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Paper Geotechnical & foundation

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Q1
Ans
Part(A)

Follwing are the forces acting on dam

- Water Pressure
- up lift Pressure
- wave Pressure
- Silt Pressure
- Ice Pressure
- sesmic Pressure

☆ Self weight of Dam:-

The weight dam and its foundation is a major resting force. It can be computed using the equation

W = γ_m Volume

where

γ_m unit weight of dam material

(11) Silt Pressure:-

Silt Pressure is caused by the defosition of the silt in the bed of the dam causing at h/3 from the base and can be computed by eaution

$$P_{silt} = 0.5\, \gamma_s h_2^{3} Ka$$

where

Ka = cofficent of active earth Pressure of silt whic is equal to

$$\frac{1 - \sin Q}{1 + \sin Q}$$

Q = angle of internal ~~Pressure~~ friction of soil, Cohesion negted

γ_s = Submerged unit weight of silt mateoal

h' = height of silt deposited

iii) Wave Pressure :-

Wave are generated on the surface of reservior by the blowing wind, which exert a Pressure on upper part of the dam above the Water level & can be calculated by

$$P_w = 2.4\, \gamma_w\, h_w$$

Wave Pressure depend upon wave height is given by

for $f < 32$ km

$$h_w' = 0.32\sqrt{P_w} + 0.763 - 0.271 \times f^{1/4}$$

$$h_w' = 0.32\sqrt{Vf}$$

Where h_w' = height of water from crust to bottom of trough in meter

V = wind velocity in km/hr

f = fetch or ~~strength~~ straight length of water expanse in km

The max Pressure intensity due to wave action occur when it acts at 0.5 total force due to water wave action give as

$$P_w = 0.5\,(2.4\, \gamma_w h_w)^{3/8}\, h_w'$$

iv) Ice Pressure :-

The Ice which may be formed on the water Surface of reservior in cold Countries may sometime melt & expand The dam force is subjected to the thrust and exerted by the expanding ice.

The force acts linearly along the length of the dam and at the reservior level the magnutude of these forces varrie from 250 to 1500 kn/m^2 depending upon Temprature

V) Sesmic forces :-

dynamic load created due to earthquake must be considered in the design of all major dams located in high risk sesmic region.

Earthquake Produce wave in every Possible direction However it has to be resovled into vertical & horizontal for design pupose. The horizontal component had greater effect. sesmic vibration influnce both dam body & water in resrviors of dam so generated dynamic load are due to motion of dam & hydrodynamic forces

PartB

i) Liqufication of soil :-

Effective stresses Keep soil Particle in contact with each other if the effective stresses decrease the soil will change to liquification soil

ii) Butress Dam :-

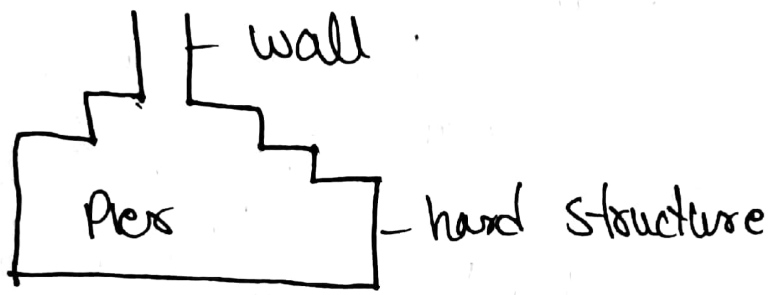
A dam with a solid water tight upstream side that is suffered at interval on the downstream by a series of buttress. The dam wall may be straight or curve. most buttress dam are made of reinforced concrete & are heavy, pushing the dam into ground

iii) infinate slope :-

The slope which have infinate area and finite depth such slope is called infinate slope

e.g. Natural slope i.e hills mountains etc
infinite slope the failure will be in form of sliding

