Name : Muhammad Imran

ID : 7847

Section : B

Semister : $6^{th}$

Subject : Geotechnical And Foundation Engineering

Teacher : Engr. Liaqat

# Question No 01 "A"

Name the forces acting on dam. Explain any five of them in detail:

Answer No 01::

Forces Acting on

The various external forces acting on Gravity Dam may be

- Water Pressure
- Up lift Pressure
- Pressure Due to Earthquake forces.
- Silt Pressure.
- Wave Pressure.
- Ice Pressure.
- The stabilizing force is the weight of the dam itself.

1) Uplift Pressure :-
water seeping through the Pores, cracks and fissures of the foundation material and water seeping through dam body and then to the bottom through the joint between the body of the

the dam. It is the second major external forces and must be accounted for in all calculations. Such an uplift force virtually reduces the downward weight of the body of the dam and hence act against the dam stability.

## Earthquake Force :-

· If the dam is to be design is to be located in a region which is susceptible to earthquakes, allowance must be made for stresses generated by the earthquakes.

· An earthquake Produces waves which are capable of shaking the Earth upon which the dam is resting in every Possible direction.

## Silt Pressure :-

It has been explained under "Reservoir Sedimentation" that silt get despired deposited against the upstream face of the dam. If h is

If h is the height of silt deposited. then the force exerted by this silt in addition to external water Pressure. can be represented by Rankine's formula as:

- $P_{silt} - \frac{1}{2} \gamma sub_w h^2 Ka$ and it acts at $h/3$ from base
- where, Ka is the coefficient of Active Earth Pressure of silt.
- $Ka - \frac{1 - \sin\theta}{1 + \sin\theta}$
- where $\theta$ is the angle of internal friction of soil, and cohesion is neglected.
- $\gamma sub_w$ - submerged unit weight of silt material
- h- height of silt deposited

## Wave Pressure :-

- waves are generated on the surface of the reservoir by the blowing winds, which cause a Pressure towards the downstream side, wave Pressure depend upon the wave height. Wave height may be given by the equation
- $H_w = 0.032\sqrt{V \cdot F} + 0.763 - 0.271 (F)^{3/4}$

for $F < 32$ km And.

- $H_w = 0.032\sqrt{V \cdot F}$ for $F > 32$ km
- where $h_w$ – height of water from top of crest and bottom of trough in meter.
- V – wind velocity in km/hr.

Water Pressure:- D is the depth of water in reservoir. P is the hydrostatic Pressure Per unit area acting on the vertical face of a concrete dam. assumed to behave as a rigid (in the Y direction) in given by $dp/di$ $\rho g$ in which $\rho$ is the density of water and g is the acceleration due to gravity.

Question No 01 "B" (5)

Define the following terms:

1) Liquification of soil:

Soil liquification occurs when a saturated or Partially saturated soil substantially loses strength and stiffness in response to an applied stress such as shaking during an earthquake or other sudden change in stress condition, in which material that is ordinarily a solid behaves like a liquid.

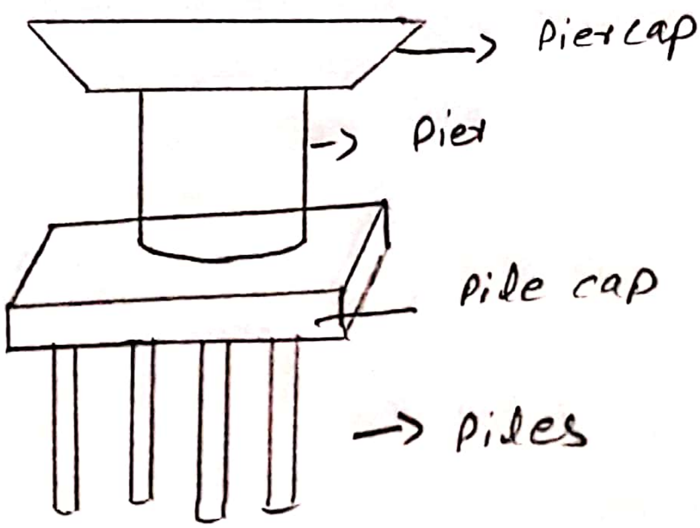
Buttress Dam:

A buttress dam or hollow dam is a dam with a solid, water-tight upstream side that is supported at intervals on the downstream side by a series of buttress or supports. The dam will may be straight o curved. Most buttress dam are made of reinforce concrete and are heavy, Pushing the dam into the ground.

