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Section: A

Paper : Geo-technical

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Question #1 (A)

Answer:-

Forces acting on dam:-

1. Water Pressure
2. Uplift Pressure
3. Wave Pressure
4. Silt pressure
5. Seismic Forces.

Water Pressure:-

The water pressure can be calculated by hydrostatic pressure distribution.

⇒ Water pressure (P) is the most major external forces acting on a dam. The horizontal water pressure exerted by the weight of the water stored on the upstream side of the dam.

⇒ Force due to water pressure

$$P = WH^2/2$$

⇒ This act at a height of h/3 from base of a dam.

2. Uplift Pressure:-

⇒ It is almost impossible to make a dam impervious structure.

⇒ Many minute cracks and pores are left in the dam and the foundation body.

⇒ Water is likely to find its ways into these minute openings though seepage and gradually fill them up.

It exerts an upward pressure on the body of the dam.

3. Wave Pressure:-

The upper portions of dam are subject to the impact of waves.

⇒ Wave pressure against massive dams of appreciable height is usually of little consequence.

→ The force and dimension of waves depends, mainly on the extent and Configuration of the water Surface, the velocity of wind.

4- Earthquake forces:-

→ Dams built in the area known to be seismically.

→ The disturbance in dam is highly dangerous because they store huge volume of water.

→ Forces that are likely to arise in a future shock.

5- ICE Pressure:

The ice pressure which may be formed on the surface of the reservior in cold countries may sometime melt & expend.

The dam face has then to resist the thrust erected by the expanding ice.

This force acts linearly along the length of the dam & at the reservoir level.
The magnitude of this force varies from 250 to 1500 kN/m² depanding upon the temperature variation. On an average a value of 500 kN/m² may be allowed under ordinary Condition.

Question # 01 (B)

Answer:-

1. Liquification of Soil
2- Butress Dam
3- Infinite slope
4- Pier Foundation
5- Dynamic load.

1. Liquification of Soil:

⇒ Liquification is the process that leads to a soil suddenly losing strength, most commonly as a result of ground shaking during a large earthquake.

⇒ A Phenomenon whereby a saturated or partially saturated soil substantially losses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in stress condition, Causing it to behave like a liquid" is called Soil liquefaction.

Buttress Dams:

. A buttress dam is defined as A dam Consisting of a relatively thin water supporting facing or deck supported by buttress generally in the form of equally spaced triangular walls or Counter forts that transmit the water load and deck weight to the foundation.

3. Infinite Slope:

⇒ Slope which have great extent with uniform soil conditions at any given depth below the surface.

⇒ The Soil stratum is not necessary homogenous, with depth but the strata of different soils are parallel to the slope surface.

4. Pier Foundation:

A Pier foundation consists of a cylindrical column of large diameter to support and transfer large. Super-imposed loads to the firm strata below.

Though pile foundations transfer the load through friction and/or bearing Pier foundations transfer the load only through bearing.

(5) Dynamic Load:-

The load which acts on ground by the movement of subjects and sometimes the load due to earthquake can be classified as Dynamic load.

Q. # 2(A)

Ans #2:

Shallow foundation:

- According to Terzagi:

The foundation in which depth of the foundation is less as equal to width of the foundation is called shallow foundation.

$Df \leq B$

- According to Skemption:-

The foundation in which Df/B ratio is less than as equal to 2.5 than the foundation is called shallow foundation.

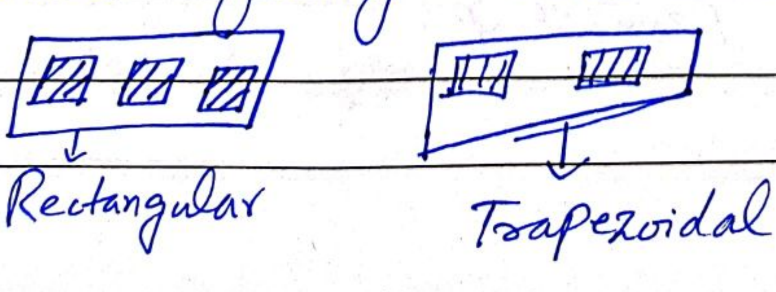
Types of Shallow foundation:

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

1. Wall / Strip Footing:
The footing which runs across the length of the wall and transfer the load of the wall to the soil safely. It is called wall or strip footing.

