ID :- 7313 AHMAD FARAZ KHAN
PAPER GEOTECHNICAL AND FOUNDATION ENGINEERING

## QUESTION # 1 "A"

Name the forces acting on Dam. Explain any five of them-?

ANS:-

Following are the forces acting on Dam.

- Self weight of Dam.
- Silt Pressure.
- Wave Pressure.
- Ice Pressure.
- Seismic Forces.
- Water Pressure.

### (i) Self Weight of Dam:-

The Weight of the dam & it's foundation is a major resting forces. It Can be Computed using the following equation.

$W = \gamma_m$ Volume

where $\gamma_m$ = unit weight of Dam material.

### (ii) 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

Ka: Coefficient of active earth pressure of silt which is equal to $\frac{1-\sin\phi}{1+\sin\phi}$

$\phi$: angle of internal friction of soil.

$\gamma_s$: Submerged unit weight of soil material

h: height of silt deposited.

## (iii) WAVE PRESSURE:-

Waves are generated on the surface of the reservoir, by the blowing minds, which exerts a pressure on the upper part of the dam above the water level. This is calculated by the following formula.

$$P_w = 2.4 \gamma_w h_w.$$

- Wave pressure depends upon wave height which is given by

For $F < 32$ Km.

$$h_w = 0.32\sqrt{V} + 0.763 - 0.271 \times F^{1/4}$$

For $F > 32$ Km:

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

Where

$h_w$ = weight of water from the top of Crest to bottom of trough in matters.

V: wind velocity in K/hr.

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 forces due to water wave action is given by:

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

## (iv) ICE PRESSURE:-

The ice which may be formed on the water surface of the reservoir in cold countries may some times melt & expand. The Dam face is subjected to the thrust of exerted by the 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/m² depending upon the temp.

## (v) SEISMIC FORCES:-

Dynamic loads created due to earthquakes must be considered in the designs of all major dams located in high risk seismic regions. Earthquake produces wave in every possible direction. However it has to be resolved into vertical and horizental components for the design purposes. The horizental components had greater effect. Seismic vibrations influence both dam today & water in the reservoir of dam. So the generated dynamic loads are due to the inertia of the dam and hydro-dynamic forces by the water in the

reservoir.

## QUESTION :- 1 "B"

:- Define the following terms :-

(i) Liquification of soil (ii) Buttress Dam
(iii) Infinite slope (iv) Pier Foundation
(v) Dynamic load.

### (i) Liquification of Soil :-

Effective stresses are the stresses which keep the soil particles in contact with each other, if the effective stresses decrease the soil loose its strength. when the effective stresses becames zero then soil will change to liquified state.

### (ii) Buttress Dam :-

A Buttress Dam is a Dam with a solid, water tight up-stream side that is supported at interval on the down stream side by a series of batttresses or support. The dam wall may be straight or curved. Most buttress dams are made of reinforced Concrete and are heavy pushing the dam into ground.

### (iii) Infinite Slope :-

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

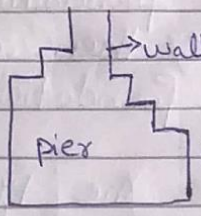
Example :-

Natural slope ie Hills, Mountains Deserts etc.

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

(iv) 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




(v) Dynamic Load :-

Dynamic load occur when loading conditions are changing with time. It may be in the form of earth quake operation of heavy machinery, wave motion, wind etc.

Due to dynamic load the settlement chances may increase.

QUESTION :- 2 "A"

:- Define Shallow foundation. Explain types of Shallow foundation in detail with appropriate Sketch-?

ANS:- According to Terzaghi :-

The foundation in which dipth of the foundation is less or eaual to width of this foundation is called Shallow foundation $D_f \leq B$

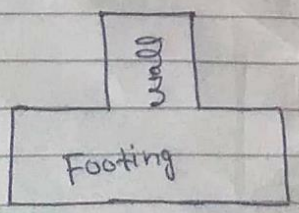
According to Skemption :-

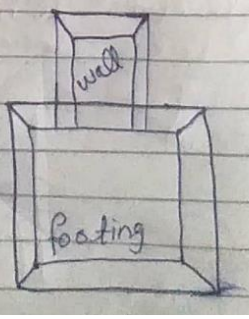
The foundation in which $D_f/B$ ratio is less then or eaual to 2.5 then the foundation is called Shallow foundation.

following are the types of Shallow foundation.

