QUESTION BANK

SUBJECT: FOUNDATION ENGINEERING

(Subject Code: RCI6D001)

6th Semester, Civil Engineering

OBJECTIVE TYPE QUESTIONS

1.The void ratio of clay sample is 0.5 and the water content is 11.11%. Compute the Bulk unit weight. G=2.7, γ_w = 9.81 KN/m^3

a) 12.31 kN/m^3

b) 14.61 kN/m^3

¢) 19.62 kN/m^3

d) 21.93 N/m^3

2.The liquid limit (LL). plastic limit (PL) and shrinkage limit (SL) of a cohesive soil satisfy the relation,

a) LL>PL<SL

b) LL<PL>SL

¢) LL<PL<SL

d) LL>PL>SL

3.A sample of saturated clay has a total mass of soil 1.5 kg and a dry mass of 1 kg: G= 2.65. For this sample determine the porosity:

a) 0.45

b) 0.57

¢) 0.65

d) 0.71 m^2

4.A soil sample has a compression index of 0.3. If the void ratio, e at a stress of 1.5 kg/m^2 is 0.5. compute the void ratio if the stress increased to 2.5 kg/ m^2

a) 0.33

b) 0.38

¢) 0.43

d) 0.51

5. Rise of water table above the ground surface causes

a) Equal increase in pore water pressure and total stress

b) Equal decrease in pore water pressure and total stress

¢) Increase in pore water pressure and decrease in total stress

d) Decrease in pore water pressure and increase in total stress

6.Wash boring may not be used for which type of soil

a) Cohesive soil

b) Cohesionless soil

¢) Soil mixed with gravel and boulder

d) All of the above

7.Unconfined compressive strength test is

a) Drained test

b) Undrained test

¢) Consolidated undrained test

d) Consolidated drained test

8.The degree of disturbance of a cohesive sample can be estimated by

a) Recovery ratio
b) Void ratio
c) Consolidation ratio
d) Permeability

9.In-situ vane shear test is used to measure shear strength of

a) Very soft and sensitive clays
b) Stiff and fissured clays
c) Sandy soils
d) All of the above

10.At a depth of 6 m below the ground surface at a site, a vane shear test gave a torque value of 30 N-m. The diameter of vane was 50 mm and height 100 mm. Calculate the undrained shear strength of soil

a) 85 kN/m^2

b) 850 kN/ m^2

c) 65 kN/ m^2

d) 650 kN/ m^2

11.The depth of boring for isolated spread footing or raft is (according to IS 1892-1979)

a) Equal to the width of the foundation
b) Half times the width of foundation
c) One and half times the width of the foundation
d) None of above

12. Disturbed sample can generally be used for

a) Consolidation test

b) Soil classification

b) Hydraulic conductivity test

c) Shear strength test

13. List I enlists bearing capacity terms, List II provides definitions. Match the type of bearing capacity terms with best possible definitions

List I

i. Ultimate bearing capacity

11. Net safe bearing capacity

111. Gross safe bearing capacity

iv. Allowable bearing pressure

List II

A) Net loading intensity at which neither soil fails in shear nor is there any excessive settlement

B) The maximum gross intensity of loading that soil can carry safely without failing in shear

C) Net ultimate bearing capacity divided by factor of safety

D) The maximum gross intensity of loading that soil can support before it fails in shear.

(a) i-D. 11-C, iii-B, iv-A

(b) i-B. ii-A, iii-D. iv-C

(e) 1-D. 11-B, 111-C, 1v-A

(d) 1-B. 11-A 11-C, iv-D

14.Two circular footings of diameters D_1 and D_2 are resting on the surface of a purely cohesive soil (ϕ=0). The ratio D_1/D_2=2. If the ultimate bearing capacity of the footing of diameter D_1, is 200 N/m^2, then the ultimate bearing capacity (in kN/m^2) of footing diameter D_2 will be

(a) 100

(b) 200

(c) 340

(d) 600

15. In Terzaghi's analysis. the loading conditions are similar to that on a retaining wall under

(a) Active pressure

(b) Effective pressure

(c) Passive pressure

(d) Neutral pressure

16.A combined footing is used when

(a) Number of columns are two and they are spaced far apart

(b) Number of columns are two and they are spaced close to each other

(¢) Number of column is more than two and they are spaced far apart

(d) There 1s only one column

17.The immediate settlement can be computed from the expression, based on

(a) Theory of plasticity

(b) Theory of elasticity

(c) Terzaghi's analysis

(d) Pressure distribution

18. As per IS code, the allowable settlement for sand is limited to

(2) 50 mm for 1solated footing and 73 mm for raft

(b) 50 mm for isolated footing and 50 mm for raft

(c) 75 mm for isolated footing and 50 mm for raft

(d) 50 mm for 1solated footing and 25 mm for raft

19.If the angular distortion of 1/300 is allowed between columns 7.5 m apart, what is the corresponding value of differential settlement?

