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Section	A
Subject	Geotechnical Engineering
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1

P=1

Ans 1

Following are forces acting on a Dam

1) Water Pressure

2) uplift Pressure

3) Wave Pressure

4) Silt Pressure

5) Ice Pressure

6) Self weight

7) Seismic forces

I would explain any five of them

1 ICE PRESSURE

The Ice pressure which may be formed on the Surface of the reservior in Cold Countries may Some time melt & expend.

The dam face has then to resist the thrust exerted by the expanding ice. This force acts linearly along the length of the dam & at the reservior level.

The magnitude of this force varies from 250 to 1500 KN/m² depending upon the temperature variation. On an average, a value of 500KN/m² may be allowed under ordinary condition.

2) Wave Pressure

Waves are generated on the surface of the reservior by the blowing wind which causes a pressure towards the downstream side. Wave pressure depends upon wave hight.

Wave hight may be given by equation

$$H_w - 0.032\sqrt{V.F} + 0.763 - 0.271(F)^{3/4}.$$

For $F < 32\,Km$

P=3

3) Earthquack Pressure

If the dam is to be design. as to be located in a region which is susceptiable to earth quakes, allowance must be made for stresses generated by the earth quack.

- An earthquack procedure waves which are Capable of shaking the earth upon which the dam is resisting in every Possiable direction.

4) UPLIFT PRESSURE:

Water seeping through pores, craks & fissures of the foundation material & water seeping through Dam body & then to the bottom through the joint b/w the body of the dam

It is the Second major external force

& must be accounted for in all Calculations. Such an uplift force virtually reduces the downward weight of the body of the dam & hence, acts against the dam Stability.

5) Water Pressure

Water pressure is the most major external force acting on Dam. The horizontal water Pressure exerted by the weight of the water stored on the upstream side of dam

⇒ The water pressre can be calculated by hydro static pressure distribution.

⇒ Force due to water Pressure

$$P = WH_2/2$$

This act at a height of h/3 from base of the dam.

P=5

(b)

1) Liquification of Soil

A Phenomenon whereby a Saturated or Partially Saturated Soil Substantially loses Strength & Stifness in response to an applied Stress, Usually earth quack Shaking or other Sudden changes in stress Condition Cause it to behave like a liquid is Called Soil Liquifaction.

⇒ It is a Process that leads to a Soil Suddenly losing Strength, most Commonly as a result of ground Shaking during a large earth quake.

2) Buttress Dam

A Dam Consisting of a relatively thin water Supporting facing or

6

2

P = 6

deck Supported by buttress generally in the form of equally spaced traingular walls or Counter forts that transmitt the water load & deck weight to the foundations.

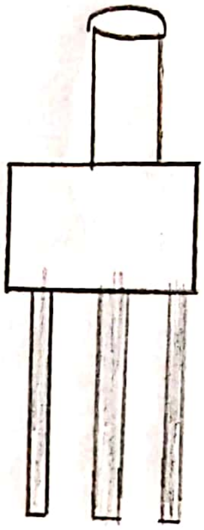
3) Infinite Slope:-

The slope which have great extent with uniform soil conditions at any given depth below the surface & soil stratum is not necessary homogenous with depth but the strata of different soils are parallel to the slope surface

4) Pier foundation:-

A Pier foundation consist of a cylinder column of large diameter to support & transfer large super-imposed loads to the firm started below

Pier foundation transfer the load only through bearing.



5) Dynamic load:-

Any load that moves, changing magnitude or direction over time.

Load in a static system are constant & unchanging

Shocks load, Impact load & vibrational load all be consider dynamic in nature, but are <u>not</u> same.

P=8

Ans (2A)

SHALLOW FOUNDATION

According to Terzaghi " The foundation in which depth of the foundation is less or equal to width of the foundation is called Shollow foundation.

$D_f \leq B$

According to Skempton " The foundation in which D_f/B ratio is less then or equal to 2.5 then the foundation is called shallow foundation.

Types of Shollow foundation:.

