UNIVERSITY OF BOLTON

SCHOOL OF THE BUILT ENVIRONMENT & ENGINEERING

FdSc/HNC CIVIL ENGINEERING

SEMESTER TWO EXAMINATION 2009/2010

STRUCTURAL ANALYSIS

MODULE NO: BLT1116

Date: Tuesday 1 June 2010 **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.

School of the Built Environment & Engineering
FdSc/HNC Civil Engineering
Semester Two Examination 2009/2010
Structural Analysis
Module No. BLT1116

Question 1

Figure Q1 below shows a 4 m long, cantilever beam, carrying both point loads and a partial length uniform distributed load.

For the beam:

a. Determine the value and direction of the support reactions at A.
(5 marks)

b. Draw the Shear Force diagram. Show the values of shear force at A, B, C, and D along the beam.
(6 marks)

c. Draw the Bending Moment diagram, indicating the values of bending moment at A, B, C, and D along the beam.
(10 marks)

d. If the only loading on the cantilever was a vertical point load at D, what would be the value and direction of this single load, to give the same maximum bending moment at A, as your calculations in part c revealed?
(4 marks)

Total 25 marks

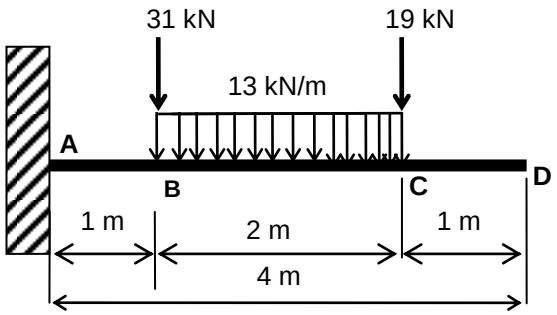

FIGURE Q1

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School of the Built Environment & Engineering
FdSc/HNC Civil Engineering
Semester Two Examination 2009/2010
Structural Analysis
Module No. BLT1116

Question 2

Figure Q2 shows a pin jointed truss, with a pin support at A and a roller support at G. The truss is subjected to three vertical loads: 20 kN at joint C, 40 kN at joint D, and 60 kN at joint E.

a. Use the formula (m + r – 2j = 0) to demonstrate that the truss is statically determinate.

(2 marks)

b. Determine the values of the support reactions at supports A and G.

(6 marks)

c. Using the Method of Joints, determine the value and type of force in each element of the truss and summarise your answer on a diagram of the truss layout.

(17 marks)

Total 25 marks

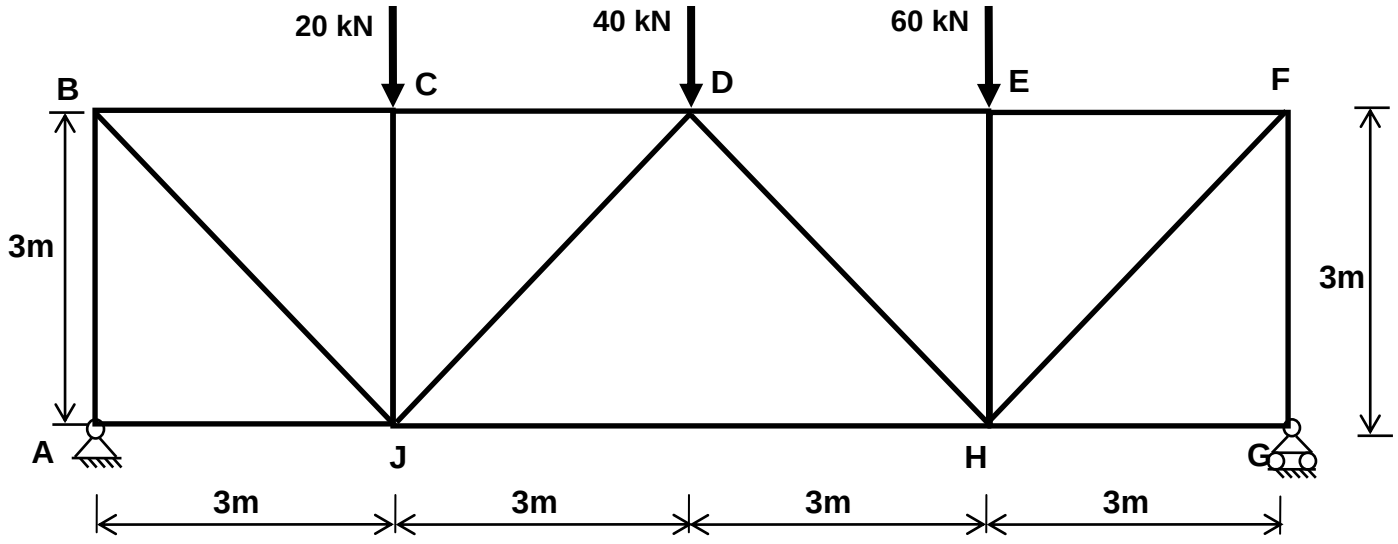

Figure Q2

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School of the Built Environment & Engineering
FdSc/HNC Civil Engineering
Semester Two Examination 2009/2010
Structural Analysis
Module No. BLT1116

Question 3

Figure Q3 shows a three pin frame, pinned to supports at A and F, with a third pin at B. There is a vertical point load of 60 kN at position C, and a horizontal point load of 20 kN at position E, as shown in Figure Q3.

