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Sec :- A

Subject :- Geotechnical & Foundation Engineering

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Q1) Name the Force acting on dam. Explain any five of them in detail.

Following are the Forces acting on dams:-

1) water Pressure
2) uplift Pressure
3) Wave Pressure
4) Silt Pressure
5) Ice Pressure
6) Self Pressure
7) Seismic Forces.

1) Self weight of dam :-

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

$W = \gamma_m \times$ Volume

γ_m : unit of dam material.

2) Wave Pressure:-

Waves are generated on the surface of the reservoir by the blowing winds. which exert the pressure on the upper part of the dam. above the water level. This pressure is calculated by the Formula.

$P_w = 2.4 \gamma_w h_w$

Waves pressure depends upon wave height which is given by $F < 32 km$

$h_w = 0.32\sqrt{F} + 0.763 - 0.27 \times F^{1/4}$

3) Silt Pressure:

It is the pressure that is caused by the deposition of the silt in the bed of the dam causing at h/3 From the base and can be computed using equation

$$P_{silt} = 0.5 \gamma_s h^2 k_a$$

4) Ice Pressure:

The ice which may beformed on the water surface of the reservoir in cold countries may sometime melt and expand. The dam Face is subjected on the thrust & exerted by the expanding ice.

5) Seismic Forces:

Dynamic load created due to earthquake must be considered in the design of all major dam located in high risk. Seismic region Earthquake pressure waves in every possible direction.

(B) Q1 (B) 7817

Define the Following terms:-

1) Liquefication of Soil:-

Soil liquefication occurs when a saturated or Partially saturated soil substantially loses strenght and stiffness in response to an applied Stress such as shaking during on earthquake.

2) Buttress Dam:-

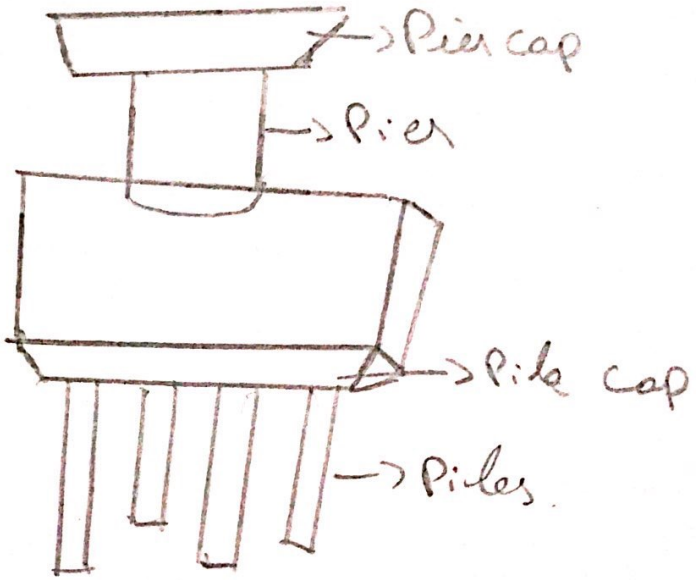
This Dam or hollow dam is a dam with a solid, water-height upstream side that is supported at intervals on the downstream side by a series of buttress or supports. The dam will may be straight or curved.

3) InFinite slope:-

This type of slope extending infinitely or up to an extent whose boundries are not well defined For this type of slope the soil properties for all identical depths below the surface are some. In the making of natural slopes. their is no contribution from our side.

4) Pier Foundation-

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



5) Dynamic load-

Soil dynamic deals with engineering behaviour of soils subjected to time varying loads and applied loads vary with time. This implies that the stress and strain induced in the soil are also Function of time.

Q2 Part (A) 7817

Ans :-

Shallow Foundation :-

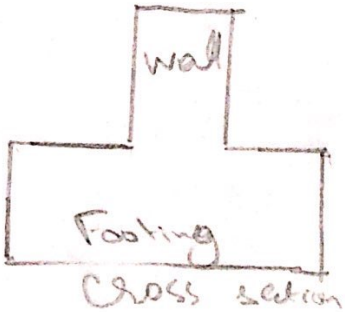
According to terzaghi, the foundation in which the depth of the foundation is less orequal to width of the foundation is called shallow foundation $D_f \leq B$.

Types of shallow foundation.

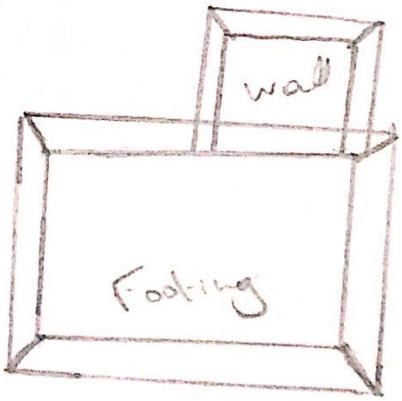
1) Wall Footing
2) Combined Footing
3) Raft/Mat Footing
4) strapped Footing
5) Column / Isolated
6) Slopped Footing

1) Wall Footing :-

The Footing which run across the lenght of the wall and transfer the load of the wall to the soil safety. It is called wall footing.



