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SECTION	"A"
SEMESTER	6th
SUBJECT	GEOTECHNICAL AND FOUNDATION ENGINEERING
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QUESTION: 01

PART: a

Following forces act on dam.

1. Water pressure
2. weight of dam
3. ice pressure
4. wave pressure
5. Earth quake pressure
6. wind pressure
7. Thermal loads
8. uplift pressure
9. Silt pressure

1. **Earthquake pressure :-** Any disturbance in a dam is very dangerous because of storage of large amount /volume of water. Dams built in area that are seismically active must be designed to withstand additional forces that are likely to arise in future shock.

2. **Water pressure :-** It is an important external force acting on a dam. Hori-zontal water pressure is exerted by weight of water stored on upstream side of dam.
   - → It can be calculated by hydrostatic water distribution.
   - → Force due to water pressure can be calculated as $P = WH^2/2$
   - → It acts at a height of $h/3$ from base of a dam.

3. **ICE PRESSURE :-** The ice pressure is exerted by ice that may be formed on surface of reservoir in cold countries. that may sometimes expand or melt and exert pressure. Co-efficient of thermal expansion of ice is 5 X that of concrete so dam has to resist.

4. **UPLIFT PRESSURE :-**
   It is not possible to make a dam based on previous structure. There are many small pores and crack that are left in dam and foundation body.

Water finds its way into those small openings or pores through seepage and ultimately fill them up. This exerts an upward pressure on body of dam

5. **Wave pressure:-**

Wave have an impact on upper portion of dam.
Wave pressure against huge dams (↑height) is of little consequence.
The wave characteristic i.e force and dimension depend on extend and configuration of water surface, velocity of wind.

PART: (b)

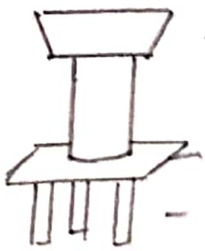
Liquification of soil:- "Process in which a saturated or partially saturated soil loses strength and stiffness in response to applied stress, usually sudden changes in stress condition causes the soil to act as a liquid" is called liquification of soil. or simply soil liquification.

There are two types.
(1) Flow liquification
(2) Cyclic Mobility.

2 **BUTRESS DAM:-** It is defined as:
" The dam consisting of thin water supporting facing or deck supported by buttress generaly in form of equally spaced triangular walls or counter forts that transmit water load and deck weight to foundation is called buttress dam.

3 **Infinite Slope:**
Slope having great extent with uniform soil condition at any given depth below surface.
Soil stratum is not necessarily homogenous. with depth but strata of different soils are parallel to slope surface

4. **PIER FOUNATION:** It consists of a cylinderical column of large diameter to support and transfer large super-imposed loads to firm strata below.
It stands several feet above ground.
also known as post foundation
There are two types
(1) Masonry / Concrete pier
(2) Drilled caiss-on.



5. **Dynamic Load:-**
Force on a structure that changes size, position or direction is called Dynamic load.
It helps to determine stress at different level of structure due to changing condition overtime.

QUESTION: 02

PART: a

SHALLOW FOUNATION:-

→ According to Terzaghi:- " Foundation having depth less or equal to width of foundation is called shallow foundation.

$$D_f \leq B$$

D_f = Depth of foundation
B = Breadth / Width

→ According to Skempton: "Foundation having Df/B ratio less than or equal to 2.5 is called shallow foundation

TYPES:-

Shallow foundation has following types.

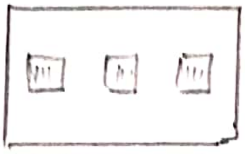
1. Wall Footing
2. Combined footing
3. Raft / Mat footing
4. Column Isolated footing
5. Strapped footing
6. Slapped footing

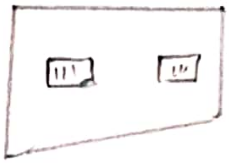
1. WALL/STRIP FOOTING:- The footing that runs across wall's ~~of~~ length and transfer wall's load to the soil safely. This is called wall / strip footing.

2. COMBINED FOOTING: The footing that is constructed for two or more column. It transfers the load of two or more columns to the soil safely. it's called combined footing.

→ If load of column are uniform i.e equal in magnitude, footing will be rectangular

→ If load of column not uniform, shape of combined footing will be Trapezoid


rectangular

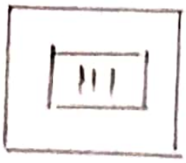

Trapezoid

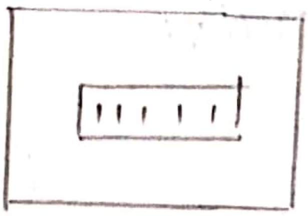
3. RAFT/MAT FOOTING:- The footing that covers whole area of structure is called raft/mat footing. It is proposed in area which have soil with weak bearing capacity.
It is also provided when load of super structure is very heavy.

