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Internal Assessment Test 3 – July. 2023

Sub:	Applied Geotechnical Engineering					Sub Code:	18CV62	Branch:	Civil Engg
Date:	05.07.2023	Duration:	90 min's	Max Marks:	50	Sem / Sec:	VI sem	OBE	

Answer any FIVE FULL Questions

		MARKS	CO	RBT
1 (a)	Define with neat sketch At rest, active and passive earth pressure?	[10]	CO3	L2
2 (a)	Determine the active earth pressure using Rebhann's graphical method.	[10]	CO3	L3
3 (a)	Explain procedure for determination of factor of safety using method of slices for C-ϕ soil.	[10]	CO3	L2
4 (a)	Determine the bearing capacity of the soil by using plate lad test as per IS 1888 guidelines?	[10]	CO5	L3
5 (a)	Write a note on Standard Penetration test and its corrections.	[10]	CO5	L2
6 (a)	A square pile group of 16 piles penetrates through a filled up soil of 3m depth. The pile diameter is 250 mm and the pile spacing is 0.75m. The unit cohesion of the material is 18KN/m2 and the unit weight of the soil is 15 KN/m3. Compute the negative skin friction on the group. Assume adhesion factor = 0.4	[10]	CO5	L3
7 (a)	A homogeneous slope 15 m high is made of c — ϕ soil with unitweight of l8kN/m3, unit cohesion of 50 kPa and angle of internal friction of 25°. Check whether the slope is stable or not. Compute the factor of safety with respect to cohesion And the critical height of slope.	[10]	CO3	L3

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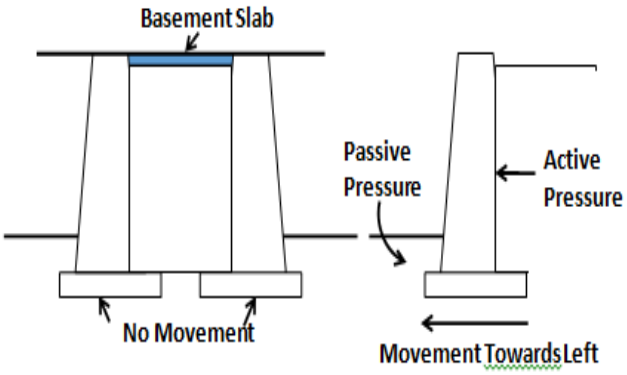
IAT 3 scheme &solution EVEN 2022 23
Subject: Applied Geotechnical Engineering (18CV62)

1. Define with neat sketch At rest, active and passive earth pressure?

Answer:

AT REST-PRESSURE	ACTIVE EARTH PRESSURE	PASSIVE EARTH PRESSURE
Not subjected to any lateral yielding or movements	Occurs when soil tends to stretch horizontally	Occurs when soil tends to compress horizontally
Firmly fixed at its top	Not fixed at top	Not fixed at top
Not allowed to move laterally or rotate freely	Allowed to rotate freely or move laterally	Allowed to rotate freely or move laterally
In elastic equilibrium	In plastic equilibrium	In plastic equilibrium
1. Retaining walls with basement slab at top 2. Bridge abutment	1. Retaining wall	1. Retaining wall



At-Rest Pressure

10M

2. Determine the active earth pressure using Rebhann's graphical method.

Answer:

Poncelet (or Rebhan's) Construction for Active Earth Pressure:

Poncelet and Rebhan have independently given graphical solutions for determination of active earth pressure.

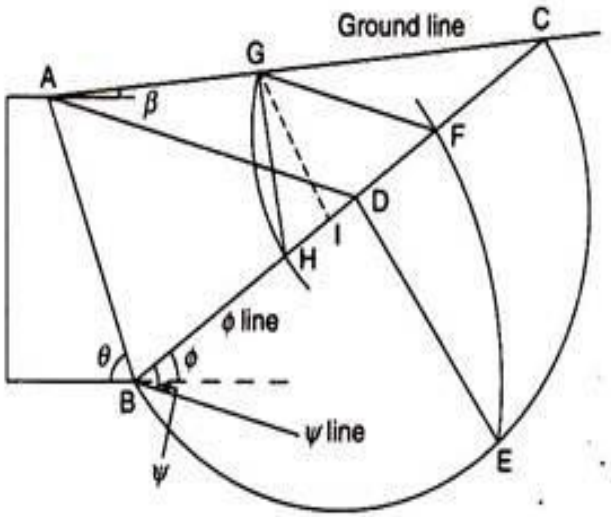


Figure 15.44 Poncelet's (Rebhan's) construction for active earth pressure.