(1) Wall footing :-

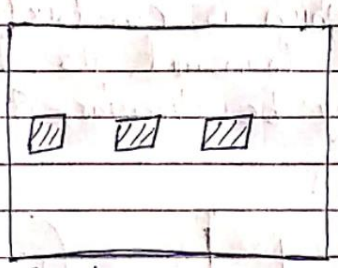
The footing which runs across the length of the wall and transfer the load of the wall to the Soil safety. It is Called wall or strip footing.



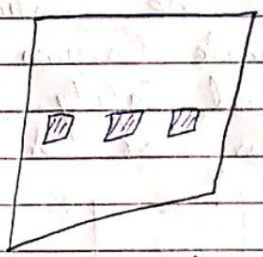



## (2) Combined footing :-

The footing which is constructed for two or more column and transfer the load of the two or more column to the soil safety than it is called combined footing. if the load of column is uniform then the combined footing will be rectangular shape and if the load is not uniform then the shape of footing will be trapezoidal.



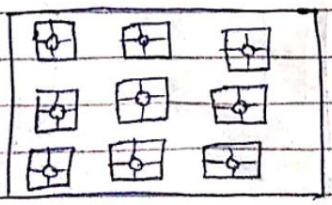
Rectangular footing



Trapezoidal footing.

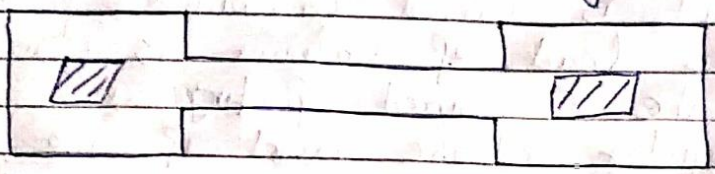
## (3) Raft/Mat footing :-

The footing which covers the white area of the structure is called Raft footing. This type of footing is proposed in area which have soft weak in beyond capacity. This is also provided when the load of super structure is heavy.



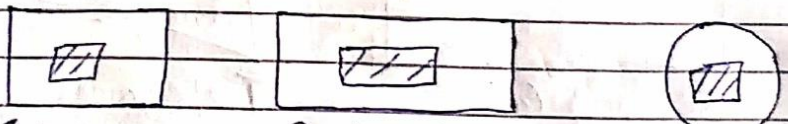
## (4) Strapped footing :-

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



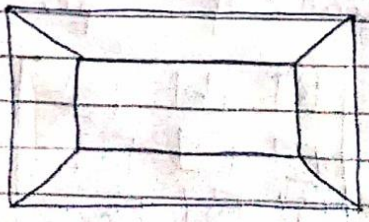

## (5) Column / isolated footing :-

The footing which is constructed for a single column and transmit its load to the soil safety. It may be circular, square, rectangular shape.




## (6) Slopped footing :-

The footing which have slope in all directions or in all sides is called sloffed footing.



## Question :- 2 "B"

∴ Why Ground improvement techniques are important. Explain five methods of ground improvement in detail along with appropriate sketch.

**Ans:-** The Soil in which voluxetric Changes takes Places due to Shrinkage or 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 Grarely
- The foundation in Sanotery Places also required ground improvement techniques.

following are the methods of ground improvement techniques.

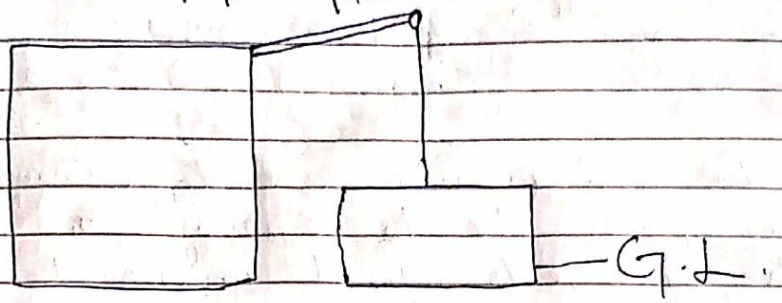
### (1) Removal and Replacement of Soil:-

This is an oldest and simple method. This method is Performed on loose Soil. In this method the unsuitable Soil is replaced with Completed fill. In this method the Same Soil is used the refilling of higher Conloction and battery engineering. This method is applicable above the ground water table.

### (2) Dynamic Computation :-

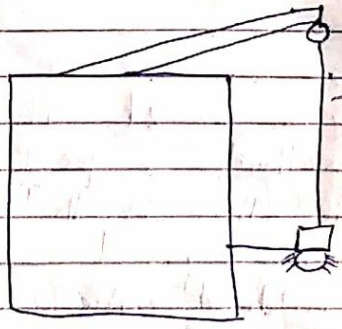
This Method is used to increas the bearing Capacity of Soil. This also

increase the Consolidation rate.
In this method actuall desification of soil takes place.




