Amar B.

(4)

MPSC,

1996

CIVIL ENGINEERING (Paper – I)

Time : 3 Hours | Max. Marks : 200

N.B. :
1) *Solve two questions from each Section.*
2) *If more than two questions are attempted in a Section, the excess will be ignored.*
3) *Figures to the right indicate the number of marks for the question.*
4) *Use of Log-Table, Non-programmable Calculators is permitted.*
5) *Make suitable assumptions, if necessary and state them.*

SECTION – A

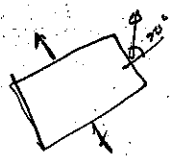
1. a) A uniform sphere of weight W rests on a rough inclined plane whose inclination with the horizontal is less than the angle of friction. A weight P is attached to the sphere at the upper end of the diameter of the sphere parallel to the plane. Determine the value of P that will just prevent the sphere from rolling down the plane. 10

   b) Five rods AB, BC, CD, DA and BD each of equal length and equal cross-section are pin-jointed together so as to form a plane frame ABCD. The frame ABCD has a rhombus shape with one horizontal diagonal BD. The frame is suspended from the topmost joint A. A weight W is attached at the lowermost joint C. Neglecting the self-weight of the frame and using the method of virtual work, find the magnitude of the thrust in the member BD.

2. a) A missile was projected from a rocket 20 Km. vertically and 10 Km. horizontally from the launching point. It was found that the fuel of the rocket was exhausted. The missile had then acquired a velocity of 1600 metre/sec. at an angle of 35° up with the horizontal. Assuming that the rest of the flight is under the influence of gravity and neglecting air resistance and curvature of the earth, calculate, (i) the horizontal range from the launching point, (ii) the time of flight after the fuel had completely burnt. 10

   b) A solid sphere of radius "r" rolls down on inclined plane inclined at an angle of θ with horizontal. Find the acceleration of the sphere. 10

3. a) The resultant stress intensity on one plane in case of a material subjected to strain is 150 N/mm^2 tensile and is inclined at 30° to its normal. The normal intensity of stress across the plane at right angles to the first plane is 100 N/mm^2 tensile. Find principal stresses and maximum shear stress produced. (magnitudes only) 10



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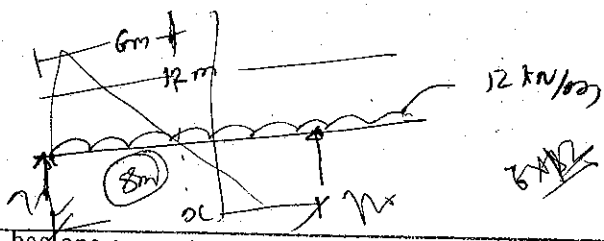
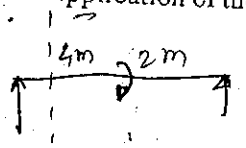


3. A beam of length 12 m has one support at one end and other support at a distance 'x' from the other end. The beam carries udl 2 KN/m over the whole length. Find the value of 'x' if middle point of the beam is a point of contraflexure. Draw BMD. 10

4. a) Compare the power transmitted by a hollow circular shaft with that of solid circular shaft of same material, same weight, same length and running at same speed. In case of hollow shaft, inner diameter is 0.8 times outer diameter. 10

b) A simply supported beam of span 6 m. and of uniform flexural rigidity $EI = 40{,}000\ KN\,m^2$ is subjected to a clockwise couple of 30 KNm. at a distance of 4 m. from the left end. Find the deflection at the point of application of the couple, using Macauley's method. 10



SECTION – B

5. A pratt truss consists fo six panels, as shown in Fig. 1. The bottom boom is loaded. Construct the influence line for the stress in the vertical member U_4L_4. Calculate the maximum force developed in this member due to combination of following loads – (i) Dead load on the truss = 5 KN/m, (ii) Moving udl of 30 KN/m, of length greater than the span and (iii) a moving wheel load of 20 KN. 20

