NAME : Qaiser Siddique.

ID : 7863

SECTION : "B"

SEMESTER : 6th

SUBJECT : "GEOTECHNICAL ENGINEERING"

SUBMMITED TO : "ENGR. LIAQAT BACHA."

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Q No. 2.

⇒ Name the force acting on dam. Explain any five of them.

Ans/ Following forces acting on dams:

→ Water pressure
→ Uplift pressure
→ wave pressure
→ Silt pressure
→ Ice pressure
→ Seismic forces.
→ Self weight of the dam.

① **Self weight of dam:-**

the weight of the dam and it's 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 Material

② **Silt pressure:-**

It is the pressure that is caused by the deposition of Silt in the bed of the dam causing at $h/3$ from the base

and can be computed using equations.

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

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 = Submerged Unit weight of Silt material.

h = Height of Silt deposited.

(3) "Wave pressure"

Wave are generated on the surface of the reservoir by the blowing winds. which exert the pressure on the upper part of the dam above the water level. this pressure is calculated by the following formula.

$$P_w = 2.4 \gamma_w h_w$$

Wave pressure depends upon wave height which is given by:

For $F < 32$ km:

$$h_w = 0.32\sqrt{PV} + 0.763 - 0.27 \times F^{1/4}$$

For $F > 32$ km:

$$h = 0.32\sqrt{VP}$$

h_w = height of water of crust to bottom of trough in meters.

V = Wind velocity in km/hours.

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

⇒ The maximum pressure intensity due to water action occurs when it acts at 0.5 total force due to action is given by:

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

④ ICE Pressure :-

The ice which is formed on the water surface of the reservior in the cold countries may some time melt or expand. The dam force is subjected on the thrust and exert 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/sq independing upon the temperature.

⑤ "Sesimic forces"

Dynamic load created due to earth-quake must be considered in the design.

of an major dam located in high risk Sesimic region earthquake pressure wave in possible direction.

However it has to be resolved into vertical and horizontal components for the design purpose. The horizontal component had greater effect. Seismic vibrations influence both dam body and water in the reservior of dam. So the generated dynamic loads are due to ~~inter~~ inertia of the dam and hydro-dynamic forces by the water in the reservioue.

PART-B:-

⇒ **Define the following terms.**

- **Liquification of Soil**
- **Buttress Dam**
- **Infinite Slope**
- **Pier foundation**
- **Dynamic Load.**

Ans/. Liquification of Soil:-

Effective Stresses are the stresses which keep the ~~water~~ Soil

Particles in contact with each other.
If the effective stresses decrease soil lose it's strength. When the effective stresses become zero then soil will be changed to liquified state.

(2) Buttress Dams:

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

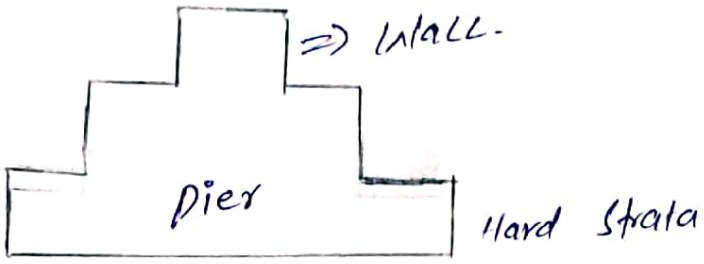
(3) INFINITE SLOPE:

The slope which have infinite area and finite depth such a slope is called infinite slope.
E.g:- 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 constructed by cost in-site process.



(5) DYNAMIC LOADS:

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

Q No 10.2

PART.A

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

⇒ Def According to TERZAGHI :- The foundation in which depth of the foundation is less or equal to width of the foundation is called shallow foundation :-

$$D_f \leq B$$

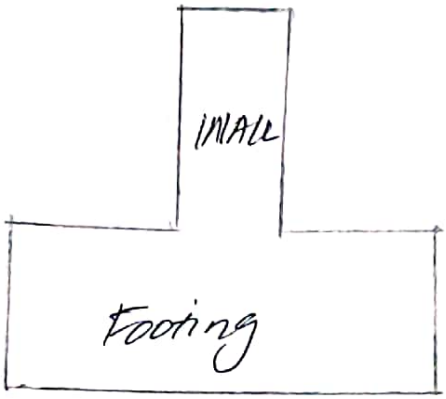
⇒ According to Skempton :- The foundation in which D_f/B ratio is less than or equal to 2.5 than the foundation is called shallow foundation.

