Final Paper

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Section B

Subject Geotechnical engineering

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Q1) (A) Name the force acting on dam. Explain any five of them in Detail-

Following are the forces acting on them:

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

1: Self weight of the dam: The weight of the dam and it's foundation is a major resisting forces. It can be computed using the following equation.

$W = \gamma_m$ Volume

Where γ_m : Unit weight of dam material.

2: **Silt pressure:** It is the pressure that caused by the deposition of silt in the bed of the dam causing at $h/3$ in the base. and can be computed using the following equation:

$P_{silt} = 0.5 \gamma s h^2 Ka$.

where Ka = co-efficiciant of active earth pressure of silt which is equal to $\frac{1 - \sin\theta}{1 + \sin\theta}$.

θ = Angle of internal friction of soil. cohesion neglected.

γ = Submerged unit weight of silt material.

h = height of soil deposition.

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

$P_w = 2.4\, \gamma_w h_w$

wave pressure depends upon the wave height which is given by:

For $f < 32$ km.

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

For $F > 32$ km.

$h_w = 0.32\sqrt{VF}$.

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

V = wind velocity in km/hour.

F = fetch or straight length of water

expense in km.
The maximum pressure intensity due to wave action occurs when it acts as 0.5.
Total force due to wave action is given by $P_w = 0.5(2.4\gamma_w h_w) \frac{3}{8} h_w$.

4) **Ice pressure:**

The ice which may be formed on the water surface of the reservoir in cold countries may some time melt and expand. The dam face is is subjected on the thrust & exerted by the expanding ice. This force acts linearly along the length of the dam and at reservoir level. The magnitude of these forces varies from 250 to 1500 kN/Sq.m depending upon the temperature.

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5) **Seismic forces:** Dynamic load created due to earthquate must be considered in the design of all major dam located in heigher risk. Seismic reigon earthquake pressure waves in every possible direction. However it has to be resolved into verticle and horizental components. for the designed purposes. The horizental component has greater effect seismic vibration 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 reservoir.

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(b) Define The Following terms:

1) **Liquifaction of Soil:** Effective stresses are the stresses which keep the soil particles in contact with each other if the effective stresses decrease the soil to lose it's strength. When the effective stresses become zero than soil will will change to Liquified state.

2) **Buttress dam:** The buttress dam with a solid, water, light, upstream side that is supported at internal on the down stream side by a series of buttress. The dam wall maybe straight or carved. most. buttress are made by reinforced concrete and are heavy pushing the dam on the ground.

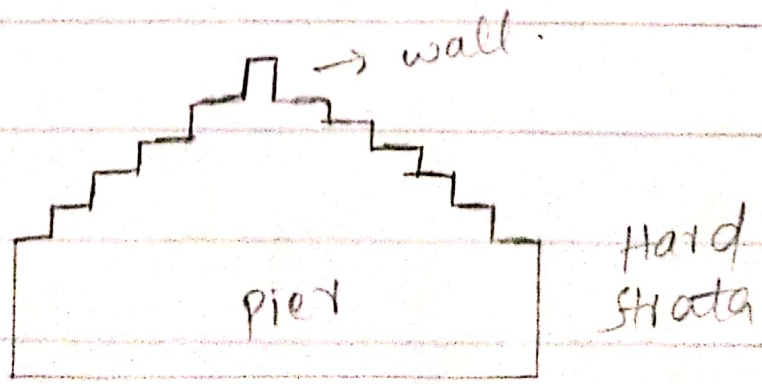
3) **Infinite slope:** The slope which have infinite area and finite depth such a slope is called infinite slope.

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

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

4) **pier foundation:**

The verticle member which have a larger dia as compared to pile and transmic 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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QNo(E) (A) Define Shallow foundation. Explain types of shallow foundation with appropriate sketch?

