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Section	"A"
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Question#03:

A)

Given data:

$G = 2.72$

$e = 0.50$

$C = 25\ KN/m^2$

$\phi = 16^\circ$

$\because i = 26^\circ$

$\because H = 6m$

Required:

a) F_c (F.o.s), when Soil is dry?

b) F_c (F.o.s), when there is Seepage in Soil?

Solution:

As we know that

a) $$F_c = \frac{C}{\gamma_d \times H \times \sin i \times \cos i} + \frac{\tan \phi}{\tan i} \quad -(*)$$

when the Soil is dry,

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

$\because \gamma_w = 9.8$

$$= \frac{2.72 \times 9.8}{1 + 0.50}$$

$$\boxed{\gamma_d = 17.77\ KN/m^3}$$

(*) ⇒ $F_c = \dfrac{C}{\gamma_d \times H \times \sin i \times \cos i} + \dfrac{\tan\phi}{\tan i}$

$= \dfrac{25}{17.77 \times 6 \times \sin(26) \times \cos(26)} + \dfrac{\tan(16^\circ)}{\tan(26^\circ)}$

⇒ $F_c = 1.183$

when the Soil is dry.

b) when there is seepage of water, then

$F_c = \dfrac{C}{\gamma \times H \times \sin i \times \cos i} + \dfrac{\gamma'}{\gamma} \times \dfrac{\tan\phi}{\tan i}$ — (*)

where

$\gamma' = \gamma - \gamma_w$ — (A)

& $\gamma = \dfrac{G+e}{1+e} \times \gamma_w = \dfrac{2.72 + 0.5}{1+0.5} \times 9.8$

$\gamma = 21.037 \text{ kN/m}^3$

(A) ⇒ $\gamma' = \gamma - \gamma_w = 21.037 - 9.8$

⇒ $\gamma' = 11.237 \text{ kN/m}^3$

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

$$= \frac{25}{21.037 \times 6 \times \sin 26^\circ \times \cos 26} + \frac{11.237}{21.037} \times \frac{\tan 16^\circ}{\tan 26^\circ}$$

$$\Rightarrow \boxed{F_c = 0.817}$$

where there is Seepage in Soil.

Question#01

A)

Forces Acting on Dam :-

There are Several forcing acting on a Dam They are the following.

1) water pressure
2) Self weight of the dam
3) Ice pressure
4) Silt pressure
5) wave pressure
6) uplift Pressure or seepage loads
7) Earthquake force or seismic pressure.

1) water pressure:

This is the major external force or pressore acting on a Dam.

Water pressure exerts pressure in both Horizontal and vertical components on both the upstream and down stream side of a Dam.

There are two cases,

A) Upstream face of the dam is vertical and there is no water on the downstream Side of the dam.

B) Upstream face with batter and there is no water on downstream side.

2) Wave Pressure:

It is the pressure which is exerted on the dam because of the wave generation on the water surface.

waves are generated on surface of the reservoir by the blowing winds due to which pressure exerts on the upper Side or part of the dam above the water level.

$$P_W = 2.4\gamma_w \cdot h_w$$

3) Ice pressure:

In cold countries, the ice may be formed on the water surface and it may sometimes melt and expand. So, the pressure or force will exert on the dam due to the melting and expansion of ice which is known as ice pressure.

Ice force varies from 250 to 1500 KN/m^2 depending upon the temperature variations.

4) Self weight of the Dam:

The self weight of the dam and its foundation is also an major resisting force which exerts in the downward direction.

It can be calculated by using the following equation.

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

where γ_m = unit weight of dam material

5) Seismic Forces:-

Seismic forces are that forces which exerts on a dam because of earthquake. Earth quake produces waves in every possible direction but for the design porposes, we only resolve into vertical and horizontal componenents.

Question #01

B)

1) Liquification of Soil:

As we know that, Effective Stresses in the Soil keeps the Soil particles in contact with each other.
when the effective stresses decrease, the Soil looses its strength and when the effective stresses in the Soil becomes zero, then the Soil converts into the liquified state, which we called the Liquification of Soil.

2) Butress Dam:

Buttress Dam is a type of dam which consists of water retaining sloping membrane, which is supported by a series of buttresses at right angles to the axis of the dam.

↳ Buttresses are used in this type of dam to transfer the water forces into the foundations.

3) Infinite Slope:

A type of slope whose boundries are not well defined is called infinite slope.

↳ Infinite Slope have infinite area and finite depth.

↳ Examples of infinite ~~dam~~ slopes are the slopes of embankments and earth dams, slope of Hills etc.

4) Pier Foundation:

Pier foundation is that type of ~~fou~~ deep foundation which consists of cylindrical colums of larger diameter in order to support and transfer large superimposed loads to firm strata below.

↳ Pier ~~constructi~~ foundations are constructed by In-situ process.

↳ The vertical members have larger diameter as compared to pile, which transmit the load into the Soil.

