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Section	B
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Q::No::01
Part A :: Name the forces acting on dam. Explain any five of them in detail:

Ans:: Following are the forces acting on dam

- Water Pressure
- Up lift Pressure
- Wave Pressure
- Silt Pressure
- Ice Pressure
- self weight of the dam
- Seismic forces

Self Weight of Dam:

The weight of the dam and it's foundation is a major resting force. It can be computed using the following equation:

$W = \gamma_m$ Volume

Where

γ_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 comlated 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

$$\frac{1 - \sin\phi}{1 + \sin\phi}$$

ϕ: angle of internal friction of soil, cohesion neglected.

γ_s: Submerged unit weight of silt material

h: height of silt deposited.

iii) Wave Pressure:

Waves are generated on the surface of the reservoir by the blowing winds, 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 is given by:

For F < 32 km

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

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

where: h_w = height of water from the top of crest to bottom of trough in ~~material~~ meters.

V = wind velocity in K/hr

F = fetch or straight length of water expanse in km.

- The max pressure intensity due to wave action occurs when it acts at 0.5

Total force due to water wave action is given by ~~Pw~~

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

iv ICE Pressure:

The ice which may be formed on the water surface of the reservoir in cold countries may sometimes melt and expand. The dam face is subjected to the thrust and [illegible] 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 temperature.

v Seismic Forces:

Dynamic loads created due to earthquake must be considered in the design of all major dams located in high risk seismic regions. Earthquake produces waves in every possible direction. However, it has to be resolved into vertical and Horizontal components for the design purpose the horizontal component had greater effect. seismic vibration influence both dam body and water in the reservoir of dam so the generated dynamic loads are due to the inertia of the dam and hydrodynamic forces by the water in the reservoir.

Part b

Define the following terms

1) 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 become zero then soil will change to liquified state.

2) Butress Dam:

A buttress dam is a dam with a solid, water tight upstream side that is supported at intervals on the downstream side by a series of buttresses or supports. The dam wall may be straight or curved. Most buttress dams are made of reinforced concrete and are heavy, pushing the dam into ground.

3) infinite slope:

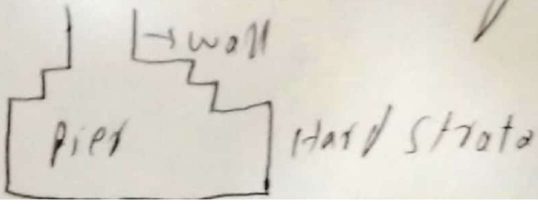
The slope which have infinite area and finite depth such a slope is called infinite slope.

Example: Natural slope i.e Hills, Mountains, deserts, etc.

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

4) 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.



Dynamic load:

Dynamic load occurs when loading conditions are changing with time. It may be in the form of earthquake operation of heavy machinery, wave motion, wind etc. Due to dynamic load the settlement chances may increase.

Q: No: 02

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

Ans: According to Terzaghi:

The foundation in which depth of the foundation is less or equal to width of the foundation is called shallow foundation $D_f \leq B$

According to Skemption:

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

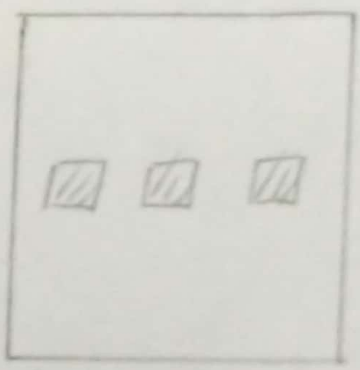
Following are the types of shallow foundations.

