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PAPER:→ GEOTECHNICAL & FOUNDATION ENGINEERING

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Q1 (A)

Ans:- FORCE ACTING ON A DAM:-

1) Water Pressure
2) uplift pressure or seepage loads
3) Earth quake forces
4) self weight of the dam.
5) silt pressure.

WATER PRESSURE:-

If the pressure of water that acts perpendicular on the up stream face of the dam for there are two cases (a) upstream face of the dam is vertical & there is no water on the down stream side of the dam, The total pressure is in horizontal direction & acts on the up stream face at height on the dom is computed according to equation. $P_1 = wH^2/2$
where w = specific of water usually it is taken as unity.
H height up to which water is stored.

2) UPLIFT PRESSURE OR SEEPAGE LOADS:-

when the water is stored on the stream side of dom there exist a head of water equal to the height up to which water is stored. This ~~watter~~ water enter pores, fissures & cracks of the foundation material under Pressure. It also enters the joints between the ~~damps~~ dams & foundation at the base & pores of dam it self.

3- EARTH QUAKES FORCES:-

Dynamics loads created due to earth quakes must be considered in the design of all major dams located in high risks seismic regions & for dams situated in close proximity to potentially active geological fault complexes.

Earth quake produces waves in every possible direction. How ever it has to be resloved in vertical & horizontal component has greater effect

4- Self weight of DAM:-

The weight of Dam & its foundation is a major resisting forces. It can be computed using the following equation

$w = \gamma_m$ volume

where

γ_m = unit of the dam materials.

5- Silt PRESSURE:-

The weight of Dam & its foundation is a major resisting force. It act at $h/3$ from the base & can be computed using equation.

$$P_{silt} = 0.5 \gamma_s h^2 ka$$

where

ka = coefficient of active earth pressure of silt which equal to $\frac{1-\sin\theta}{1+\sin\theta}$

ϕ angle of internal friction of soil, cohesion neglected

γ_s : submerged unit weight of silt material

h : height of silt deposited.

Q 1 (b)

1) LIQUIFICATION of SOIL:-

Soil liquification occur when a saturated or partially saturated soil substantially losses strenght & stiffness in response to an applied stress such as shaking during an eq earthquake or other sudden change in stress condition in which material that is ordinarrily a solid behaves like a liquid.

2) BUTTRESS DAM :-

A buttress dam is a dam with a solid water tight upstream side that is supported at intervals on down stream side by a series of buttress or support. The dam wall may be straight or curved. Most buttress dam are made of reinforced concrete are heavy pushing the dam in to ground.

3) INFINITE SLOPE :-

An infinite slope is a simply a vertical line when you plot it on a line graph, an ifinite slope is any line which runs parallel to the y-axis. You can also describe this as any line that doesn't move along the x-axis but stays fixed at one constant axis coordinate, making the change along the axis 0

(4) PIER FOUNDATION :-

A pier foundation is a collection of large diameter cylinderical columns to support the superstructure & transfer large super-imposed loads to the firm strata below. It stood several feet above the ground. It is also known as post foundation.

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5) DYNAMIC LOADS:-

Dynamic load is a mechanism by which a ~~computer~~ ~~program~~ live load (as a motor vehicle in motion on a structure (as a bridge is called Dynamic loads.

Q2 (a) SHALLOW FOUNDATION:—

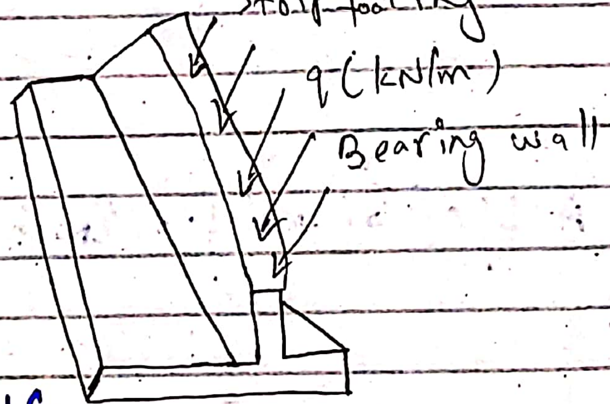
Ans The foundation in which the depth of the foundation is less than the breath then such a foundation is termed as shallow foundation. The foundation in Df/B ratio is less than 2.5 such foundation is termed as shallow foundation.