5) Dynamic Load:

A type of load that vary in their magnitude, direction and position with respect to time.

↳ Dynamic loads are time dependent loads.

↳ Dynamic load occur when loading conditions vary with time.

Question # 02

A)

Shallow Foundation:

1) According to Tarzaghi, "The foundation in which the depth of the foundation is less than or equal to the width of the foundation is known as Shallow Foundation".
2) According to Skempton, Shallow foundation is that type of foundation in which the ratio of depth of foundation to the width of foundation is less than or equal to 2.5.

Tarzaghi → $D_f \leq B$

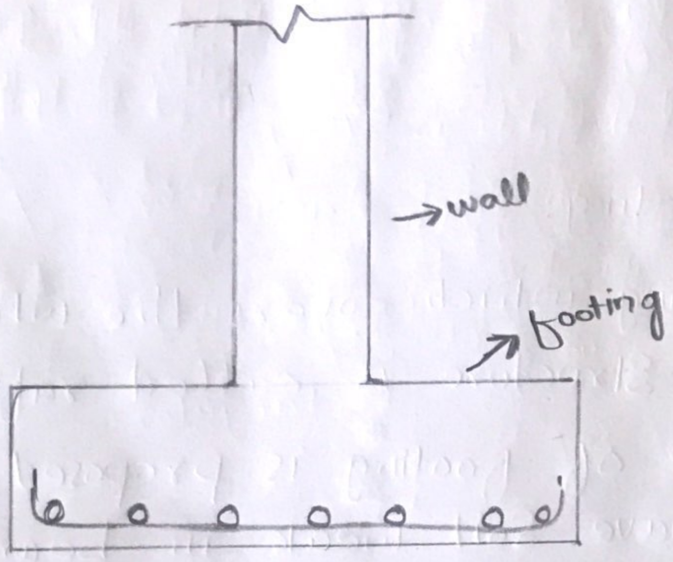
Skempton → $\frac{D_f}{B} \leq 2.5$

Types of Shallow foundations:-

1) wall footing
2) Combined footing.
3) Raft / Mat footing.
4) Strapped footing.
5) Column / Isolated footing.
6) Slopped footing.

1) Wall footing:

A type of Shallow foundation / footings which runs across the length of the wall and transfer the load of the wall to the Soil Safely is known as wall footing or strip footing.

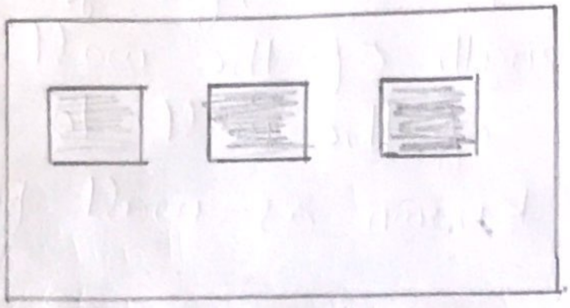


2) Combined footing:-

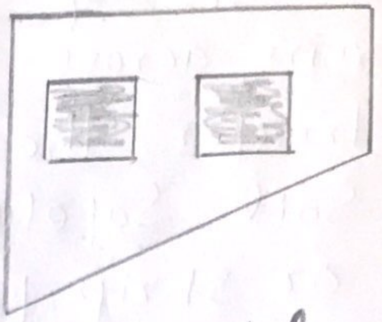
The footing which is constructed combined for two or more column and can transfer the load of two or more columns Safely to the Soil is called combined footing.

↳ For the uniform load, the combined footing will be rectangular in shape.

↳ For non uniform load, the Shape of combined footing will be trapezoidal.



