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SECTION = A

PAPER = GEOTECHNICAL ENGINEERING

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QUESTION # 01 (PART #A)

FORCING ACTING ON A DAM

The various external forces acting on a dam;

=> Water pressure
=> uplit pressure
=> Pressure due to Eqaqk vuake forces
=> Silt pressure
=> Wave pressure
=> Itself weight
=> Ice pressure

So I will explain five on them.

1) **WATER PRESSURE:-**

Water Pressure is the Most Major External force acting on such a dam. The horizontal Water Pressure exerted by the weight of Water stored on the upstream side of

the dam can be estimated from the Rule of hydrostatic Pressure distribution.

⇒ Which is a triangular in shape.

⇒ When the upstream face is vertical the intensity is Zero at the water Surface and equal to γH at the base. Where γH is the unit weight of Water and H is the depth of water. The Resultant force due this external water.

⇒ $P = \frac{1}{2} \gamma H^2$; (acting at $H/3$ from base).

2) UPLIT PRESSURE:-

Water Seeping throught the Pores, cracks and fissure of the foundation Material and water Seeping though dam body and then to the bottom though the Joint b/w the body of the dam. It is the Second Major external force and must be accounted for all calculation. Such an uplit force viotually Reduce the downward weight of the body of the dam and

and hence, acts against the dam stability.

3) EARTAQUAKE FORCE:-

If the dam is to be designed, is to be located in a Region, which is susceptible to Earthquake, allowance must be made for stresses generated by the Earthquakes.

An Earthquake produces waves which are capable for shaking the Earth upon which the dam is resting in every possible direction.

4) WAVE PRESSURE:-

Wave are generated on the surface of the Reservior by the blowing winds, which cause a pressure toward the downstream side. Wave pressure depend upon the wave height. Wave height may be given by the Equation.

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

FOR $F < 32$ KM.

$\Rightarrow$ $HW = 0.032\sqrt{V.F}$

FOR $F > 32$ KM

5) **ICE PRESSURE:-**

The ice pressure which may be found on the surface of Reservoir in cold countries. May sometimes Melt and expand. The dam face is then to Resist the thrust exerted by the expanding ice. The force acts lineaoly along the lenght of the dam and the Reservior level. The Magnitude of this force varies from 250 to 1500 KN/m^2 depends upon the temperature variations, on an average, a value of 1500 KN/m^2 may be allowed under ordinary condition.

QUESTION NO=1 (PART-B)

1) LIQUIFICATION OF SOIL:-

⇒ A phenomenon where by a saturated or partially saturated soil substantially losses strenght and stiffness in response to an applied stress, usually Earthquake shaken or other sadden change in stress condition, causing it to behave like a liquid is called soil liquification.

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

2) BUTRESS DAM:-

It a dam consisting of a relatively thin water supporting facing or deck supported by

buttress generally in the form of Equally spaced triangular walls or counter forts that transmit the water load and deck weight to the foundation.

3) INFINITE SLOPES:-

Slope which have great extent with uniform soil condition at any given depth below the surface and the stratum is not necessary.

4) PIER FOUNDATION:-

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

Though file foundation transfer the load through "pier" bearing. pier foundation transfer the load only through bearing.

5) DYNAMIC LOAD:-

A dynamic load is any load that moves changing magnitude or direction over time. Load in a static system are constant and un-changing, shock loads, impact loads impact loads and vibrational loads can all be considered dynamic in nature, but are not the same.

QUESTION NO#2 (PART # A):-

SHALLOW FOUNDATION:-

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

TYPES OF SHALLOW FOUNDATION:-

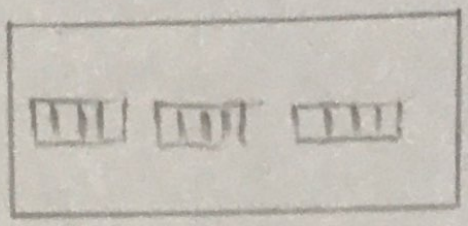
1) WALL/STRIP FOOTING:-

The wall 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.

