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Section B

Semester 6th

Subject "Geotechnical Engineering"

Submitted To,
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QNO(02):-

(A) "Forces acting On Dam"

(1) - Weight OF Dam
(2) - Water Pressure
(3) - Uplift Pressure
(4) - Wave Pressure
(5) - Earth and Silt Pressure
(6) - Earthquake Pressure
(7) - Ice Pressure
(8) - Wind Pressure
(9) - Thermal loads

(1) Weight OF Dam:-

This is the major resisting Force.

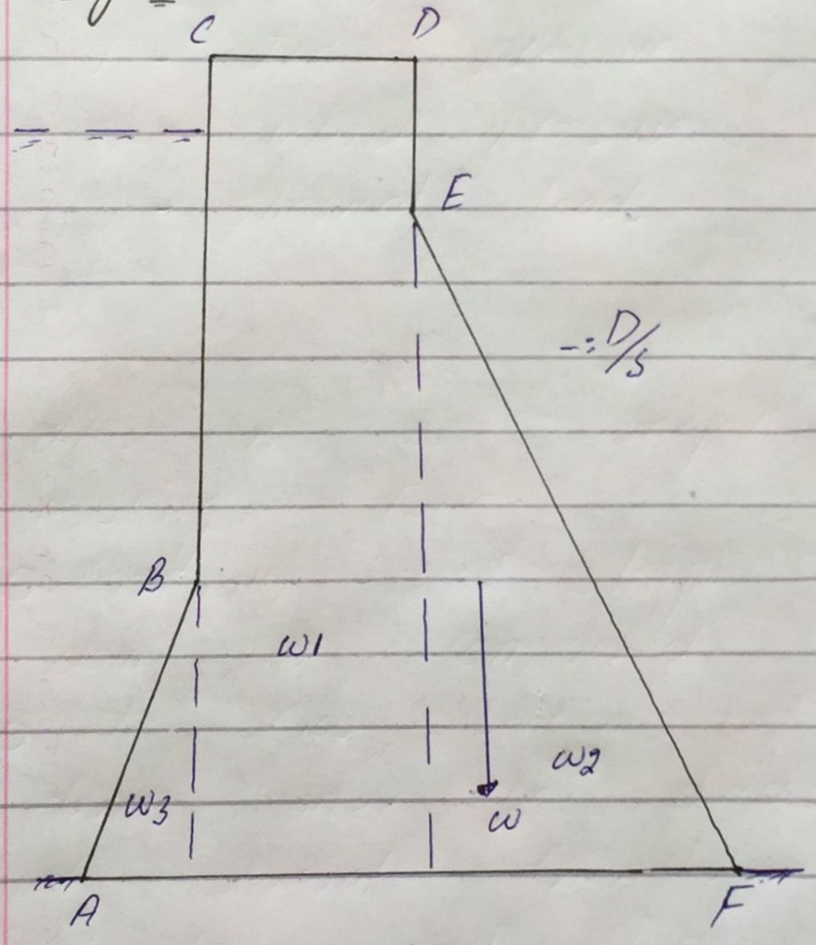
- Generally unit length OF dam is considered.
- The Cross Section of dame may be divided into Several triangles and rectangles and weights W_1, W_2, W_3 etc may be Computed.

- The total weight of the dam act's at C.G of its Section

Mathematical Form :-

- Weight = vol per unit length * Density of material.

Diagram:-



(2) Water Pressure :-
These are the major external Force acting on dam

⊙ Pressure Components on both upstream and downstream are;

1- Vertical Component
2- Horizental Component

⊙ Unit weight of water -: Formula $p = \frac{1}{2} \gamma_w h^2$

⊙ γ_w = 1000 kg/m^3

(3) Wave Pressure :-

⊙ When very high wind flow over the water Surface of the reservior. wave are formed which exert pressure on the upstream part of the dam.

⊙ The magnitade of wave depend upon -

⊙ velocity of wind
⊙ Depth of Reservior
⊙ Area of water Surface.

- It is calculated by the following Formula.

$$P_v = 2.4 \gamma_w * h_w$$

- P_v = Wave pressure
- γ_w = Unit weight of H_2O
- h_w = Height of Wave.

