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SECTION :

4B

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SUBJECT :

GEOTECHNICAL ENGG

QUESTION. 1

FORCES ACTING ON DAM.

Following are forces acting on dam.

1> Water Pressure
2> Up Lift Pressure
3> Wave Pressure
4> Silt Pressure
5> Ice Pressure
6> Sesmic forces
7> Self weight of the dam.

1> WATER PRESSURE:-

Water Pressure is one of the mass major external forces acting on gravity dam. The horizintal water ~~stem~~ Pressure exerted by the water stored on upstream side of dam can collected from hydrostatic Pressure.

2) SILT PRESSURE:-

If 'h' is the hight of silt deposited, then forces exerted by the silt in addition to external water pressure can be reprented by formula.

$P_{silt} = \frac{1}{2} \gamma_{sub} h^2 K_a$ and it acts at $h/3$ from base.

whale $K_a = 1 - \sin\theta / 1 + \sin\theta$.

γ_{sub} = Submerged unit weignt of silt material

h = hight of silt deposited.

If the upstream face is inclined the vertical weignt of the silt which is supported on the slope will also acts as vertical forces.

3) WAWE PRESSURE:-

Waves are genrated on the Surface of the reservoir by the blowing winds. which can cause a pressure towards the downstream Side wave Pressure and it depends upon the wave height. hight may be given by following eq.

$$h_w = 0.032\sqrt{VF} + 0.763 - 0.271 F^{3/4} \text{ for } F < 32.$$

h_w = hight of water from top to bottom.

V = wind velocity

F = Striaght length of water.

4) ICE PRESSURE:-

The ice may be formed on the water Surface of The reservoir in cold Countries may SomeTime melt and expend. The dam face then has to resists forces exerted by the expanding ice. The forces acts Linearly along the length of dam and at the reservoir level. The magnitude of this forces varies from 250 - 1500 Kn/m².

5) WEIGHT OF DAM:-

The weight of dam body and it's foundation is the major resisting force. In ~~two~~ 2D analysis of gravity dam unit length of dam is considered. The c/s then can be divided into rectangle and triangles. These downword forces will represent the total weight of dam acting the center of gravity of dam

1 - <b>

1> SOIL LIQUIFICATION:

It is also
called earth quake liquification, ground
failure or loss of strength that
causes otherwise solid soil to behave
temperarily as a viscous solid. The
Phenomena in (water) occur in water
saturated uncolidated soil affected
by sesmic wave. which cause
ground vibration during earth quake
Although earth quake shock is the best
known cause of liquification, certian
construction partactices including blasting
and soil compaction and vibro floatation
produces this phenomena intentionally
Poorly drained fine grained soil
such as sandy silty and gravelly
soil are most susceptible to
liquification.

2> BUTRESS DAM :

A butress dam is modification or improvization ob gravity dam. It is solid walls which are constructed parallel to the water flow with some specified thickness ate regular intervals. One these butresses, an arch slab or inclined deck slab is provided to support upstream water.

TYPES:

1> Deck slab butress dam
Multiple arch butress dam.
Massive head butteress dam
Columnar buttress dam

3) INFINITE SLOPE:-

The Slope which have infinite area and finite depth Such is called infinite slope.

E.g:

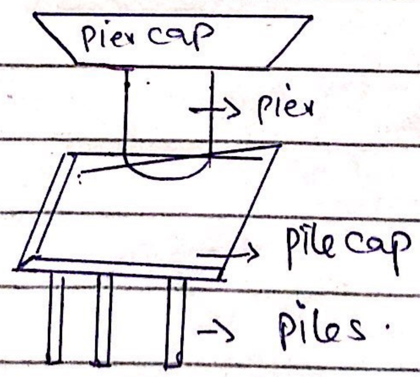
Natural Slop i-e Hill, dessert.

In infinite slope failure will be in the form of sliding

Or Slope extending infinity or up to an extent whose boundries are not well defined.

4) PIER FOUNDATION:-

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



57 DYNAMIC LOAD:

Soil dynamic deals with the engineering behaviour of soil subjected to time varying load and load applied very rapidly.

