

1) "Wall Footing:-"

The footing which run across the length of the wall and transfer the load of the wall to the soil safely - It is called wall footing -



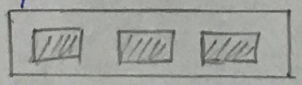
Cross Section

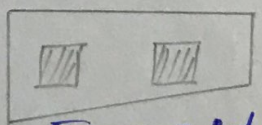


2) "Combined Footing:-"

The footing which is Constructed for two or more column and transfer the load of the two or more column to the soil safety then it is called combined footing.

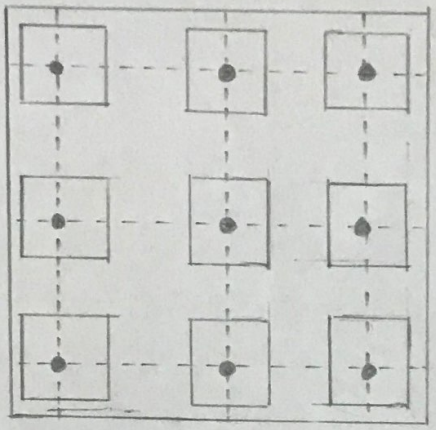
If the load of the column is uniform then the Combined footing will be rectangular in shape. If the load of the the column is not uniform then shape of Combined footing will be trapezoidal.


Rectangular

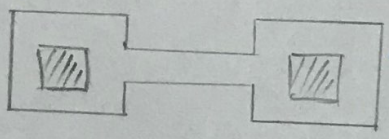

Trapozidal

3) "Raft / Mat Footing:-"

The footing which covers the whole area of the structure is called raft footing. This type of footing is proposed in area which have soil weak in bearing capacity. This is also provided when the load of super structure is heavy.

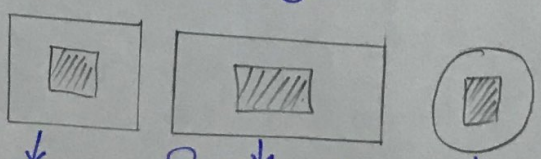


4) "Strapped Footing:-" The footing in which the outer column is connected with the inner column by mean of the beam or strap is called strapped footing.



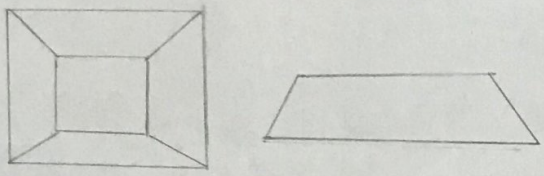
→ Top View.

5) "Column/Isolated Footing:-" The footing which is constructed for the single footing and transmit to load to the soil safely. It may be circulated, square and rectangular in shape.



Square Rectangular Circular

6) "Slopped footing:-" The slope which have slope in all direction or in all side is called as slopped footing.



b) Why ground improvement techinque are important Explain five methods of ground improvement in details along with appropriate sketch.

Ans: The soil in which volumetric changes takes place to 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 sanatery dump places also required ground improvement technique.

→ Following are the methods of ground improvement techniques

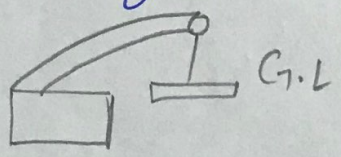
1) "Removal and Replacement of Soil:-" This is an oldest and simple method. This method is performed on loose soil.

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

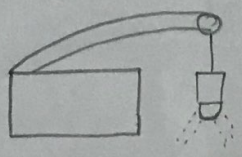
2) "Dynamic Compaction:-"

This method is used to increase the bearing capacity of soil. This also increase the consolidation rate and also increase the density of soil. In this method actually densification of soil take place.



