

UNIVERSITY OF BOLTON
**SCHOOL OF THE BUILT ENVIRONMENT &
ENGINEERING**
BSc(HONS) CIVIL ENGINEERING
SEMESTER ONE
EXAMINATION 2008/2009
STRUCTURAL ANALYSIS
MODULE NO: BLT1014

Date: Friday 23 January 2009

Time: 10.00 am – 12.00 noon

INSTRUCTIONS TO CANDIDATES:

There are **FOUR** questions.

Answer **ANY THREE** questions.

All questions carry equal marks.

Marks for parts of questions are shown in brackets.

This examination paper carries a total of 75 marks.

All working must be shown. A numerical solution to a question obtained by programming an electronic calculator will not be accepted.

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Question 1

Figure Q1 below shows a simply supported beam ABCDE, which is supported at B and D, with overhanging portions past each support. The beam carries partial UDLs of 40 kN/m between B and C, 48 kN/m between D and E and a point load of 16 kN at A as shown in Figure Q1.

For the beam:

- Determine the value and direction of the support reactions at B and D. (5 marks)
- Draw the Shear Force diagram. Show the values of shear force at A, B, C, D, and E along the beam and indicate the points along the beam where high values of bending moment will occur. (8 marks)
- Draw the Bending Moment diagram, indicating the values of bending moment at significant points along the beam. (10 marks)
- State the value of the maximum bending moment and its position along the beam. (2 marks)

Total 25 marks

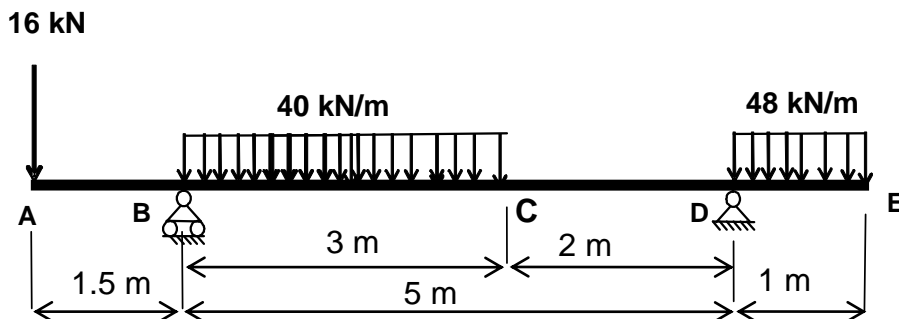


FIGURE Q1

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Question 2

Figure Q2 shows a pin jointed truss, with a pin support at A and a roller support at E. The truss is subjected to a vertical load of 66 kN at joint B and a horizontal load of 24 kN at joint D.

- Use the formula ($M+R = 2J$) to check that the truss is statically determinate. (2 marks)
- Determine the values of the support reactions at supports A and E. (5 marks)
- Using the joint method, determine the value and type of force in each element of the truss. (18 marks)

Summarise your answer on a diagram of the truss layout.

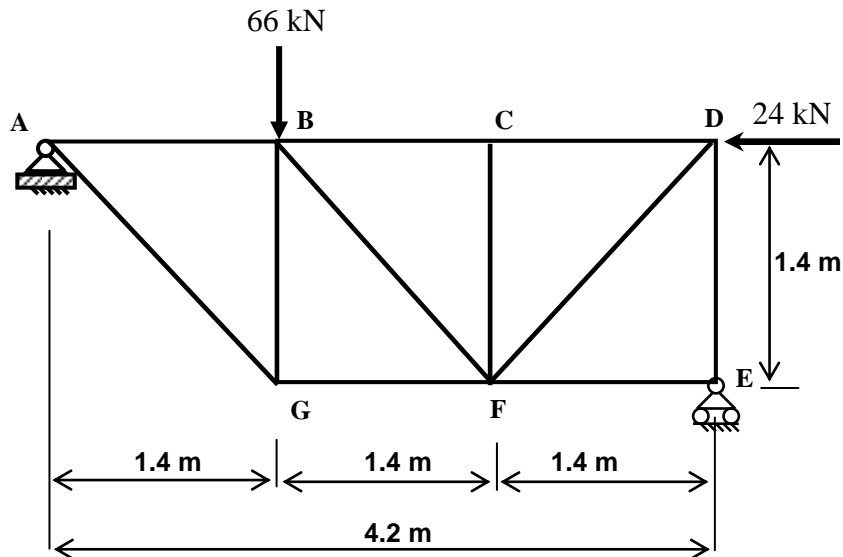


FIGURE Q2

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Question 3

Figure Q3 shows a three pin frame, pinned to supports at A and F, with a third pin at E. There is a horizontal point load of 24 kN at position B and a vertical load of 36 kN at point D as shown in Figure Q3.

