Name IKRAMULLAH

ID 7868

Section BE(C) B

Semester 6th

Geotechnical Engineering

Final Examination Paper

Date. 27th June, 2020.

Question No 1. (A)
Name the forces acting on dam. Explain any five of them in detail.

Forces Acting on Gravity Dam

The various external forces acting on Gravity dam may be:

→ water pressure:
D is the depth of water in a reservoir, P is the hydrostatic pressure per unit area acting on the vertical face of a concrete dam assumed to behave as a rigid (in the y direction) is given by $dP/dy = \rho g$ in which ρ is the density of water and g is the acceleration due to gravity.

→ Uplift Pressure:-
white seepage through the pores, cracks and fissures of the foundation material, and water seepage through dam body and then to the bottom through the joint between the body of the dam. It is the second

second major external force and must be accounted for in all calculations. Such as uplift force virtually reduces the downward weight of the body of the dam and hence, acts against the dam stability.

⇒ Earthquake Force :- → If the dam is to be designed, is to be located in a region which is susceptible to earthquakes, allowance must be made for stresses generated by the earthquakes.

→ An earthquake produces waves which are capable of shaking the Earth upon which the dam is resting, in every possible direction.

⇒ Silt Pressure :- It has been explained under 'Reservoir sedimentation' that silt gets deposited against the upstream face of the dam. If h is the height of silt deposited, then the force exerted by this silt in addition to external water pressure, can be represented by Rankine's formula as:

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

→ where, K_a is the coefficient of Active Earth pressure of silt

→ $K_a = \frac{1 - \sin\theta}{1 + \sin\theta}$

→ where θ is the angle of internal friction of soil, and cohesion is neglected.

→ γ_{sub_w} - submerged unit weight of silt material.

→ h - height of silt deposited.

⇒ Wave Pressure :-

→ waves are generated on the surface of the reservoir by the blowing winds, which causes a pressure towards the downstream side. wave pressure depends upon the wave height. wave height may be given by the equation.

→ $H_w - 0.032\sqrt{V.F} + 0.763 - 0.271 (F)^{1/4}$ for $F < 32$ km And

→ $H_w - 0.032\sqrt{V.F}$ for $F > 32$ km.

→ where h_w - height of water from top of crest and bottom of through in metre.

→ V - wind velocity in km/hr

Ans 2 Part (B)

Following Terms.

(1) ⇒ Liquification of soil:-

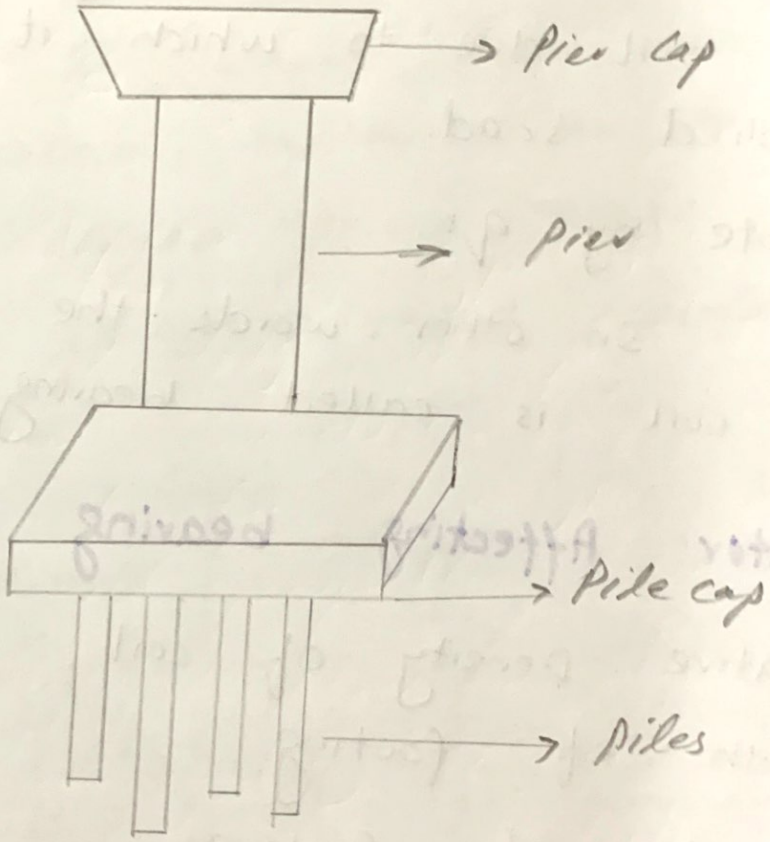
Soil liquification occurs when a saturated or partially saturated soil substantially losses strength and stiffness in response to an applied stress such as shaking during an earthquake or other sudden change in stress condition, in which material that is ordinarily a solid behaves like a liquid.