4) Pier foundation :- The vertical member which have larger dia as compared to pile & transmitt the load of structure to the underground soil, They are constructed by cost in situ Prosses



Dynamic load :-

Dynamic load occur when loading condition are changing with time it may be the form of earthquake or vibration of heavy meachinery wave motion wind etc Due to dynamic loads the settlment chances may increase

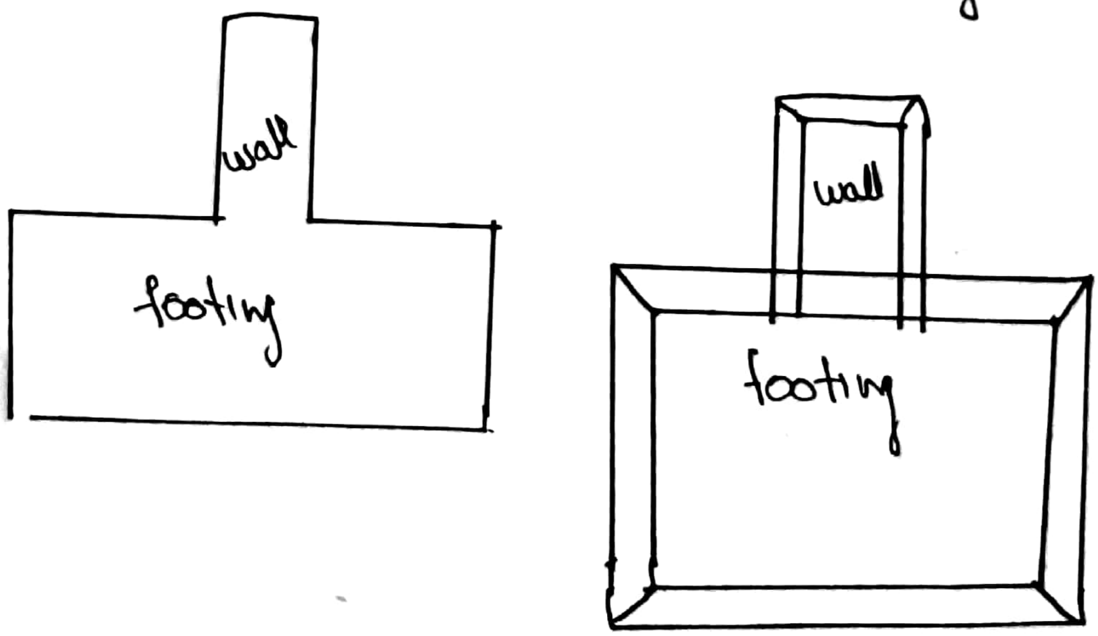
Q2 Shallow foundation

Ans According to terzaghi:- The foundation in which depth of the foundation is less or equal to width of the foundation is called shallow foundation $D_f \leq B$

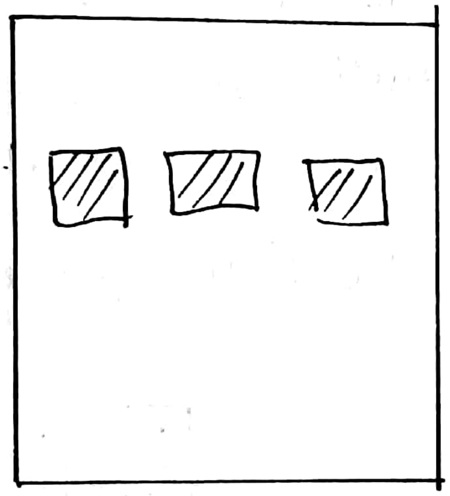
According to skemtion:- The foundation in which Df/B ratio is less or equal to 2.5 than the foundation is called shallow foundation

i) Wall footing:- The footing which run across the length of the wall and transfer the load of wall to soil safely it is called wall or strip footing