4 STRAPPED FOOTING:- "Footing having outer column connected to inner column by means of beam or strap is called strapped footing.

5. COLUMN/ISOLATED FOOTING:- "The footing that is constructed for a single column and transmits its load to soil safely.

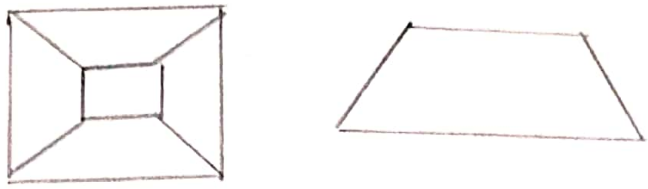
→ It may be circular, square or rectangular in shape


square


rectangular


circular

6. **SLOPPED FOOTING** : Footing having slope in all direction or in all sides is called slopped footing.



PART: (b)

IMPORTANCE OF GROUND IMPROVEMENT TECHNIQUE

It has following importance

→ Soil having volumetric changes due to swelling or shrinkage needs ground improvement techniques.

→ Soil organic in nature require improvement technique

→ Soft soil also require ground improvement technique

→ Sandy and gravely soil also require ground improvement technique.

→ Foundation in sanitary dump places also require ground improvement techniques.

METHODS OF GROUND IMPROVEMENT TECHNIQUE:

1. **Removal & Replacement of Soil:** It's performed on loose soil. It's simplest and oldest method.

The unsuitable soil is replaced with

compacted fill.

In this method same soil is used to refill higher compaction and better engineering properties.

This method is applicable above ground water table.

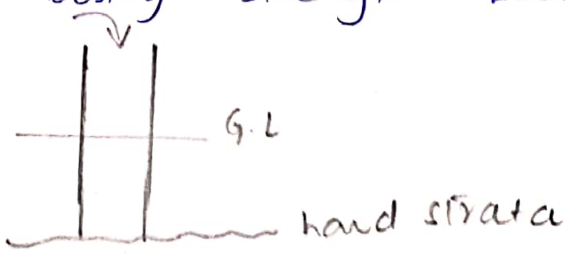
2. **DYNAMIC COMPACTION:-** Dynamic compaction is used to increase bearing capacity of soil.

→ It also increases consolidation rate.

→ In this method actually densification of soil takes place so it increases the density of soil.

3. **VIBRO CONCRETE COLUMN:-**

It is a ground improvement technique that transfers load from weak strata to hard strata by using strength ~~technique~~ concrete.



4. **WET SOIL MIXING:-** In this method of ground improvement technique a paste made of cement is inserted in soil.

It is used for improvement of characteristic of weak soil by using cementitious binder slurry.

5. **DRY MIXING OF SOIL:-** It's a ground improvement technique for improving characteristics of weak soil by using dry cementitious binder.

QUESTION: 03

Given Data:-

$C = 25 \; KN/m^2$

$\phi = 16°$

$G = 2.72$

$e = 0.50$

Required =

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

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

Solution:-

(1) Dry Soil.

We have, $F_c = \frac{C}{\gamma d \times H \times \sin i \times \cos i} + \frac{\tan \theta}{\tan i}$

Now, $\gamma d = \frac{G_s \times \gamma_w}{1+e} = \frac{2.72 \times 9.8}{1+0.5}$

$\gamma d =$ ~~17.78~~ $17.8 \; KN/m^2.$

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

$F_c = 1.18$

(II) When there is seepage of water

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

We Know

$\gamma' = \gamma - \gamma_w$

putting values

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

$\gamma = 21.04 \ KN/m^2$

$\gamma' = \gamma - \gamma_w$

putting values

$\gamma' = 21.04 - 9.8$

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

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

$F_c = 0.816.$

QUESTION: 04

PART: a

Given Data:

Height = 10m

$C = 18.8\ KN/m^2$

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

$\phi = 20^\circ$

F.O.S = 1.5

$F_\phi = 1.0$

Required:

Inclination: $i = ?$

Solution:

We know by formula:

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

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

$$\boxed{S_N = 0.073}$$

Now, Using tylor chart for $\phi = 20^\circ$

$S_N = 0.073$

$$\boxed{i = 44^\circ}$$

PART: (b)

Given Data:-

Height of water on upstream side = 15 m
Bottom width of dam = 12 m
Top width = 6m
Unit weight of water = 1000 Kg/m^3
Unit weight of concrete = 1450 Kg/m^3
Unit weight of silt = 1330 Kg/m^3
Angle of friction for silt = $\phi_s = 35°$
Free board = 3.5m
Silt Deposit height = 2.5m

Required:

Silt pressure = P_s = ?

Solution:-

We know by formula

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

putting values

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

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