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Subject Geotechnical Engineering.

QNo1 Part 'A'

Ans: Following are the force acting on dam.

- Water pressure
- uplift pressure
- Wave pressure
- Silt pressure
- Ice pressure
- Self weight of the dam.
- Seismic force.

(i) **Self weight of DAM:-** The weight of the dam and its foundation is a major resting forces. it can be computing using the following equation.

$$W = \gamma_m \text{ Volume}$$

where γ_m = unit weight of dam.

(ii) **Silt pressure:-** It is the pressure that is caused by the deposition of the silt in the bed of the dam causing the ~~bed~~ at h/3 from the base and can be computing using equation.

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

Where K_a : 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 by on the surface of the reservior, by the blowing winds, which exerts a pressure on the upper parts of the dam above the water level. This is calculating by the formula.

$$P_W = 2.4 \gamma_w h_w$$

Wave pressure depand upon wave hight which is given by

For $F < 32 Km$

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

For $F > 32 Km$

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

Where h_w = Height of water from the top of crest to bottom of trough in meter.

V = Wind velocity in K/hr

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

The max pressure intensity due to wave action accur when its act an 0.5

Total force due to water waves action is given by

$$P_W = 0.5(2.4 \gamma_w h_w)\ 3/8\ h_w.$$

(iv) <u>ice pressure</u>:- The ice which may be formed on the water surface of the reservior in cold country. may some time melt and expand. The dam face may be subjected to the thrust and exerted by the expanding ice. This face act linearly along the length of the dam and at the reservior level. The magnitude of these forces varies from 250 to 1500KN/m² depanding upon the Temperature.

(V) <u>Seismic forces</u>:- Dynamic loads created due to earth quakes must be considered the design of all major dams located in high risk seismic region. Earthquakes produce waves in every possible direction However it has to be resolved into vertical and horizental component had greater effect seismic vibration influence.

both dam body and water in the reservior of dam So the generated dynamic load are due to the ~~inter~~ inertia of the dam and hydrodynamic forces by the water in the reservior.

Part "B"

Define the following terms.

1) **Liquification of Soil:** Effective stresses are the stresses which keep the soil partical in control with each other if the effective stress decrease the soil loose its strength. When the effective stresses become zero the soil will change with liquified state.

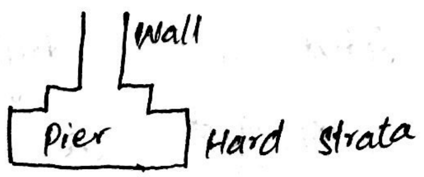
(2) **Buttress Dam:-** A butter dam is a dam with a solid water tight upstream side that is supported at interval on the downstream side by a series of buttresses

as support. The dam wall be straight or curved. Most buttresses or support dam are made of reinforced concrete and are heavey pushing the dam into the ground.

(3) infinite slope:- The slope which have infinite area finite depth Such a slope is called is called infinite slope.

Example: Natural slope i-e Hill, mountain desserts etc.

(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 cost in situ process.



Dynamic load:- Dynamic load occur when loading condition are changing with time. It may be in the form of earth quake operation of heavy machinary wave motion wind etc. Due to dynamic load. The settlement chances may increase.

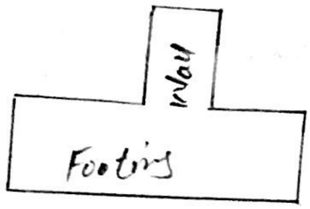
Q No 2

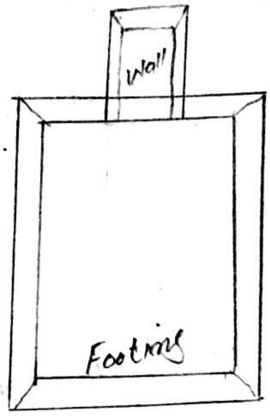
Ans:- According to terzaghi:-
The foundation in which depth of the foundation less or equal to width of the foundation is called Shallow foundation $D_f \leq B$

According to skemption:- The foundation which D_f/B ratio, is less then or equal to 2.5 Then the foundation is called Shallow ~~fotto~~ foundation.

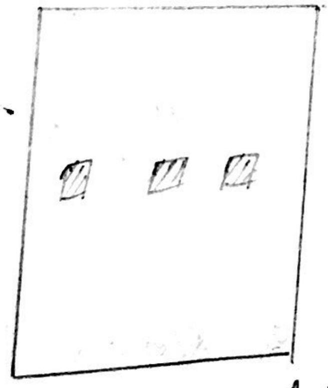
Following are the types of Shallow foundation.

1:- **Wall footing**:- The foting which run across the length of the wall and transfer the load of the wall and transfer the load of the wall to the soil safety.