The procedure for determination of active earth pressure in Rebhan's or Poncelet graphical method (refer Fig. 15.44) is as follows:

i. Draw the cross section of the retaining wall (AB) to some scale.

ii. Draw the ground line, AC, at an angle of β with the horizontal and the ϕ line, BC, at an angle of ϕ with the horizontal.

iii. Draw the Ψ line at an angle of $\Psi = \theta - \Delta$ from the ϕ line at point B.

iv. Describe a semicircle on BC with BC as the diameter.

v. From the crest of the wall A, draw a line AD parallel to the Ψ line to intersect the ϕ line at point D.

vi. From point D, draw a perpendicular DE to the ϕ line to intersect the semicircle at point E.

vii. Draw an arc with point B as the center and BE as the radius to intersect the ϕ line at point F.

viii. From point F, draw a line FG, parallel to the Ψ line to intersect the ground line AC at point G.

ix. Draw an arc with point F as the center and FG as the radius to intersect the ϕ line at point H.

x. Join the points G and H to get ΔFGH. This triangle is known as force triangle.

xi. Determine the area (A) of the force triangle (ΔFGH).

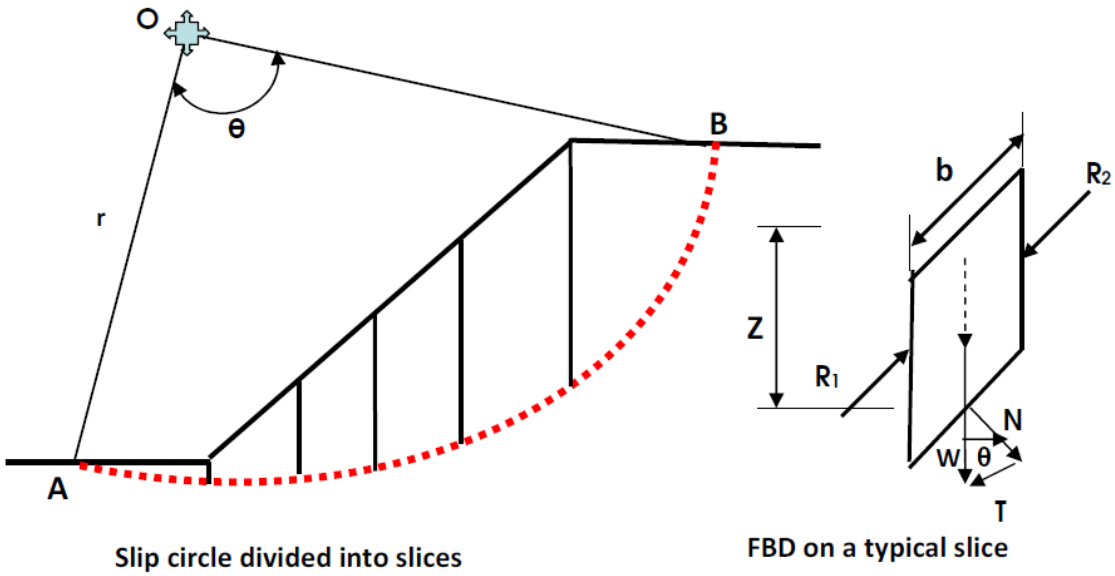
xii. The active earth pressure is given by –

$P_p = \gamma \times A \times 1 = (\gamma/2) \times FH \times GI$

where GI is the normal distance of point G on FH, as shown in Fig. 15.44. BG is the failure plane.

3. **Explain procedure for determination of factor of safety using method of slices for C-ϕ soil**

Answer:



Slip circle divided into slices

FBD on a typical slice

For a c-f soils the undrained strength envelope shows both c and f values. The total stress analysis can
be adopted.

The procedure is follows

1. Draw the slope to scale
2. A trail slip circle such as AB with radius 'r' is drawn from the center of rotation O.
3. Divide the soil mass above the slip surface into convenient number of slices (more than 5 is preferred)
4. Determine the area of each slice A1, A2, -------, An

A = width of the slice X mid height= b X Z

5. Determine the total weight W including external load if any as

$W = \Upsilon b Z = \Upsilon A$

Where, Υ = unit weight

b = width of slice

Z = height of slice.

The forces on a typical slice are given in Fig 7.

The reactions R1 and R2 on the sides of the slice are assumed equal and therefore do not have any
effect on stability.

6. The weight W of the slice is set –off at the base of the slice. The directions of its normal component
'N' and the tangential component 'T' are drawn to complete the vector triangle.