(2) ⇒ Buttress Dam :- A buttress Dam or hollow dam is a dam with a solid, water-tight upstream side that is supported at intervals on the downstream side by a series of buttresses or supports. The dam wall may be straight or curved. Most buttress dam are made of reinforced concrete and are heavy, pushing the dam into the ground.

(3) ⇒ Infinite slopes :- The type of slope extending infinitely, or up to an extent whose boundaries are not well defined. For this type of slope the soil properties for all identical depths below the surface are same. In the making of natural slopes, their is no contribution from our side.

(4) ⇒ 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".

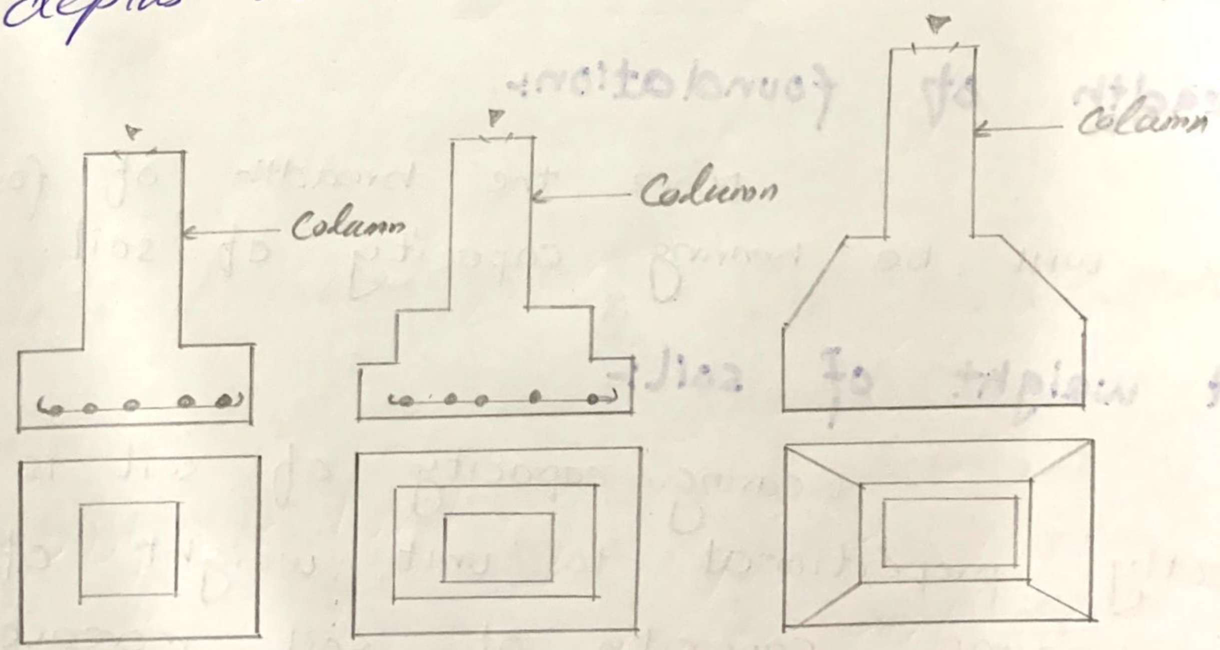


⑤ ⟹ Dynamic Load :- A dynamic load is any force that changes with time, such as car types, people walking, and wind gusts. Usually in structural engineering we treat these as static loads in order to simplify calculations.

Ans02 (A)

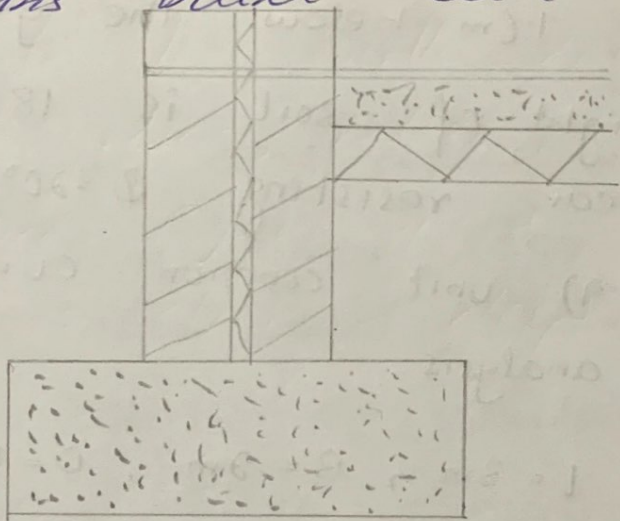
Shallow Foundations:-

A shallow foundation is a type of building foundation that transfers building loads to the earth very near to the surface, rather than to a subsurface layer or a range of depths as does a deep foundation.

