2023

CIVIL ENGINEERING

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in **English** *or in* **Bengali** *but all answers must be in one and the same language.*

All notations / symbols have their usual meanings, unless otherwise specified.

Group-A

Answer *any four* questions. 35×4=140

1. (a) A simply supported beam of a beam slab system rests on a support of width 450 mm. The clear span of the beam is 10.0 m. The thickness of slab is 120 mm. The depth of the beam is 480 mm below slab and width of the beam is 250 mm. The beam is reinforced with one row 32 mm diametre steel rods. The total is 25.0 kN. Calculate the maximum design shear stress in concrete.

   (b) Design a square R.C. column to resist an axial lood 400.0 kN due to dead lood and 240.0kN due to rive lood. Design the section as a short column. Use M25 concrete and steel grade 415 N/mm^2. Give neat sketch of the section.

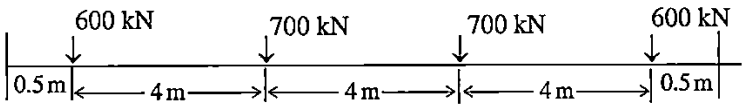
   (c) A settlement analysis carries out for a proposed structure indicates that 9 cm of settlement will occur in 5 years and final settlement will be 45 cm based on double drainage condition. A detailed site investigation indicates that only single drainage exists. Estimate the settlement at the end of 5 years. 10+10+15

2. (a) Two identical specimens were tested in a triaxial. The specimen failed at a deviator stress of 770 kN/m^2 and 1370 N/mm^2 respectively. Where the cell pressure is 200 kN/m^2 and 400 kN/m^2. Determine the value of 'C' and ϕ analytically. If the same sample is tested in a direct shear with normal stress of 600 kN/m^2. Find shear stress at failure.

   (b) (i) Discuss the assumptions of Terzaghi bearing capacity theory.

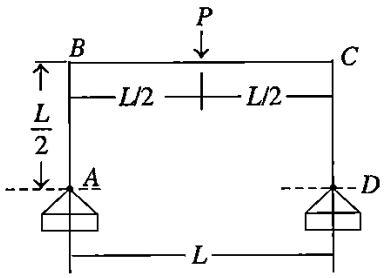
   (ii) Calculate the ultimate bearing capacity of strip footing 1.5m wide resting on a clay ($c = 30\ kN/m^2$, $\gamma_{sat} = 20\ kN/m^3$). Depth of the foundation 2.0 blow ground level. The water table also below 2.0 m ground. If the water table rises by 1.0 m, calculate the percentage reduction in the ultimate bearing capacity. 18+3+14

3. (a) Draw B.M and SF diagrams of the beam shown in the Figures.



(b) Discuss what do mean M_{25} concrete and Fe 415 grade of steel. 27+8

4. (a) Arrive the bending moment diagram for the frame loaded is shown using the moment distribution method.



(b) A 140mm × 10mm mild steel plate is lap spliced with 140mm × 12mm using 4 nos of 20mm mild steel bolts in clearance holes located in two rows. Calculate the load carrying capacity of the splice given that the allowable stresses

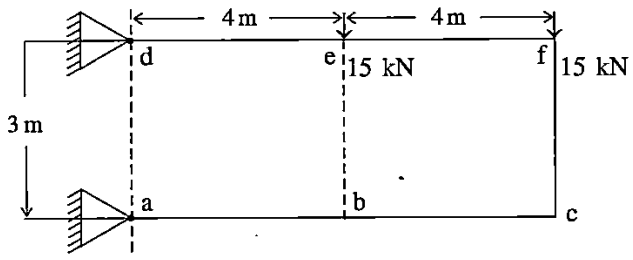
(i) Shear in bolt = 80 MPa

(ii) bearing stress in bolt = 250 MPa

(iii) Tensile stress in bolt = 120 MPa

(c) Calculate the design moment capacity by the limit states method of a rectangular concrete (reinforced) beam of 230 mm (width) × 400 mm (depth) with 3 No. of 16 mm ϕ bar Fe415 as tension reinforcement. Take clear cover 25 mm and grade concrete to be M20. 15+10+10

5. (a) Compute the forces in the members of stress shown below in Figure.



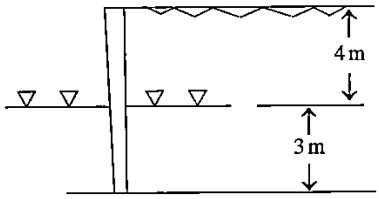
(b) A sheet of water of thickness 1m is available to fill the voids of cohesionless soil to a degree of saturation of 80%. The void ratio of the soil is 0.5. Determine the thickness of the soil layer required to accommodate this amount of water. 28+7

Group-B

Answer *any four* questions. 15×4=60

6. A cohesionless soil with a void ratio of $e = 0.6$ and specific gravity of soil solids $G_s = 2.65$ exists at a site where the water table is located at a depth of 2.0 m below the ground surface. Assuming a value of co-efficient of earth pressure at rest $K_0 = 0.5$. Calculate the following quantities at a depth of 5.0m below the ground surface: total stresses σ_V and σ_H, effective stresses σ_V^1 and σ_H^1 and pore water pressure U. Assume soil dry above the water table and saturated below the water table. Use $\gamma_w = 9.81$ kN/m^3. 15

7. (a) Plot (not to scate) the active earth pressure distribution on the retaining wall with magnitude shown by Rankinne's earth pressure theory for the data given below. Take $\gamma_w = 10$ kN/m^3.



Stratum I $\gamma = 16.2$ kN/m^3
$c = 15$ kN/m^2
$\phi = 26°$

Stratum II $\gamma_{sat} = 20.4$ kN/m^3
$\phi = 34°$

(b) Discuss earth pressure at rest, active and passive. 9+6

8. A rectangular beam 450 mm wide is subjected to bending moment 5000 kgm, a shear force of 3000 kg and torsion of 2300 km. Design the section use M25 concrete and Fe415 steel bar. 15

9. A 10m high cutting has a slope of 40° to horizontal. The properties of soil as e(void ratio) = 0.81 $c = 2.5$ t/m^2 and $\phi = 14°$ respectively. Determine the factor of safety with respect to cohesion against failure of slope

(i) when water level rises upto full height.

(ii) when water level goes down suddenly.

Given G = 2.67, for 40° slope values the stability number for different values of ϕ :

ϕ	N
6°	0.122
7°	0.116
14°	0.074

15

10. (a) Define

(i) Relative consistancy

(ii) Thixotropy

(iii) Toughness index and

(iv) stoke's law

(b) What was the absolute density and shrinkage limit of a fully saturated clay sample which had moisture content of 32% and an apparent specific gravity of 1.87, which came down to 1.77 after oven drying? 8+7