AMIE STUDY CIRCLE, ROORKEE

MODEL TEST PAPER FOR AMIE EXAMS

ANALYSIS AND DESIGN OF STRUCTURES

TEST PAPER 1

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ANALYSIS AND DESIGN OF STRUCTURES

***Time**: Three Hours*

***Maximum Marks**: 100*

Answer five questions, taking ANY TWO from Group A, any two from Group B and all from Group C.

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches.

Unnecessary long answer may result in loss of marks.

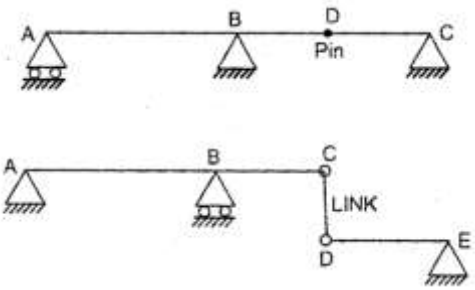
Any missing or wrong data may be assumed suitably giving proper justification.

Figures on the right-hand side margin indicate full marks.

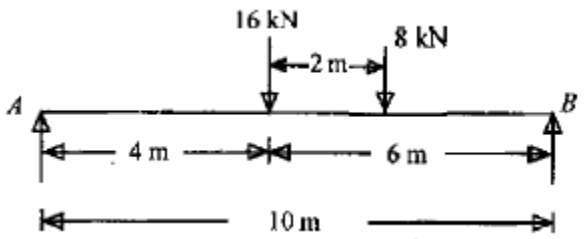
Group A

1. (a) Differentiate between the statically determinate and statically indeterminate structures. 5

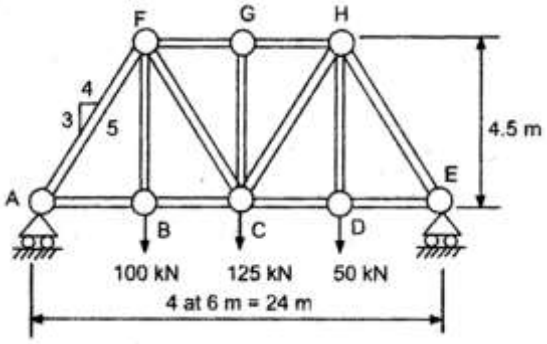
   (b) Determine the degree of external static indeterminacy of the beams as shown in Figs. 1 and 2 for general case of loading; 5



   (c) Two wheel loads, 16 kN and 8 kN, at a fixed distance apart of 2 m, cross a beam of 10 m span (see figure). Draw the influence line diagram for bending moment and shear force for a point 4 m from the left abutment and find the maximum bending moment and shear force at that point. 10

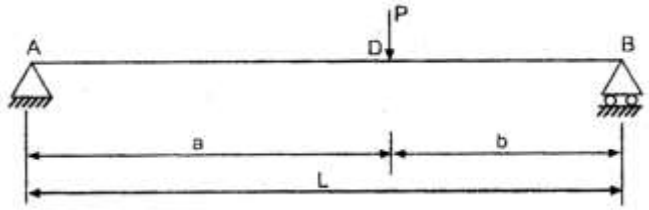


2. (a) Determine the forces in each member of the Warren truss shown below by the method of joints. 10



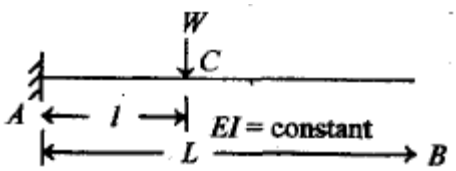
(b) The span and rise of an arch are 40 m and 10 m, respectively. The equation of the arch is $y = x - (x^2/40)$ with the origin at the left abutment and x-axis directed towards right and y-axis upwards. A UDL of 15 kN/m is applied on the left half of the arch. Find the (i) reactions at the abutments, (ii) locations of maximum moments and (iii) draw moment diagram by finding moment at 2.5 m intervals on both sides. 10

3. (a) A simple beam ABCD supports a concentrated load, P, acting at the position shown in following beam. Determine the angle of rotation, θ_A, at support A and deflection, δ_D, under the load P. The beam has length L and constant flexural rigidity Bl. (Use moment area method.) 8

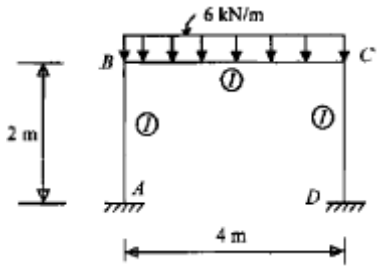


(b) Write the statement of Castigliano's first theorem. 4

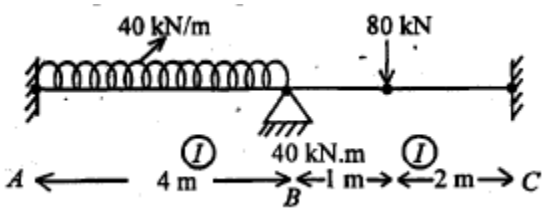
(c) A cantilever of length L carries a concentrated load W at a distance l from the fixed end (see figure). Calculate slope and deflection at the free end B using conjugate beam method. 8