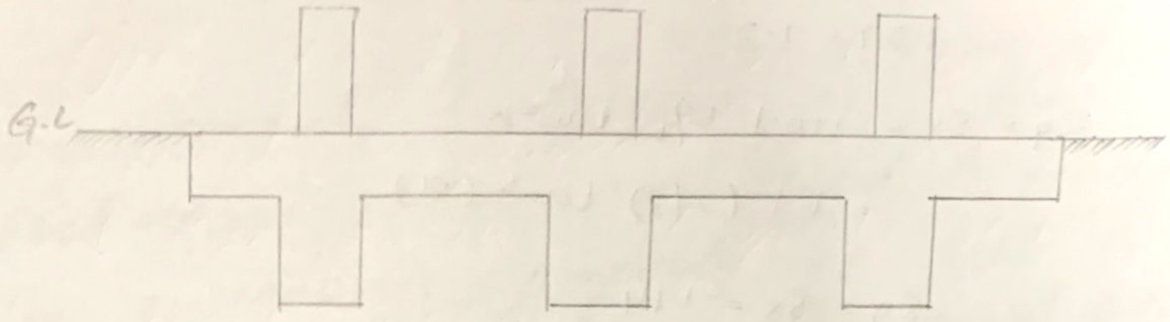


Shallow Foundation.

Strip Foundation:- strip foundation is a type of shallow foundation that are used to provide a continuous, level (or some time stepped) strip of support to a linear structure such as a wall or closely spaced rows of columns built centrally above them.



Raft Foundation:- A raft foundation, also called a mat foundation, is essentially a continuous slab resting on the soil that extends over the entire foot print of the building, thereby supporting the building and transferring its weight to the ground.



Raft foundation

⇒ Combined Foundation:-

Combined footings are constructed for two or more columns when they are close to each other and their foundations overlap. Design of combined footings with example is discussed.

The function of a footing or a foundation is to transmit the load from the structure to the underlying soil.

Ans 2 (B)

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.

Methods of Ground Improvement techniques:-

⇒ Removal And Replacement of soil:-

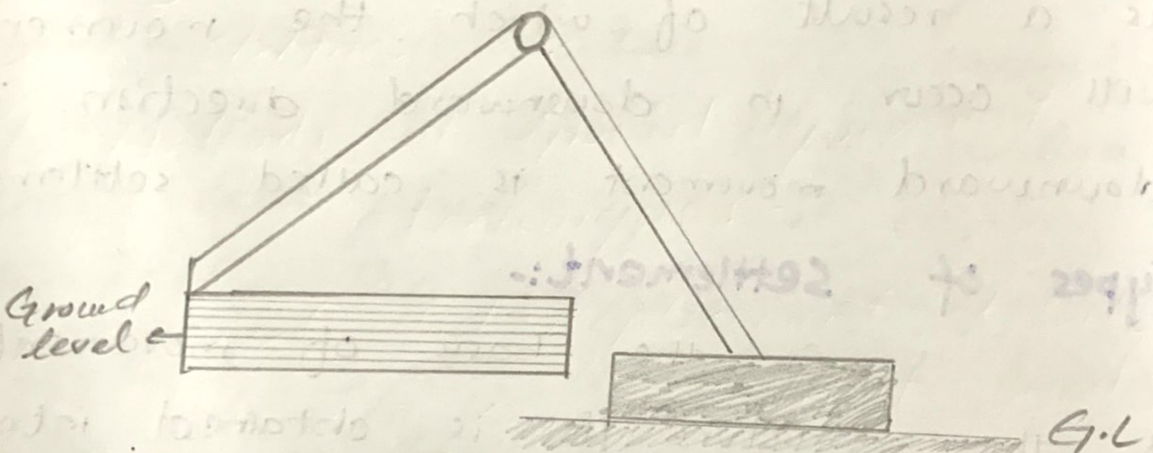
This is an oldest and simple method. This method is performed on loose soil.

