SYED JAWWAD

7386

GEOTECHNICAL
ENGINEERING

Q1(a)

Forces Acting On Dam:-

1) Water Pressure
2) Uplift Pressure
3) Wave Pressure
4) Silt Pressure
~~5) Seismic forces.~~
5) Ice Pressure

1) WATER PRESSURE:-

The Major External forces acting on gravity dam are known to be water Pressure.
The horizontal water Pressure Can be Collected from Hydro-static Pressure when exerted on upstream side of dam.

2) UPLIFT PRESSURE:-

water Seeping through the Pores of the foundation, Dam of the body and through joints between and foundation exerts and uplift Pressure this reduces the downward ~~of the~~ weight of the body of the dam. A drainage Channel ~~between~~ is constructed between the dam and it's foundation to Control the weight.

(3) WAVE PRESSURE:-

Blowing winds generate waves on the reservoir causing pressure on the downstream side.

$$H_w = 0.032\sqrt{Vf} + 0.763 - 0.271 f^{3/4}, \text{ for } f < 32$$

H_w = Height of water

V = wind velocity

f = fetch or Length of water

The Maximum may be given $P_w = 2.4 \gamma_w h_w$

(4) SILT PRESSURE:-

Rankine's formula states if H is the ~~top~~ height of silt ~~and~~ the force exerted by the silt on external water pressure

$P_{silt} = \frac{1}{2} \gamma_{sub} h^2 k_a$ and it act at $h/3$ from base

where $k_a = \frac{1 - \sin\theta}{1 + \sin\theta}$ ~~KSOA~~

γ_{sub} = unit weight of ~~Sub~~ Silt Material

H = Height of Silt.

If the upstream is inclined the silt will also act as vertical force.

5) ICE PRESSURE:-

when the Ice Melts on the water Surface, The Dam has to resist this force. This force acts linearly along the dam and Reservoir. with the Magnitude 250 to 500 kn per m^2.

Q # 1(B)

LIQUIFICATION OF SOIL:-

Soil liquification also known as Earthquake. liquification is a term used when Solid Soil behaves Temporarily as liquid. This occurs when Seismic S waves effect the water Saturated Soil Causing vibrations during Earthquake. Certain Construction Practices including blasting, Soil Compaction also Come under this term.

BUTTRESS DAM:-

A hallow dam with water tight upstream supported at downstream Side by the Series of buttress is known as buttress dam.

Buttresses are made of Concrete and are inflexible thus Preventing the dam from falling over.

INFINITE SLOPE:-

Slope which have great Extend at any depth with Same Soil Condition. The Soil Might not be Same but the Strata of different Soils are Parallel to the Slope.

PIER FOUNDATION:-

A larger Cross-Section and a Vertical Column is known as a pier. A large Cylinderical whole is excavated to ~~the~~ the desire depth and it's filled with Concrete where a pier is then installed. A cast in situ pile greater then 0.6 meter diameter is termed as pier.

DYNAMIC LOAD:-

A force that Changes direction, Position or size of a structure is known dynamic load. The importance of studying dynamic load is to get the information about different stresses on the structure at different Points. This happens due to changing conditions over time.

SHALLOW FOUNDATION:-

The foundation where $\frac{\text{depth of the foundation}}{\text{Breadth of the foundation}}$ is less than 2.5.

TYPES OF SHALLOW FOUNDATION:-

Types are as follows.

- → wall footing / Strip footing
- → Combined footing
- → Mat / Raft footing
- → Coloumn footing
- → Strapped footing.

(1) WALL FOOTING:-

The footing running across the length of the footing.

(2) COMBINED FOOTING:-

The footing where two or more Coloumns are Constructed to ~~transf~~ transfer their load to the Soil.

MAT / RAFT FOOTING:-

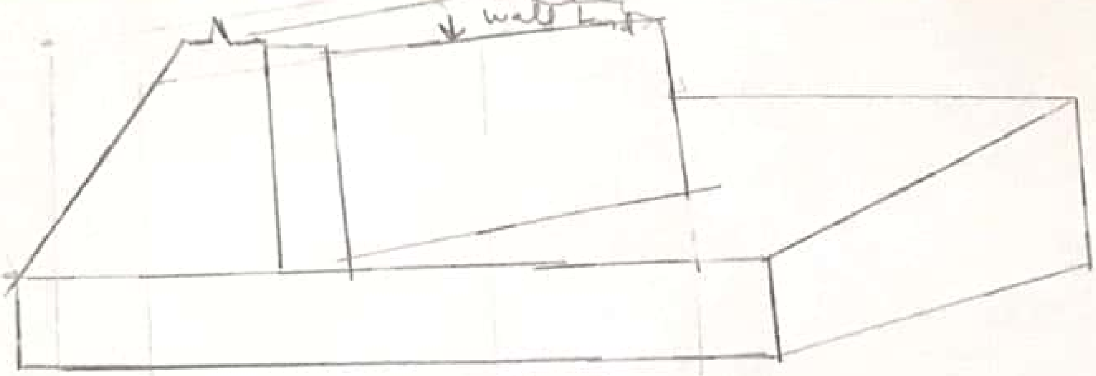
The footing Constructed to Cover the area of the Entire Structure when the Soil is weak.