1) Wall footing:-

The footing which runs across the length of the wall & transfer the load of the wall to the soil safety

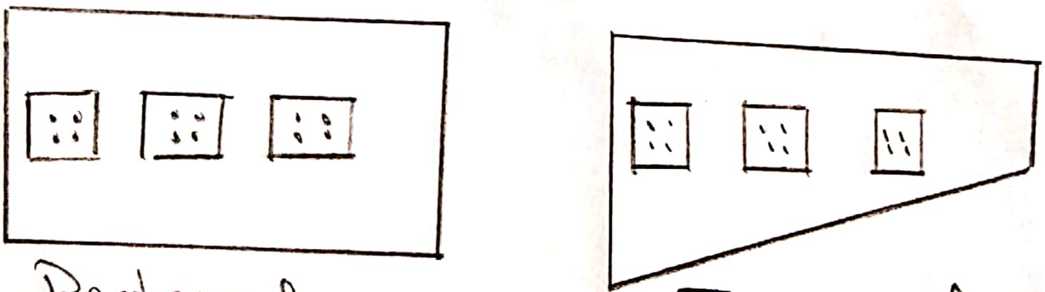
It is also called strip footing.

ii) Combined Footing:-

The footing which is Constructed for two or more Column & transfer the load of two or more Column to the Soil Safely.

⇒ If the load of Column is uniform then the Combined footing will be rectangular in shape.

⇒ If the load of Column is not uniform then the shape of Combined footing will be troperiodal



Rectangular Tropezoidal

3) Raft/MAT Foundation:-

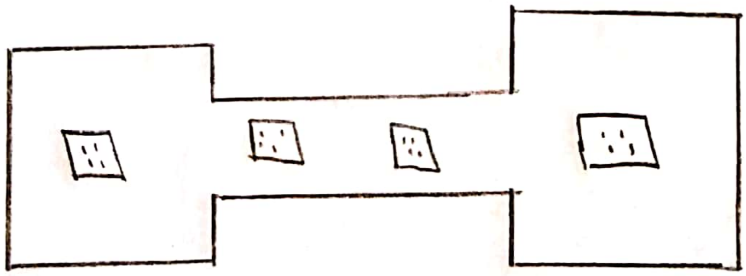
The footing which Covers the whole area of the Structure is

Called roft footing.

This is Suitable for area having weak bearing capacity soil.

4) Strapped footing:-

The footing in which the outer Column is Connected with the inner Column by mean of the beam or strap.

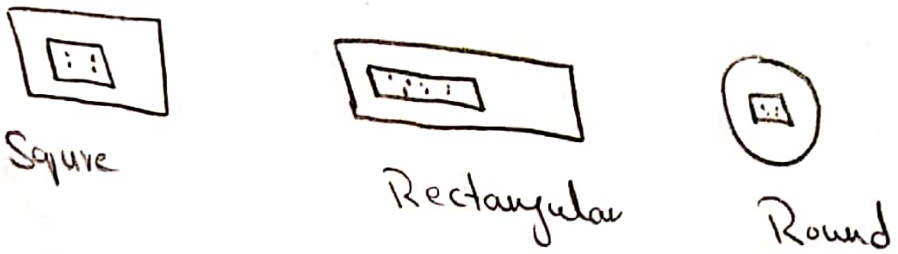


5) Isolated footing:-

The footing which have Constructed for a Single Column & transmit the load to the Soil

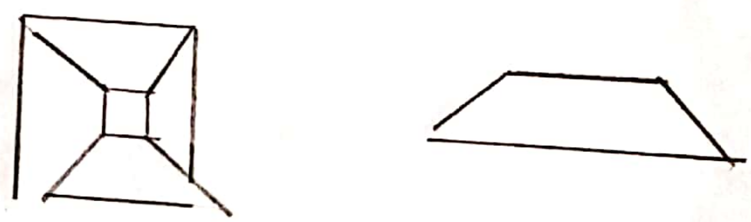
Safety.

It may be Circular, Squre, rectangular in Shape.