(4) Uplift Pressure :-

- The water Stored on the upstream side of the dam has a tendency to Seep through the Soil below foundation.
- While Seeping, the water exerts a uplift Force on the base of the dam depending upon the head of water
- This uplift pressure reduce the Self weight of the dam.

- To reduce the uplift pressure. drainage galleries are provided on the base of the dams.
- It is calculated By the following formula;

$$U = \frac{1}{2} \gamma w * h_B$$

- U = Uplift pressure.
- γw = Unit weight of water.
- h_B = Width of the base of dam.

(5) Ice pressure :-

- The Ice Pressure which may be formed on the Surface of Reservior in cold Countries, may SomeTimes melt and expand.
- The dam face has then to resists the thrust exerted by the expanding Ice.

- This force acts linearly alonge the length of the dam and at the reservior level.
- The magnitude of this force depending upon the temperature variation.
- These magnitud varies from 250 to 1500 kN/m^2.
- On an average, a value of 500 kN/m^2 may be allowed under ordinary Condition.

(B)

(1) Liquification OF Soil :-

It is define as;
A Phenomenon whereby a Saturated or partially Saturated Soil Substantially losses Strength and Stiffness in response to an applied Stress, usually earthquake Shaking or other Sudden Change in the Stress Condition causing it to behave like a liquid is called Soil liquification

Types :-
- Flow Liquification
- Cyclic mobility.

(2) Butress Dam :-

A Butress Dam is define as;
A dam Consisting of a relatively thin water Supporting faceing or deck Supporting by butress is Generally in form of

equally Spaced triangullar walls or counter forts that transmit the water load and deck weight to the foundation.

(3) Infinite Slope:-

The slope Which have infinite area and finite depth Such a Slope called as infinite Slope

Example:-

① Natural Slope i.e Hills, Mountains, desert etc.

(4) pier Foundation:-

The vertical member which have large dia as Compared to pile and transmit the load of Structure to the underground Soil they are Constructed by Cast -in- situ process.

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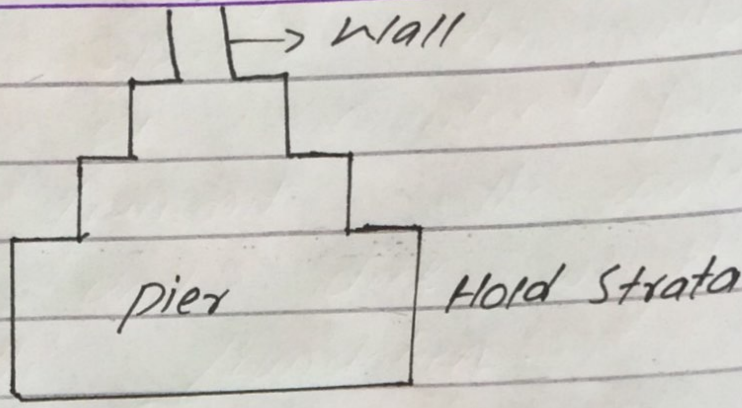
Diagram:-



(5) Dynamic load:-

- Load that change rapidly or Suddenly are called dynamic load.
- They are dangerous if ignored.
- magnitude of a load can be greatly increased by its dynamic effect

QNO(02):-

(A) Shallow Foundation:-

According to "Dr Karl Terzaghi"

- Foundation in which the depth of the foundation is less than the breath then Such a foundation is termed as Shallow foundation.

"According to Skempton"

- The foundation in Df/B ratio is less than 2.5 Such of S foundation is termed as Shallow foundation
  - Df = Depth of foundation.
  - B = breath of foundation.

