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| Subject | Geotechnical Engineering |
| Exam | Final Term |
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## Q.NO#1 Part A:-

**Ans:-**

**Forces Acting on Dam:-**

1) Water pressure:-
2) uplift pressure:-
3) Wave pressure:-
4) Silt pressure:-
5) Ice pressure:-
6) Self weight of the Dam:-
7) Seizmic Forces:-

**Detail:-**

**1) Water pressure:-** The depth of the 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 rigid body. The change in pressure with depth (in the y direction) is given by $dP/dy = \rho g$ in $\rho$ is the density of water and (g) is the acceleration due to gravity.

**2) Wave pressure:-** The effect of wave pressure on dam in the fluid in the reservoir on hydrodynamic pressure on dams due to horizantal hormonomic ground acceleration has been analyzed. It has been found that both the zeroth order solution which corresponds to the constant density solution.

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**3) Uplift Pressure:-** Computation shows that the Seismic uplift pressure can be Servel times higher then the Constant one. increasing the dynamic Instability of the Cracked dam. It is also reveled that the dynamic water flow plays the role of a wedge while the upper mouth of the crack is closing.

**4) Ice Pressure:-** The Ice which may be formed on the water Surface of the reservoir in cold Countries may Some times melt and expend. The dam face is subjected to the thrust and exerted by the expending ice. This force acts Lineary along the lenght of the dam and at the reservoir level.

**5) Earthquakes:-** It is a well Know phenomena that earthquake can result damages and failure for dams and theire appurtement Structures. there is another fact that dams with large reservoirs also trigger earthquake. Ground Shaking from earthquakes can collapse dams.

## Q.No#1 : part B:-

Ans:-

### 1) Soil Liquefaction:-

**Defenition:-** Soil liquefaction occure when a saturated or partially saturated soil substantially loses strenght and stiffness in response to an applied stress such as shaking during an earthquake or other change in stress condition, in which material that is ordinarily a solid behaves like a liquid.

### 2) Buttress Dam:-

**Defenition:-** A Buttress dam is a dam with a solid, water tight upstrem side that is supported at intervel on the down stream side by series of buttress or supports. The dam wall may be straight or curved. Most buttress dams are made of reinforced concret and are heavy.

### 3) infinite slope:-

**Defenition:-** An Infinite slope is a simply vertical line. when you plot it on a line graph an any line which runs parallel to the y-axis. The line that deos not move along the x-axis but stay fixed at one constant x-axis coordinate.

### 4) Pier foundation:-

**Defenition:-** A deep foundation is a type of foundation that transfers building load to the earth farther down from the surface than a shallow foundation deos to a subsurface layer or a range depths.

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## (5) Dynamic load:-

**Defenition:-** Dynamic load is the load which is non static Such as wind load or moving live load.

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# Question #2

C2-PLO1 (A)

**Answer:**

## Shallow Foundation:

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

## Types of Shallow foundat

There are ~~five~~ types of Shallow foundation.

Spread footing foundation.

Mat-Slab foundation.

Slab-On-grade foundation

(iv) Rubble trench foundation.
(v) Earthbag foundation.

## Spread footing foundation:

A spread footing foundation, which is common in residential buildings, has a wider bottom portion than the load-bearing foundation walls it supports. This wider part "spreads" the weight of the structure over more area for greater stability.

→ It is common in residential construction that includes a basements and in many commercial structures.

