UNIVERSITY OF GREATER MANCHESTER

OFF CAMPUS DIVISION

WESTERN INTERNATIONAL COLLEGE, RAS AL KHAIMAH

BENG (HONS) CIVIL ENGINEERING

SEMESTER TWO EXAMINATION 2024/2025

STRUCTURAL ANALYSIS AND CONCEPTUAL DESIGN

MODULE NO: CIE4023

Date: Saturday, 17 May 2025 **Time: 10:00 am – 12:00 pm**

INSTRUCTIONS TO CANDIDATES:

There are FOUR (4) questions on this paper.

Answer ANY THREE (3) questions.

Marks for parts of questions are shown in the brackets.

This examination paper carries a total of 75 marks.

The necessary design aid data and formula sheet will be provided at the examination hall.

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

A simply supported beam of length 12m is shown in **Figure 1**. The beam is pinned at A, and at D, it is supported by a roller support experiencing a horizontal force of 10kN. The beam carries a point load of 14.14kN acting at an angle of 45º at B, a point load of 30kN acting vertically downward at C together with a UDL of 2kN/m acting vertically downward between C and D.

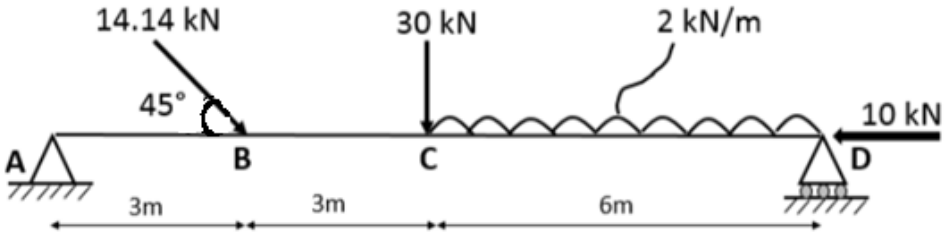

Figure 1: Simply supported beam ABCD

For the beam:

a) Determine the magnitude and direction of the support reactions at A and D.

(5 marks)

b) Draw the Shear Force Diagram. Show the values of shear force at A, B, C and D and indicate the point along the beam where a high value of bending moment will occur.

(10 marks)

c) Draw the Bending Moment Diagram, showing the values of bending moment at A, B, C and D along the beam. State the values of the maximum bending moment and its location along the beam span.

(10 marks)

[TOTAL 25 MARKS]

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QUESTION 2

a) If beam ABCD shown in **Figure 1** has an asymmetrical I-Shape cross section as shown in **Figure 2**, Compute the maximum bending stress developed in the beam. Also, sketch the stress variation along the beam depth at the point of maximum bending stress, clearly indicating regions of tension and compression.

(8 marks)

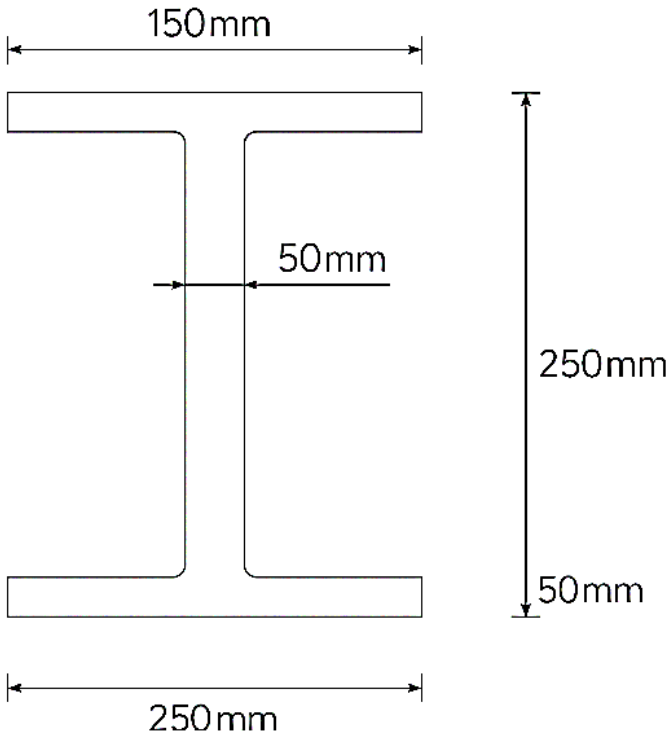

Figure 2: Cross section of beam ABCD

Question 2 continued over the page…

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Question 2 continued…

b) Find the maximum compressive stress due to pure compression and bending for the column of dimension 300 X 400 mm if an eccentric load of 1400kN acts at a distance of 100mm from the centroid of the column, as shown in **Figure 3.**

(17 marks)

[TOTAL 25 MARKS]

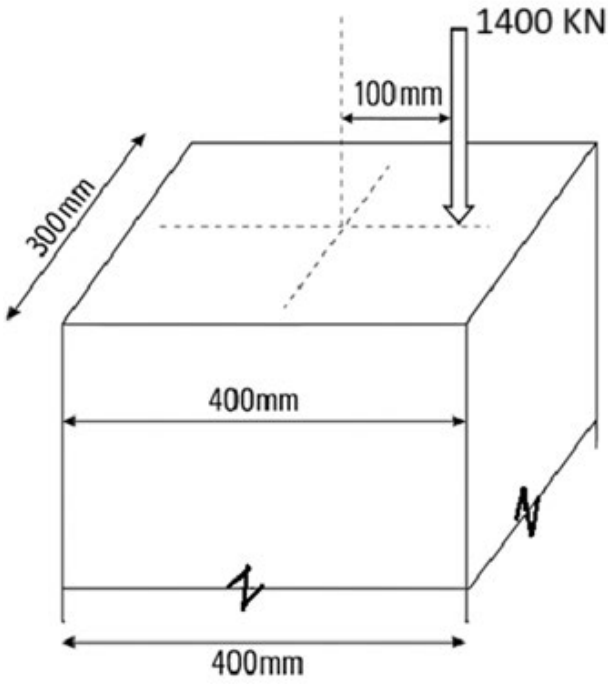

Figure 3: Column with Eccentric Loading

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QUESTION 3

Figure 4 shows a pin-jointed truss, having a hinged support at end A and roller support at end E, subjected to vertical forces 8kN at joint C and a horizontal force 6kN at joint B.

