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I.D NO 7614

SECTION B

SUBMITTED TO ENGR. LIAQAT ALI

SUBJECT GEO-TECH

DATE | 27 | June | 2020

QUESTION #01:

PART A:

Name the force acting on dam. Explain any five of them in detail?

Answer: There are different types of forces acts on a dam structure such as water pressure, self weight, wave pressure etc. These forces are considered to act per Unit length of the dam.

Forces acting on a dam Structure:

1- Water pressure
2- Earthquake forces
3- Silt pressure
4- Wave pressure
5- Ice pressure

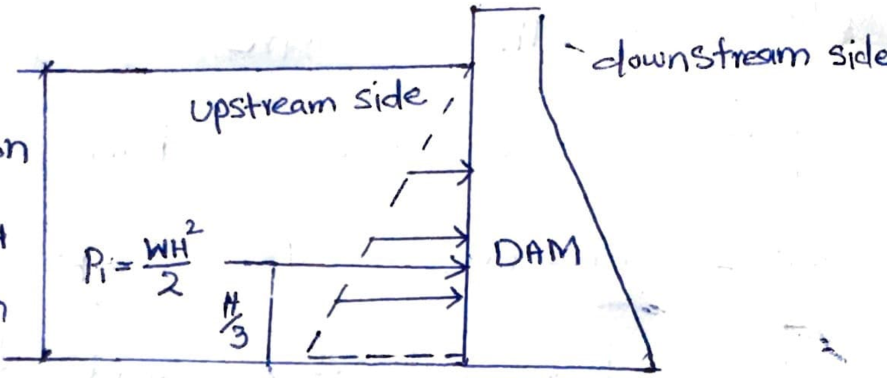
1- Water Pressure:

It is the pressure of water thats acts perpendicular on the upstream force of the dam. For this, there are two cases:

CASE #01:

Upstream face of the dam is vertical and there is no water on the downstream side of the dam.

The total pressure is in horizontal direction and acts on the upstream face at height H/3 from the bottom.



The water pressure on the dam is computed according to equation.

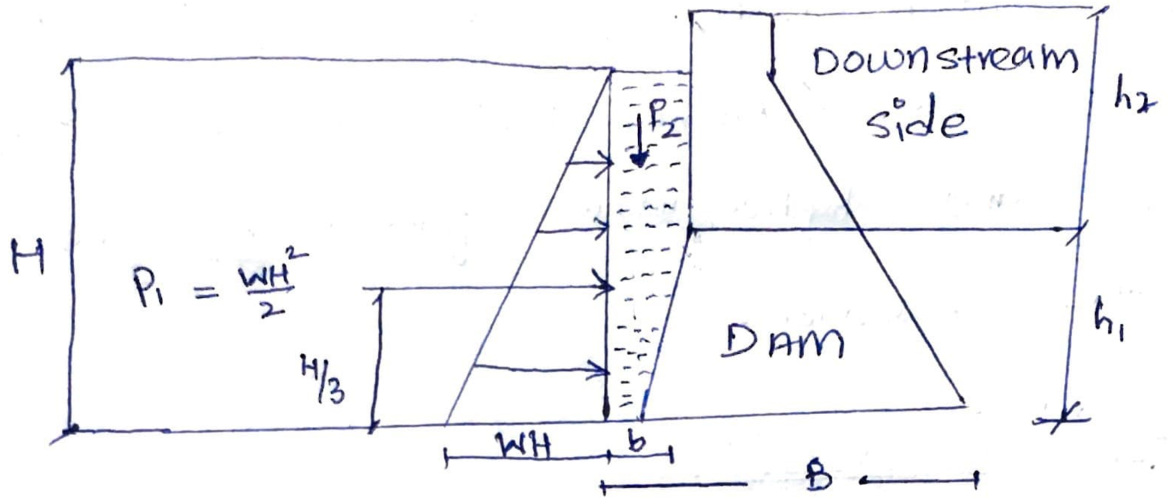
$$P_1 = WH^2/2$$

Where W = specific weight of water
H = Height of the water is stored.

CASE #02:

Upstream face with batter and there is no water on the downstream side as shown in figure.

Here in addition to the horizontal water pressure of eq ①, there is vertical pressure of the water. It is due to the water column resting on the upstream sloping side.



The vertical pressure P_2 act on the length "b" portion of the base. This vertical pressure is calculated as follows.

$$P_2 = (b \times h_2 \times W) + (0.5b \times h_1 \times W)$$

2- Earthquake forces:

Dynamics loads created due to earthquake must be considered in the design of all major dams located in high risk seismic regions and for dams situated in close proximity to potentially active geological fault complexes.