$N = W \cos\delta$, $T = W \sin\delta$

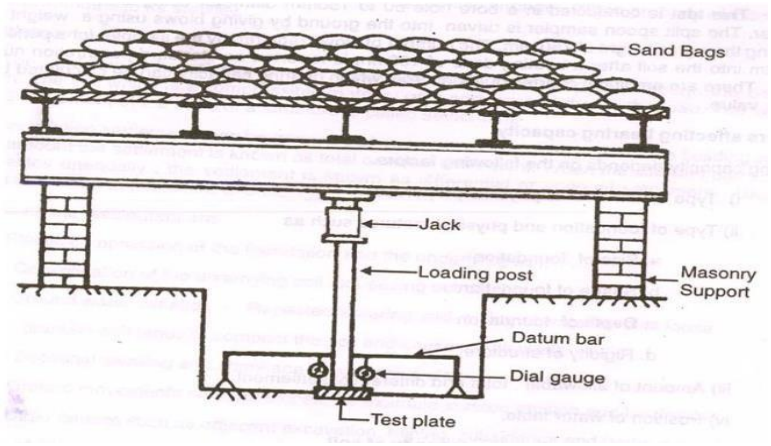
7. The values of N and T are scaled off for each of the slices
8. The values of 'N' and 'T' are tabulated and summed up as shown in the following table.
9. The factor of safety is calculated as follows

Sliding moment = $r \Sigma T$ (reckoned positive if clockwise)

Re storing moment = $r (c r\square + \Sigma N \tan\emptyset)$ (reckoned positive if counterclockwise)

4. **Determine the bearing capacity of the soil by using plate lad test as per IS 1888 guidelines?**

Answer:



- It is a field test used to determine the ultimate bearing capacity of soil
- A pit is dug up to the foundation level
- A square plate of 300mm x 300mm & 25 mm is placed at the centre of the pit
- A dial gauge is connected to the test plate
- Now weights in the form of sand bags are placed on the platforms in equal increments.
- The test is continued till the failure occurs or the plates settled by 25 mm whichever occurs earlier
- The load settlement curve is then recorded.

- The test pit should be at least five times as wide as the test plate and the bottom of the test plate should correspond to the proposed foundation level.

- At the centre of the pit, a small square hole is made the size being that of the test plate and the depth being such that,

$$Dp/b_P = D_f/b$$

(i) After excavating the pit of required size and levelling the base, the test plate is seated over the ground.

(ii) A seating pressure of 7.0 kN/m2 (70 g/cm2) is applied and released before actual loading is commenced.

(iii) The first increment of load, say about one-tenth of the anticipated ultimate load, is applied. Settlements are recorded with the aid of the dial gauges after 1 min., 4 min., 10 min., 20 min., 40 min., and 60 min., and later on at hourly intervals until the rate of settlement is less than 0.02 mm/hour, or at least for 24 hours.

(iv) The test is continued until a load of about 1.5 times the anticipated ultimate load

is applied.

According to another school of thought, a settlement at which failure occurs or at least 2.5 cm should be reached.

(V) From the results of the test, a plot should be made between pressure and settlement, which is usually referred to as the ‘‘load-settlement curve’’,. The bearing capacity is determined from this plot

5. Write a note on Standard Penetration test and its corrections.

Answer:

Standard Penetration Test (SPT):

Standard penetration test (SPT) is the most commonly used in situ test for sub- surface investigation. In SPT a split spoon sampler is made to penetrate 15 cm by light blows of a 65 kgs drop hammer on the top of the drill rod. The drill rod is connected to the top of the split spoon sampler.

After initial penetration of 15 cm of the sampler, the drop hammer is allowed to fall from a height of 75 cms and number of blows required for 30 cms penetration of sampler is recorded. This number of blows is called N-value or penetration number. In this method the driving energy is supplied by the fail of the drop weight. Hence it is essentially a dynamic sounding method.

Detailed procedure of SPT is as follows:

Apparatus required:

(i) Split spoon sampler:

It has an outside diameter of 50 mm, inside diameter of 35 mm and minimum open length (cutting edge to air vent) of 600 mm. The coupling head has four 10 mm (minimum diameter) vent ports or a ball check value.

(ii) Drive assembly:

It consists of a tripod as hoisting equipment-one of the leg is provided with ladder, a drive mass (hammer) of 65 kgs, a guide to ensure a 75 cm free fall of the drive mass and an anvil (attached to the guide) for transmitting the blow to the sampler rod.