4. (a) Analyse the portal frame shown in figure by moment distribution method. The frame is fixed at A and D and has rigid joints at B and C. Draw the bending moment diagram and sketch the deflected shape of the structure. 10



(b) A continuous beam ABC, fixed at A and C and simply- supported at B as shown in given figure, consist of span AB and BC of lengths 4 m and 3 m, respectively. The span AB carries a uniformly distributed load of 40 kN/m while the span BC carries a point load of 80 kN as shown. Analyse the beam by slope deflection method and draw the bending moment diagram. 10



Group B

5. (a) Explain various types of failure of a riveted joint in steel structures. Compare the merits of a riveted connection to that of a welded connection. 4

(b) A tie member of a truss consists of double angle section each 80 mm x 80 mm x 8 mm welded on the opposite sides of a 12 mm thick gusset plate. Design a fillet weld for making die connection in the workshop. Factored tensile force is 300 kN. 8

(c) A member consists of two ISA 90 x 90 x 10 back to back on one face to the gusset plate are tacked welded at 1000 mm spacing and the assembly is subjected to tension. Determine the tension capacity of the member and the weld required. 8

6. (a) Design a single angle strut connected to the gusset plate to carry 180 kN factored load. The length of the strut between centre-to-centre connection is 3 m. 6

(b) Design a built-up column 10 m long to carry a factored axial load of 1080 kN. The column is restrained in position but not in direction at both ends. Design the column with two channels placed back to back. 8

For IS MC 250 @ 30.4 kg/m

$A = 3867\ mm^2$; $r_x = 99.4$ mm; $r_y = 23.8$ mm; $t_f = 14.1$ mm; $f_{cd} = 100.02\ N/mm^2$

For IS MC 300 @ 35.8 kg/m

$A = 4564\ mm^2$; $r_x = 118.1$ mm; $r_y = 26.1$ mm; $t_f = 13.6$ mm; $I_x = 6362.6 \times 10^4\ mm^4$; $I_y = 310.8 \times 10^4\ mm^4$; $f_{cd} = 122.65\ N/mm^2$.

(c) Design a member carrying an axial load of 1400 kN and effective length in both planes as 6.5 m. 6

7. (a) A beam of 7 0 m effective span carries a uniformly distributed load of 1900 kg/m, including its self-weight. The compression flange is held against lateral displacement Assume allowable bending stress - 1650 kg/cm^2. allowable shearing stresses - 945 kg/cm^2. Check the suitability of the beam portion ISLB 350 @ 49.5 kg/m for the above beam.

(b) Define effective cover, development length of rebar and balanced beam section. A RCC beam is 30 cm wide and 70 cm deep. The centres of the steel are 5 cm from the respective edges. Determine the area of steel in tension and compression zone for a bending moment of 13×10^5 kg-cm. The beam is doubly reinforced. Assume the limiting stress in concrete and steel are 50 kg/cm^2 and 1400 kg/cm^2, respectively. Given modular ratio = m = 18.

(c) A singly reinforced concrete beam with an effective span of 4 m has a rectangular cross section of 250 mm x 550 mm. It is reinforced with 3 bars of 10 mm dia Fe 415 bars at an effective depth of 500 mm. The self weight of the beam together with dead load is 4 kN/m. Calculate the maximum permissible live load on the beam. Assume M20 grade concrete.

8. (a) Design a two way RCC slab for a room 4 m x 6 m to carry superimposed load = 4 kN/m^2, 3 edges are simply supported and one long edge is continuous. Assume thickness = 120 mm. Use M 20 concrete and HYSD steel grade Fe 415.

(b) Design the reinforcement in a column of size 450 mm x 600 mm, subjected to an axial load of 2000 kN. The column has unsupported length of 3 m and is braced against side sway in both ends. Assume M 20 concrete and Fe 415 steel.

Group C

9. Answer the following in brief: 20

(i) Explain various components of the Plate girder through a neat sketch.

(ii) Compare HSFG bolts and bearing bolts.

(iii) Kinematic indeterminacy

(iv) What do you understand by buckling of the column?

(v) Define the terms 'Bay', 'Rise', 'Span', 'Pitch, 'Slope' in truss design.

(vi) State the conditions for a stable determinate structure.

(vii) What are the uses of influence line diagrams?

(viii) When do you expect sway in frames?

(ix) What are the loads to be considered in the design of Gantry Girders?

(x) What is the load factor? How does it compare with a factor of safety?

(Refer our course material for answers)