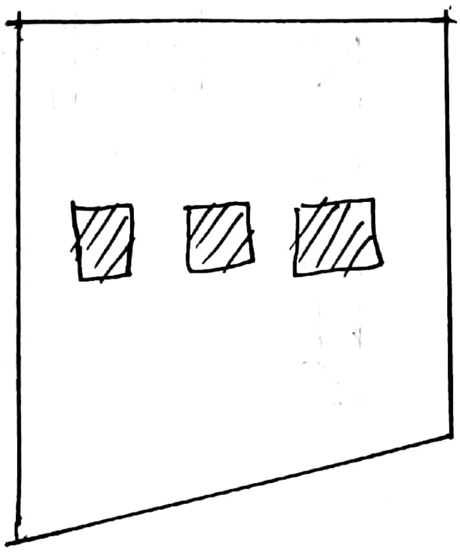
ii)



2) Combined footing :- The floating which is constructed for two or more colum and transfer the load of two are or more column to the soil safely than called combined footing. if load column is uniform the the combined footing will be rectangulr shape and if load is not uniform then the shape of footing will be tripozidal



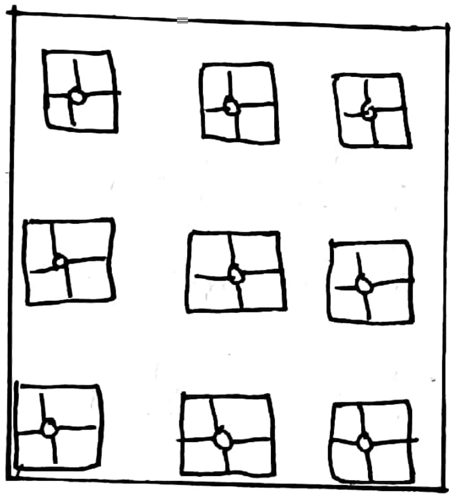
Rectangulr footiy



Tripozidal footiy

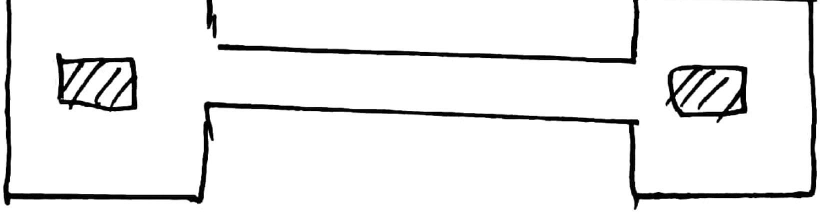
3) RafT / Mat footing :- The footiy which cover the whole area of structure is called raft footiy

This type of footiy is Proposed in area which have soft weak is capicity this is also Provided when the load of super structure is heavy



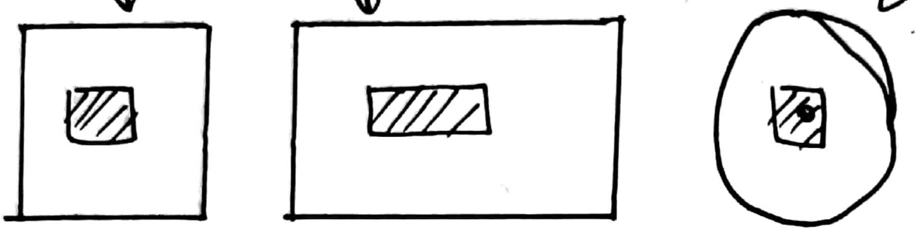
4) Strapped footing :- The footing in which the outer column is connected with the upper column by mean of beam or strt is called straffed footiy

