Name	Hamza Ejaz
SUBMITTED BY	7835
SUBMITTED TO	Sir Liaqat Ali
SUBJECT	Geotechnical Engg
SEMESTER	6th
DATE	26-06-2020

Q No 2:-

Following are the forces acting on dam:

- water pressure
- uplift pressure
- wave pressure
- silt pressure
- Ice pressure
- self weight of the dam
- seismic forces.

Self weight of the dam:-

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

$W = \gamma_m$ Volume

where

γ_m = unit wt of dam material.

Silt Pressure:-

It is the pressure that is caused by the deposition of the silt in the bed of dam causing 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 :- 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 wt of silt material

h = height of silt deposited.

~~water~~ wave Pressure:-

water 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 which is given by Formula:-

7835

For $F < 32$ Km :-

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

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

Where h_w :- height of water from the top of crest to bottom of trough. in 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 ~~is given by~~ occurs when it acts at 0.5 total force due to water wave action is given by :-

$$P_w = 0.5(2.4\, r_w h_w)\, 3/8\, h_w.$$

ICE Pressure:-

The ice which may be formed on the water surface of the reservior in cold countries may sometime 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 reservior level. The magnitude of these forces varies from

7835

4

250 to 2500 KN/m^2 depending upon the temperature.

(v) **Seismic Forces:-**

Dynamic loads created due to earthquakes 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 purposes. The horizontal component had greater effect. Seismic vibration influence both dam body and water in the reservior of dam. So the generated dynamic loads are due to the inertia of the dam and hydrodynamic forces by the water in the reservior.

B Define The following terms:-

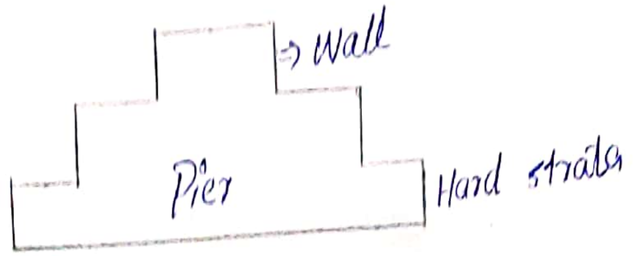
(i) Liquification of soil:-

Effective stresses are the stresses which keep the soil particles in contact with eachother. If the effective stresses decrease soil lose it's strength. When the effective stresses become zero then soil will be changed to liquified state.

(ii) 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 buttress or 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 into ground.

(iii) 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, desserts etc.
In Infinite slope the failure will be in the form of sliding.

(iv) 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.



(v) Dynamic Load:- Dynamic loads 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 settelment chances may increase.

Q.No 2:-

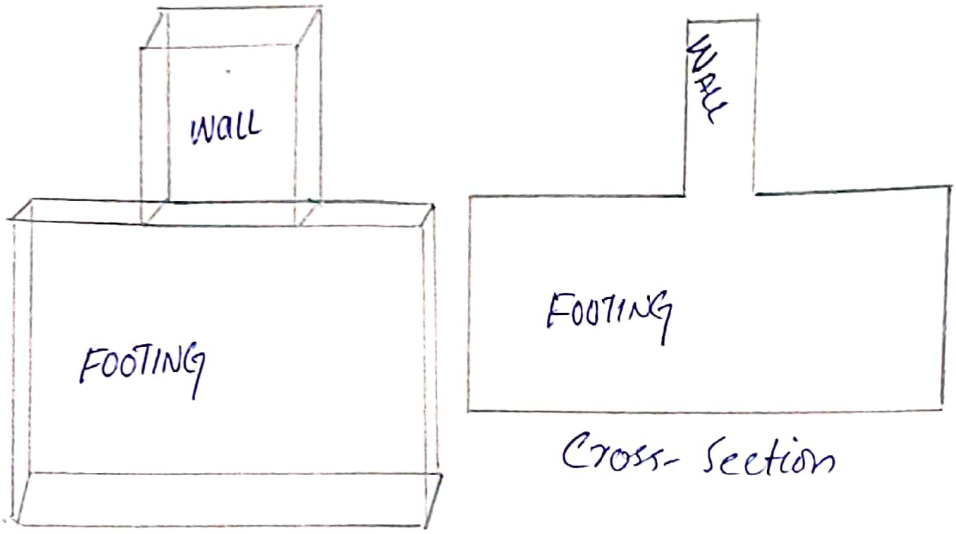
(A) According to TERZAGHI:- The foundation in which depth of the foundation is less or equal to width of the foundation is called shallow foundation:- $D_f \leq B$

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

P.T.O.

