



CIVIL ENGINEERING (PAPER-I)

Time allowed: Three Hours

Maximum Marks: 100

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

1. There are EIGHT questions printed in English.
 2. Candidate has to attempt FIVE questions in all.
 3. Question No.1 is compulsory. Out of the remaining SEVEN questions, FOUR are to be attempted.
 4. All questions carry equal marks. The number of marks carried by a question / part is indicated against it.
 5. Write answers in legible handwriting. Each part of the question must be answered in sequence and in the same continuation.
 6. Wherever any assumptions are made for answering a question, they must be clearly indicated.
 7. **Diagrams** : Figures, wherever required, shall be drawn neatly. Unless otherwise mentioned, symbols and notations carry their usual standard meanings. Use of I.S. Codes of Practice and Steel Section Handbook is permitted. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in answer book must be clearly struck off.
- (v) Re-evaluation / Re-checking of answer book of the candidate is not allowed.

1. Explain in details essentials of air conditioning system? (20)
2. (a) The stress state at a point in a body is plane with $\sigma_1 = 60 \text{ N/mm}^2$ and $\sigma_2 = -36 \text{ N/mm}^2$. If the allowable stress for the material in simple tension or compression is 100 N/mm^2 , calculate the value of factor of safety with each of the following theory of failure. Assume ($\mu = 0.3$)
 - (i) Rankine's Theory
 - (ii) Guest's Theory
 - (iii) St. Venant's Theory
 - (iv) Von mises yield Theory

(10)

- (b) If two pieces of materials A and B have the same bulk modulus but the value of E (Young Modulus) for B is 15 greater than that for A, find the value of N (Modulus of Rigidity) for the material B in terms of E and N , for material A? (10)

3. Analyze the beam loaded as shown in Fig. 1 below using flexible coefficient method of analysis for the following condition: (20)

- (i) Release the fixed end moment at A and bending moment at B.
(ii) If downward settlement of B and C is $2000/EI$ and $1000/EI$ in kN-m units respectively.

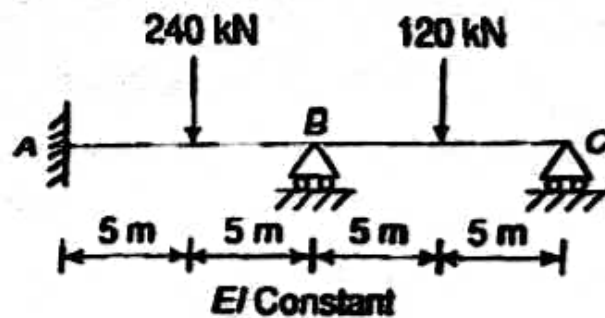


Fig. 1

4. Calculate the collapse load for the portal frame as shown in Fig. 2 below and design the members if factored load is 72 kN and f_y of steel is 250 MPa. (20)

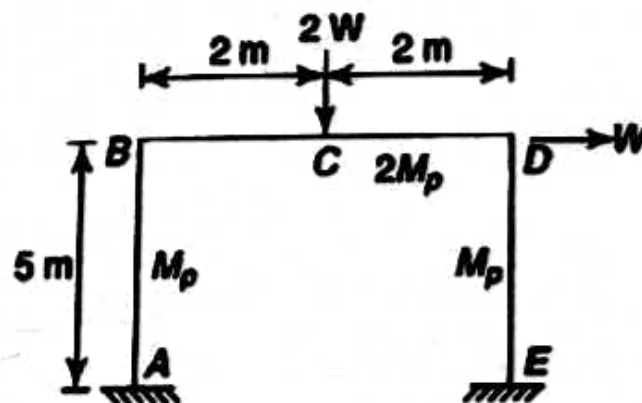


Fig. 2

5. (a) A pretensioned beam, 200 mm wide and 300 mm deep, is prestressed by 10 wires of 7 mm diameter initially stressed to 1200 N/mm^2 , with their centroids located 100 mm from the soffit. Find the maximum stress in concrete immediately after transfer, allowing only for elastic shortening of concrete.

If the concrete undergoes a further shortening due to creep and shrinkage while there is a relaxation of five per cent of steel stress, estimate the final percentage loss of stress in the wires using the Indian Standard Code IS: 1343 regulations, and the following data: (10)

$$E_s = 210 \text{ kN/mm}^2$$

$$E_c = 5700 (f_{cu})^{1/2}$$

$$f_{cu} = 42 \text{ N/mm}^2$$

$$\text{Creep coefficient } (\phi) = 1.6$$

$$\text{Total residual shrinkage strain} = 3 \times 10^{-4}$$

- (b) Design the reinforcement in a column of size 400 mm by 600 mm subjected to an axial working load of 2000kN. The column has an unsupported length of 3m and is braced against side sway in both directions. Adopt M-20 grade concrete and Fe-415 HYSD bars. Draw a neat sketch of cross section of column showing the reinforced detail? (10)

6. (a) Differentiate clearly between PERT and CPM network methods. (10)
- (b) Explain about continuous stairs with neat diagrams? (10)

7. The subsoil at the typical pier location of a major bridge consists of medium to coarse sand (corrected SPT value = 11) up to a depth of 6m from bed level (RL + 9.20m). This is underlain by 9m thick layer of very stiff to hard sandy silty clay (corrected SPT value is greater than 30) , overlying highly weathered rock (RQD = 0).