Top view



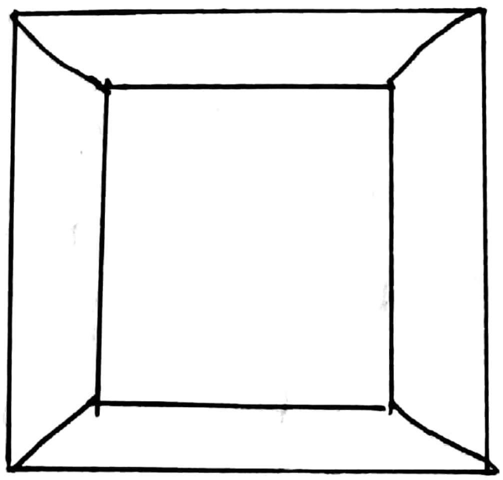
5) Column/Isolated footing :-

footing constructed for a single column and transmitts its load to soil safely. It may circular, square, rectangular in shape



6) Slope footing :-

footing having slope in all direction or in all side is called slopped footing



Q2 Part b Ans

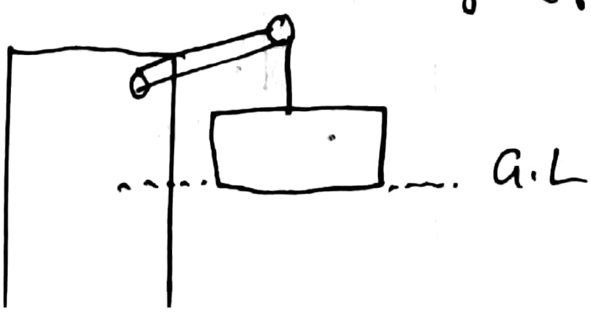
The soil in which volumetric change take place due to shrinkage and swelling
the soil which is organic in nature.
• The soft soil also required ground improvement technique
• gravelly and sandy
o) The foundation in sanetry dump place also require improvment technique

Ground improvmen technique are below

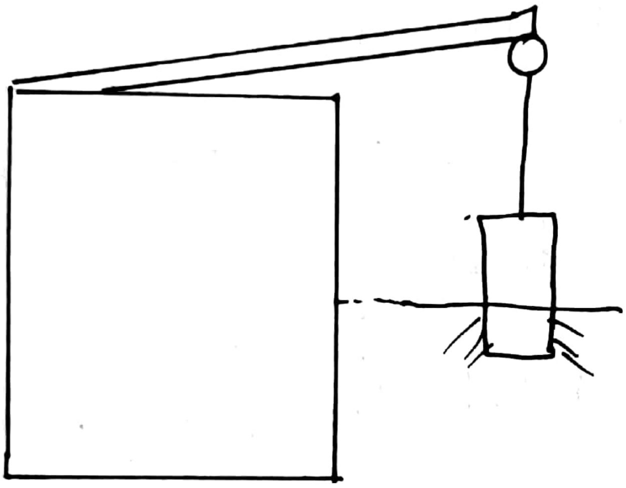
1) Remove/Replacment of soil :-

~~soft~~ Thes is oldest and simple method this method is Perform on loose soil is replaced with compact fill in this method the same soil is used to refill the higher Complaction & better engineering Properties

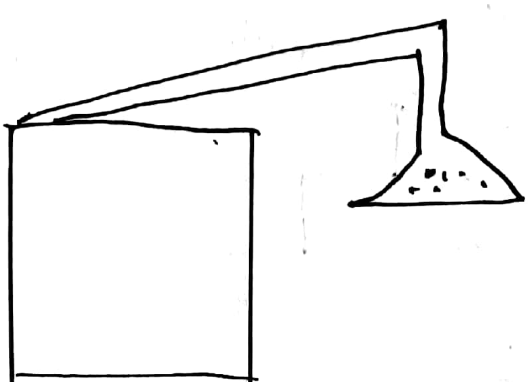
2) Dynamic computation :- this method is used to increase the bearing capacity of soil this also increase the consolidatio rate & also increase the density of soil



3) vitro compaction :- It is also called vibro disinication. in this compaction take place at certain depth in granular soil through vibratory Probe is run by an electric motor Penetration of Probe is enhance by ejecting water at Top of Probe