(iii) Extension rods:

These rods are used to transmit the driving energy from the anvil to the sampler.

(iv) Drilling equipment:

Drilling equipment should be for making a reasonably clear hole of 60-75 mm diameter so as to ensure
that the test is performed in undisturbed soil and not in the fall in material. Casing or drilling mud may
have to be used where the boring sides fall in.
In general, hand operated auger of 75 mm diameter are used for drilling boreholes.

Procedure:

(1) A borehole is drilled to the required depth and is cleaned thoroughly.
(2) The sampler attached to the extension rods is lowered to the bottom of the hole and is allowed to rest under the self weight. (3) The drive assembly is then connected to the rod and the sampler is driven with light blows from the
drive mass to a seating penetration of 15 cm.
(4) The sampler is then driven to an additional penetration of 30 cm by blows from 65 kgs drive mass falling from a height of 75 cm. The number of blows required for 30 cm penetration is recorded as standard penetration resistance, N.
(5) The sampler is then lifted from the hole and opened. The undisturbed sample is removed from the sampler and sealed from both sides.
(6) The test is performed in each identifiable soil layer or at a interval of 1.5 m whichever is smaller. As per IS:2131, for a foundation of width B, penetration test has to be carried out at an interval of 0.75 m
up to a depth of B from the bottom of the footing and at 1.5 m interval for the rest depth up to a depth of 1.5 to 2 B.
(7) The measured N-value may indicate more than the actual value in some cases and so they are to be corrected.
The standard penetration resistance i.e., N-value has been correlated to different soil properties by different investigators.

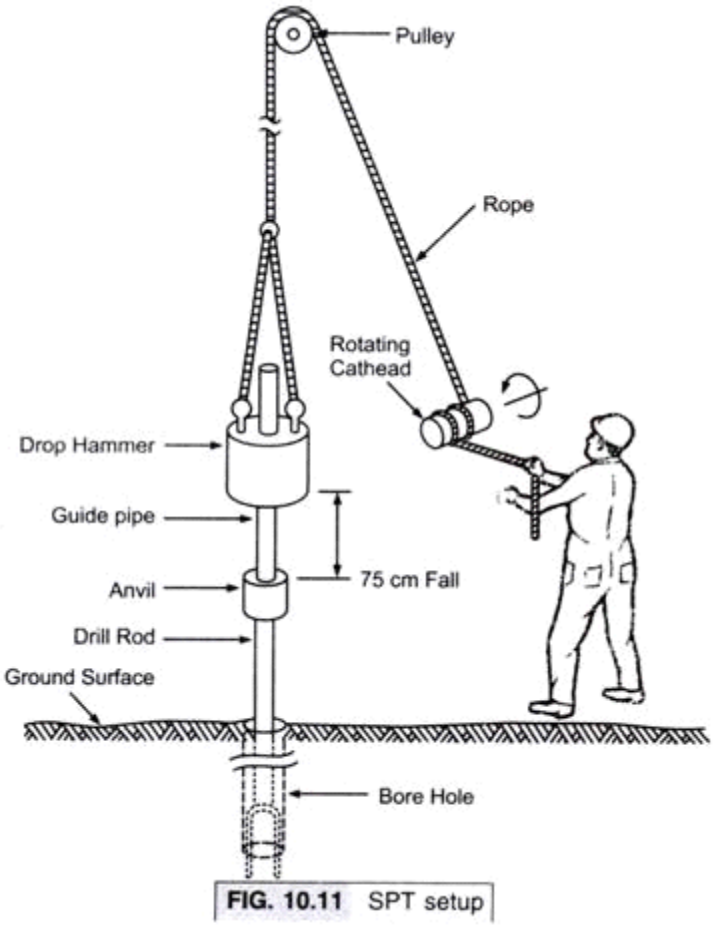


FIG. 10.11 SPT setup

Corrections to Measured Standard Penetration Resistance (N)

It has been observed by different investigators (Tergaghi and peck, 1948; Gibbs and Holtz, 1957; A.W.

Skempton, 1986) that the value of N depends on several factors, such as effective over-burden pressure,

submergence, borehole diameters, rod length etc. Therefore the observed N-value is to be corrected.

The effect of each and corrections are discussed briefly as follows:

Effect of Over-burden:

Gibbs and Holtz (1957) experimentally studied the effect of overburden pressure on the value of N.