6. **Slopped Footing:-**

The footing which have slope in all direction or in all side.



2B

Importance of Ground improvment techniques

The Soil in which Volumetric change take Place due to shrinkage & Swelling Such soil needs ground improment techniques

- The Soil which is organic in nature
- The soft soil also require ground improvment technique.
- The soil which is sandy & gravely.
- The foundation in santary dump places also need ground improvment technique.

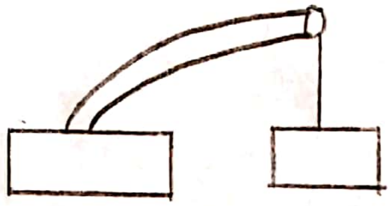
Method of Ground improvement technique

1) Removel & Placement of Soil:

This is oldest & Simplest method which is performed on loose soil. In this method the Unsuitable soil is replaced with Compacted fill & Same Soil is Used to refill the higher Compaction & better engineering Properties.

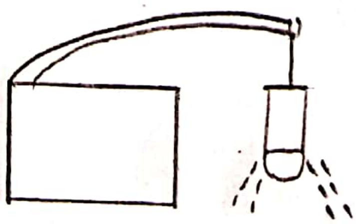
ii) Dynamic Compection

This method is Used to Increase the bearing Capacity of Soil which also Increase the Consididation rate This method also Increase the density of Soil



3) Vibro Compaction

also Called vibro densification
In this method the Compaction take place at a Certain depth in Vibratory probe is run by on electric moter. The penetration of Probe is entance by ejecting water at the tip of Probe.

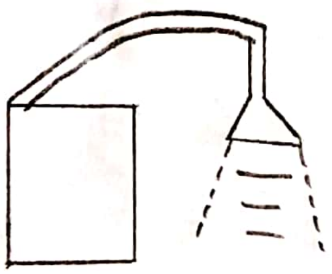


4) Rapid Impact Compaction:-

impact energy is require to Surface of ground as a result of which densification of soil take place upto a depth of 15m

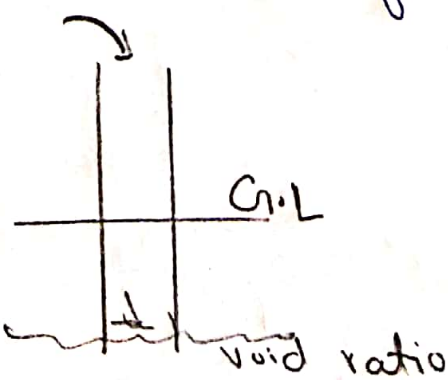
This impact energy is usually applied through hydraulic ramp.

The hydraulic ramp weight values from 4-8 tones



5) Vibro Concrete Column

It is ground improvment techniqes which transfer the load from weak strata to hold strata by using strength concrete.



Q 15

P = 15

Ans 3

Given Data

$C = 25\ KN/m^2$

$\phi = 16^\circ$

$G = 2.72$

$e = 0.50$

Required Data

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

F_c (FOS) when there is seepage in soil

Solution

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

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

$$\boxed{\gamma d = 17.8\ KN/m^3}$$

D=16

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

$$\boxed{F_c = 1.18}$$

When there is Seepage of water

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

$\gamma' = \gamma - \gamma_w$

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

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

$\gamma' = \gamma - \gamma_w$

$\gamma' = 21.04 - 9.8$

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

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

$$\boxed{F_c = 0.816}$$

P = 17

A4
4A

Given Data

Height = 10 m

c = 18.8 KN/m²

γ = 17 KN/m²

ϕ = 20°

F.O.S = 1.5

$F\phi$ = 1.0

Required

Inclination i = ?