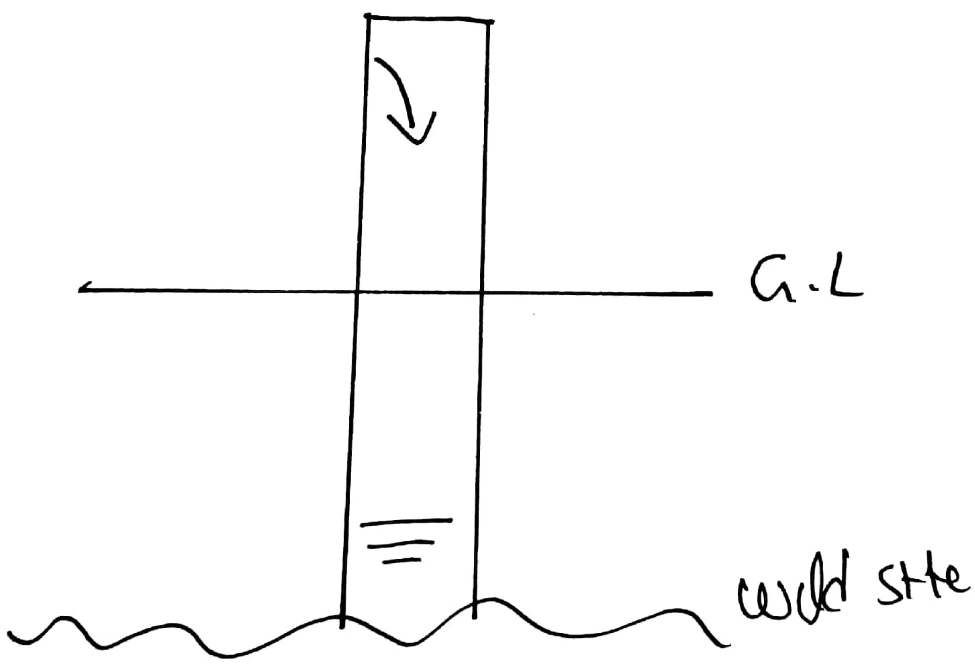


Rapid impact compation :- It is applied to surface of ground as a result of which disinfition of soil take place upto depth of 15' This impact energy is actully applied through hydrulic ramp & it weight varie from 4-8 ton



5) Concrete column :-

Vibro conrete is a ground improvment technice which transfor load from weak stral to hard strate by using strengt concrete



Q 03

Ans Given:-

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

Required

fc (fos) when soil is dry
fc (fos) when there is seepag in sol

Solution:

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

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

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

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

when there is seepage of water

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

$\gamma' = \gamma - \gamma_w$

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

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

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

$\gamma' = \gamma - \gamma_w = 21.04 \cdot 98$

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

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

$Fc = 0.846$

Q 4 Ans A

Given data

height = 10m

$C = 18.8\ kN/m^2$

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

$\phi = 20°$

F.O.S = 1.5

$F\phi = 1.0$

Required

inclinatio i = ?

Solution

~~SN = 0.073~~

~~using~~

$$SN = \frac{C}{fos \times \gamma \times H} = \frac{18.8}{1.5 \times 17 \times 10}$$

Using taylor chart for

$\phi = 20°$

SN = 0.073

$i = 44°$

Qustion 4 Part B

Ans Given data

- height of water on upstream side = 15m
- Bottom width of the dam = 12m
- top width = 6m
- unit weight of water = 1000kg/m^3
- unit weight of Concrete = 1450 kg/m^3
- unit weight of silt = 1330 kg/m^3
- Angle of friction for silt = $\phi s = 35^0$
- free Board = 3.5m
- silt Depsite height = 2.5m

Required silt Pressure = ?

Solution :-

As we know that

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

$$P_s = \frac{1330 \times (2.5)^2}{2} \times \frac{1 - \sin 35^0}{1 + \sin 35^0}$$

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