Their modification for air dried or moist sand can be represented by the following relation:

$NC = N\ 35/\ \sigma + 7$

Where

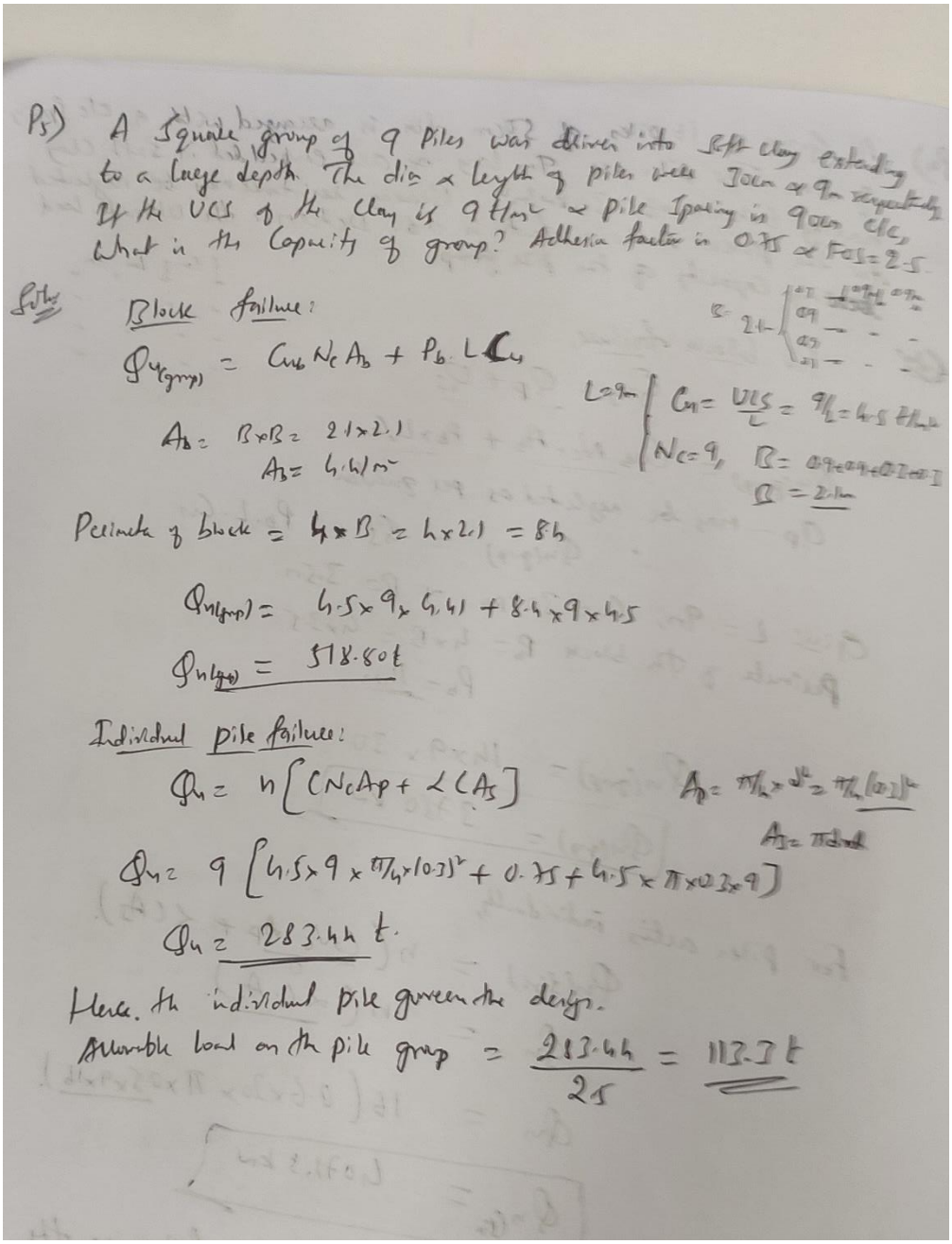
Nc = corrected N-value for overburden

N = observed SPT value

σ = effective overburden pressure, t/m2 (not to exceed 28t/m2)

6. A square pile group of 16 piles penetrates through a filled up soil of 3m depth. The pile diameter is 250 mm and the pile spacing is 0.75m. The unit cohesion of the material is 18KN/m2 and the unit weight of the soil is 15 KN/m3. Compute the negative skin friction on the group. Assume adhesion factor = 0.4

Answer:



7. A homogeneous slope 15 m high is made of c — ϕ soil with unitweight of l8kN/m3, unit cohesion of 50 kPa and angle of internal friction of 25°. Check whether the slope is stable or not. Compute the factor of safety with respect to cohesion And the critical height of slope.

Answer: