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Section A

Final Exam

Sir Liaquat

Geotechnical Engg

Ans 1:

(a) Forces acting on dam:

1) water pressure:

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

2) Uplift pressure:

water seeping through the pores and fissure of the foundation material and water seeping through the dam of the body, exerts an uplift pressure on the base of the dam, which virtually reduce the downword weight of the body

3) Earthquack force:

An earthquack produce waves which are capable of shaking the dam in every possible direction. The effect of earthquack is equivalent to impart an acceleration

* Horizontal acceleration = kh x g
* Verticle acceleration = k x g

4) Ice pressure:

The ice may be form on the water surface of the reservior. The dam face than has to resist for exerted by the expanding ice, This force act linearly along the lenght of the dam and at the reservior level.

* Varies from 250 – 1500 kn/m^2.

5) weight of dam:

The weight of the dam body and its foundation is the major resisting force, the c/s can be divided in rectangles and triangles. The resultant of all these downward forces will be represent the total weight of dam acting the centre of gravity of dam.

(B)

1- Liquification of soil:

Liquification is a phenomenon in which the strenght and stiffness of a soil is reduced by earthquack shaking or other rapid looding.

2- Buttress Dam:

Buttress dam consist of a watertight upstream side usually reinforced concrete, supported by trianguler shaped walls called buttress dam

3) Infinite slope:

A slope that extends for a relatively long distance and has a consistant subsurface profile may be analyzed as infinite slope.

4) Pier foundation:

A pier foundation consist of a cylindrical column of large diameter to support and transfer large super-imposed loads to the firm strata below.

5) Dynamic load:

A dynamic load is any force that changes with time, such as car tyre, people walking and wind gusts. usually in structure we treat these as static loads in order to simplify calculation.

ANS 2:

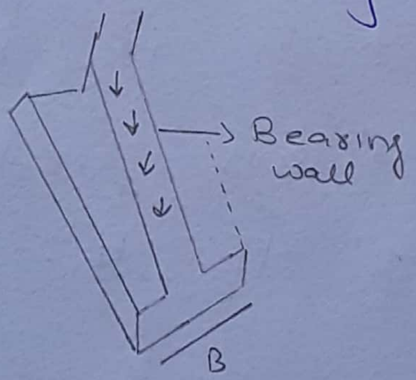
(a) Shallow foundation:

Shallow foundation is often called footings, the depth of which is Less than its width

Types:

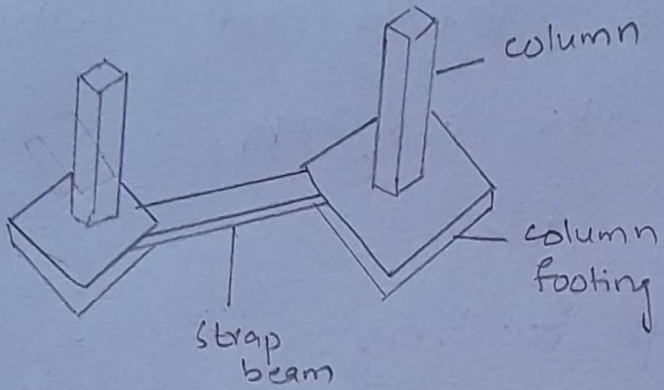
1) wall - strip footing:

wall - strip footing is a footing which runs across the length of the footing.



2) Combined footings:

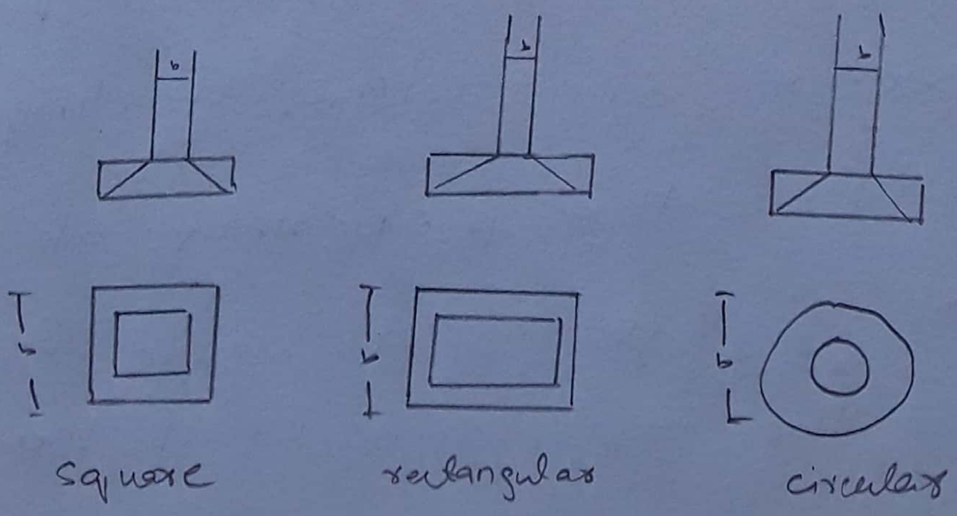
Combined footing is basically a combination of various footing, which utilizes the properties of different footings in a single footing based on the requirement of structure it carries two or more colums along a straight line.