1 Wall footing:

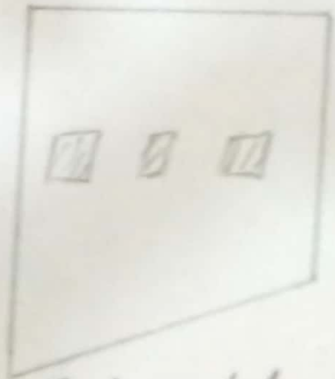
The footing which runs across the length of the wall and transfer the load of the wall to the soil safety. It is called wall or strip footing

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 safely then 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



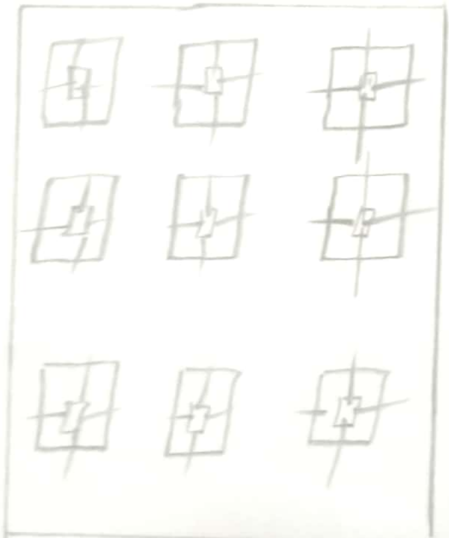
Rectangular footing



Trapezoidal footing

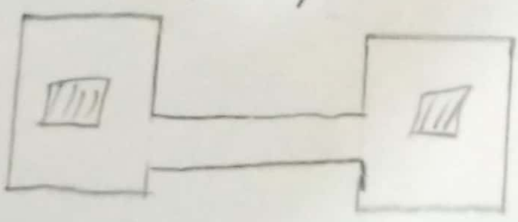
3) Raft/Mat footing:

The footing which covers the while area of the structure is called raft footing This type of footing is proposed in area which have soft 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 or strap is called strapped footing.



Top view

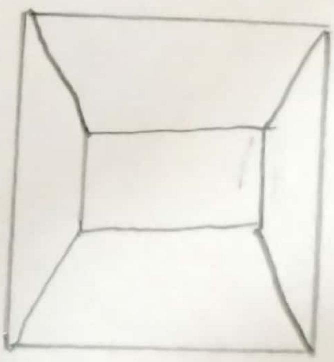
5) Column/isolated footing:

The footing which is constructed for a single column and transmit it's load to the soil safely. It may be circular, square, rectangular in shape.

square   rectangular   column.

6) Slopped Footing:

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



Q: No: 02

Part: 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 takes place due to shrinkage and 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 gravely
- The foundation in sanatery dump places also required ground improvement techniques.

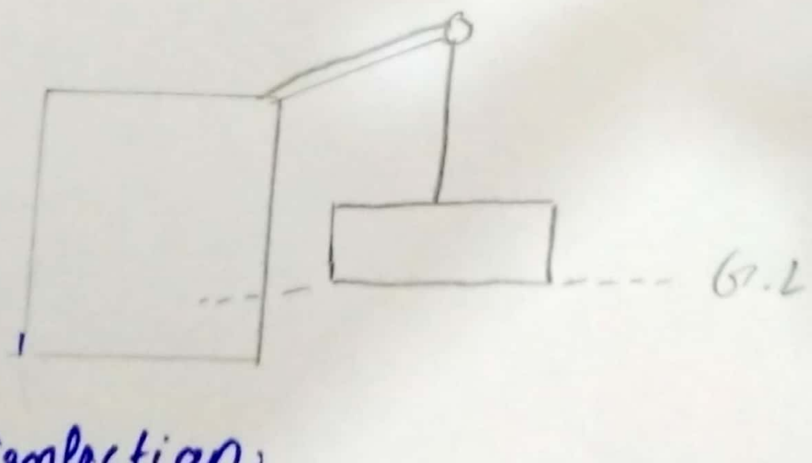
Following are the methods of ground improvement techniques.

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 compacted fill. In this method the same soil is used to refill. the higher compaction and better engineering properties. This method is applicable above the ground water table.