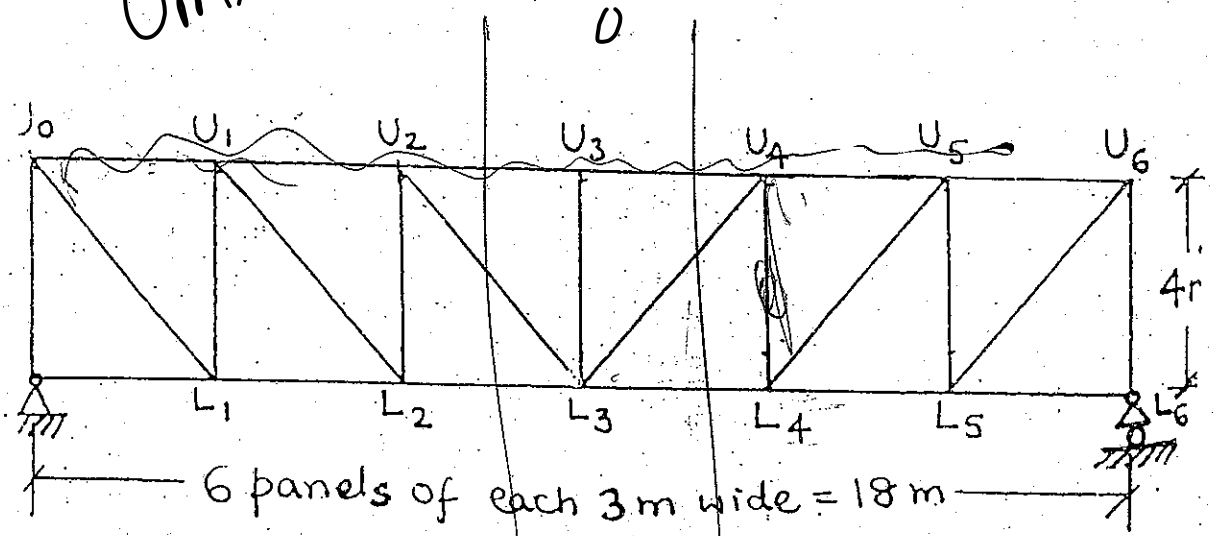


Fig. 1 (Q. No. 5)

6. Analyse rigid jointed frame shown in Fig. 2 by Moment Distribution Method. Take EI constant. Draw B.M. Diagram. 20

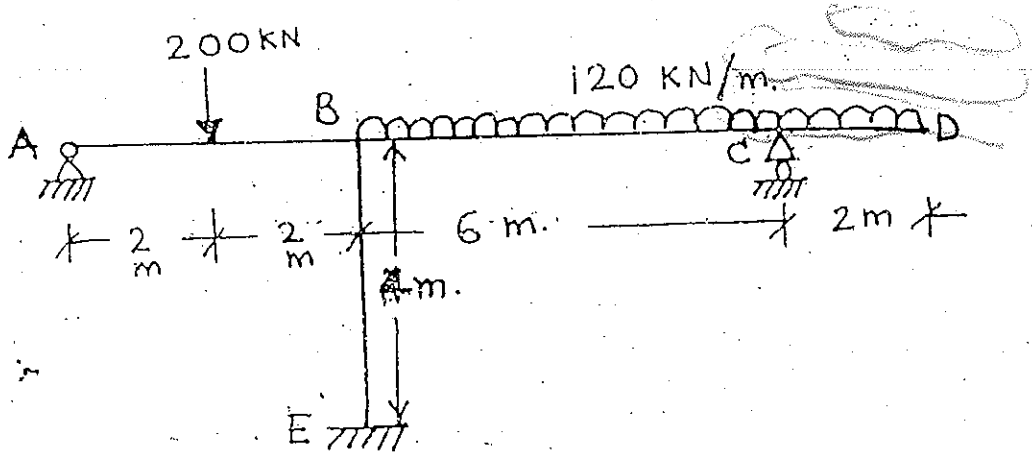


Fig. 2 (Q. No. 6)

7. a) In the case of built-up column consisting of two I-sections, explain how its compressive strength is more than 2P, if P is strength of one I section in compression. 5

b) Calculate the safe load P which the bracket shown in Fig. 3 can carry, if the size of fillet weld used is 6 mm. Take permissible stress in weld as 100 N/mm^2. 15