Earthquake produces waves in every possible direction. However it has to be resolved into vertical and horizontal components has greater effects.

Seismic vibration influence both dam body and water in the reservior of the dam. so the generated dynamic loads due to inertia of the dam and hydrodynamic forces, by the water in the reserviors.

3- Silt Pressure:-

The weight of the dam and its foundation is a major resisting force. It act at h/3 from the base and can be computed using equation:

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

where K_a = co-efficient of active earth pressure.

γ_s = Submerged unit weight of silt.

h = height of silt material.

4- Wave Pressure:

Waves are generated at the surface of the reservoirs, by the blowing of winds, which exert a pressure on the upper part of the dam above the water level.

5 - ICE PRESSURE:

The Ice which may be formed on the water surface of the reservoirs in cold countries may some time melt and expand. The dam face is subjected to the thrust and 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/sq.m depending upon temperature variations.

QUESTION # 01:

PART # B

Define the following terms;

i- Liquification of soil

ii - Butress dam

iii- Infinite slope

iv - Pier foundation

v- Dynamic load

Answer:-

i- Liquification of Soil:- (Also called earthquake Liquefaction)

Ground failure or loss of strength that cause otherwise solid soil to behave temporarily as a viscous liquid. This phenomena is occur in water saturated unconsolidated soil effected by seismic waves which cause ground vibration during earthquake.

ii- Butress Dam:

Butress dam is a dam with a solid, water tight upstream side that is supported at intervals on the downstream side by a series of butressesess or support. The dam wall may be straight or curved. Most butress dam are made of reinforced concrete and are heavy, pushing the dam into the ground. Water pushes against the dam, but the butresses are inflexible and prevent the dam from falling over.

iii - **Infinite Slope:** An infinite slope is simply a vertical line when you plot it on a line graph, an infinite slope is any line which run parallel to the Y-axis. You can also describe this as any line that doesnot move along axis but stay fixed at one constant x-axis cordinate making the change along the x-axis.

iv - **PIER FOUNDATION:** A pier foundation is a collection of large diameter cylindrical columns to support the superstructure and transfer large super imposed loads to the firm strata below. It stood several feet above the ground.

v - **DYNAMIC LOAD:** Dynamic loads can be defined as;

"Any load which is non-static, such as wind load or moving Live load".

QUESTION #02:

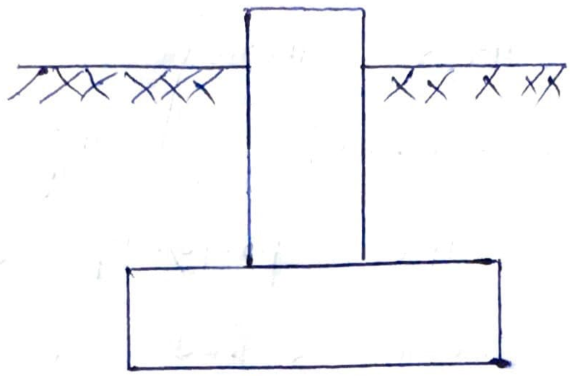
PART A:

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

Ans: **Shallow foundation:** Shallow foundation is a type of building foundation that transfer building load to the earth surface. If the bearing capacity of soil is enough to carry the structural load as with out any settlement of underlying soil layer than shallow foundation is to be provided.

Different types of foundation:

1- **Strip footing:** A strip footing is provided for a load bearing wall. A strap footing is also provided for a row of columns which are so closely spaced that their spread footing overlap or nearly touch each other. In such a cause, It is more economical to provide a strip footing than to provide a no. of spread footing in one line.



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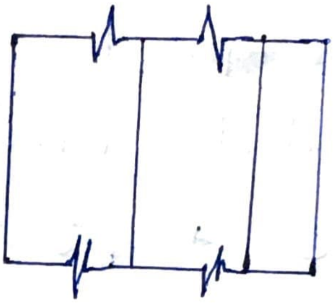

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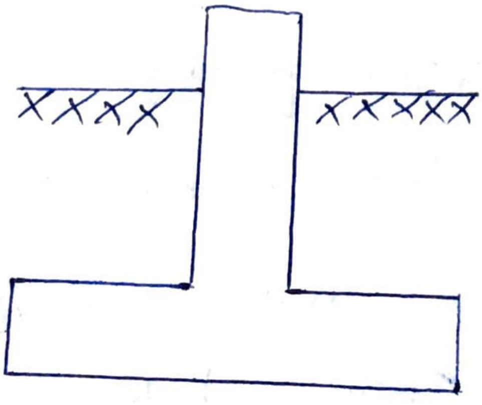
2- Spread footing:- Spread footing is provided to support an individual footing is provided to support an individual column. A Spread footing is circular, square or rectangular slab of uniform thickness.



