Name	Ashfaq Hussain
ID	7854
Section	B
Semister	6th
Instructor	Engr. Liaqat Ali
Subject	Geotechnical and foundation engineering
Date	27-6-2020

Question #1

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

Ans. 1 Water Pressure

2. Uplift pressure

3. Wave pressure

4. Silt Pressure

5. Ice Pressure

6. Self weight of dam

7. Seismic forces

Water pressure :-

Water pressure (p) is the most major external force acting on such a dam. The horizontal water pressure, exted by the weight of water stored on the upstream side of the dam can be estimated from rule of hydrostatic pressure distribution.

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 dam. it is the second major external force and must be accounted for all calculations. Such an uplift force virtually reduces the downward weight of the body of the dam and hence, acts against the dam stability.

Wave pressure :-

Wave pressure are generated on the surface of the reservior by the blowing winds, which causes a pressure towards the downstream side. Wave pressure depends upon the wave height.

Silt pressure :-

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

$P_{silt} = \frac{1}{2} \gamma_{sub_w} h^2 K_a$ and it acts at $h/3$ from base.

Ice pressure:-

The ice pressure which may be formed on the surface of the reservoir in cold countries, may sometimes melt and expand. The dam face has then to resist the thrust exerted by the expanding ice. This force acts linearly along the length of the dam and at the reservoir level. The magnitude of this force varies from 250 to 1500 kN/m² depending upon the temperature variations. On an average, a value of 500 kN/m² may be allowed under ordinary conditions.

B. Define the following terms.

1. **Liquification of Soil:-**

A phenomenon whereby a saturated or partially saturated soil substantially loses 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.

2. **Butress Dam:-**

A buttress dam or hollow dam is basically a derivation of a gravity dam with the introduction of intermediate space.

- With a buttres dam, the face of the dam is held by a series of supports or buttresses that are placed at intervals on downstream side.
- The buttresses work to combat the

force of reservoir water from trying to push the dam over.

. The advantage of buttress dam is that it typically require less concrete to construct than a gravity dam.

3. <u>Infinite Slope</u>:- The slope which have infinite area and finite depth such a slope is called as infinite slope.

example.
Natural slope i-e Hills, deserts etc.

4. <u>Pier foundation</u>:- 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.

5. **Dynamic Load:-** Dynamic loads vary in their magnitude, direction, or position with time. The type of dynamic loading in soil or the foundation of a structure depends on the nature of the source producing it.

Dynamic load may be in form of

~~(1) earth quo~~

(1) earthquick (2) Operation of Heavy Operation of Heavy Machinery.

(3) wave motion

(4) wind.

QNo 2.

A Define shallow foundation explain types of shallow foundation in detail with appropriate sketch

Ans **Shallow Foundation:-**

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

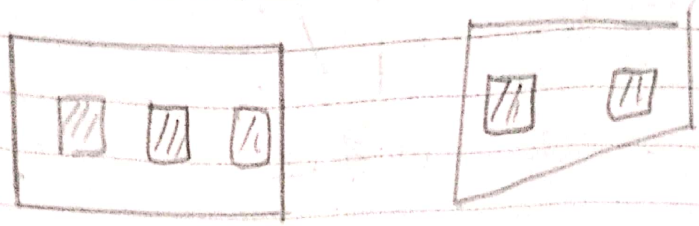
Types of shallow foundation.