2. Combined Footing:
The footing which is constructed for two or more column and transfer the load of the two as more. Column to the soil safely then it is called Combined footing.

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

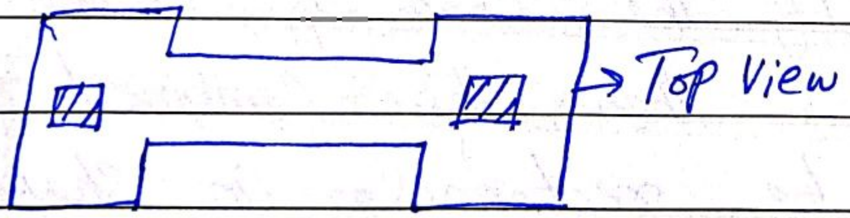


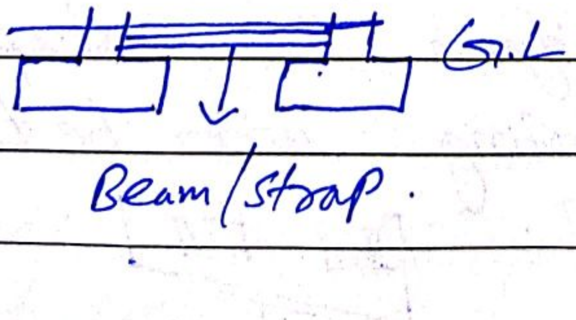
3. Raft / Mat Footing:

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.

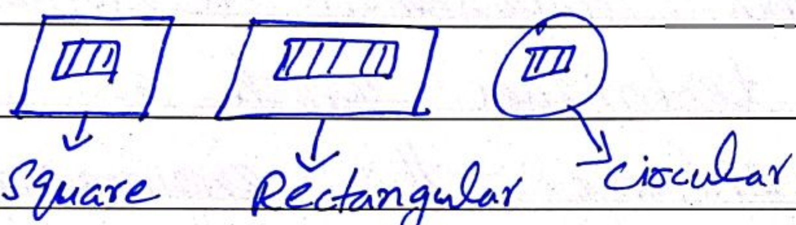
4. STRAPPED Footing:

The footing in which the outer column is connected with the inner column by means of the beam or strap is called strapped footing.

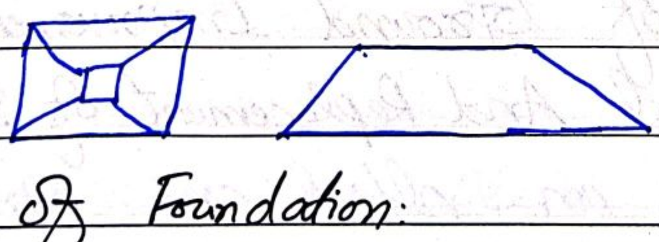




5. Column/Isolated Footing:-
The footing which is Constructed for a Single column and transmit its load to the soil safely.
It may be circular, Square, rectangular in shape.



6. Slopped Footing:-
The footing which have slope in all direction as in all sides is called as slapped footing.



Selection of Foundation:
Selection of foundation depend upon the following
1. Type of soil and condition of Soil.
2. It depands upon the load of super structure.

3) The depth at which the safe bearing Capacity exist.

———x———x———x

Question # 2 (B)

Answer :-(B) Ground Improvement Techniques:-

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

Methods of Ground Improvement TECHNIQUES:-

1. Removal And Replacement of Soil:-

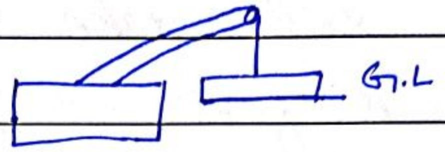
This is an oldest and simple method. This method is performed on loose soil.