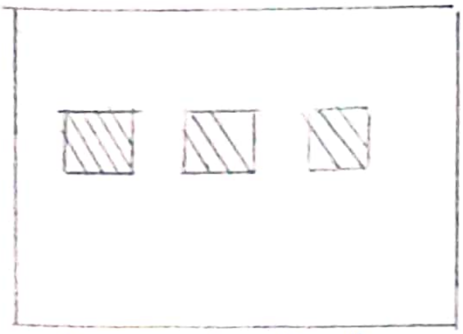
Following are the types of shallow foundation:-

1. Wall footing:- The footing which runs accross the length of the wall and transfers the load fo the wall to the soil safety It is called wall or strip footing.

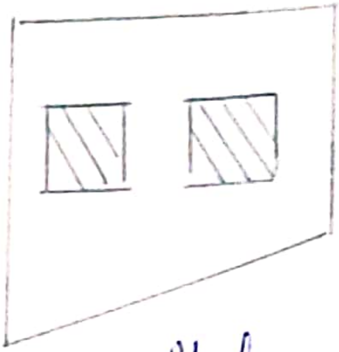


Cross- Section

2. Combined footing:- The footing which is ~~[illegible]~~ constructed for two or more column and transfer the load of two or more column to soil safety 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 it is trapezoidal.

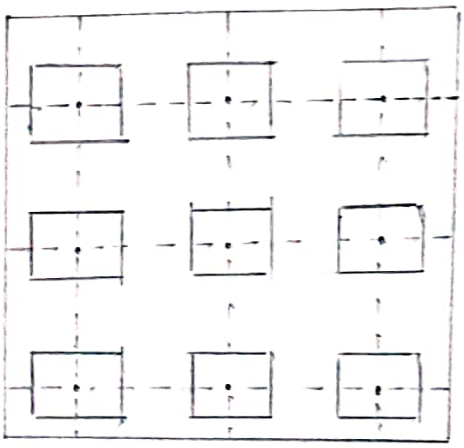


Rectangular Footing

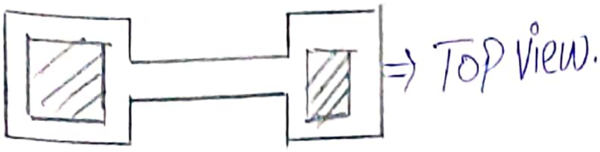


Trapezoidal Footing.

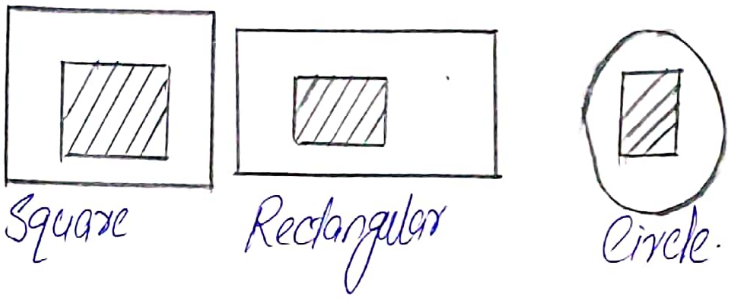
3. Raft/Mat Footing:- The footing which covers the whole area of the structure is called the raft footing. This type of footing is proposed in area which have soft/weak in bearing capacity. This is also provided when the load of super structure is heavy.



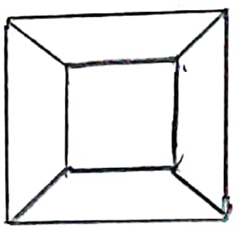
4. "Strapped Footing":- The footing in which the outer column is connected with the inner column by mean of the beam or strap is called strapped footing.



5. Column/Isolated Footing:- The footing which is Constructed for the single footing and transmit to load to the Soil safety. It may be circulated, square and rectangular in shape.



6. Slopped footing:- The footing which have slope in all direction or in all sides is called as slope footing.



B 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 require ground improvement techniques.
- The soil which is sandy and gravely.
- The foundation in sanatory dump places also require ground improvement techniques.