COLOUMN FOOTING:-

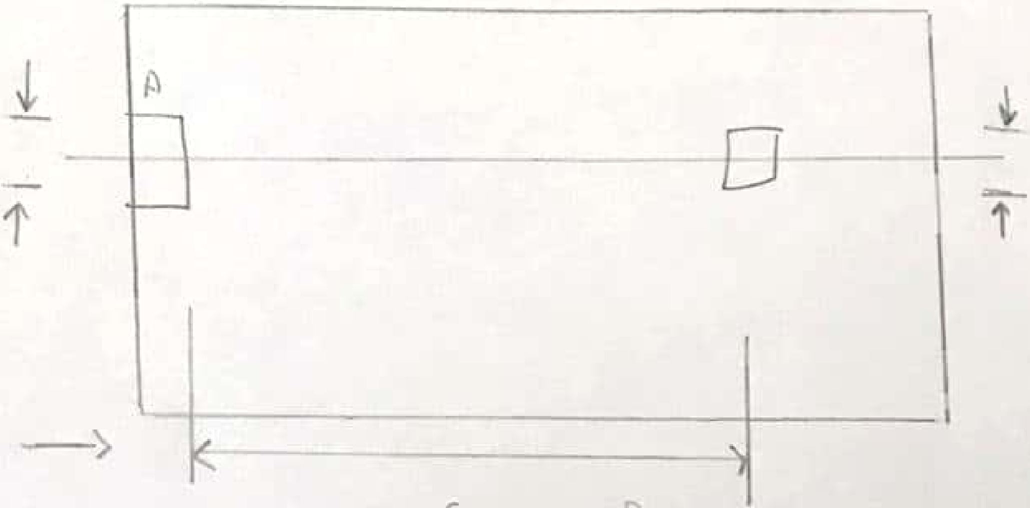
The footing Constructed for a Single Coloumn to transfer it's load to the Soil.

STRAPPED FOOTING:-

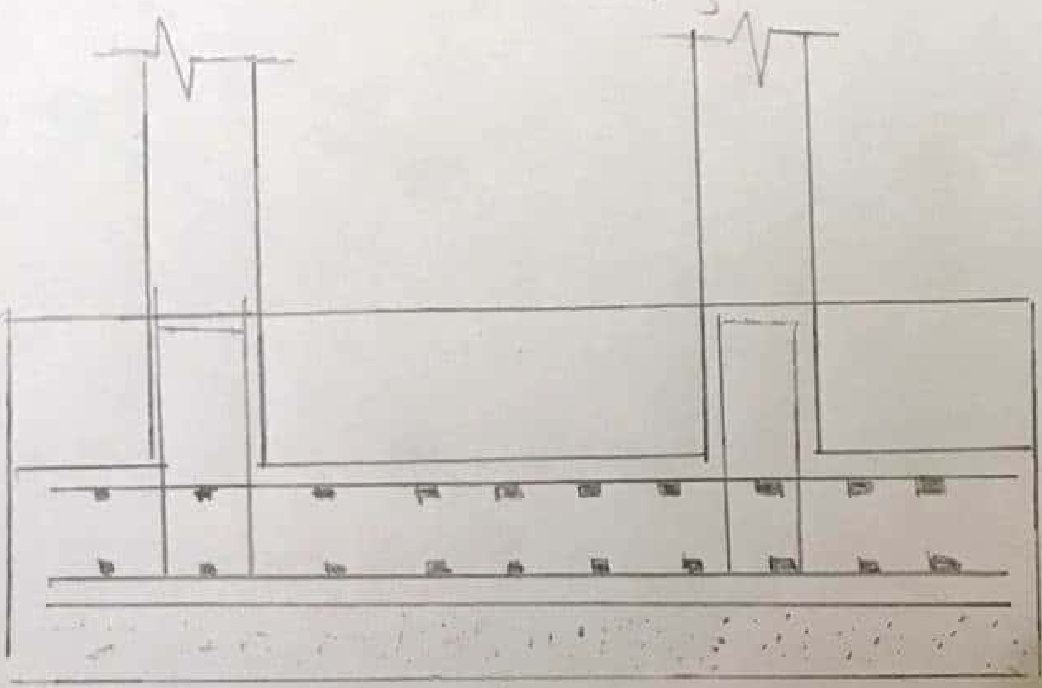
The footing where a Strap connects the outer Coloumn with the inner Coloumn.