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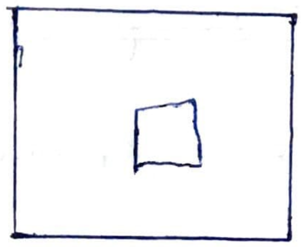

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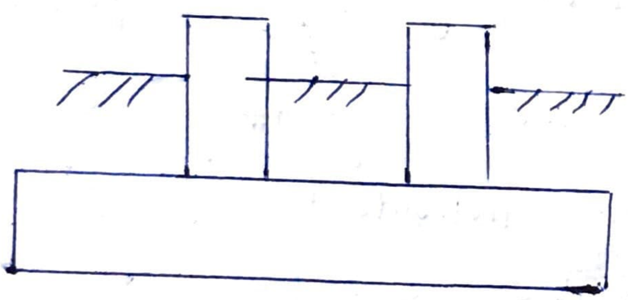
3- Combined footing:

A combined footing support two columns. It is used when the two columns are so close to each other that their individual footing would over lap. A combined footing is also provided when the property line are so close to one column, that a spread footing would be eccentrically loaded when kept entirely with in the property line.



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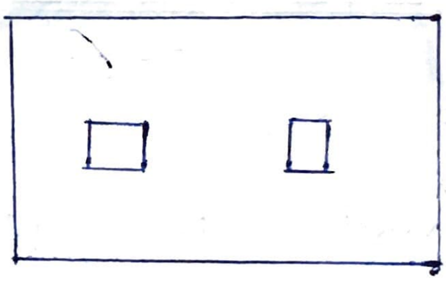

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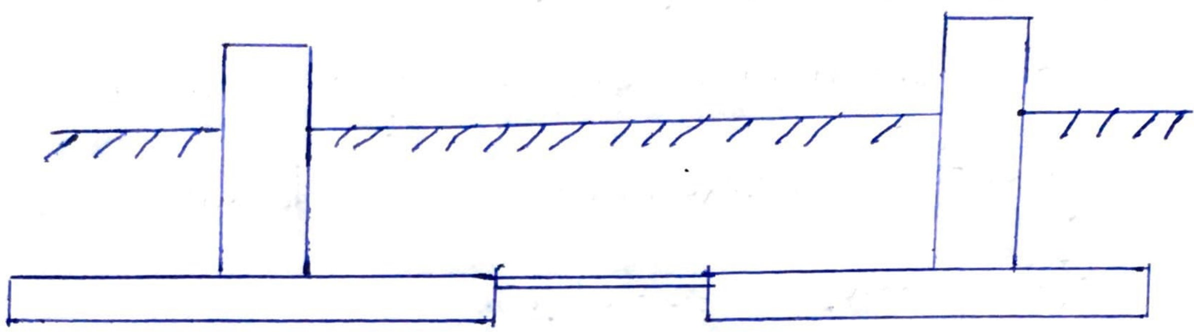
4- Strap footing:

A Strap footing consists of two isolated footing connected with a structural strap. The strap connects the two footing such that they behave as one unit. The strap is designed as a rigid beam.

→ Strap footing is more economical than a combined footing. When the allowable soil pressure is relatively high and the distance between the column is large.



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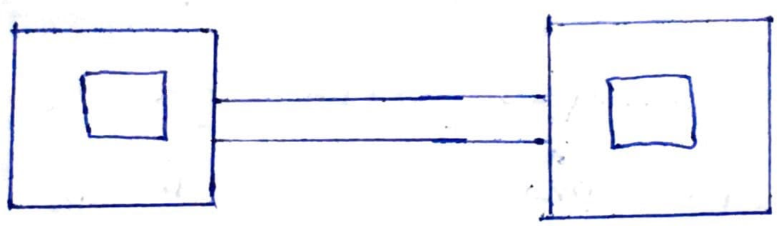

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5- MAT OR RAFT FOUNDATION:

A mat is a large slab supporting a number of columns and walls under the entire structure or a large part of the structure. A mat is required when the allowable soil pressure is low that individual footing would overlap or nearly touch each other.

QUESTION #02:

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

Answer: **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.

