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Signature:

Qno1. Name the forces acting of dam. Explain any five of them.

Answer. Different type of force acts on a Dam, whose determination is first Step in the desig of Dam.

Forces which act on Dam are given below.

- → Water Pressure
- → Earth quake forces
- → Self weight of the dam
- → Wave pressure
- → Silt Pressure.

(1) WATER PRESSURE: It is the Pressure of water, that acts Perpendicular on the upstream face of the dam.

Then, there are two Cases for this,

(1) upstream face of the dam is verticle and there is no water on the down stream Side of the dam.

The total Pressure is in horizontal direction and acts on the upstream face.

Mathematically, it can be Proved as;

$$P_1 = WH^2/2$$

where

W = Specific weight of water.

H = Height of water, up to which it is Stored.

(2) upstream face with batter and there is no water on the downstream Side.

The Water Pressure of down stream actually Stabilize the dam.

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(2) Earthquake forces:- Dynamic loads Created due to earthquake must be Considered in the design of all major dams located in high-risk Seismic region, and for dams Situated in Close Proximity to Potentially Active geological fault

Seismic waves influence both, dam body and water in the reservior of the dam. So, the generated dynamic loads are due to the "inertia of Dam" and "Hydrodynamic" force.

(3) Self weight of Dam: The weight of Dam and its foundation is a major resisting force. It Can be Computed using following equation.

$W = \gamma_w$ Volume.

where;

$\gamma_w$ = Unit weight of Dam material.

Q1-4

(4) Silt Pressure: The weight of Dam & its foundation is a major resisting force. It act at h/3 from the base and can be computed as;

$$P_{silt} = 0.5\, \gamma_s h^2 K_a.$$

where;

$K_a$ = Coefficient of active earth pressure

$\gamma_s$ = Submerged unit weight of silt material.

$h$ = height of silt deposited.

(5) Wave Pressure: Wave are generated in reservior by the blowing wind, which exerts a pressure on the upper part of dam above the water level, which can be computed as;

$$P_w = 2.4\, \gamma_w h.$$

Qno 1(B) Define the following terms Q7-B1

1. Liquification of Soil
2. Butress Dam
3. infinite Slope
4. Pier foundation
5. Dynamic load.

Ans:

Liquification of Soil. When a Sturated or Partially Satured Soil Substantially loss Strength and Stiffness in response to an applied ~~force~~ Stress, Such as Shaking during an earth quake or other Sudden Sudden Change in Stress Conditions, is called "Liquification of Soil."

buttress Dam: A dam with a Solid, water tight upstream side, that is Supported at an interval on the downstream side by a Series of buttress or Supports is Known is buttress.

Q7-B2

(3) infinite Slope: A Slope, that extend for a relative long distance and has a Consistant Subsurface profile may be analysed as an infinite Slope. The failure plane for this case is parallel to the surface of slope and the limit equilibrium method can be applied ~~can~~ easily.

(4) Peir foundation: A Peir foundation is a Collection of large diameter Cylindrical ~~Column~~ Coloumn to Support the Super Structure and transfer large Super-imposed loads to the firm firm Strata below.

Q. - B7

5) <u>Dynamic load</u> :- The load, which acts on ground ~~at~~ by the movement of Subjects and Sometimes the Load due to earthquake Can be Classified as Dynamic load.

Q2 (i) A

Q no 2: (A): Define Shallow foundation. Explain each type of Shallow foundation in details with Appropriate Sketch.

Answer: **Shallow foundation**: The foundation in which the depth of the foundation is less than the breath, then such a foundation is termed as "Shallow foundation".

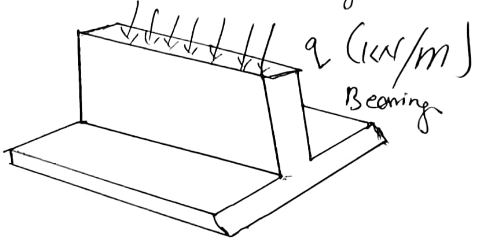
## Type of Shallow foundation.

