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Semester 6th

Subject Geotechenical Engr

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Q1 (A)

Name the forces acting on dam. Explain any five of them in detail?

Forces Acting on Dam:-

The forces acting on dam are

1. Water pressure
2. Uplift pressure.
3. Wave pressure.
4. Silt pressure.
5. Ice pressure.
6. Self Weight of dam.
7. Seismic Forces.

1. Water Pressure:-

Water pressure is one of the mass major forces acting on dam. The horizontal water pressure exerted by water stored on upstream side of dam can be collected from hydrostatic pressure distribution.

2. Ice Pressure:-

The ice which may be formed on water surface of reservior in cold countries may sometimes melt and expand. The dam face then has to resist force exerted by expanding ice. This force act linearly along length of dam and at reservior level. The magnitude of this force varies from 250 - 1500 kn/m^2.

3. Wave Pressure:-

Waves are generated on surface of reservior by blowing winds, which can cause a pressure towards downstream side wave pressure and it depends upon wave height.

4- Earthquake Forces:-

An earthquake produces waves which are capable of shaking the dam in every possible direction. The effect of earthquake is equivalent to imparting an acceleration to foundation of dam. in which wave is travelling at the moment.

5- Uplift Pressure:-

Water seeping through pores and fissures of foundation material and water seeping through dam of body and these to bottom through joints between body of dam and its foundation at base, exerts an uplift pressure on base of dam.

This kind of uplift pressure virtually reduces the downward weight of body of dam and hence acts against stability.

Q1 (B)

Define the following

1. Liquification of Soil:-

The phenomena whereby a saturated or partially saturated soil substantially losses strength and stiffness in response to applied stress, usually earthquake shaking or other sudden change in stress condition, causing it to behave like a liquid" is called soil liquefication.

Liquification is process that leads to soil suddenly losing strength, most commonly as a result of ground shaking during earthquake.

2. Butress Dam:-

A butress dam is a dam with a solid water tight up-stream side that is supported at downstream side by a series of buttresses The dam wall may be straight or curved.

3- Infinite slope:-

The type of slope extending infinitely, or up to an extent whose boundaries are not well defined.
For this type of slope the soil properties for all identical depth below surface are same.

4- Pier Foundation:-

A pier foundation is a collection of large diameter cylindrical column to support the super structure and transfer large supper imposed load to a firm strata below. It stood several feet above ground. It is also known as "post foundation"

5- Dynamic Load:-

A load which is non static, such as wind and earthquake or other live load.

OR

The load which acts on ground by movement of objects.

Q2 A

Define shallow foundation. Explain its types with appropiate sketch?

Shallow Foundation:- (According to Terzaghi)

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

$$D_f \leq B.$$

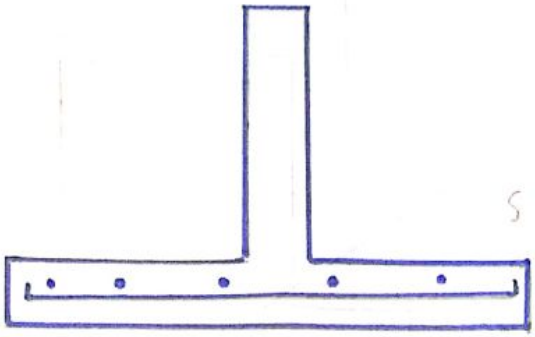
According to Skempton:-

The found in which D_f/B ratio is less than or equal to 2.5 than foundation is called shallow foundation.

Types

1) Wall footing :-

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



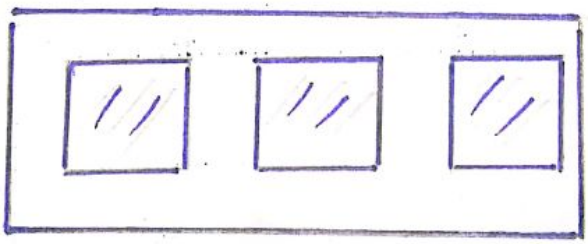
2. Combined Footing :-

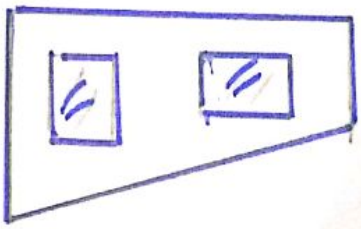
When two or more than two columns come in a row then this type of footing is constructed.

This footing is constructed for two or more column and transfer load of two or more column to soil safely.

If load of column is uniform then the combined footing will be rectangular in shape.

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





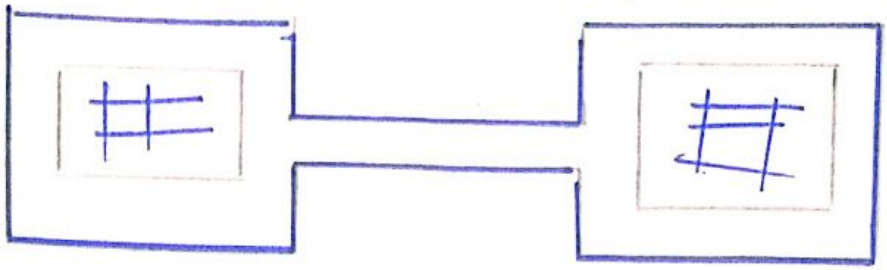
3. Mat Footing :-

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

This type of footing is proposed in area which have soil weak in bearing capacity This is also provided when load of super-structure is heavy.