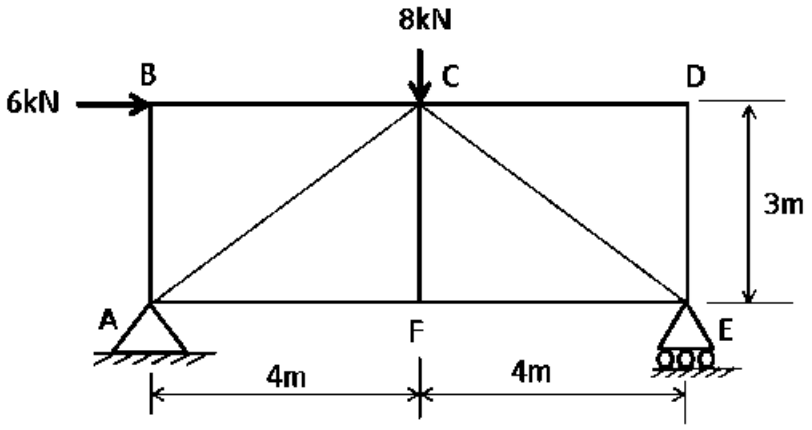

Figure 4: Pin Jointed Truss

a) Explain why the pin-jointed truss is statically determinate. Determine the magnitude and direction of the support reactions at A and E.

(6 marks)

b) Using the method of resolution at joints, calculate the axial forces in the members of this truss and state whether each axial force is in tension or in compression.

(13 marks)

c) Summarise your answer on a diagram of the truss layout.

(6 marks)

[TOTAL 25 MARKS]

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QUESTION 4

a) Discuss the differences between embodied carbon and operational carbon in buildings. Why is it important to consider both when designing sustainable structures?

(5 marks)

b) Calculate the embodied carbon of a room shown in **Figure 5** with RCC beams, columns and slabs (related solely to the concrete and steel) with the help of the data given below.

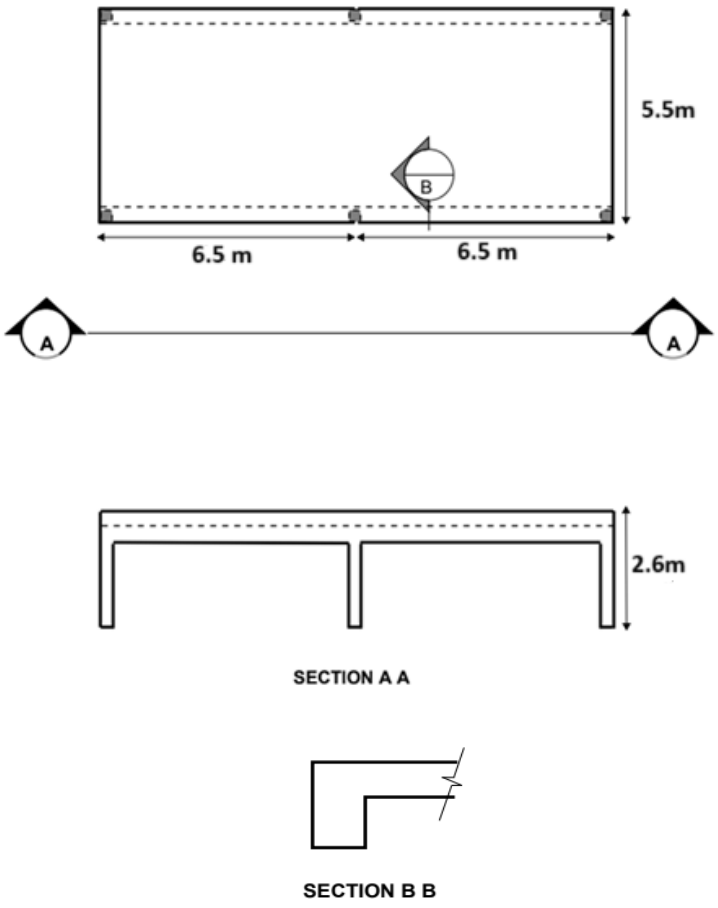

Figure 5

Question 4 continued over the page…

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Question 4 continued…

Given Data:

1. Steel Class H should be assumed for the reinforcement steel for all, which has a characteristic strength fyk = 500N/mm^2.
2. C30/37 concrete is used for all.
3. Assume embodied carbon for concrete grade C28/35 is 0.120KgeCO2/Kg
4. Assume embodied carbon for concrete grade C32/40 is 0.132KgeCO2/Kg
5. Assume embodied carbon for steel bars and rod is 1.4KgeCO2/Kg
6. Size of the room = 13m X 13m
7. Cross section of beam = 700 mm deep X 350mm wide
8. Depth of the slab = 280mm
9. Cross section of column = 280mm X 280mm
10. Density of Concrete= 2400 Kg/m^3
11. Consider the weight of steel/m^3 of concrete for

Slabs (one way)	=75 kg/m^3
Beams	=90 kg/m^3
Columns	=100 kg/m^3

(20 marks)

[TOTAL 25 MARKS]

END OF QUESTIONS