(a) 34 mm

(b) 21 mm

(c) 25mm

(d) 15mm

20.For cohesive soil, settlement is the major settlement

(a) Immediate settlement

(b) Primary consolidation settlement

(c) Secondary settlement

(d) All of the mentioned

21. Permissible settlement is relatively higher for

(a) Isolated footing on clays

(b) Isolated footing on sands

(c) Rafts on clays

(d) Rafts on sands

22. If two columns of a RCC structure are 8 m apart. the maximum differential settlement between columns should not exceed mm in case of isolated foundation on sandy soil (as per IS: 1904-1978)

a) 8mm

b) 10 mm

c) 12mm

d) 15mm

23. The maximum settlement of isolated footing which is founded on hard clay 1s (as per

IS: 1904-1978)

a) 60 mm

b) 75 mm

c) 50 mm

d) 100 mm

24.Match the following: [Correct Matching]

List-I

1. Strip footing

11. Isolated footing

111. Combined footing

iv. Raft footing

List-II

A. Provided for load bearing wall

B. Large slab supporting number of columns and walls under the entire structures

C. Provided to support an individual column

D. Provided to support more than one column

a) 1-B, 11-D, m-A, 1v-C

b) 1-A. 1-C. 11-B. 1v-D

¢) 1-B, 11-D, 11-A, 1v-C

d) 1-A. 1-C, 11-D, 1v-B

25.The changes that take place during the process of consolidation of a saturated clay would include

a) A decrease in pore water pressure and increase in effective pressure

b) An increase in pore water pressure and decrease in effective pressure

c) An increase in pore water pressure and increase in effective pressure

d) A decrease in pore water pressure and decrease in effective pressure

26.Actual contact pressure or stress distribution beneath a flexible footing resting on cohesive soil is

(a) Less at edges compared to middle

(b) More at edges compared to middle

(¢) Uniform through out

(d) None of above

27. The uses of pile are

a) To carry vertical load

b) To resist uplift load

¢) To resist horizontal or inclined load

d) All of the above

28.Which of the following pile is best for rock or very dense sand

a) H-pile

b) Circular pile

¢) Square pile

d) Rectangular pile

29.The pile which transmit the majority amount of load to the pile tips 1s called

a) Friction pile

b) End bearing pile

¢) Combined end-bearing and friction pile

d) None of the above

30.Which of the following pile is best suited to clay soil

a) Driven pile

b) Jetted pile

c) Bored pile

d) None of the above

31.The bored piles in sand have a point bearing or top resistance (qpu) is of

the value of the driven piles

a)1/2 to 1/3

b) 1/10 to 1/5

c) l to2

d) None of the above

32.The diameter of under-reamed pile 1s generally times the stem diameter

(a) 1 to 2

(b) 10 to 15

(c) 2 to 3

(d)3 to 4

33. The test which can be used for separating load (tip resistance and frictional resistance) carried by the pile 1s

(a) Static pile load test

(b) Cyclic pile load test

(c) Penetration test

(d) All of the mentioned

34. Match List-T (Types of soil) with the List- TI(suitable type of foundation) and select the correct answer using the codes given below.

List-I

Strong soil in surface layer

Weak surface layer followed by rock at shallow depth below ground

Swelling soil in surface layer expanding up to a few meters below GL

Weak heterogenous surface soil layer

List- II

1. Raft foundation

2. Isolated Foundation

3_End bearing pile

4 Under Reamed pile

AB C D

(a)4 3 2 1

(b) 3 1 2 4

(c) 1 2 3 4

(d) 3 4 1

35.The pile load test should be performed on

(a) Working pile

(b) Test pile

(c) All of the mentioned

(d) Neither (2) nor (b)

36.Under-reamed piles are usually

a) Precast piles

b) Driven piles

c) Bored piles

d) None of them

37.The pile load test are carried out under

(a) Compressive load

(b) Lateral load

(c) Uplift load

(d) All of the mentioned

38.The group efficiency of pile (1g) < 1 generally for

(a) Smaller spacing between piles

(b) Driven pile between loose to medium sand

(c) Larger spacing of piles

(d) All of the mentioned

39.The minimum pile spacing of friction pile with diameter D (length < 12 m) in sand is taken as

(a) 2D

(b) 3D

(c) 6D

(d) 8D

40. Negative skin friction in a soil is considered when the pile is constructed through a

(a) Dense fine sand

(b) Dense coarse sand

(c) Over consolidated stiff clay

(d) Fill material

41.The lateral earth pressure exerted by the soil when the retaining wall moves into the soil is

a) Earth pressure at rest

b) Active earth pressure

c) Total earth pressure

d) Passive earth pressure

42.