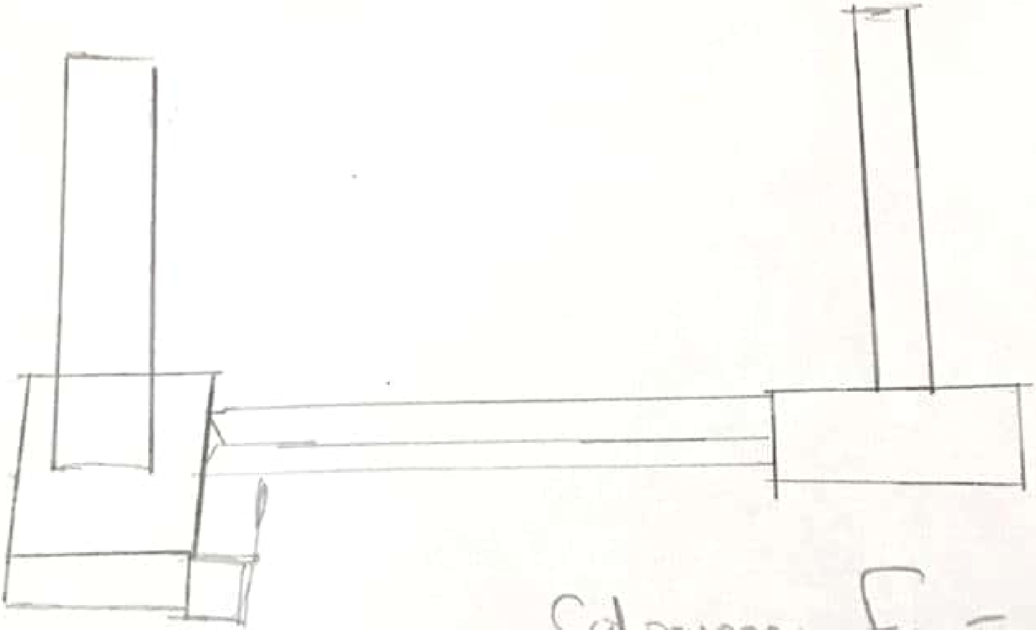
STRIP FOOTING



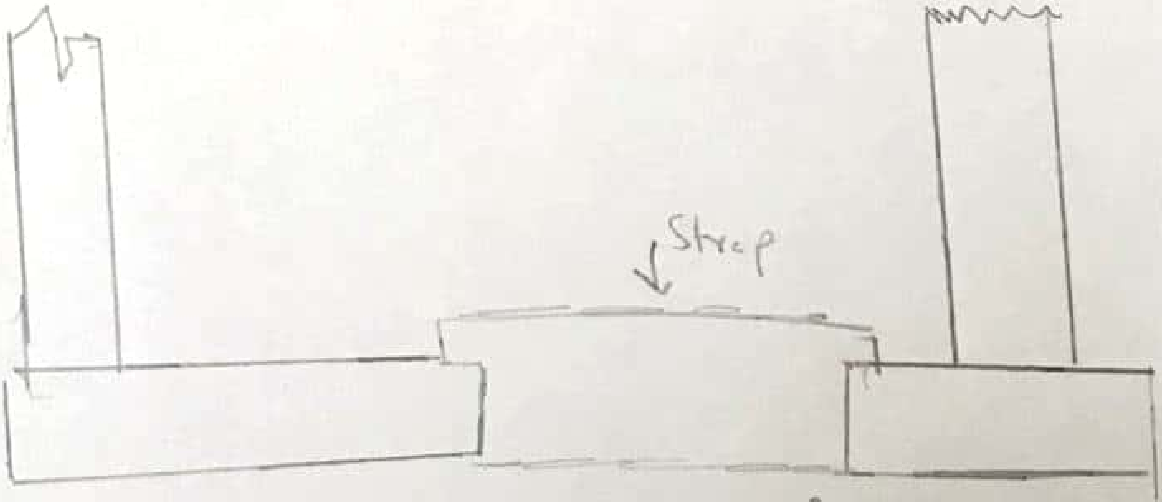
Combine footing



Raft footing.



Coloumn Footing



Strap footing

Q2(B)

GROUND IMPROVEMENT TECHNIQUES:-

To Enhance the engineering Property of Soil and bear heavy load, Ground Improvement techniques are used.