In this method the unsuitable soil is replaced with compact fill. In this method the same soil is used to refill the higher compaction and better engineering properties.

This method is aplicable above the ground water table.

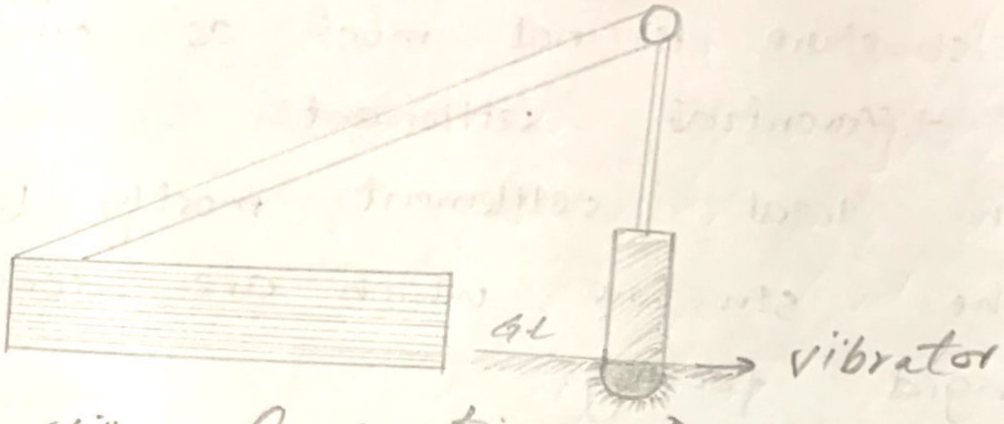
⇒ Dynamic Compaction:-

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.



⇒ VIBRO COMPACTION:-

It is also called vibro densification. In this method the compaction take place at a certain depth in granular soil through vibratory probe. This vibratratory probe is run by an electric motor. The penetration of probe is enhance by ejecting water at the tip of probe.

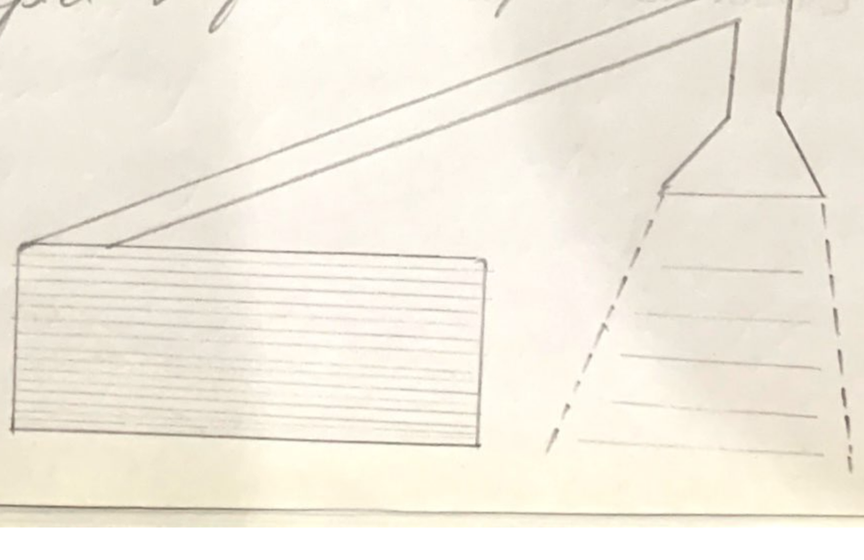


Vibro Compaction Diagram.

⇒ Rapid Impact Compaction:-

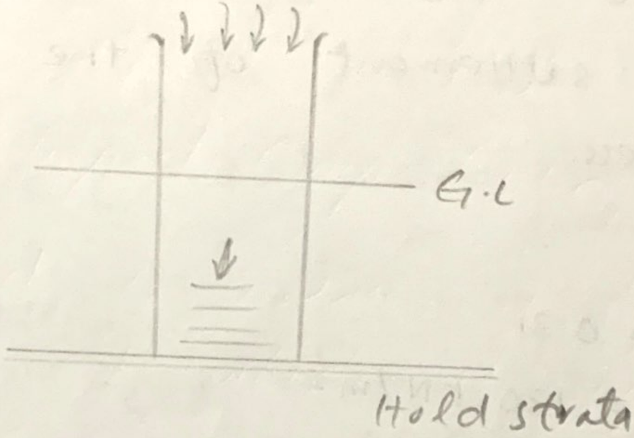
Impact energy is applied to surface of ground as a result of which densification of soil take place upto a depth of 15 feet. This impact energy is actually applied through hydraullic ramp. The hydraulic ramp weight varies from 4-8 tons.