For plane strain condition the coefficient of earth pressure at rest is given by

a) $\frac{\mu}{1+\mu}$

b) $\frac{1+\mu}{\mu}$

c) $\frac{\mu}{1-\mu}$

d) $\frac{1-\mu}{\mu}$

43.The lateral earth pressure coefficient of a soil, Ka for active state, Kp for passive state and Ky for at rest condition, compare as

a) Ko<K:<Kp

b) Ka=Kp<Ky

c) Ka<Ky<Ky

d) Ep “Kn <Ka

44.The active earth pressure caused by a cohesionless backfill on a smooth vertical retaining wall may be reduced by

a) Compacting the backfill

b) Providing a surcharge load on the backfill

¢) Saturation of backfill with water

d) None of the above

45.As per Rankine’s theory. the wall friction is

(a) Equal to ϕ

(b) Greater than ϕ

(c) Less than ϕ

(d) Zero

46.The minimum factor of safety against sliding in the case of gravity retaining wall is

(a) 3.0

(b) 1.2

(c) 1.5

(d) 2.0

47. The stability of gravity retaining wall depends upon their

a) Weight

b) Weight and reinforcement

¢) Stem of the wall

d) None of the above

48. Consider two retaining walls ‘A’ and ‘B’ of same height retaining soil with identical

properties. A has perfectly smooth back whereas ‘B’ has a rough back. ‘B” will

experience an active pressure

(a) Greater than A

(b) Less than A

(¢) Equalto A

(d) Determined by roughness

49. Weep holes are provided in retaining walls mainly for the following reason

(a) To improve the appearance

(b) To provide the drainage of the backfill

(¢) To avoid crack to due to shrinkage

(d) To avoid friction behind the wall

50. As compared to the cantilever sheet pile, the required depth of the anchored sheet pile below the dredge level 1s

(a) More

(b) Less

(c) Same

(d) All the above

51. Shear keys are provided to

(a) Avoid friction behind the wall

(b) Improve the appearance

(c) Increase the passive resistance

(d) All of the mentioned

LONG TYPE QUESTIONS/PROBLEMS

1. A sand layer at sea floor under 20 m water depth is characterised with γ= 19.5kN/m^3. specific gravity of soil = 2.65. Assume the specific gravity of sea water to be 1.03 and the unit weight of fresh water (γ_w) to be 9.81 kN/m^3. What would be the total stress and pore pressure at 25 m depth below the sea floor in the sand layer?

2. Determine the shear strength in term of effective stress on a plane within a saturated soil mass at a point where the total normal stress is 210 kN/m^{2}and the pore water pressure 85 kN/m^2. The effective stress shear strength parameter for soil are : $c^{'}$ = 15 kN/m^2. $\Phi^{'}$ = 30°.

3. A cylindrical specimen of saturated clay, 3.5 cm in diameter and 7m in height was tested in an unconfined compression testing machine. The specimen fails under an axial load of 0.4 kN when the axial deformation was 8 mm. The unconfined compressive strength of the soil is _____.

4. A square footing fails by general shear in a cohesionless soil having ϕ=35° under an ultimate load of Q_u= 380 kN. The footing is placed at a depth of 2 m below ground level. Given γ=17kN/m^2, N_q = 41.1, N_γ = 42.4. Determine the size of the footing if the water table is found at a greater depth [Use Terzaghi's Theory].

5.A rectangular footing 1 m x 2 m is placed at a depth of 1 m in saturated clay having an unconfined compressive strength 100 KN/m^2. According to Skempton the net ultimate bearing capacity is

6.Determine the ultimate bearing capacity of a strip footing, 1.5 m wide, with its base at a depth of 1 m. resting on a dry sand stratum. Take γ= 17 kN/m^3, ϕ'=38 and c'=0. Use Terzaghi's theory (N_q = 60. Nγ= 75).