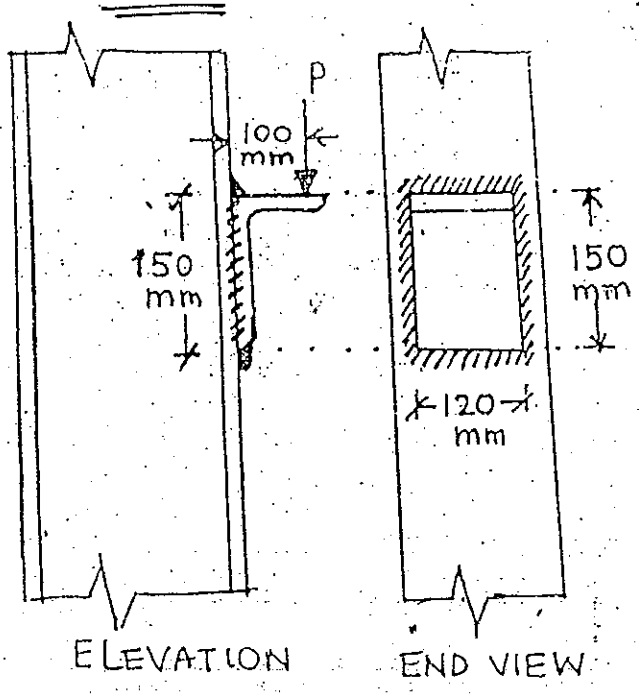


Fig. 3 (Q. No. 7 b)

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8. a) Explain the purpose of providing vertical intermediate stiffeners to plate girder. Sketch the stiffener. 5

b) A welded plate girder supports a total udl (including self weight) of 80 KN/m over a span of 18 m. Design:

i) Web plate

ii) Flanges at mid-span.

iii) End bearing stiffener taking permissible stress for fillet weld as 100 N/mm^2.

Take permissible bending and shear stresses as 165 N/mm^2 and 100 N/mm^2 respectively. Assume girder is laterally supported. 15

SECTION – C

9. A multipurpose hall of size 15 m. ×6 m. (clear) is proposed to be covered by RCC slab. Design one way continuous slab assuming slab is supported on beams running parallel to 6 m. direction. The beams are supported on columns of size 230 mm ×550 mm. Use M15 concrete and Fe 415 steel.

Take live load on floor as 4 KN/m^2 and floor finish as 1 KN/m^2. Use IS 456 coefficients for BM. Show reinforcement details by neat sketch. Adopt either working stress method or limit state design. 20

10. a) Show clearly by sketches the critical cross-sections to check for Maximum B.M., one-way shear action, Two-way shear action and development length in the design of RCC column footing. Explain how do you check in each case. (2×4=8)

b) A RCC circular column 450 mm. diameter is subjected to an axial load of 500 KN and a BM of 36 KNm. Assume σ_{cc} = 5 N/mm^2, σ_{cbc} = 7 N/mm^2 and modular ratio = 13.

Adopting working stress method, check whether column satisfies all the conditions of UNCRACKED SECTION. Take 50 mm as effective concrete cover. Ten bars of each 20 mm dia. are provided as longitudinal steel. 12

11. An open square reinforced concrete tank of size 5 m ×5 m. (clear) in plan and depth of 3 m, to store water, is to be designed. Use M 20 concrete and Mild steel. State permissible stresses you adopt with reasons. Design wall and base of the tank. Draw clearly details of reinforcements in wall, corner details at junction of two adjacent walls and at junction of wall and base slab. Assume tank is built on firm ground. 20

12. Answer the following:

a) How Tee beam is economical over rectangular beam ? In continuous Tee beam, why it is checked as a doubly reinforced rectangular beam?