③ Infinite Slope:-

The type of slope extending infinitely or up to an extent whose boundries are not well defined. for this type of slope the soil Properties for all identical depths below the surface are same. In the natural slopes. their is no making of contribution from out side.

4). Per foundation:- A pier foundation is a collection of large diameter cylindrical columns to support the super structure and transfer large super-imposed loads to the firm strata below. It stood several feet above the ground. It is also known as "Post foundation"



# Dynamic load

Soil Dynamic deals with the engineering behaviour of soils subjected to time varying loads and load applied very rapidly In soil dynamic applied loads vary with time. This implies that the stress and strain induced in the soil are also function of time.

# Question No 02 "A"

Define shallow Foundation. Explain types of shallow foundation in detail with appropriate sketch.

## Answer No 02 :-

**Foundation :-**

The lowest part of the structure which transmit the load of super structure safely to the soil surfaces.

**Types of Foundation:-**

1) Shallow Foundation.
2). Deep Foundation.

**Shallow Foundation :-**

According to Terzaghi:

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

$Df \leq B$.

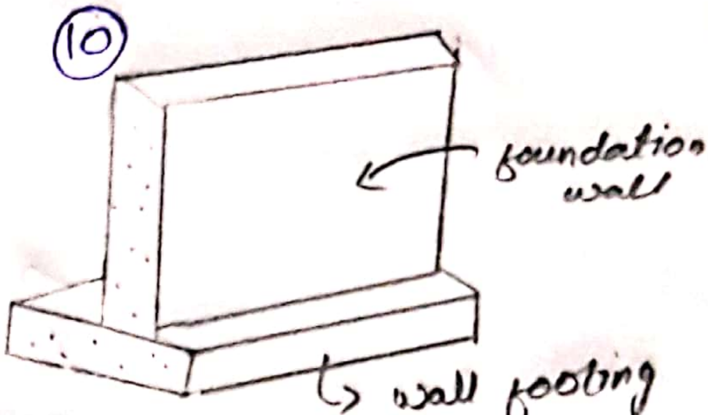
According to Skemption:- The foundation in which Df/B ratio is less than as equal to 2.5 than the foundation is called shallow foundation

## Types of SHAllOW Foundation:

1) wall footing.
2) combined footing.
3) Raft/Mat footing.
4) Strapped footing.
5) column/Isolated footing.
6) slopped footing.

## i) WALL / STRIP FOOTING:-

The footing which run a across the length of the wall to the soil and transfer the load of the wall to the soil safely It is called wall or strip footing.

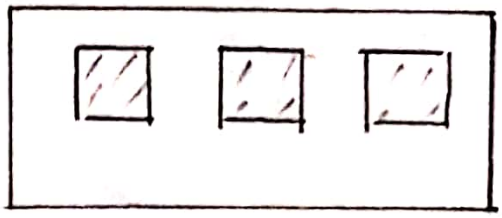


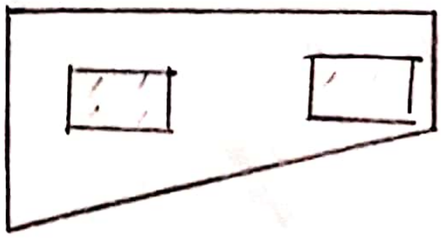

(2) COMBINED FOOTING :-

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

If the load of the column is uniform then the combined footing will be rectangular in shape.

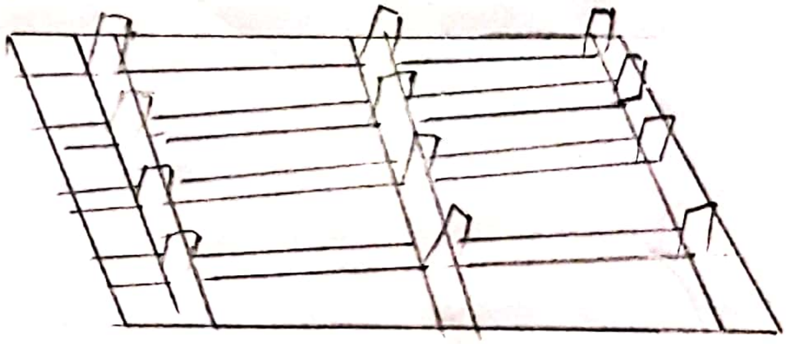
If the load of the column is not uniform then shape of combined footing will be trapezoidal.