Rapid Impact Compaction.



⇒ Vibro Concrete Column:-

Vibro concrete columns is a ground improvement technique which transfer the load from weak strata to hold strata by using strength concrete.



Q.No3 (A) **Given data :-**

$C = 25 \ kN/m^2$

$\phi = 16^\circ$

$G = 2.72$

$e = 0.50$

Required data :-

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

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

Solution :-

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

$$\gamma d = \frac{G_s \times \gamma w}{1+e} = \frac{2.72 \times 9.8}{1+0.5}$$

$\gamma d = 17.8 \ kN/m^3$

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

$Fc = 1.18$

when there is seepage of water

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

$\gamma' = \gamma - \gamma_w$

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

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

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

$\gamma' = \gamma - \gamma_w$

$= 21.04 - 9.8$

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

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

$$\boxed{FC = 0.816}$$

ANo4 (A) :-

Given data :-

Height, $H = 10m$

$c = 18.8 \ kN/m^2$

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

$\phi = 20°$

$F.O.S = 1.5$

$F\phi = 1.0$

Required Data :-

Inclination, $i = ?$

Solution :-

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

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

$S_N = 0.073$

Using taylor chart for

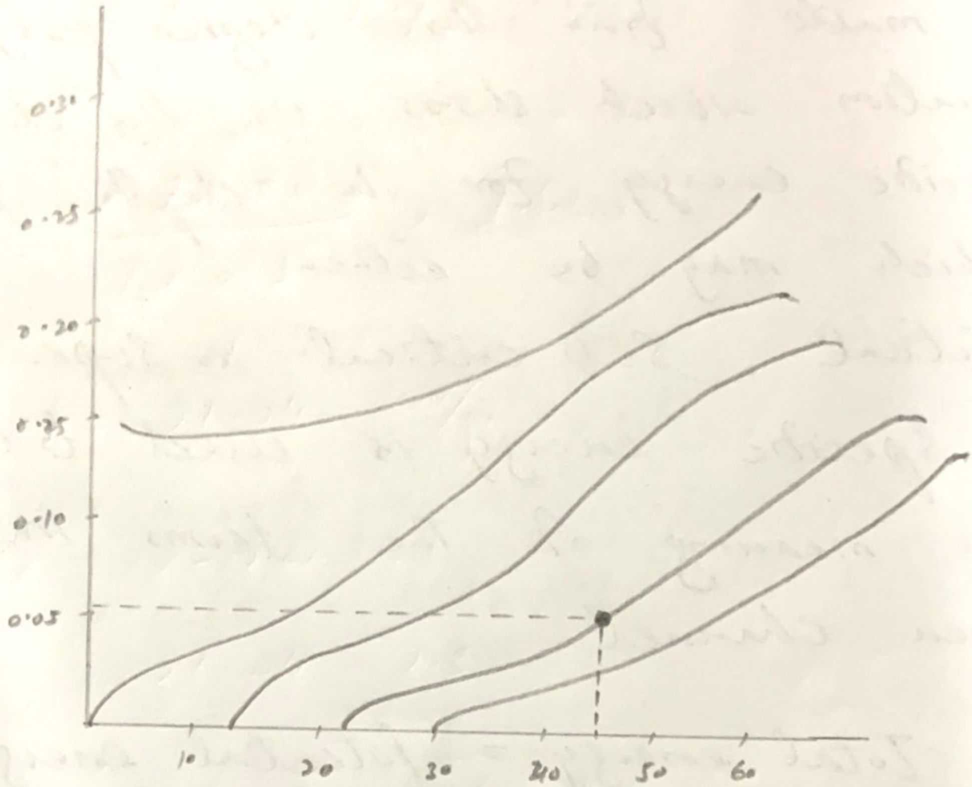
$\phi = 20°$

$S_N = 0.073$

$i = 44°$

Q.No 4 (A)

CHART



Slope Angle

Q.No 4 (B)

Given Data:

Height of water on upstream side = 15 m

Bottom, width = 12 m

Top width = 8 m

γ_{water} = 1000 kg/m²

$\gamma_{concrete}$ = 1450

γ silt = 1330 kg/m²

θ = 35°

Free Board = 3.5 m

H = 2.5 m

Required data:

Silt, pressure, Ps = ?

Solution:

As we know that

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

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

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

$$= 4156.25 \times 6.27$$

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