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Section # A

Paper # Geotechnical foundation engineering

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Ans(a) :-

force acting on Dam :-

1. water Presser
2. uplift pressure
3. wave pressure
4. silt Pressure
5. ice pressure
6. self weight of the dam
7. Seismic force.

(1) self weight of dam

The weight of the dam and its foundation is a major resisting force. It can be computed using the following equation $w = \gamma_m volume$

where γ_m = unit weight of material

(2) Silt pressures.

It is the pressure that is caused by the deposition of the silt in the bed of the dam causing at h/3 from the base and can be compacted using equation $P_{silt} = 0.5 \gamma_s h^2 K_a$.

where K_a - coefficient acting earth pressure of silt which is equal to $= \frac{1-\sin\theta}{1+\sin\theta}$.

(3) wave pressure:-

wave are generated on the Surface of the reservoir by the blowing winds which exert the pressure on the upper part of the dam above the water level. This pressure is calculated by the following formula

$P_w = 2.4 \gamma_w h_w$.

waves pressure depends upone wave heights which is given by

for $f > 32km$

$h_w = 0.32\sqrt{fv} + 0.763 - 0.27 f^{1/4}$

for $f > 32km$

$h_w = 0.32\sqrt{vf}$.

where h_w = height of water from the top of crest to bottom of trough in meter

v = wind velocity in km/hours

f = fetch or straight lenght of water exponse in km.

(4) Ice pressure:-

The ice which may beforme on the water Surface of the reservior in cold contries may Some-time melt and expand The dam face is Subjected on the trusth and exerted by the expanding ice. This force acts linearly along the length of the dam and at reservoir. level

(8) Sesimic force

Dynamic load created due to earth quakes must be considered in the design of all major dam located in high rish sesimic region Earthquake pressure wave in every possible direction However It has to be resolved into vertical and horizontal component for the design purposes..

Q' Part b:

(1) Liquefaction of soil.

Liquefaction is the Process that leads to a soil suddenly losing strength most commonly as a result of ground shaking during a large earthquake.

(2) Butter dams:-

A butter dam is defined as a dam consisting of a relatively than water supporting facting or deck Supported by butterss generally in the form of equally spaced tripular walls or counter forts that transmit the water load and deck weight to the foundations.

(3) Infinite slope.

Slope which have great extent with uniform soil condition at any given depth below the surface.

(*) The soil stratum is not necessary homogenous with depth but the strata of different soil are parallel to the slope surface.

(4) pier foundation:-

A Pier foundation consists of a clyindrical column of large condition diameter to support and transfer large super imposed loads to the firm strata below though pile foundation transfer the load through friction and or bearing Pier foundations transfer the load only through bearing.

(5) Dynamic loads:-

The load which acts on ground by the movement of subjects and sometimes the load due to earthquake can be classified as Dynamic load.

Q2 Part A

Shallow foundation :-

The foundation in which depth of the foundation is less or equall to width of the foundation is called Shallow foundation

$D_f \leq B$

Types of foundation.

1. wall footing
2. combined footing
3. Raft / Mat footing
4. strapped footing
5. column / isolated footing
6. stepped footing.

(1) wall footing

The footing which runs across ~~occurs~~ the length of the wall and transfer the load of the wall to the soil safety it is called wall or slop footing

(2) combined footing :- The footing which is constructed for two or more column transfer the load of the two or more column to the soil safety then it is called combined footing

(3) Raft/mat footing:

The footing which covers the whole area of the structure is called raft footing this type of footing is proposed in area which have soil weak in bearing capacity this is also provided when the load of super structure is heavy.

(4) Strapped footings.

The footing in which the outer column is connected with the inner column by mean of the beam or strap is called strapped footing.

(5) column / isolated footing :-

The footing which is constructed for a single column and transmit the load to the soil safety it may be circular, space rectangular.

(6) Stopped footing :-

The footing which have slope in all direction as in all sides is called as slopped

Q2 part 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 structure load. The main properties are steal strength permeability bearing capacity and stiffers etc

Need of Ground improvement Techniques.

The soil in which volometric changes takes place due to shrinkage and swelling such soil needs ground improvement techniques

• The soil which is organic in nature

(a) The soft soil also required ground improvement techniques.

(b) The soil which is sandy and gravely The foundation in sanator dump places also required ground improvement techniques.

Method of ground improvement Techniques

Removal and replacement of soil:-

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 refil the higher compaction and betles engineering properties.

(2) Dynamic compaction:

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

(3) Vibro compaction:-

It is also called vibro densification, in this method the compaction takes place. at a certain depth in granular soil through vibratory probe This 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 densification of soil take place upto a depth of 15 feet This impact energy is actually applied through hydraulic ramp. The hydraulic ramp weight values from 4-8 tons.

(5) vibro concrete column:

vibro concrete columns is a ground improved technique which transfer the load from weak strata to hald strata by using strength concrete.

(6) wet Soil Mixing:-
In this method of ground improvement technique a paste of cement is prepared and insested in the soil. This method is used to improve the deluclaictics of weak soil by using cemenditious bindes slully.

(7) Dry Mixing of Soil:-
Dry Soil mixing is ground improvement techniques by which the cholocteristic of weak soil are improvement by using dry cementitious binder.

Q3 Ans Given data:

$c = 25 kN/m^2$
$\phi = 26°$
$G = 2.72$
$e = 0.50$

Required:-
Fc (F.O.S) when soil is dry
Fc (F.O.S) when there is seepage in soil

Solution:-

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

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

$\gamma_d = 17.8\ kN/m^2$

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

$F_c = 1.18$

When there is seepage of water

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

$\gamma' = \gamma - \gamma_w$

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

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

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

$\gamma' = 21.04 - 9.8$

$\gamma' = 11.24\ kN/m^2$

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

$F_c = 0.816$

Q. 4 part a.

Given data

Height = H = 10m

c = 18.8 kN/m²

γ = 17 kN/m²

ϕ = 20°

fos = 1.5

$f\phi$ = 1.0

Required:-

inclination.

Solution:-

As we know that

$$S_n = \frac{c}{fos \times \gamma \times H}$$

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

S_n = 0.073

using Tayler chart for

ϕ = 20°

S_n = 0.073

then

i = 44 from layer chart.

Q4 part 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/m²
unit weight of concrete = 1450 kg/m²
unit weight of salt = 1350 kg/m²
Angle of friction for silt = ϕ_s = 35°
Free Board = 3.5m
silt Deposite height = 2.5m

Required

silt pressure = ?

Solution.

As we know that

$$P_s = \frac{\gamma_s \times H_1^2}{2} \times \frac{1 - \sin\phi}{1 + \sin\phi}$$

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

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