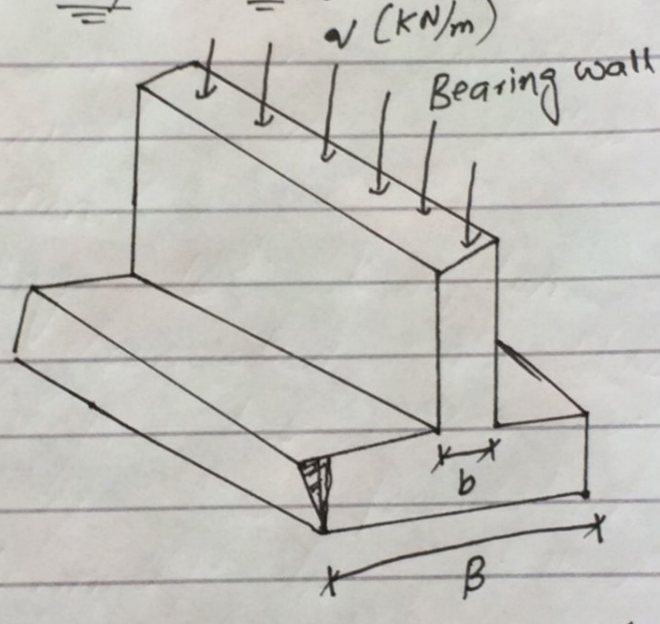
Types OF Shallow Foundation:-

Shallow Foundation is divided into the following main types;

(1) Wall / Strip footing :-

- Wall footing/strip footing is footing which runs across the length of the footing.

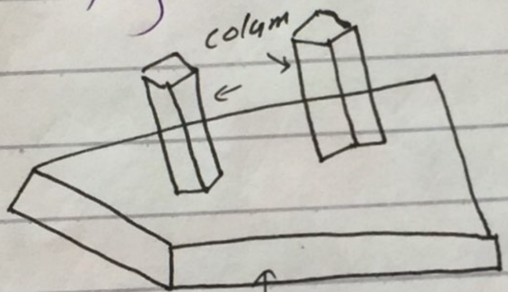
"Strip footing"



(2) Combined footing :-

- Footing which constructed combined for two or more colum to transfer the load of these columns safely to the soil then such footing called combined footing

- If load colums are uniform mean equal magnitude then shape of Combined footing will rectangular.
- if load of column is not uniform mean not equal magnitude then shape of footing will trapezoidal.



(3) Strapped Footing :-

- Footing in which the outer Column is Connected with the inner Column by means of tie beam or strap such a footing is called strapped footing.

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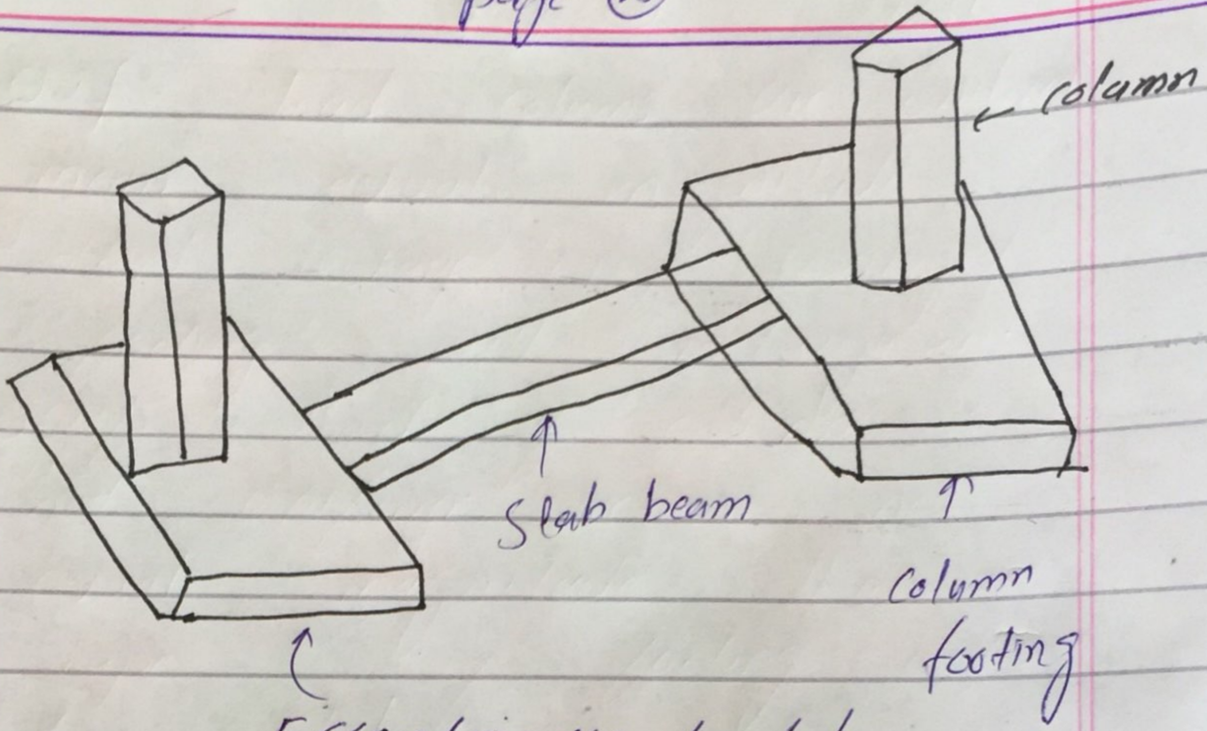
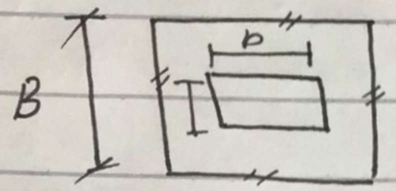