In soil dynamic applied loads vary with time. This implies that the stress and strain induced in the soil are also function of time.

Dynamic load occurs when loading condition are changing with time. It may be in form of earth quake, operation of heavey machienary wave motion, wind etc. Dynamic load causes settlment.

QUESTION - 2 (a)

SHALLOW FOUNDATION.

DEFINITION:

The foundation in which depth of foundation is less as equal to width of the foundation is called Shallow foundation

$D_f \leq B$.

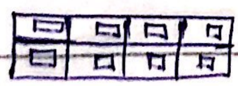
SKEMPTOM:

According to Skemptom the foundation in which depth D_f / B ratio is less than as equal to 2.5 than it is called shallow foundation.

TYPES:-

1) WALL FOOTING:-

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

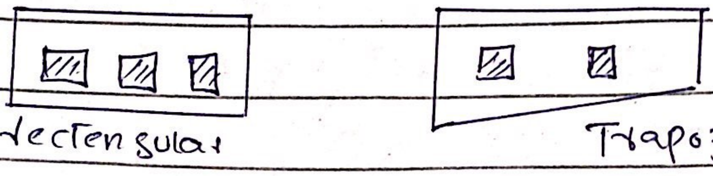


wall footing

27 COMBINED FOOTING:

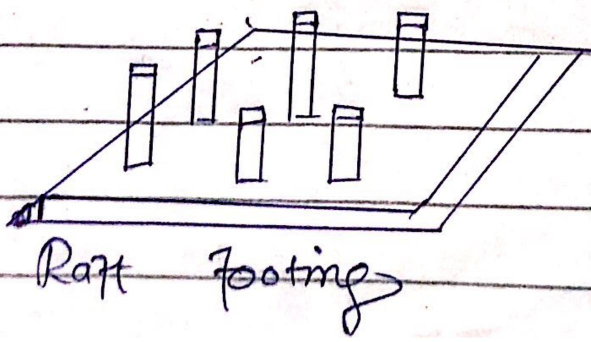
The footing which is constructed for two or more coloumn and transfer the load of the two or more coloum to the soil safely then it's called combined footing.

If load is uniform then footing will be rectengle. if not uniform then footing will be trapozoidal



RAFT FOOTING :-

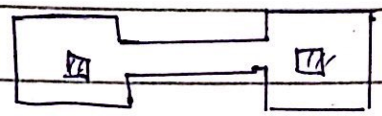
The footing which covers the whole area of the structure is called raft footing. It is proposed in area which have soil weak in bearing capacity. This is also provided when load of super structure is heavy



4> STRIPPED FOOTING:-

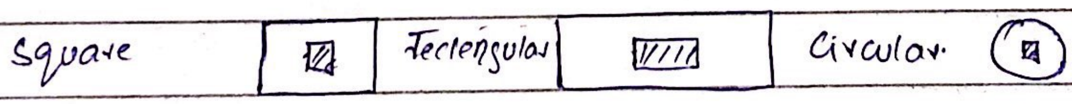
The footing in which the outer coloumn is connected with the inner coloumn by means of beam or strap is called strapped footing.

top weiw



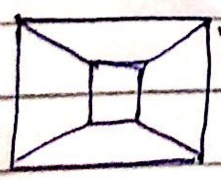
5> COLUMN ISOLATED FOOTING:

The footing which is constructed for a single coloumn and transmit its load to soil safely. it may be circular sphare or rectengular. or circular.



6> SLOPED FOOTING:

The footing which have slope in all direction as in all sides is called sloped footing



Sloped foundation

QUESTION 2 - D

GROUND IMPROVEMENT TECHNIQUES.

Ground improment techniques are the techniques which are used to enhance the engineering property of soil in order to bear heavey structual load.

The main properties are shear strength, permebility, bearing capacity and stiffness.

NEED OF GROUND IMPROVEMENT TECHNIQUES.

