Name	M. Muqaddas Khan
ID	7787
Section	A
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Submitted To	Engr. Liaqat Khan

Question 01.

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

Ans :→ Force acting on dam are given below:

1→ water pressure
2→ uplift pressure
3→ wave pressure
4→ silt pressure
5→ Ice pressure
6→ Self pressure dam.
7→ Seismic forces.

1) Silt pressure :-
It is that pressure which 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:

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

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 meterial

h = height of silt desposited.

2) → 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 meterial.

3) → Ice pressure:-

The ice which may be beformed on water surface of the reservoir in cold countries may some time melt and expend. The dam face is subjected on the thrust exerted by the expending 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/sqm depending upon the temprature.

4→ Sesmic Forces:-

Dynamic load Created due to Earth quake must be Considered in The design of all major dam located in high Risk. Sesmic Region Creates earth quake pressure wave in every direction. However. It has to be Resolved into vertical and horizontal Component of the design process. The horizontal component had greater effect. Sesmic 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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Question 01

Part B :- Definition of the following.

1 → **Liquification of Soil :→**

A phenomina whereby a Saturated or partially Satureted Soil Substantially loses Strength and Stiffness in responce to an applied Stress, usually earthquak Shacking or other Sudden changes in Stress condition, cousing it to behave like liquid is called liquification of Soil.

2 → **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 :-**

Slop which have great extent with uniform Soil conditions

at any given depth below the Surface.
Also the Strata of different Soils are parallal to the slope Surface

4) → Pier Foundation:-
pier foundation consist of 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 foundation transfer the loads only through bearing.

5) → Dynamic Load:-
The load which acts on the ground by the moment of subject and sometime the load due to earthquake can be classified as Dynamic load.

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Question (02)

Part A :->

↳ Shallow foundation:-

The foundation in which which depth of the foundation is less then or equal to width of foundation is called Shallow foundation

$$D_f \leq B.$$

↳ Types of Shallow foundation:-

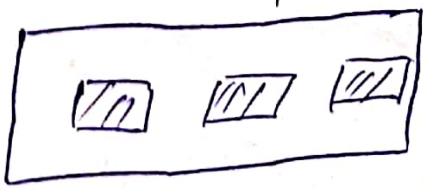
- → wall footing
- → Combined footing
- → Raft footing
- → Strapped footing
- → Column footing
- → Slapped footing

1→ Wall/strip footing:-> The footing which runs across the length of the wall and Tranfer the load of the wall to the soil safety. It is called wall on the strip footing.

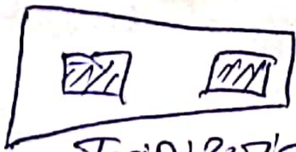
2→ Combined footing:- The footing which is constructed for Two or more Column and Transfer load of the wall

To The Soil Safety then it is called Combined footing.

if The load of column is Uniform then the combined footing will be Rectangular in Shape.



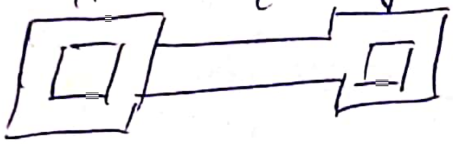
& if the load of column is not Unifor Then the combined footing will be tripizoidal. in Shape.



3→ Raft footing

The footing which covers The whole areas of The structure is called Raft footing. This type of footing is used in weak in bearing capacity where this is used proposed to be used. This is also called &
provided when the load of Super Structure is heavy.

4) → **Strapped Footing:-**
The footing in which the outer column is connect with the inner column by means of the beam or strip is called strapped footing.

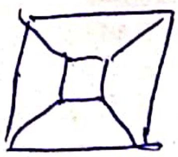


Top view.

5) → **Isolated Footing:-**
The footing which is constructed for a single column and transmit the load to the soil safety. It may be circular, squar or rectangular in shape.

Circular Squar rectangular.