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

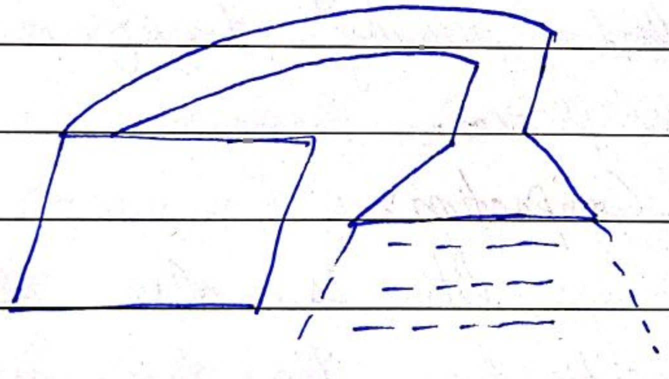
3- Vibro Compaction:

It is also called vibro densification. In this method the compaction takes place at a certain depth in granular soil through vibratory probe. This vibratory probe is run by an electric motor. The penetration of probe is entance by ejecting water at the tip of probe

4) Road Impact Compaction:-

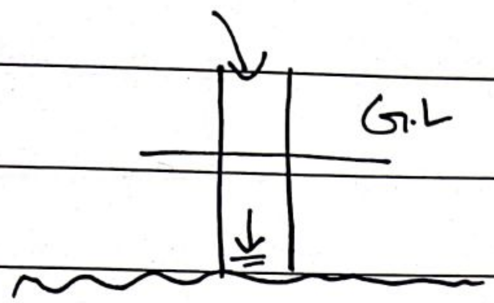
Impact energy is applied to surface of ground as a result of which densification of soil take place upto a depth of 15 feet.

This impact energy is actually applied through hydraulic ramp. The hydraulic ramp weight values from 4.8 tons.



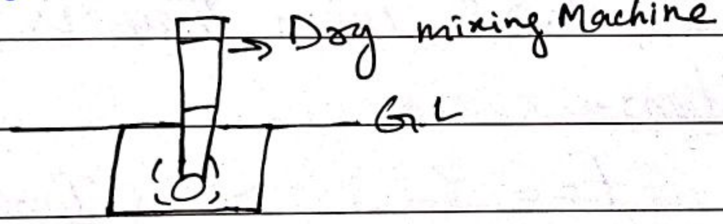
5. Vibro Concrete Column:

Vibro Concrete Column is a ground impresent technique which transfer the load from weak strat to hard strata by using strength Concrete.



Dry Mixing of Soil:

Dry soil mixing is ground improvement technique by which the characteristics of weak soil are improved by using dry cemetitious binder.



Q.No3:-

Given data:-

$C = 25 KN/m^2$

$\phi = 16°$

$G = 2.73$

$e = 0.50$

Required:-

F.O.S when soil is dry = ?

F.O.S when there is Seepage = ?

Solution:-

$$F_c = \frac{C}{\gamma d \times H \times Sini \times Cosi} + \frac{Tan\theta}{Tani}$$

By Relation:-

$$\gamma d = \frac{G_s \times \gamma w}{1+e} \Rightarrow \frac{2.72 + 9.8}{1+0.5}$$

$\gamma d = 17.8\ kN/m^3$

$$F_c = \frac{25}{17.8 \times 6 \times Sin(26°) \times Cos(26°)} + \frac{Tan(16°)}{Tan(26°)}$$

$F_c = 1.18$

Scanned with CamScanner

when there is seepage of water

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

$\gamma' = \gamma - \gamma_w$

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

$\gamma = 21.04\ kN/m^2$

$\gamma' = \gamma - \gamma_w$

$= 24.04 - 9.8$

$= 11.24\ kN/m^3$

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

Result:-

F_c when soil is dry $= 1.18$

F_c when there is seepage $= 0.816$.

QNo#4a.

Given data:-

Height = 10m

$C = 18.8 kN/m^2$

$\gamma = 17 kN/m^2$

$\theta = 20°$

F.O.S = 1.5

$F\phi = 1.0$

Required:

Inclination i = ?