The soil in which volumatric changes takes place due to shrinkage and swelling such soil needs ground improment techniques

→ The soil which is organic

→ Soft soil

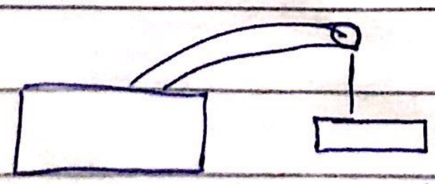
→ Sandy soil or gravity soil.

17 REPLACEMENT OF SOIL:

This is an oldest and simple method. This method to unsuitible soil is replaced wilk compacted fill. In This same soil is used to refill the hiegher compaction and better engg properties. This method is applicable above ground water table.

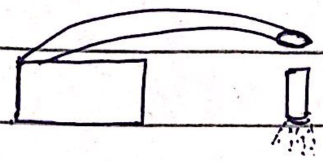
DYNAMIC COMPACTION:

This method is used to increase the bearing capacity of soil. This also increases consolidation rate. This method also increases density of soil. In This method actually densification of soil take place.



3> VIBRO COMPACTION:-

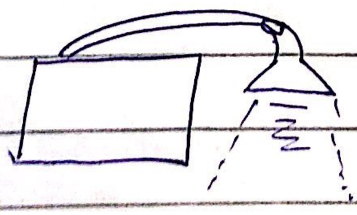
It is also called Vibro densification. In this method the compaction takes place at a certion depth in granulal soil through vibratory probe. This vibratory probe is run by an electric motor. The penetration of probe is enhance by ejecting water. at the tip of prope.



4> RAPID IMPACT COMPACTION:-

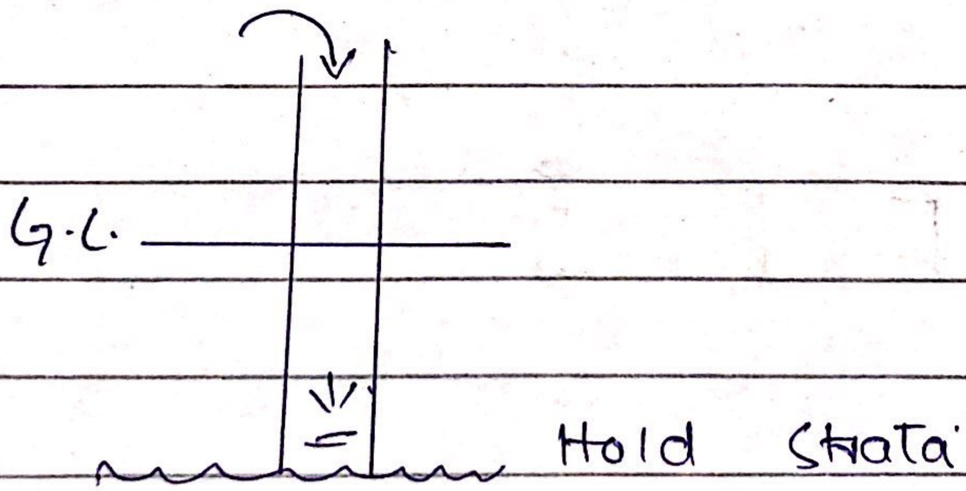
Impact energy is applied to surface of ground as a result of which densification of soil take place upto a depth of 15 ft

This impact energy is actually applied through hydraullic ramp. The hydraullic ramp weight varies from 4-8 Tons



5> VIBRO CONCRETE COLUMN:-

Vibro concrete collumn is a ground improment technique which transfer The load from weak strata to hard strata. by using strength concrete.



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QUESTION - 3

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:-

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

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

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

$$Fc = \frac{25}{17.816 \times \sin(26^\circ) \times \cos(26^\circ)} + \frac{\tan 16^\circ}{\tan 26^\circ}$$

$$Fc = 1.18.$$

When there is seepage of water

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

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

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

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

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

$$\Rightarrow 21.04 - 9.8 \Rightarrow 11.24 \text{ KN/m}^3$$

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

$$Fc = \boxed{0.816}$$

QUESTION - 4 (a)

GIVEN DATA:-

Hieght $h = 10\,m$

$c = 18.8\ KN/m^2$

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

$\phi = 20$

$F.O.S = 1.5$

$F\phi = 1.0$

REQUIRED :-

Inclination = ?

SOLUTION:-

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

$$\Rightarrow \frac{18.8}{1.5 \times 17 \times 10} \Rightarrow 0.0873$$

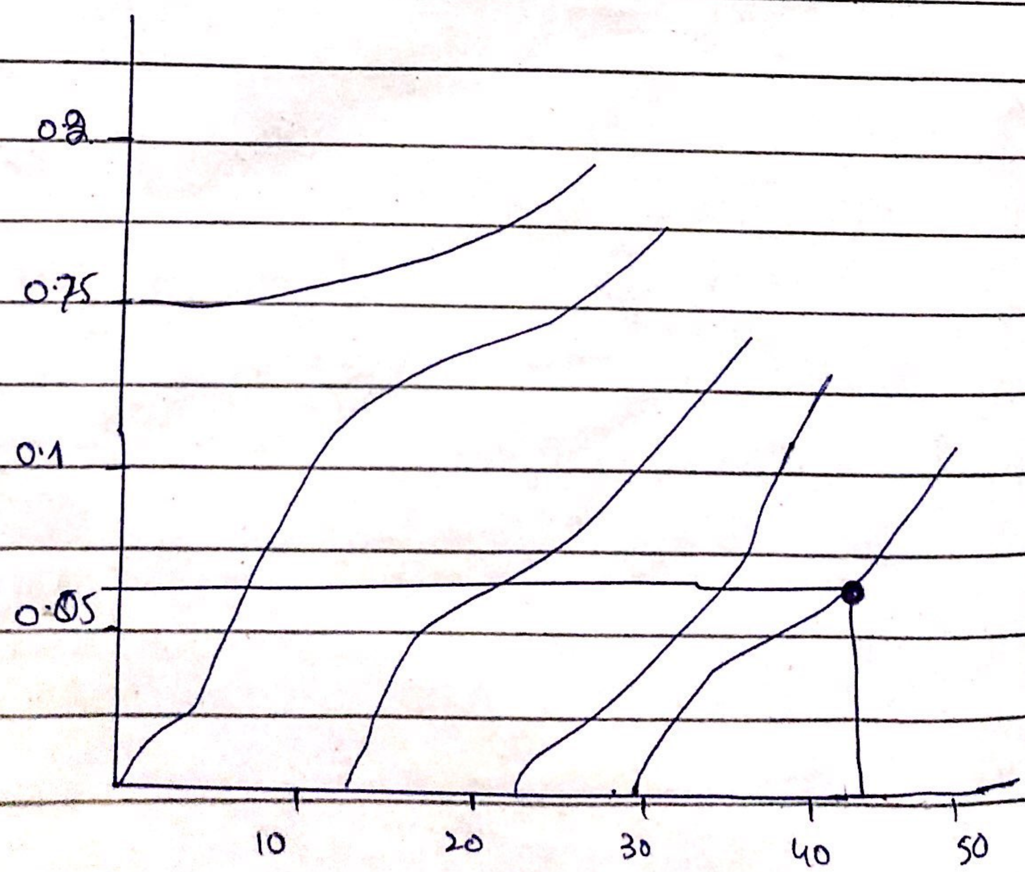
Using taylor chart:

$\theta = 20$

$S_N = 0.073$

Then

i 44 from tyler chart.



4- D

GIVEN DATA:-

hight of water = 15m
Bottom width = 12m.
Top width = 6m
γ_{water} = 1000kg/m³
$\gamma_{concrete}$ = 1450
γ_{silt} = 1330kg/m³
θ = 35°
Free boared = 3.5m
H = 2.5m.

REQUIRED:-

Silt Pressure, Ps = ?

SOLUTION:-

As

$$P_s = \frac{\gamma_{silt} \times H^2}{2} \times \frac{1-\sin\theta}{1+\sin\theta}$$

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

$$\Rightarrow \frac{1330 \times 2.5^2}{2} \times 0.27$$

PS. $\Rightarrow$ 1122.18 Kg m.