7.A strip footing of 2 m width is founded at a depth of 1 m below the ground surface. According to Terzaghi, the net ultimate bearing capacity in kN/m^{2}is _____(ϕ = 40°, c = 0, N_q =81.3, N_γ =100.4, γ=17 N/m^3)

8.A strip footing of width 3 m is founded at a depth of 2 m below the ground surface having a cohesion c= 30 kN/m^2 and the angle of shearing resistance ϕ= 38°. The water table is at a depth of 5 m below the ground level. The unit weight of soil above the water table is 17.25 kIN/m^2. Determine the net safe bearing pressure for a factor of safety of 3. [Use Terzaghi's Theory]

9.A 4 m thick layer of a fill material (γ_{bulk} = 20 kN/m^2) is to be laid instantaneously on the top surface of a 10 m thick clay layer. If the coefficient of volume compressibility (m_v) and γ_{sat} for clay are 3.2 x 10° m^{-4}/kN and 18 kN/m^3, the consolidation settlement of the clay layer due to placing of fill material will be_____. [Do not apply any correction factor for settlement].

10.What is the immediate settlement of a concrete isolated footing 1.5 x1.5 m in size founded at a depth of 1 m in silty soil whose modulus of elasticity is 90 kg/cm^2? The footing is expected to transmit a unit pressure of 200 kN/m^2. Take μ=0.3 [Do not apply any correction factor for settlement] Assume g=10 m/sec^2

11. An isolated footing 4 m x 2 m in plan, transmits a pressure of 150 kIN/m^2 on a cohesive soil having E= 6x10^4 kN/m^2 and μ=050. Determine the immediate settlement of the footing at the centre, considering it to be a flexible footing [Do not apply any correction factor for settlement].

12. Using Meyerhof's method (1974), determine the net allowable bearing pressure ($q_{a-\ net}$) for the isolated footing of width 3.5 m is founded at a depth of 1.5 m below the ground surface. The water table 1s 1.5 m below the foundation level. The corrected average SPT value N = 24, and allowable settlement (S_a) = 40 mm.

13. Using Teng's (1962) correlation, determine the net ultimate (q_{nu}) bearing capacity of a strip footing of width 3.75m resting on sandy soil. The corrected *N* values (SPT) of the soil at different depths are as follows:

Elevation (m): -1.5,-2.25,-3.0,- 3.75, -4.5,-5.25,-6.0. -6.75, -7.5, -8.25, -9

Corrected *N* Value (SPT): 11, 22, 26, 28, 31, 33, 35, 37. 40, 42, 44

14. Determine the ultimate bearing capacity of a strip footing 2.5 m in width with its base at a depth of 2 m below ground surface and resting on a saturated soil with the properties: γ_s= 20 KN/m', c'=20 kN/m^2, ϕ' = 30°, N_c=37, N_q =22.5,Nγ = 19.7. The natural water table is at a depth of 1 m below ground level. Use Terzaghi's theory.

15. A 12 m long. 300 mm diameter pile is driven in a uniform deposit of sand ($\phi' = 38^\circ$). The water table is at a great depth and is not likely to rise. Using γ = 16 N/m^3, N_q = 137, and K = 2. the ultimate pile load capacity is (without considering critical depth concept). $\delta = 0.75\phi$.

16. In problem 15 if the water table present at 4m below the ground surface, determine the ultimate pile load capacity of pile (without considering critical depth concept). Unit wt of soil above (γ) and below (γ_s) the water table are 16 kN/m' and 18 kN/m? respectively. γ_w= 10 kN/m^2.

17. A precast concrete pile of size 45x45 cm is driven into stiff clay. The unconfined compressive strength of the clay is 200 kN/m^2. Determine the length of the pile required to carry a safe working load of 400 kN with F_s=2.5. Take α=0.4.

18. A concrete pile of 45 cm diameter is driven through a system of layered cohesive soils. The length of the pile is 16m. The following details are available. The water table is close to the ground surface.

Top layer 1: Soft clay, thickness= 8m, c=30 kN/m^2, α =0.9

Layer 2: Medium stiff, thickness= 6m, c =30 kN/m^2, α = 0.75

Layer 3: Stiff stratum extends to greater depth, ϕ =105 kN/m^2, α =0.5

Find out Q_u and Q_{safe} using F_s=2.5

19. A 14 m long, 300 mm diameter pile is driven in a uniform deposit of sand ($\phi = 39^\circ$). The water table present at 3 m below the ground surface. Unit wt of soil above (γ) and below (γ_s) the water table are 16 kN/m^3 and 20 kN/m^3 respectively. γ_w = 10 kN/m^3. Using N_q, = 137, and K =1, δ =20. Determine the ultimate pile load capacity (with considering critical depth concept).