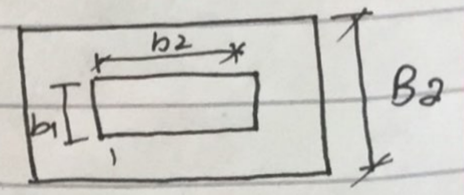
Eccentrically loaded Column Footing

(4) Isolated/column Footing:-

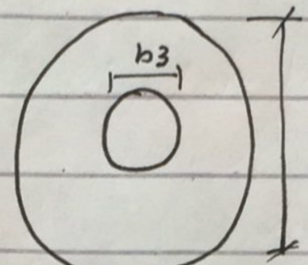
- Footing which is Constructed for a Single Column and Transfer its load Safely to Soil called column
- This column may be
  ~~cut~~
  - curculor
  - rectangular or
  - Square Shaped.



Squaer Footing



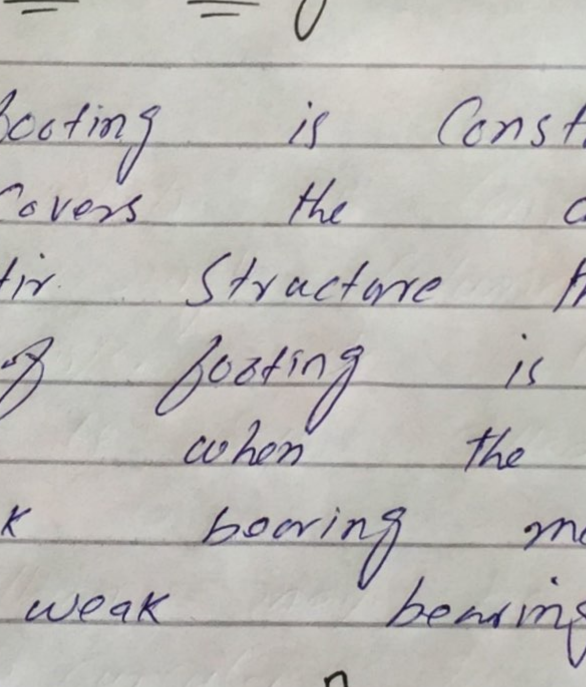
Rectangular Footing



Circular Footing

(5) Raft /mat Footing:-

◎ Raft footing is Constructed and Covers the area of entir Structure this type of footing is provided when the Soil is weak boaring mean having weak bearing Capacity.



Slab type foundation

(B) Ground Improvement Techniques :-

- Ground Improvement technique are the technique which are used to enhance the engineering property of soil in order to deal having structural load.
- The main property are are shear streanght, permeability, bearing capacity and stiffeness etc.

Need of Ground Improvement Technique :-

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

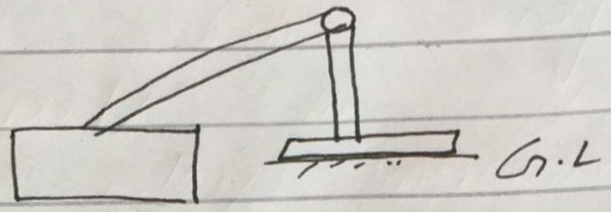
- Soil is organic in nature
- Soft soil also required Ground improvement.
- Soil which Sandy and gravely the foundation in Sanatoury improvement technique

"Methods of Ground improvement techniques"

1 - Removal and Replacement of Soil :-

- This is an oldest and Simple method this method is preffered on losse 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 good aplicable above the ground water table.