a) Calculate the value of the support reactions at A and F. (5 marks)

b) Draw the axial force diagram (AFD) (5 marks)

c) Draw the shear force diagram (SFD) (7 marks)

d) 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

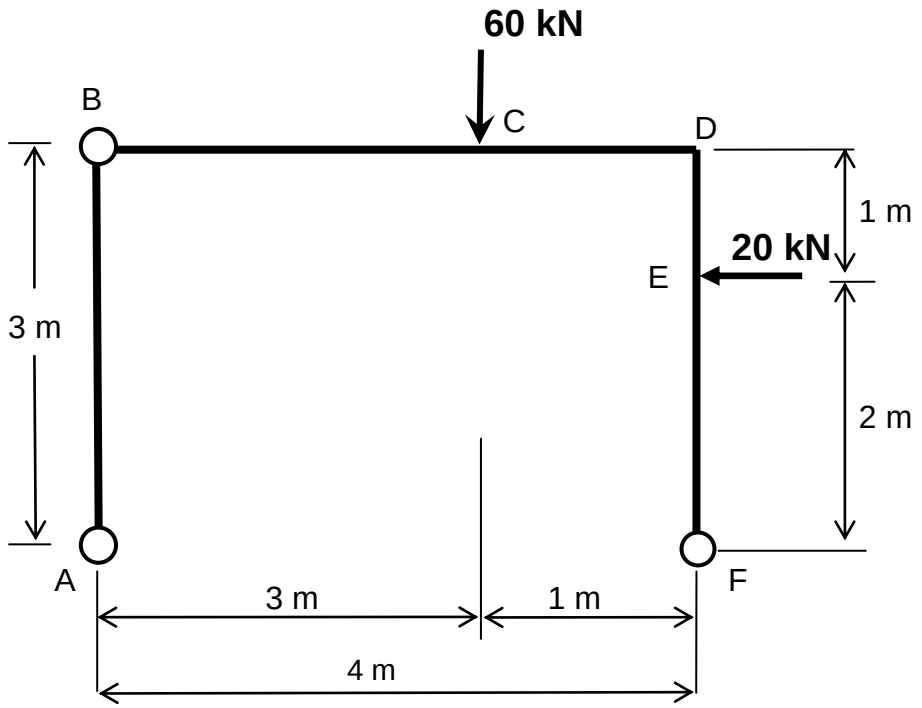

FIGURE Q3

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School of the Built Environment & Engineering
FdSc/HNC Civil Engineering
Semester Two Examination 2009/2010
Structural Analysis
Module No. BLT1116

Question 4

Figure Q4 shows a cross-section of an asymmetrical cast iron beam found in an old factory building. The allowable bending stress of the cast iron is different in tension and in compression:

Allowable bending stress of cast iron in tension	23 N/mm^2
Allowable bending stress of cast iron in compression	123 N/mm^2

a) Determine the position of the horizontal neutral axis of the beam.

(6 marks)

b) What is the value of the second moment of area I about the horizontal neutral axis of the beam section?

(11 marks)

c) The beam spans between two columns and carries a uniformly distributed load (UDL) from floor loading (including the self weight of the beam). It is proposed to increase this UDL to 10 kN/m. The beam spans 7.0m.

Calculate the maximum mid-span bending moment in the beam. Comment on the adequacy of the beam to support the new proposed applied loads.

(4 marks)

d) The same cast iron beam section is found elsewhere in the old factory building, acting as a cantilever, extending 2.0m and carrying a point load. It is proposed to increase the point load to 20kN at its end. Refer to Figure Q4.

The beam was originally installed “upside down” (i.e. with the 65mm wide flange at the bottom and the 175mm wide flange at the top). Why was it installed this way and comment on its adequacy to support the new proposed load (ignore the self-weight of the beam).

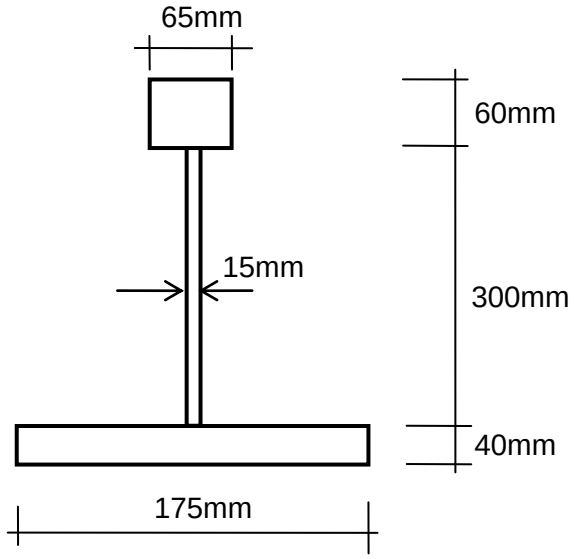
(4 marks)

Total 25 marks

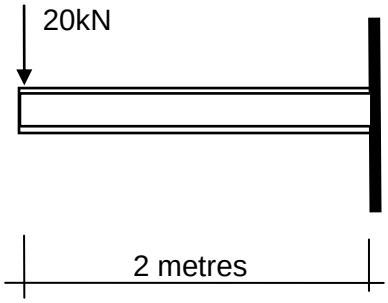
Question 4 continued over the page...

School of the Built Environment & Engineering
FdSc/HNC Civil Engineering
Semester Two Examination 2009/2010
Structural Analysis
Module No. BLT1116

Question 4 continued



Section through cast iron beam



Elevation on cantilever beam

Figure Q4

END OF QUESTIONS