Shallow foundation is divided into the following main types.

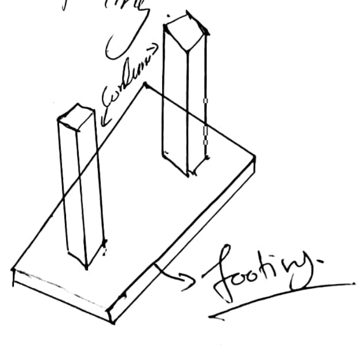
1. Wall footing
2. Combined footing
3. Mat/Raft footing
4. Coloumn footing
5. Strapped footing.

Q2 - 2A

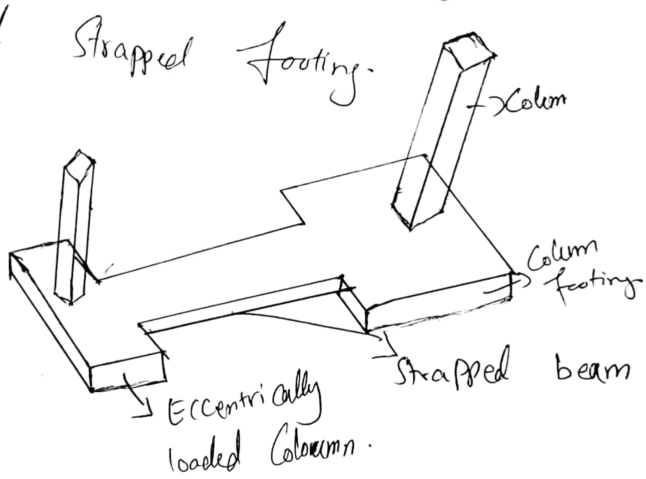
① WALL/STRIP FOOTING: The wall footing is a footing type, which Runs across the length of The footi.



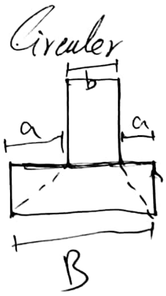

② Combined footing: Footing, Which is Conscructed Combine of two or more colums to transfer the load of these colums to transfer the load of these colums safely to soil, is know as combined footing.



→ **Strapped footing**: The footing, in which the outer Column is Connected with inner Column by means of tie beam or Strap, Such a footing is Called Strapped footing.



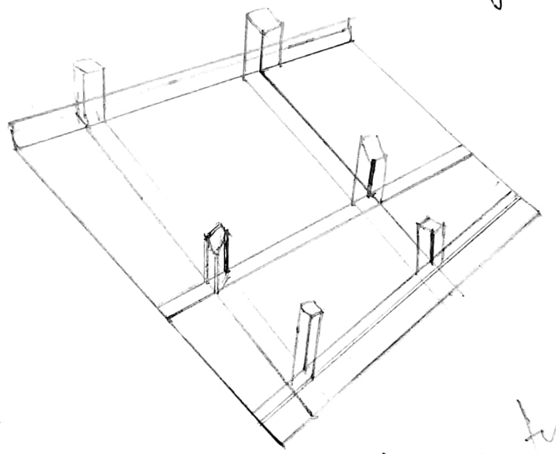

**Column footing**: Footing which is Constructed for a Single Column and transfer its load Safely to the Soil is Called Column. This Coloumn May be Circular Rec or Square in Shape.



(Q2-4A)

## RAFT FOOTING

Footing which is Constructed and Covers the area of the entire Structure, this type of footing is provided when the Soil is Weak in bearing Capacity.



Slab beam type Raft foundation.

Q no 2. Why ground improvement techniques are important. Explain five methods of ground improvement in details along with appropriate sketch (Q2 - (B)).

Ans. **Ground improvement techniques:**

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

The main properties are sheal strength, permeability, ~~bealing~~ bearing capacity and stiffness etc.

**Why is it important:** The soil, in which volumetric changes take places due to shrinkage and swelling, such soil needs ground improvement techniques.