2- Dynamic Compaction:-

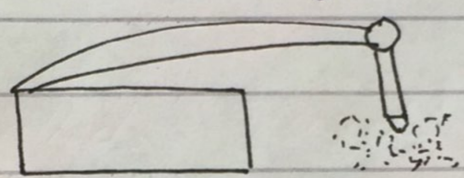
- This method used to increase the bearing capacity of soil
- This method also increase the Consolidation rate.
- This method actually densification of soil table plase.

3- Vibro Compaction:-

- It is also called vibro densification.
- This method the Compaction takes at a Certain depth in granular Soil through vibreating probe.

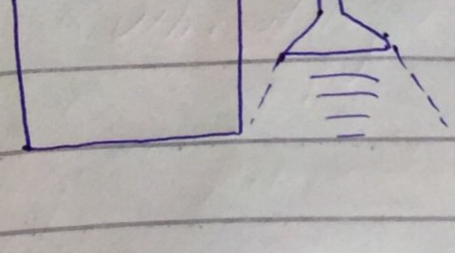
This vibrating probe is can by elestic motor.

- The penetration of probe is enhance by ejecting water at trip of probe.



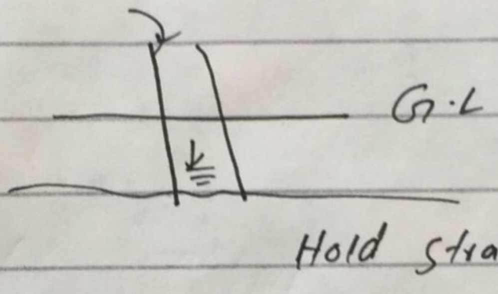
4- Rapid Impact Compaction:-

- 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 hydroulic ramp.
- The hydroulic ramp weight value from 4-8 to tons.



5- Vibro Concrete Column :-

vibro Concrete columns is a ground improvement technique which transfer the load from weak Strata to hold Strata by using Streaght Concrete.



QNO(03):-

Given Data:-

- $C = 25\ kN/m^2$
- $\phi = 16^\circ$
- $G = 2.72$
- $e = 0.50$

Req:-

- fc (F.O.S) when Soil is dry
- fc (F.O.S) when there is Seepage

Solution:-

- We know that:

$$fc = \frac{c}{\gamma d * H * \sin i * \cos i} + \frac{\tan\phi}{\tan i}$$

$$\gamma d = \frac{Gs * \gamma w}{1+e} = \frac{2.72 * 9.8}{1+0.5}$$

$$\gamma d = 17.8\ kN/m^2$$

Now

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

$$\boxed{fc = 1.18}$$

⊙ When there is Seepage of water.

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

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

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

$$\gamma = \frac{2.72+0.5}{1+0.5} * 9.8$$

$$\gamma = 21.04 \ KN/m^2$$

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

$$= 21.04 - 9.8$$

$$\gamma' = 11.24 \ KN/m^2$$

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

$$f_c = 0.826$$

thus the Required results.

QNO(04):-

(A) Given Data:-

- Height = 10m
- C = 18.8 KN/m2
- γ = 17 KN/m2
- ϕ = 20°
- F.O.S = 1.5
- Fϕ = 1.0

Req:-

Inclination (i) = ?

Solution:-

We have

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

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

$$SN = 0.073$$

using taylor chart For $\phi = 20°$

Now SN = 0.073

$$\boxed{i = 44°}$$ Ans

(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/m^3
- Unit weight of Concrete = 1450 Kg/m^3
- Unit weight of silt = 1330 Kg/m^3
- Angle of friction for the silt = ϕ_s = 35°
- Free Board = 3.5m
- Silt Deposite height = 2.5m

Required:-

Silt pressure (P_s) = ?

Solution:-

Silt pressure:-

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

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$$ps = \frac{1330 * (2.5)^2}{2} + \frac{1 - \sin(35)}{1 + \sin(35)}$$

$$= 4156.25 * 0.22$$

$$\boxed{ps = 1122.18 \ kg/m}$$

Ans

End