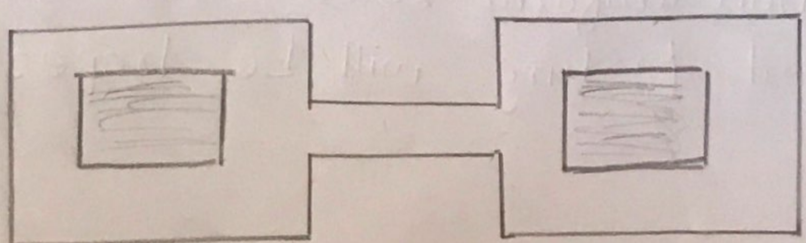
Rectangular combined footing



Trapizoidal combined footing

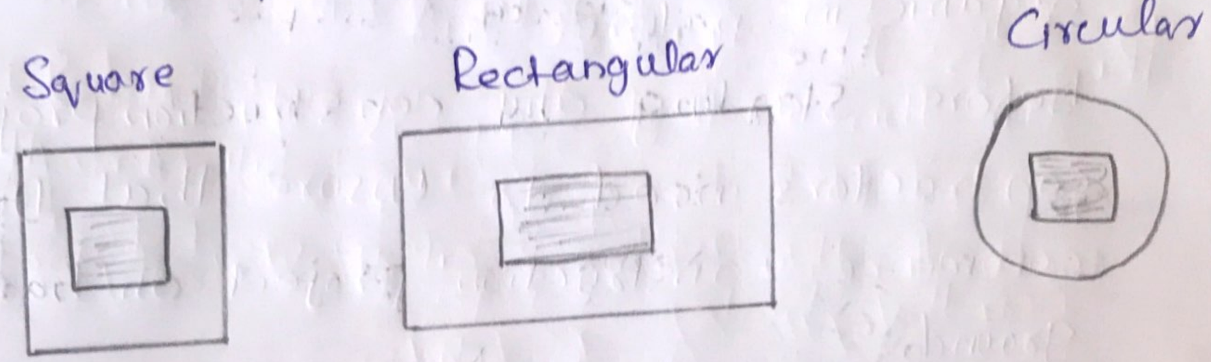
3) Raft footing:
The footing which covers the whole area of the Structure is called raft footing. This type of footing is proposed in area which have Soil weak in bearing capacity. also we provide raft footing for heavy structures.

4) Strapped footing:-
The footing whose outer column is connected with the inner column by means of the beam or strap is called Strapped footing.



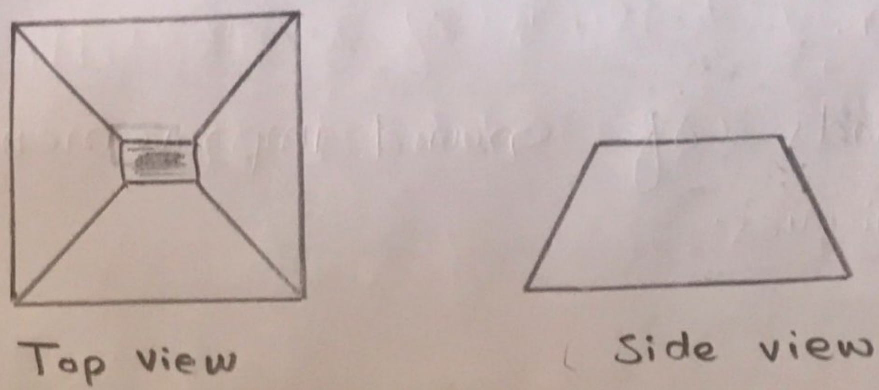
5) Column footing:

The footing which is constructed for Single Column and transmit load to the Soil Safely.
It may be circular, squar, rectangular in Shape.



6) Slopped footing:

The footing which have Slope in all direction as in all Sides is called slapped footing.



Question # 02

B)

Importance of Soil/ground improvement techniques:

Ground improvement techniques are very important for Soil which is organic in nature.
Before starting any construction project, contractors need to ensure that they commence construction project on hard ground.
For strong basement, ground improvement is much necessary.
if we donot consider ground improvement the construction project may lead to repairs and instability later.

Methods of Ground improvement techniques:

1) Removal and Replacement of Soil:-

This is the oldest and Simple method In this method, the unsuitable Soil is replaced with compacted fill. In this method, the Same Soil is used to refill ~~for~~ the higher compaction and better engineering properties.

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.

3) VIBRO Concrete Column:

Vibro concrete columns is a good method ~~or~~ technique of ground improvement which transfer the load from weak Strata to hard Strata by using Strength concrete.

4) Vibro compaction:

It is also called vibro densification. In this method, the compaction takes place at a certain depth in granular soil through vibratory probe.

5) 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 feet.

6) wet Soil mixing:-

In this method, a paste of cement is prepared and inserted in the Soil. This method is used to improve the characteristics of weak Soil by using cementitious binder Slurry.

7) Dry mixing of Soil:-

Dry Soil mixing is ground improvement technique by which the characteristics of weak

Soil are improved by using dry cementitious binder.

Question #04

A) Given data

Height $= H = 10m$

$c = 18.8\ KN/m^2$

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

$\phi = 20°$

$F.O.S = 1.5$

$F\phi = 1.0$

Required:

inclination $= i = ?$

Solution:

As we know that

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

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

$$\Rightarrow \boxed{SN = 0.0737}$$

So by using taylor chart,

$\phi = 20^\circ$

$SN = 0.0737$

$$\Rightarrow \boxed{i = 48^\circ}$$

Question #04

B) Given data

Height of water on upstream side = 15m

Bottom width of the dam = 12m

Top width = 6m

Unit ~~width~~ weight of the dam = 1000 kg/m^3

Unit weight of concrete = γ_c = 1450 kg/m^3

unit weight of Silt = 1330 kg/m^3 = γ_s

Angle of friction for Silt = $\phi_s = 35^\circ$

Free Board = 3.5 m

Silt deposite height = 2.5 m = H_s

Required data:

Silt pressure = P_s = ?

Solution:-

As we know

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

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

$P_s = 1126.302 \text{ kg/m}$

The End

Thank You!