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Section :- A

Subject :- Geotechnical and Foundation Engineering

Semester :- 6th

Question No. 1

Answer:

Forces acting On DAM:-

The forces acting on the dam are as follows.

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:- The deeper the water, the more horizantal pressure it exerts on the dam. So at the surface of reservoir, the water is exerting no pressure by at the bottom of the reservoir, the water is exerting maximum pressure.

2. Uplift Pressure:-

When the water is stored on the upstream side of a dam there exists a head of water equal to the height upto which the water is stored. This water enters the pores, fissures, by cracks of the foundation material

under pressure.

3. Wave Pressure:-

Waves are generated on the surface of the reservoir by the blowing winds, which exert a pressure on the upper part of the dam above the water level. The maximum pressure intensity due to wave action occurs when it acts at 0.5 meters above the still water surface.

4. Ice Pressure:-

The ice which may be formed on the water surface of the reservoir in cold countries may sometimes melt & expand. This force acts linearly along the length of the dam and at the reservoir level.

5. Silt Pressure:-

Silt gets deposited on the upstream side of the dam. This silt acts as a vertical pressure on the dam.

Question No. 1

part (b):-

2- Buttress 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 buttresses or supports.

3- Infinite Slope:-

An infinite slope is simply a vertical line. When you plot it on a line graph, an infinite slope is any line which runs parallel to the y-axis.

4- Pier Foundation:-

A pier foundation is a collection of large diameter cylindrical columns to support the super structure and transfer large super-imposed loads to the firm strata below.

5- Dynamic load:-

The dynamic load is a load which is nonstatic such as wind load or moving live load.

1- Liquification of Soil:-

Soil liquefaction occurs when a saturated or partially saturated soil substantically loses strength & stiffness in response to an applied stress.

Question No. 2

part (a):-

SHALLOW FOUNDATION:-

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

TYPES OF SHALLOW FOUNDATION:-

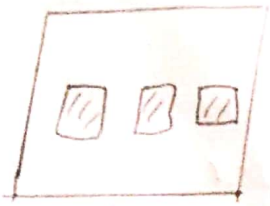
1- WALL FOOTING:-

The footing which runs across the length of wall & transfer the load of the wall to the soil safely is known as wall footing.

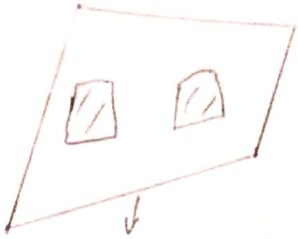
2- Combined Footing:-

The footing which is constructed for two or more column and transfer the load

of the two or more column to the soil safely then it is called ~~raft foot~~ combined footing.



Rectangular



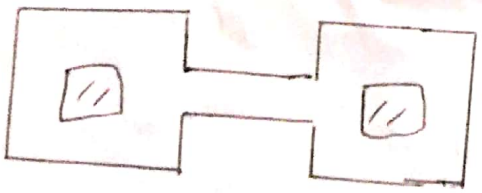
Trapezoidal

3- RAFT/MAT FOOTING:

The footing which covers the whole area of the structure is called raft footing.

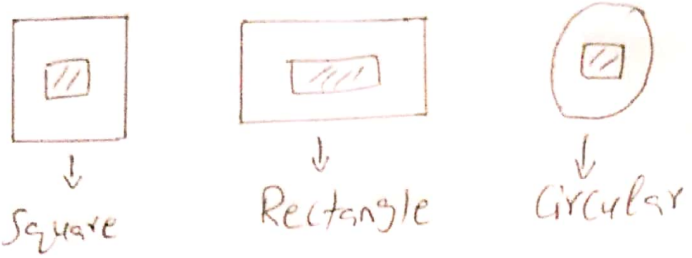
4- STRAPPED FOOTING:

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



→ Top view

5- Column/Isolated Footing:- The footing which is constructed for a single column and transmit its load to the soil safely.



6- SLOPPED FOOTING:- The footing which have slope in all direction as in all sides is called slopped footing.

Question No. 2

part b:- GROUND IMPROVEMENT TECHNIQUES:- Ground improvement techniques are important as these techniques are used to enhance the engineering property of soil.

METHODS OF GROUND IMPROVEMENT TECHNIQUES:-

1- Removal & Replacement Of Soil:-

This is the oldest & simple method. This method is usually 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 & better engineering properties.

2- ~~Dynamic~~ Compaction:-

VIBRO

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

~~VIBRO COMPACTION:-~~

3- DYNAMIC COMPACTION:-

This method is used to increase the bearing capacity of soil. This method also increase the consolidation rate.

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.

5- VIBRO CONCRETE COLUMN:-

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

Question No. 3

Given Data:-

$C = 25\ kN/m^2$

$\emptyset = 16°$

$G = 2.72$

$e = 0.50$

Required Data:-

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

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

Solution:-

$$F_c = \frac{C}{\gamma d * H x \sin i x \cos i} + \frac{\tan \emptyset}{\tan i}$$

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

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

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

$F_c = 1.18$

When there is seepage of water

$$F_c = \frac{C}{\gamma \times 1 \times \sin i \times \cos i} * \frac{\gamma'}{\gamma} \times \frac{\tan \phi}{\tan i}$$

$\gamma' = \gamma - \gamma_w$

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

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

$\gamma' = \gamma - \gamma_w$

$= 21.04 - 9.8$

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

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

$F_c = 0.816$

Question No. 4

Part A):

Given Data:

Height = 10 m

$C = 18.8\ kN/m^2$

$\gamma = 17\ kN/m^2$

$\phi = 20^\circ$

F.O.S = 1.5

$F\phi = 1.0$

Required Data:

Inclination, i = ?

Solution:

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

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

$$SN = 0.073$$

Using taylor chart for

$\phi = 20^\circ$

$SN = 0.073$

$i = 44°$

Question No. 4

Part b:

Given Data:

* Height of water on upstream side = 15 m
* 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 = $\Phi_s = 35°$
* Free Board = 3.5m
* Silt Deposite height = 2.5m

Required Data:

Silt Pressure = ?

Solution:

As we know that

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

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

Pg 12,

$P_S = 1126.30 \text{ kg/m}$