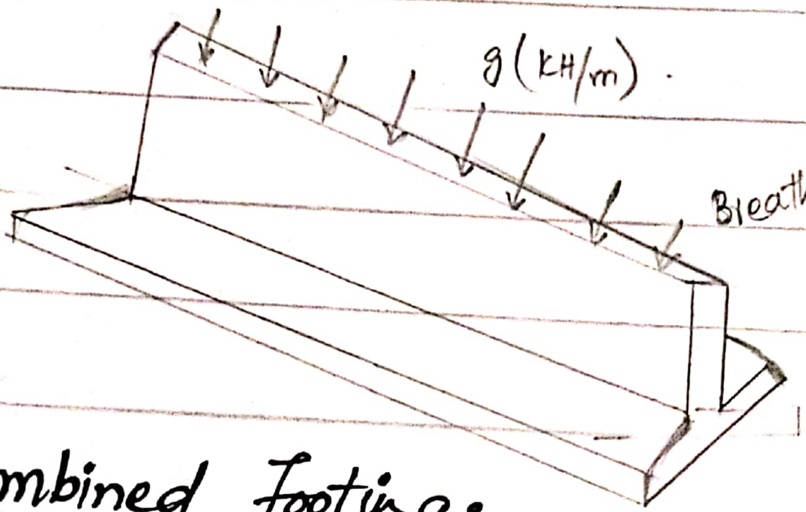
Ans: **SHALLOW FOUNDATION:** It is define as:

According to Dr. Karl Terzaghi: foundation in which the depth of the foundation is tests than the breath than such foundation is termed as shallow foundation.

According to skempton: The foundation in D_1/B ratio is less than 2.5 such foundation is termed as shallow foundation.

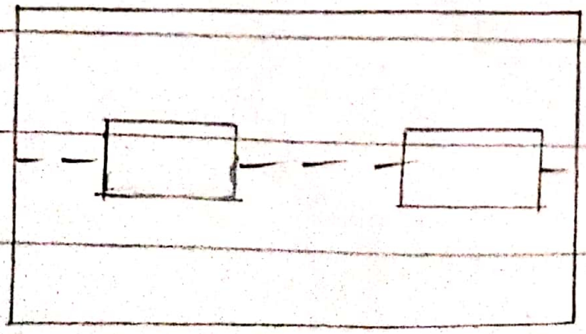
Types of shallow foundation: Shallow foundation is divided into the following main types:

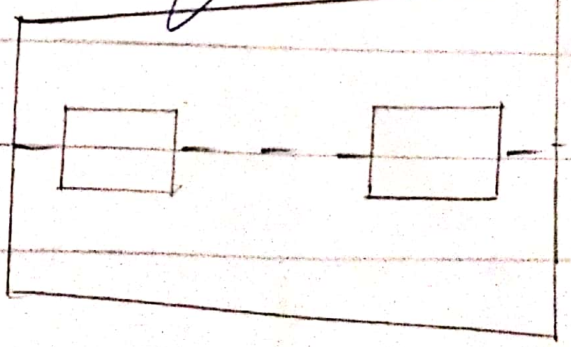
1: **Wall Footing:** Wall footing is the footing which come across the strength of the footing.