1. **Wall footing:-** The footing which runs across the length of the wall and transfer the load of the wall to the soil 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 or more column to the soil safely then it is called combined footing.
If the load of column is uniform the the combined

then the combined footing will be rectangular in shaped

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

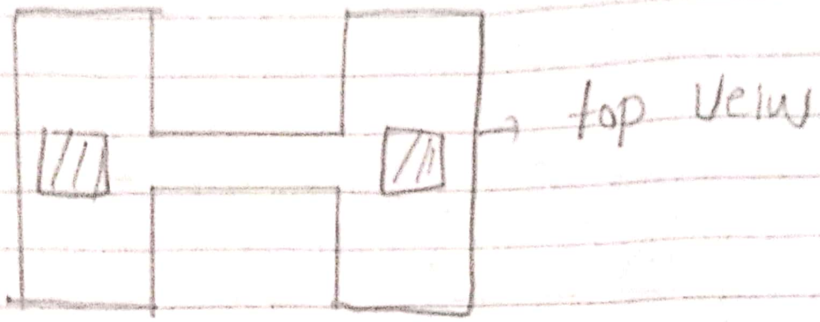


Rectangular   Trapezoidal

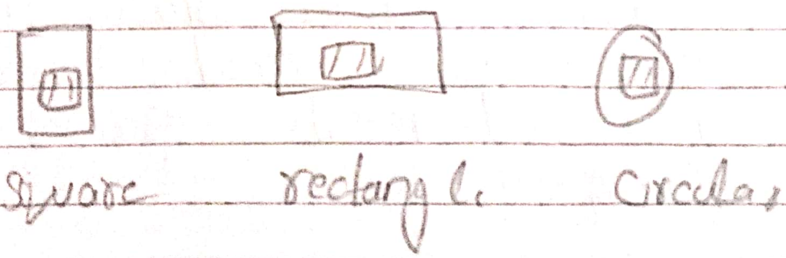
3. **Raft / Mat Footing**:- The footing which covers the whole area of the structure is called raft footing. This type of footing is proposed in area which have soil weak in bearing capacity. This is also provided when the load of super structure is heavy.

4. **Strapped Footing**: The footing

in which the Outer column is connected with the inner column by means of the beam as strap is called Strapped footing



5. Column/Isolated footing:- The footing which is constructed for a Single Column and transmit its load to Soil Safely. it may be circural, square, rectangullar in Shape.



6. Slopped Footing :- The footing

Which have slope in all direction or in all sides is called as slopped footing.

B Why ground improvement techniques are important. explain five methods of ground improvement in detail along with appropriate sketch.

Ans The soil in which volumetric changes take place due to shrinkage and swelling such soil needs ground improvement techniques.

The soft soil also required ground improvement techniques.

The foundation in Sanatory dump places also required ground improvement techniques.

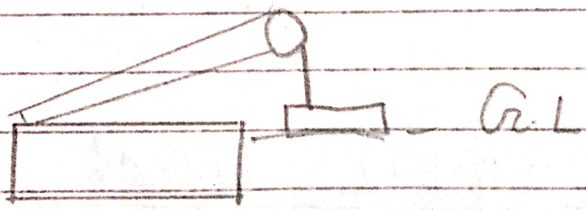
Methods of Ground Improvement techniques:

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 some soil is used to refill the higher compaction and bether engineering properties.

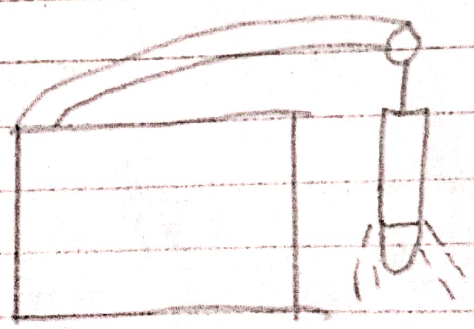
This method is applicable above the ground water table.

2. **Dynamic Compaction:**



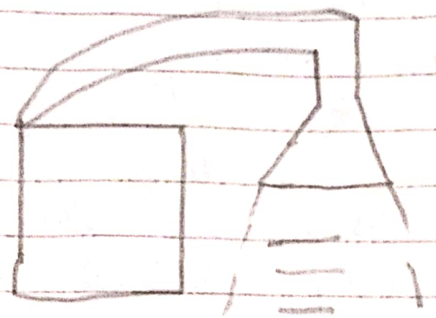
This method is used to increase the bearing capacity of soil. This also increase the consolidation rate. This method also increase the density of soil. In this method actually densification of soil take place.