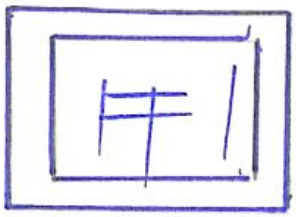
4- Strapped Footing :-

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



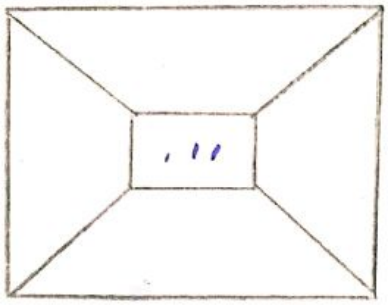
5- Column footing :-

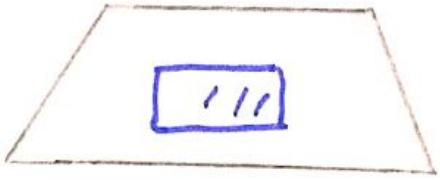
The footing which is constructed for a single column and transfer load to soil safely. It may circular, square or rectangular in shape. It is also called isolated footing



6- Scopped Footing :-

The footing which have slope in all direction or in all sides is called scopped footing.





Q2 (B) Pg 6

Why ground improving techniques. Explain five methods of ground improvement along sketch?

Ground Improvement Techniques:-

Ground improvement techniques are the techniques which are used to enhance engineering properties of soil in order to bear heavy structural load. The main properties are shear strength, permeability bearing capacity and stiffness.

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

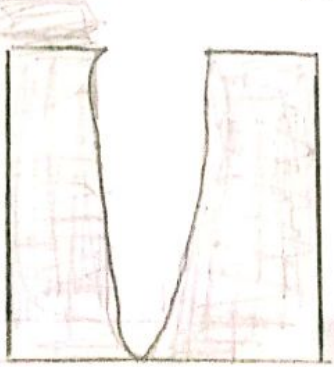
Methods Of Ground Improvement Techniques:-

1. Removal and Replacement of soil:-

This is the oldest method performed on loose soil.

In this method unsuitable soil is replaced with compacted fill. In this method same soil is used to refill higher compaction and better engineering properties.

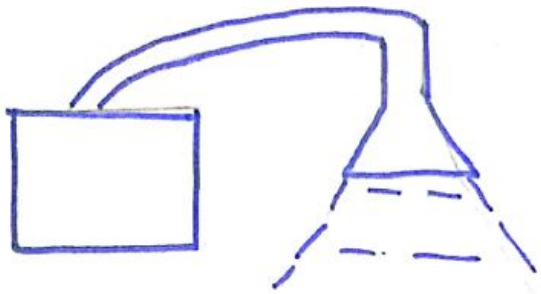
This method is applicable above ground water table.



2. Rapid Impact Compaction:-

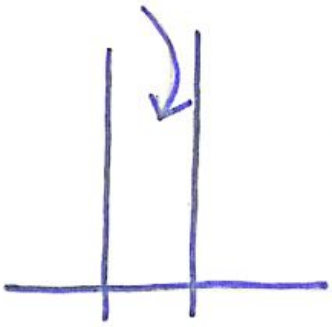
Impact energy is applied to surface of ground as a result of which densification of soil take place upto a depth of 15 feet.

The impact energy is actually applied through hydraulic ramp. The weight of which values from 4 to 8 tons.



3- Vibro concrete column:-

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



void strata.

4- Wet Soil Mixing:-

In this method of ground improvemen technique a paste of cement is prepared and inserted in soil. This technique is used to improve the decharacteristics of weak soil by using cementitious binder slurry.

5- Dry Mixing of soil:-

It is ground improvement technique by which characteristics of weak soil is improved by dry cementitious binder.

Q3

Given Data:-

$C = 25\ kN/m^2$

$\emptyset = 26° 16'$

$G = 2.72$

$\theta = 0.50$

Required:-

(Fc) FOS when soil is dry

(Fc) FOS when seepage is there

Sol:-

$$Fc = \frac{C}{\gamma d \times H \times \sin i \times \cos i} + \frac{\tan \emptyset}{\tan i}$$

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

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

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

$$Fc = 1.18$$

where there is seepage.

$$Fc = \frac{C}{\gamma \times H \times \sin i \times \cos i} + \frac{\gamma'}{\gamma} \times \frac{\tan \emptyset}{\tan i}$$

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

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

$$\gamma = 2.72 + 0.5 \times 9.8$$

$$\gamma = 2.104\ kN/m^3.$$

$$\gamma' = \gamma - \gamma_w$$
$$= 21.04 - 9.8$$
$$= 11.24 kN/m^3$$

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

$$= 0.816$$

Result

Fc when soil is dry = 1.18

Fc when there is seepage = 0.816

Q 4 (A)

Given Data

Height = H = 10m

$C = 18.8 kN/m^2$

$\gamma = 17 kN/m^3$

$\theta = 20°$

FOS = 1.5

$F_\theta = 1.0$

Required:-

Inclination i = ?

Sol:-

As we know

$$S_N = \frac{C}{FOS \times \gamma \times H}$$

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

$$S_N = 0.073$$

Using Taylor Chart.

$\theta = 20°$

SN = 0.073

then

$i = 44$ (From taylor chart)

Q4 (B)

Given Data:-

Height of water on upstream side = 15m.
Bottom width = 12m
Top width = 6m
$\gamma_{water} = 1000\ kg/m^3$.
$\gamma_{concrete} = 1450$.
$\gamma_{silt} = 1330\ kg/m^3$
$\theta = 35°$
Free Board = 3.5m
H = 2.5m.

Required:-

Silt Pressure $P_s = ?$

Sol:-

As we know

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

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

$$P_s = 1126.30\ kg/m$$