6) → **Slopped Footing:-**
The footing which have slope in all direction or in all side is called slopped footing



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Question (02)

Part B :→

Ground Improvement Techniques :-

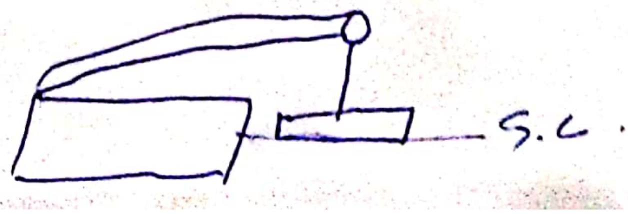
Ground Improvement Techniques are those which are used to enhance the engineering property of soil in order to bear heavy structural load.

Ground Improvement are important for shear strength, permeability, & bearing capacity and stiffness work.

↳ Methods of grounds improvement Techniques :-

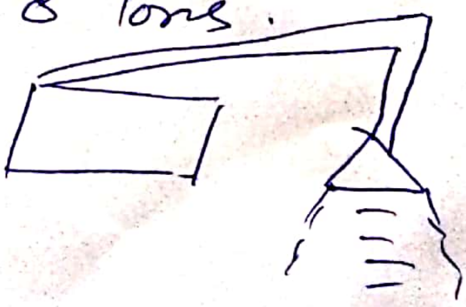
1→ Dynamic Compaction :-

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

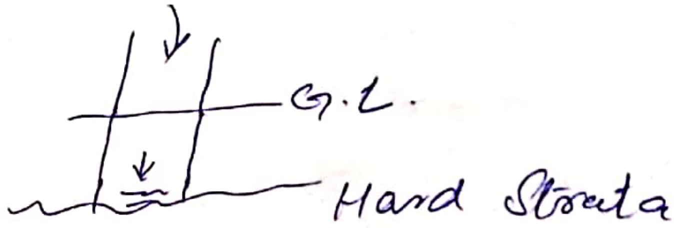


2) → Vibro Compaction :- It is also called vibro densification. In this method the compaction take place at a certain depth in granular soil through vibrotory probe. This vibrotory prope is run by an electric motor. The penetration of probe is entrance by ejecting water at the tip of probe.

3) → 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 rump. The hydraulic ramp weight varies from 4-8 tons.



4) **Vibro Concrete Column :-** Vibro concrete Column is a ground improvement Technique which Transfer the load from weak Strata to hard Strata by using Strength Concrete.



5) **Dry mixing of Soil :-** Dry mixing of Soil is also a ground improvement technique by which the Characteristics of weak Soil are improved by using Dry Cementitious binder.

Question 03

Given Data :→

$c = 25 \ kN/m^2$

$\phi = 16^\circ$

$G = 2.72$

$e = 0.50$

Required Data :-

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

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

Sol :→

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

Also

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

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

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

So

$$\boxed{F_c = 1.18}$$

So we have to find Fc where there is Seepage in Soil water.

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

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

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

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

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

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

$$= 21.04 - 9.8$$

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

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

So After calculation we have

$$\boxed{F_c = 0.816}$$

This is Fc where Seepage in Soil.

Question 04

Part A :→

Given Data :-

Height = H = 10m

c = 18.8 KN/m²

γ = 17 KN/m³

φ = 20°

F.O.S = 1.5

Fφ = 1.0

Required Data :-

Inclination = ?

Solution :-

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

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

$$\boxed{S_n = 0.073}$$

Using Tayler Chart for

φ = 20°

S_n = 0.073

⇒ i = ~~44~~° 44 (from Tayler chart.) Inclination

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Question No 4

Part B:-

Given Data:-

↳ Height of water on upstream = 15m
↳ Bottom width of Dam = 12m
↳ Top width of Dam = 6 m
↳ Unit wt of water = 1000 Kg/m³
↳ Unit wt of concrete = 1450 Kg/m³
↳ Unit wt of Silt = 1330 Kg/m³
↳ Angle of friction for Silt = ϕ_s = 35°
→ Free board = 3.5m
→ Silt Deposit height = 2.5m.

Required Data:-

Silt Pressure

Solution:→

As we know that

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

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

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