NEED OF GROUND IMPROVEMENT TECHNIQUES:

The soil in which the volumetric changes take place due to shrinkage & swelling such soil needs ground improvements techniques.

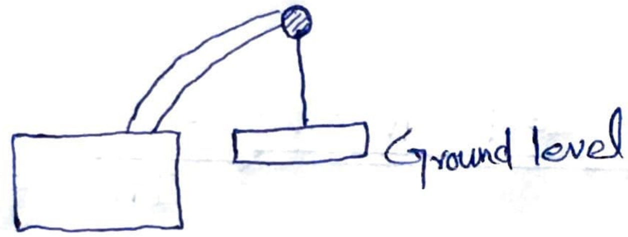
- The soil which is organic in nature.
- The soft soil also required ground improvement techniques.

- The soil which is sandy & gravely.

METHODS OF GROUND Improvement Techniques:

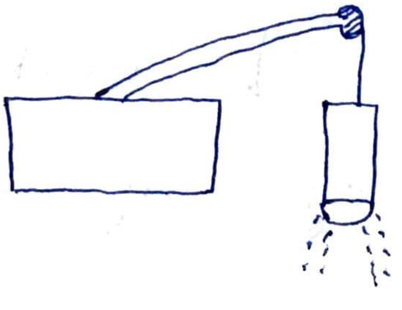
1- DYNAMIC COMPACTION:

The method is used to increase the bearing capacity of soil. This is also increase the consolidation rate. This method is also increased the density of soil.



2- VIBRO COMPACTION:

It is also called vibro disification. In this method the compaction take place at a certain depth at granular soil through vibratory probe. This vibratory probe is run by an electric moter.



3- Rapid Impact Compaction:

Impact energy is applied to surface of ground as a result of which ~~dis~~ densification of soil take place upto a depth of 15 feet. This impact energy is applied through hydraullic ramp. The hydraullic ramp weight values varies from 4-8 tonns.

4- Wet soil Mixing:-

In this method of ground Improvement techniques as paste of cement is prepared and inserted to Improve the characteristics of weak soil by using cementitious binder slurry.

5- Dry soil Mixing:

Dry soil mixing is ground Improvement techniques by which the characteristic's of weak soil are improved by using dry cementitious binder.

QUESTION #03:-

An infinite 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 6 m below and parallel to the slope surface is c = 25 kN/m², Φ = 16° Compute factor of safety when the slope is dry. If ground water flow could occur parallel to the slope on the ground surface, what factor of safety would result.

Ans: **GIVEN DATA:**

$c = 25 \; kN/m^2$

$\phi = 16^\circ$

$G = 2.72$

$e = 0.50$

REQUIRED:

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

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

SOLUTION:

As we know that

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

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

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

Now;

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

$$\boxed{F_c = 1.18}$$

When there is seepage of water.

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

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

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

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

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

$\gamma' = \gamma - \gamma_w$

$= 21.04 - 9.8$

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

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

$\boxed{Fc = 0.816}$

QUESTION # 04

PART A: It is proposed to construct a 10 m highway embankment with the following soil properties.

$c = 18.8$

$\gamma = 17 \ KN/m^3$

$\phi = 20^\circ$

What is the inclination required for the embankement If the design FOS = 1.5 & $F\phi = 1.0$

ANSWER:

Given Data:

Height $= H = 10m$

$c = 18.8\ KN/m^3$

$\gamma = 17\ KN/m^3$

$\phi = 20^\circ$

$FOS = 1.5$

$F_\phi = 1.0$

Required:

To find Inclination.

Solution:

∵ As we know that

$$S_N = \frac{c}{FOS \times \gamma \times H}$$

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

$$S_N = 0.073$$

Using tayler chart for

$\phi = 20^\circ$

$S_N = 0.073$

Then $i = 44$ (From taylor Chart).

QUESTION # 04

PART B : Consider the following data, Find silt Pressure.

Height

GIVEN DATA:

Height of water on upstream side = 15m

Bottom width of the dam = 12 m

Top width = 6 m

Unit weight of water = 1000 kg/m^3

Unit weight of concrete = 1450 kg/m^3

unit weight of silt = 1330 kg/m^3

Angle of friction for the silt = 35°

Free board = 3.5 m

Silt deposit height = 2.5 m

REQUIRED:

To find silt Pressure.

Solution:

As we know that

$$P_s = \frac{\gamma_s \times H_1^2}{2} \times \frac{1-\sin\phi}{1+\sin\phi}$$

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

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