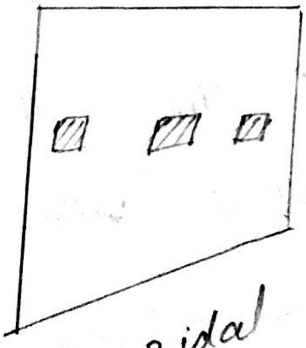




② **Combined footing**:- The footing which is constructed for two or more column and transfer the load of the two or more column to the soil safety than it is called combined footing

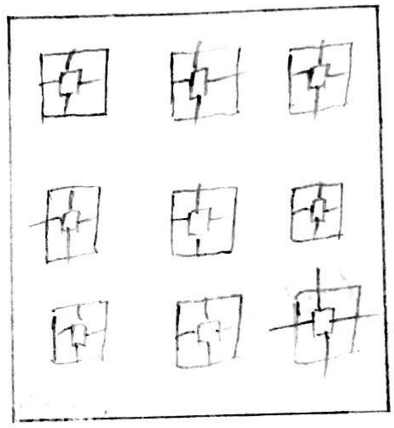


Rectangular footing

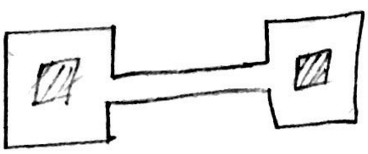


Tripozidal footing

3) **Raft/Mat footing:-** The footing which curves the while are of the structure is called raft footing. This type of footing is proposed in area which have soft weak in bearing capicity. This is also provided when the load of super structure is heavy.



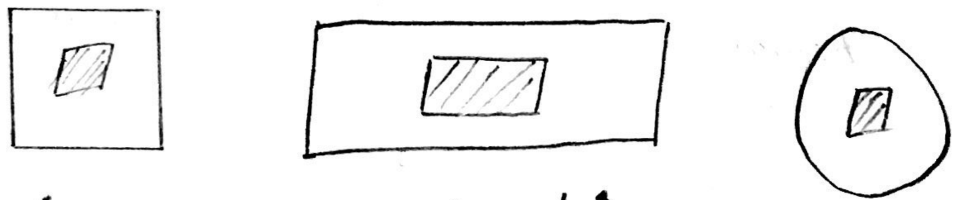
4) **Strapped footing:-** The footing in which the outer column is connected with the inner column by mean of the beam or strap is called strapped footing.



Top view.

QNo 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.

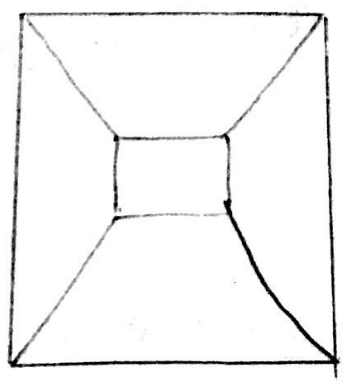
Ans



Square rectangular Column

⑥ **Slopped Footing:-**

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



QNo 2::
Part "B"

Ans:- The soil in which volumetric changes take place due to shrinkage and swelling such soil need ground improvement techniques

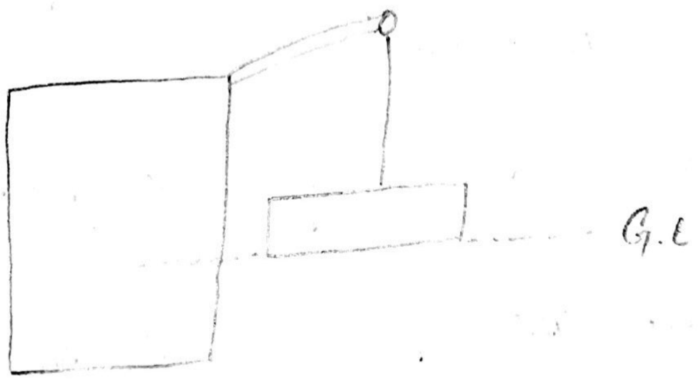
- The soil which is organic in nature
- The soft soil also required ground improvement techniques.
- The soil which is sandy and gravely.

Following are the method of ground improvement technique.

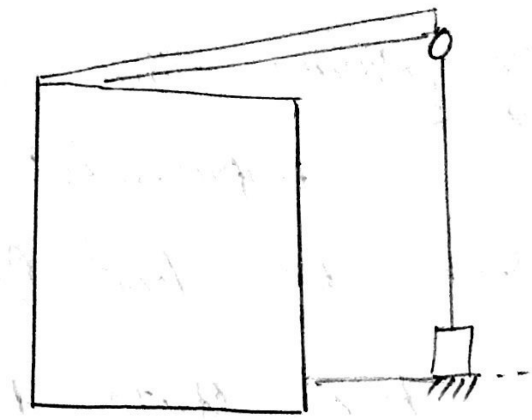
i) Removal and Replacement of Soil:-
This is an oldest simplest method this method is performed on loose soil. In this method the unsuitable soil is replaced with compacted fill.