Rectangular


Trapezoidal

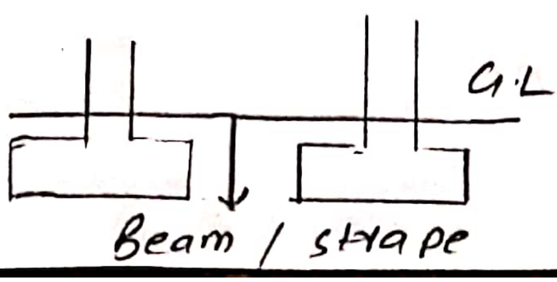
3) RAFT / MAT FOOTING:-

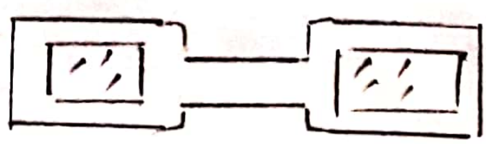
The footing which cover the whole area of the structure is called raft footing. This type of footing is proposed in area which have soil weak in bearing capacity. This is also provided when the load of super structure is heavy.



4) STRAPPED FOOTING:-

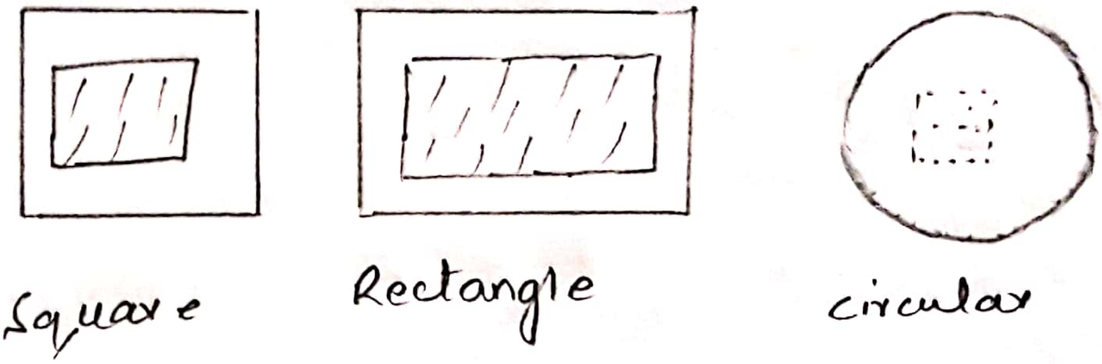
The footing in which the outer area column is connected with the inner column by means of the beam and strap is called strapped footing.



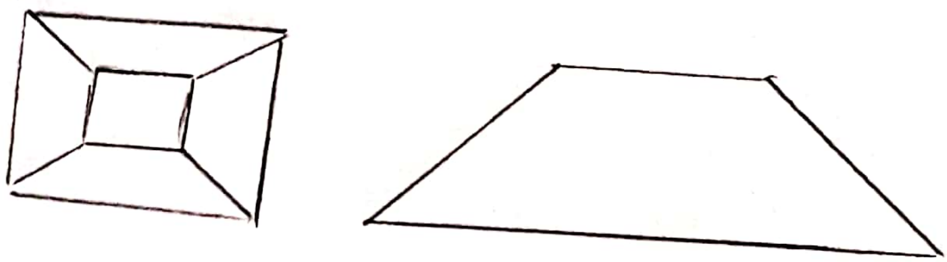
# 5) COLUMN / ISOLATED FOOTING:-

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 slopped footing.



# Question No 02 "B"

Why Ground improvement techniques are important. Explain five method of ground improvement in detail along with appropriate sketch:-

Answer:-

## Ground Improvement Techniques:-

Ground improvement techniques are the techniqes which are used to enhance the engineering Property of soil in order to deal heavy structural load. The main Properties are shear strength, Permeability, bearing capacity and stiffness etc.

## Method OF Ground Improvement Techniques:-

### 1) Removal And Replacement of Soil:-

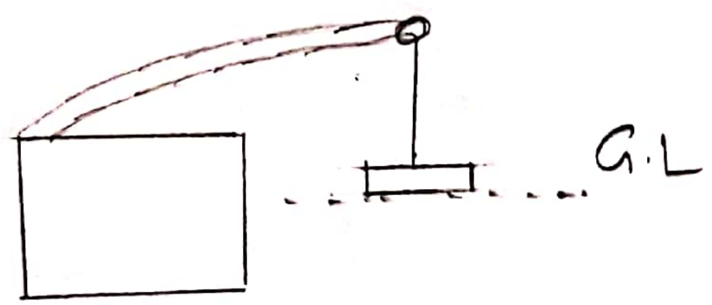
This is an oldest and simple method. This method is Performed on loose soil.