- Calculate the value of the support reactions at A and F. (5 marks)
- Draw the axial force diagram (AFD) (5 marks)
- Draw the shear force diagram (SFD) (7 marks)
- Draw the bending moment diagram (BMD) (8 marks)

For b), c) and d), show all important values on the diagrams and produce accompanying calculations to show how these values have been derived.

Total 25 marks

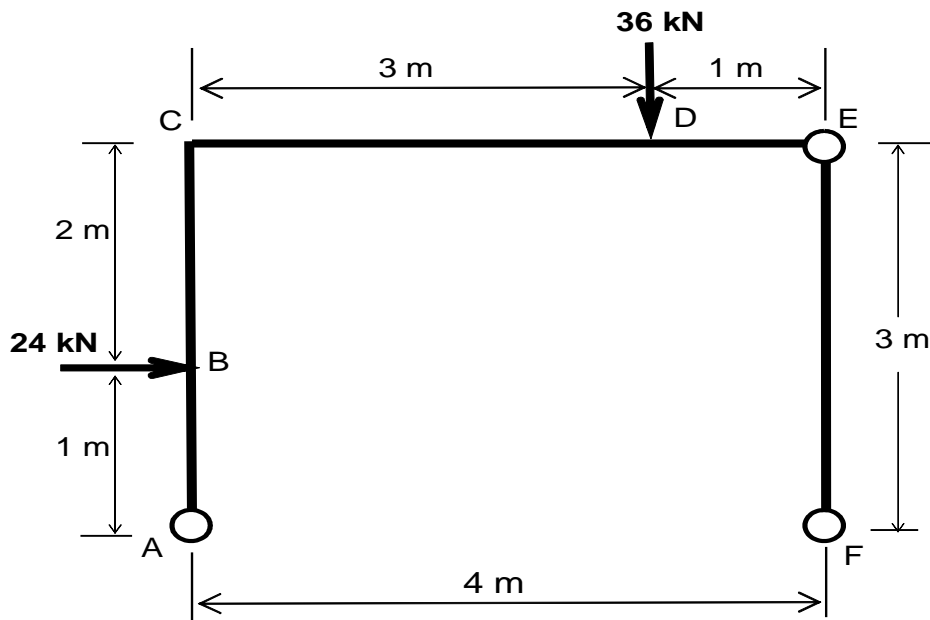


FIGURE Q3

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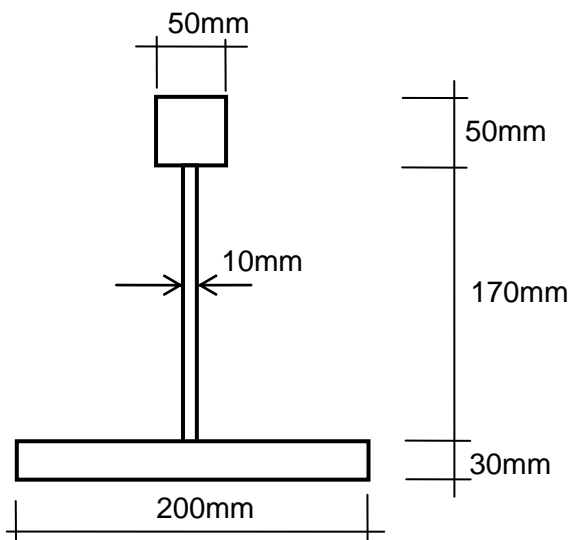
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Question 4

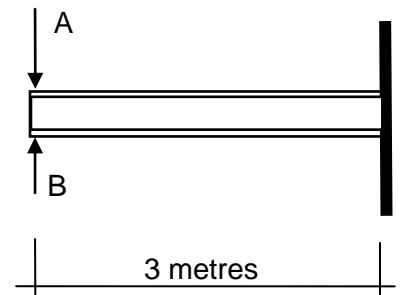
Figure Q4 shows a cross-section of an asymmetrical steel beam with a cantilever span of 3 m. The allowable bending stress either in tension or compression is 240 N/mm^2 .

- Determine the position of the horizontal neutral axis of the beam. (5 marks)
- What is the value of the moment of inertia I about the horizontal neutral axis of the beam section? (5 marks)
- What is the maximum force A that can be applied vertically downward to the cantilever beam without exceeding the allowable bending stress in the beam? (5 marks)
- What is the maximum force B that can be applied vertically upward to the cantilever beam without exceeding the allowable bending stress in the beam? (5 marks)
- What is the maximum UDL (in kN/m) (acting vertically downwards) that the beam can safely support (ignore the point loads A and B)? (5 marks)

Total 25 marks



Section through cantilever beam



Elevation on cantilever beam

Figure Q4

END OF QUESTIONS