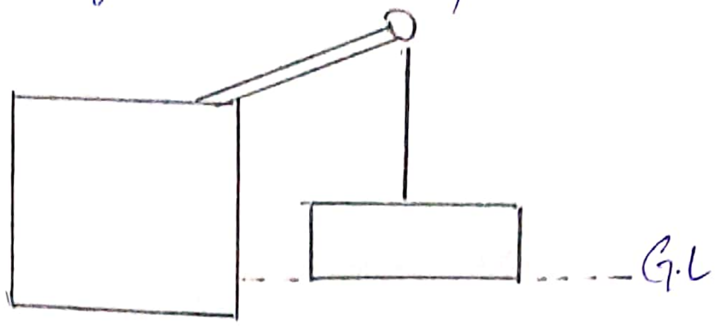
Following are the methods of ground improvement techniques

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

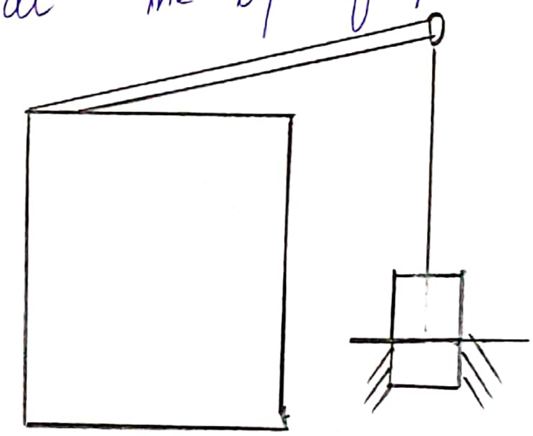
7835 11

densification of soil takes place.



3. "Vibro Compaction":-

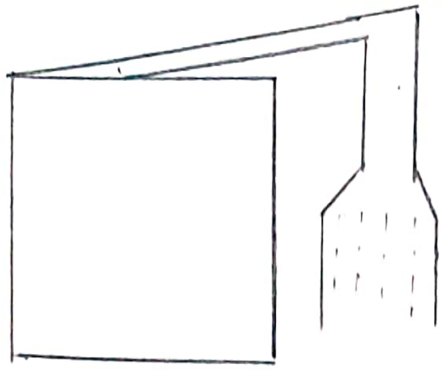
It is also called vibro densification. In this method the compaction take place at a certain depth in granular soil through vibratory probe. This vibratory probe is run by an electric motor. The penetration of probe is enhance by ejecting water at the tip of probe.



4. "Rapid Impact Compaction":-

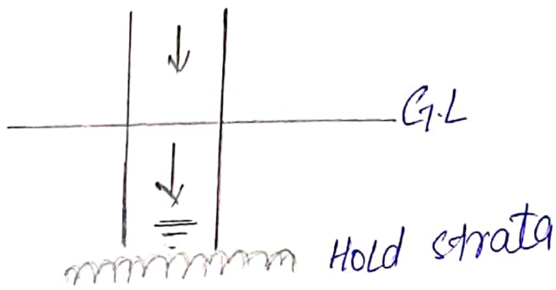
Impact energy is applied to surface of ground as a result of which densification of soil takes place upto a depth of 15'. This method of impact energy is actually applied through hydraulic ramp. It's wt is round about 4-8 tons.

7835 12



5. Concrete Column:-

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



Q3:-

Sol:- Given DATA:-

$C = 25\ Nm/m^2$

$\phi = 16^\circ$

$G = 2.72$

$e = 0.50$

Required:-

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

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

7835

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

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

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

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

$$\boxed{FC = 1.18}$$

When the seepage of water then

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

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

$$\gamma = \frac{4+e}{1+e} \times \gamma w$$

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

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

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

$$= 21.04 - 9.8$$

$$\gamma' = 11.24 KN/m^3$$

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

$$\boxed{FC = 0.836}$$

7835

Q4:- Given:-

$C = 18.8\ kN/m^2$

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

$\phi = 20^\circ$

F.O.S = 1.5

FO = 1.0

H = 10m

Required:-

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

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

$S_n = 0.073$

By Taylor chart for:-

$\phi = 20^\circ$

$S_n = 0.073$

Thus inclination, $i = 44^\circ$

(8):- Sol:-

Given Data:-

height of water on upstream side = 15m

Bottom width of dam = 12.

Top width = 6m

unit wt of water = 1000 kg/m^3

unit wt of concrete = 1450 kg/m^3

unit wt of silt = 1830 kg/m^3

Angle of friction for the silt = $\phi = 85^\circ$

silt deposited height = 2.5 m.

Required :-

silt pressure = ?

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

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

$$P_s = 4156.25 \times 0.27$$

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