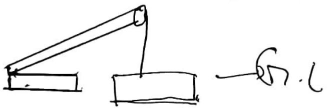
Q20 - 2.

-> The Soil which is organic in nature.
-> The Soft Soil also required g.I.

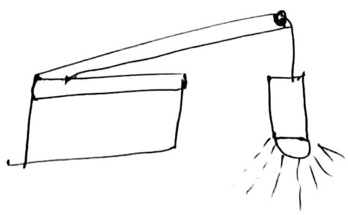
Methods.

① Removal and Replacement of Soil: This is an oldest and Simple method. This method is Perforced on loose Soil.
In this method, the unsuitable Soil is Replaced with Suitable Soil.

(2) Dynamic Compaction: In this method, the B.C of Soil is increased. This method also increase the Density of Soil.

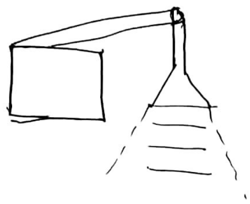



(3) Vibro Compaction: In this method, the Vibration takes place at Certain depth in granular Soil through Vibratory Probe, which is run by electric motor.

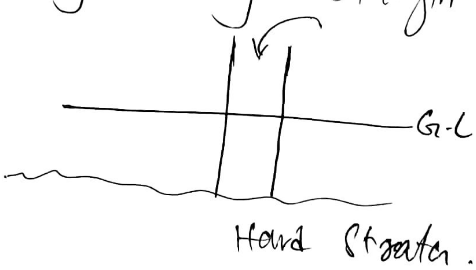


(4) Rapid impact: Impact energy is apply to ground Surface, which densify The Soil, upto the depth of 15 ft.

This metted is done by hydraulic ramp, and that ramp weighs around 4 - 8 tons.



(5) Vibro- Concrete Coloumn: Vibro Concrete Coloumn is a ground improvemt technique which transfer the load from weak Strata to hard Strata by using Strength Concrete.



Qno3: An infinitly long Slope having an inclination of 26° in an area is undertain by firm Cohesive Soil ( G= 2.72 , e=0.50), there is a thin weak layer of Soil 6m below and parallel to the slope Surface is C=25 kN/m2, Ø = 16°, Compute the factor of Safty when the Slope is dry.

If ground water flow Could occur parallel to the Slope on the ground Surface, what factor of Safty would result.

Given

$C = 25\ kN/m^2$

$\phi = 16°$

$G = 2.72$

$e = 0.50$

Required: fc (f.o.s) when Soil is dry

fc (f.o.s) when there is Seepage.

Solution:

$$f_e = \frac{c}{\gamma_d \times H_2 \times \sin i \times \cos i} + \frac{\tan\theta}{\tan i}$$

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

$$= 17.8 \text{ kN/m}^3$$

$$f_e = \frac{25}{17.8 \times 6 \times \sin(26^\circ) \times \cos(28^\circ)} + \frac{\tan 16^\circ}{\tan(28^\circ)}$$

$f_e = 1.18$.

When there is Seepage of water

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

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

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

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Q3-3

$$= \frac{2.72 + 0.5}{\not{1} + 0.5} = 9.8$$

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

$\gamma' = \gamma - \gamma_w$

~~= 21.4~~

$= 21.04 - 9.8$

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

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

$f_c = 0.816$

Q4(A) It is proposed to construct a 10m highway embankment with the following soil properties, C = 18.8 kN/m², γ = 1

Ø = 20°

Q4 (A) ①

What is the inclination required for embankment if the design F.O.S = 1.5 and $F_\phi$ = 1.0.

**Required**:

Inclination.

**Solution**,

Given data.

C = 18.8 , γ = 1

Ø = 20° , F.O.S = 1.5

$f_\phi$ = 1.0 , Height , H = 10m.