→ A spread footing that changes elevation in a series of vertical steps that it follows the contours or accomodates changes in soil strata, called stepped

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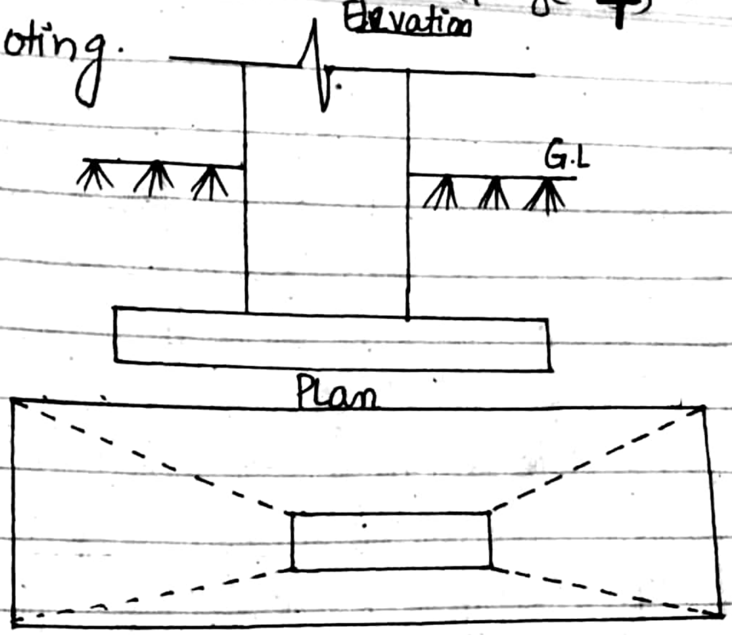
footing.

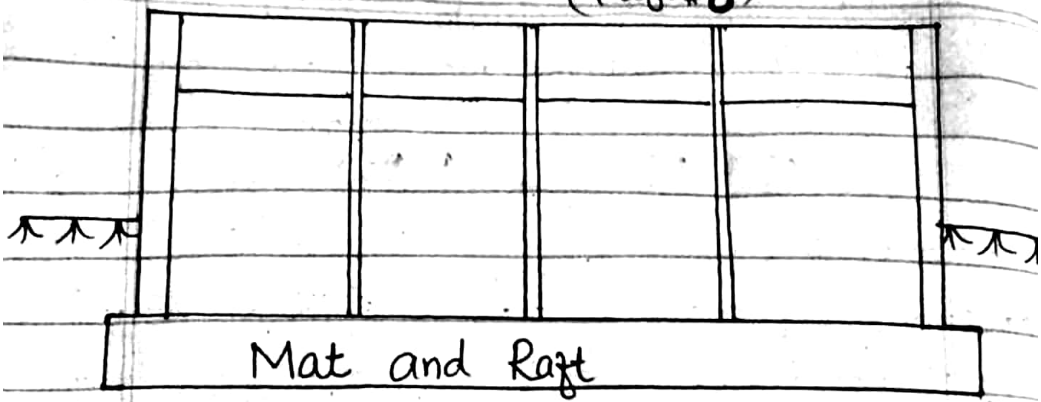



Spread footing

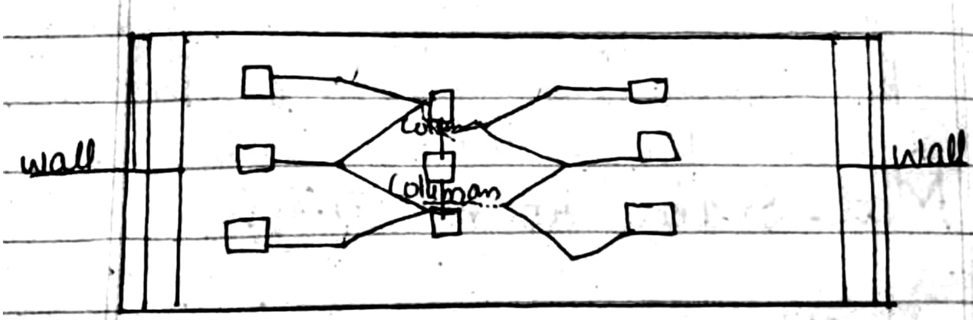
## ii) Mat-Slab foundation:

Mat-slab foundations distribute heavy column and wall loads the entire building area, to lower the contact pressure compared to conventional spread footings.

→ It can be constructed near the ground surface, or at the bottom of basements.




Elevation.