3) Isolated - column footing:

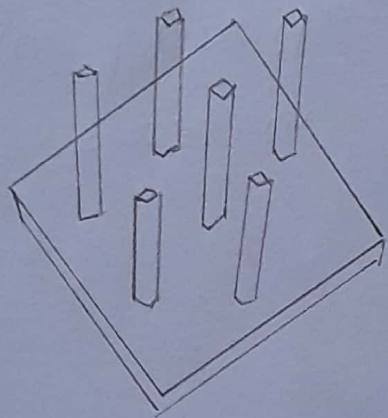
footing which is constructed for a single column and transfer its load safely to the soil.

This column may be circular, rectangular, or square in shape.



4) Raft - Mat footing:

Footing which is constructed or covers the area of the entire structure, this type of footing is provided when the soil in weak in bearing.



(B)

Importance of ground improvement techniques:

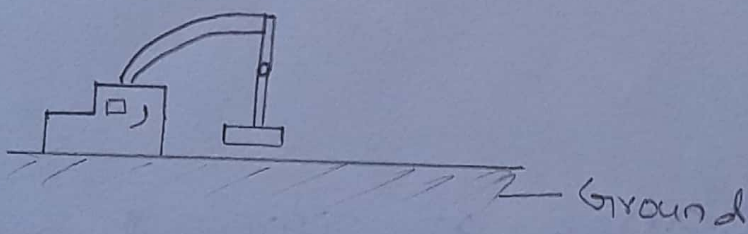
Before starting any project, constructor need to ensure that they commence construction project on hard ground, therefore modern techniques such as dynamic compaction and jet grouting are essential.

for strong basement, ground improvement is necessory, because it reduces the risk of any damage later on.

Methods

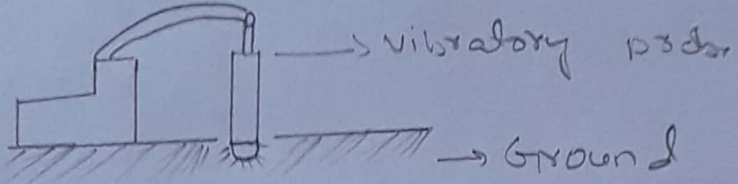
1) Dynamic compaction:

This method is used to increase the bearing copacity of soil. This method also increase the density of soil.



2) Vibro compaction:

It is also called vibro desification. In this method the compaction take place at certain depth in grounded soil through vibratory probe. The penetration of probe is entrance by ejecting water at the tip of probe.

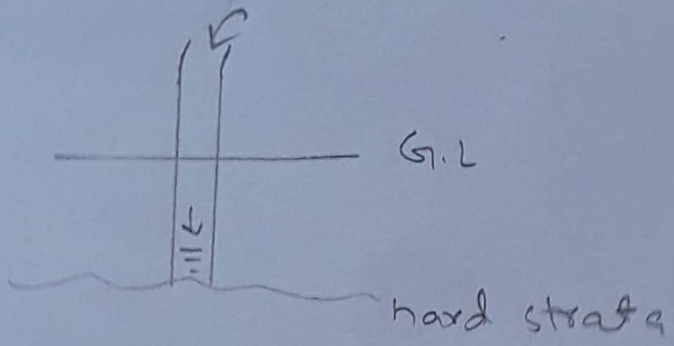


3) Removal and placement of soil:

This is an oldest and simple method and is performed on loose soil. In this method the un suitable soil is replace with compacted fill. In the method the same soil is used to refill the higher compaction and get better higher engineering properties.

4) vibro concrete column:

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



5) Dry Mixing of soil:

Dry soil mixing is ground improvement techniques by which the characteristis of weak soil are improved by using dry cementious binder.

ANS 3:

Given data:

$G = 2.72$

$C = 25\ kN/m^2$

$\phi = 16^\circ$

$e = 0.50$

Required:

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

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

Solution:

1) $$F_c = \frac{c}{\gamma_d \times H_r \times \sin i \times \cos i} + \frac{\tan \phi}{\tan i}$$

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

$$\boxed{\gamma_d = 17.8 \ kN/m^3}$$

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

$$\boxed{F_c = 1.18}$$

2) when there is seepage of water

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

$$\gamma' = \gamma - \gamma_w$$

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

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

$$\gamma = 21.04 \ \text{kN/m}^3$$

$$\Rightarrow \gamma' = 21.04 - 9.8$$

$$\gamma' = 11.24 \ \text{kN/m}^3$$

$$\Rightarrow F_c = \frac{25}{21.04 \times 6 \times \sin(26°) \cos(26°)} +$$

$$\frac{11.24}{21.04} \times \frac{\tan(16°)}{\tan(26°)}$$

$$\boxed{F_c = 0.816}$$

ANS 4:

(a) Given data:

$C = 18.8\ KN/m^2$

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

$\phi = 20^\circ$

FOS = 1.5

$F_\phi = 1.0$

Height = H = 10 m

Required:

Inclination $i = ?$

Solution:

As

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

$$= \frac{18.8}{1.5 \times 17 \times 10} = 0.073$$

Using taylor chart

$\phi = 20^\circ$

SN = 0.073

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

(b) Given data:

Top width = 6m

Bottom width = 12m

Height of water on upstream = 15m

Unit weight of water = 1000 kg/m²

Unit weight of concrete = 1450 kg/m²

Unit weight of silt = 1330 kg/m²

Angle of friction for silt = $\theta_s = 35°$

Free board = 3.5m

Silt deposit height = 2.5m

Required:

Silt pressure = ?

Solution:

As

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

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

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