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

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

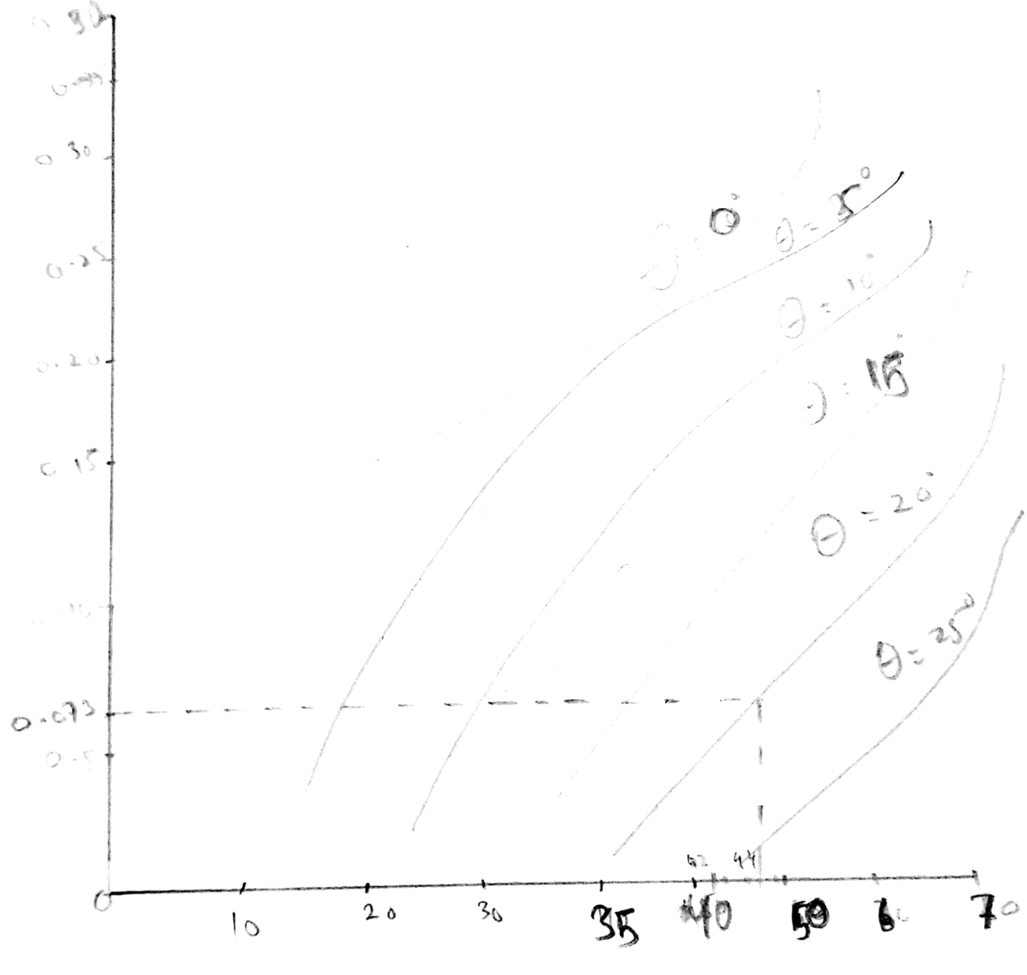
SN = 0.07

using taylor's chart

Ø = 20°

SN = 0.075

=> i = 44°.


θ = 0°
θ = 5°
θ = 10°
θ = 15
θ = 20°
θ = 25°
0.30
0.25
0.20
0.15
0.073
0
10
20
30
35
40
42
44
50
70

Q no 4 . (B) Considering the following data, find the Silt Pressure. Q40 - 0

- -> Height of water on upstream side ,= 15 m
- -> 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 the Silt = $\phi_s = 35^0$
- -> free board = 3.5m
- -> Silt Deposite height = 2.5m

**Solution** : Required : Silt pressure

Silt pressure =

$$P_1 = \frac{\gamma_w \times H^2}{2} \times \frac{1 - \sin\theta}{1 + \sin\theta}$$

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

$$= 4156.25 \times 0.27$$

$P_1 = 1122.18$ kg/m