In this method the unsuitable soil is replaced with compacted fill. In this method the some soil is used to refill the higher compaction and better engineering properties.

This method is applicable above the ground water table.

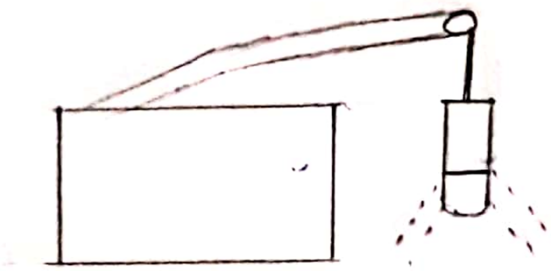
## (2) Dynamic Compaction:-

The 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 also increase actually densification of soil take place.



(3) Vibro compaction:-

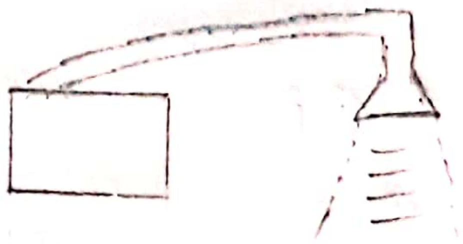
It is also called vibro densification. In the method the compaction take Places at a certain depth in ~~gradual~~ granular soil through vibrotory Porbe. This vibratory Probe is run by an ~~old~~ electric motor. The Penetration of Probe is enhance by ejecting water at the tip of Probe



4) Rapid Impact compaction:-

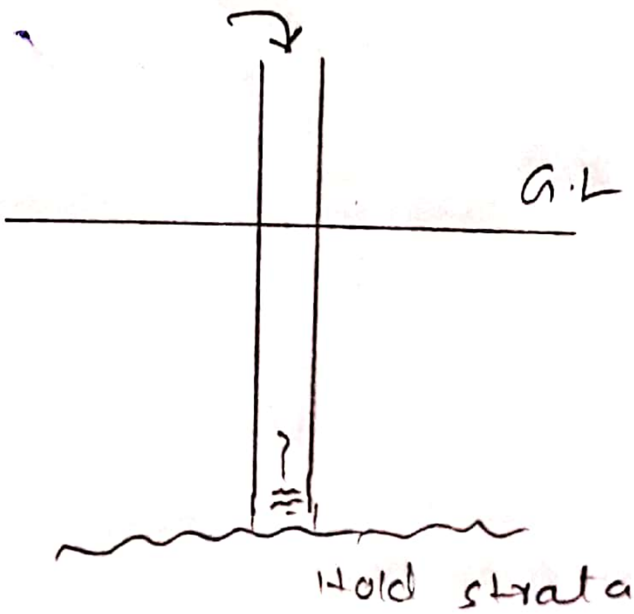
Impact energy is applied to surface of ground as a result of which densification of soil take Place upto a depth of 15 feet. This impact energy is actually applied through hydraulic ramp.

Thy hydraulic ramp weight vales from 4–8 tons.



5) Vibro Concrete column:-

Vibro concrete columns is a ground is improvement technique which transfer the load from weak strata hard strata by using strength concrete.



Question No # 03

Answer No # 03

Given Data:-

$C = 25\ KN/m^2$

$d = 16''$

$G = 2.72$

$e = 0.5$

Required:-

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

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

Solution:

As we know that

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

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

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

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

$F_c = 1.18$

when there is seepage of water

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

$\gamma' = \gamma - \gamma_w$

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

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

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

$\gamma' = \gamma - \gamma_w$

$= 21.04 - 9.8$

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

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

$F_c = 0.816$

Result :- FC when soil is dry = 1.18
FC when there is seepage = 0.816

# Question No # 04 A

## Answer No # 04 A

Given Data :-

Height, $H = 10m$

$c = 18.8 \, kN/m^2$

$\gamma = 17 \, kN/m^3$

$\phi = 20$

$F.O.S = 1.5$

$F.\phi = 1.0$

Required : ?