⇒ Types OF shallow foundation :-

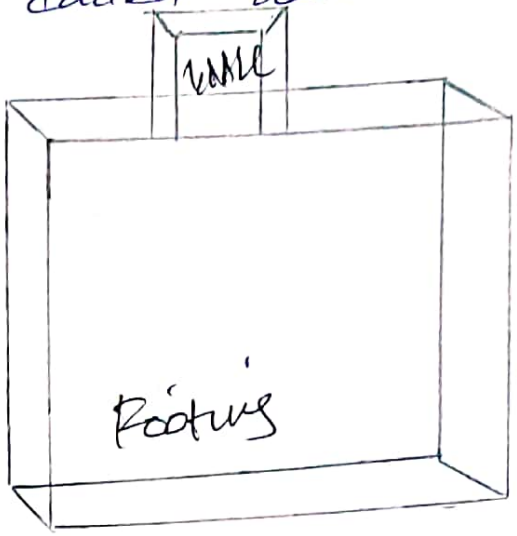
1. WALL Footing
2. Combine Footing
3. Raft footing
4. Strapped footing
5. Column footing
6. Stopped footing

① INIALL Footings

The footing which run accross the length of the wall and transfer the load of the wall to the soil safety. It is called wall footing.



"CROSS-SECTION"



② Combined footing :

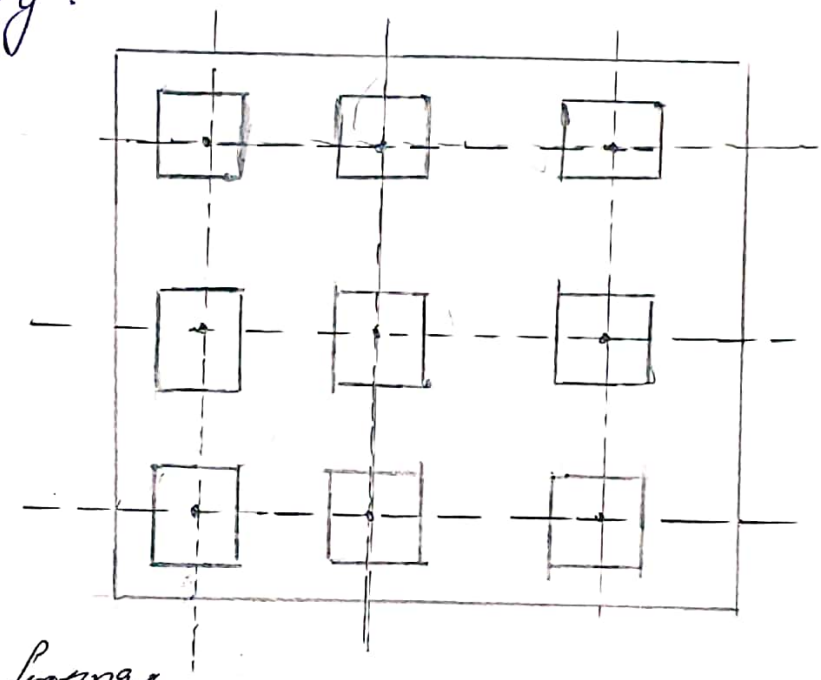
The fotting which is constructed for two or more columns and transfer the load of two or more columns to the soil safely then it is called combined footing. If the load of the column is uniformed then the combined footing will be rectangular in shape. If the load of the column is not uniform then shape of combined footing will be trapezoidal.

Rectangular

Trapozidal

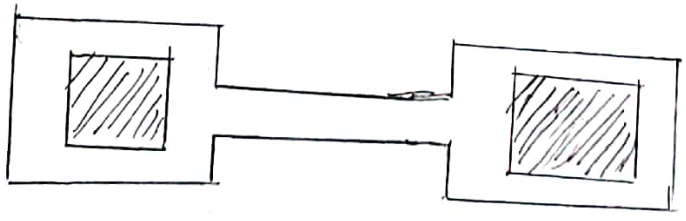
(3) Raft Footings

Footing which covers the whole are of the structure is called Raft footing. This type of footing is purposed in area which have soil weak in bearing capacity this is also provided when the load of super structure is heavy.



(4) Strapped footings

The footing in which outer layer is connected with the inner column by mean of the beam or strap is called Strapped footing.

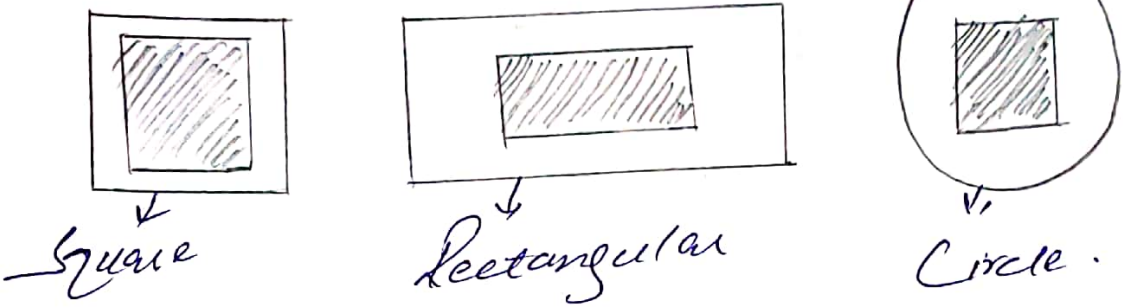


→ Top view.