## (3) Vibro Compaction:-

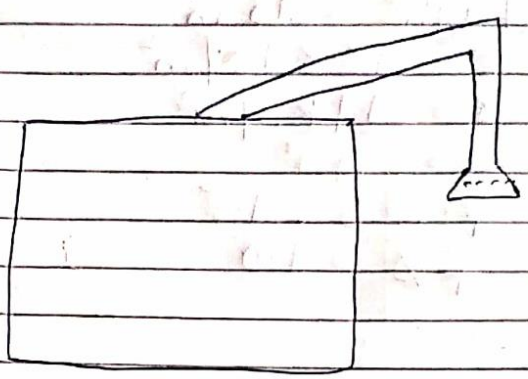
It is also called vibro desification. In this method the Compaction take Place at a Certain depth in granular soil through vibratory pobe. This vibratory probe is run by an electric motor.



## (4) Rapid impact Compaction:-

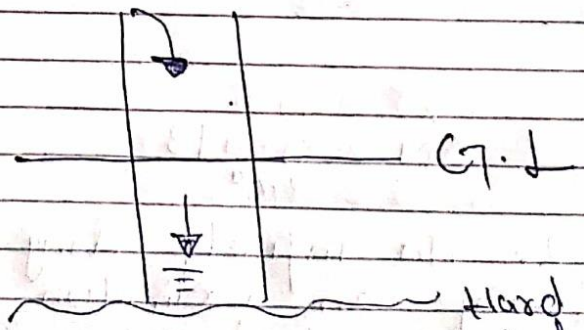
Impact energy is applied to surface of ground as a result of which desification of soil takes place into a depth of 15. This impact energy is actualy applied through

hydraulic ramp. The hydraulic ramp weight varies- from 4-8 tons.



(5) Concrete Column :-

Vibro Concrete is a ground improvement tenique which transfer the load from weak state to hard state by using strength concrete.



# QUESTION :- 3

Q3 PB = 2 = An infinety long slope having an inclination of 26° in an area is underline by firm cohesive soil. (Gs = 2.72 and C = 0.50). There is a thin, weap layer of soil 6m below and parallel to the shape surface (C = 25 kn/m², ϕ = 16°). Compute the factor of safety when the slope is dry. if ground water flow could accual parallel to the slope on the ground surface. what factor of safety would result.

Given DATA :-

$C = 25\ KN/m^2$

$\phi = 16°$

$G_s = 2.72$

$e = 0.52$

Required.

$F_c$ (F.O.S) when soil is dry.

$F_c$ (F.O.S) when there is seepage

Solution

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

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

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

$$F_c = \frac{1 \cdot 25}{F_c 8 \times 6 \times \sin(26°) \times \cos(26°)} \times \frac{\tan(16°)}{\tan(26°)}$$

$$F_c = 1.18$$

when there is seepag of water

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

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

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

$$= \frac{2.27 + 0.5}{1 + 0.5} \times 9.8$$

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

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

$$21.04 - 9.8$$

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

$$F_c = \frac{25}{21.04 \times 6 \times \sin(76^\circ) \times \cos(26^\circ)}$$

$$F_c = 0.816.$$

## QUESTION :- 4 "B"

### GIVEN Data :-

- Height of water on up stream side = 15m
- Bottom width of the Dam = 12m
- Top width = 6m
- unit weight of water = 1000 kg/m²
- Unit weight of Concrete = 1450 kg/m²
- unit weight of Salt = $\phi_s = 35^\circ$
- Angle of frictions for silt = $\phi_s = 35$
- Free Board = 3.5m
- Silt Deposite height = 2.5m

Required :-

Silt Pressure = ?

Solution :-

As we know that

$$P_s = \frac{\gamma_s \times H_3^2}{2} \times \frac{1 - \sin\phi}{1 + \sin\phi}$$

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

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

QUESTION :~ 34" A"

GIVEN :-

Height = 10 m

$C = 18.8\ KN/m^2$

$\gamma = 17\ kn/m^2$

$\phi = 20^\circ$

$F.O.\phi = 1.5$

$F\phi = 1.0$

Required :-

Inclination, $i = ?$

Solution :-

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

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

$$S_N = 0.073$$

using taylor chart for :-

$\phi = 20^\circ$

$S_N = 0.027$

$i = 44^\circ$