20. A 300 mm square bearing plate settles by 21 mm in a plate load test on a cohesive soil when the intensity of loading is 0.2 N/ mm^2 . Find the settlement of a prototype shallow footing 1m square (1m x 1m) under the same intensity of loading (considering both plate and footing are placed at same depth).

21.A retaining wall of height 8m retains dry cohesionless soil. Void ratio and angle of internal friction of the back fill respectively are 0.7 and 30° in the loose state and they are (0.3 and 40° in the dense state. G_s=2 65. Find out the passive earth pressures in loose and dense states respectively. (Use Rankine's theory), Assume γ_w = 10 kN/m^3.

22. A retaining wall 10 m high with a smooth vertical back, retains a backfill with c' = 30 KN/m^2 & ϕ'=15°, γ = 17 kN/m^3, and γ_{sat}= 20 kN/m^3. What is the total Rankine active thrust on the wall after the formation of tension crack.

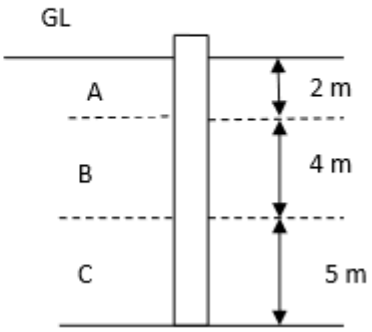
23. A retaining wall 10 m high with a smooth vertical back, retains a backfill with c' = 30 KN/m^2 & ϕ'= 30°, γ = 17 kN/m^3 . If the horizontal soil surface carries a uniform pressure of 40 kN/m^2, what is

the total Rankine passive thrust? Also, what is the point of application of total passive thrust from the base of retaining wall?

20.

Skin frictional capacities of a 40 cm diameter driven concrete pile for portion A, B and C are 17kN, 63 kN and 503 kN respectively. The point load carrying capacity is 11000 kN/m^2. Total pile load capacity will be

(a) 1965 kN
(b) 2345 kN
(c) 1545 kN
(d) 3009 kN



21.A group of 9 piles with 3 piles in a row was driven into medium clay extending from ground level to a great depth. The diameter and the length of the piles were 30 cm and 10 m respectively. The unconfined compressive strength of the clay is 70 kPa. If the piles were placed 90 cm centre to centre. compute the allowable load on the pile group on basis of shear failure criterion for a factor of safety of 2.5. $\alpha = 0.7$

22. A square pile group consisting 9 piles passes through a recently constructed soft deposits with q_u=50kN/m^2 and γ=15kN/m^2. The depth of deposit is L_n=3m. The diameter of the pile is 30cm and the piles are spaced 90 cm centre to centre. What is the negative skin friction load on the pile group.

23. A precast concrete pile of size 30x 30 em is driven by a 300 kg drop hammer with the height of fall of 1.5m. The allowable pile load is given as 2000 kg. Considering a factor of safety of 6. what is the final set per blow using Engineering News Record formula?

24. A 400 mm diameter &10 m long piles are used as foundations for a column in a uniform deposit of clay (c_u = 60 kN/m^2). The spacing between the piles is 300 mm. There are 9 piles in the ground arranged in a square pattern. Determine the group efficiency. Assume adhesion factor = 0.4.

25. A group of 9 driven piles, 12 m long and 300 mm in diameter is to be arranged m a square pattern in sandy soil ($\phi = 30°$). The centre to centre spacing of the piles are 400 mm. Calculate the ultimate load capacity of the pile group ($\eta = 1$). The unit weight of sand is 16 kN/m^3. Nq = 25, $\delta = 0.75\phi$, K =1, Le = 15D (consider critical depth concept and neglect the water table effect).

26. A group of 9 friction piles arranged in a square pattern is to be proportioned in a deposit of medium stiff clay. The size of the piles is 30x 30 cm and 10 m long. Find the optimum spacing of the piles. Assume α=0.8 and c_u=50kN/m^2.

27. A retaining wall with a smooth vertical back retains sand backfill for a depth of 5m The backfill has a horizontal surface and has the following properties c=0, $\phi' = 30°$, γ_{bulk}= 17 kN/m^3, γ_{sat} = 20 kN/m^3 . The backfill supports uniformly distributed load of 20 kN/m^2. What is the total active thrust (Use Rankine's theory)?