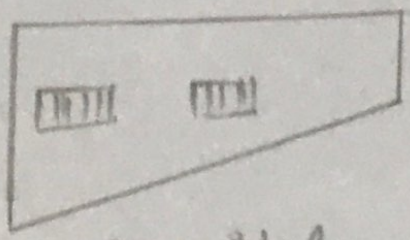
2) COMBINED FOOTING:-

The footing which is constracted for two or more column and transfer the load of two or more coloumn to the ground safety then it is called combined footing.

If the load of the column is uniform then it is Rectangular in shape. If the load of the column is not uniform then it is toapezoidal.



Rectangular



Toapezoidal.

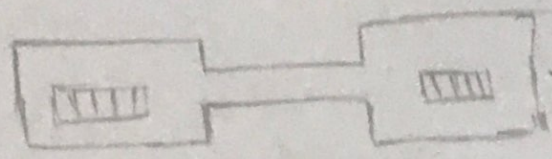
3) RAFT FOOTING:-

The footing which covers the whole area of the structure is called Raft footing. The type of footing is proposed in area which have soil weak in bearing capacity. It is also provide when load of structure is heavy.

4) STRAPPED FOOTING:-

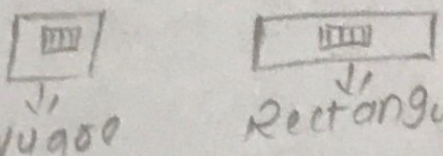
The footing in which the outer column is "com" connected with the inner

by means of the beam or strap is called strapped footing.



5) COLUMN FOOTING:-

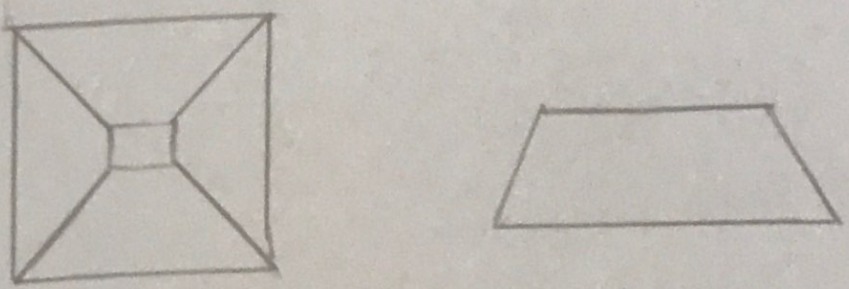
The footing which is constructed for a single column and transmit the load into soil safely.
It may be circular, Rectangular or square in the shape.



(II) → Square

6) SLOPPED FOOTING:-

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



QUESTION NO = 2 (PART = B)

IMPORTANCE OF GROUND IMPROVEMENT TECHNIQUES:-

The soil in which volumetoic changes take place due to shoinkage and swelling such soil need goound improvement techniques.

=) The soil which is organic in nature.

=) The soft soil also Requised goound improvement techniques.

=) The soil which is sandy and gravelly. The foundation in sanatooy dump places also requised goound improvement techniques.

METHODS OF GROUND IMPROVEMENT TECHNIQUES:-

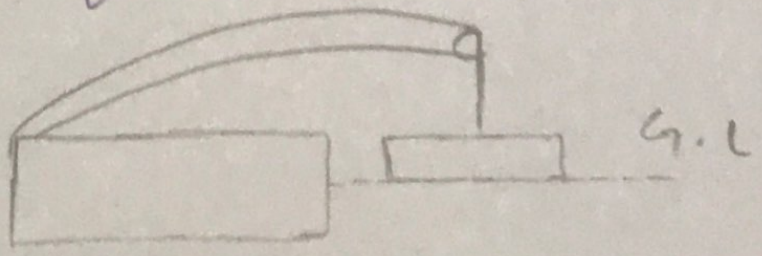
1) REMOVAL AND REPACEMENT OF SOIL:-

This is an oldest and simple method is perfoomed on loose soil.

In this Method the unsuitable soil is Replaced with compacted fill. In this Method the same soil is used to Refill the higher compaction and better engineering properties.
This Method is applicable above the ground water table.

2) **DYNAMIC COMPACTION:-**

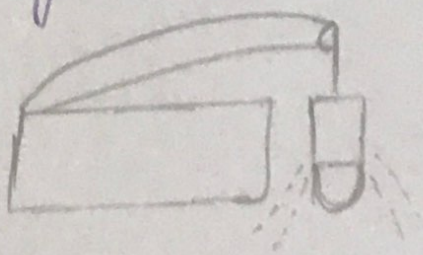
This Method is used to increase the bearing capacity of soil. This also increase the consolidation Rate. This Method also increase the density of soil. In this Method actually din-sification of soil take place.