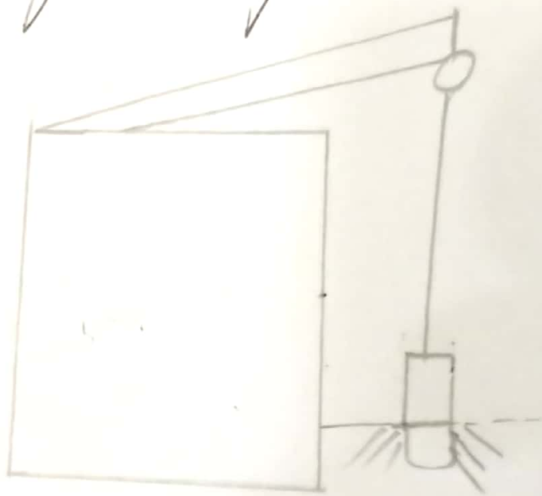
2) Dynamic computation:

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 takes place



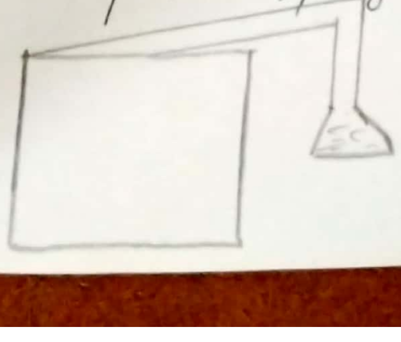
3) vibro compaction:

It is also called vibro densification In this method the compaction take place at a certain depth in granular 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 takes place upto a depth of 15'. This impact energy is actually applied through hydraulic ramp. The hydraulic ramp weight varies from 4-8 tons



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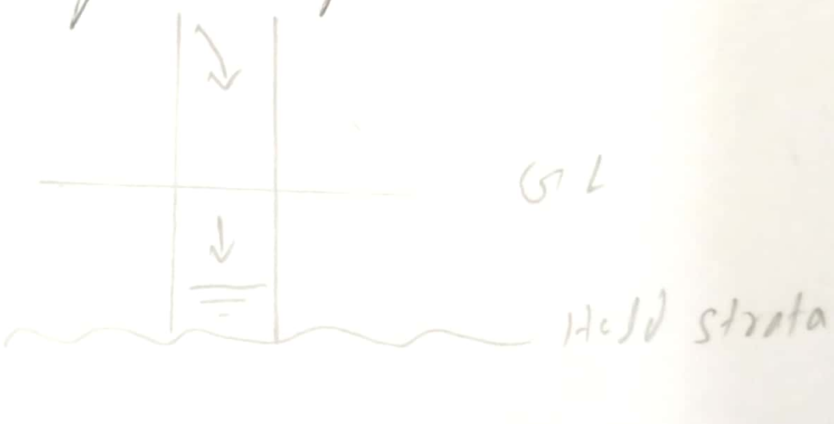
5) ~~Concr~~ Concrete Column:

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



Q: 3

An infinetly long slope having an inclination of 28° in an area.?

Sol: Given data,

$C = 25\ kN/m^2$

$\phi = 16°$

$G = 2.72$

$e = 0.50$

Required:

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

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

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

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

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

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

$$\boxed{F_c = 1.18}$$

when there seepage of water then

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

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

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

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

$$\gamma = 21.04 \ \mathrm{KN/m^3}$$

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

$$= 21.04 - 9.8$$

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

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

$$\boxed{F_c = 0.836}$$

Q:- 04 It is Proposed to construct a 10m highway embankment with...?

Sol: Given data:

$C = 18.8\ kN/m^2$

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

$\phi = 20^\circ$

$F.OS = 1.5$

$F_0 = 1.0$

$H = 10m$

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

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

$SN = 0.073$

* By using taylor chart for
$\phi = 20^\circ$
$SN = 0.073$

Thus inclination, $i = 44^\circ$

Q:-No:- 04 :: Part: b considering the following data find silt Pressure.

Ans: Given data.

- Height of water on u/stream side = 15m
- Bottom width of the 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 the silt = ϕ_1 = 35°

silt deposite height = 2.5m

Required:

silt Pressure = ?

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

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

$$P_s = 4156.25 \times 0.27$$

$$\boxed{P_s = 1126.31 \ kg/m}$$