Df = Depth of the foundation
B = breath of the foundation

TYPES of SHALLOW FOUNDATION:—

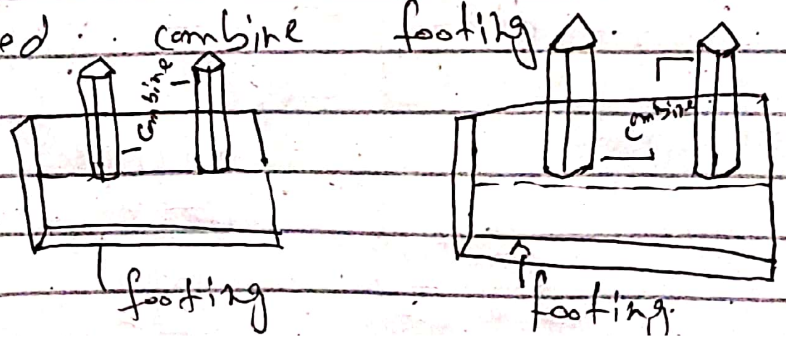
WALL/STRIP FOOTINGS:—

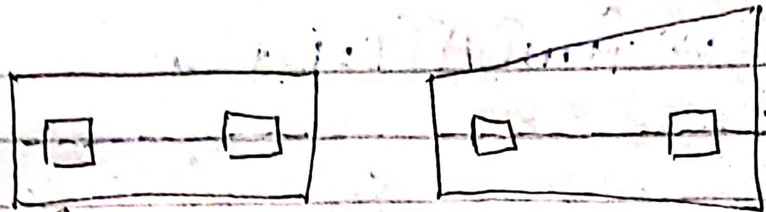
wall footing/strip footing is a footing which runs across the lenght of the footing



COMBINED FOOTINGS:—

footing which constructed combined for two or more column to transfer the load of these column safely to the soil then such footing is called combine footing

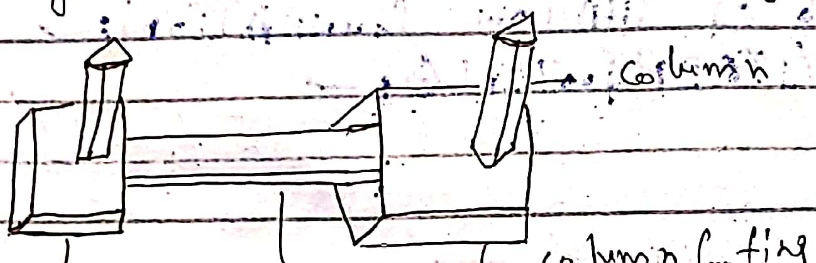




Rectangular footing   Trapezoidal footing

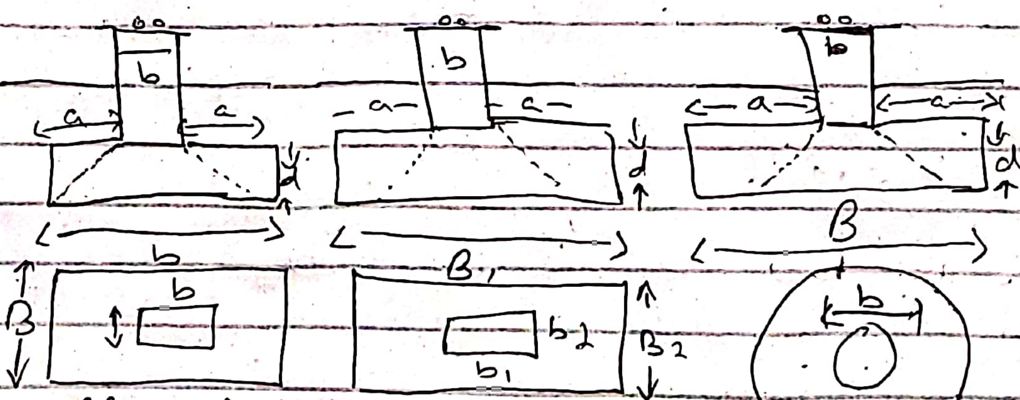
STRAPPED FOOTING:-

footing in which the outer column is connected with the inner column by means of tie beams or strap such a footing is called strapped footing.



ISOLATED / COLUMN FOOTING:-

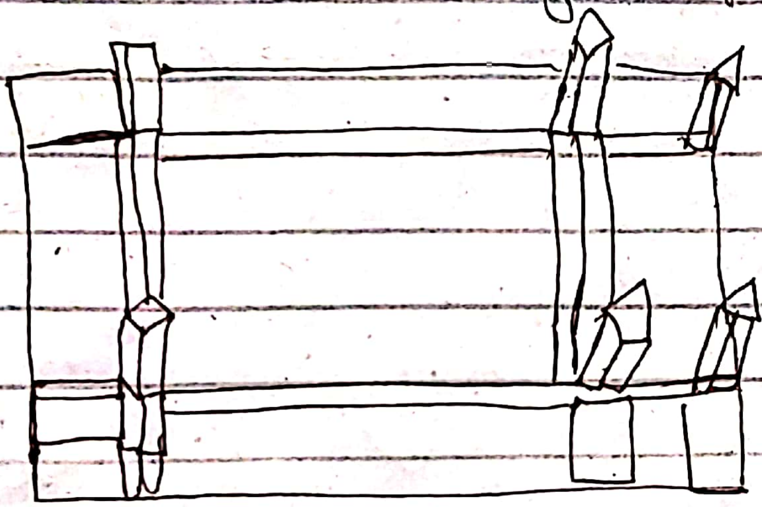
footing which is constructed for a single column & transfer its load saftely to the soil is called column. This column may be circular rectangular or square in shape.