2: **Combined Footing:**

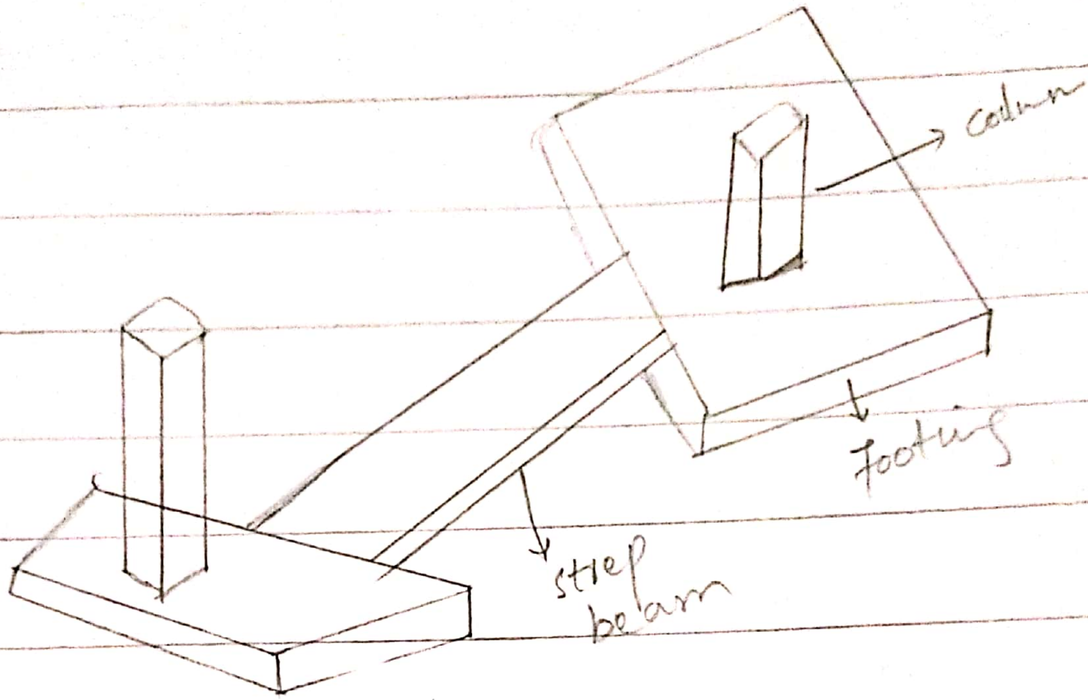
Footing which constructed combined for two or more columns to transfer the load of their columns safety to the soil then such footing is called combined footing.





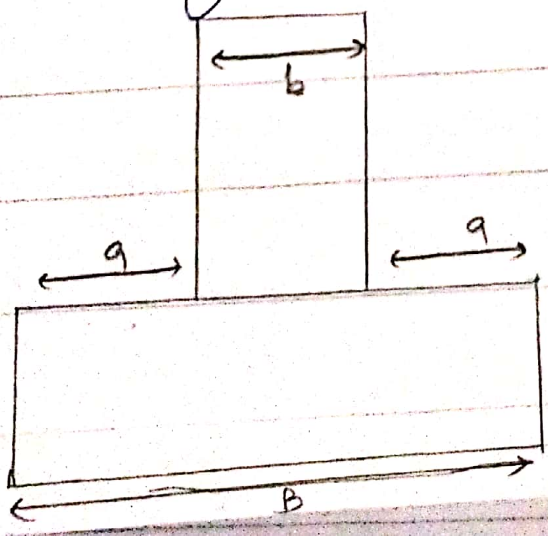
- If the load of the columns are uniform mean equal in magnitude than the shape of combined footing will rectanguler.
- If the load of the columns are not uniform means not equal in magnitude than the shape of the combined footing will be trapezoodie.

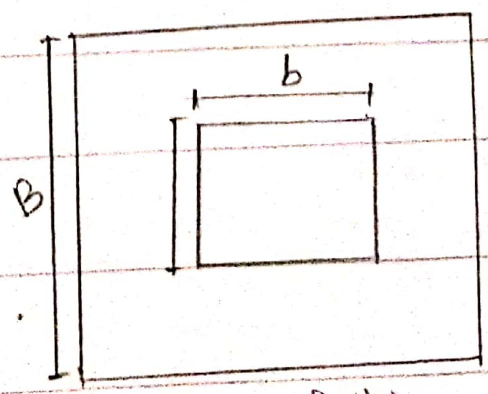
3: Strepped footing: Footing in which the outer column is connected with the inner column by means of ~~its~~ tie beam or strap such a footing is called strapped footing.



4: **Isolated footing:** Footing which is construted for a single column and transfer it's load safely to the soil is called ~~isolated~~ column.

- This column may be circuler, Rectangular or Square in shape.





Square footing

5: **Raft footing:** footing which is constructed and covers the area of the entire structure this type of footing is provided when the soil is weak in beating capaciting.

Q8 ⑧ Why ground improvement techniques are important. Explain five methods of ground improvement in detail along with apropriate sketch.

Importance of ground improvement techniques: The soil in which volumatric changes takes place due to shrinkage and swelling. Such process soil needs ground improvement. techniq-ues:

- The soil which is organic in nature.