Cross section



3) Combined Footing:-

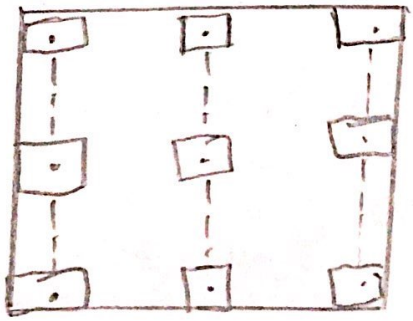
The Footing which is constructed for two or more column and transfer the load of the two or more column to the soil safety then its called combined Footing. If the load of the column is uniform then the combined Footing will be rectangular in shape.

Rectangular

Trapozidal

3) Raft Footing:-

The Footing which cover, where area of the structure is called raft footing. This types of Footing is proposed in area which have soil work in bearing capacity. It also provided when load of structure is heavy.



4) Strapped Footing:-

The Footing in which the outer column is connected with the inner column by mean of the beam or strap.

Top view

5) Column / Isolated Footing.

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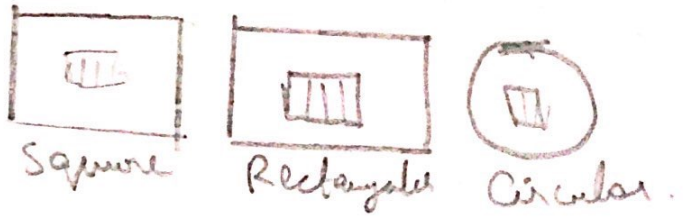
The Footing which is constructed for the single footing and transmit to load to the soil safely It may be circulated squore and rectangular in shape.



b) Slopped Footing.

The slope which have slope in all direction or in all side is called as slopped footing.

Ans 2 Part(B) 7817

Ground Improvement techniques-

It is the technique which are used to enhance the engineering property of soil in order to beat heavy structural load.

The main properties are shear strenght permsability, bearing capacity & stifness etc

Need of Ground improvement techniques.

The soil in which volumetoic changes take place due to shrinkage & swelling such soil needs ground improvement

-> The soil which is organic in nature

-> The soft soil also required ground improvement techniques.

Method of Ground improvement :-

1) Removal & Replacement of soil-

This is an oldest & simple method. This methode is performed on loose soil.

In this methods the unsuitable soil is replaced with compacted Fill. In this method the same oil is used to refill the higher compaction & better engineering Properties.

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.

3) Dry Mixing of soil:-

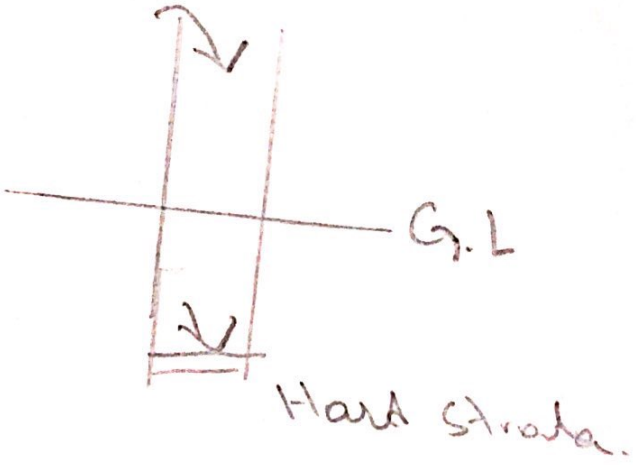
Dry soil mixing is ground improvement techniques by which the characteristics of weak soil are improved by using dry cementitions binder.

4) Wet soil Mixing:-

In this method of ground improvement technique a paste of cement is prepared & inserted in the soil. This method is used to improve the characteristics of weak soil by using cementitions.

5) Vibro concrete columns- 7817

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



Qno(3)

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Given Data:

$C = 25\ kN/m^2$

$\phi = 16°$

$G_s = 2.72$

$e = 0.50$

Solution:

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

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

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

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

$$F_c = 1.18$$

When there is seepage

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

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

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

$$= \frac{2.72 + 0.5}{1+0.5} \times 9.8 \qquad \gamma = 21.04\ kN/m^3$$

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

$$= 21.04 - 9.8$$

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

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

$$F_c = 0.816$$

Qno 4 (A)

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Given Data:

$H = 10m$

$c = 18.8\ kN/m^2$

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

$\theta = 20°$

$FOS = 1.5$

$F\theta = 1.0$

Required:-

Inclination = ?