28. What is the total active thrust in Question 27, if the water table at 3 m depth and there is no drainage. Assume γ_w = 10 kN/m^2. (Use Rankine's theory)?

29. A 6m high vertical wall supports a cohesive backfill. The unit weight and cohesion of the top 4 m of backfill are respectively 16 kN/m^3 and 20 kN/m^2. The unit weight and cohesion of the bottom 2 m of

backfill are respectively 17 kN/m^3 and 25 kN/m^2. If the tension crack develop. what is the total Rankine active thrust?

30. A 5 m high retaining wall retain a soil with the following properties c=0, ϕ' =30°, γ= 17 kN/m^3, δ =20°. The backfill surface is sloping at an angle 10° to the horizontal and the back of the wall is inclined at an angle 70° to the horizontal. Determine the Coulomb active thrust.

31. A retaining wall with smooth vertical back is 5 m high and retains a 2 layer sand backfill with the following properties

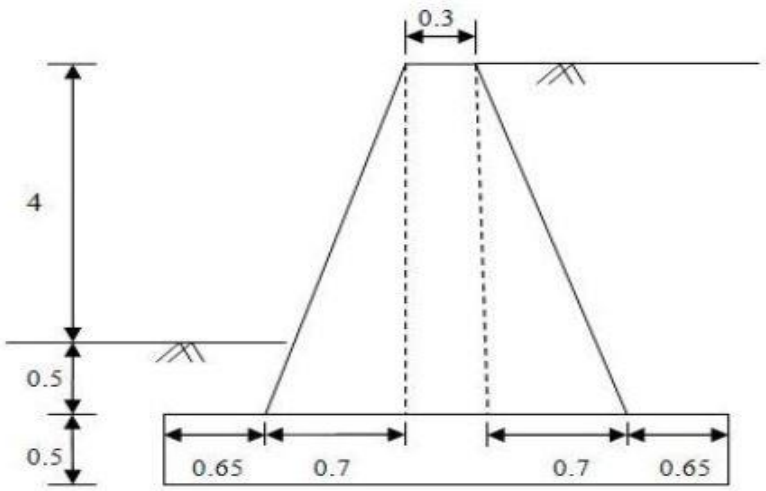
0-2.5m: ϕ' =30°, γ= 16 kN/m^3

25-5m: ϕ' =40°, γ_{sat}= 20kN/m^3

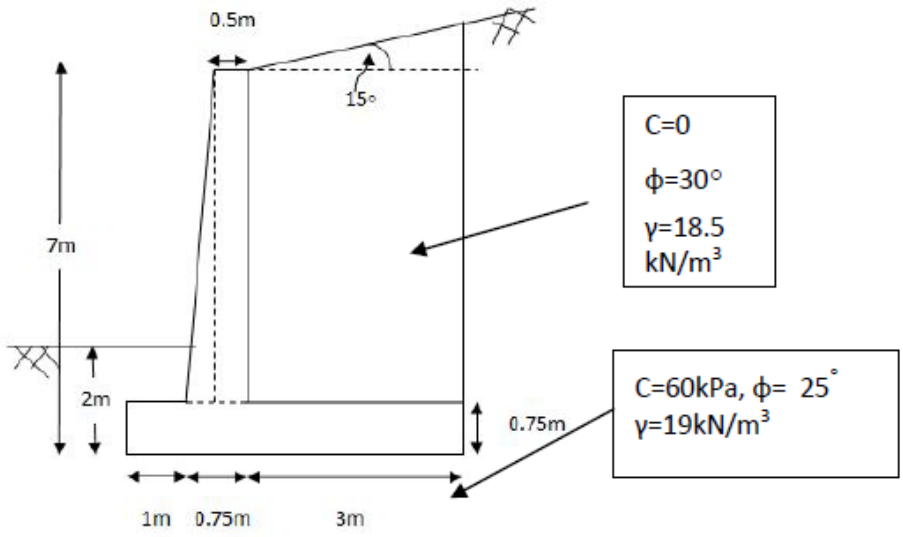
The W. T. is at a depth 2.5 below G.L. Determine Rankine active thrust assuming γ_w =10kN/m^3 .

32.

Determine the factor of safety of gravity retaining wall shown in fig (all dimensions are in m) against sliding. c = 0, $\phi' = 30^0$, $\delta = 20^0$, γ = 18 kN/m^3. Unit weight of concrete 24 kN/m^3. Use Coulomb's theory.



a) 0.93
b) 1.14
c) 1.34
d) 1.5



33. Find the factor of safety of above retaining wall with respect to sliding. The Soil properties above and below base of wall are given in the diagram. Use Rankine's theory for earth pressure calculation. Use $\gamma_{concrete}$=24 KN/m^3, δ= 0.67 $\phi_{\text{below base}}$ and α =0.55.