3. Vibro Compaction:- It is also called vibro densification. In this method the compaction takes place at a certain depth in granural soil through vibratory probe. This vibratory probe is run by an electric motor. the penetration of probe is enhance by ejecting water at the tip of probe



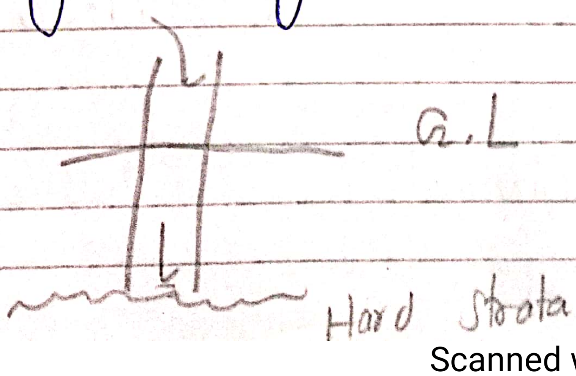
4. RapiD impact Compaction:

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



5. Vibro Concrete Columns:-

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



QNo 3

A An infinitely long slope having an inclination of 26° in an area is underlain by firm cohesive soil ($G = 2.72$ $e = 0.50$). There is a thin weak layer of soil 6m below and parallel to the slope surface is $C = 25$ kN/m², $\phi = 16$ Compute the factor of safety when the slope is dry. If ground water flow could occur parallel to the slope on ground surface, what factor of safety would result

Given Data:

$C = 25$ kN/m²

$\phi = 16°$

$G = 2.72$

$e = 0.50$

Required:

Fc (F.o.s) When Soil is dry

Fc (F.o.s) When there is Seepage in Soil.

Solution:

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

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

$$\gamma_d = 17.8 \text{ kN/m}^3$$

$$F_c = \frac{25}{17.8 \times 6 \times \sin(26^\circ) \times \cos(26^\circ)} + \frac{\tan(15^\circ)}{\tan(26^\circ)}$$

$$\boxed{F_c = 1.18}$$

When ther is Seepage of water.

(16)

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

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

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

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

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

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

$$= 21.04 - 9.8$$

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

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

$$\boxed{F_c = 0.816}$$

Q No 4.

A it is proposed to construct a 10m highway embankment with following soil properties

C = 18.8 kN/m²

γ = 17 kN/m³

ϕ = 20°

What is inclination required for embankment if design FOS = 1.5 and F_ϕ = 1.0

Given Data:

Height = H = 10m

C = 18.8 kN/m²

γ = 17 kN/m³

ϕ = 20°

FOS = 1.5

(18)

FQ = 1.0

Required - Inclination = i = ?

Solution:- As we know that

$$SN = \frac{C}{FOS \times \gamma \times H}$$

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

$$SN = 0.073$$

Using Taylor Chart for

$\phi = 20^\circ$

$SN = 0.073$

Then

$\delta = 44$ (From taylor chart)

B Considering the following data find silt pressure.

- Height of water on upstream side = 15m

Bottom width of dam = 12m

Top width = 6m

Unit weight of water = 1000 kg/m3

Unit weight of Concrete = 1450 kg/m3

Unit weight of silt = 1330 kg/m3

Angle of friction for silt = $\phi = 35°$

free board = 3.5 m

Silt deposite height = 2.5m

Given data

* Height of water on upstream side = 15m
* Bottom width of dam = 12m
* Top width = 6m
* Unit weight of water = 1000 kg/m³
* Unit weight of concrete = 1450 kg/m³
* Unit weight of silt = 1330 kg/m
* Angle of friction for silt = 35°
* Free board = 3.5m
* Silt deposite height = 2.5m

Required :- silt pressure = ?

Solution: As we know that

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

(21)

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

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