3) **VIBRO COMPACTION:-**

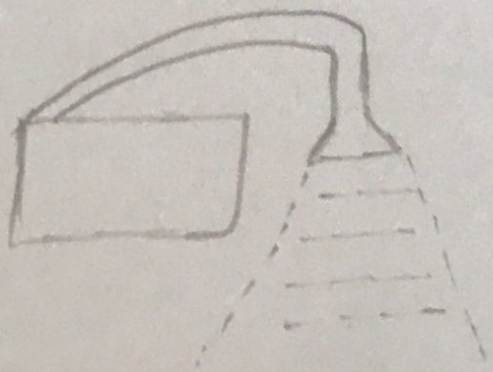
It is also called vibro dinsification In this Method the compaction take place at a certain depth in granular soil though vibratory poobe.

This vibratory is a Run by an electric Motor. The penetration of Probe is entrance by ejecting water at a tip of poobe.



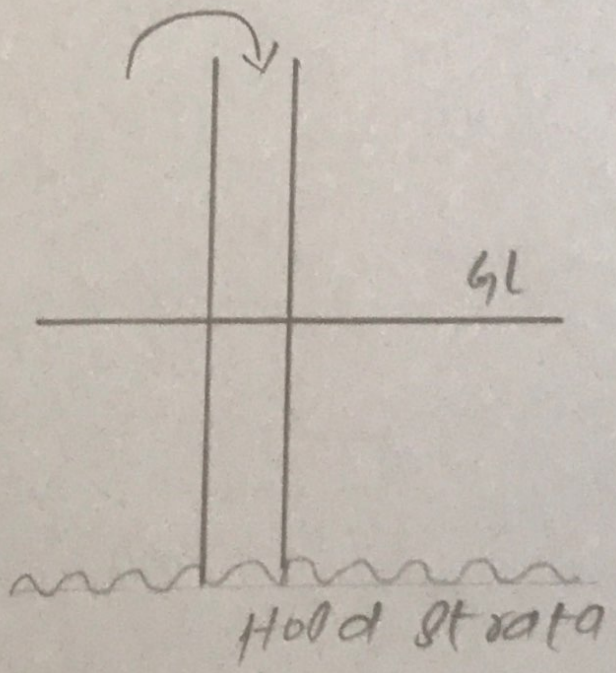
4) RAPID IMPACT COMPACTION:-

Impact energy is applied to surface of ground as a Result of which classification of soil take place upto a depth of 15 feet.
This impact energy is gradually applied thoough hydraulic Ramp.
The hydraulic Ramp weight values from 4-8 tons.



5) VIBRO CONCRETE COLUMN:-

Viboo concoete tolumn is a ground improovement techniques which transfoo the load froom weak strata to hold strata by using stronght concoete.



QUESTION NO #3

GIVEN DATA:-

$C = 25\ KN/m^2$

$\phi = 16°$

$G_s = 2.72$

$e = 0.50$

REQUIRED:-

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

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

SOLUTION:-

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

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

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

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

$$\boxed{Fc = 1.18}$$

Where there is seepage of water

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

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

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

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

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

$$= 21.04 - 9.8 \Rightarrow 11.24$$

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

$$FC = \frac{25}{21.04 \times 6 \times \sin(26°) \times \cos(26°)} + \frac{11.24}{21.04} \times \frac{\tan(18°)}{\tan(26°)}$$

$$\boxed{FC = 0.816}$$

QUESTION NO#4 (PART=A)

GIVEN DATA:-

Height = 10m

$c = 18.8 KN/m^2$

$\gamma = 17 KN/m^2$

$\delta = 20°$

F.O.S = 1.5

$F\phi = 1.0$

REQUIRED:-

Inclination = ?