34. Find the factor of safety against overturning for problem 33.

Foundation Engineering

Assignment – I

Academic Session – 2021-22 (Summer)

Sixth Semester

Module – I

(1) A retaining wall with a smooth vertical back retains sand backfill for a depth of 5m. The backfill has horizontal surface and has the following properties. $c' = 0$, $\phi' = 30^\circ$, $\gamma_{moist} = 17\ kN/m^3$, $\gamma_{sat} = 20\ kN/m^3$. The backfill supports uniformly distributed load of $20\ kN/m^2$. What is the total active thrust (Use Rankine's theory). and ~~the point~~ its position?

(2) A retaining wall 10m high with a smooth vertical back retains a backfill with $c' = 30\ kN/m^2$, $\phi' = 30^\circ$ & $\gamma = 17\ kN/m^3$. If the horizontal soil surface carries a uniform pressure of $40\ kN/m^2$. What is the total Rankine's passive thrust and its position?

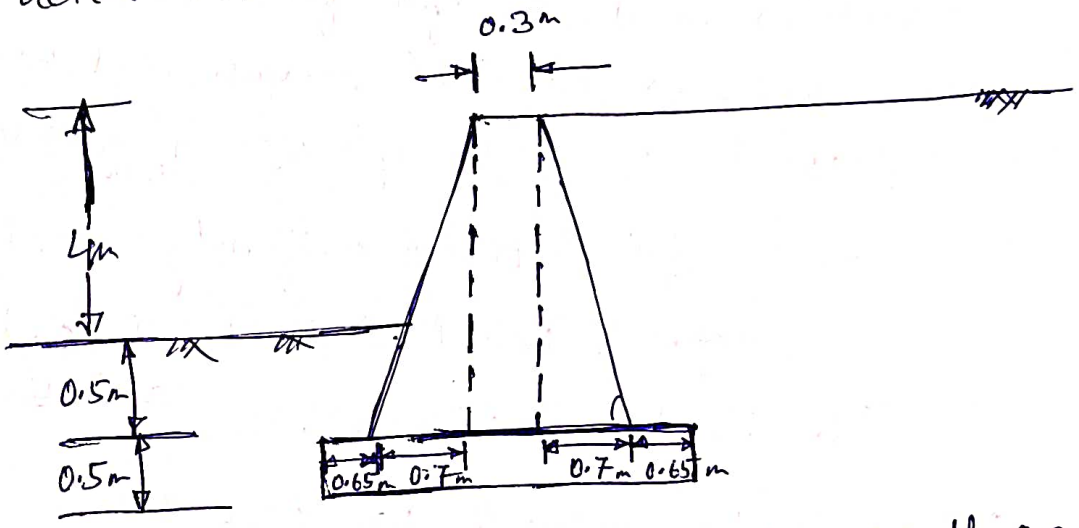
(3) Derive the expression for ~~the~~ Coulomb's theory of Passive earth pressure.

(4) A 6m high vertical wall supports a cohesive backfill. The unit weight and cohesion of the top 4m of the backfill are $16\ kN/m^3$ & $20\ kN/m^2$ respectively. The unit weight and cohesion of

the bottom 2m of the backfill are respectively 17 kN/m³ and 25 kN/m². If the tension crack develop, what is the total Rankine active thrust.

(5) A 5m heigh retaining wall retain a soil with the following properties. $c' = 0$, $\phi = 30°$, $\gamma = 17$ kN/m³, $\delta = 20°$. The backfill surface is sloping at an angle of 10° to the horizontal and the back of the wall is inclined at an angle 70° to the horizontal. Determine the Coulomb active thrust.

(6)



Determine the F.S. of gravity retaining wall as shown in the above figure against sliding. $C = 0$, $\phi' = 30°$, $\delta = 20°$, $\gamma = 18$ kN/m³. Unit weight of concrete is 24 kN/m³. Use Coulomb's theory.

Module-II

(1) Derive the Terzaghi's bearing capacity equation.

(2) Using Meyerhof's method & IS Code method determine the net allowable bearing pressure ($q_{a\text{-net}}$) for isolated footing of width 3.5m is founded at a depth

of 1.5m below the ground surface. The water table is 1.5m below the foundation level. The corrected average SPT value $N = 24$ and allowable settlement $(S_a) = 40$ mm.