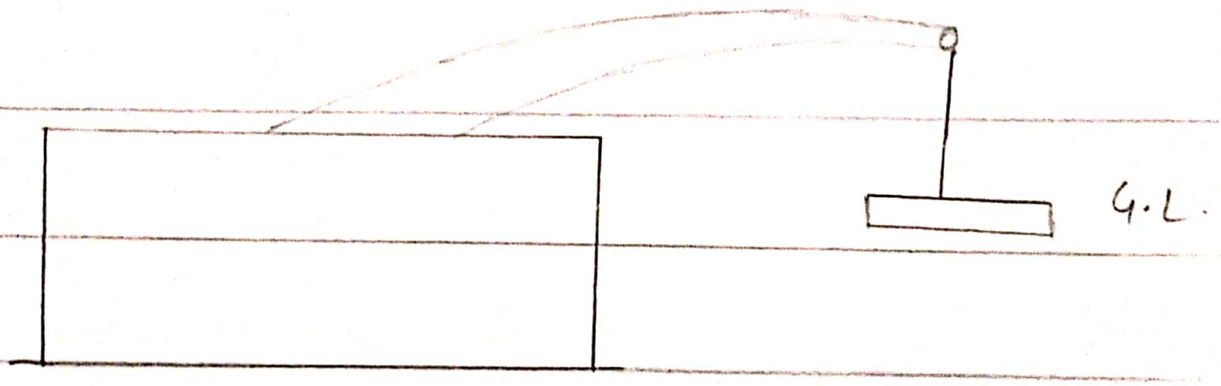
- The soft soil also requires ground improvement techniques.
- The sound which is sandy and gravely.

Methods of ground improvement techniques:

1: Removal and Replacement of soil:

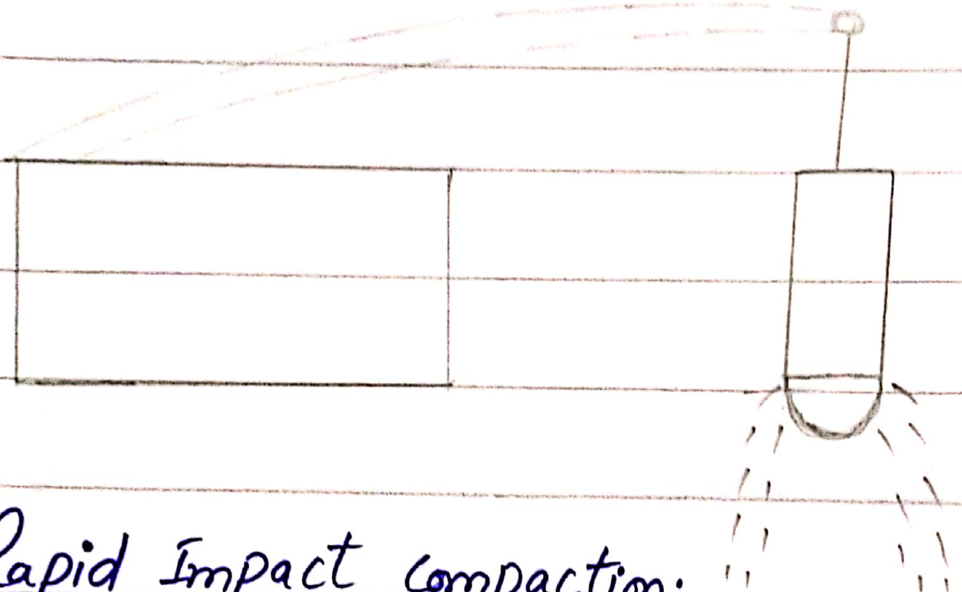
This is an oldest and simple methode.
The methode is performed on loose soil.
- In this methode the unsuitable soil is replaced with compacted fill.
In this methode the same soil is used to refill the high compaction and better engineering properties.
- This methode is applicable above the ground water table.

2: **Dynamic Compaction:** The methode is used to increase the bearing capacity of soil. This methode is also used to increase the density of soil. In this methode actual densification of soil takes place.



