Q(1) Part (A)

Ans Forces Acting on Dam:~

1) Water Pressure (2) uplift Pressure
(3) Wave Pressure (4) Silt Pressure (5) ice Pressure
(6) Self weight of the dam (7) Seismic Forces.

(1) Water Pressure :~

This is the major external force acting on dam.

Pressure Components on ~~dam~~ both upstream and downstream are:
(1) vertical component (2) Horizontal component

unit weight of water $\gamma_w = 1000 \ Kg/m^3$

(2) Silt Pressure :~

The weight of dam and its foundation is a major resisting force. It act at h/3 from the base and can be computed using equation 12:

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

Where :

K_a : coefficient of active earth Pressure of ~~soil~~ silt which 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. ②

h: height of silt deposited.

(3) Ice Pressure:~

(1) The ice formed on water surface of the reservoir is subjected to expansion and contraction due to temperature variations.

(2) coefficient of the thermal expansion of ice is 5 times more than concrete.

(3) The dam face has to resist the force due to expansion of ice.

(4) Weight of Dam:~

This is the major resisting force.

-> Generally unit length of dam is considered.

-> The cross section of dam may be divided into several triangles and rectangles and weights W_1, W_2, W_3 etc. may be computed.

-> The total weight W of the dam acts at the C.G. of its section.

(5) Self weight of Dam:~

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

$W = \gamma_m$ volume

where: γ_m : unit weight of dam material.

Part (B)

(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 than soil will change to liquified state.

(2) Butress Dam:~

uses buttresses to transfer the force of the water to the foundation.

(3) Infinite slope:~

The slope which have infinite area and finite depth such a slope is called as infinite slope. Example:- Natural slope i.e. Hill, Mountains, derset etc.

Causes of failure:~

In infinite slope the failure will be in the form of the sliding. In infinite slope at the some depth the ~~popertiss~~ properties of soil will mostly remain the same.

(4) Pier Foundation:~

The vertical member which have large larger dia as compared to pile and transmit the load of structure to the underground soil. They are constructed by cast In-situ process.

(5) Dynamic load:~

Any load which is nonstatics, such as a wind load or moving live load.

Q.No (02)

Part (A) Ans: Shallow Foundation:~

- According To Terzaghi:~

The foundation in which depth of the foundation is less as equal to width of the foundation is called shallow foundation.

$$DF \leq B$$

- According to Skempton:~

The foundation in which DF/B ratio is less than as equal to 25 than the foundation is called shallow foundation.

-> Types of shallow foundation:~

1) wall Footing (2) combined Footing (3) Raft/Mat footing (4) Strapped Footing (5) column / Isolated footing (6) Slopped footing.

(1) Wall Footing:~

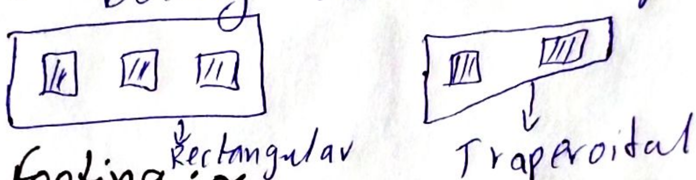
The footing which runs across the length of the wall and transfer the load of the wall to the soil safely. It is called wall or strip footing.

(2) Combined Footing:~

The footing which is constructed for two or more column and transfer the load of the two as 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 in shape.

If the load of the column is not uniform then shape of combined footing will be traperoidal.



(3) Raft / Mat footing:~

The footing which covers the whole are of the structure is called raft footing. This type of footing is proposed in area which have soil weak in bearing capacity. This is also provided when the load of super structure is heavy.

4) Strapped Footing:~

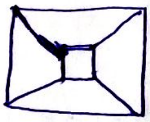
The footing in which the outer column is connected with the inner column by means of the beam or strap is called strapped footing.

(5) Column / Isolated Footing:~

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

(b) Slopped Footing:-

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




Q.No(02)

Part (b) Ans: Ground Improvement Techniques:~

Ground improvement techniques are the techniques which are used to enhance the engineering property of soil. In order to beal heavy structural load.

The main properties are steal strength, permeability, bealing capacity and stiffness etc.

Need of Ground Improvement Techniques:~

The soil in which volumetric changes take 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.

* Methods of Ground Improvement Techniques:~

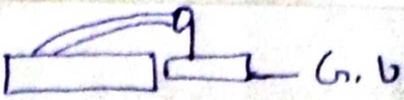
1) Removal and Replacement of soil:~

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 compaction:~



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 take place.

(3) Vibro compaction:~ →

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

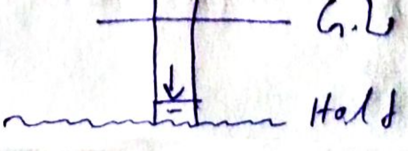
(4) Rapid impact compaction:~

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

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

5) Vibro concrete column:~

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



6) Wet Soil Mixing:~

In this method of ground improvement technique 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.

Q. No (03)

Given Data:~

$C = 25\ KN/m^2$

$\phi = 16°$

$G = 2.72$

$e = 0.50$

Required:~

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

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

Solution:~

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

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

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

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

$$F_c = 1.18$$

when there is seepage of water.

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

$\gamma' = \gamma - \gamma_w$

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

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

$\gamma = 21.04$ kN/m3

$\gamma' = \gamma - \gamma_w$

$= 21.04 - 9.8$

$\gamma' = 11.24$ kN/m2

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

$F_C = 0.826$

Q.No(04) Part (a)

Ans Given Data:~

Height = H = 10m

$c = 18.8\ kN/m^2$

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

$\phi = 20^\circ$

Fos = 1.5

$F_\phi = 1.0$

Required:~

Inclination = ?

Solution:~

As we know that

$$S_N = \frac{c}{Fos \times \gamma \times H}$$

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

$S_N = 0.733$

using taylor chart for

$\phi = 20^\circ$

$S_N = 0.073$

then $i = 44$ (From taylor chart)

Part (b)

Given Data:~

Height of water on 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 salt = 1330 Kg/m3
Angle of friction for silt = θ_s = 35°
Free Board = 3.5m
Silt Deposite height = 2.5m

Required:~ Silt pressure = ?

Solution:~

As we know that

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

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

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