Solution:-

As we know that

$$\gamma_N = \frac{c}{FOS \times \gamma \times H}$$

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

$$\gamma_N = 0.073$$

Using Taylor Chart For

$\theta = 20°$

$\gamma_N = 0.073$

then

$i = 44$ (From taylor chart

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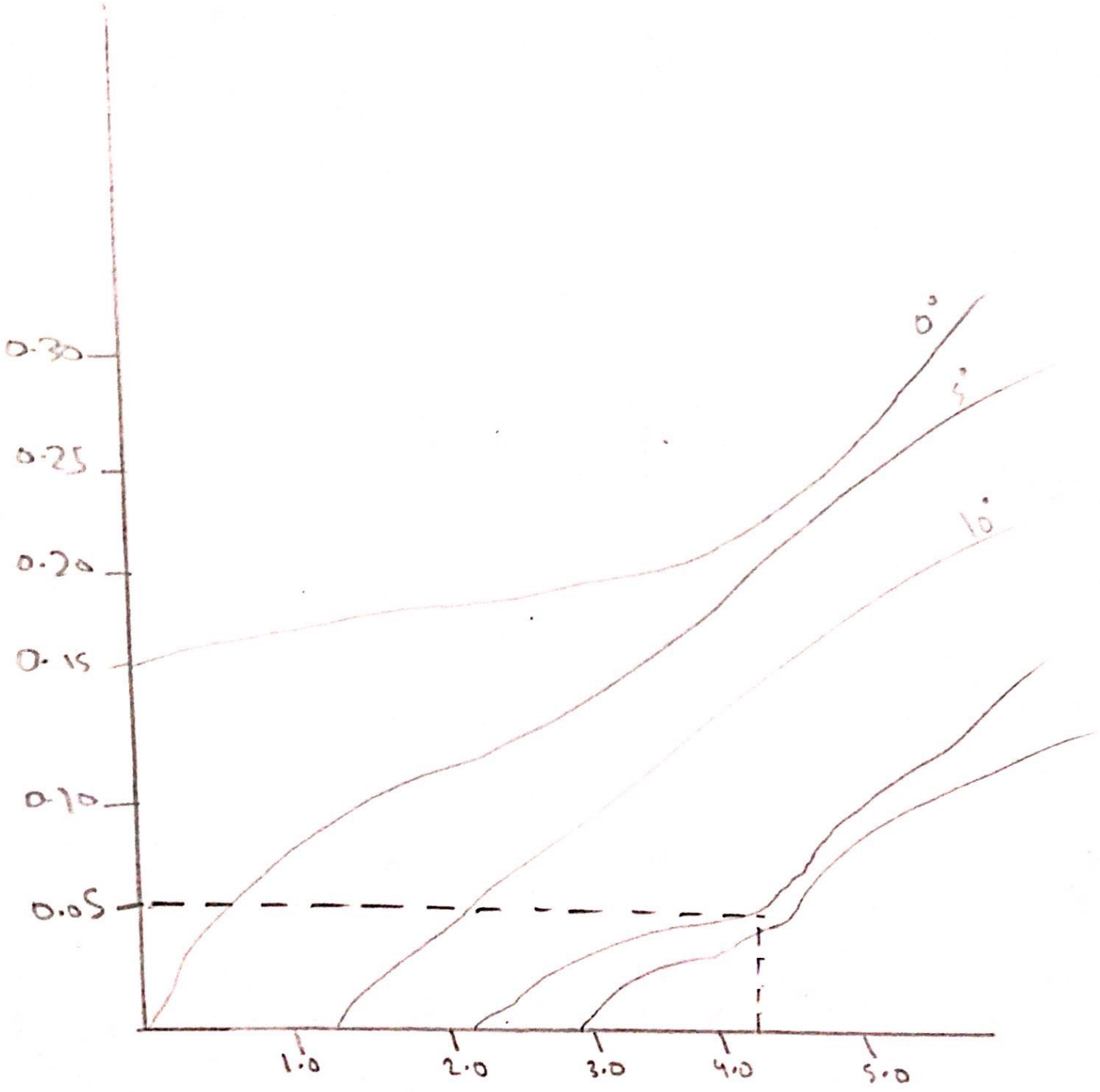

Qno 4 (B) 7817

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 = $\phi_s = 35°$
- Free Board = 3.5m
- Silt Deposite = 2.5m

Required:-

Silt pressure = ?.

Solution:-

As we know that

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

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

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