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Section	A
Final paper	Geotecnical Foundation & Engr.
Semister	6th

QNO.1):

(a):

Ans: Forces Acting on Gravity Dams

- Water pressure
- uplift pressure.
- Earthquake Forces
- silt pressure
- wave pressure.
- ICe pressure
- Weight of Dam.

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

2- Uplift pressure: Water seeping through the pores and fissures of the foundation material and water seeping through the dam of the body and there to the bottom through the joints between the body of the dam and its foundation at the base, exerts an uplift pressure on the base of the dam.

This kind of uplift pressure virtually reduces the downward weight of of the body of the dam and hence acts against the dam stability. It is assumed that uplift pressure are not affected by the earthquake forces.

It can be controlled by constructing weight of walls under the upstream face by constructing drainage channel between the dam and its foundation and by pressure grouting the foundation.

3- Silt pressure: If "h" is the height of silt deposited, then force exerted by the silt in addition to external water pressure can be represented by Rankine's formula.

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

Where $K_a = 1 - \sin\phi / 1 + \sin\phi$

γ_{sub} = Submerged unit weight of silt material.

h = height of silt deposited.

If the upstream face is inclined, the vertical weight of the silt which is supported on the slope will also acts as a vertical force. As per USBR, the total horizontal force will be $1.8 h^2$ Kn/m and vertical force will be $4.6 h^2$ Kn/m.

4- Ice pressure: The ice which may be found on water surface of reservoir in cold countries may sometimes melt and expand. The dam face then has to resist force exerted by the expanding ice. This force acts linearly along the length of the dam and at the reservoir level. The magnitude of this force varies from 250-1500 KN/m².

5- Weight of Dam: The weight of the dam body and its foundation is the major resisting force. In two dimensional analysis of the gravity dam, unit length of the dam is considered. The c/s then can be divided into rectangles and triangles. The resultant of all these downward forces will represent the total weight of dam acting the center of gravity of dam.

Q NO. 1):
(B):

Ans: Liquification of soil: A phenomenon whereby a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in the stress condition, causing it behave like a liquid is called soil Liquefacation.

Butress Dam: The term "Butress dam" as it applies to the area of the weather can be defined as Butress dams are comprised of reinforcement masonry or stonework built against concrete. They are usually in the form of flat decks or multiple arches. They required about 60 % less concrete than gravity dam, but the increased from work and reinforcement steel required usually offset savings in concrete.

Infinite Slope: An infinite slope is simply a vertical line. When you plot it on a line graph, an infinite slope is any line which runs parallel to the Y-axis. You can also describe this as any line, that doesn't moves along the x-axis but stays fixed at one constant x-axis coordinates n making the change along x-axis 0.

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. It stood several feet above the ground. It is also known as post "foundation"

Dynamic load: A dynamic load is any force that changes with time, such as car tyres, people walking, and wind gusts.

QNO.2):

(A):

Ans): Shallow Foundation:

According To TERZACHI: The foundation in which depth of the foundation is less or equal to width of the foundation is called shallow foundation. $D_f \leq B$.

According To SKEMPTON: The foundation in which D_f/B ratio is less than or equal to 2.5 than the foundation is called shallow foundation.

Types of shallow Foundation:

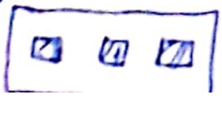
1- Wall Footing.
2- Combine Footing.
3- Raft/Mat Footing.
4- Strapped Footing.
5- Column/Isolated Footing.
6- Slopped Footing.

1- Wall/Strip 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.

2- 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 safely then it is called combined footing.

If the load of column is uniform then the combined footing will be rectangular in shape.

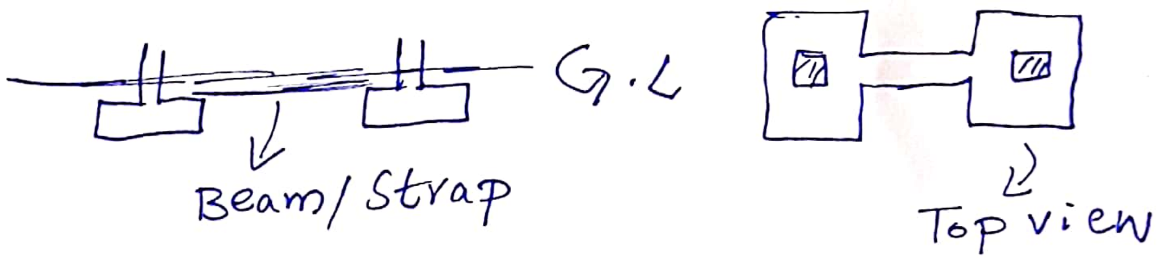
If the loud of column is not uniform then shape of combined footing will be trapezoidal.

Rectangular



→ Trapezoidal

3-Raft/MAT Footing: The footing which covers the whole area of the structure is called roof footing. This type of footing is proposed in area which have soil weak in bearing capacity. This is also provided when the load of super structure is heavy.