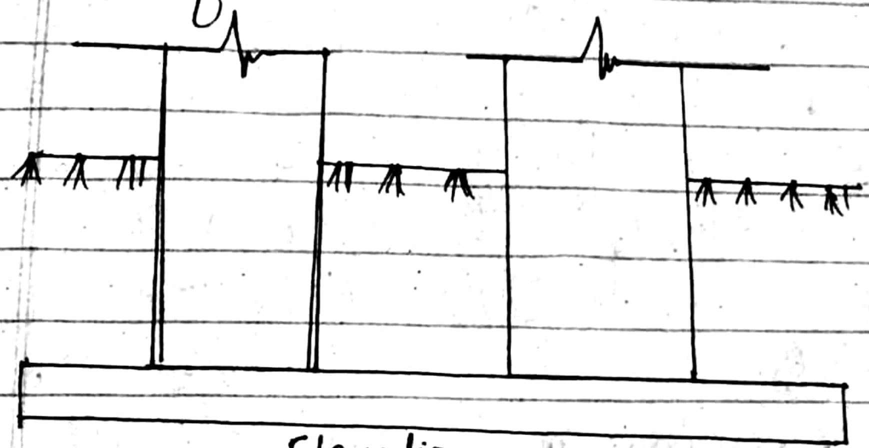



Plan.

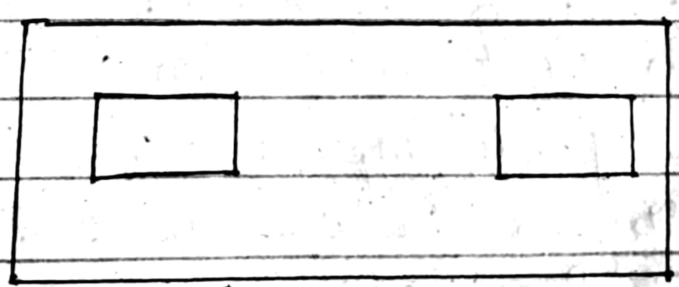
## Slab-on-grade foundation:

Slab-on-grade or floating slab foundation are a structural engineering practice whereby the concrete slab that's to serve as the foundation for structure is formed from a mold set into ground.

This type is most often seen in warmer climates, where ground freezing and thawing is less of a concern and where there is no need for heat ducting underneath the floor.



Elevation.

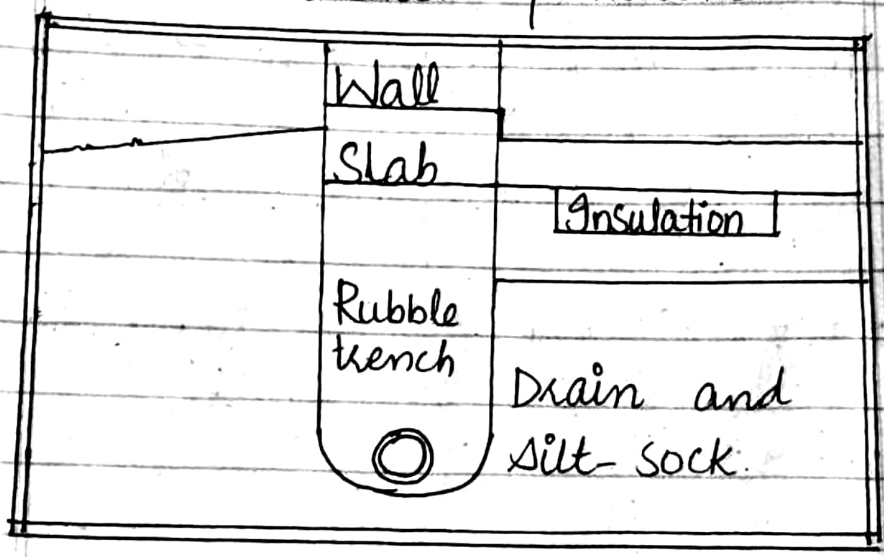


Plan.