3) "Vibro Compaction:-"

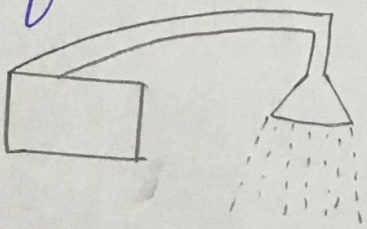
In this method the compaction take place at a certain depth in granular soil through vibrating probe. This vibrating probe is run by an electric motor. The penetration of probe is enhance by ejecting water at the tip of probe



4) "Rapid Impact Compaction:-"

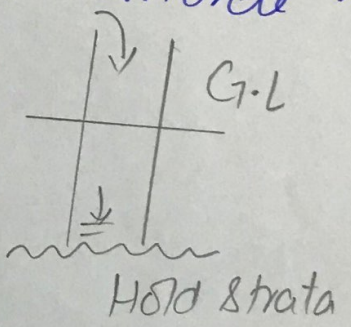
Impact energy is applied to surface of ground as a result of which densification of soil take place upto a depth of 15 feet. This impact energy is applied

through hydraulic ramp. The hydralic ramp weight value from 4-8 tons



5) "Vibro Concrete Column:-"

Vibro Concrete Column is a ground improvement technique which transfer the load from weak strata to hald strata by using strength Concrete.



Q3) An infinitely long slop ..... factor of safety would result?

Given data:-

$C = 25\ kN/m^2$

$\phi = 16°$

$G = 2.72$

$e = 0.50$

Required:

Fc (F.O.S) when soil is dry

Fc (F.O.S) when there is seepage in soil

Sol:- $$F_c = \frac{c}{\gamma_d \times H \times \sin i \times \cos i} + \frac{\tan\phi}{\tan i}$$

$$\gamma_d = \frac{G_s \times \gamma_w}{1+e} = \frac{2.72 \times 9.8}{1+0.5}$$

$$\gamma_d = 17.8\ KN/m^3$$

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

$$F_c = 1.18$$

When there is seepage of water

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

$$\gamma' = \gamma - \gamma_w$$

$$\gamma = \frac{G+e}{1+e} \times \gamma_w$$

$$= \frac{2.72 + 0.5}{1+0.5} \times 9.8$$

$$\boxed{\gamma = 21.04\ KN/m^3}$$

$$\gamma' = \gamma - \gamma_w$$

$$= 21.04 - 9.8$$

$$\boxed{\gamma' = 11.24\ KN/m^3}$$

$$F_c = \frac{25}{21.04 \times 6 \times \sin(26^\circ) \times \cos(26^\circ)} + \frac{11.24}{21.04} \times \frac{\tan(16^\circ)}{\tan(26^\circ)}$$

$$\boxed{F_c = 0.816}$$

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Q4 It is proposed to Construct a 10m highway embankment with.....?

A

"Given Data :-"

$C = 18.8\ KN/m^2$

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

$\phi = 20°$

$FDS = 1.5$

$F_0 = 1.0$

$H = 10m$

"Required :-"

Inclination = ?

"Solution :-"

$$S_N = \frac{C}{F.D.S \times \gamma \times H} = \frac{18.8}{1.5 \times 17 \times 10}$$

$S_N = 0.073$

Using Taylor Chart for:

$\phi = 20°$

$S_N = 0.073$

→ inclination, $i = 44°$

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B) Consider the following data find, silt pressure ..... Silt Deposit Height = 2.5m. (14)

Ans: Given data:-

- Height of water upstream side = 15m
- Bottom width of the dam = 12m
- Top width = 6m
- Unit weight of water = 1000 kg/m³
- unit weight of Concrete = 1450 kg/m³
- Unit weight of silt = 1330 kg/m³
- Angle of friction for silt = $\phi_3 = 35°$
- Free board = 3.5m
- Silt Deposite height = 2.5m

"Required :-" silt pressure = ?

"Solution:-" As we know that

$$P_s = \frac{r_s \times H_1^2}{2} \times \frac{1 - \sin\phi}{1 + \sin\phi}$$

$$P_s = \frac{1330 \times (2.5)^2}{2} \times \frac{1 - \sin 35°}{1 + \sin 35°}$$

$$P_s = 1126.31 \text{ kg/m}.$$