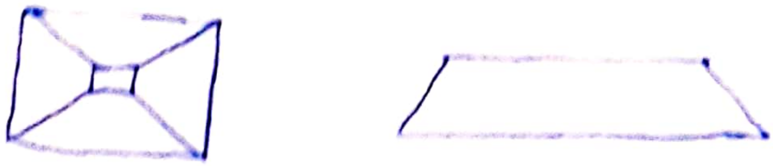
4- Strapped Footing: The footing in which the outer column is connected with the inner column by means of the beam or strap is called strapped footing.



5- Column/Isolated Footing: The footing which is constructed for a single column and transmit its load to the soil safety.

It may be circular, square, rectangular in shape.

6- Scopped Footing: The footing which is have slope in all direction or in all side is called as slopped footing.



QNO.2):
(B):

Ans: Ground Improvement Techniques:

Ground Improvement techniques are the techniques which are used to enhance the engineering property of soil in order to bear heavy structural load.

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

Need of Ground Improvement Techniques:

The soil in which volumetric changes take place due to shrinkage and swelling such soil needs ground improvement techniques.

- The soil which is organic in nature.
- The soft soil also required ground improvement techniques.

· The soil which is sandy and gravely.

The foundation in sanatory dump places also required ground improvement techniques.

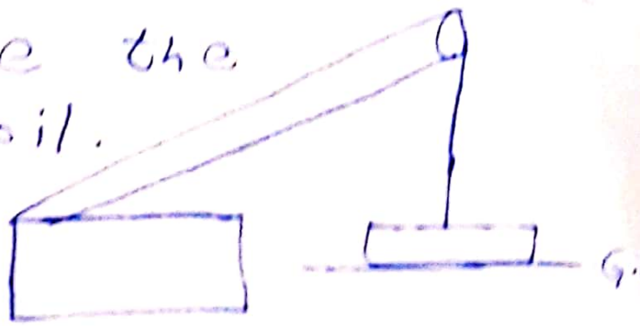
Method of Ground Improvement Technique

1- Removal & Replacement of soil: This is an oldest and simple method. This method is performed on loose soil.

In this method the unsuitable soil is replaced with compacted fill. 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.

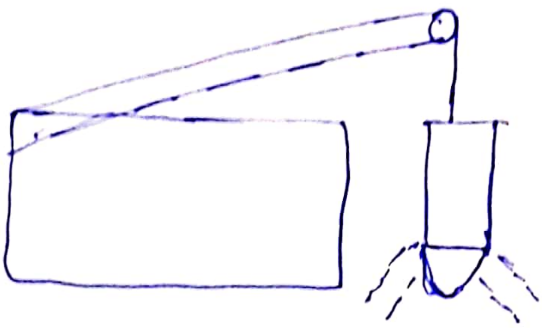
This method is applicable above the ground water table.

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



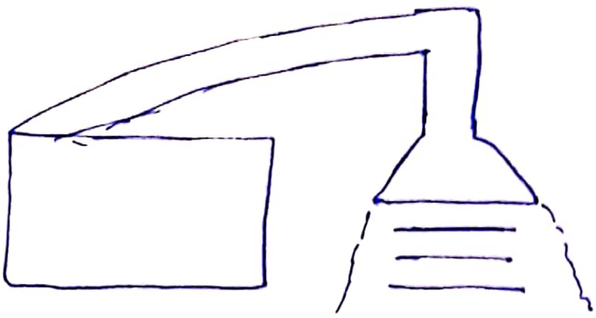
densification of soil take place.

3- VIBRO Compaction: It is also called vibro densification. In this method the compaction take place at a certain 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 probe.

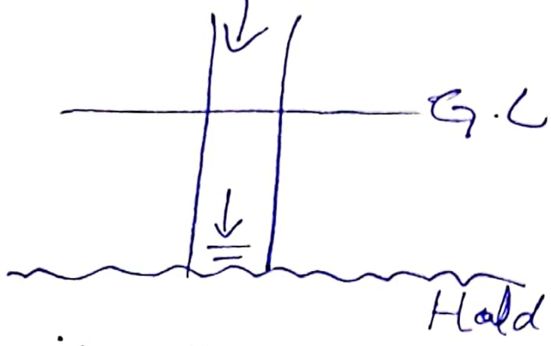


4-Rapid Impact Compaction: Impact energy is applied to surface of ground as a result of which densification of soil take place upto a depth of 15 feet.

This impact energy is actually applied through hydraullic ramp. The hydraulic ramp weight varies from 4 – 8 tons.



5- VIBRO Concrete column: Vibro concrete columns is a ground improvement technique which transfer the load from weak strata to hald strata by using strength concrete.



6- Wet Soil Mixing: In this method of ground improvement technique a paste of cement is prepared and inserted in the soil. This method is used to improve the characteristic of weak soil by using cementitious binder slurry.

7- Dry Mixing of soil: Dry soil mixing is ground improvement technique by which the characteristics of weak soil are improved by using dry cementitious binder.

QNO.4):

(A):

Given Data: Height = H = 10m

$C = 18.8\ KN/m^2$

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

$\phi = 20^\circ$

FOS = 1.5

Fø = 1.0

Required:

Inclination, i = ?