## Rubble-trench foundation:

It is type of foundation that uses loose stone or rubble to minimize the use of concrete

and improve drainage
→ It is very simple
→ low-cost, and envisomentally - friendly alternative to conventional foundation.




Cross view of a rubble trench.

## Earthbag foundation:

The basic construction method begins by digging a trench down to undisturbed mineral Sub soil. Rows of woven bags are filled with available mat-erials placed into this ~~trench~~, compacted with a pounder to around 1/3 thickness.

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## Question #2.

## (Part # B)

## Answer:

## Ground improvement Techniques:

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

**Importance:**

The main properties are seal strength, Permeability, sealing capacity and stiffness etc.

## Methods of Ground Improvement Techniques:

### 1) 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 compacted fill. In this method the same soil is used to refill the higher compaction and better engineering properties. This method is applicable above the ground water table.

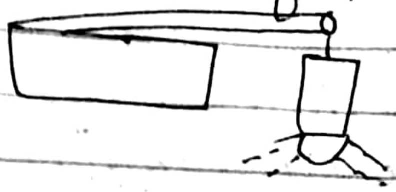
2. **Dynamic Compaction:**

This method is used to increase* the sealing capacity of soil. This method also increase consolidation rate. This also increase the density of soil in this method actually densification of soil take place.

3. **Vibro Compaction:**

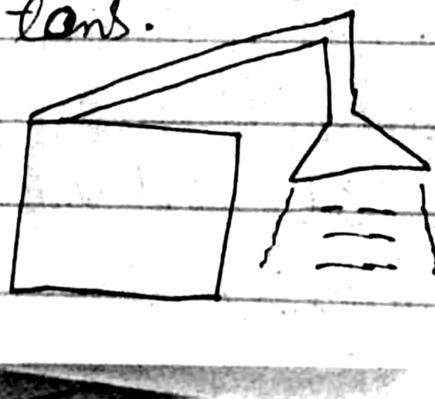
Also called vibro densification. In this method compaction take place at certain depth in granular soil through

through vibratory probe. which is run by electric motor. The penetration of probe is enhance by ejecting water at the tip of probe.



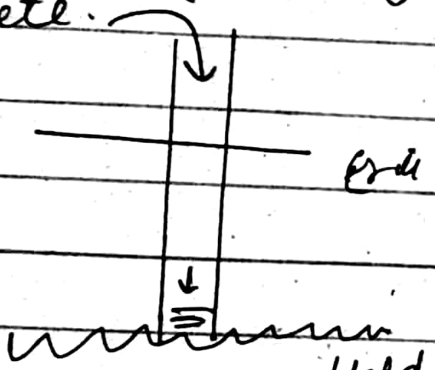
## 4) Rapid Impact compaction:

Impact energy is applied to surface of ground as a result of which densifi-cation of soil take place upto a depth of 15 feet. This is actually applied through hydraulic ramp. which has weight values from 4-8 tons.



## 5) Vibro concrete column:

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




## 6) Wet Soil Mixing:

In this method of ground improvement technique a paste of cement is prepared and inserted in soil. This method is used to improve the characteristics of weak soil by using cementitious binder slurry.

## 7). Dry mixing of soil:

This techique by which the characteristics of weak soil are improved by using dry cementitias binders.

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## Q.NO#3:-

**Ans:-**

**Given Data:-**

$C = 25 KN/m^2$

$\phi = 16$

$G = 2.72$

$e = 0.50$

**Required data:-**

Fc (F.O.S) When the Soil dry = ?

FC (F.O.S) When there is Seepage in soil = ?