Solution:

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

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

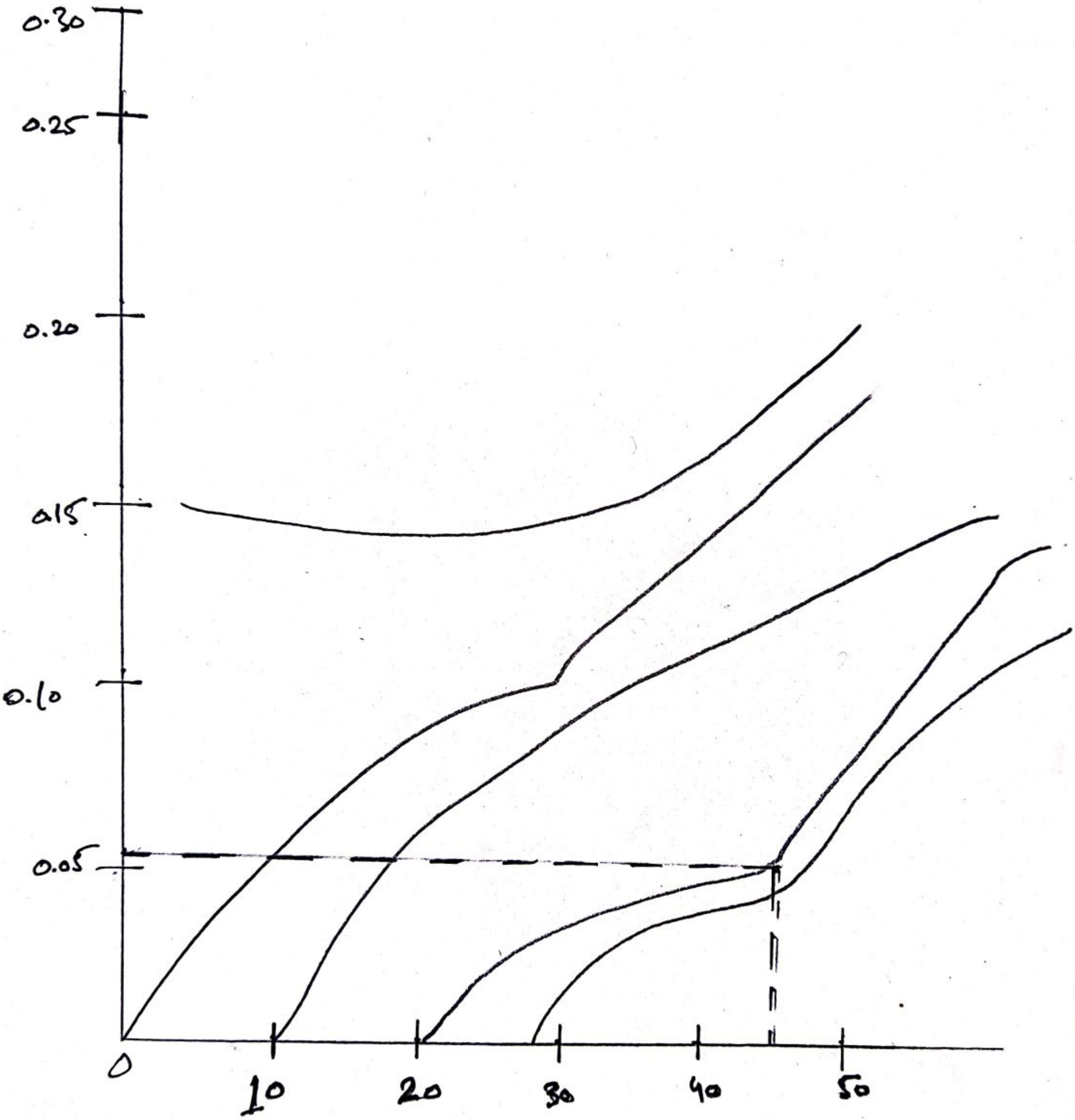
SN = 0.073

Using taylor chart for

$\phi = 20°$

SN = 0.073

$i = 44°$


0.30
0.25
0.20
0.15
0.10
0.05
0
10
20
30
40
50
Slope Angle

Question-4 (b)

Given Data:

- Height of water on upstream Side = 15m
- Bottom width of the dam = 12m
- Top width = 6m
- Until weight of water = 1000 kg/m³
- Until weight of Concrete = 1450 kg/m³
- Until weight of Salt = 1330 kg/m³
- Angle of friction for Silt = ϕ_s = 35°
- Free Board = 3.5m
- Silt Deposite height = 2.5m

Required:- Silt pressure = ?

Solution:-

As we know that

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

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

$$\boxed{P_s = 1126.30 \text{ kg/m}}$$