In this method The same soil is used to refill. The higher compaction and better engineering properties

(2) <u>Dynamic computation</u>:- This method is used to increase the bearing capicity of soil This also increase The consolidation rate. This method also increase The density of soil.

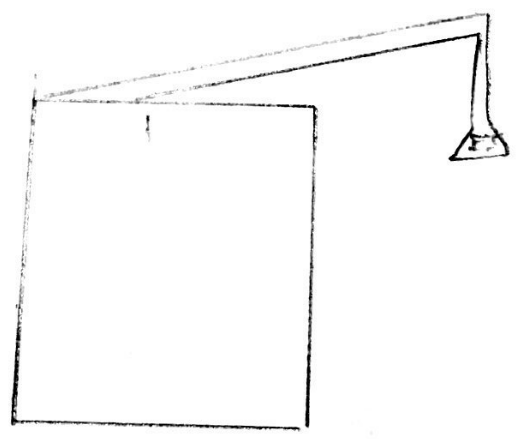


3) <u>Vitro compaction</u>:- It is also called vibro densification. In this method the Compaction take place at a certain depth in granular soil through vibratory Probe. This vibratory ~~soil~~ probe is run by an electric motor.

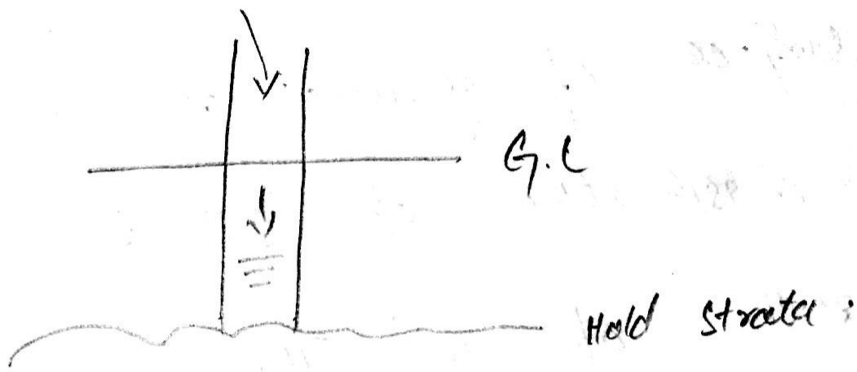


4) Rapid impact compaction:-

Impact energy is applied to surface of ground as a result of which densification of soil take place upto a depth of 15'. This impact energy is actually applied through hydraulic impact.



5) <u>Concrete</u> & <u>column</u>:- vibro concrete is a ground improvement technique which transfer the load from weak strata to hard strata by using strength concrete.



Pb#3 An infinity long slope having an inclination of 26" in an area is underline by from Cohessive Soil ($G = 2.72$ and $e = 0.50$) There is a thin weak layer of soil 6m below and Parallel to The ~~factor~~ Slope Surface ($c = 25 kN/m^2$, $\phi = 16°$) compute The The factor of safety when The slop is dry. If ground water flow could occur parallel to The slope on The ground. Surface. what factor of Safety would result.

Given:-

$C = 25 KN/m^2$

$\phi = 16°$

$G = 2.72$

$e = 0.50$

Required:-

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

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

Sol:-

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

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

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

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

$$\boxed{Fc = 1.18}$$

When There is seepage of water.

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

$$\gamma' = \gamma - \gamma w$$

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

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

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

$$\gamma' = \gamma - \gamma w$$

$$= 21.04 - 9.8$$

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

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

$$\boxed{F_c = 0.886}$$

Q4:- (a)

Given:

Height = 10m

$C = 18.8 \ kN/m^2$

$\gamma = 17 kN/m^2$

$\phi = 20^\circ$

F.O.S = 1.5

$F_\phi = 1.0$

Required

Inclination $i = ?$

Sol:

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

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

$$S_N = 0.073$$

using taylor chart for

$\phi = 20°$

$SN = 0.073$

$\boxed{i = 44°}$

Q4 part - B

Given data:-

- Height of water on upstream side =
- Bottom width of the dam =
  - Top width =
  - unit weight of water = 1000 kg/m³
  - unit weight of concrete = 1450 kg/m³
  - unit weight of selt = 1330 kg/m³
  - Angle of friction for silt = $\theta_s = 35°$
  - Free Board = 3.5 m
  - Silt deposited hight = 2.5m.

Required:-

Silt pressure = ?

Sol:-

As we know that

(19)

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

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

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