**Solution**

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

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

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

$$Fc = \frac{25}{17.8 \times 6 \times \sin(26^\circ) \times \cos(60)} + \frac{\tan(16^\circ)}{\tan(26^\circ)}$$

$Fc = 1.18$

## When there is seepage of water.

$$F_C = \frac{c}{\gamma \times H \times \sin i \times \cos i} + \frac{\gamma'}{\gamma} \cdot \frac{\tan \phi}{\tan i} \rightarrow (i)$$

$\gamma' = \gamma - \gamma_w \quad \Rightarrow \gamma = \frac{G+e}{1+e} \times \gamma_w$

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

$\boxed{\gamma = 21.04 \ KN/m^3}$

$\gamma' = \gamma - \gamma_w \quad \Rightarrow 21.04 - 9.8$

$\boxed{\gamma' = 11.24 \ KN/m^3}$

**put the values in eq(i)**

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

$\boxed{F_C = 0.816}$

## Q.NO# 4 part A:-

**Ans:-**

**Given Data:-**

Height, $H = 10m$

$C = 18.8\ KN/m^2$

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

$\phi = 20^\circ$  $F.O.S = 1.5$ , $F\phi = 1.0$

**Required Data:-**

Inclination $= i = ?$

**Solution:-**

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

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

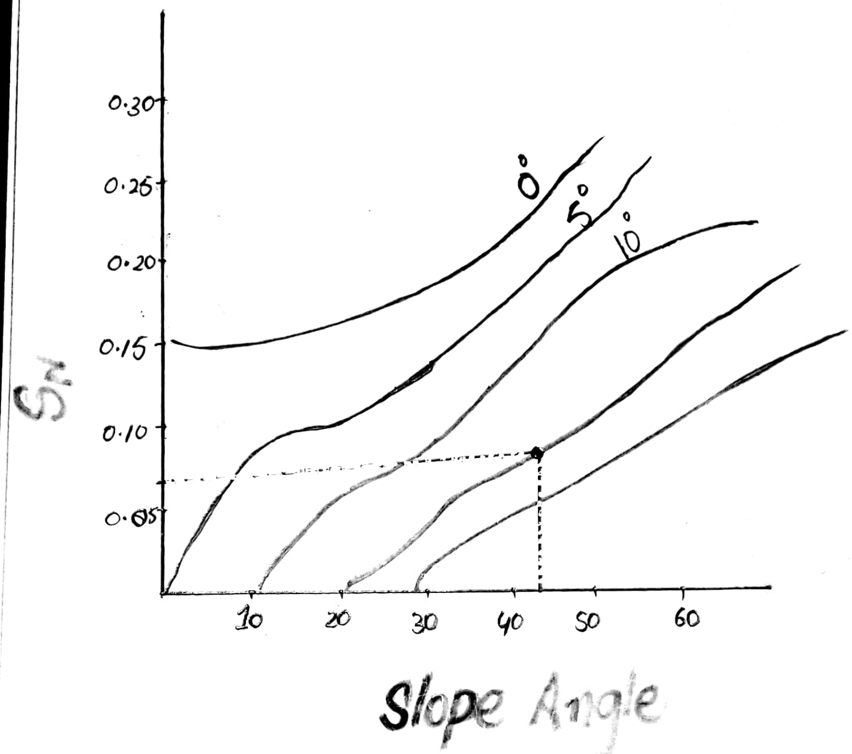
$$\boxed{S_N = 0.073}$$

**Using taylor chart:-**

$\phi = 20$

$S_N = 0.073$

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


0.30
0.25
0.20
0.15
0.10
0.05
$S_N$
0°
5°
10°
10
20
30
40
50
60
Slope Angle

## Q.NO#4
## Part B:-
## Ans:-

### Given Data:-

Height of water on upstream = 15m
Bottom width = 12m
Top width = 6m
$\gamma$ water = 1000 kg/m$^3$
$\gamma$ Concrete = 1450
$\gamma$ Silt = 1330 kg/m$^3$
$\theta$ = 35°
Free Boared = 3.5m
H = 2.5m

### Required Data:-

Silt, Pressure $P_s$ = ?

### Solution:-

**As we know that**

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

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

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

$$\Rightarrow 4156.25 \times 0.27$$

$$PS = 1122.18 Kg/m$$