③ A strip footing of width 3m is founded at a depth of 2m below the ground surface having a cohesion $C = 30\ kN/m^2$ and the angle of shearing resistance $\phi = 38°$. The W.T. is at a depth of 5m below the ground level. The unit weight of soil above the W.T. is $17.25\ kN/m^3$. Determine the net safe bearing pressure for a F.O.S. of 3. Use Terzaghi's theory.

④ A 4m thick layer of a fill material ($\gamma_{bulk} = 20 kN/m^3$) is to be laid instaneously on the top surface of a 10m thick clay layers. If the coefficient of volume change (m_v) and γ_{sat} for clay are $3.2 \times 10^{-4}\ m^2/kN$ and $18\ kN/m^3$, find the consolidation settlement of the clay layer due to placing of fill material. ~~will be~~

⑤ What is the immediate settlement of a concrete isolated footing 1.5 × 1.5m in size founded at a depth of 1m in silty soil whose modulus of elasticity is 90 kg/cm²? The footing is expected to transmit a unit pressure of $200\ kN/m^2$. Take $\mu = 0.3$ and $g = 10\ m/sec^2$.

Module-III

(1) A 12m long, 300mm diameter pile is driven in a uniform deposit of sand ($\phi' = 38^\circ$). (4) The W.T. is at a great depth and is not likely to rise. Using $\gamma = 16\ kN/m^3$, $N_q = 137$ and $K = 2$ & $\delta = 0.75\phi$. Find the ultimate pile load capacity without considering critical depth ~~consider~~ concept.

(2) In the above problem (i.e. in Q.No. 1) if the water table is at 4m below the ground surface, determine the ultimate pile load capacity of pile (without considering critical depth concept). Unit weight of soil above (i.e. γ_{bulk}) and below (i.e γ_{sat}) W.T. are $16\ kN/m^3$ and $18\ kN/m^3$ respectively. Take $\gamma_w = 10\ kN/m^3$.

(3) A concrete pile of 45 cm diameter is driven through a system of layered cohesive soils. The length of pile is 16m. The following details are available. The W.T. is close to ground surface.

Top layer: Soft clay, thickness = 8m, $c = 30\ kN/m^2$ & $\alpha = 0.9$

Layer 2: Medium stiff, thickness = 6m, $c = 50\ kN/m^2$ & $\alpha = 0.75$

Layer 3 : Stiff stratum extends to greater depth,

$C = 10.5\ kN/m^2$, $\alpha = 0.5$

Find out Q_u & Q_{safe} using $F_s = 2.5$.

(4) A 14m long, 300mm diameter pile is driven in a uniform deposit of sand ($\phi' = 39°$). The water table present at 3m below the ground surface. Unit weight of soil above (γ) and below (γ_{sat}) the W.T. are $16\ kN/m^3$ & $20\ kN/m^3$ respectively. $\gamma_w = 10 kN/m^3$ Using $N_q = 137$, $K = 1$, $\delta = 20$, find the ultimate pile load capacity with considering critical depth concept.

(5) A group of 9 piles with 3 piles in a row was driven into medium clay extending from ground level to great depth. The diameter and the length of the piles were 30cm & 10m respectively. The unconfined compressive strength of clay is 70kPa. If the piles were placed 90cm centre to centre, Compute the allowable load on the pile group on the basis of shear failure criterion for a factor of safety of 2.5 & $\alpha = 0.7$.

(6) A square pile group consisting 9 piles passes through a recently constructed soft deposits with $q_u = 50\ kN/m^2$ & $\gamma = 15\ kN/m^3$. The depth of the deposit is 3m. The diameter of the pile is 30cm & the piles are spaced at 90 cm centre to centre.

What is the negative skin friction load on the pile group.

Module - IV

(1) The observed SPT value in a deposit of fully submerged sand was 45 at a depth of 6m. The average submerged unit weight of the soil is 9.7 kN/m3. The other data given are $E_r = 80$, drill rod length correction factor = 0.9, borehole diameter correction factor = 1.05 and sampler is without liner. Determine N'_{70} (ASTM D1586).

(2) At a depth of 6m below the ground surface at a site, a vane shear test gave a torque value of 30 N-m. The diameter of the vane was 50mm and height 100mm. Calculate the undrained shear strength of soil.

(3) Describe briefly SCPT.

(4) Describe the procedure to determine the thickness of soil layer by using seismic reflection method.

(5) Give brief description of undisturbed and disturbed samplers.