QP Code : 4971

(3 Hours) [Total Marks : 80

Note:
(1) Question No. **1** is **compulsory**.
(2) Answer any **three** out of remaining **five** questions.
(3) Assume **suitable** data wherever necessary.

Answer any **four**

(a) Draw the free body diagram of forces for an embankment in c- ϕ soil with circular failure surface and define the notations used. Also determine the factor of safety with respect to cohesion for a submerged embankment 25 m high and having a slope of 40^0. The properties of soil are $\varphi = 10^0$, $c = 40$ kN/m^2, $\Upsilon_{sat} = 19$ kN/m^3, Taylor's stability number, $S_n = 0.097$. 5

(b) An unsupported excavation is to be made in soil having $\varphi = 12^0$, $c = 19$ kN/m^2, $\Upsilon = 19$ kN/m^3. What is the maximum depth of unsupported excavation in a soil? and draw the active pressure distribution diagram. 5

(c) Considering Coulomb's theory of lateral earth pressure, draw and define the forces acting on the cohesionless backfill at failure under active state behind a retaining wall. Also, why are retaining walls usually designed for active earth pressure? 5

(d) Explain the basic difference in the theoretical bearing capacity computation of shallow and deep foundations. 5

(e) Define allowable bearing capacity of soil and what is the effect of increase in width and depth of a footing on the bearing capacity and settlement behaviour of footing resting on (i) sand and (ii) clay? 5

(f) In what respect does the design of braced cuts differ from that of a retaining wall and What are apparent earth pressure diagrams used in the design of braced cuts? 5

(a) Derive an expression for factor of safety of an infinite slope in a c-Φ soil when there is a steady seepage parallel to the slope. 7

(b) A deep cut of 12 m depth is made in natural soil for the construction of a road. The properties of soil are: cohesion = 30 kN/m^2, angle of internal friction = 15^0 and a unit weight = 20 kN/m^3. The slope angle of the cut is 35^0. Consider a trial slip circle of radius 20 m passing through the toe and cutting the top ground surface at a distance 5 m from top edge. Determine the factor of safety with respect to cohesion for the given trial slip circle by friction circle method. Assume factor of safety w.r.t. friction as 1.5. 8

(c) Critically compare Rankine's theory with the Coulomb's lateral earth pressure theory. 5

(a) Explain Culmann's method for the determination of active earth pressure on retaining wall considering the effect of line load on backfill. 8

(b) A 7 m retaining wall with a smooth vertical back face has a stratified back fill and a surcharge load of 10 kpa. The properties of soil are as follows: up to 3.5 m height from top:- unit weight = 15 kN/m^3, angle of shearing resistance = 30^0 and cohesion = 0. Below 3.5 m level:- unit weight = 20 kN/m^3, angle of shearing resistance = 10^0 and cohesion = 10 kpa. Draw the lateral active earth pressure diagram and estimate the resultant thrust on the wall and its position. 8

(c) What are the different types of conduits and the factors that affect the load on a conduit? 4

4. (a) For the cantilever sheet pile wall shown in Figure 1, compute the embedment depth below the dredge line. 10

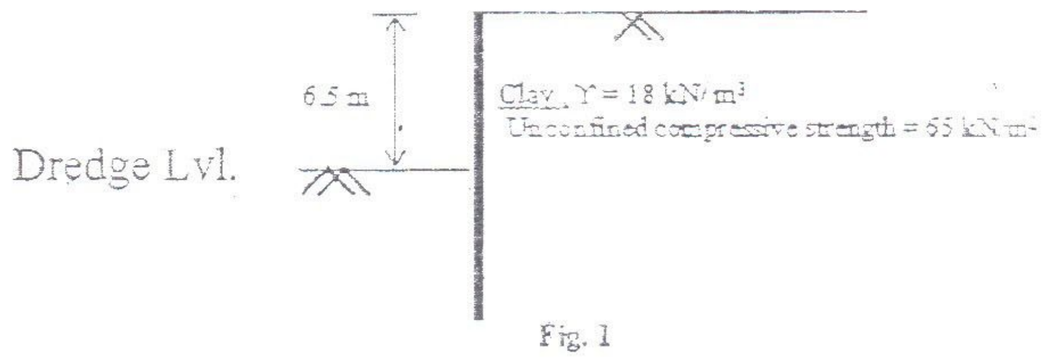
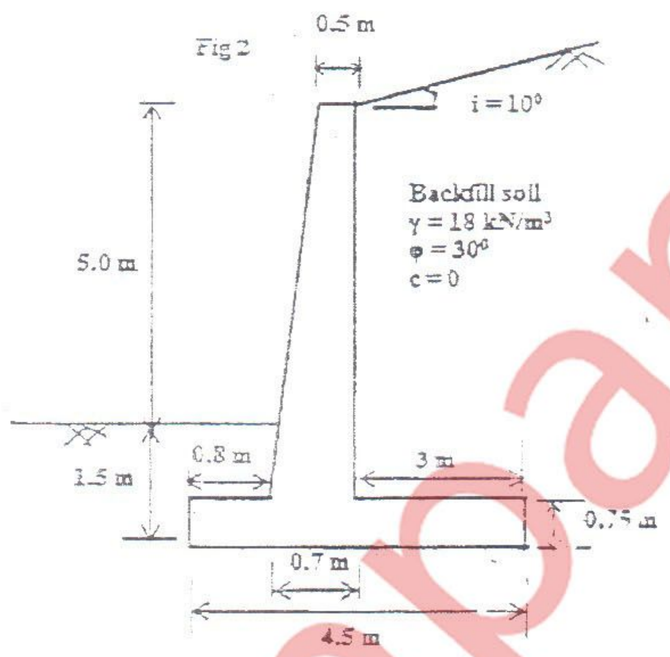


Fig. 1

(b) Differentiate between general, local and punching shear failure of shallow foundations. 5

(c) Describe how the bearing capacity of soil for shallow foundation can be determined from standard penetration test. 5

5. (a) Check the stability of the wall shown in Figure 2. Unit weight of concrete = 24 kN/m³. 10



Foundation soil: Y = 19 kN/ m³, Φ = 20°, C = 40 kpa, δ = 13°
Safe bearing capacity = 500 kpa

(b) A circular foundation of 2.5 m diameter carries a load of 2500 kN. The soil has following properties: $\Upsilon = 19$ kN/ m³, $\Phi = 30^0$, c = 4 kN/ m², $N_c = 37.2$, $N_q = 22.5$, $N_\Upsilon = 19.7$. Using Terzaghi's theory,
(a) Find the depth at which the foundation should be located to provide a factor of safety of 3.
(b) What is the depth of location of foundation if there exists a water table close to the ground surface? 10

6. (a) Explain the internal stability of mechanically stabilized retaining wall. 5

(b) Explain the method of computation of settlement of pile groups in clayey soil. 5

(c) A precast concrete pile of diameter 450 mm is driven into stiff clay. The unconfined compressive strength of the clay is 200 kN/m². Determine the length of pile required to carry a safe load of 400 kN with factor of safety = 2.5. Assume adhesion factor = 0.55. 5

(d) Following data was obtained in a vertical pile load test on a 300 mm diameter pile. Plot the load-settlement curve and determine the allowable load as per IS code. 5

Load (kN)	50	100	200	300	400	500	600
Settlement (mm)	2.5	4	9.5	16.5	27	40.5	61