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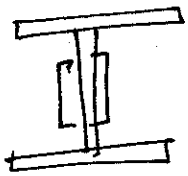

b) Name the various parts of counterfort retaining wall. State principle of design of each part.

c) List the various loads to be accounted in the design of bridges. State the details of each load in two or three sentences. (5+5+10)

SECTION – D

13. Write short notes on the following:

a) Hydration of cement. 5

b) Bulking of fine aggregate. 5

c) Effect of Fly Ash, used as admixture and replacement of cement, on concrete. 5

d) Shrinkage and creep in concrete. 5

14. a) List the various tests to ascertain physical properties of cement in the laboratory. Explain any one of them in detail. 10

b) What is meant by "Workability of concrete". Explain one of the tests on workability of concrete conducted in laboratory. 10

15. Answer the following:

a) Give reasons for using the combination of rich concrete mix and high tensile steel wires in prestressed concrete. 5

b) State five major advantages of prestressed concrete over RCC. 5

c) Enumerate various losses taking place in prestressed concrete. Explain any one of them in detail. 5

d) What is "Load balancing" concept in prestressed concrete? Illustrate with two examples. 5

16. A precast concrete floor unit of Tee section (Breadth of flange = 500 mm, thickness of flange = 75 mm, width of rib = 125 mm, depth of rib = 300 mm, overall depth = 375 mm) is laid side by side to form a simply supported floor system of span 9 m. for a hall. Each unit is prestressed so that the tensile stress in the concrete should not exceed 1.2 N/mm^2 under superimposed load of 10 KN/m^2. At mid-span section, the centroid of prestressing steel is located at a distance of 75 mm from the soffit of the section. Assuming density of concrete as 24 KN/m^3, calculate the minimum initial prestressing force required if the loss in prestress amounts to 16%. Also calculate extreme fibre stresses in concrete at mid-span section at transfer of prestress. 20

17. Analyse continuous beam ABC shown in Fig. 4 STIFFNESS METHOD and plot B.M. diagram. Take EI constant. 20

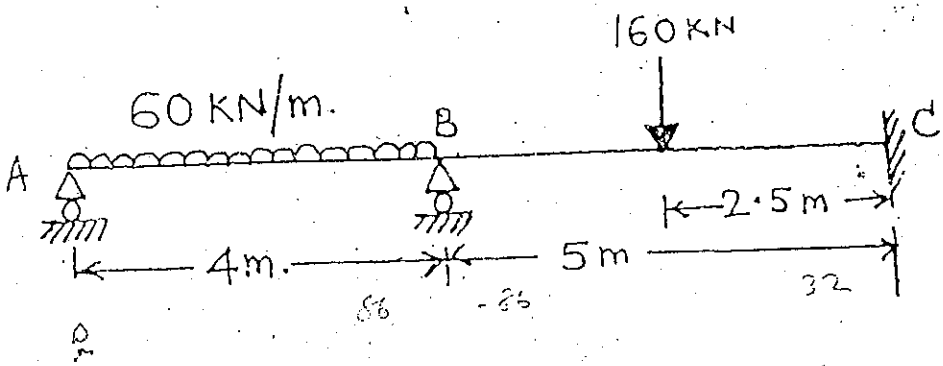

Fig. 4 (Q.No. 17)

18. Obtain reaction components at hinge support C using flexibility approach. Take EI constant. vide Fig. 5. 20

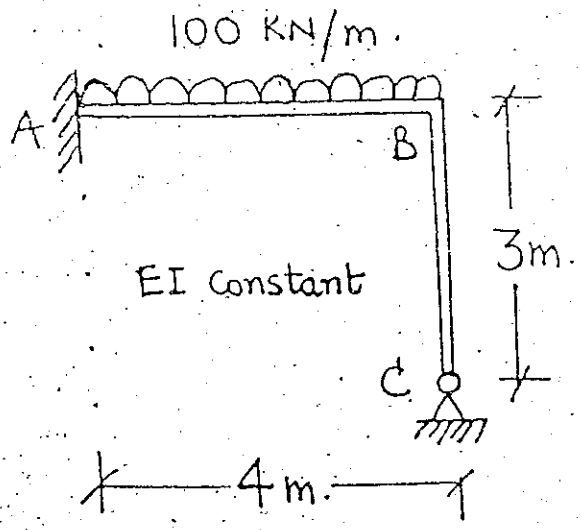

Fig. 5 (Q. No. 18)

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