Solution

$$SN = \frac{c}{F.O.S \times \gamma \times H} = \frac{18.8}{1.5 \times 17 \times 10}$$

$$\boxed{SN = 0.073}$$

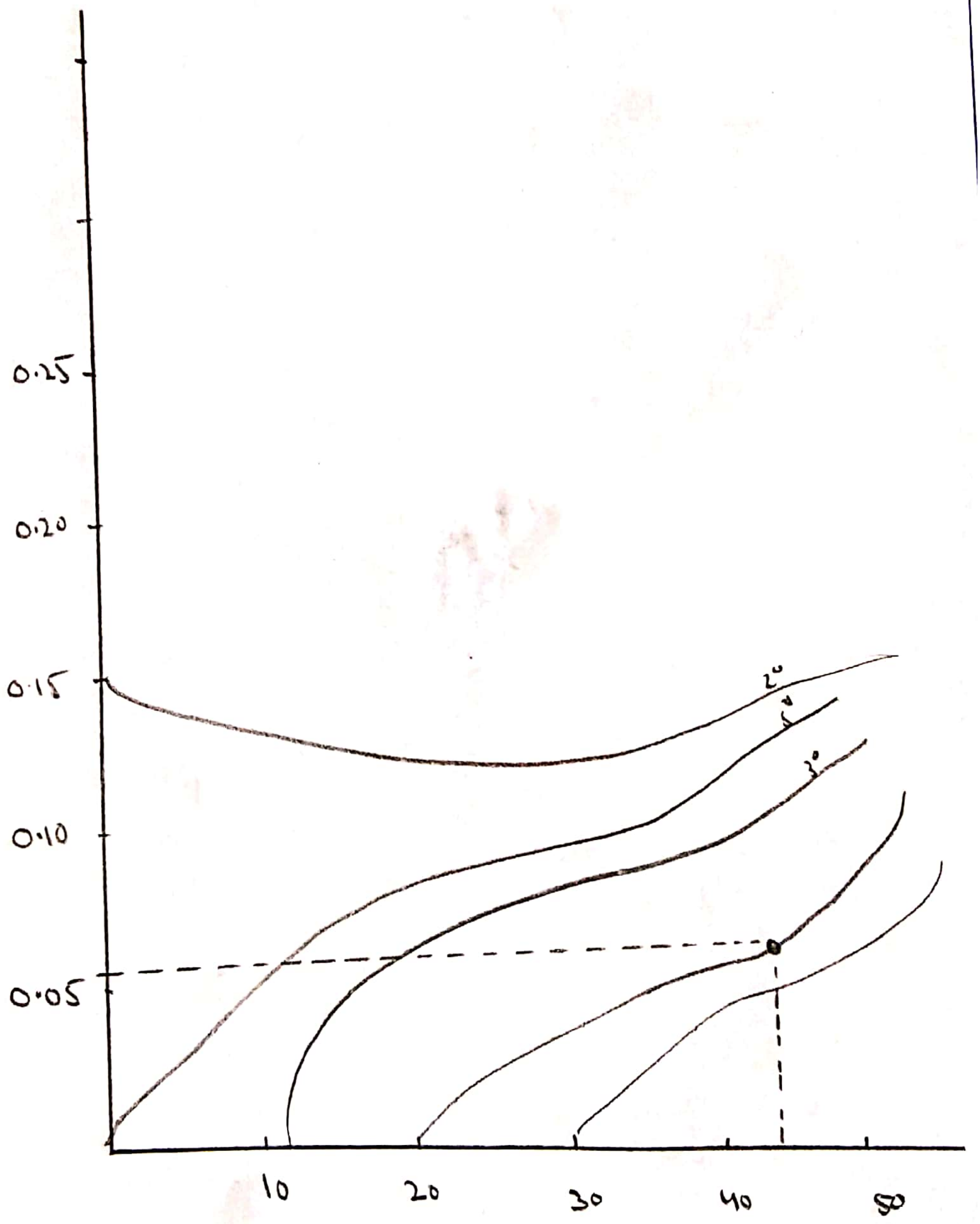
Using taylor chart for

$\phi = 20°$

$SN = 0.073$

$$\boxed{i = 44°}$$

P = 17 (A)



4b

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
- Free Beard = 3.5m
- Silt deposite height = 2.5m

Required

Silt pressure = ?

Solution

As we know that

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

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

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