IMPORTANCE:-

Ground Improvement techniques are used when the Soil is;

a) Organic
b) Soft
c) Sandy
d) Gravely

METHODS OF GROUND IMPROVEMENT TECHNIQUES:-

1) REMOVAL AND REPLACEMENT OF SOIL:-

A Simple and Oldest Method Performed on loose Soil. The Unsuitable Soil is replaced with Compacted and is used to refill the higher Compaction and better Enginearing Properties.

2) DYNAMIC COMPACTION:-

This Method is used to Increase the bearing Capacity of the Soil, Conslidation rate, Density. Densificationalso occurs.

3) VIBRO COMPACTION:-

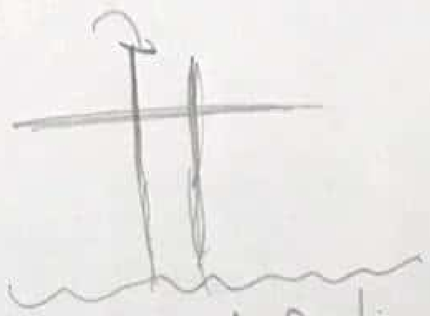
A Vibratory Probe, running through an Electric, is used at Certain depth and Granulated Soil.

(4) RAPID IMPACT COMPACTION

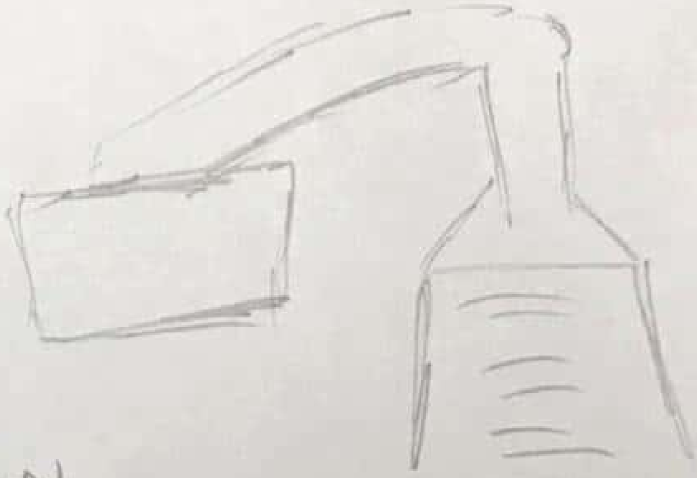
Densification of Soil upto 15ft is done by applying Impact Energy. It is Applied through Hydraulic Ramp which weighs 4-8 tons

(5) WET-SOIL MIXING:-

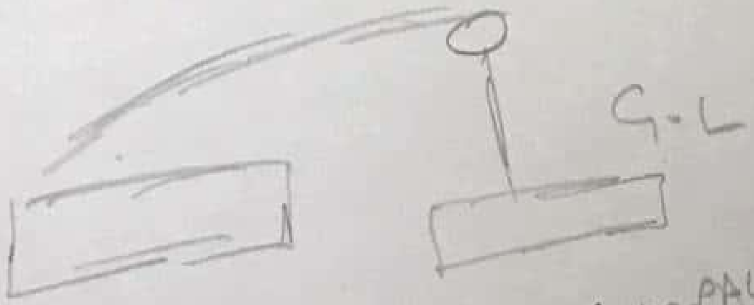
This Method is used to Improve weak Soil by making a Paste of a Cement and Inserting in the Soil.



VIBRO COMPACTION



RAPID IMPACT



DYNAMIC COMPACTION

Q #3

Given Data:-

$C = 25\ kN/m^2$

$\phi = 16^\circ$

$G = 2.72$

$e = 0.50$

Required:-

F_c (F.O.S) when Soil is dry.

F_c (F.O.S) when there is seepage in Soil.

Solution:-

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

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

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

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

$$F_c = 1.18$$

when there is seepage of water

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

$\gamma' = \gamma - \gamma_w$

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

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

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

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

$\gamma' = \gamma - \gamma_w$

$\gamma' = 21.04 - 9.8$

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

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

$F_c = 0.856$

Q# 4(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:

Inclination = ?

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's Chart for

$\phi = 20°$

$S_N = 0.073$

$\Rightarrow i = 44°$

Q#4(b) (15)

Given Data:-

Height of water on upstream Side = 15m

Bottom width of the dam = 12m

Top width = 6m

Unit weight of water = 1000kg/m³

Unit weight of Concrete = 1450kg/m³

Unit weight of Silt = 1330kg/m³

Angle of friction for Silt = ϕs = 35°

Free Board = 3.5m

Silt Deposit height = 2.5m

REQUIRED:-

Silt Pressure:?

SOLUTION:- As we know that

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

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

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