square footing   rectangular footing   circular footi

RAFT/MAT footING :-

footing which is constructed & covers the area of the entire structure this type of footing is provided when the soil is weak in bearing mean having weak bearing capacity.



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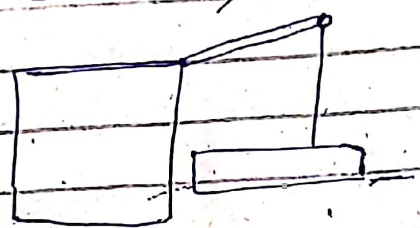
Q NO 2
(b)
(Ans) The Soil in which volumetric Changes takes place due to Shrinkage and Swelling Such Soil needs ground improvemental techniques.
⇒ The Soil which is organic in nature.
⇒ The Soft soil also required ground improvement techniques.
⇒ The Soil which is sandy and gravely
⇒ The foundation in sentry damp places also required ground improved techniques.
Following are the methods of ground improvement techniques.
(1) **Removal and Replacement of Soil**
This is an oldest and simple method the method is preferred 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 comfortable and better engineering properties. This method is applicable above the ground water table.

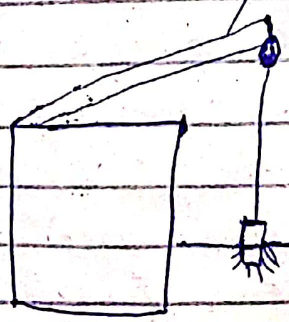
2) **Dynamic Computation:-**

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 disification of soil takes place.



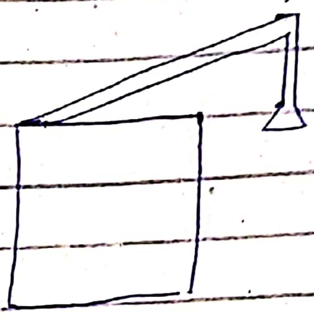
3) **Vibro Compaction:-**

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



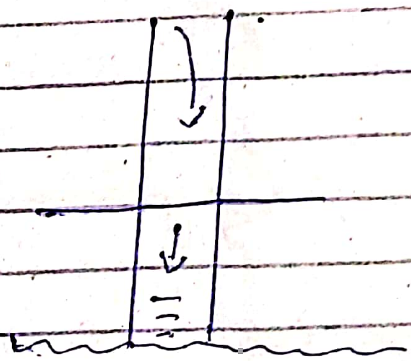
4) **Rapid impact compaction**

Impact energy is applied to surface of ground as result of which densification of soil takes place into a depth of 15'. This impact energy is actually applied through hydraulics into the hydraulic rate weight varies from 4-8 tons.



5) **Concrete column :-**

Vibro concrete is a ground improvement technique which transfer the load from weak strata to hard strata by using shuffle concrete



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Q3 GIVEN DATA:-

$C = 25 \, kN/m^2$

$\phi = 16°$

$G = 2.72$

$e = 0.50$

REQ:-

Fc (f.o.s) when soil is dry

Fc (f.o.s) when there is seepage in soil.

Sol:-

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

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

$\gamma_d = 17.8 \, kN/m^3$

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

$f_c = 1.18$

when there is seepage of water

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

$\gamma' = \gamma - \gamma_w$

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

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

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

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

$= 21.04 - 9.8$

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

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

$$F_c = 0.816$$

— x — x —

Q 4(a)

GIVEN DATA :-

Height = 10 m

$C = 18.8 \, kN/m^2$

$\gamma = 17 \, kN/m^2$

$\phi = 20^\circ$

F.O.S = 1.5

$F\phi = 1.0$

REQ :-

Inclination, $i = ?$

Sol :-

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

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

$$\boxed{SN = 0.073}$$

using taylor chart for

$\phi = 20^\circ$

SN = 0.073

$$\boxed{i = 44^\circ}$$

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Q 4(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 of silt = θ_s = 35°
- free Board = 3.5m.
- silt Deposite height = 2.5m.

Required:—

Silt Pressure = ?

Sol:—

As we know that

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

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

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

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