Solution: As we know that

$$S_N = \frac{C}{FOS \times \gamma \times H}$$

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

$S_N = 0.073$

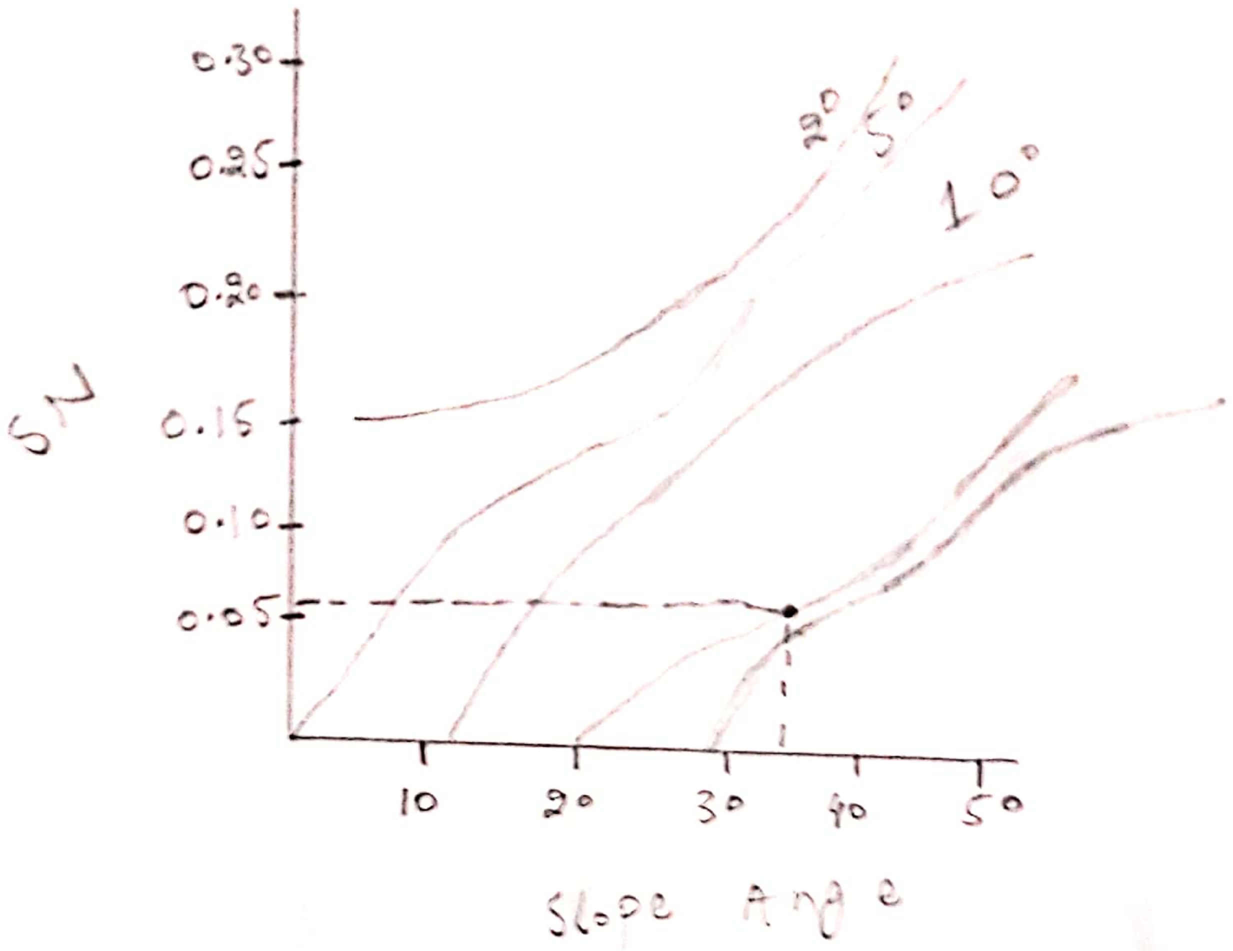
Using Taylor Chart for

$\phi = 20^\circ$

$S_N = 0.073$

then

i = 44 (From taylor chart).



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QNo.4):

(B):

Given Data:

Height of Water on upstream side=16m

Bottom width of dam=12m

Top width=6m

unit wgt of water=1000 Kg/m³

unit wgt of concrete=1450 Kg/m³

unit wgt of silt=1330 Kg/m³

Angle of friction for silt= ϕ_s=35°

Free Board=3.5m

Silt Deposite height=2.5m

Required:

Silt pressure=?

Solution: As we know that

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

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

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

QNO.3):

Given Data:

$C = 25\ KN/m^2$

$\phi = 16^\circ$

$G = 2.72$

$e = 0.50$

Required:

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

Solution:

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

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

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

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

$\boxed{F_c = 1.18}$

When there is seepage of Water.

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

$\gamma' = \gamma - \gamma_w$

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

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

$\gamma = 21.04 \ KN/m^3$

$\gamma' = \gamma - \gamma_w$

$= 21.04 - 9.8$

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

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

$$\boxed{F_c = 0.816}$$