Using Lacey's formula, calculate the maximum scour depth and determine the founding level of the well. Also, estimate the allowable net bearing pressure if the diameter of the well is 6m. Use following data:

Maximum flood discharge = 10465 m³/s, Length of bridge = 382.5 m, HFL = 13.00m, Silt factor = 1.053, submerged unit weight of soil and rock = 10 kN/m³, $C_{(drained)} = 0$ and $\phi_{(drained)} = 35^\circ$ for weathered rock. (20)

8. (a) A load 1000 kN acts as a point load at the surface of soil mass. Estimate the stress at a point 3m below and 4m away from the point of action of the load by Boussinesq's formula. Compare the value with the result from Westergaard's theory. (10)
- (b) Explain characteristics of good mortar? (10)



CIVIL ENGINEERING (PAPER-II)

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✓ 1. (a) Explain quality control practices during construction of CC pavements? (10)

✓ (b) Calculate the maximum permissible speed on a curve of high speed B.G. track having the following particulars: (10)

Degree of curve = 1

Amount of superelevation = 8.0 cm

Length of transition curve = 130 metres

Maximum speed of the section likely to be sanctioned = 153 kmph.

✓ 2. (a) Explain advantages and disadvantages of Plane Tabling? (10)

✓ (b) The maximum quantity of water expected in one of the open longitudinal drains of the clayey soil is $0.90 \text{ m}^3/\text{s}$. Design the cross section and longitudinal slope of

trapezoidal drain assuming the bottom width of the trapezoidal section to be 1.0m and cross slope to be 1.0 vertical to 1.5 horizontal. The allowable velocity of flow in the drain is 1.2m/s and Manning's roughness coefficient is 0.02. (10)

3. (a) What is active and passive remote sensing? What are the basic elements of remote sensing? (10)

(b) If a cross-over occurs between two M.G. parallel tracks of same crossing number 1 in 12 with straight intermediate portion between the reverse curves and the distance between the centres of track is 3.5m, find the intermediate straight distance and over-all length of cross-over. (10)

4. (a) A cylindrical vessel 12 cm in diameter and 30 cm deep is filled with water up to the top. The vessel is open at the top. Find the quantity of liquid left in the vessel when it is rotated about its vertical axis with a speed of 3000 r.p.m. (10)

(b) The velocity potential function is given by $\phi = 5(x^2 - y^2)$. Calculate the velocity components at the point (4, 5). (10)

5. (a) Calculate the bottom width of the channel required to carry a discharge of $15 \text{ m}^3/\text{s}$ as a critical flow at a depth of 1.2m, if the channel section is trapezoidal with side slope of 1.5 horizontal : 1 vertical. (10)

(b) A pipe line AB of diameter 300mm and of length 400m carries water at the rate of 50 litres/s. The flow takes place from A to B where point B is 30 metres above A. Find the pressure at A if the pressure at B is 19.62 N/cm^2 . Take $f = 0.008$. (10)

6. (a) The peak of flood hydrograph due to 3-h duration isolated storm in a catchment is $270 \text{ m}^3/\text{s}$. The total depth of rainfall is 5.9 cm, assuming an average infiltration loss of 0.3 cm/h and a constant base flow of $20 \text{ m}^3/\text{s}$, estimate the peak of the 3-h unit hydrograph of this catchment.

If the area of the catchment is 567 km^2 , determine the base width of the 3-h unit hydrograph by assuming it to be triangular in shape. (10)

(b) Explain important considerations for siting a rain gauge. (10)

7. (a) Describe in brief various types of groynes used for river training? (10)

✓ (b) Design a concrete lined channel to carry a discharge of 45 cumecs at a slope of 1 in 10,000. The side of the channel are 1.25:1 and Manning's N may be taken as 0.018. (10)

✓ (c) Determine the surface area of a settling tank for $0.5 \text{ m}^3/\text{sec.}$, design flow, using the design outflow rate as $32.5 \text{ m}^3/\text{day}/\text{m}^2$. Find the depth of the clarifier for this overflow rate and detention time of 95 minutes. Assume length to width ratio for settling tank between 2:1 and 5:1 and length not to exceed 100m. Recommend the dimensions of the tank. (10)

✓ (d) A population of 40,000 resides in a town covering an area of 75 hectares. Calculate the discharge for a combined system of sewers. Given: (10)

- (i) Coefficient of run off = 0.70
- (ii) Rain concentration = 40 minutes
- (iii) Water consumption = 120 l/d/person; and
- (iv) 70% of wastewater reaches the sewers.