SOLUTION:-

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

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

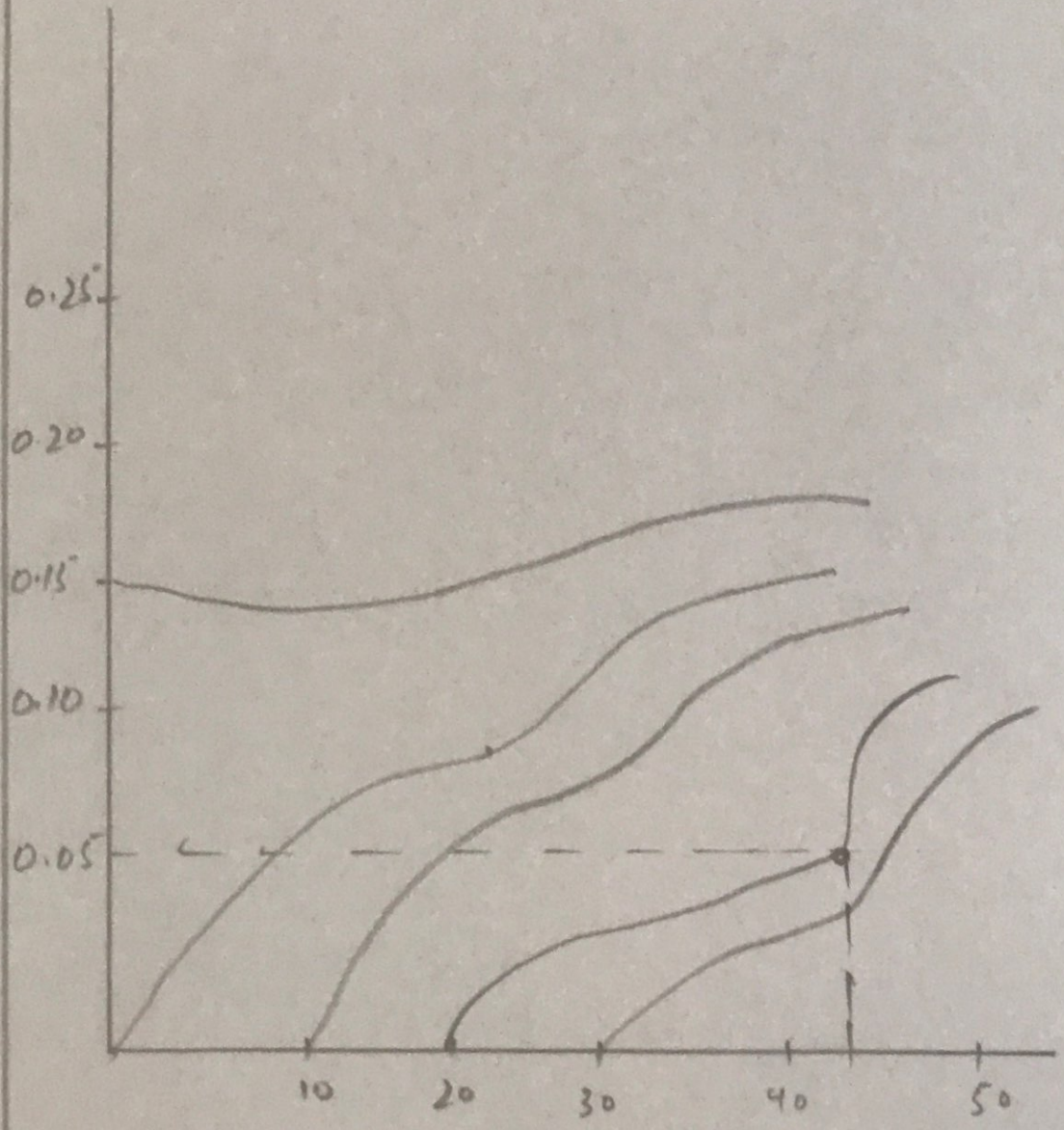
$$\boxed{SN = 0.073}$$

USING TAYLOR CHART FOR:-

$\phi = 20°$

$SN = 0.073$

$i° = 44$



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QUESTION NO #4 (PART #B)

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 silt = 1330 Kg/m³

Angle of friction for silt = $\delta s = 35^{\circ}$

Free board = 3.5m

Silt Deposit height = 2.5m

REQUIRED:-

Silt pressure = ?

SOLUTION:-

As we know that

$$Ps = \frac{\gamma s \times Hs^2}{2} \times \frac{1-\sin\delta}{1+\sin\delta}$$

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

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