3: **ViBro Compaction:** It is also called vibro densification. In this methode the compaction take place. at a certain depth in granular soil, through vibratary probe. This methode

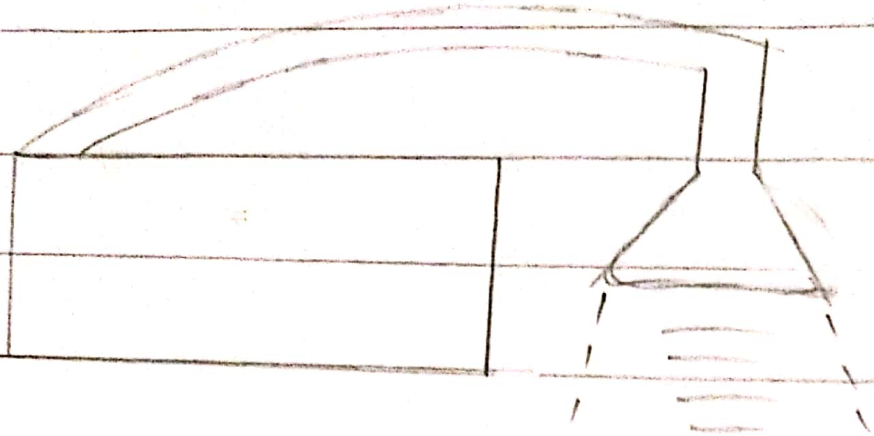
Vibratary probe is run by an electric probe. The penetration probe is enhance by ejecting water or the tip of probe.



4: **Rapid Impact compaction:**

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

This impact energy is actually applied through hydraulic pump. The hydraulic pump weight varies from 4-8 tons.



5: Dry mixing of Soil: Dry mixing is a ground improvement technique by which the characteristics of weak soil are improved by using dry cement bounder.

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Q3 PB # 3: An infinitely long slope ------
-------- what factors of safety would result?

Sol: Given data:

$C = 25\ KN/m^2$

$\phi = 16°$

$G = 2.72$

$e = 0.50$

Required data:

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

Solution:

$$F_c = \frac{C}{\gamma_d \times H v \cdot \sin i \cos i} + \frac{\tan \phi}{\tan i}$$

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

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

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

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$Fc = 1.18$

→ when there is seepage of water.

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

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

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

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

$\gamma = 21.04 \ kN/m^3$

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

$$= 21.04 - 9.8$$

$\gamma' = 11.24 \ kN/m^3$

$$Fc = \frac{25}{21.04 \times 6 \times (\sin 26°) \times \cos(26°)} + \frac{11.24}{21.04} + \frac{\tan(16°)}{\tan(26°)}.$$

$Fc = 0.816$

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Q No 4(a): It is proposed to construct --------.
soil properties:

Ans: Given:

Height = 10 m.

$C = 18.8\ kN/m^2$

$\gamma = 17\ kN/m^2$.

$\theta = 20°$

$F.O.S = 1.5$

$F\theta = 1.0$

Required:

Inclination, $i = ?$

Solution:

$$SN = \frac{C}{F.O.S \times \gamma \times H}$$

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

$SN = 0.073$

Using taylor chart for

$\theta = 20°$

$SN = 0.073$ $\boxed{i = 44°}$

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QNo ④ Ⓑ:

Given data:

- Height of water on upstream side = 15m.
- Bottom width of the Dam = 12m.
- Top width = 6m.
- Unit weight of water = 1000 kg/m^2.
- Unit weight of Concrete = 1450 kg/m^2
- Unit weight of silt = 1330 kg/m^2
- Angle of friction for the silt = θ_s = 35°
- Free board = 3.5m
- Silt Depoute height = 2.5m.

Required:

Silt Pressure = ?

Solution :-

Silt Pressure ⇒

$$P_s = \frac{\gamma_s \times H_1^2}{2} \times \frac{1-\sin\theta}{1+\sin\theta}.$$

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

$$= 4156.25 \times 0.27$$

$$P_s = 1122.18 \text{ kg/m}.$$

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