Inclination, $i = ?$

Solution :- As we know that

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

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

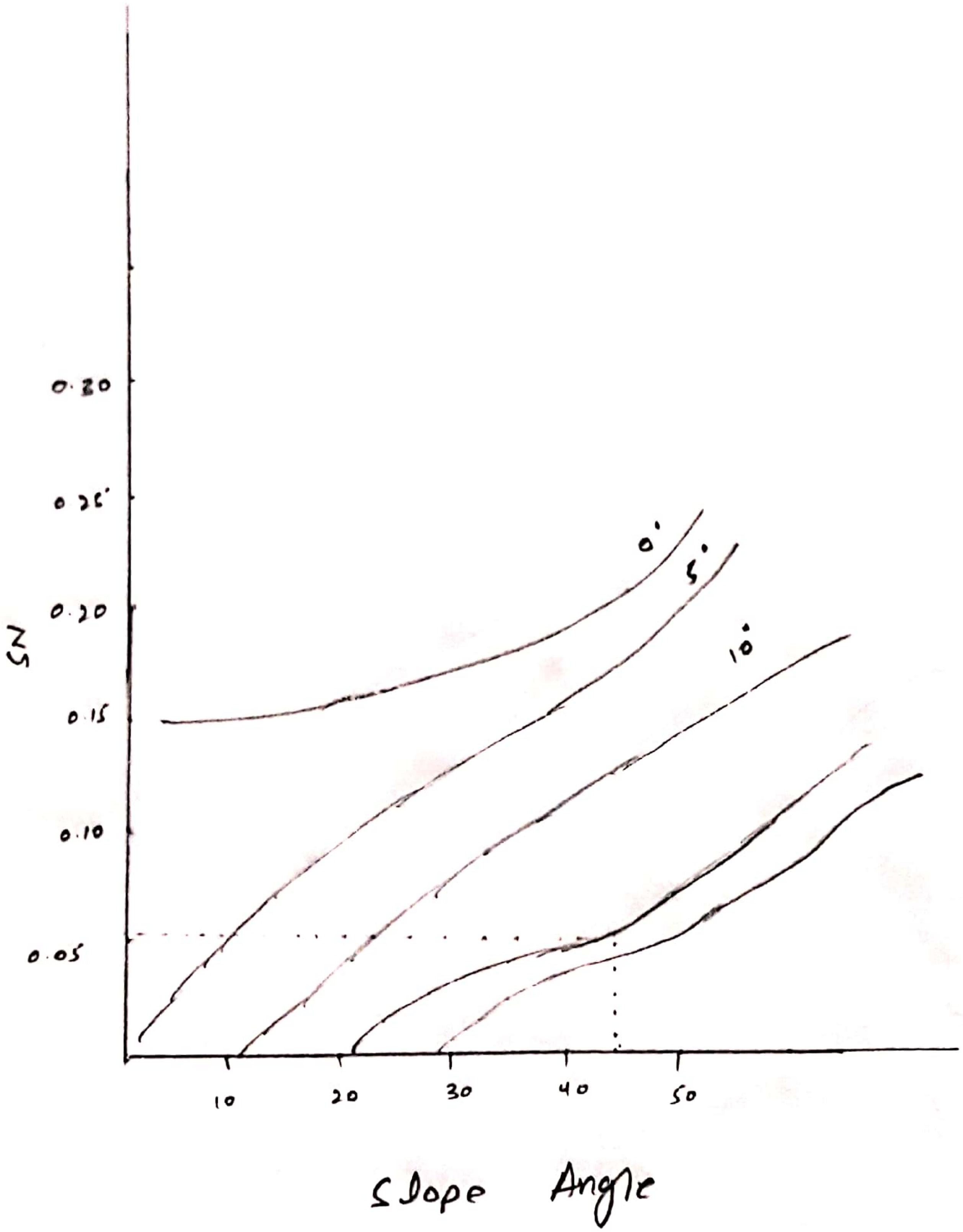
$$SN = 0.073$$

Using taylor chart for

$\phi = 20^\circ$

$SN = 0.073$

$i = 44^\circ$


0.30
0.25
0.20
0.15
0.10
0.05
$S_N$
0°
5°
10°
10
20
30
40
50
Slope Angle

Question No # 04 B

Answer No # 04 B

Given Data::

Height of water on upstream side = 15m

Bottom, width = 12 m

Top width = 6m

$\gamma$ water = 1000 kg/$m^3$

$\gamma$ concrete = 1450

$\gamma$ silt = 1330 kg/$m^3$

$\phi$ = 35°

Free Board = 3.5m

H = 2.5m

Required =?

Silt, Pressure. $P_s$ =?

Solution::

As we know that

$$P_s = \frac{\gamma_{silt} \times H^2}{2} \times \frac{1 - \sin\phi}{1 + \sin\phi}$$

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

$$= \frac{1330 \times 2.5^2}{2} \times 0.27$$

$$= 4156.25 \times 0.27$$

$$P_s = 1122.18 \ kg/m$$