(5) Column isolated footings :-

(10)

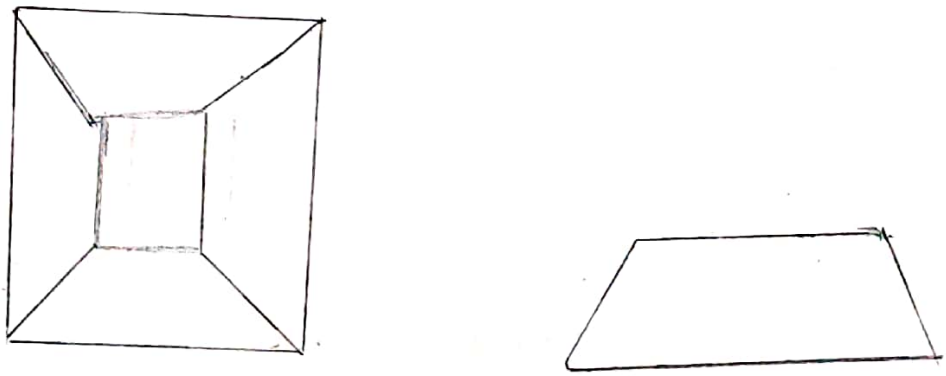
The footing which is constructed for a single column and transmits it's load to the soil safely, it may be circular, square, rectangular in shape.



Square Rectangular Circle.

(6) Stopped footing :-

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



Q NO. 2

PART = B

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

→ The soil which is organic in nature.
→ The soft soil also required ground impt. technique
→ The soil which is sandy and grawely.
→ The foundation in saturaey damp plates also required ground improvement technique
→ Following are the methods of ground improvement techniques.

① Removal and Replacement of Soils
This is an oldest and simple method. This method is performed on loose soil.
In the method the unsuitable soil is replaced with compacted fill. In this method the same soil is use to refill the higher compaction and better engineering properties. This method is applicable above the ground water table.

(2) Dynamic compaction :-

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

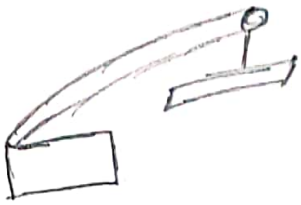
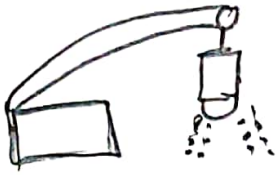


Fig 2

(3) VIBRO compaction :-

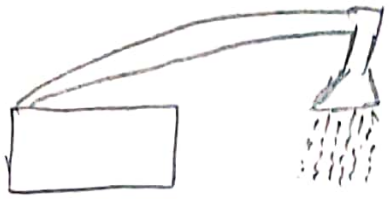
In this method the compaction take place at a certain depth in granular Soil through vibrating probe. This vibrating probe is run by an electric motor. The penetration of probe is enhance by ejecting of probe water at the tip of probe.



(4) Rapid impact compaction :-

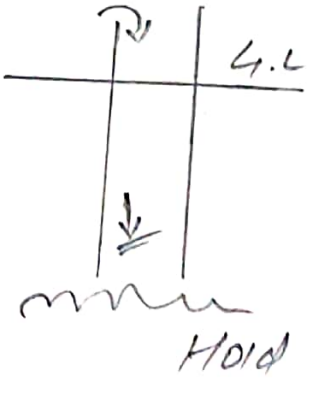
impact energy is applied to surface of ground as a result of which densification of Soil take place upto a depth of 15 feet.

This impact energy is applied through hydraulic ramp. The hydraulic hamp weight value from 4-8 tons.



(5) Vibro Concrete column:-

Vibro concrete column is ground improvment technique which transfer the load from weak strata to hold strata by using strength concrete.



Q NO. 3

SOLUTION:-

⇒ GIVE DATA:-

$$c = 25 \ kN/m^2$$
$$\phi = 16^\circ$$
$$G_s = 2.72$$
$$e = 0.50$$

⇒ Required:-

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

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

⇒ Solⁿ

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

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

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

$$F_c = \frac{25}{17.8 \times 6 \times \sin(26) \cos(20)} + \frac{\tan(16)}{\tan(26)}$$

$F_c = 1.18$

When there is seepage of water.

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

$\gamma' = \gamma - \gamma_w$

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

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

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

$\gamma' = \gamma - \gamma_w$

$= 21.04 - 9.8$

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

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

$F_c = 0.816.$

Q No.4 PART-A

⇒ Given Data:

$c = 18.8 \ KN/m^2$

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

$\phi = 20°$

$FDS = 1.5$

$F_0 = 1.0$

$H = 10m.$

Required:

Inclination = ?

Sol:

$$S_N = \frac{c}{F.D.S \times \gamma \times H} = \frac{18.8}{1.5 \times 17 \times 10}$$

$$S_N = 0.073$$

Using tylor short for;

$\theta = 20°$

$S_N = 0.073$

⇒ Inclination, $i = 44°$

Q4. PART-B

⇒ GIVEN DATA:

→ Height of water upstream 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 Silt = $\phi = 35^\circ$
⇒ Free board = 3.5 m.
→ Silt Deposite height = 2.5 m.

⇒ REQUIRED:

Silt pressure = ?

⇒ Solution:

" As we know that "

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

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

$$P_s = 1126.31 \text{ kg/m}.$$